Cisco uBR10012 Universal Broadband Router Hardware Installation Guide

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Americas Headquarters
Cisco Systems, Inc.
170 West Tasman Drive
San Jose, CA 95134-1706
USA
http://www.cisco.com
Tel: 408 526-4000
800 553-NETS (6387)
Fax: 408 527-0883

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

The following information is for FCC compliance of Class B devices: The equipment described in this manual generates and may radiate radio-frequency energy. If it is not installed in accordance with Cisco's installation instructions, it may cause interference with radio and television reception. This equipment has been tested and found to comply with the limits for a Class B digital device in accordance with the specifications in part 15 of the FCC rules. These specifications are designed to provide reasonable protection against such interference in a residential installation. However, there is no guarantee that interference will not occur in a particular installation.

Modifying the equipment without Cisco's written authorization may result in the equipment no longer complying with FCC requirements for Class A or Class B digital devices. In that event, your right to use the equipment may be limited by FCC regulations, and you may be required to correct any interference to radio or television communications at your own expense.

You can determine whether your equipment is causing interference by turning it off. If the interference stops, it was probably caused by the Cisco equipment or one of its peripheral devices. If the equipment causes interference to radio or television reception, try to correct the interference by using one or more of the following measures:

• Turn the television or radio antenna until the interference stops.

• Move the equipment to one side or the other of the television or radio.

• Move the equipment farther away from the television or radio.

• Plug the equipment into an outlet that is on a different circuit from the television or radio. (That is, make certain the equipment and the television or radio are on circuits controlled by different circuit breakers or fuses.)

Modifications to this product not authorized by Cisco Systems, Inc. could void the FCC approval and negate your authority to operate the product.

CONTENTS

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.

Revision History

Date	Revision	Reason
12/15/2008	OL-18259-01	Updated with PRE4 information. Moved the document to online only.
04/05/2006	78-11450-03 Rev.B0	Updated Table 3-6.
06/28/2005	OL-5000-03	Added HHGE line card information.
10/18/2004	OL-5000-02	Updated with PRE2 information.
12/20/2003	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.
03/20/2001	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 xii.

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 *before* 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 Headend Provisioning Requirements	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/en/US/docs/cable/cmts/ubr10012/configuration/guide/scg.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/univercd/cc/td/doc/product/cable/ubr10k/ubr10012/frus/index.htm.

- For information on using the Flash Disk, see the *Using the Flash Disk* document at the following URL:

  http://www.cisco.com/univercd/cc/td/doc/product/core/7200vx/72vxfru/5819fdsk.htm.

- 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/univercd/cc/td/doc/product/software/.

  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/univercd/cc/td/doc/product/cable/ubr10k/ub10krns/index.htm

- For information about cleaning fiber-optic connections, go to the following URL:

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

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 Definition

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

Waarschuwing **BELANGRIJKE VEILIGHEIDSINSTRUCTIES**

Dit waarschuwingssymbool betekent gevaar. U verkeert in een situatie die lichamelijk letsel kan veroorzaken. Voordat u aan enige apparatuur gaat werken, dient u zich bewust te zijn van de bij elektrische schakelingen betrokken risico's en dient u op de hoogte te zijn van de standaard praktijken om ongelukken te voorkomen. Gebruik het nummer van de verklaring onderaan de waarschuwing als u een vertaling van de waarschuwing die bij het apparaat wordt geleverd, wilt raadplegen.

BEWAAR DEZE INSTRUCTIES

Varoitus **TÄRKEITÄ TURVALLISUUSOHJEITA**

Tämä varoitusmerkki merkitsee vaaraa. Tilanne voi aiheuttaa ruumiillisia vammoja. Ennen kuin käsittelet laitteistoa, huomioi sähköpiirien käsittelemiseen liittyvät riskit ja tutustu onnettomuuksien yleisiin ehkäisytapoihin. Turvallisuusvaroitusten käännökset löytyvät laitteen mukana toimitettujen käännettyjen turvallisuusvaroitusten joukosta varoitusten lopussa näkyvien lausuntonumeroiden avulla.

SÄILYTÄ NÄMÄ OHJEET

Attention **IMPORTANTES INFORMATIONS DE SÉCURITÉ**

Ce symbole d'avertissement indique un danger. Vous vous trouvez dans une situation pouvant entraîner des blessures ou des dommages corporels. Avant de travailler sur un équipement, soyez conscient des dangers liés aux circuits électriques et familiarisez-vous avec les procédures couramment utilisées pour éviter les accidents. Pour prendre connaissance des traductions des avertissements figurant dans les consignes de sécurité traduites qui accompagnent cet appareil, référez-vous au numéro de l'instruction situé à la fin de chaque avertissement.

CONSERVEZ CES INFORMATIONS

Warnung **WICHTIGE SICHERHEITSHINWEISE**

Dieses Warnsymbol bedeutet Gefahr. Sie befinden sich in einer Situation, die zu Verletzungen führen kann. Machen Sie sich vor der Arbeit mit Geräten mit den Gefahren elektrischer Schaltungen und den üblichen Verfahren zur Vorbeugung vor Unfällen vertraut. Suchen Sie mit der am Ende jeder Warnung angegebenen Anweisungsnummer nach der jeweiligen Übersetzung in den übersetzten Sicherheitshinweisen, die zusammen mit diesem Gerät ausgeliefert wurden.

BEWAHREN SIE DIESE HINWEISE GUT AUF.

Avvertenza **IMPORTANTI ISTRUZIONI SULLA SICUREZZA**

Questo simbolo di avvertenza indica un pericolo. La situazione potrebbe causare infortuni alle persone. Prima di intervenire su qualsiasi apparecchiatura, occorre essere al corrente dei pericoli relativi ai circuiti elettrici e conoscere le procedure standard per la prevenzione di incidenti. Utilizzare il numero di istruzione presente alla fine di ciascuna avvertenza per individuare le traduzioni delle avvertenze riportate in questo documento.

CONSERVARE QUESTE ISTRUZIONI

Advarsel **VIKTIGE SIKKERHETSINSTRUKSJONER**

Dette advarselssymbolet betyr fare. Du er i en situasjon som kan føre til skade på person. Før du begynner å arbeide med noe av utstyret, må du være oppmerksom på farene forbundet med elektriske kretser, og kjenne til standardprosedyrer for å forhindre ulykker. Bruk nummeret i slutten av hver advarsel for å finne oversettelsen i de oversatte sikkerhetsadvarslene som fulgte med denne enheten.

TA VARE PÅ DISSE INSTRUKSJONENE

Aviso **INSTRUÇÕES IMPORTANTES DE SEGURANÇA**

Este símbolo de aviso significa perigo. Você está em uma situação que poderá ser causadora de lesões corporais. Antes de iniciar a utilização de qualquer equipamento, tenha conhecimento dos perigos envolvidos no manuseio de circuitos elétricos e familiarize-se com as práticas habituais de prevenção de acidentes. Utilize o número da instrução fornecido ao final de cada aviso para localizar sua tradução nos avisos de segurança traduzidos que acompanham este dispositivo.

GUARDE ESTAS INSTRUÇÕES

¡Advertencia! **INSTRUCCIONES IMPORTANTES DE SEGURIDAD**

Este símbolo de aviso indica peligro. Existe riesgo para su integridad física. Antes de manipular cualquier equipo, considere los riesgos de la corriente eléctrica y familiarícese con los procedimientos estándar de prevención de accidentes. Al final de cada advertencia encontrará el número que le ayudará a encontrar el texto traducido en el apartado de traducciones que acompaña a este dispositivo.

GUARDE ESTAS INSTRUCCIONES

Varning! **VIKTIGA SÄKERHETSANVISNINGAR**

Denna varningssignal signalerar fara. Du befinner dig i en situation som kan leda till personskada. Innan du utför arbete på någon utrustning måste du vara medveten om farorna med elkretsar och känna till vanliga förfaranden för att förebygga olyckor. Använd det nummer som finns i slutet av varje varning för att hitta dess översättning i de översatta säkerhetsvarningar som medföljer denna anordning.

SPARA DESSA ANVISNINGAR

Figyelem **FONTOS BIZTONSÁGI ELOÍRÁSOK**

Ez a figyelmezeto jel veszélyre utal. Sérülésveszélyt rejto helyzetben van. Mielott bármely berendezésen munkát végezte, legyen figyelemmel az elektromos áramkörök okozta kockázatokra, és ismerkedjen meg a szokásos balesetvédelmi eljárásokkal. A kiadványban szereplo figyelmeztetések fordítása a készülékhez mellékelt biztonsági figyelmeztetések között található; a fordítás az egyes figyelmeztetések végén látható szám alapján keresheto meg.

ORIZZE MEG EZEKET AZ UTASÍTÁSOKAT!

Предупреждение **ВАЖНЫЕ ИНСТРУКЦИИ ПО СОБЛЮДЕНИЮ ТЕХНИКИ БЕЗОПАСНОСТИ**

Этот символ предупреждения обозначает опасность. То есть имеет место ситуация, в которой следует опасаться телесных повреждений. Перед эксплуатацией оборудования выясните, каким опасностям может подвергаться пользователь при использовании электрических цепей, и ознакомьтесь с правилами техники безопасности для предотвращения возможных несчастных случаев. Воспользуйтесь номером заявления, приведенным в конце каждого предупреждения, чтобы найти его переведенный вариант в переводе предупреждений по безопасности, прилагаемом к данному устройству.

СОХРАНИТЕ ЭТИ ИНСТРУКЦИИ

警告 重要的安全性说明

此警告符号代表危险。您正处于可能受到严重伤害的工作环境中。在您使用设备开始工作之前，必须充分意识到触电的危险，并熟练掌握防止事故发生的标准工作程序。请根据每项警告结尾提供的声明号码来找到此设备的安全性警告说明的翻译文本。

请保存这些安全性说明

警告 安全上の重要な注意事項

「危険」の意味です。人身事故を予防するための注意事項が記述されています。装置の取り扱い作業を行うときは、電気回路の危険性に注意し、一般的な事故防止策に留意してください。警告の各国語版は、各注意事項の番号を基に、装置に付属の「Translated Safety Warnings」を参照してください。

これらの注意事項を保管しておいてください。

주의 중요 안전 지침

이 경고 기호는 위험을 나타냅니다. 작업자가 신체 부상을 일으킬 수 있는 위험한 환경에 있습니다. 장비에 작업을 수행하기 전에 전기 회로와 관련된 위험을 숙지하고 표준 작업 관례를 숙지하여 사고를 방지하십시오. 각 경고의 마지막 부분에 있는 경고문 번호를 참조하여 이 장치와 함께 제공되는 번역된 안전 경고문에서 해당 번역문을 찾으십시오.

이 지시 사항을 보관하십시오.

Aviso **INSTRUÇÕES IMPORTANTES DE SEGURANÇA**

Este símbolo de aviso significa perigo. Você se encontra em uma situação em que há risco de lesões corporais. Antes de trabalhar com qualquer equipamento, esteja ciente dos riscos que envolvem os circuitos elétricos e familiarize-se com as práticas padrão de prevenção de acidentes. Use o número da declaração fornecido ao final de cada aviso para localizar sua tradução nos avisos de segurança traduzidos que acompanham o dispositivo.

GUARDE ESTAS INSTRUÇÕES

Advarsel **VIGTIGE SIKKERHEDSANVISNINGER**

Dette advarselssymbol betyder fare. Du befinder dig i en situation med risiko for legemesbeskadigelse. Før du begynder arbejde på udstyr, skal du være opmærksom på de involverede risici, der er ved elektriske kredsløb, og du skal sætte dig ind i standardprocedurer til undgåelse af ulykker. Brug erklæringsnummeret efter hver advarsel for at finde oversættelsen i de oversatte advarsler, der fulgte med denne enhed.

GEM DISSE ANVISNINGER

تحذير **إرشادات الأمان الهامة**

يوضح رمز التحذير هذا وجود خطر. وهذا يعني أنك متواجد في مكان قد ينتج عنه التعرض لإصابات. قبل بدء العمل، احذر مخاطر التعرض للصدمات الكهربائية وكن على علم بالإجراءات القياسية للحيلولة دون وقوع أي حوادث. استخدم رقم البيان الموجود في أخر كل تحذير لتحديد مكان ترجمته داخل تحذيرات الأمان المترجمة التي تأتي مع الجهاز.

قم بحفظ هذه الإرشادات

Upozorenje **VAŽNE SIGURNOSNE NAPOMENE**

Ovaj simbol upozorenja predstavlja opasnost. Nalazite se u situaciji koja može prouzročiti tjelesne ozljede. Prije rada s bilo kojim uređajem, morate razumjeti opasnosti vezane uz električne sklopove, te biti upoznati sa standardnim načinima izbjegavanja nesreća. U prevedenim sigurnosnim upozorenjima, priloženima uz uređaj, možete prema broju koji se nalazi uz pojedino upozorenje pronaći i njegov prijevod.

SAČUVAJTE OVE UPUTE

Upozornění **DŮLEŽITÉ BEZPEČNOSTNÍ POKYNY**

Tento upozorňující symbol označuje nebezpečí. Jste v situaci, která by mohla způsobit nebezpečí úrazu. Před prací na jakémkoliv vybavení si uvědomte nebezpečí související s elektrickými obvody a seznamte se se standardními opatřeními pro předcházení úrazům. Podle čísla na konci každého upozornění vyhledejte jeho překlad v přeložených bezpečnostních upozorněních, která jsou přiložena k zařízení.

USCHOVEJTE TYTO POKYNY

Προειδοποίηση ΣΗΜΑΝΤΙΚΕΣ ΟΔΗΓΙΕΣ ΑΣΦΑΛΕΙΑΣ

Αυτό το προειδοποιητικό σύμβολο σημαίνει κίνδυνο. Βρίσκεστε σε κατάσταση που μπορεί να προκαλέσει τραυματισμό. Πριν εργαστείτε σε οποιοδήποτε εξοπλισμό, να έχετε υπόψη σας τους κινδύνους που σχετίζονται με τα ηλεκτρικά κυκλώματα και να έχετε εξοικειωθεί με τις συνήθεις πρακτικές για την αποφυγή ατυχημάτων. Χρησιμοποιήστε τον αριθμό δήλωσης που παρέχεται στο τέλος κάθε προειδοποίησης, για να εντοπίσετε τη μετάφρασή της στις μεταφρασμένες προειδοποιήσεις ασφαλείας που συνοδεύουν τη συσκευή.

ΦΥΛΑΞΤΕ ΑΥΤΕΣ ΤΙΣ ΟΔΗΓΙΕΣ

אזהרה **הוראות בטיחות חשובות**

סימן אזהרה זה מסמל סכנה. אתה נמצא במצב העלול לגרום לפציעה. לפני שתעבוד עם ציוד כלשהו, עליך להיות מודע לסכנות הכרוכות במעגלים חשמליים ולהכיר את הנהלים המקובלים למניעת תאונות. השתמש במספר ההוראה המסופק בסופה של כל אזהרה כד לאתר את התרגום באזהרות הבטיחות המתורגמות שמצורפות להתקן.

שמור הוראות אלה

Opomena постои кај електричните кола и треба да ги познавате стандардните постапки за спречување на несреќни случаи. Искористете го бројот на изјавата што се наоѓа на крајот на секое предупредување за да го најдете неговиот период во преведените безбедносни предупредувања што се испорачани со уредот.
ЧУВАЈТЕ ГИ ОВИЕ НАПАТСТВИЈА

Ostrzeżenie **WAŻNE INSTRUKCJE DOTYCZĄCE BEZPIECZEŃSTWA**

Ten symbol ostrzeżenia oznacza niebezpieczeństwo. Zachodzi sytuacja, która może powodować obrażenia ciała. Przed przystąpieniem do prac przy urządzeniach należy zapoznać się z zagrożeniami związanymi z układami elektrycznymi oraz ze standardowymi środkami zapobiegania wypadkom. Na końcu każdego ostrzeżenia podano numer, na podstawie którego można odszukać tłumaczenie tego ostrzeżenia w dołączonym do urządzenia dokumencie z tłumaczeniami ostrzeżeń.

NINIEJSZE INSTRUKCJE NALEŻY ZACHOWAĆ

Upozornenie **DÔLEŽITÉ BEZPEČNOSTNÉ POKYNY**

Tento varovný symbol označuje nebezpečenstvo. Nachádzate sa v situácii s nebezpečenstvom úrazu. Pred prácou na akomkoľvek vybavení si uvedomte nebezpečenstvo súvisiace s elektrickými obvodmi a oboznámte sa so štandardnými opatreniami na predchádzanie úrazom. Podľa čísla na konci každého upozornenia vyhľadajte jeho preklad v preložených bezpečnostných upozorneniach, ktoré sú priložené k zariadeniu.

USCHOVAJTE SI TENTO NÁVOD

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

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CHAPTER 1

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 1.0+, DOCSIS 1.1, EuroDOCSIS 1.1, DOCSIS 2.0, 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".
- 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/pre2gkit.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 "DC Power Entry Modules".
  - Optional external 100-120 VAC-input power shelf with redundant power supply support. For more information go to the following URL:

    http://www.cisco.com/en/US/docs/cable/cmts/ubr10012/installation/field_replaceable_units/ub10acsh.html
- 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".
- Fan module—Forced-air convection cooling, see "Cisco uBR10012 Router FRU Resources".
  - Dual-speed fan uses lower speed for when operating at nominal temperatures and high speed when operating at or above recommended operating temperatures.

- 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, except for the Cisco uBR-MC28C, which must be installed in the Cisco line card processor adapter card (Cisco uBR10-LCP2) before it can be installed in 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.

For example, users who are connecting to the Cisco uBR10012 router through the Cisco uBR10-LCP2-MC28C cable interface line card are typically divided between the two separate downstreams. Each group of users is then divided between the four separate 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 Cisco uBR10-LCP2-MC28C cable line card (or other cable interface 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 uBR10-LCP2.
    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 DOCSIS1.1 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) QPSK (2)	2.56 M	10.24 5.12	9.0 4.6
1.6 MHz	16-QAM (4) QPSK (2)	1.28 M	5.12 2.56	4.5 2.3
800 kHz	16-QAM (4) QPSK (2)	640 K	2.56 1.28	2.3 1.2
400 kHz	16-QAM (4) QPSK (2)	320 K	1.28 0.64	1.2 0.6
200 kHz	16-QAM (4) QPSK (2)	160 K	0.64 0.32	0.6 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 32-QAM 16-QAM 8-QAM QPSK	5.12M	30.96 25.80 20.54 15.48 10.30	27.2 22.3 19.8 13.3 8.9
3.2 MHz	64-QAM 32-QAM 16-QAM 8-QAM QPSK	2.56 M	15.48 12.90 10.30 7.68 5.12	13.3 11 8.9 6.6 4.4
1.6 MHz	64-QAM 32-QAM 16-QAM 8-QAM QPSK	1.28 M	7.68 6.45 5.12 3.84 2.56	6.6 5.5 4.4 3.3 2.2
800 kHz	64-QAM 32-QAM 16-QAM 8-QAM QPSK	640 K	3.84 3.20 2.56 1.92 1.28	3.3 2.75 2.2 1.65 1.1
400 kHz	64-QAM 32-QAM 16-QAM 8-QAM QPSK	320 K	1.92 1.60 1.28 0.96 0.64	1.65 1.38 1.1 0.83 0.54
200 kHz	64-QAM 32-QAM 16-QAM 8-QAM QPSK	160 K	0.96 0.80 0.64 0.48 0.32	0.83 0.63 0.54 0.40 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) 256 QAM (8)	5.056 5.360	30.34 42.88	27 39
8	64 QAM (6) 256 QAM (8)	6.592 6.592	39.55 52.74	36 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 PEMs, two PREs, 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 TCC+ cards are accessed from the rear of the chassis, see Figure 1-3.

Note The Cisco uBR10012 router uses an auxiliary 2400 WAC-input power shelf for situations where 100-120 VAC is the only available power source. The AC-input power shelf converts AC to DC for the router. For more information about the power shelf, refer to *2400W AC-Input Power Shelf for the Cisco uBR10012 Universal Broadband Router* at the following URL:

http://www.cisco.com/univercd/cc/td/doc/product/cable/ubr10k/ubr10012/frus/index.htm

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

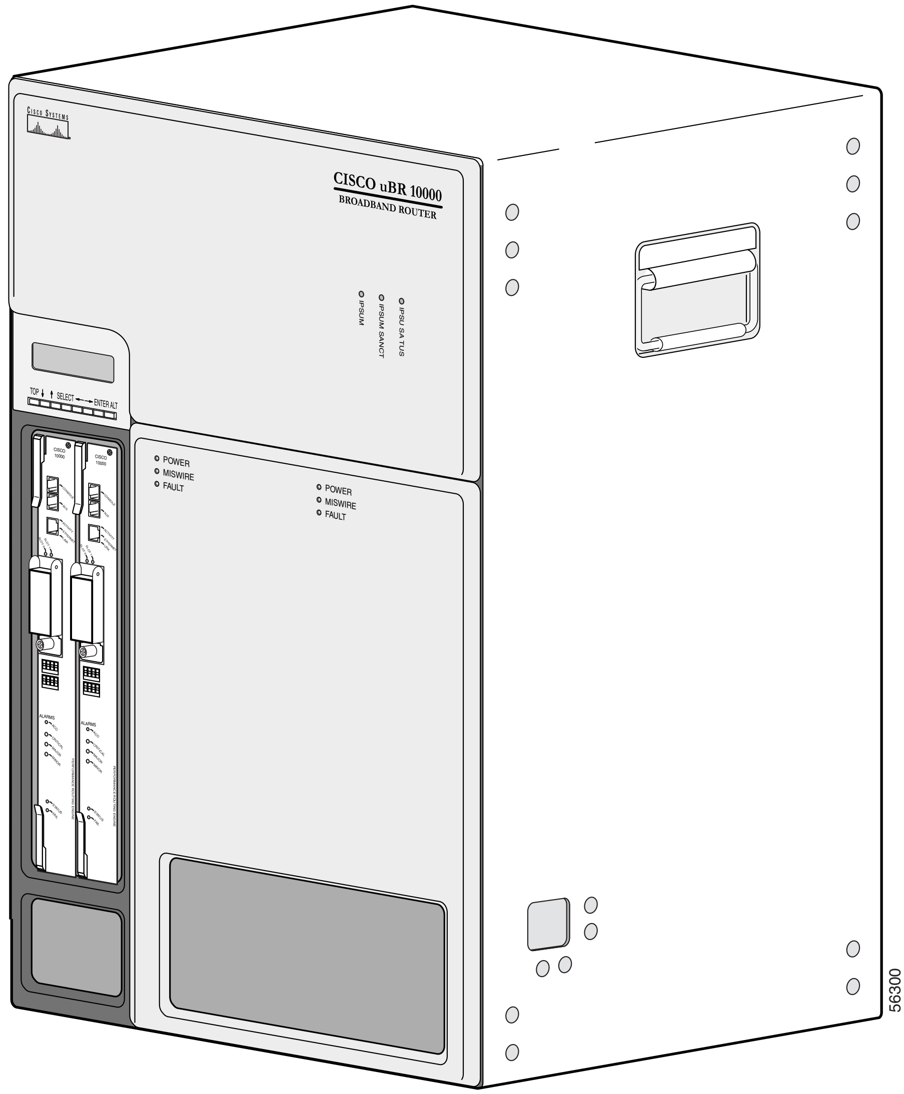
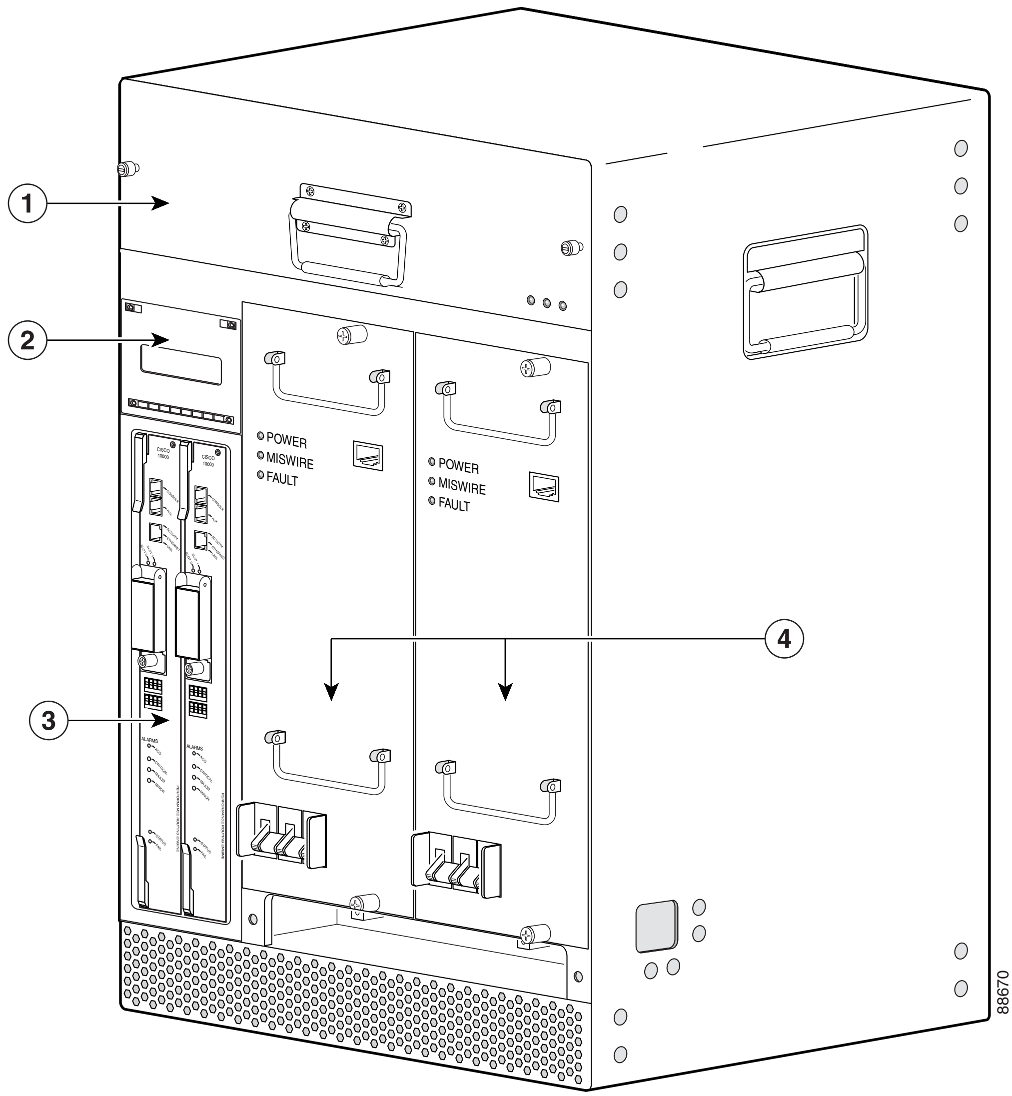


Figure 1-2 shows the front of a fully loaded chassis without the front cover.

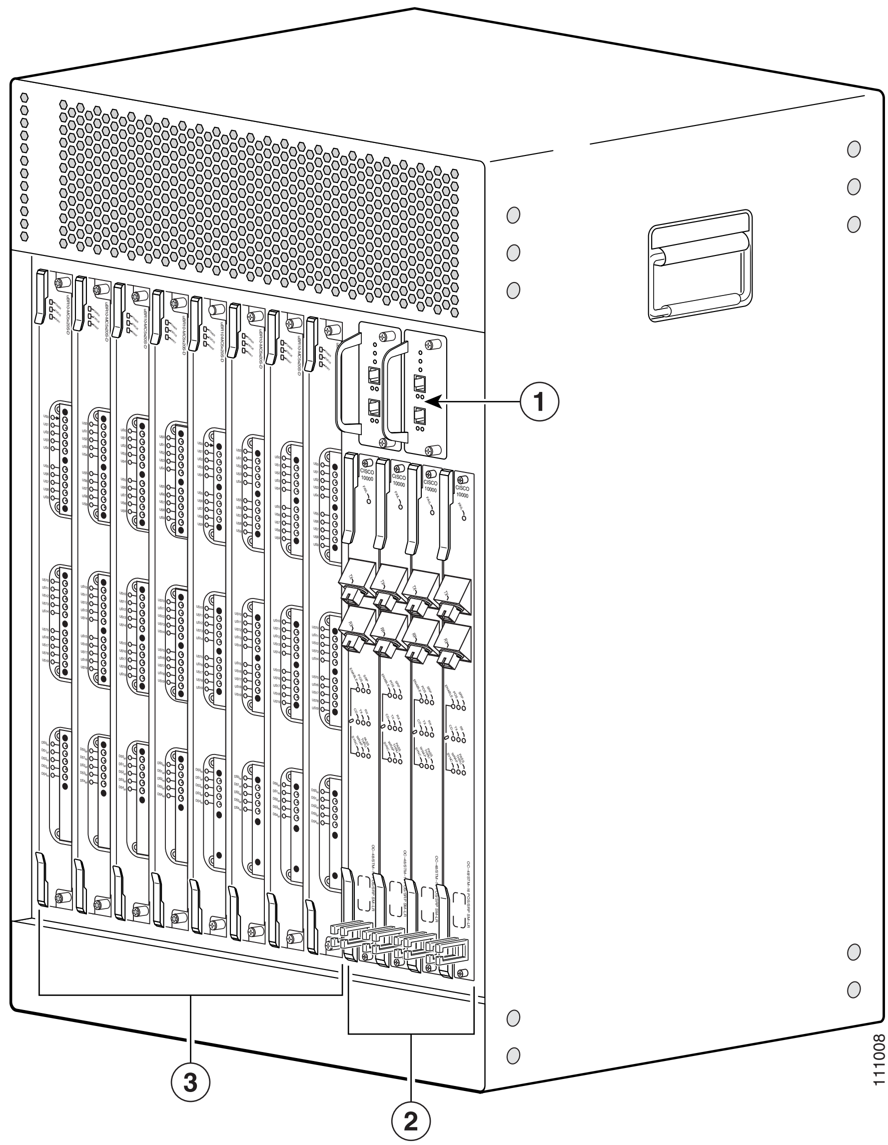
Figure 1-2 Cisco uBR10012 Router Chassis—Front View without the Front Cover



1	Fan assembly module	**3**	Two Performance Routing Engine (PRE) processor modules
2	LCD module	**4**	Two DC Power Entry Modules (DC PEMs)

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

Figure 1-3 Cisco uBR10012 Router Chassis—Rear View



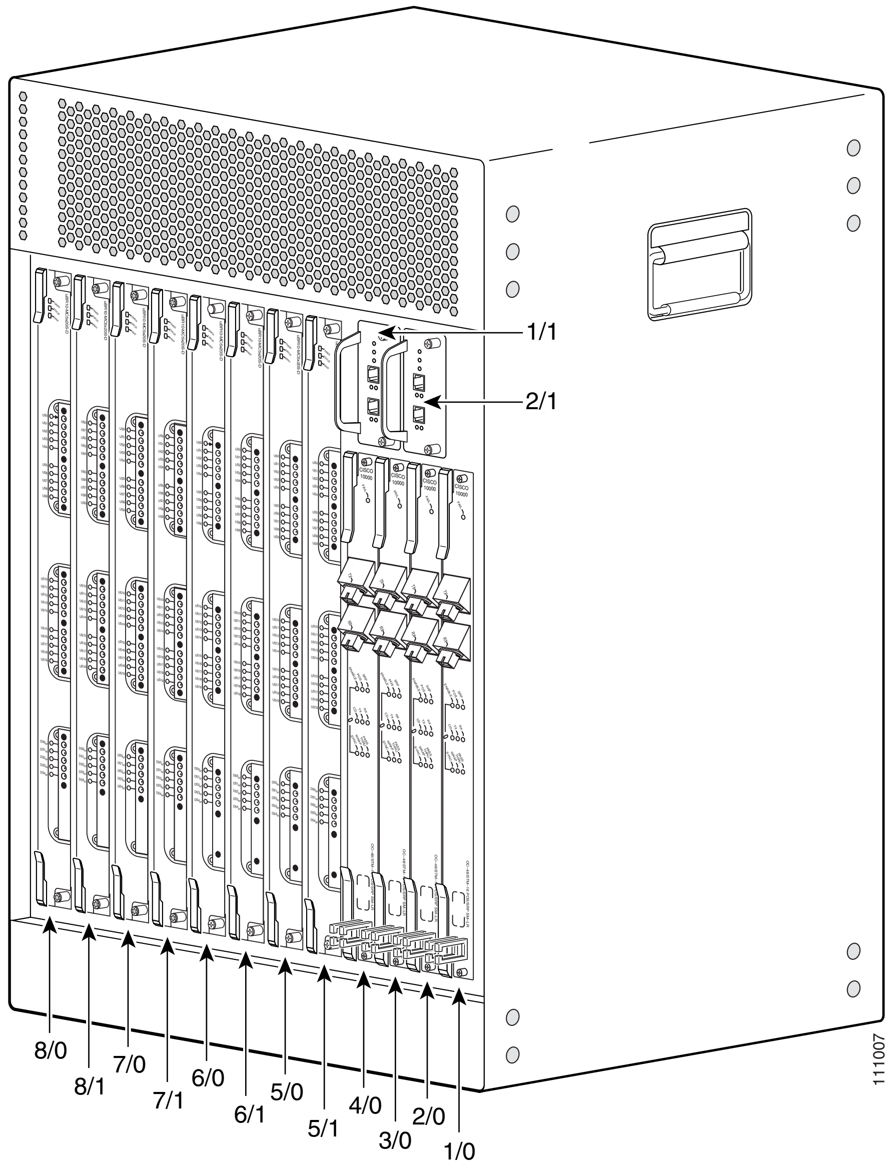
1	Two Timing, Communication, and Control Plus (TCC+) cards	**3**	Eight cable interface line cards
2	Four high-speed, high-performance network uplink line cards (HHGE line cards not shown)		

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 example.

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

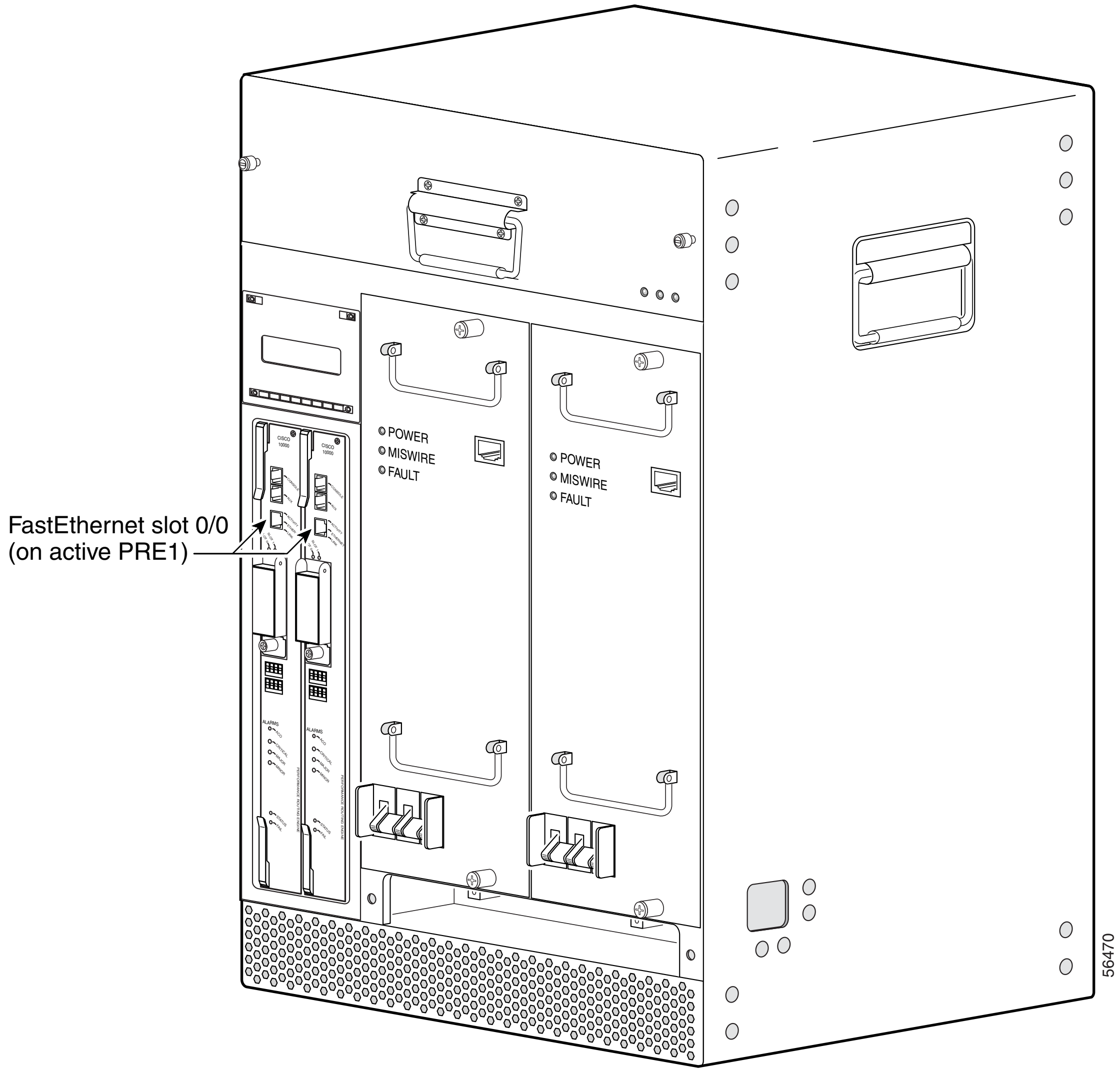


Note Half-height Gigabit Ethernet (HHGE) line cards use slot 3 and slot 4 only. These cards are used with a slot splitter that subdivides the slots so that they become slots 3/0/0, 3/0/1, and slots 4/0/0, 4/0/1.

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 router uses a fan assembly module (see Figure 1-6) containing four fans to supply cooling air to the chassis. The fan assembly connects to the chassis through a blind mate connector that plugs into a cable assembly and then into the chassis backplane.

Four internal fans draw cooling air into the front of the chassis and direct it across the internal components. The air is exhausted through openings in the rear of the chassis. The fan assembly module works at two speeds:

- Low speed (with a clean air filter)
- High speed (with a clean air filter)

The operating speed is determined by the temperature of the fan module at the module air outlet. If the temperature at the fan's outlet reaches 40° C then the blower starts to increase speed. It does not reach high speed, however, until the temperature at the outlet reaches 50° C. Three LEDs indicate the status of the fan assembly. See Table 1-4.

Figure 1-6 Fan Assembly Module

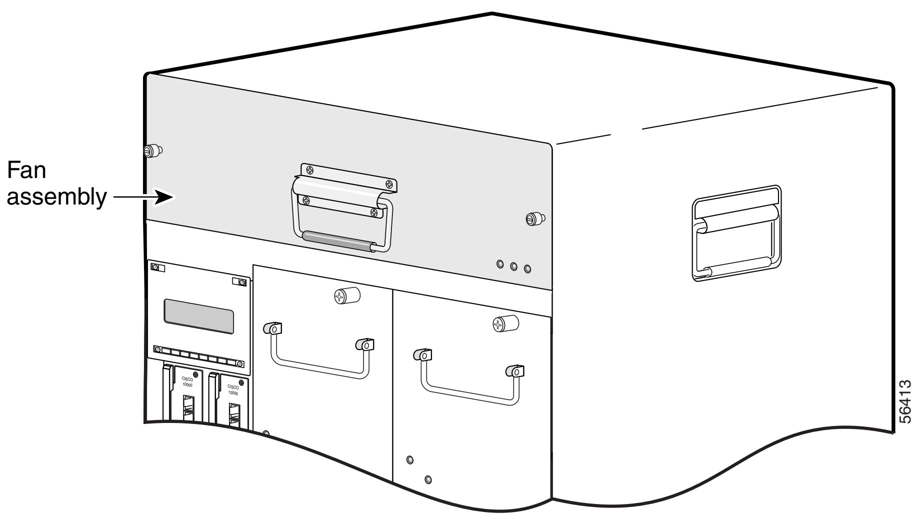


Table 1-4 Fan Assembly LEDs

LED	Status	Description
SYSTEM OK	Green	System is functioning normally, all fans are operating
SINGLE FAN FAILURE	Yellow	A single fan has failed, system triggers alarms, but the fan assembly is still able to cool the chassis—repair or replace the fan assembly as soon as possible.
MULTI-FAN FAILURE	Yellow	If two or more fans have failed, or if the temperature inside the chassis rises too high, the system automatically shuts down—replace the fan assembly immediately.

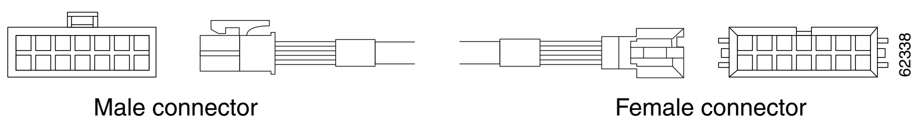
Caution Although the fan assembly supports hot-swapping and can be replaced without interruption to system operation, to prevent overheating, do not operate the system without the fan assembly for more than a few minutes.

Fan Assembly Cable

The fan assembly cable connects the fan assembly to the backplane. The cable is located inside the chassis, underneath the fan assembly. Ordinarily the cable is not removed when a fan assembly module is removed from the chassis.

Note The cable has different connectors on each end. See Figure 1-7

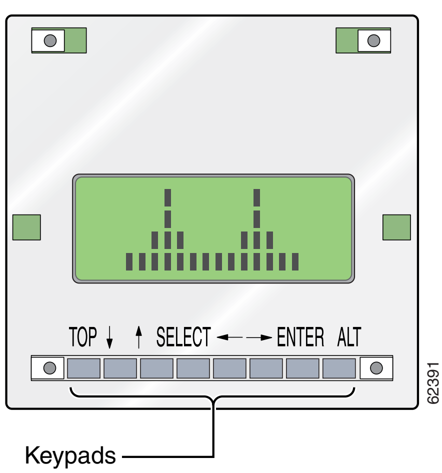
Figure 1-7 Fan Cable



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

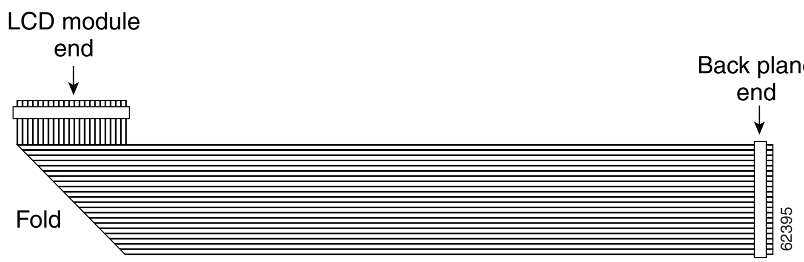


Note The LCD module functions depend on the release of the Cisco IOS software running on your Cisco uBR10012 router. Refer to the release notes for the Cisco IOS release you are using, and the *Cisco uBR10012 Software Configuration Guide*, for details. See the "Obtaining Documentation and Submitting a Service Request" section on page xxi.

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 highperformance Layer 3 forwarding of traffic. The combination of a general purpose RISC processor with advanced programmable PXF 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

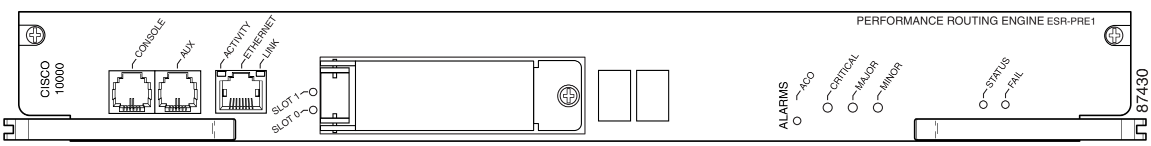
The PRE module supports redundant operation (two PRE modules in a Cisco uBR10012 chassis). If the primary PRE fails, the secondary PRE automatically takes over operation of the chassis. Because all Cisco uBR10012 line cards are physically connected to both the primary and secondary PRE modules, a switchover 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

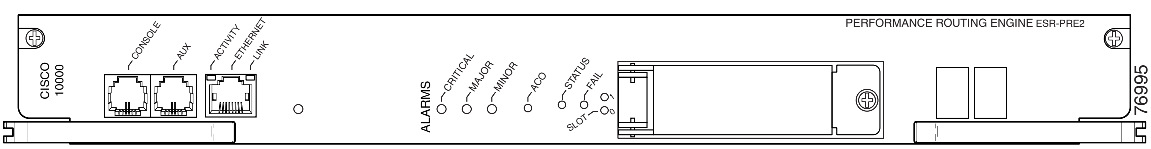
The PRE1 contains two PC media card two slots and 64 MB of onboard flash memory. Figure 1-10 shows the PRE 1 faceplate.

Figure 1-10 PRE1 Faceplate



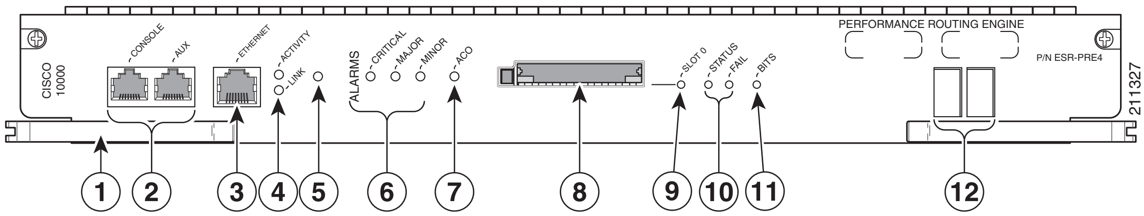
The PRE2 contains two PC media card slots and 128 MB of onboard flash memory. Figure 1-11 shows the PRE2 faceplate.

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 34 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 3-31 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 1-5 describes the LEDs and switch on the PRE.

Table 1-5 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.

Table 1-5 Cisco PRE LEDs and Cutoff Switch

LEDs/Switch	Status	Description
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
- 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 six 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

DC Power Entry Modules

The Cisco uBR10012 router ships with two DC power entry modules (DC PEMs) The PEMs receive –48/–60 VDC power through separate terminal blocks underneath each PEM. The two DC PEMs provide filtered, redundant, and loadshared DC power to the Cisco uBR10012 chassis. If one DC PEM fails, the other PEM immediately begins providing the required power to the system.

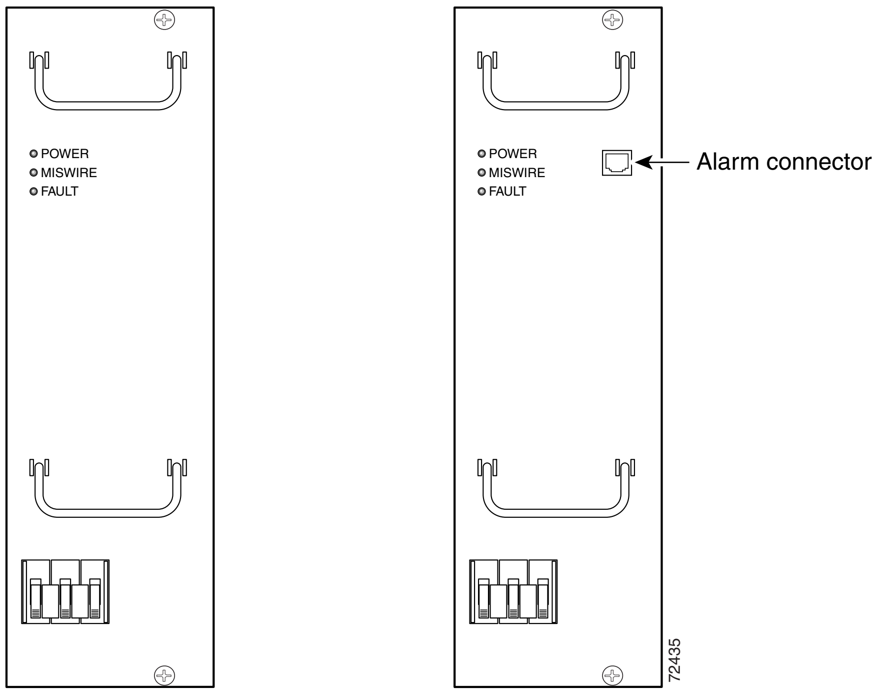
Although one DC PEM can provide sufficient power for a fully configured Cisco uBR10012 chassis, the system should not be run for an extended period time with only one DC PEM. If a DC PEM fails, install a replacement DC PEM as soon as possible.

There are two models of the DC PEM. Figure 1-13 shows the DC PEM with the original faceplate (on the left) and the DC PEM with the connector used for the power supply monitoring cables (on the right). The power supply monitoring cables connect to the optional 2400W AC-input power shelf.

The optional AC-input power shelf provides DC power to the Cisco uBR10012 router when a DC power outlet is unavailable or where AC power is desired. For information about the AC-input power shelf, refer to *2400W AC-Input Power Shelf for the Cisco uBR10012 Universal Broadband Router* at the following URL:

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

Figure 1-13 DC PEM Faceplate (Original Model) and DC PEM Faceplate with Alarm Connector



Caution The two handles on the DC PEM are for removing and inserting the PEM into the Cisco uBR10012 chassis. Do not attempt to lift the Cisco uBR10012 chassis by using these handles.

Tip When using the external AC-input power shelf and Cisco IOS Release 12.2(4)XF or later release, 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.

If you are not using the optional 2400W AC-input power shelf, the two models of DC PEM are identical.

Note The power supply monitoring cable (product order number UBR10-PWR-MON-CAB=, part number 72-3505-01) for the Cisco uBR10012 router DC PEMs is not the same cable that is used for the similar connection on the Cisco AS5850 Universal Gateway (part number 72-2673-01).

DC PEM LEDs

Table 1-6 describes the LEDs on the DC PEM.

Table 1-6 Cisco DC PEM LEDs

LED	Status	Description
POWER	Green	The DC PEM is powered on, receiving power from the external DC power source, and is providing power to the Cisco uBR10012 chassis (normal operation).
FAULT	Yellow	External DC power is being received by the DC PEM but that the PEM is not supplying power to the chassis, typically because the PEM's power switch is turned off. If the power switch is in the ON position, and the Fault LED lights, the PEM is not operating correctly
MISWIRE	Yellow	–48/–60 VDC and RTN (+) wires are reversed (see the "Powering On the System" section on page 3-60).

AC Power Entry Modules

The Cisco uBR10012 router ships with two AC power entry modules (AC PEMs) that provide a redundant power supply to the system. One AC PEM can provide sufficient power for a fully configured chassis, so that if one AC PEM fails, the other automatically begins providing power for the entire router, without impacting system operations.

Note You must use Cisco IOS Release 12.2(4)XF1, Cisco IOS Release 12.2(4)BC1a, or a later release when using the AC PEM. If using an earlier release, the **show environment** command will not correctly identify the AC PEM's error messages.

Caution The Cisco uBR10012 router 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.

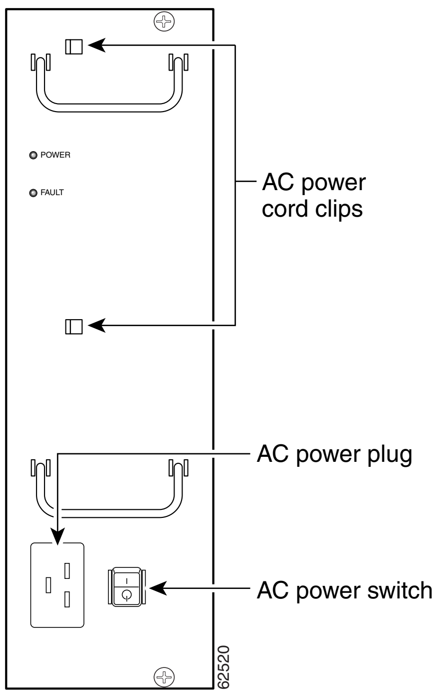
Tip You do not need to shut down the Cisco uBR10012 router to replace a redundant AC PEM. If you are replacing both AC PEMs, you can replace one, bring it online, and then replace the other one to avoid shutting down the system.

Although one AC PEM can provide sufficient power for a fully configured Cisco uBR10012 chassis, the system should not be run for an extended period of time with only one AC PEM. If an AC PEM fails, install a replacement AC PEM as soon as possible. For proper airflow (see Figure 1-15), cooling, and safety, do not remove the failed unit until the replacement unit is available for installation.

Tip For fully redundant power protection, use either an uninterruptible power supply (UPS) or a separate AC-input power source for each AC PEM.

Figure 1-14 shows the front panel of the AC PEM.

Figure 1-14 AC PEM Faceplate



Caution The two handles on the front of the AC PEM are for removing and inserting the PEM into the Cisco uBR10012 chassis. Do not attempt to lift the Cisco uBR10012 chassis by using these handles.

AC PEM LEDs

Table 1-7 describes the LEDs on the AC PEM.

Table 1-7 Cisco AC PEM LEDs and Their Functions

LED	Status	Description
POWER	Green	The PEM is on, is receiving power from the AC power source, and is providing power to the Cisco uBR10012 chassis (normal operations).
FAULT	Yellow	AC-input power is being received by the PEM, but that the PEM is not supplying power to the chassis, typically because the PEM's power switch is turned to the standby position. If the power switch is in the ON position, the PEM is not operating correctly.

Power Supply Cables

The AC PEM requires different power supply cables, depending on the country of operation. Table 1-8 lists the product order numbers for the power supply cables that are available for the AC PEM for the Cisco uBR10012 universal broadband router.

Table 1-8 Power Cables for the AC Power Entry Module for the Cisco uBR10012 Router

Description	Product Order Number
Argentina	CAB-UBR10-AC-AR
Australia/New Zealand	CAB-UBR10-AC-AU
China	CAB-UBR10-AC-CH
Europe	CAB-UBR10-AC-EU
Italy	CAB-UBR10-AC-IT
Japan	CAB-UBR10-AC-JP
North America	CAB-UBR10-AC-US
United Kingdom	CAB-UBR10-AC-UK

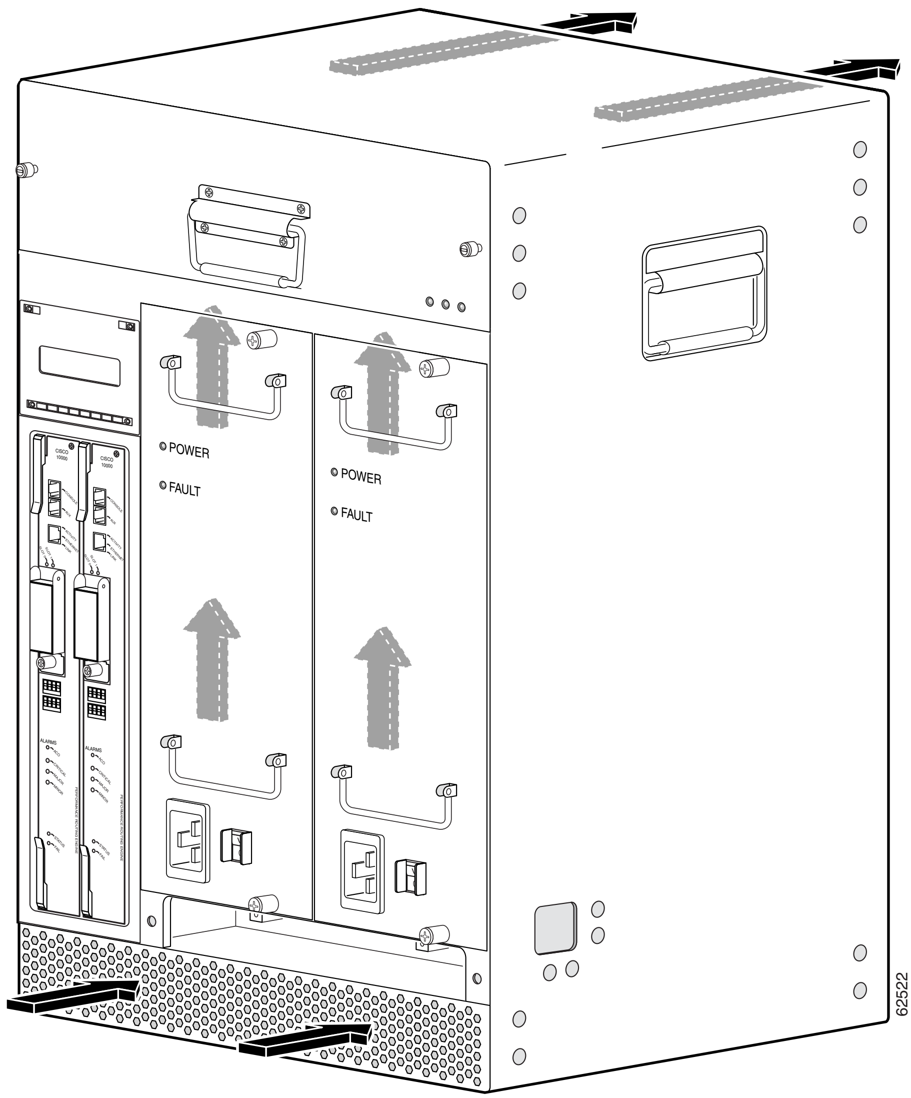
Airflow

The PEMs (both AC and DC) work together with the fan assembly module to ensure that the Cisco uBR10012 chassis is properly cooled during normal operation.

Figure 1-15 shows the airflow through the Cisco uBR10012 chassis when dual PEMs are installed.

Note Figure 1-15 shows the Cisco uBR10012 chassis without the front bezel installed, but the front bezel should be installed during normal operation so that the air filter in the bezel can filter the incoming air before it enters the chassis.

Figure 1-15 Airflow Through the Cisco uBR10012 Chassis with Dual AC PEMs



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 lose of data.

Each TCC+ card contains two RJ-45 connectors on its faceplate labeled Primary and Secondary. These connectors are for a primary and secondary (redundant) Stratum 3 external clock reference source that is traceable to a Stratum 1 clock source. The external reference source allows the Cisco uBR10012 reference clock to be synchronized to the Stratum 1 clock source, providing a free-running DOCSIS-quality clock reference and time stamp to the cable interface line cards.

Caution The TCC+ card can connect only to a national clock source such as a GPS receiver or BITS clock. The Cisco uBR10012 router does not support connecting the RJ-45 connectors on the TCC+ cards directly 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 PSTN.

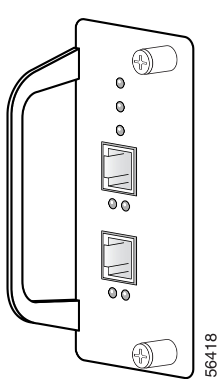
If present, the primary external clock reference on the active TCC+ card is used. If it is lost, the secondary clock reference on the active TCC+ card is used. If the active TCC+ card stops functioning, control is transferred to the backup TCC+ card, which then uses its primary and secondary clock reference sources. If neither card has a valid clock reference source, the active TCC+ card uses its own internal clock to provide the DOCSIS-quality clock reference and time stamp.

Note You do not need to provide any external clock reference source to the TCC+ cards. However, you must always have at least one functioning TCC+ card installed in the Cisco uBR10012 chassis to ensure proper systems operation.

Figure 1-23 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 1-16 TCC+ Card Faceplate



TCC+ Card LEDs

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.

Table 1-9 describes the LEDs on the TCC+ card.

Table 1-9 Cisco TCC+ Card LEDs and Their Functions

LED	Color/Status	Description
POWER	Green	Power is being supplied to the TCC+ card.
	Off	Power off
STATUS - bi-color	Yellow	The CPU is in the bootup process, self-test, or downloading code.
	Green	The CPU has successfully completed the boot, self-test. and code download process and that the TCC+ card is the Active card.
	Blinking green	The CPU has successfully completed the boot, self-test, and code download process and that the TCC+ card is the backup card.
MAINT	Off	Normally off. No maintenance action is required.
	Yellow	Maintenance operation is required, the TCC+ card can be hot-swapped.
PRESENT (Primary)	Green	Normally on. A valid clock reference signal is present at the associated input.
	Off	No signal is present or the TCC+ card is unable to sync to the signal at the associated input.
ACTIVE (Primary)	Green	Normally on. The associated input has been selected as the active clock reference for the TCC+ card.
	Off	The associated input is not the active clock reference.
PRESENT (Secondary)	Green	Normally on. A valid clock reference signal is present at the associated input.
	Off	No signal is present or the TCC+ card is unable to sync to the signal at the associated input.
ACTIVE (Secondary)	Green	Normally on. The associated input has been selected as the active clock reference for the TCC+ card.
	Off	The associated input is not the active clock reference.

Cable Interface Line Cards

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

- Cisco uBR10-LCP2-MC16x (C, E, S) Cable Interface Line Cards, page 1-28
- Cisco uBR10-LCP2-MC28C Cable Interface Line Card, page 1-32
- Cisco uBR-MC5X20S/U Cable Interface Card, page 1-34

Cisco uBR10-LCP2-MC16x (C, E, S) Cable Interface Line Cards

Note The Cisco uBR10-LCP2-MC16x (C, E, S) cable interface line cards are end of sale. For additional information, refer to END-OF-LIFE NOTICE, NO. 2600 at the following location:

http://www.cisco.com/en/US/prod/collateral/video/ps8806/ps5684/ps2209/prod_end-of-life_notice0900aecd80183921.html

The Cisco uBR10-LCP2-MC16*x* cable interface line cards together with external IF-to-RF upconverters, serve as the RF interface between the cable headend and DOCSIS/EuroDOCSIS-based cable modems.

The Cisco uBR10-LCP2-MC16*x* cable interface line cards are a combination of two components:

- Cisco uBR-MC16*x* cable interface line cards—Provide one downstream and six upstreams channels.
  - Cisco uBR-MC16C and Cisco uBR-MC16S support cable modems and set-top boxes that operate according to the Data-over-Cable Service Interface Specifications (DOCSIS). 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.

    Note The Cisco uBR-MC16S main board also includes a daughter card that provides the advanced hardware-based spectrum management feature. This daughter card is an integral part of the card assembly and cannot be removed in the field.

  - Cisco uBR-MC16E supports cable modems and set-top boxes that operate according to the European DOCSIS specifications (EuroDOCSIS). EuroDOCSIS supports the 8 MHz Phase Alternating Line (PAL) and SEquential Couleur Avec Memoire (SECAM) channel plans using the ITU J.112 Annex A RF standard. The downstream uses an 8 MHz channel width in the 85 to 860 MHz frequency range, and the upstream supports multiple channel widths in the 5 to 65 MHz frequency range.
- Cisco Line Card Processor (Cisco uBR10-LCP2) adapter card—Provides the mechanical and electrical conversions necessary for the Cisco uBR-MC16C, Cisco uBR-MC16S, or the Cisco uBR-MC16E cable interface line card to fit the form factor used in the Cisco uBR10012 universal broadband router chassis.

  Note There are two types of Cisco uBR-LCP adapter cards, LCP and LCP2. The LCP is the original adapter card shipped with the Cisco uBR10-LCP-MC16*x* card. (Installation information about the LCP adapter card also applies to the LCP2 adapter card.) The Cisco uBR10-LCP2 adapter card replaces the LCP adapter card. The upgrade to the Cisco uBR10-LCP2 increases the memory from 64- to 256-MB. The upgrade supports N+1 requirements when the card is used as a redundant or protect card. There are no problems with the original LCP version if the card is used as the operating card. See the *Proactive Upgrade Field Notice* number 18301 at the following URL:

  http://www-tac.cisco.com/Support_Library/field_alerts/fn18103.html

The Cisco uBR10-LCP2 adapter card and the Cisco uBR10-MC16*x* cable interface line cards (MC16C, MC16E, and MC16S) are mechanically connected to each other by means of brackets and power connectors (see Figure 1-17). The Cisco uBR10-LCP2 not only adapts the cable interface line card to the form factor of the Cisco uBR10012 series chassis, but also provides the following:

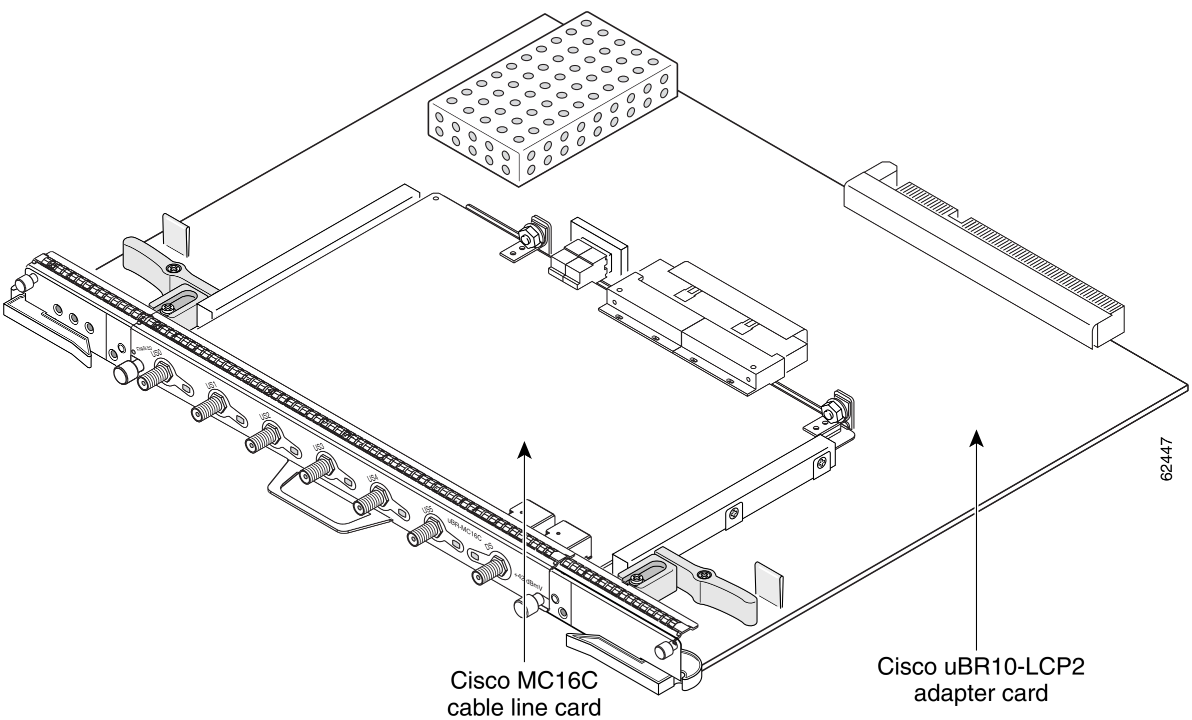
- Proper voltage conversion for the cards and chassis
- Boot code required to use the cable interface line cards
- SDRAM for buffering packets as they are transferred between the card and the PRE

The cards are inserted into and removed from the Cisco uBR10012 series chassis as a single logical and physical unit. All Cisco uBR10-LCP2-MC16*x* cable interface line cards support Online Insertion and Removal (OIR). OIR uses the MAC address assigned to the Cisco uBR10-LCP2 adapter card, allowing you to replace any Cisco uBR10-MC16*x* cable interface line card installed on the adapter card without losing the configuration information.

Caution Do not attempt to separate or remove the cable interface line card from the Cisco uBR10-LCP2 adapter card while the adapter card is inserted in the router. Remove the cards from the chassis as a unit and then separate them on a lab bench or other area that protects against ESD damage.

Figure 1-17 shows the Cisco uBR10-LCP2 adapter card with the Cisco uBR-MC16C cable interface line card installed.

Figure 1-17 Cisco uBR10-LCP2 Adapter Card with Cisco uBR-MC16x Installed



The one downstream port and six upstream ports support the modulation schemes shown in Table 1-10:

Table 1-10 Modulation and Output Specifications for the Cisco uBR MC16xx Cable Interface Line Card

Cable Interface Line Card	Downstream Modulation	Upstream Modulation	Output
Cisco uBR10-LCP2-MC16C[1]	64 QAM, 256 QAM	QPSK, 16 QAM	+42 dBmV +/– 3dB
Cisco uBR10-LCP2-MC16E[1]	64 QAM, 256 QAM	QPSK, 16 QAM	+40 dBmV +/– 3dB
Cisco uBR10-LCP2-MC16S[1]	64 QAM, 256 QAM	QPSK, 16 QAM	+42 dBmV +/– 2dB

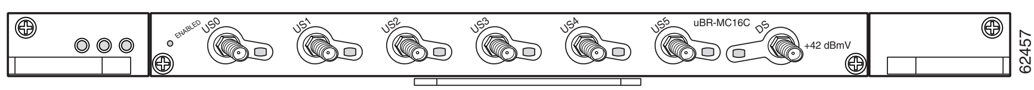
1. The Cisco uBR10-LCP2-MC16*x* cards support industry-standard F-connectors for the coaxial cable connections.

Default modulations:

- 64 quadrature amplitude modulations (QAM) for downstream
- quadrature amplitude phase-shift keying (QPSK) for upstream

Figure 1-18 shows the faceplate for the Cisco uBR10-LCP2-MC16C cable interface line card.

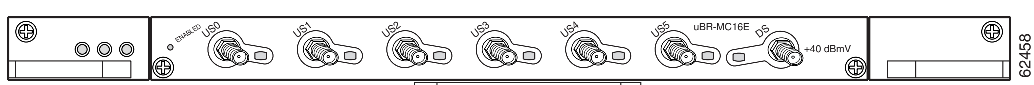
Figure 1-18 Cisco uBR10-LCP2-MC16C Faceplate



The Cisco uBR10-LCP2-MC16C cable interface line card has one downstream port and six upstream ports. The upstream ports are labeled US0 through US5. The downstream port is labeled DS. See Table 1-11 for a description of the adapter card LEDs and Table 1-12 for descriptions of the cable interface line card LEDs and their functions.

Figure 1-19 shows the faceplate for the Cisco uBR10-LCP2-MC16E cable interface line card.

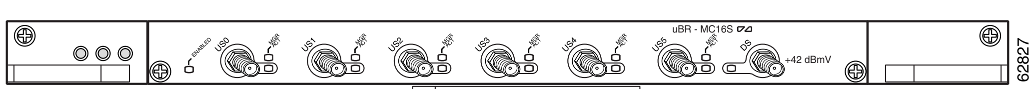
Figure 1-19 Cisco uBR10-LCP2-MC16E Faceplate



The Cisco uBR10-LCP2-MC16E cable interface line card has one downstream port and six upstream ports. The upstream ports are labeled US0 through US5. The downstream port is labeled DS. See Table 1-11 for a description of the adapter card LEDs and Table 1-12 for descriptions of the cable interface line card LEDs and their functions.

Figure 1-20 shows the faceplate for the Cisco uBR10-LCP2-MC16S cable interface line card.

Figure 1-20 Cisco uBR10-LCP2-MC16S Faceplate



The Cisco uBR10-LCP2-MC16S cable interface line card has one downstream port and six upstream ports. The upstream ports are labeled US0 through US5. The downstream port is labeled DS. There are six LEDs labeled MGR ACT (manager active) next to each upstream port. See Table 1-11 for a description of the LCP2 adapter card LEDs and Table 1-12 for descriptions of the cable interface line card LEDs and their functions.

Cisco uBR10-LCP2-MC16*x* LEDs

The Cisco uBR10-LCP2 adapter card and the cable interface line card each have their own set of status LEDs on the front of the module. The adapter card LEDs are described in Table 1-11. The Cisco uBR10-MC16*x* cable interface line card LEDs are described in Table 1-12**.**

Table 1-11 describes the adapter card LEDs and their functions.

Table 1-11 Cisco uBR10-LCP2 Adapter Card LEDs and Their Functions

LED	Color	Description
POWER	Green	Power is being supplied to the LCP2.
	Off	Power is off.
STATUS	Yellow	The Cisco uBR10-LCP2 adapter card is in the bootup process, is in self test, or is downloading code
	Green	The Cisco uBR10-LCP2 adapter card has successfully completed the boot, self test, and code download process
Status LED on N+1 or redundant card in chassis	Blinking green	The board is in Standby or Protect card mode
MAINT	Off	Normally off, no maintenance action is required.
	Yellow	It is safe to remove the entire assembly (adapter card plus cable interface line card) from the chassis

Table 1-12 describes the cable interface line card LEDs and their functions.

Table 1-12 Cisco uBR-MC16x Cable Interface Line Card LEDs and Their Functions

LED	Status	Description
ENABLE	Green	The cable interface line card is operating normally, receiving DC power from the router midplane, and configured for operation
	Off	The card is shut down or the slot is not working
Upstream	Green	For each upstream port, indicates that the upstream path is enabled and configured
	Off	The port is not properly configured, or is shut down, or the slot is not working
Downstream	Green	For each downstream port, indicates that the downstream path is enabled and configured.
	Off	The port is not properly configured, or is shut down, or the slot is not working
MGR ACT (uBR-MC16S only)	Green	Spectrum management activity on the channel.
	Off	Spectrum management is not active.

Cisco uBR10-LCP2-MC28C Cable Interface Line Card

The Cisco uBR10-LCP2-MC28C cable interface line card is a combination of two components:

- Cisco uBR-MC28C—Provides two downstreams and eight upstreams, divided into two domains. The cards are functionally identical, but the Cisco uBR-MC28C card uses industry-standard F-connectors.
- Cisco Line Card Processor (Cisco uBR10-LCP2) adapter card—Provides the mechanical and electrical conversions necessary for the Cisco uBR-MC28C cable interface line card to fit the form factor used in the Cisco uBR10012 chassis.

Note Unless otherwise indicated, all references in this document to the Cisco uBR-MC28C and Cisco uBR10-LCP2-MC28C line cards also refer to the BNC versions of these cards.

The Cisco uBR10-LCP2 adapter card and the Cisco uBR-MC28C line card are mechanically connected to each other by means of brackets and a bus connector. The LCP not only adapts the Cisco uBR-MC28C line card to the form factor of the Cisco uBR10012 chassis, but also provides the proper voltage conversion for the card and chassis, the boot code required to use the Cisco uBR-MC28C, and SDRAM for buffering packets as they are transferred between the line card and PRE.

The two cards are inserted into and removed from the Cisco uBR10012 chassis as a single logical and physical unit. The Cisco uBR10-LCP2-MC28C cable interface line card supports Online Insertion and Removal (OIR). The OIR uses the MAC address assigned to the adapter card, allowing you to replace a Cisco uBR-MC28C on a LCP2 adapter card without losing any configuration information.

Caution Do not attempt to separate or remove the Cisco uBR-MC28C card from the Cisco uBR10-LCP2 adapter card while the two cards are inserted in the Cisco uBR10012 chassis. The cards must be removed from the chassis as a unit and then separated on a lab bench or other area that protects against ESD damage.

The Cisco uBR10-LCP2-MC28C cable interface line cards, together with external IF/RF upconverters, serve as the RF interface between the cable headend and DOCSIS-based cable modems and set-top boxes (STBs). The Cisco uBR10-LCP2-MC28C cable interface line card supports 6 MHz National Television Systems Committee (NTSC) channel operation, using standard (STD), Harmonic Related Carrier (HRC), or Incremental Related Carrier (IRC) frequency plans conforming to EIA-S542. The card supports downstream channels in the 54 to 860 MHz range with upstream ranges of 5 to 42 MHz.

The cards' two downstream ports and eight upstream ports support the modulations shown in Table 1-13:

Table 1-13 Modulation and Output Specifications for the Cisco uBR MC28C Cable Interface Line Card

Cable Modem Line Card	Downstream Modulation	Upstream Modulation	Output
Cisco uBR10-LCP2-MC28C	64 QAM, 256 QAM	QPSK, 16 QAM	+42 dBMV +/– 2 dB

Default modulations:

- 64 quadrature amplitude modulations (QAM) for downstream
- quadrature amplitude phase-shift keying (QPSK) for upstream

The 256 QAM modulation can be used for the downstream and the 16 QAM modulation for the upstream only if the cable plant can support the higher carrier-to-noise ratio (CNR) thresholds required for these modulations.

The Cisco uBR10-LCP2-MC28C cable interface line card is configured identically to the Cisco uBR-MC28C cable interface line card. For information about configuring the Cisco uBR-MC28C cable interface line card, refer to chapter three of the *Cisco uBR10012 Universal Broadband Router Software Configuration Guide*, available on Cisco.com or at the following URL:

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

Caution The Cisco uBR10012 supports only the Cisco uBR10-LCP2-MC28C cable interface line card bundle. Do not install either the adapter card or Cisco uBR-MC28C card separately in the Cisco uBR10012 chassis.

Figure 1-21 shows the Cisco uBR10-LCP2 adapter card with the Cisco uBR-MC28C card installed.

Figure 1-21 Cisco uBR10-LCP2 Adapter Card with Cisco uBR-MC28C Installed

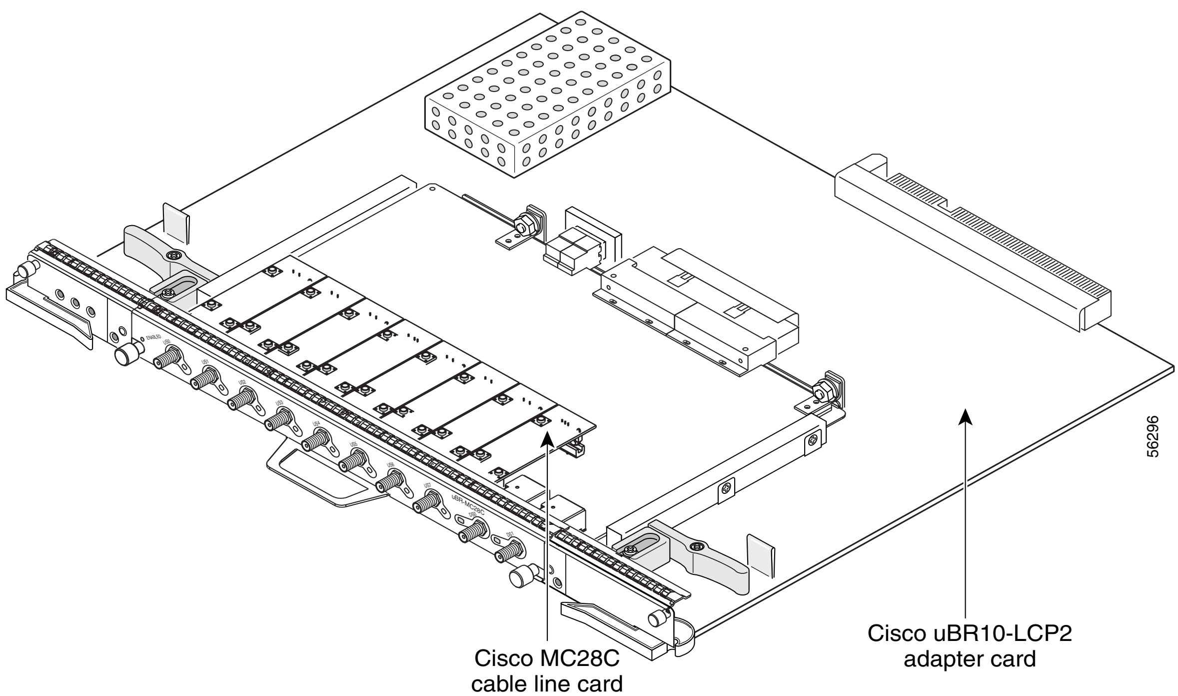
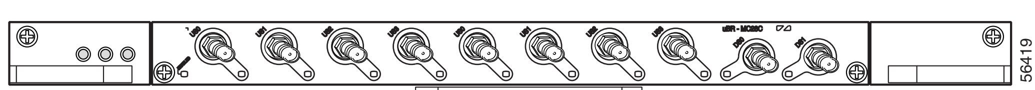


Figure 1-22 shows the faceplate for the Cisco uBR10-LCP2-MC28C cable interface line card.

Figure 1-22 Cisco uBR10-LCP2-MC28C Faceplate



The cable interface card has two downstream ports and eight upstream ports. Each downstream port is associated with four upstream ports in a DOCSIS domain. Each domain runs independently of the other. The Cisco uBR10-LCP2-MC28C cable interface line card uses a color-coded label to identify and group the two downstream domains (DS0 and DS1). Their corresponding upstream ports are labeled U0 through U3.

Cisco uBR10-LCP2-MC28C LEDs

The LCP adapter card and the cable interface line card each have their own set of status LEDs on the front of the module. The Cisco uBR10-LCP2 adapter card LEDs are described in Table 1-14. The Cisco uBR-MC28C cable interface line cards LEDs are described in Table 1-15.

Table 1-14 describes the LCP2 adapter card LEDs and their functions.

Table 1-14 Cisco uBR10-LCP2 Adapter Card LEDs and Their Functions

LED	Status	Description
POWER	Green	Power is being supplied to the LCP2 adapter card
	Off	Power is off
STATUS	Yellow	The adapter card is in the bootup process, self-test, or downloading code.
	Green	The adapter card has successfully completed the boot, self-test, and code download process.
	Blinking green	Line card is in standby or protect mode.
MAINT	Off	Normally off, no maintenance action is required
	Yellow	It is safe to remove the entire assembly (adapter card and line card) from the chassis.

The Cisco uBR-MC28C cable interface line card has its own set of LEDs. Table 1-15 describes the LEDs and their functions:

Table 1-15 Cisco uBR-MC28C Line Card LEDs

LED	Status	Description
ENABLE	Green	The cable interface line card is operating normally, receiving DC power from the router midplane and configured for operation.
	Off	Either the card is shut down or the slot is not working.
Upstream	Green	For each upstream port, green indicates that the upstream path is enabled and configured.
	Off	The port is not properly configured, or is shut down, or the slot is not working.
Downstream	Green	For each downstream port, green indicates that the downstream path is enabled and configured.
	Off	The port is not properly configured, or is shut down, or the slot is not working.

Cisco uBR-MC5X20S/U Cable Interface Card

The Cisco uBR10-MC5X20S/U cable interface line card is a 20 by 16 inch card designed specifically for the Cisco uBR10012 router. This card transmits and receives RF signals between the subscriber and the headend over hybrid fiber/coax (HFC) system.

The Cisco uBR10-MC5X20S/U cable interface line card supports downstream and upstream traffic over a Data-Over-Cable Service Interface Specification (DOCSIS)-based cable modem network. The card supports 6-MHz National Television Systems Committee (NTSC) channel operation, using standard (STD), Harmonic Related Carrier (HRC), or Incremental Related Carrier (IRC) frequency plans conforming to EIA-S542. The card supports downstream channels in the 88 to 860 MHz range, and upstream channels in the 5 to 61 MHz range.

Upstream data from the subscriber, comes through the upstream ports (US0- US19) on the Cisco uBR10-MC5X20S/U 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 cable interface line card.

The Cisco uBR10-MC5X20S/U 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. Each downstream port includes an inboard integrated upconverter.

The Cisco uBR10-MC5X20S/U cable interface line card supports all DOCSIS 1.1-specified Annex B radio frequency (RF) data rates, channel widths, and modulation schemes and has DOCSIS MAC management and spectrum management capabilities.

Figure 1-23 shows the faceplate of the Cisco uBR10-MC5X20S/U cable interface line card with the dense connector configuration.

Figure 1-23 Cisco uBR10-MC5X20S/U Cable Interface Line Card with a Dense Connector Configuration

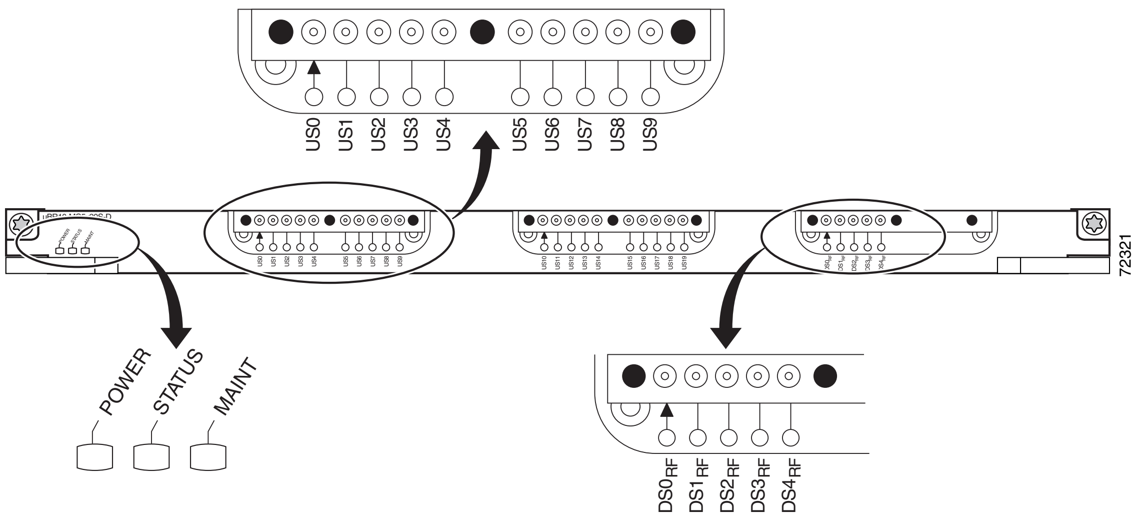


Table 1-16 describes the LEDs on the Cisco uBR10-MC5X20S/U cable interface line card.

Table 1-16 Cisco uBR10-MC5X20S/U Card LEDs and Their Functions

LED	Status	Description
POWER	Green	Card is powered on.
	Off	Card is not powered on.
STATUS	Green	Processor has booted and passed diagnostics
	Blinking Green	Protect mode when the card is the redundant card in the system
	Yellow	In bootup mode
	Off	No power to the line card, see the "Troubleshooting the Power Subsystem" section on page 4-7
MAINT	Yellow	It is OK to remove the line card
	Off	No action necessary

Table 1-16 Cisco uBR10-MC5X20S/U Card LEDs and Their Functions (continued)

LED	Status	Description
US0 through US19	Green	Upstream enabled–path is configured and able to pass traffic
	Off	Upstream port is not enabled
DS0 through DS4	Green	RF enabled–downstream path is configured and able to pass traffic out through the upconverter at RF frequencies
	Off	RF is not enabled

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 1-36
- Cisco Half-Height Gigabit Ethernet Line Card, page 1-38
- Cisco OC-12 POS Line Card, page 1-41
- Cisco uBR10-SRP-OC12SML DPT WAN Line Card, page 1-42
- Cisco uBR10012 OC-48 DPT/POS Interface Module, page 1-45

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 1-18). 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

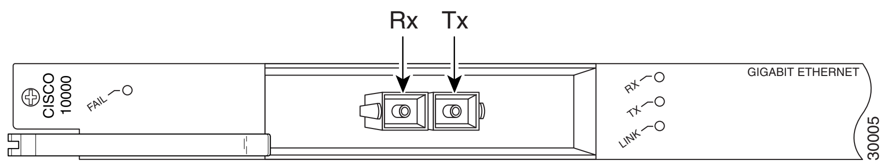
Warning **Osynlig laserstrålning när denna del är öppen och förregleringen är urkopplad. Rikta inte blicken in mot strålen.** Statement 36.

Warning Statement for Finland

Warning **Alleviates ja suojalukitus ohitettaessa olet alttiina näkymättömälle lasersäteilylle. Äjä katso säteeseen.** Statement 35

Figure 1-24 shows the faceplate for the Gigabit Ethernet line card.

Figure 1-24 Gigabit Ethernet Line Card Faceplate



Cisco Gigabit Ethernet Line Card LEDs

Table 1-17 describes the LEDs on the Gigabit Ethernet line card.

Table 1-17 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 1-18 lists the GE line card GBICs and their respective cable types and lengths.

Table 1-18 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 62.5 50.0 50.0	160 200 400 500	722 ft (220 m) 902 ft (275 m) 1640 ft (500 m) 1804 ft (550 m)

Table 1-18 GBIC Port Cabling Specifications (continued)

GBIC	Wavelength (nm)	Fiber Type	Core Size, microns	Modal Bandwidth, MHz/km	Cable Distance, feet/meters
1000Base-LX/LH ESR-GBIC-LH	1300	MMF[1] SMF	62.5 50.0 50.0 8 to 10	500 400 500 —	1804 ft (550 m) 1804 ft (550 m) 1804 ft (550 m) 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 a 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 singe-mode fiber.

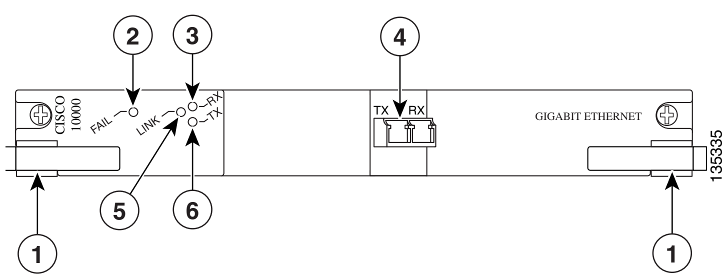
Cisco Half-Height Gigabit Ethernet Line Card

The Cisco HHGE line card (Figure 1-25) 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.

Figure 1-25 shows the faceplate for the Gigabit Ethernet line card.

Figure 1-25 Half-Height Gigabit Ethernet Line Card Faceplate



1	Ejector Levers	**4**	SFP Gigabit Ethernet Interface Converter
2	FAIL LED (yellow)	**5**	Link Status (green)
3	Receive Packet (green)	**6**	Transmit Packet (green)

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.

LEDs

This line card faceplate contains the following LEDs that continuously indicate line card status as well as the status of the port during operation (see Figure 1-25):

FAIL (yellow)—This LED lights during portions of the POST (Power-On Self Test), but remains off after the POST on a properly working line card. If the line card fails during operation, this LED lights and an alarm event occurs.

The FAIL LED blinks during the following SFP faults:

- An SFP GBIC other than a Cisco brand is inserted
- A non-Gigabit Ethernet SFP GBIC is inserted
- A hardware problem occurs in a valid SFP GBIC

- Link (green)—When on, this LED indicates that a carrier signal exists. If negotiation is enabled (at both ends), it indicates successful completion and the port can pass traffic.

Note This LED can also be on if the line card is in internal loopback.

When off, this LED indicates that no carrier signal is detected, negotiation failed, or the port is administratively down.

- RX (green)—When on, this status LED indicates that packets are being received. When this LED is off, the line card is not receiving packets.
- TX (green)—When on, this status LED indicates that packets are being transmitted. When this LED is off, the line card is not transmitting packets.

Note Because this line card operates in full-duplex mode, both the RX and TX LEDs can be on at the same time.

For additional information about using the faceplate LEDs to troubleshoot the line card, see the "Troubleshooting the Line Cards" section on page 4-12.

SFP Gigabit Ethernet Interface Converter Modules and Cable Specifications

The HHGE line card supports single Ethernet interfaces based on SFP GBIC technology. The following SFPs are supported by this line card:

- 1000Base-SX SFP—The SFP-GE-S, 1000Base-SX SFP operates on ordinary multimode fiber optic link spans of up to 550 meters in length.
- 1000Base-LX/LH SFP—The SFP-GE-L, 1000Base-LX/LH SFP operates on ordinary single-mode fiber optic link spans of up to 10,000 meters in length.
- 1000Base-ZX SFP—The GLC-ZX-SM, 1000Base-ZX SFP operates on ordinary single-mode fiber optic link spans of up to 70 kilometers (km) in length. Link spans of up to 100 km are possible using premium single-mode fiber or dispersion-shifted single-mode fiber. The SFP provides an optical link budget of 23 dB—the precise link span length depends on multiple factors such as fiber quality, number of splices, and connectors.

When shorter distances of single-mode fiber are used, it may be necessary to insert an inline optical attenuator in the link, to avoid overloading the receiver. A 5-decibel (dB) or 10-dB inline optical attenuator should be inserted between the fiber optic cable plant and the receiving port on the GLC-ZX-SM at each end of the link whenever the fiber optic cable span is less than 25 km.

- 1000Base-T SFP— Support for the GLC-T, 1000Base-T SFP module is introduced in Cisco IOS Release 12.3(23)BC1.

  The Cisco GLC-T, 1000Base-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. For more information on the Cisco GLC-T 1000Base-T SFP, see http://www.cisco.com/en/US/docs/routers/7200/install_and_upgrade/gbic_sfp_modules_install/5067g.html

Note The required line card SFP GBIC is shipped already installed in the line card. Cisco sells individual SFP GBICs separately and you can change the type of Gigabit Ethernet interface supported by this line card by simply changing its SFP GBIC module.

Table 1-19 lists the interface types supported by the Gigabit Ethernet line card.

Table 1-19 GBIC Port Cabling Specifications

SFP GBIC	Wavelength (nm)	Fiber Type	Core Size (microns)	Modal Bandwidth (MHz*km)	Cable Distance
1000Base-SX SFP-GE-S	850	MMF	62.5 62.5 50.0 50.0	160 200 400 500	722 ft (220 m) 902 ft (275 m) 1640 ft (500 m) 1804 ft (550 m)
1000Base-LX/LH SFP-GE-L	1300	MMF[1] SMF	62.5 50.0 50.0 8 to 10	500 400 500 —	1804 ft (550 m) 1804 ft (550 m) 1804 ft (550 m) 32,808 ft (10 km)
1000Base-ZX GLC-ZX-SM	1550	SMF	9, 10	—	43.4 to 62 miles (70 to 100 km)[2]
1000Base-T SFP	NA	NA	NA	NA	328 ft (100 m)

1. Mode-conditioning patch cord is required. Using an ordinary patch cord with MMF, 1000Base-LX/LH SFPs, and a short link distance (10s of meters) can cause transceiver saturation resulting in an elevated bit error rate (BER). In addition, when using the LX/LH SFP with 62.5-micron diameter MMF, you must install a mode-conditioning patch cord between the SFP 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. 1000Base-ZX SFP can reach up to 100 km by using dispersion-shifted SMF or low attenuation SMF; the distance depends on fiber quality, number of splices, and connectors.

For more information about the SFPs, see the following URL:
http://www.cisco.com/en/US/products/hw/modules/ps5000/tsd_products_support_series_home.html

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

Figure 1-26 shows the faceplate for the Cisco OC-12 POS line card.

Figure 1-26 Cisco OC-12 POS Line Card Faceplate

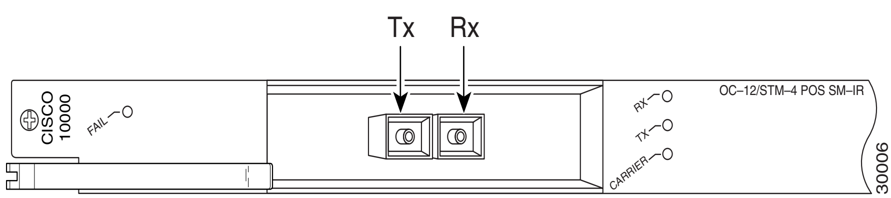


Table 1-20 lists the cable specifications for the Cisco OC12 POS card.

Table 1-20 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 1-21 describes the LEDs and their functions on the Cisco OC-12 POS line card.

Table 1-21 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
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.

Warning **Class 1 laser product.** Statement 1008

Warning **Invisible laser radiation present.** Statement 1016.

Warning **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

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

Note The Cisco uBR10-SRP-OC12SML DPT WAN line card requires two card slots. For that reason, the card is normally installed in Slot 2 and Slot 4 if you are using two cards. If you are using only one card then install the card in Slot 2, Slot 3 or Slot 4.

Figure 1-27 shows the faceplate. The part number of the card (UBR10-SRP-OC12SML) is next to the CLEI code label. The label (2xOC-12/STM-4/SRP SM-LR) above the transmit and receive port connections defines the optical carrier specifications for this card.

Figure 1-27 Cisco uBR10-SRP-OC12SML DPT Faceplate

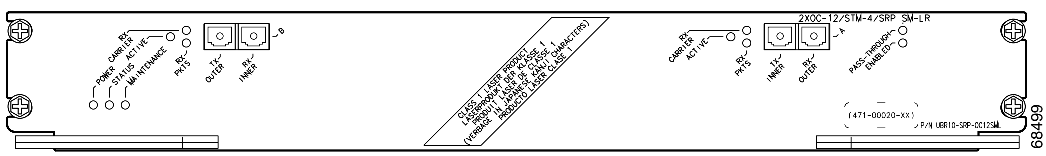
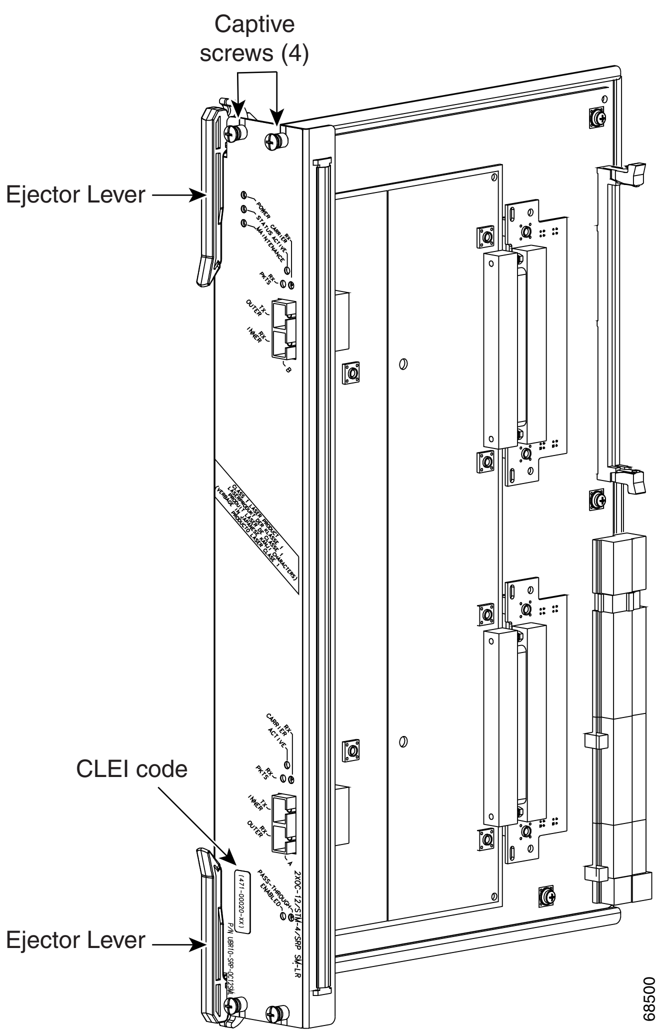


Figure 1-28 shows the Cisco uBR10-SRP-OC12SML DPT WAN line card.

Figure 1-28 Cisco uBR10-SRP-OC12SML DPT WAN Line Card



Cisco uBR10-SRP-OC12SML DPT WAN Line Card LEDs

Table 1-22 describes the LEDs and their functions on the Cisco uBR10-SRP-OC12SML DPT WAN line card.

Table 1-22 Cisco uBR10-SRP-OC12SML DPT WAN Line Card LEDs and Their Functions

LED	Color/Status	Description
POWER	Green	Power is being supplied to the Cisco uBR10-SRP- OC12SML DPT WAN line card
	Off	Power off
STATUS - bi-color	Yellow	The CPU is in the bootup process, self test, or downloading code
	Green	The CPU has successfully completed the boot, self test, and code download process, and that the Cisco uBR10-SRP- OC12SML DPT WAN line card is the active card
MAINT	Off	Normally off, no maintenance action is required
	Yellow	Indicates a required maintenance operation and that the Cisco uBR10-SRP-OC12SML DPT WAN line card can be hot-swapped
RX CARRIER–B	Green	The DPT port WAN has detected valid SONET or SDH framing on the received carrier.
	Off	No valid SONET or SDH framing
ACTIVE	Green	Side B of the DPT port line is functioning
	Off	Not active
RX PKTS (Packets)	Blinking Green	The DPT port line has received a packet. This LED flickers in normal operation, indicating traffic
	Off	No traffic
RX CARRIER–A	Green	The DPT port line has detected valid SONET or SDH framing on the received carrier
	Off	No valid SONET or SDH framing
ACTIVE	Green	Side A of the DPT port line is functioning
	Off	Not active
RX PKTS (Packets)	Blinking Green	The DPT port line has received a packet. This LED flickers during normal operation indicating traffic.
	Off	No traffic
PASS-THROUGH	Amber	The DPT port line is in a pass-through state
	Off	Not active
ENABLED	Green	The DPT port line is enabled for operation; however, the interface port might be in the shutdown state
	Off	Not active

Attenuation

The Cisco uBR10-SRP-OC12SML DPT WAN line card is designed to be used at any distance between 15 and 40 kilometers (km). For short-distance operations (less than 15 km), use a 10 dBm optical attenuator on the link between the two nodes to prevent clipping and oversaturating of the optical receiver. The attenuator should be made of a non metallic or plastic material.

The exact attenuation value is based on the real cable length or the number of couplers and splicers on the link. For example, 5 dBm attenuator could be used in a 7 km link.

Table 1-23 Cable Specification

Fiber Type	Wavelength, nm	Core Size, microns	Cable Distance
Single-mode fiber	1310	8 to 10	49,213 – 131,234 ft. (15 – 40 km)

Note The maximum distance of 40 km assumes that the 1310 nm SMF optical cable attenuation is no more than 0.5 dB per kilometer; and that there is no optical coupler or splicer in the link (each could add 0.5 dB loss).

Cisco recommends the use of a SC/PC female to SC/PC male optical attenuator for the Cisco uBR10-SRP-OC12SML DPT WAN line card.

Tip The SC/PC (Standard Connector/Physical Contact) denotes a connector with a rectangular shape. The surfaces are parallel with respect to the port (not angled). SC/APC (Standard Connector Angled Physical Contact) denotes an angled surface.

Caution Make sure that you obtain the correct connector type (SC/PC) when purchasing optical attenuators. Angled SC/APC type mating surfaces can damage the Cisco uBR10-SRP-OC12SML DPT WAN line card (RX port) interface.

See Optical Connectors and Cables, page 1-47.

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.

Figure 1-29 shows the faceplate of the Cisco uBR10012 OC-48 DPT/POS interface module.

Figure 1-29 Cisco uBR10012 OC-48 DPT/POS Interface Module Faceplate

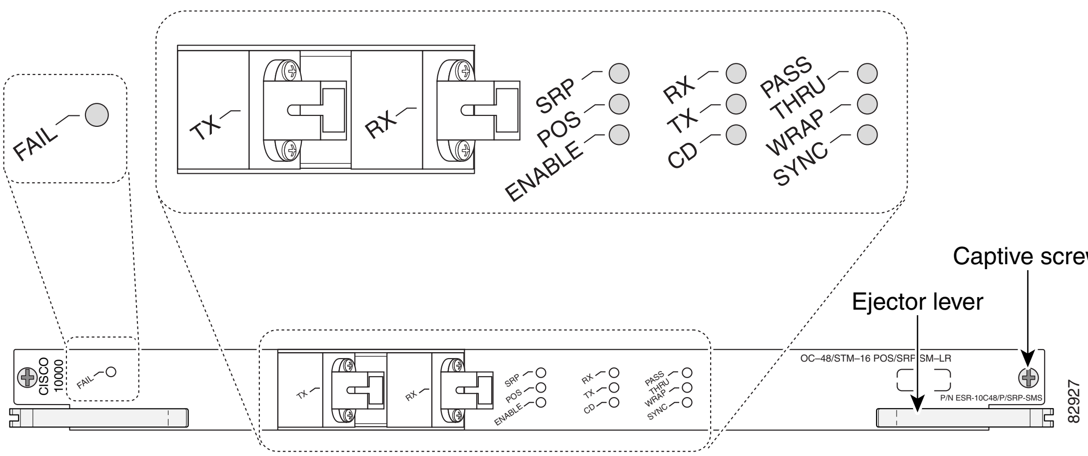


Table 1-24 describes the status of the LEDs.

Table 1-24 Cisco uBR10012 OC-48 DPT/POS Interface Module LED Status and Description

LED	Status	Description
FAIL	Yellow	Line card is disabled
	Off	Line card is operational
ENABLE	Green	Port is enabled
	Off	Port is disabled
POS	Green	Operating in POS mode
	Off	Not operating in POS mode
SRP	Green	Operating in SRP/DPT mode
	Off	Not operating in SRP/DPT mode
CD	Green	Carrier detected
	Off	No carrier detected

Table 1-24 Cisco uBR10012 OC-48 DPT/POS Interface Module LED Status and Description (continued)

LED	Status	Description
TX	Green	Packets transported
	Off	No packets transported
RX	Green	Packets received
	Off	No packets received
SYNC	Green	Card synchronized to mate card
	Off	Card not synchronized
WRAP	Yellow	Interface is wrapped
	Off	Interface not wrapped
PASS THRU	Yellow	DPT port line is in a pass-through state
	Off	DPT port line not in pass-through state

Optical Connectors and Cables

For single-mode optical fiber connections, use one duplex SC-type cable (see Figure 1-30), or two simplex SC-type cables (see Figure 1-31), 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 1-30 Duplex SC-Type Cable and Connector

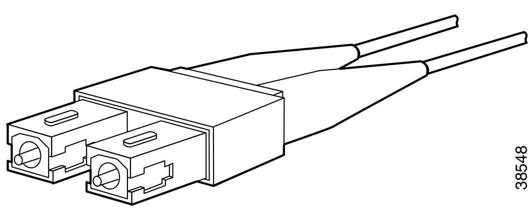
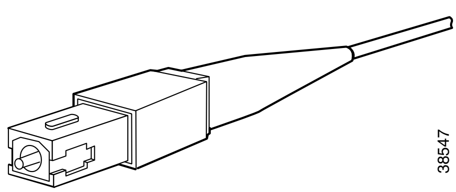


Figure 1-31 Simplex SC-Type Cable and Connector



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

- Table 1-18, for the Gigabit Ethernet line card
- Table 1-20, for the OC-12 POS line card
- Table 1-23, for the OC12SML DPT WAN 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 1-25 lists the major FRUs used in the Cisco uBR10012 router.

Table 1-25 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
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 (DCPEM)	UBR10-PWR-DC=
AC power entry module (ACPEM)	UBR10-PWR-AC=
Fan assembly module (spare)	UBR10-FAN-ASSY=
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=
AC power cables for different countries	See "Power Supply Cables" section on page 1-24
Cable Interface Line Cards	
Line Card Processor (spare)	UBR10-LCP2=
Cisco uBR10-LCP2-MC16C line card processor bundle	UBR10-LCP2-MC16C=
Cisco uBR10-LCP2-MC16E line card processor bundle	UBR10-LCP2-MC16E=
Cisco uBR10-LCP2-MC16S line card processor bundle	UBR10-LCP2-MC16S=
Cisco uBR10-LCP2-MC28C line card processor bundle	UBR10-LCP2-MC28C=
Cisco uBR10-MC5X20S cable interface line card	UBR10-MC5X20S=

Table 1-25 Cisco uBR10012 Field-Replaceable Units and Product Order Numbers (continued)

Field-Replaceable Unit	Product Order Number
Cisco uBR10-MC5X20U cable interface line card	UBR10-MC5X20U=
Blank cable interface line card cover	UBR10-MC-COVER=
Network Line Cards	
Cisco Single Port Gigabit Ethernet line card (GigE) 1000Base-SX—pluggable transceiver 1000Base-LX/LH—pluggable transceiver 1000Base-ZX— pluggable transceiver	UBR10-1GE, UBR10-1GE= ESR-GBIC-SX ESR-GBIC-LH ESR-GBIC-ZX
Cisco Half-Height Gigabit Ethernet line card Slot splitter card Half height slot blank cover Full height slot blank cover 1000Base-SX—pluggable transceiver 1000Base-LX/LH—pluggable transceiver 1000Base-ZX— pluggable transceiver	ESR-HH-1GE ESR-HH-CARRIER ESR-HH-COVER ESR-COVER SFP-GE-S SFP-GE-L 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 Single spare[2] Single mode[1], long reach modules Single spare[2]	 UBR10-SRP-OC48SMS ESR1OC48/P/SRPSMS= UBR10-SRP-OC48SML= 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.

FRU Documentation

Table 1-26 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 1-26 Cisco FRU Document Title and URL

Document title URL	*2400W AC-Input Power Shelf for the Cisco uBR10012 Universal Broadband Router* http://www.cisco.com/en/US/docs/cable/cmts/ubr10012/installation/field_replaceable_units/ub10acsh.html
Document title URL	*AC Power Entry Module for the Cisco uBR10012 Universal Broadband Router* http://www.cisco.com/en/US/docs/cable/cmts/ubr10012/installation/field_replaceable_units/ub10acpm.html
Document title URL	*DC Power Entry Module for the Cisco uBR10012 Universal Broadband Router* http://www.cisco.com/en/US/docs/cable/cmts/ubr10012/installation/field_replaceable_units/ub10pem.html
Document title URL	*Cisco uBR10012 Universal Broadband Router Fan Assembly Module* http://www.cisco.com/en/US/docs/cable/cmts/ubr10012/installation/field_replaceable_units/fan5093.html
Document title URL	*Cisco LCD Module for the Cisco uBR10012 Universal Broadband Router* http://www.cisco.com/en/US/docs/cable/cmts/ubr10012/installation/field_replaceable_units/lcd5090.html
Document title URL	Cisco uBR10012 Universal Broadband Router TCC+ Card http://www.cisco.com/en/US/docs/interfaces_modules/cable/installation/tcc5094.html
Document title URL	*Cisco uBR10-SRP-OC12SML DPT WAN Line Card for the Cisco uBR10012 Router* http://www.cisco.com/en/US/docs/interfaces_modules/cable/line_cards/ubr_srp_oc12sml_dpt_wan/quick/start/ub10oc12.html
Document title URL	*Performance Routing Engine Module for the Cisco uBR10012 Universal Broadband Router* http://www.cisco.com/en/US/docs/interfaces_modules/cable/performance_routing_engine/installation/guide/pre5096.html
Document title URL	*Installing EMI Gaskets and RF Absorber Material on the Cisco uBR10012 Universal Broadband Router* http://www.cisco.com/en/US/docs/cable/cmts/ubr10012/installation/field_replaceable_units/pre2gkit.html
Document title URL	*Cisco uBR10-LCP-MC16C/MC16E/MC16S Cable Interface Card for the Cisco uBR10012 Router* http://www.cisco.com/en/US/docs/interfaces_modules/cable/line_cards/ubr_line_card_adapter/ubr10_lcp2_mc16c_e_s/installation/guide/ublcp_16.html
Document title URL	*Cisco uBR10-LCP2-MC28C Cable Interface Line Card for the Cisco uBR10012 Router* http://www.cisco.com/en/US/docs/interfaces_modules/cable/line_cards/ubr_line_card_adapter/ubr10_lcp2_mc28c/installation/guide/ub10clcp.html
Document title URL	Cisco uBR10-MC5X20S/U Cable Interface Line Card http://www.cisco.com/univercd/cc/td/doc/product/cable/ubr10k/ubr10012/frus/index.htm
Document title URL	Cisco Half-Height Gigabit Ethernet Line Card http://www.cisco.com/univercd/cc/td/doc/product/cable/ubr10k/ubr10012/frus/index.htm
Document title URL	Inspection and Cleaning Procedures for Fiber-Optic Connections http://www.cisco.com/en/US/tech/tk482/tk876/technologies_white_paper09186a0080254eba.shtml

CHAPTER 2

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 3-3).

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.

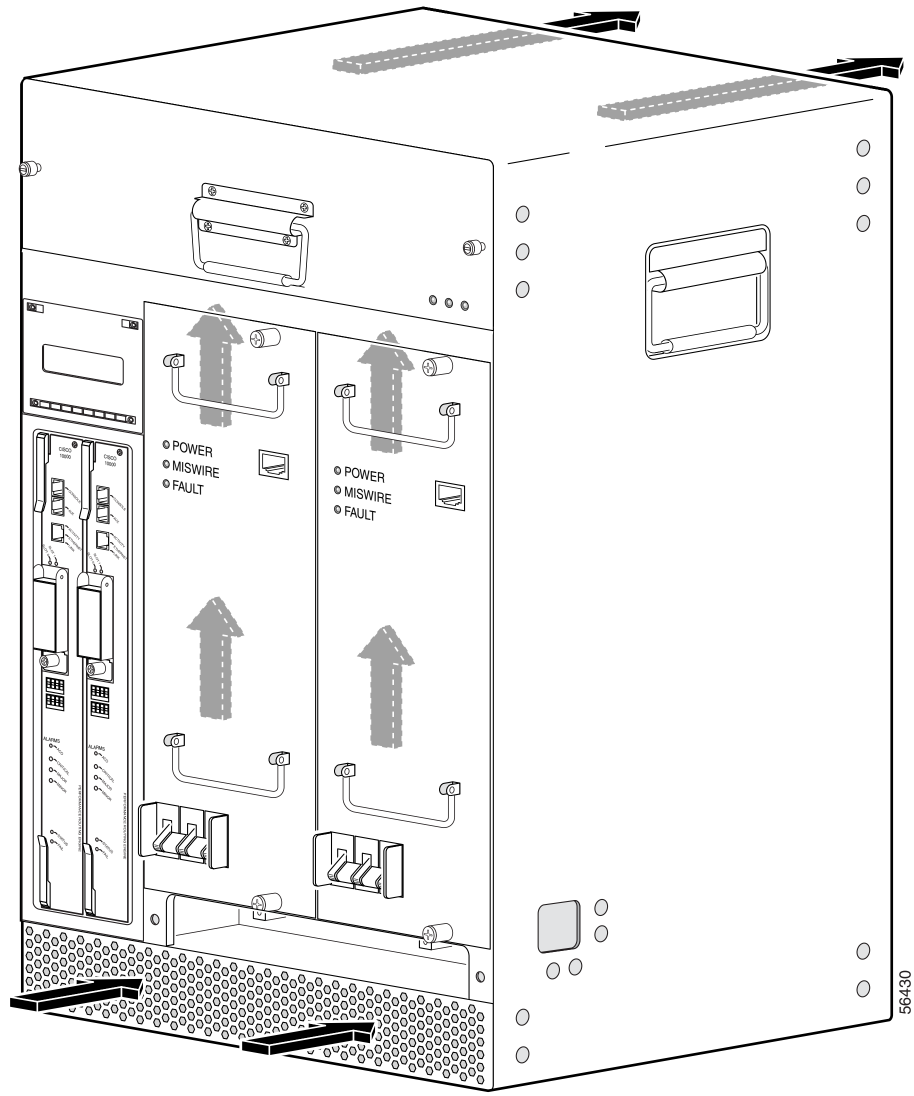
In addition, allow for approximately 3 to 4 ft (91.44 cm to 121.92 cm) clearance at the front and rear of the chassis for cabling and normal system maintenance.

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)

Table 2-1 Specifications for Operating and Nonoperating Environments (continued)

Specification	Minimum	Maximum
Humidity, ambient (noncondensing) operating	5%	85%
Humidity, ambient (noncondensing) nonoperating and storage	5%	95%
Altitude, operating and nonoperating	–197 ft (–60 m)	13,123 ft (4000 m)
Vibration, operating	—	5 to 200 Hz, 0.5 g (1 octet/min.)
Vibration, nonoperating	—	5 to 200 Hz, 1 g (1 octet/min.) 200 to 500 Hz, 2 g (1 octet/min.)

Power Guidelines

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

- 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.

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.

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.

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

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

Table 2-2 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 2-3.

Table 2-3 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.

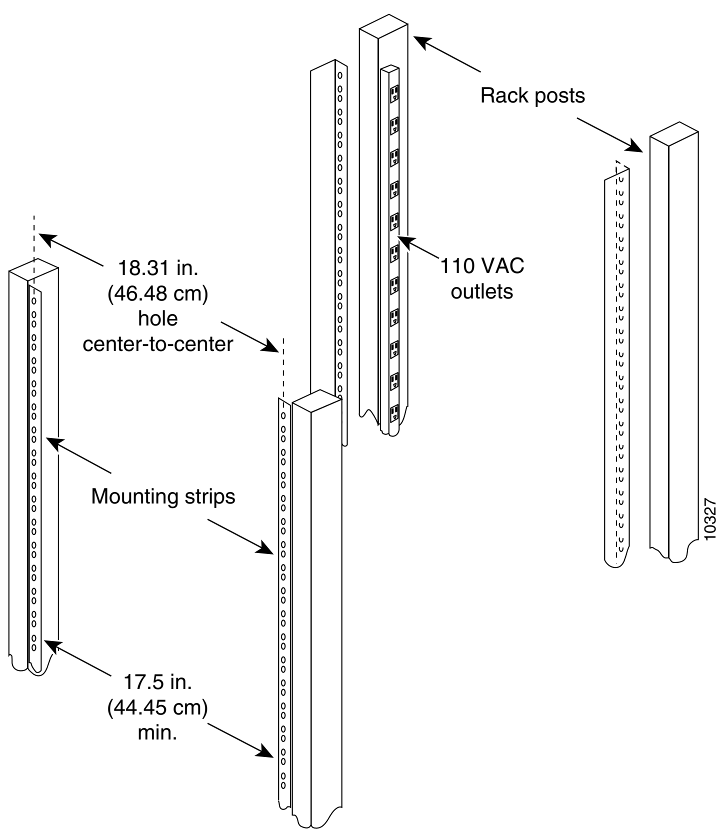
Warning **This equipment must be grounded. Never defeat the ground conductor or operate the equipment in the absence of a suitably installed ground conductor. Contact the appropriate electrical inspection authority or an electrician if you are uncertain that suitable grounding is available.** Statement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



CHAPTER 3

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:

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 Power Modules, Fan Assembly, and Line Cards, page 3-4
- Attaching the Mounting Brackets, page 3-17
- Installing the Cable Management Brackets (Optional), page 3-21

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 last 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 2-6.

Removing the Power Modules, Fan Assembly, and Line Cards

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

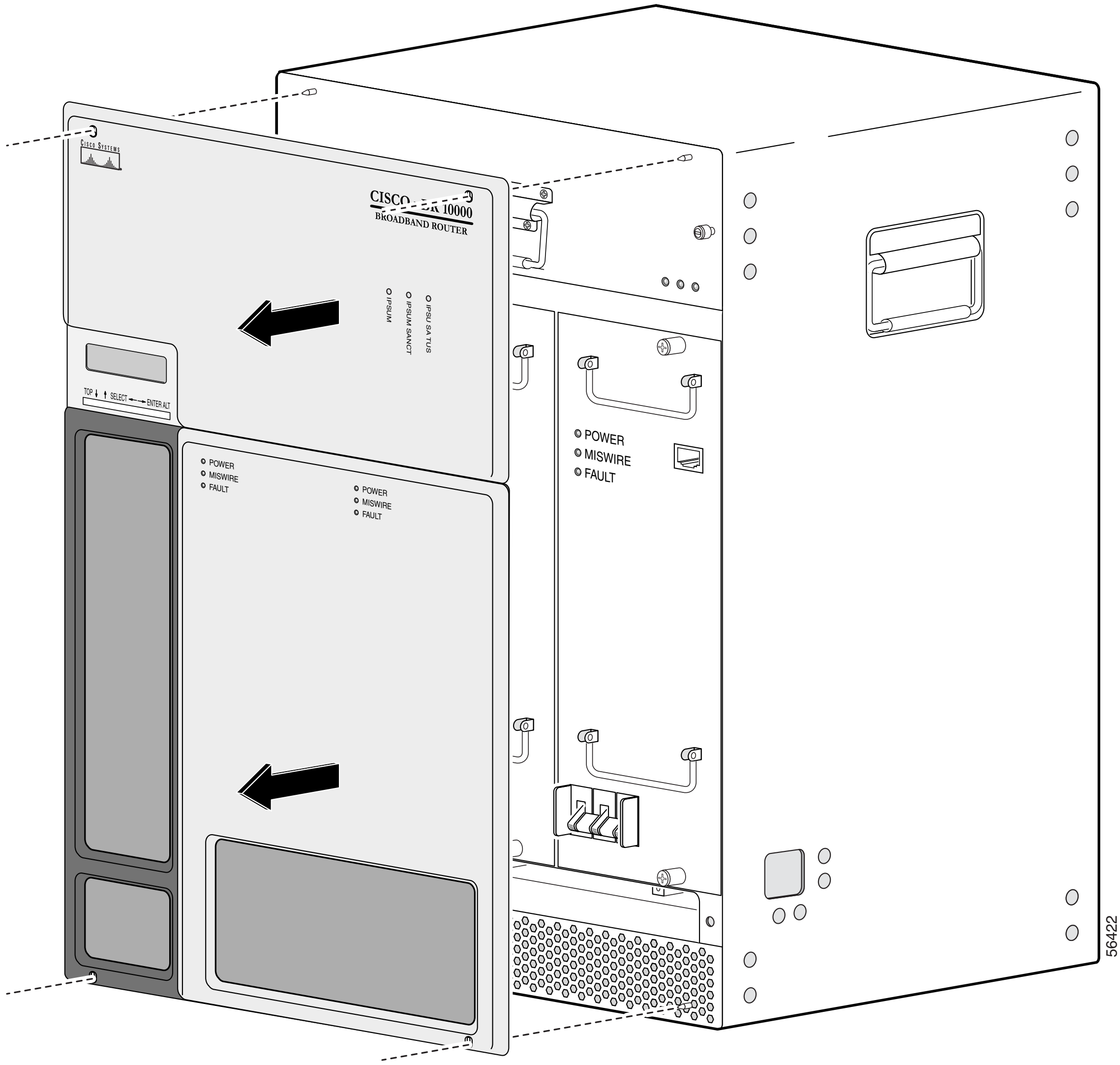
In a fully loaded chassis, these components weigh approximately 170 lbs (77.11 kg), removing the components allows the chassis to be moved ssfely using two people. Reinstall the components after the chassis has been moved and installed. Use the following procedures to remove these components.

Removing the Front Cover

Caution Remove all power from the unit and turn off the power at the source before proceeding.

Step 1 Remove the front cover by lifting it up slightly and then pulling it toward you (Figure 3-1), and carefully set it aside.

Figure 3-1 Removing the Cisco uBR10012 Chassis Front Cover



Removing the DC Power Entry Modules

Use this procedure to remove the DC power entry modules (PEMs) from the Cisco uBR10012 chassis.

Step 1 Verify that the first DC PEM you are removing is turned off by pushing the three-levered power switch down to the OFF (0) position (Figure 3-2).

Step 2 Loosen the captive screws on the DC PEM.

Step 3 Pull the PEM straight out from the chassis, using the two handles on the faceplate (Figure 3-3).

Step 4 Set the DC PEM aside.

Step 5 Repeat Step 1 through Step 4 to remove the second DC PEM, and set it aside as well.

Figure 3-2 Turning Off a DC PEM

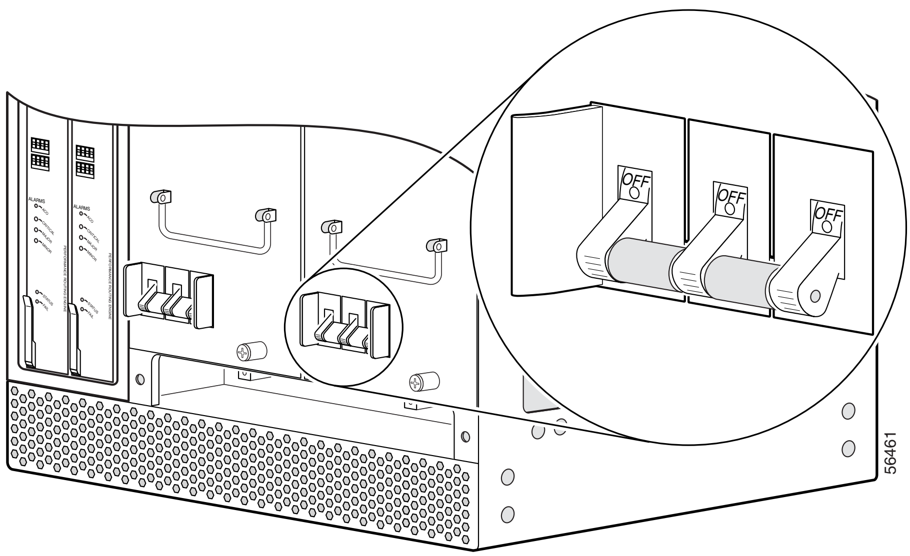
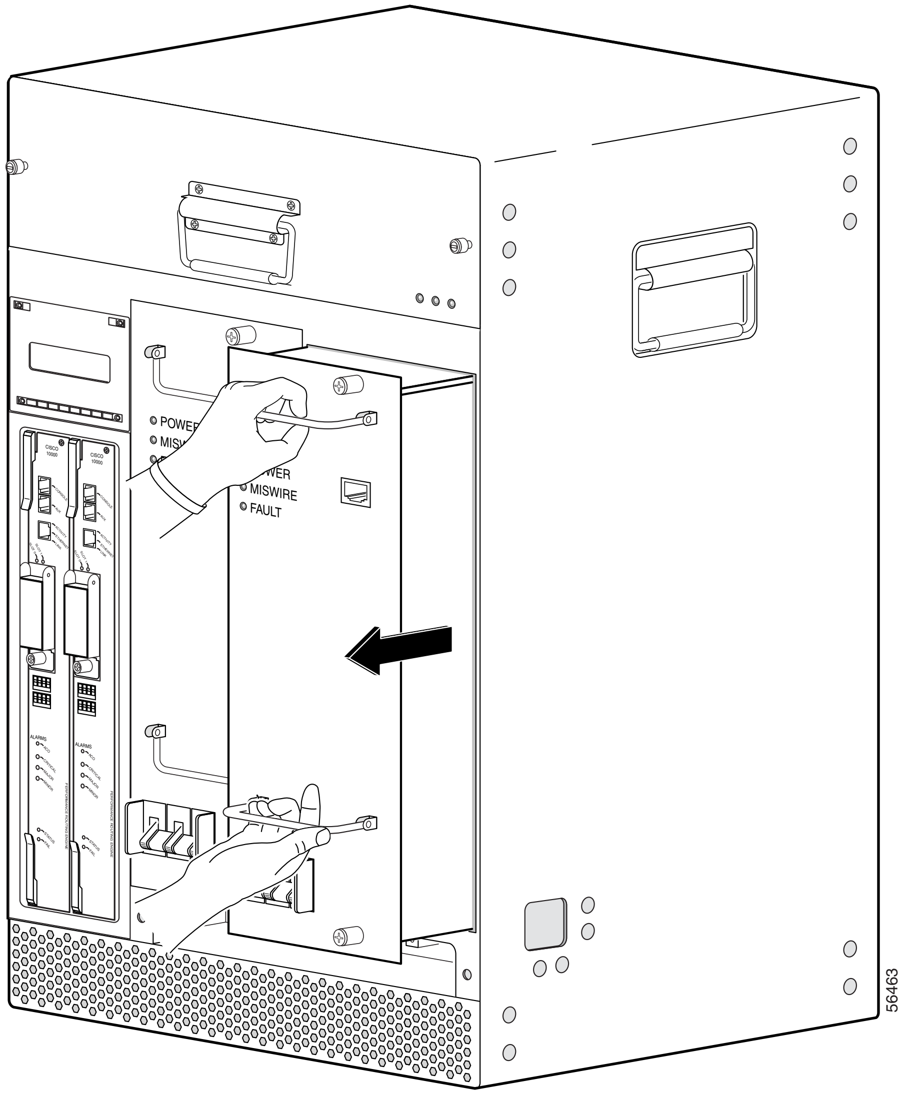


Figure 3-3 Removing a DC PEM



Removing the AC Power Entry Module

Use this procedure to remove the AC power entry modules (PEMs) from the Cisco uBR10012 chassis.

Step 1 Remove the front cover on the chassis by lifting it up slightly and then pulling it toward you. See Figure 3-1.

Step 2 Verify that the power switch on the AC PEM is turned off. See Figure 3-4.

Step 3 Unplug the AC-input power cord from the power plug on the front panel of the AC PEM.

Step 4 Remove the AC-input power cord from the chassis cord clips and set it aside.

Step 5 Use the screwdriver to loosen the captive screws on the AC PEM you are removing.

Step 6 Pull the AC PEM from the chassis by using the handle on the faceplate. See Figure 3-5.

Step 7 Set the AC PEM aside.

Step 8 Repeat Step 1 through Step 7 to remove the second AC PEM.

Figure 3-4 AC Power Cord and AC On/Off Switch Locations on the AC PEM

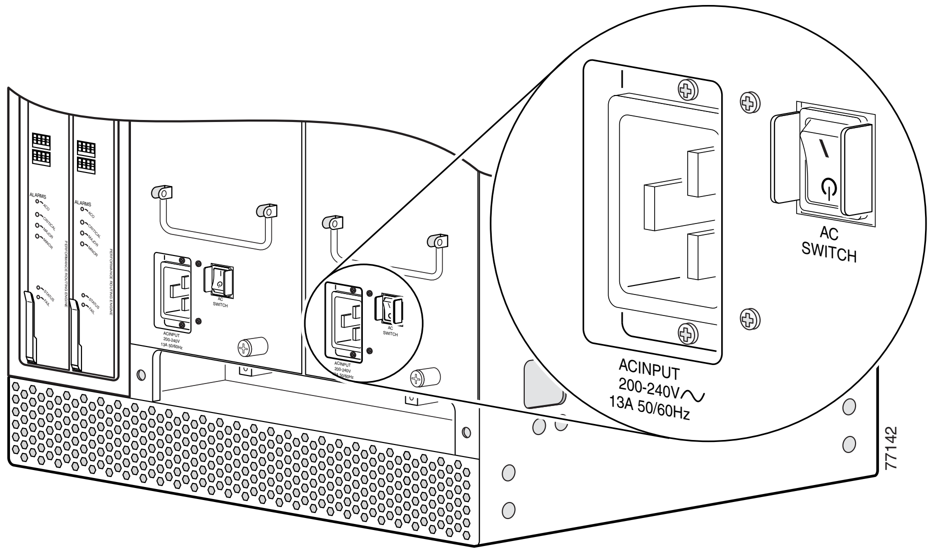
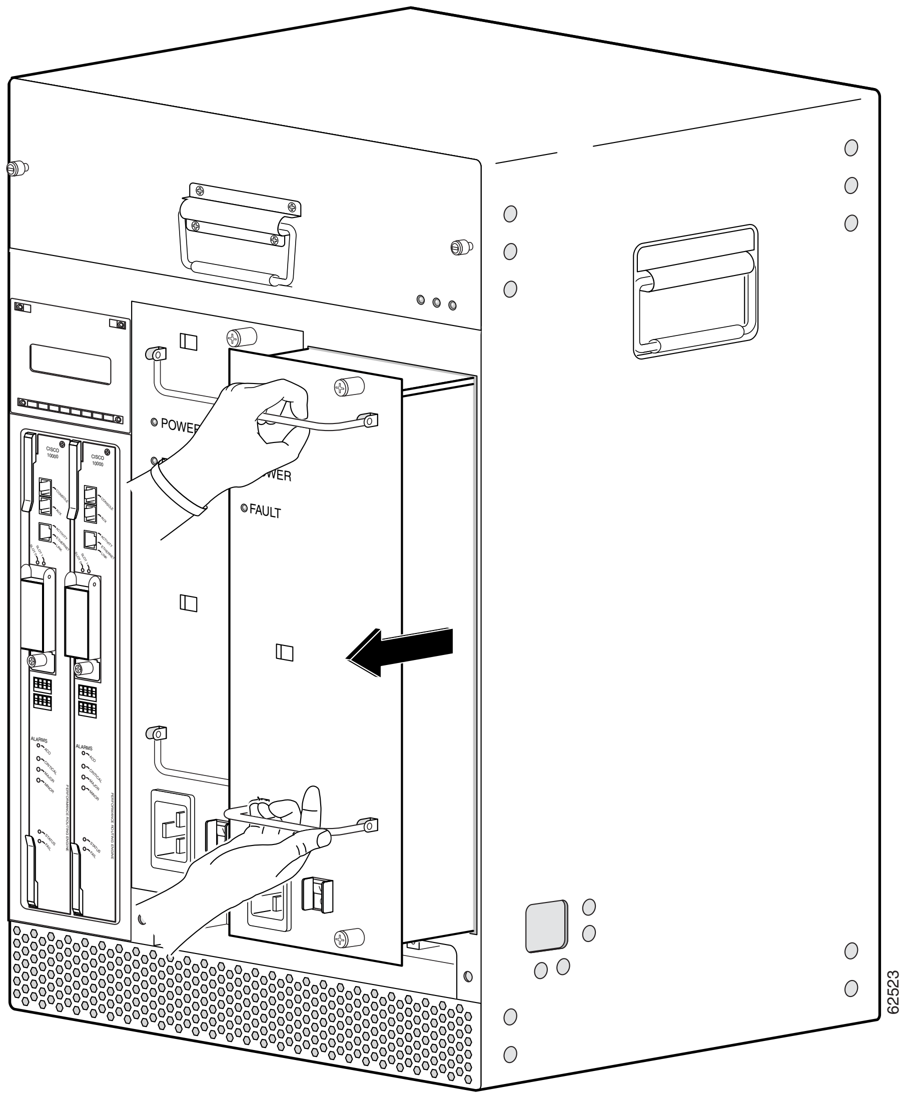


Figure 3-5 Removing the AC PEM



Removing the Fan Assembly

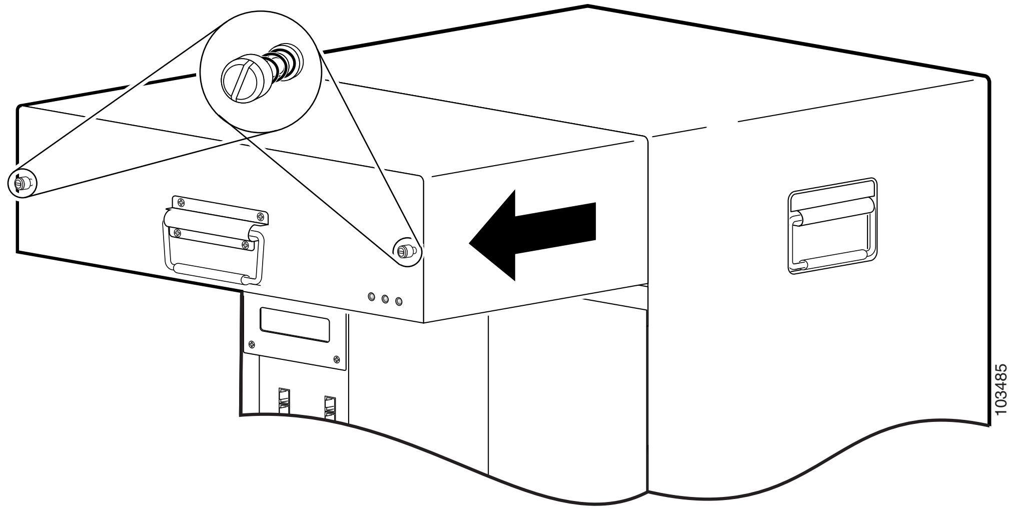
Step 1 Loosen the captive screws on each side of the fan assembly module (Figure 3-6).

Step 2 Use two hands to pull the module out of the chassis.

Caution The fan assembly module weighs approximately 30 lbs (13.61 kg). Use one hand to pull the fan assembly module using its handle and position the other hand underneath the module to support it, so that it does not suddenly swing down when it clears the chassis.

Step 3 Set the fan assembly module aside.

Figure 3-6 Removing the Fan Assembly Module



Removing the Cable Interface Line Cards and Uplink Cards

Step 1 To remove the cable interface and network uplink line cards, move to the rear of the chassis.

Step 2 Unscrew the top and bottom captive screws (Figure 3-7).

Step 3 Simultaneously pivot both ejector levers away from each other to disengage the line card from the backplane (Figure 3-8).

Step 4 Slide the line card out of the slot (see Figure 3-8).

Step 5 Place the card on an antistatic surface or in an antistatic bag.

Step 6 Repeat Step 2 through Step 5 to remove the other cable interface line cards and the network uplink cards.

Caution If you are using the Cisco uBR-MC28C or Cisco uBR-MC16xx line cards, do not attempt to separate or remove the line cards from the Cisco uBR10-LCP2 adapter card while they are installed in the Cisco uBR10012 chassis. The line cards and adapter cards must be removed from the chassis as a complete unit before they can be separated.

Figure 3-7 Captive Screws and Ejector Levers

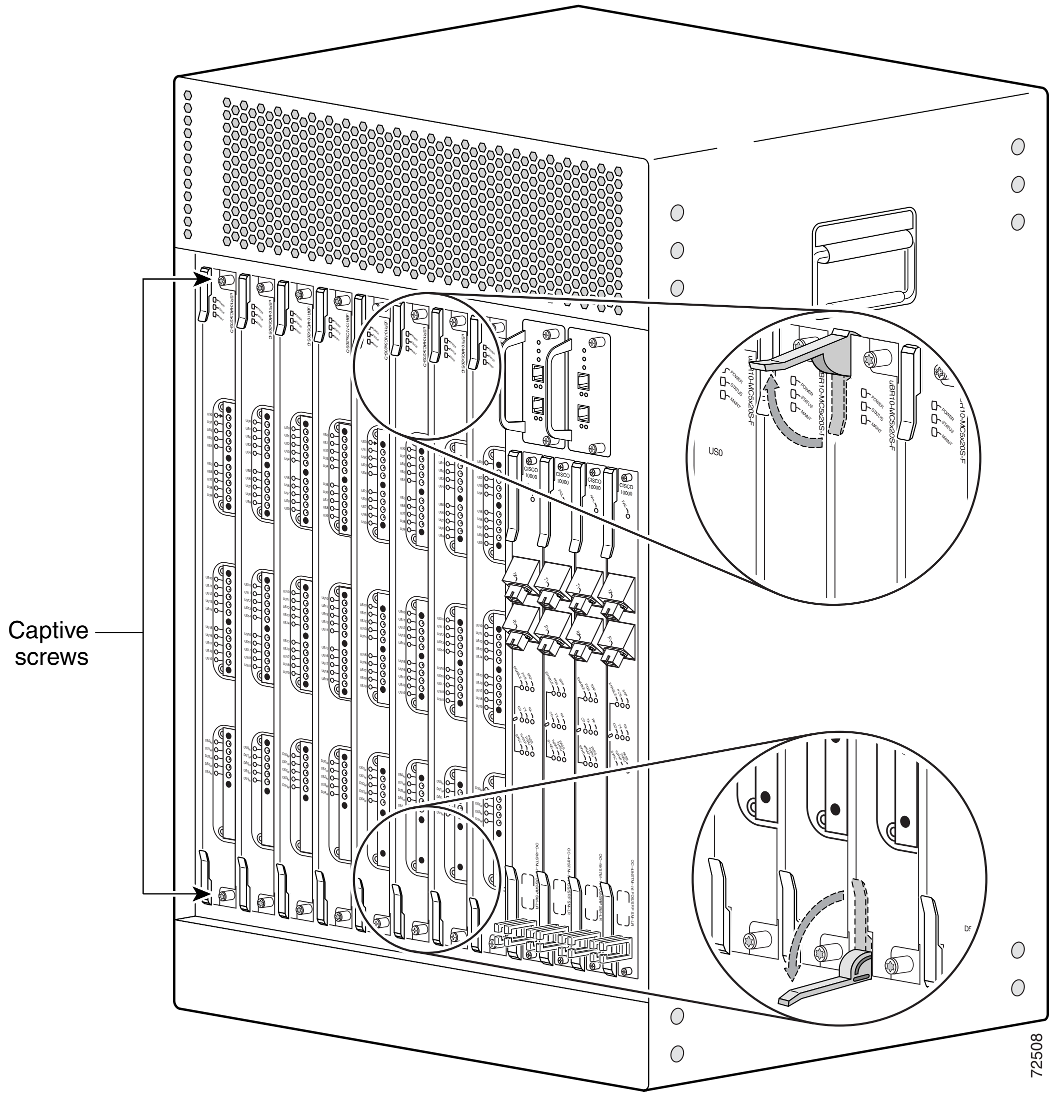
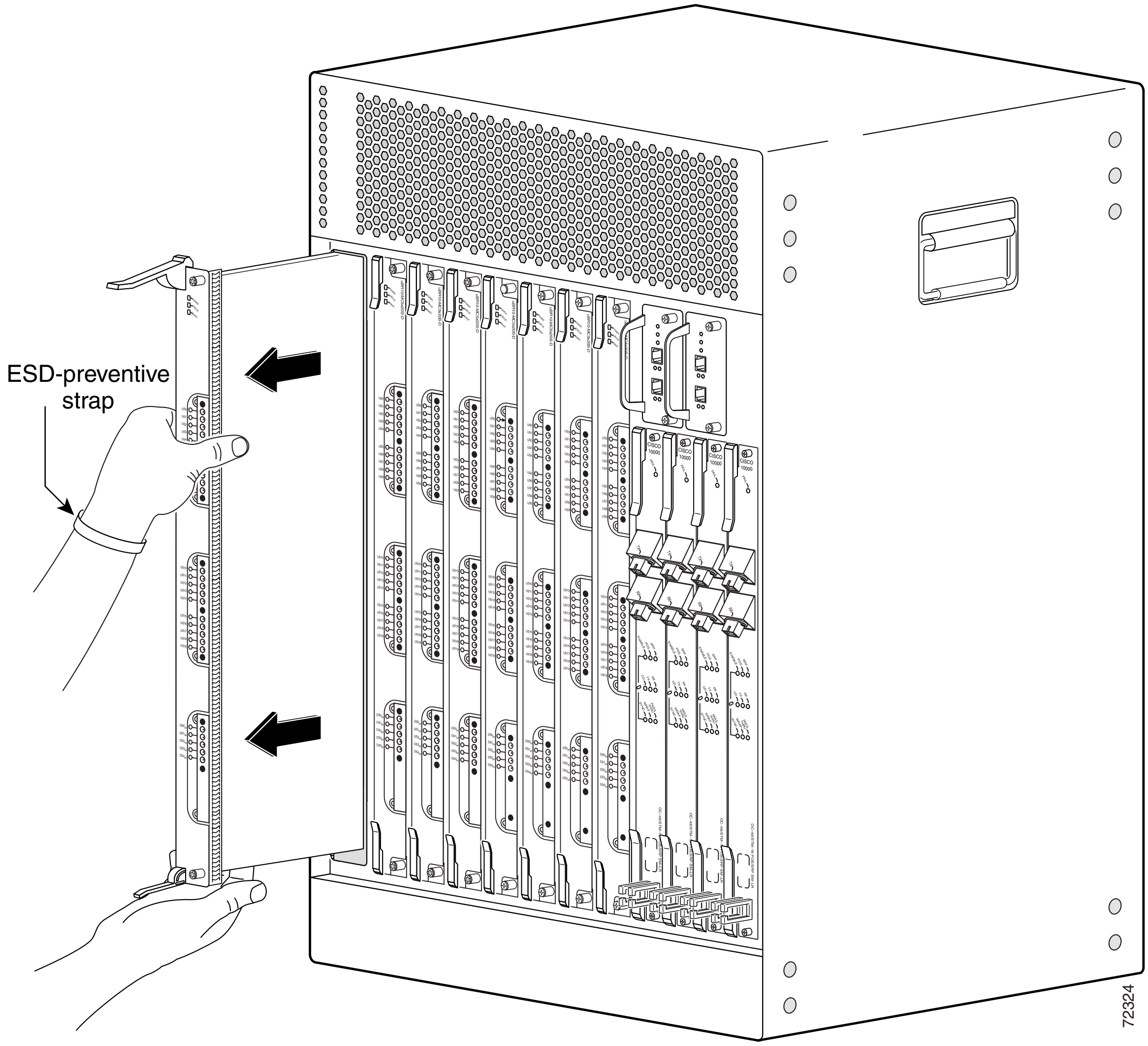


Figure 3-8 Removing the Cisco uBR10-MC5x20S/U/H Cable Interface Line Card



Note This chassis does not show the slot splitter and HHGE line card.

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 3-13
- Removing the Slot Splitter, page 3-15

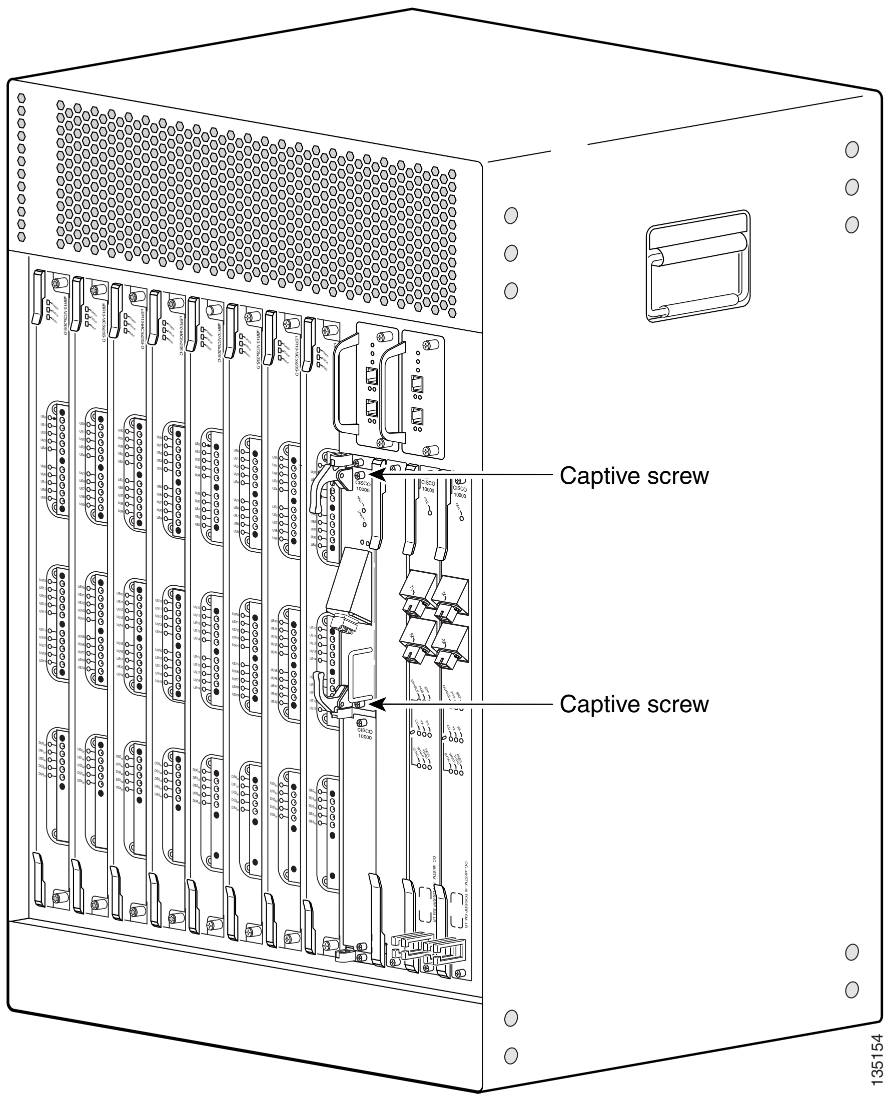
Removing a Half-Height Gigabit Ethernet Line Card

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 3-9 Captive Screw Locations



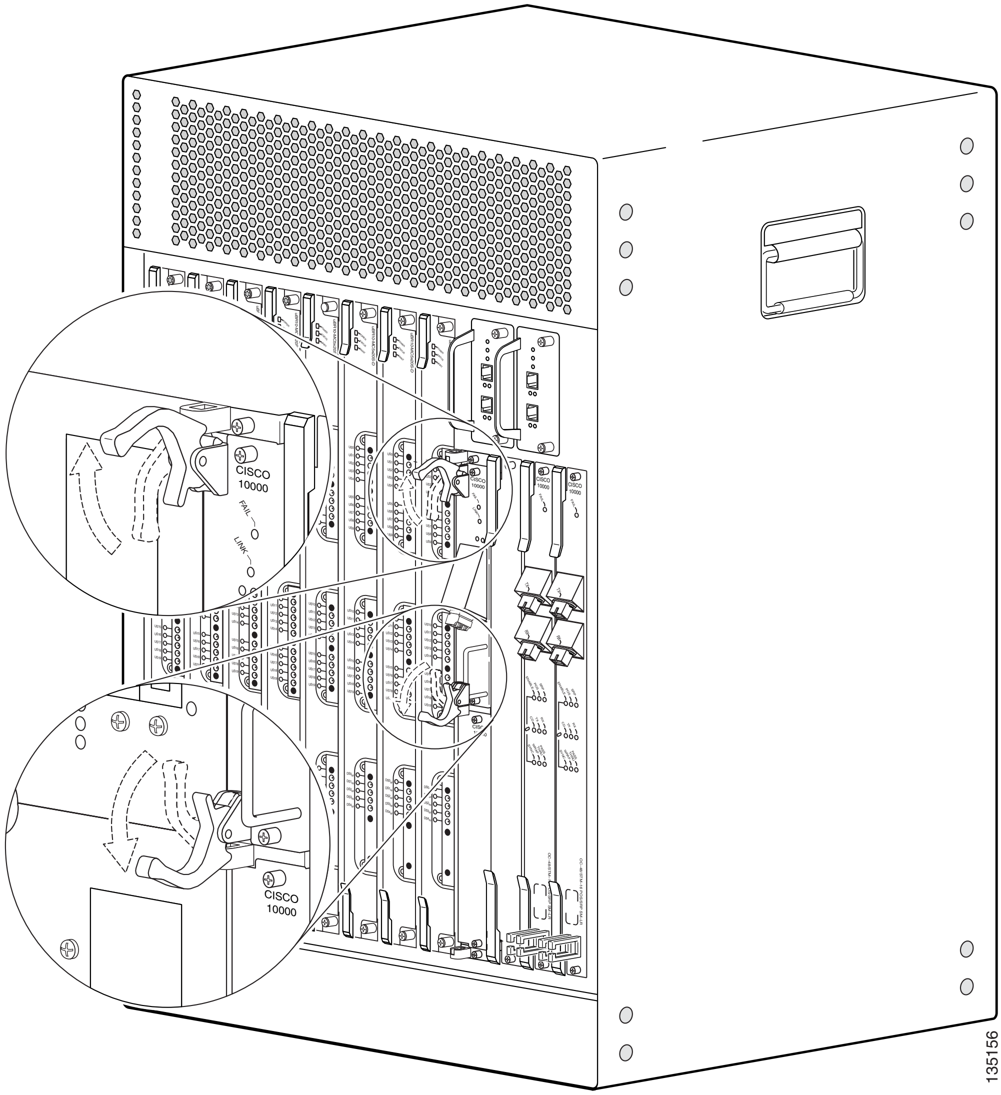
Step 3 Loosen the top and bottom captive screws until they disengage and spring away from the face plate (Figure 3-9).

Step 4 Simultaneously pivot both ejector levers away from each other to disengage the line card from the backplane (Figure 3-10).

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 3-10 Opening the Ejector Levers



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:

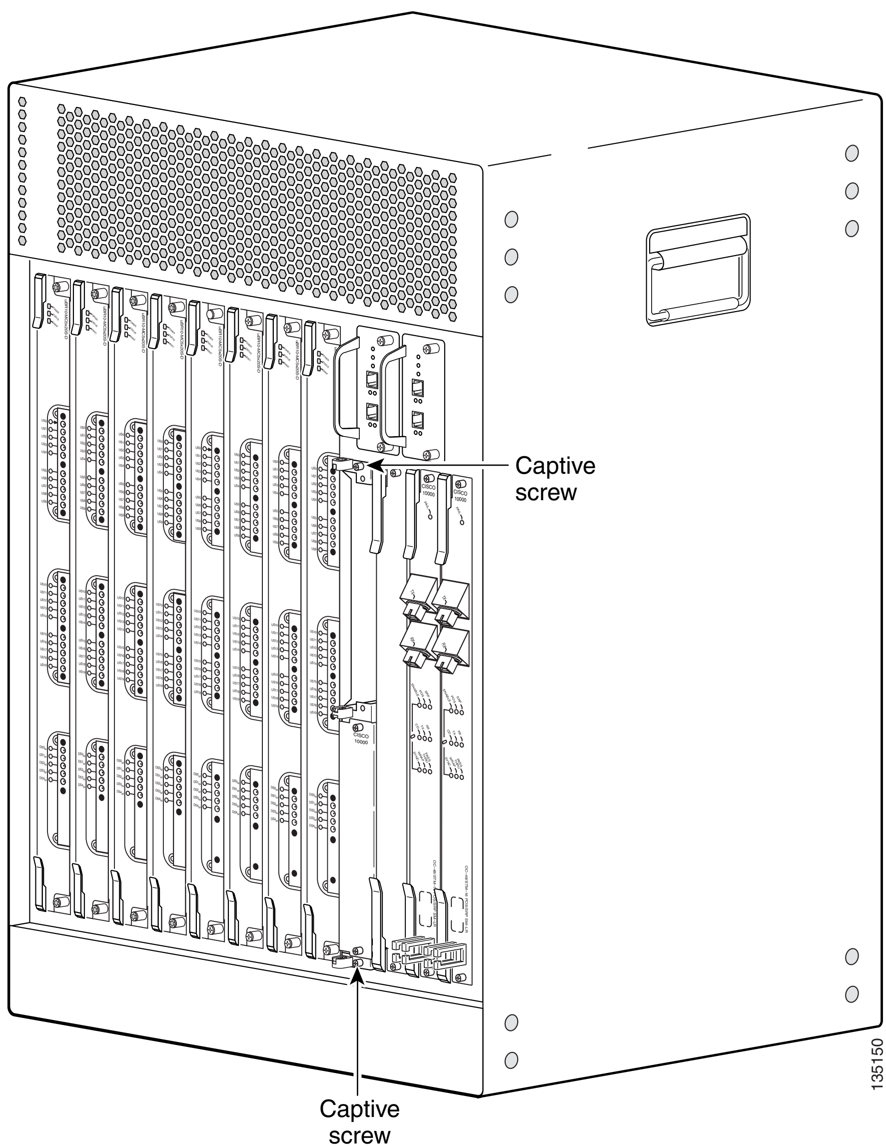
Step 1 Attach an antistatic wrist strap to your wrist and to the ESD socket on the chassis, or to a bare metal surface on the chassis or frame).

Step 2 Remove any line cards from the splitter according to the "Removing a Half-Height Gigabit Ethernet Line Card" section on page 3-13.

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 3-11).

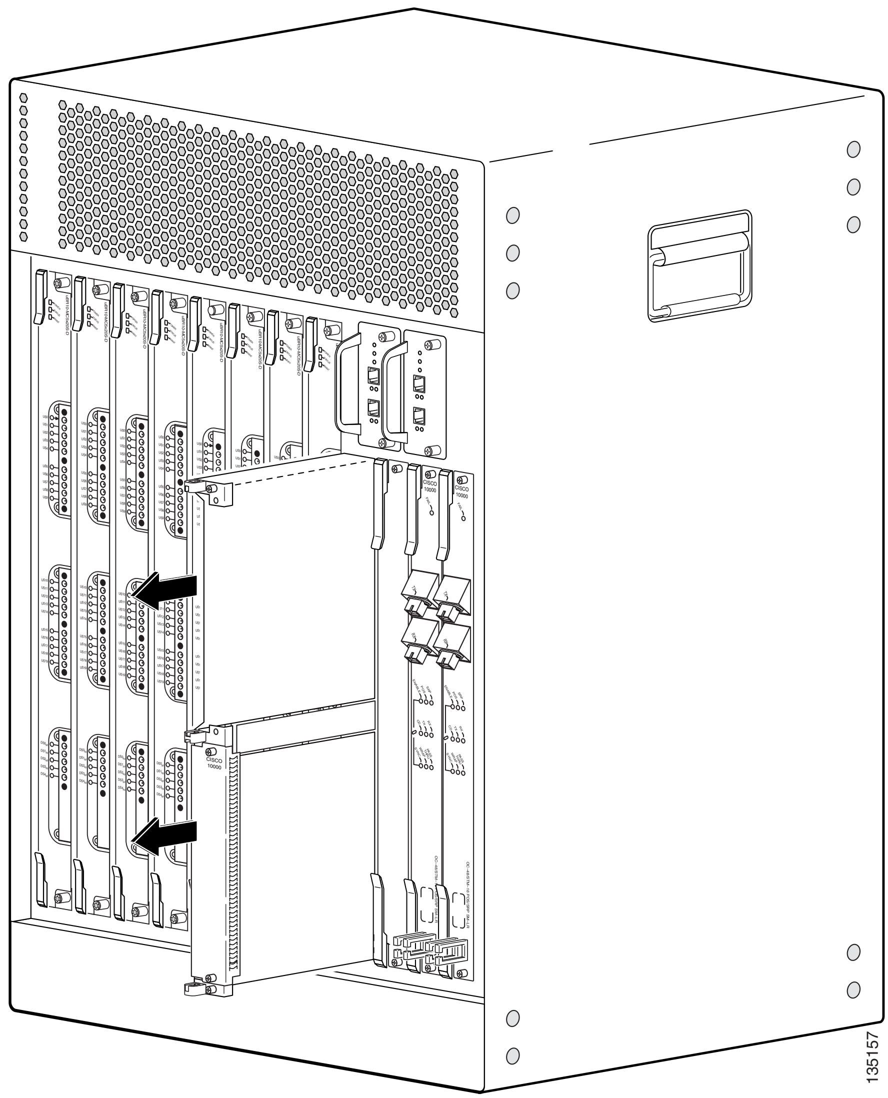
Figure 3-11 Captive Screw Locations



Step 4 Slide the splitter out of the slot (Figure 3-12).

Step 5 If you are not installing a replacement splitter or a line card, install a full-slot blank faceplate in the slot.

Figure 3-12 Removing the Slot Splitter

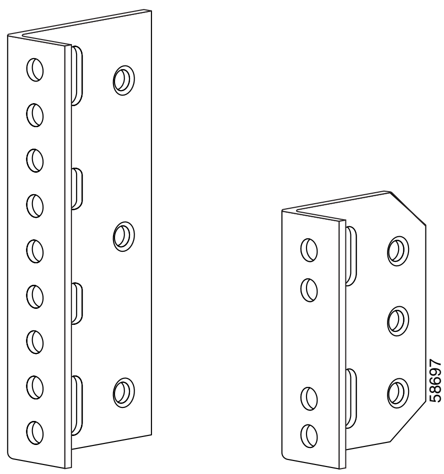


Attaching the Mounting Brackets

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 3-13 shows the mounting brackets shipped with the Cisco uBR10012 chassis for use with a standard 19-inch equipment or telco rack:

Figure 3-13 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 3-14 shows how to attach the brackets to flush-mount the chassis with the front forwards.
- Figure 3-15 shows how to attach the brackets to flush-mount the chassis with the rear forwards.
- Figure 3-16 shows how to attach the brackets to offset-mount the chassis with the front forwards.

Figure 3-14 Bracket Location for Flush Front-Mounting the Chassis

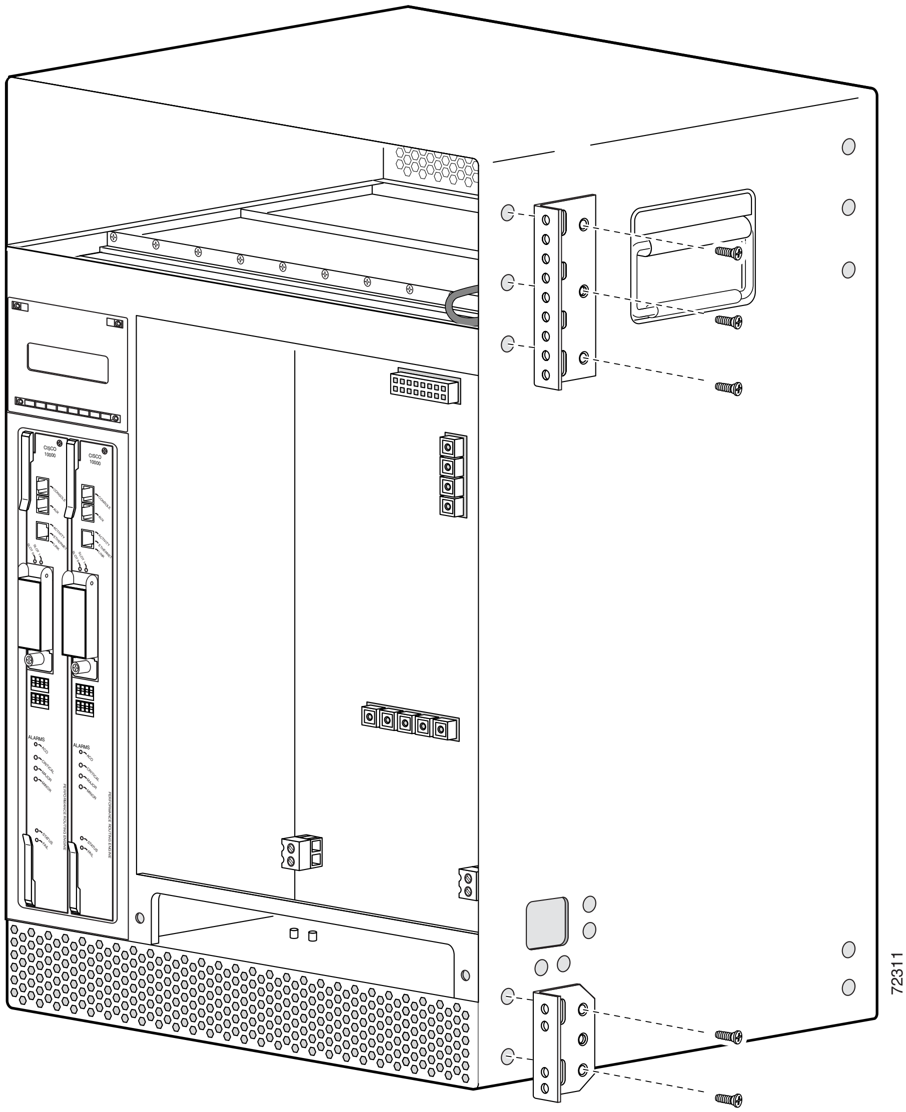


Figure 3-15 Bracket Location for Flush Rear-Mounting the Chassis

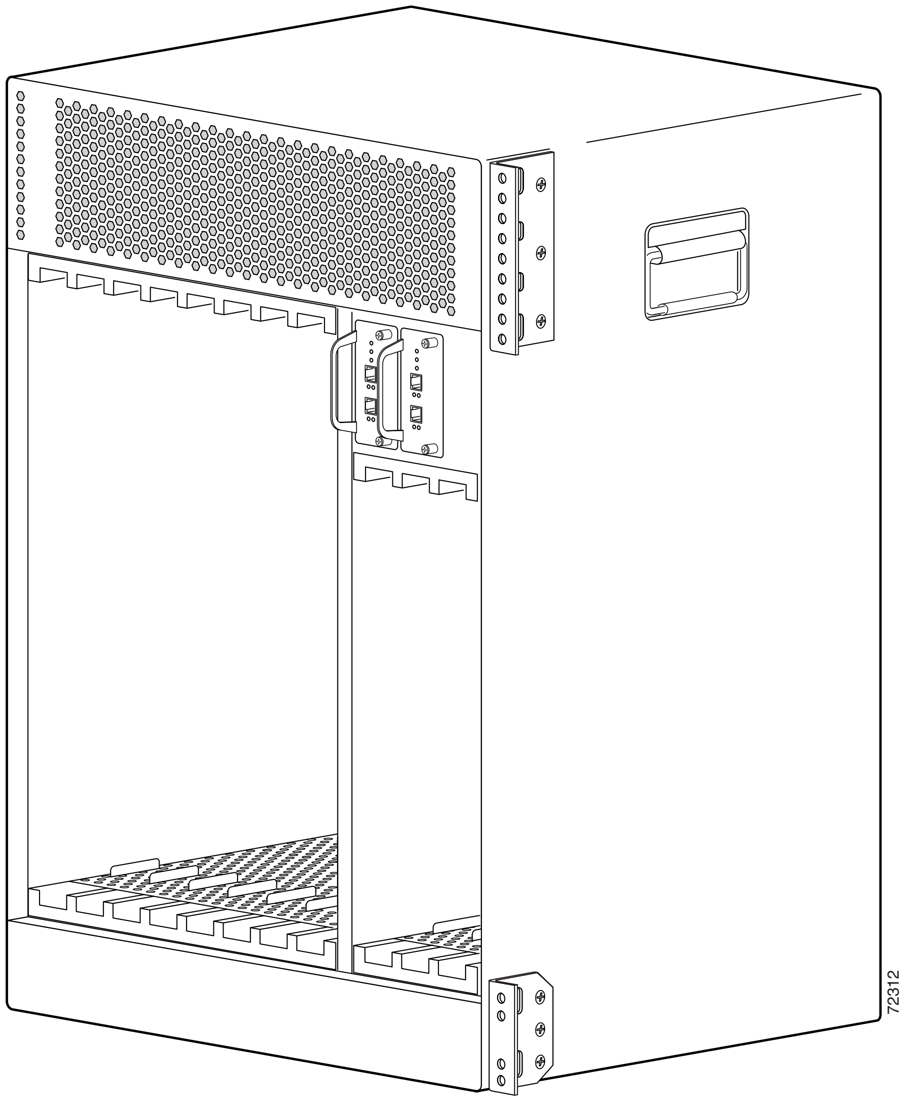
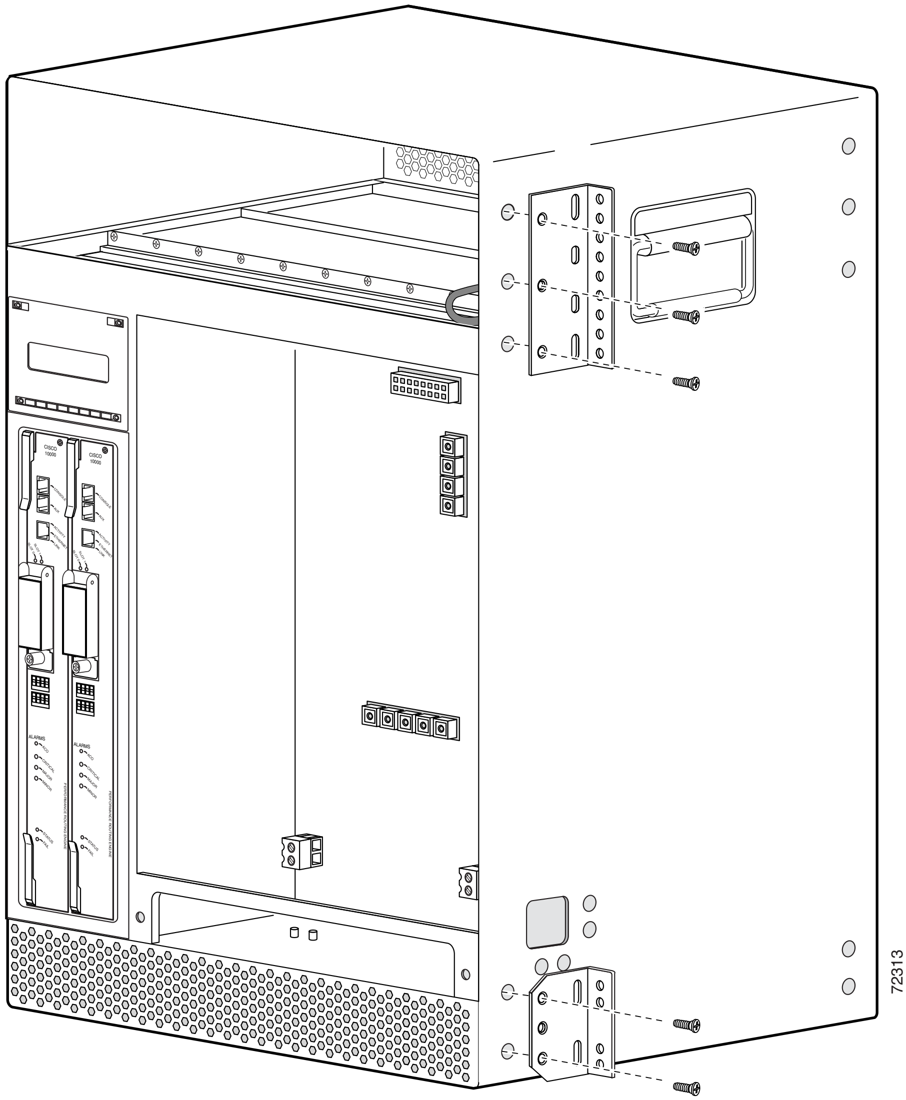


Figure 3-16 Bracket Location for Offset Front-Mounting the Chassis



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

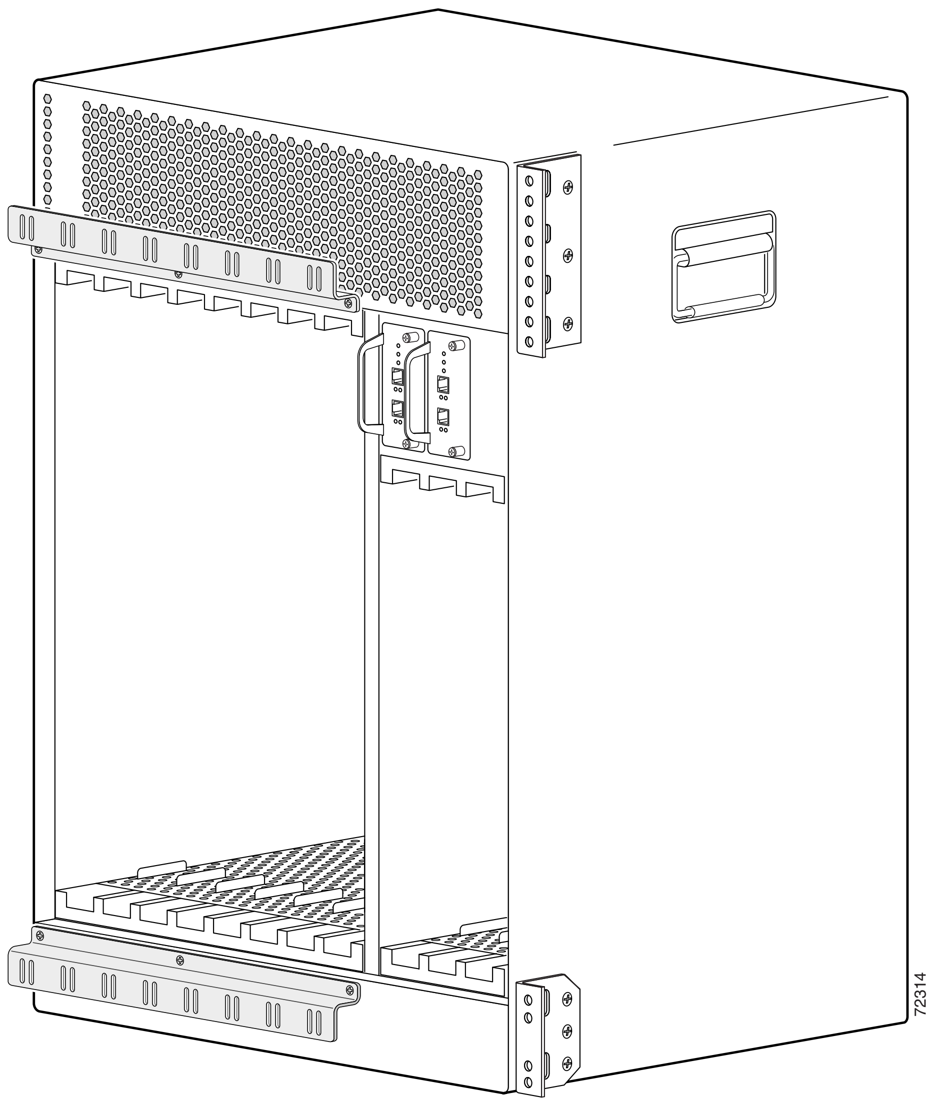
To install the optional cable management brackets, proceed to the next section. Otherwise, proceed to the "Mounting the Chassis in the Rack" section on page 3-22 for instructions on mounting the Cisco uBR10012 chassis in the equipment or telco rack.

Installing the Cable Management Brackets (Optional)

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

Figure 3-17 shows the rear of the Cisco uBR10012 chassis with the two cable-management brackets installed.

Figure 3-17 Installing the Optional Cable Management Brackets



Use the following procedure to install the optional 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 3-17.)

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 cabl- management bracket in a similar manner, making sure that the slot edge of the bracket is pointing down. See Figure 3-17.

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.

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 2-2

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 Power Modules, Fan Assembly, and Line Cards" 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.

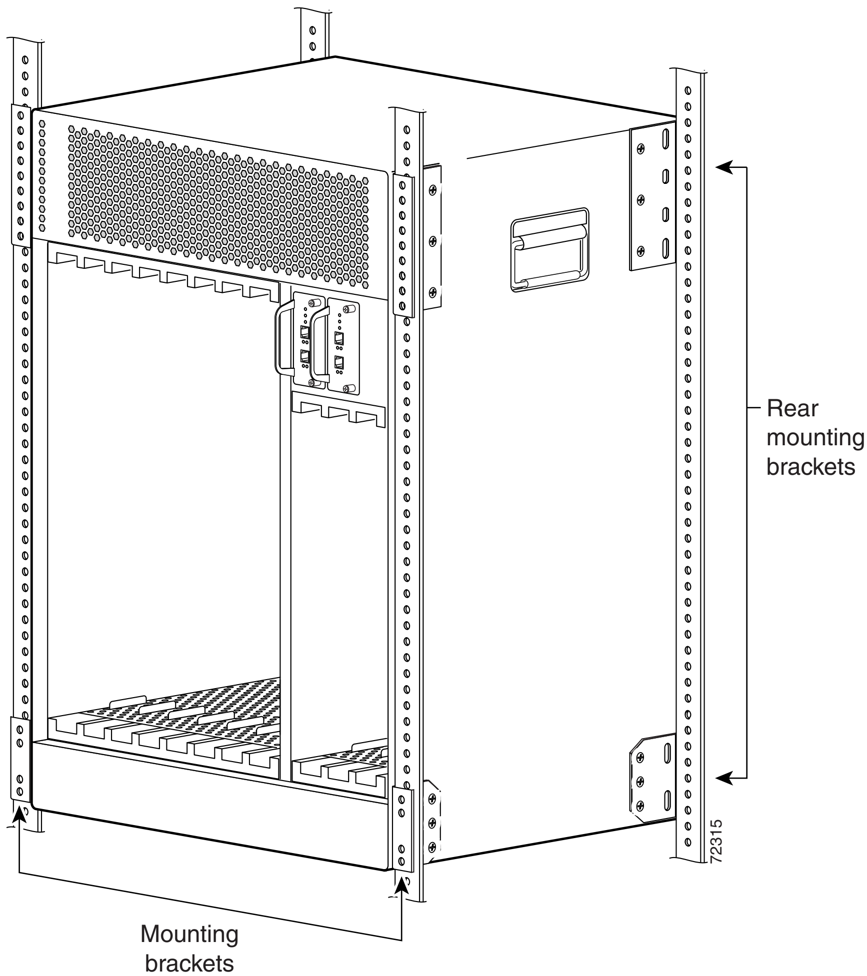
Step 7 Align the mounting bracket holes with the rack post holes (Figure 3-18) and attach the chassis to the rack with the appropriate-sized screws (performed by the third person unless the chassis is resting on a shelf).

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 3-18 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 3-18 Attaching the Chassis to the Equipment Rack



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 3-2).

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 3-2 lists the tools, equipment, and supplies necessary to connect the system ground to the chassis.

Table 3-2 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.
2	M5 PEM 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 PEM's 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 3-20).

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 3-28.

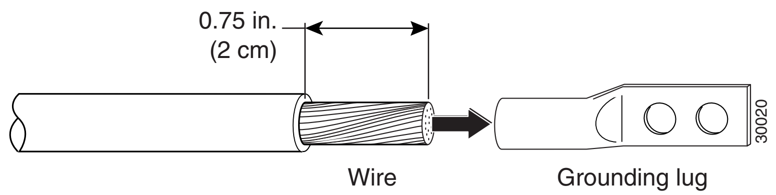


Figure 3-19 Attaching Grounding Wire to the Grounding Lug

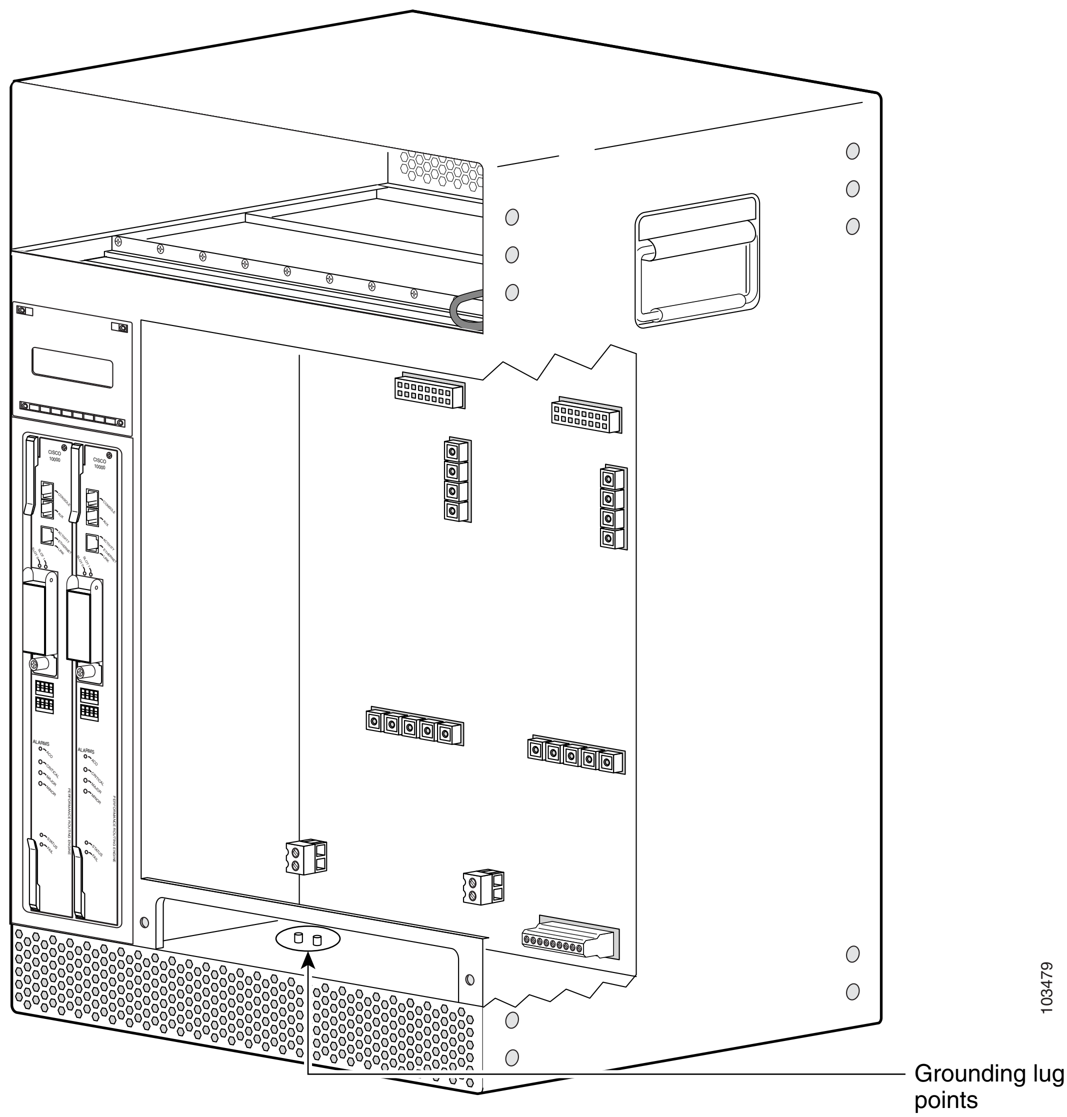


Figure 3-20 Location of the Ground Lug Connectors

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 optional 2400W AC-input power shelf. If using the 2400W AC-input power shelf, be certain you have already installed it, as described in the *2400W AC-Input Power Shelf Installation Guide*, available on Cisco.com at the following URL:

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

The DC power connectors are pillar terminal blocks on the backplane. For full power redundancy, each terminal block must be connected to a separate power source. If using the optional 2400W 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 3-3 lists the tools and supplies that you need to connect the Cisco uBR10012 router to DC power sources.

Table 3-3 Tools and Supplies for Connecting DC Power

Quantity	Description	Comments
1	Flat-blade screwdriver	—
1	Wire stripping tool	—
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).
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

Use the following procedure to connect the chassis to a DC power source:

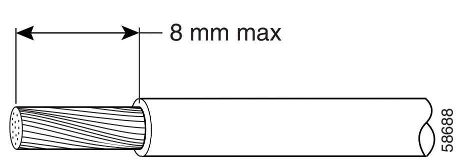
Step 1 Double-check that the DC PEMs have been reinstalled in the system, and that no power has yet been connected to the Cisco uBR10012 chassis.

Step 2 Verify that the DC power source is turned off and is not supplying power to the Cisco uBR10012 chassis.

Caution If using the 2400W AC-input power shelf as the DC power source, verify that the AC-input power cords are not plugged into AC power outlets.

Step 3 Strip not more than 5/16 in. (8 mm) of insulation off the ends of the DC power leads (Figure 3-21).

Figure 3-21 Stripping Insulation

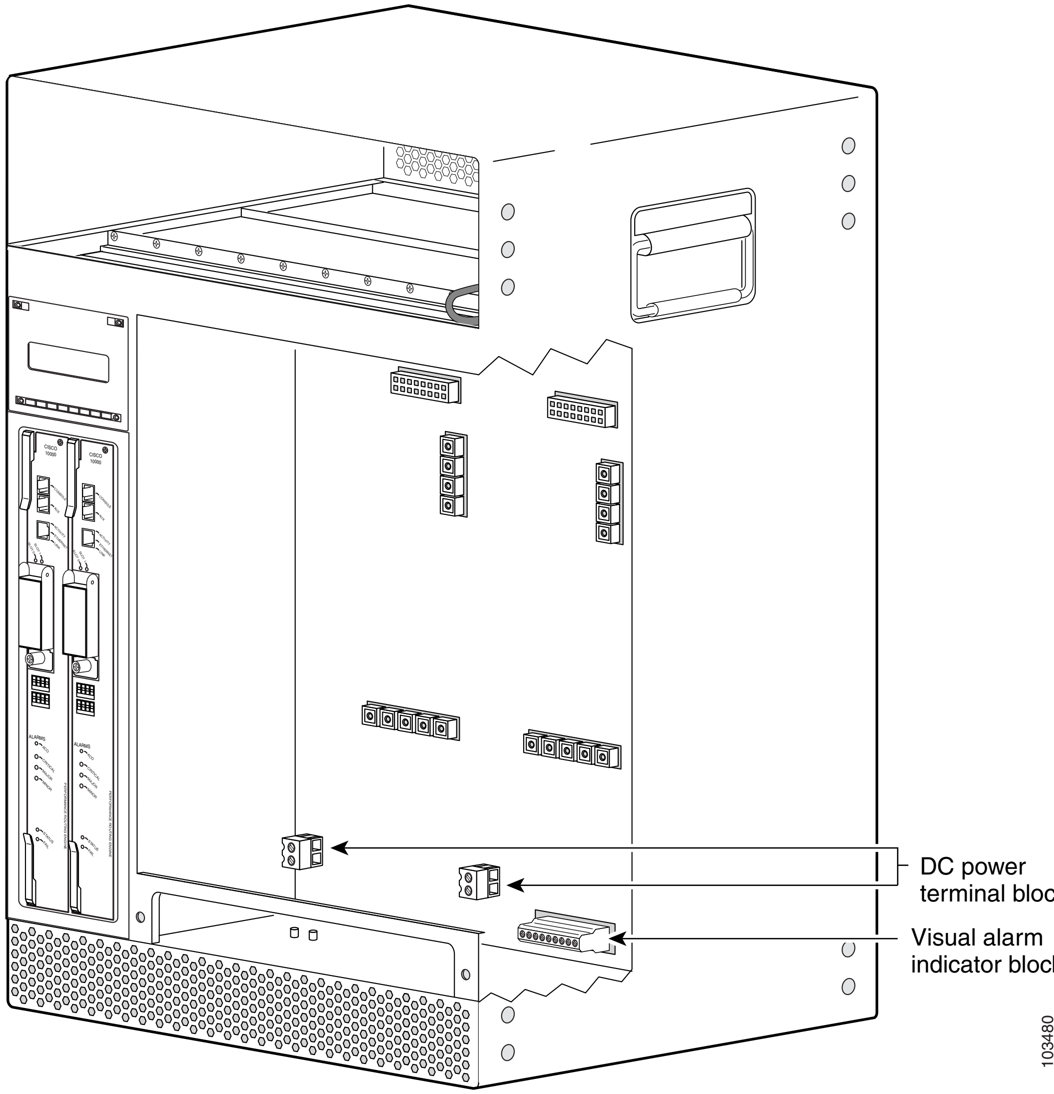


Warning **Use copper conductors only.** Statement 1025

Step 4 Route the two sets of DC power leads through the square hole at the right front of the chassis. Position each set under one of the two DC power terminal blocks (Figure 3-22).

Step 5 Connect the DC power lead from the first external power source to the –48V terminal in the DC terminal block (this is the bottom terminal, as shown in Figure 3-23).

Figure 3-22 Location of the DC Power Connectors and Alarm Connections



Step 6 Connect the return wire (RTN) to the top terminal in the terminal block (see Figure 3-23).

Step 7 Connect the DC power lead from the second external power source to the –48/–60VDC terminal in the second DC terminal block (this is the bottom terminal, as shown in Figure 3-23).

Step 8 Connect the return wire (RTN) to the top terminal in the second terminal block.

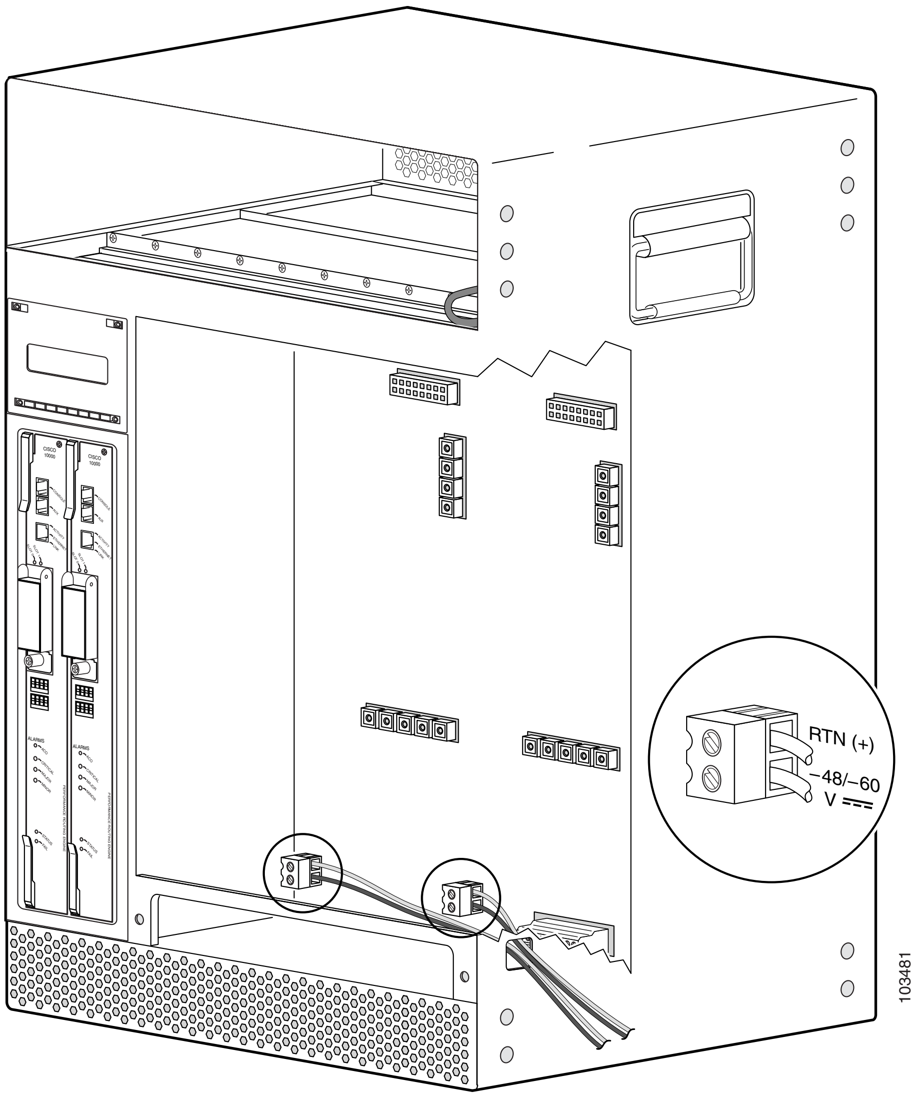
Step 9 (Optional) Secure the power cabling to the chassis by feeding a tie wrap through one of the small round holes next to the square hole on the side of the chassis and binding the cables, as shown in Figure 3-23.

Caution Do not connect power to the DC power sources or apply power to the Cisco uBR10012 chassis yet. This will be done as part of the system startup after all connections are made.

Step 10 If you are connecting visual or audio alarm indicators to your system, go to the "Connecting Alarm Indicators" section on page 3-31.

Step 11 If you are not connecting any alarm indicators, go to the "Connecting the Console Port and Auxiliary Port" section on page 3-49 to continue the installation.

Figure 3-23 DC Power Terminal Block Connections



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 3-4 lists the tools and supplies that you need to connect the alarm indicators.

Table 3-4 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

Connecting the Alarm Indicators

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

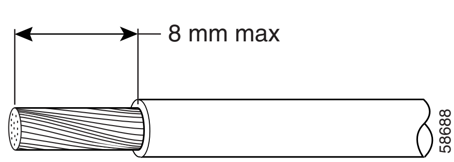
Step 1 Obtain sufficient wire for the desired connections. You will need two wires for each set of relays, or six separate wires to connect all three relay contacts. Use the gauge of wire required by the audible or visual alarm indicator equipment you are using (14 AWG maximum gauge).

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 3-24).

Figure 3-24 Stripping Insulation



Step 3 Connect one set of alarm indicator wires to the alarm terminal block as follows (see Figure 3-25):

a. Connect one lead to the common (COM) terminal.

b. If you are wiring the router in with other equipment for the alarm indicators, wire the other lead to the normally closed (NC) terminal.

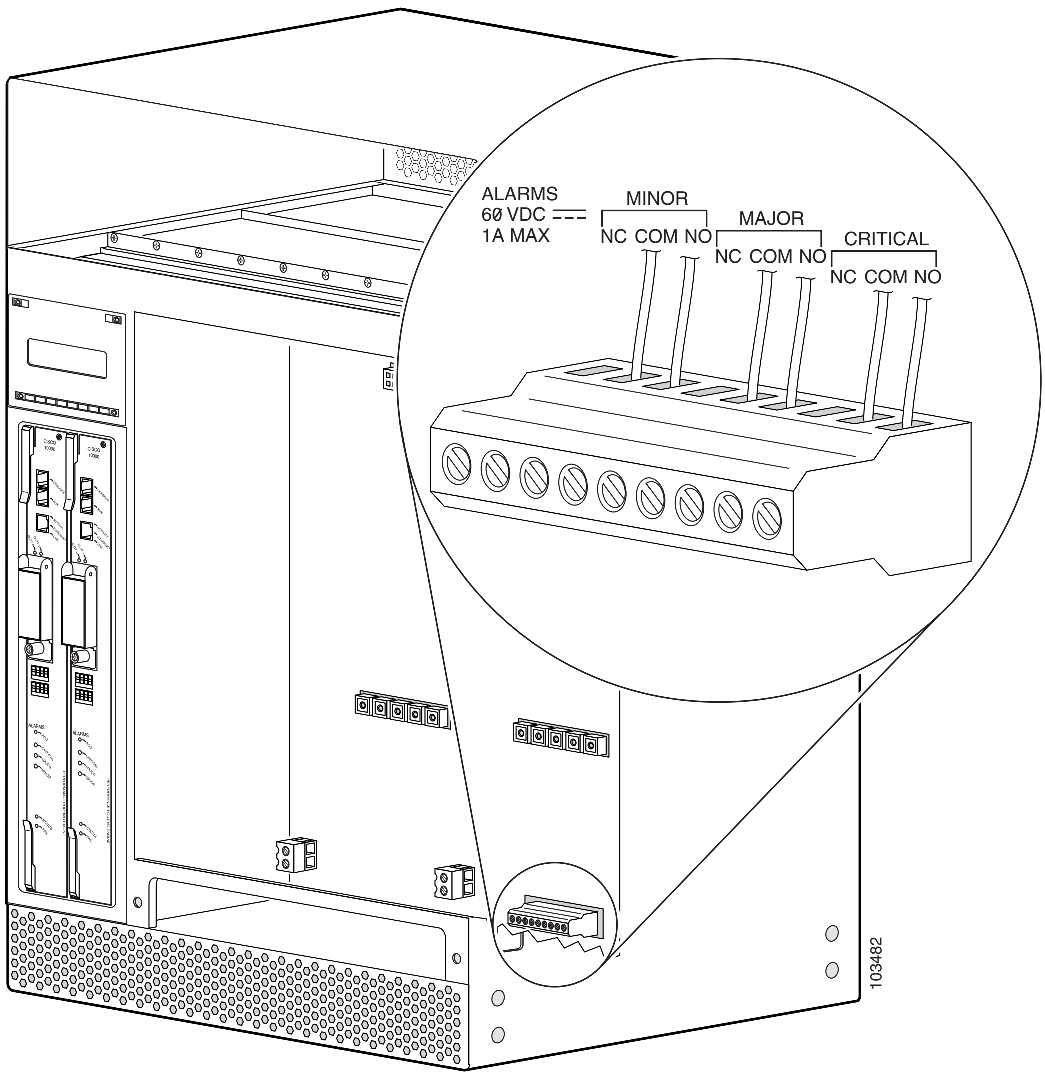
c. If you are wiring the router in *parallel* with other equipment for the alarm indicators, wire the other lead to the normally open (NO) terminal.

Caution Figure 3-25 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 3-25 Alarm Terminal Block Connections



Step 6 Go to the next section, Connecting the Console Port and Auxiliary Port, page 3-49, to continue the installation.

Reinstalling the Modules

Reinstall all the components that were removed from the chassis.

Recommended Tools and Supplies

Table 3-5 lists the tools and supplies that you need to reinstall the components in the chassis.

Table 3-5 Tools and Supplies for Installing Components in the Chassis

Quantity	Description	Comments
1	Number 2 Phillips screwdriver	—
—	ESD-preventive wrist strap	—

Reinstalling the Fan Assembly Module

Step 1 Using two hands, pick up the fan assembly module.

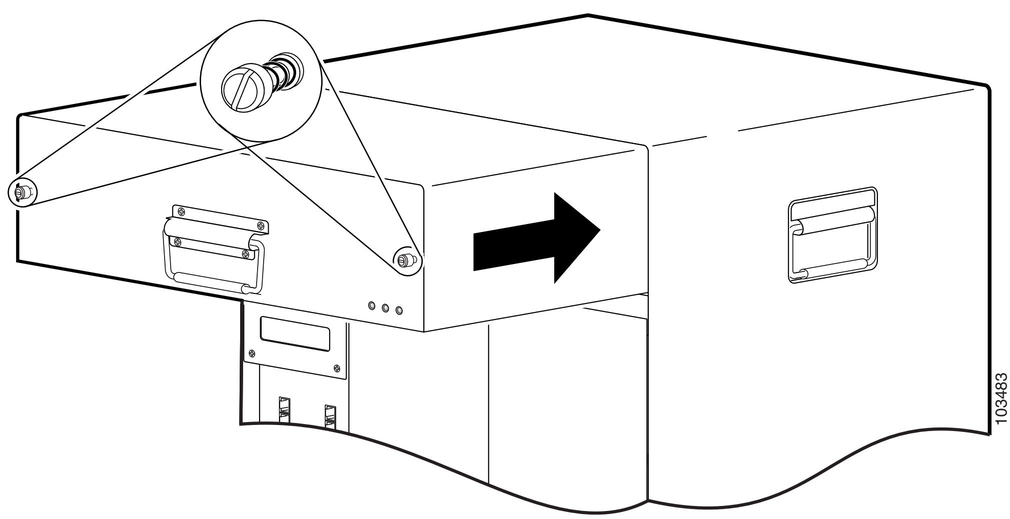
Caution The fan assembly module weighs approximately 30 lbs (13.61 kg)

Step 2 Align the module with the slot in the chassis.

Step 3 Push the fan module back firmly into the chassis, making sure that the module securely connects to the backplane. See Figure 3-26.

Step 4 Tighten the captive screws on each side of the fan assembly module.

Figure 3-26 Replacing the Fan Assembly



Reinstalling the DC Power Entry Modules

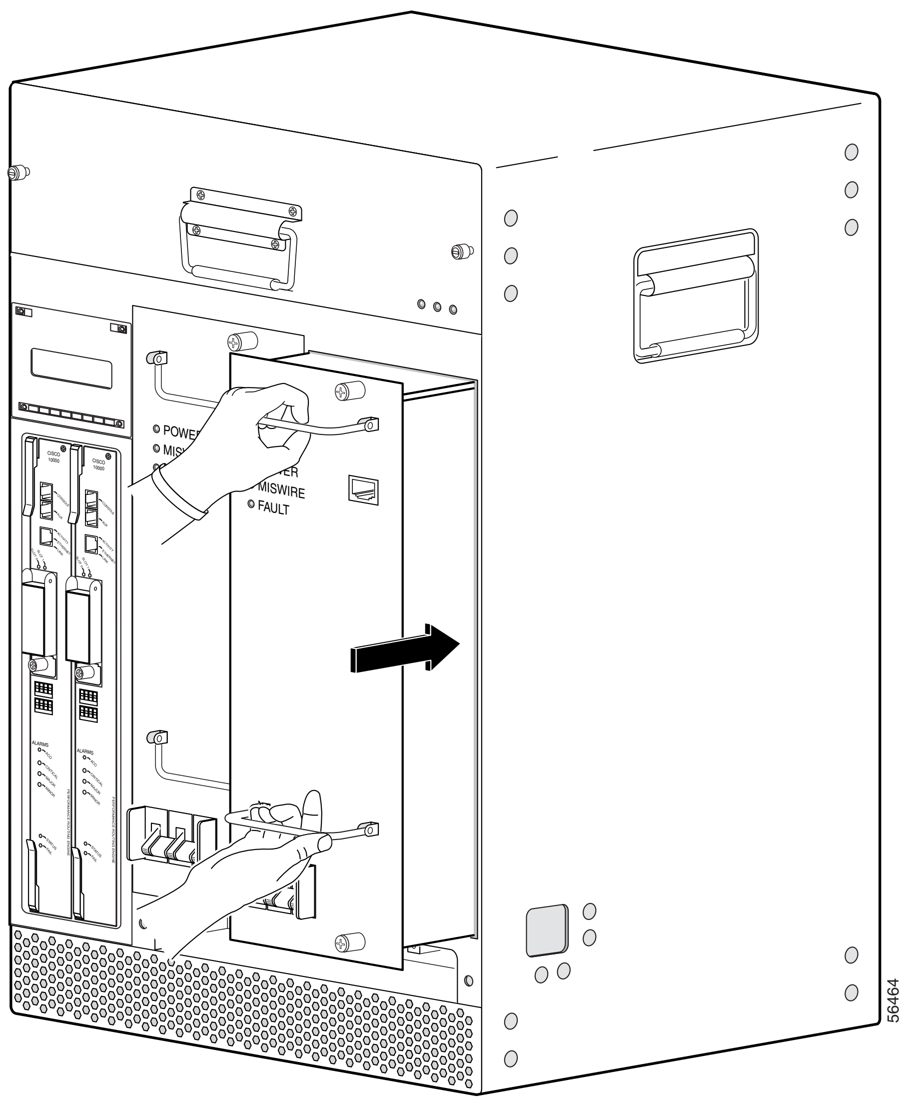
Step 1 Position the first DC PEM in the power bay and push it forward, verifying that it goes all the way in and makes a secure connection with the backplane. See Figure 3-27.

Step 2 Tighten the captive screws to secure the DC PEM.

Step 3 Repeat these steps to replace the second DC PEM.

Note If you are installing an AC PEM see Reinstalling the AC Power Entry Modules, page 3-36.

Figure 3-27 Installing a DC PEM



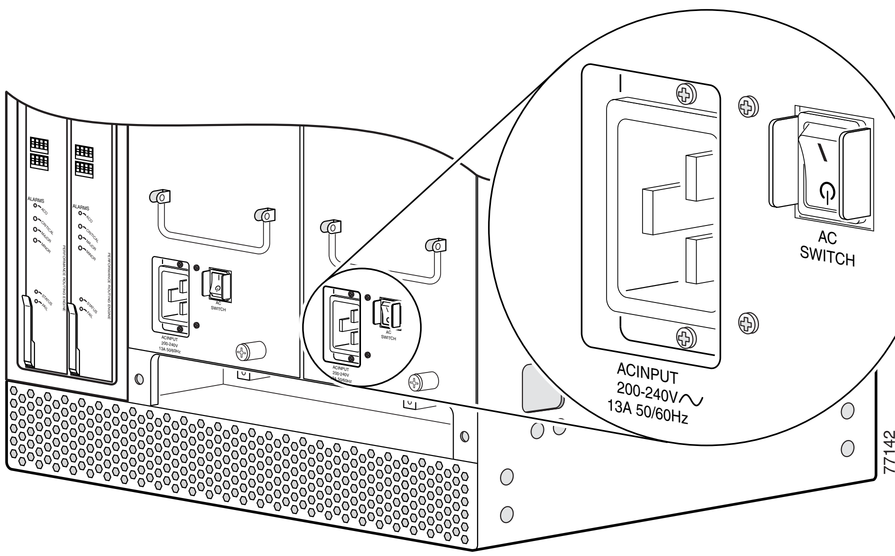
Reinstalling the AC Power Entry Modules

If you are replacing DC PEMs with AC PEMS or replacing a redundant AC PEM, see Removing and Replacing DC Power Entry Modules, page 5-8 and Removing and Replacing AC PEM Modules, page 5-21.

Note Each of two power bays in the Cisco uBR10012 chassis is above a DC terminal block that is used to provide power only when you are using the DC PEM modules. Do not use these DC terminal blocks when you are using the AC PEMs. If you have previously used this Cisco uBR10012 router with DC PEMs, first verify that these DC terminal blocks are not currently connected before proceeding with the installation or replacement of the AC PEMs.

Step 1 Verify that the power switch on the replacement AC PEM is in the standby position (Figure 3-28).

Figure 3-28 AC PEM Standby Position and AC Plug Location



Step 2 Position the AC PEM in the power bay and push it forward, verifying that it goes all the way in and makes a secure connection with the backplane (Figure 3-29).

Step 3 Use the screwdriver to tighten the captive screws to secure the unit to the chassis.

Step 4 Plug the AC-input power cable into the power receptacle on the front panel of the AC PEM. See Figure 3-28.

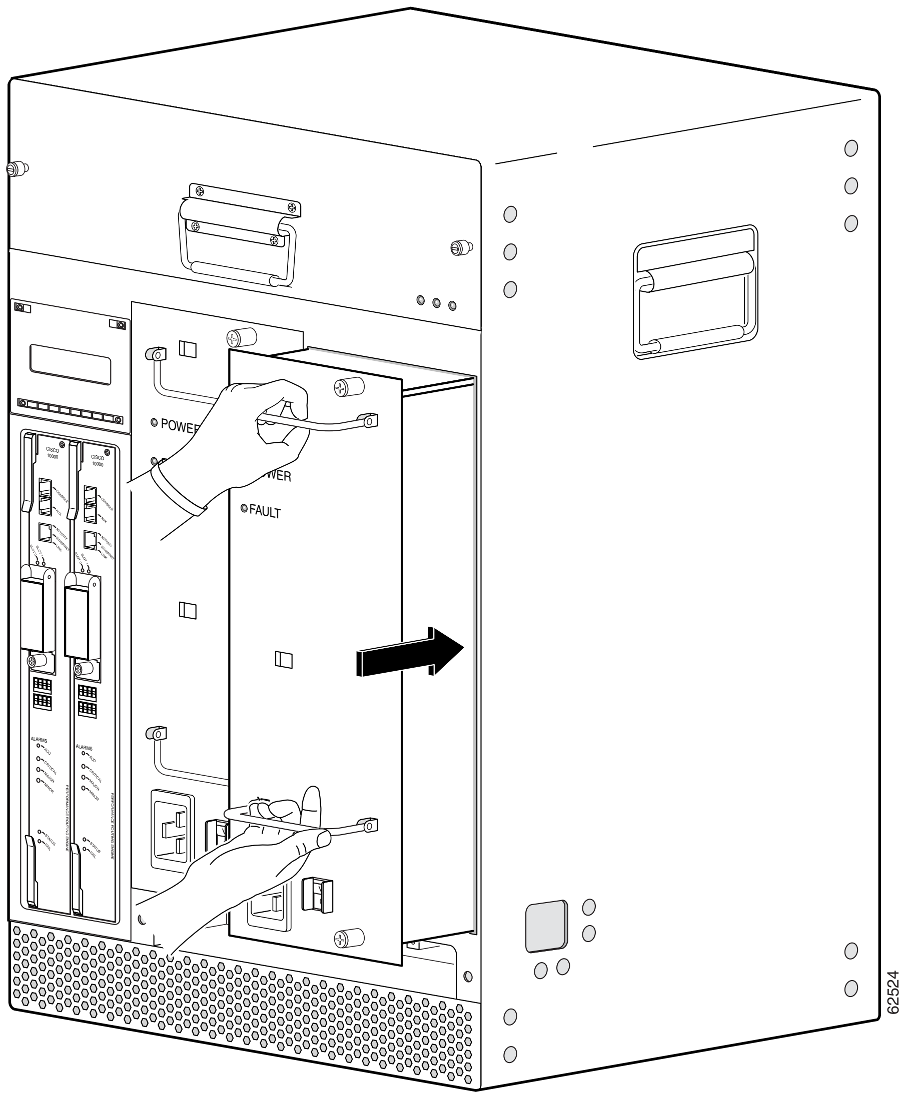
Step 5 Route the power cable up the front of the AC PEM and clip it into the two plastic retaining clips attached to the surface of the PEM. Route the power cable out through the right side, so that it will fit through the notch on the right side of the front bezel cover (Figure 3-30).

Step 6 Plug the other end of the AC-input power cable into a 200–240 VAC power outlet. For fully redundant operation, each AC PEM should use separate power sources, or you should be using an uninterruptible power supply (UPS). The FAULT LED on the AC PEM should be yellow to indicate that the AC PEM is receiving power from the power source but is not yet supplying power to the Cisco uBR10012 chassis.

Step 7 Push up the power switch on the AC PEM to the ON (|) position. See Figure 3-28.

Note When you turn on the power switch on the AC PEM, the Fault LED should go off and the POWER LED should come on (green).

Figure 3-29 Replacing the AC PEM



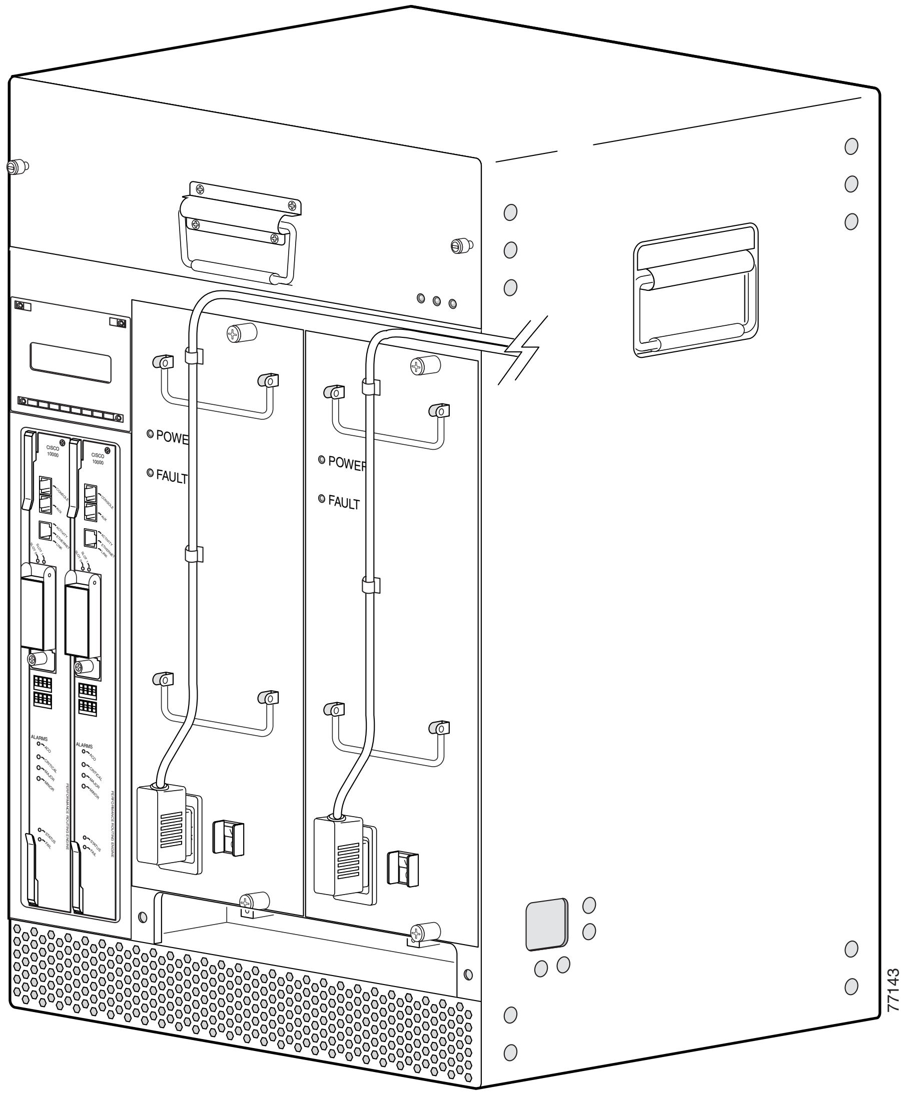
Step 8 If you are installing the front bezel cover,

a. Slide the front bezel cover onto the four corner posts of the chassis.

b. Push down, so that the posts are seated in the grooves above the cover holes.

c. Route the AC power cables through the notch on the right side of the cover.

Figure 3-30   Routing the AC Cables



Reinstalling 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 5-60 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 the they are installed in the chassis. See the "Removing and Replacing a Cable Interface Line Card" section on page 5-60 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 3-31).

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 3-32).

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 1through 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 3-31 Inserting the Cisco uBR10-MC5X20S/U/H Cable Interface Line Card

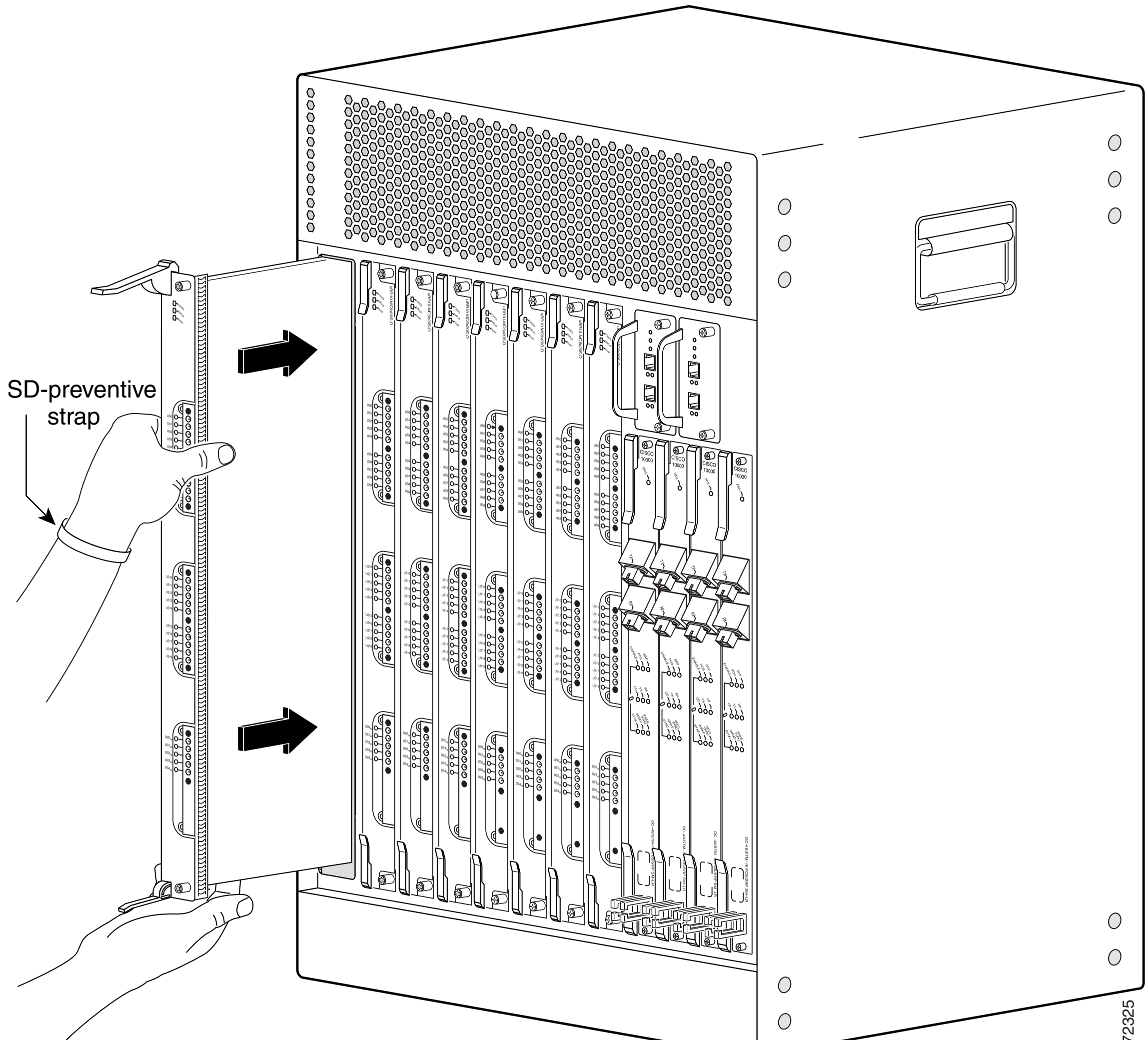
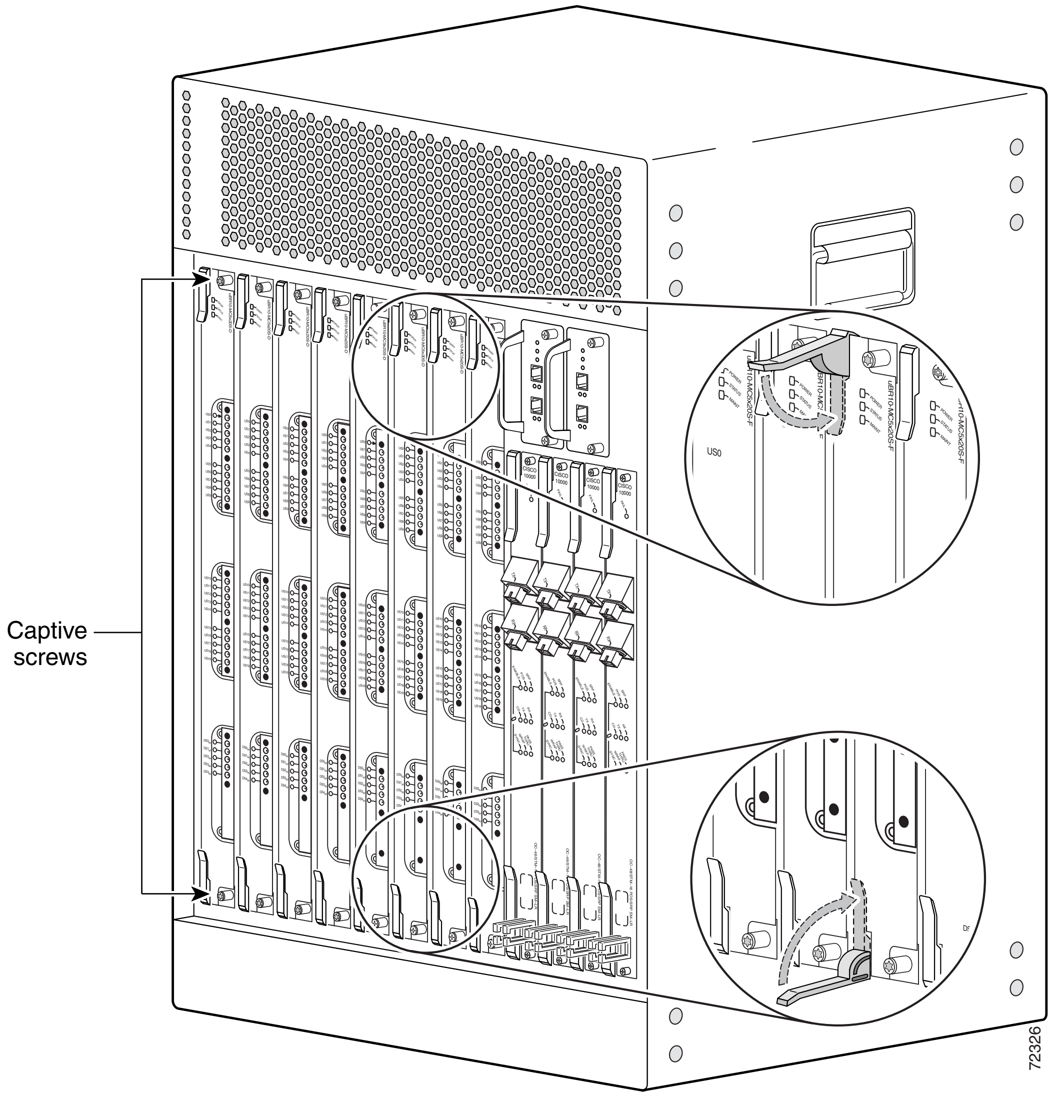


Figure 3-32 Closing the Ejector Levers



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 3-42
- Installing the Half-Height Gigabit Ethernet Line Card, page 3-46

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 3-33) 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 3-34 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 3-35).

Figure 3-33 HHGE Line Card Locations

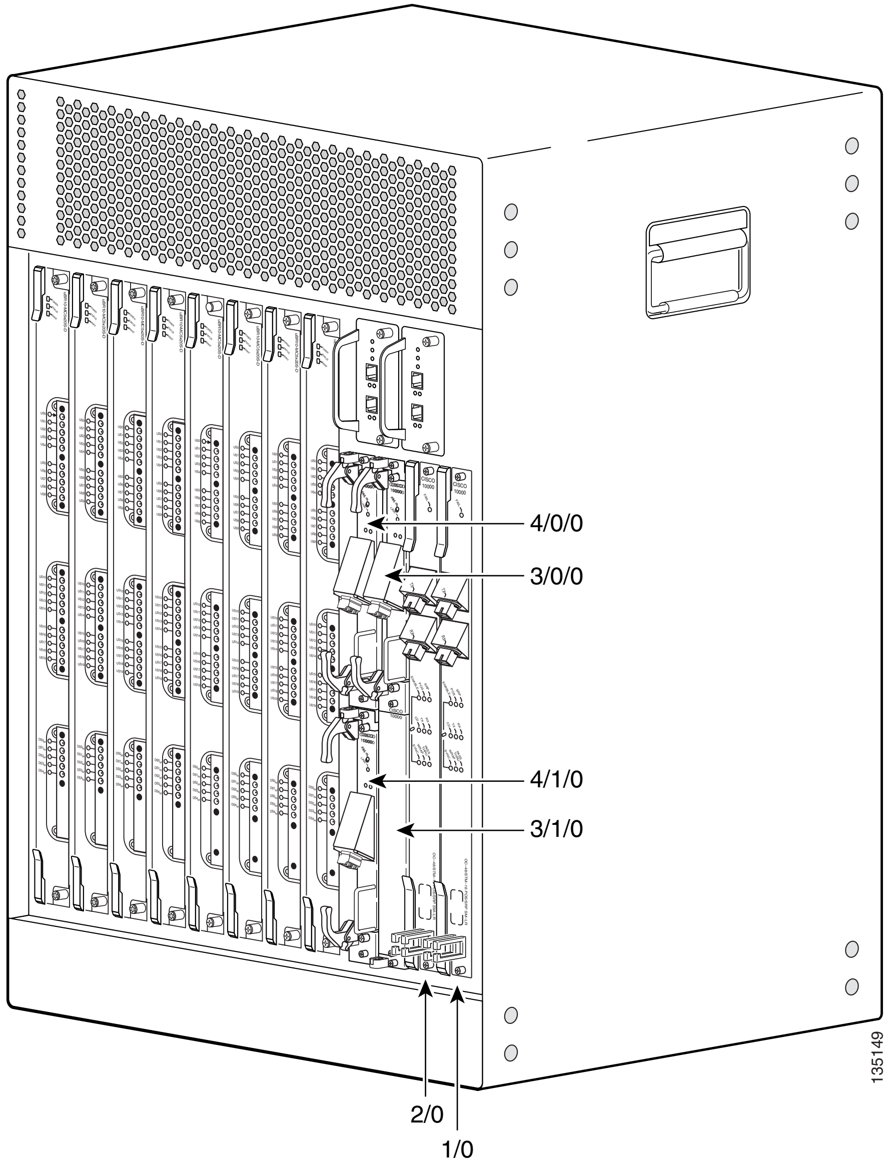


Figure 3-34 Inserting the Slot Splitter

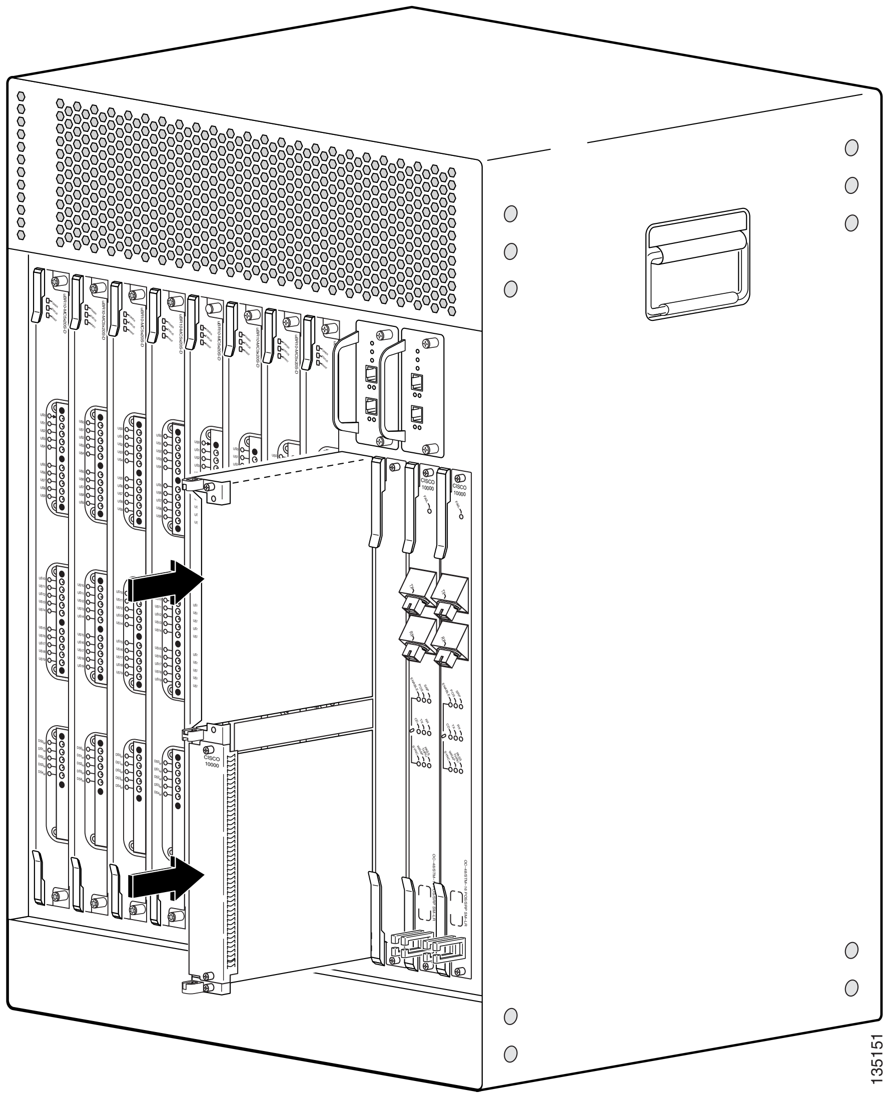
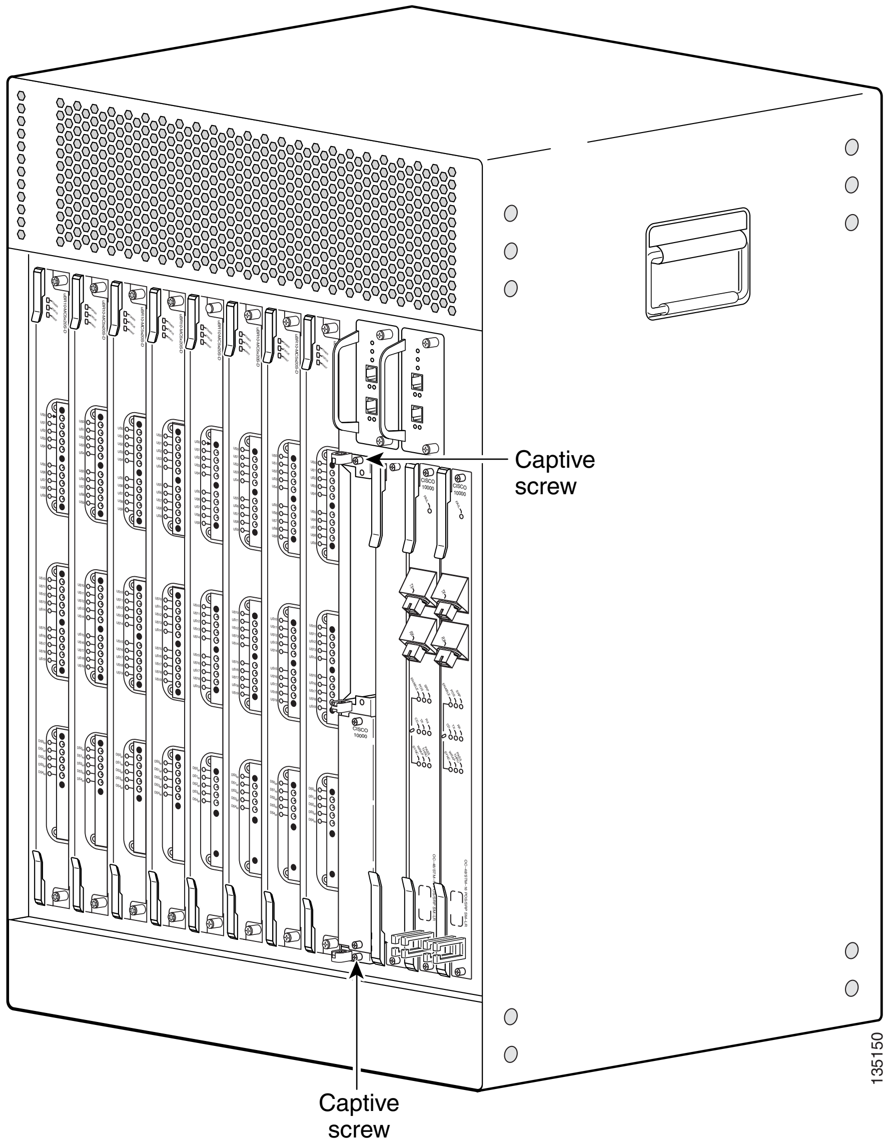


Figure 3-35 Captive Screw Locations



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

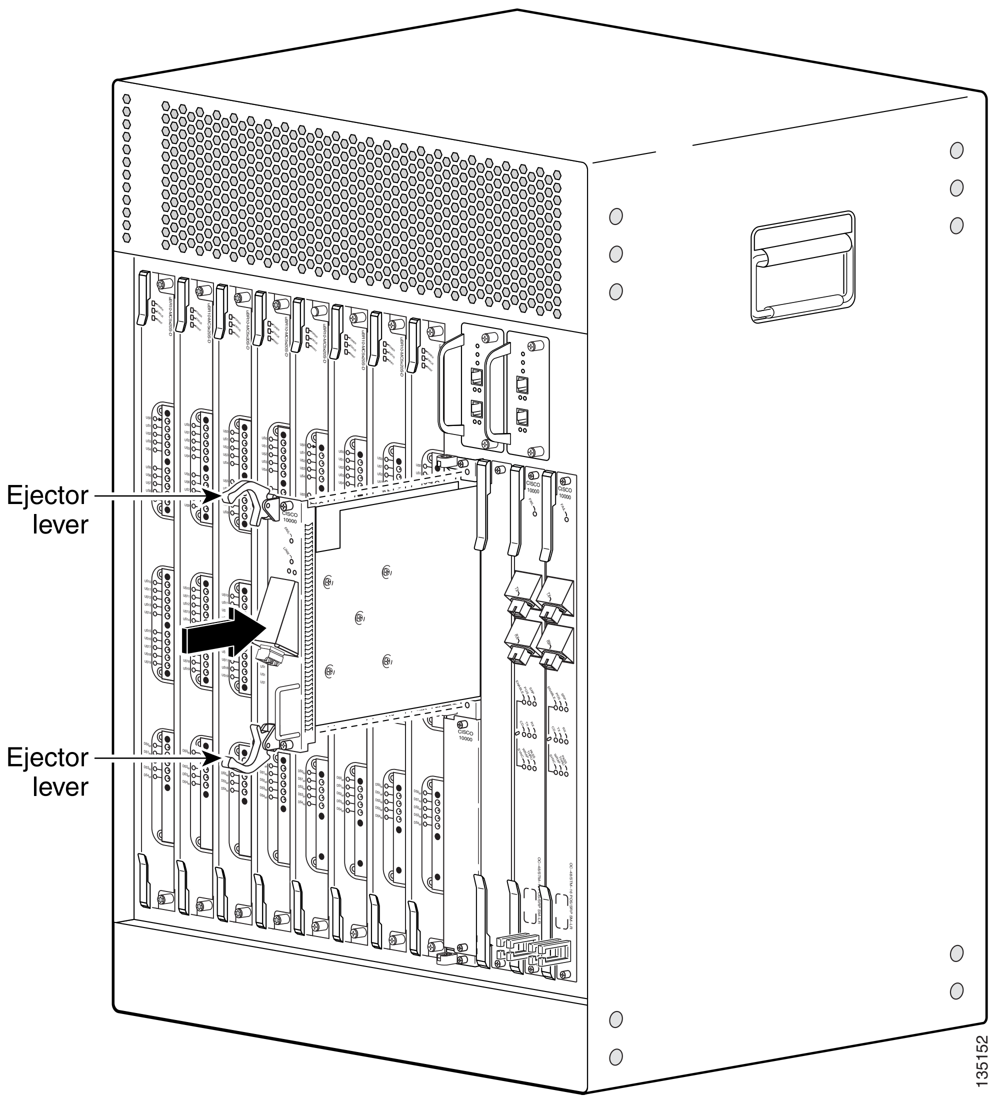
Installing the Half-Height Gigabit Ethernet Line Card

Use the following procedure to install a HHGE line card into an installed slot splitter. See the "Installing the Slot Splitter" section on page 3-42 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 3-13 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 3-36 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 3-37).

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 4-13.

Figure 3-37 Closing the Ejector Levers

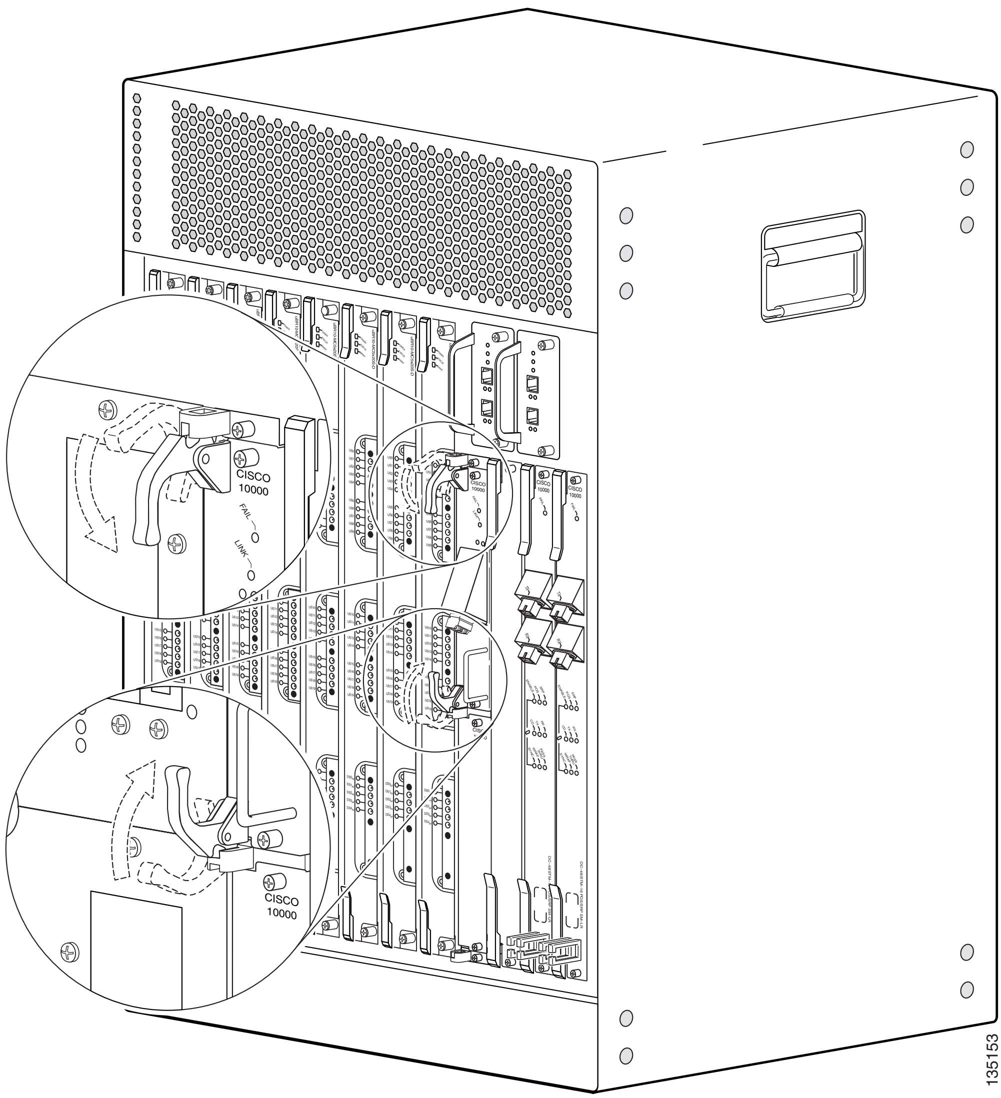
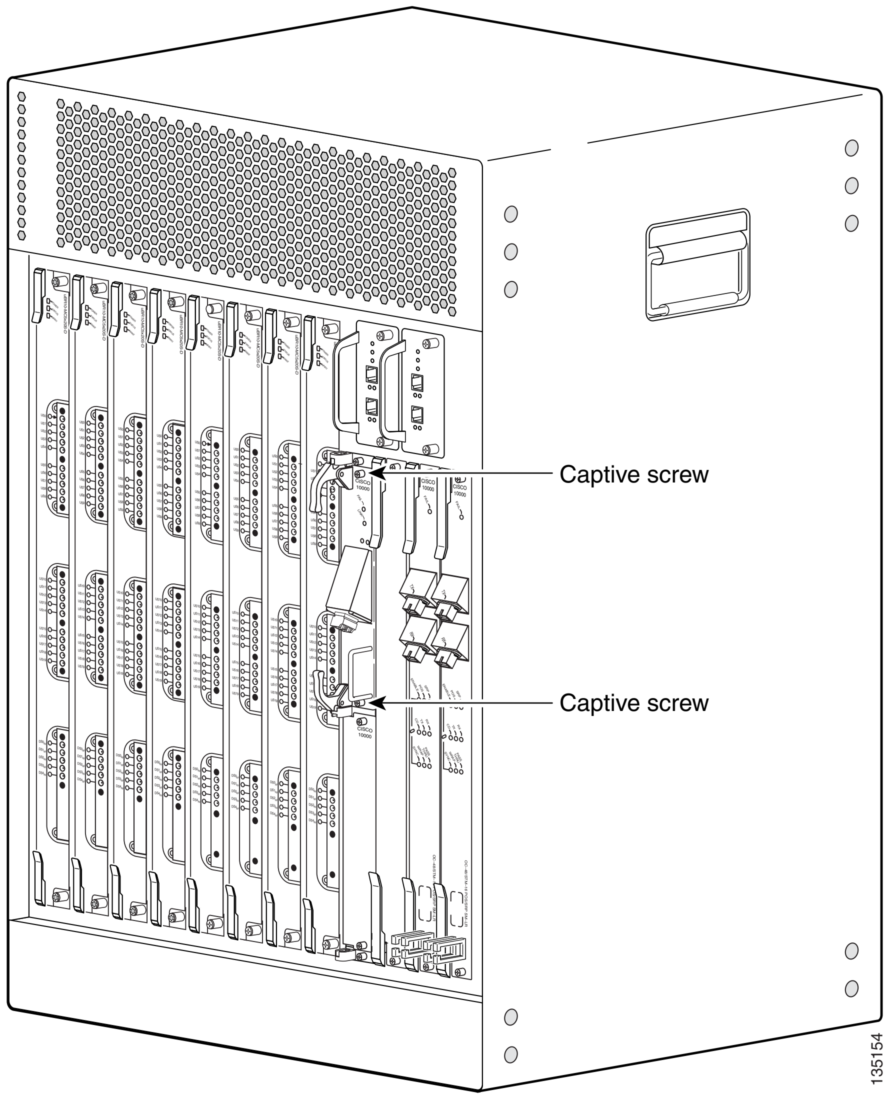


Figure 3-38 Captive Screw Locations



Step 7 Secure the line card in the slot splitter by tightening the top and bottom captive screws (Figure 3-38).

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.

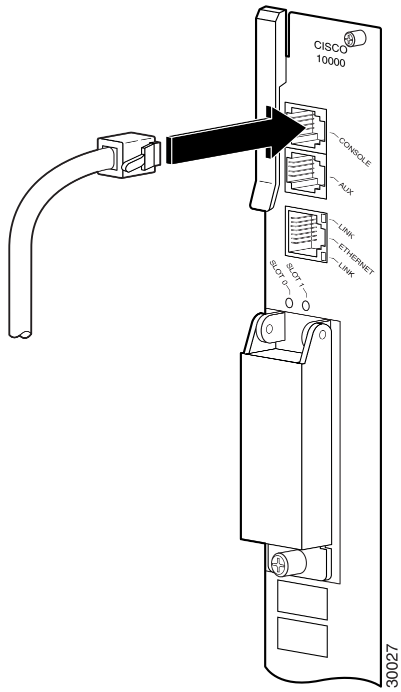
Connecting to the Console Port

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.

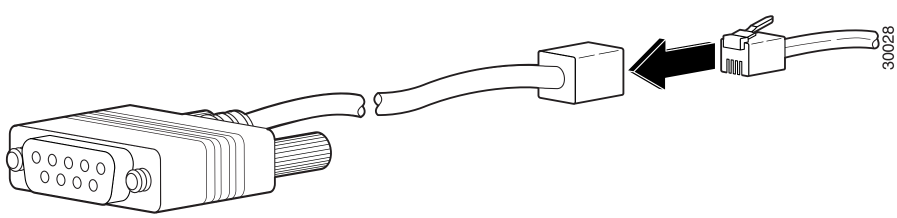
Step 1 Connect one end of the RJ-45 crossover cable to the serial RJ-45 port (labelled CONSOLE) on the PRE module (Figure 3-39).

Figure 3-39 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 3-40):

Figure 3-40 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

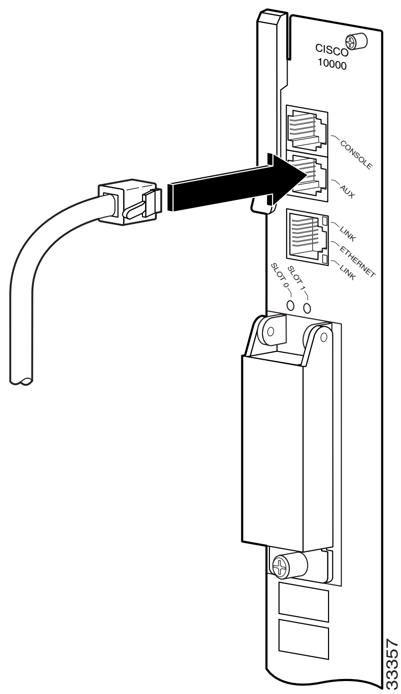
Step 6 If also connecting a modem to the auxiliary port, go to the next section, "Connecting to the Auxiliary Port." Otherwise, go to the "Connecting Network Management Cables" section on page 3-52 to continue the installation.

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 3-41).

Figure 3-41 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 3-52 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.

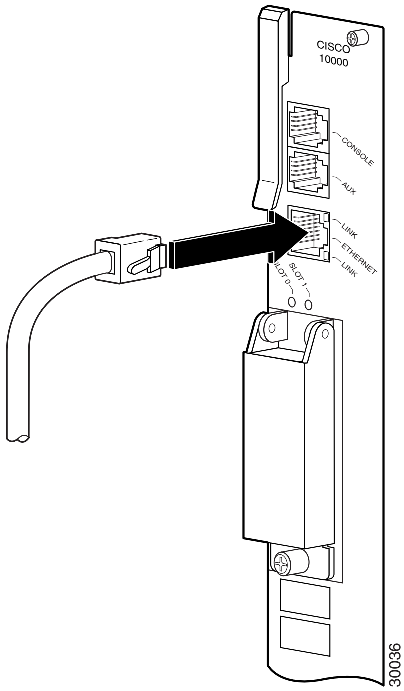
Follow these steps to connect the PRE to a 10Base-T Ethernet LAN.

Step 1 Connect one end of the Ethernet cable to the RJ-45 port on the primary PRE, labeled Ethernet (see Figure 3-42).

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 3-42 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.

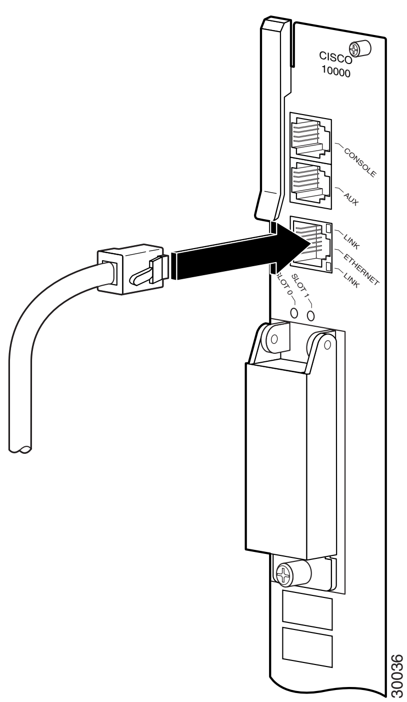
Follow these steps to connect the PRE to a 100Base-T Ethernet LAN.

Step 1 Connect one end of the Ethernet cable to the RJ-45 port on the primary PRE, labeled Ethernet (Figure 3-43).

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 3-43 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/univercd/cc/td/doc/product/cable/ubr10k/ubr10012/frus/index.htm

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/univercd/cc/td/doc/product/cable/ubr10k/ubr10012/frus/index.htm

Warning **Class 1 laser product.** Statement 1008

Warning **Invisible laser radiation present.** Statement 1016.

Warning **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

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 **Alleviates 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 3-58 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 3-56.

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 1-18.

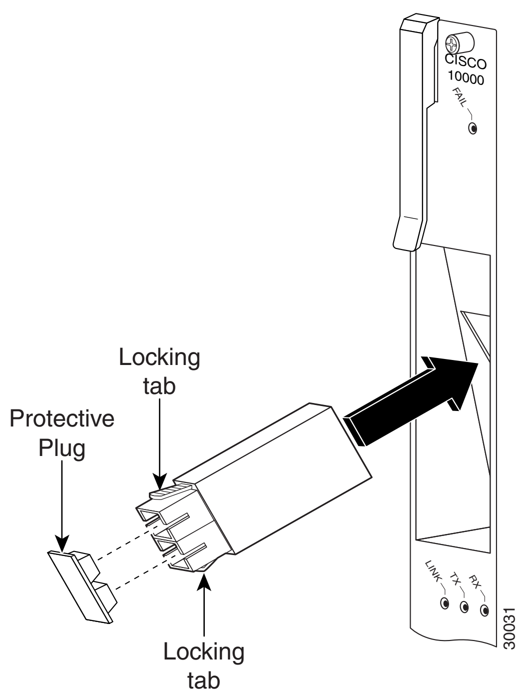
Use the following procedure to install a GBIC and then connect a fiber cable to the GBIC.

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 3-44).

Figure 3-44 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.

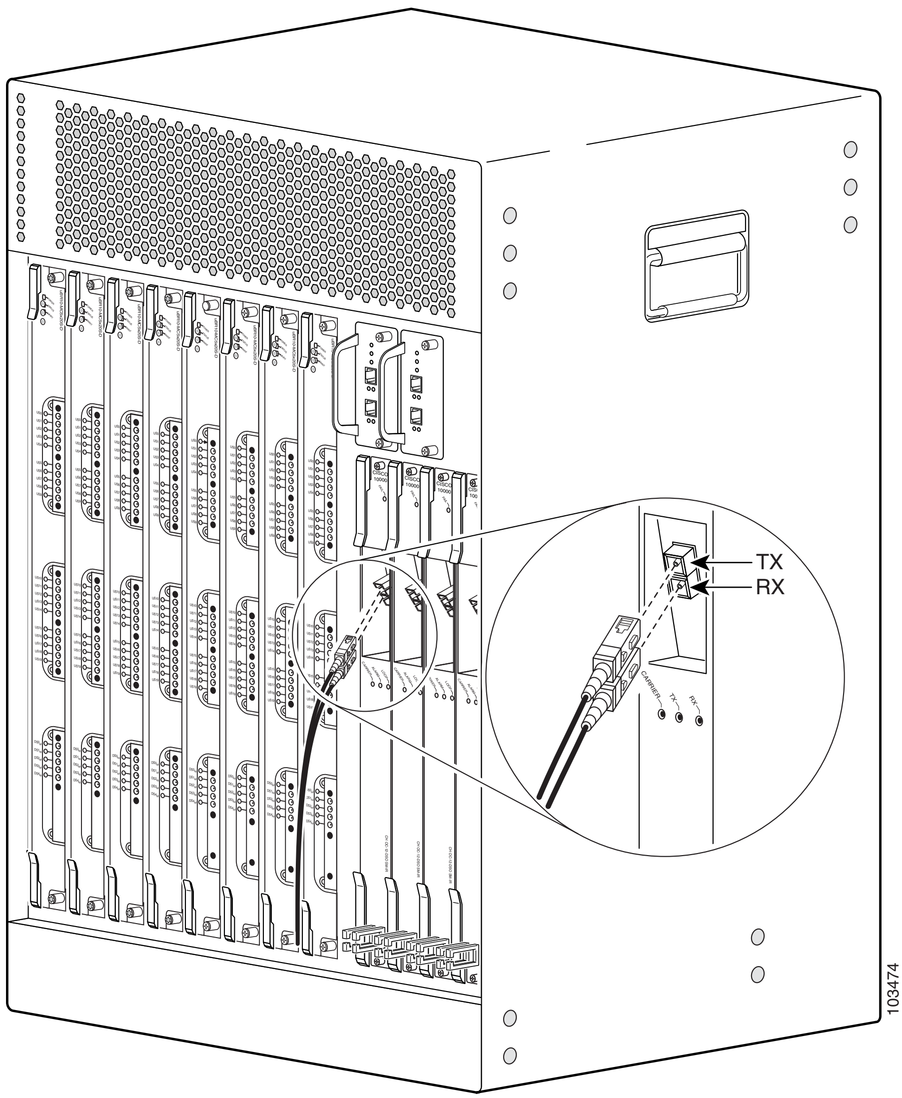
Step 3 Remove the protective plug from the GBIC by pulling it off.

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

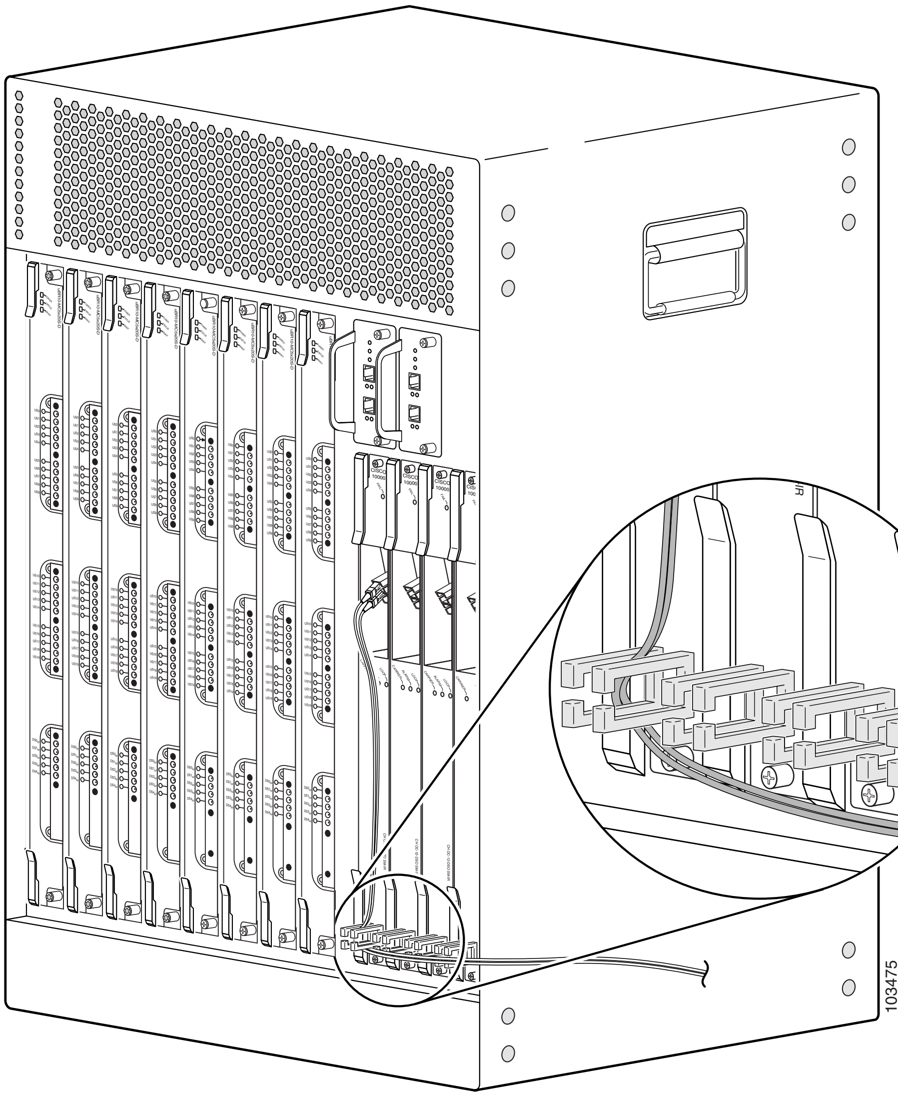
Step 4 Attach the fiber optic cable to the GBIC port (Figure 3-45).

Figure 3-45 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 3-46).

Figure 3-46 Gigabit Ethernet Cable Management



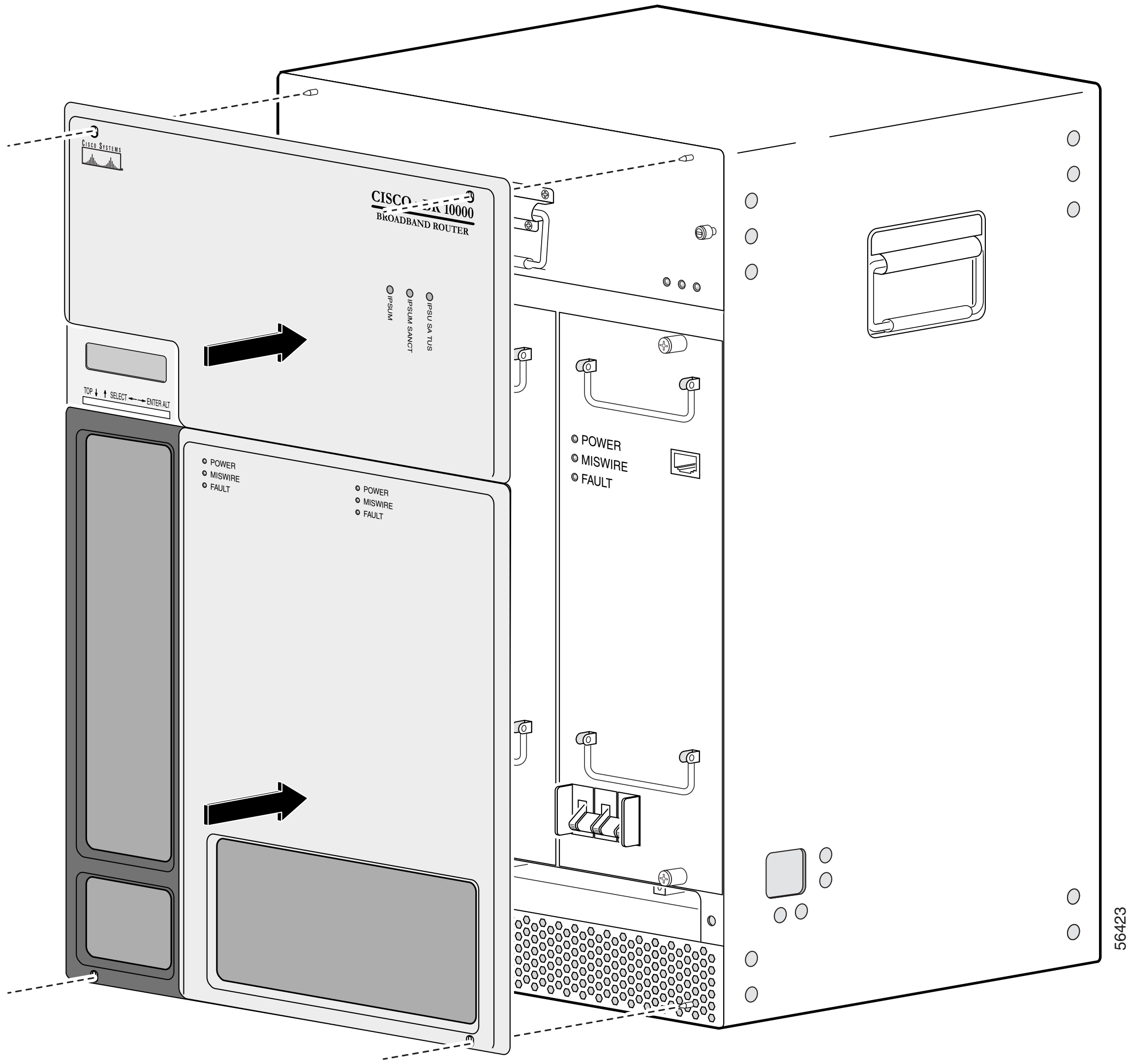
Step 6 If you have completed all cable connections, go to the next section, "Replacing the Front Cover" to continue the installation.

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 3-47).

Figure 3-47 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.

You are now ready to power on the system for the first time using the following procedure:

Step 1 Verify that each DC PEM is turned off.

Step 2 Turn on power at the power supply that is supply the DC power for the chassis.

Note If using the 2400W AC-input power shelf, this step requires plugging the three AC power cords into the back of the unit and into the outlets providing the AC power source. The AC OK and DC OK LEDs on the AC-input power shelf should both light, indicating that both AC-input and DC-output power is present.

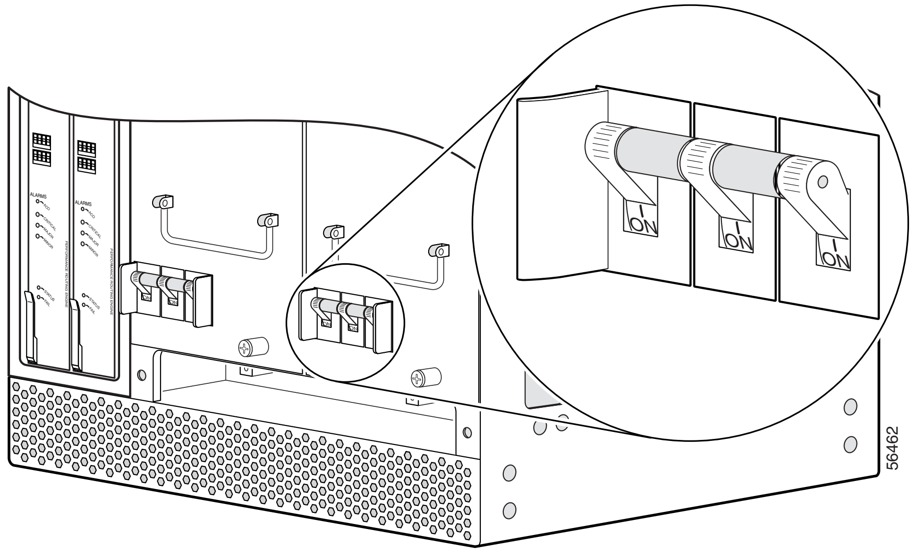
Step 3 After turning on the DC power source, verify that the Fault LED on each DC PEM lights (yellow), which indicates that the DC PEM is receiving power from the DC power source but is not yet supplying power to the chassis (because its power switch is off).

If the Fault LED does not light, turn off the DC power source and verify that the wiring from the DC power source to the two terminal blocks underneath each DC PEM is correct, as described in the "Connecting DC Power to the Cisco uBR10012 Router" section on page 3-28.

Tip If the Miswire LED lights on either PEM, it indicates that the two wires from the DC source (–48/–60 VDC and RTN) were reversed when connected. Turn off the DC power source and reverse the two wires so that the –48/–60 VDC lead is connected to the bottom terminal and the RTN lead is connected to the top terminal (see Figure 3-22 on page 3-30).

Step 4 At the front of the chassis, turn the power switches on each DC PEM to the ON (|) position (Figure 3-48).

Figure 3-48 Cisco uBR10012 Router DC PEM Power Switches (On Position)



Step 5 Verify that all LEDs are lighting properly:

a. The Power LED on each DC PEM should light (green), indicating that DC power is being received and is being delivered to the chassis.

If the other LEDs on the PEM (Miswire or Fault) light (yellow), see the "Removing the DC Power Entry Modules" section on page 3-6 or "Removing the AC Power Entry Module" section on page 3-7.

b. Listen to the fans as power is applied. When you first apply power to the chassis, the fans in the fan assembly module initially operate at high speed, but if all four fans are operating correctly, and if the temperature of the chassis is in the nominal operating range, the fans will slow down to their normal operating speed.

c. The OK LED on the fan assembly module should light (green), indicating that all fans in the blower are operating properly. You should be able to feel air being taken in at the bottom front of the chassis and being blown out at the top rear of the chassis (see Figure 2-1 on page 2-6).

If either the Single Fan Failure or Multiple Fan Failure LED lights (yellow), see the "Removing the Fan Assembly" section on page 3-9.

d. The Fail LED on each PRE module should light (yellow) briefly during the power-on sequence but then should turn off.

If the Fail LED does not turn off on either PRE, verify that the ejector levers are fully closed and that the captive screws have been tightened. If necessary, remove the PRE from the chassis and reinsert it or replace it (see the "Removing and Replacing the PRE Module" section on page 5-28).

When the power-on sequence is complete, the PRE begins to initialize the line cards. Continue with the next section, "Configuring the Cisco uBR10012 Router at Startup," to configure the line cards.

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 tmc1 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 3-65.

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

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

Step 1 To achieve network connectivity, enter the interface for the FastEthernet interface.

```
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 You must 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$uror$EFU0hKOBQXhk975qKFZlL0
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 The setup script concludes by giving you the choice to exit 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 After you complete the configuration dialog, enter global configuration mode 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 uBR10012Universal 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 following 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
Router#
```

The PC media card is ready for use.

CHAPTER 4

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:

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-swapable. 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	Check that: • All power cords are properly connected to the Cisco uBR10012 router and at the power connection end. • The DC PEM power switches are turned on and the POWER LED is on (green). • The AC PEM power switches are turned on and the POWER LED is on (green). • The fan assembly module is fully inserted, and the FANS OK LED is lighted (green).
System fails to boot up properly	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 Troubleshooting the Power Subsystem, page 4-7
DC PEM problem	• If the FAULT LED is on, see Troubleshooting the Power Subsystem, page 4-7. • 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 "Connecting DC Power to the Cisco uBR10012 Router" section on page 3-28).
AC PEM problem	• If the power LED on the AC PEM is off, check the AC power source. • If the fault LED is yellow, check to see if the PEM is properly inserted in the chassis. • 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.
System experiences a critical alarm (Critical LED on the PRE is on)	Enter the **show facility-alarm status** command at the console.
System experiences a major alarm (Major LED on the PRE is on)	Enter the **show facility-alarm status** command at the console.
System experiences a minor alarm (Minor LED on the PRE is on)	Enter the **show facility-alarm status** command at the console.

Table 4-1 General Troubleshooting Tips (continued)

Symptom	Steps to Take
You cannot establish a console or Telnet connection to the system.	For information about troubleshooting Ethernet connections, see the "Troubleshooting Ethernet Connections" section on page 4-4. For information about troubleshooting the console port serial connections, see the "Troubleshooting the Console Port Serial Connection" section on page 4-5.
Fan failure	Perform the following if a FAN FAILURE LED lights: • Reseat the fan assembly module (see the "Removing and Replacing the Fan Assembly Module" section on page 5-6). • Remove the rear safety cover and be sure that the fan assembly module cable is connected securely (see the "Removing and Replacing the Fan Assembly Module" section on page 5-6).
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 "Troubleshooting the Cooling Subsystem" section on page 4-11 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 on, 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 3-52.
- 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 off, 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 on (green).
  - If the Fail LED is on (yellow), refer to Troubleshooting the Processor Subsystem, page 4-10.
- Check the hub:
  - Is the cable connected into the correct hub port (for example, the hub LED is on, but the LNK LED on the PRE is not on).
  - Be sure that the cable is not connected to an uplink port.
- If the LNK LED is on (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:

```
switch> configure terminal
```

```
Enter configuration commands, one per line. End with CNTL/Z.
router(config-if)# int fast0/0/0
router(config-if)# no shut
router(config-if)# exit
router(config)# exit
router#
```

- 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 3-49.
- 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 xxi.

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 3-60. 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 (|) position, the following should occur:

1. Fans—the fans start operating. The FANS 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 4-11.

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 on (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 on (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 4-11.

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.

5. The initial system banner displays on the console screen.

   If it is not displayed, see the "Connecting Network Management Cables" section on page 3-52 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

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

Troubleshooting the AC Power Subsystem

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

Step 1 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
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 and earlier release, the **show environment** command does not correctly identify the AC PEM error messages.

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

b. 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.

Step 2 Verify that the power LED on each AC PEM is green.

a. If yes, the PEM is connected to an active AC power source and is supplying power to the chassis.

b. If the Power LED is not on, and if no other LEDs are on, verify that the plug is securely inserted into the wall plug and the AC power socket.

c. If the AC PEM LED is still off, try connecting the AC power cable to another wall outlet.

Step 3 Check to see if the PEM Fault LED is yellow.

If yes, it indicates that the AC PEM is connected to an active AC power source but is not providing power to the chassis. Check that the PEM is properly inserted into the chassis and that its power switch is on.

Step 4 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 xxi.

Troubleshooting the DC Power Subsystem

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

Step 1 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
Router#
```

a. Verify that the temperatures are within the valid operating ranges, and that the fan assembly and both DC PEM modules are present and OK.

b. 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.

– DC PEM is not listed—Verify that both DC 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 DC PEMs is not within the correct range. This can occur when the input DC voltage to the DC PEM is either too low or too high. Measure the input DC voltage, and if it is correct, the DC PEM has failed and should be replaced.

– 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 The **show environment** command shows status information about the external 2400 WAC-input power supply only you have the newer model of the DC PEM (PEM) installed and when the Cisco uBR10012 router is running Cisco IOS Release 12.2(4)XF or later release.

Step 2 Verify that the power LED on each DC PEM is green.

a. If yes, the PEM is connected to an active DC power source and is supplying power to the chassis.

b. If the Power LED is not on, and if no other LEDs are on, check the power source.

– DC power source—verify that the plug is securely inserted into the DC socket.

– AC power source—check that the AC-input power supply is on. If the LEDs on the AC power supply is not on, troubleshoot the AC-input power shelf. See "Troubleshooting the AC-Input Power Shelf" section on page 4-9.

c. If the DC PEM LED is still off, turn off the DC power source and then verify that the DC power source is correctly wired to the terminal blocks underneath each DC PEM. See the "Connecting DC Power to the Cisco uBR10012 Router" section on page 3-28 for details. If that does not correct the problem, try connecting the DC power source to another wall outlet or power supply.

Step 3 Check to see if the PEM Fault LED is yellow.

a. If yes, it indicates that the PEM is connected to an active DC power source but is not providing power to the chassis. Check that the DC PEM is properly inserted into the chassis and that its power switch is on.

b. If no, continue with the next step.

Step 4 Check to see if the Miswire LED yellow?

a. If yes, it indicates that the wires from the DC power source to this DC PEM are reversed. Turn off the DC power source and reverse the two wires so that the –48 VDC lead goes to the bottom terminal and the RTN lead goes to the top terminal in the terminal block. See the "Connecting DC Power to the Cisco uBR10012 Router" section on page 3-28 for details.

b. If no, continue with the next step.

Step 5 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 lighted for each of the AC power supplies.)

a. If no, and if the DC power source is connected to a valid power outlet, troubleshoot the DC power source.

b. 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 3-28 for details.

Step 6 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 xxi.

Troubleshooting the 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.

a. If you are using the newer model of DC PEM that has the power supply monitoring connector on the front panel, and if the Cisco uBR10012 router is running Cisco IOS Release 12.2(4)XF or a later release, you can also 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#
```

b. 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.

c. 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 If you are using an older version of the PEM, verify that the DC and AC OK LEDs are on.

a. If yes, then the power shelf is operational.

b. If no, 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 on, then double-check the wiring to the Cisco uBR10012 router DC-input terminal blocks.

Step 3 Check to see if the Fault LED is 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 xxi.

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 alphameric 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 xxi.

Troubleshooting the Cooling Subsystem

Check the following to help isolate a problem with the cooling system.

Step 1 Do the fans start operating when you start up the system?

When the fans are operating, you can hear them. You can also feel air being drawn in at the bottom front and expelled at the top rear of the chassis.

- **a.** If no, there is a problem with the fan or power. (See the "Troubleshooting the Power Subsystem" section on page 4-7.)
- **b.** If yes, continue with the next step.

Step 2 Is the System OK LED on the fan assembly module green and the other two LEDs (Single Fan Failure and Multiple Fan Failure) off?

a. If yes, the system is operating normally.

b. If no, remove the fan assembly module and reinsert it. If this does not help, check to see which LED that is on. The Single Fan Failure LED indicates that one fan of the four has failed, but that the system is still able to adequately cool the chassis; however, the fan assembly module must be repaired or replaced as soon as possible. The Multiple Fan Failure LED indicates that more than one fan has failed, and that the fan assembly module is no longer able to adequately cool the Cisco uBR10012 chassis. Replace the fan assembly module immediately.

c. If the following messages are displayed on the console, then the system has detected a critical overtemperature 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 41C/106F
00:00:19:%ENVM-2-ENVCRIT:chassis inlet measured at 37C/99F
00:00:19:%ENVM-2-ENVCRIT:chassis outlet 1 measured at 50C/122F
00:00:19:%ENVM-2-ENVCRIT:chassis outlet 2 measured at 50C/122F
```

Although an overtemperature condition is unlikely at initial startup, ensure that heated exhaust air from other equipment is not entering the router's inlet vent, and that there is sufficient clearance around the sides of the chassis to allow cooling air to flow.

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.

If you experience trouble with the startup that 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 xxi.

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, reseat 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 xxi.

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/univercd/cc/td/doc/product/cable/ubr10k/ubr10012/frus/ub_oc48.pdf

Note Refer to the FRU documentation for the different cards at the following URL:

http://www.cisco.com/univercd/cc/td/doc/product/cable/ubr10k/ubr10012/frus/index.htm

Troubleshooting the HHGE Installation

To troubleshoot the HHGE installation, follow the instructions in Table 4-2. Refer to Figure 1-25 for the port LED layout on the line card faceplate. The FAIL LED indicates line card status only.

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.	1. HHGE card is inserted in slot 1 or slot 2.	1. Remove the HHGE from the illegal slot and place the card in any of the following slots: • 3/0/0 or 3/1/0 • 4/0/0 or 4/1/0.
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.	1. HHGE card is inserted in slot 1 or slot 2, subslot 1.	1. Remove the line card from the illegal slot and place it in slot 3 or slot 4. 2. Use the **no hardware** *module* **shut** command to reset the slot `no hardware 2/0/0 shut`
Power entry modules (PEMs), fans, and other line cards do not operate	1. Disconnected power cord. 2. Power switch is in the Off position.	1. Check that all power cords are properly connected to both the Cisco uBR10012 system and at the power connection end. 2. Set the PEM power switches to the On position.
The yellow FAIL LED does not light during portions of the POST	1. The line card is not properly seated. 2. Bad line card slot or backplane connector.	1. Be sure the ejector levers are fully closed and that the captive screws have been tightened. 2. Remove the line card and install it in another chassis slot.

Table 4-2 Line Card Installation Troubleshooting (continued)

Symptom	Possible Cause	Corrective Action
The yellow FAIL LED blinks	1. The SFP GBIC has been rejected because: – An internal fault is detected. – Not a Gigabit Ethernet SFP. – Not a Cisco SFP. – Two SFPs with identical serial numbers are present in the system. – There is a hardware shut down	1. Replace with a Cisco SFP GBIC.
The green LINK LED does not light when you plug in the Ethernet cable	1. No Ethernet connection to upstream device. 2. The SFP GBIC was not fully inserted or seated properly. 3. Negotiation is not configured properly. 4. Hardware shut down for that port. 5. Improper SFP GBIC (FAIL LED should blink). 6. Bad cable.	1. Make sure the upstream device has an active Ethernet connection. 2. Reinstall the SFP GBIC. 3. Reconfigure negotiation. 4. Enable the port. 5. Replace with a Cisco SFP GBIC. 6. Replace the cable.
The green LINK LED is on, but does not pass traffic	1. Negotiation is off, but set to on at the remote end. 2. Internal loopback is enabled.	1. Set local and remote negotiation settings to the same value. 2. Disable loopback. 3. ARP incomplete 4. IP address not configured

CHAPTER 5

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:

Tip Before beginning any FRU procedure, be sure you are familiar with the safety precautions outlined in Chapter 2, "Preparing for Installation."

Note Detailed, up-to-date instructions are also shipped with all FRUs and upgrade kits.

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 NVRAM, and also, if you wish, to a PC media card. Refer to the *Cisco uBR10012 Universal Broadband Router Software Configuration Guide* for instructions (using the **copy** command) at the following URL:

http://www.cisco.com/univercd/cc/td/doc/product/cable/ubr10k/index.htm

Step 3 Power down the system by setting the power switch on all PEMs to the OFF (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

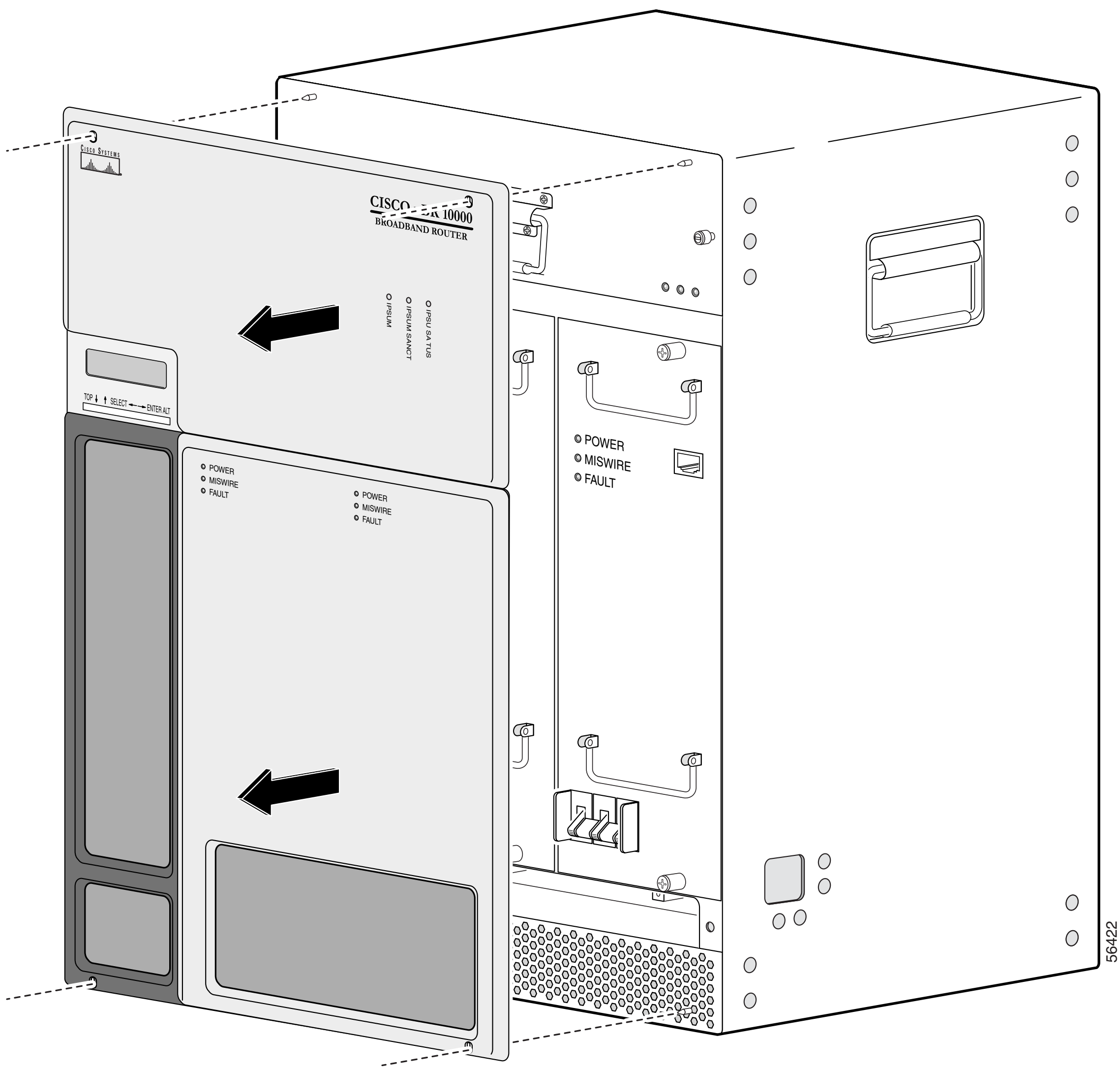
The Cisco uBR10012 router is equipped with a plastic front cover that ensures proper airflow through the system and protects the cables and connectors from damage. The following procedures describe how to remove and replace the front cover.

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

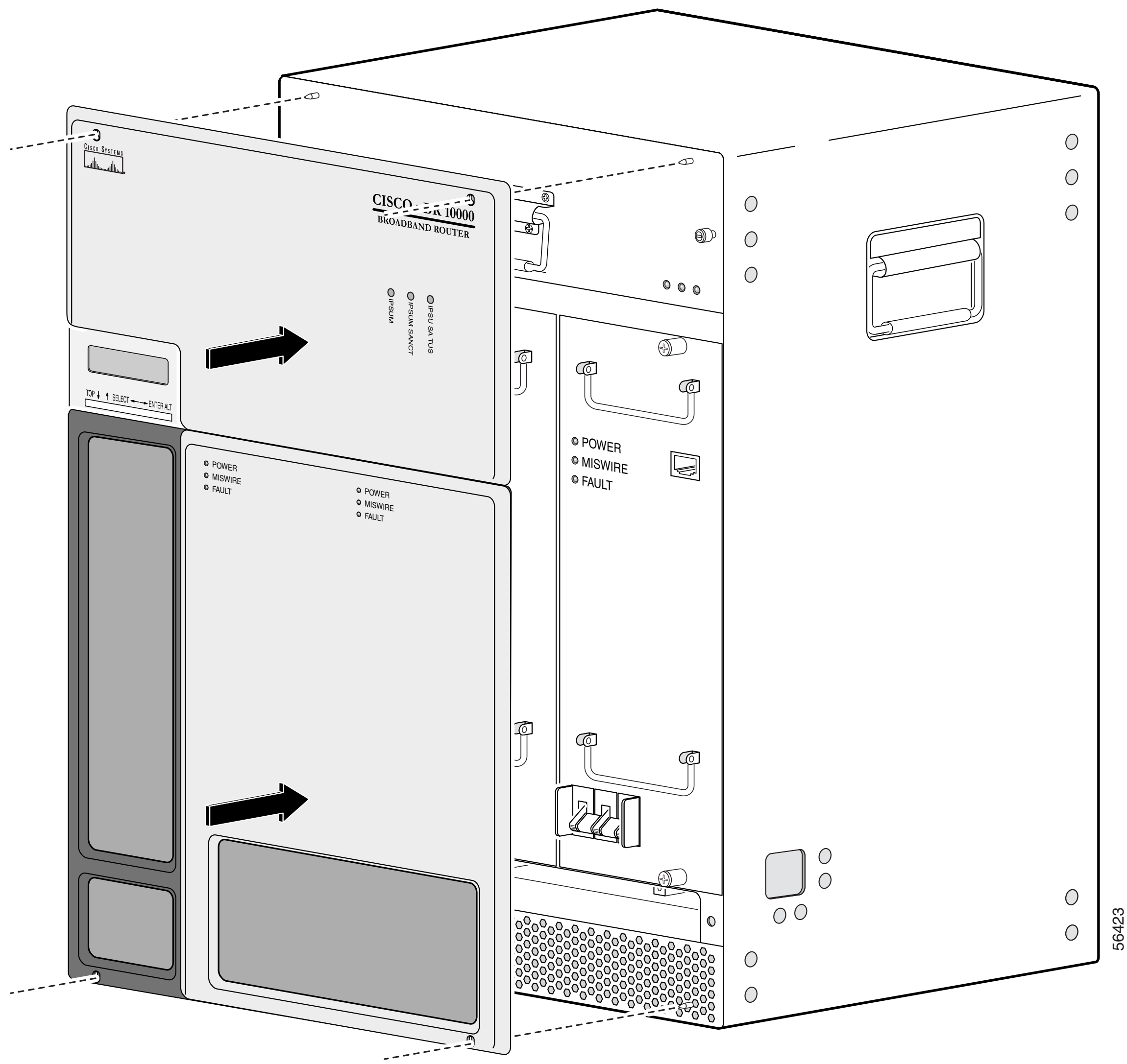


Replacing the Front Cover

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=.

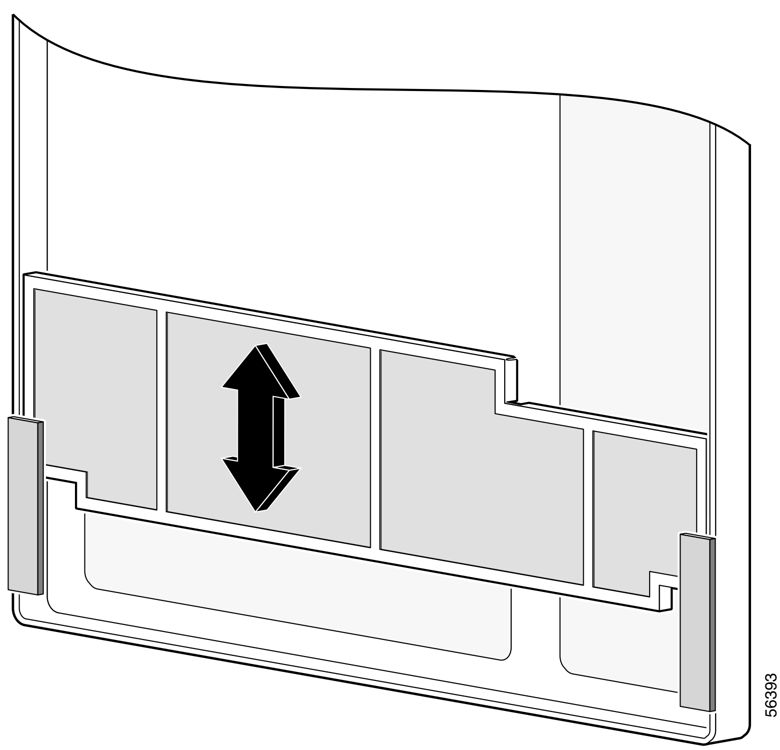
Use the following procedure to replace the air filter:

Step 1 Remove the front cover (see "Removing the Front Cover").

Step 2 Slide the air filter out of its slot.

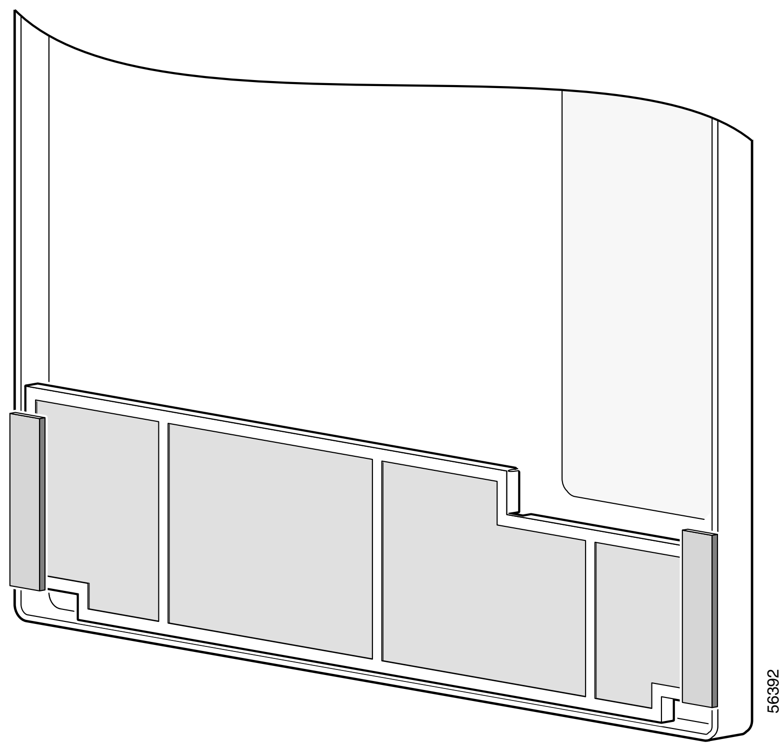
Step 3 Discard the old filter.

Figure 5-3 Removing and Inserting the Air Filter



Step 4 Position the new air filter above the tabs on the inside of the bezel 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

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 a failure LED lights, use the following procedure to remove and reinsert the fan assembly module. If the failure LED is still on, use the following procedure to replace the fan assembly module. The fan assembly module supports hot-swapping and can be replaced without interrupting system operation.

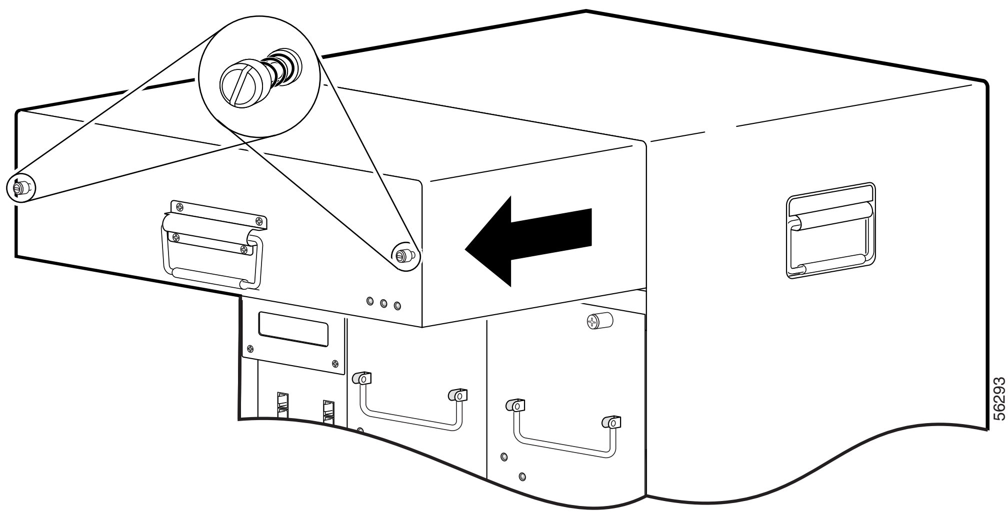
Note The product order number for a replacement fan assembly is UBR10-FAN-ASSY=.

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.

Step 1 Remove the front cover (see "Removing the Front Cover").

Step 2 Loosen the captive screws on each side of the fan assembly module and use two hands to pull the module out of the chassis (see Figure 5-5).

Figure 5-5 Removing the Fan Assembly Module



Caution The fan assembly module weighs approximately 30 pounds. Use one hand to pull the fan assembly module using its handle and position the other hand underneath the module to support it, so that it does not suddenly swing down when it clears the chassis.

Step 3 Using two hands, align the new fan assembly module in the slot on the chassis and push it back firmly, making sure it securely connects to the backplane.

Step 4 Verify that the FANS OK LED lights (green). If the FANS OK LED does not light or if either fan failure LED lights (yellow), try reseating the fan assembly module.

Step 5 Tighten the captive screws on each side of the fan assembly module.

Step 6 Replace the front cover (see "Replacing the Front Cover").

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.

Note The product order number for a replacement DC PEM is UBR10-PWR-DC=.

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 5-18 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

Removing the DC PEM

Do not use this procedure if both DC PEMs have failed; instead, use the next procedure, Replacing Both DC PEMs, page 5-13.

Step 1 Remove the front cover (see "Removing the Front Cover").

Step 2 If the FAULT LED light in on (yellow):

a. Flip the power switch on the DC PEM off and then on.

b. If this does not turn off the FAULT LED and turn on the POWER LED, verify that the DC PEM is fully inserted into the power bay and that its captive screws have been tightened.

If these steps do not correct the problem, the DC PEM must be replaced.

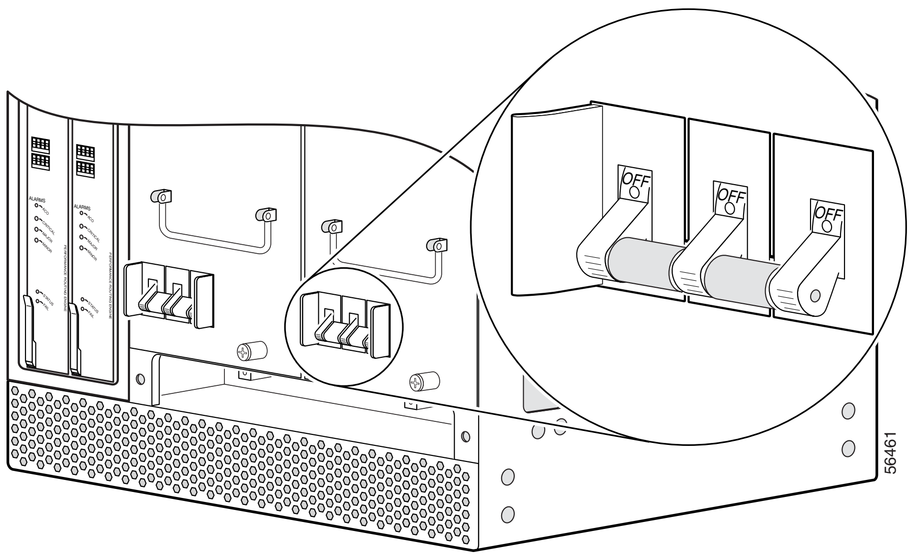
Step 3 Turn off the DC PEM, the switch is in the off (0) position (see Figure 5-6).

Caution Do not power off both DC PEMs, or the system shuts down and all data traffic stops. Turn off only the DC PEM you are replacing.

Step 4 (Optional) Turn off the DC power source that is providing power for this DC PEM. All LEDs on the DC PEM should turn off. (This step is required only if you need to rewire the terminal block for this PEM, as described in step 6.)

Tip Separate DC power sources should be used for each DC PEM. This allows you to turn off the power source for the DC PEM being replaced without affecting the power source for the online DC PEM.

Figure 5-6 Turning a DC PEM Off



Step 5 Loosen the captive screws on the DC PEM you are removing and pull the PEM from the chassis using the handles on the faceplate (see Figure 5-7). Set the DC PEM aside.

Step 6 If the MISWIRE LED indicated that the DC power source is miswired,

a. Verify that the DC power source has been turned off.

b. Then verify that the wires leading to the DC power source are connected as follows:

- The cable providing the –48/–60 VDC should be connected to the bottom terminal on the DC terminal block. This cable is typically red.
- The cable providing the return path should be connected to the top terminal on the DC terminal block. This cable is typically black.

Step 7 If the wires were reversed when connected, switch them so that they provide the power signals as listed above (see Figure 5-8).

Warning **Use copper conductors only.** Statement 1025

Figure 5-7 Removing a DC PEM

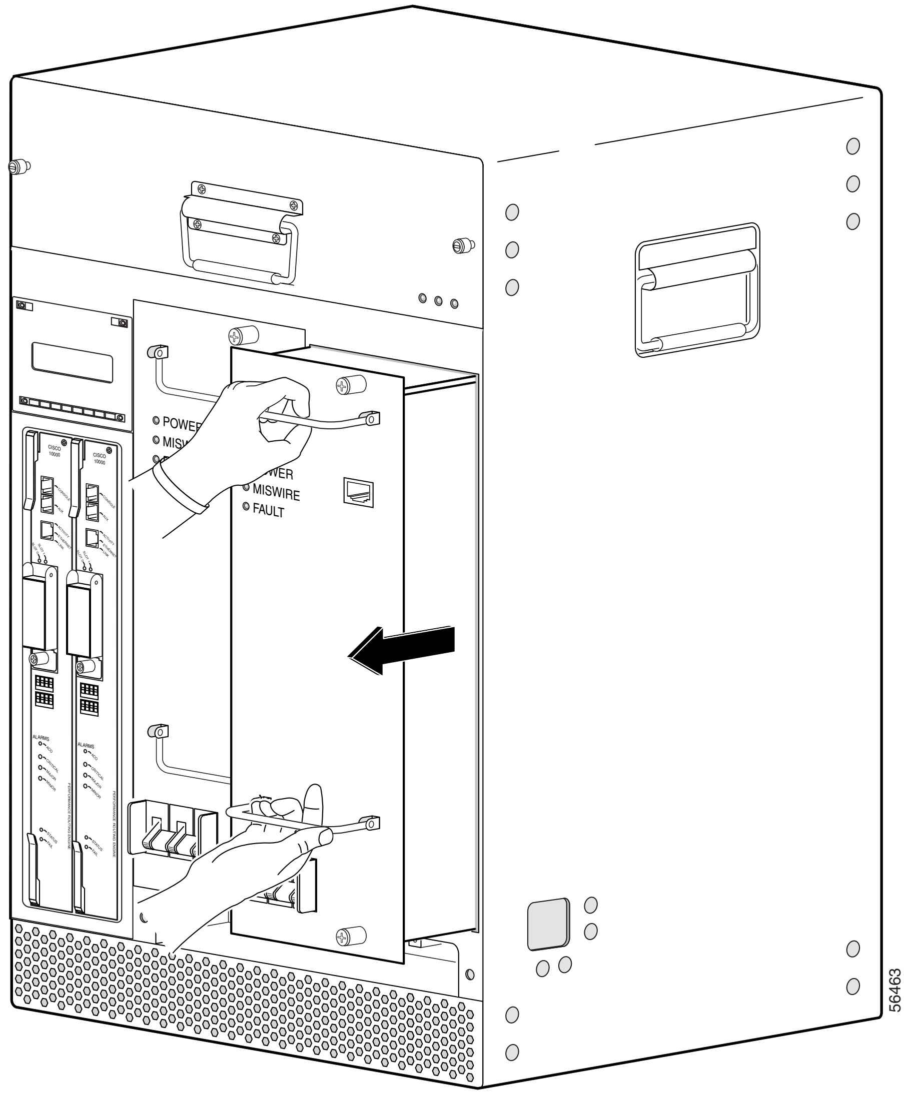
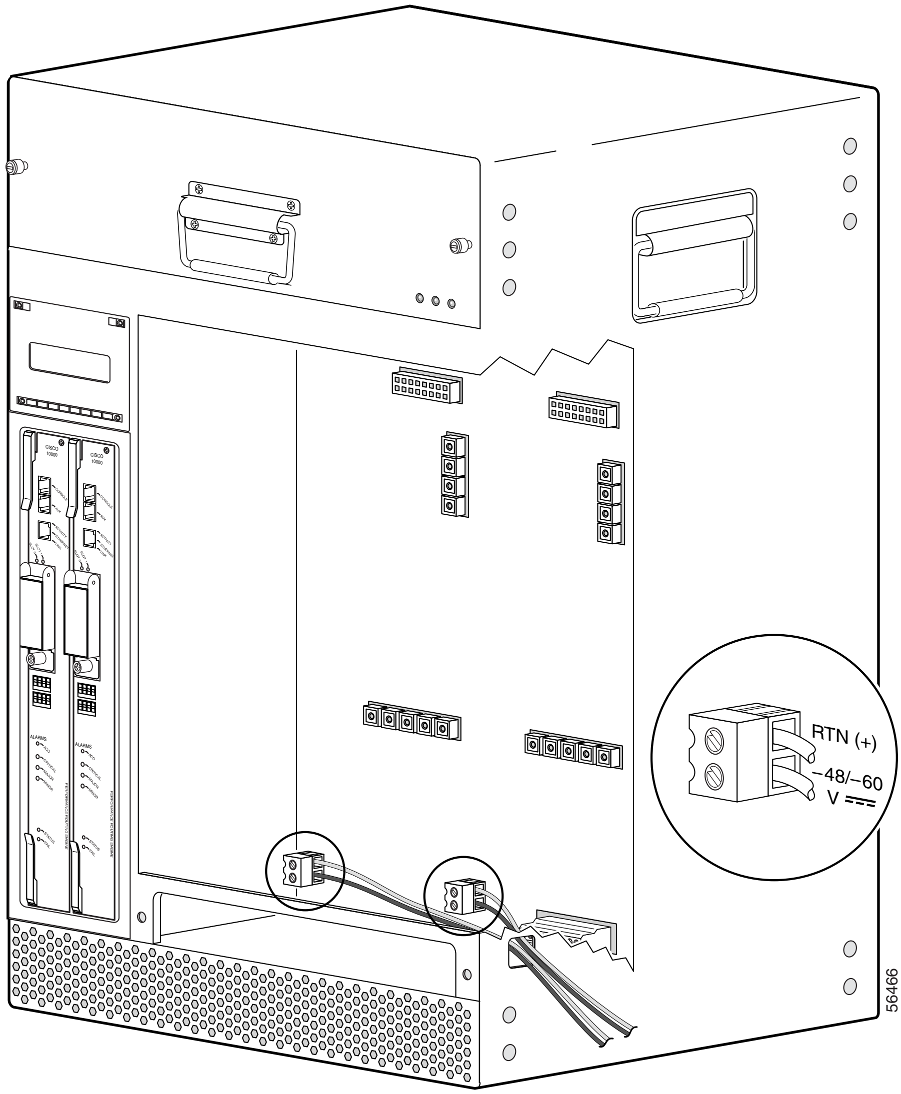


Figure 5-8 DC Power Connection



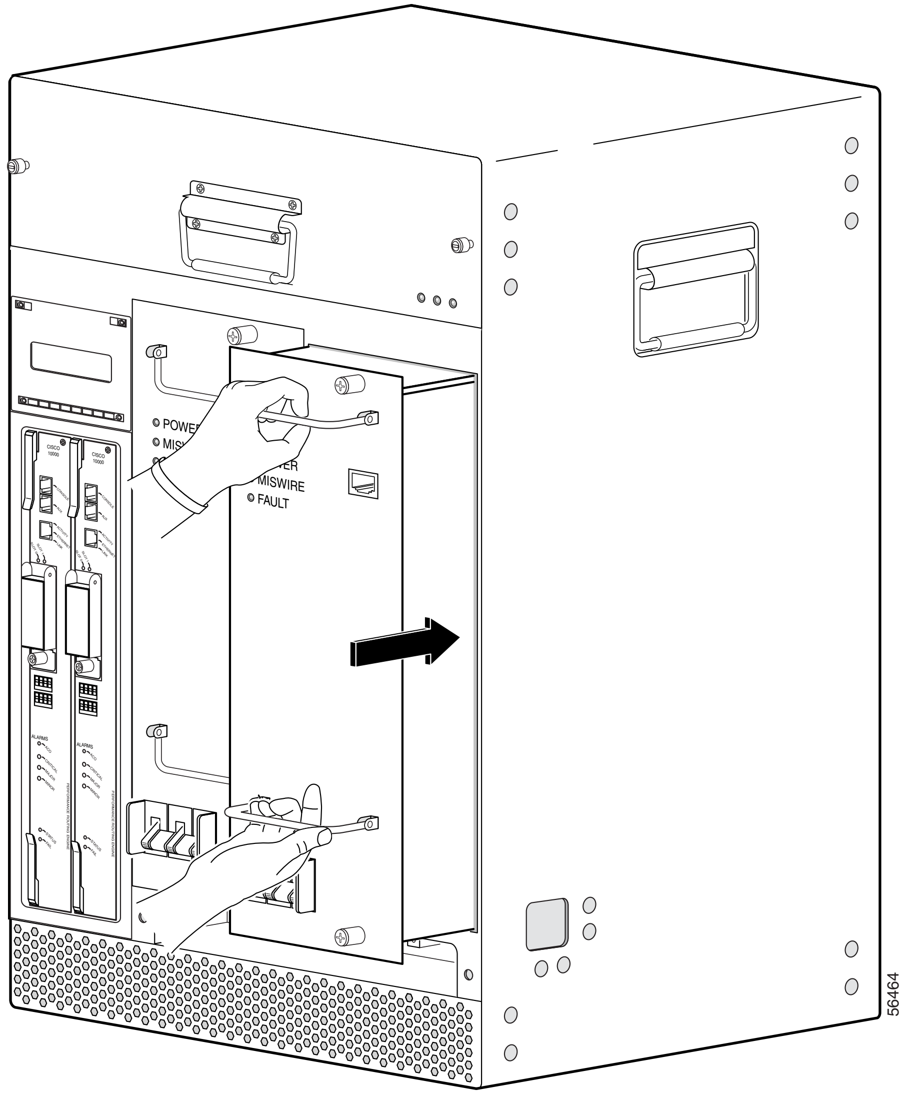
Replacing the DC PEM

Step 1 Verify that the power switch on the replacement DC PEM is in the off position (see Figure 5-6).

Tip It is a good idea to tape the power switch in the off (O) position to keep from accidentally turning the PEM on.

Step 2 Position the replacement DC PEM in the power bay and push it forward, verifying that it goes all the way in and makes a secure connection with the backplane. Tighten the captive screws (see Figure 5-9).

Figure 5-9 Installing a DC PEM



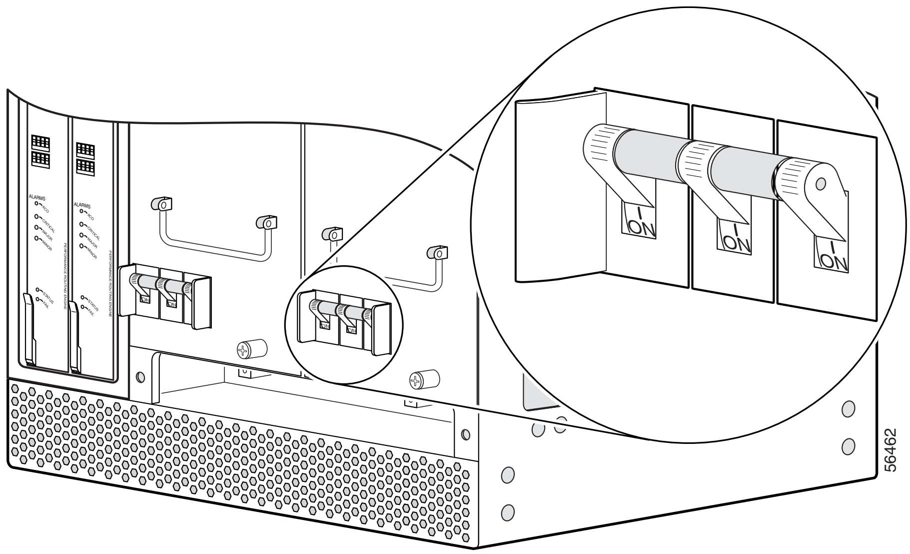
Step 3 If necessary, turn on the DC power source that is providing power for this DC PEM. The FAULT LED on the replacement DC PEM lights (yellow) to indicate that the DC PEM is receiving power from the power source but is not yet supplying power to the Cisco uBR10012 chassis.

Step 4 After installing the DC power supply, remove the tape from the circuit breaker switch handle.

Step 5 Push up the power switch on the replacement DC PEM to the on (|) position (see Figure 5-10).

Note When you turn the power switch on, the FAULT LED on the DC PEM turns off and the POWER LED lights (green).

Figure 5-10 Setting the DC Power Switch to the On Position



Step 6 Replace the front cover (see "Replacing the Front Cover").

Replacing Both DC PEMs

Use the following procedure to replace (or reinstall) both DC PEMs. This typically is done only in the following situations:

- The failure LEDs (MISWIRE or FAULT) on both DC PEMs are lighted, indicating a problem with either the DC power source or the DC PEMs.
- A single DC power source is currently being used for both DC PEMs, and you want to use a separate DC power source for each DC PEM (this is the recommended configuration).

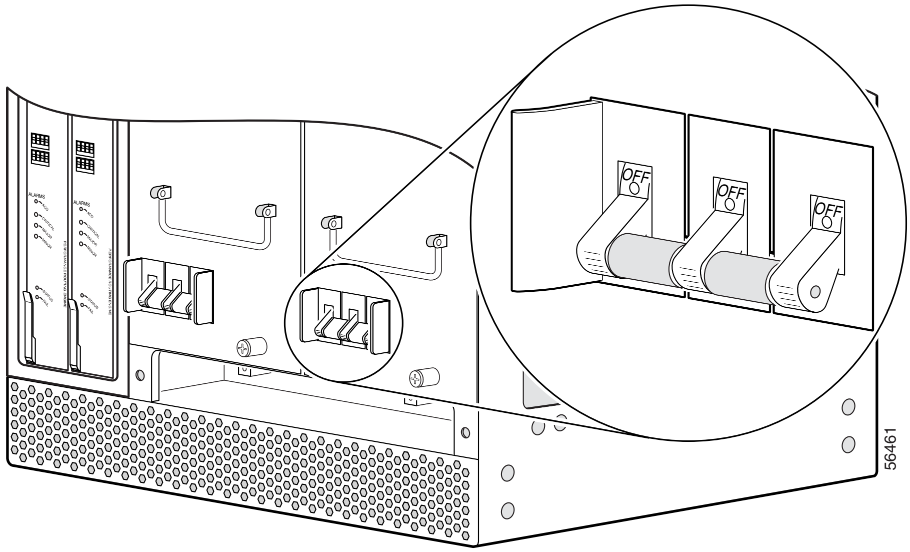
Caution This procedure requires shutting down the Cisco uBR10012 router and removing all power to the system. To avoid this, Cisco recommends replacing each DC PEM one at a time, using the instructions given in the "Removing and Replacing DC Power Entry Modules" section on page 5-8.

Step 1 Remove the front cover (refer to "Removing the Front Cover" section on page 5-3).

Step 2 Shut down the system (refer to "Shutting Down the System" section on page 5-2).

Step 3 Turn the power switch on each DC PEM to the OFF (0) position (see Figure 5-11).

Figure 5-11 Turning Off the DC PEM



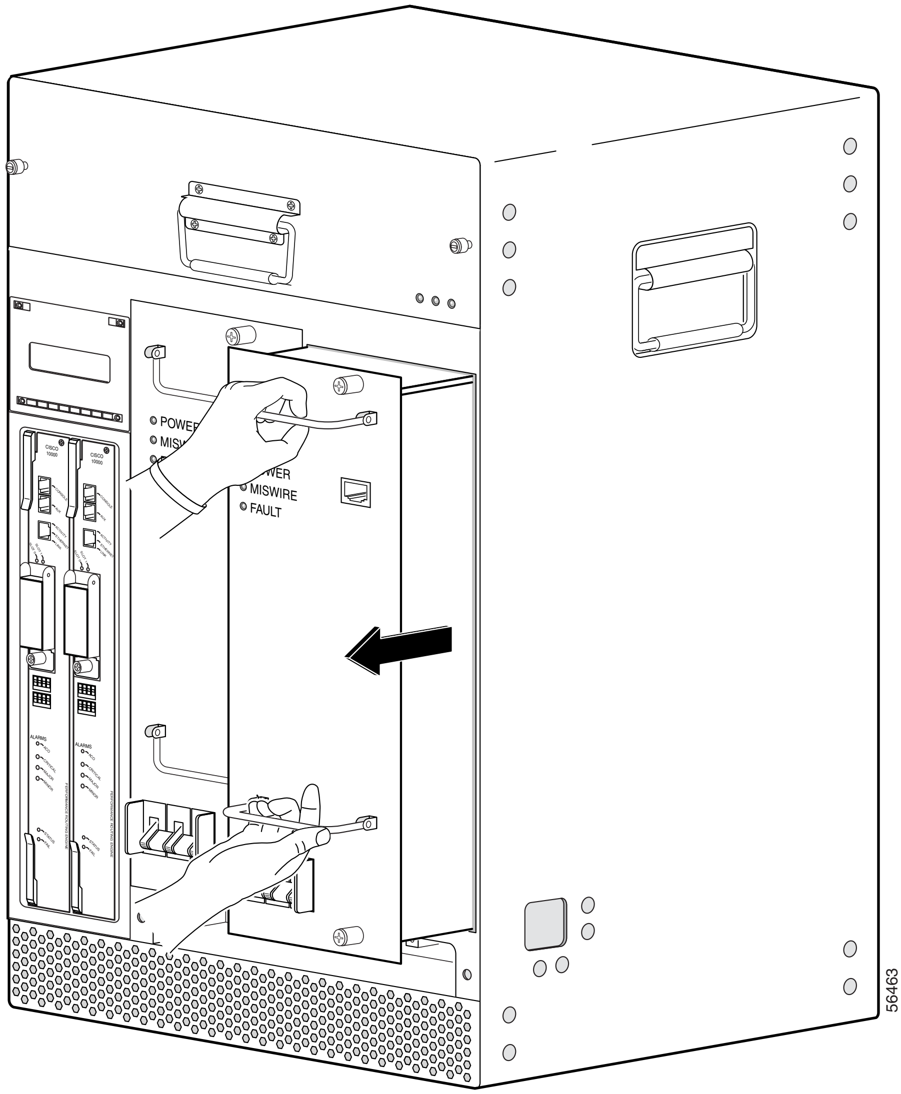
Step 4 Turn off the DC power source that is providing power for each DC PEM. All LEDs on the DC PEM should turn off.

Tip Separate DC power sources should be used for each DC PEM. This allows you to turn off the power source for one DC PEM without affecting the power source for the online DC PEM.

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 5 Loosen the captive screws on each DC PEM and pull each DC PEM from the chassis using the handle on the faceplate (see Figure 5-12). Set the two DC PEMs aside.

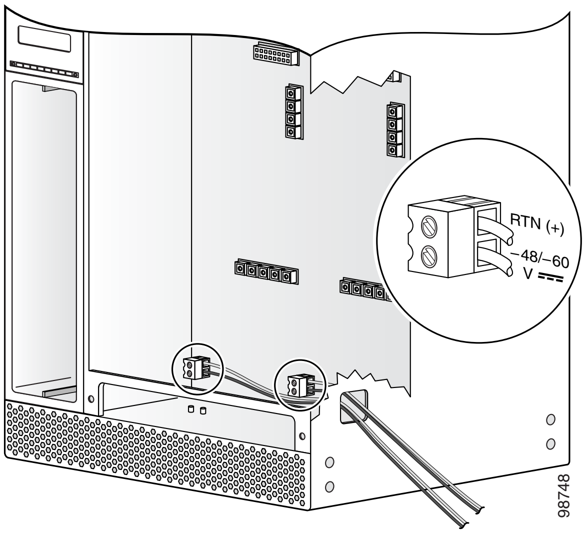
Figure 5-12 Removing a DC PEM



Step 6 If the MISWIRE LED indicated that the DC power source is miswired verify that the wires leading to the DC power source are connected as follows:

- The cable providing the –48/–60 VDC should be connected to the bottom terminal on the DC terminal block. This cable is typically red.
- The cable providing the return path (ground) should be connected to the top terminal on the DC terminal block. This cable is typically black.

Figure 5-13 DC Power Connection Location



Warning **Use copper conductors only.** Statement 1025

Step 7 Verify that the power switch on each replacement DC PEM is in the off position (see Figure 5-6).

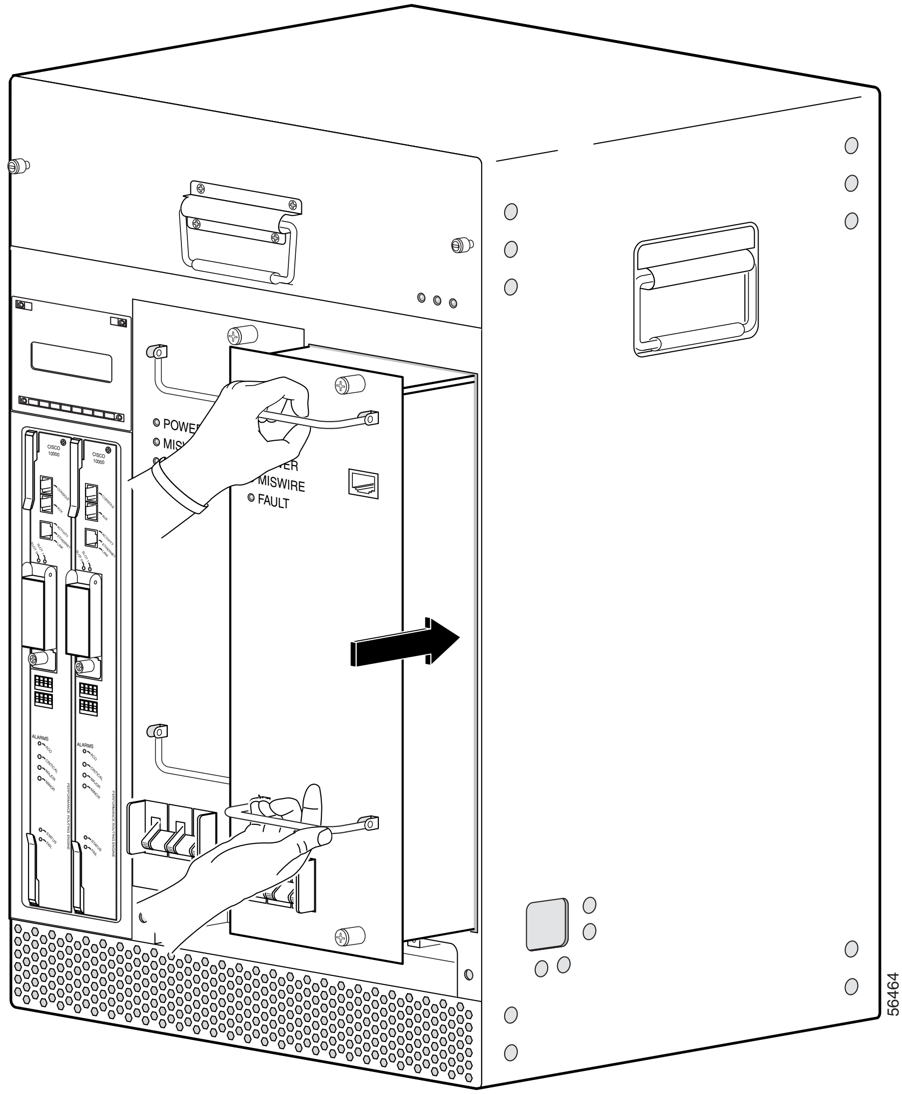
Step 8 Position the first replacement DC PEM in the power bay and push it forward, verifying that it goes all the way in and makes a secure connection with the backplane. Tighten the captive screws (see Figure 5-14).

Step 9 Position the second replacement DC PEM in the power bay and push it forward, verifying that it goes all the way in and makes a secure connection with the backplane (see Figure 5-14).

Step 10 Tighten the captive screws.

Caution Although one DC PEM can supply sufficient power for a fully configured chassis, the Cisco uBR10012 router must be run only with two DC PEMs installed because this provides redundant power support, allows for proper cooling, and prevents inadvertent contact with hazardous circuits.

Figure 5-14 Installing a DC PEM



Step 11 Turn on the DC power sources that are providing power for the DC PEMs. The FAULT LED on each replacement DC PEM lights (yellow) to indicate that the DC PEM is receiving power from the power source but is not yet supplying power to the Cisco uBR10012 chassis.

Step 12 Push up the power switch on each replacement DC PEM to the on (|) position (see Figure 5-10). When you turn on the power switch on each DC PEM, its FAULT LED turns off and the POWER LED lights (green).

Step 13 Replace the front cover (see the "Replacing the Front Cover" section on page 5-4).

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.

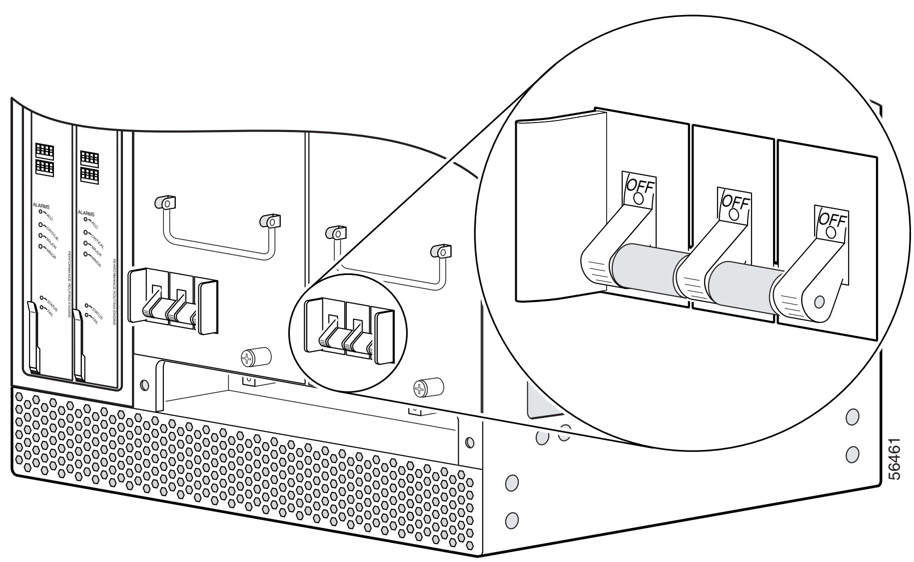
Removing the PEM from the Chassis

Step 1 Remove the front cover (see "Removing the Front Cover" section on page 5-3).

Step 2 Turn the power switch on the second DC PEM (the DC PEM on the right side, as you face the chassis) to the off (0) position (see Figure 5-15).

Caution Do not turn off the first DC PEM or turn off its DC power source. Otherwise, the system will immediately shut down.

Figure 5-15 Turning the Second DC PEM Off



Step 3 Turn off the DC power *source* that is providing power for the second DC PEM.

Note All LEDs on the DC PEM should turn off.

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 4 Loosen the captive screws on the DC PEM. Pull the DC PEM from the chassis using the handle on the faceplate (see Figure 5-12). Set the DC PEM aside.

Attaching the Alarm Wires

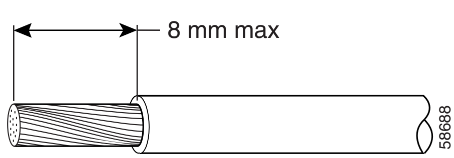
For each alarm indicator being connected (minor, major, or critical), use two wires that are long enough to reach between the Cisco uBR10012 chassis and the alarm indicator equipment. Use the gauge of wire required by the audible or visual alarm indicator equipment you are using (14 AWG maximum gauge).

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 5-16).

Figure 5-16 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.

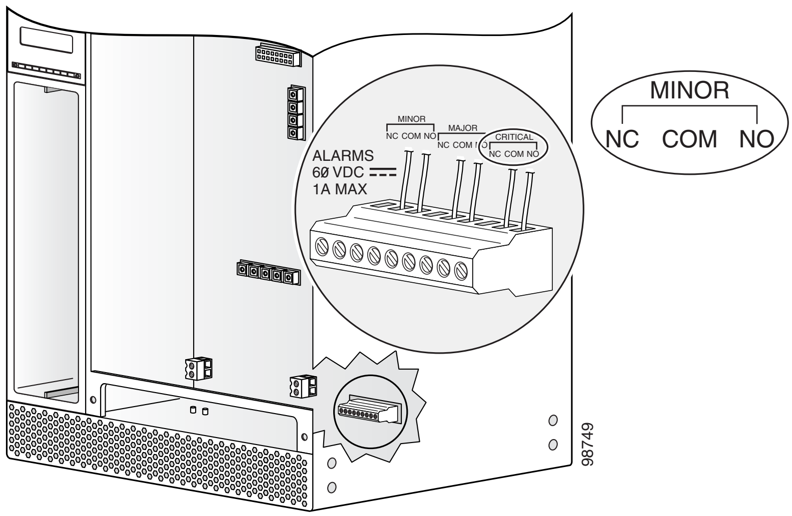
  Figure 5-17 shows the wiring configuration for normally open (NO) alarm relays.

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 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 5-17 Alarm Terminal Block Connections



Installing the PEM in the Chassis

Step 1 Position the DC PEM in the power bay and push it forward, verifying that it goes all the way in and makes a secure connection with the backplane (see Figure 5-14).

Step 2 Tighten the captive screws on the DC PEM to lock it into the chassis.

Step 3 Turn on the DC power source that are providing power for DC PEM.

Tip The FAULT LED on each replacement DC PEM lights (yellow) to indicate that the DC PEM is receiving power from the power source but that it is not yet supplying power to the Cisco uBR10012 chassis.

Step 4 Push up the power switch on each DC PEM to the on (|) position (see Figure 5-10).

Step 5 When you turn on the power switch on each DC PEM, its FAULT LED turns off and the POWER LED lights (green).

Step 6 Replace the front cover (see the "Replacing the Front Cover" section on page 5-4).

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.

Note The product order number for a replacement AC PEM is UBR10-PWR-AC=.

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 should be using Cisco IOS Release 12.2(4)XF1, Cisco IOS Release 12.2(4)BC1a, or a later release when using the AC PEM. If using an earlier release, the **show environment** command will not correctly identify the AC PEM's error messages.

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.

Replacing a Redundant AC PEM

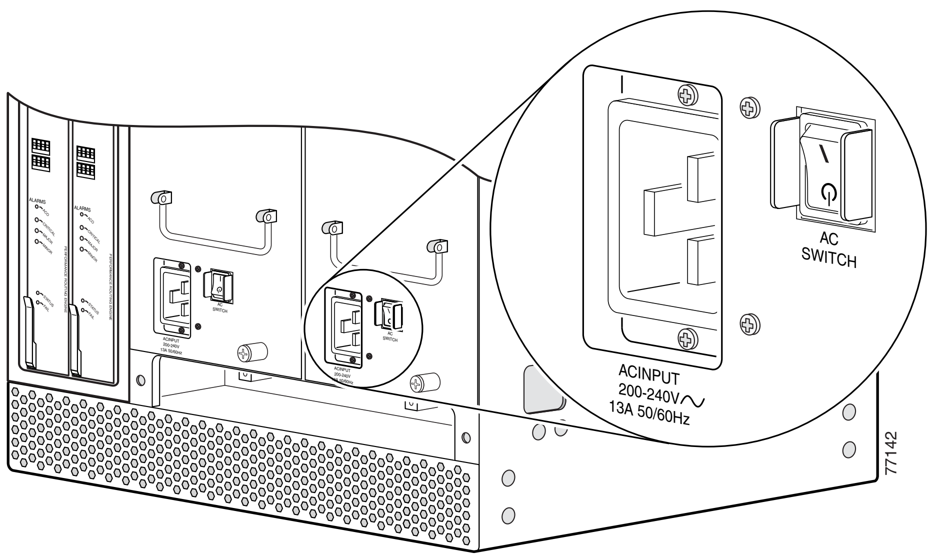
Follow this procedure to replace a redundant AC PEM, which is typically needed when the FAULT LED is on and the troubleshooting steps in the “Troubleshooting the Power Subsystem” section on page 4-7 do not correct the problem.

Tip If you want to replace both AC PEMs without shutting down the router, repeat this procedure for each AC PEM, one at a time. Do not use this procedure if both AC PEMs have failed; instead, use the procedure in the “Replacing Both DC PEMs” section on page 5-13.

Step 1 Remove the front cover by lifting it up slightly and then pulling it toward you.

Step 2 Turn off the AC PEM you are replacing by pushing down the power switch to the standby position (see Figure 5-18).

Figure 5-18 Turning an AC PEM Off



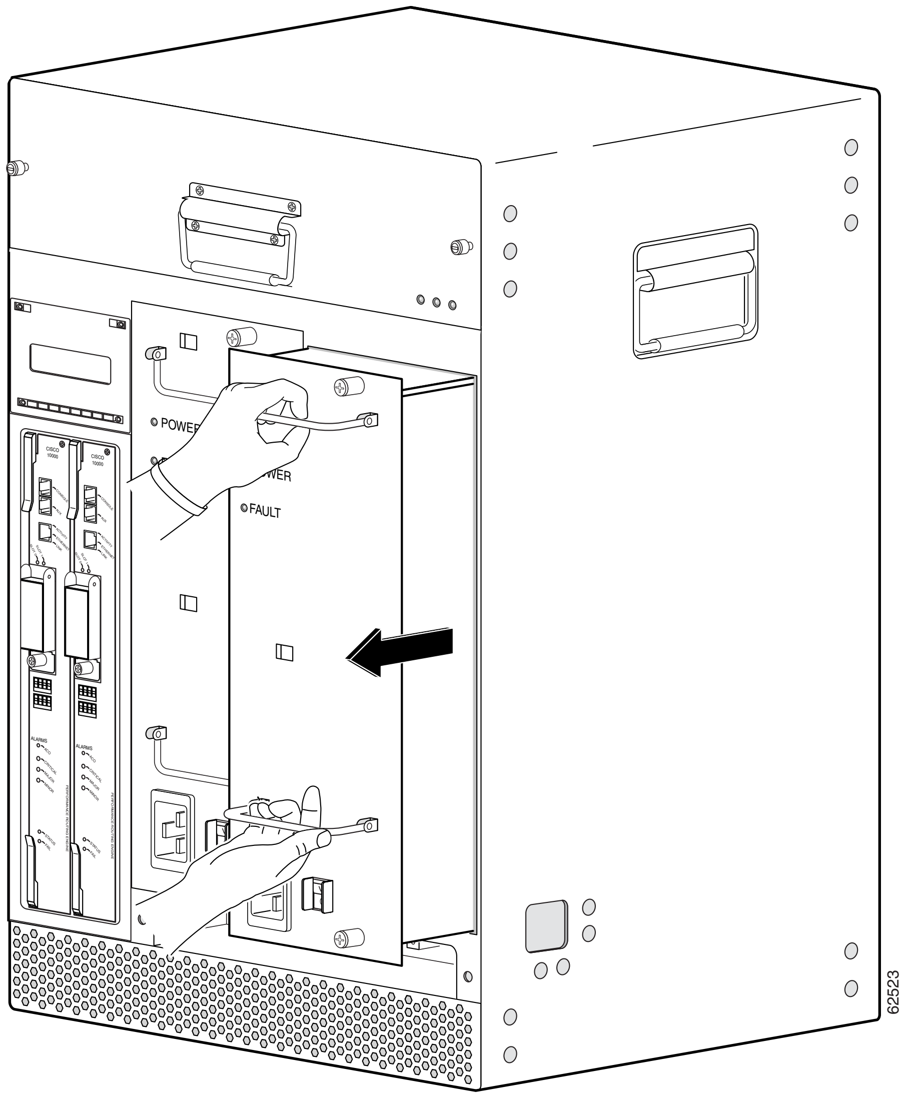
Caution Do not power off both AC PEMs, or the system shuts down and all data traffic stops. Power off only the AC PEM you are replacing.

Step 3 Unplug the AC-input power cable from the power plug on the front panel of the AC PEM. For safety, also unplug the other end of the power cable from the AC-input power source.

Tip For true redundant power protection, ensure that you are using a separate AC-input power source for each AC PEM.

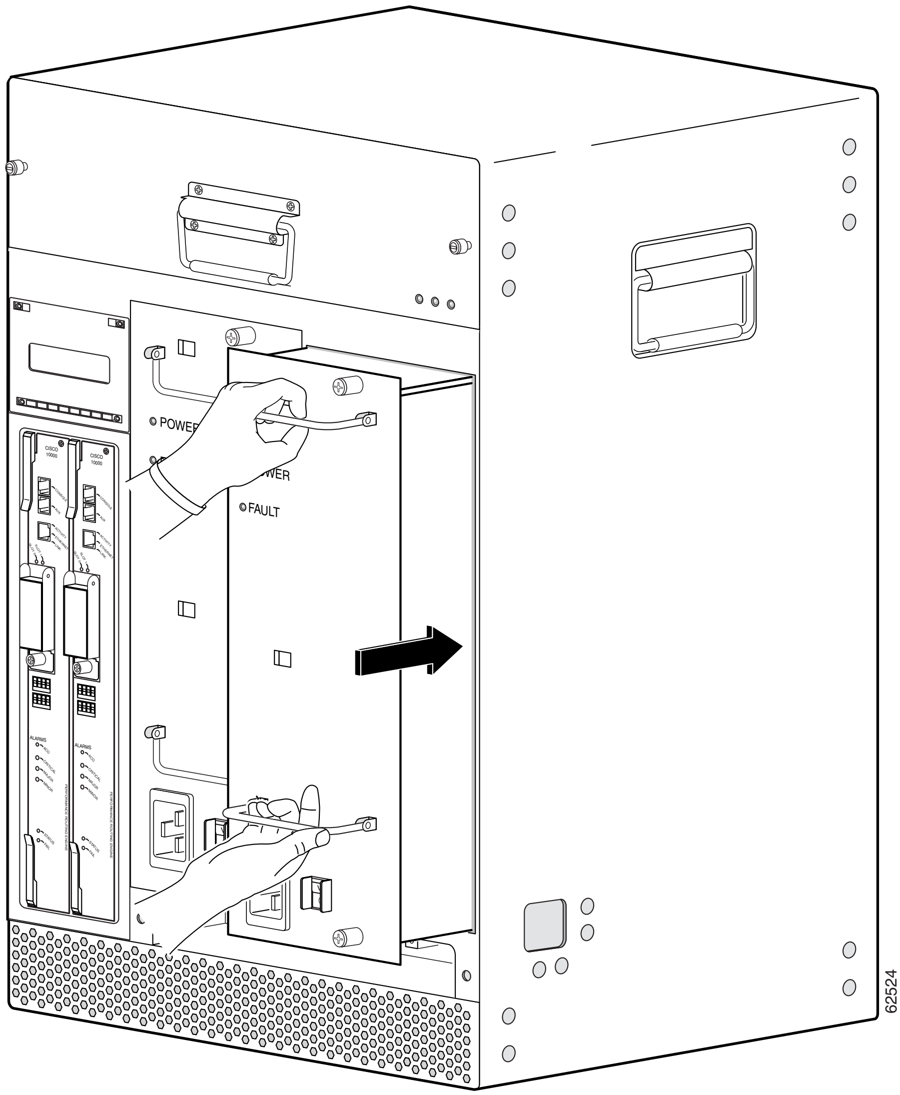
Step 4 Use the screwdriver to loosen the captive screws on the AC PEM you are removing. Then pull the PEM from the chassis by using the handle on the faceplate (see Figure 5-19). Set the AC PEM aside.

Figure 5-19 Removing the AC PEM



Step 5 Verify that the power switch on the replacement AC PEM is in the standby position (see Figure 5-18).

Figure 5-20 Installing the AC PEM



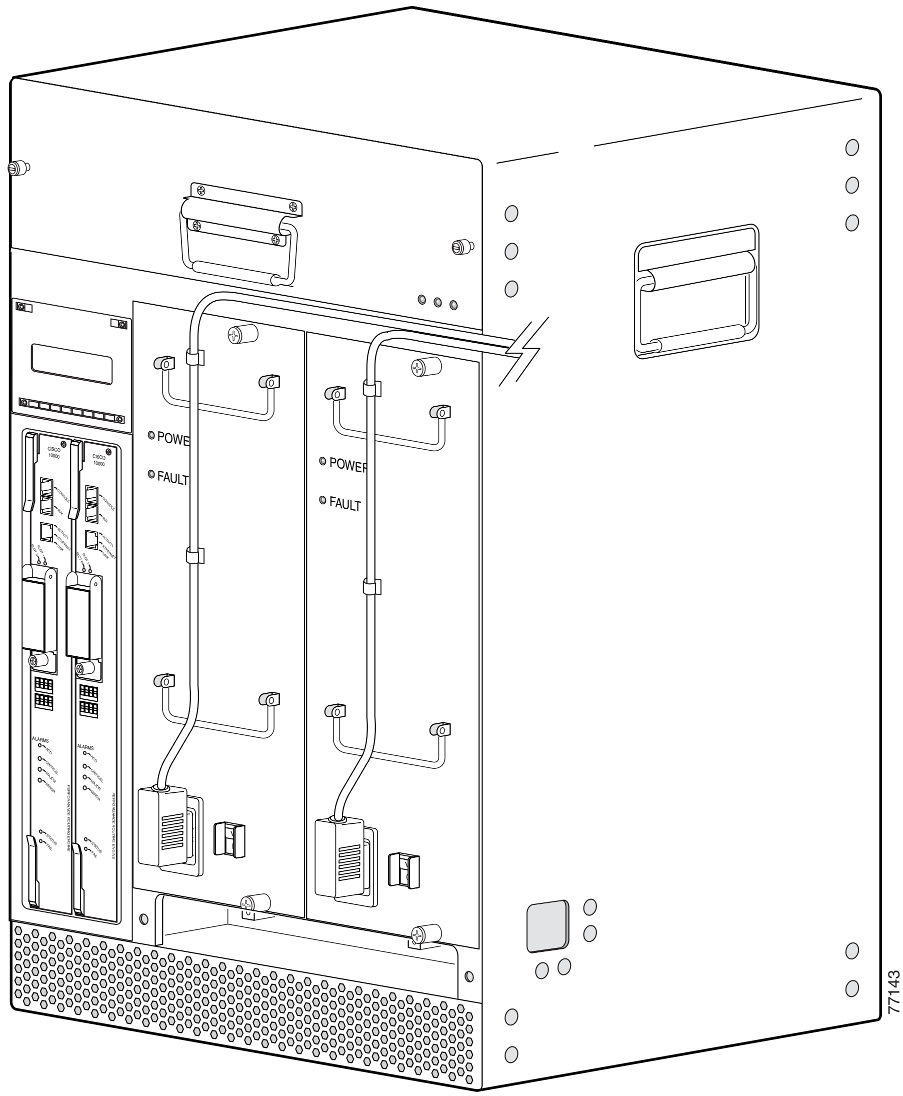
Step 6 Position the replacement AC PEM in the power bay and push it forward, verifying that it goes all the way in and makes a secure connection with the backplane.

Step 7 Use the screwdriver to tighten the captive screws to secure the unit to the chassis.

Step 8 Plug the AC-input power cable into the power receptacle on the front panel of the AC PEM.

Step 9 Route the power cable up the front of the AC PEM and clip it into the two plastic retaining clips attached to the surface of the PEM. Route the power cable out through the right side, so that it will fit through the notch on the right side of the front bezel cover. (see Figure 5-21).

Figure 5-21 Routing the AC Power Cables

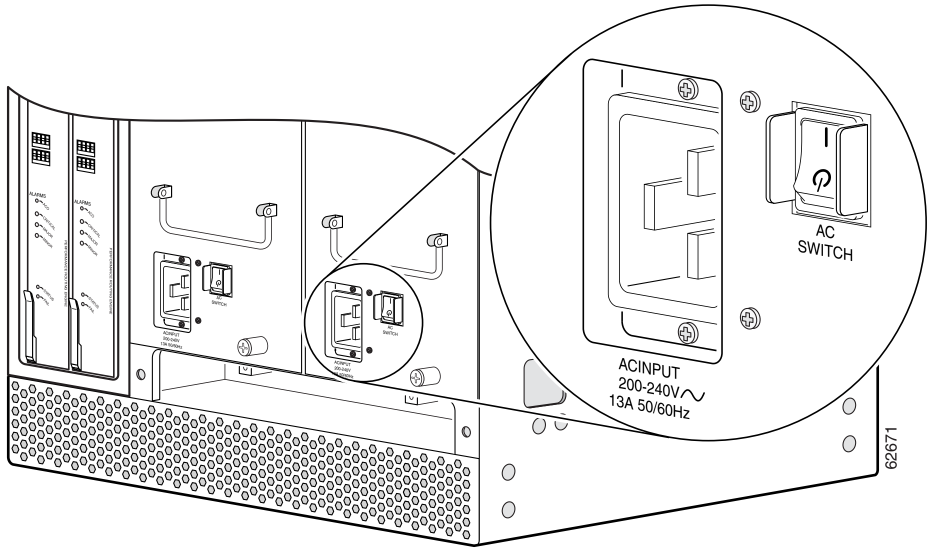


Step 10 Plug the other end of the AC-input power cable into a 200–240 VAC power outlet. For fully redundant operation, each AC PEM should use separate power sources, or you should be using an uninterruptible power supply (UPS).

The FAULT LED on the AC PEM is yellow to indicate that the AC PEM is receiving power from the power source but is not yet supplying power to the Cisco uBR10012 chassis.

Step 11 Push up the power switch on the replacement AC PEM to the on (|) position (see Figure 5-22).

Figure 5-22 Setting AC Power Switch to the ON Position



Step 12 When you turn on the power switch on the AC PEM, the FAULT LED goes off and the POWER LED goes on (green).

Step 13 Slide the front bezel 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. Route the AC power cables through the notch on the right side of the cover.

Replacing Both AC PEMs

Use the following procedure to replace or reinstall both AC PEMs. This procedure is typically needed only when you need to move the chassis or reinstall it in another location.

Tip This procedure is rarely needed for normal operations because it requires that you shut down the Cisco uBR10012 router and remove all power to the system. To avoid this, Cisco recommends replacing each AC PEM, one at a time, by following the instructions in the "Replacing a Redundant AC PEM" section on page 5-22.

Step 1 Remove the front cover.

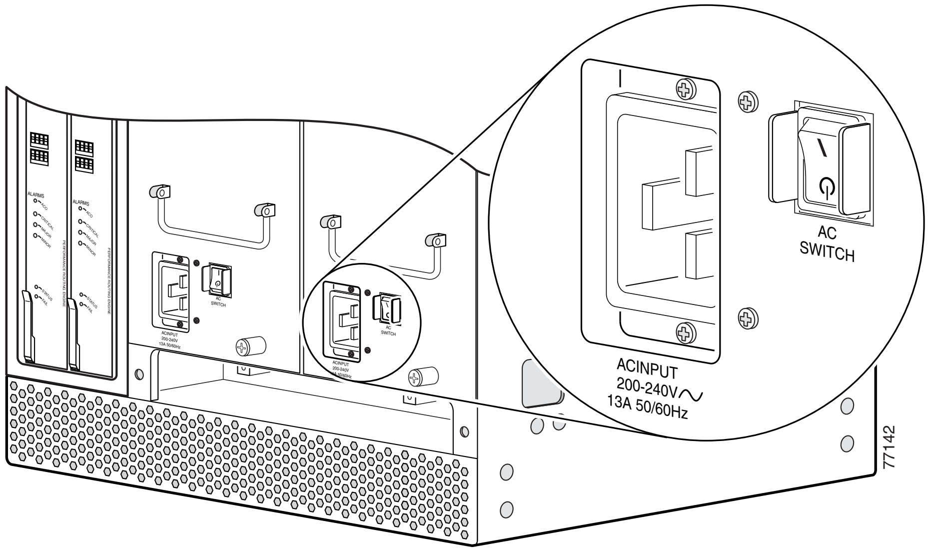
Step 2 Shut down the system using the following procedure:

a. Notify appropriate personnel that you plan to shut down the system and that the shutdown will result in total loss of service. *Appropriate personnel* includes the regional alarm or network monitoring center, central office personnel, and key customers.

b. Before you shut down the router, use the **copy** command to save any configuration changes to NVRAM and, if you wish, to a PC media card. See the *Cisco uBR10012 Universal Broadband Router Software Configuration Guide* for instructions about using the **copy** command.

c. Turn the power switch on each AC PEM to the standby position (see Figure 5-23).

Figure 5-23 Turning the AC PEM Off



Step 3 Unplug the AC-input power cable from the power plug on the front panel of each AC PEM. For safety, also unplug the other end of the power cable from each AC-input power source.

Tip For true redundant power protection, ensure that you are using a separate AC-input power source for each AC PEM.

Step 4 Use the screwdriver to loosen the captive screws on each AC PEM. Then pull each AC PEM from the chassis by using the handle on the faceplate (see Figure 5-19). Set the two AC PEMs aside.

Step 5 Verify that the power switch on each replacement AC PEM is in the standby position (see Figure 5-23).

Step 6 Position the first replacement AC PEM in the power bay and push it forward. Verify that it goes all the way in and makes a secure connection with the backplane.

Step 7 Use the screwdriver to tighten the captive screws to secure the unit to the chassis.

Step 8 Position the second replacement AC PEM in the power bay and push it forward. Verify that it goes all the way in and makes a secure connection with the backplane.

Step 9 Tighten the captive screws to secure the unit to the chassis (see Figure 5-20).

Caution Although one AC PEM can supply sufficient power for a fully configured chassis, run the Cisco uBR10012 router with two AC PEMs installed, because this provides redundant power support.

Step 10 Plug the AC-input power cable into the power receptacle on the front panel of each AC PEM.

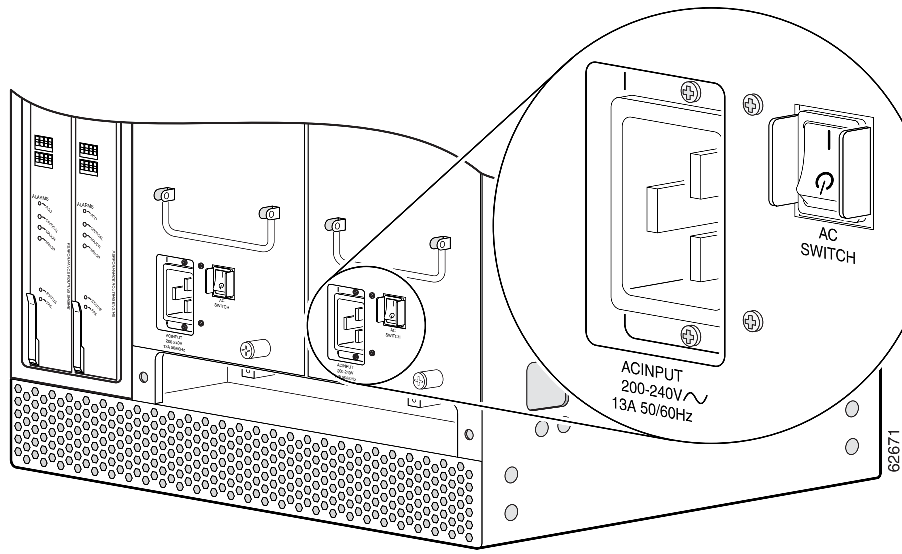
Step 11 Route the power cable up the front of the AC PEM and clip it into the two plastic retaining clips attached to the surface of the PEM. Route the power cable out through the right side, so that it fits through the notch on the right side of the front bezel cover, see Figure 5-21.

Step 12 Plug the other end of the AC-input power cable into a 200–240 VAC power outlet. For fully redundant operation, each AC PEM should use separate power sources, or you should be using an uninterruptible power supply (UPS).

The FAULT LED on each replacement AC PEM is yellow to indicate that the AC PEM is receiving power from the power source but is not yet supplying power to the Cisco uBR10012 chassis.

Step 13 Push up the power switch on the replacement AC PEM to the on (|) position (see Figure 5-24).

Figure 5-24 Setting AC Power Switch to the ON Position



Step 14 When you turn on the power switch on each AC PEM, its FAULT LED goes off and the POWER LED comes on (green).

Step 15 Slide the front bezel 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. Route the AC power cables through the notch on the right side of the cover.

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.

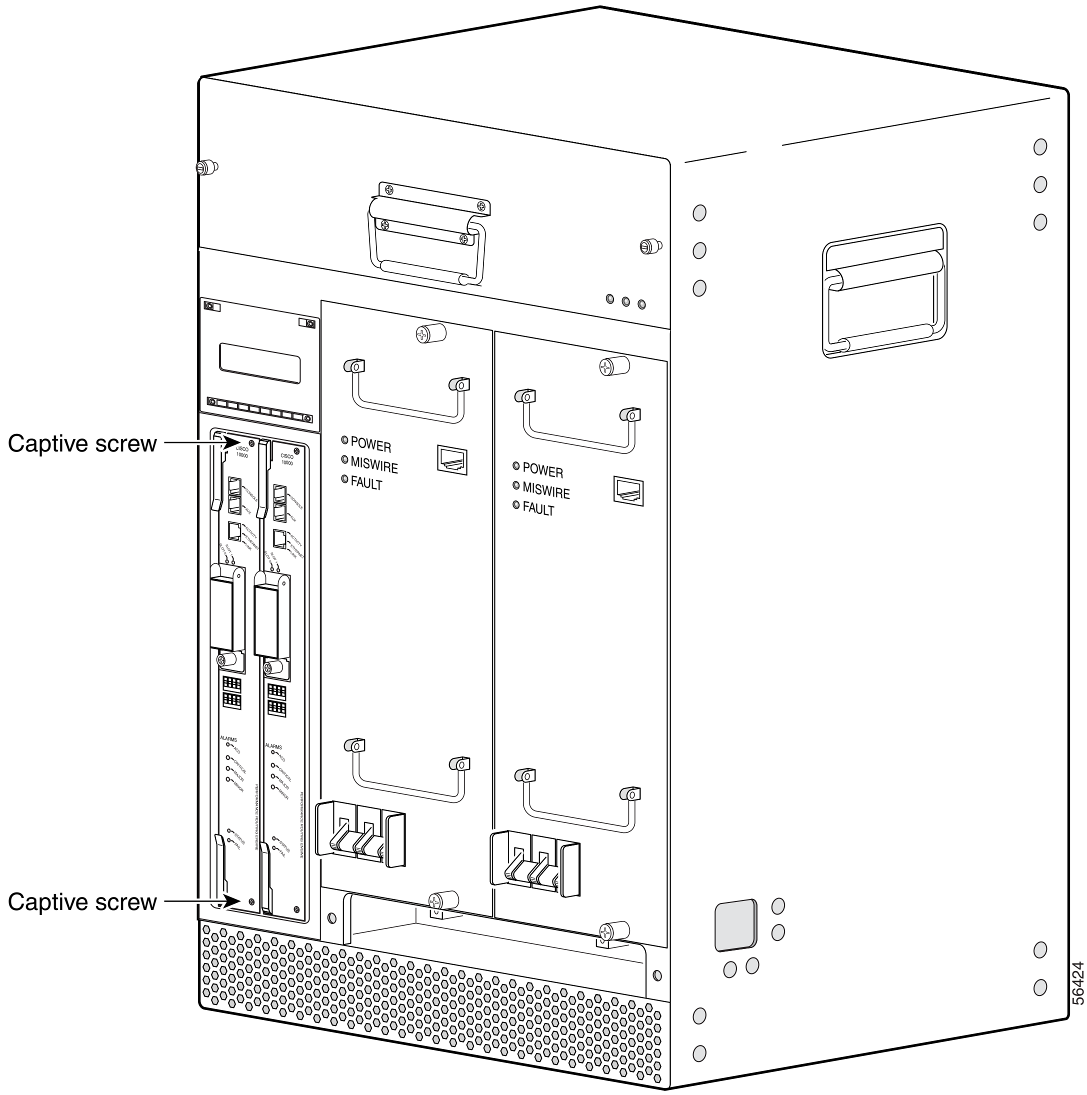
Step 2 If necessary, remove the blank cover from the PRE module slot and discard.

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 5-34).

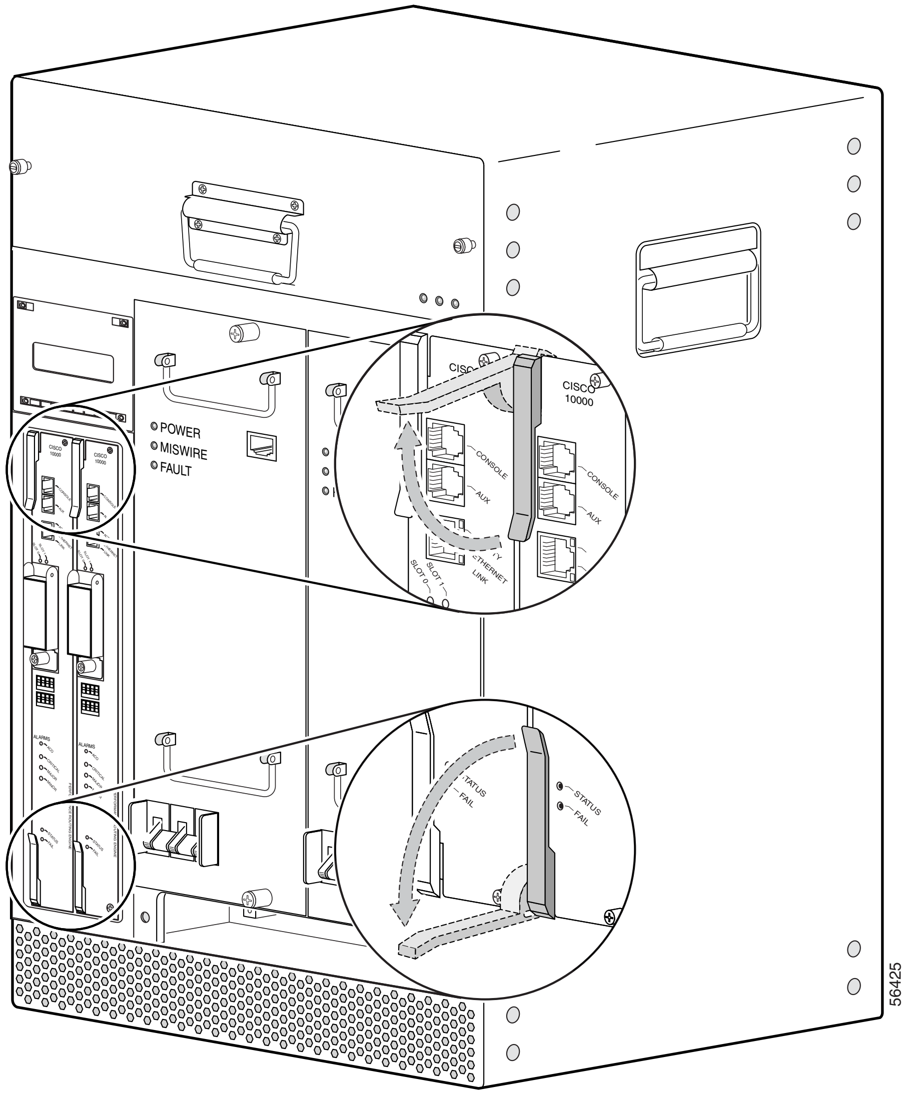
Step 5 Unscrew the top and bottom captive screws on the PRE module (see Figure 5-25).

Figure 5-25 Loosening the Captive Screws



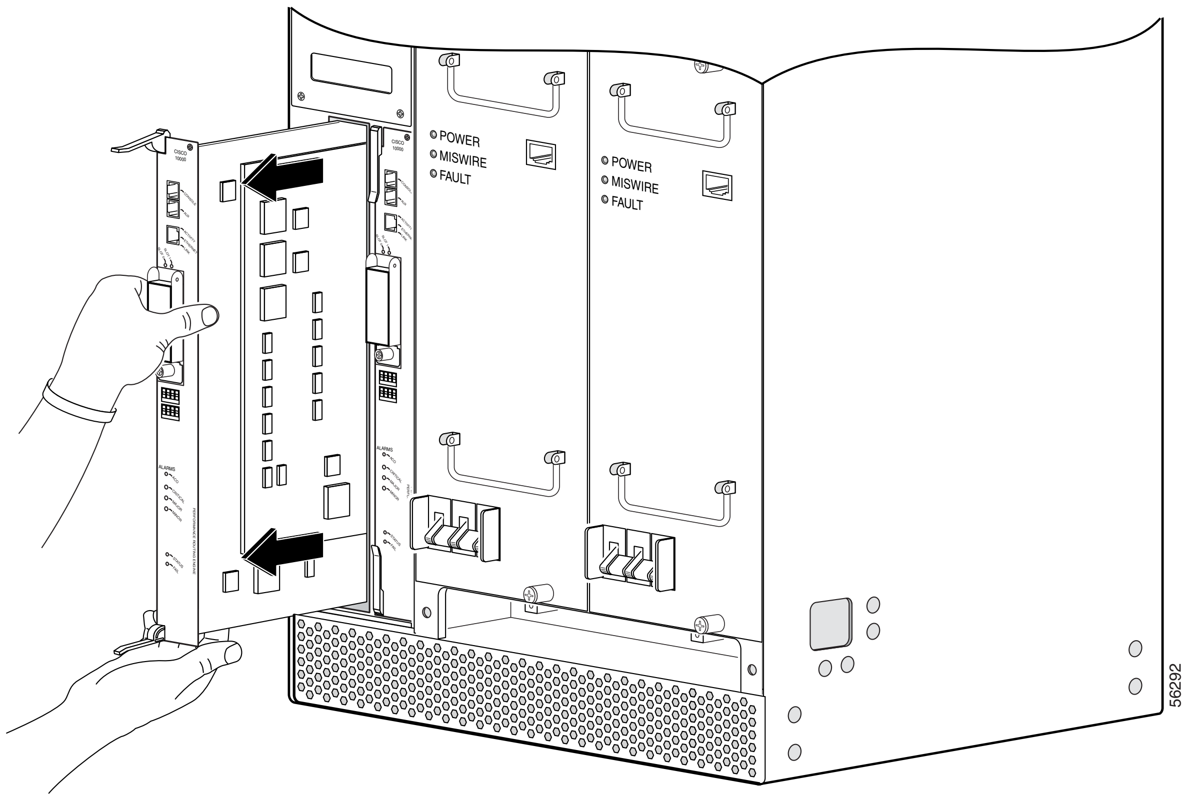
Step 6 Simultaneously pivot both ejector levers away from each other to disengage the PRE module from the backplane (see Figure 5-26).

Figure 5-26 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 5-27).

Figure 5-27 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

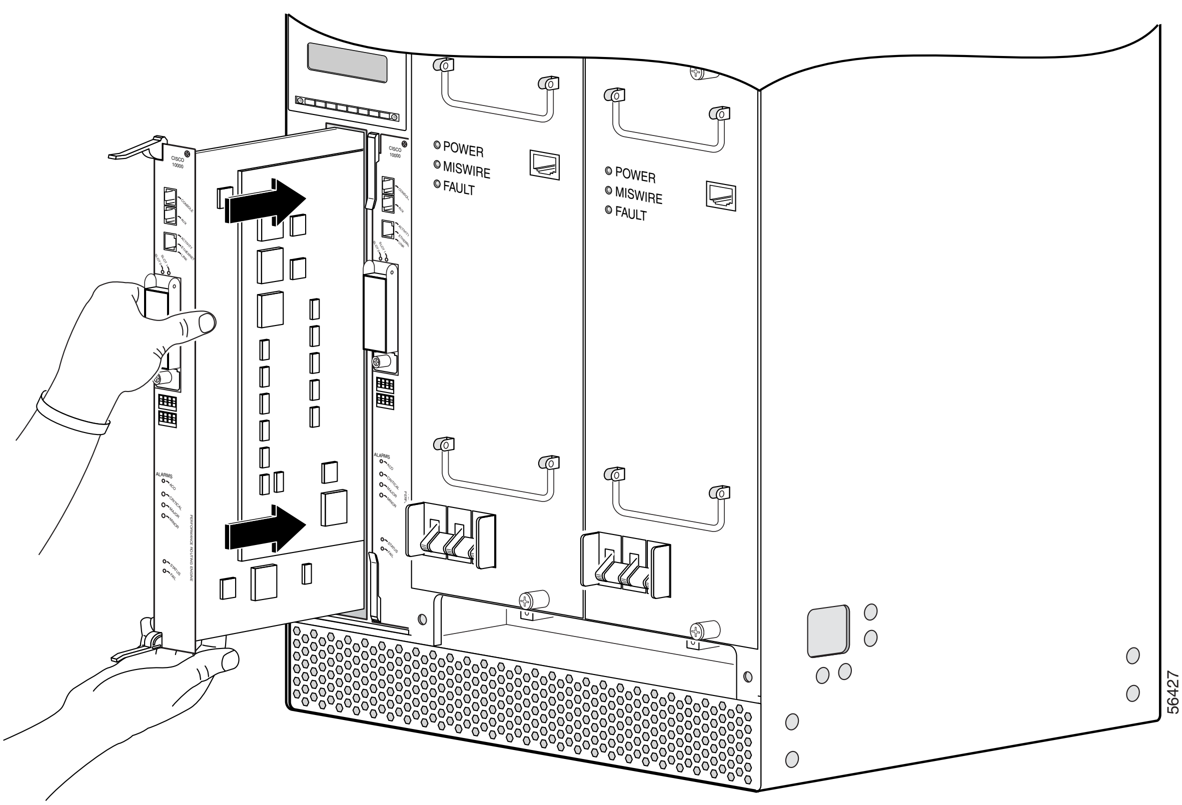
When replacing a PRE1 module with a PRE2 module, you must also install EMI gaskets and RF absorber material, for more information, go to the following URL:

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

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 5-28).

Figure 5-28 Inserting the PRE Module in the Chassis

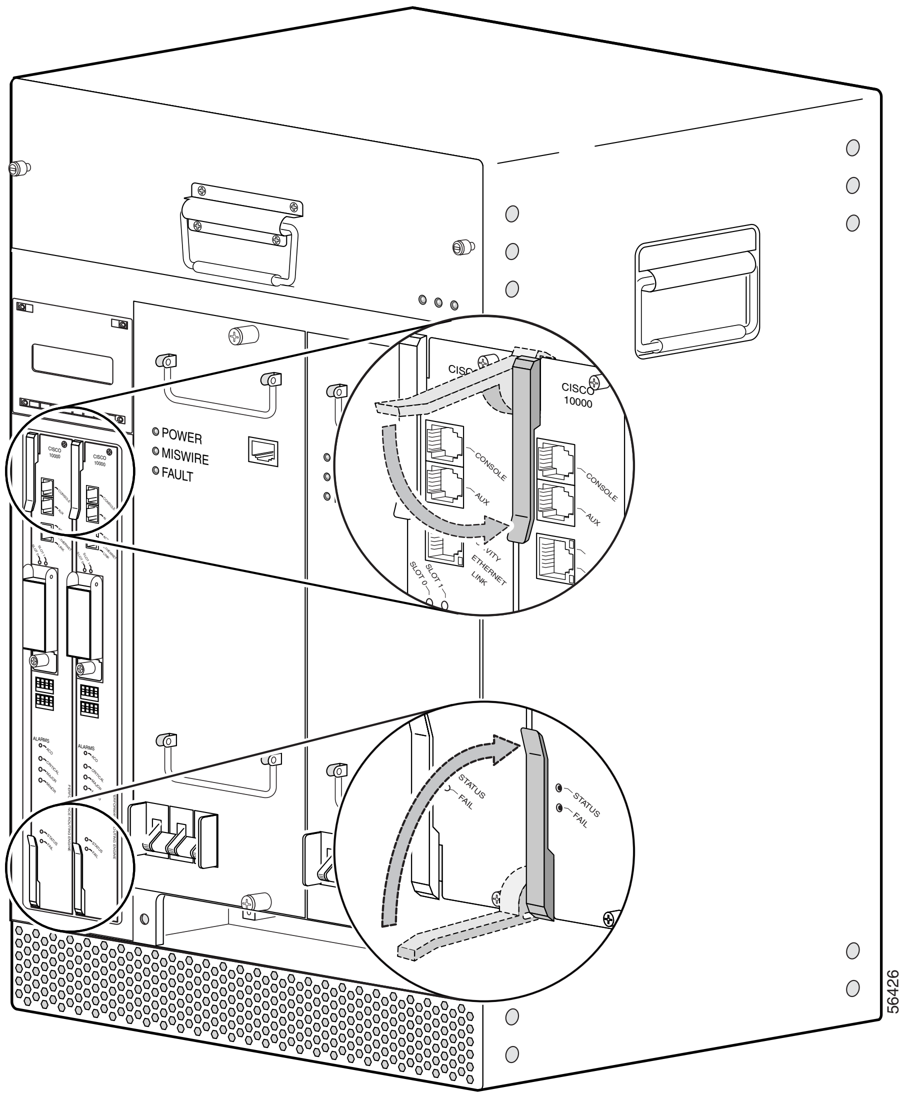


Step 3 Simultaneously pivot both ejector levers toward each other (until they are parallel to the faceplate) to firmly seat the PRE module in the backplane (see Figure 5-29).

Step 4 Secure the PRE module in the chassis by tightening the top and bottom captive screws (see Figure 5-25).

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 5-29 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 4-2.

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).

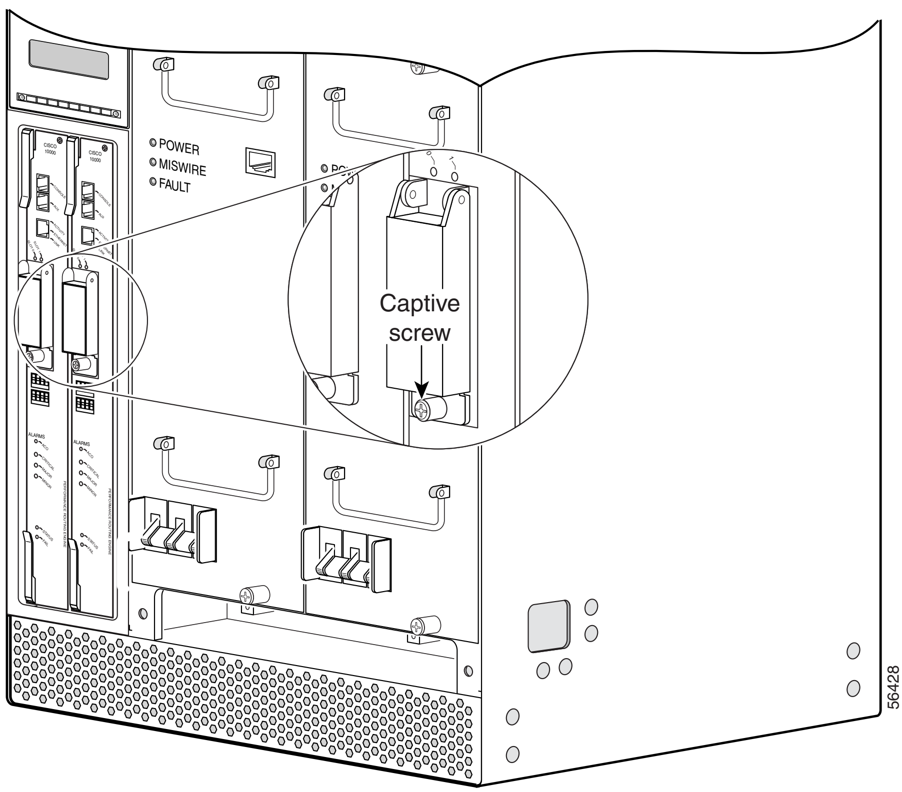
Removing and Installing a PC Media Card

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 3-66.

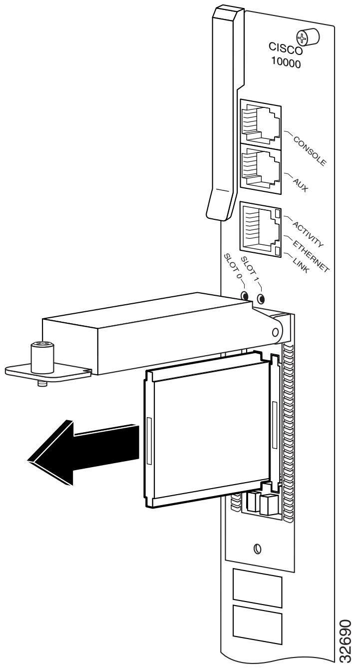
Step 1 Loosen the captive screw on the PC media card cover on the PRE (see Figure 5-30).

Figure 5-30 PC Media Card Cover Captive Screws



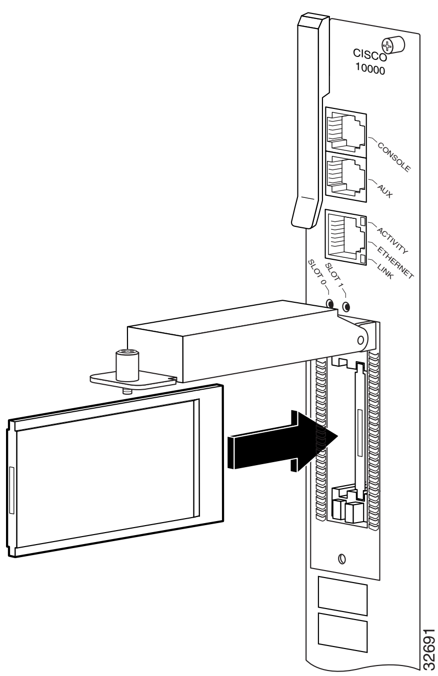
Step 2 Lift the cover, push the proper eject button, and pull the Flash card out of its slot (see Figure 5-31).

Figure 5-31 Removing the PC Media Card



Step 3 Insert the new PC media card into one of the card slots on the PRE (see Figure 5-32).

Figure 5-32 Inserting the PC Media Card



Step 4 Close the cover and tighten the captive screw to maintain proper EMI emissions levels (see Figure 5-30).

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+=

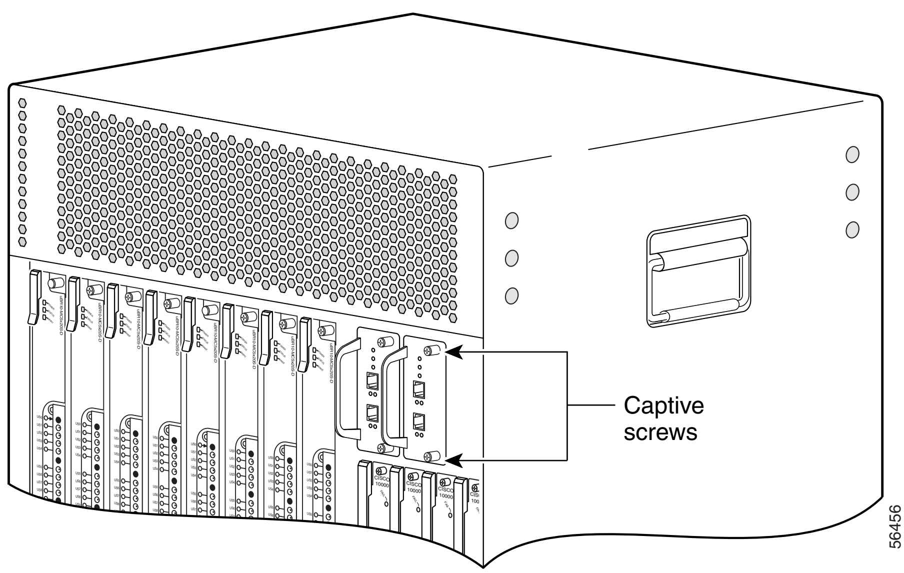
Step 1 Attach an antistatic wrist strap to your wrist and to a bare metal, unpainted surface on the chassis or frame.

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 5-33).

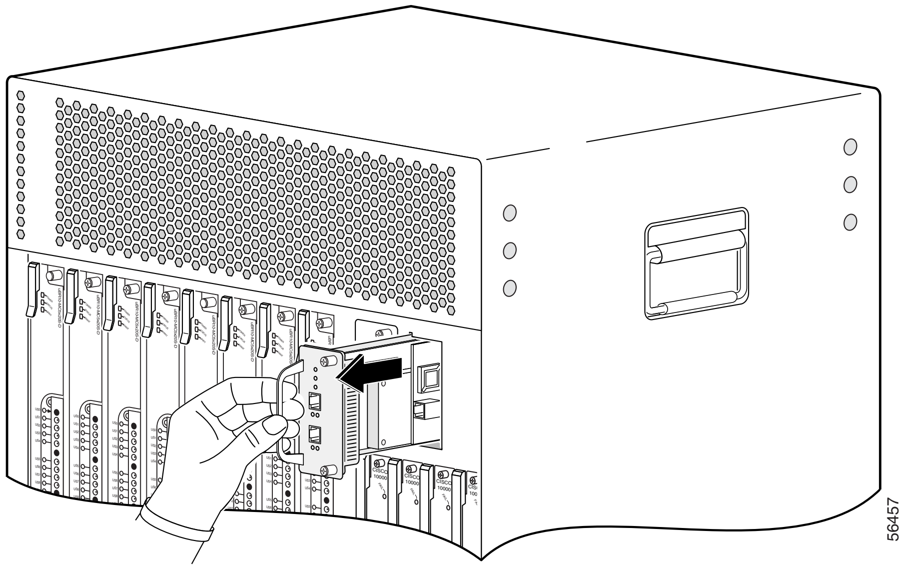
Figure 5-33 TCC+ Card Captive Screws



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 5-34).

Figure 5-34 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.

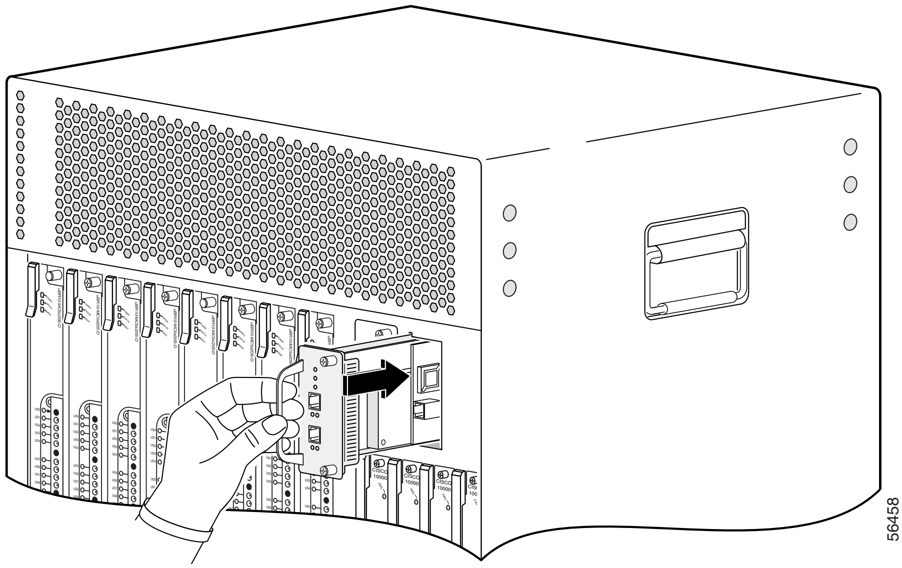
Note For proper cooling and airflow, a cover must always be installed in a blank TCC+ card slot. The product order number for the blank TCC+ card cover is UBR10-TCC+-COVER=.

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 5-35).

Figure 5-35 Inserting the TCC+ Card



Step 10 Secure the line card in the chassis by tightening the top and bottom captive screws (see Figure 5-33).

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 4-2.

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 3-66, or the *Cisco uBR10012 Router Software Configuration Guide*).

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

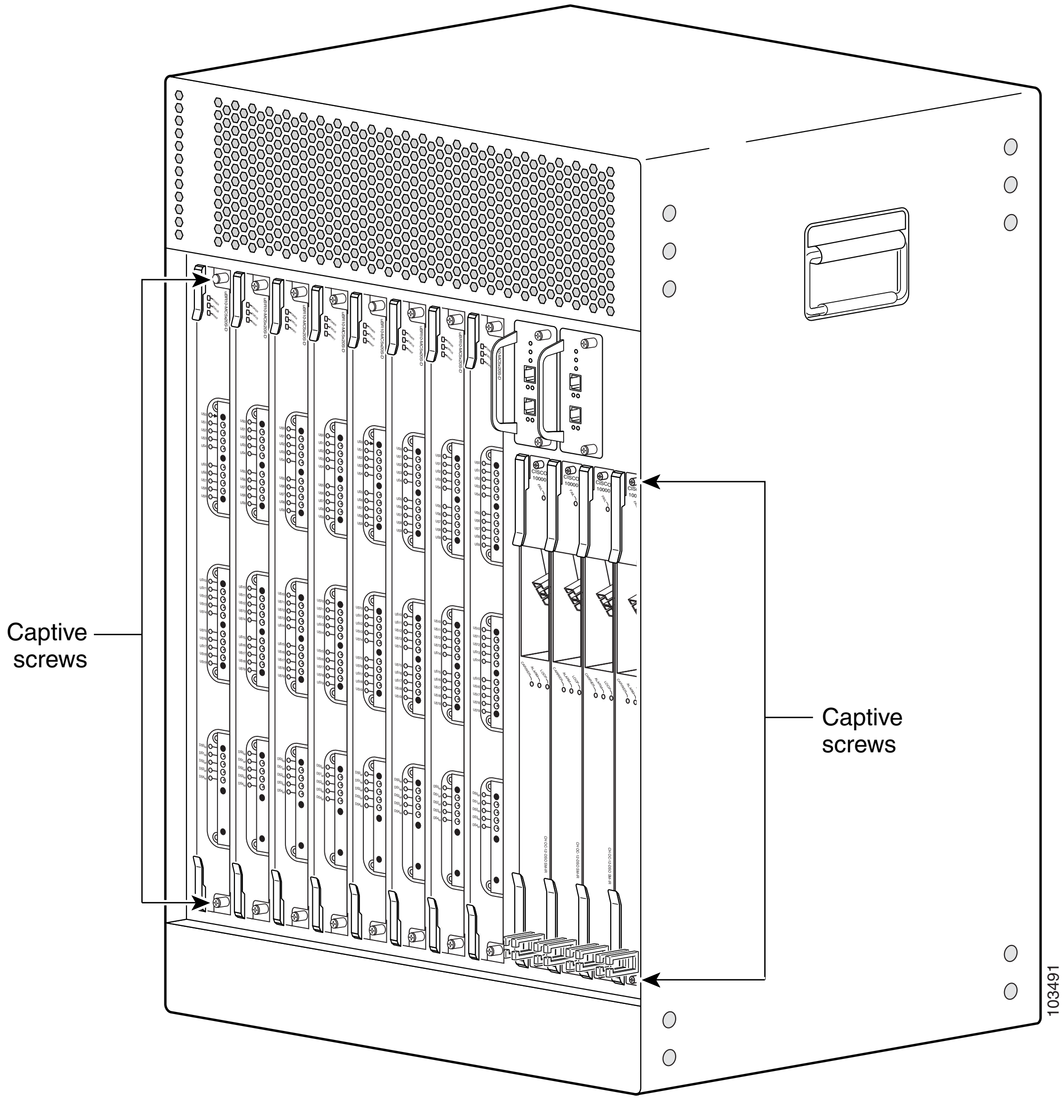
Warning Statement for Finland

Warning **Alleviates 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 5-36 Loosening the Captive Screws

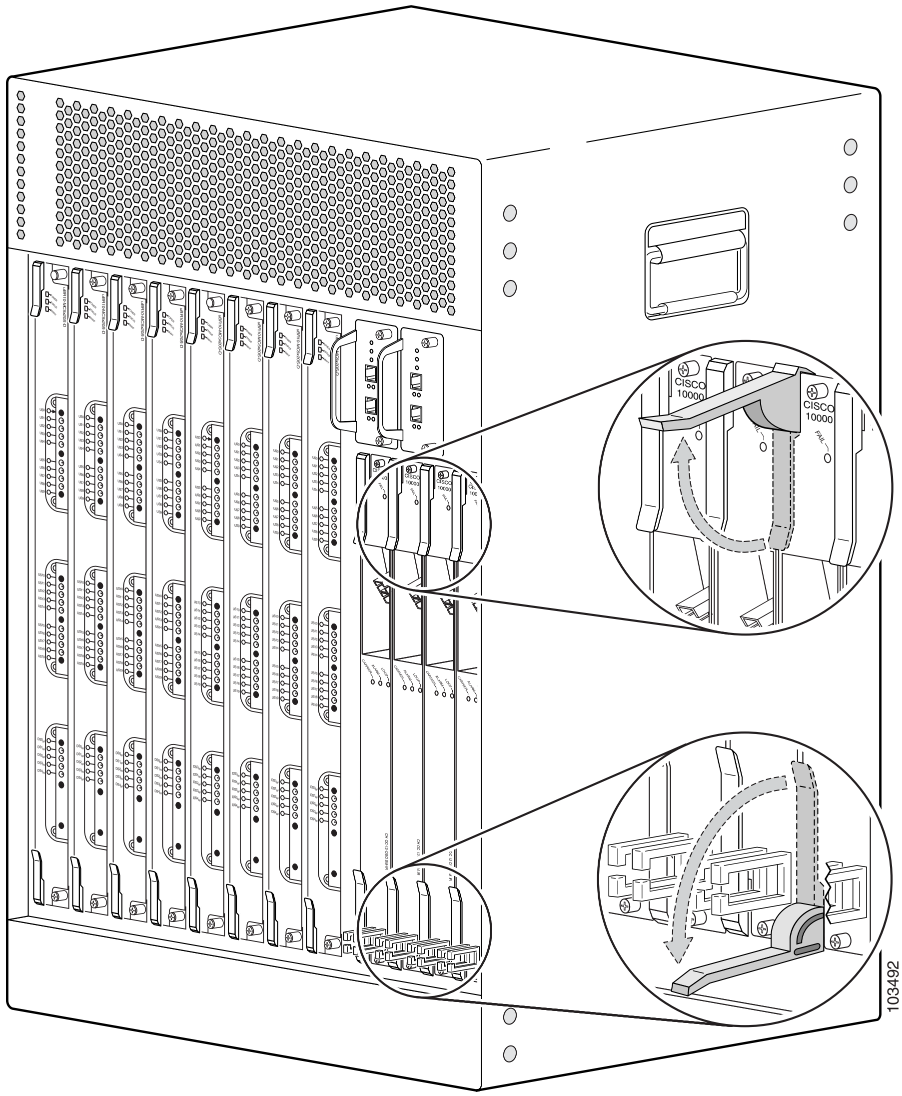


Step 3 If installing a new line card in a blank slot, remove the blank slot cover and discard. Otherwise, disconnect the cables from the network line card.

Step 4 Unscrew the top and bottom captive screws on the card (see Figure 5-36).

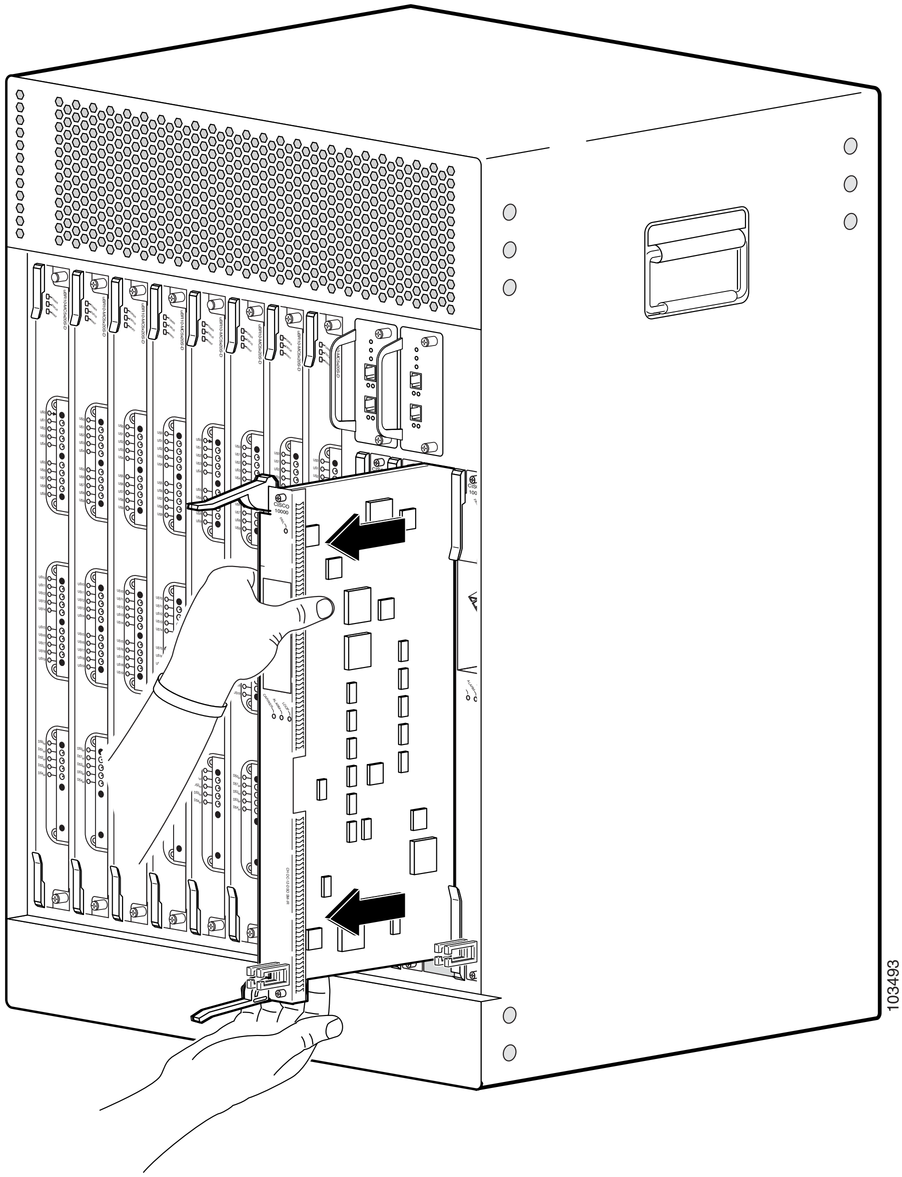
Step 5 Simultaneously pivot both ejector levers away from each other to disengage the line card from the backplane (see Figure 5-37).

Figure 5-37 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 5-38).

Figure 5-38 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

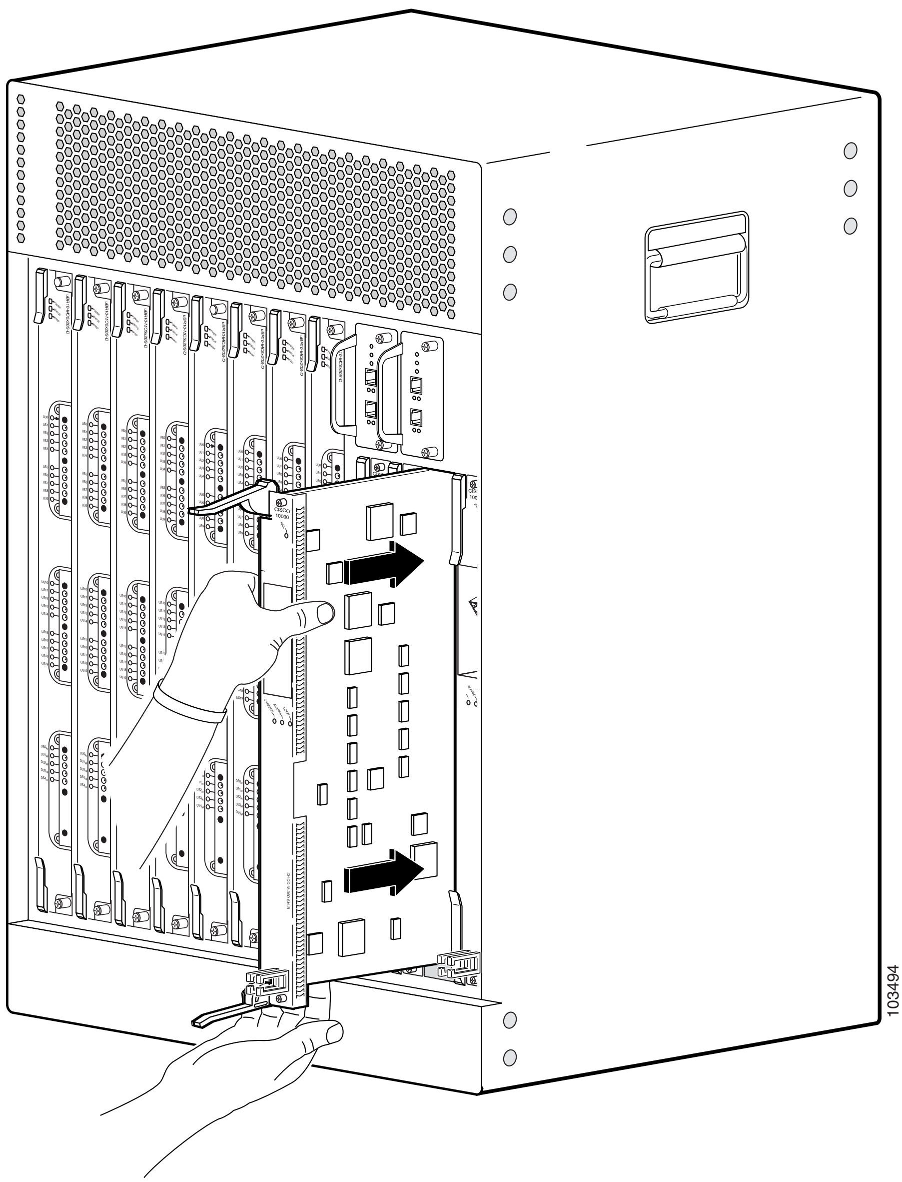
Installing the Network Line Card

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.

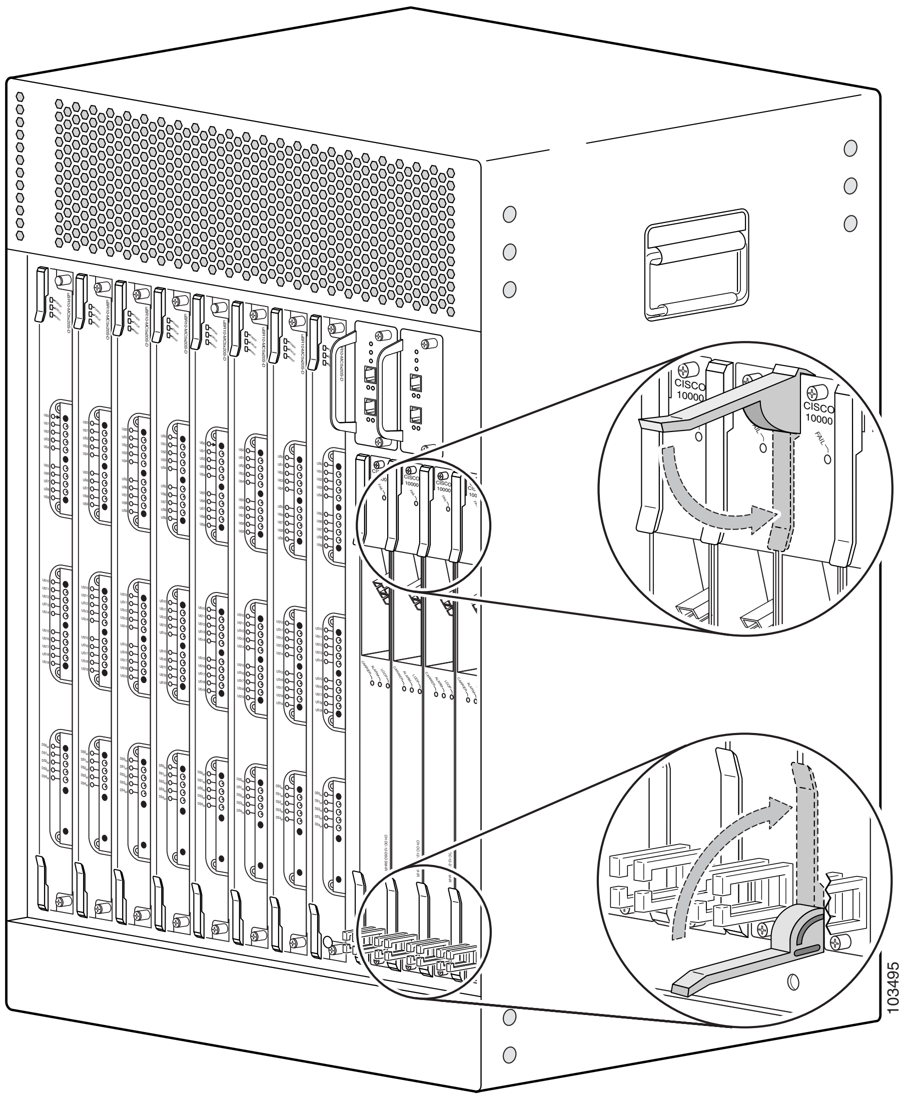
Step 2 Carefully align the upper and lower edges of the line card with the upper and lower guides in the chassis, and slide the line card into the slot until you can feel it begin to seat in the backplane connectors (see Figure 5-39).

Figure 5-39 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 5-40).

Figure 5-40 Closing the Ejector Levers



Step 4 Secure the network line card in the chassis by tightening the top and bottom captive screws (see Figure 5-36).

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.

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 4-12.

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 3-66, or refer to the *Cisco uBR10012 Router Software Configuration Guide*, for information about configuring the card).

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.

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 5-45
- Removing the Slot Splitter, page 5-48

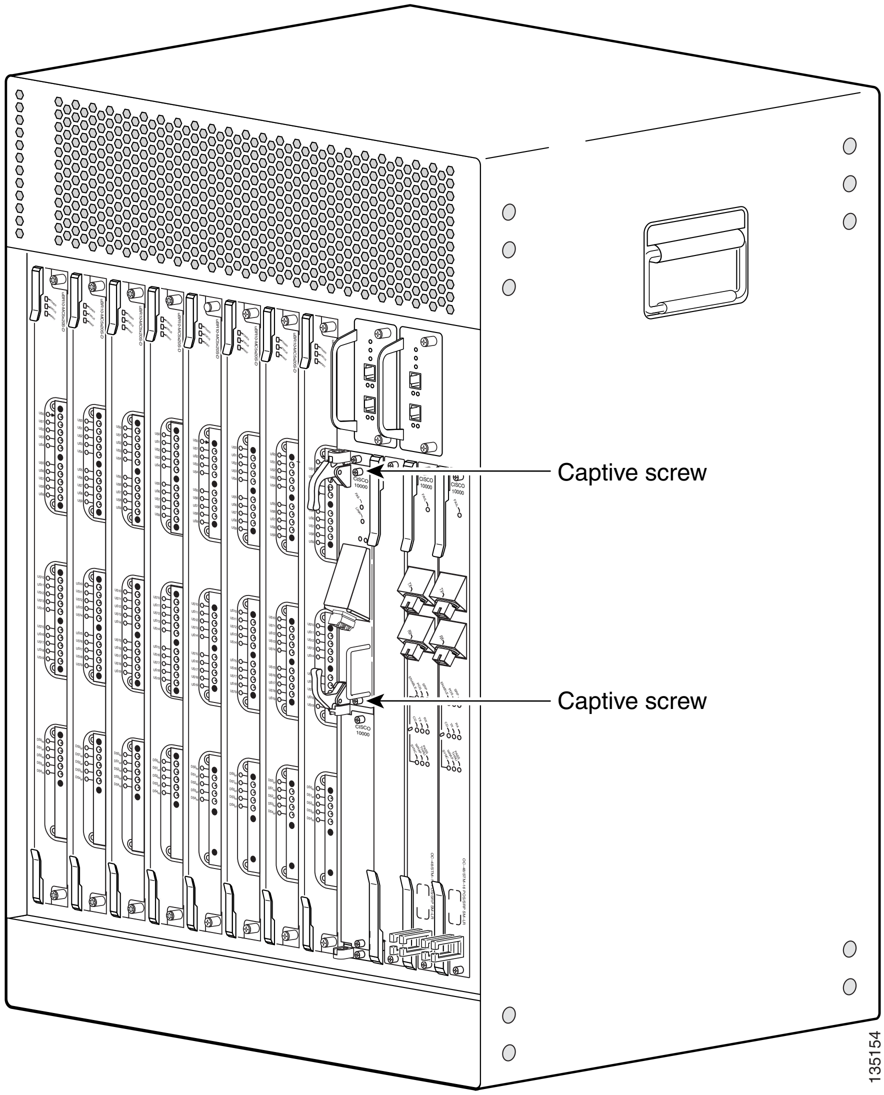
Removing a Half-Height Gigabit Ethernet Line Card

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 5-41 Captive Screw Locations



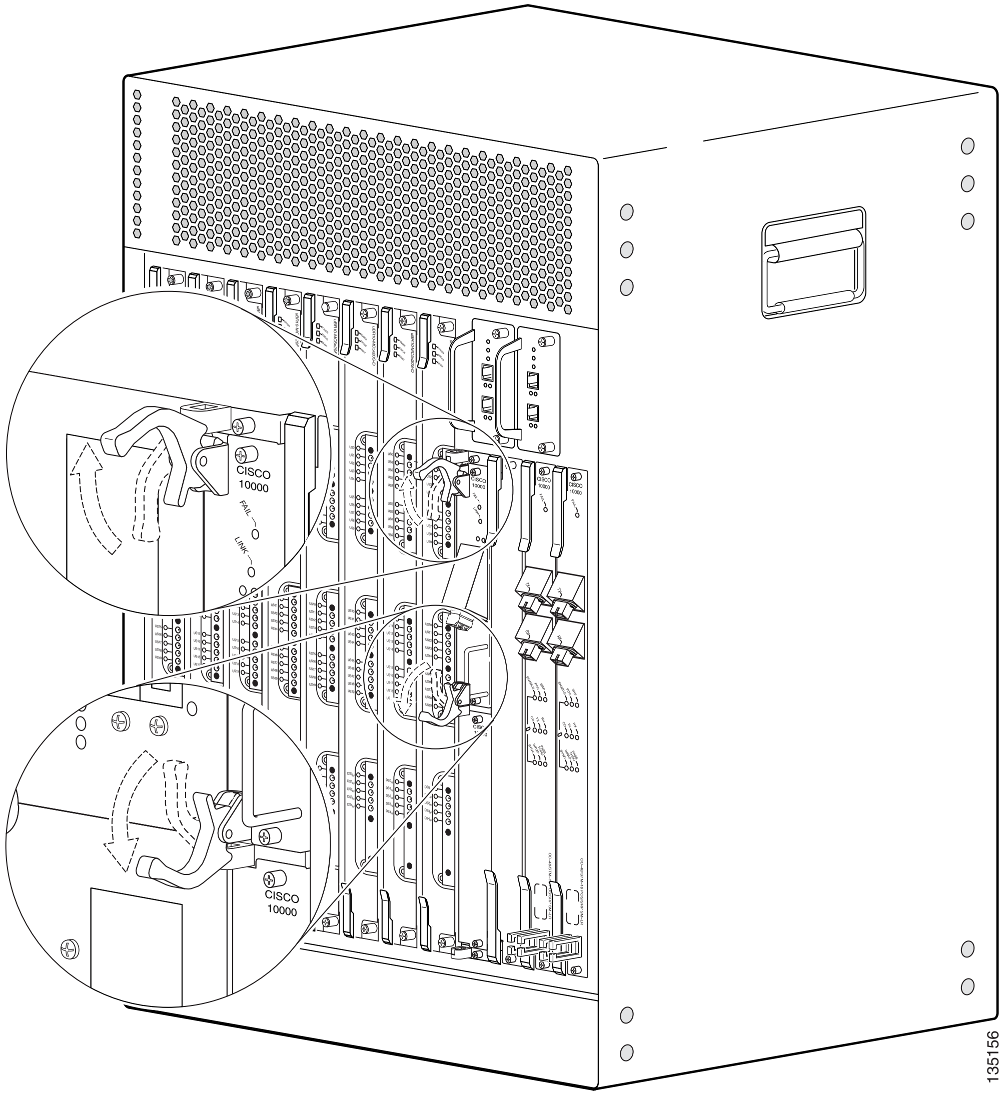
Step 3 Loosen the top and bottom captive screws until they disengage and spring away from the face plate (Figure 5-41).

Step 4 Simultaneously pivot both ejector levers away from each other to disengage the line card from the backplane (Figure 5-42).

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 5-42 Opening the Ejector Levers



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:

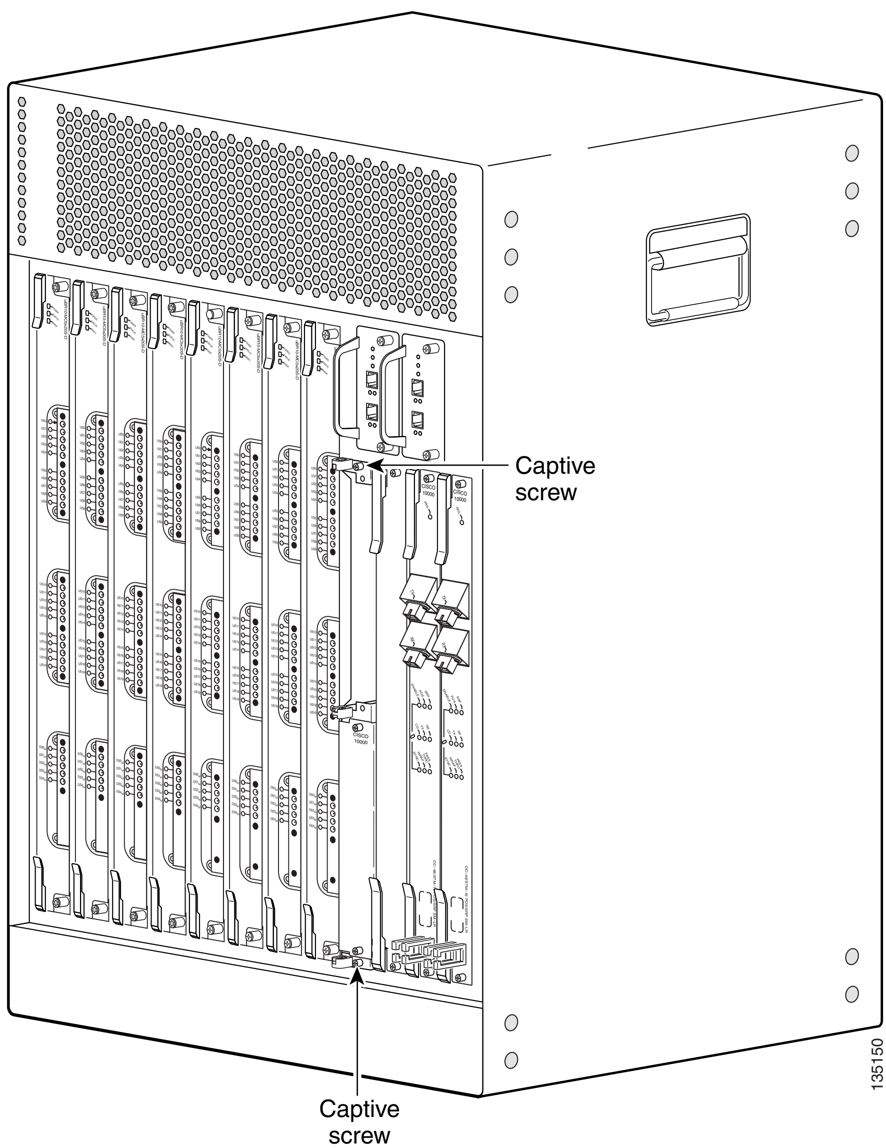
Step 1 Attach an antistatic wrist strap to your wrist and to the ESD socket on the chassis, or to a bare metal surface on the chassis or frame).

Step 2 Remove any line cards from the splitter according to the "Removing a Half-Height Gigabit Ethernet Line Card" section on page 5-45.

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 5-43).

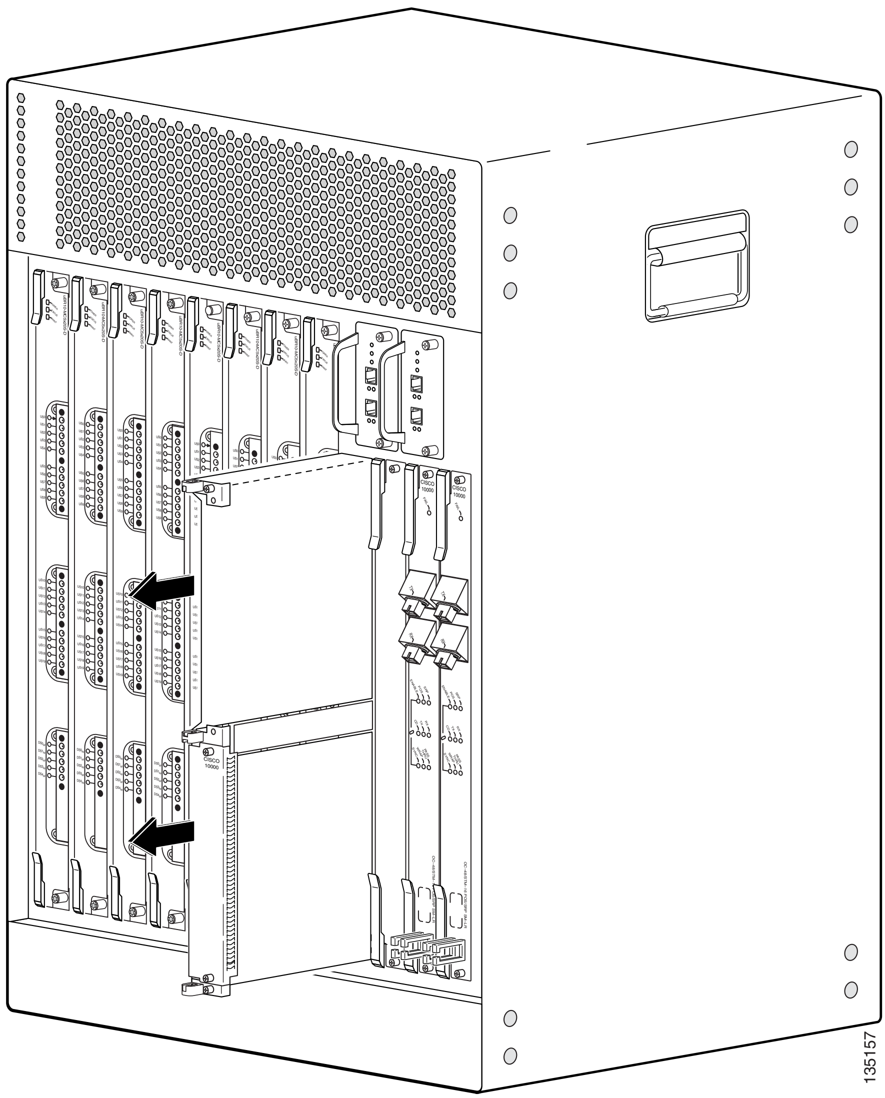
Figure 5-43 Captive Screw Locations



Step 4 Slide the splitter out of the slot (Figure 5-44).

Step 5 If you are not installing a replacement splitter or a line card, install a full-slot blank faceplate in the slot.

Figure 5-44 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 5-50
- Installing the Half-Height Gigabit Ethernet Line Card, page 5-53

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.

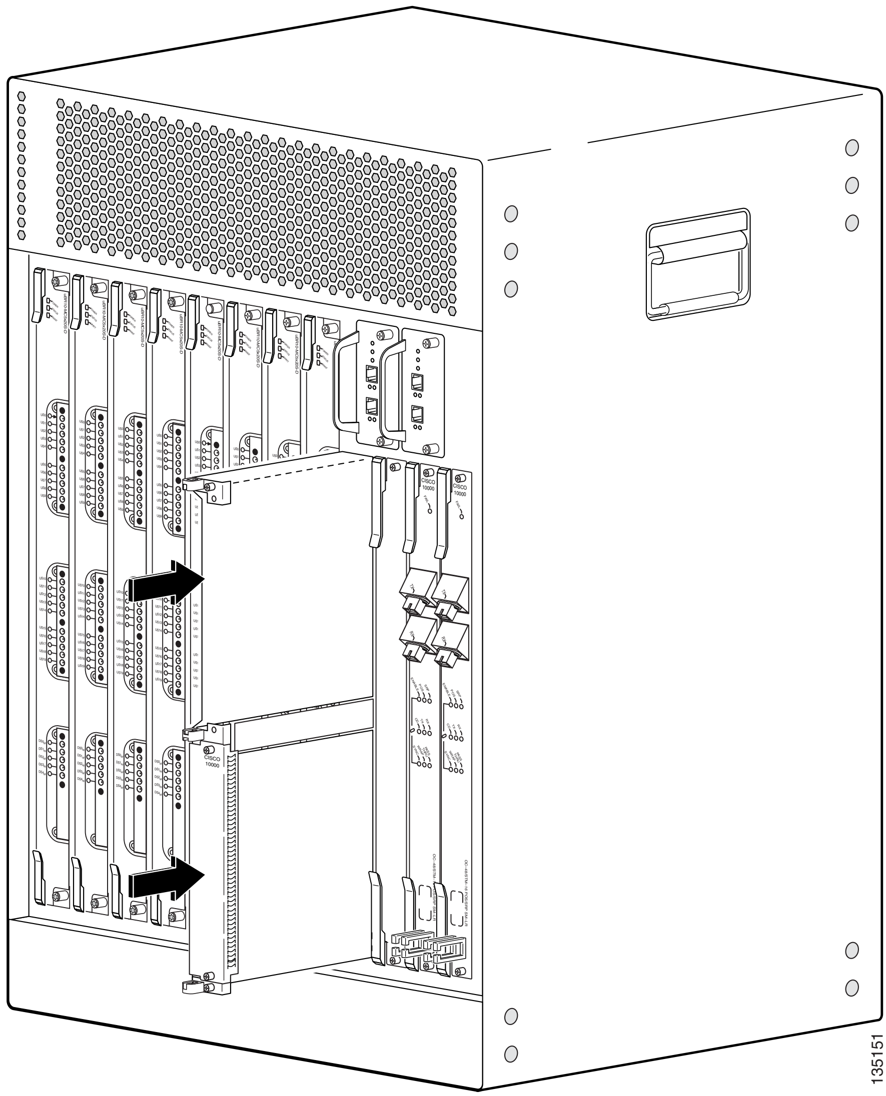
Installing the Slot Splitter

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 5-39).

Figure 5-45 Inserting the Slot Splitter

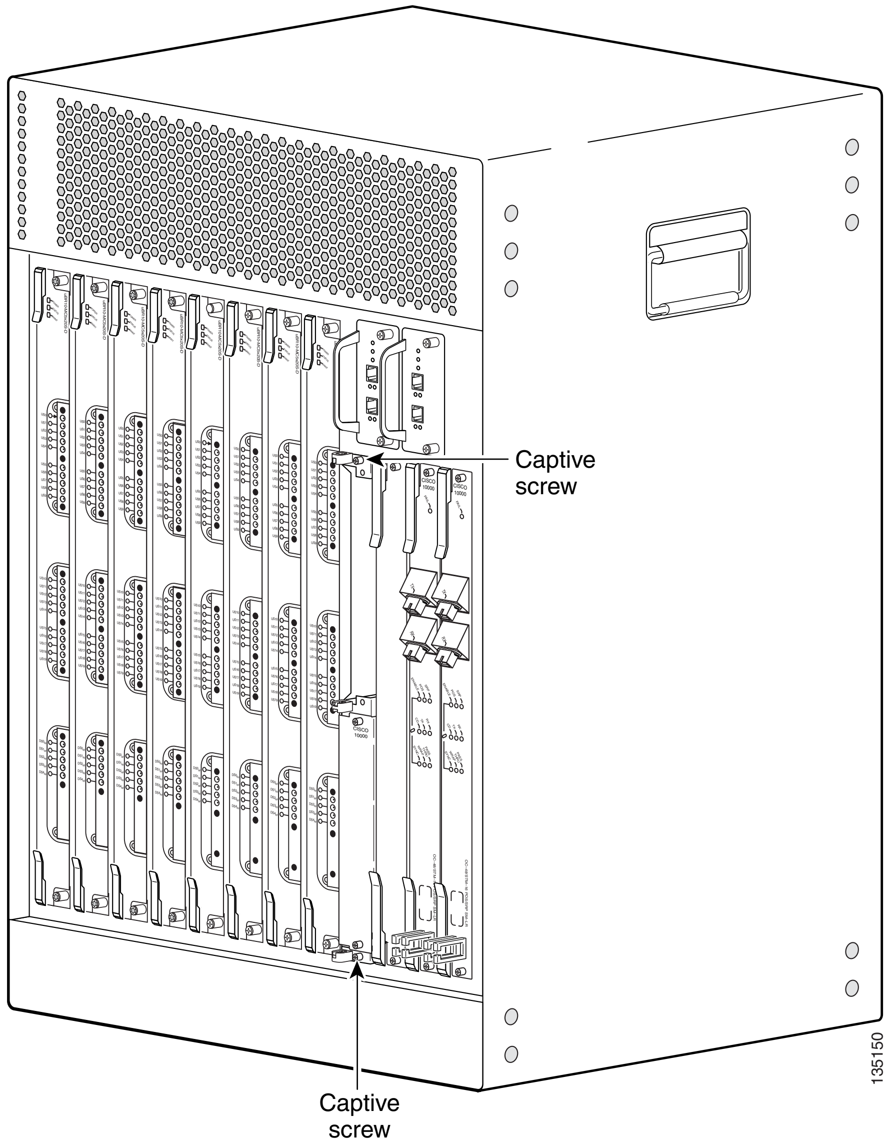


Step 2 Grasp the front of the slot splitter with one hand and place your other hand under the splitter. Position the splitter in front of the card cage slot.

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 5-39 has one open slot (top) and one slot with a slot cover (bottom).

Figure 5-46 Captive Screw Locations



Step 4 Secure the slot splitter to the chassis by tightening the top and bottom captive screws (Figure 5-46).

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

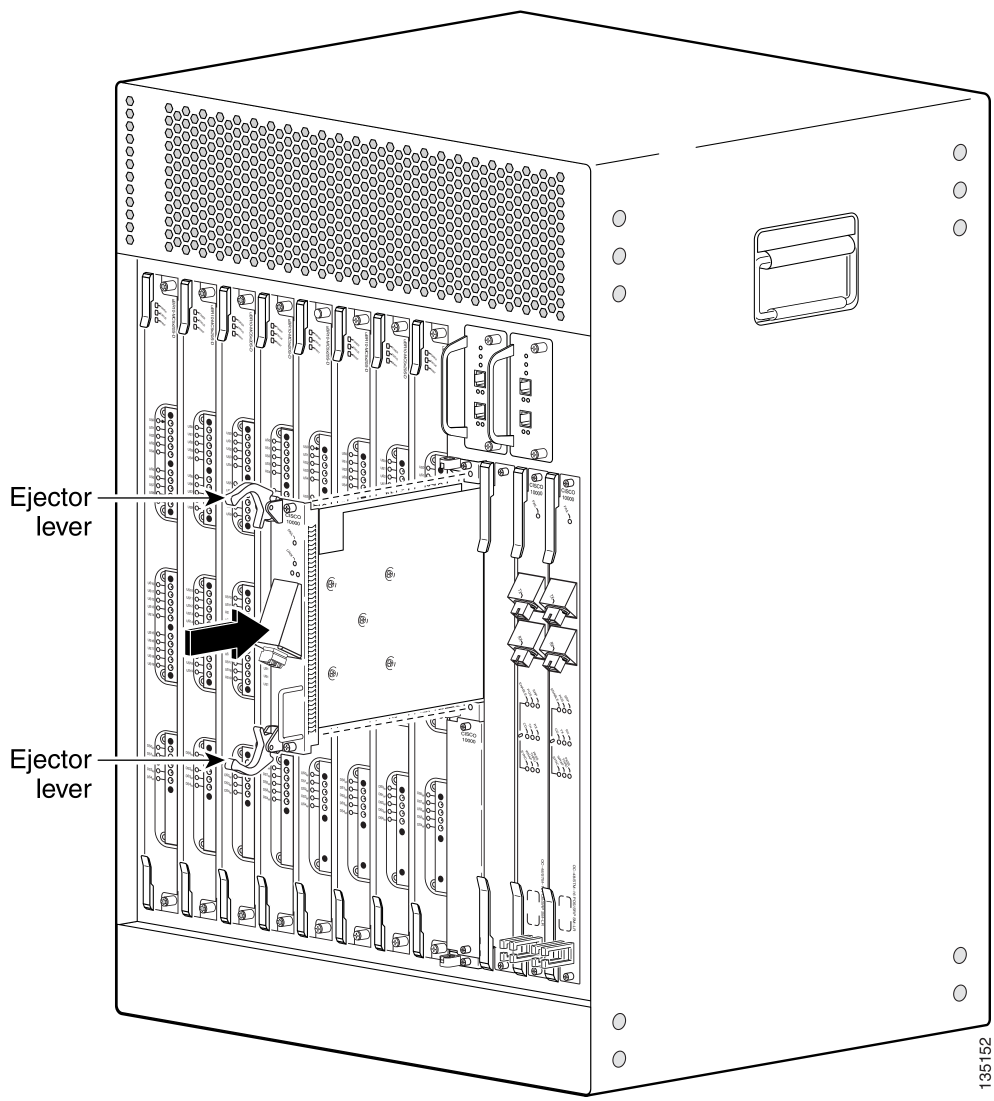
Installing the Half-Height Gigabit Ethernet Line Card

Use the following procedure to install a HHGE line card into an installed slot splitter. See the "Installing the Slot Splitter" section on page 5-50 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 5-45 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 5-47 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 5-40).

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 4-13.

Figure 5-48 Closing the Ejector Levers

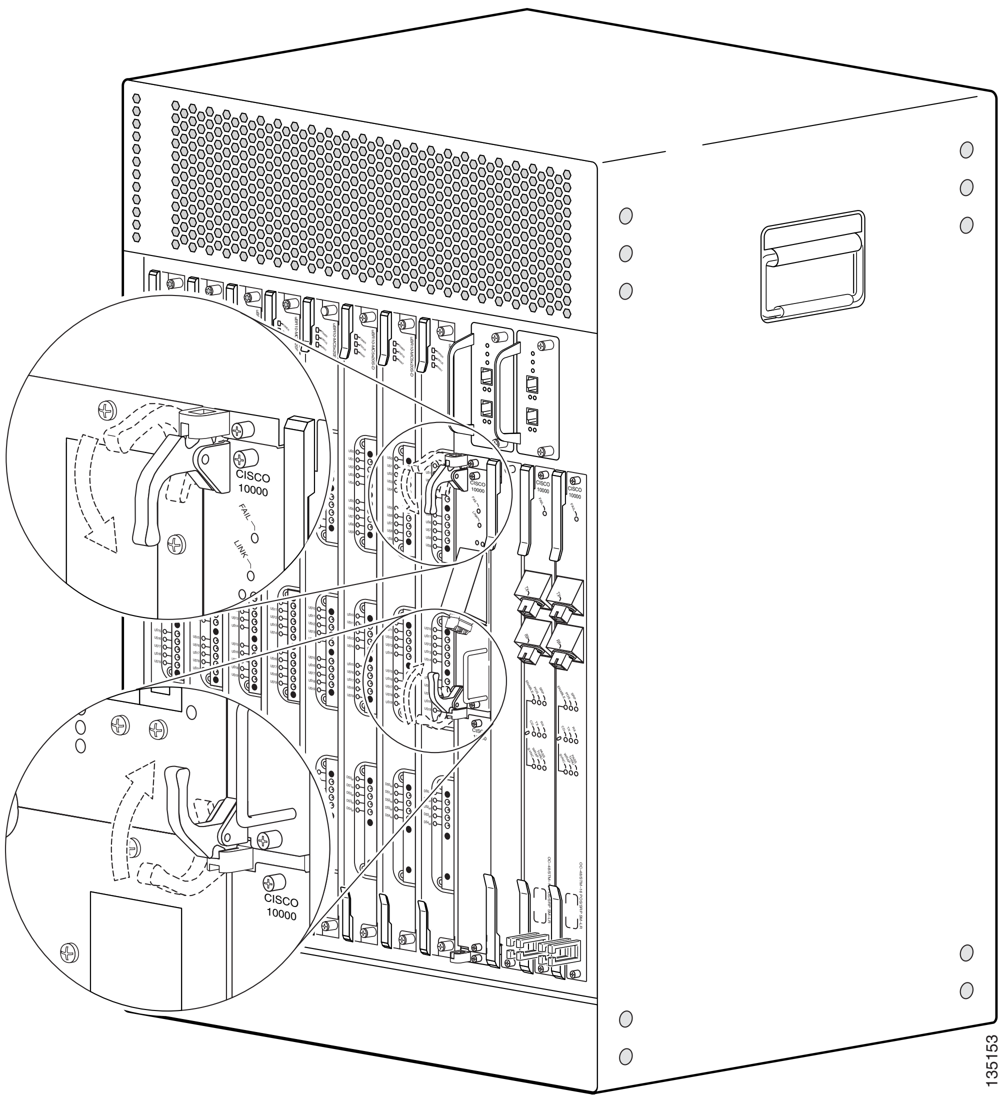
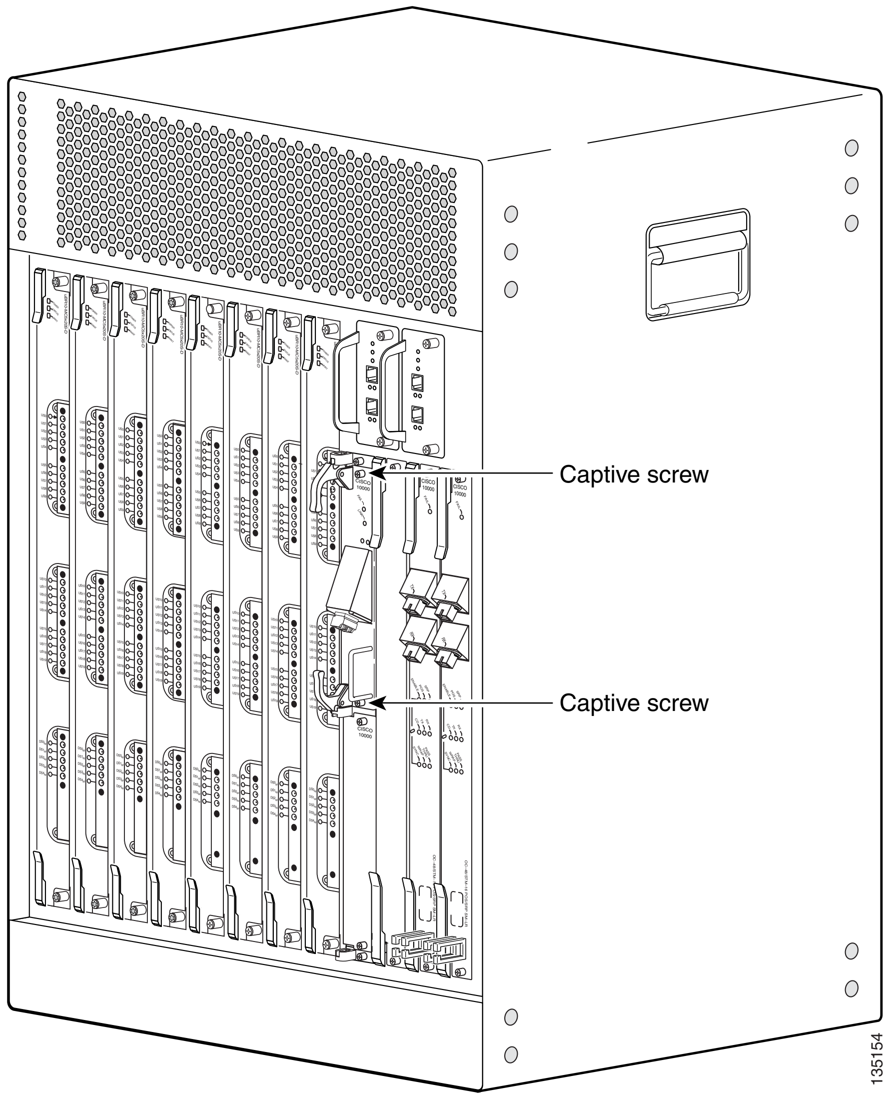


Figure 5-49 Captive Screw Locations



Step 7 Secure the line card in the slot splitter by tightening the top and bottom captive screws (Figure 5-49).

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:

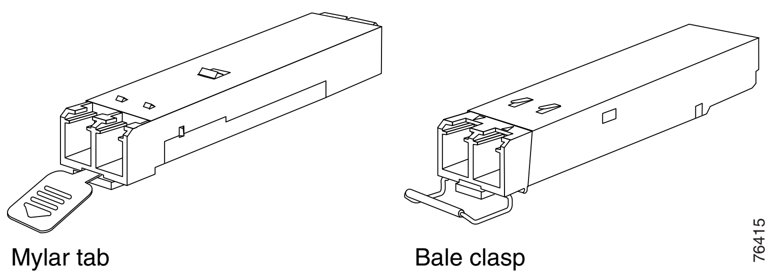
- Removing an SFP Module, page 5-56
- Inserting an SFP Module, page 5-58

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 5-50 shows two available module types.

Figure 5-50 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.

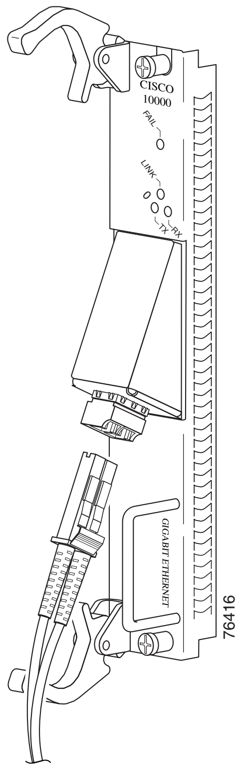
Removing an SFP Module

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.

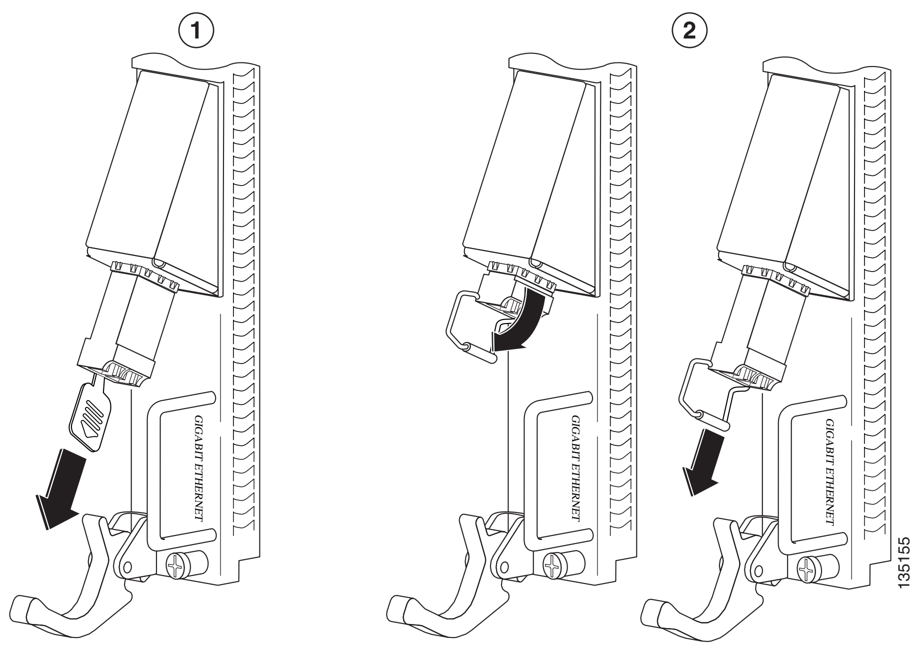
Figure 5-51 Disconnecting the LC-type Fiber-Optic Cable



Step 2 Disconnect the fiber-optic cable connector from the SFP module (Figure 5-51).

Note which cable connector plug is TX and which is RX for reattachment.

Figure 5-52 Removing an SFP Module



Step 3 Unlock and remove the SFP module as follows:

a. Mylar Tab SFP Modules—Gently, but firmly pull the plastic tab to free the locking pin and remove the SFP module (Figure 5-52).

Caution Do not twist the Mylar tab when you remove the SFP module. Twisting the tab may disconnect it from the module.

b. Bale Clasp Modules—Open the bale clasp to release the locking pin and remove the SFP module (Figure 5-52).

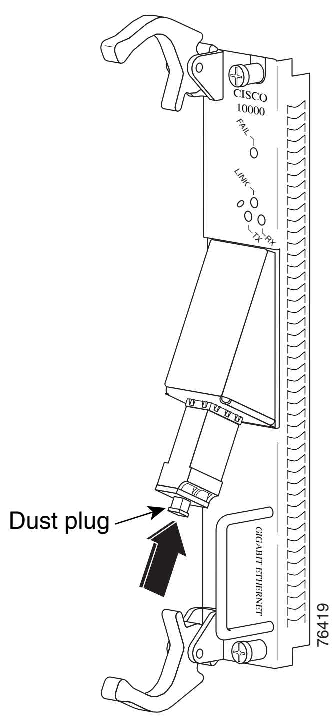
Step 4 Insert a dust plug into the optical ports of the removed SFP module to keep the optical interfaces clean, and place the module in an antistatic bag or other protective environment.

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 5-53 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 5-53).

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 5-53).

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.

To upgrade from the full-height GigE line card to the HHGE line card, perform the following steps:

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/univercd/cc/td/doc/product/cable/ubr10k/ubr10012/ub10ksw/index.htm

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-LCP2-MC16C, UBR10-LCP2-MC16C=,
- Cisco uBR10-LCP2-MC16E, UBR10-LCP2-MC16E=
- Cisco uBR10-LCP2-MC16S, UBR10-LCP2-MC16S=
- Cisco uBR10-LCP2-MC28C, UBR10-LCP2-MC28C=
- Cisco uBR10-MC5X20S/U, UBR10-MC5X20S=, UBR10-MC5X20U=

Caution Do not attempt to separate or remove the Cisco MCxx cable interface card from the Cisco uBR10-LCP2 adapter card while the cards are installed in the Cisco uBR10012 chassis. The cards must be removed from the chassis as a unit. See the "Removing and Replacing the Cable Interface Line Card in the Adapter Card" section on page 5-65.

Tip 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.

Removing the Cable Interface Line Card

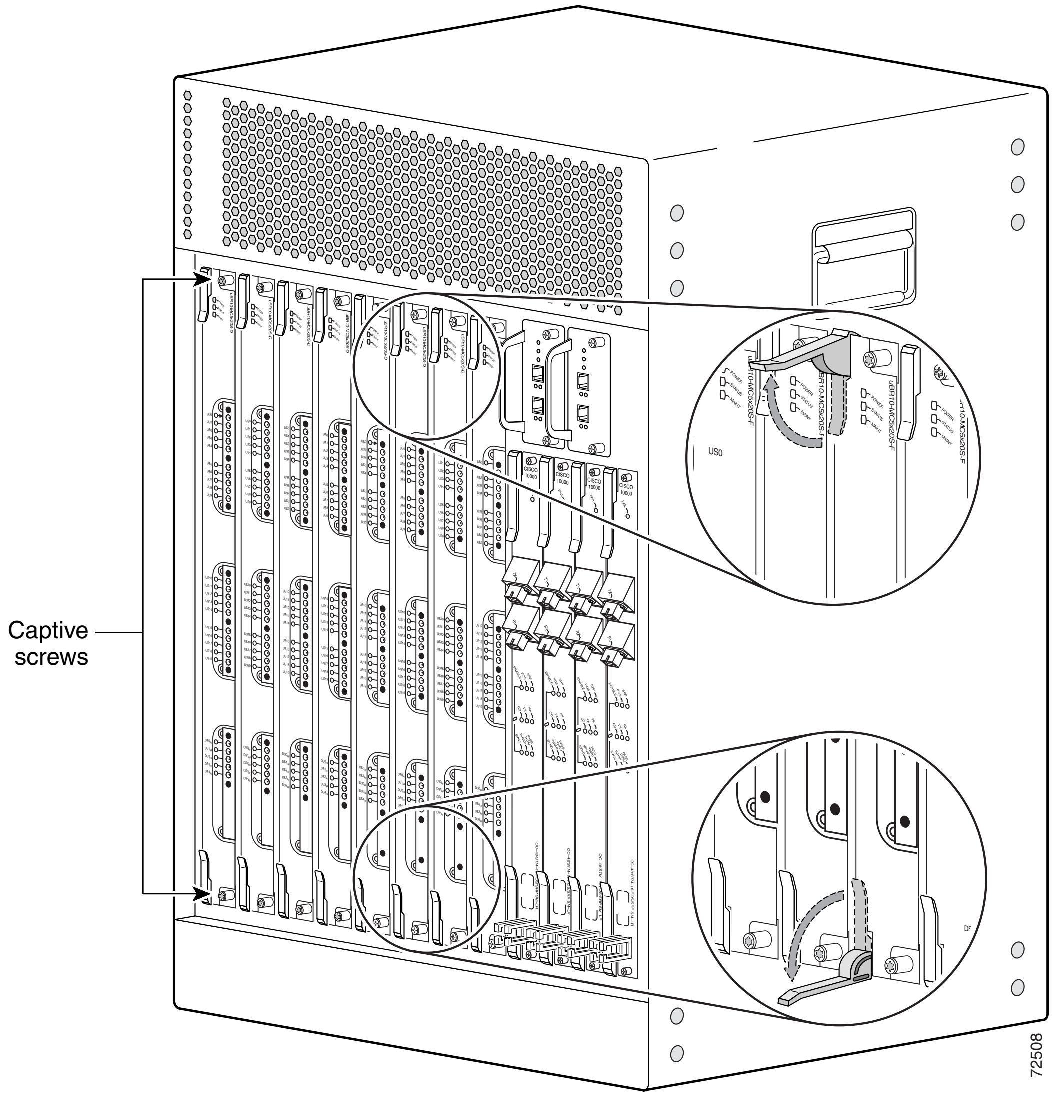
Step 1 Attach an antistatic wrist strap to your wrist and to a bare metal, unpainted surface on the chassis or frame.

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 5-54).

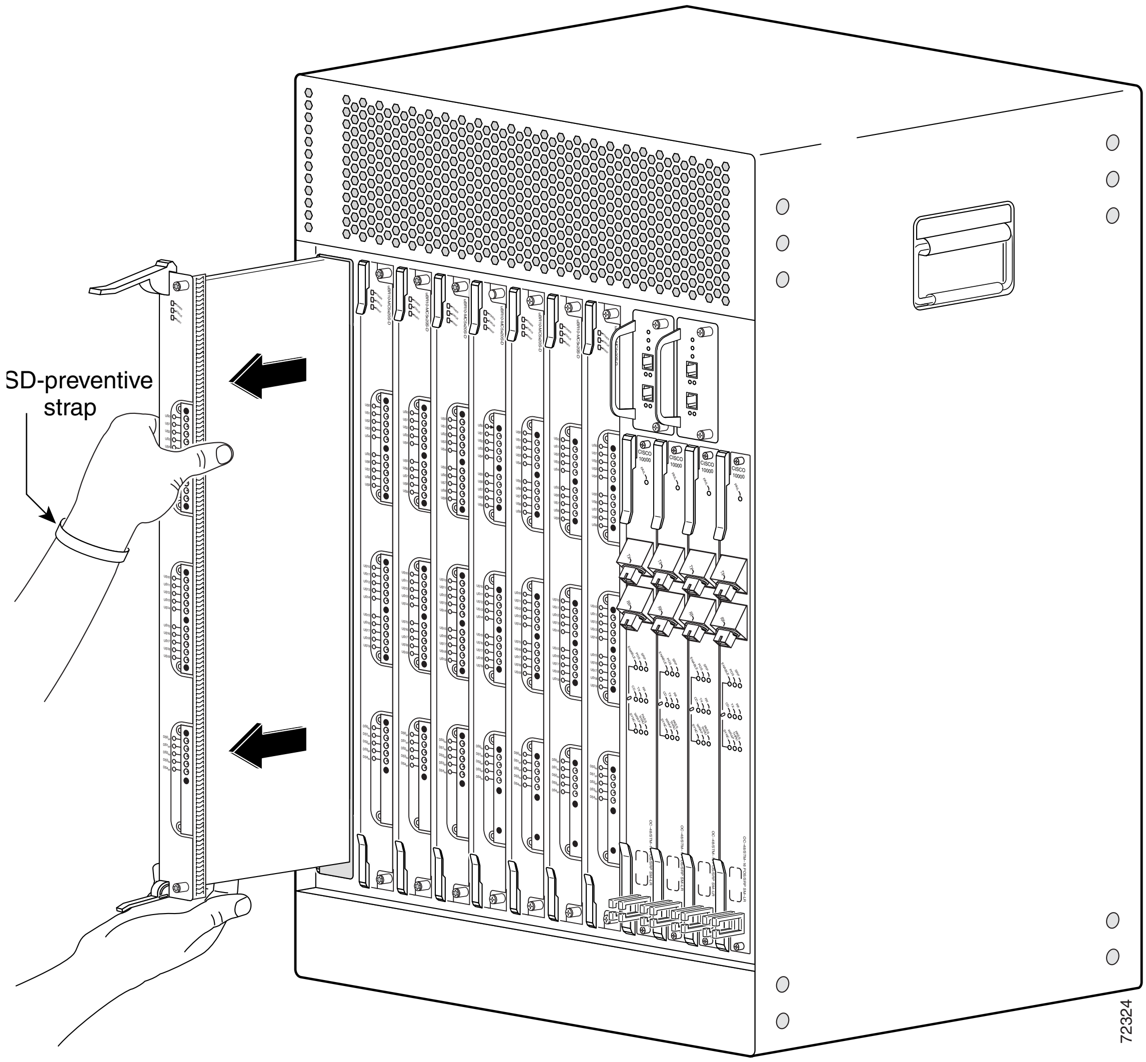
Figure 5-54 Captive Screws, Ejector Levers



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 5-55).

Figure 5-55 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=.

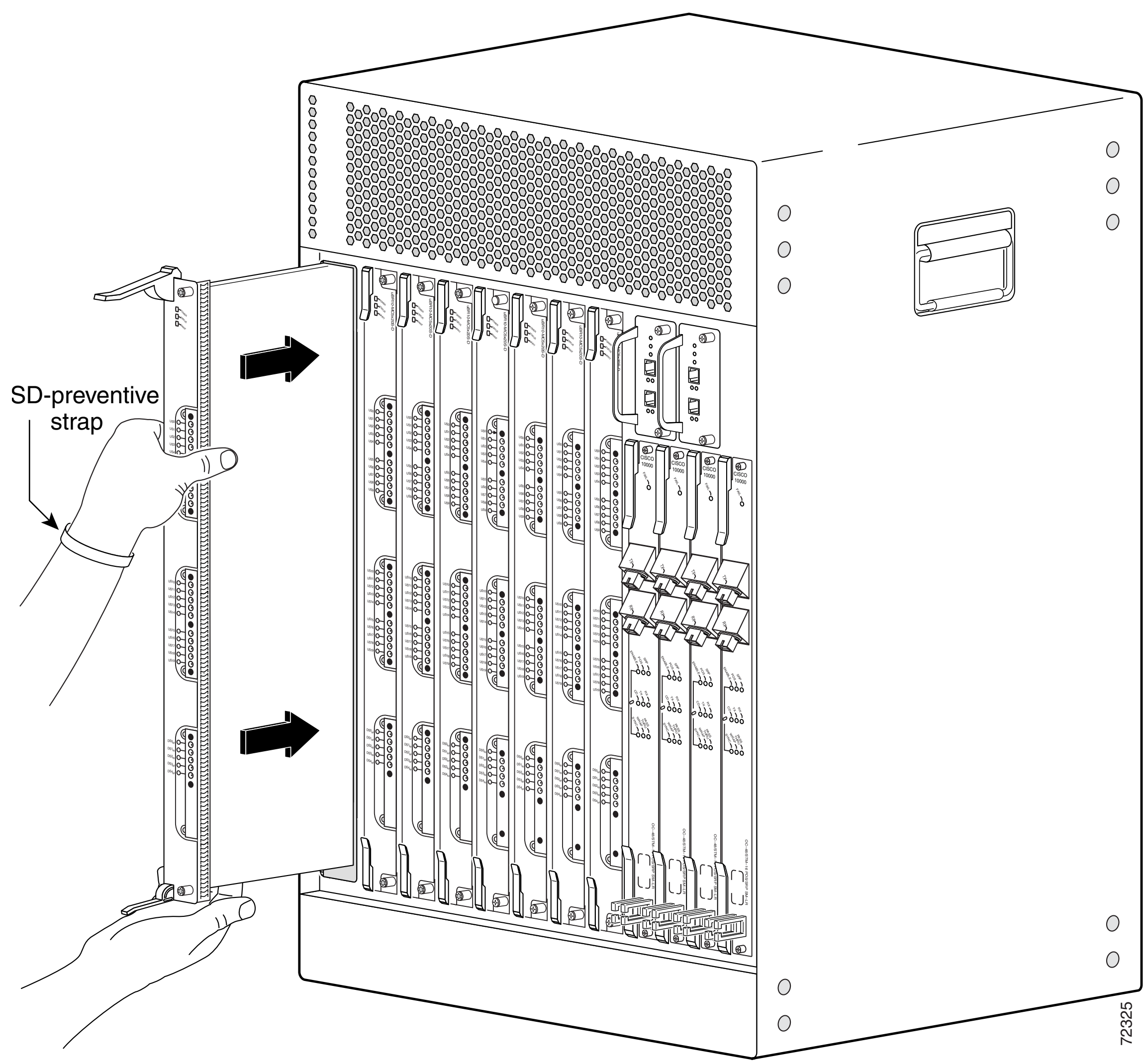
Warning **Blank faceplates (filler panels) serve three important functions: they prevent exposure to hazardous voltages and currents inside the chassis; they contain electromagnetic interference (EMI) that might disrupt other equipment; and they direct the flow of cooling air through the chassis. Do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

Installing a Cable Interface Line Card

Step 1 Grasp the faceplate of the new cable interface 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 card cage slot.

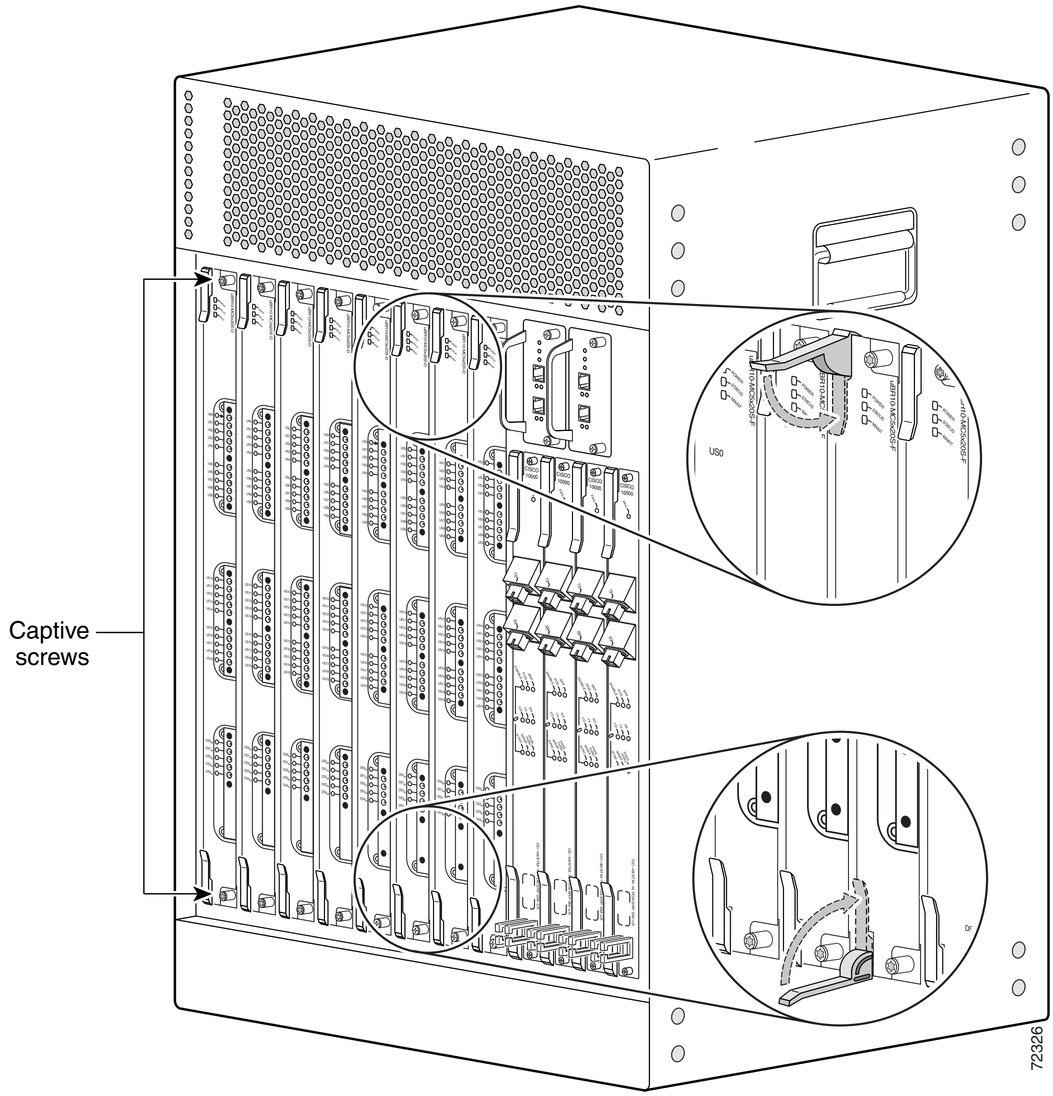
Step 2 Carefully align the upper and lower edges of the cable interface line card with the upper and lower guides in the chassis, and slide the cable interface line card into the slot until you can feel it begin to seat in the backplane connectors (see Figure 5-56).

Figure 5-56 Inserting the Cable Interface 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 5-57).

Figure 5-57 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 5-54).

Tip If you are installing more then 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 4-12.

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).

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.

Removing and Replacing the Cable Interface Line Card in the Adapter Card

The following section describes how to remove and replace a Cisco MCxx cable interface line card in the Cisco uBR10-LCP2 adapter card.

Note This procedure pertains to all Cisco MCxx cable interface line cards (Cisco MC16x and Cisco MC28C) used with the Cisco uBR10-LCP2 adapter card.

Tip Make sure you are using an ESD-preventive wrist strap, and have an appropriate antistatic surface work space, as detailed in the "Preventing Electrostatic Discharge Damage" section on page 2-2.

Removing the Cable Interface Line Card from the Adapter Card

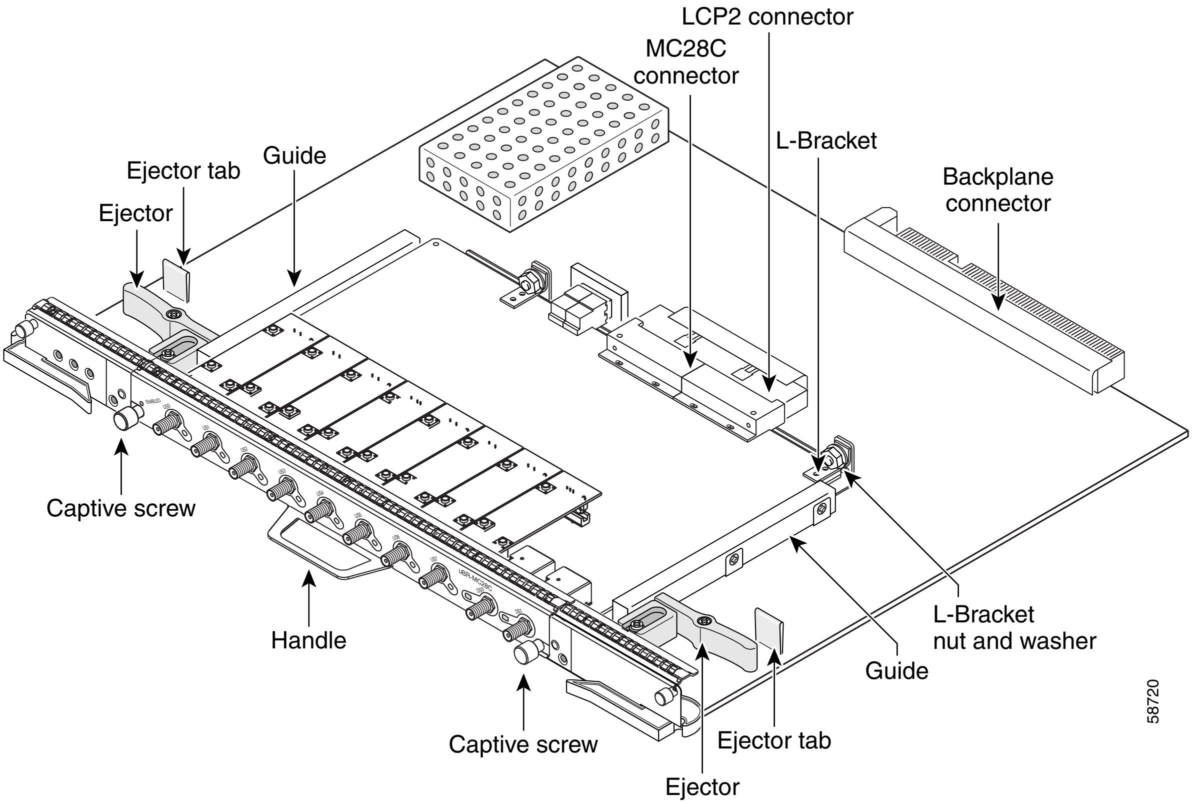
Step 1 Remove the Cisco uBR10-LCP2-MCxx cable line card, as described in steps 1 through 6 in the "Removing and Replacing a Cable Interface Line Card" section on page 5-60.

Caution Do not attempt to separate or remove the Cisco MCxx card from the Cisco uBR10-LCP2 adapter card while the two cards are installed in the Cisco uBR10012 chassis. The cards must be removed from the chassis as a unit and then separated on a lab bench or other area that protects against ESD damage.

Step 2 Place the cable line interface card on an anti-static surface. The component side should be facing up, as shown in Figure 5-58.

Note This illustration uses the Cisco MC28C cable interface card as an example. You can perform this procedure using any of the Cisco MCxx cards.

Figure 5-58 Cisco uBR10-LCP2-MC28C Cable Interface Line Card



Step 3 Loosen and remove the two sets of retaining nuts and washers on the L-brackets on the Cisco MCxx board (see Figure 5-58). Set the nuts and washers aside.

Step 4 Loosen and disengage the two captive screws on the Cisco MCxx board (see Figure 5-58).

Step 5 Use the ejector levers on each side of the Cisco uBR10-LCP2 adapter card to loosen and disengage the Cisco MCxx card from the adapter card (see Figure 5-59).

Step 6 Using the handle, pull the Cisco MC28C card straight out of the Cisco uBR10-LCP2 adapter card (see Figure 5-60).

Step 7 Place the Cisco MCxx card aside, on an antistatic surface.

Figure 5-59 Using the Ejector Levers to Remove the Line Card from the Adapter Card

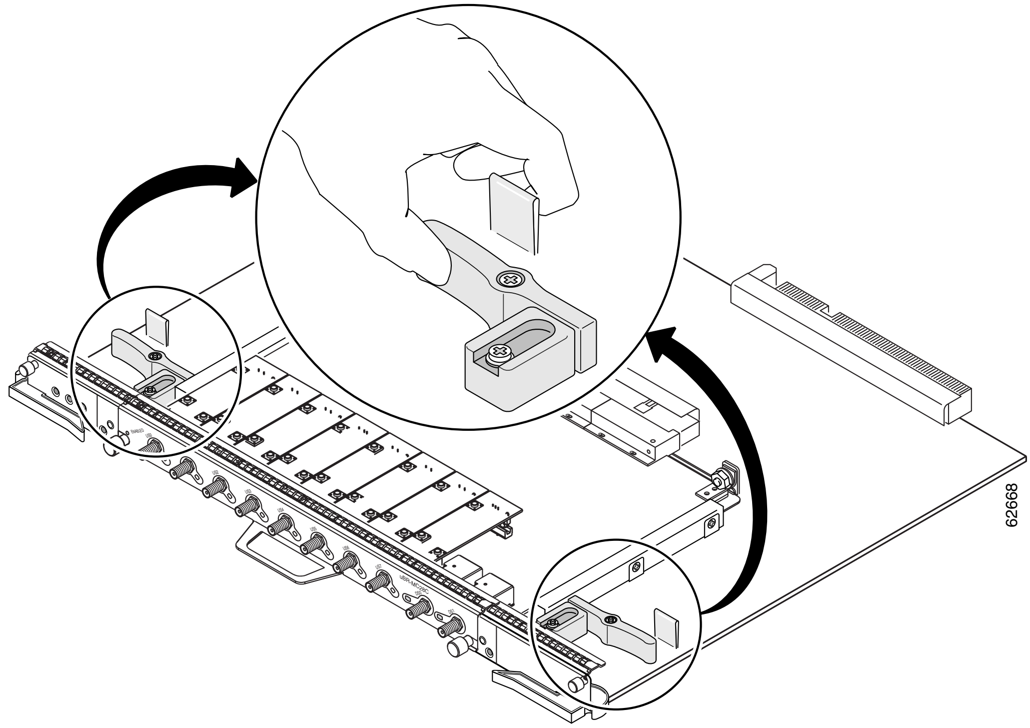
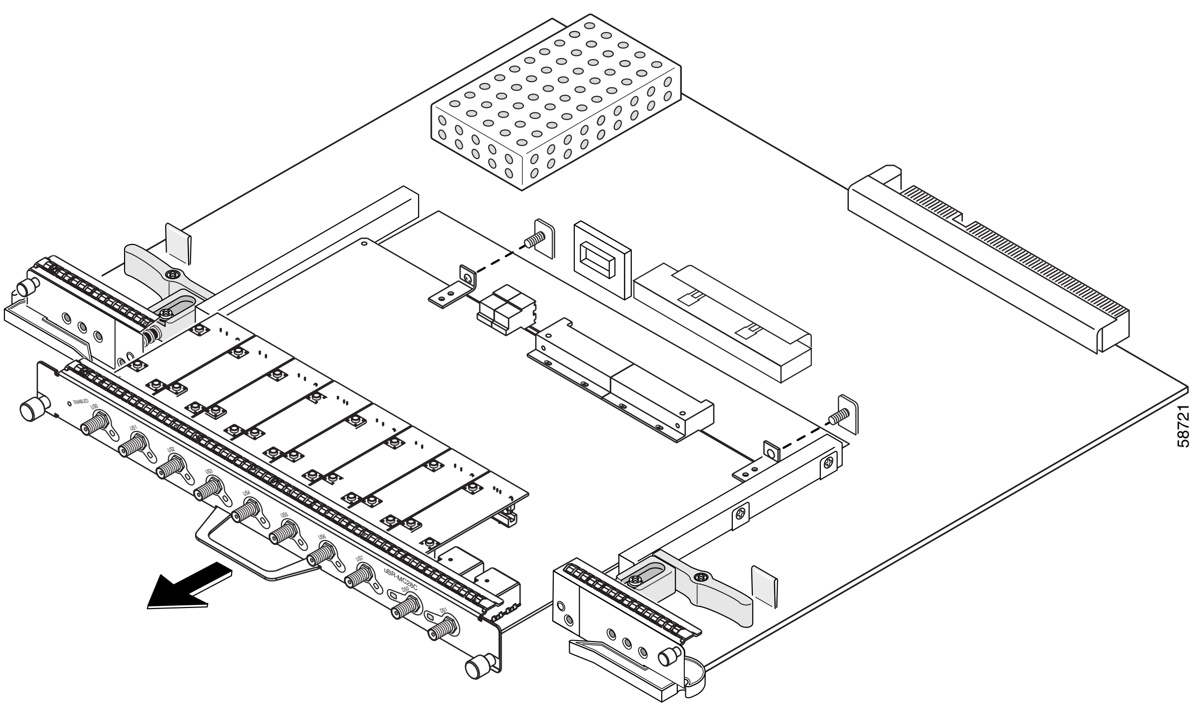


Figure 5-60 Removing the Cisco MC28C Line Card from the Adapter Card



Installing a Cable Interface Line Card in the Adapter Card

Step 1 Using the handle on the new or replacement Cisco MCxx card, align the holes in the L-brackets with the screws on the adapter card.See Figure 5-59.

Step 2 Align the Cisco MCxx card with the guide rails in the Cisco uBR10-LCP2 adapter card, and ensure that the Cisco MCxx card's sheet metal is flush with the sheet metal on the bottom of the adapter card (the Cisco MCxx card should slide under the spring guides and not over them).

Step 3 Slide the Cisco MCxx card into the Cisco uBR10-LCP2 adapter card slowly, making sure that the Cisco MCxx card is sliding under the spring guides. Also verify that its power connectors are aligned with those on the adapter card. Continue slowly pushing until the connectors on the Cisco MCxx card are firmly connected to the connectors on the adapter card. The ejector levers on each side of the card should snap into place when the card is fully inserted.

Note Make sure that the screws on the adapter card brackets slide cleanly into the holes in the L-brackets. These brackets help to align the adapter card and cable interface line card connectors and hold the cable interface line card in place.

Step 4 Tighten the captive screws on the Cisco MCxx card to secure it to the Cisco uBR10-LCP2 adapter card.

Step 5 Reattach the retaining washers and screws on the L-brackets on the Cisco MCxx card. Make sure they are finger-tight, and then turn them a half-turn with a wrench to secure them and the card in place.

Step 6 Reinsert the Cisco uBR10-LCP2-MCxx cable interface line card, as described in the "Removing and Replacing a Cable Interface Line Card" section on page 5-60.

Step 7 Connect all downstream and upstream coaxial cables to the cable interface line card as necessary.

Step 8 Configure the cable interface line card if necessary (see the *Cisco uBR10012 Software Configuration Guide* for information about configuring the line card).

Note It is not necessary to configure the cable interface line card if you are installing a replacement card in the same slot. The system automatically downloads the necessary configuration information from the PRE.

APPENDIX A

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

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	• Weight: 235 lb (106.6 kg) fully configured chassis • Height: 31.25 in. (79.4 cm)—18 Rack Units (RU) • Width: 17.2 in. (43.7 cm) • Depth: 22.75 in. (57.8 cm) • Mounting: 19 in. rack mountable (front or rear), 2 units per 7 ft. rack **Note** Mounting in 23 in. racks is possible with optional third-party hardware.
Temperature range	• Operating: 41 to 104° F (5 to 40° C) • Storage: -40 to 158° F (-40 to 70° C)
Relative humidity	• Operating—nominal: 5 to 85 percent • Storage: 5 to 95 percent
Operating altitude	–197 to 13,123 ft. (–60 to 4000 m)
Airflow	280 cfm[1] (approximately) through the system fan assembly module (low speed, normal operating temperatures, with clean air filter) 450 cfm (approximately) through the system fan assembly module (high speed, chassis temperature at air outlet exceeds 40° C, with clean air filter)
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[2] (8189btu[3])

Table A-1 Cisco uBR10012 Router and Router Components Physical Specifications (continued)

Description	Specifications
DC Power entry modules (PEM) Power supply monitoring cable Supports two separate input feeds (–48 to –60VDC) by means of built-in two-position terminal blocks.	Part Number: UBR10-PWR-DC (Primary) Part Number: UBR10-PWR-DC\R (Redundant) Part Number: UBR10-PWR-MON-CAB Part Number: UBR10-PWR-MON-CAB= (Spare) • Dimensions Height: 19.25 in (48.894 cm) Width: 6 in. (15.24 cm) Depth: 5 in. (12.4 cm) • Weight: 10 lbs. (4.54 kg) • DC input voltage -48 to -60 VDC nominal -40.5 to -72 VDC minimum to maximum • DC input current: 48 A@ -48 VDC • Heat dissipation: 360 Btu1/hr. • Power consumption: 2400W maximum (8189BTU[3]) • MTBF:150,00 hours minimum • Temperature range Operating: 41\xb0 F to 104\xb0 F (5\xb0 C to 40\xb0 C) Storage: -40\xb0 F to 158\xb0 F (-40\xb0 C to 70\xb0 C)
AC PEM 100—120 VAC operation is not supported	Part Number: UBR10-PWR-AC (Primary) Part Number: UBR10-PWR-AC\R (Redundant) Part Number: UBR10-PWR-AC= (Spare) • Dimensions: Height: 19.25 in. (48.894 cm) Width: 6 in. (15.24 cm) Depth: 5 in. (12.4 cm) • Weight: 14.7 lbs (6.65 kg) • AC input voltage rating: 200-240 VAC @ 50/60Hz • AC operating voltage rating: 180-255 VAC @ 50/60Hz • AC input current rating: 13 A • DC output voltage: -54 VDC maximum • DC output current: 45.3 A maximum • Power consumption: 2650W maximum • MTBF:150,000 - minimum • Heat dissipation: 8200 Btu1/hr. • Temperature range Operating: 23 to 122\xb0 F (-5 to 50\xb0 C) Storage: -13 to 158\xb0 F (-25 to 70\xb0 C)

Table A-1 Cisco uBR10012 Router and Router Components Physical Specifications (continued)

Description	Specifications
AC power shelf 2400W AC-input power shelf and DC PEM bundle	UBR10-PWR-AC-EXT= • Chassis dimensions Height: 3.46 in. (87.9 cm) Width: 19 in. (482.26 cm) Depth: 12.00 in. (304.2 cm) Mounting: 19-inch rack mountable (2 rack units) • Weight Shelf only: 7 lb. (3.2 kg) Each power module only: 7 lb. (3.2 kg) Fully configured shelf: 28 lb. (12.8 kg) • AC-input voltage and frequency:100,120 to 200,240 VAC, 50/60 Hz • AC voltage and current: 110 VAC at 15A maximum with power factor correction (PFC) 240 VAC at 7.4 A maximum with power factor correction (PFC) • AC power cable receptacle: IEC-320 15A receptacle that accepts right-angle cords • Temperature range: Operating: 41\xb0 F to 104\xb0 F (5\xb0 C to 40\xb0 C) Storage: -40\xb0 F to 158\xb0 F (-40\xb0 C to 70\xb0 C)
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 • Power consumption: 40 W[2] (136.5 BTU[3]) per hour • Weight:1.5 lb (0.5636 kg) • Height: 4.73 in (12.01 cm) Depth: 10.00 in (25.4 cm) Width: 1.55 in (3.937 cm) • MTBF:431,348 hours
Fan assembly module	• Part Number: UBR10-FAN-ASSY • Power consumption: 250 W [2]—4 amps, not to exceed 6 amps at startup (1365 BTU[3]) per hour • Weight: 30 lb (13.61 kg) • Height: 5.60 in. (14.22 cm) Depth: 16.15 in. (41.02 cm) Width: 19.00 in. (48.26 cm) • MTBF: fans–248,509 hours • MTBF: fan control–596,659

Table A-1 Cisco uBR10012 Router and Router Components Physical Specifications (continued)

Description	Specifications
LCD module	• Part number: module–UBR10-DSPL= Part number: cable–UBR10-DSPL-CAB= • Power consumption: 2W[2] (6.824 BTU[3]) per hour • Weight: 0.4 lb (0.1814 kg) • Height: 4.0 in. (10.16 cm) Depth: 4.8 in. (12.19 cm) Width: 1.4 in. (3.56 cm) • MTBF: module–231,576 hours • MTBF: cable–N/A
Performance routing engine (PRE)	PRE1 modules: • ESR-PRE1 (Primary and redundant) ESR-PRE1= (Spare) PRE2 modules • ESR-PRE2 (Primary and redundant) ESR-PRE2/R= (Spare) PRE4 modules • ESR-PRE4 (Primary and redundant) ESR-PRE4/R= (Spare) Max per chassis: 2 Power consumption: • PRE and PRE1: 80 Watts (273 BTU per hour) PRE2: 200 Watts (682.4 BTU[1] per hour) PRE4: 210 Watts (716.5 BTU[1] per hour) Weight: • PRE and PRE1: 7.5 lb (3.41 kg) PRE2: 8.45 lb (3.84 kg) PRE4: 9.0 lb (4.09 kg) • Height: 16.0 in. (40.64 cm) Depth: 9.97 in. (25.32 cm) Width: 1.91 in. (4.84 cm) MTBF: • PRE and PRE1: 116,904 hours PRE2: 122,426 hours PRE4: 106,574 hours Three interface ports: • RJ-45 IEEE 802.3 Ethernet 100Base-T RJ-45 auxiliary (AUX) port for modem access RJ-45 console (CON) port for terminal access

Table A-1 Cisco uBR10012 Router and Router Components Physical Specifications (continued)

Description	Specifications
PRE PC media card options	• Slot 0, Slot 1
PRE4 CompactFlash Disk options	• Disk0 512 MB—Part Number: ESR-PRE-CF-512MB(=) 1 GB—Part Number: ESR-PRE-CF-1GB(=)
PRE DRAM memory options	• 40 MB—Part Number: ESR-PRE-MEM-FD40 128 MB—Part Number: ESR-PRE-MEM-FD128 512 MB—Part Number: ESR-PRE-MEM-512M

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	• UBR10-1GE and UBR10-1GE= • Power consumption:25 W[1] (85.3 BTU[2]) • Weight: 4.75 lb (2.16 kg) • Height: 16.0 in. (40.64 cm) Depth: 9.97 in. (25.32 cm) Width: 1.12 in. (2.83 cm) • MTBF: 183,4431 hours **Gigabit Ethernet Converter (GBIC) Types:** • 1000Base-SX (SFP-GE-S), multimode • 1000Base-LX/LH (SFP-GE-L), single mode • 1000Base-ZX (GLC-ZX-SM), single-mode
Cisco Half-Height Gigabit Ethernet line card	• ESR-HH-1GE and ESR-HH-1GE= • Power consumption:15.98 W (54.53 BTU[2]) • Weight: 2 lb (0.9 kg) • Height: 7.8 in. (19.8 cm) Depth: 11.0 in. (27.9 cm) Width: 1.3 in. (3.3 cm) • MTBF: 449,330 hours **Gigabit Ethernet Converter (GBIC) Types:** • 1000Base-SX (SFP-GE-S) • 1000Base-LX/LH (SFP-GE-L) • 1000Base-ZX (GLC-ZX-SM) • 1000Base-T (GLC-T)
Slot splitter card	• ESR-HH-CARRIER • Weight: 2.28 lb (1.05 kg) • Height: 16.0 in. (40.64 cm) Depth: 10.50 in. (26.67 cm) Width: 1.80 in. (3.00 cm)
Half-height slot blank cover	• ESR-HH-COVER
Full-height slot blank cover	• ESR-COVER
SFP optical power budget—1000Base-SX GBIC	• Power budget: 7.5 dB • Transmit power: –9.5 to 0 dBm • Receive power: –17 to 0 dBm

Table A-2 Cards Used in the uBR10012 Router (continued)

Description	Specifications
SFP optical power budget—1000Base-LX/LH GBIC	• Power budget: 7.5 dB (multimode fiber), 8 dB (single mode) • Transmit power: –11.5 to -3 dBm (multimode fiber), –11 to –3 dBm (single mode) • Receive power: –19 to –3 dBm (multimode and single mode fiber)
SFP optical power budget—1000Base-ZX GBIC	• Power budget: 23 dB • Transmit power: 0 to 4.77 dBm • Receive power: –23 to 0 dBm
Cisco OC-12 Packet Over SONET (POS) line card	• UBR10-1OC12/P-SMI, UBR10-1OC12/P-SMI= • Power: 28W[1] (95.54 BTU[2]) • Weight: 4.75 lb (2.16 kg) • Height: 16.0 in. (40.64 cm) Depth: 9.97 in. (25.32 cm) Width: 1.12 in. (2.83 cm) • MTBF:329,349 hours
Cisco OC12SML-DPT WAN line card	• USB-SRP-OC12SML, USB-SRP-OC12SML= • Power consumption: 110 W[1] (375.3 BTU[2]) • Weight: 6 lb (2.72 kg) • Height: 16 in. (40.64 cm) Depth: 10.56 in. (26.82 cm) Width: 2.38 in. (6.05 cm) • MTBF: 153,624 hours
Cisco uBR10012-OC48 DPT/POS interface module	
Single-mode, short-reach modules	• Spares (2)—UBR10-SRP-OC48SMS= Spare (1)—ESR1048/P/SRPMS=
Single-mode, long-reach modules	• Spares (2)—UBR10-SRP-OC48SML= Spare (1)—ESR1048/P/SRPML= • Power consumption: 28 W[1] (95.54 BTU[2]) • Weight: 4.75 lb (2.16 kg) • Height: 16 in. (40.64 cm) Depth: 9.87 in. (25.32 cm) Width: 1.12 in. (2.83 cm) **MTBF:** • SMS—216,018 hours • SML—215,068 hours

Table A-2 Cards Used in the uBR10012 Router (continued)

Description	Specifications
Cisco uBR10-LCP2-uBR-MC28C cable interface line card	• UBR10-LCP2-MC28C, UBR10-LCP2-MC28C= • Power consumption: 110 W[1] (375.3 BTU[2]) • Weight:12 lb (5.44 kg) • Height: 21.25 in. (53.96 cm) Depth: 16.5 in. (41.91 cm) Width: 1.4 in. (3.56 cm) • MTBF: 229,494 hours
Cisco uBR10-LCP2-MC16C/MC16E/MC16S cable interface line card	• UBR10-LCP2-MC16E, UBR10-LCP2-MC16E= • UBR10-LCP2-MC16C, UBR10-LCP2-MC16C= • UBR10-LCP2-MC16S, UBR10-LCP2-MC16S= • Power consumption: 80 W[1] (273.15 BTU[2]) • Weight: 12 lb (5.44 kg) • Height: 21.25 in. (53.96 cm) Depth: 16.5 in. (41.91 cm) Width: 1.4 in. (3.56 cm) **MTBF** • UBR10-LCP2-MC16C — 138,769 hours • UBR10-LCP2-MC16E — 134,698 hours • UBR10-LCP2-MC16S — 110,946 hours
Cisco uBR10-LCP Adapter Card Cisco uBR10-LCP2 Adapter Card[3] **Note** The adapter card is used with Cisco MC16x and Cisco MC28x cable interface line cards	• UBR10-LCP • UBR10-LCP2

Table A-2 Cards Used in the uBR10012 Router (continued)

Description	Specifications
Cisco uBR10-MC5X20S/U cable interface line cards	• Cisco UBR10-MC5X20S= • Cisco UBR10-MC5X20U= • Power consumption: 185W[1] (631.2 BTU[2]/hr) • Weight:16 lb (7.26 kg) • Width: 1.36 in (3.55 cm) Height: 20 in. (50.80 cm) Depth: 16 in. (10.64 cm) • Cisco UBR10-MC5X20S MTBF: 38, 922 hours • Cisco UBR10-MC5X20U MTBF: 40,256 hours
Cable kit (3m MCX to F cables) Cable kit with pre configured cables Cable extraction tool Universal cable holder MCX connector strip tool F connector strip tool MCX connector crimper tool F connector crimper tool MCX fixed pin connector F connector MCX connector to F connector adapter 75–ohm precision miniature video cable Shrink tubing	• PN-74-2984-01, White Sands Engineering (or Asheridge Communications Limited)[4] • PN-74-2984-01-DNS, White Sands Engineering (or Asheridge Communications Limited) • RTOOLWSE, White Sands Engineering (or Asheridge Communications Limited) • PN–133-8447-026, Johnson Components[5] PN-29-4442-02, White Sands Engineering (or Asheridge Communications Limited) • PN-CPT-7538-125, White Sands Engineering (or Asheridge Communications Limited) • PN-CPT-753, White Sands Engineering (or Asheridge Communications Limited) • PN-C47-10120, White Sands Engineering (or Asheridge Communications Limited) • PN-ACT-270, White Sands Engineering (or Asheridge Communications Limited) • PN-MCXFP, White Sands Engineering (or Asheridge Communications Limited) • PN-ASFP, White Sands Engineering (or Asheridge Communications Limited) • PN-53140137, White Sands Engineering (or Asheridge Communications Limited) • PN–YR46940/WS940, Belden[6], single strand bonded foil 1855A type • Size:1/4 inch Shrink ratio:2:1 Recovered wall thickness: 0.025 inch Inside diameter after recovery: 0.125 inch

1. W = Watts
2. BTU = British thermal units
3. Faster CPU, faster SDRAM access

4. 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)
5. Johnson Components at the following URL:http://www.johnsoncomponents.com/
6. Belden Electronics division at the following URL: :http://bwcecom.belden.com/

APPENDIX B

Cable Specifications

This appendix provides the following cabling and pinout information for the Cisco uBR10012 routers.

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

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.

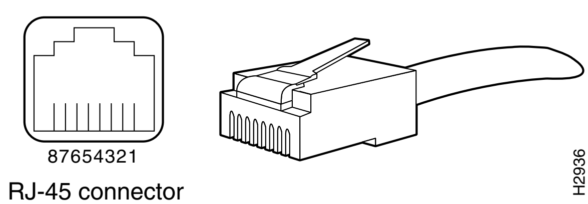
Console and Auxiliary Port Cables and Pinouts

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 as the wire connected to the pin on the right hand plug, as shown in Figure B-3.

Figure B-2 Rollover Cable

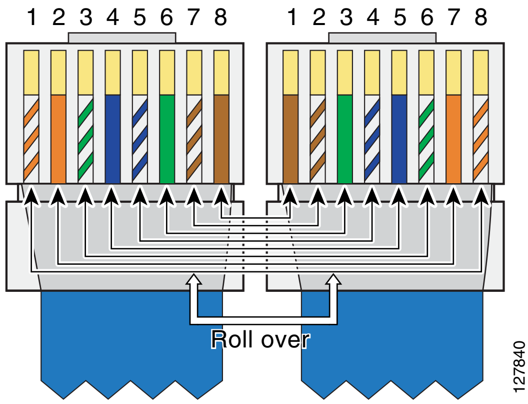
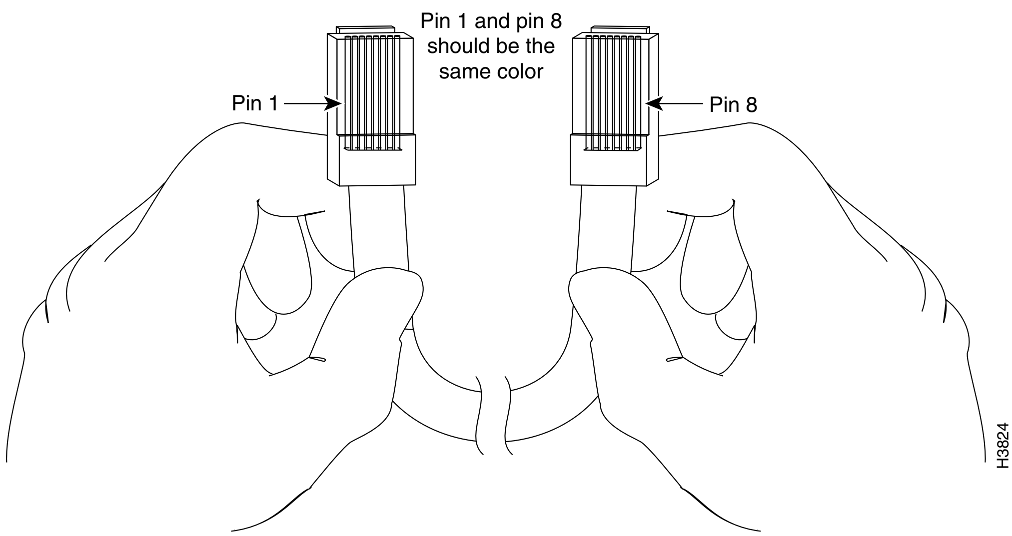


Figure B-3 RJ-45 Rollover Cable Identification



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
Signal	**RJ-45 Pin**	**RJ-45 Pin**	**DB-9 Pin**	**Signal**
RTS	1[1]	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[1]	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)
Signal	**RJ-45 Pin**	**RJ-45 Pin**	**DB-25 Pin**	**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

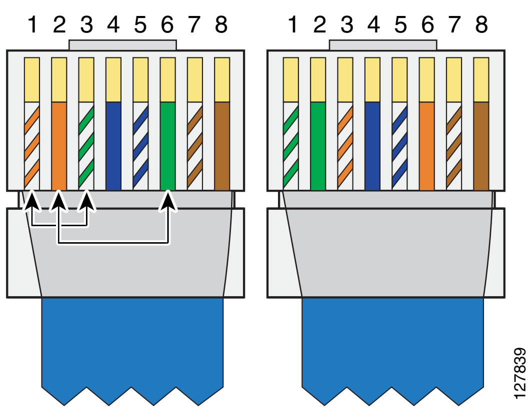
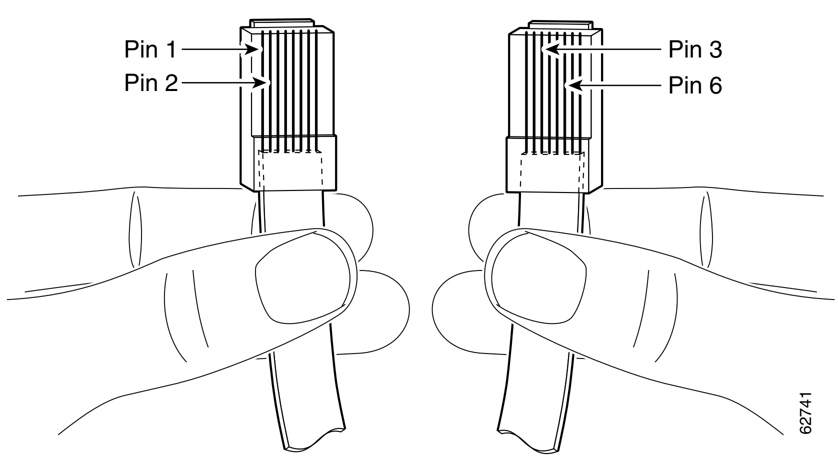


Figure B-5 RJ-45 Crossover Cable Identification



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

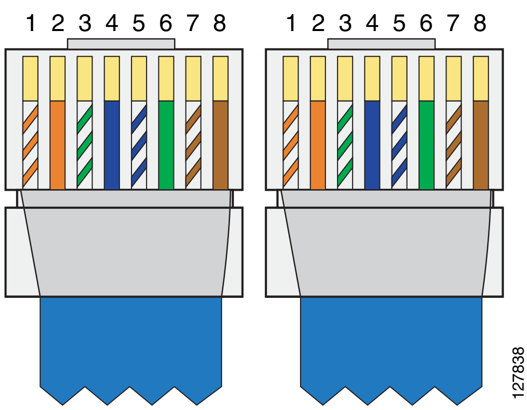
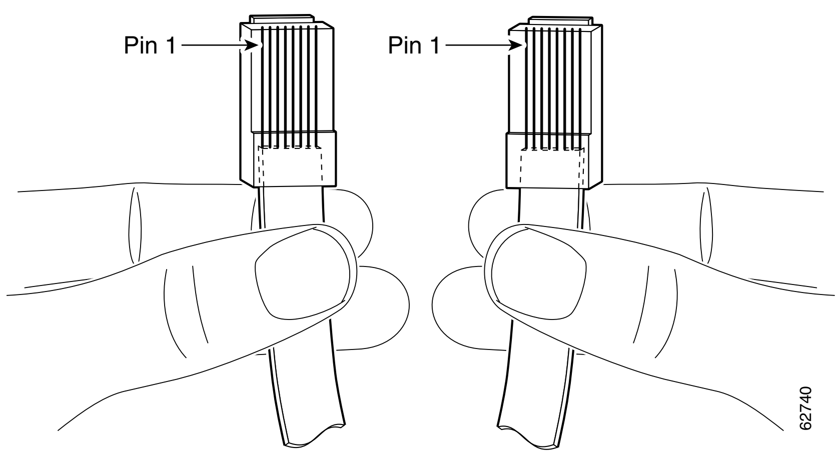


Figure B-7 RJ-45 Straight-Through Cable Identification



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 3cable 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.

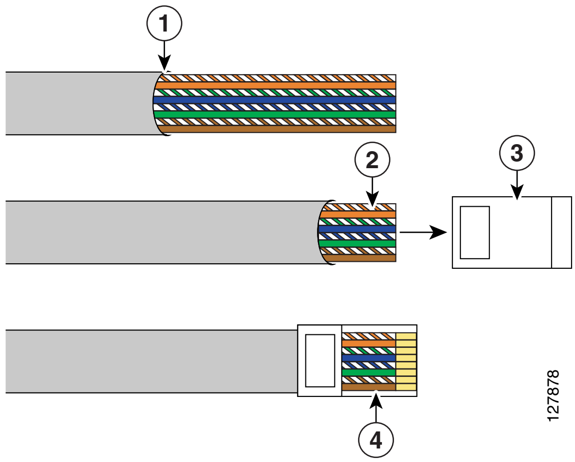
Step 3 After arranging the wires in the correct order, cut them back so there is about 1/2 inch available to install in the connector.

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



1	Jacket cut here	**3**	RJ45 connector
2	Wire cut to one half inch in length	**4**	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

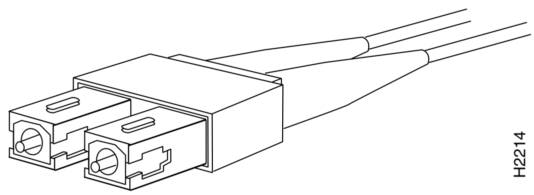
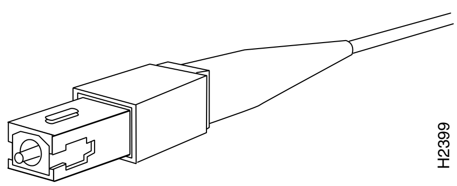


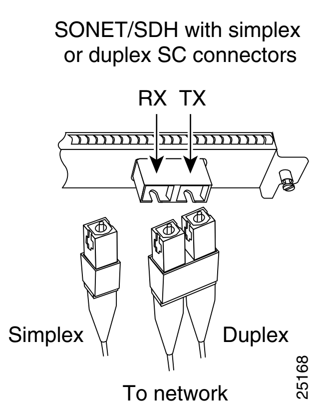
Figure B-10 Simplex SC Cable Connector



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



APPENDIX C

Frequency Allocation

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 it's 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/WebPages/Reference/pdf/CATVref_Section_5_6_r.pdf

http://www.geo-orbit.org/sizepgs/ntscp.html#anchor1016493

http://www.acterna.com/downloads/posters/frequency_chart-acterna.pdf .

http://developer.apple.com/technotes/tn/tn1012.html#RTFToC4

http://www.c-cor.com/

http://www.atxincorporated.com/

http://www.alkenmrs.com/video/standards.html

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

	M	N	B, B1, D1, G	H	I	D, K	K1	L
Lines per frame	525	625	625	625	625	625	625	625
Field rate (Hz)	Monochrome: 60 Color: 59.94	50	50	50	50	50	50	50
Horizontal rate (Hz)	Monochrome: 15,750 Color: 15,734.264	15,625	15,625	15,625	15,625	15,625	15,625	15,625
Video bandwidth (Mhz)	4.2	4.2	5	5	5.5	6	6	6

Table C-2 Analog Television Chrominance Subcarrier Frequencies

	M/NTSC	M/PAL	B, B1, D, D1, G, H, K, N/PAL	I/PAL	B, D, G, H, K, K1, L/SECAM	N/PAL[1]
Chrominance subcarrier frequency (Hz)	3,579,545 ± 10	3,575611.49 ± 10	4,433,618.75 ± 5	4,433,618.75 ± 1	f_{OR} =4,406,250 ± 2,000 f_{OB} =4,250,000 ± 2,000	3,582,056.25 ± 5

1. This value applies to the combination N/PAL used in Argentina.

Table C-3 Analog Television System RF Parameters

	M	N	B, B1, G	H	I	D, D1, K	K1	L
Channel bandwidth at RF (MHz)	6	6	B=7 B1, G=8	8	8	8	8	8
Frequency separation between visual and aural carrier (MHz)	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.[1]	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

Table C-4 NTSC Cable Television Channels and Relative Frequencies (continued)

Channel No.[1]	Channel No., EIA	Bandwidth (MHz)	Visual Carrier (MHz)	Center Freq.	Aural Carrier (MHz)	Incrementally Related Carrier		Harmonically Related Carrier	
						Visual	Aural	Visual	Aural
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[2]	108.0-114.0	109.25	111.0	113.75	109.2750	113.7750	Cannot lock to comb	
A-1	99[2]	114.0-120.0	115.25	117.0	119.75	115.2750	119.7750	Reference channel, Refer to FCC regulations	
A	14[2]	120.0-126.0	121.25	123.0	125.75	121.2625	125.7625	120.0060	124.5060
B	15[2]	126.0-132.0	127.25	129.0	131.75	127.2625	131.7625	126.0063	130.5063
C	16[2]	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
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

Table C-4 NTSC Cable Television Channels and Relative Frequencies (continued)

Channel No.[1]	Channel No., EIA	Bandwidth (MHz)	Visual Carrier (MHz)	Center Freq.	Aural Carrier (MHz)	Incrementally Related Carrier		Harmonically Related Carrier	
						Visual	Aural	Visual	Aural
J	23	216.0-222.0	217.25	219.0	221.75	217.2625	211.7625	216.0108	220.5108
K	24[2]	222.0-228.0	223.25	225.0	227.75	223.2625	227.7625	222.0111	226.5111
L	25[2]	228.0-234.0	229.25	231.0	233.75	229.2625	233.7625	228.0114	232.5114
M	26[2]	234.0-240.0	235.25	237.0	239.75	235.2625	239.7625	234.0117	238.5117
N	27[2]	240.0-246.0	241.25	243.0	245.75	241.2625	245.7625	240.0120	244.5120
O	28[2]	246.0-252.0	247.25	249.0	251.75	247.2625	251.7625	246.0123	250.5123
P	29[2]	252.0-258.0	253.25	255.0	257.75	253.2625	257.7625	252.0126	256.5126
Q	30[2]	258.0-264.0	259.25	261.0	263.75	259.2625	263.7625	258.0129	262.5129
R	31[2]	264.0-270.0	265.25	267.0	269.75	265.2625	269.7625	264.0132	268.5132
S	32[2]	270.0-276.0	271.25	273.0	275.75	271.2625	275.7625	270.0135	274.5135
T	33[2]	276.0-282.0	277.25	279.0	281.75	277.2625	281.7625	276.0138	270.5138
U	34[2]	282.0-288.0	283.25	285.0	287.75	283.2625	287.7625	282.0141	286.5141
V	35[2]	288.0-294.0	289.25	291.0	293.75	289.2625	293.7625	288.0144	292.5144
W	36[2]	294.0-300.0	295.25	297.0	299.75	295.2625	299.7625	294.0147	298.5147
AA	37[2]	300.0-306.0	301.25	303.0	305.75	301.2625	305.7625	300.0150	304.5150
BB	38[2]	306.0-312.0	307.25	309.0	311.75	307.2625	311.7625	306.0153	310.5153
CC	39[2]	312.0-318.0	313.25	315.0	317.75	313.2625	317.7625	312.0156	316.5156
DD	40[2]	318.0-324.0	319.25	321.0	323.75	319.2625	323.7625	318.0159	322.5159
EE	41[2]	324.0-330.0	325.25	327.0	329.75	325.2625	329.7625	324.0162	328.5162
FF	42[2]	330.0-336.0	331.25	333.0	335.75	331.2625	335.7625	330.0165	334.5165
GG	43[2]	336.0-342.0	337.25	339.0	341.75	337.2625	341.7625	336.0168	340.5168
HH	44[2]	342.0-348.0	343.25	345.0	347.75	343.2625	347.7625	342.0171	346.5171
II	45[2]	348.0-354.0	349.25	351.0	353.75	349.2625	353.7625	348.0174	352.5174
JJ	46[2]	354.0-360.0	355.25	357.0	359.75	355.2625	359.7625	354.0177	358.5177
KK	47[2]	360.0-366.0	361.25	363.0	365.75	361.2625	365.7625	360.0180	364.5180
LL	48[2]	366.0-372.0	367.25	369.0	371.75	367.2625	371.7625	366.0183	370.5183
MM	49[2]	372.0-378.0	373.25	375.0	377.75	373.2625	377.7625	372.0186	376.5186
NN	50[2]	378.0-384.0	379.25	381.0	383.75	379.2625	383.7625	378.0189	382.5189
OO	51[2]	384.0-390.0	385.25	387.0	389.75	385.2625	389.7625	384.0192	388.5192
PP	52[2]	390.0-396.0	391.25	393.0	395.75	391.2625	395.7625	390.0195	394.5195
QQ	53[2]	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

Table C-4 NTSC Cable Television Channels and Relative Frequencies (continued)

Channel No.[1]	Channel No., EIA	Bandwidth (MHz)	Visual Carrier (MHz)	Center Freq.	Aural Carrier (MHz)	Incrementally Related Carrier		Harmonically Related Carrier	
						Visual	Aural	Visual	Aural
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
	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

Table C-4 NTSC Cable Television Channels and Relative Frequencies (continued)

Channel No.[1]	Channel No., EIA	Bandwidth (MHz)	Visual Carrier (MHz)	Center Freq.	Aural Carrier (MHz)	Incrementally Related Carrier		Harmonically Related Carrier	
						Visual	Aural	Visual	Aural
	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	768.0-674.0	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
	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

Table C-4 NTSC Cable Television Channels and Relative Frequencies (continued)

Channel No.[1]	Channel No., EIA	Bandwidth (MHz)	Visual Carrier (MHz)	Center Freq.	Aural Carrier (MHz)	Incrementally Related Carrier		Harmonically Related Carrier	
						Visual	Aural	Visual	Aural
	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	
	88.0-108				Music band

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[1]	222.0-228.0	223.25	225.0	227.75	
25[1]	228.0-234.0	229.25	231.0	233.75	
26[1]	234.0-240.0	235.25	237.0	239.75	
27[1]	240.0-246.0	241.25	243.0	245.75	
28[1]	246.0-252.0	247.25	249.0	251.75	
29[1]	252.0-258.0	253.25	255.0	257.75	
30[1]	258.0-264.0	259.25	261.0	263.75	
31[1]	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[1]	270.0-276.0	271.25	273.0	275.75	CATV
33[1]	276.0-282.0	277.25	279.0	281.75	
34[1]	282.0-288.0	283.25	285.0	287.75	
35[1]	288.0-294.0	289.25	291.0	293.75	
36[1]	294.0-300.0	295.25	297.0	299.75	
37[1]	300.0-306.0	301.25	303.0	305.75	
38[1]	306.0-312.0	307.25	309.0	311.75	
39[1]	312.0-318.0	313.25	315.0	317.75	
40[1]	318.0-324.0	319.25	321.0	323.75	
41[1]	324.0-330.0	325.25	327.0	329.75	
42[1]	330.0-336.0	331.25	333.0	335.75	
43[1]	336.0-342.0	337.25	339.0	341.75	
44[1]	342.0-348.0	343.25	345.0	347.75	
45[1]	348.0-354.0	349.25	351.0	353.75	
46[1]	354.0-360.0	355.25	357.0	359.75	
47[1]	360.0-366.0	361.25	363.0	365.75	
48[1]	366.0-372.0	367.25	369.0	371.75	
49[1]	372.0-378.0	373.25	375.0	377.75	
50[1]	378.0-384.0	379.25	381.0	383.75	
51[1]	384.0-390.0	385.25	387.0	389.75	
52[1]	390.0-396.0	391.25	393.0	395.75	
53[1]	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	
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	CATV
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 7and 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)

Channel Number	Bandwidth (MHz)	Visual Carrier (MHz)	Aural Carrier (MHz)
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)

Channel Number	Bandwidth (MHz)	Visual Carrier (MHz)	Aural Carrier (MHz)
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	492.7‘5
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	580.725
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)

Channel Number	Bandwidth (MHz)	Visual Carrier (MHz)	Aural Carrier (MHz)
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
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

Table C-8 Cable Television Channels and Relative Frequencies, PAL D and K (continued)

Channel Number	Bandwidth (MHz)	Visual Carrier (MHz)	Aural Carrier (MHz)
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
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

Table C-8 Cable Television Channels and Relative Frequencies, PAL D and K (continued)

Channel Number	Bandwidth (MHz)	Visual Carrier (MHz)	Aural Carrier (MHz)
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

APPENDIX D

Manufacturers for Headend Provisioning Requirements

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 Cisco uBR10-MC5X20S cable interface line card.

North American Channel Plans

Table D-1 Manufacturers for North American Headend Provisioning Requirements

Manufacturer[1]	Web Site or Phone Number	Products/Model
Upconverters		
Barco	http://www.barco.com	Gemini
Motorola[2]	http://www.gi.com	CDCM2000
Scientific Atlanta	http://www.sciatl.com	Continuum 9860, 9861
Vecima Networks, Inc.	http://www.vecima.com/	HD4040, MA4040
Diplex Filters		
Eagle Comtronics	http://www.eaglecomtronics.com	Diplex filters
Microwave Filter Company, Inc.	http://www.microwavefilter.com	Diplex filters
PCI Technologies	http://www.pci.com	Diplex filters
Viewsonics	http://www.viewsonics.com	Diplex filters
Coaxial Jumpers, Attenuators, Splitters, and Taps		
Viewsonics	http://www.viewsonics.com	Variable attenuators, Comb generators, Cisco uBR kit (splitter, diplex filter, attenuators)
Vecima Networks, Inc.	http://www.vecima.com/	Cisco uBR kit (splitter, diplex filter, attenuators)

Table D-1 Manufacturers for North American Headend Provisioning Requirements (continued)

Manufacturer[1]	Web Site or Phone Number	Products/Model
White Sands Engineering, Inc	http://www.whitesandsengineering.com 1 800-jumpers or 602 581-0331	Coaxial jumpers
GPS Receivers		
Agilent[3]	http://www.tm.agilent.com	Agilent 85960B, 85961B
Symmetricom	http://www.symmetricom.com	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

Manufacturer	Web Site or Phone Number	Products/Model
Digital Signal Level Meters/QAM Analyzers		
Acterna	http://www.acterna.com	SDA-5000, w/Option 4B
Agilent[1]	http://www.tm.agilent.com	Agilent 8594Q, N1776A
Telsey[2]	http://www.telsey.it	DMA120, DMA122
Sencore	http://www.sencore.com	QAM-B970
Sunrise Telecom[3]	http://www.sunrisetelecom.com	CR1200R, AT2000RQ
Trilithic	http://www.trilithic.com	860DSP w/Option QA1
Spectrum Analyzers		
Agilent	http://www.tm.agilent.com	Agilent 8591C, N1776A
Tektronics	http://www.tek.com	2715
Sunrise Telecom	http://www.sunrisetelecom.com	AT2000R
Vector Signal Analyzers		
Agilent	http://www.tm.agilent.com	Agilent 89411A

1. Formerly Hewlett-Packard Test and Measurement Division.
2. Formerly Tektronics DMA division
3. Formerly Hukk Engineering and Avantron.

European Channel Plans

Table D-3 Manufacturers for European Headend Provisioning Requirements

Manufacturer [1]	Web Site or Phone Number	Products/Model
Upconverters		
Barco	http://www.barco.com	Gemini
Motorola[2]	http://www.gi.com	CDCM2000
Scientific Atlanta	http://www.sciatl.com	Continuum
Vecima Networks, Inc.	http://www.vecima.com/	HD4040, MA4040
Diplex Filters		
Eagle Comtronics	http://www.eaglecomtronics.com	Diplex filters
Microwave Filter Company, Inc.	http://www.microwavefilter.com	Diplex filters
PCI Technologies	http://www.pci.com	Diplex filters
Viewsonics	http://www.viewsonics.com	Diplex filters
Coaxial Jumpers, Attenuators, Splitters, and Taps		
Viewsonics	http://www.viewsonics.com	Variable attenuators, Comb generators, Cisco kit (splitter, diplex filter, attenuators, coax jumpers
Vecima Networks, Inc.	http://www.vecima.com/	Cisco uBR kit (splitter, diplex filter, attenuators)
White Sands Engineering, Inc	http://www.whitesandsengineering.com 1 800-jumpers or 602 581-0331	Coaxial jumpers
GPS Receivers		
Agilent[3]	http://www.tm.agilent.com	Agilent 85960B, 85961B
Symmetricom	http://www.symmetricom.com	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
Digital Signal Level Meters/QAM Analysers		
Acterna	http://www.acterna.com	SDA-5000 w/Option 4B
Agilent[1]	http://www.tm.agilent.com	Agilent 8594Q, N1776A
Sunrise Telecom[2]	http://www.sunrisetelecom.com	AT2000RQ
Swires Research	http://www.swire.com	TVA 2000-Q
Telsey[3]	http://www.telsey.it	DMA121, DMA122
Trilithic	http://www.trilithic.com	860DSP w/Option QA1
Spectrum Analyzers		
Agilent	http://www.tm.agilent.com	Agilent 8591C
Tektronix	http://www.tek.com	2715
Sunrise Telecom	http://www.sunrisetelecom.com	AT2000R
Vector Signal Analyzers		
Agilent	http://www.tm.agilent.com	Agilent 89411A

1. Formerly Hewlett-Packard Test and Measurement Division
2. Formerly Hukk Engineering and Avantron.
3. Formerly Tektronics DMA division

Cisco uBR10-MC5X20S/U Cable Kits and Tools

Table D-5 Cisco uBR10-MC5X20S/U 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 **Note** For a list of part numbers, see the FRU documentation.[1]	http://www.whitesandsengineering.com 1 800-jumpers or 602 581-0331	Cable kit (3m MCX to F cables) Cable kit with pre configured cables Cable extraction tool Universal cable holder MCX connector strip tool MCX connector crimper tool MCX fixed pin connector MCX connector to F connector adapter F connector strip tool F connector crimper tool F connectors

1. For Cisco uBR10-MC5X20S/U cable interface line card documentation at the following URL:
http://www.cisco.com/univercd/cc/td/doc/product/cable/ubr10k/ubr10012/frus/index.htm

GLOSSARY

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.

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.

B

Backplane 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.

Bellcore 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.

BER Bit error rate. The ratio of received bits that contain errors.

BGP Border Gateway Protocol. An interdomain routing protocol that replaces EGP. BGP exchanges connection information with other BGP systems. It is defined by RFC 1163.

Bit error rate See BER.

Border Gateway Protocol See BGP.

Broadcast Data packet that is sent to all nodes on a network. Broadcasts are identified by a broadcast address. Compare with Multicast and Unicast.

C

CCITT Consultative Committee for International Telegraph and Telephone. International organization responsible for the development of communications standards. Now called the ITU-T. (See ITU-T.)

CEF 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.

Central Office See CO.

Channel Communication path. Multiple channels can be multiplexed over a single cable in certain environments.

Cisco Express Forwarding See CEF.

Cisco IOS 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.

Clear channel DS3 A framed DS3 signal which is not multiplexed from 28 DS1 signals. Sometimes referred to as unchannelized DS3.

CLI Command line interface. Interface that allows the user to interact with the operating system by entering commands and optional arguments at the command prompt.

CO 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.

Command Line Interface See CLI.

Console Data terminal equipment (DTE) through which commands are entered into a host.

Critical alarm 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 **show facility-alarm status** command. See also Major alarm and Minor alarm.

D

Data terminal equipment See DTE.

DCE 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 DTE.

DRAM 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 SRAM.

DS0 Digital signal level 0. Framing specification used in transmitting digital signals over a single channel at 64 kbps on a T1 facility. Compare with DS1 and DS3.

DS1 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 DS0 and DS3.

DS3 Digital signal level 3. Framing specification used for transmitting digital signals at 44.736 Mbps on a T3 facility. Compare with DS0 and DS1.

DSU 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.

DTE 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.

Dynamic random access memory See DRAM.

E

E1	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.
Edge Services Router	See ESR.
Electromagnetic interference	See EMI.
Electrostatic discharge	See ESD.
EMI	Electromagnetic interference. Interference by electromagnetic signals that can cause reduced data integrity and increased error rates on transmission channels.
EMP	Electromagnetic pulse. Caused by lightning and other high-energy phenomena. Capable of coupling enough energy into unshielded conductors to destroy electronic devices.
ESD	Electrostatic discharge. Discharge of stored static electricity that can damage electronic equipment and impair electrical circuitry, resulting in complete or intermittent failures.
ESR	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.
Ethernet	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 Fast Ethernet, Gigabit Ethernet, IEEE 802.3.

F

Fast Ethernet	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 Ethernet and Gigabit Ethernet. See also 100Base-T and IEEE 802.3.
Fiber-optic cable	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.
Field-replaceable unit	See FRU.
Flash memory	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.

Frame Relay 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.

FRU 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.

G

GBIC 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 1000Base-LX/LH, 1000Base-SX, and 1000Base-ZX.

Gigabit Ethernet Gigabit Ethernet. Ethernet running at a transmission speed of 1 billion bits per second.

Gigabit Interface Converter See GBIC.

H

HHGE Half-Height Gigabit Ethernet

Hot swapping 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).

I

IEEE 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.

IEEE 802.3 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.

Institute of Electrical and Electronics Engineers See IEEE.

Intermediate reach See IR.

Internet service provider See ISP.

IOS Internet Operating System. See Cisco IOS.

IP 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.

IP multicast 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.

IR Intermediate reach. SONET/SDH specification for transmit power and receive sensitivity that achieves a 9.3-mile (15-km) reach.

ISP Internet Service Provider. A company that provides Internet access to other companies and individuals.

ITU-T 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.

L

LAN 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 MAN and WAN.

Line card Any I/O card that can be inserted in a modular chassis.

LMI 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.

Local-area network See LAN.

Loopback test 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.

LOS 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).

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 know 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.

Multicast	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 Broadcast and Unicast.
Multilink Point-to-Point	See MLP.
Multimode fiber	See MMF.
Multiplexing	An activity in which multiple logical signals are transmitted simultaneously across a single physical channel.
Multiprotocol Label Switching	See MPLS.

N

NEBS	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.
Network Equipment Building Systems	See NEBS.
Network termination unit	See NTU.
Nonvolatile RAM	See NVRAM.
NTU	Network terminating unit. The network equipment that connects directly to the data terminal equipment.
NVRAM	Nonvolatile RAM. RAM that retains its contents when a unit is powered off.

O

OC	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).
ODL	Optical data link.
OIR	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.
Online insertion and removal	See OIR.

Optical carrier See OC.

Optical fiber See Fiber-optic cable.

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.

PRE 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 PXF Network Processors.

PXF Network Processors Parallel eXpress Forwarding network processors. A pair of programmable ASICs that perform parallel processing to support high performance Layer 3 forwarding.

Q

QoS Quality of service. A measure of performance for a transmission system that reflects its transmission quality and service availability.

QPPB 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.

Quality of Service See QoS.

R

RAM Random-access memory. Volatile memory that can be read and written by a microprocessor.

Random Access Memory See RAM.

Read only memory See ROM.

Redundancy 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.

Remote monitoring See RMON.

Request for comments See RFC.

RFC 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.

RMON 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.

ROM Read only memory. Nonvolatile memory that can be read, but not written, by the microprocessor.

S

SAR 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 AAL.

SFP small formfactor pluggable (module) as in GBIC

Short reach See SR.

Simple Network Management Protocol See SNMP.

Single-mode fiber See SMF.

SMF 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 Multimode fiber.

SNMP 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 SNMP2.

SNMP2 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 SNMP.

SONET 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.

SR Short reach. SONET/SDH specification for transmit power and receive sensitivity that achieves a 1.2-mile (2 km) reach.

SRAM 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 DRAM.

Subrate DS3 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.

Synchronous Optical Network See SONET.

T

T1 Digital WAN carrier facility. T1 transmits DS1-formatted data at 1.544 Mbps through the telephone switching network.

T3	Digital WAN carrier facility. T3 transmits DS3-formatted data at 44.736 Mbps through the telephone switching network.
TAC	A Cisco Technical Assistance Center. There are four TACs worldwide.
TACACS	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.
TACACS+	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.
TCC+	See Timing, Communication, and Control Plus (TCC+) card.
TDM	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.
Telcordia	Organization that performs research and development on behalf of the Regional Bell Operating Companies (RBOCs). Formerly called Bellcore.
TELNET	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.
Terminal Access Controller Access Control System Plus	See TACACS+.
TFTP	Trivial File Transfer Protocol. Simplified version of FTP that allows files to be transferred from one computer to another over a network.
Time-division multiplexing	See TDM.
Timing, Communication, and Control Plus	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.
Traffic management	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.
Traffic shaping	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.

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.

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.

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.

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