



Cisco Wide Area Virtualization Engine 574 Hardware Installation Guide

November 2008

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Cisco Wide Area Virtualization Engine 574 Hardware Installation Guide

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Preface

This preface describes the purpose of the *Cisco Wide Area Virtualization Engine 574 Hardware Installation Guide*, who should read it, how it is organized, and its document conventions.

This preface contains the following sections:

- [Purpose, page ix](#)
- [Audience, page x](#)
- [Organization, page x](#)
- [Conventions, page xi](#)
- [Related Documentation, page xviii](#)
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Purpose

This installation guide explains how to prepare your site for installation, how to install a Wide Area Virtualization Engine 574 (WAVE-574) in an equipment rack, and how to maintain and troubleshoot the system hardware. After completing the hardware installation procedures covered in this guide, you will then use the appropriate related publications to configure your system. (See the [“Related Documentation”](#) section on page xviii.)

Audience

To use this installation guide, you should be familiar with internetworking equipment and cabling, and have a basic knowledge of electronic circuitry and wiring practices.

To complete the installation, including the software configuration for your WAVE-574 appliance and for the router that works with the WAVE-574 appliance, you should be familiar with basic networking principles, router configuration, and web page protocols.



Warning

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

Organization

This guide is organized as follows:

Chapter	Title	Description
Chapter 1	Introducing the Cisco Wide Area Virtualization Engine 574	Describes the physical properties and provides a functional overview of the WAVE-574.
Chapter 2	Preparing to Install the WAVE-574	Describes safety considerations and gives an overview of the installation and procedures that you should perform <i>before</i> the actual installation.
Chapter 3	Installing the WAVE-574	Describes how to install the hardware and connect the external network interface cables.
Chapter 4	Installing Hardware Options for the WAVE-574	Describes how to install adapters and hard disk drives.
Chapter 5	WAVE Inline Network Adapter	Describes the features and cabling requirements of the Cisco WAVE-574 inline network adapter.

Chapter	Title	Description
Chapter 6	Troubleshooting the System Hardware	Describes troubleshooting procedures for the hardware installation.
Appendix A	WAVE-574 Hardware Specifications	Gives a summary of the hardware features and specifications.
Appendix B	Maintaining the WAVE-574	Describes how to maintain the WAVE-574.

Conventions

Command descriptions use the following conventions:

Convention	Description
boldface font	Commands and keywords are in boldface .
<i>italic</i> font	Variables for which you supply values are in <i>italics</i> .
[]	Elements in square brackets are optional.
{ x y z }	Alternative keywords are grouped in braces and separated by vertical bars.
[x y z]	Optional alternative keywords are grouped in brackets and separated by vertical bars.
string	A nonquoted set of characters. Do not use quotation marks around the string, or the string will include the quotation marks.

Screen examples use the following conventions:

Convention	Description
screen font	Terminal sessions and information the system displays are in screen font.
boldface screen font	Information you must enter is in boldface screen font.

Convention	Description
<i>italic screen font</i>	Variables for which you supply values are in <i>italic screen font</i> .
^	The symbol ^ represents the key labeled Control—for example, the key combination ^D in a screen display means hold down the Control key while you press the D key.
< >	Nonprinting characters, such as passwords, are in angle brackets.
[]	Default responses to system prompts are in square brackets.
!, #	An exclamation point (!) or a pound sign (#) at the beginning of a line of code indicates a comment line.

Notes, cautionary statements, and safety warnings use these conventions:



Note

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



Caution

Means *reader be careful*. You are capable of doing something that might result in equipment damage or loss of data.

**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

Figyelem

FONTOS BIZTONSÁGI ELOÍRÁSOK

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

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이 지시 사항을 보관하십시오.

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 آخر 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 כדי לאתר את התרגום באזהרות הבטיחות המתורגמות שמצורפות להתקן.

שמור הוראות אלה

Opomena **ВАЖНИ БЕЗБЕДНОСНИ НАПАТСТВИЈА**
Симболот за предупредување значи опасност. Се наоѓате во ситуација што може да предизвика телесни повреди. Пред да работите со опремата, бидете свесни за ризикот што 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 ОБИЕ 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

Opozorilo **POMEMBNI VARNOSTNI NAPOTKI**

Ta opozorilni simbol pomeni nevarnost. Nahajate se v situaciji, kjer lahko pride do telesnih poškodb. Preden pričnete z delom na napravi, se morate zavedati nevarnosti udara električnega toka, ter tudi poznati preventivne ukrepe za preprečevanje takšnih nevarnosti. Uporabite obrazložitevno številko na koncu posameznega opozorila, da najdete opis nevarnosti v priloženem varnostnem priročniku.

SHRANITE TE NAPOTKE!

警告

重要安全性指示

此警告符號代表危險，表示可能造成人身傷害。使用任何設備前，請留心電路相關危險，並熟悉避免意外的標準作法。您可以使用每項警告後的聲明編號，查詢本裝置隨附之安全性警告譯文中的翻譯。
請妥善保留此指示

Related Documentation

The WAVE-574 appliance supports the Cisco Wide Area Application Services software (WAAS) and can function as either a WAAS Central Manager or as an Application Acceleration Engine.

The Cisco WAAS software document set includes the following documents:

- *Release Note for Cisco Wide Area Application Services*
- *Cisco Wide Area Application Services Command Reference*
- *Cisco Wide Area Application Services Quick Configuration Guide*
- *Cisco Wide Area Application Services Configuration Guide*
- *Cisco Wide Area Application Services API Reference*
- *Cisco WAAS Installation and Configuration Guide for Windows on a Virtual Blade*

The documentation for this product also includes the following hardware-related documents:

- *Regulatory Compliance and Safety Information for the Cisco Wide Area Virtualization Engines*

Obtaining Documentation and Submitting a Service Request

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

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

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CHAPTER 1

Introducing the Cisco Wide Area Virtualization Engine 574

This chapter provides a basic functional overview of the Cisco Wide Area Virtualization Engine 574 (WAVE-574) appliance and describes the hardware, major components, and front and back panel indicators and controls.

This chapter contains the following sections:

- [Supported Products, page 1-1](#)
- [Hardware Features, page 1-2](#)
- [System Board Components and LEDs, page 1-9](#)

Supported Products

The WAVE-574 appliance supports Cisco Wide Area Application Services (WAAS) software version 4.1.1 and later releases.

Hardware Features

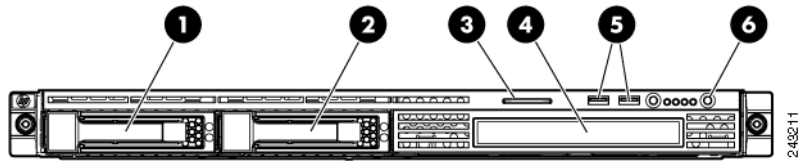
This section illustrates and describes the front and back panel controls, ports, and LED indicators on the WAVE-574. It contains the following topics:

- [Front Panel Components and LEDs, page 1-2](#)
- [Back Panel Components and LEDs, page 1-5](#)
- [Location of Ports and Connectors, page 1-7](#)

Front Panel Components and LEDs

Figure 1-1 shows the front panel components.

Figure 1-1 Front Panel



1	Hard drive bay 1 (SATA device number 0)	4	DVD/CD-ROM drive bay
2	Hard drive bay 2 (SATA device number 1)	5	USB connectors (not used, unsupported)
3	Serial label pull tab	6	Power On/Standby button and system power LED

Figure 1-2 shows the front panel LEDs.

Figure 1-2 Front Panel LEDs

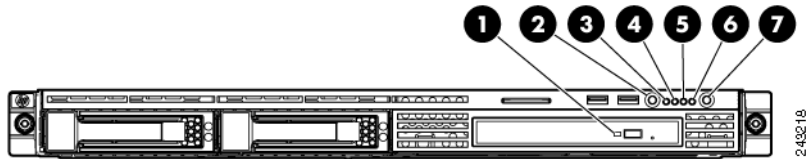


Table 1-1 describes the front panel LEDs and their functions.

Table 1-1 Front Panel LEDs

LED		Color	State	Description
1	DVD/CD-ROM drive activity LED	Green	On	Drive activity is normal.
		Amber	On	Drive failure has occurred.
		—	Off	No drive activity exists.
2	UID button/LED	Blue	On	Identification is activated.
		Blue	Flashing	System is being remotely managed.
		—	Off	Identification is deactivated.
3	Internal health LED	Green	On	System health is normal.
		Amber	On	System health is degraded. A system board LED is lit inside the appliance. See the “System Board LEDs” section on page 10.
		Red	On	System health is critical. A system board LED is lit inside the appliance. See the “System Board LEDs” section on page 10.
		—	Off	System health is normal (when in standby mode).

Table 1-1 Front Panel LEDs (continued)

LED		Color	State	Description
4	NIC 1 link/activity LED	Green	On	Network link exists.
		Green	Flashing	Network link and activity exist.
		—	Off	No network link exists. If power is off, the front panel LED is not active. View the LEDs on the RJ-45 connector.
5	NIC 2 link/activity LED	Green	On	Network link exists.
		Green	Flashing	Network link and activity exist.
		—	Off	No network link exists. If power is off, the front panel LED is not active. View the LEDs on the RJ-45 connector.
6	Drive activity LED	Green	On	Drive activity is normal.
		Amber	On	Drive failure has occurred.
		—	Off	No drive activity exists.
7	Power On/Standby button and system power LED	Green	On	System is on.
		Amber	On	System is shut down, but power is still applied.
		—	Off	Power cord is not attached or power supply failure has occurred.

Back Panel Components and LEDs

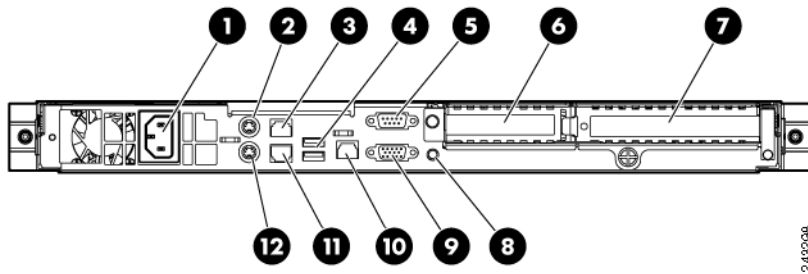
Figure 1-3 shows the back panel components.



Note

You can connect a keyboard to any USB port and connect a monitor to the video connector to troubleshoot the BIOS boot process. However, video output is for troubleshooting only during the BIOS boot process. The video output stops displaying when the serial port becomes active. To monitor the boot process in normal operation, use the serial console port.

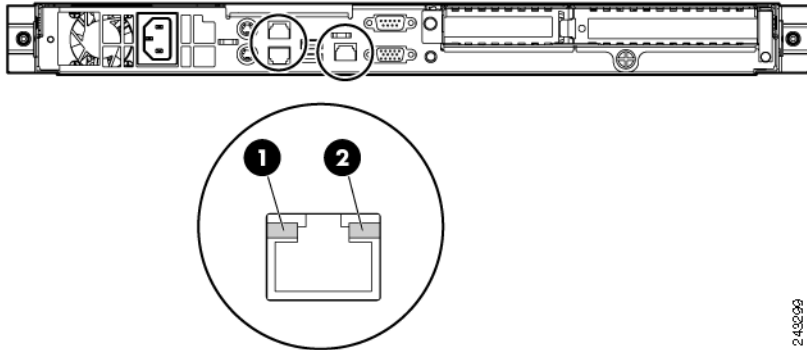
Figure 1-3 Back Panel



1	Power cord connector	7	Expansion slot for Cisco WAVE inline adapters (PCI Express expansion slot, full-length)
2	Mouse connector (unused)	8	UID button/LED
3	10/100/1000 NIC 2 connector	9	Video connector (unused)
4	USB connectors (not used, unsupported)	10	System management port (not used, unsupported)
5	Console port (serial connector)	11	10/100/1000 NIC 1 connector
6	PCI Express expansion slot, low profile, half-length	12	Keyboard connector (unused)

Figure 1-4 shows the back panel LEDs.

Figure 1-4 Back Panel LEDs



2432993

Table 1-2 describes the back panel LEDs and their functions.

Table 1-2 Back Panel LEDs

LED		Color	State	Description
1	NIC activity	Green	On	Activity exists.
		Green	Flashing	
		—	Off	No activity exists.
2	NIC link	Green	On	Link exists.
		—	Off	No link exists.

Location of Ports and Connectors

The WAVE appliance supports two Ethernet connectors and one Console port on the back of the appliance.

Figure 1-3 shows the back panel ports and connectors.



Warning

To avoid electric shock, do not connect safety extra-low voltage (SELV) circuits to telephone-network voltage (TNV) circuits. LAN ports contain SELV circuits, and WAN ports contain TNV circuits. Some LAN and WAN ports both use RJ-45 connectors. Use caution when connecting cables. Statement 1021

This section contains the following topics:

- [Ethernet Port Connectors](#)
- [Console Port Serial Connector](#)

Ethernet Port Connectors

Connect a Category 3, 4, or 5 unshielded twisted-pair cable to an Ethernet connector. 100BASE-TX and 1000BASE-T Fast Ethernet standards require Category 5 or higher cabling.

The WAVE-574 appliance has two Ethernet connectors that are attached to the Ethernet controllers (see [Figure 1-3](#) and [Figure 1-5](#)). The Ethernet controllers are integrated on the system board. They provide an interface for connecting to a 10-Mbps, 100-Mbps, or 1-Gbps network and provide full-duplex (FDX) capability, which enables simultaneous transmission and reception of data on the network. If the Ethernet ports in the server support auto negotiation, the controllers detect the data-transfer rate (10BASE-T, 100BASE-TX, or 1000BASE-T) and duplex mode (full duplex or half duplex) of the network and automatically operate at that rate and mode. You do not have to set any jumpers or configure the controllers.



Note

There is a third RJ45 connector on the rear of the appliance (see [Figure 1-3](#)). This is the unused system management port. Do not connect this port to your network.

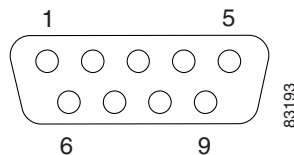
If a problem occurs with the primary Ethernet connection, all Ethernet traffic associated with this primary connection is automatically switched to the redundant Ethernet connection. If the applicable device drivers are installed, switching occurs without data loss or user intervention.

Figure 1-5 *Ethernet Port Connector*

Console Port Serial Connector

The WAVE-574 appliance has one console port connector (see [Figure 1-6](#)). Use the console port connector to access the command-line interface (CLI) for controlling the WAVE appliance.

Figure 1-6 *Console Port Serial Connector*



System Board Components and LEDs

This section shows where the system board components are located, LED functions, and describes the system maintenance switch operating options.

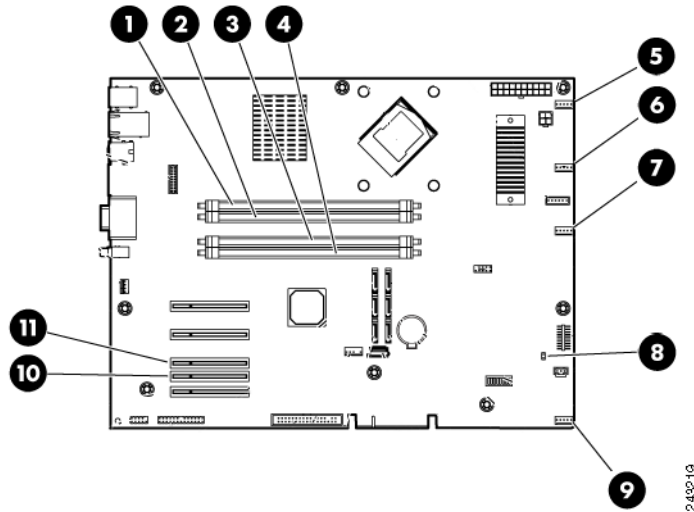
This section contains the following topics:

- [System Board Components, page 1-9](#)
- [System Board LEDs, page 1-10](#)
- [System Board Fans, page 1-12](#)

System Board Components

Figure 1-7 shows the layout of the system board components.

Figure 1-7 System Board Components



1	DIMM slot 1 (bank A)	7	Fan 3 connector
2	DIMM slot 2 (bank B)	8	NMI jumper
3	DIMM slot 3 (bank A)	9	Fan 4 connector
4	DIMM slot 4 (bank B)	10	PCI Express expansion slot 4
5	Fan 1 connector	11	PCI Express expansion slot 5
6	Fan 2 connector		

System Board LEDs

Figure 1-8 shows the system board LEDs.

Figure 1-8 System Board LEDs

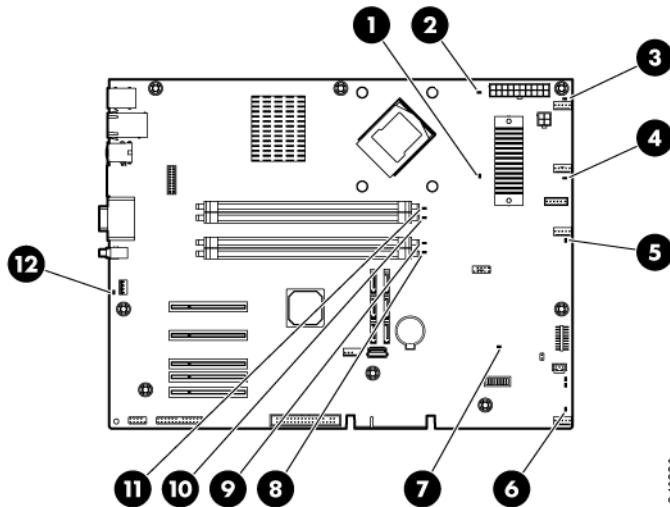


Table 1-3 describes the system board LED functions.

Table 1-3 System Board LEDs

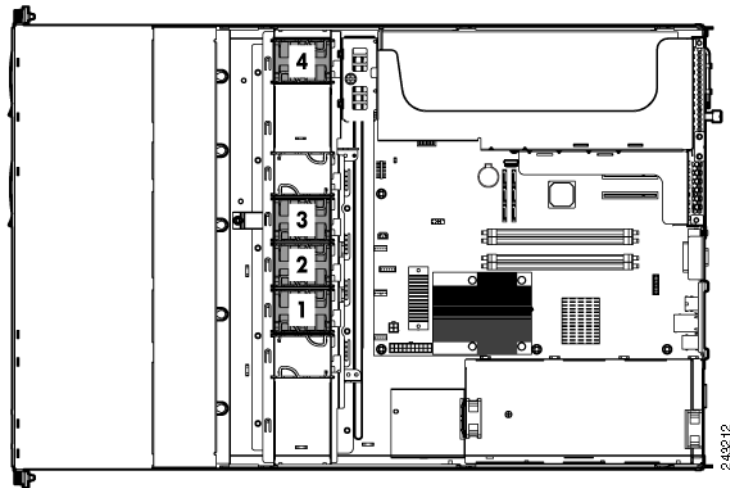
LED		Color	State	Description
1	Processor error	Amber	On	A multibit error has occurred.
		—	Off	No activity exists.
2	PMM failure	Amber	On	PPM has failed.
		—	Off	Normal.
3	Fan 1 failure	Amber	On	Fan 1 has failed or is missing.
		—	Off	Normal.
4	Fan 2 failure	Amber	On	Fan 2 has failed or is missing.
		—	Off	Normal.
5	Fan 3 failure	Amber	On	Fan 3 has failed or is missing.
		—	Off	Normal.
6	PCI fan failure	Amber	On	PCI fan has failed or is missing.
		—	Off	Normal.
7	Over temperature	Amber	On	System has reached a cautionary or critical temperature level.
		—	Off	Normal.
8	DIMM 4 failure	Amber	On	DIMM has failed or is missing.
		—	Off	Normal.
9	DIMM 3 failure	Amber	On	DIMM has failed or is missing.
		—	Off	Normal.
10	DIMM 2 failure	Amber	On	DIMM has failed or is missing.
		—	Off	Normal.

Table 1-3 System Board LEDs (continued)

LED		Color	State	Description
11	DIMM 1 failure	Amber	On	DIMM has failed or is missing.
		-	Off	Normal.
12	Reserved	-	-	-

System Board Fans

Figure 1-9 shows the location of the system board fans that provide ventilation for the chassis.

Figure 1-9 System Board Fans



CHAPTER 2

Preparing to Install the WAVE-574

This chapter contains important safety information that you should know before you work with the WAVE-574. Use the guidelines in this chapter to ensure your own personal safety and to help protect your appliance from potential damage.

This chapter contains the following sections:

- [Safety Warnings and Cautions, page 2-2](#)
- [Safety Guidelines, page 2-3](#)
- [Understanding the Environmental Requirements, page 2-7](#)
- [Understanding the Power Requirements, page 2-7](#)
- [Understanding the Grounding Requirements, page 2-8](#)



Note

Read the *Regulatory Compliance and Safety Information for the Cisco Content Networking Product Series* document and the *Site Preparation and Safety Guide* that came with your appliance before you begin the installation.

Safety Warnings and Cautions

Before you install the WAVE-574, observe the following safety warnings and cautions:

**Warning**

Read the installation instructions before connecting the system to the power source. Statement 1004

**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

**Warning**

The plug-socket combination must be accessible at all times, because it serves as the main disconnecting device. Statement 1019

**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

**Warning**

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

**Warning**

Installation of the equipment must comply with local and national electrical codes. Statement 1074

**Caution**

To properly ventilate the system, you must provide at least 7.6 cm (3.0 in) of clearance at the front and back of the WAVE appliance.

**Caution**

To reduce the risk of electric shock or damage to the equipment:

- Do not disable the power cord grounding plug. The grounding plug is an important safety feature.
 - Plug the power cord into a grounded (earthed) electrical outlet that is easily accessible at all times.
 - Unplug the power cord from the power supply to disconnect power to the equipment.
 - Do not route the power cord where it can be walked on or pinched by items placed against it. Pay particular attention to the plug, electrical outlet, and the point where the cord extends from the WAVE appliance.
-

**Caution**

To reduce the risk of personal injury or damage to the equipment:

- Observe local occupation health and safety requirements and guidelines for manual handling.
 - Obtain adequate assistance to lift and stabilize the chassis during installation or removal. The WAVE appliance is unstable when not fastened to the rails. When mounting the WAVE appliance in a rack, remove the power supplies and any other removable module to reduce the overall weight of the product.
-

Safety Guidelines

To reduce the risk of bodily injury, electrical shock, fire, and damage to the equipment, observe the precautions in this section.

This section contains the following topics:

- [General Precautions, page 2-4](#)
- [System Reliability Considerations, page 2-5](#)
- [Working Inside the WAVE-574 with the Power On, page 2-6](#)
- [Protecting Against Electrostatic Discharge, page 2-6](#)

General Precautions

Observe the following general precautions for using and working with the WAVE-574:

- Observe and follow service markings. Do not service any Cisco product except as explained in your system documentation. Opening or removing covers that are marked with the triangular symbol with a lightning bolt may expose you to electrical shock. Components inside these compartments should be serviced only by a trained and qualified service technician.
- If any of the following conditions occur, unplug the product from the electrical outlet and replace the part or contact your customer service representative:
 - The power cable or plug is damaged.
 - An object has fallen into the product.
 - The product has been exposed to water.
 - The product has been dropped or damaged.
 - The product does not operate correctly when you follow the operating instructions.
- Keep your system components away from radiators and heat sources. Also, do not block cooling vents.
- Do not spill food or liquids on your system components, and never operate the product in a wet environment.
- Do not push any objects into the openings of your system components. Doing so can cause fire or electric shock by shorting out interior components.
- Use the product only with other Cisco-approved equipment.
- Allow the product to cool before removing covers or touching internal components.
- Use the correct external power source. Operate the product only from the type of power source indicated on the electrical ratings label. If you are not sure of the type of power source required, consult your service representative or local power company.
- Use only approved power cables. If you have not been provided with a power cable for your WAVE appliance or for any AC-powered option intended for your system, purchase a power cable that is approved for use in your country.

The power cable must be rated for the product and for the voltage and current marked on the product's electrical ratings label. The voltage and current rating of the cable should be greater than the ratings marked on the product.

- To help prevent electric shock, plug the system components and peripheral power cables into properly grounded electrical outlets. These cables are equipped with three-prong plugs to help ensure proper grounding. Do not use adapter plugs or remove the grounding prong from a cable.
- Observe power strip ratings. Make sure that the total ampere rating of all products plugged into the power strip does not exceed 80 percent of the power strip ampere ratings limit.
- Do not use appliance or voltage converters or kits sold for appliances with your product.
- To help protect your system components from sudden, transient increases and decreases in electrical power, use a surge suppressor, line conditioner, or uninterruptible power supply (UPS).
- Position cables and power cords carefully; route cables and the power cord and plug so that they cannot be stepped on or tripped over. Be sure that nothing rests on your system components' cables or power cord.
- Do not modify power cables or plugs. Consult a licensed electrician or your power company for site modifications. Always follow your local or national wiring rules.

System Reliability Considerations

To help ensure proper cooling and system reliability, make sure that the following occurs:

- Each of the drive bays has either a drive or a filler panel installed.
- For rack configurations, make sure that space is available around the appliance to enable the cooling system to work properly. See the documentation that comes with the rack for additional information.
- A removed hot-swappable drive is replaced within 2 minutes of removal.
- Cables for optional adapters are routed according to the instructions provided with the adapters.
- A failed fan is replaced within 48 hours.

Working Inside the WAVE-574 with the Power On

The WAVE-574 is designed to operate safely with the cover removed for short periods (less than 30 minutes). You might need to remove the cover while the power is on, for example, to observe the diagnostic LEDs when troubleshooting. When you work inside an appliance that is powered on, follow these guidelines:

- Avoid loose-fitting clothing on your forearms. Button long-sleeved shirts before working inside the appliance; do not wear cuff links while you are working inside the appliance.
- Do not allow your necktie or scarf to hang inside the appliance.
- Remove jewelry, such as bracelets, necklaces, rings, and loose-fitting wristwatches.
- Remove items from your shirt pocket (such as pens or pencils) that could fall into the appliance as you lean over it.
- Do not drop any metallic objects, such as paper clips, hairpins, or screws, into the appliance.
- Be aware that there are hazardous moving parts exposed inside the appliance when the cover is removed.

Protecting Against Electrostatic Discharge

Static electricity can harm delicate components inside the appliance. To prevent static damage, discharge static electricity from your body before you touch any of your system's electronic components. You can do so by touching an unpainted metal surface on the chassis.

You can also take the following steps to prevent damage from electrostatic discharge (ESD):

- When unpacking a static-sensitive component from its shipping carton, do not remove the component from the antistatic packing material until you are ready to install the component in your system. Just before unwrapping the antistatic packaging, be sure to discharge static electricity from your body.
- When transporting a sensitive component, first place it in an antistatic container or packaging.

- Handle all sensitive components in a static-safe area. If possible, use antistatic floor pads and workbench pads.
- Handle the appliance carefully, holding it by its edges or its frame.
- Do not touch solder joints, pins, or exposed printed circuitry.
- Do not leave the appliance where others can handle and possibly damage the appliance.
- Take additional care when handling appliances during cold weather, because heating reduces indoor humidity and increases static electricity.

Understanding the Environmental Requirements

To ensure continued safe and reliable equipment operation, install or position the system in a well-ventilated, climate-controlled environment.

The maximum recommended ambient operating temperature (TMRA) for most server products is 35 °C (95 °F). The temperature in the room where the rack is located must not exceed 35 °C (95 °F).

For details about the WAVE-574 environmental requirements, see [Appendix A, “WAVE-574 Hardware Specifications.”](#)

Understanding the Power Requirements

Installation of this equipment must comply with local and regional electrical regulations governing the installation of information technology equipment by licensed electricians. This equipment is designed to operate in installations covered by NFPA 70, 1999 Edition (National Electric Code) and NFPA-75, 1992 (code for Protection of Electronic Computer/Data Processing Equipment).



Warning

Take care when connecting units to the supply circuit so that wiring is not overloaded. Statement 1018

**Caution**

Protect the WAVE appliance from power fluctuations and temporary interruptions with a regulating uninterruptible power supply (UPS). This device protects the hardware from damage caused by power surges and voltage spikes and keeps the system in operation during a power failure.

When installing more than one WAVE appliance, you may need to use additional power distribution devices to safely provide power to all devices. Observe the following guidelines:

- Balance the WAVE appliance power load between available AC supply branch circuits.
- Do not allow the overall system AC current load to exceed 80 percent of the branch circuit AC current rating.
- Do not use common power outlet strips for this equipment.
- Provide a separate electrical circuit for the WAVE appliance.

For details about the WAVE-574 power requirements, see [Appendix A](#), “WAVE-574 Hardware Specifications.”

Understanding the Grounding Requirements

To ensure proper operation and safety, you must properly ground the WAVE appliance. In the United States, install the equipment in accordance with NFPA 70, 1999 Edition (National Electric Code), Article 250, as well as any local and regional building codes. In Canada, you must install the equipment in accordance with Canadian Standards Association, CSA C22.1, Canadian Electrical Code. In all other countries, you must install the equipment in accordance with any regional or national electrical wiring codes, such as the International Electrotechnical Commission (IEC) Code 364, parts 1 through 7. Furthermore, you must be sure that all power distribution devices used in the installation, such as branch wiring and receptacles, are listed or certified grounding-type devices.

Because of the high ground-leakage currents associated with multiple WAVE appliances connected to the same power source, we recommend the use of a PDU that is either permanently wired to the building’s branch circuit or includes a

nondetachable cord that is wired to an industrial-style plug. NEMA locking-style plugs or those complying with IEC 60309 are considered suitable for this purpose. Using common power outlet strips for the WAVE appliance is not recommended.



CHAPTER 3

Installing the WAVE-574

This chapter describes how to install a WAVE-574 in an equipment rack. This chapter contains the following sections:

- [Rack-Mounting Parts, Tools, and Considerations, page 3-2](#)
- [Rack Mounting and Cabling the WAVE-574, page 3-3](#)
- [Connecting Power and Booting the System, page 3-4](#)
- [Checking the LEDs, page 3-5](#)
- [Removing or Replacing a WAVE Appliance, page 3-5](#)

Before you begin the installation, read [Chapter 2, “Preparing to Install the WAVE-574”](#) and the *Regulatory Compliance and Safety Information for the Cisco Content Networking Product Series* document.



Warning

Read the installation instructions before connecting the system to the power source. Statement 1004.

Rack-Mounting Parts, Tools, and Considerations

A rack mounting hardware kit is included in your shipping container. To mount the WAVE-574 in the rack, you need a T-10/T-15 Torx screwdriver.

**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

To allow for servicing and adequate airflow, observe the following space and airflow requirements when deciding where to install a rack:

- Leave a minimum clearance of 63.5 cm (25 in) in front of the rack.
- Leave a minimum clearance of 76.2 cm (30 in) behind the rack.
- Leave a minimum clearance of 121.9 cm (48 in) from the back of the rack to the back of another rack or row of racks.

The WAVE-574 draws in cool air through the front door and expels warm air through the rear door. Therefore, the front and rear rack doors must be adequately ventilated to allow ambient room air to enter the cabinet, and the rear door must be adequately ventilated to allow the warm air to escape from the cabinet.

**Caution**

To prevent improper cooling and damage to the equipment, do not block the ventilation openings.

When vertical space in the rack is not filled by a WAVE appliance or rack component, the gaps between the components cause changes in airflow through the rack and across the WAVE appliances. Cover all gaps with filler panels to maintain proper airflow.

**Caution**

Always use filler panels to fill empty vertical spaces in the rack. This arrangement ensures proper airflow. Using a rack without filler panels results in improper cooling that can lead to thermal damage.

- Observe the following additional requirements to ensure adequate airflow and to prevent damage to the equipment:
 - Front and rear doors—If the 42U rack includes closing front and rear doors, you must allow 5,350 sq cm (830 sq in) of holes evenly distributed from top to bottom to permit adequate airflow (equivalent to the required 64 percent open area for ventilation).
 - Side—The clearance between the installed rack component and the side panels of the rack must be a minimum of 7 cm (2.75 in).

Rack Mounting and Cabling the WAVE-574

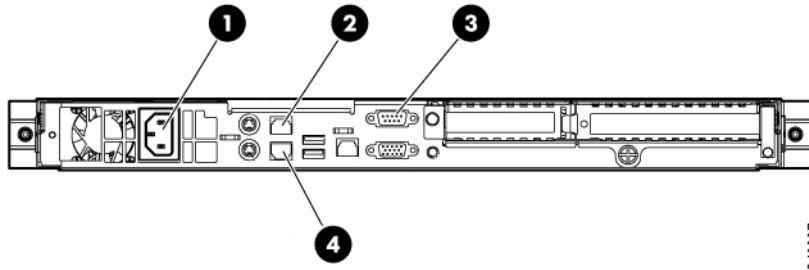
To install the WAVE appliance into a rack with square, round, or threaded holes, refer to the instructions that ship with the rack hardware kit.

Use the following information (see [Figure 3-1](#)) when connecting peripheral cables and power cords to the WAVE appliance.

**Warning**

To reduce the risk of electric shock, fire, or damage to the equipment, do not plug telephone or telecommunications connectors into RJ-45 connectors.

Figure 3-1 Cable Connections



243907

1	Power cord connector	3	Console port (serial connector)
2	10/100/1000 NIC 2 connector	4	10/100/1000 NIC 1 connector

Connecting Power and Booting the System

To connect power to your system, follow these steps:

-
- Step 1** Review the information in the [“Safety Guidelines”](#) section on page 2-3.
 - Step 2** Plug a power cord into the power cord receptacle on the back of the WAVE appliance.
 - Step 3** Connect the other end of the power cord to a power source at your installation site.
 - Step 4** Power up all externally connected devices.
 - Step 5** Press the power control button on the front of the WAVE appliance.

The system should begin booting. Once the operating system boots, you are ready to initialize the basic software configuration. (See the software configuration guide for details.)

**Note**

While the WAVE appliance is powering up, the green power-on LED on the front of the appliance is on.

Checking the LEDs

When the WAVE-574 is up and running, observe the front panel LEDs (see [Figure 1-1](#) and [Table 1-1](#)) to verify that your system is operating properly.

To troubleshoot using the LEDs, see [Chapter 6, “Troubleshooting the System Hardware.”](#)

Removing or Replacing a WAVE Appliance

To remove a WAVE appliance from your network, power it down, disconnect the power cords and network cables, and physically remove the chassis from the rack.

The WAVE appliance is in constant communication with the router on your network. When the router notices that the WAVE appliance is no longer responding to it, the router stops sending requests to the WAVE appliance. This action is transparent to users. If other WAVE appliances are attached to the router, the router continues sending requests to the other WAVE appliances.

When you remove a WAVE appliance, the pages that were cached on that appliance are no longer available to the router or other WAVE appliances. You might see an increase in outgoing web traffic that might have otherwise been fulfilled by the WAVE appliance that you are removing. However, after a time, the router and other WAVE appliances redistribute the load of web traffic.

If you remove the last WAVE appliance from your network, you can also disable WAVE support on the router. However, this action is not necessary because leaving WAVE support enabled when there are no WAVE appliances attached has no effect on the router’s performance.

To replace a WAVE appliance, remove it from the network, and then install a new WAVE appliance and configure it using the same configuration parameters (IP address and so forth) that you used for the removed WAVE appliance.



CHAPTER 4

Installing Hardware Options for the WAVE-574

This chapter provides basic instructions for installing hardware options in your WAVE-574. These instructions are intended for technicians who are experienced with setting up Cisco WAVE-574 hardware.

This chapter contains the following sections:

- [Removing the Covers, page 4-1](#)
- [Completing the Installation, page 4-2](#)
- [Installing a Cisco WAVE Inline Adapter, page 4-3](#)
- [Replacing a Hard Disk Drive, page 4-6](#)
- [Installing Memory, page 4-8](#)

Removing the Covers



Warning

Before working on a system that has an on/off switch, turn OFF the power and unplug the power cord. Statement 1



Caution

To reduce the risk of personal injury from hot surfaces, allow the drives and the internal system components to cool before touching them.

**Caution**

Do not operate the WAVE appliance for long periods with the access panel open or removed. Operating the WAVE appliance in this manner results in improper airflow and improper cooling that can lead to thermal damage.

To remove the appliance covers, follow these steps:

-
- Step 1** Review the information in the [“Safety Warnings and Cautions”](#) section on page 2-2 and the [“Safety Guidelines”](#) section on page 2-3.
 - Step 2** Power off the appliance and all attached devices and disconnect all external cables and power cords.
 - Step 3** Remove the WAVE appliance from the rack.
 - Step 4** Loosen the captive T-15 Torx thumbscrew that secures the access panel to the WAVE appliance.
 - Step 5** Slide the access panel toward the rear of the WAVE appliance, then lift it from the WAVE appliance.
-

Completing the Installation

To complete your installation after you have installed an inline adapter, hard drive, or memory, follow these steps:

-
- Step 1** Lower the access panel onto the WAVE appliance and then slide the access panel toward the front of the WAVE appliance.
 - Step 2** Tighten the captive T-15 Torx thumbscrew that secures the access panel to the WAVE appliance.
 - Step 3** Install the appliance in a rack.
For complete rack installation and removal instructions, see [Chapter 3, “Installing the WAVE-574.”](#)

**Caution**

Install the appliance only in a rack cabinet with perforated doors.

**Caution**

Do not leave open spaces above or below an installed appliance in the rack cabinet. To help prevent damage to appliance components, always install a filler panel to cover the open space and to help ensure proper air circulation. See the documentation that comes with your rack cabinet for more information.

Step 4

Connect the cables and power cords. For information on connecting cables and power cords, see the [“Rack Mounting and Cabling the WAVE-574” section on page 3-3](#).

Installing a Cisco WAVE Inline Adapter

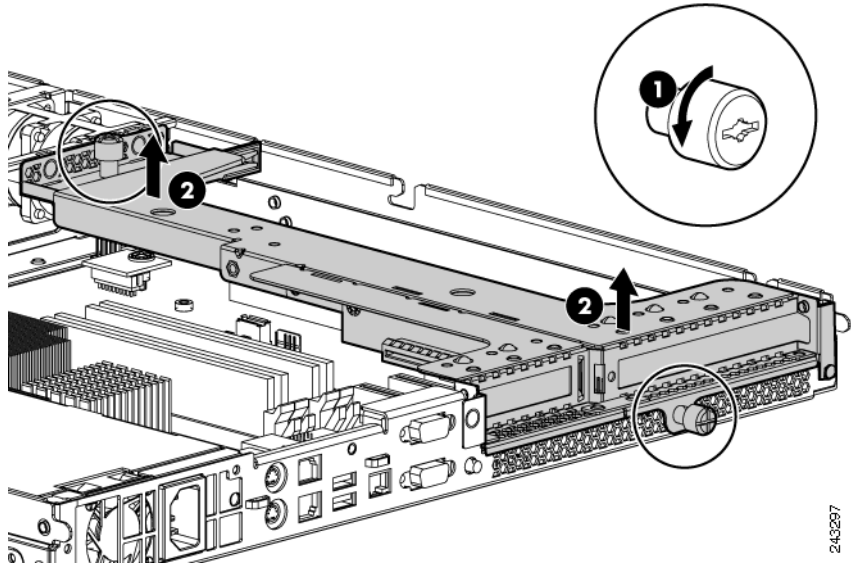
The WAVE-574 can accommodate one optional 2-port Gigabit Ethernet inline network adapter or one optional 4-port Gigabit Ethernet inline network adapter.

For information about the features of the Cisco WAVE Inline Network Adapter and its cabling requirements, see [Chapter 5, “WAVE Inline Network Adapter.”](#)

To install a PCI adapter in the riser-card assembly, follow these steps:

- Step 1** Review the information in the [“Safety Warnings and Cautions” section on page 2-2](#) and the [“Safety Guidelines” section on page 2-3](#).
- Step 2** Power down the appliance and disconnect all power cords and external cables.
- Step 3** Remove the covers. (See the [“Removing the Covers” section on page 4-1](#).)
- Step 4** Remove the PCI riser-card assembly. (See [Figure 4-1](#).)

Figure 4-1 Removing the PCI Riser-Card Assembly



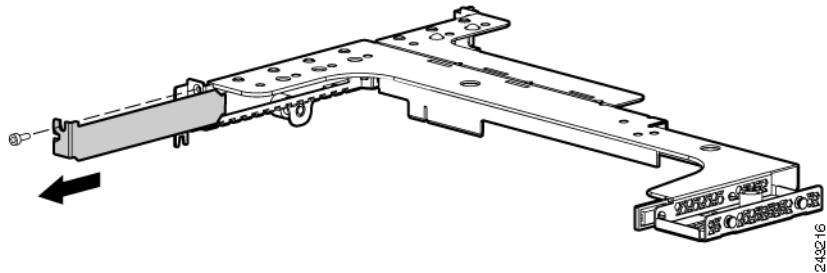
Step 5 Locate Slot 4, which is a standard PCI Express full-length slot.



Note You can only install the Cisco WAVE inline network adapter card in Slot 4.

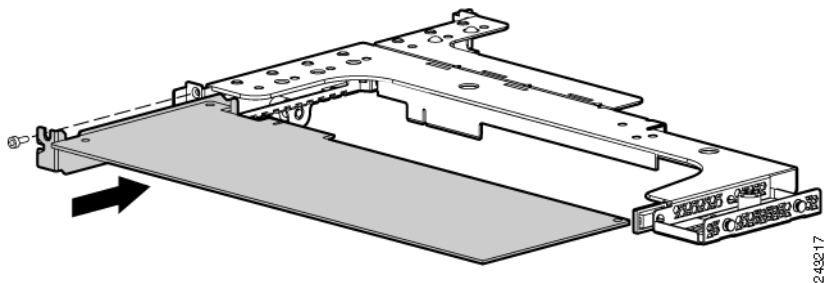
Step 6 Slide the expansion-slot cover out of the PCI riser-card assembly expansion slot. (See [Figure 4-2](#).)

Figure 4-2 Removing the Expansion Slot Cover



Step 7 Install the WAVE inline adapter, as shown in [Figure 4-3](#).

Figure 4-3 Installing the WAVE Inline Adapter in the Riser-Card Assembly



Note The WAVE appliance does not power up if the PCI riser board assembly is not seated properly.

Step 8 Install the PCI riser board assembly.

Step 9 Install the access panel.

For instructions on completing the installation, see the [“Completing the Installation”](#) section on page 4-2.

For information about connecting cables to the Cisco WAVE Inline Network Adapter, see [Chapter 5, “WAVE Inline Network Adapter.”](#)

Replacing a Hard Disk Drive

The WAVE appliance supports as many as two 3.5-inch (Large Form Factor) SATA hard drives.

When replacing hard drives to the WAVE appliance, observe the following general guidelines:

- The system automatically sets all drive numbers.
- If only one hard drive is used, install it in the bay with the lowest drive number.
- Drives must be the same capacity to provide the greatest storage space efficiency when drives are grouped together into the same drive array.



Note

All hard disk drives being used in the appliance must be identical.



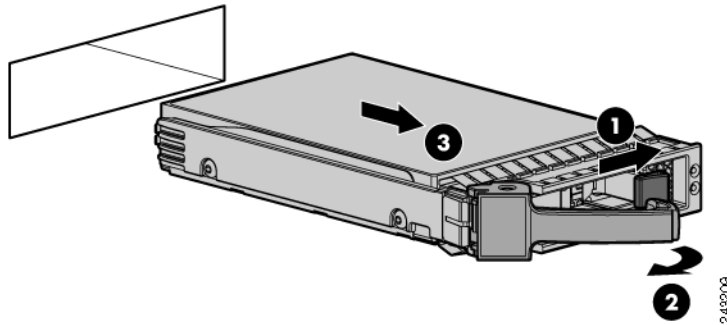
Caution

To maintain proper system cooling, do not operate the appliance for more than 10 minutes without either a hard disk drive or a filler panel installed in each bay.

To replace a hard disk drive in a bay, follow these steps:

-
- Step 1** Review the information in the [“Safety Warnings and Cautions”](#) section on [page 2-2](#) and the [“Safety Guidelines”](#) section on [page 2-3](#).
 - Step 2** Make sure that the chassis cover is in place and fully closed.
 - Step 3** Power down the device and disconnect the power cord and all external cables.
 - Step 4** Slide the latch and then pull out the handle (see [Figure 4-4](#)).

Figure 4-4 Removing a Hard Disk Drive



- Step 5** Pull the drive assembly from the bay.
- Step 6** Wait 1 minute and then insert the new drive into the same slot by aligning the replacement drive assembly with guide rails in the bay and sliding the drive assembly into the bay until it stops. Make sure that the drive is properly seated in the bay.
- Step 7** Close the drive handle.
- Step 8** Reboot the WAVE appliance.
- Step 9** Check the hard disk drive status LED after the system has booted to verify that the hard disk drive is operating correctly. If the amber hard disk drive status LED for a drive is lit continuously, that drive is faulty and must be replaced. If the green hard disk drive activity LED is flashing, the drive is being accessed.
- Step 10** Wait 1 minute and then verify that the replaced disk drive is in the Rebuilding state by using the **show disks details** command in EXEC mode.



Note The system automatically starts the rebuild operation when it detects the removal and reinsertion of a drive that is part of the logical RAID drive.

- Step 11** Wait until the rebuild operation is complete. A disk rebuild operation may take several hours. You can check if the rebuild operation is complete by using the **show disk details** command in EXEC mode. The physical drive state will be Online and the RAID logical drive state will be Okay after the rebuild operation is completed.

- Step 12** Use the **show disk tech** command in EXEC mode to verify that the firmware and BIOS information is correct for both hard drives.

If you have multiple disk failures and your RAID-1 logical status is Offline, you must recreate the RAID-1 array. For more information on disk removal and replacement procedures, see the *Cisco Wide Area Application Services Configuration Guide*, [Chapter 15, “Maintaining Your WAAS System.”](#)

Installing Memory

This section contains the following topics:

- [Memory Installation Guidelines, page 4-8](#)
- [Upgrading the Memory from 3 GB to 6 GB, page 4-9](#)

Memory Installation Guidelines

The WAVE-574 appliance supports either 3 GB or 6 GB of memory.

Observe the following guidelines when installing additional memory:

- Use only Cisco memory upgrades in your appliance.
- BIOS detects the DIMM population and sets the system to dual-bank interleaved mode (DIMMs installed in both banks with equal bank capacities).

[Table 4-1](#) lists the DIMM configurations available for the WAVE-574 appliance.

Table 4-1 **WAVE-574 DIMM Configurations**

	Slot 1A (blue)	Slot 2B (black)	Slot 3A (blue)	Slot 4B (black)
3 GB Memory	1-GB DIMM	512-MB DIMM	1-GB DIMM	512-MB DIMM
6 GB Memory	1-GB DIMM	2-GB DIMM	1-GB DIMM	2-GB DIMM

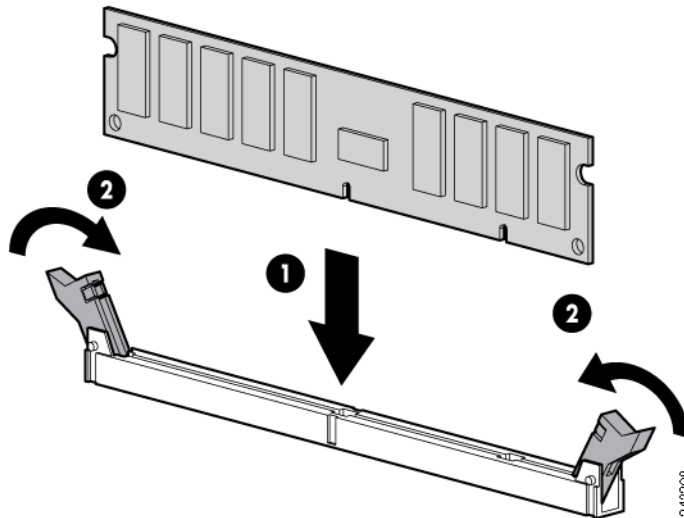
Upgrading the Memory from 3 GB to 6 GB

This section describes how to upgrade your WAVE-574 device from the standard 3 GB of memory to 6 GB of memory.

To install the Cisco memory upgrade, follow these steps:

-
- Step 1** Power down the WAVE appliance.
 - Step 2** Remove the WAVE appliance from the rack.
 - Step 3** Remove the primary access panel (See the [“Removing the Covers”](#) section on [page 4-1](#)).
 - Step 4** Open the DIMM slot latches for slot 2B and slot 4B (the black colored slots) See [Figure 4-5](#) on [page 4-10](#).
 - Step 5** Remove the 512 MB DIMMs from slot 2B and slot 4B.
 - Step 6** Install one replacement 2-GB DIMM into slot 2B. Install the other replacement 2-GB DIMM into slot 4B. See [Figure 4-5](#) on [page 4-10](#).

Figure 4-5 Installing a DIMM



- Step 7** Check to make sure that the DIMM latches are fully engaged in the notches.
- Step 8** Install the access panel.
- Step 9** Install the WAVE appliance into the rack.
- Step 10** Reboot the WAVE appliance.
- Step 11** Use the **show memory EXEC** mode command to verify that the memory you installed is recognized by the WAVE appliance.
- Step 12** Repartition the disks, using the **disk delete-data-partitions** command, and reload.



Note Repartitioning the disks is required after adding memory to reset the DRE space allocation.



CHAPTER 5

WAVE Inline Network Adapter

This chapter describes the Cisco WAVE inline network adapter and contains the following sections:

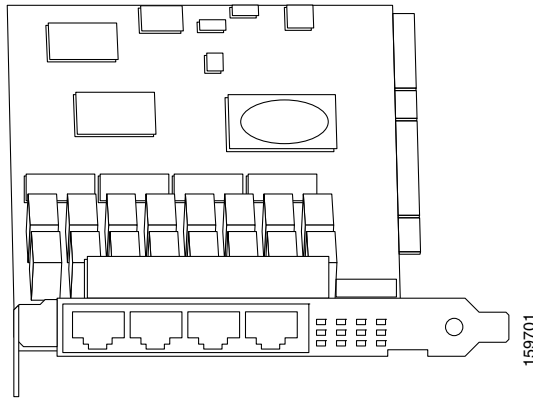
- [Inline Network Adapter Description, page 5-1](#)
- [Ports and LED Indicators, page 5-3](#)
- [Inline Network Adapter Cabling Requirements, page 5-4](#)
- [Installation Scenarios and Cabling Examples for Fast Ethernet Connections, page 5-8](#)

For information on installing an inline adapter in your WAVE-574, see the [“Installing a Cisco WAVE Inline Adapter”](#) section on page 4-3.

For adapter specifications, see [Table A-2](#) in Appendix A.

Inline Network Adapter Description

The WAVE appliance supports one optional 2-port Gigabit Ethernet inline network adapter or one optional 4-port Gigabit Ethernet inline network adapter. The inline network adapter is a full-height, three-quarter-length PCI Express network interface card that contains two or four independent Gigabit Ethernet ports. (See [Figure 5-1](#).)

Figure 5-1 4-Port Inline Network Adapter

The Cisco WAVE inline network adapter provides an inline traffic interception capability for your appliance. When you configure the WAVE appliance for inline interception mode, you can set attributes to control which interfaces are to be used over which VLANs. By default, the adapter operates on all inline-capable interfaces and VLANs. You can configure the inline redirection feature using the WAAS CLI or the WAAS Central Manager GUI.

**Note**

Throughout this section, we refer to a WAVE appliance configured for inline interception mode as a *WAVE inline appliance*.

The WAAS software defines two new interface types: A group interface that represents an inline pair grouping and a port interface that represents the individual port. These interfaces are referred to as inlineGroup and inlinePort.

InlineGroup interfaces are numbered using the format slot/group. The slot number is the slot in which the adapter is inserted. The group number is either 0 or 1 (each adapter has 2 group pairs). The group number is displayed on the adapter label.

InlinePort interfaces are numbered slot/group/lan or slot/group/wan. The last attribute is the LAN or WAN designator.

The inline network adapter also includes an onboard programmable watch dog timer (WDT) controller that allows you to set the time to wait after a failure event, such as a power outage or a kernel crash, before the unit begins to operate in mechanical bypass mode. In mechanical bypass mode, the traffic is bridged between the LAN and WAN ports of each group. Mechanical bypass mode

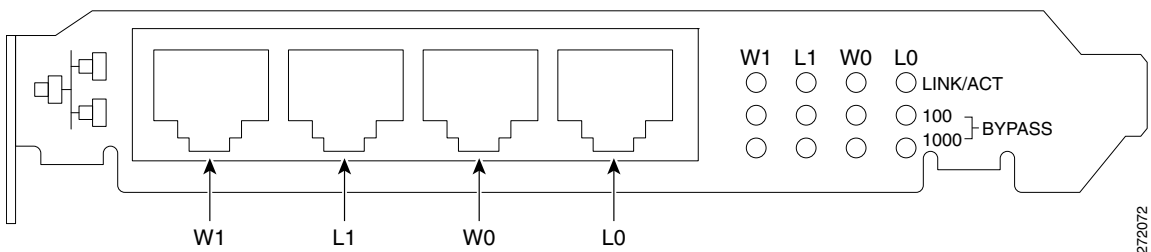
prevents the WAVE appliance from becoming a single point of failure and allows traffic to continue to flow between the router and the client while it passes through an unresponsive WAVE appliance without being processed.

For more information about configuring the inline network adapter, see the *Cisco Wide Area Application Services Configuration Guide*.

Ports and LED Indicators

Figure 5-2 shows the 4-port inline network adapter port numbers, interface designations, and LEDs. The 2-port adapter is similar, but has only two ports and two sets of LEDs.

Figure 5-2 4-Port Inline Network Adapter Port Numbering and LEDs



W1	Port WAN1; Group 1 WAN interface	L1	Port LAN1; Group 1 LAN interface
W0	Port WAN0; Group 0 WAN interface	L0	Port LAN0; Group 0 LAN interface

The inline network adapter has three LEDs that correspond to each port (the W1 LEDs correspond to Port W1, and so forth). Table 5-1 describes the LEDs.

Table 5-1 *Inline Network Adapter LEDs*

LEDs	State	Description
Link / Activity	On	The 10/100/1000BASE-T interface is receiving power.
	Blinking	The Ethernet link is transmitting data.
100	On	The speed of the Ethernet connection is 100BASE-TX.
1000	On	The speed of the Ethernet connection is 1000BASE-TX.
Bypass	Both the 100 and 1000 LEDs are on	The corresponding ports are in mechanical bypass mode.

Inline Network Adapter Cabling Requirements

The inline network adapter ships with two types of cables: crossover and straight-through. When you connect the WAVE inline network adapter, the cable that you use depends on the link speed (Gigabit Ethernet or Fast Ethernet) and the types of devices (DCE or DTE) being connected.



Note

You must retain the same link speed from one end of the connection to the other end. Inline adapter interfaces are able to autonegotiate link speeds. If you configure any of your connecting interfaces for Fast Ethernet (whether on a switch or a router), your WAVE inline adapter uses Fast Ethernet. If you configure any of your connecting interfaces for Gigabit Ethernet, your WAVE inline adapter uses Gigabit Ethernet. Speed and duplex settings are port specific so that two inline ports can negotiate different speeds independently.

If you are connecting a WAVE inline appliance between two devices using Gigabit Ethernet, you can use either straight-through cables, crossover cables, or any combination of the two cable types, regardless of the type of device. However, for consistency, we recommend that you use straight-through cables for all Gigabit Ethernet connections.

[Table 5-2](#) shows the cable requirements for WAVE appliance and non-WAVE appliance connections when you are using Gigabit Ethernet end to end.

Table 5-2 *Cable Requirements for WAVE Connections Using Gigabit Ethernet*

Connection	Required Cable
Switch to switch (no WAVE)	Crossover or straight-through
Switch to router (no WAVE)	Crossover or straight-through
Router to router (no WAVE)	Crossover or straight-through
Switch to WAVE and	Crossover or straight-through
WAVE to Router	Crossover or straight-through
Switch to WAVE and	Crossover or straight-through
WAVE to Switch	Crossover or straight-through
Router to WAVE and	Crossover or straight-through
WAVE to Router	Crossover or straight-through
WAVE to WAVE	Crossover or straight-through

Some switches support automatic medium-dependent interface crossover (MDIX). You can configure MDIX by using the **mdix auto** global configuration switch command. If your switch supports MDIX, you do not need to follow these cabling rules because MDIX automatically adjusts transmit and receive pairs when an incorrect cable type (crossover or straight-through) is installed on a 10/100 Fast Ethernet port. However, when you configure MDIX, you must also configure the port to use autosense (not manual selection of speed/duplex).

**Caution**

If you are connecting to Fast Ethernet ports on both the LAN and the WAN sides of the WAVE inline appliance, you must consider the types of devices that are being connected, and you must use the correct cables. You must follow these cabling instructions for the inline network adapter to work properly. (See [Table 5-3](#). For illustrations and examples, see the “[Installation Scenarios and Cabling Examples for Fast Ethernet Connections](#)” section on page 5-8.)

To connect the inline network adapter using the correct cables for Fast Ethernet connections, follow these steps:

- Step 1** Determine the type of cable that you would use for a direct connection between your two end devices (without a WAVE inline network appliance connected between them) by using the following standard cabling rules:
- When you are directly connecting two network devices that are similar, such as two switches, use a crossover cable.
 - When you are directly connecting two network devices that are different, such as a switch and router, use a straight-through cable.



Note Because the inline network adapter has an internal crossover connection that becomes active when the InlineGroup interface is placed in mechanical bypass mode, you must decide which cable you would use to connect the two network devices directly, and then you must install the other cable type (on one side, usually the WAN side of the inline appliance) instead.

Table 5-3 shows the cable requirements for WAVE and non-WAVE connections when you are using Fast Ethernet end to end.

Table 5-3 *Cable Requirements for WAVE Connections Using Fast Ethernet*

Connection	Required Cable
Switch to switch (no WAVE)	Crossover
Switch to router (no WAVE)	Straight-through
Router to router (no WAVE)	Crossover
Switch to WAVE and	Straight-through
WAVE to Router	Crossover
Switch to WAVE and	Straight-through
WAVE to Switch	Straight-through

Table 5-3 *Cable Requirements for WAVE Connections Using Fast Ethernet (continued)*

Connection	Required Cable
Router to WAVE and	Straight-through
WAVE to Router	Straight-through
WAVE to WAVE	Crossover

Step 2 Connect Fast Ethernet ports on both the LAN and the WAN sides of the WAVE inline appliance by using the following cable types:

- On the LAN side of the connection, use a straight-through cable between the WAVE inline appliance and the network device.
- On the WAN side of the connection, use the cable that is different from the cable that you would use to connect the two network devices directly (as determined in [Step 1](#)).

For example, if you are connecting a router and a switch (two different devices) through the WAVE inline appliance, use a straight-through cable on the LAN side of the connection and use a crossover cable on the WAN side of the connection. (If you were connecting the two different devices directly, you would use a straight-through cable, so use the crossover cable instead.)

If you are connecting two switches (or two similar devices), use straight-through cables on both the LAN and the WAN sides of the WAVE inline appliance.

[Figure 5-3](#) through [Figure 5-5](#) show which cables to use for the WAVE LAN and WAN connections between Fast Ethernet ports.

Installation Scenarios and Cabling Examples for Fast Ethernet Connections

WAVE appliances can be installed physically between two network devices (such as the branch office router and branch office LAN switch) by connecting the WAVE inline network adapter ports to the network devices using the proper cables.

If you are connecting a WAVE inline appliance between two devices using Gigabit Ethernet, you can use either straight-through cables, crossover cables, or any combination of the two cable types, regardless of the type of device. This section shows cabling examples for Fast Ethernet connections only, because Fast Ethernet has specific cabling requirements.

The inline network adapter has four ports that are divided into two inline groups (see the “[Ports and LED Indicators](#)” section on page 5-3). The WAVE appliance can be physically placed inline between two distinct network paths, creating redundant WAN links. (See [Figure 5-3](#).)

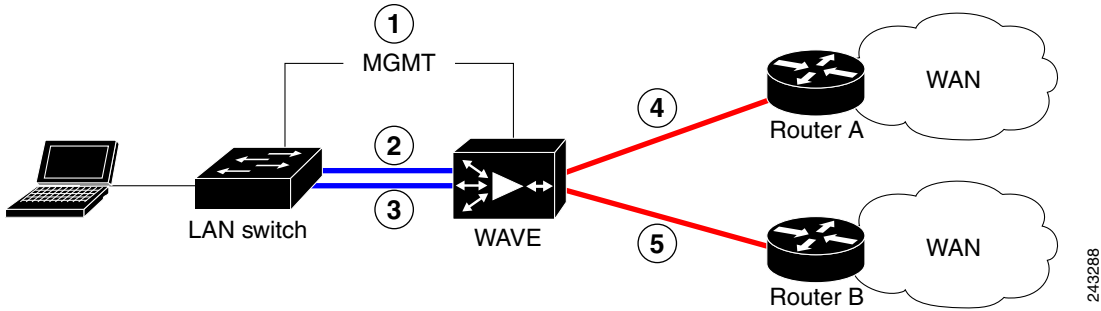
Two WAVE appliances with inline network adapters can also be installed back-to-back in a serial fashion between two network devices for failover purposes. In this serial cluster configuration, if one WAVE appliance fails, the other WAVE appliance can provide optimization. (See [Figure 5-4](#).)



Note

When you connect two WAVE inline appliances to each other serially, always use a crossover cable between the two WAVE appliances. (See [Figure 5-5](#).)

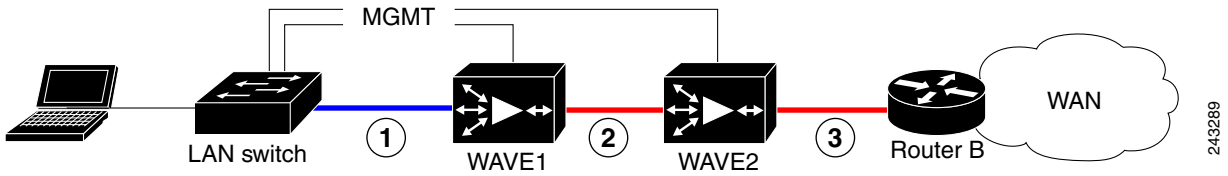
Figure 5-3 Cabling for a Single Inline WAVE Appliance with Redundant WAN Connections



243288

1	Connection: Management Gigabit Ethernet: 1/0 Cable type: Straight-through (recommended)	2	Connection: WAVE to LAN switch (using InlineGroup 1/0) Fast Ethernet: LAN0 (InlinePort 1/0/lan) Cable type: Straight-through
3	Connection: WAVE to LAN switch (using InlineGroup 1/1) Fast Ethernet: LAN1 (InlinePort 1/1/lan) Cable type: Straight-through	4	Connection: WAVE to WAN router A (using InlineGroup 1/0) Fast Ethernet: WAN0 (InlinePort 1/0/wan) Cable type: Crossover
5	Connection: WAVE to WAN router B (using InlineGroup 1/1) Fast Ethernet: WAN1 (InlinePort 1/1/wan) Cable type: Crossover		

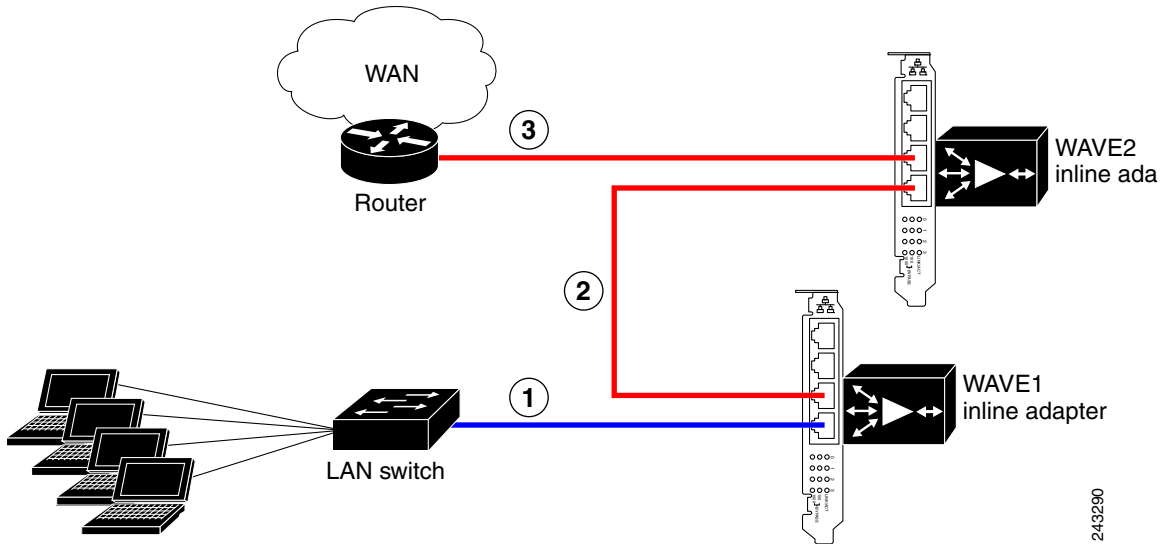
Figure 5-4 Cabling for Serial Cluster Inline WAVEs with a Single WAN Connection



243289

1	Connection: WAVE 1 to LAN switch Fast Ethernet: LAN0 (InlinePort 1/0/lan) Cable type: Straight-through	2	Connection: WAVE 1 to WAVE 2 Fast Ethernet: WAVE1 WAN0 (InlinePort 1/0/wan) to WAVE 2 LAN0 (InlinePort 1/0/lan) Cable type: Crossover
3	Connection: WAVE 2 to WAN router Fast Ethernet: WAVE 2 WAN0 (InlinePort 1/0/wan) Cable type: Crossover		

Figure 5-5 Cabling Between Two Inline WAVEs



243290

1	Connection: WAVE 1 to LAN switch Fast Ethernet: WAVE 1 LAN0 (InlinePort 1/0/lan) Cable type: Straight-through	2	Connection: WAVE 1 to WAVE 2 Fast Ethernet: WAVE 1 WAN0 (InlinePort 1/0/wan) to WAVE 2 LAN0 (InlinePort 1/0/lan) Cable type: Crossover
3	Connection: WAVE 2 to WAN router Fast Ethernet: WAVE 2 WAN0 (InlinePort 1/0/wan) Cable type: Crossover		



CHAPTER 6

Troubleshooting the System Hardware

This chapter provides basic troubleshooting information to help you identify some common problems that might occur with your WAVE-574.

This chapter contains the following sections:

- [Identifying System Problems, page 6-2](#)
- [Checking Connections and Switches, page 6-3](#)
- [Troubleshooting the Ethernet Controller, page 6-4](#)
- [Identifying Problems Using Trouble Indicators and Status LEDs, page 6-6](#)
- [Undetermined Problems, page 6-7](#)
- [Problem-Solving Tips, page 6-8](#)
- [Error Symptoms, page 6-9](#)
- [Power-On Self Test \(POST\), page 6-13](#)

Use the information in this chapter to determine whether a problem originates with the hardware or the software. For further assistance, contact your Cisco customer service representative.



Note

The WAAS software does not support the use of a keyboard or mouse (Personal System/2 [PS/2] or Universal Serial Bus [USB]) for Linux and WAAS software troubleshooting. However, the keyboard and mouse are supported by the BIOS for power-on self-test (POST) and the diagnostic programs that are located in the appliance ROM.

When console redirection is enabled (it is enabled by default), all the tests available from a keyboard are accessible through the console connection as well. (Mouse support, however, is not available through the console connection.)

**Caution**

Customer-replaceable components include the WAVE inline network adapter, system memory, and hard disk drives. All other components that are not orderable as spare hardware options can only be replaced by a qualified service technician. Once you have identified a faulty component, contact the Cisco Technical Assistance Center (TAC).

**Note**

Read the [“Working Inside the WAVE-574 with the Power On”](#) section on page 2-6 before opening the chassis cover.

Identifying System Problems

To identify system problems, follow these steps:

- Step 1** Check the power LED.
 - Step 2** Check the internal health LED (see [Internal health LED, page 1-3](#)).
 - Step 3** Power down the appliance and all external devices.
 - Step 4** Check all cables and power cords. (See the [“Checking Connections and Switches”](#) section on page 6-3.)
 - Step 5** Power up the appliance.
 - Step 6** Record any POST error messages that are displayed on the screen. If an error is displayed, look up the first error in the [“POST Error Codes”](#) section on page 6-14.
 - Step 7** If the self-diagnostic programs were completed successfully and you still suspect a problem, see the [“Undetermined Problems”](#) section on page 6-7.
 - Step 8** Check the system error log to see if an error was recorded by the system.
-

Checking Connections and Switches

Improperly set switches and controls and loose or improperly connected cables are the most likely source of problems for the chassis or other external equipment. A quick check of all the switches, controls, and cable connections can easily solve these problems. (See [Figure 1-1](#) for the location of front panel controls and indicators. See [Figure 1-3](#) for the location of back panel connectors on the system.)

To check all the connections and switches, follow these steps:

-
- Step 1** Power down the system. Disconnect all the power cables from their electrical outlets.
- Step 2** If the system is connected to a power strip (or power distribution unit), turn the power strip off and then on again.
If the power strip is receiving power go to [Step 5](#).
If the power strip is not receiving power go to [Step 3](#).
- Step 3** Plug the power strip into another electrical outlet.
If the power strip is receiving power, the original electrical outlet probably does not function. Use a different electrical outlet.
If the power strip is not receiving power go to [Step 4](#).
- Step 4** Plug a system that you know works into the electrical outlet.
If the system receives power, the power strip is probably not functioning properly. Use another power strip.
If the system does not receive power, go to [Step 5](#).
- Step 5** Reconnect the system to the electrical outlet or power strip.
Make sure that all connections fit tightly together.
- Step 6** Power up the system.
If the problem is resolved, the connections were loose. You have fixed the problem.

If the problem is not resolved, call your customer service representative. (See the [“Obtaining Documentation and Submitting a Service Request”](#) section on page xix.)

Troubleshooting the Ethernet Controller

This section provides troubleshooting information for problems that might occur with the 10/100/1000-Mbps Ethernet controller.

This section contains the following topics:

- [Network Connection Problems, page 6-4](#)
- [Ethernet Controller Troubleshooting Chart, page 6-5](#)

Network Connection Problems

If the Ethernet controller cannot connect to the network, check the following conditions:

- Make sure that the cable is installed correctly.
The network cable must be securely attached at all connections. If the cable is attached but the problem remains, try a different cable.
If you set the Ethernet controller to operate at either 100 Mbps or 1000 Mbps, you must use Category 5 or higher cabling.
- Determine whether the switch or device to which the WAVE appliance is connected supports autonegotiation. If it does not, try configuring the integrated Ethernet controller manually to match the speed and duplex mode of the switch.
- Check the Ethernet controller LEDs on the appliance back panel. (See [Figure 1-3](#).)
These LEDs indicate whether a problem exists with the connector, cable, or switch:

- The Ethernet link status LED is on when the Ethernet controller receives a link pulse from the switch. If the LED is off, there might be a defective connector or cable or a problem with the switch.
- The Ethernet activity LED is on when the Ethernet controller sends or receives data over the Ethernet network. If the Ethernet activity LED is off, make sure that the switch and network are operating and that the correct device drivers are installed.

Ethernet Controller Troubleshooting Chart

Table 6-1 lists solutions to 10/100/1000-Mbps Ethernet controller problems.

Table 6-1 *Ethernet Troubleshooting Chart*

Ethernet Controller Problem	Actions
Ethernet link status LED does not work.	Check the following: <ul style="list-style-type: none"> • Make sure that the switch to which the WAVE appliance is connected is powered on. • Check all connections at the Ethernet controller and the switch. • Use another port on the switch. • If the switch does not support autonegotiation, manually configure the Ethernet controller to match the switch. • If you manually configured duplex mode, make sure that you also manually configure the speed.
The Ethernet activity LED does not work.	Check the following: <ul style="list-style-type: none"> • The network might be idle. Try sending data from this appliance. • Check all connections at the Ethernet controller and the switch. • Use another port on the switch.

Table 6-1 Ethernet Troubleshooting Chart (continued)

Ethernet Controller Problem	Actions
Data is incorrect or sporadic.	Check the following: <ul style="list-style-type: none"> • Make sure that you are using Category 5 or higher cabling when operating the appliance at 100 Mbps or 1000 Mbps. • Make sure that the cables do not run close to noise-inducing sources such as fluorescent lights.
The Ethernet controller stopped working without apparent cause.	Check the following: <ul style="list-style-type: none"> • Try a different connector on the switch. • If you suspect the adapter is faulty, contact the Cisco Technical Assistance Center (TAC).

Identifying Problems Using Trouble Indicators and Status LEDs

If the internal health LED on the front of the appliance is amber or red (see [Internal health LED, page 1-3](#)), one or more LEDs inside the appliance or on the power supply will be on. Your appliance has LEDs to help you identify problems with some components. See “[System Board LEDs](#)” section on [page 1-10](#) for the location and description of these indicators.



Caution

Customer-replaceable components include the WAVE inline network adapter, system memory, and hard disk drives. All other components that are not orderable as spare hardware options can only be replaced by a qualified service technician. Once you have identified a faulty component, contact the Cisco Technical Assistance Center (TAC).

Undetermined Problems

Use the information in this section if the diagnostic tests did not identify the failure, the devices list is incorrect, or the system is inoperative.

**Note**

Damaged data in CMOS can cause undetermined problems.

**Note**

Damaged data in BIOS code can cause undetermined problems.

Check the system LEDs for the power supplies (see the [“System Board LEDs” section on page 1-10](#)). If the LEDs indicate the power supplies are working correctly, follow these steps:

-
- Step 1** Power down the appliance.
- Step 2** Be sure the appliance is cabled correctly.
- Step 3** Remove or disconnect the following devices (one at a time) until you find the failure (power up the appliance and reconfigure it each time):
- Any non-Cisco devices
 - Surge suppressor device (on the appliance)
 - Each Cisco inline adapter
 - Disk drives
 - Memory modules (minimum requirement = 2 GB; two banks of 1 GB DIMMs)

**Note**

Any component that is internal to the appliance, with the exception of customer-replaceable adapters, must be serviced by trained and qualified personnel. Contact your customer service representative.

- Step 4** Power up the appliance. If the problem remains, contact Cisco TAC:

**Note**

If the problem goes away when you remove an adapter from the system, and replacing that adapter does not correct the problem, check the system board.

**Note**

If you suspect a networking problem and all the system tests pass, check if there is a network cabling problem external to the system.

Problem-Solving Tips

Because of the variety of hardware and software combinations that can be encountered, use the following information to assist you in identifying the problems. If possible, have this information available when requesting technical assistance.

- Machine type and model
- Microprocessor or hard disk upgrades
- Failure symptom
 - What, when, where; single or multiple systems?
 - Is the failure repeatable?
 - Has this configuration ever worked?
 - If it has been working, what changes were made before it failed?
 - Is this the original reported failure?
- Hardware configuration
 - Print (print screen) configuration currently in use
 - BIOS level
- WAAS system software type and version level

To eliminate confusion, identical systems are considered identical only if they meet all these conditions:

- Are the exact machine type and models
- Have the same BIOS level
- Have the same adapters or attachments in the same locations
- Have the same address jumpers, terminators, and cabling
- Have the same WAAS software versions and levels
- Have the same configuration options set in the system
- Have the same setup for the operating system control files

Comparing the configuration and software setup in working and nonworking systems might help to resolve the problem.

Error Symptoms

You can use the error symptom tables to find solutions to problems that have definite symptoms.

In the following tables ([Table 6-2](#) to [Table 6-9](#)), the first entry in the “Cause and Action” column is the most likely cause of the symptom.

Table 6-2 *CD-RW/DVD Drive Problems*

Symptom	Cause and Action
CD-RW/DVD drive is not recognized.	Verify that all cables and jumpers are installed correctly.
The CD-RW/DVD drive is not working correctly.	<ol style="list-style-type: none"> 1. Clean the CD or DVD. 2. Check the CD-RW/DVD drive.
The CD-RW/DVD drive tray is not working.	<ol style="list-style-type: none"> 1. Make sure that the appliance is turned on. 2. Insert the end of a straightened paper clip into the manual tray-release opening.

Table 6-3 *Hard Disk Drive Problems*

Symptom	Cause and Action
Hard disk drive stops responding during system startup.	<ol style="list-style-type: none"> 1. Remove the hard disk drive that stopped responding and try starting the appliance again. 2. If the system starts successfully, the drive that you removed needs to be replaced.
A hard disk drive was not detected while the operating system was being started.	Reseat all hard disk drives and cables.

Table 6-4 *General Problems*

Symptom	Cause and Action
Problems such as broken cover latch or indicator LEDs not working.	Broken component. Call your customer service representative.

Table 6-5 *Intermittent Problems*

Symptom	Cause and Action
A problem occurs only occasionally and is difficult to detect.	<ol style="list-style-type: none"> 1. Verify the following items: <ol style="list-style-type: none"> a. All cables and cords are connected securely to the rear of the appliance and attached hardware options. b. When the appliance is powered on, air is flowing from the rear of the appliance at the fan grille. If there is no airflow, the fans are not working. This causes the appliance to overheat and shut down. 2. Check the system error log. 3. See the “Undetermined Problems” section on page 6-7.

Table 6-6 **Memory Problems**

Symptom	Cause and Action
The amount of system memory displayed is less than the amount of physical memory installed.	<ol style="list-style-type: none"> 1. Verify the following items: <ol style="list-style-type: none"> a. The internal health LED is not lit on the front panel. b. The memory modules are seated properly. c. Only Cisco memory has been installed. 2. Check the POST error log for DIMM error messages.

Table 6-7 **Hardware Option Problems**

Symptom	Cause and Action
A hardware option that was just installed does not work.	<ol style="list-style-type: none"> 1. Verify the following items: <ol style="list-style-type: none"> a. The hardware option is designed for the appliance. b. You followed the installation instructions that came with the hardware option. c. The hardware option is installed correctly. d. You have not loosened any other installed hardware options or cables. 2. Check the hardware option that you just installed.
A hardware option that used to work does not work now.	<ol style="list-style-type: none"> 1. Verify that all of the hardware options and cable connections are secure. 2. Check for a failing hardware option and replace it if necessary.

Table 6-8 **Power Problems**

Symptom	FRU or Action
<p>The power-control button does not work, and the reset button does not work (the appliance does not start).</p> <p>Note The power-control button will not function until 20 seconds after the appliance has been connected to power.</p>	<ol style="list-style-type: none"> 1. Verify the following items: <ol style="list-style-type: none"> a. The power cables are properly connected to the appliance. b. The electrical outlet functions properly. c. The type of memory installed is correct. 2. If you just installed a hardware option, remove it, and restart the appliance. 3. See the “Undetermined Problems” section on page 6-7.
<p>The appliance does not power down.</p>	<ol style="list-style-type: none"> 1. Turn off the appliance by pressing the power-control button for 5 seconds. 2. Restart the appliance. 3. If the appliance fails POST and the power-control button does not work, disconnect the power cord for 20 seconds. Reconnect the power cord and restart the appliance.
<p>The appliance unexpectedly shuts down, and the LEDs on the operator information panel are not lit.</p>	<p>See the “Undetermined Problems” section on page 6-7.</p>

Table 6-9 **Console Port Problems**

Symptom	FRU or Action
<p>A serial appliance does not work. For more information about the console port, see the “Console Port Serial Connector” section on page 1-8.</p>	<ol style="list-style-type: none"> 1. Verify the following items: <ol style="list-style-type: none"> a. The appliance is compatible with the WAVE appliance. b. The serial port is enabled and is assigned a unique address. c. The appliance is connected to the correct port (see the “Hardware Features” section on page 1-2). 2. Check for a failing serial appliance.

Power-On Self Test (POST)

This section describes the power-on self test (POST) and the POST error codes and messages. This section contains the following topics:

- [POST Overview, page 6-13](#)
- [POST Error Codes, page 6-14](#)

POST Overview

When you power up the appliance, it performs a series of tests that check the operation of components and some of the hardware options installed in the appliance. This series of tests is called the power-on self-test, or POST.

If the POST finishes without detecting any problems, a single beep sounds, and the first screen of your operating system or application program appears.

If the POST detects a problem, more than one beep sounds, and an error message appears on your screen. See the “[POST Error Codes](#)” section on page 6-14 for more information.



Note

If you have a power-up password or administrator password set, you must enter the password and press **Enter** when prompted, before POST will continue.



Note

A single problem might cause several error messages. When this situation occurs, you should correct the cause of the first error message. After you correct the cause of the first error message, the other error messages usually will not occur the next time that you run the test.

The POST error log contains the three most recent error codes and messages that the system generated during the POST. The system error log contains all messages issued during the POST and all system status messages from the service processor.

You can view the contents of the system error log from the diagnostic programs.

POST Error Codes

The error messages and codes in this section include all messages generated by the WAVE appliance. Some messages are informational only and do not indicate any error. A WAVE appliance generates only the codes that are applicable to its configuration and options.

**Caution**

Customer-replaceable components include the WAVE inline network adapter, system memory, and hard disk drives. All other components that are not orderable as spare hardware options can only be replaced by a qualified service technician. Once you have identified a faulty component, contact the Cisco Technical Assistance Center (TAC).

Advanced Memory Protection mode: Advanced ECC

Possible Cause: Advanced ECC support is enabled.

Action: None.

Advanced Memory Protection mode: Advanced ECC with hot-add support

Possible Cause: Advanced ECC with Hot-Add support is enabled.

Action: None.

Advanced Memory Protection mode: Online spare with Advanced ECC

...Xxxx MB System memory and xxxx MB memory reserved for Online Spare.

Possible Cause: This message indicates Online Spare Memory is enabled and indicates the amount of memory reserved for this feature.

Action: None.

Advanced Memory Protection mode: Multi-board mirrored memory with Advanced ECC

...Xxxx MB System memory and xxxx MB memory reserved for Mirroring.

Possible Cause: This message indicates Mirrored Memory is enabled and indicates the amount of memory reserved for this feature.

Action: None.

**Advanced Memory Protection mode: RAID memory with Advanced ECC
...Xxxx MB System memory and xxxx MB memory reserved for RAID.**

Possible Cause: This message indicates RAID Memory is enabled and indicates the amount of memory reserved for this feature.

Action: None.

An Unexpected Shutdown occurred prior to this power-up

Possible Cause: The WAVE appliance shut down because of an unexpected event on the previous boot.

Action: Check the System Management Log or OS Event Log for details on the failure.

Critical Error Occurred Prior to this Power-Up

Possible Cause: A catastrophic system error, which caused the WAVE appliance to crash, has been logged.

Action: If the problem persists, contact the Cisco Technical Assistance Center.

Fan Solution Not Fully Redundant

Possible Cause: The minimum number of required fans is installed, but some redundant fans are missing or failed.

Action: If the problem persists, contact the Cisco Technical Assistance Center.

Fan Solution Not Sufficient

Possible Cause: The minimum number of required fans is missing or failed.

Action: If the problem persists, contact the Cisco Technical Assistance Center.

Fatal DMA Error

Possible Cause: The DMA controller has experienced a critical error that has caused an NMI.

Action: If the problem persists, contact the Cisco Technical Assistance Center.

Fatal Express Port Error

Possible Cause: A PCI Express port has experienced a fatal error that caused an NMI.

Action: Reseat any loose PCI Express boards. If the problem persists, contact the Cisco Technical Assistance Center.

Fatal Front Side Bus Error

Possible Cause: The processor front-side bus experienced a fatal error.

Action: Reseat any loose processors. If the problem persists, contact the Cisco Technical Assistance Center.

Fatal Global Protocol Error

Possible Cause: The system experienced a critical error that caused an NMI.

Action: If the problem persists, contact the Cisco Technical Assistance Center.

Fatal Hub Link Error

Possible Cause: The hub link interface has experienced a critical failure that caused an NMI.

Action: If the problem persists, contact the Cisco Technical Assistance Center.

FATAL ROM ERROR: The System ROM is not Properly Programmed.

Possible Cause: The System ROM is not properly programmed.

Action: If the problem persists, contact the Cisco Technical Assistance Center.

Fibre Channel Mezzanine/Balcony Not Supported.

Description: The Fibre Channel adapter is not supported on the WAVE appliance.

Action: Install the supported Fibre Channel adapter.

High Temperature Condition detected by Processor X

Possible Cause: Ambient temperature exceeds recommended levels, fan solution is insufficient, or fans have failed.

Action: Adjust the ambient temperature and check fans. If the problem persists, contact the Cisco Technical Assistance Center.

Illegal Opcode - System Halted

Possible Cause: The WAVE appliance has entered the Illegal Operator Handler because of an unexpected event. This error is often software-related and does not necessarily indicate a hardware issue.

Action: Be sure that all software is installed properly. If the problem persists, contact the Cisco Technical Assistance Center.

iLO Generated NMI

Possible Cause: The iLO controller generated an NMI.

Action: If the problem persists, contact the Cisco Technical Assistance Center.

Internal CPU Check - Processor

Possible Cause: A processor has experienced an internal error.

Action: If the problem persists, contact the Cisco Technical Assistance Center.

Invalid memory types were found on the same node. Please check DIMM compatibility. - Some DIMMs may not be used

Description: Invalid or mixed memory types were detected during POST.

Action: Use only Cisco DIMM pairs when populating memory sockets. See the [“Installing Memory” section on page 4-8](#). If the problem persists, contact the Cisco Technical Assistance Center.

Invalid Password - System Halted!

Possible Cause: An invalid password was entered.

Action: Enter a valid password to access the system.

Invalid Password - System Restricted!

Possible Cause: A valid password that does not have permissions to access the system has been entered.

Action: Enter a valid password with the correct permissions.

Memory found on unpopulated Node. — Processor is required to be installed for memory to be used.

Description: The system detects DIMMs, but is unable to use the DIMMs because a processor is not installed in the corresponding socket.

Action: Be sure the memory is installed correctly. Use only Cisco DIMM pairs when populating memory sockets. See the [“Installing Memory” section on page 4-8](#). If the problem persists, contact the Cisco Technical Assistance Center.

Mixed processor speeds detected. Please make sure that all processors are the same speed. — System Halted!

Description: Mixed processor speeds are not supported.

Action: Refer to the WAVE appliance documentation for supported processors. If the problem persists, contact the Cisco Technical Assistance Center.

Network Server Mode Active and No Keyboard Attached

Possible Cause: A keyboard is not connected. An error has not occurred, but a message is displayed to indicate the keyboard status.

Action: No action is required.

NMI - Button Pressed!

Possible Cause: The NMI button was pressed, initiating a memory dump for crash dump analysis.

Action: Reboot the WAVE appliance.

NMI - Undetermined Source

Possible Cause: An NMI event has occurred.

Action: Reboot the WAVE appliance.

Node Interleaving disabled - Invalid memory configuration

Description: Each node must have the same memory configuration to enable interleaving.

Action: Be sure the memory is installed correctly. Use only Cisco DIMM pairs when populating memory sockets. See the [“Installing Memory” section on page 4-8](#). If the problem persists, contact the Cisco Technical Assistance Center.

Parity Check 2 - System DIMM Memory

Possible Cause: An uncorrectable error memory event occurred in a memory DIMM.

Action: Use the DIMM LEDs to identify failed DIMMs and replace the DIMMs. If the problem persists, contact the Cisco Technical Assistance Center.

PCI Bus Parity Error, PCI Slot x

Possible Cause: A PCI device has generated a parity error on the PCI bus.

Action: For plug-in PCI cards, remove the card. If the problem persists, contact the Cisco Technical Assistance Center.

Power Fault Detected in Hot-Plug PCI Slot x

Possible Cause: PCI-X Hot Plug expansion slot was not powered up properly.

Action: Reboot the WAVE appliance.

Processor X Unsupported Wattage.

Possible cause: Processor not supported by current WAVE appliance.

Action: Refer to the WAVE appliance documentation for supported processors. If the problem persists, contact the Cisco Technical Assistance Center.

Redundant ROM Detected - This system contains a valid backup system ROM.

Possible Cause: The system recognizes both the system ROM and redundant ROM as valid. This is not an error.

Action: None

REDUNDANT ROM ERROR: Backup ROM Invalid. -run ROMPAQ to correct error condition.

Possible Cause: The backup system ROM is corrupted. The primary ROM is valid.

Action: If the problem persists, contact the Cisco Technical Assistance Center.

**REDUNDANT ROM ERROR: Bootblock Invalid. - ...
...contact Your Representative.**

Possible Cause: ROM bootblock is corrupt.

Action: If the problem persists, contact the Cisco Technical Assistance Center.

**REDUNDANT ROM ERROR: Primary ROM invalid. Booting Backup ROM. -...
...run ROMPAQ to correct error condition**

Possible Cause: The primary system ROM is corrupt. The system is booting from the redundant ROM.

Action: If the problem persists, contact the Cisco Technical Assistance Center.

Temperature violation detected - system Shutting Down in x seconds

Possible Cause: The system has reached a cautionary temperature level and is shutting down in X seconds.

Action: Adjust the ambient temperature and check the fans. If the problem persists, contact the Cisco Technical Assistance Center.

There must be a first DIMM in pair if second DIMM in pair is populated. Second DIMM in pair ignored.

Description: The first DIMM socket in the pair is not populated. The second DIMM in the pair is not recognized or used.

Action: Be sure the memory is installed correctly. Use only Cisco DIMM pairs when populating memory sockets. See the [“Installing Memory” section on page 4-8](#). If the problem persists, contact the Cisco Technical Assistance Center.

This system only supports 667 MHz Front Side Bus Speed Processors. One or more 800 MHz Front Side Bus Speed Processors have been initialized at 667 MHz. System Halted!

Possible cause: One or more 800-MHz front side bus speed processors have been initialized at 667-MHz.

Action: If the problem persists, contact the Cisco Technical Assistance Center.

Unsupported DIMM(s) found in system. - DIMM(s) may not be used

Description: Unsupported memory types found in system.

Action: Be sure the memory is installed correctly. Use only Cisco DIMM pairs when populating memory sockets. See the [“Installing Memory” section on page 4-8](#). If the problem persists, contact the Cisco Technical Assistance Center.

Unsupported PCI Card Detected Remove PCI Card from Slot

Possible cause: The PCI card installed in the slot referenced in the message is strictly not supported on this system.

Action: Remove the card from the slot reported in the message.

Unsupported Processor Detected System will ONLY boot ROMPAQ Utility. System Halted.

Possible Cause: Processor and/or processor stepping is not supported by the current system ROM.

Action: If the problem persists, contact the Cisco Technical Assistance Center.

WARNING: A Type 2 Header PCI Device Has Been Detected...

The BIOS will not configure this card. It must be configured properly by the OS or driver.

Possible Cause: Only Type 0 and Type 1 Header PCI Devices are configured by the system ROM. The device will not work unless the OS or device driver properly configure the card. Typically this message only occurs when PCI cards with a PCI to PCMCIA bridge are installed.

Action: Check the installation of any PCI devices. If the problem persists, contact the Cisco Technical Assistance Center.

WARNING - Mixed Stepping Processors were detected. System cannot proceed.

Possible cause: One or more 800-MHz front side bus speed processors have been initialized at 667-MHz.

Action: If the problem persists, contact the Cisco Technical Assistance Center.

301-Keyboard Error

Possible Cause: Keyboard failure occurred.

Action: To correct this failure, follow these steps:

Step 1 Power down the WAVE appliance, and then reconnect the keyboard.

- Step 2** Be sure no keys are depressed or stuck.
- Step 3** If the failure reoccurs, replace the keyboard.
-

301-Keyboard Error or Test Fixture Installed

Possible Cause: Keyboard failure occurred.

Action: To correct this failure, follow these steps:

- Step 1** Power down the WAVE appliance, and then reconnect the keyboard.
- Step 2** Be sure no keys are depressed or stuck.
- Step 3** If the failure reoccurs, replace the keyboard.
-

303-Keyboard Controller Error

Possible Cause: System board, keyboard, or mouse controller failure occurred.

Action: To correct this failure, follow these steps:

- Step 1** Be sure the keyboard and mouse are connected.



Caution

Only authorized technicians should attempt to remove the system board. If you believe the system board requires replacement, contact your support representative before proceeding.

- Step 2** 2. If the problem persists, contact the Cisco Technical Assistance Center.
-

304-Keyboard or System Unit Error

Possible Cause: Keyboard, keyboard cable, mouse controller, or system board failure.

Action: To correct this failure, follow these steps:

Step 1 Be sure the keyboard and mouse are connected.



Caution Only authorized technicians should attempt to remove the system board. If you believe the system board requires replacement, contact your support representative before proceeding.

Step 2 If the problem persists, contact the Cisco Technical Assistance Center.



APPENDIX **A**

WAVE-574 Hardware Specifications

This appendix provides hardware specifications for the WAVE-574 appliance. It contains the following sections:

- [Appliance Specifications, page A-1](#)
- [Adapter Specifications, page A-4](#)

Appliance Specifications

[Table A-1](#) provides a summary of the features and specifications of the WAVE-574.

Table A-1 **WAVE-574 Features and Specifications**

Specification	Description
Microprocessor	<ul style="list-style-type: none">• 1 Intel Xeon Quad-Core Processor X3220, or 1 Intel Core 2 Quad Processor Q9400• 2.4 GHz• 8 MB Level 2 cache• 1066-MHz front-side bus (FSB)
Memory	<ul style="list-style-type: none">• 3 GB (optionally 6 GB) ECC DDR2 SDRAM
Drives standard	<ul style="list-style-type: none">• DVD-ROM/CD-RW combination drive• RAID-1 array with two 500-GB SATA hard disk drives

Table A-1 WAVE-574 Features and Specifications (continued)

Specification	Description
Fans	<ul style="list-style-type: none"> 4 dual-rotor fans
Expansion slots	<ul style="list-style-type: none"> 2 PCI Express ×8 (1 @ ×8, 1 @ ×1 speed)
Size	<ul style="list-style-type: none"> Height: 4.32 cm (1.70 in.) Depth: 68.20 cm (26.85 in.) Width: 44.80 cm (17.64 in.)
Weight	11.79 kg (26.0 lb) to 15.20 kg (33.50 lb) depending upon configuration
Electrical Input Requirements ¹	<ul style="list-style-type: none"> Range Line Voltage: 90 to 132 VAC, 180 to 264 VAC Rated Input Current: 6 A (at 100 VAC), 3 A (at 200 VAC) Rated Input Frequency: 47 to 63 Hz Rated Input Power: 486 W (at 100 VAC), 479 W (at 200 VAC)
BTU Rating	<ul style="list-style-type: none"> 1836 BTU/hr (100 VAC) 1706 BTU/hr (200 VAC)
Power supply output	<ul style="list-style-type: none"> Rated steady-state power: <ul style="list-style-type: none"> 400 W (100 VAC) 400 W (200 VAC) Maximum peak power: <ul style="list-style-type: none"> 400 W (100 VAC) 400 W (200 VAC)

Table A-1 WAVE-574 Features and Specifications (continued)

Specification	Description
Acoustic noise ²	<ul style="list-style-type: none"> • Idle: <ul style="list-style-type: none"> – L_{WAd} –6.30 B – L_{pAm} –52.07 dB • Operating: <ul style="list-style-type: none"> – L_{WAd} –6.38 B – L_{pAm} –52.77 dB
Environment	<ul style="list-style-type: none"> • Air temperature: <ul style="list-style-type: none"> – Operating³: 10 to 35 °C (50 to 95 °F) – Non-operating: –30 to 60 °C (–22 to 140 °F) • Maximum rate of temperature change: <ul style="list-style-type: none"> – Operating^{4, 5}: 10 °C/hr (18 °F/hr) – Non-operating: 20 °C/hr (36 °F/hr) • Humidity: <ul style="list-style-type: none"> – Operating: 10% to 90% – Nonoperating: 5% to 95% • Maximum wet bulb temperature (noncondensing): <ul style="list-style-type: none"> – Operating: 28 °C (82.4 °F) – Nonoperating: 38.7 °C (101.7 °F) • Altitude: <ul style="list-style-type: none"> – Operating: 3,050 m (10,000 ft) – Nonoperating: 9144 m (30,000 ft) • Maximum rate of altitude change: <ul style="list-style-type: none"> – Operating: 457 m/min (1,500 ft/min) – Nonoperating: 457 m/min (1,500 ft/min)

1. The limits apply when operated in an ambient environment temperature of +23.0°C ± 2° (+73.4°F ± 2°).

Adapter Specifications

2. Average A-Weighted sound power levels (LWAd) and average bystander position A-Weighted sound pressure levels (LpAm) in a 23°C ambient environment, measured in accordance with ISO 7779 (ECMA 74) and declared in accordance with ISO 9296 (ECMA 109). Acoustic noise levels are maximum measurements with four fans installed.
3. All temperature ratings shown are for sea level. An altitude derating of 1°C per 300 m (1.8°F per 1,000 ft) to 2000 m (6500 ft) is applicable. No direct sunlight allowed.
4. The type and number of options installed can limit the upper limit.
5. System performance may be reduced if operating with a fan fault above 30°C (86°F).

Adapter Specifications

Table A-2 describes the inline network adapter technical and general specifications.

Table A-2 *Inline Network Adapter Specifications*

Specification	Description
Copper Gigabit Ethernet Specifications	
IEEE standard	Gigabit Ethernet, 1000BASE-T Fast Ethernet, 100BASE-T Ethernet, 10BASE-T
Full duplex and half duplex	Supports both half-duplex and full-duplex operation in all operating speeds
Autonegotiation	Autonegotiates between full-duplex and half-duplex operations and between 1000-Mbps, 100-Mbps, and 10-Mbps speeds
Data transfer rate	1000-Mbps, 100-Mbps, and 10-Mbps speeds per port in half-duplex mode 2000-Mbps, 200-Mbps, and 20-Mbps speeds per port in full-duplex mode
Ports	4-Port Inline Adapter: 4 × RJ-45 socket connectors 2-Port Inline Adapter: 2 × RJ-45 socket connectors
General Technical Specifications	
Interface standard	PCI-Express Base Specification Revision 1.0
Size	PCI Short add in card: 6.6 × 4.4 in. (167.6 × 111.2 mm)
PCI Express card type	×4

Table A-2 *Inline Network Adapter Specifications (continued)*

Specification	Description
PCI Express connector	Gold Finger: ×4
PCI voltage	+3.3 V ±9% +12 V ±8%
Weight	6.4 oz (180.0 g)
Operating humidity	0 to 90%, noncondensing
Operating temperature	50 to 95 °F (10 to 35 °C)
Storage temperature	−4 to 149 °F (−20 to 65 °C)

■ Adapter Specifications



APPENDIX **B**

Maintaining the WAVE-574

Proper use of preventive maintenance procedures can keep the WAVE-574 in good operating condition and minimize the need for costly, time-consuming service procedures. This chapter contains maintenance procedures that you should perform regularly.

This chapter covers the tasks required for maintaining a WAVE-574 or a WAVE-574 farm:

- [Maintaining Your Site Environment, page B-1](#)
- [Using Power Protection Devices, page B-7](#)

Maintaining Your Site Environment

An exhaust fan in the power supply cools the power supply and system by drawing air in through various openings in the system and blowing it out the back. However, the fan also draws dust and other particles into the system, causing contaminant buildup, which results in an increase in the system's internal temperature and interferes with the operation of various system components.

To avoid these conditions, we recommend keeping your work environment clean to reduce the amount of dust and dirt around the system, thereby reducing the amount of contaminants drawn into the system by the power supply fan.

This section discusses various environmental factors that can adversely affect system performance and longevity.

- [Temperature, page B-2](#)
- [Humidity, page B-3](#)

- [Altitude, page B-3](#)
- [Dust and Particles, page B-4](#)
- [Corrosion, page B-4](#)
- [Electrostatic Discharge, page B-4](#)
- [Electromagnetic and Radio Frequency Interference, page B-5](#)
- [Magnetism, page B-5](#)
- [Shock and Vibration, page B-6](#)
- [Power Source Interruptions, page B-6](#)

Temperature

Temperature extremes can cause a variety of problems, including premature aging and failure of chips or mechanical failure of appliances. Extreme temperature fluctuations can cause chips to become loose in their sockets and can cause expansion and contraction of disk drive platters, resulting in read or write data errors.

To minimize the negative effects of the temperature on system performance, follow these guidelines:

- Ensure that the system is operated in an environment no colder than 50° F (10° C) or hotter than 95° F (35° C).
- Ensure that the system has adequate ventilation. Do not place it within a closed-in wall unit or on top of cloth, which can act as insulation. Do not place it where it will receive direct sunlight, particularly in the afternoon. Do not place it next to a heat source of any kind, including heating vents during winter.

Adequate ventilation is particularly important at high altitudes. System performance may not be optimum when the system is operating at high temperatures as well as high altitudes.

- Make sure that all slots and openings on the system remain unobstructed, especially the fan vent on the back of the system.
- Clean the system at regular intervals to avoid any buildup of dust and debris, which can cause a system to overheat.

- If the system has been exposed to abnormally cold temperatures, allow a 2-hour warm-up period to bring it up to a normal operating temperature before turning it on. Failure to do so may cause damage to internal components, particularly the hard disk drive.
- If intermittent system failures are noticed, try reseating any socketed chips, which might have become loose because of temperature fluctuations.

Humidity

High-humidity conditions can cause moisture migration and penetration into the system. This moisture can cause corrosion of internal components and degradation of properties such as electrical resistance and thermal conductivity. Extreme moisture buildup inside the system can result in electrical shorts, which can cause serious damage to the system.

Each system is rated to operate at 8 to 80 percent relative humidity, with a humidity gradation of 10 percent per hour. Buildings in which climate is controlled by air conditioning in the warmer months and by heat during the colder months usually maintain an acceptable level of humidity for system equipment. However, if a system is located in an unusually humid location, a dehumidifier can be used to maintain the humidity within an acceptable range.

Altitude

Operating a system at high altitude (low pressure) reduces the efficiency of forced and convection cooling and can result in electrical problems related to arcing and corona effects. This condition can also cause sealed components with internal pressure, such as electrolytic capacitors, to fail or perform at reduced efficiency.

Each system is designed to operate at a maximum altitude of 3000 feet (914.4 meters) and can be stored at a maximum altitude of 7000 feet (2133 meters).

Dust and Particles

A clean operating environment can greatly reduce the negative effects of dust and other particles, which act as insulators and interfere with the operation of a system's mechanical components. In addition to regular cleaning, you should follow these guidelines to deter contamination of the system equipment:

- Do not permit smoking anywhere near the system.
- Do not permit food or drink near the system.
- Use dust covers when the system is not in use.
- Close windows and outside doors to keep out airborne particles.

Corrosion

The oil from a person's fingers or prolonged exposure to high temperature or humidity can corrode the gold-plated edge connectors and pin connectors on various devices in the system. This corrosion on system connectors is a gradual process that can eventually lead to intermittent failures of electrical circuits.

To prevent corrosion, you should avoid touching contacts on boards and cards. Protecting the system from corrosive elements is especially important in moist and salty environments, which tend to promote corrosion. Also, as a further deterrent to corrosion, the system should not be used in extreme temperatures, as explained in the [“Temperature” section on page B-2](#).

Electrostatic Discharge

Electrostatic discharge (ESD) results from the buildup of static electricity on the human body and certain other objects. This static electricity is often produced by simple movements such as walking across a carpet. ESD is a discharge of a static electrical charge that occurs when a person whose body contains such a charge touches a component in the system. This static discharge can cause components, especially chips, to fail. ESD is a problem particularly in dry environments where the relative humidity is below 50 percent.

To reduce the effects of ESD, you should observe the following guidelines:

- Wear a grounding wrist strap. If a grounding wrist strap is unavailable, touch an unpainted metal surface on the chassis periodically to neutralize any static charge.
- Keep components in their antistatic packaging until they are installed.
- Avoid wearing clothing made of wool or synthetic materials.

Electromagnetic and Radio Frequency Interference

Electromagnetic interference (EMI) and radio frequency interference (RFI) from a system can adversely affect devices such as radio and television (TV) receivers operating near the system. Radio frequencies emanating from a system can also interfere with cordless and low-power telephones. Conversely, RFI from high-power telephones can cause spurious characters to appear on the system's monitor screen.

RFI is defined as any EMI with a frequency above 10 kilohertz (kHz). This type of interference can travel from the system to other devices through the power cable and power source or through the air like transmitted radio waves. The Federal Communications Commission (FCC) publishes specific regulations to limit the amount of EMI and RFI emitted by computing equipment. Each system meets these FCC regulations.

To reduce the possibility of EMI and RFI, follow these guidelines:

- Operate the system only with the system cover installed.
- Ensure that the screws on all peripheral cable connectors are securely fastened to their corresponding connectors on the back of the system.
- Always use shielded cables with metal connector shells for attaching peripherals to the system.

Magnetism

Because they store data magnetically, hard disk drives are extremely susceptible to the effects of magnetism. Hard disk drives should never be stored near magnetic sources such as the following:

- Monitors
- TV sets

- Printers
- Telephones with real bells
- Fluorescent lights

Shock and Vibration

Excessive shock can damage the function, external appearance, and physical structure of a system. Each system has been designed to operate properly even after withstanding a minimum of six consecutively executed shock pulses in the positive and negative x, y, and z axes (one pulse on each side of the system). Each shock pulse can measure up to 5 gravities (G) for up to 11 milliseconds (ms). In storage, the system can withstand shock pulses of 20 G for 11 ms.

Excessive vibration can cause the same problems as mentioned earlier for shock, as well as causing components to become loose in their sockets or connectors. Systems can be subject to significant vibration when being transported by a vehicle or when operated in an environment with machinery that causes vibration.

Power Source Interruptions

Systems are especially sensitive to variations in voltage supplied by the AC power source. Overvoltage, undervoltage, and transients (or spikes) can erase data from memory or even cause components to fail. To protect against these types of problems, power cables should always be properly grounded and one or both of the following methods should be used:

- Use one of the power protection devices described in the [“Using Power Protection Devices” section on page B-7](#).
- Place the system on a dedicated power circuit (rather than sharing a circuit with other heavy electrical equipment). In general, do not allow the system to share a circuit with any of the following:
 - Copier machines
 - Air conditioners
 - Vacuum cleaners
 - Space heaters
 - Power tools

- Teletype machines
- Adding machines
- Laser printers
- Facsimile machines
- Any other motorized equipment

Besides these appliances, the greatest threats to a system's supply of power are surges or blackouts caused by electrical storms. Whenever possible, turn off the system and any peripherals and unplug them from their power sources during thunderstorms.

If a blackout occurs—even a temporary one—while the system is turned on, turn off the system immediately and disconnect it from the electrical outlet. Leaving the system on may cause problems when the power is restored; all other appliances left on in the area can create large voltage spikes that can damage the system.

Using Power Protection Devices

A number of devices are available that protect against power problems such as power surges, transients, and power failures. The following subsections describe some of these devices:

- [Surge Protectors, page B-7](#)
- [Line Conditioners, page B-8](#)
- [Uninterruptible Power Supplies, page B-8](#)

Surge Protectors

Surge protectors are available in a variety of types and usually provide a level of protection commensurate with the cost of the device. Surge protectors prevent voltage spikes, such as those caused during an electrical storm, from entering a system through the electrical outlet. Surge protectors, however, do not offer protection against brownouts, which occur when the voltage drops more than 20 percent below the normal AC line voltage level.

Line Conditioners

Line conditioners go beyond the overvoltage protection of surge protectors. Line conditioners keep a system's AC power source voltage at a fairly constant level and therefore can handle brownouts. Because of this added protection, line conditioners cost more than surge protectors—up to several hundred dollars. However, these devices cannot protect against a complete loss of power.

Uninterruptible Power Supplies

Uninterruptible power supply (UPS) systems offer the most complete protection against variations in power because they use battery power to keep the system running when AC power is lost. The battery is charged by the AC power while it is available, so once AC power is lost, the battery can provide power to the system for a limited amount of time—from 15 minutes to an hour or so—depending on the UPS system.

UPS systems range in price from a few hundred dollars to several thousand dollars, with the more expensive units allowing you to run larger systems for a longer period of time when AC power is lost. UPS systems that provide only 5 minutes of battery power let you conduct an orderly shutdown of the system but are not intended to provide continued operation. Surge protectors should be used with all UPS systems, and the UPS system should be Underwriters Laboratories (UL) safety-approved.



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