Catalyst 6500 Series Ethernet Modules Installation Guide

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

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

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

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

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

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Preface

This preface describes who should read the *Catalyst 6500 Series Ethernet Modules Installation Guide*, how it is organized, and its document conventions.

Audience

Only trained and qualified service personnel (as defined in IEC 60950 and AS/NZS3260) should install, replace, or service the equipment described in this publication.

Organization

This publication is organized as follows:

Chapter	Title	Description
Chapter 1	Catalyst 6500 Series Switch Chassis Overview	Describes and lists the hardware features and functionality of the Catalyst 6500 series switch chassis.
Chapter 2	Ethernet Switching Modules	Provides descriptions and specifications for the Ethernet modules available for installation on the Catalyst 6500 series switch chassis.
Chapter 3	Installing Ethernet Switching Modules	Provides procedures on how to correctly install Ethernet modules in your Catalyst 6500 series switch chassis.
Appendix A	Ethernet Module Daughter Cards	Provides descriptions and specifications for the PoE daughter cards and the DFC daughter cards available for installation on the Catalyst 6500 series Ethernet modules.

Chapter	Title	Description
Appendix B	Pluggable Transceiver Modules	Gives brief descriptions of the copper and optical transceiver modules, physical connectors, and the cables used with the Ethernet modules.
Appendix C	ESD Precautions	Provides a brief description of the hazards of electrostatic staic discharge (ESD) and procedures for correctly attaching an ESD wrist strap to the chassis.

Note Service module descriptions and specifications are beyond the scope of this document. Information on the currently available service modules is contained in the individual service module documentation sets.

Conventions

This publication uses the following conventions:

Convention	Description
boldface font	Commands, command options, and keywords are in **boldface**.
italic font	Arguments for which you supply values are in *italics*.
[ ]	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.

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.
italic screen font	Arguments for which you supply values are in *italic screen* font.
^	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.

Notes use the following conventions:

Note Means *reader take note*. Notes contain helpful suggestions or references to material not covered in the publication.

Cautions use the following conventions:

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

Warnings use the following conventions:

Statement 1071—Warning Definition

Warning **IMPORTANT SAFETY INSTRUCTIONS**

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

SAVE THESE INSTRUCTIONS

Waarschuwing **BELANGRIJKE VEILIGHEIDSINSTRUCTIES**

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

BEWAAR DEZE INSTRUCTIES

Varoitus **TÄRKEITÄ TURVALLISUUSOHJEITA**

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

SÄILYTÄ NÄMÄ OHJEET

Attention **IMPORTANTES INFORMATIONS DE SÉCURITÉ**

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

CONSERVEZ CES INFORMATIONS

Warnung **WICHTIGE SICHERHEITSHINWEISE**

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

BEWAHREN SIE DIESE HINWEISE GUT AUF.

Avvertenza **IMPORTANTI ISTRUZIONI SULLA SICUREZZA**

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

CONSERVARE QUESTE ISTRUZIONI

Advarsel **VIKTIGE SIKKERHETSINSTRUKSJONER**

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

TA VARE PÅ DISSE INSTRUKSJONENE

Aviso **INSTRUÇÕES IMPORTANTES DE SEGURANÇA**

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

GUARDE ESTAS INSTRUÇÕES

¡Advertencia! **INSTRUCCIONES IMPORTANTES DE SEGURIDAD**

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

GUARDE ESTAS INSTRUCCIONES

Varning! **VIKTIGA SÄKERHETSANVISNINGAR**

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

SPARA DESSA ANVISNINGAR

Figyelem **FONTOS BIZTONSÁGI ELOÍRÁSOK**

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

ORIZZE MEG EZEKET AZ UTASÍTÁSOKAT!

Предупреждение **ВАЖНЫЕ ИНСТРУКЦИИ ПО СОБЛЮДЕНИЮ ТЕХНИКИ БЕЗОПАСНОСТИ**

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

СОХРАНИТЕ ЭТИ ИНСТРУКЦИИ

警告 重要的安全性说明

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

请保存这些安全性说明

警告 安全上の重要な注意事項

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

これらの注意事項を保管しておいてください。

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이 지시 사항을 보관하십시오.

Aviso **INSTRUÇÕES IMPORTANTES DE SEGURANÇA**

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

GUARDE ESTAS INSTRUÇÕES

Advarsel **VIGTIGE SIKKERHEDSANVISNINGER**

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

GEM DISSE ANVISNINGER

تحذير **إرشادات الأمان الهامة**

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

Upozorenje **VAŽNE SIGURNOSNE NAPOMENE**

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

SAČUVAJTE OVE UPUTE

Upozornění

DŮLEŽITÉ BEZPEČNOSTNÍ POKYNY

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

USCHOVEJTE TYTO POKYNY

Προειδοποίηση

ΣΗΜΑΝΤΙΚΕΣ ΟΔΗΓΙΕΣ ΑΣΦΑΛΕΙΑΣ

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

ΦΥΛΑΞΤΕ ΑΥΤΕΣ ΤΙΣ ΟΔΗΓΙΕΣ

אזהרה

הוראות בטיחות חשובות

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

שמור הוראות אלה

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 ОВИЕ НАПАТСТВИЈА

Ostrzeżenie

WAŻNE INSTRUKCJE DOTYCZĄCE BEZPIECZEŃSTWA

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

NINIEJSZE INSTRUKCJE NALEŻY ZACHOWAĆ

Upozornenie **DÔLEŽITÉ BEZPEČNOSTNÉ POKYNY**

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

USCHOVAJTE SI TENTO NÁVOD

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 obrazložitveno 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

For additional Catalyst 6500 series switch information, refer to these publications:

- *Regulatory Compliance and Safety Information for the Catalyst 6500 Series Switches*
- *Site Preparation and Safety Guide*
- *Catalyst 6500 Series Switch Quick Software Configuration Guide*
- *Catalyst 6500 Series Switch Module Installation Guide*
- *Catalyst 6500 Series Switch Software Configuration Guide*
- *Catalyst 6500 Series Switch Command Reference*
- *Catalyst 6500 Series Switch Cisco IOS Software Configuration Guide*
- *Catalyst 6500 Series Switch Cisco IOS Command Reference*
- *ATM Software Configuration and Command Reference—Catalyst 5000 Family and Catalyst 6000 Family Switches*
- *Catalyst 6500 Series Switches System Message Guide*
- For information about MIBs, refer to this URL:
  http://www.cisco.com/public/sw-center/netmgmt/cmtk/mibs.shtml

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

Catalyst 6500 Series Switch Chassis Overview

Revised: August 27, 2012

This chapter describes the Catalyst 6500 series switches and contains these sections:

Note Throughout this publication, except where noted, the term *supervisor engine* is used to refer to Supervisor Engine 2, Supervisor Engine 32, and Supervisor Engine 720.

Catalyst 6503 Switch

The Catalyst 6503 switch is a 3-slot horizontal chassis. Figure 1-1 shows the front view of the chassis and Figure 1-2 shows the rear view of the chassis. Table 1-1 provides a description of the major switch features. Table 1-2 lists specifications of the Catalyst 6503 switch chassis.

Figure 1-1 Catalyst 6503 Switch Chassis—Front View

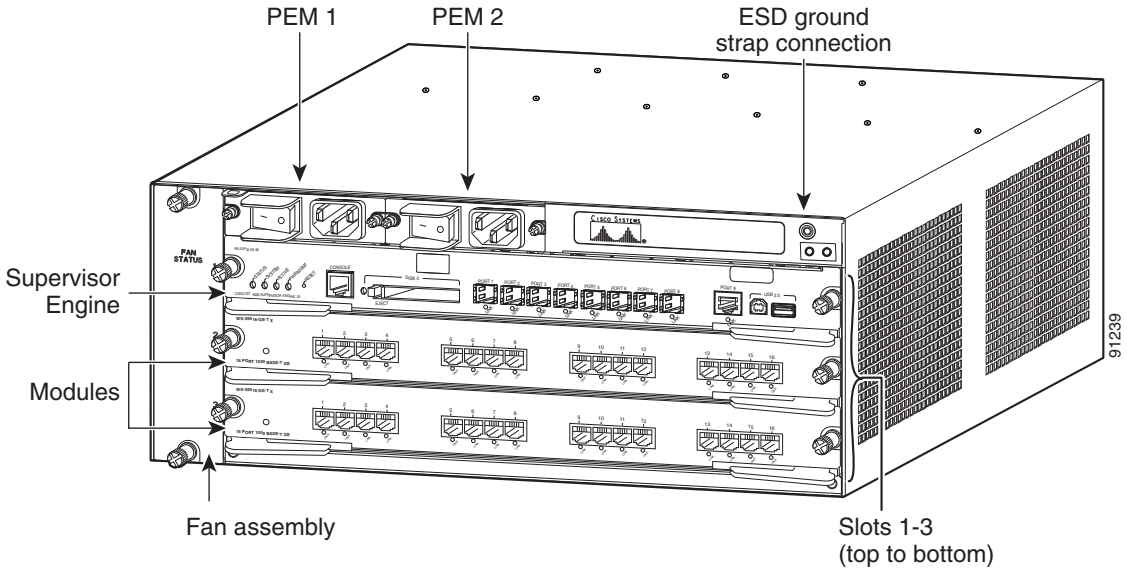


Figure 1-2 Catalyst 6503 Switch—Rear View

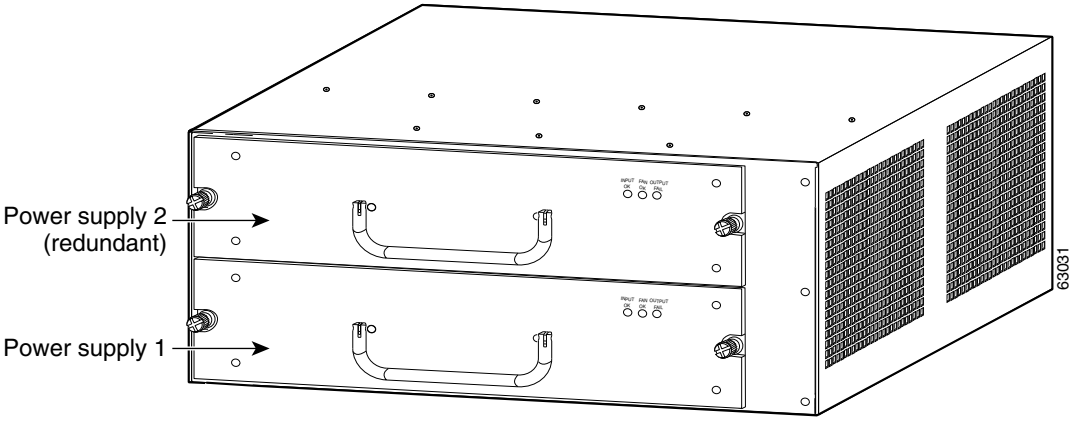


Table 1-1 Catalyst 6503 Switch Features

Feature	Description
Chassis	Three horizontal slots. Slots are numbered from 1 (top) to 3 (bottom).
Power supplies	• Supports one or two power supplies. The following power supplies are supported: – 950 W AC-input power supply (PWR-950-AC) – 950 W DC-input power supply (PWR-950-DC) – 1400 W AC-input power supply (PWR-1400-AC) **Note** For information and specifications for each of the supported power supplies, refer to Appendix A, "Power Supply Specifications," in the *Catalyst 6500 Series Switches Installation Guide*. • Installed power supplies can be of different wattage ratings. Installed power supplies can be both AC-input, both DC-input, or one AC-input and one DC-input. Power supplies can be configured in either redundant or nonredundant mode. **Note** For Catalyst 6503 and Catalyst 6503-E chassis that are equipped with DC-input power supplies, the system (NEBS) ground serves as the primary safety ground and must be installed. The DC-input power supplies for these chassis do not have a separate ground. • All Catalyst 6500 series AC-input power supplies require single-phase source AC. Source AC can be out of phase between multiple power supplies or multiple AC-power plugs on the same power supply because all AC power supply inputs are isolated. • Single power supplies are installed in the lower power supply bay. The second power supply is installed in the upper power supply bay.

Table 1-1 Catalyst 6503 Switch Features (continued)

Feature	Description
Supervisor engines	• Supports Supervisor Engine 2, Supervisor Engine 32, Supervisor Engine 32 PISA, and Supervisor Engine 720. – Supervisor engines are installed in slot 1 and slot 2. – Supervisor Engine 720 with 10-GB uplink ports (VS-S720-10G-3C and VS-S720-10G-3CXL) is not supported on the Catalyst 6503 chassis. – Supervisor Engine 32, Supervisor Engine 32 PISA, or Supervisor Engine 720 requires that the optional high-speed fan tray (FAN-MOD-3HS) be installed in the chassis. – Supervisor Engine 720 has built-in switching fabric. Switch Fabric Modules (WS-C6500-SFM and WS-X6500-SFM2) are not supported by Supervisor Engine 720 and cannot be installed in the same chassis. – Supervisor Engine 32 and Supervisor Engine 32 PISA do not support the Switch Fabric Modules ((WS-C6500-SFM and WS-X6500-SFM2). • The uplink ports are fully functional on the redundant supervisor engine while it is in standby mode. **Note** In systems with redundant supervisor engines, both supervisor engines must be the same model and have the same daughter card configurations. Each supervisor engine must have the resources to run the switch on its own, which means all supervisor engine resources are duplicated. Identical supervisor engine memory configurations are recommended, but are not required as long as the supervisor engine with the smaller memory configuration is sufficient to run the configured features of the switch. Additionally, each supervisor engine must have its own flash device and console port connections.
Modules	• Supports up to two Catalyst 6500 series modules. • Does not support the WS-C6500-SFM and WS-X6500-SFM2 Switch Fabric Modules. • Does not support the WS-X67xx modules. • Some Catalyst 6500 series modules: – Are not supported – Require that you install a Supervisor Engine 720 – Have chassis slot restrictions – Require a specific software release level Check your software release notes for specific information on module support.

Table 1-2 Catalyst 6503 Switch Specifications

Item	Specification
Environmental	
Temperature, operating	Certified for operation: 32° to 104°F (0° to 40°C) Designed and tested for operation: 32° to 130°F (0° to 55°C) **Note** The Catalyst 6500 series switches are equipped with internal air temperature sensors that are triggered at 104°F (40°C) generating a minor alarm and at 131°F (55°C) generating a major alarm.
Temperature, nonoperating and storage	–4° to 149°F (–20° to 65°C)
Thermal transition	0.5°C per minute (hot to cold) 0.33°C per minute (cold to hot)
Humidity (RH), ambient (noncondensing) operating	10% to 85%
Humidity (RH), ambient (noncondensing) nonoperating and storage	5% to 95%
Altitude, operating	Certified for operation: 0 to 6500 feet (0 to 2000 m) Designed and tested for operation: –200 to 10,000 feet (–60 to 3000 m)
Physical Characteristics	
Dimensions (H x W x D)	• 7 x 17.37 x 21.75 in. (17.78 x 44.12 x 55.25 cm). • Chassis requires 4 RU. • Chassis can be mounted in equipment racks that meet ANSI/EIA 310-D and ETS 300-119 standards.
Weight	• Chassis only: 27 lb (12.25 kg). • Chassis fully configured with 1 supervisor engine, 2 modules, 2 AC-input PEMs, and 2 AC-input power supplies: 85.4 lb (38.7 kg).
Airflow	• FAN-MOD-3 (standard fan tray)—170 CFM • FAN-MOD-3HS (optional high-speed fan tray)—270 CFM **Note** To maintain proper air circulation through the Catalyst switch chassis, we recommend that you maintain a minimum 6-inch (15 cm) separation between a wall and the chassis air intake or a wall and the chassis air exhaust. You should also allow a minimum separation of 12 inches (30.5 cm) between the hot air exhaust on one chassis and the air intake on another chassis. Failure to maintain adequate air space can cause the chassis to overheat and the system to fail. On Catalyst chassis in which the airflow is from front to back, the chassis may be placed side-by-side.

Catalyst 6503-E Switch

The Catalyst 6503-E switch is an enhanced version of the Catalyst 6503. Figure 1-3 shows the front view of the chassis and Figure 1-4 shows the rear view of the chassis. Table 1-3 provides a description of the major switch features. Table 1-4 lists the specifications of the Catalyst 6503-E switch chassis.

Figure 1-3 Catalyst 6503-E Switch—Front View

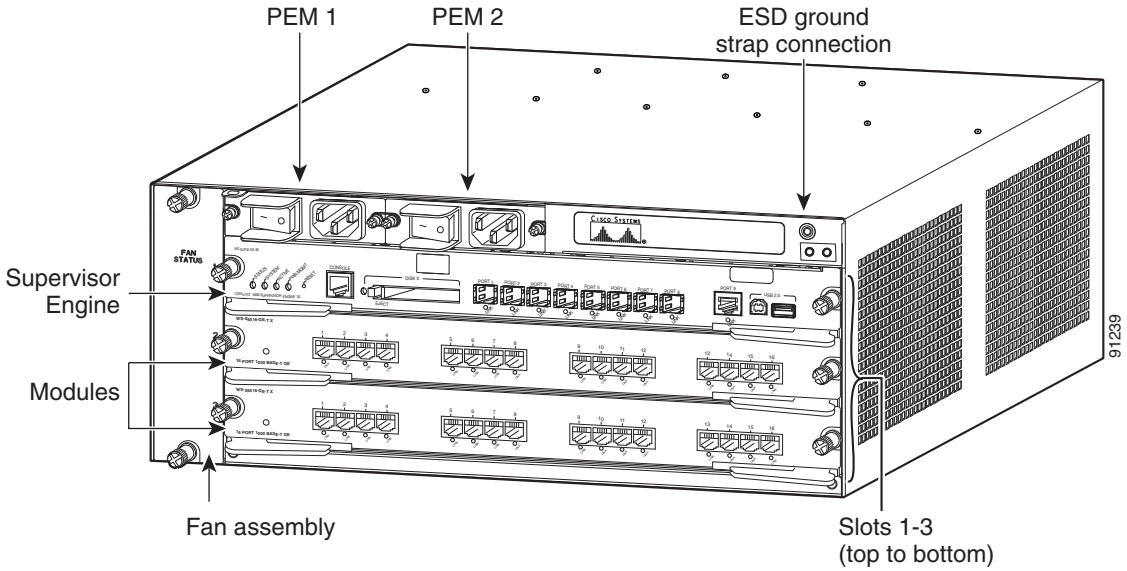


Figure 1-4 Catalyst 6503-E Switch—Rear View

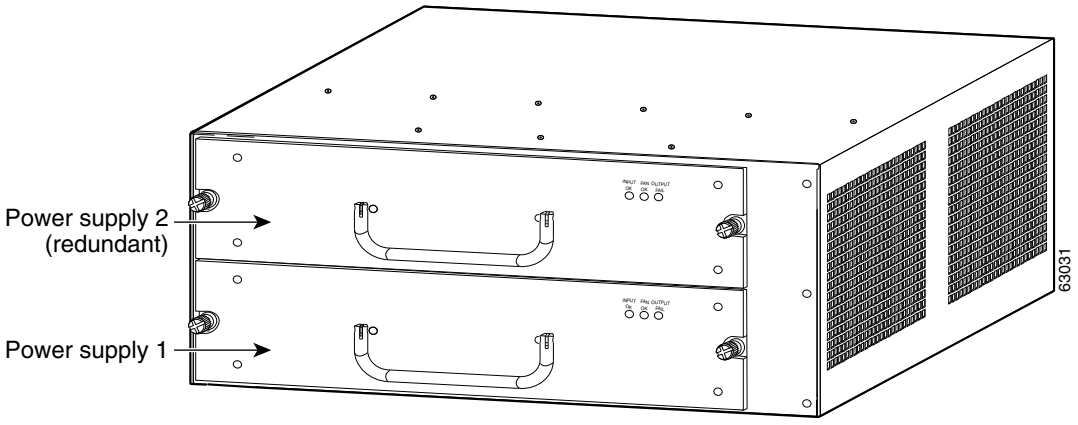


Table 1-3 Catalyst 6503-E Switch Features

Feature	Description
Chassis	Three horizontal slots. Slots are numbered from 1 (top) to 3 (bottom).
Power supplies	• Supports one or two power supplies. The following power supplies are supported: – PWR-950-AC (950 W AC-input power supply) – PWR-950-DC (950 W DC-input power supply) – PWR-1400-AC (1400 W AC-input power supply) **Note** For information and specifications for each of the supported power supplies, refer to Appendix A, "Power Supply Specifications," in the *Catalyst 6500 Series Switches Installation Guide*. • Installed power supplies can be of different wattage ratings. Installed power supplies can be both AC-input, both DC-input, or one AC-input and one DC-input. Power supplies can be configured in either redundant or nonredundant mode. • All Catalyst 6500 series AC-input power supplies require single-phase source AC. Source AC can be out of phase between multiple power supplies or multiple AC-power plugs on the same power supply because all AC power supply inputs are isolated. • Supervisor Engine 2T requires a 1400 W power supply to operate. • Single power supplies are installed in the lower power supply bay. The second power supply is installed in the upper power supply bay.

Table 1-3 Catalyst 6503-E Switch Features (continued)

Feature	Description
Supervisor engines	• Supports Supervisor Engine 2, Supervisor Engine 32, Supervisor Engine 32 PISA, Supervisor Engine 720, Supervisor Engine 720-10GE, and Supervisor Engine 2T. – Supervisor engines are installed in slot 1 and slot 2. – Supervisor Engine 720, Supervisor Engine 720-10GE, and Supervisor Engine 2T have built-in switching fabric and do not support Switch Fabric Modules (WS-C6500-SFM and WS-X6500-SFM2). – Supervisor Engine 32 and Supervisor Engine 32 PISA do not support the Switch Fabric Modules ((WS-C6500-SFM and WS-X6500-SFM2). • The uplink ports are fully functional on the redundant supervisor engine when it is in standby mode. **Note** In systems with redundant supervisor engines, both supervisor engines must be the same model and have the same daughter card configurations. Each supervisor engine must have the resources to run the switch on its own, which means all supervisor engine resources are duplicated. Identical supervisor engine memory configurations are recommended, but are not required as long as the supervisor engine with the smaller memory configuration is sufficient to run the configured features of the switch. Additionally, each supervisor engine must have its own flash device and console port connections.
Modules	• Chassis supports up to two Catalyst 6500 series modules. • Chassis does not support the WS-C6500-SFM and WS-X6500-SFM2 Switch Fabric Modules. • Some Catalyst 6500 series modules: – Are not supported – Require that you install a Supervisor Engine 720 or Supervisor Engine 2T – Have chassis slot restrictions – Require a specific software release level Check your software release notes for specific information on module support and restrictions.

Table 1-4 Catalyst 6503-E Switch Specifications

Item	Specification
Environmental	
Temperature, operating	Certified for operation: 32° to 104°F (0° to 40°C) Designed and tested for operation: 32° to 130°F (0° to 55°C) **Note** The Catalyst 6500 series switches are equipped with internal air temperature sensors that are triggered at 104°F (40°C) generating a minor alarm and at 131°F (55°C) generating a major alarm.
Temperature, nonoperating and storage	–4° to 149°F (–20° to 65°C)
Thermal transition	0.5°C per minute (hot to cold) 0.33°C per minute (cold to hot)
Humidity (RH), ambient (noncondensing) operating	10% to 85%
Humidity (RH), ambient (noncondensing) nonoperating and storage	5% to 95%
Altitude, operating	Certified for operation: 0 to 6500 feet (0 to 2000 m) Designed and tested for operation: –200 to 10,000 feet (–60 to 3000 m)
Physical Characteristics	
Dimensions (H x W x D)	• 7 x 17.37 x 21.75 in. (17.78 x 44.12 x 55.25 cm). • Chassis requires 4 RU. • Chassis can be mounted in equipment racks that meet ANSI/EIA 310-D and ETS 300-119 standards.
Weight	• Chassis only: 33 lb (15 kg). • Chassis fully configured with 1 supervisor engine, 2 modules, 2 AC-input PEMs, and 2 AC-input power supplies: 85.4 lb (38.7 kg).
Airflow	WS-C6503-E-FAN—282 CFM **Note** To maintain proper air circulation through the Catalyst switch chassis, we recommend that you maintain a minimum 15 cm (6-inch) separation between a wall and the chassis air intake or a wall and the chassis air exhaust. You should also allow a minimum separation of 12 inches (30.5 cm) between the hot air exhaust on one chassis and the air intake on another chassis. Failure to maintain adequate air space can cause the chassis to overheat and the system to fail. On Catalyst chassis in which the airflow is from front to back, the chassis may be placed side-by-side.

Catalyst 6504-E Switch

The Catalyst 6504-E switch is a 4-slot horizontal enhanced chassis. Figure 1-5 shows the front view of the chassis and Figure 1-6 shows the rear view of the chassis. Table 1-5 provides a description of major switch features. Table 1-6 lists the specifications of the Catalyst 6504-E switch chassis.

Figure 1-5 Catalyst 6504-E Switch—Front View

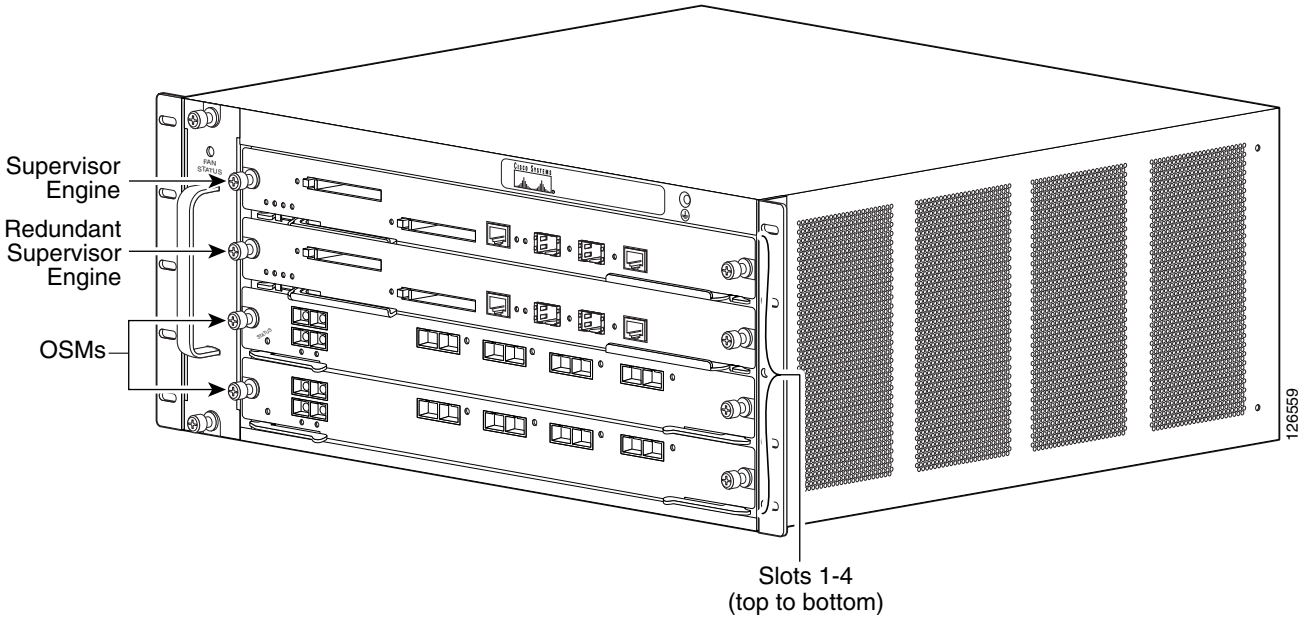


Figure 1-6 Catalyst 6504-E Switch—Rear View

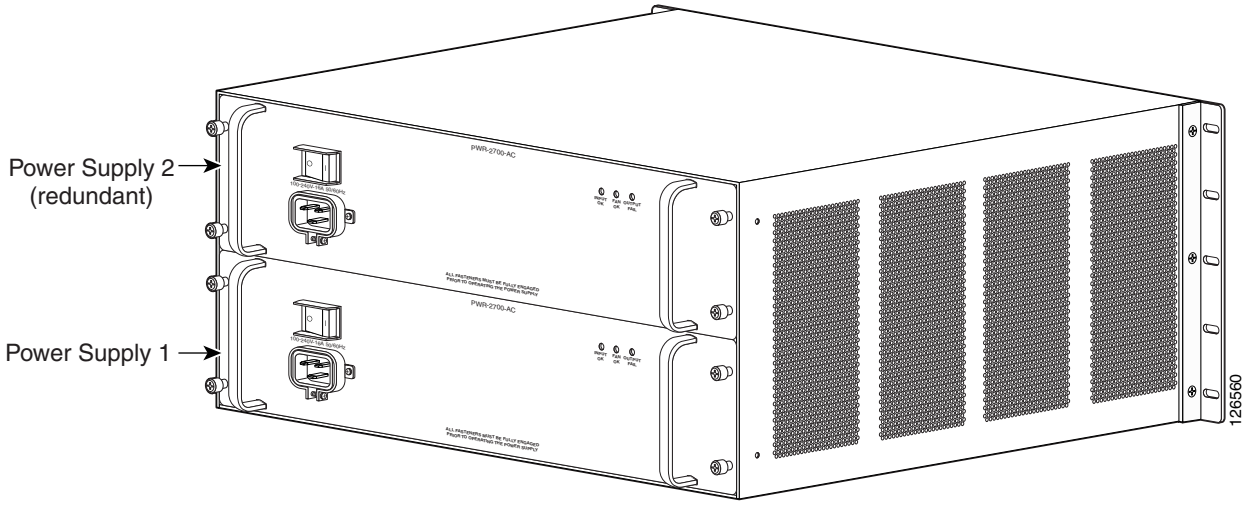


Table 1-5 Catalyst 6504-E Switch Features

Feature	Description
Chassis	Four horizontal slots. Slots are numbered from 1 (top) to 4 (bottom).
Power supplies	• Supports one or two power supplies. The following power supplies are supported: – PWR-2700-AC/4 (2700 W AC-input power supply) – PWR-2700-DC/4 (2700 W DC-input power supply) **Note** For information and specifications for each of the supported power supplies, refer to Appendix A, "Power Supply Specifications," in the *Catalyst 6500 Series Switches Installation Guide*. • Installed power supplies can be both AC-input, both DC-input, or one AC-input and one DC-input. Power supplies can be configured in either redundant or nonredundant mode. • All Catalyst 6500 series AC-input power supplies require single-phase source AC. Source AC can be out of phase between multiple power supplies or multiple AC-power plugs on the same power supply because all AC power supply inputs are isolated. • Single power supplies are installed in the lower power supply bay. The second power supply is installed in the upper power supply bay.

Table 1-5 Catalyst 6504-E Switch Features (continued)

Feature	Description
Supervisor engines	• Supports Supervisor Engine 2, Supervisor Engine 32, Supervisor Engine 32 PISA, Supervisor Engine 720, Supervisor Engine 720-10GE, and Supervisor Engine 2T. – Supervisor engines are installed in slot 1 and slot 2. – Supervisor Engine 720, Supervisor Engine 720-10GE, and Supervisor Engine 2T have built-in switching fabric. Switch Fabric Modules (WS-C6500-SFM and WS-X6500-SFM2) are not supported by those supervisor engines. – Supervisor Engine 32 and Supervisor Engine 32 PISA do not support the Switch Fabric Modules ((WS-C6500-SFM and WS-X6500-SFM2). • The uplink ports are fully functional on the redundant supervisor engine when it is in standby mode. **Note** In systems with redundant supervisor engines, both supervisor engines must be the same model and have the same daughter card configurations. Each supervisor engine must have the resources to run the switch on its own, which means all supervisor engine resources are duplicated. Identical supervisor engine memory configurations are recommended, but are not required as long as the supervisor engine with the smaller memory configuration is sufficient to run the configured features of the switch. Additionally, each supervisor engine must have its own flash device and console port connections.
Modules	• Chassis supports up to three Catalyst 6500 series modules. • Chassis does not support the WS-C6500-SFM and WS-X6500-SFM2 Switch Fabric Modules. • Some Catalyst 6500 series modules: – Are not supported – Require that you install a Supervisor Engine 720 or Supervisor Engine 2T – Have chassis slot restrictions – Require a specific software release level Check your software release notes for specific information on module support and restrictions.

Table 1-6 Catalyst 6504-E Switch Specifications

Item	Specification
Environmental	
Temperature, operating	Certified for operation: 32° to 104°F (0° to 40°C) Designed and tested for operation: 32° to 130°F (0° to 55°C) **Note** The Catalyst 6500 series switches are equipped with internal air temperature sensors that are triggered at 104°F (40°C) generating a minor alarm and at 131°F (55°C) generating a major alarm.
Temperature, nonoperating and storage	–4° to 149°F (–20° to 65°C)
Thermal transition	0.5°C per minute (hot to cold) 0.33°C per minute (cold to hot)
Humidity (RH), ambient (noncondensing) operating	10% to 85%
Humidity (RH), ambient (noncondensing) nonoperating and storage	5% to 95%
Altitude, operating	Certified for operation: 0 to 6500 feet (0 to 2000 m) Designed and tested for operation: –200 to 10,000 feet (–60 to 3000 m)
Physical Characteristics	
Dimensions (H x W x D)	• 8.7 x 17.5 x 21.6 in. (22.09 x 44.45 x 54.86 cm). • Chassis requires 5 RU. • Chassis can be mounted in equipment racks that meet ANSI/EIA 310-D and ETS 300-119 standards.
Weight	• Chassis only: 27 lb (12.25 kg). • Chassis fully configured with 2 supervisor engines, 2 modules, and 2 AC-input power supplies: 97 lb (43.99 kg).
Airflow	FAN-MOD-4HS—300 CFM **Note** To maintain proper air circulation through the Catalyst switch chassis, we recommend that you maintain a minimum 6-inch (15 cm) separation between a wall and the chassis air intake or a wall and the chassis air exhaust. You should also allow a minimum separation of 12 inches (30.5 cm) between the hot air exhaust on one chassis and the air intake on another chassis. Failure to maintain adequate air space can cause the chassis to overheat and the system to fail. On Catalyst chassis in which the airflow is from front to back, the chassis may be placed side-by-side.

Catalyst 6506 Switch

The Catalyst 6506 switch is a 6-slot horizontal chassis. Figure 1-7 shows a front view of the chassis. Table 1-7 provides a description of the major switch features. Table 1-8 lists the specifications of the Catalyst 6506 switch chassis.

Figure 1-7 Catalyst 6506 Switch

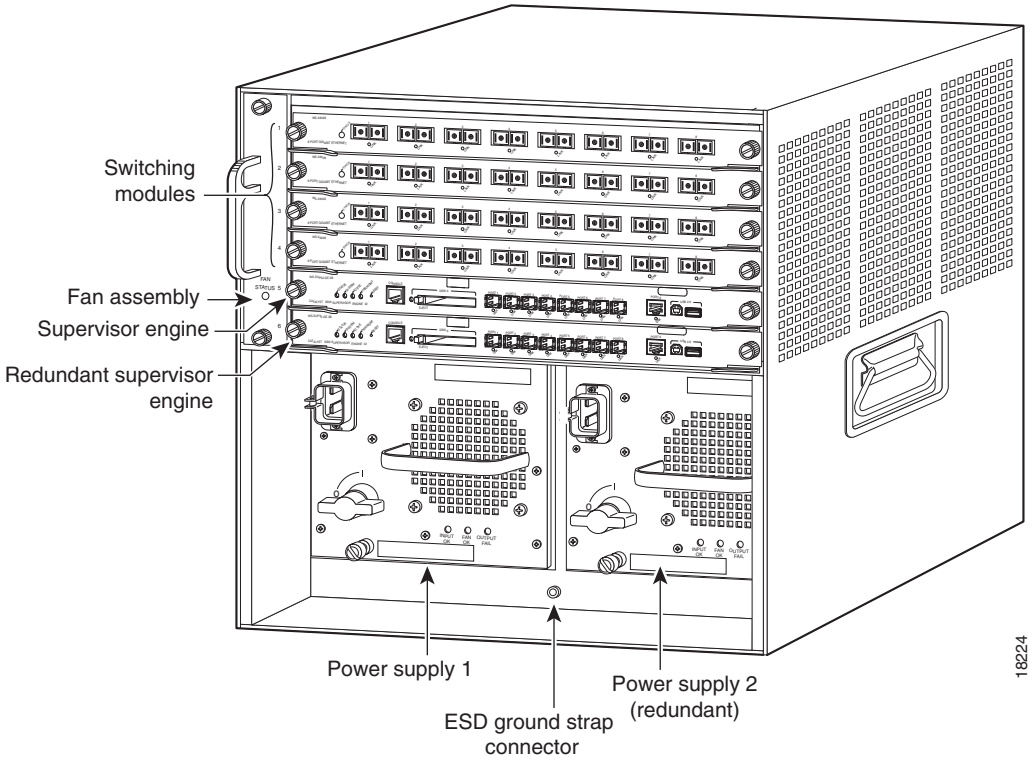


Table 1-7 Catalyst 6506 Switch Features

Feature	Descriptions
Chassis	Six horizontal slots. Slots are numbered from 1 (top) to 6 (bottom).
Power supplies	• Supports one or two power supplies. The following power supplies are supported: – WS-CAC-1000W (1000 W AC-input power supply) – WS-CAC-1300W (1300 W AC-input power supply) – WS-CDC-1300W (1300 W DC-input power supply) – WS-CAC-2500W (2500 W AC-input power supply) – WS-CDC-2500W (2500 W DC-input power supply) – WS-CAC-3000W (3000 W AC-input power supply) – WS-CAC-4000W-US (4000 W AC-input power supply) – WS-CAC-4000W-INT (4000 W AC-input power supply) – PWR-4000-DC (4000 W DC-input power supply) – WS-CAC-6000W (6000 W AC-input power supply) – WS-CAC-8700W (8700 W AC-input power supply) **Note** The 6000 W and the 8700 W AC-input power supplies are limited to 4500 W maximum output when installed in the Catalyst 6506 chassis. **Note** For information and specifications for each of the supported power supplies, refer to Appendix A, "Power Supply Specifications," in the *Catalyst 6500 Series Switches Installation Guide*. • Installed power supplies can be of different wattage ratings. Installed power supplies can also be both AC-input, both DC-input, or one AC-input and one DC-input. Power supplies can be configured in either redundant or nonredundant mode. • All Catalyst 6500 series AC-input power supplies require single-phase source AC. Source AC can be out of phase between multiple power supplies or multiple AC-power plugs on the same power supply because all AC power supply inputs are isolated. • Single power supplies are installed in the left power supply bay. The second power supply is installed in the right power supply bay. • You must install a 2500 W or higher capacity power supply when using the Supervisor Engine 32 or the Supervisor Engine 720 and the high-speed fan tray.

Table 1-7 Catalyst 6506 Switch Features (continued)

Feature	Descriptions
Supervisor engines	• Supports Supervisor Engine 2, Supervisor Engine 32, Supervisor Engine 32 PISA, Supervisor Engine 720, and Supervisor Engine 720-10GE. – Supervisor Engine 2 is installed in slot 1 or slot 2. – Supervisor Engine 32, Supervisor Engine 32 PISA, Supervisor Engine 720, and Supervisor Engine 720-10GE are installed in slot 5 or slot 6. – Supervisor Engine 32, Supervisor Engine 32 PISA, Supervisor Engine 720, and Supervisor Engine 720-10GE all require the high-speed fan tray (WS-C6K-6SLOT-FAN2) be installed in the chassis. You must also install a 2500 W or higher capacity power supply in the chassis to power the high-speed fan tray. **Note** The 2500 W power supply, when supporting the high-speed fan tray, can be powered from either 120 VAC or 220 VAC. – Supervisor Engine 720 and Supervisor Engine 720-10GE have built-in switching fabric. Switch Fabric Modules (WS-C6500-SFM and WS-X6500-SFM2) are not supported by Supervisor Engine 720 and Supervisor Engine 720-10GE and cannot be installed in the same chassis. – Supervisor Engine 32 and Supervisor Engine 32 PISA do not support the Switch Fabric Modules (WS-C6500-SFM and WS-X6500-SFM2). • The uplink ports are fully functional on the redundant supervisor engine in standby mode. **Note** In systems with redundant supervisor engines, both supervisor engines must be the same model and have the same daughter card configurations. Each supervisor engine must have the resources to run the switch on its own, which means all supervisor engine resources are duplicated. Identical supervisor engine memory configurations are recommended, but are not required as long as the supervisor engine with the smaller memory configuration is sufficient to run the configured features of the switch. Additionally, each supervisor engine must have its own flash device and console port connections.

Table 1-7 Catalyst 6506 Switch Features (continued)

Feature	Descriptions
Modules	• Chassis supports up to five Catalyst 6500 series modules. • WS-C6500-SFM and WS-X6500-SFM2 Switch Fabric Modules must be installed in slot 5 or slot 6. • Some Catalyst 6500 series modules: – Are not supported – Require that you install a Supervisor Engine 720 – Have chassis slot restrictions – Require a specific software release level Check your software release notes for specific information on supported modules.

Table 1-8 Catalyst 6506 Switch Specifications

Item	Specification
Environmental	
Temperature, operating	Certified for operation: 32° to 104°F (0° to 40°C) Designed and tested for operation: 32° to 130°F (0° to 55°C) **Note** The Catalyst 6500 series switches are equipped with internal air temperature sensors that are triggered at 104°F (40°C) generating a minor alarm and at 131°F (55°C) generating a major alarm.
Temperature, nonoperating and storage	–4° to 149°F (–20° to 65°C)
Thermal transition	0.5°C per minute (hot to cold) 0.33°C per minute (cold to hot)
Humidity (RH), ambient (noncondensing) operating	10% to 90%
Humidity (RH), ambient (noncondensing) nonoperating and storage	5% to 95%
Altitude, operating	Certified for operation: 0 to 6500 feet (0 to 2000 m) Designed and tested for operation: –200 to 10,000 feet (–60 to 3000 m)

Table 1-8 Catalyst 6506 Switch Specifications (continued)

Item	Specification
Physical Characteristics	
Dimensions (H x W x D)	• 20.1 x 17.2 x 18.1 in. (51.1 x 43.7 x 46.0 cm). • Chassis depth including cable guide is 21.64 in. (55.0 cm). • Chassis requires 12 RU. • Chassis can be mounted in equipment racks that meet ANSI/EIA 310-D and ETS 300-119 standards.
Weight	• Chassis only: 45 lb (20.4 kg). • Chassis fully configured with 1 supervisor engine, 5 switching modules, and 2 power supplies: 156.6 lb (71.0 kg).
Airflow	• WS-C6K-6SLOT-FAN (Standard fan tray)—227 CFM. • WS-C6K-6SLOT-FAN2 (Optional high-speed fan tray)—420 CFM. **Note** To maintain proper air circulation through the Catalyst switch chassis, we recommend that you maintain a minimum 6-inch (15 cm) separation between a wall and the chassis air intake or a wall and the chassis air exhaust. You should also allow a minimum separation of 12 inches (30.5 cm) between the hot air exhaust on one chassis and the air intake on another chassis. Failure to maintain adequate air space can cause the chassis to overheat and the system to fail. On Catalyst chassis in which the airflow is from front to back, the chassis may be placed side-by-side.

Catalyst 6506-E Switch

The Catalyst 6506-E switch is an enhanced version of the Catalyst 6506 chassis. Figure 1-8 shows a front view of the chassis. Table 1-9 provides a description of the major switch features. Table 1-10 lists the specifications of the Catalyst 6506-E switch chassis.

Figure 1-8 Catalyst 6506-E Switch

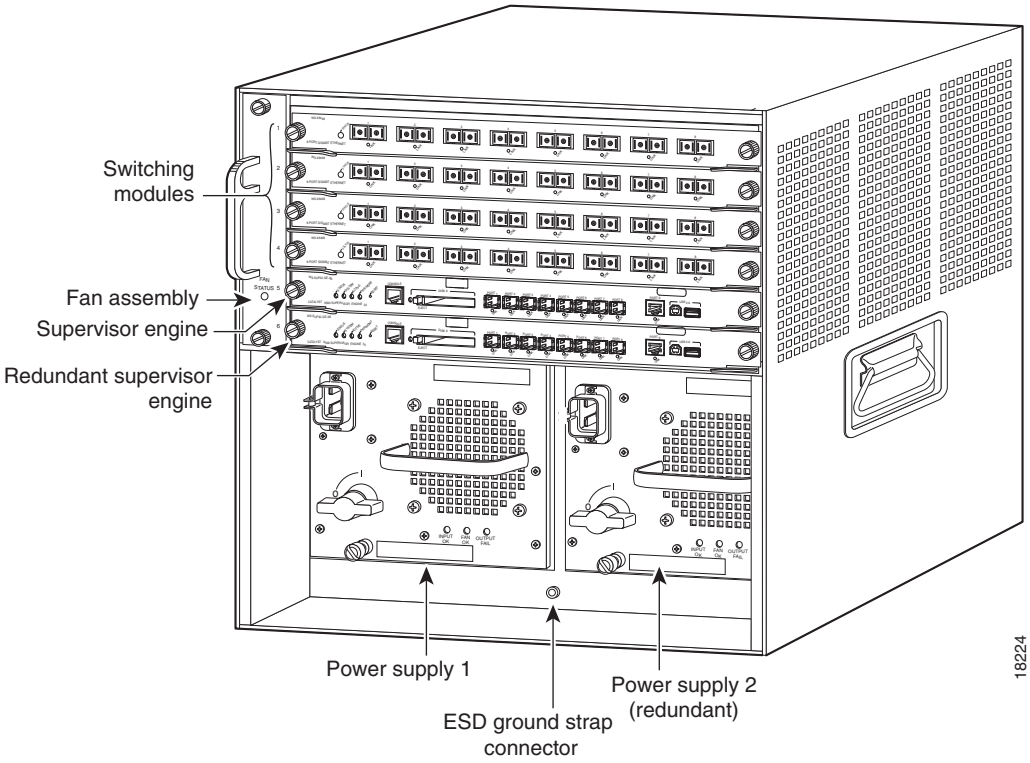


Table 1-9 Catalyst 6506-E Switch Features

Feature	Descriptions
Chassis	Six horizontal slots. Slots are numbered from 1 (top) to 6 (bottom).
Power supplies	• Supports one or two power supplies. The following power supplies are supported: – WS-CAC-2500W (2500 W AC-input power supply) – WS-CDC-2500W (2500 W DC-input power supply) – WS-CAC-3000W (3000 W AC-input power supply) – WS-CAC-4000W-US (4000 W AC-input power supply) – WS-CAC-4000W-INT (4000 W AC-input power supply) – PWR-4000-DC (4000 W DC-input power supply) – WS-CAC-6000W (6000 W AC-input power supply) – WS-CAC-8700W-E (8700 W AC-input power supply) **Note** For information and specifications for each of the supported power supplies, refer to Appendix A, "Power Supply Specifications," in the *Catalyst 6500 Series Switches Installation Guide*. • Installed power supplies can be of different wattage ratings. Installed power supplies can also be both AC-input, both DC-input, or one AC-input and one DC-input. Power supplies can be configured in either redundant or nonredundant mode. • All Catalyst 6500 series AC-input power supplies require single-phase source AC. Source AC can be out of phase between multiple power supplies or multiple AC-power plugs on the same power supply because all AC power supply inputs are isolated. • The Supervisor Engine 2T requires a 3000 W or greater power supply to operate. • Single power supplies are installed in the left power supply bay. The second power supply is installed in the right power supply bay.

Table 1-9 Catalyst 6506-E Switch Features (continued)

Feature	Descriptions
Supervisor engines	• Supports Supervisor Engine 2, Supervisor Engine 32, Supervisor Engine 32 PISA, Supervisor Engine 720, Supervisor Engine 720-10GE, and Supervisor Engine 2T. – Supervisor Engine 2 is installed in slot 1 and slot 2. – Supervisor Engine 32, Supervisor Engine 32 PISA, Supervisor Engine 720, Supervisor Engine 720-10GE, and Supervisor Engine 2T are installed in slot 5 and slot 6. – Supervisor Engine 720, Supervisor Engine 720-10GE, and Supervisor Engine 2T have built-in switching fabric; Switch Fabric Modules (WS-C6500-SFM and WS-X6500-SFM2) are not supported. – Supervisor Engine 32 and Supervisor Engine 32 PISA do not support the Switch Fabric Modules ((WS-C6500-SFM and WS-X6500-SFM2). • The uplink ports are fully functional on the redundant supervisor engine in standby mode. **Note** In systems with redundant supervisor engines, both supervisor engines must be the same model and have the same daughter card configurations. Each supervisor engine must have the resources to run the switch on its own, which means all supervisor engine resources are duplicated. Identical supervisor engine memory configurations are recommended, but are not required as long as the supervisor engine with the smaller memory configuration is sufficient to run the configured features of the switch. Additionally, each supervisor engine must have its own flash device and console port connections.
Modules	• Chassis supports up to five Catalyst 6500 series modules. • WS-C6500-SFM and WS-X6500-SFM2 Switch Fabric Modules must be installed in slot 5 or slot 6. • Some Catalyst 6500 series modules: – Are not supported – Require that you install a Supervisor Engine 720 – Have chassis slot restrictions – Require a specific software release level Check your software release notes for specific information on module support and restrictions.

Table 1-10 Catalyst 6506-E Switch Specifications

Item	Specification
Environmental	
Temperature, operating	Certified for operation: 32° to 104°F (0° to 40°C) Designed and tested for operation: 32° to 130°F (0° to 55°C) **Note** The Catalyst 6500 series switches are equipped with internal air temperature sensors that are triggered at 104°F (40°C) generating a minor alarm and at 131°F (55°C) generating a major alarm.
Temperature, nonoperating and storage	–4° to 149°F (–20° to 65°C)
Thermal transition	0.5°C per minute (hot to cold) 0.33°C per minute (cold to hot)
Humidity (RH), ambient (noncondensing) operating	10% to 90%
Humidity (RH), ambient (noncondensing) nonoperating and storage	5% to 95%
Altitude, operating	Certified for operation: 0 to 6500 feet (0 to 2000 m) Designed and tested for operation: –200 to 10,000 feet (–60 to 3000 m)
Physical Characteristics	
Dimensions (H x W x D)	• 19.2 x 17.5 x 18.2 in. (48.8 x 44.5 x 46.0 cm). • Chassis depth including cable guide is 21.64 in. (55.0 cm). • Chassis requires 12 RU. • Chassis can be mounted in equipment racks that meet ANSI/EIA 310-D and ETS 300-119 standards.
Weight	Chassis only: 45 lb (20.41 kg). Chassis fully configured with 1 supervisor engine, 5 switching modules, and 2 power supplies: 159 lb (72.3 kg).
Airflow	WS-C6506-E-FAN—564 CFM. **Note** To maintain proper air circulation through the Catalyst switch chassis, we recommend that you maintain a minimum 6-inch (15 cm) separation between a wall and the chassis air intake or a wall and the chassis air exhaust. You should also allow a minimum separation of 12 inches (30.5 cm) between the hot air exhaust on one chassis and the air intake on another chassis. Failure to maintain adequate air space can cause the chassis to overheat and the system to fail. On Catalyst chassis in which the airflow is from front to back, the chassis may be placed side-by-side.

Catalyst 6509 Switch

The Catalyst 6509 switch is a 9-slot horizontal chassis. Figure 1-9 shows a front view of the chassis. Table 1-11 provides a description of the major switch features. Table 1-12 lists the specifications of the Catalyst 6509 switch chassis.

Figure 1-9 Catalyst 6509 Switch

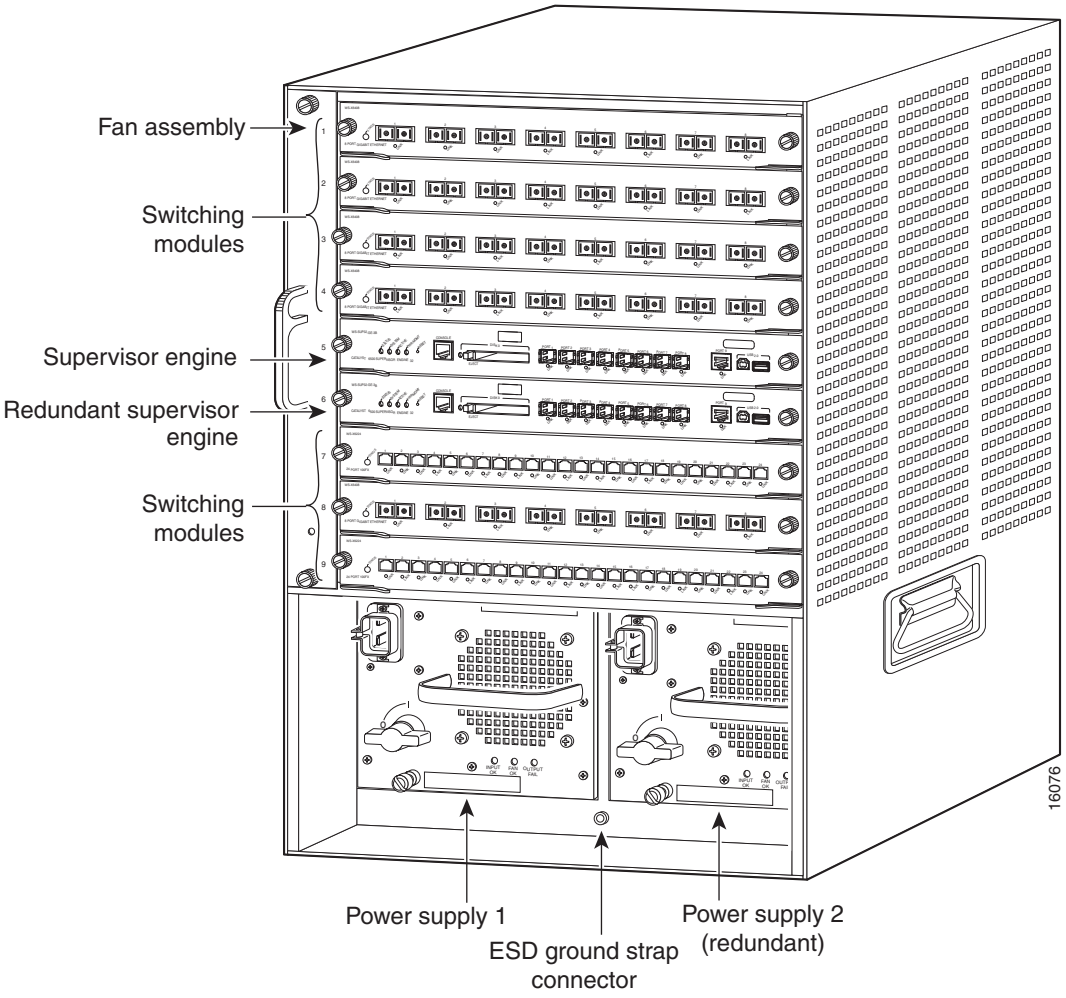


Table 1-11 Catalyst 6509 Switch Features

Feature	Description
Chassis	Nine horizontal slots. Slots are numbered from 1 (top) to 9 (bottom).
Power supplies	• Supports one or two power supplies. The following power supplies are supported: – WS-CAC-1000W (1000 W AC-input power supply) – WS-CAC-1300W (1300 W AC-input power supply) – WS-CDC-1300W (1300 W DC-input power supply) – WS-CAC-2500W (2500 W AC-input power supply) – WS-CDC-2500W (2500 W DC-input power supply) – WS-CAC-3000W (3000 W AC-input power supply) – WS-CAC-4000W-US (4000 W AC-input power supply) – WS-CAC-4000W-INT (4000 W AC-input power supply) – PWR-4000-DC (4000 W DC-input power supply) – WS-CAC-6000W (6000 W AC-input power supply) – WS-CAC-8700W-E (8700 W AC-input power supply) **Note** The 6000 W and the 8700 W AC-input power supplies are limited to 4500 W maximum output when installed in the Catalyst 6509 chassis. **Note** For information and specifications for each of the supported power supplies, refer to Appendix A, "Power Supply Specifications," in the *Catalyst 6500 Series Switches Installation Guide*. • Installed power supplies can be of different wattage ratings. Installed power supplies can also be both AC-input, both DC-input, or one AC-input and one DC-input. Power supplies can be configured in either redundant or nonredundant mode. • All Catalyst 6500 series AC-input power supplies require single-phase source AC. Source AC can be out of phase between multiple power supplies or multiple AC-power plugs on the same power supply because all AC power supply inputs are isolated. • Single power supplies are installed in the left power supply bay. The second (redundant) power supply is installed in the right power supply bay. • You must install a 2500 W or higher capacity power supply when using the Supervisor Engine 32 or the Supervisor Engine 720 and the high-speed fan tray.

Table 1-11 Catalyst 6509 Switch Features (continued)

Feature	Description
Supervisor engines	• Supports Supervisor Engine 2, Supervisor Engine 32, Supervisor Engine 32 PISA, Supervisor Engine 720, and Supervisor Engine 720-10GE. – Supervisor Engine 2 is installed in slot 1 and slot 2. – Supervisor Engine 32, Supervisor Engine 32 PISA, Supervisor Engine 720, and Supervisor Engine 720-10GE are installed in slot 5 and slot 6. – Supervisor Engine 32, Supervisor Engine 32 PISA, Supervisor Engine 720, and Supervisor Engine 720-10GE require that the high-speed fan tray be installed in the chassis. You must also install a 2500 W or higher capacity power supply in the chassis to power the high-speed fan tray. **Note** The 2500 W power supply, when supporting the high-speed fan tray, can be powered from either 120 VAC or 220 VAC. – Supervisor Engine 720 and Supervisor Engine 720-10GE have built-in switching fabric. Switch Fabric Modules (WS-C6500-SFM and WS-X6500-SFM2) are not supported by Supervisor Engine 720 and Supervisor Engine 720-10GE and cannot be installed in the same chassis. – Supervisor Engine 32 and Supervisor Engine 32 PISA do not support the Switch Fabric Modules (WS-C6500-SFM and WS-X6500-SFM2). • The uplink ports are fully functional on all redundant supervisor engine models when they are in standby mode. **Note** In systems with redundant supervisor engines, both supervisor engines must be the same model and have the same daughter card configurations. Each supervisor engine must have the resources to run the switch on its own, which means all supervisor engine resources are duplicated. Identical supervisor engine memory configurations are recommended, but are not required as long as the supervisor engine with the smaller memory configuration is sufficient to run the configured features of the switch. Additionally, each supervisor engine must have its own flash device and console port connections.

Table 1-11 Catalyst 6509 Switch Features (continued)

Feature	Description
Modules	• Chassis supports up to eight Catalyst 6500 series modules. • WS-C6500-SFM and WS-X6500-SFM2 Switch Fabric Modules must be installed in slot 5 or slot 6. • Some Catalyst 6500 series modules: – Are not supported – Require that you install a Supervisor Engine 720 – Have chassis slot restrictions – Require a specific software release level Check your software release notes for specific information on supported modules.

Table 1-12 Catalyst 6509 Switch Specifications

Item	Specification
Environmental	
Temperature, operating	Certified for operation: 32° to 104°F (0° to 40°C) Designed and tested for operation: 32° to 130°F (0° to 55°C) **Note** The Catalyst 6500 series switches are equipped with internal air temperature sensors that are triggered at 104°F (40°C) generating a minor alarm and at 131°F (55°C) generating a major alarm.
Temperature, ambient nonoperating and storage	–20° to 65°C (–4° to 149°F)
Thermal transition	0.5°C per minute (hot to cold) 0.33°C per minute (cold to hot)
Humidity (RH), ambient (noncondensing) operating	10% to 90%
Humidity (RH), ambient (noncondensing) nonoperating and storage	5% to 95%
Altitude, operating	Certified for operation: 0 to 6500 feet (0 to 2000 m) Designed and tested for operation: –200 to 10,000 feet (–60 to 3000 m)
Physical Characteristics	
Dimensions (H x W x D)	• 25.2 x 17.2 x 18.4 in. (64.0 x 43.7 x 46.7 cm). • Chassis depth including cable guide is 21.64 in. (55.0 cm). • Chassis requires 15 RU. • Chassis can be mounted in equipment racks that meet ANSI/EIA 310-D and ETS 300-119 standards.
Weight	Chassis only: 55 lb (24.9 kg). Chassis fully configured with 1 supervisor engine, 8 switching modules, and 2 power supplies: 194.5 lb (88.2 kg).
Airflow	• WS-C6K-9SLOT-FAN (Standard fan tray)—340 CFM • WS-C6K-9SLOT-FAN2 (Optional high-speed fan tray)—630 CFM **Note** To maintain proper air circulation through the Catalyst switch chassis, we recommend that you maintain a minimum 6-inch (15 cm) separation between a wall and the chassis air intake or a wall and the chassis air exhaust. You should also allow a minimum separation of 12 inches (30.5 cm) between the hot air exhaust on one chassis and the air intake on another chassis. Failure to maintain adequate air space can cause the chassis to overheat and the system to fail. On Catalyst chassis in which the airflow is from front to back, the chassis may be placed side-by-side.

Catalyst 6509-E Switch

The Catalyst 6509-E switch is an enhanced version of the Catalyst 6509 chassis. Figure 1-10 shows a front view of the chassis. Table 1-13 provides a description of the major switch features. Table 1-14 lists the specifications of the Catalyst 6509-E switch chassis.

Figure 1-10 Catalyst 6509-E Switch

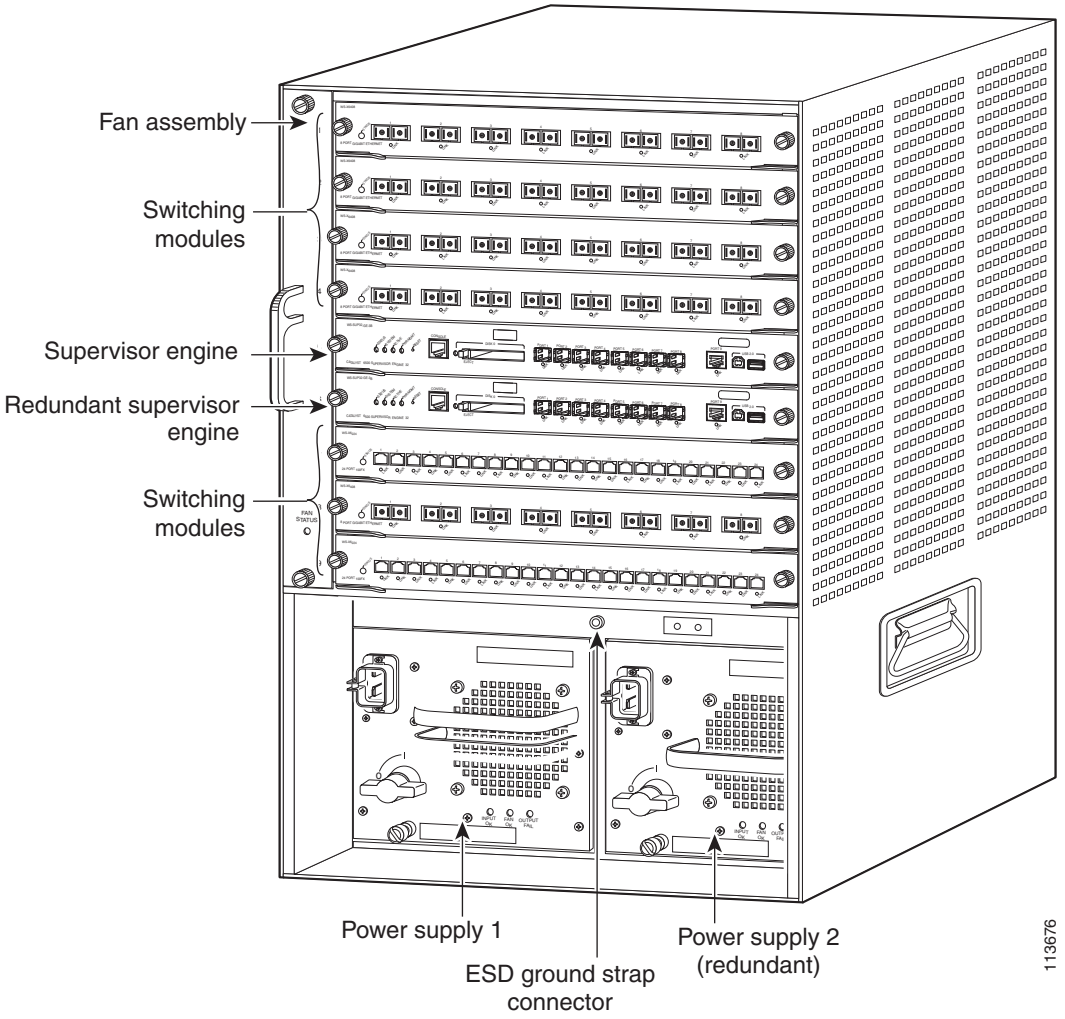


Table 1-13 Catalyst 6509-E Switch Features

Feature	Description
Chassis	Nine horizontal slots. Slots are numbered from (1) top to (9) bottom.
Power supplies	• Supports one or two power supplies. The following power supplies are supported: – WS-CAC-2500W (2500 W AC-input power supply) – WS-CDC-2500W (2500 W DC-input power supply) – WS-CAC-3000W (3000 W AC-input power supply) – WS-CAC-4000W-US (4000 W AC-input power supply) – WS-CAC-4000W-INT (4000 W AC-input power supply) – PWR-4000-DC (4000 W DC-input power supply) – WS-CAC-6000W (6000 W AC-input power supply) – WS-CAC-8700W-E (8700 W AC-input power supply) **Note** For information and specifications for each of the supported power supplies, refer to Appendix A, "Power Supply Specifications," in the *Catalyst 6500 Series Switches Installation Guide*. • Installed power supplies can be of different wattage ratings. Installed power supplies can also be both AC-input, both DC-input, or one AC-input and one DC-input. Power supplies can be configured in either redundant or nonredundant mode. • Supervisor Engine 2T requires a 3000 W or greater power supply to operate. • All Catalyst 6500 series AC-input power supplies require single-phase source AC. Source AC can be out of phase between multiple power supplies or multiple AC-power plugs on the same power supply because all AC power supply inputs are isolated.

Table 1-13 Catalyst 6509-E Switch Features (continued)

Feature	Description
Supervisor engines	• Supports Supervisor Engine 2, Supervisor Engine 32, Supervisor Engine 32 PISA, Supervisor Engine 720, Supervisor Engine 720-10GE, and Supervisor Engine 2T. – Supervisor Engine 2 is installed in slot 1 and slot 2. – Supervisor Engine 32, Supervisor Engine 32 PISA, Supervisor Engine 720, Supervisor Engine 720-10GE, and Supervisor Engine 2T are installed in slot 5 and slot 6. – Supervisor Engine 720, Supervisor Engine 720-10GE, and Supervisor Engine 2T have built-in switching fabric; Switch Fabric Modules (WS-C6500-SFM and WS-X6500-SFM2) are not supported. – Supervisor Engine 32 and Supervisor Engine 32 PISA do not support the Switch Fabric Modules (WS-C6500-SFM and WS-X6500-SFM2). • The uplink ports are fully functional on all redundant supervisor engine models when they are in standby mode. **Note** In systems with redundant supervisor engines, both supervisor engines must be the same model and have the same daughter card configurations. Each supervisor engine must have the resources to run the switch on its own, which means all supervisor engine resources are duplicated. Identical supervisor engine memory configurations are recommended, but are not required as long as the supervisor engine with the smaller memory configuration is sufficient to run the configured features of the switch. Additionally, each supervisor engine must have its own flash device and console port connections.
Modules	• Chassis supports up to eight Catalyst 6500 series modules. • WS-C6500-SFM and WS-X6500-SFM2 Switch Fabric Modules must be installed in slot 5 or slot 6. • Some Catalyst 6500 series modules: – Are not supported – Require that you install a Supervisor Engine 720 or Supervisor Engine 2T – Have chassis slot restrictions – Require a specific software release level **Note** Check your software release notes for specific information on module support and restrictions.

Table 1-14 Catalyst 6509-E Switch Specifications

Item	Specification
Environmental	
Temperature, operating	Certified for operation: 32° to 104°F (0° to 40°C) Designed and tested for operation: 32° to 130°F (0° to 55°C) **Note** The Catalyst 6500 series switches are equipped with internal air temperature sensors that are triggered at 104°F (40°C) generating a minor alarm and at 131°F (55°C) generating a major alarm.
Temperature, nonoperating and storage	–4° to 149°F (–20° to 65°C)
Thermal transition	0.5°C per minute (hot to cold) 0.33°C per minute (cold to hot)
Humidity (RH), ambient (noncondensing) operating	10% to 90%
Humidity (RH), ambient (noncondensing) nonoperating and storage	5% to 95%
Altitude, operating	Certified for operation: 0 to 6500 feet (0 to 2000 m) Designed and tested for operation: –200 to 10,000 feet (–60 to 3000 m)
Physical Characteristics	
Dimensions (H x W x D)	• 24.5 x 17.5 x 18.2 in. (62.2 x 44.5 x 46.0 cm). • Chassis depth including cable guide is 21.64 in. (55.0 cm). • Chassis requires 15 RU. • Chassis can be mounted in equipment racks that meet ANSI/EIA 310-D and ETS 300-119 standards.
Weight	Chassis only: 55 lb (24.9 kg). Chassis fully configured with 1 supervisor engine, 8 switching modules, and 2 power supplies: 135 lb (61.2 kg).
Airflow	WS-C6509-E-FAN—846 CFM **Note** To maintain proper air circulation through the Catalyst switch chassis, we recommend that you maintain a minimum 6-inch (15 cm) separation between a wall and the chassis air intake or a wall and the chassis air exhaust. You should also allow a minimum separation of 12 inches (30.5 cm) between the hot air exhaust on one chassis and the air intake on another chassis. Failure to maintain adequate air space can cause the chassis to overheat and the system to fail. On Catalyst chassis in which the airflow is from front to back, the chassis may be placed side-by-side.

Catalyst 6509-NEB Switch

The Catalyst 6509-NEB switch is a 9-slot vertical chassis. Figure 1-11 shows a front view of the chassis. Table 1-15 provides a description of the major switch features. Table 1-16 lists the specifications of the Catalyst 6509-NEB switch chassis.

Figure 1-11 Catalyst 6509-NEB Switch

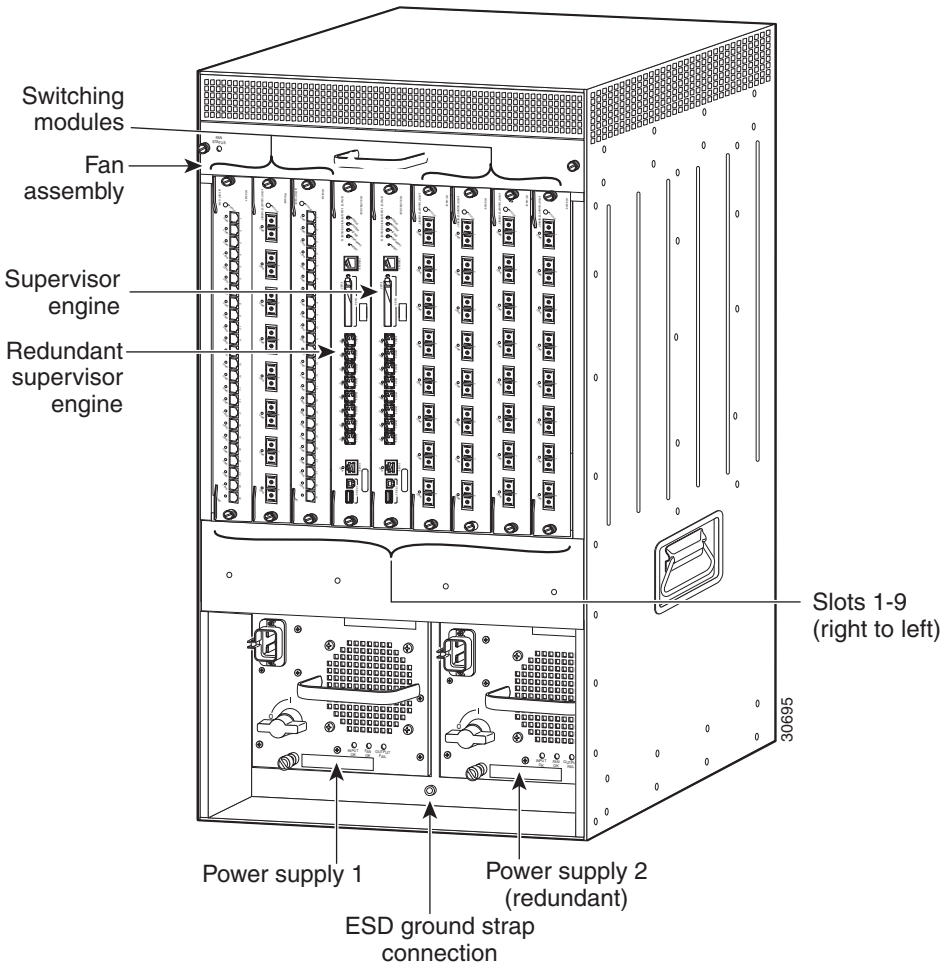


Table 1-15 Catalyst 6509-NEB Switch Features

Feature	Features
Chassis	Nine vertical slots. Slots are numbered from 1 (right) to 9 (left).
Power supplies	• Supports one or two power supplies. The following power supplies are supported: – WS-CAC-2500W (2500 W AC-input power supply) – WS-CDC-2500W (2500 W DC-input power supply) – WS-CAC-3000W (3000 W AC-input power supply) – WS-CAC-4000W-US (4000 W AC-input power supply) – WS-CAC-4000W-INT (4000 W AC-input power supply) – PWR-4000-DC (4000 W DC-input power supply) – WS-CAC-6000W (6000 W AC-input power supply) – WS-CAC-8700W-E (8700 W AC-input power supply) **Note** The 6000 W and the 8700 W AC-input power supplies are limited to 4500 W maximum output when installed in the Catalyst 6509-NEB chassis. **Note** For information and specifications for each of the supported power supplies, refer to Appendix A, "Power Supply Specifications," in the *Catalyst 6500 Series Switches Installation Guide*. • Installed power supplies can be of different wattage ratings. Installed power supplies can also be both AC-input, both DC-input, or one AC-input and one DC-input. Power supplies can be configured in either redundant or nonredundant mode. • All Catalyst 6500 series AC-input power supplies require single-phase source AC. Source AC can be out of phase between multiple power supplies or multiple AC-power plugs on the same power supply because all AC power supply inputs are isolated. • Single power supplies are installed in the left power supply bay. The second power supply is installed in the right power supply bay.

Table 1-15 Catalyst 6509-NEB Switch Features (continued)

Feature	Features
Supervisor engines	• Supports Supervisor Engine 2, Supervisor Engine 32, Supervisor Engine 32 PISA, Supervisor Engine 720, and Supervisor Engine 720-10GE. – Supervisor Engine 2 is installed in slot 1 or slot 2. – Supervisor Engine 32 is installed in slot 5 or slot 6. • Supervisor Engine 32, Supervisor Engine 32 PISA, Supervisor Engine 720, and Supervisor Engine 720-10GE are supported if the WS-6509-NEB-UPGRD kit is installed. – Supervisor Engine 32, Supervisor Engine 32 PISA, Supervisor Engine 720, and Supervisor Engine 720-10GE. are installed in slot 5 or slot 6. – Supervisor Engine 720 and Supervisor Engine 720-10GE have built-in switching fabric. Switch Fabric Modules (WS-C6500-SFM and WS-X6500-SFM2) are not supported by Supervisor Engine 720 and cannot be installed in the same chassis. – Supervisor Engine 32 and Supervisor Engine 32 PISA do not support the Switch Fabric Modules ((WS-C6500-SFM and WS-X6500-SFM2). • The uplink ports are fully functional on all redundant supervisor engine models when they are in standby mode. **Note** In systems with redundant supervisor engines, both supervisor engines must be the same model and have the same daughter card configurations. Each supervisor engine must have the resources to run the switch on its own, which means all supervisor engine resources are duplicated. Identical supervisor engine memory configurations are recommended, but are not required as long as the supervisor engine with the smaller memory configuration is sufficient to run the configured features of the switch. Additionally, each supervisor engine must have its own flash device and console port connections.
Modules	• Chassis supports up to eight Catalyst 6500 series modules. • WS-C6500-SFM and WS-X6500-SFM2 Switch Fabric Modules must be installed in slot 5 or slot 6. • Some Catalyst 6500 series modules: – Are not supported – Require that you install a Supervisor Engine 720 – Have chassis slot restrictions – Require a specific software release level **Note** Check your software release notes for specific information on module support and restrictions.

Table 1-16 Catalyst 6509-NEB Switch Specifications

Item	Specification
Environmental	
Temperature, operating	Certified for operation: 32° to 104°F (0° to 40°C) Designed and tested for operation: 32° to 130°F (0° to 55°C) **Note** The Catalyst 6500 series switches are equipped with internal air temperature sensors that are triggered at 104°F (40°C) generating a minor alarm and at 131°F (55°C) generating a major alarm.
Temperature, nonoperating and storage	–4° to 149°F (–20° to 65°C)
Thermal transition	0.5°C per minute (hot to cold) 0.33°C per minute (cold to hot)
Humidity (RH), ambient (noncondensing) operating	10% to 90%
Humidity (RH), ambient (noncondensing) nonoperating and storage	5% to 95%
Altitude, operating	Certified for operation: 0 to 6500 feet (0 to 2000 m) Designed and tested for operation: –200 to 10,000 feet (–60 to 3000 m)
Physical Characteristics	
Dimensions (H x W x D)	• 33.3 x 17.2 x 18.1 in. (84.6 x 43.7 x 46.0 cm). • Chassis requires 20 RU. • Chassis can be mounted in equipment racks that meet ANSI/EIA 310-D and ETS 300-119 standards.
Weight	Chassis only: 55 lb (24.9 kg). Chassis fully configured with 1 supervisor engine, 8 switching modules, and 2 power supplies: 135 lb (61.2 kg).
Airflow	• WS-C6509-NEB-FAN (standard fan tray)—294 CFM • Optional high-speed fan tray[1]—630 CFM **Note** To maintain proper air circulation through the Catalyst switch chassis, we recommend that you maintain a minimum 6-inch (15 cm) separation between a wall and the chassis air intake or a wall and the chassis air exhaust. You should also allow a minimum separation of 12 inches (30.5 cm) between the hot air exhaust on one chassis and the air intake on another chassis. Failure to maintain adequate air space can cause the chassis to overheat and the system to fail. On Catalyst chassis in which the airflow is from front to back, the chassis may be placed side-by-side.

1. Part of the WS-6509-NEB-UPGRD kit.

Catalyst 6509-NEB-A Switch

The Catalyst 6509-NEB-A switch is a 9-slot vertical chassis. Figure 1-12 shows a front view of the chassis. Table 1-17 provides a description of the major switch features. Table 1-18 lists the specifications of the Catalyst 6509-NEB-A switch chassis.

Figure 1-12 Catalyst 6509-NEB-A Switch Chassis

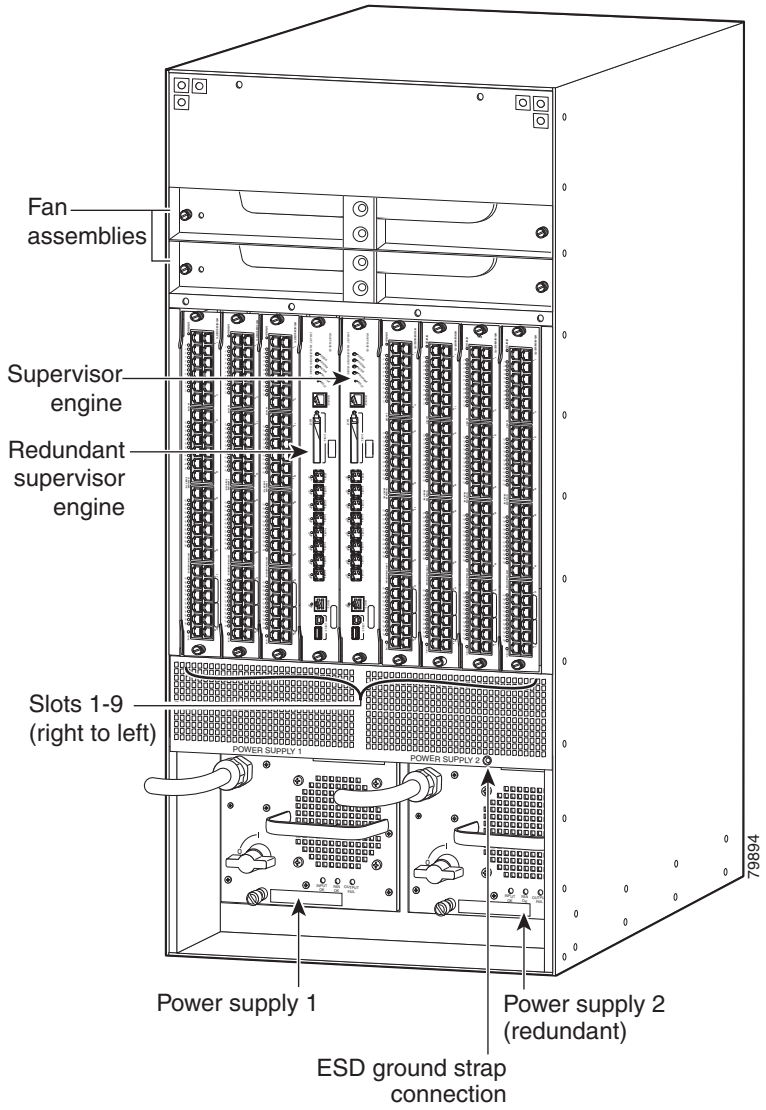


Table 1-17 Catalyst 6509-NEB-A Switch Features

Feature	Description
Chassis	Nine vertical slots. Slots are numbered from 1 (right) to 9 (left).
Power supplies	• Supports one or two power supplies. The following power supplies are supported: – WS-CAC-2500W (2500 W AC-input power supply) – WS-CDC-2500W (2500 W DC-input power supply) – WS-CAC-3000W (3000 W AC-input power supply) – WS-CAC-4000W-US (4000 W AC-input power supply) – WS-CAC-4000W-INT (4000 W AC-input power supply) – PWR-4000-DC (4000 W DC-input power supply) – WS-CAC-6000W (6000 W AC-input power supply) – WS-CAC-8700W-E (8700 W AC-input power supply) **Note** The 6000 W and the 8700 W AC-input power supplies are limited to 4500 W maximum output when installed in the Catalyst 6509-NEB-A chassis. **Note** For information and specifications for each of the supported power supplies, refer to Appendix A, "Power Supply Specifications," in the *Catalyst 6500 Series Switches Installation Guide*. • Installed power supplies can be of different ratings. Installed power supplies can also be both AC-input, both DC-input, or one AC-input and one DC-input. Power supplies can be configured in either redundant or nonredundant mode. • All Catalyst 6500 series AC-input power supplies require single-phase source AC. Source AC can be out of phase between multiple power supplies or multiple AC-power plugs on the same power supply because all AC power supply inputs are isolated.

Table 1-17 Catalyst 6509-NEB-A Switch Features (continued)

Feature	Description
Supervisor engines	• Supports Supervisor Engine 2, Supervisor Engine 32, Supervisor Engine 32 PISA, Supervisor Engine 720, and Supervisor Engine 720-10GE. – Supervisor Engine 2 is installed in slot 1 and slot 2. – Supervisor Engine 32, Supervisor Engine 32 PISA, Supervisor Engine 720, and Supervisor Engine 720-10GE are installed in slot 5 and slot 6. – Supervisor Engine 720 and Supervisor Engine 720-10GE have built-in switching fabric. Switch Fabric Modules (WS-C6500-SFM and WS-X6500-SFM2) are not supported by Supervisor Engine 720 and Supervisor Engine 720-10GE and cannot be installed in the same chassis. – Supervisor Engine 32 and Supervisor Engine 32 PISA do not support the Switch Fabric Modules ((WS-C6500-SFM and WS-X6500-SFM2). • The uplink ports are fully functional on all redundant supervisor engine models when they are in standby mode. **Note** In systems with redundant supervisor engines, both supervisor engines must be the same model and have the same daughter card configurations. Each supervisor engine must have the resources to run the switch on its own, which means all supervisor engine resources are duplicated. Identical supervisor engine memory configurations are recommended, but are not required as long as the supervisor engine with the smaller memory configuration is sufficient to run the configured features of the switch. Additionally, each supervisor engine must have its own flash device and console port connections.
Modules	• Chassis supports up to eight Catalyst 6500 series modules. • WS-C6500-SFM and WS-X6500-SFM2 Switch Fabric Modules must be installed in slot 5 or slot 6. • Some Catalyst 6500 series modules: – Are not supported – Require that you install a Supervisor Engine 720 – Have chassis slot restrictions – Require a specific software release level **Note** Check your software release notes for specific information on module support and restrictions.

Table 1-18 Catalyst 6509-NEB-A Switch Specifications

Item	Specification
Environmental	
Temperature, operating	Certified for operation: 32° to 104°F (0° to 40°C) Designed and tested for operation: 32° to 130°F (0° to 55°C) **Note** The Catalyst 6500 series switches are equipped with internal air temperature sensors that are triggered at 104°F (40°C) generating a minor alarm and at 131°F (55°C) generating a major alarm.
Temperature, nonoperating and storage	–4° to 149°F (–20° to 65°C)
Thermal transition	0.5°C per minute (hot to cold) 0.33°C per minute (cold to hot)
Humidity (RH), ambient (noncondensing) operating	10% to 90%
Humidity (RH), ambient (noncondensing) nonoperating and storage	5% to 95%
Altitude, operating	Certified for operation: 0 to 6500 feet (0 to 2000 m) Designed and tested for operation: –200 to 10,000 feet (–60 to 3000 m)
Physical Characteristics	
Dimensions (H x W x D)	• 36.7 x 17.2 x 20.3 in. (93.1 x 43.7 x 51.6 cm). • Chassis requires 21 RU. • Chassis can be mounted in equipment racks that meet ANSI/EIA 310-D and ETS 300-119 standards.
Weight	Chassis only: 121 lb (54.9 kg). Chassis fully configured with 1 supervisor engine, 8 modules, 2 AC-input power supplies: 270 lb (122.47 kg).
Airflow	FAN-MOD-09 (high-speed fan tray)—760 CFM **Note** To maintain proper air circulation through the Catalyst switch chassis, we recommend that you maintain a minimum 6-inch (15 cm) separation between a wall and the chassis air intake or a wall and the chassis air exhaust. You should also allow a minimum separation of 12 inches (30.5 cm) between the hot air exhaust on one chassis and the air intake on another chassis. Failure to maintain adequate air space can cause the chassis to overheat and the system to fail. On Catalyst chassis in which the airflow is from front to back, the chassis may be placed side-by-side.

Catalyst 6509-V-E Switch

The Catalyst 6509-V-E switch is a 9-slot vertical enhanced chassis. Figure 1-13 shows a front view of the chassis. Table 1-19 provides a description of the major switch features. Table 1-20 lists the specifications of the Catalyst 6509-V-E switch chassis.

Figure 1-13 Catalyst 6509-V-E Switch Chassis

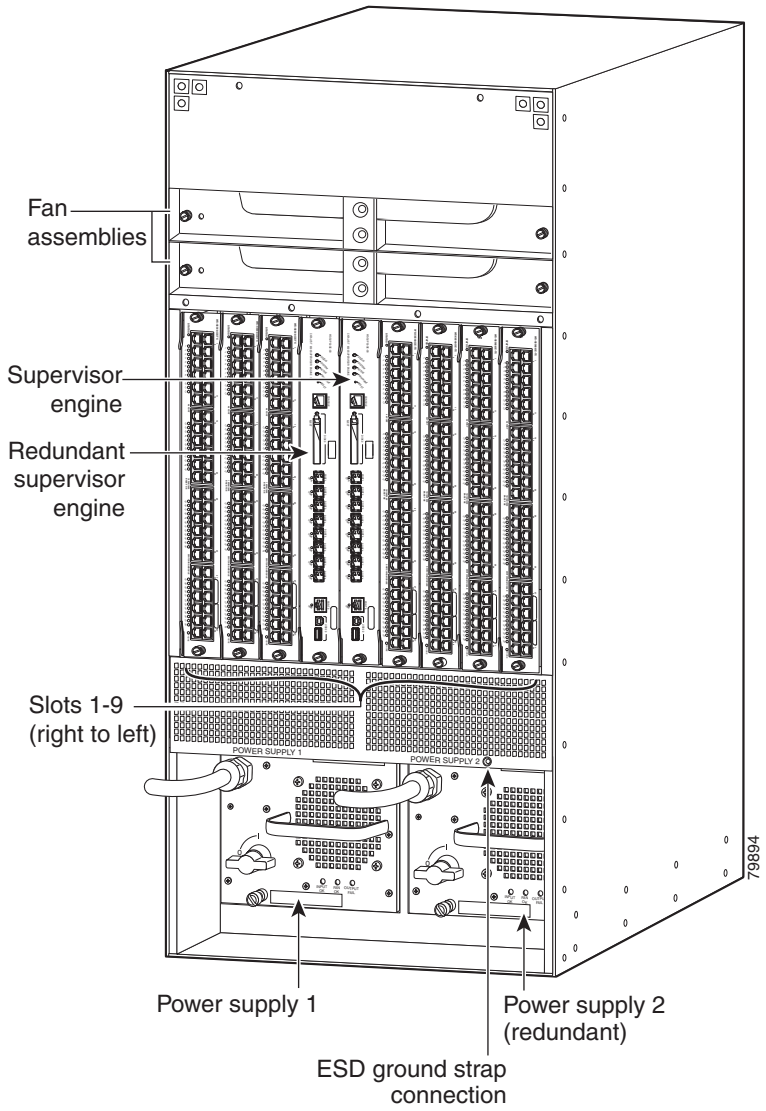


Table 1-19 Catalyst 6509-V-E Switch Features

Feature	Description
Chassis	Nine vertical slots. Slots are numbered from 1 (right) to 9 (left).
‘	• Supports one or two power supplies. The following power supplies are supported: – WS-CAC-2500W (2500 W AC-input power supply) – WS-CDC-2500W (2500 W DC-input power supply) – WS-CAC-3000W (3000 W AC-input power supply) – WS-CAC-4000W-US (4000 W AC-input power supply) – WS-CAC-4000W-INT (4000 W AC-input power supply) – PWR-4000-DC (4000 W DC-input power supply) – WS-CAC-6000W (6000 W AC-input power supply) – WS-CAC-8700W-E (8700 W AC-input power supply) **Note** For information and specifications for each of the supported power supplies, refer to Appendix A, “Power Supply Specifications,” in the *Catalyst 6500 Series Switches Installation Guide*. • Installed power supplies can be of different ratings. Installed power supplies can also be both AC-input, both DC-input, or one AC-input and one DC-input. Power supplies can be configured in either redundant or nonredundant mode. • Supervisor Engine 2T requires a 3000 W or greater power supply to operate. • All Catalyst 6500 series AC-input power supplies require single-phase source AC. Source AC can be out of phase between multiple power supplies or multiple AC-power plugs on the same power supply because all AC power supply inputs are isolated.

Table 1-19 Catalyst 6509-V-E Switch Features (continued)

Feature	Description
Supervisor engines	• Supports Supervisor Engine 32, Supervisor Engine 32 PISA, Supervisor Engine 720, Supervisor Engine 720-10GE, and Supervisor Engine 2T. – Supervisor Engine 32, Supervisor Engine 32 PISA, Supervisor Engine 720, Supervisor Engine 720-10GE, and Supervisor Engine 2T are installed in slot 5 and slot 6. – Supervisor Engine 720, Supervisor Engine 720-10GE, and Supervisor Engine 2T have built-in switching fabric; Switch Fabric Modules are not supported. – Supervisor Engine 32 and Supervisor Engine 32 PISA do not support the Switch Fabric Modules ((WS-C6500-SFM and WS-X6500-SFM2). • The uplink ports are fully functional on all redundant supervisor engine models when they are in standby mode. **Note** In systems with redundant supervisor engines, both supervisor engines must be the same model and have the same daughter card configurations. Each supervisor engine must have the resources to run the switch on its own, which means all supervisor engine resources are duplicated. Identical supervisor engine memory configurations are recommended, but are not required as long as the supervisor engine with the smaller memory configuration is sufficient to run the configured features of the switch. Additionally, each supervisor engine must have its own flash device and console port connections.
Modules	• Chassis supports up to eight Catalyst 6500 series modules. • Some Catalyst 6500 series modules: – Are not supported – Require that you install a Supervisor Engine 720 – Have chassis slot restrictions – Require a specific software release level **Note** Check your software release notes for specific information on module support and restrictions.

Table 1-20 Catalyst 6509-V-E Switch Specifications

Item	Specification
Environmental	
Temperature, operating	Certified for operation: 32° to 104°F (0° to 40°C) Designed and tested for operation: 32° to 130°F (0° to 55°C) **Note** The Catalyst 6500 series switches are equipped with internal air temperature sensors that are triggered at 104°F (40°C) generating a minor alarm and at 131°F (55°C) generating a major alarm.
Temperature, nonoperating and storage	–4° to 149°F (–20° to 65°C)
Thermal transition	0.5°C per minute (hot to cold) 0.33°C per minute (cold to hot)
Humidity (RH), ambient (noncondensing) operating	10% to 90%
Humidity (RH), ambient (noncondensing) nonoperating and storage	5% to 95%
Altitude, operating	Certified for operation: 0 to 6500 feet (0 to 2000 m) Designed and tested for operation: –200 to 10,000 feet (–60 to 3000 m)
Physical Characteristics	
Dimensions (H x W x D)	• 36.7 x 17.2 x 20.3 in. (93.1 x 43.7 x 51.6 cm). • Chassis requires 21 RU. • Chassis can be mounted in equipment racks that meet ANSI/EIA 310-D and ETS 300-119 standards.
Weight	Chassis only: 121 lb (54.9 kg). Chassis fully configured with 1 supervisor engine, 8 modules, 2 AC-input power supplies: 270 lb (122.47 kg).
Airflow	WS-C6509-V-E-FAN (High-speed fan tray—760 CFM). **Note** To maintain proper air circulation through the Catalyst switch chassis, we recommend that you maintain a minimum 6-inch (15 cm) separation between a wall and the chassis air intake or a wall and the chassis air exhaust. You should also allow a minimum separation of 12 inches (30.5 cm) between the hot air exhaust on one chassis and the air intake on another chassis. Failure to maintain adequate air space can cause the chassis to overheat and the system to fail. On Catalyst chassis in which the airflow is from front to back, the chassis may be placed side-by-side.

Catalyst 6513 Switch

The Catalyst 6513 switch is a 13-slot horizontal chassis. Figure 1-14 shows a front view of the chassis. Table 1-21 provides a description of the major switch features. Table 1-22 lists the specifications of the Catalyst 6513 switch chassis.

Figure 1-14 Catalyst 6513 Switch

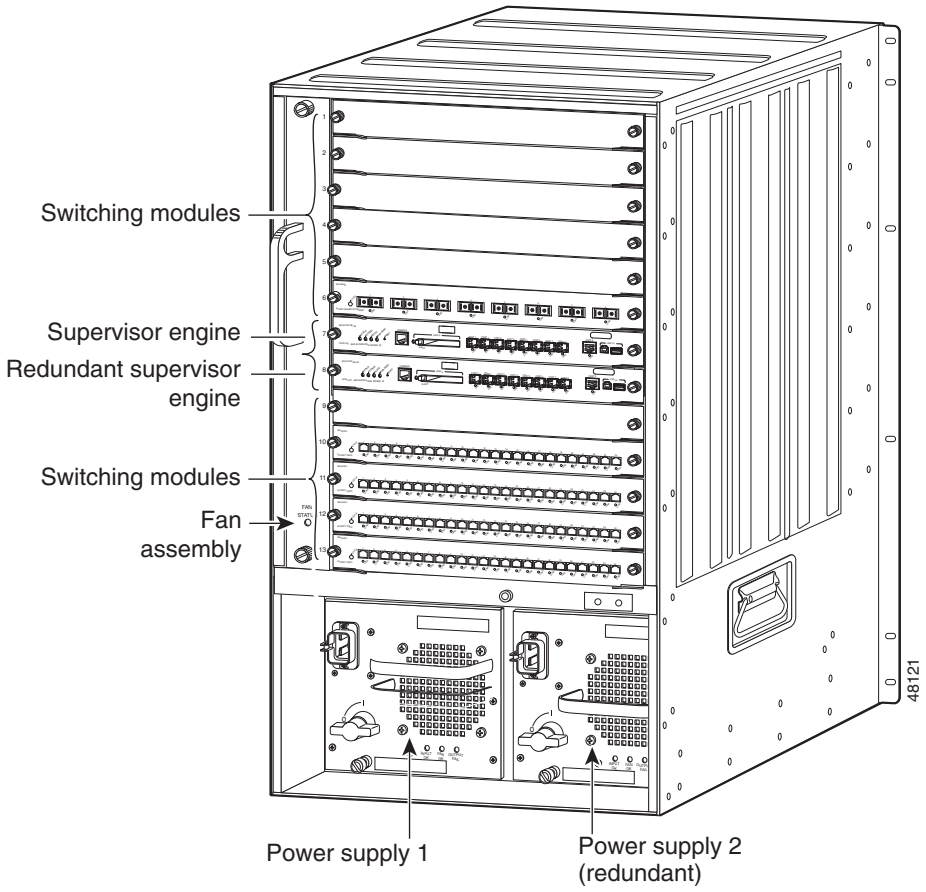


Table 1-21 Catalyst 6513 Switch Features

Feature	Description
Chassis	Thirteen horizontal slots. Slots are numbered from (1) top to (13) bottom.
Power supplies	• Supports one or two power supplies. The following power supplies are supported: – WS-CAC-2500W (2500 W AC-input power supply) – WS-CDC-2500W (2500 W DC-input power supply) – WS-CAC-3000W (3000 W AC-input power supply) – WS-CAC-4000W-US (4000 W AC-input power supply) – WS-CAC-4000W-INT (4000 W AC-input power supply) – PWR-4000-DC (4000 W DC-input power supply) – WS-CAC-6000W (6000 W AC-input power supply) – WS-CAC-8700W-E (8700 W AC-input power supply) **Note** For information and specifications for each of the supported power supplies, refer to Appendix A, "Power Supply Specifications," in the *Catalyst 6500 Series Switches Installation Guide*. • The 8700 W AC-input power supply is limited to 6000 W when it is installed in a Catalyst 6513 switch chassis. • Installed power supplies can be of different ratings. Installed power supplies can also be both AC-input, both DC-input, or one AC-input and one DC-input. Power supplies can be configured in either redundant or nonredundant mode. • All Catalyst 6500 series AC-input power supplies require single-phase source AC. Source AC can be out of phase between multiple power supplies or multiple AC-power plugs on the same power supply because all AC power supply inputs are isolated. • You must install a 2500 W or higher capacity power supply when using the Supervisor Engine 32 or the Supervisor Engine 720 and the high-speed fan tray.

Table 1-21 Catalyst 6513 Switch Features (continued)

Feature	Description
Supervisor engines	• Supports Supervisor Engine 2, Supervisor Engine 32, Supervisor Engine 32 PISA, Supervisor Engine 720, and Supervisor Engine 720-10GE. – Supervisor Engine 2 is installed in slot 1 and slot 2. – Supervisor Engine 32, Supervisor Engine 32 PISA, Supervisor Engine 720, and Supervisor Engine 720-10GE are installed in slot 7 and slot 8. – Supervisor Engine 32, Supervisor Engine 32 PISA, Supervisor Engine 720, and Supervisor Engine 720-10GE require that you install the high-speed fan tray (WS-C6K-13SLT-FAN2) be installed in the chassis. You must also install a 2500 W or higher capacity power supply in the chassis to power the high-speed fan tray. – Supervisor Engine 720 and Supervisor Engine 720-10GE have built-in switching fabric. Switch Fabric Modules (WS-C6500-SFM and WS-X6500-SFM2) are not supported by Supervisor Engine 720 and Supervisor Engine 720-10GE and cannot be installed in the same chassis. – Supervisor Engine 32 and Supervisor Engine 32 PISA do not support the Switch Fabric Modules ((WS-C6500-SFM and WS-X6500-SFM2). • The uplink ports are fully functional on all redundant supervisor engine models when they are in standby mode. **Note** In systems with redundant supervisor engines, both supervisor engines must be the same model and have the same daughter card configurations. Each supervisor engine must have the resources to run the switch on its own, which means all supervisor engine resources are duplicated. Identical supervisor engine memory configurations are recommended, but are not required as long as the supervisor engine with the smaller memory configuration is sufficient to run the configured features of the switch. Additionally, each supervisor engine must have its own flash device and console port connections.

Table 1-21 Catalyst 6513 Switch Features (continued)

Feature	Description
Modules	• Chassis supports up to 12 Catalyst 6500 series modules. • WS-C6500-SFM and WS-X6500-SFM2 Switch Fabric Modules must be installed in slot 7 or slot 8. • WS-X6748-SFP, WS-X6748-GE-TX, and WS-X6704-10GE modules are not supported in slots 2–8; they are supported in slots 9–13. – Slots 1–8 support a single fabric channel; slots 9–13 support dual fabric channels. • Some Catalyst 6500 series modules: – Are not supported – Require that you install a Supervisor Engine 720 – Have chassis slot restrictions – Require a specific software release level **Note** Check your software release notes for specific information on module support and restrictions.

Table 1-22 Catalyst 6513 Switch Specifications

Item	Specification
Environmental	
Temperature, operating	Certified for operation: 32° to 104°F (0° to 40°C) Designed and tested for operation: 32° to 130°F (0° to 55°C) **Note** The Catalyst 6500 series switches are equipped with internal air temperature sensors that are triggered at 104°F (40°C) generating a minor alarm and at 131°F (55°C) generating a major alarm.
Temperature, nonoperating and storage	–4° to 149°F (–20° to 65°C)
Thermal transition	0.5°C per minute (hot to cold) 0.33°C per minute (cold to hot)
Humidity (RH), ambient (noncondensing) operating	10% to 90%
Humidity (RH), ambient (noncondensing) nonoperating and storage	5% to 95%
Altitude, operating	Certified for operation: 0 to 6500 feet (0 to 2000 m) Designed and tested for operation: –200 to 10,000 feet (–60 to 3000 m)
Physical Characteristics	
Dimensions (H x W x D)	• 33.3 x 17.2 x 18.1 in. (84.6 x 43.7 x 46.0 cm). • Chassis requires 20 RU. • Chassis can be mounted in equipment racks that meet ANSI/EIA 310-D and ETS 300-119 standards.
Weight	Chassis fully configured with 2 supervisor engines, 11 switching modules, and 2 power supplies: 280 lb (127 kg).
Airflow	• WS-C6K-13SLOT-FAN (standard fan tray)—641 CFM • WS-C6K-13SLT-FAN2 (optional high-speed fan tray)—1090 CFM **Note** To maintain proper air circulation through the Catalyst switch chassis, we recommend that you maintain a minimum 6-inch (15 cm) separation between a wall and the chassis air intake or a wall and the chassis air exhaust. You should also allow a minimum separation of 12 inches (30.5 cm) between the hot air exhaust on one chassis and the air intake on another chassis. Failure to maintain adequate air space can cause the chassis to overheat and the system to fail. On Catalyst chassis in which the airflow is from front to back, the chassis may be placed side-by-side.

Catalyst 6513-E Switch

The Catalyst 6513-E switch is an enhanced version of the Catalyst 6513 chassis. Figure 1-15 shows a front view of the chassis. Table 1-23 provides a description of the major switch features. Table 1-24 lists the specifications of the Catalyst 6513-E switch chassis.

Figure 1-15 Catalyst 6513-E Switch

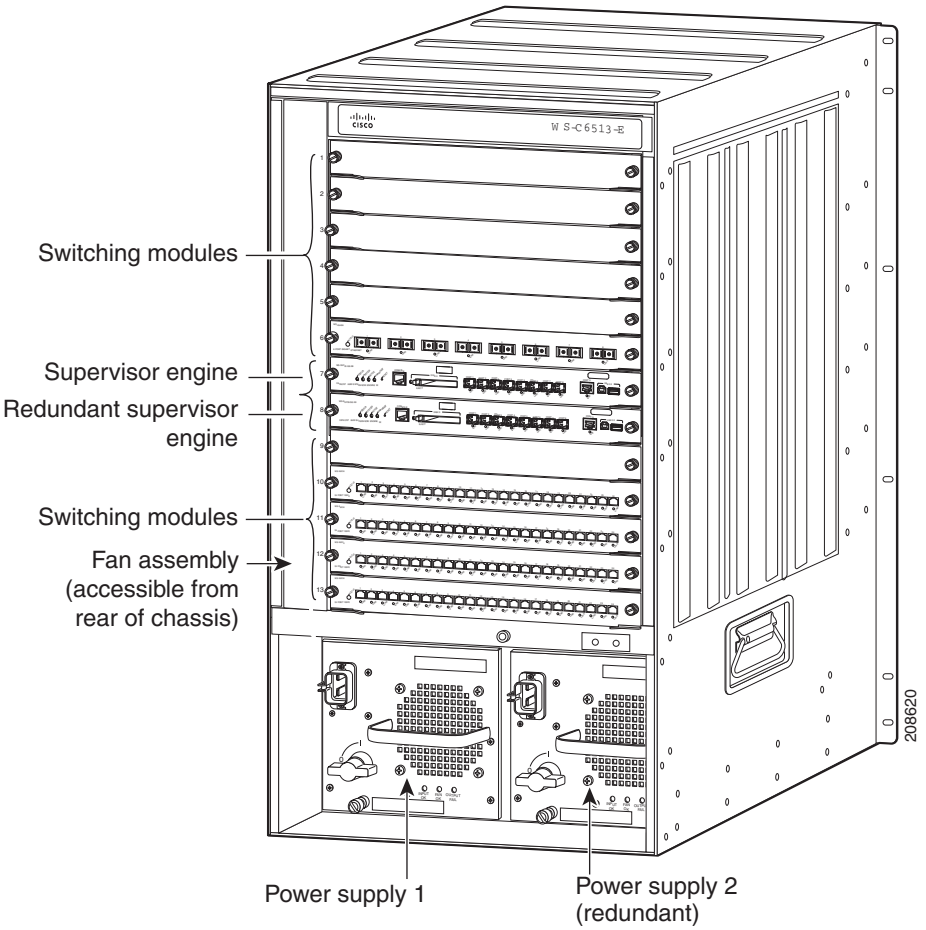


Table 1-23 Catalyst 6513-E Switch Features

Feature	Description
Chassis	Thirteen horizontal slots. Slots are numbered from (1) top to (13) bottom.
Power supplies	• Supports one or two power supplies. The following power supplies are supported: – WS-CDC-2500W (2500 W DC-input power supply) – WS-CAC-3000W (3000 W AC-input power supply) – WS-CAC-4000W-US (4000 W AC-input power supply) – WS-CAC-4000W-INT (4000 W AC-input power supply) – PWR-4000-DC (4000 W DC-input power supply) – WS-CAC-6000W (6000 W AC-input power supply) – PWR-6000-DC (6000 W DC-input power supply) – WS-CAC-8700W-E (8700 W AC-input power supply) **Note** For information and specifications for each of the supported power supplies, refer to Appendix A, "Power Supply Specifications," in the *Catalyst 6500 Series Switches Installation Guide*. • Installed power supplies can be of different ratings. Installed power supplies can also be both AC-input, both DC-input, or one AC-input and one DC-input. Power supplies can be configured in either redundant or nonredundant mode. • Supervisor Engine 2T requires a 3000 W or greater power supply to operate. • All Catalyst 6500 series AC-input power supplies require single-phase source AC. Source AC can be out of phase between multiple power supplies or multiple AC-power plugs on the same power supply because all AC power supply inputs are isolated.

Table 1-23 Catalyst 6513-E Switch Features (continued)

Feature	Description
Supervisor engines	• Supports Supervisor Engine 32, Supervisor Engine 720, Supervisor Engine 720-10GE, and Supervisor Engine 2T. – Supervisor Engine 32, Supervisor Engine 720, and Supervisor Engine 720-10GE are installed in slot 7 and slot 8. – Supervisor Engine 720, Supervisor Engine 720-10GE, and Supervisor Engine 2T have built-in switching fabric; Switch Fabric Modules (WS-C6500-SFM and WS-X6500-SFM2) are not supported. – Supervisor Engine 32 does not support the Switch Fabric Modules ((WS-C6500-SFM and WS-X6500-SFM2). • The uplink ports are fully functional on all redundant supervisor engine models when they are in standby mode. **Note** In systems with redundant supervisor engines, both supervisor engines must be the same model and have the same daughter card configurations. Each supervisor engine must have the resources to run the switch on its own, which means all supervisor engine resources are duplicated. Identical supervisor engine memory configurations are recommended, but are not required as long as the supervisor engine with the smaller memory configuration is sufficient to run the configured features of the switch. Additionally, each supervisor engine must have its own flash device and console port connections.

Table 1-23 Catalyst 6513-E Switch Features (continued)

Feature	Description
Modules	• Chassis supports up to 12 Catalyst 6500 series modules. • Some Catalyst 6500 series modules: – Are not supported – Require that you install a specific supervisor engine – Have chassis slot restrictions – Require a specific software release level **Note** Check your software release notes for specific information on module support and restrictions.

Table 1-24 Catalyst 6513-E Switch Specifications

Item	Specification
Environmental	
Temperature, operating	Certified for operation: 32° to 104°F (0° to 40°C) Designed and tested for operation: 32° to 130°F (0° to 55°C) **Note** The Catalyst 6500 series switches are equipped with internal air temperature sensors that are triggered at 104°F (40°C) generating a minor alarm and at 131°F (55°C) generating a major alarm.
Temperature, nonoperating and storage	–4° to 149°F (–20° to 65°C)
Thermal transition	0.5°C per minute (hot to cold) 0.33°C per minute (cold to hot)
Humidity (RH), ambient (noncondensing) operating	10% to 90%
Humidity (RH), ambient (noncondensing) nonoperating and storage	5% to 95%
Altitude, operating	Certified for operation: 0 to 6500 feet (0 to 2000 m) Designed and tested for operation: –200 to 10,000 feet (–60 to 3000 m)

Table 1-24 Catalyst 6513-E Switch Specifications (continued)

Item	Specification
Physical Characteristics	
Dimensions (H x W x D)	• 33.3 x 17.2 x 18.1 in. (84.6 x 43.7 x 46.0 cm). • Chassis requires 20 RU. • Chassis can be mounted in equipment racks that meet ANSI/EIA 310-D and ETS 300-119 standards.
Weight	Chassis fully configured with 2 supervisor engines, 11 switching modules, and 2 power supplies: 280 lb (127 kg).
Airflow	• WS-C6513-E-FAN—1755 CFM **Note** To maintain proper air circulation through the Catalyst switch chassis, we recommend that you maintain a minimum 6-inch (15 cm) separation between a wall and the chassis air intake or a wall and the chassis air exhaust. You should also allow a minimum separation of 12 inches (30.5 cm) between the hot air exhaust on one chassis and the air intake on another chassis. Failure to maintain adequate air space can cause the chassis to overheat and the system to fail. On Catalyst chassis in which the airflow is from front to back, the chassis may be placed side-by-side.

CHAPTER 2

Ethernet Switching Modules

Revised: August 2012

This chapter describes the 10BASE, 10/100BASE, 10/100/1000BASE, 1-Gigabit, 10-Gigabit, and 40-Gigabit Ethernet modules and contains these sections:

Note Service modules are not covered in this document. They have their own separate documentation sets.

10 and 10/100 Fiber-Based Ethernet Modules

This section describes the following 10 and 10/100 fiber-based Ethernet modules:

Note All 10 and 10/100 Fiber-based Ethernet modules are hot-swappable.

WS-X6024-10FL-MT Ethernet Module

The WS-X6024-10FL-MT Ethernet module (Figure 2-1) provides 24 10-Mbps full- or half-duplex ports. Table 2-1 lists the module features, and Table 2-2 lists the module physical and environmental specifications.

Figure 2-1 WS-X6024-10FL-MT Ethernet Module Front Panel

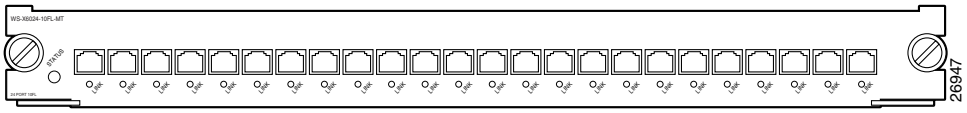


Table 2-1 WS-X6024-10FL-MT Ethernet Module Features

Feature	Description
Ports per module	• 24 ports. Ports are numbered from 1 (left) to 24 (right). • 2 port groups • Port ranges per port group: 1–12, 13–24
Port connector type	MT-RJ
Cabling distance	1.24 mi (2 km) full- or half-duplex over 62.5- and 125-micron MMF
Buffer size	64 KB per port
Maximum frame size	Up to 9216 bytes per frame
Module oversubscription rate	N/A
Supervisor engine support	Supported by the following supervisor engines: • Supervisor Engine 2 • Supervisor Engine 32 • Supervisor Engine 32 PISA • Supervisor Engine 720
Software support	• With Supervisor Engine 2—12.2(17d)SXB • With Supervisor Engine 32—12.2(18)SXF • With Supervisor Engine 32 PISA—12.2(18)ZY • With Supervisor Engine 720—12.2(14)SX • Catalyst OS support—6.4(11)
Queues per port	• Tx—2q2t • Rx—1q4t
Chassis/slot restrictions	No chassis or slot restrictions; the module can occupy any slot in any Catalyst 6500 or Catalyst 6500-E chassis.

Table 2-1 WS-X6024-10FL-MT Ethernet Module Features (continued)

Feature	Description
Bus connection	Single connection into the 32-Gbps shared bus
Module upgrades available	
PoE support	Not available.
Distributed forwarding support	Not available.
Pluggable transceivers support	Not supported.
Digital Optical Monitoring (DOM) support	Not supported
Module front panel LEDs	**STATUS** • Green—All diagnostics pass; the module is operational. • Orange—The module is booting or running diagnostics; an overtemperature condition has occurred. **LINK** • Green—The port is active (the link is connected and operational). • Flashing orange—The port failed diagnostics and is disabled. • Orange—The port is disabled. • Red—The module is resetting; an overtemperature condition has occurred. **Note** If the module fails to download code and configuration information successfully during the initial reset, the LED stays red; the module does not come online. • Off—The port is not active or the link is not connected.

Table 2-2 WS-X6024-10FL-MT Ethernet Module Physical and Environmental Specifications

Item	Specification
Dimensions (H x W x D)	1.2 x 14.4 x 16 in. (3.0 x 35.6 x 40.6 cm). Occupies one slot in the chassis.
Weight	7.0 lb (3.18 kg)
Power and heat numbers	• Module current—1.52 A • Module power—63.84 W • AC-input power—79.8 W • AC heat dissipation—272.52 BTU/hour • DC-input power—85.81 W • DC heat dissipation—293.0 BTU/hour
Environment	
Operating temperature	• Certified for operation: 32° to 104°F (0° to 40°C) • Designed and tested for operation: 32° to 130°F (0° to 55°C)
Humidity (RH) ambient (noncondensing)	10 to 90%
Operating altitude	• Certified for operation: 0 to 6500 ft (0 to 2000 m) • Designed and tested for operation: –200 to 10,000 ft (–60 to 3000 m)

WS-X6148-FE-SFP Ethernet Module

The WS-X6148-FE-SFP Ethernet module (Figure 2-2) provides 48 100-Mbps full- or half-duplex ports. Table 2-3 lists the module features, and Table 2-4 lists the module physical and environmental specifications.

Figure 2-2 WS-X6148-FE-SP Ethernet Module Front Panel

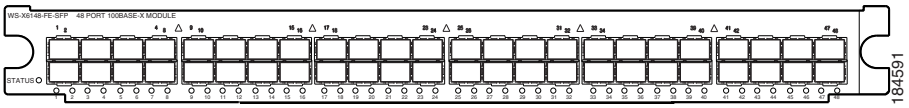


Table 2-3 WS-X6148-FE-SFP Features

Feature	Description
Ports per module	• 48 ports. Ports are numbered (left to right). – Top row, odd numbered ports 1–47. – Bottom row, even numbered ports 2–48. • 3 port groups • Port ranges per port group: 1–16, 17–32, 33–48
Port connector type	LC or RJ-45 (depending on the type of 100-Mbps Fast Ethernet SFP transceiver installed in the module port)

Table 2-3 WS-X6148-FE-SFP Features (continued)

Feature	Description
Cabling distance	Depends on the 100BASE-X Fast Ethernet SFP transceiver installed in the module port. Refer to the transceiver installation guides located at the following URL: http://www.cisco.com/en/US/products/hw/modules/ps5455/prod_installation_guides_list.html Refer to Appendix B for descriptions of the Fast Ethernet SFP transceiver types and supported cabling distances.
Buffer size	256 MB shared between 48 ports (5.4 MB per port)
QoS	• Number of egress queues: 4 • Number of ingress queues: 2 • Number of thresholds per egress queue: 8 • Number of thresholds per ingress queue: 4
Maximum frame size	Up to 9216 bytes per frame
Module oversubscription rate	N/A
Supervisor engine support	Supported on the following supervisor engines: • Supervisor Engine 2 • Supervisor Engine 32 • Supervisor Engine 32 • Supervisor Engine 720 • Supervisor Engine 720-10GE • Supervisor Engine 2T
Software support	• With Supervisor Engine 2—12.2(18)SXF2 • With Supervisor Engine 32—12.2(18)SXF • With Supervisor Engine 32 PISA—12.2(18)ZY • With Supervisor Engine 720—12.2(18)SXF • With Supervisor Engine 720-10GE—12.2(33)SXH • Supervisor Engine 2T—12.2(50)SY • Catalyst OS—8.4(1)
Queues per port	• Tx—1p3q8t (per port) • Rx—1p1q2t (per group of 8 ports)
Chassis/slot restrictions	No chassis or slot restrictions; the module can occupy any slot in any Catalyst 6500 or Catalyst 6500-E chassis.
Bus connection	Single connection into the 32-Gbps shared bus
Module upgrades available	
PoE support	Not available.
Distributed forwarding support	Not available.

Table 2-3 WS-X6148-FE-SFP Features (continued)

Feature	Description
Pluggable transceivers support	The module supports 100BASE-X Fast Ethernet SFP transceivers. Refer to your software release notes to determine which Fast Ethernet SFP transceivers are supported. See the "100-MB Transceivers" section on page B-1 in Appendix B for additional information on the Fast Ethernet SFP transceivers.
Digital Optical Monitoring (DOM) support	Not supported
Module front panel LEDs	**STATUS** • Green—All diagnostics pass; the module is operational. • Orange—The module is booting or running diagnostics; an overtemperature condition has occurred. **LINK** • Green—The port is active (the link is connected and operational). • Flashing orange—The port failed diagnostics and is disabled. • Orange—The port is disabled. • Red—The module is resetting; an overtemperature condition has occurred. **Note** If the module fails to download code and configuration information successfully during the initial reset, the LED stays red; the module does not come online. • Off—The port is not active or the link is not connected.

Table 2-4 WS-X6148-FE-SFP Physical and Environmental Specifications

Item	Specification
Dimensions (H x W x D)	1.2 x 14.4 x 16 in. (3.0 x 35.6 x 40.6 cm). Occupies one slot in the chassis.
Weight	6.6 lb (3 kg)
Power and heat numbers	• Module current—2.3 A • Module power—96.60 W • AC-input power—120.75 W • AC heat dissipation—412.36 BTU/hour • DC-input power—129.84 W • DC heat dissipation—443.40 BTU/hour

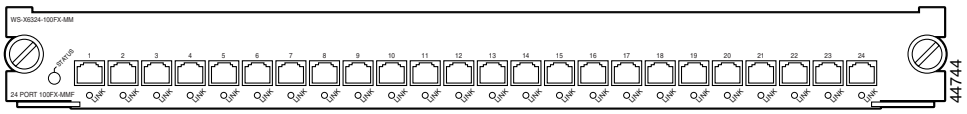
Table 2-4 WS-X6148-FE-SFP Physical and Environmental Specifications (continued)

Item	Specification
Environment	
Operating temperature	• Certified for operation: 32° to 104°F (0° to 40°C) • Designed and tested for operation: 32° to 130°F (0° to 55°C)
Humidity (RH) ambient (noncondensing)	10 to 90%
Operating altitude	• Certified for operation: 0 to 6500 ft (0 to 2000 m) • Designed and tested for operation: –200 to 10,000 ft (–60 to 3000 m)

WS-X6324-100FX-MM and WS-X6324-100FX-SM Ethernet Modules

The WS-X6324-100FX-MM and the WS-X6324-100FX-SM Ethernet modules (Figure 2-3) provide 24 100-Mbps full- or half-duplex ports. The WS-X6324-100FX-MM Ethernet module operates over multimode fiber-optic (MMF) cable and the WS-X6324-100FX-SM Ethernet module operates over G.652 single-mode fiber-optic (SMF) cable. Table 2-5 lists both modules features, and Table 2-6 lists both modules physical and environmental specifications.

Figure 2-3 WS-X6324-100FX-MM and WS-X6324-100FX-SM Ethernet Modules Front Panel



Note The WS-X6324-100FX-SM Ethernet module front panel is identical to the WS-X6324-100FX-MM Ethernet module front panel with the exception of the product part number.

Table 2-5 WS-X6324-100FX-MM and WS-X6324-100FX-SM Ethernet Module Features

Feature	Description
Ports per module	• 24 ports. Ports are numbered 1 (left) to 24 (right). • 2 port groups • Port ranges per port group: 1–12, 13–24
Port connector type	MT-RJ (both modules)
Cabling distance	• WS-X6324-100FX-MM—1.24 mi (2 km) full-duplex over MMF • WS-X6324-100FX-MM—1312 ft (400 m) half-duplex over MMF • WS-X6324-100FX-SM—6.2 mi (10 km) full- or half-duplex over G.652 SMF
Buffer size	128 KB per port

Table 2-5 WS-X6324-100FX-MM and WS-X6324-100FX-SM Ethernet Module Features (continued)

Feature	Description
QoS	• Number of egress queues: 2 • Number of ingress queues: 1 • Number of thresholds per egress queue: 2 • Number of thresholds per ingress queue: 4
Maximum frame size	Up to 9216 bytes per frame
Module oversubscription rate	N/A
Supervisor engine support	Supported by the following supervisor engines: • Supervisor Engine 2 • Supervisor Engine 32 • Supervisor Engine 32 PISA • Supervisor Engine 720 • Supervisor Engine 720-10GE
Software support	• With Supervisor Engine 2—12.1(2)E • With Supervisor Engine 32—12.2(18)SXF • With Supervisor Engine 32 PISA—12.2(18)ZY • With Supervisor Engine 720—12.2(14)SX • With Supervisor Engine 720-10GE—12.2(33)SXH • Catalyst OS—6.4(11)
Queues per port	Both modules: • Tx—2q2t • Rx—1q4t
Chassis/slot restrictions	No chassis or slot restrictions; the modules can occupy any slot in any Catalyst 6500 or Catalyst 6500-E chassis.
Bus connection	Single connection into the 32-Gbps shared bus
Module upgrades available	
PoE support	Not available.
Distributed forwarding support	Not available.
Pluggable transceivers support	Not supported.

Table 2-5 WS-X6324-100FX-MM and WS-X6324-100FX-SM Ethernet Module Features (continued)

Feature	Description
Digital Optical Monitoring (DOM) support	Not supported.
Module front panel LEDs	**STATUS** • Green—All diagnostics pass; the module is operational. • Orange—The module is booting or running diagnostics; an overtemperature condition has occurred. **LINK** • Green—The port is active (the link is connected and operational). • Flashing orange—The port failed diagnostics and is disabled. • Orange—The port is disabled. • Red—The module is resetting; an overtemperature condition has occurred. **Note** If the module fails to download code and configuration information successfully during the initial reset, the LED stays red; the module does not come online. • Off—The port is not active or the link is not connected.

Table 2-6 WS-X6324-100FX-MM and WS-X6324-100FX-SM Ethernet Modules Physical and Environmental Specifications

Item	Specification
Dimensions (H x W x D)	1.2 x 14.4 x 16 in. (3.0 x 35.6 x 40.6 cm). Occupies one slot in the chassis.
Weight	7.0 lb (3.18 kg)
Power and heat numbers	• Module current—1.52 A • Module power—63.84 W • AC-input power—79.8 W • AC heat dissipation—272.52 BTU/hour • DC-input power—85.81 W • DC heat dissipation—293.03 BTU/hour
Environment	
Operating temperature	• Certified for operation: 32° to 104°F (0° to 40°C) • Designed and tested for operation: 32° to 130°F (0° to 55°C)
Humidity (RH) ambient (noncondensing)	10 to 90%
Operating altitude	• Certified for operation: 0 to 6500 ft (0 to 2000 m) • Designed and tested for operation: –200 to 10,000 ft (–60 to 3000 m)

WS-X6524-100FX-MM Ethernet Module

The WS-X6524-100FX-MM Ethernet module (Figure 2-4) provides 24 100-Mbps full- or half-duplex ports. Table 2-7 lists the module features, and Table 2-8 lists the module physical and environmental specifications.

Figure 2-4 WS-X6524-100FX-MM Switching Modules Front Panel

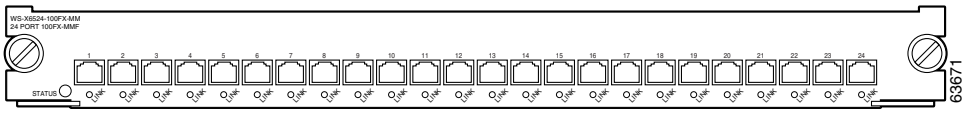


Table 2-7 WS-X6524-100FX-MM Features

Feature	Description
Ports per module	• 24 ports. Ports are numbered 1 (left) to 24 (right). • 1 port group • Port ranges per port group: 1–24
Port connector type	MT-RJ
Cabling distance	1.24 mi (2 km) full-duplex; 1312 ft (400 m) half-duplex over MMF
Buffer size	1.2 MB per port
QoS	• Number of egress queues: 4 • Number of ingress queues: 2 • Number of thresholds per egress queue: 1 • Number of thresholds per ingress queue: 0
Maximum frame size	Up to 9216 bytes per frame
Module oversubscription rate	N/A
Supervisor engine support	Supported by the following supervisor engines: • Supervisor Engine 2 • Supervisor Engine 32 • Supervisor Engine 32 PISA • Supervisor Engine 720 • Supervisor Engine 720-10GE
Software support	• With Supervisor Engine 2—12.1(8a)EX • With Supervisor Engine 32—12.2(18)SXF • With Supervisor Engine 32 PISA—12.2(18)ZY • With Supervisor Engine 720—12.2(14)SX • With Supervisor Engine 720-10GE—12.2(33)SXH • Catalyst OS—7.6(9)

Table 2-7 WS-X6524-100FX-MM Features (continued)

Feature	Description
Queues per port	• Tx—1p3q1t • Rx—1p1q0t
Chassis/slot restrictions	No chassis or slot restrictions; the module can occupy any slot in any Catalyst 6500 or Catalyst 6500-E chassis.
Bus connection	Single connection into the 32-Gbps shared bus
Module upgrades available	
PoE support	Not available
Distributed forwarding support	Field upgradeable to support distributed forwarding with the following daughter cards: • WS-F6K-DFC • WS-F6K-DFC3A • WS-F6K-DFC3B • WS-F6K-DFC3BXL See Appendix A for further information on the DFC daughter cards. See the *Catalyst 6500 Series DFC, DFC3A, DFC3B, and DFC3BXL Installation Note* for field installation procedures.
Pluggable transceivers support	Not supported
Digital Optical Monitoring (DOM) support	Not supported
Module front panel LEDs	**STATUS** • Green—All diagnostics pass; the module is operational. • Orange—The module is booting or running diagnostics; an overtemperature condition has occurred. **LINK** • Green—The port is active (the link is connected and operational). • Flashing orange—The port failed diagnostics and is disabled. • Orange—The port is disabled. • Red—The module is resetting; an overtemperature condition has occurred. **Note** If the module fails to download code and configuration information successfully during the initial reset, the LED stays red; the module does not come online. • Off—The port is not active or the link is not connected.

Table 2-8 WS-X6524-100FX-MM Physical and Environmental Specifications

Item	Specification
Dimensions	1.2 x 14.4 x 16 in. (3.0 x 35.6 x 40.6 cm). Occupies one slot in the chassis.
Weight	Base module—7.0 lb (3.18 kg)
Power and heat numbers	• Base module – Module current—1.90 A – Module power—79.8 W – AC-input power—99.75 W – AC heat dissipation—340.65 BTU/hour – DC-input power—107.30 W – DC heat dissipation—366.30 BTU/hour • Base module + DFC3 daughter card – Module current—4.00 A – Module power—168.00 W – AC-input power—210.00 W – AC heat dissipation—717.15 BTU/hour – DC-input power—225.81 W – DC heat dissipation—771.13 BTU/hour • Base module + DFC3A daughter card – Module current—4.47 A – Module power—187.74 W – AC-input power—234.68 W – AC heat dissipation—801.42 BTU/hour – DC-input power—252.34 W – DC heat dissipation—861.74 BTU/hour

Table 2-8 WS-X6524-100FX-MM Physical and Environmental Specifications (continued)

Item	Specification
Power and heat numbers (continued)	• Base module + DFC3B daughter card – Module current—3.57 A – Module power—149.94 W – AC-input power—187.43 W – AC heat dissipation—640.06 BTU/hour – DC-input power—201.53 W – DC heat dissipation—688.23 BTU/hour • Base module + DFC3BXL daughter card – Module current—3.37 A – Module power—141.54 W – AC-input power—176.93 W – AC heat dissipation—604.20 BTU/hour – DC-input power—190.24 W – DC heat dissipation—649.68 BTU/hour
Environment	
Operating temperature	• Certified for operation: 32° to 104°F (0° to 40°C) • Designed and tested for operation: 32° to 130°F (0° to 55°C)
Humidity (RH) ambient (noncondensing)	10 to 90%
Operating altitude	• Certified for operation: 0 to 6500 ft (0 to 2000 m) • Designed and tested for operation: –200 to 10,000 ft (–60 to 3000 m)

10/100 and 10/100/1000 Ethernet Modules

This section describes the following 10/100 and 10/100/1000BASE Ethernet modules:

- WS-X6516-GE-TX Ethernet Module, page 2-47
- WS-X6548-GE-TX, WS-X6548-GE-45AF, and WS-X6548V-GE-TX Ethernet Modules, page 2-50
- WS-X6548-RJ-21 Ethernet Module, page 2-54
- WS-X6548-RJ-45 Ethernet Module, page 2-57
- WS-X6748-GE-TX and WS-X6848-TX-2T/-2TXL Ethernet Modules, page 2-61

Note All 10/100 and 10/100/1000 Ethernet modules are hot-swappable.

WS-X6148-GE-TX and WS-X6148A-GE-TX Ethernet Modules

The base WS-X6148-GE-TX and the base WS-X6148A-GE-TX Ethernet modules and their variants (See Table 2-9) provide 48 10/100/1000-Mbps full- or half-duplex ports. (See Table 2-9.). Figure 2-5 shows the module front panel.

Table 2-9 WS-X6148-GE-TX and WS-X6148A-GE-TX Ethernet Module Variants

Module	Description
WS-X6148-GE-TX	Base module without daughter cards installed.
WS-X6148-GE-45AF	Base module equipped with a factory-installed IEEE 802.3af PoE daughter card (WS-F6K-GE48-AF).
WS-X6148V-GE-TX	Base module equipped with a factory-installed Cisco prestandard PoE daughter card (WS-F6K-VPWR-GE).
WS-X6148A-GE-TX	Base module (with enhanced port buffer size) without daughter cards installed.
WS-X6148A-GE-45AF	Base module (with enhanced port buffer size) equipped with a factory-installed IEEE 802.3af PoE daughter card (WS-F6K-GE48-AF).

Figure 2-5 WS-X6148-GE-TX Ethernet Module Front Panel

Note The WS-X6148-GE-TX and the WS-X6148A-GE-TX Ethernet modules share the same front panel. The product numbers located in the upper-left corner will differ.

Table 2-10 lists the features and descriptions for the base modules and their variants, and Table 2-11 lists the physical and environmental specifications for the base modules and their variants.

Table 2-10 WS-X6148-GE-TX and WS-X6148A-GE-TX Features

Feature	Description
Ports per module	• 48 ports (all variants). Ports are numbered (left to right) – Top row, odd numbered ports 1–47. – Bottom row, even numbered ports 2–48. • Port groups – WS-X6148-GE-TX—2 – WS-X6148A-GE-TX—6 • Port ranges per port group – WS-X6148-GE-TX: 1–24, 25–48 – WS-X6148A-GE-TX: 1–8, 9–16, 17–24, 25–32, 33–40, 41–48
Port connector type	RJ-45 (all variants)
Cabling distance	328 ft (100 m) over Category 5, 5e, and 6 UTP/STP cable (all variants)
Buffer size	• WS-X6148-GE-TX, WS-X6148V-GE-TX, and WS-X6148-GE-45AF—1.4 MB per 8 ports • WS-X6148A-GE-TX and WS-X6148A-GE-45AF—5.5 MB per port
QoS	• Number of egress queues: 3 • Number of ingress queues: 1 • Number of thresholds per egress queue: 2 • Number of thresholds per ingress queue: 2
Maximum frame size	• WS-X6148-GE-TX, WS-X6148V-GE-TX, and WS-X6148-GE-45AF—Up to 1518 bytes per frame • WS-X6148A-GE-TX and WS-X6148A-GE-45AF—Up to 9216 bytes per frame
Module oversubscription rate	8:1
Supervisor engine support	Supported by the following supervisor engines: • Supervisor Engine 2 • Supervisor Engine 32 • Supervisor Engine 32 PISA • Supervisor Engine 720 • Supervisor Engine 720-10GE • Supervisor Engine 2T (only supported with the WS-X6148A-GE-TX and the WS-X6148A-GE-45AF Ethernet modules)

Table 2-10 WS-X6148-GE-TX and WS-X6148A-GE-TX Features (continued)

Feature	Description
Software support	• With Supervisor Engine 2—12.2(18)SXF2 • With Supervisor Engine 32—12.2(18)SXF • With Supervisor Engine 32 PISA—12.2(18)ZY • With Supervisor Engine 720—12.2(18)SXF • With Supervisor Engine 720 and WS-F6K-GE48-AF or WS-F6K48-AF PoE daughter cards—12.2(17d)SXB (WS-X6148-GE-TX only) • With Supervisor Engine 720-10GE—12.2(33)SXH • With Supervisor Engine 2T—12.2(50)SY • Catalyst OS – WS-X6148-GE-TX—7.6(9) – WS-X6148A-GE-TX—8.4(1)
Queues per port	WS-X6148-GE-TX, WS-X6148V-GE-TX, and WS-X6148-GE-45AF • Tx—1p2q2t (per 8 ports) • Rx—1p2t (per port) WS-X6148A-GE-TX and WS-X6148A-GE-45AF • Tx—1p3q8t • Rx—1q2t
Chassis/slot restrictions	No chassis or slot restrictions; the module can occupy any slot in any Catalyst 6500 or Catalyst 6500-E chassis (all variants)
Bus connection	Single connection into the 32-Gbps shared bus (all variants).
Module upgrades available	
PoE support	WS-X6148-GE-TX and WS-X6148A-GE-TX: • The WS-X6148-GE-TX is field upgradeable with the WS-F6K-VPWR-GE= daughter card that supports only the Cisco prestandard. • Both the WS-X6148-GE-TX and the WS-X6148A-GE-TX are field upgradeable with the WS-F6K-GE48-AF= daughter card that supports both the Cisco prestandard and the IEEE 802.3af standard. Refer to the *Catalyst 6500 Series Power over Ethernet Daughter Cards Field-Upgrade Installation Note* for field upgrade procedures. Refer to Appendix A for additional information on the PoE daughter cards.
Distributed forwarding support	Not supported.
Pluggable transceivers support	Not supported.
TDR support	All variants are supported.

Table 2-10 WS-X6148-GE-TX and WS-X6148A-GE-TX Features (continued)

Feature	Description
Module front panel LEDs	**STATUS** • Green—All diagnostics pass; the module is operational. • Orange—The module is booting or running diagnostics; an overtemperature condition has occurred. **LINK** • Green—The port is active (the link is connected and operational). • Flashing orange—The port failed diagnostics and is disabled. • Orange—The port is disabled. • Red—The module is resetting; an overtemperature condition has occurred. **Note** If the module fails to download code and configuration information successfully during the initial reset, the LED stays red; the module does not come online. • Off—The port is not active or the link is not connected. **PHONE** • Green—The PoE daughter card is installed and detected. • Off—The PoE daughter card is not detected or is not installed.

Table 2-11 WS-X6148-GE-TX and Variants Physical and Environmental Specifications

Item	Specification
Dimensions (H x W x D)	1.2 x 14.4 x 16 in. (3.0 x 35.6 x 40.6 cm). Occupies one slot in the chassis.
Weight	• WS-X6148-GE-TX (base module only)—7.6 lb (3.4 kg) • WS-X6148A-GE-TX (base module only)—6.6 lb (3 kg)

Table 2-11 WS-X6148-GE-TX and Variants Physical and Environmental Specifications (continued)

Item	Specification
Power and heat numbers	• Base module (WS-X6148-GE-TX) – Module current—2.47 A – Module power—104.00 W – AC-input power— 130.00W – AC heat dissipation—443.00 BTU/hour – DC-input power—139.00 W – DC heat dissipation—476.00 BTU/hour • WS-X6148-GE-45AF (base module + PoE daughter card) – Module current—2.65 A – Module power—111.30 W – AC-input power—139.13 W – AC heat dissipation—475.11 BTU/hour – DC-input power—149.60 W – DC heat dissipation—510.87 BTU/hour • WS-X6148V-GE-TX (base module + PoE daughter card) – Module current—2.89 A – Module power—121.38 W – AC-input power—151.72 W – AC heat dissipation—518.14 BTU/hour – DC-input power—163.15 W – DC heat dissipation—557.14 BTU/hour • WS-X6148A-GE-TX (enhanced base module) – Module current— 2.50A – Module power—105.00 W – AC-input power—131.25 W – AC heat dissipation—448.22 BTU/hour – DC-input power—141.13 W – DC heat dissipation—481.96 BTU/hour • WS-X6148A-GE-45AF (enhanced base module + PoE daughter card) – Module current—2.68 A – Module power—112.56 W – AC-input power—140.70 W – AC heat dissipation—480.49 BTU/hour – DC-input power—151.29 W – DC heat dissipation—516.66 BTU/hour

Table 2-11 WS-X6148-GE-TX and Variants Physical and Environmental Specifications (continued)

Item	Specification
Environment	
Operating temperature	• Certified for operation: 32° to 104°F (0° to 40°C) • Designed and tested for operation: 32° to 130°F (0° to 55°C)
Humidity (RH) ambient (noncondensing)	10 to 90%
Operating altitude	• Certified for operation: 0 to 6500 ft (0 to 2000 m) • Designed and tested for operation: –200 to 10,000 ft (–60 to 3000 m)

WS-X6148-RJ21 Ethernet Modules

The WS-X6148-RJ21 Ethernet module and its two variants provide 48 10/100-Mbps full- or half-duplex ports. (See Table 2-12.) Figure 2-6 shows the module front panel.

Table 2-12 WS-X6148-RJ21 Ethernet Module Variants

Module	Description
WS-X6148-RJ21	Base module without daughter cards installed.
WS-X6148-21AF	Base module equipped with a factory-installed IEEE 802.3af PoE daughter card (WS-F6K-GE48-AF).
WS-X6148-RJ21V	Base module equipped with a factory-installed Cisco prestandard PoE daughter card (WS-F6K-VPWR-GE).

Figure 2-6 WS-X6148-RJ-21 Ethernet Module Front Panel

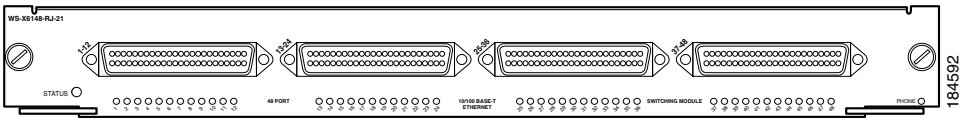


Table 2-13 lists the features and descriptions for the modules, and Table 2-14 lists the physical and environmental specifications for the modules.

Table 2-13 WS-X6148-RJ-21 Ethernet Modules Features

Feature	Description
Ports per module	• 48 ports (all variants). Ports are numbered from left to right. First connector, ports 1–12; second connector, ports 13–24; third connector, ports 25–32; fourth connector, ports 33–48. • 4 port groups • Port ranges per port group: 1–12, 13–24, 25–36, 37–48
Port connector type	RJ-21 (all variants)

Table 2-13 WS-X6148-RJ-21 Ethernet Modules Features (continued)

Feature	Description
Cabling distance	328 ft (100 m) over Category 5, 5e, and 6 UTP/STP cable (all variants)
Buffer size	128 KB per port (all variants)
QoS	• Number of egress queues: 2 • Number of ingress queues: 1 • Number of thresholds per egress queue: 2 • Number of thresholds per ingress queue: 4
Maximum frame size	Up to 8092 bytes per frame (all variants)
Module oversubscription rate	1.2:1
Supervisor engine support	Supported by the following supervisor engines: • Supervisor Engine 2 • Supervisor Engine 32 • Supervisor Engine 32 PISA • Supervisor Engine 720 • Supervisor Engine 720-10GE
Software support	• With Supervisor Engine 2—12.1(12c)E1 • With Supervisor Engine 2 and WS-F6K-VPWR PoE daughter card—12.1(13)E • With Supervisor Engine 32—12.2(18)SXF • With Supervisor Engine 32 PISA—12.2(18)ZY • With Supervisor Engine 720 except with WS-F6K-48-AF PoE daughter card—12.2(14)SX • With Supervisor Engine 720 and WS-F6K-48-AF PoE daughter card—12.2(17d)SXB • With Supervisor Engine 720-10GE—12.2(33)SXH • Catalyst OS—6.4(11) (for software release 6.x); 7.6(9) (for software release 7.x)
Queues per port	All variants: • Tx—2q2t • Rx—1q4t

Table 2-13 WS-X6148-RJ-21 Ethernet Modules Features (continued)

Feature	Description
Chassis/slot restrictions	No chassis or slot restrictions; the module can occupy any slot in any Catalyst 6500 or Catalyst 6500-E chassis (all variants).
Bus connection	Single connection into the 32-Gbps shared bus (all variants)
Daughter card support	
PoE support	WS-X6148-RJ-21—Field upgradeable to Cisco Prestandard only by installing the WS-F6K-VPWR= daughter card. Refer to the *Cisco Catalyst 6500 Series Power over Ethernet Daughter Cards Field-Upgrade Installation Note* for field upgrade procedures. **Note** An IEEE 802.3af standard PoE daughter card is available through factory advance replacement only; the IEEE 802.3af standard PoE daughter card is not field upgradeable.
Distributed forwarding support	Not available.
Pluggable transceivers support	Not supported.
TDR support	All variants supported.
Module front panel LEDs	**STATUS** • Green—All diagnostics pass; the module is operational. • Orange—The module is booting or running diagnostics; an overtemperature condition has occurred. **LINK** • Green—The port is active (the link is connected and operational). • Flashing orange—The port failed diagnostics and is disabled. • Orange—The port is disabled. • Red—The module is resetting; an overtemperature condition has occurred. **Note** If the module fails to download code and configuration information successfully during the initial reset, the LED stays red; the module does not come online. • Off—The port is not active or the link is not connected. **PHONE** • Green—The PoE daughter card is installed and detected. • Off—The PoE daughter card is not detected or is not installed.

Table 2-14 WS-X6148-RJ-21 Physical and Environmental Specifications

Item	Specification
Dimensions (H x W x D)	1.2 x 14.4 x 16 in. (3.0 x 35.6 x 40.6 cm). Occupies one slot in the chassis.
Weight	• Base module only—8.0 lb (3.6 kg)
Power and heat numbers	• WS-X6148-RJ-21 (base module) – Module current—2.39 A – Module power—100.38 W – AC-input power—125.48 W – AC heat dissipation—428.50 BTU/hour – DC-input power—134.92 W – DC heat dissipation—460.75 BTU/hour • WS-X6148-21AF (base module + PoE daughter card) – Module current—2.57 A – Module power—107.94 W – AC-input power—134.93 W – AC heat dissipation—460.77 BTU/hour – DC-input power—145.08 W – DC heat dissipation—495.45 BTU/hour • WS-X6148-RJ21V (base module + PoE daughter card)— – Module current—2.39 A – Module power—100.38 W – AC-input power—125.48 W – AC heat dissipation—428.50 BTU/hour – DC-input power—134.92 W – DC heat dissipation—460.75 BTU/hour
Environment	
Operating temperature	• Certified for operation: 32° to 104°F (0° to 40°C) • Designed and tested for operation: 32° to 130°F (0° to 55°C)
Humidity (RH) ambient (noncondensing)	10 to 90%
Operating altitude	• Certified for operation: 0 to 6500 ft (0 to 2000 m) • Designed and tested for operation: –200 to 10,000 ft (–60 to 3000 m)

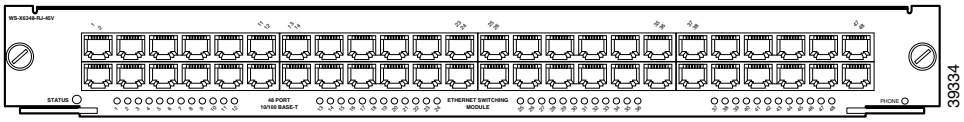
WS-X6148-RJ-45 and WS-X6148A-RJ-45 Ethernet Modules

The WS-X6148-RJ-45 and the WS-X6148A-RJ-45 Ethernet modules provide 48 10/100-Mbps full- or half-duplex ports. Table 2-15 lists the two base modules and their variants. Figure 2-7 shows the module front panel.

Table 2-15 WS-X6148-RJ-45 and WS-X61248A-RJ-45 Ethernet Modules and Variants

Module	Description
WS-X6148-RJ-45	Base module without daughter cards installed.
WS-X6148-45AF	Base module equipped with a factory-installed IEEE 802.3af PoE daughter card (WS-F6K-GE48-AF).
WS-X6148-RJ45V	Base module equipped with a factory-installed Cisco prestandard PoE daughter card (WS-F6K-VPWR-GE).
WS-X6148A-RJ-45	Base module (with enhanced port buffer size) without daughter cards installed.
WS-X6148A-45AF	Base module (with enhanced port buffer size) equipped with a factory-installed IEEE 802.3af PoE daughter card (WS-F6K-GE48-AF).

Figure 2-7 WS-X6148-RJ-45 Ethernet Module Front Panel



Note The WS-X6148-RJ-45 and the WS-X6148A-RJ-45 Ethernet modules share the same front panel. The product numbers in the upper-left corner will differ.

Table 2-16 lists the features and descriptions for the modules, and Table 2-17 lists the physical and environmental specifications for the modules.

Table 2-16 WS-X6148-RJ-45 and WS-X6148A-RJ-45 Ethernet Modules Features

Feature	Description
Ports per module	• 48 ports (all variants). Ports are numbered (left to right): – Top row, odd numbered ports 1–47. – Bottom row, even numbered ports 2–48. • Port groups: – WS-X6148-RJ-45—2 – WS-X6148A-RJ-45—6 • Port ranges per port group: – WS-X6148-RJ-45: 1–24, 25–48 – WS-X6148A-RJ-45: 1–8, 8–16, 17–24, 25–32, 33–40, 41–48
Port connector type	RJ-45 (all variants)
Cabling distance	328 ft (100 m) over Category 5, 5e, and 6 UTP/STP cable (all variants)
Buffer size	• WS-X6148-RJ-45, WS-X6148-45AF, and WS-X6148-RJ45V—1 MB per 8 ports • WS-X6148A-RJ-45 and WS-X6148A-45AF—5.3 MB per 8 ports
QoS	• Number of egress queues: 2 (6148), 4 (6148A) • Number of ingress queues: 1 (6148), 2 (6148A) • Number of thresholds per egress queue: 2 (6148), 8 (6148A) • Number of thresholds per ingress queue: 4 (6148), 4 (6148A)
Maximum frame size	• WS-X6148-RJ-45, WS-X6148-45AF, and WS-X6148-RJ45V—Up to 8092 bytes per frame • WS-X6148A-RJ-45 and WS-X6148A-45AF—Up to 9216 bytes per frame
Module oversubscription rate	1.2:1
Supervisor engine support	Supported on the following supervisor engines: • Supervisor Engine 2 • Supervisor Engine 32 • Supervisor Engine 32 PISA • Supervisor Engine 720 • Supervisor Engine 720-10GE • Supervisor Engine 2T (only supported with the WS-X6148A-RJ-45 and the WS-X6148A-45AF Ethernet modules)

Table 2-16 WS-X6148-RJ-45 and WS-X6148A-RJ-45 Ethernet Modules Features (continued)

Feature	Description
Software support	• With Supervisor Engine 2—12.1(12c)E1 • With Supervisor Engine 32—12.2(18)SXF • With Supervisor Engine 32 PISA—12.2(18)ZY • With Supervisor Engine 720—12.2(18)SXF (6148A) • With Supervisor Engine 720 except with WS-F6K-48-AF PoE daughter card—12.2(14)SX (6148) • With Supervisor Engine 720 and WS-F6K-48-AF PoE daughter card—12.2(17d)SXB (6148) • With Supervisor Engine 720-10GE—12.2(33)SXH • With Supervisor Engine 2T—12.2(50)SY • Catalyst OS (6148A)—8.4(1) • Catalyst OS (6148)—6.4(11) (for software release 6.x); 7.6(9) (for software release 7.x)
Queues per port	• WS-X6148-RJ-45, WS-X6148-45AF, and WS-X6148-RJ45V – Tx—1p2q2t per 8 ports – Rx—1p2t per port • WS-X6148A-RJ-45 and WS-X6148A-45AF – Tx—1p3q8t – Rx—1q2t
Chassis/slot restrictions	No chassis or slot restrictions; the module can occupy any slot in any Catalyst 6500 or Catalyst 6500-E chassis (all variants).
Bus connection	Single connection into the 32-Gbps shared bus (all variants)
Module upgrades available	
PoE support	• WS-X6148-RJ-45—Field upgradeable to the Cisco prestandard only with the WS-F6K-VPWR-GE= daughter card or both the Cisco prestandard and the IEEE 802.3af standard by installing the WS-F6K-GE48-AF= daughter card. • WS-X6148A-RJ-45—Field upgradeable to the Cisco prestandard and the IEEE 802.3af standard by installing the WS-F6K-GE48-AF= daughter card. See the *Cisco Catalyst 6500 Series Power over Ethernet Daughter Cards Field-Upgrade Installation Note* for field upgrade procedures. See Appendix A for further information on the PoE daughter cards.
Distributed forwarding support	Not supported.

Table 2-16 WS-X6148-RJ-45 and WS-X6148A-RJ-45 Ethernet Modules Features (continued)

Feature	Description
Pluggable transceivers support	Not supported.
TDR support	Yes
Module front panel LEDs	**STATUS** • Green—All diagnostics pass; the module is operational. • Orange—The module is booting or running diagnostics. An overtemperature condition has occurred. (A minor temperature threshold has been exceeded during environmental monitoring.) • Red—The module is resetting. The switch has just been powered on or the module has been hot inserted during the normal initialization sequence. An overtemperature condition has occurred. (A major temperature threshold has been exceeded during environmental monitoring.) If the module fails to download code and configuration information successfully during the initial reset, the LED stays red; the module does not come online. **LINK** • Green—The port is active (the link is connected and operational). • Orange—The module or port is disabled through the CLI command or the module is initializing. • Flashing orange—The port is faulty and has been disabled. • Off—The port is not active or the link is not connected. **PHONE** • Green—The PoE daughter card is installed and detected. • Off—The PoE daughter card is not detected or is not installed.

Table 2-17 WS-X6148-RJ-45 Ethernet Modules Physical and Environmental Specifications

Item	Specification
Dimensions (H x W x D)	1.2 x 14.4 x 16 in. (3.0 x 35.6 x 40.6 cm). Occupies one slot in the chassis.
Weight	• WS-X6148-RJ-45 (Base module)—6.8 lb (3.08 kg) • WS-X6148A-RJ-45 (Enhanced base module)—7.2 lb (3.27 kg)
Power and heat numbers	• WS-X6148-RJ-45 – Module current—2.39 A – Module power—100.38 W – AC-input power—125.48 W – AC heat dissipation—428.50 BTU/hour – DC-input power—134.92 W – DC heat dissipation—460.75 BTU/hour • WS-X6148-45AF (base module + PoE daughter card) – Module current—2.57 A – Module power—107.94 W – AC-input power—134.33 W – AC heat dissipation—460.77 BTU/hour – DC-input power—145.08 W – DC heat dissipation—495.45 BTU/hour • WS-X6148-RJ45V (base module + PoE daughter card) – Module current—2.81 A – Module power—118.02 W – AC-input power—147.53 W – AC heat dissipation—503.80 BTU/hour – DC-input power—158.63 W – DC heat dissipation—541.72 BTU/hour

Table 2-17 WS-X6148-RJ-45 Ethernet Modules Physical and Environmental Specifications (continued)

Item	Specification
Power and heat numbers (continued)	• WS-X6148A-RJ-45 – Module current—1.00 A – Module power—42.00 W – AC-input power—52.50 W – AC heat dissipation—179.29 BTU/hour – DC-input power—55.45 W – DC heat dissipation—192.78 BTU/hour • WS-X6148A-RJ45AF (enhanced base module + PoE daughter card) – Module current—1.42 A – Module power—59.64 W – AC-input power—74.55 W – AC heat dissipation—254.59 BTU/hour – DC-input power—80.16 W – DC heat dissipation—273.75 BTU/hour
Environment	
Operating temperature	• Certified for operation: 32° to 104°F (0° to 40°C) • Designed and tested for operation: 32° to 130°F (0° to 55°C)
Humidity (RH) ambient (noncondensing)	10 to 90%
Operating altitude	• Certified for operation: 0 to 6500 ft (0 to 2000 m) • Designed and tested for operation: –200 to 10,000 ft (–60 to 3000 m)

WS-X6148E-GE-45AT Ethernet Module

The WS-X6148E-GE-45AT Ethernet module provides 48 10/100/1000-Mbps full- or half-duplex ports. Figure 2-8 shows the module front panel. The module provides 48 ports of enhanced PoE support.

Figure 2-8 WS-X6148E-GE-45AT Ethernet Module Front Panel

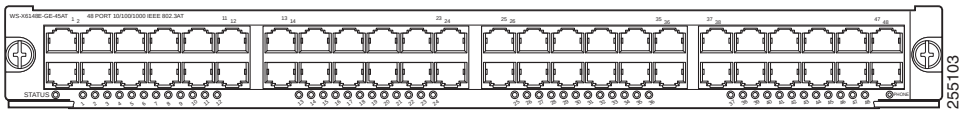


Table 2-18 lists the features and descriptions for the module, and Table 2-19 lists the physical and environmental specifications for the modules.

Table 2-18 WS-X6148E-GE-45AT Ethernet Module Features

Feature	Description
Ports per module	• 48 ports. Ports are numbered (left to right): – Top row, odd numbered ports 1–47 – Bottom row, even numbered ports 2–48 • Port groups: 6 • Port ranges per port group: 1–8, 8–16, 17–24, 25–32, 33–40, 41–48
Port connector type	RJ-45
Cabling distance	328 ft (100 m) over Category 5, 5e, and 6 UTP/STP cable
Buffer size	5.3 MB per 8 ports
QoS	• Number of egress queues: 4 • Number of ingress queues: 2 • Number of thresholds per egress queue: 8 • Number of thresholds per ingress queue: 4
Maximum frame size	Up to 9216 bytes per frame
Module oversubscription rate	8:1
Supervisor engine support	Supported on the following supervisor engines: • Supervisor Engine 32 • Supervisor Engine 720 • Supervisor Engine 720-10GE • Supervisor Engine 2T
Software support	12.2(33)SXI4 Supervisor Engine 2T support requires 12.2(50)SY
Queues per port	• Tx—1p3q8t • Rx—1q2t
Chassis/slot restrictions	No chassis or slot restrictions; the module can occupy any slot in any Catalyst 6500 or Catalyst 6500-E chassis.

Table 2-18 WS-X6148E-GE-45AT Ethernet Module Features (continued)

Feature	Description
Bus connection	Single connection into the 32-Gbps shared bus
Module upgrades available	
PoE support	Comes equipped with the WS-F6K-48-AT PoE daughter card. The WS-F6K-48-AT PoE daughter card can not be used on any other Ethernet module. See Appendix A for further information on the PoE daughter cards.
Distributed forwarding support	Not supported.
Pluggable transceivers support	Not supported.
TDR support	Yes
Module front panel LEDs	**STATUS** • Green—All diagnostics pass; the module is operational. • Orange—The module is booting or running diagnostics. An overtemperature condition has occurred. (A minor temperature threshold has been exceeded during environmental monitoring.) • Red—The module is resetting. The switch has just been powered on or the module has been hot inserted during the normal initialization sequence. An overtemperature condition has occurred. (A major temperature threshold has been exceeded during environmental monitoring.) If the module fails to download code and configuration information successfully during the initial reset, the LED stays red; the module does not come online. **LINK** • Green—The port is active (the link is connected and operational). • Orange—The module or port is disabled through the CLI command or the module is initializing. • Flashing orange—The port is faulty and has been disabled. • Off—The port is not active or the link is not connected. **PHONE** • Green—The PoE daughter card is installed and detected. • Off—The PoE daughter card is not detected or is not installed.

Table 2-19 WS-X6148E-GE-45AT Ethernet Modules Physical and Environmental Specifications

Item	Specification
Dimensions (H x W x D)	1.65 x 14.4 x 16 in. (4.2 x 35.6 x 40.6 cm). Occupies one slot in the chassis.
Weight	11 lb (5 kg)
Power and heat numbers	• Module current—2.5 A • Module power—105.0 W • AC-input power—131.25 W • AC heat dissipation—448.22 BTU/hour • DC-input power—141.13 W • DC heat dissipation—481.96 BTU/hour
Environment	
Operating temperature	• Certified for operation: 32° to 104°F (0° to 40°C) • Designed and tested for operation: 32° to 130°F (0° to 55°C)
Humidity (RH) ambient (noncondensing)	10 to 90%
Operating altitude	• Certified for operation: 0 to 6500 ft (0 to 2000 m) • Designed and tested for operation: –200 to 10,000 ft (–60 to 3000 m)

WS-X6148X2-RJ-45 and WS-X6148X2-45AF Ethernet Modules

The WS-X6148X2-RJ-45 and the WS-X6148X2-45AF Ethernet modules, listed in Table 2-20, provide 96 10/100-Mbps full- or half-duplex ports. (See Figure 2-9.) The WS-X6148X2-RJ-45 and the WS-X6148X2-RJ-45AF modules are shipped with a 96-port splitter panel (WS-F6K-48X2-SPLTR). (See Figure 2-10.)

Table 2-20 WS-X6148X2-RJ-45 and the WS-X6148X2-45AF Ethernet Modules

Module	Description
WS-X6148X2-RJ-45	Base module without daughter cards installed.
WS-X6148X2-45AF	Base module equipped with a factory-installed IEEE 802.3af PoE daughter card (WS-F6K-FE48X2-AF=).

Figure 2-9 WS-X6148X2-RJ-45 Ethernet Module Front Panel

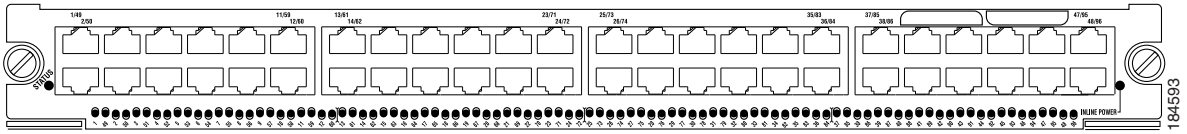


Figure 2-10 WS-F6K-48X2-SPLTR Splitter Panel

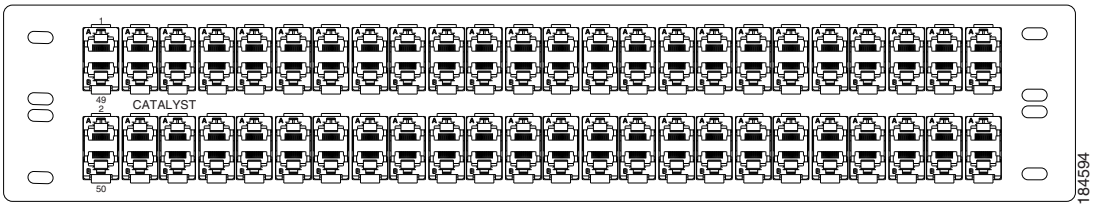


Table 2-21 lists the features for the modules, and Table 2-22 lists the physical and environmental specifications for the module.

Note With the IEEE 802.3af PoE daughter card installed, the WS-X6148X2-RJ-45 module can support up to 48 Class 3 (15.4 W) devices per module when operating as a 48-port module or up to 96 Class 2 (7 W) devices per module when operating as a 96-port module.

Table 2-21 WS-X6148X2-RJ-45 and WS-X6148X2-45AF Ethernet Modules Features

Feature	Description
Ports per module	48 ports, but scalable to 96 ports with the use of the supplied splitter panel (both modules) • Each connector supports two ports. Ports are numbered (left to right): – Top row, odd numbered ports 1/49 through 47/95. – Bottom row, even numbered ports 2/50 through 48/96.
Port connector type	• RJ-45 (both modules) • RJ-45 (splitter panel)
Cabling distance	328 ft (100 m) over Category 5, 5e, and 6 UTP/STP cable (both modules)
Buffer size	1.116 MB per port (both modules)
QoS	• Number of egress queues: 4 • Number of ingress queues: 2 • Number of thresholds per egress queue: 1 • Number of thresholds per ingress queue: 0
Maximum frame size	Up to 9216 bytes per frame (both modules)
Module oversubscription rate	N/A
Supervisor engine support	Supported on the following supervisor engines: • Supervisor Engine 2 • Supervisor Engine 32 • Supervisor Engine 32 PISA • Supervisor Engine 720 • Supervisor Engine 720-10GE
Software support	• With Supervisor Engine 2—Not supported with the 12.1E Release • With Supervisor Engine 32—12.2(18)SXF3 • With Supervisor Engine 32 PISA—12.2(18)ZY • With Supervisor Engine 720—12.2(18)SXF3 • With Supervisor Engine 720-10GE—12.2(33)SXH • Catalyst OS—8.3(3)
Queues per port	Both modules: • Tx—1p3q1t • Rx—1p1q0t

Table 2-21 WS-X6148X2-RJ-45 and WS-X6148X2-45AF Ethernet Modules Features (continued)

Feature	Description
Chassis/slot restrictions	No chassis or slot restrictions; the module can occupy any slot in any Catalyst 6500 or Catalyst 6500-E chassis.
Bus connection	Single connection into the 32-Gbps shared bus (both modules)
Module upgrades available	
PoE support	• WS-X6148X2-RJ-45—Field upgradeable to both Cisco prestandard and IEEE 802.3af with the WS-F6K-FE48X2-AF= PoE daughter card. **Note** With the IEEE 802.3af PoE daughter card installed, the WS-X6148X2-RJ-45 module can support up to 48 Class 3 (15.4 W) devices per module when operating as a 48-port module or up to 96 Class 2 (7 W) devices per module when operating as a 96-port module. See the *Cisco Catalyst 6500 Series Power over Ethernet Daughter Cards Field-Upgrade Installation Note* for field upgrade procedures. See Appendix A for further information on the PoE daughter cards.
Distributed forwarding support	Not supported.
Pluggable transceivers support	Not supported.

Table 2-21 WS-X6148X2-RJ-45 and WS-X6148X2-45AF Ethernet Modules Features (continued)

Feature	Description
TDR support	Not supported
Module front panel LEDs	**STATUS** • Green—All diagnostics pass; the module is operational. • Orange—The module is booting or running diagnostics. An overtemperature condition has occurred. (A minor temperature threshold has been exceeded during environmental monitoring.) • Red—The module is resetting. The switch has just been powered on or the module has been hot inserted during the normal initialization sequence. An overtemperature condition has occurred. (A major temperature threshold has been exceeded during environmental monitoring.) If the module fails to download code and configuration information successfully during the initial reset, the LED stays red; the module does not come online. **LINK** • Green—The port is active (the link is connected and operational). • Orange—The module or port is disabled through the CLI command or the module is initializing. • Flashing orange—The port is faulty and has been disabled. • Off—The port is not active or the link is not connected. **PHONE** • Green—The PoE daughter card is installed and detected. • Off—The PoE daughter card is not detected or is not installed.

Table 2-22 WS-X6148X2-RJ-45 Physical and Environmental Specifications

Item	Specification
Dimensions (H x W x D)	Module—1.2 x 14.4 x 16 in. (3.0 x 35.6 x 40.6 cm). Occupies one slot in the chassis. Splitter panel—3.5 x 19 x 1.25 in. (8.9 x 48.26 x 3.18 cm). Occupies 2 RUs in the rack.
Weight	WS-X6148X2-RJ-45 (base module)—7.2 lb (3.26 kg) Splitter panel—5.2 lb (2.36 kg)
Power and heat numbers	• WS-X6148X2-RJ-45 (base module) – Module current—2.65 A – Module power—111.30 W – AC-input power—139.13 W – AC heat dissipation—475.11 BTU/hour – DC-input power—149.60 W – DC heat dissipation—510.87 BTU/hour • WS-X6148X2-45AF (base module + PoE daughter card) – Module current—3.07 A – Module power—128.94 W – AC-input power—161.18 W – AC heat dissipation—550.41 BTU/hour – DC-input power—173.31 W – DC heat dissipation—591.84 BTU/hour
Environment	
Operating temperature	• Certified for operation: 32° to 104°F (0° to 40°C) • Designed and tested for operation: 32° to 130°F (0° to 55°C)
Humidity (RH) ambient (noncondensing)	10 to 90%
Operating altitude	• Certified for operation: 0 to 6500 ft (0 to 2000 m) • Designed and tested for operation: –200 to 10,000 ft (–60 to 3000 m)

WS-X6196-RJ-21 and WS-X6196-21AF Ethernet Modules

The WS-X6196-RJ-21 and the WS-X6196-21AF Ethernet modules, provide 96 10/100-Mbps full- or half-duplex ports. (See Table 2-23.) Figure 2-11 shows the module front panel.

Table 2-23 WS-X6196-RJ-21 Modules

Module	Description
WS-X6196-RJ-21	Base module without daughter cards installed.
WS-X6196-21AF	Base module equipped with a factory-installed IEEE 802.3af PoE daughter card (WS-F6K-GE48-AF).

Figure 2-11 WS-X6196-RJ-21 Switching Module Front Panel

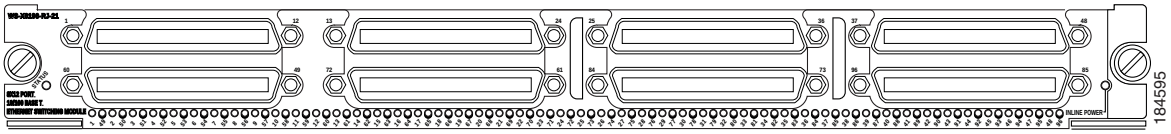


Table 2-24 lists the module features, and Table 2-25 lists the module physical and environmental specifications.

Note With the PoE daughter card installed, the WS-X6196-RJ-21 module can support 96 Class 2 (7 W) devices or 62 Class 3 (15.4 W) devices per module.

Table 2-24 WS-X6196-RJ-21 and WS-X6196-21AF Ethernet Modules Features

Feature	Description
Ports per module	• 96 ports (both modules). Ports are numbered (left to right) – Top row of connectors—First connector, ports 1–12; second connector, ports 13–24; third connector, ports 25–36; fourth connector, ports 37–48. – Bottom row of connectors—First connector, ports 60–49; second connector, ports 72–61; third connector, ports 73–84; fourth connector, ports 85–96. **Note** The bottom row of four RJ-21 connectors are inverted. The highest port number for a bottom row connector appears on the left side of the connector and the connector's lowest port number appears on the right side.
Port connector type	RJ-21 (both modules)
Cabling distance	328 ft (100 m) over Category 5, 5e, and 6 UTP/STP cable (both modules)
Buffer size	1.116 MB per port (both modules)

Table 2-24 WS-X6196-RJ-21 and WS-X6196-21AF Ethernet Modules Features (continued)

Feature	Description
QoS	• Number of egress queues: 4 • Number of ingress queues: 2 • Number of thresholds per egress queue: 1 • Number of thresholds per ingress queue: 0
Maximum frame size	Up to 9216 bytes (both modules)
Module oversubscription rate	N/A
Supervisor engine support	Supported on the following supervisor engines: • Supervisor Engine 2 • Supervisor Engine 32 • Supervisor Engine 32 PISA • Supervisor Engine 720 • Supervisor Engine 720-10GE
Software support	• With Supervisor Engine 2—Not supported with Release 12.1E • With Supervisor Engine 32—12.2(18)SXF3 • With Supervisor Engine 32 PISA—12.2(18)ZY • With Supervisor Engine 720—12.2(18)SXF3 • With Supervisor Engine 720-10GE—12.2(33)SXH • Catalyst OS Release—8.2.1
Queues per port	Both modules: • Tx—1p3q1t • Rx—1p1q0t
Chassis/slot restrictions	No chassis or slot restrictions; the module can occupy any slot in any Catalyst 6500 or Catalyst 6500-E chassis.
Bus connection	32-Gbps shared bus (both modules)
Module upgrades available	
PoE support	WS-X6196-RJ-21—Field upgradeable to both Cisco prestandard and IEEE 802.3af with the WS-F6K-FE48X2-AF= PoE daughter card. **Note** With the PoE daughter card installed, the WS-X6196-RJ-21 module can support 96 Class 2 (7 W) devices or 62 Class 3 (15.4 W) devices per module. WS-X6196-21AF—Shipped with a WS-F6K-FE48X2-AF PoE daughter card installed. See the *Cisco Catalyst 6500 Series Power over Ethernet Daughter Cards Field-Upgrade Installation Note* for field upgrade procedures. See Appendix A for further information on the PoE daughter cards.
Distributed forwarding support	Not supported.

Table 2-24 WS-X6196-RJ-21 and WS-X6196-21AF Ethernet Modules Features (continued)

Feature	Description
Pluggable transceivers support	Not supported.
TDR support	Not supported.
Module front panel LEDs	**STATUS** • Green—All diagnostics pass; the module is operational. • Orange—The module is booting or running diagnostics. An overtemperature condition has occurred. (A minor temperature threshold has been exceeded during environmental monitoring.) • Red—The module is resetting. The switch has just been powered on or the module has been hot inserted during the normal initialization sequence. An overtemperature condition has occurred. (A major temperature threshold has been exceeded during environmental monitoring.) If the module fails to download code and configuration information successfully during the initial reset, the LED stays red; the module does not come online. **LINK** • Green—The port is active (the link is connected and operational). • Orange—The module or port is disabled through the CLI command or the module is initializing. • Flashing orange—The port is faulty and has been disabled. • Off—The port is not active or the link is not connected. **PHONE** • Green—The PoE daughter card is installed and detected. • Off—The PoE daughter card is not detected or is not installed.

Table 2-25 WS-X6196-RJ-21 and WS-X6196-21AF Ethernet Modules Physical and Environmental Specifications

Item	Specification
Dimensions (H x W x D)	1.2 x 14.4 x 16 in. (3.0 x 35.6 x 40.6 cm). Occupies one slot in the chassis.
Weight	WS-X6196-RJ-21—7.8 lb (3.54 kg) WS-X6196-21AF—11.2 lb (5.08 kg)
Power and heat numbers	• WS-X6196-RJ-21 (base module) – Module current—2.74 A – Module power—115.08 W – AC-input power—143.85 W – AC heat dissipation—491.25 BTU/hour – DC-input power—154.68 W – DC heat dissipation—528.22 BTU/hour • WS-X6196-21AF (base module + PoE daughter card) – Module current—3.16 A – Module power—132.72 W – AC-input power—165.90 W – AC heat dissipation—566.55 BTU/hour – DC-input power—178.39 W – DC heat dissipation—609.19 BTU/hour
Environment	
Operating temperature	• Certified for operation: 32° to 104°F (0° to 40°C) • Designed and tested for operation: 32° to 130°F (0° to 55°C)
Humidity (RH) ambient (noncondensing)	10 to 90%
Operating altitude	• Certified for operation: 0 to 6500 ft (0 to 2000 m) • Designed and tested for operation: –200 to 10,000 ft (–60 to 3000 m)

WS-X6348-RJ21V Ethernet Module

The WS-X6348-RJ21V Ethernet module provides 48 10/100-Mbps full- or half-duplex ports. (See (Figure 2-12.) Table 2-26 lists the features and description for the module, and Table 2-27 lists the physical and environmental specifications for the module.

Figure 2-12 WS-X6348-RJ21V Switching Module Front Panel

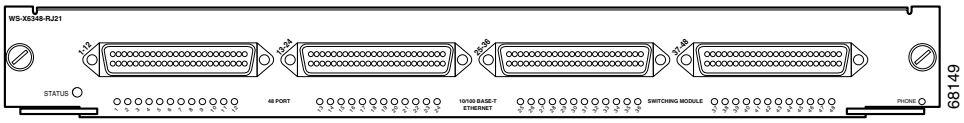


Table 2-26 WS-X6348-RJ21V Features

Feature	Description
Ports per module	• 48 ports. Ports are numbered (left to right): – First connector, ports 1 to 12; second connector, ports 13–24; third connector, ports 25–32; fourth connector, 33–48. • 4 port groups • Port ranges per port group: 1–12, 13–24, 25–36, 37–48
Port connector type	RJ-21 (12 ports per connector)
Cabling distance	328 ft (100 m) over Category 5, 5e, and 6 UTP/STP cable
Buffer size	128 KB
QoS	• Number of egress queues: 2 • Number of ingress queues: 1 • Number of thresholds per egress queue: 2 • Number of thresholds per ingress queue: 4
Maximum frame size	Up to 8092 bytes per frame
Module oversubscription rate	N/A
Supervisor engine support	Supported on the following supervisor engines: • Supervisor Engine 2 • Supervisor Engine 32 • Supervisor Engine 32 PISA • Supervisor Engine 720 • Supervisor Engine720-10GE
Software support	• With Supervisor Engine 2—12.1(8a)EX • With Supervisor Engine 32—12.2(18)SXF • With Supervisor Engine 32 PISA—12.2(18)ZY • With Supervisor Engine 720—12.2(14)SX • With Supervisor Engine720-10GE—12.2(33)SXH

Table 2-26 WS-X6348-RJ21V Features (continued)

Feature	Description
Queues per port	• Tx—2q2t • Rx—1q4t
Chassis/slot restrictions	No chassis or slot restrictions; the module can occupy any slot in any Catalyst 6500 or Catalyst 6500-E chassis.
Bus connection	32-Gbps shared bus
Module upgrades available	
PoE support	Cisco prestandard only. The WS-F6K-VPWR= PoE daughter card is factory installed on the module. No PoE field upgrades are available.
Distributed forwarding support	Not supported.
Pluggable transceivers support	Not supported.
TDR support	Not supported.
Module front panel LEDs	**STATUS** • Green—All diagnostics pass; the module is operational. • Orange—The module is booting or running diagnostics. An overtemperature condition has occurred. (A minor temperature threshold has been exceeded during environmental monitoring.) • Red—The module is resetting. The switch has just been powered on or the module has been hot inserted during the normal initialization sequence. An overtemperature condition has occurred. (A major temperature threshold has been exceeded during environmental monitoring.) If the module fails to download code and configuration information successfully during the initial reset, the LED stays red; the module does not come online. **LINK** • Green—The port is active (the link is connected and operational). • Orange—The module or port is disabled through the CLI command or the module is initializing. • Flashing orange—The port is faulty and has been disabled. • Off—The port is not active or the link is not connected. **PHONE** • Green—The PoE daughter card is installed and detected. • Off—The PoE daughter card is not detected or is not installed.

Table 2-27 WS-X6348-RJ21V Physical and Environmental Specifications

Item	Specification
Dimensions (H x W x D)	1.2 x 14.4 x 16 in. (3.0 x 35.6 x 40.6 cm). Occupies one slot in the chassis.
Weight	9.1 lb (4.13 kg)
Power and heat numbers	• Module current—2.81 A • Module power—118.02 W • AC-input power—147.53 W • AC heat dissipation—503.80 BTU/hour • DC-input power—158.63 W • DC heat dissipation—541.72 BTU/hour
Environment	
Operating temperature	• Certified for operation: 32° to 104°F (0° to 40°C) • Designed and tested for operation: 32° to 130°F (0° to 55°C)
Humidity (RH) ambient (noncondensing)	10 to 90%
Operating altitude	• Certified for operation: 0 to 6500 ft (0 to 2000 m) • Designed and tested for operation: –200 to 10,000 ft (–60 to 3000 m)

WS-X6348-RJ45 and WS-X6348-RJ45V Ethernet Modules

The WS-X6348-RJ45 and the WS-X6348-RJ45V Ethernet modules, provide 48 10/100-Mbps full- or half-duplex ports. (See Table 2-28.) Figure 2-13 shows the module front panel.

Table 2-28 WS-X6348-RJ45 Modules

Module	Description
WS-X6348-RJ45	Base module without daughter cards installed.
WS-X6348-RJ45V	Base module equipped with a factory-installed Cisco prestandard PoE daughter card (WS-F6K-VPWR-GE).

Figure 2-13 WS-X6348-RJ45 and WS-X6348-RJ45V Ethernet Modules Front Panel

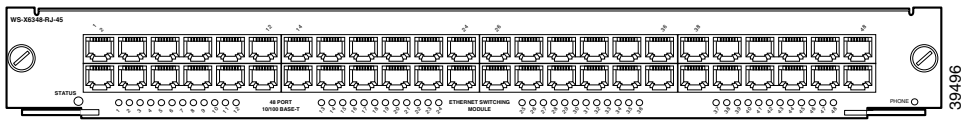


Table 2-29 lists the module features, and Table 2-30 lists the module physical and environmental specifications.

Table 2-29 WS-X6348-RJ45 and WS-X6348-RJ45V Ethernet Modules Features

Feature	Description
Ports per module	• 48 ports (both modules). Ports are numbered (left to right): – Top row, odd numbered ports 1 through 47. – Bottom row, even numbered ports 2 through 48. • 4 port groups • Port ranges per port group: 1–12, 13–24, 25–36, 37–48
Port connector type	RJ-45 (both modules)
Cabling distance	328 ft (100 m) over Category 5, 5e, and 6 UTP/STP cable (both modules)
Buffer size	128 KB per port (both modules)
QoS	• Number of egress queues: 2 • Number of ingress queues: 1 • Number of thresholds per egress queue: 2 • Number of thresholds per ingress queue: 4
Maximum frame size	Up to 8092 bytes per frame (both modules)
Module oversubscription rate	N/A
Supervisor engine support	Supported on the following supervisor engines: • Supervisor Engine 2 • Supervisor Engine 32 • Supervisor Engine 32 PISA • Supervisor Engine 720 • Supervisor Engine720-10GE
Software support	• With Supervisor Engine 2—12.1(2)E • With Supervisor Engine 32—12.2(18)SXF • With Supervisor Engine 32 PISA—12.2(18)ZY • With Supervisor Engine 720—12.2(14)SX • With Supervisor Engine720-10GE—12.2(33)SXH
Queues per port	Both modules: • Tx—2q2t • Rx—1q4t
Chassis/slot restrictions	No chassis or slot restrictions; the modules can occupy any slot in any Catalyst 6500 or Catalyst 6500-E chassis.

Table 2-29 WS-X6348-RJ45 and WS-X6348-RJ45V Ethernet Modules Features (continued)

Feature	Description
Bus connection	32-Gbps shared bus (both modules)
Module upgrades available	
PoE support	• WS-X6348-RJ45—Field upgradeable to Cisco prestandard with the WS-F6K-VPWR= PoE daughter card. • WS-X6348-RJ-45V—Comes equipped with the WS-F6K-VPWR daughter card. See the *Cisco Catalyst 6500 Series Power over Ethernet Daughter Cards Field-Upgrade Installation Note* for field upgrade procedures. See Appendix A for further information on the PoE daughter cards.
Distributed forwarding support	Not supported.
Pluggable transceivers support	Not supported.
TDR support	Not supported.
Module front panel LEDs	**STATUS** • Green—All diagnostics pass; the module is operational. • Orange—The module is booting or running diagnostics. An overtemperature condition has occurred. (A minor temperature threshold has been exceeded during environmental monitoring.) • Red—The module is resetting. The switch has just been powered on or the module has been hot inserted during the normal initialization sequence. An overtemperature condition has occurred. (A major temperature threshold has been exceeded during environmental monitoring.) If the module fails to download code and configuration information successfully during the initial reset, the LED stays red; the module does not come online. **LINK** • Green—The port is active (the link is connected and operational). • Orange—The module or port is disabled through the CLI command or the module is initializing. • Flashing orange—The port is faulty and has been disabled. • Off—The port is not active or the link is not connected. **PHONE** • Green—The PoE daughter card is installed and detected. • Off—The PoE daughter card is not detected or is not installed.

Table 2-30 WS-X6348-RJ45 and WS-X6348-RJ45V Physical and Environmental Specifications

Item	Specification
Dimensions (H x W x D)	1.2 x 14.4 x 16 in. (3.0 x 35.6 x 40.6 cm). Occupies one slot in the chassis.
Weight	• WS-X6348-RJ45—7.2 lb (3.26 kg) • WS-X6348-RJ45V—8.8 lb (3.99 kg)
Power and heat numbers	• WS-X6348-RJ45 – Module current—2.39 A – Module power—100.38 W – AC-input power—125.48 W – AC heat dissipation—428.50 BTU/hour – DC-input power—134.92 W – DC heat dissipation—460.75 BTU/hour • WS-X6348-RJ45V (base module + PoE daughter card) – Module current—2.81 A – Module power—118.02 W – AC-input power—147.53 W – AC heat dissipation—503.80 BTU/hour – DC-input power—158.63 W – DC heat dissipation—541.72 BTU/hour
Environment	
Operating temperature	• Certified for operation: 32° to 104°F (0° to 40°C) • Designed and tested for operation: 32° to 130°F (0° to 55°C)
Humidity (RH) ambient (noncondensing)	10 to 90%
Operating altitude	• Certified for operation: 0 to 6500 ft (0 to 2000 m) • Designed and tested for operation: –200 to 10,000 ft (–60 to 3000 m)

WS-X6516-GE-TX Ethernet Module

The WS-X6516-GE-TX Ethernet module provides 16 10/100/1000-Mbps full- or half-duplex ports. (See (Figure 2-14).) Table 2-31 lists the features and description for the module, and Table 2-32 lists the physical and environmental specifications for the module.

Figure 2-14 WS-X6516-GE-TX Ethernet Module Front Panel

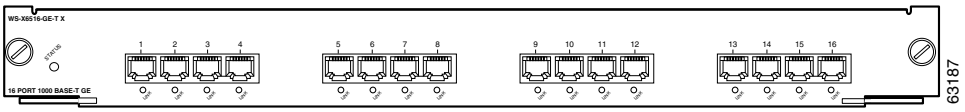


Table 2-31 WS-X6516-GE-TX Ethernet Module Features

Feature	Description
Ports per module	• 16 ports. Ports are numbered from 1 (left) to 16 (right). • 2 port groups • Port ranges per port group: 1–8, 9–16
Port connector type	RJ-45
Cabling distance	328 ft (100 m) over Category 5, 5e, and 6 UTP/STP cable
Buffer size	512 KB per port
QoS	• Number of egress queues: 3 • Number of ingress queues: 2 • Number of thresholds per egress queue: 2 • Number of thresholds per ingress queue: 4
Maximum frame size	Up to 9216 bytes per frame
Module oversubscription rate	N/A
Supervisor engine support	Supported on the following supervisor engines: • Supervisor Engine 2 • Supervisor Engine 32 • Supervisor Engine 32 PISA • Supervisor Engine 720 • Supervisor Engine 720-10GE
Software support	• With Supervisor Engine 2—12.1(8a)EX • With Supervisor Engine 32—12.2(18)SXF • With Supervisor Engine 32 PISA—12.2(18)ZY • With Supervisor Engine 720—12.2(14)SX • With Supervisor Engine720-10GE—12.2(33)SXH
Queues per port	• Tx—1p2q2t • Rx—1p1q4t

Table 2-31 WS-X6516-GE-TX Ethernet Module Features (continued)

Feature	Description
Chassis/slot restrictions	No chassis or slot restrictions; the module can occupy any slot in any Catalyst 6500 or Catalyst 6500-E chassis.
Bus connection	32-Gbps shared bus
Module upgrades available	
PoE support	Not supported.
Distributed forwarding support	Not supported.
Pluggable transceivers support	Not supported.
TDR support	Not supported.
Module front panel LEDs	**STATUS** • Green—All diagnostics pass; the module is operational. • Orange—The module is booting or running diagnostics. An overtemperature condition has occurred. (A minor temperature threshold has been exceeded during environmental monitoring.) • Red—The module is resetting. The switch has just been powered on or the module has been hot inserted during the normal initialization sequence. An overtemperature condition has occurred. (A major temperature threshold has been exceeded during environmental monitoring.) If the module fails to download code and configuration information successfully during the initial reset, the LED stays red; the module does not come online. **LINK** • Green—The port is active (the link is connected and operational). • Orange—The module or port is disabled through the CLI command or the module is initializing[1]. • Flashing orange—The port is faulty and has been disabled. • Off—The port is not active or the link is not connected. **PHONE** • Green—The PoE daughter card is installed and detected. • Off—The PoE daughter card is not detected or is not installed.

1. Verify that all LINK LEDs are functioning.

Table 2-32 WS-X6516-GE-TX Ethernet Module Physical and Environmental Specifications

Item	Specification
Dimensions (H x W x D)	1.2 x 14.4 x 16 in. (3.0 x 35.6 x 40.6 cm). Occupies one slot in the chassis.
Weight	7.65 lb (3.43 kg)
Power and heat numbers	• Module current—3.45 A • Module power—144.90 W • AC-input power—181.13 W • AC heat dissipation—618.54 BTU/hour • DC-input power—194.76 W • DC heat dissipation—665.10 BTU/hour
Environment	
Operating temperature	• Certified for operation: 32° to 104°F (0° to 40°C) • Designed and tested for operation: 32° to 130°F (0° to 55°C)
Humidity (RH) ambient (noncondensing)	10 to 90%
Operating altitude	• Certified for operation: 0 to 6500 ft (0 to 2000 m) • Designed and tested for operation: –200 to 10,000 ft (–60 to 3000 m)

WS-X6548-GE-TX, WS-X6548-GE-45AF, and WS-X6548V-GE-TX Ethernet Modules

The WS-X6548-GE-TX Ethernet module and its variants, listed in Table 2-33, provide 48 10/100/1000-Mbps full- or half-duplex ports. Figure 2-15 shows the module front panel.

Table 2-33 WS-X6548-GE-TX Ethernet Module Variants

Module	Description
WS-X6548-GE-TX	Base module without daughter cards installed.
WS-X6548-GE-45AF	Base module equipped with a factory-installed IEEE 802.3af PoE daughter card (WS-F6K-GE48-AF).
WS-X6548V-GE-TX	Base module equipped with a factory-installed Cisco prestandard PoE daughter card (WS-F6K-VPWR-GE).

Figure 2-15 WS-X6548-GE-TX Ethernet Module Front Panel

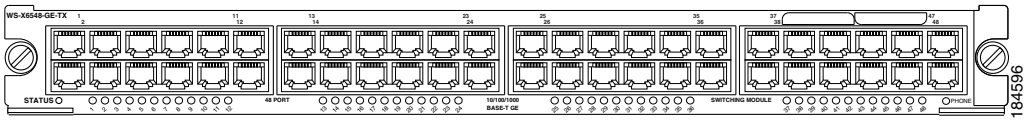


Table 2-34 lists the features and descriptions for the modules, and Table 2-35 lists the physical and environmental specifications for the modules.

Table 2-34 WS-X6548-GE-TX Modules Features

Feature	Description
Ports per module	• 48 (all variants). Ports are numbered (left to right): – Top row, odd-numbered ports 1–47. – Bottom row, even-numbered ports 2–48. • 2 port groups • Port ranges per port group: 1–24, 25–48
Port connector type	RJ-45 (all variants)
Cabling distance	328 ft (100 m) over Category 5, 5e, and 6 UTP/STP cable (all variants)
Buffer size	1.4 MB per 8 ports
QoS	• Number of egress queues: 3 • Number of ingress queues: 1 • Number of thresholds per egress queue: 2 • Number of thresholds per ingress queue: 2
Maximum frame size	Up to 1518 bytes per frame
Module oversubscription rate	N/A

Table 2-34 WS-X6548-GE-TX Modules Features (continued)

Feature	Description
Supervisor engine support	Supported on the following supervisor engines: • Supervisor Engine 2 • Supervisor Engine 32 • Supervisor Engine 32 PISA • Supervisor Engine 720 • Supervisor Engine 720-10GE
Software support	• With Supervisor Engine 2—12.1(19)E1 • With Supervisor Engine 32—12.2(18)SXF • With Supervisor Engine 32 PISA—12.2(18)ZY • With Supervisor Engine 720 (without either the WS-F6K-GE48-AF or the WS-F6K-48-AF daughter cards)—12.2(17a)SX • With Supervisor Engine 720 (with either the WS-F6K-GE48-AF or the WS-F6K-48-AF daughter cards)—12.2(17d)SXB • With Supervisor Engine720-10GE—12.2(33)SXH
Queues per port	• Tx—1p2q2t (per 8 ports) • Rx—1p2t (per 8 ports)
Chassis/slot restrictions	No chassis or slot restrictions; the module can occupy any slot in any Catalyst 6500 or Catalyst 6500-E chassis (all variants).
Bus connection	32-Gbps shared bus (all variants)
Module upgrades available	
PoE support	WS-X6548-GE-TX—Field-upgradeable to Cisco prestandard only by installing the WS-F6K-VPWR-GE= daughter card or both Cisco prestandard and IEEE 802.3af by installing the WS-F6K-GE48-AF= daughter card. **Note** Refer to the *Cisco Catalyst 6500 Series Power over Ethernet Daughter Cards Field-Upgrade Installation Note* for field upgrade procedures.
Distributed forwarding support	Not supported.
Pluggable transceivers support	Not supported.

Table 2-34 WS-X6548-GE-TX Modules Features (continued)

Feature	Description
TDR support	All module variants support TDR.
Module front panel LEDs	**STATUS** • Green—All diagnostics pass; the module is operational. • Orange—The module is booting or running diagnostics. An overtemperature condition has occurred. (A minor temperature threshold has been exceeded during environmental monitoring.) • Red—The module is resetting. The switch has just been powered on or the module has been hot inserted during the normal initialization sequence. An overtemperature condition has occurred. (A major temperature threshold has been exceeded during environmental monitoring.) If the module fails to download code and configuration information successfully during the initial reset, the LED stays red; the module does not come online. **LINK** • Green—The port is active (the link is connected and operational). • Orange—The module or port is disabled through the CLI command or the module is initializing. • Flashing orange—The port is faulty and has been disabled. • Off—The port is not active or the link is not connected. **PHONE** • Green—The PoE daughter card is installed and detected. • Off—The PoE daughter card is not detected or is not installed.

Table 2-35 WS-X6548-GE-TX and Variants Physical and Environmental Specifications

Item	Specification
Dimensions (H x W x D)	1.2 x 14.4 x 16 in. (3.0 x 35.6 x 40.6 cm). Occupies one slot in the chassis.
Weight	Base module—7.2 lb (3.3 kg)
Power and heat numbers	• WS-X6548-GE-TX (base module) – Module current—2.98 A – Module power—125.16 W – AC-input power—156.45 W – AC heat dissipation—534.28 BTU/hour – DC-input power—168.23 W – DC heat dissipation—574.49 BTU/hour • WS-X6548-GE-45AF (base module + PoE daughter card) – Module current—3.16 A – Module power—132.72 W – AC-input power—165.90 W – AC heat dissipation—566.55 BTU/hour – DC-input power—178.39 W – DC heat dissipation—609.19 BTU/hour • WS-X6548V-GE-TX (base module + PoE daughter card) – Module current—3.40 A – Module power—142.80 W – AC-input power—178.50 W – AC heat dissipation—609.58 BTU/hour – DC-input power—191.94 W – DC heat dissipation—655.46 BTU/hour
Environment	
Operating temperature	• Certified for operation: 32° to 104°F (0° to 40°C) • Designed and tested for operation: 32° to 130°F (0° to 55°C)
Humidity (RH) ambient (noncondensing)	10 to 90%
Operating altitude	• Certified for operation: 0 to 6500 ft (0 to 2000 m) • Designed and tested for operation: –200 to 10,000 ft (–60 to 3000 m)

WS-X6548-RJ-21 Ethernet Module

The WS-X6548-RJ-21 Ethernet module provides 48 10/100-Mbps full- or half-duplex ports. (See Figure 2-16.) Table 2-36 lists the features and description of the module, and Table 2-37 lists the physical and environmental specifications for the module.

Figure 2-16 WS-X6548-RJ-21 Ethernet Module Front Panel

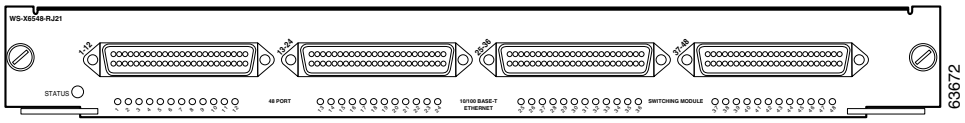


Table 2-36 WS-X6548-RJ-21 Ethernet Module Features

Feature	Description
Ports per module	• 48 ports. Ports are numbered (left to right): – First connector, ports 1–12; second connector, ports 13–24; third connector, ports 25–32; fourth connector, 33–48. • Bottom row, even numbers 2 through 48. • 1 port group • Port ranges per port group: 1–48
Port connector type	RJ-21 (12 ports per connector)
Cabling distance	328 ft (100 m) over Category 5, 5e, and 6 UTP/STP cable
Buffer size	1.116 MB per port
QoS	• Number of egress queues: 4 • Number of ingress queues: 2 • Number of thresholds per egress queue: 1 • Number of thresholds per ingress queue: 0
Maximum frame size	Up to 1518 bytes per frame.
Module oversubscription rate	N/A
Supervisor engine support	• Supervisor Engine 2 • Supervisor Engine 32 • Supervisor Engine 32 PISA • Supervisor Engine 720 • Supervisor Engine 720-10GE
Software support	• With Supervisor Engine 2—12.1(8a)E • With Supervisor Engine 32—12.2(18)SXF • With Supervisor Engine 32 PISA—12.2(18)ZY • With Supervisor Engine 720—12.2(14)SX • With Supervisor Engine 720-10GE—12.2(33)SXH

Table 2-36 WS-X6548-RJ-21 Ethernet Module Features (continued)

Feature	Description
Queues per port	• Tx—1p3q1t • Rx—1p1q0t
Chassis/slot restrictions	No chassis or slot restrictions; the module can occupy any slot in any Catalyst 6500 or Catalyst 6500-E chassis.
Bus connection	32-Gbps shared bus
Module upgrades available	
PoE support	Not available.
Distributed forwarding support	Can be field-upgraded with either the WS-F6K-DFC, WS-F6K-DFC3B, or WS-F6K-DFC3BXL daughter cards. See the *Catalyst 6500 Series DFC, DFC3A, DFC3B, and DFC3BXL Installation Note* for additional information and field upgrade procedures. See Appendix A for additional information on the DFC daughter cards.
Pluggable transceivers support	Not supported.
TDR support	Not supported.
Module front panel LEDs	**STATUS** • Green—All diagnostics pass; the module is operational. • Orange—The module is booting or running diagnostics. An overtemperature condition has occurred. (A minor temperature threshold has been exceeded during environmental monitoring.) • Red—The module is resetting. The switch has just been powered on or the module has been hot inserted during the normal initialization sequence. An overtemperature condition has occurred. (A major temperature threshold has been exceeded during environmental monitoring.) If the module fails to download code and configuration information successfully during the initial reset, the LED stays red; the module does not come online. **LINK** • Green—The port is active (the link is connected and operational). • Orange—The module or port is disabled through the CLI command or the module is initializing[1]. • Flashing orange—The port is faulty and has been disabled. • Off—The port is not active or the link is not connected. **PHONE** • Green—The PoE daughter card is installed and detected. • Off—The PoE daughter card is not detected or is not installed.

1. Verify that all LINK LEDs are functioning.

Table 2-37 WS-X6548-RJ-21 Physical and Environmental Specifications

Item	Specification
Dimensions (H x W x D)	1.2 x 14.4 x 16 in. (3.0 x 35.6 x 40.6 cm). Occupies one slot in the chassis.
Weight	7.6 lb (3.45 kg)
Power and heat numbers	• Base module – Module current—2.90 A – Module power—121.80 W – AC-input power—152.25 W – AC heat dissipation—519.93 BTU/hour – DC-input power—163.71 W – DC heat dissipation—559.07 BTU/hour • Base module + DFC3A daughter card – Module current—5.47 A – Module power—229.74 W – AC-input power—287.18 W – AC heat dissipation—980.70 BTU/hour – DC-input power—308.79 W – DC heat dissipation—1054.52 BTU/hour • Base module + DFC3B daughter card – Module current—4.57 A – Module power—191.94 W – AC-input power—239.93 W – AC heat dissipation—819.34 BTU/hour – DC-input power—257.98 W – DC heat dissipation—881.01 BTU/hour • Base module + DFC3BXL daughter card – Module current—4.37 A – Module power—183.54 W – AC-input power—229.43 W – AC heat dissipation—783.49 BTU/hour – DC-input power—246.69 W – DC heat dissipation—842.46 BTU/hour

Table 2-37 WS-X6548-RJ-21 Physical and Environmental Specifications (continued)

Item	Specification
Environment	
Operating temperature	• Certified for operation: 32° to 104°F (0° to 40°C) • Designed and tested for operation: 32° to 130°F (0° to 55°C)
Humidity (RH) ambient (noncondensing)	10 to 90%
Operating altitude	• Certified for operation: 0 to 6500 ft (0 to 2000 m) • Designed and tested for operation: –200 to 10,000 ft (–60 to 3000 m)

WS-X6548-RJ-45 Ethernet Module

The WS-X6548-RJ-45 Ethernet module provides 48 10/100-Mbps full- or half-duplex ports. (See Figure 2-17.) Table 2-38 lists the features and descriptions of the module, and Table 2-39 lists the physical and environmental specifications for the module.

Figure 2-17 WS-X6548-RJ-45 Switching Module Front Panel

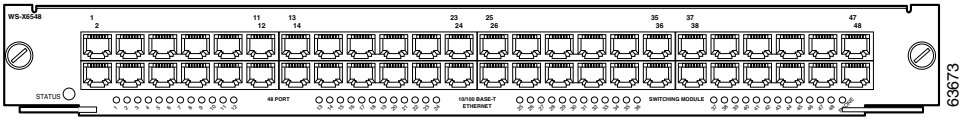


Table 2-38 WS-X6548-RJ-45 Features

Feature	Description
Ports per module	• 48 ports. Ports are numbered (left to right): – Top row, odd numbered ports 1–47. – Bottom row, even numbered ports 2–48. • 1 port group • Port ranges per port group: 1–48
Port connector type	RJ-45
Cabling distance	328 ft (100 m) over Category 5, 5e, and 6 UTP/STP cable
Buffer size	1.116 MB per port
QoS	• Number of egress queues: 4 • Number of ingress queues: 2 • Number of thresholds per egress queue: 1 • Number of thresholds per ingress queue: 0
Maximum frame size	Up to 1518 bytes per frame
Module oversubscription rate	N/A

Table 2-38 WS-X6548-RJ-45 Features (continued)

Feature	Description
Supervisor engine support	Supported on the following supervisor engines: • Supervisor Engine 2 • Supervisor Engine 32 • Supervisor Engine 32 PISA • Supervisor Engine 720 • Supervisor Engine 720-10GE **Note** Check your release notes for specific information on the software release required to support the supervisor engines.
Software support	• With Supervisor Engine 2—12.1(8a)E • With Supervisor Engine 32—12.2(18)SXF • With Supervisor Engine 32 PISA—12.2(18)ZY • With Supervisor Engine 720—12.2(14)SX • With Supervisor Engine 720-10GE—12.2(33)SXH
Queues per port	• Tx—1p3q1t • Rx—1p1q
Chassis/slot restrictions	No chassis or slot restrictions; the module can occupy any slot in any Catalyst 6500 or Catalyst 6500-E chassis.
Bus connection	One 8-Gbps fabric connection and 32-Gbps shared bus
Module upgrades available	
PoE support	Not supported.
Distributed forwarding support	Can be field-upgraded with either the WS-F6K-DFC, WS-F6K-DFC3B, or WS-F6K-DFC3BXL daughter cards. See the *Catalyst 6500 Series DFC, DFC3A, DFC3B, and DFC3BXL Installation Note* for additional information and field upgrade procedures. See Appendix A for additional information on the DFC daughter cards.
Pluggable transceivers support	Not supported.

Table 2-38 WS-X6548-RJ-45 Features (continued)

Feature	Description
TDR support	Not supported.
Module front panel LEDs	**STATUS** • Green—All diagnostics pass; the module is operational. • Orange—The module is booting or running diagnostics. An overtemperature condition has occurred. (A minor temperature threshold has been exceeded during environmental monitoring.) • Red—The module is resetting. The switch has just been powered on or the module has been hot inserted during the normal initialization sequence. An overtemperature condition has occurred. (A major temperature threshold has been exceeded during environmental monitoring.) If the module fails to download code and configuration information successfully during the initial reset, the LED stays red; the module does not come online. **LINK** • Green—The port is active (the link is connected and operational). • Orange—The module or port is disabled through the CLI command or the module is initializing[1]. • Flashing orange—The port is faulty and has been disabled. • Off—The port is not active or the link is not connected. **PHONE** • Green—The PoE daughter card is installed and detected. • Off—The PoE daughter card is not detected or is not installed.

1. Verify that all LINK LEDs are functioning.

Table 2-39 WS-X6548-RJ-45 Physical and Environmental Specifications

Item	Specification
Dimensions (H x W x D)	1.2 x 14.4 x 16 in. (3.0 x 35.6 x 40.6 cm). Occupies one slot in the chassis.
Weight	7.6 lb (3.45 kg)

Table 2-39 WS-X6548-RJ-45 Physical and Environmental Specifications (continued)

Item	Specification
Power and heat numbers	• Base module – Module current—2.90 A – Module power—121.80 W – AC-input power—152.25 W – AC heat dissipation—519.93 BTU/hour – DC-input power—163.71 W – DC heat dissipation—559.07 BTU/hour • Base module + DFC3A daughter card – Module current—5.47 A – Module power—229.74 W – AC-input power—287.18 W – AC heat dissipation—980.70 BTU/hour – DC-input power—308.79 W – DC heat dissipation—1054.52 BTU/hour • Base module + DFC3B daughter card – Module current—4.57 A – Module power—191.94 W – AC-input power—239.93 W – AC heat dissipation—819.34 BTU/hour – DC-input power—257.98 W – DC heat dissipation—881.01 BTU/hour • Base module + DFC3BXL daughter card – Module current—4.37 A – Module power—183.54 W – AC-input power—229.43 W – AC heat dissipation—783.49 BTU/hour – DC-input power—246.69 W – DC heat dissipation—842.46 BTU/hour
Environment	
Operating temperature	• Certified for operation: 32° to 104°F (0° to 40°C) • Designed and tested for operation: 32° to 130°F (0° to 55°C)
Humidity (RH) ambient (noncondensing)	10 to 90%
Operating altitude	• Certified for operation: 0 to 6500 ft (0 to 2000 m) • Designed and tested for operation: –200 to 10,000 ft (–60 to 3000 m)

WS-X6748-GE-TX and WS-X6848-TX-2T/-2TXL Ethernet Modules

The WS-X6748-GE-TX and WS-X6848-TX-2T/-2TXL Ethernet modules provide 48 10/100/1000-Mbps full- or half-duplex ports. (See Figure 2-18.) Table 2-40 lists the modules features, and Table 2-41 lists the modules physical and environmental specifications.

Figure 2-18 WS-X6748-GE-TX and WS-X6848-TX-2T Ethernet Modules Front Panel

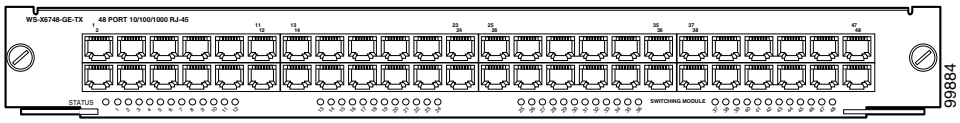


Table 2-40 WS-X6748-GE-TX and WS-X6848-TX-2T/-2TXL Ethernet Module Features

Feature	Description
Ports per module	• 48 ports. Ports are numbered (left to right): – Top row, odd numbered ports 1 through 47. – Bottom row, even numbered ports 2 through 48. • 4 port groups • Port ranges per port group: 1–12, 13–24, 25–36, 37–48
Port connector type	RJ-45
Cabling distance	328 ft (100 m) over Category 5, 5e, and 6 UTP/STP cable
Buffer size	1.3 MB per port
QoS	• Number of egress queues: 4 • Number of ingress queues: 1 (2 if DFC3x is present) • Number of thresholds per egress queue: 1 or 2 • Number of thresholds per ingress queue: 8
Maximum frame size	Up to 9216 bytes per frame
Module oversubscription rate	1.2:1
Supervisor engine support	• WS-X6748-GE-TX – Supervisor Engine 720 – Supervisor Engine 720-10GE – Supervisor Engine 2T-10GE • WS-X6848-TX-2T/-2TXL – Supervisor Engine 2T-10GE **Note** WS-X6748-GE-TX modules that have a CFC daughter card or are upgraded with DFC4-A or DFC4-AXL daughter cards are supported only on the Supervisor Engine 2T.

Table 2-40 WS-X6748-GE-TX and WS-X6848-TX-2T/-2TXL Ethernet Module Features (continued)

Feature	Description
Software support	• WS-X6748-GE-TX – With Supervisor Engine 720—12.2(17a)SX – With Supervisor Engine 720-10GE—12.2(33)SXH • WS-6848-TX-2T/-2TXL – With Supervisor Engine 2T-10GE—12.2(50)SY
Queues per port	• With CFC daughter card: – Tx—1p3q8t – Rx—1q8t • With DFC daughter card: – Tx—1p3q8t – Rx—2q8t
Chassis/slot restrictions	• The WS-X6748-GE-TX is not supported in the Catalyst 6503 switch chassis. The WS-X6748-GE-TX module can occupy any slot in any other Catalyst 6500 or Catalyst 6500-E chassis except the Catalyst 6513 chassis where the module must be installed in slots 9–13. The module does not power up when it is installed in slots 1–8. • The WS-X6848-TX-2T/-2TXL operates only in a Catalyst 6500 E-series chassis equipped with a Supervisor Engine 2T-10GE
Fabric connection	• Dual switch-fabric connections: – Fabric channel 1: Ports 25–48 – Fabric channel 2: Ports 1–24
Fabric channel speed	20 Gb/sec
Module upgrades available	
PoE support	Not supported.
Distributed forwarding support	• WS-X6748-GE-TX ships with the WS-F6700-CFC daughter card factory-installed. The module can be upgraded in the field to support the WS-F6700-DFC3A, WS-F6700-DFC3B, WS-F6700-DFC3BXL, WS-F6700-DFC3C, WS-F6700-DFC3CXL, WS-F6K-DFC4-A, or the WS-F6K-DFC4-AXL daughter cards. • WS-X6848-TX-2T/-2TXL supports either the DFC4-A or the DFC4-AXL daughter card. **Note** Refer to the *Catalyst 6500 Series CFC, DFC3A, DFC3B, and DFC3BXL Installation Note* or the *Catalyst 6500 Series Distributed Forwarding Card 4 for WS-X68xx Modules Installation Note* for additional information and field upgrade procedures. See Appendix A for additional information on the DFC daughter cards.

Table 2-40 WS-X6748-GE-TX and WS-X6848-TX-2T/-2TXL Ethernet Module Features (continued)

Feature	Description
Pluggable transceivers support	Not supported.
TDR support	Supported.
Module front panel LEDs	**STATUS** • Green—All diagnostics pass; the module is operational. • Orange—The module is booting or running diagnostics. An overtemperature condition has occurred. (A minor temperature threshold has been exceeded during environmental monitoring.) • Red—The module is resetting. The switch has just been powered on or the module has been hot inserted during the normal initialization sequence. An overtemperature condition has occurred. (A major temperature threshold has been exceeded during environmental monitoring.) If the module fails to download code and configuration information successfully during the initial reset, the LED stays red; the module does not come online. **LINK** Green—The port is active (the link is connected and operational). Orange—The module or port is disabled through the CLI command or the module is initializing[1]. Flashing orange—The port is faulty and has been disabled. Off—The port is not active or the link is not connected. **PHONE** Green—The PoE daughter card is installed and detected. Off—The PoE daughter card is not detected or is not installed.

1. Verify that all LINK LEDs are functioning.

Table 2-41 WS-X6748-GE-TX and WS-X6848-TX-2T/-2TXL Physical and Environmental Specifications

Item	Specification
Dimensions (H x W x D)	1.2 x 14.4 x 16 in. (3.0 x 35.6 x 40.6 cm). Occupies one slot in the chassis.
Weight	Base module + CFC daughter card (WS-F6700-CFC)—10.2 lb (4.63 kg)
Power and heat numbers	• Base module + WS-F6700-CFC daughter card – Module current—7.75 A – Module power—325.50 W – AC-input power—406.88 W – AC heat dissipation—1389.48 BTU/hour – DC-input power—437.50 W – DC heat dissipation—1494.06 BTU/hour • Base module + WS-F6700-DFC3A daughter card – Module current—10.00 A – Module power—420.00 W – AC-input power—525.00 W – AC heat dissipation—1792.88 BTU/hour – DC-input power—564.52 W – DC heat dissipation—1927.82 BTU/hour • Base module + WS-F6700-DFC3B daughter card – Module current—9.70 A – Module power—407.40 W – AC-input power—509.25 W – AC heat dissipation—1739.09 BTU/hour – DC-input power—547.58 W – DC heat dissipation—1869.99 BTU/hour

Table 2-41 WS-X6748-GE-TX and WS-X6848-TX-2T/-2TXL Physical and Environmental Specifications (continued)

Item	Specification
Power and heat numbers (continued)	• Base module + WS-F6700-DFC3BXL daughter card – Module current—10.30 A – Module power—363.30 W – AC-input power—454.13 W – AC heat dissipation—1550.84 BTU/hour – DC-input power—488.31 W – DC heat dissipation—1667.57 BTU/hour • Base module + WS-F6700-DFC3C daughter card – Module current—8.65 A – Module power—363.30 W – AC-input power—454.13 W – AC heat dissipation—1550.84 BTU/hour – DC-input power—488.31 W – DC heat dissipation—1667.57 BTU/hour • Base module + WS-F6700-DFC3CXL daughter card – Module current—9.35 A – Module power—392.70 W – AC-input power—490.88 W – AC heat dissipation—1676.34 BTU/hour – DC-input power—527.82 W – DC heat dissipation—1802.51 BTU/hour • WS-X6848-TX-2T + WS-F6K-DFC4-A daughter card – Module current—9.64 A – Module power—404.88 W – AC-input power—506.10 W – AC heat dissipation—1728.33 BTU/hour – DC-input power—544.19 W – DC heat dissipation—1858.42 BTU/hour • WS-X6848-TX-2TXL + WS-F6K-DFC4-AXL daughter card – Module current—9.76 A – Module power—409.92 W – AC-input power—512.40 W – AC heat dissipation—1749.85 BTU/hour – DC-input power—550.97 W – DC heat dissipation—1881.55 BTU/hour

Table 2-41 WS-X6748-GE-TX and WS-X6848-TX-2T/-2TXL Physical and Environmental Specifications (continued)

Item	Specification
Environment	
Operating temperature	• Certified for operation: 32° to 104°F (0° to 40°C) • Designed and tested for operation: 32° to 130°F (0° to 55°C)
Humidity (RH) ambient (noncondensing)	10 to 90%
Operating altitude	• Certified for operation: 0 to 6500 ft (0 to 2000 m) • Designed and tested for operation: –200 to 10,000 ft (–60 to 3000 m)

1-Gigabit Ethernet Modules

This section describes the following 1-Gigabit Ethernet modules:

Note 1-Gigabit Ethernet modules are hot swappable.

WS-X6408A-GBIC

The WS-X6408A-GBIC Ethernet module provides 8 1-Gbps full- or half-duplex ports. (See Figure 2-19.) Table 2-42 lists the features and descriptions for the module, and Table 2-43 lists the physical and environmental specifications for the module.

Figure 2-19 WS-X6408A-GBIC Ethernet Module Front Panel

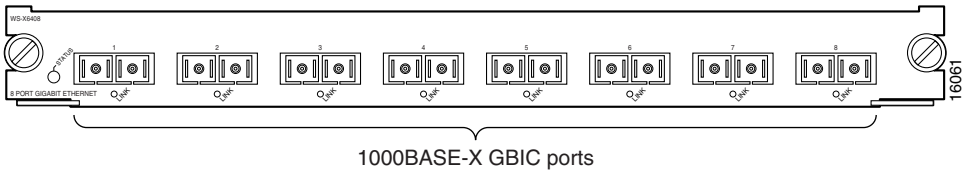


Table 2-42 WS-X6408A-GBIC Ethernet Module Features

Feature	Description
Ports per module	• 8 ports. Ports are numbered from 1 (left) to 8 (right). • 1 port group • Port ranges per port group: 1–8
Port connector type	SC or RJ-45 depending on the GBIC transceiver installed in the module port
Cabling distance	Depends on the GBIC transceiver installed in the module port. Refer to Appendix B for descriptions of the GBIC transceiver types and supported cabling distances.
Buffer size	512 KB per port
QoS	• Number of egress queues: 3 • Number of ingress queues: 2 • Number of thresholds per egress queue: 2 • Number of thresholds per ingress queue: 4

Table 2-42 WS-X6408A-GBIC Ethernet Module Features (continued)

Feature	Description
Maximum frame size	Up to 9216 bytes per frame
Module oversubscription rate	N/A
Supervisor engine support	Supported on the following supervisor engines: • Supervisor Engine 2 • Supervisor Engine 32 • Supervisor Engine 32 PISA • Supervisor Engine 720 • Supervisor Engine 720-10GE
Software support	• With Supervisor Engine 2—12.2(17d)SXB • With Supervisor Engine 32—12.2(18)SXF • With Supervisor Engine 32 PISA—12.2(18)ZY • With Supervisor Engine 720—12.2(14)SX • With Supervisor Engine 720-10GE—12.2(33)SXH • Catalyst OS support—6.4(11)
Queues per port	• Tx—1p2q2t • Rx—1p1q4t
Chassis/slot restrictions	No chassis or slot restrictions; the module can occupy any slot in any Catalyst 6500 or Catalyst 6500-E chassis.
Bus connection	32 Gbps shared bus
Module upgrades available	
PoE support	Not supported.
Distributed forwarding support	Not supported.
Pluggable transceivers support	GBIC transceivers are supported. Refer to your software release notes to determine which GBIC transceivers are supported. See the "1-GB Transceivers" section on page B-3 in Appendix B for additional information on the GBIC transceivers.

Table 2-42 WS-X6408A-GBIC Ethernet Module Features (continued)

Feature	Description
TDR support	Not supported.
Module front panel LEDs	**STATUS** • Green—All diagnostics pass; the module is operational. • Orange—The module is booting or running diagnostics; an overtemperature condition has occurred. **LINK** • Green—The port is active (the link is connected and operational). • Flashing orange—The port failed diagnostics and is disabled. • Orange—The port is disabled. • Red—The module is resetting; an overtemperature condition has occurred. **Note** If the module fails to download code and configuration information successfully during the initial reset, the LED stays red; the module does not come online. • Off—The port is not active or the link is not connected.

Table 2-43 WS-X6408A-GBIC Physical and Environmental Specifications

Item	Specification
Dimensions (H x W x D)	1.2 x 14.4 x 16 in. (3.0 x 35.6 x 40.6 cm). Occupies one slot in the chassis.
Weight	6.4 lb (2.9 kg)
Power and heat numbers	• Module current—2.00 A • Module power—84.00 W • AC-input power—105.00 W • AC heat dissipation—358.58 BTU/hour • DC-input power—112.90 W • DC heat dissipation—385.56 BTU/hour
Environment	
Operating temperature	• Certified for operation: 32° to 104°F (0° to 40°C) • Designed and tested for operation: 32° to 130°F (0° to 55°C)
Humidity (RH) ambient (noncondensing)	10 to 90%
Operating altitude	• Certified for operation: 0 to 6500 ft (0 to 2000 m) • Designed and tested for operation: –200 to 10,000 ft (–60 to 3000 m)

WS-X6416-GBIC

The WS-X6416-GBIC Ethernet module provides 16 1-Gbps full- or half-duplex ports. (See Figure 2-20.) Table 2-44 lists the module features, and Table 2-45 lists the module physical and environmental specifications.

Figure 2-20 WS-X6416-GBIC Ethernet Module Front Panel

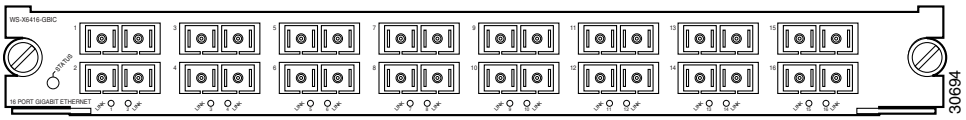


Table 2-44 WS-X6416-GBIC Features

Feature	Description
Ports per module	• 16 ports. Ports are numbered (left to right): – Top row, odd numbered ports 1–15. – Bottom row, even numbered ports 2–16. • 2 port groups • Port ranges per port group: 1–8, 9–16
Port connector type	SC or RJ-45 depending on the type of GBIC transceiver installed
Cabling distance	Depends on the GBIC transceiver installed in the module port. Refer to Appendix B for descriptions of the GBIC transceiver types and supported cabling distances.
Speed	1 Gbps
Buffer size	512 KB per port
QoS	• Number of egress queues: 3 • Number of ingress queues: 2 • Number of thresholds per egress queue: 2 • Number of thresholds per ingress queue: 4
Maximum frame size	Up to 9216 bytes per frame
Module oversubscription rate	N/A
Supervisor engine support	• Supervisor Engine 2 • Supervisor Engine 32 • Supervisor Engine 32 PISA • Supervisor Engine 720 • Supervisor Engine 720-10GE

Table 2-44 WS-X6416-GBIC Features (continued)

Feature	Description
Software support	• With Supervisor Engine 2—12.1(2)E • With CWDM-GBIC and WS-G5483 GBIC transceiver support—12.1(13)E • With DWDM-GBIC transceiver support—12.1(20)E2 • With Supervisor Engine 32—12.2(18)SXF • With Supervisor Engine 32 PISA—12.2(18)ZY • With Supervisor Engine 720—12.2(14)SX • With Supervisor Engine 720-10GE—12.2(33)SXH
Queues per port	• Tx—1p2q2t • Rx—1p1q4t
Chassis/slot restrictions	No chassis or slot restrictions; the module can occupy any slot in any Catalyst 6500 or Catalyst 6500-E chassis.
Bus connection	32-Gbps shared bus
Forwarding architecture	Cisco Express Forwarding (CEF)
Module upgrades available	
PoE support	Not supported.
Distributed forwarding support	Not supported.
Pluggable transceivers support	GBIC transceivers are supported. Refer to your software release notes to determine which GBIC transceivers are supported. See the "1-GB Transceivers" section on page B-3 in Appendix B for additional information on the GBIC transceivers.

Table 2-44 WS-X6416-GBIC Features (continued)

Feature	Description
Digital Optical Monitoring (DOM) support	Supported on some GBIC transceivers **Note** Refer to your software release notes for specific information on which GBIC transceivers support DOM and the software release required for support.
Module front panel LEDs	**STATUS** • Green—All diagnostics pass; the module is operational. • Orange—The module is booting or running diagnostics; an overtemperature condition has occurred. **LINK** • Green—The port is active (the link is connected and operational). • Flashing orange—The port failed diagnostics and is disabled. • Orange—The port is disabled. • Red—The module is resetting; an overtemperature condition has occurred. **Note** If the module fails to download code and configuration information successfully during the initial reset, the LED stays red; the module does not come online. • Off—The port is not active or the link is not connected.

Table 2-45 WS-X6416-GBIC Ethernet Module Physical and Environmental Specifications

Item	Specification
Dimensions (H x W x D)	1.2 x 14.4 x 16 in. (3.0 x 35.6 x 40.6 cm). Occupies one slot in the chassis.
Weight	7.0 lb (3.17 kg)
Power and heat numbers	• Module current—2.81 A • Module power—118.02 W • AC-input power—147.53 W • AC heat dissipation—503.80 BTU/hour • DC-input power—158.63 W • DC heat dissipation—541.72 BTU/hour
Environment	
Operating temperature	• Certified for operation: 32° to 104°F (0° to 40°C) • Designed and tested for operation: 32° to 130°F (0° to 55°C)
Humidity (RH) ambient (noncondensing)	10 to 90%
Operating altitude	• Certified for operation: 0 to 6500 ft (0 to 2000 m) • Designed and tested for operation: –200 to 10,000 ft (–60 to 3000 m)

WS-X6516-GBIC and WS-X6516A-GBIC

The WS-X6516-GBIC and the WS-X6516A-GBIC Ethernet modules (Figure 2-21) provide 16 1-Gbps full- or half-duplex ports. Table 2-46 lists the module features, and Table 2-47 lists the module physical and environmental specifications.

Figure 2-21 WS-X6516-GBIC and WS-X6516A-GBIC Ethernet Modules Front Panel

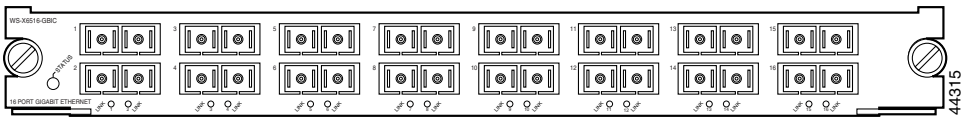


Table 2-46 WS-X6516-GBIC and WS-X6516A-GBIC Features

Feature	Description
Ports per module	• 16 ports. Ports are numbered (left to right): – Top row, odd numbered ports 1–15. – Bottom row, even numbered ports 2–16. • 2 port groups • Port ranges per port group: 1–8, 9–16
Port connector type	SC or RJ-45 depending on the type of GBIC transceiver installed in the module port
Cabling distance	Depends on the GBIC transceiver installed in the module port. Refer to Appendix B for descriptions of the GBIC transceiver types and supported cabling distances.
Speed	1 Gbps
Buffer size	• 512 KB per port—WS-X6516-GBIC • 1 MB per port—WS-X6516A-GBIC
QoS	• Number of egress queues: 3 • Number of ingress queues: 2 • Number of thresholds per egress queue: 2 • Number of thresholds per ingress queue: 4
Maximum frame size	Up to 9216 bytes per frame (both modules)
Module oversubscription rate	2:1
Supervisor engine support	Supported on the following supervisor engines: • Supervisor Engine 2 • Supervisor Engine 32 • Supervisor Engine 32 PISA • Supervisor Engine 720 • Supervisor Engine 720-10GE

Table 2-46 WS-X6516-GBIC and WS-X6516A-GBIC Features (continued)

Feature	Description
Software support	• With Supervisor Engine 2—12.1(18a)E, WS-X6516-GBIC; 12.1(19)E1, WS-X6516A-GBIC • With Supervisor Engine 32—12.2(18)SXF • With Supervisor Engine 32 PISA—12.2(18)ZY • With Supervisor Engine 720—12.2(14)SX • With Supervisor Engine 720-10GE—12.2(33)SXH
Queues per port	Both modules: • Tx—1p2q2t • Rx—1p1q4t
Chassis/slot restrictions	No chassis or slot restrictions; the module can occupy any slot in any Catalyst 6500 or Catalyst 6500-E chassis.
Bus connection	32-Gbps shared bus
Module upgrades available	
PoE support	Not supported.
Distributed forwarding support	Can be field-upgraded with either the WS-F6K-DFC, WS-F6K-DFC3B, or WS-F6K-DFC3BXL daughter cards. Refer to the *Catalyst 6500 Series DFC, DFC3A, DFC3B, and DFC3BXL Installation Note* for additional information and field upgrade procedures.
Pluggable transceivers support	GBIC transceivers are supported. Refer to your software release notes to determine which GBIC transceivers are supported. See the "1-GB Transceivers" section on page B-3 in Appendix B for additional information on the GBIC transceivers.

Table 2-46 WS-X6516-GBIC and WS-X6516A-GBIC Features (continued)

Feature	Description
Digital Optical Monitoring (DOM) support	Supported on some GBIC transceivers. **Note** Refer to your software release notes for specific information on which GBIC transceivers support DOM and the software release required for support.
Module front panel LEDs	**STATUS** • Green—All diagnostics pass; the module is operational. • Orange—The module is booting or running diagnostics; an overtemperature condition has occurred. **LINK** • Green—The port is active (the link is connected and operational). • Flashing orange—The port failed diagnostics and is disabled. • Orange—The port is disabled. • Red—The module is resetting; an overtemperature condition has occurred. **Note** If the module fails to download code and configuration information successfully during the initial reset, the LED stays red; the module does not come online. • Off—The port is not active or the link is not connected.

Table 2-47 WS-X6516-GBIC and WS-X6516A-GBIC Physical and Environmental Specifications

Item	Specification
Dimensions (H x W x D)	1.2 x 14.4 x 16 in. (3.0 x 35.6 x 40.6 cm). Occupies one slot in the chassis.
Weight	8.6 lb (3.9 kg)

Table 2-47 WS-X6516-GBIC and WS-X6516A-GBIC Physical and Environmental Specifications (continued)

Item	Specification
Power and heat numbers	• WS-X6516-GBIC (base module) – Module current—3.40 A – Module power—142.80 W – AC-input power—178.50 W – AC heat dissipation—609.58 BTU/hour – DC-input power—191.94 W – DC heat dissipation—655.46 BTU/hour • Base module + DFC3A daughter card (WS-F6K-DFC3A) – Module current—5.97 A – Module power—250.74 W – AC-input power—313.43 W – AC heat dissipation—1070.35 BTU/hour – DC-input power—337.02 W – DC heat dissipation—1150.91 BTU/hour • Base module + DFC3B daughter card (WS-F6K-DFC3B) – Module current—5.07 A – Module power—212.94 W – AC-input power—266.18 W – AC heat dissipation—908.99 BTU/hour – DC-input power—286.21 W – DC heat dissipation—977.41 BTU/hour • Base module + DFC3BXL daughter card (WS-F6K-DFC3BXL) – Module current—4.87 A – Module power—204.54 W – AC-input power—255.68 W – AC heat dissipation—873.13 BTU/hour – DC-input power—274.92 W – DC heat dissipation—938.85 BTU/hour

Table 2-47 WS-X6516-GBIC and WS-X6516A-GBIC Physical and Environmental Specifications (continued)

Item	Specification
Power and heat numbers (continued)	• WS-X6516A-GBIC (enhanced base module) – Module current—3.62 A – Module power—152.04 W – AC-input power—190.05 W – AC heat dissipation—649.02 BTU/hour – DC-input power—204.35 W – DC heat dissipation—697.87 BTU/hour • Base module + DFC3A daughter card (WS-F6K-DFC3A) – Module current—6.19 A – Module power—259.98 W – AC-input power—324.98 W – AC heat dissipation—1109.79 BTU/hour – DC-input power—349.44 W – DC heat dissipation—1193.32 BTU/hour • Base module + DFC3B daughter card (WS-F6K-DFC3B) – Module current—5.29 A – Module power—222.18 W – AC-input power—277.73 W – AC heat dissipation—948.43 BTU/hour – DC-input power—298.63 W – DC heat dissipation—1019.82 BTU/hour • Base module + DFC3BXL daughter card (WS-F6K-DFC3BXL) – Module current—5.09 A – Module power—213.78 W – AC-input power—267.23 W – AC heat dissipation—912.57 BTU/hour – DC-input power—287.34 W – DC heat dissipation—981.26 BTU/hour
Environment	
Operating temperature	• Certified for operation: 32° to 104°F (0° to 40°C) • Designed and tested for operation: 32° to 130°F (0° to 55°C)
Humidity (RH) ambient (noncondensing)	10 to 90%
Operating altitude	• Certified for operation: 0 to 6500 ft (0 to 2000 m) • Designed and tested for operation: –200 to 10,000 ft (–60 to 3000 m)

WS-X6724-SFP and WS-X6824-SFP-2T/-2TXL

The WS-X6724-SFP and the WS-X6824-SFP-2T/-2TXL Ethernet modules (Figure 2-22) provide 24 1-Gbps full- or half-duplex ports. Table 2-48 lists the module features, and Table 2-49 lists the module physical and environmental specifications.

Note A sticker is placed on the module faceplate identifying it as either a WS-X6824-SFP-2T or WS-X6824-SFP-2TXL depending on whether a WS-F6K-DFC4-A or WS-F6K-DFC4-AXL daughter card is installed on the module.

Figure 2-22 WS-X6724-SFP and WS-X6824-SFP-2T/-2TXL Ethernet Module Front Panel

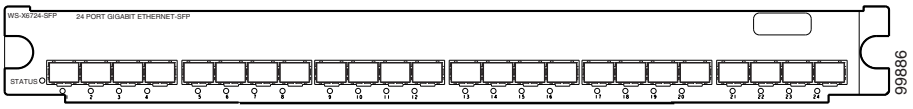


Table 2-48 WS-X6724-SFP and WS-X6824-SFP-2T/-2TXL Ethernet Module Features

Feature	Description
Ports per module	• 24 ports. Ports are numbered 1 (left) to 24 (right). • 2 port groups • Port ranges per port group: 1–12, 13–24
Port connector type	LC (optical) or RJ-45 (copper) depending on the SFP transceiver installed.
Cabling distance	Depends on the SFP transceiver installed in the module port. Refer to the transceiver installation notes at the following URL: http://www.cisco.com/en/US/products/hw/modules/ps5455/prod_installation_guides_list.html
Buffer size	• Rx—166 kB per port • Tx—1.17 MB per port
QoS	• Number of egress queues: 4 • Number of ingress queues: 1 (2 if DFC3x daughter card is present.) • Number of thresholds per egress queue: 1 or 2 • Number of thresholds per ingress queue: 8
Maximum frame size	Up to 9216 bytes per frame
Module oversubscription rate	1.2:1

Table 2-48 WS-X6724-SFP and WS-X6824-SFP-2T/-2TXL Ethernet Module Features (continued)

Feature	Description
Supervisor engine support	• WS-X6724-SFP – Supervisor Engine 720 – Supervisor Engine 720-10GE – Supervisor Engine 2T (The WS-X6724-SFP must be equipped with either a CFC, DFC4 or DFC4XL daughter card) • WS-X6824-SFP-2T/-2TXL – Supervisor Engine 2T-10GE **Note** WS-X6724-SFP modules that are equipped with a CFC daughter card are supported on the Supervisor Engine 2T. WS-X6724-SFP modules that are upgraded with DFC4-A or DFC4-AXL daughter cards are supported only on the Supervisor Engine 2T-10GE
Software support	• WS-X6724-SFP – With Supervisor Engine 720—12.2(17a)SX – With Supervisor Engine 720 and DFC3C or DFC3CXL—12.2(33)SXH – With Supervisor Engine 720-10GE—12.2(33)SXH – With Supervisor Engine 2T (module equipped with either CFC or DFC4—12.2(50)SY • WS-X6824-SFP-2T/-2TXL – With Supervisor Engine 2T-10GE—12.2(50)SY
Queues per port	• With CFC daughter card: – Tx—1p3q8t – Rx—1q8t • With DFC daughter card: – Tx—1p3q8t – Rx—2q8t
Chassis/slot restrictions	• The WS-X6724-SFP module is not supported in the Catalyst 6503 chassis. • The WS-X6724-SFP when equipped with either a CFC, or DFC4 daughter card is supported by the Supervisor Engine 2T. • The WS-X6824-SFP-2T/-2TXL is support only in Catalyst 6500 E-series chassis equipped with Supervisor Engine 2T. • Requires that modules be installed in adjacent slots or, if either adjacent slot is unused, you must install a switching-module filler plate (Cisco part numbers WS-X6K-SLOT-CVR-E or SLOTBLANK-09) rather than a blank slot cover (WS-X6K-SLOT-CVR) to maintain an adequate air flow through the chassis.
Fabric connection	Single fabric channel.

Table 2-48 WS-X6724-SFP and WS-X6824-SFP-2T/-2TXL Ethernet Module Features (continued)

Feature	Description
Fabric channel speed	20 Gb/sec
Module upgrades available	
PoE support	Not supported.
Distributed forwarding support	• WS-X6724-SFP ships with the WS-F6700-CFC daughter card factory-installed. The module can be upgraded in the field to support the WS-F6700-DFC3A, WS-F6700-DFC3B, WS-F6700-DFC3BXL, WS-F6700-DFC3C, WS-F6700-DFC3CXL, WS-F6K-DFC4-A, or the WS-F6K-DFC4-AXL daughter cards. • WS-X6824-SFP-2T ships with the DFC4-A installed and the WS-X6824-SFP-2TXL ships with the DFC4-AXL daughter card installed. **Note** Refer to the *Catalyst 6500 Series CFC, DFC3A, DFC3B, and DFC3BXL Installation Note* or the *Catalyst 6500 Series Distributed Forwarding Card 4 for WS-X68xx Modules Installation Note* for additional information and field upgrade procedures.
Pluggable transceivers support	SFP transceivers are supported. Refer to your software release notes to determine which SFP transceivers are supported. See the "1-GB Transceivers" section on page B-3 in Appendix B for additional information on the SFP transceivers.
Digital Optical Monitoring (DOM) supported	Not supported.
Module front panel LEDs	**STATUS** • Green—All diagnostics pass; the module is operational. • Orange—The module is booting or running diagnostics; an overtemperature condition has occurred. **LINK** • Green—The port is active (the link is connected and operational). • Flashing orange—The port failed diagnostics and is disabled. • Orange—The port is disabled. • Red—The module is resetting; an overtemperature condition has occurred. **Note** If the module fails to download code and configuration information successfully during the initial reset, the LED stays red; the module does not come online. • Off—The port is not active or the link is not connected.

Table 2-49 WS-X6724-SFP and WS-X6824-SFP-2T/-2TXL Ethernet Modules Physical and Environmental Specifications

Item	Specification
Dimensions (H x W x D)	1.2 x 14.4 x 16 in. (3.0 x 35.6 x 40.6 cm). Occupies one slot in the chassis.
Weight	Base module—8.8 lb (4.0 kg) Base module + DFC daughter card—9.4 lb (4.3 kg)
Power and heat numbers	• Base module + CFC daughter card (WS-F6700-CFC) – Module current—2.98 A – Module power—125.16 W – AC-input power—156.45 W – AC heat dissipation—534.28 BTU/hour – DC-input power—168.23 W – DC heat dissipation—574.49 BTU/hour • Base module + DFC3A daughter card (WS-F6700-DFC3A) – Module current—5.23 A – Module power—219.66 W – AC-input power—274.58 W – AC heat dissipation—937.67 BTU/hour – DC-input power—295.24 W – DC heat dissipation—1008.25 BTU/hour • Base module + DFC3B daughter card (WS-F6700-DFC3B) – Module current—4.93 A – Module power—207.06 W – AC-input power—258.83 W – AC heat dissipation—883.89 BTU/hour – DC-input power—278.31 W – DC heat dissipation—950.42 BTU/hour

Table 2-49 WS-X6724-SFP and WS-X6824-SFP-2T/-2TXL Ethernet Modules Physical and Environmental Specifications

Item	Specification
Power and heat numbers (continued)	• Base module + DFC3BXL daughter card (WS-F6700-DFC3BXL) – Module current—5.53 A – Module power—232.26 W – AC-input power—290.33 W – AC heat dissipation—991.46 BTU/hour – DC-input power—312.18 W – DC heat dissipation—1066.09 BTU/hour • Base module + DFC3C daughter card (WS-F6700-DFC3C) – Module current—3.88 A – Module power—162.96 W – AC-input power—203.70 W – AC heat dissipation—695.64 BTU/hour – DC-input power—219.03 W – DC heat dissipation—748.00 BTU/hour • Base module + DFC3CXL daughter card (WS-F6700-DFC3CXL) – Module current—4.58 A – Module power—192.36 W – AC-input power—240.45 W – AC heat dissipation—821.14 BTU/hour – DC-input power—258.55 W – DC heat dissipation—882.94 BTU/hour • WS-X6824-SFP-2T + DFC4-A daughter card – Module current—4.87 A – Module power—204.66 W – AC-input power—255.68 W – AC heat dissipation—873.13 BTU/hour – DC-input power—274.92 W – DC heat dissipation—938.85 BTU/hour • WS-X6824-SFP-2TXL + DFC4-AXL daughter card – Module current—4.99 A – Module power—209.66 W – AC-input power—261.98 W – AC heat dissipation— 894.64BTU/hour – DC-input power—281.69 W – DC heat dissipation—961.98 BTU/hour

Table 2-49 WS-X6724-SFP and WS-X6824-SFP-2T/-2TXL Ethernet Modules Physical and Environmental Specifications

Item	Specification
Environment	
Operating temperature	• Certified for operation: 32° to 104°F (0° to 40°C) • Designed and tested for operation: 32° to 130°F (0° to 55°C)
Humidity (RH) ambient (noncondensing)	10 to 90%
Operating altitude	• Certified for operation: 0 to 6500 ft (0 to 2000 m) • Designed and tested for operation: –200 to 10,000 ft (–60 to 3000 m)

WS-X6748-SFP and WS-X6848-SFP-2T/-2TXL

The WS-X6748-SFP and WS-X6848-SFP-2T/-2TXL Ethernet modules (Figure 2-23) provide 48 1-Gbps full- or half-duplex ports. Table 2-50 lists the module features, and Table 2-50 lists the module physical and environmental specifications.

Note A sticker is placed on the module faceplate identifying it as either a WS-X6848-SFP-2T or WS-X6848-SFP-2TXL depending on whether a WS-F6K-DFC4-A or WS-F6K-DFC4-AXL daughter card is installed on the module.

Figure 2-23 WS-X6748-SFP and WS-X6848-SFP-2T/-2TXL Switching Module Front Panel

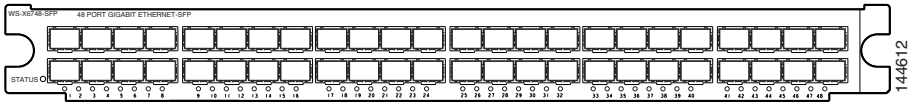


Table 2-50 WS-X6748-SFP and WS-X6848-SFP-2T/-2TXL Features

Feature	Description
Ports per module	• 48 ports. Ports are numbered (left to right): – Top row, odd numbered ports 1–47. – Bottom row, even numbered ports 2–48. • 4 port groups • Port ranges per port group: – 1, 3, 5, 7, 9, 11, 13, 15, 17, 19, 21, 23 – 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24 – 25, 27, 29, 31, 33, 35, 37, 39, 41, 43, 45, 47 – 26, 28, 30, 32, 34, 36, 38, 40, 42, 44, 46, 48
Port connector type	LC (optical) or RJ-45 (copper) depending on the type of SFP transceiver installed in the port.

Table 2-50 WS-X6748-SFP and WS-X6848-SFP-2T/-2TXL Features (continued)

Feature	Description
Cabling distance	Depends on the SFP transceiver installed in the module port. For SFP transceivers currently supported, refer to the compatibility matrices at the following URL: http://www.cisco.com/en/US/products/hw/modules/ps5455/products_device_support_tables_list.html For cabling distance information, refer to the transceiver installation guides at the following URL: http://www.cisco.com/en/US/products/hw/modules/ps5455/prod_installation_guides_list.html
Buffer size	Rx—166 kB per port Tx—1.17 MB per port
Maximum frame size	Up to 9216 bytes per frame
Module oversubscription rate	1.2:1
Supervisor engine support	• WS-X6748-SFP – Supervisor Engine 720 – Supervisor Engine 720-10GE – Supervisor Engine 2T (the module must be equipped with either a CFC daughter card, or a DFC4-A or DFC4-AXL daughter card. • WS-X6848-SFP-2T/-2TXL – Supervisor Engine 2T-10GE **Note** WS-X6748-SFP modules that are upgraded with DFC4-A or DFC4-AXL daughter cards are supported only on the Supervisor Engine 2T-10GE
Software support	• WS-X6748-SFP – With Supervisor Engine 720—12.2(17d)SXB – With Supervisor Engine 720 and DFC3C or DFC3CXL—12.2(33)SXH – With Supervisor Engine 720-10GE—12.2(33)SXH • WS-X6848-SFP-2T/-2TXL – With Supervisor Engine 2T-10GE—12.2(50)SY
Queues per port	• With CFC daughter card: – Tx—1p3q8t – Rx—1q8t • With DFC daughter card: – Tx—1p3q8t – Rx—2q8t

Table 2-50 WS-X6748-SFP and WS-X6848-SFP-2T/-2TXL Features (continued)

Feature	Description
Chassis/slot restrictions	• The module is not supported in the Catalyst 6503 switch chassis. • The WS-X6748-SFP module can occupy any slot in any other Catalyst 6500 or Catalyst 6500-E chassis with the exception of the Catalyst 6513 chassis where the module must be installed only in slots 9–13. The module will not power up if it is installed in slots 1–8. • The WS-X6848-SFP-2T/-2TXL operates only in a Catalyst 6500 E-series chassis equipped with a Supervisor Engine 2T-10GE • Requires that modules be installed in adjacent slots or, if either adjacent slot is unused, you must install a switching-module filler plate (Cisco part numbers WS-X6K-SLOT-CVR-E or SLOTBLANK-09) rather than a blank slot cover (WS-X6K-SLOT-CVR) to maintain an adequate air flow through the chassis.
Fabric connection	• Dual switch-fabric connections: – Fabric channel 1—Ports 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, 30, 32, 34, 36, 38, 40, 42, 44, 46, 48 – Fabric channel 2—Ports 1, 3, 5, 7, 9, 11, 13, 15, 17, 19, 21, 23, 25, 27, 29, 31, 33, 35, 37, 39, 41, 43, 45, 47

Table 2-50 WS-X6748-SFP and WS-X6848-SFP-2T/-2TXL Features (continued)

Feature	Description
Fabric channel speed	20 Gb/sec (dual channel, 40 Gb/sec total)
Module upgrades available	
PoE support	Not supported.
Distributed forwarding support	• The WS-X6748-SFP module ships with the WS-F6700-CFC daughter card factory-installed. The module can be upgraded in the field to support dCEF with the installation of a WS-F6700-DFC3A, WS-F6700-DFC3B, WS-F6700-DFC3BXL, WS-F6700-DFC3C, WS-F6700-DFC3CXL, WS-F6K-DFC4-A, or the WS-F6K-DFC4-AXL daughter card. • The WS-X6848-SFP-2T module ships with the DFC4-A installed; the WS-X6848-TX-2TXL ships with the DFC-4AXL daughter card installed. **Note** Refer to the *Catalyst 6500 Series DFC3A, DFC3B, and DFC3BXL Installation Note* or the *Catalyst 6500 Series Distributed Forwarding Card 4 for WS-X68xx Modules Installation Note* for additional information and field upgrade procedures.
Pluggable transceivers support	SFP transceivers are supported. Refer to your software release notes to determine which SFP transceivers are supported. See the "1-GB Transceivers" section on page B-3 in Appendix B for additional information on the SFP transceivers.
Digital Optical Monitoring (DOM) support	Not supported.
Module front panel LEDs	**STATUS** • Green—All diagnostics pass; the module is operational. • Orange—The module is booting or running diagnostics; an overtemperature condition has occurred. **LINK** • Green—The port is active (the link is connected and operational). • Flashing orange—The port failed diagnostics and is disabled. • Orange—The port is disabled. • Red—The module is resetting; an overtemperature condition has occurred. **Note** If the module fails to download code and configuration information successfully during the initial reset, the LED stays red; the module does not come online. • Off—The port is not active or the link is not connected.

Table 2-51 WS-X6748-SFP and WS-X6848-SFP-2T/-2TXL Physical and Environmental Specifications

Item	Specification
Dimensions (H x W x D)	1.2 x 14.4 x 16 in. (3.0 x 35.6 x 40.6 cm). Occupies one slot in the chassis.
Weight	• Base module with CFC daughter card (WS-F6700-CFC) installed—9.0 lb (4.1 kg) • Base module with DFC daughter card WS-F6700-DFC installed—10.8 lb (4.5 kg) • Base module with DFC4-A or DFC4-AXL installed—10.8 lb (4.5 kg)
Power requirement (at 42 VDC)	• WS-X6748-SFP + CFC daughter card WS-X6700-CFC) – Module current—6.07 A – Module power—254.94 W – AC-input power—318.68 W – AC heat dissipation—1088.28 BTU/hour – DC-input power—342.66 W – DC heat dissipation—1170.19 BTU/hour • WS-X6748-SFP + DFC3A daughter card (WS-F6700-DFCA) – Module current—8.32 A – Module power—349.44 W – AC-input power—436.80 W – AC heat dissipation—1491.67 BTU/hour – DC-input power—469.68 W – DC heat dissipation—1603.95 BTU/hour • WS-X6748-SFP + DFC3B daughter card (WS-F6700-DFC3B) – Module current—8.02 A – Module power—336.84 W – AC-input power—421.05 W – AC heat dissipation—1437.89 BTU/hour – DC-input power—452.74 W – DC heat dissipation—1546.11 BTU/hour

Table 2-51 WS-X6748-SFP and WS-X6848-SFP-2T/-2TXL Physical and Environmental Specifications (continued)

Item	Specification
Power and heat numbers (continued)	• WS-X6748-SFP + DFC3BXL daughter card (WS-F6700-DFC3BXL) – Module current—8.62 A – Module power—362.04 W – AC-input power—452.55 W – AC heat dissipation—1545.46 BTU/hour – DC-input power—486.61 W – DC heat dissipation—1661.78 BTU/hour • WS-X6748-SFP + DFC3C daughter card (WS-F6700-DFC3C) – Module current—6.97 A – Module power—292.74 W – AC-input power—365.93 W – AC heat dissipation—1249.63 BTU/hour – DC-input power—393.47 W – DC heat dissipation—1343.69 BTU/hour • WS-X6748-SFP + DFC3CXL daughter card (WS-F6700-DFC3CXL) – Module current—7.67 A – Module power—322.14 W – AC-input power—402.68 W – AC heat dissipation—1375.14 BTU/hour – DC-input power—432.98 W – DC heat dissipation—1478.64 BTU/hour • WS-X6848-SFP-2T + DFC4-A daughter card – Module current—7.96 A – Module power—334.44 W – AC-input power—417.90 W – AC heat dissipation—1427.13 BTU/hour – DC-input power—449.35 W – DC heat dissipation—1534.55 BTU/hour • WS-X6848-SFP-2TXL + DFC4-AXL daughter card – Module current—8.08 A – Module power—339.44 W – AC-input power—424.20 W – AC heat dissipation—1448.64 BTU/hour – DC-input power—456.13 W – DC heat dissipation—1557.68 BTU/hour

Table 2-51 WS-X6748-SFP and WS-X6848-SFP-2T/-2TXL Physical and Environmental Specifications (continued)

Item	Specification
Environment	
Operating temperature	• Certified for operation: 32° to 104°F (0° to 40°C) • Designed and tested for operation: 32° to 130°F (0° to 55°C)
Humidity (RH) ambient (noncondensing)	10 to 90%
Operating altitude	• Certified for operation: 0 to 6500 ft (0 to 2000 m) • Designed and tested for operation: –200 to 10,000 ft (–60 to 3000 m)

WS-X6816-GBIC

The WS-X6816-GBIC Ethernet module (Figure 2-24) provides 16 1-Gbps full- or half-duplex ports. Table 2-52 lists the module features, and Table 2-53 lists the module physical and environmental specifications.

Figure 2-24 WS-X6816-GBIC Switching Module Front Panel

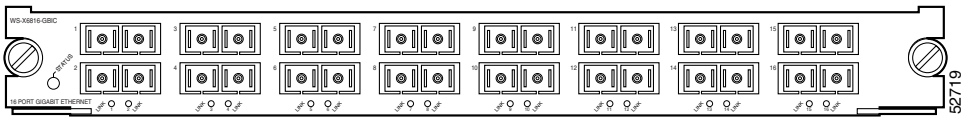


Table 2-52 WS-X6816-GBIC Ethernet Module Features

Feature	Description
Ports per module	• 16 ports. Ports are numbered (left to right): – Top row, odd numbered ports 1 through 15. – Bottom row, even numbered ports 2 through 16. • 2 port groups • Port ranges per port group: 1–8, 9–16
Port connector type	SC (optical) or RJ-45 (copper) depending on the type of GBIC transceiver installed in the module port.
Cabling distance	Depends on the GBIC transceiver installed in the module port. Refer to Appendix B for supported GBIC transceiver types and supported cabling distances.
Buffer size	• Tx—1.17 MB per port • Rx—166 kB per port
QoS	• Number of egress queues: 3 • Number of ingress queues: 2 • Number of thresholds per egress queue: 2 • Number of thresholds per ingress queue: 4

Table 2-52 WS-X6816-GBIC Ethernet Module Features (continued)

Feature	Description
Maximum frame size	Up to 9216 bytes per frame
Module oversubscription rate	Approximately 1:1
Supervisor engine support	Supported by the following supervisor engines: • Supervisor Engine 2 (requires a Switch Fabric Module or SFM2 be installed in the switch chassis and a DFC3 daughter card installed on the WS-X6816-GBIC) • Supervisor Engine 720 (requires a DFC3A, DFC3B, or DFC3BXL daughter card be installed on the module) • Supervisor Engine 720-10GE (requires a DFC3A, DFC3B, or DFC3BXL daughter card be installed on the module)
Software support	• With Supervisor Engine 720-10GE—12.2(33)SXH • With Supervisor Engine 720—12.2(14)SX • With Supervisor Engine 2—12.2(17d)SXB • With Supervisor Engine 2—12.1(8a)E **Note** With CWDM GBIC and WS-G5483 GBIC support—12.1(13)E. With DWDM GBIC support—12.1(20)E2
Queues per port	• Tx—1p2q2t • Rx—1p1q4t **Note** Rx is 2q8t when using dCEF.
Chassis/slot restrictions	• Can occupy any slot in any Catalyst 6500 or Catalyst 6500-E chassis except for the Catalyst 6513 switch chassis. • In the Catalyst 6513 chassis, the module can occupy only slots 9–13. The module does not power up if it is installed in slots 1–8.
Fabric connection	• Dual switch-fabric connections: – Fabric channel 1—Ports 1–8 – Fabric channel 2—Ports 9–16
Fabric channel speed	8 Gb/sec
Module upgrades available	
PoE support	Not supported.
Distributed forwarding support	Can be upgraded in the field to support dCEF with the installation of a DFC daughter card (WS-F6K-DFC3A, WS-F6K-DFC3B, or the WS-F6K-DFC3BXL). **Note** Refer to the *Catalyst 6500 Series DFC3A, DFC3B, and DFC3BXL Installation Note* for additional information and field upgrade procedures.
Pluggable transceivers support	GBIC transceivers are supported. Refer to your software release notes to determine which GBIC transceivers are supported. See the "1-GB Transceivers" section on page B-3 in Appendix B for additional information on the GBIC transceivers.

Table 2-52 WS-X6816-GBIC Ethernet Module Features (continued)

Feature	Description
Digital Optical Monitoring (DOM) support	Supported on some GBIC transceivers. **Note** Refer to your software release notes for specific information on which GBIC transceivers support DOM and the software release required for support.
Module front panel LEDs	**STATUS** • Green—All diagnostics pass; the module is operational. • Orange—The module is booting or running diagnostics; an overtemperature condition has occurred. **LINK** • Green—The port is active (the link is connected and operational). • Flashing orange—The port failed diagnostics and is disabled. • Orange—The port is disabled. • Red—The module is resetting; an overtemperature condition has occurred. **Note** If the module fails to download code and configuration information successfully during the initial reset, the LED stays red; the module does not come online. • Off—The port is not active or the link is not connected.

Table 2-53 WS-X6816-GBIC Physical and Environmental Specifications

Item	Specification
Dimensions (H x W x D)	1.2 x 14.4 x 16 in. (3.0 x 35.6 x 40.6 cm). Occupies one slot in the chassis.
Weight	Base module—9.2 lb (4.2 kg)
Power and heat numbers	• Base module + DFC daughter card (WS-F6K-DFC3A) – Module current—5.94 A – Module power—249.48 W – AC-input power—311.85 W – AC heat dissipation—1064.97 BTU/hour – DC-input power—335.32 W – DC heat dissipation—1145.13 BTU/hour • Base module + DFC daughter card (WS-F6K-DFC3B) – Module current—5.51 A – Module power—231.42 W – AC-input power—289.28 W – AC heat dissipation—987.87 BTU/hour – DC-input power—311.05 W – DC heat dissipation—1062.23 BTU/hour • Base module + DFC daughter card (WS-F6K-DFC3BXL) – Module current—6.22 A – Module power—261.24 W – AC-input power—326.55 W – AC heat dissipation—1115.17 BTU/hour – DC-input power—351.13 W – DC heat dissipation—1199.11 BTU/hour
Environment	11.2 lb (5.08 kg)
Operating temperature	• Certified for operation: 32° to 104°F (0° to 40°C) • Designed and tested for operation: 32° to 130°F (0° to 55°C)
Humidity (RH) ambient (noncondensing)	10 to 90%
Operating altitude	• Certified for operation: 0 to 6500 ft (0 to 2000 m) • Designed and tested for operation: –200 to 10,000 ft (–60 to 3000 m)

10-Gigabit Ethernet Modules

This section describes the following 10-Gigabit Ethernet modules:

Note All of the 10-Gigabit Ethernet modules are hot swappable.

WS-X6704-10GE Ethernet Module

The WS-X6704-10GE Ethernet module (Figure 2-25) provides 4 10-Gbps full- or half-duplex ports. Table 2-54 lists the module features, and Table 2-55 lists the module physical and environmental specifications.

Figure 2-25 WS-X6704-10GE Ethernet Module Front Panel

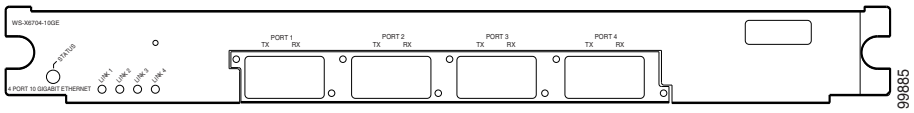


Table 2-54 WS-X6704-10GE Ethernet Module Features

Feature	Description
Ports per module	• 4 ports. Ports are numbered from 1 (left) to 4 (right). • 4 port groups • Port ranges per port group: 1 port in each group
Port connector type	SC or InfiniBand 4X depending on the type of XENPAK transceiver installed in the module.
Cabling distance	Depends on the XENPAK transceiver installed in the module port. Refer to Appendix B for supported XENPAK transceiver types and cabling distances.
Buffer size	16 MB
QoS	• Number of egress queues: 8 • Number of ingress queues: 1 (8 if DFC3x is present) • Number of thresholds per egress queue: 8 Number of thresholds per ingress queue: 8
Maximum frame size	Up to 9216 bytes
Module oversubscription rate	Approximately 1:1

Table 2-54 WS-X6704-10GE Ethernet Module Features (continued)

Feature	Description
Supervisor engine support	Supported on the following supervisor engines: • Supervisor Engine 720 • Supervisor Engine 720-10GE • Supervisor Engine 2T (module must be equipped with a CFC daughter card or either a DFC4-A or DFC4-AXL daughter card)
Software support	• With Supervisor Engine 720—12.2(17a)SX • With Supervisor Engine 720 and DFC3C or DFC3CXL—12.2(33)SXH • With Supervisor Engine 720-10GE—12.2(33)SXH • With Supervisor Engine 2T (module equipped with either CFC, DFC4-A, or DFC4-AXL daughter card)—12.2(50)SY
Queues per port	• With CFC daughter card: – Tx—1p7q8t – Rx—1q8t • With DFC daughter card: – Tx—1p7q8t – Rx—8q8t
Chassis/slot restrictions	• Not supported in the Catalyst 6503 chassis. • Supported only in slots 9–13 in the Catalyst 6513 chassis. The module does not power up if it is installed in slots 1–8.
Switch fabric connection	• Dual switch-fabric connections: – Fabric channel 1—Ports 3 and 4 – Fabric channel 2—Ports 1 and 2
Fabric channel speed	20 Gb/sec
Module upgrades available	
PoE support	Not supported.
Distributed forwarding support	Ships with the WS-F6700-CFC daughter card factory-installed. Can be upgraded in the field with a DFC daughter card (WS-F6700-DFC3A, WS-F6700-DFC3B, WS-F6700-DFC3B, WS-F6700-DFC3C, WS-F6700-DFC3CXL, WS-)F6K-DFC4-A, or WS-F6K-DFC4-AXL.
Pluggable transceivers support	XENPAK transceivers are supported. Refer to your software release notes to determine which XENPAK transceivers are supported. See the "10-GB Transceivers" section on page B-8 in Appendix B for additional information on the XENPAK transceivers.

Table 2-54 WS-X6704-10GE Ethernet Module Features (continued)

Feature	Description
Digital Optical Monitoring (DOM) support	Supported on some XENPAK transceivers. **Note** Refer to your software release notes for specific information on which XENPAK transceivers support DOM and the software release required for support.
Module front panel LEDs	**STATUS** • Green—All diagnostics pass; the module is operational. • Orange—The module is booting or running diagnostics; an overtemperature condition has occurred. **LINK** • Green—The port is active (the link is connected and operational). • Flashing orange—The port failed diagnostics and is disabled. • Orange—The port is disabled. • Red—The module is resetting; an overtemperature condition has occurred. **Note** If the module fails to download code and configuration information successfully during the initial reset, the LED stays red; the module does not come online. • Off—The port is not active or the link is not connected.

Table 2-55 WS-X6704-10GE Ethernet Module Physical and Environmental Specifications

Item	Specification
Dimensions	1.2 x 14.4 x 16 in. (3.0 x 35.6 x 40.6 cm). Occupies one slot in the chassis.
Weight	Base module + CFC daughter card (WS-F6700-CFC)—9.0 lb (4.08 kg)
Power and heat numbers	• WS-X6704-10GE (base module + CFC daughter card) – Module current—7.03 A – Module power—295.26 W – AC-input power—369.08 W – AC heat dissipation—1260.39 BTU/hour – DC-input power—396.85 W – DC heat dissipation—1355.26 BTU/hour • WS-X6704-10GE (base module + DFC3A daughter card) – Module current—9.28 A – Module power—389.76 W – AC-input power—487.20 W – AC heat dissipation—1663.79 BTU/hour – DC-input power—523.87 W – DC heat dissipation—1789.02 BTU/hour • WS-X6704-10GE (base module + DFC3B daughter card) – Module current—8.98 A – Module power—377.16 W – AC-input power—471.45 W – AC heat dissipation—1610.00 BTU/hour – DC-input power—506.94 W – DC heat dissipation—1731.18 BTU/hour • WS-X6704-10GE (base module + DFC3BXL daughter card) – Module current—9.58 A – Module power—402.36 W – AC-input power—502.95 W – AC heat dissipation—1717.57 BTU/hour – DC-input power—540.81 W – DC heat dissipation—1846.85 BTU/hour

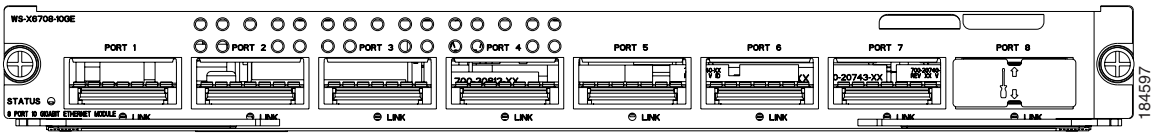
Table 2-55 WS-X6704-10GE Ethernet Module Physical and Environmental Specifications (continued)

Item	Specification
Power and heat numbers (continued)	• WS-X6704-10GE (base module + DFC3C daughter card) – Module current—7.93 A – Module power—333.06 W – AC-input power—416.33 W – AC heat dissipation—1421.75 BTU/hour – DC-input power—447.66 W – DC heat dissipation—1528.76 BTU/hour • WS-X6704-10GE (base module + DFC3CXL daughter card) – Module current—8.63 A – Module power—362.46 W – AC-input power—453.08 W – AC heat dissipation—1547.25 BTU/hour – DC-input power—487.18 W – DC heat dissipation—1663.71 BTU/hour
Environment	
Operating temperature	• Certified for operation: 32° to 104°F (0° to 40°C) • Designed and tested for operation: 32° to 130°F (0° to 55°C)
Humidity (RH) ambient (noncondensing)	10 to 90%
Operating altitude	• Certified for operation: 0 to 6500 ft (0 to 2000 m) • Designed and tested for operation: –200 to 10,000 ft (–60 to 3000 m)

WS-X6708-10G-3C and WS-X6708-10G-3CXL Ethernet Modules

The WS-X6708-10G-3C and WS-X6708-10G-3CXL Ethernet module (Figure 2-26) provides 8 10-Gbps full- or half-duplex ports. Table 2-54 lists the module features, and Table 2-55 lists the module physical and environmental specifications.

Figure 2-26 WS-X6708-10G-3C and WS-X6708-10G-3CXL Ethernet Module Front Panel



Note Both of the modules (WS-X6708-10G-3C and WS-X6708-10G-3CXL) are identified on the faceplate as WS-X6708-10GE.

Table 2-56 WS-X6708-10G-3C and WS-X6708-10G-3CXL Ethernet Module Features

Feature	Description
Ports per module	• 8 ports. Ports are numbered from 1 (left) to 8 (right). • 1 port group • Port ranges per port group: 1–8
Port connector type	SC or CX4 depending on the type of X2 transceiver installed in the module port.
Cabling distance	Depends on the X2 transceiver installed in the module port. Refer to Appendix B for supported X2 transceiver types and cabling distances.
Buffer size	200 MB per port
QoS	• Number of egress queues: 8 • Number of ingress queues: 8 • Number of thresholds per egress queue: 4 • Number of thresholds per ingress queue: 4
Maximum frame size	Up to 9216 bytes
Module oversubscription rate	2:1
Supervisor engine support	Supported on the following supervisor engines: • Supervisor Engine 720 • Supervisor Engine 720-10GE **Note** Check your release notes for specific information on the software release versions required to support the supervisor engines.
Software support	• With Supervisor Engine 720—12.2(18)SXF5 • With Supervisor Engine 720-10GE—12.2(33)SXH

Table 2-56 WS-X6708-10G-3C and WS-X6708-10G-3CXL Ethernet Module Features (continued)

Feature	Description
Queues per port	• Tx—1p7q4t • Rx—8q4t
Chassis/slot restrictions	• Not supported in the Catalyst 6503 chassis. • Supported only in slots 9–13 in the Catalyst 6513 chassis. The module does not power up if it is installed in slots 1–8. • When the WS-X6708-10G module is installed in a Catalyst 6500-E series chassis or a Catalyst 6509-NEB-A chassis, the configuration is NEBS 3 compliant (chassis supports operating temperatures up to 55°C). • When the WS-X6708-10G module is installed in a Catalyst 6500 non-E series chassis that is equipped with a fan tray 2 and a 2500 W or larger power supply, the configuration is not NEBS 3 compliant (chassis supports operating temperatures up to 40°C only). • Support for the Catalyst 6509-NEB-A chassis requires two FAN-MOD-09 fan trays.
Fabric connection	• Dual switch-fabric connections: – Fabric channel 1: Ports 2, 3, 6, 8 – Fabric channel 2: Ports 1, 4, 5, 7
Fabric channel speed	20 Gb/sec
Module upgrades available	
PoE support	Not supported.
Distributed forwarding support	• WS-X6708-10G-3C comes factory-equipped with a DFC3C daughter card. • WS-X6708-10G-3CXL comes factory-equipped with a DFC3CXL daughter card.
Pluggable transceivers support	X2 transceivers are supported. Not all types of X2 transceivers may be supported. Refer to your software release notes to determine which X2 transceivers are currently supported. See the "10-GB Transceivers" section on page B-8 in Appendix B for additional information on the X2 transceivers. **Note** The WS-6708-10GE does not support X2 transceivers shipped prior to the release of the WS-X6708-10GE with Cisco IOS Release 12.2(18)SXF5. The unsupported X2 transceivers are labeled with a number that ends with -01. This restriction does not apply to the X2-10GB-LRM transceiver.

Table 2-56 WS-X6708-10G-3C and WS-X6708-10G-3CXL Ethernet Module Features (continued)

Feature	Description
Digital Optical Monitoring (DOM) support	Supported on some X2 transceivers. **Note** Refer to your software release notes for specific information on which X2 transceivers support DOM and the software release required for support.
Module front panel LEDs	**STATUS** • Green—All diagnostics pass; the module is operational. • Orange—The module is booting or running diagnostics; an overtemperature condition has occurred. **LINK** • Green—The port is active (the link is connected and operational). • Flashing orange—The port failed diagnostics and is disabled. • Orange—The port is disabled. • Red—The module is resetting; an overtemperature condition has occurred. **Note** If the module fails to download code and configuration information successfully during the initial reset, the LED stays red; the module does not come online. • Off—The port is not active or the link is not connected.

Table 2-57 WS-X6708-10G-3C and WS-X6708-10G-3CXL Ethernet Module Physical and Environmental Specifications

Item	Specification
Dimensions	1.2 x 14.4 x 16 in. (3.0 x 35.6 x 40.6 cm). Occupies one slot in the chassis.
Weight	16.0 lb (7.26 kg)
Power and heat numbers	• WS-X6708-10G-3C (base module + the DFC3C daughter card) – Module current—10.58 A – Module power—444.36 W – AC-input power—555.45 W – AC heat dissipation—1896.86 BTU/hour – DC-input power—597.26 W – DC heat dissipation—2039.64 BTU/hour • WS-X6708-10G-3CXL (base module + the DFC3CXL daughter card) – Module current—11.28 A – Module power—473.76 W – AC-input power—592.20 W – AC heat dissipation—2022.36 BTU/hour – DC-input power—636.77 W – DC heat dissipation—2174.58 BTU/hour
Environment	
Operating temperature	• Certified for operation: 32° to 104°F (0° to 40°C) • Designed and tested for operation: 32° to 130°F (0° to 55°C)
Humidity (RH) ambient (noncondensing)	10 to 90%
Operating altitude	• Certified for operation: 0 to 6500 ft (0 to 2000 m) • Designed and tested for operation: –200 to 10,000 ft (–60 to 3000 m)

WS-X6716-10GE and WS-X6816-10G-2T/-2TXL Ethernet Modules

The WS-X6716-10GE and WS-X6816-10G-2T/-2TXL Ethernet modules (Figure 2-27) provide 16 10-Gbps full- or half-duplex ports. Table 2-58 lists the module features, and Table 2-59 lists the module physical and environmental specifications.

Note A sticker is placed on the module faceplate identifying it as either a WS-X6816-10G-2T or WS-X6816-10G-2TXL depending on whether a WS-F6K-DFC4-E or WS-F6K-DFC4-EXL daughter card is installed on the module.

Figure 2-27 WS-X6716-10GE and WS-X6816-10G-2T/-2TXL Ethernet Module Front Panel

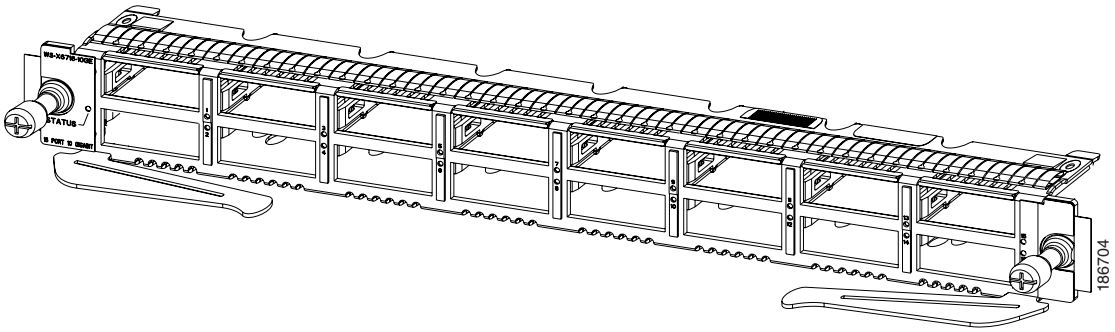


Table 2-58 WS-X6716-10GE and WS-X6816-10G-2T/-2TXL Ethernet Module Features

Feature	Description
Ports per module	• 16 ports. Ports are numbered (left to right): – Top row, odd numbered ports 1 through 15. – Bottom row, even numbered ports 2 through 16. • 4 port groups • Port ranges per port group: 1–4, 5–8, 9–12, 13–16
Port connector type	SC or CX4 depending on the type of X2 transceiver installed in the module port.
Cabling distance	Depends on the X2 transceiver installed in the module port. For X2 transceivers currently supported, refer to the compatibility matrices at the following URL: http://www.cisco.com/en/US/products/hw/modules/ps5455/products_device_support_tables_list.html For cabling distance information, refer to the transceiver installation guides at the following URL: http://www.cisco.com/en/US/products/hw/modules/ps5455/prod_installation_guides_list.html
Buffer size	• Oversubscription mode—90 MB per port group • Performance mode—200 MB per port

Table 2-58 WS-X6716-10GE and WS-X6816-10G-2T/-2TXL Ethernet Module Features (continued)

Feature	Description
QoS	• Number of egress queues: 8 • Number of ingress queues: 8 • Number of thresholds per egress queue: 2 per queue in oversubscription mode or 4 per queue in performance mode • Number of thresholds per ingress queue: 4
Maximum frame size	Up to 9216 bytes
Module oversubscription rate	4:1
Supervisor engine support	• WS-X6716-10GE supported on the following supervisor engines: – Supervisor Engine 720 – Supervisor Engine 720-10GE – Supervisor Engine 2T (module must be upgraded with either a DFC4-E or DFC4-EXL daughter card) • WS-X6816-10G-2T/-2TXL supported on the following supervisor engines: – Supervisor Engine 2T-10GE
Software support	• WS-X6716-10GE – With Supervisor Engine 720—12.2(33)SXH2 – With Supervisor Engine 720-10GE—12.2(33)SXH2 – With Supervisor Engine 2T (module upgraded with DFC4-E or DFC4-EXL)—12.2(50)SY • WS-X6816-10G-2T/-2TXL – With Supervisor Engine 2T-10GE—12.2(50)SY
Queues per port	• Oversubscription mode: – Tx—1p7q4t per port group – Rx—1p7q2t per port • Performance mode: – Tx—1p7q4t per port – Rx—8q4t per port

Table 2-58 WS-X6716-10GE and WS-X6816-10G-2T/-2TXL Ethernet Module Features (continued)

Feature	Description
Chassis/slot restrictions	• Not supported in the Catalyst 6503 chassis. • Supported only in slots 9–13 in the Catalyst 6513 chassis and does not power up in slots 1–8. • When the WS-X6716-10G module is installed in a Catalyst 6500 E-series chassis or a Catalyst 6509-NEB-A chassis, the configuration is NEBS 3 compliant (chassis supports operating temperatures up to 55°C). • When the WS-X6716-10G module is installed in a Catalyst 6500 non-E series chassis that is equipped with a fan tray 2 and a 2500 W or larger power supply, the configuration is not NEBS 3 compliant (chassis supports operating temperatures up to 40°C only). • Support in the Catalyst 6509-NEB-A chassis requires two FAN-MOD-09 fan trays. • WS-X6816-10G-2T/-2TXL is supported only in Catalyst 6500 E-series switches equipped with a Supervisor Engine 2T. • Requires that modules be installed in adjacent slots or, if either adjacent slot is unused, you must install a switching-module filler plate (Cisco part numbers WS-X6K-SLOT-CVR-E or SLOTBLANK-09) rather than a blank slot cover (WS-X6K-SLOT-CVR) to maintain an adequate air flow through the chassis.
Fabric connection	• Dual switch-fabric connections: – Fabric channel 1: Ports 1–8 – Fabric channel 2: Ports 9–16
Fabric channel speed	20 Gb/sec (dual channel, 40 Gb/sec total)

Table 2-58 WS-X6716-10GE and WS-X6816-10G-2T/-2TXL Ethernet Module Features (continued)

Feature	Description
Module upgrades available	
PoE support	Not supported.
Distributed forwarding support	• WS-X6716-10G-3C comes factory-equipped with a DFC3C daughter card. • WS-X6716-10G-3CXL comes factory-equipped with a DFC3CXL daughter card. • WS-X6816-10G-2T comes factory-equipped with a DFC4-E daughter card. • WS-X6816-10G-2TXL comes factory-equipped with a DFC4-EXL daughter card.
Pluggable transceivers support	X2 transceivers are supported. Not all types of X2 transceivers may be supported. For an up-to-date list of supported transceivers, refer to your transceiver compatibility matrices at the following URL. http://www.cisco.com/en/US/products/hw/modules/ps5455/products_device_support_tables_list.html See the "10-GB Transceivers" section on page B-8 in Appendix B for additional information on the X2 transceivers. **Note** WS-6716-10GE does not support X2 transceivers shipped prior to the release of the WS-X6708-10GE with Cisco IOS Release 12.2(18)SXF5. The unsupported X2 transceivers are labeled with a number that ends with -01. This restriction does not apply to the X2-10GB-LRM transceiver. **Note** Some X2 transceivers shipped prior to the WS-X6716-10GE becoming available might not provide EMI compliance with the WS-X6716-10GE. All X2 transceivers shipped since the WS-X6716-10GE became available provide EMI compliance with the WS-X6716-10GE. See the "10-GB Transceivers" section on page B-8 in Appendix B for additional information.

Table 2-58 WS-X6716-10GE and WS-X6816-10G-2T/-2TXL Ethernet Module Features (continued)

Feature	Description
Digital Optical Monitoring (DOM) support	Supported on some X2 transceivers. **Note** Refer to your software release notes for specific information on which X2 transceivers support DOM and the software release required for support.
Module front panel LEDs	**STATUS** • Green—All diagnostics pass; the module is operational. • Orange—The module is booting or running diagnostics; an overtemperature condition has occurred. **LINK** • Green—The port is active (the link is connected and operational). • Flashing orange—The port failed diagnostics and is disabled. • Orange—The port is disabled. • Red—The module is resetting; an overtemperature condition has occurred. **Note** If the module fails to download code and configuration information successfully during the initial reset, the LED stays red; the module does not come online. • Off—The port is not active or the link is not connected.

Table 2-59 WS-X6716-10GE and WS-X6816-10G-2T/-2TXL Ethernet Module Physical and Environmental Specifications

Item	Specification
Dimensions	1.2 x 14.4 x 16 in. (3.0 x 35.6 x 40.6 cm). Occupies one slot in the chassis.
Weight	13.6 lb (6.16 kg) (Excludes weight of X2 transceivers)
Power and heat numbers	• WS-X6716-10G-3C (base module + the DFC3C daughter card)—10.9 A – Module power—457.80 W – AC-input power—572.25 W – AC heat dissipation—1954.23 BTU/hour – DC-input power—615.32 W – DC heat dissipation—2101.33 BTU/hour • WS-X6716-10G-3CXL (base module + the DFC3CXL daughter card)—11.6 A – Module power—487.20 W – AC-input power—609.00 W – AC heat dissipation—2079.74 BTU/hour – DC-input power—654.84 W – DC heat dissipation—2236.27 BTU/hour • WS-X6816-10G-2T (base module + the DFC4-E daughter card)—11.63 A – Module power—488.46 W – AC-input power—610.58 W – AC heat dissipation—2085.11 BTU/hour – DC-input power—656.53 W – DC heat dissipation—2242.06 BTU/hour • WS-X6816-10G-2TXL (base module + the DFC4-EXL daughter card)—11.99 A – Module power—503.58 W – AC-input power—629.48 W – AC heat dissipation—2149.66 BTU/hour – DC-input power—676.85 W – DC heat dissipation—2311.46 BTU/hour

Table 2-59 WS-X6716-10GE and WS-X6816-10G-2T/-2TXL Ethernet Module Physical and Environmental Specifications (continued)

Item	Specification
Environment	
Operating temperature	• Certified for operation: 32° to 104°F (0° to 40°C) • Designed and tested for operation: 32° to 130°F (0° to 55°C)
Humidity (RH) ambient (noncondensing)	10 to 90%
Operating altitude	• Certified for operation: 0 to 6500 ft (0 to 2000 m) • Designed and tested for operation: –200 to 10,000 ft (–60 to 3000 m)

WS-X6716-10T and WS-X6816-10T-2T/-2TXL Ethernet Modules

The WS-X6716-10T and WS-X6816-10T-2T/-2TXL Ethernet modules (Figure 2-28) provide 16 10-Gbps full- or half-duplex copper ports. Table 2-60 lists the module features, and Table 2-61 lists the module physical and environmental specifications.

Note A sticker is placed on the module faceplate identifying it as either a WS-X6816-10T-2T or WS-X6816-10T-2TXL depending on whether a WS-F6K-DFC4-E or WS-F6K-DFC4-EXL daughter card is installed on the module.

Figure 2-28 WS-X6716-10T and WS-X6816-10T-2T/-2TXL Ethernet Module Front Panel

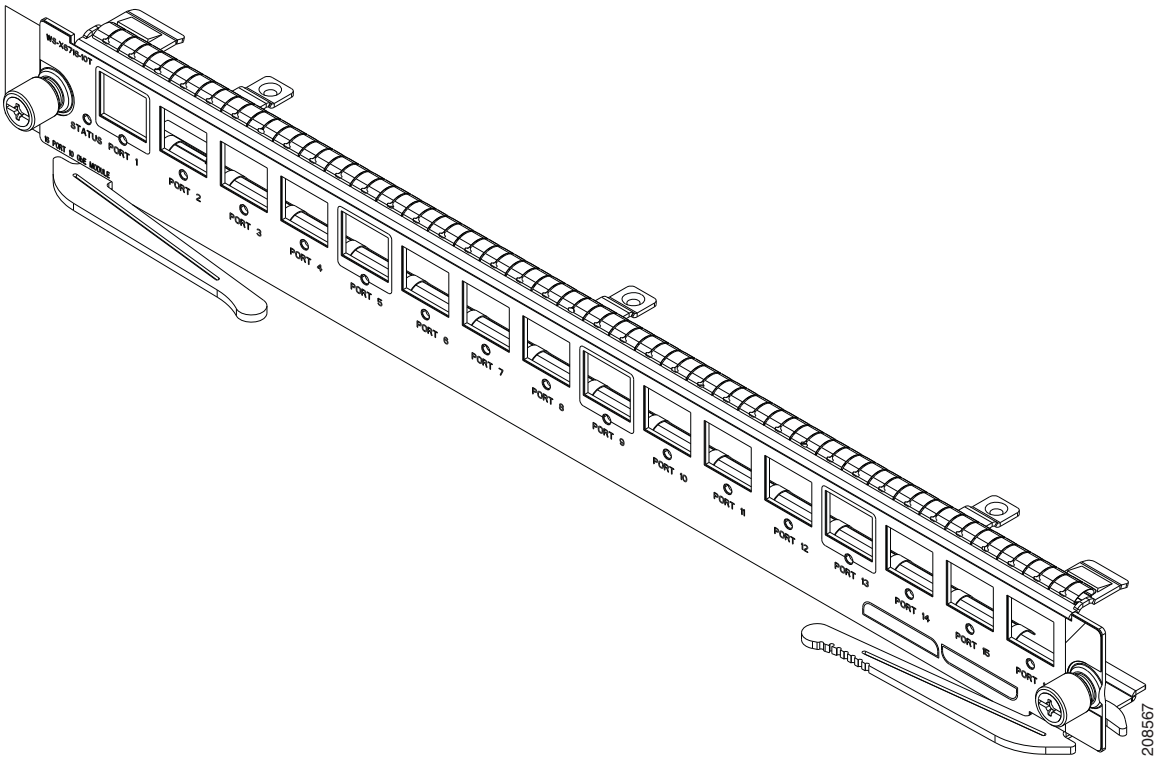


Table 2-60 WS-X6716-10T and WS-X6816-10T-2T/-2TXL Ethernet Module Features

Feature	Description
Ports per module	• 4 ports (Transparent mode): – Only port numbers 1, 5, 9, and 13 are used. • 16 ports (MUX mode, 4:1 oversubscription). Ports are numbered (left to right) • 4 port groups • Port ranges per port group: 1–4, 5–8, 9–12, 13–16
Port connector type	RJ-45
Cabling distance	Cat 6 cable—Up to 179 ft (55 m) Cat 5 cable—Up to 98 ft (30 m)
Buffer size	• Oversubscription mode—90 MB per port group • Performance mode—200 MB per port
QoS	• Number of egress queues: 8 • Number of ingress queues: 8 • Number of thresholds per egress queue: 2 per queue in oversubscription mode or 4 per queue in performance mode • Number of thresholds per ingress queue: 4
Maximum frame size	Up to 9216 bytes

Table 2-60 WS-X6716-10T and WS-X6816-10T-2T/-2TXL Ethernet Module Features (continued)

Feature	Description
Module oversubscription rate	4:1
Supervisor engine support	• The WS-X6716-10T is supported on the following supervisor engines: – Supervisor Engine 720 – Supervisor Engine 720-10GE – Supervisor Engine 2T (module must be upgraded with either a DFC4-E or DFC4-EXL daughter card) • The WS-X6816-10T-2T/-2TXL is supported on the following supervisor engines – Supervisor Engine 2T
Software support	• WS-X6716-10T – With Supervisor Engine 720—12.2(33)SXI4a or later – With Supervisor Engine 720-10GE—12.2(33)SXI4 – With Supervisor Engine 2T (module upgraded with either a DFC4-E or DFC4-EXL daughter card)—12.2(50)SY • WS-X6816-10T-2T/-2TXL – With Supervisor Engine 2T—12.2(50)SY
Queues per port	• Oversubscription mode: – Tx—1p7q4t per port group – Rx—1p7q2t per port • Performance mode: – Tx—1p7q4t per port – Rx—8q4t per port

Table 2-60 WS-X6716-10T and WS-X6816-10T-2T/-2TXL Ethernet Module Features (continued)

Feature	Description
Chassis/slot restrictions	• Not supported in the Catalyst 6503 chassis or the Catalyst 6509-NEB chassis • Supported only in slots 9–13 in the Catalyst 6513 chassis and does not power up in slots 1–8. • When the WS-X6716-10T module is installed in a Catalyst 6500-E series chassis or a Catalyst 6509-NEB-A chassis, the configuration is NEBS 3 compliant (chassis supports operating temperatures up to 55°C). • When the WS-X6716-10T module is installed in a Catalyst 6500 non-E series chassis that is equipped with a fan tray 2 and a 2500 W or larger power supply, the configuration is not NEBS 3 compliant (chassis supports operating temperatures up to 40°C only). • Support in the Catalyst 6509-NEB-A chassis requires two FAN-MOD-09 fan trays be installed. • The WS-X6816-10T-2T/-2TXL Ethernet module is only supported on the Catalyst 6500 E-series switches equipped with Supervisor Engine 2T. • Requires that modules be installed in adjacent slots or, if either adjacent slot is unused, you must install a switching-module filler plate (Cisco part numbers WS-X6K-SLOT-CVR-E or SLOTBLANK-09) rather than a blank slot cover (WS-X6K-SLOT-CVR) to maintain an adequate air flow through the chassis.
Fabric connection	• Dual switch-fabric connections: – Fabric channel 1: Ports 1–8 – Fabric channel 2: Ports 9–16
Fabric channel speed	20 Gb/sec (40Gb/sec total)

Table 2-60 WS-X6716-10T and WS-X6816-10T-2T/-2TXL Ethernet Module Features (continued)

Feature	Description
Module upgrades available	
PoE support	Not supported.
Distributed forwarding support	• WS-X6716-10T-3C comes factory-equipped with a DFC3C daughter card. • WS-X6716-10T-3CXL comes factory-equipped with a DFC3CXL daughter card. **Note** The WS-X6716-10T can be upgraded with the DFC4-E or DFC4-EXL daughter card to operate with the Supervisor Engine 2T. • WS-X6816 -10T-2T comes factory-equipped with a DFC4-E daughter card. • WS-X6816-10T-2TXL comes factory-equipped with a DFC4-EXL
Pluggable transceivers support	No
Digital Optical Monitoring (DOM) support	No
Module front panel LEDs	**STATUS** • Green—All diagnostics pass; the module is operational. • Orange—The module is booting or running diagnostics; an overtemperature condition has occurred. **LINK** • Green—The port is active (the link is connected and operational). • Flashing orange—The port failed diagnostics and is disabled. • Orange—The port is disabled. • Red—The module is resetting; an overtemperature condition has occurred. **Note** If the module fails to download code and configuration information successfully during the initial reset, the LED stays red; the module does not come online. • Off—The port is not active or the link is not connected.

Table 2-61 WS-X6716-10T and WS-X6816-10T-2T/-2TXL Ethernet Module Physical and Environmental Specifications

Item	Specification
Dimensions	1.2 x 14.4 x 16 in. (3.0 x 35.6 x 40.6 cm). Occupies one slot in the chassis.
Weight	17.71 lb (8.03 kg)

Table 2-61 WS-X6716-10T and WS-X6816-10T-2T/-2TXL Ethernet Module Physical and Environmental Specifications (continued)

Item	Specification
Power and heat numbers	• WS-X6716-10T-3C (base module + the DFC3C daughter card)—11.53 A – Module power—484.26 W – AC-input power—605.33 W – AC heat dissipation—2067.18 BTU/hour – DC-input power—650.89 W – DC heat dissipation—2222.78 BTU/hour • WS-X6716-10T-3CXL (base module + the DFC3CXL daughter card)—12.23 A – Module power—513.66 W – AC-input power—642.08 W – AC heat dissipation—2192.69 BTU/hour – DC-input power—690.40 W – DC heat dissipation—2357.73 BTU/hour • WS-X6816-10T-2T (base module + the DFC4-E daughter card)—12.26 A – Module power—514.96 W – AC-input power—643.65 W – AC heat dissipation—2198.06 BTU/hour – DC-input power—692.10 W – DC heat dissipation—2363.51 BTU/hour • WS-X6816-10T-2TXL (base module + the DFC4-EXL daughter card)—12.62 A – Module power—529.96 W – AC-input power—662.55 W – AC heat dissipation—2262.61 BTU/hour – DC-input power—712.42 W – DC heat dissipation—2432.91 BTU/hour

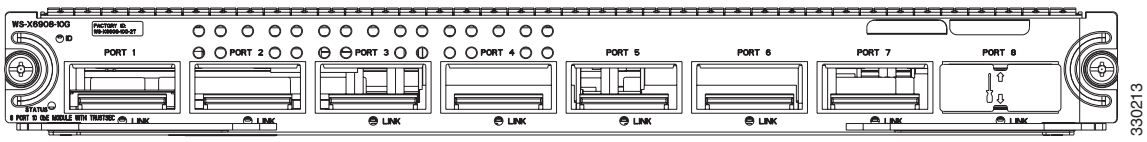
Table 2-61 WS-X6716-10T and WS-X6816-10T-2T/-2TXL Ethernet Module Physical and Environmental Specifications (continued)

Item	Specification
Environment	
Operating temperature	• Certified for operation: 32° to 104°F (0° to 40°C) • Designed and tested for operation: 32° to 130°F (0° to 55°C)
Humidity (RH) ambient (noncondensing)	10 to 90%
Operating altitude	• Certified for operation: 0 to 6500 ft (0 to 2000 m) • Designed and tested for operation: –200 to 10,000 ft (–60 to 3000 m)

WS-X6908-10G Ethernet Module

The WS-X6908-10G Ethernet module (Figure 2-29) provides 8 10-Gbps full- or half-duplex copper ports. Table 2-62 lists the module features, and Table 2-63 lists the module physical and environmental specifications.

Figure 2-29 WS-X6908-10GEthernet Module Front Panel



Note The WS-X6908-10G is the product identifier on the module front panel. The two orderable product IDs for the module are WS-X6908-10G-2T (equipped with a WS-F6K-DFC4-E daughter card) and WS-X6908-10G-2TXL (equipped with WS-F6K-DFC4-EXL daughter card).

Table 2-62 WS-X6908-10G Ethernet Module Features

Feature	Description
Ports per module	• 8 ports • 1 port group • Port ranges per port group: 1–8
Port connector type	Either SC, RJ45, or InfiniBand depending on the type of X2 transceiver installed in the module port.
Cabling distance	Dependent on the type of X2 transceiver installed in the module port. For cabling distances, refer to the transceiver installation guides at the following url: http://www.cisco.com/en/US/products/hw/modules/ps5455/prod_installation_guides_list.html
Maximum frame size	Up to 9216 bytes

Table 2-62 WS-X6908-10G Ethernet Module Features (continued)

Feature	Description
Module oversubscription rate	1:1
Supervisor engine support	Supervisor Engine 2T
Software support	12.2(50)SY
Queues per port	• Tx—1p7q4t per port • Rx—8q4t per port
Chassis/slot restrictions	• Not supported in non E-series Catalyst 6500 switches • Requires that modules be installed in adjacent slots or, if either adjacent slot is unused, you must install a switching-module filler plate (Cisco part numbers WS-X6K-SLOT-CVR-E or SLOTBLANK-09) rather than a blank slot cover (WS-X6K-SLOT-CVR) to maintain an adequate air flow through the chassis.
Fabric connection	Dual 40 Gbps switch-fabric connections • Fabric Channel 1: Ports 2, 3, 6, 8 • Fabric Channel 2: Ports 1, 4, 5, 7
Fabric channel speed	80 Gb/sec full duplex
Module upgrades available	
PoE support	Not supported.
Distributed forwarding support	• Supports either the WS-F6K-DFC4-E or WS-F6K-DFC4-EXL
Pluggable transceivers support	10GBASE-X X2 transceivers

Table 2-62 WS-X6908-10G Ethernet Module Features (continued)

Feature	Description
Digital Optical Monitoring (DOM) support	No
Module front panel LEDs	**STATUS** • Green—All diagnostics pass; the module is operational. • Orange—The module is booting or running diagnostics; an overtemperature condition has occurred. **LINK** • Green—The port is active (the link is connected and operational). • Flashing orange—The port failed diagnostics and is disabled. • Orange—The port is disabled. • Red—The module is resetting; an overtemperature condition has occurred. **Note** If the module fails to download code and configuration information successfully during the initial reset, the LED stays red; the module does not come online. • Off—The port is not active or the link is not connected. **ID** • Blinking blue—The module is being identified for attention. The LED is turned on by the user to aid servicing personnel in identifying the module. • Off—The module is not being identified.

Table 2-63 WS-X6908-10G Ethernet Module Physical and Environmental Specifications

Item	Specification
Dimensions	1.73 x 14.4 x 16 in. (4.4 x 36.6 x 40.6 cm). Occupies one slot in the chassis.
Weight	12.6 lb (5.72 kg)

Table 2-63 WS-X6908-10G Ethernet Module Physical and Environmental Specifications (continued)

Item	Specification
Power and heat numbers	• WS-X6908-10G-2T (base module + the DFC4-E daughter card)—14.00 A – Module power—488.0 W – AC-input power—610.05 W – AC heat dissipation—2083.32 BTU/hour – DC-input power—655.97 W – DC heat dissipation—2240.13 BTU/hour • WS-X6908-10G-2TXL (base module + the DFC4-EXL daughter card)—14.36 A – Module power—603.0 W – AC-input power—753.90 W – AC heat dissipation—2574.57 BTU/hour – DC-input power—810.65 W – DC heat dissipation—2768.35 BTU/hour
Environment	
Operating temperature	• Certified for operation: 32° to 104°F (0° to 40°C) • Designed and tested for operation: 32° to 130°F (0° to 55°C)
Humidity (RH) ambient (noncondensing)	10 to 90%
Operating altitude	• Certified for operation: 0 to 6500 ft (0 to 2000 m) • Designed and tested for operation: –200 to 10,000 ft (–60 to 3000 m)

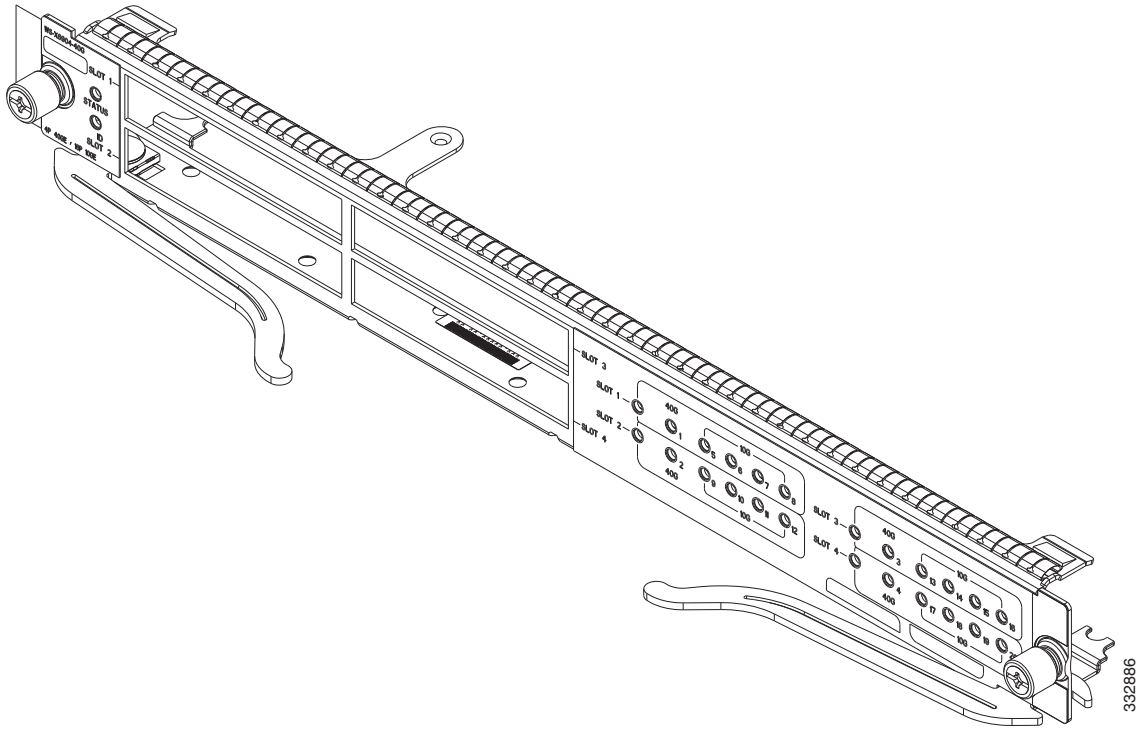
40-Gigabit Ethernet Modules

This section describes the following 40-Gigabit Ethernet modules:

WS-X6904-40G Ethernet Module

The WS-X6904-40G Ethernet module (Figure 2-30) has four optics bays that can accept four 40-Gigabit Ethernet CFP optics modules or four FourX adapters each providing four 10-Gigabit ports (using SFP+ transceivers). The ports can also be mixed between 40-Gigabit and 10-Gigabit transceivers. Table 2-64 lists the module features, and Table 2-65 lists the module physical and environmental specifications.

Figure 2-30 WS-X6904-40GEthernet Module Front Panel



Note The WS-X6904-40G is the product identifier on the module front panel. The two orderable product IDs for the module are WS-X6904-40G-2T (equipped with a WS-F6K-DFC4-E daughter card) and WS-X6904-40G-2TXL (equipped with WS-F6K-DFC4-EXL daughter card).

Table 2-64 WS-X6904-40G Ethernet Module Features

Feature	Description
Ports per module	• 4 ports—four 40-Gigabit CFP optics modules (ports 1 through 4) • 16 ports—four 10-Gigabit FourX adapters (ports 5 through 20) **Note** Each of the four optics bays on the module front panel can accept either one CFP transceiver module (one 40-Gigabit port) or a FourX converter and up to four SFP+ transceivers (four 10-Gigabit ports). The module can also support a mix of both 40-Gigabit CFP optics modules and 10-Gigabit SFP+ transceivers (two 40-Gigabit ports and 16 10-Gigabit ports).
Port connector type	• MPO/MTP connector for the 40-Gigabit CFP transceiver module. • LC connector for the 10- Gigabit SFP+ transceiver.
Cabling distance	Dependent on the type of transceiver installed. See the transceiver data sheets or the transceiver installation notes for specific information on cabling distances with the each transceiver type.
Maximum frame size	Up to 9216 bytes
Supervisor engine support	Supervisor Engine 2T-10GE only
Software support	15.0(1)SY1 or higher
Queues per port	• 40-Gigabit Ethernet ports: – Tx—1p7q4t – Rx—1p7q4t • 10-Gigabit Ethernet ports: – Tx—1p7q4t – Rx—8q4t
Chassis/slot restrictions	• Not supported in non E-series Catalyst 6500 switches • Supported in a WS-C6503-E chassis with a hardware revision 1.3 or higher • Requires that modules be installed in adjacent chassis slots or, if either adjacent slot is unused, you must install a switching-module filler plate (Cisco part numbers WS-X6K-SLOT-CVR-E or SLOTBLANK-09) rather than a blank slot cover (WS-X6K-SLOT-CVR) to maintain an adequate air flow through the chassis.

Table 2-64 WS-X6904-40G Ethernet Module Features (continued)

Feature	Description
Fabric connection	Dual 40 Gbps switch-fabric connections • Fabric Channel 1: Ports 1 and 2 (40-Gigabit ports) or 5 through 12 (10-Gigabit ports) • Fabric Channel 2: Ports 3 and 4 (40-Gigabit ports) or 13 through 20 (10-Gigabit ports)
Fabric channel speed	80 Gb/sec full duplex
Module upgrades available	
PoE support	Not supported.
Distributed forwarding support	• Supports only the WS-F6K-DFC4-E or the WS-F6K-DFC4-EXL
Pluggable transceivers support	• Supports 40-Gigabit CFP optical modules • Supports 10-Gigabit SFP+ transceivers using FourX converters **Note** Not all 40-Gigabit CFP optical modules or SFP+ transceivers may be supported. For an up-to-date list of supported CFP optical modules and SFP+ transceivers along with software requirements, refer to either the 40-Gigabit Ethernet Transceivers Compatibility Matrix or the 10-Gigabit Ethernet Transceivers Compatibility Matrix both available on cisco.com.

Table 2-64 WS-X6904-40G Ethernet Module Features (continued)

Feature	Description
Module front panel LEDs	**STATUS** Indicates the status of the module. • Green—All diagnostics pass; the module is operational. • Orange—The module is booting or running diagnostics; an overtemperature condition has occurred. • Red—A fault has been detected in the module. • Off—The module is not powered up. **ID** • Blinking blue—The module is being identified for attention. The LED is turned on by a CLI command to aid servicing personnel in identifying the module. **SLOT 1, 2, 3, 4** Indicates the operational status of the CFP slot. • Green—Slot is occupied and operational. • Alternate flashing green and yellow—Slot is identified for customer attention. The alternate color flashing operates in conjunction with the flashing blue ID LED. • Off—Slot is empty. **LINK** Indicates the link status of each port. When operating with 40-Gigabit CFP transceiver modules, the first LINK LED under each CFP slot indicates the status of the 40-Gigabit port. When operating with 10-Gigabit SFP+ transceivers, the four grouped LEDs associated with each optical bay indicate the port status of the four SFP+ transceivers in the FourX converter. • Green—The port is active (the link is connected and operational). • Yellow—The port is disabled. • Alternate flashing green and yellow—Port is identified for customer attention. The alternate color flashing operates in conjunction with the flashing blue ID LED. • Off—The port is not active or the link is not connected.

Table 2-65 WS-X6904-40G Ethernet Module Physical and Environmental Specifications

Item	Specification
Dimensions	1.73 x 14.4 x 16 in. (4.4 x 35.6 x 40.6 cm). Occupies one slot in the chassis.
Weight	12 lb (5.4 kg) Excludes CFP optical modules. Each CFP optical module weighs 0.25 lb (0.11 kg)

Table 2-65 WS-X6904-40G Ethernet Module Physical and Environmental Specifications (continued)

Item	Specification
Power and heat numbers	• WS-X6904-40G-2T (base module + the DFC4-E daughter card)—16.67 A – Module power—700.14 W – AC-input power—875.18 W – AC heat dissipation—2988.72 BTU/hour – DC-input power—941.05 W – DC heat dissipation—3213.68 BTU/hour • WS-X6908-10G-2TXL (base module + the DFC4-EXL daughter card)—17.03 A – Module power—715.26 W – AC-input power—894.08 W – AC heat dissipation—3053.27 BTU/hour – DC-input power—961.37 W – DC heat dissipation—3283.08 BTU/hour
Environment	
Operating temperature	• Certified for operation: 32° to 104°F (0° to 40°C) • Designed and tested for operation: 32° to 130°F (0° to 55°C)
Humidity (RH) ambient (noncondensing)	10 to 90%
Operating altitude	• Certified for operation: 0 to 6500 ft (0 to 2000 m) • Designed and tested for operation: –200 to 10,000 ft (–60 to 3000 m)

For more information about the WS-X6904-40G Ethernet module, see these publications:

- 40 Gigabit Ethernet on Cisco Catalyst 6500 Series Switches: How It Works

Note Some features described in the whitepaper will be supported in future releases.

- Cisco Catalyst 6900 Series 40 Gigabit Ethernet Interface Module for Cisco Catalyst 6500 Series Switches Data Sheet

CHAPTER 3

Installing Ethernet Switching Modules

Revised: April 2012

This chapter describes how to safely install, remove, and verify the operation of the Ethernet switching modules in the Catalyst 6500 series switches, and it contains these sections:

Safety

Safety warnings appear throughout this publication in procedures that may harm you if performed incorrectly. A warning symbol precedes each warning statement. The warnings below are general warnings that are applicable to the entire publication.

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

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

Warning **Before opening the unit, disconnect the telephone-network cables to avoid contact with telephone-network voltages.** Statement 1041

Warning **During this procedure, wear grounding wrist straps to avoid ESD damage to the card. Do not directly touch the backplane with your hand or any metal tool, or you could shock yourself.** Statement 93

Warning **Invisible laser radiation may be emitted from disconnected fibers or connectors. Do not stare into beams or view directly with optical instruments.** Statement 1051

Warning **During this procedure, wear grounding wrist straps to avoid ESD damage to the card. Do not directly touch the backplane with your hand or any metal tool, or you could shock yourself.** Statement 94

Installing an Ethernet Switching Module

This section describes how to safely install and verify the operation of the Ethernet switching modules.

Required Tools

These tools are required to install switching modules in the chassis:

- Small flat-blade screwdriver
- No. 2 Phillips screwdriver
- Antistatic mat or foam pad to support an unpackaged module
- Your own ESD-prevention equipment or the disposable grounding wrist strap included with the module

Chassis Slot Filler Restrictions for WS-X68xx and WS-X69xx Modules

If you are installing one or more of the WS-X68xx or WS-X69xx modules in your chassis, the slots directly adjacent to these modules (above and below or to the left and to the right) must contain either another module or switching-module filler plates (Cisco part numbers WS-X6K-SLOT-CVR-E or SLOTBLANK-09). If either adjacent slot is unused and currently has a blank slot cover (Cisco part number WS-X6K-SLOT-CVR) installed, you must remove the blank slot cover and replace it with a switching-module filler plate for NEBS compliance.

Installing an Ethernet Switching Module

Caution To prevent ESD damage, handle modules by the carrier edges only.

To install an Ethernet switching module in the chassis, follow these steps:

Step 1 Attach an ESD grounding strap to your wrist and to ground.

Note If you are unsure about the correct way to attach an ESD grounding strap, see the "Attaching Your ESD Grounding Strap" section on page C-1 for instructions.

Step 2 Choose a slot for the module.

Note Refer to your software release notes or to Chapter 2 for any information on slot or chassis restrictions for the module that you are installing.

Step 3 If you are installing either a WS-X68xx or WS-X69xx module, verify that the two slots adjacent to the slot where you are installing the module have either a module installed in them or a switching-module filler plate installed (Cisco part numbers SLOTBLANK-09 or WS-X6K-SLOT-CVR-E) if either slot is unused. If either slot has a blank slot cover (Cisco part number WS-X6K-SLOT-CVR), you need to remove the blank slot cover and replace it with a switching-module filler plate for NEBS compliance.

Step 4 Verify that there is enough clearance to accommodate any interface equipment, such as pluggable transceivers, that you will install directly to the module ports. If possible, install modules between empty slots that contain only module filler plates.

Step 5 Verify that you have adequate cable guides installed on the chassis to accept the additional network interface cables for the new module.

Step 6 Verify that the captive installation screws are tightened on all modules installed in the chassis.

Note This action assures that the EMI gaskets on all of the modules are fully compressed in order to maximize the opening space for the new or replacement module. If the captive installation screws are loose, the EMI gaskets on the installed modules will push adjacent modules toward the open slot, reducing the opening size and making it difficult to install the module.

Step 7 Remove the module filler plate covering the selected slot by removing the two Phillips pan-head screws from the filler plate.

Note If you must remove an existing module, refer to "Removing an Ethernet Switching Module" section on page 3-10.

Step 8 Remove the new module from its shipping packaging and from the antistatic shipping bag.

Caution To prevent ESD damage, handle modules by the carrier edges only.

Step 9 Fully open both ejector levers on the new module. (See Figure 3-1.)

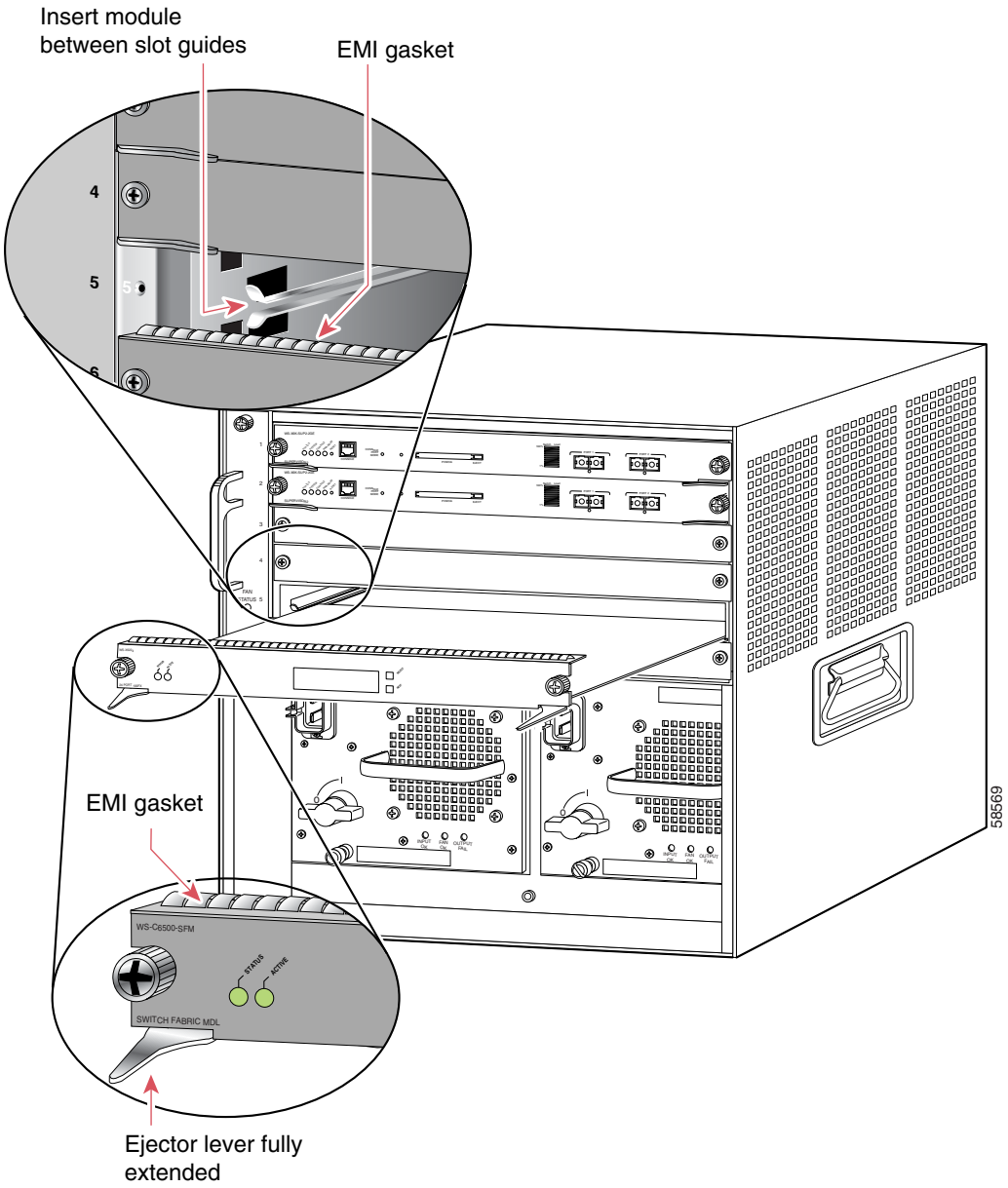
Step 10 Depending on the orientation of the slots in the chassis (horizontal or vertical), perform one of the following two sets of steps:

Chassis with horizontal slots

a. Position the new module in the slot. (See Figure 3-1.) Make sure that you align the sides of the module carrier with the slot guides on each side of the chassis slot.

b. Carefully slide the module into the slot until the EMI gasket along the top edge of the module makes contact with the module or cover plate in the slot above it and the module ejector levers have both closed to approximately 45 degrees with respect to the module faceplate. (See Figure 3-2.)

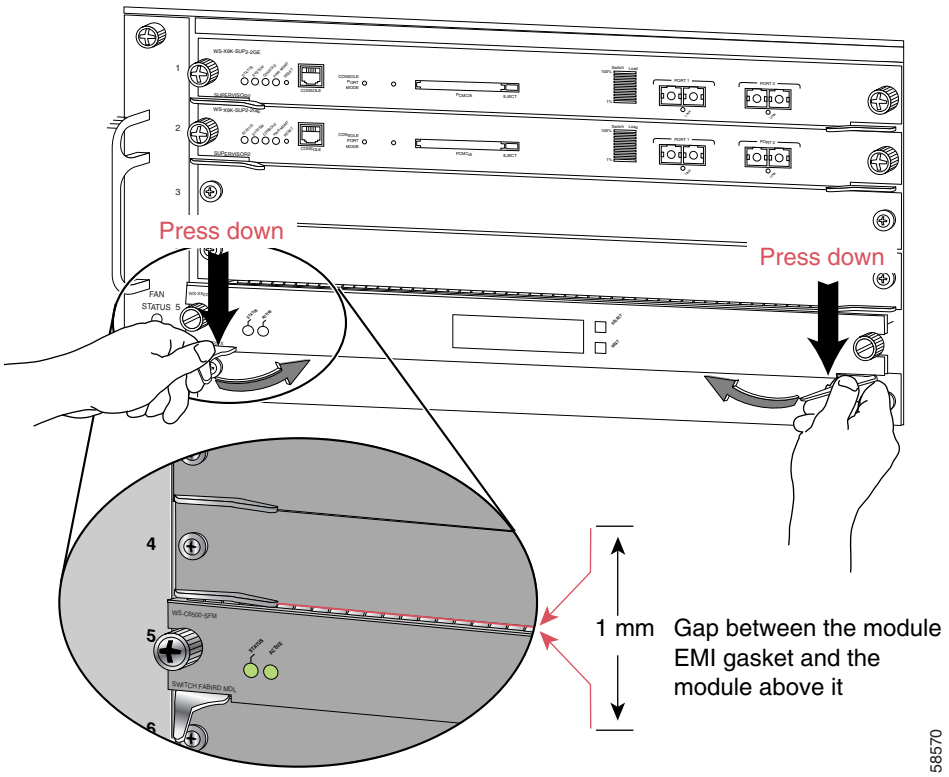
Figure 3-1 Positioning the Module in a Horizontal Slot Chassis



c. Using the thumb and forefinger of each hand, grasp the two ejector levers and gently press down to create a small 0.040 inch (1 mm) gap between the module's EMI gasket and the module or cover plate above it. (See Figure 3-2.)

Note Do not press down too forcefully on the levers because they will bend and get damaged.

Figure 3-2 Clearing the EMI Gasket in a Horizontal Slot Chassis



d. While gently pressing down, simultaneously close the left and right ejector levers to fully seat the module in the backplane connector. The ejector levers are fully closed when they are flush with the module faceplate. (See Figure 3-3.)

Note Failure to fully seat the module in the backplane connector can result in error messages.

e. Tighten the two captive installation screws on the module.

Note Make sure the ejector levers are fully closed before tightening the captive installation screws.

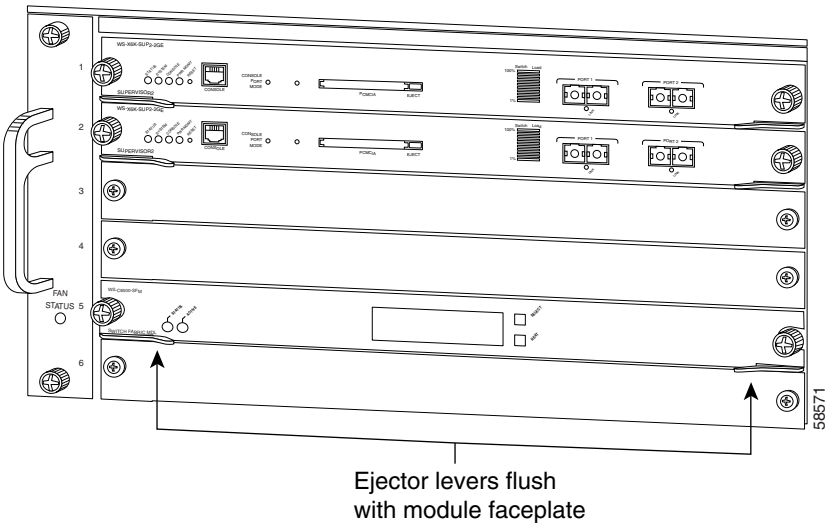
f. Verify that the module STATUS LED is lit.

g. Periodically check the STATUS LED:

- If the STATUS LED changes from orange to green, the module has successfully completed the boot process and is now online.
- If the STATUS LED remains orange or turns red, the module has not successfully completed the boot process and may have encountered an error. For more information about the orange or red STATUS LED states, see the LED table for your specific module in Chapter 2.

Note You should install switching-module filler plates (Cisco part number 800-00292-01) in any empty slots to maintain consistent airflow through the switch chassis.

Figure 3-3 Closing the Ejector Levers in a Horizontal Slot Chassis



Chassis with vertical slots

a. Position the module in the slot. (See Figure 3-4.) Make sure that you align the sides of the switching-module carrier with the slot guides on the top and bottom of the chassis slot.

b. Carefully slide the module into the slot until the EMI gasket along the right edge of the module makes contact with the module or cover plate in the slot adjacent to it and the module ejector levers have both closed to approximately 45 degrees with respect to the module faceplate. (See Figure 3-5.)

Figure 3-4 Positioning the Module in a Vertical Slot Chassis

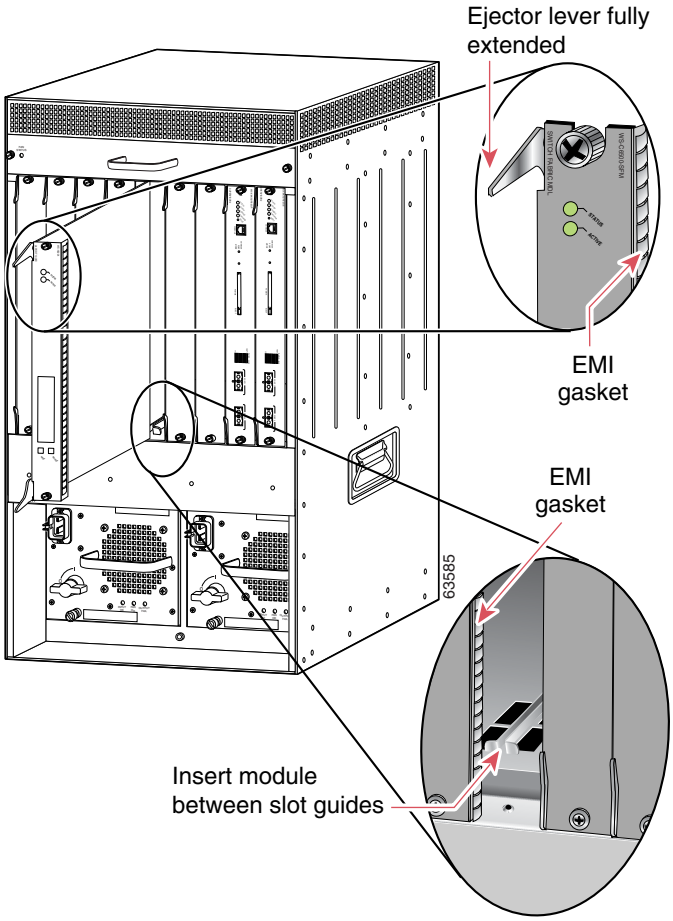
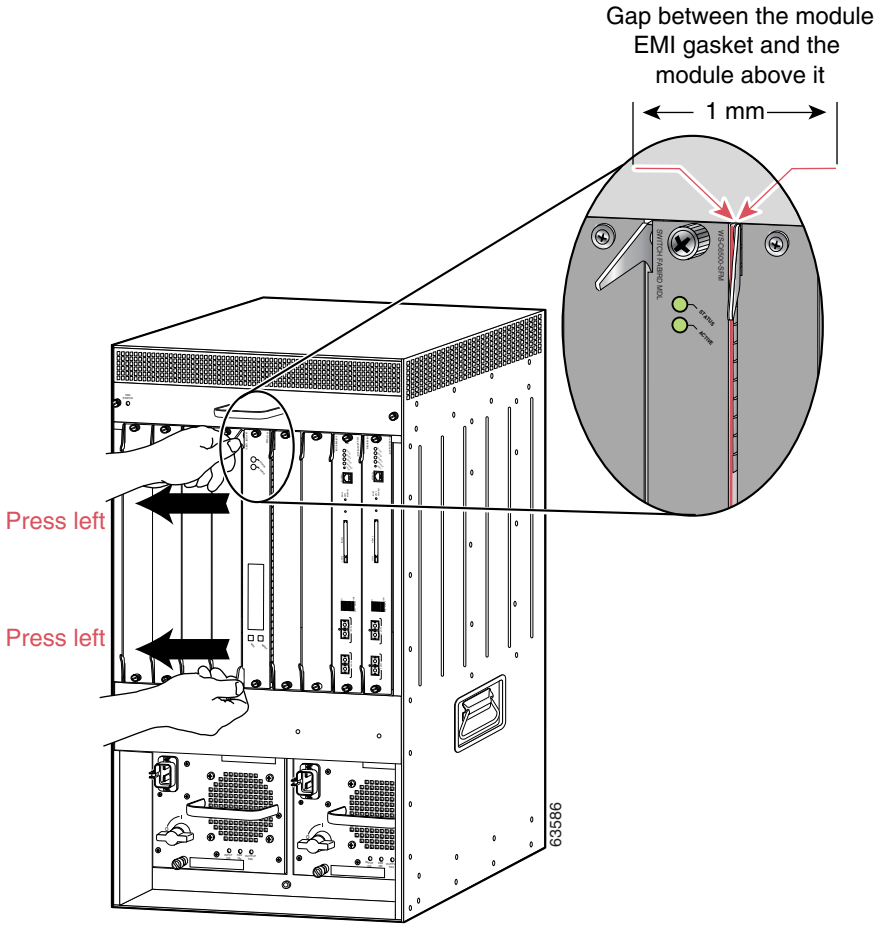


Figure 3-5 Clearing the EMI Gasket in a Vertical Slot Chassis

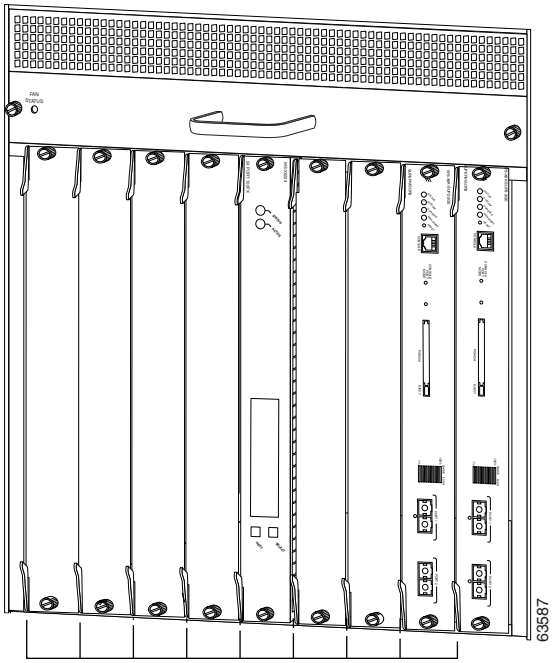


c. Using the thumb and forefinger of each hand, grasp the two ejector levers and exert a slight pressure to the left, deflecting the module approximately 0.040 inches (1 mm) creating a small gap between the module's EMI gasket and the module or cover plate adjacent to it. (See Figure 3-5.)

Note Do not exert too much pressure on the ejector levers because they will bend and get damaged.

d. While gently pressing down on the ejector levers, simultaneously close both levers to fully seat the module in the backplane connector. The ejector levers are fully closed when they are flush with the module faceplate. (See Figure 3-6.)

Figure 3-6 Closing the Ejector Levers in a Vertical Slot Chassis



e. Tighten the two captive installation screws on the module.

Note Make sure that the ejector levers are fully closed before tightening the captive installation screws.

f. Verify that the module STATUS LED is lit.

g. Periodically check the STATUS LED:

- If the STATUS LED changes from orange to green, the module has successfully completed the boot process and is now online.
- If the STATUS LED remains orange or turns red, the module has not successfully completed the boot process and may have encountered an error. For more information about the orange or red STATUS LED states, see the LED table for your specific module in Chapter 2.

Removing an Ethernet Switching Module

This section describes how to remove an Ethernet switching module from the Catalyst 6500 series switch chassis.

Note The WS-X6904-40G Ethernet module has a blue ID beacon LED. This led can be turned on and off by the user through CLI commands. Turning the beacon on helps to identify the module to servicing personnel.

Caution During this procedure, wear grounding wrist straps to avoid ESD damage to the module.

Warning **Invisible laser radiation may be emitted from disconnected fibers or connectors. Do not stare into beams or view directly with optical instruments.** Statement 1051

To remove a module from the chassis, perform these steps:

Step 1 Attach an ESD grounding strap to your wrist and to ground.

Note If you are unsure about the correct way to attach an ESD grounding strap, see the "Attaching Your ESD Grounding Strap" section on page C-1 for instructions.

Step 2 Disconnect any network interface cables attached to the module.

Step 3 Verify that the captive installation screws on all of the modules in the chassis are tight.

Note This step ensures that the space created by the removed module is maintained. If the captive installation screws are loose, the EMI gaskets on the installed modules will push the modules toward the open slot, reducing the opening size and making it difficult to remove the module.

Step 4 Loosen the two captive screws on the module. Make sure that the two captive screws are completely unscrewed from the chassis.

Step 5 Depending on the orientation of the slots in the chassis (horizontal or vertical), perform one of the following two sets of steps:

Horizontal slots

a. Place your thumbs on the left and right ejector levers and simultaneously rotate the levers outward to unseat the module from the backplane connector.

b. Grasp the front edge of the module and slide the module part of the way out of the slot. Place your other hand under the module to support the weight of the module. Do not touch the module circuitry.

Vertical slots

a. Place your thumbs on the ejector levers located at the top and bottom of the module, and simultaneously rotate the levers outward to unseat the module from the backplane connector.

b. Grasp the edges of the module, and slide the module straight out of the slot. Do not touch the module circuitry.

Step 6 Place the removed module on an antistatic mat or in an antistatic bag, or immediately reinstall it in another slot.

Step 7 If the slot is to remain empty and is adjacent to either a WS-X68xx or WS-X69xx module, you must install a module filler plate (Cisco part numbers SLOTBLANK-09 or WS-X6K-SLOT-CVR-E) to maintain proper air flow through the chassis. Do not install a blank slot cover (Cisco part number WS-X6K-SLOT-CVR) over the unused slot.

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

Warning **Invisible laser radiation may be emitted from disconnected fibers or connectors. Do not stare into beams or view directly with optical instruments.** Statement 1051

Installing Pluggable Transceivers

Some Catalyst 6500 Ethernet modules require that pluggable transceivers be installed in the module port sockets. These transceivers are normally shipped separately from the module and must be installed after the module is installed in the chassis slot. This section provides references to installation procedures for the various kinds of pluggable transceivers. Table 3-1 lists the transceiver installation documents located on http://www.cisco.com.

Table 3-1 Transceiver Installation Procedure Documentation and Links

Transceiver Type	Installation Procedure Document and Link
GBIC	*Gigabit Interface Converter Installation Note*
SFP and SFP+	*Cisco SFP and SFP+ Transceiver Module Installation Notes*
XENPAK	*Cisco XENPAK Transceiver Modules Installation Note*
X2	*Cisco 10-Gigabit Ethernet X2 Transceiver Modules Installation Note*
CFP	*Cisco 40-Gigabit and 100-Gigabit CFP Transceiver Modules Installation Note*

Note The WS-X6904-40G Ethernet module can support both 40-Gigabit CFP transceiver modules and 10-Gigabit SFP+ transceiver modules simultaneously.

Attaching the Network Interface Cables

This section describes how to attach network interface cables (optical and copper) to the modules.

Attaching Optical Network Interface Cables

Before you remove the dust plugs from the connector optical bores and make any connections, observe the following guidelines:

- Always keep the protective dust plugs on the unplugged fiber-optic cable connectors and the transceiver optical bores until you are ready to make a connection.

Caution Do not remove the plugs from the transceiver optical bores or the fiber-optic cable until you are ready to connect the cable. The plugs protect the transceiver optical bores and cable from contamination.

- Always inspect and clean the SC or the LC connector end-faces just before making any connections. Refer to the Tip on inspecting and cleaning fiber-optic connections for a pointer to a fiber-optic inspection and cleaning document.
- Always grasp the SC or the LC connector housing rather than the fiber-optic cable to plug or unplug the fiber-optic cable.

To install the optical interface cables, perform the following steps:

Step 1 Remove the dust plugs from the network interface cable optical connectors. Save the dust plugs for future use.

Step 2 Immediately inspect and clean the optical connector's fiber-optic end-faces.

Tip For complete information on inspecting and cleaning fiber-optic connections, see the document at this URL:

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

Step 3 Remove the dust plugs from the transceiver optical bores.

Note If you are using the LX/LH GBIC with MMF, you need to install a patch cord between the GBIC and the MMF cable.

Note The Read-Only WDM GBIC (WDM-GBIC-REC=) has only one optical bore (receive).

Step 4 Immediately attach the network interface cable optical connector to the transceiver.

Mode-Conditioning Patch Cord

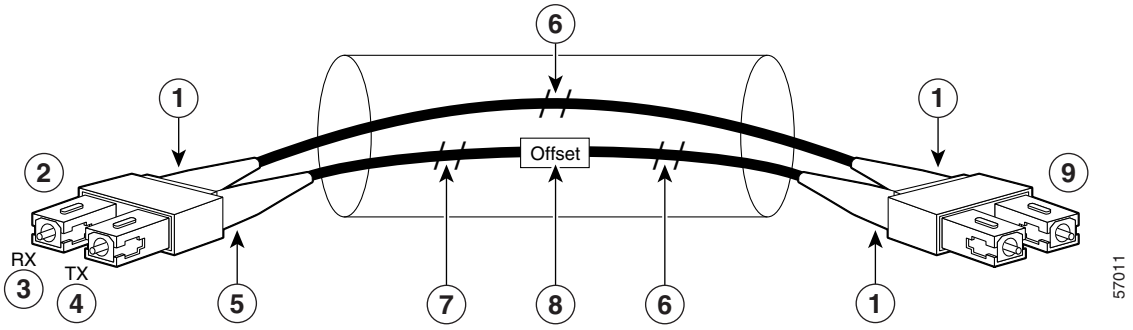
A mode-conditioning patch cord is recommended for use with an LX/LH GBIC or an LX/LH SFP transceiver and MMF to allow reliable laser transmission.

When an unconditioned laser source designed for operation on single-mode optical fiber is directly coupled to a multimode optical fiber cable, an effect known as *differential mode delay* (DMD) might result in a degradation of the modal bandwidth of the optical fiber cable.

This degradation results in a decrease in the link span (the distance between a transmitter and a receiver) that can be supported reliably. The effect of DMD can be overcome by conditioning the launch characteristics of a laser source. A practical means of performing this conditioning is to use a device called a mode-conditioning patch cord.

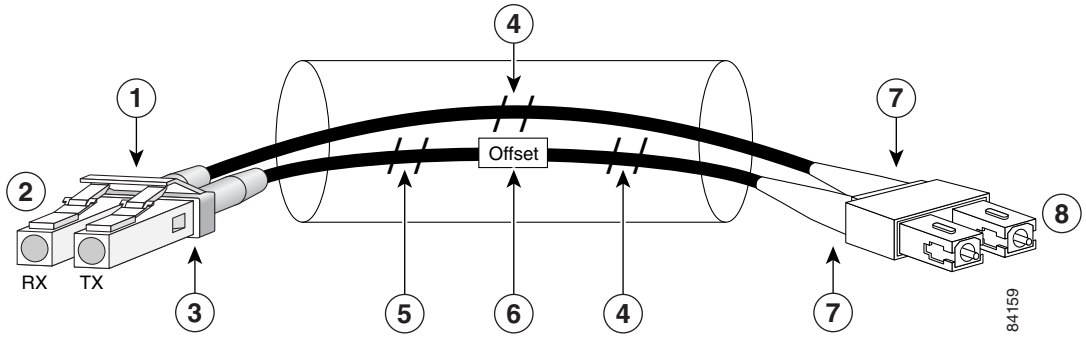
A mode-conditioning patch cord is an optical fiber cable assembly that consists of a pair of optical fibers terminated with connector hardware. Specifically, the mode-conditioning patch cord is composed of a single-mode optical fiber permanently coupled off-center (see Offset in Figure 3-7 and Figure 3-8) to a graded-index multimode optical fiber. Figure 3-7 and Figure 3-8 show a diagram of the mode-conditioning patch cord assembly.

Figure 3-7 Mode Conditioning Patch Cord with SC (GBIC Transceiver) Connector



1	Beige color identifier	**2**	To Gigabit Ethernet interface
3	RX (receiver)	**4**	TX (transmitter)
5	Blue color identifier	**6**	Multimode fiber (MMF)
7	Single-mode fiber (SMF)	**8**	Offset junction
9	To cable plant		

Figure 3-8 Mode Conditioning Patch Cord with LC (SFP Transceiver) Connector



1	Gray color identifier	**2**	To gigabit Ethernet interface
3	Blue color identifier	**4**	Multimode fiber
5	Single-mode fiber	**6**	Offset junction
7	Beige color identifier	**8**	To cable plant

The mode-conditioning patch cord assembly is composed of duplex optical fibers, including a single-mode-to-multimode offset launch fiber connected to the transmitter, and a second conventional graded-index multimode optical fiber connected to the receiver. The use of a plug-to-plug patch cord maximizes the power budget of multimode 1000BASE-LX/LH links.

Note The mode-conditioning patch cord is required to comply with IEEE standards. The IEEE found that link distances could not be met with certain types of fiber-optic cable cores. The solution is to launch light from the laser at a precise offset from the center, which is accomplished by using the mode-conditioning patch cord. At the output end of the patch cord, the GBIC-LX/LH is compliant with the IEEE 802.3z standard for 1000BASE-LX.

Connecting Transceivers to a Copper Network

Caution To comply with GR-1089 intrabuilding lightning immunity requirements, you must use grounded, shielded, twisted-pair Category 5 cabling.

To connect transceivers to a copper network, follow these steps:

Step 1 Insert the network cable RJ-45 connector into the RJ-45 connector on the transceiver.

Note When connecting to a 1000BASE-T-compatible switch or repeater, use four-twisted-pair, crossover Category 5 cabling.

Step 2 Insert the other end of the network cable into an RJ-45 connector on a 1000BASE-T-compatible target device.

Verifying the Installation

This section describes how to verify the installation of a supervisor engine or switching module.

To verify the installation of a Catalyst 6500 series switch running Cisco IOS software, see the *Catalyst 6500 Series Switch IOS Software Configuration Guide.*

This section contains the following topics:

Verifying Newly Installed Modules

Enter the **show module** or **show port** [*mod_num/port_num*] command to verify that the system acknowledges the new modules and has brought them online.

This example shows the output of the **show module** command:

```
Console> show module
Mod Slot Ports Module-Type               Model               Sub Status
--- ---- ----- ------------------------- ------------------- --- --------
1   1    2     1000BaseX Supervisor      WS-X6K-SUP1A-2GE    yes ok
15  1    1     Multilayer Switch Feature WS-F6K-MSFC         no  ok
3   3    2     Network Analysis Module   WS-X6380-NAM        no  ok
5   5    48    10/100BaseTX Ethernet     WS-X6248-RJ-45      no  ok

Mod Module-Name         Serial-Num
--- ------------------- -----------
1                       SAD03392376
15                      SAD03366264
3                       JAB0343055Y
5                       SAD03181291

Mod MAC-Address(es)                         Hw     Fw          Sw
--- --------------------------------------- ------ ----------- ------------------
1   00-30-96-29-9f-84 to 00-30-96-29-9f-85 1.0    5.2(1)      6.1(0.128)ORL
    00-30-96-29-9f-86 to 00-30-96-29-9f-87
    00-50-3e-8d-64-00 to 00-50-3e-8d-67-ff
15  00-d0-bc-ed-6b-2c to 00-d0-bc-ed-6b-6b 1.2    12.0(7T)XE 12.0(7T)XE1(2.07)
3   00-90-2b-00-a7-ca to 00-90-2b-00-a7-cb 0.201  4B4LZ0XA   1.1(0.20)
5   00-50-f0-ac-30-54 to 00-50-f0-ac-30-83 1.0    4.2(0.24)V 6.1(0.128)ORL
Mod Sub-Type                Sub-Model           Sub-Serial  Sub-Hw
--- ----------------------- ------------------- ----------- ------
1   L3 Switching Engine     WS-F6K-PFC          SAD03365068 1.0

Console>
```

This example shows the output of the **show port** command:

```
Console> show port 1/1
Port  Name               Status     Vlan       Duplex Speed Type
----- ------------------ ---------- ---------- ------ ----- ------------
 1/1                     connected  1            full  1000 1000BaseSX

Port  Security Secure-Src-Addr   Last-Src-Addr     Shutdown Trap     IfIndex
----- -------- ----------------- ----------------- -------- -------- -------
 1/1  disabled                                     No       disabled 3

Port     Broadcast-Limit Broadcast-Drop
-------- --------------- --------------------
 1/1                   -                    0
```

```
Port   Send FlowControl    Receive FlowControl   RxPause    TxPause
       admin    oper       admin    oper
-----  -------- --------   -------- --------     ---------- ----------
 1/1   desired  on         off      off          0          0

Port  Status     Channel   Admin Ch    Neighbor                          Neighbor
                 Mode      Group Id    Device                               Port
----- ---------- --------- ----- ----- ---------------------------------- -----

 1/1  connected  auto      123   0

Port  Align-Err  FCS-Err    Xmit-Err   Rcv-Err    UnderSize
----- ---------- ---------- ---------- ---------- ---------
 1/1           0          0          0          0         0

Port  Single-Col Multi-Coll Late-Coll  Excess-Col Carri-Sen Runts     Giants
----- ---------- ---------- ---------- ---------- --------- --------- ---------
 1/1           0          0          0          0        23         0         0

Last-Time-Cleared
--------------------------
Fri March 2 2003, 20:41:52
Console>
```

Checking Connectivity

To check connectivity on any switching module port, perform these tasks:

Task	Command
Ping a host.	**ping** *host*
If the host is unresponsive, check the IP address of the switch and default IP route, if appropriate.	**show interface** **show ip route**

For example, to ping a host named server1, enter this command:

```
Console> ping server1
server1 is alive
Console>
```

What To Do After Installing Modules and Verifying Connectivity

After you verify the switching module installation and check connectivity, you must configure the module. For complete information on configuring the modules, see the *Catalyst 6500 Series Switch Software Configuration Guide* or the *Catalyst 6500 Series Switch Cisco IOS Software Configuration Guide*. For information on all Catalyst 6500 series switch commands, see the *Catalyst 6500 Series Switch Command Reference* or the *Catalyst 6500 Series Switch Cisco IOS Command Reference* publications.

APPENDIX A

Ethernet Module Daughter Cards

Revised: August 2012

This appendix describes the daughter cards that are available for installation on certain Catalyst 6500 series Ethernet modules. The daughter cards are divided into two groups: Power over Ethernet (PoE) daughter cards and Distributed Forwarding Card (DFC) daughter cards.

PoE Daughter Cards

The PoE daughter cards can be installed either at the factory or in the field on select 10/100 and 10/100/1000 Ethernet switching modules to upgrade the Ethernet switching modules to provide inline power support, which allows the system to power inline devices, such as IP phones, video phones, and wireless access points, over standard copper cabling. There are six PoE daughter cards available for installation on Catalyst 6500 series modules. Table A-1 lists the PoE daughter cards and provides a brief description of their usage.

Table A-1 PoE Daughter Card Support

PoE Daughter Card	Description	Supported on Ethernet Module	Maximum Power per Port (Watts)
WS-F6K-VPWR=	Cisco prestandard PoE daughter card for 10/100 and 10/100/1000 Ethernet modules. Provides 48 VDC over Category 5, Category 5e, or Category 6 UTP cable up to 328 feet (100 meters). **Note** The WS-F6K-VPWR and WS-F6K-VPWR-GE PoE daughter cards are not interchangeable between Ethernet modules.	• WS-X6148-RJ-21 • WS-X6148-RJ-21V[1] • WS-X6148-RJ-45 • WS-X6148-RJ-45V[1] • WS-X6348-RJ-21V[1] • WS-X6348-RJ-45 • WS-X6348-RJ-45V[1]	6.3

Table A-1 PoE Daughter Card Support (continued)

PoE Daughter Card	Description	Supported on Ethernet Module	Maximum Power per Port (Watts)
WS-F6K-VPWR-GE=	Prestandard PoE daughter card for 10/100 and 10/100/1000 Ethernet modules. Provides 48 VDC over Category 5, Category 5e, or Category 6 UTP cable up to 328 feet (100 meters). **Note** The WS-F6K-VPWR and WS-F6K-VPWR-GE PoE daughter cards are not interchangeable between Ethernet modules.	• WS-X6148-GE-TX • WS-X6148V-GE-TX[1] • WS-X6548-GE-TX • WS-X6548V-GE-TX[1]	6.3
WS-F6K-GE48-AF=	IEEE 802.3af-compliant PoE daughter card for 10/100 and 10/100/1000 Ethernet modules. Provides 48 VDC over Category 5, Category 5e, or Category 6 UTP cable up to 328 feet (100 meters).	• WS-X6148-GE-TX • WS-X6148-GE-45AF[1] • WS-X6148A-GE-TX • WS-X6148A-GE-45AF[1] • WS-X6548-GE-TX • WS-X6548-GE-45AF[1]	15.4
WS-F6K-FE48X2-AF=	IEEE 802.3af-compliant PoE daughter card for 96-port 10/100 modules. Provides 48 VDC over Category 5, Category 5e, or Category 6 UTP cable up to 328 feet (100 meters).	• WS-X6148X2-RJ-45 • WS-X6148X2-45AF[1] • WS-X6196-RJ-21 • WS-X6196-21AF[1]	15.4
WS-F6K-48-AF=	IEEE 802.3af-compliant PoE daughter card for 10/100 and 10/100/1000 Ethernet modules. Provides 48 VDC over Category 5, Category 5e, or Category 6 UTP cable up to 328 feet (100 meters).	• WS-X6148A-RJ-45 • WS-X6148-GE-TX • WS-X6148-GE-45AF[1] • WS-X6148A-GE-TX • WS-X6148A-GE-45AF[1] • WS-X6548-GE-TX • WS-X6548-GE-45AF[1]	15.4
WS-F6K-48-AT	IEEE 802.af-compliant for the WS-X6148E-GE-45AT Ethernet module only. Provides 48 VDC over Category 5, Category 5e, or Category 6 UTP cable up to 328 feet (100 meters).	• WS-X4148E-GE-45AT[1]	15.4

1. The base Ethernet module is shipped with the PoE daughter card factory installed.

Centralized and Distributed Forwarding Daughter Cards

The centralized forwarding card (CFC) and the distributed forwarding cards (DFC) can be installed on select Ethernet switching modules in the field to upgrade the modules to support local switching. There is one CFC and six DFC daughter cards available for installation on Catalyst 6500 series modules. Table A-2 lists the available CFC and DFC daughter cards, provides a brief description of the daughter card, and lists the modules that the daughter card is supported on.

Table A-2 CFC and DFC Daughter Card Descriptions

CFC and DFC Daughter Card	Description	Modules supported on	Memory	Power Required
WS-F6K-DFC	Distributed Forwarding Card (DFC) for use on CEF256-based modules (WS-X65xx and WS-X6816-GBIC Ethernet modules). This daughter card is supported only by the Supervisor Engine 2.	• WS-X6516-GBIC • WS-X6816-GBIC • WS-X6516-GE-TX	128 MB	2.10 A at 42 VDC
WS-F6K-DFC3A	Distributed Forwarding Card (DFC) for use on CEF256-based modules (WS-X65xx and WS-X6816-GBIC Ethernet modules). This daughter card is supported only by the Supervisor Engine 720.	• WS-X6516-GBIC • WS-X6816-GBIC	512 MB (Memory is located on base module)	2.57 A at 42 VDC
WS-F6K-DFC3B	Distributed Forwarding Card 3B (DFC3B) for use on dCEF256 and CEF256 modules. This daughter card is supported only by the Supervisor Engine 720.	• WS-X6516-GBIC • WS-X6816-GBIC	256 MB (Memory is located on base module)	1.67 A at 42 VDC
WS-F6K-DFC3BXL	Distributed Forwarding Card 3BXL (DFC3BXL) for use on dCEF256 and CEF256 modules. This daughter card is supported only by the Supervisor Engine 720.	• WS-X6516-GBIC • WS-X6816-GBIC	1 GB (Memory is located on base module)	2.38 A at 42 VDC
WS-F6700-CFC	Centralized Forwarding Card (CFC) for use on WS-X67xx Ethernet modules. This daughter card is supported only by the Supervisor Engine 720. There are no memory options for this daughter card.	• WS-X6704-10GE • WS-X6724-SFP • WS-X6748-SFP • WS-X6748-GE-TX	256 MB (Memory is located on base module)	0.75 A at 42 VDC

Table A-2 CFC and DFC Daughter Card Descriptions (continued)

CFC and DFC Daughter Card	Description	Modules supported on	Memory	Power Required
WS-F6700-DFC3A	The Distributed Forwarding Card (DFC) is for use on CEF720 modules. This daughter card is supported only by the Supervisor Engine 720.	• WS-X6704-10GE • WS-X6724-SFP • WS-X6748-SFP • WS-X6748-GE-TX	256 MB (Memory is located on base module)	3.0 A at 42 VDC
WS-F6700-DFC3B	The Distributed Forwarding Card 3B (DFC3B) is for use on CEF720 modules. This daughter card is supported only by the Supervisor Engine 720.	• WS-X6704-10GE • WS-X6724-SFP • WS-X6748-SFP • WS-X6748-GE-TX	256 MB (Memory is located on base module)	2.70 A at 42 VDC
WS-F6700-DFC3BXL	The Distributed Forwarding Card 3BXL (DFC3BXL) is for use on CEF720 modules. This daughter card is supported only by the Supervisor Engine 720.	• WS-X6704-10GE • WS-X6724-SFP • WS-X6748-SFP • WS-X6748-GE-TX	1 GB[1]	3.30 A at 42 VDC
WS-F6700-DFC3C	The Distributed Forwarding Card 3C (DFC3C) is shipped as standard on the WS-X6708-10G-3C and the WS-X6716-10G-3C Ethernet modules. It is an option for all other CEF720 line cards beginning with Cisco IOS Release 12.2(33)SXH. This daughter card is supported only by the Supervisor Engine 720.	• WS-X6704-10GE • WS-X6708-10G-3C • WS-X6716-10G-3C • WS-X6716-10T-3C • WS-X6724-SFP • WS-X6748-SFP • WS-X6748-GE-TX	• 512 MB[2] • 1 GB • 1 GB • 1 GB • 512 MB[2] • 512 MB[2] • 512 MB[2]	1.65 A at 42 VDC
WS-F6700-DFC3CXL	The Distributed Forwarding Card 3CXL (DFC3CXL) is shipped standard on the WS-X6708-10G-3CXL and the WS-X6716-10G-3CXL Ethernet modules. It is an option for all other CEF720 line cards beginning with Cisco IOS Release 12.2(33)SXH. This daughter card is supported only by the Supervisor Engine 720.	• WS-X6704-10GE • WS-X6708-10G-3CXL • WS-X6716-10G-3CXL • WS-X6716-10T-3CXL • WS-X6724-SFP • WS-X6748-SFP • WS-X6748-GE-TX	• 1 GB • 1 GB • 1 GB • 1 GB • 1 GB • 1 GB • 1 GB	2.35 A at 42 VDC
WS-F6K-DFC4-A	The DFC4-A daughter card is shipped as standard on the WS-X6824-SFP-2T, WS-X6848- SFP-2T, and the WS-X6848-TX-2T Ethernet modules. **Note** WS-X67xx versions of these three modules can be upgraded with the DFC4-A daughter card so that they can operate with the Supervisor Engine 2T	• WS-X6824-SFP-2T • WS-X6848-SFP-2T • WS-X6848-TX-2T • WS-X6724-SFP • WS-X6748-SFP • WS-X6748-GE-TX	• 1 GB • 1 GB • 1 GB • 1 GB • 1 GB • 1 GB	2.38 A at 42 VDC

Table A-2 CFC and DFC Daughter Card Descriptions (continued)

CFC and DFC Daughter Card	Description	Modules supported on	Memory	Power Required
WS-F6K-DFC4-AXL	The DFC4-AXL daughter card replaces the DFC-4-A on the heavy versions of the WS-X6824-SFP-2T, WS-X6848-SFP-2T, and the WS-X6848-TX-2T Ethernet modules. **Note** WS-X67xx versions of these three modules can be upgraded with the DFC4-AXL daughter card so that they can operate with the Supervisor Engine 2T	• WS-X6824-SFP-2TXL • WS-X6848-SFP-2TXL • WS-X6848-TX-2TXL • WS-X6724-SFP • WS-X6748-SFP • WS-X6748-GE-TX	• 1GB	2.74 A at 42 VDC
WS-F6K-DFC4-E	The DFC4-E daughter card is shipped standard on the WS-X6816-10G-2T, the WS-X6816-10T-2T, and the WS-X6904-40G-2T Ethernet modules. **Note** WS-X67xx versions of these two modules can be upgraded with the DFC4-E daughter card so that they can operate with the Supervisor Engine 2T	• WS-X6816-10G-2T • WS-X6816-10T-2T • WS-X6904-40G-2T	• 1G • 1G	2.38 at 42 VDC
WS-F6K-DFC-EXL	The DFC4-EXL daughter card replaces the DFC4-E on the WS-X6816-10G-2T, the WS-X6816-10T-2T, and the WS-X6904-40G-2T Ethernet modules. **Note** WS-X67xx versions of these two modules can be upgraded with the DFC4-EXL daughter card so that they can operate with the Supervisor Engine 2T	• WS-X6816-10G-2TXL • WS-X6816-10T-2TXL • WS-X6904-40G-2TXL	•	2.74 A at 42 VDC

1. Requires a memory upgrade on the base module. Refer to the *Catalyst 6500 Series DFC3A, DFC3B, DFC3BXL, DFC3C, and DFC3CXL Installation Note* for additional information.
2. 512 MB is standard. The memory can be upgraded to 1 GB.

Table A-3 lists the supported combinations of WS-F6K-DFC3 daughter cards with the Supervisor Engine 720 models and the corresponding functionality levels.

Table A-3 WS-F6K-DFC Daughter Card Functionality Levels

Supervisor Engine 720 Model	WS-F6K-DFC3A	WS-F6K-DFC3B	WS-F6K-DFC3BXL
WS-SUP720	PFC3A functionality	PFC3A functionality	PFC3A functionality
WS-SUP720-3B	PFC3A functionality	PFC3B functionality	PFC3B functionality
WS-SUP720-3BXL	PFC3A functionality	PFC3B functionality	PFC3BXL functionality
VS-S720-10G-3C	PFC3A functionality	PFC3B functionality	PFC3B functionality
VS-S720-10G-3CXL	PFC3A functionality	PFC3B functionality	PFC3BXL functionality

Table A-4 lists the supported combinations of WS-F6700-DFC3 daughter cards with the Supervisor Engine 720 and Supervisor Engine 720-10G models and the corresponding functionality levels.

Table A-4 WS-F6700-DFC Daughter Card Functionality Levels

Supervisor Engine 720 Model	WS-F6700-DFC3A	WS-F6700-DFC3B	WS-F6700-DFC3BXL	WS-F6700-DFC3C	WS-F6700-DFC3CXL
WS-SUP720	PFC3A functionality	PFC3A functionality	PFC3A functionality	PFC3A functionality	PFC3A functionality
WS-SUP720-3B	PFC3A functionality	PFC3B functionality	PFC3B functionality	PFC3B functionality	PFC3B functionality
WS-SUP720-3BXL	PFC3A functionality	PFC3B functionality	PFC3BXL functionality	PFC3B functionality	PFC3BXL functionality
VS-S720-10G-3C	PFC3A functionality	PFC3B functionality	PFC3B functionality	PFC3C functionality	PFC3C functionality
VS-S720-10G-3CXL	PFC3A functionality	PFC3B functionality	PFC3BXL functionality	PFC3C functionality	PFC3CXL functionality

When DFC4 and DFC4XL daughter cards are mixed in a chassis, the system will operate in the lowest common denominator mode (DFC4). Supervisor Engine 2T does not support DFC3 daughter cards installed on modules..

APPENDIX B

Pluggable Transceiver Modules

Revised: April 2012

This appendix provides descriptions and specifications for the pluggable transceiver modules that are supported on the Catalyst 6500 series Ethernet switching modules.

The appendix is divided into these topics:

100-MB Transceivers

100-MB small form-factor pluggable (SFP) transceivers are currently the only 100-MB transceivers that are supported on a Catalyst 6500 series Ethernet switching module. They are supported only on the WS-X6148-FE-SFP Ethernet module.

The 100-MB SFP transceiver module is shown in Figure B-1. Table B-1 lists the types of 100-MB SFP transceivers and their cabling distances.

Note The 100-MB and the 1-GB SFP transceivers share the same form factor, but are not interchangeable.

Figure B-1 100-MB SFP Transceiver Module

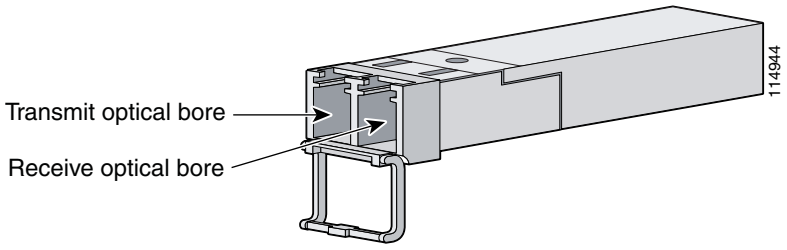


Table B-1 100-MB SFP Transceiver Cabling Specifications

100-MB SFP Transceiver Product Number	Description	Interface Connector	Nominal Wavelength (nm)	Network Cable Type	Fiber Core Size[1] (micron)	Cable Distance[2]
GLC-FE-100FX	100BASE-FX SFP for 100 Mb (Fast Ethernet) ports	Dual LC	1310	MMF	50/62.5	1.24 miles (2 km)
GLC-FE-100LX	100BASE-LX10 SFP for 100 Mb (Fast Ethernet) ports	Dual LC	1310	SMF	G.652[3]	6.21 miles (10 km)
GLC-FE-100BX-D	100BASE-FX SFP for 100 Mb (Fast Ethernet) ports	Single LC	1550 (receive) 1310 (transmit)	Single-strand SMF	G.652[3]	6.21 miles (10 km)
GLC-FE-100BX-U	100BASE-FX SFP for 100 Mb (Fast Ethernet) ports	Single LC	1310 (receive) 1550 (transmit)	Single-strand SMF	G.652[3]	6.21 miles (10 km)
GLC-FE-100EX	100BASE-EX for 100 Mb (Fast Ethernet) ports	Dual LC	1310	SMF	G.652[3]	24.86 miles (40 km)
GLC-FE-100ZX	100BASE-ZX for 100 Mb (Fast Ethernet) ports	Dual LC	1550	SMF	G.652[3]	49.7 miles (80 km)

1. The numbers given for multimode fiber-optic (MMF) cable refer to the core diameter.
2. Cable distances are based on fiber loss. Additional factors, such as the number of splices and the optical quality of the fiber, can affect cabling distances.
3. ITU-T G.652 SMF as specified by the IEEE 802.3z standard.

Note The minimum cable distance for all 100-MB SFP transceivers listed, both MMF and SMF (G.652), is 6.5 feet (2 meters).

Table B-2 lists the fiber loss budgets for the 100-MB SFP transceivers.

Table B-2 Fiber Loss Budgets for the 100-MB SFP Transceivers

100-MB SFP Transceiver Product Number	Transmit (dBm)	Receive (dBm)
GLC-FE-100FX	–14 (maximum) –20 (minimum)	–14 (maximum) –31 (minimum)
GLC-FE-100LX	–8 (maximum) –15 (minimum)	–8 (maximum) –28 (minimum)
GLC-FE-100BX-U	–8 (maximum) –14 (minimum)	–7 (maximum) –28.2 (minimum)
GLC-FE-100BX-D	–8 (maximum) –14 (minimum)	–7 (maximum) –28.2 (minimum)

Table B-2 Fiber Loss Budgets for the 100-MB SFP Transceivers (continued)

100-MB SFP Transceiver Product Number	Transmit (dBm)	Receive (dBm)
GLC-FE-100EX	0 (maximum) –5 (minimum)	–8 (maximum) –28 (minimum)
GLC-FE-100ZX	2 (maximum) –3 (minimum)	–8 (maximum) –30 (minimum)

Table B-3 lists the physical and environmental specifications for the 100-MB SFP transceivers.

Table B-3 100-MB SFP Transceiver Physical and Environmental Specifications

Item	Specification
Dimensions (H x W x D)	0.04 x 0.53 x 2.22 in. (8.5 x 13.4 x 56.5 mm)
Operating temperature	32° to 122°F (0° to 50°C)
Storage temperature	–40° to 185°F (–40° to 85°C)

1-GB Transceivers

The 1-GB transceivers include the Gigabit Interface Converter (GBIC) transceiver and the SFP transceiver. The GBIC transceivers and SFP transceivers differ in both form-factor and in connector type; they are not interchangeable. Table B-4 lists the 1-GB transceiver types, the modules that support them, the transceiver illustrations, and the specification tables.

Table B-4 1-GB Transceiver Types

1-GB Transceiver Type	Supported on these Modules[1]	Transceiver Illustrations	Transceiver Specification Tables
GBIC	• WS-X6408A-GBIC • WS-X6416-GBIC • WS-X6516-GBIC • WS-X6516A-GBIC • WS-X6816-GBIC	Figure B-2 (1000BASE-T copper GBIC) Figure B-3 (1000BASE-X optical GBIC)	Table B-5 (cabling specifications) Table B-6 (fiber loss budgets) Table B-7 (environmental specifications)
SFP	• WS-X6724-SFP • WS-X6748-SFP • WS-X6824-SFP • WS-X6848-SFP	Figure B-4 (1000BASE-T copper SFP) Figure B-5 (1000BASE-X optical SFP)	Table B-8 (cabling specifications) Table B-9 (fiber loss budgets) Table B-10 (environmental specifications)

1. Not all GBIC transceiver types or SFP transceiver types may be supported on your module. Refer to your software release notes to determine if a specific GBIC transceiver or SFP transceiver is supported on your module.

1-GB GBIC Transceivers

Figure B-2 shows a 1000BASE-T (copper) GBIC transceiver. Figure B-3 shows a 1000BASE-X (optical) GBIC transceiver. Table B-5 lists the cabling specifications for the GBIC transceivers.

Figure B-2 1000BASE-T GBIC Transceiver (WS-G5483)

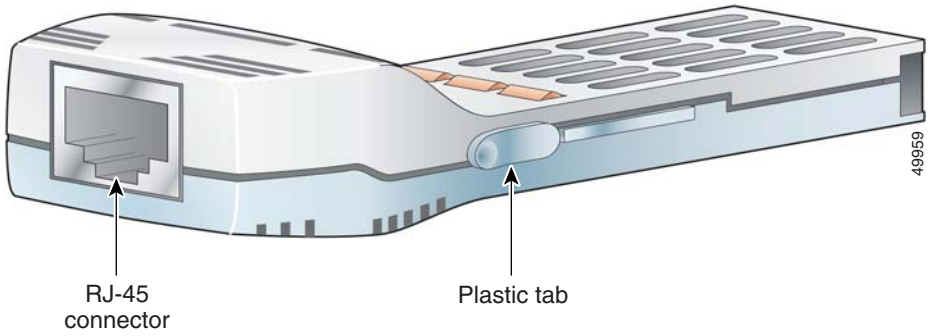


Figure B-3 1000BASE-X GBIC Transceiver Modules (WS-G5484, WS-G5486, and WS-G5487)

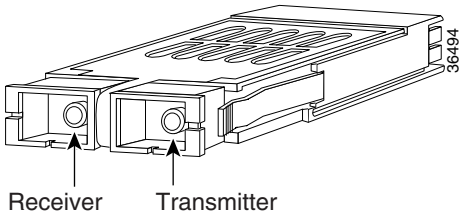


Table B-5 GBIC Transceiver Module Cabling Specifications

GBIC Transceiver Model and Product Number	Interface Connector	Nominal Wavelength (nm)	Network Cable Type	Fiber Core Size[1] (micron)	Modal Bandwidth (MHz km)	Cable Distance[2]
1000BASE-T (WS-G5483)	RJ-45	—		—	—	328 ft (100 m)
1000BASE-SX[3] (WS-G5484)	SC duplex	850	MMF	62.5	160	722 ft (220 m)
				62.5	200	902 ft (275 m)
				50.0	400	1640 ft (500 m)
				50.0	500	1804 ft (550 m)

Table B-5 GBIC Transceiver Module Cabling Specifications (continued)

GBIC Transceiver Model and Product Number	Interface Connector	Nominal Wavelength (nm)	Network Cable Type	Fiber Core Size[1] (micron)	Modal Bandwidth (MHz km)	Cable Distance[2]
1000BASE-LX/LH (WS-G5486)	SC duplex	1310	MMF[4]	62.5	500	1804 ft (550 m)
				50.0	400	1804 ft (550 m)
				50.0	500	1804 ft (550 m)
			SMF	G.652[5]	—	6.2 mi (10 km)
1000BASE-ZX[6] (WS-G5487)	SC duplex	1550	SMF	G.652[5]	—	43.5 mi (70 km)[8]
			SMF[7]	G.652[5]	—	62.1 mi (100 km)

1. The numbers given for multimode fiber-optic (MMF) cable refer to the core diameter.
2. Cable distances are based on fiber loss. Additional factors, such as the number of splices and the optical quality of the fiber, can affect cabling distances.
3. Use with MMF only.
4. Refer to the product bulletin for the usage of mode conditioning patch cords in 1000BASE and 10GBASE Ethernet laser-based transmissions at this URL: http://www.cisco.com/en/US/prod/collateral/modules/ps5455/product_bulletin_c25-530836.html
5. ITU-T G.652 SMF as specified by the IEEE 802.3z standard.
6. Use with SMF only.
7. Dispersion-shifted single-mode fiber-optic cable.
8. The minimum link distance for ZX GBICs is 6.2 miles (10 km), when an 8-dB attenuator is installed at each end of the link. Without attenuators, the minimum link distance is 24.9 miles (40 km).

Table B-6 lists the fiber loss budgets for the GBIC transceivers.

Table B-6 Fiber Loss Budgets for the 1-GB GBIC Transceivers

1-GB GBIC Transceiver Product Number	Transmit (dBm)	Receive (dBm)
WS-G5484	–3 (maximum)	0 (maximum)
(1000BASE-SX)	–9.5 (minimum)	–17 (minimum)
WS-G5486	–3 (maximum)	–3 (maximum)
(1000BASE-LX/LH)	–9.5 (minimum)	–19 (minimum)
WS-G5487	5 (maximum)	–3 (maximum)
(1000BASE-ZX)	0 (minimum)	–23 (minimum)[1]

1. The 1000BASE-ZX GBIC transceiver provides a minimum optical power budget of 23 dB. To determine the supported link distance, you need to measure your cable plant with an optical loss test set to verify that the optical loss of the cable plant (including connectors and splices) is less than or equal to this value. The optical measurement must be performed with a 1550 nanometer light source.

Table B-7 lists the physical and environmental specifications for the GBIC transceivers.

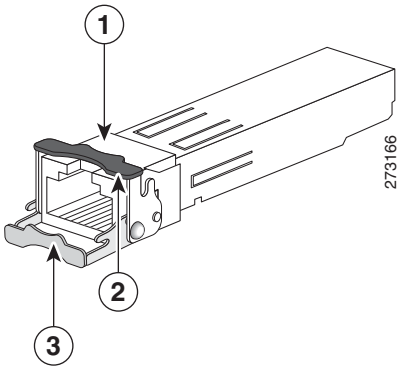
Table B-7 1-GB GBIC Transceiver Physical and Environmental Specifications

Item	Specification
Dimensions (H x W x D)	0.75 x 1.54 x 3.50 in. (19.0 x 39.1 x 88.9 mm)
Operating temperature	32° to 122°F (0° to 50°C)
Storage temperature	–40° to 185°F (–40° to 85°C)

1-GB SFP Transceivers

Figure B-4 shows a 1000BASE-T (copper) SFP transceiver. Figure B-5 shows a 1000BASE-X (optical) SFP transceiver. Table B-8 lists the cabling specifications for the GBIC transceivers.

Figure B-4 1000BASE-T SFP Transceiver (GLC-T)



1	RJ-45 connector	**3**	Bale-clasp shown in the open (unlocked) position
2	Bale-clasp shown in the closed (locked) position		

Figure B-5 1000BASE-X SFP Transceivers

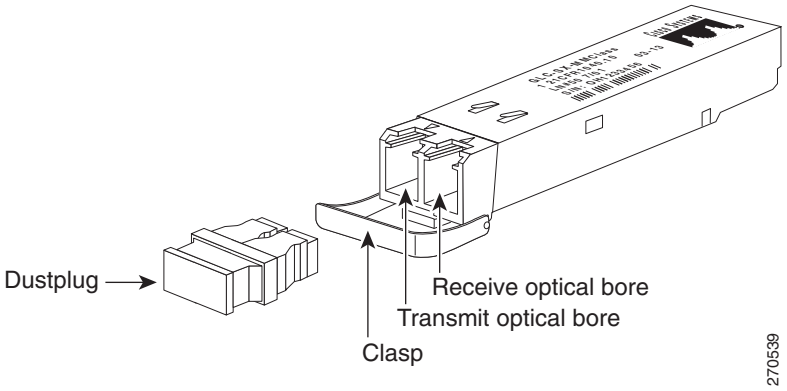


Table B-8 SFP Transceiver Cabling Specifications

SFP Transceiver Module and Product Number	Interface Connector	Nominal Wavelength (nm)	Network Cable Type	Fiber Core Size (micron)	Modal Bandwidth (MHz/km)	Cable Distance[1]
1000BASE-T (GLC-T=)	RJ-45	—	Category 5, 5e, or 6 UTP/FTP	—	—	328 ft (100 m)
1000BASE-SX (GLC-SX-MM=)	LC duplex	850	MMF	62.5 62.5 50.0 50.0	160 200 400 500	722 ft (220 m) 902 ft (275 m) 1640 ft (500 m) 1804 ft (550 m)
1000BASE-LX/LH (GLC-LH-SM=)	LC duplex	1300	MMF[2] SMF	62.5 50.0 50.0 G.652[3]	500 400 500 —	1804 ft (550 m) 1804 ft (550 m) 1804 ft (550 m) 6.21 mi (10 km)
1000BASE-ZX (GLC-ZX-SM=)	LC duplex	1550	SMF	G.652[3]	—	43.4 to 62 mi (70 to 100 km)[4]

1. Cable distances are based on fiber loss. Additional factors, such as the number of splices and the optical quality of the fiber, can affect cabling distances.
2. Refer to the product bulletin for the usage of mode conditioning patch cords in 1000BASE and 10GBASE Ethernet laser-based transmissions at this URL: http://www.cisco.com/en/US/prod/collateral/modules/ps5455/product_bulletin_c25-530836.html
3. ITU-T G.652 SMF as specified by the IEEE 802.3z standard.
4. 1000BASE-ZX SFP modules can reach up to 62 miles (100 km) by using dispersion-shifted SMF or low-attenuation SMF; the actual distance depends on the fiber quality, the number of splices, and the connectors.

Table B-9 lists the fiber loss budgets for the 1-GB SFP transceivers.

Table B-9 Fiber Loss Budgets for the 1-GB SFP Transceivers

1-GB SFP Transceiver Product Number	Transmit (dBm)	Receive (dBm)
GLC-SX-MM (1000BASE-SX)	–4 (maximum) –9.5 (minimum)	0 (maximum) –17 (minimum)
GLC-LH-SM (1000BASE-LX/LH)	–3 (maximum) –9.5 (minimum)	–3 (maximum) –20 (minimum)
GLC-ZX-SM (1000BASE-ZX)	5 (maximum) 0 (minimum)	–3 (maximum) –23 (minimum)
GLC-BX-U	–3 (maximum) –9 (minimum)	–3 (maximum) –19.5 (minimum)
GLC-BX-D	–3 (maximum) –9 (minimum)	–3 (maximum) –19.5 (minimum)

Table B-10 lists the physical and environmental specifications for the 1-GB SFP transceivers.

Table B-10 1-GB SFP Transceiver Physical and Environmental Specifications

Item	Specification
Dimensions (H x W x D)	0.04 x 0.53 x 2.22 in. (8.5 x 13.4 x 56.5 mm)
Operating temperature	32° to 122°F (0° to 50°C)
Storage temperature	–40° to 185°F (–40° to 85°C)

Note You can use any combination of SFP modules that your Cisco device supports. The only restrictions are that each SFP port must match the wavelength specifications on the other end of the cable and that the cable must not exceed the stipulated cable length for reliable communications.

10-GB Transceivers

The 10-GB transceiver types include the XENPAK transceiver and the X2 transceiver. The XENPAK transceivers and X2 transceivers differ in form-factor; they are not interchangeable. Table B-11 lists both 10-GB transceiver types and the modules that support them

Table B-11 10-GB Transceiver Types and Module Support

10-GB Transceiver Type	Supported on these Modules[1]
XENPAK transceivers	• WS-X6704-10GE • WS-SUP32-10GE-3B
X2 transceivers	• VS-S720-10G-3C • VS-S720-10G-3CXL • WS-X6708-10G-3C • WS-X6708-10G-3CXL • WS-X6716-10G-3C • WS-X6716-10G-3CXL
SFP+ transceivers	• VS-S720-10G-3C[2] • VS-S720-10G-3CXL[2] • WS-X6904-40G[3]

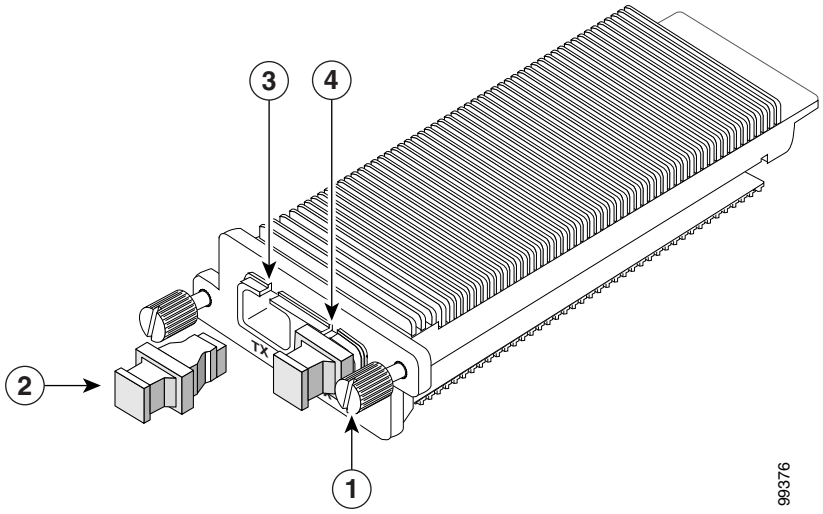
1. Not all 10-GB transceiver versions may be supported on your module. Refer to your software release notes to determine if a specific 10-GB transceiver is supported on your module.
2. The VS-S720-10G-3C and the VS-S720-10G-3CXL supervisor engines have two 10-Gigabit transceiver uplink ports on the front panel. Normally, the ports support X2 transceivers. By using a OneX converter, the 10-Gigabit port can also support SFP+ transceivers
3. The WS-X6904-40G Ethernet module has four ports that support 40-Gigabit CFP transceivers. By installing a FourX converter in a port, that port can accept up to four SFP+ transceivers.

XENPAK Transceivers

XENPAK transceivers are supported in the WS-X6704-10GE 10-Gigabit Ethernet module. Figure B-6 shows the form-factor of the XENPAK transceiver. Table B-12 lists the optical and the cabling distance specifications for the XENPAK transceivers.

Note The dual SC connector on the X2 transceivers support network interface cables with either Physical Contact (PC) or Ultra-Physical Contact (UPC) polished face types. The connectors do not support network interface cables with an Angle Polished Connector (APC)-polished face type.

Figure B-6 10-Gigabit XENPACK Transceiver



1	Captive installation screw	3	Transmit optical bore
2	Optical bore dust plug	4	Receive optical bore

Table B-12 10-GB XENPAK Transceiver Specifications and Cabling Distances

XENPAK	Connector	Nominal Wavelength	Network Fiber Type	Fiber Core Size (microns)	Modal Bandwidth (Mhz/km)	Maximum Cable Distance[1]
XENPAK-10GB-CX4	InfiniBand 4X	N/A	CX4 (copper)	—	—	49 ft (15 m)[2]
XENPAK-10GB-SR	SC duplex	850 nm	MMF	62.5	160	85.3 ft (26 m)
				62.5	200	108.3 ft (33 m)
				50.0	400	216.5 ft (66 m)
				50.0	500	269.0 ft (82 m)
				50.0	2000	984.3 ft (300 m)
XENPAK-10GB-LX4	SC duplex	1310 nm	MMF	62.5	500	984.3 ft (300 m)[3]
				50.0	400	787.4 ft (240 m)
				50.0	500	984.3 ft (300 m)
XENPAK-10GB-LR XENPAK-10GB-LR+	SC duplex	1310 nm	SMF	G.652[4]	—	6.2 mi (10 km)
XENPAK-10GB-LRM	SC duplex	1310 nm	MMF	62.5	500	722 ft (220 m)[5]
				50.0	400	328 ft (100 m)
				50.0	500	722 ft (220 m)
XENPAK-10GB-LW[6]	SC duplex	1310 nm	SMF	G.652[2]	—	6.21 mi (10 km)
XENPAK-10GB-ER[7] XENPAK-10GB-ER+[7]	SC duplex	1550 nm	SMF	G.652[4]	—	24.9 mi (40 km)
XENPAK-10GB-ZR	SC duplex	1550 nm	SMF	—	—	50 mi (80 km)

1. Cable distances are based on fiber loss. Additional factors, such as the number of splices and the optical quality of the fiber, can affect cabling distances. The minimum cabling distance for optical XENPAK types (LX4, SR, LR, and ER) is 6.6 ft (2 m) according to the IEEE 802.3ae standard. The minimum cabling distance for the XENPAK-10GB-LRM is 1.6 ft (0.5 m) according to IEEE 802.3aq standard.
2. The Cisco XENPAK-10GB-CX4 transceiver supports link lengths of up to 49.2 feet (15 m) on CX4 cable. Cisco offers four CX4 cables: CAB-INF-28G-1= (1 meter cable), CAB-INF-28G-5= (5 meter cable), CAB-INF-28G-10= (10 meter cable), and CAB-INF-26G-15= (15 meter cable).
3. The Cisco XENPAK-10GB-LX4 transceiver supports link lengths of 300 meters on standard Fiber Distributed Data Interface (FDDI) grade multimode fiber (MMF). To ensure that specifications are met, the transmitter output should be coupled through a mode conditioning patch cord. Cisco offers two mode conditioning patch cords: CAB-GELX-625= (mode conditioning patch cable, 62.5 microns, dual SC connectors) and CAB-MCP50-SC= (mode conditioning patch cable, 50 microns, dual SC connectors).
4. ITU-T G.652 SMF as specified by the IEEE 802.3z standard. Even though dispersion-shifted optical fiber reduces signal dispersion, which allows the signal to travel farther, signal attenuation still limits its distance.
5. The Cisco XENPAK-10GB-LRM transceiver supports link lengths of 220m on standard Fiber Distributed Data Interface (FDDI) grade multimode fiber (MMF). To ensure that specifications are met over FDDI-grade, OM1 and OM2 fibers, the transmitter should be coupled through a mode conditioning patch cord. Cisco offers two mode conditioning patch cords: CAB-GELX-625= (mode conditioning patch cable 62.5 microns, dual SC connectors) and CAB-MCP50-SC= (mode conditioning patch cable 50 microns, dual SC connectors). No mode conditioning patch cord is required for applications using OM3.
6. The XENPAK-10GB-LW (WAN PHY) supports a link length of 6.2 miles (10 km) on standard SMF (G.652).
7. Requires a 5 db 1550 nm fixed loss attenuator for cable distances less than 12.43 miles (20 km). The attenuator is available from Cisco Systems (p/n WS-X6K-5DB-ATT=)

Table B-13 lists the fiber loss budgets for the 10-GB XENPAK transceivers.

Table B-13 Fiber Loss Budgets for the 10-GB XENPAK Transceivers

10-GB XENPAK Transceiver Product Number	Transmit (dBm)	Receive (dBm)
XENPAK-10GB-SR	–1.2[1] (maximum) –7.3 (minimum)	–1 (maximum) –9.9 (minimum)
XENPAK-10GB-LX4	–0.5 per lane (maximum) –6.75 per lane (minimum)	–0.5 per lane (maximum) –14.25 per lane (minimum)
XENPAK-10GB-LR XENPAK-10GB-LR+	0.5 (maximum) –8.2 (minimum)	0.5 (maximum) –14.4 (minimum)
XENPAK-10GB-LRM	0.5 (maximum) –6.5 (minimum)	0.5 (maximum) –8.4 (minimum) (in average) 6.4 (minimum) (in Optical Modulation Amplitude (OMA))[2]
XENPAK-10GB-LW	0.5 (maximum) –8.2(minimum)	0.5 (maximum) –14.4 (minimum)
XENPAK-10GB-ER XENPAK-10GB-ER+	4.0 (maximum) –4.7 (minimum)	–1.0 (maximum) –15.8 (minimum)
XENPAK-10GB-ZR	4.0 (maximum) 0 (minimum)	–7.0 (maximum) –24.0 (minimum)

1. The launch power shall be the lesser of the class 1 safety limit or the maximum receive power. Class 1 laser requirements are defined by IEC 60825-1: 2001.
2. Both the average and the OMA specifications must be met simultaneously.

Table B-14 lists the physical and environmental specifications for the XENPAK transceivers.

Table B-14 10-GB XENPAK Transceiver Physical and Environmental Specifications

Item	Specification
Dimensions (H x W x D)	0.47 x 1.42 x 4.76 in. (18 x 36 x 121 mm)
Operating temperature	32° to 104°F (0° to 40°C)
Storage temperature	-40° to 167°F (–40° to 75°C)

X2 Transceivers

X2 transceivers are supported on the WS-X6708-10GE, WS-X6716-10GE, and the WS-X6848-10GE 10-Gigabit Ethernet modules. Not all X2 transceiver types are supported unconditionally by these two modules; the following caveats apply:

- X2-10GB-CX4—10GBASE for CX4 (copper) cable. No restrictions for use.
- X2-10GB-ER—10GBASE-ER serial 1550-nm extended-reach, single-mode fiber (SMF), dispersion-shifted fiber (DSF). X2-10GB-ER transceivers labeled with a serial number that ends in -02 do not provide EMI compliance with the WS-X6716-10GE module. (See Figure B-7 for the serial number location.)
- X2-10GB-LR—10GBASE-LR serial 1310-nm long-reach, single-mode fiber (SMF), dispersion-shifted fiber (DSF). X2-10GB-LR transceivers labeled with a serial number that ends in -02 do not provide EMI compliance with the WS-X6716-10GE module. (See Figure B-7 for the serial number location.)
- X2-10GB-LRM—10GBASE-LRM for FDDI-grade multimode fiber (MMF). The X2-10GB-LRM is not supported by the **show idprom** command.
- X2-10GB-LX4—10GBASE-LX4 serial 1310-nm multimode fiber (MMF). X2-10GB-LX4 transceivers that are labeled with a serial number that ends with -01, -02, or -03 do not provide EMI compliance when they are installed in the WS-X6716-10GE. (See Figure B-7 for the serial number location.)
- X2-10GB-SR—10GBASE-SR serial 850-nm short-reach multimode fiber (MMF). No restrictions for use.

Figure B-7 X2 Transceiver Serial Number Label Locator

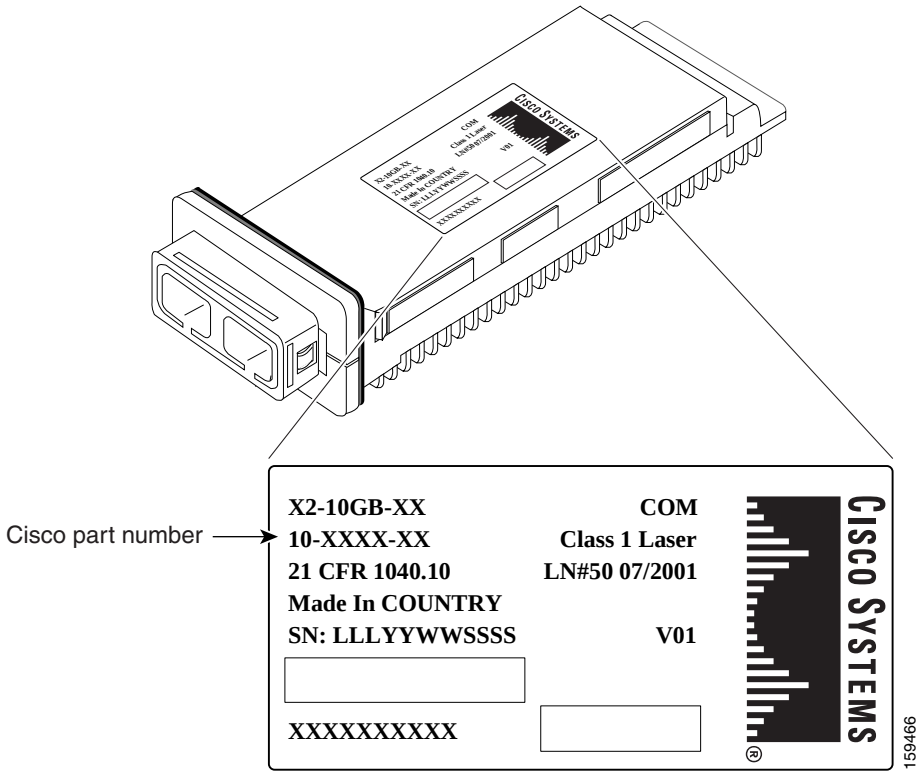
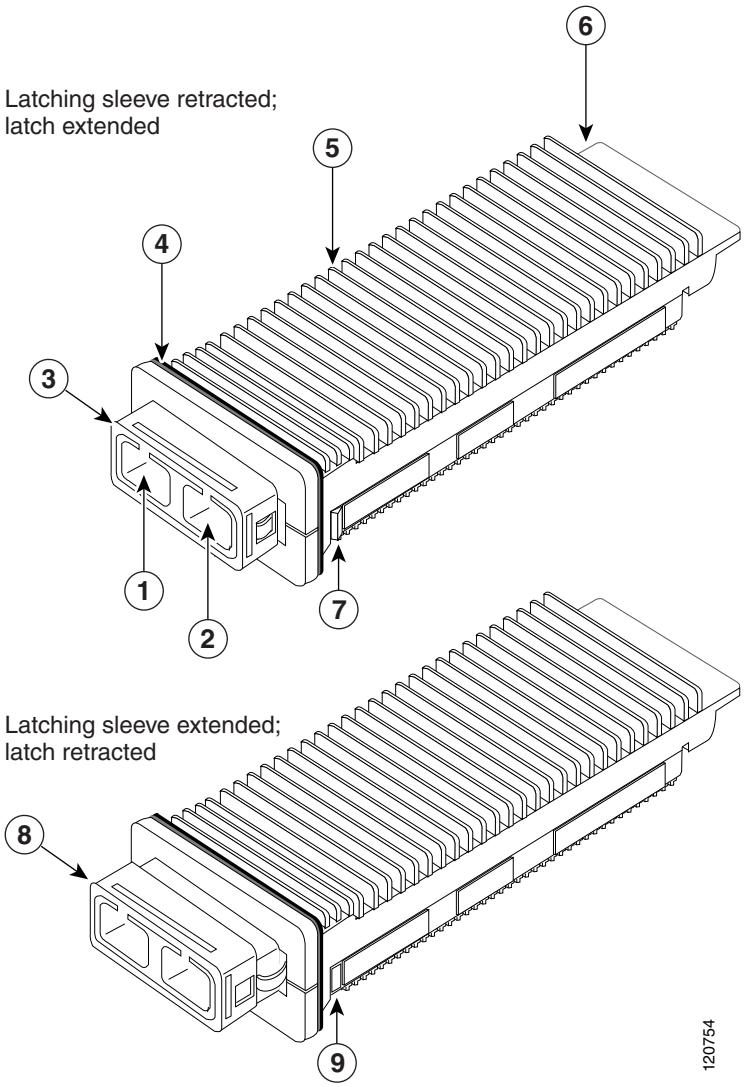


Figure B-8 shows the X2 transceivers with the major features identified. Table B-15 lists the cabling specifications for the X2 transceivers.

Figure B-8 10-GB X2 Transceiver



1	Transmit optical bore	**6**	Module connector
2	Receive optical bore	**7**	Latch (extended)
3	Latching sleeve (retracted)	**8**	Latching sleeve (extended)
4	EMI gasket	**9**	Latch (retracted)
5	Transceiver heat sink		

Table B-15 X2 Transceiver Cabling Specifications

X2 Transceiver Product Number	Connector Type	Wavelength (nm)	Cable Type	Core Size (microns)	Modal Bandwidth (MHz/km	Maximum Cabling Distance[1]
X2-10GB-CX4	InfiniBand 4X	—	InfiniBand (copper)	—	—	49.2 ft (15 m)[2]
X2-10GB-SR	SC duplex	850	MMF	62.5	160	85.3 ft (26 m)
				62.5	200	108.3 ft (33 m)
				50.0	400	216.5 ft (66 m)
				50.0	500	269 ft (82 m)
				50.0	2000	984.3 ft (300 m)
X2-10GB-LX4	SC duplex	1310	MMF	62.5	500	984.3 ft (300 m)[3]
				50.0	400	787.4 ft (240 m)
				50.0	500	984.3 ft (300 m)
X2-10GB-LR	SC duplex	1310	SMF	G.652 fiber	—	6.21 mi (10 km)
X2-10GB-LRM	SC duplex	1310	MMF	62.5	500	722 ft (220 m)[4]
				50.0	400	328 ft (100 m)
				50.0	500	722 ft (220 m)
X2-10GB-ER[5]	SC duplex	1550	SMF	G.652 fiber	—	24.84 mi (40 km)

1. Cable distances are based on fiber loss. Additional factors, such as the number of splices and the optical quality of the fiber, can affect cabling distances. The minimum cabling distance for optical X2 transceiver types (LX4, SR, LR, and ER) is 6.6 ft (2 m) according to the IEEE 802.3ae standard. The minimum cabling distance for the X2-10GB-LRM is 1.6 ft (0.5 m) according to IEEE 802.3aq standard.
2. The Cisco X2-10GB-CX4 transceiver supports link lengths of up to 49.2 feet (15 m) on CX4 cable. Cisco offers four CX4 cables: CAB-INF-28G-1= (1 meter cable), CAB-INF-28G-5= (5 meter cable), CAB-INF-28G-10= (10 meter cable), and CAB-INF-26G-15= (15 meter cable).
3. The Cisco X2-10GB-LX4 transceiver supports link lengths of 300 meters on standard Fiber Distributed Data Interface (FDDI) grade multimode fiber (MMF). To ensure that specifications are met, the transmitter output should be coupled through a mode conditioning patch cord. Cisco offers two mode conditioning patch cords: CAB-GELX-625= (mode conditioning patch cable, 62.5 microns, dual SC connectors) and CAB-MCP50-SC= (mode conditioning patch cable, 50 microns, dual SC connectors).
4. The Cisco X2-10GB-LRM transceiver supports link lengths of 220 meters on standard Fiber Distributed Data Interface (FDDI) grade multimode fiber (MMF). To ensure that specifications are met over FDDI-grade, OM1 and OM2 fibers, the transmitter should be coupled through a mode conditioning patch cord. Cisco offers two mode conditioning patch cords: CAB-GELX-625= (mode conditioning patch cable 62.5 microns, dual SC connectors) and CAB-MCP50-SC= (mode conditioning patch cable 50 microns, dual SC connectors). No mode conditioning patch cord is required for applications using OM3.
5. Requires a 5 db 1550 nm fixed loss attenuator for cable distances less than 12.43 miles (20 km). The attenuator is available from Cisco Systems (p/n WS-X6K-5DB-ATT=)

Table B-16 lists the fiber loss budgets for the 10-GB X2 transceivers.

Table B-16 X2 Transceiver Optical Transmit and Receive Specifications

X2 Transceiver Product Number	Transmit Power (dBm)	Receive Power (dBm)
X2-10GB-LRM	0.5 (max) –6.5 (min)	0.5 (max) –8.4 (min) (In average)[1] –6.4 (min) (in Optical Modulation Amplitude (OMA))
X2-10GB-SR	–1.2 (max)[2] –7.3 (min)	–1.0 (max) –9.9 (min)
X2-10GB-LR	0.5 (max) –8.2 (min)	0.5 (max) –14.4 (min)
X2-10GB-ER	4.0 (max) –4.7 (min)	–1.0 (max) –15.8 (min)
X2-10GB-LX4	–0.5 per lane (max) –6.75 per lane	–0.5 (max) –14.4 per lane

1. Both the average and the OMA specifications must be met simultaneously.
2. The launch power shall be the lesser of the class 1 safety limit or the maximum receive power. Class 1 laser requirements are defined by IEC 60825: 2001.

Table B-17 lists the physical and environmental specifications for the X2 transceiver.

Table B-17 10-GB X2 Transceiver Physical and Environmental Specifications

Item	Specification
Dimensions (H x W x D)	0.53 x 1.41 x 3.58 in. (13.46 x 36 x 91 mm)
Operating temperature	32° to 104°F (0° to 40°C)
Storage temperature	–40° to 167°F (–40° to 75°C)

SFP+ Transceivers

10-Gigabit SFP+ transceivers are supported by the Virtual Switching Supervisor Engine 720 (VS-S720-10G-3C and VS-S720-10G-3CXL) and the WS-X6904-40G Ethernet module (with the use of FourX converter modules). The supervisor engine has two 10-Gigabit ports on the the front panel. The two ports normally accepts X2 10-Gigabit transceivers. By installing a OneX converter module (CVR-X2-SFP10G) in the port, the port can accept a 10-Gigabit SFP+ transceiver. For general information, compatibility matrix, and installation instructions for the SFP+ transceiver, see the following publications:

- For general information on the 10-Gigabit SFP+ transceiver modules including models and specifications, see the *Cisco 10GBASE SFP+ Modules Data Sheet* at the following URL:

  http://www.cisco.com/en/US/prod/collateral/modules/ps5455/data_sheet_c78-455693.html

- For details on which modules support the 10-Gigabit SFP+ transceiver module and software requirements, see the *Cisco 10-Gigabit Ethernet Transceiver Modules Compatibility Matrix* at the following URL:

  http://www.cisco.com/en/US/docs/interfaces_modules/transceiver_modules/compatibility/matrix/OL_6974.html
- For 10-Gigabit SFP+ transceiver installation instructions, see the *Cisco SFP and SFP+ Transceiver Module Installation Notes* at the following URL:

  http://www.cisco.com/en/US/docs/interfaces_modules/transceiver_modules/installation/note/78_15160.html
- For general information on the OneX converter, see the *Cisco OneX Converter Module* data sheet at the following URL:
- http://www.cisco.com/en/US/prod/collateral/modules/ps5455/data_sheet_c78-547521.html

40-Gigabit Transceivers

40-Gigabit CFP transceivers are supported by the WS-X6904-40G Ethernet module. The module accepts up to four of the 40-Gigabit CFP transceivers in slots on the module front panel. For general information, compatibility matrix, and installation instructions, see the following publications:

- For general information, including specifications and optical characteristics, on the 40-Gigabit CFP transceiver modules, see the *Cisco 40GBASE CFP Modules Data Sheet* at the following URL:

  http://www.cisco.com/en/US/prod/collateral/modules/ps5455/data_sheet_c78-702617.html
- For 40-Gigabit CFP transceiver module compatibility information, see the *Cisco 40-Gigabit Ethernet Transceiver Modules Compatibility Matrix* at the following URL:

  http://www.cisco.com/en/US/docs/interfaces_modules/transceiver_modules/compatibility/matrix/OL_24900.html
- For 40-Gigabit CFP transceiver module installation instructions, see the *Cisco 40-Gigabit and 100-Gigabit CFP transceiver Modules Installation Note* at the following URL:

  http://www.cisco.com/en/US/docs/interfaces_modules/transceiver_modules/installation/note/OL_23946.html

WDM Transceivers

The WDM transceiver modules are listed in Table B-18 along with brief descriptions of the transceiver modules and illustration references.

Table B-18 WDM Transceivers

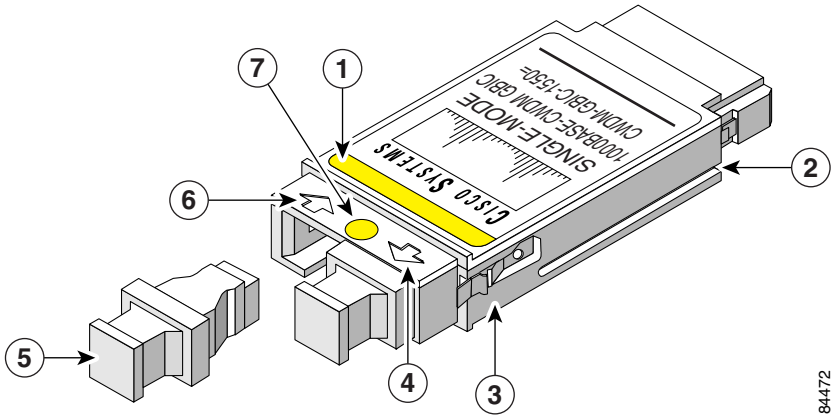
WDM Transceiver Type	Description	Supported on these Modules[1]	WDM Transceiver Illustration	WDM Transceiver Specification Table
CWDM GBIC	The CWDM GBIC transceivers provide 1000BASE-X full-duplex connectivity between the GBIC-compatible modules, supervisor engines, and the network. A set of eight CWDM GBICs are available for use with the CWDM Passive Optical System. The CWDM GBIC transceivers have a duplex SC connector.	• WS-X6408A-GBIC • WS-X6416-GBIC • WS-X6516-GBIC • WS-X6516A-GBIC • WS-X6816-GBIC	Figure B-9	Table B-19
DWDM GBIC	DWDM GBIC transceivers are used as part of a DWDM optical network to provide high-capacity bandwidth across an fiber-optic network. There are 32 fixed-wavelength DWDM GBICs that support the International Telecommunications Union (ITU) 100-GHz wavelength grid. The DWDM GBIC transceivers have a duplex SC connector.	• WS-X6408A-GBIC • WS-X6416-GBIC • WS-X6516-GBIC • WS-X6516A-GBIC • WS-X6816-GBIC	Figure B-10	Table B-20
R/O WDM GBIC	The R/O WDM GBIC receiver (WDM-GBIC-REC) operates as a pluggable receiver on any unidirectional link in a CWDM or DWDM transport network; there is no transmitter in the GBIC. The receiver can be used for all wavelengths supported by Cisco CWDM and DWDM transceivers and can be used interchangeably with 1000BASE-SX, 1000BASE-LX/LH, and 1000BASE-ZX transceivers on a port-by-port basis. The W/O WDM receiver has a single SC connector.	• WS-X6408A-GBIC • WS-X6416-GBIC • WS-X6516-GBIC • WS-X6516A-GBIC • WS-X6816-GBIC	—	—

Table B-18 WDM Transceivers (continued)

WDM Transceiver Type	Description	Supported on these Modules[1]	WDM Transceiver Illustration	WDM Transceiver Specification Table
CWDM SFP	The Coarse Wavelength Division Multiplexing (CWDM) SFPs are hot-swappable, transceiver components that you plug into SFP-compatible modules and supervisor engines. The CWDM SFP transceiver uses an LC optical connector to connect to single-mode fiber-optic (SMF) cable. You can connect the CWDM SFPs to CWDM passive optical system add/drop multiplexer (OADM) modules or multiplexer/demultiplexer plug-in modules using single-mode fiber-optic cables.	• WS-X6724-SFP • WS-X6748-SFP	Figure B-11	Table B-21
DWDM XENPAK	DWDM XENPAK transceivers are used as part of a DWDM optical network to provide high-capacity bandwidth across an fiber-optic network. There are 32 fixed-wavelength DWDM XENPAK transceivers that support the International Telecommunications Union (ITU) 100 GHz wavelength grid. The DWDM XENPAK transceivers have a duplex SC connector.	• WS-X6704-10GE	Figure B-12	Table B-22
R/O WDM XENPAK	The R/O WDM XENPAK receiver (WDM-XENPAK-REC) operates as a pluggable receiver on any unidirectional link in a CWDM or DWDM transport network; there is no transmitter in the XENPAK. The receiver can be used for all wavelengths supported by Cisco DWDM XENPAK transceivers. The W/O WDM receiver has a single SC connector.	• WS-X6704-10GE	—	—

1. Not all WDM transceivers may be supported on the modules. Refer to your software release notes for specific information on which WDM transceivers are supported and the software release level necessary to support them.

Figure B-9 CWDM GBIC Transceiver



1	Color arrow on label	**5**	Optical bore dust plug
2	Alignment groove	**6**	Receive optical bore
3	Spring clip	**7**	Color dot
4	Transmit optical bore		

Table B-19 CWDM GBIC Transceivers Wavelengths

Model Number	Color Code	CWDM GBIC Wavelength
CWDM-GBIC-1470=	Gray	1470 nm laser single-mode
CWDM-GBIC-1490=	Violet	1490 nm laser single-mode
CWDM-GBIC-1510=	Blue	1510 nm laser single-mode
CWDM-GBIC-1530=	Green	1530 nm laser single-mode
CWDM-GBIC-1550=	Yellow	1550 nm laser single-mode
CWDM-GBIC-1570=	Orange	1570 nm laser single-mode
CWDM-GBIC-1590=	Red	1590 nm laser single-mode
CWDM-GBIC-1610=	Brown	1610 nm laser single-mode

Figure B-10 DWDM GBIC Transceiver Module

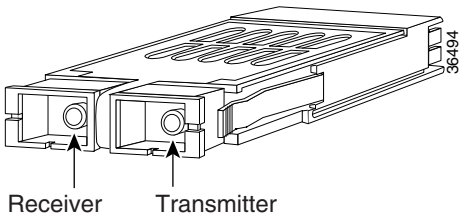


Table B-20 DWDM GBIC Transceiver Product Numbers and ITU Channel Numbers

DWDM GBIC Product Number	Description	ITU Channel
DWDM-GBIC-60.61	1000BASE-DWDM 1560.61 nm GBIC	21
DWDM-GBIC-59.79	1000BASE-DWDM 1559.79 nm GBIC	22
DWDM-GBIC-58.98	1000BASE-DWDM 1558.98 nm GBIC	23
DWDM-GBIC-58.17	1000BASE-DWDM 1558.17 nm GBIC	24
DWDM-GBIC-56.55	1000BASE-DWDM 1556.55 nm GBIC	26
DWDM-GBIC-55.75	1000BASE-DWDM 1555.75 nm GBIC	27
DWDM-GBIC-54.94	1000BASE-DWDM 1554.94 nm GBIC	28
DWDM-GBIC-54.13	1000BASE-DWDM 1554.13 nm GBIC	29
DWDM-GBIC-52.52	1000BASE-DWDM 1552.52 nm GBIC	31
DWDM-GBIC-51.72	1000BASE-DWDM 1551.72 nm GBIC	32
DWDM-GBIC-50.92	1000BASE-DWDM 1550.92 nm GBIC	33
DWDM-GBIC-50.12	1000BASE-DWDM 1550.12 nm GBIC	34
DWDM-GBIC-48.51	1000BASE-DWDM 1548.51 nm GBIC	36
DWDM-GBIC-47.72	1000BASE-DWDM 1547.72 nm GBIC	37
DWDM-GBIC-46.92	1000BASE-DWDM 1546.92 nm GBIC	38
DWDM-GBIC-46.12	1000BASE-DWDM 1546.12 nm GBIC	39
DWDM-GBIC-44.53	1000BASE-DWDM 1544.53 nm GBIC	41
DWDM-GBIC-43.73	1000BASE-DWDM 1543.73 nm GBIC	42
DWDM-GBIC-42.94	1000BASE-DWDM 1542.94 nm GBIC	43
DWDM-GBIC-42.14	1000BASE-DWDM 1542.14 nm GBIC	44
DWDM-GBIC-40.56	1000BASE-DWDM 1540.56 nm GBIC	46
DWDM-GBIC-39.77	1000BASE-DWDM 1539.77 nm GBIC	47
DWDM-GBIC-39.98	1000BASE-DWDM 1539.98 nm GBIC	48
DWDM-GBIC-38.19	1000BASE-DWDM 1538.19 nm GBIC	49
DWDM-GBIC-36.61	1000BASE-DWDM 1536.61 nm GBIC	51
DWDM-GBIC-35.82	1000BASE-DWDM 1535.82 nm GBIC	52
DWDM-GBIC-35.04	1000BASE-DWDM 1535.04 nm GBIC	53
DWDM-GBIC-34.25	1000BASE-DWDM 1534.25 nm GBIC	54
DWDM-GBIC-32.68	1000BASE-DWDM 1532.68 nm GBIC	56
DWDM-GBIC-31.90	1000BASE-DWDM 1531.90 nm GBIC	57
DWDM-GBIC-31.12	1000BASE-DWDM 1531.12 nm GBIC	58
DWDM-GBIC-30.33	1000BASE-DWDM 1530.33 nm GBIC	59

Table B-21 CWDM SFP Transceivers

Model Number	Color Code	CWDM GBIC Wavelength
CWDM-SFP-1470=	Gray	1470 nm laser, single-mode
CWDM-SFP-1490=	Violet	1490 nm laser, single-mode
CWDM-SFP-1510=	Blue	1510 nm laser, single-mode
CWDM-SFP-1530=	Green	1530 nm laser, single-mode
CWDM-SFP-1550=	Yellow	1550 nm laser, single-mode
CWDM-SFP-1570=	Orange	1570 nm laser, single-mode
CWDM-SFP-1590=	Red	1590 nm laser, single-mode
CWDM-SFP-1610=	Brown	1610 nm laser, single-mode

Figure B-11 CWDM SFP Transceiver

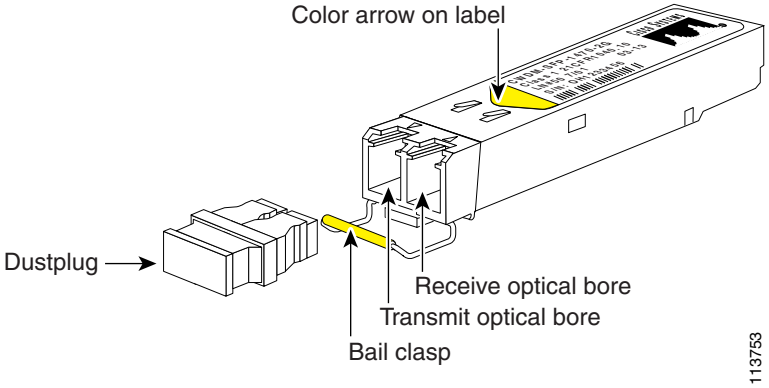


Table B-22 DWDM XENPAK Transceiver Module Product Numbers and ITU Channel Numbers

DWDM XENPAK Product Number	Description	ITU Channel
DWDM-XENPAK-60.61	1000BASE-DWDM 1560.61 nm XENPAK	21
DWDM-XENPAK-59.79	1000BASE-DWDM 1559.79 nm XENPAK	22
DWDM-XENPAK-58.98	1000BASE-DWDM 1558.98 nm XENPAK	23
DWDM-XENPAK-58.17	1000BASE-DWDM 1558.17 nm XENPAK	24
DWDM-XENPAK-56.55	1000BASE-DWDM 1556.55 nm XENPAK	26
DWDM-XENPAK-55.75	1000BASE-DWDM 1555.75 nm XENPAK	27
DWDM-XENPAK-54.94	1000BASE-DWDM 1554.94 nm XENPAK	28

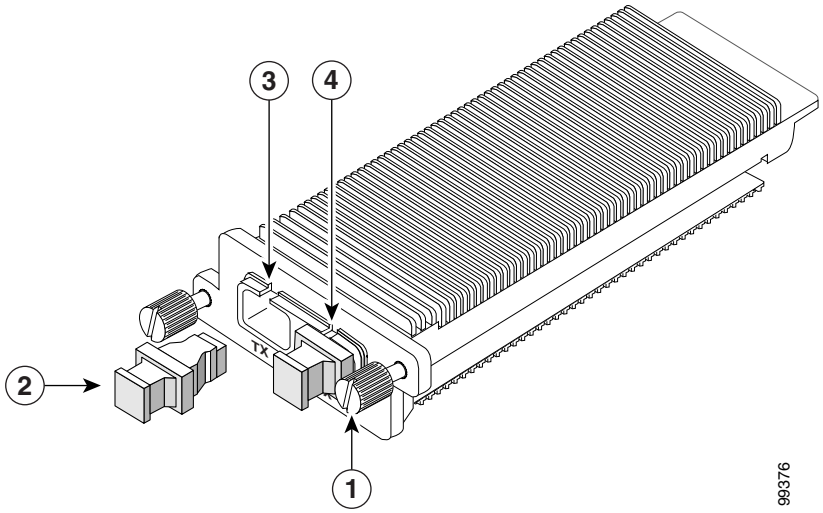
Table B-22 DWDM XENPAK Transceiver Module Product Numbers and ITU Channel Numbers (continued)

DWDM XENPAK Product Number	Description	ITU Channel
DWDM-XENPAK-54.13	1000BASE-DWDM 1554.13 nm XENPAK	29
DWDM-XENPAK-52.52	1000BASE-DWDM 1552.52 nm XENPAK	31
DWDM-XENPAK-51.72	1000BASE-DWDM 1551.72 nm XENPAK	32
DWDM-XENPAK-50.92	1000BASE-DWDM 1550.92 nm XENPAK	33
DWDM-XENPAK-50.12	1000BASE-DWDM 1550.12 nm XENPAK	34
DWDM-XENPAK-48.51	1000BASE-DWDM 1548.51 nm XENPAK	36
DWDM-XENPAK-47.72	1000BASE-DWDM 1547.72 nm XENPAK	37
DWDM-XENPAK-46.92	1000BASE-DWDM 1546.92 nm XENPAK	38
DWDM-XENPAK-46.12	1000BASE-DWDM 1546.12 nm XENPAK	39
DWDM-XENPAK-44.53	1000BASE-DWDM 1544.53 nm XENPAK	41
DWDM-XENPAK-43.73	1000BASE-DWDM 1543.73 nm XENPAK	42
DWDM-XENPAK-42.94	1000BASE-DWDM 1542.94 nm XENPAK	43
DWDM-XENPAK-42.14	1000BASE-DWDM 1542.14 nm XENPAK	44
DWDM-XENPAK-40.56	1000BASE-DWDM 1540.56 nm XENPAK	46
DWDM-XENPAK-39.77	1000BASE-DWDM 1539.77 nm XENPAK	47
DWDM-XENPAK-39.98	1000BASE-DWDM 1539.98 nm XENPAK	48
DWDM-XENPAK-38.19	1000BASE-DWDM 1538.19 nm XENPAK	49
DWDM-XENPAK-36.61	1000BASE-DWDM 1536.61 nm XENPAK	51
DWDM-XENPAK-35.82	1000BASE-DWDM 1535.82 nm XENPAK	52
DWDM-XENPAK-35.04	1000BASE-DWDM 1535.04 nm XENPAK	53

Table B-22 DWDM XENPAK Transceiver Module Product Numbers and ITU Channel Numbers (continued)

DWDM XENPAK Product Number	Description	ITU Channel
DWDM-XENPAK-34.25	1000BASE-DWDM 1534.25 nm XENPAK	54
DWDM-XENPAK-32.68	1000BASE-DWDM 1532.68 nm XENPAK	56
DWDM-XENPAK-31.90	1000BASE-DWDM 1531.90 nm XENPAK	57
DWDM-XENPAK-31.12	1000BASE-DWDM 1531.12 nm XENPAK	58
DWDM-XENPAK-30.33	1000BASE-DWDM 1530.33 nm XENPAK	59

Figure B-12 DWDM XENPACK Transceiver



1	Captive installation screw	**2**	Dustplug
3	Transmit optical bore	**4**	Receive optical bore

APPENDIX C

ESD Precautions

Revised: July 2011

This appendix provides information on preventing ESD when removing and installing modules in a chassis.

Attaching Your ESD Grounding Strap

Electrostatic discharge (ESD) damage, which can occur when modules or other FRUs are improperly handled, results in intermittent or complete failures. Modules consist of printed circuit boards that are fixed in metal carriers. Electromagnetic interference (EMI) shielding and connectors are integral components of the carrier. Although the metal carrier helps to protect the board from ESD, always use an ESD grounding strap when handling modules.

For preventing ESD damage, follow these guidelines:

- Always use an ESD wrist strap and ensure that it makes maximum contact with bare skin. ESD grounding straps are available with banana plugs, metal spring clips, or alligator clips. All Catalyst 6500 series chassis are equipped with a banana plug connector (identified by the ground symbol next to the connector) somewhere on the front panel.
  - If you have an older Catalyst 6500 series chassis equipped with a plastic banana plug connector, we recommend that you use either the supplied ESD grounding wrist strap (with a metal clip) or an ESD grounding wrist strap equipped with an alligator clip.
  - If you have a newer Catalyst 6500 series chassis that has a bare metal hole as the banana plug connector (also identified by the ground symbol next to the hole), we recommend that you use a personal ESD grounding strap equipped with a banana plug.
- If you choose to use the disposable ESD wrist strap supplied with most FRUs or an ESD wrist strap equipped with an alligator clip, you must attach the system ground lug to the chassis in order to provide a proper grounding point for the ESD wrist strap.

  Note This system ground is also referred to as the network equipment building system (NEBS) ground.

- If your chassis does not have the NEBS system ground attached, you must install the system ground lug and a ground wire. Refer to the online *Catalyst 6500 Series Switches Installation Guide* for the procedure.

After you install the system ground lug, follow these steps to correctly attach the ESD wrist strap:

Step 1 Attach the ESD wrist strap to bare skin as follows:

a. If you are using the ESD wrist strap supplied with the FRUs, open the wrist strap package and unwrap the ESD wrist strap. Place the black conductive loop over your wrist and tighten the strap so that it makes good contact with your bare skin.

b. If you are using an ESD wrist strap equipped with an alligator clip, open the package and remove the ESD wrist strap. Locate the end of the wrist strap that attaches to your body and secure it to your bare skin.

Step 2 Grasp the spring or alligator clip on the ESD wrist strap and momentarily touch the clip to a bare metal spot (unpainted surface) on the rack.

We recommend that you touch the clip to an unpainted rack rail so that any built-up static charge is then safely dissipated to the entire rack.

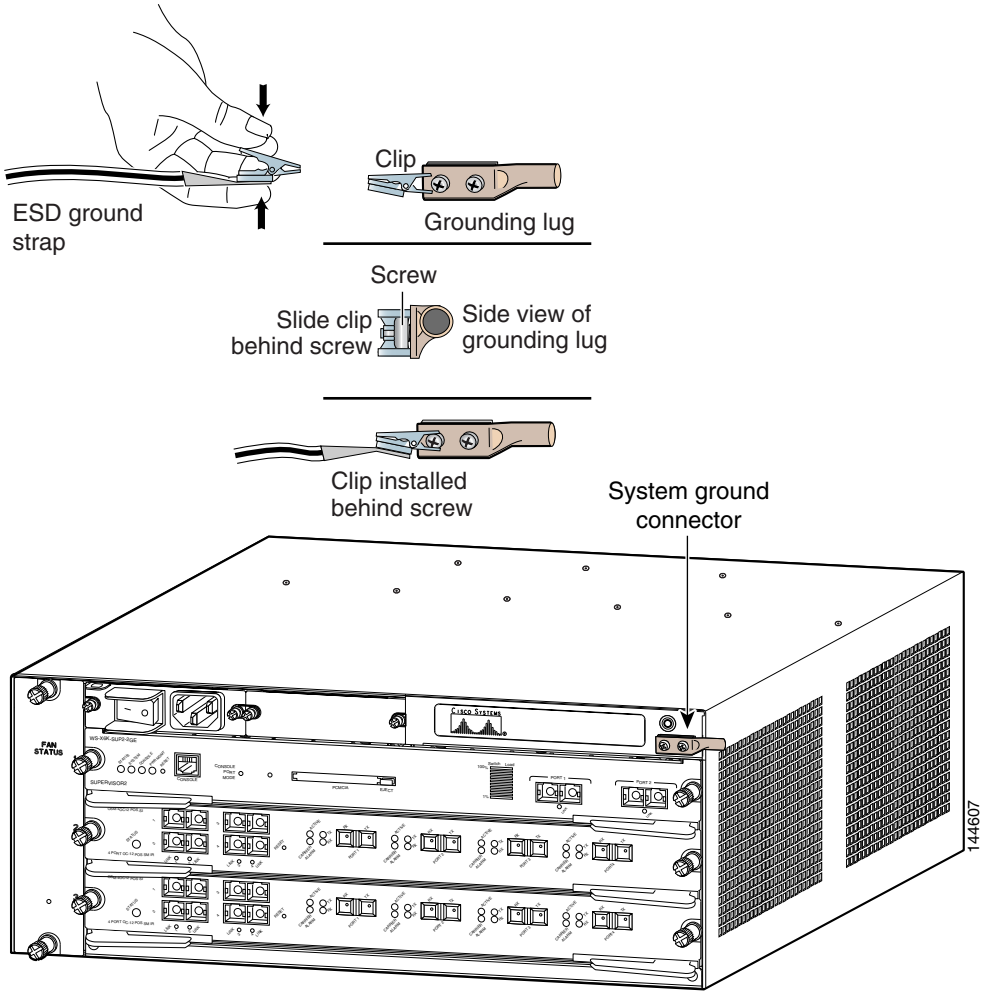
Step 3 Attach either the spring clip or the alligator clip to the ground lug screw as follows (See Figure C-1):

a. If you are using the ESD wrist strap that is supplied with the FRUs, squeeze the spring clip jaws open, position the spring clip to one side of the system ground lug screw head, and slide the spring clip over the lug screw head so that the spring clip jaws close behind the lug screw head.

Note The spring clip jaws do not open wide enough to fit directly over the head of the lug screw or the lug barrel.

b. If you are using an ESD wrist strap that is equipped with an alligator clip, attach the alligator clip directly over the head of the system ground lug screw or to the system ground lug barrel.

Figure C-1 Attaching the ESD Wrist Strap Clip to the System Ground Lug Screw



In addition, follow these guidelines when handling modules:

- Handle carriers by available handles or edges only; avoid touching the printed circuit boards or connectors.
- Place a removed component board-side-up on an antistatic surface or in a static-shielding container. If you plan to return the component to the factory, immediately place it in a static-shielding container.
- Never attempt to remove the printed circuit board from the metal carrier.

Caution For safety, periodically check the resistance value of the antistatic strap. The measurement should be between 1 and 10 megohm (Mohm).

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