



ECS3510-28F  
28-Port Fast Ethernet  
Fiber Access Switch

Installation Guide



# INSTALLATION GUIDE

## **ECS3510-28F FAST ETHERNET FIBER ACCESS SWITCH**

*Layer 2 Switch*

*with 24 100BASE-FX Single-fiber Ports,  
and 4 Combination Gigabit (RJ-45/SFP) Ports*

ECS3510-28F  
E062010-CS-R01  
150200000112A



# COMPLIANCES AND SAFETY STATEMENTS

## **FCC - CLASS A**

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

You are cautioned that changes or modifications not expressly approved by the party responsible for compliance could void your authority to operate the equipment.

You may use unshielded twisted-pair (UTP) for RJ-45 connections - Category 3 or better for 10 Mbps connections, Category 5 or better for 100 Mbps connections, Category 5, 5e, or 6 for 1000 Mbps connections. For fiber optic connections, you may use 50/125 or 62.5/125 micron multimode fiber or 9/125 micron single-mode fiber.

### CE MARK DECLARATION OF CONFORMANCE FOR EMI AND SAFETY (EEC)

This information technology equipment complies with the requirements of the Council Directive 89/336/EEC on the Approximation of the laws of the Member States relating to Electromagnetic Compatibility and 73/23/EEC for electrical equipment used within certain voltage limits and the Amendment Directive 93/68/EEC. For the evaluation of the compliance with these Directives, the following standards were applied:

- RFI Emission:
- ◆ Limit class A according to EN 55022
  - ◆ Limit class A for harmonic current emission according to EN 61000-3-2
  - ◆ Limitation of voltage fluctuation and flicker in low-voltage supply system according to EN 61000-3-3
- Immunity:
- ◆ Product family standard according to EN 55024
  - ◆ Electrostatic Discharge according to EN 61000-4-2
  - ◆ Radio-frequency electromagnetic field according to EN 61000-4-3
  - ◆ Electrical fast transient/burst according to EN 61000-4-4
  - ◆ Surge immunity test according to EN 61000-4-5
  - ◆ Immunity to conducted disturbances, Induced by radio-frequency fields: EN 61000-4-6
  - ◆ Power frequency magnetic field immunity test according to EN 61000-4-8
  - ◆ Voltage dips, short interruptions and voltage variations immunity test according to EN 61000-4-11
- LVD:
- ◆ EN 60950-1:2006

## SAFETY COMPLIANCE

### Warning: Fiber Optic Port Safety

CLASS I  
LASER DEVICE

When using a fiber optic port, never look at the transmit laser while it is powered on. Also, never look directly at the fiber TX port and fiber cable ends when they are powered on.

### Avertissement: Ports pour fibres optiques - sécurité sur le plan optique

DISPOSITIF LASER  
DE CLASSE I

Ne regardez jamais le laser tant qu'il est sous tension. Ne regardez jamais directement le port TX (Transmission) à fibres optiques et les embouts de câbles à fibres optiques tant qu'ils sont sous tension.

### Warnhinweis: Faseroptikanschlüsse - Optische Sicherheit

LASERGERÄT  
DER KLASSE I

Niemals ein Übertragungslaser betrachten, während dieses eingeschaltet ist. Niemals direkt auf den Faser-TX-Anschluß und auf die Faserkabelenden schauen, während diese eingeschaltet sind.

## PSE ALARM

本製品に同梱いたしております電源コードセットは、本製品専用です。本電源コードセットは、本製品以外の製品並びに他の用途でご使用いただくことは出来ません。製品本体に同梱された電源コードセットを利用し、他製品の電源コードセットを使用しないで下さい。

## POWER CORD SAFETY

**Please read the following safety information carefully before installing the switch:**

**WARNING:** Installation and removal of the unit must be carried out by qualified personnel only.

- ◆ The unit must be connected to an earthed (grounded) outlet to comply with international safety standards.
- ◆ Do not connect the unit to an A.C. outlet (power supply) without an earth (ground) connection.
- ◆ The appliance coupler (the connector to the unit and not the wall plug) must have a configuration for mating with an EN 60320/IEC 320 appliance inlet.
- ◆ The socket outlet must be near to the unit and easily accessible. You can only remove power from the unit by disconnecting the power cord from the outlet.
- ◆ This unit operates under SELV (Safety Extra Low Voltage) conditions according to IEC 60950. The conditions are only maintained if the equipment to which it is connected also operates under SELV conditions.

### *France and Peru only*

This unit cannot be powered from IT<sup>†</sup> supplies. If your supplies are of IT type, this unit must be powered by 230 V (2P+T) via an isolation transformer ratio 1:1, with the secondary connection point labelled Neutral, connected directly to earth (ground).

† Impédance à la terre

**IMPORTANT!** Before making connections, make sure you have the correct cord set. Check it (read the label on the cable) against the following:



**Power Cord Set**

U.S.A. and Canada	<p>The cord set must be UL-approved and CSA certified.</p> <p>The minimum specifications for the flexible cord are:  - No. 18 AWG - not longer than 2 meters, or 16 AWG.  - Type SV or SJ  - 3-conductor</p> <p>The cord set must have a rated current capacity of at least 10 A</p> <p>The attachment plug must be an earth-grounding type with NEMA 5-15P (15 A, 125 V) or NEMA 6-15P (15 A, 250 V) configuration.</p>
Denmark	The supply plug must comply with Section 107-2-D1, Standard DK2-1a or DK2-5a.
Switzerland	The supply plug must comply with SEV/ASE 1011.
U.K.	<p>The supply plug must comply with BS1363 (3-pin 13 A) and be fitted with a 5 A fuse which complies with BS1362.</p> <p>The mains cord must be &lt;HAR&gt; or &lt;BASEC&gt; marked and be of type HO3VVF3GO.75 (minimum).</p>
Europe	<p>The supply plug must comply with CEE7/7 ("SCHUKO").</p> <p>The mains cord must be &lt;HAR&gt; or &lt;BASEC&gt; marked and be of type HO3VVF3GO.75 (minimum).</p> <p>IEC-320 receptacle.</p>

**Veillez lire à fond l'information de la sécurité suivante avant d'installer le Switch:**

**AVERTISSEMENT:** L'installation et la dépose de ce groupe doivent être confiés à un personnel qualifié.

- ◆ Ne branchez pas votre appareil sur une prise secteur (alimentation électrique) lorsqu'il n'y a pas de connexion de mise à la terre (mise à la masse).
- ◆ Vous devez raccorder ce groupe à une sortie mise à la terre (mise à la masse) afin de respecter les normes internationales de sécurité.
- ◆ Le coupleur d'appareil (le connecteur du groupe et non pas la prise murale) doit respecter une configuration qui permet un branchement sur une entrée d'appareil EN 60320/IEC 320.

## COMPLIANCES AND SAFETY STATEMENTS

- ◆ La prise secteur doit se trouver à proximité de l'appareil et son accès doit être facile. Vous ne pouvez mettre l'appareil hors circuit qu'en débranchant son cordon électrique au niveau de cette prise.
- ◆ L'appareil fonctionne à une tension extrêmement basse de sécurité qui est conforme à la norme IEC 60950. Ces conditions ne sont maintenues que si l'équipement auquel il est raccordé fonctionne dans les mêmes conditions.

### *France et Pérou uniquement:*

Ce groupe ne peut pas être alimenté par un dispositif à impédance à la terre. Si vos alimentations sont du type impédance à la terre, ce groupe doit être alimenté par une tension de 230 V (2 P+T) par le biais d'un transformateur d'isolement à rapport 1:1, avec un point secondaire de connexion portant l'appellation Neutre et avec raccordement direct à la terre (masse).

## **Cordon électrique** - Il doit être agréé dans le pays d'utilisation

Etats-Unis et Canada: Le cordon doit avoir reçu l'homologation des UL et un certificat de la CSA.

Les spécifications minimales pour un câble flexible sont AWG No. 18, ou AWG No. 16 pour un câble de longueur inférieure à 2 mètres.  
- type SV ou SJ  
- 3 conducteurs

Le cordon doit être en mesure d'acheminer un courant nominal d'au moins 10 A.

La prise femelle de branchement doit être du type à mise à la terre (mise à la masse) et respecter la configuration NEMA 5-15P (15 A, 125 V) ou NEMA 6-15P (15 A, 250 V).

Danemark: La prise mâle d'alimentation doit respecter la section 107-2 D1 de la norme DK2 1a ou DK2 5a.

Suisse: La prise mâle d'alimentation doit respecter la norme SEV/ASE 1011.

Europe La prise secteur doit être conforme aux normes CEE 7/7 ("SCHUKO")  
Le cordon secteur doit porter la mention <HAR> ou <BASEC> et doit être de type HO3VVF3GO.75 (minimum).

**Bitte unbedingt vor dem Einbauen des Switches die folgenden Sicherheitsanweisungen durchlesen:**

**WARNUNG:** Die Installation und der Ausbau des Geräts darf nur durch Fachpersonal erfolgen.

- ◆ Das Gerät sollte nicht an eine ungeerdete Wechselstromsteckdose angeschlossen werden.
- ◆ Das Gerät muß an eine geerdete Steckdose angeschlossen werden, welche die internationalen Sicherheitsnormen erfüllt.
- ◆ Der Gerätestecker (der Anschluß an das Gerät, nicht der Wandsteckdosenstecker) muß einen gemäß EN 60320/IEC 320 konfigurierten Geräteeingang haben.
- ◆ Die Netzsteckdose muß in der Nähe des Geräts und leicht zugänglich sein. Die Stromversorgung des Geräts kann nur durch Herausziehen des Gerätenetzkabels aus der Netzsteckdose unterbrochen werden.
- ◆ Der Betrieb dieses Geräts erfolgt unter den SELV-Bedingungen (Sicherheitskleinstspannung) gemäß IEC 60950. Diese Bedingungen sind nur gegeben, wenn auch die an das Gerät angeschlossenen Geräte unter SELV-Bedingungen betrieben werden.

**Stromkabel.** Dies muss von dem Land, in dem es benutzt wird geprüft werden:

Schweiz	Dieser Stromstecker muß die SEV/ASE 1011 Bestimmungen einhalten.
Europe	Das Netzkabel muß vom Typ HO3VVF3G0.75 (Mindestanforderung) sein und die Aufschrift <HAR> oder <BASEC> tragen. Der Netzstecker muß die Norm CEE 7/7 erfüllen ("SCHUKO").

## WARNINGS AND CAUTIONARY MESSAGES



**WARNING:** This product does not contain any serviceable user parts.

**WARNING:** Installation and removal of the unit must be carried out by qualified personnel only.

**WARNING:** When connecting this device to a power outlet, connect the field ground lead on the tri-pole power plug to a valid earth ground line to prevent electrical hazards.

**WARNING:** This switch uses lasers to transmit signals over fiber optic cable. The lasers are compliant with the requirements of a Class 1 Laser Product and are inherently eye safe in normal operation. However, you should never look directly at a transmit port when it is powered on.



**CAUTION:** Wear an anti-static wrist strap or take other suitable measures to prevent electrostatic discharge when handling this equipment.

**CAUTION:** Do not plug a phone jack connector in the RJ-45 port. This may damage this device.

**CAUTION:** Use only twisted-pair cables with RJ-45 connectors that conform to FCC standards.

## ENVIRONMENTAL STATEMENTS

The manufacturer of this product endeavours to sustain an environmentally-friendly policy throughout the entire production process. This is achieved through the following means:

- ◆ Adherence to national legislation and regulations on environmental production standards.
- ◆ Conservation of operational resources.
- ◆ Waste reduction and safe disposal of all harmful un-recyclable by-products.
- ◆ Recycling of all reusable waste content.
- ◆ Design of products to maximize recyclables at the end of the product's life span.
- ◆ Continual monitoring of safety standards.

### **END OF PRODUCT LIFE SPAN**

This product is manufactured in such a way as to allow for the recovery and disposal of all included electrical components once the product has reached the end of its life.

### **MANUFACTURING MATERIALS**

There are no hazardous nor ozone-depleting materials in this product.

### **DOCUMENTATION**

All printed documentation for this product uses biodegradable paper that originates from sustained and managed forests. The inks used in the printing process are non-toxic.



# ABOUT THIS GUIDE

## PURPOSE

This guide details the hardware features of the switch, including the physical and performance-related characteristics, and how to install the switch.

## AUDIENCE

The guide is intended for use by network administrators who are responsible for installing and setting up network equipment; consequently, it assumes a basic working knowledge of LANs (Local Area Networks).

## CONVENTIONS

The following conventions are used throughout this guide to show information:



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**NOTE:** Emphasizes important information or calls your attention to related features or instructions.

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**CAUTION:** Alerts you to a potential hazard that could cause loss of data, or damage the system or equipment.

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**WARNING:** Alerts you to a potential hazard that could cause personal injury.

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## RELATED PUBLICATIONS

The following publication gives specific information on how to operate and use the management functions of the switch:

The *Management Guide*

Also, as part of the switch's software, there is an online web-based help that describes all management related features.

**REVISION HISTORY**

This section summarizes the changes in each revision of this guide.

**JUNE 2010 REVISION**

This is the first revision of this guide.



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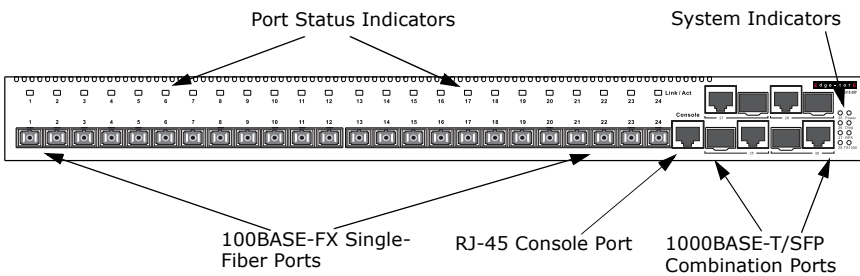


## OVERVIEW

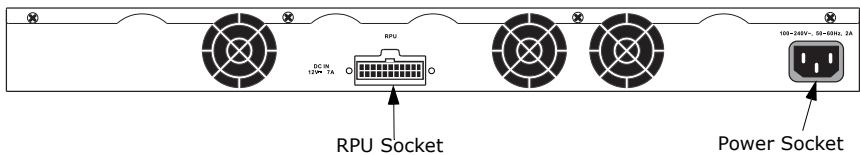
The ECS3510-28F is an intelligent Layer 2 switch designed for delivering Fiber-To-The-Home (FTTH) for high-speed Internet access. Deployed at the service provider's central office (CO), the switch supports up to 24 subscribers through 100BASE-FX single-fiber downlink connections to remote CPEs (customer premises equipment). Uplink connections from the switch to other devices at the CO are provided by four Gigabit combination ports, which are comprised of four RJ-45 ports and four SFP transceiver slots.

The switch includes an SNMP-based management agent embedded on the main board, which supports both in-band and out-of-band access for managing the switch. The switch also supports comprehensive OAM (Operations, Administration, and Maintenance) functions for management of CPEs on the subscriber fiber links.

**Figure 1: Front Panel**



**Figure 2: Rear Panel**



## **SWITCH ARCHITECTURE**

The switch employs a wire-speed, non-blocking switching fabric. This permits simultaneous wire-speed transport of multiple packets at low latency on all ports. The switch also features full-duplex capability on all ports, which effectively doubles the bandwidth of each connection.

The switch uses store-and-forward switching to ensure maximum data integrity. With store-and-forward switching, the entire packet must be received into a buffer and checked for validity before being forwarded. This prevents errors from being propagated throughout the network.

## **NETWORK MANAGEMENT OPTIONS**

With a comprehensive array of LEDs, the switch provides “at a glance” monitoring of network and port status. The switch can be managed over the network with a web browser or Telnet application, or via a direct connection to the console port. The switch includes a built-in network management agent that allows it to be managed in-band using SNMP or RMON (Groups 1, 2, 3, 9) protocols. It also has an RJ-45 serial port on the front panel for out-of-band management. A PC may be connected to this port for configuration and monitoring out-of-band through a straight-through UTP or STP Ethernet cable and the included RJ-45-to-DB-9 converter.

For a detailed description of the management features, refer to the *Management Guide*.

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## **DESCRIPTION OF HARDWARE**

### **100BASE-FX FIBER PORTS**

The switch provides 24 SC ports on the front of the switch. Each single-fiber SC connector supports a 100BASE-FX full-duplex link to a subscriber’s CPE. The switch’s fiber transceivers use Wavelength Division Multiplexing (WDM) technology to achieve bi-directional operation (1550 nm transmit, 1310 nm receive) over a single optical fiber. The WDM single-mode fiber links can run up to 15 km.

The 100 Mbps bandwidth of the fiber links can be restricted by rate-limiting, which is configurable through switch management. Each port also supports



auto-negotiation of flow control, so the switch can automatically prevent port buffers from becoming saturated.

## RJ-45 PORTS

The switch contains four combination RJ-45 ports that operate at 10 Mbps or 100 Mbps, half or full duplex, or at 1000 Mbps, full duplex. They are shared with SFP ports 25~28. In its default configuration, if an SFP transceiver (purchased separately) is installed in a slot and has a valid link on its port, the associated RJ-45 port is disabled and cannot be used. The switch can also be configured to force the use of an RJ-45 port or SFP slot, as required.

Because the RJ-45 ports support automatic MDI/MDI-X operation, you can use straight-through cables for all network connections to PCs or servers, or to other switches or hubs. (See ["Twisted-Pair Cable and Pin Assignments" on page 53](#))

Each of these ports support auto-negotiation, so the optimum transmission mode (half or full duplex), and data rate (10, 100, or 1000 Mbps) can be selected automatically. If a device connected to one of these ports does not support auto-negotiation, the communication mode of that port can be configured manually.

## SFP TRANSCEIVER SLOTS

The switch contains four Small Form Factor Pluggable (SFP) transceiver slots that operate at 1000 Mbps full duplex. These slots support 1000 Mbps SFP Gigabit Ethernet transceivers. The supported transceiver types are listed below:

- ◆ SFP 100BX20
- ◆ SFP 100BX20D
- ◆ SFP 1000SX
- ◆ SFP 1000LX
- ◆ SFP 1000LHX
- ◆ SFP 1000ZX
- ◆ SFP 1000RJ-45
- ◆ SFP 1000BX20

- ◆ SFP 1000BX20D
- ◆ SFP 1000BX10
- ◆ SFP 1000BX10D

For information on the recommended standards for fiber optic cabling, see ["1000 Mbps Gigabit Ethernet Collision Domain" on page 47](#).

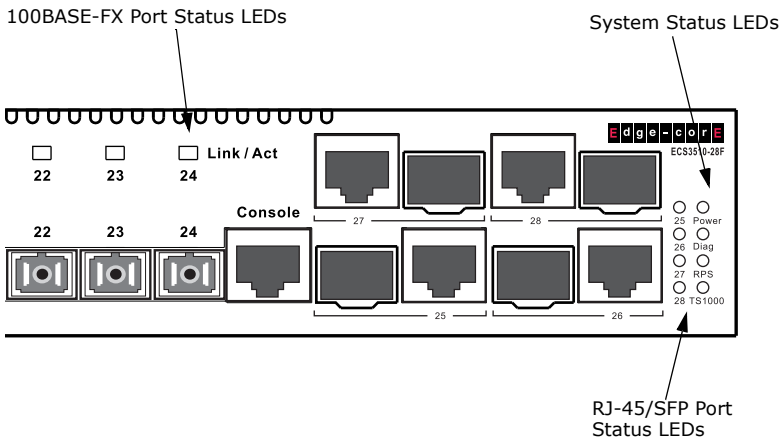
### CONSOLE PORT

An RJ-45 serial console port is provided on the switch front panel for a connection to a console device through a straight-through UTP or STP Ethernet cable and an RJ-45-to-DB-9 converter. The console device can be a PC or workstation running a VT-100 terminal emulator, or a VT-100 terminal. An RJ-45-to-DB-9 converter is supplied with the unit for connecting to the console port.

### PORT AND SYSTEM STATUS LEDs

The switch includes a display panel for key system and port indications that simplify installation and network troubleshooting. The LEDs, which are located on the front panel for easy viewing, are shown below and described in the following tables.

**Figure 3: Port LEDs**



**Table 1: 100 Mbps SC Port Status LEDs (1~24)**

LED	Condition	Status
Link/Act	On/Flashing Green	Port has established a valid 100 Mbps network connection. Flashing indicates activity.
	Off	There is no valid link on the port.

**Table 2: 1000 Mbps Combination RJ-45/SFP Ports Status LEDs (25~28)**

LED	Condition	Status
25~28 (Link/Activity)	On/Flashing Green	Port has established a valid 1000 Mbps network connection. Flashing indicates activity.
	On/Flashing Amber	Port has established a valid 10/100 Mbps network connection. Flashing indicates activity.
	Off	There is no valid link on the port.

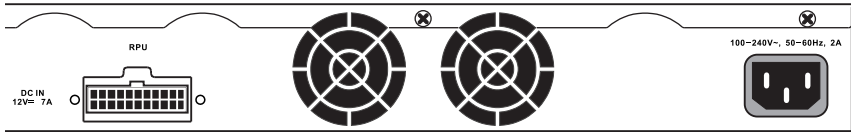
**Table 3: System Status LEDs**

LED	Condition	Status
Power	On Green	The unit's internal power supply is operating normally.
	On Amber	The unit has an internal power supply fault.
	Off	The unit has no power connected.
Diag	On Green	The system diagnostic test has completed successfully.
	Flashing Green	The system diagnostic test is in progress.
	On Amber	Indicates one of the following: <ul style="list-style-type: none"> <li>◆ After powering on, indicates that the system diagnostic test has detected a fault.</li> <li>◆ During operation, indicates that an installed SFP transceiver has failed.</li> </ul>
RPS	On Green	An RPU is connected and operating normally.
	On Amber	A fault has been detected in a connected RPU.
TS1000	On Green	A TS1000 optional converter module is installed.
	On Amber	A TS1000 optional converter module is not installed

## POWER SUPPLY SOCKETS

There are two power sockets located on the rear panel of the switch. The standard power socket is for the AC power cord. The socket labeled "RPU" is for the optional Redundant Power Unit (RPU).

**Figure 4: Power Supply Sockets**



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## FIBER-TO-THE-HOME (FTTH)

Fiber-To-The-Home (FTTH) has always been an attractive option for Internet access. It has all the benefits of optical fiber. It provides a future-proof network, in that you do not have to go through the hassles of upgrading from ADSL to XDSL, or digital co-ax to digital wireless. It does not have to struggle with electromagnetic interference problems, and with no active “outside-plant” components, it offers the highest reliability. Moreover, it does not require electric power and is immune to lightning and other transients. These properties of fiber lead to the lowest possible power and operational costs, such as maintenance, provisioning and facilities planning.

The ECS3510-28F and CPE provide an ideal FTTH system, allowing a service provider to extend an Ethernet connection over optical fiber directly to a subscriber. The ECS3510-28F contains 24 100BASE-FX full-duplex single-fiber single-mode cable connections that run from the service provider’s central office (CO) directly to CPEs installed at subscriber premises. Each single-mode fiber connection can be run up to a distance of 15 km from the CO. The switch also provides four 1000BASE-T/SFP uplink ports for connections to other switches or routers at the CO.

The CPE is typically a single-channel fiber-to-copper converter housed in a compact unit. The CPE connects to the fiber cable from the CO and provides one standard 10/100BASE-TX RJ-45 Ethernet port for connecting to a subscriber’s PC, switch, or other network device using twisted-pair cable.

## APPLICATION EXAMPLES

The ECS3510-28F switch is designed to offer a cost-effective solution for FTTH, providing downlink fiber connections to subscribers and high-bandwidth twisted-pair uplink connections to core switches and routers at the CO.

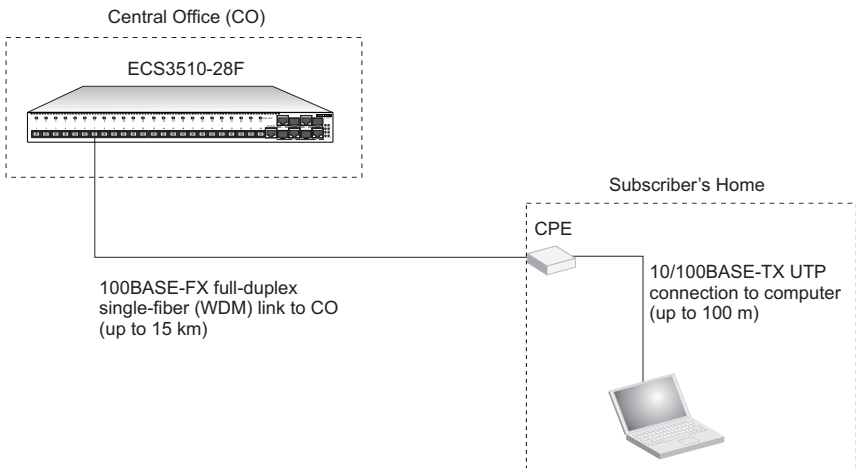
Some basic connection configurations are described in the following pages.

### DOWNLINK FIBER CONNECTIONS

Fiber optic technology allows for longer cabling than any other media type. A 100BASE-FX single-mode fiber link from the chassis can connect to a subscriber up to 15 km away. The CPE is installed inside a subscriber's premises, so there are no active outside components between the CO and the end user.

The figure below illustrates a basic switch to CPE connection.

**Figure 5: Downlink Fiber Connections**

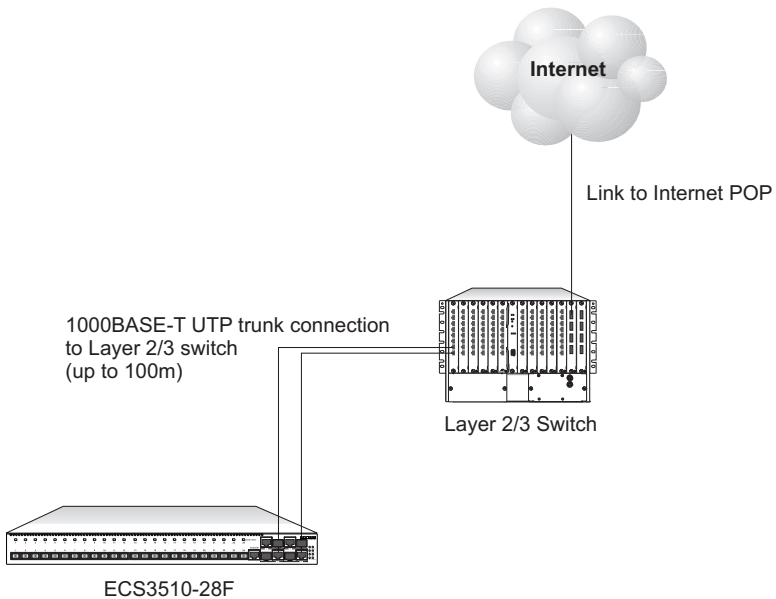


## UPLINK SFP CONNECTIONS

The ECS3510-28F switch provides 24 downlink fiber ports and four combination SFP/RJ-45 uplink ports. The 1000BASE-T ports can provide a trunked high-bandwidth connection to a core switch or router at the CO. Besides balancing the load across each port in the trunk, the additional port provides redundancy by taking over the load if the other port in the trunk fails.

The figure below illustrates the ECS3510-28F connecting to a core switch with UTP cable.

**Figure 6: Uplink SFP Connections**



---

## APPLICATION NOTES

1. Full-duplex operation only applies to point-to-point access (such as when a switch is attached to a workstation, server or another switch). When the switch is connected to a hub, both devices must operate in half-duplex mode.
2. Avoid using flow control on a port connected to a hub unless it is actually required to solve a problem. Otherwise back pressure jamming signals may degrade overall performance for the segment attached to the hub.
3. Based on recommended standards, the length of fiber optic cable for a single switched link should not exceed:
  - 1000BASE-SX: 550 m (1805 ft) for multimode fiber.
  - 1000BASE-LX: 10 km (6.2 miles) for single-mode fiber.
  - 1000BASE-LH: 80 km (49.7 miles) for single-mode fiber.
  - 1000BASE-LHX: 40 km (24.8 miles) for single-mode fiber.
  - 1000BASE-ZX: 100 km (62 miles) for single-mode fiber.
  - 1000BASE-BX20: 20 km (12.4 miles) for single-mode fiber.
  - 1000BASE-BX10: 10 km (6.2 miles) for single-mode fiber.

However, power budget constraints must also be considered when calculating the maximum cable length for your specific environment.



# 3

## INSTALLING THE SWITCH

---

### SELECTING A SITE

Switch units can be mounted in a standard 19-inch equipment rack or on a flat surface. Be sure to follow the guidelines below when choosing a location.

- ◆ The site should:
  - be at the center of all the devices you want to link and near a power outlet.
  - be able to maintain its temperature within 0 to 50 °C (32 to 122 °F) and its humidity within 5% to 95%, non-condensing
  - provide adequate space (approximately two inches) on all sides for proper air flow
  - be accessible for installing, cabling and maintaining the devices
  - allow the status LEDs to be clearly visible
- ◆ Make sure twisted-pair cable is always routed away from power lines, fluorescent lighting fixtures and other sources of electrical interference, such as radios and transmitters.
- ◆ Make sure that the unit is connected to a separate grounded power outlet that provides 100 to 240 VAC, 50 to 60 Hz, is within 2 m (6.6 feet) of each device and is powered from an independent circuit breaker. As with any equipment, using a filter or surge suppressor is recommended.

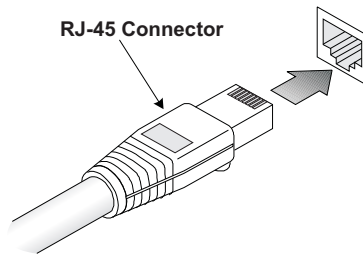
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## ETHERNET CABLING

To ensure proper operation when installing the switch into a network, make sure that the current cables are suitable for 10BASE-T, 100BASE-TX or 1000BASE-T operation. Check the following criteria against the current installation of your network:

- ◆ Cable type: Unshielded twisted pair (UTP) or shielded twisted pair (STP) cables with RJ-45 connectors; Category 3 or better for 10BASE-T, Category 5 or better for 100BASE-TX, and Category 5, 5e or 6 for 1000BASE-T.
- ◆ Protection from radio frequency interference emissions
- ◆ Electrical surge suppression
- ◆ Separation of electrical wires (switch related or other) and electromagnetic fields from data based network wiring
- ◆ Safe connections with no damaged cables, connectors or shields

**Figure 7: RJ-45 Connections**



---

## EQUIPMENT CHECKLIST

After unpacking this switch, check the contents to be sure you have received all the components. Then, before beginning the installation, be sure you have all other necessary installation equipment.

### PACKAGE CONTENTS

- ◆ Fast Ethernet Fiber Access Switch (ECS3510-28F)
- ◆ Power Cord—either US, Continental Europe or UK
- ◆ Four adhesive foot pads
- ◆ Rack-mounting kit (two brackets and eight M4 screws, plus four 12-24 rack screws with cage nuts)
- ◆ RJ-45 to DB-9 serial converter (for console connection)
- ◆ This Installation Guide
- ◆ Management Guide CD

### OPTIONAL RACK-MOUNTING EQUIPMENT

If you plan to rack-mount the switch, be sure to have a screwdriver (Phillips or flathead, depending on the type of screws used).

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## MOUNTING

This switch can be mounted in a standard 19-inch equipment rack or on a desktop or shelf. Mounting instructions for each type of site follow.

### RACK MOUNTING

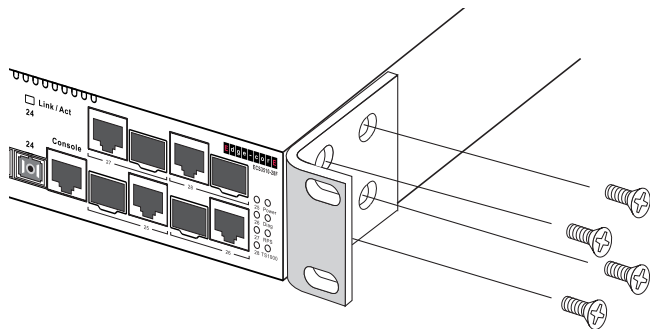
Before rack mounting the switch, pay particular attention to the following factors:

- ◆ **Temperature:** Since the temperature within a rack assembly may be higher than the ambient room temperature, check that the rack-environment temperature is within the specified operating temperature range.
- ◆ **Mechanical Loading:** Do not place any equipment on top of a rack-mounted unit.
- ◆ **Circuit Overloading:** Be sure that the supply circuit to the rack assembly is not overloaded.
- ◆ **Grounding:** Rack-mounted equipment should be properly grounded. Particular attention should be given to supply connections other than direct connections to the mains.

To rack-mount devices:

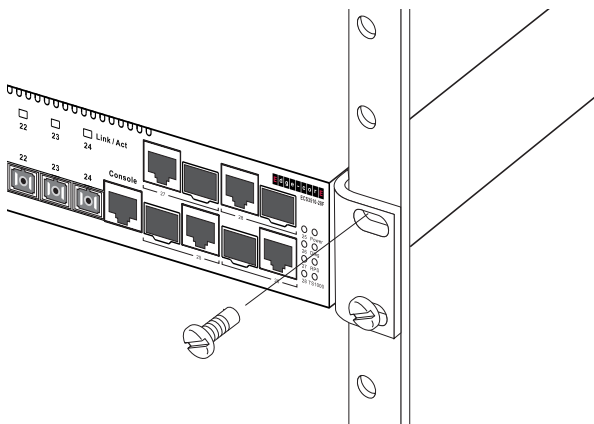
1. Attach the brackets to the device using the eight M4 screws provided in the Rack-Mounting Kit.

**Figure 8: Attaching the Brackets**



2. Mount the device in the rack, using the four 12-24 rack-mounting screws in the Rack-Mounting Kit. Be sure to secure the lower rack-mounting screws first to prevent the brackets being bent by the weight of the switch.

**Figure 9: Installing the Switch in a Rack**



3. If installing a single switch only, turn to [“Connecting to a Power Source” on page 40](#).
4. If installing multiple switches, mount them in the rack, one below the other, in any order.

5. If also installing an RPU, mount it in the rack below the other devices.

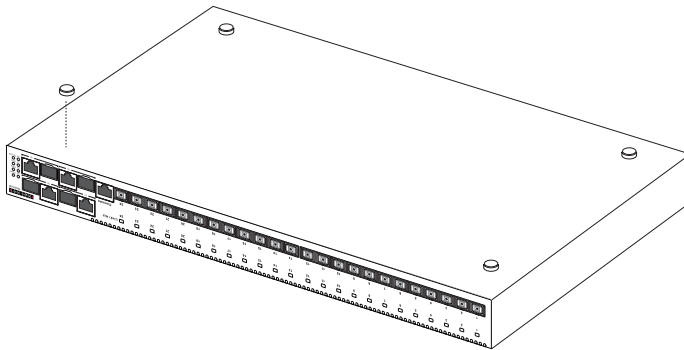
## DESKTOP OR SHELF MOUNTING

The switch includes four pre-installed rubber feet for desktop or shelf mounting.

To mount devices on a horizontal surface, follow these steps:

1. Attach the four adhesive feet to the bottom of the first switch.

**Figure 10: Attaching the Adhesive Feet**



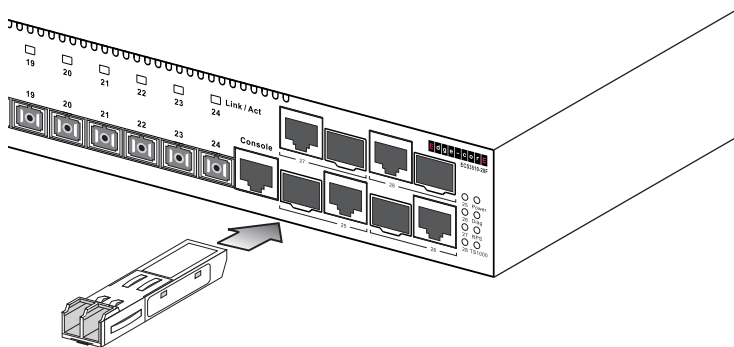
2. Set the device on a flat surface near an AC power source, making sure there are at least two inches of space on all sides for proper air flow.
3. If installing a single switch only, go to [“Connecting to a Power Source” on page 40](#).
4. If installing multiple switches, attach four adhesive feet to each one, then place each device squarely on top of the one below, in any order.
5. If also installing an RPU, place it close to the stack.

## INSTALLING AN OPTIONAL SFP TRANSCEIVER

The SFP slots support the following optional SFP transceivers:

- ◆ 1000BASE-SX
- ◆ 1000BASE-LX
- ◆ 1000BASE-LH
- ◆ 1000BASE-LHX
- ◆ 1000BASE-ZX
- ◆ 1000BASE-BX20
- ◆ 1000BASE-BX10

**Figure 11: Inserting an SFP Transceiver into a Slot**



To install an SFP transceiver, follow these steps:

1. Consider network and cabling requirements to select an appropriate SFP transceiver type.
2. Insert the transceiver with the optical connector facing outward and the slot connector facing down. Note that SFP transceivers are keyed so they can only be installed in one orientation.

- Slide the SFP transceiver into the slot until it clicks into place.



**NOTE:** SFP transceivers are hot-swappable. The switch does not need to be powered off before installing or removing a transceiver. However, always first disconnect the network cable before removing a transceiver.

**NOTE:** SFP transceivers are not provided in the switch package.

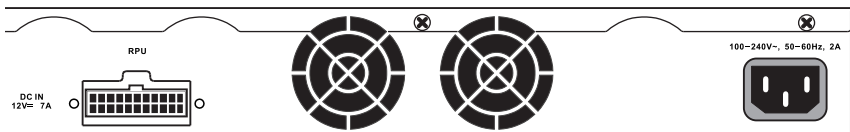
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## CONNECTING TO A POWER SOURCE

To connect a switch to a power source:

- Insert the power cable plug directly into the AC socket located at the back of the switch.

**Figure 12: Power Socket**



- Plug the other end of the cable into a grounded, 3-pin, AC power source.



**NOTE:** For International use, you may need to change the AC line cord. You must use a line cord set that has been approved for the socket type in your country.

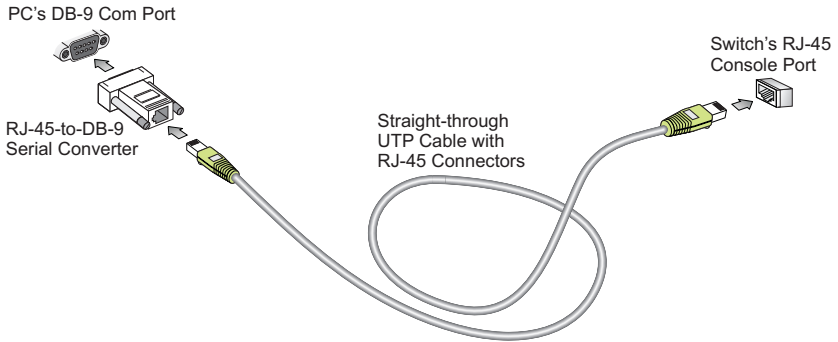
- Check the front-panel LEDs as the device is powered on to be sure the Power LED is lit. If not, check that the power cable is correctly plugged in.
- If you have purchased a Redundant Power Unit, connect it to the switch and to an AC power source now, following the instructions included with the package.



## CONNECTING TO THE CONSOLE PORT

This port is used to connect a console device to the switch through a straight-through UTP cable and an RJ-45-to-DB-9 serial converter. The console device can be a PC or workstation running a VT-100 terminal emulator, or a VT-100 terminal. An RJ-45-to-DB-9 converter is supplied with the unit for connecting to a RS-232 serial DB-9 DTE port, as illustrated below. The pin assignments used in the RJ-45-to-DB-9 converter are described below.

**Figure 13: Console Port Connection**



### WIRING MAP FOR SERIAL CONVERTER

The following table describes the pin connections for the RJ-45-to-DB-9 serial converter. The converter should be used with straight-through UTP or STP Ethernet cable.

**Table 4: Serial Converter Wiring**

8-PIN RJ-45 Port (Switch Console Port)	Null Modem	9-PIN DB-9 Port (PC's DTE Com Port)
6 TXD (transmit data)	----->	2 RXD (receive data)
3 RXD (receive data)	<-----	3 TXD (transmit data)
4 SGND (signal ground)	-----	5 SGND (signal ground)

The serial port's configuration requirements are as follows:

- ◆ Default Baud rate—115,200 bps
- ◆ Character Size—8 Characters
- ◆ Parity—None
- ◆ Stop bit—One
- ◆ Data bits—8
- ◆ Flow control—none

# 4

## MAKING NETWORK CONNECTIONS

The ECS3510-28F switch is designed to provide high-speed Internet access to individual subscribers through its 100BASE-FX single-fiber downlink connections. Four combination 1000BASE-T/SFP ports provide the uplink connection from the switch to other switches or routers at the central office.

---

### TWISTED-PAIR DEVICES

Each device requires an unshielded twisted-pair (UTP) cable with RJ-45 connectors at both ends. Use Category 5, 5e or 6 cable for 1000BASE-T connections, Category 5 or better for 100BASE-TX connections, and Category 3 or better for 10BASE-T connections.

### CABLING GUIDELINES

The RJ-45 ports on the switch support automatic MDI/MDI-X pinout configuration, so you can use standard straight-through twisted-pair cables to connect to any other network device (PCs, servers, switches, routers, or hubs).

See Appendix B for further information on cabling.



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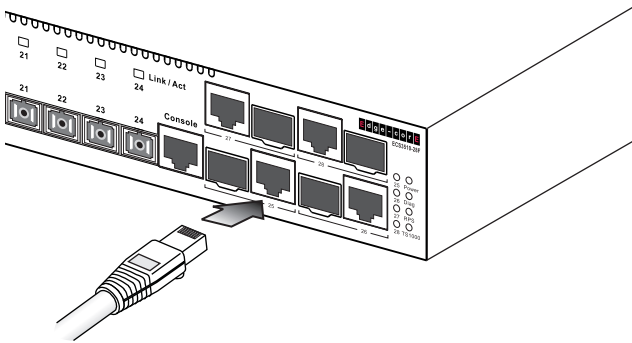
**CAUTION:** Do not plug a phone jack connector into an RJ-45 port. This will damage the switch. Use only twisted-pair cables with RJ-45 connectors that conform to FCC standards.

---

## CONNECTING TO PCs, HUBS, AND SWITCHES

1. Attach one end of a twisted-pair cable segment to the device's RJ-45 connector.

**Figure 14: Making Twisted-Pair Connections**



2. Attach the other end to an available port on the switch.

Make sure each twisted pair cable does not exceed 100 meters (328 ft) in length.

3. As each connection is made, the Link LED (on the switch) corresponding to each port will light green or amber to indicate that the connection is valid.

---

## FIBER OPTIC DEVICES

Each single-fiber SC connector on the switch's front panel connects directly to a CPE at the subscriber's premises.

The switch's single-fiber ports require one strand of 9/125 micron single-mode fiber optic cable with an SC connector at the switch end.

An optional Gigabit SFP transceiver (1000BASE-SX, 1000BASE-LX, 1000BASE-LH, 1000BASE-LHX, 1000BASE-ZX, 1000BASE-BX20, or 1000BASE-BX10) can be used for uplink connections from the switch to other network devices at the CO. A Gigabit SFP transceiver may also be used for long distance connections to devices at another service provider site.

Each single-mode fiber port requires 9/125 micron single-mode fiber optic cable with an LC connector at both ends. Each multimode fiber optic port requires 50/125 or 62.5/125 micron multimode fiber optic cabling with an LC connector at both ends.



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**WARNING:** This switch uses lasers to transmit signals over fiber optic cable. The lasers are compliant with the requirements of a Class 1 Laser Product and are inherently eye safe in normal operation. However, you should never look directly at a transmit port when it is powered on.

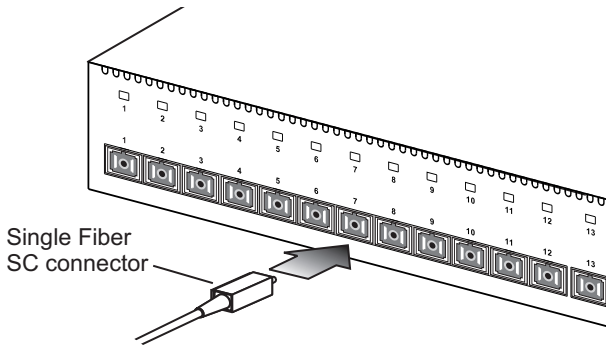
**WARNING:** When selecting a fiber SFP device, considering safety, please make sure that it can function at a temperature that is not less than the recommended maximum operational temperature of the product. You must also use an approved Laser Class 1 SFP transceiver.

---

1. Remove and keep the SC/LC port's rubber plug. When not connected to a fiber cable, the rubber plug should be replaced to protect the optics.
2. Check that the fiber terminators are clean. You can clean the cable plugs by wiping them gently with a clean tissue or cotton ball moistened with a little ethanol. Dirty fiber terminators on fiber optic cables will impair the quality of the light transmitted through the cable and lead to degraded performance on the port.

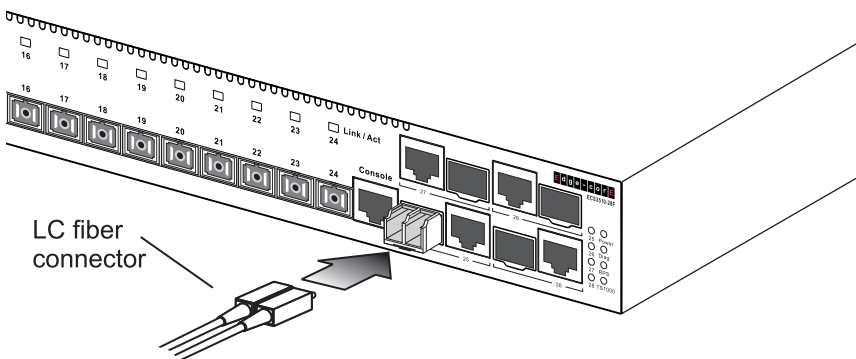
- 3.** Connect fiber devices to the switch.
  - a.** For connections to the CPE, connect one end of the cable to the SC port on the switch and the other end to the CPE at the subscriber's premises. Note that this requires an internal splice and SC connection for the single-mode fiber, which should be performed by trained service personnel only.

**Figure 15: Making SC Port Fiber Connections**



- b.** For SFP connections, connect one end of the cable to the LC port on the switch and the other end to the port on the other device. Since LC connectors are keyed, the cable can be attached in only one orientation.

**Figure 16: Making SFP Port Fiber Connections**



4. As a connection is made, check the Link LED on the switch corresponding to the port to be sure that the connection is valid.

The 100BASE-FX fiber optic ports operate at 100 Mbps, full duplex. You can run each single-mode fiber link up to a maximum of 15 kilometers from the central office. However, note that power budget constraints must also be considered when calculating the maximum cable length for each specific connection.

The SFP fiber optic ports operate at 1 Gbps, full duplex, with auto-negotiation of flow control. The maximum length for fiber optic cable operating at Gigabit speed will depend on the fiber type as listed under "[1000 Mbps Gigabit Ethernet Collision Domain](#)" on page 47.

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## CONNECTIVITY RULES

When adding hubs (repeaters) to your network, please follow the connectivity rules listed in the manuals for these products. However, note that because switches break up the path for connected devices into separate collision domains, you should not include the switch or connected cabling in your calculations for cascade length involving other devices.

### 1000BASE-T CABLE REQUIREMENTS

All Category 5 UTP cables that are used for 100BASE-TX connections should also work for 1000BASE-T, providing that all four wire pairs are connected. However, it is recommended that for all critical connections, or any new cable installations, Category 5e (enhanced Category 5) or Category 6 cable should be used. The Category 5e and 6 specifications include test parameters that are only recommendations for Category 5. Therefore, the first step in preparing existing Category 5 cabling for running 1000BASE-T is a simple test of the cable installation to be sure that it complies with the IEEE 802.3-2005 standards.

### 1000 MBPS GIGABIT ETHERNET COLLISION DOMAIN

**Table 5: Maximum 1000BASE-T Gigabit Ethernet Cable Length**

Cable Type	Maximum Cable Length	Connector
Category 5, 5e, or 6 100-ohm UTP or STP	100 m (328 ft)	RJ-45

**Table 6: Maximum 100BASE-SX Gigabit Ethernet Cable Lengths**

Fiber Size	Fiber Bandwidth	Maximum Cable Length	Connector
62.5/125 micron multimode fiber	160 MHz/km	2-220 m (7-722 ft)	LC
	200 MHz/km	2-275 m (7-902 ft)	LC
50/125 micron multimode fiber	400 MHz/km	2-500 m (7-1641 ft)	LC
	500 MHz/km	2-550 m (7-1805 ft)	LC

**Table 7: Maximum 100BASE-LX Gigabit Ethernet Cable Length**

Fiber Size	Fiber Bandwidth	Maximum Cable Length	Connector
9/125 micron single-mode fiber	N/A	2 m - 10 km (7 ft - 6.2 miles)	LC

**Table 8: Maximum 100BASE-LH Gigabit Ethernet Cable Length**

Fiber Size	Fiber Bandwidth	Maximum Cable Length	Connector
9/125 micron single-mode fiber	N/A	2 m - 80 km (7 ft - 49.7 miles)	LC

**Table 9: Maximum 100BASE-LHX Gigabit Ethernet Cable Length**

Fiber Size	Fiber Bandwidth	Maximum Cable Length	Connector
9/125 micron single-mode fiber	N/A	2 m - 40 km (7 ft - 24.8 miles)	LC

**Table 10: Maximum 100BASE-ZX Gigabit Ethernet Cable Length**

Fiber Size	Fiber Bandwidth	Maximum Cable Length	Connector
9/125 micron single-mode fiber	N/A	2 m - 100 km (7 ft - 62 miles)	LC



**Table 11: Maximum 100BASE-BX20 Gigabit Ethernet Cable Length**

Fiber Size	Fiber Bandwidth	Maximum Cable Length	Connector
9/125 micron single-mode fiber	N/A	2 m - 20 km (7 ft - 12.4 miles)	LC

**Table 12: Maximum 100BASE-BX10 Gigabit Ethernet Cable Length**

Fiber Size	Fiber Bandwidth	Maximum Cable Length	Connector
9/125 micron single-mode fiber	N/A	2 m - 10 km (7 ft - 6.2 miles)	LC

## 100 MBPS FAST ETHERNET COLLISION DOMAIN

**Table 13: Maximum Fast Ethernet Cable Lengths**

Type	Cable Type	Max. Cable Length	Connector
100BASE-TX	Category 5 or better 100-ohm UTP or STP	100 m (328 ft)	RJ-45
100BASE-FX	9/125 micron single-mode fiber (SMF) for single-fiber downlink connections	15 km (9.3 miles)	SC

## 10 MBPS ETHERNET COLLISION DOMAIN

**Table 14: Maximum Ethernet Cable Length**

Type	Cable Type	Max. Cable Length	Connector
10BASE-T	Category 3 or better 100-ohm UTP	100 m (328 ft)	RJ-45

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## CABLE LABELING AND CONNECTION RECORDS

When planning a network installation, it is essential to label the opposing ends of cables and to record where each cable is connected. Doing so will enable you to easily locate inter-connected devices, isolate faults and change your topology without need for unnecessary time consumption.

To best manage the physical implementations of your network, follow these guidelines:

- ◆ Clearly label the opposing ends of each cable.
- ◆ Using your building's floor plans, draw a map of the location of all network-connected equipment. For each piece of equipment, identify the devices to which it is connected.
- ◆ Note the length of each cable and the maximum cable length supported by the switch ports.
- ◆ For ease of understanding, use a location-based key when assigning prefixes to your cable labeling.
- ◆ Use sequential numbers for cables that originate from the same equipment.
- ◆ Differentiate between racks by naming accordingly.
- ◆ Label each separate piece of equipment.
- ◆ Display a copy of your equipment map, including keys to all abbreviations at each equipment rack.

---

## DIAGNOSING SWITCH INDICATORS

**Table 15: Troubleshooting Chart**

Symptom	Action
Power LED is Off	<ul style="list-style-type: none"><li>◆ Check connections between the switch, the power cord and the wall outlet.</li><li>◆ Contact your dealer for assistance.</li></ul>
Power LED is on Amber	<ul style="list-style-type: none"><li>◆ Power cycle the switch to try and clear the condition.</li><li>◆ If the condition does not clear, contact your dealer for assistance.</li></ul>
Diag LED On Amber	<ul style="list-style-type: none"><li>◆ If an SFP transceiver has failed, replace it.</li><li>◆ Power cycle the switch to try and clear the condition.</li><li>◆ If the condition does not clear, contact your dealer for assistance.</li></ul>
Link/Act LED is Off	<ul style="list-style-type: none"><li>◆ Verify that the switch and attached device are powered on.</li><li>◆ Be sure the cable is plugged into both the switch and corresponding device.</li><li>◆ If the switch is installed in a rack, check the connections to the punch-down block and patch panel.</li><li>◆ Verify that the proper cable type is used and its length does not exceed specified limits.</li><li>◆ Check the adapter on the attached device and cable connections for possible defects. Replace the defective adapter or cable if necessary.</li></ul>

---

## POWER AND COOLING PROBLEMS

If the power indicator does not turn on when the power cord is plugged in, you may have a problem with the power outlet, power cord, or internal power supply. However, if the unit powers off after running for a while, check for loose power connections, power losses or surges at the power outlet. If you still cannot isolate the problem, the internal power supply may be defective.

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## INSTALLATION

Verify that all system components have been properly installed. If one or more components appear to be malfunctioning (such as the power cord or network cabling), test them in an alternate environment where you are sure that all the other components are functioning properly.

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## IN-BAND ACCESS

You can access the management agent in the switch from anywhere within the attached network using Telnet, a web browser, or other network management software tools. However, you must first configure the switch with a valid IP address, subnet mask, and default gateway. If you have trouble establishing a link to the management agent, check to see if you have a valid network connection. Then verify that you entered the correct IP address. Also, be sure the port through which you are connecting to the switch has not been disabled. If it has not been disabled, then check the network cabling that runs between your remote location and the switch.



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**NOTE:** The management agent accepts up to four simultaneous Telnet sessions. If the maximum number of sessions already exists, an additional Telnet connection will not be able to log into the system.

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# B

## CABLES

### TWISTED-PAIR CABLE AND PIN ASSIGNMENTS

For 10/100BASE-TX connections, the twisted-pair cable must have two pairs of wires. For 1000BASE-T connections the twisted-pair cable must have four pairs of wires. Each wire pair is identified by two different colors. For example, one wire might be green and the other, green with white stripes. Also, an RJ-45 connector must be attached to both ends of the cable.

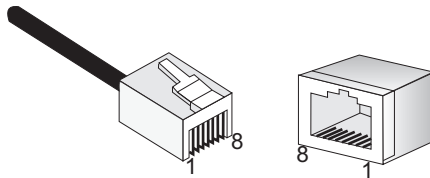


**CAUTION:** DO NOT plug a phone jack connector into any RJ-45 port. Use only twisted-pair cables with RJ-45 connectors that conform with FCC standards.

**CAUTION:** Each wire pair must be attached to the RJ-45 connectors in a specific orientation.

The figure below illustrates how the pins on the RJ-45 connector are numbered. Be sure to hold the connectors in the same orientation when attaching the wires to the pins.

**Figure 17: RJ-45 Connector Pin Numbers**



## 10BASE-T/100BASE-TX PIN ASSIGNMENTS

Use unshielded twisted-pair (UTP) or shielded twisted-pair (STP) cable for RJ-45 connections: 100-ohm Category 3 or better cable for 10 Mbps connections, or 100-ohm Category 5 or better cable for 100 Mbps connections. Also be sure that the length of any twisted-pair connection does not exceed 100 meters (328 feet).

The RJ-45 ports on the switch base unit support automatic MDI/MDI-X operation, so you can use straight-through cables for all network connections to PCs or servers, or to other switches or hubs. In straight-through cable, pins 1, 2, 3, and 6, at one end of the cable, are connected straight through to pins 1, 2, 3, and 6 at the other end of the cable. When using any RJ-45 port on this switch, you can use either straight-through or crossover cable.

**Table 16: 10/100BASE-TX MDI and MDI-X Port Pinouts**

Pin	MDI Signal Name	MDI-X Signal Name
1	Transmit Data plus (TD+)	Receive Data plus (RD+)
2	Transmit Data minus (TD-)	Receive Data minus (RD-)
3	Receive Data plus (RD+)	Transmit Data plus (TD+)
6	Receive Data minus (RD-)	Transmit Data minus (TD-)
4,5,7,8	Not used	Not used

**Note:** The "+" and "-" signs represent the polarity of the wires that make up each wire pair.

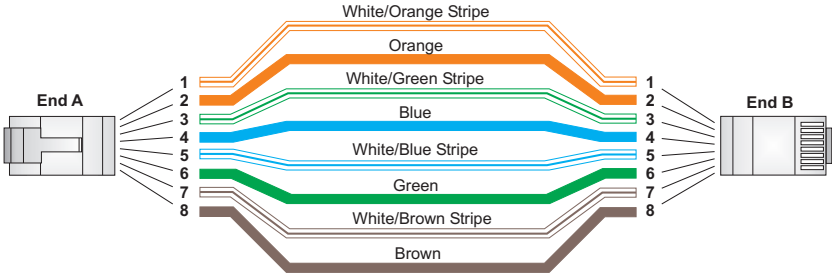
## STRAIGHT-THROUGH WIRING

If the twisted-pair cable is to join two ports and only one of the ports has an internal crossover (MDI-X), the two pairs of wires must be straight-through. (When auto-negotiation is enabled for any RJ-45 port on this switch, you can use either straight-through or crossover cable to connect to any device type.)

You must connect all four wire pairs as shown in the following diagram to support Gigabit Ethernet.

**Figure 18: Straight-through Wiring**

EIA/TIA 568B RJ-45 Wiring Standard  
10/100BASE-TX Straight-through Cable



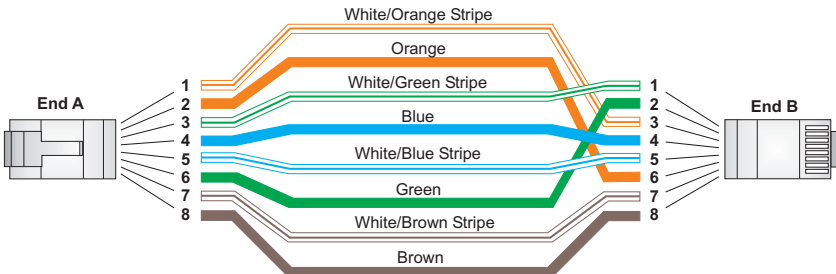
## CROSSOVER WIRING

If the twisted-pair cable is to join two ports and either both ports are labeled with an "X" (MDI-X) or neither port is labeled with an "X" (MDI), a crossover must be implemented in the wiring. (When auto-negotiation is enabled for any RJ-45 port on this switch, you can use either straight-through or crossover cable to connect to any device type.)

You must connect all four wire pairs as shown in the following diagram to support Gigabit Ethernet.

**Figure 19: Crossover Wiring**

EIA/TIA 568B RJ-45 Wiring Standard  
10/100BASE-TX Crossover Cable



## 1000BASE-T PIN ASSIGNMENTS

All 1000BASE-T ports support automatic MDI/MDI-X operation, so you can use straight-through cables for all network connections to PCs or servers, or to other switches or hubs.

The table below shows the 1000BASE-T MDI and MDI-X port pinouts. These ports require that all four pairs of wires be connected. Note that for 1000BASE-T operation, all four pairs of wires are used for both transmit and receive.

Use 100-ohm Category 5, 5e or 6 unshielded twisted-pair (UTP) or shielded twisted-pair (STP) cable for 1000BASE-T connections. Also be sure that the length of any twisted-pair connection does not exceed 100 meters (328 feet).

**Table 17: 1000BASE-T MDI and MDI-X Port Pinouts**

Pin	MDI Signal Name	MDI-X Signal Name
1	Bi-directional Pair A Plus (BI_DA+)	Bi-directional Pair B Plus (BI_DB+)
2	Bi-directional Pair A Minus (BI_DA-)	Bi-directional Pair B Minus (BI_DB-)
3	Bi-directional Pair B Plus (BI_DB+)	Bi-directional Pair A Plus (BI_DA+)
4	Bi-directional Pair C Plus (BI_DC+)	Bi-directional Pair D Plus (BI_DD+)
5	Bi-directional Pair C Minus (BI_DC-)	Bi-directional Pair D Minus (BI_DD-)
6	Bi-directional Pair B Minus (BI_DB-)	Bi-directional Pair A Minus (BI_DA-)
7	Bi-directional Pair D Plus (BI_DD+)	Bi-directional Pair C Plus (BI_DC+)
8	Bi-directional Pair D Minus (BI_DD-)	Bi-directional Pair C Minus (BI_DC-)

## CABLE TESTING FOR EXISTING CATEGORY 5 CABLE

Installed Category 5 cabling must pass tests for Attenuation, Near-End Crosstalk (NEXT), and Far-End Crosstalk (FEXT). This cable testing information is specified in the ANSI/TIA/EIA-TSB-67 standard. Additionally, cables must also pass test parameters for Return Loss and Equal-Level Far-End Crosstalk (ELFEXT). These tests are specified in the ANSI/TIA/EIA-TSB-95 Bulletin, "The Additional Transmission Performance Guidelines for 100 Ohm 4-Pair Category 5 Cabling."

Note that when testing your cable installation, be sure to include all patch cables between switches and end devices.



## ADJUSTING EXISTING CATEGORY 5 CABLING TO RUN 1000BASE-T

If your existing Category 5 installation does not meet one of the test parameters for 1000BASE-T, there are basically three measures that can be applied to try and correct the problem:

1. Replace any Category 5 patch cables with high-performance Category 5e or Category 6 cables.
2. Reduce the number of connectors used in the link.
3. Reconnect some of the connectors in the link.

## FIBER STANDARDS

The International Telecommunication Union (ITU-T) has standardized various fiber types for data networks. These are summarized in the following table.

**Table 18: Fiber Standards**

ITU-T Standard	Description	Application
G.651	<b>Multimode Fiber</b> 50/125-micron core	Short-reach connections in the 1300-nm or 850-nm band
G.652	<b>Non-Dispersion-Shifted Fiber</b> Single-mode, 9/125-micron core	Longer spans and extended reach. Optimized for operation in the 1310-nm band, but can also be used in the 1550-nm band
G.652.C	<b>Low Water Peak Non-Dispersion-Shifted Fiber</b> Single-mode, 9/125-micron core	Longer spans and extended reach. Optimized for wavelength-division multiplexing (WDM) transmission across wavelengths from 1285 to 1625 nm. The zero dispersion wavelength is in the 1310-nm region.
G.653	<b>Dispersion-Shifted Fiber</b> Single-mode, 9/125-micron core	Longer spans and extended reach. Optimized for operation in the region from 1500 to 1600-nm.

**Table 18: Fiber Standards (Continued)**

<b>ITU-T Standard</b>	<b>Description</b>	<b>Application</b>
G.654	<b>1550-nm Loss-Minimized Fiber</b> Single-mode, 9/125-micron core	Extended long-haul applications. Optimized for high-power transmission in the 1500 to 1600-nm region, with low loss in the 1550-nm band.
G.655	<b>Non-Zero Dispersion-Shifted Fiber</b> Single-mode, 9/125-micron core	Extended long-haul applications. Optimized for high-power dense wavelength-division multiplexing (DWDM) operation in the region from 1500 to 1600-nm.

---

## PHYSICAL CHARACTERISTICS

### PORTS

24 100BASE-FX, single-fiber single-mode

4 10/100/1000BASE-T, shared with four SFP transceiver slots

### NETWORK INTERFACE

Ports 1~24: single fiber SC connector

100BASE-FX: 9/125 micron single-mode fiber cable

Shared Ports 25~28: RJ-45 connector, auto MDI/X

10BASE-T: RJ-45 (100-ohm, UTP cable; Category 3 or better)

100BASE-TX: RJ-45 (100-ohm, UTP cable; Category 5 or better)

1000BASE-T: RJ-45 (100-ohm, UTP or STP cable; Category 5, 5e or 6)

*\*Maximum Cable Length - 100 m (328 ft)*

### BUFFER ARCHITECTURE

1 Mbit packet buffer

### AGGREGATE BANDWIDTH

48 Gbps

### SWITCHING DATABASE

16K MAC address entries

### LEDs

System: Power, Diag (Diagnostic), RPS, TS1000

Ports 1~24: Link/Act

Ports 25~28: Status (link, speed, and activity)

## **WEIGHT**

4.2 kg (9.26 lbs)

## **SIZE**

(W x D x H): 440 x 324 x 43 mm (17.32 x 12.76 x 1.69 inches)

## **TEMPERATURE**

Operating: 0°C to 50°C (32°F to 122°F)

Storage: -40°C to 70°C (-40°F to 158°F)

## **HUMIDITY**

Operating: 5% to 95% (non-condensing)

## **AC INPUT**

100 to 240 V, 50-60 Hz, 2A

## **POWER SUPPLY**

Internal, auto-ranging transformer: 100 to 240 VAC, 50 to 60 Hz

## **POWER CONSUMPTION**

83 Watts maximum

## **MAXIMUM CURRENT**

0.9 A @ 100 VAC

0.4 A @ 240 VAC

---

## SWITCH FEATURES

### FORWARDING MODE

Store-and-forward

### THROUGHPUT

Wire speed

### FLOW CONTROL

Full Duplex: IEEE 802.3x

Half Duplex: Back pressure

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## MANAGEMENT FEATURES

### IN-BAND MANAGEMENT

SSH, Telnet, SNMP, or HTTP

### OUT-OF-BAND MANAGEMENT

RS-232 RJ-45 console port

### SOFTWARE LOADING

HTTP, TFTP in-band

## **STANDARDS**

IEEE 802.3-2005  
Ethernet, Fast Ethernet, Gigabit Ethernet  
Full-duplex flow control  
Link Aggregation Control Protocol  
IEEE 802.1D -2004  
Spanning Tree Protocol  
Rapid Spanning Tree Protocol  
Multiple Spanning Tree Protocol  
ISO/IEC 8802-3

---

## **COMPLIANCES**

### **EMISSIONS**

EN55022 (CISPR 22) Class A  
EN 61000-3-2/3  
FCC Class A  
CE Mark

### **IMMUNITY**

EN 61000-4-2/3/4/5/6/8/11

### **SAFETY**

CSA (CSA 22.2 NO 60950-1 & UL 60950-1)  
CB (IEC/EN60950-1)

# GLOSSARY

## **10BASE-T**

IEEE 802.3 specification for 10 Mbps Ethernet over two pairs of Category 3, 4, or 5 UTP cable.

## **100BASE-TX**

IEEE 802.3u specification for 100 Mbps Ethernet over two pairs of Category 5 UTP cable.

## **1000BASE-LH**

Specification for long-haul Gigabit Ethernet over two strands of 9/125 micron core fiber cable.

## **1000BASE-LX**

IEEE 802.3z specification for Gigabit Ethernet over two strands of 50/125, 62.5/125 or 9/125 micron core fiber cable.

## **1000BASE-SX**

IEEE 802.3z specification for Gigabit Ethernet over two strands of 50/125 or 62.5/125 micron core fiber cable.

## **1000BASE-T**

IEEE 802.3ab specification for Gigabit Ethernet over 100-ohm Category 5, 5e or 6 twisted-pair cable (using all four wire pairs).

## **AUTO-NEGOTIATION**

Signalling method allowing each node to select its optimum operational mode (e.g., speed and duplex mode) based on the capabilities of the node to which it is connected.

**BANDWIDTH**

The difference between the highest and lowest frequencies available for network signals. Also synonymous with wire speed, the actual speed of the data transmission along the cable.

**COLLISION DOMAIN**

Single CSMA/CD LAN segment.

**CSMA/CD**

CSMA/CD (Carrier Sense Multiple Access/Collision Detect) is the communication method employed by Ethernet, Fast Ethernet, and Gigabit Ethernet.

**END STATION**

A workstation, server, or other device that does not forward traffic.

**ETHERNET**

A network communication system developed and standardized by DEC, Intel, and Xerox, using baseband transmission, CSMA/CD access, logical bus topology, and coaxial cable. The successor IEEE 802.3 standard provides for integration into the OSI model and extends the physical layer and media with repeaters and implementations that operate on fiber, thin coax and twisted-pair cable.

**FAST ETHERNET**

A 100 Mbps network communication system based on Ethernet and the CSMA/CD access method.

**FULL DUPLEX**

Transmission method that allows two network devices to transmit and receive concurrently, effectively doubling the bandwidth of that link.

**GIGABIT ETHERNET**

A 1000 Mbps network communication system based on Ethernet and the CSMA/CD access method.



**IEEE**

Institute of Electrical and Electronic Engineers.

**IEEE 802.3**

Defines carrier sense multiple access with collision detection (CSMA/CD) access method and physical layer specifications.

**IEEE 802.3AB**

Defines CSMA/CD access method and physical layer specifications for 1000BASE-T Gigabit Ethernet. (Now incorporated in IEEE 802.3-2005.)

**IEEE 802.3u**

Defines CSMA/CD access method and physical layer specifications for 100BASE-TX Fast Ethernet. (Now incorporated in IEEE 802.3-2005.)

**IEEE 802.3x**

Defines Ethernet frame start/stop requests and timers used for flow control on full-duplex links. (Now incorporated in IEEE 802.3-2005.)

**IEEE 802.3z**

Defines CSMA/CD access method and physical layer specifications for 1000BASE Gigabit Ethernet. (Now incorporated in IEEE 802.3-2005.)

**LAN SEGMENT**

Separate LAN or collision domain.

**LED**

Light emitting diode used for monitoring a device or network condition.

**LOCAL AREA NETWORK (LAN)**

A group of interconnected computer and support devices.

**MEDIA ACCESS CONTROL (MAC)**

A portion of the networking protocol that governs access to the transmission medium, facilitating the exchange of data between network nodes.

**MIB**

An acronym for Management Information Base. It is a set of database objects that contains information about the device.

**MODAL BANDWIDTH**

Bandwidth for multimode fiber is referred to as modal bandwidth because it varies with the modal field (or core diameter) of the fiber. Modal bandwidth is specified in units of MHz per km, which indicates the amount of bandwidth supported by the fiber for a one km distance.

**NETWORK DIAMETER**

Wire distance between two end stations in the same collision domain.

**RJ-45 CONNECTOR**

A connector for twisted-pair wiring.

**SWITCHED PORTS**

Ports that are on separate collision domains or LAN segments.

**TIA**

Telecommunications Industry Association

**TRANSMISSION CONTROL PROTOCOL/INTERNET PROTOCOL (TCP/IP)**

Protocol suite that includes TCP as the primary transport protocol, and IP as the network layer protocol.

**USER DATAGRAM PROTOCOL (UDP)**

UDP provides a datagram mode for packet-switched communications. It uses IP as the underlying transport mechanism to provide access to IP-like services. UDP packets are delivered just like IP packets – connection-less datagrams that may be discarded before reaching their targets. UDP is useful when TCP would be too complex, too slow, or just unnecessary.

**UTP**

Unshielded twisted-pair cable.

**VIRTUAL LAN (VLAN)**

A Virtual LAN is a collection of network nodes that share the same collision domain regardless of their physical location or connection point in the network. A VLAN serves as a logical workgroup with no physical barriers, allowing users to share information and resources as though located on the same LAN.



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