MUSTANG 4000 SWITCH SERIES

DG-FS4510
INSTALLATION GUIDE

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DG-FS4510 FAST ETHERNET MANAGED SWITCH

Layer 2 Switch
with 8 10/100BASE-T (RJ-45) Ports,
and 2 Gigabit Combination Ports (RJ-45/SFP)

DG-FS4510
E012011-R02

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:

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

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

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

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.

NOVEMBER REVISION

This is the First revision of this guide

Contents

Tables

Figures

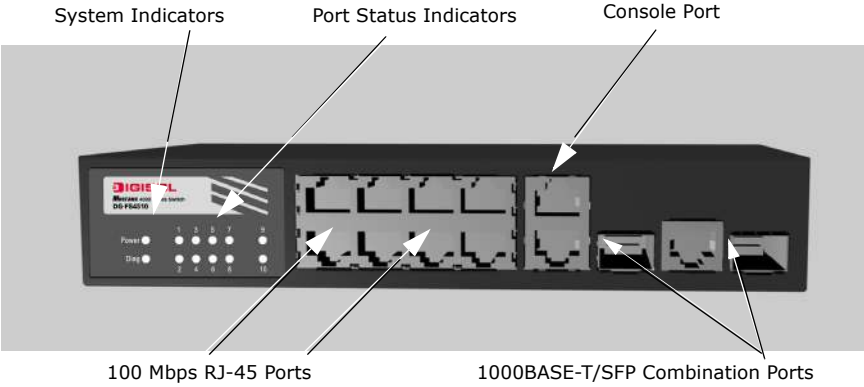
INTRODUCTION

OVERVIEW

The DG-FS4510 is a Fast Ethernet Layer 2 switch with 8 100BASE-TX ports, and two combination 1000BASE-T ports: RJ-45/Small Form Factor Pluggable (SFP) transceiver slots[1] (see Figure 1-1, Ports 9-10). The switch also includes an SNMP-based management agent, which provides both in-band and out-of-band access for managing the switch.

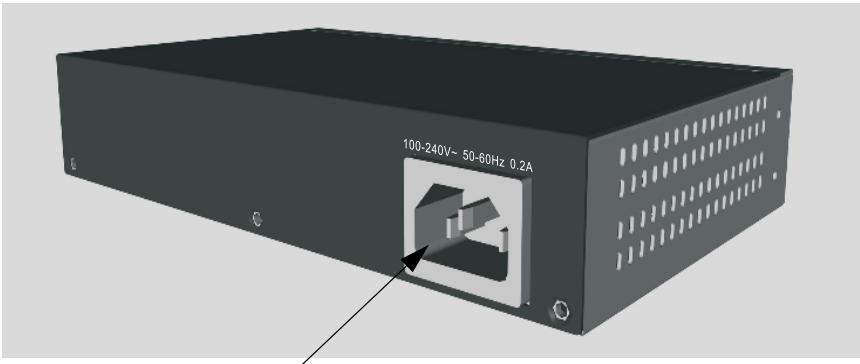
The DG-FS4510 provides a broad range of powerful features for Layer 2 switching, delivering reliability and consistent performance for your network traffic. It brings order to poorly performing networks by segregating them into separate broadcast domains with IEEE 802.1Q compliant VLANs, and empowers multimedia applications with multicast switching and CoS services.

Figure 1: Front Panel



1. If an SFP transceiver is plugged in, the corresponding RJ-45 port is disabled for ports 9-10.

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.

This 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 a serial port (RJ-45 connector) on the front panel for out-of-band management. A PC may be connected to this port for configuration and monitoring out-of-band via a null-modem serial cable.

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

DESCRIPTION OF HARDWARE

RJ-45 PORTS

The switch contains 8 100BASE-TX RJ-45 ports and 2 shared 1000BASE-T RJ-45/SFP ports. All RJ-45 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. (See "1000BASE-T Pin Assignments" on page 46.)

Each of these ports support auto-negotiation, so the optimum transmission mode (half or full duplex), and data rate (10, or 100 Mbps - ports 1~8, and 10, 100, or 1000 - ports 9~10) can be selected automatically[2].

Each port also supports IEEE 802.3x auto-negotiation of flow control, so the switch can automatically prevent port buffers from becoming saturated.

SFP TRANSCEIVER SLOTS

The Small Form Factor Pluggable (SFP) transceiver slots are shared with the two 1000BASE-T RJ-45 ports (ports 9~10). In the default configuration, if an SFP transceiver (purchased separately) is installed in a slot and has a valid link on the port, the associated RJ-45 port is disabled. The switch can also be configured to force the use of an RJ-45 port or SFP slot, as required.

The following table shows a list of transceiver types which have been tested with the switch. For an updated list of vendors supplying these transceivers, contact your local dealer. For information on the recommended standards for fiber optic cabling, see "1000 Mbps Gigabit Ethernet Collision Domain" on page 37.

Table 1: Supported SFP Transceivers

Media Standard	**Cable Diameter** (microns)	**Wavelength** (nm)	**Maximum Distance***
1000BASE-SX	50/125	850	550 m
	62.5/125	850	400 m

2. The 1000BASE-T standard does not support forced mode. Auto-negotiation must always be used to establish a connection over any 1000BASE-T port or trunk.

Table 1: Supported SFP Transceivers

Media Standard	Cable Diameter (microns)	Wavelength (nm)	Maximum Distance*
1000BASE-LX	50/125	1300	550 m
	62.5/125	1300	550 m
	9/125	1300	10 km
1000BASE-LH	9/125	1310	35 km
		1550	80 km
1000BASE-T			100 m

* Maximum distance may vary for different SFP vendors.

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

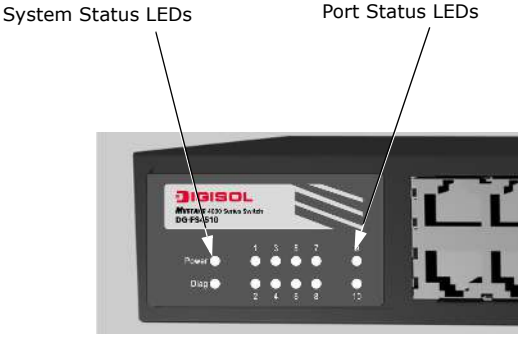


Table 2: 10/100 Mbps Port Status LEDs (1~8)

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

Table 3: 1000 Mbps Port Status LEDs (9~10)

LED	Condition	Status
(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.

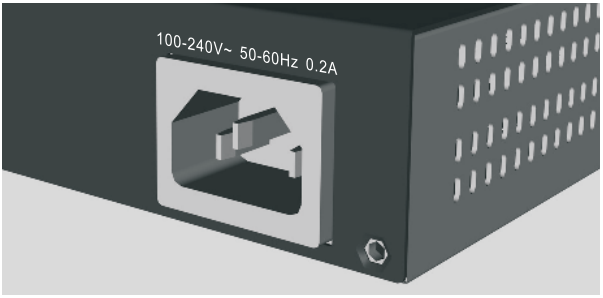
Table 4: System Status LEDs

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.
	On Amber	The system diagnostic test has detected a fault if Amber LED doesn't turn green after system bootup (Approx 45Sec.)

POWER SUPPLY SOCKET

There is one power socket on the rear panel of the switch. The standard power socket is for the AC power cord.

Figure 4: Power Supply Socket



Network Planning

Introduction to Switching

A network switch allows simultaneous transmission of multiple packets via non-crossbar switching. This means that it can partition a network more efficiently than bridges or routers. The switch has, therefore, been recognized as one of the most important building blocks for today's networking technology.

When performance bottlenecks are caused by congestion at the network access point (such as the network card for a high-volume file server), the device experiencing congestion (server, power user, or hub) can be attached directly to a switched port. And, by using full-duplex mode, the bandwidth of the dedicated segment can be doubled to maximize throughput.

When networks are based on repeater (hub) technology, the distance between end stations is limited by a maximum hop count. However, a switch turns the hop count back to zero. So subdividing the network into smaller and more manageable segments, and linking them to the larger network by means of a switch, removes this limitation.

A switch can be easily configured in any Ethernet, Fast Ethernet, or Gigabit Ethernet network to significantly boost bandwidth while using conventional cabling and network cards.

APPLICATION EXAMPLES

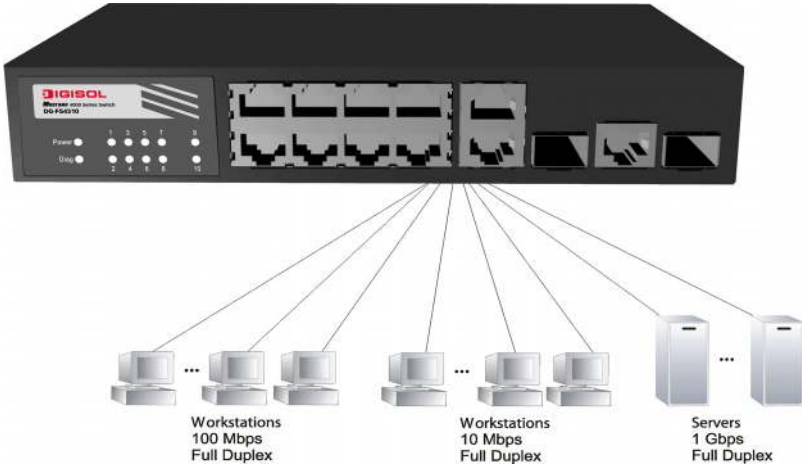
The switch is not only designed to segment your network, but also to provide a wide range of options in setting up network connections. Some typical applications are described below.

COLLAPSED BACKBONE

The switch is an excellent choice for mixed Ethernet, Fast Ethernet, and Gigabit Ethernet installations where significant growth is expected in the near future. You can easily build on this basic configuration, adding direct full-duplex connections to workstations or servers. When the time comes for further expansion, just connect to another hub or switch using one of the Fast Ethernet ports built into the front panel or a Gigabit Ethernet port on a plug-in SFP transceiver.

In the figure below, the switch is operating as a collapsed backbone for a small LAN. It is providing dedicated 10 Mbps full-duplex connections to workstations, 100 Mbps full-duplex connections to power users, and 1 Gbps full-duplex connections to servers.

Figure 5: Collapsed Backbone

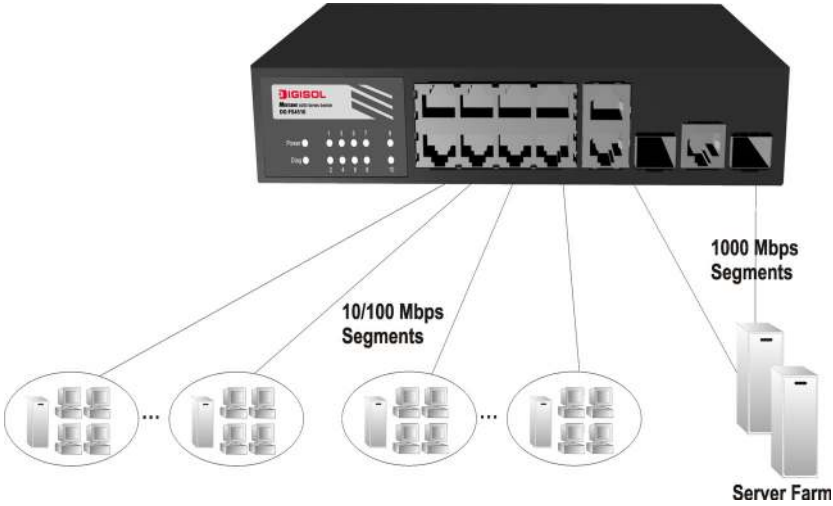


NETWORK AGGREGATION PLAN

With 10 parallel bridging ports (i.e., 10 distinct collision domains), the switch can collapse a complex network down into a single efficient bridged node, increasing overall bandwidth and throughput.

In the figure below, the 100BASE-TX ports on the switch are providing 100 Mbps connectivity for up to 8 segments. In addition, the switch is also connecting several servers at 1000 Mbps.

Figure 6: Network Aggregation Plan

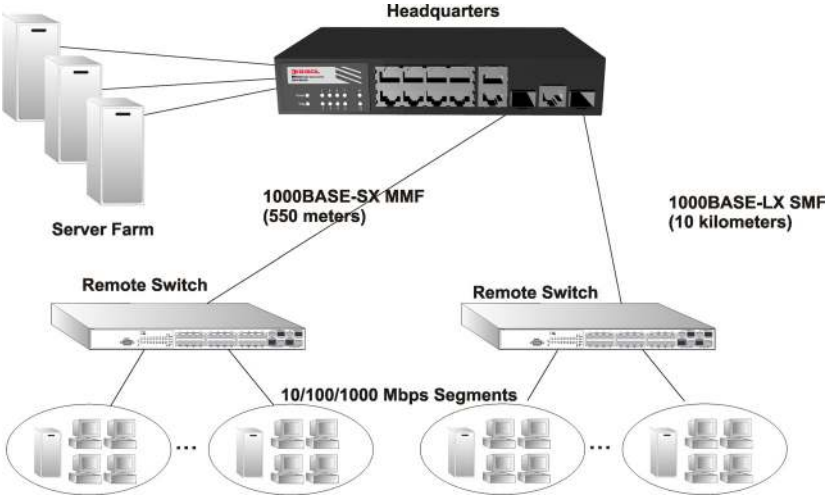


REMOTE CONNECTIONS WITH FIBER CABLE

Fiber optic technology allows for longer cabling than any other media type. A 1000BASE-SX (MMF) link can connect to a site up to 550 meters away, a 1000BASE-LX (SMF) link up to 10 km, and a 1000BASE-LH link up to 80 km. This allows the switch to serve as a collapsed backbone, providing direct connectivity for a widespread LAN.

The figure below illustrates the switch connecting multiple segments with fiber cable.

Figure 7: Remote Connections with Fiber Cable

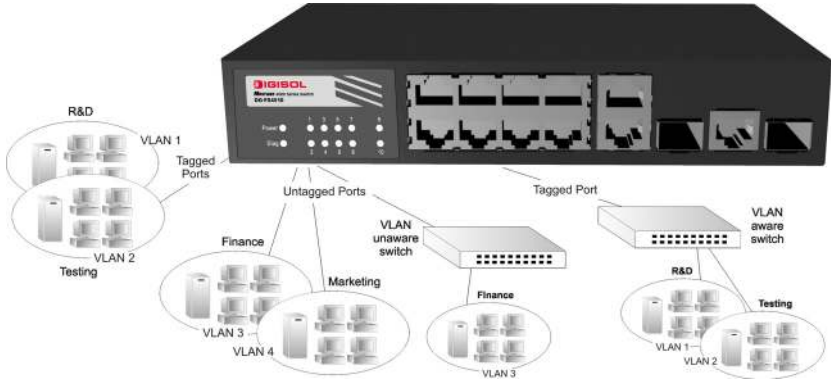


MAKING VLAN CONNECTIONS

This switch supports VLANs which can be used to organize any group of network nodes into separate broadcast domains. VLANs confine broadcast traffic to the originating group, and can eliminate broadcast storms in large networks. This provides a more secure and cleaner network environment.

VLANs can be based on untagged port groups, or traffic can be explicitly tagged to identify the VLAN group to which it belongs. Untagged VLANs can be used for small networks attached to a single switch. However, tagged VLANs should be used for larger networks, and all the VLANs assigned to the inter-switch links.

Figure 8: Making VLAN Connections



NOTE: When connecting to a switch that does not support IEEE 802.1Q VLAN tags, use untagged ports.

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.

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

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.

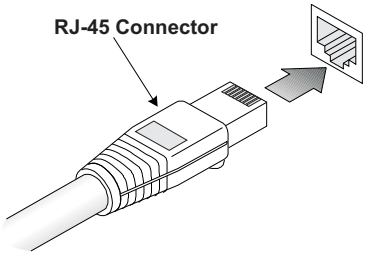
- The site should:
  - be at the center of all the devices you want to link and near a power outlet.
  - be able to maintain its temperature within 0 to 45 °C (32 to 113 °F) and its humidity within 10% to 90%, non-condensing
  - provide adequate space (approximately two inches) on all sides for proper 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.

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 9: 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 Switch (DG-FS4510)
- Four adhesive foot pads
- Rack Mounting Kit
- Power Cord
- RJ-45 to RS-232 console cable
- Installation and Management Guide CD

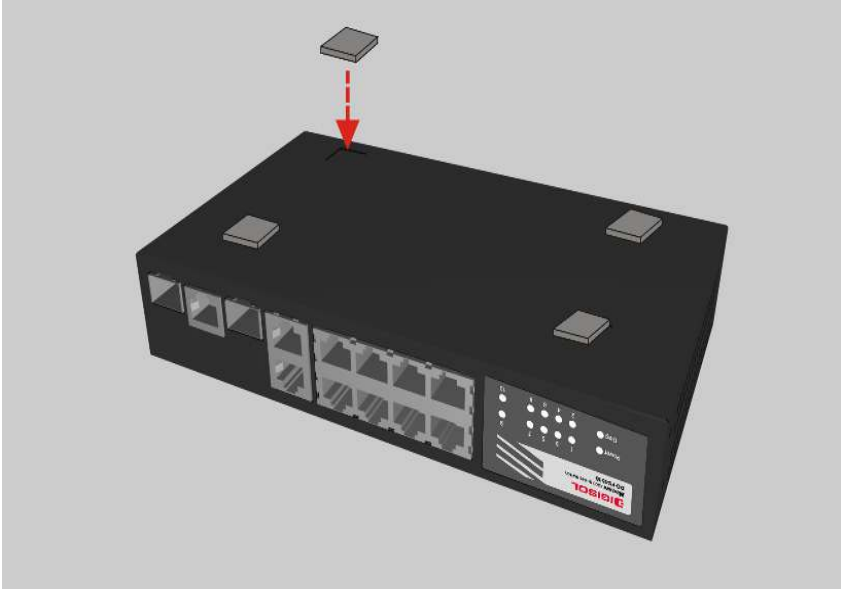
MOUNTING

The switch can be mounted on a desktop or shelf. Mounting instructions follow.

DESKTOP OR SHELF MOUNTING

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

Figure 10: Attaching the Adhesive Feet



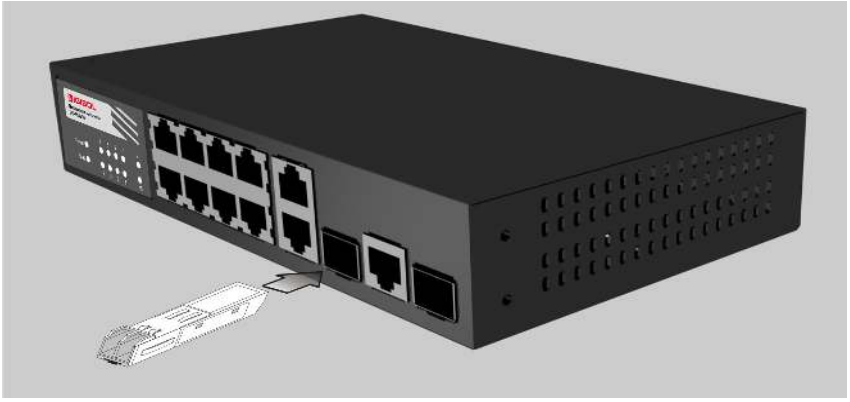
2. Set the device on a flat surface near an AC power source, making sure there are at least two inches of space on all sides for proper air flow.

3. If installing a single switch only, go to "Connecting to a Power Source" at the end of this chapter.

4. If installing multiple switches, attach four adhesive feet to each one. Place each device squarely on top of the one below, in any order.

INSTALLING AN OPTIONAL SFP TRANSCEIVER

Figure 11: Inserting an SFP Transceiver into a Slot



The SFP slots support the following optional SFP transceivers:

- 1000BASE-SX
- 1000BASE-LX
- 1000BASE-LH

To install an SFP transceiver, do the following:

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.
3. 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.

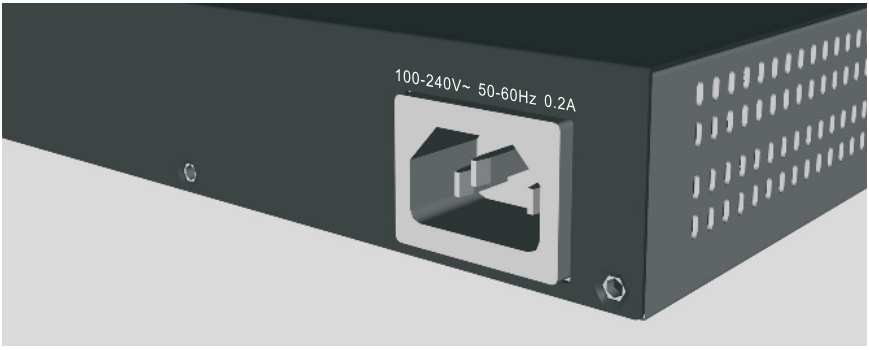
NOTE: SFP transceivers are not provided in the switch package.

CONNECTING TO A POWER SOURCE

To connect a switch to a power source:

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

Figure 12: Power Socket



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

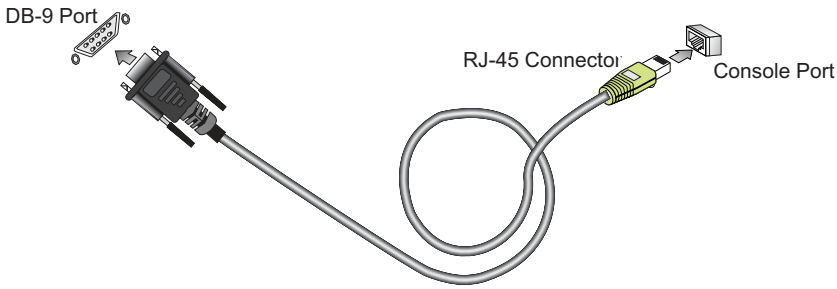
NOTE: For International use, you may need to change the AC line cord. You must use a line cord set that has been approved for the socket type in your country.

3. 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.

CONNECTING TO THE CONSOLE PORT

This port is used to connect a console device to the switch through a serial cable. The console device can be a PC or workstation running a VT-100 terminal emulator, or a VT-100 terminal. A crossover RJ-45 to DB-9 cable is supplied with the unit for connecting to the console port, as illustrated below. The PIN assignments used to connect to the serial port are described below.

Figure 13: Console Cable



WIRING MAP FOR SERIAL CABLE

The serial port's configuration requirements are as follows:

Table 5: Serial Cable Wiring

Switches 8-PIN Serial Port	Null Modem	PC's 9-PIN DTE Port
6 RXD (receive data)	<----------	3 TXD (transmit data)
3 TXD (transmit data)	---------->	2 RXD (receive data)
5 SGND (signal ground)	----------	5 SGND (signal ground)

- Default Baud rate—115,200 bps
- Character Size—8 Characters

- Parity—None
- Stop bit—One
- Data bits—8
- Flow control—none

MAKING NETWORK CONNECTIONS

CONNECTING NETWORK DEVICES

The switch is designed to be connected to 10 or 100 Mbps network cards in PCs and servers, as well as to other switches and hubs. It may also be connected to remote devices using optional 1000BASE-SX, 1000BASE-LX, or 1000BASE-LH SFP transceivers.

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).

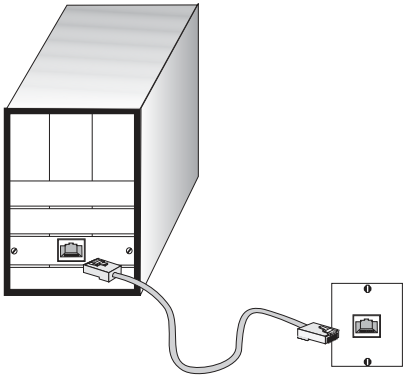
See Appendix B for further information on cabling.

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, SERVERS, 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. If the device is a network card and the switch is in the wiring closet, attach the other end of the cable segment to a modular wall outlet that is connected to the wiring closet. (See the section "Fiber Optic SFP Devices.") Otherwise, 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.

NOTE: 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. 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 SFP DEVICES

An optional Gigabit SFP transceiver (1000BASE-SX, 1000BASE-LX or 1000BASE-LH) can be used for a backbone connection between switches, or for connecting to a high-speed server.

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.

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.

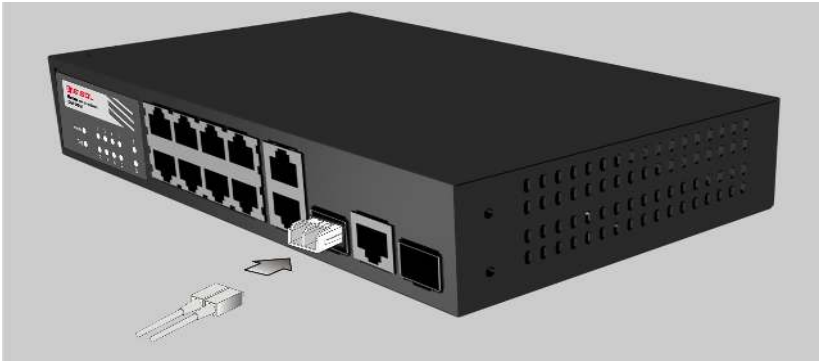
WARNING: When selecting a fiber SFP device, considering safety, please make sure that it can function at a temperature that is not less than the recommended maximum operational temperature of the product. You must also use an approved Laser Class 1 SFP transceiver.

1. Remove and keep the 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 one end of the cable to the LC port on the switch and the other end to the LC port on the other device. Since LC connectors are keyed, the cable can be attached in only one orientation.

Figure 15: Making Fiber Port 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 1000BASE-SX, 1000BASE-LX, 1000BASE-LH 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 25.

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 6: 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 7: Maximum 1000BASE-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 8: Maximum 1000BASE-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 9: Maximum 1000BASE-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

100 MBPS FAST ETHERNET COLLISION DOMAIN

Table 10: 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

10 MBPS ETHERNET COLLISION DOMAIN

Table 11: 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

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.

TROUBLESHOOTING

DIAGNOSING SWITCH INDICATORS

Table 12: Troubleshooting Chart

Symptom	Action
Power LED is Off	u Check connections between the switch, the power cord and the wall outlet. u Contact your dealer for assistance.
Power LED is on Amber	u Contact your local dealer for assistance.
DIAG LED On Amber	u Power cycle the switch to try and clear the condition. u If the condition does not clear, contact your dealer for assistance.
Link LED is Off	u Verify that the switch and attached device are powered on. u Be sure the cable is plugged into both the switch and corresponding device. u If the switch is installed in a rack, check the connections to the punch-down block and patch panel. u Verify that the proper cable type is used and its length does not exceed specified limits. u Check the adapter on the attached device and cable connections for possible defects. Replace the defective adapter or cable if necessary.

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.

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.

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.

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.

CABLES

TWISTED-PAIR CABLE AND PIN ASSIGNMENTS

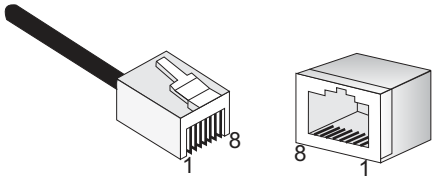
For 10/100BASE-TX connections, the twisted-pair cable must have two pairs of wires. For 1000BASE-T connections the twisted-pair cable must have four pairs of wires. Each wire pair is identified by two different colors. For example, one wire might be green and the other, green with white stripes. Also, 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 16: 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 13: 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

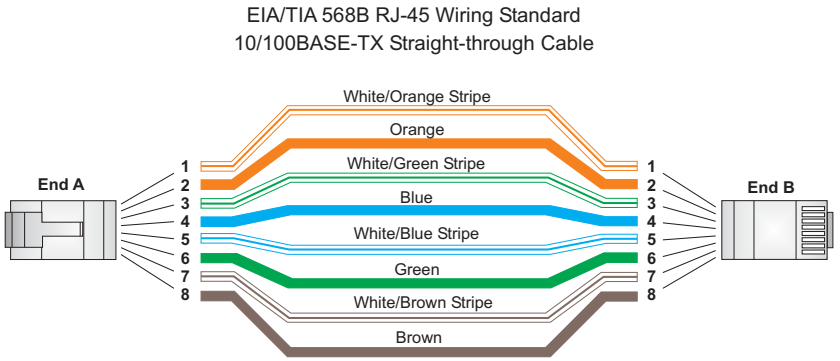
Note: The "+" and "-" signs represent the polarity of the wires that make up each wire pair.

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 17: Straight-through Wiring

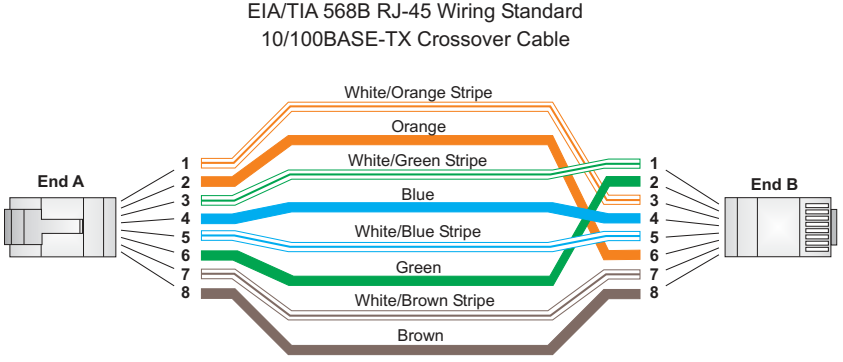


CROSSOVER WIRING

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 18: Crossover Wiring



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 14: 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 15: Fiber Standards

ITU-T Standard	Description	Application
G.651	**Multimode Fiber** 50/125-micron core	Short-reach connections in the 1300-nm or 850-nm band
G.652	**Non-Dispersion-Shifted Fiber** 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	**Low Water Peak Non-Dispersion-Shifted Fiber** 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	**Dispersion-Shifted Fiber** Single-mode, 9/125-micron core	Longer spans and extended reach. Optimized for operation in the region from 1500 to 1600-nm.

Table 15: Fiber Standards (Continued)

ITU-T Standard	Description	Application
G.654	**1550-nm Loss-Minimized Fiber** 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	**Non-Zero Dispersion-Shifted Fiber** 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.

SPECIFICATIONS

PHYSICAL CHARACTERISTICS

PORTS
8 10/100BASE-TX, with auto-negotiation
2 10/100/1000BASE-T, shared with two SFP transceiver slots

NETWORK INTERFACE
Ports 1-10: 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
4 Mbit packet buffer

AGGREGATE BANDWIDTH
5.6 Gbps

SWITCHING DATABASE
8K MAC address entries

LEDS
System: Power, DIAG (Diagnostic),
Port: status (link, speed, and activity)

WEIGHT
0.72 kg (1.59 lbs)

SIZE
(W x D x H): 195 mm x 115 mm x 36 mm

TEMPERATURE
Operating: 0°C to 45°C (32°F to 113°F)
Storage: -40°C to 70°C (-40°F to 158°F)

HUMIDITY
Operating: 10% to 90% (non-condensing)

AC INPUT
100 to 240 V, 50-60 Hz, 0.2A

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

POWER CONSUMPTION
32 Watts maximum

MAXIMUM CURRENT
0.25 A @ 100 VAC
0.12 A @ 240 VAC

SWITCH FEATURES

FORWARDING MODE
Store-and-forward

THROUGHPUT
Wire speed

FLOW CONTROL
Full Duplex: IEEE 802.3x
Half Duplex: Back pressure

MANAGEMENT FEATURES

IN-BAND MANAGEMENT
SSH, Telnet, SNMP, or HTTP

OUT-OF-BAND MANAGEMENT
RJ-45 console port

SOFTWARE LOADING
TFTP in-band, or XModem out-of-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

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.

Index

M

N

O

P

R

S

T

V

W

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