April 1999

LE14XXA

Modular Switches

Customer Support Information

Call our Technical Support Specialists to discuss your application.

For 24-hour technical support: Call **(724) 746-5500** or Fax: **(724) 746-0746**

To order: Call **(724) 746-5500** 7:00 A.M. to 8:00 P.M. EST

Mail order: Black Box Corporation. 1000 Park Drive, Lawrence, PA 15055

Black Box®

Modular Switches

Installation and User Guide

Trademarks

UL is a registered trademark of Underwriters Laboratories

Important: The LE14XXA Modular Switches contain no user-serviceable parts. Attempted service by unauthorized personnel shall render any and all warranties null and void. If problems are experienced with an LE14XXA, consult Section 6, Troubleshooting, of this User Guide.

©1999 Black Box Corporation

Printed in the United States of America.

Contacting Black Box Corporation

Please use the mailing address and phone and fax numbers listed below:

Black Box Corporation

1000 Park Drive

Lawrence, PA 15055

Phone: (724) 746-5500

Fax: (724) 746-0746

P/N 84-00020 (Rev A 08/99)

FCC STATEMENT

FEDERAL COMMUNICATIONS COMMISSION AND CANADIAN DEPARTMENT OF COMMUNICATIONS RADIO FREQUENCY INTERFERENCE STATEMENTS

This equipment generates, uses, and can radiate radio frequency energy and if not installed and used properly, that is, in strict accordance with the manufacturer's instructions, may cause interference to radio communication. It has been tested and found to comply with the limits for a Class A computing device in accordance with the specifications in Subpart J of Part 15 of FCC rules, which are designed to provide reasonable protection against such interference when the equipment is operated in a commercial environment. Operation of this equipment in a residential area is likely to cause interference, in which case the user at his own expense will be required to take whatever measures may be necessary to correct the interference.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

This digital apparatus does not exceed the Class A limits for radio noise emission from digital apparatus set out in the Radio Interference Regulation of the Canadian Department of Communications.

Le présent appareil numérique n'émet pas de bruits radioélectriques dépassant les limites applicables aux appareils numériques de classe A prescrites dans le Règlement sur le brouillage radioélectrique publé par le ministère des Communications du Canada.

NORMAS OFICIALES MEXICANAS (NOM)
ELECTRICAL SAFETY STATEMENT

INSTRUCCIONES DE SEGURIDAD

1. Todas las instrucciones de seguridad y operación deberán ser leídas antes de que el aparato eléctrico sea operado.
2. Las instrucciones de seguridad y operación deberan ser guardadas para referencia futura.
3. Todas las advertencias en el aparato eléctrico y en sus instrucciones de operación deben ser respetadas.
4. Todas las instrucciones de operación y uso deben ser seguidas.
5. El aparato eléctrico no deberá ser usado cerca del agua—por ejemplo, cerca de la tina de baño, lavabo, sótano mojado o cerca de una alberca, etc..
6. El aparato eléctrico debe ser usado únicamente con carritos o pedestales que sean reconnendados por el fabricante.
7. El aparato eléctrico debe ser montado a la pared o al techo sólo como sea recommendado por el fabricante.
8. Servicio—El usuario no debe intentar dar sercicio al equipo eléctrico más allá a lo descrito en las instrucciones de operatión. Todo otro servicio deberá ser referido a personal de servicio calificado.
9. El aparato eléctrico debe ser situado de tal mannera que su posición no interfiera su uso. La colocación del aparato eléctrico sobre una cama, sofá, alfombra o superficie similar puede bloquea la ventilación, no se debe colocar en libreros o gabinetes que impidan el flujo de aire por los orificios de ventilación.
10. El equipo eléctrico deber ser situado fuera del alcance du fuentes de calor como radiadores, registros de calor, estufas u otros aparatos (incluyendo amplificadores) que producen calor.
11. El aparato eléctrico deberá ser connectado una fuente de poder sólo del tipo descrito en el instrucivo de operación, o como se indique en el aparato.
12. Precaución debe ser tomada de mal manera que la tierra fisica y la polarización del equipo no sea eliminada.
13. Los cables de la fuente de poder deben ser guiados de tal manera que no sean pisados ni pellizcados por objetos colocados sobre o contra ellos, poniendo particular atención a los contactos y receptáculos donde salen del aparato.
14. El equipo eléctrico debe ser limpiado únicamente de acuerdo a las recommendaciones del fabricante.
15. En caso de existir, una antena externa deberá ser localizada lejos de las lineas de energia.
16. El cable de corriente deberá ser desconectado del cuando el equipo no sea usado por un largo periodo de tiempo.
17. Cuidado debe ser tomado de tal manera que objectos liquidos no sean derramados sobre la cubierta u orificios de ventilación.
18. Servicio por personal calificado deberá ser provisto cuando:
    - A: El cable de poder o el contacto ha sido dañado; u
    - B: Objectos han caído o líquido ha sido derramado dentro del aparato; o
    - C: El aparato ha sido expuesto a la lluvia; o
    - D: El aparato parece no operar normalmente o muestra un cambio en su desempeño; o
    - E: El aparato ha sido tirado o su cubierta ha sido dañada.

TABLE OF CONTENTS **PAGE**

1. SPECIFICATIONS

1.1 Technical Specifications

Performance

Aggregate Filtering Rate:	2,380,800 frames/sec for 16 100Mbps ports (for LE1416A)
(all ports are wire speed)	1,190,400 frames/sec for 8 100Mbps ports (for LE1401A & LE1408A)
Aggregate Forwarding Rate:	(for Modular Switch Fast Ethernet ports)
(all ports are wire speed)	1,190,400 frames per second, 16-port units 595,200 frames per second, 8-port units
Data Rate:	10 Mbps and 100Mbps
Address Table Capacity:	24K node addresses (12K on 8-port models), with address aging
Packet buffer Size :	8 MB dynamic (4MB for 8-port)
Latency:	5 µs + packet time (100 to 100Mbps) 15 µs + packet time (10 to 10 Mbps, and 10 to 100Mbps)

Network Standards

Ethernet V1.0/V2.0 IEEE 802.3: 10BASE-T,
IEEE 802.3u: 100BASE-TX, 100BASE-FX

Maximum 10 Mbps Ethernet Segment Lengths

Unshielded twisted pair	- 100 m (328 ft)
Shielded twisted pair	- 150 m (492 ft)
10BASE-FL multi-mode fiber optic	- 2 km (6,562 ft)
10BASE-FL single-mode fiber optic	- 10 km (32,810 ft)

Maximum Standard Fast Ethernet Segment Lengths:

10BASE-T (CAT 3, 4, 5 UTP)	- 100 m (328 ft)
100BASE-TX (CAT 5 UTP)	- 100 m (328 ft)
Shielded twisted pair	- 150 m (492 ft)
100BASE-FX, half-duplex, multi-mode	- 412 m (1350 ft)
100BASE-FX, full-duplex, multi-mode	- 2.0 km (6,562 ft)
100BASE-SX, short wavelength HDX m.m.	- 300 m (935 ft)
100BASE-FX, half-duplex, single-mode	- 412 m (1350 ft)
100BASE-FX, full-duplex, single-mode	- 15.0 km (49,215 ft)

Connectors for copper wiring

Twisted Pair at 10/100Mb: RJ-45 shielded, female, front mounted
(for LE14XXA-Series Fast Ethernet copper ports, use Cat 5 cable)

Fiber Multi-mode connector types:

Fiber Port, SC-type (snap-in): Fiber optic multi-mode, 100BASE-FX

Fiber Port, ST-type (twist-lock): Fiber optic multi-mode, 100BASE-FX

Fiber Port, MTRJ-type (plug-in):Fiber optic multi-mode, 100BASE-FX

Fiber Port, VF-45 type (plug-in): Fiber optic multi-mode, 100BASE-FX

Fiber Port, ST-type (twist-lock): Fiber optic multi-mode, 10ASE-FL

Fiber Single-mode connector types:

Fiber Port, SC-type: Fiber optic single-mode, 100BASE-FX

Manual switch-selections and jumpers

Up-link Push-button: Crossover sw for one RJ-45 port per LE1425C

Fiber default: Full-duplex (Internal jumpers may select HDX mode)

Copper default: Auto-negotiation (Internal jumpers may alternatively lect fixed 100Mb full-duplex, or fixed 100Mbps half-duplex)

LEDs: Per Port

LK: Steady ON when media link is operational

ACT: ON with receiver port activity

FDX/HDX: ON = Full-Duplex Mode
OFF = Half-Duplex Mode

100/10: ON = 100Mbps speed
OFF = 10 Mbps

Operating Environment

Ambient Temperature: 32° to 120° F (0° to 50°C)

Storage Temperature: -5°to 140°F (-20°to 60°C)

Ambient Relative Humidity: 10% to 95% (non-condensing)

Packaging

Enclosure:Rugged High strength metal. Suitable for stand-alone or rack-mounting

Dimensions: 1.75 in H x 17.0 in W x 9.0 in D (9.0 in W for QS580)
4.45cm H x 43.2cm W x 22.9cm D (22.5 cm W for QS580)

Weight: 4.0 lb. (1.8 Kg) for rack-mount models, 2.5 lb. for table-top

Cooling method: Fan cooled, @ 9 cfm

Power Supply (Internal)

AC Power Connector: IEC-type, male recessed, rear of chassis, with adjacent manual ON-OFF switch (on AC model only)

Input Voltage: 110 to 240 VAC (auto-ranging)

Input Frequency: 47 to 63 Hz (auto-ranging)

Power Consumption: 20 watts typical (8 port model)
35 watts typical (16 port model)

Redundant power supplies available as options

48VDC Power Supply (Optional)

Power Input Voltage : 36 to 70 VDC (auto ranging)

Terminal Block in rear: "-, GND, +"

Power Consumption: same as for AC models, see above

For Dual Source and Redundant DC supply options, see Appendices
For optional 23" Telco rack-mount brackets, order **Model # RMB-23W**

Agency Approvals

UL listed (UL1950), cUL, CE
Emissions meet FCC Part 15 Class A

Warranty Three years, return to factory Made in USA

2 Model Information

Black Box Modular Switches

MODEL	DESCRIPTION
LE1401A	8-port 10/100 Switch, holds up to two 4-port Modules with 4 switched ports each. Shelf or table-top mounting. For mixed-media flexibility, combinations of RJ-45 and various fiber port connector types, modes, and speeds can be configured. Full speed filtering and forwarding at 100Mbps speed across all ports, self-learning 12K-node address table, and large 4MB packet buffers. Front-mounted LEDs, internal auto-ranging power supply
LE1408A	Same as Model LE1401A Switch, but in a 19" rack-mount package, with mounting brackets.
LE1416A	Same as Model LE1408A, but with 24K-node address table and 8MB packet buffers. Holds up to four 4-port Modules (4PMs), 19" rack-mount package, with mounting brackets.
LE14XXA-Series 4Port Modules	
LE1419C	Fiber module for LE14XXA-Series Switches, with four 100Mbps multi-mode FX SC connectors
LE1428C	Fiber module for LE14XXA-Series Switches, with four 100Mbps multi-mode FX ST connectors
LE1421C	Fiber module for LE14XXA-Series Switches, with four 100Mbps single-mode FX SC connectors
LE1422C	Fiber module for LE14XXA-Series Switches, with four 100Mbps multi-mode FX "MTRJ" connectors
LE1423C	Fiber module for LE14XXA-Series Switches, with four 100Mbps multi-mode FX "VF-45" connectors
LE1424C	Fiber module for LE14XXA-Series Switches, with four 10 Mbps multi-mode FL ST-type connectors
LE1425C	RJ-45 module for LE14XXA-Series Switches, with four 100Mbps auto-negotiating RJ-45 ports, one of which has an up-link push-button
LE1426C	3TP+1F module for LE14XXA-Series Switches, with three 10/100MB auto-negotiating RJ-45 ports and one fiber port with 100Mbps multi-mode FX SC connector
LE1427C	3TP+1F module, same as LE1426C but with fiber ST-type multi-mode connector
LE1429C	3TP+1F module, same as LE1426C but with fiber SC-type single-mode connector

2. Introduction

2.1 Inspecting the Package and Product

Examine the shipping container for obvious damage prior to installing this product; notify the carrier of any damage which you believe occurred during shipment or delivery. Inspect the contents of this package for any signs of damage and ensure that the items listed below are included.

This package should contain:

1 LE1401A, LE1408A, LE1416A Modular Switches

1 AC Power Cord (U.S. and other 115 VAC only)

1 Set of two wall-mounting brackets (for LE1401A Model only)

1 Set of metal “Ears” for optional “19” rack mounting (for LE1408A & LE1416A only)

1 Installation and User Guide (this manual),

Remove the items from the shipping container. Be sure to keep the shipping contain should you need to re-ship the unit at a later date.

In the event there are items missing or damaged, contact Black Box. If the unit needs be returned, please use the original shipping container if possible. Refer to Section 6, Troubleshooting, for specific return procedures.

2 Product Description , 8-port and 16-port Modular Switches

Black Box LE14XXA series Modular Switches boost the performance of large Ethernet ANs, and have the flexibility of both fiber and twisted-pair switched ports. Their "mixed-edia" capability provides for a variety of configurations including various types of fiber port nnectors and modes, as well as allowing a mix of 10/100Mb RJ-45 (copper) ports in the same it. This flexibility is achieved via a family of 4-Port modules that can be integrated with a base it, in the factory and in the field, to adapt the unit to the individual application's changing xed-media requirements for a 10/100 Switch product.

The Black Box LE14XXA-Series provide the switching speed and the reliability to ıoothly support multiple workgroups at 100Mbps or 10 Mbps speed. The LE14XXA-Series fers the flexibility of four, eight, twelve or sixteen switched 100Mbps or 10 Mbps fiber and/or /100 twisted pair ports, in all the popular connector types. The Black Box LE14XXA-Series fers the LE1401A, LE1404A and LE1416A models, each with a configuration of four port ɔdules (4-Port Modules) for fiber types and for copper, as well as "3+1" combo (3 RJ-45 and fiber) port modules. The 4-Port Modules can be configured into a LE14XXA-Series Switch se unit in any mix of port connector or media types.

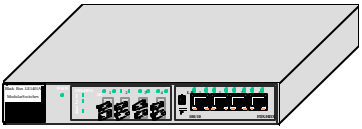
Designed for use in departments with multiple workgroups, in remote offices and in twork traffic centers, the LE14XXA-Series Switches are easy to install and use. Addresses of ached nodes are automatically learned and maintained, adapting the switching services to twork changes and expansions. Front-mounted LEDs provide status information on each port. ıe LE14XXA-Series Switches provide high performance plug-and-play operation in convenient ɔle-top and rack-mount packages.

2.1 LE14XXA-Series chassis models

The LE14XXA-Series Modular Switches come in three chassis sizes, an 8-port table-p, an 8-port rack-mount, and a 16-port rack-mount. Each is configurable with a selection of ad-port (i.e., 4-port) modules, providing the capability of 4, 8, 12, and 16 switched ports. The port modules are normally factory installed, but may be changed or added in the field. (See ction 5)

The 8-port LE1401A table-top chassis is compact in size and suitable for shelf-ɔunted use in network wiring centers. The LE1408A and LE1416A are 19" rack-mountable

Switches with two or four 4-port slots in the front, i.e., with a capacity of 8 or 16 switched ports. The LE1408A and LE1416A rack-mount units are typically used in larger network wirin centers.



8 Ports Table-Top

8-Port Rack Mount

16-Port Rack Mount

Figure 2.2.1a: Front view, 8-port LE1401A table-top, 8-port LE1408A and 16-port LE1416A Modular Switches

Mixed-media combination modules (4-port modules with three fiber ports and one twisted-pair port) are supported in all of the LE14XXA-Series Fiber Switch models. All 4Port-module manual-selection switches and LED's are located on the front panel, with the IEC standard AC power connector (and a manual ON - OFF power switch) located at the rear. Fan driven cooling air flows left to right.

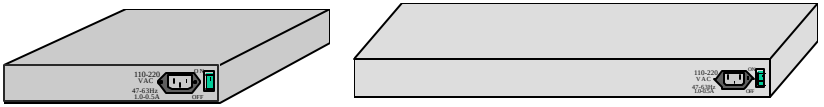
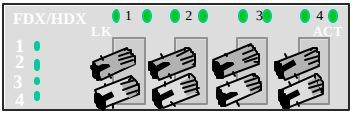
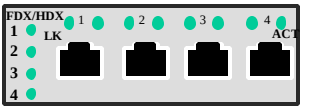


Figure 2.2.1b: Rear view - Black Box table-top & rack-mount 4-Series Switches

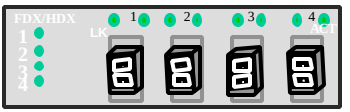
2.2 4-port modules, 100Mb fiber



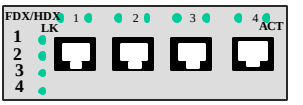
ST-Type



VF45-Small Form Factor



SC-Type



MTRJ-Small Form Factor

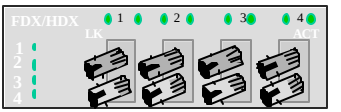
g.2.2.2 Fiber 4-Port Modules, LE1420C, LE1419C LE1423C LE1422C

In a fiber 4-port module, all of the fiber ports are of the same speed, the same multi- or ıgle-mode, and the same connector type. Multi-mode 100Mbps models are available with ST, C, MTRJ, and VF-45 connectors. Single-mode 100Mbps models are available with SC nnectors.

The 100Mb fiber 4-port modules on the Black Box LE14XXA-Series normally are set ıctory default) to operate in full-duplex mode for best fiber distance and performance. On the E14XXA-Series, the user may select full- or half-duplex mode per-port with an internal jumper tting (See Section 3.4) for the flexibility to adapt to any type of Fast Ethernet devices.

On Black Box fiber 4PMs, there are three LED's per fiber port. The Link (LK) LED dicates "ready for operation" when lit, another LED indicates operation in full-duplex mode ıen ON (when it is OFF, operation is half-duplex), and an LED indicates Receiving Activity .CT) on the port. A fiber cable must be connected to each 100Mb port and a proper link (LK) must be made with the device at the other end of the cable in order for the LK LEDs to ovide valid indications of operating conditions.

2.3 4-port modules, 10 Mb fiber



ST-Type

The 10 Mb model LE1424C fiber 4-port odule is the same as the 100Mb LE1428C, except r 10Mb speed rather than 100Mb speed. It pports distances according to the 10Base-FL standard, i.e., 2Km distance for multi-mode fiber. ingle-mode for 10km distance may be available as a special order).

2.2.4 4-Port Module, RJ-45 (copper)

The Black Box LE14XXA-Series copper port module, model LE1425C, provides four 10/100Mb switched. RJ-45 ports. The 10/100Mb switched ports are independently N-way auto-negotiating

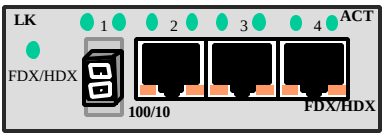
LE1425C

for operation at 10 or 100Mb speed in full- or half-duplex mode (as a default setting). They independently move to half-duplex mode at 10 Mb or at 100Mb speed if the device at the other end of the twisted pair cable is half-duplex or is not an auto-negotiating device.

On the model LE1425C , there are four LED's for each port. The LK (Link) indicates "ready for operation" when lit, the ACT (Activity) indicates receiving activity on that port, the 10/100 LED indicates operation at 100Mb speed when ON and at 10 Mb speed when OFF (when auto-negotiation is not disabled), and the FDX/HDX LED is ON to indicate full-duplex operation and OFF, to indicate half-duplex mode. A twisted pair cable must be connected into each RJ-45 10/100Mb port and a proper link (LK lit) must be made with the device at the other end of the cable in order for the LEDs to provide valid indications of operating conditions.

Internal jumper settings (See Section 3.4) allow technicians to over-ride the auto-negotiation feature and to manually set each port at full-duplex or half-duplex. One port on each RJ-45 4-port module is equipped with a Media Dependent Interface-Crossover (MDI-X) push button switch to simplify cascaded or up-link connections.

2.2.5 Combo 4 Port Modules, "3 + 1", 3 RJ-45 and 1 fiber port



The combo 4-port modules are combination of copper and fiber media, available as three 10/100 switched RJ-45 copper ports and one 100Mb switched multi-mode fiber ST or SC port or single-mode SC port.

LE1426C

The RJ-45 ports run at 10/100Mbps with **N-way** auto-negotiation capability, whereas e fiber port runs at 100Mbps with half- or full-duplex capability manually selected. The fault condition is full-duplex. Internal jumpers settings allow technicians to set the 100Mb ɔer port to half-duplex mode. (See Section 3.4).

ı LE14XXA Combo 4-port modules, there are three LED's for each RJ-45 port, which indicate ıtus as described for the LE1426C in Section 2.2.4 above. The fiber port will run at 100Mbs eed at all times, and has LEDs that indicate status the same way as described for the Fiber 4-ırt modules in Section 2.2.2 above.

2.6 Frame Buffering and Latency

The Black Box LE14XXA-Series are store-and-forward switches. Each frame (or cket) is loaded into the Switch's memory and inspected before forwarding can occur. This :hnique ensures that all forwarded frames are of a valid length and have the correct CRC, i.e., e good packets. This eliminates the propagation of bad packets, enabling all of the available ndwidth to be used for valid information.

While other switching technologies such as "cut-through" or "express" impose minimal ıme latency, they will also permit bad frames to propagate out to the Ethernet segments nnected. The "cut-through" technique permits collision fragment frames, which are a result of :e collisions, to be forwarded to add to the network traffic. Since there is no way to filter ımes with a bad CRC (the entire frame must be present in order for CRC to be calculated), the sult of indiscriminate cut-through forwarding is greater traffic congestion, especially at peak tivity. Since collisions and bad packets are more likely when traffic is heavy, the result of ɔre-and-forward operation is that more bandwidth is available for good packets when the traffic ad is greatest.

To minimize the possibility of dropping frames on congested ports, each Black-Box E14XXA-Series Switches dynamically allocates buffer space from an 8 MB memory pool, suring that heavily used ports receive very large buffer space for packet storage. (Many other vitches have their packet buffer storage space divided evenly across all ports, resulting in a ıall, fixed number of packets to be stored per port. When the port buffer fills up, dropped ckets result.) The other two LE14XXA-Series Switches LE1408A and LE1416A dynamically ocates buffer from an 4MB memory pool. This dynamic buffer allocation provides the pability for the maximum resources of the LE14XXA-Series unit to be applied to all traffic ads, even when the traffic activity is unbalanced across the ports. Since the traffic on an erating network is constantly varying in packet density per port and in aggregate density, the

LE14XXA-Series Switches are constantly adapting internally to provide maximum network performance with the least dropped packets.

When the Switch detects that its free buffer queue space is low, the Switch sends industry standard (full-duplex only) PAUSE packets out to the devices sending packets to caus "flow control". This tells the sending devices to temporarily stop sending traffic, which allows traffic catch-up to occur without dropping packets. Then, normal packet buffering and processing resumes. This flow-control sequence occurs in a small fraction of a second and is transparent to an observer. See Section 4.6 for additional details.

Another feature implemented in LE14XXA--Series Switches is a collision-based flow control mechanism (when operating at half-duplex only). When the Switch detects that its free buffer queue space is low, the Switch prevents more frames from entering by forcing a collision signal on all receiving half-duplex ports in order to stop incoming traffic.

The latency (the time the frame spends in the Switch before it is sent along or forwarded to its destination) of the LE14XXA-Series Switches varies with the port-speed type and the length of the frame is a variable here as it is with all store-and-forward switches. For 10 Mb-to-10 Mb or 10 Mb-to-100Mb or 100Mb-to-10 Mb forwarding, the latency is 15 microseconds plus the packet time at 10 Mb. For 100Mb-to-100Mb forwarding, the latency is microseconds plus the packet time at 100Mb.

3 Features and Benefits

- **100Mb switching services for large, high performance Ethernet LANs**

  LE14XXA-Series Switches provide Fast Ethernet switching on all ports. They perform high speed filter/forward operations on the traffic, giving each port's segment a full 100Mb (or 10 Mb) of bandwidth.

- **Configurable with fiber ports, all connector types and speeds**

  4-port modules are available with 100Mb mm ST, SC, VF-45, MTRJ single-mode SC, and 10 Mb ST-type connectors. The configuration of the fiber ports, in the factory or in the field, allows the LE14XXA-Series Switches to adapt to mixed and changing fiber types in any application.

- **Configurable with RJ-45 (copper) ports, 10/100 auto-negotiation**

  RJ-45 4-port modules provide twisted pair segment connections, with N-way auto-negotiation or with manual speed and mode settings per port

- **Mixed-media configurations for maximum flexibility**

  Combinations of port module types can be configured in the same unit, adapting the LE14XXA-Series Switches to varying quantities and types of fiber vs. copper media. Port module changes can even be done in the field.

- **Full-duplex or Half-duplex operation, auto-sensing**

  All fiber and RJ-45 (copper) ports are capable of half- or full-duplex, individually selected. All RJ-45 ports support 10/100 auto-negotiation, or can be user-selected for the desired operating mode and speed.

- **16-port, 12-port, 8-port and 4-port models**

  With two chassis sizes (16-port and 8-port) configurable with 4-port 4PMs, capacity options complement the mixed-media configurability.

- **Plug-and-Play installation for high performance switching**

  Black Box LE14XXA-Series Switches are self-learning for node addresses. They can be placed into operation without complex set-up procedures, even in large networks. They operate transparent to system software.

- **Front-mounted LEDs, world-wide AC power supply**

  Front panel LED's on each 4-port module display the status of each port for easy monitoring. An internal auto-ranging AC power supply allows LE14XXA Series Switches to be used throughout the world. (A 48VDC power supply is optional, see Appendix B).

.2.4 Applications

Black Box LE14XXA-Series Modular Switches offer high performance and flexibility and are easily used in a variety of applications including client/server computing, performance upgrades of departmental networks, and collapsed backbone applications. The Dual-Speed characteristic of the LE14XXA-Series Switches enables them to inter-connect a series of subnet (one subnet per LE14XXA-Series Switch) in a LAN traffic center. The subnet connections may be via either fiber or twisted pair cabling, and may be 100Mbps or 10 Mbps speed and full-or half-duplex mode.

The mixed-media capability is ideal for upgrading existing Ethernet LAN networks, where existing cabling must be accommodated. The fiber-built-in media capability is ideal for integrating future-proof fiber cabling into the LAN structure.

Example 1 : LE1401A

In a typical 10 Mb network performance upgrade, some existing cascaded 10 Mbps hubs connect a group of users who share one 10 Mb traffic domain. The LE1401A 4port Series Switch provides eight 10/100Mb traffic domains for increased performance. It can segment 10 Mbps and 100Mbps units, hubs and servers, in the existing network into multiple domains, providing greatly increased bandwidth. In this case, two 100Mb fiber connections are required t connect to more distant LAN centers, and a configuration with two “combo” 3@RJ-45 + 1@fiber-built-in 4PMs is used.

The LE1401A provides complete network connectivity so that all 10 Mb and 100Mb nodes operate in a unified manner, functioning as one plug-and-play switched network facility. It filters and forwards packets from one segment to another, containing the local traffic and allowing only the packets which need to be forwarded to go outside to the appropriate other segments. This is ideal for a central departmental switch in a high-performance LAN center. Figure 2.4 illustrates this example.

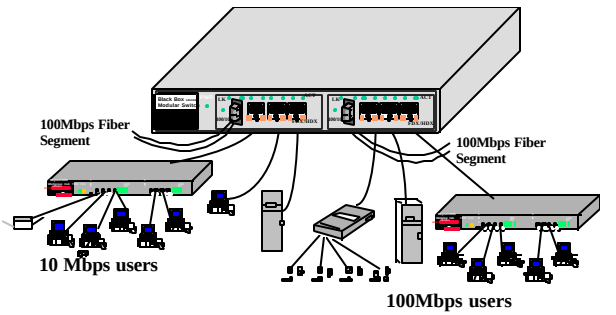


Fig. 2.4a: AFTER LE1401A Switch provides central connectivi ty while maintaining full 10 Mbps and 100Mbps bandwidth on each segment.

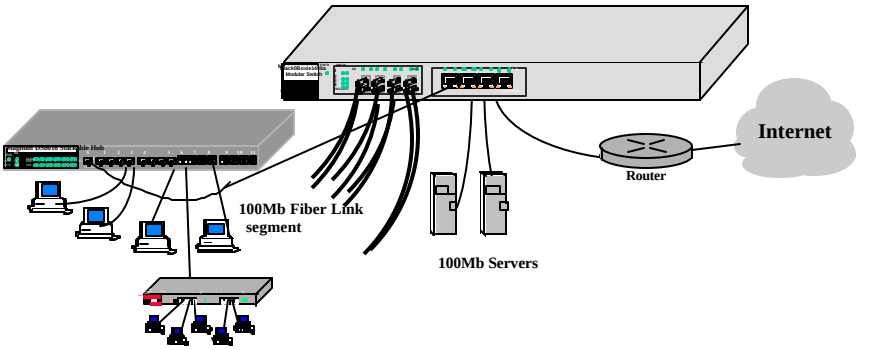
ɛample 2 : 8-port LE1408A

In another application, a Switch is needed to provide a Fast Ethernet backbone. The ckbone consists of four high-speed LAN segments, each operating over 100MB full-duplex ɔer lines. In addition to interconnecting the fiber backbone segments in the network center, the vitch needs to provide high-speed switched support for two central servers, for a 100MB nnection to a router, and for a dual-speed hub serving a local workgroup of over a dozen users, inters, etc.

The LE1408A equipped with one Fiber and one RJ-45 4-port modules provides an onomical solution, configured with 8 switched ports (four 100Mbps fiber and four 10/100 RJ-) in a rack-mount box. No Media Converters are needed. The Fiber 4PM can be selected to ovide any 100Mbps fiber media connector type desired. 4PMs with multi-mode or single-ɔde fiber types are available.

This requirement for connecting local devices over twisted pair cabling is handled by ɛ LE1408A using a RJ-45 4-Port Module. The 4PM provides a switched port for two local gh speed servers, another for the router, another for the users connecting into a 16-port dual-eed hub such as the LE1408A.

Since 100Mb fiber Ethernet has severe distance limitations at half-duplex, it is cessary in high speed backbones to operate fiber links in the full-duplex mode. Many low-end vitches that only have RJ-45 N-way 10/100Mb ports would need to have a media converter on ch fiber line. But most media converters do not support auto-negotiation and would not enable ɛ fiber backbone lines to operate full-duplex. But the LE1408A . . . with built-in switched fiber ɹrts at 100Mb speed, with full-duplex mode as a default setting on fiber ports, and with some l-45 N-way 10/100Mb ports as well. . . handles this application readily.



gure 2.4b: The LE1408A provides a 100Mb fiber backbone facility.

Example 3 : 16-port LE1416A

In another situation similar to Example 2 above, a larger central Switch is needed to provide for a 6-segment 100Mb fiber Fast Ethernet backbone, and switched copper support fo 4 high speed local servers. In addition, the router and two dual-speed hubs need switched copp ports. The total is 14 ports, 6 fiber and 8 copper.

The mixed-media flexibility of the Black-Box 4-Port Switches provides the user with more than one configuration in this case. The two ports not immediately used may be either fib or copper. If the probable growth of the central Switch is towards more fiber backbone segments, then two 4-port fiber 4PMs are selected to provide 6 required fiber ports and two fo spares and/or future backbone expansion. The 8 switched copper ports are handled with two R 45 4-Port Modules configured into the LE1416A. Should the number of servers expand, more than one server can be serviced by a switched LE1416A port by using a small 4-port 100Mbps hub.

If the probable growth of the central Switch is towards more local high speed servers and users, then one 4-port fiber 4PM is selected to provide 4 of the required fiber ports, and tw "combo 3 RJ-45 + 1 fiber" 4PMs are configured for the other 2 fiber ports plus 6 of the switch copper ports. Finally, an RJ-45 QPM is configured to provide for the remaining 2 copper port plus two for spares and/or future expansion. Should the need arise to add a built-in-fiber backbone port in the future, the RJ-45 4PM could be removed and another "3+1 combo" 4PM installed in the field. Alternatively, a 100MB Media Converter (such as the LH1500A-ST-R2) may be used on a copper port, with internal jumpers (See Section 3.4) set to support fixed 100MB FDX on the RJ-45 port.

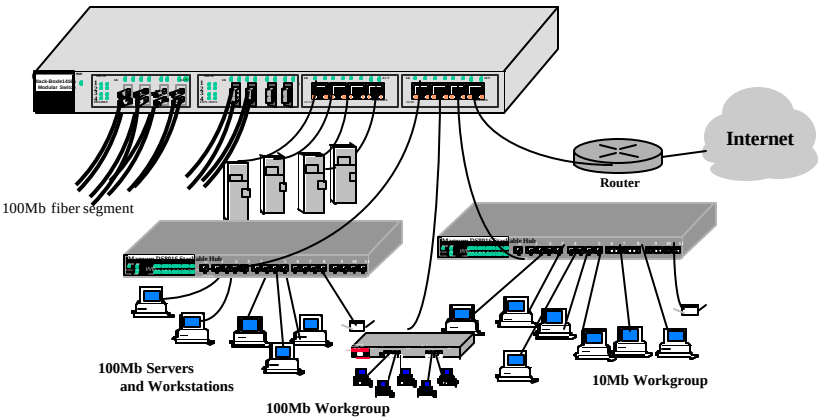


Fig 2.4c: LE1416A provides a 100Mb mixed-media backbone Switch.

) Installation

Before installing the equipment, it is necessary to take the following precautions:
1.) If the equipment is mounted in an enclosed or multiple rack assembly, the environmental temperature around the equipment must be less than or equal to 50°C.
2.) If the equipment is mounted in an enclosed or multiple rack assembly, adequate air flow must be maintained for proper and safe operation.
3.) If the equipment is mounted in an enclosed or multiple rack system placement of the equipment must not overload or load unevenly the rack system.
4.) If the equipment is mounted in an enclosed or multiple rack assembly, verify the equipment's power requirements to prevent overloading of the building/s electrical circuits.
5.) If the equipment is mounted in an enclosed or multiple rack assembly verify that the equipment has a reliable and uncompromised earthing path.

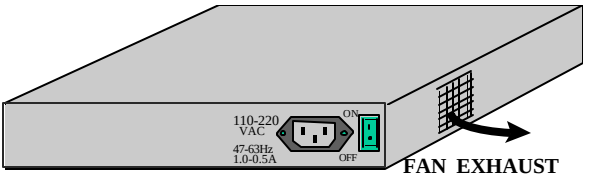
stallation: This section describes installation of the LE14XXA-Series Switches, as well as nnection of the various Ethernet media types.

l Locating LE14XXA-Series Switches

The location of a LE14XXA-Series Switch is dependent on the physical layout of the twork. Typically the Switch is placed in a central wiring location where groups of network vices need to be connected in order to communicate with each other. These Switches are pically rack mounted in a wiring closet see Section 3.3.2 below), but because they have rubber et they can also be installed on a shelf or table top. The compact size of the 8-port LE1401A it allows it to be easily placed in an office or lab area, and it can also be either shelf of wall-ounted (see Section 3.3.1 below).

Locate an AC receptacle that is within six feet (2 meters) of the intended LE14XXA-ries site. The rugged metal case of the LE14XXA-Series will normally protect it from cidental damage in a lab or workplace setting. Maintain an open view of the front to visually onitor the status LEDs. Keep an open area around the unit so that cooling can occur from the all fan on the left side, while the unit is in operation. See figure below.

Figure 3.1: Location of 8-port LE1401A's cooling fan exhaust



3.2 Connecting Ethernet Media

The Black-Box LE14XXA-Series Fiber Switches are specifically designed t support all standard Ethernet media types within a single Switch unit. This is accomplished by using a family of 4-port Modules (4PMs) which can be individually selected and configured per-port. See Section 2.4 for a description of the 4PMs.

The various media types supported along with the corresponding IEEE 802.3 and 802.3u standards and connector types are as follows:

IEEE Standard	Media Type	Max. Distance	Port Module
Fiber:			
100BASE-FX	mm[1] Fiber	2.0km (6,562 ft)	LE1428C, LE1419C
	sgl.m[2] Fiber	18.0km (95K ft)	LE1421C
small form factor	mm[1] Fiber	2.0km (6,562 ft)	LE1422C, LE1423C
10BASE-FL	mm[1] Fiber	2.0km(6,562 ft)	LE1424C
Copper:			
10BASE-T & 100BASE-TX	twisted pair	100m (328 ft)	LE1425C

[1] mm = multi-mode [2] sgl.m = single-mode

3.2.1 Connecting Fiber Optic ST-type, "twist-lock"

The following procedure applies to installations using a 4PM with ST-type fiber connectors. This procedure applies to ports using a LE1428C or LE1424C.

1. Before connecting the fiber optic cable, remove the protective dust caps from the tips c the connectors on the 4PM. Save these dust caps for future use.
2. Wipe clean the ends of the dual connectors with a soft cloth or lint-free lens tissue dampened in alcohol. Make certain the connectors are clean before connecting.

   Note: ***One strand of the duplex fiber optic cable is coded using color bands at regular intervals; you must use the color-coded strand on the associated ports at eacl end of the fiber optic segment.***
3. Connect the Transmit (TX) port (light colored post) on the 4PM to the Receive (RX) port of the remote device. Begin with the color-coded strand of the cable for this first TX-to RX connection.
4. Connect the Receive (RX) port (dark colored post on the PM) to the Transmit (TX) pc of the remote device. Use the non-color coded fiber strand for this.
5. The LINK LED on the front of the 4PM will illuminate when a proper connection has been established at both ends (and when power is ON in the unit). If LINK is not lit aft cable connection, the normal cause is improper cable polarity. Swap the fiber cables at the 4PM connector to remedy this situation.

2.2 Connecting Fiber Optic SC-type, "Snap-In"

The following procedure applies to installations using a 4PM with SC-type fiber connectors, i.e., using LE1419C, LE1421C single-mode.
When connecting fiber media to SC connectors, simply snap on the two square male connectors into the SC female jacks of the 4PM until it clicks and secures.

2.3 Connecting Single-Mode Fiber Optic

When using single-mode fiber cable, be sure to use single-mode fiber port connectors. Single-mode fiber cable has a smaller diameter than multi-mode fiber cable (9/125 microns for single-mode, 50/125 or 62.5/125 microns for multi-mode where xx/xx are the diameters of the core and the core plus the cladding respectively). Single-mode fiber allows full bandwidth at longer distances, and may be used to connect 10 Mb nodes up to 10 Km apart, or 18Km with the LE1421C.

The same procedures as for multi-mode fiber applies to single-mode fiber connectors. Follow the steps listed in Section 3.2.2 above.

2.4 Connecting Twisted Pair (RJ-45,CAT3, CAT5, Unshielded or Shielded)

The RJ-45 ports of the LE14XXA-Series can be connected to the following two media types: 100BASE-TX and 10BASE-T. CAT 5 cables should be used when making 100BASE-TX connections. When the ports are used as 10BASE-T ports, CAT 3 may be used. In either case, the maximum distance for unshielded twisted pair cabling is 100 meters (328 ft).

Media	IEEE Standard	Connector
Twisted Pair (CAT 3, 4, 5)	10BASE-T	RJ-45
Twisted Pair (CAT 5)	100BASE-TX	RJ-45

OTE : *It is recommended that high quality CAT. 5 cables (which work for both 10 Mb and 100Mb) be used whenever possible in order to provide flexibility in a mixed-speed network, since dual-speed ports are auto-sensing for either 10 and 100Mb/s.*

The following procedure describes how to connect a 10BASE-T or 100BASE-TX twisted pair segment to the RJ-45 port. The procedure is the same for both unshielded and shielded twisted pair cables.

1. Using standard twisted pair media, insert either end of the cable with an RJ-45 plug into the RJ-45 connector of the port. Note that, even though the connector is shielded, either unshielded or shielded cables and wiring may be used.
2. Connect the other end of the cable to the corresponding device
3. Use the LINK LED to ensure proper connectivity by noting that the LED will be illuminated when the unit is powered and proper connection is established.

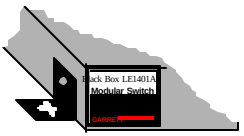
3.3 Table-Top or Shelf Mounting

The LE14XXA-Series Switches can be easily mounted on a table-top or any suitable horizontal surface, and has four rubber feet to provide stability without scratching finished surfaces.

3.3.1 Wall (or Vertical Surface) Mounting, 8-port LE1401A

Each LE1401A Switch is shipped with two metal mounting brackets (and screws) to allow the unit to be mounted in nearly any desired orientation or position. The brackets are attached to the metal hub case using one of the metal screws for each bracket, and attached to the LE1401A through the round hole of the bracket. A user-supplied screw attaches the bracket to the mounting surface. It is recommended that the mounting brackets be attached to two opposite corners of the unit. When properly attached, the brackets will extend slightly below the base of the unit to allow clearance for the rubber feet and for cooling fan exhaust space.

Magnum LE1401A, optional mounting brackets

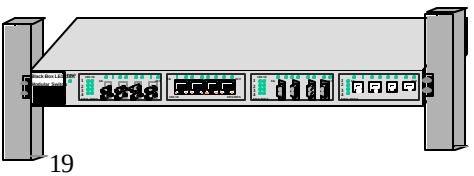


Proper mounting bracket attachment

Figure 3.1: LE1401A, metal mounting brackets

3.3.2 Rack-mounting, models LE1408A and LE1416A

Installation of a LE1408A and LE1416A Mixed-Media Fiber Switch in a 19” rack is simple procedure. The units are 1U (1.75”) high. When properly installed, the front-mounted LED status indicators should be in plain



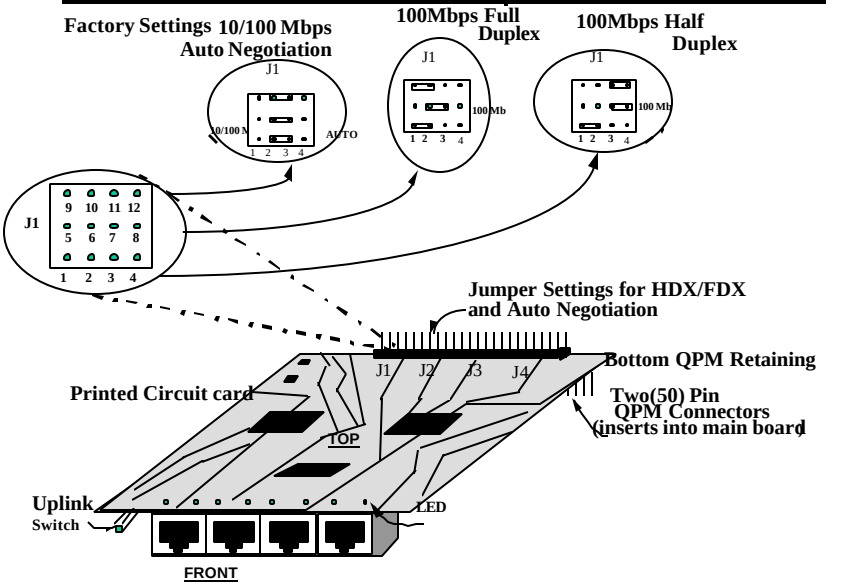
ew and easy to read. Rack-mount installation requires special rack-mounted brackets and rews (included with each LE1408A and LE1416A unit). The brackets attach to the front sides the Switch, which is then fastened into a standard 19" rack.

4 RJ-45 ports, internal jumper settings for 10/100Mb (auto-negotiation) or for ced Half- or Full-Duplex 100Mb, per port

The factory (or default) setting is for auto-negotiation on all RJ-45 ports, which is generally pular. It works well under most circumstances, but cannot always be

Jumper Settings for Auto-Negotiation, or for 100MB Half or Full Duplex

Jumper	Port	Function	Factory Settings	Speed
JP2-3,6-7, 10-11	Pin 2-3,6-7,10-11	Auto-Negotiation	YES	10/100 Mb,
JP1-2, 6-7, 9-10	Pin 1-2, 6-7, 9-10	FDX @100 config	NO	100 Mb
JP1-2, 7-8, 11-12	Pin 1-2, 7-8, 11-12	HDX@100 config	NO	100 Mb



gure 3.4. RJ-45 ports, internal jumper settings. Note: *Be certain that the main power is sconnected before opening the unit or changing any internal jumper settings.*

pended upon to work as expected. If auto-negotiation will not function properly in your tup, internal jumpers allow the speed and mode of the LE14XXA-Series RJ-45 (copper) 4-rts to be fixed, even if the attached device may or may not support auto-negotiation. This is sirable when there are unknown devices presently or potentially connected, which will not erate correctly with auto-negotiation. Examples include some NICs and most Media nverters.

Therefore, the default setting of auto-negotiation (copper ports) is generally desirable because it is widely used and allows for the connection of various devices without re-configuration. Under certain conditions,(where the connected device is full duplex and does not support Auto-negotiation; or the connected device does not support Auto-negotiation properly no auto-negotiation is better and the internal jumper settings will permit this to be selected on a per-port basis.

See Section 4.4 for additional information on auto-negotiation functionality.

3.5 Fiber ports, internal jumper settings for 100Mb fixed Half- or Full-Duplex, per port

The factory (or default) setting is for full-duplex on all fiber 100Mbps ports, which is generally popular. It works well under most circumstances, but cannot always be depended upon to work as expected. If full-duplex will not function properly in your setup, internal jumpers allow the speed and mode of the LE14XXA-Series fiber 4-ports to be

Jumper Settings for 100Mbps Fiber Half or Full Duplex

Jumper	Port	Function	Factory Settings	Speed
JP1-2, 6-7, 9-10	Pin 1-2, 6-7, 9-10	FDX @100 config	YES	100 Mb
JP1-2, 7-8, 11-12	Pin 1-2, 7-8, 11-12	HDX@100 config	NO	100 Mb

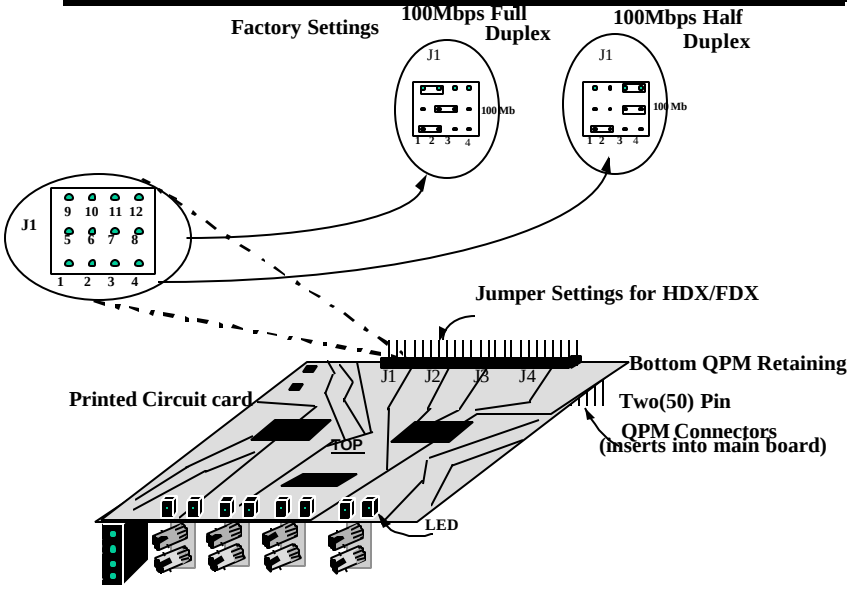


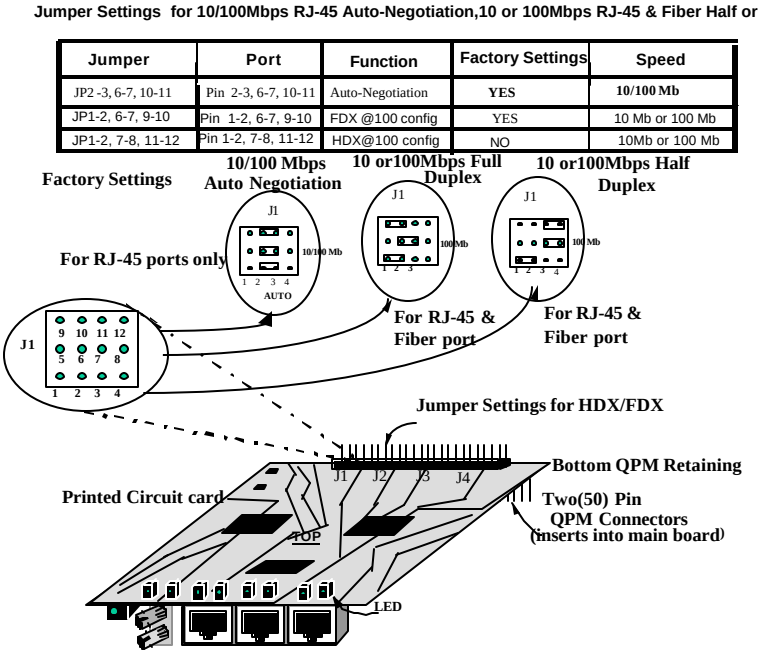
Figure 3.5. Fiber ports, internal jumper settings. Note: *Be certain that the main power is disconnected before opening the unit or changing any internal jumper settings*

ted, even if the attached device may or may not support full-duplex. This is desirable when ere are unknown devices presently or potentially connected, which will not operate correctly th full-duplex. Examples include hubs which support only half-duplex by default.

Therefore, the default setting of full-duplex (fiber ports) is generally desirable because is widely used and allows for the connection of various devices without re-nfiguration(specially along with switches). Under certain conditions,(where the connected vice is half duplex and does not support full-duplex; or the connected device does not support ll-duplex properly) no full-duplex is better and the internal jumper settings will permit this to selected on a per-port basis.

5 Combo(3+1) ports, internal jumper settings for 10/100 RJ-45 Auto-Negotiation or 10 or 100Mb or for fixed Half- or Full-Duplex 100Mb, per port

The factory (default) setting is Auto-Negotiation on all RJ-45 ports and full-duplex on fiber 10 Mbps or 100Mbps ports, which is generally



gure 3.6 Combo ports, internal jumper settings. Note: *Be certain that the main power is sconnected before opening the unit or changing any internal jumper settings*

pular. Auto-Negotiation on RJ-45 and FDX on fiber port works well under most cumstances, but cannot always be depended upon to work as expected. If full-duplex will not nction properly in your setup, internal jumpers allow the speed and mode of the LE14XXA-

Series Combo- 4ports to be fixed, even if the attached device may or may not support full-duplex. This is desirable when there are unknown devices presently or potentially connected, which will not operate correctly with full-duplex. Examples include hubs that support only hal duplex by default.

If auto-negotiation will not function properly in your setup, internal jumpe allow the speed and mode of the LE14XXA-Series RJ-45 (copper) 4-ports to be fixed, even if the attached device may or may not support auto-negotiation. This is desirable when there are unknown devices presently or potentially connected, which will not operate correctly with auto-negotiation. Examples include some NICs and most Media Converters.

3.7 Fiber 10Mb ports, internal jumper settings for 10Mb fixed Half- or Full-Duple at all ports

The factory (default) setting is for half-duplex on all fiber 10Mbps ports, which is generally popular. HDX works well under most circumstances. If half-duplex on 10Mbps will not function properly in your setup, internal jumpers allow the duplex mode of tl LE14XXA-Series fiber 4- ports to be changed, even if the attached device supports full-duplex. This is desirable when there are devices connected which will not operate correctly with half-duplex. Examples include Switches that support full-duplex only.

Jumper Settings for 10Mb Fiber Half or Full Duplex

Jumper	Port	Function	Factory Settings	Speed
JP3 OPEN	OPEN	FDX @10Mb config	NO	10 Mb
JP3 JP2-4	Pin 2-4	HDX@10Mb config	YES	10 Mb
JFD1 JP1-3	PIN 1-3	FDX@10Mb config	NO	10Mb
JFD1 OPEN	OPEN	HDX @10Mb config	YES	10Mb

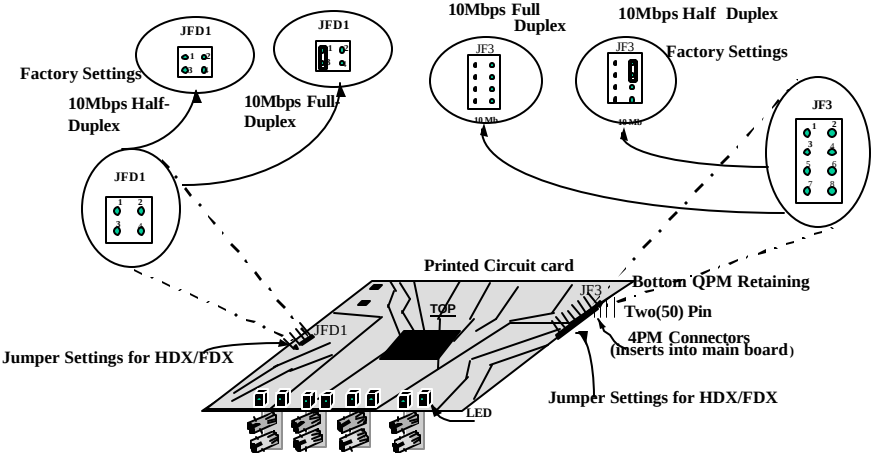


Figure 3.7 10Mbps Fiber ports internal jumper settings.

ote: *Be certain that the main power is disconnected before opening the unit or changing any ternal jumper settings*

nerefore, the default setting of half-duplex (fiber ports) is generally desirable because it is dely used and allows for the connection of various devices without re-configuration.(where the nnected device is half duplex and does not support full-duplex i.e., Hub and media-converters.)

ote: *For 10Mbps fiber ports, the user can set the jumpers either at full-duplex or half duplex on l the four ports. There is no individual port duplex options for 10 Mb port.*

3 Powering the LE14XXA-Series Switch

The Black-Box LE14XXA-Series Switches incorporate an internal universal power pply, and has a recessed male IEC connector for the AC power cord at the left-rear. A manual wer ON-OFF switch is adjacent. A six-foot 115 VAC 60 Hz standard power cord is supplied th each unit shipped within the United States and Canada.

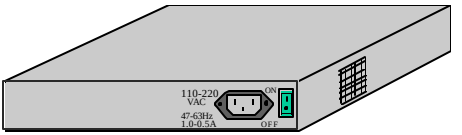


Figure 3.5: LE14XXA-Series AC power connector

The auto-ranging power supply supports installation environments where the AC ltage is from 90 to 260 volts with a power input frequency of between 47 and 63 Hz. The 8-rt units will consume just under 20 watts of power typically, and the 16-port units will nsume about 35 watts typically.

When connecting the Ethernet cabling, there is no need to power down the unit. dividual segments can be connected or disconnected without concern for AC power-related oblems or damage to the unit.

Power supply options are available to suit the LE14XXA-Series Switches to special gh-availability communications and/or heavy industrial-grade applications, including:

* -48VDC with single DC input,
* -48VDC with dual-source DC input,
* -48VDC with dual redundant internal power supply units and dual-source DC input,
* AC with dual redundant internal power supply units and dual-source AC input

See the Appendices of this manual for more details. Use an RFQ for other variations.

9 4 Port Module (4PM) Installation

The LE14XXA-Series Modular Switches are normally received from the factory with required 4PM modules installed. There may be situations where 4PM cards need to be added replaced. In cases where additional 4PM cards are needed, the face plate for an available front-ounted slot must be removed. The following procedure describes this operation.

9.1 Preparation for Installing and Removing 4PMs

STOP!!!

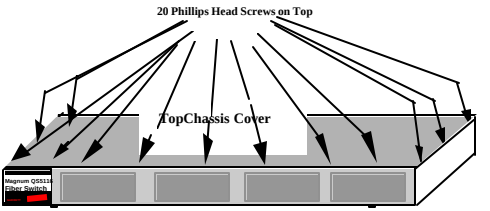
Be sure the power cord is unplugged from the chassis before attempting to remove and/or replace any 4PM cards. Failure to do so may result in damage to the unit and will void the warranty.

aution- Avoid Static Discharge: The port modules (like most electronic equipment) are sensitive to static discharge. Use proper ESD measures when handling port modules.

ep 1. Make sure the 4PM Card package has all necessary accessories to install it properly. The 4PM Card package for field installation comes along with a 4PM Card, two 7/16 stand-offs , two #4-40 Pan-Head screws, two #4-40 black color Flat-head screws and two Headers pin.

ep 2. Remove Chassis Cover

The LE14XXA-Series chassis are combined with top and bottom part and assembled gether with the help of 20 Philips head screws. There are 7 screws located on front-top of the it and three screws each on the left and right edges. Remove these screws. Once these are moved, the top cover is easily lifted off the chassis base. When the chassis top cover has been moved, the interior of the unit exposed.



gure 3.9.1a: Removing hassis Cover

Caution: Be careful not to disturb the power supply.

Looking down into the LE14XXA-Series unit, notice that there are individual 4PM connector sockets along with two stand-offs for each 4PM card position. There are four 4PM slots located on the front of the LE1416Amodel, whereas LE1401A and LE1408A has two 4P slots in the front. (See Figure 3.9.1b).

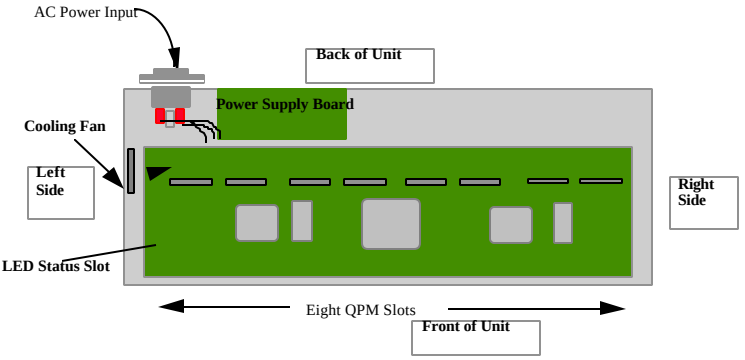


Figure 3.9.1b: LE1416A, Top View with Chassis Cover

Step 3. Remove bottom-front and modules rear top Retaining Screws in any 4PM or Face Plates

On the bottom-front of the unit, there are two retaining screws for each 4PM card sl as well as two other retaining screws on the rear top of the module. These four screws are used to secure a 4PM face plate in position. These screws are also used to secure the individual 4PM cards, which can be subjected to significant forces from the attached cables. (See Figure 3.9.1c)

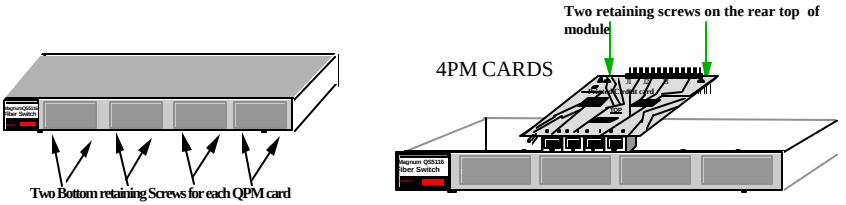


Figure 3.9.1c: Front View - 4PM Retaining Screws hold Face Plates

9.2 Installing 4PM Cards in the LE14XXA-Series

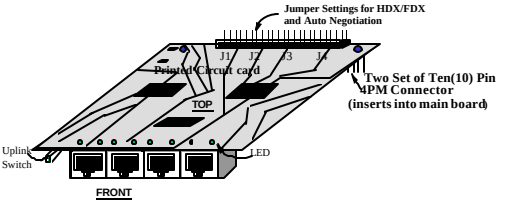
Up to four front-mounted 4PM cards may be installed in one LE1416A Fiber Hub unit. Follow these steps to install a 4PM.

ep 1. Remove top chassis cover. See procedure in Section 3.9.1 above.

ep 2. Screw down tightly the two 7/16 stand-offs on the top of pre installed stand-offs from the factory.

ep 3. Align the two headers pin on the top of the two sets of socket fixed at the bottom side of the 4PM module. (Note: After firmly attached the sockets and the header pin, move the mounted pins slightly tilted towards the front of the chassis.

ep 4. The figure here illustrates the basic layout of an individual 4PM card. Each 4PM card fits into the selected 4PM connector socket slot. Align the connector pins on the bottom of the 4PM card with the connector socket inside the unit.



ep 5. Be sure the 4PM front panel is guided into the front slot cut-out first and then precisely aligned the header pins with the holes in the socket slot mounted on the board. Slowly and carefully apply enough pressure on both rear corner of 4PM Module to insert the 4PM card's pins into position. A click sound will determine the proper lockup of the two, see Figure 3.9.2b. (If you force the 4PM down when the pins are not properly aligned with the holes in the header, the pins will become bent and the 4PM is damaged).

ep 6. Once inserted, the 4PM card will be secured by the header connector, the front panel port slot cut-out, and retaining screws. Use #4-40 Pan Head retaining screws to secure the module rear part and #4-40 Flat Head (Black color) retaining screws for front panel.

NOTE: *If a 4PM is difficult to install, try it in another port slot. Some of the port modules may fit easily in one port slot and be very hard to install in another.*

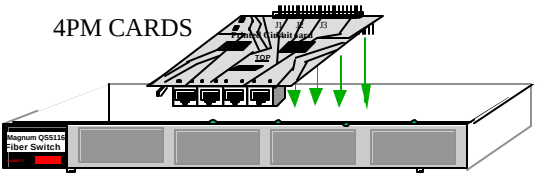


Figure 3.9.2a: Inserting 4PM Cards into a LE1416A

NOTE: ***All 4PM slots need not be filled in order for the LE14XXA-Series unit to be operational. When leaving 4PM slots empty, always use a face plate (4PM-FP) to cover the slot opening in the front panel. This will maintain proper cooling air flow, safety, and operation as required by FCC, CE, and other regulations.***

Step 7. The figure below shows the top view of 4PM Card after successfully installed the 4P cards inside the LE1416A.

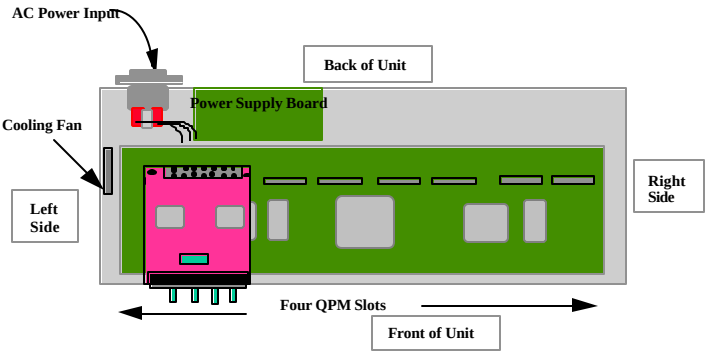


Fig. 3.9.2b Top View : 4PM Module Installed inside a LE1416A

Step 8. Once all 4PM cards have been installed (including face plates for empty slots), the chassis cover should be replaced.

3.9.3 Removing 4PM Cards

To properly remove a 4PM card from the Fiber Switch, follow the 3 steps below

Step 1. Remove chassis cover See procedure in Section 3.9.1 above.

Caution: Be sure the power cord is unplugged.

Step 2. Remove bottom-front retaining screws for the 4PM and Face Plate

On the bottom-front of the unit there are two retaining screws for each 4PM card and face plate slot. These screws are used to secure a 4PM card in position (see Figure 3.9.3a). Remove the front screws first and then screw mounted on the rear-top of the 4PM to be removed.

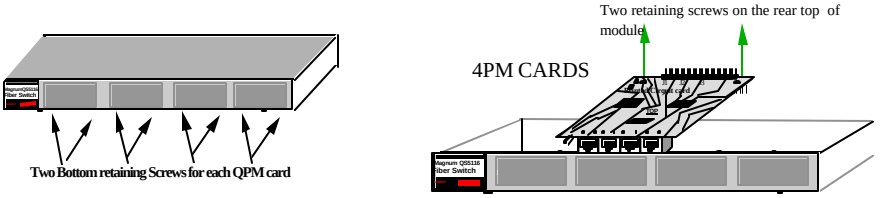


Figure 3.9.3a: Front View - Face Plate & 4PM Retaining Screws

ep 3. Remove 4PM Card

Gently pull the 4PM card up and out of the connector socket (see Figure 3.9.3b).

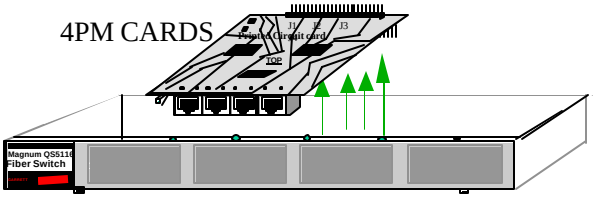


Figure 3.9.3b: Removing a 4PM Card

If the slot from which the 4PM card has been removed is to remain unused, be sure to install a 4PM face plate cover in it. If another 4PM card is replacing the one that has been removed, follow the steps as described for installing a 4PM card discussed in Section 3.9.1.

4.0 OPERATION

This chapter describes the functions and operation of the LE14XXA-Series.

4.1 Switching Functionality

A LE14XXA-Series provides switched connectivity at Ethernet wire-speed among al of its ports. The LE14XXA-Series supports10/100Mbs for copper media and 10 or 100Mb separate traffic domain for fiber port to maximize bandwidth utilization and network performance. All ports can communicate to all other ports in a LE14XXA-Series, but local traffic on a port will not consume any of the bandwidth on any other port.

LE14XXA-Series units are plug-and-play devices. There is no software configuring t be done at installation or for maintenance. The only hardware configuration settings are user options for UP-LINK on RJ-45 4-port. Half / Full duplex mode and 10 or 100Mbps selection f the switched ports can be done through jumper settings inside the unit. The internal functions c both are described below.

Filtering and Forwarding

Each time a packet arrives on one of the switched ports, the decision is taken to eithe filter or to forward the packet. Packets whose source and destination addresses are on the same port segment will be filtered, constraining them to one port and relieving the rest of the networl from processing them. A packet whose destination address is on another port segment will be forwarded to the appropriate port, and will not be sent to the other ports where it is not neede Traffic needed for maintaining the operation of the network (such as occasional multi-cast packets) are forwarded to all ports.

The LE14XXA-Series Switches operate in the store-and-forward switching mode, which eliminates bad packets and enables peak performance to be achieved when there is heavy traffic on the network.

Address Learning

All 16-port LE14XXA-Series units have address table capacity of 24K node addresse (12K for 8-port models), suitable for use in large networks. They are self-learning, so that as

ıdes are added or removed or moved from one segment to another, the 4-Port Switch tomatically keeps up with node locations.

An address-aging algorithm causes least-used addresses to fall out in favor of new equently-used addresses. To reset the address buffer, cycle power down-and-up.

2 Status LEDs

For all LE14XXA-Series models :

PWR : Power LED, ON when AC power is applied to the unit.
LK : Steady ON, Link status for 10 Mbps and 100Mbps operation.
ACT : ON with port activity for 10 Mbps and 100Mbps operation.
F/H : Full / Half duplex LED, ON when the port is running full duplex, OFF for half duplex.
100/10 : Speed LED, ON when the speed is 100Mbps , OFF when the speed is 10 Mbps

3 Up-link push-button, for RJ-45 4-port only

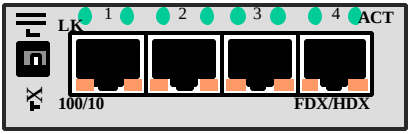


Figure 4.3 : Up-link push-ıtton on RJ-45 4-port

The unit has a manual Up-link ısh-button, located on the front panel next to 10/100Mb RJ-45 4-port # 1 which it controls. It ables the port's cable to either connect to a user station node (push in) or to be cascaded (push t) to a 10/100Mb repeater or switching hub in the network. Verify proper Up-link push-tton position by noting Port 1's LK (link) LED status, which is illuminated when a proper lk is made.

4 Auto-negotiation, for Fast Ethernet copper ports

The LE14XXA-Series Fast Ethernet copper ports can be set for either fixed 100Mb eed or for 10/100 F/H N-way auto-negotiation per the IEEE802.3u standard. The selection is ade via an internal jumper (see Section 3.4 for jumper-setting instructions). The factory default tting is for auto-negotiation. At 100Mb-fixed speed, the user may select half- or full-duplex ode by internal jumpers for each RJ-45 port separately.

One frequently-used application for the 4-Port-Switch copper ports is to connect one of them using a fiber media converter to another Switch in the network backbone, or to some other remote 100Mb device. In this case, it is desirable to operate the fiber link at 100Mb speed and at either half- or full duplex mode depending on the capabilities of the remote device. Standard commercially-available Fast Ethernet media converters mostly do not support auto-negotiation properly, and require that the switched port to which they are connected be at 100Mb fixed speed. Attachment to 10/100 auto-negotiation ports typically will not work properly. The 4-Port-Switch's RJ-45 ports handle this situation by changing the internal jump settings. (see Section 3.4)

When 4Port-Switch's RJ-45 copper ports are set for auto-negotiation and connected an another auto-negotiating device, there are 4 different speed and F/H modes selection dependi on what the other device supports. These are: (1) 100Mb full-duplex, (2) 100Mb half-duplex, (10 Mb full-duplex and (4) 10 Mb half-duplex.

The auto-negotiation logic will attempt to operate in descending order and will normally arrive the highest order mode that both devices can support at that time. (Since auto-negotiation is potentially an externally-controlled process, the original "highest order mode" result can change at any time depending on network changes that may occur). If the device at the other end is no an auto-negotiating device, the 4Port-Switch's RJ-45 ports will try to detect its idle signal to determine 10 or 100 speed, and will default to half-duplex at that speed per the IEEE standard.

General information -

Auto-negotiation per-port for 802.3u-compliant switches occurs when:

the devices at both ends of the cable are capable of operation at either 10 Mb or 100Mb speed and/or in full- or half-duplex mode, and can send/receive auto-negotiation pulses, and . . .

-- when the second of the two connected devices is powered up*, i.e., when LINK is established for a port, or

-- when LINK is re-established on a port after being lost temporarily.

- **NOTE** – ***some NIC cards only auto-negotiate when the computer system that they are in is powered up. These are exceptions to the "negotiate at LINK – enabled" rule above, but may be occasionally encountered.***

When operating in 100Mb half-duplex mode, cable distances and hop-counts may be nited within that collision domain. The Path Delay Value (PDV) bit-times must account for all vices and cable lengths within that domain. For Black Box LE14XXA-Series Fast Ethernet /itched ports operating at 100Mb half-duplex, the bit time delay is 50BT.

5 Auto-negotiation for 10 Mb ports, half- or full-duplex mode

Full-duplex Ethernet provides separate Transmit and Receive data paths, enabling nultaneous bi-directional collision-free data movements on a port. The network topology must a "star" type, not a "bus" type. With full-duplex mode, the cable distance is only limited by e physical layer line driver and cable attenuation. There are no collision-domain restrictions or nitations.

The LE14XXA-Series Switches perform half- or full-duplex mode auto-negotiation dependently on all switched ports. If the device or node on the other end of a port's attached ble supports F/H mode auto-negotiation or is set to operate as full-duplex, the 4-Port Switch ll negotiate to run full-duplex. If the attached device or node doesn't support F/H mode auto-gotiation (for example, if it is a 10 Mb repeater or a standard 10 Mb hub), the 4-Port-Switch's I-45 ports will default to operate at half-duplex.

5 Flow-control, IEEE 802.3x standard

Black-Box LE14XXA- Series Switches incorporate a flow-control mechanism for Full-uplex mode. The purpose of flow-control is to reduce the risk of data loss if a long burst of tivity causes the switch to save frames until its buffer memory is full. This is most likely to cur when data is moving from a 100Mb port to a 10 Mb port, and the speed difference makes e 10Mb port unable to keep up. It can also occur when multiple 100Mb ports are attempting transmit to one 100Mb port, and in other protracted heavy traffic situations.

LE14XXA-Series Fiber Switches implement the 802.3x flow control (non-blocking) on ull-Duplex ports, which provides for a "PAUSE" packet to be transmitted to the sender when e packet buffer is nearly filled and there is danger of lost packets. The transmitting device is mmanded to stop transmitting into the 4-switch port for sufficient time to let the Switch

reduce the buffer space used. When the available free-buffer queue increases, the Switch will sen a "RESUME" packet to indicate the transmitter to start sending the packets. Of course, the transmitting device must also support the 802.3x flow control standard in order to communicate properly during normal operation.

Note: When in Half-Duplex mode, the Modular-switch implements a back-pressure algorithm on 10/100 Mb ports for flow control. That is, the switch prevents frames from entering the device by forcing a collision indication on the half-duplex ports that are receiving. This temporary "collision" delay allows the available buffer space to improve, as the switch catches up with the traffic flow.

4.7 Power Budget Calculations for LE14XXA-Series 4PM's with Fiber Media

Receiver Sensitivity and Transmitter Power are the parameters necessary to compute the power budget. To calculate the power budget of different fiber media installations using LE14XXA models, the following equations should be used:

OPB (Optical Power Budget) = P_T(min) - P_R(min)

where P_T = Transmitter Output Power, and P_R = Receiver Sensitivity

Worst case OPB = OPB - 1dB(for LED aging) - 1dB(for insertion loss)

Worst case distance = {Worst case OPB, in dB} / [Cable Loss, in dB/Km]

where the "Cable Loss" for 62.5/125 and 50/125µm (M.m) is 2.8 dB/km,
and the "Cable Loss" for 100/140 (Multi-mode) is 3.3 dB/km,
and the "Cable Loss" for 9/125 (Single-mode) is 0.5 dB/km

The following data has been collected from component manufacturer's (HP's and Siemens') we sites and catalogs to provide guidance to network designers and installers.

Fiber Port Module	Speed, Std.	Mode	Std. km fdx (hdx)	Wave-length nm	Cable Size mm	X'mitr Output P_T, dB	R'cvr Sens. P_R, dB	Worst OPB, dB	Worst* distance Km, fdx	typical OPB, dB	typical* distance Km, fdx
LE1424C	**10 Mb FL**	Multi-mode	2 (2)	850	62.5/125 100/140 50/125	-15.0 -9.5 -19.5	-31 -31 -31	14 19.5 9.5	5 5.9 3.4	17 23.5 13.5	6 7 4.8
LE1428C	**100Mb FX**	Multi-mode	2 (0.4)	1300	62.5/125 50/125	-20 -23.5	-31 -31	9.0 5.5	2.5 2.0	14 12	5 4
LE1421C	**100Mb FX**	Single-mode	18+ (0.4)	1300	9/125	-15	-31	14	28	17.5	35
LE1422C	**100Mb FX**	Multi-mode	2 (0.4)	1300	62.5/125 50/125	-20 -23.5	-31 -31	9.0 5.5	3.0 2.0	15.8 12.2	5.5 4.0

422C	**100Mb FX**	Multi-mode	2 (0.4)	1300	62.5/125	-14	-31	15	5		16	5.7

Note: *The use of either multi-mode or single-mode fiber to operate at 100Mbps speed over long distances (i.e., in excess of approx. 400 meters) can be achieved* **only** *if the following factors are both applied:*

- *The 100Mb fiber segment must operate in full-duplex (FDX) mode, i.e. the full-duplex (factory default) setting for 100Mbps fiber ports must be used, and*
- *The worst-case OPB of the fiber link must be greater than the fiber cable's passive Attenuation.*

(Attenuation = Cable loss + LED aging loss + Insertion loss + safety factor)

) Introduction - LE14XXA-Series 4-Port Modules(4PM)

This chapter describes each 4-Port Module (4PM), including appearance, functionality, and status displays.

1 Inspecting the Package and Product

This section applies only to 4PMs shipped as separate items, i.e., 4PMs not factory installed in a LE14XXA-Series 4PM slot.

Examine the shipping container for obvious damage prior to installing a 4PM; notify the carrier of any damage which you believe occurred during shipment or delivery. Inspect the contents of this package for any signs of damage and ensure that the items listed below are included.

This package should contain:

One or more 4PMs.

Installation instructions, with illustrations

Remove the 4PM(s) from the shipping container. Be sure to keep the shipping container should you need to ship any of the 4PMs separately at a later date.

In the event there are items missing or damaged contact your supplier. If you need to return the unit, use the original shipping container if possible. Refer to Chapter 5 for specific return procedures.

2 Product Description

An important feature of the LE14XXA-Series is the use of 4-Port Modules (4PMs) and for flexible mixed-media connectivity to RJ-45 and fiber media use of Combo 4-port module. Since the LE14XXA-Series have dual-speed capability for copper-port, the front port slots are designed to support all standard Ethernet media types at 10 o 100Mps speed. Each 4PM provides one port for connecting one Ethernet segment with its individual connector type and media.

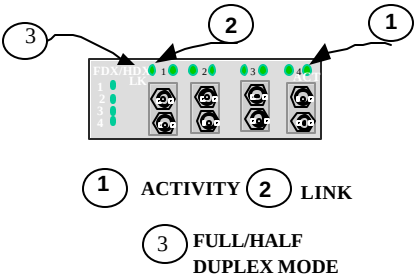
For a list and brief illustration of 4-Port Module types, refer to Section 2.4

Each 4PM is individually described in the following sections.

5.2.1 LE1428C, 100Mb multi-mode FX-ST-4-port Module, "twist lock" connector

The LE1428C is a multi-mode 100Mbps fiber optic 4-port module equipped with a dual ST-type connector. It functions as a fiber optics transceiver to support 100BASE-FX network segments. When installed in a LE14XXA-Series Fiber Switches, it supports fiber optic cable distances up the IEEE-specified 100Mbps shared-collision-domain distance limits, i.e., typically 2km at full-duplex and 412m at half-duplex.

100BASE-FX, and 10BASE-FL ST Connectors



The module is equipped with an Activity (ACT) LED, a Link (LK) LED which indicates proper connectivity with the remote device when lit, and the FDX/HDX LED indicat the full or half-duplex mode. Lettering on the front of the module identifies it as "100 FX" to avoid confusion with other similar-looking 10 Mb fiber 4PMs.

5.2.1a LE1424C, 10 Mbps multi-mode FL-ST-4-port type, "twist-lock" connector

The LE1424C is a multi-mode 10 Mbps fiber optic module equipped with a dual ST-type connector. It looks similar to the 100Mb LE1428C, but has the lettering "10 Mb" on the front to distinguish it. It supports fiber optic cable distances up the IEEE -standard 10 Mb distance limits , i.e., typically 2km at full-duplex and at half-duplex.

Each port has an Activity (ACT) LED indicating packets being received, a Link (LK) LED that indicates proper connectivity with the remote device when lit, and a FDX/HDX LED to indicate full-duplex mode when lit (or half-duplex when off). Lettering on t

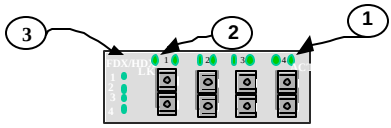
ont of the module identifies it as “10 FL” to avoid confusion with other similar-looking 100Mb ber QPMs.

2.2 LE1419C 100Mbps multi-mode FX-SC-4-port type, “snap-in” connector

The LE1419C is also a multi-mode 100Mbps ber optic transceiver module, similar to the LE1428C. has the same LEDs indicating port activity (ACT), nk (LK), and FDX.HDX operational, and the same ce-plate lettering.

While the functionality of the these two odules is the same, the LE1419C is equipped with an C-type "snap-in" connector instead of an ST-type.

100BASE-FX Multi-Mode SC Connectors



1 ACTIVITY 2 LINK

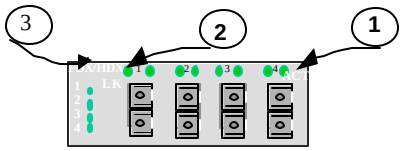
3 FULL/HALF DUPLEX MODE

2.3 LE1421C 100Mbps single-mode FX-SC-type, “snap-in” connector

The LE1421C is a single-mode 100Mbps fiber optic module equipped with a dual SC-pe connector. It functions as a full fiber optic transceiver to the Modular-Switches, supporting ur single-mode fiber network segments.

TheLE1421C, when installed in a E14XXA-Series Modular Switch operating at 0Mbps full-duplex, supports single-mode fiber ble lengths of as much as 25+ Km (see Power dget, Section 4.5)

100BASE-FX Single-Mode SC Connectors



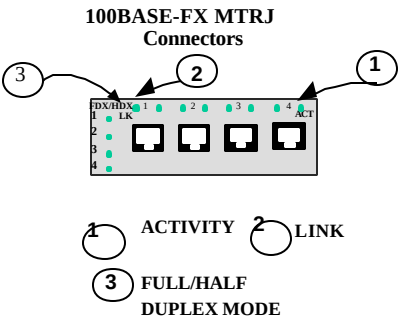
1 ACTIVITY 2 LINK

3 FULL/HALF DUPLEX MODE

Each port is equipped with an Activity CT) LED, LINK(LK) LED, (10/100) Speed and DX/FDX) Half or full Duplex mode identical to se of the LE1419C. To distinguish the single-ode LE1421C from the multi-mode LE1419C, the label “Sgl. M.” is at the top of the faceplate the LE1421C.

5.2.4 LE1422C, 100Mb multi-mode FX 4-Port, MTRJ small-form-factor connector

LE1422C is a multi-mode fiber optic 4-port module equipped with a small-form-facto MTRJ-type connector. It looks almost like an RJ-45 port, but it is black in color. The MT-RJ's small size and ease of connection make it a good choice for 100Mbps "fiber-to-the-desktop" Ethernet connectivity. When installed in a LE14XXA-Series full-duplex Switch, it supports fiber optic cable distances up the IEE-standard 100Mbps shared-collision-domain distance limits, i.e., typically 2 km at full-duplex and 412m at half-duplex.



"small-form-factor"

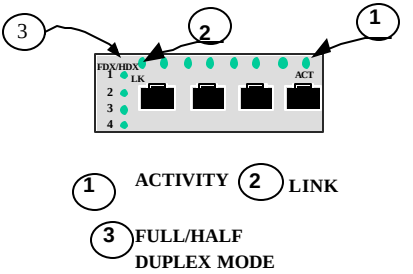
The functionality of this 100BASE-FX multi-mode 4PM is same as the ST and SC-types, and it is equipped with the same ACTIVITY (ACT), LINK (LK) LEDs to indicate proper connectivity with the remote device and (FDX/HDX) indicate the FULL OR HALF DUPLEX MODE at the port. It has the same "100Mb FX" lettering on the faceplate. Note tha the other end of the fiber cable may have a different connector, not necessarily an MT-RJ type.

5.2.5 LE1423C, 100Mbps multi-mode FX 4-Port, VF-45 small-form-factor connector

LE1423C is a 4-port multi-mode fiber FX "small-form-factor" VF-45 connector used imarily in 100Mbps fiber-to-the-desktop links. Its size is similar to the MT-RJ port, but the F-45 shell is slightly larger. When not in use, its appearance is distinctive because it has a tiny nged door over the port hole to act as a dust cover.

When installed in a LE14XXA-Series odular Switches at full-duplex, it supports fiber tic cable distances up the IEEE-standard 100Mbps stance limits, i.e., typically 2 km at full-duplex and 2m on half-duplex.

100BASE-FX MV45 Connectors



The small size, about the same as an RJ-45, duces the size of wiring panels in wiring closets ile providing the advantage of "future-proof" fiber tic technology.

"small-form-factor"

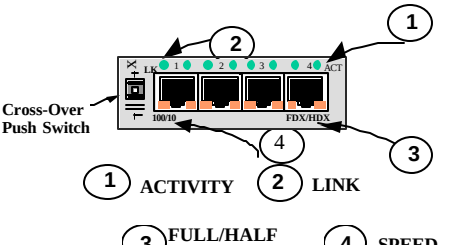
The cable port is a "plug-in" connector, with th fiber strands terminated in one housing that cannot be improperly inserted. The module is uipped with a LINK (LK) LED to indicate proper connectivity with the remote device, an CTIVITY (ACT) LED that flashes to show when Fast Ethernet packets are being received and FDX/HDX) LED indicate the full-duplex mode when lit (or half-duplex when off).

2.6 LE1425C (Twisted Pair), 10/100Mb TP 4-Port

The LE1425C module supports Ethernet twisted pair segments of any standard length. is equipped with 4-port RJ-45 connector with 10/100 and auto-negotiating capability on each rt. The RJ-45 connector is shielded to minimize emissions and will allow both unshielded isted pair (UTP) and shielded twisted pair (STP) cable connections.

The LE1425C 4-port module is equipped with a Media Dependent Interface-ossover (MDI-X) push-button to allow for one cascaded connections. This feature eliminates e need for a special twisted pair crossover ble when connecting to a hub or another itch.

10/100BASE-T,4Port RJ-45 Connectors



With the push-button in the IN (X) sition, the PM-TP port is used for scaded and up-link connections (i.e.: a

connection to another hub or switch typically.) When used for segments going to workstation and other user node device connections, the MDI-X push-button should be in the OUT (=) position.

The LE1425C will support 10BASE-T unshielded twisted pair wiring (UT environments with maximum segment distances up to 100m (325 ft.), or shielded twisted pair wiring (STP) of 150m (500 ft.). Each port has an Activity (ACT) LED indicating packets being received, a Link (LK) LED that indicates proper connectivity with the remote device when lit, a FDX/HDX LED to indicate full-duplex mode when lit (or half-duplex when off), and a "speed" LED indicating 100Mb when lit (or 10 Mbps when off).

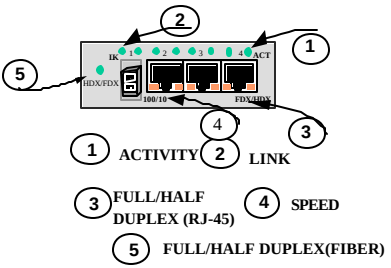
Important Note: For the LE1425C Crossover Push-button -
OUT for workstations and user connections.
IN for Up-Link connections to other hubs, etc.

The RJ-45 pins normally (TP crossover push-button DOWN) are per the standard for hubs-to-users twisted pair wiring: 1 = receive+, 2 = receive-, 3 = transmit+, 6 = transmit-, other pins not used. When the TP crossover push-button is UP, the pins of the RJ-45 po are per the standard for up-links using twisted pair wiring, i.e., the transmit and the receive pairs are exchanged: 1 = transmit+, 2 = transmit-, 3 = receive+, 6 = receive-, other pins no used.

5.2.7 LE1426C, "3TP + 1F" 3 10/100Mb RJ-45 and 1 100Mb Fiber SC (multi-mode) Connector Combo 4-Port

The LE1426C Combo 4-port supports three auto-negotiating twisted pair ports at 10/100Mbps FDX/HDX, and one fiber port with 100Mbps multi-mode FX SC connector. The three RJ-45 ports on the right operate the same as those in the same place on the QPM-RJ45 module.

10/100BASE-T and 100BASE-FX Combo Quad-Port Connectors



The fiber SC connector functions as a fiber optics transceiver to support 100BASE-FX network segments. When installed in a LE14XXA-Series Fiber Switches, it supports fiber optic cable distances up the IEEE-standard 100Mbps distance limits, i.e., typically 2km at full-duplex and 412m at half-duplex. The factory default setting is for full-duplex operation, and a jumper on the module must be moved to select half-duplex. (See Section 3.4).

Each 3+1 combo 4-port has an Activity (ACT) LED indicating packets being received, Link (LK) LED that indicates proper connectivity with the remote device when lit, a DX/HDX LED to indicate full-duplex mode when lit (or half-duplex when off). In addition, the J-45 ports have a "speed" LED indicating 100Mb when lit (or 10 Mbps when off). The fiber rt is always 100Mbps speed.

2.8 LE1427C, "3TP + 1F" 3 10/100Mb RJ-45 and 1 100Mb Fiber ST (multi-mode) Connector Combo 4-Port

ıe LE1427C is also a Combo 4-port, supports three auto-negotiating twisted pair ports at /100Mbps and one fiber port with 100Mbps multi-mode similar to the FX SC connector. It s the same LEDs indicating port activity (ACT), Link (LK), (10/100) Speed, FDX/HDX erational and the FDX LED for multi-mode 100Mbps fiber optic transceiver module, similar the LE1426C.

2.9 LE1429C, "3 + 1" 3 10/100Mb RJ-45 and 1 100Mb Fiber SC Single-mode Connector, "Combo" 4-Port Module

The LE1428C is also a 3+1 Combo 4-port module. It is the same as the LE1426C +1 combo" module except the fiber port is single-mode. See Section 5.2.3 for a description of e 100Mb single-mode fiber port.

2.10 4PM-FP

The 4PM-FP is a blank face plate that must be installed in empty 4PM slot. When the E14XXA chassis contains less than required ont mounted 4PMs, the empty front slots must covered with the 4PM-FP face plate in order maintain proper cooling air flow, and for fety, etc.

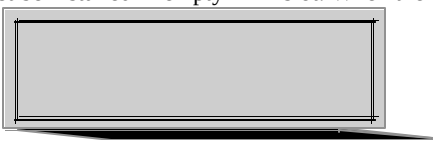


Fig.5.2.10 Blank Face Plate

6.0 TROUBLESHOOTING

If problems should develop during installation or operation, follow the suggestions below prior to calling Technical Support for help. If you are unsure of any procedure described in this chapter, or if the LE14XXA is not operating as expected, do not attempt to repair or alter the unit. Contact Black Box for assistance.

6.1 Before Calling for Assistance

1. If you have difficulty installing or operating the LE14XXA Modular Switches, refer to **Chapters 3** and **4.** Make sure that the various other components of the network are working.
2. Check the cables and connectors to make sure that they have been properly connected and the cables/wires have not been crimped or in some way impaired during installation.
3. Check that the AC power cord is plugged into a functioning electrical outlet. Make sure that the AC power cord is properly plugged into the Modular Switches. Use the PWR LED to verify that the unit is receiving proper power.

4. If the problem is isolated to a network device other than the LE14XXA -Series Modular Switch, replace the problem device with a known good device. Verify whether or not the problem is corrected. If it is not, go to step 5. If the problem is corrected, the Modular Switches and its associated cables will function properly.
5. If the problem still exists, contact Black Box.

2 When Calling for Assistance

If you determine that your LE14XXA-Series Modular Switch is malfunctioning, do not attempt to alter or repair the unit. It contains no user-serviceable parts. Contact Black Box at (724) 746-5500.

Before you do, make a record of the history of the problem. Black Box will be able to provide more efficient and accurate assistance if you have a complete description, including:

- the nature and duration of the problem.
- when the problem occurs.
- the components involved in the problem.
- any particular application that, when used, appears to create the problem or make it worse.

3 Shipping and Packaging Information

If you need to transport or ship your LE14XXA -Series Modular Switch:

- Package it carefully. We recommend that you use the original container.
- If you are shipping the LE14XXA -Series Modular Switch for repair, make sure you include everything that was in the original package. Before you ship, contact Black Box to get a Return Materials Authorization (RMA) number.

Ship the package to:

Black Box Corporation

1000 Park Drive

Lawrence, PA 15055

Phone: (724) 746-5500

Fax: (724) 746-0746

Black Box Corporation

The World's Source for Connectivity

© Copyright 1999. Black Box Corporation. All rights reserved.

1000 Park Drive · Lawrence, PA 15055 · (724) 746-5500 · Fax (724) 746-0746