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**July 2005**
**LBH1500A-R3**

# Black Box LH1500

**LBH1500AE-R3**
**LBH1501A-R3**
**LBH1501AE-R3**
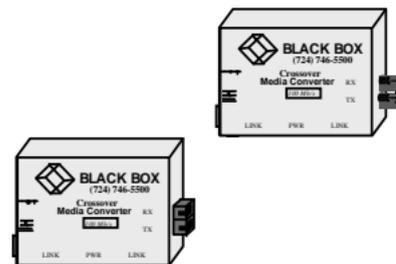
# Fast Ethernet Media Converters

# Black Box LH1500 Media Converters

# Installation and User Guide

**Trademarks**

UL is a registered trademark of Underwriters Laboratories

Ethernet is a trademark of Xerox Corporation

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> **Important:**  Black Box LH1500 Media Converters contain no user serviceable
>
> parts.  Attempted service by unauthorized personnel shall render any and all
>
> warranties null and void.  If problems are experienced with a Black Box
>
> LH1500 Media Converter, consult Section 5, Troubleshooting, of this User
>
> Guide.

**Contacting Black Box**

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

*Black Box Corporation*

*P.O. Box 12800*

*Pittsburgh, PA 15241*

*Phone: (724) 746-5500*

*Fax: (724) 746-0746*

**FCC STATEMENT**

### FEDERAL COMMUNICATIONS COMMISSION &

### 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 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 operación.  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.

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**TABLE OF CONTENTS (CONTINUED)**                               **Page**

\*     Changed in this revision

08/05   Added Power Budget Calculation for Fiber media.

05/99   (changed power supplies from a single model to separate models each for 115vac 60Hz, and 230vac 50Hz).

**1.0      SPECIFICATIONS**

**1.1.      Technical Specifications**

**Performance:**

Data Rate:  100 Mb/s

Half- or Full-Duplex, auto-sensing

800ns (80 bit-times) Path Delay Value (PDV) for conversion delay

**Network Standards:**

Fast Ethernet IEEE 802.3u: 100BASE-TX, 100BASE-FX

(Black Box LH1500 Media Converters are physical layer standard Fast
Ethernet products, and operate independently of all software.)

**Number of Media Converters in series:**

> *Experience shows that up to three units can be used in series between*
>
> *repeaters. For 4 or more in series, noise build-up will typically preclude*
>
> *proper operation.*

**Maximum Standard Fast Ethernet Segment Lengths:**

| | |
|---|---|
| 100BASE-TX (twisted pair): | 100 m (328 ft) |
| 100BASE-FX Fiber optic, half-duplex: (multi-mode) | 412 m (1350 ft) |
| 100BASE-FX Fiber optic, full duplex:  (multi-mode) | 2.0 km (6,562 ft) |
| 100BASE-FX Fiber optic, half-duplex: (single-mode) | 412 m (1350 ft) |
| 100BASE-FX Fiber optic, full duplex:  (single-mode) | 15.0 km (49,215 ft) |

> *Note:*  *Black Box LH1500 Media Converters  <u>DO NOT</u> support full length*
> *shared Fast Ethernet segments.  See Section 3.2 of this manual for*
> *media lengths and shared segment distance calculations.*

**Operating Environment:**

Ambient Temperature:  32°F to 122°F (0°C to 50°C)
      Storage Temperature: -20°C to 60°C
Ambient Relative Humidity:  10% to 95% (non-condensing)

**Power Supply (External):**

Power Input:   <u>95-125 vac at 60Hz</u> for "LH1500A-SC-R2, LH1500A-ST-R2, LH1501A-R2" Models

<u>200-250 vac at 50Hz</u> (or auto-ranging) for "LH1500A**E**-SC-R2, LH1500A**E**-ST-R2, LH1501A**E**-R2" Models

Power Consumption:  5 watts max. for the unit

Power output: +5VDC / 1000ma  **<u>DO NOT USE A 12VDC P.S. UNIT</u>**

**Connectors:**

RJ-45 Port:  Modular 8-Pin female, with MDI-X up-link switch
**Multi-mode:**

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

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

**Single-mode:**

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

**Packaging:**

Enclosure:  High strength sheet metal.

Dimensions:  3.0 in H x 3.5 in W x 1.0 in D (7.6 cm x 8.9 cm x 2.5 cm)

Power Supply:  3.8 in x 1.5 in x 2 in  (9.7 cm x 3.8 cm x 5.1 cm)

Weight:  9.5 oz. (275 gr);  Power Supply 5.85 oz (166 gr)

**LED Indicators for the Black Box LH1500's and LH1501's:**

| LED | TX port | FX port | Description |
|-----|---------|---------|-------------|
| PWR | | | Indicates unit is receiving DC power. |
| LINK | TP | Fiber | Steady ON when proper link is established at both ends of the media segment, i.e., when both end's connections are properly made and when power is applied to the devices on both ends of the segment. |

**Agency Approvals:**

Power Supply is UL Listed (UL 1310), cUL

Emissions: Meets FCC Part 15 Class A, cUL

Made in USA

**1.2  Model Number        Description**

| | |
|---|---|
| **LH1500A-SC-R3** | Twisted pair to mm fiber SC, ext. 115 vac, 60Hz power supply |
| **LH1500AE-SC-R3** | Twisted pair to mm fiber SC, ext. 230 vac, 50Hz power supply |
| **LH1500A-ST-R3** | Twisted pair to mm fiber ST, ext. 115 vac, 60Hz power supply |
| **LH1500AE-ST-R3** | Twisted pair to mm fiber ST, ext. 230 vac, 50Hz power supply |
| **Single-mode:** | |
| **LH1501A-R3** | Twisted pair to fiber SC, single mode, ext. 115 vac, 60 Hz PS |
| **LH1501AE-R3** | Twisted pair to fiber SC, single mode, ext. 230 vac, 50 Hz PS |

**2.0        INTRODUCTION**

This section describes the Black Box LH1500's and LH1501's  Media Converters, including appearance, features and possible applications.

**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        Black Box LH1500 Media Converter unit

1        External Power Supply, either 115 vac at 60Hz or 230 vac at 50Hz.

(Continued)

1          Set of two (2) metal mounting clips with screws

1          Velcro® Tape section, approximately 3 inches in length


Remove the Black Box LH1500 Media Converter from the shipping container. Be sure to keep the shipping container should you need to ship the unit 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.  Refer to Section 5, Troubleshooting, for specific return procedures.

Use the power supply provided, which has output at **5VDC only.**

**USE OF A 12VDC POWER SUPPLY WILL DAMAGE THE UNIT**

**2.2      Product Description**

Black Box LH1500 Media Converters offer a convenient and graceful way to convert and transmit data among twisted pair and fiber network cabling environments. They allow the use of fiber media with full-duplex devices such as Fast Ethernet Switching Hubs, and may sometimes be used with shared (half-duplex) Fast Ethernet segments as well.   They offer a compact, cost-effective way to adapt a pre-existing Ethernet cabling configuration as network requirements change.

Black Box LH1500 Media Converters are designed for quick and easy installation even in very tight spaces.  Media cables are easily attached. Black Box LH1500 Media Converters feature an up-link switch on the TX port to eliminate the need for a special cross-over cable when connecting the TX port to a hub or concentrator. Because of their compact size, Black Box Media Converters can be Velcro®-mounted on an office wall or the side of a desk or cabinet. The external power supply plugs into a

nearby AC wall socket or power strip.  Each converter features a full set of LEDs that convey essential diagnostic and status information.  See Section 4.1, LED Indicators, for specific LED function information.

Black Box LH1500 Media Converters are designed to provide low-temperature operation over an extended period to make them some of the most reliable in the industry.  Their high-strength fabricated metal packaging shields against Radio Frequency Interference (RFI) and Electromagnetic Interference (EMI), avoiding interference with other nearby electronic devices.

The Black Box LH1500 units comply with the IEEE 802.3u (100BASE-TX and 100BASE-FX) specification for 100 Mb/sec traffic via shielded (STP) or unshielded twisted pair (UTP) segments.

The Black Box LH1500A-ST is equipped with one fiber-ST and one RJ-45 connector for connection to 100BASE-FX compliant networks segments.

**Twisted Pair**
**(100BASE-TX)**

**Black Box LH1500**
**Media Converter**

100 Mb/s

LINK          PWR          LINK

**Fiber Multimode**
**(100BASE-FX)**
**(ST-type)**
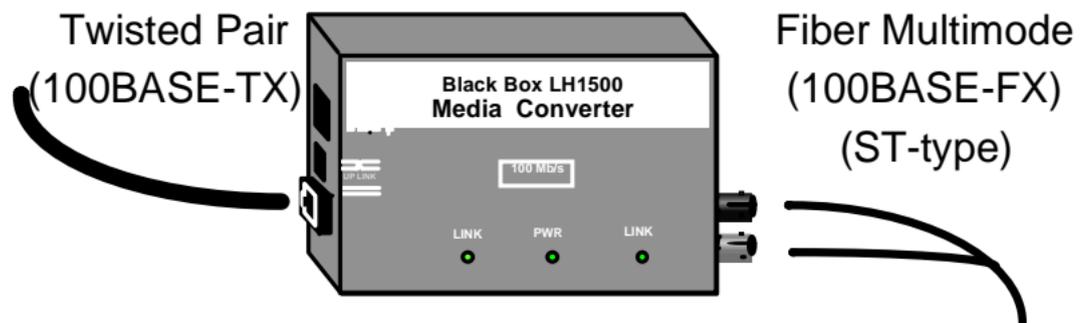
**An LH1500A-ST-R2 integrates 100BASE-TX and FX networks, with fiber ST connectors.**

The Black Box LH1500A-SC is equipped with one fiber-SC and one RJ-45

connector for connection to 100BASE-FX compliant networks segments.

Fiber

Twisted Pair
(100BASE-TX)

**Black Box LH1500
Media  Converter**

(100BASE-FX)
(SC-type)

100 Mb/s

LINK        PWR        LINK
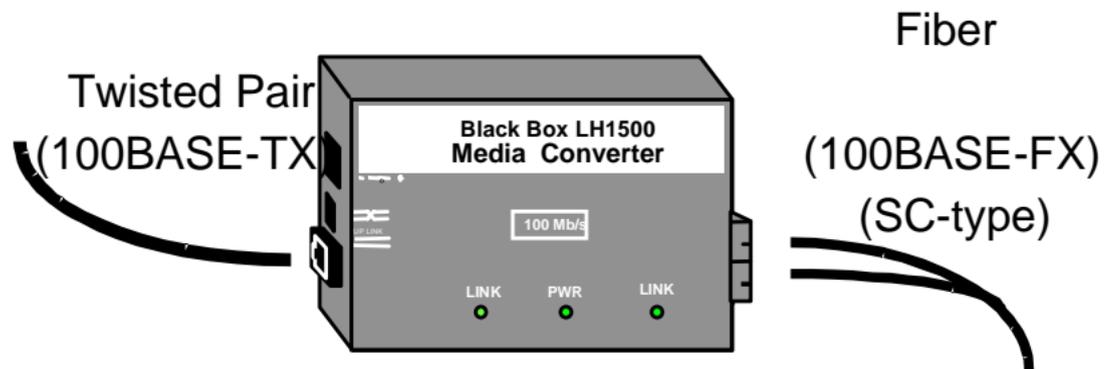
**An LH1500A-SC-R2 integrates 100BASE-TX and FX networks, with fiber SC**

**connectors.**

**2.3       Features and Benefits**

■      **Reduces Network Costs**

Black Box LH1500 Media Converters offer an ideal solution to quickly
and inexpensively connect Twisted-Pair TX with Fiber FX segments.

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

LH1500s can be used in full-duplex fiber segments for distances up to
2Km for the multi-mode model, and up to 15Km for single-mode model.

■      **Low PDV for Maximum Cable Lengths in Shared Segments**

Black Box LH1500 Media Converters add signal timing delays of only 80
Bit Times in a shared half-duplex segment, less than a Class II Fast
Ethernet Repeater (90 to 95 BT typical), and can be used to attach fiber
cable to TX ports with minimum distance loss in the collision domain.

- **Small, Compact, Lightweight Design**

  Featuring a compact and lightweight metal case with an external power supply, Black Box LH1500 Media Converters can be conveniently installed in minimal space, on horizontal or vertical surfaces.

- **Full Complement of LEDs.**

  Each LH1500 Media Converter is equipped with a full complement of LEDs to provide network LINK status on each port separately, and to indicate power on the unit.

- **Highly Reliable and Dependable**

  Black Box LH1500 Media Converters are based on a robust design and packaged in a metal enclosures to ensure high reliability and durability.

**2.4          Applications**

The primary function of Black Box LH1500 Media Converter is to permit two different media types to coexist within the same network by allowing data to be transmitted and received between different media types.  Black Box 1500s are typically used where new 100MB switching hubs with RJ-45 ports are being installed, and where full-duplex fiber segments (of up to 2Km for multi-mode or 15Km for single mode) are needed to interconnect them with other 100Mb switching hubs in distant wiring closets. Alternatively, a server with a full-duplex NIC needs to be connected via fiber to a 100Mb switching hub with RJ-45 ports.  In these and similar situations, the Black Box LH1500 conveniently converts the twisted pair cable to fiber, allowing use of any available RJ-45 Fast Ethernet switched port with a new or existing fiber cable. See Section 3.2.1 for cable distance calculation information.
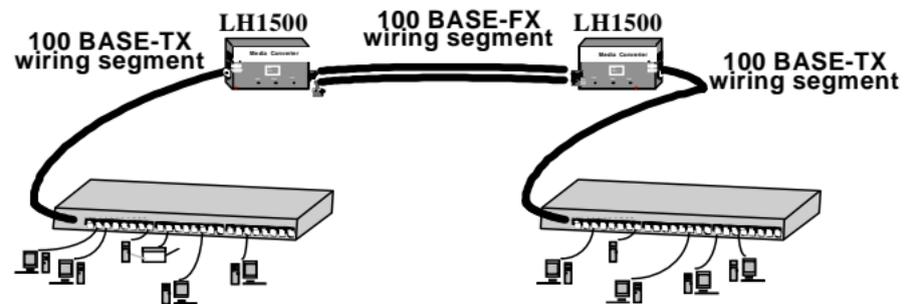
**Two Black Box LH1500s provide connectivity for switched 100Mb hubs via fiber.**

Where shared Fast Ethernet segments are used, such as with Fast Ethernet hubs with RJ-45 ports, it may be desirable to connect one or more servers or users via fiber

cable.  It is necessary to calculate the PDV of the overall collision domain (see Section

3.2.2) for proper operation when the LH1500 is used in shared half-duplex applications.

**100 BASE-TX**
**wiring segment**

**LH1500**

**100 BASE-FX**
**wiring segment**
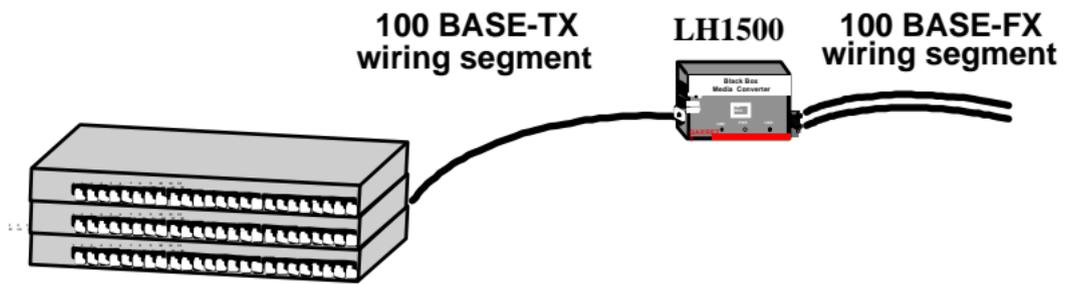
**Black Box LH1500 provides connectivity to servers or users via fiber.**

**3.0      INSTALLATION**

This section describes the installation of the Black Box LH1500 Media Converters, including location, segment distance calculation and media connection.

**3.1      Locating the Media Converter Unit**

The compact and lightweight design of the Black Box LH1500 Media Converter allows it to be easily installed in most any location. A Velcro strip and a set of two metal clips and screws are included (either may be used) for mounting the unit on a vertical surface such as a wall or cabinet, or for securing the unit on a table-top or shelf.  The installation location is dependent upon the physical layout of the Ethernet network and the cabling.
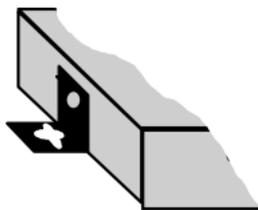


**Secure attachment of mounting clips for wall mounting**

Make sure the unit is installed in a location that is easily accessible to an AC power outlet or power strip, and where convection cooling is not inhibited.

**3.2      Calculating Segment Distances**

The media distance considerations are quite different for full-duplex and for half-duplex (standard Fast Ethernet) installations.  Each of these situations are covered below in a separate section.

**3.2.1    Segment Distances, Full-duplex**

Full-duplex ports, such as are found in switching hubs and some NICs, can receive and transmit signals simultaneously and do not experience collisions accordingly. There may be only two nodes present on a full-duplex segment.  Media distance rules are not the same as for standard (half-duplex) Fast Ethernet because collision distance

limitations are not a factor.  Specifically, fiber segments can be up to 2Km for multi-mode and up to 15Km for single mode.

The Black Box LH1500, with full-duplex operation as a standard feature, can be used in these applications.  When installing the Black Box LH1500 in a full-duplex segment, it is important to consider the combined overall segment length of  both of the attached media types.  The overall segment length is calculated by adding together the segment lengths on both sides of the Black Box LH1500 Media Converters.  The figure below illustrates how a Black Box Media Converter is used to connect a multi-mode fiber (100BASE-FX) with a twisted pair (100BASE-T) segment.

Segment length on each side of the LH1500 Media Converter is measured as a percentage of the maximum allowable standard media distance for the given media type.  The percentages, when added together, must not exceed 100%.

**Media Distance Formula for Black Box LH1500's, <u>full-duplex</u>:**
$$X\% + Y\% \leq 100\%$$

Where **X** = The segment distance on one side of the Black Box LH1500 Media Converter divided by the Standard Maximum Media Distance for that media type, x 100%

Where **Y** = The segment length on the other side of the Black Box LH1500 Media Converter divided by the Standard Maximum Media Distance for that media cabling type, x 100%

Segment Y
10m (33ft)

**Black Box
Media Converter**

Segment X
1500m (4920ft)

100 Mb/s

LINK          PWR          LINK

Fiber Multimode
(100BASE-FX)

Twisted Pair
(100BASE-TX)

**Connectivity between 100BASE-TX and 100BASE-FX Ethernet Media.**

In the example figure shown above, the length of fiber Segment X is 1500m (4920 ft).  This is 75% of the maximum allowable distance for multi-mode 100BASE-FX fiber full-duplex media (2000 m) [75/2000 x 100% = 75%].  The length of twisted pair Segment Y is 10m (33 ft).  This is 10% of the maximum allowable distance for

100BASE-TX full-duplex twisted-pair media (100 m) [10/100 x 100% = 10%].  The total

of the two percentages (75% + 10%) is 85%, which is allowable.

> *Note 1:*  Where more than one media converter is used in one
> segment run, the percentages for all of the cabling lengths in the run
> must be added together and must not exceed 100%.

In another instance, a Black Box Media Converter is used to connect a  *single*

mode fiber (100BASE-FX) with a twisted pair (100BASE-T) segment.  In this example,

the length of fiber Segment X is 8500m (27,880 ft).  This is 57% of the maximum

allowable distance for single mode 100BASE-FX fiber full-duplex media (15,000 m)

[57/15,000 x 100% = 57%].  The length of twisted pair Segment Y is 12m (40 ft).

This is 12% of the maximum allowable distance for 100BASE-TX full-duplex twisted-pair media (100 m) [12/100 x 100% = 12%]. The total of the two percentages (57% + 12%) is 69%, which is allowable.

### 3.2.2     Segment Distances, Half-duplex

Fast Ethernet shared bandwidth devices operate with multiple nodes in a traffic domain. When a node attempts to send a packet, it may hit another packet passing by, i.e., a collision may occur. This is normal and does not cause a problem because the Ethernet protocol provides for this situation and requires that the sender wait and try again. When installing the Black Box LH1500 in a half-duplex segment, it is important to consider the collision domain of the segment, including the LH1500 itself, repeaters and hubs present, and the lengths of both of the attached media types.

**Collision Domain**

A collision domain is defined in the IEEE 802.3u standard as a cluster of network devices that, regardless of topology, must be less than 512 BT (Bit Times) of signal delay (PDV or Path Delay Value) in diameter between any two nodes. Nodes in a collision domain are connected by means of a repeater or repeaters such that no bridging or switching devices are present between any two nodes in the cluster. A Black Box LH1500 has a PDV of  about eighty Bit Times (80 BT), and this value must be included in the overall collision domain diameter PDV calculations as applicable for the placement of the LH1500 in the topology of the collision domain.

**Collision Domain Diameter**

The Collision Domain Diameter is the length of the longest path between any two devices in a single collision domain.  Regardless of the actual network topology, the

Collision Domain Diameter must be less than 512 BT (Bit Times).  Bit Times are related

to media type as shown in Table 3.2.2a.

**Table 3.2.2a:  Worst case round-trip delay for Fast Ethernet media\***

| Media Type | Round-trip delay in Bit Time per Meter (BT/m) |
|---|---|
| Fiber Optic | 1.000 |
| Shielded TP cable | 1.112 |
| Category 5 Cable | 1.112 |
| Category 4 Cable | 1.140 |
| Category 3 Cable | 1.140 |

\*Worst case delays taken from IEEE Std 802.3u-1995, actual delays may be less for a particular
cable.  Contact your cable supplier for exact cable specifications.

Each shared Fast Ethernet network device also has an associated BT delay.

Table 3.2.2b shows typical Fast Ethernet device components and the associated BT

delay.  Note that there is only one DTE pair associated with any device-to-device path.

**Table 3.2.2b:  Worst case round-trip delay for Fast Ethernet device components\***

| Component | Round-trip delay in Bit Times (BT) |
|---|---|
| **2 TX DTEs** | 100 |
| **2 FX DTEs** | 100 |
| **1 FX and 1 TX DTE** | 100 |
| **2 T4 DTEs** | 138 |
| **1 T4 and 1 TX or FX DTE** | 127 |
| **Class I Repeater** | 140 |
| **Class II Repeater with any combination of TX and FX ports** | 92 |
| **Class II Repeater with T4 ports** | 67 |

\*Worst case delays taken from IEEE Std 802.3u-1995.

To determine whether a prospective network topology adheres to the collision domain diameter specification, the following formula should be applied to the worst case path through the network.  The worst case path is the path between the two Fast Ethernet devices (DTEs) which have the longest round trip delay time.

27

**PDV = (sum of cabling delays) + (sum of repeater & media converter delays) + (DTE pair delays) + (safety margin)**

PDV is the Path Delay Value of the worst case path.  For the network to adhere to IEEE 802.3u standard, this value must be less than 512 BT.  The safety margin is specified in BT and may be a value between 0 and 5.  This margin can be used to accommodate unexpected delays, such as an extra long patch cable.  A safety margin of at least 4 BT is recommended.

**"Rules-of-thumb" Collision Domain Calculations**

Rules-of-thumb, while inexact, may be helpful in planning network topology. As a rule-of-thumb, a Class II Repeater has a PDV of  about 90 to 95 BTs, and twisted-pair or fiber media has a PDV of about 1 BT per meter of length.  The Black Box LH1500 has a PDV of 80 BT.  Therefore, in shared Fast Ethernet applications, the LH1500 uses about 80 meters of equivalent cable distance to convert from TX media to fiber FX media, i.e., it consumes almost as much of the available PDV as a Class II repeater.  Since a 512BT collision domain will almost always include at least one repeater and two media segments, the remaining amount of Bit Times left after allowing for a LH1500 and a length of fiber media indicates that the available fiber length will be much less than the 412 meters that is the known maximum for fiber.  Therefore, in shared environments, Black Box LH1500 Media Converters will be of benefit when they allow

the use of fiber media, but <u>not to gain distance</u> by facilitating use of fiber media instead of twisted pair.

As a sample calculation, consider the question of what fiber cable distance (connected by a pair of Black Box LH1500 on each end) can be obtained that will interconnect two 100Mb hubs where the twisted pair cables to the user nodes are 10 meters in length.    The solution is :

512 = total available Bit Times  in a collision domain diameter,

minus 100 BT for two DTEs on each end leaves 412 BTs,

minus 180 BT for two Class II repeaters leaves 232 BTs,

minus 20 BT for two 10-meter TP cables for hubs to users leaves 212 BTs,

minus 10 BT for two short TP cables from the hubs to 15E's leaves 202 BTs,

minus 160 BT for two Black Box LH1500 leaves 42 BTs for fiber cable,

which indicates a fiber cable length of about <u>40 meters</u>.

It is obvious that using twisted pair wiring to connect the hubs would enable the interconnect length to be the 100 meters maximum for twisted pair media, and this would still leave about a hundred BTs as a safety margin.  In other words, use of LH1500s and fiber in this case did not gain allowable maximum cable distance vs. TP cable without the LH1500s.

Consider a more typical use of Black Box LH1500s in a shared Fast Ethernet segment.  A stack of Fast Ethernet hubs comprises the only repeater in the collision domain, and the users and servers in the local workgroup are each connected via Category 5 twisted pair cable, a maximum of 30 meters (100 ft.) in length.  It is desired to connect one remote user with a fiber NIC via fiber cable, using a LH1500 in the circuit. How long can the fiber cable be?

The solution is :

512 = total available Bit Times in a collision domain diameter,

minus 100 BT for two DTEs on each end leaves 412 BTs,

minus 90 BT for one Class II stackable repeater leaves 322 BTs,

minus 30 BT for one 30-meter TP cable from hub to user node leaves 292 BTs,

minus 5 BT for a short TP cable from the hub to 15E leaves 287 BTs,

minus 80 BT for one LH1500 leaves 207 BTs for fiber cable,

which indicates a fiber cable length of about 200 meters.

**3.3          Connecting Ethernet Media**

Connecting Ethernet media to the Black Box LH1500 Media Converter is very simple and straightforward.  Using a properly terminated media segment, simply attach the cable end to the appropriate connector.

See Sections 4.2 and 4.3 for a description of the LEDs.

**3.3.1          Connecting Twisted Pair (RJ-45, Unshielded or Shielded)**

The following procedure describes how to connect a 100BASE-TX twisted pair segment to the RJ-45 port on the Black Box LH1500 Media Converters.  The procedure is the same for both unshielded and shielded twisted pair segments.

1. Using standard 100BASE-TX media, insert either end of the cable with an RJ-45 plug into the RJ-45 connector of the Black Box LH1500 Media Converter.
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.  If the LINK LED is not illuminated, change the setting of the up-link switch  (See Section 4.4 for up-link switch information.)  If this does not help, ensure that the cable is connected properly and  is not defective.

**3.3.2   Connecting Fiber Optic 100BASE-FX, Type ST and SC**

The following procedure applies to 100BASE-FX applications using the Black

Box LH1500 Media Converter with ST-type (twist-lock) and SC-type (snap-in) fiber

connectors.

1.  Before connecting the fiber optic cable, remove the protective dust caps from the tips of the connectors on the Black Box LH1500.  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 each end of the fiber optic segment.*

3.  Connect the Transmit (TX) port (light colored post) on the LH1500A to the Receive (RX) port of the remote device.  Begin with the color-coded strand of the cable for this first "Transmit-to-Receive" connection.

4.  Connect the Receive (RX) port (dark colored post) on the LH1500 to the Transmit (TX) port of the remote device. Use the non-color coded fiber strand for this.

5.  The LINK LED corresponding to the fiber port on the front of the LH1500 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 after cable connection, the normal cause is improper cable polarity.  Swap the fiber cables on the LH1500 fiber connectors to remedy this situation.

**3.4.1        Power Budget Calculations for 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, 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 (Agilent's) web 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 μm | 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LH1500A MST, MSC | 100Mb FX | Multi-mode | 2 (0.4) | 1300 | 62.5/125 | -20 | -31 | 9.0 | 2.5 | | 14 | 5 |
| | | | | | 50/125 | -23.5 | -31 | 5.5 | 2.0 | | 12 | 4 |
| LH1501A | 100Mb FX | Single-mode | 25 (0.4) | 1300 | 9/125 | -15 | -31 | 14 | 28 | | 17.5 | 35 |

*Note:  The use of either multi-mode or single-mode fiber to operate at 100Mbps speed

over long distances (i.e., over 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. a switch (or equal external unit such as a FDX NIC) 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)

**4.0 OPERATION**

      This section describes the operation of the Black Box LH1500 Media Converters including power supply requirements, up-link switch functionality, and a description of all LEDs.

**4.1      Power Requirements, Power Supply Types**

Black Box LH1500 Media Converters require 5 watts of power and are designed to be used with an external power supply.  The external power supply unit supplied is one of two types; one version AC input power auto-ranging 115 vac at 60Hz for "LH1500A-SC-R2, LH1500A-ST-R2, LH1501A-R2" Models. The 115 vac version has a small transformer integral with a convenience power outlet plug. The 230 vac at 50Hz version for "LH1500AE-SC-R2, LH1500AE-ST-R2, LH1501AE-R2" Models. The 230 vac version has a small transformer integral with an IEC-type power plug for a user-supplied AC power cord with a convenience power outlet plug. Both type includes a lightweight DC power cord to the applicable power jack on the Media Converter unit.

**4.2**      **Front Panel LEDs**

| LED | Description |
| --- | --- |
| PWR | Illuminates GREEN to indicate the unit is receiving DC power. |
| LINK | (RJ-45 port) Illuminates GREEN, to indicate proper connectivity on the 100BASE-TX network segment.  LINK will turn off in the event connectivity is lost between the ends of the twisted pair segment or a loss of power occurs in the unit or remote device. |
| LINK | (Fiber port) Illuminates GREEN, to indicate proper connectivity on the 100BASE-FX network segment.  LINK will turn off in the event connectivity is lost between the ends of the fiber segment or a loss of power occurs in the unit or remote device. |

**4.3**      **Up-Link Switch  (On TX port)**

Black Box LH1500 Media Converters are equipped with an up-link slide

switch to accommodate repeater-to-converter connections without a special cross-over

cable. When set to the UP position (=), the Black Box LH1500 Media Converter is wired

for normal twisted pair connection to a user device.  When set to the DOWN position
(X), the Media Converter is wired with cross-over functionality for direct up-link to a
network hub or concentrator.

up-link   ( ✂ )

user device ( = )

Up-link
Switch
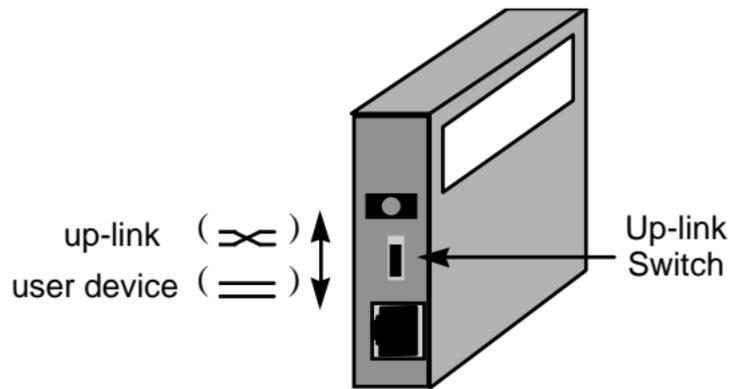
**End view - Black Box LH1500**

**5.0      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 LH1500 Media Converter is
not operating as expected, do not attempt to repair or alter the unit.  Contact
Black Box for assistance.

**5.1      Before Calling for Assistance**

1.   If you have difficulty installing or operating the LH1500 Media Converter, 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 LH1500. 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 LH1500 Media Converter, 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 Ethernet Media Converter and its associated cables will function properly.

5. If the problem still exists, contact Black Box.

**5.2  When Calling for Assistance**

Please be prepared to provide the following information.

1.  A complete description of the problem, including the following points:

    a.  The nature and duration of the problem;
    b.  Situations when the problem occurs;
    c.  The components involved in the problem;
    d.  Any particular application that, when used, appears to create the problem;

2.  An accurate list of BLACK BOX product model(s)involved, with serial

    number(s).  Include the date(s) that you purchased the products from BLACK

    BOX.

3.  It is useful to include other network equipment models and related hardware,

    including Convenient computers, workstations, terminals and printers;  plus,

    the various network media types being used.

4.  A record of changes that have been made to your network configuration prior to the occurrence of the problem.  Any changes to system administration procedures should all be noted in this record.

## 5.3  Return Material Authorization (RMA) Procedure

### Shipping and Packaging Information

Should you need to ship the unit back to Black Box Corporation, please follow these instructions:

1.  Package the unit carefully.  It is recommended that you use the original container if available.  Units should be wrapped in a "bubble-wrap" plastic sheet or bag for shipping protection.  ( You may retain all connectors and this Installation Guide.)

**CAUTION : Do not pack the unit in Styrofoam "popcorn" type packing material.  This material may cause electro-static shock damage to the unit.**

2.  Clearly mark the Return Material Authorization (RMA) number on the outside of the shipping container.

3. Black Box Corporation is not responsible for your return shipping charges.

4. Ship the package to:

**Black Box Corporation**
**1000 Park Drive**
**Lawrence, PA 15055**
**Phone:    (724) 746-5500**
**Fax:       (724) 746-0746**