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NETWORK SERVICES

OCTOBER 1998
LW9000A
LW9000-WALL
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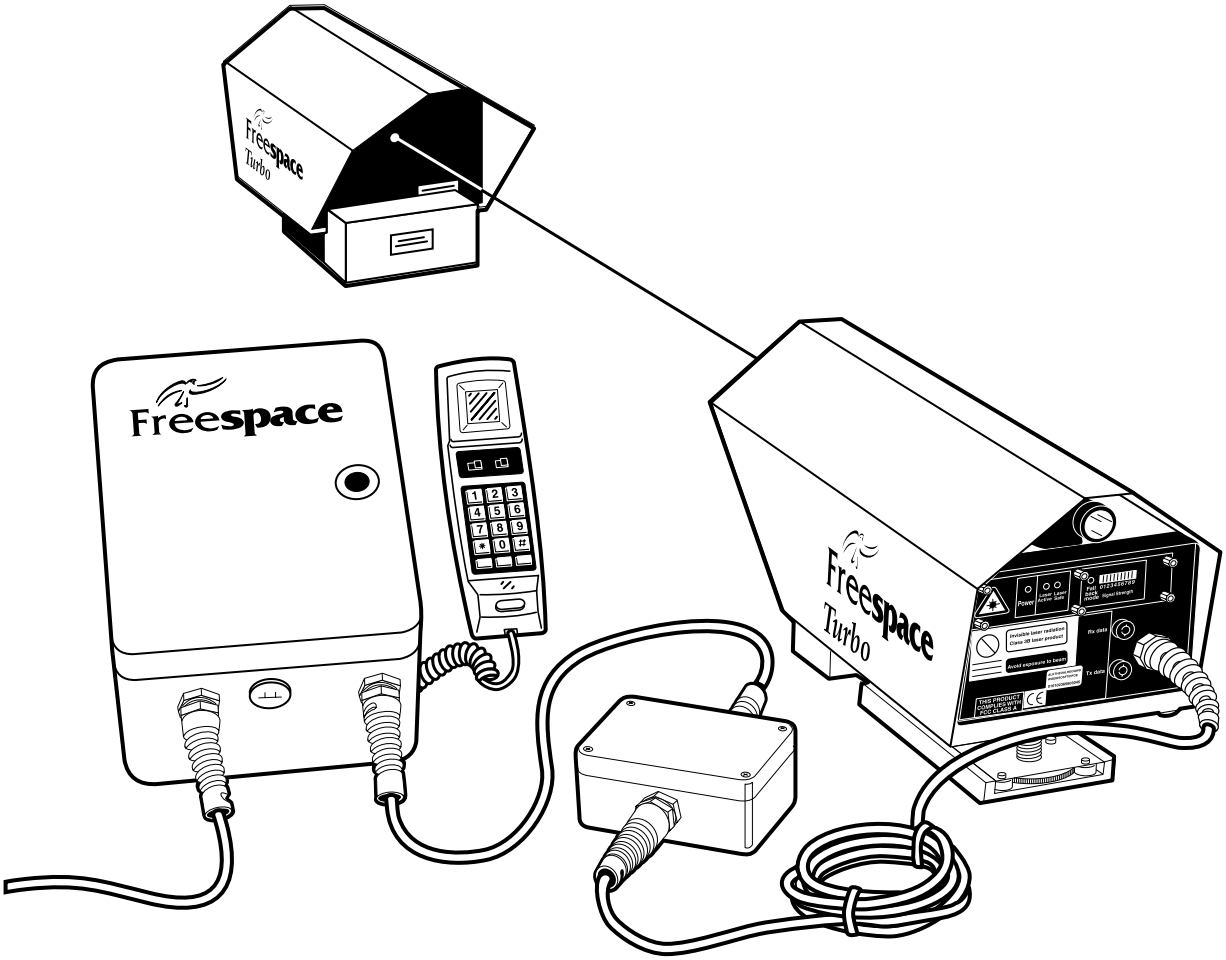
LW9001A

Freespace Turbo



NOTE

This manual contains important safety information. Please read this manual before installing Freespace Turbo.

CUSTOMER SUPPORT INFORMATION

To order or for technical support: Call **724-746-5500** or fax **724-746-0746**
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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 la classe A prescrites dans le Règlement sur le brouillage radioélectrique publié par le ministère des Communications du Canada.

INSTRUCCIONES DE SEGURIDAD (Normas Oficiales Mexicanas Electrical Safety Statement)

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 deberán 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 recomendados por el fabricante.
7. El aparato eléctrico debe ser montado a la pared o al techo sólo como sea recomendado por el fabricante.
8. Servicio—El usuario no debe intentar dar servicio 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 manera 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 de fuentes de calor como radiadores, registros de calor, estufas u otros aparatos (incluyendo amplificadores) que producen calor.
11. El aparato eléctrico deberá ser connectado a una fuente de poder sólo del tipo descrito en el instructivo de operación, o como se indique en el aparato.
12. Precaución debe ser tomada de tal 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 recomendaciones 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.

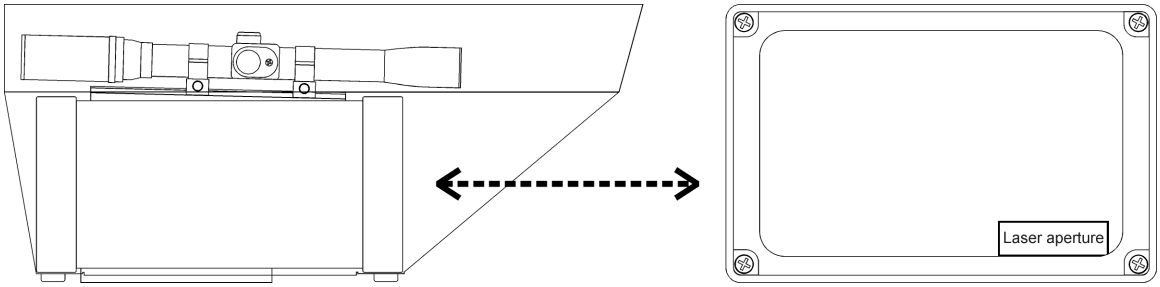
CE

The CE symbol on your equipment indicates that it complies with the Electromagnetic Compatibility (EMC) directive and the Low Voltage Directive (LVD) of the Union European (EU).

TRADEMARKS

Introduction to Eye Safety

Freespace Turbo uses a Class IIIb laser, operating at a wavelength of 780 nm, to generate an infrared (IR) signal. Although the signal is invisible to the naked eye and uses very low output power (less than 20 mW), it is generated from a laser source, and precautions must be taken to ensure eye safety. You can sustain permanent eye damage if you view the IR laser beam at close proximity for an extended period of time. Therefore, for eye safety, *never* stare directly into the laser aperture from which the IR laser beam is transmitted. The laser aperture is located immediately above the "Laser aperture" label on the lens of the link head front panel. Side and front views of the laser aperture are provided in the following diagram. Refer to the detailed information on Safe Viewing Distances and Nominal Optical Hazard Distances in **Appendix C**.



Laser Aperture Side and Front Views.

DANGER

Even though this manual specifies safe viewing distances under certain operational states, you should always assume the laser is emitting full power. *Never* look into the laser aperture.

CONTENTS

1. Specifications

Network protocol and standards compatibility—Protocol-independent; proven on 45 to 155 Mbps full duplex

Network interface—Two 1300-nm ST-II multimode fiberoptic connections for 50/125 or 62.5/125 cable

Data rate—45 to 155 Mbps full-duplex

Performance—More than 99.9% availability at full range; unfaded BER $<10^{-10}$

Range—1000 ft. (300 m) recommended maximum

Electrical

Input power—30 W maximum for entire link

Link head—24 VDC

Power Box—120 VAC, 60 Hz; 240 VAC, 50 Hz

Power Box fuse—120 VAC, 500 mA (T); 240 VAC, 250 mA (T)

Lens Defroster—Powered via separate indoor-mounted transformer: Input 120/240 Volts AC, 60 Hz; Output 4.2 A @ 24 Volts AC

Uninterruptible Power Supply (UPS)—*System hold time*: 1 hour nominal; *UPS power-up time*: 8 hours from zero to full charge

Optical

Transmitter (TX)—*Wavelength*: 780 nm (typical); *Power output:* 20 mW (typical), 30 mW (max.), Low power: 0.4 mW, Medium power: 3 mW, Full power: 20 mW; *Beam divergence*: 0.35° (typical) for standard beam, 0.5° (typical) for wide beam; *Laser diode:* Gallium Aluminum Arsenide (GaAlAs)

Receiver (RX)—*Sensitivity:* -27 dBm; *Effective active receive area:* 17.7 square inches (11,400 square mm); *Dynamic range:* 27 dB; *Fade margin:* 17 dB minimum, 20 dB (typical)

Mechanical

Mounting—*Link head:* Standard video-equipment mounting; 4" PCD w. four 6-mm holes and screws: *Power Box:* Wallmount via external brackets

Size—*Link head:* 6"H x 7"W x 22"D (16 x 17.9 x 56 cm); *Power Box:* 10"H x 8"W x 6"D (25 x 20 x 15 cm)

Weight—*Link head*: 13 lb. (6 kg); *Power Box*: 7.5 lb. (3.4 kg)

Environmental

Operating temperature range— -22° to +122°F (-30° to +50°C)

Operating humidity range—Up to 100% relative humidity, non-condensing

Electromagnetic Emissions

Meets requirements of FCC Part 15 Class A; EN 50 082, EN 55 022

Certification

CE Mark, EN 60 950

2. Introduction

2.1 Purpose

This Installation Guide is intended for network installers, administrators, and integrators who are responsible for installing, configuring, and maintaining a network that incorporates the Freespace Turbo wireless link. A thorough understanding of your network topology and of fiberoptic installation is essential. An understanding of internetworking concepts and terminology will be helpful when installing Freespace Turbo.

2.2 Objectives

This guide provides you with the processes required to install and maintain a highly reliable network connection. Guidelines for a site survey have been included; they will help to select and prepare the best-suited site for installing Freespace Turbo. Detailed procedures are included to simplify installation of the Freespace Turbo system and to align the link heads.

2.3 Importance of Reading this Document

To ensure personal safety and the best possible performance, read all of this document before beginning the installation. The topics covered include Freespace Turbo capabilities, limitations, and other issues that affect performance.

2.4 Organization

This user manual is divided into six chapters and three appendixes:

1. Specifications
2. Introduction (this chapter)
3. FreespaceFibre/Freespace Turbo Description
4. Site Survey
5. Installing and Connecting Freespace
6. System Diagnostics

Appendix A: FreespaceFibre/Freespace Turbo Standard Mount Specifications

Appendix B: Pre-Installation Site Survey

Appendix C: Safe Viewing Distances

3. Freespace Turbo Description

This section describes the physical portion of the Freespace Turbo wireless link. The following sections are included:

- Overview
- Component Description

3.1 Overview

Freespace Turbo is a protocol-independent, high-speed digital wireless link that provides building-to-building connectivity at full wire-speeds. Freespace Turbo is ideal for situations where installing a fiberoptic cable or a leased line is impractical, too costly, or too time-consuming. Freespace Turbo uses a Gallium Aluminum Arsenide (GaAlAs) laser diode to generate the modulated infrared signal that transmits data between links. No FCC or CRTC license is required to use this system, as it is completely unrestricted.

Freespace Turbo delivers a highly available and reliable signal at distances up to 1,000 ft. (300 m). Freespace Turbo is a wireless physical-layer transport medium. Freespace Turbo provides wire-speed connections for all network protocols from 45-Mbps through 100-Mbps Ethernet and FDDI, to 155-Mbps ATM. Logically, Freespace Turbo appears to your network as a continuous piece of fiberoptic cable.

Installation and configuration of Freespace Turbo is quick and easy. Review the following sections for a detailed description of the components that make up a Freespace Turbo link.

3.2 Component Description

A complete Freespace Turbo link consists of two link-head systems. The connection is full-duplex, meaning both sides of the connection can transmit and receive data at the same time. Each link-head system is made up of a number of components:

- Link head with vernier adjustment and lens defroster, attached to the Power Junction Box and Power Box
- Fiber Patch Box
- Lens defroster transformer
- Link phone
- Mounting brackets (see **Appendix A**)

This section provides a detailed description of these components.

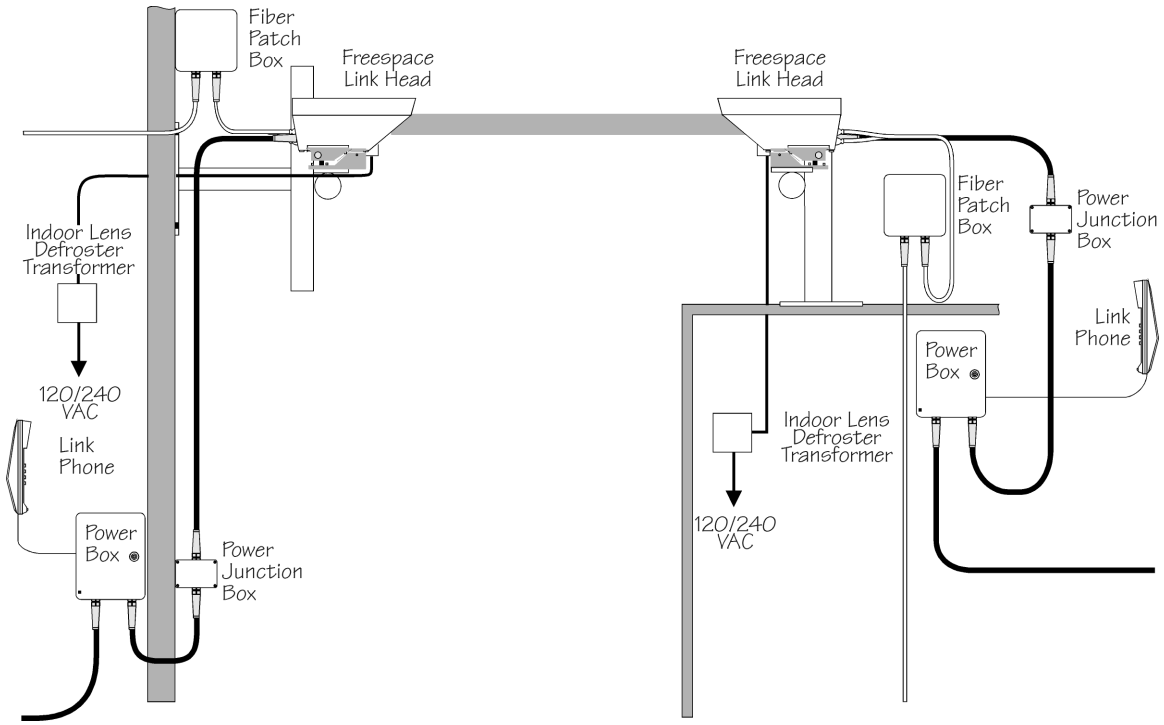


Figure 3-1. Typical Freespace Turbo Installation.

3.2.1 Link Head

The link head is the Freespace Turbo laser transmit and receive unit. The entire Freespace Turbo link consists of two link-head systems.

The link head features:

- Gallium Aluminum Arsenide (GaAlAs) Laser diode to generate the infrared data signal.
- A receiving lens with an effective active area of 17.7 square inches (114 square cm) (5.7" x 3.1"; 11.4 cm x 10 cm).
- A wide horizontal, oval capture zone in the receiver and a vertical, oval shape in the transmission beam, producing an adaptive cross-hair effect that enhances stability.
- A front screen in the link head that acts as a daylight filter.
- Two 1300-nm ST-II fiberoptic connections.
- A 3-ft. (1-m), six-pair, screened copper cable sealed into the link head, connected to the Power Junction Box, which is connected to the Power Box by a 6-ft. (2-m) cable

- A weather shield.
- A permanently-fixed telescopic sight, used for alignment.
- A set of verniers, used to fine-tune alignment.
- An environmental seal. The unit is dry-nitrogen-purged and leak-tested to 20 psi. This eliminates the possibility of internal condensation and corrosion.
- Electrical isolation of your network from the link head by means of the direct fiberoptic data connection. This isolation helps to protect the network from electrical noise, earth loops, and potential damage from lightning strikes.
- A lens defroster.
- LED status indicators:

- Power
- Laser status (Laser Active/Laser Safe)
- Link mode (Fall back mode)
- Signal strength (0 to 9)

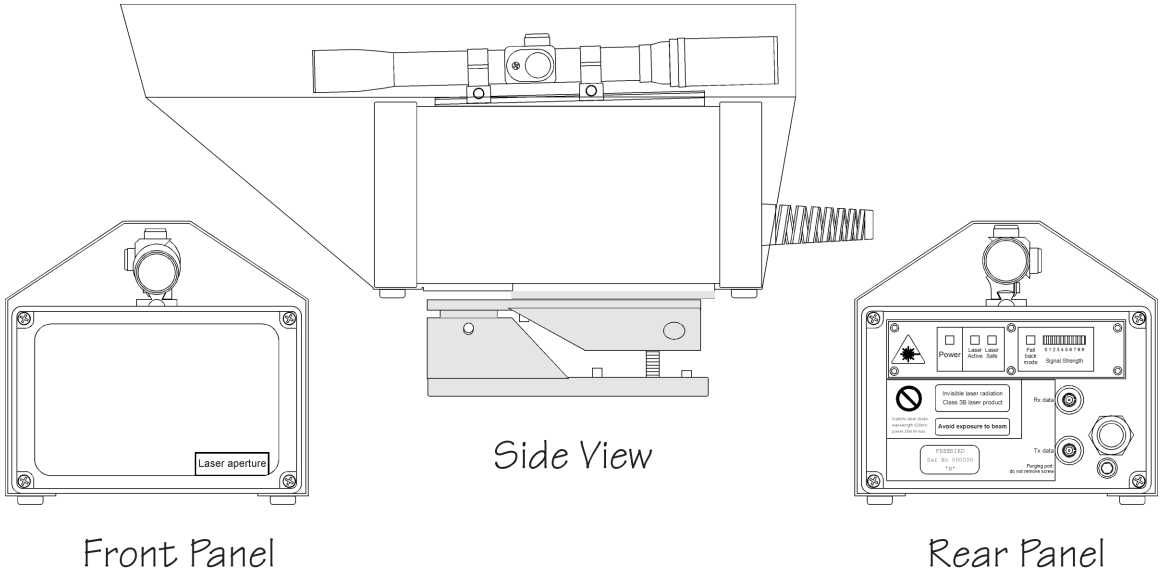


Figure 3-2. Freespace Turbo Link Head Profiles.

3.2.2 Link Head LEDs

LED	LED State	Description
Power	Off	Indicates power is not being received from the Power Box.
	Solid	Indicates power is being received from the Power Box.
	Flashing	Indicates low power is being received; Freespace Turbo will not function correctly when the Power LED is flashing.
Laser Active	**Danger: For eye safety, never look directly into the laser aperture.**	
	Off	Indicates the Laser control key switch is in the Safe position.
	Solid	Indicates the Laser control key switch is in the Active position.
	Flashing	Indicates laser diode has failed or is in fault mode.
Laser Safe	**Danger: For eye safety, never look directly into the laser aperture**.	
	Off	Indicates the Laser control key switch is in the Active position and the Program DIP switches are set to medium or high power.
	Solid	Indicates the Laser control key switch is in the Safe position.
	Flashing	Indicates the Laser control key switch is in the Active position and the Program DIP switches are set to low power.
Fall Back	On	Indicates data is not being passed through the unit.
	Flashing	Looped is switched on, or link phone is in use (i.e., a link phone is plugged in and off hook).
	Off	Indicates unit is operating properly, and data is passing through the unit.
Signal Strength	0 - 9	These LEDs form an analog bar graph indicating the signal strength being received from the remote link head when in Voice Mode. Use for link-head alignment during installation and to determine signal strength during operation. When in Data Mode (both phones on hook and with the network connected) the signal strength is binary. That is, when a good signal is received the signal meter will register “9” and when the signal is insufficient or poor the signal meter will register “0”; there is no intermediate reading.

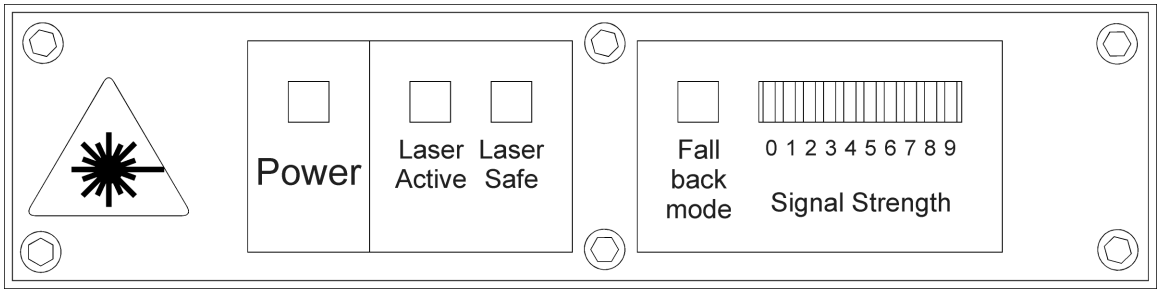


Figure 3-3. Link Head LEDs.

3.2.3 Power Box

The Power Box controls and receives diagnostic information and supplies all the power to the link head. It contains the power supply, the uninterruptible power supply (UPS), configuration and diagnostic features, and a link-phone facility.

The Power Box contains:

- A laser-control key switch.
- A test-loop key switch.
- Configuration DIP switches.
- A built-in UPS with a bypass switch, which maintains power to the system for for up to one hour in the event of accidental disconnection or utility power failure.
- A link-phone connection for talking across the link during installation and tone alignment (accessed through an RJ-11 or a BT-style jack).
- A utility AC-power switch.
- Voltage selector (120 or 240 VAC).
- A fuse.
- A mains (AC) input connection block (labeled “Mains input”).
- A connection block to transmit control and diagnostic information to a remote point (labeled “Alarms”).
- A system test and diagnostic controls connection block (labeled “Remote controls”).
- A link head wire connection block (labeled “Laserhead”).
- Mounting brackets and screws (in the accessory pack).

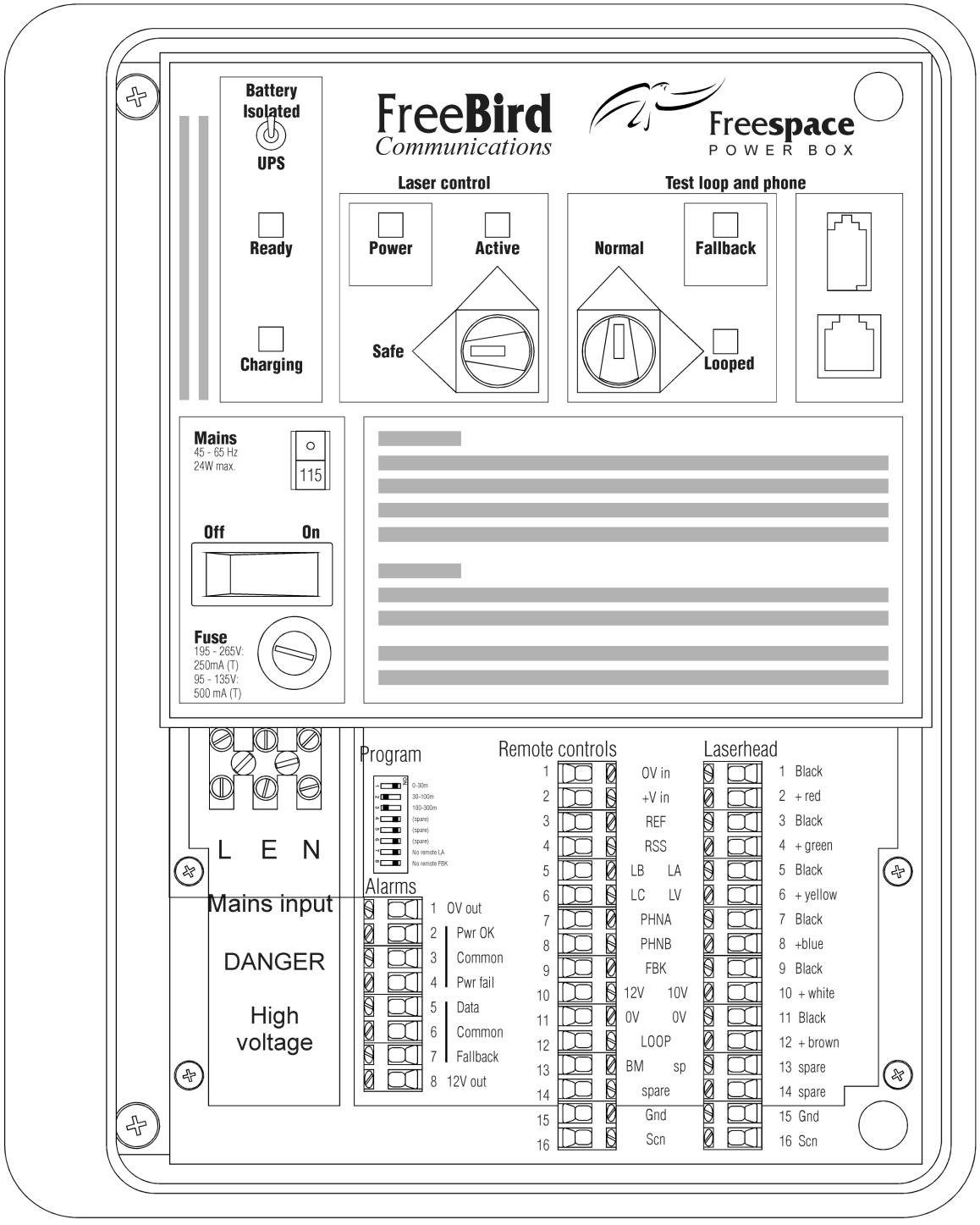


Figure 3-4. Power Box Front Panel.

3.2.4 Power Box Switches

Switch	Position	Description
Mains Power	On	This illuminated rocker switch controls power input to the system; when power is supplied to the system, the switch is lit red.
	Off	Power is not being supplied to the system.
Laser Control	**Danger: Even though this manual specifies safe viewing distances under certain operational states, you should always assume the laser is emitting full power. NEVER look into the laser aperture.**	
	Key Horizontal	The laser *Safe* mode is selected; the laser is inactive. The key is removable in this position.
	Key Vertical	The laser *Active* mode is selected; the Laser Control Active LED is lit when this mode is selected. The key is locked into unit.
Loopback	Key Horizontal	*Looped* mode is selected. This mode is used for system commissioning and for fault isolation; the data signal is not passed through the laser. The fiber data signal on the TX is wrapped to the fiber RX and the laser signal received is retransmitted across the link. See **Figure 3-5**.
	Key Vertical	*Normal* mode is selected. This mode is used for normal link operation; all data is transmitted through the laser across the link. The key is locked into unit. See **Figure 3-5**.
UPS Control	Up	*Battery Isolated* is selected. The UPS is disabled; the Ready and Charging LEDs will not be lit.
	Down	The UPS is activated. The Charging LED will be lit while the UPS is charging and will not be lit when the UPS is fully charged. The Ready LED will be lit when the UPS holds enough charge to power the system. The UPS can maintain the system for up to three hours for FreespaceFibre and for up to one hour for Freespace Turbo.
Voltage Selector	**Warning: Incorrectly setting this switch can cause permanent damage to your equipment.**	
	115	115 VAC set as local input voltage.
	230	230 VAC set as local input voltage.

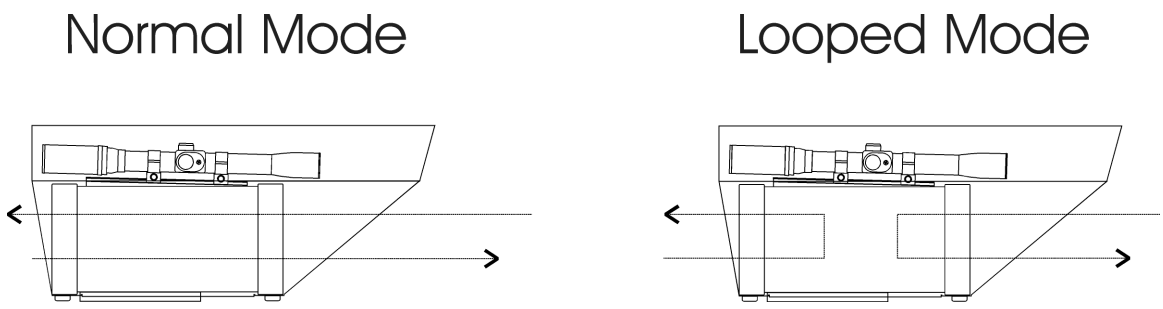


Figure 3-5. Normal Mode/Looped Mode.

3.2.5 Power Box LEDs

LED	LED State	Description
Power	On	Indicates that system power is being supplied to the Power Box and the link head is attached to the Power Box.
	Off	Indicates that system power is not being supplied to the Power Box or that the link head is not attached to the Power Box.
Active	**Danger: Even though this manual specifies safe viewing distances under certain operational states, you should always assume the laser is emitting full power. NEVER look into the laser aperture.**	
	On	Indicates the *Laser control* key switch is in the *Active* position.
	Off	Indicates the *Laser control* key switch is in the *Safe* position.
Fallback	On	Indicates *Looped* mode has been selected in the Power Box; or phones are plugged in, or no data is being passed through the unit.
	Off	Indicates data is being passed through the link.
Looped	On	Indicates the data entering the link head is sent back around to the source; the data received on the TX fiber port is sent out on the RX fiber port, and data received from the remote link head is transmitted back to the link head.
	Off	Indicates that data will be transmitted through the link head.
Ready	On	Indicates the UPS has a sufficient charge (approximately 70%) to maintain the system, and the UPS toggle switch is in the On (down) position.
	Off	Indicates the UPS does not have a sufficient charge to maintain the system, or the UPS toggle switch is in the Battery Isolated (up) position, or the Mains rocker switch is turned Off.
Charging	On	Indicates the UPS is charging.
	Off	Indicates the battery is fully charged or the UPS switch is in the Battery Isolated (up) position, or the Mains rocker switch is turned Off.

Fuse Assembly

Use a coin or slot screwdriver to remove the fuse from the assembly (counter-clockwise to open, clockwise to close). See the label on the Mains power control for the proper fuse size and rating: 500 mA (T) @ 120 VAC, 250 mA (T) @ 240 VAC.

CAUTION

Always use a fuse of the proper size and rating in the fuse assembly. Failure to do so may result in equipment damage.

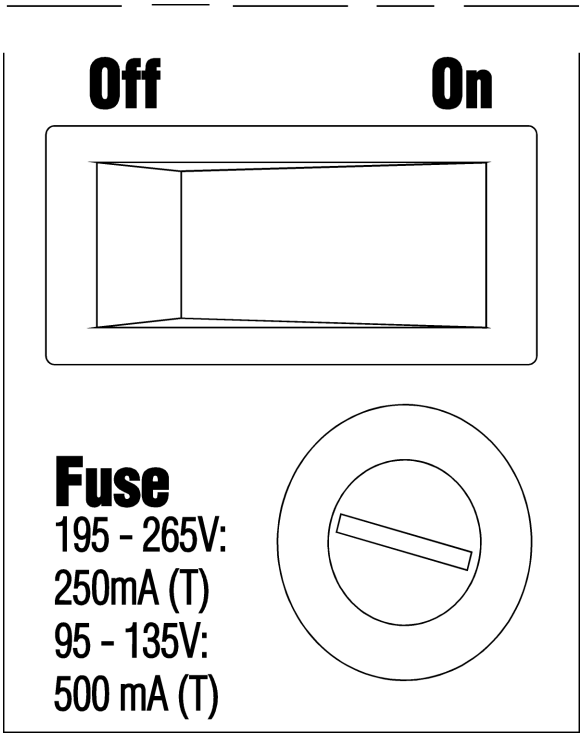


Figure 3-6. Fuse Assembly and Mains Rocker Switch.

Power Cable

The Power Box is connected to the link head with a 9-ft. (3-m) Power Cable. This connection, wired through an intermediate Power Junction Box, makes it easy to extend the length of the Power Cable connection. Since the link head has been environmentally sealed, extensions to the Power Cable must be done between the Power Box and the Power Junction Box.

Program DIP Switches

This block of eight DIP switches is used to configure the laser power output for the link head. The default power setting for Freespace Turbo is Low Power.

Program

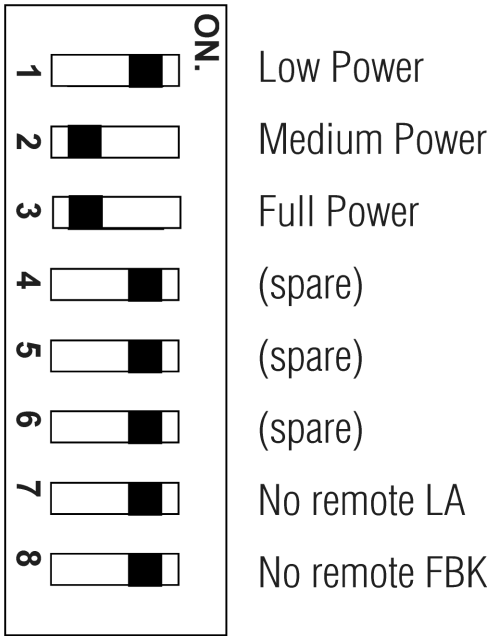


Figure 3-7. Program DIP Switches.

NOTE

DIP switches 1 to 3 represent mutually exclusive options. Only one of these switches should be in the "ON" position at any one time. Other settings may have unpredictable results.

NOTE

DIP switches 7 and 8 should be left in their default "ON" (right) position.

Link-Phone Jacks

Two telephone jacks are located on the unit: a standard BT jack on top and a standard RJ-11 jack on the bottom. The system is designed to accept standard telephones intended for direct connection to an external telephone line. A full-duplex audio signal is transmitted on a 6-Mbps carrier across the link. The link phones can be used for Remote Tone Alignment Mode and for communicating across the link.

NOTE

Use only the supplied link phones or standard phones designed for direct connection to external lines.

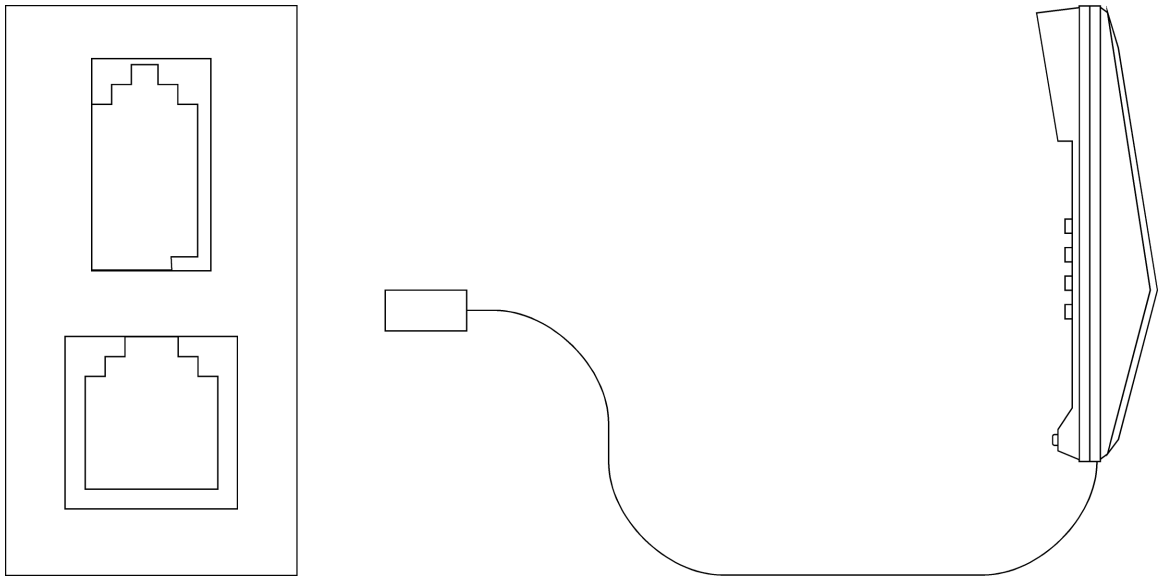


Figure 3-8. Link Phone Jacks.

Remote Control Connection Block ("Alarms")

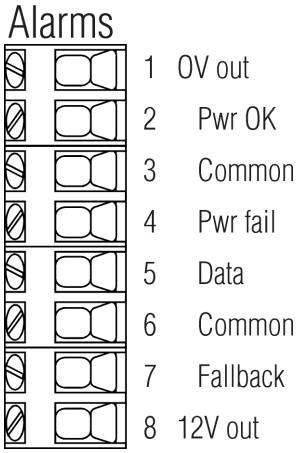


Figure 3-9. Remote Control Connection Block ("Alarms").

This connection block is used for remote management capabilities. The terminals are dry relay contacts. Terminals 2, 3, and 4 register the state of auxiliary power. Terminals 5, 6, and 7 register the state of data flow. The specific functions of the terminals are:

"Alarms" Connection Block Terminal Assignments

Terminal Number	Terminal Label	Function
1	0V out	This terminal is connected to the "Ground Star Point."
2	Pwr OK	This terminal is connected to terminal 3 of the "Alarms" connection block when the +12VDC auxiliary power is present. The circuit goes open (high impedance) if the power fail.
3	Common	This is the common connection for the "dry" relay contacts for terminals 2 and 4 of the "Alarms" connection block; the Power alarm.
4	Pwr fail	This terminal is connected to terminal 3 of the "Alarms" connection block when the +12VDC auxiliary power fails. When auxiliary power is present the circuit goes open (high impedance).
5	Data	This terminal is connected to terminal 6 of the "Alarms" connection block when the link is in Data Mode. The circuit goes open (high impedance) when the link is in Loopback (Fallback) Mode.
6	Common	This is the common connection for the "dry" relay contacts for terminals 5 and 7 of the "Alarms" connection block; the Loopback (Fallback) alarm.
Terminal Number	**Terminal Label**	**Function**
7	Fallback	This terminal is connected to terminal 6 of the "Alarms" connection block when the link is in Loopback (Fallback) Mode. When the link is in Data Mode the circuit goes open (high impedance).
8	12V out	This terminal provides a regulated +12VDC from the auxiliary power supply in the Power Box; it is connected to terminal 10 of the "Remote controls" connection block.

3.2.6 Link Phone

The link phone is supplied to aid in fine-tuning the link-head alignment. It is a standard telephone, used for direct connection to an external telephone line supplied with either an RJ-11 or BT-style jack. Any telephone intended for direct external connection can be used.

3.2.7 Fiber Patch Box

The Fiber Patch Box is provided so that a standard two- or four-core fiber cable can be easily terminated and protected. Use the fiber patch cable supplied to connect from the ST barrels in the Fiber Patch Box to the ST-II connections on the link head. The network fiber connection is terminated on the Fiber Patch Box. This provides a termination point for easy cable replacement if the cable connecting to the link head is accidentally damaged.

The Fiber Patch Box:

- Weatherproofs the fiber connection
- Has plastic ST barrel connectors to eliminate the possibility of corrosion
- Has special sealing nuts (grommets) to match with waterproofed boots on the cable supplied

The fiber patch cables:

- Are outdoor-rated from -40°F to 140°F (-40°C to 60°C)
- Have rubber boots, which provide a weatherproof seal when pushed over the lip of the ST-II sealing nuts
- Are full duplex
- Are made with 62.5/125 fiber
- Are covered with a waterproof external coating

3.2.8 Power Junction Box

The Power Junction Box is used to extend the standard length of the cable joining the link head to the Power Box. This box is weatherproof, and provides a convenient place to extend the length of cable between the Power Box and the link head. The cable connecting to the link head cannot be extended, since it has been environmentally sealed into the link head. Therefore the cable distance is lengthened by replacing the cable between the Power Box and the Power Junction Box. See **Chapter 5** for details.

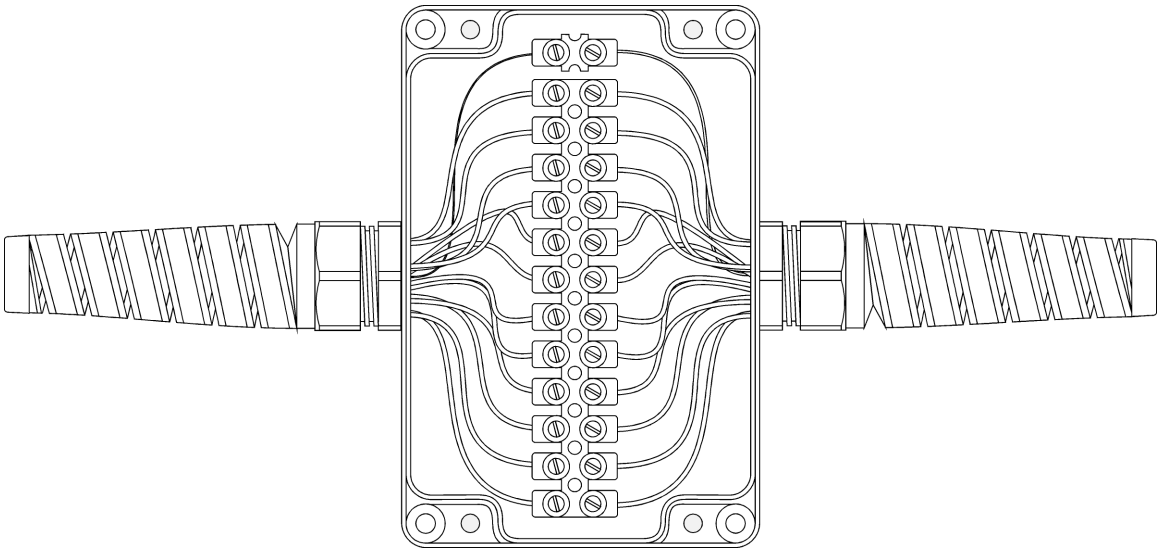


Figure 3-10. Power Junction Box.

3.2.9 Lens Defroster Transformer

The factory-installed lens defroster keeps ice and snow away from the laser-head lens through the convection of heated air. The lens defroster begins operating when the outdoor temperature falls to 37°F (3°C) or below. To power the lens defroster, a separate transformer included with Freespace Turbo provides an output of 24 VAC @ 4.2 amps. This transformer is indoor/outdoor rated.

3.2.10 Accessory Package

The accessory package contains various accessories needed for the link-head components:

- One Power Box key
- Studs, washers, and nuts for mounting the link heads
- Brackets, lugs, and screws for mounting the Power Box

4. Site Survey

4.1 Site Survey Overview

Completing a site survey is essential for successfully installing and maintaining a Freespace Turbo link. This information will ensure a smooth and complete installation, and will help to provide maximum system availability and long-term reliability of the link. The site survey is a complete analysis of the environment in which Freespace Turbo is being installed, including:

- Physical considerations, such as transmission distance, mounting location, and cabling issues
- Power requirements
- Physical and logical network-integration issues
- A description and drawing of your existing network topology

The site survey should be completed by the people responsible for the installation and should include input from the people who are familiar with:

- Installing and certifying AC power sources
- Installing and certifying data and fiberoptic cables
- The physical and logical aspects of your network topology

Completing the survey prior to installation will help to identify all the necessary details to ensure a smooth installation. The survey will also help to eliminate many of the surprises that might arise during installation, and to identify additional equipment or resources that need to be acquired for installation. Finally, the site survey will help to compile a list of things that need to be done before starting the Freespace Turbo installation. Once you have completed the site survey and decided how Freespace Turbo will be connected to your network, the following topics will have been addressed:

- Network description and topology
  - Physical and logical drawings of your networks
  - Equipment currently installed at both sites
  - How sites are currently connected
  - Network access points for Freespace Turbo on both networks
  - Equipment that will be used for the Freespace Turbo connection (include makes and models)
  - Nature and format of the traffic to be carried on the link
- Distance between link heads and a description of how the distance was determined

If possible, include photographs of:

- The link-head mount locations

- Line-of-sight path from each mount location

The Freespace Turbo pre-installation site survey is provided as **Appendix B** of this document. If you have any questions while you are conducting the site survey, please contact Black Box Technical Support at 724-746-5500. E-mail inquiries can be directed to info@blackbox.com.

4.2 Determine Physical Considerations

4.2.1 Consider Factors That May Affect Transmission

Line of Sight

A clear line of sight is essential for Freespace Turbo operation. Both link heads must be aimed at each other, and an unobstructed transmission path must exist.

The transmission beam must clear all objects by at least 8 ft. (2.5 m), both horizontally and vertically. This includes intermediate buildings, rooftops, air conditioners, and heater vents, which might cause heat shimmer (scintillation) and disrupt the beam.

When installing a link head on a rooftop, position it so that window-cleaning apparatus and maintenance personnel will not disrupt the beam. If mounting on the side of an elevator shaft, the link head should be located 8 ft. (2.5 m) above walkway height.

WARNING

Permanent eye injury may result if Freespace Turbo is mounted in a location where people can accidentally interrupt the Freespace Turbo beam. Also, an accidental interruption of the beam will cause the communication link to be lost until the interference is removed.

DANGER

For eye safety, never look directly into the laser aperture.

Link-Head Orientation

Avoid a direct east-west orientation to prevent the rising and setting sun from temporarily blinding the system.

Link-Head Angle

Avoid a link head pointing upward at a steep angle, more than 45° from grade. This will compromise the effect of the weather shield in preventing rain or snow from falling directly onto the lens surface.

Electrical Interference

Freespace Turbo has passed the European test specification for electromagnetic susceptibility and electrostatic discharge immunity (designation EN 50 082). The units display a high degree of resistance to interference from external radio fields. It is sensible, however, to avoid mounting in very close proximity to any known high-power transmission antennae or satellite dishes, as well as three-phase power lines.

Indoor Mounting

If necessary, Freespace Turbo can be mounted indoors and its beam aimed through a window.

When transmitting through glass, the maximum transmission distance to achieve a high statistical availability is approximately 600 ft. (200 m). If the nature of the glass is in question, a trial should be undertaken. Not all glass is created equal as far as infrared transmission is concerned. A single pane of normal glass offers very little signal degradation (attenuation). However, some modern glass is either heavily tinted or specially coated to control the passage of infrared light.

Other factors to consider are rain or snow accumulation on the window. This effect can be minimized by locating the head at the top of the pane. Try to choose a window with an overhang above it. Avoid locations where condensation will obscure transmission. Also, avoid direct perpendicular mounting: do not mount at an angle precisely 90° to the window glass. Mount Freespace Turbo as close to the glass as possible, and keep the angle of the beam to within 30° on either side, rather than precisely perpendicular to the window glass. Angles greater than 30° from center will result in either substantial signal attenuation or a total internal reflection that will compromise eye safety, and will not allow the beam to pass through the glass.

WARNING

There is partial reflection of the laser beam from the glass. The safe viewing distance for the naked eye is 3.5 ft (1 m) from the glass.

WARNING

To avoid eye injury, the Freespace Turbo unit must be turned off when maintenance activities (e.g., window washing) are being performed outside the window through which Freespace Turbo is aimed. Only when the Mains (AC) power is off (toggle switch is set to "Off") and the UPS battery is inactive (toggle switch is set to "Battery Isolated") is the unit turned off.

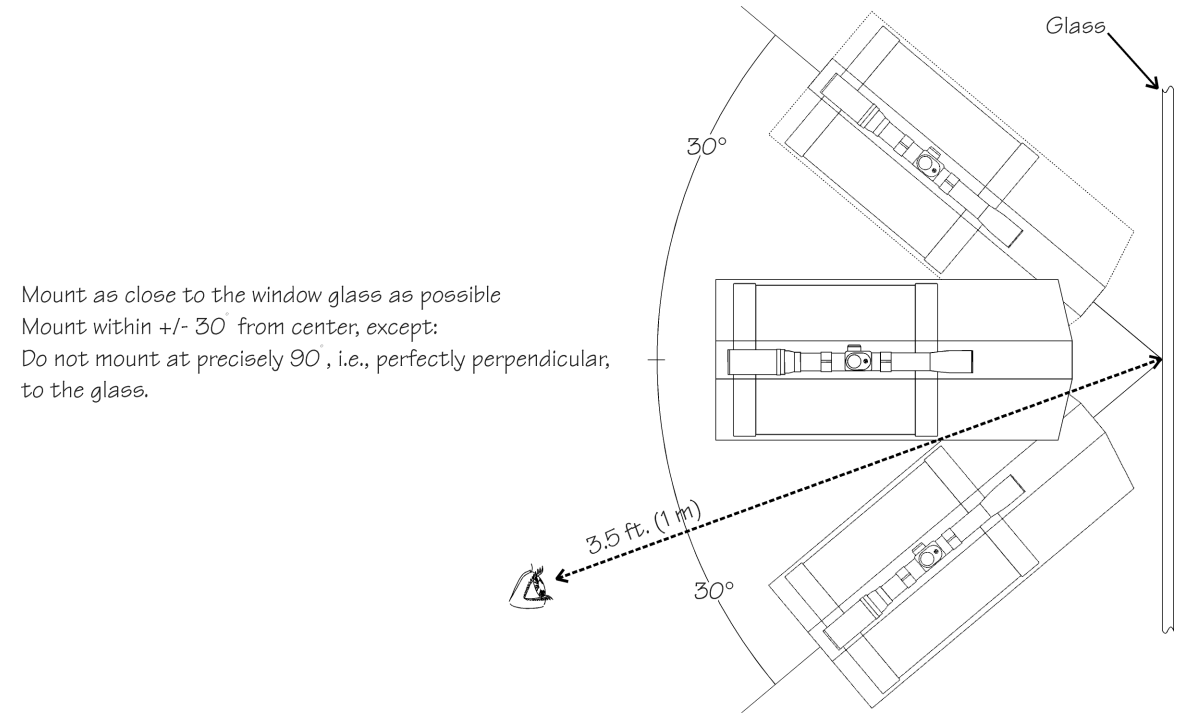


Figure 3-11. Mounting Link Heads Indoors.

4.2.2 Verify Transmission Distance

Verify that the distance between link heads is within 1,000 ft. (300 m). Standard street or survey maps with a known scale are good for distance determination. A meter-wheel or optical range finder will provide a more accurate measurement.

Freespace's high statistical availability is based on the recommended maximum distance of 1,000 ft. (300 m) between links. Beyond 1,000 ft. (300 m), the signal becomes increasingly susceptible to environmental interference and availability may decrease.

4.3 Select a Mounting Location

You must consider many issues when selecting a location to mountFreespace Turbo components. Easy access to the link heads for system maintenance should always be taken into consideration when choosing the site. Also, when selecting a mounting location, consider that a person must install, align, and maintain the unit.

4.3.1 Get Permission

Freespace Turbo is small and discreet; it is similar in appearance to a CCTV camera. However, permission from local authorities or landlords may be required to mount the link on a building. Electrical approval may also be required to bring power onto a rooftop. Make sure all necessary approvals are received from landlords and/or local government. The issue of approvals and permission should be considered in the early stages of planning.

4.3.2 Select the Appropriate Mounts

Two standard mount configurations are available:

- Wallmount bracket with pan-and-tilt arm, accommodating either wall-face or corner fixing
- Pedestal-mount with pan-and-tilt arm, for mounting on a horizontal surface, such as a parapet

4.3.3 Post Potential Eye Hazard Warning

Since most people responsible for providing communication services do not control exterior maintenance personnel (e.g., window washers), we strongly recommend a sign similar to the following be posted to caution people who may work in the area.

Figure 3-12. Potential Eye Hazard Danger Sign.

NOTE

Post a number of signs so they will be visible from both sides, inside and outside the installation.

4.5 Design Guidelines

This section of the site survey discussion deals with Freespace Turbo integration. Since every networking environment is different, it is beyond the scope of this document to specify how and where to interconnect Freespace Turbo into your network. For example, the network interconnection can be made through fiber repeaters, hubs, MAUs, bridges, routers, or switches. For this reason, you must rely on your own networking expertise or on the expertise of your integrator.

4.5.1 Cabling

Mains Power Supply

This cable carries standard utility power at 120 or 240 volts AC as required by the Power Box. There may be local building codes regarding the external use and provision of such power. You may need to install a conduit or use a specific grade of cable. Investigating this issue will help you to install Freespace Turbo in accordance with all regulations.

Certify the quality of the power delivered to the Power Box. Since electrical motors cut in and out, the power can be very noisy. If possible, have a clean power line installed at the location.

Power Cable

This cable connects the Power Box to the link head through the Power Junction Box. The supplied cable is 9 ft. (3 m) long. This cable can be extended up to a maximum length of 65 ft. (20 m), using 6-pair screened 24-gauge wire (part number EDN12A). Calculate the distance from the Link Head to the Power Box, including the Junction Box.

If the cable is extended beyond the standard 9-ft. (3-m) length, document the length in the site survey. When stripping the extended cable, isolate each "color plus black" pair of wires, (use a length of heat shrink to isolate each pair); this will help to avoid an accidental wrong connection.

Local building codes may require the use of flame-retardant cables: For any valid length, use LSOH- or PTFE-coated equivalents to EDN12A cable (for example, part number EYN12A).

This cable carries only low-voltage DC power. Caution still must be exercised when routing the cable to avoid close parallel proximity to AC utility power cables. Induced noise spikes can impair the system performance and cause random errors. This is particularly important when the cable is installed near high-voltage or power cables.

As good practice, use the same outline rules that apply to installing twisted-pair cable for network data when in parallel with mains power:

- up to 2 KVA, allow 4-inch (10-cm) clearance
- up to 5 KVA, allow 12-inch (30-cm) clearance
- 5 KVA and over, allow 40-inch (100-cm) clearance

It is a good practice as well to keep cable runs and Freespace Turbo equipment at least 6.5 ft. (2 m) away from microwave-based products.

Fiberoptic Data Cables

Installation of two fiberoptic pairs (cores) is required: one for transmit and one for receive.

NOTE

We recommend that a minimum of four pairs be installed to provide fault tolerance through redundancy and to allow for future expansion.

Fiberoptic cable must be multimode standard 62.5/125 or 50/125. ST-II connectors are required to be compatible with the link head and with supplied patch cables. Currently, 62.5/125 is the preferred fiber for most fiberoptic installations.

Use an external grade of fiberoptic cable. The fiber cable will eventually run outdoors.

The fiber run from the network terminates in a fiber splice. The supplied patch cables are used to make the connection to the link head. These cables are rated from -40°F to 140°F (-40°C to 60°C).

Freespace Turbo Fiber Specifications

The fiberoptic connection to the Freespace Turbo link head is through 50/125 or 62.5/125 multimode fiber, running at 1300 nm using ST-II connectors. This connection is protocol-independent, and is standard for:

- 100BASE-FX (Fast Ethernet) full duplex, supporting fiber runs up to 6,561 ft. (2,000 m)
- 100BASE-FX (Fast Ethernet) half duplex, supporting fiber runs up to 1,351 ft. (412 m)
- FDDI, supporting fiber runs up to 6,561 ft. (2,000 m)
- ATM, supporting fiber runs up to 6,561 ft. (2,000 m)
- 100VG, supporting fiber runs up to 6,561 ft. (2,000 m)

4.5.2 Freespace Turbo Properties

Latency

For application purposes, consider the link to have the same latency (delay) as a piece of fiberoptic cable. Traffic is passed through the link heads with minimal latency. Delay is nullified because the data travels across the link at nearly the speed of light. Across fiber optics, data travels at 65% the speed of light.

Loss of Signal

When visibility drops below the level for reliable transmission, or when the transmission beam is interrupted, the link stops the output of data from the fiber port, protecting the network from corrupted frames. This looks to the network as if the fiber has been temporarily broken. When reliable communication can be resumed, the link automatically begins sending data.

Network Transparency

Even though every network environment is different, the basic concepts for interconnecting networks using Freespace Turbo are the same. Freespace Turbo appears to the network as a piece of fiberoptic cable and is connected to your network in exactly the same way as a single fiberoptic cable pair.

For network-design purposes, Freespace Turbo and the fiber cable connecting to it should be treated as a continuous piece of fiber (it does not affect repeater counts, lobe lengths, network timing, etc.).

Physically, the only difference between Freespace Turbo and a fiberoptic cable is that Freespace Turbo is wireless. Logically, the fiber cable connecting Freespace Turbo and the link itself appears to your network as a continuous piece of fiberoptic cable. The link has identical properties to a fiberoptic cable.

4.5.3 Additional Design Considerations

Use of Fiber Ports

Use fiber ports from the same vendor(s) at each end of a link. Ports from different vendors may not be fully compatible.

5. Installing and Connecting Freespace

5.1 Installation Overview

This chapter contains information about laser products, safety, system specifications, unpacking and inspecting the system, verifying the system's operation before installation, and installing and connecting Freespace Turbo.

These activities should be completed before installing the Freespace Turbo system:

- Selecting appropriate mounting locations and installing the mounts
- Installing and certifying the fiberoptic cable

NOTE

Fiber loss measurements are one of the few ways that you can be assured that fiber runs were installed and terminated properly. So you should ensure that these measurements are completed.

- Installing and certifying an AC power source

This chapter contains the following topics:

- Eye Safety
- Unpacking and Inspecting the System
- Mounting the Link Head Brackets
- Mounting the Power Box
- Installing the Freespace Turbo Link
- Aligning the Link Heads
- Making Data Connections
- Connecting Freespace Turbo to Your Network
- Completing Final Steps
- Installation Checklist

5.2 Eye Safety

Freespace Turbo uses a Class IIIb laser, operating at a wavelength of 780 nm, to generate an infrared (IR) signal. Although the signal is invisible to the naked eye and uses very low output power (less than 20 mW), it is generated from a laser source and precautions must be taken to ensure eye safety. You can sustain permanent eye damage if you view the IR laser beam at close proximity.

for an extended period of time. Therefore, for eye safety, never stare directly into the laser aperture from which the IR laser beam is transmitted. The laser aperture is located immediately above the "Laser aperture" label on the lens of the link-head front panel. Side and front views of the laser aperture are provided in the following diagram. Refer to the detailed information on Safe Viewing Distances and Nominal Optical Hazard Distances in **Appendix C**.

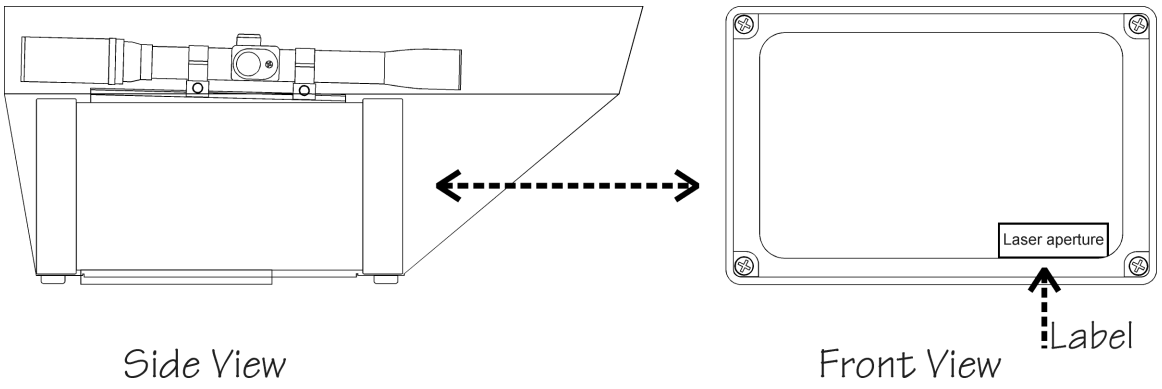


Figure 5-1. Laser Aperture Side and Front Views.

DANGER

Even though this manual specifies safe viewing distances under certain operational states, you should always assume the laser is emitting full power. NEVER look into the laser aperture.

Laser Operating Modes

The Laser Active and Laser Safe LEDs on the back of the link head and the Laser Active LED in the Power Box indicate the operational mode of the laser.

Laser Operating Modes

Program DIP Laser Switches (Power)	Laser Control Key Switch Setting		Link Head Laser Mode LEDs		Power Box Mode LED
	Safe	Active	Laser Safe	Laser Active	Laser Active
Low	√		solid	off	off
Medium	√		solid	off	off
Full	√		solid	off	off
Low		√	flashing	solid	solid
Medium		√	off	solid	solid
Full		√	off	solid	solid

5.3 Unpack and Inspect System

On receipt, unpack the system and verify the safe arrival of all items on the packing list in each box. If the final installation sites are not ready, re-pack the Freespace Turbo system in the shipping container to prevent accidental damage. When you have installed the mounts and prepared the sites for final installation, proceed with final unpacking. The system is shipped in multiple boxes. One complete link-head unit is shipped in a box. Two link heads make up one complete Freespace Turbo wireless link. Mounting brackets are shipped in separate boxes.

NOTE

We recommend that you inspect the Freespace Turbo in a controlled environment rather than at the actual installation site.

Check the packing list to make sure you have received the following items in each head box:

- One link head (connected to the Power Junction Box)
- One Power Box (connected to the Power Junction Box)
- One Power Junction Box (connected to the link head and the Power Box)
- One Fiber Patch Box
- One duplex fiber patch cable
- One lens defroster prefitted to head
- One lens defroster transformer
- One link phone and shorting plug
- One “Danger” sign
- One accessory pack, containing:

  - One Power Box key

- One small plastic bag with heater sensor clip and heater power cable plug

- Four link-head mounting studs with washers and nuts

- Four Power Box brackets with lugs and screws

- This user manual

Inspect all the items. We recommend that you complete an operational test of all components before mounting components in their final locations. If anything is damaged or missing, contact Black Box immediately at 724-746-5500.

5.4 Mount the Link Head Brackets

Select mounting locations so brackets are fixed to solid masonry or to a metal structural framework. The brackets must not move. Mounting on wood or sheet-metal can cause unpredictable movements.

When mounting a link head on a ledge or parapet, place it on the outer edge. This will help to avoid rain splash, snow build-up, and perching birds.

Freespace Turbo has a nominal 0.5° transmit beam divergence to adapt to most normal building movement. Additionally, Freespace Turbo has been designed with a wide horizontal receiving zone and a tall vertical transmit pattern. This produces an adaptive cross-hair effect that enhances stability.

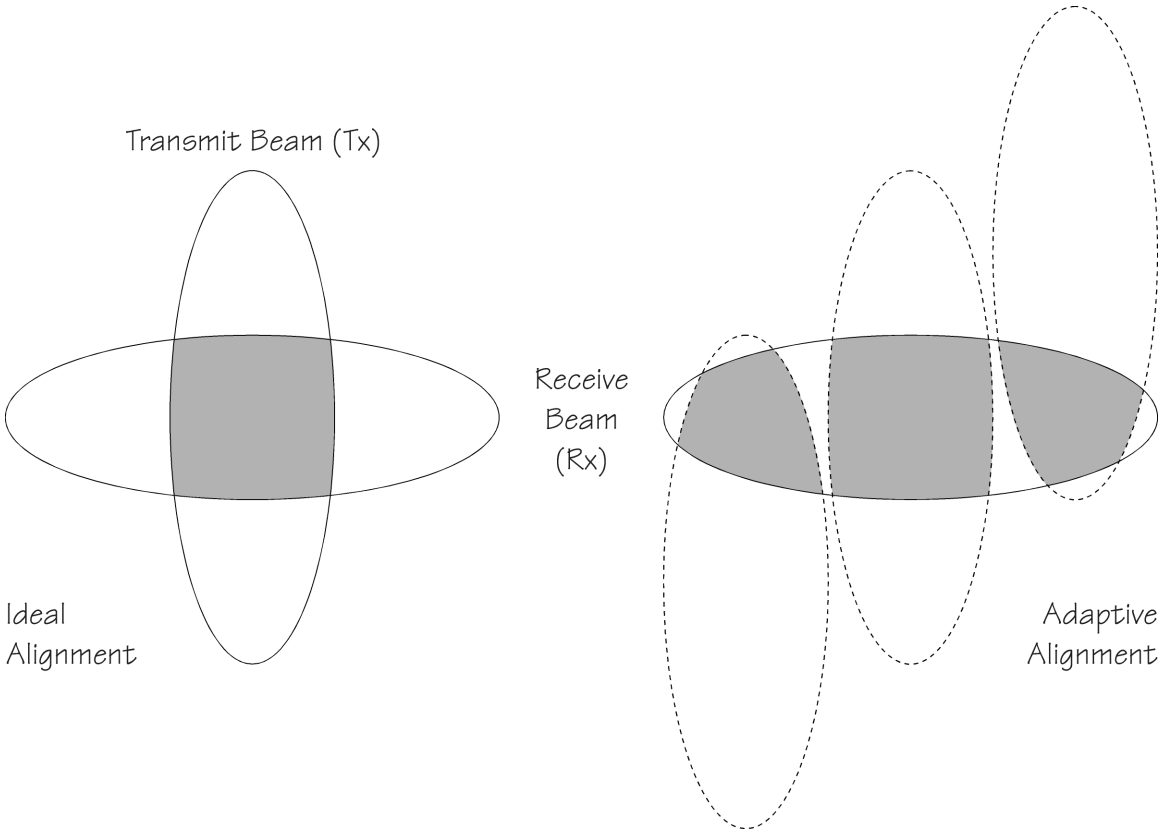


Figure 5-2. Freespace Turbo Adaptive Cross-hair Effect.

5.5 Mount the Power Box

The Power Box is weatherproof (not waterproof) and can be vertically mounted almost anywhere above the potential level of any standing water. When mounting the Power Box, ensure the cable strain reliefs are facing downwards to prevent water access. The Power Box requires an input of standard utility power at 120 or 240 volts AC. The Power Cable, connecting the Power Box to the link head, carries 24 volts DC. There may be local building codes regarding the external use and provision of such power. You may need to install a conduit or use a specific grade of cable. Investigate this issue to make sure the installation is in accordance with all regulations. The maximum recommended distance for the Power Cable is 65 ft. (20 m). Calculate distance from Link Head to Power Box including Junction Box.

Mounting the Power Box in an indoor location may make the installation easier. For example, it can be mounted inside an elevator motor room, with the link head mounted on the outside wall of the room. Easy access to the Power Box for maintenance should be considered.

5.6 Verify Individual Link Operation

Each Freespace Turbo link head is shipped from the factory fully operational, and correctly connected to the Power Box. After the link head is unpacked and visually inspected, verify its operation. This inspection procedure ensures no damage has occurred in transit.

Use the following procedure to verify the link head and the Power Box are in proper working order. Perform this procedure for each link head.

DANGER

Even though this manual specifies safe viewing distances under certain operational states, you should always assume the laser is emitting full power. NEVER look into the laser aperture.

1. Verify that the power cord is not connected to a power source.
2. Use the access key to open the Power Box.
3. Put the *Laser control* key in the *Safe* position (key switch is horizontal).
4. Use the *Program* DIP switches on the Power Box to set the power setting to Low. Set DIP switch 1 ON, DIP switches 2 and 3 off, and DIP switches 4 to 8 ON.
5. Put the *Test loop* key in the *Looped* position (key switch is horizontal).
6. Put the *Battery Isolated/UPS* switch in the Up/*Battery Isolated* position.
7. Select the appropriate voltage setting for your local power (120 or 240 volts AC).

WARNING

Incorrectly setting this switch will cause permanent damage to your equipment.

8. Verify that the *Mains* power rocker switch is in the Off position.
9. Connect the power cord to an AC power source.

10. Put the *Mains* power rocker switch in the *On* position.
11. On the Power Box, the *Mains* power rocker switch, and the *Power*, *Fallback*, and *Looped* LEDs will be lighted.
12. On the Link Head, the *Power* and *Laser Safe* LEDs will be lit, and the *Fallback* LED will flash.
13. Put the *Laser control* key in the *Active* position (key switch is vertical). The *Active* LED on the Power Box and the *Laser Active* LED on the link head will be lighted, and the *Laser Safe* LED will flash on the link head.
14. Put the *Test loop* key in the *Normal* position (key switch is vertical). The *Fallback* LED in the Power Box will remain lighted, the Looped LED in the Power Box will unlight, and the *Fallback mode* LED on the link head will stop flashing and light.
15. Put the *Battery Isolated/UPS* switch in the Down/*UPS* position.
16. Verify the UPS *Ready* LED is lighted.
17. The *Charging* LED will light, but may rapidly go out depending on the UPS's charge.
18. Put the *Mains* power rocker switch in the *Off* position.
19. Verify the UPS *Ready* LED, and that the other LEDs on the Power Box and link head remain lighted. These LEDs may remain lit only a short time if the UPS has not been sufficiently charged.
20. Put the *Mains* power rocker switch in the *On* position, and verify that all LEDs stay lit.
21. Put the *Battery Isolated*/UPS switch in the Up/*Battery Isolated* position.
22. Perform this procedure for the other link head.

5.7 Install the Freespace Turbo Link

You must complete the following set of procedures for both link heads.

5.7.1 Mount the Power Box

Use the mounting lugs supplied to attach the Power Box to the location specified in the site survey.

WARNING

Do not drill holes in the Power Box, as doing so will compromise the box's weatherproof properties.

NOTE

When mounting the Power Box, make sure the cable strain reliefs are facing downwards to prevent water access.

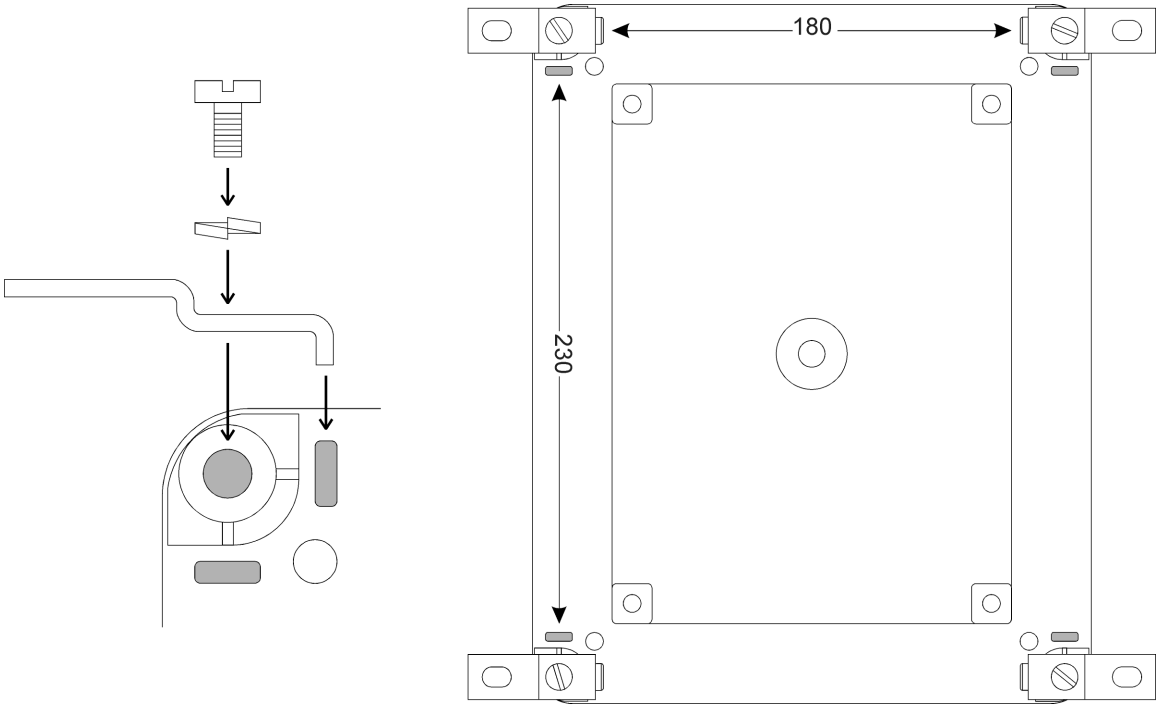


Figure 5-3. Mounting Power Box.

Verify the utility power connection has been terminated correctly on the *Mains input* terminals in the Power Box: L - live; E - earth (ground); and N - neutral. If mounting the Power Box indoors, verify that a phone cable can run from it to the outside if tone alignment is to be used.

WARNING

Verify that the Power Box is not connected to a power source during the installation. Failure to do so may result in personal injury or damage to the equipment.

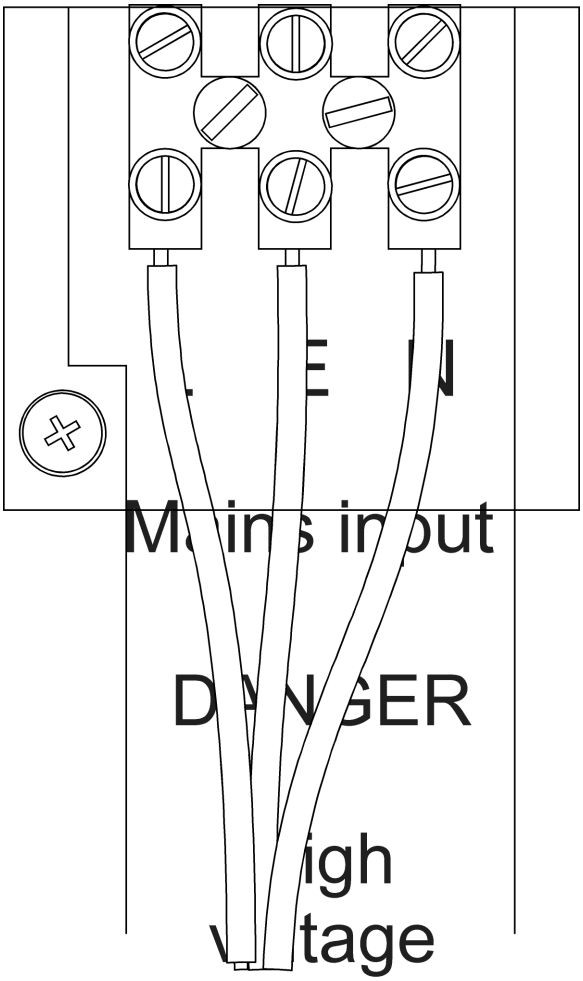


Figure 5-4. Utility Power Connection Terminations.

5.7.2 Attach the Link Head

Attach the link head to the mount without making network or electrical connections. See figure below.

1. Attach the plate of the pan and tilt arm to the vernier on the bottom of the link head. Fully tighten the bolts holding the link head to the pan and tilt arm. If additional space is required to offset the Link Head from a wall, also attach the extension plate with the bolts provided.

2, Connect the pan-and-tilt-arm/link-head assembly to its mount (wall or pedestal) by sliding the pan-and-tilt-arm through one pair of u-bolts on the u-bolt plate, and sliding the other pair of u-bolts over the vertical post of the mount. Tighten the u-bolts sufficiently to hold the pan-and-tilt-arm/link-head assembly in position, while allowing slight movement for rough alignment.

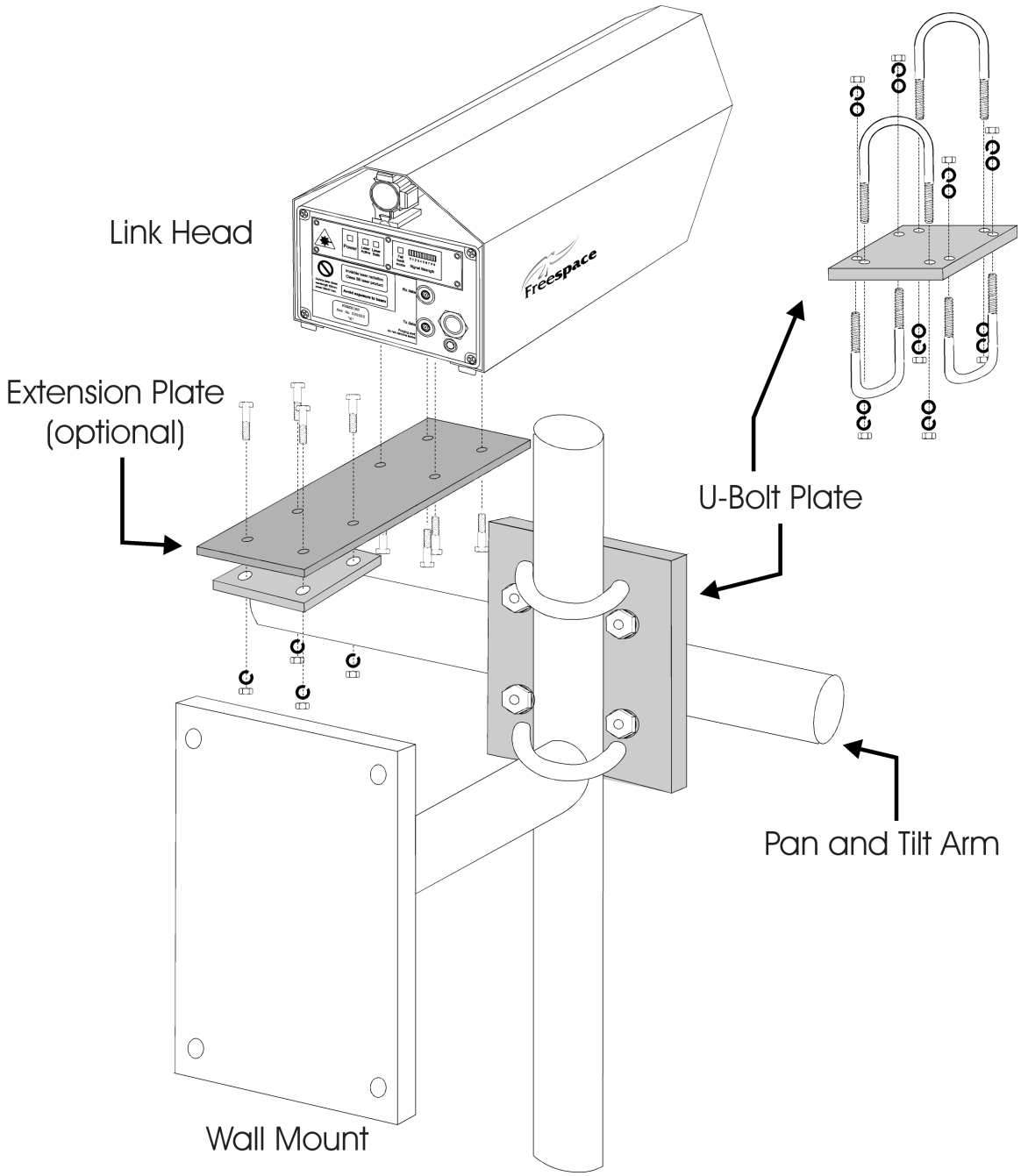


Figure 5-5. Link Head Attachment.

5.7.3 Connect Defroster Transformer and Temperature Sensor

The factory-installed lens defroster keeps ice and snow away from the laser-head lens through the convection of heated air. The Freespace lens defroster is powered by a UL listed indoor/outdoor-rated encapsulated dry-type transformer. Input voltages of either 120 or 240 volts are possible with this transformer; choose the input voltage to match your supply voltage. The output voltage to the lens defroster must be 24 volts.

The lens defroster transformer comes boxed, along with a 120-volt power cord and two strain relief connectors. No connections are completed on the lens defroster transformer as supplied. Cable the lens-defroster transformer to input and output power as follows:

1. Open the lens defroster transformer cover plate by removing the screws on the front and bottom of the transformer.
2. Make knockouts to fit strain reliefs and to run cables. Select knockout locations to minimize cable exposure to outside dirt and water.
3. Identify primary (input) wires and make connections. The lens defroster transformer has four primary connection wires: H1, H2, H3, and H4. Connect a power cord suitable to the input voltage (a 120-volt cord is supplied) according to the connection diagram on the faceplate of the transformer.

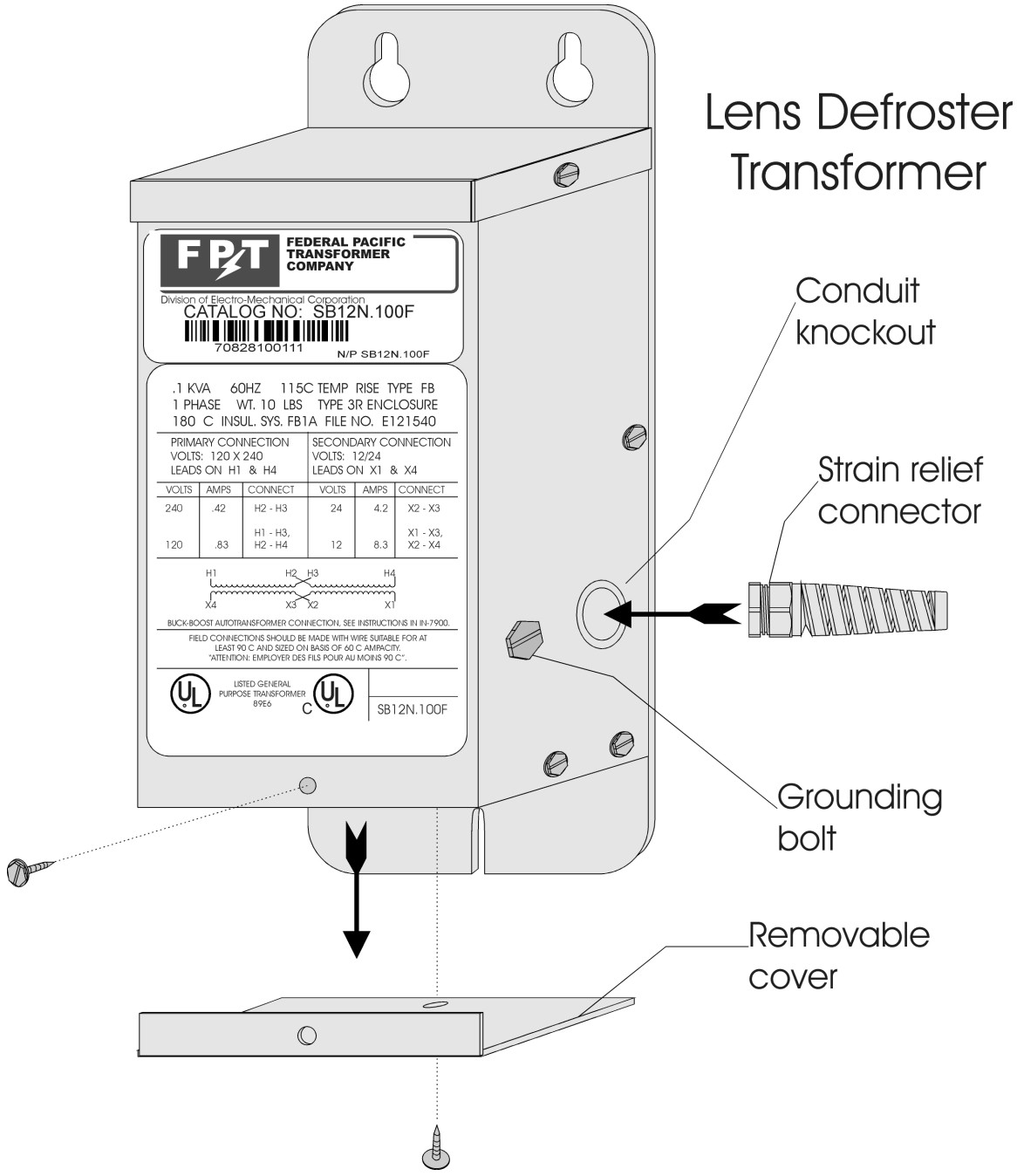


Figure 5-6. Lens Defroster Transformer.

4. Identify secondary (output) wires and make connections. Note: Use only the 24-volt output connection. The lens defroster transformer has four secondary connection wires: X1, X2, X3, and X4. Connect cabling (not supplied) to run from the lens defroster on the Freespace link head to the lens defroster transformer according to the connection diagram on the faceplate of the transformer. Observe maximum cable run distances.

5. Properly insulate all leads not being used.

6. Replace the lens-defroster transformer's cover plate.

NOTES

1. Output voltage from the lens-defroster transformer must be 24 volts.

2. This lens defroster transformer is not backward compatible with the 18-volt heaters supplied with earlier Freespace units. If in doubt, note the serial number of the Freespace unit and consult technical support.

3. Follow local installation codes and requirements where applicable. Local building codes regarding the external use and provision of such power may apply. Installing conduit and junction boxes or use of a specific outdoor grade of cable may be required. Investigate to ensure the installation, including the junction of the transformer output cable with the installed extension cable, is in accordance with all regulations.

4. The lens-defroster transformer must also be protected by lightning arrestors or other suitable equipment from outside lines that may cause lightning and switching surges to be transmitted to the transformer. Ground the transformer enclosure to a water pipe or similar effective common ground using the large grounding bolt located on the side of the lens-defroster transformer's case.

5. The lens-defroster transformer's power output cable can be extended using outdoor two-core cable to the maximum distances below:

Gauge	Maximum Distance
20	65 feet (20 m)
18	102 feet (30 m)
16	129 feet (39 m)
14	208 feet (63 m)
12	333 feet (100 m)

To compete the installation of the lens-defroster power (see diagrams on the next page):

NOTE

The lens-defroster power wires are most easily attached to the link head before attaching the link head to its mount.

- Find a suitable location for the lens-defroster transformer.
- Pull the lens-defroster output-power extension cable between the link head and the transformer.
- Complete the junction of the transformer power output cable and the extension cable.
- Attach the lens defroster power wires to the orange heater power cable plug (shipped in small plastic bag in link head box).
- Connect the heater power cable plug to the lens defroster power receptacle.

- After completing the link head installation, plug the lens defroster transformer into a 120 or 240 VAC outlet, depending on the wiring configuration you have used in the transformer.

The temperature sensor may be inside the lens-defroster assembly for protection during shipping. Extract the temperature sensor and attach it to the bottom of the link head (not to the defroster itself) using the sensor clip shipped in small plastic bag in link head box.

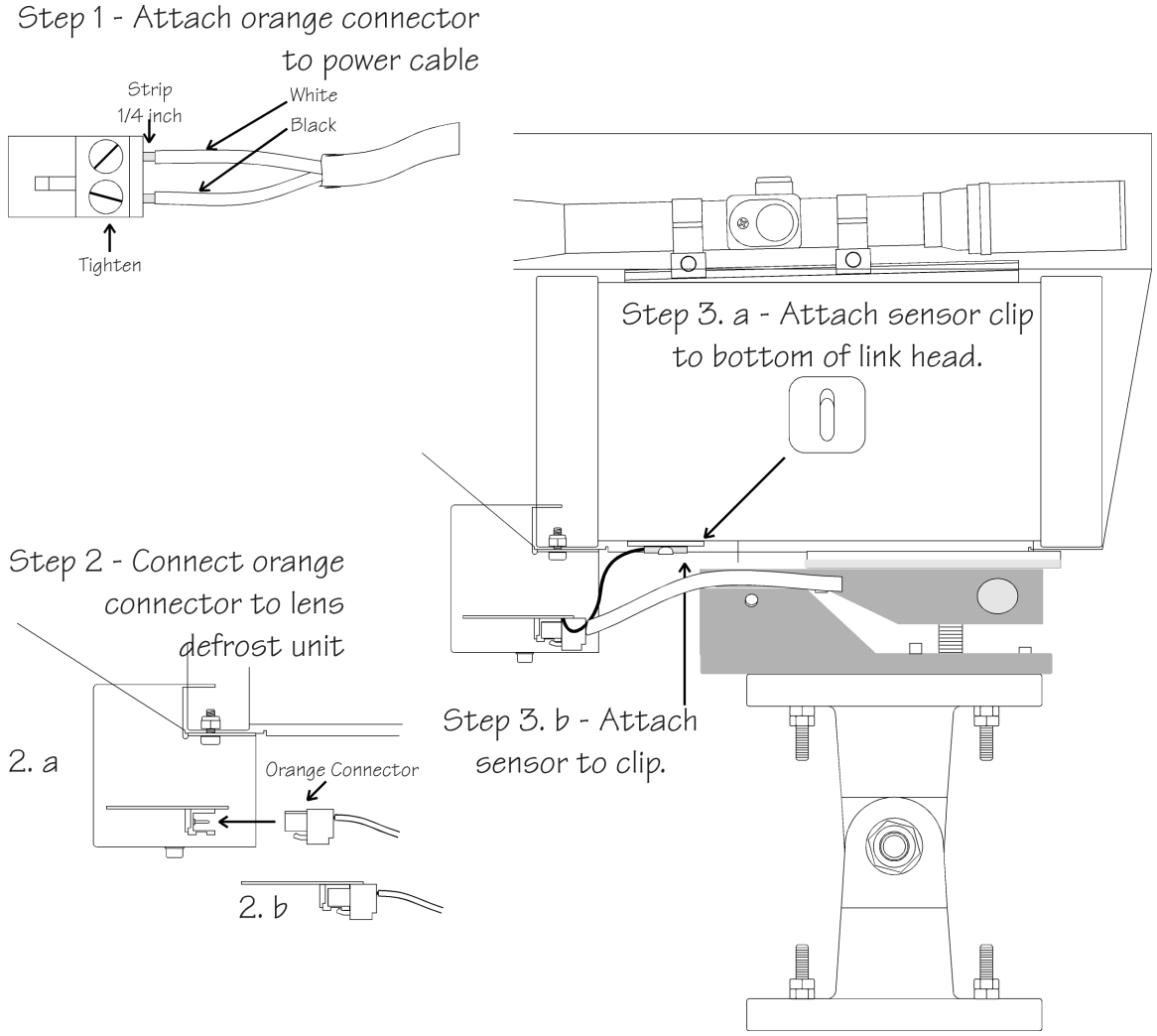


Figure 5-7. Lens Defroster Power Connection.

5.7.4 Connect Power Cable

The Power Cable consists of six pairs (12 wires). If the Power Cable has been extended beyond the 9-ft. (3-m) standard supplied length:

1. Make sure that each "color plus black" pair of wires is isolated (use a length of heat shrink to isolate each pair); this will help to avoid an accidental wrong connection.

2. Connect the cable pairs to the terminals in the Power Box.
3. Connect the cable pairs to the terminals in the Power Junction Box.
4. Verify visually that the Power Cable pairs have been correctly terminated at:

- The Power Box
- The Power Junction Box

5.7.5 Mount Power Junction Box

Use the pre-drilled mounting holes and lugs supplied to attach the Power Junction Box to the location specified in the site survey. Wiring in the Power Junction Box corresponds wire-to-wire on both sides of the box. The dimensions of the Power Junction Box are 4.75" x 3" x 2.25" (12 x 8 x 5.5 cm).

WARNING

Do not drill holes in the Power Junction Box, as doing so will compromise the box's weatherproof properties.

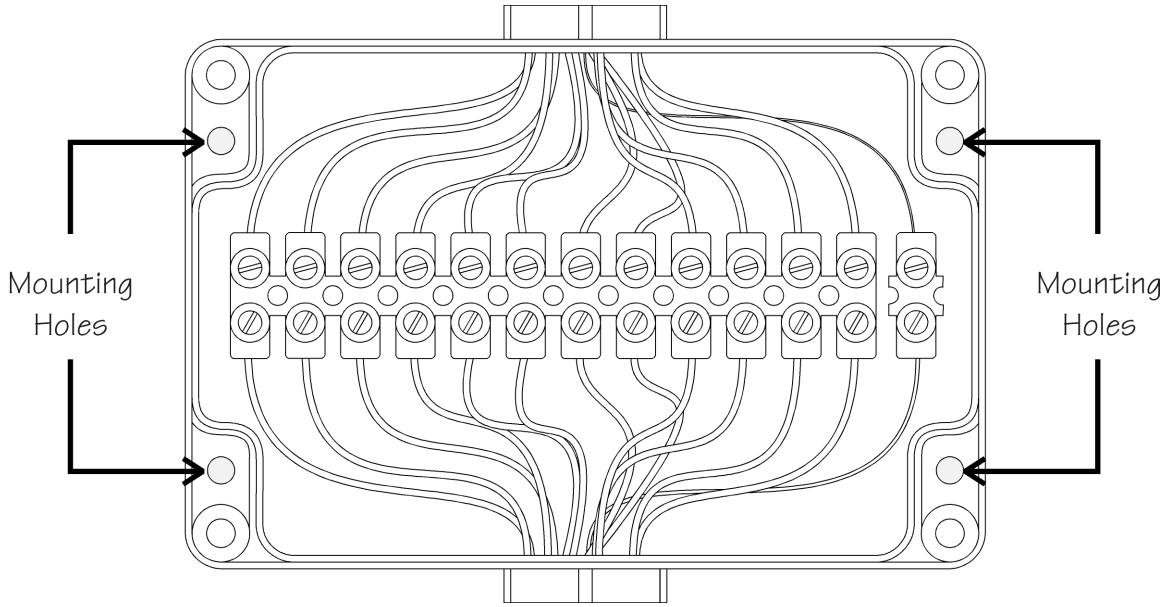


Figure 5-8. Power Junction Box.

5.7.6 Mount Fiber Patch Box

Use the mounting lugs supplied to attach the Fiber Patch Box to the location specified in the site survey. It is good practice to mount the box with cable openings downwards to minimize the potential for water leakage. The Fiber Patch Box measures 5" x 5" x 3" (13 cm x 13 cm x 7.5 cm).

5.7.7 Verify Link Configuration

1. Verify that the voltage-selector switch is set to the correct local-utility power setting:

- 120 volts, or
- 240 volts

WARNING

Incorrectly setting this switch can cause permanent damage to your equipment.

2. Select the appropriate power setting based on the link-head beam (standard or wide beam) and on the distance determined by the site survey, in conjunction with the following table:

Table 5-1. Recommended Power Settings.

Link-Head Beam Configuration	Recommended Power Setting Low	Medium	Full
Standard Beam	6-100 feet(2-30 m)	100-325 feet(30-100 m)	325-1000 feet(100-300 m)

NOTE

These power settings are suggested for initial alignment. After fine alignment, the units will be running at the highest power setting that will not produce errors in transmission.

2. Set the power level using the DIP switches on the Power Box, labeled *Program*. DIP switches 1 to 3 are used to set link-range power.

NOTE

DIP switches 1 to 3 represent mutually exclusive options. Only one of these switches should be in the "ON" position at any one time. Other settings may have unpredictable results.

3. Verify that DIP switches 7 and 8 are set to the default ON position (set to the right).

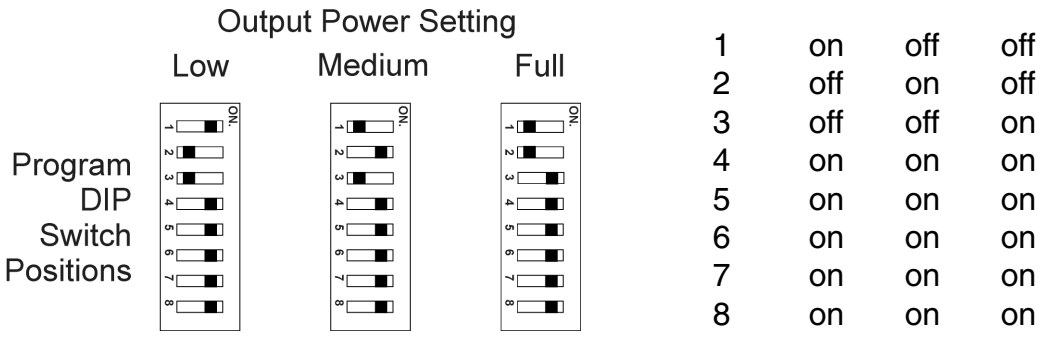


Figure 5-9. Program DIP Switch Positions.

5.8 Align Link Heads

Link alignment is a two-step process. An alignment is done initially using the built-in telescopic sights. This provides an adequate initial signal strength on which a 6-Mbps carrier signal can be transmitted, to pass phone traffic. The second step of this process is to fine tune the alignment. This will provide maximum signal integrity and availability.

The goal of this two-step process is to obtain an ideal alignment. This way, Freespace Turbo's adaptive cross-hair alignment will compensate for most normal building movement.

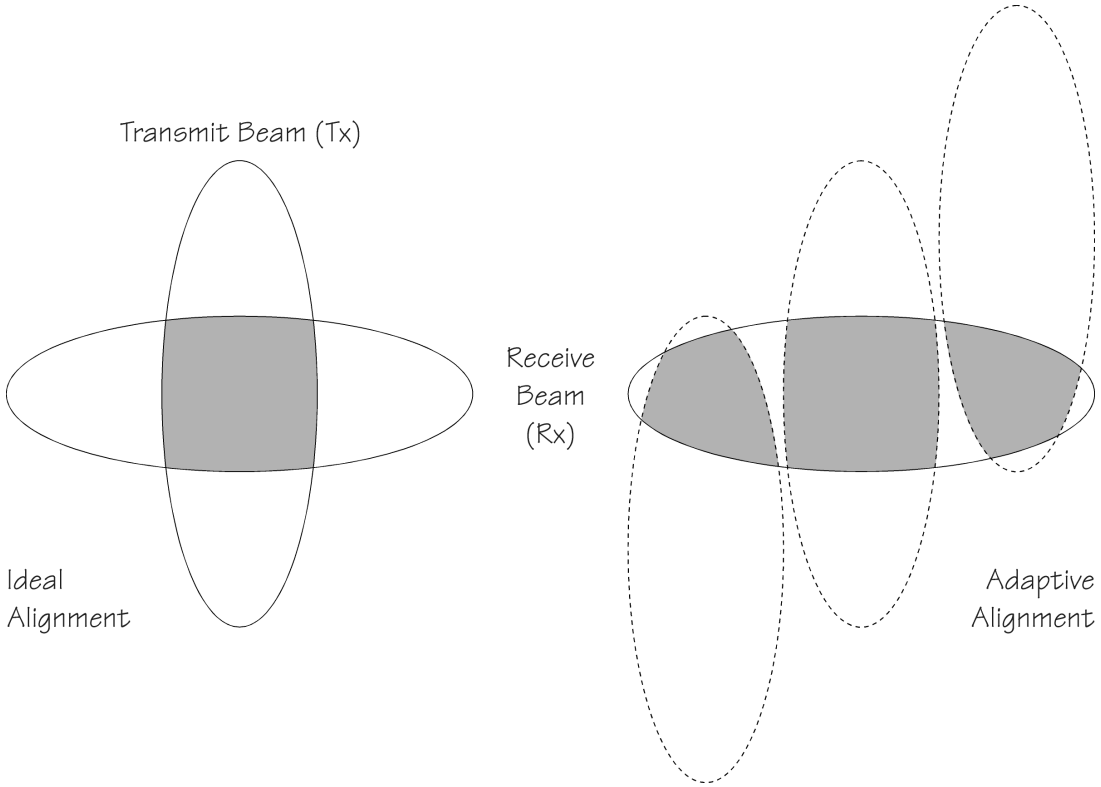


Figure 5-10. Link Alignment Objective.

5.8.1 Perform Initial Alignment

1. On one of the link heads, remove the covers from the telescopic sights.

WARNING

To avoid eye injury, the Freespace Turbo unit must be turned off when visual alignments are being performed. Only when the Mains (AC) power is off (toggle switch is set to "Off") and the UPS battery is inactive (toggle switch is set to "Battery Isolated") is the unit turned off. For additional safety, close and lock the doors of the Power Boxes in the link to prevent someone accidentally turning a unit on while visual alignment is being performed.

DANGER

Even though this manual specifies safe viewing distances under certain operational states, you should always assume the laser is emitting full power. NEVER look into the laser aperture.

2. Turn off the power to the heads as described in the warning note above. Position the link head so the cross-hairs are aimed at the telescopic sight on the other link head. Your eye needs to be approximately 2 in. (5 cm) behind the rear sight lens for proper forward vision. The telescopic sights are for approximate alignment only; proper alignment may require further adjustment. Once the heads appear aligned, cover the telescopic sights and cease visual sighting.

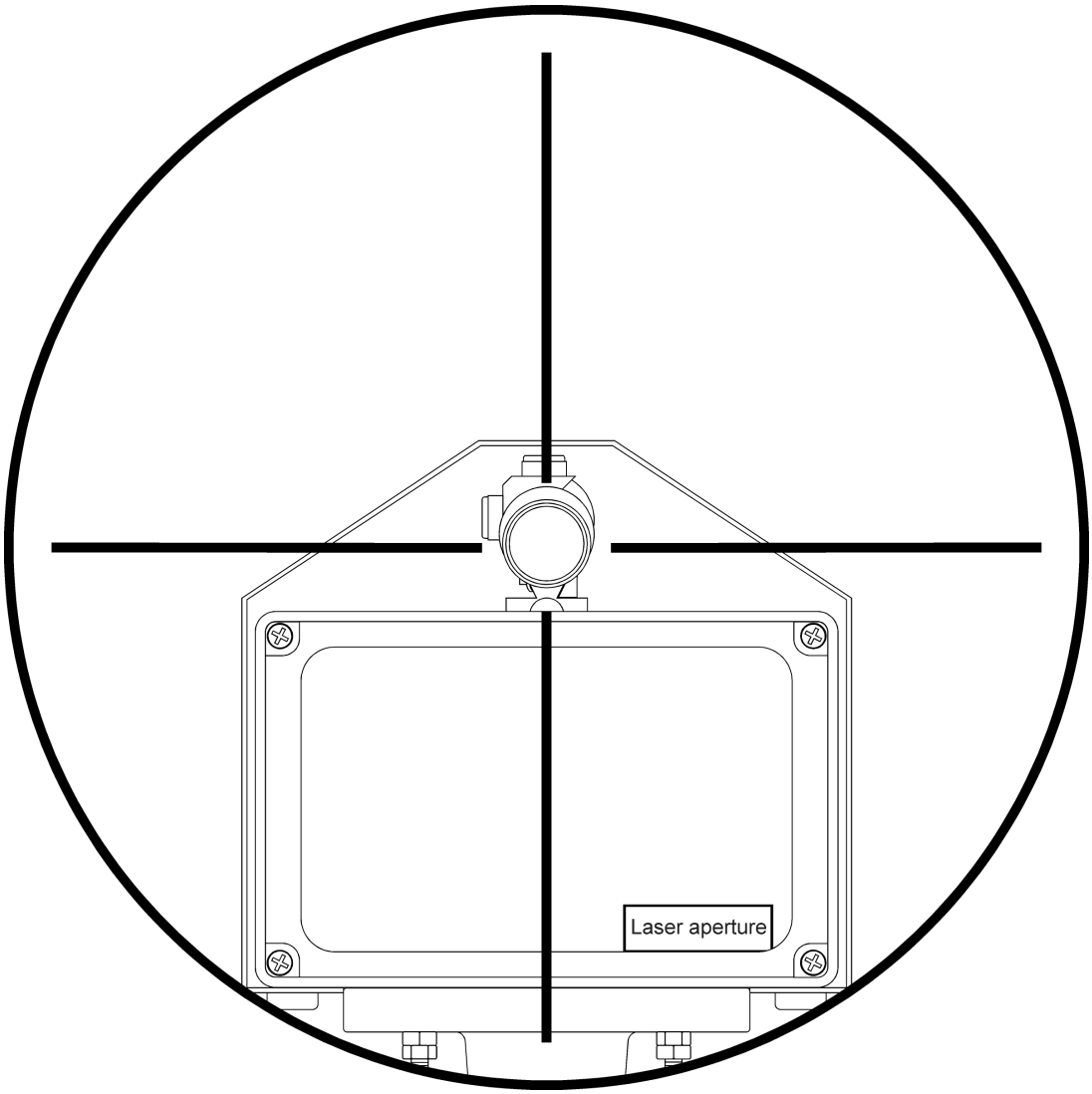


Figure 5-11. Link Head Telescopic Sight Cross-Hairs.

3. Next, turn on the power to the heads and test the link with the link phones to determine whether the alignment is adequate to carry a tone across the phone link. If a signal is not being received from the remote link head following the initial visual alignment, *without sighting to the remote head* attempt moving the link head slightly until a signal is received. If a signal is still not received, return to step 2 to attempt a slight variation of the alignment.

4. Once the initial alignment is complete, fully tighten all u-bolts on the u-bolt plate. Turn off power to the heads and verify with the telescopic sights that the link heads are still aligned. If the signal being received is clear and stable, disregard that the telescopes may show some misalignment.

5. Replace the covers on the telescopic sights.

6. Repeat this process for the other link head.

7. Fine-tune the alignment using the procedure in the next section.

5.8.2 Perform Fine Alignment

Fine-tuning the link-head alignment will achieve a maximum signal strength for greater link availability and integrity. This process can be undertaken by one or two people. Since the process involves performing repetitive tasks at both ends of the link, we recommend for efficiency to use two people, one person located at each end. Freespace Turbo offers two methods to perform the fine adjustment: one uses remote tone alignment and the other uses the signal-strength meters and the link phones. A single person doing the alignment must use the Remote Tone Alignment procedure; two people may use either procedure. When fine tuning is fully complete the vernier positioning screws should be secured with Loc-Tite or a similar thread-locking compound.

Power-On Link Heads

Both link heads must be powered on before you can fine tune the alignment.

WARNING

To avoid eye injury, perform all alignment with the UPS inactivated by switching the Battery Isolated/UPS switch to the Battery Isolated position (up). When the UPS is activated the laser may go to full power unexpectedly. For additional safety, close and lock the doors of the Power Boxes in the link to prevent someone accidentally turning a UPS on while visual alignment is being performed.

DANGER

Even though this manual specifies safe viewing distances under certain operational states, you should always assume the laser is emitting full power. NEVER look into the laser aperture.

To power on the link head:

1. Put the Test loop switch in the Normal position (key is vertical).
2. Put the Laser control switch in the Active position (key is vertical).
3. Turn on the power using the Mains On/Off switch. The On/Off switch will illuminate red, indicating power is being supplied to the unit. The Power, Active, and Fallback LEDs on the link head will light, indicating the unit is active. The Laser Safe LED will flash if the Low power setting has been selected.
4. View the Signal Strength meters on each of the link heads. Depending on the accuracy of the rough alignment, a signal strength of three or higher may be registering, even though the alignment is not fine-tuned.
5. Plug in the link phones. When a link-phone cable is connected and the phone is taken off hook, the Remote Tone Alignment mode overrides all other system functions as long as the remote side is shorted with the supplied shorting plug. It transmits a full-duplex audio signal across the link on a 6-Mbps carrier. Similarly, when both phones are connected and taken off hook, Voice Communication mode can be

established across the link. Voice Communication mode also means Data mode is disabled.

NOTE

For single-person alignment of Freespace Turbo only, use the shorting plug (supplied with the system) in the appropriate phone jack in the other (“remote”) location. If the shorting plug is missing, the phone can be shorted across terminals 7 “PHNA” and 8 “PHNB” on the “Remote Controls” connection block in the Power Box.

To enable the Remote Tone Alignment mode, one link phone needs to be put on hook (disconnecting a phone cable does the same thing). A beeping audio signal is transmitted from the remote link to the local link. The pitch (frequency) of the tone relates to the strength of the signal received at the remote link. This allows the alignment to be verified.

WARNING

The link-phone jacks are not intended for connection to PSTN or PABX telephone systems. Doing so may result in damage to the equipment. Use only the supplied link phones or normal phones designed for direct connection to external lines.

7. Turn on the UPS by putting the UPS switch in the down position. The Ready and Charging LEDs will light, indicating power. The Charging LED may go off quite rapidly depending on the current charge of the UPS.

Remote Tone Alignment

The Remote Tone process is designed for a one- or two-person alignment. The audio and remote tone signals transmitted across the link on a 6-Mbps carrier verify correct operation of the link, except for the fiberoptic interfaces.

For this process, the link being adjusted will be referred to as the local link, while the other link will be referred to as the remote link. (The remote side is the side where the person is not working at a given time). Adjust one link at a time. (The remote side must have the shorting plug installed).

WARNING

To avoid eye injury, perform all alignment with the UPS inactivated by switching the Battery Isolated/UPS switch to the Battery Isolated position (up). When the UPS is activated the laser may go to full power unexpectedly. For additional safety, close and lock the doors of the Power Boxes in the link to prevent someone accidentally turning a UPS on while visual alignment is being performed.

DANGER

Even though this manual specifies safe viewing distances under certain operational states, you should always assume the laser is emitting full power. NEVER look into the laser aperture.

1. Enable Remote Tone Alignment mode.

- Unplug remote link phone and install supplied shorting plug.

- With the local phone off hook, you can hear the strength of the signal received at the remote link. The higher the remote tone pitch, the stronger the signal received.

2. Adjust the link head to locate the center of the transmission beam:

- Adjust the horizontal positioning screw until the pitch of the remote tone falls.
- Keeping track of the number of turns, adjust the positioning screw in the opposite direction. The tone will become stronger. Continue until the tone weakens.
- Adjust the positioning screw one-half the number of turns back into the center of the beam.
- Repeat these steps using the vertical positioning screws.

3. Do the same for the remote link head.
4. Repeat this process until a maximum signal strength is indicated on both link heads. If you cannot get a full signal on both link heads (8 or higher on the Signal Strength meter), boost the laser power setting on the link-head Power Boxes to the next level. Repeat the fine-tuning process.

Signal-Strength Meter Alignment

The Signal-Strength Meter process is designed for a two-person alignment.

NOTE

The Remote Tone alignment procedure described on the previous page must be used when the alignment is being done by just one person.

Using the Remote Tone Alignment through the link phones is a good test of the Freespace Turbo connection. An audio signal is transmitted onto a 6 Mbps carrier between the link heads. This verifies correct operation of the link, excluding the fiber interfaces.

For this process, the link head being adjusted will be referred to as local, and the other link head is referred to as remote. In this procedure, one person adjusts the local link head and the other person reads the signal-strength meter on the remote link head.

NOTE

The signal-strength meter measures the power received from the remote link head.

WARNING

To avoid eye injury, perform all alignment with the UPS inactivated by switching the Battery Isolated/UPS switch to the Battery Isolated position (up). When the UPS is activated the laser may go to full power unexpectedly. For additional safety, close and lock the doors of the Power Boxes in the link to prevent someone accidentally turning a UPS on while visual alignment is being performed.

DANGER

Even though this manual specifies safe viewing distances under certain operational states, you should always assume the laser is emitting full power. NEVER look into the laser aperture.

1. Take both link phones *off* hook; they will both be used to communicate across the link.
2. Use the vernier adjusters on the local link to locate the center of the transmission beam:

- Adjust the horizontal positioning screw on the local link head until the Signal Strength meter on the local link head dips to zero.
- Keeping track of the number of turns, adjust the positioning screw in the opposite direction. The signal strength will become stronger. Continue until Signal Strength meter again dips to zero.
- Adjust the positioning screw half the number of turns back into the center of the beam.

3. Repeat these steps using the vertical positioning screws.
4. Perform the same procedure for the remote link head.
5. Repeat this process until a maximum signal strength is seen on both link heads. If you cannot get a full signal on both link heads (8 or higher on the Signal Strength meter), boost the laser power setting to the next level. Repeat the fine-tuning process.

NOTE

These LEDs form an analog bar graph indicating the signal strength being received from the remote link head when in Voice Mode. Use for link-head alignment during installation and to determine signal strength during operation. When in Data Mode (both phones on hook and with the network connected) the signal strength is binary. That is, when a good signal is received the signal meter will register "9" and when the signal is insufficient or poor the signal meter will register "0"; there is no intermediate reading.

5.9 Make Data Connections

5.9.1 Check Fiber Loss for Cable Runs

Check the loss for each of the fiber cables brought to the Fiber Patch Box using a fiber-loss tester that gives better than 1-dB accuracy with ST connectors. This will verify that the connectors have been properly spliced and were not damaged during installation. Mark the fiber cables for easy identification.

Test the entire cable run, excluding the network interface and the link head. This includes all the installed fiber, patch panels, and patch cables, starting from the network interface and the link head.

Fiber Loss Guidelines

On standard 62.5/125 fiber:

- 3 dB approximate loss per kilometer of continuous fiber cable

- 1 to 2 dB loss for each cross-connect

NOTE

If the loss on any cable segment is 2 dB greater than others in the system, check the termination and patches.

An acceptable maximum loss is 6 dB on the entire cable run. Freespace Turbo and most fiber interfaces can sustain fiber losses up to 10 dB. It is good practice to minimize losses in the cable and to allow an "aging" margin.

5.9.2 Connect Fiber Cables

Verify the Fiber Patch Box has been mounted with the cable openings pointing downwards. This will minimize the potential for water seepage.

Connect the fiber patch cables between the link head and Fiber Patch Box, and verify the rubber sealing boots are pushed firmly over the lip of the sealing nuts. Pay attention when making the transmit (TX) and receive (RX) fiber-optic cable connections on the link heads. Remember that TX from the head goes to RX on the network fiber port and vice versa.

NOTE

Be careful when handling and connecting the fiberoptic cables and their connectors. These parts are fragile.

Fiber Care

NOTE

Handle the fiberoptic cable carefully. Bend the cable as little as possible while it is stored and during its installation. Unlike rope, fiberoptic cable is not load-bearing, so do not hang anything on it. The factory-installed connectors at the cable ends are delicate.

There are two major parts to each data cable end, the bayonet connector and the protective boot (see the figure on the next page). The bayonet connector is part of the communications path, while the boot protects the communications connection between the data cable and the link-head receptacle.

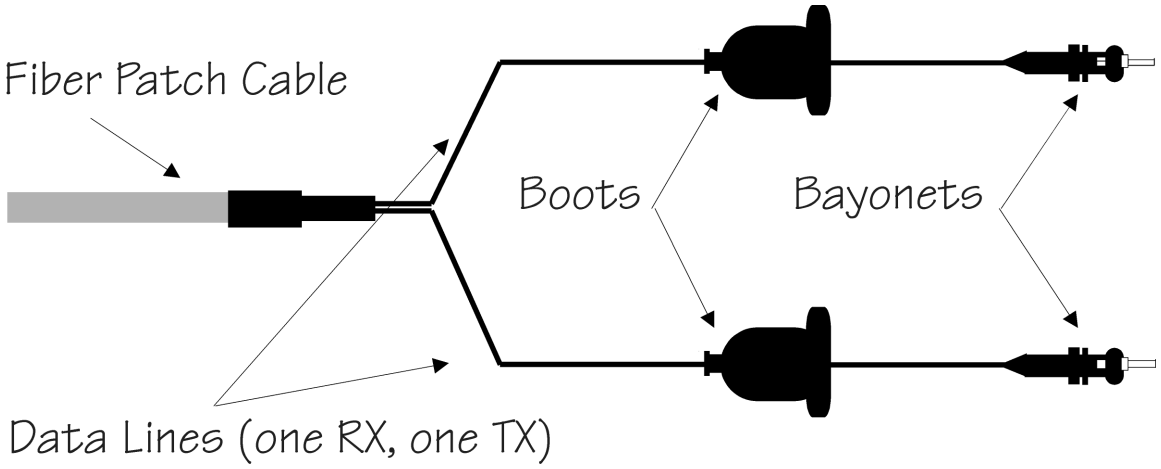


Figure 5-12. Fiber Patch Cable End Details.

To connect the fiber patch cable, carry out the following procedures:

Step A. Communications Connection

1. Remove the round protective covers from the Rx data and Tx data outlets on the back panel of the link head.
2. Grasp one bayonet connector.
3. Hold the bayonet connector so that the key is upright (vertically aligned) and the square cutouts on the inside of the outer jacket are evenly balanced on the right and left (horizontally aligned).
4. Verify that the key on the bayonet connector and the keyhole opening in the chosen data port are aligned. Verify that the square cutouts on the inside of the outer jacket of the bayonet connector and the respective square blocks on the inside of the chosen data port are aligned.
5. With firm, gentle pressure, push the bayonet connector straight into the port receptacle until it is completely inserted and give a quarter-turn clockwise to lock in place.
6. Make sure that there is no lateral stress exerted on the sprung bayonet. This data port now is connected to the communications network.

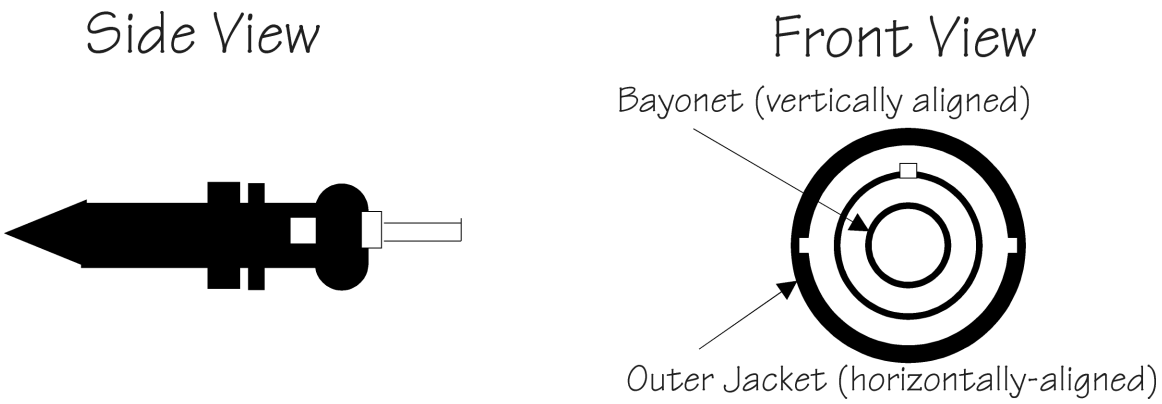


Figure 5-13. Bayonet Connector Details and Alignment.

Step B. Weather Protection

1. Grasp the boot belonging to the just-installed bayonet connector.
2. With firm, gentle pressure, push the boot straight over the inserted bayonet connector and onto the port receptacle until it is completely covering the receptacle.
3. Observe the boot face is flush against the back panel of the link head. This data port now is weather-protected.

   Repeat the preceding two steps to connect the other fiber patch cable data line to the other data outlet on the back panel of the link head.

5.9.3 Test Whole Link

Use a fiber Bit Error Rate Tester (BERT) to test the entire Freespace Turbo link:

1. Unplug the link phones. Data will not pass over the link when the phones are off hook.
2. At the remote end, loop out the final fiber patch before the actual network connection. At the local end, connect the BERT tester to the last fiber patch before the network connection. When data is transmitted over the Freespace Turbo link, the Fall Back mode LEDs on the link heads and Power Boxes will be unlighted.
3. Run the test for at least one hour. An error rate of less than 1 in 109 indicates a high-quality data transmission.

An alternative test procedure uses two standard network protocol analyzers attached via standard fiberoptic transceivers. One is used to generate traffic and the other to analyze traffic. Unplug the link phones. Data will not pass over the link when the phones are off hook.

To set up a live data transmission through the entire link:

1. Set up a large file transfer.

2. Run the Novell Perform 3 utility or a similar utility or a packet-/traffic-generating application.
3. Use a network protocol analyzer connected to the copper side of the connection rather than directly into the fiber. Doing so will test the end-to-end link, including all the network hardware.

NOTE

If data does not pass through the integrated link (the link connected to all the network hardware), but does successfully pass over the isolated link:

- Verify the fiber connections are correct (TX from the head goes to RX on the network fiber port).
- Verify the network hardware is operating properly.

4. Attach the analyzers, with the traffic generator at one end and the traffic analyzer at the other end. When data is transmitted over the Freespace Turbo link, the Fallback Mode LEDs on the link heads and Power Boxes will be unlighted.
5. Run the test for at least one hour. An error rate of less than 1 in 109 indicates a high-quality data transmission.

5.10 Connect Freespace Turbo to Your Network

Make the necessary fiber connections at the network-access points. Verify that the Freespace Turbo link and your network hardware are operating correctly by running live data across the link. Remember that TX from the link head goes to RX on the network fiber port and vice versa.

To set up a live data transmission through the entire link:

1. Set up a large file transfer.
2. Run Novell's Perform 3 utility or a packet-/traffic-generating application.
3. Use a network protocol analyzer connected to the copper side of the connection rather than directly into the fiber. Doing so will test the end-to-end link, including all the network hardware.

NOTE

If data does not pass through the integrated link (the link connected to all the network hardware), but does successfully pass over the isolated link:

- Verify that the fiber connections are correct (TX from the head goes to RX on the network fiber port).
- Verify that the network hardware is operating properly.

5.11 Complete Final Steps

Verify that:

- All mounting bolts are tight
- All boxes are locked and secured

- Power Box

- Power Junction Box
- Fiber Patch Box

• The Power Box keys, link phones, and documentation are safely stored

• All shipping boxes and packing materials are stored

6. System Diagnostics

The Freespace Turbo system is manufactured to ISO 9002 standards for quality control. The individual components and completed link go through extensive testing. It is therefore unlikely that the link will not operate if correctly installed. Problems are generally due to faulty cabling, connections, or LAN components.

Diagnostics have been built into the system to aid in fault isolation. When used in conjunction with the correct test equipment, these features will aid in the rapid diagnosis and correction of errors.

Fault Isolation

Using Looped Function

Incorrectly patched fibers or a fiber connector not being fully mated into the socket are the most common causes of a system's inability to transmit data. Use the Looped function on the Power Box to isolate the problem area. Put the link into Looped mode by switching the Test loop switch into the Looped position (key is vertical). When a link head is put in Looped mode:

- Data entering through the RX data fiber port is sent straight back out through the TX data fiber port
- Data entering the receive lens from the remote link is sent straight back out through the transmitter

Using Fiber Patch Cables

Incorrectly patched fibers or a fiber connector not fully mated into the socket are the most common causes of a system's inability to transmit data. Use fiber patch cables at the fiber interconnection points along the fiber runs to isolate the problem area.

Use a fiber patch cable to loop the RX port directly to the TX port on a link head. Use another patch cable to loop the fibers in the Fiber Patch Box.

Making Data Connections

If data traffic does not appear, use a network protocol analyzer connected to the copper side of the connection rather than directly into the fiber. Doing so will test the end-to-end link, including all the network hardware.

NOTE

If data does not pass through the integrated link (the link connected to all the network hardware), but does successfully pass over the isolated link:

1. Verify that the fiber connections are correct (TX from the head goes to RX on the network fiber port).
2. Verify that the network hardware is operating properly.

Appendix A: Freespace Turbo Standard Mount Specifications

Each link head is supplied with a pan-and-tilt arm, and either a pedestal mount or a wall-mount bracket.

The pan-and-tilt arm is designed to allow aiming of the link head to provide ideal alignment.

The pedestal mount and wall-mount brackets are designed to provide a solid mounting base, eliminating any movement that might be introduced to the link head. These mounts must not move. They must be fixed to solid masonry or to a metal structural framework. Mounting on wood or sheet-metal can cause unpredictable movements.

A.1 Pan-and-Tilt Arm

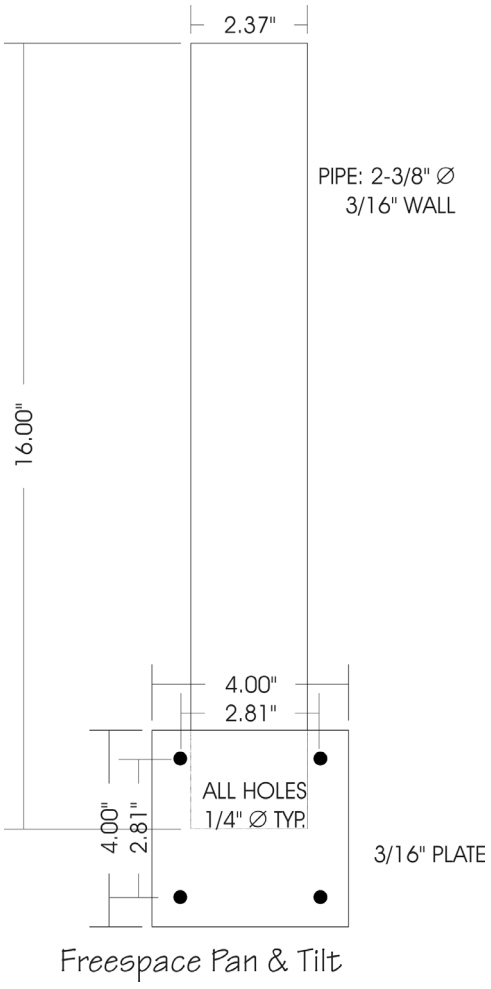


Figure A-1. Pan-and-Tilt Arm.

A.2 Pedestal Mount

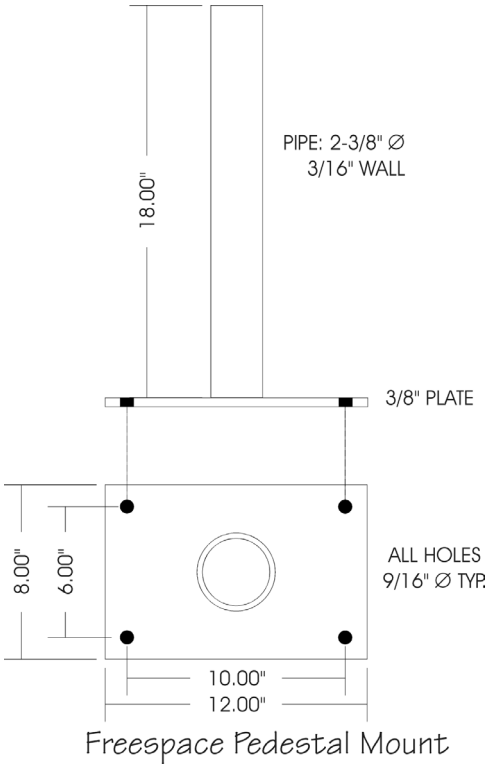


Figure A-2. Pedestal Mount.

A.3 Wallmount Bracket

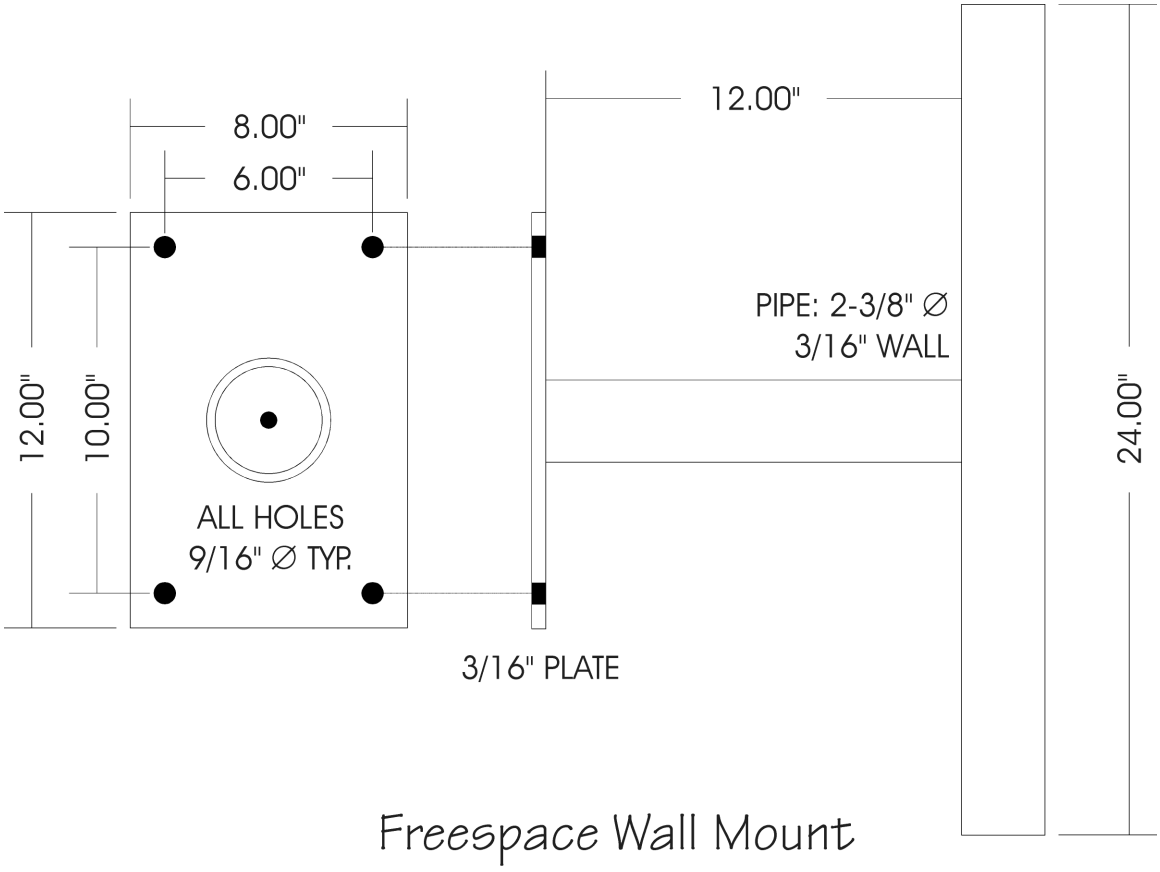


Figure A-3. Wallmount Bracket.

A.4 U-Bolt Plate and Typical Bolt (NTS)

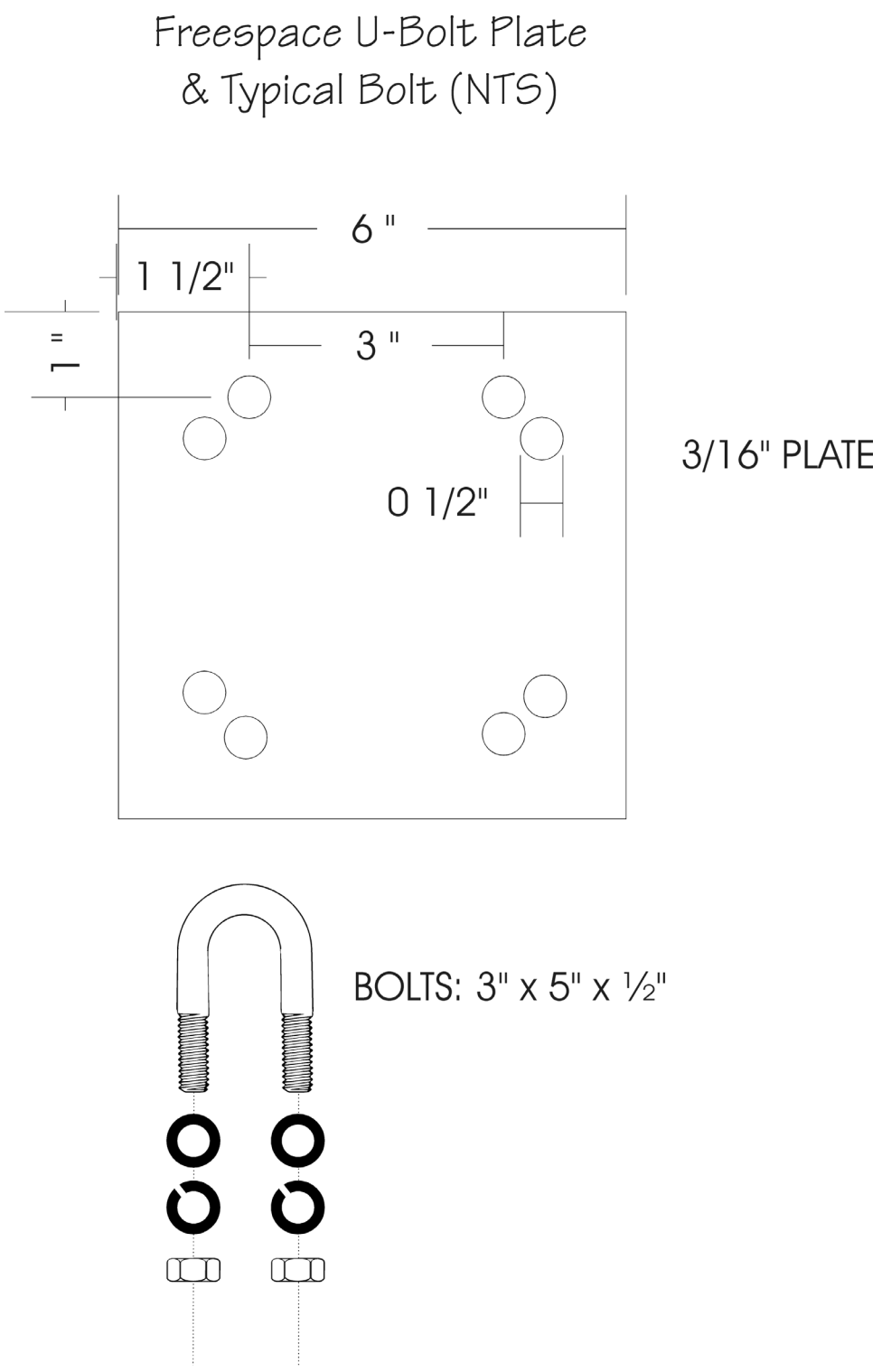


Figure A-4. U-Bolt Plate and Typical Bolt (NTS).

Appendix B: Installation Planning Guide and Site Survey

This document guides your examination of your proposed Freespace installation site and networking environment. By completing the survey prior to installing the Freespace links, you can help ensure a timely, smooth, and complete installation. The information reported will:

- Enable Black Box Technical Support to provide the highest level of support possible for your Freespace installation
- Supply the insight needed to ensure a smooth and complete installation
- Provide maximum system availability and long-term reliability of your Freespace link.

Have the survey completed by those responsible for installing and maintaining your network facilities. They should be familiar with installing and certifying data and fiber-optic cables, AC power sources, and the physical and logical characteristics of your networking environment.

NOTE

"Site 1" refers to your main network, and "Site 2" refers to your remote network.

B.1 Verify a Clear Line of Sight

The two Freespace link heads must be within a clear line of sight of each other. Verify that a clear line of sight exists (there are no obstructions, such as trees or buildings) between the two link heads. When determining a clear line of sight, consider temporary objects that may disrupt the transmission beam (for example, window-cleaning apparatus and maintenance personnel).

Heat shimmer (scintillation) from nearby objects can temporarily disrupt the transmission beam. Also, the transmission path must clear all objects by at least 8 ft. (2.5 m), both horizontally and vertically. This includes intermediate buildings, rooftops, air conditioners, and heater vents. The Freespace units have passed strict electromagnetic susceptibility testing; however, we recommend that you avoid mounting the link heads close to high-power transmission equipment, satellite dishes, and three-phase power lines. If possible, include photographs of both proposed Freespace link-head mount locations and the line-of-sight path from each mount location.

Figure B-1. Verify a Clear Line of Sight.

B.2 Link-Head Orientation

The Freespace link operates in the brightest of indirect sunlight. Avoid pointing a Freespace link directly into the sun, as it may become blinded and a temporary loss of communication will result. When positioning links, consider the sun's year-round varying positions.

B.3 Link-Head Angle

Avoid pointing a link head upward at a steep angle (greater than 45° from grade) to enable the weather shield to prevent rain or snow from falling directly onto the lens surface.

B.4 Mounting Indoors

Not all glass transmits infrared light equally. A single pane of normal glass imposes very little attenuation, so the conservative link distance through such glass is approximately 600 ft. (200 m). However, some modern glass is either very heavily tinted, or specially coated to control the passage of infrared light, greatly reducing the link distance. Also, rain or snow may accumulate on the window. Finally, the greater the angle from perpendicular between the beam and the glass surface the less infrared light transmission through the glass, further cutting link distance.

NOTE

Avoid direct perpendicular mounting, i.e., mounting at 90° to the glass.

B.5 Freespace Link Distance & Mounting Information

Enter the Freespace link head distance information in the Site Survey table on **page 69**.

(A) Estimate the distance between Freespace link heads. Standard street or survey maps with a known scale are good sources. A meter-wheel or optical range finder is still more accurate.

(B) & (C) Determine the height from street level (in building stories) of each Freespace link head.

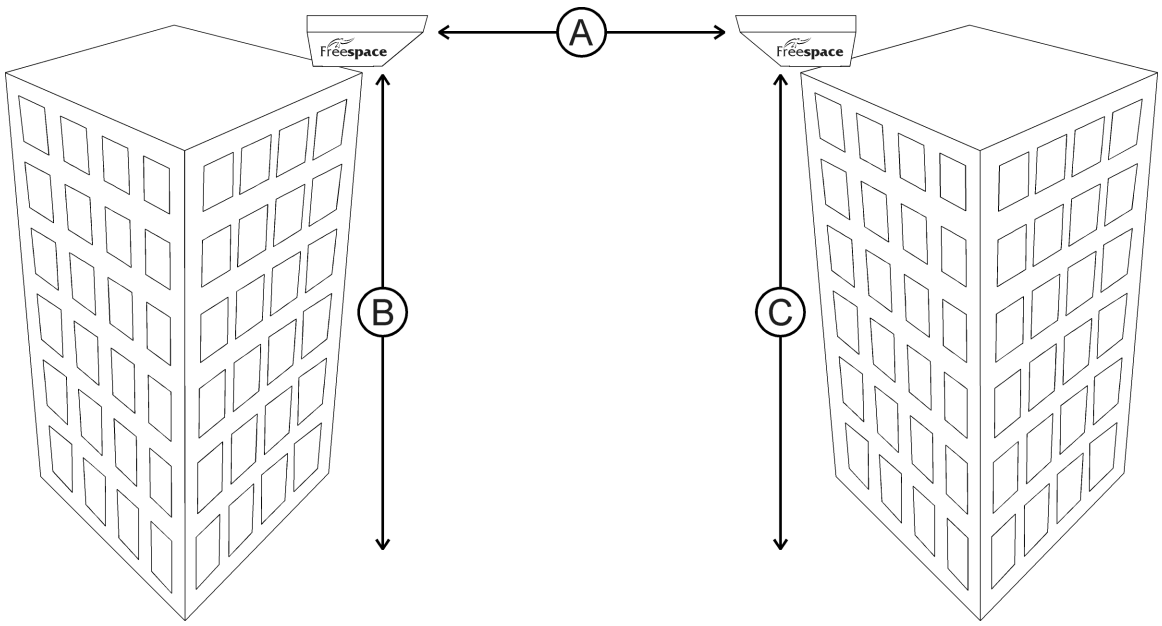


Figure B-2. Measuring the Distance Between Site 1 and Site 2.

B.6 Select The Appropriate Mounts

Freespace link heads must be mounted on solid masonry or to metal structural framework. The mounting brackets must not move. Mounting on wood or sheet-metal can cause unpredictable movements, and force you to realign the heads periodically! Two standard mounts are available:

- A wallmount bracket, accommodating either wall-face or corner fixing
- A pedestal mount, for mounting on a horizontal surface, such as a parapet

When mounting a link head on a ledge or parapet, place it on the outer edge. This will help to avoid rain splash, snow build-up, and perching birds.

Indicate the preferred mounts in the Site Survey table on **page 69**.

B.7 Freespace Cable Distance Information

Enter the Freespace data-cable distance information in the Site Survey table on **page 69**.

(D) & (F) Determine the power-cable run distance from each Freespace link head to its power box, Nine ft. (3 m) of cable is supplied with each link head.

NOTES

Fiber cable exposed outdoors must be outdoor-rated. Indoor-rated cable deteriorates rapidly.

Use hot-melt or chemical-bonded fiber connections. Do not use crimp-ons.

(E) & (G) Determine the data-cable run distance (multimode fiber/AUI) from each Freespace link head to your network connection points.

(H) & (I) Determine the power-cable run distance from the indoor location of the lens-defroster transformer to each link head.

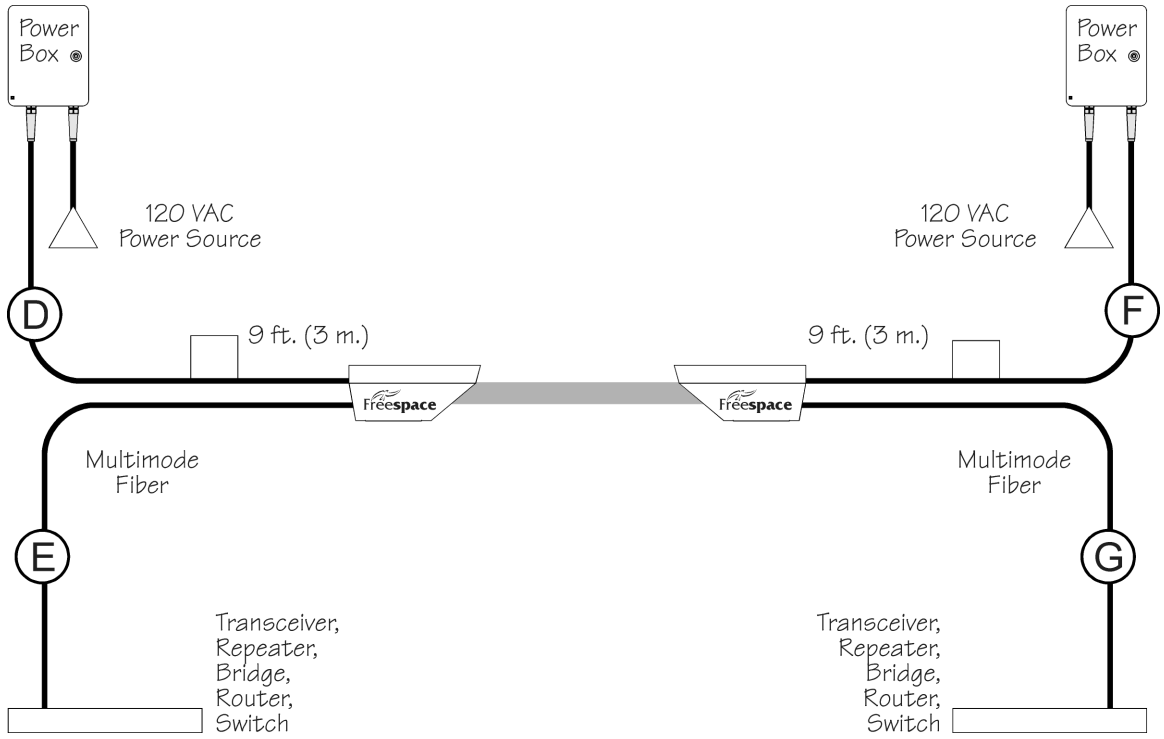


Figure B-3. Freespace Cable Distance.

NOTE

The overall power-cable run can be up to 65 ft. (20 m), using 6-pair screened 24-gauge wire (part number EDN12A).

B.8 Network Design Issues

A Freespace Turbo link acts as a fiber line driver, transmitting the exact signal it receives from the network. As such, when designing a Freespace link, simply prepare your networks for a fiber connection using ST-II multimode fiber.

NOTE

Keep in mind that fiberoptic devices from different vendors are not always compatible. To avoid unnecessary delays during the installation process, we recommend that you use compatible fiberoptic devices from the same vendor at both sites. Secondly, in a high-speed application with Turbos, we have found that some fiber transceivers and converters contribute significant enough jitter to cause packet errors in some situations. It is therefore advisable to connect Turbos directly to the repeater or switch through a retimed plug-in fiber module. If a direct plug-in module is not available, consider a 2-port copper-to-fiber switch.

B.9 Network Description

On **page 69**, enter the fiberoptic network access device information for Sites 1 & 2 (labeled J & K):

- type of device (bridge, router, switch, etc.)
- manufacturer/vendor
- exact model number.
- Is an external transceiver or converter to be used?

On **page 70**, draw a block diagram to describe your proposed network topology, integrating the Freespace link. Be sure to:

- Include a diagram of your physical network topology
- Indicate the speed and format of the traffic to be carried across the Freespace link (Ethernet, full-duplex Ethernet, 4/16-Mbps Token Ring, OC-3 ATM, Ethernet + T1/E1, etc.)
- Describe how the sites are currently connected (not connected, dial-up, T1, etc.)

Fax Transmission—Freespace Site Survey

Company Name _____

Contact for this installation _____

Considering Which Product? Turbo ___ Standard ___ Lite ___

Freespace End-User Information

Company Name _____

Address _____

City _____

State/Province _____

Zip/Postal Code _____

Contact _____

Telephone _____

Fax _____

E-mail _____

Site Reference Number _____

NOTE

To permit faster service from our customer assistance staff, please assign a site reference number in the following format: first five letters of the company's name + survey date (mmddyy) + site number. For example: BBOX-110196-101.

After you complete the Freespace Site Survey, please forward pages 69, 70, and 71 to Black Box via fax or mail:

Call **724-746-5500** or fax **724-746-0746**
Black Box Corporation, 1000 Park Drive, Lawrence, PA 15055-1018
Web site: **http://www.blackbox.com** • E-mail: **info@blackbox.com**

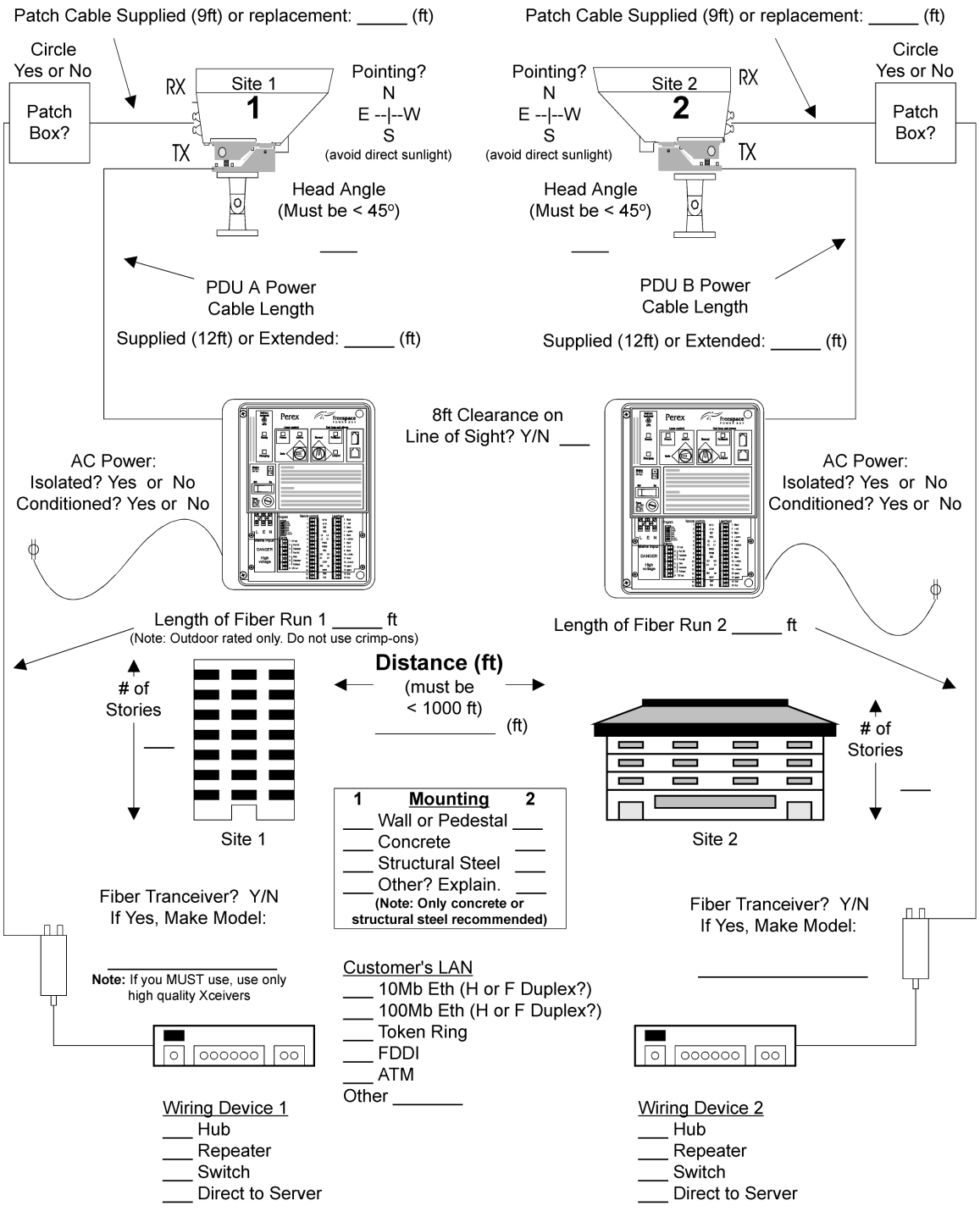
Fax Transmission—Freespace Site Survey

Have you satisfied the following Freespace link head mounting recommendations as outlined on page 2?

- Does a clear line of sight exist? Yes No
- Do you avoid close proximity to high-power transmission equipment? Yes No
- Do you avoid direct sun exposure? Yes No
- Are the link heads mounted less than 45° from grade? Yes No
- If mounting indoors, have you followed the listed recommendations? Yes No
- Is there solid masonry or metal structure available for mounting? Yes No
- Any reflective surfaces directly behind or below mounting locations? Yes No

Label	Description	Distance	
A	Distance Between Freespace Link Heads		feet/meters
	Describe how you determined the distance between link heads.		
B	Site 1 - Height above street level stories		
C	Site 2 - Height above street level stories		
Location	Mount	Height & Dist. From Edge	
Site 1	Wall/Pedestal/Custom		
Site 2	Wall/Pedestal/Custom		
Label	Description	Distance	
D	Site 1 - Pwr (PDU) Cable Run feet/meters		
E	Site 1 - Fiber/AUI Cable Run feet/meters		
F	Site 2 - Pwr (PDU) Cable Run		feet/meters
G	Site 2 - Fiber/AUI Cable Run		feet/meters
H	Site 1 - Defroster Cable Run		feet/meters
I	Site 2 - Defroster Cable Run	feet/meters	
Label	Fiberoptic Device	Description	
LAN Used	Type (10/100 Eth, ATM, Token Ring, etc.)		
J - Site 1	Type (bridge, switch, etc.)	Duplex H / F	
	Manufacturer/Vendor		
	Exact Model Number		
	Using Fiber Transceiver?		
K- Site 2	Type (bridge, switch, etc.)	Duplex H/F	
	Manufacturer/Vendor		
	Exact Model Number		
	Using Fiber Transceiver?		

Fax Transmission—Freespace Site Survey



Appendix C: Safe Viewing Distances

Safe Viewing Distances

DANGER

Even though this manual specifies safe viewing distances under certain operational states, you should always assume the laser is emitting full power. NEVER look into the laser aperture.

The following tables list the viewing distances which are considered safe during installation, alignment, and maintenance of the Freespace Turbo system. The safe distance for viewing Freespace Turbo's laser aperture depends on whether a standard or wide-beamed product is used (beam dispersion), and on the output Beam Power setting. The beam dispersion can be determined by the serial number stamped on the link head: "NB" indicates the link head has a standard beam; "WB" indicates the link head has a wide beam. There are three Beam Power settings, one each for low, medium, and full laser beam power, set by the Power Box Program DIP Switches. Refer to the following tables and diagram to determine safe viewing distance. If you are unsure of Freespace Turbo's output Beam Power setting, use the safe viewing distances listed for the Full power setting. The Nominal Optical Hazard Distance (NOHD) legend is provided below, after the tables and diagram.

Table C-1. Freespace Turbo Standard Beam NOHD.

Power Setting	NOHD[1]	NOHD (20 mm)[2]	NOHD (80 mm)[3]
Low (0.4 mW)	0 ft. (0 m)	0 ft. (0 m)	0 ft. (0 m)
Medium (3 mW)	10 ft. (3 m)	29 ft. (9 m)	116 ft. (36 m)
Full (20 mW)	37 ft. (11 m)	107 ft. (33 m)	428 ft. (130 m)

Table C-2. Freespace Turbo Wide Beam NOHD.

Power Setting	NOHD[1]	NOHD (20 mm)[2]	NOHD (80 mm)[3]
Low (0.4 mW)	0 ft. (0 m)	0 ft. (0 m)	0 ft. (0 m)
Medium (3 mW)	7 ft. (3 m)	21 ft. (6 m)	83 ft. (26 m)
Full (20 mW)	26 ft. (8 m)	76 ft. (23 m)	305 ft. (93 m)

Nominal Optical Hazard Distance (NOHD) Legend

1 NOHD means Nominal Optical Hazard Distance with the unaided eye.

2 NOHD (20 mm) means NOHD when viewed through a 20-mm objective lens (the telescopic sight).

3 NOHD (80 mm) means NOHD when viewed through standard 80-mm objective binoculars.

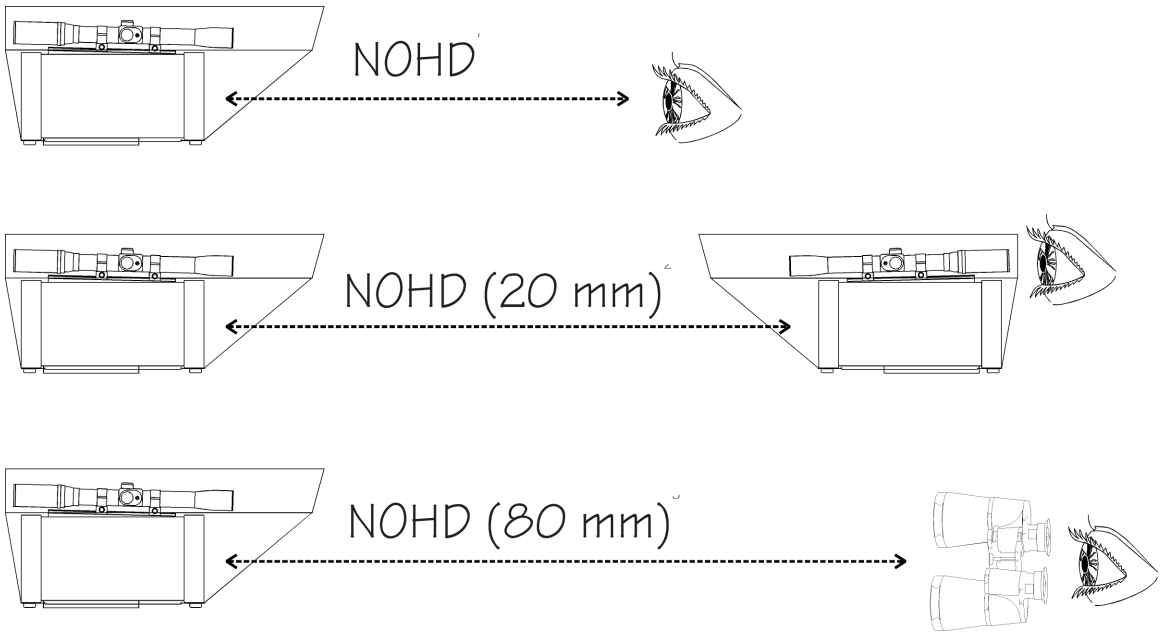


Figure C-1. Safe Viewing Distances.

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