# FlightTransport® Systems

## Installation and Maintenance


**FlightStrata**

***FSA 155E***

***FSA 155EW***

LIGHTPOINTE™

505-002000-0001M Rev L

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# Safety

### Cautions and Warnings

The following symbols are used in this manual to indicate that the installer should take particular caution to prevent injury or damage to the equipment.

Exercise caution when you see this symbol. It indicates actions that could be harmful to the installer or to the equipment.

Exercise extreme caution when you see this symbol. It indicates potentially lethal voltages!

**Note:** There are no serviceable parts within the units and the linkheads should not be opened in the field.

### Observe Standard Precautions

All persons having access to this equipment must observe all standard precautions as defined in applicable national statutory health and safety legislation.

### Qualified Personnel

There are hazardous circuits within this product. Qualified personnel who understand and are trained to work with these hazards must perform all repair, modification, reconfiguration, and upgrading operations.

# Service

There are no serviceable parts within the units and the linkheads should not be opened in the field. Only factory trained personnel can provide service on any internal components of the linkheads. Do not open the linkhead in the field. Opening the linkhead will void the Standard LightPointe warranty.

# Warranty

LightPointe warrants this product against faulty materials or workmanship under the terms of our current Standard Warranty And Support Agreement provided that the product was purchased directly from us or from one of our authorized resellers. Please visit http://www.lightpointe.com/downloads/support/LIGHTPOINTE_StandardWarranty_v11.pdf for specifics on our Warranty. The warranty registration form was included with your system.

## Contacting LightPointe

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http://lightpointe.custhelp.com

Email: techsupport@lightpointe.com

## Using This Manual

This manual describes how to install provision and maintain all FlightStrata 155 systems.

| Section | Contents |
|---|---|
| 1. System Overview | System functional and physical overview |
| 2. System Installation and Alignment | Detailed step-by-step installation and alignment procedures |
| 3. Optical Management Interface | Reference to FlightManager PC manual and general information about product capability |
| 4. Maintenance | Minimal activities to maintain the system |
| 5. Troubleshooting and Diagnostics | Resolving operational problems |
| 6. Specifications | Physical and electrical specifications |
| 7. Index | Keyword index |

## Additional Resources

Refer to the following documents for additional information about the LightPointe system. FlightManager PC is included with your system.

| Document Number | Title |
|---|---|
| 505-002014-00000 | FlightManager LDX SNMP Proxy Agent Installation Manual |
| 505-003098-00000 | FlightManager PC Software User's Guide |
| Not numbered | Field Engineering and Planning Guide |


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# 1. System Overview

## 1.1. The LightPointe System

### 1.1.1. Optical Wireless Transmission

LightPointe wireless optical systems communicate using multiple beams of infrared light (invisible to the human eye). The systems require true line-of-sight between locations. The systems operate using optical wavelengths so that spectrum or Radio Frequency licensing is not required.

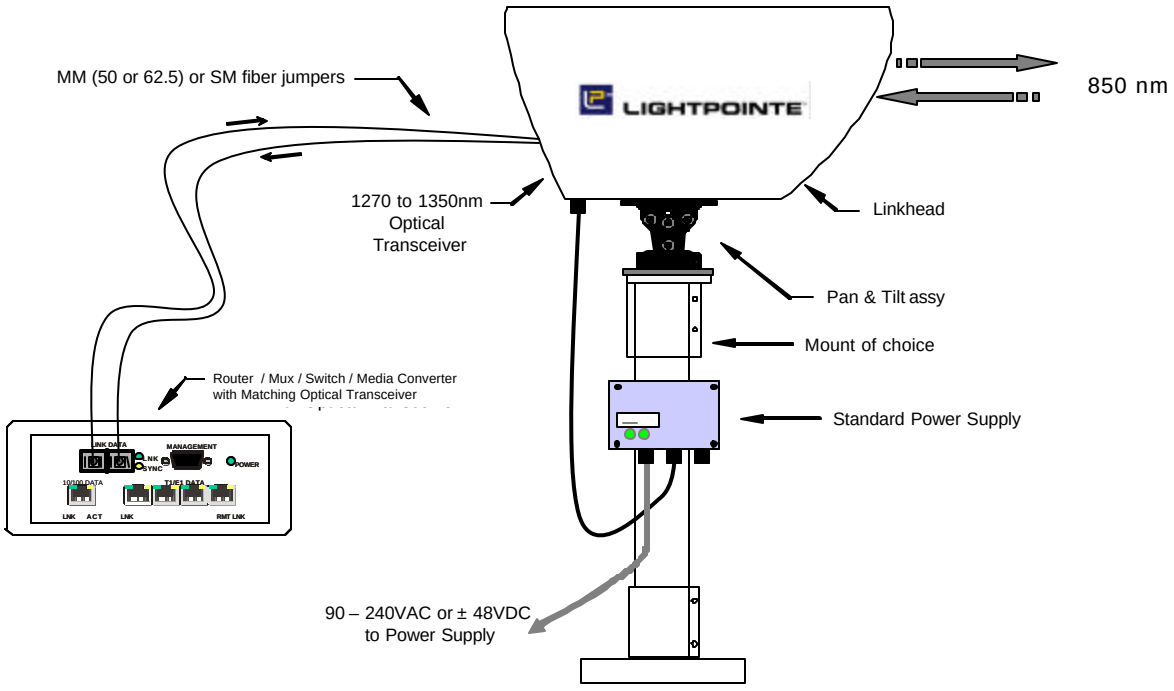



*Figure 1-1: Typical Optical Wireless System*

**Note:** The linkheads can be monitored with two types of Network Management options through the OMI ports. This diagram does NOT show the OMI network management connections.

The linkhead transmits four infrared light beams carrying the data from the network. The linkhead on the opposite side receives the beams on four receivers, filters the optical signal, and places it on an optical fiber that connects with the network. The system always operates in a full-duplex mode – both linkheads are transmitting and receiving the entire data stream simultaneously in both directions.

### 1.1.2. Typical Applications

Typical system applications include:

- Enterprise LAN and PABX extensions
- Metro networks and Rings
- Mobile Wireless backhaul and connectivity

### 1.1.3. Network Interface Connectivity

LightPointe FlightStrata 155 systems are protocol transparent and can support any point to point network architecture. The input requirement is a digital signal supplied to the linkhead via single mode or multimode fiber (depending on the system purchased) using standard SC optical fiber patch cords.

**Local Area Network (LAN) options**

- 10/100 Ethernet
- FDDI

**ATM/SONET Network options**

- STM-1, SDH
- OC-1, OC-3, SONET

**T1/E1 (Single/Multiple T1/E1) options**

- PABX, Mobile Wireless, Digital Video

**Mixed Voice/Data Applications options**

- Single/multiple T1/E1 + LAN Using LightPointe FlightMux products.

### 1.1.4. Transmission Method

FlightStrata systems use four transmission beams and four receiver lenses to provide signal redundancy. Each transmit beam carries the full payload and provide resistance to blockage from birds, weather or other affects..

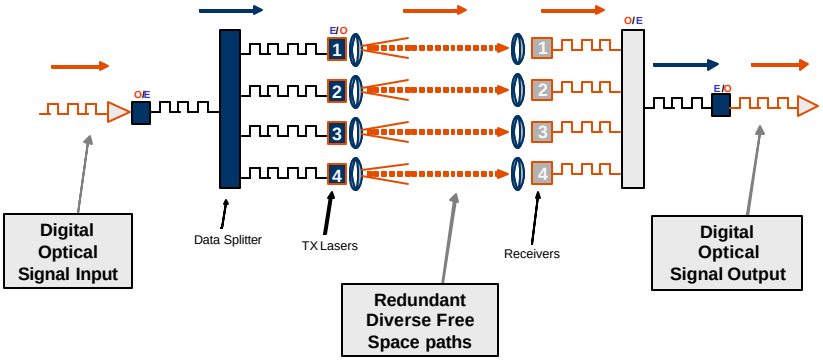



*Figure 1-2: Block Diagram of 4-Beam, 4-Receiver system*

#### Transmission Components

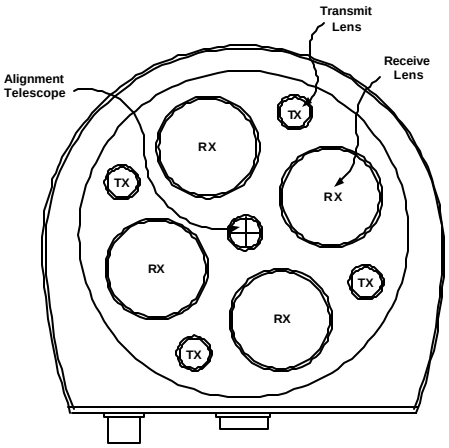
Optical signals from the data network are received at the Data Transceiver and converted to four identical data streams. Four VCSEL lasers convert the electrical signals into optical signals that are transmitted as four infrared beams into free-space.

#### Receiver Components

The receive amplifier converts the infrared signals coming from the free-space path into an electrical signal which drives the optical Network Transceiver sending the original signal to the data network at the far end..

#### Lens Geometry

The transmit (small) and receive (large) lenses are positioned for perfect alignment between Transmitters and Receivers at all distances including short distance shots.




Transmit lens – 2.5 cm each
Receive lens - 8 cm each

*Figure 1-3: Lens Functions and Orientation*

### 1.1.5. FlightStrata Operating Parameters

The following tables list operational performance parameters for FlightStrata systems.

**Table 1-1: FlightStrata 155 XX Operating Parameters**

| | | | | |
|---|---|---|---|---|
| *Bit rate* | 1.5 to 155 Mbps | | | |
| *Recommended link length* | | | | |
| | | 20 dB | 15 dB | 5 dB |
| *Calculated distances, in meters, at LightPointe recommended Fade Margins* | FSA 155 E | 1600 | 2100 | 3300 |
| | FSA 155 EW | 1300 | 1800 | 3000 |
| *Minimum link length* | 10 meters | | | |
| *Protocol* | Transparent | | | |
| *Beam Divergence* | 2 mrad, 2.8 mrad (EW) | | | |

## 1.2. Linkhead Devices

### 1.2.1. The FlightStrata 155 Linkheads

The FlightStrata is a multi beam transmitter/receiver. The following products belong to the FlightStrata product family:

- **FlightStrata 155E** (high power, standard divergence)
- **FlightStrata 155EW** (high power, wide divergence)


*Figure 1-4: FlightStrata Linkhead*

All FlightStrata 155E and 15EW include the following main components:

- Front window heater and defroster to prevent condensation from forming
- Multi-beam optical assembly with perfect alignment between transmitters and receivers at all distances
- Integrated telescope for coarse alignment of the system
- Four Receive lenses with APD amplifiers
- Four Transmit lenses with VCSEL lasers
- 90 – 240 Volt AC (or ± 48 Volt DC) power supply with fully connectorized cables
- User back panel with complete status display and optical receive level meter – no need for laptop or other tools
- Optical Management Interface (OMI) for use with PC-based software package included with linkhead or for use with optional SNMP network management using additional equipment

## 1.3. Laser Safety

LightPointe optical systems use semiconductor lasers as transmission sources. You must be aware of corresponding laser safety regulations and take the necessary precautions to avoid close direct exposure to the laser beam. The infrared laser beam is invisible and has the potential to penetrate to the retina and cause thermal damage.

FlightStrata optical laser communication systems use a Class 1M laser in accordance with the international laser safety standard IEC/EN 60825-1 A2:2001.

Familiarize yourself with laser safety regulations and strictly enforce all necessary precautions.

**Warning:** Do not look directly into the laser aperture from a short distance for extended time periods using any optical instruments to view the laser beam.

The built-in telescope uses a safety filter so there is no danger in viewing the opposite linkhead through the telescopes. Do not use another magnifying device such as high powered telescope or binoculars to view the beams from less than 50 meters for extended periods of time. These distances assume an exposure of more than ten seconds.

**Table 1-2: Safe Distances for Telescope Operation**

| Linkhead | Naked Eye safety distance | Telescope safety distance* |
|---|---|---|
| FlightStrata 155E, 155EW | 0 m | 0 m |

*The alignment telescopes in the linkheads have filters for safe operation at all distances

The FlightStrata system transmits laser radiation from four separated transmission apertures. The transmitted power from each of these apertures, and the radiation density combined from all four is safe for the naked human eye from any distance.

**Caution:** *Use of controls or adjustments or performance of procedures other than those specified herein may result in hazardous radiation exposure.*

**Caution:** *This is a Class 1M Free Space Optical Communication System (FSOCS) transmitter and may be installed in unrestricted, restricted or controlled locations. For additional details, please refer to IEC 60825: SAFETY OF LASER PRODUCTS Part 12: Safety of free space optical communication systems used for transmission of information.*

*Unrestricted locations are those areas that are normally accessible to the public (e.g., unrestricted areas of rooftops, public areas at ground level, open areas of offices and industrial premises, etc.). If a LightPointe Communications FSO system is installed in an unrestricted area, a warning must be posted that*

*states "**Do not use binoculars, telescopes or other optical aids to view the FSO linkheads."***

*Restricted locations are those areas that are normally inaccessible by the general public (including workers, visitors, and residents in the immediate vicinity) by means of any administrative or engineering control measure but that is accessible to authorized personnel (e.g. maintenance or service personnel including window cleaners in exterior locations) that may not have laser safety training. There are no special requirements for a LightPointe Communications FSO system installed in a restricted area.*

*Controlled locations are those locations where any kind of engineering or administrative control measure is introduced to make it inaccessible except to authorized personnel with appropriate laser safety training (e.g., tower-mounted terminals, fenced/secure areas of rooftops, locked rooms with strictly-controlled access, etc.). There are no special requirements for a LightPointe Communications FSO system installed in a controlled area.*

*The laser system shall be installed in accordance with ANSI Z136.1 control measures (engineering, administrative, and procedural controls).*

### 1.3.1. Laser Safety Labels

All relevant labels are affixed to the linkheads as required by the agencies responsible for the oversight of Free Space Optics products. These identification and warning labels are affixed to the outer shell of the linkhead:

- Product label with details on company name, product information and specific compliance data, normally affixed to the side of the linkhead
- Laser classification product label with caution comments, normally affixed to the side of the linkhead
- Aperture label indicating that invisible laser radiation is being emitted, affixed near the transmission point of the linkhead

**Caution:** Do not modify this certified laser product.

### 1.3.2. Laser Safety Contact Information

Laser Safety in the United States is regulated by the Food and Drug Administration's Center for Devices and Radiological Health (FDA/CDRH). The FDA enforces laser performance standards within the US:

*U.S Department of Health and Human Services*
*Food and Drug Administration*
*Center for Devices and Radiological Health*
*2094 Gaither Road*
*Rockville, MD 20850*

*http://www.fda.gov/cdrh*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# 2. System Installation and Alignment

## 2.1. Major System Components

### 2.1.1. Linkhead and Accessories

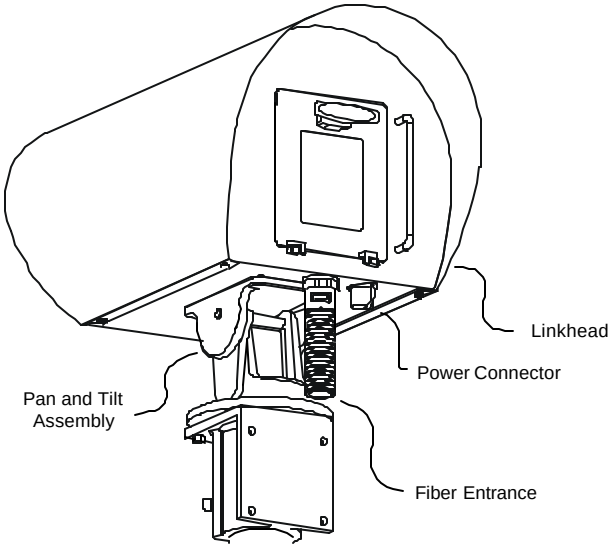



*Figure 2-1: FlightStrata linkhead*

Two linkheads are installed to complete the system. All accessories and hardware are packed with the linkhead. The linkhead assembly consists of:

- An IP 66 rated weatherproof housing
- A rear operations panel with all user indications and controls
- Built in alignment telescope
- Power connector and fiber access to the linkhead
- Pan and Tilt assembly which must be attached to the linkhead at the time of installation
- All hardware, wrenches, nuts, bolts and screws
- FMG PC Software CD for local Maintenance and Monitoring
- Optical Management Interface serial adapter
- Installation and Maintenance Manuals for FligthStrata 155 and FlightManager PC
- Warranty Form

The linkhead is the smallest replaceable component. There are no replaceable parts inside the linkheads- return the entire linkhead unit in the original shipping container. Empty shipping boxes are available from LightPointe.

### 2.1.2. Pan and tilt Assembly

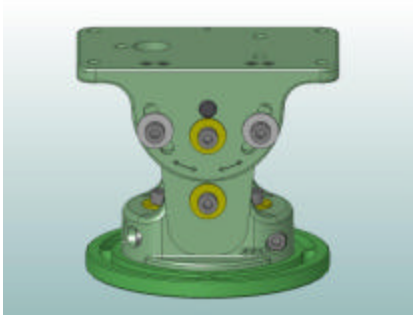


*Figure 2-2: Pan and Tilt Assembly*

The pan and tilt assembly and hardware is used for initial coarse alignment and final fine alignment of the linkheads for maximum receive power. The Pan and Tilt is specially engineered to provide the stability and strength required by Free Space Optics systems to provide trouble free performance.

### 2.1.3. Universal Mounting Kit and Hardware

The universal mount is used for pedestal or wall mounting the linkhead.

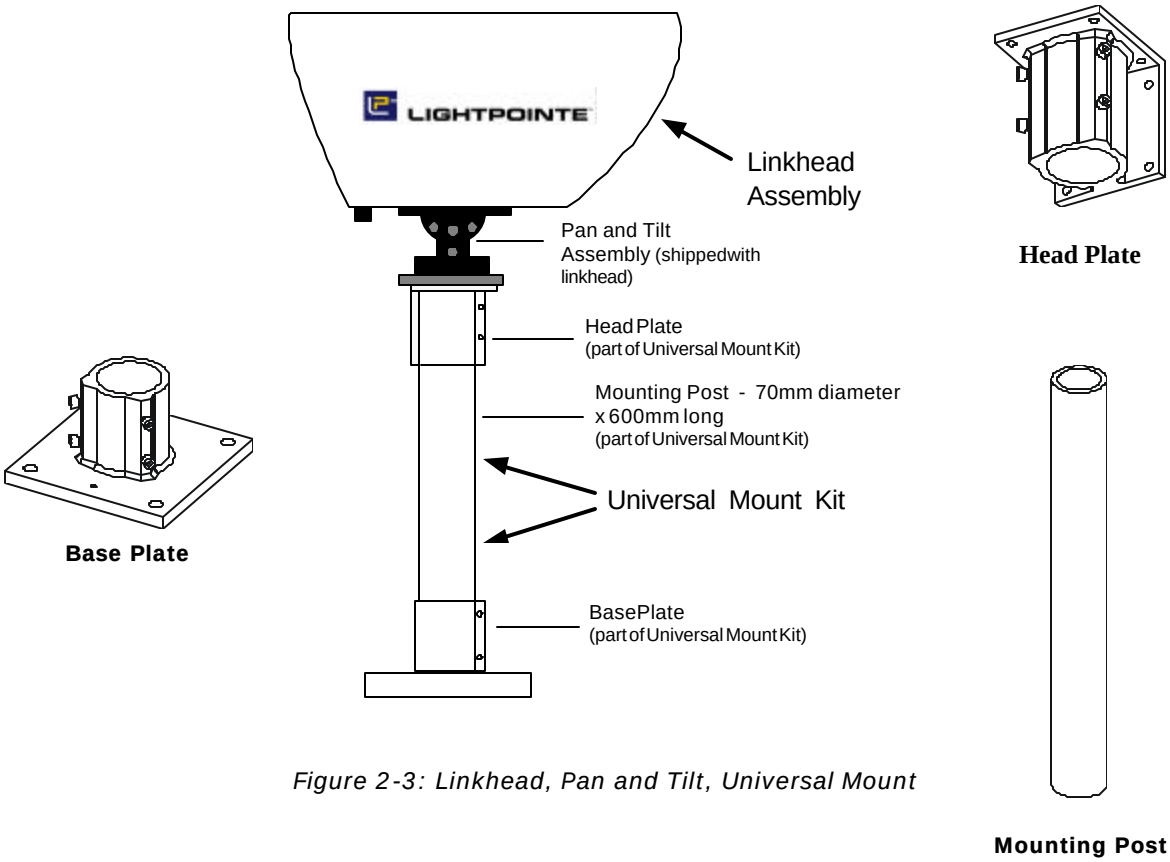



*Figure 2-3: Linkhead, Pan and Tilt, Universal Mount*

### 2.1.4. Power Supply Assembly

The weatherproof power supply assembly mounts near the linkhead.

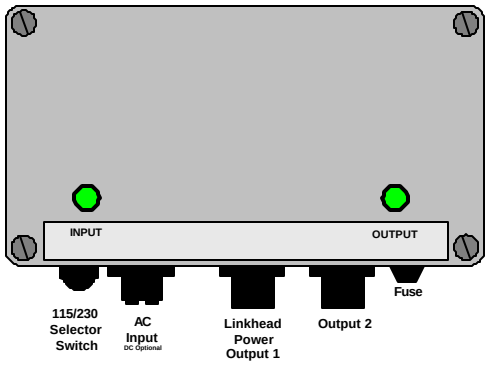



*Figure 2-4: Power Supply Assembly*

This Power Supply Assembly provides:

- 90 - 240 VAC 50/60 Hz power input (requires correct user option-switch setting) An optional power supply with ±48 VDC inputs may be ordered instead of the AC power supply
- Vertical or Horizontal Pole mount or Wall mount brackets
- Dual outputs to power one or two linkheads with a single power supply
- Redundant load sharing power supplies may be configured for maximum reliability by ordering the "Y" cable described below.

### 2.1.5. FlightStrata Powering Options

The following power supplies and accessories are available.

**Table 2-1: Power Supply Options**

| Power Supply | Description |
|---|---|
| LPC-A12 | Standard 90 – 240 VAC 50/60 Hz Power Supply |
| LPC-D12 | Standard ± 48 VDC Power Supply |
| LPS-00-I | Spare AC input cord from power source |
| LPC-00-O | Spare DC output cord to linkhead |
| LPC-00-Y | Y Cable to allow two power supplies to be configured feeding one linkhead in a redundant load sharing configuration |

## 2.2. Recommended Survey and Installation Tools and Test Equipment

The following tools and supplies may be needed for survey, installation, testing, and maintenance of the LightPointe system hardware.

**Site Surveys:**

- ❑ Accurate scaled map for locating sites and distance calculations
- ❑ Laser range finder or GPS for accurate distance measurement
- ❑ Binoculars to assist in locating opposite end installation location
- ❑ Sketch pad to make rough drawings and notes (recommend using LightPointe Field Engineering Planning Guide)
- ❑ Tape measure to determine length of fiber, power runs, etc.
- ❑ Camera to photograph installation sites

**Installations:**

- ❑ Standard electro-mechanical tool kit with pliers, screwdrivers, wire cutters, wire strippers, etc.
- ❑ Two-way radio or cell phones to communicate
- ❑ Optical fiber connector cleaning kit
- ❑ Plastic tie wraps to secure flexible conduits, etc.
- ❑ 13mm socket or open end wrench for mounting bolts
- ❑ Electrical tape for securing and fastening
- ❑ Measuring level to evaluate flatness of mounting surfaces
- ❑ Optical light source and fiber power meter to verify fiber runs

**Other Equipment:**

The following items may also be needed for installation and/or service, depending on the location and type of installation:

- ❑ Digital volt meter to check electrical systems
- ❑ Power drill or power hammer with appropriate bits to securely install the linkhead mounting platforms
- ❑ Step or extension ladder for access to elevated locations
- ❑ High quality rope to use for hoisting materials and/or to be used in conjunction with a safety harness to ensure installer safety when appropriate
- ❑ Exterior rated extension cord (50' or shorter recommended) rated for 100 Watt load.

## 2.3. Site Review

LightPointe has created a Field Engineering & Planning Guide. This guide is available from our customer service group or from the Tech Support website. Use this guide to create a complete check of the proposed installation against actual LightPointe installation standards.

**Choose the appropriate system for your application:**

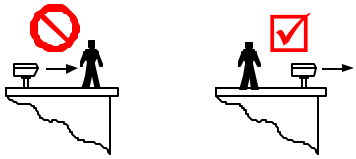
**Step 1**

- ❑ Measure point-to-point distance using a laser range finder or GPS
- ❑ Is a single mode or multimode fiber being used to feed the linkhead? Both require a standard SC connector at the linkhead
- ❑ The wavelength of the optical interface must be 1260 to 1360 nm (commonly referred to as 1300 nm) either Singlemode or Multimode

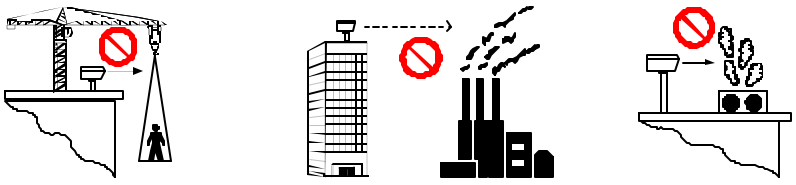
**Ensure a quality line-of-sight.**

**Step 2**

- ❑ Mount the linkhead near the edge of the building to avoid interruptions of the Line Of Sight - Is there a possibility of work activity or people passing in front of the linkhead?



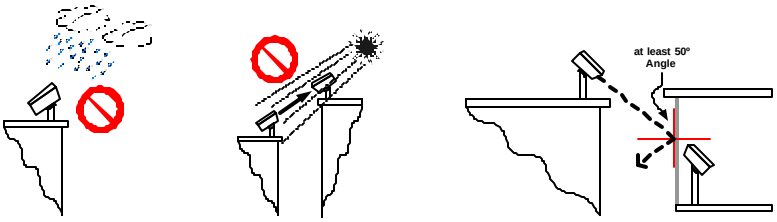
- ❑ Notice anything that might interfere with the Line of Sight after the installation. Look for mechanical equipment that may move into the path (cranes, window washing equipment, scaffolding, boats or trains). Pay attention to Heating Ventilation Air Conditioning equipment which gives off steam or smoke. Remember this may occur during a different season of the year or time of day (for example, Air Conditioning equipment is active during the summer months - factories only give off smoke during the work week)



- ❑ Avoid shooting across large flat roofs which will create heat shimmer in front of the linkhead. Also, do not shoot very low over an intermediate building that could generate shimmer

- ❑ Consider plants and trees that can grow, move in the wind, or sprout leaves during different seasons of the year.

- ❑ Do not mount the linkhead at an extreme angle.




## Step 3

### Evaluate Security considerations

*The transmission beam is narrow and invisible, making it very difficult to tap into without interrupting the beam path.*

- ❑ Place the linkhead in front of a structure to block any signal power from traveling past the linkhead
- ❑ Data Encryption schemes will pass transparently across the system

## Step 4

### Evaluate environmental mounting conditions

- ❑ Only mount the linkheads to a stable and vibration-free mounting platform – this is a critical factor to successful performance.
- ❑ Evaluate that the foundation at the mounting location is not susceptible to change due to humidity or temperature Avoid wood, plastic or other materials that can absorb water and expand or shrink.
- ❑ Linkheads do not require grounding. If you have the need for a lightning protection system contact your certified Reseller or visit http://lightpointe.custhelp.com

**Step 5**

### Evaluate mounting locations for safety of the installer or technician

- ❑ Safe access to the controls
- ❑ Stable location/platform to stand upon
- ❑ Safety for installers and maintainers of the system in the dark, high winds and all weather conditions

**Step 6**

### Evaluate how stable is the mounting surface

- ❑ Mount only to a Solid concrete or steel structural building member
- ❑ Directly on a flat roof surface if using a non-penetrating mount
- ❑ Securely fastened to the side or top of parapet wall
- ❑ Indoor floor mount should be bolted to the floor

**Step 7**

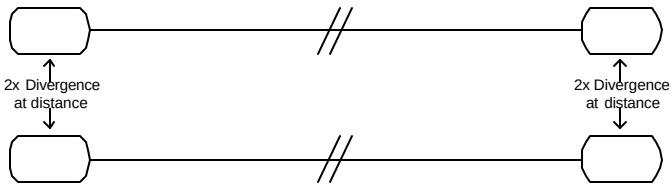
### Choose a type of mount (refer to Section 2.3.1)

- ❑ Universal mount (vertical or horizontal) will work in most applications
- ❑ Consider LightPointe engineered mounts for unusual applications. These mounts are specially engineered to provide the required stability
- ❑ Other site-made mounts should be approved by your certified Reseller or representative

## 2.4. Special Installation Situations

### Parallel Systems

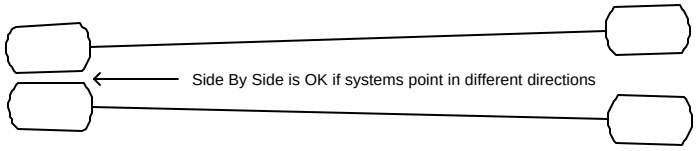
Two LightPointe systems operating side by side may rarely interfere with each other, *but only if operating on perfectly parallel paths*. In practice this is extremely rare because a very small degree of separation is all that is required to eliminate this problem.




Space the linkheads if systems are perfectly parallel

If they are perfectly parallel, do not mount the linkheads of adjacent systems too close to each other. Maintain a distance of twice the beam width between linkheads per Table 2-2.

If the two systems are pointed in even slightly different directions (as little as one degree is enough to eliminate the problem) then the spacing of the linkheads is not a requirement because the field of view of the linkhead is very small and they will not interfere with each other in any way




IT IS NOT necessary to space the linkheads if systems are shooting at different angles

**Table 2-2: Beam width over distance**

| Beam Divergence | Beam Width at 500 meters | Beam Width at 1000 meters | Beam Width at 2000 meters |
|---|---|---|---|
| *2 milliradians* | 1 m | 2 m | 4 m |
| *2.8 milliradians* | 1.4 m | 2.8 m | 5.6 m |

## Short distance shots

There are times when you wish to use the FlightStrata for a very short reach system. This most often happens in Laboratory or Demo situations, as well as for very short distance shots across a street or between close buildings.

The lens geometry is designed to accommodate this by giving perfect alignment between transmit and receive lenses at all distances. The Automatic Power control will also adjust the receiver power level to prevent saturation. So the system is designed for such short reach applications.

We have found in actual practice that the installation and alignment is much easier at distances greater than 40 meters where the beam size is large enough to begin to overlap across multiple lenses, but the system is able to work in distances as short as 10 meters.

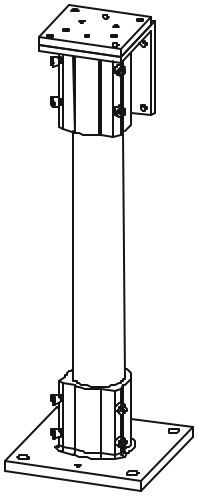
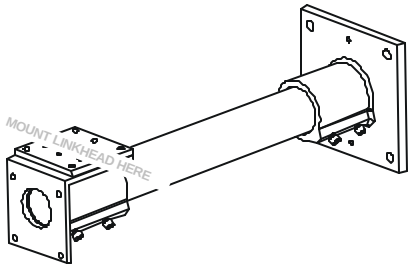
### 2.4.1. Linkhead Mounts and Mounting Equipment

Refer to the following table for examples of different mounting applications and details.

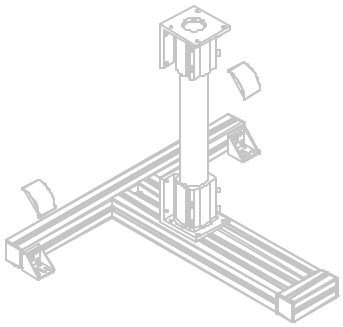
A well-engineered mount will be solid and will not move. The tracker in the linkhead will counter slow, large movements such as building sway and thermal expansion and contraction (diurnal affects). The divergence of the lenses will counter wind, vibration from motors and other small fast movement. However, it is always wise to make the mount as absolutely stable as possible. By spending time to build a good mount you will eliminate at least one variable (a poor mount) in how well your FSO system will perform over time.

LightPointe has found over the years that most of our customer's problems with FSO systems are due to unstable mounts.

**Table 2-3: General Types of Mounts**

| Mount Style | Typical Use |
|---|---|
|  | **Universal Mount**<br>Use the Universal Mount for upright installations using large anchor bolts or through bolts at the base plate. If possible, cut the mounting pole to a shorter length to provide additional stability. Only place the mount on solid and structurally sound material.<br>**Tighten all bolts as tightly as possible with your hands using the hex/Allen wrench provided.**<br>**Tighten all anchor bolts to the manufacturer's specifications using appropriate wrenches and tools.** |
|  | **Universal Mount used horizontally**<br>You may also use the Universal Mount in horizontal installations. Be sure that the base plate is mounted into a wall surface using penetrating anchor bolts or through bolts. The wall material must be solid and deep enough to accommodate the bolts.<br>The Power Supply has a top and bottom, mount the Standard Power Supply box with cables exiting at the bottom.<br>**Tighten all bolts very tight with the hex/Allen wrench provided.** |

**Caution:** For indoor installations where people may be curious about the device, the linkhead(s) should be installed close enough to the window to prohibit looking into the transmitter beams. Also avoid linkhead angles of 50 degrees or less measured from the window glass.



**Engineered Mount –**
**Indoor Floor Mounting Kit**

Use this mount in a laboratory or office environment or when a stable indoor mount is needed. Bolt the mount to the floor for permanent installations.

**For additional mounting options using 3rd party materials please contact your reseller, LightPointe, or visit the LightPointe support site http://lightpointe.custhelp.com.**

## 2.5. Site Preparation

Please refer to the Field Engineering & Planning Guide for detailed site survey instructions.

**Step 1** Check space and clearance requirements

- ❑ Allow room to install and maintain the equipment.
- ❑ Do not place the linkhead near hazardous machinery, power lines or AC cabinets
- ❑ If possible do not mount the linkhead near radar dishes, large antennas, motors or other equipment which can radiate large amounts of Egress RF power

**Step 2** Carefully inspect the mounting locations for strength and stability

- ❑ Inspect the surface to ensure that it is a solid material that can be penetrated by bolts.
- ❑ Make sure the mounting surface is not cracked or broken

**Step 3** Determine where you will be powering the linkhead from.

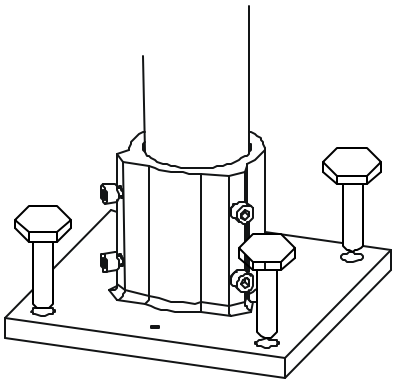
- ❑ Place the power supply as close as possible to the electrical outlet
- ❑ Use cable of correct gauge and rating for the amperage (20 Watts)
- ❑ Be aware of local safety and code requirement

**Step 4** Determine how your fiber connections will be routed and run to the linkheads. Check Fiber optic cable routing – use a protected route, or place fiber runs in conduit.

- ❑ Determine the fiber type (single mode or multimode)
- ❑ Pull at least 8 fiber strands (4 for data and 4 for OMI) in case one fiber is damaged or has high losses. Most installations require four optical fibers as a bare minimum
- ❑ Make sure the correct fiber is used – Always use a Single mode Linkhead ONLY with Singlemode fiber and a Multimode linkhead with Multimode fiber and network interface.
- ❑ SC connectors require NO special polish (e.g., angled or physical contact ferrules are not required)
- ❑ Be careful to track and mark which fiber is Transmit and which Receive
- ❑ Use a fiber optic cable tester to check the attenuation of all fiber optic cables from the network and OMI interfaces.
- ❑ All optical inputs must meet the specified levels for proper operation

## 2.6. Assemble and Mount the System Hardware

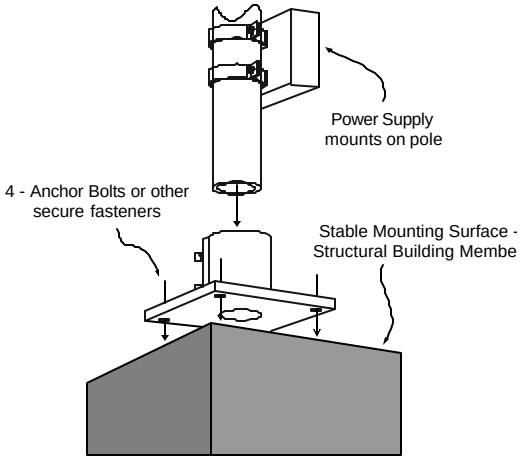
It is possible for one person to perform all installation and alignment procedures. However, installation will always be done more effectively and safely with two people. This is especially true at the alignment phase which is the most critical part of the installation process.



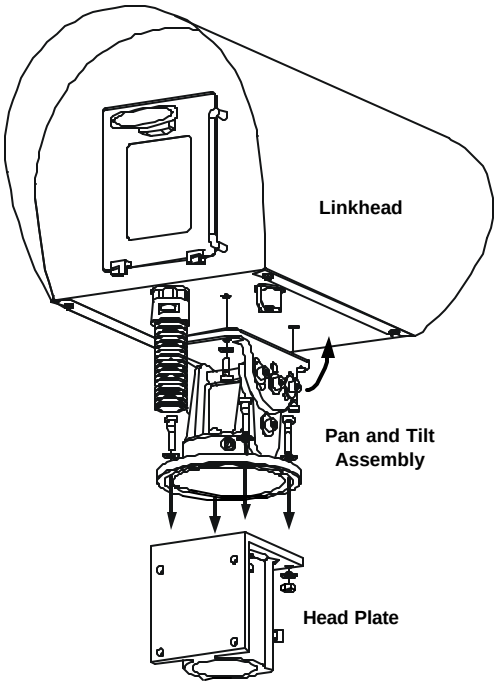
**Step 1** Install the mounting base plate to a solid platform using 12 mm (1/2") screws.

- ❑ Anchor the mount in wall or concrete (recommend M12-screws)
- ❑ Use good quality bolts of hardness class >6.6

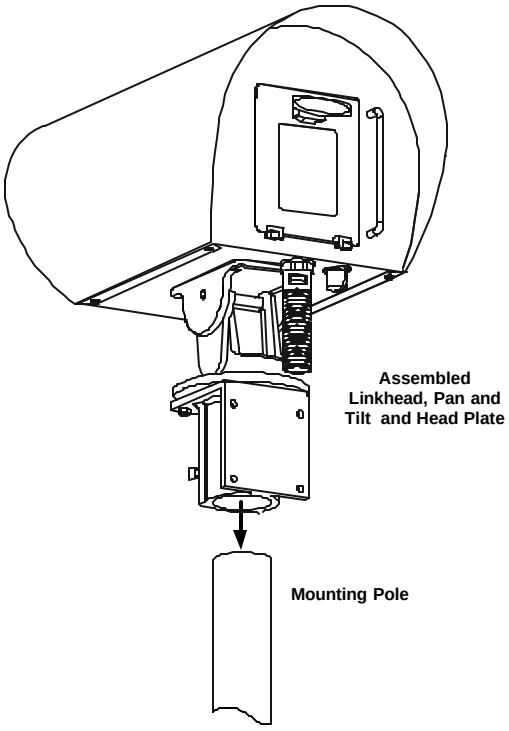
To ensure stability, we recommend that you cut the pole to keep the mounting post as short as possible. The maximum allowable mounting pole length is 110 cm.




**Step 2** Attach and fasten the mounting post assembly to the installed base plate using the supplied set screws. Tighten the set screws snugly with the hex wrench supplied.




**Step 3** Mount the linkhead and Pan and Tilt assembly to the Head Plate using the hardware supplied by LightPointe.




**Step 4** Place the linkhead (with pan and tilt and head plate assembled) onto the mounting pole. It is much easier to assemble these components and then place them onto the pole as a unit. This is especially recommended in dangerous locations such as towers or high buildings.

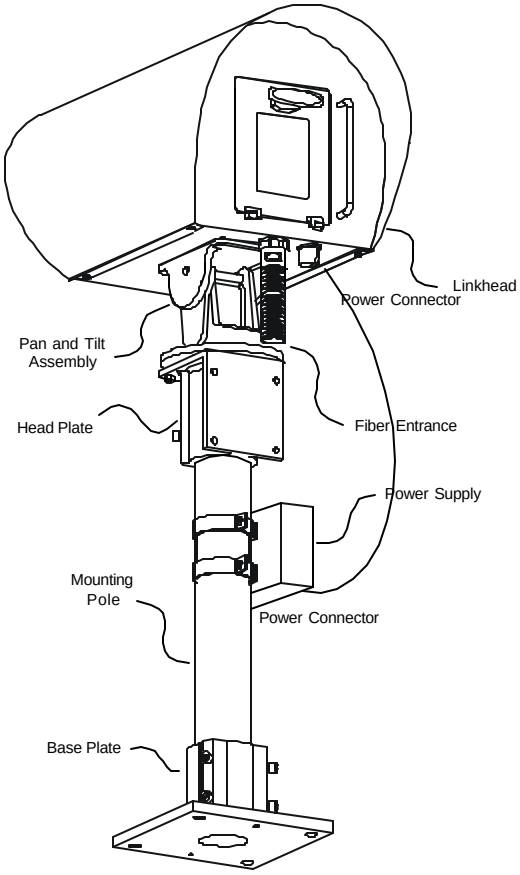



*Figure 2-5: Completed Universal Mounting assembly*

**Step 5**

Mount the power supply to the Mounting Pole using the hardware supplied with the power supply assembly.

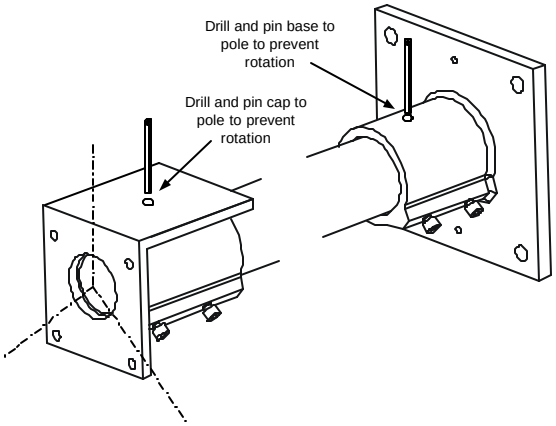
The illustration shows the power supply in a typical position. There are other ways to mount the power supply. These options are explained later in this document.

**Caution:** The base plate and head plate should be pinned to the mounting post when the base plate is mounted in a horizontal position to prevent rotation and misalignment from a strong wind.

**Extra security for Horizontal mounting situations**

To pin the base plate and head plate to the mounting post when used in a horizontal mount:

- Drill an 8 mm hole through the cylinder wall of the base plate and the mounting post and pin the assemblies together using 8 mm grooved pins or 3/8 x 1 inch screws.
- Drill an 8 mm hole through the cylinder wall of the head plate and the mounting post and pin the assemblies together using 8 mm grooved compression fit pins or 3/8 x 1 inch stainless steel screws.
- Position the pins at the opposite side of the cap and base from the tensioning screws. This will assure that the mount does not rotate and cause system misalignment.




## 2.7. Test the Stability of your mount

LightPointe FSO systems are engineered to allow for a certain amount of movement in each of the three axes in which a link head can move under force. The three axes can be thought of as:

- Rocking back and forth
- Swaying from side to side
- Twisting

The twisting and rocking movements cause the most significant problem because they affect the angle of launch. Fortunately, these two movements are also the least likely to occur. Use only LightPointe mounts which are engineered to not twist or torque. The optical divergence of the linkhead is engineered to match LightPointe mount specifications.

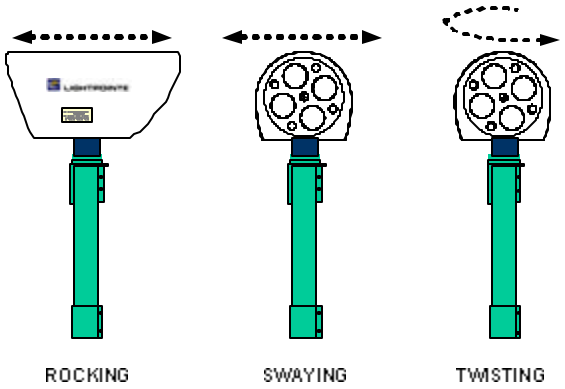



*Figure 2-6: Three types of mount movement*

A simple test can be used to verify if you have a solid mount. The test simulates 100 mph wind and 1.5 mr or less of deflection. The universal LightPointe mount is engineered to withstand winds of 140 mph.

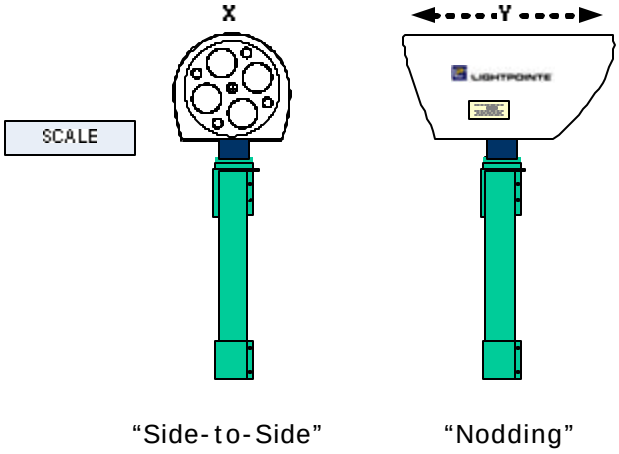



*Figure 2-7: Mount stability tests*

| | |
|---|---|
| **Step 1** | Attach a fish weight scale to the head plate (Gimbaled Mount) as shown in Figure 2-7 |
| **Step 2** | Apply a force of 55 pounds (25 Kg) to the mount in the side-to-side direction. Observe the received power LED indicators to see if the signal level drops. |
| **Step 3** | Apply a force of 25 pounds (12 Kg) to the link head in the "nodding" direction. Observe the received power LED indicators. If the force can be applied in both Step 2 and this step without gaining or losing more than two bars of power at either link head your mount is solid and should give good service. |

## 2.8. Assemble and Mount the Power Supply

**Step 1**

If the power supply will be used with the standard LightPointe universal mount, use the two round, insulated clamps provided with the power supply to attach the unit to the pole.

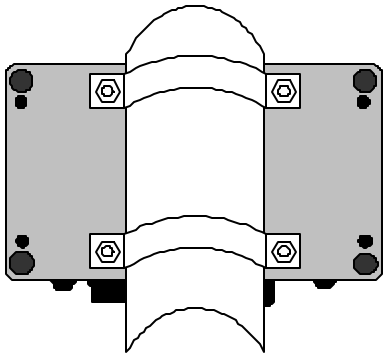


*Figure 2-8: Rear View Vertical Power Supply Mounting*

If the power supply will be mounted with the pole in a horizontal position, turn the back plate by removing the four sets of nuts, rotating the plate and then re-securing the back plate.

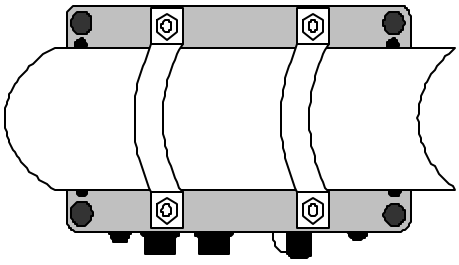


*Figure 2-9: Rear View Horizontal Power Supply Mounting*

If the power supply is to be mounted to a surface other than the standard LightPointe pole, the power supply may be secured using the two metal brackets provided with the system. The mounting brackets are secured to the power supply as indicated, and the system should then be attached to a solid surface with the appropriate type of mounting screws.

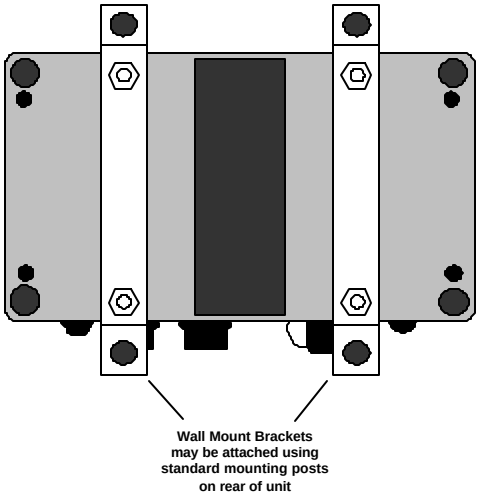



*Figure 2-10: Wall Power Supply Mounting*

**Note: The maximum recommended distance between the power supply box and the linkhead is 3 meters.**

**Caution: Disconnect main power before connecting electrical cables.**

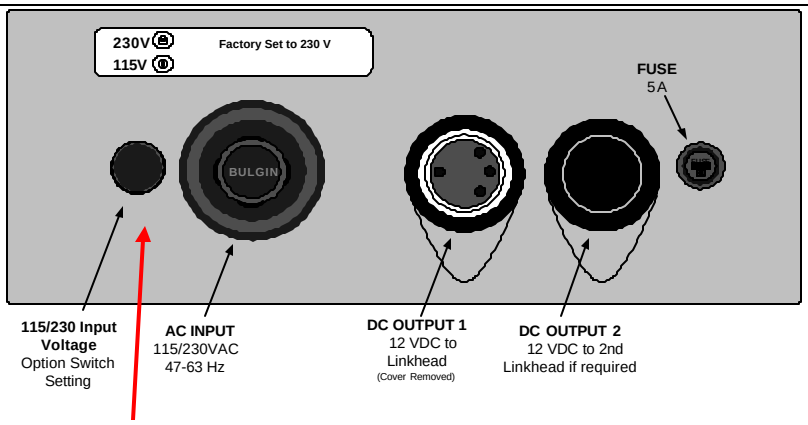
**Caution: Connectors should always face down.**

**Step 2** There is a 3-meter power cord provided with the standard AC power supply. The connector on the cord is pre-wired, and the cord tail provides three labeled wires (Hot, Neutral and Ground) that must be properly terminated (junction box, electrical plug, etc.) for connection to an electrical power source. LightPointe recommends that the power cord be hard-wired into a dedicated and surge protected circuit.

Once the power cord is properly connected to an electrical source, the power cord connector can be plugged into the AC Input connector on the power supply.

**Warning: Ensure that the correct power cable is used. Exercise extreme caution when terminating the wires into the connector!**

**Incorrect wiring at the connector can injure people and cause fire hazards and may cause damage to the equipment that is NOT covered under warranty!**




**Input Voltage Selector – protective cap removed**

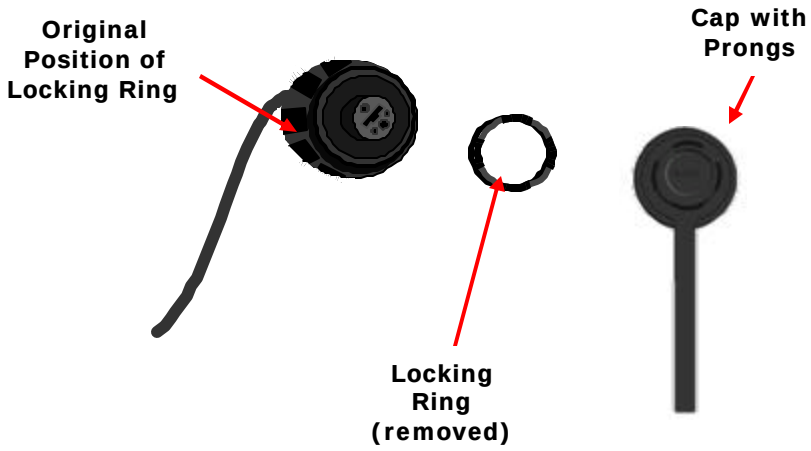
**Step 3** Set the power supply input selector switch to the correct position. The power supply is preset at the factory to an input voltage of 230 VAC. To reset the input voltage to 115 VAC, remove the input selector switch cover protective cap, turn the selector switch to the vertical position and replace the protective cover.

**Caution: Ensure that the correct power input voltage is selected BEFORE applying power to the power supply.**

- **Do not set the power supply to 115 VAC and then apply 230 VAC – this will damage the power supply.**
- **If the power supply is set to 230 VAC and then connected to 115 VAC, the output from the power supply will not be high enough to operate the linkhead.**

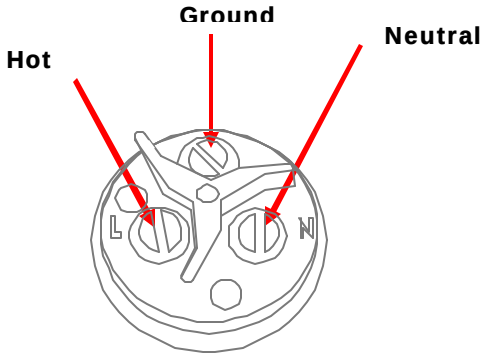
**The power supply input selector switch should NEVER be changed while power supply is connected to its primary power source.**

If it is necessary to lengthen the power cord, another longer cord may be retrofit to the existing input connector. Open the power connector by removing the locking ring from the connector. The prongs on the caps of the protective cover of the cord can be used to remove the locking ring.




**Step 4** Loosen the strain relief on the connector to release the power cord and detach the power cord wires from the connector.

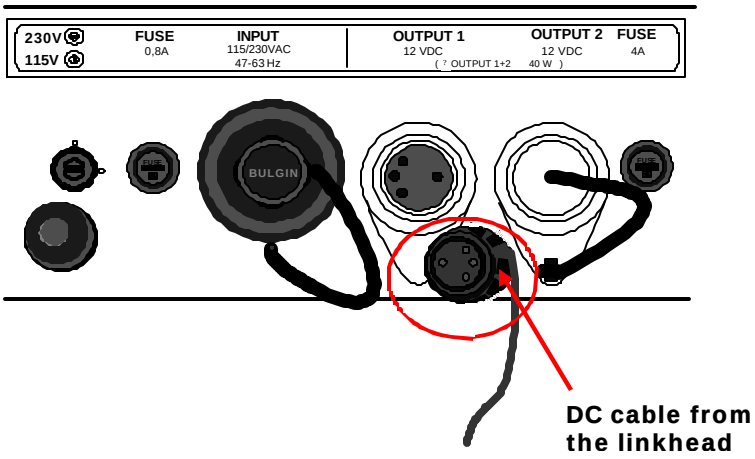
Place the strain relief over the new power cord, thread the power cord through the connector and connect the wires of the power cable to the correct pins of the terminal connector as indicated on the connector and in the following picture. The power cord cable outer sheath diameter must be between 5 and 10.25 mm (.19 to .38 inches) in diameter, and the individual wire connections at the connector plug must be between .75 $mm^2$ and 3.31 $mm^2$ (18 AWG to 12 AWG).




Once the wires have been connected, reassemble the input power connector. Ensure that the key slot on the terminal block is properly aligned with the key tab on the connector. Replace and tighten the locking ring, then connect the power cord to the AC Input connector.

**Step 5** Connect the 12 VDC cable to the bottom of the linkhead at the external connector plug receptacle.

Connect the DC cable from the linkhead to the power supply (one 3 meter cord provided with each power supply) to the power supply by unscrewing the cap from the Output 1 port and securing the connector into the plug.




**Note:** The second power output port (Output 2) from the power supply can be used to connect to a second linkhead.

**Note:** If redundant power supplies are desired, a separate (backup) power supply and cable to interconnect two power supplies may be ordered from LightPointe. The LPS-00-R "Y" Cable should be ordered.

**Step 6** Repeat these steps at the second linkhead.

**Step 7** Apply power to both linkheads by connecting the input power cable from its AC source into the Input connector on the power supply. Make sure that both the "Input" and "Output" indicator lights on the power supply are illuminated.

## 2.9. Linkhead alignment and tracking

The FlightStrata systems have an automatic beam tracking and Automatic Power Control system which adjusts the alignment and receive power levels of the linkheads during day to day operation.

However, the tracker mechanism will perform best when the mounts are solid and the initial starting position is perfectly centered in the Range of Motion of the tracker. This is why it is important to have the tracker OFF when performing the initial alignment.

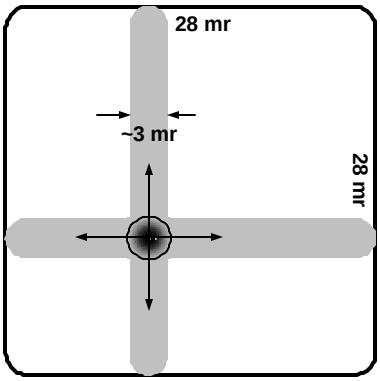



*Figure 2-11: Automatic Tracking*

The tracker will move within the Field of Regard in first in the X and then in the Y direction over a total of 28 mr of angular deflection. The Field of View/Divergence remains the same at all times.

The Tracker will search for the highest receive power within the Field of Regard. It constantly searches to see if there is a higher power level and moves all four beams at the same time.

The Tracker samples on a random time interval varying from 15 to 25 seconds. This is much faster than any diurnal affects which typically occur over hours. The random timing of the sample is done to eliminate the chance that both linkheads would begin tracking at the exact same time and thus never “find” each other.

Automatic Power Control samples every two seconds and adjusts the Receiver power level for optimal performance. This is much faster than a fog or fading event ever occurs. The action is dampened (statistically) to prevent flapping or constant adjustment problems when the power is changing rapidly due to blowing fog or rain.

When the Strata is first powered on, Tracker/APC should be off. The system will perform self-diagnostics at power on. During this sequence (up to a minute in length) the motors will make different noises because the system is testing the edges of the Field of Regard. When the motors hit the edge of travel, you will hear the motors running. The main purpose of this sequence is to center the tracker in preparation for the manual alignment process. When the self-diagnostics are complete you should proceed to linkhead alignment with Tracker OFF.

After manual alignment, you may turn on tracker/AGC and Strata will automatically optimize both alignment and received power level.

- APC starts first and will quickly reduce power to 7 or 8 bars. This should take only a few seconds - the power levels will fluctuate as the tracker activates
- Tracker then begins to find perfect alignment by hunting back and forth and up and down. This entire process may take up to five minutes

The tracking switch controls both the Tracker and Automatic Power Control functions. APC will not operate if Tracker is working. Tracker will not operate while APC is adjusting power. You will never see Tracker and APC fighting each other in any way.

### 2.9.1. Alignment Theory

The linkheads must be pointing directly at each other in perfect alignment for best operation. You will need to complete both coarse and fine alignment procedures before you engage the Tracker/APC.

When the linkhead is first powered up it goes through a self diagnostic routine that centers the tracker in its ranges of motion and opens the Automatic Power Control all the way. Once this initial sequence is done, then the test button is pushed and the manual alignment process can begin.

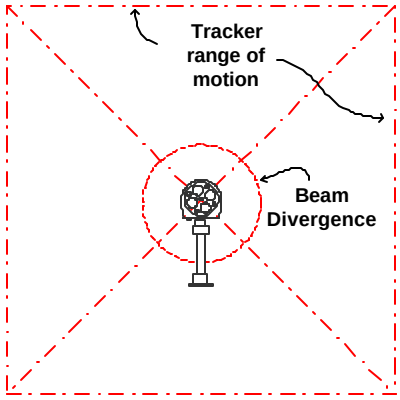
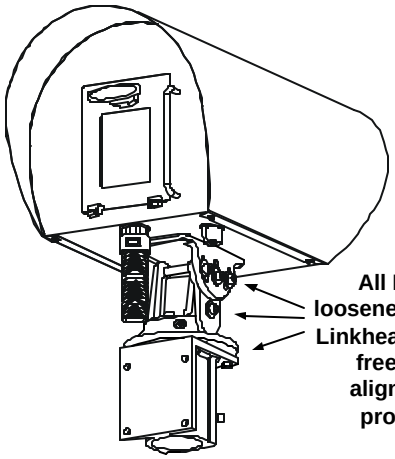



Figure 2-12: Tracker is centered for alignment process

One person can perform linkheads alignment; however it is easier with two people.

The only tools required to perform system alignment are the Allen wrench (metric #6mm) provided with the system (stored on the back of the linkhead) and a wrench to secure the nuts on the base plate.

## 2.10. Step By Step Alignment Process

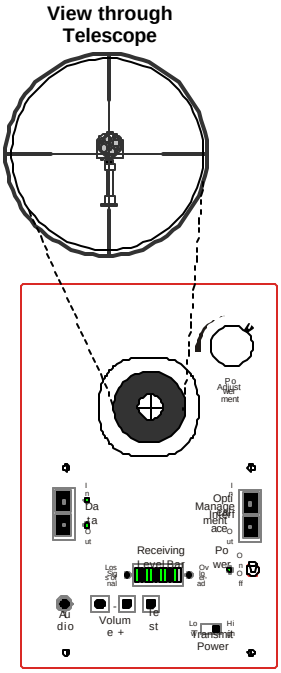



**Step 1**
**Loosen the Pan and Tilt bolts to allow for coarse alignment**

The Pan and Tilt assembly has two sets of bolts – Coarse alignment and Fine Alignment bolts.

There are also two fine alignment screws that are used as a final adjustment. The fine alignment screws make it easy to get perfect alignment of the systems by fine tuning the pointing direction.

***Loosen all bolts until pan and tilt moves freely***

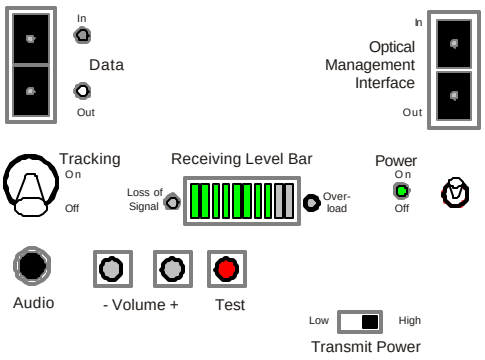



**Step 2**
**Roughly align the linkheads using the telescopes**

- ❑ Remove the lens cover from the built in telescope.
- ❑ Sight through the telescopes to locate the opposite end link
- ❑ Move both linkheads until the other end is on the crosshairs of the telescope

**Installation Note:**

The telescope is an installation aid and is not always perfectly parallel with the lasers and receivers (i.e., when you have a well-aligned linkhead, the telescope crosshairs *may not* be perfectly centered on the opposite linkhead) This is normal and is no cause for concern. The absolute receive power level with the Tracker/APC turned off is the true indicator of good alignment.




**Rear Panel Indicators on Linkhead**

## Step 3
## Power up and put the linkheads into Test Mode

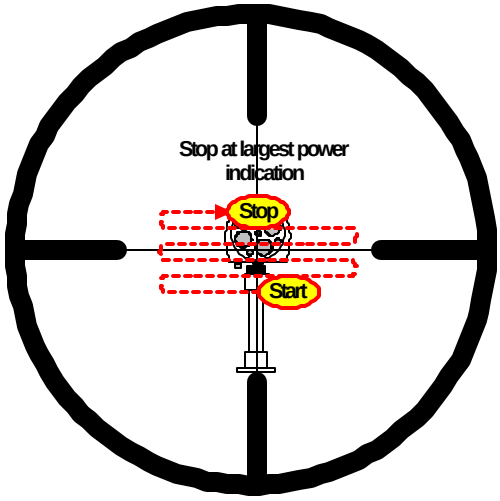
- ❑ Turn only the Power Switch ON for each linkhead.

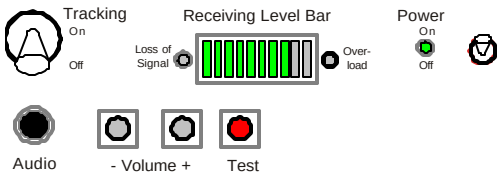
**DO NOT TURN ON THE TRACKING SWITCH UNTIL AFTER YOU HAVE DONE A CAREFUL ALIGNMENT AND OBTAINED THE MAXIMUM POWER READING POSSIBLE WITH TRACKING OFF!**

- ❑ The system will perform self-diagnostics and will center the tracker range of motion and will also open wide the APC. This can take up to three minutes.
- ❑ The power bars and the LEDs will flash in many strange ways during this self-test. Ignore them.
- ❑ The linkhead will make noises as the motors center the tracker and open the APC. This is normal.

***DO NOT ATTEMPT TO ALIGN THE SYSTEM UNTIL THE POWER-UP SEQUENCE IS COMPLETE***

- ❑ Push the Test button ON for each linkhead so that they begin transmitting laser signal over the Free Space link.
- ❑ The red Test switch LED on the back panel should be illuminated and the Data In LED should blink.
- ❑ The Transmit Power should be in the High position. (New models don't have the switch – they are always in High Power.)
- ❑ THE TRACKER REMAINS OFF!



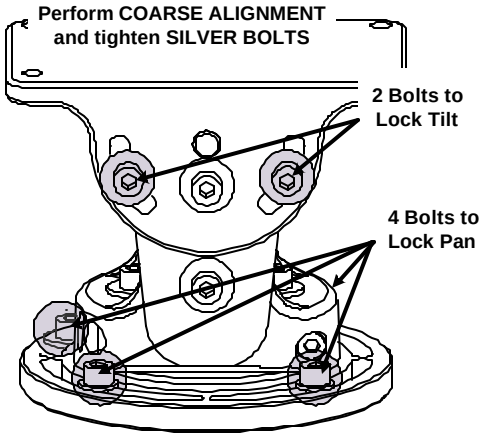

**Rear Panel Indicators on Linkhead**

**Step 4**
**Move the linkhead by hand until you see strong power indications on both rear panels**

- Slowly move one linkhead at a time in a pattern of movement back and forth (pan) then up and down (tilt) until you see an indication of received power. Continue until you have the largest number of bars of power that you can get.
- You may see the Overload light flashing - this is OK. It will be a sign that you have good alignment and will be corrected when the Power Control is set.
- You may see the power bars fluctuate quickly – this is OK. The APC is not operating, so the receiver is wide open and is subject to overload.
- Persist to obtain the maximum power bars that you can. When you have the maximum power bars with the tracker off, you are centered in the Field of Regard and the coarse alignment is complete.

***BOTH ENDS SHOULD HAVE THE SAME POWER READING PLUS OR MINUS ONE BAR***

***MOVE ONE LINKHEAD AT A TIME AS YOU DO THE COARSE ALIGNMENT***

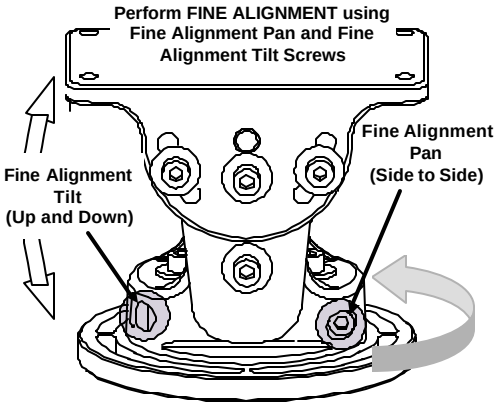



**Step 5**
**Tighten the six Silver Coarse Alignment bolts**

- ❑ When the power is at the maximum level, tighten the six Silver bolts on the Pan and Tilt assembly.

There are four bolts around the base and two bolts on the side of the top table section of the Pan and Tilt assembly.

***TIGHTEN THE SIX BOLTS AS TIGHT AS YOU CAN USING THE HEX WRENCH SUPPLIED***



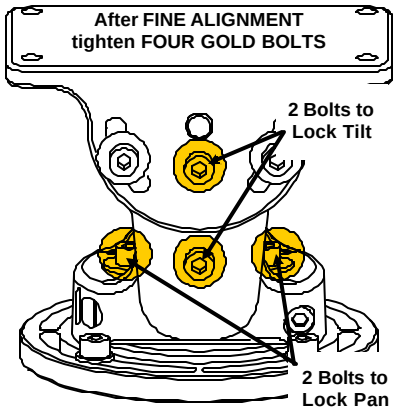

**Step 6**
**Tune and refine the alignment using the Fine Alignment Adjuster screws**

It is usually best to start with the aim a little low adjust back and forth in one complete sweep. Then turn the tilt adjuster screw 1/8 turn to raise the linkhead angle and repeat the back and forth movement. Stop when you have reached the highest reading you can obtain by panning back and forth.

- ❑ Now proceed to find the best tilt angle using the rear pan adjuster screw to tune the receive level up and down to find peak power.

Move only one linkhead at a time.

***OVERLOAD CONDITION MAY OCCUR ON SHORTER SHOTS. THIS IS NORMAL!*** It will often be a sign that you have good alignment and will be corrected when the Power Control is engaged.

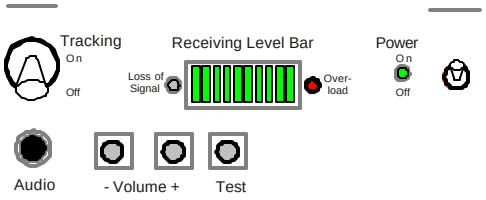



### Step 7
### Tighten the four Gold Fine Alignment Bolts

- When the fine alignment is complete, tighten the four Gold colored Fine Alignment bolts.

There are two bolts on the base and two bolts on the side of the top table section of the Pan and Tilt assembly.

***TIGHTEN THE FOUR BOLTS AS TIGHT AS YOU CAN USING THE HEX WRENCH SUPPLIED***




**Rear Panel Indicators on Linkhead**

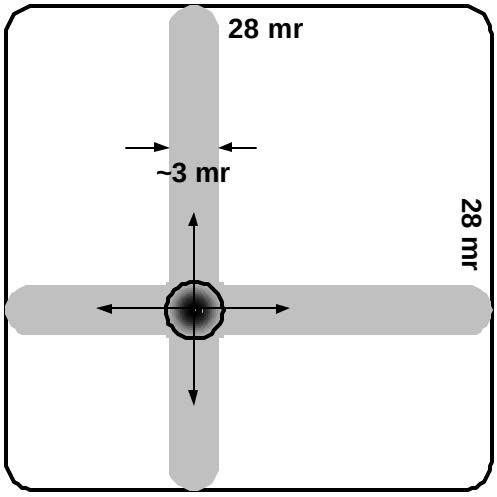
### Step 8
### Turn off the Test Signals

- On both linkheads, Re-set the Test switch to the Test off position – LED dark.

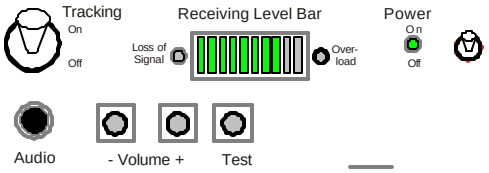
***TURN THE TEST MODE SWITCHES OFF AFTER THE LINKHEADS ARE ALIGNED. DATA WILL NOT PASS THROUGH THE SYSTEM IF EITHER LINKHEAD IS LEFT IN TEST MODE***

***TEST MODE WILL TIME OUT AFTER 50 MINUTES IF THE TEST BUTTON IS NOT TURNED OFF.***

You should not attempt to run long duration tests using the test mode button because it will time out automatically. You must apply a valid data stream to the linkhead using a test set or network traffic to maintain the FSO signal for long term testing.




**Tracker will search for the best position within its range of operation.**




**Rear Panel Indicators on Linkhead**

**Step 9**
**Turn ON the automatic Tracking/Power Control switch**

- ❑ Turn Tracker/AGC on and allow system to optimize.

***DO NOT PAY ANY ATTENTION TO THE POWER BARS OR ANY OTHER INDCATORS FOR AT LEAST FOUR MINUTES AFTER YOU TURN TRACKING ON.***

- ❑ Power bars will level off at around 7-8 bars if during alignment you had greater then 7 bars, but will change as the tracker finds the best position.
- ❑ The power bars will fluctuate as the tracker senses the perfect position. The motors will turn off and on. The system will make some sounds as the motors operate.

***TRACKER MUST SEE AT LEAST FOUR BARS OF POWER BEFORE IT WILL FUNCTION. YOU MUST ACHIEVE AT LEAST FOUR BARS DURING THE ALIGNMENT PROCESS***

- ❑ Tracker is finding the perfect position for the best power levels for optimum performance. When it is done with the initial alignment, the tracker will only run every 15 to 25 seconds.

***INTIAL POSITIONING MAY TAKE UP TO FIVE MINUTES. THIS IS NORMAL***

- ❑ Once the tracker has finished and APC is stable at 7-8 bars (less bars will show on longer links), the system is at optimum alignment and receive power. In this position, the tracker can work across the full ± 14 mr and the APC attenuator has set the receiver level for best performance.

### 2.10.1. Alignment Troubleshooting tips

**Tip 1**

If you cannot get a signal, confirm that the linkhead is transmitting through Free Space with its lasers by checking that the power is on and that the Test switches are still in the ON position on both linkheads.

- ❑ The red Test switch LED on the back panel should remain illuminated through the alignment procedure.

**Tip 2**

Keep watching the receive power level bar graph as you slowly move only one of the linkheads. At least three signal level bars will be quickly illuminated when you pass through the alignment range. Evan a small flicker of power is an indication that you have alignment for a moment. Return to that position and make small movements.

**Tip 3**

Before you leave, re-tighten all locking screws and reset the test switch to the Test off position – LED dark. After the linkheads are aligned it is important to switch both Test mode switches off. Network traffic will not pass through the system if either one of the linkheads is left in Test Mode. Replace the Hex wrench.

### 2.10.2. Audio Fine Alignment Procedure (Optional)

In TEST MODE the linkhead also sends out a 1 kHz tone through the headphone jack. Use this tone to align the linkheads so that the volume of the 1 KHz test tone reaches its loudest sound level.

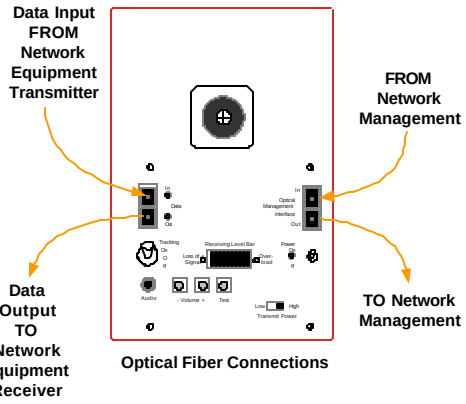
All procedures are identical to the power indicators provided by the LED bar graphs. A louder tone means more power. An overload condition is still possible but must be confirmed visually.

## 2.11. Network Data (Optical Cables) Connections

**Step 1** **Connect the fiber optic data network cables from the network interfaces to the linkheads.**

- ❑ Connect DATA OUT (TX) from the network interface to the DATA IN (RX) port (SC connector) on the linkhead.
- ❑ Connect DATA IN (RX) from the network interface to the DATA OUT (TX) port (SC connector) on the linkhead.

**Note:** The receive power levels may drop approximately 1 bar when the network interface fiber optic cables are attached. This is normal.

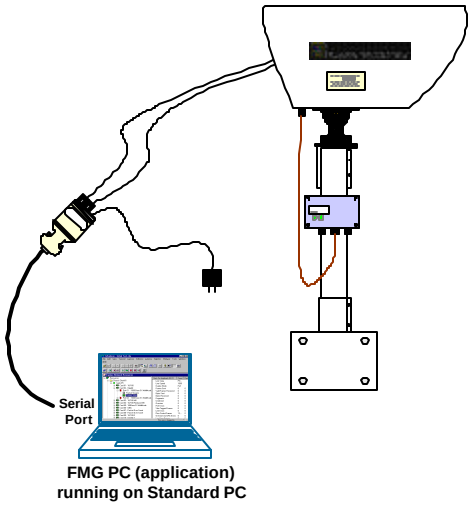



Optical Fiber Connections

**(OPTIONAL) Step 2**

**Connect the fiber optic OMI interface to the linkhead**. Multimode linkheads provide a multimode interface, Single mode linkheads provide Single mode OMI interface.

- ❑ FMG PC Local Craft Access Mode: Connect the OMI Bidirectional Optical converter to the optical patch cords from the OMI ports (Data ports are SC optical connectors) on the linkhead. The converter may be directly attached to the 9-pin COM port on a Windows PC or to a standard DB 9 extender cable and then to the COM port on the PC. See Figure 3-1




- ❑ SNMP remote monitoring mode is also possible. To monitor the linkhead with SNMP requires additional equipment. An external SNMP Proxy Agent (FMG LDX) can be connected to the linkheads (FMG LDX or HDX) with optical patch cords from the OMI port (SC connector) in place of the Serial FMG PC application

See Section 3 of this manual for a complete explanation.

**Step 3**

**Close and secure the linkhead back panel doors** on both linkheads. The rear door is critical to the sealing of the unit from dust and moisture. Remember to replace the hex wrench.

***The Installation, Alignment and Connection procedures are now completed.***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## 2.12. Rear Panel Display and Operation

Figure 2-13: shows the displays, controls, and indicators on the back panel of the linkhead. Table 2-3 describes these components.

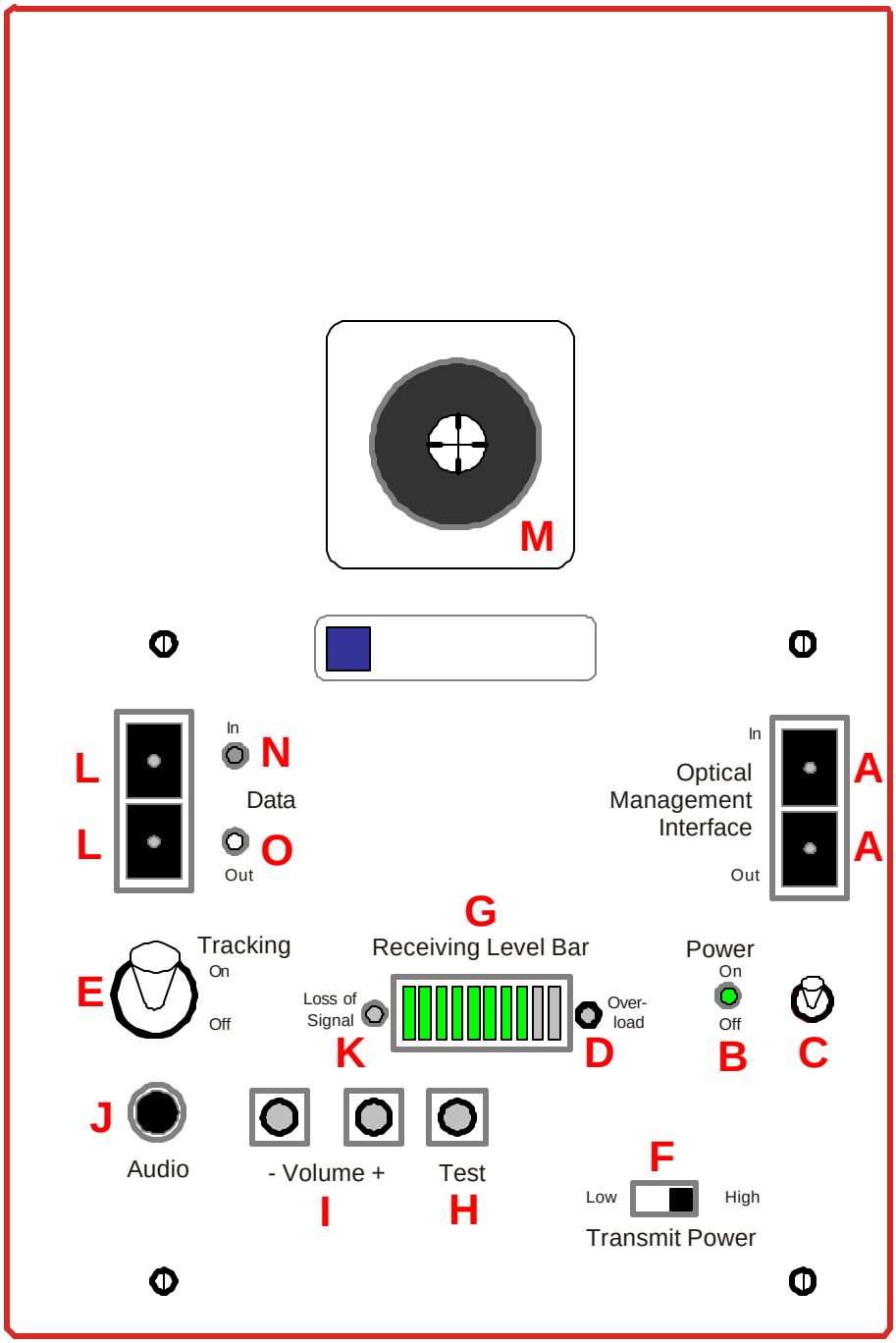



*Figure 2-13: Linkhead Back Panel*

**Check for normal operation of the linkhead system by observing the LEDs and bar graph displays on the back panel of each linkhead.**

**Table 2-4: Linkhead Back Panel Displays, Controls, and Indicators**

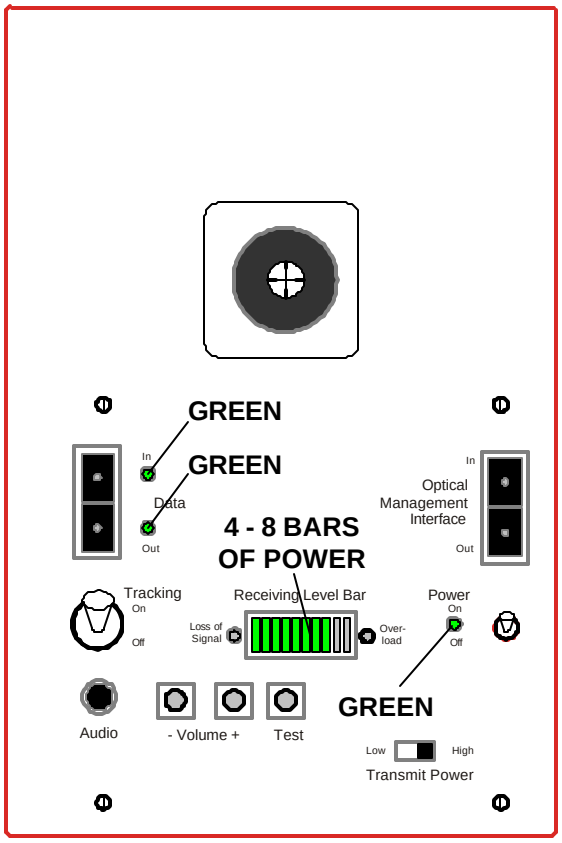
| | Back Panel Item | Description |
|---|---|---|
| **A** | OMI Input/Output | OMI Fiber connections for Input and Output (SC-connectors Mode is same as Data Connectors) |
| **B** | Power Switch LED | Green LED when power is on. Off when power is off |
| **C** | Power (tilt) Switch | Main power switch to linkhead |
| **D** | Receiver Overload LED | Normal State is OFF. LED is RED if the Free Space interface receiver is receiving too much power. Automatic Power Control will correct for Overload |
| **E** | Tracker/Automatic Power Control Switch | Turns both tracking and automatic power control functions on or off |
| **F** | Transmit Power Switch | Free Space laser transmit power level – always use the High power setting<br>Newer units don't have a switch they are factory set to high power |
| **G** | Free Space Receive Level LED Bar graph | Normal State is 6 to 9 bars of power. This will give the best performance |
| **H** | Test Mode (push button) Switch | Normal State is OFF. LED is RED when Test Mode is active. Activates the test mode and sends laser test signal over the air |
| **I** | Volume Control (push button) Switches | Normal State is OFF. Volume Control for 1KHz audio test signal. LEDs flash if test signal is received at the Free Space interface. As volume is adjusted, flashing stops at high and low limits |
| **J** | Head Phone Connector jack | 1KHz audio test signal output jack |
| **K** | Loss of Signal LED | Normal State is OFF. LED is Red if the Free Space receive level is too low for proper operation |
| **L** | Data Input and Output connectors (SC-connector – SM or MM) | Data input and output from the network to Free Space Wireless Optical linkhead can be either Singlemode or Multimode 1300 nm optical interface |
| **M** | 4X Telescope | Used to establish initial system alignment |
| **N** | Data In LED | Normal Sate is GREEN. LED is RED when no network data signal into the linkhead present |
| **O** | Data Out LED | Normal State is GREEN or Yellow. LED is OFF when no signal is transmitted from the linkhead to fiber network |

Check the following displays for unit power and receive power status:

**Table 2-5: Bar graph and LED Operational Checks**

| Display | Back Panel | Description |
|---|---|---|
| Bar graph | **G** | Current receive power level (should be 6 to 9 bars). |
| Power LED | **B** | GREEN when power supply is turned on |
| Data In LED | **N** | GREEN when receiving input from the network interface |
| Data Out LED | **O** | GREEN or Yellow when receiving data from the far side linkhead |

Please contact your distributor or reseller Technical Support if one of the red LEDs is illuminated and if you cannot fix the problem by using the troubleshooting procedures in Section 5.




LIGHTPOINTE

# 3. FlightManager Optical Management Interface

The FlightManager capability for LightPointe's FlightTransport products is addressed in a separate manual, the FlightManager PC Software User's Guide (Document 505-003098-00000). Please refer to this manual for information concerning the local monitoring of the linkhead and how to use this capability to assist in trouble-shooting linkhead performance.

## 3.1. Optical Management Interface Connection

The following diagram shows how to connect the Optical Management Interface (OMI) fibers to the linkhead to monitor linkhead and perform system troubleshooting activities on a Windows PC. The connection to the PC uses a 9-pin serial Optical Management Interface Converter furnished with the linkhead.

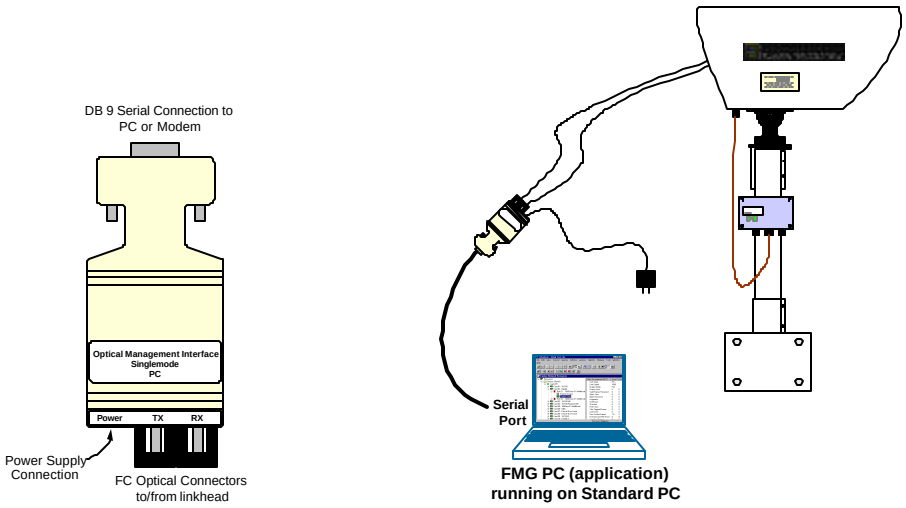



*Figure 3-1: Direct OMI connection for Network Management*

The data is transferred both directions to/from the linkhead to a Windows PC running FMG-PC software through any Serial Port.

OMI monitoring requires two fiber optic cables and a Serial Optical converter that is supplied with the linkhead. Singlemode linkheads are equipped with Singlemode OMI transceivers and multimode linkheads are equipped with multimode OMI transceivers.

Please refer to the FlightManager PC Software User's Guide for full details on connecting and using the OMI capability.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# 4. Maintenance

## 4.1. Scheduled Maintenance

In general FlightStrata systems are maintenance-free. Maintenance is typically limited to cleaning the front window of the linkhead in the case of a drop in receive power levels.

Except for the rear door, do not attempt to open the housing, as there are no user-serviceable parts inside.

### 4.1.1. Linkhead Front Window

As required, clean the front window of the linkhead semi-annually. Use only a soft, moist cloth and water for cleaning. You may need to clean the window more often in dusty, salt spray or other dirty environments.

### 4.1.2. Field of View

Periodically check the linkhead line of sight for obstructions such as trees or buildings that were not originally in the line of sight.


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# 5. Troubleshooting and Diagnostics

This chapter covers the following main topics

- Failure types
- Fault isolation troubleshooting charts
- Additional troubleshooting methods
- Technical support
- RMA procedures

The linkheads can be thought of as nothing more than fiber pipes through free space that are used to move data. No processing of data occurs within the linkheads. If the linkheads are aligned and data is moving between them, the problem is usually outside the system.

## 5.1. Failure Types

Three different kinds of failures can affect system performance:

- Failures caused by attached network components
- Failures caused by the environment
- LightPointe system failures

The most important error detection functions can be performed from the PC running FMG PC and using the Optical Management Interface that allows you to pinpoint the failure precisely (refer to Section 3, FlightManager Optical Management Interface). More detailed troubleshooting can be done through the optional FMG LDX or FMG HDX SNMP Proxy Agent if it is installed in your system.

**Caution:** If a failure is found in the power supply unit, please remember that only authorized technical personnel may conduct checks of the AC input to the power supply. In all cases, the linkhead should always be disconnected from the AC or DC power supply for maintenance.

### 5.1.1. Network Component Problems

There are a number of network-related problems that can cause the optical transport systems to malfunction.

**Table 5-1: Networking Equipment Problems**

| Network Problem | Effect on the Optical System |
|---|---|
| High output signal power of router/switch, etc. | Saturated Data transceiver at the linkhead Data In port. This usually occurs with Singlemode inputs that are too hot for the linkhead transceiver |
| Bad network input signal | System failure or high BER due to a faulty or intermittent fiber patch cord connection |
| Input and Output cables reversed | Incorrect signal at the linkhead<br>THIS IS A VERY COMMON PROBLEM! |
| Cable length violation | Low signal strength at the linkhead |
| New network equipment or Configuration added | Network equipment and/or network software incompatible with linkhead has been added or changed |
| Optical fiber or SC optical connector is damaged | No or weak signal at the linkhead |
| Free-space optical signal weak | Usually Environmental Problem causing Loss Of Signal between the linkheads. Observe the line of Sight to confirm that the Input Power on the power bar indicators on the back of the linkhead. |
| Incorrect optical wave length | 1260 - 1360 nm network interface (standard 1300 nm) required for both Singlemode and multimode inputs. 850 nm will not work. |

### 5.1.2. Environmental Problems

There are a number of environmental problems that can cause the optical transport systems to malfunction:

- Smoke emissions
- Fog, snow, or heavy rain
- Heat turbulence (shimmer)

## 5.1.3. System Failures

### Checking Data IN/OUT LEDs

The Data Out (Transmit) and Data In (Receive) LEDs can be used to identify data transmit and receive problems.

**Table 5-2: LED Operational Checks**

| Data IN | Data OUT | Description |
|---|---|---|
| Green | Green or Yellow | Normal Transmit and Receive of network traffic |
| Red | Green or Yellow | Missing data from the local network into the linkhead<br>Data from Free Space (far side) is OK |
| Yellow | Off | Missing data from the Free Space link (far side)<br>Data from the network into the linkhead is OK |
| Red | Off | No network interface communications |
| Blinking Red/Yellow | Yellow | System in Test mode |

### Operational Check

An operational linkhead will display the following status at the back panel. If any of the settings or indicators is different than those below, refer to Section 5.2, Fault Isolation Troubleshooting Trees.

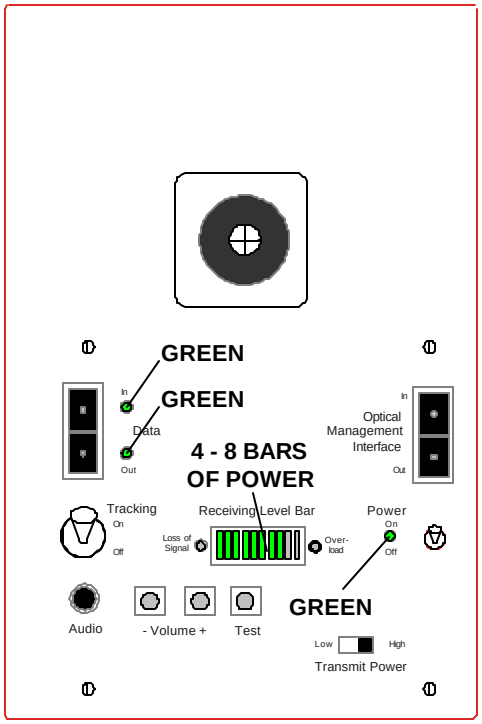



*Figure 5-1: Normal Back Panel Display*

## 5.2. Fault Isolation and Troubleshooting without OMI

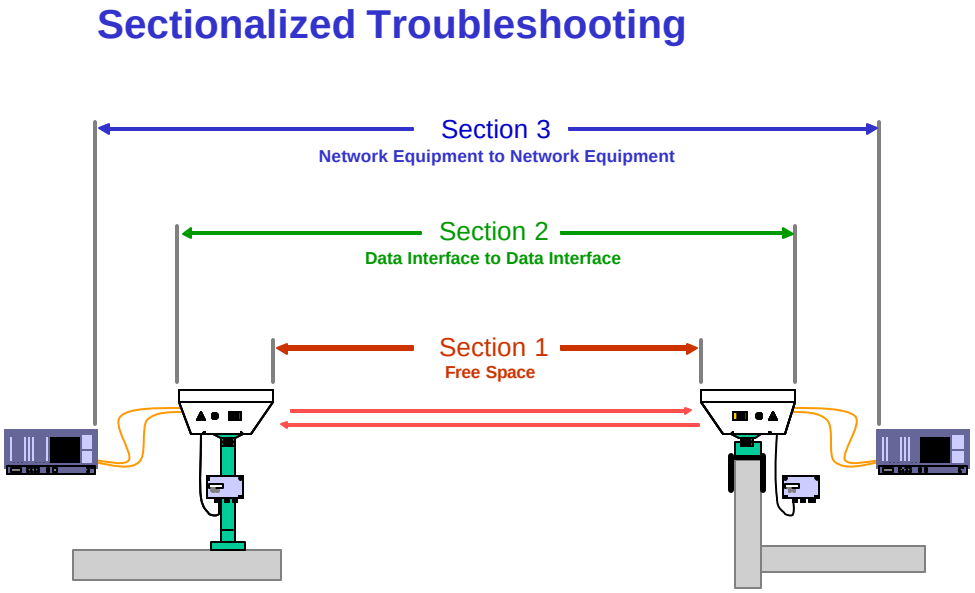


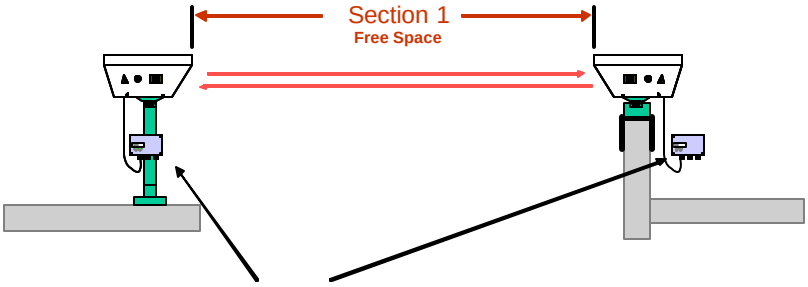

*Figure 5-2: Sectionalized Troubleshooting*

It is useful to take a Sectionalized approach to troubleshooting these systems. Assuming that the installation is completed properly, that proper alignment is achieved, and that power is present at the linkheads. Proceed in a step by step manner to analyze:

- Section One – the Free Space section of the circuit from FSO Transceiver across space to the other end FSO Transceiver.
- Section Two – the Data Interface section of the circuit from the rear interface of one linkhead across space to the rear interface to the other linkhead.
- Section Three – the Data interface from the Network Equipment fiber transceiver of one end through the optical patch cords to the linkhead interface and across space to the Network Equipment on the far side.

The following idea charts can be used to troubleshoot the FlightStrata system.

## Free Space Section - Power



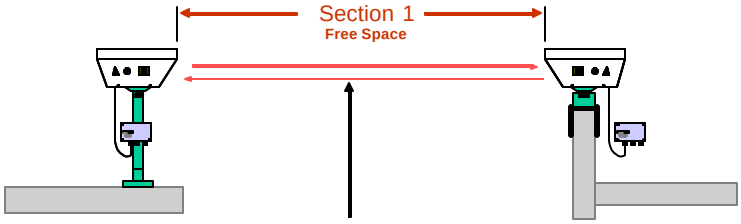

**External Power Supply**

**a) Commercial Power Input option switch set correctly to 115 or 230 V**
**b) Power Supply input light is on**
**c) Power Supply output light is on**
**d) DC input and output connectors tightened**

**Test OK Criteria**
a) Power light at Linkhead
b) 9 – 16 VDC at input to linkhead

*Figure 5-3: Troubleshooting Section 1 – Power to linkheads*

## Free Space Section – Line Of Sight




**Line Of Sight Issues**

**a) Weather/Visibility**
1) Fog – far end is visible
2) Rain – far end is visible
3) Vapor or Steam – far end visible
4) Scintillation – no dark, reflective surfaces in path

**b) Realign using power bar indicators**

**c) Distance**
1) Calculate Fade Margin
2) Verify number of power bars
3) Too close – saturation/reflection

**d) Sun Saturation**
1) Predictable pattern
2) Relocation/Blocking

**e) Human Factors**
1) New Construction
2) Foot Traffic
3) Accidental blocking of beam
4) Machinery/Crane/Window washing equpt.
5) Vapor or Steam

**f) Check Laser output with phosphor card**

**Test OK Criteria**
- 5-9 Bars of Power at both ends balanced
- Saturation indicator is not lit
- No reflected power when one linkhead is turned off

*Figure 5-4: Troubleshooting Section 1 – Good Line of Sight*

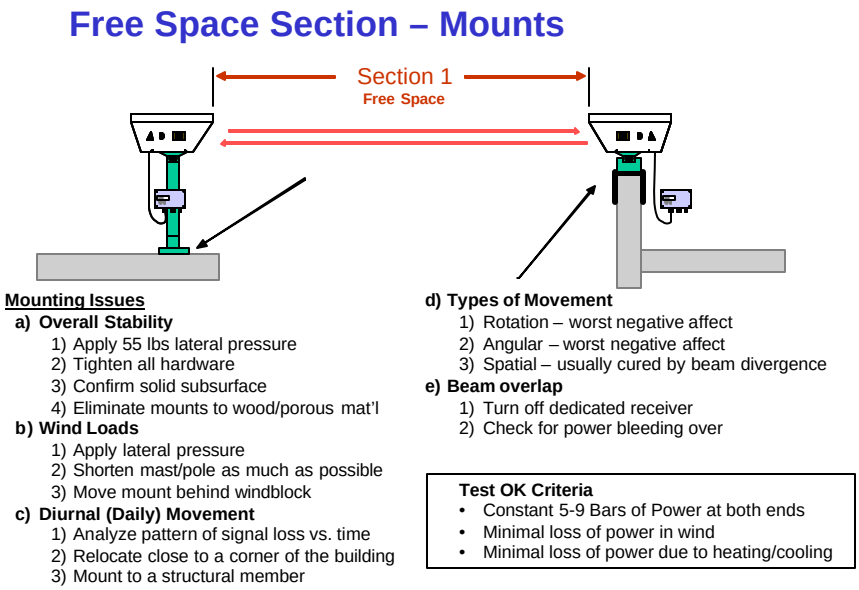



*Figure 5-5: Troubleshooting Section 1 – Stable mounts at both ends*

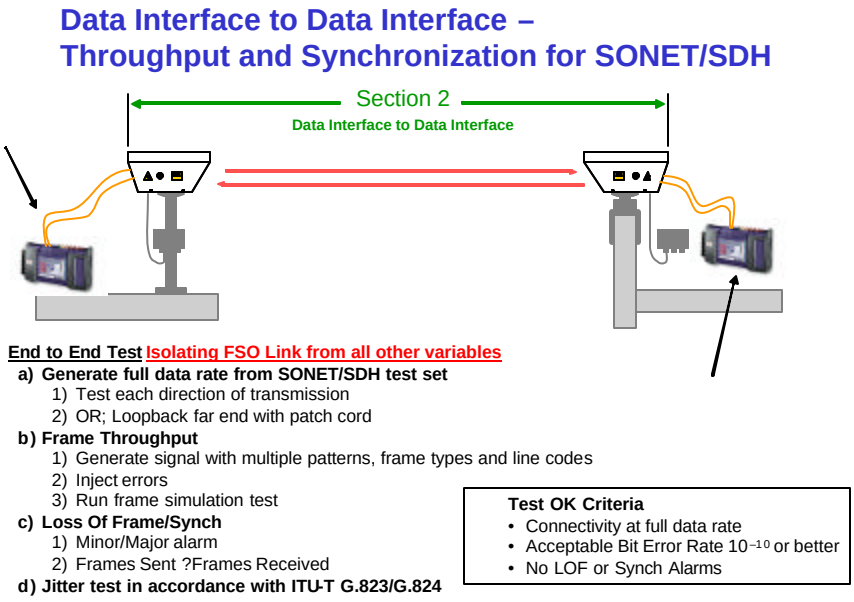



*Figure 5-6: Troubleshooting Section 2 – SONET/SDH testing*

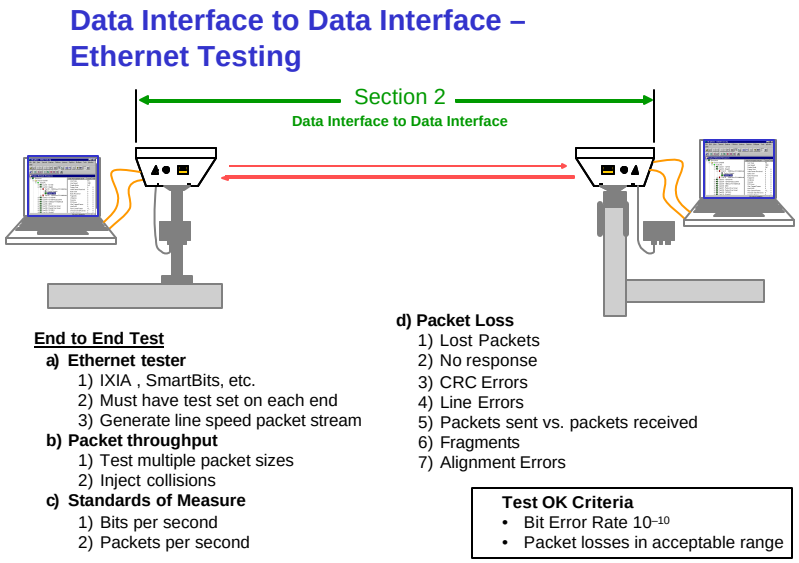
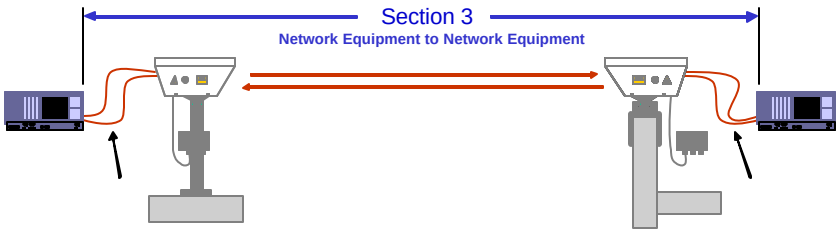



*Figure 5-7: Troubleshooting Section 2 – Ethernet Testing*

## Network Equipment to Network Equipment – Patchcords and Fiber cabling




**Patch Cords and Connectors**

**a) Patch Cords Reversed (most common problem)**
1) Out to IN -- IN to OUT

**b) Length of Fiber Data Feeds in/out of linkhead**
1) MM = 2,000 meters (or less)
2) SingleMode = 10,000 meters

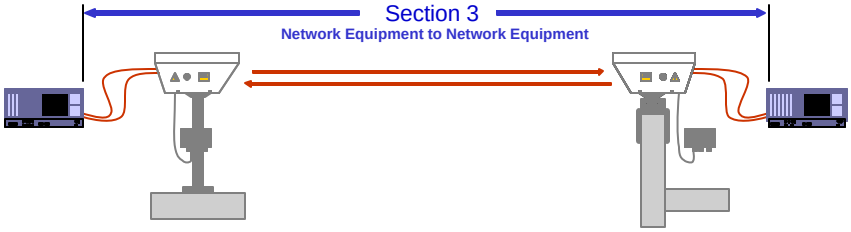
**c) Damaged Strand/Connector**
1) Measure with Power meter at far end outputs
2) Damaged/Unseated Connectors measure loss of patchcord end to end

**d) Intermediate Connection panels**
1) Paths Reversed – confirm continuity with power meter
2) Consistent Singlemode OR Multimode entire fiber path

**Test OK Criteria**
- Power transmitted appears at RX of Linkhead
- Power is at proper level
- Optical wavelength is correct usually 1310 nm

*Figure 5-8: Troubleshooting Section 3 – Patch cord & fiber connections*

## Network Equipment to Network Equipment – Inputs and Outputs




**Inputs and Outputs to and from Data Equipment**

**a) Optical Interface (Transceivers)**
1) Levels
2) Wavelengths

**b) Data Rate**
1) 1.5 – 155, 622, 1250, 2500

**c) Digital Signal**
1) NRZ, Etc...

**d) Valid Data Format**
1) Garbage in; Garbage out
2) Consistent Singlemode or Multimode entire path
3) Timing source is correct (Loop, Clock)

**Test OK Criteria**
- Levels match specification
- Proper Data rate
- 1300 nm interfaces
- Higher Layer session OK

*Figure 5-9: Troubleshooting Section 3 – Network Equipment*

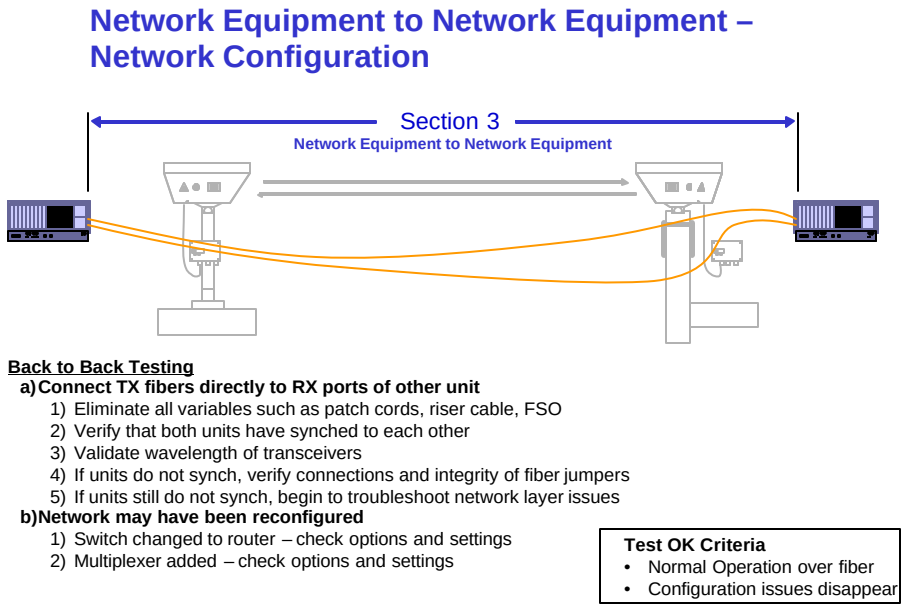



*Figure 5-10: Troubleshooting Section 3 –Test back to back*

## 5.3. Additional Troubleshooting Methods

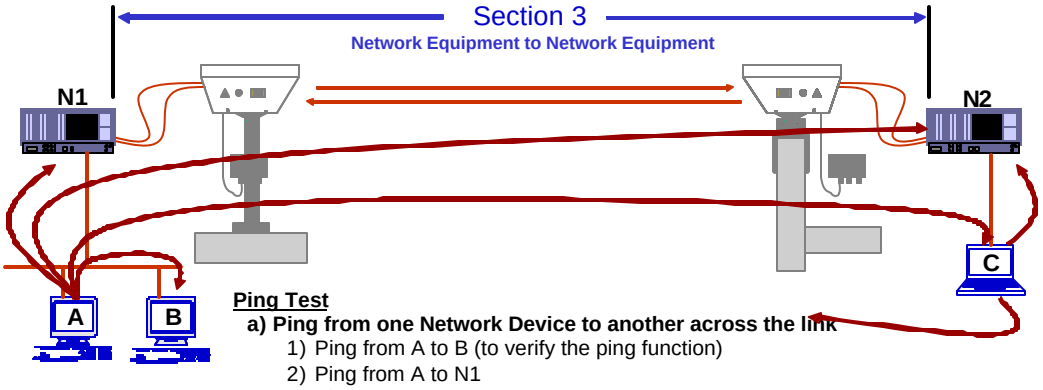
### 5.3.1. Ping Test Setup

The following equipment and software are required to perform a ping test.

- Two laptops with Ethernet cards
- Ethernet cables with RJ45 connectors
- RJ45 to Optical Cable 10/100mbs Media Converters
- Four optical fiber cables with SC connectors

The connections shown in Figure 5-11 are required to perform the field diagnostic ping tests.

# Network Equipment to Network Equipment – Ping Test




**Ping Test**

**a) Ping from one Network Device to another across the link**

1) Ping from A to B (to verify the ping function)
2) Ping from A to N1
3) Ping from A to N2
4) Ping from A to C
5) Ping from C to N2
6) Ping from C to A

NOTES:
Adjust ping packet size from 64 to 1500 bytes
Example: ping 123.45.789.87–l 1500

**Test OK Criteria**
- Bit Error Rate $10^{-10}$ or better
- Ping rate of 10 Ms or less

*Figure 5-11: Ping Test Setup*

**Note**:

This ping test is based on using two computers. It is possible to do a ping test with one laptop if the remote linkhead is connected to the network and there is a known IP address that can be pinged through the remote linkhead.

### 5.3.2. Optical Link Ping Test

You can use a laptop with transceiver to send signals to the LightPointe system and perform a loopback test.

**Step 1** Locate all required equipment (refer to section 5.3.1).

**Step 2** On each side, attach two optical fiber cables to the linkhead Data IN/OUT ports. Connect the opposite ends of the fiber cables to the Media Converter IN/OUT ports.

**Step 3** Connect an Ethernet cable between the PC RJ45 network port and the media converter RJ45 port on each laptop and complete the following steps on each laptop.

**Step 4** From Windows click the **Start** button.

**Step 5** Click on **Settings.**

**Step 6** Click on **Control Panel.**

**Step 7** Click on the **Network And Dial-Up Connector** icon.

**Step 8** Click on **Incoming Connection.**

**Step 9** Click on the **Network** tab**.**

**Step 10** Double click on **Internet Protocol TCP/IP**.

**Step 11** Select the **Specify TCP/IP Address** radio button.

**Step 12** The near side should type **168.101.1.10** in the IP Address Box. The far side should type **168.101.1.11** in the IP address box. The Subnet address will automatically generate.

**Step 13** Click the **Okay** button.

**Step 14** Exit all dialog boxes.

**Step 15** Click on the **Start** button.

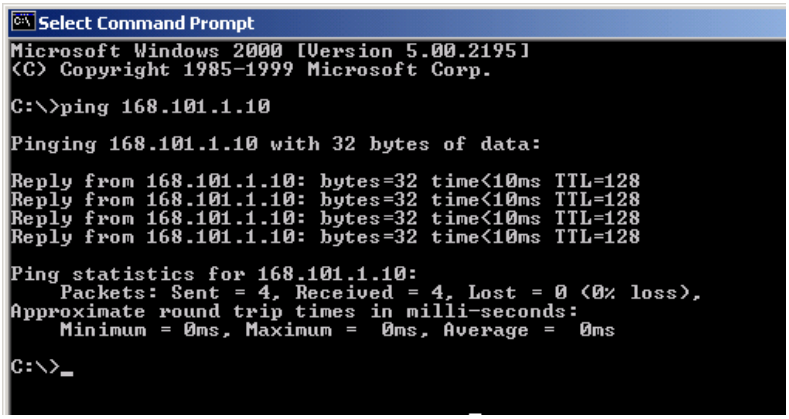
**Step 16** Select **Programs**.

**Step 17** Select the **MS-DOS** Prompt.

**Step 18** The near side laptop type in the far side IP address. From C:\> Type: **ping 168.10.1.11 -T.** The far side laptop can ping by typing: **ping 168.10.1.10 -T**.

To stop the ping tests, type **<Ctrl> C** on each laptop.

**Step 19** A successful ping will display the following information on the PC screen.




**Step 20** If you block the FOV (field of view) of the linkhead and ping, the PC screen should read "unreachable parameters".

### BER Test

Bit Error Rate (BER) correlates directly with a cable's attenuation and cross talk measurements. Bit Error Ratio increases as attenuation and/or cross talk increases.

A BER tester can be used to monitor the LightPointe System. Once the system has been placed in loopback mode, the BER tester is used to generate a test pattern over the looped line, read the received looped data, and report on the error rate.

Results can be automatically logged to a printer or disk to help isolate intermittent problems. The degree of error is usually expressed fractionally or as an exponential relationship between good data and data errors.

Refer to your BER tester manual for setup and operating instructions.

## 5.4. Technical Support

- ❑ Did you complete the steps in the Fault Isolation guidelines?

### 5.4.1. Checklist before You Call Technical Support

- ❑ Be sure to fill out the following checklist before contacting LightPointe Technical Support.

| General Information | Your Installation |
|---|---|
| ❑ Application (Protocol)? | |
| ❑ Distance? | |
| ❑ How long has system been in operation? | |
| **How does the error show up?** | |
| ❑ Temporary/permanent error? | |
| ❑ Is error observed for the first time? | |
| **How was the weather when error showed up?** | |
| ❑ Light or Dark? | |
| ❑ Weather conditions (fog, snowfall) | |
| ❑ Outside temperature | |
| **Status of Back Panel LEDs** | |
| ❑ Are all red LEDs off? | Yes/No |
| ❑ Data In / Data Out? | Color of each? |
| ❑ How many bars does the bar graph indicator show? | |
| **Status of Back Panel Indicators** | |
| ❑ Connection to network | Yes/No |
| ❑ Failure of endpoint equipment | Checked/Not Checked |
| **What type of system is installed?** | |
| ❑ Warranty registration sent to LightPointe | |
| ❑ Model number | |
| ❑ Serial numbers | |
| ❑ Singlemode or multimode | |

## 5.5. Return Material Authorization (RMA) Procedure

Please contact LightPointe before returning any system components for repair or replacement.

RMA products include:

- Linkheads
- Standard power supply
- FMG LDX or FMG HDX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# 6. Specifications

**Table 6-1: FlightStrata 155 System Specifications**

| | FlightStrata 155E and 155EW | |
|---|---|---|
| Description | Four TX, Four RX System | |
| Dimensions | 11.8 x 11.8 x 25 inches<br>30.0 x 30.0 x 64.0 cm | |
| Weight | 29.7 lbs / 13.5 kg | |
| Linkhead input voltage | 12 – 16 VDC | |
| Power Supply operating voltage | 115 / 230 VAC (50/60 Hz) or<br>± 48 VDC | |
| Power consumption | Max. 20 W | |
| Operating temperature | -13° to +140° F (-25° to +60° C) | |
| Relative humidity | Up to 95% (non-condensing) | |
| Bandwidth | 1.5 to 155 Mbps | |
| Recommended Distance | See Table 1.2 | |
| Optical transmitter | VCSEL | |
| Output wavelength | 850 nm | |
| Beam divergence | FSA 155E<br>FSA 155EW | 2.0 mr<br>2.8 mr |
| Laser Output Power | FSA 155E, 155EW | 24 mW |
| Receiver Sensitivity | FSA 155E, 155EW | -45 dBm |
| RX Dynamic Range | 34 dB | |
| Protocol | Transparent | |
| From the Network Information | | |
| Optical Interface | SC connector standard polish | |
| Connection optical fiber | Singlemode:<br>6-9.5 µm inner core<br>125 µm external diameter<br>Multimode:<br>50-62.5 µm inner core<br>125 µm external diameter | |
| Receiver Type | Si APD | |
| Wavelengths Supported | SM:1260 - 1360 nm<br>MM:1270 - 1360 nm | |
| Optical receive power | SM:-8 to -31 dBm<br>MM:-14 to -30 dBm | |
| Optical transmit power | SM:-8 to -15 dBm<br>MM:-14 to -22 dBm | |

LightPointe FlightStrata products are certified eye-safe in accordance with IEC/EN 60825-1 A2:2001 Class 1M.


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# 7. Index