

# Class-L Laser Transmission Systems

**Class-L 155/1000, 2000**

Installation and Maintenance



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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 link heads 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.

**Note:** Power the system down before removing the link head.

## Warranty

Lamon International GmbH 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 contact Lamon International GmbH Customer Service for additional information or to obtain a copy of the Warranty Agreement.

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## Using This Manual

This manual describes how to install and maintain the Class-L 155 systems.

Step-by-step procedures describe:

- ☞ Performing a site review
- ☞ Preparing an installation site
- ☞ Performing a physical installation
- ☞ Performing system connection and alignment
- ☞ Using the Optical Management Interface (OMI)
- ☞ Checking the system for proper operation
- ☞ Performing troubleshooting procedures

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	Software installation, configuration, and display instructions
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 **Lamon International GmbH** system.

Document Number	Title
Not numbered	Field Engineering and Planning Guide





# 1. System Overview

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This chapter covers the following main topics:

- ✍️ The Lamon International Class-L System
- ✍️ Link head devices
- ✍️ Laser safety

## 1.1. The Lamon International Class-L System

### 1.1.1. Free-Space Optical Transmission

Lamon International GmbH wireless optical systems communicate using multi-beam infrared light (invisible to the human eye). The link systems require true line-of-sight between locations or relay locations (hopping points) and operate in high and ultra-high bandwidths.

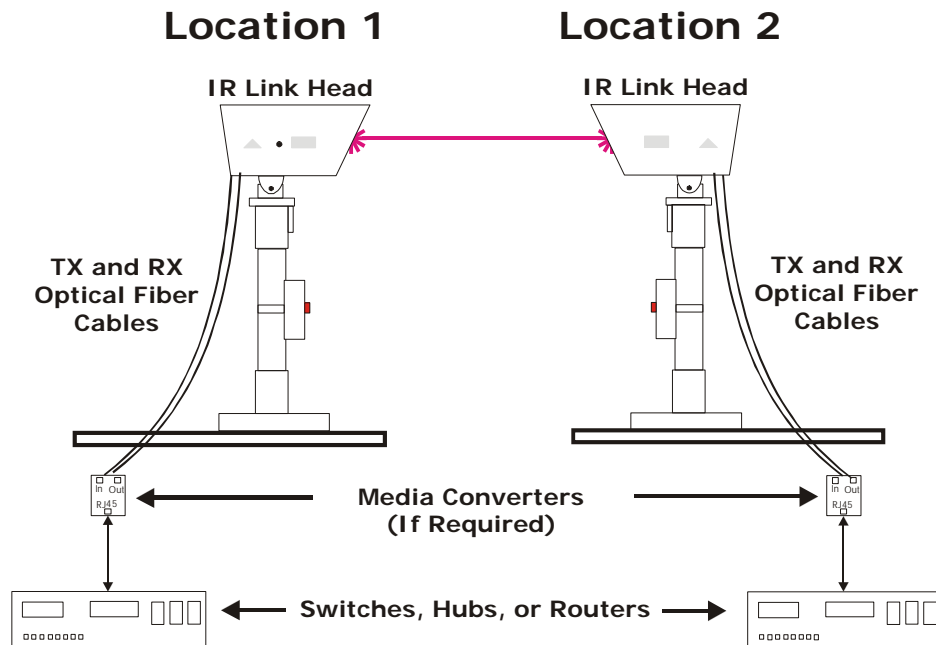


Figure 1-1: Typical Wireless LAN Connection

The link head on the transmission side transmits a narrow infrared light beam carrying the data received from the network interface. The link head on the opposite side receives the beam, filters the optical signal, and places it on an optical fiber that connects with the network fiber interface on the receiving side. The system is capable of operating in a full-duplex mode, transmitting and receiving data simultaneously.

### 1.1.2. Typical Applications

Typical system applications include the following:

- ☒ Wireless backhaul
- ☒ Metro network extension
- ☒ Enterprise/LAN solutions

### 1.1.3. Network Interface Connectivity

The Lamon International Class-L 155 is protocol transparent and can support any current network architecture. The only requirement is a digital signal supplied to the link head via single mode or multimode fiber.

#### Local Area Network (LAN) options

- ☒ Ethernet or Fast Ethernet
- ☒ Token Ring
- ☒ FDDI

#### ATM/ SONET Network options

- ☒ OC-3/STM-1

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

- ☒ PBX systems or intelligent concentrators

#### Mixed Voice/Data Applications options

- ☒ Single/multiple T1/E1 + LAN using external multiplexer equipment

### 1.1.4. Transmission Method

The Class-L 155 system uses four transmission beams to provide a high level of signal redundancy.

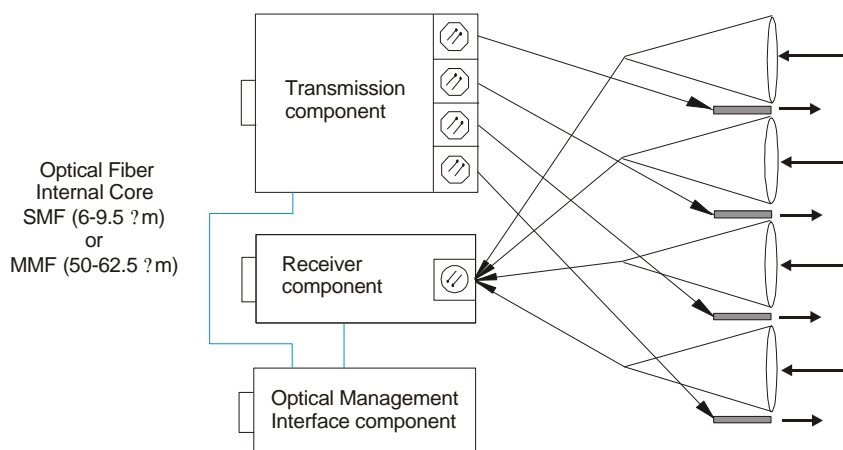


Figure 1-2: Block Diagram of Multi Beam Lamon International Class-L System

### Optical Components

The transmission and receive optics are positioned to make optimum use of the entire front surface of the link head. The sub-assemblies that perform electro-optic conversion are arranged around the optical portion of the system.

### Transmission Components

Four photo diodes convert the optical signals from the network interface into an electrical signal. The electrical signal is used to modulate a high power laser source that transmits an infrared beam into free-space.

### Receiver Components

The receive amplifier converts the infrared signal(s) coming from the free-space path into an electrical signal by using a highly sensitive photo diode. This amplified receive signal drives an optical source that sends the receive signal back to the fiber optic network interface.

### 1.1.5. Class-L 155 Operating Parameters

The system naming convention used by Lamon International GmbH also describes the operational parameters. For example, 155/1000 describes the transmission rate (155 Mbps) and transmission distance (1000 meters). The following tables list operational performance parameters for the Class-L 155/1000 and 2000 systems.

**Table 1-1: Class-L 155/1000, 2000 Operating Parameters**

<i>Bit rate</i>	155 Mbps
<i>Distances</i>	280m to 3900m (1000m, 2000m nominal)
<i>Protocol</i>	Transparent
<i>Transmission power</i>	1000: 1 mW, 2000: 3.9 mW
<i>Beam Divergence</i>	2 mrad
<i>Max. Dynamic range</i>	30 dB

## 1.2. Link Head Devices

### 1.2.1. The Class-L 155/1000, 2000 Link Head

The Class-L 155/1000 is a multi beam transmitter/receiver. The following products belong to the Class-L system product line:

✂ Class-L 155/1000

✂ Class-L 155/2000

The Class-L 155 includes the following main components:

✂ Heatable front window/lens defroster

✂ Multibeam optical assembly with optical fiber connections

✂ Integrated telescope for coarse alignment of the system

✂ Receiver amplifier with APD

✂ Transmitter amplifier with 4 VCSELS

✂ Power supply

✂ Optical management interface card (OMI)

✂ Back panel with system status display and optical level meter

### 1.3. Laser Safety

Lamon International GmbH 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.

The Class-L 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. Never use any optical instruments other than the built-in telescope to view the laser beam.

When using the built-in telescope, you must be aware of the appropriate safety distance (refer to Table 1-2). For distances below the safety distance the operator must wear appropriate eye-protective laser safety glasses. These distances assume an exposure of more than ten seconds.

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

Link head	Naked Eye safety distance	Telescope safety distance
Class-L 155/1000	0	14 m
Class-L 155/2000	0	18 m

The Class-L 155/1000/2000 transmits laser radiation from four separated transmission apertures. These transmission beams start overlapping at a distance of about 100 m. At this distance the radiation density is safe for the human eye when viewed with or without optical magnification.



**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.). To install a Lamon International GmbH FSO system in an *unrestricted* location, the link head must be installed 3 meters high or higher above the surface of the *unrestricted* area or must be 1 meter or closer to the edge of the *unrestricted* area. If a Lamon International GmbH FSO system is installed in an *unrestricted* area, a warning sign must be posted that states **"Do not use binoculars, telescopes or other optical aids to view the FSO link heads."**

*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 Lamon International GmbH 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 Lamon International GmbH 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 inside of the link head near the laser aperture.







## 2. System Installation and Alignment

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This chapter covers the following main topics

- /// Major system components
- /// Recommended installation tools and test equipment
- /// Site review
- /// Site installation preparation
- /// Installation
- /// Link head alignment

### 2.1. Major System Components

#### 2.1.1. Universal Mount Hardware

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

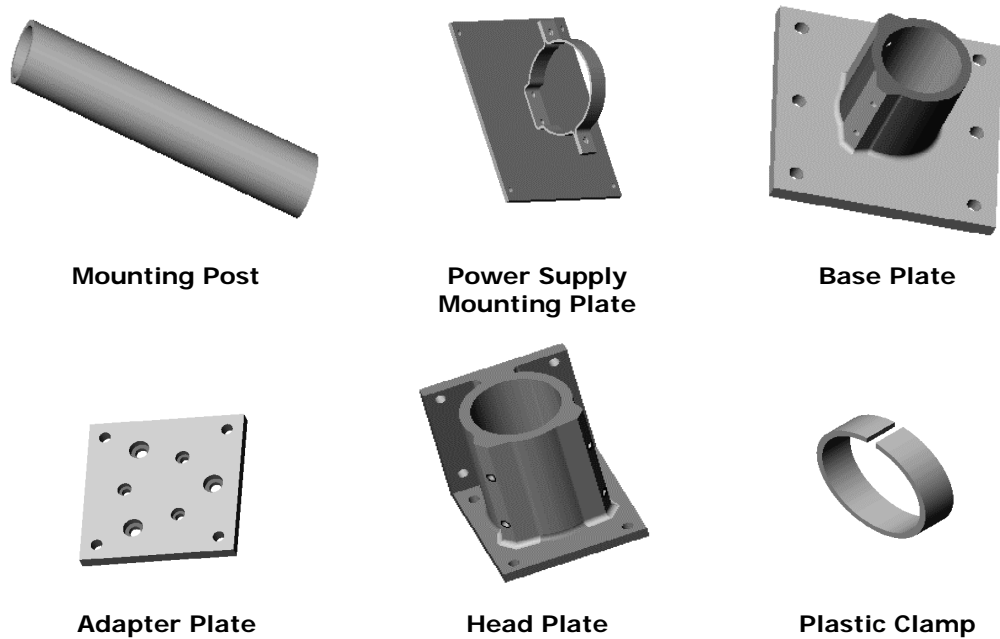


Figure 2-1: Universal Mount Hardware



### 2.1.2. Pan and Tilt Hardware

The pan and tilt hardware is used for coarse alignment of the link head.

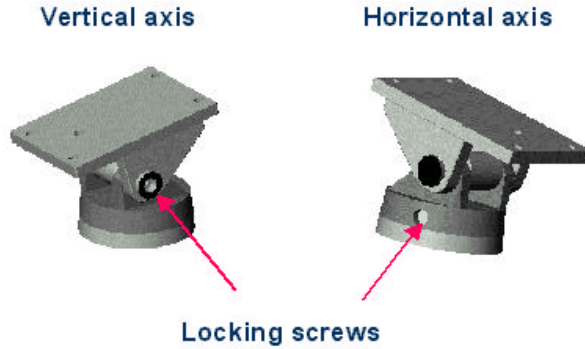


Figure 2-2: Pan and Tilt Hardware

### 2.1.3. Power Supply Assembly

The weatherproof power supply assembly mounts near the link head.

**Note:** In order for the power supply to work, the remote connector plug cap on the power supply must be removed, the interlock connector plug must be inserted into the remote connector, and securely screwed into place. Additionally, the lockable emergency switch (red button) must be in the “on” position (pulled out).

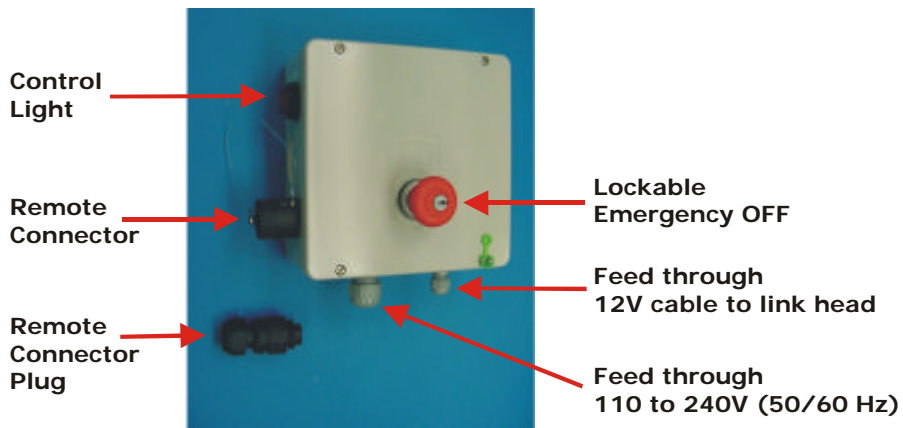


Figure 2-3: Power Supply Assembly

This assembly provides:

- ⚡ 12 VDC power to the link head
- ⚡ A 110 or 240 VAC service connector for test equipment, etc.
- ⚡ Lockable emergency power off switch (key required to apply power)
- ⚡ Main power LED Indicator

## Power Supply

The following power supply is available for the link heads.

**Table 2-1: Power Supply**

Power Supply	Description
FPW AC/12-R	Standard Class-L Power Supply

### 2.1.4. Link Head Assembly

The link head and pan and tilt hardware are mounted on the head plate assembly.

The link head assembly consists of:

- ///A link head cover
- ///Optics, transmission, and receiver assembly
- ///An alignment telescope
- ///Interface back panel



## 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 Lamon International GmbH system hardware.

### Site Surveys:

- ✂✂ Thomas Guide or equivalent map for locating sites and doing rough distance calculations
- ✂✂ Laser range finder or GPS for accurate distance measurement
- ✂✂ Binoculars to assist in locating the planned opposite end installation location
- ✂✂ Sketch pad to make rough drawings and notes (recommend using Lamon International GmbH Field Engineering Guide)
- ✂✂ Tape measure to determine approximate short distance fiber, power runs, etc.
- ✂✂ Camera (digital recommended) to photograph installation sites to reduce need for return visits to sites (optional)

### Installations:

- ✂✂ Standard electro-mechanical tool kit with pliers, screw drivers, wire cutters, wire strippers, etc.
- ✂✂ Two-way radio or cell phones to communicate when aligning link heads
- ✂✂ Optical fiber connector cleaner kit to clean connectors before plugging them into the system
- ✂✂ Plastic tie wraps to secure flexible conduits, etc.
- ✂✂ Two each 6mm hex (Allen) wrenches to supplement wrenches shipped with the equipment
- ✂✂ 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 ensure fiber performance from/to the link head
- ✂✂ The tape measure and camera from the site survey can also be helpful in completing and documenting site installations

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 link head 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 longer recommended)

### 2.3. Site Review

For customer supplied preliminary installation assessment data and detailed site review instructions refer to the Lamon International GmbH Field Engineering & Planning Guide. Use this guide to check the proposed installation against actual Lamon International GmbH installation standards.

**Step 1** Determine the appropriate system to meet the needs of each specific location:

- ☒ ☒ Data rate protocol
- ☒ ☒ Measure point-to-point distance using a laser range finder or GPS
- ☒ ☒ Are both the physical distance of the link heads and the maximum transmission distance at the maximum?
- ☒ ☒ Is a single mode or multimode interface required?
- ☒ ☒ Wavelength of optical interface

**Step 2** Ensure true, free line-of-sight.

- ☒ ☒ Can emissions, trees, or other obstacles in the line of sight interrupt the connection?
- ☒ ☒ Is there a possibility of work activity that could interfere with the transmission of data?
- ☒ ☒ No vents, big flat roofs, or smoke stacks

**Step 3** Ensure transmission security.





- ☒ ☒ The transmission beam is narrow and invisible, making it very difficult to tap into without interrupting the beam path.
- ☒ ☒ Ensure that equipment mounted behind the link heads to intercept the transmission beam would be difficult to hide.

- Step 4** Evaluate environmental mounting conditions.
- ☒ Stable and vibration-free mounting platform
  - ☒ Foundation at the mounting location not susceptible to change due to humidity or temperature
  - ☒ Evaluate the need for a lightning protection system
  - ☒ Use non-penetrating roof mounting hardware if possible
- Step 5** Evaluate mounting locations for system access.
- ☒ Easy access to link heads
  - ☒ Stable location/platform for mounting
  - ☒ Safety considerations for installers and maintainers of the system
- Step 6** Evaluate mounting locations for operational integrity (refer to Section 2.3.1 to see different types of mounts).
- ☒ Near roof edge to avoid interruptions of transmission
  - ☒ Near roof edge to minimize heat (shimmer) effects
  - ☒ Weather protected location if possible
  - ☒ Personnel laser protection considerations
- Step 7** Consider the mount foundation (refer to Section 2.3.1).
- ☒ Penetrating
  - ☒ Roof surface
  - ☒ Wall
  - ☒ Interior floor behind window
- Step 8** Consider mount type (refer to Section 2.3.1).
- ☒ Universal mount (floor or wall)
  - ☒ Other specialized mount






### 2.3.1. Typical Mounting Locations and Platforms

Refer to the following table for examples of different mounting location and details regarding use.

**Table 2-2: Link Head Mounting Locations**

Mount Style	Typical Use
	<p><b>Universal Mount</b></p> <p>Use this mount on normal upright installations where the surface is a solid material that can be penetrated with mounting bolts.</p>
	<p><b>Office Floor Mount</b></p> <p>Use this mount in a laboratory or office environment or when a stable indoor mount is needed for a short period of time.</p>
	<p><b>Mast Side Mount</b></p> <p>Use this mount when there is an existing pole that allows the standard mount to be easily affixed (with U-bolts, brackets, etc.).</p> <p>Make sure that there is no wind influence to the mounting from the other antennas.</p>
	<p><b>Special Custom Mount</b></p> <p>Use this mount based on unique customer needs or requirements.</p>



Mount Style	Typical Use
	<p><b>Wall Mount</b></p> <p>Use this mount when normal horizontal installation into a wall surface can be made with penetrating bolts. The wall material must be solid and deep enough to accommodate the bolts.</p> <p>Mount Power Box with cables at the bottom.</p>
	<p><b>Parapet Custom Mount</b></p> <p>Use this mount when the parapet is of sufficient height and made of solid material. This application does not allow foot traffic in front of the system.</p>
	<p><b>Guy Wire Custom Mount</b></p> <p>Use this mount for taller mast heights and/or where there are sustained high wind loads.</p>
	<p><b>Tower Mount</b></p> <p>Use this mount when significant heights are required for true line of sight.</p>
	<p><b>Multiple Link heads</b></p> <p>Use this mount when multiple link heads are installed at the same location.</p>



## 2.4. Site Preparation

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

### Step 1 Check space requirements.

- ⚠️ Multiple link heads can be co-located at the same site. Multiple link heads should be spaced at least nine feet apart if they are pointed in the same direction. There are no restrictions for link heads pointed in different directions.

### Step 2 Prepare the surface for mounting.

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

### Step 3 Check the available power.

- ⚠️ Ensure that the power cable is long enough
- ⚠️ Use cable of correct diameter and rating
- ⚠️ Be aware of local building code requirements

### Step 4 Check the network interface connections.

The number of connections varies depending on system type and redundancy requirements. *Always pull double the amount of required cables.*

- ⚠️ Determine the fiber type (single mode or multimode)
- ⚠️ Pull at least 8 strands for the Class-L 155 systems if redundancy is desired.
- ⚠️ OMI is *always* multimode

### Step 5 Check Fiber optic cable routing.

The system uses either single mode or 50/62.5  $\mu\text{m}$  multimode fiber.

- ⚠️ Make sure the correct fiber is used
- ⚠️ Termination at link head side: SC-connectors
- ⚠️ Label all link head connectors (Data IN, Data OUT, and OMI)

### Step 6 Use a fiber optic cable tester to check the attenuation of all fiber optic cables from the network and OMI interfaces.

- ⚠️ Measure fiber losses to ensure acceptable performance

## 2.5. Installation Staffing

A single person can perform all required installation and alignment procedures at most locations. However, installation can be completed more efficiently and safely if two people are used.

## 2.6. Assemble and Mount the System Hardware

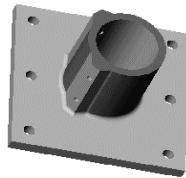


**Caution:** For indoor installations where people may be present, the link head(s) should be installed close enough to the window to prohibit looking into the transmitter beams. Avoid link head angles of 50 degrees or less measured from the window glass.

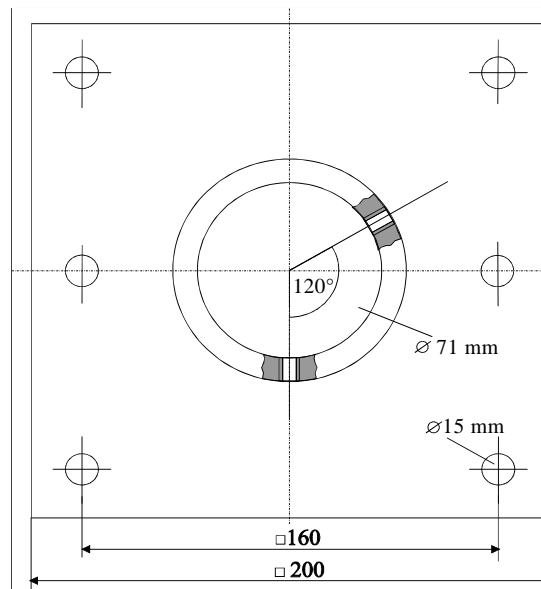
**Step 1** Install the mounting base plate to a solid platform using 12 mm (1/2") screws.

⚠ Anchor the mount in wall or concrete (recommend M12-screws)

⚠ Use bolts of hardness class not less than 6.6



⚠ Use the mounting plate hole template provided for aligning any penetration holes

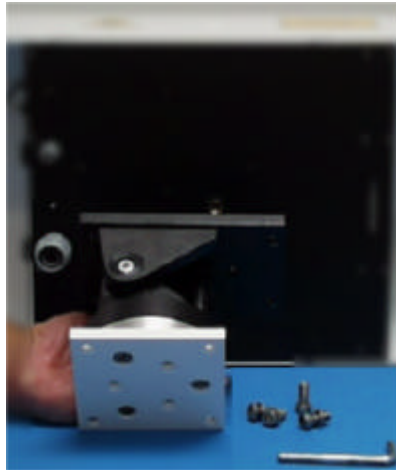


**Step 2** To ensure stability, keep the mounting post as short as possible.

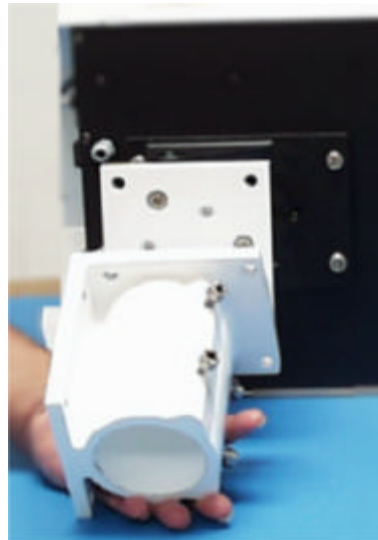
The maximum allowable mounting pole length is:

System	Maximum Pole Length
Class-L 155/1000/2000	70 cm (27.5")

**Step 3** Attach the adapter plate and pan and tilt assembly to the link head.



**Step 4** Fasten the head plate to the link head using the supplied fasteners.



- Step 5** Attach and fasten the mounting post assembly to the base plate using the supplied fastening screws. Do not over tighten the mounting screws.



- Step 6** Fasten the head plate to the mounting post using the supplied fastening screws.



**Caution:** The base plate and head plate must be pinned to the mounting post when the base plate is wall mounted.

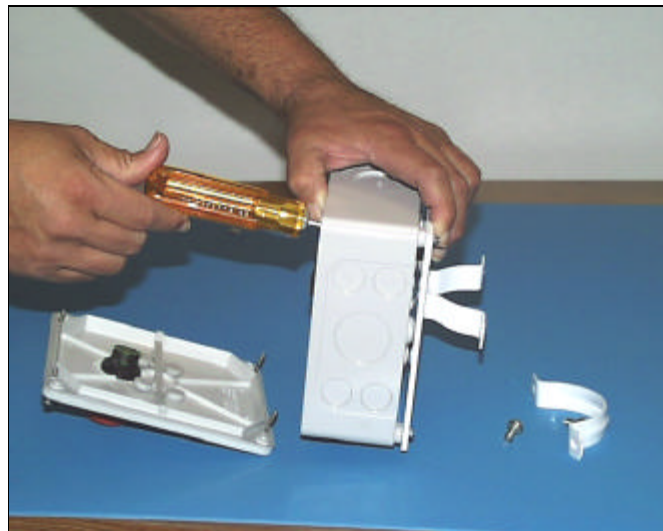


To pin the base plate and head plate to the mounting post:

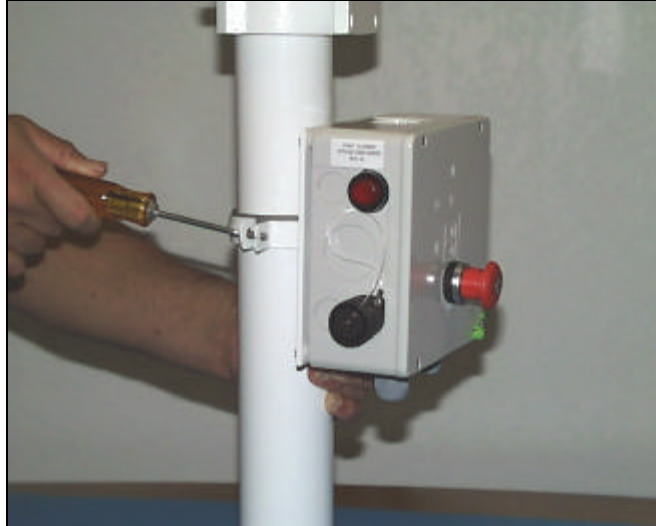
- ⚠️ Drill an 8 mm hole through the cylinder wall of the base plate and the mounting post and pin the assemblies together using 8 mm grooved pins or 3/8 x 1 inch screws.
- ⚠️ Drill an 8 mm hole through the cylinder wall of the head plate and the mounting post and pin the assemblies together using 8 mm grooved pins or 3/8 x 1 inch screws.



**Step 7** Fasten the power supply to the power supply mounting plate.



- Step 8** Attach and fasten the power supply, plastic ring, and mounting plate assembly to the mounting post as close to the head plate as possible. Make sure the cable feed throughs are pointing down.



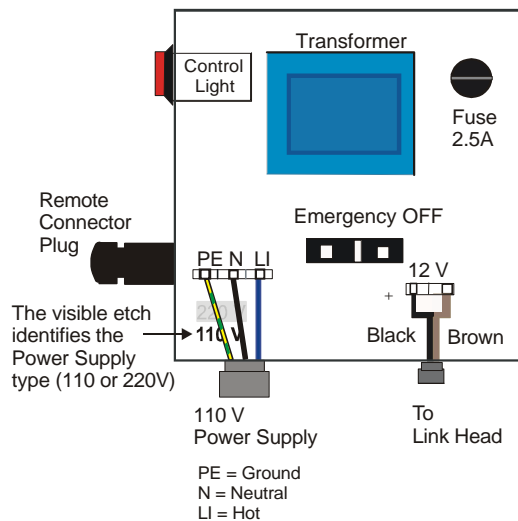
**Note:** The maximum recommended distance between the power supply box and the link head is 1.5 m (longer distances are possible upon request).



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

- Step 9** Connect the 12 V link head power supply cable to the power supply connector.

Inside View of Power Supply Module



- Step 10** Connect the 110/240 VAC and 12 VDC power cables to the power supply connectors.

**Step 11** Remove the remote connector plug cap. Insert the remote connector plug and securely tighten into place.



**Note:** The power supply will not work without the remote connector plug installed (see Figure 2-4). . Additionally, the lockable emergency switch (red button) must be in the "on" position (pulled out).

**Step 12** Repeat these steps at the second link head.

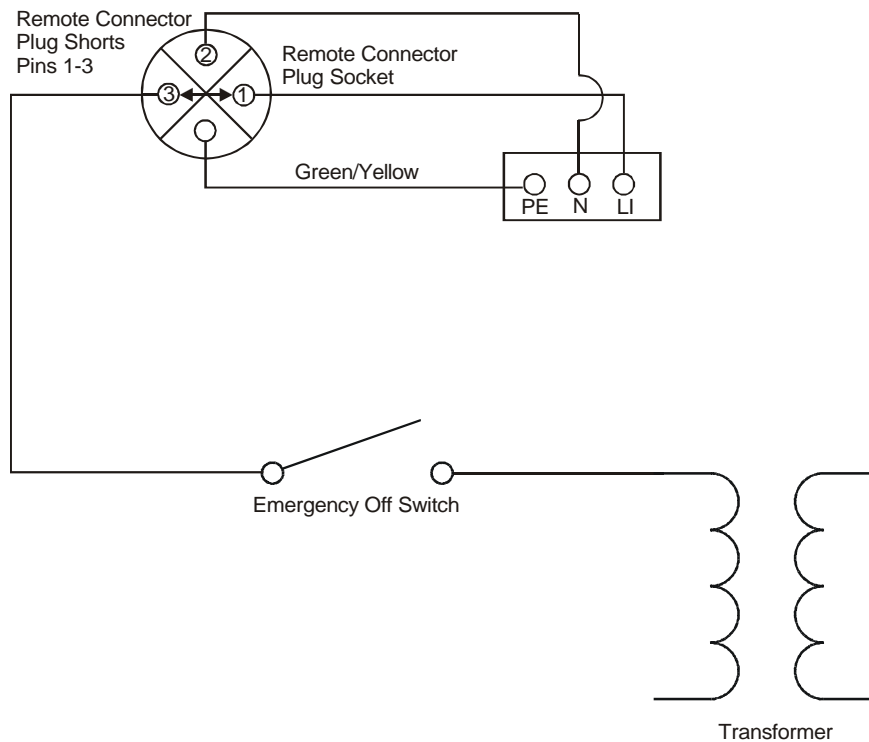


Figure 2-4: Remote Connector Plug Wiring Diagram

## 2.7. Link Head Alignment

You will need to complete both coarse and fine alignment procedures.

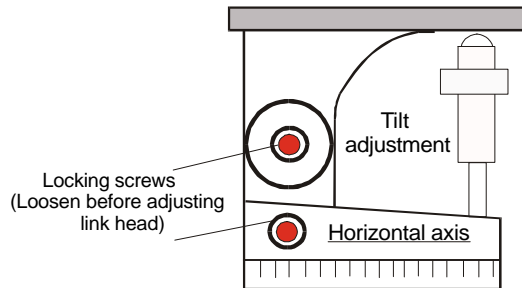
### 2.7.1. Coarse Alignment Procedure

A single person can perform link heads alignment, however it is easier with two people. The only tool required to perform coarse system alignment is the Allen wrench (metric #6) that is provided with the system (stored on the back of the link head).

**Note:** When you are finished aligning the system, always return the Allen wrench back to its holder.

Perform the following steps at both link heads:

- Step 1** Open the back panel door.
- Step 2** Remove the lens cover from the link head telescope.
- Step 3** Loosen the locking screws at the pan and tilt assembly.



**Caution:** Before aiming the telescopes, refer to the following table of safe telescope operating distances (refer to Section 1.3).

Link head	Built-in telescope safety distance
Class-L 155/1000	14 m
Class-L 155/2000	18 m

- Step 4** Center the telescope crosshairs on the opposite link head face plate. In the Class-L series, the telescope is integrated into the enclosure. The telescope is not a true indicator of alignment – use the power level indicators.
- Step 5** Turn on power to both link heads. Make sure the red control light on the power supply module is on. Set the link head power switch to the "1" position.



**Note:** To aim the telescopes in darkness or poor visibility conditions, press the Test switch on both link head back panels. Two red test mode LEDs on the front of each link heads will illuminate. The LEDs can be used to visually align the telescope crosshairs.

**Step 6** Tighten all locking screws on the pan and tilt assembly

The coarse alignment procedures are now completed.



### 2.7.2. Receive Power Level Fine Alignment Procedure

- Step 1** With link head power on, set the Test switch to the on position on both link heads.
- ⚡ The red Test switch LED on the back panel should be illuminated.
- Step 2** Check the receive power level bar graph. A few signal level bars will be illuminated.
- ⚡ Make sure the Transmit Power switches are in the same position on both link heads.
- Step 3** Align the link head using the power level bar graph display. Use the Allen wrench supplied with the system.
- ⚡ Insert the wrench into the port on the right side of the link head (horizontal axis adjustment). Slowly turn the wrench (maximum of 2-3 turns in each direction) until 5 to 9 bars are illuminated on the power level bar graph (Be sure to replace the port cap when you are done).
- ⚡ Insert the wrench into the port on the bottom side of the link head (vertical axis adjustment). Slowly turn the wrench until 5 to 9 bars are illuminated on the power level bar graph (Be sure to return the Allen wrench to its holder).
- Step 4** Repeat Steps 1-4 at the opposite link head. Adjust both link heads until they have approximately the same maximum receive power levels.
- ⚡ If you have a receive signal overload condition with the Transmit Power switches in the low power position, use fine adjustment to slightly misalign the link heads.
- Step 5** On both link heads, tighten all locking screws. and set the Test switch to the off (0) position.

**Note:** After the link heads 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 link heads is left in Test mode.

The fine alignment procedures are now completed.

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

In TEST MODE operation the link head sends out a 1 kHz tone. The TEST MODE switch is found on the backplane of the link head. This procedure is performed by adjusting the link heads so that the volume of the 1KHz test tone reaches its maximum value.

- Step 1** Turn on the TEST MODE signal at Station A using the test mode switch. During TEST MODE:
- ⚡ The DATA IN LED is blinking.
- ⚡ Two red LEDs at the front of the link head are illuminated.

**Step 2** Connect a headphone to Station B.

⚠️ The volume level can be controlled by pushing the VOLUME+ or VOLUME- buttons on the backpanel of the link head.

**Step 3** Align Link Head A.

Slowly move the link head in vertical and horizontal position until you hear the 1 kHz tone. Tighten the Pan and Tilt locking screws when the tone reaches its maximum volume.

⚠️ Check the bar graph at the back panel of the link head. The bar graph shows the received power level on a bar graph scale ranging from 1 to 10. Note the receive power level.

**Step 4** Align Link Head B.

⚠️ Repeat steps 1 through 3 to align Station B. (Station A listens, Station B in TEST MODE)



**Step 5** Finalize the alignment process. Fine-tune the position of the link heads by using the alignment screws on the right side at the bottom of the link head. The goal is to have both link heads at the same maximum receive power level.

⚡ Slowly turn the screws back and forth to re-align the link head to its optimal position.

⚡ The bar graphs at both link heads should show nearly the same receive power level.

**Note:** After the link heads 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 link heads is left in Test mode.

## 2.8. Optical Cable Connection

**Step 1** Connect the pre-wired fiber optic data cables from the network interface to the link head.

⚡ Connect DATA OUT (TX) from the network interface to the DATA IN (RX) port (SC connector) on the link head.

⚡ Connect DATA IN (RX) from the network interface to the DATA OUT (TX) port (SC connector) on the link head.

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

**Step 2** (Optional Step) Connect the pre-wired fiber optic OMI interface to the link head.

⚡ Standard Mode: Connect the OMI PC RS-232 converter to the OMI port (SC connector) on the link head. The converter is directly attached to the PC COM port (a 9 pin COM port will require a 25 to 9 pin adapter).

⚡ Optional Mode: Connect the NMS SNMP Interface (FMG LDX or HDX) to the OMI port (SC connector) on the link head.

**Step 3** Close the link head back panel doors.

The connection procedures are now completed.

### 2.8.1. Verify System Operation

Figure 2-5 shows the displays, controls, and indicators on the back panel of the link head. Table 2-3 describes these components.

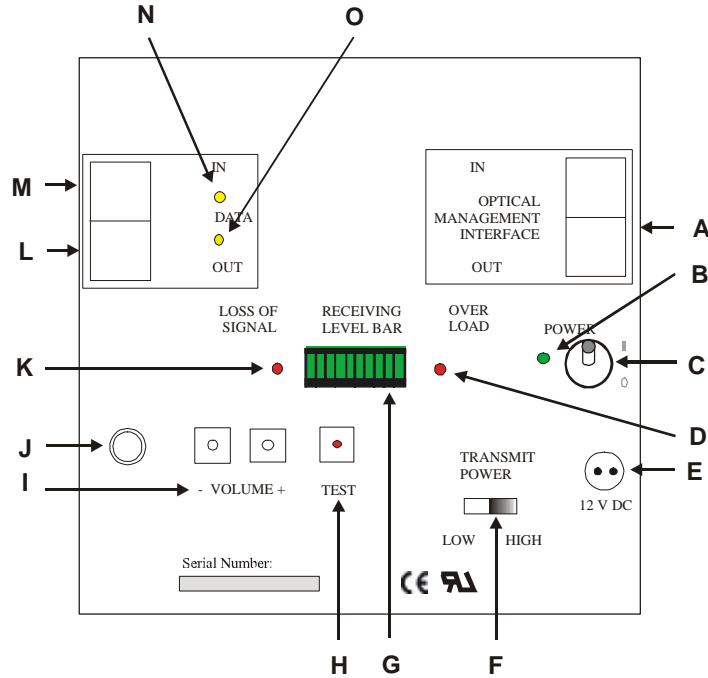


Figure 2-5: Link Head Back Panel

Table 2-3: Link Head Back Panel Displays, Controls, and Indicators

Back Panel Item	Description
<b>A</b> OMI Input/Output	OMI Output (SC-connectors 850 nm Multimode)
<b>B</b> Power Control LED	Green LED when power is on
<b>C</b> Power Switch	Main power switch
<b>D</b> Receiver Overload LED	Red if the air interface receiver is overloaded
<b>E</b> Power Supply Connector	12Vdc power supply input
<b>F</b> Transmit Power Switch	Select air interface power level
<b>G</b> Receive Level LED Bar graph	Display receive signal strength
<b>H</b> Push-Button Test Mode Switch	Switch unit to the test mode (On and Off) Red LED when test mode is active
<b>I</b> Push-Button Volume Control	For 1KHz audio test signal LED flash if test signal is found at the air interface
<b>J</b> Head Phone Connector	1KHz audio test signal output jack
<b>K</b> Loss of Signal LED	Red if the air interface receiver is too low
<b>L</b> Data Out (SC-connector)	Data output from the link head to Network

	Back Panel Item	Description
<b>M</b>	Data In (SC-connector)	Data input from the network to link head
<b>N</b>	Data In LED	Red LED when no fiber network to link head signal is present, otherwise yellow
<b>O</b>	Data Out LED	Red LED when no signal is transmitted from the link head to fiber network, otherwise yellow

Check for normal operation of the link head system by observing the LEDs and bar graph displays on the back panel of each link head. Check the following displays for unit power and receive power status:

**Table 2-4: Bar graph and LED Operational Checks**

Display	Back Panel	Description
Bar graph	G	Current receive power level (should be 6 to 9 bars). The Transmit Power switch can be used to boost power if necessary.
Power LED	B	Green when power supply is turned on
Data In LED	N	Yellow receiving input from the network interface
Data Out LED	O	Yellow when receiving data from the far side link head

Please contact your distributor or Lamon International GmbH 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.

System installation and alignment procedures are now completed. The system should be fully operational.

## 3. Optical Management Interface

---

This chapter covers the following main topics:

- /// OMI software introduction
- /// OMI test setup
- /// Installing and starting the OMI application
- /// OMI program windows
- /// Running OMI diagnostic tests

### 3.1. Introduction

The optical management interface (OMI) provides a tool to monitor and test Laser Transmission Systems from a remote location. The status information sent from the link head to the management software can be used to monitor the system performance or diagnose a system failure.

#### Connectivity

The data is transferred from the link head to a standalone PC-based platform through a pair of multimode fiber optic cables. The optical signal is transformed into an electrical RS-232 signal by a bi-directional V.24 converter (supplied) that plugs into the RS-232 port (25 pin to 9 pin adapter may be required) of a PC. The maximum fiber length between the link head and the management system is 2 km.

#### OMI Software

The OMI management software can monitor two link heads from the PC where the software is loaded. OMI can be installed under Microsoft Windows.

#### Statistical Database

The OMI software polls the connected link head(s) every second and displays the status information. In addition, a statistical database is generated in the background. The database uses the status information and computes statistical values that are stored as database entries.

### 3.2. OMI Test Setup

The following equipment and software are required to perform OMI diagnostic tests.

- ✂✂ OMI Application Software
- ✂✂ Windows PC or Laptop
- ✂✂ RS232 cable, 9 pin to 25 pin (Not required if the PC has a 25 pin connector)
- ✂✂ RS232 to Optical Cable Media Converter
- ✂✂ Two optical fiber cables with SC connectors
- ✂✂ SC Female Loopback Plug

The connections shown in Figure 3-1 are required to perform OMI field diagnostic tests.

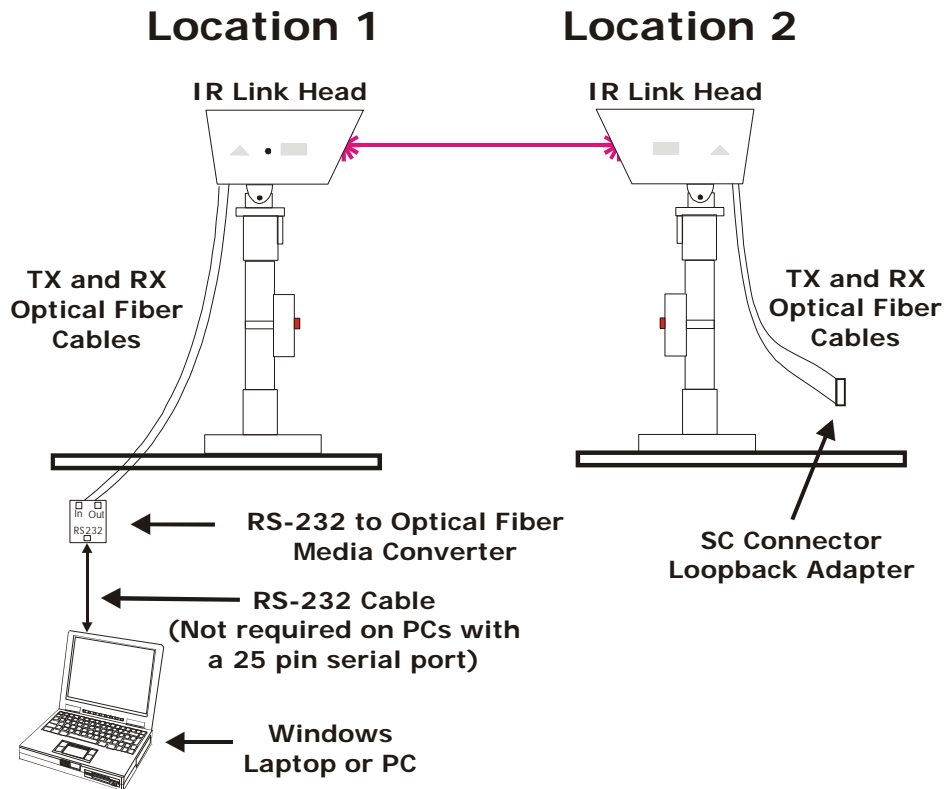


Figure 3-1: Typical OMI Diagnostic Test Connection



### **3.3. Installing and Starting the OMI Application**

Place the Lamon International GmbH OMI install disk into your computer. Run Link Manager setup application. Run Link Manager.

Use Online Help for further Information.





## **4. Maintenance**

---

### **4.1. Scheduled Maintenance**

In general, the Class-L 155 systems are maintenance-free. Maintenance is typically limited to cleaning the front window of the link head.

Do not attempt to open the housing, as there are no user-serviceable parts inside.

#### **4.1.1. Link Head Front Window**

As required, clean the heatable front window of the link head semi-annually. Use only a soft, moist cloth and water for cleaning. You may need to clean the window more often in dusty environments.

#### **4.1.2. Field of View**

Periodically check the link head field of view for obstructions.





## 5. Troubleshooting and Diagnostics

---

This chapter covers the following main topics

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

The link heads can be thought of as nothing more than pipes used to move data. No processing of data occurs within the link heads. If the link heads are aligned and data is moving between them (i.e. Test Mode), 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
- /// Lamon International GmbH system failures

The troubleshooting flow chart (Section 5.2) should be used in the event of a Lamon International GmbH system failure. If a system failure occurs during initial installation, contact Lamon International GmbH Technical Support.

The most important error detection functions can be performed from the PC using the Optical Management Interface that allows you to pinpoint the failure precisely (refer to Section 3, Optical Management Interface).



**Caution:** If a failure is found in the power supply unit, please remember that only authorized technical personnel may conduct checks of the emergency OFF switch and fuse. In all cases, the system must be disconnected from the AC or DC power supply in advance.

### 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 receiver at the link head Data In port
Bad network input signal	System failure or high BER
Cables reversed	Incorrect signal at the link head
Cable length violation	Low signal strength at the link head
New network equipment	Network equipment and/or network software incompatible with link head
Optical fiber damaged	No signal at the link head
Free-space optical signal weak	Link failure
Damaged optical SC connector	No signal at the link head back panel Data ports
Incorrect input cable wave length	850 nm network cable (special order) only works with multimode fiber 1310 nm network cable (standard) works with singlemode or multimode fiber

### 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
Yellow	Yellow	Normal Transmit and Receive network traffic
Red	Yellow	Missing data from the opposite link head Data to network normal
Yellow	Red	Missing data from the link head receiver Data from the network normal
Red	Red	No network interface communications
Blinking Red/Yellow	Yellow	System in Test mode

#### Operational Check

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

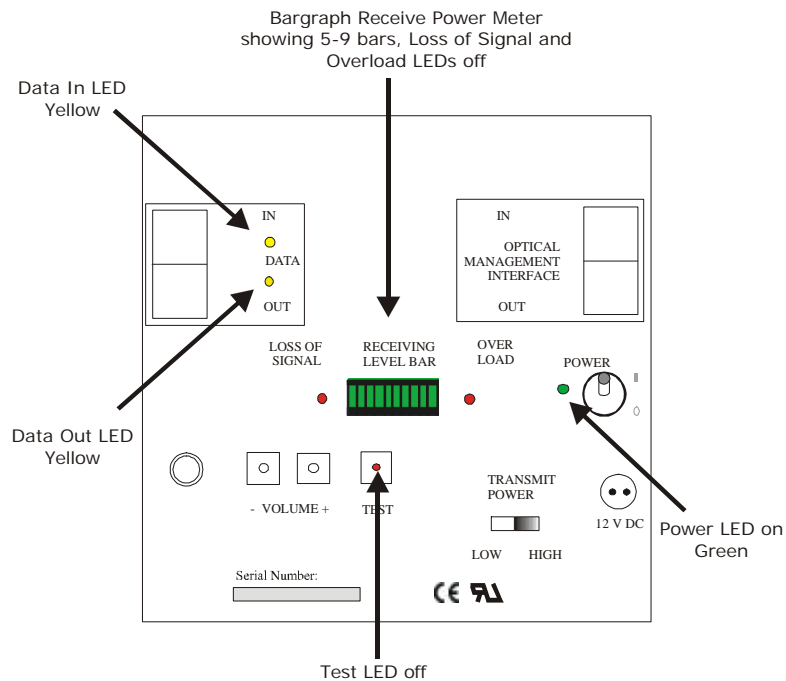


Figure 5-1: Normal Back Panel Display

### 5.2. Fault Isolation and Troubleshooting without OMI

The following flowcharts can be used to troubleshoot the Laser Transmission System without using the Lamon International GmbH OMI software. Tasks marked with a green dot can be accomplished using OMI diagnostic loopback tests.

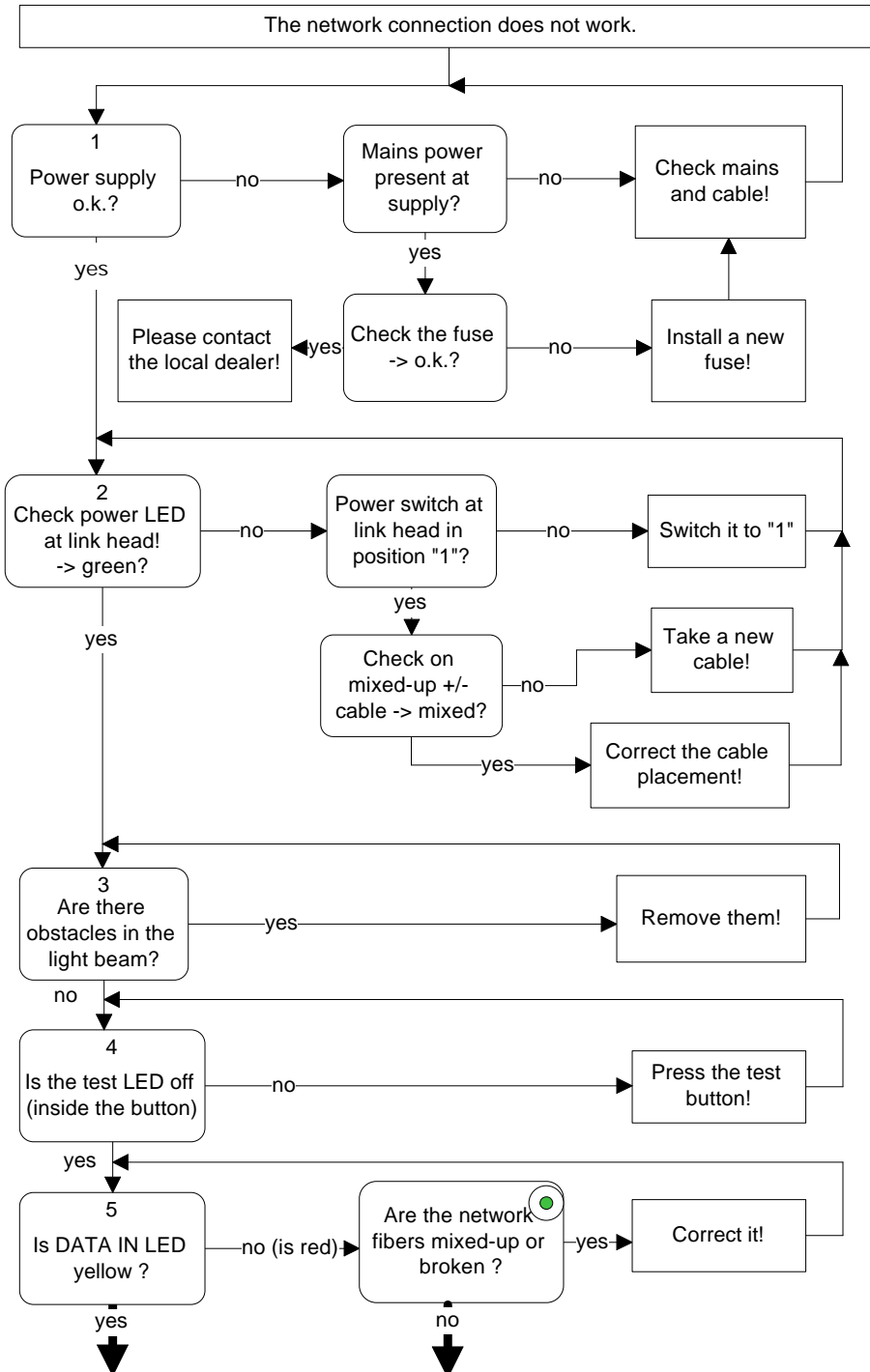


Figure 5-2: Troubleshooting without OMI (Flowchart - Part 1)



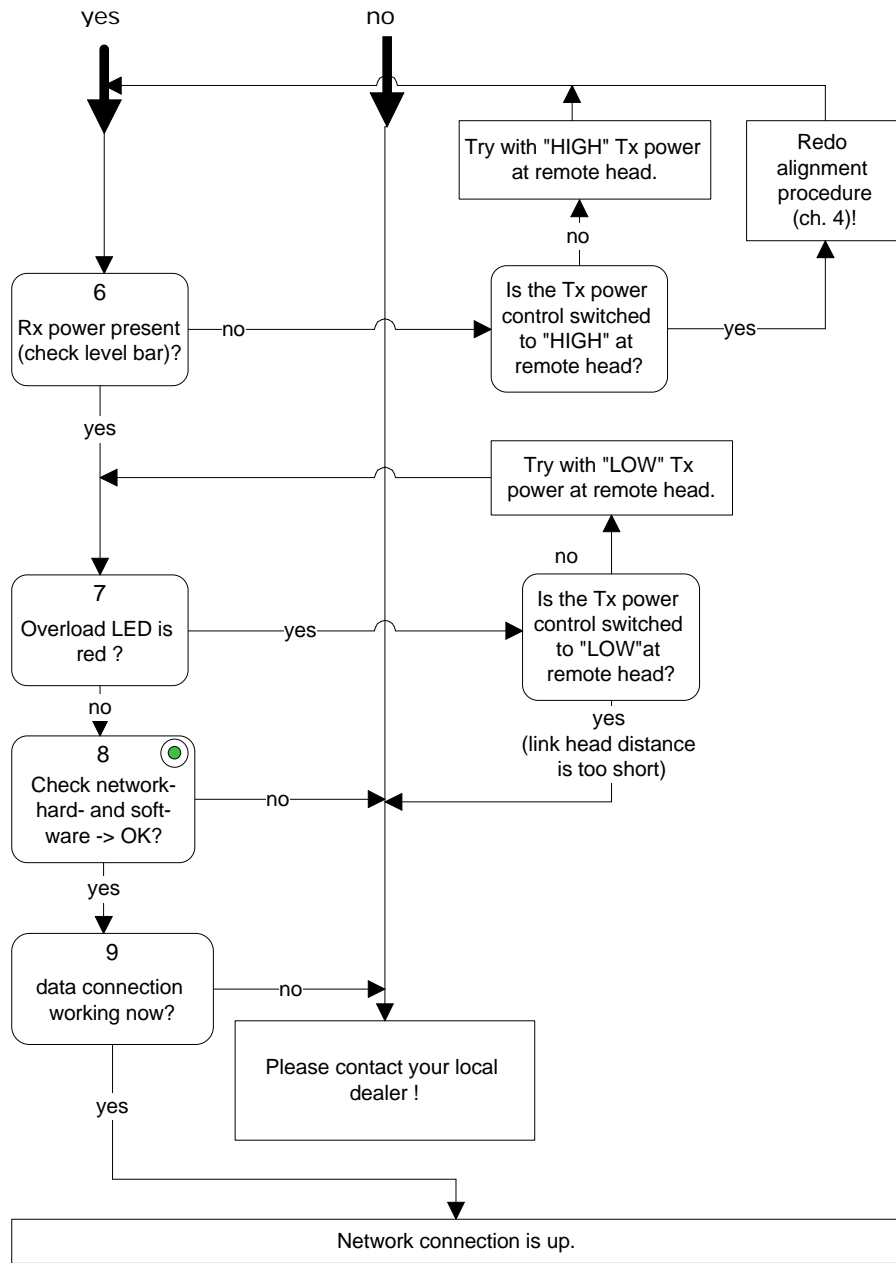


Figure 5-3: Troubleshooting without OMI (Flowchart - Part 2)

### 5.3. Fault Isolation and Troubleshooting with OMI

The following flowchart can be used to troubleshoot the Laser Transmission System using the Link Manager software. Tasks marked with a green dot are accomplished using OMI diagnostic loopback test.

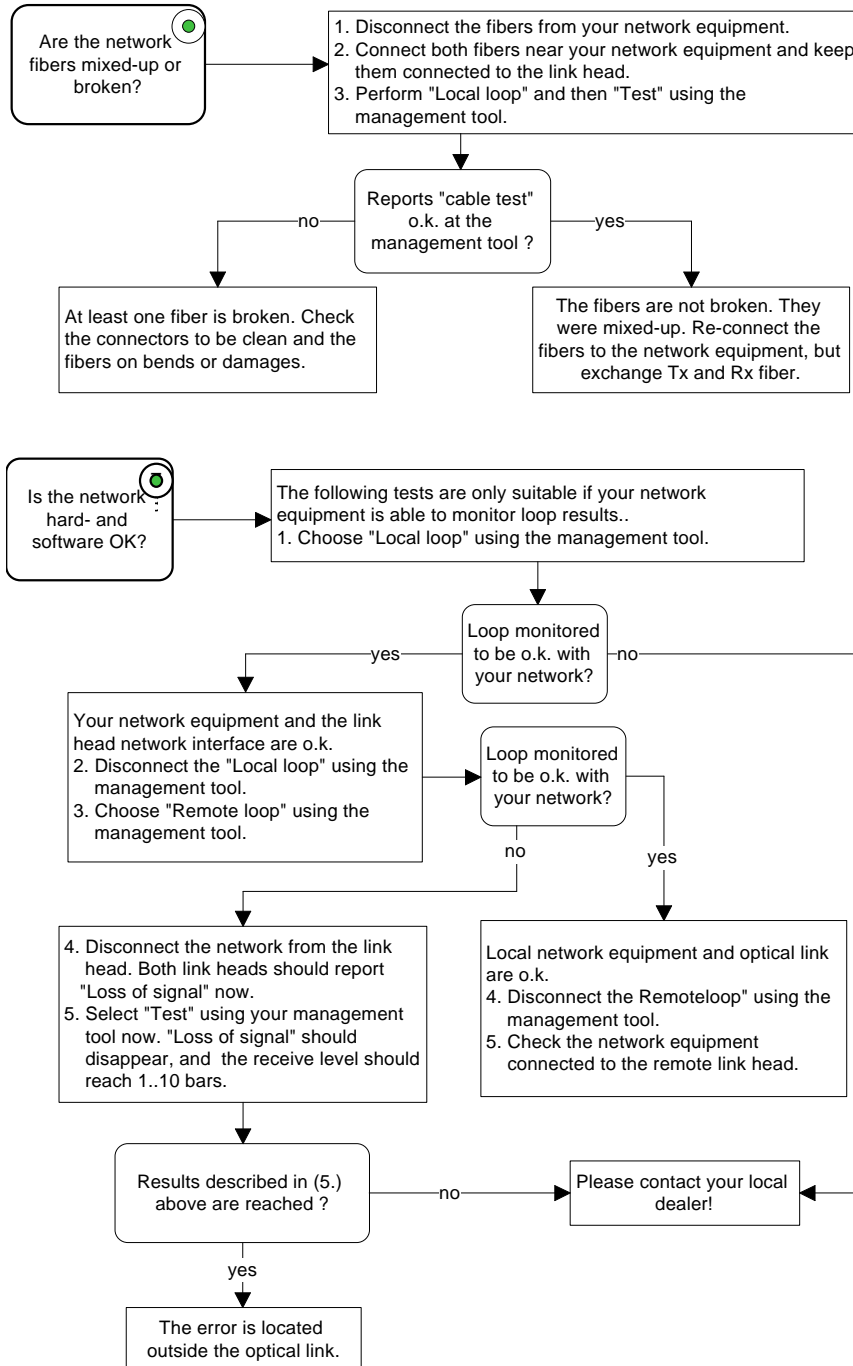


Figure 5-4: Troubleshooting with OMI Software (Flowchart)

## 5.4. Additional Troubleshooting Methods

### 5.4.1. Ping Test Setup

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

- ☞ Laptop with Ethernet card
- ☞ Ethernet cable with RJ45 connectors
- ☞ RJ45 to Optical Cable 100mbs Media Converter
- ☞ Four optical fiber cables with SC connectors
- ☞ SC Female Loopback Plug

The connections shown in Figure 5-5 are required to perform OMI field diagnostic tests.

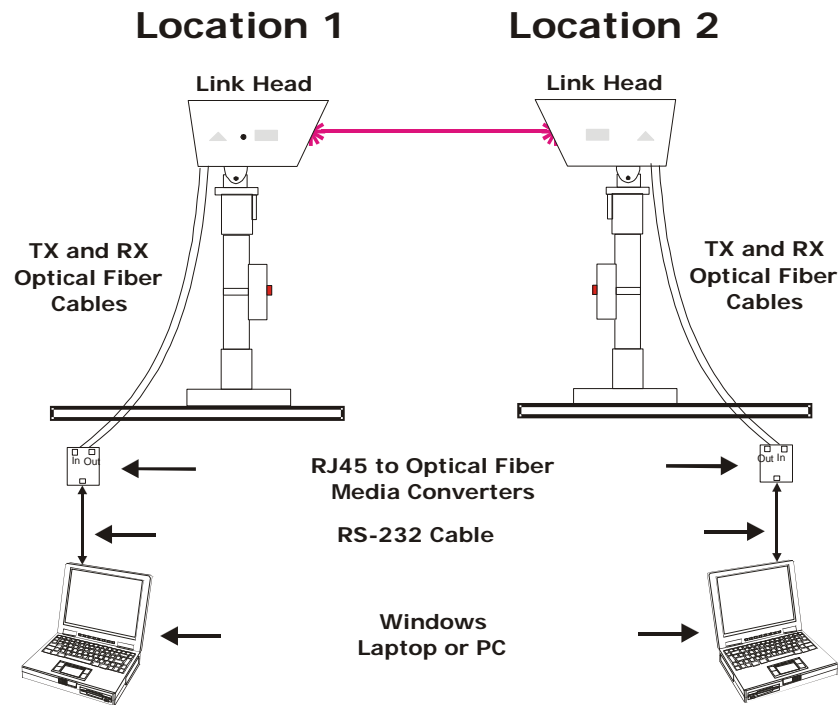


Figure 5-5: Ping Test Setup

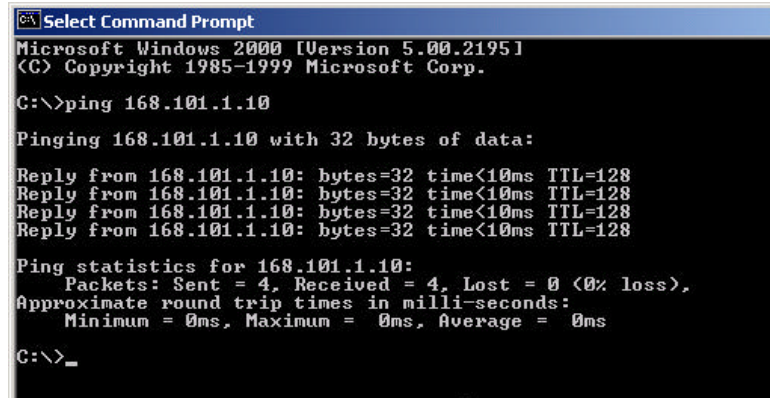
### 5.4.2. Optical Link Ping Test

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

- Step 1** Locate all required equipment (refer to section 5.4.1).
- Step 2** On each side, attach two optical fiber cables to the link head 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 **168.10.1.10** in the IP Address Box. The far side should type **168.10.1.11** 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.



```
Select Command Prompt
Microsoft Windows 2000 [Version 5.00.2195]
(C) Copyright 1985-1999 Microsoft Corp.

C:\>ping 168.101.1.10

Pinging 168.101.1.10 with 32 bytes of data:

Reply from 168.101.1.10: bytes=32 time<10ms TTL=128
Reply from 168.101.1.10: bytes=32 time<10ms TTL=128
Reply from 168.101.1.10: bytes=32 time<10ms TTL=128
Reply from 168.101.1.10: bytes=32 time<10ms TTL=128

Ping statistics for 168.101.1.10:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>_
```

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

### OMI Statistical Data Interpretation

Refer to Section 3, Optical Management Interface.

### BER Test

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

A BER tester can be used to monitor the Lamon International GmbH 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.

The following figure displays a typical printed BER test output.

<b>ANT-20 - Anomaly/Defect Analyzer</b>		
Start of measurement: 03/26/01 09:02:20.0		
End of measurement : 03/27/01 19:14:26.9		
RX structure: STM1 optical AU4 VC4 140M framed PRBS23		
Settings : BLOCK		
TYPE	Total Results	Intermediate Results
FAS-STM	0 *	0 *
B1	0 *	0 *
B2SUM	0 *	0 *
MS-REI	0 *	0 *
AU-PJE	0	0
AU-NDF	0	0
B3	1 1.48E-10	0 *
HP-REI	1 1.02E-10	0 *
FAS-140	1 1.71E-10	0 *
TSE	1 1.34E-10	0 *

Figure 5-6: Sample of a BER Test Printed Output

## 5.5. Technical Support

☞☞ Did you complete the steps in the Fault Isolation Troubleshooting Tree?

### 5.5.1. Checklist Before You Call Technical Support

☞☞ Be sure to fill out the following checklist before contacting Lamon International GmbH Technical Support.

General Information	Your Installation
☞☞ Application (Protocol)?	
☞☞ Distance?	
☞☞ How long has system been in operation?	
<b>How does the error show up?</b>	
☞☞ Temporary/permanent error?	
☞☞ Is error observed for the first time?	
<b>How was the weather when error showed up?</b>	
☞☞ What time of day?	
☞☞ Special weather conditions (fog, snowfall)	
☞☞ Outside temperature (moisture on entrance window)	
<b>Status of Back Panel LEDs</b>	
☞☞ Are all red LEDs off?	Yes/No
☞☞ How many bars does the bar graph indicator show?	
☞☞ Outside temperature (moisture on entrance window)	
<b>Status of Back Panel Indicators</b>	
☞☞ Connection to network	Yes/No
☞☞ Failure of endpoint equipment	Checked/Not Checked
<b>What type of system is installed?</b>	
☞☞ Model number	
☞☞ Single mode or multimode	

**Note:** This form is available as a downloadable PDF file on our web site.

## 5.6. Return Material Authorization (RMA) Procedure

Please contact Lamon International GmbH before returning any system components for repair or replacement.

RMA products include:

~~Link head~~

~~Standard power supply~~



## 6. Specifications

**Table 6-1: Class-L 155 System Specifications**

<b>Class-L 155/1000, 2000</b>	
<b>Outdoor Unit</b>	
Description	Four beam system
Dimensions	11.8 x 11.8 x 25 inches 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	110 / 240 VAC (50/60 Hz)
Power consumption	Max. 20 W
Operating temperature	13° to +122° F (-25° to +50° C)
Relative humidity	Up to 95% (non-condensing)
<b>Free-space Path</b>	
Bandwidth	155 Mbps
Recommended Distance	155/1000 (280m to 2200m) 155/2000 (650m to 3900m)
Optical transmitter	VCSEL
Output wavelength	850 nm
Beam divergence	2 mrad
Laser Output Power	155/1000 1 mW each beam 155/2000 3.9 mW each beam
Receiver Sensitivity	-41 dB
Dynamics	30 dB
<b>Network Interface</b>	
Protocol	Transparent
System Interface	SC-compatible
Connection optical fiber	Singlemode: 6-9.5 µm inner core 125 µm external diameter Multimode: 50-62.5 µm inner core 125 µm external diameter
Receiver Type	Si APD
Wavelengths Supported	SMF/MMF 1270-1350 nm
Optical receive power	-30 to -15 dBm
Optical Transmission power	-20 dBm
Status displays (LEDs)	Power, Data IN/OUT, LOS, Overload, Test, and Bar graph (10 Bars)

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





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