EAGLE OPTOELECTRONICS, LLC.

Simply Better Networking Solutions

Connections By Light

Operating Manual

LightStation Laser Communication Systems

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The *LightStation* Series product line combines the results of 30 years of research in the field of infrared (IR-) laser communication. It is one of the highest performance laser communication systems available on the market and it can be tailored for specific customer needs.

It is our commitment to our customers to provide laser communication systems that are at the leading edge of technology and that will guarantee the highest level customer satisfaction.

We appreciate your business and hope you enjoy many productive years with our equipment. Please call if we can be of further assistance or if you would like information about our other LAN and Telecom products.

Eagle Optoelectronics, October 1997

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1. THE *LIGHTSTATION* PRODUCT LINE

EAGLE OPTOELECTRONICS, LLC. offers two versions of the *LightStation* laser communication link product line:

A. Short distance communication links operating up to 600 meters (2000 ft.) and at variable data rates between 1 and 155 Mbps.
Instead of using lasers, these links are equipped with high power and high performance light emitting diodes (LED).

The following products belong to this category:

LightStation MonoLink 20/200

LightStation MonoLink 20/600

LightStation MonoLink 155/300

B. Long distance communication links operating up to 4000 meter (2.5 miles) and at variable data rates between 1 and 155 Mbps.
The MultiLink 155/800 and the MultiLink 20/2000 are equipped with 4 high power LED's. The MultiLink 155/2000 and the MultiLink 20/4000 use 2 high power lasers to accommodate higher bandwidth and/or range requirements. In addition these links use 4 receiving optics to allow for highest reliability over longer distances and/or higher transmission speeds.

The following products belong to this category:

LightStation MultiLink 20/2000

LightStation MultiLink 20/4000

LightStation MultiLink 155/800

LightStation MultiLink 155/2000

There is no difference in the installation procedure for both types of laser links. A detailed and illustrated description on how to install the link heads can be found in chapter 3 of the manual.

2. SYSTEM DESCRIPTION AND GENERAL REMARKS

PRINCIPLE OF OPERATION

A complete transmission link consists of two link heads mounted at each side of the locations to be connected to the network. The full duplex operation allows both heads to transmit and receive information from either site and at the same time. Two multimode fiber optic cables terminated with ST-connectors are used to interconnect the networking interface to the transmit and receive optics incorporated into the link heads. Inside a link head the signal to be transmitted is converted from an optical into an electrical signal. This electrical signal is amplified and drives the high power light-emitting diodes (LED) or laser diodes (LD). The light emitted by the LED/LD is sent out through free space towards the opposite link head. This link head picks up the light with its receiving optics and a PIN or avalanche photodiode converts the signal back into an electrical signal. Subsequently this electrical signal is amplified and drives a LED which connects to the networking interface via a multimode fiber optic cable. In the MonoLink series the transmit and receive optics are mounted in a coaxial package to ensure that both signals are lined up and propagate exactly along the same optical path. The MultiLink series uses multi-beam transmit and receive signal technology to allow for reliable networking operation over longer distances and at higher speeds.

By using different combinations of transmit sources (LED or LD) and photodetectors (PIN or Avalanche) the links are optimized for specific speed and range requirements. In case the system is moved to a location which has a different speed and/or range requirement, the link heads can be modified easily to accomplish this task. Ask your distributor or call Eagle Optoelectronics, LLC. to find out more about this upgrade option.

Please, refer to the specification table at the end of the manual to find out more about the electronic assembly of your specific laser communication link.

3. LINK INSTALLATION

HOW TO FIND THE BEST INSTALLATION SITE?

To ensure reliable operation of the LightStation products, it is important to carefully look for the best mounting position. *Please, read these instructions carefully before you proceed with the installation process!*

We recommend to install the links according to the following guidelines:

1. To ensure the proper operation of a laser link, the link heads must be within a clear line of sight of each other. Verify that a clear line of sight exists between the two link heads. There should be no obstructions, such as trees or buildings that block the view between both links. Consider also temporary objects that may disrupt the transmission beam. Heat shimmer (scintillation) from nearby objects can temporarily disrupt the transmission beam. To ensure the highest reliability of the communication link we recommend to find a transmission path that is clear of all objects by at least eight feet (2.5 m) in horizontal and vertical direction. Consider that scintillation can also be caused by intermediate buildings, rooftops, air conditioners, and heater vents. If possible, we also recommend to avoid mounting the link heads close to high-power transmission equipment, satellite dishes and three-phase power lines.

2. A solid mount is the key for reliable operation of the laser link. Eagle provides a solid mounting post that can be used either as a wall mount or a pedestal mount. If you can not attach (bolt) the mount directly to the wall or onto the roof, please call your local distributor or Eagle Optoelectronics, LLC. for suggestions of alternate mounting procedures.

3. The LightStation links are equipped with a high performance optical bandpass filter which block most of the sunlight that might interfere with the optical signal transmitted between both link heads. Therefore our links will even operate in the brightest of indirect sunlight. However, we strongly recommend to avoid pointing the link head directly into the sun. This might result in a saturation of the receiver and consequently in a temporary loss of communication. When positioning links, consider that the position of the sun varies around the year. Although the links are equipped with a rather long weather shield, avoid pointing a link head upward at a steep angle. This might reduce the effectiveness of the weather shield to prevent rain or snow to fall directly onto the lens surface.

4. Before making the decision to mount the link head indoors, be aware of the fact that not all glass transmits infrared light equally. A single pane of normal glass imposes very little attenuation. However the link range will slightly decrease when the unit is kept behind a glass window. We do not recommend to mount the link head indoors if the glass is either very heavily tinted, or specially coated. Also, rain or snow may accumulate on the window. Installing the link head under a great angle towards the glass surface will decrease the transmission distance. The greater the angle from perpendicular between the beam and the glass surface, the less infrared light is transmitted through the glass. In any case do not mount the link head directly perpendicular to the glass surface.

MECHANICAL INSTALLATION

The standard mounting equipment provided with the laser link heads can be used either for pedestal or wall mounting. The mount consist of three parts:

1. Base mounting plate
2. Mounting post (diameter 70 mm)
3. Mounting head plate

1. To ensure the mechanical stability of the mount, we recommend to limit the length of the mounting post to 80 cm for pedestal and 50 cm for wall mounting. Fig.1 shows a schematic drawing and the dimensions of the base mounting plate.

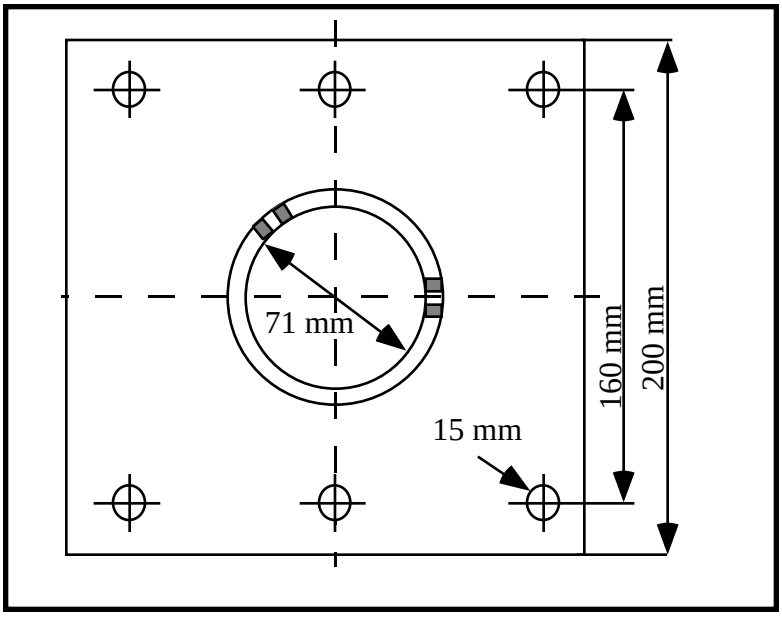


Fig. 1: Dimensions of the base mounting plate.

The base mounting plate should be directly bolted to the supporting structure. If possible, we recommend to bolt the base plate onto a concrete or a brick wall.

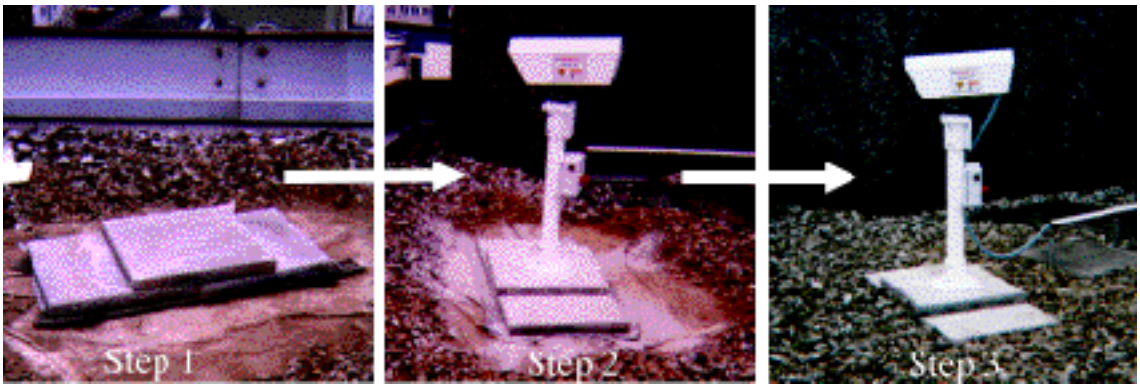


Fig. 2: Mounting the link head on concrete slabs.

An alternate mounting procedure to install the link heads on a flat roof is shown in Fig. 2. This installation uses pre-formed concrete slabs to build a solid mounting platform. Please, contact your local distributor or Eagle Optoelectronics if you have any questions regarding the mounting procedure of the link heads.

ELECTRICAL INSTALLATION

2. The links are provided with a weather resistant power transform box which transforms the line voltage (110 Vac) into the low voltage (12 Vdc, 1.6 A) needed to operate the link head. The transformer box is also equipped with an emergency switch (red knob located at the front side of the box). When the low voltage cable supplied with the link head is used for installation, the transformer box should be attached not further than 1.5 m from the link head. Fig. 3 shows the inside of the transformer box and the wiring diagram.
   The user can also choose to run the 12 Vdc supply voltage directly to the link head. In this case it is important to choose the right wire diameter to ensure that there is not to much voltage drop across the cable.

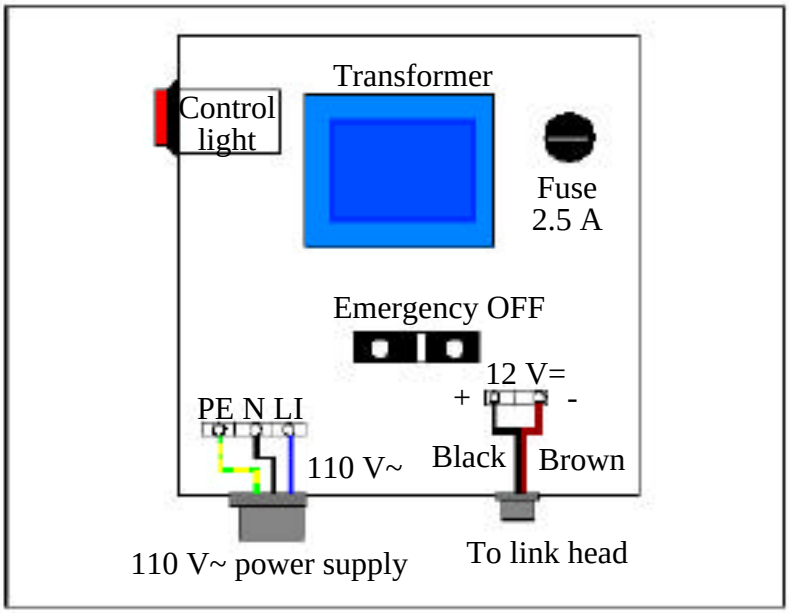


Fig. 3: Wiring diagram of the transformer box.

FIBER INSTALLATION

3. The link head is connected to the network by using standard 62.5 or 50 µm optical multimode fibers. At the link head side the fibers must be terminated with a standard ST-connector.

   Network connection
   Two multimode fibers (DATA receive and DATA transmit) are needed for the network connection.

   Optical Management Interface (Optional)
   One fiber is needed to connect the Optical Management Interface (OMI) or the SNMP interface to monitor the link performance.

Adaptive Power Control (Optional)
One fiber is needed for the adaptive power control option which is available for the longer range Multi-Link systems.

MOUNTING / INSTALLATION EXAMPLES

Fig. 4: Pedestal mount of a LightStation MonoLink.

Fig. 5: Side by side pedestal mount of four LightStation Mono-Links.

Fig. 6: Wall mount of a LightStation MonoLink.

Fig. 7: Custom mount of a LightStation MultiLink.

Operation and Display Panels

The connection to the network is done via fiber optic ST-connectors situated at the backside of the laser link head. The backside panel is also equipped with the connector for the power supply, a head phone connector with volume control, the test mode switch, a bargraph optical power meter, and various LEDs displaying the link status. Fig. 8 shows a schematic of the backside of the link head.

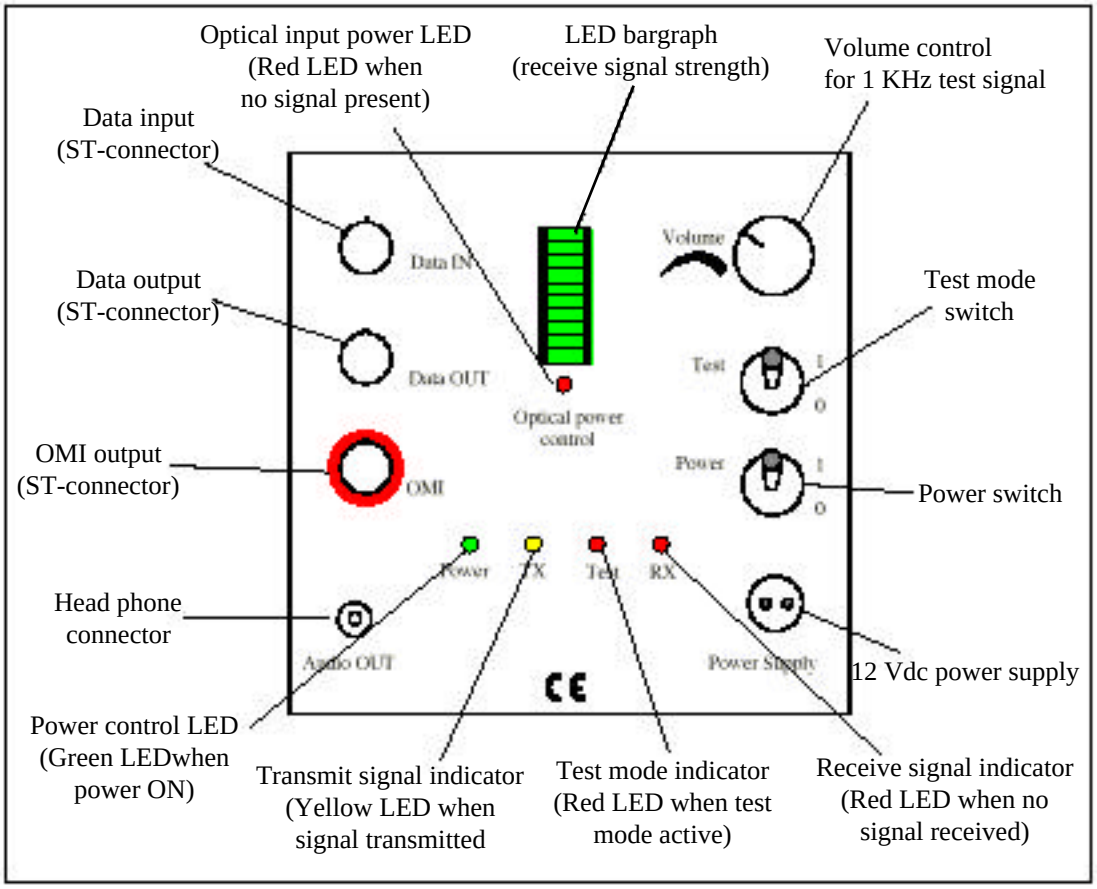


Fig. 8: Control panel at the backside of the LightStation link head.

4. ALIGNMENT PROCEDURE

In general the installation of the LightStation links can be performed by a single person. However, for longer range links we recommend two people (one at either installation site) to shorten the time to perform the installation process. The only tools needed to perform the installation is an Allen wretch provided with the delivery package.

After completion of the installation process described in section 2., and mounting the link heads onto the mounting posts, the following procedure should be followed to successfully install the communication links:

A. Coarse alignment of the link heads.

Loosen the locking screws (see Fig. 9) situated at the bottom part of the link head. You can easily turn the link head along its horizontal axis and use the tilt adjustment screw to vertically adjust the link head.

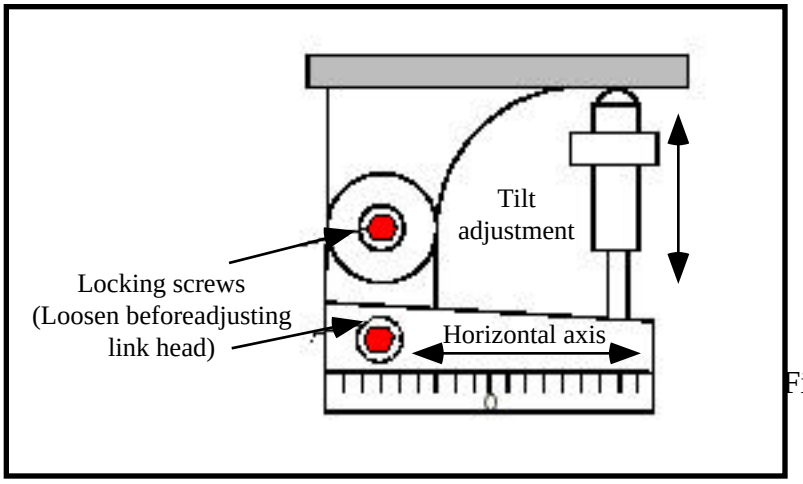


Fig. 9: Coarse alignment mechanics at the bottom part of the link head.

Use the telescope integrated into the link head and aim at the link head at the opposite installation site. Under bad weather conditions or during the night, switch both links head into the “TEST MODE” by using the switch on the backside of the link head (see Fig. 8). Under test mode operation two red LEDs can be seen at the front of the link heads. The LEDs can be seen from both installation sites even under bad visibility or in darkness.

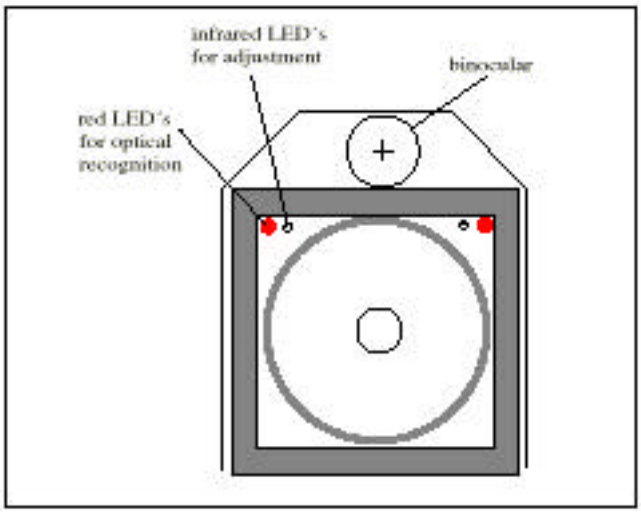


Fig. 10: Location of the telescope in the MonoLink series.

In the MonoLink series the telescope is mounted under the weather shield of the weather proved enclosure. In the MultiLink series the telescope is integrated into the enclosure.

B. Power on the link heads.

Turn on the power by using the power switch on the backside of the link head. Make sure that the red control light at the transformer box is switched on. Otherwise release the emergency push button to activate the transformer box.

C. Fine alignment of the link heads.

Follow the following steps to fine align the link heads:

1. Turn on the TEST MODE signal at Station A by using the test mode switch.

In TEST MODE operation the link head sends out a 1 kHz tone. The TEST MODE switch can be found on the backplane of the link head. When the link head is switch into the TEST MODE operation two red LEDs at the front of the link head are switched on.

The link head adjustment is done by adjusting the opposite (listening) station in such a way that the volume of the tone reaches its maximum value.

2. Connect a headphone to Station B.

For the alignment procedure a headphone is supplied with the link. The head phone connector plugs into the back panel of the link head.

3. Align Link head A.

Slowly move the link head in vertical and horizontal position until you hear the 1 kHz tone. Tighten the locking screws when the tone reaches at its maximum volume. Check the bar-graph at the back panel of the link head. The bargraph shows the received power level on a bargraph scale ranging from 1 to 10. Mark down the receive power level.

4. Align Link head B.

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

5. Finalize the alignment process.

After tightening of the locking screws the optical receive signal level might have been slightly decreased due to the fastening process. The fine tuning of the link head position is done by using the alignment screws on the right side at the bottom of the link head (see Fig. 11). By slowly turning the screws back and forth it is very easy to re-align the link head to its optimal position. When the alignment procedure is completed, the bargraphs at both link heads should show nearly the same receive power level.

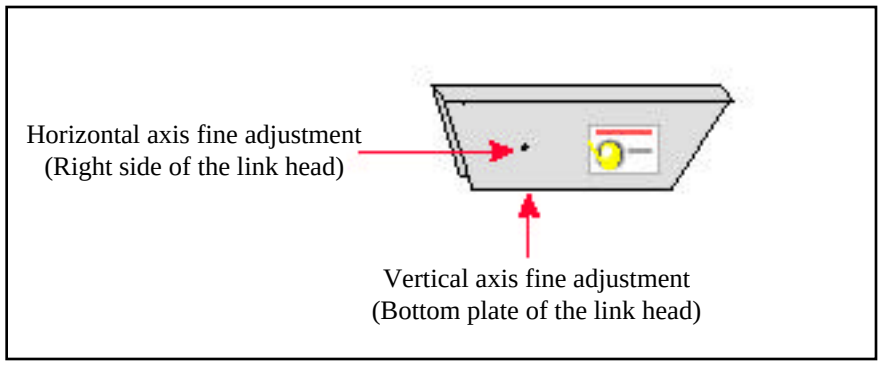


Fig. 11: Locations of the fine adjustment ports.

Important!

After both link heads are aligned its is very important to SWITCH OFF THE TEST MODE FUNCTION at either side of the links. Network traffic can not pass through the links when either one of think Stations is in test mode!

5. CONNECTION TO THE NETWORK

Connect the send a receive signal from the network interface (Hub, Router, NIC card etc.) to the corresponding fiber input ports (DATA IN and DATA OUT) at the back panel of the link heads. The DATA IN port must be connected to the transmission port of the network interface. The DATA OUT port is connected to the receiving port of the network interface (see Fig. 12).

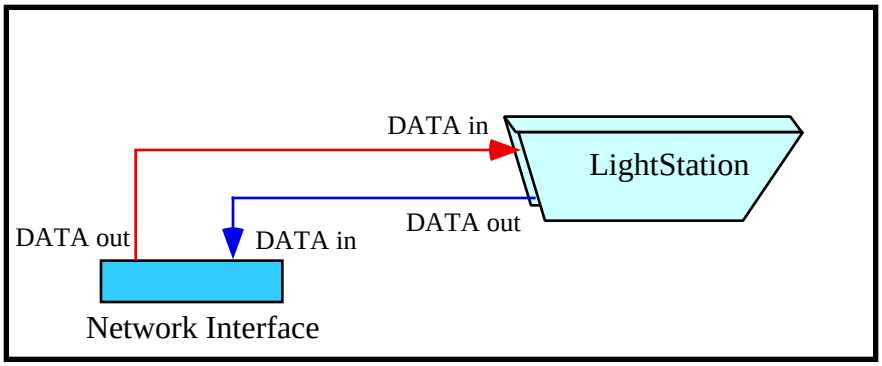


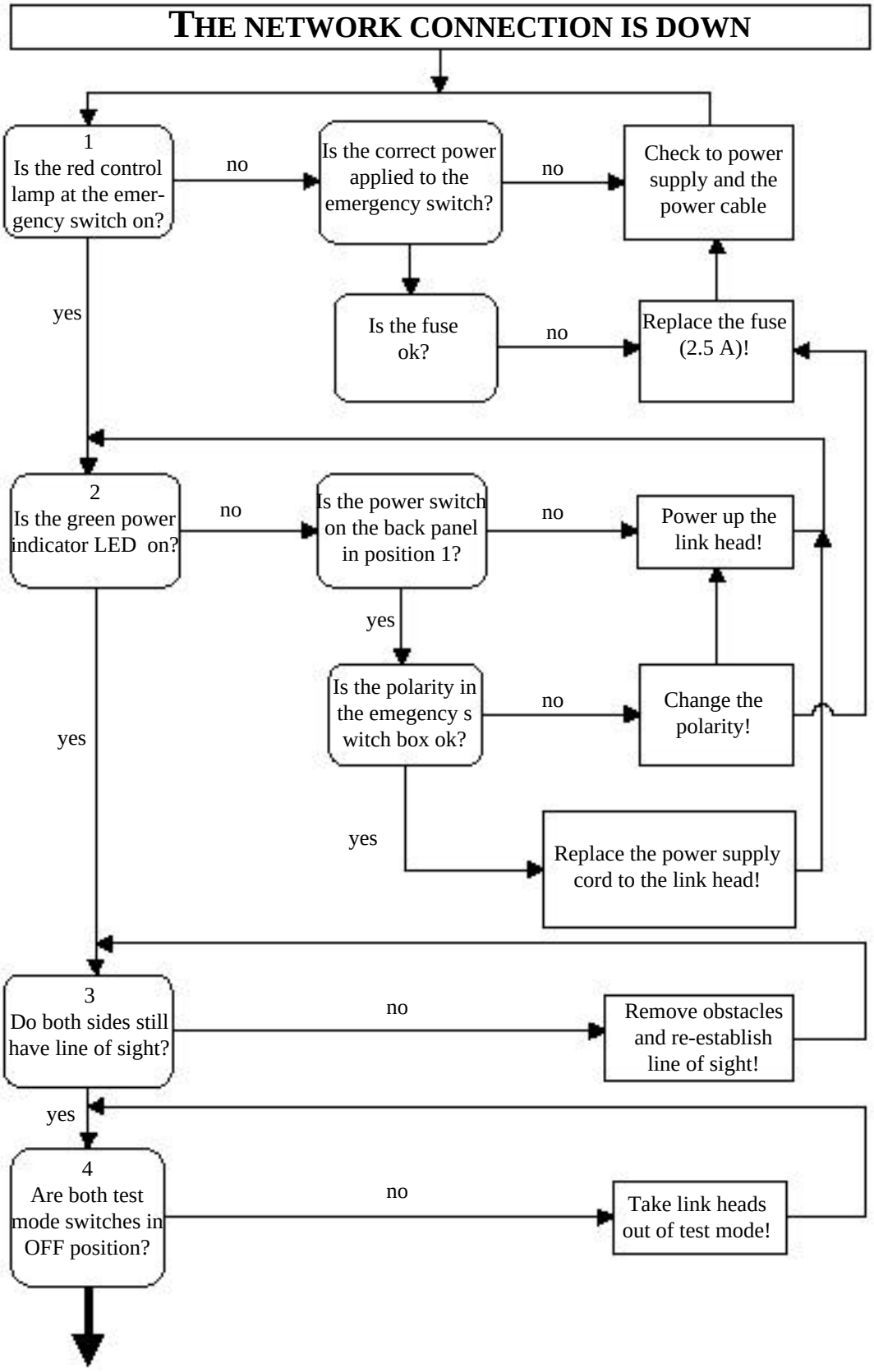
Fig. 12: Connection. to the network interface.

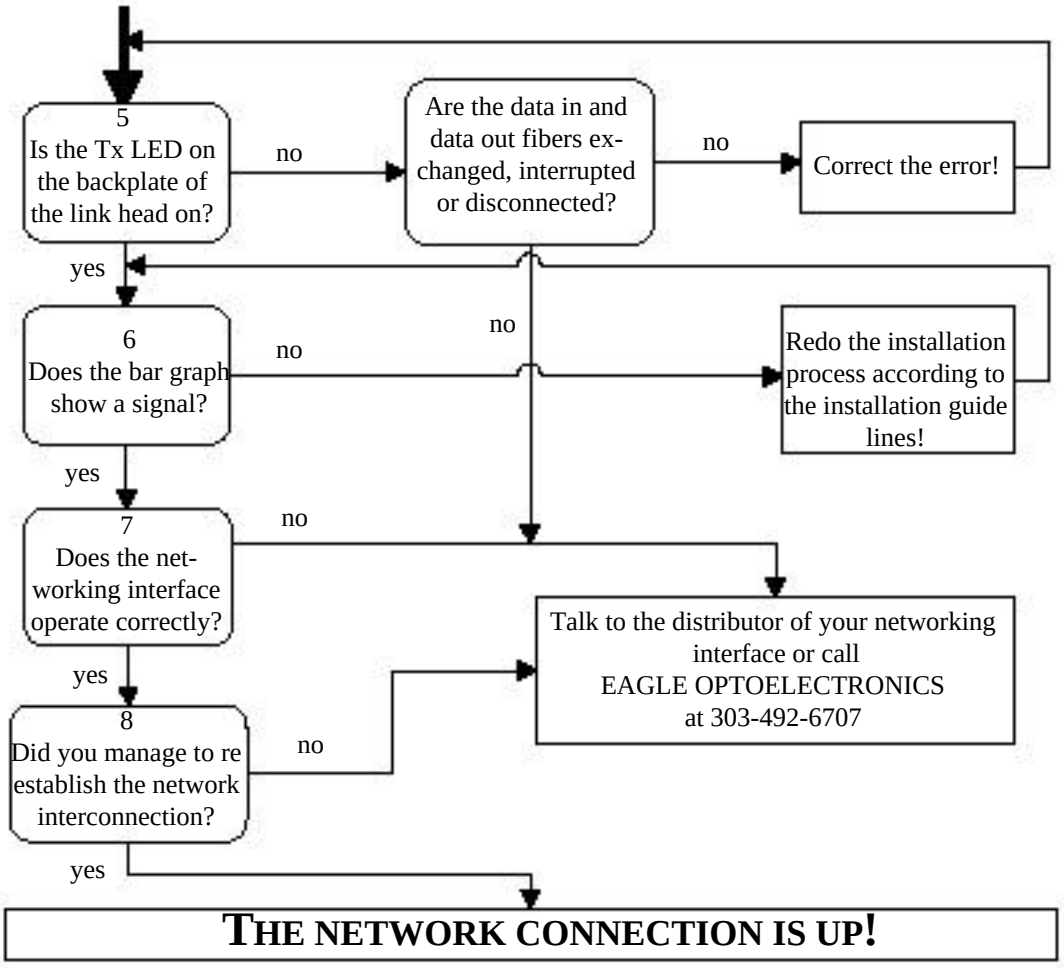
After finishing the network connection. please check the status of the LEDS at the backpanel of the link head. If the installation was successful only the following LEDs should be switched on:

Power	Green LED on
TX	Yellow LED on
Optical Power Control	Bargraph on (shows receive signal power)

In case you will see another LED switched on, please follow the instructions in section 6. (Troubleshooting) or call your local distributor.

6. TROUBLE SHOOTING




5
Is the Tx LED on the backplate of the link head on?
no
Are the data in and data out fibers ex-changed, interrupted or disconnected?
no
Correct the error!
yes
6
Does the bar graph show a signal?
no
no
Redo the installation process according to the installation guide lines!
yes
7
Does the net-working interface operate correctly?
no
Talk to the distributor of your networking interface or call
EAGLE OPTOELECTRONICS
at 303-492-6707
yes
8
Did you manage to re establish the network interconnection?
no
yes
THE NETWORK CONNECTION IS UP!

7. TECHNICAL SPECIFICATIONS

LightStation Laser Communication Systems

Technical Specifications

General

	MonoLink series	MultiLink series	
Dimensions (LxHxD)	135 x 165 x 500	300 x 300 x 650	mm
Weight	5.5	13.5	kg
Operating voltage	110–, opt. 12-...72-		V
Power consumption	max. 20 (including power for heater operation)		W
Status controls (LED)	Power (green), RX (yellow), Test (red),TX (red), Optical Power Control (red), Bargraph (10 bars)		

Free space transmit and receive unit

	MonoLink 20/200 MonoLink 20/600	MonoLink 155/300	MultiLink 20/2000 MultiLink 20/4000	MultiLink 155/800 MultiLink 155/2000	
Range	200/600	300	2000/4000	800/2000	m
Transmitter					
Source	LED	LED	LED/Laser	LED/Laser	
Beam divergence	6	6	3	3	mrad
Opt. output signal power	1	1	4/20	4/20	mW
Receiver					
Photo detector	PIN/APD	APD	APD	APD	
Opt. input signal power	-43...-15/-53...-20	-43...-18	-53...-20	-43...-18	dBm

Network interface

Protocol	transparent	transparent	transparent	transparent	
Bandwidth	1...20	20...155	1...20	20...155	Mbps
Optical system interface	ST-compatible	ST-compatible	ST-compatible	ST-compatible	
Fiber (Multimode)	50...62.5/125	50...62.5/125	50...62.5/125	50...62.5/12	µm
Signal input					
Photo detector	PIN	PIN	PIN	PIN	
Input wavelength	780...900	1270...1350	780...900	1270...135	nm
Input power	-30...-15	-27...-15	-30...-15	-27...-1	dBm
Signal output					
Transmitter	LED	LED	LED	LED	
Output wavelength	860	1320	860	1320	nm
Output power	-15	-20	-15	-2	dBm

Options

Adaptive power control	no	no	yes/no	yes/no
Optical management-interface	yes	yes	yes	yes
Upgradable to 155Mbit/s	yes	no	yes	no

The basic system includes besides 2 head units, two mounting systems for alternate wall or roof installation, an emergency shut-off switch including 2.5 A fuses and an installation and operation manual, and a 1 year limited warrantee on part and labor.

Made in Germany

BZT G123 640H IF

BZT G129 560H IF