



## *Pluto Mobility V1.1a*

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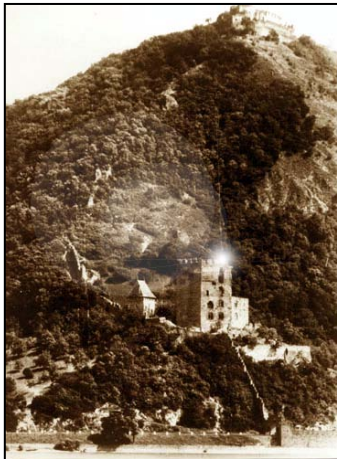
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## 1 Introduction

### 1.1 What is FSO?

**FSO** is free space optics provides point-point broadband communications using Laser Light as the transmission medium.

**FSO** is a state of art data communication method which is based on a very old communication solution. Ancient Chinese developed a protection system against the Mongol tribes, building watchtowers within the line of site to other towers. And as soon as the towers saw some hostile sign on the horizon they use they shield to reflect the sun to the remote towers. In this way the area could be prepared against the attack in a very short period of time.



In the ancient times for this communication use the mirror as a transmitter and the sunlight was the light source, and the receiver was the remote guard's eye. This basic signalling method was developed later into up communication device which used „line coding”. This allowed the guards to tell the number of enemy, or the direction they are coming from.

Current **FSO** systems use a laser-diode as a light source, and a receptor diode (photo diode) to receive the signals coming from the laser diode from the transmitter side. But the basic elements are still the same: line of site between the communication nodes, and individual line coding. It is all about performance. **GeoDesy FSO** offers **FSO** systems with the highest power budget available on the market.

### 1.2 Why is it important?

Because of in the ancient Chinese times, the rain, the fog, or even the cloudy weather, could impact the operation of the whole system.

In the **FSO** units, comprising light source and receiver the cloud problem was solved, but development conditions still can impair performance. To go throw the rain, the fog, or snow you need more and more power to be seen from the remote side. Achievable power levels are limited by a number of factors including eye safety.

In this way there is no other choice to see more than „training the eye”. Making the receiver more and more sensitive to sense delight emitted from the remote side.

**GeoDesy FSO** offers high transmit power and also



very hard receiver sensitivity. These two factors combined to provide one of the best performing **FSO** systems on the market today.

To meet the demands for every higher bandwidth, **GeoDesy FSO (Europe) Limited** continues to invest heavily in research and development with the newest product line which offers Gigabit speeds being launched.

This manual describes the **GeoDesy FSO Next** series of free space laser transmission system.

The **GeoDesy FSO Next** product range offers cost effective reliable free space laser transmission for two Mbps up to 1000 Mbps data to the air, where a clean line of site is available. It delivers the most effective point-to-point connection between computer networks or telephone exchanges.

No need for installing cables, no rental costs, no licensing requirements.

Ideal for urban areas or city centres, where the use of these lines are expensive. Suitable for factories or industrial environments where high noise level can interfere with the transmitted data. The best choice to make a connection across rivers and other natural or artificial obstacles, where cable is not available.

The transmission technique used in the **GeoDesy FSO** devices provides transparent and wire-speed data transfer with virtually zero latency. Because they use infrared light as the transmission medium, **GeoDesy FSO** system do not require frequency licenses and the transmission is not effected by electro-magnetic or radio-frequency interference. Basically the **GeoDesy FSO** link can be considered as a virtual fibre in the air, which ends in real fibre optic cable at both ends.

Our product is built using high quality components for operation in even the most adverse conditions.

Metal housing gives robust, waterproof environment for the electronics.

The shield protects the device from direct sunlight and provides extra air isolation.

The **GeoDesy FSO X** systems comprise two laser-heads and the two indoor interconnection units (OIU) - one at each end. The interface connections are housed in the outdoor unit together with the PSU of the system.

Best practises were employed in cost engineering throughout the development of **GeoDesy FSO**.

## 1.3 Optical Free-space Transmission

The principle used in free space laser transmission is very similar to the one is used for fibre optic transmission. The difference is while fibre optic devices use electronics and optics optimized for transmission to the air. Also one can observe to the similarity in the transmission properties. No galvanic contact, no ground-loops, no need for surge protection, noise immunity, long distances, high bandwidth.

What makes it unique – and difficult to design – is that it does not require any transmission medium like fibre or copper, but it has to cope with the dynamically changing parameters. For instance while the attenuation of an optical fibre is constant, the attenuation of the atmosphere between the laser units can change dramatically (depending on the weather conditions).

The laser-heads are usually placed on top of building, where the clean line of site is guaranteed and the beam cannot be interrupted.

In the head the incoming signal is amplified, encoded, and then drives the laser-diode. The transmitter optics assures the proper beam shape and controls the beam divergence. The receive optics perceives and directs the transmitter signal to the photo diode. The diode converts it back into electrical, than it is decoded, amplified and converted.

There are several things that can influence the quality of transmission. We can classify those factors into three main groups.

System conditions - transmitting power, transmitter's wavelength, beam divergence, receiver optics diameter, receiver sensitivity, parameters of optical system and casing. These parameters determine the system's characteristic at a certain distance and are controlled by system design and factory set up.

Weather conditions - molecular absorption, particle scattering and turbulence. These elements have great effect on the operational conditions of the system. We do not have very much influence on them; proper product selection can eliminate the undesirable effects.

Environmental conditions - building movements, direct sunlight, refractive surfaces. These are also key factors related to the installation sites and can be controlled by appropriate site survey and system installation

## 1.4 Typical applications

Most typically the **GeoDesy FSO Next** products are used to interconnect LAN-s. The system is protocol transparent, thus other applications also can be taken into consideration. Appropriate interface converters are needed and system bandwidth must be matched for that.

Here we collected some circumstances, where the deployment of the **GeoDesy FSO** is the most adequate as a cost effective solution.

Those are:

### ***Areas with natural or artificial obstacles***



Where cable is actually not an alternative, like across rivers or railways or in rugged terrain.

### ***Urban areas***

Where only leased lines are available with limited speed, and high rental cost. With GeoDesy FSO links you can establish on line LAN-to-LAN connections.



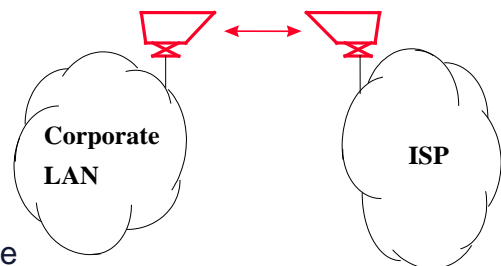
### ***Industrial areas***



Where you have noisy environment with high EMI or RFI. Factory buildings, airport objects can be connected through laser link.

### ***ISP connections***

Where high bandwidth is required. ISP's can offer high-speed links to their customers or trunks can be established between ISP's instead of expensive leased lines.



## 2 Interfaces for the X Series

### 2.1 100Mbps TP interface

The **GeoDesy FSO X PoE** series products are designed to provide easy-to-use and cost-effective solution for interconnecting Local Area Networks. By utilizing standard Category 5 cable and using standard IEEE802.3af interface the deployment of the system is easier than ever before. The transparent and wire speed data transfer together with virtually zero latency assures the easy integration of the system in all environments.

The **X PoE** systems should be considered as repeaters in the network. So the installation distance between the head and the network device is 100m. The distance on a back to back site is maximum 5 meters, between the heads without signal regeneration.

The **X PoE** systems connecting to the network with an RJ 45 cable which provides the power required for operation and the data. The system requires IEEE 802.3af Power over Ethernet switch or power injector. The power consumption suits to the standards described in the standard. Also provides fast and easy connection for the management system for more details please see the chapters below. The system is certified **Class 1M product**, this way 100% eye safe.

### 3 Sites of installation

#### 3.1 Key factors of operation

There are four key issues that the site survey has to shed light on. Proper system operation cannot be guaranteed without satisfying all of the four requirements.

**Clear line of sight** - The entire optical path between the two ends must be free of any obstacles. It not only means that one has to see the other side, but other possible sources of disturbance should also be taken into consideration. For example there might be turbulence above the roofs and other constructions, and this can cause fraction or scattering of the beam or snow accumulation on roofs too close to the beam can influence or even interrupt communication.

**Solid mount surface** - is the key for long-term operation. Since the diameter of the beam is limited, it is extremely important to mount the unit on a stable structure with the possible smallest movement. This way the receiver of the remote unit cannot get out of the beam due to the movement of the opposite head.

**East-West orientation** - although the receiver optics are equipped with optical filters to protect the receiver diode from the effect of undesired light sources, direct sunshine can cause saturation of the diode. This prevents the system from working properly for several minutes a day at certain times of the year. In most cases this effect can be avoided by careful selection of the mounting spot.

In order to comply with the requirements of the successful installation - including the discussed four key factors and other criteria - the following matters should be taken into consideration.

#### 3.2 Preferred installation sites

All buildings and constructions have a certain movement of their own. It's determined by the structure and material of the building. Metal structures can shift or twist due to temperature changes. Wooden construction can expand or shrink with any changes in humidity. Give preference to concrete or brick buildings. On the other hand high structures like towers, skyscrapers or poles are always subject to movement. Mount the support frame to walls of the building or near corners, as they are the most stable spots. Use appropriate consoles for wall mounting. If a stand is used on the top of building, secure it directly to the ceiling or to the concrete cornice wherever is possible. Do not fix stands to insulating materials as they can slowly sink under the weight of the unit and with temperature changes. Big chimneys and smokestacks may look stable, but as their inner temperature varies they can also move. Vibration caused by heavy traffic, trains and elevators etc. may slowly move the system out of its specified direction. Another important consideration is to provide enough space



for alignment and to have the potential for future maintenance. Consider that the support frame is usually heavy, so the selected spot should be easily accessible.

<b>Preferred installation sites</b>	<b>Pay attention to</b>	<b>Avoid (*)</b>
Concrete wall	Behind window	Soft materials
Brick wall	Old constructs	Chimneys
	Microwave towers	Wooden constructs
		Metal masts or Frames
		Hidden heat isolations, like Styrofoam

(\*)

*In cases where installations are listed under "AVOID" cannot be avoided than special mounting accessories to be designed and special installations must be used.*

It is not only the building that has to be solid, but the support structure too. Antenna poles and security camera holders are not suitable for the **GeoDesy FSO** units.

### 3.3 Content of the package

Laserbit provides three product range with three different kinds of package contents. The Laserbit Pluto Mobility (comprising Pico, Pinto and Pronto links) has all the necessary nuts, bolts wall plugs and for the easy installation of the link. Also you can find in the package the power supply units. These units also have all the necessary gadgets for the fastening. Laserbit does not provide power cable for the connection of the main and the outdoor box. For the detailed information please see the chapters below:

#### 3.3.1 Contents of a Laserbit Pluto Mobility

For the Pluto Mobility systems Laserbit provides all the necessary accessories to fix the head to the bracket, fix the Power supply unit and the bracket to the wall, below you can see what is provided in the Pluto Mobility package.

- 2 pcs Switch
- 1 pcs Hand knob with threaded stud
- 1 washer M8
- 2 spring washer
- 1 M6x 20 screw
- 1 M4x25 alan headed screw
- 1 3mm alan key
- 1 laser head
- 1 Instructional manual



## 4 Sites of installation

### 4.1 Key factors of operation

Pluto Mobility was designed to cover only about 20 meters with a wide transmitter beam; the following should be taken into consideration, to decrease the factors causing inconveniences during every day use. There are four key issues that the site survey has to shed light on. Proper system operation cannot be guaranteed without satisfying all of the four requirements. Pluto Mobility is only for indoor use, not suitable for outdoor use.

#### Clear line of sight

- The entire optical path between the two ends must be free of any obstacles. It not only means that one has to see the other side, but other possible sources of disturbance should also be taken into consideration.

#### Solid mount surface

- is the key for long-term operation. Since the diameter of the beam is limited, it is extremely important to mount the unit on a stable structure with the possible smallest movement. This way the receiver of the remote unit cannot get out of the beam due to the movement of the opposite head.

#### East-West orientation

- although the receiver optics are equipped with optical filters to protect the receiver diode from the effect of undesired light sources, direct sunshine can cause saturation of the diode. This prevents the system from working properly for several minutes a day at certain times of the year. In most cases this effect can be avoided by careful selection of the mounting spot.

In order to comply with the requirements of the successful installation - including the discussed four key factors and other criteria - the following matters should be taken into consideration.

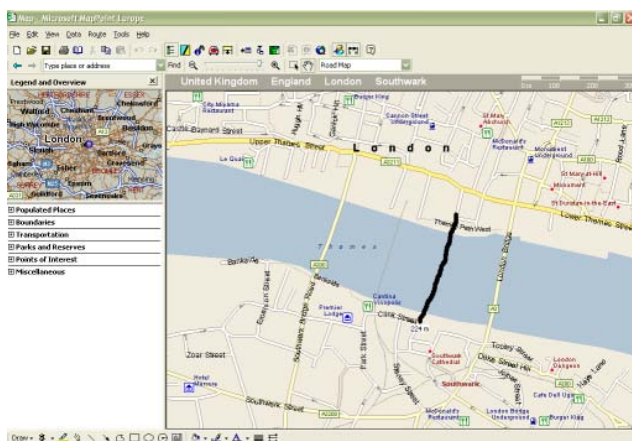
### 4.2 Preferred installation sites

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wherever is possible. Do not fix stands to insulating materials as they can slowly sink under the weight of the unit and with temperature changes. Big chimneys and smokestacks may look stable, but as their inner temperature varies they can also move. Vibration caused by heavy traffic, trains and elevators etc. may slowly move the system out of its specified direction. Another important consideration is to provide enough space for alignment and to have the potential for future maintenance. Consider that the support frame is usually heavy, so the selected spot should be easily accessible. It is not only the building that has to be solid, but the support structure too. Antenna poles and security camera holders are not suitable for the Laserbit units.

### 4.3 Distance measurement

Because the units were designed, and calibrated for certain distance operations the higher distance will decrease the availability. GeoDesy FSO pre-calibrates and pre-tests every unit shipped to the customer. To ensure that the unit you are about to



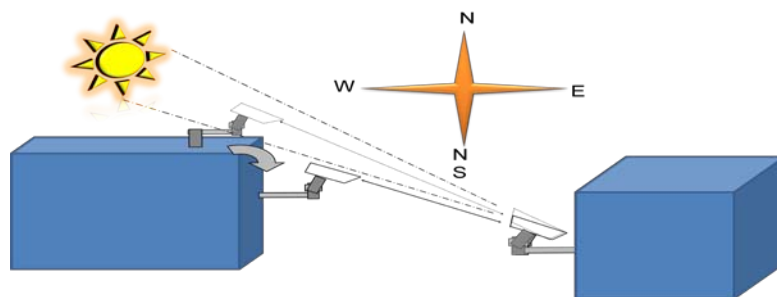
buy fits to the needs, the first step is to measure the distance. The best way to measure it is by GPS (Global Positioning System), these units are accurate enough to determine the distance between two points. For more details please refer to the GPS manufacturer handbook. Also there are several other ways to measure the distance. If you know the exact address you can use mapping



software like MapPoint or Auto route.

### 4.4 Direct sunshine

To prevent the sun shining directly into the receiver optics, first one has to determine the orientation of the link. Try to avoid East-West orientation wherever it is possible. Examine both sides of the link at sunset and sunrise and find a position where the sun cannot get behind any of the heads. Be aware that the path of the sun is changing throughout the year.



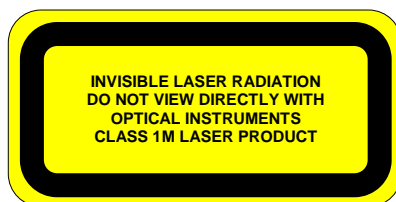
## 5 Eye safety

There are no two installation spots of the same kind, the buildings or structures, the available space and the accessibility of the place will be different in each case. Nevertheless, as a general rule it is very important to select the installation site so that nobody can look directly into the transmitter. For this reason place the head either so high (on the side wall of the building) or so close to the edge of the building (on a parapet on the rooftop) that no person can approach it accidentally and can get into the beam path. Set up barriers if necessary and put warning signs at prominent places.

The laser heads are provided with all labels and hazard warnings required by the laser standard. There are warning labels on both the left and right side of the protective cover next to the optical window and there is a warning and an informative label on the rear side of the laser head.



Type	: LB PP-0020-E100TP
S/N	: LBH-«Ssz_1»
Input Power	: -48VDC IEEE 802.3af compliant
Laser	: 1M
Wavelength	: 785nm
Manufactured by: GeoDesy FSO 1162 Budapest,	

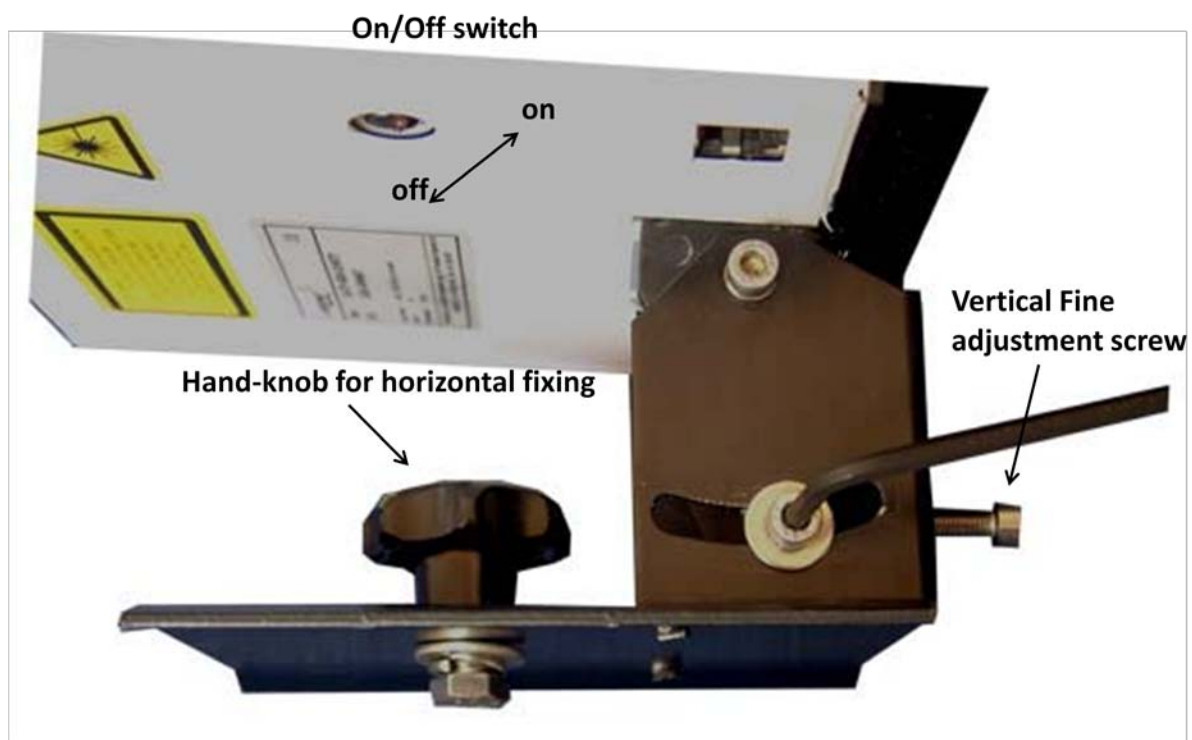


## 6 The mounting bracket

In the following chapter you will find detailed description of the bracket fastenings.

Pluto Mobility was designed to be used for high speed data transfer, on short distances. The unit provides Point-to-point connection at the speed of 100Mbps, and a POE interface.

The bracket was designed to fulfill these requirements. The horizontal movement of the link is fixed with the hand-knob. This point will hold the weight of the unit as well as fix the horizontal alignment of the unit.



After the unit was turned on it will take about max. 20 seconds for the unit to boot up, and lit up the LEDs on the back of the device, turn on the buzzer and the pointer.

## 7 System installation

### 7.1 On the table test

Warning! Do not look either into the transmitter or the receiver optics because at this distance even the reflected laser beam can be dangerous to your eyes. Operating the system on much shorter distance than presumed originally can cause saturation or even permanent damage to the receiver. Always use optical attenuators for this kind of test.

The on-the-table test needs careful planning and careful use during the test period. The units should be placed at about 2 m distance from each other with optical windows facing one another. Put an appropriate optical attenuator (Attenuating foil or cardboard with several small holes) between the heads. Make all the necessary connection as described below to connect your network equipment (computer or protocol analyzer) to the heads and power up the units.

You should be able to align the units without any tool and get full received level on the signal strength LED's. Make sure that the "Saturation" indicator is OFF. Adjust your attenuators if necessary to avoid saturation of the receivers.

Please also take in consideration that the laser beam is concentrated and in such a short distance can harm your eyes, every time you test the units on short distance, do it with extra care. Never look into the sighting device if the remote laser is turned on. We strongly suggest to double check the power connection before you turn on the device. Handle the power connection with extra care. Safety first

After obtaining the desired received level, check the data connection between devices. Using computers or appropriate testing devices.

On the table tests are perfect for troubleshooting (If there is a transmission problem, check the status of the connecting devices (e.g. Link signal or cable polarity) and cables.) in a controlled area. If you experience some problems during the test, please try to test the connected equipments with a direct connection.

### 7.1.1 Alignment of the heads

To make the alignment easier, we have equipped the unit with an audio aiming tool, and a laser pointer. These tools will help you with small beep signals, and laser light to confirm the alignment.

#### Audio Alignment tool

The Audio Alignment Tool, when you first power up the unit will give one second long beep. That means that the unit has booted up and ready for operation. During the alignment as you getting more and more receiving level you will hear the beeping faster and faster. Starting with a 0.5Hz (0 Level LED) beeping and finishing beeping at 8Hz (3 Level LED). The beeper will beep in the case of dramatic receive level loss, or change. So it might happen that the unit will start beeping if someone blocks the beam for a second.

The beeper will stop working after the received level is not changing.

The Laser pointer is a collimated 650nm laser beam which can be dangerous to the eye. The pointer is pointing exactly where the middle of the laser beam is pointing. This way will make the alignment easy. All should be done is to line up the two pointer exactly to each other. The pointer is located right below the transmitter optics. The pointer is operated automatically; after the alignment is done it will turn off automatically after 10 minutes.



Laser pointer



## Link alignment

The sheet below is a quick overview table of how the alignment steps following each other. Pluto is only 20 meter distance, however the installation, is still the same as for the longer distance units. Only one head should be moved at the time. Moving both units will make confusion and make the installation time longer.

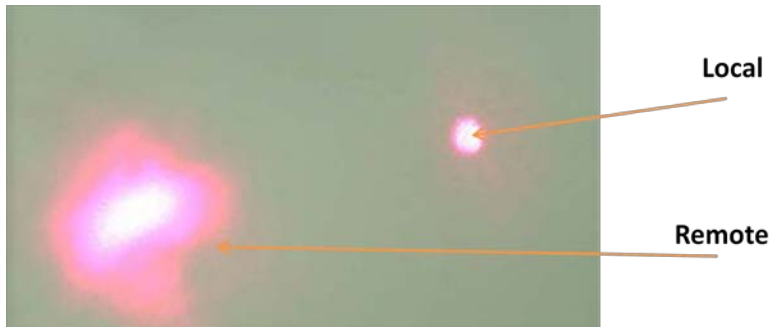
Side A	Side B
1, Roughly align the links horizontal alignment and tighten the Hand-knob	1, Roughly align the links horizontal alignment and tighten the Hand-knob
2, Roughly align the vertical position and tighten the vertical fixing bolts	2, Roughly align the vertical position and tighten the vertical fixing bolts
3, Turn on device (1s long beeping)	3, Turn on device (1s long beeping)
4, Using the built in pointer, direct the laser head to Site A pointer	
	5, Using the built in pointer, direct the laser head to Site A pointer
6, check receiving level you should be able to see 1-3 LEDs after the alignment depending on the distance	6, check receiving level you should be able to see 1-3 LEDs after the alignment depending on the distance
7, tighten the horizontal and the vertical fixing.	7, tighten the horizontal and the vertical fixing.

During the alignment the receiving levels will show you the reception from the remote end. Also it is an indication of the laser head settings on your local end as well. The receiver lens focuses the beam into the receiver so if your head is pointing some other direction, you wont have receive even if the remote ends head is point at your end.

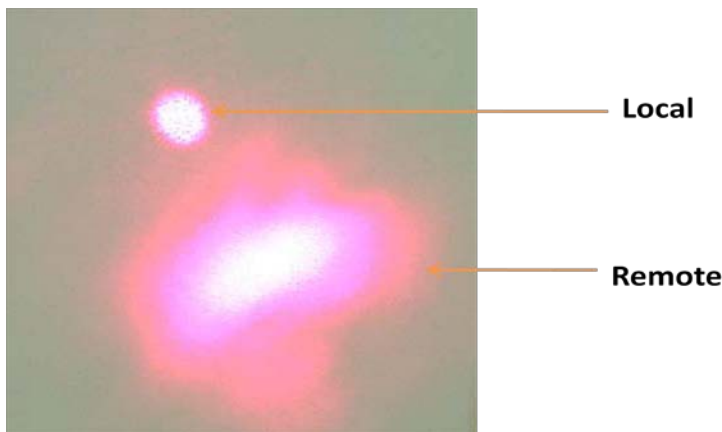
The unit turns off the beeping after the receiving level is not changing. 30 seconds later the Laser pointer will turn off as well you can always turn them on by blocking one of the heads, transmitter and receiver as well.

## How to set up the link using a laser pointer

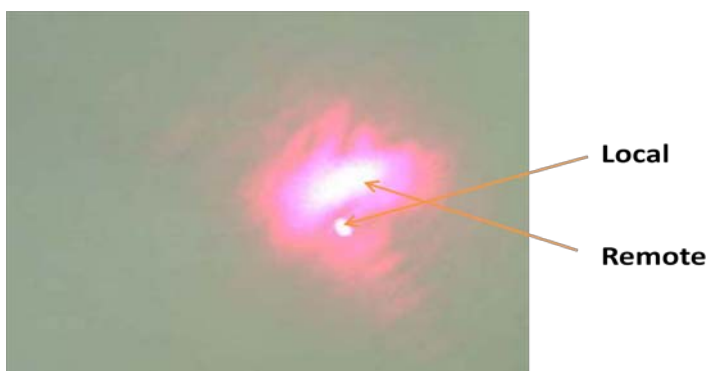
Place a piece of paper in front of your local unit. Direct the pointer beam from the remote end to your local unit



Keep on directing the remote pointer beam closer to your local pointer beam.



Set the remote beam center to your local beam.



Repeat these steps on the remote end as well. Check the receiving level, and with smooth movements you can fine tune the unit, further more. Please note that on 20 meters the level 1 LED should come on.

## 7.2 Meaning of the LEDs



FO Link:  
Fibre optical link between the two heads.

TP Link:  
Copper link between the head and the Network equipment.

Level 1:  
25% of the total (acceptable by the receiver) incoming power. It indicates after 25µW incoming light efficiency.

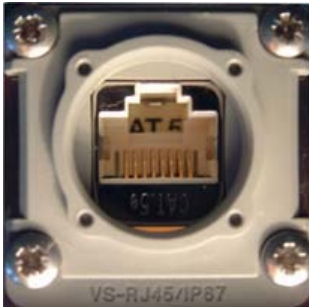
Level 2:  
50% of the total (acceptable by the receiver) incoming power. It indicates after 50µW incoming light efficiency.

Level 3:  
100% of the total (acceptable by the receiver) incoming power. It indicates after 100µW incoming light efficiency.

Saturation:  
Overload (Overloading can cause stop in the communication, and permanently it can damage the receiver) After 15mW (or higher) incoming light efficiency

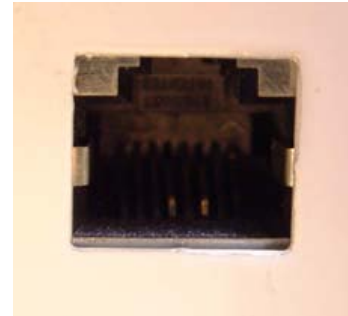
## 8 Cable connections

### 8.1 PoE+Data MGM



Also the MGM connector can be found on the bottom of the device. Use Blue and Blue/White cable for connecting the LB View to the system.

For more information please see the handbook for LB view.



1. Orange/White
2. Orange
3. Green/White
4. Blue
5. Blue/White
6. Green
7. Brown/White
8. Brown

- TX+
- TX
- RX+
- +VIN
- +VIN
- RX-
- VIN
- VIN

1. Not connected
2. Not connected
3. +RS485(MGM)
4. -RS485(MGM)
5. Not connected
6. Not connected

## 9 Warranty conditions

**GeoDesy FSO (Europe) LTD** warrants that the **GeoDesy FSO** product purchased will be free from defects in material and workmanship for a period of one (1) year from the date of purchase. This warranty period will not be extended by virtue of a repair of the product or a replacement of any component of the product during the warranty period.

This warranty covers only normal commercial use. **GeoDesy FSO (Europe) LTD** is not responsible for warranty service should the **GeoDesy FSO** identification marks, serial numbers or original seals be removed, altered, or broken, or should the product fail to be properly maintained or fail to function properly as a result of any modification, misuse, abuse, improper installation, neglect, improper shipping, damage caused by disasters such as fire, flood, earthquake or lightning, improper electrical current, or service other than by **GeoDesy FSO (Europe) LTD** or its authorised partners.

If the **GeoDesy FSO** product fails to operate as warranted at any time during the warranty period, **GeoDesy FSO (Europe) LTD** will repair, or at its option, replace the defective product at no additional charge.

In no event will **GeoDesy FSO (Europe) LTD** be liable for any damages including loss of data, lost profits, lost savings, lost business, or other incidental or consequential or indirect damages arising out of the installation, use, maintenance, performance, failure or interruption of the **GeoDesy FSO** product, even if **GeoDesy FSO (Europe) LTD** has been advised of the possibility of such damage.

If you purchased the **GeoDesy FSO** product in the United States, some states do not allow the limitation or exclusion of liability for incidental or consequential damages, so the above limitation may not apply to you.

The purchaser or user shall have the responsibility to give **GeoDesy FSO (Europe) LTD** prompt written notice of any warranty claims. If the product was purchased through an authorised partner of **GeoDesy FSO (Europe) LTD**, notice may be given in writing to that authorised partner in the area in which the product was being used.

The product may be returned to **GeoDesy FSO (Europe) LTD** only if it has a Return Material Authorisation (RMA) number. The product must be shipped prepaid, insured and in the original shipping package or similar package for safe shipment. The RMA number must be marked on the outside of the shipping package. Any product returned without an RMA number shall be rejected.

Transportation charges for the return of the product will be paid by **GeoDesy FSO (Europe) LTD** if it is determined by **GeoDesy FSO (Europe) LTD** that the product was defective within the terms of the warranty; otherwise the purchaser or user shall be responsible for costs of return handling and transportation.

If the **GeoDesy FSO** product does not operate as warranted above, the customer's sole remedy shall be repair or replacement. The foregoing warranties and remedies are exclusive and are in lieu of all other warranties, expressed or implied, either in fact or by operation of law, statutory or otherwise, including warranties of merchantability and fitness for a particular purpose. **GeoDesy FSO** neither assumes nor authorises any other person to assume for it any other liability in connection with the sale, installation, use or maintenance of the product.

## 10 Privacy statement

We will never share, sell, or rent individual personal information with anyone without your advance permission or unless ordered by a court of law. Information submitted to us is only available to employees managing this information for purposes of contacting you or sending you emails based on your request for information and to contracted service providers for purposes of providing services relating to our communications with you.

## 11 Pluto Mobility Data Sheet

### ELECTRICAL CHARACTERISTICS

Light source	Laser Diode
Laser diode power	70 mW
Detector	Si PIN Photodiode
Dynamic range	>12 dB
Bandwidth	100 Mbps
BER	< 10 <sup>-9</sup>
System latency	< 50 ns

### ENVIRONMENT

Operating temperature	- 25 to + 60 Centigrade
Storage temperature	- 40 to + 80 Centigrade
Humidity	95% non condensed
Protection rating	IP20

### DATA IN / OUT

Fast Ethernet	100BaseTX, RJ-45 socket
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### POWER

Power required	IEEE 802.3af compliant device
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### PHYSICAL CHARACTERISTICS

Head Housing	Stainless Steel
Weight	2.5 kg
Dimensions (with cover and Alignment Unit, mm)	172 x 124 x 149

### OPTICAL CHARACTERISTICS

Wavelength	785 nm
Beam divergence	100 mrad
Receiver acceptance angle	100 mrad

### ORDERING INFORMATION

PP-0020E100TP	LaserBit PlutoMobility LINK with Fast Ethernet (100BaseTX) I/F and PoE. Maximum 20 m distance between heads.
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