欧镭激光

Sensing Reality!

2D 270° LiDAR Sensors
LR-1F Series
User Manual

Please read this user manual for best product performance before using the product.
Be sure to keep this manual properly for future reference.

OMEN-1F-202012

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1 About this documen

This document summarizes supplementary information on mounting and electrical installation as well as measured value output format of the LR-1F. It is aimed at sufficiently qualified personnel for the purposes of installation, commissioning and further data processing. Notes on commissioning, configuration and maintenance can be found in the LR-1F operating instructions

2 Safety information

- Read the notes on mounting and electrical installation before carrying out these tasks;
- Read additionally the LR-1F operating instructions to familiarize yourself with the device and its functions;
- The LR-1F complies with laser class 1.
- Only use the device in permissible ambient conditions (e.g. temperature, ground potential). Any applicable legal regulations or regulations of other authorities will have to be observed during operation.
- Opening the screws of the LiDAR housing will invalidate any warranty claims against OLEI.
- Repairs may only be performed on the LiDAR by trained and authorized OLEI service personnel

3 Product introduction

LR-1F is a 360° continuous scanning LiDAR. It not only provides a full-angle scanning range, but also obtains a longer measuring distance due to optimized optical design.

LR-1F has been widely applied to industries robot obstacle avoidance, safety monitoring, industrial automation, and intelligent logistics, etc., and can also be used for spatial surveying and mapping systems such as mobile surveying and mapping. Users can choose different LiDAR products according to different requirements on environmental perception and navigation.

With industry-leading manufacturing facilities, professional-level calibration laboratory, and rigorous verification process, OLEI strives to provide users with a reliable, high-quality, durable LiDAR.

4 Installation and operation

4.1 Mechanical interface

The LiDAR can be installed in two ways: back-mounted and bottom-mounted.

- **Back-mounted**

There are four M5 screw holes (hole depth is 8mm) at the back of the LiDAR.

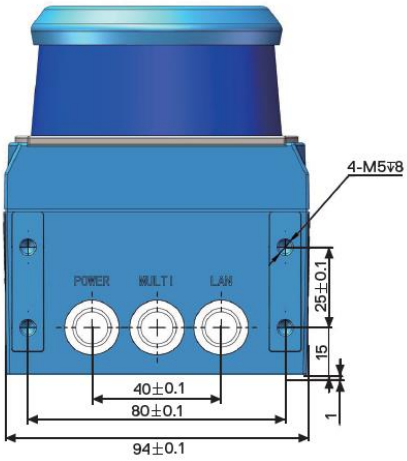


Figure 1 Back mounting interface of LR-1F

- **Bottom-mounted**

  There are three M5 screw holes (hole depth is 8mm) at the bottom of the LiDAR.

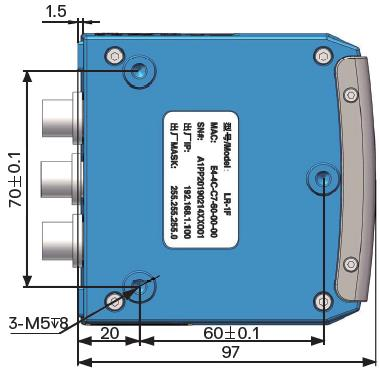


Figure 2 Bottom mounting interface of LR-1F

4.2 Pin and wire color assignments

LR-1F is equipped with 3 interfaces, namely power supply interface, I/O interface and 4 PIN Ethernet interface.

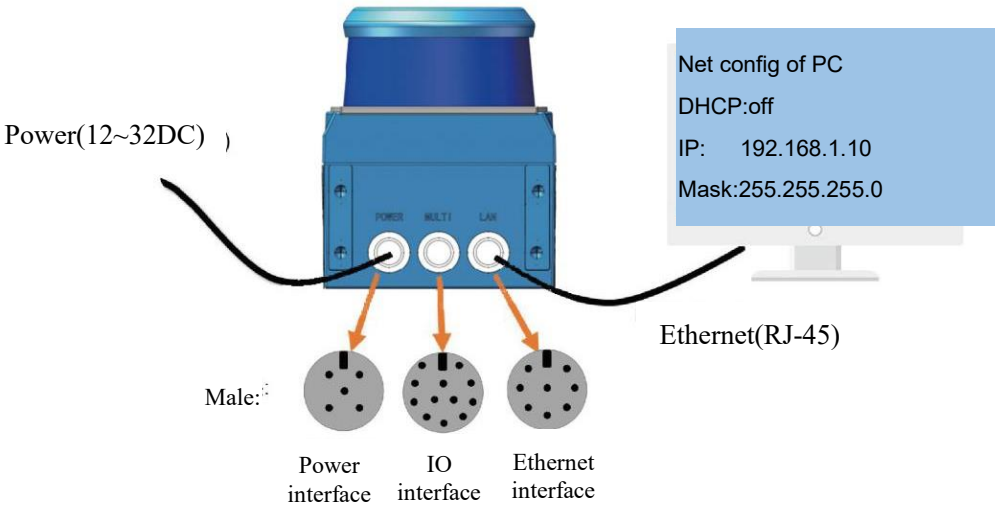


Figure 3 Diagram of electrical interface

- Power interface

The power interface adopts 12~32VDC power supply

NO.	Definition	Cable color
1	GND	black
2	GND	gray
3	NC	blue
4	NC	white
5	VCC（12~32VDC）	brown/red

Table 1 Definition of power interface

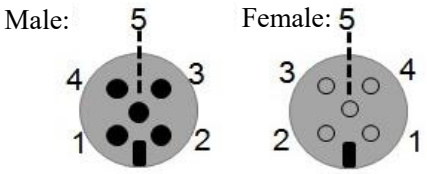


Figure 4 Diagram of power interface

- I/O interface

NO.	Definition	Cable color
1	NC	orange
2	Output 0	orange
3	NC	yellow
4	NC	green
5	NC	purple
6	NC	gray
7	NC	dark blue
8	NC	light blue
9	NC	white
10	GND_IO	black
11	NC	pink
12	VCC_IO	red

Table 2 Definition of I/O interface

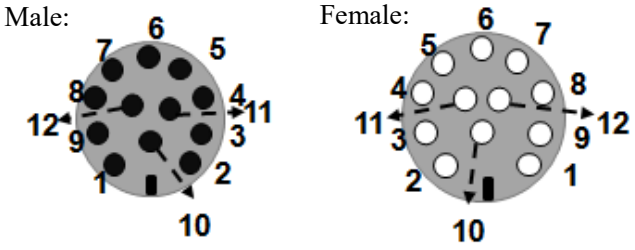


Figure 5 Diagram of I/O interface

- Ethernet interface

NO.	definition
1	TxData+: Send +
2	TxData-: send-
3	RxData+: Receive+
4	NC
5	NC

NO.	definition
6	RxData-: receive-
7	NC
8	NC

Table 3 Definition of Ethernet interface

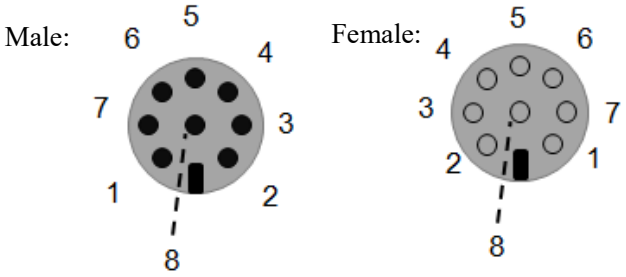


Figure 6 Diagram of Ethernet interface

4.3 Communication interface

The LR-1F is connected to the computer by a RJ-45 Ethernet interface. The computer IP address should be set up before communication. The LiDAR and computer IP must be set up in the same subnet without any conflict. The host port is 2368 by default.

The factory default settings are as follows

- Computer IP:192.168.1.10
- Computer subnet mask:255.255.255.0

The default factory settings of LiDAR are as follows

- Lidar IP:192.168.1.100
- Lidar subnet mask:255.255.255.0

The operation steps are as follows

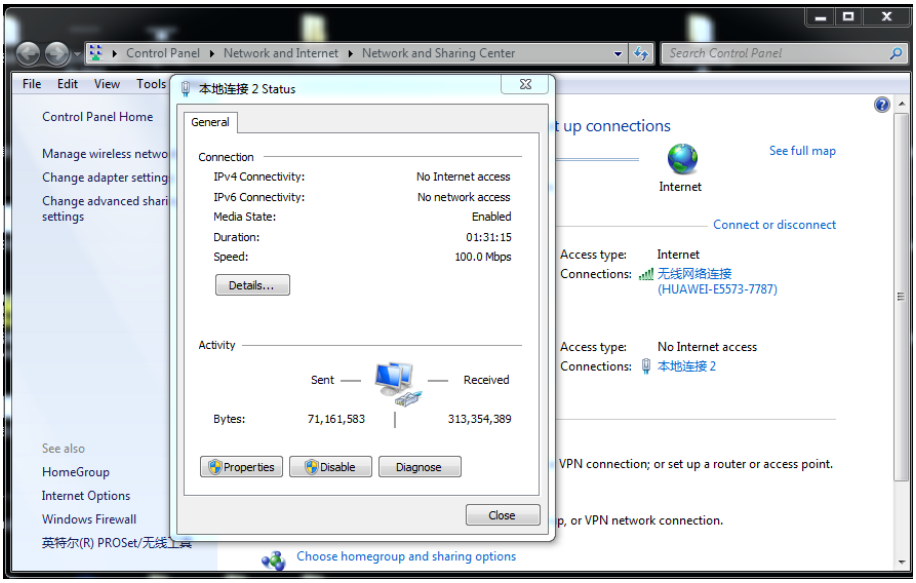


Figure 7 Step 1 of computer IP setting

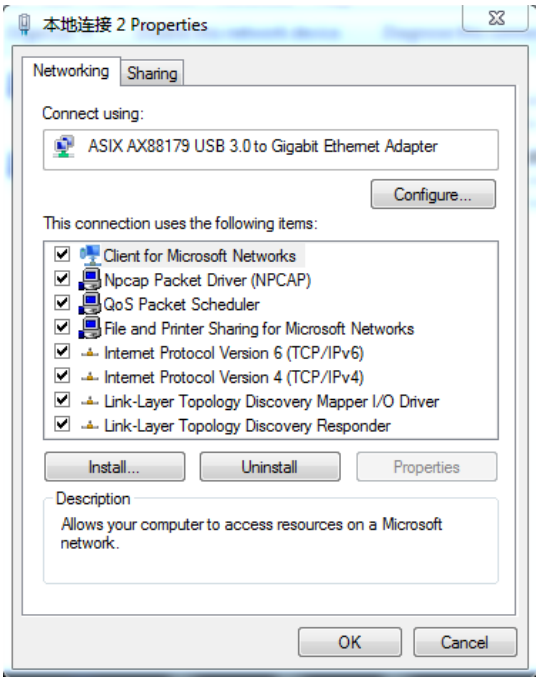


Figure 8 Step 2 of computer IP setting

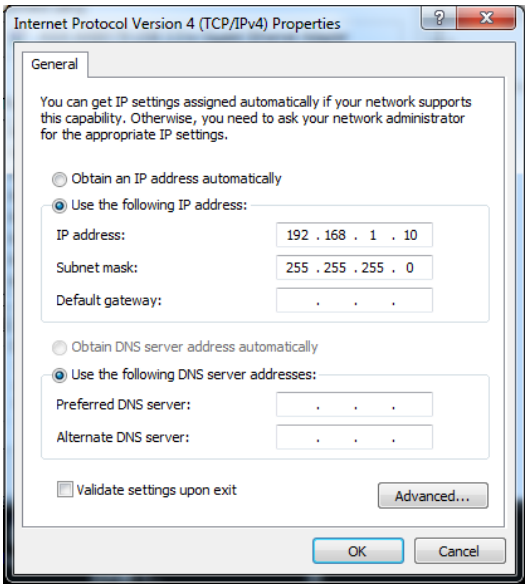


Figure 9 Step 3 of computer IP setting

5 Measurement principle

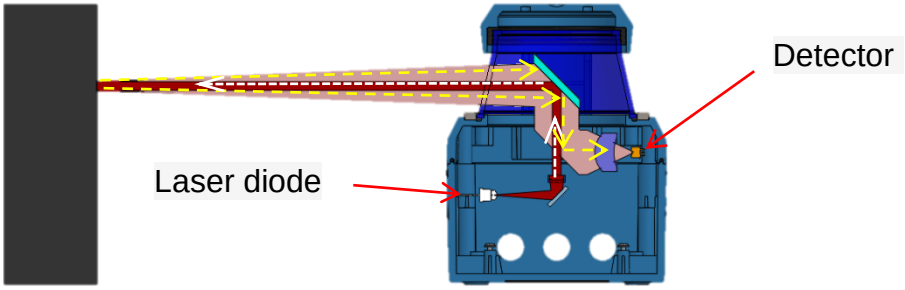


Figure 10 Diagram of LR-1F LiDAR work principle

As is shown in the figure above, LR-1F measures distance by using the time-of-flight principle. The LiDAR emits pulsed laser beams using a laser diode. If one of these laser pulses hits an object or a person, this is reflected at its surface. The reflection is detected in the LiDAR's receiver by a photodiode. The LiDAR calculates the distance to the object from the transit time required by the light from emission of the beam to receipt of the reflection. The calculation method is as follows:

$$D = \frac{CT}{2}$$

D—Detection distance
T—Flight time
C—Speed of light

6 Data packet format

LR-1F can realize laser point cloud data transmission. Please refer to the following for the analysis of LiDAR point cloud data.

The information transmission between LR-1F and the computer follows UDP standard network protocol. The data adopts the Little-endian format,the low byte is in the front,and the high byte is in the back.

6.1 Overview

Total length of data packet is 1240 bytes, among which header accounts for 40 bytes, data returned by laser is 1200 bytes.

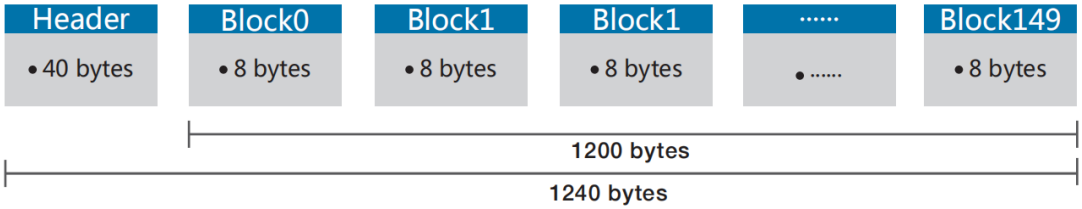


Figure 11 Format of point cloud information packet

The total length of the data frame is 1240 bytes, among which:

- Frame header: 40 bytes.
- Data block: 150×8=1200 bytes.

6.2 Definition of Header

Total length of data packet is 1240 bytes, among which header accounts for 40 bytes, data returned by laser is 1200 bytes.

Offset	Length	Description
0	4	Identifier, fixed as 0xFEF0010F
4	2	Protocol version, currently 0x0200
6	1	Distance ratio, actual distance value = distance reading ×distance ratio (mm)
7	3	Brand code, indicate with capitalized letters and numbers, fill in with '\0' in the end if isn't long enough.
10	12	Sales model string ending with '\0'

Offset	Length	Description
22	2	Internal model code
24	2	Hardware version
26	2	Software version
28	4	Timestamp, unit: ms
32	2	Bit[14:0]: Rotation rate BIT 15：rotation direction（0：clockwise，1： anticlockwise）
34	1	Safe zone status, same as status of the hardware INPUT/OUTPUT BIT[3:0]: Same as OUTPUT[3:0] BIT[7:4]: Same as INPUT[3:0]
35	1	Error status, the corresponding position is “1”, indicates an error BIT0: Motor fault, BIT1: Power fault, BIT2: Temperature fault
36	4	Reserved (detailed meaning to be determined)

Table 4 Definition of header file

6.3 Definition of Data Block

Total length of data packet is 1240 bytes, among which header accounts for 40 bytes, data returned by laser is 1200 bytes.

Offset	Length	Description
0	2	Angle，unsigned integer，valid range：0~35999 Unit :0.01 °LSB，indicating range：0 °~359.99 ° Note：If this value is greater than or equal to 0xFF00, then this block is invalid and must be ignored.
2	2	Distance reading, unsigned integer. The measured distance is determined by the distance ratio of the header, that is, measured distance="the reading value × the distance ratio of the packet header" (unit: mm).
4	2	Signal strength indicates the strength of the received signal, ranging from 0 to 65535.
6	2	Reserved (detailed meaning to be determined)

Table 5 Definition of data block

6.4 Data conversion

6.4.1 Angle calculation

Details on calculating angle of LR-1F is shown as below:

1) Obtain angle value:0xaa & 0x1d
2) Interchange of high bits and low bits:0x1d & 0xaa
3) Combine into an unsigned hexadecimal number:0x1daa
4) Convert to decimal:7594
5) Multiply by minimum resolution:0.01°
6) Result:75.94°

6.4.2 Distance calculation

Details on calculating distance of LR-1F is shown as below:

1) Obtain distance value:0x11 & 0x12
2) Interchange of high bits and low bits:0x12 & 0x11
3) Combine into an unsigned hexadecimal number:0x1211
4) Convert to decimal:4625
5) Multiply by distance ration:suppose distance ration is 1mm
6) Result:4625mm

6.4.3 Calculation of signal strength

The signal strength calculation method of LR-1F is shown in the following example:

1) Obtain the signal strength value: 0x11 & 0x12
2) Interchange of high bits and low bits: 0x12 & 0x11
3) Combine into an unsigned hexadecimal number: 0x1211
4) Converted to decimal number: 4625
5) Results: 4625

7 Parameter configuration

7.1 Parameter configuration of web page

Web page parameter configuration method of LR-1F is as follows:

- Open the browser (please use **Chrome,Firefox, Edge** or other standard browsers), and enter the LiDAR IP address;
- "**Model**" and "**Version**" at the top of the UI indicate the product model and firmware version;
- "**Temperature**", "**Voltage**" on the right side of the UI are the LiDAR parameters displayed in real time, indicating the temperature and voltage. When the font color of parameter turns red, please check whether the LiDAR is malfunctioning;
- Automatically read the current settings of LiDAR by refreshing the page;
- Select the desired speed through "**Motor RPM**": 600/900/1200/1500 (The corresponding scanning frequency is 10/15/20/25HZ), and click "**SetConfigs**" to confirm;
- Set the offset of the LiDAR's 0 degree angle through "**Angle offset**";
- Enable/disable the **DHCP** function: the LiDAR dynamically obtains an IP address from the **DHCP** server (ON), and the LiDAR needs to set up a static IP address (OFF);
- Modification of LiDAR IP: Host IP and the LiDAR IP should be in the same network segment, click the "**Set Network**" to confirm, and the modification is complete after the LiDAR is powered on again.

Figure 12 Parameter configuration of web page

7.2 Configuration of OlamViewer

The OlamViewer interface is shown as following. Please refer to OlamViewer software manual for detail.

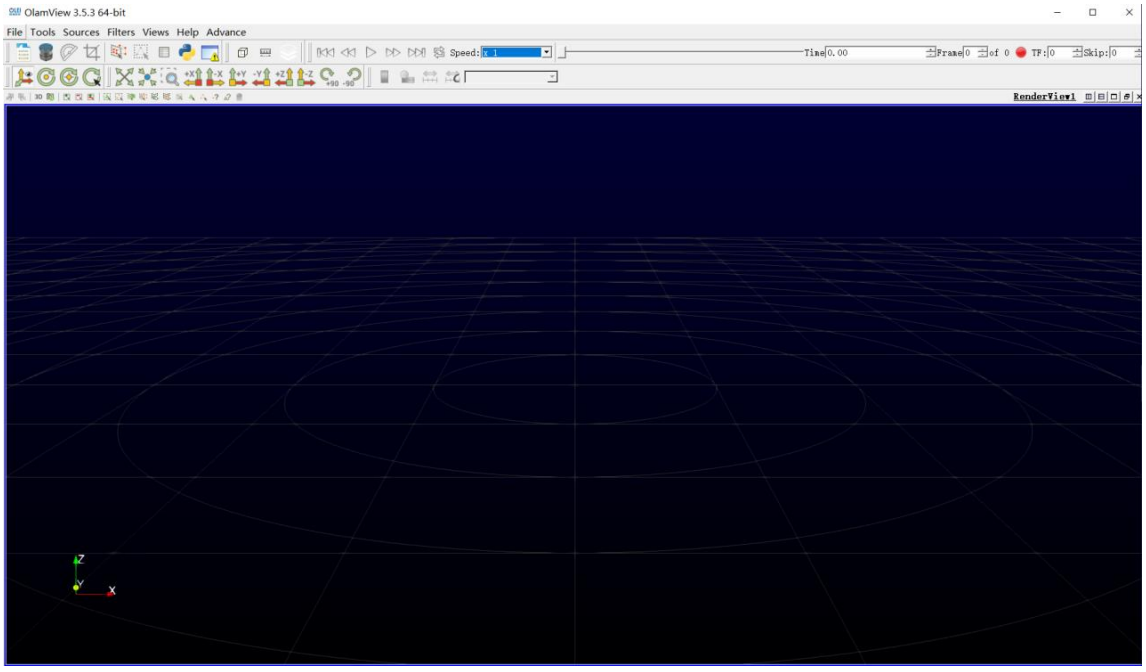


Figure 13 Sample of The OlamViewer interface

The Web page setting interface and The OlamViewer interface may change due to continuous update of products and is subject to actual content.

8 Troubleshooting

Problem	Method
LiDAR fails to scan	● Verify whether the power supply is properly connected ● Verify whether the power voltage meets 12~32VDC ● Please contact OLEI if the above conditions are normal.
LiDAR scan produces no data	● Verify whether the network connection is normal ● Verify whether the IP settings on the data receiver are correct. ● Try to use third-party data scraping software to verify whether data could be obtained normally ● Verify whether only one LiDAR software is enabled. ● Verify whether firewall of the data receiver is disabled or if there are other security software or processes blocking data transmission. ● Please contact OLEI if the above conditions are normal.

Table 6 Troubleshooting

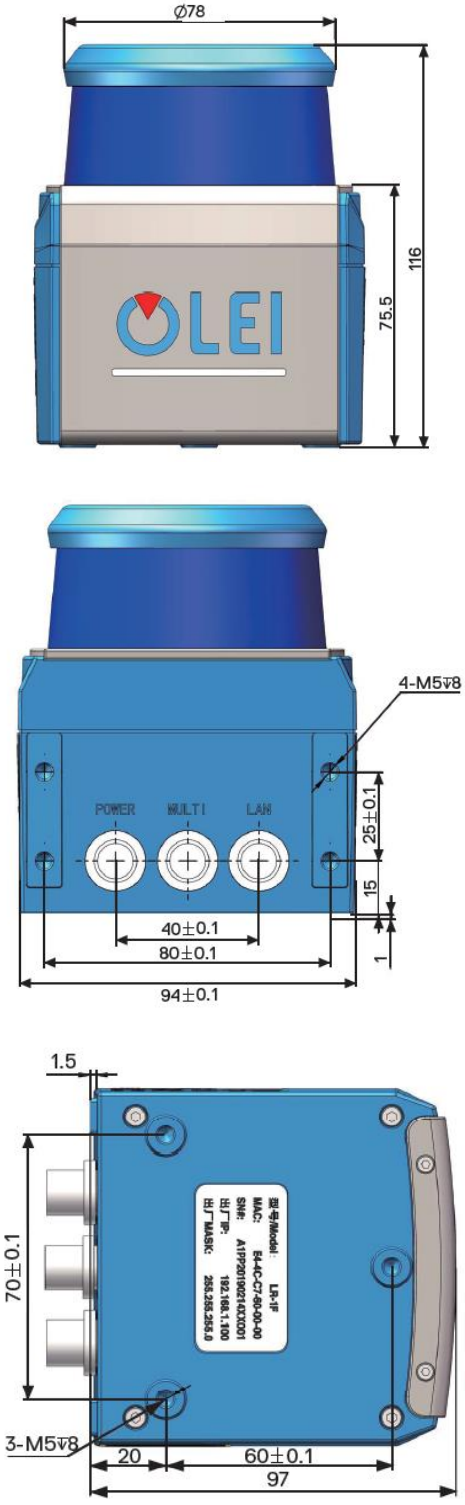
Appendix A Data packet

No.	Source	Destination	Protocol	Length	Info
2254	192.168.1.100	192.168.1.10	UDP	1282	2368 → 2368 Len=1240
2255	192.168.1.100	192.168.1.10	UDP	1282	2368 → 2368 Len=1240
2256	192.168.1.100	192.168.1.10	UDP	1282	2368 → 2368 Len=1240
2257	192.168.1.100	192.168.1.10	UDP	1282	2368 → 2368 Len=1240
2258	192.168.1.100	192.168.1.10	UDP	1282	2368 → 2368 Len=1240
2259	192.168.1.100	192.168.1.10	UDP	1282	2368 → 2368 Len=1240
2260	192.168.1.100	192.168.1.10	UDP	1282	2368 → 2368 Len=1240
2261	192.168.1.100	192.168.1.10	UDP	1282	2368 → 2368 Len=1240
2262	192.168.1.100	192.168.1.10	UDP	1282	2368 → 2368 Len=1240
2263	192.168.1.100	192.168.1.10	UDP	1282	2368 → 2368 Len=1240
2264	192.168.1.100	192.168.1.10	UDP	1282	2368 → 2368 Len=1240
2265	192.168.1.100	192.168.1.10	UDP	1282	2368 → 2368 Len=1240
2266	192.168.1.100	192.168.1.10	UDP	1282	2368 → 2368 Len=1240

```
> Frame 2261: 1282 bytes on wire (10256 bits), 1282 bytes captured (10256 bits) on interface 0
> Ethernet II, Src: Hangzhou_01:3b:7a (e4:4c:c7:61:3b:7a), Dst: Dell_07:b2:54 (10:7d:1a:07:b2:54)
> Internet Protocol Version 4, Src: 192.168.1.100, Dst: 192.168.1.10
> User Datagram Protocol, Src Port: 2368, Dst Port: 2368
> Data (1240 bytes)
```

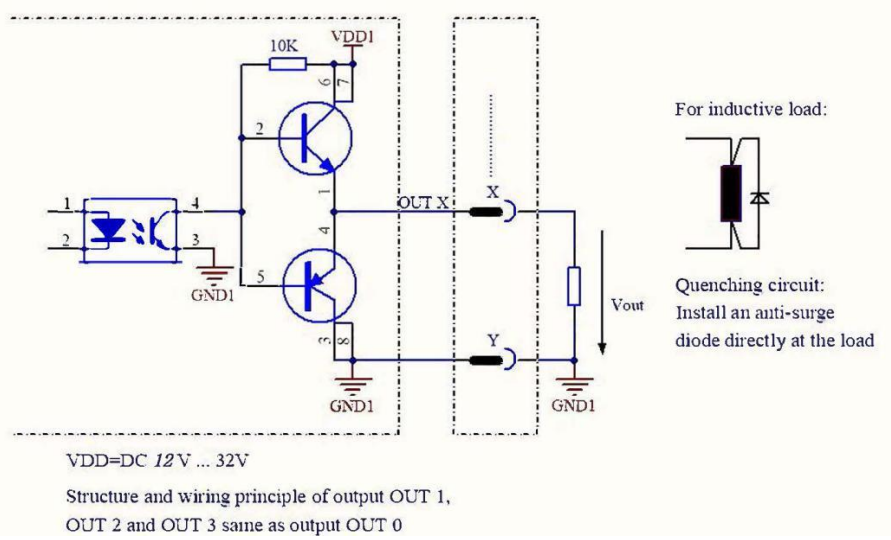
```
0000  10 7d 1a 07 b2 54 e4 4c  c7 61 3b 7a 08 00 45 00   ·}···T·L ·a;z··E·
0010  04 f4 81 f9 00 00 ff 11  b1 40 c0 a8 01 64 c0 a8   ········ ·@···d··
0020  01 0a 09 40 09 40 04 e0  2d ac 0f 01 f0 fe 00 02   ···@·@·· -·······
0030  01 4f 4c 45 4c 52 2d 31  46 4d 49 49 00 00 00 00   ·OLELR-1 FMII····
0040  02 02 01 00 01 00 1a 35  01 00 84 03 00 00 00 00   ·······5 ········
0050  00 00 89 1d 11 07 c3 07  00 00 92 1d 12 07 b8 07   ········ ········
0060  00 00 9b 1d 15 07 bf 07  00 00 a4 1d 15 07 d7 07   ········ ········
0070  00 00 aa 1d 15 07 c1 07  00 00 b3 1d 10 07 c1 07   ········ ········
0080  00 00 bc 1d 0f 07 b8 07  00 00 c5 1d 0d 07 c2 07   ········ ········
0090  00 00 ce 1d 0d 07 b8 07  00 00 d7 1d 10 07 c7 07   ········ ········
00a0  00 00 dd 1d 0f 07 b6 07  00 00 e6 1d 09 07 c3 07   ········ ········
00b0  00 00 ef 1d 0a 07 af 07  00 00 f8 1d 08 07 b8 07   ········ ········
00c0  00 00 01 1e 0b 07 c7 07  00 00 07 1e 08 07 cc 07   ········ ········
00d0  00 00 10 1e 0b 07 bd 07  00 00 19 1e 0b 07 c1 07   ········ ········
00e0  00 00 22 1e 0c 07 b6 07  00 00 2b 1e 09 07 bb 07   ··"····· ··+·····
00f0  00 00 31 1e 0b 07 c7 07  00 00 3a 1e 08 07 be 07   ··1····· ··:·····
0100  00 00 43 1e 07 07 ba 07  00 00 4c 1e 09 07 bd 07   ··C····· ··L·····
0110  00 00 52 1e 0a 07 b6 07  00 00 5b 1e 0b 07 b8 07   ··R····· ··[·····
0120  00 00 64 1e 08 07 b5 07  00 00 6d 1e 06 07 ba 07   ··d····· ··m·····
0130  00 00 76 1e 04 07 af 07  00 00 7f 1e 05 07 ac 07   ··v····· ········
0140  00 00 85 1e 06 07 bd 07  00 00 8e 1e 07 07 c5 07   ········ ········
0150  00 00 97 1e 07 07 d0 07  00 00 a0 1e 07 07 c5 07   ········ ········
```

Appendix B Mechanical Dimensions



Appendix C Example of Electrical Connection

OUTPUT



Appendix D Firmware Upgrade

This appendix will explain how to use **LidarUpgrade2D** to upgrade the firmware version of the LR-1F series LiDAR.

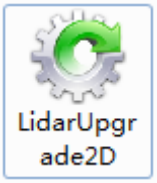


Figure 14 Icon

D.1 Function of software

For 2D LiDAR LR-1F series firmware upgrade

D.2 Surroundings for software

- Windows 7,8,10
- .Net framework 4.5.2

D.3 Software operation

-1. Connect the LiDAR correctly. Check whether the LiDAR communication is normal.

-2. Click the File Information box or drag the firmware file in. The relevant information of the corresponding firmware is prompted after the firmware file is correctly loaded.

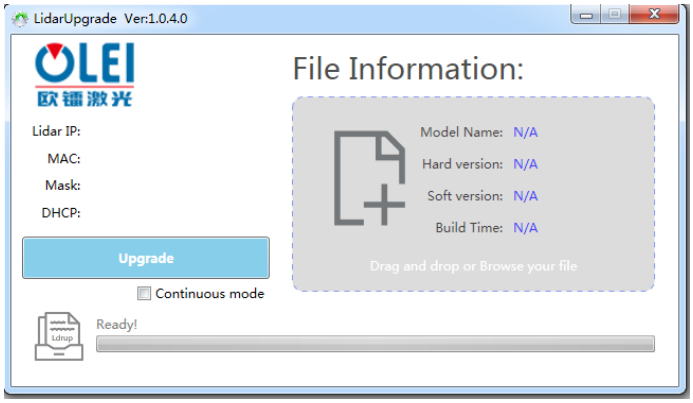


Figure 15 Interface of software upgrade

-3. Clicking the"**Upgrade**",restart the LiDAR power, the file will be downloaded to the LiDAR automatically.

-4. Check the"**Continuous mode**", after the upgrade, it will automatically wait for the next upgrade, which can be used to upgrade LiDAR firmware in batches.

Appendix E ROS Drive

One-key script of 2D LiDAR ROS drive:

wget http://cn.ole-systems.com/sh/ole2d.sh

chmod -R 777 ole2d.sh&&./ole2d.sh

Note: shell script will be automatically downloaded to the latest version of ROS1.0 from the company's official website, and will be built, compiled, run and demonstrated in rviz with one-key.

build

1. make catkin workspace at your ROS machine

> mkdir -p ole2d_ws

2. copy 'src' to ole2d_ws

>cp src ole2d_ws

3. install depend

>rosdep install --from-paths src --ignore-src --rosdistro kinetic -y

4. build

>chmod -R 777 src

>catkin_make

Note: before compiling, please "chmod" commond give executable permission to "src" folder.

run

1. source to path

>source devel/setup.bash

2. new terminal,then run roscore

>roscore

3. connect LiDAR and host,LiDAR IP default 192.168.1.100,port default 2368

Note that you must change the Internet address and netmask.

host IP default 192.168.1.10,netmask default 255.255.255.0

these IP and port can be modified by vendor config software
4. run LiDAR drive at first terminal
>roslaunch olelidar scan.launch

rviz view
1. new terminal,then run rviz
>rosrun rviz rviz -f olelidar
2. at rviz,add topic olelidar/scan/LaserScan

Appendix F Suggestions on Mechanical Installation

When installing LiDAR, pay attention to the following points:
1. Please remove the transparent protective film on the window when using it on site.
2. Make it as immune to shock and vibration as possible..
3. So that it is not exposed to any direct sunlight (window, skylight) or any other heat sources. to prevent the internal temperature of the device from rising.
4. It is recommended that the mounting base used to fix the LiDAR be as flat as possible.
5. The positioning column on the mounting base should strictly follow the depth of the positioning column at the bottom of the LiDAR, and should not be higher than 4mm. It is recommended to use aluminum alloy mounting base for better heatdissipation .
6. When installing the LiDAR, if the LiDAR has contact mounting surfaces on both top and bottom, please make sure that the distance between the mounting surfaces is greater than the height of the LiDAR to avoid squeezing.
7. The tilt angle should not exceed 90 degrees when the LiDAR is installed.Excessive tilt angle will affect the life of the LiDAR.
8. When arrange the wiring of the LiDAR, wiring on the LiDAR should not be too tight; keep the wiring loose.

In order to avoid any influence to the measurement accuracy due to mutual interference between LiDARs, we recommend the following installation. (A≥6°, H≥200mm, the position of the line segment in the diagram represents the LiDAR emission position)

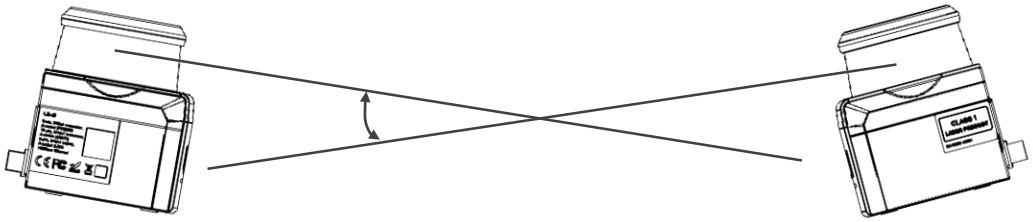


Figure 16 Placement of two LiDARs opposed to each other

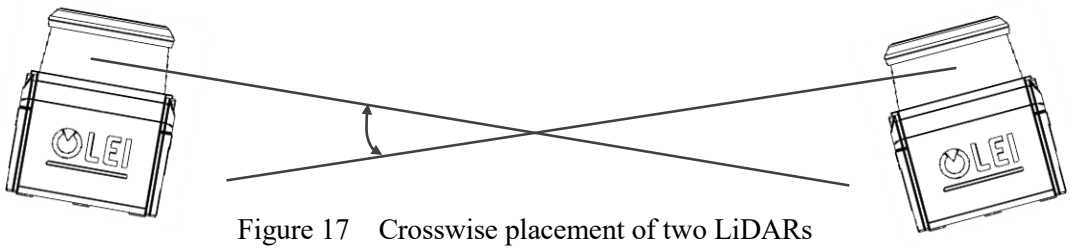


Figure 17 Crosswise placement of two LiDARs

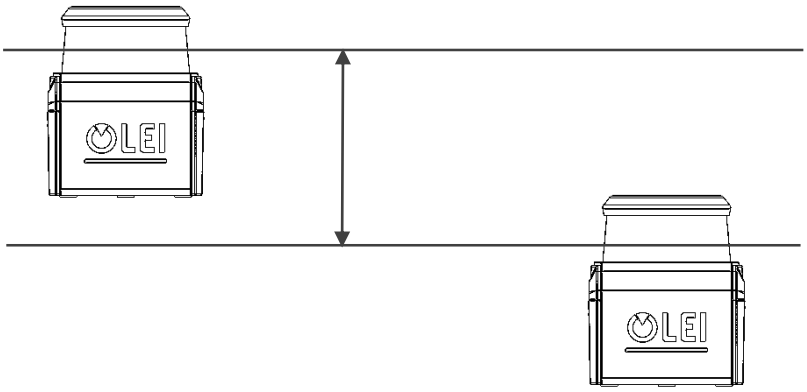


Figure 18 Placement of two LiDARs with parallel offset

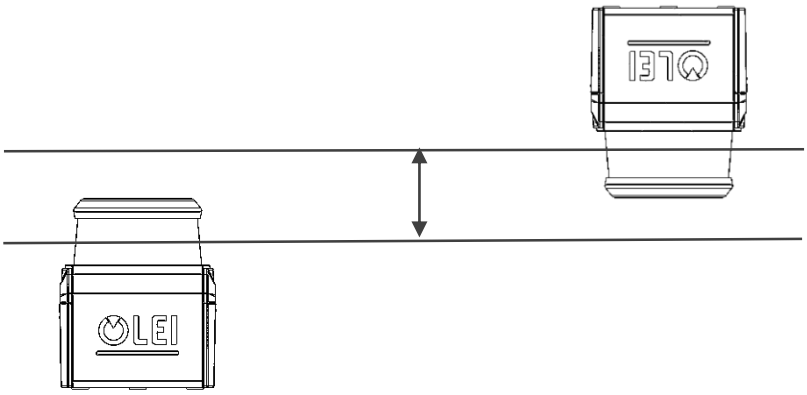


Figure 19 Placement of two LiDARs with parallel offset, one of these upside down

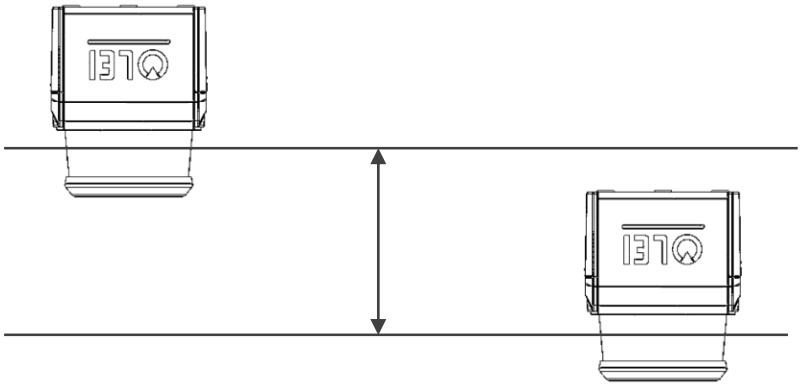


Figure 20 Placement of two LiDARs upside down, parallel offset

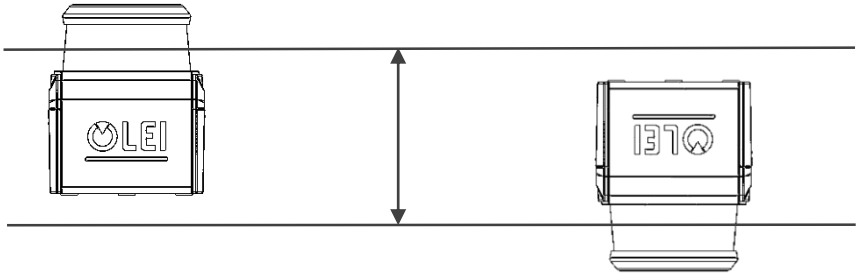


Figure 21 Placement of two LiDARs with parallel offset, one of these upside down

The emission position of the 2D LiDAR from the reference plane is as follows:

Figure 22 Light emission position of LR-1BS, LR-1B, LR-1F

Appendix G Cleaning of sensor

OLE-LiDAR, especially the ring-shaped protective cover, should be kept clean in order to accurately sense the surrounding environment.

G.1 Notice

Please read Appendix E thoroughly and carefully before cleaning OLE-LiDAR, otherwise improper operation may damage the equipment.

G.2 Materials required

1. Clean fiber cloth
2. Neutral soap spray
3. Clean water spray
4. Isopropanol solvent
5. Clean gloves

G.3 Cleaning method

If there are only some dust on the surface of the LiDAR, directly use a clean fiber cloth with a small amount of isopropyl alcohol solution to gently wipe the surface of the LiDAR, and then wipe it with a dry and clean fiber cloth.

If there are mud or other blocky foreign matter on the surface of LiDAR, first spray clean water on the surface of the dirty part on the LiDAR to remove the mud and other foreign matter (Note: please do not wipe off the mud directly with a fiber cloth, as this may scratch the surface, especially the surface of the protective cover). Then spray with soapy water on the dirty parts, since the lubricating effect of soapy water could accelerate the separation of foreign materials. Gently wipe the surface of the LiDAR with a fiber cloth, be careful not to scratch the surface. Finally, clean the soap residue on the LiDAR surface with clean water (if there are still residues stains on the surface, use an isopropyl alcohol solution to clean it again), and wipe it with a dry microfiber cloth.

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Regarding changes in specifications, etc., without notice!

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