欧镭激光

Sensing Reality!

2D 270°

Lidar Sensors
LR-1BS Series
User Manual

This manual is only applicable to LR-1BS3/3D/5/5D

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

OMEN-1BS35-202012

目录

1. Document description

To ensure the normal operation of the product and avoid damage to the equipment, please do not disassemble the sensor.

- Read the instructions: Please read through all the safety and operating instructions carefully before using this product;
- Properly keep the instructions: Please keep all the safety and operating instructions properly for future reference;
- Pay attention to the warnings: please pay attention to all the warnings on the product and in the user manual;
- Follow the instructions: Please follow all the operating instructions;
- Maintenance instructions: please do not attempt to repair the product by yourself except for following the troubleshooting instructions in the operation manual, and contact the OLEI laser technicians for help in time.

Any equipment damage caused by violation of the above safety regulations is not covered by the warranty.

2. Safety Instruction

Pay attention to laser radiation

- This product contains invisible Class 1 laser;
- Do not dissemble the cover of the device without authorization. Removing the cover will not cause the laser to turn off;
- The laser is not guaranteed to be still Class 1 after the cover is removed.

Pay attention to electrical safety

- Disconnect the power supply when connecting or removing electrical cables;
- The power supply connected to the equipment must meet the requirements of the operating instructions;
- When using the equipment, connect the reference potential terminal correctly to avoid personal injury caused by equipotential current.

3. Product introduction

LR-1BS3/5 is a 2D flat scanning lidar, which scans the surrounding areas on a single plane with the aid of an infrared invisible laser beam. Based on its measurement origin, LR-1BS3/5 uses two-dimensional polar coordinates to indicate the surrounding environment. With a scanning angle range of 270°, LR-1BS3/5 detects and outputs the target's angle, distance and signal strength to facilitate the SLAM system to better identify the target. Thus LR-1BS3/5 has been widely applied to industries such as robot obstacle avoidance, safety monitoring, industrial automation, and intelligent logistics.

4. Installation and operation

4.1. Mechanical interface

LR-1BS lidar can be installed in two ways: back-mounted and bottom-mounted.

- 4.1.1 Back installation

There are two M3 screw holes (hole depth is 3mm) at the back of the main body for installation.

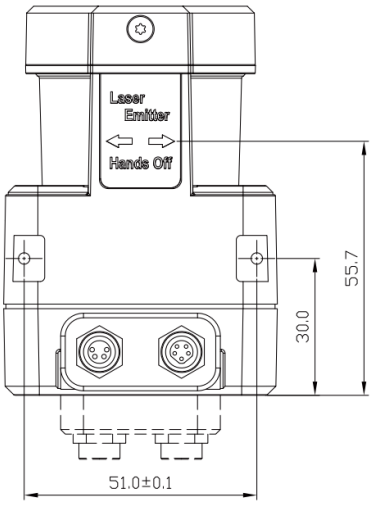


Figure 1: Back mounting interface of LR-1BS

- 4.1.2 Bottom installation

There are two M3 screw holes (hole depth is 3mm) at the bottom of the main body for installation.

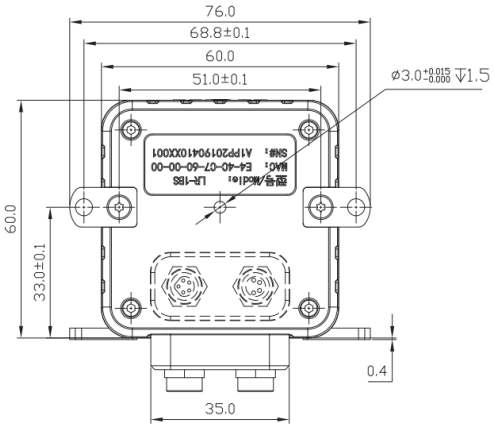


Figure 2: Bottom mounting interface of LR-1BS

4.2. Electrical interface

LR-1BS has 2 interfaces, namely power supply I/O interface and 4 PIN Ethernet interface, as shown in the figure below.

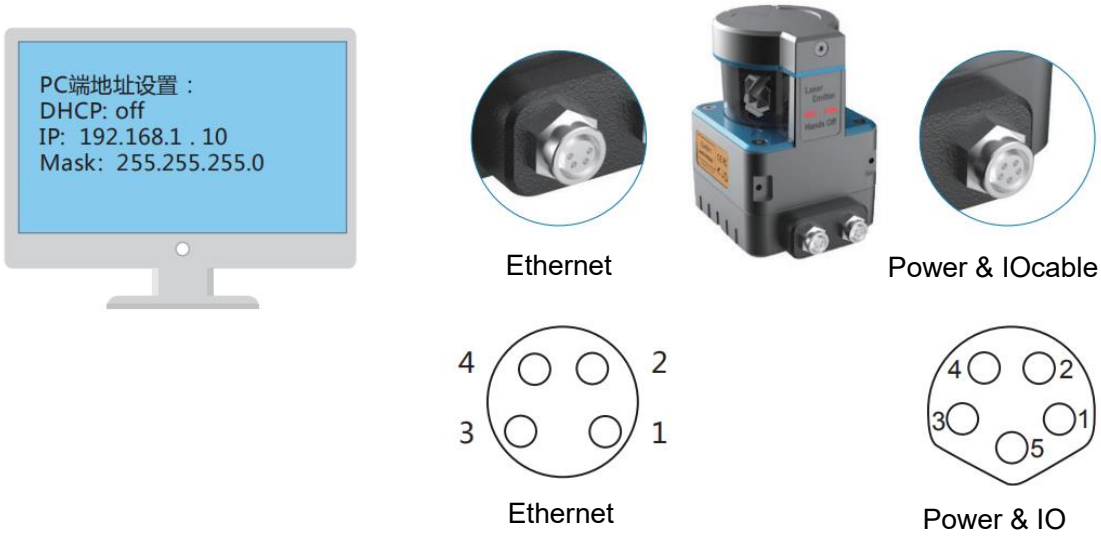


Figure 3 LR-1BS electrical interface diagram

- 4.2.1 Power, I/O interface

PIN Definitions of power supply and I/O interface is shown in the table below.

NO.	definition	Cable color
1	GND	black
2	VCC	red
3	GND_IO	gray
4	VCC_IO	brown
5	OUT0	blue

Table 2 Definition of power supply and I/O interface

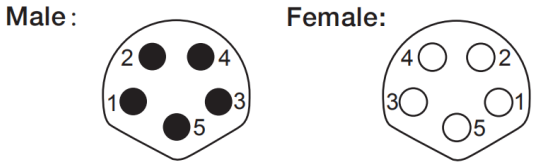


Figure 4 Diagram of interface

- 4.2.2 Ethernet interface

The PIN code definition of the Ethernet interface is shown in the table below.

NO.	definition
1	TxData+： Send +
2	TxData-： Send -
3	RxData+： receive +
4	RxData-： receive -

Table 3 Definition of Ethernet interface

Definition of Ethernet interface

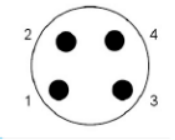


Figure 5 Diagram of interface

4.3. Communication interface

The LR-1BS is connected to the computer by a standard Ethernet RJ-45 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 port number of the point cloud data package 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 setting processes on the computer are as follows

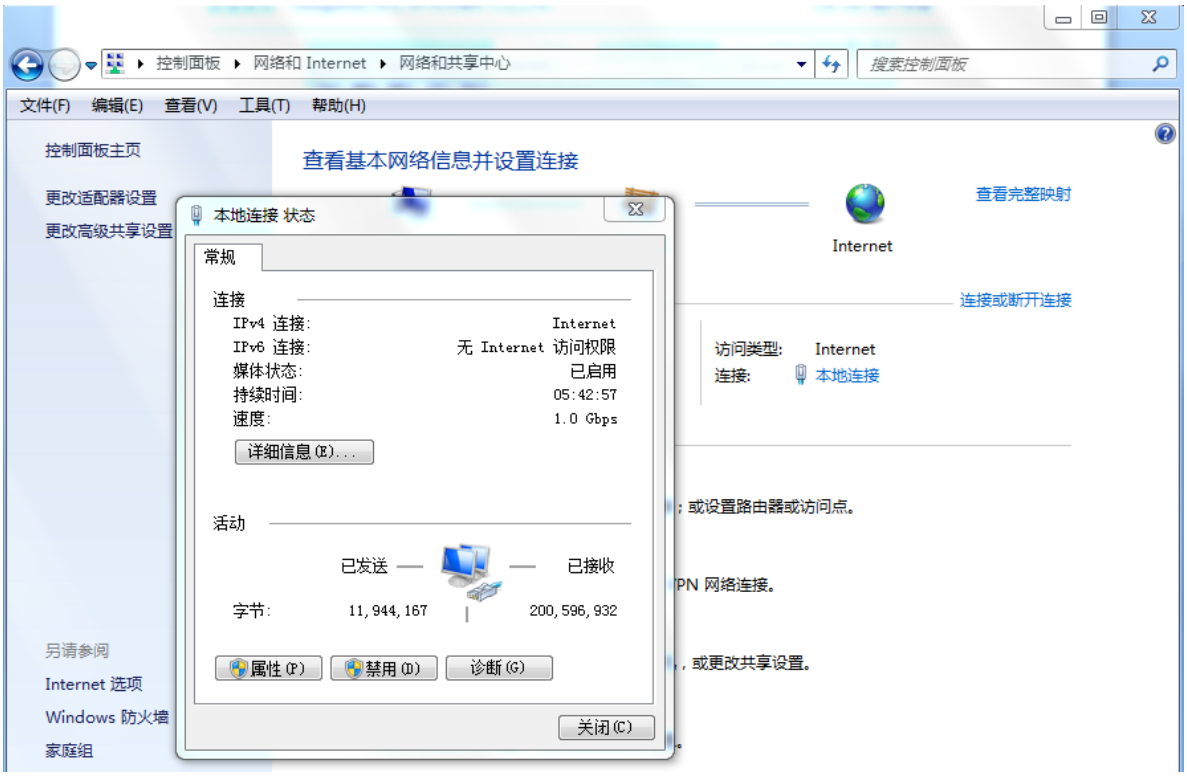


Figure 6 Step 1 of computer IP setting

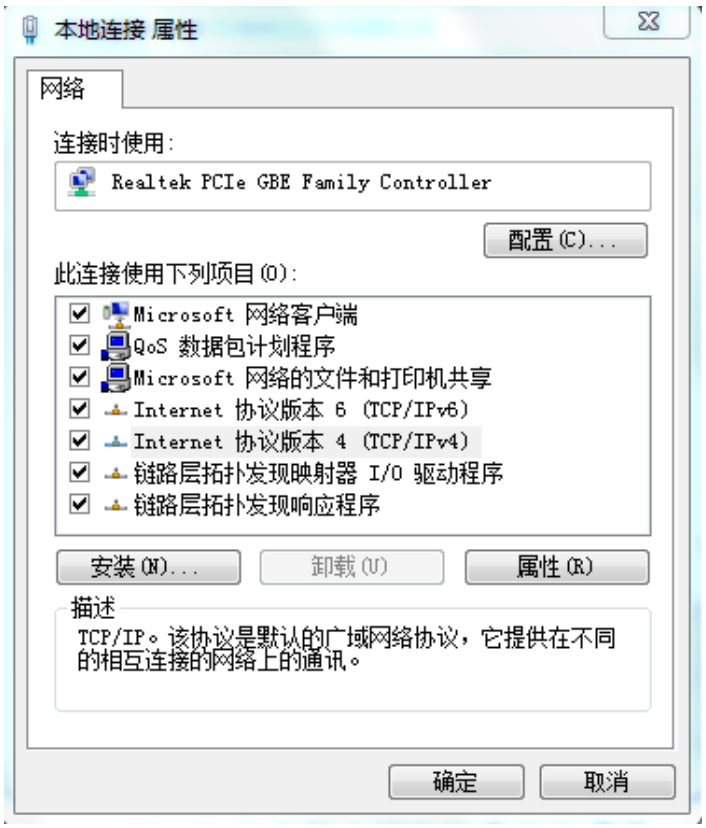


Figure 7 Step 2 of computer IP setting

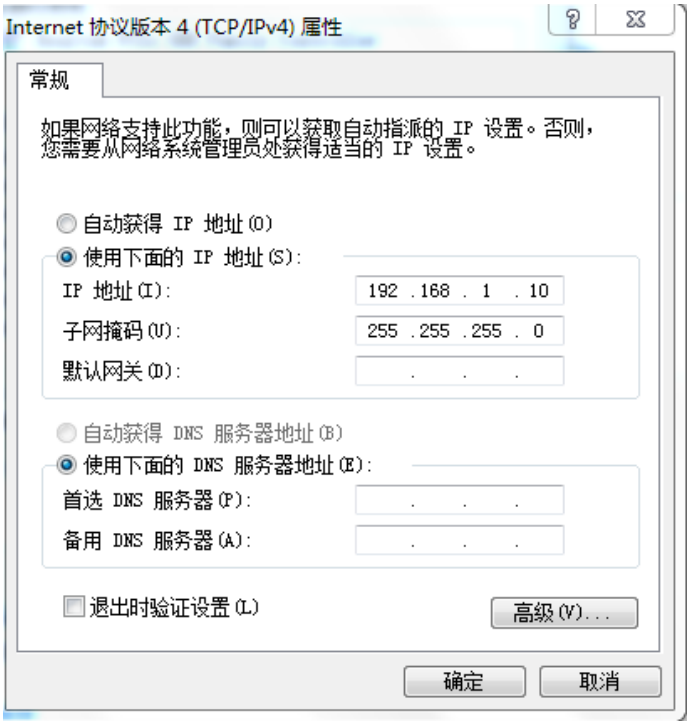


Figure 8 Step 3 of computer IP setting

5. Working principle

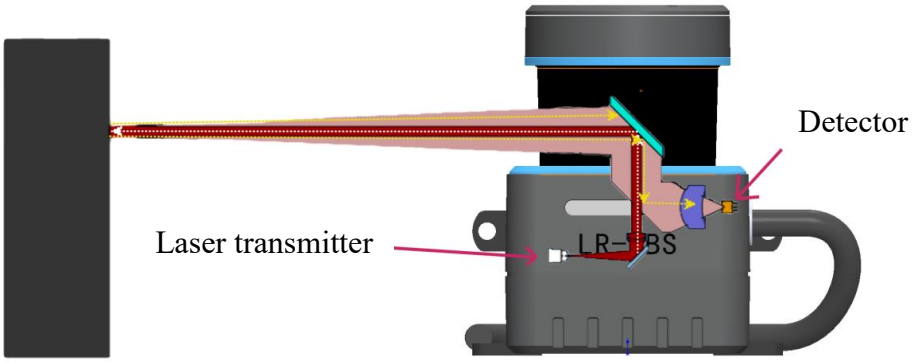


Figure 9 Diagram of LR-1BS lidar work principle

As is shown in the figure above, LR-1BS measures distance by using the time-of-flight principle. Lidar emits laser pulses at uniform and short time intervals. After the laser is reflected back when it encounters obstacles, the lidar receives reflected light signal. The distance between the object and the lidar can be calculated according to the time difference between emission and reception of laser (ie the flight time of the laser) T and the speed of light C. 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-1BS can realize laser point cloud data transmission. Please refer to the following for the analysis of lidar point cloud data.

Information transmission between LR-1BS and computer follows UDP standard network protocol. The data adapts Little-endian format with low byte at the front and high byte at the back.

6.1. Overview

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

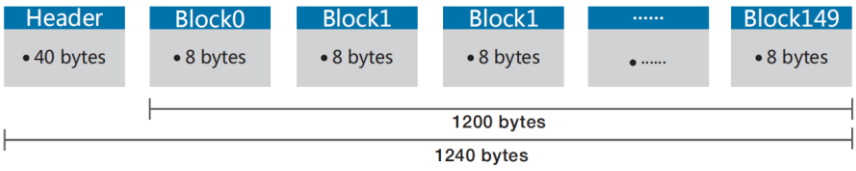


Figure 10 Format of point cloud information packet

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 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 cod, 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'
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 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 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 Block

Total length of data packet is 1240 bytes, among which header accounts 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 packet 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-1BS 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-1BS 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-1BS 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-1BS3/3D/5/5D 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 interface indicate the product model and firmware version number;
- Temperature, Voltage and SafeArea on the right side of the interface are the lidar parameters displayed in real time, indicating the temperature, voltage and current active bank of the specific internal module. 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 required rotation speed value through Motor RPM: 600/900/1200/1500 (the corresponding scanning frequency is 10/15/20/25Hz respectively), and click Set Configs to confirm;

- Set the Led on and off state of the lidar through the Led Marquee, and click Set Configs to confirm;
- Set the on and off state of the lidar safety function through the Safe Area, and click Set Configs to confirm;
- Select current active safe bank input mode trough Safe bank input（GPIO mode is invalid in 1BS3/5）;
- Set the mode of the radar's Led light through Led Mode;
- Select current bank through Safe bank config when Safe bank input is “Software”;
- Set the IP address and port of the PC receiving LiDAR data through Host IP & Port. Up to 3 groups of Host IP & Port can be set. Click ⊕ to add a group, click ⊖ to delete a group.
- 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: Enter the new IP into the lidar IP column (must be in the same network segment as the local IP), click the Set Network button to confirm, and the modification is complete after the LiDAR is powered on again.

Figure 11 Parameter configuration of web page

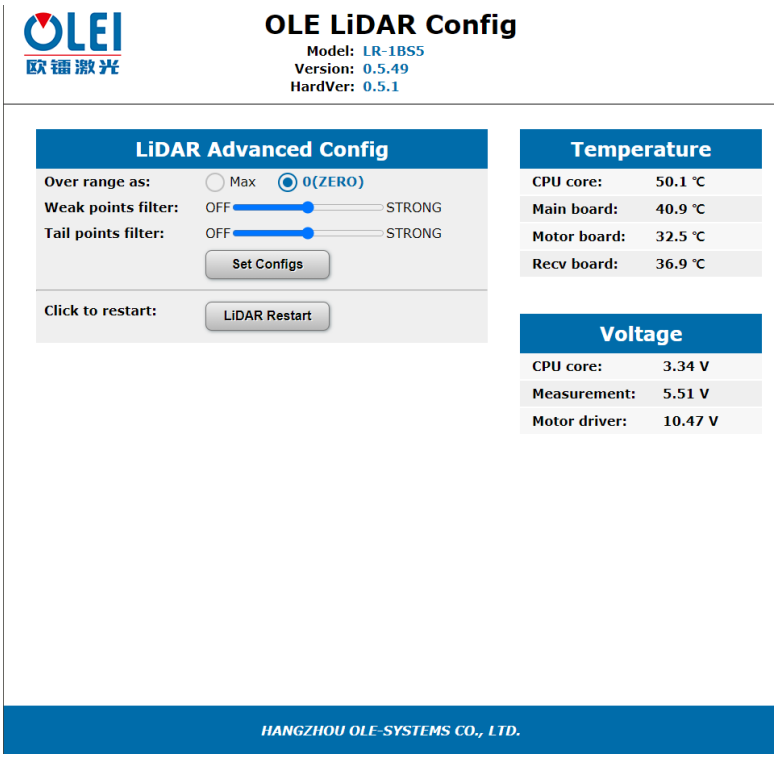


Figure 12 Advanced configuration page

7.2. Parameter configuration of OlamViewer

OLamViewer's interface is shown as following. Please refer to OLamViewer software manual for detail.

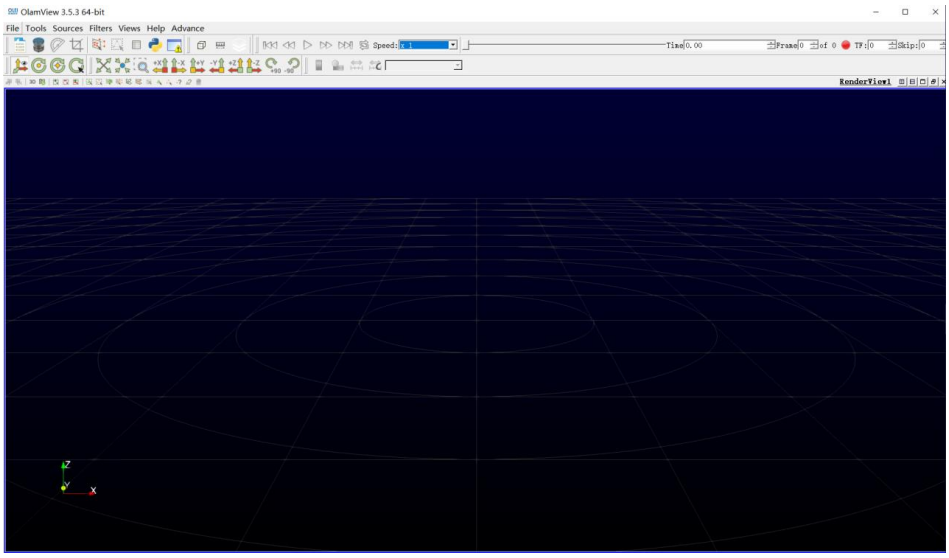


Figure 13 Sample of upper computer software interface

The page setting interface and upper computer software 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 and Port 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.
Lidar fails to achieve safe zone trigger	● Check whether the software configuration is normal and whether the configuration file is successfully written into the lidar. ● Verify whether the wiring at the I/O port is correct. ● When the I/O port is not wired, Bank 0 is the effective field group by default. ● The I/O port is only connected to VCC and GND. When other PIN are not connected, Bank 15 is considered to be the valid field group by default. Please contact OLEI if the above conditions are all normal.

Table 6 Troubleshooting

Appendix A Data Package

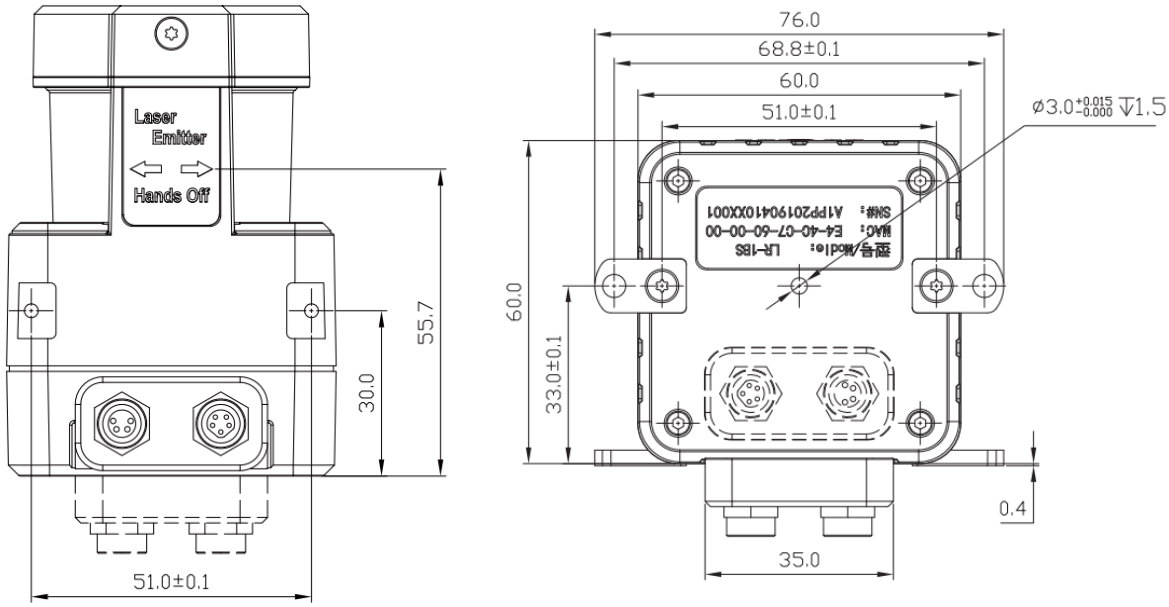
No.	Time	Source	Destination	Protocol	Length	Info
11953	2021-01-22 10:12:49.688102	192.168.1.100	192.168.1.10	UDP	1282	49153 → 2368 Len=1240
11954	2021-01-22 10:12:49.691856	192.168.1.100	192.168.1.10	UDP	1282	49153 → 2368 Len=1240
11955	2021-01-22 10:12:49.695573	192.168.1.100	192.168.1.10	UDP	1282	49153 → 2368 Len=1240
11956	2021-01-22 10:12:49.698081	192.168.1.100	192.168.1.10	UDP	1282	49153 → 2368 Len=1240
11957	2021-01-22 10:12:49.701916	192.168.1.100	192.168.1.10	UDP	1282	49153 → 2368 Len=1240
11958	2021-01-22 10:12:49.705622	192.168.1.100	192.168.1.10	UDP	1282	49153 → 2368 Len=1240
11959	2021-01-22 10:12:49.709359	192.168.1.100	192.168.1.10	UDP	1282	49153 → 2368 Len=1240
11960	2021-01-22 10:12:49.713114	192.168.1.100	192.168.1.10	UDP	1282	49153 → 2368 Len=1240
11961	2021-01-22 10:12:49.716857	192.168.1.100	192.168.1.10	UDP	1282	49153 → 2368 Len=1240

```
> Frame 11958: 1282 bytes on wire (10256 bits), 1282 bytes captured (10256 bits) on interface \Device\NPF_{4267FC5B-99DB-41BF-855B-0C8
> Ethernet II, Src: Hangzhou_1a:e0 (e4:4c:c7:60:1a:e0), Dst: RealtekS_30:12:9b (00:e0:4c:30:12:9b)
> Internet Protocol Version 4, Src: 192.168.1.100, Dst: 192.168.1.10
> User Datagram Protocol, Src Port: 49153, Dst Port: 2368
> Data (1240 bytes)
```

```
0000  00 e0 4c 30 12 9b e4 4c  c7 60 1a e0 08 00 45 00   ··L0···L ·`····E·
0010  04 f4 f7 4e 00 00 ff 11  3b eb c0 a8 01 64 c0 a8   ···N···· ;····d··
0020  01 0a c0 01 09 40 04 e0  c1 ca 0f 01 f0 fe 00 02   ·····@·· ········
0030  01 4f 4c 45 4c 52 2d 31  42 53 35 00 00 00 00 00   ·OLELR-1 BS5·····
0040  0f 01 05 00 05 00 71 3d  07 00 dc 05 00 00 00 00   ······q= ········
0050  00 00 2f 0d 00 00 00 00  00 00 46 0d 00 00 00 00   ··/····· ··F·····
0060  00 00 5c 0d 00 00 00 00  00 00 73 0d 00 00 00 00   ··\····· ··s·····
0070  00 00 89 0d 00 00 00 00  00 00 a0 0d 00 00 00 00   ········ ········
0080  00 00 b6 0d 00 00 00 00  00 00 cd 0d 00 00 00 00   ········ ········
0090  00 00 e3 0d 00 00 00 00  00 00 fa 0d 00 00 00 00   ········ ········
00a0  00 00 10 0e 00 00 00 00  00 00 27 0e 00 00 00 00   ········ ··'·····
00b0  00 00 3d 0e 00 00 00 00  00 00 54 0e 00 00 00 00   ··=····· ··T·····
00c0  00 00 6a 0e 00 00 00 00  00 00 81 0e 00 00 00 00   ··j····· ········
00d0  00 00 97 0e 00 00 00 00  00 00 ae 0e 00 00 00 00   ········ ········
00e0  00 00 c4 0e 00 00 00 00  00 00 db 0e 00 00 00 00   ········ ········
00f0  00 00 f1 0e 00 00 00 00  00 00 08 0f 00 00 00 00   ········ ········
0100  00 00 1e 0f 00 00 00 00  00 00 35 0f 00 00 00 00   ········ ··5·····
```

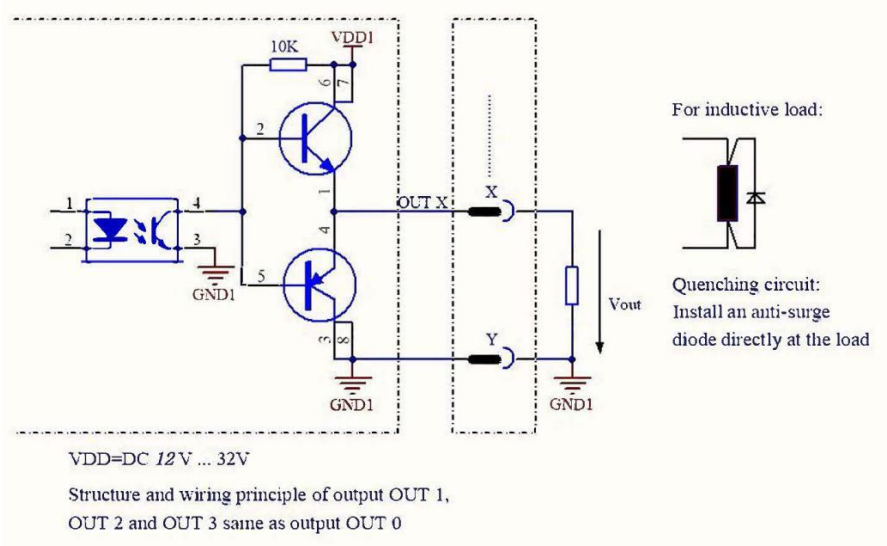
Appendix B Mechanical Dimensions

Mechanical size of LR-1BS



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-1BS series radar.

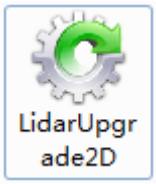


Figure 14 Icon of software

D.1 Function of software

For 2D radar 1BS series firmware upgrade

D.2 Surroundings for software

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

D.3 Software operation

-1. Connect the radar correctly. Check whether the radar 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 .

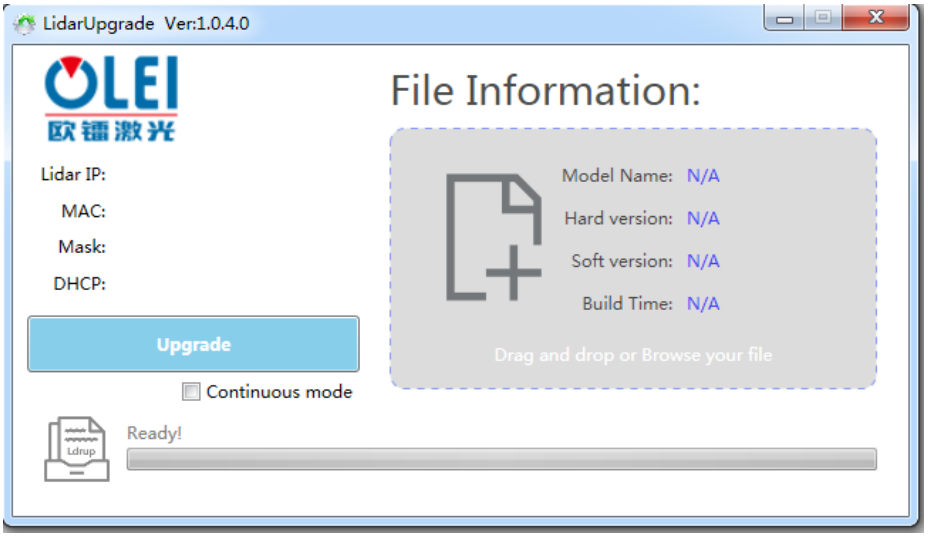


Figure 15 Interface of software upgrade

-3. After clicking the 'Upgrade' button, power on the radar again and the firmware write operation will be executed.
-4. Check the 'Continuous mode' option, after the upgrade, it will automatically wait for the next upgrade, which can be used to upgrade radar firmware in batches.

Appendix E 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. Try best to avoid shock and vibration.
3. Keep it away from any direct sunlight (windows, skylights) or any other heat source 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 heat dissipation .
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 larger than the height of the lidar to avoid squeezing the lidar.
7. The tilt angle should not exceed 90 degrees when the lidar is installed. If the tilt angle is too large, it will affect the life of the lidar.
8. When arrange the wiring of the lidar, wiring on the radar 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, taking LR-1BS as an example. (A≥6°, H≥200mm, the position of the line segment in the diagram represents the lidar emission position)

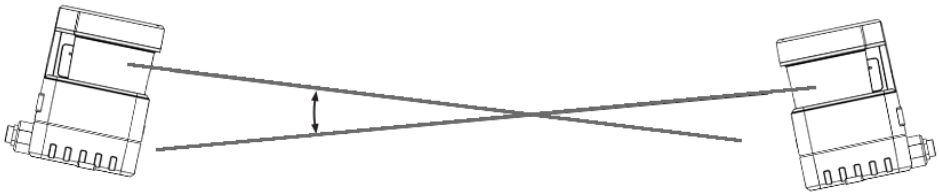


Figure 16 Lidars in opposite position

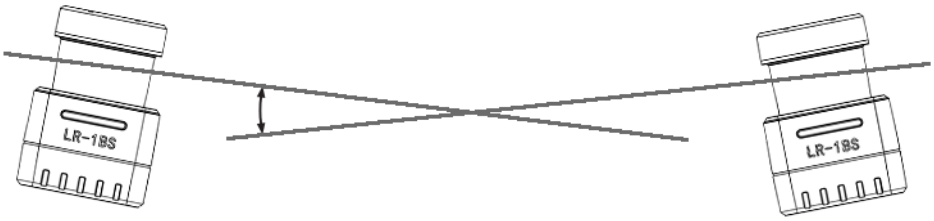


Figure 17 Horizontal placement of lidar

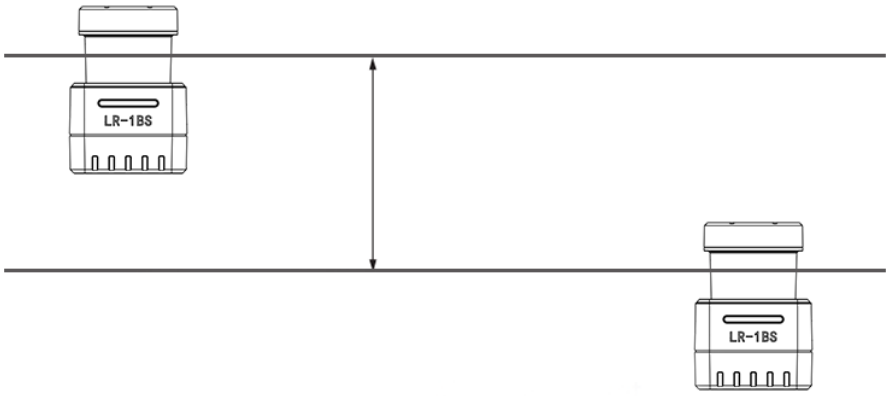


Figure 18 Placement of two lidars with parallel offset

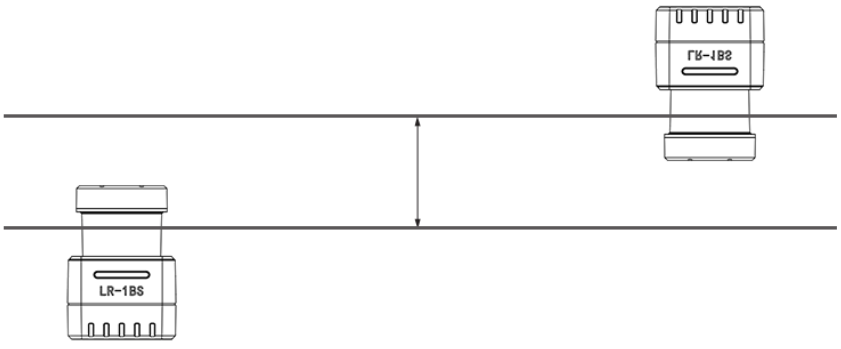


Figure 19 Placement of two lidars with parallel offset, one is upside down

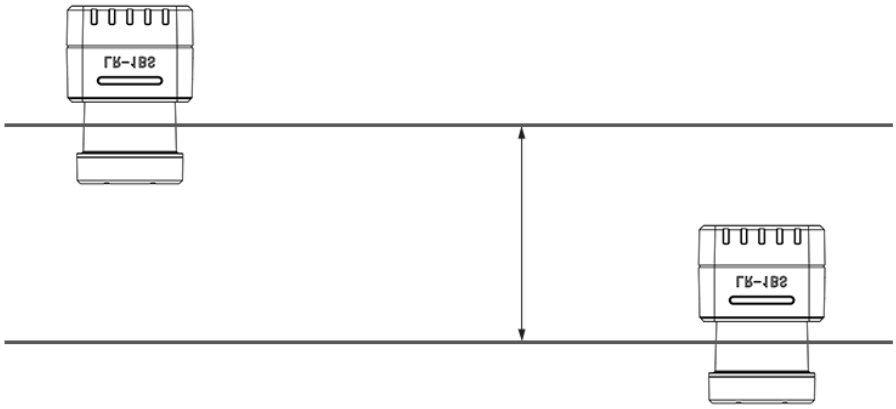


Figure 20 Two lidars upside down, with parallel offset

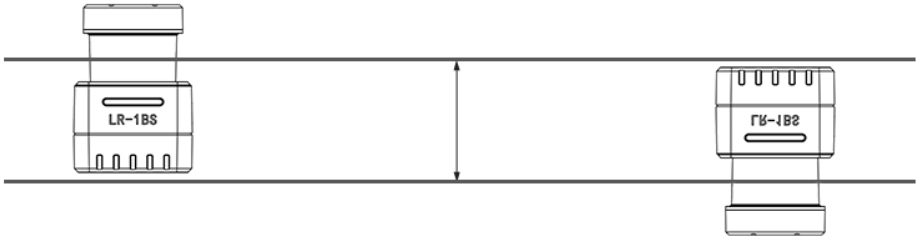


Figure 21 Place two Lidars with parallel offsets, one is upside down

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 F Cleaning of sensor

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

F.1 Notice

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

F.2 Materials required

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

F.3 Cleaning method

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

If there are mud or other blocky foreign matter on the surface of radar, first spray clean water on the surface of the dirty part on the radar 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 radar with a fiber cloth, be careful not to scratch the surface. Finally, clean the soap residue on the radar 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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Release: 2020-12