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-1BS35-202404

目录

1. About this documen

This document summarizes supplementary information on mounting and electrical installation as well as measured value output format of the LR-1BS3/5. 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-1BS3/5 operating instructions.

2. Safety information

- Read the notes on mounting and electrical installation before carrying out these tasks;
- Read additionally the LR-1BS3/5 operating instructions to familiarize yourself with the device and its functions;
- The LR-1BS3/5 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

The LR-1BS3/5 is an opto-electronic laser scanner that electro-sensitively scans the perimeter of its surroundings at a single plane with the aid of laser beams. The LR-1BS3/5 measures its surroundings using two-dimensional polar coordinates based on its measurement origin.

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

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

- **Back-mounted**

  There are two M3 screw holes (hole depth is 3mm) at the back of the LiDAR.

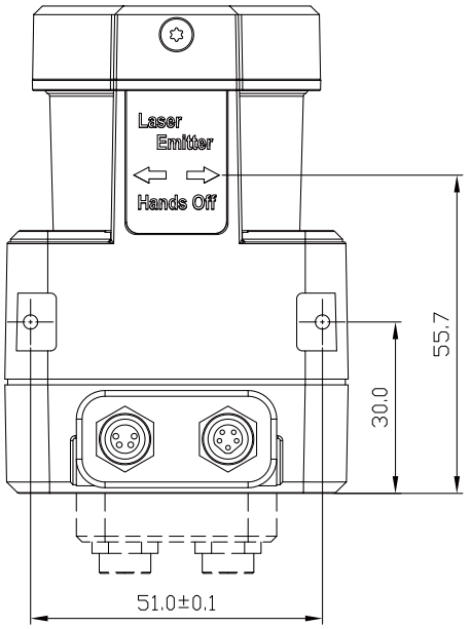


Figure 1: Back mounting interface of LR-1BS3/5

- **Bottom-mounted**

  There are two M3 screw holes (hole depth is 3mm) at the bottom of the LiDAR.

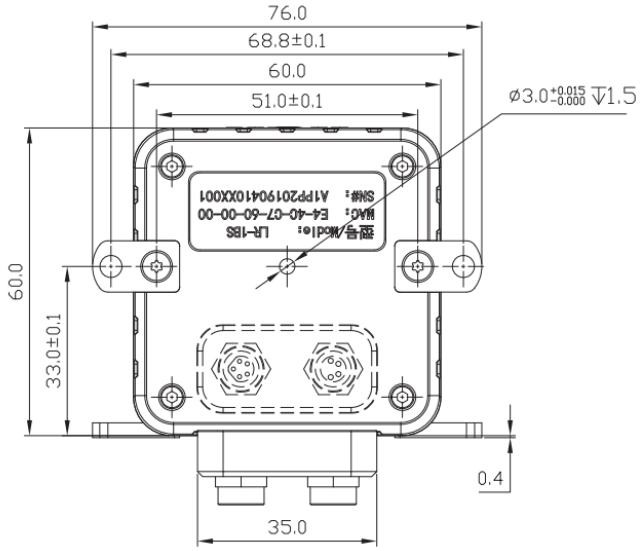


Figure 2: Bottom mounting interface of LR-1BS3/5

4.2. Pin and wire color assignments

LR-1BS3/5 is equipped with a "Power/IO" connection and an "Ethernet" connection.

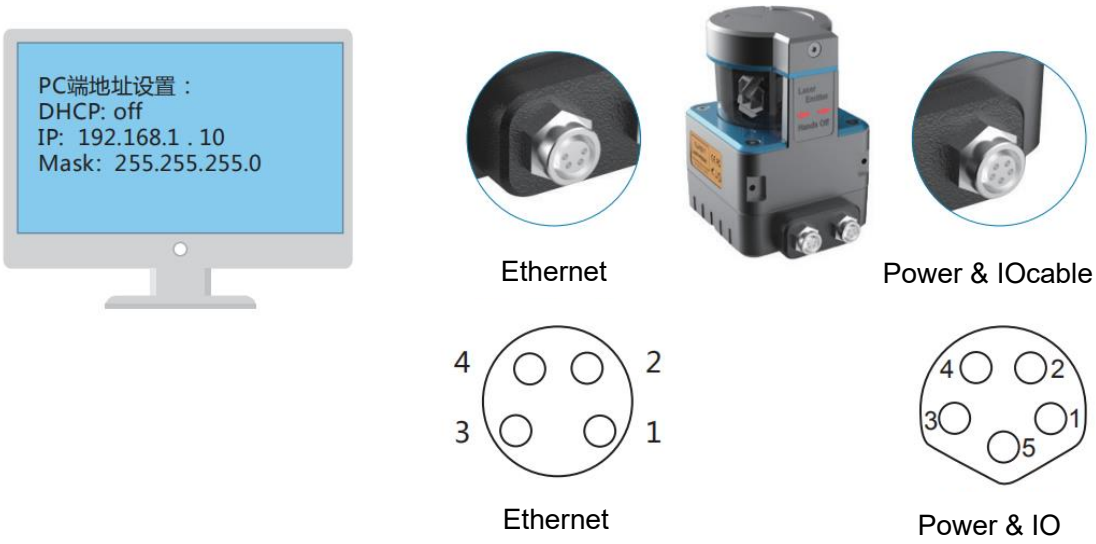


Figure 3 Diagram of electrical interface

- 4.2.1 **"Power/IO"** connection

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

Table 1 Definition of "Power/IO" connection

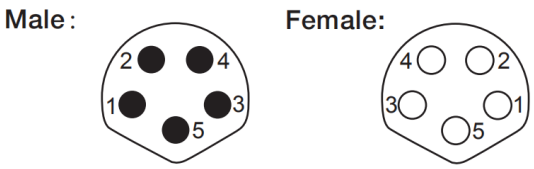


Figure 4 Diagram of "Power/IO" connection

- 4.2.2 Ethernet connection

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

Table 2 Definition of Ethernet connection

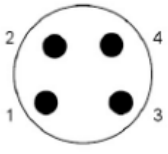


Figure 5 Diagram of Ethernet connection

4.3. Communication interface

The LR-1BS3/5 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

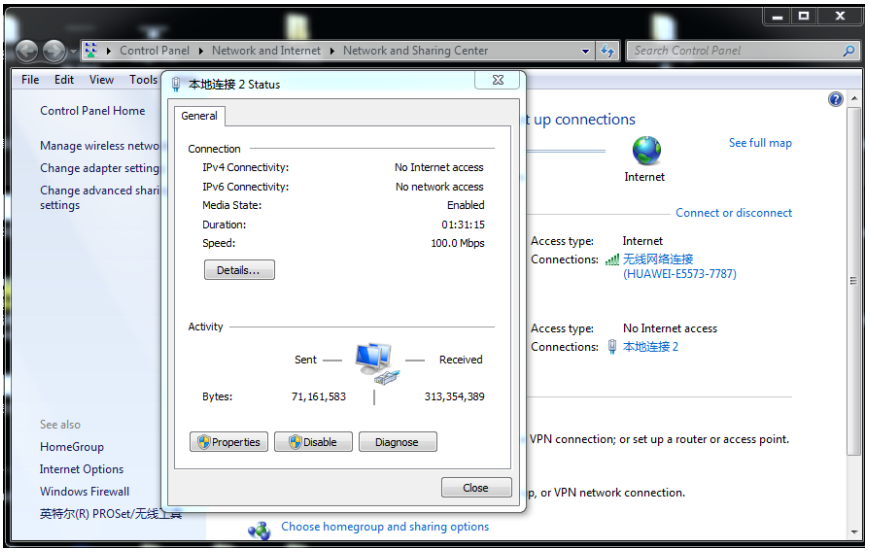


Figure 6　Step 1 of computer IP setting

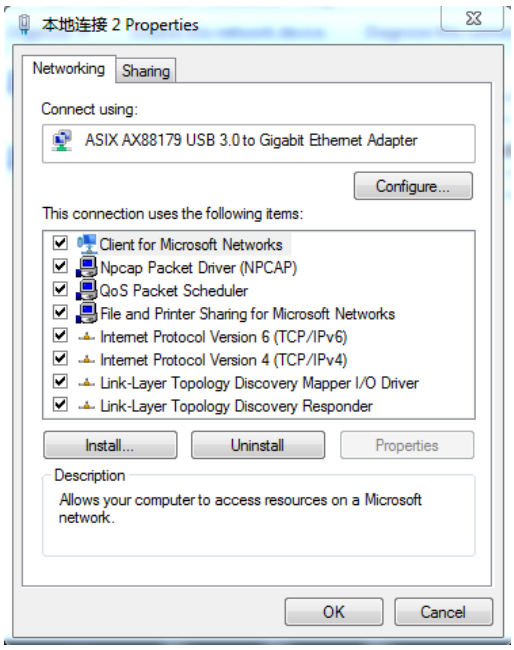


Figure 7　Step 2 of computer IP setting

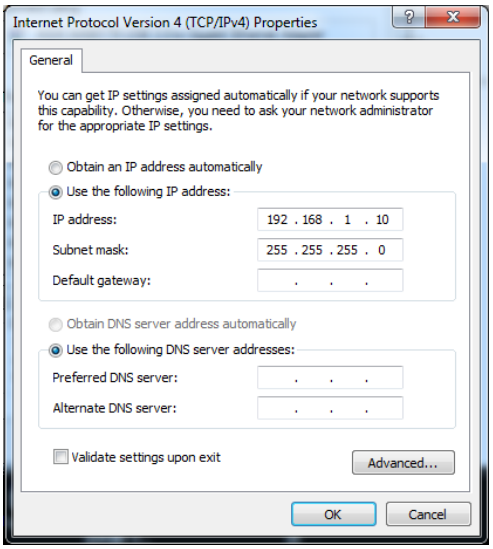


Figure 8 Step 3 of computer IP setting

5. Measurement principle

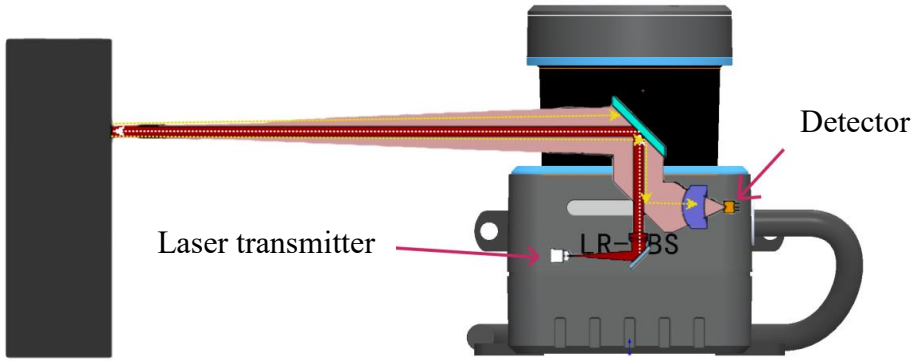


Figure 9 Diagram of LR-1BS3/5 LiDAR work principle

As is shown in the figure above, LR-1BS3/5 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-1BS3/5 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-1BS3/5 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.

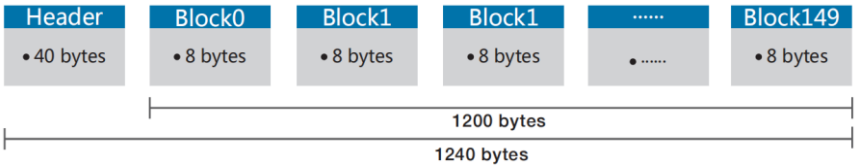


Figure 10 Format of point cloud information packet

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 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, expressed in 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 3 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, it means that this data block is invalid and must be ignored .
2	2	Distance reading, unsigned integer. The measurement distance is determined by the distance ratio of the header, that is, measured distance="the reading value × the distance ratio of the 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 4 Definition of data block

6.4. Data conversion

- 6.4.1 Angle calculation
  Details on calculating angle of LR-1BS3/5 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-1BS3/5 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-1BS3/5 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-1BS3/5 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**" and "**SafeAre**a" on the right side of the UI are the LiDAR parameters displayed in real time, indicating the temperature, voltage and current active Bank. 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 LED indicator **ON** and **OFF** through "**Led Marquee**", and click "**Set Configs**" to confirm;
- Set the **ON** and **OFF** of the LiDAR safety function through "**Safe Area**", and click "**Set Configs**" to confirm;
- Select input mode of "**safe bank**" trough "**Safe bank input**" (GPIO mode is not available for 1BS3/5);
- Set the mode of the LED indicator through "**Led Mode**";
- Select current Bank through "**Safe bank config**" when "**Safe bank input**" is "**Software**";
- Set receiving computer IP and port through "**Host IP & Port**".Up to 3 groups 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**" to confirm, and the modification is complete after the LiDAR is powered on again

Figure 11 Parameter configuration of web page

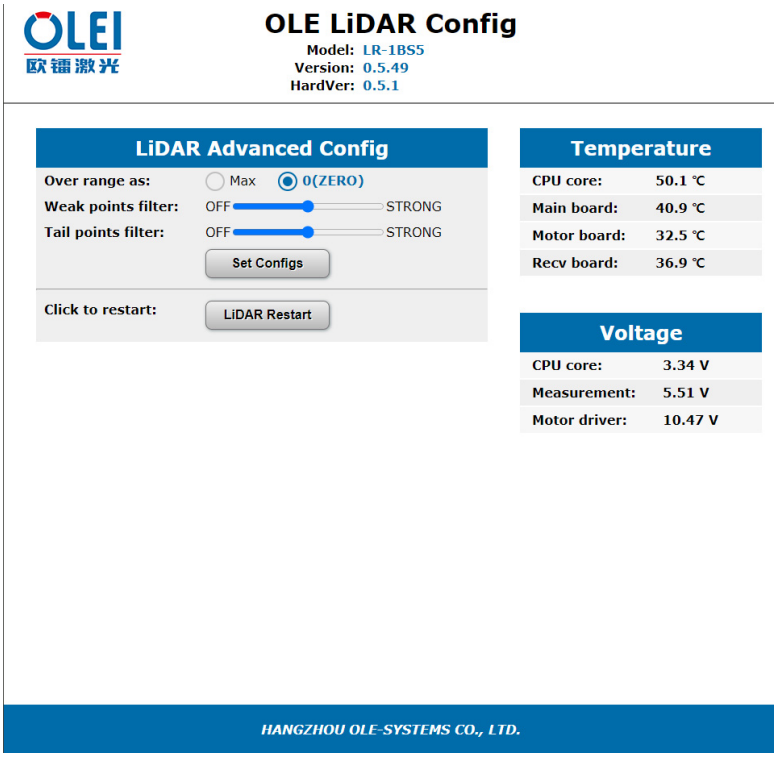


Figure 12 Advanced configuration page

7.2. Configuration of OlamViewer

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

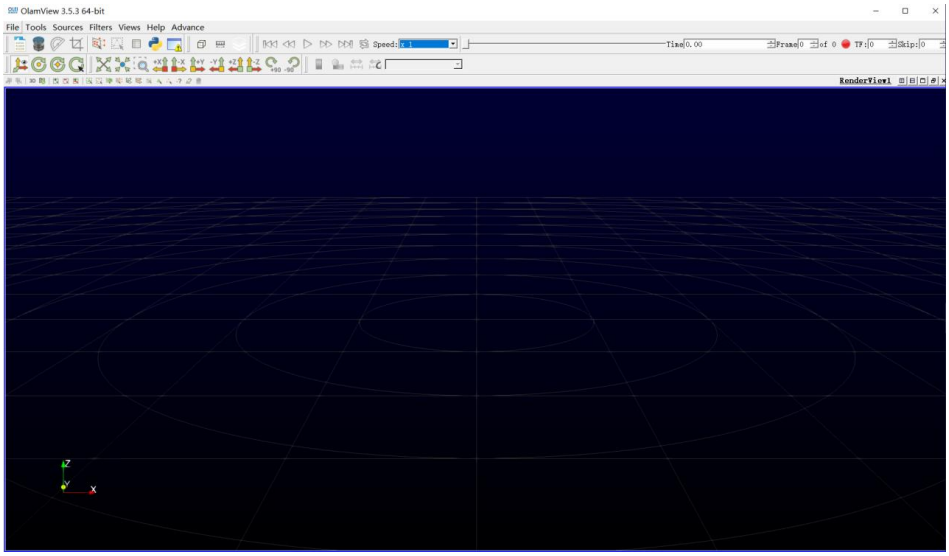


Figure 13 Sample of The OlamViewer interface

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.
LiDAR can not respond when obstacle is detected	● Check if the software configuration is correct and if the configuration file is successfully downloaded. ● Verify whether the wiring at the I/O port is correct. ● When the I/O port is not not connected , 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 5 Troubleshooting

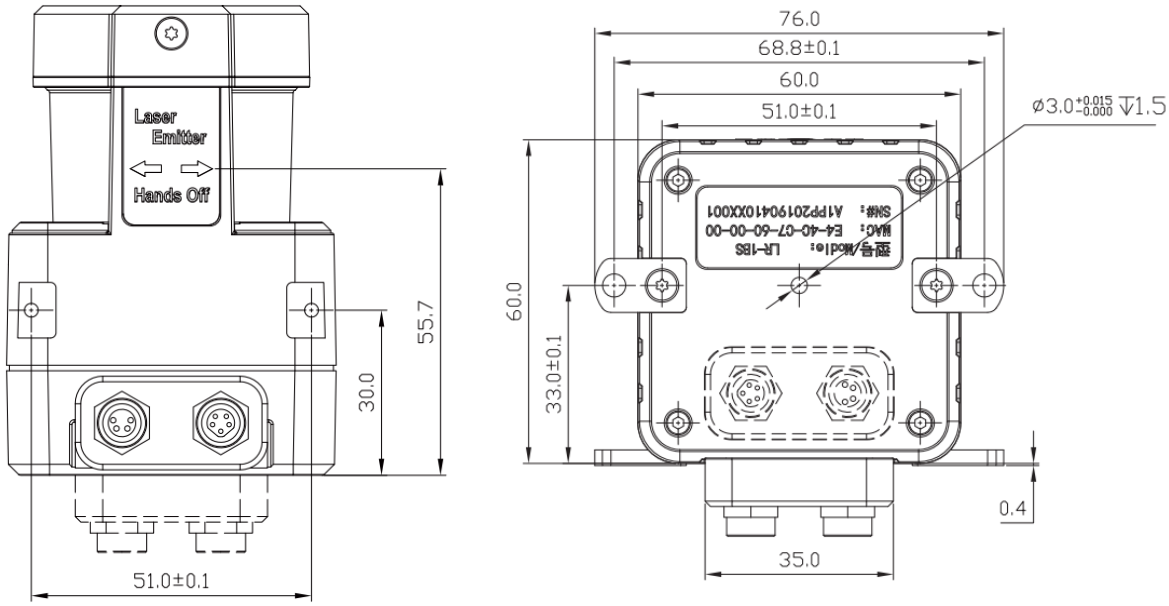
Appendix A Data packet

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)
```

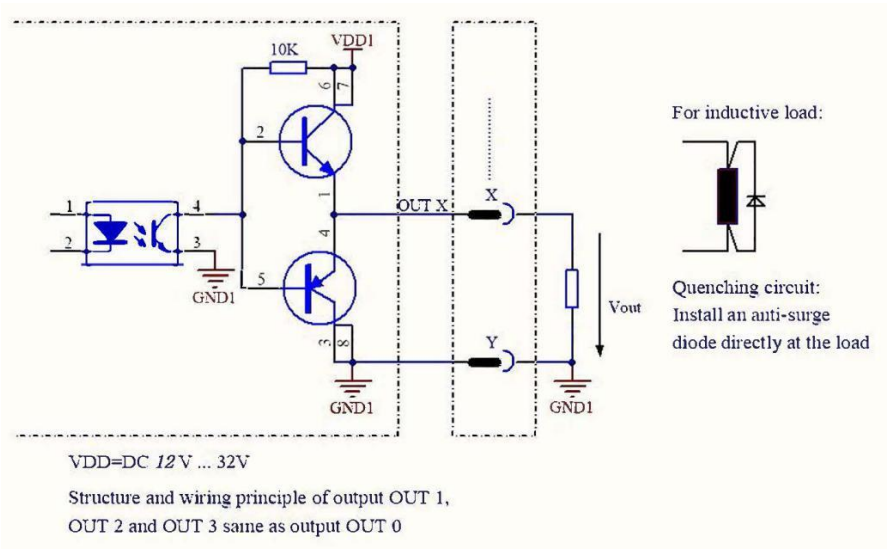
```
0000  00 e0 4c 30 12 9b e4 4c  c7 60 1a e0 08 00 45 00   ··L0···L ·`····E·
0010  04 f4 f7 4e 00 00 ff 11  3b eb c0 a8 01 64 c0 a8   ···N···· ;····d··
0020  01 0a c0 01 09 40 04 e0  c1 ca 0f 01 f0 fe 00 02   ·····@·· ········
0030  01 4f 4c 45 4c 52 2d 31  42 53 35 00 00 00 00 00   ·OLELR-1 BS5·····
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



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 LiDAR.

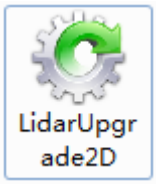


Figure 14 Icon

D.1 Software features

For 2D LiDAR LR-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 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 .

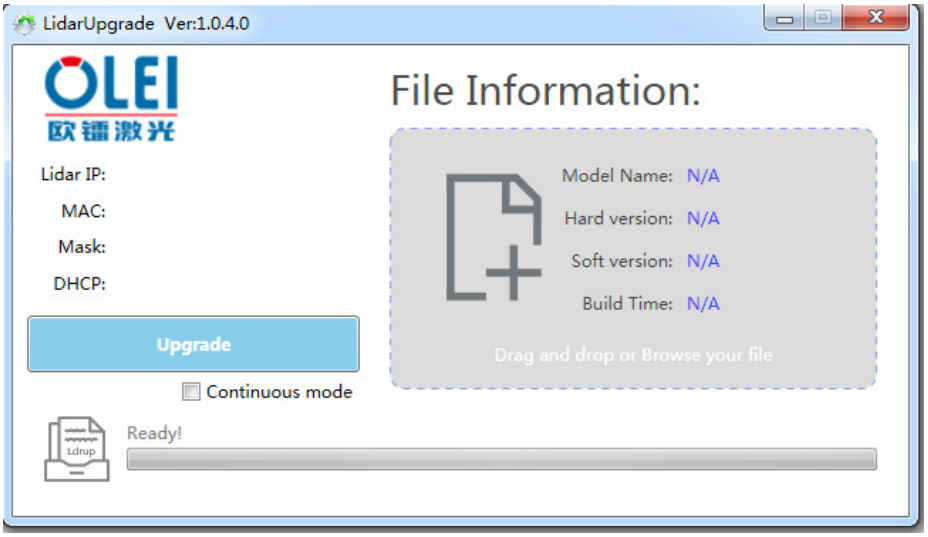


Figure 15 Interface of software upgrade

-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 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)

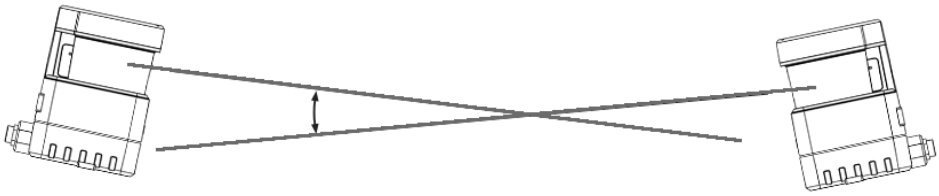


Figure 16 Placement of two LiDARs opposed to each other

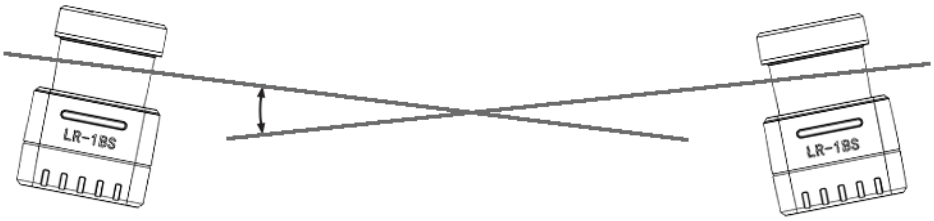


Figure 17 Crosswise placement of two LiDARs

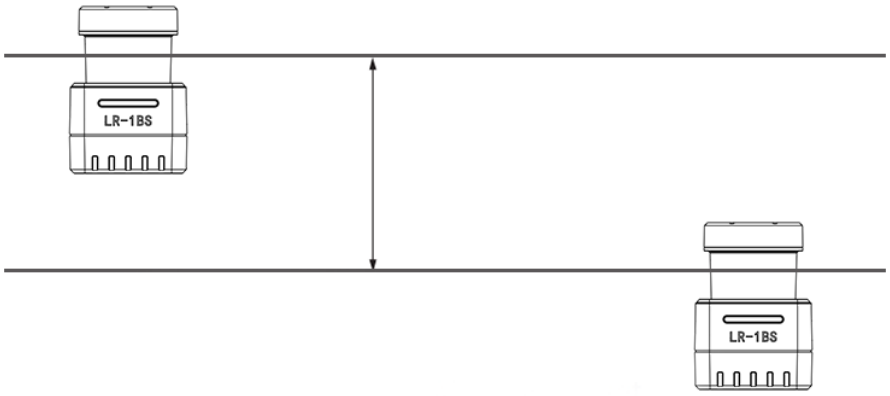


Figure 18 Placement of two LiDARs with parallel offset

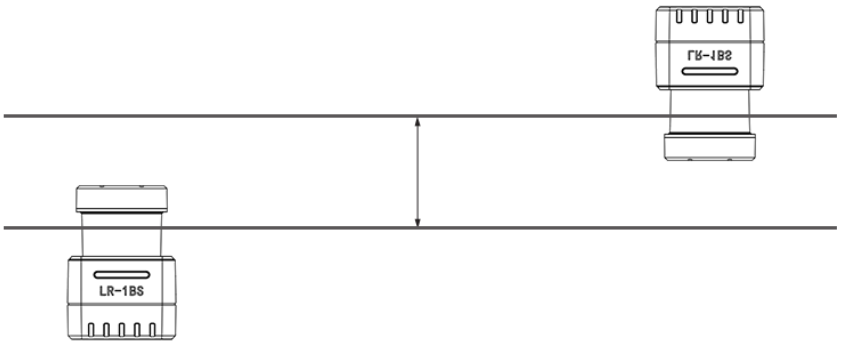


Figure 19 Placement of two LiDARs with parallel offset, one of these upside down

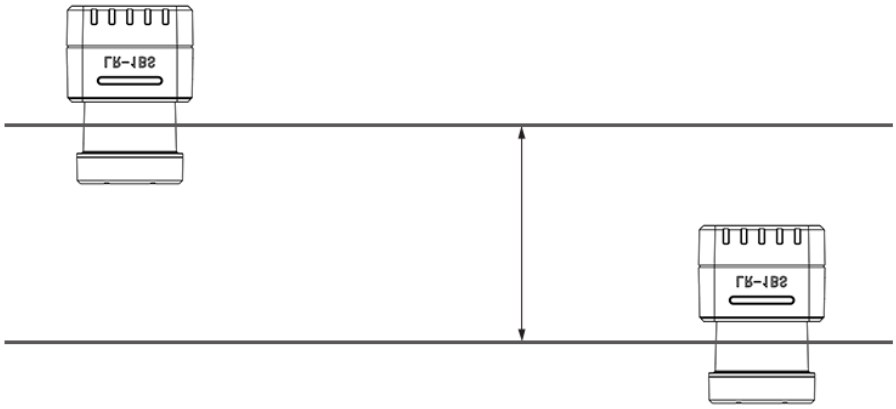


Figure 20 Placement of two LiDARs upside down, parallel offset

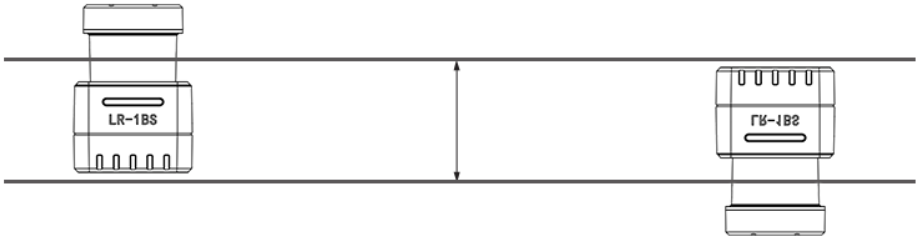


Figure 21 Placement of two LiDARs with parallel offset, one of these upside down

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 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 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.

Official WeChat

Regarding changes in specifications, etc., without notice!

Hangzhou Ole-systems Co., Ltd.

No. 35, Jiuhuan Road, Jianggan District,
Hangzhou City, Zhejiang Province, China
Web: www.ole-systems.com
Email: sales@ole-systems.com

TEL: (+86) 400 102 5850

Release: 2024-04