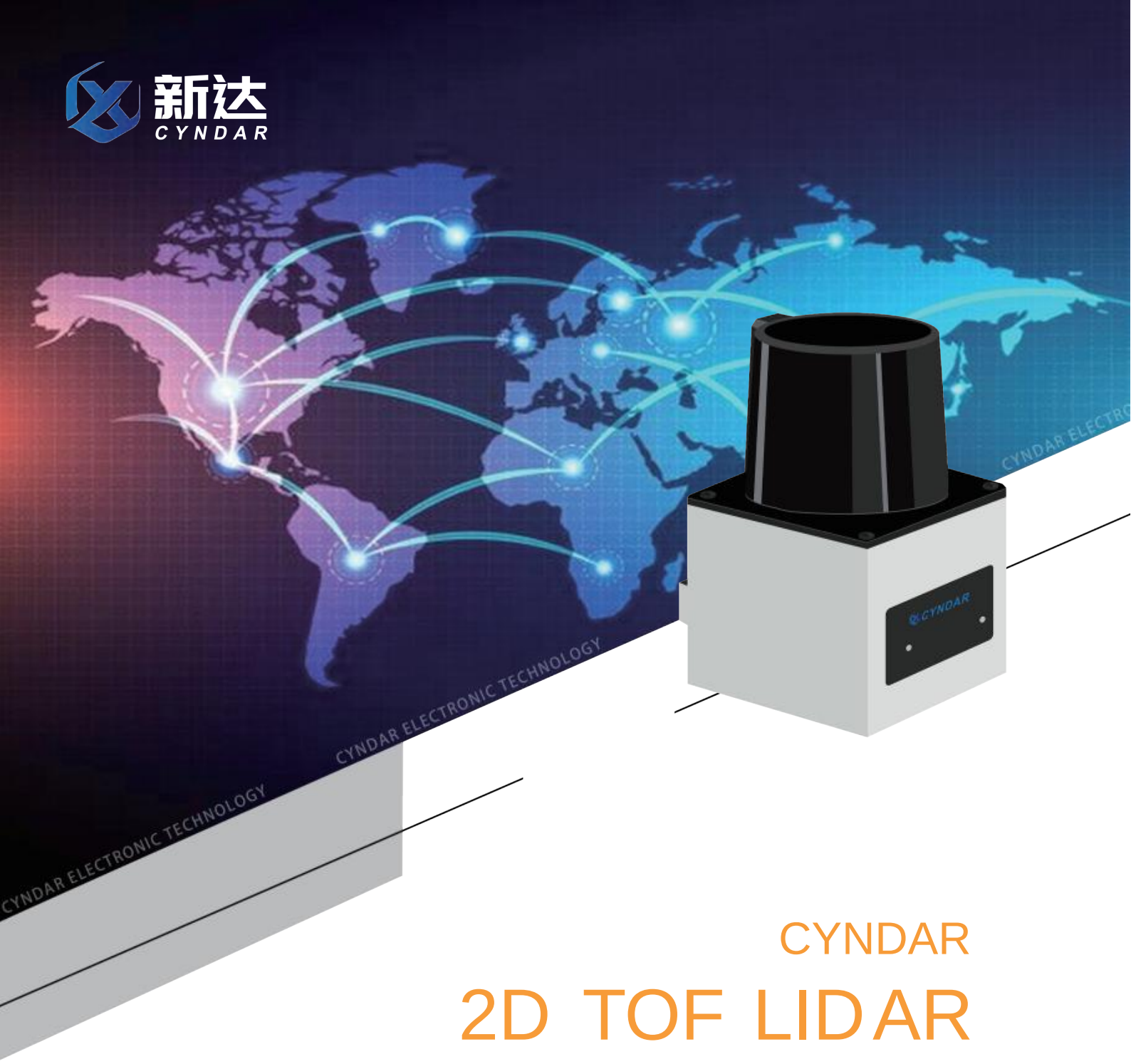
新达
CYNDAR



CYNDAR

2D TOF LIDAR

Navigation manual

2.3V

广州市新达电子科技有限公司
Guangzhou Cyndar Electronic Technology Co., Ltd.

Warranties and representations

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Document number

XD-TOF-Navigation- 180620-A1

Statement

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The information provided in this manual supersedes all previous publications;

CYNDAR reserves the right to interpret errors that may be contained in this manual, or information and deductive functions provided by this manual, and any incidental or consequential losses caused by the use of this manual;

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English website：www.cyndar.net

Email: sales@cyndar.net

Safety requirements

(In order to a void possible danger, please use this product according to regulations**)**

General safety summary

Please read the following safety precautions carefully to avoid damaging this product or other products connected with this product.

Use the specified power cord:

Only the power cord approved by the host country is allowed to be used;

To view product ratings:

To avoid the impact of excessive current, please check the rating and marking instructions marked on the product, and consult the product manual for details of rating before connecting the product;

Always use suitable over-voltage protection:

Make sure that no excessive voltage is connected to the product.

Ground the product:

Ground the power cable of this product. To avoid electric shock, before connecting any input or output terminal of the product, please ensure that the grounding terminal of the power cable of the product is reliably connected with the protective grounding terminal;

It is forbidden to disassemble the instrument and open the cover without permission:

Without the permission of cyndar, the user can not disassemble the device without permission, and it is strictly prohibited to open the product when the device is running;

Do not use hard objects to scratch the optical cover

Scratches of foreign objects may cause scratches on the optical cover, surface scratches may affect the measurement distance, or increase the noise data;

Anti static protection:

Static electricity may cause damage to the instrument, so it should be tested in the anti-static area or under the premise of good grounding.

In case of suspected product failure, it is forbidden to operate:

If you suspect that this product is faulty, please contact cyndar for testing. Any maintenance, adjustment or part replacement must be performed by cyndar;

Do not use in corrosive environment:

In order to prevent the equipment from being corroded, it is strictly prohibited to use or place the equipment in the corrosive environment;

Do not operate in flammable and explosive environment:

In order to avoid equipment damage and personal safety, it is strictly prohibited to operate or place the instrument in inflammable and explosive environment;

Keep the optical surface of the product clean:

In order to avoid dust affecting the ranging performance, please keep the optical surface of the product clean;

Keep good heat dissipation:

Please install the equipment on the surface of metal heat sink to keep good heat dissipation.

Do not look straight for a long time

The equipment has continuous infrared laser emission during operation, which meets the class I laser safety standard. To ensure safety, do not look directly at the light-emitting surface for a long time.

Catalog

1. Product introduction

Navigation It is a high-performance lidar product developed by cyndar. The principle of TOF(time of flight) is adopted in the design. Through the precise time measurement of the laser pulse reflection process, the high-precision distance information is obtained, and the two-dimensional scanning of the surrounding environment is completed with the rotation of the motor.

Navigation can achieve reliable measurement within 20 m, and the angle range is 270 °. Thanks to the advantages of TOF scheme and the unique high-performance time measurement technology of CYNDAR , Navigation shows far higher ranging performance than the triangulation radar. Even for the white board measurement at 20m, the ranging accuracy of ± 3cm can be obtained.

The 45khz laser sampling rate supported by Navigation is ahead of the industry, with 45000 point cloud data per second enabling Navigation to perform fine restoration of the surrounding environment. The user can change the rotation speed of the motor through configuration, so that the frame rate of the output point cloud image can be adjusted in the range of 10-30hz. Corresponding to the high sampling rate, Navigation provides the highest angular resolution of 0.08 °, which greatly enhances the recognition ability of small targets and effectively reduces the rate of missed detection.

Through the control software Navigation view and SDK provided by cyndar users can easily and quickly start the system level development. Navigation can be used in robot positioning and and navigation, mapping, environmental modeling, security and other fields.

Navigation adopts semi-solid design, the whole machine reaches the protection level of IP65, which can meet the severe industrial environment or complex outdoor scene application.The high-quality, long-life motor and light load design ensure that the radar can work stably for a long time, and the excellent optical performance ensures that Navigation can still perform well in the outdoor with strong sunlight. It adopts 905nm laser band and meets the class I eye safety level.

2. Working principle

Navigation is a TOF radar, its core components include optical, mechanical, circuit and software. When working, the laser emits a beam of laser to the outside, which will reflect when it hits the object. The receiver detects the reflected light signal, and then measures the time difference between the reflected light and the emitted light through the time analysis module. Multiplying the time by the speed of light will get the distance of light flight, and then calculate the position of the measured object, as shown in Figure 1.

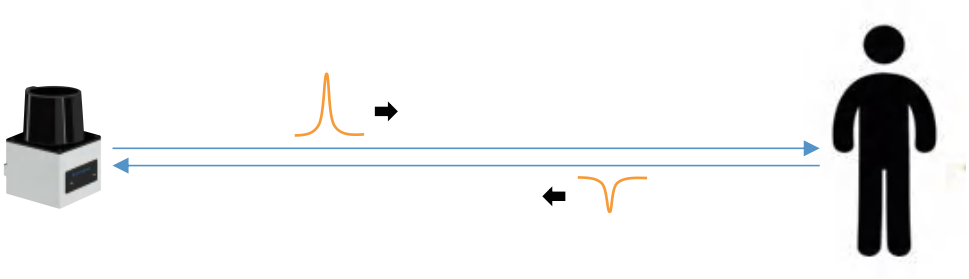


Figure 1. Schematic diagram of lidar ranging principle

Single point fixed position measurement can only get the distance information of the target. In order to get more angle information, a rotating motor is installed in Navigation, which can get the distance of different angles through the rotation of the motor, so as to splice into a contour image of the surrounding environment.

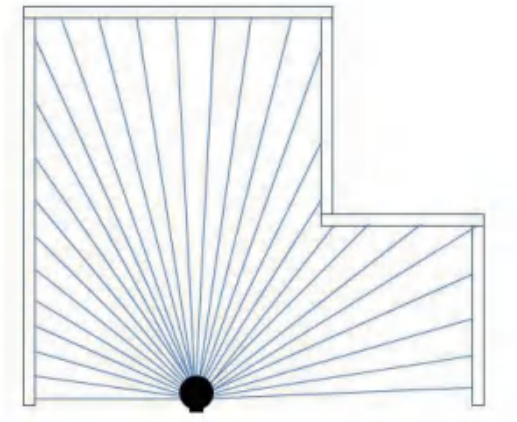


Figure 2. Lidar scanning and imaging

Navigation The measured images are as follows:

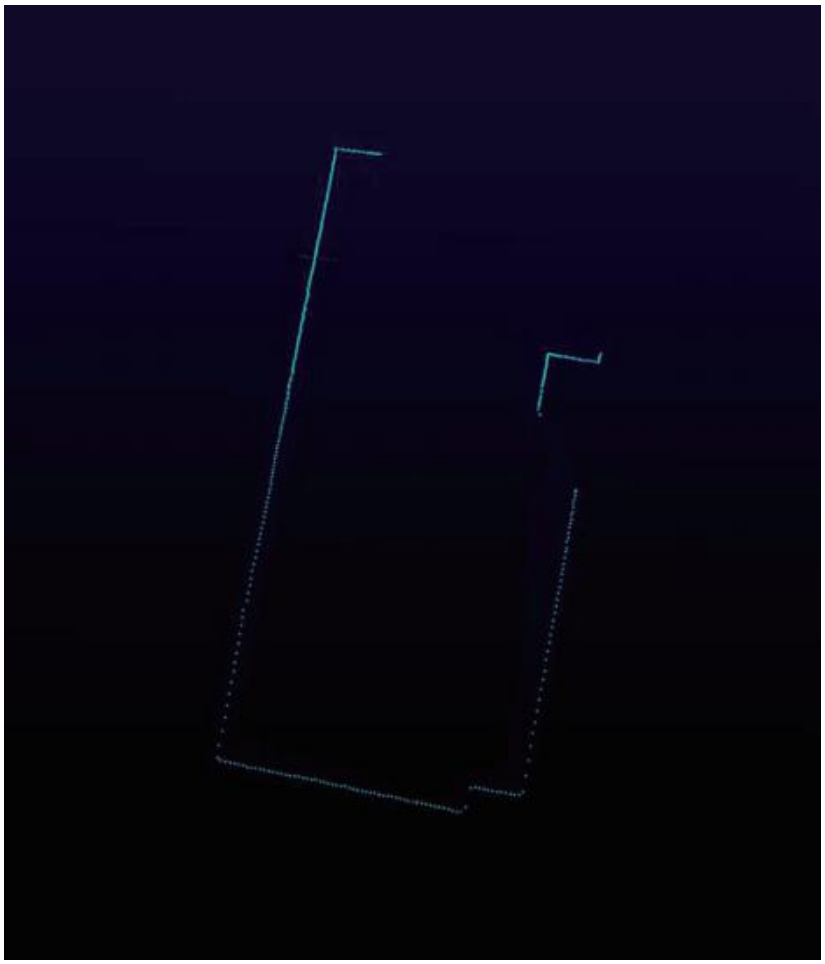


Figure 3. Example of Navigation point cloud image

3. Characteristics

1、 Scan range

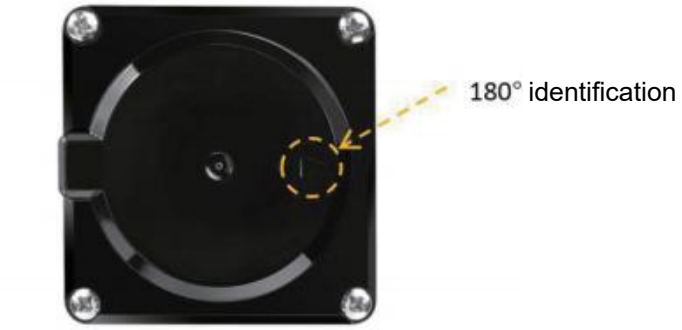


Figure 4 (a). 180 ° sign in Navigation top view

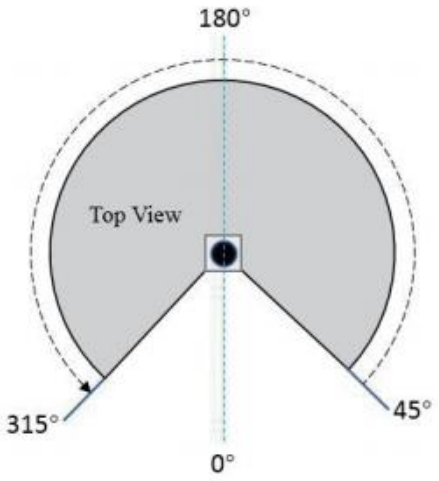


Figure 4 (b). Navigation rotation angle definition

Navigation can provide point cloud information in the range of 270 °, and the position of 180 ° is in the front of the sensor, which is identified by the triangle mark at the top . In the perspective of top view, the angle increases with the counter clockwise direction. There is a blind area of 90 ° in Navigation , which lies between 315 ° and 45 °.

2、optical characteristics

Light out position

Figure 5. Schematic diagram of light out position

Taking the plane of the sensor base as the reference plane, the height of the laser output position of Navigation from the reference plane is 52.6mm.

Vertical angle of laser output

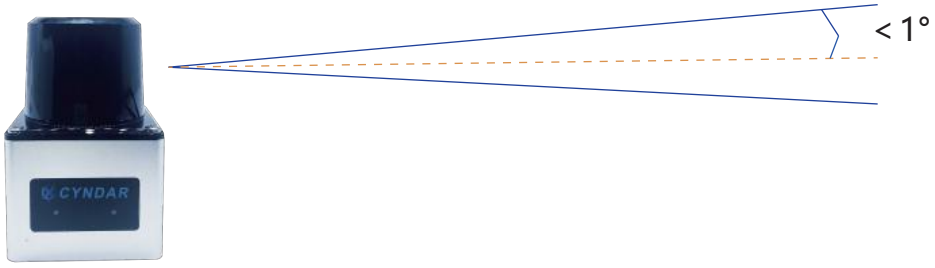


Figure 6. Laser vertical angle diagram

The vertical angle of the output laser of each f actory made Navigation will have small deviation. Taking the horizontal plane as a reference, the vertical angle deviation range of the outgoing laser of Navigation is ± 1 °.

Flare properties

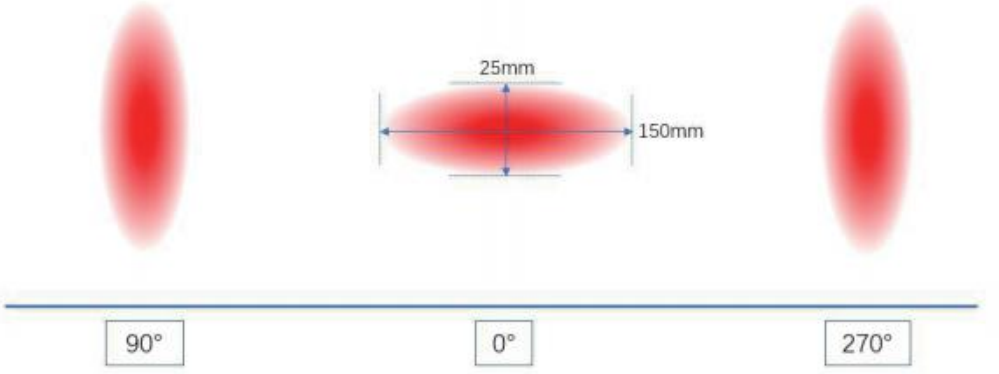


Figure 7. Spot characteristics (10m)

In Navigation, semiconductor LD is used as the light source. There is a divergence angle difference between fast and slow axis in the light output char acteristics of LD. Therefore, when the motor rotates, the shape of the spot on the target object will also rotate. At 0 °, the shape of the spot on the target 10 m a way is as shown in the figure. The transverse width is 150 mm, and the vertical width is 25 mm. With the increase of the angle, the spot will rotate anticlockwise. At 90 ° and 270 °, the spot is v ertically distributed.

Laser safety level

Navigation uses a low power 905nm laser source, and uses pulse modulation to reduce the average power. The laser safety standard of class I can ensure the safety of human eyes.

3、 Interface and indication

Interface

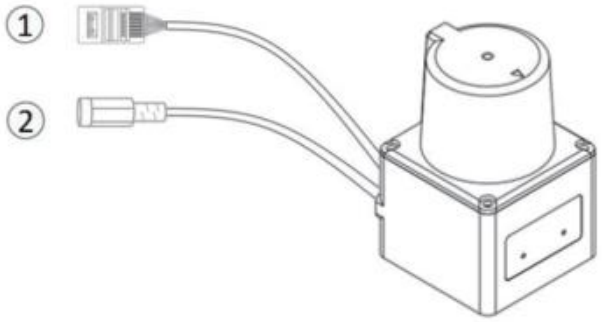


Figure 8. Interface cable

As shown in the figure, there are two types of cables for navigation. Cable 1 is a network port cable; cable 2 is a power cable. The length of the network port cable is 1m, and the standard RJ45 interface is defined as follows

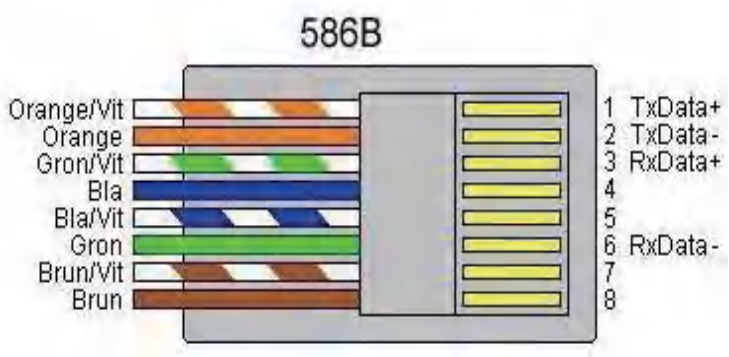


Figure 9. Network terminal Harness

Defined as follows：

Colour	Signal
Orange white	TX+
Orange	TX-
green white	RX+
green	RX-

The length of the power cord is 1m, and the power head is 5.5mm/2.1mm.
Defined as follows:

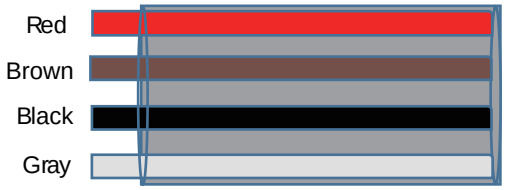


Figure 10. Network terminal Harness

Defined as follows:

Colour	Signal	Typical value	Range
红	VCC+	12V	12V~24V
棕	VCC+	12V	12V~24V
黑	VCG	0V	0V
灰	VCG	0V	0V

The network IP address is set as follows:

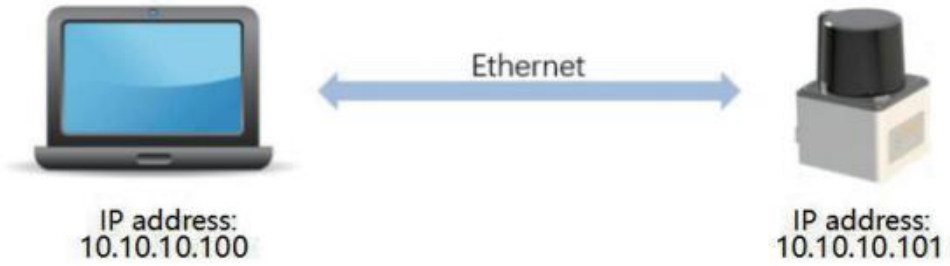


Figure 11. IP address setting

Instructions

Figure 12. Navigation indicator

Power indicator: on indicates that the power supply is working normally;

Dark indicates that the power is not connected or the power is abnormal.

Status indicator: normally on indicates normal status;

Flashing indicates that the equipment status is abnormal;

Note: When the device is powered on, the status indicator will flash briefly, indicating that the device is starting up and is in a normal state.

4、Software

Lidar can read and configure the relevant parameters of the radar through the Navigation view software, view the radar point cloud data in a visual way, and analyze the point cloud data for the convenience of users.

The Navigation SDK package realizes the encapsulation and analysis of r adar related information. Users can make rapid secondary development by calling related apiapi.

Please refer to the electronic document Navigation view user's guide and pavosdk programming guide for details.

5、data format

Navigation Data transfer format

Navigation point cloud data is transmitted based on the Ethernet UDP protocol package. Each UDP packet contains 134 bytes, including 8 UDP protocol information fields, 120 byte point cloud information fields, 4 byte time information fields and 2 bytes of data. Factory custom fields

The 120-byte point cloud information field is divided into 12 groups of 10 bytes each, of which 2 bytes have the device ID number (OxFF01), 2 bytes of angle information and 6 bytes (2 points) of point cloud information. The point cloud information of each point also contains 2 bytes of distance information and 1 Byte of intensity signal. The angle range of the radar output is 0°-360°, and the output contains the shielded 90° range (0°-45°, 315°-360°).

The specific UDP encapsulation format is as follows:

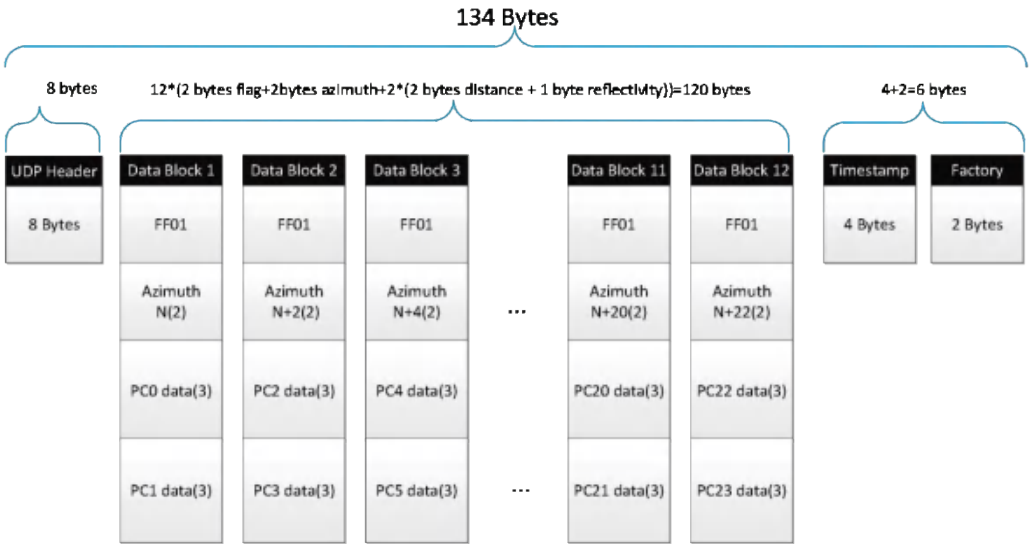


Figure 13. Transmission format of point cloud data UDP packets in Nnavigation

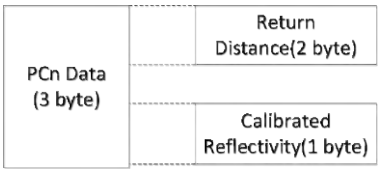


Figure 14. Nnavigation single point cloud data f ormat

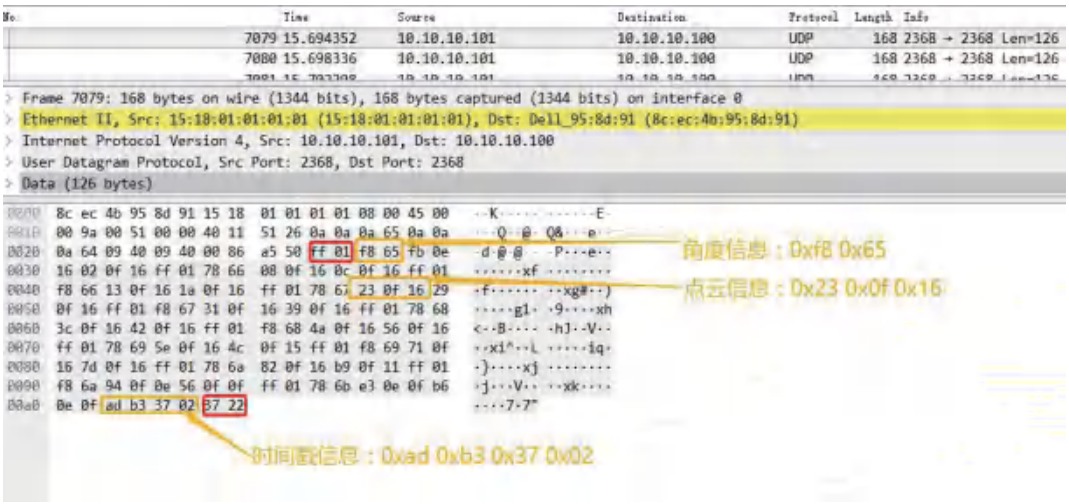


Figure 15. Nnavigation point cloud pack et analysis example

Angle information extraction and calculation

Each group of 10 bytes contains 1 angle information,with a length of 2 bytes and a value range of 0 ° - 360 °.

The angle is calculated as follows:

1. Extract angle information 0xf8 & 0x65 from UDP packets;

2. Turning the angle inf ormation value to get: 0x65 & 0xf8, combining to get 0x65f8;

3. Converted to decimal: 26104;

4. Divide by 100;

5. Get 261.04 °.

Extraction and calculation of strength and distance information

Each group of 10 bytes of data contains two point cloud data inf ormation. Each point cloud data contains two bytes of distance inf ormation and one byte of strength information. The unit of distance inf ormation is 2mm.

The information field in the information packet, point cloud data, the first two bytes are used to transmit the interest rate of the distance between the lidar and the object, the unit of the distance information is 2 mm; the third field is used to indicate the information strength, strength information Is a relative value, ranging from 0-255.

The strength and distance information is calculated as follows:

1. Extract point cloud information from UDP packets: 0x23 0xf 0x16;

2. Extract distance information 0x23 0xf and strength inf ormation 0x16;

3. Flip the distance information value to get 0x0f & 0x23, and combine to get 0x0f23;

4. 3875 after conversion to decimal system;

5. Multiply the distance unit (unit: 2mm) to get: 7750mm;

Extraction and calculation of time stamp information

Each UDP packet contains a time stamp information with a length of 4 bytes and a value range of 0-3600x10^6us. The current time stamp inf ormation indicates the time when the last point cloud data of the current UDP pack et sends the laser.

The time information is calculated as follows:

1. Propose time information from UDP packet: 0xad 0xb3 0x37 0x02;

2 · hi-lo flip: 0×02 0×37 0×b3 0×ad, portfolio is 0×0237b3ad;

3. Conversion to decimal system: 37204909 μ s;

6、 Data communication mode

There are two modes of data communication between Navigation radar and upper computer, one is passive data upload mode, the other is active data upload mode.

The radar passive upload data mode refers to that when the upper computer and the radar can communicate normally on the network, the upper computer turns on the r adar according to the r adar IP and directly sends the data request to obtain the r adar data.

Radar active upload data mode refers to the configuration of radar-based DestIP and DestPort. Configure the IP of the network port connected to the radar. The host opens the data port according to the configuration interfaces DestIP and DestPort. According to the radar IP, get the radar to actively upload data.

At the beginning of radar power on, the def ault data transmission mode is active upload data mode. At this time, the upper computer can use the radar active upload data mode to acquire data, or the r adar passive upload data mode to acquire data (at this time, the radar upload data mode changes to passive upload data mode). When the radar's data transmission mode is passive data upload mode, the radar will only support this mode of data upload, not active data upload mode, unless the radar is restarted hard.

7、 Physical parameters of equipment

essential information	
Product name	Single line TOF lidar
model	**XD-TOF-20H**
Measurement characteristics	
Detection range	0.1-20m@90% reflectivity 0.1-8m@10% reflectivity
Repeatability	± 30 mm
Scanning range	270°

sampling rate	45 kHz
Point cloud data consolidation	1 / 2 / 4 / 8 point
Scan frame rate	10/ 15/20/25/30 Hz
Minimum angular resolution	0.08°
Photoelectric characteristics	
supply voltage	DC12V- 24 V
Working current	0.25 A / 12 V (t yp.)
Laser source	905 nm class I
power waste	2.5 W
other	
Data transmission interface	Ethernet 100BASE-TX
Start time	< 10 s
indicator light	Power indicator Status indicator
Ambient light	< 15000 lx
working temperature	-10℃~55 ℃
Storage temperature	-30℃~75 ℃
working life	5 years (motor life)
Degree of protection	IP65
size	50 × 50 × 76 mm^3
weight	148g (excluding cable)

8、Device configuration parameters

motor speed	Point cloud data consolidation	Angular resolution in degrees	Data volume of physical point cloud	Effective point cloud data
10	1	0.08	4500	3375
10	2	0.16	2250	1688
10	4	0.32	1125	844
10	8	0.64	562	422
15	1	0.12	3000	2251
15	2	0.24	1500	1126
15	4	0.48	750	563
15	8	0.96	375	282
20	1	0.16	2250	1687
20	2	0.32	1125	843
20	4	0.64	562	422
20	8	1.28	281	211
25	1	0.2	1800	1351
25	2	0.4	900	676
25	4	0.8	450	338
25	8	1.6	225	169
30	1	0.24	1500	1125
30	2	0.48	750	562
30	4	0.96	375	281
30	8	1.92	187	141

*Note: The output angle range is 0° to 360°. When the angle value is within the shielded 90° range (0°-45°, 315°-360°), the distance value in the output point cloud data is 0.The physical point cloud data refers to the radar point cloud data of the actual output number; the effective point cloud data volume refers to the point cloud data obtained by the user who filters out the shielding range

9、Installation guide

When installing Nnavigation , the following items shall be noted:

1. Make it as free from impact and vibration as possible;

2. Keep it from any direct sunlight (windows, skylights) or any other heat source. This prevents the temperature inside the device from rising.

In order to avoid mutual interference between radars and any impact on measurement accuracy, we suggest to install as follows:

1. When two or more radars are installed in parallel, it is recommended to incline the radar downward at a certain angle to avoid counter shooting, as shown in Figure 16 and Figure 17;

2. When two or more radars are installed vertically, it is recommended to stagger the light output position of the radar by a certain distance to avoid the opposite shooting, as shown in Fig. 18, FIG. 19, FIG. 20 and Fig. 21.

***Note: the light output position of Navigation is lower than the middle of the radome, see 2 optical characteristics for details.**

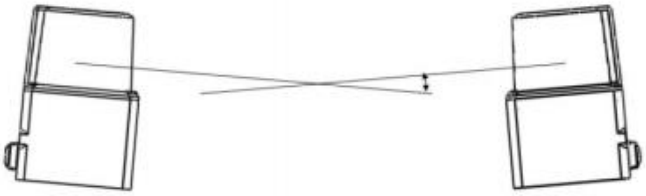


Figure 16. Parallel installation diagram (1)

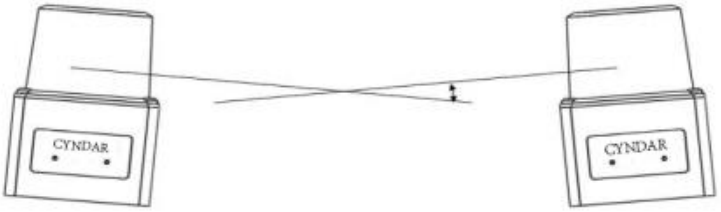


Figure 17. Parallel installation diagram (2)

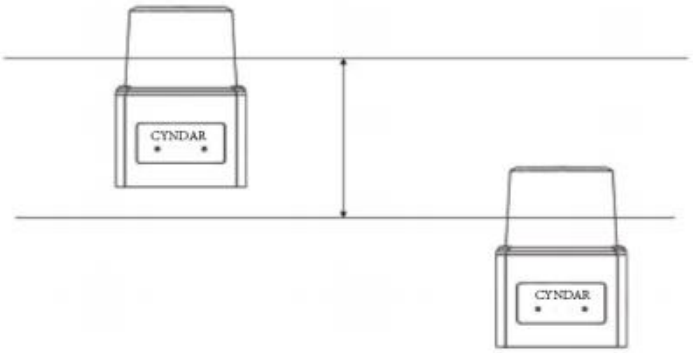


Figure 18. Vertical installation diagram (1)

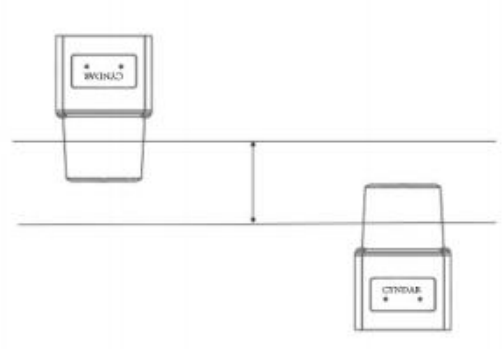


Figure 19. Vertical installation diagram (2)

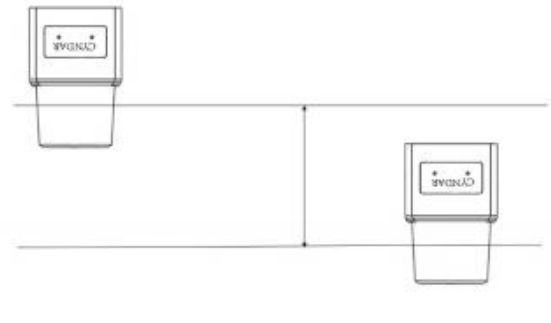


Figure 20. Vertical installation diagram (3)

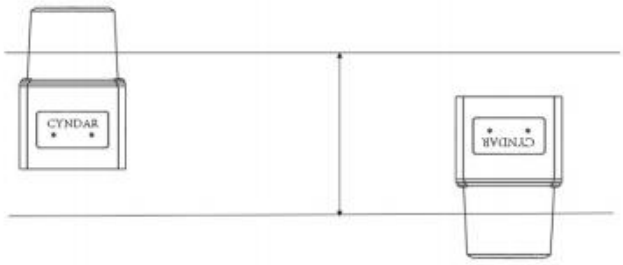
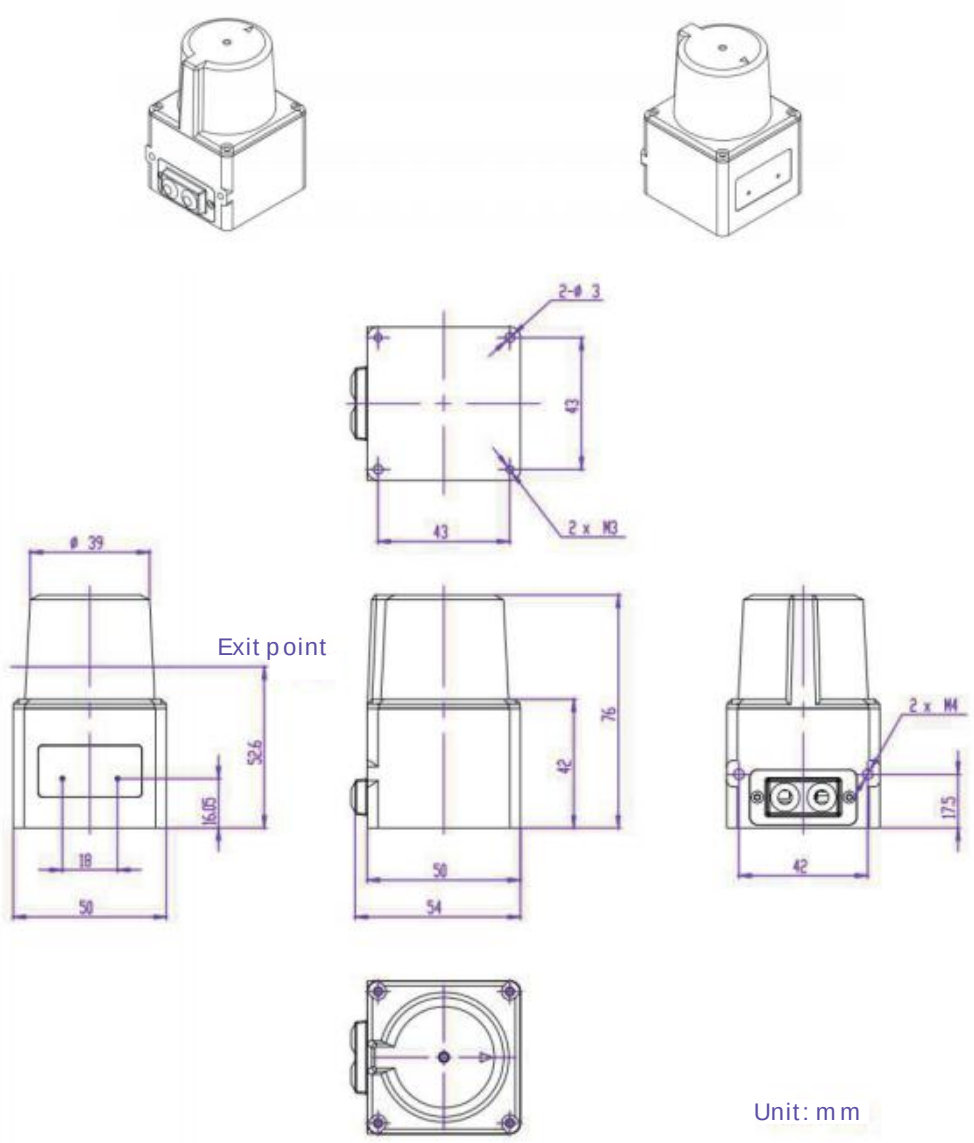


Figure 21. Vertical installation diagram (4)

10、Mechanical Dimensions



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