Operation Manual of Obstacle Avoidance Lidar

Guangzhou Cyndar Electronic Technology Co., Ltd.

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

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1 Safety instructions

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 high 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 damaged by corrosion, it is strictly prohibited to use or place the equipment in a 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.

2 Appearance of equipment

The appearance of Obstacle avoidance is shown as follows:

Optical externality

Shell

LED indicator

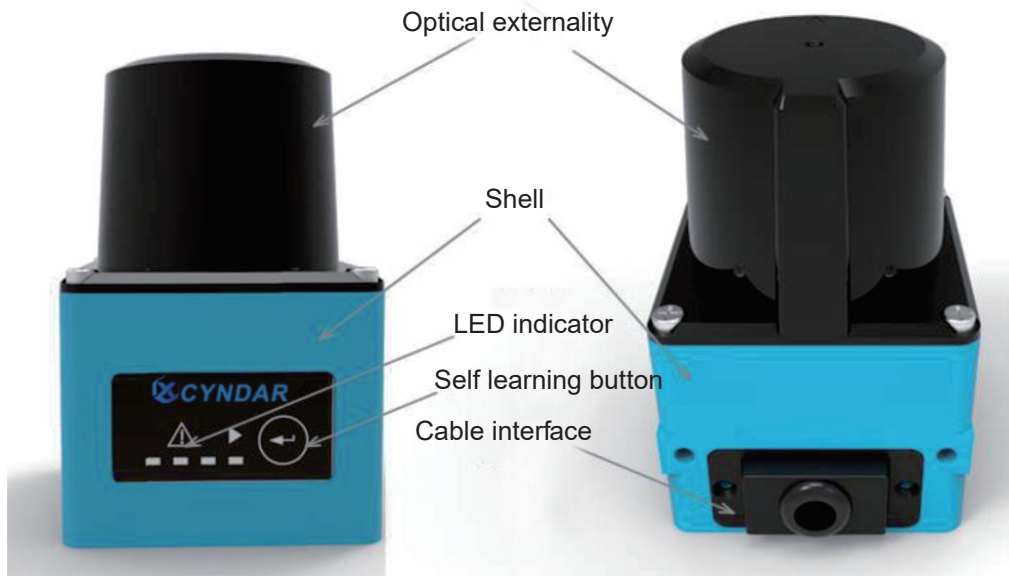Self learning button

Cable interface

Figure 2-1 Obstacle avoidance appearance 1

Note:

1. Optical cover: the optical cover is made of plastic. Please be careful that the cover is scratched by sharp tools, which will affect the optical performance.

2. LED indicator: the indicator has two functionsa) When Obstacle avoidance is working, if there is an the working area, it will give an alarm through the LED indicator light.b) Indicates whether Obstacle object invading avoidance is working properly

3. Self learning button: Obstacle avoidance has self-learning function. It can scan the surrounding en vironment to build the region and region group.

USB interface

Figure 2-2 vironment to build appearance 2

Note:

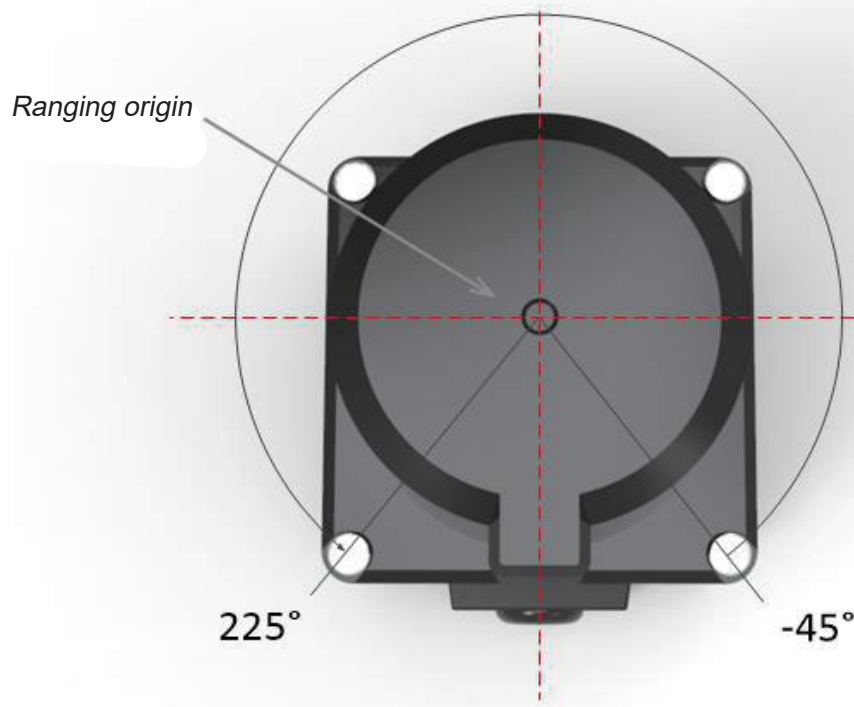*USB interface: Obstacle avoidance is connected to the upper computer though micro USB*

Figure 2-3 scanning angle

Note:

The angle scanning range of airs is 270 ° from - 45 ° to 225 °.

In the actual display, due to the limit of angular resolution, the actual value of the angle range is different under different motor speeds:

Motor speed 15Hz (angle resolution 0.1 °): actual value of angle range, min. - 45 °, max. 224 .9 °.

Motor speed 30Hz (angle resolution 0.3 °): actual value of angle range, min. - 45 °, max. 224 .7 °.

3 Working principle

3.1 Ranging principle

Obstacle avoidance is a TOF radar, its core components include optical, mechanical, circuit and software. During operation, the laser emits a beam of laser, 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 can get the distance of light flight, and then calculate the position of the measured object, as shown in the figure:
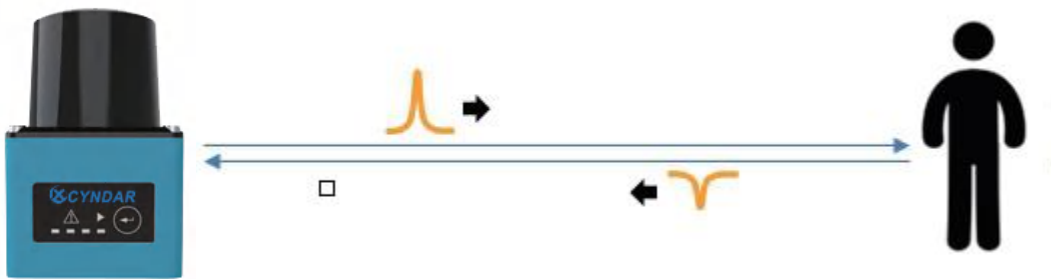
Figure 3-1 schematic diagram of lidar ranging principle

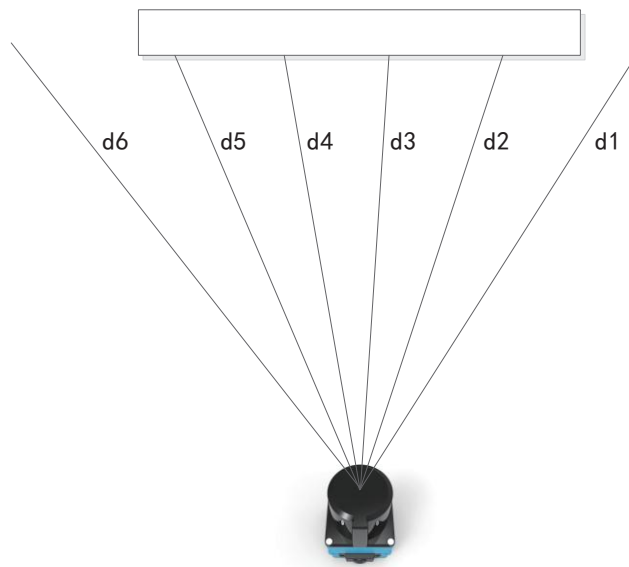The calculation of object size is shown in the figure below:

Figure 3-2 calculation method of object size

d1, d2 … D6: it indicates the distance between the object and lidar, and the angle difference between them is the angle resolution of Obstacle avoidance.

The calculation formula of the object size is:

$$W = (d2 + d3 + d4 + d5) \boxtimes 0$$
$$\text{among,} 0 = 2\pi/3600$$

Because of the parameter "shielding size", when w is larger than the shielding size, the obstacle avoidance radar will alarm.

3.2 working mode

Obstacle avoidance has four modes of operation:

1. Monitoring mode

This mode is Obstacle avoidance normal operation mode. When an object intrudes, the radar will alarm through LED light and corresponding output signal.

When alarm through is powered on, it will enter monitoring mode automatically

2. Edit mode

This mode is the working mode when the user edits the Obstacle avoidance workspace group
The user uses Obstacle avoidance designer software to edit the area and area group
so that the radar enters editing mode.

3. Self learning mode

Users scan the surrounding environment through Obstacle avoidance to generate the mode of working area group Long press the "self-learning button" on the Obstacle avoidance shell to make

Obstacle avoidance enter the self-learning mode, as shown in the figure:

Figure 3-3 self learning button

4. Standby mode

Obstacle avoidance is in standby mode and stops working. The main features are:

(1) The motor stops turning.

(2) Click cloud to stop uploading.

(3) The regional group is uploaded and downloaded normally.

The user enters the radar into standby mode by inputting signals.

3.3 Area definition

Obstacle avoidance monitors the range specified by the user. When an object enters the range, the radar will alarm the main control equipment, and the defined range is "area".

3.3.1 Area type

According to the geometry of the region and its relationship with other regions, the regions are divided into the following types:

1. Polygon area

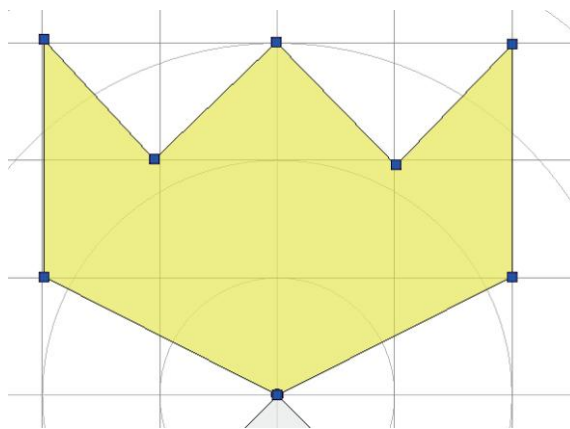The points defined by the user and the origin are connected to form a polygon area.

Figure 3-4 polygon area

2. Rectangular area

It is connected by two user -defined points (top left and bot tom right) and the origin to form a rectangular area.
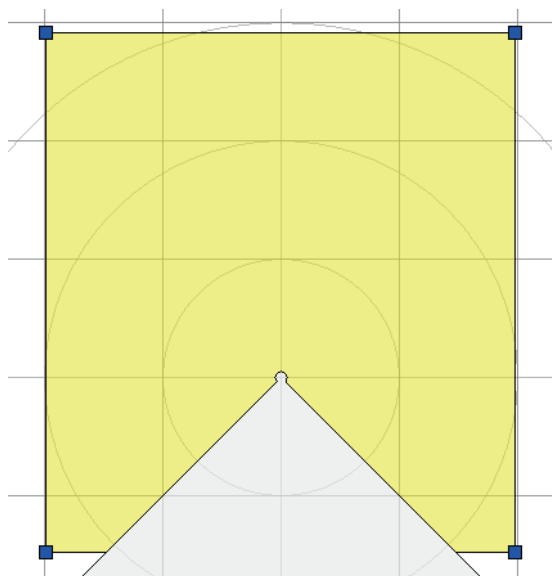
Figure 3-5 rectangular area

3. Arc area

It is connected by two points and the origin to form an arc area.

Figure 3-6 arc area

4. Linear scale area

The outer region serves as the reference region, the region where the line intersects the outer region.

Figure 3-7 linear scale area

5. Sector scale area

The outer region serves as the reference region, which is formed by the intersection of the arc and the outer region.
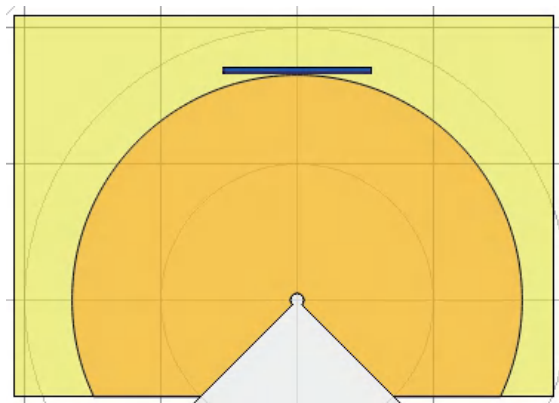
Figure 3-8 sector scale area

6. Full scale area

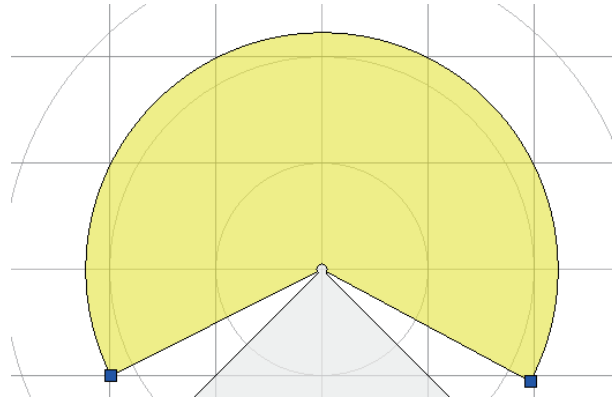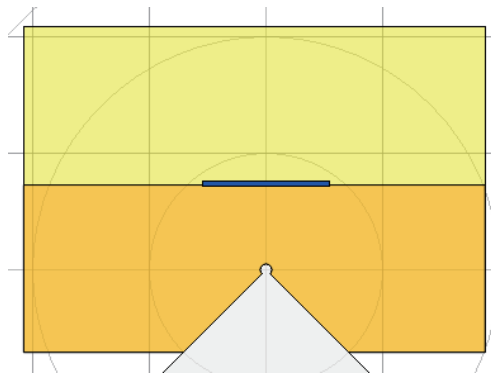The outer region serves as the reference region, and the arc is generated in proportion to the inner region.
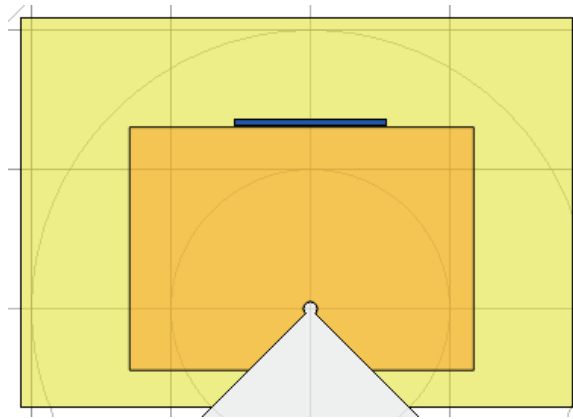
Figure 3-9 full scale area

When defining an area, pay attention to the following:

● The points defining polygon, rectangle and arc must be within - 5 ~ 5m (radar range).

● All regions are undefined between - 90 ° and - 45 °.

● The scale area is within the upper level area.

3.3.2 regional groups

A region group consists of three regions: region 1 (red), region 2 (Or ange), and region 3 (y ellow). The areas within the group can be independent or related to each other, and users can set them according to their needs. As shown in the figure:
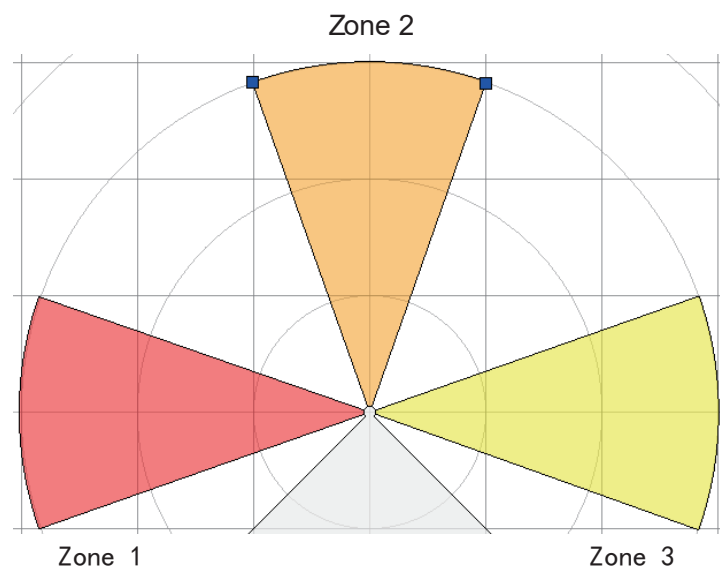
Figure 3-10 area groups - separate areas
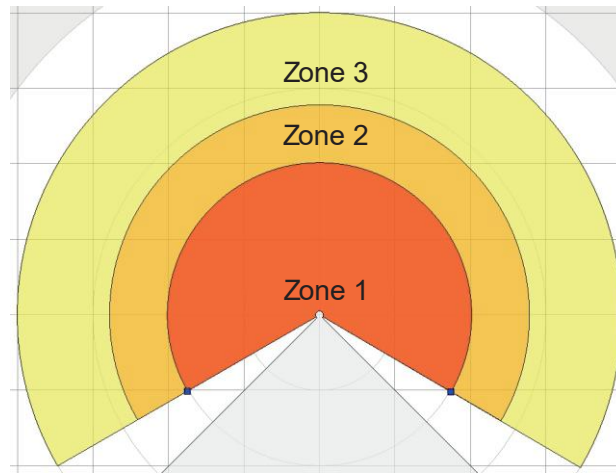
Figure 3-11 area groups - associated areas

When an object intrudes into an area, its corresponding LED light will be lit, and its corresponding output signal will also become high level.

3.4 Area selection

Aries supports 16 area groups. The user selects the current working area group through the combination of input signals to switch the area group .

The relationship between area group and input signal is shown in the following table:

Regional group number	Input4	Input3	Input2	Input1
Regional Group 1	0	0	0	0
Regional Group 2	0	0	0	1
Regional Group 3	0	0	1	0
Regional Group 4	0	0	1	1
Regional Group 5	0	1	0	0
Regional Group 6	0	1	0	1
Regional Group 7	0	1	1	0
Regional Group 8	0	1	1	1
Regional Group 9	1	0	0	0
Regional Group 10	1	0	0	1
Regional Group 11	1	0	1	0
Regional Group 12	1	0	1	1
Regional Group 13	1	1	0	0
Regional Group 14	1	1	0	1
Regional Group 15	1	1	1	0
Regional Group 16	1	1	1	1

Note:

1. The input signal is floating enabled, and the value is "1".

2. Input grounding is not enabled, the value is "0".

3.5 Intrusion alarm

When Obstacle avoidance detects that an object has invaded the work area, it will alarm through the output signal and LED [1-3] light. The relationship is shown in the table:

Intrusion detection			Signal output			Indicator light		
Zone 1	Zone 2	Zone 3	Output1	Output2	Output3	Led1	Led2	Led3
0	0	0	0	0	0	OFF	OFF	OFF
1	0	0	1	0	0	ON	OFF	OFF
0	1	0	0	1	0	OFF	ON	OFF
1	1	0	1	1	0	ON	ON	OFF
0	0	1	0	0	1	OFF	OFF	ON
1	0	1	1	0	1	ON	OFF	ON
0	1	1	0	1	1	OFF	ON	ON
1	1	1	1	1	1	ON	ON	ON

Note:

1. The area is "1", indicating that there is an object intrusion in this area; "0", indicating that there is no intrusion.

2. Ouyput is "1", indicating that the output signal indicates that there is an object intrusion; "0", indicating that ther e is no intrusion.

3. "ON" indicates that the LED is on, and "OFF" indicates that the LED is off.

3.6 Self-learning

The user can set the work area through the Obstacle avoidance Designer software. However, for some actual work scenarios, the user needs to measure accurately to draw the area.

Obstacle avoidance radar provides self-learning function. When the user presses the "self-learning" button for 3 seconds, Aries enters self-learning mode. It will automatically scan the surrounding en vironment, and the outline of the scanned en vironment is the boundary of the area.

4. Working parameters

4.1 Variable parameters

4.1.1 Motor speed

There are two values to control the motor speed of the laser transmitter: 15Hz and 30Hz.
When the speed changes, the angular resolution of the machine also changes.
The specific values are:
15Hz: angular resolution 0.1 °
30Hz: angular resolution 0.3 °

4.1.2 Shield size

If the intruding object is smaller than this size, Obstacle avoidance will not alarm.
Value range: 10mm ~ 1,000mm, default value: 10mm.

4.1.3 Response time

When the radar detects an intrusive object, how long after it alarms. According to different angular resolutions
(ie different speeds), the response time ranges are different.
At 15Hz: Value range: 67ms ~ 29,949ms (≈30s), the def ault value is 134ms (the motor rotates twice)
At 30Hz: Value range: 33ms ~ 29,997ms (≈30s), the def ault value is 66ms (the motor rotates twice).

4.1.4 Holding time

When the intruder leaves the protected area, the time that the output signal remains in the alarm state.
Value range: 10ms ~ 10,000ms (10s), the def ault value is 330ms.

4.2 Device parameters

Only the parameters related to the distance calculation are listed here. For other parameters,
please refer to the appendix.

4.2.1 Angular resolution

The angle difference between two adjacent laser pulses, the angular resolution is 0.1 ° at a
motor speed of 15 Hz, and the angular resolution is 0.3 ° at a motor speed of 30 Hz.

4.2.2 Scanning angle range

The minimum angle and maximum angle range of the laser pulse.

At 15Hz: The angle range is -45 ° to 224 .9 °.

At 30Hz: The angle range is -45 ° to 224 .7 °.

4.2.3 Communication rate

Obstacle avoidance and the host computer use USB to serial communication, the baud rate is 2941176bps.

4.2.4 Number of power-on

Obstacle avoidance The total number of power -on times.

4.2.5 The working time

How long has Obstacle avoidance worked since this power-up.

4.2.6 Total working hours

Obstacle avoidance has been working since the first power -on.

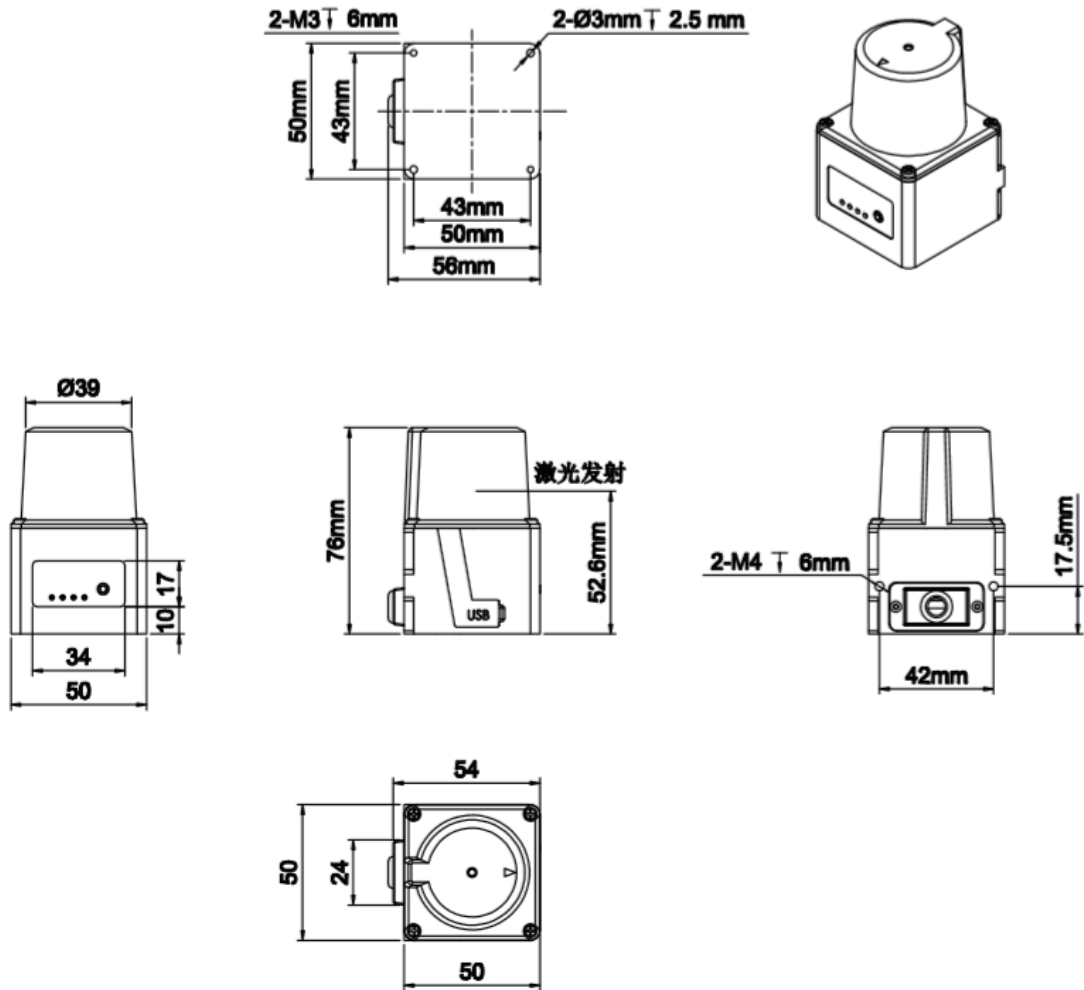# 5. Equipment installation

5.1 Mechanical dimensions

Figure 5-1 Obstacle avoidance mechanical dimensions

5.2 Mechanical installation

There are mounting screw holes on the bottom and sides of Obstacle avoidance, users can use standard screws to fix the r adar. As shown:

Figure 5-2 Obstacle avoidance basic installation

5.3 Optical interference

Obstacle avoidance uses laser pulses to detect surrounding objects. If there is interference light source in the working range, its detection ability will be affected, and even lead to false alarm.

If the user cannot remove the disturbing light source in the working environment, please place the light source at least within ± 3 ° of the radar .

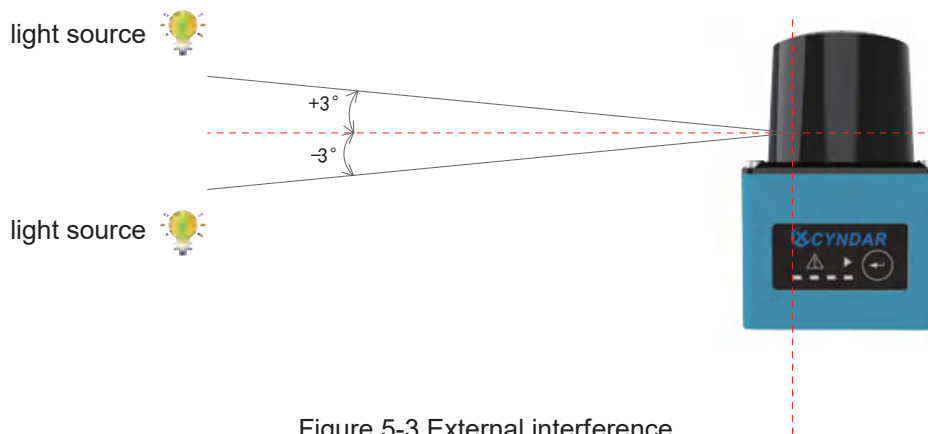Figure 5-3 External interference

5.4 Mutual interference

If two or more Aries lidars work together , they will cause interf erence with each other. The figure below provides installation methods to avoid such interference.

1. Vertical installation

By changing the installation height of the radar, the radar laser scanning planes are at different heights, so as to avoid mutual interference.
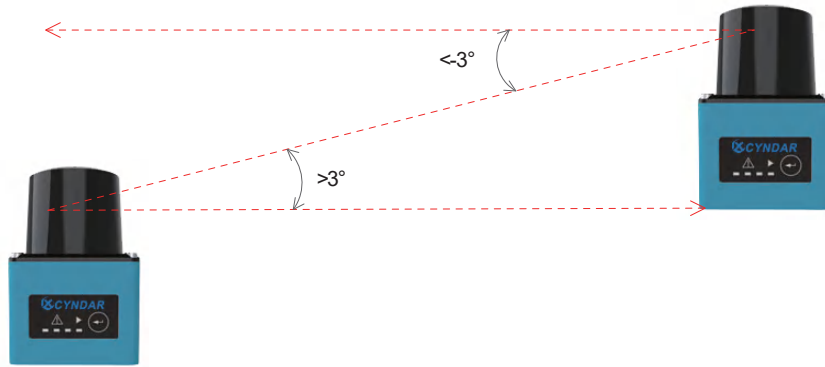
Figur e 5-4 Vertical installation

2. Parallel installation

Tilt the radar slightly during installation to avoid mutual interf erence.
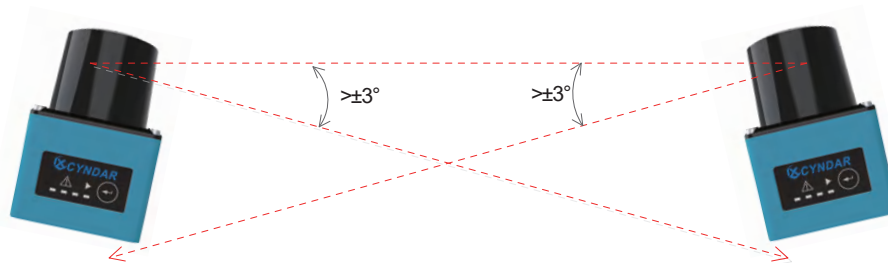
Figure 5-5 Parallel installation

3. Isolated installation

Adding obstructions between radars will prevent laser pulses from being received by other radars, thus avoiding interf erence.
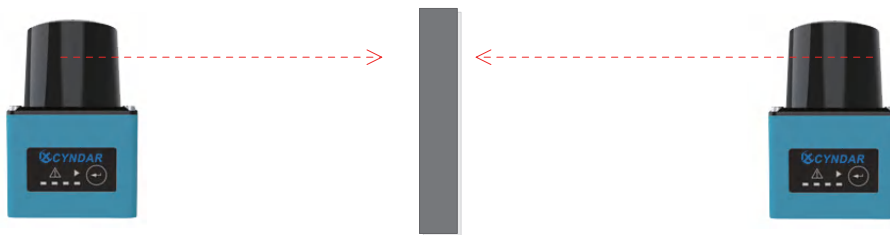
Figur e 5-6 Isolated installation

5.5 Electrical connection

5.5.1 Connecting cables

Obstacle avoidance provides two electrical connection methods: 15-Pin D-Sub and 1.25mm 12-Pin.

The cable has a diameter of 6mm and a length of 2m.

The meaning of the circuit is shown in the figure:

1	DC 9~28V
2	N.C.
3	N.C.
4	OUT4/ERROR OUT
5	GND
6	OUTPUT_COM-
7	INPUT5/STANDBY
8	INPUT1
9	INPUT2
10	INPUT3
11	INPUT4
12	OUTPUT1
13	OUTPUT2
14	OUTPUT3
15	N.C.

Figure 5-7 15 pin D-sub interface

1.25mm 12-Pin

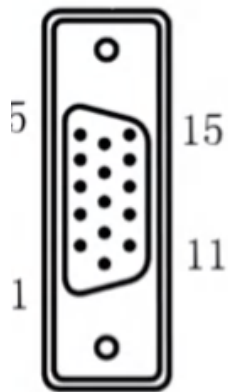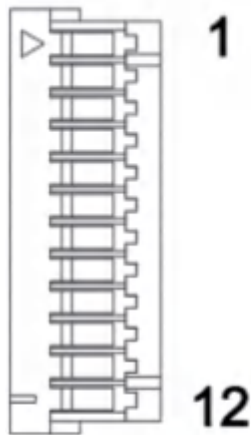|		
1	INPUT5/STANDBY	BROWN AND WHITE
2	SHIELD	YELLOW AND WHITE
3	OUTPUT_COM-	PINK
4	OUTPUT1	PURPLE
5	OUTPUT2	GRAY
6	OUTPUT3	LIGHT GREEN
7	OUTPUT4	YELLOW
8	N.C.	BROWN
9	INPUT4	ORANGE
10	INPUT3	BLUE
11	INPUT2	WHITE
12	INPUT1	GREEN

Naked wire

VCC	RED
VCC	RED AND WHITE
GND	BLACK
GND	BLUE AND WHITE

Figure 5-8 1.25mm 12 pin interface

The cable is 6mm in diameter and 2m in length.

The meanings of each interface are as follows:

| Interface name	function	explain
VCC	Power Supply	DC 9 ~ 28 V
GND	Power Supply	Grounding
INPUT1	input	Area selection input bit 1
INPUT2	input	Area selection input bit 2
INPUT3	input	Region selection input bit 3
INPUT4	input	Area selection input bit 4
INPUT5/STANDBY	input	Put the device in standby mode
OUTPUT1	output	When an obstacle is detected in zone 1, this pin and output_ Com short circuit
OUTPUT2	output	When an obstacle is detected in zone 2, this pin and output_ Com short circuit
OUTPUT3	output	When an obstacle is detected in zone 3, this pin and output_ Com short circuit
OUT4/ERROR_OUT	Output / error indication	When a functional failure occurs inside the product, the pin and output_ Com short circuit
SHIELD	shield	Short circuit between wire shield and metal shell
OUTPUT_COM-	Output common negative	Output common negative

5.5.2 input circuit
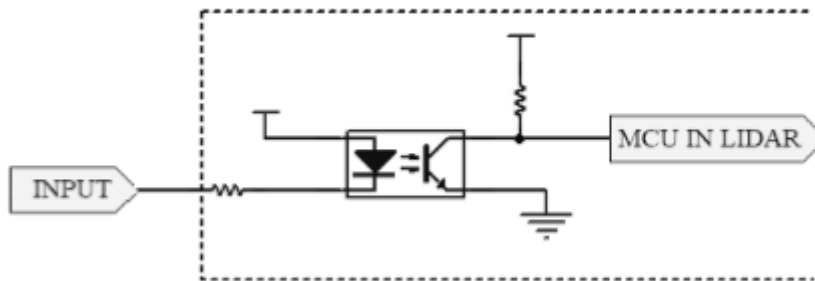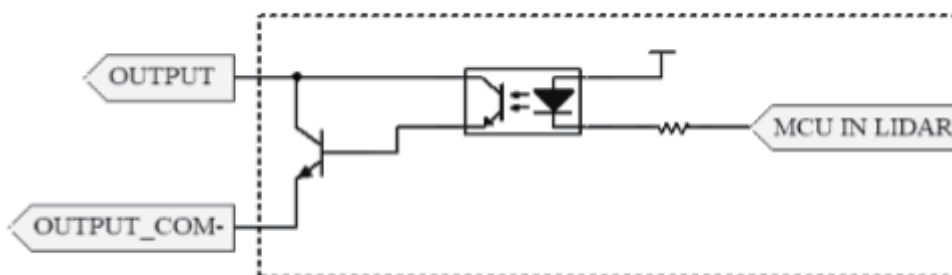

Figure 5-9 input circuit

5.5.3 output circuit

Figure 5-10 output circuit

5.6 Indicator Status

When Obstacle avoidance is in different working modes, 4 LED indicators have different meanings, as shown in the table below:

Led	monitor model	Edit mode	Self learning mode	Standby mode
Led4	Abnormal indicator: normally on, once in 1s	Abnormal indicator: normally on, once in 1s	Abnormal indicator: normally on, once in 1s	Flash once in 1s
Led3	Zone 3 intrusion flag, same as out 3(yellow zone)	Always on	Always off	Always on
Led2	Zone 2 intrusion flag, same as out 2 (orange zone)	Always on	Always off	Always on
Led1	Zone 1 intrusion sign, same as Out1 (red zone)	Always on	Enter the self-learning state: Press the button and the LED flashes once every 1 second; Fast flash: Enter fast flash (once in 0.25s, the hand is not released, the hand can be released) means that it can enter the self-learning state (releasing the hand to enter self-learning); Self-learning stage: 60 seconds (60 * 15 circles) always on; End of self-learning: Fast flashing (once every 0.25s) indicates the completion of self-learning and the stage of storing self-learning data.	Always on

6. Typical cases

This chapter will list several typical application cases of Obstacle avoidance, and users can use it as a reference to modify it according to their own applications. Before officially designating a plan, the following issues should generally be considered

1. What is the purpose of the plan.
2. Where is the suitable installation location of the radar.
3. What are the regional settings and how many regional groups are needed?
4. How to switch the regional group during the system operation.
5. How to deal with the alarm signal when the radar alarms.

6.1 Access control
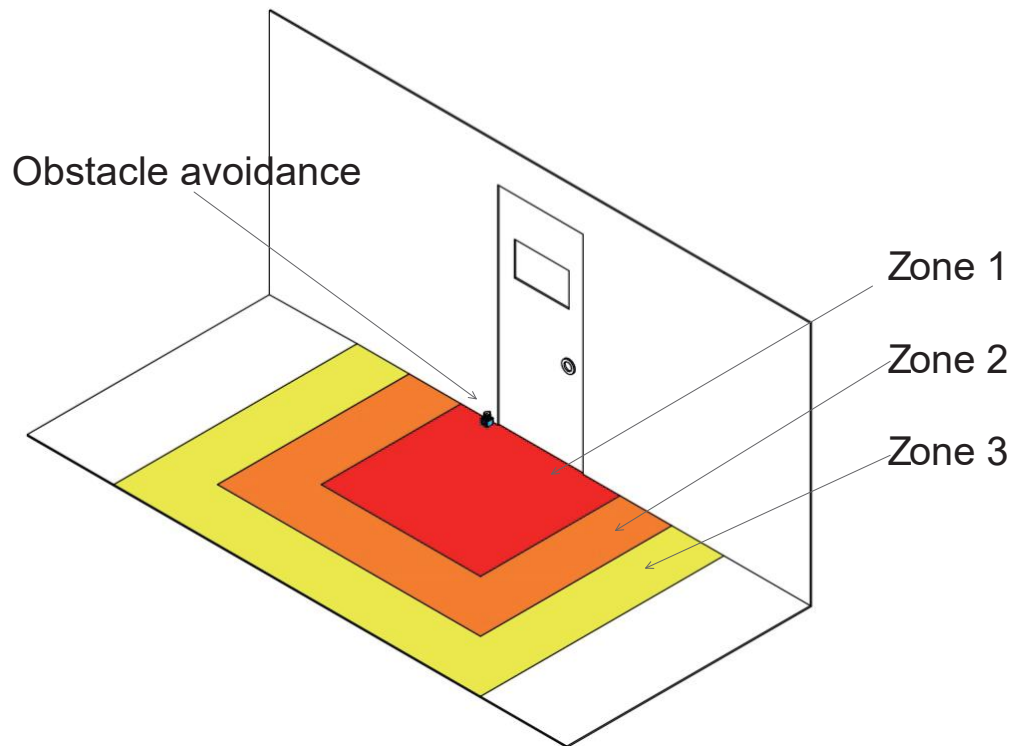
Figure 6-1 Access control

In this case, the protection area of area 3 to area 1 in the work area group is gradually decreasing.

1. When an object or person invades area 3, the system warns the intrusion.

2. When invading area 2, a stronger warning is issued.

3. When intruding into area 1, an alarm sounds and the system administrator is alerted.

According to the different needs of users, the installation position and height of Obstacle avoidance can be adjusted appropriately.

The shape and type of the area can also be changed according to the environment where the access control is located.

6.2 Detection of protrusions

In this case, Obstacle avoidance is installed on the shelf to detect whether there is a cargo intrusion detection plane to prevent the cargo from falling.
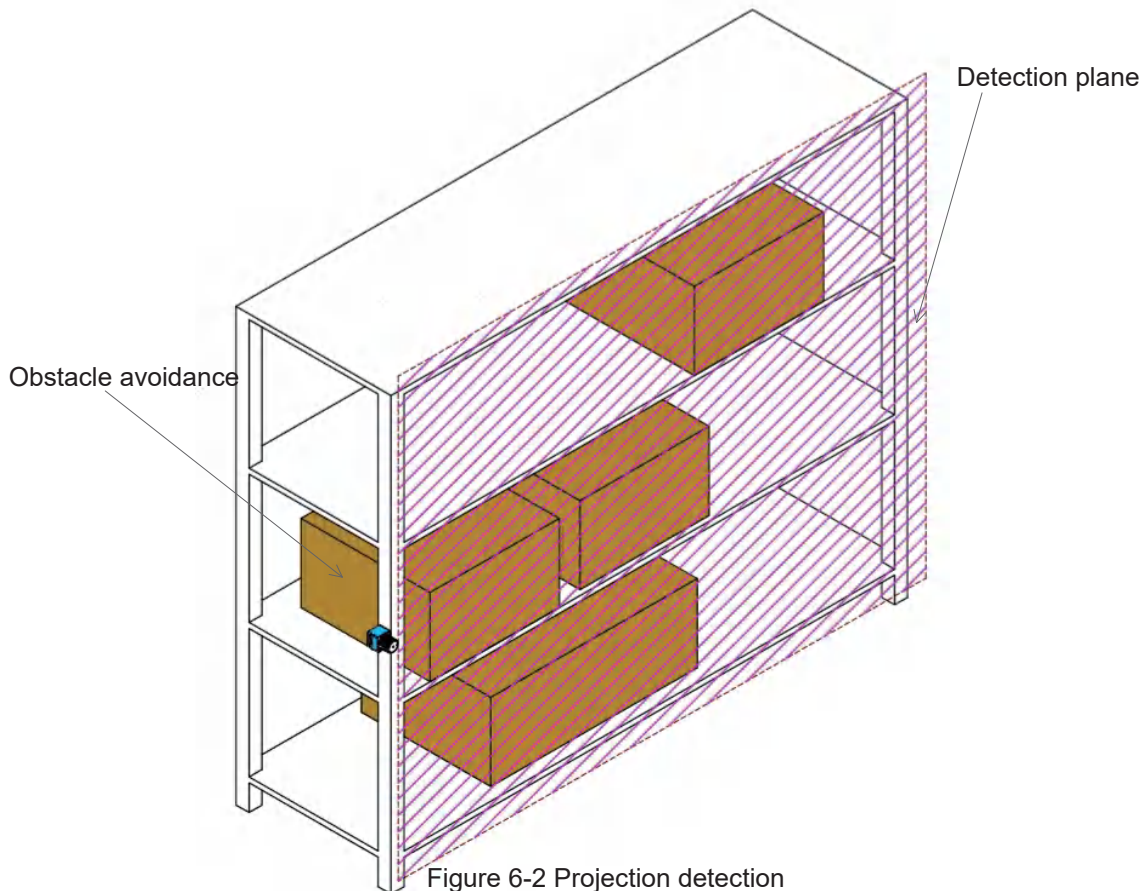

Figure 6-2 Projection detection

Similarly, Obstacle avoidance can also be used to detect protrusions on a horizontal surface. Users can configure it according to their needs.

6.3 Area protection

Area protection has a large-scale application in the protection of mobile systems, one of which is AGV or vehicle obstacle avoidance.

Obstacle avoidance is installed on the AGA trolley. The AGV car follows a fixed route. When an object enters zone 3,the car starts to slow down; when it enters zone 2, it continues to slow down; when it enters zone 3, it stops driving.

On the AGV driving path, due to different environments, the car needs to change the range of its protection area, that is, change the shape of the area. The user can load the pre-set area groups in Obstacle avoidance, and when the trolley travels to a specific node on the path, replace the work area groups to adapt to different environments.
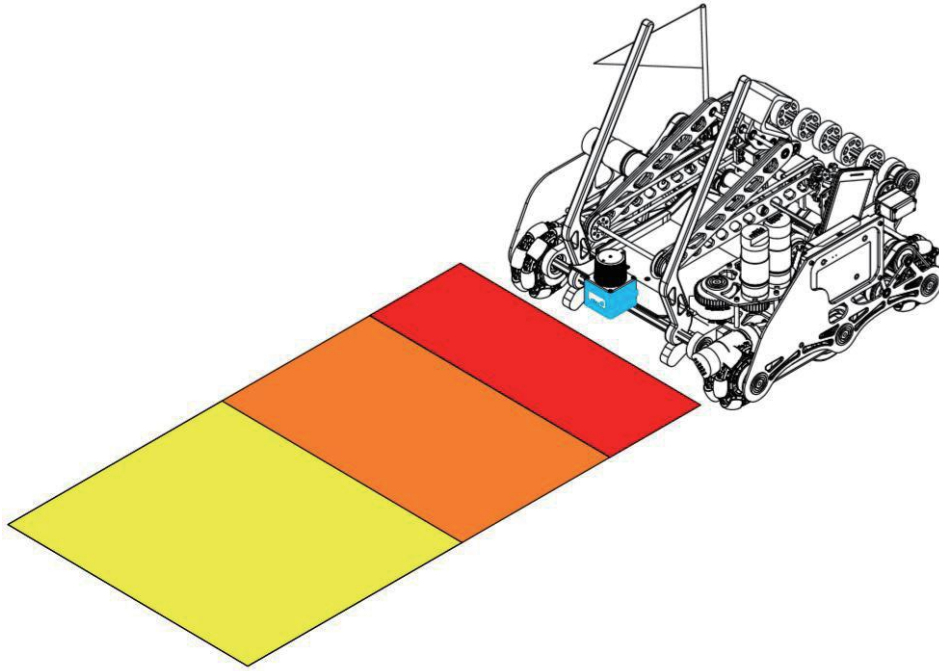
Figure 6-3 Obstacle avoidance trolley

7 Equipment inspection and maintenance

Equipment inspection and maintenance are important for the safe use of equipment.
The user must inspect and maintain the equipment as required.

7.1 Review before use

After the equipment is installed and configured, at least the inspections listed in the following table are required before the equipment can be used.

Numbering	Check item	Whether to pass	Remarks
1	The equipment is correctly installed in the designated location without looseness		
2	All signal cables are properly connected		
3	When the test obstacle enters the defined area, the corresponding signal line is triggered and the corresponding LED light is on		
4	When the test obstacle leaves the designated area, the corresponding signal line fails and the corresponding LED light goes out		
5	When the input signal changes, the corresponding working area also changes		

7.2 Daily inspection

Numbering	Check item	Whether to pass	Remarks
1	The equipment is correctly installed in the designated location without looseness		
2	All signal cables are properly connected		
3	When the test obstacle enters the defined area, the corresponding signal line is triggered and the corresponding LED light is on		
4	When the test obstacle leaves the designated area, the corresponding signal line fails and the corresponding LED light goes out		
5	When the input signal changes, the corresponding working area also changes		
6	The system where the device is located is working normally		

7.3 Occasional inspection

Numbering	Check item	Whether to pass	Remarks
1	The equipment is correctly installed in the designated location without looseness		
2	The device is still in the original installation position and has not moved		
3	The optical cover of the device is free of dust and scratches		
4	The equipment cable is properly connected		
5	When the input signal changes, the corresponding working area also changes		
6	The system where the device is located is working normally		
7	When the test obstacle enters the defined area, the corresponding signal line is triggered and the corresponding LED light is on		
8	When the test obstacle leaves the designated area, the corresponding signal line fails and the corresponding LED light goes out		
9	When the input signal changes, the corresponding working area also changes		
10	The system where the device is located is working normally		

When the optical cover is covered with dust or oil, the detection ability of Obstacle avoidance will be affected, and the user should clean it according to the correct method:

● Wipe with a clean cotton cloth

● Use a soft brush to clean

● Use a hair dryer to blow off the dust

● Use a neutral detergent to remove oil on the surface

8 Product performance parameters

Features	
Laser light source	905 nm (Class I)
Scanning angle range	270°
Scanning frequency	15 Hz/30 Hz
Angle resolution	0.1°/0.3 °
Working area	0.05m ～ 5m
Self-learning function	Automatically scan the environment and generate areas
Mechanical / electronic parameters	
Electrical connections	DB15 Male loose wire
Supply voltage	DC 9 V ～ 28 V
Power consumption	2 W
Switch drive	DC30V 50mA MAX
Shell color	light blue
Protection level	IP65
weight	150g, without cable
Dimensions (LxWxH)	50 mm x 50 mm x 76 mm
Performance	
Recognizable object shape	Almost any shape
Measurement error	± 30 mm
Number of regional groups	16 regional groups, each regional group contains 3 regions
Interface	
USB	Micro - USB
Digital input	GND/NC * 4
Switch output	NPN * 3, equipment work instructions * 1
Signal output hold time	10 ms ~ 10,000 ms (adjustable) 330ms t ypical
Response time	15Hz: 67 ms ~ 29,949 ms (adjustable) 134ms t ypical 30Hz: 33 ms ~ 29,997 ms (adjustable) 66ms t ypical
Status Indicator	Power indicator * 1, status indicator * 4
Environmental parameters	
Anti-vibration	10-55Hz, amplitude 0.75mm, XYZ triaxial, 2 hours per axis; 50-200Hz, 196m / s² (20G), scanning speed 2min / cycle, XYZ triaxial, 2 hours per axis
Working temperature	−10 °C ～ +55 °C
Storage temperature range	−30 °C ～ +75 °C
Ability to resist ambient light	< 15,000 lux

CYNDAR

Contact us

Website: www.gzcyndar.com
Email: sale1@cyndar.net
Tel:+86-20-83717854

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