LE-50821F/FA

LiDAR sensor

Manual

Thank you for using our products.

This manual explains the usage and safety of the product.

Read this manual carefully and pay attention to safety during use.

Keep this manual in a appropriate place for easy reference at any time.

Guangdong Hinson Technology Co.LTD

Version Declaration

Version	Increase or decrease information
V1.0	Release

Contents

1 SPECIFICATIONS

Basic characteristics	
Detection distance	0.1m~20m（Reflectivity 10%）
	0.1m~50m（Reflectivity 90%）
	0.1m~50m（Reflector）
Detection angle	360°
Start Time	＜18s（30Hz）
Sensor Parameters	
Light Source	Laser diode
Laser Class	1 class（IEC 60825-1:2014,EN 60825-1:2014）（Do not look directly）
Wavelenght	905nm
Pulse time	5ns
Laser scanning frequency	600K
Measurement method	Pulse ranging technology（PRT）
Single point sampling times	1-50 times adjustable
Scanning motor speed	10Hz、15Hz、20Hz、25Hz、30Hz Five kinds of settings
Ambient light limit	Resistant to sunlight （<80000 Lux）
Multiple echo explanation	LE-50821F:Single echo function
	LE-50821FA:Support multi echo function, support first echo, second echo, last echo, maximum energy
Measurement accuracy	
Absolute accuracy	±20mm
Measurement accuracy	±10mm
Angle resolution	minimum0.018°.Determined by laser scanning frequency, scanning motor speed, and single point sampling times
Repeat accuracy	＜10mm
Measurement resolution	1mm
Electrical Specification	
Working Voltage	18V~60V
Working Current（DC 24V）	＜300mA
Rated power	About 6W
Start time	＜30s
Interface	
Interface	6 NPN inputs. 4 NPN outputs, through 6 NPN input ports to switch channels (channels 0-63).and 4 NPN output ports to output red. orange.and yellow areas and their fault signals
	RS485-Modbus Output switch value obstacle avoidance data
	CAN Open Output switch value obstacle avoidance data
	Ethernet TCP/UDP output 360° raw measurement data
Display	

Power Indicator	Green
Fault status indicator	Red
Output status indicator	Red,Yellow,Orange
Window indicator	24*252 Pixel. Red
Environmental conditions	
Ambient temperature	-10℃-50℃,Indoor
Use environment humidity	＜80%RH
Storage environment temperature	Storage temperature（-20℃-70℃）
Mechanical specifications	
Protection level	IP65
Connection port	M12-4 female cable, Ethernet port
	M12-6 female cable, power supply and communication port
	M12-12 female cable, IO port
Material	Base, aluminum alloy
	Scan window, PUMA

2 PREPARATION

2.1 Configuration list confirmation form

Please confirm whether the product name and product model on the outer label of the product box are consistent with the one you purchased.
Please confirm the product name and model number through the external label of the product.
Please confirm whether the following items are complete after unpacking, if not, please contact the supplier.

Configuration list confirmation form

Name	Model	Quantity	Description
2D Navigation LiDAR	LE-50821	1	Sensor
Cable	HCX4L20BE	1（must buy）	2m M12-4 female cable,Ethernet output port
Cable	HCX6L20BX	1（must buy）	2m M12-6 female cable,power port, RS485 port, CAN port
Cable	HCX12L20BX	1（buy on demand）	2m M12-12 female cable,IO port
Cable	HCX12L01A-HCX8L01B-HCX4L01B	1（buy on demand）	0.5m M12-4, M12-6 female to M12 connector

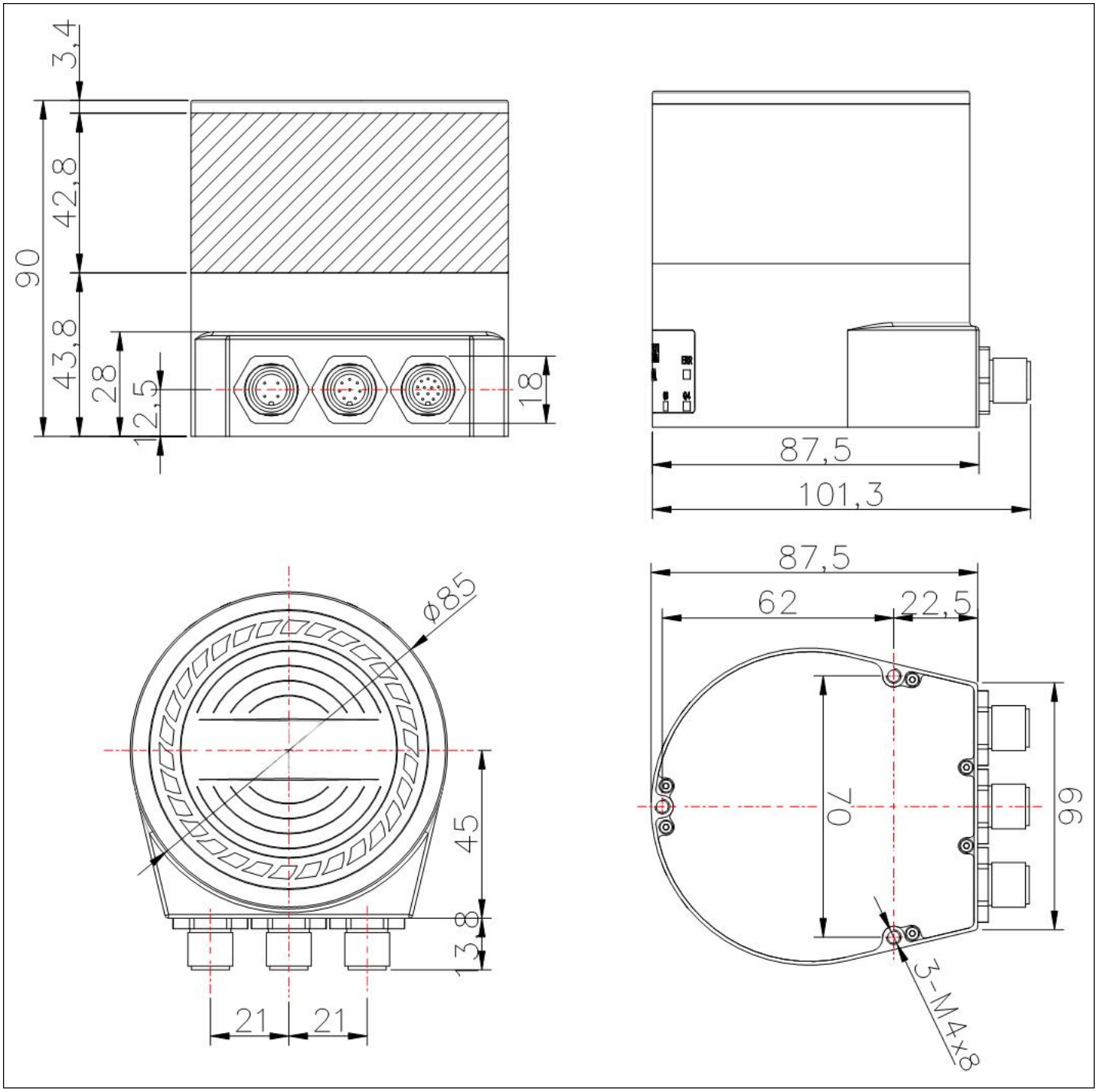
2.2 Configration tool

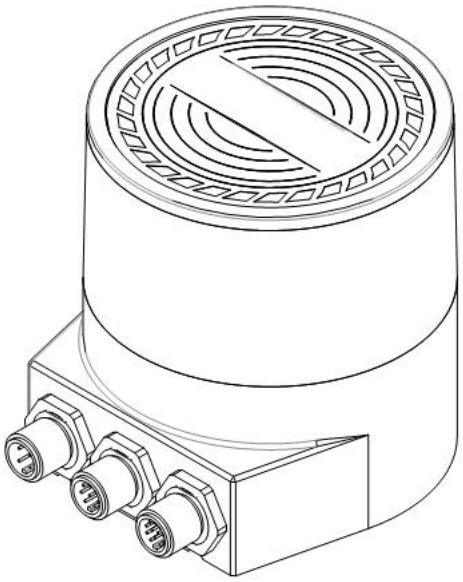
The following software and hardware are needed for auxiliary configuration.

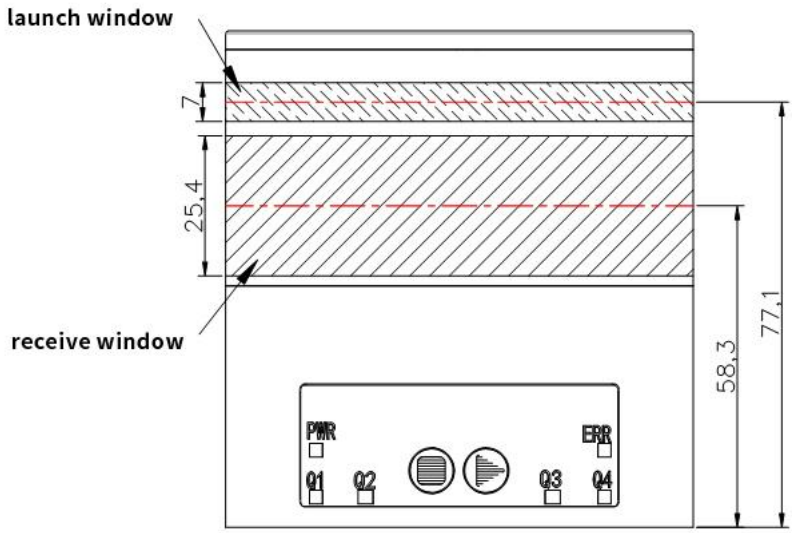
Software tools	Software Hinson Navigation Radar Editor 1.0.0 and above
Power	DC 24V
Tool	PC computer is equipped with RJ45 interface

3 PHYSICAL PARAMETERS

3.1 Product siza

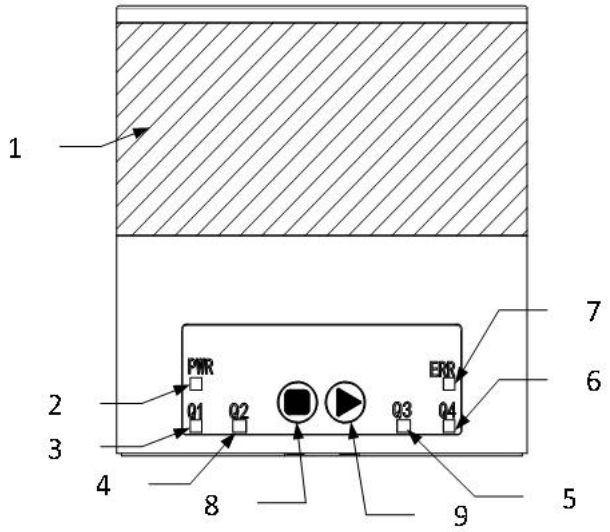




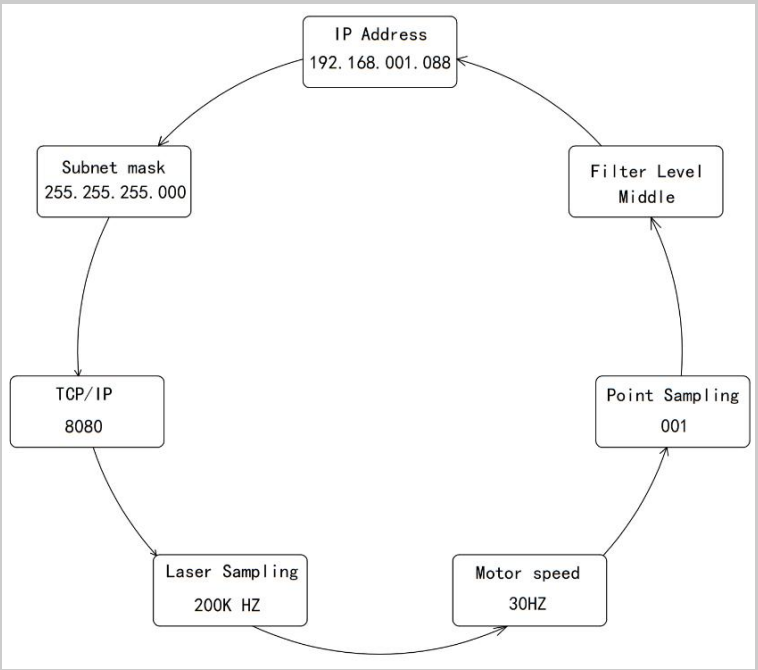


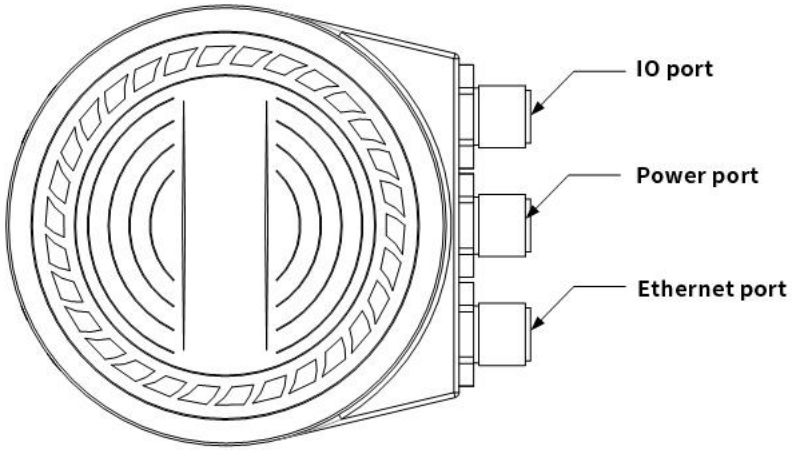
Unit：mm

3.2 Front view and key display

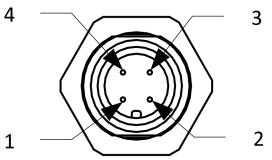


NO.	Symbol	Function Description	Remarks
1	-	Sensor detection window	Be sure to keep the sensor detection window clean
2	PWR	Power Indicator	Orange during normal power supply
3	Q1	Protection zone operation status indicator	There are obstacles intruding into the protection zone indicator light is red
4	Q2	Warning zone 2 operation status indicator	Obstacle intrusion warning zone 2 indicator is orange
5	Q3	Warning zone 1 operation status indicator	Obstacle intrusion warning zone 1 indicator is yellow

<table>
<tr><td>6</td><td>Q4</td><td>Not defined</td><td>Invalid</td></tr>
<tr><td>7</td><td>ERR</td><td>Fault status indicator</td><td>The indicator light is orange when the sensor is faulty</td></tr>
<tr><td>8</td><td>  </td><td>Window display content switching</td><td>Press this button to switch the display between "scanning range display" and "customized Chinese and English display"
 
</td></tr>
<tr><td>9</td><td>  </td><td>Window display content switching</td><td>Press this button to cycle through the display
 
</td></tr>
<tr><td></td><td></td><td></td><td>
<table>
<tr><td>IP Address</td><td>IP address</td></tr>
<tr><td>Subnet mask</td><td>Subnet mask</td></tr>
<tr><td>TCP/IP</td><td>Port number</td></tr>
<tr><td>Laser Sampling</td><td>Laser scanning frequency</td></tr>
<tr><td>Motor speed</td><td>Scanning motor speed</td></tr>
<tr><td>Point Sampling</td><td>Single point sampling times</td></tr>
<tr><td>Filter Level</td><td>Noise filtering level</td></tr>
</table>
</td></tr>
</table>



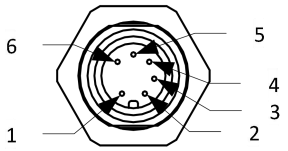
Ethernet port:



NO.	Symbol	Function Description
Pin1	Tx+	Ethernet TX+
Pin3	Tx-	Ethernet TX-
Pin2	Rx+	Ethernet RX+
Pin4	Rx-	Ethernet RX-

Cable model	NO.	Color	Symbol	Function Description	RJ45
HCX4L20BE	Pin1	White&Red	Tx+	Ethernet TX+	1
	Pin3	Red	Tx-	Ethernet TX-	2
	Pin2	White&Green	Rx+	Ethernet RX+	3
	Pin4	Green	Rx-	Ethernet RX-	6

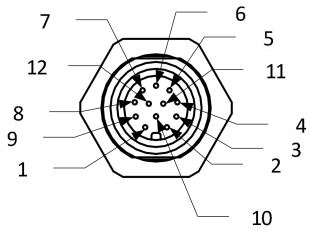
Power and Communication Port:



NO.	Symbol	Function Description
Pin1	Invalid	
Pin2	VCC	Positive power input
Pin3	GND	Negative power input
Pin4	Invalid	
Pin5	Invalid	
Pin6	Invalid	

IO Port:

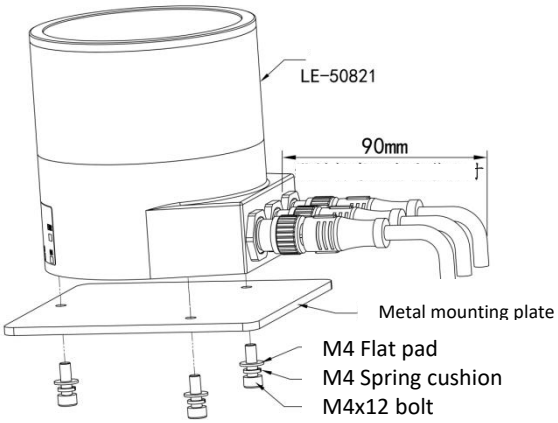
Cable Model	NO.	Color	Symbol	Function Description
HCX6L20BX	Pin1	White	Invalid	
	Pin2	Brown	VCC	Positive power input
	Pin3	Green	GND	Negative power input
	Pin4	Yellow	Invalid	
	Pin5	Gray	Invalid	
	Pin6	Pink	Invalid	



NO.	Symbol	Function Description
Pin1	INCOM	Input common
Pin2	IN1	Input port 1
Pin3	IN2	Input port 2
Pin4	IN3	Input port 3
Pin5	IN4	Input port 4
Pin6	IN5	Input port 5
Pin7	IN6	Input port 6
Pin8	OUTCOM	Output common
Pin9	OUT1	Warning: Port acts when zone 2 senses an object
Pin10	OUT2	Warning: Port acts when zone 1 senses an object
Pin11	OUT3	Port acts when protected zone senses an object
Pin12	Error OUT	Port acts when sensor fails

Cable Model	NO.	Color	Symbol	Function Description
HCX12L20BX	Pin1	White	INCOM	Input common
	Pin2	Brown	IN1	Input port 1
	Pin3	Green	IN2	Input port 2
	Pin4	Yellow	IN3	Input port 3
	Pin5	Gray	IN4	Input port 4
	Pin6	Pink	IN5	Input port 5
	Pin7	Blue	IN6	Input port 6
	Pin8	Red	OUTCOM	Output common
	Pin9	Orange	OUT1	Warning: Port acts when zone 2 senses an object
	Pin10	Purple	OUT2	Warning: Port acts when zone 1 senses an object
	Pin11	Black	OUT3	Port acts when protected zone senses an object
	Pin12	Light purple	Error OUT	Port acts when sensor fails

3.3 Installation requirements



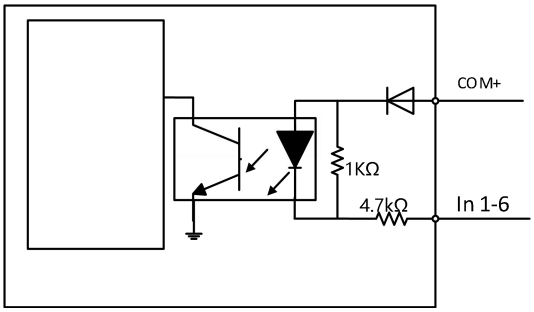
Remark:1) Bolt length can be adjusted
2) The metal mounting plate is to dissipate heat for the sensor

3.4 Input and Output signal wiring

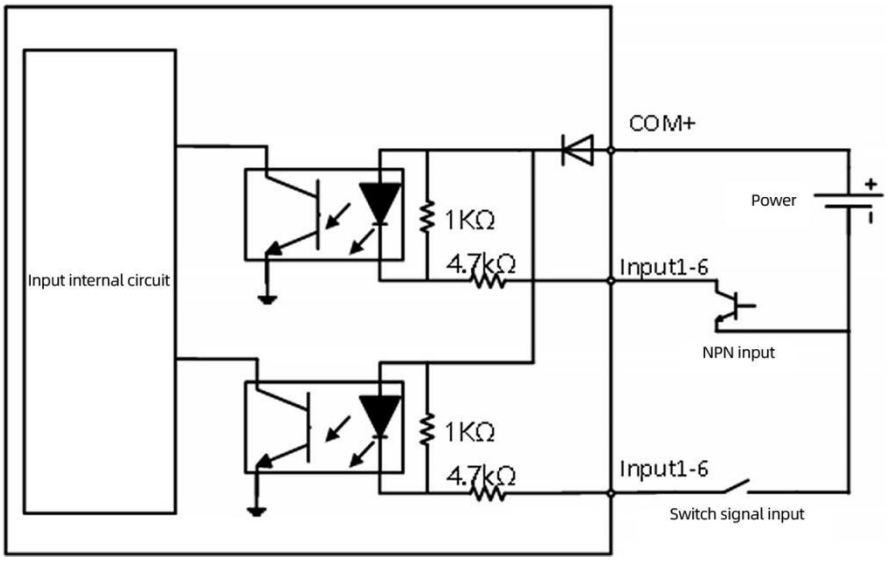
3.4.1 Input signal wiring

The input is an open collector (NPN) signal, using optocoupler isolation input.

Use external power supply: C0M+ input DC24V±20%, more than 100mA;



The sensor has 64 channels, and the input signal combination is switched to the specified channel number through 6 IO ports. The detection range of the channel needs to be set in advance through the configuration software. The external device selects and switches the area through the input signal.

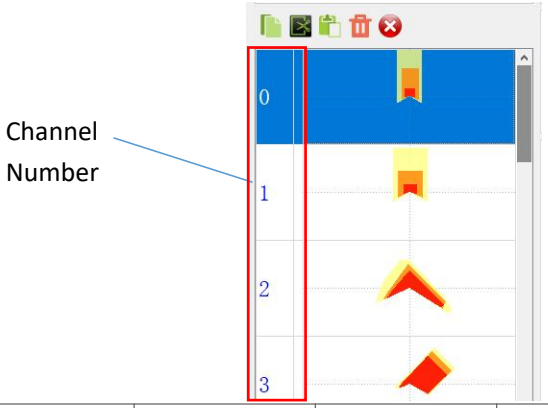


3.4.2 Signal combination

The sensor provides 6 input port combination signals.

ON: input has signal;

0FF: input has no signal or is open circuit;



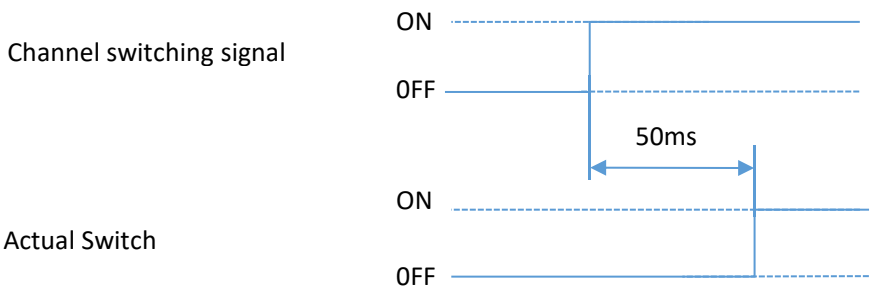
Channel Number	In6	In5	In4	In3	In2	In1
63	OFF	OFF	OFF	OFF	OFF	OFF
62	OFF	OFF	OFF	OFF	OFF	**ON**
61	OFF	OFF	OFF	OFF	**ON**	OFF
60	OFF	OFF	OFF	OFF	**ON**	**ON**
59	OFF	OFF	OFF	**ON**	OFF	OFF
58	OFF	OFF	OFF	**ON**	OFF	**ON**
57	OFF	OFF	OFF	**ON**	**ON**	OFF
56	OFF	OFF	OFF	**ON**	**ON**	**ON**
55	OFF	OFF	**ON**	OFF	OFF	OFF
54	OFF	OFF	**ON**	OFF	OFF	**ON**
53	OFF	OFF	**ON**	OFF	**ON**	OFF
52	OFF	OFF	**ON**	OFF	**ON**	**ON**
51	OFF	OFF	**ON**	**ON**	OFF	OFF
50	OFF	OFF	**ON**	**ON**	OFF	**ON**
49	OFF	OFF	**ON**	**ON**	**ON**	OFF
48	OFF	OFF	**ON**	**ON**	**ON**	**ON**
47	OFF	**ON**	OFF	OFF	OFF	OFF
46	OFF	**ON**	OFF	OFF	OFF	**ON**
45	OFF	**ON**	OFF	OFF	**ON**	OFF
44	OFF	**ON**	OFF	OFF	**ON**	**ON**
43	OFF	**ON**	OFF	**ON**	OFF	OFF
42	OFF	**ON**	OFF	**ON**	OFF	**ON**
41	OFF	**ON**	OFF	**ON**	**ON**	OFF
40	OFF	**ON**	OFF	**ON**	**ON**	**ON**
39	OFF	**ON**	**ON**	OFF	OFF	OFF
38	OFF	**ON**	**ON**	OFF	OFF	**ON**
37	OFF	**ON**	**ON**	OFF	**ON**	OFF
36	OFF	**ON**	**ON**	OFF	**ON**	**ON**

Channel Number	In6	In5	In4	In3	In2	In1
35	OFF	**ON**	**ON**	**ON**	OFF	OFF
34	OFF	**ON**	**ON**	**ON**	OFF	**ON**
33	OFF	**ON**	**ON**	**ON**	**ON**	OFF
32	OFF	**ON**	**ON**	**ON**	**ON**	**ON**
31	**ON**	OFF	OFF	OFF	OFF	OFF
30	**ON**	OFF	OFF	OFF	OFF	**ON**
29	**ON**	OFF	OFF	OFF	**ON**	OFF
28	**ON**	OFF	OFF	OFF	**ON**	**ON**
27	**ON**	OFF	OFF	**ON**	OFF	OFF
26	**ON**	OFF	OFF	**ON**	OFF	**ON**
25	**ON**	OFF	OFF	**ON**	**ON**	OFF
24	**ON**	OFF	OFF	**ON**	**ON**	**ON**
23	**ON**	OFF	**ON**	OFF	OFF	OFF
22	**ON**	OFF	**ON**	OFF	OFF	**ON**
21	**ON**	OFF	**ON**	OFF	**ON**	OFF
20	**ON**	OFF	**ON**	OFF	**ON**	**ON**
19	**ON**	OFF	**ON**	**ON**	OFF	OFF
18	**ON**	OFF	**ON**	**ON**	OFF	**ON**
17	**ON**	OFF	**ON**	**ON**	**ON**	OFF
16	**ON**	OFF	**ON**	**ON**	**ON**	**ON**
15	**ON**	**ON**	OFF	OFF	OFF	OFF
14	**ON**	**ON**	OFF	OFF	OFF	**ON**
13	**ON**	**ON**	OFF	OFF	**ON**	OFF
12	**ON**	**ON**	OFF	OFF	**ON**	**ON**
11	**ON**	**ON**	OFF	**ON**	OFF	OFF
10	**ON**	**ON**	OFF	**ON**	OFF	**ON**
9	**ON**	**ON**	OFF	**ON**	**ON**	OFF
8	**ON**	**ON**	OFF	**ON**	**ON**	**ON**
7	**ON**	**ON**	**ON**	OFF	OFF	OFF
6	**ON**	**ON**	**ON**	OFF	OFF	**ON**
5	**ON**	**ON**	**ON**	OFF	**ON**	OFF
4	**ON**	**ON**	**ON**	OFF	**ON**	**ON**
3	**ON**	**ON**	**ON**	**ON**	OFF	OFF
2	**ON**	**ON**	**ON**	**ON**	OFF	**ON**
1	**ON**	**ON**	**ON**	**ON**	**ON**	OFF
0	**ON**	**ON**	**ON**	**ON**	**ON**	**ON**

NOTE **If all 64 channels are not needed, the input signal can be determined based on the number of channels required;**

Switching time

After the sensor receives the channel switching signal, there is a switching delay due to the influence of the scanning cycle. The switching delay is shown in the figure below.



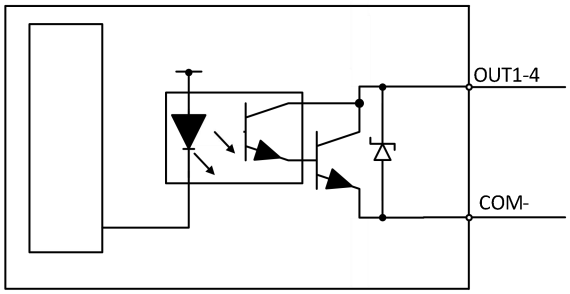
NOTE **When switching to a channel without graphics, the sensor will maintain the previous monitoring of the graphics channel status. If the graphics channel is empty, the sensor will not detect**

3.4.3 Output signal wiring

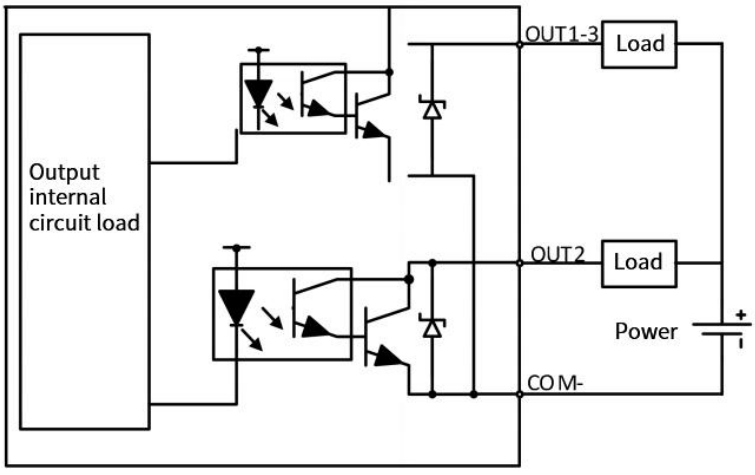
Output signal usage function

Port	Function	Output logic
OUT1	Used for far-end obstacle warning and deceleration;	Default: Normally closed, can be changed to normally open through configuration software;
OUT2	Used for normal obstacle detection and normal stop;	Default: Normally closed, can be changed to normally open through configuration software;
OUT3	Used for near-end emergency stop;	Default: Normally closed, can be changed to normally open through configuration software;
ERR	Used for sensor fault status output;	Default: Normally open, cannot be changed;

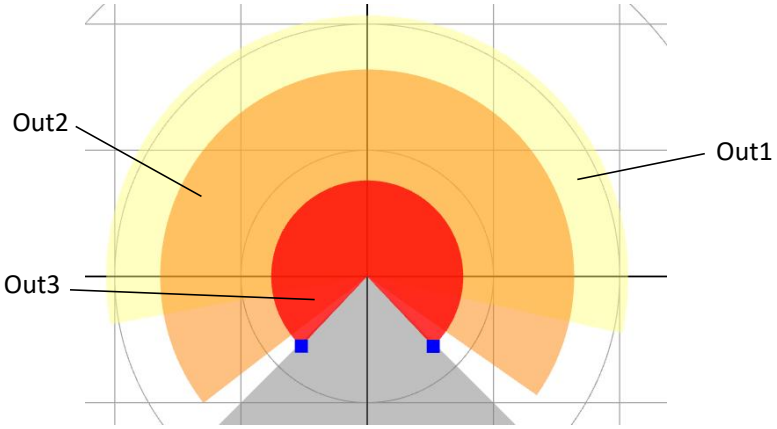
The output is an open collector (NPN) signal, using optocoupler isolation output. When there is a signal, the voltage is 0V-, and the maximum load capacity of the output port is 100mA.



The output ports are all NPN outputs. Please refer to the following figure for the output schematic:



The sensor output ports correspond to the graphics drawn in the configuration software.



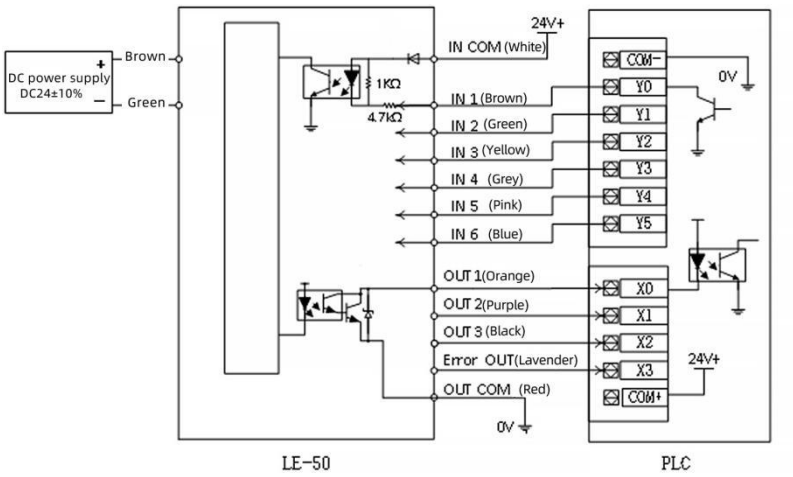
NOTE **There will be detection output only when there is a drawing graphic for the corresponding output**

3.4.4 Connection Example

Based on the wiring when all 64 channels are fully used and all outputs are fully used.

NPN signal wiring

The figure below shows that the host computer outputs and receives signals through NPN transistors.



X0-3 is the signal input port of PLC;

Y0-Y5 is the signal output port of PLC;

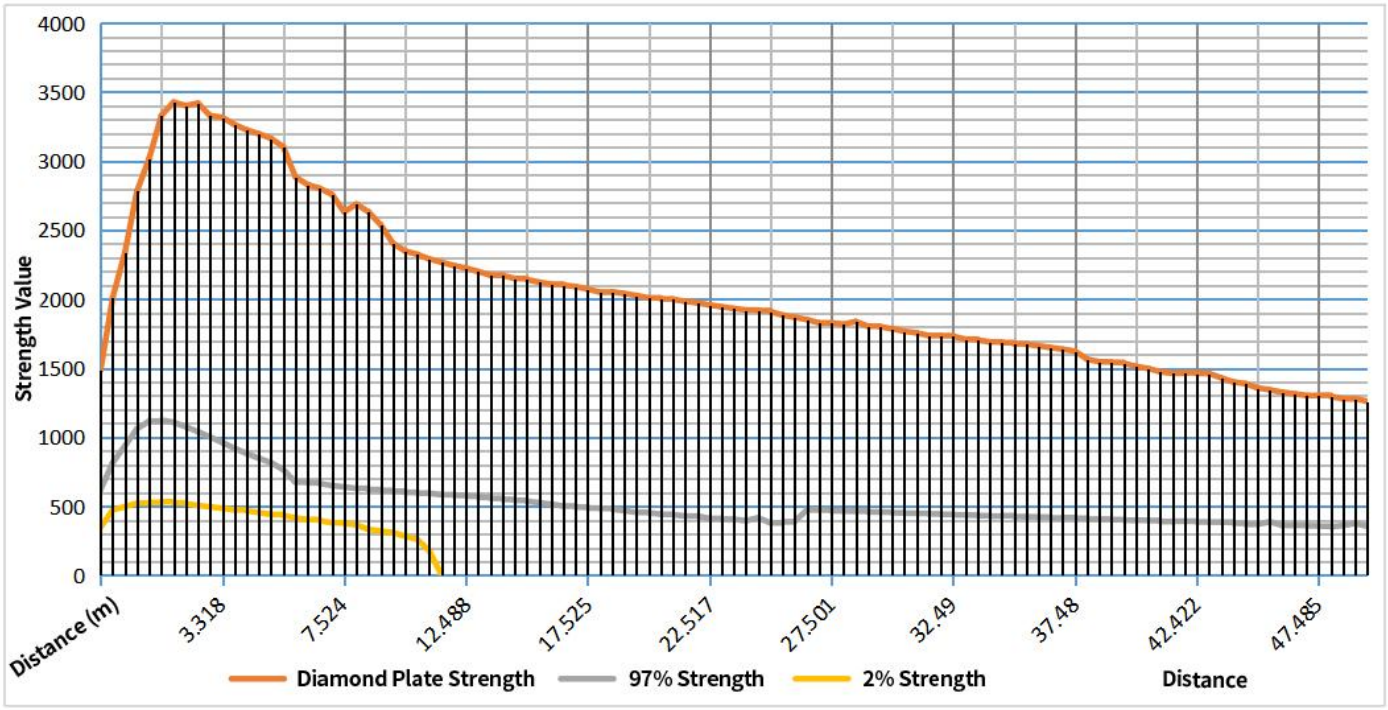
IN1-IN6 input current is greater than 10mA;

Out1-Out4 output current is less than 100mA;

NOTE **The input and output ports cannot be short-circuited or connected to a load exceeding the specified current, otherwise the sensor will be damaged.**

4 STRENGTH AND DISTANCE

The following tables are the correspondence tables of three types of reflectivity intensity and distance



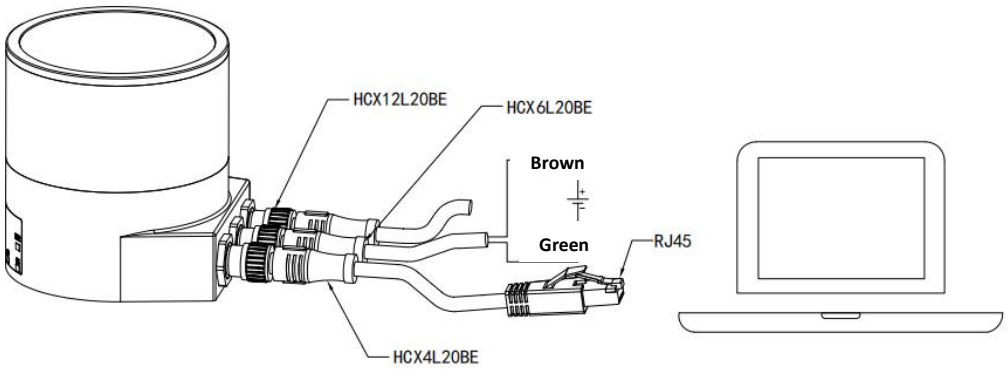
5 FUNCTION CONFIGURATION

5.1 Device preparation

Power and communication port	Brand	Hinson
	Model	HCX6L20BX
Ethernet port cable	Brand	Hinson
	Model	HCX4L20BE
DC power supply	Voltage	DC18V-DC60V
	Current	1A above
PC	System	Windows XP above
	Port	Equipped with RJ45 interface or equipped with USB to RJ45 network cable interface
	Resolution	1280*720 above

5.2 Connection of sensor and configuration software

Connection:



Configure computer： Open "Control Panel"-"Network and Internet"-"Network Connections"-"Ethernet 5"

Right-click "Ethernet 5"-"Internet Protocol Version 4 (TCP/IPv4)"-"Properties"

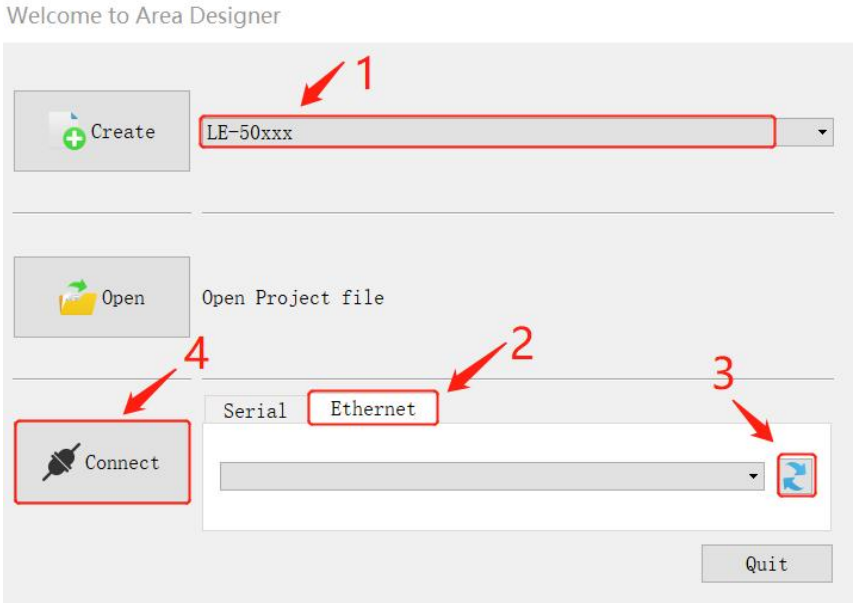
Fill in the computer's IP address 192.168.1.10, subnet mask 255.255.255.0, and click the OK button. It should be noted that the last digit of the computer's IP address 192.168.1.10 ranges from 1-254, and the sensor's IP address defaults to 192.168.1.88. The last digit here must be different from the last digit of the sensor's IP address. Special attention should be paid. The first 3 digits of the computer's IP address and the sensor's IP address must be the same and the last digit mus be different.

Open the configuration software:

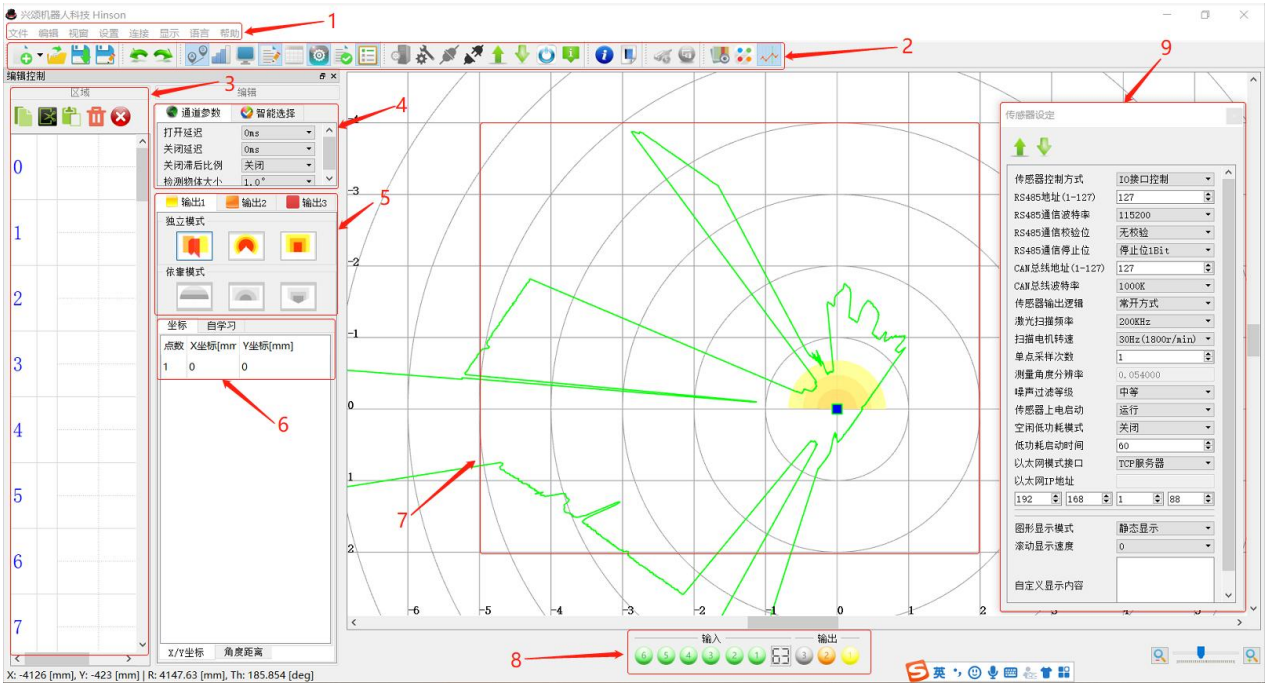
Unzip the Hinson.exe configuration software, double click LE-xxx After

entering the "Device List" interface, click to enter the following interface:

Follow the steps 1, 2, 3, and 4 below to connect the sensor and configuration software.



After the sensor is connected to the configuration software, the following interface will be displayed:



Part 1: Menu

Menu A	Menu B	Menu C	Corresponding icon	Remarks
File	New build	-		New build file
	Open file	-		Open the created file

	Save file	-		Save the edited file
	Save as	-		Save the edited file as
	Exit	-		Exit the current configuration software
Edit	Revoke	-		Undo the previous step
	Redo	-		Resume the previous step
	Copy	-		Copy the detection pattern of a detection channel
	Cut	-		Cut the detection pattern of a detection channel
	Paste	-		Paste the detection pattern to another channel
	Delete	-		Delete the currently selected detection channel graphics
	Delete all	-		Delete all the detection channel graphics
	Setting	-		-
Windows	Windows	Edit		Click the icon to display the edit function box
		Monitor		Click the icon to display the monitoring status
		Sensor setting		Click the icon to display the sensor parameter setting function box
		Input and Output simulation		Click the icon to display the sensor input and output simulation function box
		Self-check status		Click the icon to display the sensor self-check status
	Distance	-		Click to close or display the scan profile within the current 360° range of the sensor
	Strength	-		Click to close or display the reflective intensity of obstacles
	Datasheet	-		The configuration software does not support the output of distance data of all current detection points, this item is not available
Setting	Serial port	-		The sensor does not support serial port connection configuration software, this item is not available
	Ethernet	-		Click to select the Ethernet connection configuration software
	Serial port settings	-		The sensor does not support serial port connection configuration software, this item is not available

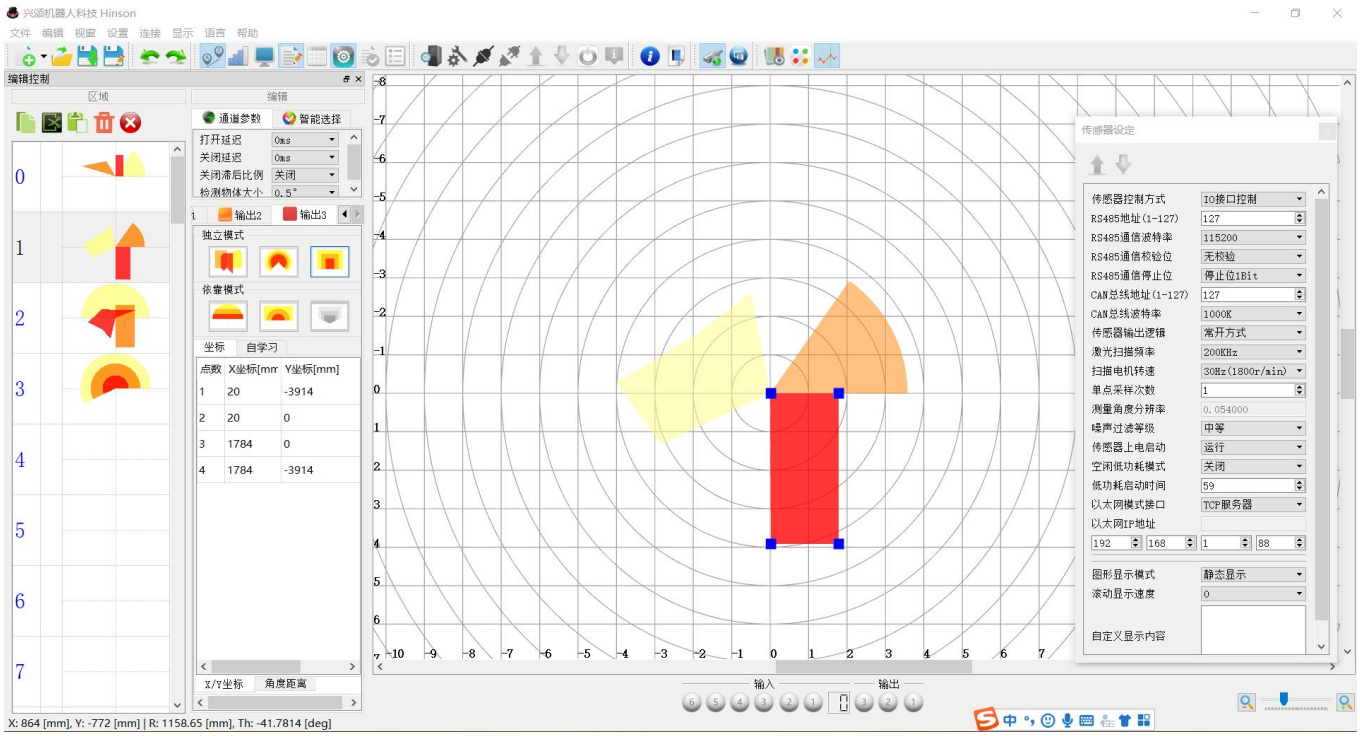
	Ethernet settings	-		Click to view the current sensor Ethernet address
Connect	Interface	Serial port		The sensor does not support serial port connection configuration software, this item is not available
		Ethernet		
	Connect the device	-		Click Connect Sensor and Configuration Software
	Disconnect device	-		Click to disconnect the sensor and configuration software
	Upload data	-		Click to upload the set detection channel graphics and various parameters of the sensor
	Download data	-		Click to download the detection channel graphics and various parameters
	Restart device	-		After setting the detection channel graph and its various parameters, click this icon to restart the sensor, and the parameters can take effect
	Sensor imformation	-		-
Display	Graphic display	-		Click the icon to display the 360° scan profile of the sensor as a flat graphic
	Point cloud display	-		Click the icon to display the 360° scan profile of the sensor as a point cloud
	Line display	-		Click the icon to display the 360° scan outline of the sensor as a line
Language	Chinese	-		Click the icon to display in Chinese
	English	-		Click the icon to display in English
Help	About	-		Click the icon to display version information
	Guide	-		-

Part 2: Shortcut icons

All shortcut icons are explained in the menu bar of Part 1

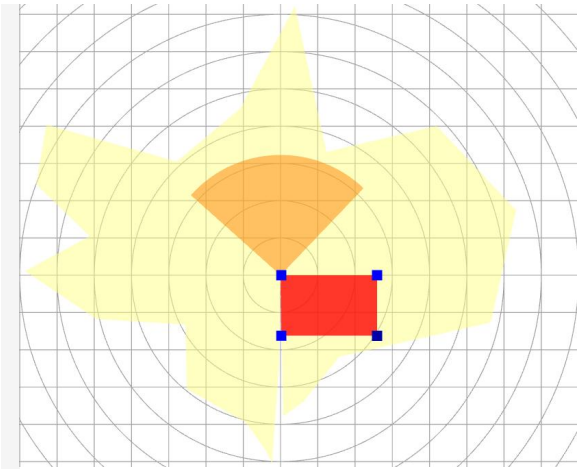
Part3: Graphical Editing of Detection Channels

The sensor supports 0-63 detection channels, each detection channel supports 3 detection area detection graphics output, the sensor can select the channel through IO, RS485-Modbus, CANOpen, and output whether there are obstacles in the 3 detection areas of the channel.

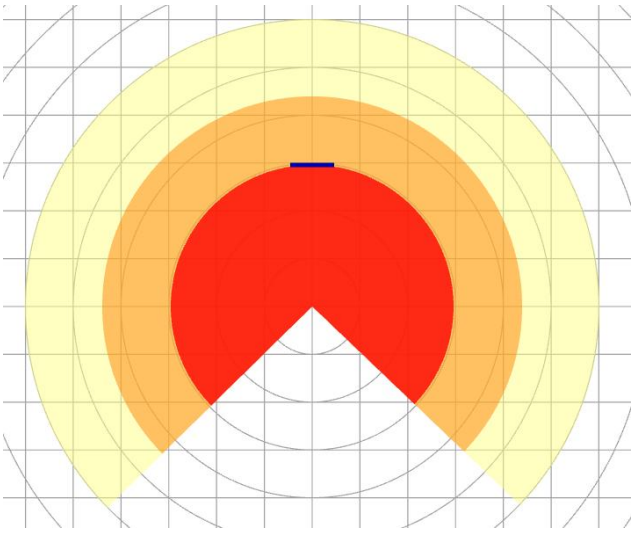


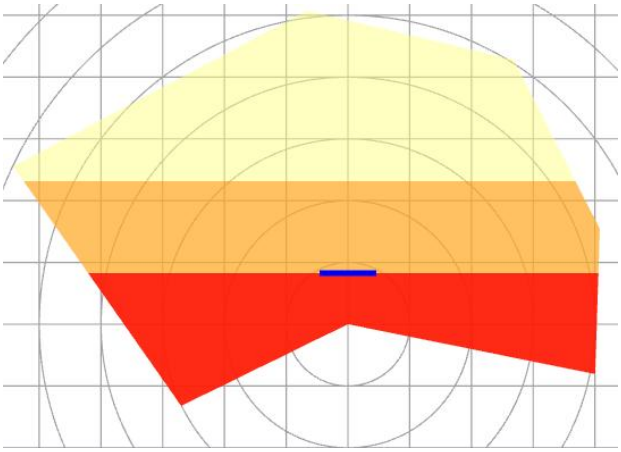
Part 4: Channel detection graphics output 1, output 2, output 3 editing mode.

Independent mode: In the independent mode, irregular shapes, sectors and rectangles can be set separately, among which irregular shapes are composed of up to 100 points.



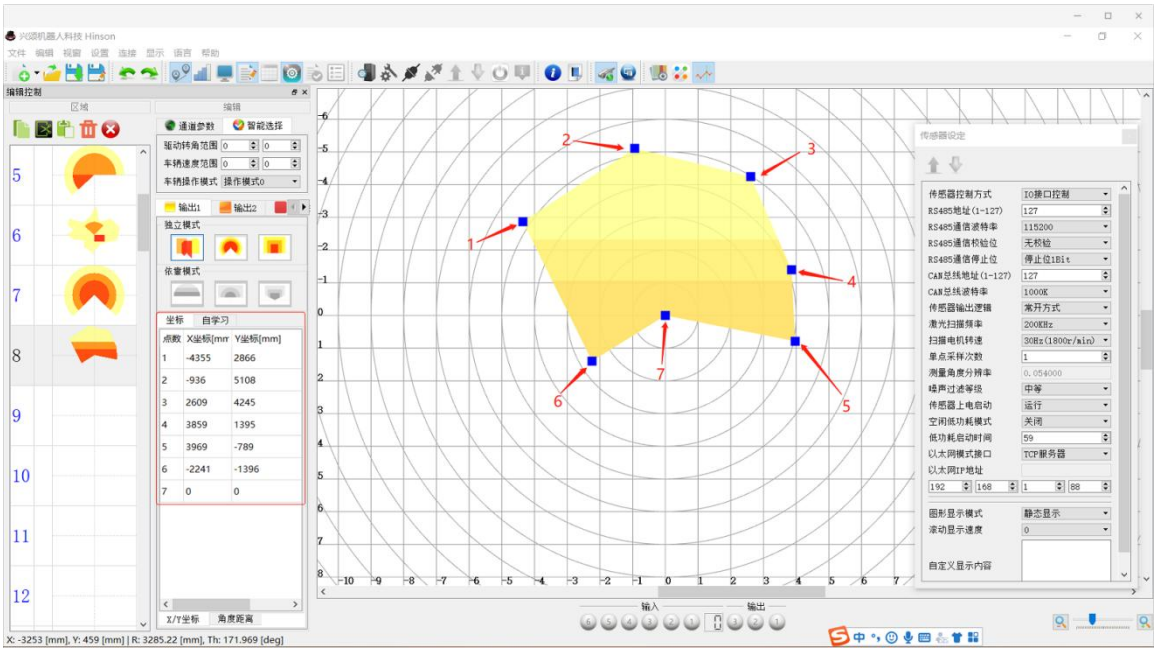
Dependent mode: After setting the graphics of output 1, you can select the dependent mode to copy the graphics of output 1 in different proportions.





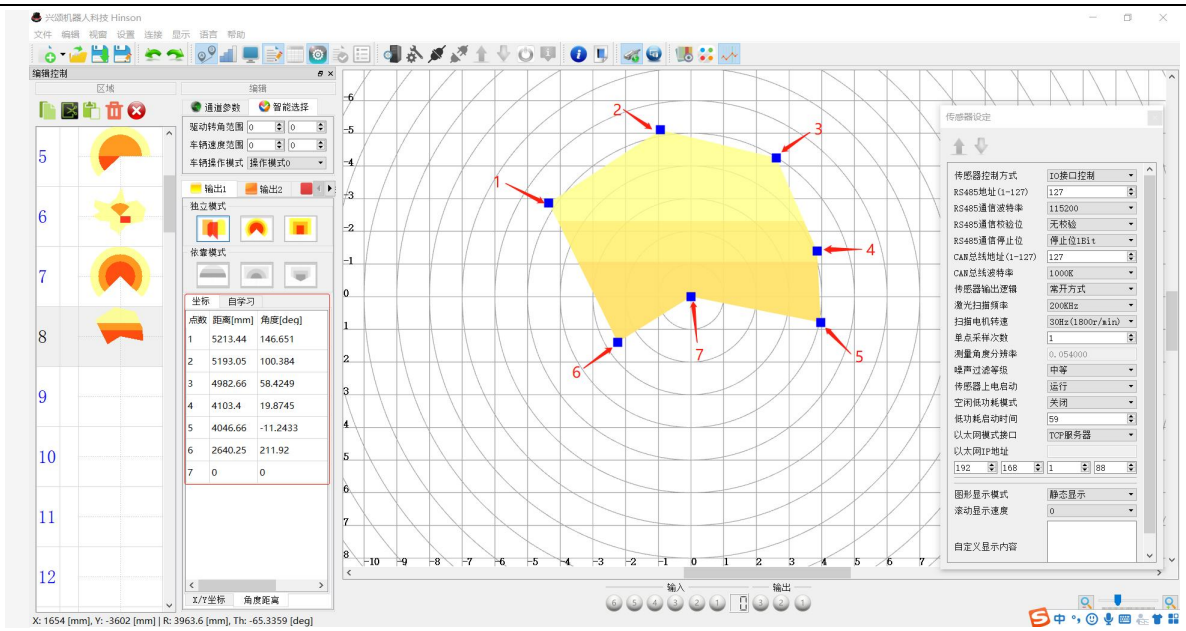
Part 5： Coordinates and their angle values

Coordinates (X, Y) of each point of irregular graph in independent mode:



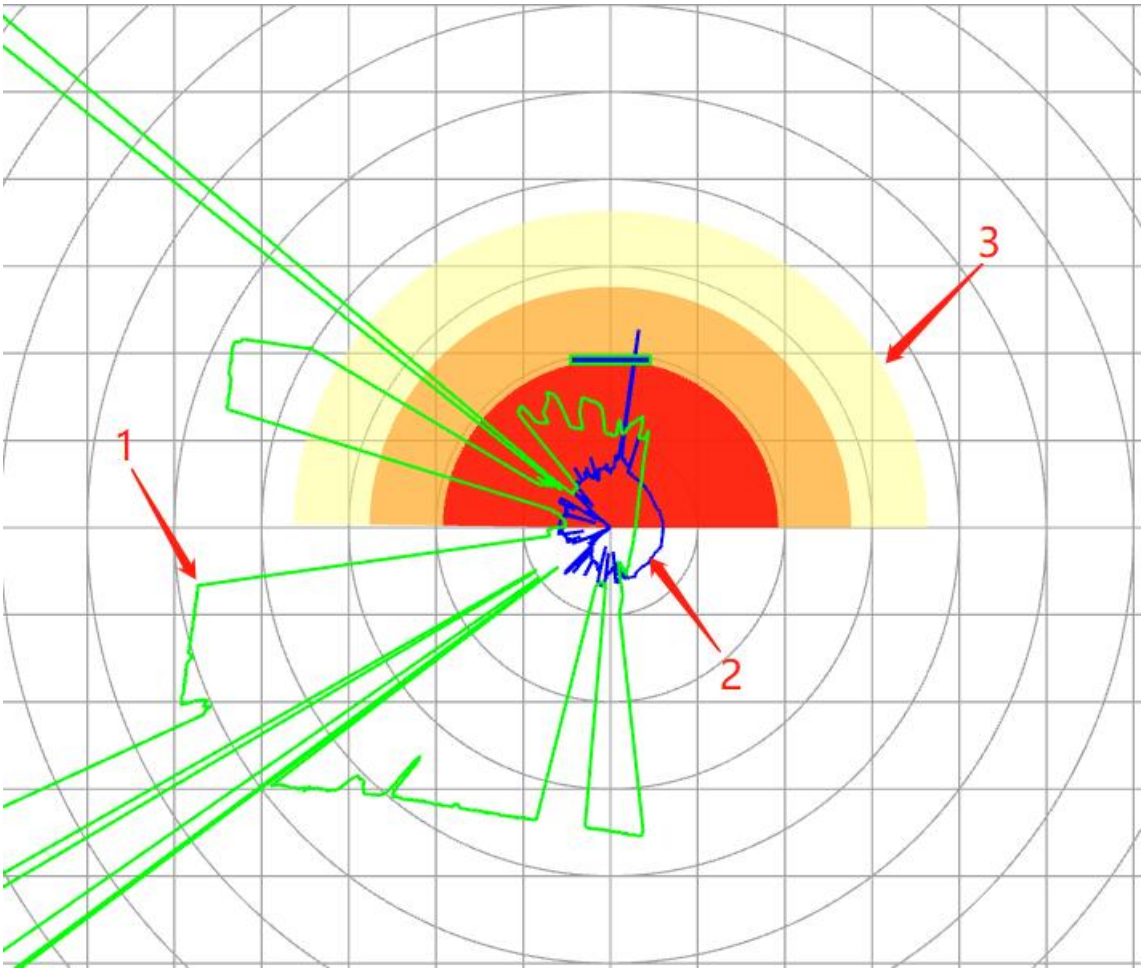
Remarks: The 7th point is the origin of coordinates

The distance and angle between each point of the irregular shape and the origin of the coordinate in the independent Mode:



Remarks: The 7th point is the origin of coordinates

Part 6：Scanning profile, reflection intensity, detection channel graphics Display area:



Remarks: 1 the green line shows the scanning outline, 2 the blue line shows the reflection intensity, and 3 is the set detection pattern.

Part 7：6 groups of switch input selection detection 0-63 channels, 3 groups of switch output respectively 1, 2, and 3 status signals.

Part 8: Sensor Settings

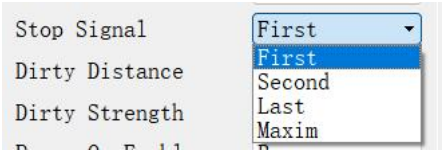
Parameter list	Parameter value	Remark
Sensor control method	IO interface control	When selecting sensor channel for input, select one of IO, Modbus, and Canopen. Only one of them can be valid at the same time, and IO is always valid when outputting.
	Modbus control	When the sensor channel is selected for input, select one of IO, Modbus, and Canopen. Only one of them can be valid at the same time. IO is always valid when outputting. When Modbus communication control is selected, Modbus output is valid.
	Canopen control	When the sensor channel is selected for input, one of IO, Modbus, and Canopen can be selected. Only one of them can be

		valid at the same time. IO is always valid during output. When Canopen communication control is selected, Canopen output is valid.
RS485 address（1-127）	1-127	RS485 communication address 1-127 can be set
RS485 communication baud rate	9600bps	RS485 Communication baud rate setting
	19200bps	
	38400bps	
	57600bps	
	115200bps	
RS485 check bit	No verification	RS485 Check code setting
	Odd parity	
	Even parity	
RS485 communication stop bit	Stop bit 1Bit	RS485 stop bit setting
	Stop bit 1.5Bit	
	Stop bit 2Bit	
CANbus address（1-127）	1-127	CANbus address 1-127 Can be set
CANbus baud rate	125K	CANbus baud rate
	250K	
	500K	
	1000K	
Sensor output logic	Normally open	Sensor output normally open, normally closed setting
	Normally close	
Laser scanning frequency	50KHZ	Laser scanning frequency setting
	100KHZ	
	150KHZ	
	200KHZ	
Scanning motor speed	10HZ(600r/min)	Scanning motor speed setting
	15HZ(900r/min)	
	20HZ(1200r/min)	
	25HZ(1500r/min)	
	30HZ(1800r/min)	
Single point sampling times	1-50	Single point sampling times 1-50 times setting
Measurement angle resolution	—	The measurement angle resolution is determined by "laser scanning frequency" and "scanning motor speed" , "Single point sampling times" 3 parameters

Noise filtering level	Close	Noise filtering level setting, generally the default is simple
	Simple	
	Medium	
	Strict	
Sensor power on and	Dormant	Set the power-on state of the sensor

start	Run	
Idle low power mode	Close	Turn off or turn on low power mode
	Open	
Low power start-up time	1-3600	
Ethernet mode interface	TCP server	TCP server is selected by default
	UDP mode	
Ethernet IP address		Sensor IP address setting
Graphic display	Static	Can dynamically or statically display customize content in Chinese and English
	dynamic	
Scroll display speed	0-3	Dynamic display speed
Customize display content		The Chinese and English can be customized displayed in the sensor window

5.3 Multi-echo setting (for LE-50821FA only)



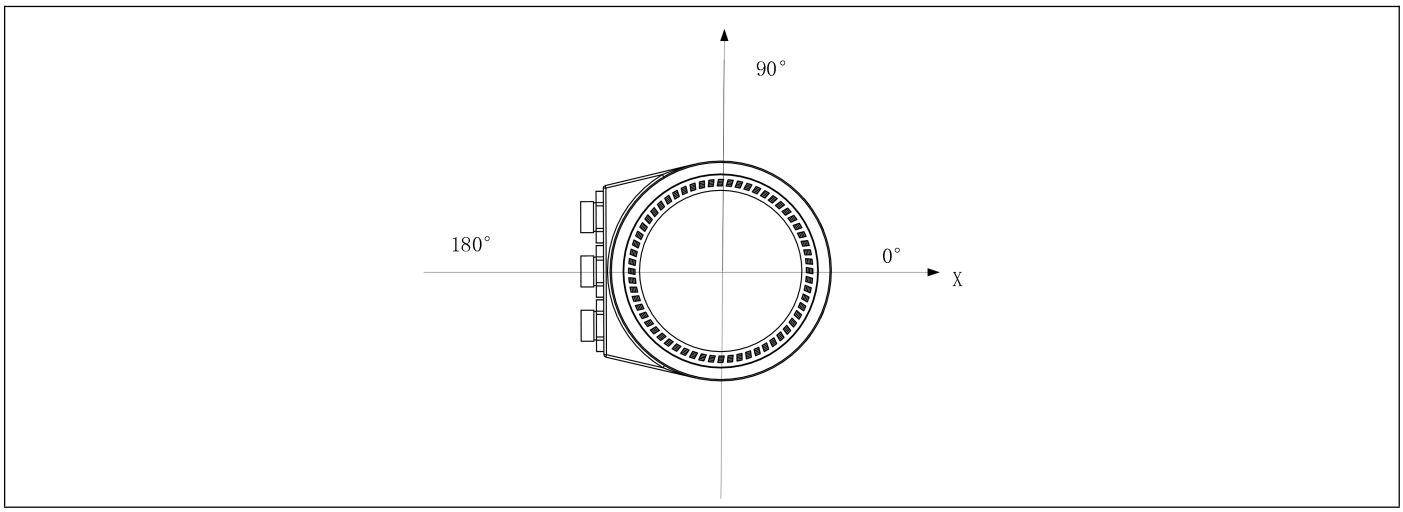
Frist	Normal mode, no filtering function
Second	Select the second echo, with filtering function (recommended option for echo function)
Last	Select the last echo, with filtering function
Maxim	Receive echo with maximum energy
Note: When there are multiple lasers, use the multiple echo function and select delete in the crosstalk filter mode, and a small part of the point cloud will disappear on the image. Do not use the above functions at the same time.	

6 DESCRIPTION OF SENSOR DATA

6.1 Data collection

LE-50821 measures the distance of obstacles within 360° and their reflection intensity according to a fixed period. The period is determined by the parameter of "scanning motor speed". The laser emitting tube of the sensor rotates 360° to complete a measurement. The total number of points for a measurement is determined by The current "laser scanning frequency", "scanning motor speed", and "single point sampling times" are determined. Each measurement point contains two kinds of data: distance and intensity. The sensor scanning 360° distance and reflective intensity data is not transmitted in one communication process, but is transmitted in multiple frames. Each frame of transmission data includes "Identifier", "Start Angle", "End Angle", "Total Measurement Points of Current Data Frame", "Sequence Number of Last Detection Point of Current Data Frame", "Start Angle to End" The total number of measurement points within the angle range", "time stamp", "distance of each detection point and its reflection intensity", the client uses the start and end angle values to reconstruct the distance of each point, and the measurement result is the scan of the sensor Current environmental results.

6.2 Sensor coordinate system

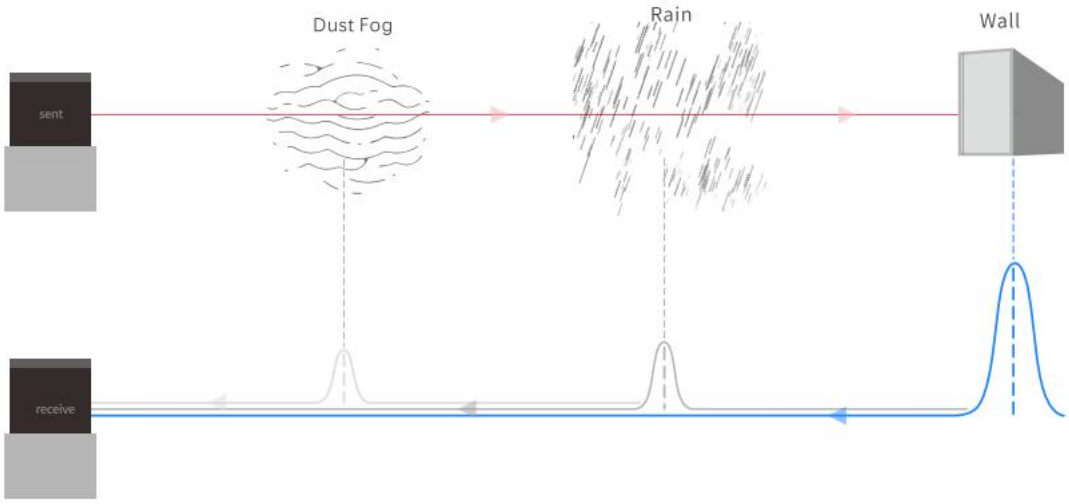


6.3 Multiple echo technology

6.3.1 Filtering environment and minimum distance

The multi-echo technology detects multiple echo signals per measuring beam. This allows echoes caused by rain or fog, complex structures, etc., in the middle of the transmission beam cycle to be identified and filtered out if necessary.

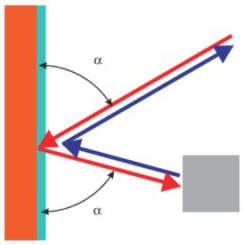
In order to be able to display the echoes as individual measured values, there must be a minimum distance of about 2.5 m between two objects.



6.3.2 Effect of object surface on measurement

- **Smooth reflective surface**

Cannot detect smooth reflective surfaces, but can detect objects illuminated by the reflected light from smooth reflective surfaces



Smooth reflective surface

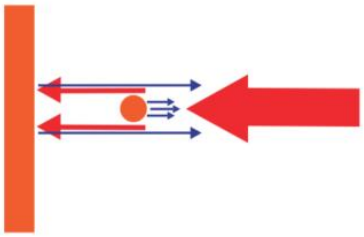
- **Detect small objects or no objects**

If the object to be detected is a small object smaller than the beam diameter, it is possible that

① the small object surface is not reflective enough and there is no background object, so it cannot be detected;

② the small object is not reflective enough, but the background object is reflective enough, so the detection is wrong;

③ the small object and the background object are both reflective enough, so the measurement value is distorted;

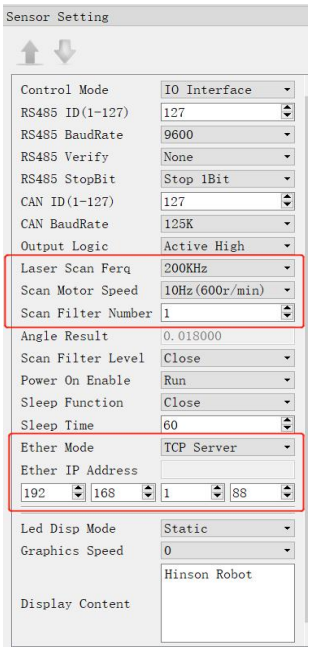


The object is smaller than the laser beam diameter

6.4 Ethernet data transmission

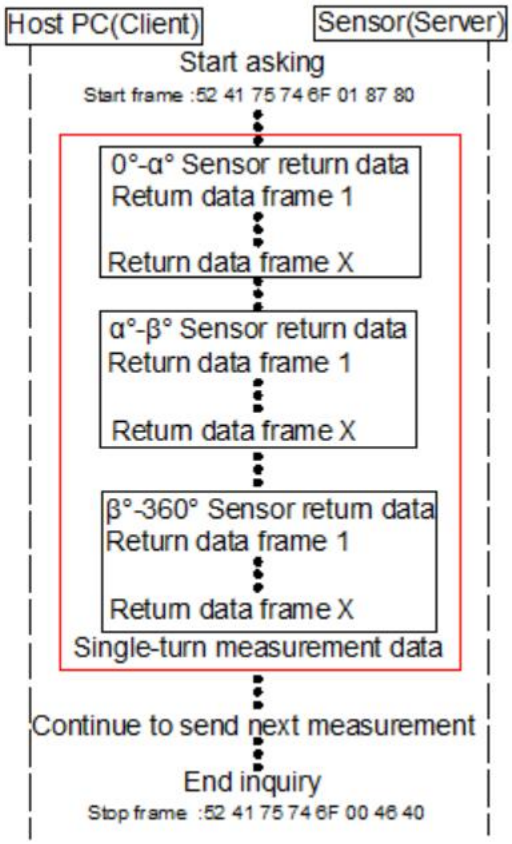
◆ Parameter setting

Open the configuration software, enter the sensor (server side) setting interface, and set the following 5 parameters.

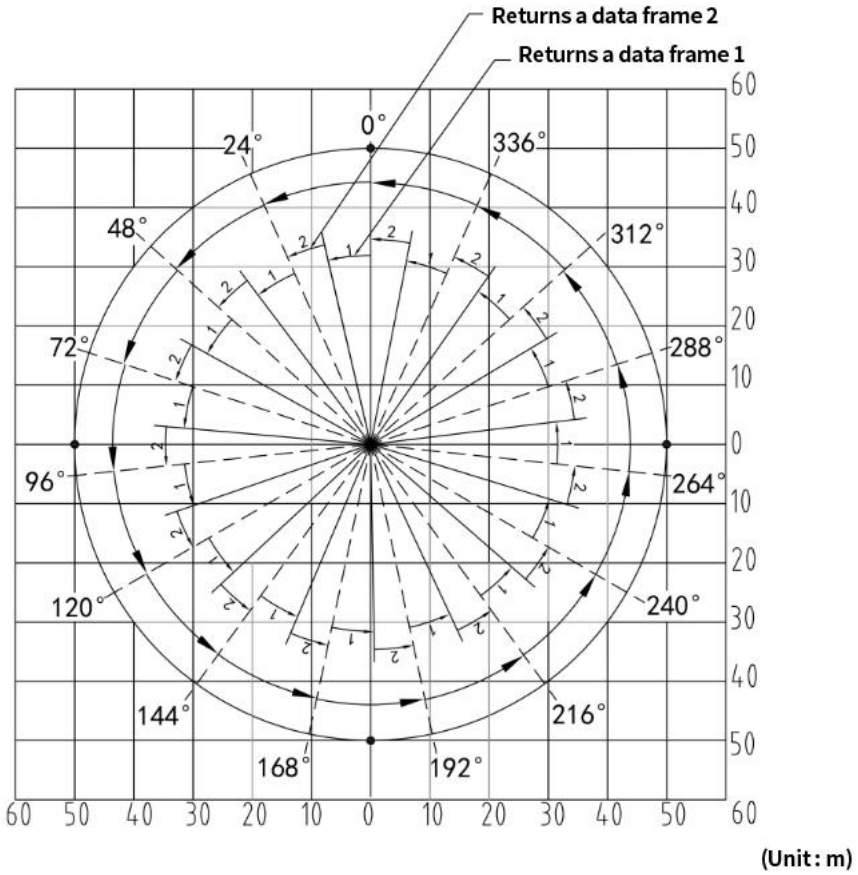


Parameter name	Parameter value	Defaults
Ethernet mode	TCP Server	TCP Server
	UDP Mode	
Ethernet IP address	IP address: 192.0.0.1 to 223.255.255.254 Subnet mask: 255.255.255.0 (fixed) Port number: 8080 (fixed)	192.168.1.88
Laser scanning frequency	50KHZ、100KHZ、150KHZ、200KHZ	200KHZ
Scanning motor speed	10HZ、15HZ、20HZ、25HZ、30HZ	10HZ
Single point sampling times	1-50 can be set	2

After the client initiates a request and establishes a connection, data transmission starts, and the transmission method is as follows:



◆ The host computer (client) sends a "start data frame" to the sensor (server). The sensor completes the measurement in 15 times according to 360°, and outputs data after completing a measurement every 24°. The data is sent in multiple data frames within the measured 24°.



Calculation of measurement angle resolution:

$$\textbf{Actual angular resolution} = \frac{24^\circ}{\textbf{Total measurement points from the start angle to the end angle}}$$

Calculation of the total number of measurement points:

$$\textbf{Total measurement points per lap} = \textbf{Total measurement points from the start angle to the end angle} \times 15$$

◆ Start data frame (Hex)

Data structure

Start code	Control bit	Check bit
5Byte	1Byte	2Byte

Start code： The fixed data is 0x52 0x41 0x75 0x74 0x6F

Control bit：

0x01 The sensor starts to send data automatically

0x00 The sensor stop send data

Check bit： 0x87 0x80 Low bit in front, high bit in back

Check digit calculated using Modbus-CRC16 calculation method.

◆ Measurement data frame（Hex）

Data structure:

Data frame header	Measurement data
16Byte	Length is not fixed

Data frame header format（Hex）：

Identifier	1Byte
	1Byte
	1Byte
	1Byte
Starting angle	1Byte（High priority）
	1Byte（Low behind）
End angle	1Byte（High priority）
	1Byte（Low behind）
The total number of measurement points in the current data frame	1Byte（High priority）
	1Byte（Low behind）
The sequence number of the last detection point of the current data frame	1Byte（High priority）
	1Byte（Low behind）
The total number of measurement points from the start angle to the end angle	1Byte（High priority）
	1Byte（Low behind）
Time stamp	1Byte（High priority）
	1Byte（Low behind）

1. Identifier（4Byte）： 0x48 0x49 0x53 0x4e
2. Starting angle (2Byte): the starting angle of the currently returned measurement data
3. End angle (2Byte): the end angle of the currently returned measurement data
4. The total number of measurement points in the current data frame (2Byte):

Due to different angle resolutions, the total number of measurement points from the start angle to the end angle will be different. The measurement data will be returned in several data frames from the start angle to the end angle. The "Total number of measurement points in the current data frame" is the current The data frame returns the total number of measurement points.

5. The sequence number of the last detection point of the current data frame (2Byte):

For example: the total number of measurement points from the start angle to the end angle is 667, and the measurement data is returned in 2 frames. The current data frame returns the data from the 1st to the 355th point, then "the order of the last detection point of the current data frame The value of "Number" is 355. If the current data frame returns data from the 356th to the 667th point, then the value of "Sequential number of the last detection point in the current data frame" is 667.

6. The total number of measurement points in the range from the starting angle to the ending angle (2Byte):

The total number of measurement points in the range from the start angle to the end angle is determined by the current "laser scanning frequency", "scanning motor speed", and "single point sampling "Number" to determine, the following will illustrate.

7. Time stamp (2Byte):

Not activated

Measurement data (Hex):

First point measurement data （4Byte）				Second point measurement data （4Byte）				……（4Byte）				Last point measurement data （4Byte）			
Measuring distance (2Byte)		Measure intensity (2Byte)		Measuring distance (2Byte)		Measure intensity (2Byte)		Measuring distance (2Byte)		Measure intensity (2Byte)		Measuring distance (2Byte)		Measure intensity (2Byte)	
L	H	L	H	L	H	L	H	L	H	L	H	L	H	L	H

The unit of measuring distance is mm, and the output is the distance data between the reflection point and the sensor.

The measured intensity is the reflection of the reflected light intensity of the reflection point. The higher the value, the stronger the reflection ability of the object.

Both the measured distance and the measured intensity are low in the front and high in the back.

◆ Stop data frame (Hex)

0x52 0x41 0x75 0x74 0x6F 0x00 0x46 0x40

After the host computer sends a stop data frame to the sensor, the sensor stops returning measurement data.

◆ For Examples

1. The sensor parameters are set as follows:

Ethernet mode interface: TCP server
Ethernet IP address：192.168.1.88
Laser scanning frequency：200KHZ
Scanning motor speed：10HZ
Single point sampling times：2
Sensor (server) port：8080

It is important to note that the port of the sensor (server) is fixed at 8080, and the connection between the host computer and the sensor is successfully established.

2. Data analysis:

The data frame 1 is returned within the range of 0°-24°, and the distance between the 1st to the 355th point (355 points in total) and the reflection intensity data are currently returned.

Identifier	0x48	4Byte
	0x49	
	0x53	
	0x4e	

Starting angle	0x00	H(High priority)	2Byte
	0x00	L(Low behind)	
End angle	0x00	H(High priority)	2Byte
	0x18	L(Low behind)	
The total number of measurement points in the current data frame	0x01	H(High priority)	2Byte
	0x63	L(Low behind)	
The sequence number of the last detection point of the current data frame	0x01	H(High priority)	2Byte
	0x63	L(Low behind)	
The total number of measurement points from the start angle to the end angle	0x02	H(High priority)	2Byte
	0x9b	L(Low behind)	
Time stamp	0xd4	H(High priority)	2Byte
	0x5a	L(Low behind)	
Distance of the first detection point	0x xx	L(Low priority)	The detection distance of each point is expressed by 2Byte, and the reflective intensity of each point is expressed by 2Byte. The data frame returns a total of 355 points, so the total number of bytes in this part is 355*4=1420Byte
	0x xx	H(High behind)	
Reflective intensity of the first detection point	0x xx	L(Low priority)	
	0x xx	H(High behind)	
Distance of the second detection point	0x xx	L(Low priority)	
	0x xx	H(High behind)	
Reflective intensity of the second detection point	0x xx	L(Low priority)	
	0x xx	H(High behind)	
Distance of the third detection point	0x xx	L(Low priority)	
	0x xx	H(High behind)	
Reflective intensity of the third detection point	0x xx	L(Low priority)	
	0x xx	H(High behind)	
Distance of the 4th detection point	0x xx	L(Low priority)	
	0x xx	H(High behind)	
Reflective intensity of the 4th detection point	0x xx	L(Low priority)	
	0x xx	H(High behind)	
↓ ↓			
Distance of the 354th detection point	0x xx	L(Low priority)	
	0x xx	H(High behind)	
Reflective intensity of the 354th detection point	0x xx	L(Low priority)	
	0x xx	H(High behind)	
Distance of the 355th detection point	0x xx	L(Low priority)	
	0x xx	H(High behind)	
Reflective intensity of the 355th detection point	0x xx	L(Low priority)	
	0x xx	H(High behind)	

The data frame 2 is returned within the range of 0°-24°, and the distance and reflection intensity data of the 356th to the 667th point (312 points in total) are currently returned. The analysis is as follows:

Identifier	0x48	4Byte
	0x49	
	0x53	

	0x4e		
Starting angle	0x00	H(High priority)	2Byte
	0x00	L(Low behind)	
End angle	0x00	H(High priority)	2Byte
	0x18	L(Low behind)	
The total number of measurement points in the current data frame	0x01	H(High priority)	2Byte
	0x38	L(Low behind)	
The sequence number of the last detection point of the current data frame	0x02	H(High priority)	2Byte
	0x9b	L(Low behind)	
The total number of measurement points from the start angle to the end angle	0x02	H(High priority)	2Byte
	0x9b	L(Low behind)	
Time stamp	0xd4	H(High priority)	2Byte
	0x5a	L(Low behind)	
Distance of the 356th detection point	0x xx	L(Low priority)	The detection distance of each point is expressed by 2Byte, and the reflective intensity of each point is expressed by 2Byte. The data frame returns a total of 312 points, so the total number of bytes in this part is 312*4=1248Byte
	0x xx	H(High behind)	
Reflective intensity of the 356th detection point	0x xx	L(Low priority)	
	0x xx	H(High behind)	
Distance of the 357th detection point	0x xx	L(Low priority)	
	0x xx	H(High behind)	
Reflective intensity of the 357th detection point	0x xx	L(Low priority)	
	0x xx	H(High behind)	
Distance of the 358th detection point	0x xx	L(Low priority)	
	0x xx	H(High behind)	
Reflective intensity of the 358th detection point	0x xx	L(Low priority)	
	0x xx	H(High behind)	
Distance of the 359th detection point	0x xx	L(Low priority)	
	0x xx	H(High behind)	
Reflective intensity of the 359th detection point	0x xx	L(Low priority)	
	0x xx	H(High behind)	
↓ ↓			
Distance of the 666th detection point	0x xx	L(Low priority)	
	0x xx	H(High behind)	
Reflective intensity of the 666th detection point	0x xx	L(Low priority)	
	0x xx	H(High behind)	
Distance of the 667th detection point	0x xx	L(Low priority)	
	0x xx	H(High behind)	
Reflective intensity of the 667th detection point	0x xx	L(Low priority)	
	0x xx	H(High behind)	

3. Calculation of measurement angle resolution:

Laser scanning frequency: the number of laser beams emitted by the laser emitting tube in 1 second, the following takes 200KHZ as an example;

Scanning motor speed: the number of revolutions that drive the laser emitting tube to rotate the motor in 1 second. The following is an example of 10HZ (10r in 1 second);

Single point sampling times: the number of repeated measurements for a single measuring point. The following takes 2 measurements of a single detection point as an example;

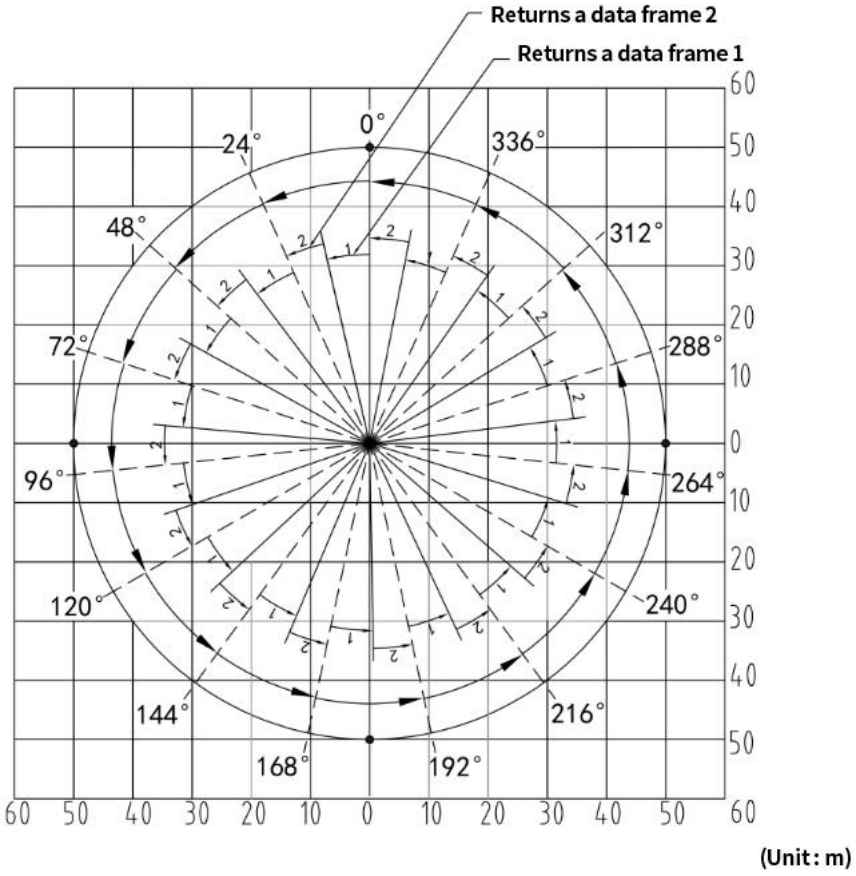
Measurement angle resolution=scanning motor speed*360°/(laser scanning frequency/single point sampling times)=0.036°, the measurement angle resolution is automatically calculated by the configuration software, no additional settings are required;

Calculation of the total number of measurement points:

The total number of measurement points = (end angle-start angle)/measurement angle resolution, the total number of measurement points is rounded to one decimal place, according to the design of the sensor (end angle-start angle) = 24° is a fixed value, not with the angle resolution Change with change;

Taking the ending angle of 24°, the starting angle of 0°, and the angular resolution of 0.036° as an example, the total number of measurement points = (24-0)/0.036=666.67, after rounding up, the total number of measurement points is 667.

4. Data sending process:



The starting angle is 0°, the ending angle is 24°, the angular resolution is 0.036°, the total number of points measured in the angle range of 0°-24° is 667, the distance and intensity data of the 667 measuring points are returned in 2 frames, respectively To return data frame 1 (the number of measurement points is the first to the 355th point, a total of 355 points of data is returned) and the return data frame 2 (the number of measurement points is the 366th to the 667th point, and a total of 312 points of data are returned) , The angle resolution that needs special explanation is different, the number of returned data frames is also different.

The start angle is 24°, the end angle is 48°, the angular resolution is 0.036°, the total number of points measured in the angle range of 24°-48° is 667, and the distance and intensity data of the 667 measuring points are returned in 2 frames, respectively To return data frame 1 (the number of measurement points is the first to the 355th point, a total of 355 points of data is returned) and the return data frame 2 (the number of measurement points is the 366th to the 667th point, and a total of 312 points of data are returned) , The angle resolution that needs special explanation is different, the number of returned data frames is also different.

The starting angle is 48°, the ending angle is 72°, the angular resolution is 0.036°, the total number of points measured in the angle range of 48°-72° is 667, the distance and intensity data of the 667 measuring points are returned in 2 frames, respectively To return data frame 1 (the number of measurement points is the first to the 355th point, a total of 355 points of data is returned) and the return data frame 2 (the number of measurement points is the 366th to the 667th point, and a total of 312 points of data are returned) , The angle resolution that needs special explanation is different, the number of returned data frames is also different.

The start angle is 72°, the end angle is 96°, the angular resolution is 0.036°, the total number of points measured in the angle range of 72°-96° is 667, the distance and intensity data of the 667 measurement points are returned in 2 frames, respectively To return data frame 1 (the number of measurement points is the first to the 355th point, a total of 355 points of data is returned) and the return data frame 2 (the number of measurement points is the 366th to the 667th point, and a total of 312 points of data are returned) , The angle resolution that needs special explanation is different, the number of returned data frames is also different.

The starting angle is 96°, the ending angle is 120°, the angular resolution is 0.036°, the total number of points measured in the angle range of 96°-120° is 667, the distance and intensity data of the 667 measuring points are returned in 2 frames, respectively To return data frame 1 (the number of measurement points is the first to the 355th point, a total of 355 points of data is returned) and the return data frame 2 (the number of measurement points is the 366th to the 667th point, and a total of 312 points of data are returned) , The angle resolution that needs special explanation is different, the number of returned data frames is also different.

The starting angle is 120°, the ending angle is 144°, the angular resolution is 0.036°, the total number of points measured in the angle range of 120°-144° is 667, the distance and intensity data of the 667 measuring points are returned in 2 frames, respectively To return data frame 1 (the number of measurement points is the first to the 355th point, a total of 355 points of data is returned) and the return data frame 2 (the number of measurement points is the 366th to the 667th point, and a total of 312 points of data are returned) , The angle resolution that needs special explanation is different, the number of returned data frames is also different.

The starting angle is 144°, the ending angle is 168°, the angular resolution is 0.036°, the total number of points measured in the angle range of 144°-168° is 667, the distance and intensity data of the 667 measuring points are returned in 2 frames, respectively To return data frame 1 (the number of measurement points is the first to the 355th point, a total of 355 points of data is returned) and the return data frame 2 (the number of measurement points is the 366th to the 667th point, and a total of 312 points of data are returned) , The angle resolution that needs special explanation is different, the number of returned data frames is also different.

The starting angle is 168°, the ending angle is 192°, the angular resolution is 0.036°, the total number of points measured in the angle range of 168°-192° is 667, the distance and intensity data of the 667 measuring points are returned in 2 frames, respectively To return data frame 1 (the number of measurement points is the first to the 355th point, a total of 355 points of data is returned) and the return data frame 2 (the number of measurement points is the 366th to the 667th point, and a total of 312 points of data are returned) , The angle resolution that needs special explanation is different, the number of returned data frames is also different.

The starting angle is 192°, the ending angle is 216°, the angular resolution is 0.036°, the total number of points measured in the angle range of 192°-216° is 667, the distance and intensity data of the 667 measuring points are returned in 2 frames, respectively To return data frame 1 (the number of measurement points is the first to the 355th point, a total of 355 points of data is returned) and the return data frame 2 (the number of measurement points is the 366th to the 667th point, and a total of 312 points of data are returned) , The angle resolution that needs special explanation is different, the number of returned data frames is also different.

The starting angle is 216°, the ending angle is 240°, the angular resolution is 0.036°, the total number of points measured in the angle range of 216°-240° is 667, the distance and intensity data of the 667 measuring points are returned in 2 frames, respectively To return data frame 1 (the number of measurement points is the first to the 355th point, a total of 355 points of data is returned) and the return data frame 2 (the number of measurement points is the 366th to the 667th point, and a total of 312 points of data are returned) , The angle resolution that needs special explanation is different, the number of returned data frames is also different.

The starting angle is 240°, the ending angle is 264°, the angular resolution is 0.036°, the total number of points

measured in the 240°-264° angle range is 667, the distance and intensity data of the 667 measuring points are returned in 2 frames, respectively To return data frame 1 (the number of measurement points is the first to the 355th point, a total of 355 points of data is returned) and the return data frame 2 (the number of measurement points is the 366th to the 667th point, and a total of 312 points of data are returned) , The angle resolution that needs special explanation is different, the number of returned data frames is also different.

The starting angle is 264°, the ending angle is 288°, the angular resolution is 0.036°, the total number of points measured in the angle range of 264°-288° is 667, the distance and intensity data of the 667 measurement points are returned in 2 frames, respectively To return data frame 1 (the number of measurement points is the first to the 355th point, a total of 355 points of data is returned) and the return data frame 2 (the number of measurement points is the 366th to the 667th point, and a total of 312 points of data are returned) , The angle resolution that needs special explanation is different, the number of returned data frames is also different.

The starting angle is 288°, the ending angle is 312°, the angular resolution is 0.036°, the total number of points measured in the angle range of 288°-312° is 667, the distance and intensity data of the 667 measuring points are returned in 2 frames, respectively To return data frame 1 (the number of measurement points is the first to the 355th point, a total of 355 points of data is returned) and the return data frame 2 (the number of measurement points is the 366th to the 667th point, and a total of 312 points of data are returned) , The angle resolution that needs special explanation is different, the number of returned data frames is also different.

The starting angle is 312°, the ending angle is 336°, the angular resolution is 0.036°, the total number of points measured in the angle range of 312°-336° is 667, the distance and intensity data of the 667 measuring points are returned in 2 frames, respectively To return data frame 1 (the number of measurement points is the first to the 355th point, a total of 355 points of data is returned) and the return data frame 2 (the number of measurement points is the 366th to the 667th point, and a total of 312 points of data are returned) , The angle resolution that needs special explanation is different, the number of returned data frames is also different.

The starting angle is 336°, the ending angle is 360° (360° is 0° of the sensor), the angular resolution is 0.036°, the total number of points measured in the angle range of 336°-360° is 667, and the distance between 667 measuring points Its intensity data is returned in 2 frames, which are the return data frame 1 (the number of measurement points is 1-355, a total of 355 points of data are returned) and the return data frame 2 (the number of measurement points is 366-667) Points, a total of 312 points of data are returned), the number of returned data frames is also different for the angle resolution that needs special explanation.

5.Data analysis:

The data frame 1 is returned within the range of 0°-24°, and the distance between the 1st to the 355th point (355 points in total) and the reflection intensity data are currently returned.

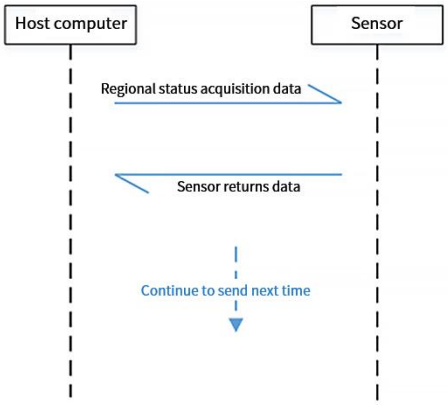
Identifier	0x48		4Byte
	0x49		
	0x53		
	0x4e		
Starting angle	0x00	H(High priority)	2Byte
	0x00	L(Low behind)	
End angle	0x00	H(High priority)	2Byte
	0x18	L(Low behind)	
The total number of measurement points in the current data frame	0x01	H(High priority)	2Byte
	0x63	L(Low behind)	
The sequence number of the last detection point of the current data frame	0x01	H(High priority)	2Byte
	0x63	L(Low behind)	
The total number of measurement points from the start angle to the end angle	0x02	H(High priority)	2Byte
	0x9b	L(Low behind)	
Time stamp	0xd4	H(High priority)	2Byte
	0x5a	L(Low behind)	
Distance of the first detection point	0x xx	L(Low priority)	The detection distance of each point is expressed by 2Byte, and the reflective intensity of each point is expressed by 2Byte. The data frame returns a total of 355 points, so the total number of bytes in this part is 355*4=1420Byte
	0x xx	H(High behind)	
Reflective intensity of the first detection point	0x xx	L(Low priority)	
	0x xx	H(High behind)	
Distance of the second detection point	0x xx	L(Low priority)	
	0x xx	H(High behind)	
Reflective intensity of the second detection point	0x xx	L(Low priority)	
	0x xx	H(High behind)	
Distance of the third detection point	0x xx	L(Low priority)	
	0x xx	H(High behind)	
Reflective intensity of the third detection point	0x xx	L(Low priority)	
	0x xx	H(High behind)	
Distance of the 4th detection point	0x xx	L(Low priority)	
	0x xx	H(High behind)	
Reflective intensity of the 4th detection point	0x xx	L(Low priority)	
	0x xx	H(High behind)	
↓ ↓			
Distance of the 354th detection point	0x xx	L(Low priority)	
	0x xx	H(High behind)	
Reflective intensity of the 354th detection point	0x xx	L(Low priority)	
	0x xx	H(High behind)	
Distance of the 355th detection point	0x xx	L(Low priority)	
	0x xx	H(High behind)	
Reflective intensity of the 355th detection point	0x xx	L(Low priority)	
	0x xx	H(High behind)	

The data frame 2 is returned within the range of 0°-24°, and the distance and reflection intensity data of the 356th to the 667th point (312 points in total) are currently returned. The analysis is as follows:

Identifier	0x48		4Byte
	0x49		
	0x53		
	0x4e		
Starting angle	0x00	H(High priority)	2Byte
	0x00	L(Low behind)	
End angle	0x00	H(High priority)	2Byte
	0x18	L(Low behind)	
The total number of measurement points in the current data frame	0x01	H(High priority)	2Byte
	0x38	L(Low behind)	
The sequence number of the last detection point of the current data frame	0x02	H(High priority)	2Byte
	0x9b	L(Low behind)	
The total number of measurement points from the start angle to the end angle	0x02	H(High priority)	2Byte
	0x9b	L(Low behind)	
Time stamp	0xd4	H(High priority)	2Byte
	0x5a	L(Low behind)	
Distance of the 356th detection point	0x xx	L(Low priority)	The detection distance of each point is expressed by 2Byte, and the reflective intensity of each point is expressed by 2Byte. The data frame returns a total of 312 points, so the total number of bytes in this part is 312*4=1248Byte
	0x xx	H(High behind)	
Reflective intensity of the 356th detection point	0x xx	L(Low priority)	
	0x xx	H(High behind)	
Distance of the 357th detection point	0x xx	L(Low priority)	
	0x xx	H(High behind)	
Reflective intensity of the 357th detection point	0x xx	L(Low priority)	
	0x xx	H(High behind)	
Distance of the 358th detection point	0x xx	L(Low priority)	
	0x xx	H(High behind)	
Reflective intensity of the 358th detection point	0x xx	L(Low priority)	
	0x xx	H(High behind)	
Distance of the 359th detection point	0x xx	L(Low priority)	
	0x xx	H(High behind)	
Reflective intensity of the 359th detection point	0x xx	L(Low priority)	
	0x xx	H(High behind)	
↓ ↓			
Distance of the 666th detection point	0x xx	L(Low priority)	
	0x xx	H(High behind)	
Reflective intensity of the 666th detection point	0x xx	L(Low priority)	
	0x xx	H(High behind)	
Distance of the 667th detection point	0x xx	L(Low priority)	
	0x xx	H(High behind)	
Reflective intensity of the 667th detection point	0x xx	L(Low priority)	
	0x xx	H(High behind)	

6. Sensor status and area detection data acquisition

After the client initiates a request and establishes a connection, data transmission begins according to the following rules.



Get data to send message

Data identifier	**5Byte**
Sensor operating mode	1Byte
Sensor channel value	1Byte
Switching angle value in intelligent channel selection mode	2Byte
Switching speed value in intelligent channel selection mode	2Byte
Channel group number	2Byte
Invalid data data bit	3Byte
Parity bit	2Byte

- Data identifier (5byte)

  The identifier is fixed data: 0x57 0x53 0x69 0x6d 0x75 This data function;

- Sensor working mode (1byte)

  00: Invalid instruction
  01: Channel specified mode
  02: Intelligent channel selection mode

- Sensor channel value (1byte)

  Control the current sensing channel of the sensor, data range 00-63;

- Sensor channel angle (2byte)

  Angle value in channel group mode, data is signed data range -180-180;

- Sensor channel speed value (2byte)

  Speed value in channel group mode, data is signed data range -300-300;

- Sensor channel group number (2byte)

  Control the current sensing channel group number of the sensor, data range 00-04;

- Invalid data (3byte)

  Invalid data, the default data must be sent 0x00;

- Check bit (2byte)

  Data check bit, using modbus low bit first CRC16 check method. The check value is calculated by the check formula. For detailed calculation method, please see the appendix.

Sensor returns data

Data Identifier	**5Byte**
Sensor Channel Value	1Byte
Invalid	1Byte
Output State	1Byte
Invalid Data	1Byte
Fault State	1Byte（H）
	1Byte（L）
Current Temperature	1Byte
	1Byte
Internal motor speed	1Byte（H）
	1Byte（L）
Driving voltage	1Byte（H）
	1Byte（L）
Receiving voltage	1Byte（H）
	1Byte（L）
Send voltage	1Byte（H）
	1Byte（L）
Check digit	1Byte（L）
	1Byte（H）

- Data identifier (5 bytes)

The identifier is fixed data: 0x57 0x53 0x69 0x6d 0x75 This data function;

- Current channel value (1 byte)

Current channel value of the sensor;

- Invalid data (1 byte)

Invalid data;

- Output status (1 byte)

Bit7	**Bit6**	**Bit5**	**Bit4**	**Bit3**	**Bit2**	**Bit1**	**Bit0**
invalid					OUT3	OUT2	OUT1

- Related to the parameter setting item sensor output logic:

Normal closed mode (default)

00: object detected;

01: no object detected

- Normal open mode

01: object detected;

00: no object detected;

- Invalid data (1 byte)

Invalid data;

- Sensor fault status (2 bytes)

1Byte high bit	1Byte low bit
Invalid	Fault code

Sensor fault codes

0x00	Sensor normal state
0x01	Sensor encoder signal error
0x02	No receiving board signal
0x03	Memory data error
0x04	Connection error
0x05	Simulation error
0x06	Overtemperature protection
0x07	Transmit undervoltage protection
0x08	Transmit overvoltage protection
0x09	Drive undervoltage protection
0x0A	Drive overvoltage protection
0x0B	Receive undervoltage protection
0x0C	Receive overvoltage protection

- Current temperature (2 bytes)

1Byte High bit	1Byte Low bit
Temperature value	

Signed data, data range -5000-10000; displays the current internal temperature of the sensor, temperature unit

0.01℃; when the monitored temperature exceeds 80.00℃, the sensor prompts over-temperature protection

- Internal motor speed (2byte)

1Byte High bit	1Byte Low bit
Internal motor speed	

Unsigned data, data range 0-3000, display the current sensor internal motor speed, speed unit 1r/min;

- Drive voltage (2byte)

1Byte High bit	1Byte Low bit
Drive motor voltage	

Unsigned data, data range 0-1600; displays the current sensor driving motor voltage, voltage unit 0.01V;

- Receiver board voltage (2byte）

1Byte High bit	1Byte Low bit
Receiver board voltage	

Unsigned data, data range 0-25000; displays the current sensor receiving board ADP voltage, voltage unit 0.01V;

- Sending board voltage (2byte)

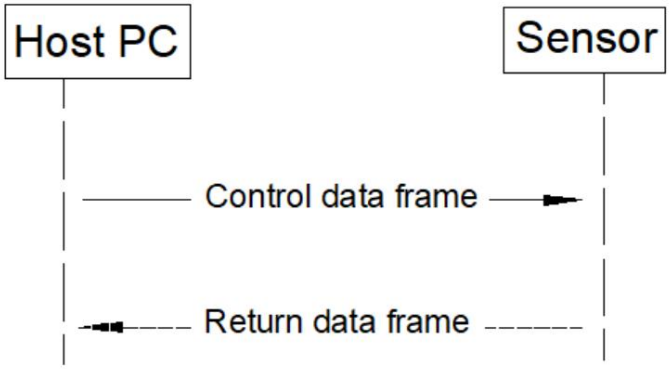
1Byte High bit	1Byte Low bit
Receiver board voltage	

Unsigned data, data range 0-5500; displays the current sensor sending board voltage, voltage unit 0.01V;

- Check digit (2 bytes)

  Data check bit uses the modbus low-order CRC16 check method. The check value is calculated by the check formula.

7. Control commands



1) Take effect immediately after the sensor receives the data.

2) After the status changes, the initial status will be restored after restarting.

Control data frame (Hex)

Data frame	Data	Check bit
5Byte	5Byte	2Btye

Data frame

0x53 0x43 0x74 0x72 0x6c

Data

1Byte	2Byte	3Byte	4Byte	5Byte
Dormant	Measuring frequency	Scanning frequency	Single point sampling times	Noise filtering level

Dormant control -- In the case of low power consumption, the sensor can be put into dormant mode to reduce energy consumption.

0x00：Control the sensor to enter the dormant state.

0x01：Start the sensor operation.

Measuring frequency—The total number of times the sensor completes in 1S, generally according to the default 200k.

0x00：50k；

0x01：100k；

0x02：150k；

0x03：200k；

Scanning frequency—The sensor completes the scan times within 1S.

0x00：10Hz；

0x01：15Hz；

0x02：20Hz；

0x03：25Hz；

0x04：30Hz；

Single point sampling times—The number of repeated measurements for a single point; the data range is 1-50 times, the more the number of measurements, the smaller the measurement fluctuation, and the angular resolution of the measurement is also increased.

Noise filtering level—Control the degree of data filtering, the higher the filtering level, the smaller the measurement fluctuation, but the greater the degree of distortion of the image corners.

0x00：Turn off filtering

0x01：Simple

0x02：Medium

0x03：Strict

Check bit

Low	High

The data check bit adopts the CRC16 check method with modbus low bit first. The calibration value is calculated by the calibration formula, and the specific calculation method is detailed in the appendix.

C language CRC check function

cBuffer：Calculate the array of CRC check codes.

iBufLen：The length of the array.

```
unsigned int CRC_Verify(unsigned char *cBuffer, unsigned int iBufLen)
{
    unsigned int i, j;                          //#define wPolynom 0xA001
    unsigned int wCrc = 0xffff;
    unsigned int wPolynom = 0xA001;
/*-----------------------------------------------------------------------------*/
    for (i = 0; i < iBufLen; i++)
    {
        wCrc ^= cBuffer[i];
for (j = 0; j < 8; j++)
        {
            if (wCrc &0x0001)
            {   wCrc = (wCrc >> 1) ^ wPolynom;  }
            else
            {  wCrc = wCrc >> 1;  }
         }
     }
return wCrc;
}
```

Return data frame (Hex)

Feedback current sensor status

Data frame code	Data	Check bit
5Byte	5Byte	2Btye

Data frame code

0x53 0x43 0x74 0x72 0x6c

Data

1Byte	2Byte	3Byte	4Byte	5Byte
Dormant	Measuring frequency	Scanning frequency	Single point sampling	Noise filtering level

			times	

Dormant control -- Contrary to the control data representation.

0x00：Indicates that the sensor is currently dormant.

0x01：Indicates that the sensor is currently in operation.

Measuring frequency—Current sensor measuring frequency

0x00：50k；

0x01：100k；

0x02：150k；

0x03：200k；

Scanning frequency—The current scanning frequency of the sensor

0x00：10Hz；

0x01：15Hz；

0x02：20Hz；

0x03：25Hz；

0x04：30Hz；

Single point sampling times—The current single-point sampling times of the sensor

Noise filtering level—Current filter level of the sensor

0x00：Turn off filtering

0x01：Simple

0x02：Medium

0x03：Strict

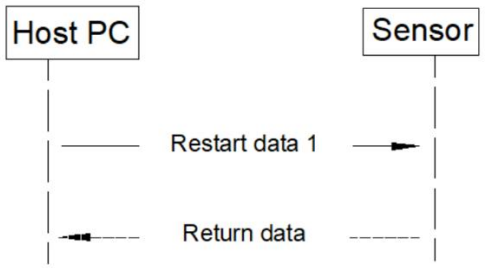
Check bit

Low	High

The data check bit adopts the CRC16 check method with modbus low bit first. The check value is calculated by the check formula. For the detailed calculation method, please refer to the control data frame.

Return data frame (Hex)

Send this data frame once, and the sensor will restart once. The interval between two transmissions is greater than 10s.



Sending a restart data sensor will respond to the data once

Restart data

Data frame header	Check bit
5Byte	2Byte

Data frame header

0x52 0x42 0x6f 0x6f 0x74

Check bit

0x94 0x7E

Return data

Data frame header	Data	Check bit
5Byte	1Btye	2Byte

Data frame header

0x52 0x42 0x6f 0x6f 0x74

Data

0x00：Restart command sent successfully

Check bit

0x7F 0xAF

7 AFTER-SALE INFORMATION

7.1 Warranty period

LE-50821 provides a limited time warranty. During the warranty period, if the product cannot be used normally due to quality problems, design defects, etc., we will carry out after-sales maintenance for free.

■Warranty period: 2 years from sale.

7.2 Warranty scope

If the product is within the scope of the warranty during the warranty period, we will repair or replace it free of charge.

- The product warranty and after-sales service are limited to mainland China.
- The product cannot be used normally when it is out of the box due to transportation.
- Failure to work normally caused by damage to the product's own components.
- Product design defects can not be used normally.

7.3 Exemption scope

Please pay attention to the following conditions during the use of the product, we will not provide free after-sales and warranty.

- Failure to install the product according to the instructions correctly, causing damage to the product.
- Use this product under unsuitable environments and conditions, causing product damage.
- Damage to the product due to non-compliance with the product manual.
- Disassemble or repair the product without the permission of the company.
- Product damage caused by irresistible external forces such as natural disasters and fires.

7.4 Technical Support

If a fault occurs that cannot be rectified, please contact us as follows.

- Tel: +86-757-22218956
- Email: lixianjiao@hinson-xs.com
- Company website: www.hinson-xs.com
- Manufacturer: Guangdong Hinson Technology Co., Ltd.
- WhatsAPP:+8618670078135