LE-50711F/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	**Date**
V1.0	Release	

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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）
Laser parameters	
Light source	Laser diode
Laser class	Class 1（IEC 60825-1:2014,EN 60825-1:2014）（Do not look directly）
Wavelength	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 (5 setting)
Ambient light limitation	Resistant to sunlight（<80000 Lux）
Multiple echo description	LE-50711F：Single echo function
	LE-50711FA： Support multi echo function, support first echo, second echo, last echo, maximum energy
Measurement accuracy	
Absolute accuracy	±20mm
Measurement accuracy	±10mm
Angle resolution	Minimum 0.018°, 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	RS485-Modbus, Output switch value obstacle avoidance data
	CAN open, Output switch value obstacle avoidance data
	Ethernet TCP/UDP output 360° original test 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
Operating ambient humidity	<80%RH
Storage ambient temperature	Storage temperature（-20℃-70℃）
Mechanical specifications	
Protecting class	IP65
Connection port	M12-4 female cable, Ethernet port
	M12-6 female cable, power and communication port
Material	Base, aluminum alloy
	Scan window, PUMA

2 PREPARATION

2.1 CONFIGURATION LIST CONFIRMATION FORM

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.

Name	Model	Quantity	Description
Navigation Lidar sensor	LE-50711	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

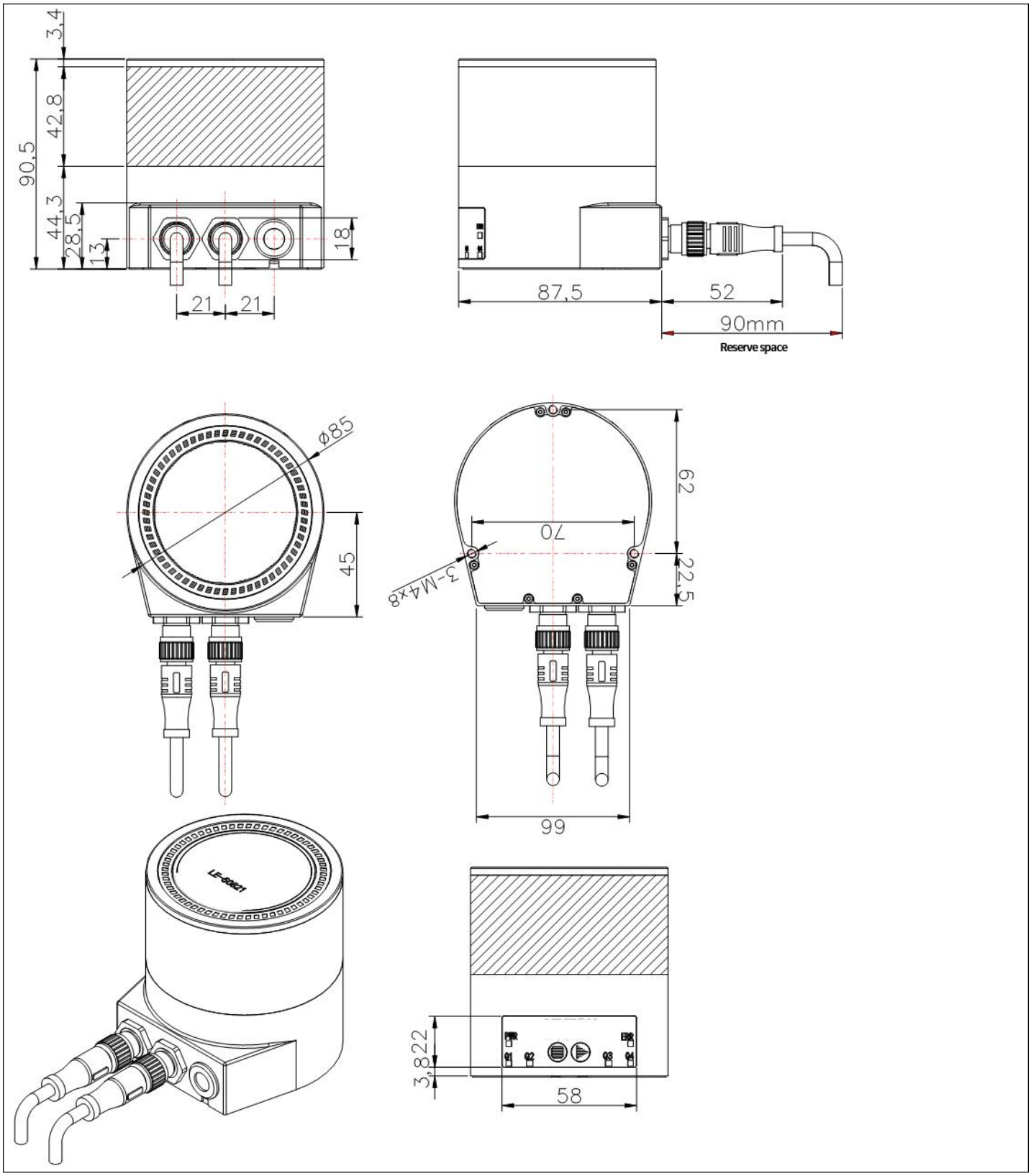
2.2 CONFIGURATION TOOL

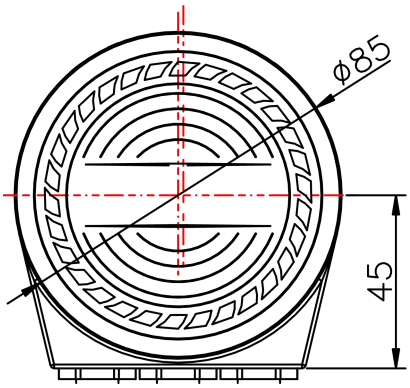
The following software and hardware are needed for auxiliary configuration：

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

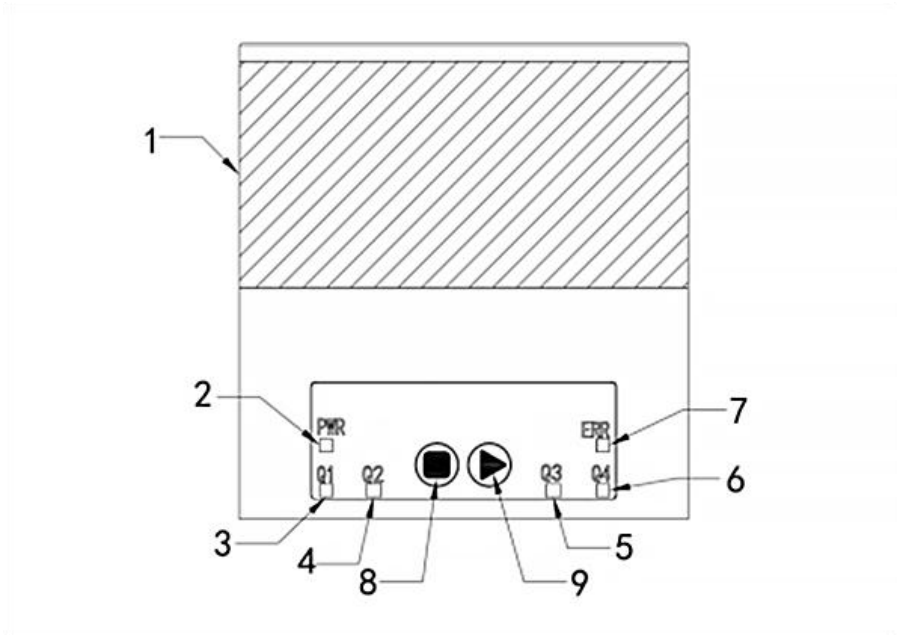
3.1 PRODUCT DIMENSIONS



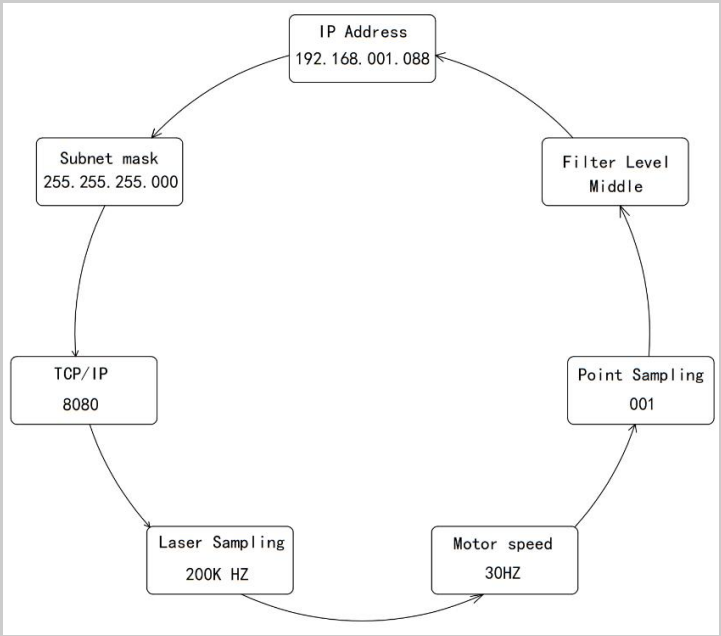


Unit：mm

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 orange
6	Q4	Not defined	Invalid
7	ERR	Fault status indicator	The indicator light is orange when the sensor is faulty

8		Window display content switching	Press this button to switch the display between "scanning range display" and "customized Chinese and English display" 
9		Window display content switching	Press this button "IP address", "subnet mask", "port number", "laser scanning frequency", "scanning motor speed", "single point sampling times", "noise filtering level" to switch the display sequentially 

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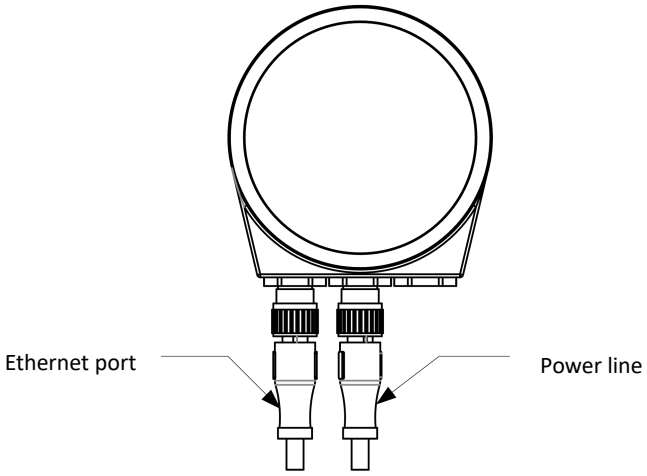
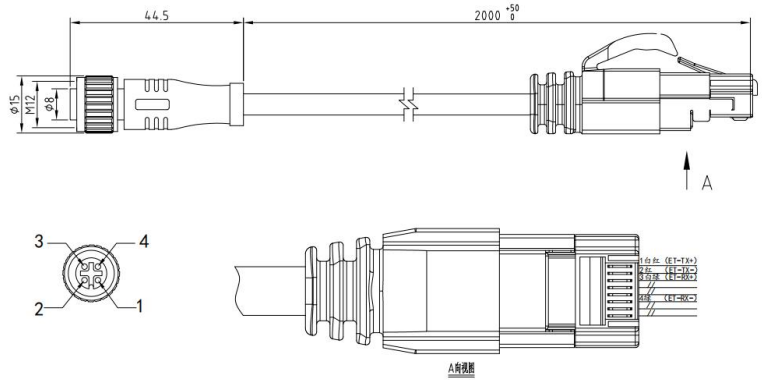
3.3 CONNECTOR

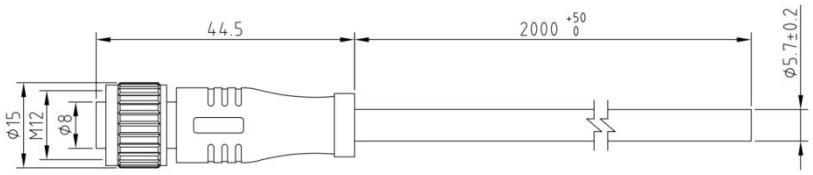


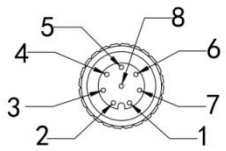
Ethernet port：



Cable model	NO.	Color	Symbol	Function description
HCX4L20BE	Pin1	White&Red	Tx+	Ethernet TX+
	Pin2	Red	Tx-	Ethernet TX-
	Pin3	White&Green	Rx+	Ethernet RX+
	Pin4	Green	Rx-	Ethernet RX-

Power and communication port：

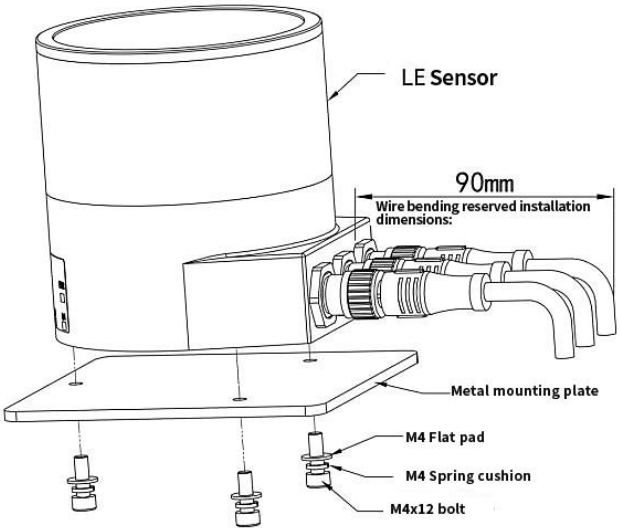




PIN1 White A
PIN2 Brown VCC
PIN3 Green GND
PIN4 Yellow B
PIN5 Grey C-H
PIN6 Pink C-L
PIN7 //
PIN8 //

Cable model	NO.	Color	Symbol	Function description
HCX6L20BX	Pin1	White	A	RS485-A
	Pin2	Brown	VCC	Power positive input
	Pin3	Green	GND	Power negative input
	Pin4	Yellow	B	RS485-B
	Pin5	Gray	C-H	CAN bus H
	Pin6	Pink	C-L	CAN bus L

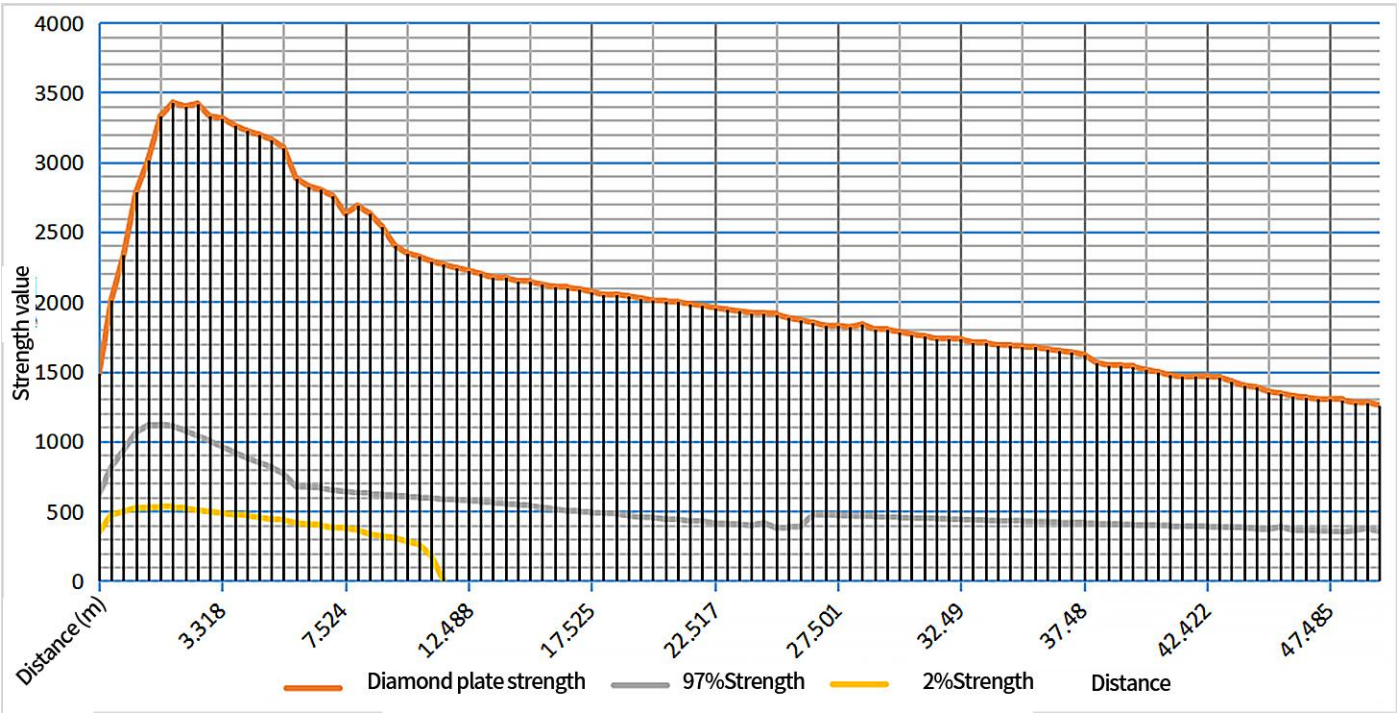
3.4 INSTALLATION REQUIREMENTS



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

4 STRENGTH AND DISTANCE

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



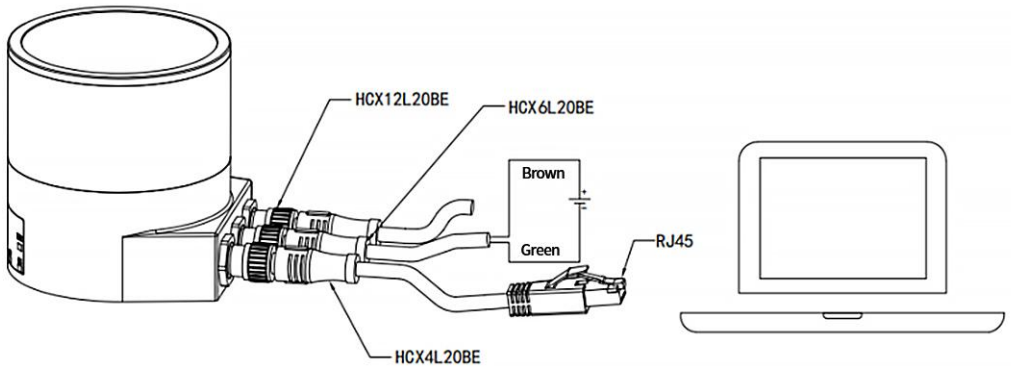
5 FUNCTION CONFIGURATION

5.1 DEVICE PREPARATION

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

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"

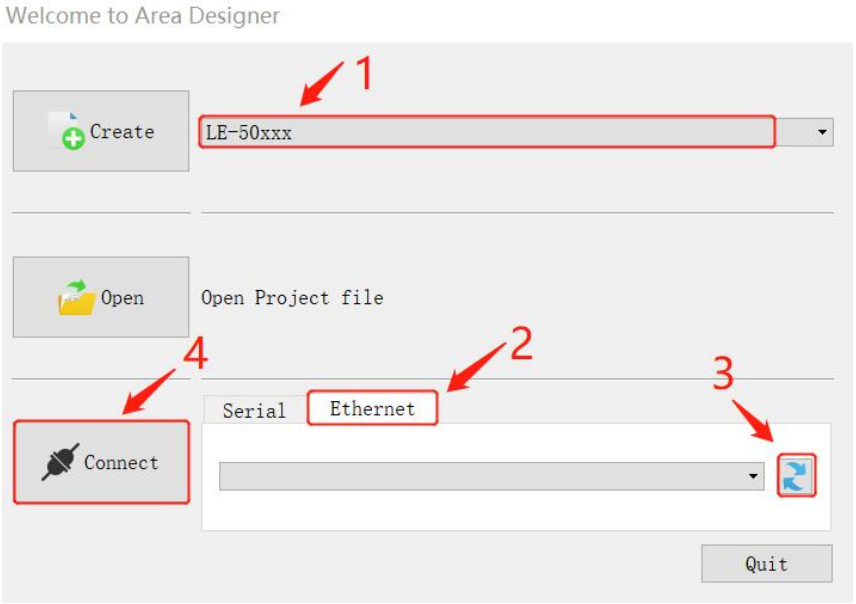
Fill in the computer's IP address 192.168.1.10, subnet mask 255.255.255.0, and click the OK button. It should be noted that the last digit of the computer's IP address 192.168.1.10 ranges from 1-254, and the sensor's IP address defaults to 192.168.1.88. The last digit here must be different from the last digit of the sensor's IP address. Please note that 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：

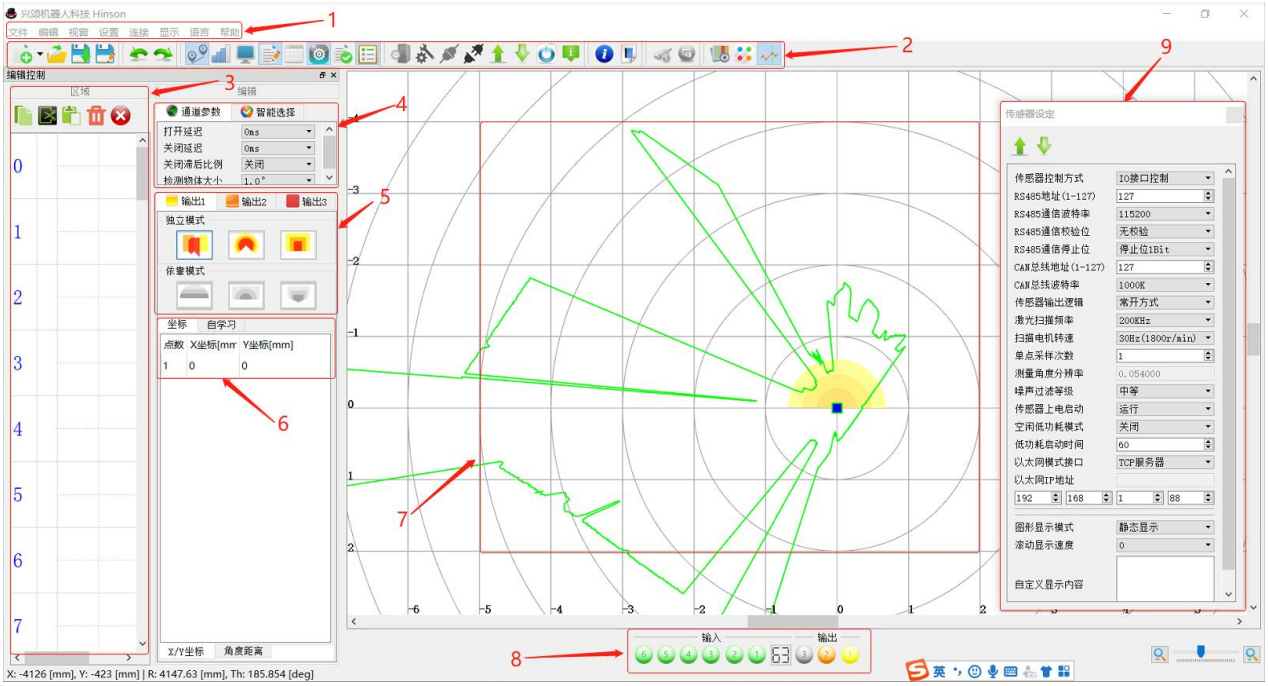
Unzip the configuration 

software，double-click 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 file	-		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 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 information	-		-

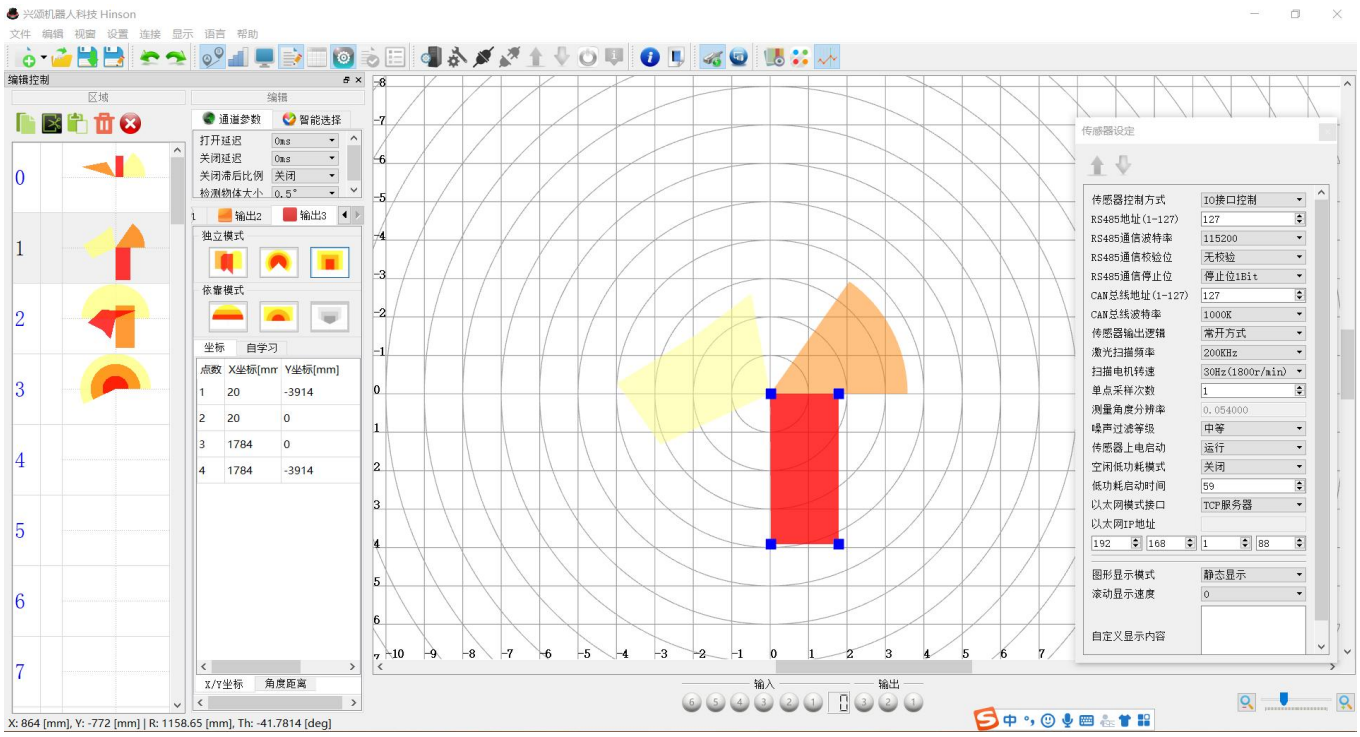
Display	Graphic display	-		Click the icon to display the 360° scan profile of the sensor as a flat graphic
	Point cloud display	-		Click the icon to display the 360° scan profile of the sensor as a point cloud
	Line display	-		Click the icon to display the 360° scan outline of the sensor as a line
Language	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

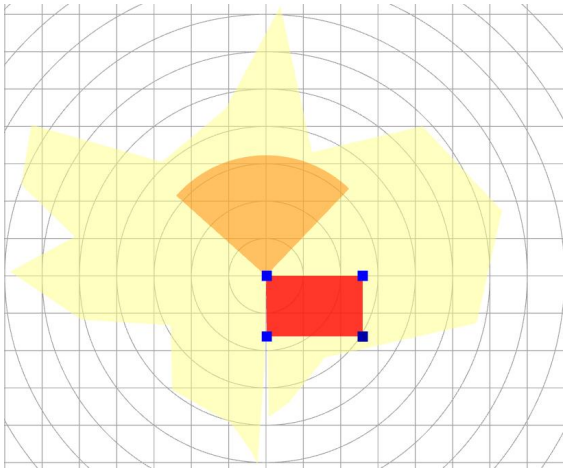
Part3: Graphical Editing of Detection Channels

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.

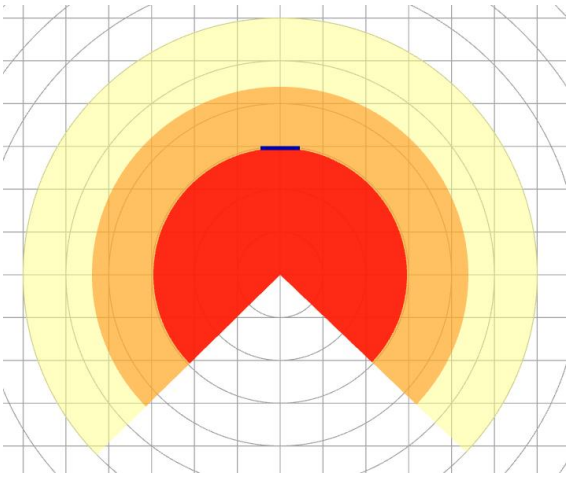


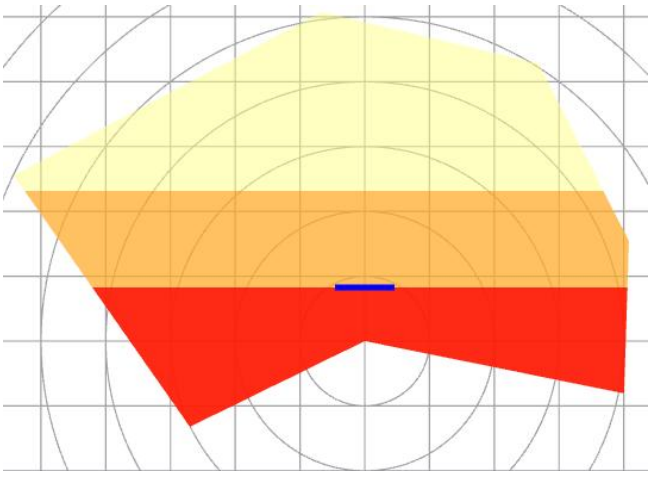
Part 4: Channel detection graphics output 1, output 2, output 3 editing mode.

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.



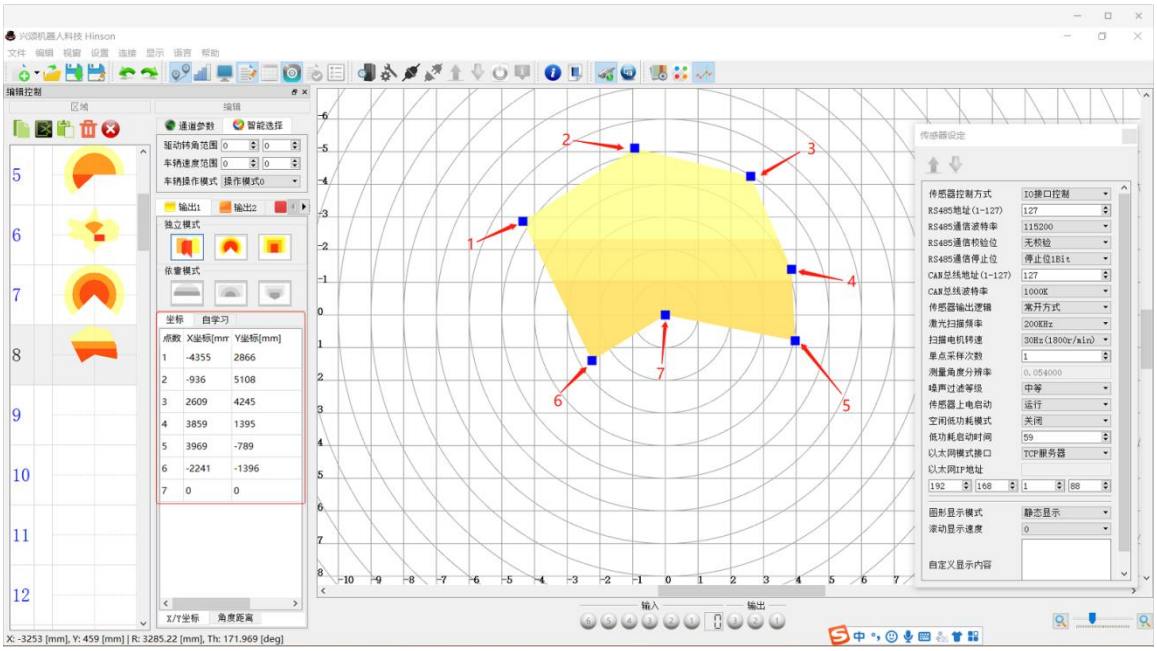
Dependent mode: After setting the graphics of output 1, you can select the dependent mode to copy the graphics of output 1 in different proportions.





Part 5： Coordinates and their angle values

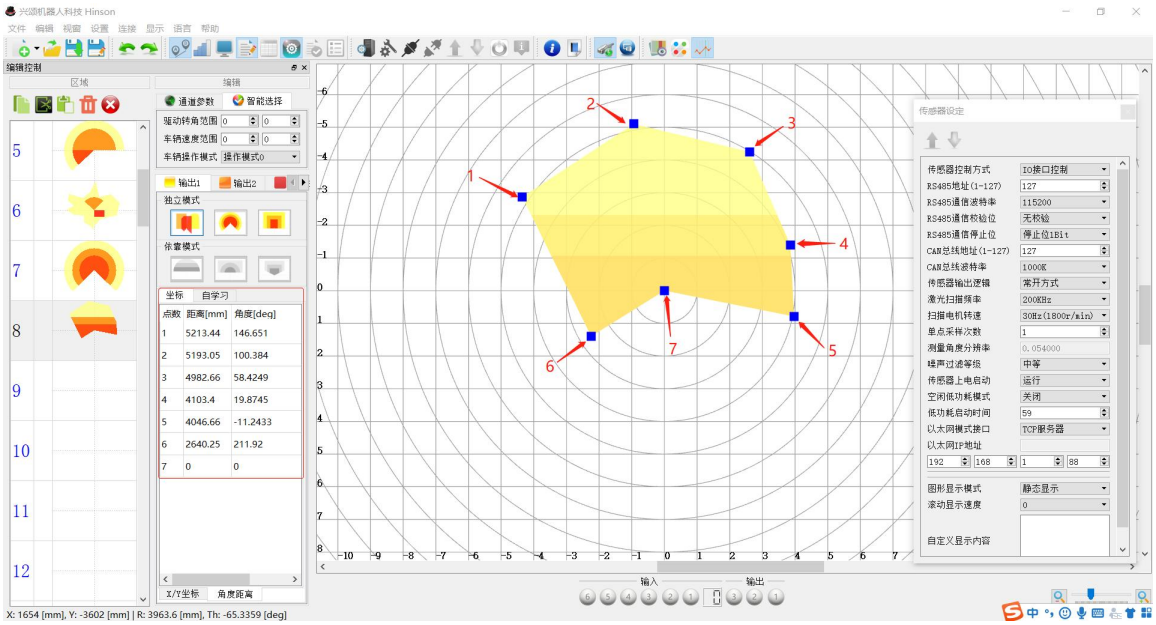
Coordinates (X, Y) of each point of irregular graph in independent mode



Remarks: The 7th point is the origin of coordinates

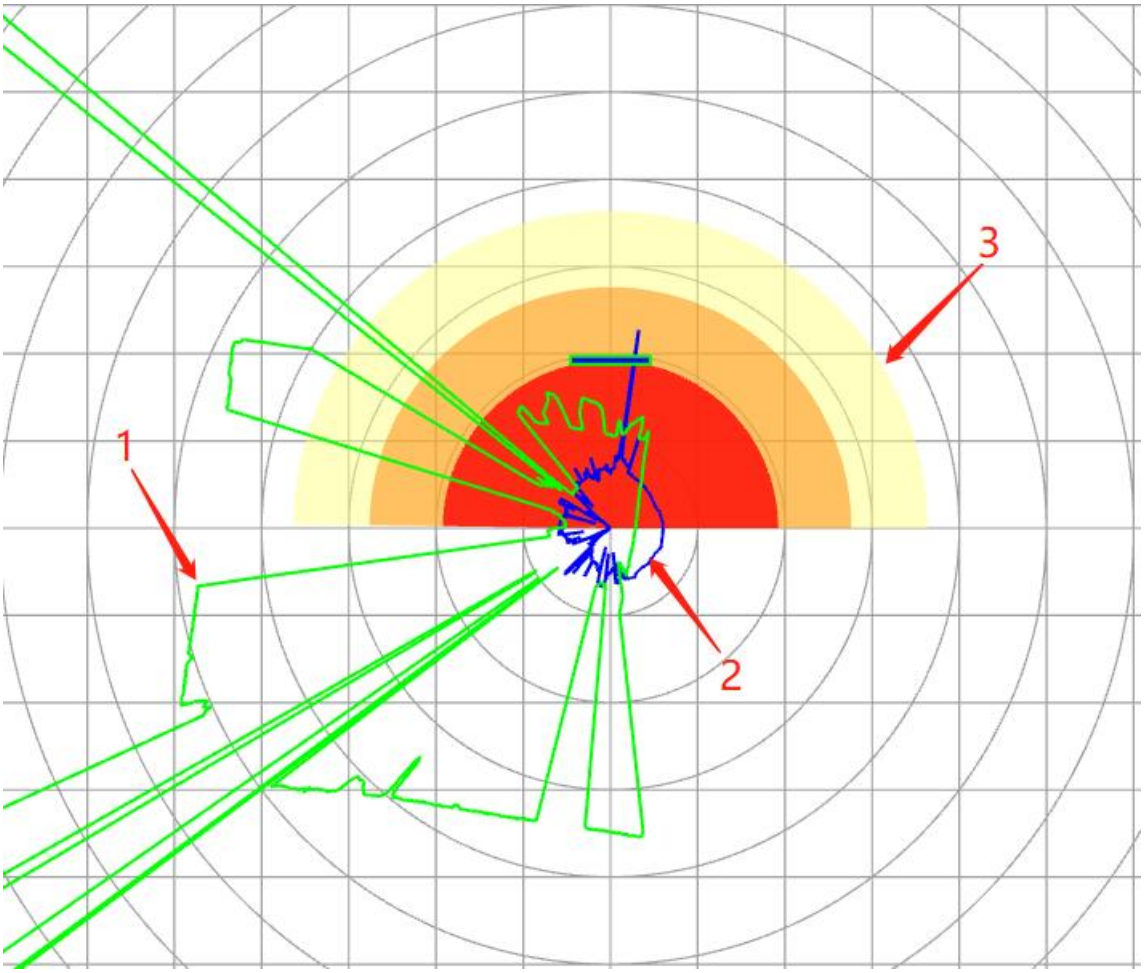
The distance and angle between each point of the irregular shape and the origin of the coordinate in the independent

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

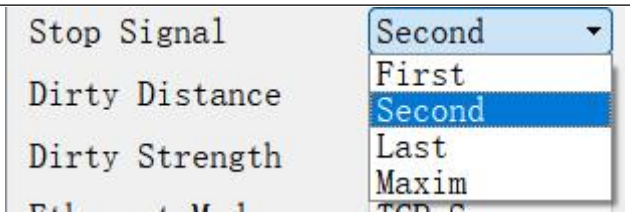
Parameter list	Parameter value	Remark
Sensor control method	IO interface control	When selecting sensor channel for input, select one of IO, Modbus, and Canopen. Only one of them can be valid at the same time, and IO is always valid when outputting.
	Modbus control	When the sensor channel is selected 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	9600bps	RS485 Communication baud rate setting

baud rate	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	
CAN bus address （1-127）	1-127	CANbus address 1-127 Can be set
CAN bus baud rate	125K	CAN bus 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 start	Dormant	Set the power-on state of the sensor
	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

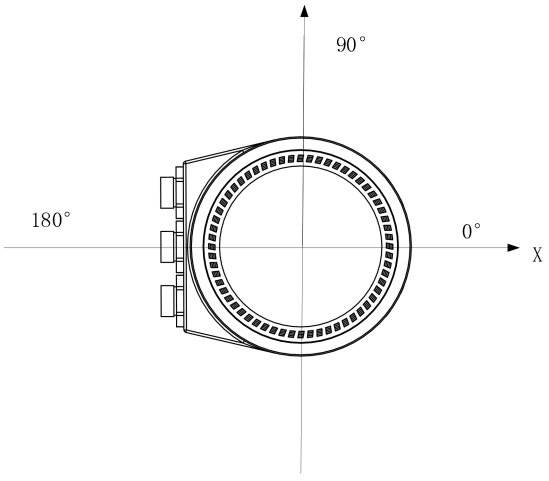
5.3 MULTI-ECHO SETTING (FOR LE-50711FA ONLY)



First time	Normal mode, no filtering function
Second time	Select the second echo, with filtering function (recommended option for echo function)
Last time	Select the last echo, with filtering function
The most energy	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 SENSOR COORDINATE SYSTEM

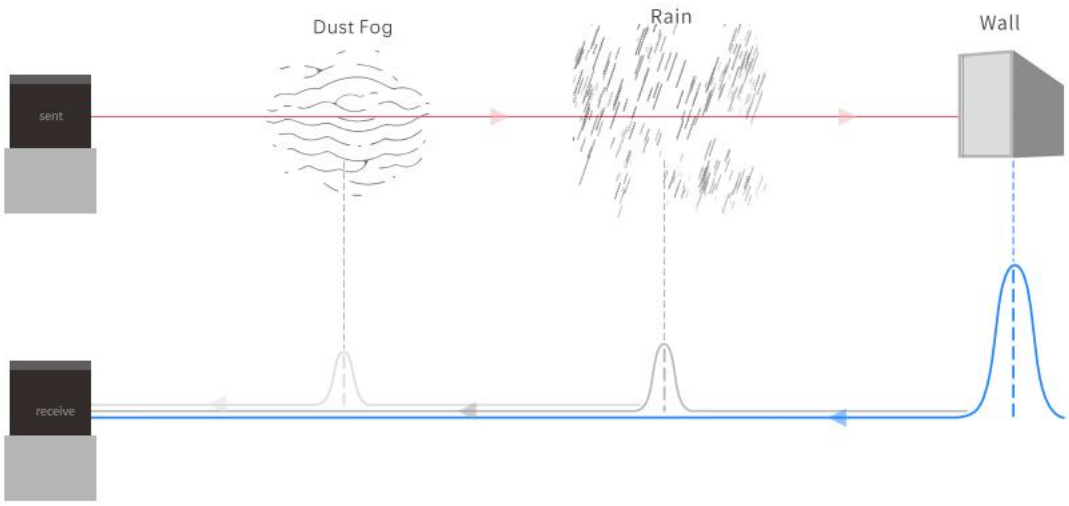


6.2 MULTIPLE ECHO TECHNOLOGY

6.2.1 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.

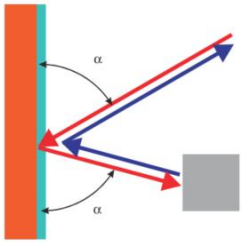
In order to be able to display the echoes as individual measured values, there must be a minimum distance of about 2.5 m between two objects.



6.2.2 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

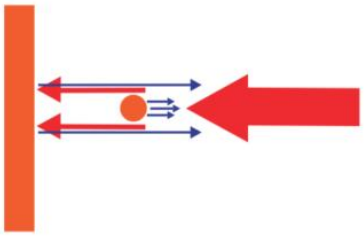
- **Detect small objects or no objects**

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;

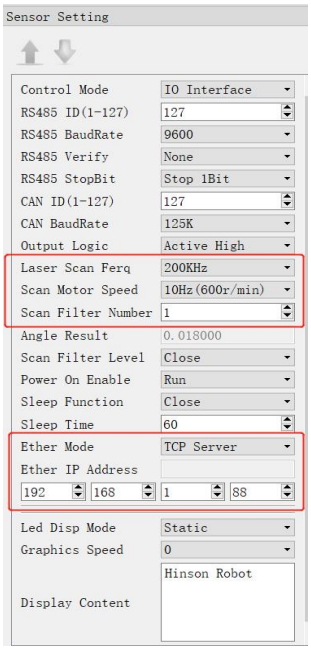


The object is smaller than the laser beam diameter

6.3 ETHERNET DATA TRANSMISSION

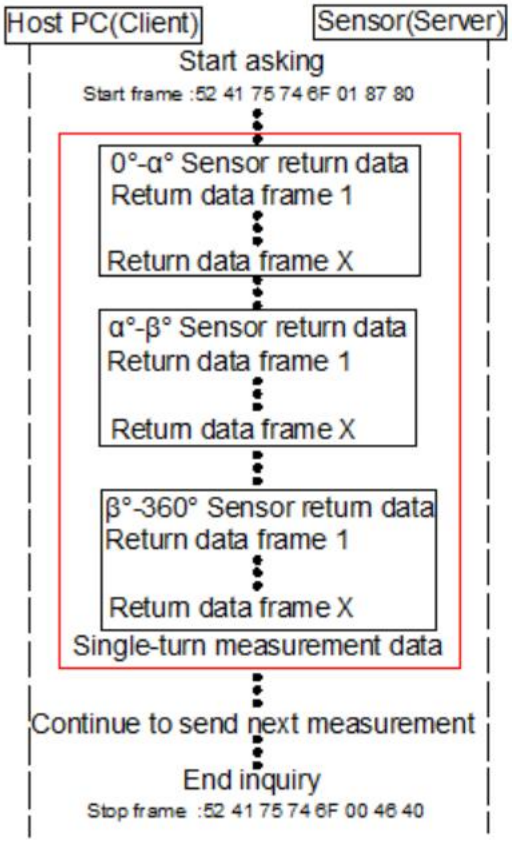
◆ Parameter setting

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

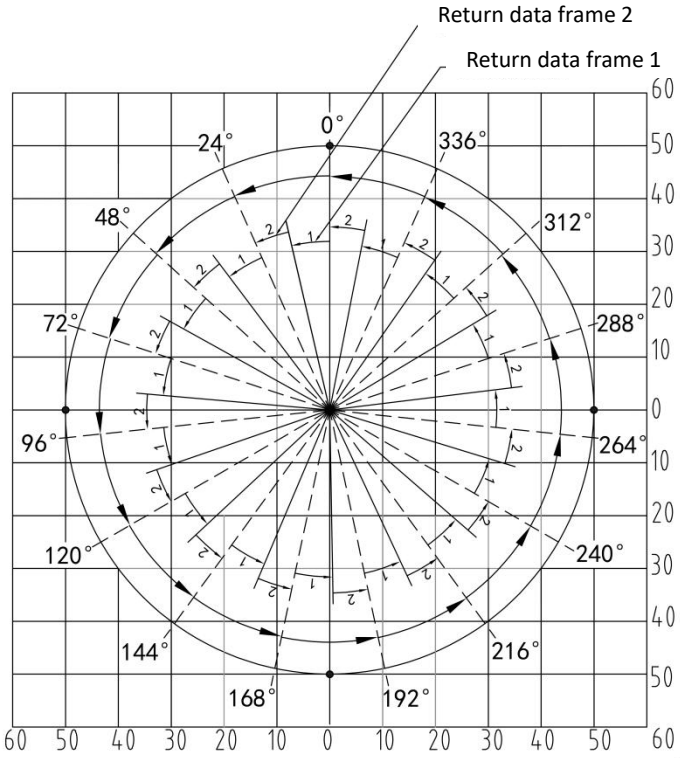


Parameter name	Parameter value	Defaults
Ethernet mode	TCP Server UDP Mode	TCP Server
Ethernet IP address	IP address: 192.0.0.1 to 223.255.255.254 Subnet mask: 255.255.255.0 (fixed) Port number: 8080 (fixed)	192.168.1.88
Laser scanning frequency	50KHZ、100KHZ、150KHZ、200KHZ	200KHZ
Scanning motor speed	10HZ、15HZ、20HZ、25HZ、30HZ	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°.



(Unit: m)

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

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):

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°. The total number of measurement points in the current data frame is the number of measurement points contained in the current data frame.

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

For example: the total number of measurement points within the range 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 points, so the value of "the sequence number of the last detection point in the current data frame" is 355. If the current data frame returns the data from the 356th to the 667th points, then the value of "the sequence 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 within the current 24° measurement range.

7. Time stamp (2Byte):

The internal timing time when the current 24° data is measured, the time unit is us, the time recording range is 0-65535us, and the data is cleared after the record is full.

Measurement data（Hex）:

First point measurement data（4Byte）				Second point measurement data（4Byte）				……（4Byte）				Last point measurement data（4Byte）			
Measuring distance (2Byte)		Measuring distance (2Byte)		Measuring distance (2Byte)		Measuring distance (2Byte)		Measuring distance (2Byte)		Measuring distance (2Byte)		Measuring distance (2Byte)		Measuring distance (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

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)	

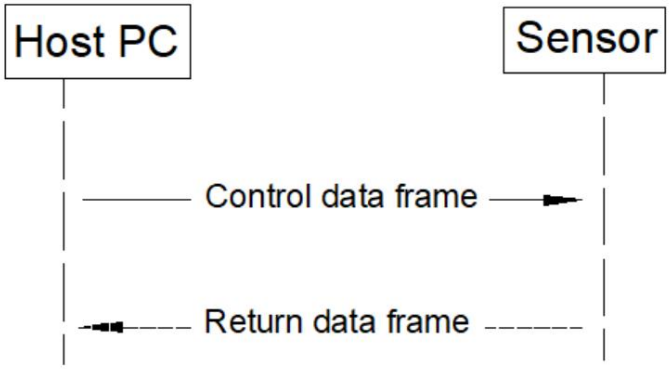
Reflective intensity of the 4th detection point	0x xx	L(Low priority)	
	0x xx	H(High behind)	
↓ ↓			
Distance of the 354th detection point	0x xx	L(Low priority)	
	0x xx	H(High behind)	
Reflective intensity of the 354th detection point	0x xx	L(Low priority)	
	0x xx	H(High behind)	
Distance of the 355th 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)	

6.4 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 times	Noise filtering level

Dormant control -- Contrary to the control data representation.

0x01：Indicates that the sensor is currently dormant.

0x00：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

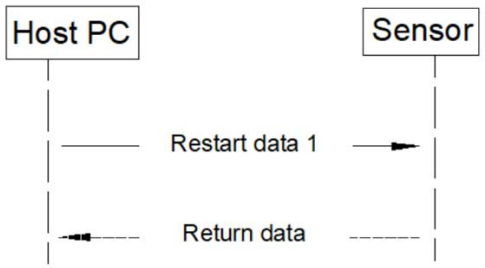
Check bit

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）

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



Transmitting 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 RS485-MODBUS PROTOCOL

7.1 COMMUNICATION SPECIFICATIONS

The basic parameters of the serial port need to be set before communication. The following parameters are the basis for establishing communication.

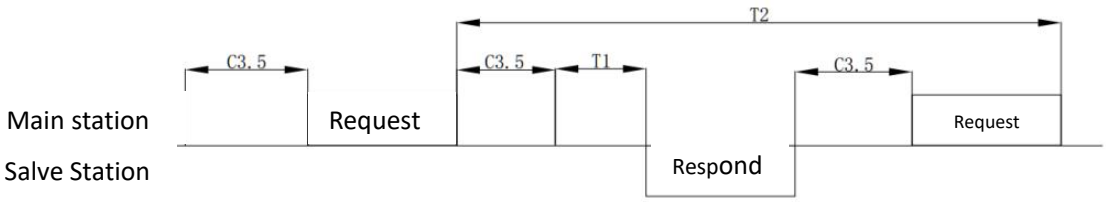
	Parameters	**Default setting**
Communication way	Single master/multi-slave mode	
Operating mode	MODBUS RTU mode	RTU mode
Accept/send method	Half-duplex communication mode	

Communication ID	1-127 configurable	1/127
Communication rate	9600bps， 19200bps， 38400bps，576000bps，115200bps	115200bps
Data bit	8 bit	8 bit
Check bit	No parity; odd parity; even parity	No parity
Stop bit	1 bit；2 bit	1 bit

7.2 MASTER-SLAVE COMMUNICATION TIMING

The communication mode of MODBUS protocol is single-master/multi-slave mode.

Main station transmit request to station1. slave station responses.

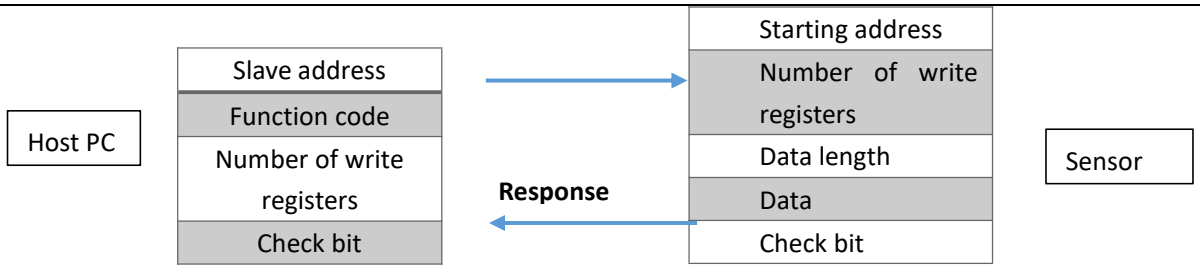


Serial number	Name	Content
C3.5	Quiet interval	As the sending waiting time, please be sure to leave an interval of 3.5 words or more. If the number of words is not full, the sensor cannot respond. When the communication speed exceeds 19200 bps, please keep the interval at least 1.75 ms.
T1	Send waiting time	After receiving the inquiry from the master station, the slave station switches the communication line to the sending state, and the time until it starts to reply to the response. In order to send a waiting time of 10 ms. The actual sending waiting time will become the static interval (C3.5) + command processing time + sending waiting time (T1)
T2	Communication timeout	Can be configurable within 0.05s – 1s

7.3 DATA STRUCTURE

Write holding register data format

Request	**Respond**
	Slave address
	Function code



◆ Inquiry information structure

Slave address code	Function code	Starting address	Number of write registers	Data length	Data	Check bit
1Byte	1Byte	2Byte	2Byte	1Byte	（Number of write registers）*2 Byte	2Byte

●Slave address

The specified slave address, the slave sensor address set by the configuration software.

●Function code

The write function code information supported by the sensor is as follows:

Function code	Function
16	Write data to the holding register

●Starting address

The starting address of the holding register written from the sensor starts from 2000;

●Number of write registers

The number of registers that need to write data from the starting address.

●Data length

The length of the data written into the register = the number of the written register * 2 number.

●Data

The data that needs to be written from the starting address, the amount of data = the number of registers written * 2Byte.

●Check bit

Communication check bit

◆ Response message structure

After receiving the inquiry information, the slave station responds, and the response data is as follows:

Slave address code	Function code	Starting address	Number of write registers	Check bit
1 Byte	1 Byte	2 Byte	2Byte	2 Byte

●Slave address

The specified slave address, the slave sensor address set by the configuration software.

●Function code

The write function code information supported by the sensor is as follows:

Function code	Function
16	Write data to the holding register

●Starting address

The starting address of writing the holding register from the sensor, starting from 2000.

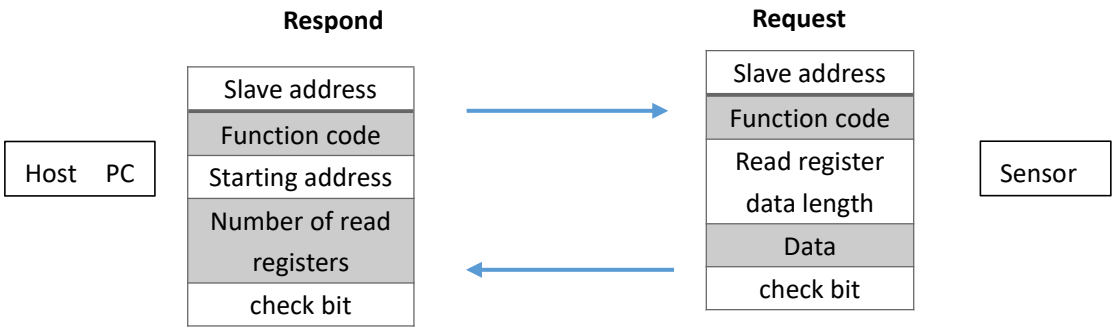
●Number of write registers

The number of registers to write data from the starting address.

●Check bit

Communication check bit

◆ Read input register data format



◆ Inquiry information structure

Slave address code	Function code	Starting address	Number of read registers	Check bit
1 Bye	1 Bye	2Bye	1Byte	2Byte

●Slave address

The designated slave address, the slave sensor address set after configuring the software.

●Function code

The read function code information supported by the sensor is as follows:

Function code	Function
04	Read data from input register

●Starting address

The starting address of the register read from the sensor, starting from 1000.

●Number of read registers

The number of registers read from the starting address.

●Check bit

Communication check bit

◆ Response message structure

After receiving the inquiry information, the slave station responds, and the response data is as follows:

Slave address code	Function code	Read register data length	Data	Check bit
1 Byte	1 Byte	1 Byte	（ Number of read registers）*2 Byte	2 Byte

●Slave address

The designated slave address, the slave sensor address set by the configuration software.

●Function code

The read function code information supported by the sensor is as follows:

Function code	Function
04H	Read data from input register

●Read register data length

The length of the register data that the host computer needs to read.

●Data

The data of the register that the host computer needs to read. Since one register is 2 Bytes, the data length of this section is the number of read registers * 2 Byte.

●Check bit

Communication check bit

7.4 REGISTER DEFINITION

Write to holding register function (function code 16)

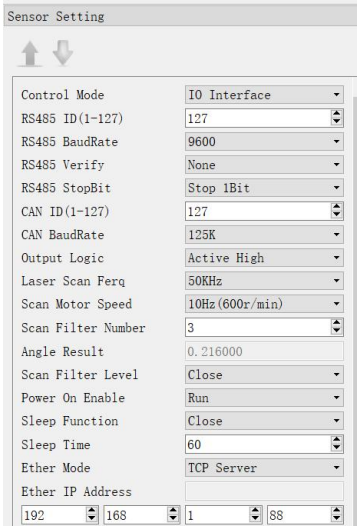
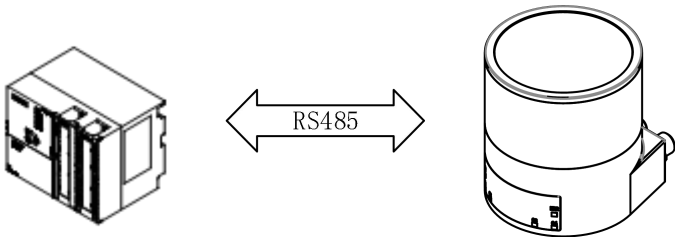
Register address	Write value	Content
2000	00 - 01	Sensor working mode 00：Channel selection mode 01：intelligent channel selection mode
2001	00 - 63	Control the sensor channel value in channel specified mode 1-63
2002	-180-180	Switching angle value in intelligent channel selection mode
2003	-300-300	Switching speed value in intelligent channel selection mode
2004	00 - 04	Channel group number in intelligent channel selection mode 0-4

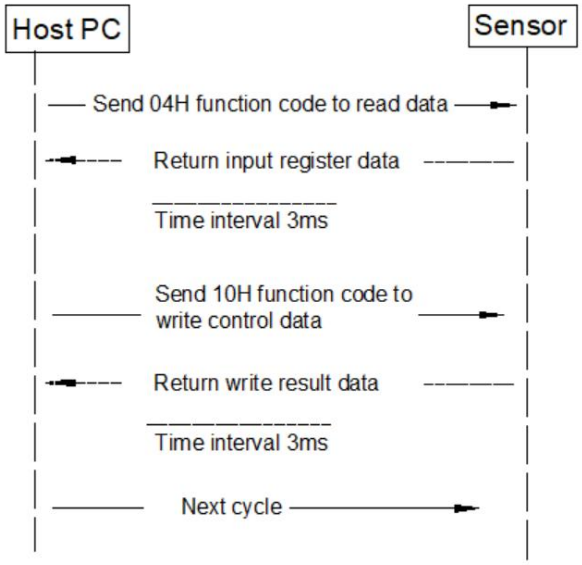
Read input register function (function code 04)

Register address	Read value	Content
1000	00 - 63	Sensor current channel value
1001	00 – 01	Sensor Out2 output status Related to the sensor output logic of the parameter setting item: Normally closed mode (default) 00：Object detected 01：No object detected Normally open 01：Object detected 00：No object detected
1002	00 – 01	Sensor Out1 output status Related to the sensor output logic of the parameter setting item: Normally closed mode (default) 00：Object detected 01：No object detected Normally open 01：Object detected 00：No object detected
1003	00 – 01	Sensor Out3 output status Related to the sensor output logic of the parameter setting

		item: Normally closed mode (default) 00：Object detected 01：No object detected Normally open 01：Object detected 00：No object detected
1004	0-7	Display the current state of the sensor, the value range is 00-07; 00：Normal state of the sensor 01-07：Sensor failure status

7.5 SERIAL PORT TO TRANSMIT DATA

Sensor setting parameters	
	1) Configure according to the left picture
Connect	
	Host computer: client data sending equipment, which can be single-chip microcomputer, PLC, industrial computer, etc. Sensor: Model LE50821
Send data timing	



Send 04H function code to read data frame

The upper computer reads the sensor input register parameters, the following is the analysis of the hexadecimal data sent in a single time.

0x01	0x04	0x03 0xE8(1000)	0x00 0x05	0xB0 0x79
Sensor RS485 address code	Read input register function code	Need to read the start address of the input register	Need to read the number of registers	Check bit
1Byte	1Btye	2Byte	2Byte	2Byte

Returns the input register data frame

0x01	0x04	0x0A	0x00 0x00 0x00 0x01 0x00 0x01 0x00 0x00 0x00 0x00	0xFC 0x7D
Sensor RS485 address code	Read input register function code	Return register data length	Data	Check bit
1Byte	1Btye	1Byte	10Byte	2Byte

Data

0x00 0x00	0x00 0x01	0x00 0x01	0x00 0x00	0x00 0x00
1000 address data	1001 address data	1002 address data	1003 address data	1004 address data
The sensor is currently channel 0	Sensor Out2 output status: No object detected	Sensor Out1 output status: No object detected	Sensor Out3 output status: Object detected	Display the current state of the sensor Normal status

Send 10H function code to write control data frame

The upper computer writes the sensor holding register parameters, the following is the analysis of the hexadecimal data sent in a single time.

0x01	0x10	0x07 0xD0(2000)	0x00 0x05	0x0A	See the table below	0x97 0xEA
Sensor RS485 address code	Read input register function code	Need to write the starting address of the holding register	Need to write the number of registers	Write register data length	Data	Check bit

1Byte	1Btye	2Byte	2Byte	1Byte	10Byte	2Byte

Data

0x00 0x00	0x00 0x00	0x00 0x00	0x00 0x00	0x00 0x00
2000 address data	2001 address data	2002 address data	2003 address data	2004 address data
The sensor currently specifies the mode for the channel	The sensor is switched to channel 0	In channel designation mode: Invalid	In channel designation mode: Invalid	In channel designation mode: Invalid

Return data frame of writing result

0x01	0x10	0x07 0xD0(2000)	0x00 0x87
Sensor RS485 address code	Write to holding register function code	Write the start address of the holding register	Check bit
1Byte	1Btye	1Byte	2Byte

8 CAN OPEN DATA PROTOCOL

In the Can open mode, only the switch of signal of the detected obstacle can be output, and the Ethernet mode can only output the sensor measurement data.

8.1 BASIC CONCEPTS

Electronic Data Files（EDS）: A directory used to record and describe all the parameters of a CANopen node; all CAN open parameters such as the type, manufacturer, serial number, version information, baud rate, etc. of the node can be obtained through the EDS file. When using the CAN OPEN function in PLCs, etc., you need to import the EDS file first, and configure it through the object dictionary recorded in the EDS.

Service Data Object（SDO）: SDO is mainly used for the parameter configuration of the CAN OPEN master station to the slave station node. After each SDO message is sent, there will be a response message to ensure that the message is delivered accurately. In a CAN OPEN communication system, there is usually only one master station as the client, and the slave node as the SDO server responds to the SDO message. The client of the master station accesses and modifies the corresponding index parameter in the EDS of any node through the SOD message.

Process Data Object（PDO）:PDO is used to transmit real-time data, one-way transmission, without receiving the response from the slave node, a PDO message can transmit up to 8 bytes of data, which is mainly used to transmit real-time data. The master node and the slave node predefine the sending data and receiving data corresponding to the PDO, so there is no need to reconfirm during the transmission process, and there is no response time and response data, thereby improving the bus utilization.

8.2 COMMUNICATION SPECIFICATIONS

Communication way	Bus mode

Communication rate	1000k(default)，500k，250k，125k
Communication address	1-127(default)
TPDO	4
RPDO	4
Online message	Support
Heartbeat message	Support
Heartbeat consumption	Support
SDO	Support

8.3 CONTROL MESSAGE

The sensor node supports the control message (NMT Module Control message) sent by the master station, and the control message information does not respond.

Message format

COB-ID	DLC	Byte 0	Byte 1
0x 000	1	CS control function code	Node-ID

CS：Control function code

Command code	NMT service	Effect
0x01	Enter operating state	Node starts PDO sending and receiving status
0x02	Enter the stop state	The node enters the stopped state
0x80	Enter pre-operational state	The node enters the pre-operational state, which is used to configure PDO mapping and parameter setting
0x81	Reset node	Reset the application layer of the node, and the communication parameters are restored to the initial state values
0x82	Reset communication	Reset the node communication, reinitialize the communication when the communication is disturbed, the node bus is wrong, and the bus is closed

Node-ID：node address, when Node-ID=0, all nodes are controlled.

8.4 NODE ONLINE MESSAGE

After the sensor node is powered on and initialized, it sends a frame of online message.

Message format

The frame ID of the node online message is 0x700+Node-ID, the data length is 1, and the data is 00.

COB-ID	DLC	Byte 0
0x 700+Node-ID	1	00

8.5 HEARTBEAT MESSAGE

Sensor nodes support heartbeat message sending, configure the heartbeat time according to index 0x1017, and send heartbeat messages.

Index	Subindex	Data type	Defaults	Describe
0x1017	None	Uns 16	0x00	Configure the sending period of heartbeat messages, Unit ms;

Message format

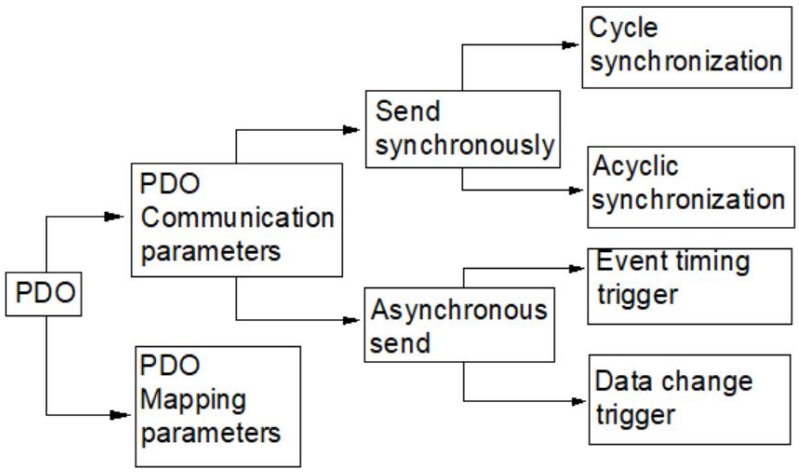
COB-ID	DLC	Byte 0
0x 700+Node-ID	1	Status code

The frame ID of the node online message is 0x700+Node-ID, the data length is 1, and the data represents the current node status.

Status code

Status code	Status
0x05	Enter operating state
0x04	Enter the stop state
0x7F	Enter pre-operational state

8.6 PROCESS DATA OBJECT（PDO）



PDO transmission/reception is observed by the (slave) CAN node.
The sensor node defines 1 TPDO and 1 RPDO.

PDO message format

COB-ID	**DLC**	**Data**
	1-8	1-8Byte

COB-ID

Object	**COB-ID**
TPDO1（Transmit）	0x180+Node ID
RPDO1（Receive）	0x200+Node ID

Data (1-8Byte): The length is determined by the mapping data in the mapping parameters.

PDO communication parameters

Index	**Subindex**	**Data type**	**Default**	**Description**
RPDO	0x00	Uns 8	0x08	Number of parameter entries

0x1400 TPDO 0x1800	0x01	Uns 32	0x 00	COB-ID
	0x02	Uns 8	0x 00	Synchronization type
	0x03	Uns 16	0x 00	Synchronization type
	0x05	Uns 16	0x 00	Event timer trigger time (unit: ms)

Number of parameter entries: This citation contains the number of sub citations.

COB-ID： Receive and send the frame ID of the current PDO

Synchronization type:

Synchronization type	Trigger conditions (B=satisfy two conditions, O=satisfy one condition)			PDO transmission
	SYNC (Sync message received)	RTR (Remote Frame Received)	Event (data change or timer)	
00	B	-	B	Acyclic synchronization
01-240	O	-	-	Cycle, synchronization, (1-240 values represent the number of SYNC messages received between two PDO messages)
241-251	-	-	-	Reserve
252	B	B	-	Sync, after RTR
253	-	O	-	Asynchronous, after RTR
254	-	O	O	Asynchronous, manufacturer specific event
255	-	O	O	Asynchronous, device sub-protocol specific event

Production prohibition time： The minimum interval between two PDO transmissions to avoid excessive PDO transmissions, resulting in increased bus load.

Event timer trigger time： PDO timing transmitting cycle time ；

PDO mapping parameters

Set the data in the corresponding index that the current PDO needs to transmit, and complete the custom transmission of data by setting the PDO to map to the corresponding index. The length of a PDO is a maximum of 8 Bytes, and the length of the mapped data cannot exceed 8 Bytes. The sensor has a default mapping, and the mapping can be changed according to requirements;.

RPDO default mapping

Only RPDO1 is used in the default mapping

Index	Subindex	Data type	Default	Describe
RPDO1 0x1600	0x00	Uns 8	8	Number of parameter entries
	0x01	Uns 32	0x20000008	8-bit length data mapped to index 0x2000 and sub-index 0x00
	0x02	Uns 32	0x20010008	8-bit length data mapped to index 0x2001 and sub-index 0x00
	0x03	Uns 32	0x20020008	8-bit length data mapped to index 0x2002 and sub-index 0x00

	0x04	Uns 32	0x20030010	16-bit length data mapped to index 0x2003 and sub-index 0x00
	0x05	Uns 32	0x20040010	16-bit length data mapped to index 0x2004 and sub-index 0x00;
	0x06-0x08	Uns 32	0x00	Unmapped

TPDO default mapping

Index	Subindex	Data type	Default	Describe
TPDO1 0x1A00	0x00	Uns 8	8	Number of parameter entries
	0x01	Uns 32	0x20050008	8-bit length data mapped to index 0x2005 and sub-index 0x00
	0x02	Uns 32	0x20060008	8-bit length data mapped to index 0x2006 and sub-index 0x00
	0x03	Uns 32	0x20070008	16-bit length data mapped to index 0x2007 and sub-index 0x00
	0x04	Uns 32	0x20080008	16-bit length data mapped to index 0x2008 and sub-index 0x00
	0x05	Uns 32	0x20090008	16-bit length data mapped to index 0x2009 and sub-index 0x00
	0x06-0x08	Uns 32	0x00	Unmapped

8.7 SERVICE DATA OBJECT（SDO）

Send message format

COB-ID	DLC	LBS							MBS
0x600+Node-ID	8	Control function code	Object index	Object sub-index		Up to 4 bytes			

Control function code

Command code	Describe
0x40	Command word when sending message
0x2F	Indicates that the sent data is 1 byte
0x2B	Indicates that the sent data is 2 byte
0x23	Indicates that the sent data is 4 byte

Node response message format

COB-ID	DLC	LBS						MBS
0x580+Node-ID	8	Receive command code	Object index	Object sub-index	Up to 4 bytes			

Control function code

Command code	Describe
0x60	SDO message sent successfully
0x80	SDO message error
0x4F	Indicates that the received data is 1 byte
0x4B	Indicates that the received data is 2 byte
0x43	Indicates that the received data is 4 byte

8.8 EDS FILE

For EDS file please visit www.hinson-xs.com.

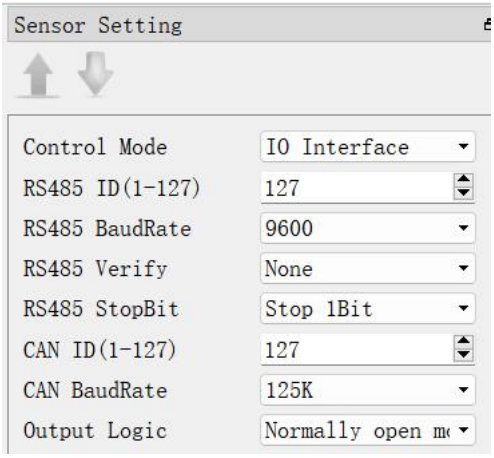
8.9 INDEX DEFINITION

Index (Hex)	Sub Index (Hex)	parameter name	Type	Attributes	Write value (D): function
0x2000	0x00	Mode selection	UNS 8	Read/Write	00：Channel selection mode 01：Channel intelligent selection mode
0x2001	0x00	Channel value	UNS 8	Read/Write	In channel designated mode: the value range is 00-63, and the control sensor is switched to the designated channel
0x2002	0x00	Channel group value	UNS 8	Read/Write	In the channel intelligent selection mode: the value range is 00-04, and the sensor is controlled to switch to the specified channel group
0x2003	0x00	Vehicle speed value	IN 16	Read/Write	In the channel intelligent selection mode: the speed condition value of the channel switching
0x2004	0x00	Vehicle angle value	IN 16	Read/Write	Channel intelligent selection mode: angle condition value for channel switching
0x2005	0x00	OUT2 status	UNS 8	Read only	Sensor Out2 output status Related to the sensor output logic of the parameter setting item: Normally closed mode (default) 00：Object detected 01：No object detected Normally open 01：Object detected 00：No object detected
0x2006	0x00	OUT1 status	UNS 8	Read only	Sensor Out1 output status Related to the sensor output logic of the parameter setting item: Normally closed mode (default) 00：Object detected 01：No object detected Normally open 01：Object detected 00：No object detected
0x2007	0x00	OUT3 status	UNS 8	Read only	Sensor Out3 output status Related to the sensor output logic of the parameter setting item: Normally closed mode (default) 00：Object detected 01：No object detected Normally open 01：Object detected

					00： No object detected
0x2008	0x00	Sensor current channel	UNS 8	Read only	The current channel value of the sensor
0x2009	0x00	Sensor failure status	UNS 8	Read only	The current status of EOUT; 00： Normal Not 00: Error status

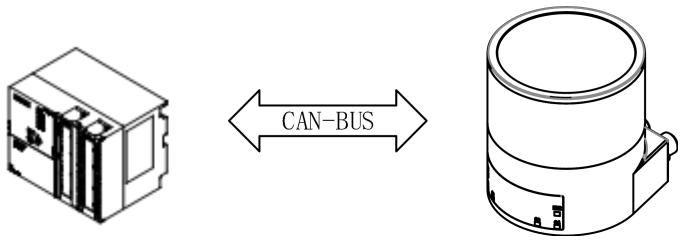
8.10 SEND DATA DIRECTLY

Sensor setting parameters



1)Configure according to the left picture

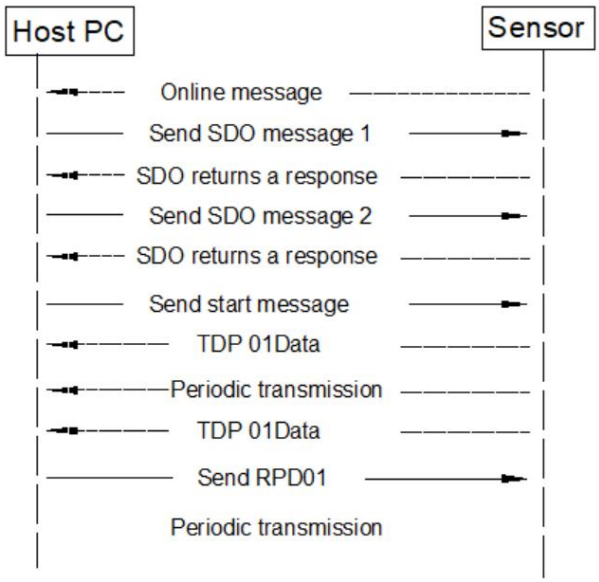
Connect



Host computer: client data sending equipment, can be single chip microcomputer, PLC, industrial computer, etc.

Sensor： LE50711

Transmit data timing



Online message

After the sensor is powered on, it sends a frame of online message.

COB-ID	DLC	Byte 0
0x 77F	1	00

Transmit SDO message 1

COB-ID	DLC	LBS							MBS
0x67F	8	0x2F	0x00	0x18	0x02	0xFF	0x00	0x00	0x00

SDO return message

COB-ID	DLC	LBS							MBS
0x5FF	8	0x60	0x00	0x18	0x02	0x00	0x00	0x00	0x00

Transmit SDO message 2

COB-ID	DLC	LBS							MBS
0x67F	8	0x2F	0x00	0x18	0x05	0x0A	0x00	0x00	0x00

SDO return message

COB-ID	DLC	LBS							MBS
0x5FF	8	0x60	0x00	0x18	0x05	0x00	0x00	0x00	0x00

Transmit start message

COB-ID	DLC	LBS	MBS
0x000	2	0x01	0x7F

Transmit RPDO1 message

COB-ID	DLC	LBS							MBS
0x27F	8	0x00	0x05	0x00	0x00	0x00	0x00	0x00	0x00

9 AFTER-SALE INFORMATION

9.1 WARRANTY PERIOD

LE-50711 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.

9.2 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.

9.3 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.

9.4 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