AkuSense

AS-100C User Manual

V 0.9

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1 Description

1.1 Tips

This manual provides methods and precautions for proper use of Akusense AS-100C LiDAR products.In order to be able to use this product safely, users should also note:

- Comply with the necessary safety production guidelines;
- Comply with AS-100C workplace safety regulations and general safety specifications.

This manual is intended for electrical and electronics professionals.

重要提示

Before operating the AS-100C, read this manual carefully and familiarize yourself with the features and functions of the AS-100C.

This manual does not cover the usage information of other devices and devices in the application system where AS-100C is installed and used. Please read the relevant documents of such devices and devices if you need such information.

1.2 Content Description

This manual is intended to provide technicians with information on the installation, electrical connection, equipment configuration, and maintenance of the AS-100C. Read the sections of this manual in sequence.The contents of this manual (in order) include:

- 2 Basic operations and Precautions
- 3 Product Description
- 4 Product Application
- 5 Device Installation
- 6 Electrical installation

- 7 Device Configuration
- 8 Equipment Maintenance
- 9 Troubleshooting
- 10 Technical Specifications

Table 1.1 Basic product information

The work environment	Indoor/outdoor
The light source	Infrared laser (905nm)
Laser safety level	Class I (GB 7247.1-2012, safe for human eyes)
Scan angle range	360 °
Sweep frequency	10Hz / 20Hz
Scan angle resolution	0.05 ° / 0.1 °
Measuring range	0.2 m - 100 - m
Reflector range (ф100mm)	100m
10% reflectance range	20m
The measurement data	Composite data (distance +RSSI)
Working voltage	A DC 9 v, 30 v
Power consumption	5W
Case protection level	IP65(GB 4208-2008)
The weight of the	0.7 Kg
Size (L ╳ W ╳ H)	97mm(W) X 110mm(D) X 72mm (H)
Operating temperature range	- 10 ℃ to + 50 ℃
Storage temperature range	- 30 ℃ to + 70 ℃
Ambient illuminance range	0 lux - 80000 lux

相关阅读

Read "10 Technical Specifications" for complete technical information.

Use "Lidar Diagnostic and Configuration Software (FILPS)" to diagnose and configure the AS-100C, and read "Lidar Diagnostic and Configuration Software (FILPS) Manual" for how to use FILPS.

1.3 Description of Pattern symbols

The following symbols are used in this manual to mark important precautions. Pay special attention when reading this manual to avoid personal injury and equipment damage.

危险	Meaning: An imminent dangerous situation, if not prevented, may result in serious bodily injury.
警告	Meaning: A potentially dangerous situation, if left unguarded, could result in serious personal injury.
谨慎操作	Meaning: A potentially dangerous situation, if not prevented, may result in general personal injury.
注意	Meaning: Potentially harmful conditions, if left unguarded, may cause equipment damage.
重要提示	Meaning: Helpful suggestions and tips for efficient and smooth use of equipment.
要点	Meaning: Information about important features of the device.
解释	Meaning: Background on the technical problem.
相关阅读	Meaning: Related documents that can provide more information.
软件操作	Meaning: Device inspection and configuration to be done using FILPS software.

1.4 Extended Reading

要点	Complete information about the AS-100C can be downloaded online from:

Can download information including:

- Akusense Lidar Product Guide: Users can obtain comparison information of Askusense LiDAR products to help users complete product selection;
- As-100c Product Manual: Users can get complete information about AS-100C technology and applications;
- As-100c Instruction Manual: Users can get basic information about AS-100C and how to quickly try out AS-100C;
- Lidar Diagnostic and Configuration Software (FILPS) : Windows installation package and manual for FILPS software;
- Lidar application development SDK: basic C++ code base, Windows dynamic library, Demo program and SDK user manual required for lidar application development.

2 Basic operations and precautions

This chapter describes the basic operations and precautions related to personal safety and equipment safety. Be sure to read them carefully before using the AS-100C.

2.1 Proper usage

The AS-100C is a single-layer panoramic scanning liDAR with diffuse reflectance (RSSI) measurement capability.The output measurement data is a combination of distance and RSSI measurements at each measurement Angle. The scan Angle range is up to 360°, mainly for indoor applications, but also can be used in outdoor environments under non-rainfall conditions.

The AS-100C is mainly aimed at reflector-based AGV navigation applications and can also be used in scene measurement applications, such AS structural mapping of outdoor areas and inside buildings, AS well AS free navigation applications without reflectors.

The AS-100C should only be operated by professionals and used in compliant environments.

重要提示 Please read "10.1 Data Book" for the requirements for the AS-100C operating environment.

2.2 Warnings for incorrect usage

- As-100c can only be used for safety warning purposes, and cannot physically protect personal safety in dangerous environments;
- As-100c cannot be used in hazardous environments where explosive hazards exist;
- Use of accessories not supplied by Akusense is at the user's risk.

2.3 Networking Instructions

The AS-100C uses standard TCP/IP technology to network devices.In actual networking, ensure that the following prerequisites are met:

- Users must ensure the integrity and confidentiality of device data transmitted over the network.
- You need to plan and implement necessary network security measures, such as network isolation, firewalls, and antivirus software.

2.4 Disclaimer for Device Damage

Akusense is not liable for equipment damage caused by:

- Failure to read the manual carefully;
- Failure to use the equipment properly as required;
- Operating by unqualified personnel;
- Disassembly of equipment not approved by Akusense;
- Equipment modification behavior not approved by Akusense;
- Technical modification of equipment;
- Use of self-made accessories.

2.5 Laser radiation instructions

The AS-100C is measured using an infrared laser with a wavelength of 905nm, the laser beam not visible to the naked eye.

As-100c conforms to the requirements of Class A laser safety grade stipulated in GB 7247.1-2012. It is harmless to human eyes and skin under normal use conditions, but incorrect use may bring safety risks. The main precautions are AS follows:

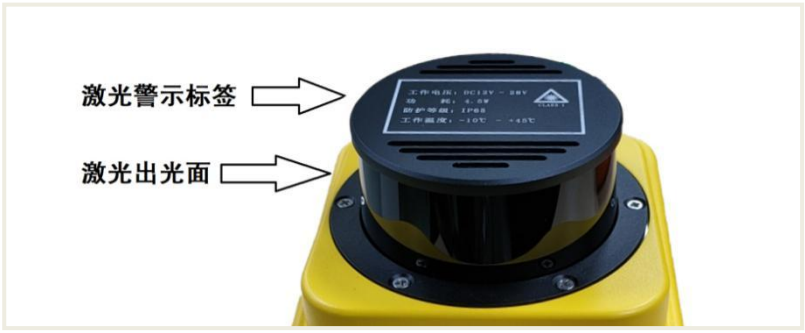
- Do not open the shell of AS-100C. The AS-100C running on power will not stop the laser emission when

the shell is opened;

- Do not look directly at the AS-100C's laser-emitting surface for a long time, especially for children, which may cause blindness.

The laser outlet of AS-100C is an optical light transmission hood, and the laser warning sign is located on the top cover of the device, AS shown in "Figure 2.1 Laser Outlet and Laser Warning Sign".

Figure 2.1 Laser Outlet surface and laser warning sign



2.6 Power supply and quick start and stop

The AS-100C is powered through the circular M12 power outlet at the rear of the device, AS shown in "Figure 2.2 Power Outlet";The power supply voltage should be DC9V-30V, and the power consumption in the running state is 5W. Please provide power according to the above standards when using the device.

Figure 2.2 Power socket

重要提示	Please read "10.1 Data Book" in detail to understand the complete power supply requirements for AS-100C.The user should follow the local regulations and take necessary protection for the power supply cable of AS-100C to avoid short circuit or overload of power supply;In addition, an emergency circuit breaker should be installed on the power supply cable to quickly cut off the power supply in case of emergency.

- Stop method: turn off the power supply, or unplug the power supply cable of the power socket;
- Starting method: connect the power cable of the power socket and turn on the power switch.

The device configuration information of the AS-100C is kept in a non-volatile storage medium, and starting and stopping the device will not cause this information to be lost.

2.7 Maintenance

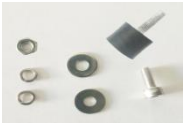
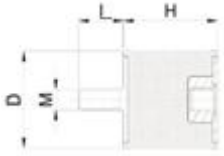
注意	The AS-100C must be repaired by an employee of Akusense or a Akusense designated agency.If the equipment is repaired by other personnel, it may cause damage to the equipment, in which case Akusense will not be responsible for subsequent repairs.

3 Product Description

3.1 Packing list

The accessories for AS-100C are shown in "Table 3.1 Packing list".

Table 3.1 Packing list

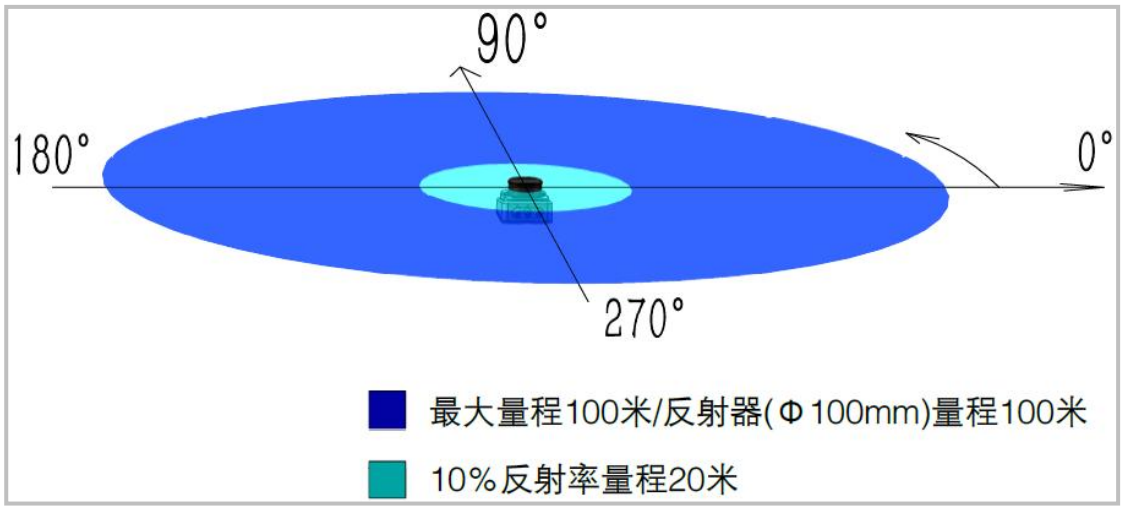
Items	Quantity	Unit	Instructions
Certificate of approval	1	pcs	
Warranty card	1	pcs	
	1	pcs	As-100c LiDAR
	3	pcs	M12 dustproof plug included
	1	pcs	Power cable Length of 1.5 meters A-end: M12 terminal (type A), Female, 5 cores End B: Lead wire, 4 cores
	1	pcs	RJ45 cable Length of 1.5 meters End A: M12 terminal (type B), Female, 5 cores End B: RJ45 plug
	1	pcs	I/O cable Length of 1.5 meters End A: M12 terminal (type A), Female, 8 cores End B: Lead wire, 8 cores
Mounting screws, spacers and simple installation tools	4	pcs	M5*8
 Shock absorbing screws, nuts and spacers	4	pcs	 The M5 × D15 × H20 × L12

3.2 Product Features

Table 3.2 Product Features

The work environment	➢ Power supply voltage range: DC 9V-30V; ➢ Power consumption: 5W; ➢ Environmental adaptability: anti dirt, anti sunlight, support smoke penetration, non-rainfall conditions; ➢ IP65 enclosure protection level; ➢ -10℃ - +50℃ operating temperature range;
measurement	➢ Pulse time-of-flight measurement technology, output range and diffuse reflectance (RSSI) data; ➢ 905nm infrared laser measurement, Class A safety laser (GB 7247.1-2012, eye safety); ➢ The maximum range of 100 meters, reflector range (ф100mm) range of 100 meters, 10% reflectance range of 20 meters;
scanning	➢ Use mechanical scanning mode; ➢ 360° scanning range, scanning Angle resolution: 0.05°/ 0.1°; ➢ Scanning frequency: 10Hz / 20Hz;
Device interface	➢ Ethernet interface, function: device configuration/composite measurement data output ➢ I/O interface, function: peripheral control
Typical applications	Navigation and structural map mapping ➢ Reflector detection based on RSSI and registration based on reflector coordinates; ➢ Depth image-based registration; ➢ Reflector navigation map rendering and reflector-based navigation; ➢ Depth image mode and mixed mode region structure map rendering, and free navigation based on region structure map;
availability reliability	➢ Sun resistance, dirt resistance, with smoke penetration (optional); ➢ Equipment failure self-test ability, including the light hood dirt, close shielding, excessive temperature, fog shielding; ➢ Output device self-test information through indicators and TCP packets.

Figure 3.1 Measurement coordinate system/scan range/range

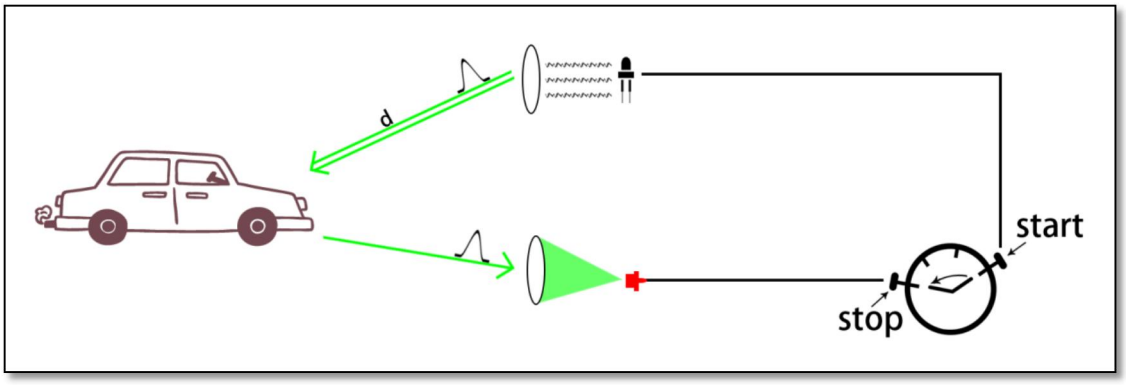


3.3 Working principle

3.3.1 Distance and RSSI measurement

The basic working principle of AS-100C range measurement is laser ranging based on time-of-flight measurements.As-100c emits a laser pulse and measures the return time of the pulse after reflection from the surface of the measured target, which is then converted into range data, AS shown in "Figure 3.2 Working Principle of time-of-flight Measurement".Based on the intensity of the echo pulse and the distance to the target, the diffuse reflectance (RSSI) information of the measured target surface can also be obtained.

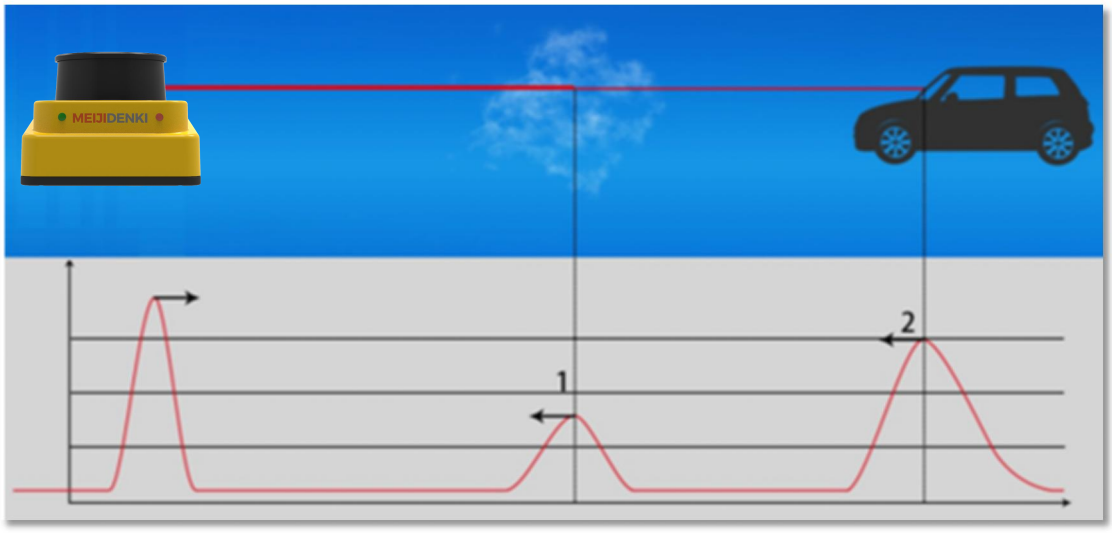
Figure 3.2 Working principle of time-of-flight measurement



As-100c has multiple echo analysis capability.In smoke working environment,

atmospheric impurities will also reflect ranging laser pulse, forming a reflected echo pulse, and the measured target together with the reflected echo pulse to the photoelectric receiving system.By analyzing all the received reflected echo pulses, AS-100C removes the interference pulses and outputs the real range data of the measured target, AS shown in "FIG. 3.3 Reflection Echo Filtering".

FIG. 3.3 Reflection echo filtering



3.3.2 2D scanning

The AS - 100 - c the turntable driven a pair of laser pulse transmitting/receiving cylinder rotate at a constant speed to the mirror, emission and receiving of the tube, the tube, optical axis parallel to each other with sending and receiving optical axis perpendicular to the plane of rotation of the turntable and isometric, so the actual distance optical axis distribution in a scanning plane perpendicular to the axis of rotation, and the range azimuth and motor rotation Angle is the same, Thus, the 360° two-dimensional optical scanning is realized, and the distance of each point on the section of the ranging scanning plane can be obtained from the external environment, as shown in "Figure 3.4 scanning measurement mechanism" and "Figure 3.5 two-dimensional section scanning".As-100c uses specific TCP/UDP network packets to provide 2D measurement data with a fixed scanning frequency to the user through the Ethernet port.

Figure 3.4 Scanning measurement mechanism

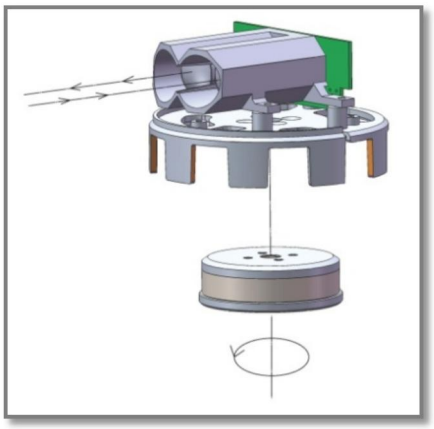
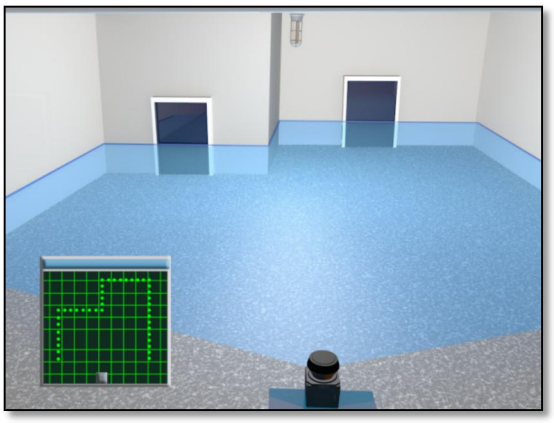


Figure 3.5 2D cross section scanning



3.3.3 Application development

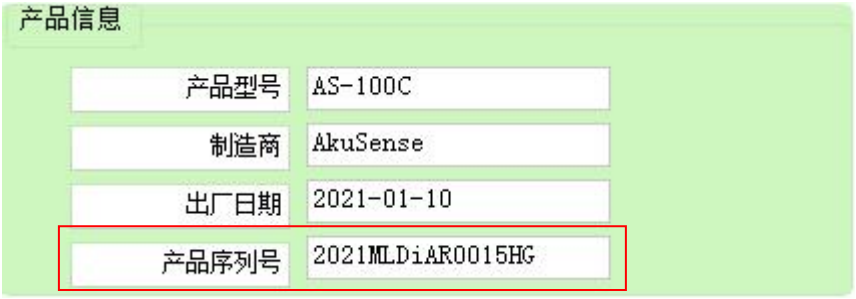
Typical applications of AS-100C include reflector detection based on RSSI, and two registration methods based on reflector coordinate position and scene depth image.With these functions, the mapping and assembling of the reflector navigation map and the area structure map can be completed, and the navigation based on the reflector and the scene depth image can be realized in the two maps.

相关阅读	For more information on map mapping and navigation application development, please read "4.4 Map Mapping and Navigation Application Development".

3.4 Device Serial Numbers

Each AS-11C has a unique, non-modifiable device serial number, which is shown in "Figure 3.6 Device Serial Number".

Figure 3.6 Device Serial number



要点

The composition of AS-100C equipment serial number and the meanings of each field are:

- Serial number: LD-AS-100C-F_1 F_2N_1 N_2 N_3 $N_4X_1X_2$;
- LD: device type, LiDAR;
- As-100c: equipment type;
- F_1 F_2: factory number;
- N_1 N_2 N_3 N_4 X_1X_2: Serial number.

3.5 Device Ports

The AS-100C has three external ports, including "power port", "Ethernet port" and "I/O port", all in the form of M12 round waterproof sockets, respectively "power socket", "Ethernet socket" and "I/O socket", AS shown in "Figure 3.7 Device Socket". The types of each socket are AS shown in "Table 3.3 Device Socket". The interface signals are defined as shown in "Table 3.4 Device Interface Signals".

Figure 3.7 Device socket

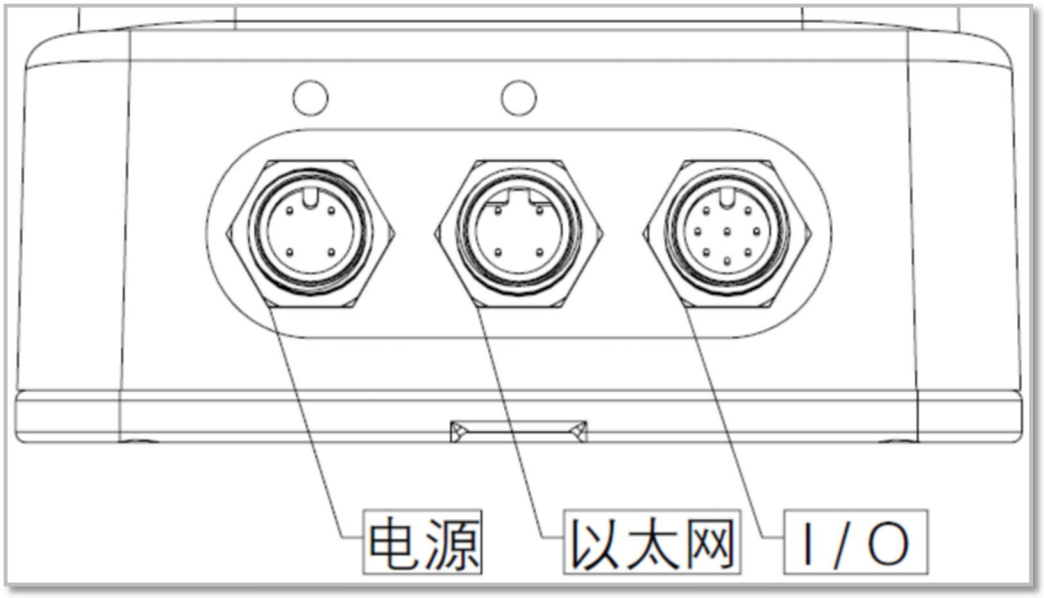


Table 3.3 Device socket

The socket	type	Terminal number
A power outlet	M12(model A), Male	4
Ethernet socket	M12(model B), Male	4
The I/O socket	M12(model A), Male	8

相关阅读 Please read "10.1 Data Book" for electrical characteristics of each socket.

Table 3.4 Definitions of device interface signals

interface	signal	instructions
The power interface	Vs	The power is end
	GND S	The power to
Ethernet interface	RX+	Data reception plus end
	RX-	Data receive negative end
	TX+	Data send plus end
	TX-	Data send negative end
The I/O interface	IN1	Universal input 1# positive end
	IN2	Universal input 2# positive end
	IN3	Universal input 3# plus end
	GND IN	Common input Common ground
	OUT1	Universal output 1# plus end

	OUT2	Universal output 2# positive end
	OUT3	Universal output 3# plus end
	GND OUT	Common output Common ground

相关阅读 Read "6.3 Device Socket Signal Definitions" for each socket signal definition.

3.6 Device Control and Running Status Display

3.6.1 Device Control Mode

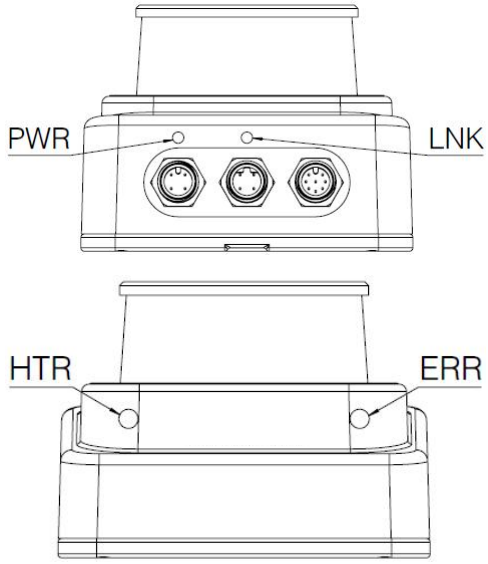
After the AS-100C is powered on, it automatically enters the running state according to the current configuration of the system without intervention.If you need to control, configure, or query the running status of AS-100C, you can do so in the following two ways:

- Diagnostic and Configuration software (FILPS) : FILPS interacts with AS-100C through Ethernet interfaces using TCP packets for comprehensive configuration and operation control. For details, please read "7 Device Configuration and Commissioning Tests";
- I/O input terminals: By inputting an effective control level to the I/O input terminals, control functions such as power saving and life extension are realized. For details, please read "4.5 I/O Interface Instructions and Application Development".

3.6.2 Indicator light

After the AS-100C starts to work, the basic working status is displayed through the indicators on the front and rear panels. The meanings of each indicator are shown in "Table 3.5 Indicator Description".

Table 3.5 Indicator Description



Name	Instructions
PWR	Power indicator ✧ Off: No power/No power is available ✧ Steady on: The power is on
LNK	Ethernet Indicators ✧ Off: No network connection ✧ Steady on: The network is connected
ERR	Working fault indicator ✧ Startup status: On (about 24 seconds) ✧ Off: There is no fault ✧ Off: Internal fault/abnormal measurement[1] ✧ Long blinking (0.5Hz) : high/low temperature alarm ✧ Short blink (1Hz) : the light transmission hood is dirty/blocked[2]
HTR	Normal measurement indicator light ✧ Starting status: Off ✧ Off: The device does not start measuring ✧ Steady on: The device is measuring normally

1. Including measurement stop and motor stop;
2. Including being obscured by dense fog.

4 Product Applications

4.1 Technology applications

In practical application, the range and measurement effect of AS-100C are affected by many environmental factors. Special attention should be paid to these factors and their effects, and appropriate measures should be taken to deal with them.

4.1.1 Actual range

The actual range of AS-100C for a specific target is affected by the following factors:

- Actual diffuse reflectance: refers to the actual diffuse reflectance of the part of the target surface illuminated by the measuring laser spot emitted by AS-100C.The actual diffuse reflectance is not only related to the material, but also to the surface orientation.The higher the actual diffuse reflectance is, the farther the actual range is.
- Reflected area: the area of the target surface covered by the laser spot.The larger the area covered, the farther the actual measurement distance;
- The dirtier of the transmittance hood: the dirtier of the transmittance hood of AS-100C will cause the decline of the transmittance performance. The more the transmittance performance decreases, the worse the measurement ability is. When the transmittance decreases to 60%, the measurement ability may completely fail.
- Atmospheric conditions: the actual measurement ability of AS-100C is affected by atmospheric conditions at the same time, especially when working outdoors.The worse the light propagation ability of the atmosphere, the lower the actual measurement ability of the AS-100C.In extreme weather conditions (e.g., thick fog), the measurement capability becomes completely ineffective.

要点 When building an application with AS-100C, the operating

range of AS-100C needs to be set based on a comprehensive consideration of various application requirements factors, including:

- The minimum actual diffuse reflectance rate and minimum size of the target to be discovered;
- And the cleanliness of the AS-100C working environment and whether it can be maintained in a timely manner, such AS cleaning the light shield.

4.1.2 Relationship between spot diameter and target size

The laser beam emitted by AS-100C has a certain divergence Angle, which is 2MRad in the horizontal direction and 8mrad in the vertical direction.At a specific measurement distance, the relationship between spot size R and measurement distance d of AS-100C is AS follows:

$r_H = r_0 + alpha._H d.$

$r_V = r_0 + alpha._V d.$

Among them:

r_HIs the horizontal dimension of the spot;

r_VIs the vertical dimension of the spot;

r_0Is the spot outlet diameter, for AS-100C, r_0 = 0.01 m.

Alpha.$_H$Is the horizontal divergence Angle of the spot, for AS-100C, α_H= 0.002;

Alpha.$_V$Is the vertical divergence Angle of the spot, for AS-100C, α_V= 0.008.

解释	The farther the measurement distance is, the larger the spot diameter is, and for a particular target, the lower is the probability that the spot will hit the target surface completely, and the lower is the proportion of the effective reflected area of the target surface.Therefore, for a target with the same actual diffuse reflectance of the surface, the smaller the target size, the closer the actual range will be.

4.1.3 Rain, fog and soot penetration

When the rain, fog and dust penetration function is enabled, AS-100C will filter the weak reflection measurement data within a certain distance range to avoid the measurement results triggered by smoke replacing the measurement results of the real target at a longer distance, AS shown in "FIG. 3.3 Reflection Echo Filtering". However, this will also reduce or disable the measurement ability of AS-100C for targets with very low comprehensive reflectance (e.g., less than 5%) within a short range (e.g., 2-4 meters) or

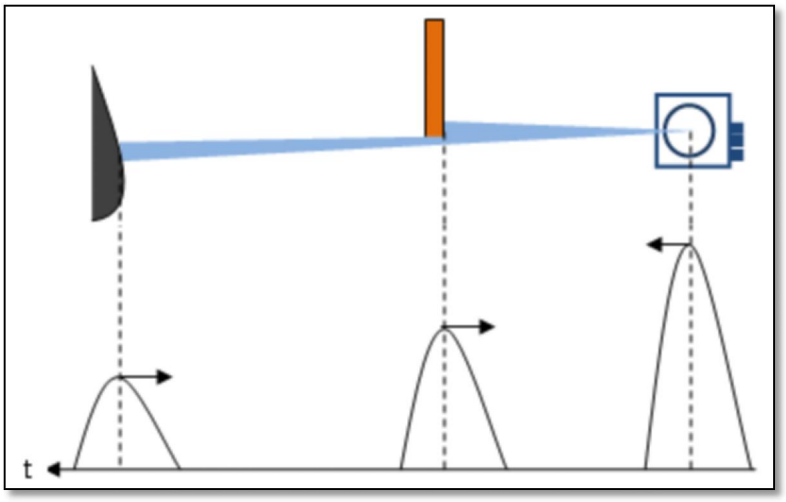
small targets (e.g., flying insects and linear targets).

软件操作	Please refer to Section 6.3 "Operating Configuration Parameters" of the "LiDAR Diagnostic and Configuration Software (FILPS) User Manual" for the method of turning on and off the rain, fog and smoke penetration function.
要点	Whether to enable the rain, fog and soot penetration function should be carefully selected based on application requirements.

4.1.4 False edge point

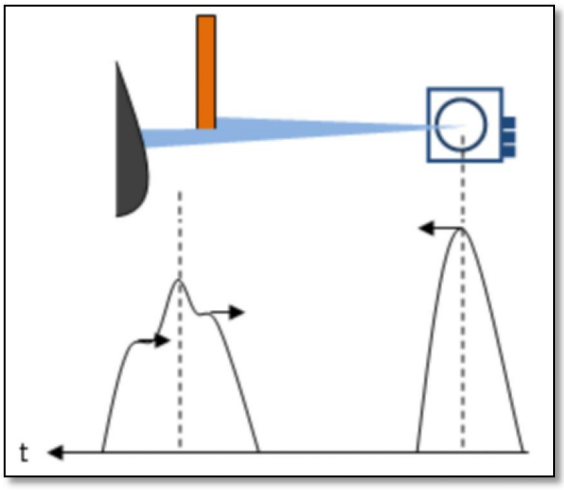
When the laser spot hits the edge of the target, the AS-100C will also receive two reflected echoes, one from the target surface and the other from the background at the same Angle, AS shown in "Figure 4.1 Edge Point Measurement".

Figure 4.1 Edge Point Measurement



If the distance between the target and the background is relatively close, the two reflected echoes will overlap each other, which will lead to inaccurate measurement, and will produce "false edge points" that are farther than the actual distance of the target edge, as shown in "Figure 4.2 False edge points".The difference between the measured distance value of the pseudo-edge point and the real value may be as much as 15cm.

Figure 4.2 Pseudo-edge points



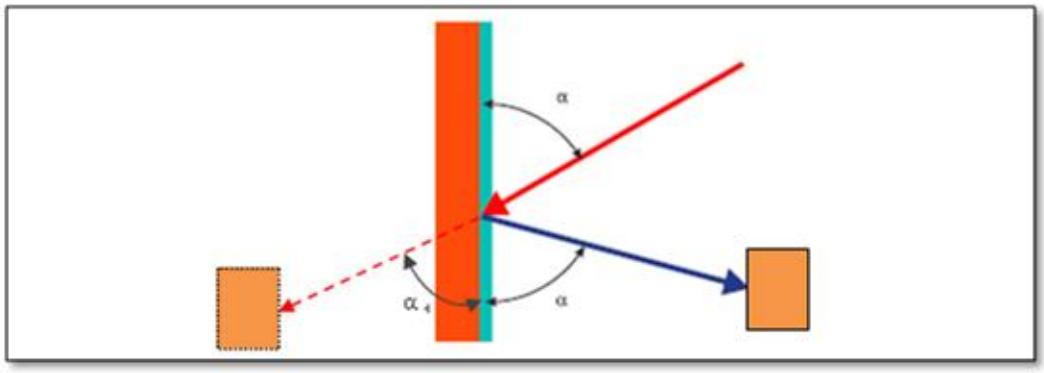
要点

The pseudo-edge points have a certain impact on the accurate positioning of the target. In a class of applications requiring accurate positioning of the target, the target edge points should be specially treated.

4.1.5 Mirror target

When measuring a mirror target, it can only be effectively measured when the target surface is perpendicular to the incident laser. If the laser incidence Angle is not perpendicular, the actual diffuse reflectance rate is very low, which makes it impossible to measure effectively. The actual measurement result is the mirror target distance on the mirror reflection path, as shown in "Figure 4.3 Mirror Measurement".

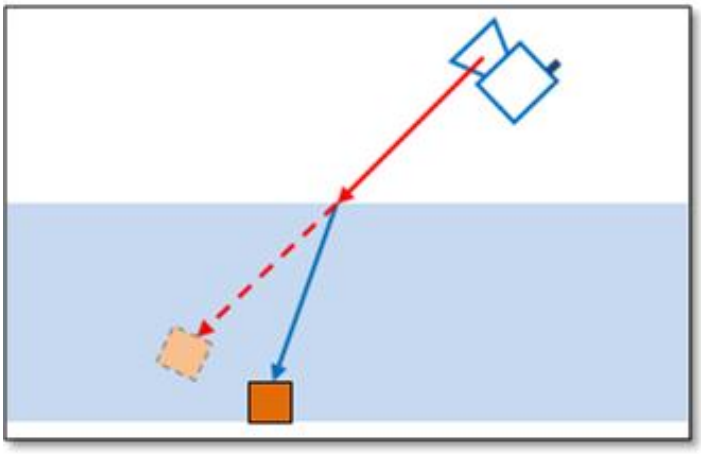
Figure 4.3 Specular measurement



4.1.6 Transparent medium

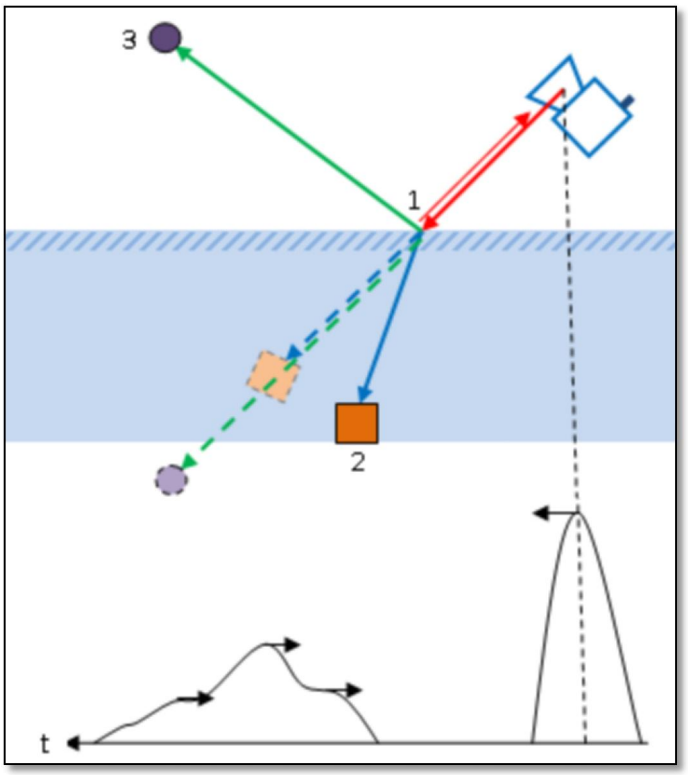
When there is a transparent medium (such as clean water) in the surrounding environment, the target located inside or behind the transparent medium can be detected.Because light refracts in the transparent medium, the measured target is actually on the refracted light path, while the measurement result is on the straight light path, and the measured target position will be biased, as shown in "Figure 4.4 Measurement of transparent Medium".

Figure 4.4 Transparent medium measurement



In addition, AS-100C may also receive two reflection echoes, one from the reflection of the actual target surface inside or behind the transparent medium, and the other from the diffuse reflection of the incomplete clean transparent medium surface. In this case, the measurement results are uncertain, which may be the medium surface or the actual target.If the surface of the transparent medium close to the lens (glass, for example), due to the AS - 100 - c emission measuring laser pulse reflection and hit in the reflected light will happen the other goals on the road, is also likely to produce the echo of the third, the echo may be based on the actual optical path length to form complex overlapping relation, cause uncertainty of measurement results, As shown in "Figure 4.5 Specular Transparent Medium Measurement".

Figure 4.5 Specular transparent medium measurement



要点

In practice, the transparent medium in the environment, especially the transparent medium whose surface is close to the mirror, needs special treatment to avoid unstable or wrong measurement results.Specific treatment can be done on the surface of the medium diffuse translucent processing, reduce the transparency and reflection ability, or in the processing of measurement data to do shielding of these positions.

4.1.7 Strong light interference

要点

If the AS - 100 - c pervious to light cover continued strong illuminant irradiation by parallel to scanning plane, the irradiation range of scanning target echo may be submerged by the incident light, and the incident light may also trigger measurements, produce instability, not

	correct measurement results, lead to measure failure, may also cause "pervious to light cover dirt" false alarm equipment.This kind of situation should be avoided during actual deployment.

4.2 Overview of application system development

As-100c is a single-layer panoramic scanning lidar with diffuse reflectance (RSSI) measurement capability.The output measurement data is a combination of distance and RSSI measurements at each measurement Angle. The scan Angle range is up to 360°, mainly for indoor applications, but also can be used in outdoor environments under non-rainfall conditions.

The AS-100C is mainly aimed at reflector-based AGV navigation applications and can also be used in scene measurement applications, such AS structural mapping of outdoor areas and inside buildings, AS well AS free navigation applications without reflectors.

When the AS-100C is used to develop the application system, the application system interacts with the AS-100C mainly through Ethernet interface in the form of UDP broadcast packets and TCP/UDP packets. The obtained information is used for subsequent processing and the AS-100C is controlled to fulfill the application requirements.The functions that can be completed include:

- Obtain configuration information of AS-100C;
- The composite measurement data including range and target surface diffuse reflectance (RSSI) were obtained.
- The operating status of the device is obtained.
- Read and control the I/O port;
- Real-time control of the device;
- According to the application requirements, the measurement data is processed by the application algorithm.

The network packets used by AS-100C are shown in "Table 4.1 Application Development Network Packets", which are defined in detail in "LiDAR Application

Development SDK".

相关阅读	For details on network packets, read Section 4 "LIM Review" of the "LiDAR Application Development SDK User Manual".

要点	For applications requiring high real-time performance, the I/O interface I/O terminals of AS-100C can be directly used to complete peripheral control.For the function and application development of the I/O interface, please read "4.5 I/O Interface Instructions and Application Development".

Table 4.1 Application development network message

Function	Message type code	Initiator	Reply message
The heartbeat	LIM_CODE_HB	Application side	LIM_CODE_HBACK
Heart rate response	LIM_CODE_HBACK	AS-100C	N/A
The measurement data	LIM_CODE_LMD_HDRSSI	AS-100C	N/A
Request for measurement data	LIM_CODE_START_LMD	Application side	LIM_CODE_START_LMD_ACK
Request measurement data reply	LIM_CODE_START_LMD_ACK	AS-100C	N/A
Stop measuring data	LIM_CODE_STOP_LMD	Application side	LIM_CODE_STOP_LMD_ACK
Stop measuring data responses	LIM_CODE_STOP_LMD_ACK	AS-100C	N/A
Query measurement data Scan Angle table	LIM_CODE_NATBL_QUERY	Application side	LIM_CODE_ NATBL
The measurement data Scan Angle table	LIM_CODE_ NATBL	AS-100C	N/A
The query Equipment ready signal	LIM_CODE_DEVICE_STATUS_QUERY	Application side	LIM_CODE_DEVICE_STATUS
Device ready signal	LIM_CODE_DEVICE_STATUS	AS-100C	N/A
Query the I/O status	LIM_CODE_IOREAD	Application side	LIM_CODE_IOSTATUS
Set up the I/O output status	LIM_CODE_IOSET	Application side	LIM_CODE_IOSTATUS
Unset I/O	LIM_CODE_IOSET_RELEAS	Application	LIM_CODE_IOSTATUS

	E	side	
The I/O state	LIM_CODE_IOSTATUS	AS-100C	N/A
Equipment alarm query	LIM_CODE_ALARM_QUERY	Application side	LIM_CODE_ALARM LIM_CODE_DISALARM
Equipment alarm	LIM_CODE_ALARM	AS-100C	N/A
Equipment away p	LIM_CODE_DISALARM	AS-100C	N/A
Device configuration information	LIM_CODE_LDBCONFIG	AS-100C	N/A
Start device configuration information broadcast	LIM_CODE_START_LDBCONFIG	Application side	LIM_CODE_LDBCONFIG
Stop the device configuration information broadcast	LIM_CODE_STOP_LDBCONFIG	Application side	N/A
To obtain Device configuration information	LIM_CODE_GET_LDBCONFIG	Application side	LIM_CODE_LDBCONFIG
The query Device firmware version	LIM_CODE_FIRMWARE_VER_QUERY	Application side	LIM_CODE_FIRMWARE_VER
Device Firmware version	LIM_CODE_FIRMWARE_VER	AS-100C	N/A

function	Message type code	The initiator	Reply message
System restart	LIM_CODE_SYS_REBOOT	Application side	LIM_CODE_SYS_REBOOT_ACK
System restart reply	LIM_CODE_SYS_REBOOT_ACK	AS-100C	N/A
Start-stop motor	LIM_CODE_SET_MOTO	Application side	LIM_CODE_SET_MOTO_ACK
Start and stop motor reply	LIM_CODE_SET_MOTO_ACK	AS-100C	N/A
Status of rain and fog filter switch	LIM_CODE_RAINDUST_FLT_SWICTH	AS-100C	N/A
Query the status of the rain and fog filter switch	LIM_CODE_RAINDUST_FLT_SWICTH_STS_QUERY	Application side	LIM_CODE_RAINDUST_FLT_SWICTH
Set the rain fog filter switch status	LIM_CODE_RAINDUST_FLT_SWICTH_STS_SET	Application side	LIM_CODE_RAINDUST_FLT_SWICTH
Statically apply switch state	LIM_CODE_STATIC_APP_SWICTH	AS-100C	N/A
Query static application switch status	LIM_CODE_STATIC_APP_SWICTH_STS_QUERY	Application side	LIM_CODE_STATIC_APP_SWICTH
Set static application switch status	LIM_CODE_STATIC_APP_SWICTH_STS_SET	Application side	LIM_CODE_STATIC_APP_SWICTH
Spatial filtering Switch state	LIM_CODE_SPATIAL_FLT_SWICTH	AS-100C	N/A
Query the status of the spatial filtering switch	LIM_CODE_SPATIAL_FLT_SWICTH_STS_QUERY	Application side	LIM_CODE_SPATIAL_FLT_SWICTH
Set the airspace filtering switch status	LIM_CODE_SPATIAL_FLT_SWICTH_STS_SET	Application side	LIM_CODE_SPATIAL_FLT_SWICTH
Measuring switch status	LIM_CODE_MEASURE_SWICTH	AS-100C	N/A
The query Measure switch status	LIM_CODE_MEASURE_SWICTH_STS_QUERY	Application side	LIM_CODE_MEASURE_SWICTH
Set up the Measure switch status	LIM_CODE_MEASURE_SWICTH_STS_SET	Application side	LIM_CODE_MEASURE_SWICTH
Fog occlusion detection switch	LIM_CODE_FOGCHK_SWICTH	AS-100C	N/A

status			
Query fog occlusion Detect switch status	LIM_CODE_FOGCHK_SWICTH_STS_QUERY	Application side	LIM_CODE_FOGCHK_SWICTH
Set fog occlusion detection switch status	LIM_CODE_FOGCHK_SWICTH_STS_SET	Application side	LIM_CODE_FOGCHK_SWICTH

4.3 Network Configuration and device detection

4.3.1 Network Factory Configuration

The AS-100C's Ethernet factory configuration is defined by the product serial number LD-AS-100C-F_1 F_2N_1 N_2 N_3 $N_4X_1X_2$Ok, the rules are:

- IP: 192.168.1.2AB, where A = N_3B = N_4;
- MAC: 00:00: YY: DD: SS: AB.
- Mask: 255.255.255.0.
- Gate: 192.168.1.1;
- DNS: 192.168.1.1;
- TCP port: 2112;

Where IP/MAC/Mask/Gate/DNS can be modified using FILPS.

4.3.2 Device configuration information broadcast

When AS-100C is started, it automatically broadcasts its configuration information to the following multicast addresses and UDP port numbers:

237.1.1.200:2111

Device Configuration information The type code of the broadcast packet is LIM_CODE_LDBCONFIG

The application system can listen to the device configuration information broadcast packet at this address and port to obtain the configuration information of AS-100C that has been online and establish a TCP connection with it.After the TCP connection is established, the AS-100C can send a "stop device configuration information broadcast" packet (type code is LIM_CODE_LDBCONFIG_STOP) to the AS-100C, and then the AS-100C stops the configuration information broadcast. You can also send a "Start Device configuration information broadcast" packet (type code LIM_CODE_LDBCONFIG_START) to AS-100C, at which point AS-100C starts configuration information broadcast again.

相关阅读 For details on the configuration information Broadcast

	packet, see Section 9 "Device Configuration Packet" in the "LiDAR Application Development SDK User Manual".
软件操作	FILPS automatically listens for online AS-100C and lists all online Akusense LiDAR devices in the "Online Devices" form. After double-clicking the device entry to establish a TCP connection with the AS-100C, you can make changes to the Ethernet configuration in the Device Configuration TAB.

4.4 Map Mapping and navigation application development

Based on the composite measurement data output by AS-100C, the navigation applications of AGV and service robot, AS well AS the map mapping necessary for these navigation applications, can be realized. The necessary supporting algorithms for the above applications include:

- Reflector detection algorithm based on RSSI;
- Registration algorithm based on reflector coordinates;
- Registration algorithm based on depth image;

Features that can be achieved using these algorithms include:

- Reflector navigation map mapping and reflector-based navigation;
- Depth image mode and mixed mode area structure map mapping, and free navigation based on area structure map;

In this section, the relevant concepts, working principles and application methods of the above algorithms and applications are explained.

4.4.1 Reflector detection algorithm based on RSSI

In the LMD_HDRSSI scene composite image frame output by AS-100C, by checking the RSSI value of each measurement point, the candidate measurement points covered by the reflector can be initially screened based on the known RSSI threshold of the reflector.Then the adjacent candidate measurement points are further processed by

regional analysis, and the accurate measurement points of the reflector can be obtained and output in cartesian coordinates.

4.4.2 Registration algorithm based on reflector coordinates

Given two sets of reflector coordinates and the initial values of the displacement vectors at the origin (acquisition position) of the two sets of coordinates, the reflector coordinate registration algorithm computes the coordinate transformation parameters of the two sets of coordinates, including the origin displacement vector and rotation Angle, so that the two sets of coordinates can be overlap-ed to the maximum extent after coordinate transformation.

4.4.3 Registration algorithm based on depth image

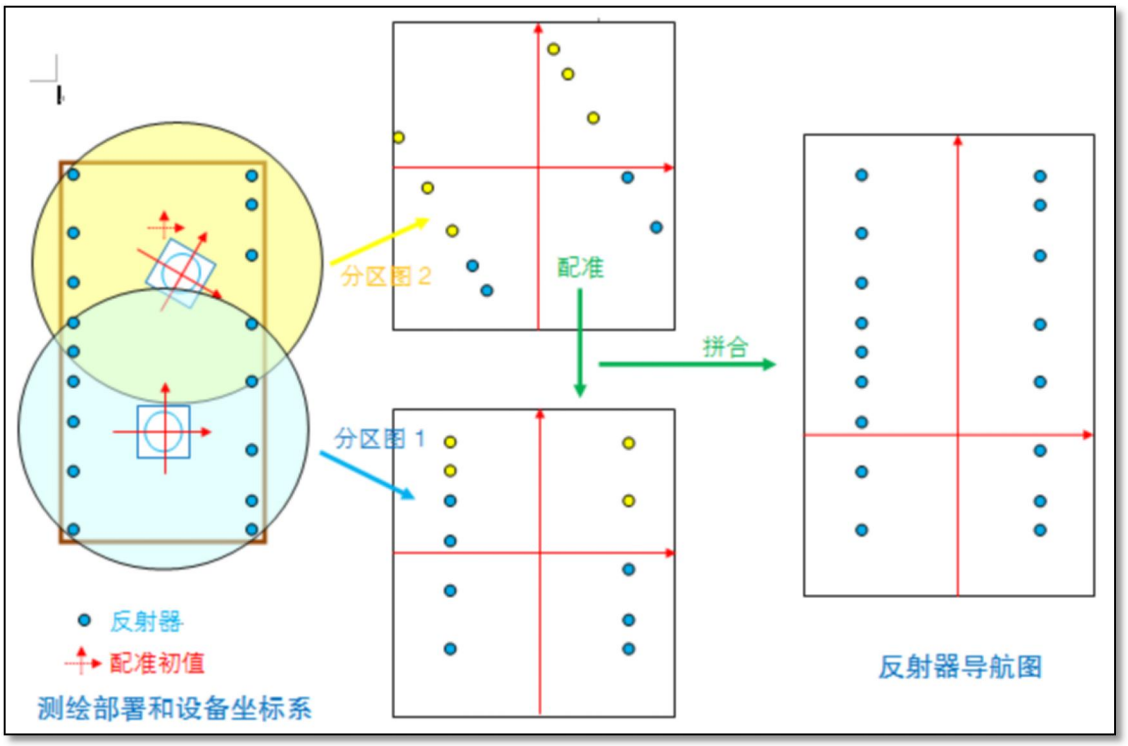
The depth image-based registration algorithm works based on the SLAM framework.In a given scene depth image, the two frames have enough contact ratio and the origin of coordinates of the two frames (acquisition) under the condition of displacement vector of initial values, registration algorithm for calculating the coordinate transformation parameters of two depth images, including the origin displacement vector and rotation Angle, and makes the scene depth information of the two frames after coordinate transformation to the maximum overlap.

4.4.4 Mapping of reflector navigation map

During the mapping of the coordinate map of the reflector, the composite images of the partitioned scene are collected at different positions, and the coordinate position of each reflector in the AS-100C device coordinate system and the coordinate partition map of the reflector in each composite image are obtained by the reflector detection algorithm.By applying the reflector coordinate registration algorithm between the two maps with sufficient reflector recoincidence, the transformation parameters of the device coordinate system at the two acquisition positions, including the origin displacement vector and rotation Angle, can be obtained.These parameters can be used to complete

the assembly of the two partition maps.By piecing them step by step, the reflector navigation map including all the reflector coordinate positions can be obtained, as shown in "Figure 4.6 Reflector Navigation Map Mapping".

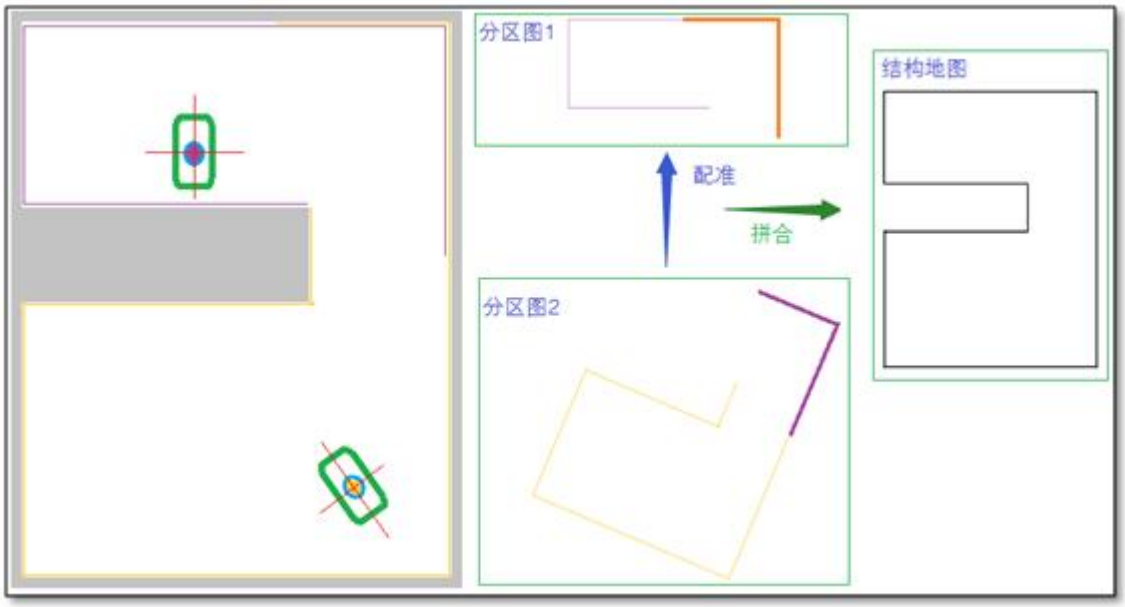
Figure 4.6 Reflector Navigation Map Mapping



4.4.5 Area structure map mapping based on depth image

When conducting regional structure map mapping based on depth image, composite images of partitioned scene are collected at different positions, and the depth information is used to obtain the partitioned structure map in AS-100C coordinate system at each acquisition position.When the depth image registration algorithm is implemented between two partitioned structure maps with sufficient scene coincidence, the transformation parameters of the device coordinate system at the two acquisition positions can be obtained, including the origin displacement vector and rotation Angle.These parameters can be used to complete the assembly of the two partitioned structure maps.The region structure map including all the scene depth information can be obtained by step-by-step assembling, as shown in "Figure 4.7 region Structure Map Mapping based on depth Image".

Figure 4.7 Region structure map mapping based on depth image



4.4.6 Mixed mode regional structure map mapping

The main difficulties in the application of structural map mapping include that there should be enough overlap regions between the partitioned maps to be assembled, otherwise the registration algorithm may produce incorrect results, leading to errors in the mapping.In addition, structures such as transparent glass walls are difficult to be directly measured by liDAR.The hybrid mapping mode can effectively solve such problems, and the specific process is as follows:

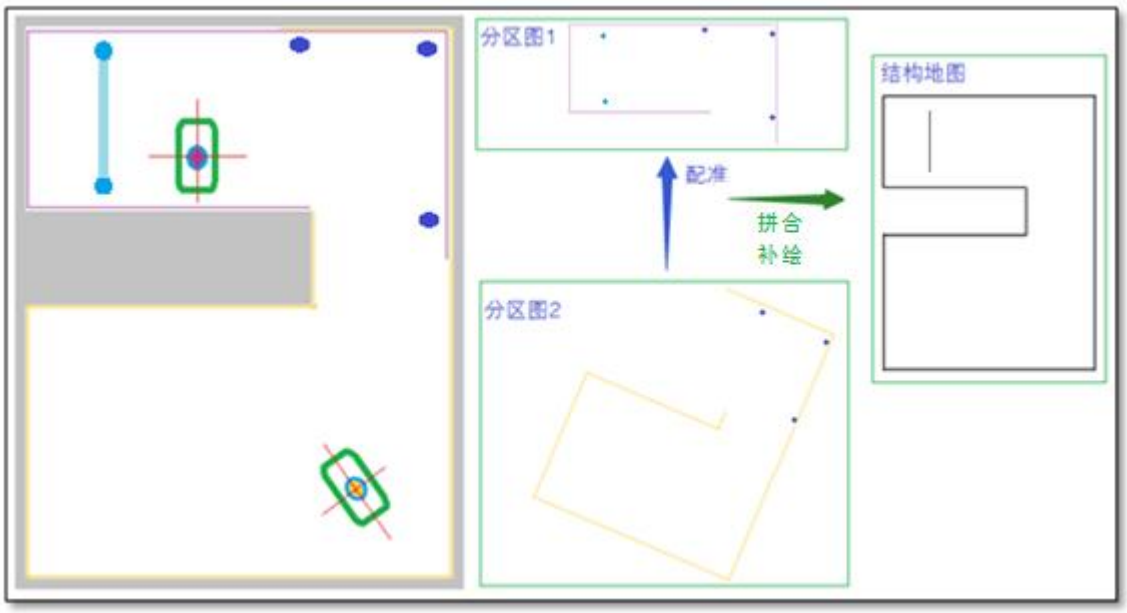
- Deploy reflectors at appropriate locations throughout the area to be mapped;
- The composite images of the partitioned scene were collected at different positions, and the reflector coordinates in the partitioned scene were obtained by using the reflector detection algorithm, and then the coordinate configuration algorithm of the reflector was used to obtain the coordinate transformation parameters of the equipment at each acquisition position.
- The device coordinate transformation parameters of each partition image and the depth information in the partition composite image were used to complete the assembly of the partition depth images, so as to obtain the complete regional structure map.

- For the transparent structure, reflectors with slightly lower RSSI can be placed at the edges and shape inflection points of the structure, and the reflector positions of such RSSI features can be extracted by the reflector detection algorithm, and then the transparent structure can be complemented by an interactive method.

The above process is shown in "Figure 4.8 Mixed Mode Area Structure Map Mapping".

For a broad working area, through proper deployment of reflector AS registration target, using the AS - 100 - c for reflector found far effective distance, the distance can increase the partition map surveying and mapping interval, reduce the workload measurement zoning map, improve the efficiency of measurement, also helps to improve the partition map split robustness.

Figure 4.8 Map mapping of regional structure in mixed mode



4.4.7 Reflector based navigation

Based on the navigation map of the reflector and the initial value of the initial position coordinates of AS-100C, the scene composite image of AS-100C is processed frame by frame, and the coordinates of the reflector that can be detected in the device coordinate system are detected. The registration algorithm of the reflector coordinates is executed on

the navigation map of the reflector. The transformation parameters between the AS-100C device coordinate system and the navigation map coordinate system are obtained, and the position coordinates, orientation Angle, instantaneous velocity/acceleration vector of AS-100C in the navigation map can be obtained, which can be used to complete the path planning and walking control of the system, AS shown in "Figure 4.9 Navigation Based on the Reflector".

4.4.8 Free Navigation based on depth image

Based on the regional structure map and roughly correct initial value of AS-100C initial position coordinates, the scene composite image of AS-100C is processed frame by frame. The scene depth image is used to execute the depth image registration algorithm on the regional structure map, and the transformation parameters between the AS-100C device coordinate system and the regional structure map coordinate system are obtained. Thus, the position coordinates, orientation Angle and instantaneous velocity/acceleration vector of AS-100C in the structure map can be obtained, which can be used to complete path planning and walking control by the system, AS shown in "Figure 4.10 Free Navigation Based on depth Image".

Figure 4.9 Reflector-based navigation

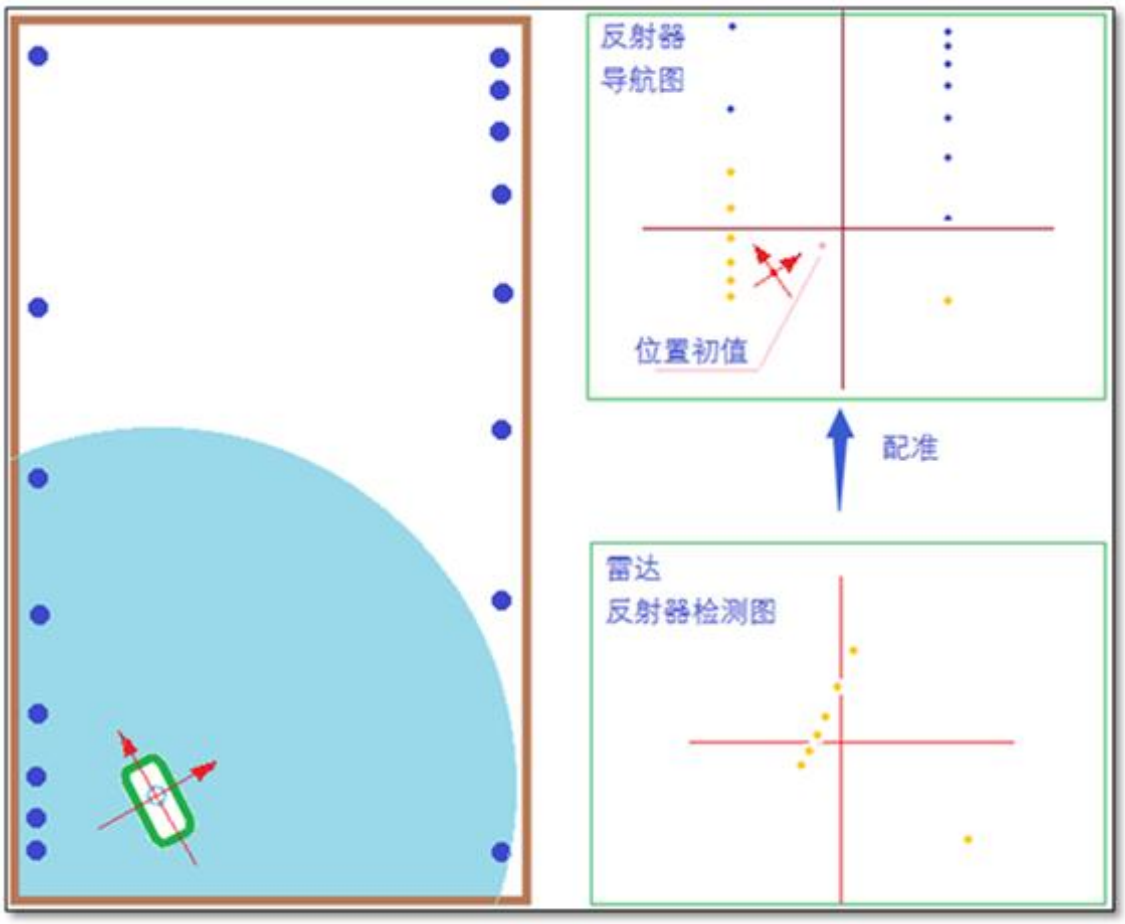
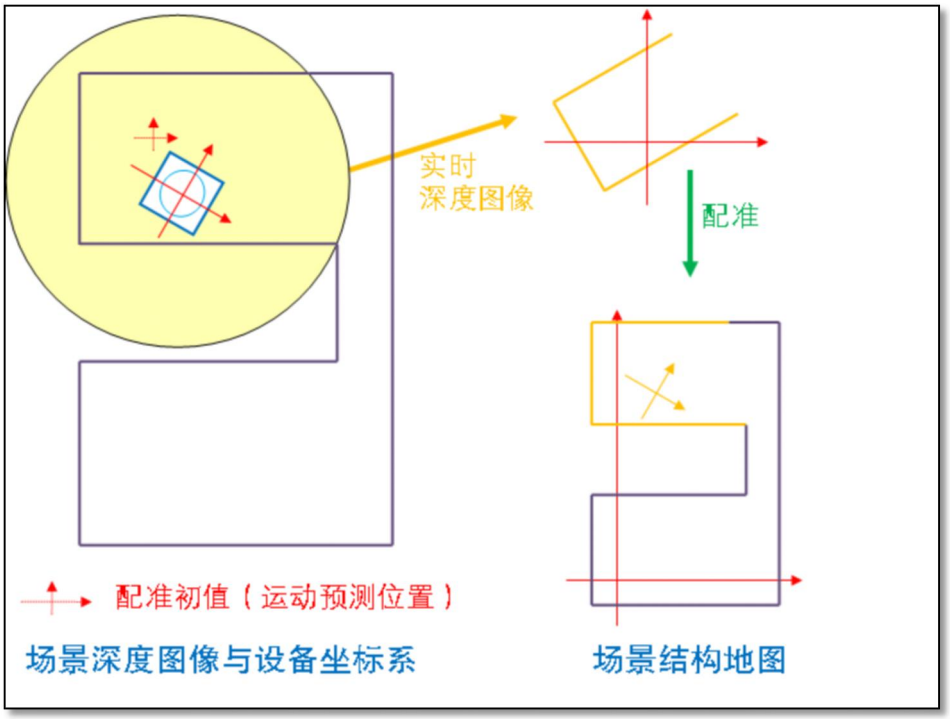


Figure 4.10 Free navigation based on depth image



4.4.9 Meteorological conditions for outdoor applications

The measurement function of AS-100C can work effectively in outdoor non-rainfall environment.When outdoor weather conditions are bad, the measurement data of output characteristics are influenced by a certain degree, this kind of weather conditions including fog or haze, quantitative terms such AS "table 4.2 / haze fog obscured visibility on the definition", AS is shown in actual use should be according to the requirement of the application of meteorological conditions on the AS - 100 - c output measurement data to make the necessary processing.

Table 4.2 Definition of fog/haze Visibility

Fog/haze level	visibility[1]Typical reference values
A slight haze	10Km
Slight haze	5Km
Moderate haze/mist	3Km
Heavy haze	1Km
The fog	100m

1: Visibility is the maximum horizontal distance at which a sighted person can see and identify an object from the sky background under prevailing weather conditions.

Under fog/haze conditions, the visibility reference limit of AS-100C measurement data can be stably output is 2Km. If the visibility is lower than this value, the measurement ability will be significantly decreased.

要点

- Under fog/haze conditions, particulate matter in the air will scatter the measurement laser pulse of AS-100C and the reflected light of the target, which will reduce the light energy and reduce the measurement ability of AS-100C for distant targets.
- Under the condition of heavy haze or fog, particulate matter in the air will effectively reflect the measurement laser pulse of AS-100C and form effective measurement data. Such measurement data are generally distributed

within the range of 2~4 meters, and the shape is unstable round or oval.

- If AS-100C turns on the function switch of "fog detection", heavy haze or fog will also trigger the device self-test signal of "blocked by fog". For details, please refer to "4.6.1 Equipment Self-test Item" and "4.8 Equipment Control and Function Switch".

4.5 I/O Interface instruction and application development

4.5.1 I/O input terminal function definition

The preset function of the I/O input terminal of the AS-100C is power saving and life extension control, AS shown in "Table 4.3 Input Terminal Preset Function Definition".

Table 4.3 Input terminal preset function definition

function	IN1	IN2	IN3	Signals for
Motor stalling		Shutdown: High level		For 5 seconds
		Start up: Low		For 2 seconds
Measure to stop			Stop: High level	For 5 seconds
			Start up: Low	For 2 seconds

4.5.2 I/O output terminal function definition

The preset function of OUT1 in the I/O output terminal of AS-100C is defined AS the device ready signal, AS shown in "Table 4.4 Preset Function Definition of Output Terminal".

Table 4.4 Output Terminal preset function definition

	OUT1	OUT2	OUT3
signal	Equipment is ready	There is no	There is no
Valid output state (default setting)	On (high level)[1]		
Valid output state hold time[2](Default setting)	There is no		

1. The valid output status of the device ready signal is fixed as "on" and cannot be changed.

要点

- After the device is ready, you can read the status of the I/O terminal through TCP packets or control the output status of the OUT port.
- If you do not need to use the IN port for power saving and life extension control, or do not need to output the device ready signal through the OUT port, you can use

	the FILPS software to cancel the association between the IN port and the start and stop motor/start and stop measurement function, or cancel the association between the device ready signal and the corresponding OUT port. For the setting method, read chapter 10 "Advanced Configuration" in the "Lidar Diagnostic and Configuration Software (FILPS) Manual".

4.5.2 I/O Interface Network Packets

I/O terminals can be read and set through TCP packets. The packet type codes are as follows:

- Read I/O terminal status: LIM_CODE_IOREAD
- Set I/O terminal status: LIM_CODE_IOSET (Output terminal only)

After receiving the above packet, AS-100C will finish reading or setting the I/O terminal and reply the reply packet with the type code LIM_CODE_IOSTATUS.

The TCP packets used by the I/O interface are listed in Table 4.5 I/O Interface Network Packets.

Table 4.5 I/O Interface Network Packets

function	Network packet			The initiator	Reply message
	The type of code	Data[0]	Data[1]		
read	LIM_CODE_IOREAD	0	0	Application side	LIM_CODE_IOSTATUS
Set up the	LIM_CODE_IOSET	0/1[1]	0: OUT1[1] 1: OUT2[1] 2: OUT3[1]	Application side	LIM_CODE_IOSTATUS
remove Set up the	LIM_CODE_IOSET_RELEASE	0	0	Application side	LIM_CODE_IOSTATUS
The I/O state	LIM_CODE_IOSTATUS	Bit0: OUT1[1] Bit1: OUT2[1] Bit2: OUT3[1] Bit3: IN1[2] Bit4: IN2[2] Bit5: IN3[2]	0	AS-100C	There is no

1: "0" means "off", "1" means "on";
2: "0" for low level, "1" for high level.

相关阅读 For details on TCP packets for I/O interfaces, read Section 7 "I/O Packets" in "LiDAR Application Development SDK User Manual".

4.6 Device self-test and device ready Signal

4.6.1 Equipment self-test items

As-100c can self-check its own working state, find internal and external factors that may affect the normal measurement function, and output the device through the alarm signal. The TCP packet code of the device alarm signal is LIM_CODE_ALARM, and the Data[0] in the packet is the alarm code.When the alarm item returns to normal, AS-100C will send the corresponding device alarm clearance signal to the application. The TCP message code is LIM_CODE_DISALARM.The device self-check items include:

- Internal errors: equipment failures due to mechanical or electrical failures;
- High and low temperature: AS-100C internal temperature is too high or too low, resulting in AS-100C can not complete the normal measurement, or the effective range can not be guaranteed;
- Motor stop: the application system sends the motor stop command to AS-100C due to power saving, life extension and other reasons, so that AS-100C enters the stop mode, and the motor rotation is suspended;
- Measurement failure: the correct measurement data cannot be generated, possibly due to the failure of the photoelectric device or the surrounding environment is too empty;
- Measurement stop: the application system sends a stop measurement command to AS-100C for power saving, life extension and other reasons, so that AS-100C enters the power saving mode, and the laser emission and distance measurement are suspended.
- Occluded: AS-100C is occluded at close range, resulting in AS-100C unable to complete normal measurement;
- Fog occlusion: AS-100C is blocked by the fog that the laser cannot penetrate, and the reflected echo energy formed by the fog is strong, resulting in incorrect measurement data, which are generally unstable and irregular circles or elliptic arcs with a radius of 2~4 meters.

- Dirty light transmittance hood: AS-100C light transmittance hood cleaning is too low, resulting in AS-100C can not complete normal measurement, or the effective range can not be guaranteed.

Table 4.6 Equipment self-test items

Self-checking program	The alarm code	Directions for use
Internal error	LIM_DATA_ALARMCODE_INTERNAL	
The temperature is too high	LIM_DATA_ALARMCODE_High_Temperature	Triggered when the internal temperature is higher than 65C
The temperature is too low	LIM_DATA_ALARMCODE_Low_Temperature	Triggered when the internal temperature falls below 10 ° C
Motor stalling	LIM_DATA_ALARMCODE_Moto_Stopped	
Measurement of the failure	LIM_DATA_ALARMCODE_Measurement_Failure	A false alarm may be generated when the surrounding environment is empty.
Measure to stop	LIM_DATA_ALARMCODE_Measurement_Stopped	
obscured	LIM_DATA_ALARMCODE_Occluded	
Occluded by fog	LIM_DATA_ALARMCODE_Fog_Occluding	Use in small indoor Spaces may produce false alarms, so it should be enabled in outdoor environments*.
The transmittance hood is dirty	LIM_DATA_ALARMCODE_OCDirty	

* : For how to enable and disable fog occlusion detection, please read Chapter 10 "Advanced Configuration" in the "Lidar Diagnostic and Configuration Software (FILPS) User Manual".

4.6.2 Device Ready Signal

The equipment ready signal is associated with the equipment self-test item, reflects the basic working state of AS-100C, and provides a convenient way for the application system to monitor the running condition of AS-100C.When the status of the device self-check item changes, AS-100C updates the status of the device ready signal according to the device configuration. When the status of the device ready signal changes, the AS-100C outputs the device ready signal to the application system through TCP packets and I/O output ports.The TCP packet code of the device ready signal is LIM_CODE_DEVICE_STATUS, Data[0]:bit0 is the device ready state, Data[0]:bit1~bit10 is the current status of each device self-test item defined by bit.

The generation logic of device ready signal is as follows: when the status of all device

self-test items associated with device ready signal is invalid, the status of device ready signal is valid;When the status of one or some equipment self-test items associated with the equipment ready signal is valid, the status of the equipment ready signal is invalid.The "Internal Error" and "motor stop" states are associated with the device ready signal by default. When these two self-check states are valid, the device ready signal status is invalid.

The device self-check items associated with the device ready signal can be configured through the FILPS software;The I/O output port corresponding to the device ready signal is OUT1. When the device ready signal is valid, the output state corresponding to OUT1 is on.Whether to output the device ready signal through OUT1 can also be configured through FILPS software.In practice, the correct association content and I/O configuration should be selected according to the application requirements.

要点	For the Settings related to the device ready signal, read Chapter 10 "Advanced Configuration" in the LiDAR Diagnostic and Configuration Software (FILPS) User Manual.

4.7 Essential Security Configuration

4.7.1 Automatic Release of I/O output port timeout Setting

When AS-100C is used in the application with high security requirements in the system integration mode, if the application system controls the I/O output port of AS-100C by LIM packet and uses it AS an alarm control signal with essential security requirements, the security risks caused by various abnormal factors should also be fully considered. To ensure that the system can automatically enter the security protection mode in case of these abnormal conditions to avoid the occurrence of security accidents.

The most typical case of such abnormal factors is that the network cable is interrupted when the system is in a safe state, resulting in the I/O output port of AS-100C being in a safe state all the time and losing the alarm output capability.In order to deal with such security risks, the I/O output port of AS-100C is designed to automatically set timeout release function, which ensures that the I/O output port of AS-100C can automatically enter the safe protection mode when the application system loses control of AS-100C.

重要提示

The following describes how to use the I/O output port to set the automatic timeout release function:

- As the alarm control signal, the signal state of the I/O output port should adopt the intrinsical safety design, that is, "on/high level" represents the safety state, and "off/low level" represents the alarm state;
- Enable the "I/O output port setting timeout automatic release function" of AS-100C, and set the automatic release time limit, generally 2~5 seconds;
- In the safe state, the application system should periodically use LIM packets to set the status of the output port to "on/high level", and the period should not exceed the automatic release time limit.

- If the timeout is set, the AS-100C automatically sets the state of the output port to "off/low", and the system enters the safe protection mode.
- When the application system uses LIM packets to set the state of the output port to "off/low" in the alarm state, the automatic release function of setting timeout on the I/O output port does not work.

For the configuration method of setting the automatic timeout release function of the I/O output port, please read Chapter 10 "Advanced Configuration" of the Lidar Diagnosis and Configuration Software (FILPS) User Manual.

4.8 Power Saving and Life Extension Control

For vehicle-mounted applications that use batteries AS power supply and have power saving requirements, AS-100C has power saving control function and can enter the power saving mode.The basic power saving method is to stop the measurement, the laser transmitting and receiving of AS-100C will stop working, and the power consumption of the whole machine will be reduced by about 60%. At the same time, the AS-100C can quickly return to the normal working mode, avoiding the delay effect on the application.There are two ways to stop the measurement:

- TCP packet: Send a measurement control switch setting packet (LIM_CODE_MEASURE_SWICTH_STS_SET packet code) to AS-100C and set Data[0] to 0;
- I/O input port: Set the I/O input port IN3 of AS-100C to high level and maintain it for 5 seconds.

There are two ways to restore normal measurements:

- TCP packet: Send a measurement control switch setting packet (LIM_CODE_MEASURE_SWICTH_STS_SET packet code) to AS-100C and set Data[0] to 1;
- I/O input port: Set the I/O input port IN3 of AS-100C to low and hold it for 2 seconds.

The way to further save power is to stop the motor. The scanning motor inside the AS-100C will stop rotating, and the power consumption of the whole machine will further decrease by about 6%. It will take about 3 seconds to restore the normal working mode again.There are two ways to control motor stoppage:

- TCP packets: Send motor control packets (packet code LIM_CODE_SET_MOTO) to AS-100C and set Data[0] to 0;
- I/O input port: Set the I/O input port IN2 of AS-100C to high level and maintain it for 5 seconds.

There are two ways to restart the motor:

- TCP packet: Send a motor control packet (packet code LIM_CODE_SET_MOTO)

to AS-100C and set Data[0] to 1;

- I/O input port: Set the I/O input port IN2 of AS-100C to low and hold it for 2 seconds.

Stopping the measurement and stopping the motor have a life extension effect.The service life of AS-100C is mainly determined by the service life of the internal scanning motor. The motor shutdown can use the idle time of AS-100C to reduce the internal wear of the motor, and directly extend the service life of the whole machine of AS-100C.At the same time, stop measurement can use the idle time of AS-100C to reduce the number of sending and receiving of AS-100C internal optoelectronic devices, reduce the temperature of optoelectronic devices, and also play a certain role in prolonging the service life of the whole machine.

- After stopping the measurement, AS-100C will generate a "measurement stop" device alarm, and its front panel ERR indicator will enter the steady on mode;If the device ready signal is associated with the "measurement stop" self-test, the device ready signal will also turn to invalid state;
- After the motor stops, AS-100C will generate an alarm of "motor stops" equipment, and the ERR indicator on the front panel will enter the steady on mode;The device ready signal is associated with the self-test state of "motor stop" by default, and the device ready signal turns to invalid state;

要点

- The delay time for AS-100C to exit from the stop measurement state and resume the normal measurement is 200ms (excluding the low level holding time of IN3).
- The delay time for AS-100C to exit from the stopped state of motor and return to normal measurement is 3S (low level holding time without IN2).
- Whether to use IN2 / IN3 as a power saving and life extension control port is a configurable option. Please read Chapter 10 "Advanced Configuration" of the "Lidar Diagnostic and Configuration Software (FILPS) User Manual" for related configuration methods.

4.9 Device Control and Function Switch

As-100c has a number of built-in device control and data processing functions, data processing functions can be selectively turned on or off according to the application requirements, not only through the operation control function of FILPS software to make the control options take effect in real time, but also through the FILPS software device configuration function to make the control options continue to take effect. You can also send TCP packets to AS-100C for real-time control.

These device control features include:

- Device restart: Restart AS-100C with the corresponding TCP packet code LIM_CODE_SYS_REBOOT;
- Stop/start motor: stop or start the internal scanning motor of AS-100C to enable AS-100C to enter or exit the power saving and life extension mode. For details, please refer to "4.8 Power Saving and life Extension Control". The corresponding TCP message code is LIM_CODE_SET_MOTO.
- Stop/start measurement: stop or start measurement to enable AS-100C to enter or exit the power saving and life extension mode, please refer to "4.8 Power saving and life extension control" for details, the corresponding TCP message code is LIM_CODE_MEASURE_SWICTH_STS_SET.

要点 When the internal scanning motor of AS-100C is stopped, the measurement will be stopped at the same time.

Data processing functions include:

- Rain fog and dust penetration: whether to enable the rain fog and dust penetration function, the rain fog and dust generated by the close-range measurement data filtering, as far as possible to find distant targets.For details of this function item, please refer to "4.1.3 Rain and Fog and dust Penetration". The corresponding TCP packet code is LIM_CODE_RAINDUST_FLT_SWICTH_SET.
- Static application: The measurement data output of AS-100C has two modes, which are static application mode and mobile application mode.In the static

application mode, a time-domain filter is used to filter the original measurement data before output. In this case, the measurement data of the stationary target in the scene has a small statistical error, and the real-time measurement data of the moving target can be ensured.In the mobile application mode, the original measurement data will be directly output to ensure the real-time performance of the whole scene.The corresponding TCP packet code is LIM_CODE_STATIC_APP_SWICTH_SET;

- Airspace filtering: As-100c has a built-in spatial filtering function to filter the unreliable measurement results in the measurement data, such AS "false edge points" (see "4.1.4 false edge points"), to reduce the noise in the measurement data, the corresponding TCP packet code is LIM_CODE_SPATIAL_FLT_SWICTH_SET;
- Fog detection function: whether to detect the possibility of fog occlusion in the scene and generate a device alarm "blocked by fog", the corresponding TCP packet code is LIM_CODE_FOGCHK_SWICTH_SET.

要点

- In factory Settings, the application mode of AS-100C is "Mobile application mode".
- When the real-time control function of FILPS is used or the function switch is started or stopped through TCP packets, it is only valid for the current running cycle of AS-100C. After the AS-100C is restarted, the initial status of each function switch is determined by the device configuration.
- If you want the control of the functional switch of AS-100C to continue to take effect, you should use the "Device Configuration" and "Advanced configuration" functions of FILPS software to modify the configuration of the functional switch and upload it to AS-100C.

相关阅读

- For the method of device control and configuration of AS-100C using FILPS software, please read Chapter 6 "Device Configuration", Chapter 9 "Operating Status Monitoring" and Chapter 10 "Advanced Configuration" of the "Lidar Diagnostic and Configuration Software (FILPS) User Manual".
- Refer to Section 10 "Device Control and Function Switch Packets" of "LiDAR Application Development SDK User Manual" for TCP packets for Device control and function switch control of AS-100C.

5 Device Installation

注意	The AS-100C has a seal label at the joint of the equipment housing. If this label is damaged, or the housing is disassembled, Akusense is no longer responsible for the warranty of the product.The AS-100C enclosure should only be removed by a person approved by Akusense.

5.1 Installation Preparations

5.1.1 Basic Installation Requirements

The overall weight of AS-100C is 0.7Kg.When installing AS-100C, the basic requirements are:

- Install the fastening;
- Keep away from vibration sources or take shock absorbing measures;
- Avoid being hit.

For AS-100C working outdoors, the necessary protective facilities should be added to avoid contamination, damage or direct sunlight of the light shield AS much AS possible.

5.1.2 Installation materials

- A set of AS-100C-AT mounts provided by Akusense, together with the necessary installation equipment;
- Or a mounting bracket designed by the user with the ability to adjust the mounting Angle and the necessary installation equipment

5.1.3 Selection of installation position

注意

- The AS-100C should be protected from direct sunlight, which may cause the AS-100C to overheat internally and fail;
- Direct collision of AS-100C should be avoided, which may lead to direct wear or rupture of the light transmission hood;
- As-100c should be avoided from being directly exposed to dirt, water, oil, dust and other dirty sources, which will lead to the cover of the light shield by opaque substances, causing the failure of measurement.

If the above possibility exists, appropriate protective cover should be installed for AS-100C, and attention should be paid to cleaning and maintenance of AS-100C's transparent cover in time.

5.1.4 Special Reminders

注意

When installing AS-100C, pay special attention to:

- Make sure that the view of the entire light transmission hood within the 360° scanning range of the AS-100C is not blocked by the mounting parts;
- If the 360° scanning range of AS-100C is not blocked by the installed parts or mounting surface due to the limitation of installation conditions, the effective scanning Angle of AS-100C needs to be adjusted. For details, please read "5.6 Adjusting the Scanning Range";
- 4 indicator lights of AS-100C should be easily seen;

- At the rear of the AS-100C should leave enough space to facilitate the completion of cable connection on the waterproof socket;
- Avoid excessive vibration of the AS-100C;
- If the AS-100C is installed in an environment with obvious vibration, anti-loosening measures should be taken to install the screw;
- Check the fastening of the mounting screws regularly;
- Check the hood for dirt regularly.

5.2 Installation height and pitching Angle

5.2.1 Relationship between mounting height and effective working distance

As-100c range laser spot is rectangular, the divergence Angle in the vertical direction is different from the horizontal divergence Angle, the divergence Angle in the horizontal direction is 2MRAD, the divergence Angle in the vertical direction is 8MRAD, with the increase of the detection distance, the spot gradually increases, its lower edge gradually extends downward, if hit the ground or installation surface, If hit the ground or installed surface, it can not measure the farther target.Therefore, there is a certain relationship between the effective working distance and the installation height of AS-100C, AS shown in "Figure 5.1 The relationship between the effective working distance and the installation height".

Taking the horizontal ground installation mode AS an example, the installation height H of the bottom surface of AS-100C and the effective working distance d '$_{max}$Is as follows:

$d'_{max} = 2(h+h_0-r_0)/alpha$.

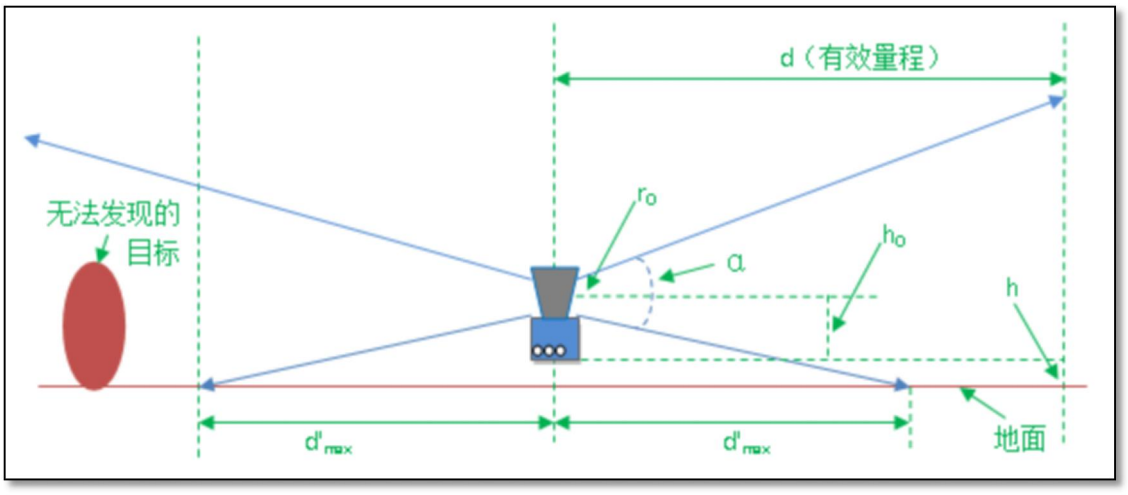
Among them:

h_0Is the height of the outgoing optical axis of AS-100C relative to the bottom surface, h_0 = 0.057 m.

r_0Is the spot outlet diameter, r_0 = 0.01 m.

α is spot divergence Angle, α= 0.008.

Figure 5.1 Relationship between effective working distance and installation height



重要提示

The actual installation height of AS-100C should be determined according to the relative height between the ground or baseline working face on the work site and the installation position, AS well AS the requirements of the working range.

5.2.2 Height and Angle adjustment for simultaneous operation of multiple lidars

If there are multiple Akusense LiDAR operating at the same time in the operating environment, the laser emitted by one Lidar should not be directly incident on the light cover of the other LiDAR. Otherwise, the measurements of the two LiDAR may be interfered with each other, resulting in false measurements at their specific scanning angles.If this possibility exists, the laser scanning surface height or pitch Angle of the LiDAR should be adjusted to avoid mutual interference, as shown in "Figure 5.2 Scanning surface Height Adjustment" and "Figure 5.3 Scanning surface Pitch Angle Adjustment".

Figure 5.2 Scanning surface Elevation Adjustment

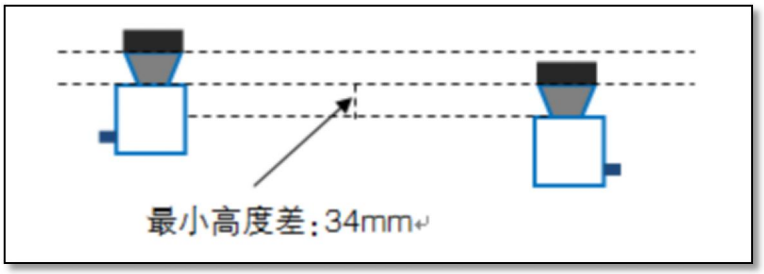
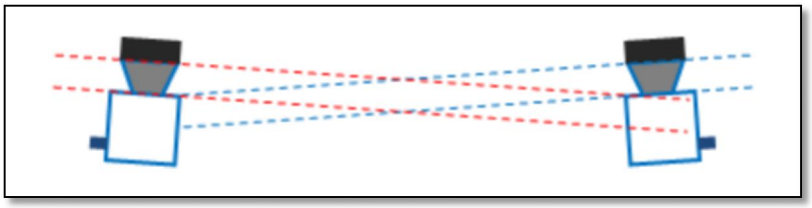


Figure 5.3 Scanning surface pitch Angle adjustment



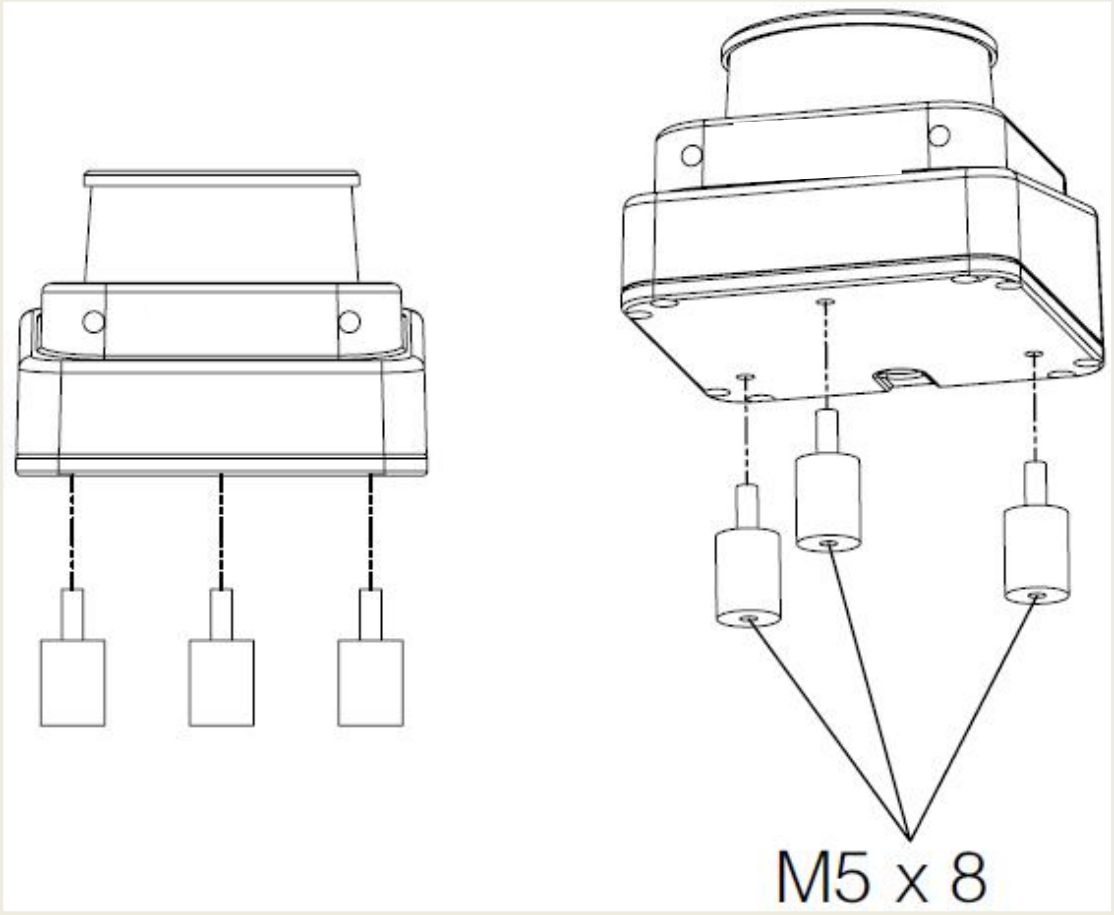
重要提示

If the above installation adjustment cannot be achieved, you can try to power off and re-power on the lidar that produced the false measurement until the false measurement data disappears. Once the mismeasurement disappears, it will not reappear in a short time.

5.3 Direct Installation

The direct installation of the AS-100C is a sit-mount, using the 3 mounting screw holes on the underside and the three shock absorbing screws in the product deliverable, as shown in "Figure 5.4 Direct Installation Schematic".

Figure 5.4 Schematic diagram of Direct mounting



重要提示

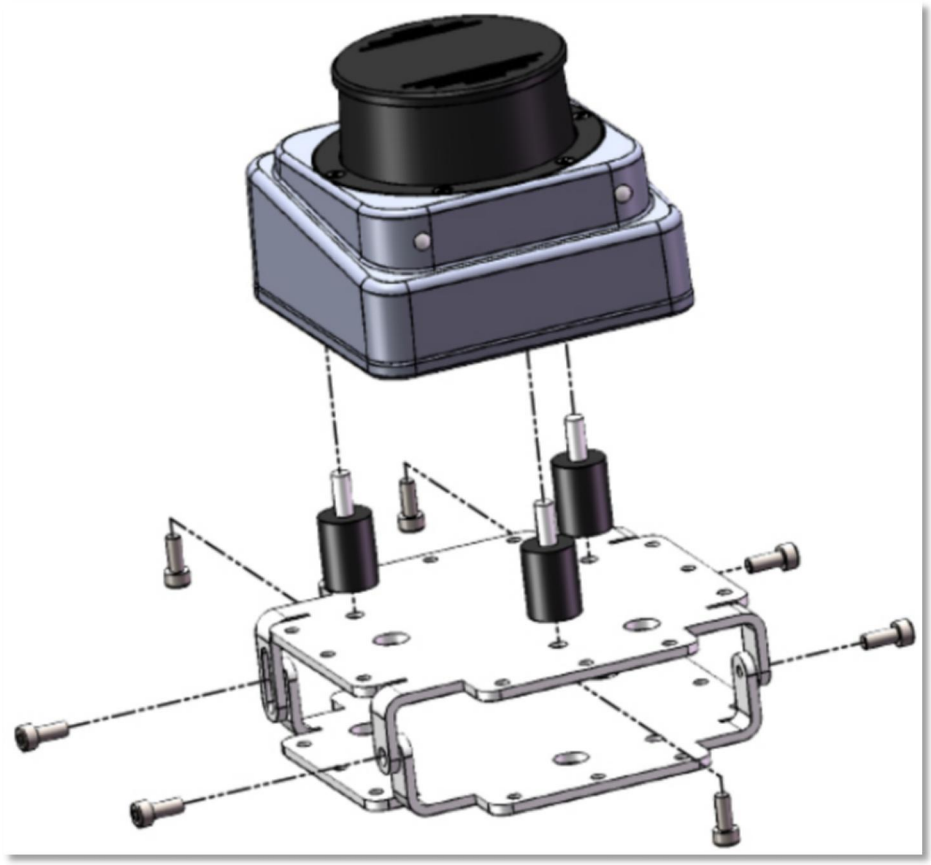
For the design of the screw through hole on the mounting surface when the direct installation mode is adopted, please read "10.3 Equipment Appearance Drawings".

5.4 Use Mounting brackets

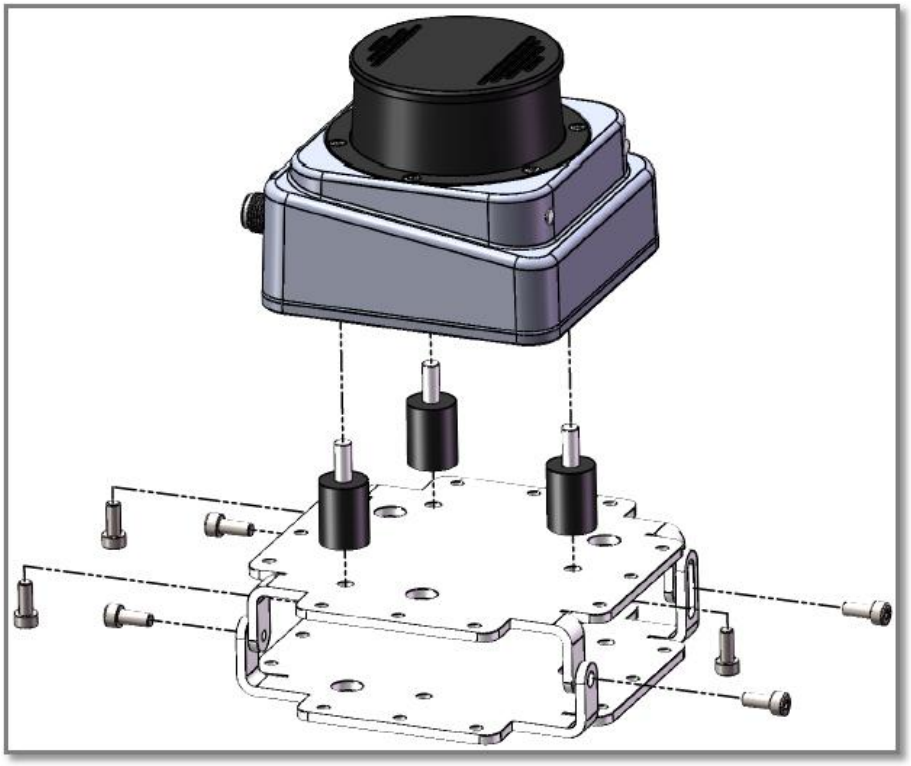
The AS-100C-AT, a sit-mount bracket that is compatible with the AS-100C, can be used to adjust the rotation Angle of the laser scanning surface around the X-axis of the measurement coordinate system, and also can be used to adjust the rotation Angle

around the Y-axis, AS shown in "Figure 5.5 Installation Schematic Diagram using the AS-100C-AT".The combination of the two AS-100C-ats can adjust the two rotation angles of the laser scanning surface around the X-axis and Y-axis of the measurement coordinate system, and accurately adjust the levelness of the laser scanning surface installation, AS shown in "Figure 5.6 Installation Schematic Diagram of the AS-100C-AT with Double AS-100C".

Figure 5.5 Installation schematic diagram using AS-100C-AT

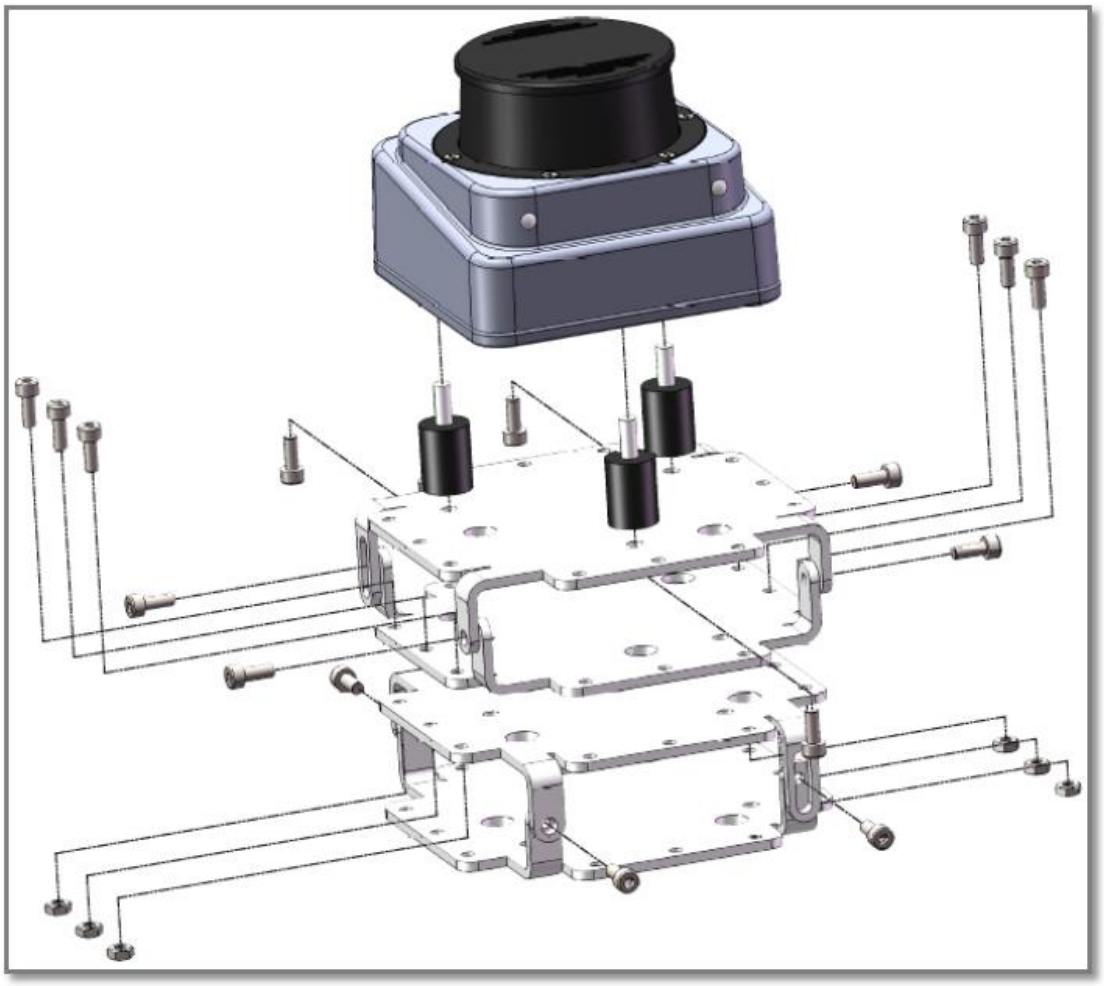


Adjust the rotation Angle around the X-axis



Adjust the rotation Angle around the Y-axis

Figure 5.6 Schematic installation using Dual AS-100C-AT



Adjust the rotation Angle around the X/Y axis

重要提示

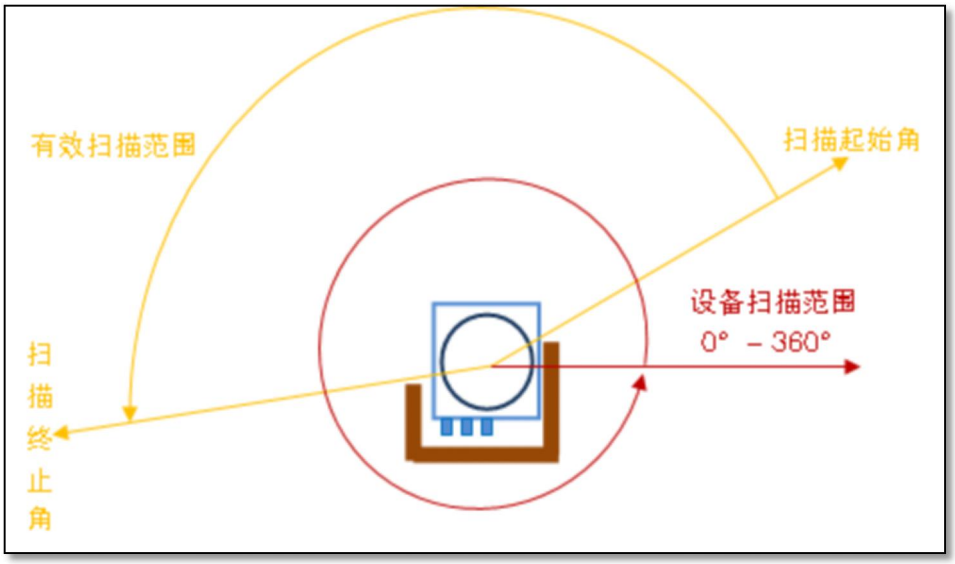
- Read "10.4 Accessory Outline Drawings" to design how the AS-100C-AT will be mounted on the mounting surface;
- Users can refer to the AS-100C-AT to design their own installation bracket with the ability to adjust the tilt Angle of the laser scanning surface.

5.6 Adjust the scan range

In factory Settings, the original working scan range of AS-100C is 360° device scan range, scan start Angle is 0°, scan end Angle is 360°, AS shown in "Figure 10.1 Measurement coordinate system/scan range/Range".When AS-100C is installed and

used, if there is an object within 5cm of the height of the laser scanning surface within the original working scanning range, such AS the protective cover structure designed by the user, or the non-removable object or wall in the installation environment, the device will cause a shielding alarm.In order to avoid this situation, it is necessary to adjust the scanning starting Angle and scanning ending Angle according to the actual effective scanning range of AS-100C in the working environment, AS shown in "Figure 5.7 Effective scanning range".

Figure 5.7 Effective scan range



You can use the FILPS software to adjust the scan start Angle and scan end Angle of AS-100C AS follows:

- Use FILPS to connect AS-100C through Ethernet and configure the AS-100C. For details, please read "7.3 Device Configuration".
- Open the Running Status TAB in the device window, and you can observe the on-site measurement data of AS-100C.Use the mouse to enlarge the measured scene depth image to the maximum level, and then use the function of "Specific Angle measurement data" to check the occlusion Angle of the occluded object and determine the effective scanning range of AS-100C, AS shown in "Figure 5.8 Determining the effective scanning range by measuring Data";
- Window of the device in the "device configuration" TAB "run configuration parameters" column, within "effective scanning Angle range" edit box input the

correct starting point and end Angle values, such AS "figure 5.9 effective scanning range adjustment software operation interface, FILPS will be based on the current the AS - 100 - c scan Angle resolution to adjust the input values;

- Press the "Upload Device" button to send the configuration data to AS-100C, then AS-100C will restart automatically.

After the AS-100C restarts, the newly set working scan range parameter starts to take effect. At this time, AS-100C outputs only the measurement data within the working scan range.

相关阅读

For details related to scan Angle range adjustment, please read Section 7.11 "Specific Angle Measurement Data" and Section 6.3 "Operating Configuration Parameters" in the "Lidar Diagnostic and Configuration Software (FILPS) User Manual.

Figure 5.8 Determining the effective scan range from the measurement data

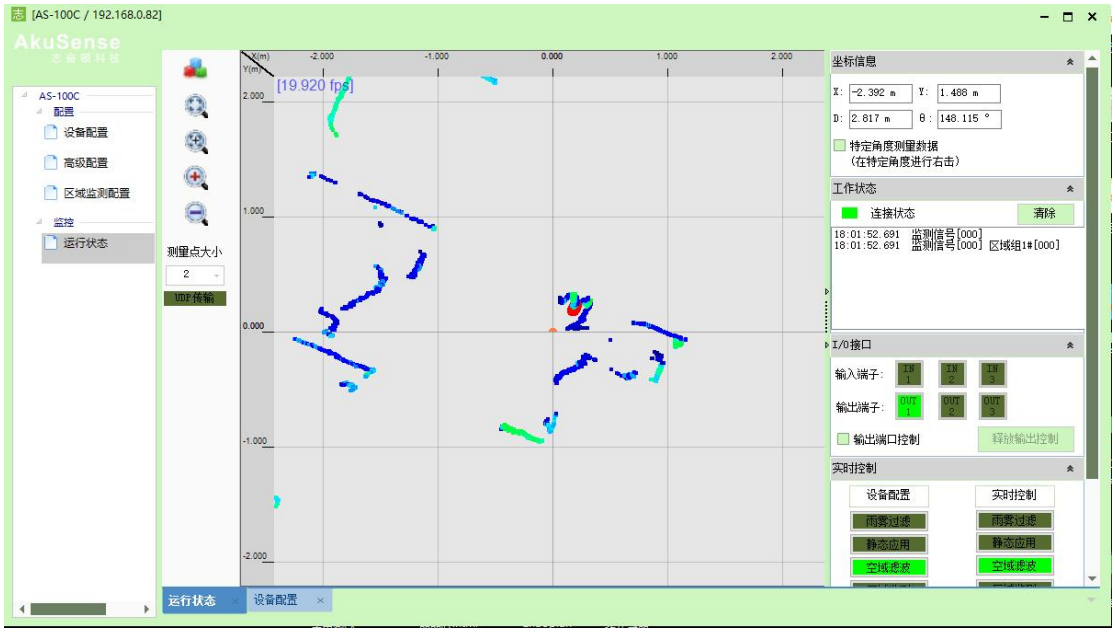


Figure 5.9 Operating interface of effective scan range adjustment software

6 Electrical Installation

注意

When installing the AS-100C electrically, pay special attention to:

- Select personnel with electrical installation qualifications to perform the operation;
- Avoid electrical installation; otherwise, the device may be damaged.

6.1 Installation Steps

Follow these basic steps for electrical installation of the AS-100C:

- Prepare the proper power supply for the AS-100C and finish wiring the power interface;
- Wiring the I/O interface according to the needs of the application;
- Connect to PC through Ethernet interface, prepare to configure AS-100C;
- Connect to the power port and prepare to power on and run.

6.2 Installation Preparations

6.2.1 Power supply

The power supply voltage of AS-100C should be DC9V-30V, and the measured power consumption under the running state is 5W. Please provide power according to the above standards when using it.

重要提示

Please read "10.1 Data Manual" in detail to understand the complete power supply requirements of AS-100C.The user should follow the local regulations and take necessary protection for the power supply cable of AS-100C to avoid short circuit or overload of power supply;In addition, an

	emergency circuit breaker should be installed on the power supply cable to quickly cut off the power supply in case of emergency.

6.2.2 Grounding Requirements

It is essential to ensure that the ground on the installation surface of the AS-100C is equipotential with that of the remote equipment; otherwise, the current generated by the potential difference of the ground will flow through the AS-100C housing and cause the following potential hazards:

- Creating a contact voltage on the AS-100C housing and causing personal injury;
- Causing AS-100C to not work properly;
- Cause heating effect on the cable and produce fire hazard.

6.2.3 Wire Requirements

Please use copper wire to complete wiring. The section requirements of wire are shown in "Table 6.1 Wire Requirements".

Table 6.1 Wire Requirements

The socket	Wire section area requirements
A power outlet	Install power supply nearby: minimum 0.25mm^2 Power supply is not installed nearby: for DC24V power supply with a transmission distance of 20 meters, minimum 1mm^2
Ethernet socket	CAT5 standard Ethernet cable
The I/O socket	A minimum of 0.25 mm^2 Minimum 0.5mm for 50 m transmission distance^2

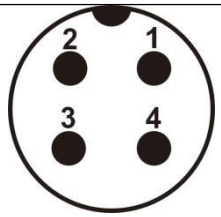
6.2.4 Connect to PC

You can use the CB21@M12BF5RJ45 cable in the AS-100C deliverable to connect to the PC through an Ethernet port.

6.3 Device socket signal definition

6.3.1 Definition of power outlet signal

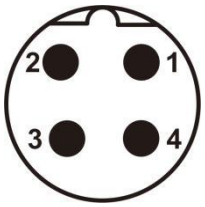
Table 6.2 Definition of power outlet signal



No.	The signal name	function
1	RESV2	keep
2	GND S	The power to
3	Vs	The power is end
4	RESV3	keep

6.3.2 Ethernet socket signal definition

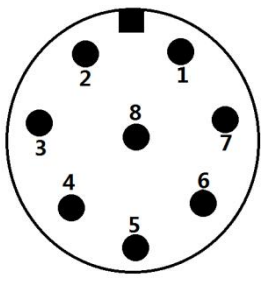
Table 6.3 Ethernet Socket Signal Definitions



No.	The signal name	function	Cable color	Cable sequence
1	TX-	Data send negative end	orange	2
2	RX+	Data reception plus end	White, light green,	3
3	RX-	Data receive negative end	Dark green	6
4	TX+	Data send plus end	White and orange	1

6.3.3 I/O socket signal definition

Table 6.4 I/O socket signal definitions



No.	The signal name	function
1	IN2	Universal input 2# positive end
2	IN1	Universal input 1# positive end
3	GND OUT (GND S)	Common output Common ground
4	OUT2	Universal output 2# positive end
5	OUT1	Universal output 1# plus end
6	IN3	Universal input 3# plus end

	7	GND IN	Common input Common ground
	8	OUT3	Universal output 3# plus end

Description:

- Generic input positive end "IN1...3 "input signal is level input (vs. universal input common ground" GND IN "), the logic state is "high level" and "low level";
- Universal output positive-end "OUT1...3 "is the PNP switch output (vs. the positive end of the power supply" vs "), and the logical state is "on" and "off".

相关阅读

Please read "10.1 Data Book" for the electrical characteristics of I/O signals.

6.4 Socket Wiring

注意

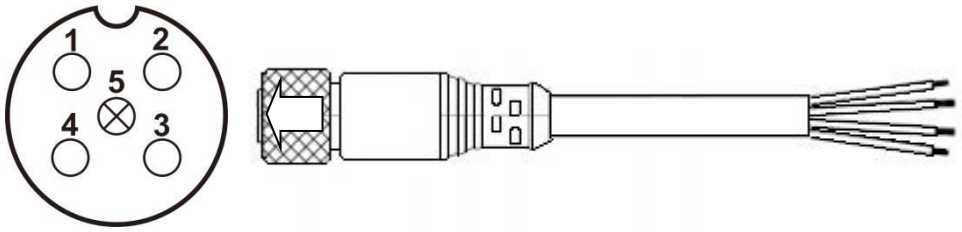
The protection level of AS-100C shell is IP65. The following requirements should be met when the external cable matching with the M12 waterproof socket of AS-100C is welded by the user:

- The selected cable and M12 plug must meet the protection level requirements of IP65;
- The M12 plug of the external cable connected to the M12 socket of AS-100C must be tightened without loosening;
- The M12 socket that is not in use on AS-100C must be tightened according to the state of delivery, and the dust plug can not be exposed;Keep the dust stoppers that are not in use.

The AS-100C accessories include three finished cables with M12 plugs, which can usually be used directly to finish wiring the device.Of the three finished cables, AS-100C-RJ45 is an Ethernet interface cable with an RJ45 plug, which can be us ed directly;As-100c-ec and AS-100C-IOCB are power cables and I/O cables, respec tively, with leads. The lead wiring needs to be completed according to the signal d efinition and reference circuit of the leads, AS shown in "Table 6.5 Definition of Po wer cable Lead Signal" and "Table 6.6 Definition of I/O Cable Lead Signal".

6.4.1 Definition of power cable Lead Signal

Table 6.5 Definition of power cable lead signal



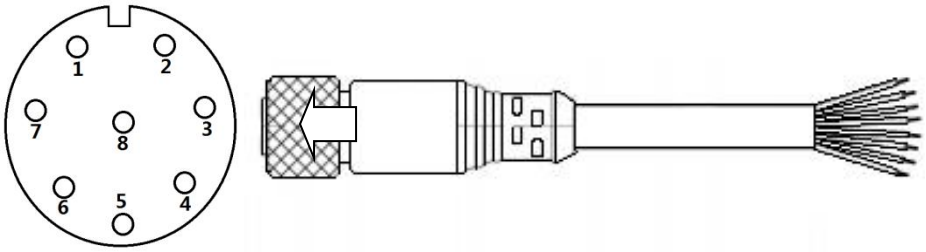
Power Socket No.	The signal name	function	Lead the color
1	RESV2	keep	blue
2	GND S	The power to	black
3	Vs	The power is end	brown
4	RESV3	keep	white
5	RESV1	keep	-

注意

Connect the power ports in strict accordance with the correct lead sequence; otherwise, the device may be permanently damaged.

6.4.2 I/O Cable Lead Signal Definition

Table 6.6 Definition of I/O cable lead signal



I/O socket serial number	The signal name	function	Lead the color
1	IN2	Universal input 2# positive end	white
2	IN1	Universal input 1# positive end	brown
3	GND OUT (GND S)	Common output Common ground	green
4	OUT2	Universal output 2# positive end	yellow
5	OUT1	Universal output 1# plus end	grey

6	IN3	Universal input 3# plus end	powder
7	GND IN	Common input Common ground	blue
8	OUT3	Universal output 3# plus end	red

6.5 I/O interface external reference circuit

Figure 6.1 I/O interface input Terminal External circuit (refer to GND potential)

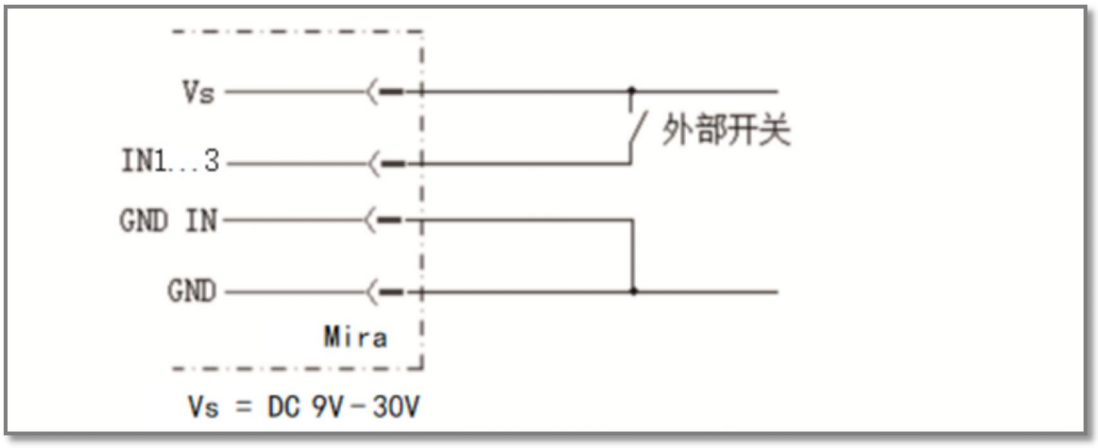
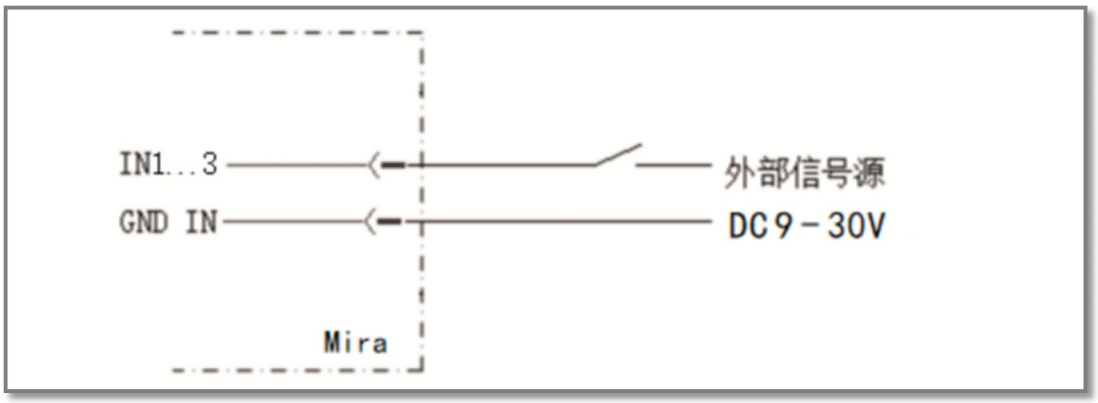


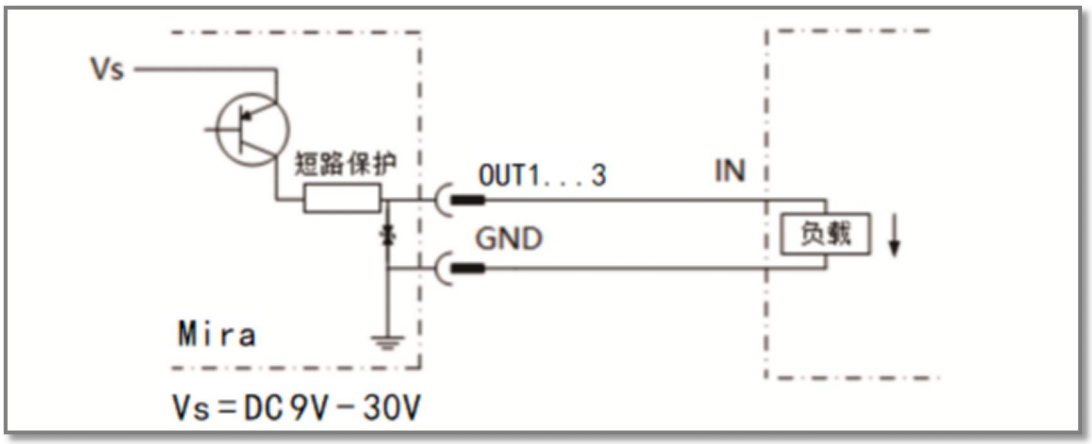
Figure 6.2 I/O interface input Terminal External circuit (floating)



重要提示

In the input connection mode shown in the figure above, the voltage of the external signal power supply must be DC9V - 30 v.

Figure 6.3 I/O interface output terminal external circuit



7 Device configuration and commissioning test

警告	Incorrect device configuration can cause damage or abnormal operation of the device.Always make sure the equipment has been fully inspected before configuring the AS-100C.Read "2 Basic Operations and Precautions" carefully and make the necessary preparations.

Device configuration and commissioning tests of AS-100C require the use of "LiDAR Diagnosis and Configuration Software (FILPS)".FILPS is used to configure the operating parameters of AS-100C according to the application requirements, obtain and display measurement data, and test the I/O interface input and output functions.

相关阅读	For details on how to use FILPS, please read the Lidar Diagnostic and Configuration Software (FILPS) User Manual.

7.1 Configuration and Test Steps

- Install FILPS software on your PC;
- Establish TCP connection between PC and AS-100C through Ethernet port;
- According to the application requirements, the equipment parameters and functional parameters of AS-100C are adjusted and saved;
- Perform functional tests on AS-100C.

7.2 Software and equipment preparation

- Download "Lidar Diagnostic and Configuration Software (FILPS)";
- Install the FILPS software on your PC using the "FILPS Installation Package" in "Lidar Diagnosis and Configuration Software (FILPS)";
- Power off the AS-100C;
- Connect the Ethernet port between the PC and the AS-100C in direct connection mode, and the Ethernet cable in the AS-100C deliverable is recommended.

- On the PC, disable all network adapters except those connected to the AS-100C, and configure the IP address 192.168.1.25x / 255.255.255.0 for the network adapter connected to the AS-100C, x is set to 1...4. The IP address does not conflict with the IP address of other network adapters.
- The M12 plug of the I/O cable is inserted in the I/O socket of AS-100C, according to the wiring definition of the I/O lead and the external circuit requirements of the input and output end of the I/O interface to connect switches, indicators and other external devices, ready to test the I/O interface control function.

7.3 Device Configuration

- After the AS-100C is powered on, the device enters the initialization state. About 24 seconds later, the "HTR" indicator lights on, and the device has started to measure normally.
- Run FILPS on PC;
- Locate the AS-100C you are configuring in the "Online Devices" form on the FILPS interface, AS shown in "Figure 7.1 Online Devices";Double-click the device icon of AS-100C and add AS-100C to the "New Project" form. Double-click the device icon of AS-100C again in the project form to establish a TCP connection with AS-100C. Then the device window of the configured AS-100C will appear, AS shown in "Figure 7.2 Device Form and Device Configuration TAB".
- In the device form of AS-100C, open the "Device Configuration" TAB, AS shown in "Figure 7.2 Device Form and Device Configuration TAB", modify the Ethernet configuration of AS-100C in the "Network Configuration" column according to the requirements of the application system, and press the "Upload Device" button to send the configuration data to AS-100C. In this case, AS-100C will restart automatically.

Figure 7.1 Online Device form

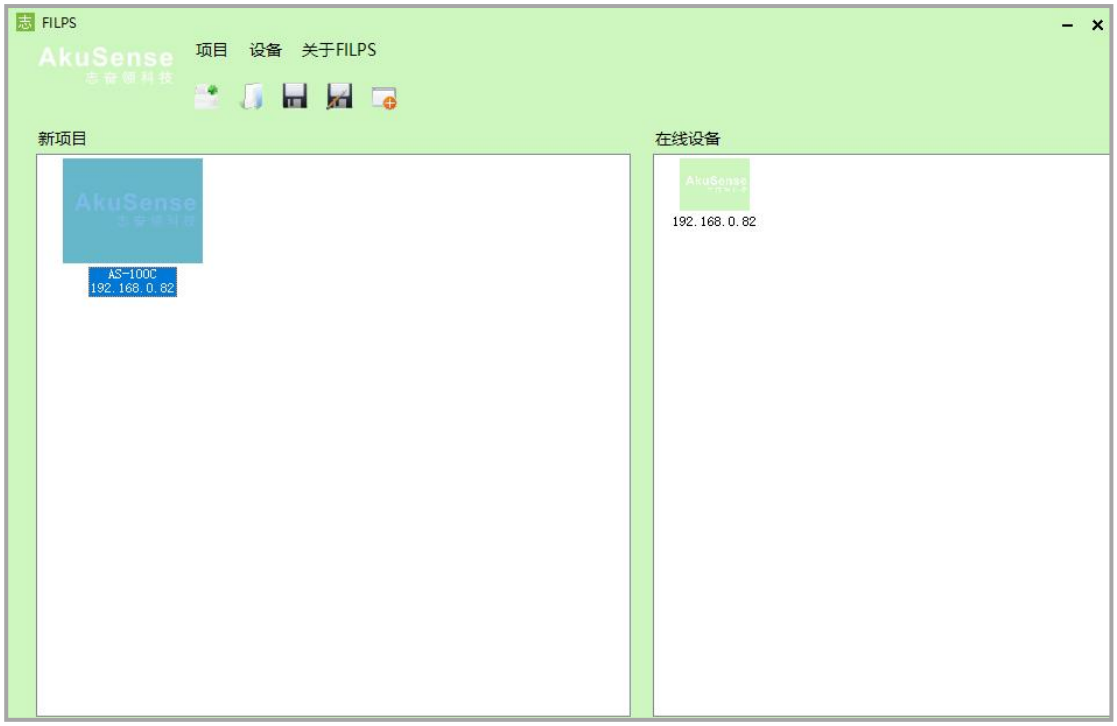


Figure 7.2 Device Form and Device Configuration TAB

7.4 Test Steps for Commissioning

After the AS-100C is restarted and the "HTR" indicator is switched to steady on, use FILPS to reconnect the AS-100C and you can start the test run of the device AS follows:

- Open the "Running Status" TAB in the device window, AS shown in "Figure 7.3 Running Status TAB", and observe the measurement results of AS-100C on the spot. The RSSI of the measurement point is represented by color and brightness.
- Open the "Running Status" TAB, and in the "I/O Interface" column, as shown in "Figure 7.4 I/O Interface Status and Output Terminal Status Control", you can view the status of the I/O port, and use the external switch and indicator to test the functions such as I/O reading, I/O output setting, and I/O output setting.

相关阅读

Please read the "Commissioning Test" section of "AS-100C Concise User Manual" to understand the test preparation and basic test process, and design other test methods AS required.

Figure 7.3 Running Status TAB

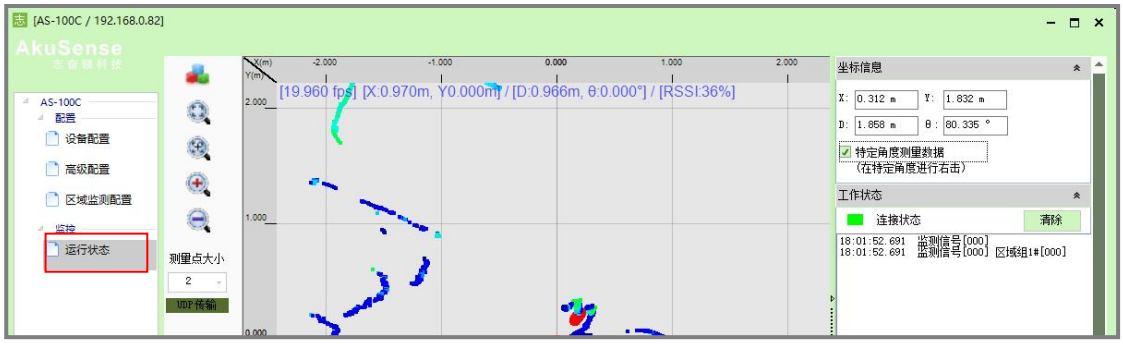
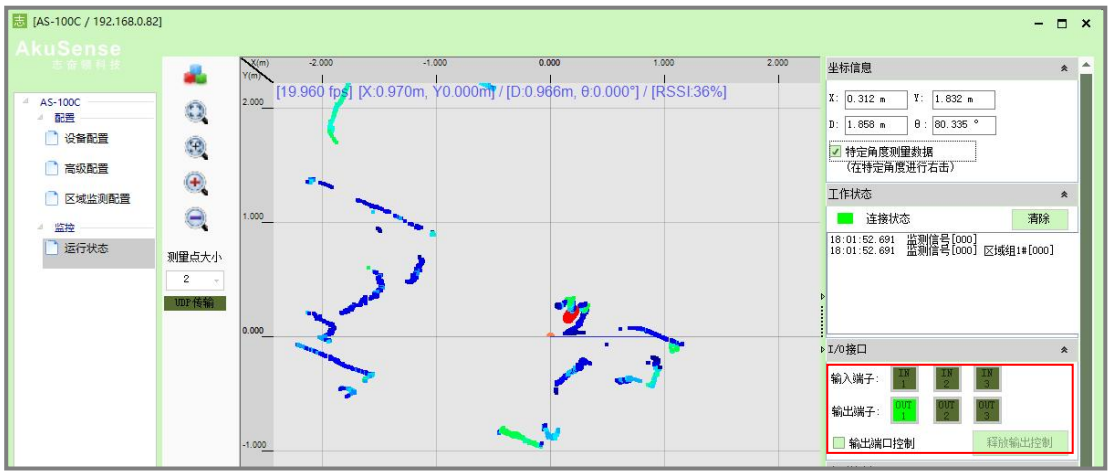


Figure 7.4 I/O interface status and output terminal status control



8 Equipment Maintenance

注意	The AS-100C has a seal label at the joint of the equipment shell. If this label is damaged, or the shell is disassembled, Akusense is no longer responsible for the warranty of the product.The AS-100C enclosure should only be removed by a person approved by Akusense.

8.1 Operation and Maintenance

As-100c operating in a clean environment requires little maintenance.When working in an environment that may be contaminated by dirt, the main maintenance is to clean the light transmittance hood.When cleaning a light shed, be aware of:

- Do not use cleaning agents that are corrosive or contain solid substances;
- Do not use hard cleaning materials.

The static electricity on the light shed will cause dust particles to easily adhere, causing a decrease in the measurement ability, in this case, you should use a lens cloth that has the ability to eliminate static electricity to wipe the light shed.

8.2 Replacing the Device

When replacing a failed AS-100C, if the cables and plugs of the original device are not damaged, you do not need to replace them. You only need to replace the failed AS-100C by following the following steps:

- Turn off the power switch of the AS-100C that is being replaced;
- Unscrew and unplug all connecting cables;
- Install the AS-100C for replacement (see "5 Equipment Installation" and "6 Electrical installation");
- Connect all cables;
- Turn on the power switch;

- Configure the AS-100C on the replacement through a PC (see "7.3 Device Configuration").

After the AS-100C on the replacement is restarted, the system can be put back into service.

9 Troubleshooting

注意

The AS-100C has a seal label at the joint of the device housing. If this label is damaged, or the housing is disassembled, Akusense is no longer responsible for the warranty of the product.The AS-100C enclosure should only be removed by a person approved by Akusense.

1. The "HTR" indicator light is off at all times:

   Power on and restart AS-100C after power off. If restart for several times still cannot return to normal, it is necessary to return to the factory for maintenance;

2. The "ERR" indicator is steady on or continuously blinking:

   Table 9.1 Troubleshooting of "ERR" indicator failure

Indicator Status	why	The disposal way
Normally on	Internal error Measurement of the failure	Restart after power failure by adding power. If it still can't return to normal after multiple power ups, you need to return to the factory for repair.
	Measure to stop	Restart the measurement with FILPS.
Short flashes (1 hz)	Light transmission hood dirty/occluded	Clean the light shed or remove the cover.
	Obscured by fog	If it is confirmed that it is not fog occlusion, use FILPS to turn off Fog Occlusion Detection.
Long blink (0.5 Hz)	High and low temperature alarm	High temperature: power cooling, heat insulation facilities or protective cover; Low temperature: continue to run, if it can not return to normal for a long time, need to add a heating device for the equipment.

3. FILPS cannot find AS-100C configured/cannot connect AS-100C directly with PC:

   See Chapter 10 "Troubleshooting" in the "Lidar Diagnostic and Configuration Software (FILPS) User Manual".

10 Technical Specifications

10.1 Data Sheet

Table 10.1 Data Book

Function parameters	The minimum	Typical values	The maximum
Scan angle range	360 °		
Scanning angle	0 °		360 °
Scan angle resolution	0.05 °		0.1 °
Sweep frequency	10Hz		20Hz
Measurement delay[1]	0ms	50ms	100ms
Measurement data	Composite data (distance +RSSI)		
Distance measurement range	0.2 m		100m
Reflector[2]range			100m
18% reflectivity range			28m
10% reflectivity range			20m
Distance measurement error (absolute value)			
System error		± 25 mm (1 m to 20 m) + 40 mm (20 m to 50 m)	± 60 mm (1 m to 20 m) + 100 mm (20 m to 50 m)
System error (reflector[2])		± 8 mm (1 m to 40 m) ± 15 mm (40 m ~ 100 m)	± 20 mm (1 m to 40 m) ± 30 mm (40 m ~ 100 m)
Statistical error (1σ)		± 10 mm (1 m to 20 m) ± 20 mm (20 m to 50 m)	± 20 mm (1 m to 20 m) + 40 mm (20 m to 50 m)
Statistical error (1σ, reflector[2])		± 6 mm (1 m to 40 m) ± 12 mm (40 m ~ 100 m)	± 10 mm (1 m to 40 m) ± 20 mm (40 m ~ 100 m)
Temperature drift			0.4 cm / ℃
RSSI measurement range	3%		1000%(reflector)
RSSI measurement error (relative value)			
System error		± 2% (1 m to 20 m) ± 4% (20 m to 50 m)	± 5% (1 m to 20 m) ± 10% (20 m to 50 m)

Systematic error (reflector[2])		± 2% (1 m to 40 m) ± 5% (40 m ~ 100 m)	± 5% (1 m to 40 m) ± 10% (40 m ~ 100 m)
Statistical error (1σ)		± 1% (1 m to 20 m) ± 2% (20 m to 50 m)	± 2% (1 m to 20 m) ± 3% (20 m to 50 m)
Statistical error (1σ, reflector[2])		± 0.2% (1 m to 40 m) ± 0.5% (40 m ~ 100 m)	± 2% (1 m to 40 m) ± 3% (40 m ~ 100 m)
Power-on startup delay	22s	24s	27s

General Parameters	The minimum	Typical values	The maximum
Laser emitter	Pulsed laser diode		
The laser wavelength	895nm	905nm	915nm
Laser class	Class I (GB 7247.1-2012, eye safe)		
Laser exit diameter	10mm		
Laser divergence Angle	1.8 (H) × 7.6 mrad (V)	2.0 (H) × 8.0 mrad (V)	2.2 (H) × 8.8 mrad (V)
The distance between the emission light axis and the rear side	The 48.3 mm		
The height of the light axis of the scanning surface from the bottom surface	57mm		
Ambient light intensity	0lux		80000 lux
Protection degree	IP65(GB 4208-2008)		
Safety Protection Level			
Insulation resistance	1 m Ω (GB 16796-2009, 5.4.4)		
Dielectric strength	0.5 KV (GB 16796-2009, 5.4.3)		
EMC test			
Electrostatic discharge	6KV(GB/ T1766.2 -2006, level 3)		
Fast pulse	1KV(GB/T17626.4-2008, Level 2)		
Electromagnetic field radiation immunity	GB/T17626.3-2006, Grade 2		
Surge immunity	GB/T17626.5-2008 Power interface: 1.2/50US, 2KV/1KA(grade 3) Ethernet interface: 10/700US, 1KV/25A(level 2) I/O interface: 1.5/50US, 0.5kV / 0.25kA (Class 1)		
Impact	GB/T 2423.5		
Single impact	15 g, 11 ms		
Continuous impact	10 g, 16 ms		
Vibration	GB/T 2423.10		
Frequency	10Hz		150Hz

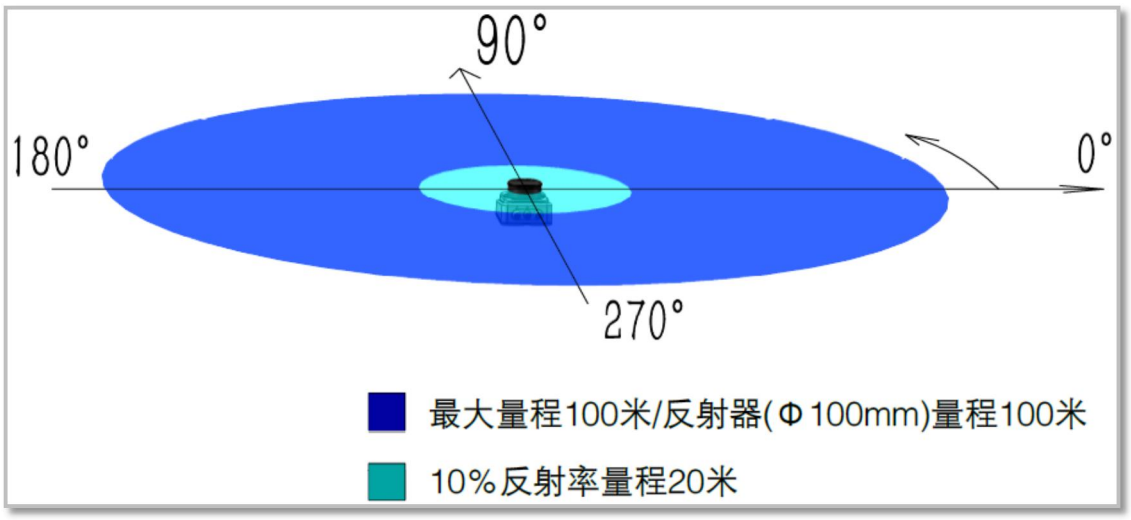
Amplitude	5g		
The temperature	GB/T 2423.1, GB/T 2423.2		
Working temperature	- 10 ℃		+ 50 ℃
Storage temperature	- 30 ℃		+ 70 ℃
Humidity	93%, +40 ° C, 2H (GB/T 2423.3)		
The altitude			5000m
Housing			
Material	Aluminum (GD - AlSi12 3.2582.05)		
Color	Blue (PANTONE 305 u)		
Translucent cover			
Material	PC		
Coating	Wear resistant coating		
Overall dimensions			
Long	The 96.5 mm		
Wide[3]	The 96.5 mm		
High	The 71.5 mm		
Weight	0.7 Kg		
Electrical parameters	The minimum	Typical values	The maximum
Power			
Type	DC power supply		
The power supply voltage	9V	24V	30V
Starting current[4]			0.21 A
Working current[4]	0.20 A	0.21 A	0.21 A
Power consumption	4.9 W.	5W	5.1 W.
Electrical interface	The minimum	Typical values	The maximum
The power interface	M12(Model A) Round socket, Male, 4 cores		
Ethernet port	M12(model B) Round socket, Male, 4-core		
Rate	10/100 Mbps		
The I/O interface	M12(Model A) Round socket, Male, 8-core		
I/O port input terminals	IN1 / IN2 / IN3		
Number	3		
Type	Level input (vs. common input Common ground "GND IN")		
High level input impedance		7.5 K Ω	
High level	9V		30V
Low level			0.7 V
Input capacitance		10nF	
Static input current	1mA	3mA	3.8 mA
Preset functions	Power saving & Life extension control (IN2 / IN3), effective level: High level		
I/O interface output terminal	OUT1 / OUT2 / OUT3		

Number	3		
Type	PNP switch output (vs. positive end of power supply)		
State	Off		
Switch voltage	DC9V	DC24V	DC30V
Output current			200mA
Output capacitance			10pF
Preset functions	"Device ready" (OUT1), valid status: On		

1. The delay at 20Hz scanning frequency is related to the location and timing of the target under test, and does not include TCP/UDP network transmission delay.
2. For ф100mm cylindrical reflector, reflector material diffuse reflectance rate of 1000%, reflector length of 400mm;
3. Including aviation plug: 110mm;
4. DC24V power supply conditions under the operating parameters.

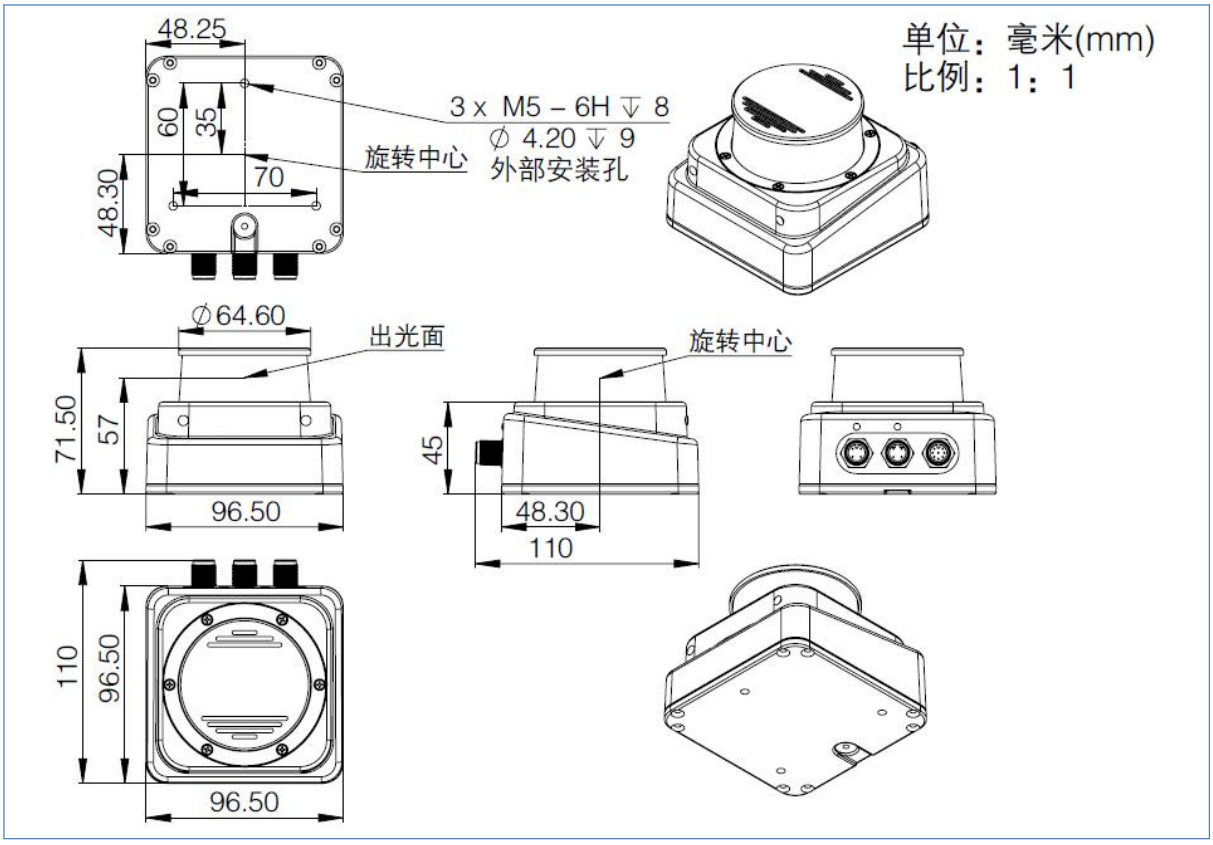
10.2 Measurement coordinate system/scan range/range

Figure 10.1 Measurement coordinate system/scan range/range



10.3 Device outline drawing

Figure 10.2 Equipment outline drawing



10.4 Outline drawing of accessories

Figure 10.3 AS-100C-AT Outline Drawing (A)

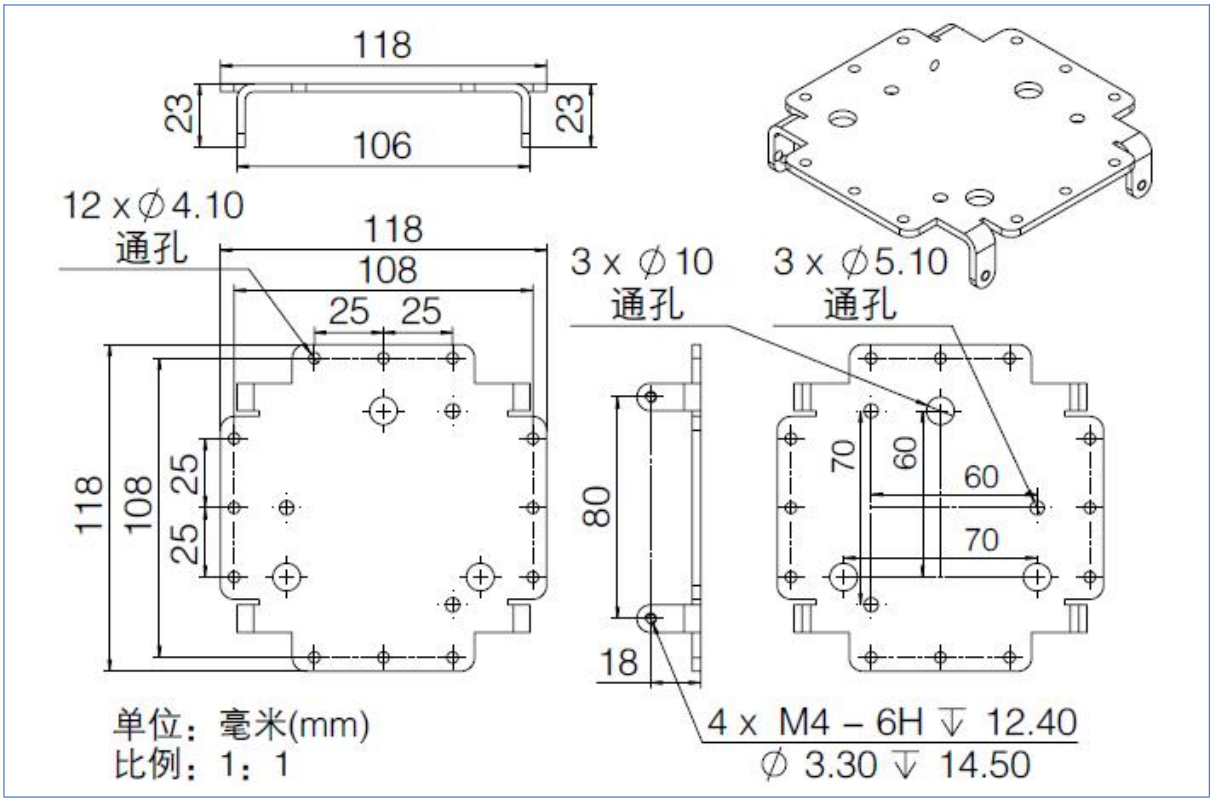
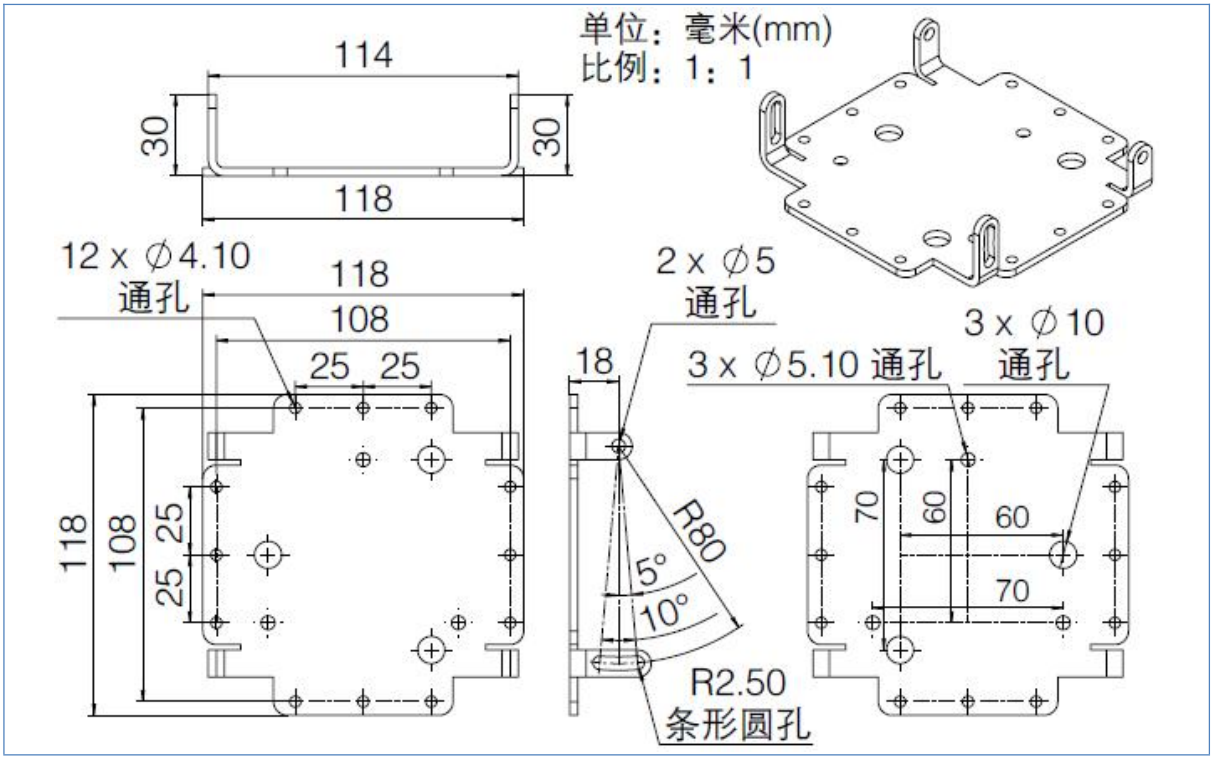


Figure 10.4 AS-100C-AT Outline Drawing (B)



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