

SKYLAND-AIO-C01 3D Lidar

User Manual v2.0

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Catalogue

Product Overview.....	2
brief introduction.....	2
product features.....	3
Part Description.....	3
Interface Definition.....	4
One outlet with two cables.....	4
install.....	6
Effective Field of View (FOV) Range.....	6
Installation Notes.....	7
installation size.....	7
prepare.....	8
Design External Power Source.....	8
ligature.....	8
make use of.....	9
coordinate system.....	9
Point Cloud Data.....	9
Storage, Transportation, and Maintenance.....	11
memory.....	11
transport.....	11
take good care of one's health.....	11
Common Questions.....	12
Appendix.....	13
The structural dimensions of the I/O-C01 unit:.....	13
Parameter Specifications.....	14

Product Overview

Brief Introduction

The SKYLAND-AIO-C01 is specifically designed for all-in-one scenarios requiring robust obstacle avoidance, as well as for front-mounted applications in compact vehicles such as autonomous mobile robots (AMRs), underground forklifts, and unmanned lawn mowers. Leveraging its high-density point cloud coverage, it rapidly detects minute obstacles in the environment, significantly enhancing both obstacle detection accuracy and response speed.

Range detection capability:The AIO-C01 radar can detect objects at a minimum distance of 0.05 meters and a maximum distance of 50 meters (at 90% reflectivity).

Ultra-wide angle:The AIO-C01 features exceptional ultra-wide-angle scanning capabilities, with a field of view (FOV) extending to 360° horizontally and 65° vertically (-20° to 45°). Its robust mechanical design enables flexible installation in both vertical and horizontal orientations, allowing seamless switching between ceiling-based and horizontal navigation modes.

High-resolution capability:Featuring an exclusive three-axis longitudinal non-repetitive scanning technology combined with high-frequency on-chip TDC technology, it generates hundreds of thousands of high-precision point clouds per second, offering superior coverage and detailed detection capabilities. This delivers a point cloud configuration tailored for intelligent robotics applications in obstacle avoidance, navigation, and recognition.

IMU Motion Monitoring Technology:Compact design with convenient IMU synchronization, capable of real-time detection of object acceleration, angular velocity, and attitude information. By integrating point cloud data with IMU measurements and employing kinematic models for state estimation, it achieves high-precision positioning and mapping even in dynamic environments. Utilizing a 6-axis MEMS motion tracking™ device with an ODR of 32 kHz, it enables robots to easily detect operational anomalies or errors; the acceleration measurement range extends up to 32 g with 1 mg resolution, ensuring reliable tracking of substantial linear motions; and features programmable digital output from X-, Y-, and Z-axis angular rate sensors (gyroscopes) with a full-scale range of $\pm 2000^\circ/\text{s}$.

Intelligent Rotational Balance Technology:A proprietary and patented innovative technology that fundamentally addresses vibrations caused by the "gyro effect" during the startup and shutdown of multiple motors in compound-axis sensors. It adapts to various rotational speed combinations of compound-axis systems, ensuring smooth, seamless, and quiet operation, thereby providing a quiet and stable environment for robotic performance.

High Reliability:The AIO-C01 not only delivers outstanding performance but also boasts exceptional reliability, operating effectively across a temperature range of -20°C to 55°C and meeting the IEC-60825 Class 1 safety standard for human eye exposure.

Multiple configuration options:The AIO-C01 supports network port and Bluetooth configuration, enabling wireless upgrade configurations from smartphones or computers.

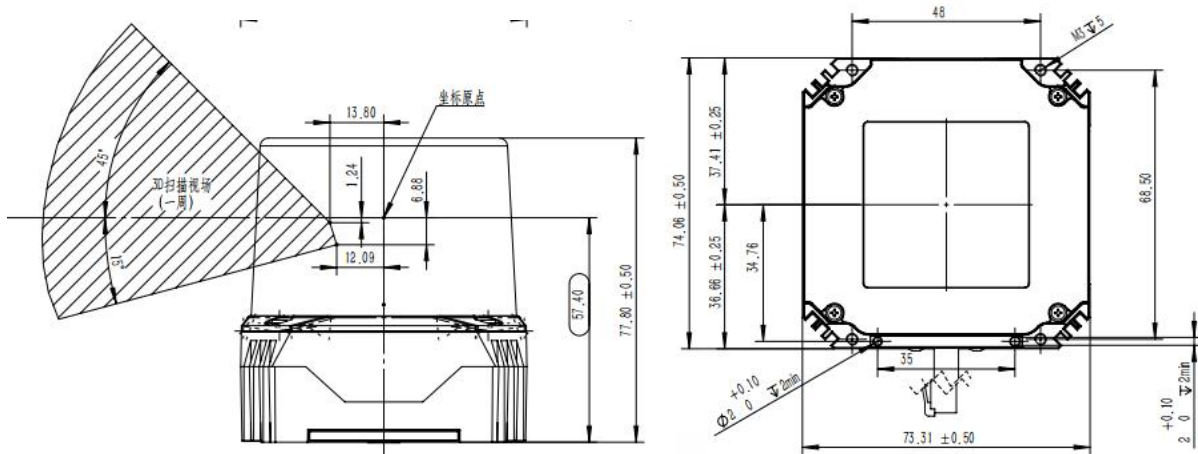
Product Features

The AIO-C01 employs an ingenious and reliable optical and structural design to achieve non-repetitive scanning, enabling detection of richer details and adapting to various application scenarios.

Non-repetitive Scanning Mode

In non-repetitive scanning mode, AIO-C01 achieves high field-of-view coverage. As the integration time increases, the field-of-view coverage significantly improves, enabling detection of richer details.

Part Description



Radar Component Diagram

1. optical window

The laser beam diverging outward through the optical window enables scanning of objects within the field of view (FOV).

2. Output Interface

The AIO-C01's output cable consists of two separate harnesses: one for the power bare wire (power port) and another for the RJ45 male connector (network port), as detailed in the Interface Definition section.

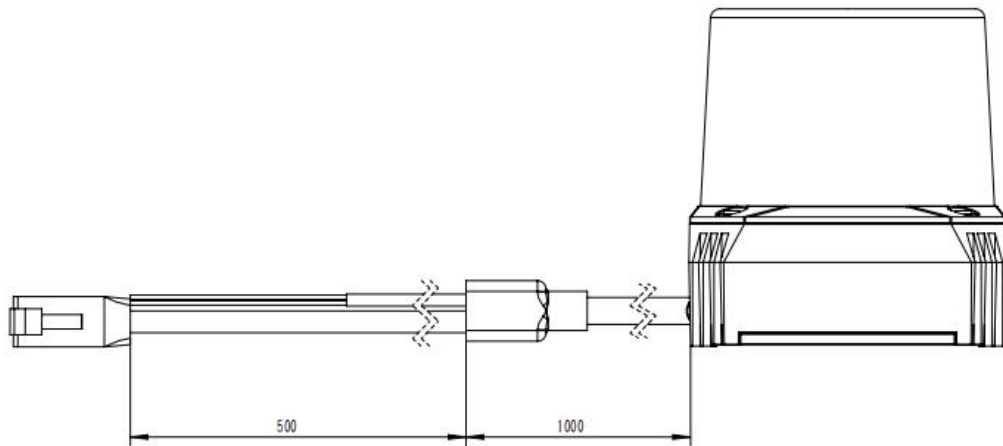
3. M3 installation hole

There are four mounting holes in total; use M3 screws to secure the AIO-C01 in the desired position.

Interface Definition

One Outlet With Two Cables

The AIO-C01's output port is divided into two branches via a single bus: a power cable (for the power input) and an RJ45 male connector (for the network interface). Users can connect to the AIO-C01 using power or network cables for power supply, control signal transmission, and data transfer, or utilize Bluetooth for parameter configuration. Additionally, it supports customizable communication interfaces to enhance overall protection capabilities (e.g., dust and water resistance).



AIO-C01 Circuit Diagram

The cable sequence for the AIO-C01 cable is defined as follows:

Output Interface	Pin Number	Definition	Wiring Harness Color	Function
Power cable core wire	The first month of the lunar year	Power positive terminal	White	Power line
	Negative	Negative terminal of the power supply	Gray	Power line
RJ45 Male	1	BI_DA+	White Orange	Data wire
	2	BI_DA-	Citrus sinensis	Data wire
	3	BI_DB+	White and green	Data wire
	4	BI_DC+	Lan	Data wire
	5	BI_DC-	Blue and White	Data wire

	6	BI_DB-	Green	Data wire
	7	BI_DD+	Brownish-white	Data wire
	8	BI_DD-	Brown	Data wire

Install

Effective Field of View (FOV) Range

The AIO-C01 incorporates both a high-speed motor and a low-speed motor: the high-speed motor drives the mirror to rotate, enabling vertical 360° measurement; the low-speed motor then rotates the core measurement component 360°, achieving an ultra-wide-angle scan of 360°×65° for comprehensive three-dimensional spatial measurement around the radar, as shown in the figure below. During installation, ensure the FOV remains unobstructed.

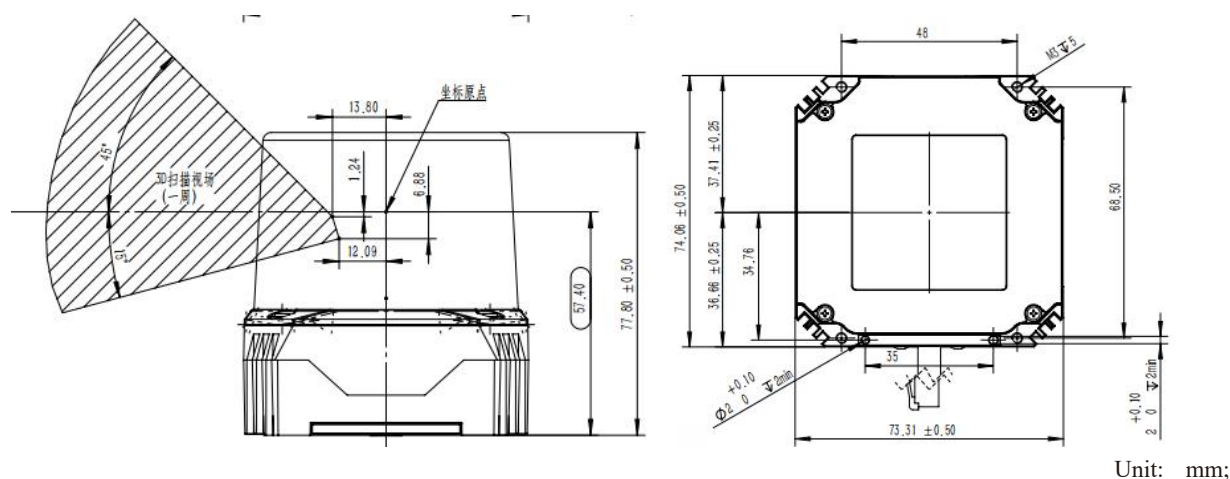
Installation Notes

Before officially installing the AIO-C01, please carefully read the following precautions:

1. Before installation, clean the optical window with alcohol or a cleaning cloth. During use, ensure the optical window is clean, as dust or other contaminants may affect the scanning performance of the AIO-C01.
2. During installation, ensure the FOV is not obstructed; even installing a transparent glass panel on the optical window may affect the performance of the AIO-C01.
3. The AIO-C01 can be installed in any direction through the mounting hole at the bottom.
4. The installation design of the AIO-C01 ensures only its own reliability; the housing cannot withstand additional loads.
5. During installation, leave sufficient space on all four sides to prevent poor air circulation from affecting heat dissipation.
6. Operating Environment: To ensure proper radar operation, the instrument must not be used or stored in flammable, explosive, or corrosive environments.
7. Eye Safety: This product meets Class 1 laser safety standards, but the device emits continuous infrared laser light during operation. For safety reasons, avoid prolonged direct exposure to the illuminated surface.
8. Product malfunction: If you suspect a malfunction, contact Wukong Innovation's technical support for inspection. All maintenance, adjustments, or part replacements must be be performed by Wukong Innovation; unauthorized disassembly or opening of the instrument is strictly prohibited.

Installation Size

The bottom of the AIO-C01 features four M3 mounting holes with a depth of 5 mm. Install the AIO-C01 in the correct position according to its mechanical dimensions and hole specifications shown in the figure below.



Mechanical dimensions of AIO-C01

AIO-C01 Weight and Dimensions

Weight	460g
Size	73 (Wide) x 73.75 (Deep) x 77.8 (Height) mm

Prepare

Design External Power Source

The AIO-C01 operates within a voltage range of 12 to 30 V, with 24 V being recommended. Under low-temperature conditions, the minimum operating voltage should be appropriately increased. When connected directly to an external DC power supply, ensure that the output voltage falls within the specified operating range. When extending the cable, the output voltage of the external power supply must be raised to compensate for additional voltage drop caused by cable lengthening, but the maximum voltage must not exceed 30 V. Note that voltage fluctuations exceeding 30 V on the cable due to factors such as interference or sudden power failure in other devices connected in parallel may cause abnormal operation or damage to the equipment.

Ligature

Network Port Connection

To test or use the AIO-C01, connect it as follows:

- Connect the power cord to the charging port of the power bank to supply electricity.
- Connect the RJ45 crystal communication interface directly to a personal computer.



The default configuration for the AIO-C01 is:

IP:192.168.1.10, Gateway:192.168.1.1, Subnet Mask:255.255.255.0, The default target server IP address for data transmission is 192.168.1.5. The radar provides 4 UDP socket ports, dedicated to parameter configuration (control commands), heartbeat messages (push commands), PCL data (point cloud data), and IMU data communication.

Make Use Of

Coordinate System

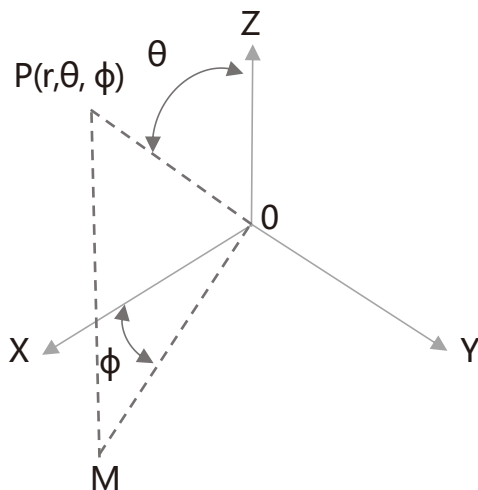
The Cartesian coordinate system O-XYZ of the AIO-C01 is defined as follows: the front of the radar corresponds to the positive half-length of the x-axis in the point cloud image. O is the origin of the point cloud coordinate system, located at the center of the bottom; the +X-axis points opposite to the emission port; the +Y-axis extends 90° counterclockwise from the +X-axis; and O-XYZ constitutes the point cloud coordinate system of the AIO-C01.

Point Cloud Data

The AIO-C01 outputs data in UDP mode. By default, it begins transmitting point cloud data immediately after establishing a connection upon power-on, with the data including three-dimensional coordinates and reflectivity values.

Point cloud data represents the collection of all point clouds detected on the surface of the object within the field of view by a laser rangefinder. Each point cloud primarily contains the following information:

Coordinate Information: The coordinate information for the AIO-C01 can be expressed in either Cartesian coordinates (x, y, z) or spherical coordinates (r, θ , ϕ), as illustrated below. When there are no detected objects ahead or when detection objects exceed the range (e.g., >40 m), the point cloud output is (0, 0, 0) in Cartesian coordinates and (0, θ , ϕ) in spherical coordinates.



$$X = r \times \sin(\theta) \times \cos(\phi)$$

$$Y = r \times \sin(\theta) \times \sin(\phi)$$

$$Z = r \times \cos(\theta)$$

Reflectivity: The reflectivity of the detected object, represented by a value between 0 and 255. Values from 0 to 150 correspond to diffuse reflective objects with reflectivity ranging from 0% to 100%, while values from 151 to 255 correspond to fully reflective objects. When the distance between the object and the radar is less than 2 m, the reflectivity measurement may be inaccurate and can only distinguish between fully reflective and diffuse reflective objects.

Timestamp: The AIO-C01 supports local timestamp synchronization.

IMU Data:The laser rangefinder integrates an IMU chip (a 3-axis accelerometer and a 3-axis gyroscope). By default, it begins transmitting IMU data at 200 Hz upon power-on (this can be enabled or disabled via the host computer). The data includes 3-axis acceleration and 3-axis angular velocity, with directions aligned with the point cloud coordinate system.

Work Status Data:

Single-line mode:

With a power consumption of approximately 7.3 W, it operates in either 0-line or 1-line modes. In single-line mode, the point cloud data volume is halved, significantly reducing computational resource usage and improving processing efficiency—making it ideal for scenarios requiring high real-time performance (e.g., high-speed AGV obstacle avoidance or low-power embedded systems). This configuration also minimizes hardware wear and extends radar lifespan.

Dual-line Mode:

With a power of approximately 8 W, in dual-line mode the two scanning lines form two parallel planes, enabling the creation of simple 3D scenes and acquisition of limited yet critical 3D information, while detecting changes in ground clearance and low obstacles.

Self-check Status	Description
Self-check Status	TDC self-checking
	DDR self-checking
	Motor Speed Check
	Disk Array Inspection
	Temperature Check
	High-pressure inspection

Storage, Transportation, and Maintenance

Memory

- The storage temperature range for AIO-C01 is -30°C to 70°C. Store it in a dry, well-ventilated, and dust-free environment. Avoid placing it alongside corrosive, flammable, or explosive substances.
- Handle carefully when storing to avoid damaging the device.
- For devices stored for extended periods, perform regular inspections and maintenance.

Transport

- Before transportation, secure the equipment and confirm it is properly installed before packing.
- Use dedicated packaging boxes or protective cushioning materials to ensure adequate protection.
- During transportation, avoid impacts, vibrations, and friction to prevent mechanical damage.

Take Good Care of One's Health

The AIO-C01 exhibits excellent reliability and stability; during normal operation, only periodic inspection and cleaning of the optical window are required. If the optical window area becomes contaminated (e.g., with dust or mud), it may impair radar ranging performance, necessitating cleaning according to the following steps:

First, use a compressed air cleaner to spray targeted areas of contamination on the optical window. Then gently wipe the surface with a clean lens cleaning cloth to remove dirt. Apply gentle pressure during wiping to avoid scratching the window surface and compromising performance. If visible stains remain, moisten the cleaning cloth with a small amount of alcohol before wiping.



When the window is contaminated with particulate dust or other impurities, direct wiping may cause scratches on the window surface, thereby compromising the performance of the laser probe.

The detection performance of the rangefinder.

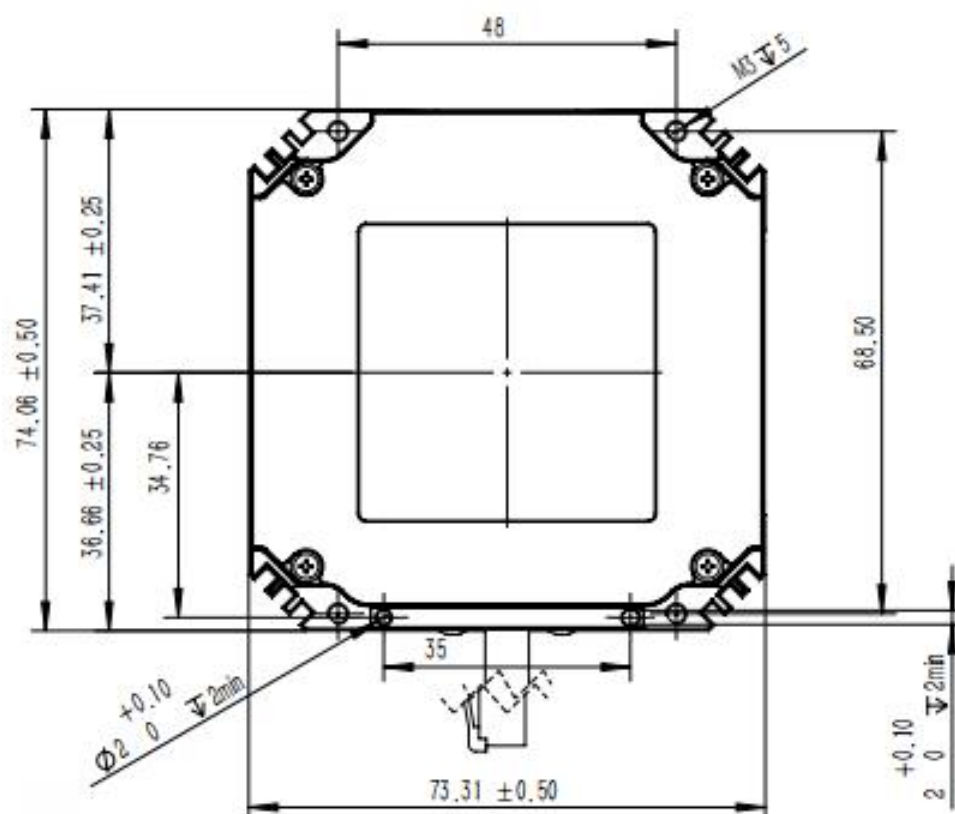
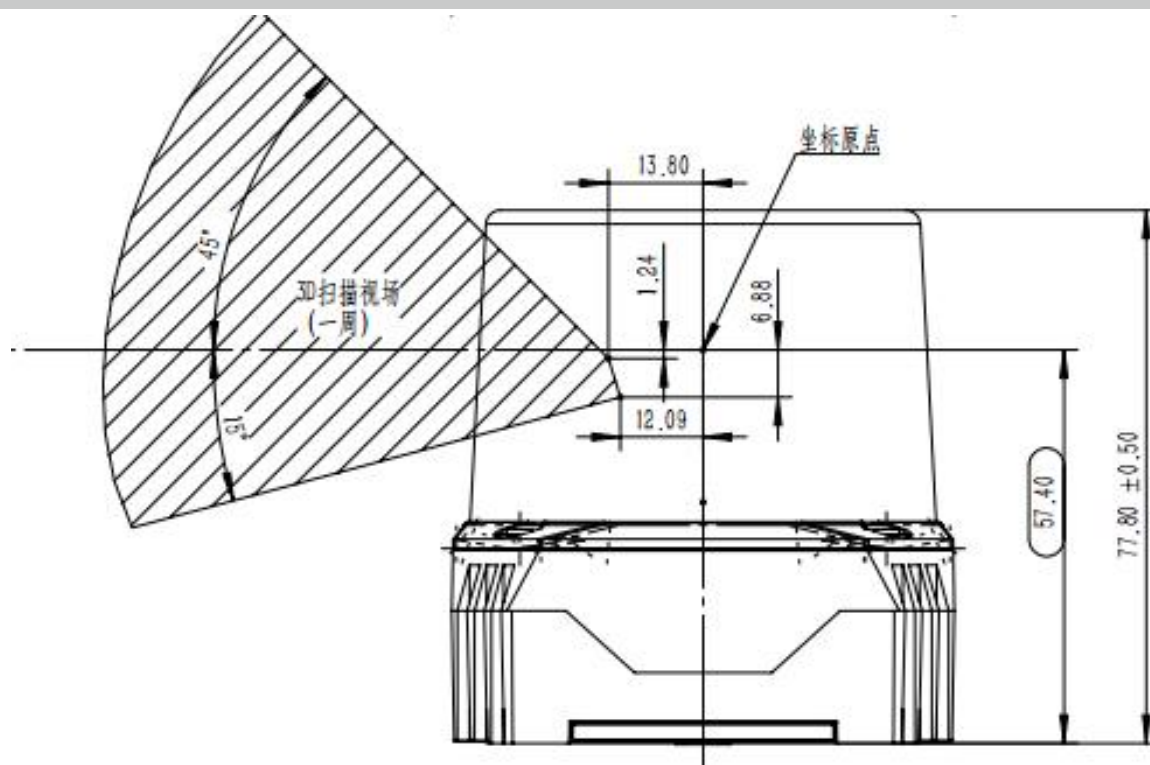
Common Questions

If you encounter issues while using the product, refer to the table below for solutions. If the issue persists, contact Wuqiong Innovation's technical support team.

Question	Rx
The laser rangefinder could not be detected.	• Confirm that all cables are connected correctly. • Check that the voltage is correct: the operating voltage of the AIO-C01 laser detector ranges from 12 to 30 V. • Confirm the laser detector is not connected to any other software. • Confirm the device and host computer are connected to the same LAN. • Confirm that no antivirus software or other programs blocking Ethernet broadcasts are installed. After confirming the above steps, if the device still cannot be detected, disable all firewalls and restart the software to search for the laser detector again on the local network.
The laser detector is detected, but connection cannot be established or sampling cannot begin.	• All cables are confirmed to be connected correctly. • Check that the voltage is correct: the AIO-C01 laser detector operates at 12–30 V. After confirming the above, if the issue persists, restart the laser detector and the relevant testing software.
No data	Use network packet analysis software (e.g., Wireshark) to analyze the output data.

Appendix

AIO-C01 Structural Dimensions



Parameter Specifications

SKYLAND-AIO-C01 3D LiDAR	
Laser wave length	905nm
Human Eye Safety Level	Class 1: Safe for human eyes (IEC 60825-1:2014)
Maximum Range	50 m (@90% reflectivity) 25 m (@10% reflectivity)
Near blind spot	0.05m
FOV	360° (H) × 65° (V) (Vertical: 20° to 45°)
Frequency of sampling	200 K/s (dual-line mode) 100 K/s (single-line mode)
Full—圈 output	30Hz
Scanning mode	Non-repetitive Scan
3D information	3 D position
Communication interface	UDP
Certainty of measurement	≤ 2.0cm
Angular resolution	0.3° (H) / 0.36° (V) (Integration time: 1 s) 0.15° (H) / 0.36° (V) (Integration time: 2 s)
IMU sampling rate	200Hz
Attitude Perception Dimension	3 Axial acceleration + 3-axis angular velocity
Light Resistance Capability	100Klux
Operating ambient temperature	-20°C-55°C
Storage Environment Temperature	-30°C-70°C
Levels of protection	IP67
Power	Maximum rated power: 15 W
Working voltage	12V~30V DC
Size	73(Long) x 73.75 (Wide) x 77.8 (Height) mm
Weight	420g