DADISICK®

# TECHNICAL DATA SHEET

## MEASURING SINGLE-LAYER SCANNING LIDAR
## PRODUCT MANUAL
## LD-100R series


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## Product type

**LD-100R**

( Diffuse reflectance measurement single layer scanning lidar )

## Manufacturer

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## Copyright Notice



## Trademark Statement

# LD-100R

## ——Single-layer panoramic scanning lidar with diffuse reflectance (RSSI) measurement capability


### Overview

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LD-100R is mainly designed for reflector-based AGV navigation applications, but can also be used for scene measurement applications, such as structural mapping of outdoor areas and interior buildings, as well as free navigation applications without reflectors.

### Measurement capability

LD-100R has excellent distance measurement capabilities. Even for targets with 10% reflectivity, its effective range can reach 20 meters. For commonly used reflectors with a diameter of 10cm, it is necessary to ensure that the measured RSSI of the reflector is high enough to be effective. Under the premise of resolution, its effective range can reach 100m, and it can work effectively even in a large working area.

### Measurement accuracy

LD-100R has good measurement accuracy, and the resolution of distance measurement data reaches millimeter level. For most surfaces with different reflectivity, within the range of 1-20 meters, the distance measurement accuracy can reach within 20 mm, the distance measurement fluctuation can be controlled within 30 mm, and the RSSI measurement error can reach within 2%; Even if it is 20 meters away, its measurement accuracy can reach within 40 mm, the measurement fluctuation can be controlled within 60 mm, and the RSSI measurement error can reach within 4%.

For a commonly used reflector with a diameter of 10cm, within the range of 1 to 40 meters, the distance measurement accuracy can reach within 8mm, the distance measurement fluctuation can be controlled within 18mm, and the RSSI measurement error can reach within 2%; even at 40 Beyond meters, its measurement accuracy can reach within 15 mm, measurement fluctuation can be controlled within 36 mm, and RSSI measurement error can reach within 5%.

### Scan frequency and angular resolution

At a scanning frequency of 20Hz, it can achieve an angular resolution of 0.1°; at a scanning frequency of 10Hz, it can achieve an angular resolution of 0.05°; the high-resolution scanning ability is matched with the strong measurement ability, even in In a larger working area and a working environment where reflectors are sparsely deployed, AGV can also find a sufficient number of reflectors to achieve effective navigation.

### Mobile application system integration

LD-100R has a small device size and low power consumption, supports DC10V-30V wide voltage input, and supports power saving and life extension control, and is easy to integrate in mobile application systems.

### Equipment self-testing and intrinsically safe design

LD-100R has comprehensive equipment self-inspection capabilities, and can effectively detect and give feedback on abnormal working environment factors that affect measurement performance and normal working capabilities, such as close-range occlusion (including dirty light transmission cover), high or low temperature, etc. It also provides a flexible configuration method for the intrinsically safe design of the application system to ensure that the application system can automatically enter the safety protection mode under abnormal and fault conditions to avoid safety accidents.

### Work environment adaptability

LD-100R is fully designed to adapt to various working environments. It is mainly designed for indoor applications and can also be used in outdoor environments under non-rainfall conditions. In terms of measurement technology, even if the sunlight is strong or the light-transmitting cover is dirty to a certain extent, it can still measure normally; it also has a certain smoke penetration ability and can find actual targets without being interfered by atmospheric impurities. In terms of electrical and structural design, it can resist strong electromagnetic interference. Its shell protection level has reached IP65, and its operating temperature range has reached -10 ° C ~ 50 ° C. These technical performances ensure its effective work in general indoor industrial environments ability.

**It is the smallest, lowest priced, and most feature-rich product on the market with similar scan angle resolution, measurement capabilities, and operating environment tolerance.**

## Measurement

LD-100R laser ranging based on time-of-flight measurements. LiDAR emits laser pulses and measures the return time of the pulses after being reflected by the surface of the measured target, and then converts them into distance data, as shown in Figure 1. Based on the intensity of the echo pulse and the target distance, the diffuse reflectance (RSSI) information of the measured target surface can also be obtained.

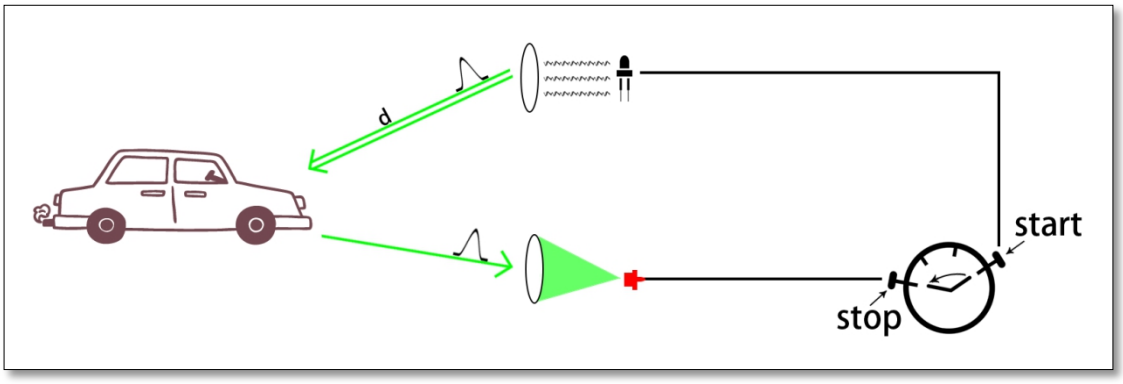



Figure 1 Time-of-flight measurement

LD-100R has multiple echo analysis capabilities. In a smoke working environment, atmospheric impurities will also reflect the ranging laser pulse, forming a reflected echo pulse, which reaches the pulse receiving system together with the reflected echo pulse of the measured target.
LD-100R analyzes all received reflected echo pulses, eliminates interference pulses, and outputs real distance data of the measured target, as shown in Figure 2.

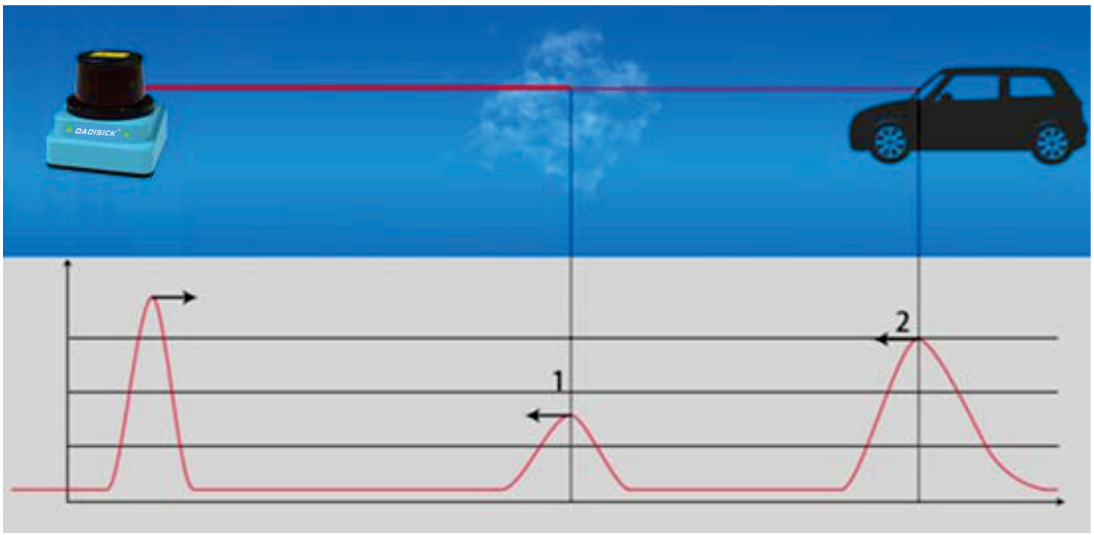



Figure 2 Multiple echo analysis

## 2D scan

LD-100R A pair of laser pulse transmitting/receiving lens barrels are driven by the turntable to rotate at a constant speed. The optical axes of the transmitting lens barrel and the receiving lens barrel are parallel to each other and perpendicularly intersect with the rotation axis of the turntable. In this way, the actual ranging optical axis is distributed with the rotation axis. On the vertical scanning plane, and the ranging azimuth angle is the same as the motor rotation azimuth angle, 360° two-dimensional optical scanning is achieved, and the distance of each point of the external environment on the cross section of the ranging scanning plane can be obtained, as shown in Figure 3, Figure Four shown. Use specific network messages to provide users with two-dimensional measurement data at a fixed scanning frequency through the Ethernet port.

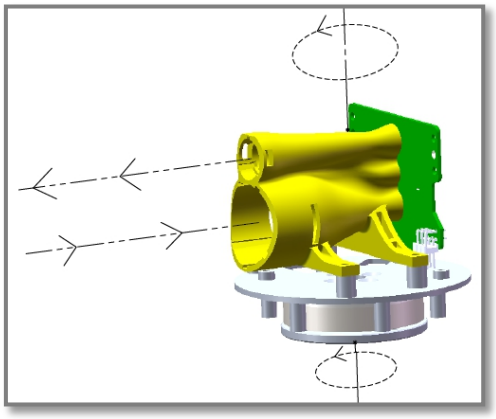


Figure 3 2D scanning mechanism

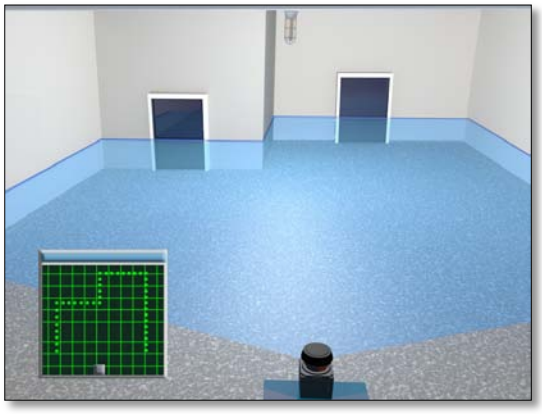


Figure 4: Working principle of 2D scanning

## Map mapping and navigation

LD-100R is mainly designed for reflector coordinate map surveying and AGV navigation applications.

When performing reflector coordinate map mapping, composite images of partitioned scenes are collected at different locations, and the coordinate position of each reflector in each composite image in the LD-100R device coordinate system can be obtained through the reflector detection algorithm. By executing the reflector position registration algorithm between two scene composite images with sufficient reflector coincidence, the device coordinate system transformation parameters at the two positions can be obtained, including the origin displacement vector and rotation angle; these parameters can be used to complete the two The coordinate position maps of reflectors between the two images are stitched together; through step-by-step stitching, a reflector navigation map including coordinate positions of all reflectors can be obtained.

Based on the reflector navigation map and the roughly correct initial value of the initial position coordinates of the AGV (LD-100R), the AGV navigation controller processes the composite image frame by frame to detect the coordinates of the detectable reflector in the device coordinate system. Execute the reflector coordinate position registration algorithm on the reflector navigation map to obtain the position coordinates, orientation angle, and instantaneous velocity/acceleration vector of the AGV (LD-100R) in the navigation map for the AGV navigation controller to complete path planning and walking control .

For structural map mapping and free navigation applications that do not use reflectors, SLAM registration algorithms can also be used on scene depth images collected by LD-100R. The map stitching and navigation process is similar to that based on reflector position registration.

For structural map surveying and mapping applications, if conditions permit, the reflector position registration method can also be used to obtain the coordinate system transformation parameters, and the coordinate system transformation parameters can be used to complete the stitching of local scene depth images, and then obtain the entire structural map. Compared with using depth images alone, this mixed-mode mapping method requires less coincidence of images and has better robustness.

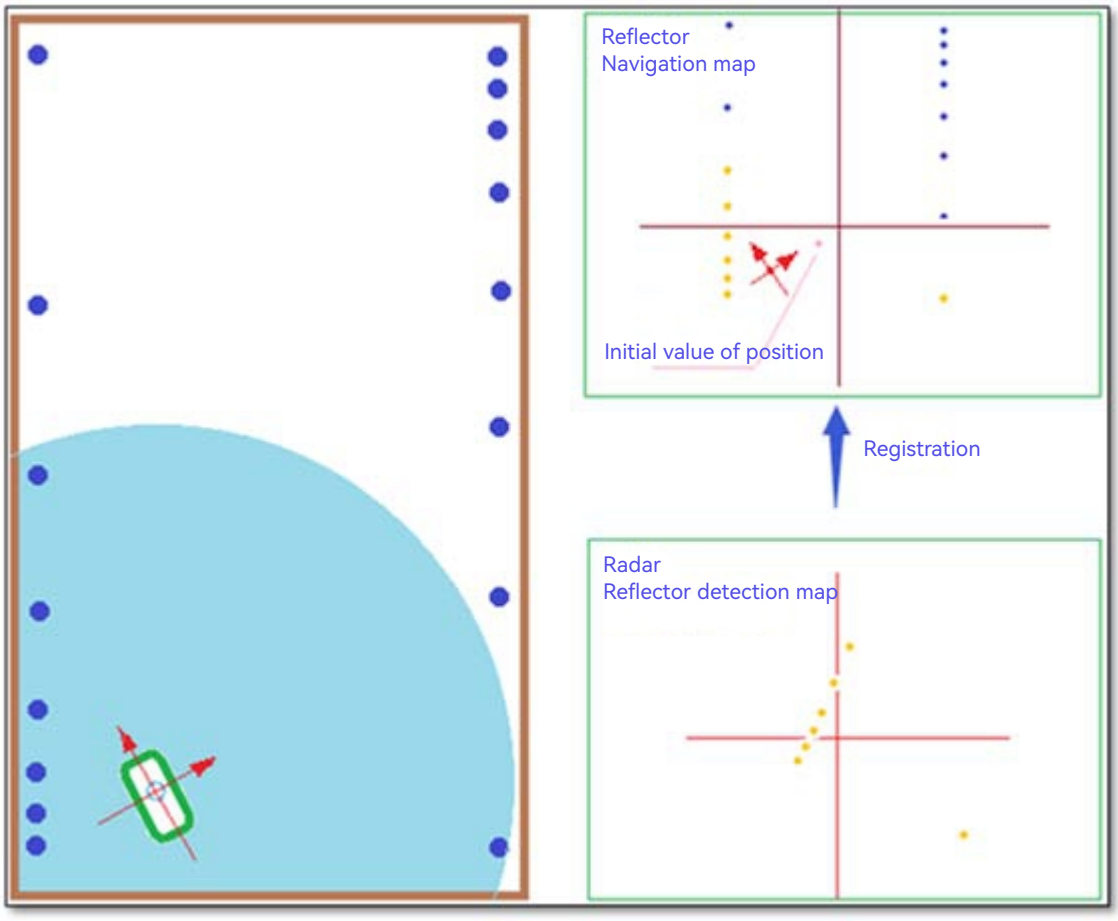



Figure 5 Working principle of reflector-based navigation

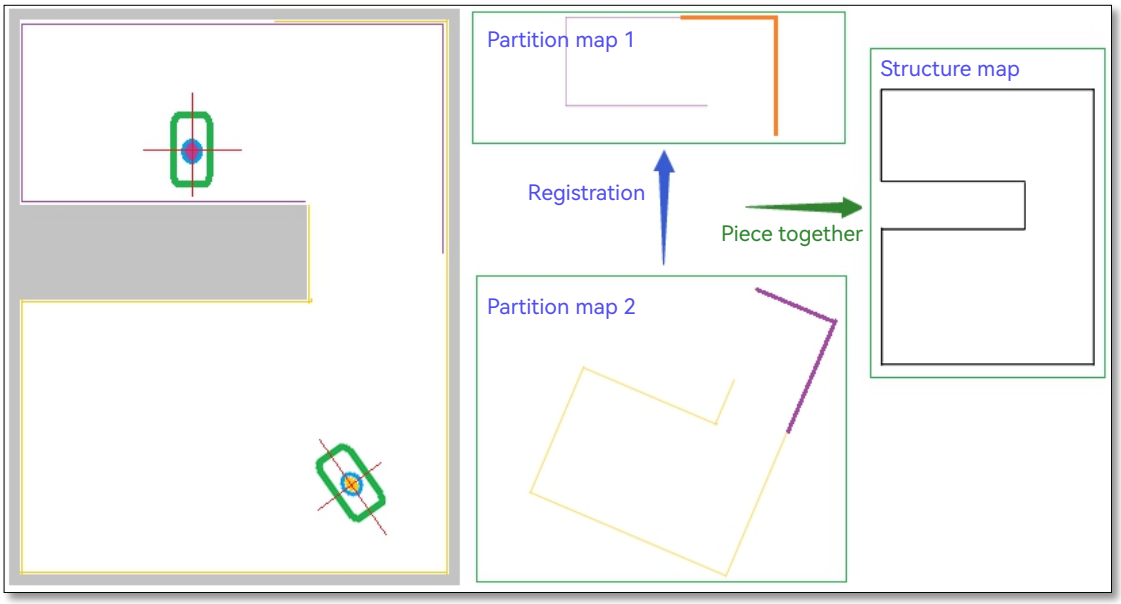


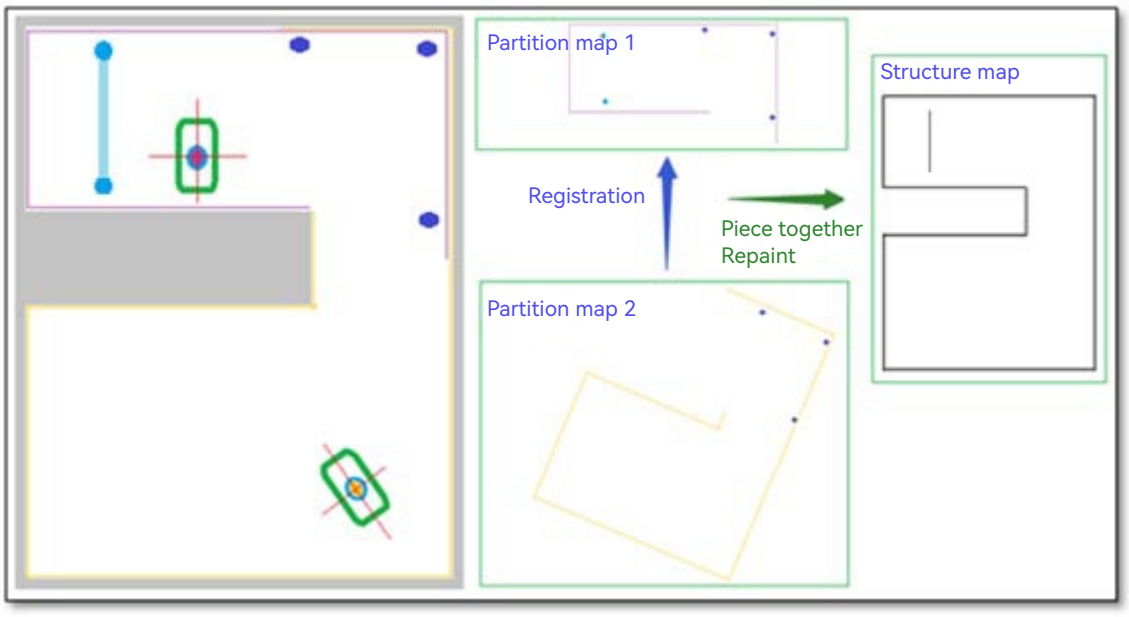

Figure 6 Working principle of structural map surveying and mapping based on depth image

## Reflector-Based AGV Navigation

In reflector-based AGV navigation applications, it is necessary to ensure the effective discovery and precise positioning of reflectors. The LD-100R's highest scanning angle resolution of 0.05° and the effective detection distance of the reflector up to 100 meters ensure the scanning density and scanning range of the scene, even in the case of a large working area and low reflector deployment density. It can work normally; its maximum scanning frequency of 20Hz can also meet the requirements of fast applications.

LD-100R's ability to resist sunlight and smoke penetration ensures the system's wide adaptability and reliability to the operating environment. Once the degree of dirt intensifies or is blocked by a short distance, LD-100R can automatically send out an operation failure alarm and prompt for system maintenance, which further enhances the reliability of the system, reduces the frequency of system maintenance, and reduces the cost of use and maintenance.

## Mixed Mode Structural Mapping




The main difficulties faced in the application of structural map surveying and mapping include the need for sufficient overlap areas between the local maps that need to be stitched, otherwise the registration algorithm may produce incorrect results, leading to stitching errors; in addition, structures such as transparent glass walls are difficult to Direct measurement with lidar. Using the mixed configuration method of LD-100R can effectively solve such problems.

For a wider working area, by properly deploying reflectors as registration targets, and using the LD-100R's effective discovery distance for farther reflectors, the distance interval during zoning map surveying can be increased and the measurement work of zoning maps can be reduced. Quantity, improve measurement efficiency, and also help to improve the robustness of partition map stitching.

For transparent structures, reflectors with slightly lower RSSI can be placed at the edges of the structure and at the inflection points of the shape. The reflector position of such RSSI features can be extracted through the reflector detection algorithm, and then the transparent structure can be detected through an interactive method. Supplementary drawing.

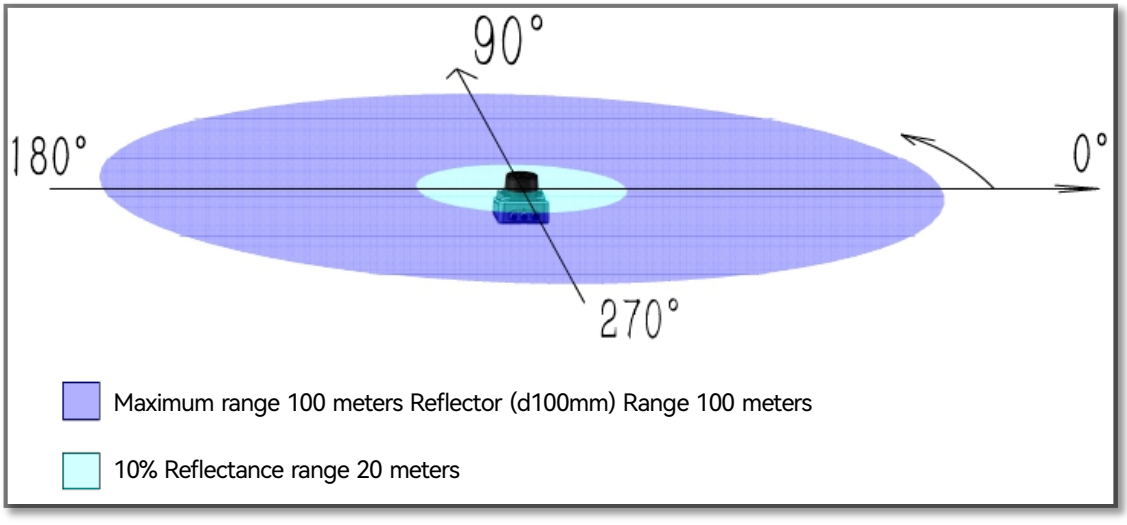
## Technical data

| Characteristic | |
|---|---|
| Light source | Infrared laser ( 905nm ) |
| Laser safety level | Class I (GB 7247.1-2012, human eye safety) |
| Laser spot outlet aperture | 10mm |
| Laser spot divergence angle | 2.4mrad(H) × 10mrad(V) |
| Scanning angle range | 360° |
| Scanning frequency | 10Hz / 20Hz |
| Scan angle resolution | 0.05°/ 0.1° |
| Measuring range | 0.1m – 100m |
| Reflector 1 range | 100m |
| 10% reflectance range | 20m |
| Outdoor performance | Anti-dirt, anti-sunlight |
| Smoke penetration | Support |
| **Technical performance** | |
| Measurement data | Composite data (distance + RSSI) |
| Distance measurement error (absolute value)<br>System error (typical value)<br>System error (reflector 1)<br>Statistical error (1 σ, Typical value)<br>Statistical error (1 σ, Reflector 1) | <br>20 mm(1m~20m) / 40mm(20m~50m)<br>8mm(1m~40m) / 15mm(40m~100m)<br>10mm(1m~20m) / 20mm(20m~50m)<br>6mm(1m~40m) / 12mm(40m~100m) |
| RSSI measurement error (relative value)<br>System error (typical value)<br>System error (reflector 1)<br>Statistical error (1σ, typical value)<br>Statistical error (1σ, reflector 1) | <br>2%(1m~20m) / 4%(20m~50m)<br>2%(1m~40m) / 5%(40m~100m)<br>1%(1m~20m) / 2%(20m~50m)<br>0.2%(1m~40m) / 0.5%(40m~100m) |
| Equipment self inspection | Content: Dirty translucent cover / occlusion / high temperature / low temperature / dense fog<br>Output mode: indicator light + TCP message |
| **Device interface** | |
| Ethernet | Speed: 10/100Mbps<br>Network protocol: TCP/UDP<br>Function: Device configuration/measurement data output |
| I/O Input | Quantity: 4 pieces<br>Type: level input<br>High level range: DC10V-30V<br>Low level range: DC0 V -0.7V<br>Preset function: power saving and life extension control, effective level: high level |
| I/O Output | Quantity: 4 pieces<br>Type: PNP/NPN switch output<br>Switching Voltage: Supply Voltage<br>Power on status: off<br>Preset function: device ready, valid state: on |
| Indicator light | Quantity: 4 pieces<br>Definition: PWR (power supply)<br>LNK (Ethernet)<br>ERR (device alarm: dirty/blocked/dense fog, high and low temperature)<br>HTR (normal measurement) |

| Electrical/Mechanical Parameters | |
|---|---|
| Working voltage | DC 10V – 30V |
| Power dissipation | 6W@DC24V |
| Shell protection level | IP65(GB 4208- 2008) |
| Security protection level | |
| Insulation resistance | 1MΩ( GB 16796-2009, 5.4.4) |
| Dielectric strength | 0.5KV(GB 16796- 2009, 5.4.3) |
| Dimensions (L X W X H) | 97 X 97 X 90 (mm) |
| Weight | 0.7Kg |
| **Working environment standards** | |
| Electromagnetic compatibility (EMC) | |
| Electrostatic discharge | 6KV(GB/T17626.2- 2006, Level 3) |
| Fast burst | 1KV(GB/T17626.4- 2008, Level 2) |
| Electromagnetic field radiation immunity | GB/T17626.3- 2006, Level 2 |
| Surge Immunity | GB/T17626.5- 2008<br>Power interface: 1.2/50us, 2KV/1KA (Level 3)<br>Ethernet interface:10/700us, 1KV/25A (Level 2)<br>I/O Interface: 1.5/50us, 0.5KV/0.25KA (Level 1) |
| Impact | GB/T 2423.5 |
| Single impact | 15g, 11ms |
| Continuous impact | 10g, 16ms |
| Vibration | GB/T 2423.10 |
| Frequency range | 10Hz -150Hz |
| Range | 5g |
| Humidity | 93%, +40℃, 2h(GB/T 2423.3) |
| Operating temperature range | -10℃ - +50℃ |
| Storage temperature range | -30℃ - +70℃ |
| Environmental illumination range | 0lux - 8 0,000lux |

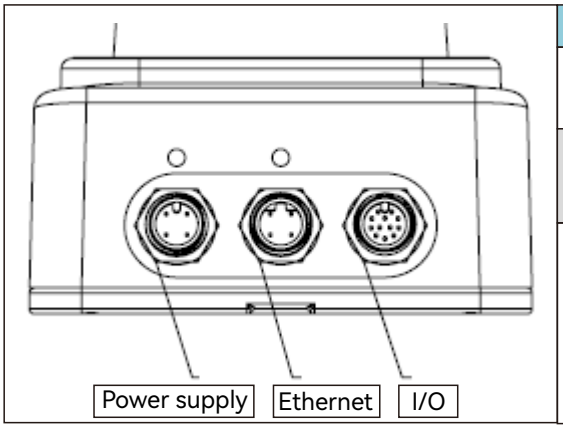
1: Refers to a ϕ 100mm cylindrical reflector, the reflective surface material has a diffuse reflectance of 1000%, and the reflective surface length is 600mm.

## Measuring coordinate system / scanning range / measuring range



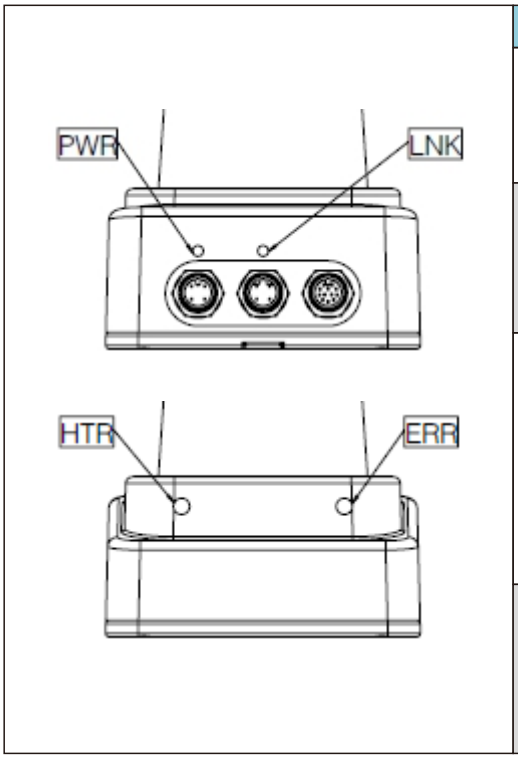
## Device interfaces and indicator lights

### Device interface




| Socket | Type | Illustrate |
|---|---|---|
| Power supply | M12 (A-type), Male | 4-pin |
| Ethernet | M12 (B-type), Male | 4-pin |
| I/O | M12 (A-type), Male | 12-pin |

### Indicator light




| Name | Explanation |
|---|---|
| PWR | Power Indicator<br>Normally closed: no power/power inactive<br>Steady on: Power on |
| LNK | Ethernet indicator<br>Normally closed: no network connection<br>Always on: There is a network connection |
| ERR | Working fault indicator light<br>Start status: yellow (about 24 seconds)<br>Green: no fault<br>Yellow: Internal fault/measurement abnormality 1<br>Long flashing (0.5Hz): high temperature/low temperature alarm<br>Short flash (1Hz): The light-transmitting cover is dirty/obstructed 2 |
| HTR | Normal measurement indicator<br>Start status: yellow<br>Yellow: The device has not started measuring<br>Green: The device measures normally |

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

## Accessories

| Accessories | Model | Illustrate |
|---|---|---|
| **Dust plug** | | |
|  | DP11@M12 | 3 pcs, included randomly<br>Deliverables |
| **Connecting cables** | | |
|  | CB11@M12AF5LD | Power cable, length 1.5 m<br>A–side: M12 terminal (Type A)<br>Female, 5–pin<br>B–side: Lead wire, 4 cores<br>Deliverables |
|  | CB21@M12BF5RJ45 | RJ45 network cable, length 1.5 m<br>A–side: M12 terminal (Type B)<br>Female, 5 cores<br>B–side: RJ45 plug<br>Deliverables |
|  | CB31@M12AF12LD | I/O cable, length 1.5 meters<br>A–side: M12 terminal (A type)<br>Female, 12 cores<br>B–side: lead wire, 12 cores<br>Deliverables |
| **Connecting cables** | | |
|  | HD34@ LD-100R | seat mount<br>stainless steel material<br>Adjustable horizontal and<br>bidirectional pitch angle<br>to be ordered separately |