ERDI LASER®
ERDI TECH LTD

LR1000B23

User Manual

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v1.2

ERDI TECH LTD

1. Product Overview

The LR1000B23 series of ranging modules is a new type of high - precision and compact ranging module, with a working central wavelength of 905nm. The measuring range of the product is from 4m to 1000m, and the ranging refresh rate is 2 - 10Hz, which can be customized according to customers' requirements. It adopts the UART - TTL communication interface, and comes with test software and interface protocol instructions, which is convenient for users to carry out secondary development. It features small size, light weight, high precision, and high refresh rate. It can be used for auxiliary ranging in handheld devices such as night vision devices, thermal imagers, telescopes, laser illuminators, etc. It can also be applied to other ranging fields, such as auxiliary ranging in scenarios like border security monitoring, aviation, communications, railways, police work, intelligent water conservancy, and outdoor sports.

2. Technical Specifications

No.	Parameter	Specification
1	Laser wavelength	905nm ± 5nm
2	Laser divergence angle	<6mrad
3	Optical material	PMMA
4	Receiving aperture	20mm ± 0.05mm
5	Ranging range	4m - 1000m (max 1200m)
6	Ranging accuracy	δ ≤ ±1m, when 6m ≤ d < 1000m. 1) ±1m for the regular version
7	Ranging frequency	2 - 10Hz
8	Ranging resolution	Typical value: 10CM
9	Accuracy rate	≥98%
10	False alarm rate	≤1%
11	Communication interface	UART - TTL, customizable
12	Baud rate	115200bps
13	Power supply voltage	3.3V - 5V. Recommended voltage ≥ 3.5V
14	Operating power consumption	Maximum power consumption during continuous ranging < 0.8W. Average power consumption ≈ 0.6W

15	Instantaneous current	Typical value of instantaneous starting current ≈ 300mA (at a typical voltage of 3.3V)
16	Operating temperature	-20℃ - +55℃ (Custom version can reach -40℃)
17	Storage temperature	-40℃ - +60℃
18	Protection level	None (IP67 inside the lens cavity)
19	Laser safety level	IEC CLASS 1
20	Dimensions	ϕ23mm × 45.6mm
21	Weight	≈20g
22	Shock	1000g/ms (10 times/s in the optical axis direction)
23	Vibration	5 - 50 - 5 Hz, 1 octave/min, 2.5g
24	Reliability	MTBF≥1500h

Notes:

1) The target size is 2.3m × 2.3m with a reflectivity of 90%.

2) The target size is 2.3m × 4.6m with a reflectivity of 90%.

3) The accuracy indicated in the table is the accuracy for the white board.

3. Functional Description

The whole machine has functions such as single measurement, multiple measurements, and angle measurement.

3.1 External circuit enable

Enable this module to work normally.

3.2 External circuit disable

Turn off the external circuit to save power consumption.

3.3 Single measurement

Trigger a single target distance measurement. For low - reflectivity targets, it will automatically repeat the measurement until stable distance data is obtained. Then, it will report the data in serial port form according to the standard data format.

3.4 Multiple measurements

In the continuous multiple - measurement mode, it will trigger the laser module to continuously measure the distance of the object. The typical value of the refresh rate is set to 2HZ or 5Hz, and the maximum refresh rate

can reach 30Hz (customization required). This refresh rate can be adjusted through the serial port.

3.5 Angle measurement

If the customer has the need for angle measurement, it can be customized. The pitch angle of the target is measured, and the detectable angle range is -70° to +70°, with an angle accuracy of ±0.3°. Internal angle information (X/Y/Z coordinates) can be provided for the customer's own development.

4. Hardware Installation Guide

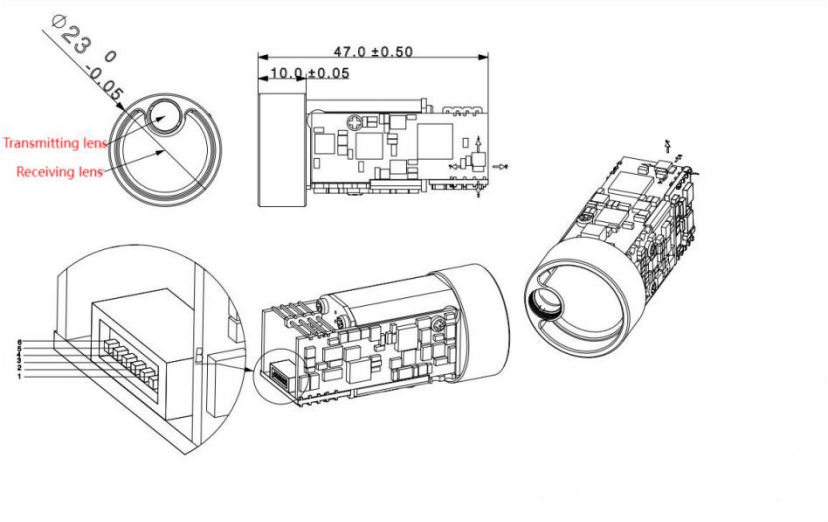
4.1 Packing List

Laser Ranging Module × 1
Power Cable × 1

4.2 Electrical Interface Definition

Pin	Definition	Description
1	SW-SHOT	Function Enable (active high) Note: Compatible with active-low control requirements
2	RXD	Signal input port, Host → Ranging Module
3	TXD	Signal output port, Ranging Module → Host
4	I/O (Reserved)	Reserved for expansion
5	VCC	Power +
6	GND	Power −

4.3 Mechanical Interface



4.4 Optical Window Selection and Coating Recommendations

4.4.1 Material Recommendations

It is recommended to use H-K9L optical glass (Chengdu Guangming Optical Glass) or fused silica for the optical window.

H-K9L and fused silica are the most commonly used colorless optical materials, suitable for the 300 nm to 2100 nm wavelength range, offering good cost performance and excellent physical properties.

4.4.2 Manufacturing Recommendations

- The wedge angle tolerance of the window should be as small as possible. Recommended wedge angle tolerance: ≤ 3′ (tolerance grade ≤ Grade 7).

- The optical surfaces should be as smooth as possible. Recommended surface roughness (Ra, arithmetic mean deviation): 0.012.

4.4.3 Coating Recommendations

For a 905 nm laser rangefinder, it is recommended to apply an anti-reflection (AR) coating for 855 nm to 955 nm, with transmittance ≥ 99.5%.

Depending on the operating environment, additional protective coatings may be applied on the outer surface, such as hydrophobic coating or hard coating. Other requirements shall refer to GJB 2485-95, with transmittance ≥ 98%.

4.4.4 Optical Window Shape and Usage Recommendations

The effective aperture of the window depends on the specific product. The outer dimensions shall ensure:

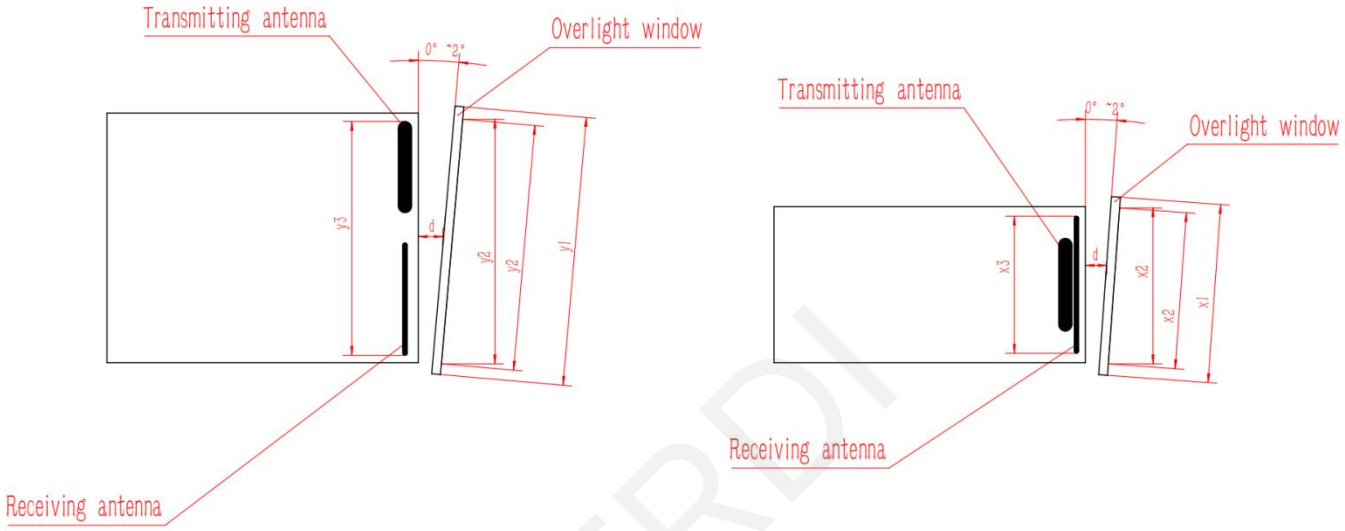
- Effective aperture − outer diameter ≥ 2 mm
- Rangefinder antenna outer diameter − projected size of the effective aperture ≥ 1.5 mm

A schematic is shown below.

Since the window absorbs a small portion of laser energy, it is recommended to control the window thickness to 2–4 mm according to the mechanical envelope.

Due to the high transmittance of the window, it is recommended that the transmit optical axis be parallel to the window normal. The positional relationship between the window and the two lens barrels is shown in the figure below.

In addition, the air gap between the window and the rangefinder should be less than 0.5 mm. Figure 5 shows schematics of two window placement methods.



The effective aperture of the optical window y_2 - the outer diameter of the optical window y_1>2mm

The outer diameter of the rangefinder antennay$_3$-the projection size of the effective aperture of the optical window y_2，>1.5mm

The air gap d between the optical window and the rangefinder should be as small as possible

The effective aperture of the optical window x_2 - the outer diameter of the optical window x_1>2mm

The outer diameter of the rangefinder antenna x_3-the projection size of the effective aperture of the optical window x_2，>1.5mm

The air gap d between the optical window and the rangefinder should be as small as possible

Schematic diagrams of two ways of the external dimensions and placement of the optical window

5. Software Operation Instructions

5.1 Test Guide

Operating Procedure

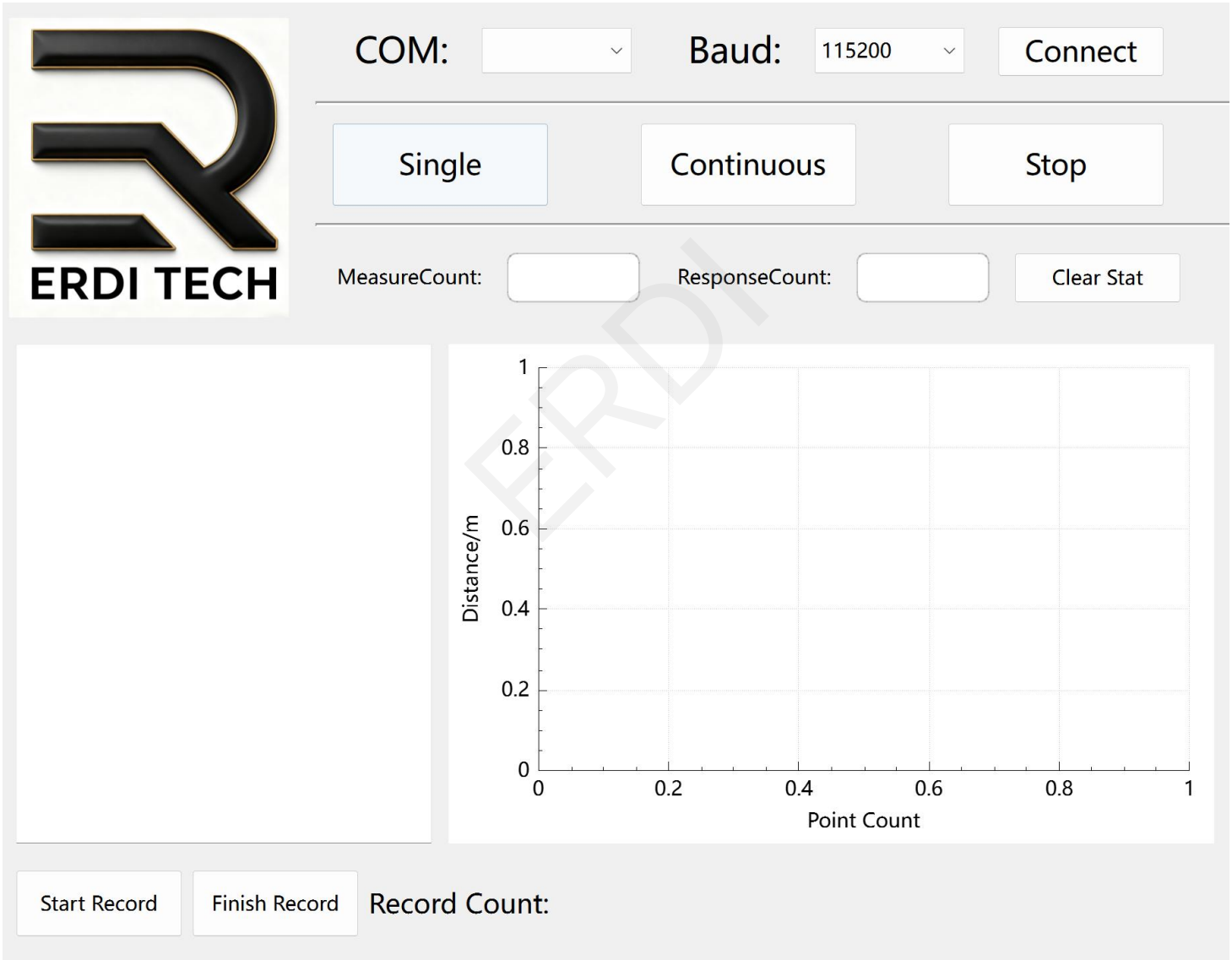
Step 1: Insert the data cable into the ranging module to power the module and enable measurement data output.

- **Note 1:** Use the factory-supplied cable and strictly control the supply voltage within **3.3 - 5V**.
- **Note 2:** The **Enable pin must be pulled LOW** (connected to GND).

Step 2: Install the **ERDI-Tools** software and use the **LR1000B23** module to convert the serial (TTL) signal to USB for connection to the computer.

- **Note 1:** Connect the module **TXD** to the TTL-USB converter **RXD**, and connect the module **RXD** to the TTL-USB converter **TXD**.

Step 3: After installing the software, open the display interface.



Step 4: Debugging and Testing

1. Select the COM Port: Set the corresponding COM port in the software according to the port number on the

computer.

2. Baud Rate Setting: After opening the software interface, set the baud rate. Available baud rates include 9600, 115200, etc. (see the Communication Protocol).

5.2 Protocol Format

- Communication method: Serial communication
- Baud rate: 115200 (default)
- Data bits: 8 bits
- Frame length: 8 bytes

Data Protocol									
		Frame Header (H)	Frame Header (L)	Function Code	D1	D2	D3	D4	Checksum
	Send	55	AA						SUM(Function Code + DATA1 + … + DATA4)
	Reply	55	AA						SUM(Frame Header (H) + Frame Header (L) + … + DATA4)

Measurement Command									
Single-Shot Ranging	Send	55	AA	88	FF	FF	FF	FF	SUM[3：7]
		55 AA 88 FF FF FF FF 84							
	Reply	55	AA	88	STA	FF	DIS_H	DIS_L	SUM[1：7]
		STA = other value: Measurement failed; STA = 1: Measurement successful DIS_H: High byte of the measurement result; DIS_L: Low byte of the measurement result **Data is returned in hexadecimal format, and all measurement results are output as the actual value × 10**							
Continuous Ranging	Send	55	AA	89	FF	FF	FF	FF	SUM[3：7]
		55 AA 89 FF FF FF FF 85							
	Reply	55	AA	89	STA	FF	DIS_H	DIS_L	SUM[1：7]
		STA = other value: Measurement failed; STA = 1: Measurement successful DIS_H: High byte of the measurement result; DIS_L: Low byte of the measurement result **Data is returned in hexadecimal format, and all measurement results are output as the actual value × 10**							
Stop Ranging	Send	55	AA	8E	FF	FF	FF	FF	SUM[3：7]
		55 AA 8E FF FF FF FF 8A							
	Reply	55	AA	8E	STA	FF	FF	FF	SUM[1：7]
		STA = 0: Failed to stop continuous measurement; STA = 1: Successfully stopped continuous measurement							
Angle	Send	55	AA	8A	FF	FF	FF	FF	SUM[3：7]

Measurement		55 AA 8A FF FF FF FF 86						
	Reply	55	AA	8A	STA	FF	ANG_H	ANG_L	SUM[1：7]
		STA = 0: Measurement failed; STA = 1: Measurement successful ANG_H: High byte of the measurement result; ANG_L: Low byte of the measurement result **Data is returned in hexadecimal format, and all measurement results are output as the actual value × 10** **Effective only for modules equipped with an angle sensor**						

Power-On Self-Test									
Self-Test Information	Reply	55	AA	80	STA	00	00	ErrCode	SUM[1：7]
		STA = 0: Power-on initialization failed; ErrCode is the error code STA = 1: Power-on initialization successful							

System Settings									
Baud Rate	Send	55	AA	TYPE	FF	FF	FF	FF	SUM[3：7]
		TYPE = 01: Set baud rate to 9600 bps TYPE = 02: Set baud rate to 14400 bps TYPE = 03: Set baud rate to 19200 bps TYPE = 04: Set baud rate to 38400 bps TYPE = 05: Set baud rate to 56000 bps TYPE = 06: Set baud rate to 57600 bps TYPE = 07: Set baud rate to 115200 bps TYPE = 08: Set baud rate to 128000 bps TYPE = 09: Set baud rate to 230400 bps **The baud rate change does not take effect immediately; it becomes effective only after a reboot.**						
	Reply	55	AA	TYPE	STA	FF	FF	FF	SUM[1：7]
		STA = 0: Setting failed; STA = 1: Setting successful							
LD Constant-ON Mode	Send	55	AA	86	FF	FF	FF	STA	SUM[3：7]
		STA = 0: LD constant-ON OFF; STA = 1: LD constant-ON ON 55 AA 86 FF FF FF 01 84 Enable 55 AA 86 FF FF FF 00 83 Disable							
	Reply	55							
		STA = 0: Already ON; STA = 1: Already OFF; STA = FF: Operation failed **Note: Do not keep the constant-ON mode enabled for long periods.**							

Notes:

1. The checksum calculation for the transmitted frame and the response frame is different; make sure to distinguish them.

2. The checksum is the sum of the bytes to be checked, taking the lower 8 bits.

3. All data is transmitted and received in hexadecimal format.

6. Safety Warnings and Precautions

Warning

- Do not look directly into the laser emission aperture to avoid eye injury (compliant with **Class 1**).
- Operating ambient temperature range: **−20 to +60 °C**. Avoid high temperature, humidity, rain/snow, or dusty environments.
- Do not disassemble the module yourself; otherwise, the warranty may become invalid or the device may be damaged.
- This product is intended mainly for integration into civilian equipment such as UAVs, outdoor observation devices, and surveying/mapping systems, and must not be used for military applications.
- The spot/beam adjustment mode is for developers only. Do not aim at human eyes in this mode to avoid eye injury.
- Factors affecting ranging capability, ranging response time, and ranging accuracy include:

Target reflectivity: In general, the higher the target reflectivity, the better the ranging capability and the faster the ranging response. For example, a medium-reflectivity target may be measured up to 1200 m, a high-reflectivity target up to at least 1500 m, while a low-reflectivity target may only reach about 600 m. (Targets that hardly produce diffuse reflection, such as water surfaces, may be impossible to measure.)
Target shape: When the reflective surface area is too small or the surface is uneven, ranging capability and response speed will decrease accordingly.

Measurement angle: When the laser beam is incident perpendicular to the target's reflective surface, ranging capability is higher and response is faster; otherwise, both ranging capability and response speed will decrease. Under extreme incidence angles, the ranging capability and response time specified in this manual cannot be guaranteed.

Measurement environment: Factors affecting ranging capability and response speed also include sunlight intensity, the concentration of water vapor and suspended particles in the air, and the angle relative to direct sunlight. (Rain, fog, snow, haze/smog conditions will reduce the ranging distance.)

The ranging performance of this series of ranging telescopes is specified under the following conditions:

- The target has **medium reflectivity**, such as a building wall;
- The target reflective surface is **perpendicular** to the laser emission direction;
- The weather is **clear**, and the measurement is performed **without direct sunlight**.

Recommendation: When measuring long-distance targets, mount the module on a tripod to reduce vibration during measurement and achieve better ranging performance.

Factors affecting ranging capability and ranging response time include:

Target reflectivity: In general, higher target reflectivity provides better ranging capability and faster response. For example, a medium-reflectivity target may be measured up to **600 m**, a high-reflectivity target up to **at least 800 m**, while a low-reflectivity target may only reach about **300 m**. (Targets that hardly produce diffuse reflection, such as water surfaces, may be impossible to measure.)

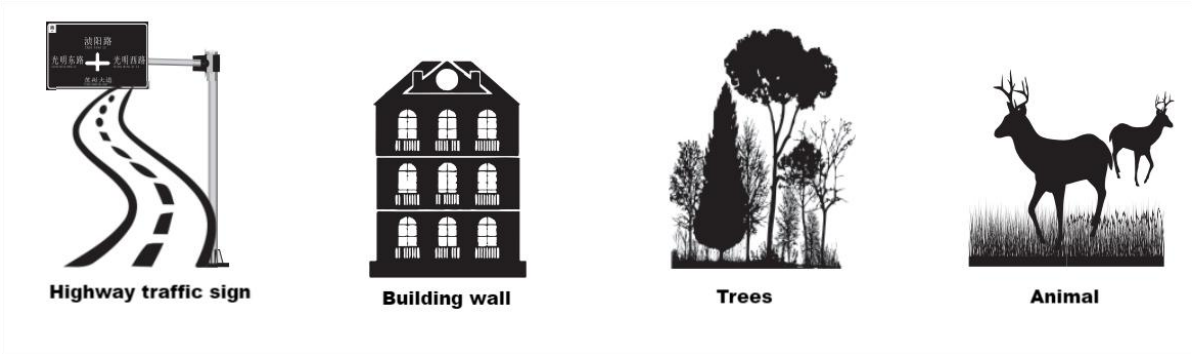
Target shape: If the reflective surface is too small or uneven, ranging capability and response time will decrease accordingly.

Measurement angle: When the laser beam is incident perpendicular to the target's reflective surface, ranging capability is higher and response is faster; otherwise, both ranging capability and response speed will decrease. Under extreme incidence angles, the ranging capability and response time specified in this manual cannot be guaranteed.

Measurement environment: Factors affecting ranging capability and response time also include sunlight intensity, the concentration of water vapor and suspended particles in the air, and the angle relative to direct sunlight. (Rain, fog, snow, haze/smog conditions will reduce the ranging distance.)

Suitable Targets for Measurement

This product can measure **high-reflectivity targets** (e.g., highway traffic signs), **medium-reflectivity targets** (e.g., building walls), and **low-reflectivity targets** (e.g., trees, golf flagpoles, animals, etc.). As target reflectivity decreases to a certain level, the ranging distance will decrease accordingly.



The ranging performance of this module is specified under the following conditions:

The target has **medium reflectivity**, such as a building wall;

The target reflective surface is **perpendicular** to the laser emission direction;

The weather is **clear**, and the measurement is performed **without direct sunlight**.

Note:

When measuring long-distance targets, it is recommended to mount the module on a tripod to reduce vibration during measurement and achieve better ranging performance.