

LR1500E2

User Manual

2025.10

v1.2



ERDI TECH LTD

1. Product Overview

The **LR1500E2 series laser ranging module** is a new high-precision, compact rangefinder module with a center operating wavelength of **905 nm**. The measurement range is **4–1500 m**, with a maximum nighttime range of **up to 1800 m** (visibility 10 km). The ranging refresh rate is **3–10 Hz**, and can be customized according to customer requirements.

The module adopts a **UART-TTL communication interface** and is supplied with dedicated test software and communication protocol documentation, enabling convenient secondary development. It features **compact size, light weight, high accuracy, and high refresh rate**.

It is suitable for integration into handheld devices such as **night vision devices, thermal imagers, telescopes, and laser illuminators** for auxiliary ranging. It can also be applied in other ranging applications, including **border security monitoring, aviation, communications, railway systems, law enforcement, smart water conservancy, and outdoor sports scenarios**.

2. Technical Specifications

No.	Parameter	Specification
1	Laser Wavelength	905 nm $\pm$ 5 nm
2	Laser Beam Divergence	< 6 mrad (small laser spot)
3	Optical Material	Resin Aspherical Lens
4	Receiving Aperture	9.2 mm $\times$ 14.5 mm
5	Measurement Range	4 m – 1500 m Maximum 1800 m (nighttime)
6	Ranging Accuracy	$\delta \leq \pm 1m, 6m \leq d < 500m^{1)}$ $\delta \leq \pm 50cm + d * 1\%, 500m \leq d \leq 1000m^{2)}$
7	Measurement Frequency	2 Hz – 10 Hz Adaptive (higher refresh rates customizable)
8	Measurement Accuracy Rate	$\geq 98\%$
9	False Alarm Rate	$\leq 1\%$
10	Communication Interface	UART-TTL (Customizable)
11	Baud Rate	115200 bps

12	Supply Voltage	3.3 V – 5 V
13	Startup Time	≤ 200 ms
14	Inrush Current	≈ 350 mA
15	Sleep Power Consumption	< 1 mW
16	Standby Power Consumption	≈ 0.2 W
17	Power Consumption (Short Range)	≈ 0.4 W
18	Operating Power Consumption	≈ 1 W
19	Operating Temperature	-20°C to +55°C (-40°C customizable)
20	Storage Temperature	-40°C to +60°C
21	Protection Rating	IP67 (Inside Lens Cavity)
22	Laser Safety Class	IEC Class I
23	Dimensions	25.65 mm × 13.2 mm × 24.6 mm (Rectangular)
24	Weight	≤ 10 g
25	Shock Resistance	1000 g/ms (10 times/s along optical axis)
26	Vibration Resistance	5–50–5 Hz, 1 octave/min, 2.5 g
27	Reliability	MTBF ≥ 1500 h

Notes:

- 1) Target size 2.3m × 2.3m, reflectivity 90%;
- 2) Target size 2.3m × 4.6m, reflectivity 90%;
- 3) The accuracy indicated in the table refers to the accuracy of a whiteboard.

3. Functional Description

The system supports **single measurement and continuous measurement** functions.

3.1 External Circuit Enable

Enables the module for normal operation.

3.2 External Circuit Disable

Disables the external circuit to reduce power consumption.

3.3 Single Measurement

Triggers a single distance measurement to the target. For low-reflectivity targets, the system automatically performs repeated measurements until stable distance data is obtained. The measured result is then transmitted via the serial interface in the standard data format.

3.4 Continuous Measurement

In continuous measurement mode, the laser module performs repeated distance measurements on the target. The typical refresh rate is set to **2 Hz or 5 Hz**, and the maximum refresh rate can reach **30 Hz (customized version required)**. The refresh rate can be adjusted via the serial interface.

4. Hardware Installation Guide

4.1 Packing List

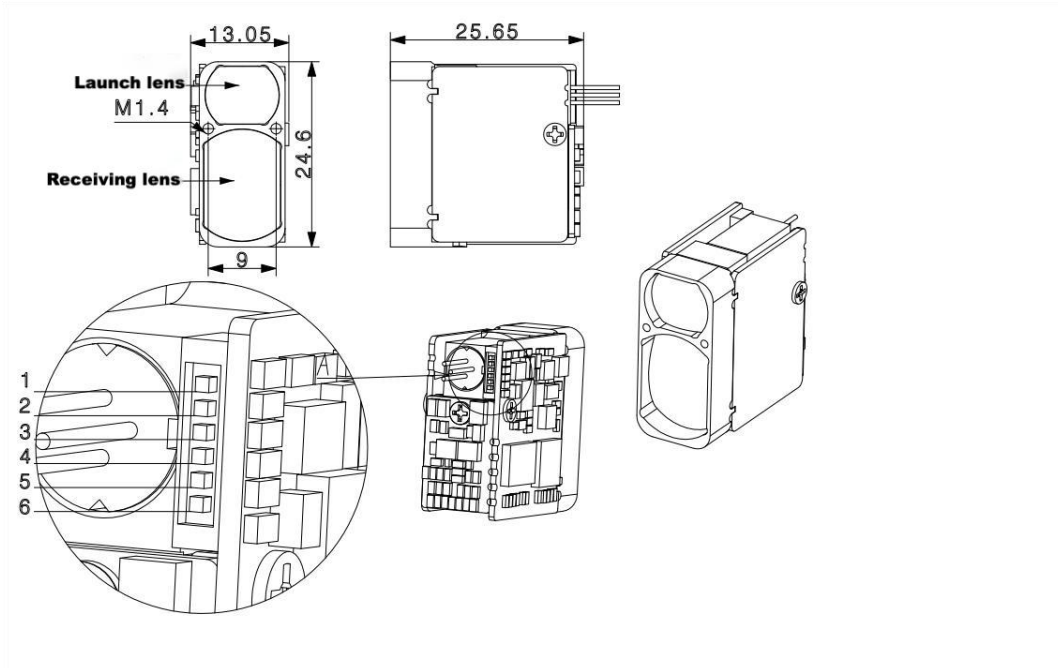
Laser Ranging Module × 1

Power Cable × 1

4.2 Electrical Interface Definition

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

4.3 Mechanical Interface



Mechanical Dimension Drawing and Electrical Interface Diagram

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: $\leq 3'$ (tolerance grade $\leq$ Grade 7).
- The optical surfaces should be as smooth as possible. Recommended surface roughness (R_a , 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 $\geq 99.5\%$.

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 $\geq 98\%$.

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:

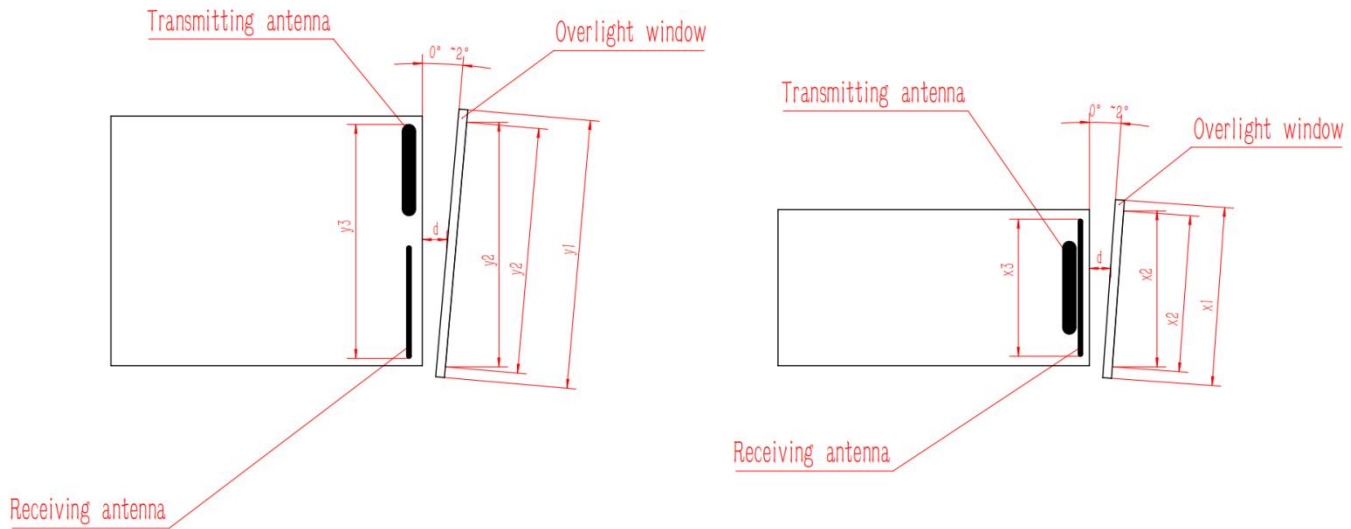
- Effective aperture – outer diameter ≥ 2 mm
- Rangefinder antenna outer diameter – projected size of the effective aperture ≥ 1.5 mm

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 $y_1 > 2$ mm

The outer diameter of the rangefinder antenna y_3 - the projection size of the effective aperture of the optical window y_2 , > 1.5 mm

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 $x_1 > 2$ mm

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

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 **LR1500E2** module to convert the serial (TTL) signal to USB for connection to the computer.

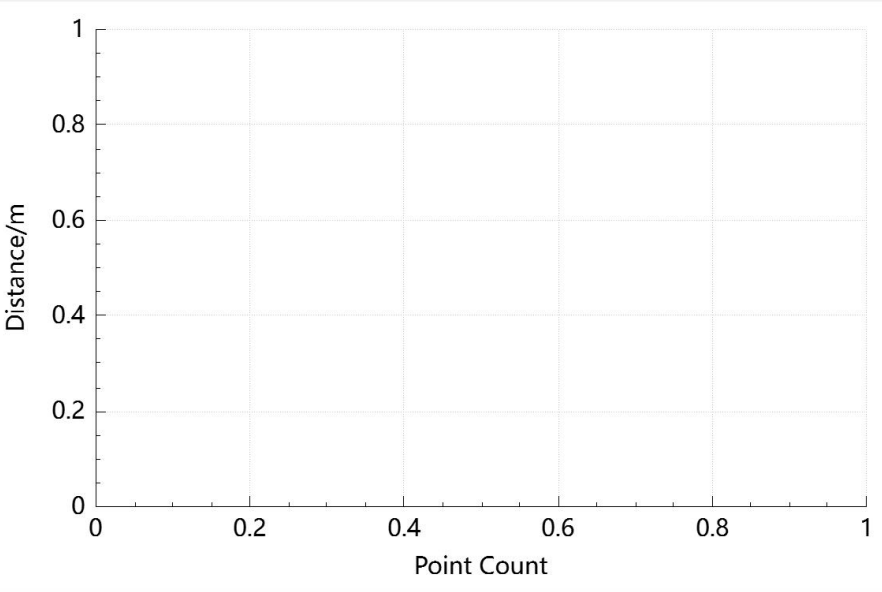
- **Note 1:** Connect the module **TXD** to the TTL-USB converter **RXD**, and connect the module **RXD** to the TTL-USB converter **TXD**.

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



COM:
Baud:

MeasureCount:
ResponseCount:



Record Count:

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	Frame Header	Function Code	D1	D2	D3	D4	Checksum

		(H)	(L)						
	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 Measurement	Send	55	AA	8A	FF	FF	FF	FF	SUM[3: 7]
		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.)

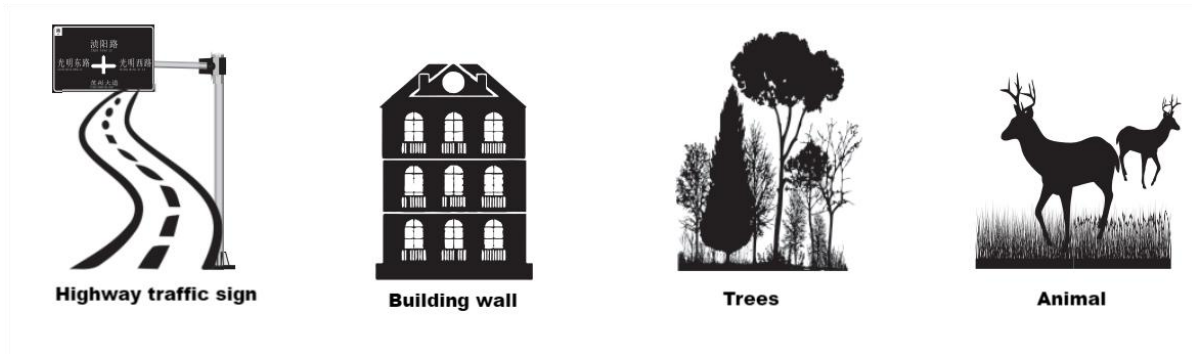
Target shape: If the reflective surface is too small or uneven, ranging capability and response time will decrease accordingly.

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.