LR2000E2

User Manual

2025.10

v1.2

ERDI TECH LTD

1. Product Overview

The **LR2000E2 series ranging module** is a high-precision, compact ranging module with a center operating wavelength of **905 nm**. It provides a ranging capability of **4 m to 2000 m**. The ranging update rate is **2–10 Hz** and can be customized according to customer requirements.

It uses a **UART-TTL communication interface** and is supplied with test software and an interface protocol document, making secondary development convenient. The module features **small size, low weight, high accuracy, and a high update rate**.

It can be used for auxiliary ranging in handheld devices such as **night vision devices, thermal imagers, telescopes, and laser illuminators**. It is also suitable for other ranging applications, including **perimeter security monitoring, aviation, communications, railways, law enforcement, power line inspection, smart water conservancy, and outdoor sports**.

2. Technical Specifications

No.	Parameter	Specification
1	Laser Wavelength	905 nm ± 5 nm
2	Laser Beam Divergence	< 6 mrad
3	Optical Material	PMMA
4	Receiver Aperture	9.2 mm × 14.5 mm
5	Ranging Range	4m-2000m
6	Ranging Accuracy	±1 m (≤ 400 m) d × 0.4% (400 m < d ≤ 2000 m)
7	Ranging Frequency	2 Hz – 10 Hz, adaptive
8	Valid Measurement Rate	≥98%(≤400m) ≥80%(400m<d≤2000m)
9	False Alarm Rate	≤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	Startup Inrush Current	< 400 mA
15	Operating Power Consumption	≈ 1.2 W

16	Operating Temperature	–20 °C ~ +60 °C
17	Storage Temperature	–40 °C ~ +60 °C
18	Protection Rating	IEC Class 1
19	Laser Safety Class	25.65 mm × 13.05 mm × 24.6 mm (square)
20	Dimensions	≈ 10 g
21	Weight	1000 g/ms (10 times/s along the optical axis)
21	Shock	5–50–5 Hz, 1 octave/min, 2.5 g
22	Vibration	IEC Class 1
23	Reliability	MTBF≥1500h

3. Functional Description

The device supports **single-shot measurement** and **continuous (multiple) measurements**.

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-Shot Measurement

Triggers a single distance measurement. For low-reflectivity targets, the module will automatically repeat the measurement until stable distance data is obtained, and then reports the result via the serial port in the standard data format.

3.4 Multiple Measurements

In continuous measurement mode, the laser module performs continuous ranging with a typical update rate of **2 Hz**, and a maximum update rate of up to **10 Hz**.

4. Hardware Installation Guide

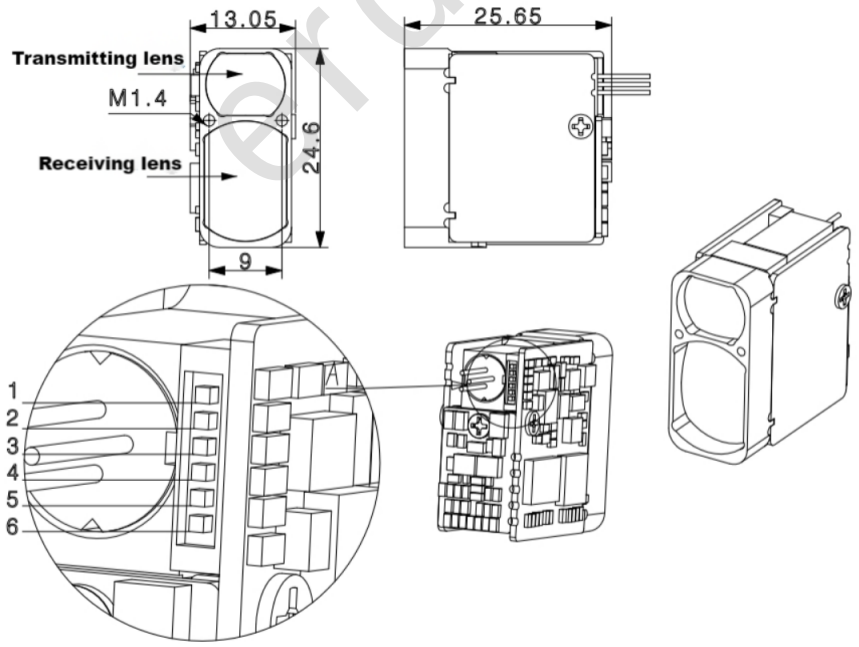
4.1 Packing List

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:

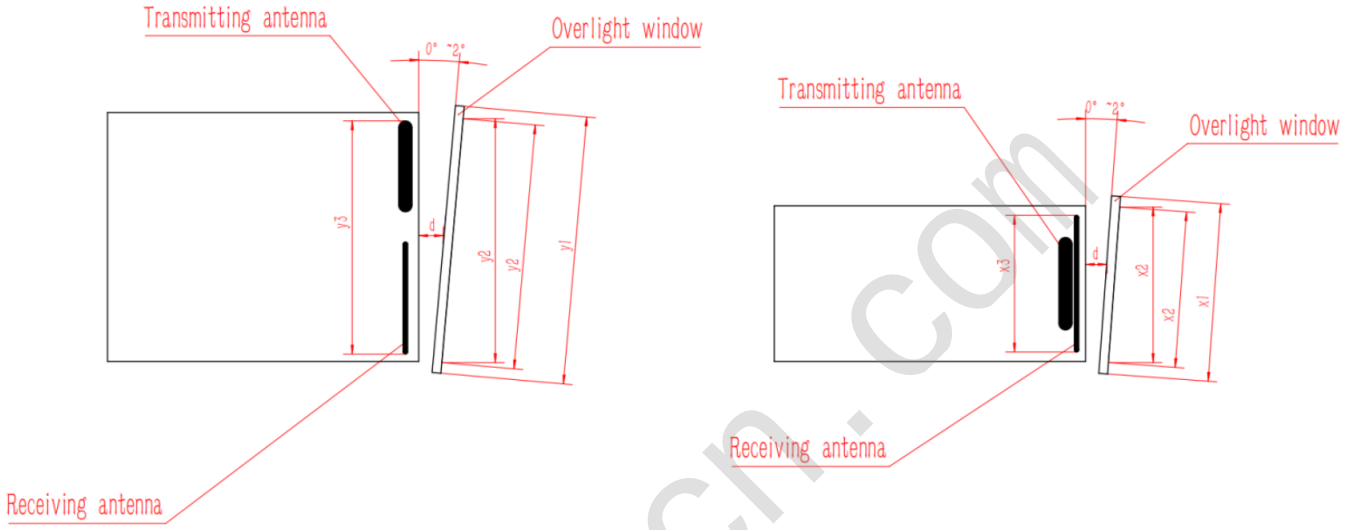
- Effective aperture − outer diameter ≥ 2 mm
- Rangefinder antenna outer diameter − projected size of the effective aperture ≥ 1.5 mm

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

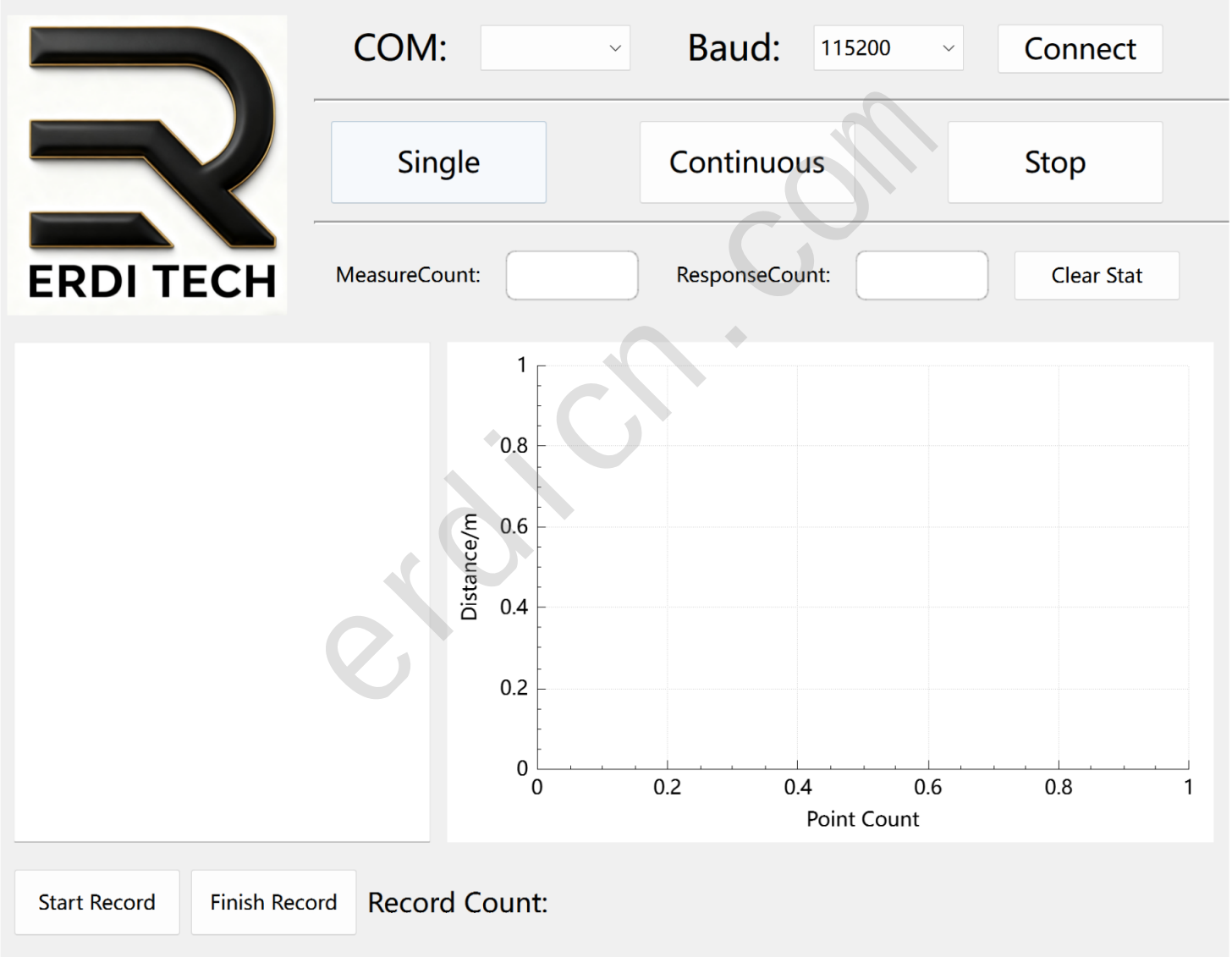
Step 1: Insert the data cable into the ranging module to power the module and enable measurement data output.

- **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 **LR2000E2** 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 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.


Highway traffic sign


Building wall


Trees


Animal

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.