# LR1500E4

## USER MANUAL



**v1.2 | 2025.10 | ERDI TECH LTD**

**905 ± 5 nm**
WAVELENGTH

**IEC Class 1**
LASER SAFETY CLASS
IEC classification

**4–1500 m**
MEASUREMENT RANGE

**±1 m**
RANGING ACCURACY
At ≤ 400 m; see notes

**25.7 × 14.2 × 26.2 mm**
DIMENSIONS
Rectangular

**UART-TTL**
COMMUNICATION
Customizable

Accuracy: ±1 m at d ≤ 400 m; ±(1 m + d × 0.1%) at d > 400 m. See the Technical Specifications table for target conditions.
Drawing dimensions: 25.7 ± 0.1 mm × 14.2 mm (+0/−0.05 mm) × 26.2 mm (+0/−0.05 mm). See Section 6.

# 1. Product Overview

The LR1500E4 is a compact 905 nm laser rangefinder module with a measurement range of 4–1500 m and an adaptive measurement rate of 2–10 Hz. The Technical Specifications table lists the operating conditions and electrical requirements.

The module uses a UART-TTL interface and is supplied with test software and a communication protocol for integration and application development.

Applications include handheld observation devices, thermal imagers, telescopes, surveying instruments, railway monitoring, water management, and outdoor sports. The civilian-use restrictions in the safety section apply.

# 2. Technical Specifications

| NO. | PARAMETER | SPECIFICATION |
|---|---|---|
| 1 | Laser Wavelength | 905 nm ±5 nm |
| 2 | Laser Beam Divergence | < 6 mrad (small laser spot) |
| 3 | Optical Material | Resin Aspheric Lens |
| 4 | Receiver Aperture | 9.2 mm × 14.5 mm |
| 5 | Measurement Range | 4 m – 1500 m<br>Maximum 1800 m (nighttime) |
| 6 | Ranging Accuracy | ±1 m (≤ 400 m)[1]<br>±(1 m + d × 0.1%) (> 400 m)[2] |
| 7 | Measurement Rate | 2 Hz – 10 Hz Adaptive (higher refresh rates customizable) |
| 8 | Valid Measurement Rate | ≥ 98% |
| 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 | 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 |



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| NO. | PARAMETER | SPECIFICATION |
|---|---|---|
| 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 1 |
| 23 | Dimensions | 25.7 × 14.2 × 26.2 mm (rectangular; tolerances in Section 6) |
| 24 | Weight | ≤ 10 g |
| 25 | Shock Resistance | — |
| 26 | Vibration Resistance | 5–50–5 Hz, 1 octave/min, 2.5 g |
| 27 | Reliability | MTBF ≥ 1500 h |

**NOTES —** 1) Target size 2.3 m × 2.3 m, reflectivity 90%;
2) Target size 2.3 m × 4.6 m, reflectivity 90%;
3) The accuracy values in the table apply to measurements of a whiteboard target.

# 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 through 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 through the serial interface.

# 4. Hardware Installation Guide

## 4.1 Packing List

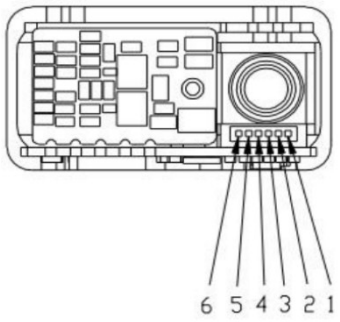
Laser Rangefinder Module × 1
Power Cable × 1



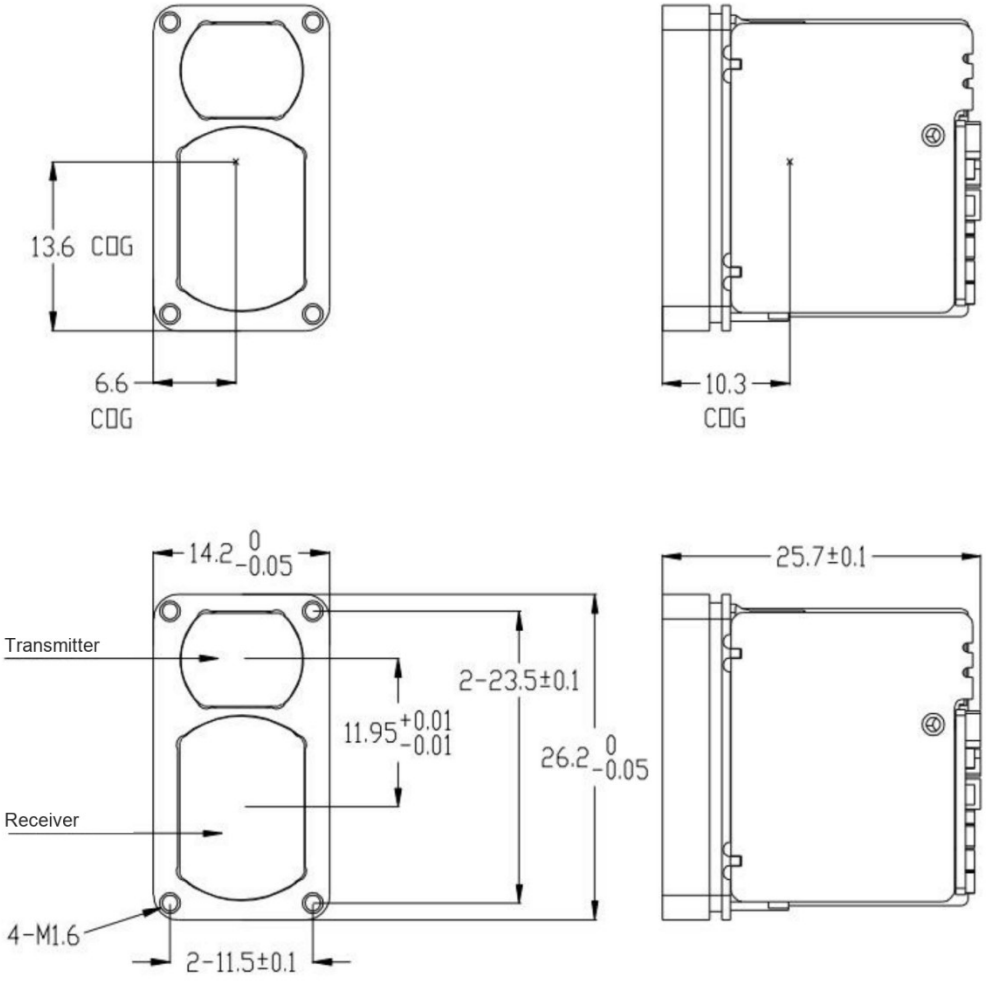
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# 5. Electrical Interface Definition

| Pin | Signal | Description |
|---|---|---|
| 1 | GND | Power ground |
| 2 | VCC | Power input |
| 3 | I/O (Reserved) | Reserved for expansion |
| 4 | TXD | Transmit data: module → host |
| 5 | RXD | Receive data: host → module |
| 6 | SW-SHOT | Function-enable input (configured active high or active low) |




# 6. Mechanical Dimensions




Mechanical Drawing and Center-of-Gravity Locations

# 7. Optical Window Selection and Coating Recommendations

## 7.1 Material Recommendations

H-K9L optical glass or fused silica is recommended for the optical window.

H-K9L and fused silica are among the most commonly used colorless optical materials. They are suitable for the 300–2,100 nm wavelength range and offer good cost efficiency and excellent physical properties.

## 7.2 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.

## 7.3 Coating Recommendations

For a 905 nm laser rangefinder, an anti-reflection (AR) coating for the 855–955 nm wavelength range is recommended, with transmittance ≥ 99.5%.

Depending on the operating environment, additional protective coatings, such as a hydrophobic coating or a hard coating, may be applied to the outer surface. For other coating requirements, refer to GJB 2485-95; the specified transmittance is ≥ 98%.

## 7.4 Optical Window Geometry and Installation Recommendations

The clear aperture of the window depends on the specific product. The outer dimensions shall meet the following requirements:

- Optical-window outer dimension − clear-aperture dimension > 2 mm
- Projected clear-aperture dimension − optical-assembly outer dimension > 1.5 mm

The following schematics illustrate these requirements.

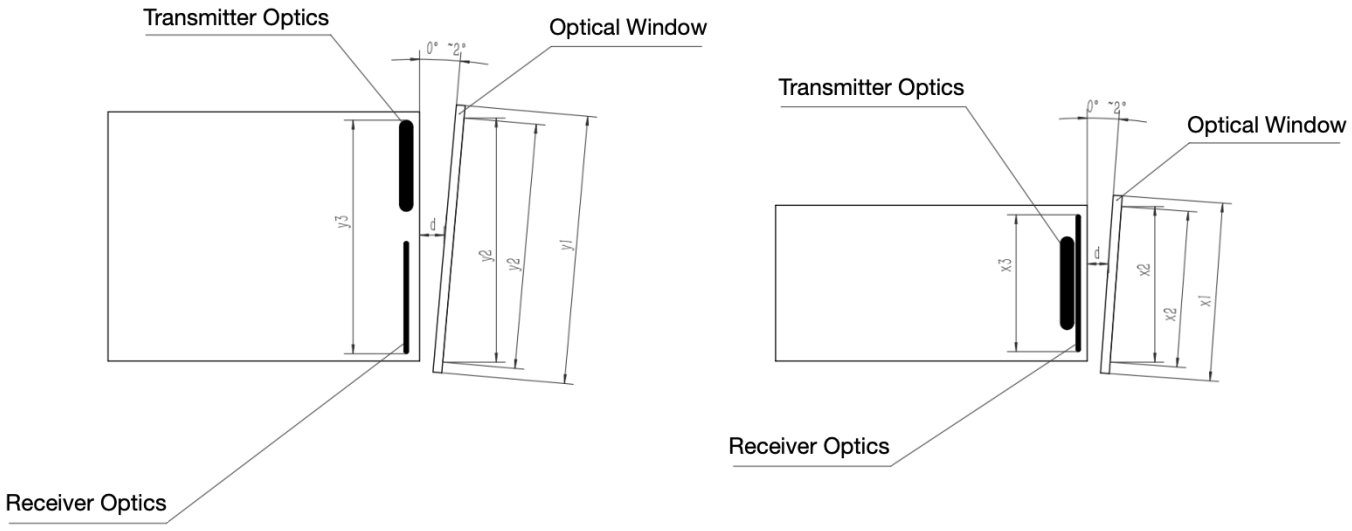
Since the window absorbs a small portion of the laser energy, a window thickness of 2–4 mm is recommended, depending on the available mechanical space.

The transmitter optical axis should be parallel to the surface normal of the optical window. The figure below shows the relative positions of the window and the two lens barrels.

Keep the air gap between the optical window and the rangefinder below 0.5 mm. The figure below shows two recommended window-installation arrangements.



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| | |
|---|---|
| Optical-window outer dimension $y_1$ − clear-aperture dimension $y_2$ > 2 mm<br>Projected clear-aperture dimension $y_2$ − optical-assembly outer dimension $y_3$ > 1.5 mm<br>The air gap d between the optical window and the rangefinder should be as small as possible | Optical-window outer dimension $x_1$ − clear-aperture dimension $x_2$ > 2 mm<br>Projected clear-aperture dimension $x_2$ − optical-assembly outer dimension $x_3$ > 1.5 mm<br>The air gap d between the optical window and the rangefinder should be as small as possible |

# 8. Host Communication Protocol

## Protocol Format

- Communication interface: UART-TTL serial
- Baud rate: 115200 bps (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) |
| | Response | 55 | AA | | | | | | SUM(Frame Header (H) + Frame Header (L) + ... + DATA4) |
| | | | | | | | | | |

| Data Protocol | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Frame Header (H) | Frame Header (L) | Function Code | D1 | D2 | D3 | D4 | Checksum |
| **Measurement Commands** | | | | | | | | | |
| Single-Shot Ranging | Send | 55 | AA | 88 | FF | FF | FF | FF | SUM[3:7] |
| | | 55 AA 88 FF FF FF FF 84 | | | | | | | |
| | Response | 55 | AA | 88 | STA | FF | DIS_H | DIS_L | SUM[1:7] |
| | | STA = 1: Measurement successful; any other STA value: Measurement failed<br>DIS_H: High byte of the measured distance; DIS_L: Low byte of the measured distance<br>**The returned value is expressed in hexadecimal notation. Raw output = measured value × 10.** | | | | | | | |
| Continuous Ranging | Send | 55 | AA | 89 | FF | FF | FF | FF | SUM[3:7] |
| | | 55 AA 89 FF FF FF FF 85 | | | | | | | |
| | Response | 55 | AA | 89 | STA | FF | DIS_H | DIS_L | SUM[1:7] |
| | | STA = 1: Measurement successful; any other STA value: Measurement failed<br>DIS_H: High byte of the measured distance; DIS_L: Low byte of the measured distance<br>**The returned value is expressed in hexadecimal notation. Raw output = measured value × 10.** | | | | | | | |
| Stop Ranging | Send | 55 | AA | 8E | FF | FF | FF | FF | SUM[3:7] |
| | | 55 AA 8E FF FF FF FF 8A | | | | | | | |
| | Response | 55 | AA | 8E | STA | FF | FF | FF | SUM[1:7] |
| | | **STA = 0: Failed to stop continuous ranging; STA = 1: Continuous ranging stopped successfully** | | | | | | | |
| Angle Measurement | Send | 55 | AA | 8A | FF | FF | FF | FF | SUM[3:7] |
| | | 55 AA 8A FF FF FF FF 86 | | | | | | | |
| | Response | 55 | AA | 8A | STA | FF | ANG_H | ANG_L | SUM[1:7] |
| | | STA = 0: Measurement failed; STA = 1: Measurement successful<br>ANG_H: High byte of the measured angle; ANG_L: Low byte of the measured angle<br>**The returned value is expressed in hexadecimal notation. Raw output = measured value × 10.**<br>**Available only for modules equipped with an angle sensor.** | | | | | | | |
| | | | | | | | | | |
| **Power-On Self-Test** | | | | | | | | | |
| Self-Test Information | Response | 55 | AA | 80 | STA | 00 | 00 | ErrCode | SUM[1:7] |
| | | STA = 0: Power-on initialization failed; ErrCode identifies the corresponding error<br>STA = 1: Power-on initialization successful | | | | | | | |
| | | | | | | | | | |



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| Data Protocol | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Frame Header (H) | Frame Header (L) | Function Code | D1 | D2 | D3 | D4 | Checksum |
| System Settings | | | | | | | | | |
| Baud Rate | Send | 55 | AA | TYPE | FF | FF | FF | FF | SUM[3:7] |
| | | TYPE = 01: Set baud rate to 9600 bps<br>TYPE = 02: Set baud rate to 14400 bps<br>TYPE = 03: Set baud rate to 19200 bps<br>TYPE = 04: Set baud rate to 38400 bps<br>TYPE = 05: Set baud rate to 56000 bps<br>TYPE = 06: Set baud rate to 57600 bps<br>TYPE = 07: Set baud rate to 115200 bps<br>TYPE = 08: Set baud rate to 128000 bps<br>TYPE = 09: Set baud rate to 230400 bps<br>**A baud rate change takes effect only after the module is restarted.** | | | | | | | |
| | Response | 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: Disable LD constant-on mode; STA = 1: Enable LD constant-on mode<br>55 AA 86 FF FF FF 01 84 Enable<br>55 AA 86 FF FF FF 00 83 Disable | | | | | | | |
| | Response | 55 | | | | | | | |
| | | STA = 0: LD is already on; STA = 1: LD is already off; STA = FF: Operation failed<br>**Note: Do not leave LD constant-on mode enabled for extended periods.** | | | | | | | |

**Notes:**

1. Command and response frames use different checksum ranges. Use the range specified for each frame.
2. The checksum is the least significant 8 bits of the sum of the specified bytes.
3. All transmitted and received frame bytes are represented in hexadecimal notation.

# 9. Safety Warnings and Precautions

- To avoid eye injury, do not look directly into the laser emission aperture. The module is classified as IEC **Class 1**.
- Operating ambient temperature range: **−20 °C to +55 °C**. Avoid exposure to high temperatures, high humidity, rain, snow, or dust.
- Do not attempt to disassemble the module yourself. Doing so may void the warranty or damage the device.
- This product is intended mainly for integration into civilian equipment such as UAVs, outdoor observation devices, and surveying and mapping systems.
- The beam-adjustment mode is for developers only. To avoid eye injury, do not direct the laser beam toward anyone's eyes in this mode.
- 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. The LR1500E4 measurement range is 4–1500 m, as specified in Section 2. The achievable range depends on the target and measurement conditions. (Targets that produce little 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 perpendicular to the target's reflective surface, ranging performance is better and response is faster. Otherwise, ranging performance and response speed 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 measurement direction relative to direct sunlight. (Rain, fog, snow, haze, and smog reduce the measurement range.)

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

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

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

**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 flagsticks, animals, etc.). When target reflectivity falls below a certain level, the measurement range decreases accordingly.


Highway Traffic Sign


Building Wall


Trees


Animals

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

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

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

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

**Note:**

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



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