ERDI LASER®
ERDI TECH LTD

905nm Laser Ranging Module

Model: LRF2000A

1. PRODUCT DESCRIPTION

The LRF2000A is a 905nm Class 1 eye-safe laser rangefinder module that measures 5–2000 m on 70% reflectivity building targets with ±0.7 m / ±(0.7+0.0004·d) m accuracy, 0.1 m resolution and 1–3 Hz output. Powered from 3.3 V with ≤0.5 mW standby and ≤1.5 W operating power in a 26×25×14.5 mm, 11 g housing and using a UART-TTL interface with enable control, it is ideal for surveying, industrial automation, robotics and outdoor measuring instruments.

2. TECHNICAL SPECIFICATIONS

Laser wavelength	905±10nm Class 1(IEC 60825-1)
Typical Beam Divergence	≤ 10mrad
Average Laser Power	7.63mW
Receiver Field of View (FOV)	≈ 8mrad
Maximum Ranging Distance (visibility > 6 km)	≥ 2000 m @ 70% reflectivity, building target
Minimum Ranging Distance	3 m @ 90% reflectivity, white board
Ranging Accuracy (building targets)	For distance **d ≤ 100 m:** ±0.7 m For distance **d > 100 m:** ±(0.7 + 0.004·d) m (*d represents distance in meters*)
Measurement Frequency	**3 Hz when measuring the same target continuously** **2 Hz when switching between different targets**
Valid Measurement Rate	≥98%
False Alarm Rate	≤1%
Baud Rate	15200 bps (factory default) / 9600 bps
Response Time (System Startup + First Ranging)	**Minimum:** ≤ 550 ms + 46 ms (near-range) **Maximum:** ≤ 550 ms + 458 ms (long-range)
Weight	12±0.5g
Dimensions	14.5mm×25mm ×26mm
Shock	1000 g/ms (10 times/s along the optical axis)
Vibration	5–50–5 Hz, 1 octave/min, 2.5 g
Interface Type	UART(TTL_3.3V)

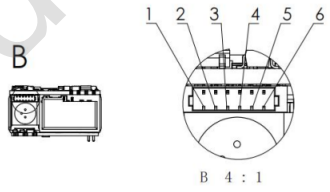
Supply Voltage	DC 3.3±0.1V
Standby Power Consumption	≤ 350 mW (Power-on pull-down) ≤ 1 mW (Power-on pull-up)
Operating Power Consumption (+3.3 V in)	≤1.8W@25℃ ≤2.1W@70℃ ≤1.6W@-20℃
Operating Temperature	-20～+60℃
Storage Temperature	-25～+75℃
Reliability	MTBF≥1500h
Protection Rating	IP67

3. PACKING LIST

1	Laser ranging module × 1	
2	Power connection cable × 1	

4. INTERFACE DEFINITION

Interface Type: UART (TTL_3.3V)



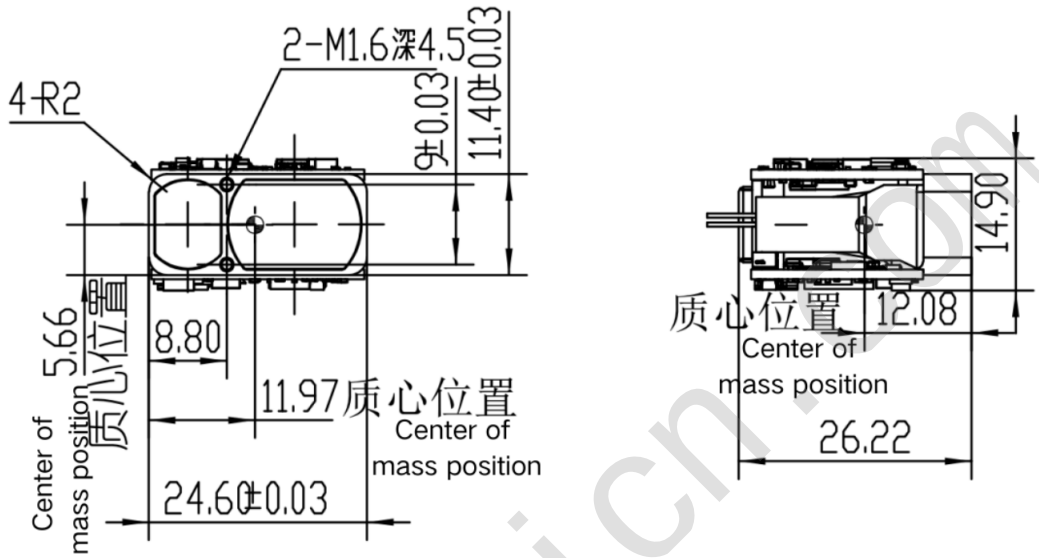
Connector Model: A1002WV-S-6P

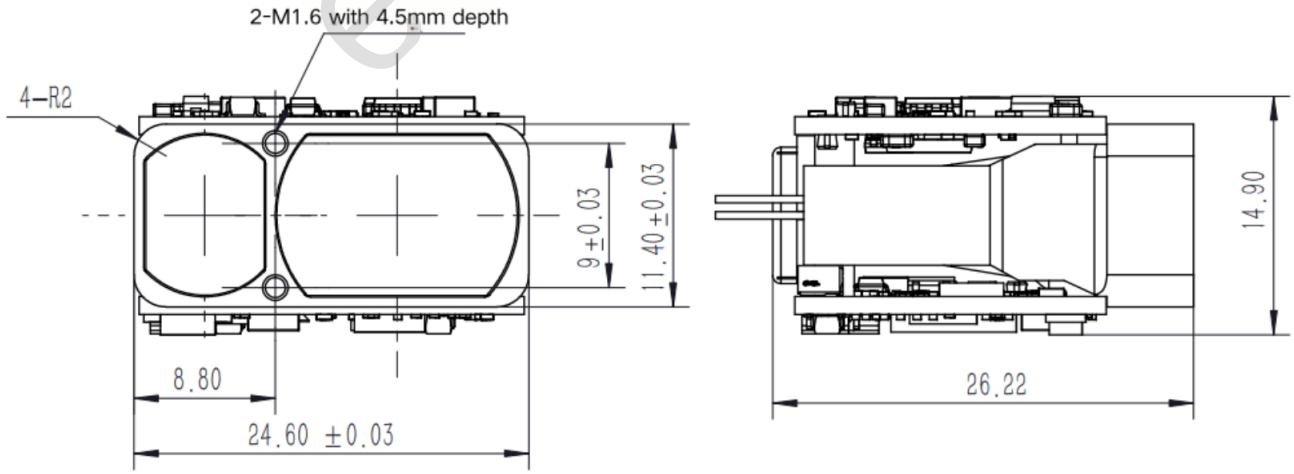
Pin	Definition	Description
1	GND	Ground wire
2	Power Supply	3.3V DC power supply
3	NC	No connection (NC)
4	TTL_TXD	Serial port transmitter, TTL_3.3V level
5	TTL_RXD	Serial port receiver, TTL_3.3V level
6	Enable Pin	Low level to power on

Low-Power Mode:
In this mode, the device consumes extremely low power.
The MCU is turned off and does not respond to any commands.

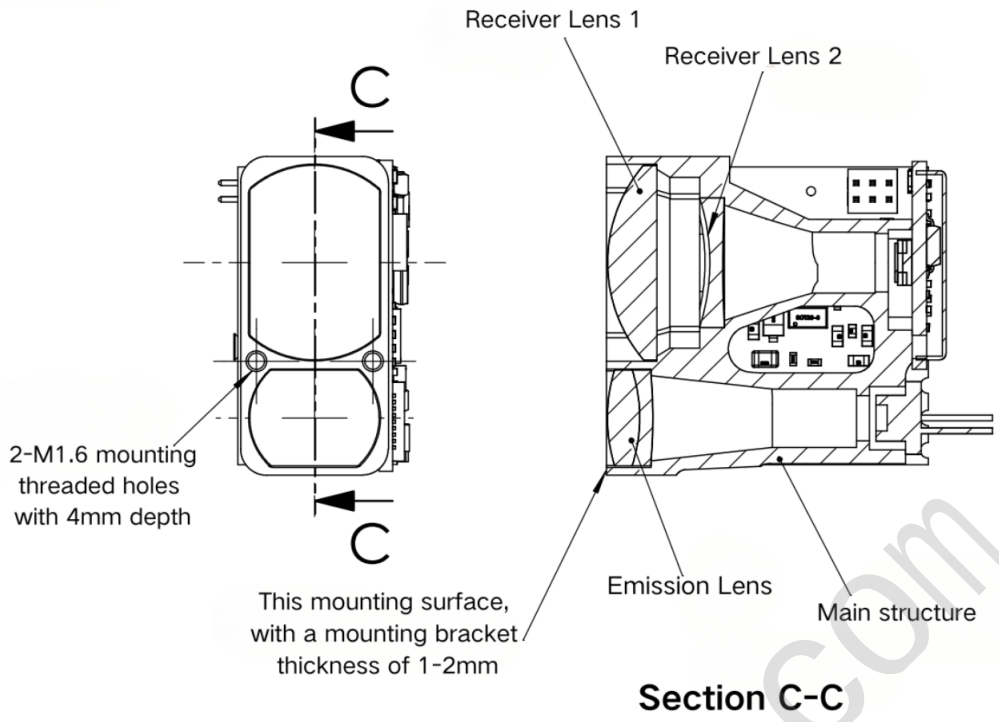
When measurement is required, pull the enable pin **low** to switch the device into normal operating mode. After the measurement is completed, pull the enable pin **high** to return the device to low-power mode, where power consumption is **less than 1 mW**.

5. MECHANICAL INTERFACE AND CENTER OF MASS POSITION



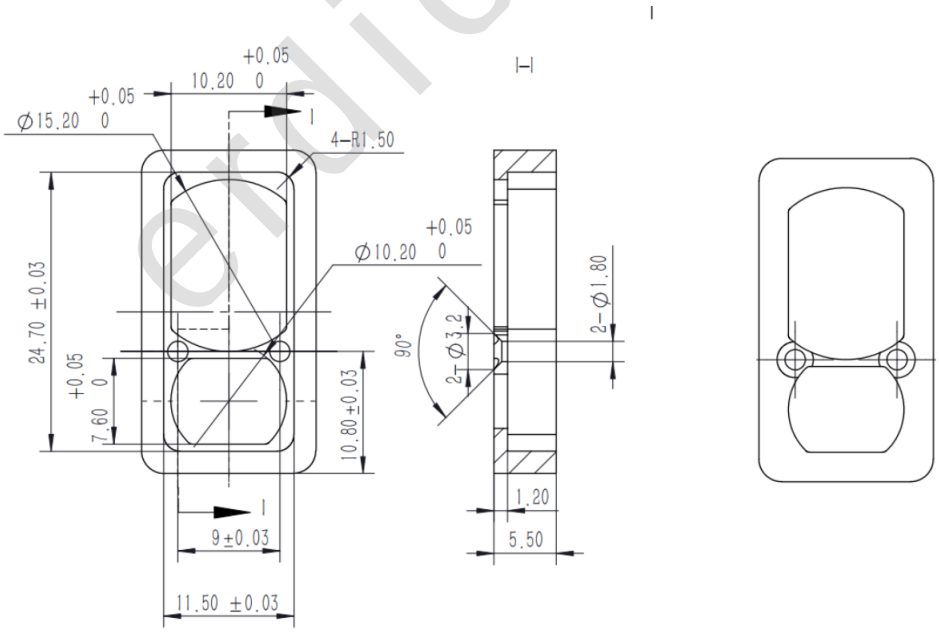


Assembly Diagram

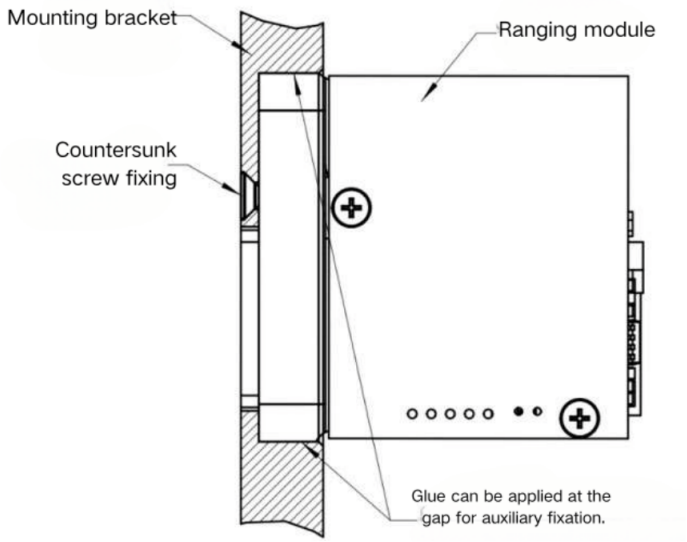


Structural Installation

The recommended dimensions of the mounting bracket are as follows:



Installation Diagram:



The thread length of the countersunk head screw must not exceed 3.5mm.

6. OPERATING STEPS

Step 1:
Insert the data cable into the ranging module.
This will both **power the module** and allow it to **output measurement data**.

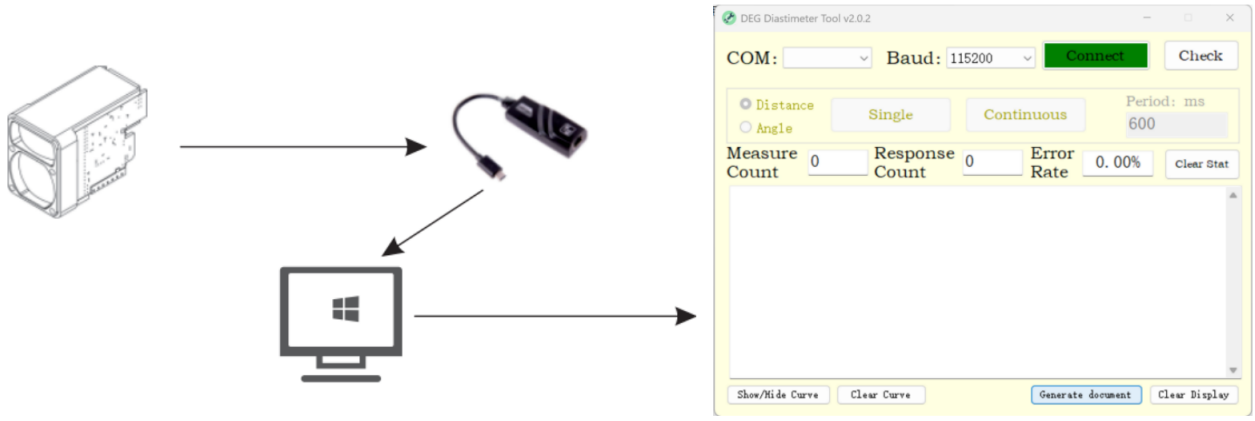
- **Note 1:** Use the factory-supplied internal cable and strictly ensure the supply voltage is within **3.3 ± 0.1 V**.
- **Note 2:** The **Enable pin must be pulled LOW** (connected to GND).

Step 2:
Install the **DEG-Tools** software.
Use a **CH340** or **CP2102** module to convert the serial (TTL) signal to USB for connection to a computer.

Note:

- The module's **TXD** must connect to the TTL-USB converter's **RXD**.
- The module's **RXD** must connect to the converter's **TXD**.

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



Step 4: Debugging and Testing

1. **Select the COM Port:**
   According to the serial port number shown on the computer, set the corresponding COM port in the software.
2. **Baud Rate Setting:**
   After opening the software interface, you may configure the baud rate.
   Supported baud rates include **9600, 115200**, etc. (see Communication Protocol for details).

7. OPTICAL WINDOW AND COATING

1. **Material Recommendations**

It is recommended to use Chengdu Guangming Optical Glass H-K9L for the optical window material. H-K9L is the most common colorless optical glass, suitable for the laser range of 300nm to 2100nm, with high cost performance and excellent physical properties.

2. **Processing Recommendations**

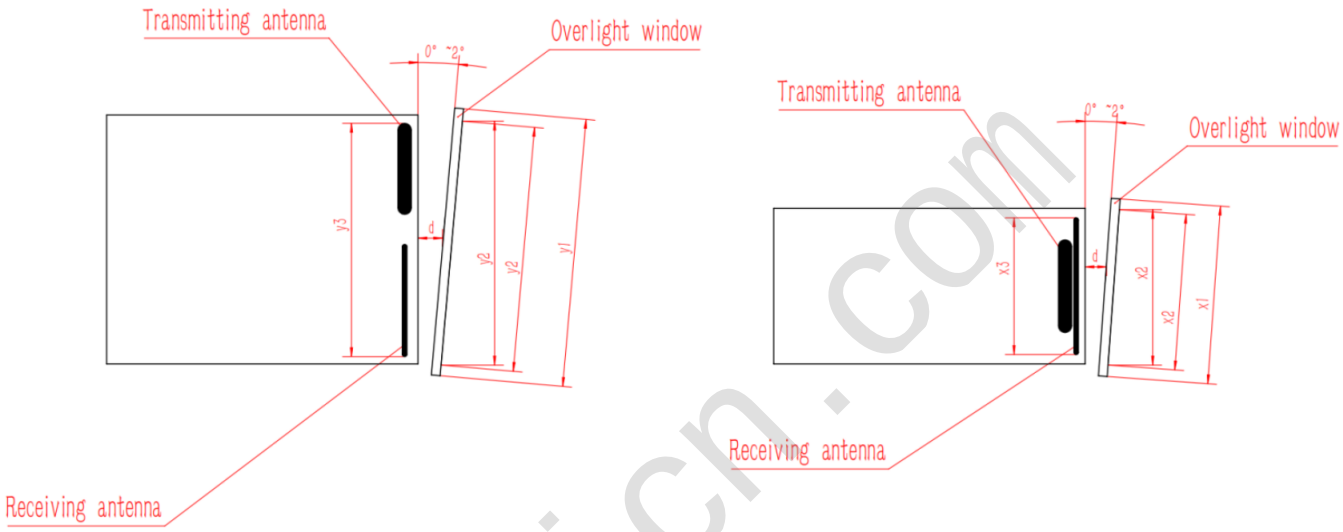
The wedge angle tolerance of the optical window should be as small as possible, and we recommend a wedge angle tolerance of ≤3′ (tolerance grade ≤7);
The optical surface of the optical window should be as smooth as possible, and we recommend the arithmetic mean deviation of the profile (Ra) to be 0.012.

3. **Coating Recommendations**

For the optical window of the 905nm laser rangefinder, it is recommended to coat an anti-reflection film for 855nm to 955nm, with a transmittance of ≥99.5%. According to the specific use environment of the product, other protective films such as hydrophobic film or hard film can be optionally coated on the outer surface of the optical window. Other indicators refer to GJB2485-95, with a transmittance of ≥98%.

4. **Recommendations for Optical Window Shape and Usage**

The effective aperture of the optical window depends on different products, and its overall dimensions should ensure that the effective aperture of the optical window minus the outer diameter of the optical window is ≥2mm, and the outer diameter of the rangefinder antenna minus the projected size of the effective aperture of the optical window is ≥1.5mm, as shown in the schematic diagram below. Since the optical window has a certain absorption of laser, it is recommended that the thickness of the optical window itself be controlled within 2-4mm according to its overall dimensions. Due to the high transmittance of the optical window, it is recommended that the emission optical axis be parallel to the normal line of the optical window, and the schematic diagram of the positions of the optical window and the two lens barrels is shown below. Meanwhile, the air gap between the optical window and the rangefinder should be less than 0.5mm, and Figure 5 shows the schematic diagrams of two ways of placing the optical window.



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

8. COMMUNICATION PROTOCOL

Communication mode: using serial communication mode

Baud rate: 115200 (default)

Data Bits: 8 Bits

Length of a frame: 8 bytes

905nm Laser Ranging Module

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DATA PROTOCOL									
		Frame header H	Frame header L	Function word	D1	D2	D3	D4	Calibration
	Send	55	AA						SUM(function word +DATA1+...+DATA4)
	Reply	55	AA						SUM(frame header H + frame header L + ...+DATA4)

MEASUREMENT INSTRUCTION									
Single 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 = 0 measurement failure; STA = 1: The measurement was successful DIS_H: high bytes of the measured result; DIS_L: The lower bytes of the measurement result **Data is returned in hexadecimal format, and all measurement results are output as the actual value multiplied by 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 = 0 measurement failure; STA = 1: The measurement was successful DIS_H: high bytes of the measured result; DIS_L: The lower bytes of the measurement result Data returns are returned in hexadecimal, and all data results are output by multiplying the real data by 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 closes multiple measurement failures; STA = 1 closes multiple measurements successfully							
Angular 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 values are output as **the actual value × 10**. This function is effective **only for modules equipped with an angle sensor**.							
Switch Measurement Mode	**Send**	55	AA	0A	MODE	FF	FF	FF	SUM[3：7]
		55 AA 0A 00 FF FF FF 07 **55 AA 0A 01 FF FF FF 08** **MODE:**							

		0 – Normal Mode (3 Hz) 1 – Long-Range Mode (1 Hz)						
	Reply	55	AA	0A	STA	MODE	00	00	SUM[1：7]
		STA indicates the switching status. STA = 0 → Switching failed STA = 1 → Switching successful **MODE** indicates the current operating mode.						

POWER-ON SELF-TEST									
Self-test information	Reply	55	AA	80	STA	00	00	ErrCode	SUM[1：7]
		STA= 0 Boot initialization failed, ErrCode is the error code; STA= 1 Boot initialization success. By default, initialization success does not reply to such messages.							

SETTING UP THE SYSTEM									
Baud rate	Send	55	AA	TYPE	FF	FF	FF	FF	SUM[3：7]
		TYPE = 01 sets the baud rate to 9600 bps TYPE = 02 Set the baud rate to 14400 bps TYPE = 03 Set the baud rate to 19200 bps TYPE = 04 Set the baud rate to 38400bps TYPE = 05 Set the baud rate to 56000 BPS TYPE = 06 Set the baud rate to 57600bps TYPE = 07 Set the baud rate to 115200bps TYPE = 08 Set the baud rate to 128000bps TYPE = 09 Set the baud rate to 230400bps The baud rate does not change immediately after it is set and only takes effect after a restart							
	Reply	55	AA	TYPE	STA	FF	FF	FF	SUM[1：7]
		STA = 0 setting failure; STA = 1 is set successfully							
LD Constant-ON Mode	Send	55	AA	86	FF	FF	FF	STA	SUM[3：7]
		STA = 0: LD constant-ON mode **OFF** **STA = 1:** LD constant-ON mode **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:

- The checksum in the transmitted frame and the returned frame are **not the same**; pay attention when validating.
- The checksum is calculated as the **sum of all bytes to be checked, taking the lower 8 bits**.
- All data is transmitted and received in **hexadecimal format**.

9. OPERATION STEPS

1. When using this module, do not look directly into the laser beam.
2. Do not use a lens barrel or other additional optical devices to operate this module to avoid increasing the risk of eye damage.
3. Do not disassemble the module. Disassembling the product will result in the loss of the right to repair.
4. When transporting, please add sufficient cushioning materials to the packaging box to avoid damage to the module.
5. Do not place the module on an unstable high place to prevent it from falling and being damaged.
6. Do not place the module in a harsh environment or near a heat source to prevent uncontrollable impacts on the module.
7. When there is a sharp change in temperature, there will be condensation fog on the surface of the main lens of the module. Do not use the module at this time.
8. If the exposed lens is dirty, gently wipe it clean with a lens cleaning cloth. Do not use other items to wipe it to avoid damaging the coating layer on the surface of the lens.
9. This module comes with a one-year quality guarantee and lifetime maintenance. In case of quality problems of its own, it can be replaced free of charge. For problems caused by human factors, repair and replacement of parts will be charged according to the actual situation of the product.

The factors that affect the ranging ability, ranging response speed, and speed measurement accuracy include:

Target reflectivity: Generally, the higher the target reflectivity, the better the ranging ability and the faster the ranging response speed. For example, for a target with medium reflectivity, a distance of 1500 meters can be measured, for a target with high reflectivity, a distance of not less than 1800 meters can be measured, and for a target with low reflectivity, it may only be possible to measure a distance of 600 meters. (Targets that are difficult to form diffuse reflection, such as the water surface, may not be measurable.)

Target shape: When the area of the reflective surface of the measured target is too small or uneven, the ranging ability and ranging response speed will be correspondingly reduced.
- Measurement angle: When the laser angle is vertically incident on the reflective surface of the measured target, the ranging ability is better and the ranging response speed is faster. Conversely, the ranging ability and ranging response speed will decrease. Using it at extreme measurement angles cannot ensure that the ranging ability and ranging response speed specified in this manual can be achieved.

Measurement environment: The factors affecting the ranging ability and ranging response speed also include the intensity of sunlight, the concentration of water vapor and suspended particulate matter in the air,

the angle of deviation from the sunlight irradiation, etc. (For example, in rainy, foggy, snowy, or hazy weather conditions, the measuring range will be reduced.)

The measuring range of this series of ranging telescopes is defined under the following conditions:

1) The measured target has a medium reflectivity, such as the wall surface of a building.
2) The reflective surface of the measured target is perpendicular to the direction of laser emission.
3) The measuring weather is sunny but not under direct sunlight.

Suggestion: When measuring distant targets, please fix this module with a tripod to reduce the shaking of the module during the measurement process, so as to obtain better measurement results.

I. The factors that affect the ranging ability and ranging response speed include:

Target reflectivity: Generally, the higher the target reflectivity, the better the ranging ability and the faster the ranging response speed. For example, for a target with medium reflectivity, a distance of 600 meters can be measured; for a target with high reflectivity, a distance of not less than 800 meters can be measured; and for a target with low reflectivity, it may only be possible to measure a distance of 300 meters. (For targets that are difficult to form diffuse reflection, such as the water surface, it may not be possible to measure the distance.)

Target shape: When the reflective surface of the measured target is too small or uneven, the ranging ability and ranging response speed will be correspondingly reduced.

Measurement angle: When the laser angle is vertically incident on the reflective surface of the measured target, the ranging ability is better and the ranging response speed is faster. Conversely, the ranging ability and ranging response speed will decrease. Using it at extreme measurement angles cannot ensure that the ranging ability and ranging response speed specified in this manual can be achieved.

Measurement environment: The factors affecting the ranging ability and ranging response speed also include the intensity of sunlight, the concentration of water vapor and suspended particulate matter in the air, the angle of deviation from the sunlight irradiation, etc. (For example, in rainy, foggy, snowy, or hazy weather conditions, the measuring range will be reduced.)
II. Suitable Targets for Measurement This product can measure targets with high reflectivity (such as highway road signs), targets with medium reflectivity (such as the walls of buildings), and targets with low reflectivity (such as trees, golf flagsticks, animals, etc.). When the reflectivity drops to a certain level, the measuring range will be correspondingly reduced.

Highway road sign

The wall surface of a building

Trees

Animal

The measuring range of this module is defined under the following conditions:

1) The measured target has a medium reflectivity, such as the wall surface of a building.
2) The reflective surface of the measured target is perpendicular to the direction of laser emission.
3) The measuring weather is sunny but not under direct sunlight.

Remarks:
It is recommended that when you measure distant targets, you fix this module with a tripod to reduce the shaking of the module during the measurement process, so as to obtain better measurement results.

10. SAFETY PRECAUTIONS

10.1 Measured distance result does not match the actual distance

- If tests are carried out in conditions such as heavy smog or water-mist weather with high humidity, it is easy to measure back water droplets or particles in the air. It is recommended to choose a good test environment.
- Under extreme low-temperature conditions, within 20 m there is a risk that the ranging accuracy exceeds the tolerance.

10.2 Ranging performance is reduced, target at theoretical range cannot be measured

- Very low target reflectivity will affect the returned laser energy and thus affect the ranging performance. When the ranging target is a low-reflectivity object such as a lake surface, wet road surface in rainy weather, or glass, the actual performance of the product cannot reach the theoretical range.
- The ranging module does not irradiate the target point vertically but forms a certain angle. In an oblique-measurement state, the returned laser energy will attenuate, resulting in reduced ranging performance.
- Under extreme low-temperature conditions, the ranging performance may decrease slightly.

10.3 Using our complete communication cable to communicate with the PC, no command response

Check whether the communication cable is broken (the 6-pin communication cable is thin and easy to break).

10.4 Using self-prepared cable for communication, no command response

Check whether the external wiring sequence of the module is correct, whether the communication cable is short-circuited, open-circuited or has poor contact, and check whether the serial-port TX and RX wire order is reversed.