ERDI LASER®

1535nm Eye safe Laser Rangefinder Module - 12km

1 PRODUCT DESCRIPTION

The LRF1221C is a 1535nm wavelength laser rangefinder developed by ERDI TECH LTD. It can measure distances of up to 12 kilometers under NATO standards, with a beam divergence angle of no more than 0.35 mrad. It can operate in environments ranging from -40°C to +70°C. Featuring long distance laser measure, high precision, and strong environmental adaptability, it is highly suitable for applications in reconnaissance, surveying, and mapping.

2 TECHNICAL SPECIFICATIONS

PROJECT	PERFORMANCE INDICATORS
Model	LRF1221C
Laser Wavelength	1.54μm±0.02μm
Eye- safety	Class I
Divergence Angle	≤0.3 mrad
Laser Energy	≥300 μJ
Launch Lens Diameter	Φ12 mm
Receiver Lens Diameter	Φ40 mm
Measuring Range (Reflectance 30%; visibility ≥15km.)	4m × 6m Objective ≥12 km
Minimum Range	≤50 m
Ranging Frequency	0.5Hz ~10Hz
Number of multi-target detections	RS422
Ranging Accuracy	±2 m
Range Resolution	≤0.1m
Precision Rate	≥98%
False Alarm Rate	≤1%
Pin-in-lead package model	J30J

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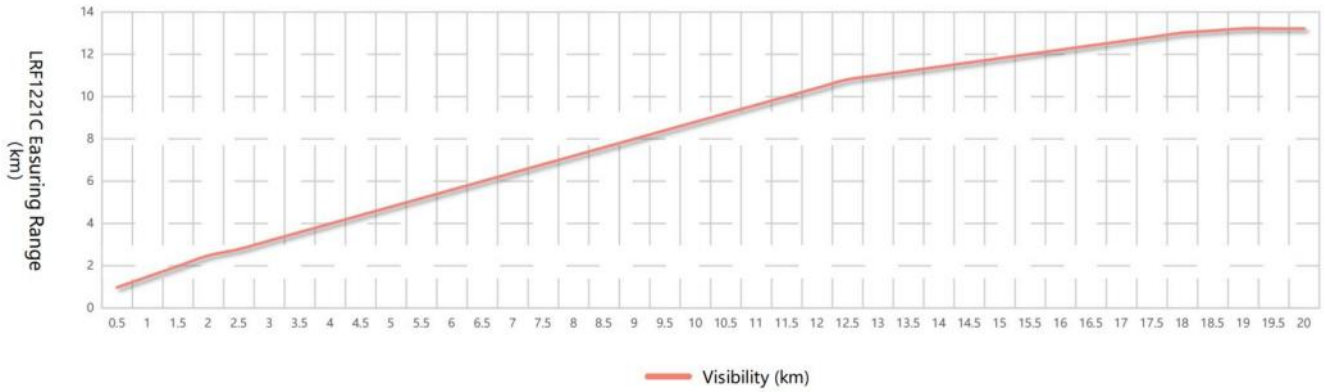
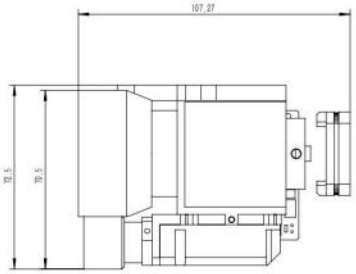
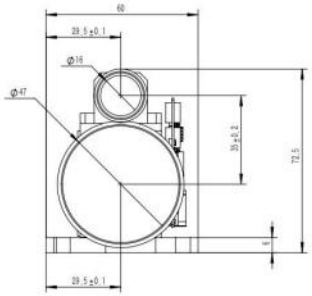
ERDI TECH LTD

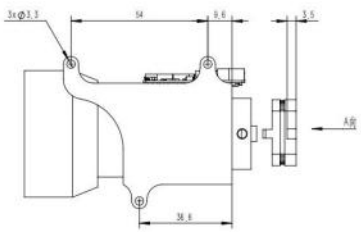
Supply Voltage	DC12 V
Standby power consumption	≤1.2W
Average power consumption	≤2 W
Peak Power Consumption	≤3W@10Hz
Weight	≤275g
Dimension (L×W×H)	107×62×72mm
Operating Temperature	-40 ~ +70 ℃
Storage Temperature	-55 ~ +75 ℃
Impact Resistance	Meet the MIL-STD-810G testing standard
Vibration Resistance	Meet the MIL-STD-810G testing standard

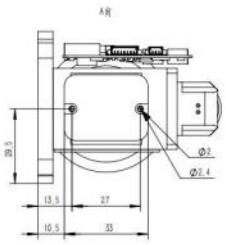


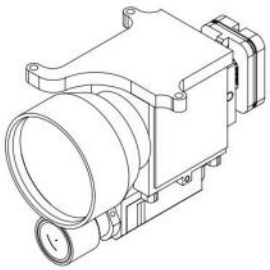
3 OUTLINE DIMENSION(mm)











4 PIN INTERFACE

Electrical connector model: J30J; The corresponding plug and cable shall be provided by Party B. The detailed definition of the electrical interface is shown in the following table:

Interface Definition

Pin	Definition	Function	Remarks
1	GND	Serial Port Ground	
2	GND	12V Input Negative	
3	GND	12V Input Negative	
4	VCC 5V	12V Input Positive	
5	VCC 5V	12V Input Positive	
6	RS422 RX+	Serial Port Receive +	From the upper computer to the rangefinder
7	RS422 RX-	Serial Port Receive -	From the upper computer to the rangefinder
8	RS422 TX-	Serial Port Transmit -	From the rangefinder to the upper computer
9	RS422 TX+	Serial Port Transmit +	From the rangefinder to the upper computer

5 EMBEDDED SOFTWARE

Communication format: RS - 422 communication, baud rate of 115200 bps;
Data format: 8 - bit data, one start bit, one stop bit, no parity check. The data consists of a header byte, a command part, data length, a parameter part, and a check byte.
Communication mode: The master control and the rangefinder adopt a master - slave communication mode. The master control sends control commands to the rangefinder, and the rangefinder receives and executes the commands. In the ranging state, the rangefinder sends back its data and status to the upper computer according to the ranging cycle. The communication format and command content are shown in the following table.

a) Sent by the master control
The format of the sent message is as follows**:**

STX0	CMD	LEN	DATA1H	DATA1L	CHK

Send message format description

Table 2 Description of sending message format

No.	Name	illustrate	code	Remark

No.	Name	illustrate	code	Remark
1	STX0	Message start flag	55(H)	
2	CMD	Command word	See table 3	
3	LEN	Data length	The number of all bytes except the start flag, command word, and check value.	
4	DATAH	parameter		
5	DATAL			
6	CHK	Exclusive OR (XOR) check	Perform an exclusive OR operation on all bytes except the check byte.	

The command is described as follows:

Table 3 Description of commands and data words sent by the main control to the distance measuring machine

No.	command word	Functions	Data byte	Remarks	Length	sample code (computing)
1	0x00	Standby (continuous ranging stop)	DATAH=00（H） DATAL=00（H）	Distance measuring machine stops working	6 bytes	55 00 02 00 00 57
2	0x01	Single ranging	DATAH=00（H） DATAL=00（H）		6 Bytes	55 01 02 00 00 56
3	0x02	Continuous ranging	DATAH=XX（H） DATAL=YY（H）	DATA expresses the ranging period in ms.	6 bytes	55 02 02 03 E8 BE (1Hz ranging)
4	0x03	Self-test	DATAH=00（H） DATAL=00（H）		6 Bytes	55 03 02 00 00 54
5	0x04	Distance selection and nearest distance setting	DATAH=XX（H） DATAL=YY（H）	DATA expresses the blind zone value, unit 1m	6 Bytes	55 04 02 00 64 37 (100m closest)
6	0x06	Cumulative number of light out query	DATAH=00（H） DATAL=00（H）	Cumulative number of light out query	6 bytes	55 06 02 00 00 51
7	0x11	APD power on	DATAH=00（H） DATAL=00（H）		6 bytes	55 11 02 00 00 46
8	0x12	APD power off	DATAH=00（H） DATAL=00（H）		6 bytes	55 12 02 00 00 45
9	0xEB	Number Query	DATAH=00（H） DATAL=00（H）		6 bytes	55 EB 02 00 00 BC

- Master receive format

The receive message format is as follows:

STX0	CMD	LEN	DATAn	DATA0	CHK

Table 4 Description of receive message format

No.	Name	Description	Code	Remarks
1	STX0	Message start flag 1	55(H)	
2	CMD_JG	Data command word	See Table 5	
3	LEN	Data length	Number of all bytes except start flag, command word, and checksum	
4	Dn	Parameter	See Table 5	
5	D0			
6	CHK	Checksum	All bytes except parity byte	

Master receive status description:

Table 5 Description of the data word sent from the rangefinder to the master control

No.	command word	Functions	Data byte	Remarks	Total length
1	0x00	Standby (continuous ranging stop)	D1=00（H） D0=00（H）		6 bytes
2	0x03	Self-test	D7 ~D0	D0: char type, indicates APD temperature in degrees Celsius; D1: APD high-voltage value, unit V; D3-D2: blind value, unit 1m D5-D4: -5V voltage, unit 0.01V. D7-D6:+5V voltage, unit 0.01V	12 bytes
3	0x04	Setting of the nearest distance to the opt-in, unit m	D1 D0	DATA expresses the closest distance value in 1m; First high then low	6 bytes
4	0x06	Cumulative number of light out query	D3~D0	DATA expresses the number of times the light is emitted, 4 bytes, the high byte comes first	8 bytes
5	0x11	APD power on	DATAH=00（H） DATAL=00（H）	APD with high voltage	6 Bytes
6	0x12	APD power off	DATAH=00（H） DATAL=00（H）	APD without high voltage	6 Bytes
7	0xED	Work timeout	0x00 0x00	The laser is in laser protection and cannot measure the distance.	6 bytes
8	0xEE	Validation error	0x00 0x00		6 bytes
9	0XEF	Serial communication timeout	0x00 0x00		6 bytes
10	0x01	Single Distance Measurement	D9 D8 D7 D6 D5 D4 D3 D2 D1 D0	D8-D6 first target distance (unit 0.1m) D5-D3 second target distance (data is 0 when single target) (unit 0.1m) D2-D0 third target distance (data is 0 when single target) (unit 0.1m) 3 target from near to far D9 (bit7-bit0) flag byte:	14 bytes

No.	command word	Functions	Data byte	Remarks	Total length
				D9 bit 7 indicates main wave; 1: with main wave, 0: without main wave. D9 bit 6 indicates return wave; 1: with return wave, 0: without return wave D9 bit 5 indicates the laser status; 1: laser normal, 0: laser failure D9 bit 4 timeout alarm; 1 normal, 0 timeout D9 bit 3 invalid, =1 D9 bit 2 indicates APD status; 1: normal, 0: error D9 bit 1 indicates whether there is a former target; 1: target, 0: no target (the target before the main target is the former target) D9 bit 0 indicates whether there is an after-target; 1: with target, 0: without target (the target after the main target is the after-target)	
11	0x02	Continuous distance measurement	D9 D8 D7 D6 D5 D4 D3 D2 D1 D0	D8-D6 first target distance (unit 0.1m) D5-D3 second target distance (data is 0 when single target) (unit 0.1m) D2-D0 third target distance (data is 0 when single target) (unit 0.1m) 3 target from near to far D9 (bit7-bit0) flag byte: D9 bit 7 indicates main wave; 1: with main wave, 0: without main wave. D9 bit 6 indicates return wave; 1: with return wave, 0: without return wave D9 bit 5 indicates the laser status; 1: laser normal, 0: laser failure D9 bit 4 timeout alarm; 1 normal, 0 timeout D9 bit 3 invalid, =1 D9 bit 2 indicates APD status; 1: normal, 0: error D9 bit 1 indicates whether there is a former target; 1: target, 0: no target (the target before the main target is the former target) D9 bit 0 indicates whether there is an after-target; 1: with target, 0: without target (the target after the main target is the after-target)	14 bytes
14	0xEB	Number Search	D16…… D0	D15 D12 Complete model D11 D10 Product number	20 bytes

No.	command word	Functions	Data byte	Remarks	Total length
				D9 D6 Software version D5 D4 APD number D3 D2 Laser number D1 D0 FPGA version	

Remarks: ① Undefined data byte/bit, default is 0;

6 INSTRUCTIONS FOR USE

1. In order to enable the operators to safely and correctly use various functions of the LRF0105C miniature laser rangefinder product, this operation and maintenance manual provides instructions on its operation and maintenance. It is applicable to the operators and maintenance personnel of this product.

The LRF0105C miniature laser rangefinder (hereinafter referred to as the laser rangefinder) is a precision optoelectronic product that emits laser towards the measured target and calculates the distance information based on the laser flight time. This laser rangefinder achieves communication through the Uart (TTL_3.3V) communication interface, and is characterized by outstanding performance and simple operation. The laser of this rangefinder is prohibited from direct exposure to human eyes.

2. Recommendations for Optical Window Selection and Coating

2.1 Material Recommendations

The optical glass H-K9L is recommended as the material for the optical window. H-K9L is the most common colorless optical glass, suitable for the laser range of 300nm to 2100nm. It has a high cost-performance ratio and superior physical properties.

2.2 Processing Recommendations

The wedge angle tolerance of the optical window should be as small as possible. It is recommended that the wedge angle tolerance ≤ 3' (tolerance grade ≤ level 7);
The optical surface of the optical window should be as smooth as possible. It is recommended that the arithmetic average deviation of the profile (Ra) is 0.012.

2.3 Coating Recommendations

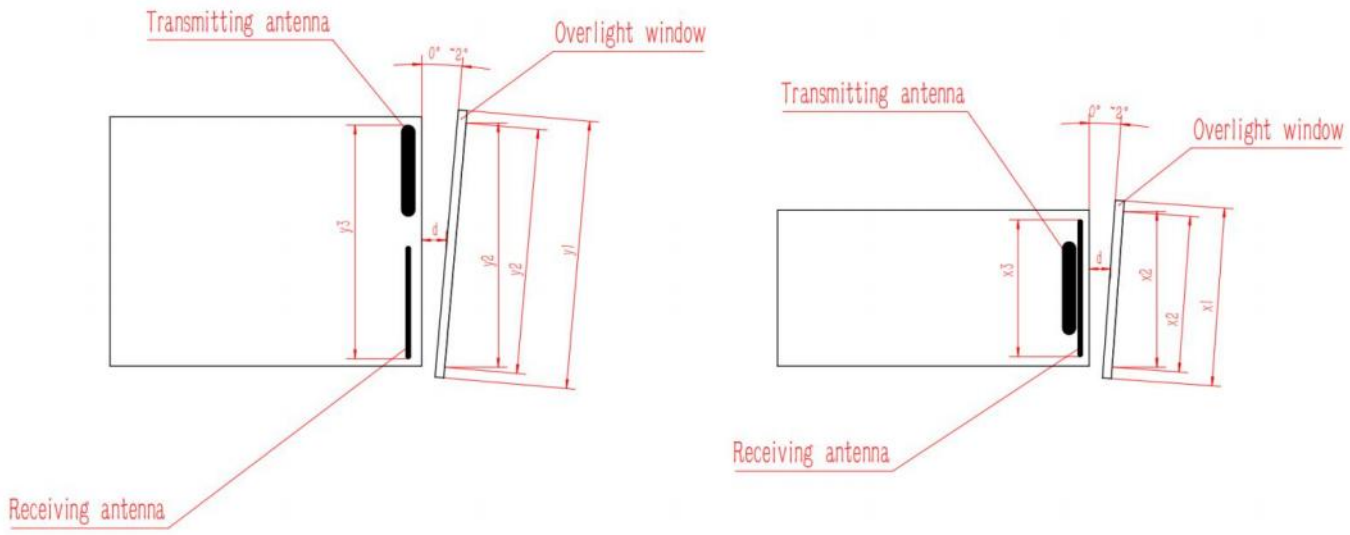
For the optical window of the 1535nm laser rangefinder, it is recommended to coat an anti-reflective film in the range of 1525nm to 1545nm, with a transmittance of ≥ 99%.
According to the specific usage environment of the product, other protective films such as a hydrophobic film or a hard film can be additionally selected for coating on the outer surface of the optical window. For the remaining indicators, refer to MIL-STD-810G, and the transmittance should be ≥ 97%.

2.4 Recommendations for the Shape and Use of the Optical Window

The effective aperture of the optical window depends on different products. Its external dimension should ensure that the effective aperture of the optical window - the outer diameter of the optical window ≥ 2mm, and the outer diameter of the rangefinder antenna - the projected dimension of the effective aperture of the

optical window ≥ 1.5mm. The schematic diagram is shown as follows. Since the optical window has a certain absorption of the laser, it is recommended that the thickness of the optical window itself be controlled within 2 to 4mm according to the external dimension.

Since the optical window has a high transmittance, it is recommended that the axial deviation between the emitting optical axis and the normal of the optical window be controlled within 0° to 2°. The schematic diagram of the position of the optical window and the two lens barrels is shown as follows. At the same time, the air gap between the optical window and the rangefinder should be as small as possible. Figure 4 shows the schematic diagrams of the placement of the optical window in two ways.



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

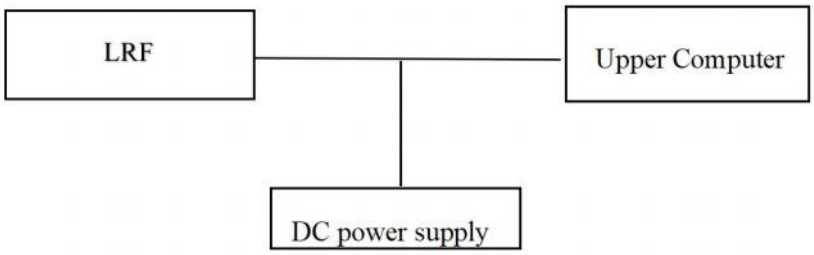
Schematic diagrams of two ways of the external dimensions and placement of the optical window

3. Operation In order for you to fully understand all the functions of this system and correctly master the installation, operation and maintenance methods, please read the content of this chapter carefully before installing and using this system.

3.1 Power-on Operation

3.1.1 Before Power-on

Connect the laser rangefinder, the debugging cable, the DC power supply and the host computer as shown in the figure.



Schematic Diagram of the Connection

3.1.2 Power-on

Power-on operation: Connect the power supply.

3.2 Power-off Operation

3.2.1 Before Power-off

Before powering off, it should be confirmed that the working processes and tasks of each product are in the ended state, and the program is exited.

3.2.2 Power-off

Power-off steps: Disconnect the power supply.

3.3 Operation

3.3.1 Ranging Mode

Operation method of the ranging mode:

a) Send the "Single Ranging" command to the laser rangefinder. The laser rangefinder will perform single ranging and report the ranging status and the distance value.

b) Send the "1Hz Ranging" command to the laser rangefinder. The laser rangefinder will perform ranging once per second and report the ranging status and the distance value.

c) Send the "Stop Ranging" command to stop ranging.

d) Send the "5Hz Ranging" command to the laser rangefinder. The laser rangefinder will perform ranging five times per second and report the ranging status and the distance value.

e) Send the "Stop Ranging" command to stop ranging.

f) Send the "10Hz Ranging" command to the laser rangefinder. The laser rangefinder will perform ranging ten times per second and report the ranging status and the distance value.

g) Send the "Stop Ranging" command to stop ranging.

3.3.2 Distance Gating Setting

Distance gating means setting a section of gating distance (represented in hexadecimal) within the ranging capability range. The target distance information lower than the gating value will not be sent back, and the ranging value higher than the gating value within the measurement range is the effective ranging value.

If setting is required, the operation method is as follows:

a) Send the "Gating Value Setting" command to the laser rangefinder.

Send the "Ranging" command to the laser rangefinder. The laser rangefinder will perform ranging, determine whether the sent-back distance value is greater than the distance gating value, and then report the ranging result.

c) Send the "Stop Ranging" command to stop the ranging operation. If the distance gating function is not

needed, the initial settings need to be manually restored (set the gating value to 0).

3.3.3 Self-check Mode

The operation method of the self-check:

a) Send the "Self-check Inquiry" instruction to the laser rangefinder. The laser rangefinder starts to conduct a self-check and sends back information such as the current ambient temperature and working status.

4. Inspection and Maintenance

4.1 General Inspection

Visual inspection and power-on inspection should be carried out when the product is used for the first time and after the resource module is replaced. For products in normal use, only power-on inspection is required before use.

4.1.1 Visual Inspection

The steps of visual inspection are as follows:

a) Check whether the appearance of the product is normal;

b) Check if there is any error in the cable connection, and the connection should be firm.

4.1.2 Power-on Inspection

The steps of power-on inspection are as follows:

a) Complete the power-on operation according to the steps in 3.1;

b) Start the self-test module;

c) After the inspection is completed, complete the power-off operation according to the steps in 3.2.

4.2 Regular Maintenance

The laser rangefinder does not need maintenance under normal working conditions. Maintenance is required if it is stored in a dust-free environment for more than one year. The maintenance content includes:

4.2.1 General Inspection

Conduct a general inspection of the product when it is not energized. The steps are as follows:

a) All marks and numbers on the product and the test cable plug (socket) should be correct and clear;

b) All kinds of screws on the panel should be tightened;

c) It should be ensured that there are no attachments such as light spots, pockmarks, water stains, mold, fingerprints, dust particles, etc. and cracks that hinder normal observation on the optical glass of the product as seen visually.

4.2.2 Power-on Inspection

Conduct a comprehensive inspection and maintenance of the laser rangefinder when it is powered on. The content includes:

a) Turn on the power of the product in sequence;

b) Complete the power-on operation according to the steps in 3.1;

c) Start the product self-test module and complete the product self-test;

d) Complete the power-off operation according to the steps in 3.2.

5. Analysis of Fault Symptoms and Troubleshooting Methods

The laser rangefinder is a precision product. When a fault occurs, the entire device needs to be returned to the factory for fault analysis, location, and repair. Self-repair is not allowed.
Common fault symptoms and troubleshooting methods are shown in the following table.
Common Fault Symptoms and Troubleshooting Methods

Fault Symptoms	Possible Reasons	Inspection Method	Measures for Troubleshooting
The product cannot be powered on normally.	a) Faults in the power supply and connection cables. b) Circuit faults.	Check the power supply and the connection cable.	a) Replace the power supply or the connection cable. b) b) In case of a circuit fault, contact the manufacturer for assistance in solving the problem.
Cannot return communication information.	a) Fault of the connection cable b) Abnormal power supply c) c) Communication fault of the laser rangefinder	a) Check whether the connection cable is normal. b) Check whether the power supply is normal.	a) Replace the connection cable and the power supply. b) For communication problems, contact the manufacturer for assistance in solving them.

6. Requirements for Packaging, Transportation and Storage

6.1 Packaging

For the products that have been unsealed and need to be restocked, they should be packaged according to the original packaging. When the products need to be returned to the factory, the original packaging should be used as much as possible. When other forms of packaging are used, it should not cause a decrease in product performance or damage to the products.

6.2 Transportation

The products that have been repacked can be transported by means of automobiles, trains, airplanes, ships, etc. During transportation, the packaged items should be fixed on the means of transportation to avoid phenomena such as impact, rough handling, and being exposed to rain and snow. For the road transportation and railway transportation environments, refer to MIL-STD-810G.

6.3 Storage

The repacked products shall not be stored in the open air in the wild. They should be stored in a warehouse with a storage temperature of 0℃ to +30℃, a relative humidity not exceeding 80%, free from the erosion of corrosive substances, strong mechanical vibration and impact, and strong magnetic fields.

7 SAFETY PRECAUTIONS

In order to use this product safely, please read this instruction manual carefully before operating the product.

- This laser rangefinder is a precision optical and mechanical product. Operating it in violation of the regulations may lead to dangerous laser injury. Do not open or adjust any part of the laser rangefinder, and do not attempt to repair or adjust the performance of the laser rangefinder by yourself.
- Pay attention to electrostatic protection: The electronic components of the laser rangefinder are sensitive

to electrostatic discharge. Do not touch any electronic devices without protective measures.

- Only turn on the power of the laser rangefinder for operation within the specified voltage and power range.
- It is prohibited to touch the optical lenses with fingers or hard objects (to prevent oil contamination or scratching of the lenses).
- It is prohibited to measure high-reflectivity targets at too close a distance (to prevent damage to core components of the detector, etc.).
- It is prohibited to store the laser rangefinder under non-specified conditions (such as a highly polluted environment, exceeding the storage temperature range, etc.).
- It is prohibited for the laser rangefinder to be subjected to strong mechanical impacts (vibration, impact, dropping, etc.).