ERDI LASER®

LDR60K1 Laser Rangefinder &Laser Irradiation

Model:LDR60K1

1 PRODUCT DESCRIPTION

LDR60K1 1064nm Laser Rangefinder & Laser Irradiation. The ranging capability for NATO targets is ≥ 12 km. The ranging frequency is 1~ 20 Hz. The laser illumination distance is ≥6 km. The pulse width is ≥ 15 ns ± 5 ns. The beam divergence angle is ≤ 0.30 mrad. The weight is ≤680 g.

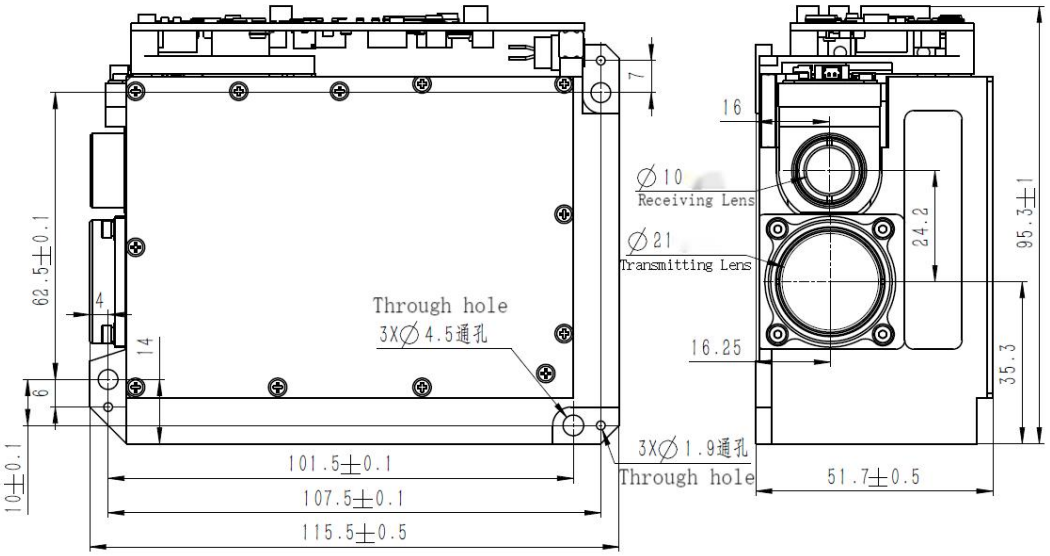
2 TECHNICAL SPECIFICATIONS

CONTROL FUNCTION	
The laser target indicator can achieve the following control functions through the serial interface.	It has the laser ranging function. During ranging, distance data and status information are output once for each pulse.
	It can respond to the laser ranging command and can stop ranging at any time according to the stop command.
	It can perform cumulative counting of laser pulses.
	It can monitor the temperature and report the current temperature value to the system.
	It can set the target indication time, coding, and can output the selected settings.
	It can respond to the laser target indication command and perform target indication according to the set mode and coding.
	During laser target indication, the distance value and status information are output once for each pulse.
	It can perform laser target indication at the frequency set by external commands (in the state of laser coding irradiation, a software interface is reserved, supporting 8 kinds of fixed codings).
	Power-on Self-check: After powering on, it automatically conducts a self-check on relevant items. After the self-check is completed, it reports the self-check result and enters the standby state.

	Periodic Self-check: The laser ranging target indicator conducts periodic tests during the operation process. The periodic self-check does not affect the normal operation of the laser ranging target indicator. If a fault is detected, it reports the self-check report.
	Initiated Self-check: The system sends an initiated self-check signal. After the laser ranging target indicator receives this signal, it detects its functions and reports the inspection result.
PARAMETER INDICATORS	
Pump Source	Laser LD (Laser Diode) Pumping
Cooling Method	Passive cooling, no temperature control
Working Mode	Laser Ranging, Laser target indication
Operating Wavelength	1064nm±3nm
Pulse Energy	≥60 mJ
Laser Energy Stability	Within a single irradiation cycle, the pulse energy fluctuation does not exceed 10% of the average energy.
Pulse Width	≥15ns±5ns
Beam Divergence Angle	≤0.30 mrad
Stability of The Laser Optical Axis	≤0.05mrad
RANGING PERFORMANCE	
Ranging Frequency	1~20 Hz
Continuous Ranging Time	≤300m
Maximum Ranging Distance	≥12km(Visibility: 16 km, target reflectivity: 0.2, target size: 2.3 m × 2.3 m)
Ranging accuracy	±1m.
Successful Ranging Rate	≥98%
Continuous Laser Ranging Time	5min(1Hz)/1min (5Hz)/20S（20hz）
IRRADIATION PERFORMANCE	
Precision of Laser Coding	±1μs
Laser Irradiation Frequency	1~20Hz
Laser Irradiation Distance	≥6000m
Laser Target Designation Cycle	**Short-period Irradiation Time:** The duration of a single irradiation is 17 seconds, with an interval of 10 seconds, and it can perform continuous irradiation for 6 cycles.
	Long-period Irradiation Time: The duration of a single irradiation is 47 seconds, with an interval of 30 seconds, and it can perform continuous irradiation for 2 cycles. After completing a short-period or long-period irradiation, the time interval before starting the next irradiation should be no less than 30 minutes.
LASER CODING	
It complies with the requirements of MIL-STD-810G standard and has the expandable capability of user self-coding.	
It has the ability to receive external synchronous signals and encodes by controlling the laser beam emitting mode through	

external signals.		
Coding method: Precise frequency code (encoded with eight groups of pre-stored periodic codes).		
DIMENSIONS AND WEIGHT		
External Dimension Envelope		≤116mm×52mm×96mm
Weight		≤680g
Degree of non-parallelism between the installation reference base and the optical axis		0.5mrad
INPUT POWER SUPPLY REQUIREMENTS		
During operation, the average power consumption is not more than 55W, and the peak power consumption is not more than 100W.		
The operating voltage range is from 20V ~ 28V.		
THREE-PROOFING FOR ELECTRICAL COMPONENTS		
After the circuit board is designed and debugged, it is coated with three-proofing paint for "three-proofing" treatment.		
ENVIRONMENTAL ADAPTABILITY REQUIREMENTS		
High Temperature	Operating temperature	≤ +55°C
	Storage temperature range	≥ -40°C
Low Temperature	Operating temperature	≥ -40°C
	Storage temperature range	≥ -45°C
Vibration Requirements		It can withstand the flight vibration as well as the impacts during takeoff and landing, and all equipment can withstand the environmental conditions of automobile transportation.
		The vibration is in the form of a swept frequency spectrum. From 15Hz to 33Hz, it is a sinusoidal vibration with equal displacement, and the displacement magnitude is 0.91mm; from 33Hz to 700Hz, it is a sinusoidal vibration with equal acceleration, and the acceleration is 2g.
		Vibrate in each of the three directions for 1 hour.
		Specimen Status: The product is placed on the test bench in the normal operating state for the impact test, and the product is powered on.
		After the impact test, the product should operate normally.
Shock Requirements		Vertical axial direction: ≥ 10g,
		Horizontal axis direction: ≥ 10g,
		Longitudinal axis direction: ≥ 10g;
		Post-peak sawtooth wave with a duration of 11ms. For the X, Y, and Z axes, in two directions of each axis, once for each direction, a total of 18 times.
		Specimen Status: The product is placed on the test bench in the normal use state for the shock test, and the product is powered on.
		After the shock test, the product should operate normally.

3 OUTLINE DIMENSION(mm)



4 PIN INTERFACE

Baud Rate: 115200 bit/s

Communication Interface: RS422 Interface;

External Trigger Interface: Reserved for External Code Trigger Interface;

Connector Interface Definitions are provided in Table .

Electrical Interface Definitions

Pin	Definition	Description
1	422-GND	RS422 Ground
2	24V	Power Supply +
3	24V	Power Supply +
4	24VGND	Power Supply -
5	24VGND	Power Supply -
6	422_Rx+	Upper Computer ->Laser Rangefinder Target Designator +
7	422_Rx-	Upper Computer ->Laser Rangefinder Target Designator -
8	422_Tx-	Laser Rangefinder Target Designator ->Upper Computer-
9	422_Tx+	Laser Rangefinder Target Designator ->Upper Computer+

5 EMBEDDED SOFTWARE

1.Communication Standard

Asynchronous Serial Communication Standard: RS422 Serial Port

Baud Rate: 115200bps

Transmission Format: 8 data bits, 1 start bit, 1 stop bit, no parity bit

For each byte of information, the least significant bit (lsb) is transmitted first. For multi-byte information, the lower byte is transmitted first.

2.Output Information

Output information refers to commands sent by the host computer system to the Laser Rangefinder Target Designator module, including:

- Information header (0x55);
- Command word 1;
- Command word 2;
- Command word 3;
- "Information tail" is the checksum, which is the result of the XOR operation of bytes 1-4.

The relevant definitions of command word 1 are as follows:

Table 2 Command word 1 definition

BIT07	BIT06	BIT05	BIT04	BIT03	BIT02	BIT01	BIT00
0x00: Standby 0x01: Initiate self-test 0x02: Single distance measurement 0x03: Continuous distance measurement (1Hz) 0x04: Continuous distance measurement (5Hz) 0x05: Short target designation (duration 18s, interval 10s, 8 cycles of target designation) 0x06: Long target designation (duration 60s, interval 60s, 4 cycles of target designation) 0x08: Stop distance measurement/ target designation 0x09: Set gating value 0x0A: Report cumulative laser pulse count 0x19 ~ 0x20: Change laser encoding parameters 9 ~ 16 0x29 ~ 0x30: Read laser encoding parameters 9 ~ 16							

The relevant definitions of command word 2 are as follows:

Table 3 Command word 2 definition

BIT07	BIT06	BIT05	BIT04	BIT03	BIT02	BIT01	BIT00
When Laser target designation is active: Laser codes range from 1 ~ 16. When laser ranging is active: 1 - First target, 2 - Last target. When setting the gating value: Low byte of distance gating value. When modifying parameters for laser codes 9 to 16: Low byte of laser code, period × 100 (5000 represents 50ms, range of 46ms ~ 56ms).							

The relevant definitions of command word 3 are as follows:

Table 4 Command word 3 definition

BIT07	BIT06	BIT05	BIT04	BIT03	BIT02	BIT01	BIT00

When setting Laser Target Designation: Set Laser Target Designation time (1 ~ 25).

When setting the gating value: High byte of distance gating value.

When modifying parameters for laser codes 9 ~ 16: High byte of laser code, period × 100 (5000 represents 50ms, range of 46ms ~ 56ms).

3.Input Information

Input information refers to the status information received by the Upper Computer from the Laser Target Designation module, including:

- Information header (0x55);
- Status word;
- Target distance/accumulated laser pulse count (2 bytes); low byte first, high byte second;
- For laser codes 9 to 16 parameters, period × 100 (5000 represents 50ms, range of 46ms to 56ms); low byte first, high byte second;
- Current temperature of the Laser Target Designation module;
- "Information tail" is the checksum, which is the XOR result of bytes 1 to 5.

The relevant definitions of the status word information are shown in Table 5:

Table 5: Definitions of Status Word Information

BIT07	BIT06	BIT05	BIT04	BIT03	BIT02	BIT01	BIT00
0: No laser 1: Laser present	0: Ranging effective 1: Ranging ineffective	Laser marker alternating between 1 / 0	1: Over-temperature alarm 0: Temperature normal		0: None 1: External trigger	00: Standby 01: Ranging 02: Indicating	

Definition of target distance information: The distance value is represented by 2 bytes (16 BIT) as an integer, which can be directly converted to a decimal number.

In standby mode, a self-check status is returned every 10S cycle. In ranging and Target Designator modes, the status is returned based on the laser frequency.

Definition of cumulative laser pulse count: Since a 16-bit binary number represents a range of 0 ~ 65535, and the service life of the laser rangefinder is 1 million times, it is agreed that the laser emission count is a multiple of 20, with a range of 0 ~ 1310700.

Current temperature of the Laser Rangefinder Target Designator module: d7-d0: represented in two's complement, with a range of -128 ~ +127, in units of ℃ (degrees Celsius).

Notes:

- A status feedback frame is automatically returned every 10 seconds, meaning that a status frame is fed back every 10s during power-on, standby, stop ranging, and stop Target Designator states.
- The device automatically stops ranging after 5 minutes of ranging at 1Hz and 1 minute of ranging at 5Hz (both are 300 rangings).
- After changing the encoding settings, the parameters are saved in the flash memory and will not be lost when the power is turned off and back on.

- BIT05 in Table 5 indicates 1/O alternating, which means that the feedback data has been updated.
- Each activation of Target Designator involves a continuous Target Designator cycle, which stops automatically upon completion. Therefore, the encoding only involves the laser pulse interval, and the Target Designator time parameter (1 ~ 60s) is included when initiating Target Designator .

When sending short/long Target Designator commands, the Target Designator cycle is selected from encodings 1 ~ 16, with the Target Designator period set by encodings 9 ~ 16.

6 INSTRUCTIONS FOR USE

1. **Security**

The laser wavelength of the Laser Rangefinder & Target Designator is not within the human-eye-safe band. It can directly cause harm to human eyes and skin. Therefore, it is necessary to avoid the direct incidence of the emitted light beam into human eyes and onto the skin to prevent accidental injuries.

In order to ensure the safety of the test subjects and the testing personnel, the following safety measures have been taken during the design process of the LDR40K1 Small Laser Rangefinder & Target Designator:

a) Conduct safety design and analysis in accordance with MIL-STD-810G "General Requirements for Equipment Safety Work";

b) Use non-flammable materials, and ensure that the mechanical and electrical interface connections are stable and reliable;

c) The components that control the key systems and key functions are designed with error-proofing features;

d) Adopt reasonable design methods to prevent the accumulation of water vapor, which may lead to short circuits;

e) It operates below the safe voltage for the human body.

2 . Installation and Calibration

The mechanical interface of the laser rangefinder and target designator includes screw mounting through holes. Fix the laser rangefinder and target designator on the mounting platform with screws of the specified specification. Then, connect the communication plug to the connector socket of the laser rangefinder and target designator, and correctly connect the power supply according to the interface definition.

3.Suggestions for the Use of the Optical Window

3.1 Material Selection

3.1.1 Optical Window Material

The optical window material selects Chengdu Bright Optical Glass H-K9L. 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.

3.1.2 Processing Requirements

a) The wedge angle tolerance of the optical window should be as small as possible. We recommend that the wedge angle tolerance ≤ 3′ (the tolerance grade ≤ Grade 7);

b) The optical surface of the optical window should be as smooth as possible. We recommend that the arithmetic average deviation of the profile (Ra) is 0.012.

3.2 Usage Suggestions

3.2.1 Suggestions for Optical Window Coating

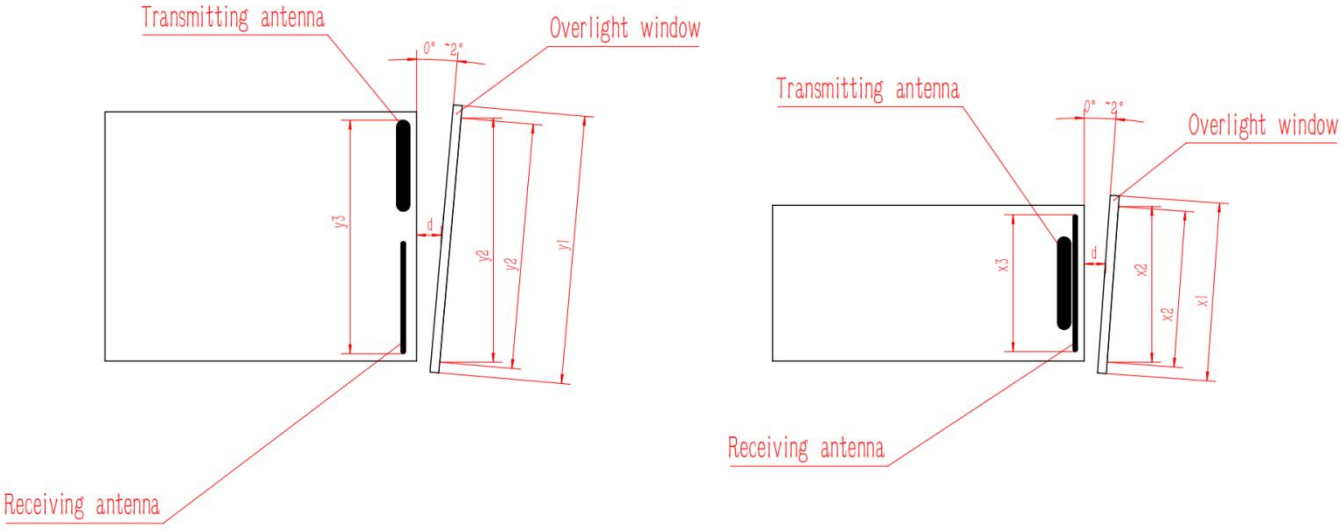
It is recommended to coat the optical window of the 1064nm Laser Rangefinder & Target Designator with an anti-reflection

coating in the range of 1040nm to 1090nm, and the transmittance ≥ 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 to be coated on the outer surface of the optical window. For the remaining indicators, refer to MIL-STD-810G, and the transmittance ≥ 97%. In addition, the damage threshold of the film layer should be ≥ 50MW/cm².

3.2.2 Optical Window Shape and Usage Suggestions

The effective aperture of the optical window varies depending on different products. Its external dimensions should ensure that the difference between the effective aperture of the optical window and the outer diameter of the optical window is ≥ 2 mm, and the difference between the outer diameter of the rangefinder and designator antenna and the projected size of the effective aperture of the optical window is ≥ 1.5 mm. 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 4 mm according to its external dimensions.

Due to the relatively high transmittance of the optical window, it is recommended that the axial deviation between the transmitting optical axis and the normal of the optical window be controlled within the range of 2° to 4°. The schematic diagram of the positions 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 and designator should be as small as possible.



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

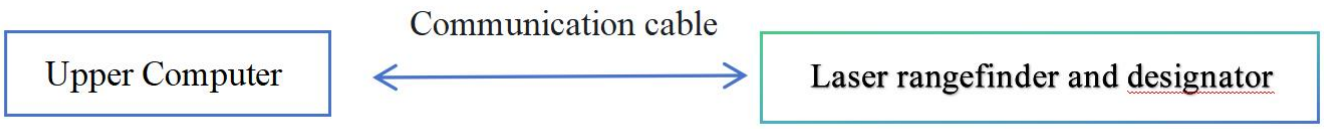
4. .Operation

To enable you to fully understand various functions of this system and correctly master the installation, usage, and maintenance methods, please carefully read the content of this chapter before installing and using this system.

4.1 Power-on Operation

4.1.1 Before Power-on

Before powering on, correctly connect the product and the cross-linked equipment according to the cross-linking diagram shown below.



Cross-linking Diagram of the Product and Equipment

4.1.2 Power-on

Power-on operation: Connect the power supply.

4.2 Power-off Operation

4.2.1 Before Power-off

Before powering off, it should be confirmed that the working process and task of the product are in the finished state, and the program is exited (at least 50 ms after the product returns data).

4.2.2 Power-off

Power-off steps: Disconnect the power supply.

4.3 Usage Operation

To enable you to fully understand various functions of this product and correctly master the installation, usage, and maintenance methods, please carefully read the content of this chapter before installing and using this system.

After the product is powered on, a power-on self-check will be carried out before usage operation. Other detection tasks can be carried out only after the test is passed. The self-check process and method are as follows:

a) Wait for the reply of the self-check instruction;

b) Receive the normal reply of the self-check instruction.

4.3.1 Ranging Mode

Operation steps in the ranging mode:

a) Send the "Single-shot Ranging" command to the laser rangefinder and designator. The laser rangefinder and designator will conduct single-shot ranging and report the ranging status and distance value;

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

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

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

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

f) Send the "20Hz Illumination" command to the laser rangefinder and designator. The laser rangefinder and designator will conduct ranging twenty times per second and report the ranging status and distance value;

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

4.3.2 Self-check Mode

Self-check operation method:

a) Send the "Self-check" command to the laser rangefinder and designator;

b) The laser rangefinder and designator will start the self-check and send back information such as the current ambient temperature and working status.

4.3.3 Low Power Consumption Mode

Operation method in the low power consumption mode:

a) Send the "Enable Low Power Consumption" command to the laser rangefinder and designator;
b) The laser rangefinder and designator will enter the low power consumption operation state and send back the status information;
c) Send the "Disable Low Power Consumption" command to the laser rangefinder and designator;
d) The laser rangefinder and designator will enter the normal standby state and send back the status information.

4.3.4 Illumination Mode

Operation steps in the illumination mode:
a) Send the "Laser Illumination" command to the laser rangefinder and designator. The laser rangefinder and designator will emit laser periodically at a fixed frequency once and report the ranging status and distance value;
b) After one cycle time elapses, the illumination will stop automatically.

5. Inspection and Maintenance

5.1 General Inspection

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

5.1.1 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.

5.1.2 Power-on Inspection

The steps of power-on inspection are as follows:
a) Complete the startup operation according to the steps;
b) Complete the self-check operation as required;
c) After the inspection is completed, complete the shutdown operation according to the steps.

5.2 Regular Maintenance

The laser rangefinder and designator does not require 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:

5.2.1 General Inspection

Conduct a general inspection of the product in the unpowered state. The steps are as follows:
a) All markings 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, mildew, fingerprints, dust particles, etc., and cracks that will interfere with normal observation on the optical glass of the product when viewed visually.

5.2.2 Power-on Inspection

Conduct a comprehensive inspection and maintenance of the laser rangefinder and designator after powering it on. The content includes:
a) Turn on the power of the product in sequence;
b) Complete the startup operation according to the steps;
c) Complete the self-check operation as required;
d) Complete the shutdown operation according to the steps.

6. Analysis of Fault Phenomena and Troubleshooting Methods

The laser rangefinder and designator 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 phenomena and troubleshooting methods are shown in the following table.

Common Fault Phenomena and Troubleshooting Methods

Fault Phenomena	Possible causes	Inspection method	Troubleshooting measures
The product cannot be powered on normally.	Faults in the power supply and connection cables Circuit faults	Check the power supply and connection cables.	Replace the power supply or connection cables. In case of a circuit fault, contact the manufacturer for assistance in resolving it.
Communication commands cannot be sent.	Faults in the connection cables Abnormal power supply Communication failure of the laser rangefinder and designator	Check whether the connection cables are normal. Check whether the power supply is normal.	Replace the connection cables and the power supply. For communication problems, contact the manufacturer for assistance in resolving them.

7. Packaging, Transportation and Storage Requirements

7.1 Packaging

For the product that has been unsealed, when it needs to be restocked, it should be packaged according to the original packaging. When the product needs 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 product.

7.2 Transportation

The repacked product 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 impacts, rough handling, exposure to rain and snow, and other such situations. For the road transportation and railway transportation environments, refer to MIL-STD-810G.

7.3 Storage

The repacked product shall not be stored outdoors in the open air. It should be stored in a warehouse with a temperature range of 0°C to +30°C, a relative humidity not exceeding 70%, free from the erosion of corrosive substances, without strong mechanical vibration and impact, and without a strong magnetic field.

Safety Precautions

For the safe use of this product, please carefully read this instruction manual before operating the product.

a) This laser rangefinder and designator is a precision optical and mechanical product. Operating it in violation of the regulations may lead to dangerous laser injuries. Do not open or adjust any part of the laser rangefinder and designator, and do not attempt to repair or adjust the performance of the laser rangefinder and designator by yourself.

b) Pay attention to electrostatic protection: The electronic components of the laser rangefinder and designator are sensitive to electrostatic discharge. Do not touch any electronic devices without protective measures.

c) Only turn on the power of the laser rangefinder and designator for operation within the specified voltage and power range.

d) It is prohibited to touch the optical lenses with fingers or hard objects (to prevent oil contamination or scratching of the lenses).

e) It is prohibited to measure high-reflectivity targets at an extremely close distance (to prevent damage to the core devices of the detector).

f) It is prohibited to store the laser rangefinder and designator under non-specified conditions (such as a highly polluted environment, beyond the storage temperature range, etc.).

g) It is prohibited for the laser rangefinder and designator to be subjected to strong mechanical impacts (vibration, shock,

dropping, etc.).