

LDR20K1 Laser Rangefinder & Target Designator

Model:LDR20K1

1

PRODUCT DESCRIPTION



LDR20K1 1064nm Laser Rangefinder & Target Designator. The ranging capability for NATO targets is ≥ 3 km. The ranging frequency is 1~20 Hz. The laser illumination distance is ≥ 2 km. The pulse width is ≥ 15 ns ± 5 ns. The beam divergence angle is ≤ 0.6 mrad. The weight is ≤ 290 g.

2

TECHNICAL SPECIFICATIONS

CONTROL FUNCTION

The laser target indicator can achieve the following control functions through the serial interface.

- Respond to the laser ranging command and be able to stop the ranging operation at any time according to the stop command.
- Output distance data and status information once for each pulse during the ranging process.
- The ranging function has a range gating feature
- After starting continuous ranging, if no stop command is received, the ranging will automatically stop after 5 minutes (at a frequency of 1Hz) / 1 minute (at a frequency of 5Hz).
- It is possible to set the illumination mode and encoding
- Respond to the laser target indication command, perform target indication according to the set mode, encoding, and target, and be able to stop the target indication at any time according to the stop command.
- After starting the target indication, if no stop command is received, the target indication will automatically stop after one cycle.
- Output the distance value and status information once for each pulse

	during the laser target indication.
	Conduct power-on self-check and periodic self-check and output status information.
	Respond to the self-check activation command and output status information.
	Be able to report the cumulative number of laser pulses.

PARAMETER INDICATORS

Pump Source	Laser LD (Laser Diode) Pumping
Cooling Method	Passive cooling, no temperature control
Working Mode	Ranging, target indication
Operating Wavelength	1.064μm
Pulse Energy	≥20 mJ
Laser Energy Stability	Within one target indication cycle, the fluctuation of the single-pulse energy does not exceed 10% of the average energy (statistical data is collected 2 seconds after the light is emitted).
Pulse Width	≥15 ns±5ns
Beam Divergence Angle	≤0.6mrad
Stability of The Laser Optical Axis	≤0.05mrad

RANGING PERFORMANCE

Ranging frequency	1~20Hz
Continuous Laser Ranging Time	5min(1Hz)/1min (5Hz)/20S (20hz)
Minimum measuring distance	≤ 300m.
Maximum measuring distance	≥ 5000m(Visibility: 13.5 km, target reflectivity: 0.2, target size: 2.3 m × 4.6 m)
Ranging accuracy	±1m.
Rate of successful measurement	98%.
Ranging logic	first and last target.

IRRADIATION PERFORMANCE

Precision of laser coding	≤1μs
Laser Irradiation Frequency	1~20Hz
Laser Irradiation Distance	≥ 2 km

Laser Target Designation Cycle	Short-cycle Target Designation: The duration of a single target designation shall not be less than 20 seconds, and the interval shall not be more than 30 seconds. Conduct continuous target designations for 8 cycles.
	Long-period Target Indication: The duration of a single target indication is not less than 47 seconds. When starting the target indication again, the interval shall not be greater than 30 seconds, and it is capable of continuous target indication for 2 cycles.
	After the end of one target indication cycle, the time interval for starting the continuous target indication again shall not be 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	≤92mm×67mm×53mm
Weight	≤290g

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.

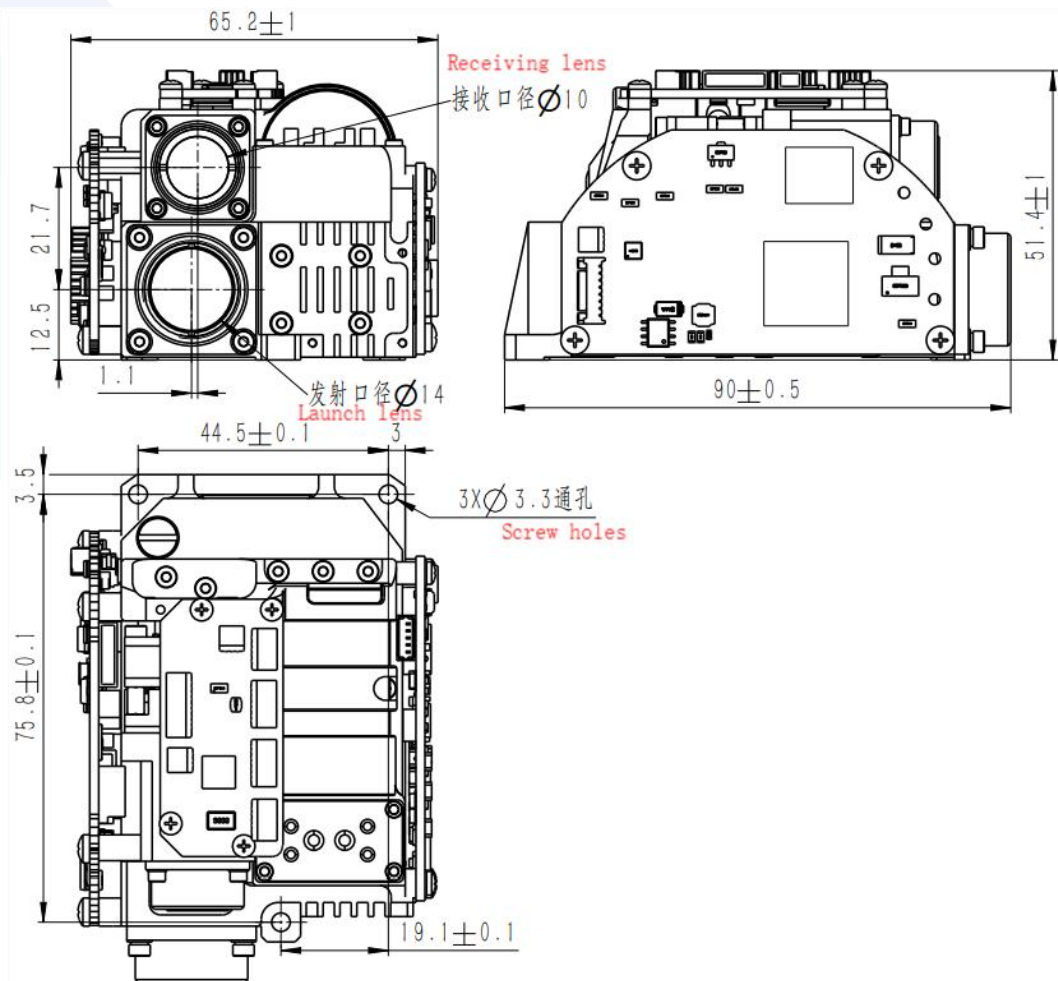
ENVIRONMENTAL ADAPTABILITY REQUIREMENTS

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
<p>When Laser target designation is active: Laser codes range from 1 ~ 16.</p> <p>When laser ranging is active: 1 - First target, 2 - Last target.</p> <p>When setting the gating value: Low byte of distance gating value.</p> <p>When modifying parameters for laser codes 9 to 16: Low byte of laser code, period \times 100 (5000 represents 50ms, range of 46ms ~ 56ms).</p>							

The relevant definitions of command word 3 are as follows:

Table 4 Command word 3 definition

BIT07	BIT06	BIT05	BIT04	BIT03	BIT02	BIT01	BIT00
<p>When setting Laser Target Designation: Set Laser Target Designation time (1 ~ 25).</p> <p>When setting the gating value: High byte of distance gating value.</p> <p>When modifying parameters for laser codes 9 ~ 16: High byte of laser code, period \times 100 (5000 represents 50ms, range of 46ms ~ 56ms).</p>							

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 \times 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 $-128 \sim +127$, in units of °C (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 I/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

- The wedge angle tolerance of the optical window should be as small as possible. We recommend that the wedge angle tolerance $\leq 3'$ (the tolerance grade \leq Grade 7);
- 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

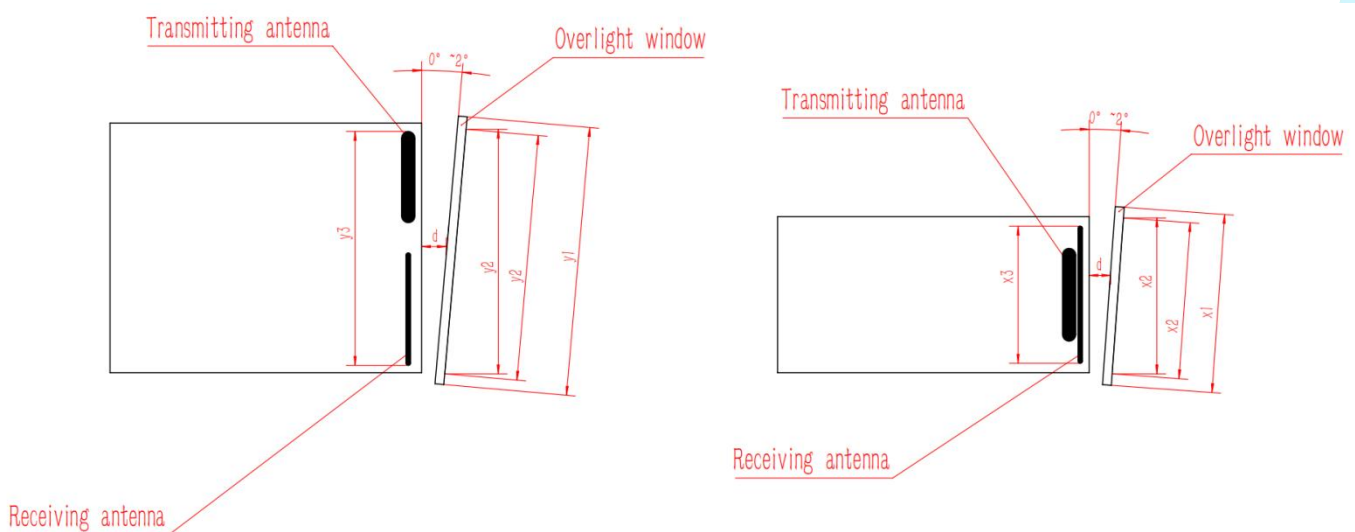
3.2.1 Suggestions for Optical Window Coating

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 $\geq 99\%$. 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 $\geq 97\%$. In addition, the damage threshold of the film layer should be $\geq 50\text{MW}/\text{cm}^2$.

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

The effective aperture of the optical window x_2 - the outer

diameter of the optical window $y_1 > 2\text{mm}$

The outer diameter of the rangefinder antenna y_3 -the projection size of the effective aperture of the optical window y_2 , $> 1.5\text{mm}$

The air gap d between the optical window and the rangefinder should be as small as possible

diameter of the optical window $x_1 > 2\text{mm}$

The outer diameter of the rangefinder antenna x_3 -the projection size of the effective aperture of the optical window x_2 , $> 1.5\text{mm}$

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

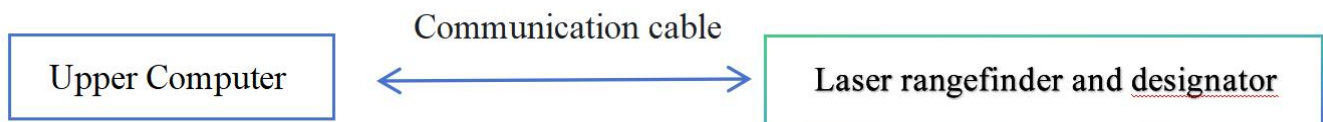
4. .Operation

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:

- Wait for the reply of the self-check instruction;
- Receive the normal reply of the self-check instruction.

4.3.1 Ranging Mode

Operation steps in the ranging mode:

- 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;
- 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;
- Send the "Stop Ranging" command to stop ranging;
- 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:

- Turn on the power of the product in sequence;
- Complete the startup operation according to the steps;
- Complete the self-check operation as required;
- 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.

- 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.).

