40mJ Laser Target Designator Module

Model: LDR40K3

1. PRODUCT DESCRIPTION

The LDR40K3 laser rangefinder/designator measures the distance to a target and provides laser target designation for laser-guided projectiles. It is intended for airborne applications with high reliability requirements. The unit has a compact form factor, low mass, long ranging and designation distance, high accuracy, and strong environmental adaptability.

2. FUNCTIONS AND TECHNICAL SPECIFICATIONS

2.1 Product Application

The laser rangefinder/designator is used to measure the distance to a target and to provide laser-coded illumination for guiding laser-guided weapons.

2.2 Product Control Functions

- Supports laser ranging with real-time reporting of measured distance values.
- Equipped with reverse polarity protection and over-voltage protection circuits.
- Performs laser designation at a built-in frequency of 20 Hz.
- Supports externally synchronized laser firing (external sync mode) via an external trigger signal, allowing precise encoding *(specific characteristics TBD)*.
- Capable of reporting real-time operating temperature to the host system for monitoring and analysis *(reserved function; communication protocol TBD)*.
- Power-on and startup self-test functionality.
- **Overtemperature warning function:** When the internal temperature exceeds safe operating limits and laser emission must be stopped, the device sends an overtemperature warning to the host system and automatically enters a protection mode to ensure laser safety *(reserved function; protocol TBD; temperature read from pump module)*.
- Laser emission pulse count reporting.
- **Energy adjustment interface (reserved):** A software interface is reserved to allow fine-tuning of laser energy (standalone capability). When energy output decreases, it can be recalibrated via software to maintain ≥ 45 mJ.
- During ranging and laser designation operations, feedback data include pulse count identifiers.
- **Self-test and fault code output:**
  a) **Power-on self-test** includes:
  RS-422 serial communication status;
  High-temperature warning;
  b) **Startup and periodic self-test** include:
  RS-422 serial communication status;

High-temperature warning;
Laser emission/no-emission status.

Note: Because the rangefinder/designator can only detect charging/discharging and laser emission faults during laser firing, the power-on self-test does not require these checks. Startup and periodic self-tests will report results from the last emission or ranging operation.

- **Temperature alarm and performance prediction:**

Provides temperature alarm output and estimated operational capability across temperature ranges:

Standby mode: –40 °C to +60 °C

Active (operating) mode: –40 °C to +80 °C

2.3 Principal Performance Technical Specifications

- **Operating modes:** ranging, designation.
- **Pump source:** diode array.
- **Operating wavelength:** 1.064 µm.
- **Pulse energy:** ≥ 40 mJ.
- **Pulse energy stability:** Within a single designation cycle, single-pulse energy deviation shall not exceed ±10% of the mean pulse energy (statistics taken after 2 s of emission).
- **Beam divergence:** ≤ 0.5 mrad.
- **Pulse width:** 6 ns – 15 ns.
- **Laser optical-axis stability:** ≤ 0.05 mrad.
- **Optical-axis parallelism error relative to mounting datum:** azimuth ≤ 0.5 mrad; elevation ≤ 0.25 mrad.
- **Ranging performance:**

➢ **Ranging frequency:** 1 Hz / 5 Hz / single-shot.
➢ **Continuous ranging (1 Hz):** ≥ 5 minutes, then 1 minute rest.
➢ **Continuous ranging (5 Hz):** ≥ 1 minute, then 1 minute rest.
➢ **Minimum measurement range:** ≤ 300 m.
➢ **Maximum measurement range:** ≥ 5,000 m.
➢ **Ranging accuracy:** ±2 m.
➢ **Acquisition rate:** ≥ 98%.

- **Designation performance:**

➢ **Laser code accuracy:** ≤ ±2.5 µs.
➢ **Base designation frequency:** conforms to weapon system requirements (baseline 20 Hz).

- **Coding method:** precise frequency coding; supports user-defined precise frequencies.

- **Designation range:** ≥ 3.5 km.
  Designation condition: visibility ≥ 15 km; target: medium tank side, 2.3 m × 4.6 m.

- **Continuous designation durations:**

- ✓ **Short-cycle designation:** single active period ≥ 20 s, interval ≤ 30 s, continuous for 10 cycles.
- ✓ **Long-cycle designation:** single active period ≥ 47 s, repeat start with interval ≤ 30 s, continuous for 2 cycles.
- ✓ After completing one long and one short designation sequence, the interval before reactivation shall be ≤ 30 minutes.

- **Service life:** ≥ 1,000,000 pulses.
- **Power consumption:**

- **Standby power:** ≤ 10 W, fluctuation ≤ 2.5 W (after system stabilizes).
- **Designation (active) power:** ≤ 140 W (during designation).

3. ENVIRONMENTAL ADAPTABILITY

3.1 Operating Temperature

Operating temperature range: **–40°C to +60°C**.
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At +50°C, after maintaining constant temperature for **2 hours**, the equipment shall power on (without laser emission) and operate normally for **2 hours**.

3.2 Storage Temperature

Storage temperature range: **–40°C to +70°C**.
At –40°C, the equipment shall withstand **24 hours** of constant temperature storage.
At +70°C, the equipment shall withstand **48 hours** of constant temperature storage.

3.3 Vibration

Vibration performance requirements:
The vibration levels are shown in **Table 1**, and the corresponding vibration profile is illustrated in **Figure 1**.

Table 1 Vibration Levels

Broadband Random Vibration: 15–500 Hz	T1=0.001g²/Hz	T2=0.01g²/Hz	T3=0.05g²/Hz	
Narrowband Random Vibration	28Hz		84Hz	
	±5%		±5%	

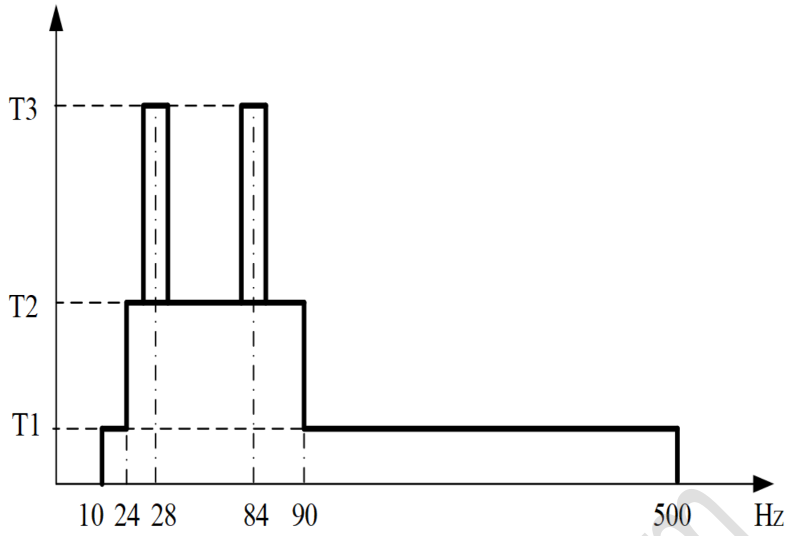


Figure 1 Vibration Spectrum Diagram

Duration: 60 minutes per axis.
The prototype shall remain powered on and operational during the vibration test.

3.4 Shock

The test shall be conducted in accordance with the parameters and tolerances of the post-peak sawtooth waveform shown in Figure 2 of *MIL-STD-810G*.
Shock intensity: **20 g**, duration: **11 ms**.
Each axis shall be subjected to shocks in both directions, **three times per direction**, for a total of **18 shocks**.
The prototype shall remain powered on and operational during the shock test.

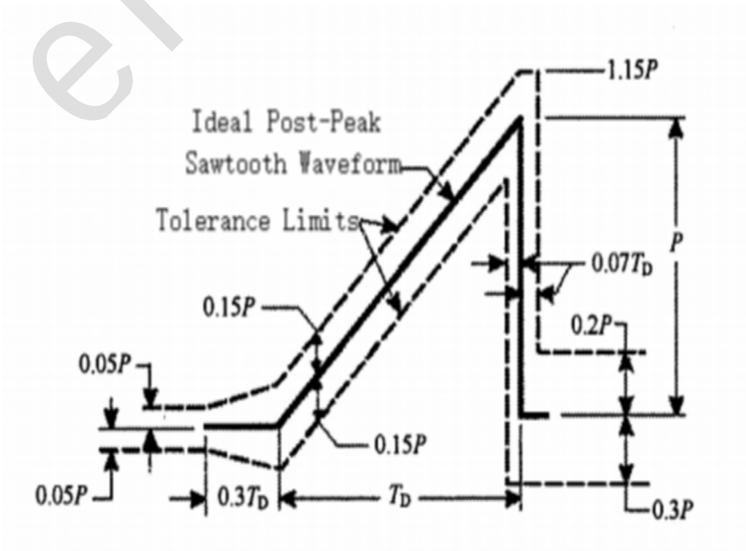


Figure 2 Post-Peak Sawtooth Shock Waveform Diagram

4. ELECTRICAL INTERFACE REQUIREMENTS

The device is equipped with **one RS422 communication interface**.

The connector model on the **laser rangefinder/designator** is **J30JZLN15ZKWA000**, and the corresponding **plug** is **J303JZ/XN15TJCAL01**.
The matching plug will be supplied with the product upon delivery.
The electrical interface definitions are shown in **Table 1** below.

Table 1: Electrical Interface Definition

Pin No.	Label	Description / Remarks
P-1	VIN+	26 V ± 4 V power input
P-2	VIN+	26 V ± 4 V power input
P-3	T+	External sync signal (positive)
P-4	VDD	For programming use
P-5	GND	For programming use (ground)
P-6	ARM_SWCLK	Programming clock (SWD interface)
P-7	ARM_SWDAT	Programming data (SWD interface)
P-8	T–	External sync signal (negative)
P-9	GND	Power ground (26 V return)
P-10	GND	Power ground (26 V return)
P-11	RS422_TX+	Laser Rangefinder/Designator Transmit (+)
P-12	RS422_TX–	Laser Rangefinder/Designator Transmit (–)
P-13	RS422_RX–	Laser Rangefinder/Designator Receive (–)
P-14	RS422_RX+	Laser Rangefinder/Designator Receive (+)
P-15	GND	Signal ground

Notes:

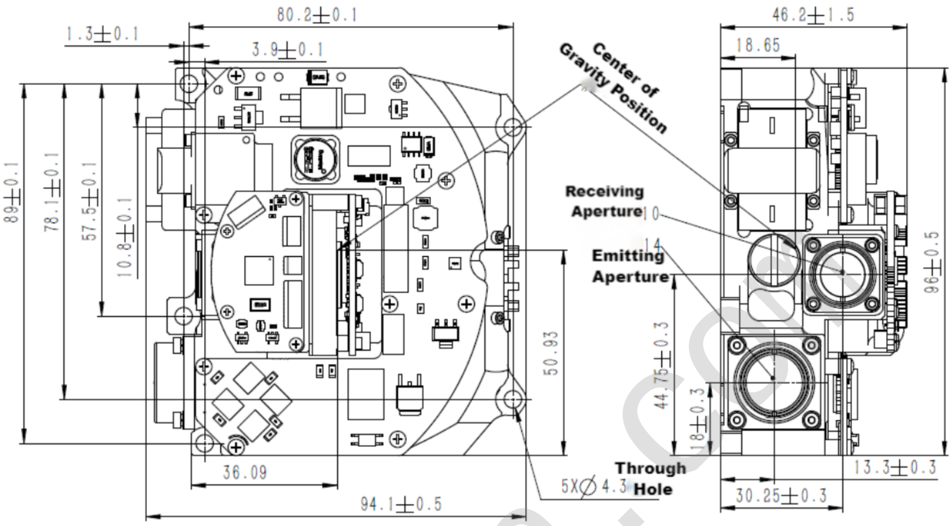
- The laser rangefinder/designator is equipped with reverse polarity protection for the power supply.
- The contractor (manufacturer) shall provide the corresponding plug.

5. WEIGHT REQUIREMENT

The total weight of the laser rangefinder/designator unit shall be ≤ **420 g**.

6. MECHANICAL INTERFACE AND OVERALL DIMENSIONS

Overall dimensions: **95 mm × 97 mm × 48 mm**



7. RELIABILITY REQUIREMENTS

The Mean Time Between Failures (MTBF) shall be **≥360 hours (minimum acceptable value)** and **≥380 hours (specified value)**.

8. MAINTAINABILITY REQUIREMENTS

The Mean Time To Repair (MTTR) at the basic maintenance level (field/unit level) shall be **≤30 minutes**.

9. COMMUNICATION PROTOCOL

9.1 Serial Port Parameters

Asynchronous Serial Communication Standard: RS-422

Baud Rate: 115200 bps

Transmission Format:

- 8 data bits
- 1 start bit
- 1 stop bit
- No parity bit

For each byte, the **least significant bit (LSB)** is transmitted first.
For multi-byte data, the **low byte** is transmitted before the high byte.

9.2 Message Format

The structure of communication messages is shown in

Table 2: Message Format.

Message Header (1 byte)
Subsystem ID Number
Message Body
Message Tail (1 byte, i.e., checksum)

In the table above, the message body is described in detail in Section 2, "Data Protocol."
The message header, subsystem ID number, and message tail are defined in Tables 3, 4, and 5 respectively.

Table 3: Message Header Description

Byte Name	Data Type	Byte Length	Value / Range	Remarks
Start Code	Unsigned Byte	1	0xCC	Constant

Table 4: Subsystem ID Description

Byte Name	Data Type	Byte Length	Value / Range	Remarks
Subsystem ID	Unsigned Byte	1	0x08	Constant

Table 5: Message Tail (Checksum) Description

Byte Name	Data Type	Byte Length	Value / Range	Remarks
Checksum	Unsigned Byte	1	0-255	The sum of all bytes in the message body modulo 256.

The first byte of the **message header** is **0xCC**, which serves as the synchronization code indicating the start of a data frame.
The **Subsystem ID** is the identifier assigned by the system to the laser rangefinder/designator for unit recognition; the Subsystem ID for the laser rangefinder/designator is **0x08**.
The **message trailer** is a **checksum**, calculated as the sum of all bytes in the message body modulo 256.

9.3 Data Protocol

9.3.1 Output Information

Output information refers to commands sent from the **servo control software** to the **laser rangefinder/designator**.
Each command message is a **fixed-length 6-byte packet**, with a **3-byte message body**, as defined in **Table 6** below:

Table 6: Output Command Message Body Data Format

Command Content	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6
Start Self-Test	0x01	N/A	N/A	N/A	N/A	N/A
Continuous Ranging at 5 Hz (1 min)	0x02	N/A	N/A	N/A	N/A	N/A
Laser Illumination	0x03	Irradiation Time (27s–60s)	Code 1–8	N/A	N/A	N/A
Stop Laser	0x05	N/A	N/A	N/A	N/A	N/A
Pulse Count Report	0x0A	N/A	N/A	N/A	N/A	N/A
Product Identification Report	0x10	N/A	N/A	N/A	N/A	N/A
Laser Code Parameter Storage	0x13	Code 1–8	Encoding parameters, type UINT32, with the low byte transmitted first. Value range: 40–53 ms, with a resolution of 0.01 ms.			
Laser Code Storage Parameter Confirmation	0x14	N/A	N/A	N/A	N/A	N/A
Laser Code Parameter Query	0x15	Code 1–8	N/A	N/A	N/A	N/A
Single Ranging	0x0B	N/A	N/A	N/A	N/A	N/A
Continuous Ranging at 1 Hz (5 min)	0x0C	N/A	N/A	N/A	N/A	N/A
Temperature Reading	0x06	N/A	N/A	N/A	N/A	N/A
Long Illumination	0x07	N/A	Code 1–8	N/A	N/A	N/A
Short Illumination	0x08	N/A	Code 1–8	N/A	N/A	N/A

Notes:

When the laser rangefinder/designator is in **ranging mode**, it **can respond to irradiation commands**.

When the laser rangefinder/designator is in **irradiation mode**, it **only responds to the laser stop command**.

N/A fields default to **0x00**.

9.3.2 Input Information

The input information refers to the **status data** transmitted from the **laser rangefinder/designator** to the **servo control software**.
The **status message packet** has a **fixed length of 9 bytes**, with a **6-byte information body**.
The detailed definition is shown in **Table 7: Status Message Body**.

Table 7: Status Message Body

Status Content	Byte 1	Byte 2	Byte 3	Byte 4～5	Pulse Count Index
Power-on Self-Test Response	0x00	Power-On Self-Test Result: 0x00: Normal 0x01: Fault	When "Power-On Self-Test Completed": Fault Code (Note 1)	N/A	N/A
Start Self-Test Response	0x01	Startup Self-Test Result: 0x00:Normal 0x01: Fault	When "Startup Self-Test Completed": Fault Code (Note 1)	N/A	N/A
Continuous Ranging 5 Hz (1 min)	0x02	Fault Status: 0x00:Normal 0x01: Fault	Laser Emission Status: d Fault Code (Note 1)	Laser Range Value (Note 2)	0~255
Laser Emitting	0x03	Fault Status: 0x00:Normal 0x01:Fault	Laser Emission Status: Fault Code (Note 1)	Laser Range Value (Note 2)	0~255
Laser Stop	0x05	N/A	N/A	N/A	N/A
Pulse Count Report Response	0x0A	N/A	N/A	Laser Pulse Count (Note 3)	N/A
Product Identification Report	0x10	Identifier 1 (Note 4)	Identification Code 2 (Note 4)	N/A	N/A
Laser Code Parameter Storage	0x13	Code 1–8	Encoding Parameters, UINT32 type, low byte first, range 40–65 ms, with a resolution of 0.01 ms, transmitted simultaneously.		
Laser Code Storage Confirmation	0x14	N/A	N/A	N/A	N/A
Laser Code Parameter Query	0x15	Code 1–8	Encoding Parameters, UINT32 type, low byte first, range 40–65 ms, resolution 0.01 ms.		
Single Ranging	0x0B	Fault Status: 0x00:Normal	Laser Presence: Error Code (Note 1)	Laser Distance Value	N/A

		0x01: Fault		(Note 2)	
Continuous Ranging 1 Hz (5 min)	0x0C	Fault Status: 0x00:Normal 0x01: Fault	Laser Presence: Error Code (Note 1)	Laser Distance Value (Note 2)	0~255
Temperature Report	0x06	N/A	Temperature Value (Note 5)	N/A	N/A
Long-Duration Emission	0x07	Fault Status: 0x00:Normal 0x01: Fault	Laser Presence: Error Code (Note 1)	Laser Distance Value (Note 2)	0~255
Short-Duration Emission	0x08	Fault Status: 0x00:Normal 0x01: Fault	Laser Presence: Error Code (Note 1)	Laser Distance Value (Note 2)	0~255

Note 1: Fault codes are determined by bit position, where 0 = Pass and 1 = Fail. Bits **Bit0–Bit7** correspond to each SRU. Detailed definitions are provided in **Table 8**.
Note 2: Bits **Bit4** and **Bit5** represent the **low byte** and **high byte** of the distance value, respectively (distance range: 0–65535; when ranging is invalid, the value is set to 0).
Note 3: The **actual laser pulse count** = *Pulse Count* × *100* (Scale = 100).
(Example: 65535 × 100 = 6,553,500 pulses)
Note 4: The **product identification code** consists of **2 bytes**. Byte 2 represents the laser rangefinder/designator **Product ID** (fixed value 0x05), and Byte 3 represents the **software version number**, where the **high nibble** indicates the integer part and the **low nibble** indicates one decimal place.
Note 5: Byte 3 represents the **temperature value**, corresponding to the ambient temperature (range: −55°C to +125°C).
Note 6: N/A fields default to 0x00.

Table 8: SRU Fault Code Table

Fault Bit (bit)	SRU Name
0	Reserved
1	Reserved
2	Reserved
3	Reserved
4	Laser Not Emitted
5	Temperature Sensor Overheat
6	Reserved
7	Reserved

9.4 Control Process

9.4.1 Information Response

After power-on, the laser rangefinder/illuminator performs a power-on self-test (POST). Upon completion, it reports the self-test results and enters standby mode.

- During normal operation, the system sends control commands to the laser rangefinder/illuminator. Upon receiving a command, the laser rangefinder/illuminator executes it and reports its status information back to the system. The main control process is as follows:
- When the system sends a **"Start Self-Test"** command, the laser rangefinder/illuminator performs the self-test and actively reports the detailed self-test result upon completion.
- When the system sends a **"Range Measurement"** command, the laser rangefinder/illuminator starts measuring distance and reports its ranging status and distance value.
- When the system sends a **"Laser Illumination"** command, the laser rangefinder/illuminator starts illumination and reports the illumination status and distance value.
- When the system sends a **"Laser Stop"** command, the laser rangefinder/illuminator stops the ongoing laser emission.
- When the system sends a **"Read Product Identification"** command, the laser rangefinder/illuminator replies with the product identification code within the response timeout period.

Response timeout settings:

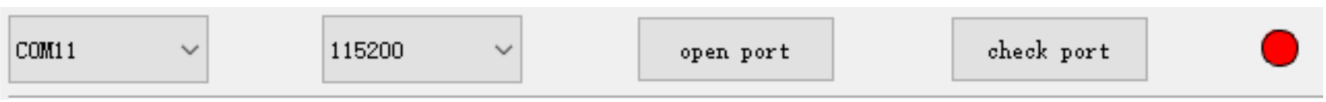
- **Passive response timeout:** 600 ms
- **Active response timeout** (only applicable to "Start Self-Test Completed"): 1000 ms

The **laser illumination command has the highest priority**.
During ranging, the laser rangefinder/illuminator must be able to respond to an illumination command.
During illumination, the laser rangefinder/illuminator only responds to a **"Stop"** command or stops automatically after the illumination duration expires.

10. DEVICE OPERATION INSTRUCTIONS

10.1 Communication Connection

- **Asynchronous Serial Communication Standard:** RS-422
- **Baud Rate:** 115200 bps

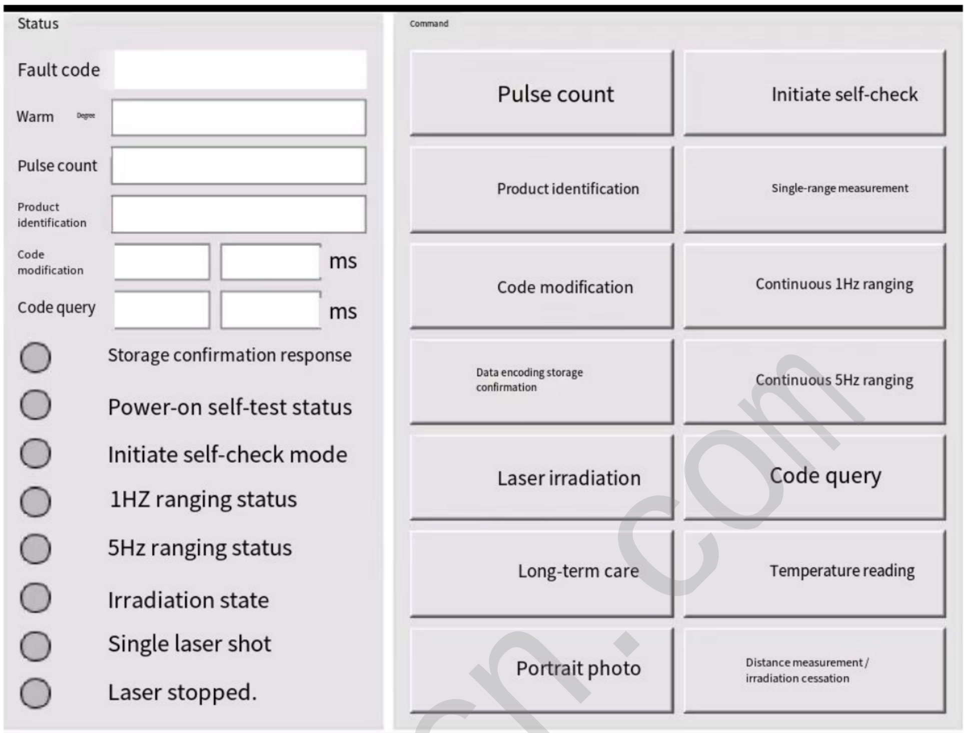


Check the communication cable and click **"Detect"** until an available serial port is found.
Select **115200 baud rate** to connect to the serial port.

10.2 Receiving Information

The output information appears in the **data reception window** of the software.
Click **“Clear”** to erase historical data and start receiving new data.
After each command is executed, corresponding **feedback data** will be received.

10.3 Command Transmission and Status Indication



10.3.1 Status Bar — Operation and Fault Indication

The status bar icons indicate the current operation and fault status.

Gray icons initial or idle state (not running).

Active icons indicate normal operation.

Red icons indicate a fault condition.

10.3.1.1 When the software opens the serial port but does not receive a heartbeat packet or a response to any command, the system remains in the initialization state, and all icons are displayed in gray.

10.3.1.2 Each time data is received from the lower computer (including heartbeat packets), it contains fault code information, which is displayed in the status indicator “Fault code ”.

- When the system is operating normally, **no fault code** is shown.
- When a **red fault indicator** appears, it means a fault has occurred. The user should **immediately stop the current operation**, **check for faults**, and **avoid possible equipment damage**.

10.3.1.3 Operation Indicator

Displays the **current command** being executed.

10.3.1.4 Query Information Display

When a **query command** is executed, the corresponding **query results** are displayed in the appropriate fields within the status bar.

10.3.2 Command Bar — Sending Commands

Overview:
The command bar includes buttons for:

- **Laser Pulse Count Query**
- **Product Identification**
- **Code Parameter Query**
- **Temperature Reading Query**

The **query results** are displayed in the corresponding areas of the **status bar**.
Buttons for **laser ranging** and **illumination commands** (and the **Stop** button for terminating these operations midway) are also included.
All **command responses** are displayed in the **data reception window**.

10.3.2.1 Pulse Count Query

During operation, the device records the number of laser pulses emitted by the laser rangefinder/illuminator in both ranging and illumination modes. By sending a **Pulse Count Query** command, the device will return information containing the number of laser pulses, which will be displayed in the **status bar**.

10.3.2.2 Start Self-Test

Click **Start Self-Test** to send the self-test command. After receiving it, the device enters the self-test state and simulates working conditions to check the internal operating status. The device then returns its status information, and if any fault occurs, it will be shown in the **status bar**.

10.3.2.3 Single Measurement

The **Single Measurement** command instructs the device to emit one laser pulse and return the laser ranging result, including **main/secondary echo information** (see Section 7.5 for details on echo explanation) and the calculated distance for this measurement.

10.3.2.4 Continuous 1 Hz Measurement

When the device receives this command, it continuously emits laser pulses at a frequency of **1 Hz** and returns laser ranging results. The returned information format is the same as for the single measurement.

10.3.2.5 Continuous 5 Hz Measurement

When the device receives this command, it continuously emits laser pulses at a frequency of **5 Hz** and returns laser ranging results. The returned information format is the same as for the single measurement.

10.3.2.6 Short Illumination

This command sets the device to **illumination mode**. The illumination cycle duration is **20 s**, followed by a **30 s interval**, with continuous encoded laser pulse output for **10 consecutive cycles**. Each illumination cycle returns the **main/secondary echo information** and the corresponding **illumination distance**.

10.3.2.7 Long Illumination

This command sets the device to **illumination mode** with an illumination cycle duration of **47 s** and a **30 s interval**, continuously outputting encoded laser pulses for **2 consecutive cycles**. Each illumination cycle returns the **main/secondary echo information** and the corresponding **illumination distance**.

10.3.2.8 Laser Illumination

This command sets the device to **illumination mode** for a single illumination cycle of less than **60 s**, after which it automatically stops. Each illumination cycle returns the **main/secondary echo information** and the corresponding **illumination distance**.

10.3.2.9 Stop Ranging/Illumination

After receiving the **Stop** command, the device terminates the current operation. Each operation must be ended with a stop command.

10.3.2.10 Code Modification

The **Code Modification** function allows users to adjust the parameters of the selected code number in the code settings panel. After modification, the selected code will operate using the new encoding parameter (e.g., 50 ms) during illumination.

10.3.2.11 Code Storage Confirmation

After selecting a code number, this function stores the modified encoding parameter (e.g., 50 ms) into the internal **FLASH** and **EEPROM** memory. The parameter will be automatically loaded the next time the device is powered on.

10.3.2.12 Code Query

After selecting a code number, click **Code Query** to retrieve the encoding information configured by the user. The result will be displayed in the **status bar** under the code query section.

10.3.2.13 Temperature Reading

Reads the device's temperature and displays the temperature value in the **status bar**.

10.3.2.14 Product Identification

Each device has a **unique internal product ID**, which identifies the product number of the current laser rangefinder/illuminator.

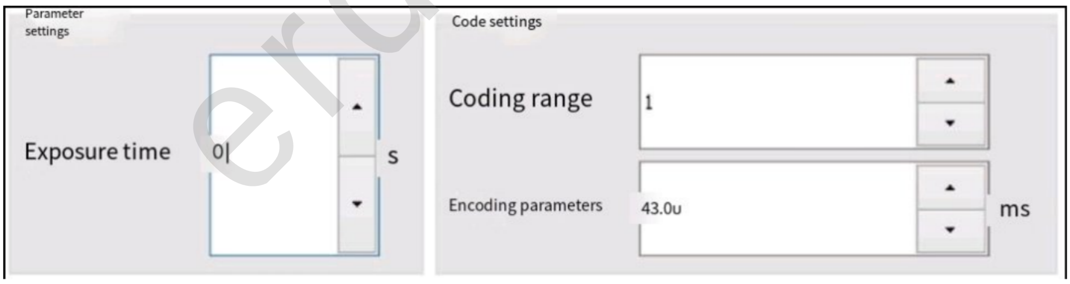
Notes:

The **Code Settings Panel** allows users to select the current code number. After modifying the related parameters, the updated data will be displayed in the **status bar** under **Code Modification**.

Code Modification only changes the current code's working parameters temporarily; these parameters are **not saved after power-off**. To permanently store parameters, use the **Code Storage Confirmation** function.

You can use **Code Query** to check the current encoding parameters and compare them with the parameters in the **Code Modification** panel to verify whether the changes were successful.

10.4 Parameter Settings and Code Configuration



10.4.1 Code Number Modification

Modify the **code number** and set a **reasonable cycle time range**. Click **Set** to apply the encoding parameter (i.e., cycle time) for the selected code number. This parameter is essential for encoded laser illumination operation.

10.4.2 Illumination Time Setting

The **illumination time** defines the operating duration for the selected code. When the **Laser Illumination** command is executed, the device will operate according to the current code number's encoding parameter (e.g., 50 ms) and the specified illumination time (e.g., 30 s).

10.5 Distance Display

10.5.1 Distance 1 Display

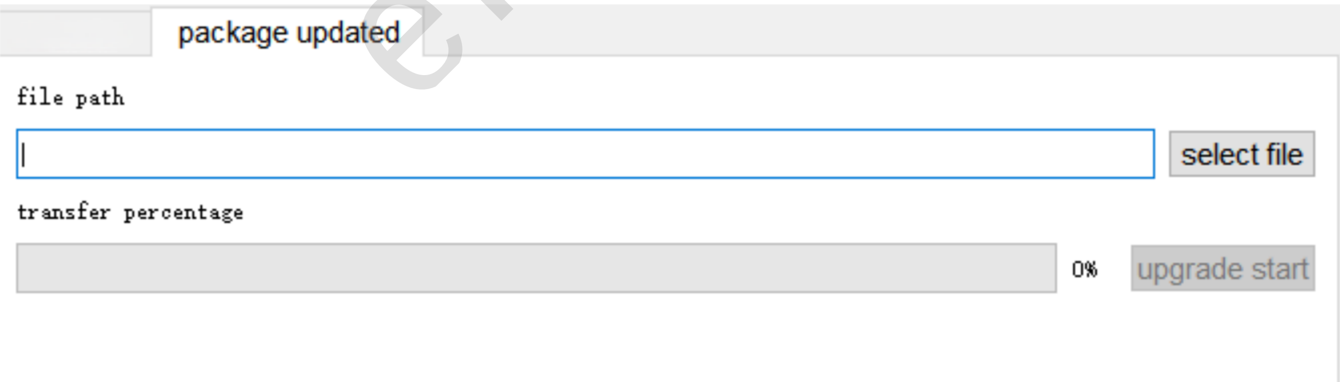
Distance 1 indicates the calculated target distance during ranging or illumination operation. When the device has not yet performed ranging/illumination, or after clicking the **Clear** button, the display will remain as shown above. During normal ranging or illumination, **Distance 1** shows the measured distance. If the distance exceeds the valid range or is invalid, **Distance 1** will display **0xFFFF**.

10.5.2 Main Pulse

The **main pulse** refers to the laser pulse signal transmitted by the device, while the **echo pulse** represents the received laser pulse signal.
If a main pulse is detected, it indicates that the device is transmitting laser pulses normally. The main pulse feedback will display "1." If no main pulse is detected, it means that the transmission was incomplete and the device status should be checked.

10.6 Program Upgrade

When a program upgrade is required, switch the software to the following **Upgrade Page**.



At this stage, the **Upgrade Program** button is grayed out and cannot be operated. You must first click **Select Firmware File** (typically a .bin file). When the receiving interface displays the symbol **"C"**, it indicates that the system is in **firmware upgrade waiting mode**.

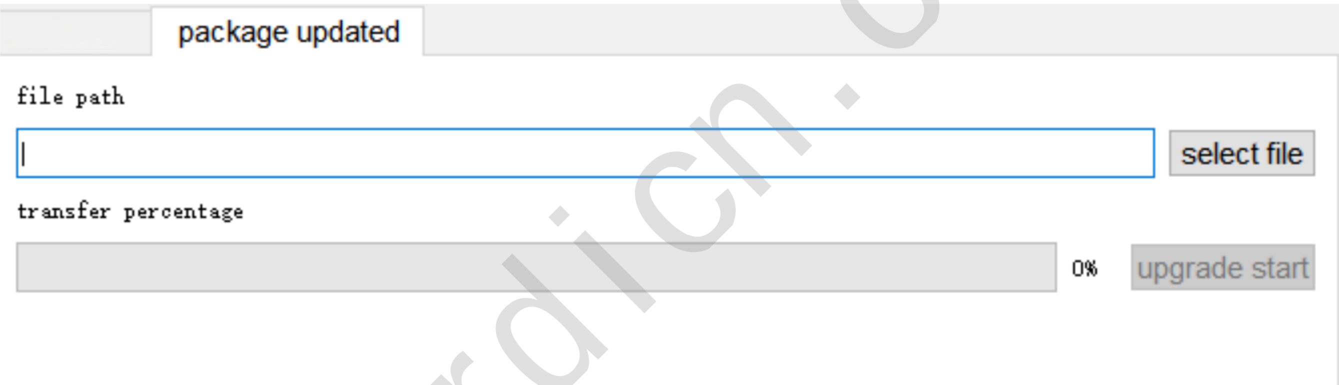
At this point, the **Upgrade Program** button becomes active and can be clicked to begin the update process. Wait until the progress bar reaches **100%**, indicating that the program update is complete. The system will **automatically restart** after the update is finished.

5.7 Distance Display

Displays the measured or calculated target distance during ranging or illumination operations.

When no ranging or illumination is being performed, the distance display appears as shown above. During normal ranging or illumination operation, **"Distance 1"** displays the current measured distance.

5.8 File Update



When a program update is required, click the **"Select File"** button to choose the update file. After selecting the file, click **"Update Start"** and wait for the progress bar to complete. When the "Update Successful" popup appears, the program update has been completed successfully.

11. PROTOTYPE DELIVERY

- **LDR40K3 Laser Rangefinder/Designator**
- **Mating connectors and debugging cables**
- **Certificate of Conformity**
- **Factory Inspection Report**

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12. TRANSPORTATION AND STORAGE

During transportation or storage, the device must be protected from **dust, humidity, acidic or alkaline vapors, and other corrosive chemicals**.

13. PRECAUTIONS FOR USE

- **This product emits Class IIIB laser radiation. Do not aim the laser directly or through optical instruments at human eyes or skin.**
- The **laser housing** is hermetically sealed and dustproof. **Do not attempt to open the enclosure**, as breaking the seal may cause damage to the core laser components.
- **High voltage is present inside the device.** Only qualified personnel are permitted to disassemble or service the product.
- To avoid damage to the **laser detector**, **do not measure distances to targets within 50 meters**, and **do not block the optical window** with hands or any objects.
- During **optical axis alignment** or **indoor laser emission testing**, ensure the **receiving window is fully covered** to prevent damage to the photodetector.
- Always **power off the device before connecting or disconnecting cables.**
- Ensure the **power supply parameters** are within the range specified in the user manual.
- Make sure the **laser emission and receiving windows are clean and free of contamination.**