

1. PRODUCT DESCRIPTION

The LDR20K1 laser rangefinder/designator can measure the distance to a target and provide laser target designation for laser-guided projectiles. It is primarily used in airborne applications requiring high reliability. The device features a compact size, low weight, long ranging and designation distance, high accuracy, and strong environmental adaptability.



2. CONTROL FUNCTIONS

The laser rangefinder/designator can perform the following control functions through a serial interface:

- Respond to a laser ranging command and stop ranging at any time upon receiving a stop command;
- Output one set of range data and status information for each pulse during ranging;
- Support range gating during ranging;
- Automatically stop ranging after 5 minutes (at 1 Hz) or 1 minute (at 5 Hz) if no stop command is received after continuous ranging is initiated;
- Allow configuration of designation mode and code;
- Respond to a laser designation command, perform designation according to the preset mode and code, and stop designation at any time upon receiving a stop command;
- Automatically stop designation after completing one cycle if no stop command is received;
- Output one set of range data and status information for each pulse during laser designation;
- Perform power-on self-test and periodic self-test, and output status information;
- Respond to a self-test command and output status information;
- Report the cumulative number of emitted laser pulses.

3. TECHNICAL SPECIFICATIONS

1. Operating modes: ranging, designation.
2. Pump source: diode array.
3. Operating wavelength: 1.064 μm (1064 nm).
4. Pulse energy: $\geq 20 \text{ mJ}$.
5. Pulse energy fluctuation: within one designation cycle, single-pulse energy deviation shall not exceed $\pm 10\%$ of the mean pulse energy (statistics taken after 2 s of emission).
6. Beam divergence: $\leq 0.6 \text{ mrad}$.
7. Pulse width: $10 \pm 5 \text{ ns}$.

8. Laser optical-axis stability: ≤ 0.05 mrad.**9. Ranging performance:**

Ranging frequency: 1 Hz / 5 Hz, and single-shot.

- a) Continuous ranging at 1 Hz: duration ≥ 5 minutes, then rest 1 minute.
- b) Continuous ranging at 5 Hz: duration ≥ 1 minute, then rest 1 minute.
- c) Minimum measurement range: ≤ 300 m.
- d) Maximum measurement range: $\geq 3,000$ m.
- e) Ranging accuracy: ± 1 m.
- f) Acquisition rate: $\geq 98\%$.
- g) Ranging logic: first and last target.

10. Designation performance:

- a) Laser code accuracy: $2.5 \mu\text{s}$.
- b) Fundamental designation frequency: 20 Hz.
- c) Designation cycles:
 - Short-cycle designation: single designation duration ≥ 20 s, interval ≤ 30 s, continuous for 8 cycles.
 - Long-cycle designation: single designation duration ≥ 47 s, repeat start with interval ≤ 30 s, continuous for 2 cycles.

After completion of one designation cycle, the interval before restarting continuous designation shall be ≥ 30 minutes.

11. Laser coding:

- a) Complies with weapon system requirements and supports user-defined code expansion.
- b) Supports external synchronization signal input to control emission timing for coding.
- c) Coding method: precise frequency code (eight groups of pre-stored periodic codes).

12. Dimensions and mass:

- a) External envelope: $\leq 92 \text{ mm} \times 67 \text{ mm} \times 53 \text{ mm}$.
- b) Mass: $\leq 290 \text{ g}$.

13. Power input requirements:

- a) Average operating power consumption $\leq 55 \text{ W}$; peak power $\leq 100 \text{ W}$.
- b) Operating voltage range: $20 \text{ V} - 28 \text{ V}$.

14. Electrical "three-proof" treatment: circuit boards shall receive conformal coating after design and debugging to provide three-proof protection.

4. ENVIRONMENTAL ADAPTABILITY REQUIREMENTS**4.1 Temperature Requirements**

- High-temperature conditions
 - Operating temperature: $\leq +55 \text{ }^{\circ}\text{C}$
 - Storage temperature: $\leq +70 \text{ }^{\circ}\text{C}$
- Low-temperature conditions

Operating temperature: $\geq -40\text{ }^{\circ}\text{C}$

Storage temperature: $\geq -45\text{ }^{\circ}\text{C}$

4.2 Vibration Requirements

- The unit shall withstand flight vibration and the shocks occurring during takeoff and landing. All equipment shall also withstand environmental conditions equivalent to vehicle transportation.
- Vibration type: swept-frequency sinusoidal vibration.
- From 15 Hz to 33 Hz: constant displacement vibration with an amplitude of 0.91 mm.
- From 33 Hz to 700 Hz: constant acceleration vibration with an acceleration of 2 g.
- Duration: 1 hour per axis in three orthogonal directions.
- Test condition:

The product shall be mounted on the vibration test bench in normal operating configuration and powered on.

Post-test requirement:

The product shall operate normally after the vibration test.

4.3 Shock Requirements

- Vertical axis: $\geq 10\text{ g}$
- Lateral axis: $\geq 10\text{ g}$
- Longitudinal axis: $\geq 10\text{ g}$
- Shock waveform: post-peak sawtooth wave, duration 11 ms.
- Each of the X, Y, and Z axes shall be tested in both directions, for a total of 18 shocks.
- Test condition:

The product shall be mounted on the shock test bench in normal operating configuration and powered on.

Post-test requirement:

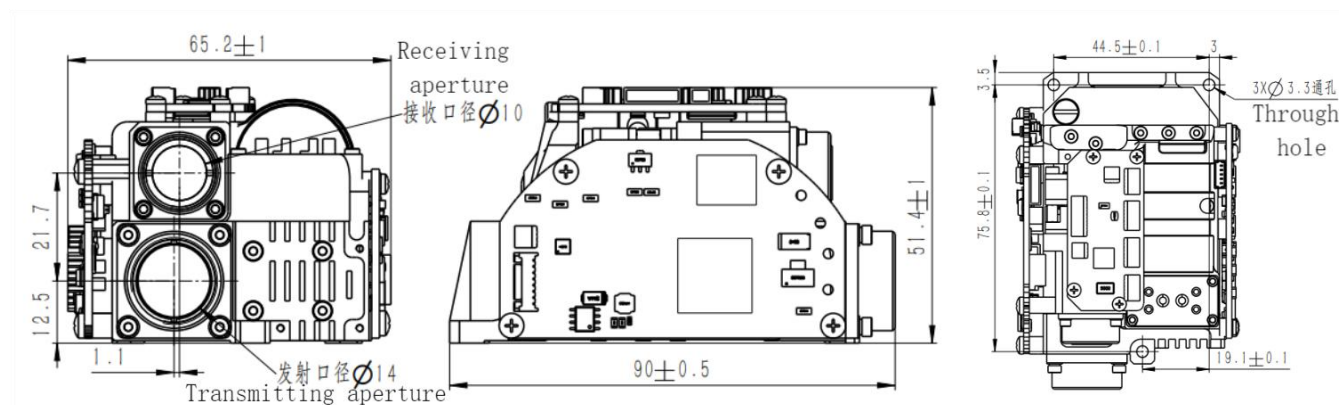
The product shall operate normally after the shock test.

5. INTERFACES

5.1 Mechanical Interface

(The mechanical interface defines the physical mounting and alignment requirements of the laser rangefinder/designator.

Details such as mounting holes, reference surfaces, and alignment axes should be specified according to the system integration design.)



5.2 Electrical Interface

Communication interface: RS422.

Connector model and interface definition can be found in Table 1.

Connector: MOLEX 53048-0810

Mating plug: MOLEX 51021-0800

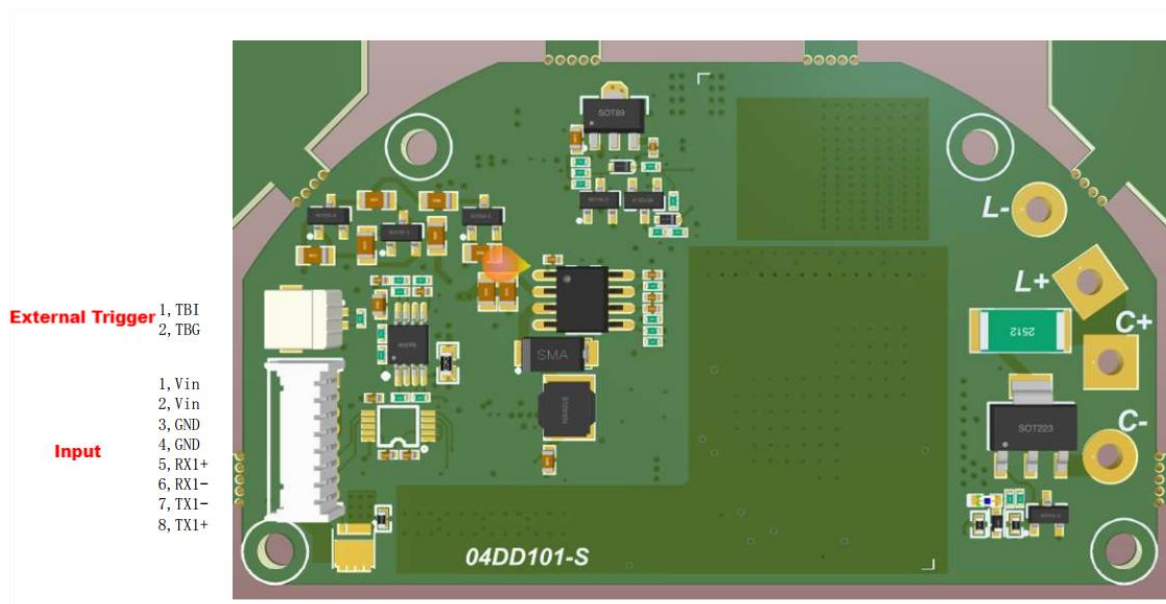
Table 1 — Electrical Interface Definition (TTL)

Pin No.	Signal Name	Description
1	Vin	Power supply +24 V
2	Vin	Power supply +24 V
3	GND	Power return (–)
4	GND	Power return (–)
5	RX1+	Host → Laser rangefinder/designator module (RS-422 RX+)
6	RX1–	Host → Laser rangefinder/designator module (RS-422 RX–)
7	TX1–	Laser rangefinder/designator module → Host (RS-422 TX–)
8	TX1+	Laser rangefinder/designator module → Host (RS-422 TX+)

External trigger interface:

Pin No.	Signal Name	Description
1	TBI	External trigger + (triggered on rising edge)
2	TBG	External trigger –

Figure 2 — Electrical Interface Diagram



6. COMMUNICATION PROTOCOL

6.1 Communication Standard

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 first.

6.2 Output Information

Output information refers to the commands sent from the host system to the laser rangefinder/designator module, consisting of:

Header: 0x55

Command byte 1

Command byte 2

Command byte 3

Checksum (tail): obtained by performing a bitwise XOR operation on bytes 1 through 4.

The definitions of Command Byte 1 are as follows:

Table 2 — Definition of Command Byte 1

BIT07	BIT06	BIT05	BIT04	BIT03	BIT02	BIT01	BIT00
0x00 Standby 0x01 Start self-test 0x02 Single ranging 0x03 Continuous ranging (1 Hz) 0x04 Continuous ranging (5 Hz) 0x05 Designation 0x06 Long-cycle designation 0x07 Short-cycle designation 0x08 Stop ranging/designation 0x09 Set gate value 0x0A Report cumulative laser pulse count 0x19–0x20 Modify laser code parameters 9–16 0x29–0x30 Read laser code parameters 9–16							

The definitions of Command Byte 2 are as follows:

Table 3 — Definition of Command Byte 2

BIT07	BIT06	BIT05	BIT04	BIT03	BIT02	BIT01	BIT00
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BIT07	BIT06	BIT05	BIT04	BIT03	BIT02	BIT01	BIT00
When in laser designation mode: Laser code 1–16 When in ranging mode: 1 – first target, 2 – last target When in gate value setting mode: lower byte of range gate value When modifying laser code parameters 9–16: lower byte of the laser code, period $\times$ 100 (e.g., 5000 represents 50 ms, valid range 40 ms–63 ms)							

The definitions of Command Byte 3 are as follows:

Table 4 — Definition of Command Byte 3

BIT07	BIT06	BIT05	BIT04	BIT03	BIT02	BIT01	BIT00
When in designation mode: laser designation time setting (1–25) When in gate value setting mode: higher byte of range gate value When modifying laser code parameters 9–16: higher byte of the laser code, period $\times$ 100 (e.g., 5000 represents 50 ms, valid range 40 ms–63 ms)							

6.3 Input Information

Input information refers to the status data received by the host system from the laser rangefinder/designator module, including:

- **Header:** 0x55
- **Status byte**
- **Target distance / cumulative laser pulse count** (2 bytes): low byte first, high byte second.
 For laser code parameters 9–16, the value represents the period $\times$ 100 (e.g., 5000 = 50 ms, valid range 40–63 ms); low byte first, high byte second.
- **Current temperature** of the laser rangefinder/designator module
- **Checksum (tail):** obtained by performing a bitwise XOR operation on bytes 1–5.

The definitions of the status byte are as follows:

Table 5 — Status Byte Definition

BIT07	BIT06	BIT05	BIT04	BIT03	BIT02	BIT01	BIT00
0: No laser emission 1: Laser emission present	0: Valid ranging 1: Invalid ranging	Laser flag alternates between 1 and 0	1: Over-temperature warning 0: Temperature normal		0: No external trigger 1: External trigger present	00: Standby 01: Ranging 02: Designation	

Target Distance Information Definition:

The distance value is represented by **2 bytes (16 bits)** as an integer, which can be directly converted to a decimal value.

In **standby mode**, status information is returned every **10 seconds** as part of the periodic self-test.

In **ranging** and **designation** modes, status is returned according to the laser emission frequency.

Cumulative Laser Pulse Count Definition:

Since a 16-bit binary number represents values in the range **0–65535**, and the laser rangefinder/designator has a service life of **1,000,000 pulses**, the pulse count is defined as a multiple of **20**, resulting in a range of **0–1,310,700**.

Current Temperature of the Laser Rangefinder/Designator Module:

Bits **d7–d0** represent the temperature in **two's complement** format, with a valid range of **–128 to +127**, in units of °C.

7. EQUIPMENT OPERATION INSTRUCTIONS

7.1 Communication Connection

Asynchronous serial communication standard: RS-422

Baud rate: 115200 bps

v	115200	open port	check port	☐
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Check the communication cable and click **“Detect”** until an available serial port is found. Select the **115200 baud rate** and connect to the serial port.

7.2 Receiving Information

The output information is displayed in the software's data reception window.

Click **“Clear”** to erase historical data and receive new data.

After each command is executed, corresponding feedback data will be received.

7.3 Command Transmission and System Status Indication

system temperature ● 		laser ranging range gating 50 m Set	
standby self check queries total		Head-End target Head target	
code num 9 code set		single ranging continuous 1HZ continuous 5HZ	
period 40.00 ms code read		code num 9 continue time 18 S radition start	
		stop radition/ranging	

7.3.1 Status Bar — Operation Status and Fault Indication

In the status bar, a **gray icon**  indicates the **initial or idle state**,
 a **green (or active) icon**  indicates **normal operation**,
 and a **red icon**  indicates a **fault condition**.

7.3.1.1

Each time data is received from the lower module, it includes **temperature information** . The temperature value is displayed in the **status section**.

When a **red fault indicator** appears, the current operation must be stopped immediately and the fault investigated to prevent potential equipment damage.

7.3.1.2

When executing a **query command**, the corresponding query result will be displayed in the respective display field of the status bar.

7.3.2 Command Bar — Sending Commands

Overview:

The command bar includes options such as **laser pulse count query** and **code query**, with the results displayed in the corresponding areas of the status bar.

Buttons for **laser emission** and **designation commands** (or to **stop ranging/designation**) are also provided. Command feedback information will be displayed in the **reception window**.

7.3.2.1 Pulse Count Query

During operation, the device records the number of laser pulses emitted in both ranging and designation modes.

When a **pulse count query command** is sent, the device returns information containing the laser pulse count, which is displayed in the **status bar**.

7.3.2.2 Self-Test

Click “**Self-Test**” to send a self-test command.

Upon receiving the command, the device enters the self-test mode, simulating operating conditions to verify internal system status.

The device returns its status, and any detected faults are displayed in the **status bar**.

7.3.2.3 Single Ranging

The **single ranging command** instructs the device to emit one laser pulse and return the measurement result, including **main/echo information** (see Section 7.5 for explanation) and the calculated range data.

7.3.2.4 Continuous 1 Hz Ranging

Upon receiving this command, the device continuously emits laser pulses at **1 Hz** and returns the corresponding ranging results.

The returned data format is the same as for single ranging.

7.3.2.5 Continuous 5 Hz Ranging

Upon receiving this command, the device continuously emits laser pulses at **5 Hz** and returns the corresponding ranging results.

The returned data format is the same as for single ranging.

7.3.2.6 Short Designation

This command sets the device to **designation mode**, emitting coded laser pulses with a **20 s active duration** and a **30 s interval**, for up to **8 consecutive cycles**.

Each designation cycle returns **main/echo information** and **distance data** for that cycle.

7.3.2.7 Long Designation

This command sets the device to **designation mode**, emitting coded laser pulses with a **47 s active duration** and a **30 s interval**, for up to **2 consecutive cycles**.

Each designation cycle returns **main/echo information** and **distance data**.

7.3.2.8 Designation

This command sets the device to **designation mode** with a **single cycle duration less than 60 s**.

After completing one designation cycle, the device automatically stops.

Each cycle returns **main/echo information** and **distance data**.

7.3.2.9 Stop Ranging/Designation

When this command is received, the device immediately stops the current operation.

Each working process must be terminated with a **stop command**.

7.3.2.10 Code Setting

This command allows modification of the parameters for the selected **laser code number**.

After modification, subsequent operations using this code will apply the updated code parameters (e.g., 50 ms).

7.3.2.11 Code Reading

After selecting a **code number**, click “**Code Query**” to read back the user-set coding information.

The returned information will be displayed in the **code parameter cycle field**.

7.3.2.12 Range Gate and Target Selection Setting

This function allows configuration of the **range gate** and **target type**.

The **range gate** defines the minimum displayed distance (see Section 7.4). Targets below this distance will display a range of zero.

The **target selection** allows switching between **first target** and **last target** display modes.

7.3.2.13 Standby

This command sets the device to **standby mode**, switching internal circuits to a low-power state until the next operational command is received.

Note:

The **parameter panel** allows selection of the current code number. If this code number has been configured, its **code cycle parameter** will be displayed automatically.

The **duration setting** defines how long the selected code will remain active.

When a **designation command** is sent, the device will operate according to the selected code's period (e.g., 50 ms) and the configured duration (e.g., 30 s).

7.4 Range Display

Distance1	Distance2	Distance3	mutireturn	return	emission
88888	88888	88888	0	0	0

7.4.1 Distance 1

“Distance 1” displays the **target distance** calculated during ranging or designation operation.

When the device has **not yet performed ranging or designation**, or when the “**Clear**” button is clicked, the display remains in the initial state as shown above.

During **normal ranging or designation**, Distance 1 shows the **measured distance value**.

When the measurement is **out of range** or **invalid**, Distance 1 displays **0xFFFF**.

7.4.2 Main and Echo Wave Indication

The **main wave** represents the **laser pulse emission signal** generated by the device.

The **echo wave** represents the **received laser pulse signal**.

A **main wave value of 1** indicates that the device has successfully emitted a laser pulse.

An **echo wave value of 1** indicates that the device has successfully received the reflected pulse.

A **display value of 0** for either the main or echo wave means that the transmission or reception for that cycle was **incomplete**, and the **device status should be checked**.

7.5 Program Upgrade

When a **firmware or software upgrade** is required, switch the program to the **upgrade page** as shown below (the specific interface or procedure follows in the next section).

File Path

Transfer Progress

0%

At this time, the **Upgrade Program** button is grayed out and unavailable. Click **Select Burn File** (usually a *.bin* file). When the receiving interface displays the symbol ‘**C**’, it indicates that the system is in the **waiting-for-upgrade** state. The **Upgrade**

Program button then becomes active. Click **Upgrade Program** to start the update. Wait until the progress bar reaches **100%**, indicating that the program update is complete. The system will **automatically restart** after the update.

8. ACCOMPANYING DOCUMENTS AND ACCESSORIES

- One laser illuminator
- One operation manual
- One connector plug
- One inspection report
- One certificate of conformity

9. TRANSPORTATION AND STORAGE

During transportation or storage, avoid exposure to **dust, moisture, acidic or alkaline vapors**, and **other corrosive chemicals**.

10. PRECAUTIONS FOR USE

- This product emits **Class IIIB laser radiation**. Do **not** aim the laser directly at the **eyes or skin**, or focus it through optical lenses.
- The laser housing is **airtight and dustproof**. Do not attempt to open it — breaking the seal may cause **damage to the core laser components**.
- The product contains **high voltage**; **unauthorized personnel** must not disassemble it.
- To prevent damage to the **laser detector**, do not perform ranging on **targets within 50 meters**, and do not cover the optical window with hands or other objects.
- During **optical axis alignment** or **indoor laser emission**, ensure the **receiving window is fully covered** to avoid damaging the photodetector.
- **Disconnect power** before plugging or unplugging cables.
- Ensure the **power supply parameters** meet the specified requirements in this manual.
- Keep the **transmitting and receiving windows** clean and free of contamination.