80 mJ Laser Target Designator/Rangefinder Module

Model: LDR80K2

1. PRODUCT DESCRIPTION

The LDR80K2 1064nm laser target designator is an 80 mJ solid-state module that combines 1–20 Hz ranging and fixed-frequency coded illumination for long-range fire-control and surveillance systems. It offers ≥ 15 km measuring distance on NATO-type targets, ≥ 8 km laser illumination, ≤ 5 m accuracy and ≥ 98% valid ranging rate, with 24 V ± 4 V input, ≤ 55 W average power, RS-422 control and −40 °C to +60 °C environmental capability, making it ideal for UAV pods, vehicle turrets and coastal or border-defense EO/IR payloads.



2. KEY PERFORMANCE PARAMETERS

Laser Wavelength	1064nm±1nm
Pump Mode	Side-pumped semiconductor (diode) pumping
Designation Frequency	Fixed Frequency: **45 ms – 125 ms** (default **20 Hz**)
Trigger Mode	Internal-Synchronization Illumination / External-Synchronization Illumination (Trigger Delay: **304.0 μs ± 0.1 μs**)
Output Energy	≥80m
Dimensions	≤150×102×55mm
Weight	≤850g
Designation Capability	≥10km
Q-Switch Type	Electro-optic Q-switch (EO Q-switch)
Pulse Width	15ns ±5ns
Beam Divergence	≤0.15mrad
Energy Instability	≤8%(RMS)
Laser Designation Performance	Short-duration irradiation mode: The irradiation time for each cycle is 17 seconds, followed by a 30-second interval. The system can perform up to 8 consecutive irradiation cycles. Long-duration irradiation mode: The irradiation time for each cycle is 60 seconds, followed by a 45-second interval. The system can perform up to 4 consecutive irradiation cycles.

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Optical Axis Parallelism Error Relative to Mounting Datum	≤0.5mrad
Ranging Performance	· **Minimum Measuring Distance:** ≤ 300 m · **Maximum Measuring Distance:** ≥ 15 km *(under conditions of a 2.3 m × 2.3 m target, diffuse reflectivity ≥ 0.2, visibility ≥ 20 km, and relative humidity ≤ 70%)* · **Ranging Frequency:** 1–20 Hz (up to 3 simultaneous targets) · **Ranging Accuracy:** ≤ 5 m · **Probability of Valid Ranging:** ≥ 98% · **Continuous Ranging Operating Time:** 90 s *(20 Hz continuous operation for 90 s, rest time ≤ 5 minutes before continuing ranging)*
Communication Serial Interface	RS422
External Synchronization Interface	+5 V differential line driver/receiver, RS-422 interface (delay from external synchronization signal to laser emission: 304.0 μs ± 0.1 μs).
Laser Coding Mode	● Precise Frequency Coding ● Time Coding ● Pseudo-Random Coding
Period Accuracy	<+-1us
Power Supply	DC 20V ~ 28V
Power Consumption	During operation, the average power consumption is not more than 55W, and the peak power consumption is not more than 100W.
Low-Temperature Test	Operating temperature: −40 °C Storage temperature: −45 °C
High-Temperature Test	Operating temperature: +60 °C Storage temperature: +65 °C
Damp-Heat Test	Relative humidity: **95% ± 3%** Temperature: **+35 °C ± 2 °C** Storage duration: **72 h**
Shock Test	**Waveform:** Half-sine pulse **Peak acceleration:** 10 g **Pulse duration:** 11 ms Vertical axis: ≥ 10 g Lateral axis: ≥ 10 g

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	Longitudinal axis: ≥ 10 g Shock waveform: post-peak sawtooth, duration **11 ms**, applied along the **X, Y, and Z axes**, in **both directions on each axis**, **three shocks per direction**, for a total of **18 shocks**. **Test condition:** The product shall be mounted on the shock test bench in its normal operating configuration and powered on during the test. **Post-test requirement:** After shock testing, the equipment shall operate normally.
Vibration	The equipment shall withstand **flight vibration** and the shocks occurring during **takeoff and landing**, and all components shall meet the environmental conditions of **vehicle transportation**. The vibration profile is a **swept-frequency spectrum**: ● From **5 Hz to 16 Hz**, constant-displacement sinusoidal vibration with an amplitude of **1.5 mm**; ● From **16 Hz to 60 Hz**, constant-acceleration sinusoidal vibration with an acceleration level of **1.5 g**. Each of the three axes shall be vibrated for **36 minutes**. **Test condition:** The product shall be mounted on the vibration table in its normal operating configuration and powered on during the test. **Post-test requirement:** After vibration testing, the equipment shall operate normally.

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3. COMMUNICATION INTERFACE

1. The electrical connection interface consists of the **J30J-21ZKP** and **J30J-04ZK** connectors.
The interface definitions are as follows:

Table 1 — J30J-21ZKP Interface Definition

J30J-21ZKP				
Pin	**Function**	**Description**	**Direction**	**Remarks**
1	TX+	RS-422 TX+	Output	RS-422 Communication Interface
2	TX-	RS-422 TX−	Output	

3	RX+	RS-422 RX+	Input	
4	RX-	RS-422 RX−	Input	
5	GND	RS-422 GND	GND	
6	EN+	Power Enable		24 V Power Enable Switch
7	EN-	Power Enable		
8-13		Not Connected / NC		
14	A	External Sync Differential + (A)	Input	A and B are the **A/B differential outputs of the RS-422 driver chip**
15	B	External Sync Differential − (B)	Input	
16	LED+	DC5V	Input	Laser Designation Power Supply
17	LED-	GND	Input	
18-21				

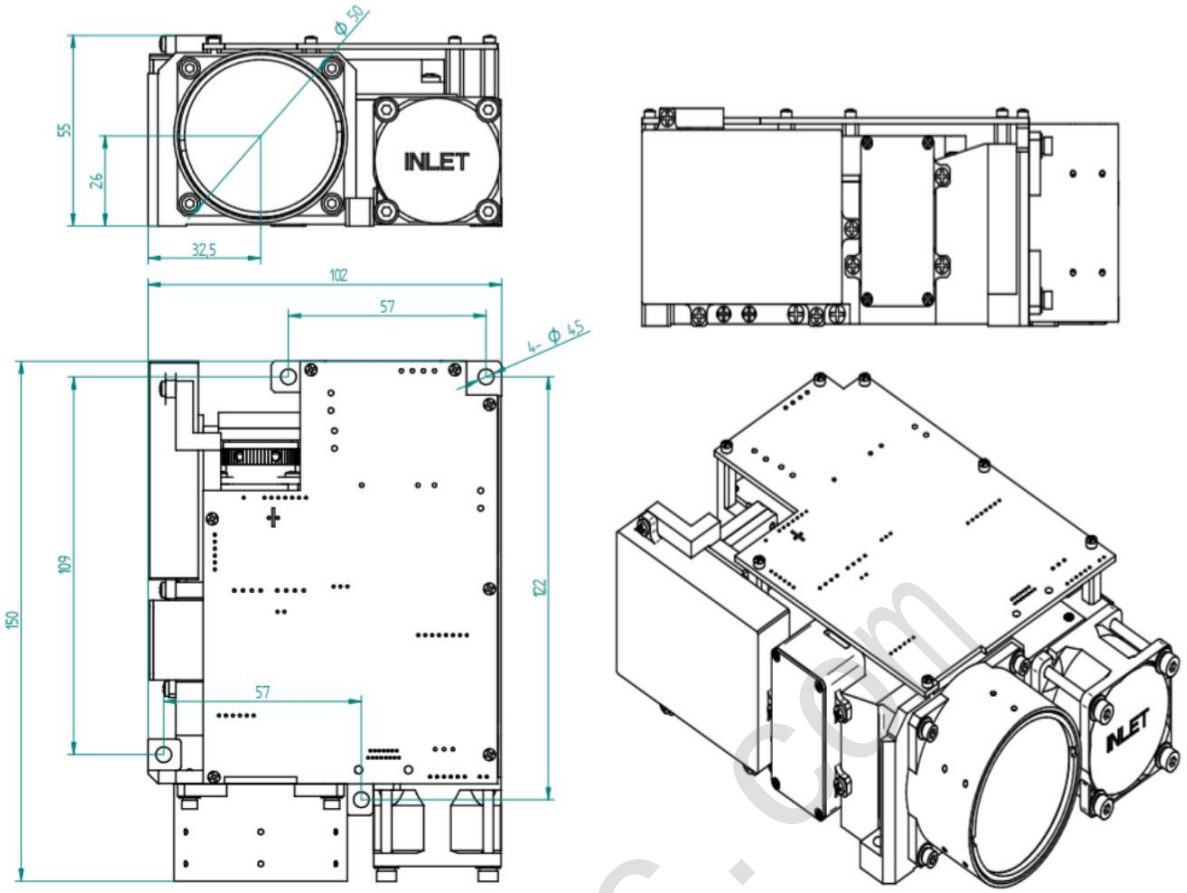
Table 2 — J30J-04ZK Interface Definition

J30J-04ZK				
Pin	**Function**	**Description**	**Direction**	**Remarks**
A、B	24V	Power Supply	Input	Red
C、D	GND	Power GND	Input	Black

2. **Power Supply Interface:** +24 VDC ±10%
3. **External Trigger:** RS-422 differential signal
4. **Cooling Method:** Cooling fan located at the front of the device

4. MECHANICAL DIMENSIONS

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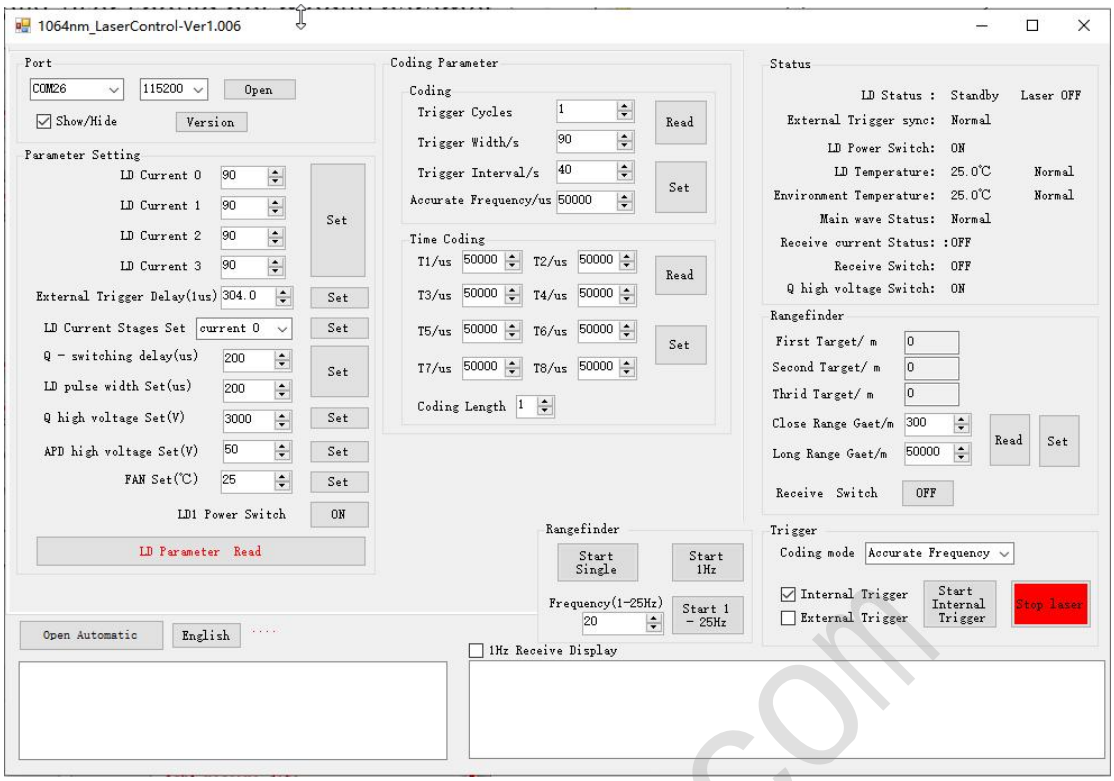
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5. TEST SOFTWARE OPERATION INSTRUCTIONS

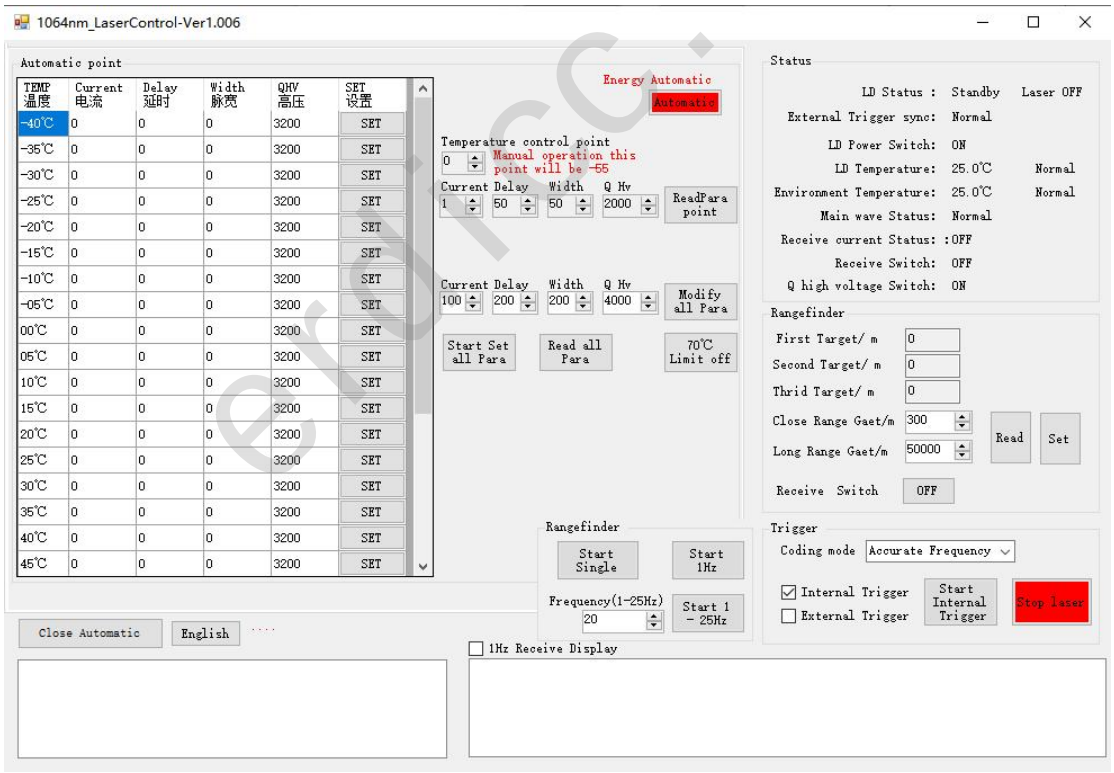
NOTICE:
When the unit is placed in a high/low-temperature chamber, the receiver must be switched off.
When the LDR is powered on, the receiver is off by default.
When opening the GUI or after the LDR is powered on, the user must press the **"Read"** button to load the current configuration parameters.
The LDR supports Manual mode and Automatic mode. Under normal conditions, the LDR operates in Automatic mode.

5.1 GUI software

The GUI software has two pages.
Page 1:



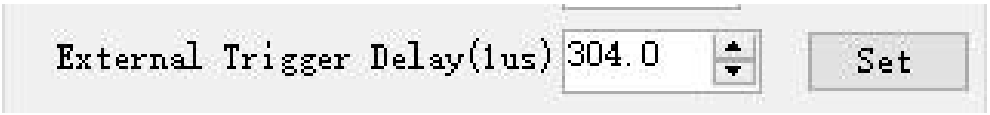
Page2：



5.2 Press the  button to open or close Page 2.

5.3 Parameter Setting

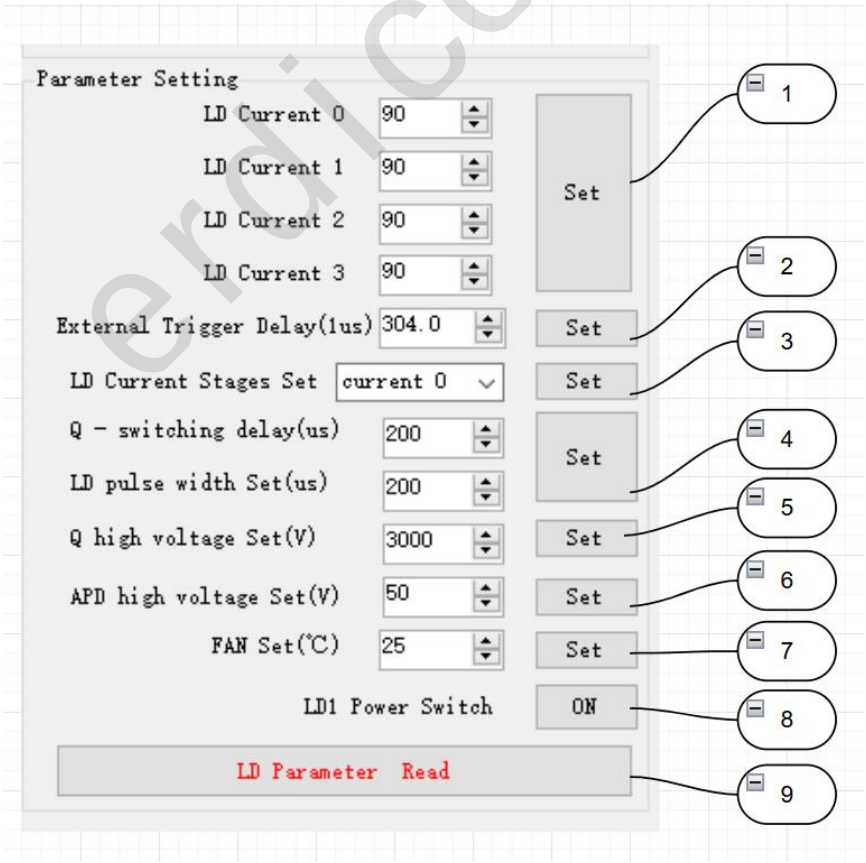
As shown below, the user must first click the **"LD Parameter Read"** button (No. 9) to read the parameters stored in the LDR.
The user only needs to set the **External Trigger Delay** parameter. After changing the value, click the **"Set"** button (No. 2) to apply the new setting.
When the LDR is powered on, the **External Trigger Delay** will default to **304.0**.



The parameters at positions **1, 3, 4, and 5** are only used in **Manual mode**. When the LDR is powered on, the system starts in **Automatic mode**, so these parameters are not active.

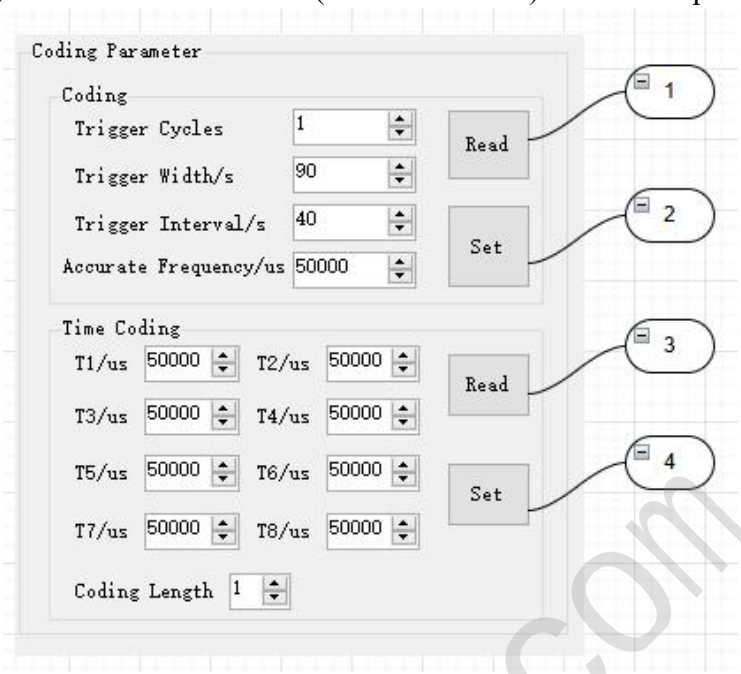
It is **not recommended** for customers to modify the parameters at positions **6 and 7**, as they are set to factory-optimized values.
Parameter **6** is the **receiver APD bias voltage**.
Parameter **7** is the **fan turn-on temperature threshold**: when the temperature is higher than this value, forced air cooling is enabled; when the temperature is lower than this value, the fan is turned off.

Parameter **8** is the **LD power enable** control, but it does **not** enable or disable the entire LDR module.



5.4 Coding and Time-Coding Parameters

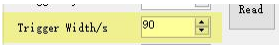
As shown below, the user must first click the **"Read"** buttons (No. 1 and No. 3) to load the parameters stored in the LDR.
After adjusting the values, click the **"Set"** buttons (No. 2 and No. 4) to save the parameters to the LDR.



5.5 Rangefinder and Internal / External Trigger (Designate) Modes

As shown below:

- **Buttons 1, 2, and 3** are used in **Rangefinder mode**.
  They generate either a **single-shot** pulse or **1–25 Hz** laser emission.
  The maximum duration of 1–25 Hz emission is limited by the Coding parameter **Trigger Width**



- **Buttons 4, 5, and 7** are used in **Trigger mode**.
  In this mode, the laser can be fired according to the **Coding and Time-Coding parameters** or by an **external single trigger signal**.

- **Button 4** selects between **Coding (fixed / accurate frequency)** and **Time-Coding** modes.
- **Button 7** selects between **Internal** and **External** trigger modes.
  The operating duration in Internal or External trigger mode is also limited by the Coding parameter **"Trigger Width *"**.

- **Button 6** is used to **stop laser emission**.

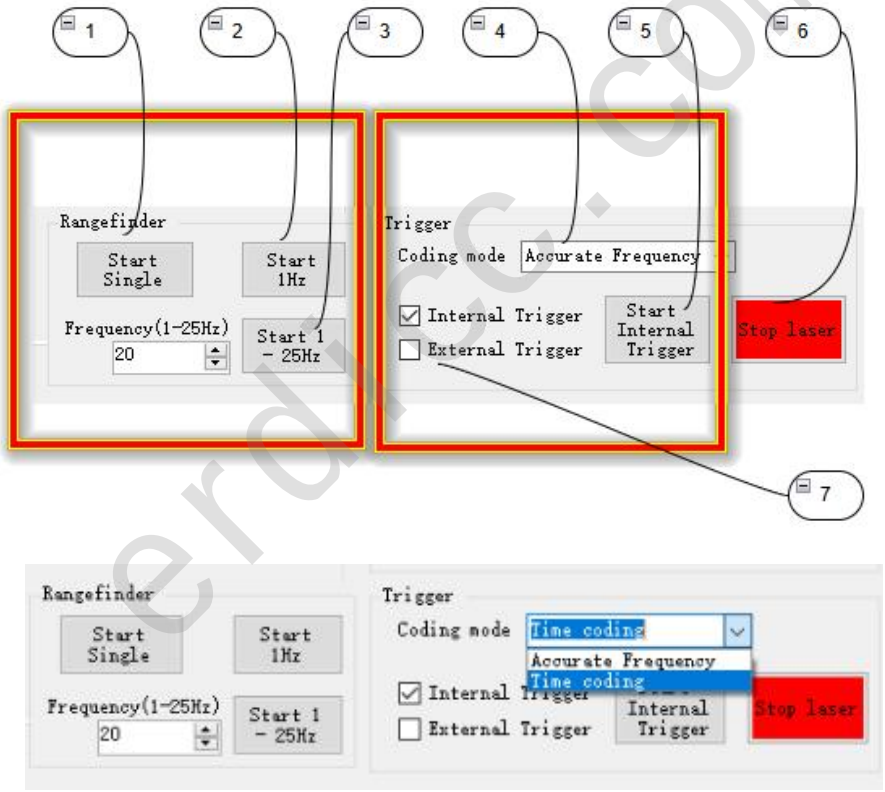
External Sync Mode Behavior

In **External Sync mode**, after the **"Lasing Start"** command is sent:

- In the first case, if **no external sync signal** is received, the unit will **time out after 2 s**, exit the *external sync lasing start state* (but remain in External Sync mode), and set an alarm in **Status Word 2, bit 3** indicating **"external sync signal lost"**.
- In the second case, if lasing has started normally and the **external sync signal is lost during operation**, the unit will again **time out after 2 s**, exit the *external sync lasing start state* (still remaining in External Sync mode), and set the same alarm in **Status Word 2, bit 3** for **"external sync signal lost"**.

The alarm bit remains set until the **"Lasing Start"** command is sent again, at which point the status bit is cleared.

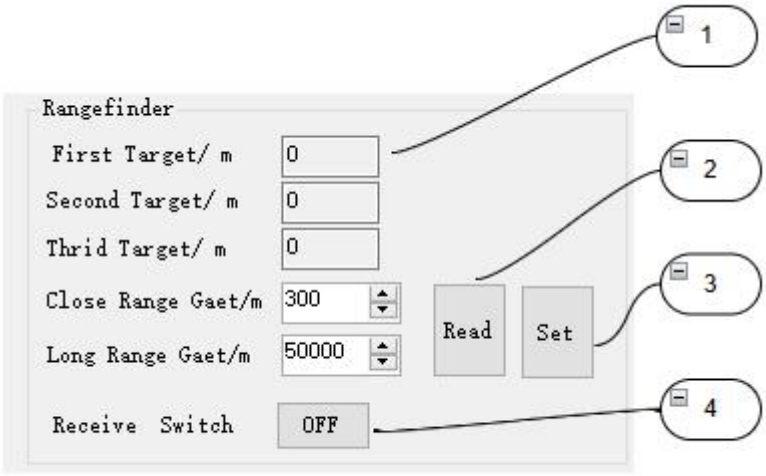
In the alarm state, if the user switches to **Internal Sync mode**, the **"external sync signal lost"** alarm is **not reset automatically**.



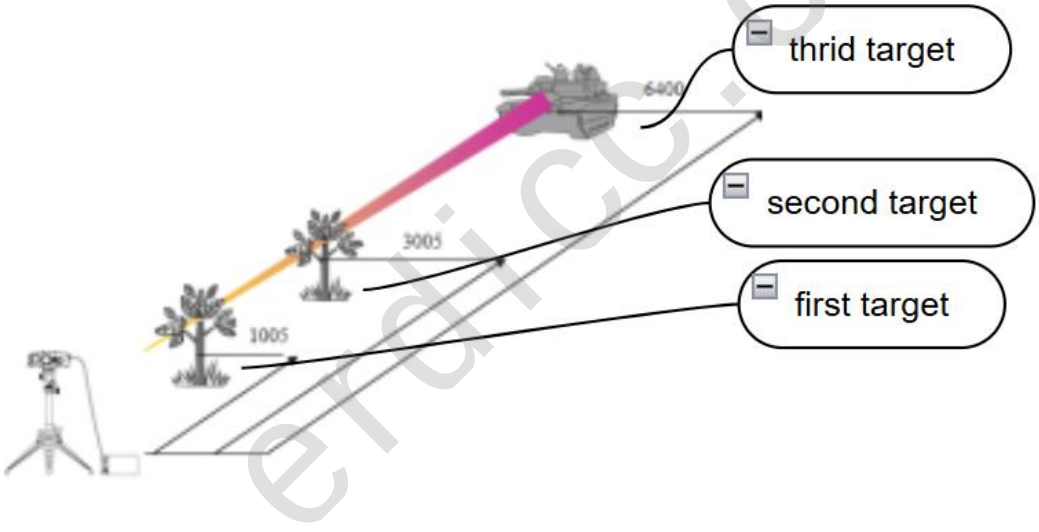
5.6 Ranging Distance Display

As shown in the figure below, **Position 1** displays the target distance returned during ranging and illumination.
Button 2 reads the LDR's near-range and far-range gate settings, and
Button 3 configures the LDR's near-range and far-range gate values.

By default, when the LDR is powered on, the near-range and far-range gate range is **300 m to 50,000 m**.



Three-Target Illustration



5.7 LDR Status Display

5.7.1 D Status indicates *Laser ON* or *Laser OFF*, showing whether the laser is enabled or disabled.

5.7.2 When the LDR is operating in **External Mode**, if the **external sync signal is lost**, the laser output will stop and the interface will display the warning **"external sync signal lost."**

5.7.3 LD Power Switch Status changes according to the 

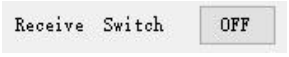
toggle state; no user configuration is required.

5.7.4 If a temperature fault occurs, the **Temperature** status will display **"Error"** instead of "Normal."

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5.7.5 When the laser energy is too low or there is no laser output, the **Main Wave Status** will trigger an **Error** alarm.

5.7.6 When the LDR powers on, **Receive Current Status** is in the OFF state.

It can be switched ON/OFF using the 

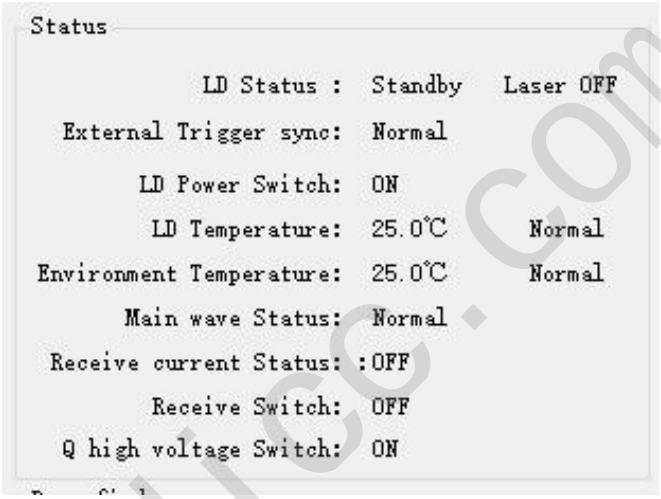
button, and it displays the actual voltage status.

5.7.7 When the LDR powers on, **Receive Switch Status** is also OFF by default.

It can be toggled via the 

command sent from the interface.

5.7.8 Q High Voltage Switch does not require user attention.



5.8 On Page 2, Button 1 is used to switch between Manual Mode and Automatic Mode.

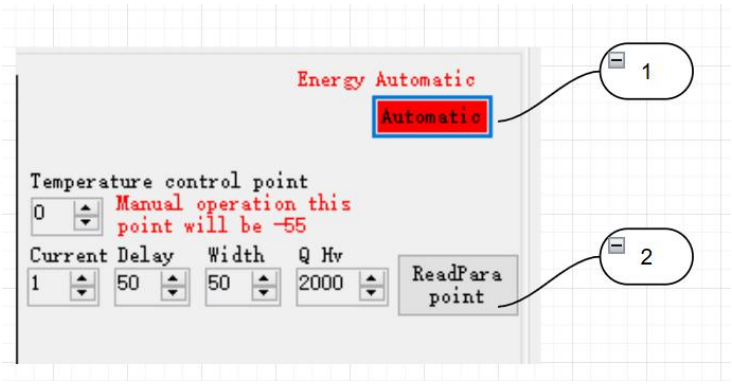
Button 2 is used to read the current **LD Temperature Control Point**.

In **Manual Mode**, the LD Temperature Control Point is fixed at **–55**.

In **Automatic Mode**, the LD Temperature Control Point varies according to the LD temperature, following the **Automatic Point List** shown on Page 2. The reference list is illustrated in the figure below.

After switching modes, you must use **Button 2** again to read back the current temperature point to verify whether the mode switching was successful.

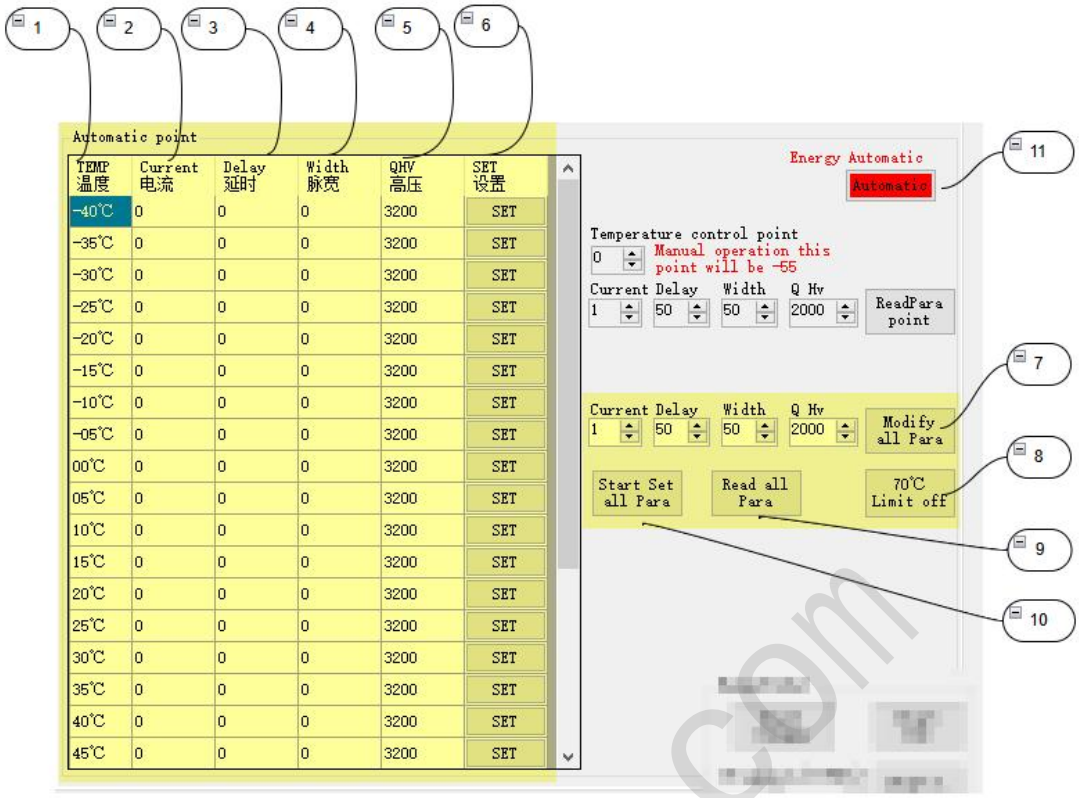
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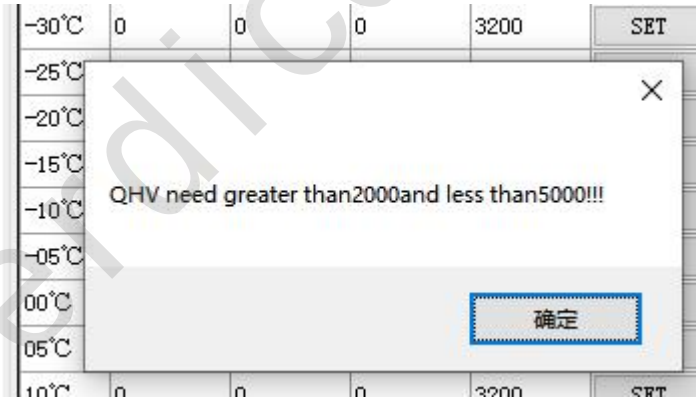
5.9 On **Page 2**, the yellow area on the left contains the **temperature parameter table** for **Automatic Mode**, covering the corresponding **current**, **delay**, **width**, and **Qhv** parameters from **–40 °C to +80 °C**.
This table is **not recommended for customer modification**.
When switching to Page 2, if the LDR is connected, the user must first click **Button 9 – Read All Parameters**.

- **Position 1** displays the temperature list from **–40 °C to +80 °C**.
- **Position 2** shows the **current** parameter; clicking the table allows editing. The valid range is **1–170 A**.
- **Position 3** shows the **delay** parameter; clicking the table allows editing. The valid range is **50–300 µs**.
- **Position 4** shows the **width** parameter; clicking the table allows editing. The valid range is **50–300 µs**.
- **Position 5** shows the **Qhv** parameter; clicking the table allows editing. The valid range is **2000–5000 V**.
- **Position 6** is the **Set** function; click **SET** to apply parameter changes to the corresponding temperature point.
- **Position 7** allows bulk modification of the temperature table values to a unified value.
  However, this only modifies the values in the **LDR GUI software**, and **does not** change the stored values in the **LDR device**.
- **Position 8** disables the **70 °C over-temperature limit**.
  After enabling this function, the LDR will *not* stop laser emission when **LD temperature** exceeds **70 °C** during the current power cycle.
  If the LD temperature exceeds **70 °C**, it must drop **below 60 °C** before emission is allowed again.
- **Position 9 – Read All Parameters** retrieves the stored temperature parameters from the LDR device and updates the GUI's temperature table.
- **Position 10** performs a bulk update of the LDR's stored temperature parameters.
  Use of this function is not recommended for users.
- **Position 11** is used to switch between **Manual Mode** and **Automatic Mode**.

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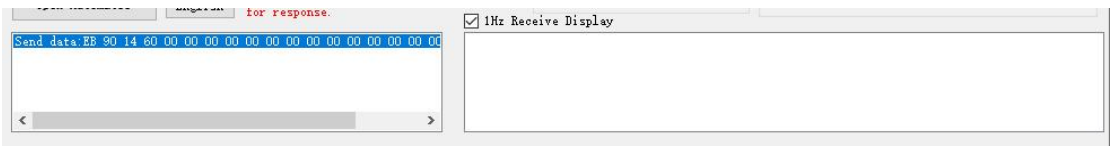


If the input values in columns 2, 3, 4, or 5 of the temperature parameter table are outside the allowed range, a warning dialog will pop up.



5.10 1 Hz Receive Display

When the **1 Hz Receive Display** option is checked, the GUI will display data at 1 Hz.



5.11 LDR Feedback Data Frame Display

The area highlighted in yellow in the figure below is used to display the LDR feedback data frame information.



6. COMMUNICATION PROTOCOL

6.1 Physical Interface

- Communication interface: **RS-422 full-duplex**
- Communication format: **1 start bit, 8 data bits, 1 stop bit, no parity**
- Baud rate: **115200 bps**
- Message format: **case-insensitive**

6.2 Communication Messages

The corresponding messages are sent from the computer to the device.

6.3 Communication Format

The communication format is as follows:

Frame Header	Data Length	Command Word	Data	Checksum
2 bytes	1 bytes	1 byte	N bytes	1 bytes

- **Frame Header:**
  The first byte is fixed to **0xEB**, and the second byte is fixed to **0x90**.
- **Data Length:**
  Indicates the total number of bytes being sent, **including the length byte itself but excluding the Frame Header**.
- **Command Word:**
  1 byte.
- **Data:**
  Instruction data to be transmitted.
  If the data is **16-bit**, it must be split into **two bytes**, with the **high byte first**, **low byte second**.
- **Checksum:**
  8-bit accumulated sum of all data bytes
  (**excluding the Frame Header and the Checksum itself**).

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6.4 Control Commands

Table 1 — Laser Control Commands 1

No.	Command	Description	Remarks
Byte 1	0×EB	Frame Header 1	
Byte 2	0×90	Frame Header 2	
Byte 3	0×14	Data Length	Byte3~Byte 22
Byte 4	0×00	Laser Stop	**Internal/External Sync Laser Designation Mode — Laser Stop**
	0×01	Single-Shot Ranging Start	
	0×02	1 Hz Ranging Start	
	0×03	1–25 Hz Ranging Start	
	0×04	External Sync Illumination Delay Setting	**External Sync Laser Designation — Laser Emission Delay After Receiving the External Sync Signal**
	0×05	Internal/External Sync Illumination Start	
	0×06	Range Gate Setting	
	0×07	Range Gate Query	
	0×08	Internal Sync Illumination Period Setting	
	0×09	Internal Sync Illumination Period Query	
	0×0A	Time Code Setting	
	0×0B	Internal/External Sync Illumination Switching	
	0×0C	LD Current Option Setting	**Default LD current = 0 (valid for the current power cycle only)**
	0×50	Q-Delay and LD Pulse Width Setting	
	0X51	LD Current Setting	
	0×52	Q High Voltage Setting	
	0X53	APD High Voltage Setting	
	0X54	LD Parameter Query	
	0×55	Receiver Status Setting	Default: OFF （Receiver on/off switch）
	0×56	Q High Voltage Status Setting	Default: ON (temporarily unavailable)
	0×57	LD1 Power Status Setting	Default: ON
	0×59	Fan Activation Temperature Setting	
	0×5A	Write Temperature Parameter Command	

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	0×5B	Read Temperature Parameter Command	
	0×5C	Automatic/Manual Mode Switching Command	
	0×5D	Query Current Temperature Parameter	
	0×5E	Disable 70°C Over-Temperature Shutdown Command	
	0×5F	Serial Port Firmware Upgrade Command	
	0×60	Software Version Query	
Byte 5~21	Data1~17		
Byte 22	Checksum		Sum of bytes 3 through 21

Table 2 — Description of Laser Control Commands 1

Relationship between **Byte 4** and **Data 1–17** contained in **Bytes 5 through 21**.

NUM	Byte 4	Byte5~Byte 21 Data 1~17		Remarks
1	0X00	Data 1~17	0×00	Laser Stop
2				
3	0×01、0×02	Data 1~17	0×00	Single-Shot Ranging, 1 Hz Ranging
4	0×03	Data 1	Ranging Frequency	Ranging Start Range: 1–25 Hz (1 LSB = 1 Hz)
		Data 2~17	0×00	
5	0×04 (Save)	Data 1	External Sync Emission Delay – High Byte	External Sync Illumination — Laser Emission Delay After Receiving the External Sync Signal Range: 303.0–305.0 μs (1 LSB = 0.1 μs) Factory Default: 304.0 μs
		Data 2	External Sync Emission Delay – Low Byte	
		Data 3~17	0×00	
6	0×05	Data1~5	0×00	**Laser Designation Start**
		Data 6	1. **Internal Sync Illumination Code Index:** ● **0x01:** Fixed Frequency ● **0xF2:** Time Coding 2. **In External Sync mode, this value is fixed to 0x01.**	
7	0×06	Data 1	Range Gate High Byte – Near Range	**Range Gate Setting** Unit: meters (minimum ranging distance **300 m**,
		Data 2	Range Gate Low Byte – Near	

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			Range	maximum ranging distance **50,000 m**)	
		Data 3	Range Gate High Byte – Far Range		
		Data 4	Range Gate Low Byte – Far Range		
		Data 5~17	0×00		
8	0×07	Data 1~17	0×00	Range Gate Query	
9	0×08 (Save)	Data 1	Internal Sync Illumination Period – High Byte	Internal Sync Laser Designation Period Setting	**Internal Sync Laser Designation Period T.** Laser designation period = **45,000 µs – 125,000 µs**, unit: **µs** **Default: 50,000 µs (20 Hz)**
		Data 2	Internal Sync Illumination Period – Middle Byte		
		Data 3	Internal Sync Illumination Period – Low Byte		
		Data 4	Internal Sync Illumination Duration		Unit: seconds, range 1–90, factory default: 90
		Data 5	Internal Sync Illumination Interval		Unit: seconds, range 1–255, factory default: 40
		Data 6	Internal Sync Illumination Cycle Count		Range: 1–4, factory default: 1
10	0×09	Data 1~5	0×00	**Internal Sync Laser Designation Period Query**	
		Data 6	Synchronization Illumination Code Index: **0x01: Fixed Frequency** **0xF2: Time Coding**		
11	0×0A (Save)	Data1	Time Code length	Time Code length	Range: 1–8 (1 LSB = 1) Default: 1
		Data 2	Time Code 1 – High Byte	Time Code 1 1LSB=1us	Length: 8 Time Code values 1 LSB = 1 µs Range: 40,000–60,000 µs Default: 8 Time Code values set to 50,000 µs Each Time Code value is 16 bits (high byte first, low byte second).
		Data 3	Time Code 1 – Low Byte		
		Data 4	Time Code 2 - High Byte	Time Code 2 1LSB=1us	
		Data 5	Time Code 2 - Low Byte		
		Data 6	Time Code 3 - High Byte	Time Code 3 1LSB=1us	
		Data 7	Time Code 3 - Low Byte		
		Data 8	Time Code 4 - High Byte	Time Code 4 1LSB=1us	
		Data 9	Time Code 4 - Low Byte		
		Data 10	Time Code 5 - High Byte	Time Code 5 1LSB=1us	
		Data 11	Time Code 5 - Low Byte		
		Data 12	Time Code 6 - High Byte	Time Code 6 1LSB=1us	
		Data 13	Time Code 6 - Low Byte		
		Data 14	Time Code 7 - High Byte	Time Code 7 1LSB=1us	
		Data 15	Time Code 7 - Low Byte		
		Data 16	Time Code 8 - High Byte	Time Code 8 1LSB=1us	
		Data 17	Time Code 8 - Low Byte		

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12	0×0B	Data 1	**Internal Sync: 0x00** **External Sync: 0x01**	Internal/External Sync **Laser Designation** Switching
		Data 2~17	0×00	
13	0×0C	Data 1	LD Current Option 0: 0x00 LD Current Option 1: 0x01 LD Current Option 2: 0x02 LD Current Option 3: 0x03	**LD Current Option Setting** Default: **LD Current Option 0**
		Data 2~17	0×00	
14	0×50 (Save)	Data 1	Q Delay – High Byte	**Laser Q-Delay and LD Pulse Width Setting** Range: **50–300 μs** (1 LSB = 1 μs)
		Data 2	Q Delay – Low Byte	
		Data 3	LD Pulse Width – High Byte	Range：50-300us (1LSB=1us)
		Data 4	LD Pulse Width – Low Byte	
		Data 5~17	0×00	
15	0×51 (Save)	Data 1	LD Current Option 0 Parameters	Range：0-140A(1LSB=1A)
		Data 2	LD Current Option 1 Parameters	Range：0-140A(1LSB=1A)
		Data 3	LD Current Option 2 Parameters	Range：0-140A(1LSB=1A)
		Data 4	LD Current Option 3 Parameters	Range：0-140A(1LSB=1A)
		Data 5~17	0×00	
16	0×52 (Save)	Data 1	Q High Voltage – High Byte	Range：2000-5000(1LSB=1V)
		Data 2	Q High Voltage – Low Byte	
		Data 3~17	0×00	
17	0×53 (Save)	Data 1	APD High Voltage – High Byte	Range：40-450(1LSB=1V)
		Data 2	APD High Voltage – Low Byte	
		Data 3~17	0×00	
18	0×54	Data 1~17	0×00	LD Parameter Query
19	0×55	Data 1	0x01: ON 0x00: OFF	Receiver Status Setting (Receiver ON/OFF Switch)
		Data 2~17	0×00	
20	0×56	Data 1	0x01: ON 0x00: OFF	Q High Voltage Status Setting
		Data 2~17	0X00	
21	0×57	Data1	0x01: ON 0x00: OFF	LD1 Power Status Setting
		Data 2~17	0×00	
22	0×59 (Save)	Data 1	Fan startup temperature point	**Fan Activation Temperature Setting** Unit: **°C** (range: **0–100**)
		Data 2	0x01: Set 0x00: Query	When querying, **Data1 = 0x00**.
		Data 3~17	0×00	
23	0×5A	Data 1	Temperature Index	
		Data 2	Current	Range: 0–140 A (1 LSB = 1 A)
		Data 3	Q Delay – High Byte	Q Delay

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		Data 4	Q Delay – Low Byte	Range: 50–300 μs (1 LSB = 1 μs)
		Data 5	LD Pulse Width – High Byte	LD Pulse Width Range: 50–300 μs (1 LSB = 1 μs)
		Data 6	LD Pulse Width – Low Byte	
		Data 7	Q High Voltage – High Byte	Range：2000-5000(1LSB=1V)
		Data 8	Q High Voltage – Low Byte	
		Data 9~17		
24	0×5B	Data 1~17	0X00	Read Temperature Parameter Command
25	0×5C	Data 1	Disable Automatic Mode: 0x00 Enable Automatic Mode: 0x01	Automatic/Manual Mode Switching Command
		Data 2-17		
26	0×5D	Data 1~17	0×00	Query Current Temperature Parameter Command
27	0×5E	Data 1-17	0×00	Disable 70 °C Over-Temperature Shutdown Command
28	0×5F	Data 1~17	0×5F	Serial Port Firmware Upgrade Command
29	0×60	Data 1~17	0×00	Software Version Query

Table 3 — Laser Return Data

No.	Command	Description	Remarks
Byte 1	0×EB	Frame Header 1	
Byte 2	0×90	Frame Header 2	
Byte 3	0×18	Data Length	Byte3~Byte26
Byte 4	0×00	Laser Stop Ranging/Illumination	Rangefinder /Internal Trigger
	0×01	Single-Shot Ranging	
	0×02	1 Hz Ranging	
	0×03	1–25 Hz Ranging Start	1-25Hz
	0×04	External Sync Illumination Setting	
	0×05	Internal/External Sync Illumination Start	
	0×06	Range Gate Setting	
	0×07	Range Gate Query	
	0×08	Internal Sync Illumination Period Setting	
	0×09	Internal Sync Illumination Period Query	
	0×0A	Time Code Setting	
	0×0B	Internal/External Sync Illumination Switching	
	0×0C	LD Current Option Setting	
	0×0D	1 Hz Status Frame	Uploaded at 1 Hz when the laser is not emitting
	0×50	Q-Delay and LD Pulse Width Setting	
	0×51	LD Current Setting	
	0×52	Q High Voltage Setting	
	0×53	APD High Voltage Setting	
	0×54	LD Parameter Query	

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	0×55	Receiver Status Setting (Receiver ON/OFF Switch)	
	0×56	Q High Voltage Status Setting	
	0×57	LD1 Power Status Setting	
	0×59	Fan Activation Temperature Point	
	0×5A	Write Temperature Parameter Command	
	0×5B	Read Temperature Parameter Command	
	0×5C	Automatic/Manual Mode Switching Command	
	0×5D	Query Current Temperature Parameter Command	
	0×5E	Disable 70°C Over-Temperature Shutdown Command	
	0×60	Software Version Query	
	0×EE	Receive Data Error	
	0×ED	Parameter Setting Failed	
Byte 5~21	Data 1~17		
Byte 22	Data 18	Status Word 1	
Byte 23	Data 19	Status Word 2	
Byte 24	Data 0	Ambient Temperature	S8,1LSB=1℃
Byte 25	Data 21	LD Temperature	S8,1LSB=1℃
Byte 26	Checksum		Sum of bytes 3 through 25

Table 4 — Laser Return Data Description
Relationship between **Byte 4** and **Bytes 5–25**

NUM	Byte4	Byte5~Byte25 Data1~17		Remarks
1	0×00	Data1~17	0×11	Laser Stop
2	0×01、0×02、0×03、0×05、	Data 1	Distance 1 High Byte	Target distance values for Single-Shot Ranging, 1 Hz Ranging, 1–25 Hz Ranging, and Internal/External Sync Laser Designation, in meters (m)
		Data 2	Distance 1 Low Byte	
		Data 3	Distance 2 High Byte	
		Data 4	Distance 2 Low Byte	
		Data 5	Distance 3 High Byte	
		Data 6	Distance 3 Low Byte	
		Data 7~17	0×00	
3	0×04	Data 1	External Sync Emission Delay – High Byte	**External Sync Laser Designation — Laser Emission Delay After Receiving the External Sync Signal** Range: **303.0–305.0 µs** (1 LSB = 0.1 µs) Default: **304.0 µs** (1 LSB = 0.1 µs)
		Data 2	External Sync Emission Delay – Low Byte	
		Data 3~17	0×00	
4	0×06、	Data 1	Range Gate High Byte – Near	**Range Gate Setting, Range Gate Query**

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	0×07		Range	**Range Gate Setting** Unit: **meters** (minimum ranging distance **300 m**, maximum ranging distance **50,000 m**).	
		Data 2	Range Gate Low Byte – Near Range		
		Data 3	Range Gate High Byte – Far Range		
		Data 4	Range Gate Low Byte – Far Range		
		Data 5~17	0×00		
5	0×08、0×09	Data 1	Internal Sync Illumination Period – High Byte	Internal Sync Illumination Period Setting	**Internal Sync Laser Designation Period T.** Laser designation period = **45,000 µs to 125,000 µs**, unit: **µs** Default: **50,000 µs (20 Hz)**
		Data 2	Internal Sync Illumination Period – Middle Byte		
		Data 3	Internal Sync Illumination Period – Low Byte		
		Data 4	Internal Sync Illumination Duration		Unit: seconds, range 1–90, default 90
		Data 5	Internal Sync Illumination Interval		Unit: seconds, range 1–255, default 40
		Data 6	Internal Sync Illumination Cycle Count		Range: 1–4, default 1
		Data 6-Data 17	0×00		
6	0×0A	Data 1	Time Code length	Time Code length	**Range: 1–8 (1 LSB = 1)** **Default: 1**
		Data 2	Time Code 1 – High Byte	Time Code 1 1LSB=1us	Length: 8 Time Code values 1 LSB = 1 µs Range: 40,000–60,000 µs Default: 8 Time Code values set to 50,000 µs Each Time Code value is 16 bits (high byte first, low byte second).
		Data 3	Time Code 1 – Low Byte		
		Data 4	Time Code 2 - High Byte	Time Code 2 1LSB=1us	
		Data 5	Time Code 2 - Low Byte		
		Data 6	Time Code 3 - High Byte	Time Code 3 1LSB=1us	
		Data 7	Time Code 3 - Low Byte		
		Data 8	Time Code 4 - High Byte	Time Code 4 1LSB=1us	
		Data 9	Time Code 4 - Low Byte		
		Data 10	Time Code 5 - High Byte	Time Code 5 1LSB=1us	
		Data 11	Time Code 5 - Low Byte		
		Data 12	Time Code 6 - High Byte	Time Code 6 1LSB=1us	
		Data 13	Time Code 6 - Low Byte		
		Data 14	Time Code 7 - High Byte	Time Code 7 1LSB=1us	
		Data 15	Time Code 7 - Low Byte		

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		Data 16	Time Code 8 - High Byte	Time Code 8 1LSB=1us	
		Data 17	Time Code 8 - Low Byte		
7	0×0B	Data 1	**Internal Sync: 0x00** **External Sync: 0x01**	Internal/External Sync Laser Designation Switching	
		Data 2~17	0×00		
8	0×0C	Data 1	**LD Current Option 0: 0x00** **LD Current Option 1: 0x01** **LD Current Option 2: 0x02** **LD Current Option 3: 0x03**	**LD Current Option Setting** **Default: LD Current Option 0**	
		Data 2~17	0×00		
9	0×0D (1Hz 上传)	Data 1	External Sync Emission Delay – High Byte	**External Sync Laser Designation — Laser Emission Delay After Receiving the External Sync Signal** Range: **303.0–305.0 μs** (1 LSB = 0.1 μs) Default: **304.0 μs** (1 LSB = 0.1 μs)	
		Data 2	External Sync Emission Delay – Low Byte		
		Data 3	Time Code length	**Range: 1–8 (1 LSB = 1)** **Default: 1**	
		Data 4	Internal Sync Illumination Period – High Byte	**Internal Sync Laser Designation Period T.** Laser designation period = **45,000 μs to 125,000 μs**, unit: **μs** Default: **50,000 μs (20 Hz)**	
		Data 5	Internal Sync Illumination Period – Middle Byte		
		Data 6	Internal Sync Illumination Period – Low Byte		
		Data 7	Range Gate High Byte – Near Range	**Range Gate Setting, Range Gate Query** **Range Gate Setting** Unit: **meters** (minimum ranging distance **300 m**, maximum ranging distance **50,000 m**)	
		Data 8	Range Gate Low Byte – Near Range		
		Data 9	Range Gate High Byte – Far Range		
		Data10	Range Gate Low Byte – Far Range		
		Data11~17	0×00		
10	0×50	Data 1	Q Delay – High Byte	**Laser Q-Delay and LD Pulse Width Setting/Query** Range: **50–300 μs** (1 LSB = 1 μs)	
		Data 2	Q Delay – Low Byte		
		Data 3	LD Pulse Width – High Byte	Range: 50–300 μs (1 LSB = 1 μs)	
		Data 4	LD Pulse Width – Low Byte		
		Data 5~17	0x00		
11	0×51	Data 1	Set LD Current Option 0	Range：0-140A(1LSB=1A)	
		Data 2	Set LD Current Option 1	Range：0-140A(1LSB=1A)	
		Data 3	Set LD Current Option 2	Range：0-140A(1LSB=1A)	

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		Data 4	Set LD Current Option 3	Range：0-140A(1LSB=1A)
		Data5~17	0x00	
12	0×52	Data 1	Q High Voltage 1 – High Byte	Range：2000-5000(1LSB=1V)
		Data 2	Q High Voltage 1 – Low Byte	
		Data 3~17	0×00	
13	0×53	Data 1	APD High Voltage – High Byte	Range：40-450(1LSB=1V)
		Data 2	APD High Voltage – Low Byte	
		Data 3~17	0x00	
14	0×54	Data 1	Q Delay – High Byte	Range：50-300us (1LSB=1us)
		Data 2	Q Delay – Low Byte	
		Data 3	LD Pulse Width – High Byte	Range：50-300us (1LSB=1us)
		Data 4	LD Pulse Width – Low Byte	
		Data 5	LD Current Option 0	Range：0-140A(1LSB=1A)
		Data 6	LD Current Option 1	Range：0-140A(1LSB=1A)
		Data 7	LD Current Option 2	Range：0-140A(1LSB=1A)
		Data 8	LD Current Option 3	Range：0-140A(1LSB=1A)
		Data 9	Q High Voltage – High Byte	Range：2000-5000(1LSB=1V)
		Data 10	Q High Voltage – Low Byte	
		Data 11	APD High Voltage – High Byte	Range：40-450(1LSB=1V)
		Data 12	APD High Voltage – Low Byte	
		Data 13	External Sync Emission Delay – High Byte	**External Sync Laser Designation — Laser Emission Delay After Receiving the External Sync Signal** Range: **303.0–305.0 μs** (1 LSB = 0.1 μs) Default: **304.0 μs** (1 LSB = 0.1 μs)
		Data 14	External Sync Emission Delay – Low Byte	
		Data 15	Fan Activation Temperature Point	
		Data 16~17	0×00	
15	0×55	Data 1	0x01: ON 0x00: OFF	Receiver Status Setting
		Data 2~17	0×00	
16	0×56	Data 1	0x01: ON 0x00: OFF	Q High Voltage Status Setting
		Data 2~17	0×00	
17	0×57	Data 1	0x01: ON 0x00: OFF	LD1 Power Status Setting
		Data 2~17	0×00	
18	0×59	Data1	0x01: ON 0x00: OFF	Fan Activation Temperature Point (range 0–100)

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		Data 2~17	0×00	
19	0×5A、0×5B	Data 1	Temperature Index	1-121
		Data 2	Current	Range：0-140A(1LSB=1A)
		Data 3	Q Delay – High Byte	Q Delay Range：50-300us (1LSB=1us)
		Data 4	Q Delay – Low Byte	
		Data 5	LD Pulse Width – High Byte	LD Pulse Width Range：50-300us (1LSB=1us)
		Data 6	LD Pulse Width – Low Byte	
		Data 7	Q High Voltage – High Byte	Range：2000-5000(1LSB=1V)
		Data 8	Q High Voltage – Low Byte	
		Data 9~17		
20	0×5C	Data 1	**Disable Automatic Mode: 0x00** **Enable Automatic Mode: 0x01**	Automatic/Manual Mode Switching Command
		Data 2-17		
21	0×5D	Data 1	Current	Range：0-140A(1LSB=1A)
		Data 2	Q Delay – High Byte	Q Delay Range：50-300us (1LSB=1us)
		Data 3	Q Delay – Low Byte	
		Data 4	LD Pulse Width – High Byte	LD Pulse Width Range：50-300us (1LSB=1us)
		Data 5	LD Pulse Width – Low Byte	
		Data 6	Q High Voltage – High Byte	Range：2000-5000(1LSB=1V)
		Data 7	Q High Voltage – Low Byte	
		Data 8	Current Temperature Point	Disable Automatic Mode, fixed at –55
		Data 9~17		
22	0×5E	Data 1-17	0×00	Disable 70 °C Over-Temperature Shutdown Command
23	0×60	Data 1	Year (last two digits, e.g., 25 for 2025)	ARM Software Version
		Data 2	Month	
		Data 3	Day	
		Data 4	AA fixed value	
		Data 5	Current Version	
		Data 6	Current Version Revision	
		Data 7	Year (last two digits, e.g., 25 for 2025)	FPGA Software Version
		Data 8	Month	
		Data 9	Day	
		Data 10	AA fixed value	

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		Data 11	Current Version	
		Data 12	Current Version Revision	
		Data 13-17		
24	0×EE	Data 1~17	0×EE	Receive Data Error
25	0×ED	Data 1~17	0×ED	Parameter Setting Failed

Status Word 1

Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
Internal/External Sync Illumination 0: Internal 1: External	Ready / Standby 0: Standby 1: Preparing	Temperature Sensor Status 0: Normal 1: Error	Main Pulse 0: Normal 1: Error	Receiver ON/OFF Switch 0: ON 1: OFF	Receiver Current Status 0: ON 1: OFF	Ambient Temperature 0: Normal 1: Error	LD Temperature 0: Normal 1: Error (Over-Temperature > 70 °C)

Status Word 2

Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
Laser Designation Status 0: No Emission 1: Emitting	LD Current Status 0: Normal 1: Error	LD Power Status 0: ON 1: OFF	External Sync Signal Status 0: Normal 1: Error	X Default: 0	X Default: 0	LD Current Option LD Current Option 0: 0x00 LD Current Option 1: 0x01 LD Current Option 2: 0x02 LD Current Option 3: 0x03	

After laser emission ends, one complete data frame will be automatically returned.

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