ERDILRF

# 1535nm Eye-safe Laser Ranging Module

Model: LRF0612C

## 1. PRODUCT DESCRIPTION

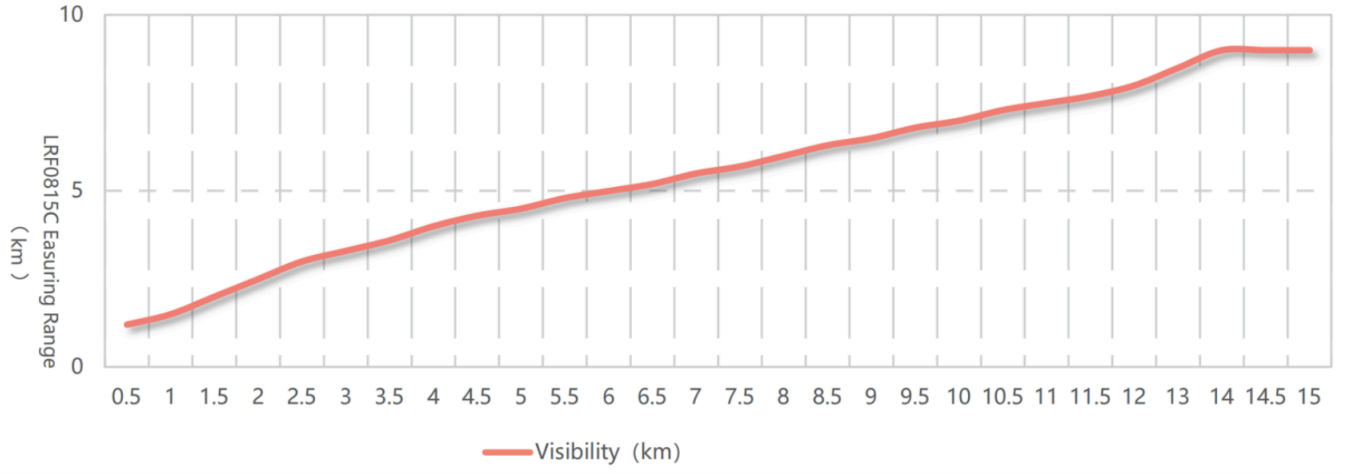
The LRF0612C is a 6km 1535nm Class I eye-safe multi-pulse laser rangefinder module delivering ≥200μJ pulses, ≤0.3mrad divergence and 50–6000m range with ±2m accuracy, ≤0.1m resolution and up to three simultaneous targets at 1–10Hz. Powered from a 4.5–16V supply with ≤4W average power in a 65×48×32mm, ≤58g housing and controlled via TTL UART, it is ideal for security monitoring, traffic cameras, UAV payloads, robotic systems, thermal imagers and smart infrastructure sensors.




## 2. TECHNICAL SPECIFICATIONS

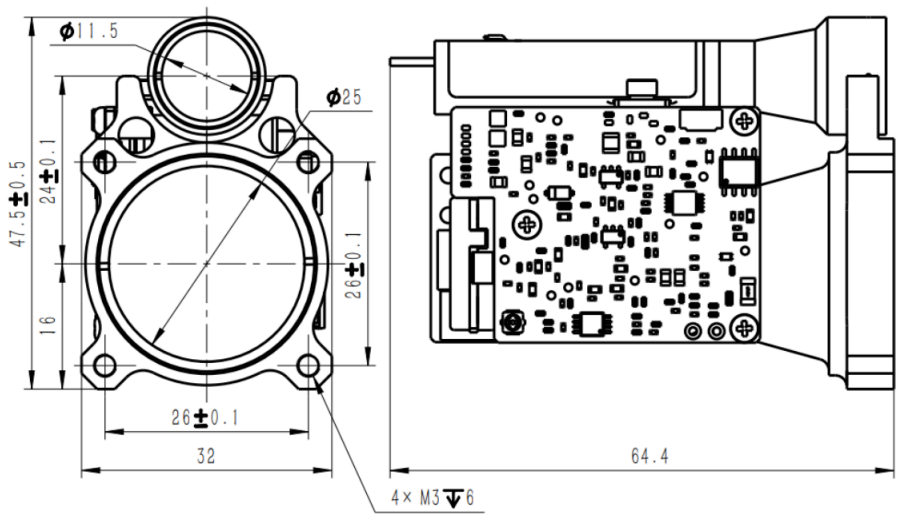
| PROJECT | PERFORMANCE INDICATORS |
|---|---|
| Model | LRF0612C |
| Laser Wavelength | 1535±5nm |
| Eye- safety | Class I |
| Divergence Angle | ≤0.3 mrad |
| Laser Energy | ≥200 μJ |
| Launch Lens Diameter | Φ12 mm |
| Receiver Lens Diameter | Φ25 mm |
| Measuring Range<br>(Reflectance 30%; visibility ≥ 8 km.) | Reference target(2.3m×2.3m)≥6000m<br>Measuring human target(0.5m×1.7m) ≥1200m |
| Minimum Range | ≤50 m |
| Ranging Frequency | 1Hz ~10Hz |
| Number of multi-target detections | Up to 3 targets |
| Ranging Accuracy | ±2 m |
| Range Resolution | ≤0.1 m |
| Precision Rate | ≥98% |
| False Alarm Rate | ≤1% |
| Pin-in-lead package model | A1257WR-S-6P |
| Supply Voltage | DC 4.5 ~ 16 V |
| Standby power consumption | ≤1 mW |
| Average power consumption | ≤4 W @ |
| Peak Power Consumption | ≤14W @12 V |
| Weight | ≤ 58±1g |

| | |
|---|---|
| Dimension (L×W×H) | 65mm×48mm×32 mm |
| Operating Temperature | -40 ~ +70 ℃ |
| Storage Temperature | -55 ~ +75 ℃ |
| Impact Resistance | Per factory shock test procedure |
| Vibration Resistance | Per factory vibration test procedure |




## 3. MECHANICAL DIMENSIONS

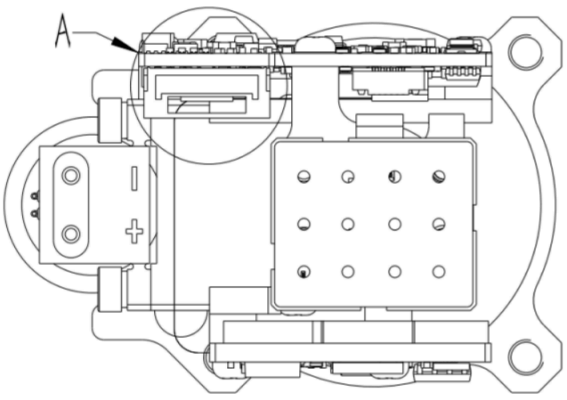
The overall dimension of the ranging module and the user installation interface are shown in the figure below.

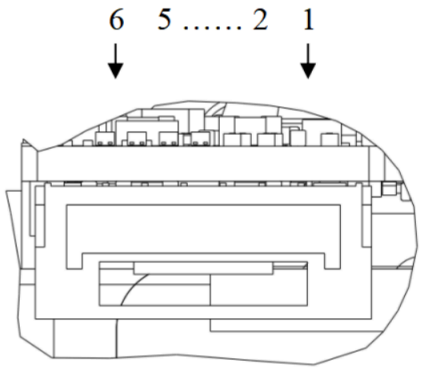



## 4. PIN INTERFACE

User electrical interface:UART,TTL_ 3.3V

The connector model of electrical interface is A1257WR-S-6P, and the specific wiring definition is shown in the table below.




| Pin | Definition | Description | Cable color |
|---|---|---|---|
| 1 | Positive power supply | Power supply, 4.5 ~ 16V | Red |
| 2 | Negative power supply | Power supply, ground | Black |
| 3 | POWER_ON | Module power switch, TTL_ 3.3V level;<br>Module on (> 2.7V), module off (< 0.3V); | White |
| 4 | UART_TX | Serial port sender, TTL_ 3.3V level | Yellow |
| 5 | UART_RX | Serial port receiver, TTL_ 3.3V level | Green |

# 5. COMMUNICATION PROTOCOL

## 5.1 Communication rate and format

| | |
|---|---|
| Format standard | Baud rate: 115200bps (ex factory) / 57600bps / 9600bps<br>Byte data format: 1 start bit, 8 data bits, 1 stop bit, no verification |

### 5.1.1 Basic packet format

| Section description | Section length(number of bytes) | Value range | Remarks |
|---|---|---|---|
| Frame header | 2 | 0xEE<br>0x16 | Fixed value |
| Data length | 1 | 2~9 | The data length is the total number of bytes in the three parts: device code, command code and command parameters |
| Equipment code | 1 | 0x03 | Fixed value, LRF S Series ranging module |
| Command code | 1 | 0~255 | Indicates the control object of the current control command |
| Command parameters | 0~4 | 0~255 | Indicates the control object parameters of the current control command |
| Checksum | 1 | 0~255 | Checksum is the sum of all byte data in the three parts of equipment code, command code and command parameters, with the lower 8 bits |

### 5.1.2 control command (system → ranging module)

| Command code | explain | Command parameter bytes |
|---|---|---|
| 0x01 | Equipment self inspection | 0 |
| 0x02 | Single ranging | 0 |
| 0x03 | Set first / last / multiple targets | 1 |
| 0x04 | Continuous ranging | 0 |
| 0x05 | Stop ranging | 0 |
| 0xA0 | Set baud rate of laser ranging module | 4 |
| 0xA1 | Set continuous ranging frequency | 2 |
| 0xA2 | Set minimum gating distance | 2 |
| 0xA3 | Query minimum gating distance | 0 |
| 0xA4 | Maximum gating distance | 2 |
| 0xA5 | Query the maximum gating distance | 0 |
| 0xA6 | Query FPGA software version number | 0 |
| 0xA7 | Query MCU software version number | 0 |
| 0xA8 | Query hardware version number | 0 |
| 0xA9 | Query Sn number | 0 |
| 0x90 | Total times of light output | 0 |
| 0x91 | Query the power on and light out times this time | 0 |

### 5..1.3 Response data (ranging module → system)

| Command code | explain | Command parameter bytes |
|---|---|---|
| 0x01 | Equipment self inspection | 4 |
| 0x02 | Single ranging | 7 |
| 0x03 | Set first / last / multiple targets | 0 |
| 0x04 | Continuous ranging | 4 |
| 0x05 | Stop ranging | 0 |
| 0x06 | Ranging abnormality (only when the state in the ranging abnormality command is abnormal, the command is returned after the response command of single ranging or continuous ranging is returned) | 4 |
| 0xA0 | Set baud rate of laser ranging module | 4 |
| 0xA1 | Set continuous ranging frequency | 2 |
| 0xA2 | Set minimum gating distance | 2 |
| 0xA3 | Query minimum gating distance | 2 |
| 0xA4 | Maximum gating distance | 2 |
| 0xA5 | Query the maximum gating distance | 2 |
| 0xA6 | Query FPGA software version number | 4 |
| 0xA7 | Query MCU software version number | 4 |
| 0xA8 | Query hardware version number | 4 |
| 0xA9 | Query Sn number | 3 |

| | | |
|---|---|---|
| 0x90 | Total times of light output | 3 |
| 0x91 | Query the power on and light out times this time | 3 |

### 5..1.4 Operation process

fter the ranging module is powered on, it is in the standby mode by default. It needs to enable the module power switch (power_on is pulled up) for about 0.5 s (the driving capacitor completes charging), and then all the command operations in 6.2 below can be carried out.

## 5.2 Specific agreement

### 5.2.1 Equipment self inspection

5.2.1.1 Send to laser ranging module:

| Byte | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| Describe | 0xEE | 0x16 | 0x02 | 0x03 | 0x01 | 0x04 |

5.2.1.2 Laser ranging module return:

| Byte | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|---|
| Describe | 0xEE | 0x16 | 0x06 | 0x03 | 0x01 | Status3 | Status2 | Status1 | Status0 | Check_sum |

| | | |
|---|---|---|
| Status3: reserved | | |
| Status2: echo intensity | | 0x00~0xFF |
| Status1: bit0 -- FPGA system status; | 1 Normal | 0 Exception |
| bit1 -- laser light output state; | 1 light output | 0 no light |
| bit2 -- main wave detection status; | 1 main wave | 0 no main wave |
| bit3 -- echo detection status; | 1 echo | 0 no echo |
| bit4 -- bias switch status; | 1 bias on | 0 bias off |
| bit5 -- bias output state; | 1 the bias voltage is normal | 0 bias abnormal |
| bit6 -- temperature state; | 1 the temperature is normal | 0 temperature abnormal |
| bit7 -- light output off state; | 1 valid | 0 invalid |
| Status0: bit0 -- 5v6 power status; | 1 normal | 0 exception |

### 5.2.2 Single ranging

5.2.2.1 Send to laser ranging module:

| Byte | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| Describe | 0xEE | 0x16 | 0x02 | 0x03 | 0x02 | 0x05 |

5.2.2.2 Laser ranging module return:

| Byte | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|---|
| Describe | 0xEE | 0x16 | 0x06 | 0x03 | 0x02 | Status | Ranging value integer high 8 bits | Ranging value integer lower 8 bits | Ranging value decimal places | Check_sum |

When ranging the first / last target:
Status: 0x00 indicates that the ranging result is a single target;
0x01 indicates that there is a front target in the ranging result;
0x02 indicates that there is a rear target in the ranging result;
0x03 reserved;
0x04 indicates that the ranging result is out of range;
0x05 reserved;
In case of multi-target ranging:
Status_ bit3~0：
0x0 indicates that the ranging result is a single target;
0x1 indicates that there is a front target in the ranging result;
0x2 indicates that there is a rear target in the ranging result;
0x3 indicates that the ranging result has front target and rear target;
0x4 indicates that the ranging result is out of range;
0x5 reserved;
Status_ bit7~4：
0x0 ~ 0xf indicates the current distance result number; Value range [0, N-1], number of targets $1 \le N \le 16$;
Range value = range value integer high 8 bits × 256 + range value integer low 8 bits + range value decimal bits × 0.1, unit m

### 5.2.3 Set first / last / multiple targets

5.2.3.1 Send to laser ranging module:

| Byte | 0 | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|---|
| Describe | 0xEE | 0x16 | 0x03(data length) | 0x03 | 0x03 | Target | Check_sum |

Target：0x01 Set the first target ranging;
0x02 set terminal target ranging;
0x03 set multi-target ranging;

5.2.3.2 Laser ranging module return:

| Byte | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| Describe | 0xEE | 0x16 | 0x02 | 0x03 | 0x03 | 0x06 |

### 5.2.4 Continuous ranging

5.2.4.1 Send to laser ranging module:

| Byte | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| Describe | 0xEE | 0x16 | 0x02 | 0x03 | 0x04 | 0x07 |

5.2.4.2 Laser ranging module return:

| Byte | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|---|
| Describe | 0xEE | 0x16 | 0x06 | 0x03 | 0x04 | Status | Ranging value integer high 8 bits | Ranging value integer lower 8 bits | Ranging value decimal places | Check_sum |

When ranging the first and last targets:
Status: 0x00 indicates that the ranging result is a single target;
0x01 indicates that there is a front target in the ranging result;

0x02 indicates that there is a rear target in the ranging result;
0x03 reserved;
0x04 indicates that the ranging result is out of range;
0x05 reserved;
In case of multi-target ranging:
Status_ bit3~0:
0x0 indicates that the ranging result is a single target;
0x1 indicates that there is a front target in the ranging result;
0x2 indicates that there is a rear target in the ranging result;
0x3 indicates that the ranging result has front target and rear target;
0x4 indicates that the ranging result is out of range;
0x5 reserved;
Status_ bit7~4:
0x0 ~ 0xf indicates the current distance result number; Value range [0, N-1], number of targets 1 ≤ N ≤ 16;

### 5.2.5 Stop ranging

5.2.5.1 Send to laser ranging module:

| Byte | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| Describe | 0xEE | 0x16 | 0x02 | 0x03 | 0x05 | 0x08 |

5.2.5.2 Laser ranging module return:

| Byte | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| Describe | 0xEE | 0x16 | 0x02 | 0x03 | 0x05 | 0x08 |

### 5.2.6 Ranging anomaly

Laser ranging module return:

| Byte | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|---|
| Describe | 0xEE | 0x16 | 0x06 | 0x03 | 0x06 | reserve | reserve | reserve | Status1 | Check_sum |

Status1: bit0 -- FPGA system status; 1 normal 0 exception
Bit1 -- laser light output state; 1 light output 0 no light
Bit2 -- main wave detection status; 1 main wave 0 no main wave
Bit3 -- echo detection status; 1 echo 0 no echo
Bit4 -- bias switch status; 1 bias on 0 bias off
Bit5 -- bias output state; 1 The bias voltage is normal 0 bias abnormal
Bit6 -- temperature state; 1 The temperature is normal 0 abnormal temperature
Bit7 -- light output off state; 1 valid 0 is invalid
This instruction is returned only when bit0~7 in status1 is abnormal.

### 5.2.7 Set baud rate of laser ranging module

5.2.7.1 Send to laser ranging module:

| Byte | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|---|
| Describe | 0xEE | 0x16 | 0x06 | 0x03 | 0xA0 | BaudHigh24 | BaudHigh16 | BaudLow8 | BaudLow0 | Check_sum |

5.2.7.2 Laser ranging module return:

| Byte | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|---|
| Describe | 0xEE | 0x16 | 0x06 | 0x03 | 0xA0 | BaudHigh24 | BaudHigh16 | BaudLow8 | BaudLow0 | Check_sum |

### 5.2.8 Set continuous ranging frequency

5.2.8.1 Send to laser ranging module:

| Byte | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|---|
| Describe | 0xEE | 0x16 | 0x04(data length) | 0x03 | 0x0A1 | Freq | Num | Check_sum |
| Freq： 0x01~0x0A Single / continuous ranging frequency<br>Num：0x00 reserve | | | | | | | | |

5.2.8.2 Laser ranging module return:

| Byte | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| Describe | 0xEE | 0x16 | 0x02 | 0x03 | 0xA1 | 0xA4 |

### 5.2.9 Set minimum gating distance

5.2.9.1 Send to laser ranging module:

| Byte | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|---|
| Describe | 0xEE | 0x16 | 0x04(data length) | 0x03 | 0xA2 | DIS_H | DIS_L | Check_sum |
| DIS_H： Distance high 8 bits<br>DIS_L： Distance lower 8 bits<br>DIS： 10~20000 Minimum gating distance range, in M | | | | | | | | |

5.2.9.2 Laser ranging module return:

| Byte | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|---|
| Describe | 0xEE | 0x16 | 0x04(data length) | 0x03 | 0xA2 | DIS_H | DIS_L | Check_sum |
| DIS_H： Distance high 8 bits<br>DIS_L： Distance lower 8 bits<br>DIS： 10~20000 Minimum gating distance range, in M | | | | | | | | |

### 5.2.10 Query minimum gating distance

5.2.10.1 Send to laser ranging module:

| Byte | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| Describe | 0xEE | 0x16 | 0x02 | 0x03 | 0xA3 | 0xA6 |

5.2.10.2 Laser ranging module return:

| Byte | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|---|

| Describe | 0xEE | 0x16 | 0x04(data length) | 0x03 | 0xA3 | DIS_H | DIS_L | Check_sum |
|---|---|---|---|---|---|---|---|---|
| DIS_H: Distance high 8 bits<br>DIS_L: Distance lower 8 bits<br>DIS: 10~20000 Minimum gating distance range, in M | | | | | | | | |

### 5.2.11 Set maximum gating distance

5.2.11.1 Send to laser ranging module:

| Byte | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|---|
| describe | 0xEE | 0x16 | 0x04(data length) | 0x03 | 0xA4 | DIS_H | DIS_L | Check_sum |
| DIS_H: Distance high 8 bits<br>DIS_L: Distance lower 8 bits<br>DIS: 10~20000 Minimum gating distance range, in M | | | | | | | | |

5.2.11.2 Laser ranging module return:

| Byte | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|---|
| describe | 0xEE | 0x16 | 0x04(data length) | 0x03 | 0xA4 | DIS_H | DIS_L | Check_sum |
| DIS_H: Distance high 8 bits<br>DIS_L: Distance lower 8 bits<br>DIS: 10~20000 Minimum gating distance range, in M | | | | | | | | |

### 5.2.12 Query maximum gating distance

5.2.12.1 Send to laser ranging module:

| Byte | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| describe | 0xEE | 0x16 | 0x02 | 0x03 | 0xA5 | 0xA8 |

5.2.12.2 Laser ranging module return:

| Byte | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|---|
| describe | 0xEE | 0x16 | 0x04(data length) | 0x03 | 0xA5 | DIS_H | DIS_L | Check_sum |
| DIS_H: Distance high 8 bits<br>DIS_L: Distance lower 8 bits<br>DIS: 10~20000 Minimum gating distance range, in M | | | | | | | | |

### 5.2.13 Query FPGA software version number

5.2.13.1 Send to laser ranging module:

| Byte | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| describe | 0xEE | 0x16 | 0x02 | 0x03 | 0xA6 | 0xA9 |

5.2.13.2 Laser ranging module return:

| Byte | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|---|
| describe | 0xEE | 0x16 | 0x06 | 0x03 | 0xA6 | Version | Date | MonYear | Author | Check_sum |

| | | |
|---|---|---|
| Version： | bit7~bit4 | Major version number（1~15） |
| | bit3~bit0 | Minor version number（0~15） |
| eg： | 0x10——V1.0 | |
| Data： | Date（1~31） | |
| MonYear： | bit7~bit4 | month（1~12） |
| | bit3~bit0 | particular year（0~15）， Corresponding to 2020-2035 |
| Author： | 0x6c | cliu； |
| | 0x5d | dwu |
| | 0xcc | cycheng |

### 5.2.14 Query MCU software version number

5.2.14.1 Send to laser ranging module:

| Byte | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| describe | 0xEE | 0x16 | 0x02 | 0x03 | 0xA7 | 0xAA |

5.2.14.2 Laser ranging module return:

| Byte | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|---|
| describe | 0xEE | 0x16 | 0x06 | 0x03 | 0xA7 | Version | Date | MonYear | Author | Check_sum |

| | | |
|---|---|---|
| Version： | bit7~bit4 | Major version number（1~15） |
| | bit3~bit0 | Minor version number（0~15） |
| eg： | 0x10——V1.0 | |
| Data： | Date（1~31） | |
| MonYear： | bit7~bit4 | month（1~12） |
| | bit3~bit0 | particular year（0~15A）,Corresponding to 2020-2035 |
| Author： | 0x00 | jyang |
| | 0xf1 | llfu |
| | 0x01 | zqxiong |

### 5.2.15 Query hardware version number2.15.1 Send to laser ranging module:

| Byte | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| describe | 0xEE | 0x16 | 0x02 | 0x03 | 0xA8 | 0xAB |

5.2.15.2 Laser ranging module return:

| Byte | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|---|
| describe | 0xEE | 0x16 | 0x06 | 0x03 | 0xA8 | MBVS | CTVS | APDVS | LDVS | Check_sum |

| | |
|---|---|
| MBVS： | Motherboard hardware version number |
| CTVS： | Control board hardware version number |
| Apdvs: | detection board hardware version number |
| LDVS： | Driver board hardware version number |
| | Bit7 ~ bit4 major version number (1 ~ 15) |

| |
|---|
| bit3 ~ bit0 minor version number (0 ~ 15)<br>eg：0x10——V1. 0 |

### 5.2.16 Query Sn number

5.2.16.1 Send to laser ranging module:

| Byte | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| describe | 0xEE | 0x16 | 0x02 | 0x03 | 0xA9 | 0xAC |

5.2.16.2 Laser ranging module return:

| Byte | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|---|
| describe | 0xEE | 0x16 | 0x05 | 0x03 | 0xA9 | MonYear | Num_H | Num_L | Check_sum |

Monyear: bit7 ~ bit4 months (1 ~ 12)
Bit3 ~ bit0 years (0 ~ 15), corresponding to 2020 ~ 2035
Num_ H: The number is 8 digits high
Num_ 50: Lower 8 digits of No
Num： 1 ~ 999 No

### 5.2.17 Total times of light output

5.2.17.1 Send to laser ranging module:

| Byte | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| describe | 0xEE | 0x16 | 0x02 | 0x03 | 0x90 | 0x93 |

5.2.17.2 Laser ranging module return:

| Byte | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|---|
| describe | 0xEE | 0x16 | 0x05 | 0x03 | 0x90 | PNUM3 | PNUM2 | PNUM1 | Check_sum |

PNUM3: total light output times, bit23 ~ bit16
PNUM2: total light output times, bit15 ~ bit8
PNUM1: total light output times, bit7 ~ bit0

### 5.2.18 Query the power on and light out times this time

5.2.18.1 Send to laser ranging module:

| Byte | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| describe | 0xEE | 0x16 | 0x02 | 0x03 | 0x91 | 0x94 |

5.2.18.2 Laser ranging module return:

| Byte | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|---|
| describe | 0xEE | 0x16 | 0x05 | 0x03 | 0x91 | PNUM3 | PNUM2 | PNUM1 | Check_sum |

PNUM3: total light output times, bit23 ~ bit16
PNUM2: total light output times, bit15 ~ bit8
PNUM1: total light output times, bit7 ~ bit0

### 5.3 Instruction example

| | |
|---|---|
| 3.1 Equipment self inspection<br>SEND: ee 16 02 03 01 04<br>RECV: ee 16 06 03 01 ff 00 f7 ff f9 | 3.5 Set first target<br><br>SEND: ee 16 03 03 03 01 07<br>RECV: ee 16 02 03 03 06 |
| 3.2 Single ranging<br><br>SEND: ee 16 02 03 02 05<br>RECV: ee 16 06 03 02 04 00 00 00 09 | 3.6 Set end goal<br><br>SEND: ee 16 03 03 03 02 08<br>RECV: ee 16 02 03 03 06 |
| 3.3 Continuous ranging<br><br>SEND: ee 16 02 03 04 07<br>RECV: ee 16 06 03 04 04 00 00 00 0b<br>RECV: ee 16 06 03 04 04 00 00 00 0b<br>RECV: …… | 3.7 Set multiple targets<br><br>SEND: ee 16 03 03 03 03 09<br>RECV: ee 16 02 03 03 06 |
| 3.4 Stop ranging<br><br>SEND: ee 16 02 03 05 08<br>RECV: ee 16 02 03 05 08 | 3.8 Set continuous ranging frequency 1Hz<br><br>SEND: ee 16 04 03 a1 01 00 a5<br>RECV: ee 16 02 03 a1 a4 |
| | 3.9 Set continuous ranging frequency 5Hz<br><br>SEND: ee 16 04 03 a1 05 00 a9<br>RECV: ee 16 02 03 a1 a4 |

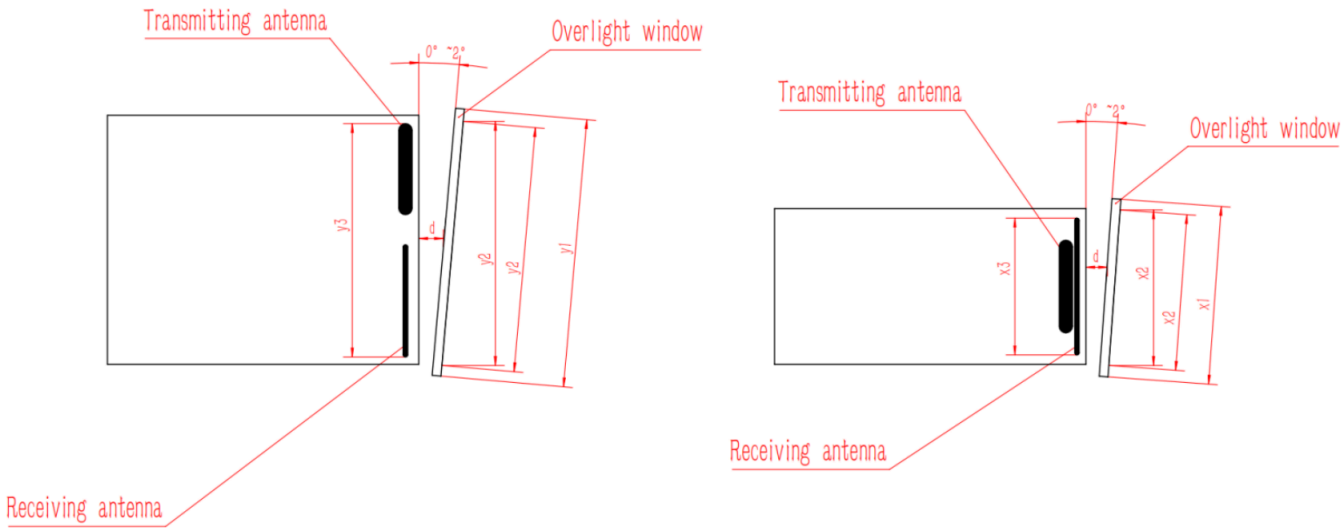
## 6. OPTICAL COATING RECOMMENDATION

For 1535 nm laser rangefinders, it is recommended that the optical window be coated with an **anti-reflective (AR) coating** optimized for 1525 nm–1545 nm, with transmittance ≥ 99%.
Depending on the actual application environment, additional protective coatings such as **hydrophobic** or **hard coatings** can be applied to the external surface. Other performance criteria should comply with the factory environmental test procedure, with overall transmittance > 97%.

**Optical Window Geometry and Installation Recommendations**

- The **effective aperture** of the optical window should be determined according to the specific product design.
- The **outer diameter** of the window should ensure:
  - (Effective aperture – outer diameter) ≥ 2 mm
  - (Antenna outer diameter – projection of effective aperture) ≥ 1.5 mm
    *(See schematic illustration below.)*

- Since the optical window introduces some laser absorption, its **thickness** should be controlled within **2 – 4 mm**, depending on overall dimensions.
- Due to the high transmittance of the window, the **emission optical axis** should be aligned with the **window normal** within **2°–4°**.
  *(See the schematic diagram showing the relative positions of the window and optical barrels.)*
- The **air gap** between the optical window and the rangefinder should be minimized. Figure 3 illustrates two recommended configurations for optical window placement.




The effective aperture of the optical window $y_2$ - the outer diameter of the optical window $y_1$>2mm
The outer diameter of the rangefinder antenna$y_3$-the projection size of the effective aperture of the optical window $y_2$，>1.5mm
The air gap d between the optical window and the rangefinder should be as small as possible

The effective aperture of the optical window $x_2$ - the outer diameter of the optical window $x_1$>2mm
The outer diameter of the rangefinder antenna $x_3$-the projection size of the effective aperture of the optical window $x_2$，>1.5mm
The air gap d between the optical window and the rangefinder should be as small as possible

**Schematic diagrams of two ways of the external dimensions and placement of the optical window**

## 7. DAILY MAINTENANCE AND TROUBLESHOOTING

### 7.1 Measured distance result does not match the actual distance

- If tests are carried out in conditions such as heavy smog or water-mist weather with high humidity, it is easy to measure back water droplets or particles in the air. It is recommended to choose a good test environment.
- Under extreme low-temperature conditions, within 20 m there is a risk that the ranging accuracy exceeds the tolerance.

### 7.2 Ranging performance is reduced, target at theoretical range cannot be measured

- Very low target reflectivity will affect the returned laser energy and thus affect the ranging performance. When the ranging target is a low-reflectivity object such as a lake surface, wet road surface in rainy weather, or glass, the actual performance of the product cannot reach the theoretical range.
- The ranging module does not irradiate the target point vertically but forms a certain angle. In an oblique-measurement state, the returned laser energy will attenuate, resulting in reduced ranging performance.
- Under extreme low-temperature conditions, the ranging performance may decrease slightly.

**7.3 Using our complete communication cable to communicate with the PC, no command response**

Check whether the communication cable is broken (the 6-pin communication cable is thin and easy to break).

**7.4 Using self-prepared cable for communication, no command response**

Check whether the external wiring sequence of the module is correct, whether the communication cable is short-circuited, open-circuited or has poor contact, and check whether the serial-port TX and RX wire order is reversed.

