ERDILRF

1535nm Eye-safe Laser Ranging Module

Model: LRF1221C

1. PRODUCT DESCRIPTION

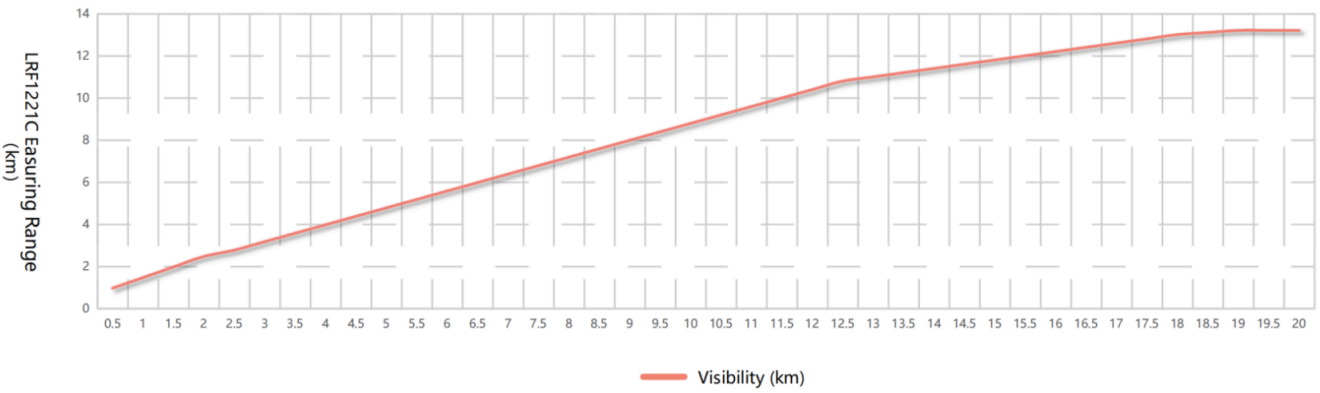
The LRF1221C is a 12km 1535nm Class I eye-safe long-range laser rangefinder module that measures 50–12000 m with ±2 m accuracy, ≤0.3 mrad divergence and up to three targets at 0.5–10 Hz. Powered from 12 V with ≤2 W average power in a 107×62×72 mm, ≤275 g OEM design and offering selectable TTL or RS-422 interfaces, it is ideal for coastal and port monitoring, long-range EO/IR systems, observation and mapping applications.



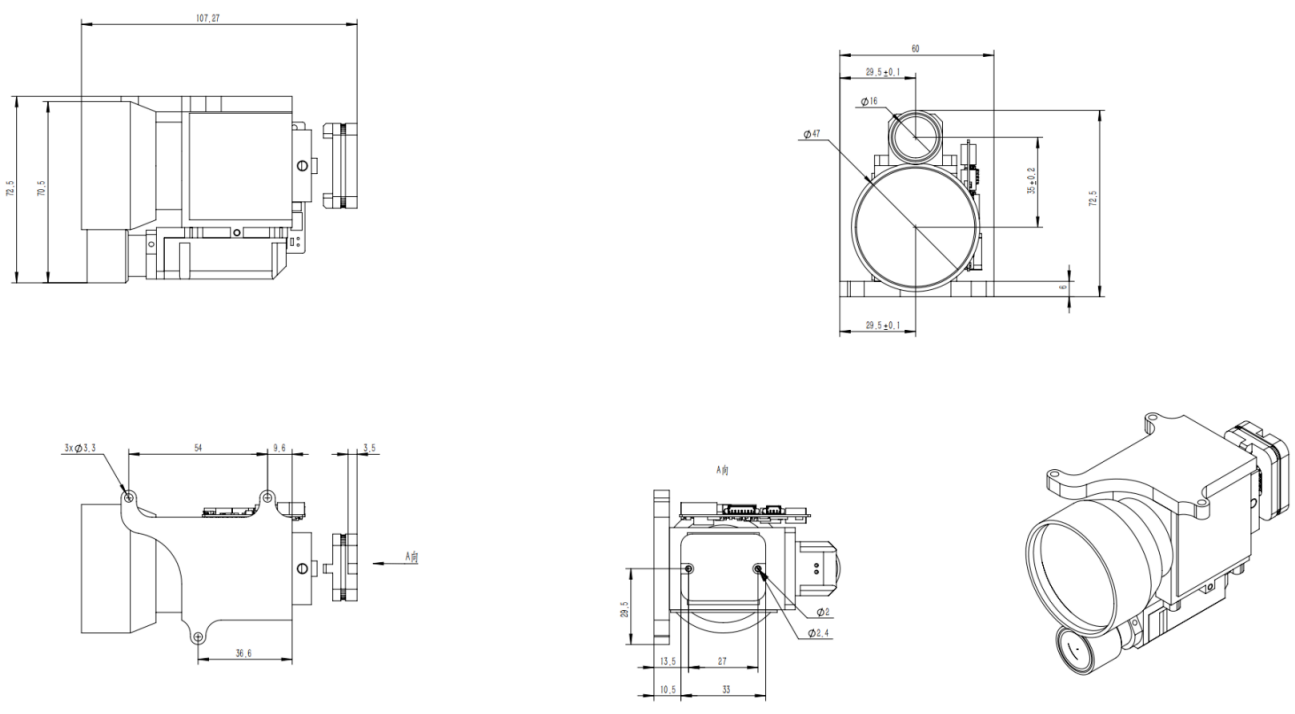
2. TECHNICAL SPECIFICATIONS

PROJECT	PERFORMANCE INDICATORS
Model	LRF1221C
Laser Wavelength	1.54μm±0.02μm
Eye- safety	Class I
Divergence Angle	≤0.3 mrad
Laser Energy	≥300 μJ
Launch Lens Diameter	Φ12 mm
Receiver Lens Diameter	Φ40 mm
Measuring Range (Reflectance 30%; visibility ≥15km.)	4m × 6m Objective ≥12 km
Minimum Range	≤50 m
Ranging Frequency	0.5Hz ~10Hz
Communication interface	RS422
Ranging Accuracy	±2 m
Range Resolution	≤0.1 m
Precision Rate	≥98%
False Alarm Rate	≤1%
Pin-in-lead package model	J30J
Supply Voltage	DC12 V
Standby power consumption	≤1.2W
Average power consumption	≤2 W
Peak Power Consumption	≤3W@10Hz

Weight	≤275g
Dimension (L×W×H)	107×62×72mm
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



107×62×72mm

4. PIN INTERFACE

Selectable between TTL (Molex 51021-0500) / RS-422 (J30J)

4.1 Electrical connector model: Molex51021-0500. The detailed definition of the electrical interface is as follows:

Table 1 Interface definition

External plug-in XS3	Model：Molex51021-0500	Remark
1	TTL RX	3.3V
2	TTL TX	3.3V
3	CTRL	3.3V-5V power on, 0V power off
4	+12V	Power supply+
5	GND	Power supply-

4.2. Electrical connector model: J30J; The corresponding plug and cable shall be provided by Party B. The detailed definition of the electrical interface is shown in the following table:

Interface Definition

Pin	Definition	Function	Remarks
1	GND	Serial Port Ground	
2	GND	12V Input Negative	
3	GND	12V Input Negative	
4	VCC 5V	12V Input Positive	
5	VCC 5V	12V Input Positive	
6	RS422 RX+	Serial Port Receive +	From the upper computer to the rangefinder
7	RS422 RX-	Serial Port Receive -	From the upper computer to the rangefinder
8	RS422 TX-	Serial Port Transmit -	From the rangefinder to the upper computer
9	RS422 TX+	Serial Port Transmit +	From the rangefinder to the upper computer

5. COMMUNICATION PROTOCOL

Communication format:Selectable between TTL/RS422 communication, baud rate 115200bps;
Data format: 8 bits of data, one start bit, one stop bit, no parity check, the data consists of header byte, command part, data length, parameter part, check byte;.
Communication method: The main control and the distance measuring machine adopt a master-slave communication method. The main control sends control commands to the distance measuring machine, and the distance measuring machine receives and executes the instructions. In the ranging state, the ranging machine sends back the data and status of the ranging machine to the host computer according to the ranging cycle. The communication format and command content are as shown in the table below.

- Master sending

The format of the sent message is as follows:

STX0	CMD	LEN	DATA1H	DATA1L	CHK

Send message format description

Table 2 Description of sending message format

No.	Name	illustrate	code	Remark
1	STX0	Message start flag	55(H)	
2	CMD	Command word	See table 3	
3	LEN	Data length	The number of all bytes except the start flag, command word, and checksum	
4	DATAH	parameter		
5	DATAL			
6	CHK	XOR check	Except for the validation byte, other bytes are XORed	

The command is described as follows:

Table 3 Description of commands and data words sent by the main control to the distance measuring machine

	command word	Functions	Data byte	Remarks	Length	sample code (computing)
1	0x00	Standby (continuous ranging stop)	DATAH=00（H） DATAL=00（H）	Distance measuring machine stops working	6 bytes	55 00 02 00 00 57
2	0x01	Single ranging	DATAH=00（H） DATAL=00（H）		6 Bytes	55 01 02 00 00 56
3	0x02	Continuous ranging	DATAH=XX（H） DATAL=YY（H）	DATA expresses the ranging period in ms.	6 bytes	55 02 02 03 E8 BE (1Hz ranging)
4	0x03	Self-test	DATAH=00（H） DATAL=00（H）		6 Bytes	55 03 02 00 00 54
5	0x04	Distance selection and nearest distance setting	DATAH=XX（H） DATAL=YY（H）	DATA expresses the blind zone value, unit 1m	6 Bytes	55 04 02 00 64 37 (100m closest)
6	0x06	Cumulative number of light out query	DATAH=00（H） DATAL=00（H）	Cumulative number of light out query	6 bytes	55 06 02 00 00 51
7	0x11	APD power on	DATAH=00（H） DATAL=00（H）		6 bytes	55 11 02 00 00 46
8	0x12	APD power off	DATAH=00（H） DATAL=00（H）		6 bytes	55 12 02 00 00 45

	command word	Functions	Data byte	Remarks	Length	sample code (computing)
9	0xEB	Number Query	DATAH=00（H） DATAL=00（H）		6 bytes	55 EB 02 00 00 BC

- Master receive format

The receive message format is as follows:

STX0	CMD	LEN	DATAn	DATA0	CHK

Table 4 Description of receive message format

No.	Name	Description	Code	Remarks
1	STX0	Message start flag 1	55(H)	
2	CMD_JG	Data command word	See Table 5	
3	LEN	Data length	Number of all bytes except start flag, command word, and checksum	
4	Dn	Parameter	See Table 5	
5	D0			
6	CHK	Checksum	All bytes except parity byte	

Master receive status description:

Table 5 Description of the data word sent from the rangefinder to the master control

No.	command word	Functions	Data byte	Remarks	Total length
1	0x00	Standby (continuous ranging stop)	D1=00（H） D0=00（H）		6 bytes
2	0x03	Self-test	D7 ~D0	D0: char type, indicates APD temperature in degrees Celsius; D1: APD high-voltage value, unit V; D3-D2: blind value, unit 1m D5-D4: -5V voltage, unit 0.01V. D7-D6:+5V voltage, unit 0.01V	12 bytes
3	0x04	Setting of the nearest distance to the opt-in, unit m	D1 D0	DATA expresses the closest distance value in 1m; First high then low	6 bytes
4	0x06	Cumulative number of light out query	D3~D0	DATA expresses the number of times the light is emitted, 4 bytes, the high byte comes first	8 bytes
5	0x11	APD power on	DATAH=00（H） DATAL=00（H）	APD with high voltage	6 Bytes
6	0x12	APD power off	DATAH=00（H） DATAL=00（H）	APD without high voltage	6 Bytes
7	0xED	Work timeout	0x00 0x00	The laser is in laser protection and cannot measure the distance.	6 bytes

No.	command word	Functions	Data byte	Remarks	Total length
8	0xEE	Validation error	0x00 0x00		6 bytes
9	0XEF	Serial communication timeout	0x00 0x00		6 bytes
10	0x01	Single Distance Measurement	D9 D8 D7 D6 D5 D4 D3 D2 D1 D0	D8-D6 first target distance (unit 0.1m) D5-D3 second target distance (data is 0 when single target) (unit 0.1m) D2-D0 third target distance (data is 0 when single target) (unit 0.1m) 3 target from near to far D9 (bit7-bit0) flag byte: D9 bit 7 indicates main wave; 1: with main wave, 0: without main wave. D9 bit 6 indicates return wave; 1: with return wave, 0: without return wave D9 bit 5 indicates the laser status; 1: laser normal, 0: laser failure D9 bit 4 timeout alarm; 1 normal, 0 timeout D9 bit 3 invalid, =1 D9 bit 2 indicates APD status; 1: normal, 0: error D9 bit 1 indicates whether there is a former target; 1: target, 0: no target (the target before the main target is the former target) D9 bit 0 indicates whether there is an after-target; 1: with target, 0: without target (the target after the main target is the after-target)	14 bytes
11	0x02	Continuous distance measurement	D9 D8 D7 D6 D5 D4 D3 D2 D1 D0	D8-D6 first target distance (unit 0.1m) D5-D3 second target distance (data is 0 when single target) (unit 0.1m) D2-D0 third target distance (data is 0 when single target) (unit 0.1m) 3 target from near to far D9 (bit7-bit0) flag byte: D9 bit 7 indicates main wave; 1: with main wave, 0: without main wave. D9 bit 6 indicates return wave; 1: with return wave, 0: without return wave D9 bit 5 indicates the laser status; 1: laser normal, 0: laser failure D9 bit 4 timeout alarm; 1 normal, 0 timeout D9 bit 3 invalid, =1	14 bytes

No.	command word	Functions	Data byte	Remarks	Total length
				D9 bit 2 indicates APD status; 1: normal, 0: error D9 bit 1 indicates whether there is a former target; 1: target, 0: no target (the target before the main target is the former target) D9 bit 0 indicates whether there is an after-target; 1: with target, 0: without target (the target after the main target is the after-target)	
14	0xEB	Number Search	D16…… D0	D15 D12 Complete model D11 D10 Product number D9 D6 Software version D5 D4 APD number D3 D2 Laser number D1 D0 FPGA version	20 bytes

Remarks: ① Undefined data byte/bit, default is 0;

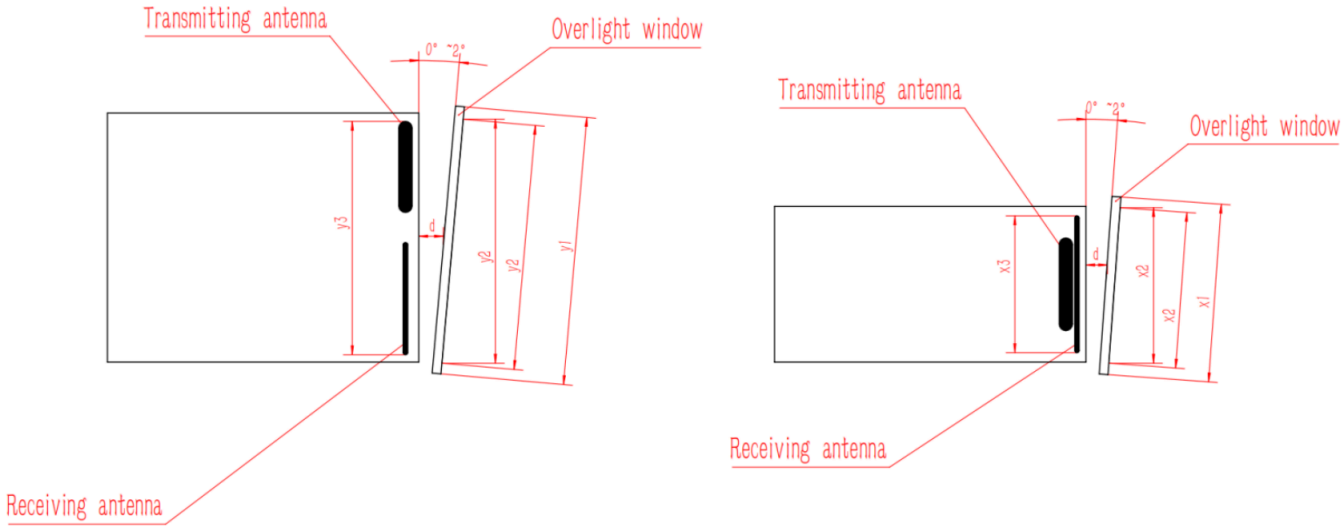
6. OPTICAL COATING RECOMMENDATION

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 antennay_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.



