ERDI LASER®

1535nm Eye-safe Laser Ranging Module

1 PRODUCT DESCRIPTION

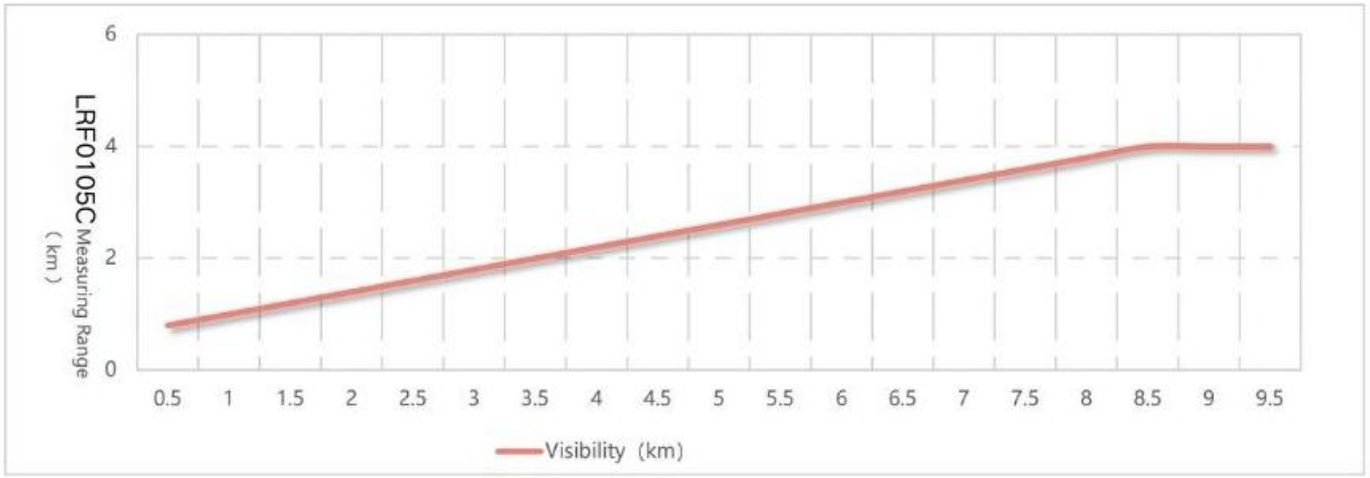
The 1535nm erbium glass laser rangefinder is developed and produced using the self - developed bonded crystal erbium glass laser. It belongs to the Class 1 eye - safe laser rangefinder. It can measure NATO targets at a distance of ≥3000m, featuring a small size and low power consumption. It is a precision optoelectronic product that calculates distance information by emitting laser to the target to be measured and based on the laser flight time. This laser rangefinder achieves communication through a 3.3V TTL communication interface, and is characterized by outstanding performance and simple operation.

2 TECHNICAL SPECIFICATIONS

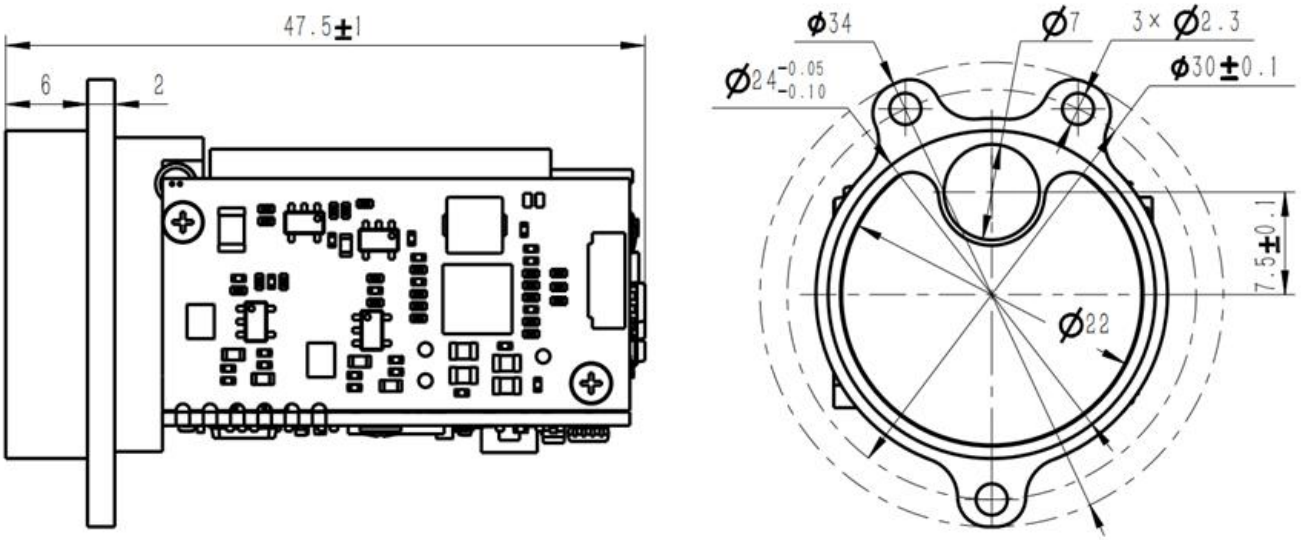
PROJECT	PERFORMANCE INDICATORS
Model	LRF0105C
Laser Wavelength	1535±5nm
Eye- safety	Class I
Divergence Angle	≤1mrad
Laser Energy	≥100 μJ
Launch Lens Diameter	Φ8 mm
Receiver Lens Diameter	Φ20 mm
Measuring Range (Reflectance 30%; visibility ≥ 5km.)	NATO objective(2.3m×2.3m) ≥3000m Measuring human target(0.5m×1.7m) ≥1500m
Minimum Range	≤15 m
Ranging Frequency	Single, 1Hz, 5Hz, 10Hz
Number of multi-target detections	Up to 3 targets
Ranging Accuracy	±2 m
Range Resolution	≤20 m
Precision Rate	≥98%
False Alarm Rate	≤1%

https://erdicn.com **Email :** sales@erdicn.com
Tel: +86-28-81076698 **Fax:**+86-28-87897578
ERDI TECH LTD

Pin-in-lead package model	FWF08002-S06B13W5M
Supply Voltage	DC3 ~ 5 V
Standby power consumption	≤1mW
Average power consumption	≤0.8W
Peak Power Consumption	≤1.5W
Weight	≤29±1 g
Dimension (L×W×H)	Φ34mm×47.5mm
Operating Temperature	-40 ~ +70 ℃
Storage Temperature	-55 ~ +75 ℃
Impact Resistance	Meet the MIL-STD-810G testing standard
Vibration Resistance	Meet the MIL-STD-810G testing standard



3 OUTLINE DIMENSION(mm)



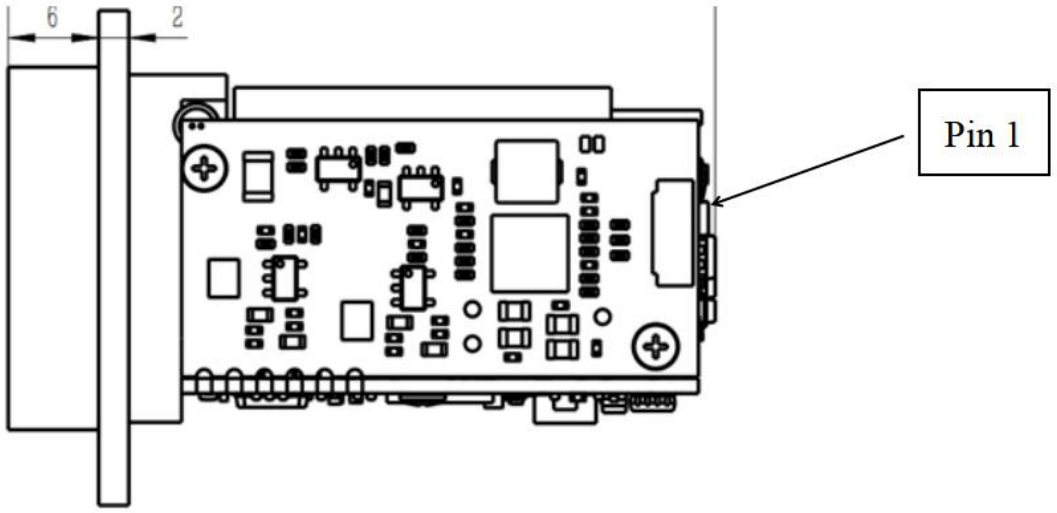
Mechanical and optical interface diagram

4 PIN INTERFACE

a) Power supply voltage: 3~5V;
The host computer realizes cross-linking test with the rangefinder through a 6PIN connector (FWF08002-S06B13W5M (Teska connector)). The pin definition of the communication port on the rangefinder is shown in the table.

Product electrical pin definition

Pin	Identification number	Definition of electrical characteristics	Cable color
P-1	COM	Input power negative pole	Power supply
P-2	VIN+	Input power positive pole	
P-3	-	(Empty)	
P-4	TTL_TXD	Signal output port	From rangefinder to host computer
P-5	TTL_RXD	Signal input port	From host computer to rangefinder
P-6	POWER_CTL	Low power control port	＞0.7V to turn on, ＜0.15V to turn off



Connector connection 1 pin position

5 EMBEDDED SOFTWARE

1. Interface Overview

The system is connected to the laser rangefinder through the TTL interface. The system sends control commands to the laser rangefinder through the serial port and receives the status and self-test information of the laser rangefinder.

2. Communication interface

The data transmission between the rangefinder and the host computer includes the following:

- Control commands: including single, 1Hz ranging commands, 5Hz ranging commands (expandable), query commands, etc.;
- Return data: including distance information, ambient temperature, rangefinder status, etc.

The data exchange between the rangefinder and the host computer adopts TTL communication, and its characteristics are as follows:

- Baud rate: 115200bps (factory)/57600bps/9600bps;
- Byte structure: low bit first, high bit last;
- Byte composition: 1 start bit, 8 data bits, 1 stop bit, no check.

3. Basic format of data packet

Table 1 Data packet format

Segment description	Segment length (bytes)	Ranges	Notes
Frame header	2	0xEE 0x16	Fixed value
Data length	1	2~9	The data length is the total number of bytes of the device code, command code, and command parameters.
Device code	1	0x03	Fixed value
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	The checksum is the sum of all the byte data of the device code, command code, and command parameters, and takes the lower 8 bits.

4. Control instructions

Table 2 Control instructions table

Command Code	Description	Command parameter bytes
0x01	Equipment self-test	0
0x02	Single distance measurement	0
0x03	Set first/last/multi-target	1
0x04	Continuous distance measurement	0
0x05	Stop distance measurement	0
0xA0	Set laser distance measurement module baud rate	4
0xA1	Set continuous distance measurement frequency	2
0xA2	Set minimum gate distance	2
0xA3	Query minimum gate distance	0
0xA4	Set maximum gate distance	2
0xA5	Query maximum gate distance	0

0x90	Query total number of light outputs	0
0x91	Query the number of light outputs during this power-on	0

5. Response data (ranging module → system)

Table 3 Response data table

Command Code	Description	Command parameter bytes
0x01	Device self-check	4
0x02	Single distance measurement	7
0x03	Set first/last/multi-target	0
0x04	Continuous distance measurement	4
0x05	Stop distance measurement	0
0x06	Distance measurement exception (This command is sent back after the single distance measurement or continuous distance measurement response command is sent back only when the status in the distance measurement exception command is abnormal)	4
0xA0	Set the baud rate of the laser ranging module	4
0xA1	Set the continuous ranging frequency	2
0xA2	Set the minimum gate distance	2
0xA3	Query the minimum gate distance	2
0xA4	Set the maximum gate distance	2
0xA5	Query the maximum gate distance	2
0x90	Query the total number of light outputs	3
0x91	Query the number of light outputs during this power-on	3

6 INSTRUCTIONS FOR USE

1. In order to enable the operators to safely and correctly use various functions of the LRF0105C miniature laser rangefinder product, this operation and maintenance manual provides instructions on its operation and maintenance. It is applicable to the operators and maintenance personnel of this product.

The LRF0105C miniature laser rangefinder (hereinafter referred to as the laser rangefinder) is a precision optoelectronic product that emits laser towards the measured target and calculates the distance information based on the laser flight time. This laser rangefinder achieves communication through the Uart (TTL_3.3V) communication interface, and is characterized by outstanding performance and simple operation. The laser of this rangefinder is prohibited from direct exposure to human eyes.

2. Recommendations for Optical Window Selection and Coating

2.1 Material Recommendations

The optical glass H-K9L is recommended as the material for the optical window. H-K9L is the most common colorless optical glass, suitable for the laser range of 300nm to 2100nm. It has a high cost-performance ratio and superior physical properties.

2.2 Processing Recommendations

The wedge angle tolerance of the optical window should be as small as possible. It is recommended that the wedge angle tolerance ≤ 3' (tolerance grade ≤ level 7);
The optical surface of the optical window should be as smooth as possible. It is recommended that the arithmetic average deviation of the profile (Ra) is 0.012.

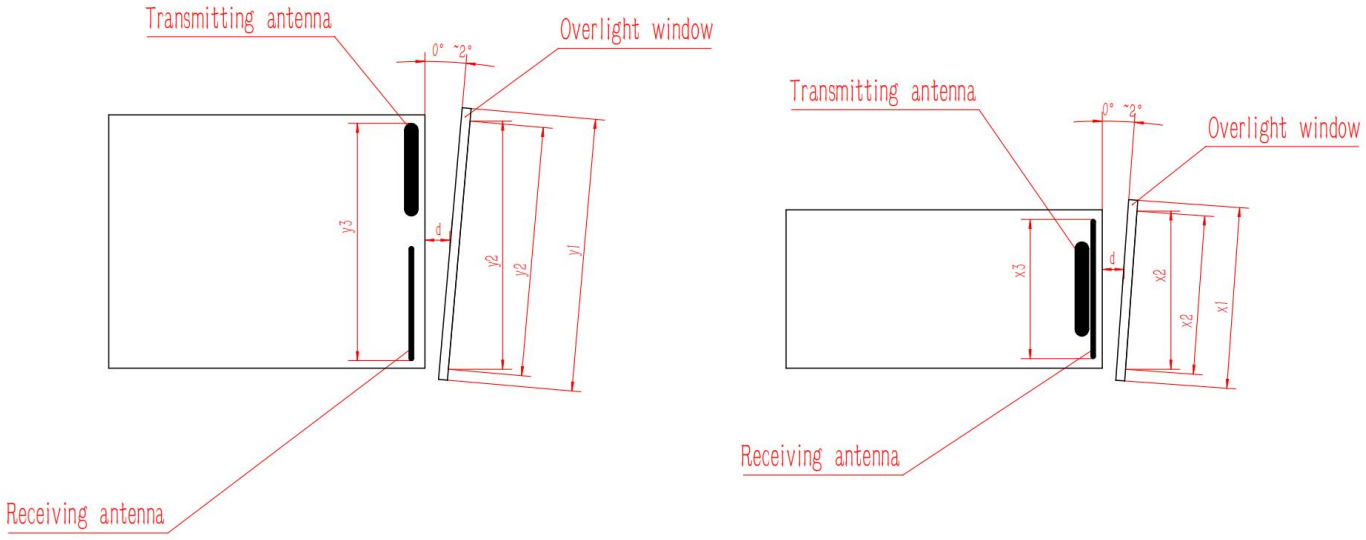
2.3 Coating Recommendations

For the optical window of the 1535nm laser rangefinder, it is recommended to coat an anti-reflective film in the range of 1525nm to 1545nm, with a transmittance of ≥ 99%.
According to the specific usage environment of the product, other protective films such as a hydrophobic film or a hard film can be additionally selected for coating on the outer surface of the optical window. For the remaining indicators, refer to MIL-STD-810G, and the transmittance should be ≥ 97%.

2.4 Recommendations for the Shape and Use of the Optical Window

The effective aperture of the optical window depends on different products. Its external dimension should ensure that the effective aperture of the optical window - the outer diameter of the optical window ≥ 2mm, and the outer diameter of the rangefinder antenna - the projected dimension of the effective aperture of the optical window ≥ 1.5mm. The schematic diagram is shown as follows. Since the optical window has a certain absorption of the laser, it is recommended that the thickness of the optical window itself be controlled within 2 to 4mm according to the external dimension.

Since the optical window has a high transmittance, it is recommended that the axial deviation between the emitting optical axis and the normal of the optical window be controlled within 0° to 2°. The schematic diagram of the position of the optical window and the two lens barrels is shown as follows. At the same time, the air gap between the optical window and the rangefinder should be as small as possible. Figure 4 shows the schematic diagrams of the placement of the optical window in two ways.



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

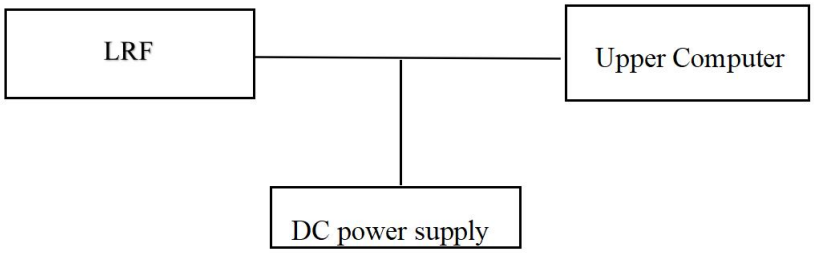
Schematic diagrams of two ways of the external dimensions and placement of the optical window

3. Operation In order for you to fully understand all the functions of this system and correctly master the installation, operation and maintenance methods, please read the content of this chapter carefully before installing and using this system.

3.1 Power-on Operation

3.1.1 Before Power-on

Connect the laser rangefinder, the debugging cable, the DC power supply and the host computer as shown in the figure.



Schematic Diagram of the Connection

3.1.2 Power-on

Power-on operation: Connect the power supply.

3.2 Power-off Operation

3.2.1 Before Power-off

Before powering off, it should be confirmed that the working processes and tasks of each product are in the ended state, and the program is exited.

3.2.2 Power-off

Power-off steps: Disconnect the power supply.

3.3 Operation

3.3.1 Ranging Mode

Operation method of the ranging mode:

a) Send the "Single Ranging" command to the laser rangefinder. The laser rangefinder will perform single ranging and report the ranging status and the distance value.

b) Send the "1Hz Ranging" command to the laser rangefinder. The laser rangefinder will perform ranging once per second and report the ranging status and the distance value.

c) Send the "Stop Ranging" command to stop ranging.

d) Send the "5Hz Ranging" command to the laser rangefinder. The laser rangefinder will perform ranging five times per second and report the ranging status and the distance value.

e) Send the "Stop Ranging" command to stop ranging.

f) Send the "10Hz Ranging" command to the laser rangefinder. The laser rangefinder will perform ranging ten times per second and report the ranging status and the distance value.

g) Send the "Stop Ranging" command to stop ranging.

3.3.2 Distance Gating Setting

Distance gating means setting a section of gating distance (represented in hexadecimal) within the ranging capability range. The target distance information lower than the gating value will not be sent back, and the ranging value higher than the gating value within the measurement range is the effective ranging value.

If setting is required, the operation method is as follows:

a) Send the "Gating Value Setting" command to the laser rangefinder.

Send the "Ranging" command to the laser rangefinder. The laser rangefinder will perform ranging, determine whether the sent-back distance value is greater than the distance gating value, and then report the ranging result.

c) Send the "Stop Ranging" command to stop the ranging operation. If the distance gating function is not needed, the initial settings need to be manually restored (set the gating value to 0).

3.3.3 Self-check Mode

The operation method of the self-check:

a) Send the "Self-check Inquiry" instruction to the laser rangefinder. The laser rangefinder starts to conduct a self-check and sends back information such as the current ambient temperature and working status.

4. Inspection and Maintenance

4.1 General Inspection

Visual inspection and power-on inspection should be carried out when the product is used for the first time and after the resource module is replaced. For products in normal use, only power-on inspection is required before use.

4.1.1 Visual Inspection
The steps of visual inspection are as follows:
a) Check whether the appearance of the product is normal;
b) Check if there is any error in the cable connection, and the connection should be firm.

4.1.2 Power-on Inspection
The steps of power-on inspection are as follows:
a) Complete the power-on operation according to the steps in 3.1;
b) Start the self-test module;
c) After the inspection is completed, complete the power-off operation according to the steps in 3.2.

4.2 Regular Maintenance
The laser rangefinder does not need maintenance under normal working conditions. Maintenance is required if it is stored in a dust-free environment for more than one year. The maintenance content includes:

4.2.1 General Inspection
Conduct a general inspection of the product when it is not energized. The steps are as follows:
a) All marks and numbers on the product and the test cable plug (socket) should be correct and clear;
b) All kinds of screws on the panel should be tightened;
c) It should be ensured that there are no attachments such as light spots, pockmarks, water stains, mold, fingerprints, dust particles, etc. and cracks that hinder normal observation on the optical glass of the product as seen visually.

4.2.2 Power-on Inspection
Conduct a comprehensive inspection and maintenance of the laser rangefinder when it is powered on. The content includes:
a) Turn on the power of the product in sequence;
b) Complete the power-on operation according to the steps in 3.1;
c) Start the product self-test module and complete the product self-test;
d) Complete the power-off operation according to the steps in 3.2.

5. Analysis of Fault Symptoms and Troubleshooting Methods
The laser rangefinder is a precision product. When a fault occurs, the entire device needs to be returned to the factory for fault analysis, location, and repair. Self-repair is not allowed.
Common fault symptoms and troubleshooting methods are shown in the following table.
Common Fault Symptoms and Troubleshooting Methods

Fault Symptoms	Possible Reasons	Inspection Method	Measures for Troubleshooting
The product cannot be powered on normally.	a) Faults in the power supply and connection cables. b) Circuit faults.	Check the power supply and the connection cable.	a) Replace the power supply or the connection cable. b) b) In case of a circuit fault, contact the manufacturer for assistance in solving the problem.

Cannot return communication information.	a) Fault of the connection cable b) Abnormal power supply c) c) Communication fault of the laser rangefinder	a) Check whether the connection cable is normal. b) Check whether the power supply is normal.	a) Replace the connection cable and the power supply. b) For communication problems, contact the manufacturer for assistance in solving them.

6. Requirements for Packaging, Transportation and Storage

6.1 Packaging

For the products that have been unsealed and need to be restocked, they should be packaged according to the original packaging. When the products need to be returned to the factory, the original packaging should be used as much as possible. When other forms of packaging are used, it should not cause a decrease in product performance or damage to the products.

6.2 Transportation

The products that have been repacked can be transported by means of automobiles, trains, airplanes, ships, etc. During transportation, the packaged items should be fixed on the means of transportation to avoid phenomena such as impact, rough handling, and being exposed to rain and snow. For the road transportation and railway transportation environments, refer to MIL-STD-810G.

6.3 Storage

The repacked products shall not be stored in the open air in the wild. They should be stored in a warehouse with a storage temperature of 0℃ to +30℃, a relative humidity not exceeding 80%, free from the erosion of corrosive substances, strong mechanical vibration and impact, and strong magnetic fields.

7 SAFETY PRECAUTIONS

In order to use this product safely, please read this instruction manual carefully before operating the product.

- This laser rangefinder is a precision optical and mechanical product. Operating it in violation of the regulations may lead to dangerous laser injury. Do not open or adjust any part of the laser rangefinder, and do not attempt to repair or adjust the performance of the laser rangefinder by yourself.
- Pay attention to electrostatic protection: The electronic components of the laser rangefinder are sensitive to electrostatic discharge. Do not touch any electronic devices without protective measures.
- Only turn on the power of the laser rangefinder for operation within the specified voltage and power range.
- It is prohibited to touch the optical lenses with fingers or hard objects (to prevent oil contamination or scratching of the lenses).
- It is prohibited to measure high-reflectivity targets at too close a distance (to prevent damage to core components of the detector, etc.).
- It is prohibited to store the laser rangefinder under non-specified conditions (such as a highly polluted environment, exceeding the storage temperature range, etc.).
- It is prohibited for the laser rangefinder to be subjected to strong mechanical impacts (vibration, impact, dropping, etc.).





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Email : sales@erdicn.com
Tel: +86-28-81076698
Fax:+86-28-87897578