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# **Fiber Delivered Direct Diode Lasers User Guide**

**RFL-A3000D~6000D**

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## 1 Safety Information

Thank you for choosing Raycus fiber laser. This User Guide provides important, safety, operation, warranty and other information. Please read it carefully before you use this product. In order to ensure safe operation and optimal performance of the product, please follow the warnings, cautions, operating procedures and other instructions accordingly.


### 1.1 Symbols Used in this User Guide

	◆ Refers to a potential hazard that may lead to a personal injury or death.
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	◆ Refers to potential a hazard that may lead to a minor personal injury or product damage.
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### 1.2 Laser Classification

This series of lasers are classified as a high power Class 4 laser instrument according to the European Community standards EN 60825-1, clause 9. This product emits invisible laser radiation at or around a wavelength of 915 nm, and the total light power radiated from the optical output is greater than 3000W~6000W (depending on model). Direct or indirect exposure of this level of light intensity may cause damage to the eyes or skin. Despite the radiation being invisible, the beam may cause irreversible damage to the retina and/or cornea. Appropriate and approved laser safety eyewear must be worn all the time while the laser is operating.

	◆ You must use appropriate laser safety eyewear when this device is operating. The laser safety eyewear is selected according to the range of wavelengths emitted from this product. The end user must ensure that the laser safety eyewear being used protects against light emitted by the device over its entire range of wavelengths. Please verify that the personal protective equipment (e.g. enclosures, viewing windows or viewports, eyewear, etc.) being utilized is adequate for the output power and wavelength ranges listed on the product.
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### 1.3 Optical Safety

Any dust on the end of the collimator assembly can burn the lens and damage the laser.


	<ul style="list-style-type: none"><li>◆ If the output of the device is delivered through a lens with an anti-reflection coating, make sure that the lens is of good quality and clean.</li></ul>
---	--

### 1.4 Electrical Safety

Make sure your product is grounded through the PE line of the AC power cord. The grounding must be firm and reliable.

	<ul style="list-style-type: none"><li>◆ Any interruption from the protective earth will electrify the enclosure, which may result in personal injury.</li></ul>
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Make sure that the correct voltage of the AC power source is used.

	<ul style="list-style-type: none"><li>◆ Failure to connect the correct voltage could damage the product.</li></ul>
---	--

### 1.5 Other Safety Rules

- Never look directly into the laser output port when power is supplied to the laser.
- Avoid using the laser in a dim or darkened environment.
- If this device is used in a manner not specified in this document, the protection provided by the device may be impaired and the warranty will be voided.
- Do not remove the covers of the laser, or the warranty will be voided. All maintenance must be performed in Raycus or by qualified Raycus personnel.

## **2 Product Description**

### **2.1 Features**

Compared with traditional lasers, Raycus CW fiber diode laser has higher efficiency electric-optical conversion, lower power consumption. The fiber laser is compact and ready to use. Because of its flexible form, it can be easily integrated with the system equipment.

Main Features:

- a) Flexible output optical cable
- b) High reliability and long service life
- c) Maintenance free operation
- d) High photoelectric conversion efficiency
- e) Convenient control interface
- f) High frequency modulation

Main Applications:

- a) Laser-quenching
- b) Laser-cladding
- c) Laser-welding
- d) 3D-printing
- e) Scientific research

### **2.2 Package Contents**


Please refer to the packing list accompanying the shipment to check actual items included.

### **2.3 Unpacking and Inspection**

Raycus ensure that the laser do get adequate protection by special designed packaging material and box during the transit. Even so, In order to prevent the unpredictable component damage, users need to scrutinize the packing box is right before unpacking it whether or not cracking, abrasion, dampened and other phenomena. if there is any abnormality in the box body, Please contact us, we will correct it immediately.

On unwrapping the box, Please check that packing lists and physical goods are the same. If you have any questions, feel free to contact any of us at any time.

When taking the laser out of the box, Avoiding knock against and violent vibration on the laser. When taking optical fiber and output head, In particular, It is not possible to bend, twist and pull optical cable, At the same time should avoid output head suffering the blows and vibrations.

	<p>◆ The fiber optic cable and output head is precise optic instrument, any vibration or impact to the output head, and twist or excessive bend to the cable will damage the instrument.</p>
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## 2.4 Operation Environment

The basic operation conditions are listed in the table below:

Table 1 Basic Operation Conditions for the Laser

Product Model	RFL-A3000D	RFL-A4000D	RFL-A6000D
Power Source	TN-S, 380±38VAC, 50/60Hz		
Power Capacity	8kW	10kW	15kW
Installation Environment	Flat with no vibration and shock		
Ambient Temperature	10~40°C		
Relative Humidity	<70%		

- a) Ensure reliable grounded before using the laser.
- b) The laser output is connected to the output cable. Please check the laser output carefully to prevent dust or other contamination. Use special paper when cleaning the laser output lens.
- c) If the laser is used in accordance without the method specified in this manual, the laser may be in abnormal working state and cause damage.
- d) It is strictly forbidden to install the laser output when the laser is in operation.
- e) Do not look directly into the laser output. Be sure to wear protective glasses when operating the laser.

## 2.5 Matters Need Attention

- a) Before supplying the power to the device, make sure that the voltage of the AC power source is 380V. Failure to connect power source correctly will damage the device.



- b) Failure to follow the instructions may cause malfunction and damage to the device, such damage is not covered by warranty.
- c) It is very important to ensure the cleanness of the calibrated laser output head, otherwise it will cause irreparable damage to the laser.
- d) Please inspect the output head carefully for dust or other contaminations. Use appropriate lens paper to clean it if necessary. Do not touch the output lens at any time; as well as remember to cap the output head when it is not in use, and make sure the cap is clean.
- e) Failure to follow the specified instructions may result in the loss of laser power, and such loss will not be covered by the warranty.

## 2.6 Specifications

Table 2 Properties of Products

<b>Optical Parameters</b>			
Model	RFL-A3000D	RFL-A4000D	RFL-A6000D
Nominal Output Power (W)	3000	4000	6000
Operation Modes	CW/Modulated		
Polarization Orientation	Random		
Output Power Tunability(%)	10~100		
Emission Wavelength(nm)	915±10		
Output Power Instability(%)	≤3		
Modulation Frequency(Hz)	50~5k		
Pilot Light Power(mW)	0.25~1		
<b>Output Cables Parameters</b>			
Output Header Type	QBH	HQBH	
Fiber Core Diameter(μm)	600	800	
Minimum Bending Diameters	≥400	≥500	
Half Angle of beam divergence (rad)	≤0.22		
Delivery Cable Length(m)	20(Customizable)		

Electrical Parameter		
Power Supply	AC 380V±38, 50/60Hz, TN-S	
Control Mode	Hyper Terminal/RS-232/AD	
Other Parameters		
Dimensions(W×H×D) (mm)	650×950×980	890×1010×952
Weight(kg)	<150	<300
Operating Ambient Temperature (°C)	10~40	
Humidity (%)	<70	
Storage Temperature (°C)	-10~60	
Cooling Method	Water Cooling	

### 3 Installation

#### 3.1 Dimensions

Figure 1 shows dimensions of products:

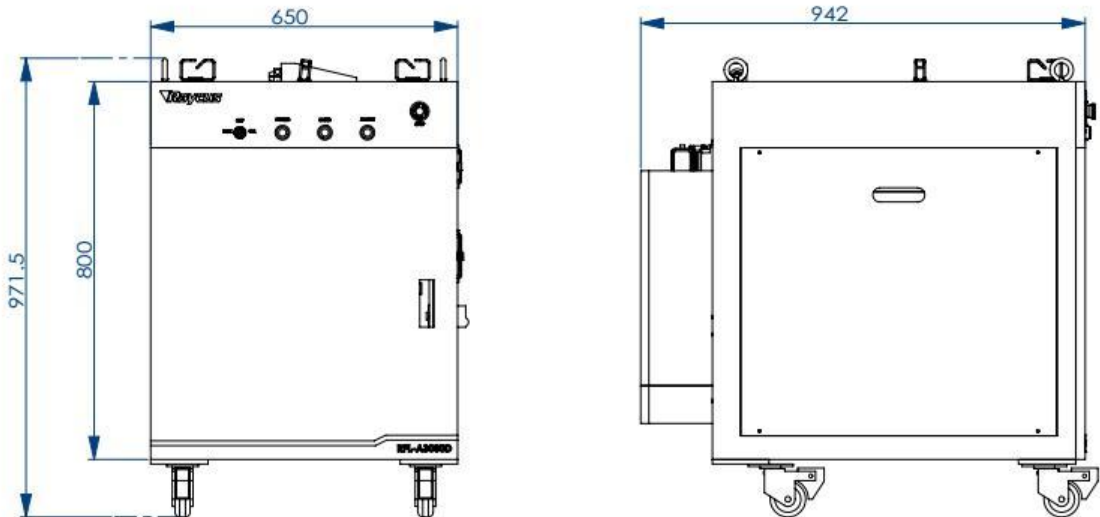


Figure 1a) 3000W Overall Dimension (unit: mm)

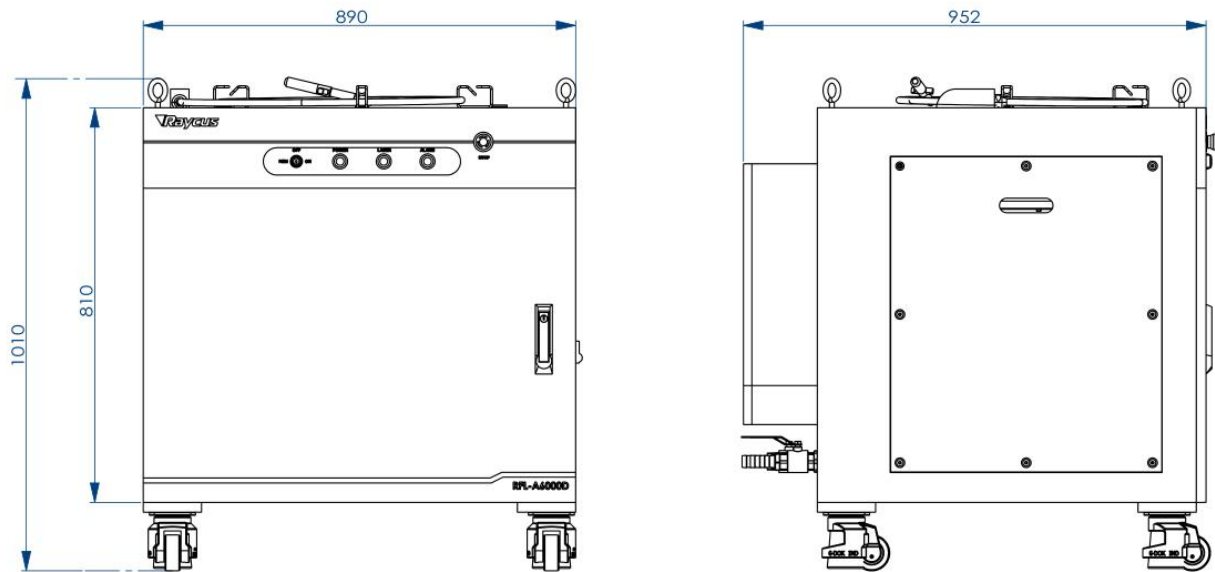


Figure 1b) 4000W, 6000W Overall Dimension (unit: mm)

### 3.2 Installation Procedure

- a) Place the product in an appropriate position, immobilize it if necessary.
- b) Check if the power supply has the correct voltage (AC  $380\pm 38V$ , 50/60Hz, TN-S), and the earth line is connected, make sure it is firm and reliable.
- c) Connect the power cable and control cable to the product when power supply is OFF.
- d) Insert the water pipes into the inlet and outlet;
- e) Check the output head and clean it if necessary. This procedure must be performed by Raycus personnel or person authorized by Raycus. Make sure the environment is clean, or the output cable may be contaminated.
- f) Prevent the delivery cable from treading, pinching or excessive bending during installation.
- g) In the installation of laser output cable and output head process, please make sure that the surrounding environment is clean, otherwise it may pollute the output head (do not use fans to avoid dust).
- h) The client can use four hooks or rollers at the top or bottom of the product to move the product, as shown in figure 2. Examine each hooks and rollers for damage before use.

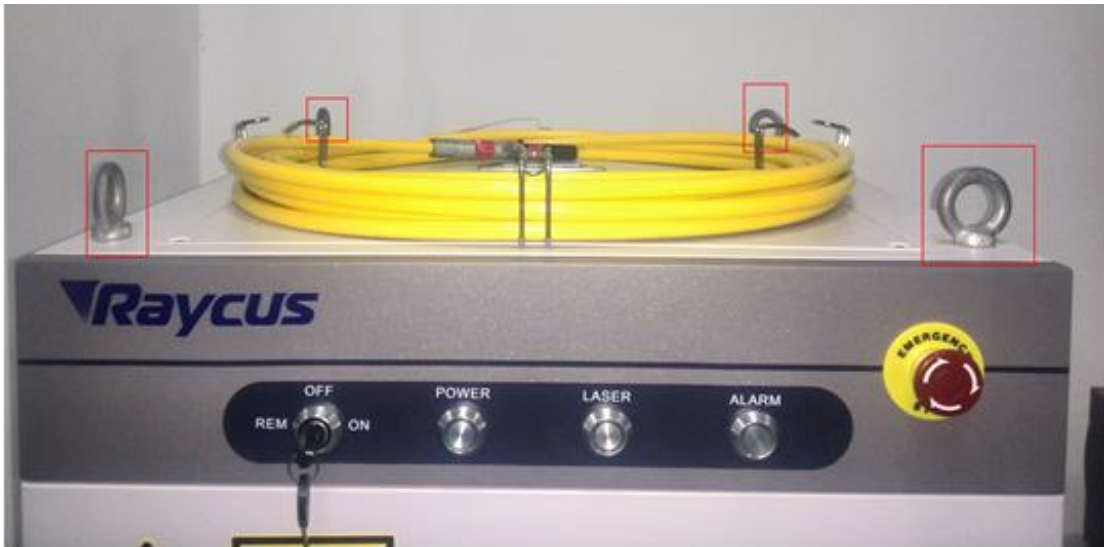


Figure 2a) Hooks at the Top of the Laser

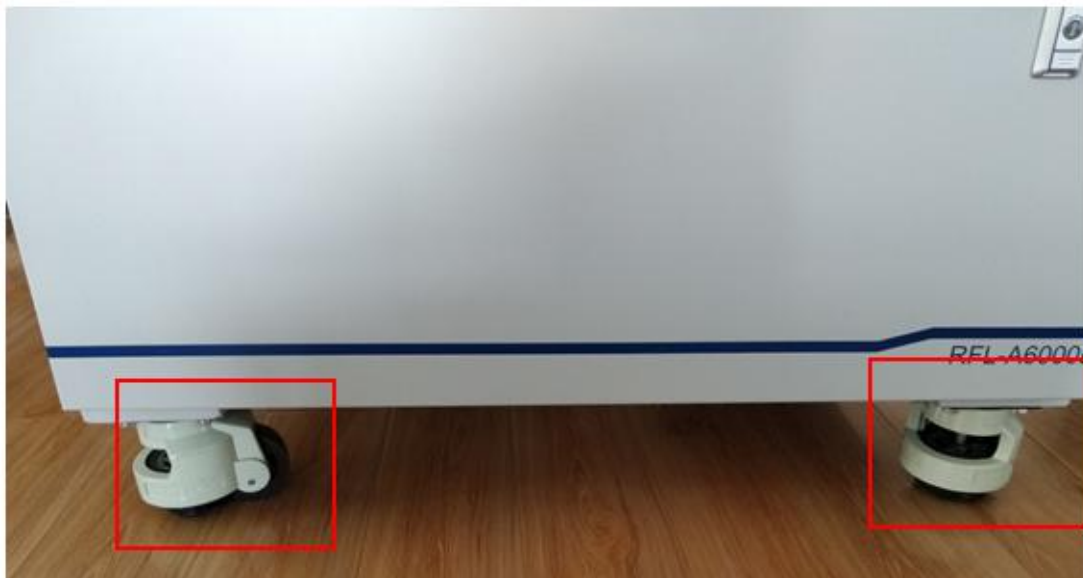




Figure 2b) Rollers at the Top of the Laser

	<p>◆ All the cables can only be connected when power supply is OFF. Hot plug may damage the laser.</p>
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	<ul style="list-style-type: none"> <li>◆ The laser output optical cable should be kept as natural as possible and not be distorted.</li> <li>◆ The too small bending radius of the output fiber cable will damage the laser.</li> </ul>
---	---

	<ul style="list-style-type: none"> <li>◆ Make sure the aperture and the cavity of the processing head is clean.</li> <li>◆ Prevent it from contamination; Or the aperture will be contaminated when capped.</li> </ul>
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### 3.3 Cooling Requirements

Table 3 Cooling Requirements

Parameters	unit	RFL-A3000D	RFL-A4000D	RFL-A6000D
Cooling Capability	kW	≥6 (2.4HP)	≥10 (4HP)	≥14 (5.6HP)
Minimum Flow	L/min	25	40	60
Maximum Input Pressure	Bar	4~6		
Pagoda-Shape Connectors	mm	Connect Inner Diameter Φ19 Water pipe	Outside Screw 3/4, Hose Connection Φ25	
Water Chiller Categories	/	dual-temperature control		

The water temperature setting of cooling system:

- a) summer (Ambient temperature is higher than 30°C) 25±0.5°C.
- b) winter (Ambient humidity temperature is lower than 30°C) 22±0.5°C.


Coolant requirements:


- a) The cooling water is pure water. It is recommended to use pure drinking water;
- b) In order to prevent mould growing that may lead to pipe blockage, we recommend to add alcohol about 10% of the total volume.
- c) When the ambient temperature ranging between -10 °C and 0 °C, user need to add alcohol about 30% of the total volume, change alcohol every two years.

- d) When the ambient temperature below  $-10^{\circ}\text{C}$ , user must use dual-cooling water chiller, and ensure continuity of work.

Other requirements for chiller:

- a) When starting the cooling system for the first time, check the entire water system and the joint for water leakage. The external water pipe must be installed and connected according to the inlet (IN) and outlet (OUT) by the laser. Otherwise, the laser may not work properly.
- b) If you will not use the laser for a long time, water must be emptied from the product, and then both the inlet and outlet must be blocked with the nuts we provide. Failure to do so may lead to permanent equipment damage.
- c) When the customer is emptying the cooling water of the laser water-cooling system, please use compressed gas with pressure less than 0.5mpa, otherwise it will cause irreparable damage to the chiller.

	◆ Please set the water temperature in strictly accordance with the requirements above. Too low temperature may lead to condensation on the laser module and the output cable. This can cause serious damage to the equipment.
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	◆ Make sure that the water temperature reaches the set point and the cooling system is working well before you start the laser.(summer: $25\pm 0.5^{\circ}\text{C}$ ; winter: $22\pm 0.5^{\circ}\text{C}$ )
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## 4 Using the Product

### 4.1 Front Panel

Figure 3 shows the front panel of the product:

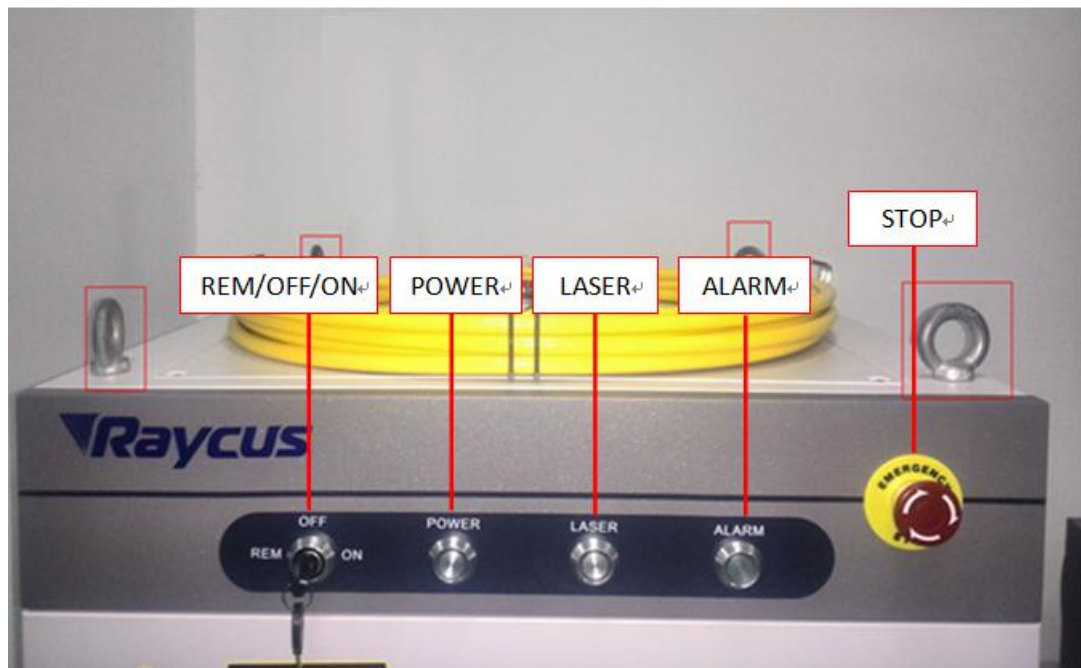


Figure 3 Front Panel

- a) **REM/OFF/ON:** Key switch, the power switch of the laser. Insert the key and turn the key clockwise to the 'ON' position or counterclockwise to 'REM' position will power on the laser. Then the laser will enter a control mode depending on your previous setup on the 'INTERFACE'. You can refer to 4.6 Control Mode for more details.
- b) **POWER:** Power Indicator, indicates that the power is switched on, when the green LED illuminates.
- c) **LASER:** Laser emission indicator, RED, illuminates when laser emission is on.
- d) **ALARM:** Alarm indicator, YELLOW, indicates an error condition.
- e) **STOP:** Pressing this button can shut down the laser, then Rotating this button to release. Use the key to power up the laser to get back.
- f) **Indicator Light:** Turn the key clockwise to the 'ON' or 'REM' position, the green indicator light is on; The red indicator light is on, when the laser emit laser; The yellow indicator light is on and the alarm goes off.

## 4.2 Rear Panel

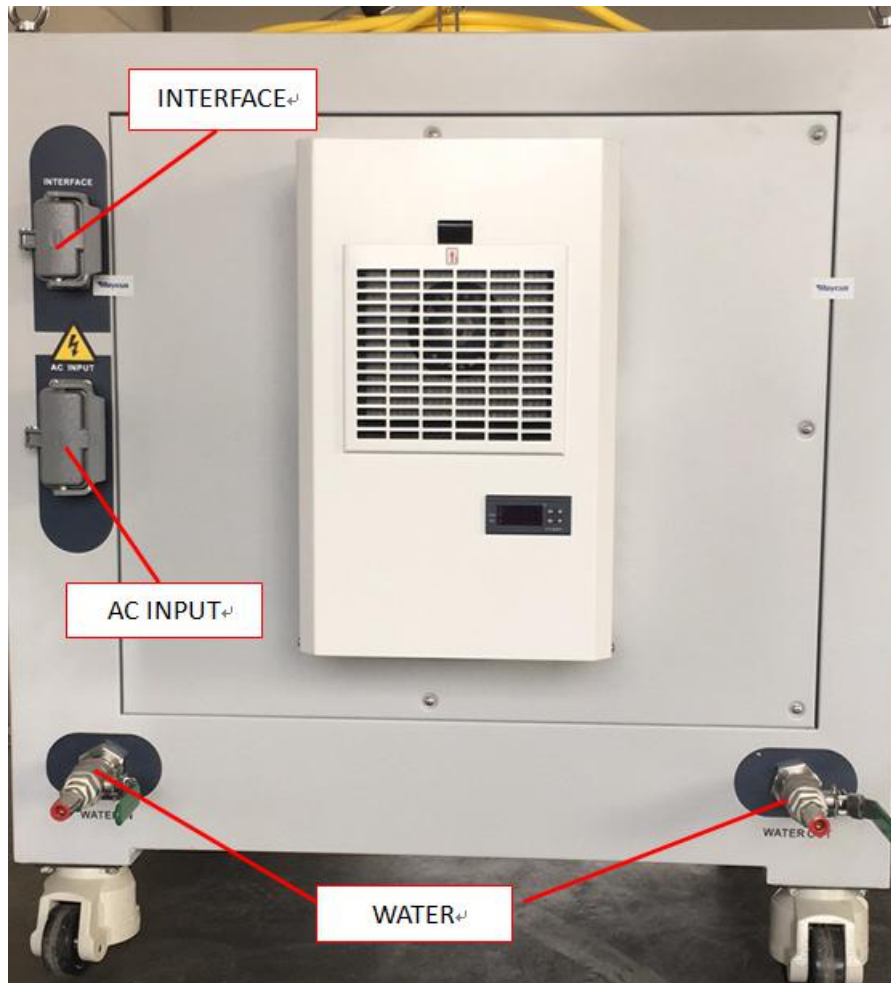


Figure 4 Rear Panel

Figure 4 shows the rear panel of the product:

- a) **AC INPUT:** The socket for supply source input that can only be mated with the plug on the power cord we provided. The socket is equipped with protective cover and latch, Cover the power input interface with protective cover and secure it with latch when not using the product for a long time.
- b) **INTERFACE:** This interface provides all control signals, including RS232 communication, laser switch control, laser remote control mode selection, analog control, modulation signal, Interlock interface and so on. The socket is equipped with protective cover and latch, Cover the power input socket with protective cover and secure it with latch when not using the product for a long time.




- c) **WATER:** Pagoda-Shape Connectors, water inlet and outlet are used for cooling water inflow and outflow.

The laser side panel circuit breaker is shown in figure 5, It is the main power switch of the laser.



Figure 5 Side Panel

### 4.3 Power Connection

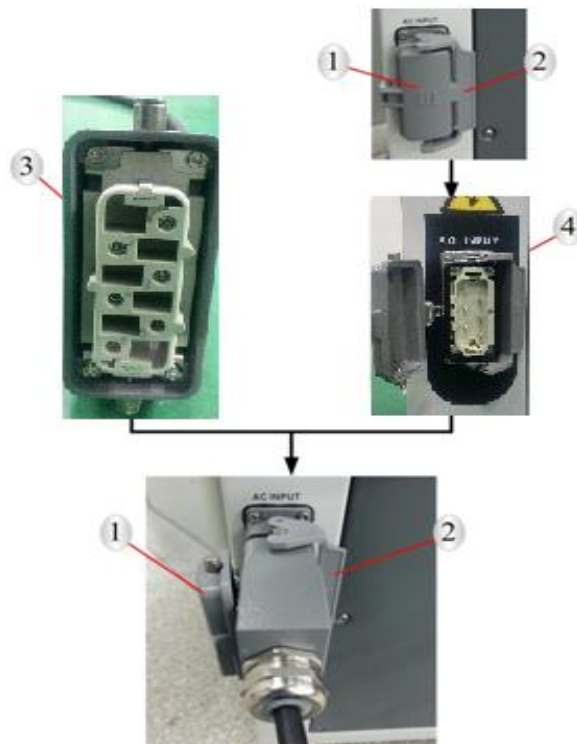
	<ul style="list-style-type: none"><li>◆ Before connecting the product to AC supply source, you must check up that the AC supply you will apply is in accordance with the specifications provided.</li><li>◆ Failure to connect power source correctly will damage the device. Please carefully inspect before energize the laser to make sure the connections are correct</li></ul>
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As the figure 6 shows, the power cord, provided by the company:



Figure 6 Power Cord

One end of the power cord is a plug, insert it into the socket 'AC INPUT' on the rear panel. Notice that the plug is wrong-side preventing. After inserting it, lock it with the lever, as shown in figure 7.



1. Protective Cap; 2. Lock Catch; 3. Plug; 4. Socket

Figure 7 Locked Power Outlet Port

The lasers' power line consists of five lines, L1, L2, L3, N and PE, Connected to the

380VAC. Before the laser is powered up, Users must connect as shown in table 4.

Table 4 Power Connection Instructions

Label	Pin Number	Color	Definition
L1	1	Red	Phase Line 1
L2	3	Yellow	Phase Line 2
L3	5	Blue	Phase Line 3
N	4	Black	Neutral line
PE	GND	Yellow Green	Protective Ground Wire

The length of the The lasers' power line provided by us is 8m.

#### 4.4 Interface Definitions

All control signal centers on rear panel's port 'INTERFACE'. Figure 8 shows the control signal line provided by us.



Figure 8 Control Signal Line

When you want to use the product, please insert control signal cables provided by us in rear panel's port 'INTERFACE', and lock it with the lever, as shown in figure 9.

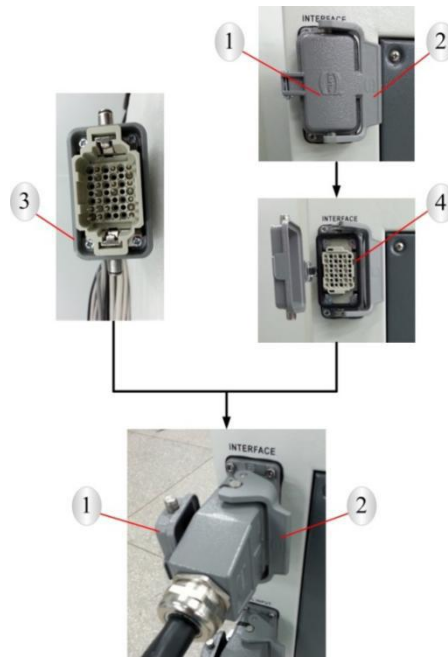


Figure 9 Locked Power Outlet Port


1. Protective Cap; 2. Lock Catch; 3. Plug; 4. Socket

The following table details each pin in the ‘INTERFACE’ port.

Table 5 The Definition of Control Signal Cables

Name	Pin	Label	Color	Definition	Remark
CONTROL	6	LAS_C	White	Enable signal for emitting laser light, high level is 24V. The laser is in ready state of emitting laser. This port have the same function as the button ‘LASER’ on the front panel. Both cannot be used together, otherwise laser doesn't work on the primary. While using this signal line, the button ‘LASER’ in a closed state.	All reference ground of ‘CONTROL’ cables are ‘EGND’
	7	AD/RS	Green	Control mode selection. Turn the key switch to the "REM" position, this port is powered and in high level, the laser enter AD mode, Otherwise, it goes to RS232 mode.	
	\	PE	\	Protecting earthing, Connect the cable shielding layer with protecting earthing.	
AD	22	0-10V	Red	Analog voltage signal. Adjust the laser power by setting the input analog voltage.	Exclusive analog voltage input cable
	25	AGND	Black	Analog voltage ground	
	\	PE	\	Protecting earthing, Connect the cable shielding layer with protecting earthing	
MODULATION	36	MOD+	Red	24V modulation signal input port	\
	37	MOD-	Black		

	\	PE	\	Protecting earthing, Connect the cable shielding layer with protecting earthing.	
INTERLOCK	38	ITL_A	Red	Remote protection. Port 'ITL_A' and 'ITL_B' must be connected during the laser working.	\
	39	ITL_B	Black		
RS-232	40	RX	Red	Connect upper computer RX	RS232 or HyperTerminal Control
	41	TX	Yellow	Connect upper computer TX	
	42	GND	Blue	Serial port line ground	
	\	PE	\	Protecting earthing, Connect the cable	

	<p>◆ Please check the level of control signal to ensure it meets the requirements. Both fluctuated and overloaded voltage may damage the laser</p>
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#### 4.5 Work Patterns and Control Modes

There are two work patterns for the laser: CW(continuous wave) and pulse mode. In CW mode, the laser emits continuously. As for pulse mode, The output of the laser is a pulsed laser, transform the waveform by setting frequency, duty ratio and the percentage of power.

There are three control modes to choose from, namely hyperterminal mode, RS-232 mode and AD mod. Hyperterminal mod is fundamental mode , Both RS-232 mode and AD mode are external control mode. As for hyperterminal mode and RS-232 mode, All parameters can be set up in two work patterns: CW and pulse mode. In AD mod, output power is under the control of input analog voltage signal and enable signal for emitting laser light is controlled by modulating signal. The sensors allow user to monitor the state of the laser. The laser shut off automatically once an exception occurs, and sends error messages by RS-232.

#### 4.6 Selection of Control Mode

Figure 10 shows the selection of control mode.

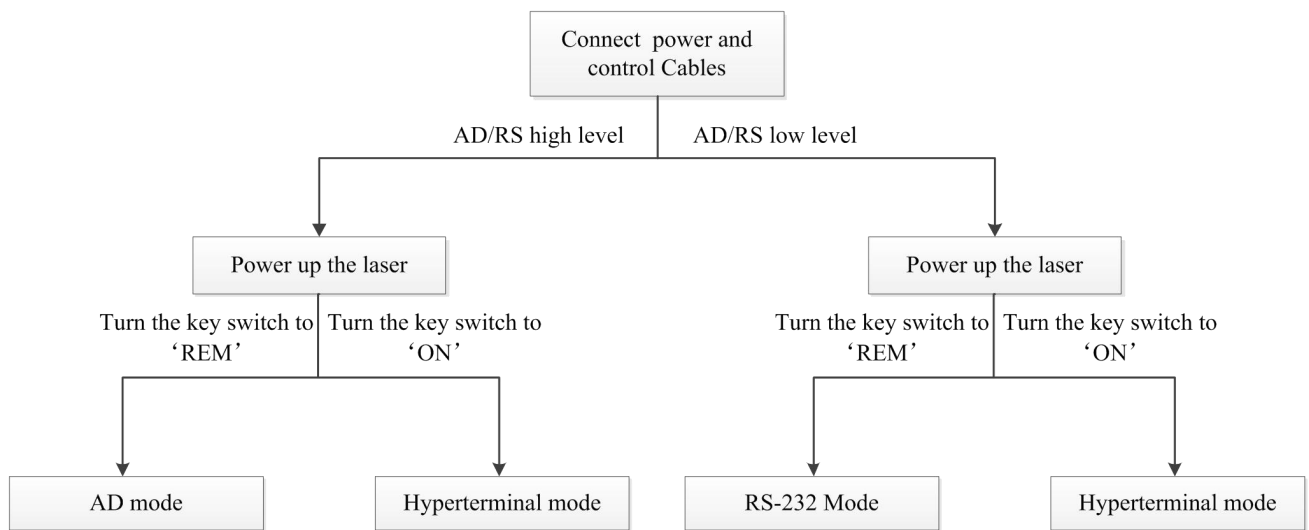


Figure 10 The Procedure of Mode Selection

To select hyperterminal mode, user must turn the key switch to the “ON” position. If user want to enter external control mode (RS-232 mode and AD mode), need to turn the key switch to the “REM” position. In addition, the wipers default to select RS-232 mode while the key switch is turned to the “REM” position. If the laser is to enter AD mode, user must apply 24V high level to port ‘AD/RS’ in advance.

#### 4.7 Precautions before power up the laser

Before power up the laser, Check if the laser’s condition meets the following requirements:

- Power line and control line is connected properly and voltage meets the product requirements.
- Enable signal button on the front panel is in the position of release and ‘INTERFACE’ port’s Pin 6 ‘LAS\_C’ on the rear panel is low level.
- ‘Interlock’ is in good condition.
- Complete the water cooling system, The chiller start work and water is at appropriate operating temperature, then ensure there is no leakage phenomenon in the whole water system.

#### 4.8 Hyperterminal Mode

Hyperterminal mode is a tool for Windows communications, so the laser need to be controlled by windows PC. In this mod, user can set up all parameters and view fault records.

### 4.8.1 Wiring in Hyperterminal Mode

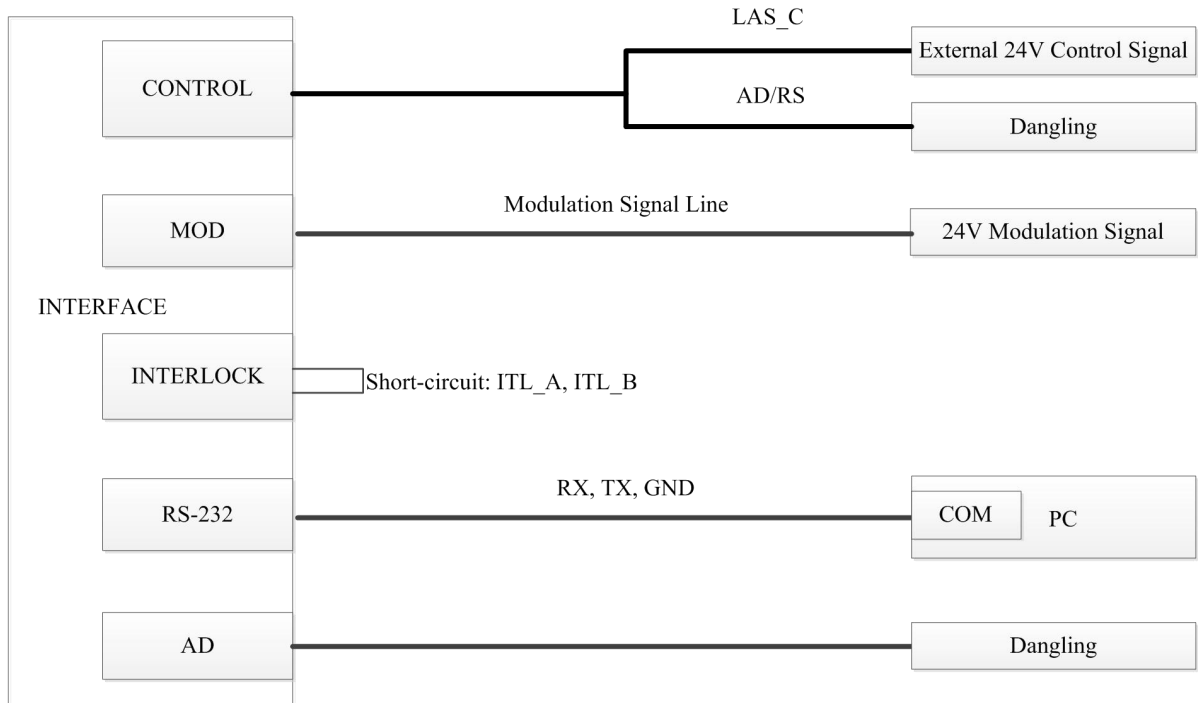


Figure 11 Wiring in Hyperterminal Mode

### 4.8.2 The Setting Process of Hyperterminal Mode

You can follow these steps to set up hyperterminal mode:

- Do the following in windows: Click 'Start'-'Accessory'-'Communication'- 'hyperterminal mode'.
- A dialog then pops up recommend setting 'Hyper Terminal' as default 'telnet' program, Click 'Yes'.
- You can name 'New Connection' whatever you want, then Click 'OK'.
- Choose port number that the transmission cable connected (COM1 or COM2 or COM3) , then Click 'OK'.
- Set up the COM port and parameters. Baud Rate 9600, Data length 8, Parity check-off, Stop bit 1, Data flow-off, then Click 'OK'.

The setup of Hyperterminal Mode is now complete.

### 4.8.3 Operations in Hyperterminal Mode.

- a) Turn the key switch to 'ON', The laser is electrified, Green indicator 'POWER' is on.
- b) Waiting for 10s until the internal main control board circuit initialization is completed.
- c) Enter user interface through following the prompts in hyperterminal.
- d) Users according to need to choose work pattern and set the related parameters.
- e) Trigger enable signal for emitting laser light (press enable signal button on the front panel or pin 6 'LAS\_C' on the rear panel is high level)

Note: click '3' or '4' on pattern user interface, then enter external control mode. In this mode, the laser is set in the same way as CW mode, just adds a pre-condition that external 24V modulating signal, through 'MODULATION' cable.

## 4.9 RS-232 Mode

RS232 belongs to external control mode. In this mode, the laser is controlled by PC through communication protocol, user can set operating parameter and switch optical shutter. In addition, provides external MOD signal to control enable signal for emitting laser light.

### 4.9.1 Wiring in RS-232 Mode

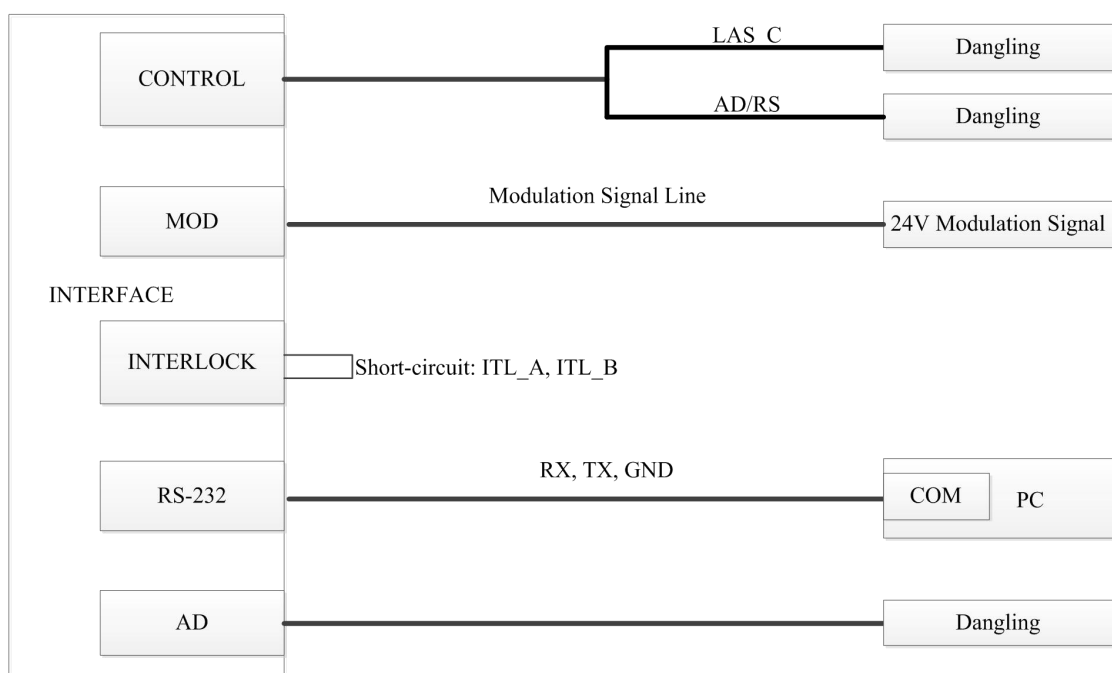


Figure 12 Wiring in RS-232 Mode



### 4.9.2 Communication Protocol

The communication protocol is as follows in this table.

Table 6 Communication Protocol Based on RS-232 Mode

Code	Definition	Sample
1B4F0D	Open optical shutter	TXD:1B4F0D RXD: 54530D
1B530D	Close optical shutter	TXD: 1B530D RXD: 54530D
1B4350XX0D	Set as CW mode, XX represent power percentage, range from 0 to 100, Hexadecimal notation.	TXD: 1B4350320D RXD: 54530D In CW mode, power percentage is 50%.
1B46XXXX44##50&&0D	Set as Pulse mode, XXXX represent frequency (50~5000), ## represent duty cycle (0~100), && represent the percentage of power (0~100), are Hexadecimal notation.	TXD: 1B461388443C50500D RXD: 54530D In the pulse mode, Repetition frequency: 5kHz Duty ratio: 60% Power percentage: 80%
54530D	Receive code echo reply message	\
5445310D	Error 1	\
5445320D	Error 2	\
5445330D	Error 3	\
5445340D	Error 4	\
5445350D	Error 5	\
5445360D	Error 6	\
5445370D	Error 7	\
5445380D	Error 8	\
5445390D	Error 9	\
5445400D	Error 10	\

### 4.9.3 RS232 Mode Operation Procedure

- a) Turn the key switch to ‘REM’, The laser is electrified, Green indicator ‘POWER’ is on.
- b) Wait 10s, The internal circuit initialization phase is complete.
- c) Send Open optical shutter signal with code of 1B4F0D.
- d) Set the parameters follow the instructions in the table 6.
- e) External modulating signal is 24V through ‘MODULATION’ cable.

### 4.10 AD Mode

AD mode belongs to the external control mode too. In AD mode, output power is under direct control of analog voltage signal.

### 4.10.1 Wiring in AD Mode

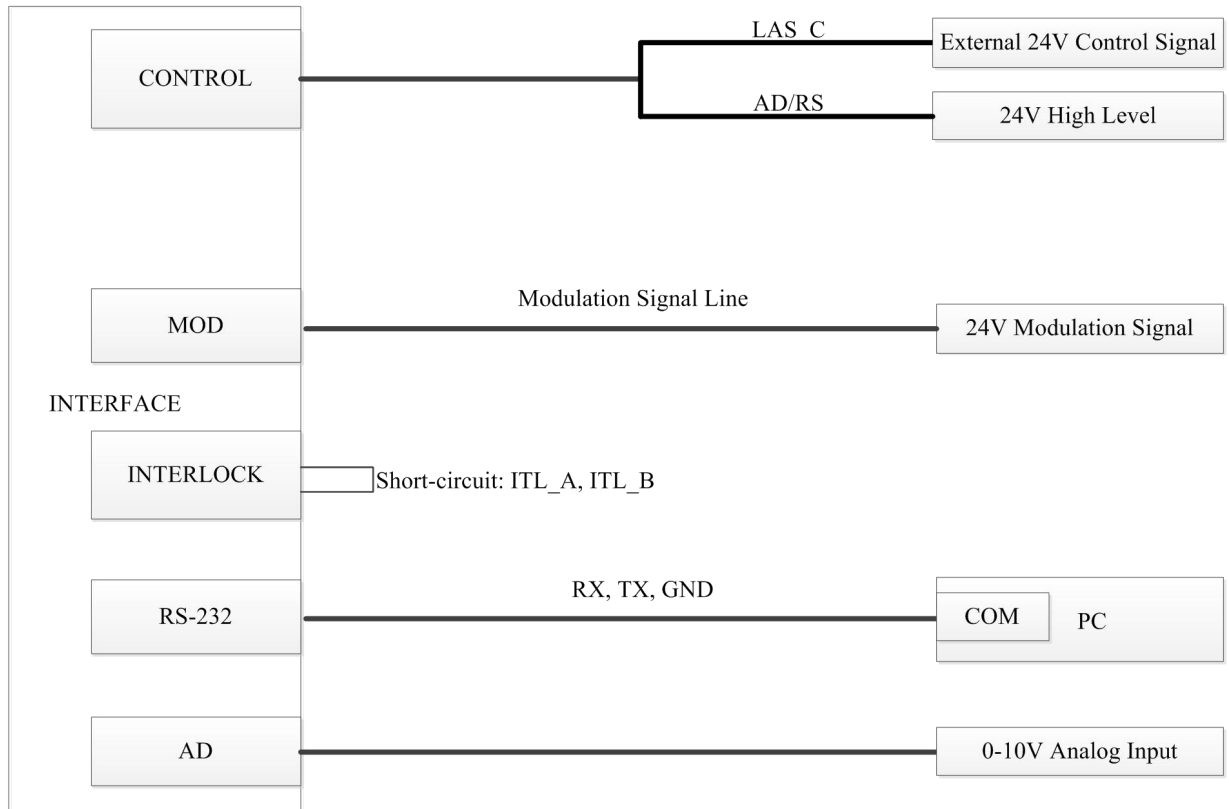



Figure 13 Wiring in AD Mode

### 4.10.2 AD Mode Operation Procedure


- a) When PIN 7 and PIN 9 of the DB25 control interface is applied to 24V, the laser enters the external AD mode.
- b) Turn the key switch to 'REM', Green indicator 'POWER' is on.
- c) Waiting for 10s until the internal main control board circuit initialization is completed.
- d) The power of the laser is controlled by the voltage obtained by PIN 22 and PIN 25 of the DB25 interface connector.
- e) The external MOD interface provides modulating signal for the laser.
- f) Enable the laser to emit laser light through one of the following ways:
  - 1) PIN 6 and PIN 9 of the DB25 control interface is applied to 24V. – laser enable signal.
  - 2) Press 'Laser' button on the front panel. – laser enable signal.

	◆ Please Make sure that analog voltage signals never exceed 10v, it may damage the laser.
---	---

### 4.10.3 Pilot Light to Control

In hyperterminal and AD mode, Turn the key switch to the ‘REM’ or ‘ON’ position and power up the laser, ‘POWER’ green indicator light is on and the laser emit pilot light. ‘LASER’ button on the front panel is pressed or external control signal ‘LAS\_C’ is high level, pilot light is off.

In RS-232 mode, when open optical shutter, Pilot light is off; when close optical shutter, Pilot light is on.

	◆ The pilot light and laser beam cannot exist simultaneously. If there is no pilot light, please check if ‘LASER’ button on the front panel is pressed, external control signal ‘LAS_C’ is high level, or optical shutter is opened.
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## 5 Alarms and Solutions

### 5.1 Fault Records and Occurrences

Connect computer and open hyperterminal interface, each time the laser is started and pass self-inspection, will display fault records, as shown in figure 23.

```
Err1 record: 0
->Module 1 T1 High-temperature record:255
->Module 1 T1 Low-temperature record:255
->Module 1 T2 High-temperature record:255
->Module 1 T2 Low-temperature record:255
->Module 1 T3 High-temperature record:255
->Module 1 T3 Low-temperature record:255
->Module 1 T4 High-temperature record:255
->Module 1 T4 Low-temperature record:255
Err2 record:255
Err3 record:255
Err4 record:0
->Module 1 this record:255
Err5 record:255
Err6 record:0
->Module 1 this record:255
Err7 record:255
Err8 record:255
Err9 record:255
Press 'U' in 3s, to enter UI.....
```

Figure 14 Fault Records in Hyperterminal Interface

When inner temperature, output power, Power supply is abnormal and ‘INTERLOCK’ is off, the laser will break down.

Hyperterminal interface shows any defects at run time, meanwhile, the ALARM light (yellow) on the front panel of the laser will light up, the laser will stop emitting and lock. Before repower the laser, can’t unlock the laser.

## 5.2 Alarm Solutions

The instructions and solutions of alarms are as follows:

Table 7 Instructions and Solutions for Alarms of Laser

Alarm name	Alarm instructions and solutions
Failure 1	<p><b>Instruction:</b> Temperature alarm of the laser. There are 4 sensor in the laser detects an abnormal temperature inside the laser. A high-temperature / low-temperature error occurs when the temperature at the monitoring point exceeds the set upper / lower limit.</p> <p><b>Solution:</b> High temperature alarm, please check if the water-cooling system is normally working, the water temperature and connection is correct. When the water cooling system works normally and the water temperature drops below 30°C, restart the laser. If the alarm continues, please contact Raycus. Low temperature alarm, please check if the actual water temperature of the water is too low. In addition, a low ambient temperature may also cause a low temperature alarm when the laser is cold. Please wait until the water temperature of the water rises above 10°C. If the alarm continues, please contact Raycus. If T4 sensor sends out low temperature alarm, one possibility is that one pair of contacts ‘Interlock pins’ is not connected reliably. Please verify contacts stay in good contact.</p>
Failure 2	Allowance fault code, no meaning.
Failure 3	Allowance fault code, no meaning.
Failure 4	<p><b>Instruction:</b> The laser will get this error when it does not emit with correct settings. Power error occurs only when the laser is emitting.</p> <p><b>Solution:</b> Restart the laser, if this error continues to occur, please contact Raycus.</p>
Failure 5	<p><b>Instruction:</b> Occurs when the InterLock is disconnected.</p> <p><b>Solution:</b> Short-circuit the InterLock pins (please consult table 5, Connect ‘ITL_A’ and ‘ITL_B’) and restart the laser to try. If this error continues to occur, please contact Raycus.</p>
Failure 6	Allowance fault code, no meaning.
Failure 7	Allowance fault code, no meaning.
Failure 8	<p><b>Instruction:</b> ACDC1 Error, failure of the laser power supply or sudden power failure of the power supply system may cause an alarm.</p> <p><b>Solution:</b> Check if the input AC voltage is normal. Restart the laser, if this error continues to</p>

	occur, please contact Raycus.
Failure 9	<p><b>Instruction:</b> ACDC2 Error, overcurrent or overvoltage in interior circuit may cause an alarm.</p> <p><b>Solution:</b> Restart the laser, if this error continues to occur, please contact Raycus.</p>

In addition to the above, if there are any questions or errors in using of the laser, you can contact Raycus to get help.

## 6 Warranty, Return and Maintenance

### 6.1 General Warranty


Raycus warrants that all Raycus fiber laser products are conformed to applicable product specifications under normal use and are free from defects in materials and workmanship. The warranties start on the date of shipment from Raycus for a period of time as set forth in the applicable purchase contracts or product specifications.

Raycus has the right to choose to repair or replace any product that proves to be defective in materials and workmanship selectively during the warranty period. Only products with particular defects are under warranty. Raycus reserves the right to issue a credit note for any defective products produced in normal conditions.

### 6.2 Limitations of Warranty

The warranty does not cover the maintenance or reimbursement of our product of which the problem results from tampering, disassembling, misuse, accident, modification, unsuitable physical or operating environment, improper maintenance, damages caused by those who are not from Raycus due to excessive use or not following the instructions. Customer has the responsibility to understand and follow this instruction to use the device. Any damage caused by fault operating is not warranted. Accessories and fiber connectors are excluded from this warranty.

According to the warranty, client should write to us within 31 days after the defect is discovered. This warranty does not involve any other party, including specified buyer, end-user or customer and any parts, equipment or other products produced by other companies.

	<p>◆ It is the customer's responsibility to understand and follow operating instructions in this User Guide and specifications prior to operation-failure to do so may void this warranty. Accessories and fiber connectors are not covered by this warranty.</p>
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### 6.3 Service and Repair

- a) Do not open the device. There are no user serviceable parts, equipment or assemblies for user in this product. All service and maintenance shall be performed by qualified Raycus personnel.
- b) Please contact Raycus as soon as possible when problems under warranty about maintenance happened to the product.
- c) The product returned with permission should be placed in a suitable container.
- d) If any damage happened to the product, please notify the carrier in document immediately.
- e) We reserve the right to make changes in design or constructions of any of our products at any time without incurring any obligation to make changes or install the same on units previously purchased.

All the items about warranty and service above provided by Raycus are for user's reference; formal contents about warranty and service are subject to the contract.