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**英文版使用说明书**

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**RFL-C2000XZ Continuous-Wave  
Fiber Laser User Guide**

Wuhan Raycus Fiber Laser Technologies Co., Ltd.

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# 1 Safety Information

Thank you for choosing Raycus Fiber Laser. This user manual provides you with important safety, operation, maintenance and other relevant information. Please read the manual carefully before using this product. To ensure safe operation and optimum product operation, please carefully review the following cautions and warnings as well as other information within this manual.


## 1.1 Security Labels

	<p><b>WARNING:</b> Describes a hazard that leads to severe personal injury or death.</p>
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	<p><b>CAUTION:</b> Describes a hazard that leads to general personal injury or damages to product.</p>
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English	English (20000W)	English
		
Chinese	Chinese (20000W)	Chinese
1: Laser output Head	2: Type 4 Laser Product	3: Class 2 Laser Product Label-1mW Red Laser
		
4: CE Authentication	5: ID Label (20000W)	6: Laser Radiation Hazard



		
<p>7: Electrical Hazard</p>		


### 1.2 Laser Safety Grade

According to Clause 9 from European Standard EN 60825-1, this series of lasers are Class 4 laser instruments. The product emits laser radiation at a wavelength of 1080 nm or around 1080 nm, and the average laser power radiated from the output head is 20 kW. Direct or Indirect exposure to high power laser radiation causes damage to the eye or skin. Although the radiation is not visible, the beam will cause irreparable damage to the retina or cornea, so appropriate and certified laser safety glasses must be worn whenever the laser is emitting.

	<p><b>WARNING:</b> Users must use appropriate laser goggles when operating this device. The laser goggles are selected according to the range of wavelength emitted from this product. Users must select the appropriate laser goggles according to the entire range of laser wavelengths. Please do not directly view the laser output head when laser emitting.</p>
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### 1.3 Optical Safety

Any dust on the end of the collimator assembly can damage the crystal of output head or the entire laser device.

	<p><b>CAUTION:</b> DO NOT emit when the protective cap is not removed, otherwise the lens or crystal will be damaged.</p>
---	---

### 1.4 Electrical Safety

- a) Ensure that the PE line is effectively grounded, and the installation environment is safe and reliable.



**WARNING:** The disconnection of the product grounding will electrify the enclosure , which may result in personal injury to the operator.

- b) Ensure that the AC voltage is supplied normally.



**CAUTION:** Wrong wiring mode or power supply voltage will cause irreversible damages to the laser device.

## 1.5 Other Safety Rules

- a) Do not view the laser output head directly when laser is emitting.
- b) Do not use fiber lasers in dark or dim environments.
- c) If this device is used in a manner not specified in this manual, the protection provided by the device may be impaired and the warranty will be voided.
- d) There are no user serviceable parts, equipment or assemblies inside the product. All service and maintenance shall be conducted by a certified Raycus engineer. In order to prevent electric shock, please do not break the seal or uncover the shield. Otherwise, any damage to the device will not be guaranteed.

## 2. Product Description

### 2.1 Features

Fiber lasers are more compact and ready to use than conventional lasers, with higher electrical and optical conversion efficiencies, lower power consumption and better beam quality. Thanks to its flexible laser output ways, it can be easily integrated with system equipment.

Main Features:

- High beam quality

- Highly reliable
- Maintenance-free operation
- High electro-optical conversion efficiency
- Convenient control interface
- Fast modulation

Product's main applications:

- Industrial cutting and welding
- Scientific research

## 2.2 Package Parts

Please refer to package accessories that are in the packing box.

## 2.3 Unpacking and Inspection

The specially designed packaging materials and cabinets helps Raycus ensures that the lasers are fully protected during transportation. Nevertheless, in order to prevent unpredictable situations during transportation, the users still need to carefully check whether the package is correctly placed before unpacking, and there is no damage from phenomenon such as collision, cracking and flooding on the outside of the box. Once you find that there is an abnormality in the external cabinet, please inform Raycus Company in time to deal with it as soon as possible.

Please double check if each listed object is inside the package; and contact Raycus as soon as possible if there are any issues.

Take extra care when removing the unit from the package and make sure that the fiber optic cable stays away from any possible collision and vibration. Please do NOT distort, bend or pull the output cable when unpacking the device; and avoid any collision to the head of laser output.



**CAUTION:** The fiber optic cable and the output head are precise optic instrument, ANY vibration or impact to the output head, and twist or excessive bend to the cable will damage the instrument.

## 2.4 Operation Environment

The operation conditions are listed as the following table:

Table 1: The Operation Environment for the Laser

Model	C20000XZ
Supply voltage (V)	Three-phase four-wire system AC 323V~AC 437V、 50/60Hz (including PE)
Power supply capacity (kVA)	>85
Water cooling flow (L/min)	>167(TOP flow>75, BOTTOM flow>92)
Installation Environment	Flat, no vibration nor impact
Ambient Temperature	10°C ~40°C
Relative Humidity	<70%

- a) Make sure the product is properly grounded before use.
- b) The laser output head is connected with fiber optic cable. Please inspect the output head carefully for dust or other contaminations. Use appropriate lens paper to clean it if necessary.
- c) Failure to follow the instructions when operating the laser may cause malfunction and damage.
- d) It is not allowed to install the output head when the laser is in operation.
- e) Do not look directly into the output head. Always wear appropriate protective eyeglasses when operating the laser.

Tips: Install the laser in an air-conditioned environment for longer life and better performance.

## 2.5 Attentions

- a) Make sure that the correct voltage of 380VAC is used. Power supply connection failures will damage the device.
- b) The output laser is collimated by the collimating lens, it is important to keep the collimating lens clean, otherwise it will damage the device.

- c) Please cap the output head when it is not in use. Do not touch the output lens at any time. Use appropriate lens paper to clean it if necessary.
- d) Please keep the protective cap of output head properly when using the laser. To avoid dust, make sure to place the protective cap with the opening facing downward.
- e) Failure to follow the instructions may cause laser power loss, and such loss is not covered by warranty.

## 2.6 Specifications

Table 2 Product Specifications

Optical properties		Test Conditions
Model	C20000XZ	
Output Power(kW)	20	/
Operation Mode	CW/Modulated	/
Polarization State	Random	/
Output Power Tunability (%)	10~100	/
Emission Wavelength(nm)	1080±5	Nominal Output Power
Output Power Instability	±1.5%	Nominal Output Power; Duration: 5hrs; Ambient Temp.: 25°C
Modulation Frequency (Hz)	50~2k	Nominal Output Power
Red Guide Laser Power(mW)	0.5~1	/
Fiber output Types	QP	/
Beam Quality (BPP, mm•mrad)	<4	Nominal Output Power
Fiber core diameter (μm)	100	customizable
Delivery Cable Length(m)	20	customizable

Electrical characteristics		
Operating Voltage	Three-phase four-wire system AC323V~AC437V, 50/60Hz (Include PE)	/
Maximum power Consumption (kW)	57	/
Way to control	Serial communication / AD	/
Other characteristics		/
Dimension (mm)	1200×1610×1230 (mm)	Includes casters and rings, without warning lights
Weight (kg)	<800	Air conditioning included
Operating Ambient Temperature (°C)	10~40	/
Humidity (%)	<70	/
Storage temperature (°C)	-10~60	/
Cooling method	Water cooling	/

### 3 Installation

#### 3.1 Dimensions

The main body dimensions of RFL-C20000XZ continuous wave fiber laser are shown in Figure 1.

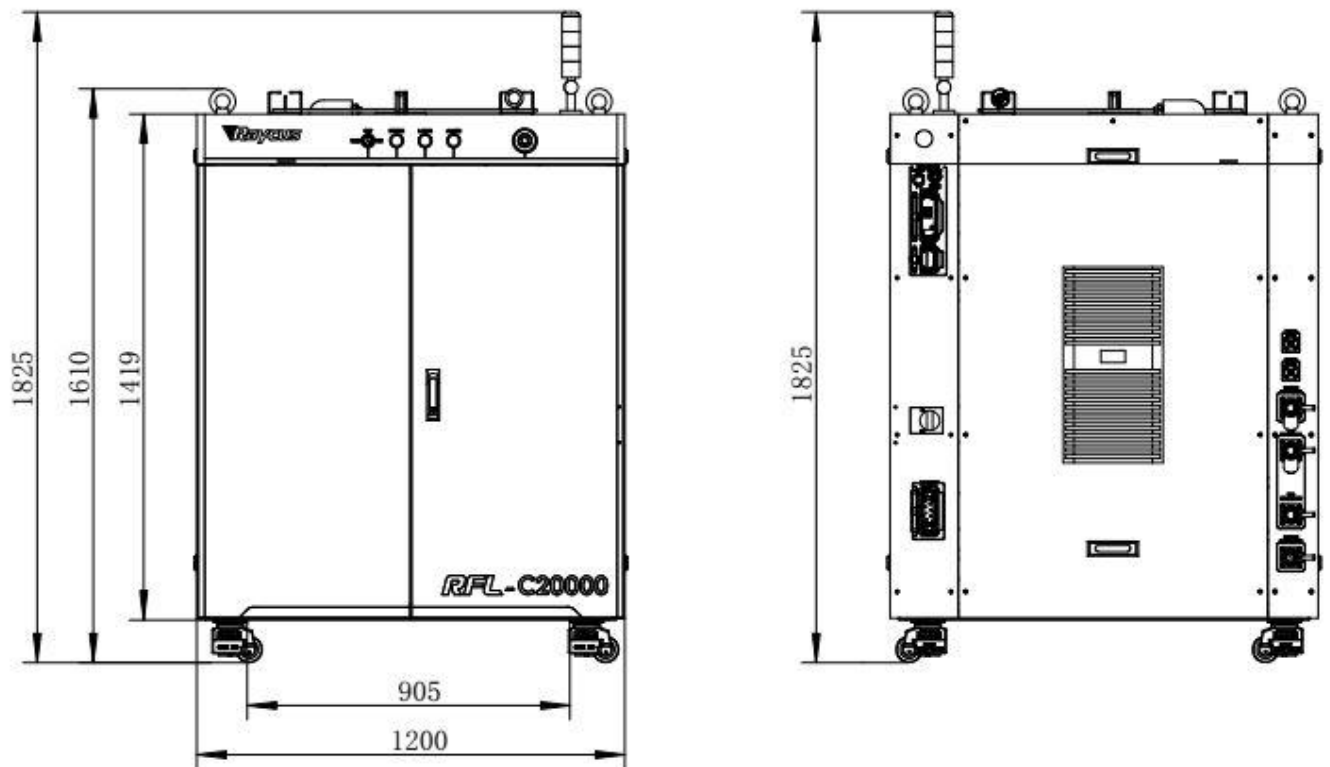


Figure 1-a Front and rear view of the laser.

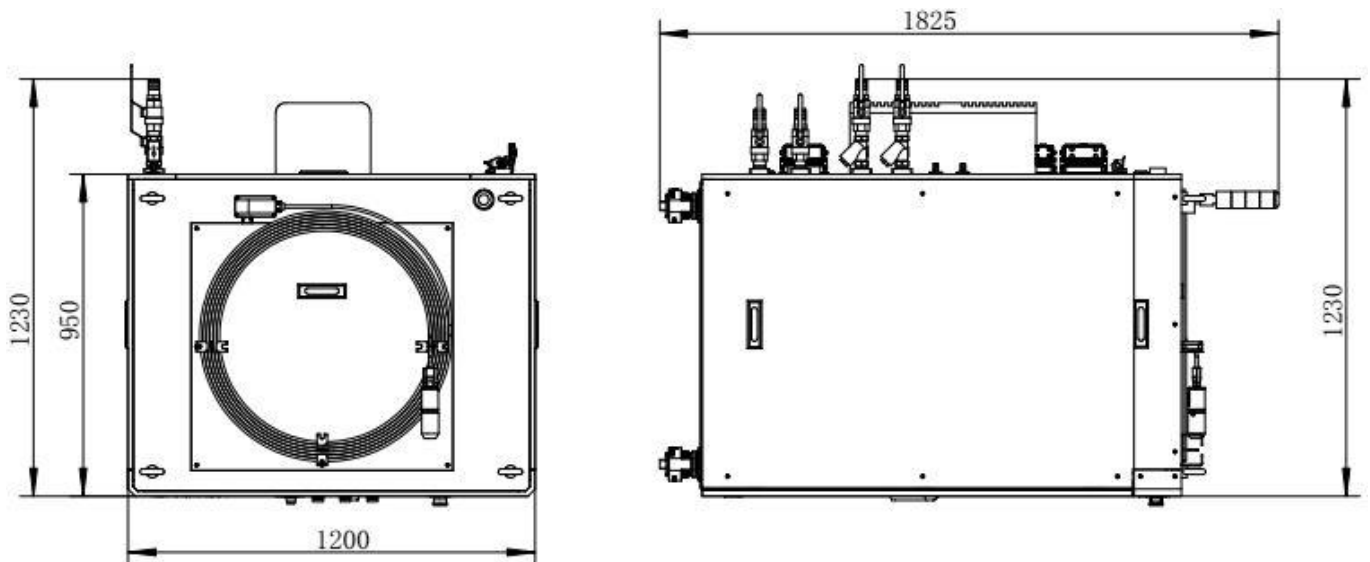


Figure 1-b Top and left view of the laser.

Figure 1 the dimensions of RFL-C20000XZ continuous fiber laser

The structural size of RFL-C20000XZ laser is 1200×1610×1230mm (width×height×depth; including casters and rings, without warning light); RFL-C20000XZ laser weighs less than 800kg.

The RFL-C20000XZ continuous fiber laser uses the RFL-QP output optical cable, and the external dimensions of the output optical cable head are shown in Figure 2.

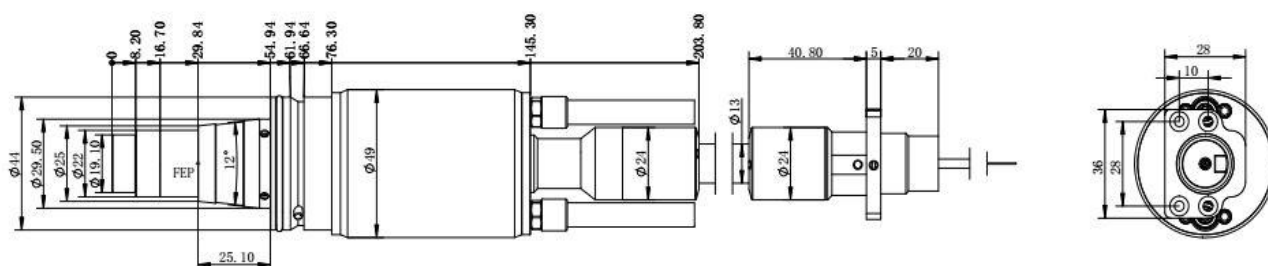


Figure 2 External dimensions of the RFL-HPQ output optical cable head (for 20kW)

**Note: The dimensions in the above diagram are in the unit of mm.**

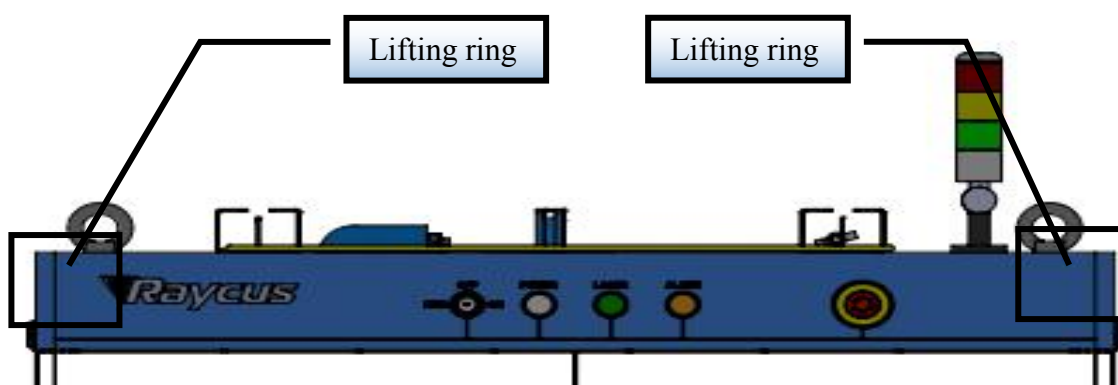
Before the laser works, make sure that the two copper contacts (Interlock pins) on the output head are shorted, otherwise the laser will not work properly. Before installing the output cable into the processing head, the lens of the output cable must be inspected. If the output cable lens is dirty, the lens must be cleaned. It is forbidden to disassemble the output lens by anyone other than staffs from Raycus, otherwise the warranty will be invalidated.

### 3.2 Installation rules

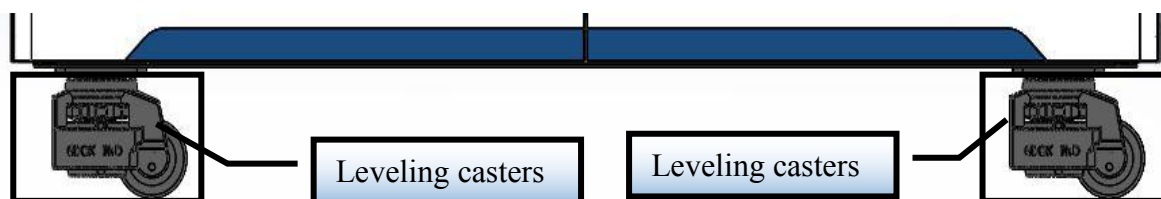
- a) Place the laser horizontally in a suitable position and ground it, as necessary.
- b) Before the laser is powered on, please check if the power supply has the correct voltage (Three-phase four wire system AC323V~AC437V, 50/60Hz including PE, See Table 2 Product Technical Data Sheet for details.), and check whether the grounding line is well grounded.
- c) Connect the power cable and control cable to the product when power supply is OFF.
- d) Connect the cooling system to the laser and output optical cable head according to the water inlet and outlet signs.
- e) Please check the laser output head and make sure to clean it before installing it in the equipment.



- f) Do not step on, squeeze or excessively bend the protective tube during the installation of the output optical cable to avoid damage to the optical fiber.
- g) In the process of installing the optical cable output head, ensure the cleanliness of the surrounding environment (do not use electric fans to dissipate heat when it is hot in summer to avoid large dust in the air).
- h) The minimum bending diameter of the laser transmission cable in non-working conditions such as transportation and storage shall not be less than 20cm. When the laser is emitting light, the minimum bending diameter shall not be less than 30cm.
- i) Customers can use the four lifting rings at the top of the product or the four casters at the bottom to lift or move the product. Before lifting the laser source, make sure that the four lifting rings are installed firmly and reliably. When lifting the laser source, be sure to use the four lifting rings; when pushing the laser source, please make sure that the support block at the bottom of the horizontal adjustment caster is off the ground. After the laser source is positioned, adjust the support block to make it contact the ground to avoid displacement of the laser source. As shown in Figure 3.






a) Lifting ring (RFL-C20000XZ)



b) Leveling casters (RFL-C20000XZ)

Figure 3 Laser top lifting ring and bottom level adjustment caster.

	<p><b>CAUTION:</b> All the cables can only be connected when power supply is off. Hot plug may damage the device.</p>
	<p><b>CAUTION:</b></p> <p>(1) The placement of the laser output cable should be as natural as possible, and the output cable should not be twisted.</p> <p>(2) If the coil diameter of the output optical cable is too small, it will damage the laser.</p>
	<p><b>CAUTION:</b></p> <p>(1) During the process of installation and disassembly, please handle the laser output head gently, and avoid vibration.</p> <p>(2) Before assembling the laser output head, ensure that the optical lens and cutting head cavity are clean and free of pollution.</p>

### 3.3 Protective end cap of output cable and using descriptions

#### 3.3.1. Category and ex-factory for protective end cap

For multi module high-power fiber laser, the output optical cable model used is QBH / QD / QP output optical cable, and there are two types of protective end caps with the device, as shown in the figure;

Type A end cap: it is assembled on the output optical cable when it leaves the factory, and the end cap is equipped with protective window, which is used to ensure the cleanliness of the end cap (or crystal) during transportation.

Type B end cover: it is attached to the packaging accessories and is generally packed in a film box. The end cover is not equipped with a protective window, which is used to prevent the end cap from being damaged when the optical cable is loaded with the cutting head (or welding head).

Table 3 instruction for protective end cap of output optical cable

Model of machine	Model of cable	End cap type of ex-factory	End cap type
RFL-C4000X	QBH	A-type end cap (with protective window)	A-type end cap (with protective window)
RFL-C6000X	QBH	A-type end cap (with protective window)	A-type end cap (with protective window)
RFL-C8000X	QD	A-type end cap (with protective window)	A-type end cap (with protective window)
RFL-C10000X	QD	A-type end cap (with protective window))	A-type end cap (with protective window)
RFL-C12000X	QD	A-type end cap (with protective window)	A-type end cap (with protective window)
RFL-C15000W	QD	A-type end cap (with protective window)	B-type (without protective window)
RFL-C20000XZ	QP	A-type end cap (with protective window)	B-type (without protective window)
RFL-C30000XZ	QP	A-type end cap (with protective window)	B-type (without protective window)

**Note:** Because of the difference in the protective end cap of optical cable used by customers, some models need to replace the end cover. Please refer to the "cleaning instructions for optical cable before installation" to clean the end cap of optical cable.

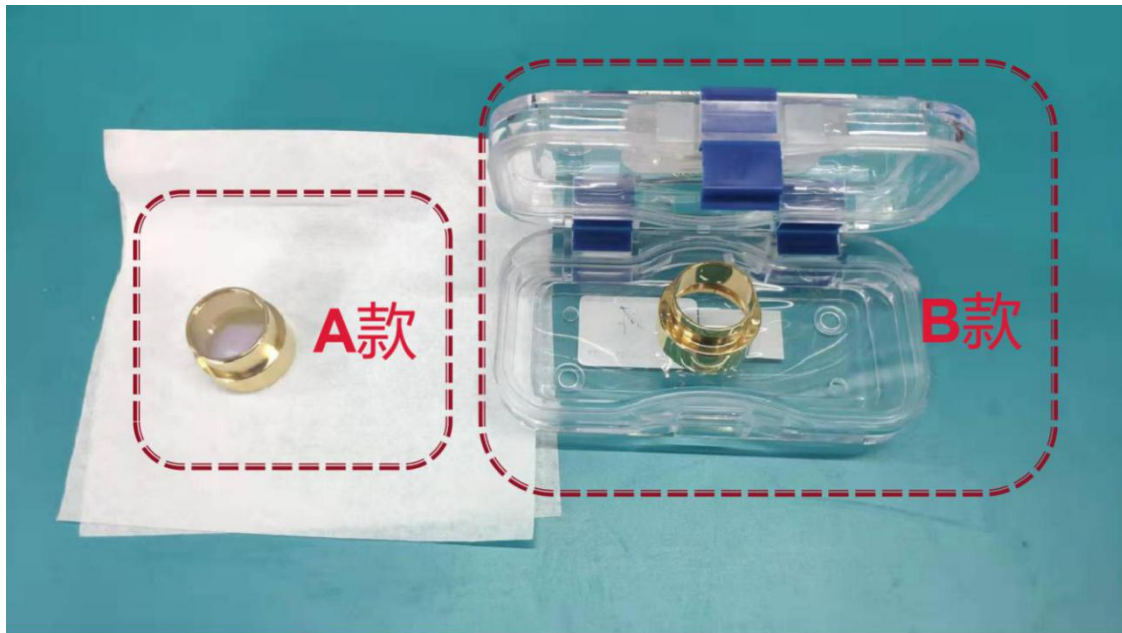


Figure 4 diagram of protective end cap.

### 3.3.2 Cleaning Description before Installation

#### a) Preparation tools

1.1 Cleaning agent: anhydrous ethanol, or isopropanol.

1.2 Cleaning tools: cleaning swab, dust-free paper, compressed air bottle, etc.

#### b) Operation steps

1.3 Open the air extraction for at least 5 minutes in advance before cleaning workbench and take out the output optical cable from the black packaging box, as shown in figure 5. Blow air with a compressed air bottle on the outer surface of the shell for preliminary cleaning;



Figure5 Output optical cable place inside packaging box.

- 1) Place output optical cable in a clean workbench;

Note: the following operations need to be carried out in a clean workbench. If the operation is not carried out in a clean environment, it will cause great risks to the QP output optical cable; Operators should wear fingerstalls.



- 1) Figure 6 output optical cable placed in cleaning workbench and with air extraction.
- 2) Remove white anti-dust cap and place it in a new dust-free paper facing down.

Note: the dust-free paper is disposable, and there is a risk of dust falling if it is used repeatedly.

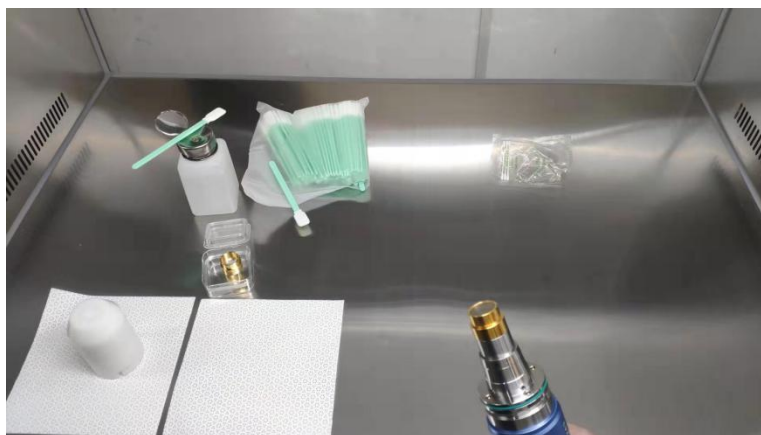


Figure 7 remove the output optical cable of white anti-dust cover.

- 3) Clean the metal shell of the optical cable with cotton swab and absolute ethanol, then remove the type –A end cover (with window) installed on the optical cable and put it on the dust-free paper.

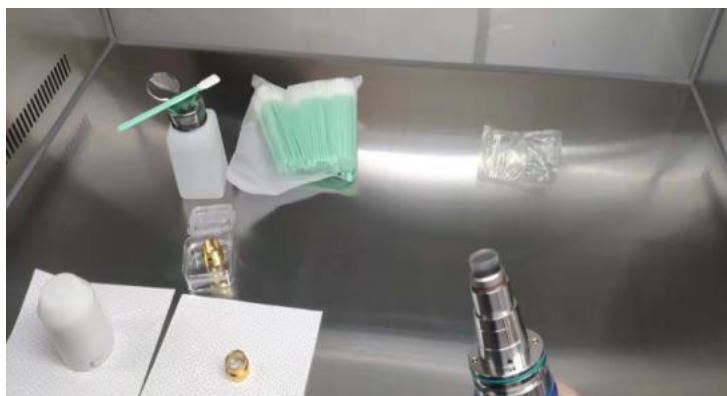


Figure 8 remove A-type end cap in the cable.

- 4) In this state, check the cleanliness of the end cap. If the cleanliness is not enough, please clean the end cap. Please refer to the following cleaning methods: <http://www.raycuslaser.com/view/1852.html>, video reference: <https://mp.weixin.qq.com/s/hRXrPkb8DAyvDYegSWwYLg>.

**Note: the end cap cleaning is generally operated by our professional personnel. If customers need to operate by themselves, they need to receive relevant training from our personnel and obtain relevant qualification before they can carry out the above**

**operation. If the operation mode is improper, the output optical cable will be irreversibly damaged.**

After the cleanliness is ensured, load the B type end cap. During the installation process, when screwing it to the bottom, there will be resistance, which is a Normal phenomenon. It is necessary to ensure that there is no gap between the end cap and the main sleeve, then check the smooth surface finish and cleanliness of the end cap, as shown in the figure. Then connect the optical cable output head with the cutting head (or welding head) under the condition of loading type B end cap. The operation needs to ensure the cleanliness of the internal and external surfaces of the cutting head (or welding head) connector.

**Note: connecting with cutting head (welding head) needs to be carried out in a clean workbench; it is necessary to check the cleanliness and finish of related components for the cutting head (or welding head)**

Keep the corresponding accessories as shown in figure 9 to facilitate the reoperation of the laser or output optical cable.

**Note: during each transfer, the optical cable must be loaded with type A end cap. Each time the output optical cable is unloaded from the cutting head and needs to be transferred, the B-type end cover must be replaced by A-type end cover, and the white anti-dust cover must be covered, and finally put into the black packaging box for transfer.**



Figure 9 customers need to keep the following accessories:

black protective box、 white anti-dust cap、 type-A end cap.

### 3.4 Cooling Requirements

Table 4 Cooling Requirements

Model	Cooling capacity (kW)	Minimum flow (L/min)		Input pressure (Bar)	Hose inner diameter (mm)	Cooling water temperature (°C)
RFL-C20000XZ	≥40	>167		4~6	Φ32	24±0.5
		Top flow	Bottom flow			
		>75	>92			

#### Requirements of Cooling Water:

- a) The laser source cooling water connection is shown in Figure 10, and the arrow direction indicates the water flow direction;
- b) Cooling water needs to be pure water;
- c) In order to prevent the water in the water cooler from growing mold and causing pipeline blockage, it is recommended to add alcohol when filling pure water, and the amount of alcohol added is 10% of pure water;
- d) When the ambient temperature of the equipment is between -10 °C and 0 °C, the glycol solution with a volume ratio of 30% must be used and replaced every two months;
- e) If ambient temperature is below -10°C, the chiller with both heating and cooling functions must be used and kept in full-time operation.



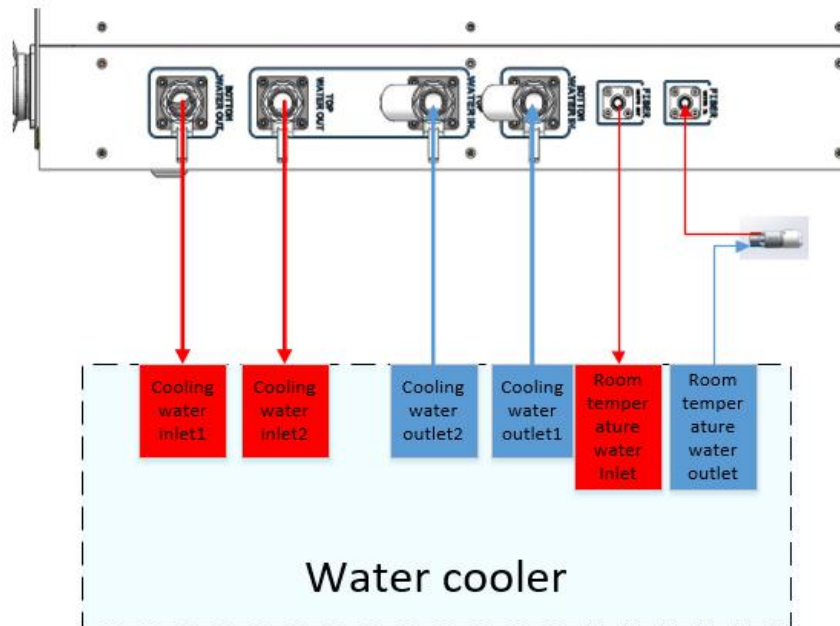


Figure 10 diagram of laser cooling system connection.


#### Water cooling requirements for output optical cables:

- a) Water flow requirements: water flow for QP output cable is more than 3.0L/min;
- b) Water cooling pressure: 0.4~0.6Mpa at the water inlet;
- c) Water inlet and outlet connector type: M6 to  $\phi 8$  quick-tightening connector;
- d) Water pipe type: outer diameter  $\phi 8$  and inner diameter  $\phi 5.5$ ;
- e) Cooling water quality: deionized water, distilled water, purified water; it is recommended to replace the water once a month, and the replacement period should not exceed two months.
- f) PH value of cooling water: 5.5~9;
- g) The water cooler needs to be equipped with a filter element whose filter particle size is less than 100um; the filter element needs to be cleaned once a month.
- h) Maximum cooling water temperature: 35°C;
- i) The lowest cooling water temperature: 5°C greater than the saturated dew point temperature;
- j) Additives in cooling water: meet the above PH value and solid particle size requirements;

- k) Armored pipe bending radius: in non-working conditions such as transportation and storage, the minimum bending diameter shall not be less than 15cm. When the laser is emitting, the minimum bending diameter shall not be less than 20cm;
- l) Long-term vibration, less than 2G; impact, less than 10G.

**Other requirements:**

- a) When starting the cooling system for the first time, check the entire water system and joint for water leakage.
- b) If the laser is not used for a long time, the cooling water inside the cooling system and the laser inside should be drained, otherwise the laser equipment will be damaged.
- c) Please use compressed gas below 0.5MPa when emptying water from the device. Failure to do so may cause permanent equipment damage to cooling system.

	<p><b>CAUTION:</b></p> <p>(1) Set the water temperature of the cooling system correctly according to the ambient temperature. Setting the water temperature too high will result in the laser not working properly. Setting the water temperature too low will cause condensation inside the laser or the laser output head, which will cause damage to the laser;</p> <p>(2) Before turning on the laser, the cooling system must be working properly, and the water temperature should be suitable for the temperature.</p>
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## 4 Using the Product

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Please log in to the official website of Raycus to download the new PC software and the PC software user manual. Website: <http://www.raycuslaser.com>

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### 4.1 Front Panel

Figure 11 shows the front panel.

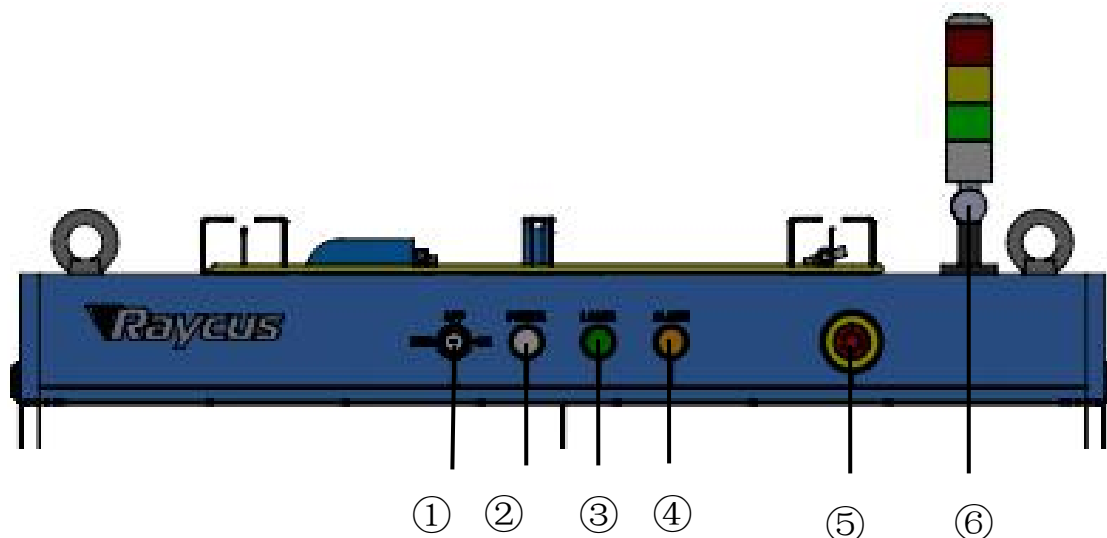


Figure 11 Front view of the panel

Note: ① REM/OFF/ON      ② POWER      ③ LASER  
 ④ ALARM      ⑤ STOP      ⑥ INDICATOR LIGHT

**REM/OFF/ON:** The key switch is the main control switch of the laser. Insert the key and turn it to the "ON" position, the main control part of the laser is powered on, and the POWER light is on, Rotate to the "REM" position, you need to close the Pin8 and Pin9 of the XP2 interface on the rear panel to achieve remote power-on, and rotate to REM to activate the hard-wired control mode of the laser.

**POWER:** Control power indicator, when the white indicator light is on, it means the main control system is on.

**LASER:** The power button of the laser main power supply has a green light indicator function. After the laser main control system is powered on and all INTERLOCKS are detected as normal, press this button, the laser main power supply is powered on, and the button lights up after the main power supply is powered on.

**ALARM:** INTERLOCK alarm indication, the ALARM indicator lights up during the power-on self-check on the control panel. After the self-inspection is completed, all INTERLOCK interfaces are normally closed, and the ALARM indicator is off. During the operation of the laser, any INTERLOCK failure will cause the indicator to light.

**STOP:** Emergency stop button, press it to turn off the laser immediately; turn clockwise to release the button. Use the key to turn on the laser and power on the laser again to return to normal.

**INDICATOR LIGHT:** After the main power supply of the laser is turned on, the green indicator light is on when the laser is Ready; when the laser is emitting light, the red indicator light is on; when the laser has a fault, the yellow indicator light is on, accompanied by an alarm sound.

## 4.2 Rear Panel

Figure 12 shows the rear panel.

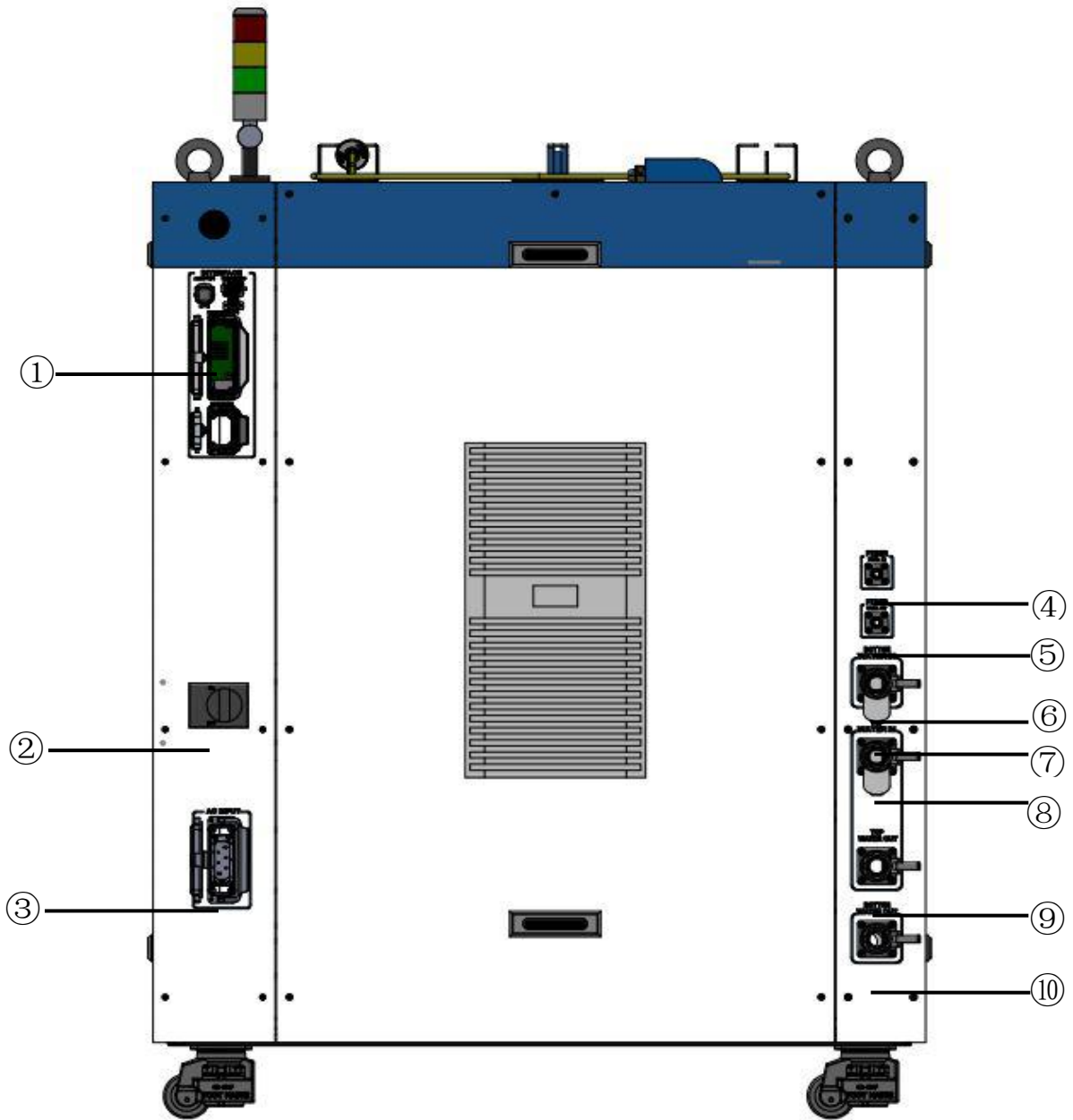


Figure 12 Rear view of product panel.

Note: ①-INTERFACE    ②-BREAKER    ③-AC INPUT

④-FIBER WATER IN    ⑤-FIBER WATER OUT    ⑥-BOTTOM WATER IN

⑦-FILTER    ⑧-TOP WATER IN    ⑨-TOP WATER OUT

⑩-BOTTOM WATER OUT

①**INTERFACE:** this interface provides all control signals, including: RS232 communication, laser on/off control, laser remote control mode selection, analog control, modulation signal, Interlock interface, etc. Refer to Table 4 for the definition of control lines. This socket comes with a protective cover and a lock. When you are not using the product, you can cover the power input socket with the protective cover and lock it with the lock.

②**BREAKER:** the circuit breaker (air switch) on the rear panel of the laser is the main power switch of the laser.

③**AC INPUT:** the power input socket must be matched with the plug provided by us. This socket comes with a protective cover and a lock. When you are not using the product, you can cover the power input socket with the protective cover and lock it with the lock.

④**FIBER WATER IN:** Output optical cable water inlet interface, this interface is connected to the water outlet of the Normal temperature water of the water cooler and connected to the  $\phi$  13 inner diameter water pipe.

⑤**FIBER WATER OUT:** Output fiber optic cable out of the water interface, this interface is connected to the output fiber optic cable inlet, connected to the  $\phi$ 13 inner diameter of the water.

⑥**BOTTOM WATER IN:** The lower water inlet of the laser, this interface is connected to the outlet of the cooling water of the water cooler, connected to the water pipe of  $\phi$ 32 inner diameter.

⑦**FILTER:** Filter the cooling water entering the laser.

⑧**TOP WATER IN:** The upper water inlet of the laser, this interface is connected to the outlet of the cooling water of the water cooler, connected to the water pipe of  $\phi$ 32 inner diameter.

⑨**TOP WATER OUT:** The upper water outlet of the laser, this interface is connected to the cooling water return port of the water chiller and connected to the  $\phi$  32 inner diameter water pipe. The combination of TOP WATER OUT and TOP WATER IN is used for the outflow and return of the upper cooling water of the laser.

⑩**BOTTOM WATER OUT:** The lower water outlet of the laser, this interface is connected to the cooling water return port of the water chiller and connected to the  $\phi$  32 inner diameter water pipe. The

combination of TOP WATER OUT and TOP WATER IN is used for the outflow and return of cooling water from the lower layer of the laser.

### 4.3 Power Connection


	<p><b>CAUTION:</b></p> <p>(1) Before connecting to the AC power supply, please check whether the supplied AC power supply meets the requirements in Table 1;</p> <p>(2) Incorrect wiring will cause damage to the laser, so please check whether the power cord is connected correctly before powering on the laser.</p>
---	--

Figure 13 shows the power cord provided by Raycus.



Figure 13 RFL-C20000XZ Laser source power cord

Insert the plug at the end of the power cord into the socket marked "AC INPUT" on the rear panel. Note that the plug has an anti-reverse connection function. After inserting it, use the lock to lock. The plug and socket as shown in Figure 14.



Figure 14 RFL-C20000XZ physical picture of power cord plugs and socket

The AC input line of RFL-C20000XZ laser adopts a seven-core cable. The definition and parameter requirements of the AC input line interface are shown in Table 5.

Table 5 The interface definition and parameter requirements of AC input line.

Interface definition and parameter requirements of RFL-C20000XZ AC input line				
Connector Tag	Interface definition	Logo	Wire diameter	Wire color
1、2	AC380V-L1	L1	16mm <sup>2</sup>	Brown
3、4	AC380V-L2	L2	16mm <sup>2</sup>	Black
5、6	AC380V-L3	L3	16mm <sup>2</sup>	Gray
7	Protective	PE	16mm <sup>2</sup>	Yellow green
8	/	/	/	/

The standard length of C20000XZ provided by Raycus is 15 meters.



#### 4.4 Control Interface Definition

This type of laser does not provide a control signal line, only a control signal connector. The appearance of the joint is shown in Figure 15.

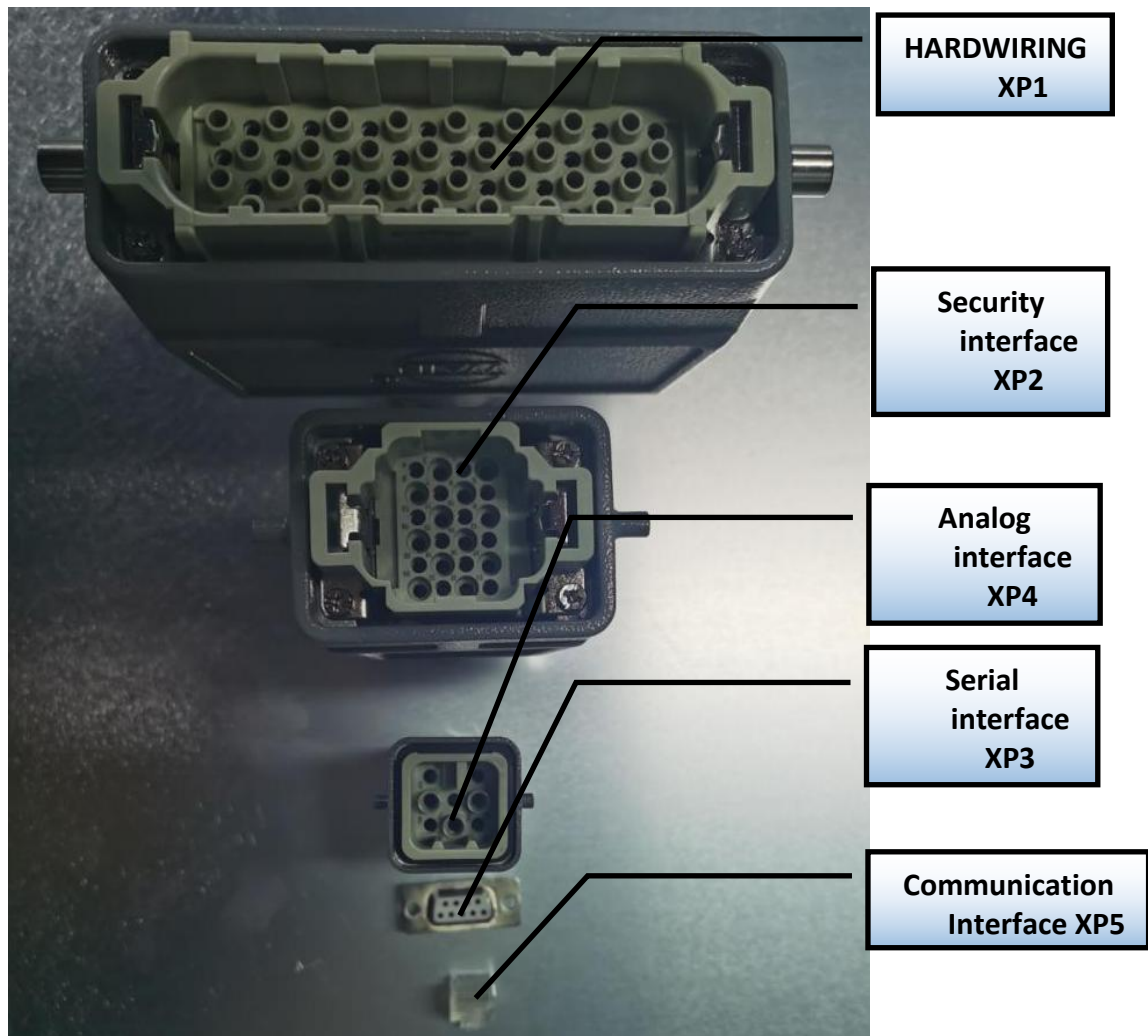


Figure 15 Control signal line.

##### 4.4.1 Safety XP2 Interface

24-pin safety interface, with remote control system power-on, remote main power power-on and active and passive output of some lasers. The detailed interface definition is shown in Table 6.

Table 6 XP2 security interface definition

Pin Number	Type	Description
1	MOD+	Output control, voltage input signal; laser ON: 4~30V; Laser OFF: -3~2V. Highest frequency 5kHz
2	MOD-	
3	OUT ( FET S pole)	Laser output indication, MOS pipe D、 S output;
4	OUT(FET D pole)	Current<0.5A, Vds<30V, passive signal
5	OUT	Light warning light negative, current<100mA
6	OUT	Main power on alarm light negative, current<100mA
7	OUT (24V)	Output light and main power on alarm light positive, current<400mA
8	IN	Remote main control board power on REM mode ,24 V active contact Output, no external voltage or grounding. The main control board is powered on
9	IN	
10	24V OUT	Output light and main power on alarm light positive, current<400mA
11	OUT	Front panel emergency output 1, relay contact output, passive contact, current <100 mA, voltage<30V; The current panel stop press ,11,14 open, or short circuit
14	OUT	
12	OUT	Front panel emergency output 2, relay contact output, passive contact, current <100 mA, voltage<30V; The current panel stop press ,12,13 open, or short circuit
13	OUT	
15	OUT (FET S pole)	Main power supply power on output indication, MOS pipe D、 S output current<0.5A, voltage<30V, passive signal
16	OUT(FET D pole)	
17	IN	Interlock1 import, Active contacts, Normal short connection 17、 20, no external voltage or grounding
20	IN	
18	IN	Interlock2 import, Active contacts, Normal short connection18、 19, no external voltage or grounding
19	IN	
21	IN	Remote main power supply power up, the Power button function on the front panel is the same, when the 21,22 feet closed, start the main power supply, active contact, no external voltage or grounding
22	IN	
23	OUT	Remote main power supply power up, the Power button function on the front panel is the same, when the 21,22 feet closed, start the main power, passive signal, external voltage, current<1A, voltage<30V
24	OUT	

a) MOD SINGLE

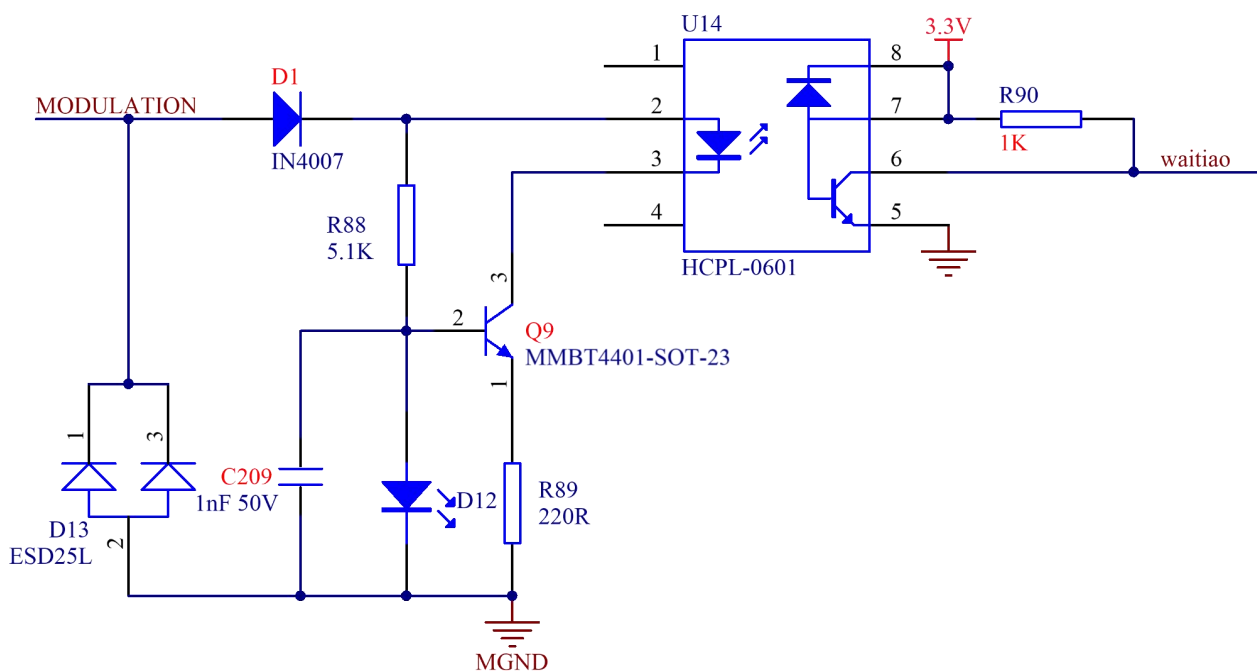


Figure 16 MOD Signal Circuit Diagram.

This signal is 5/24V compatible, and reverse connection is not allowed.

MOD is used to control the laser output and off when the key switch is hit ON and the laser is working out of light external control mode.

When the key switch hits REM, and the laser is operating in outgoing light control mode, MOD and XP1-A2 (at this time, the A2 bit outgoing light enable signal) are jointly used to control the laser output and off (in REM mode, outgoing light control can be controlled only by A2, to be customized).

b) Passive light output indication and main power up indication

XP2's 3/4 light output indication, 15/16 is the main power has been powered on output indication, the internal circuit diagram is as follows.

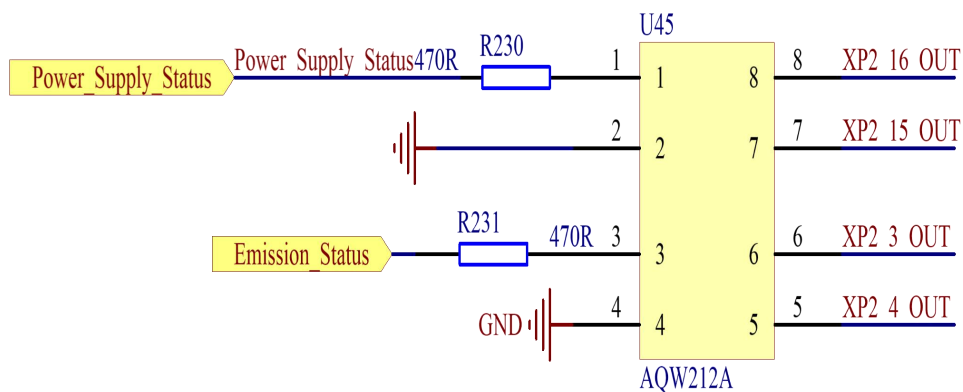


Figure 17 Out light output and main power up indication circuit diagram

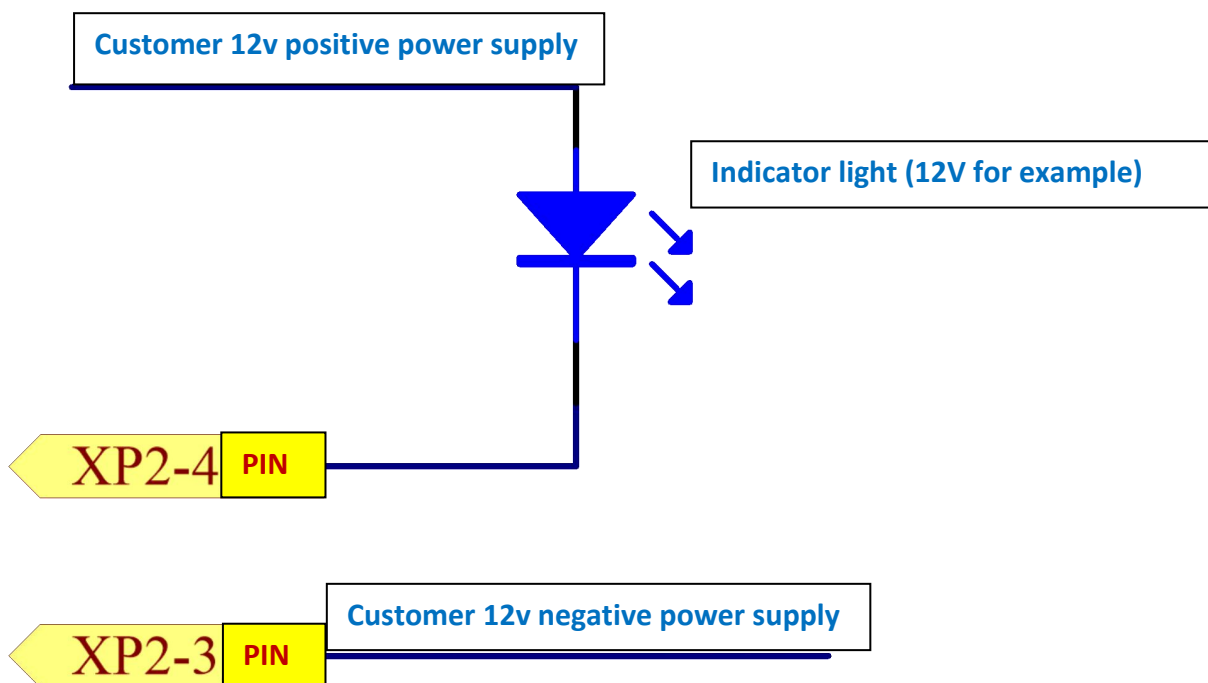


Figure 18 Recommended wiring diagram for light output indication (12V as an example).

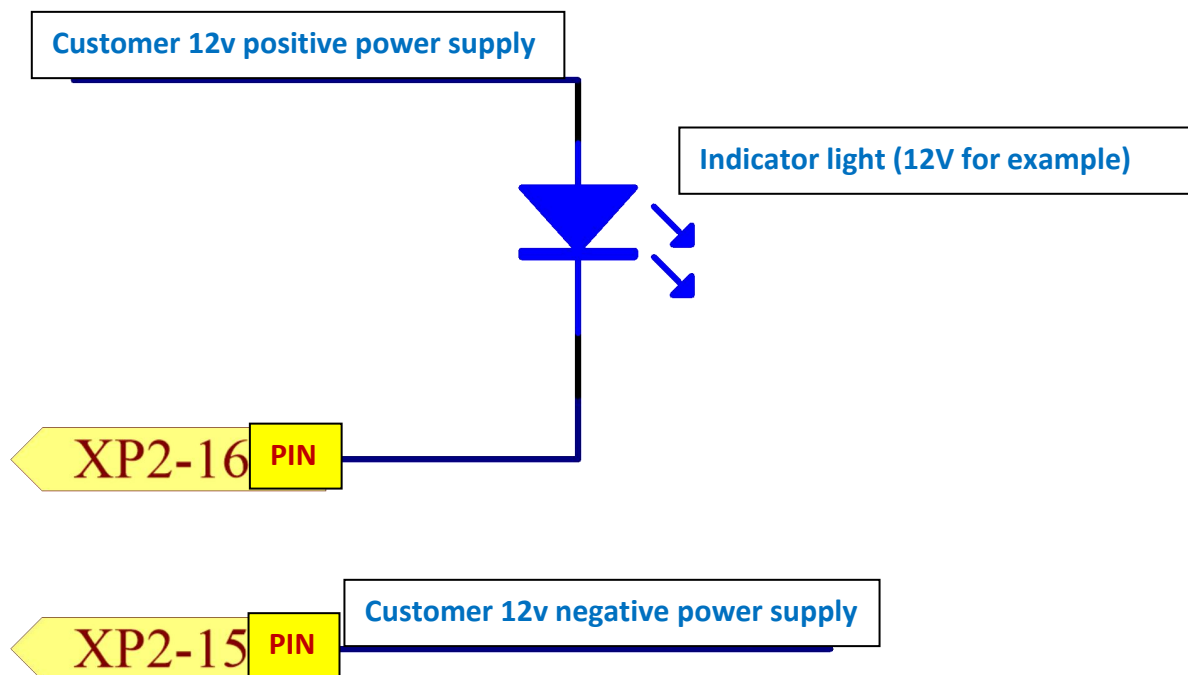


Figure 19 Recommended wiring diagram for main power up indication (12V as an example)

c) Active light out indication and main power up indication.

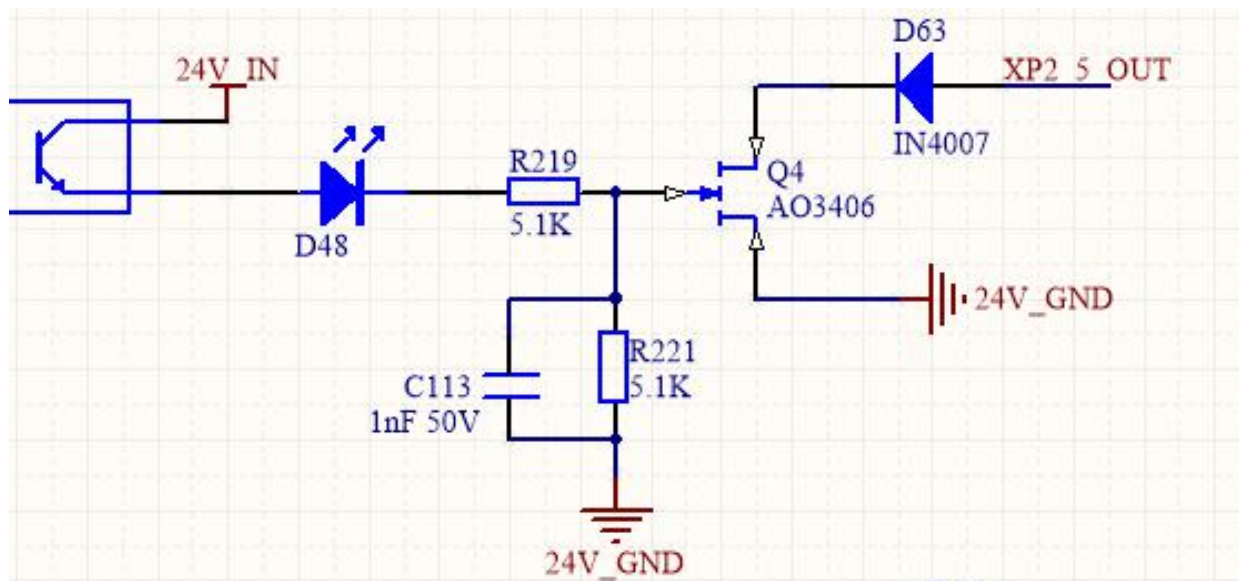


Figure 20 Active light out indication and main power supply has been powered on indication circuit diagram.

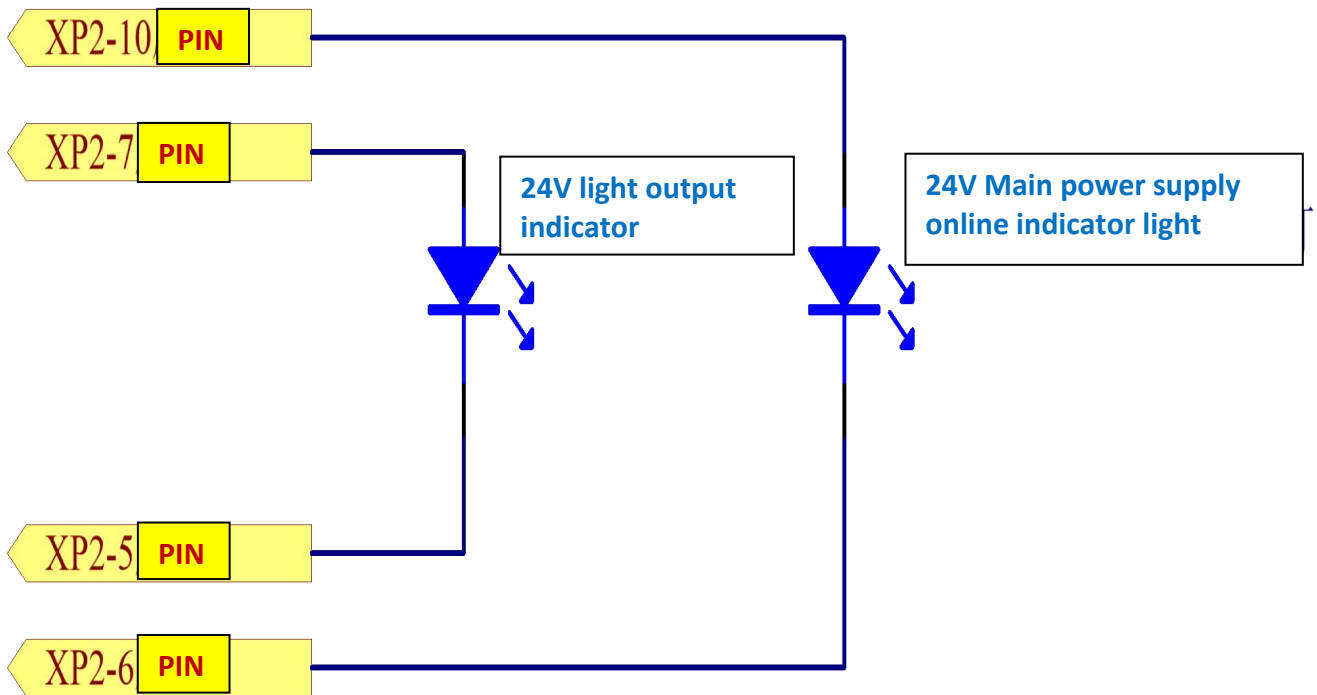


Figure 21 Active light indication and main power supply has been powered on the recommended wiring diagram.

d)Powering up the remote-control board

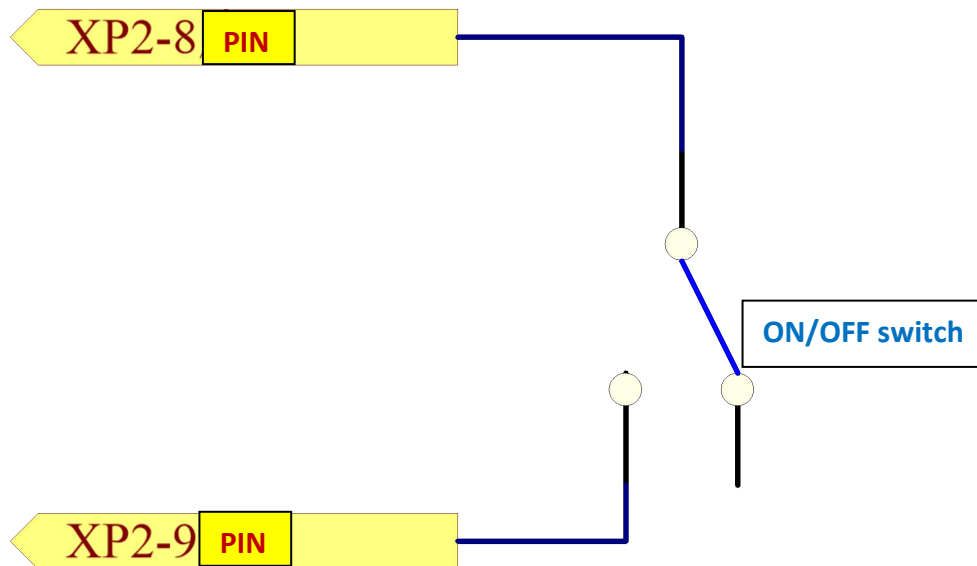


Figure 22 Remote control board power-up recommended wiring diagram.

When the laser key switch hits REM mode, pin 8/9 must be shorted to the main control board to power up.

e) Remote Mains Power Up

This signal is used to enable mains power-up via the XP2 interface.

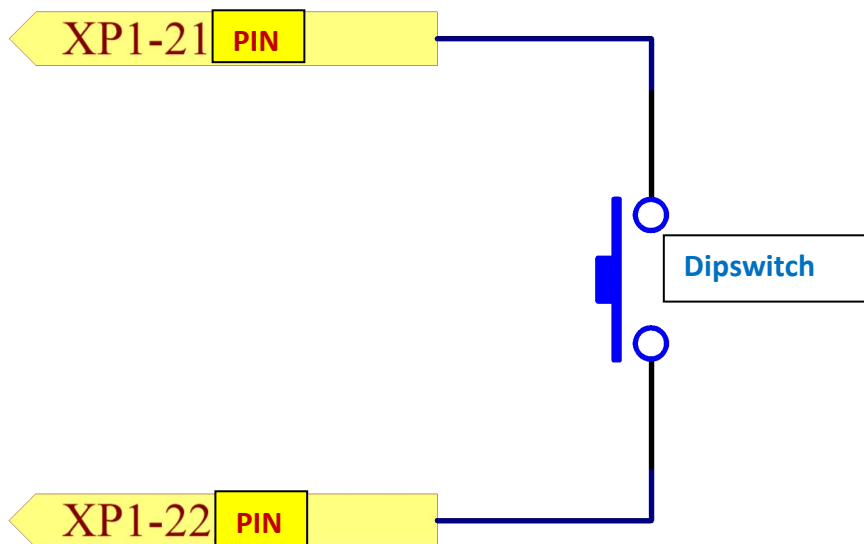


Figure 23 XP2 remote main power up wiring diagram.

f) Control board is powered up output

This signal is relay output, the main control board power on the relay suction.

4.4.2 Hard Wiring XP1

64 pin hard wire interface, control signal input and output interface of laser in remote mode. Input high level is greater than 18V valid, input low level is less than 3V valid. Specific interface definitions are shown in Table 7 below.

Table 7 XP1 Hardwire interface definitions.

No. XP1	Interface Requirements		Type	Description
	Pin number	Pin definition		
XP1	A1	Laser request signal	Input signal	Import signal, request laser, this bit is valid before the laser receives other instructions

	A2	Programming Mode start-up execution	Input signal	Import signal, rising edge start according to the pre-downloaded programming instructions output laser, program number is determined by the A8~A14. The laser power is set by AD analog if the program number is 0000000 and the A6 is high; if the program number is 0000000 and the A6 is low, the laser power is set by the host computer; if the program number is 0000000 and the A6 is low, the A3 is high, and the output is controlled by the host computer software
	A3	Enabling Internal patterns	Input signal	High level enables PC software control function
	A4	Reset signal	Input signal	High level effective, clear laser alarm bit, effective high-level time at least 1 MS
	A5	Red light indicator	Input signal	The effective red light indicates light.
	A6	Simulation control enabling energy	Input signal	The input signal can simulate the input signal (Program num = 0000000)
	A7	Stop programming Mode	Input signal	Stop programming mode at high power
	A8	Program Num 0	Input signal	Input signal, low position
	A9~A14	Program Num 1~6	Input signal	Input signal ,1~6 bits high, select programming signal
	A15	Synchronous input	Input signal	Backup
	A16	COM	Reference for all signals	
	C1	Laser-driven power supply	Input signal	Input signal, up edge starts main power supply, down edge turns off main power supply.
	C2	null		



C3~C6	Choice of gate channel	Input signal	Input signal: C3 is low, C6 is high ;0000-gate closing ,0001-gate 1 open ,0010-gate 2 open, 0011-gate 3 open (Open only to laser with optical gate, Normal type this pin standby)
C7	Currently reserved (Enable signal to be used as QCW mode)	Input signal	Input signal, enable QCW mode (For lasers with QCW modes only)
C8~C16			Backup
B1	The laser is ready	Output signal	Output signal, indicating that the laser is ready to produce light
B2	Laser output	Output signal	Output signal, indicating that the laser is emitting light
B3	The laser operates in internal mode	Output signal	Output signal indicating that the laser operates in internal mode
B4	Laser anomalies	Output signal	Output signal indicating Abnormal laser
B5	Laser red light indication	Output signal	Output signal, indicating that the laser is red
B6	AD mode	Output signal	Output signal indicating that the laser operates in AD mode(A1)
B7	Laser received request signal	Output signal	Output signal indicating that the laser receives a request signal
B8	Main power supply in laser	Output signal	Output signal indicating that the main power supply of the laser is powered on
B9	The laser is operating in programming mode	Output signal	Output signal indicating that the laser is performing programming mode

B10	Programming mode execution completed	Output signal	Output signal, indicating that the laser programming mode is completed, the bit clears when the A2 is invalid
B11	Abnormal Wave Mode Termination	Output signal	output signal indicating that the laser programming mode is abnormally terminated RESET (a4) cleared
B12	Synchronous output	Output signal	Output signal, high effective, low invalid
B13	Warning output	Output signal	Output signal, indicating a warning to the laser
B14	Backup		
B15	External power supply positive		The external 24 V input voltage, all table output signal power supply, only these two feet access 24 V power output signal is effective
B16	Negative external power		
D1~D4	Current gate channel indication	Output signal	Output signal indicating the actual channel position of the current gate. 0000-gate closed, channel 0001-1 selected, channel 0010-2 selected, channel 0011-3 selected (Open only to lasers with gate pairs, other lasers this pin standby)
D5	Backup		
D6	Backup		
D7	QCW mode	Output signal	Output signal indicating that the current laser operates in QCW mode (only for lasers with QCW mode)
D8~D11	Laser hardware address	Output signal	Coding-Cable function ;0000-0 laser ,0001-1 laser; D8 low, D11 high

	D12~D16	Backup		
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#### 4.4.3 RS232 XP3 Interface

The 9-pin serial interface is used for the communication between the laser and the upper computer. It can be used to communicate with the upper computer of Raycus Company or the software of the upper computer which integrates the communication protocol of Raycus. The definitions are as follows:

Table 8 XP3 Serial Interface Definitions

Pin No.	Type	Description
2	IN	RXD, Serial port receiving pin of laser
3	OUT	TXD, Serial Sending Foot of Laser
5	COM	GND, Serial port public end

#### 4.4.4 Analog Interface XP4

The analog interface, an 8-core Harting interface, is used to control the output power of the laser by analog in AD mode and can also monitor the output light and power feedback signals of the laser. The interface definition is shown in Table 9 below.

Table 9 XP4 Analog interface definitions

Pin No.	Type	Description
1	IN	0~10 V analog signal, laser power control signal in AD mode, 0~10 V corresponding to 0~100% output power
2	AGND	Analog Signal
3	OUT	Power amplifier voltage output 0 V 0% laser power output 8 V 100% laser power output
4	Reference	Reference for power amplifier voltage
5	OUT	High back-amplification voltage (reserve, no)
6	Reference	Reference Ground for High Backup Voltage

#### 4.4.5 INTERNET Interface XP5

Table 10 XP5 Communication interface definitions.

Pin	Function	Description
1	TX+	Data transmission+
2	TX-	Data transmission-
3	RX+	Data transmission+
4	N/C	Connectionless
5	N/C	Connectionless
6	RX-	Data acceptance-
7	N/C	Connectionless
8	N/C	Connectionless

#### 4.5 Introduction to Safety Interlock

Raycus' product is designed with a safe interlocking loop, which is a two-channel system with output monitoring and manual reset. When the safety interlocking circuit is open, the safety circuit will disconnect the working power of the optical module, that is, the main power supply of the optical module. To start the main power supply, you must close the two interlocking channels (24 pin interface :17 and 20 feet short ,18 and 19 feet short). Otherwise, the main power will be turned off and the laser cannot be turned on. When one of the channels is open, the laser main power supply is impossible to start until the other channel is open, and then the two channels are closed before the laser main power supply can be started.

If the interlock is closed (the stop button is also released) and there is no error alarm, press the start (LASER) button to start the main power supply, and the 'main power has been started' pin of the external interface will have a high-level output.

When the security interlocking circuit is open or the error is detected, the main power supply of the optical module will be turned off, and the 'main power supply has been started' signal of the interface will become low level. The detected 'error state' is latched and the on-board relay opens the manual reset loop with monitoring until the error is cleared, thus preventing the laser from being restarted. If errors such as short circuit between interlocking channels or short circuit of start (LASER) button are detected, the safety loop cannot be reset before the error is cleared.

#### 4.6 Schematic diagram of the internal electrical circuit of the laser

The internal electrical circuit of the laser is shown in figure 24:

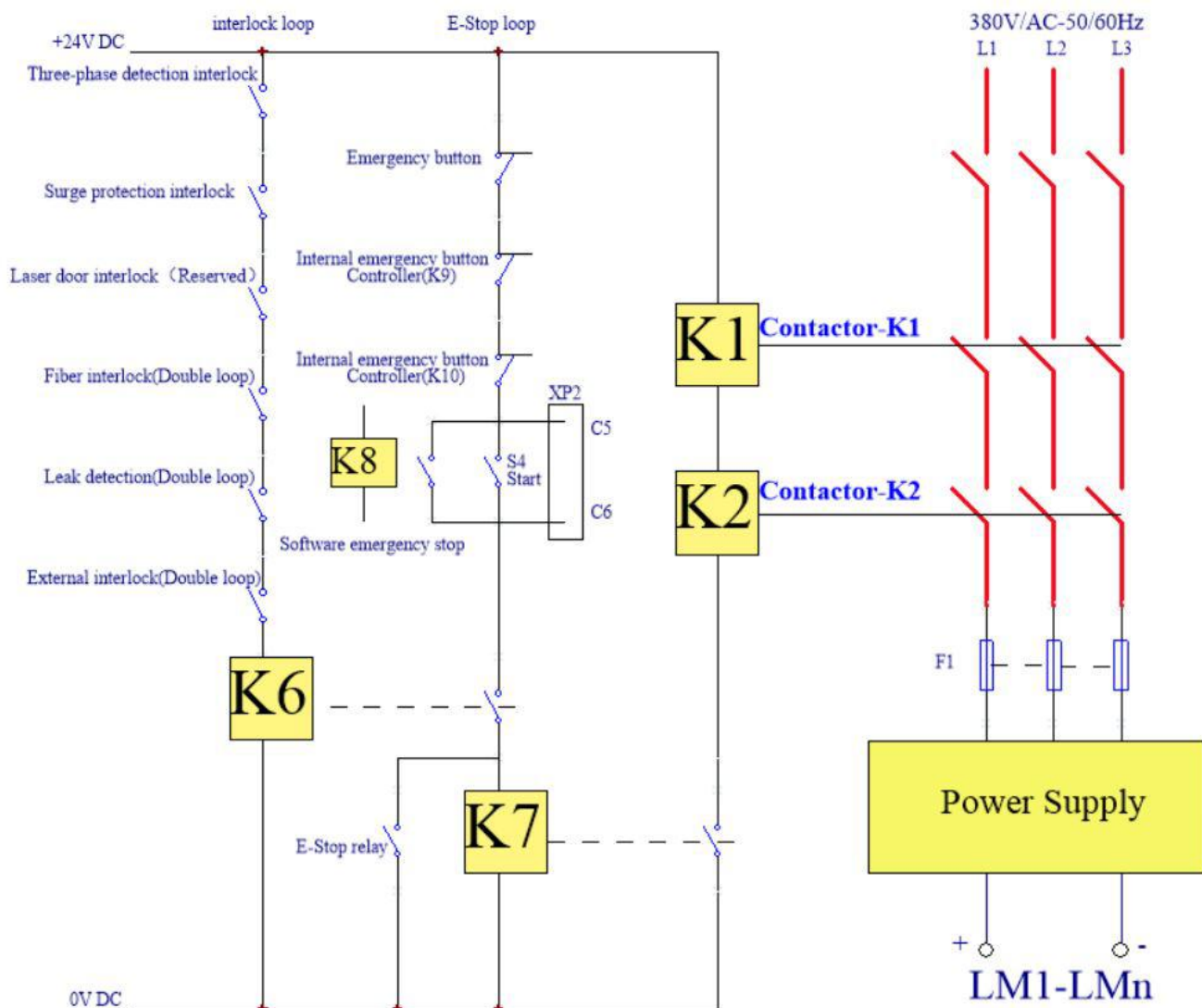


Figure 24 Schematic diagram of the internal electrical circuit of the laser.

**Note:** in the strong power control part contactor K1 and K2 of RFL-C20000XZ laser, its power part is 3 pieces 50A contactors in parallel use, and signal end 6 in series use.

#### 4.7 Start operation sequence.

- a) Turn on the water cooler, check whether the water pipe is leaking, turn off the water cooler and connect electrically.

- b) Make sure the circuit breaker is in an OFF state and the stop button on the front panel of the laser EMERGENCY STOP pressed; all electrical connections must be completed before the laser is powered on.
- c) Confirm that the three-phase electrical connection is correct, and the power supply meets the specifications of the power supply.
- d) Close the rear panel circuit breaker, release the laser front panel emergency stop switch; turn on the key switch and the laser has a temperature and humidity alarm, turn off the key switch. After the air conditioner works for 10minutes, turn on the key switch again. Wait for the air conditioner to continue working for 10minutes until the temperature and humidity alarm of the laser does not appear, at this time, turn off the key switch and turn on the water cooler; ensure that all laser doors are closed, optical cable output head has been inserted into the cutting head (or corresponding equipment), all interlock interfaces have been closed.
- e) Select the required control mode according to 1.4 control mode, turn on the key switch, and start the main power supply waiting for the laser to ready. When the laser is ready, the green light comes in the tricolor above the machine, representing that the laser can light.


## 5 Control Mode Selection


Raycus high-power continuous wave laser has two control modes: respectively ON mode and REM mode; the user can select mode that needs to enter through the key to the front panel.

Table 11 Function of REM mode and ON mode


	AD mode	Emission control	Programming mode	Power	Radiating and closing of the laser	Red-light	Wiring diagram
ON	close①	close②	-	communication (13)	communication(11)	communication (12)	
	enable③	close②	-	XP4-1 、 2pin pressure	communication(11)	communication (12)	
	close①	enable④	-	communication (13)	XP2-1、 2pin level	communication (12)	
	enable③	enable④	-	XP4-1 、 2pin pressure	XP2-1、 2pin level	communication (12)	
REM	close⑤	close⑥	close⑦	communication	communication(11)	communication	

			(13)		(12)	
enable⑧	close⑥	close⑦	XP4-1 、 2pin pressure	communication(11)	XP1-A1 、 A5 is high level	
close⑤	enable⑨	close⑦	communication (13)	XP1-A1 laser request is high. XP1-A2 light output enable is high. XP2-1,2 input MOD signal	XP1-A1 、 A5 is high level	
enable⑧	enable⑨	close⑦	XP4-1、 2pin pressure	XP1-A1 laser request is high. XP1-A2 light output enable is high. XP2-1,2 input MOD signal	XP1-A1 、 A5is high level	
close⑤	enable⑨	enable⑩	determined by programming command	XP1-A1 laser request is high. XP1-A2 high level indicates operating programs	XP1-A1 、 A5is high level	

① Communication sends “DEC”, or computer software clicks  button;

② Communication sends “DLE”, or computer software clicks  button;

③ Communication sends “EEC”, or computer software clicks  button;

④ Communication sends “ELE”, or computer software clicks  ;


⑤ XP1-A1 is high level, XP1-A6 is low level and suspending;


- ⑥ XP1-A1 is high level, XP1-A3 is high level;
- ⑦ XP1-A1 is high level, XP1-A8~A14 is low level and suspending;
- ⑧ XP1-A1 is high level, XP1-A6 is high level
- ⑨ XP1-A1 is high level, XP1-A3 is low level and suspending;
- ⑩ XP1-A1 is high level, XP1-A8~A14 is not all low level;
- ⑪ Emit laser: Communication sends “EMON” or computer software

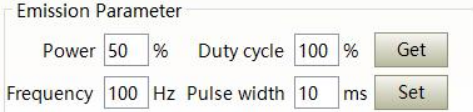
clicks   button.

Turn off the laser: communication sends “EMOFF”, or computer software

clicks   button.

- ⑫ Communication sends “ABN” or computer software clicks  button to emit red light,

communication sends “ABF” or computer software clicks  button to turn off the red light.

- ⑬ The communication sends "SDC XX" to set the power percentage, XX represents the power percentage, or the computer software clicks  button;

### 25.1 ON Mode

In the ON mode, the user can send commands to set different working modes through computer software or direct communication. After the laser is powered on again, the mode before power failure will be memorized.

#### 2.1.15.2 AD Enable Mode.

When AD mode is enabled, the laser power is determined by the analog voltage of pin 1 and pin 2 of xp4; if the AD mode is not enabled, the laser power can be set through the computer software or send the "SDC XX" command.



### 2.1.25.3 Emission External Control Enable

When the external control is enabled, the laser emission is determined by the MOD level state on the pin 1 and pin 2 of xp2; If the external control emission is not enabled, the laser emission and shutdown are determined by the light output button of the computer software, or communication sends "EMON" to control the laser emission and send "EMOFF" to control the laser off.

### 5.4 Red Light Control

In the ON mode, the red light can only be turned on by sending "ABN" through the computer software or communication, and "ABF" turns off red light. The red-light module in the laser works by means of communication, so there is a time delay of at least 10 MS when the red light is turned on and off;

When the red light is on, the laser cannot be set to Ready position. Only when the red light is off, can the laser be ready (this limit can be changed, please contact Raycus Engineer).

### 5.5 Programming Mode

In the ON mode, when the current program number of the laser is not 0, the laser will run in the programming mode.

Please use the computer software of Raycus to edit the wave and select the pre-operation program number.

When the laser is in the emission internal control mode, press



or send EMON command, the laser starts to operate program; send



or press EMOFF, the laser can stop program at any time;

When the laser is in the external control mode, the rising edge of MOD starts to operate the program, and the falling edge of MOD can terminate the program at any time.

## 5.6 REM mode

### 5.6.1 AD enable mode

When both A1 and A6 of xP1 are set high, the laser operates in AD mode, and the current laser power is determined by the analog voltage of pin 1 and pin 2 of xp4; When A6 of xP1 is set low or suspended, the current laser power is set by sending "SDC XX" command through PC software or communication.

### 5.6.2 Emission external control

When both A1 and A3 of xP1 are set high, the laser is in the internal control mode, and the light output is controlled by the computer software's light on button or by communication sending "EMON" to control the light output, and "EMOFF" to control the light off; When A1 of xP1 is set high, A3 is suspended or set low, the laser is in the external control mode, and the output light is determined by the high and low levels of A2, xp2-1 and PIN 2 MOD signals of xP1.

### 5.6.3 Red light control

When both A1 and A3 of xP1 are set high, the laser is in the red light internal control mode, and the red light is controlled by the computer software red light button or communication to send "ABN" and "ABF" used to control the ON and OFF of the red light; When A1 of xP1 is set high, A3 is suspended or set low, the laser is in external control mode, and the red light is controlled by A5 of xP1.

The red-light module in the laser works by means of communication, so there is a time delay of at least 10 MS when the red light is turned on and off;

When the red light is on, the laser cannot be set to ready. Only when the red light is off, can the laser be ready (this limit can be changed, please contact Raycus Engineer).

### 5.6.4 Programming mode

When A1 of xP1 is set high and a8-a14 is not 0, the laser is in programming mode. At this time, the output light of the laser is controlled by A2 of xP1, and the output wave of the laser is determined by the edited wave.

## 6 Wiring diagram and operation steps

## 6.1 Internal control in ON mode

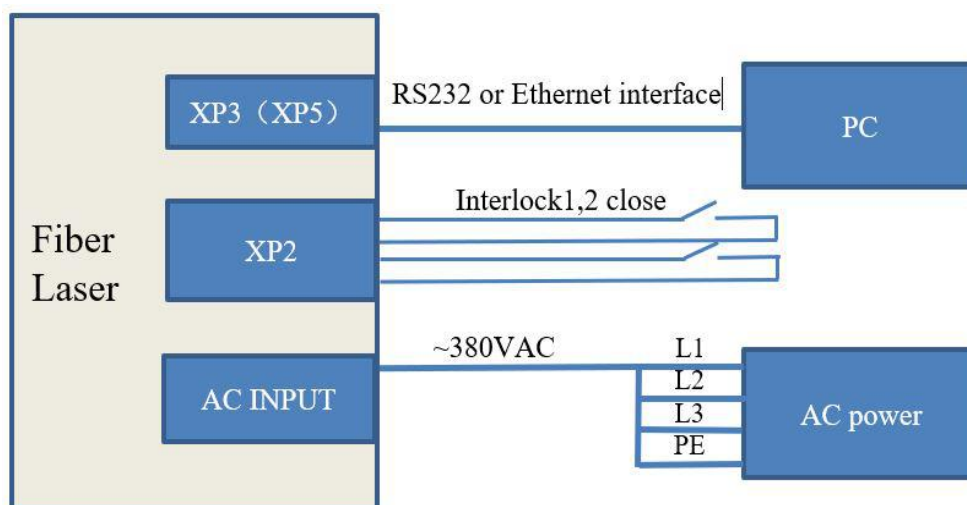


Figure 25 wiring diagram of “ON” mode of key switch.

Operation methods:

1. Turn the knob switch of the rear panel to on;
2. Turn the key switch to on;
3. Open the computer software;
4. Click the red light ON button to view the red light;
5. Turn off AD mode and external control mode (This mode can be memorized if power off)
6. Click main power ON button;
7. Wait for Ready;
8. Set the light output parameters;
9. Click laser on button.

## 6.2 Emission external control mode set by power communication in ON mode

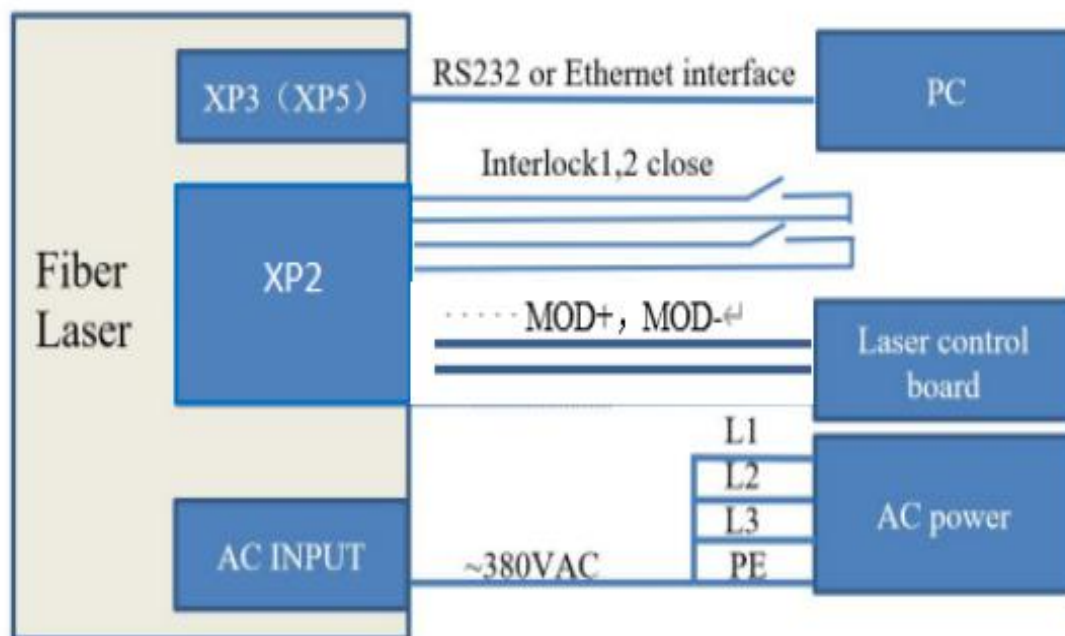


Figure 26 wiring diagram of Emission external control mode set by power communication in ON mode.

Operation methods:

1. Turn the knob switch of the rear panel to ON;
2. Turn the key switch to ON;
3. Open the computer software;
4. Click the red light ON button to view the red light;
5. Turn off AD mode and turn on external control mode ( This mode can be memorized after power failure)
6. Click main power ON button;
7. Wait for Ready;
8. Setting the light power percentage;
9. Mod signal outputs high level to turn on the laser;

### 6.3 Emission external control set by power analog in ON mode

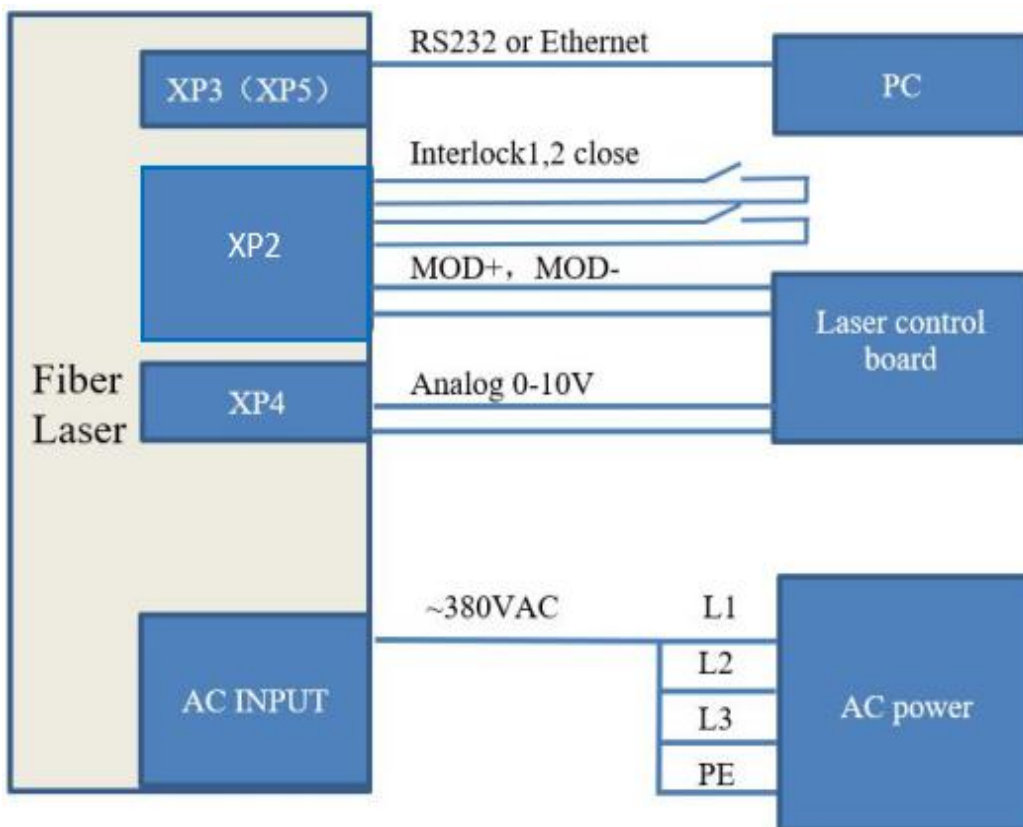


Figure 27 Wiring diagram of emission external control set by power analog on the ON mode.

Operation methods:

1. Turn the knob switch of the rear panel to ON;
2. Turn the key switch to ON;
3. Open the computer software;
4. Click the red light ON button to view the red light;
5. Turn off AD mode and turn on external control mode ( This mode can be memorized after power failure)
6. Click main power ON button;

7. Wait for Ready;

8. The control board outputs analog and light output signal;

#### 6.4 Emission external control through programming mode on the ON mode

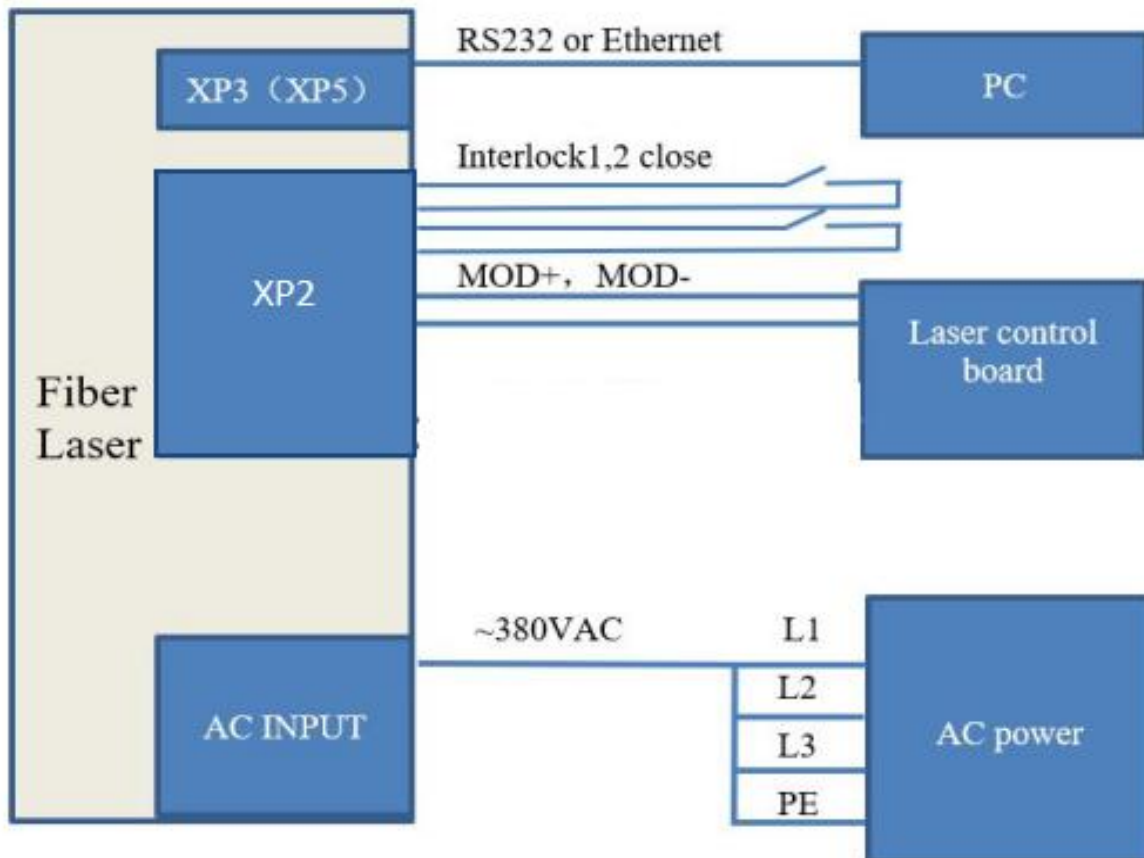


Figure 28 Wiring diagram of Emission external control through programming mode on the ON mode.

Operation methods:

1. Turn the knob switch of the rear panel to ON;
2. Turn the key switch to ON;
3. Open the computer software;
4. Click the red light ON button to view the red light;

5. Click main power ON button;
6. Wait for Ready;
- 7, Set the wave number of pre-operations (program number is more than 0) ;
- 8, The lifting edge of MOD signal starts wave;

Note: high level time of MOD must be more than program operation; if MOD gives the falling edge in advance, the computer software will show that the laser program is stopped abnormally.

**6.5 Set the power analog as emission external control on the REM mode**

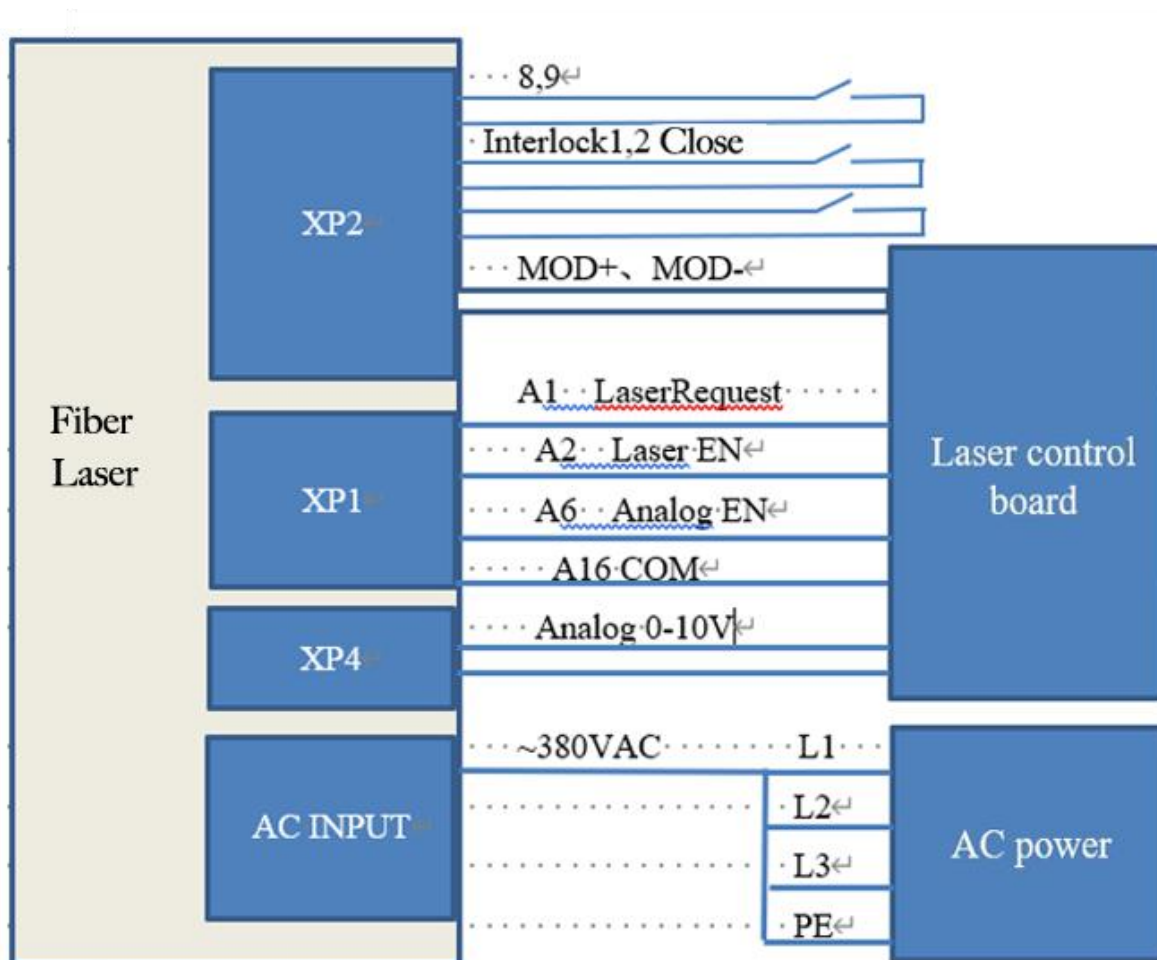


Figure 29 Wiring diagram of setting the power analog as emission external control on the REM mode.

Operation methods:

- 1, Turn the knob switch of the rear panel to ON button;
- 2, Turn the key switch to REM button;
- 3, Short PIN8/9 of XP2;
- 4, XP1-A1 connects 24V, XP1-A6 connects 24V;
- 5, XP1-A5 connects 24V, and turn on red light; XP1-A5 connects 0V after checking optics, and turn off red light;
- 6, XP1-C1 connects 24V, main power on (You can also directly press the laser button, or the main power ON button)
- 7, Wait for Ready;
- 8, XP1-A2 connects 24V, and control board outputs analog and MOD signal;

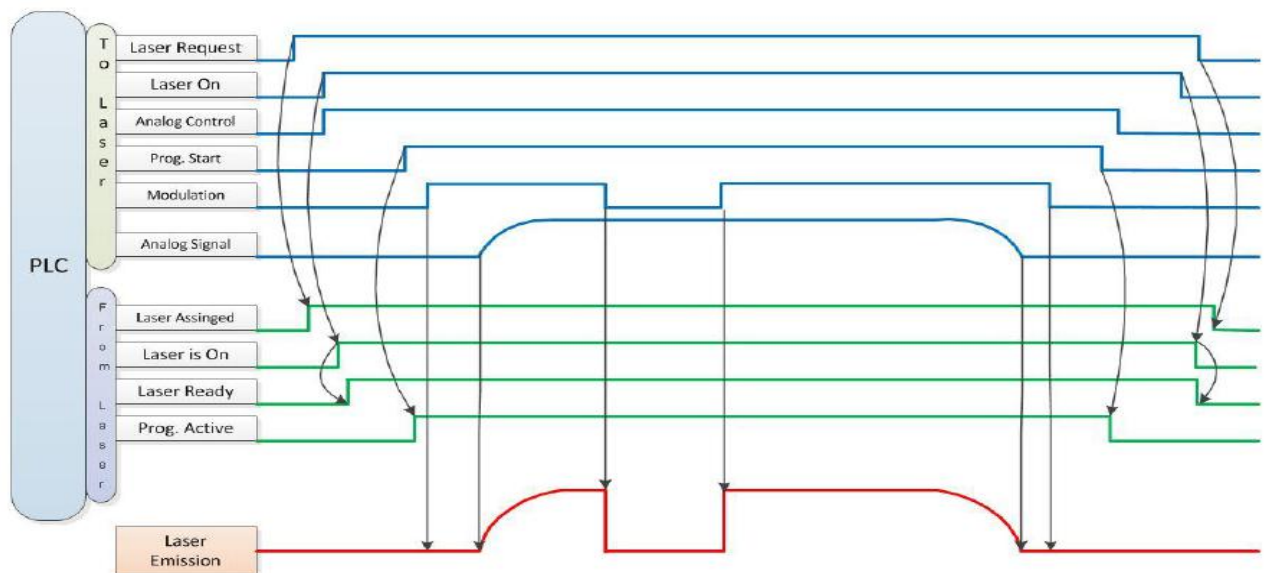


Figure 30 timing diagram of setting power analog as emission external control signal on REM mode

## 6.6 REM mode power communication set out light external control



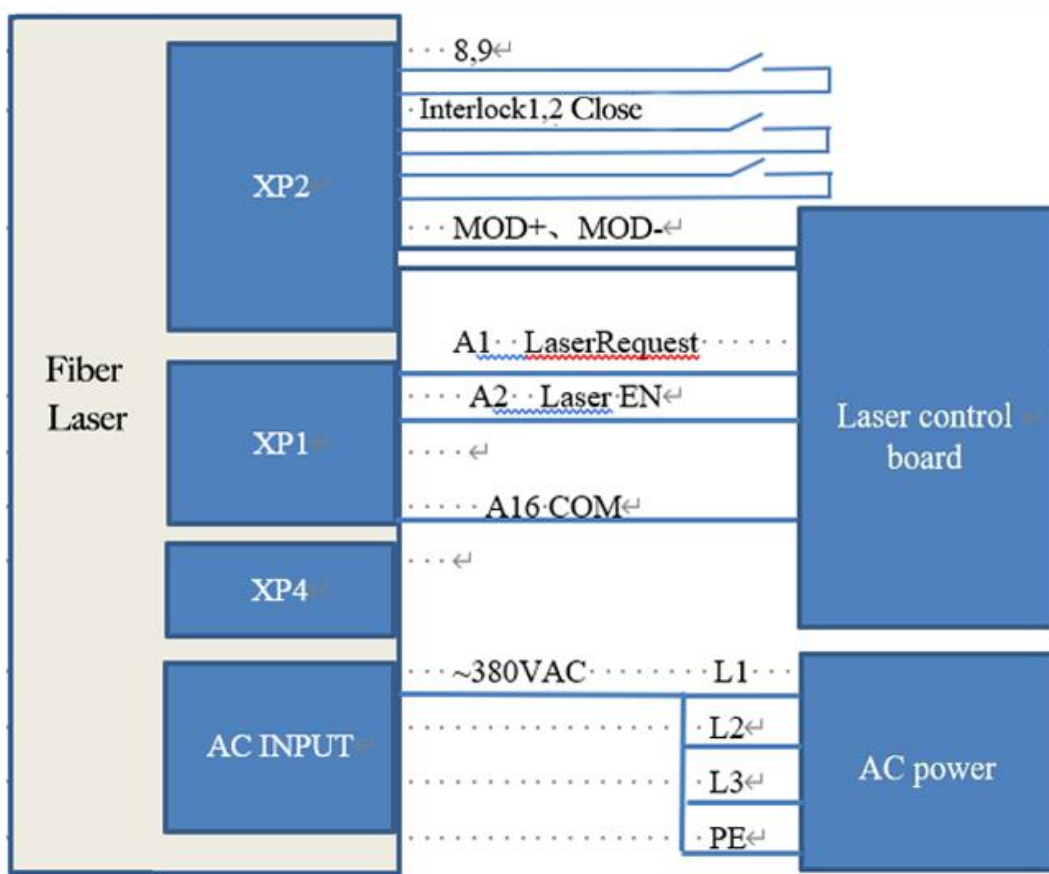


Figure 31 Wiring diagram of setting power communication as emission external control on REM mode.

operation methods:

- 1, Turn the knob of the rear panel to ON button;
- 2, Turn the key switch to REM;
- 3, Short Pin8/Pin9 of XP2;
- 4, XP1-A1 connects 24V;
- 5, XP1-A5 connects 24V, and turn on the red light; XP1-A5 connects 0V after checking optics, and turn off red light;
- 6, XP1-C1 connects 24V, main power supply powers on (You can also directly press the laser button, or the main power ON button) ;

- 7, Wait for Ready button;
- 8, the computer software sets power, XP1-A2 connects 24V, control board outputs MOD signal;

### 6.7 Programming mode in REM mode

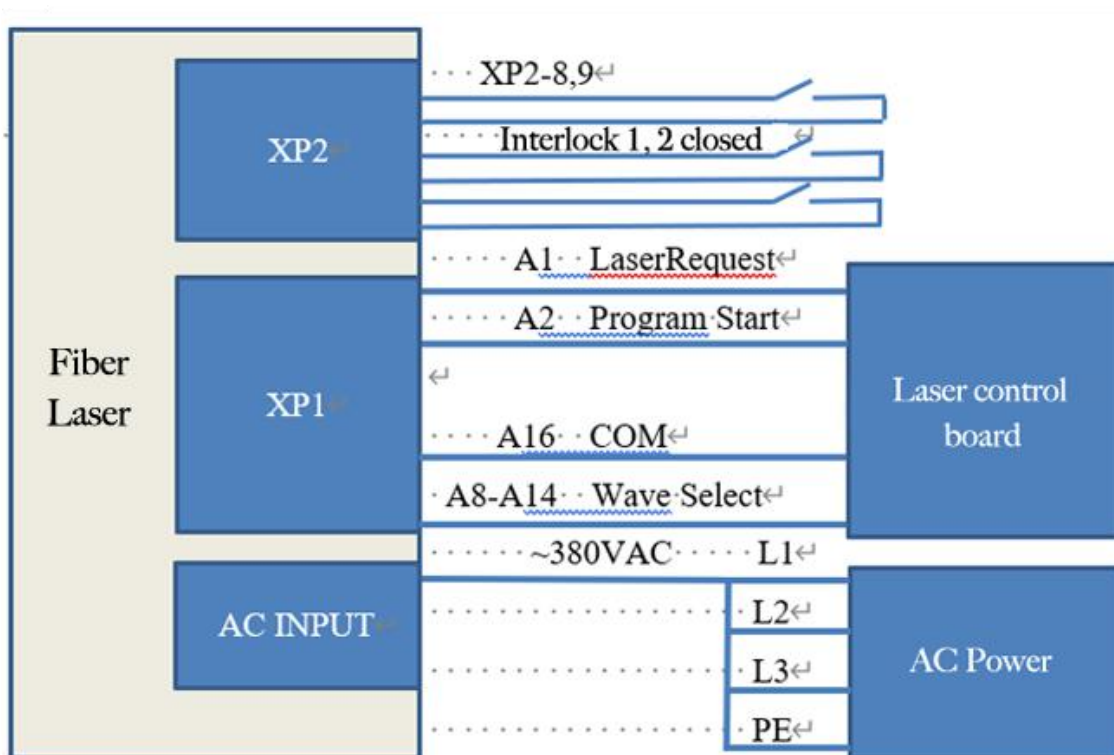


Figure 32 Wiring diagram of programming mode on REM mode.

Operation methods:

- 1, Turn the knob switch of the rear panel to ON button;
- 2, Turn the key switch to REM button;
- 3, Short PIN8/PIN9 of XP2;;
- 4, XP1-A1 connects 24V;

- 5, XP1-A5 is connected to 24 V to turn on red light; After checking the optics, connect XP1-A5 to 0V and turn off the red light;
- 6, XP1-C1 is connected to 24 V, and the main power supply is powered on (you can also directly press the LASER button, or click the ON button in the main power supply of the upper computer software);
- 7, Wait for Ready button;
- 8, XP1- (A8-14) selects the pre-executed program number, and XP1-A2 sets high level to start operating the program;

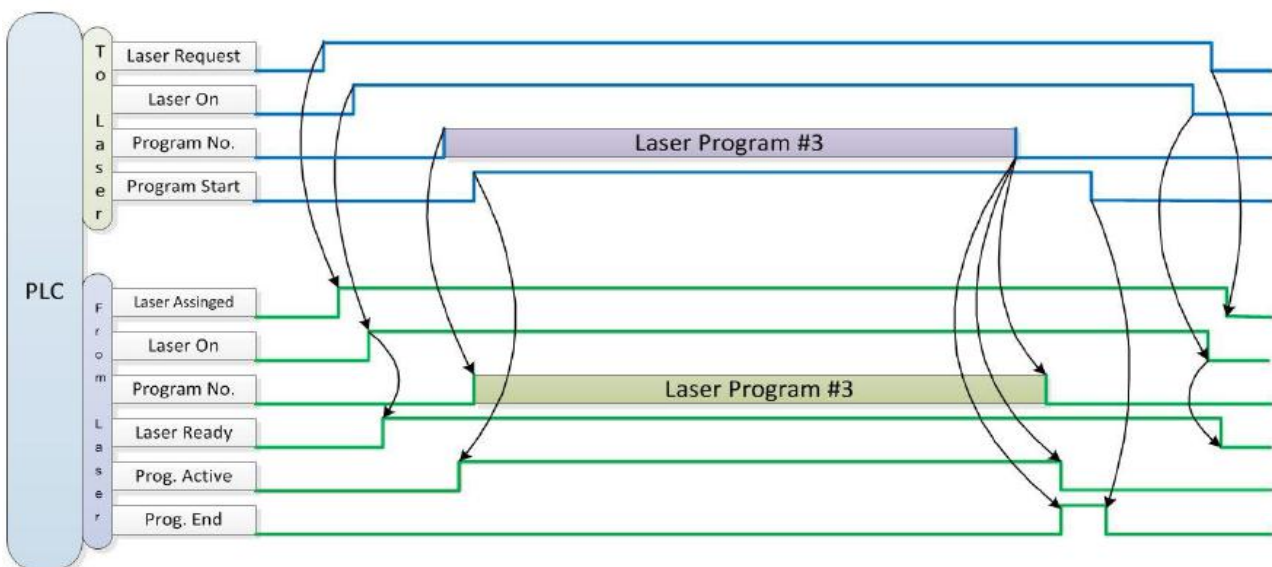


Figure 33 Timing diagram of control signal of programming mode.

## 7 RS232 and INTERNET Communication Command

### 7.1 Port Configuration

RS-232 configuration is as follows:

baud rate :9600, data bit :8, stop bit :1, no parity bit and no control flow.

Ethernet port is configured as follows:

Default laser IP address :192.168.0.10

Laser port :10001

## 7.2 Laser Communication Protocol (Network Port & Serial Port)

All commands and return values in this Agreement are composed of ASCII characters. Note the following points when entering :

- a) Commands generally consist of three or four letters, sometimes with additional values.
- b) All commands and return values end with the enter character (CR,0x0D, \r. If this product receives a string with a 'enter' character but the command is invalid, the Command Err! is returned r".
- c) For easy identification, all commands are capital letters, but in fact this product is not case-sensitive. To facilitate identification, add a space between the command and the parameter.
- d) This product sends a return value for each command received. The return value generally contains the command content itself. If the returned content contains a numeric value or contains an error type, the returned command content is separated from the numeric value or from the error type.

The specific agreement content and command examples of this product are shown in Table 12.

Table 12 Specific Protocol Contents and Command Examples of Laser

Command	Description	Command example
ABF	Aiming Beam OFF –Turn off red light	Send: 'ABF\r' Return: 'ABF\r'
ABN	Aiming Beam ON – Turn on red light	Send: 'ABN\r' Return: 'ABN\r'
DEABC	Disable External Aiming Beam Control	Send: 'DEABC\r' Return: 'DEABC\r'
EEABC	Enable External Aiming Beam Control	Send: 'EEABC\r' Return: 'EEABC\r'
DEC	Disable External Control	Send: 'DEC\r' Return: 'DEC\r'
EEC	Enable External Control	Send: 'EEC\r' Return: 'EEC\r'
DLE	Disable Hardware Emission Control	Send: 'DLE\r' Return: 'DLE\r'
ELE	Enable Hardware Emission Control	Send: 'ELE\r' Return: 'ELE\r'

EM OFF	Stop Emission	Send: 'EMOFF\r' Return: 'EMOFF\r'
EM ON	Start Emission	Send: 'EMON\r' Return: 'EMON\r'
MPWR OFF	Main Power OFF	Send: 'MPWROFF\r' Return: 'MPWROFF\r'
MPWR ON	Main Power ON	Send: 'MPWRON\r' Return: 'MPWRON\r'
SPW	Set Pulse Width	Send: 'SPW 100\r' Return: 'SPW:100\r' (Set pulse width as 100ms) Other return values: 'ERR: input Err\r' (Input pulse width <0.0001) 'ERR: Out of Range\r' (Over maximum pulse width) 'ERR: Duty Cycle too High\r'
SPRR	Set Pulse Repetition Rate	Send: 'SPRR 1000\r' Return: 'SPRR: 1000\r' 'ERR: input Err\r' 'ERR: Out of Range\r' 'ERR: Duty Cycle too High\r' 'ERR: Duty Cycle too Low\r' 'SPW: 100, Duty=100%\r'
SDC	Set Diode Current (%) The set value must be less than 100% and above the minimum current setting value, which can be set to 0. If the set value is greater than 100, the default is input 100.	Send: 'SDC 100\r' Return: 'SDC: 100\r' Other return values: 'ERR: Input Err\r' 'Laser is worked in AD Mode\r'
RCS	Read Current Setpoint	Send: 'RCS\r' Return: 'RCS: 56.7\r' (The current set value is 56.7 %)
RPRR	Read Pulse Repetition Rate (Hz)	Send: 'RPRR\r' Return: 'RPRR:10\r' (Repeat frequency is10Hz)
RBT	Read Board Temperature	Send: 'RBT\r' Return: 'RBT:36.6\r'
RPW	Read Pulse Width (MS)	Send: 'RPW\r' Return: 'RPW:5.5\r' (pulse width is 5.5ms)

RCT	Read Laser Temperature	Send: 'RCT\r' Return: 'RCT:34.5\r'	
PERR	Reset Errors	Send: 'PERR\r' Return: 'PERR\r'	
SUT	Set Up Time (MS)	Send: 'SUT 50\r' Return: 'SUT:50\r'	
SDT	Set Down Time (MS)	Send: 'SDT 50\r' Return: 'SDT:50\r'	
RUT	Read Up Time (MS)	Send: 'RUT \r' Return: 'RUT:50\r'	
RDT	Read Down Time (MS)	Send: 'RDT \r' Return: 'RDT:50\r'	
PSRT	Program Start	Send: 'PSRT 1\r' Return: 'PSRT:1\r'	
PSTP	Program Stop	Send: 'PSTP\r' Return: 'PSTP\r'	
ECM	Enable Calibration Mode –Power linear correction mode (in this mode, the external analog is corrected and output after filtering, so the response time of AD analog is larger than that of through mode)	Send: 'ECM \r' Return: 'ECM\r'	
DCM	Disable Calibration Mode (AD analog response time is less than 100 us in this mode)	Send: 'DCM\r' Return: 'DCM\r'	
Others	Command error	Send: 'BGM\r' Return: 'Command Err! \r'	
STA	Read device status – Read the product status. A return value of 32-Bit digital information. The meaning of each Bit is as follows (undefined or 'reserved' Bit negligible):	Send: 'STA' Return: 'STA:4100' returned value 4100(Decimal) can be converted to 0 x1004 (hexadecimal), and then converted to binary to see that Bits2 and 12 have been set. The laser enable is on and the modulation mode is enabled	
	Bit 0		Normal operation
			Authorization time
	Bit 1		Normal
Temperature too high			

Bit 2	Emission Off
	Emission On or in preparation
Bit 3	No high reflection
	High reflection Abnormal
Bit 4	External AD mode=off
	External AD mode=on
Bit 5	Power Correction Mode=off
	Power Correction Mode=on
Bit 6	Normal
	Sub-controlling communication Abnormal
Bit 7	Normal
	Sub-module Abnormal
Bit 8	Guide red light=off
	Guide red light=on
Bit 9	The laser is not ready
	The laser is ready
Bit 10	QCW mode=off
	QCW mode=on
Bit 11	Module Main Power=off
	Module Main Power=on
Bit 12	Modulation mode=off
	Modulation mode=on
Bit 13	Normal
	Leakage sensors 1 leaking
Bit 14	Normal
	Leakage sensors 2 leaking
Bit 15	No laser
	Laser is power on
Bit 16	Gate mode=off
	Gate mode=on
Bit 17	AC input normal

		AC input abnormal
Bit 18		External Emission control=off
		External Emission control=on
Bit 19		Normal
		Laser fault
Bit 20		Slow up slow down mode off
		Slow up slow down mode on
Bit 21		A laser operates in ON" mode
		A laser operates in REM" mode
Bit 22		Wave mode off
		Wave mode on
Bit 23		Surge protector Normal
		Surge protector failure
Bit 24		normal
		Low temperature fault
Bit 25		normal
		Humidity alarm
Bit 26		normal
		Water flowmeter 1 Flow Alarm
Bit 27		Red light internal control
		Red Light External Control
Bit 28		normal
		Water flowmeter 2 Flow Alarm
Bit 29		normal
		Module locked
Bit 30		Optical circuit safety interlock normal
		Optical circuit safety interlock abnormal
Bit 31		normal
		High average power

## 8 PC Software Instructions

PC software downloads address: <http://www.raycuslaser.com/list/56.html>



### 8.1 Main interface of PC software

The PC software’s main interface is shown in Figure 34.

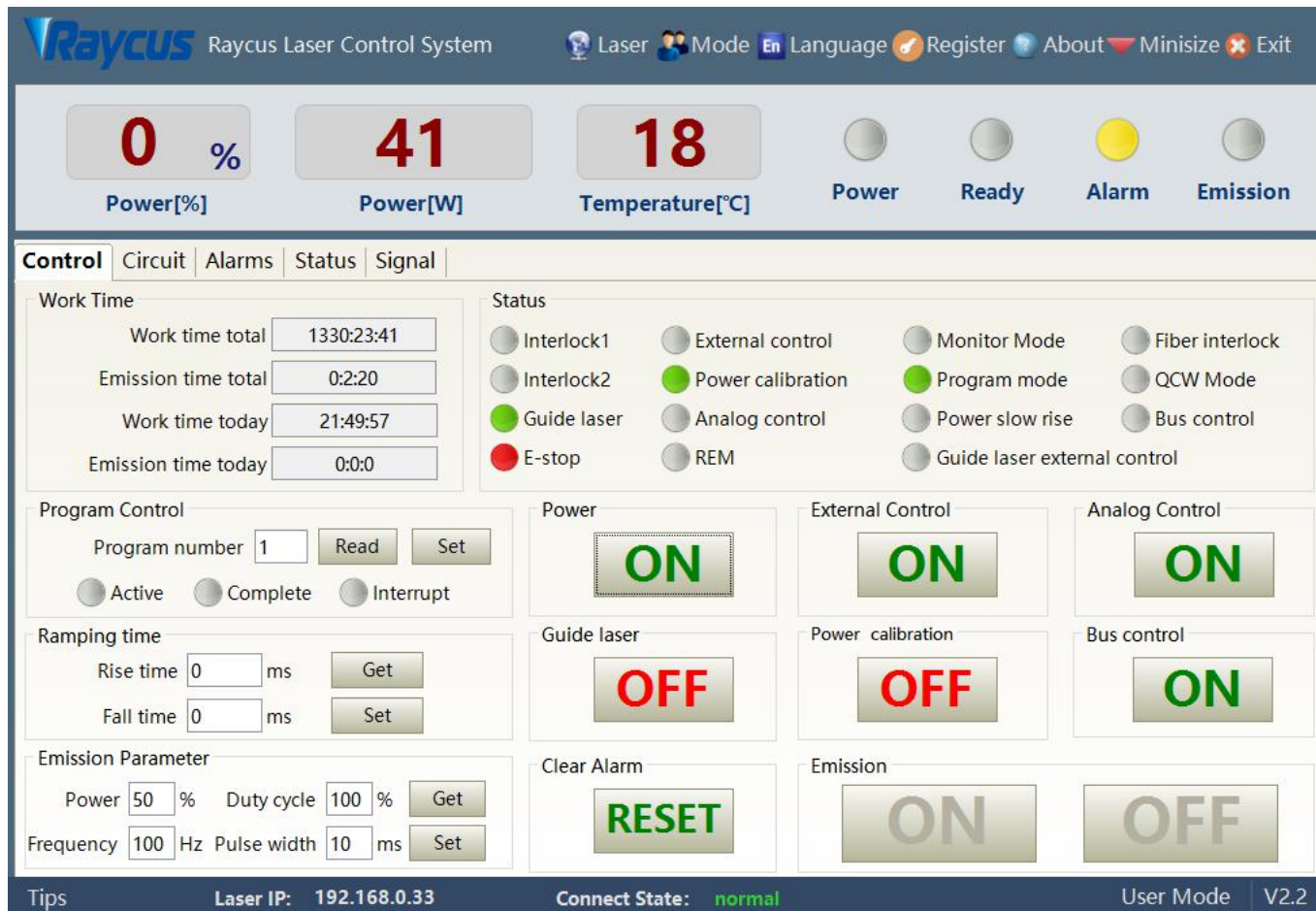


Figure 34 PC software display main interface.

### 8.2 Multi-laser Control Area

Multi-laser control area is shown in Figure 35.

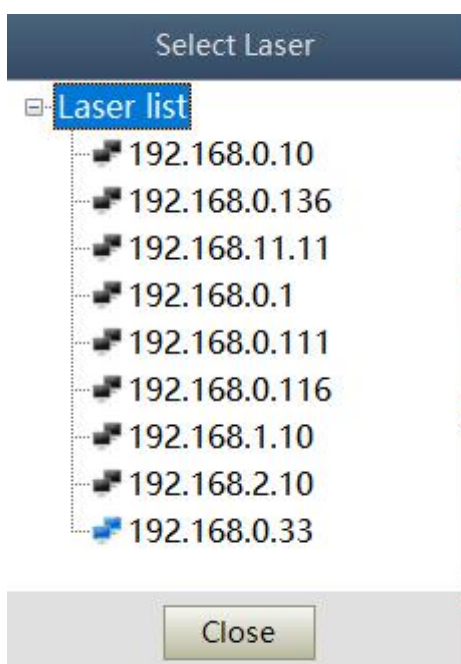


Figure 35 Multi-laser control area interface.

Select IP address of corresponding laser, and then double click. PC software will take communication with selected laser. After the communication established, the lower left status display shows that the network connection is ok, shown in Figure 36.



Figure 36 communication status interface between PC software and laser

### 8.2.1 Add/delete laser

You can add/delete laser in the laser list area by right-click to add/delete In the PC software. You need to type the IP address of laser to add a new laser. Detailed operation is shown in Figure 37.

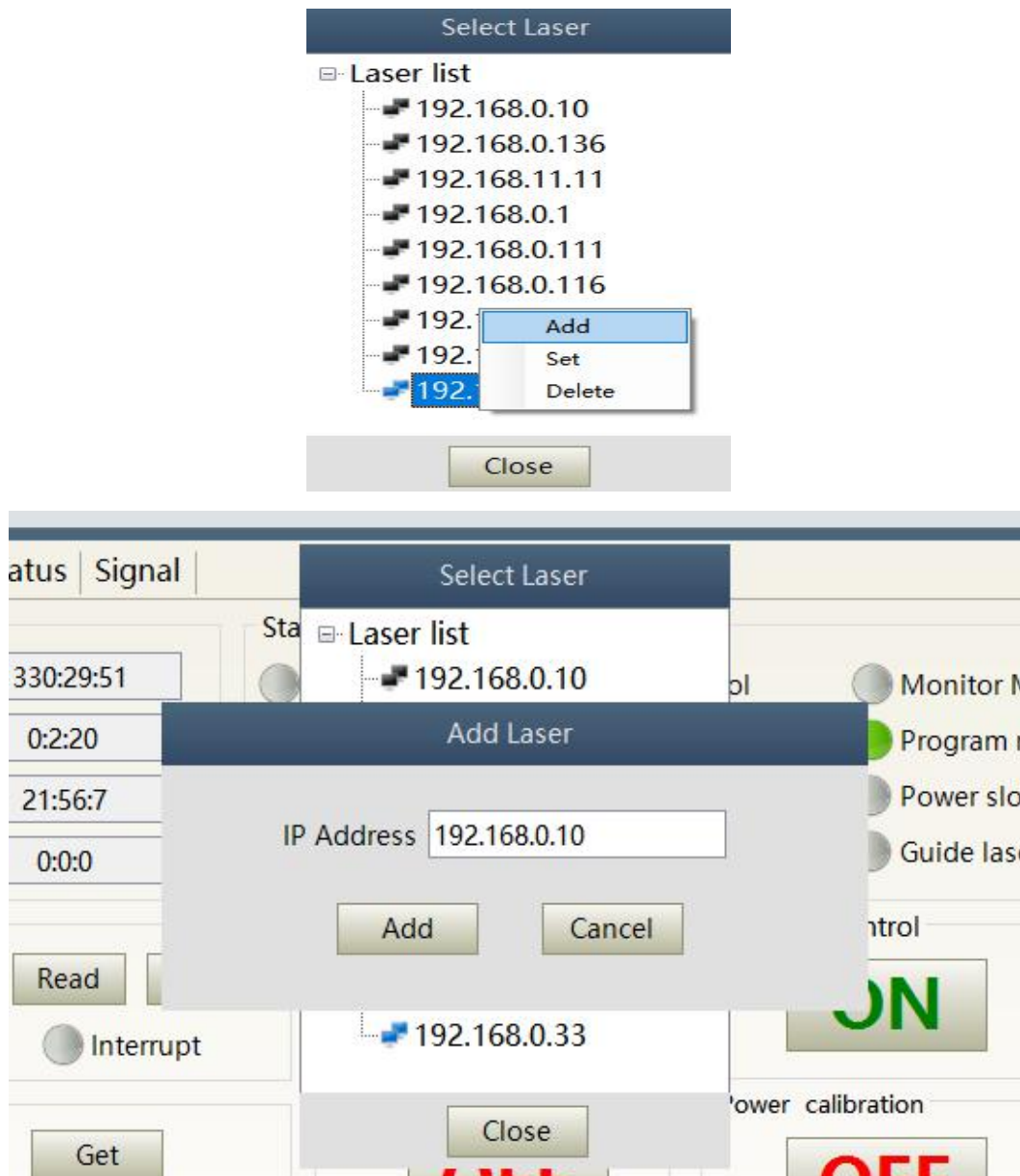


Figure 37 Procedure for adding a laser to the PC software.

### 8.2.2 Modify laser IP

After the laser connection has been established, select the IP address of current laser and right-click to set it up in Figure 38.

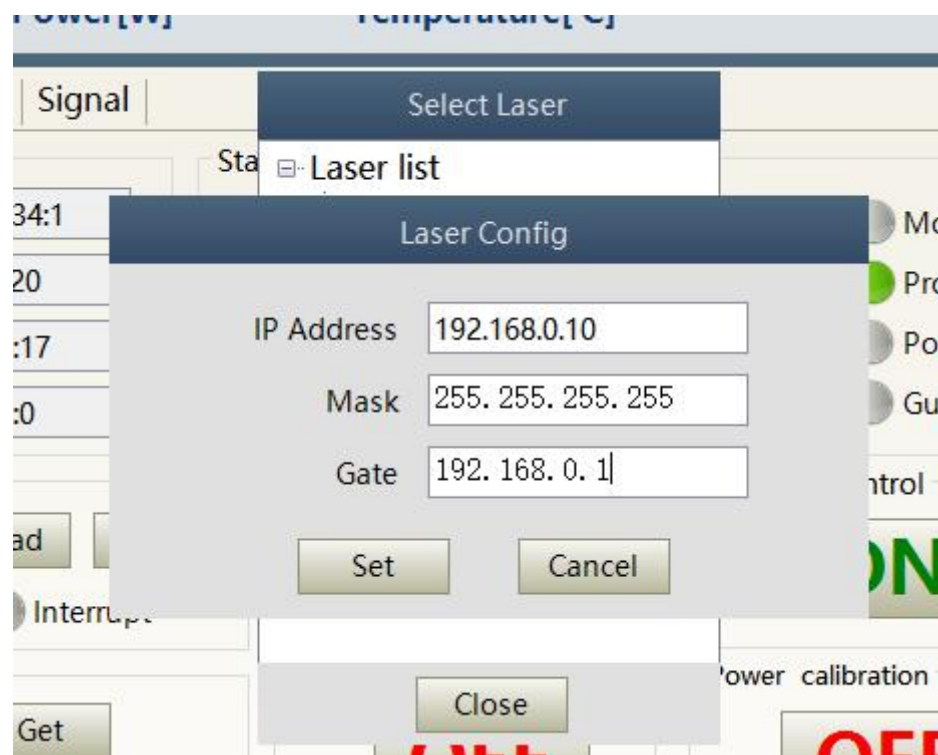
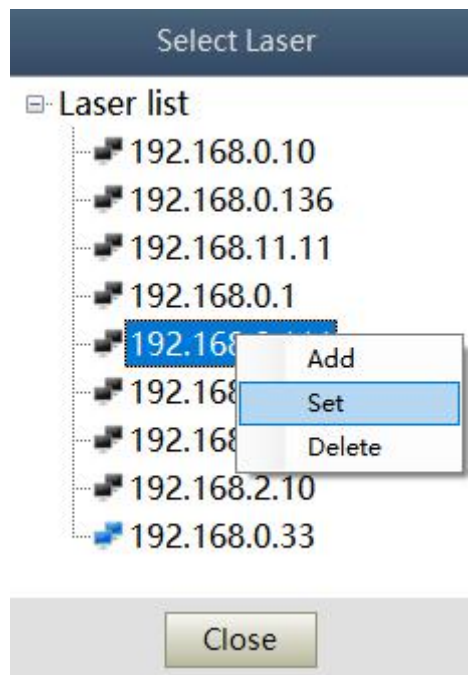


Figure 38 Modify the IP address of laser.

### 8.3 Main working status display

The laser's main status display is as shown in Figure 39, Table 13.



Figure39 diagram of the laser's main display area

Table 13 the laser main display content and meaning

Display	Meaning
Output power	current setting percentage of power in real time
Output power	Average laser output power in real time (W)
Laser temperature	Water cooling temperature in real time (°C)
Power light	Status of main power supply: green-main power supply is on, gray-main power supply is off
Ready light	Indicates readiness of current laser: green-laser is ready; gray-laser is not ready
Alarm light	indicates alarm status of current laser: yellow- laser is abnormal, gray-laser is normal
Emission light	indicates the working model of the current laser: red laser is in working model; gray-laser is not in output model

### 8.3.1 Laser’s cumulative operating time display area

The laser’s cumulative operating time display is shown in Figure 40. The cumulative start-up time, cumulative laser output time, today's power-on time and today's lighting time can be displayed in hours, minutes and seconds, respectively.

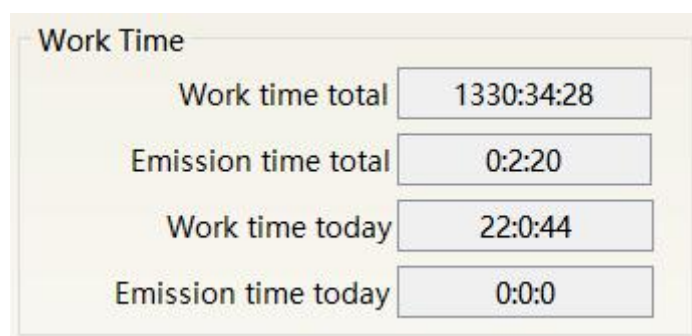


Figure40 Laser cumulative operating time display interface

### 8.3.2 Laser working status display area

The laser working status display area is shown in Figure 41, Table 14.



Figure 41 A diagram of the laser's working status display area.

Table 14 The laser main display area clarification

Display	Content explanation
Emergency stop	Red: emergency stop button on front panel is pressed Gray: emergency stop button is reset
REM	Green: laser works in REM mode Gray: laser works in ON mode
Red laser external control	Green: laser works in red laser external control mode Gray: laser works in red laser internal mode. Laser on/off controllable by software
Red laser	Green: red laser is on Gray: red laser is off
Output fiber Interlock status	Green: Interlock spot at output fiber end is make Gray: Interlock spot at output fiber end is break
External control model	Green: Laser works in external control mode Gray: laser works in internal control mode. Laser on/off is controllable by software
Power correction	Green: Laser operates in power linear correction mode, in which control system automatically adjusts the laser's output power. It makes the output power linear, with a longer response time for AD analog in this mode, longer than 1mS. Gray laser operates in non-correction mode, and the external 0-10V analog voltage is linear only with the current of the pump auxiliary tube. The response time for this mode AD simulation is less than 100uS
AD model	Green: Laser power is determined by the 0-10V analog voltage on XP4 when laser works in AD mode. Gray: laser power is set by PC software or communication commands.
Monitoring model	Green: PC software is in monitoring mode. User can monitor laser status only, but not able to take control of laser. Monitoring model is activated when interface 10001 of laser occupied. Gray: PC software operate in Normal mode
InterLock1 make	Green: XP2 leg 17,20 on safety interface make Gray: XP2 leg 17,20 on safety interface break

InterLock2 make	Green: XP2 leg 18,19 on safety interface make Gray: XP2 leg 18,19 on safety interface break
Programming model	Green: Laser is in program mode Gray: Laser is not in program mode
Power slow rise & fall mode	Green: laser works in power slow rise & fall mode Gray: laser does not work in power slow rise & fall mode

### 8.3.3 Laser power-up, mode selection, light-out control area

Laser power-up, mode selection, light out control display area is as in Figure 42, the display content is as in Table 15.

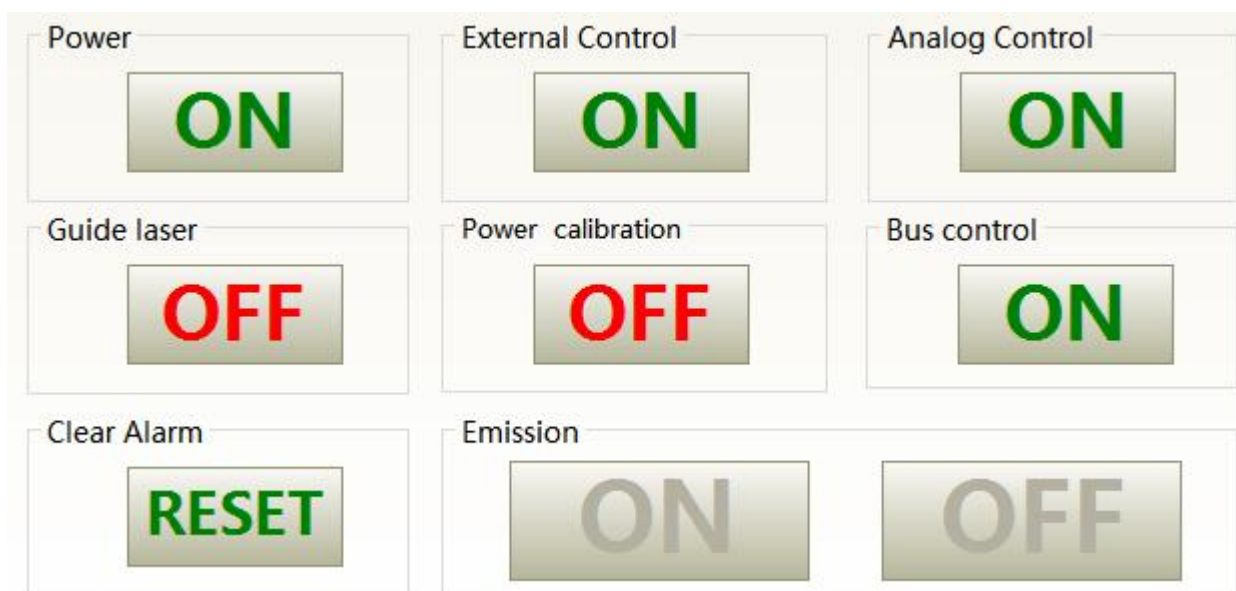


Figure 42 Laser power-on, mode selection, light out control display area.

Table 15 Laser power-on, mode selection, light out control display area explanation.

Display	Explanation
Main power button	Click ON, main power on; click OFF, main power off
External control mode	Click ON, activate laser external control; Click OFF, shut laser external control; mode power-off memory automatically
AD mode	Click ON, AD analog mode on; click OFF, AD analog mode off; mode power-off memory automatically
Red guide beam	Click ON, red guide beam on; click OFF, red guide beams off

Power correction	Click ON, activate laser power correction mode; click OFF, shut laser power correction mode; mode power-off memory automatically
Eliminate alarm	Eliminate current laser alarm
Laser ON	Laser is in output
Laser OFF	Laser is off

### 8.3.4 Programming mode test area

The laser programming mode test area interface is shown in Figure 43, in which the ‘START’ button is used to test the programming of the programming mode. This function can only run internal mode (when external mode is turned off). Enter the current pre-tested programming number in the digital text box and click the START button.

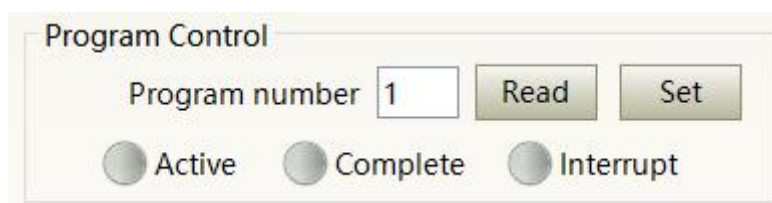


Figure 43 Laser programming mode test area display interface

### 8.3.5 Power slow rise & down parameter setting area

The interface of the laser power slow rise & fall parameter setting area is shown in Figure 44. Click ‘read parameter’ to read the power rise and fall times stored in the laser. Click ‘setting parameters’ to set a new power rise and fall time. When the rise and fall, times are set to 0, the power slow rise & fall function is automatically switched off. When there is no 0, the slow rise or fall function is automatically turned on.

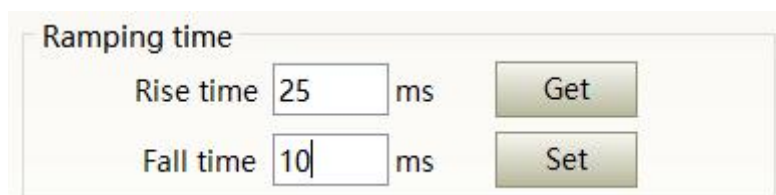






Figure 44 the power slow rise and fall setting area interface and measured programming.

### 8.3.6 Laser output parameters read the setting area

Laser output parameter setting interface is shown in Figure 45. The output parameter setting is not valid when AD mode is on.

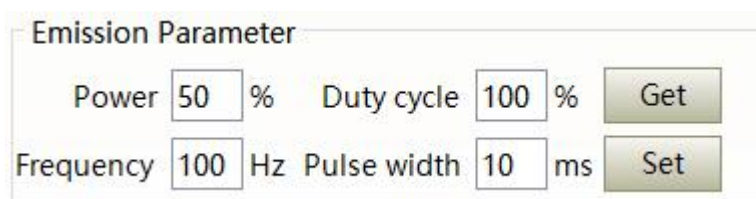


Figure 45 Laser output parameter setting area display interface

### 8.4 Laser parameter display area

The display interface for laser parameter display area is shown in Figure 46. The module status is used to shield the faulty module, the green light indicates the number of modules installed inside the current laser, and the check box indicates the module that is running in the current laser.

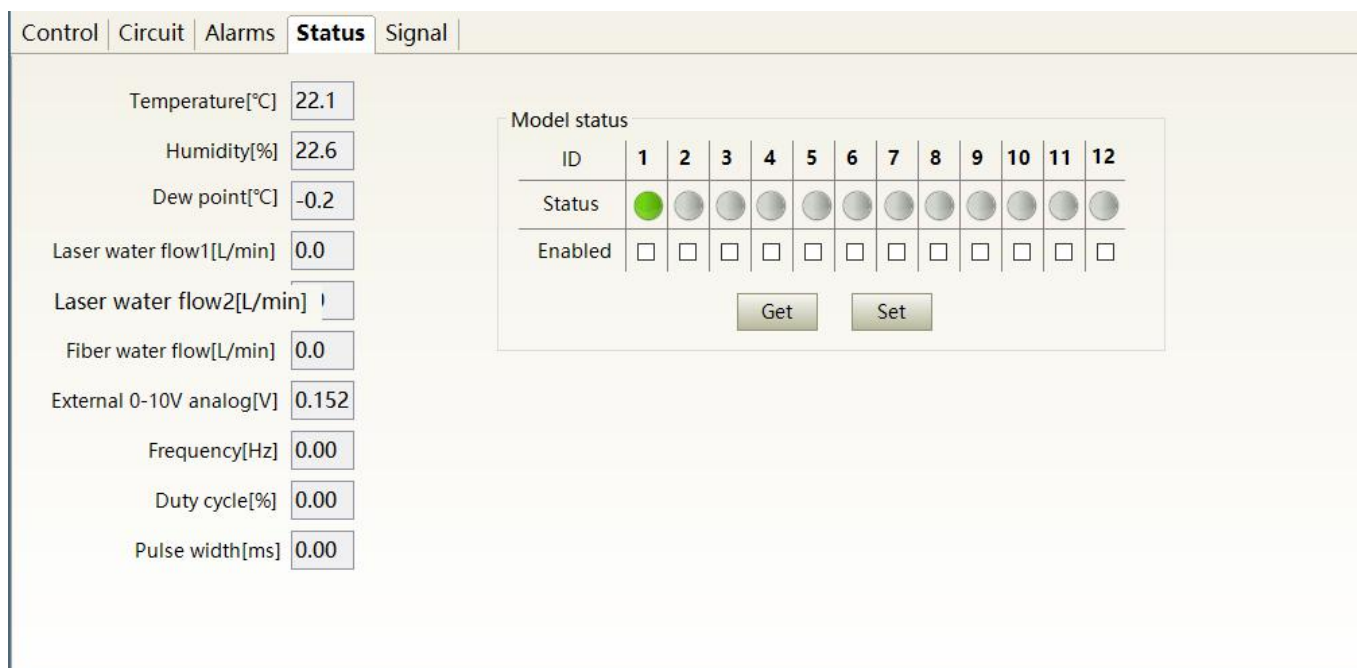


Figure 46 Laser parameter display area display interface.

### 8.5 Alarm type display area

The laser alarm type display area interface is shown in Figure 47. This interface shows the cause of the alarm for the current laser.



Figure 47 Laser alarm type display area interface

### 8.6 PC software operating mode selection

The laser operating mode is set by the PC software. Its operating interface is show in Figure 48. The interpretation of the various patterns can be found in Table 16. The programming editing interface is displayed on the software only when programming mode is selected.

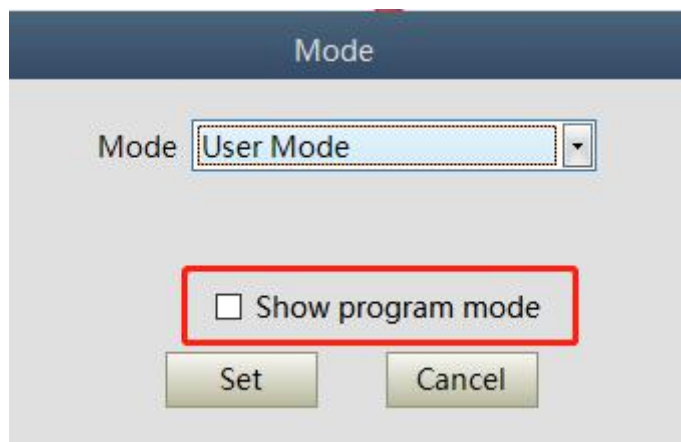
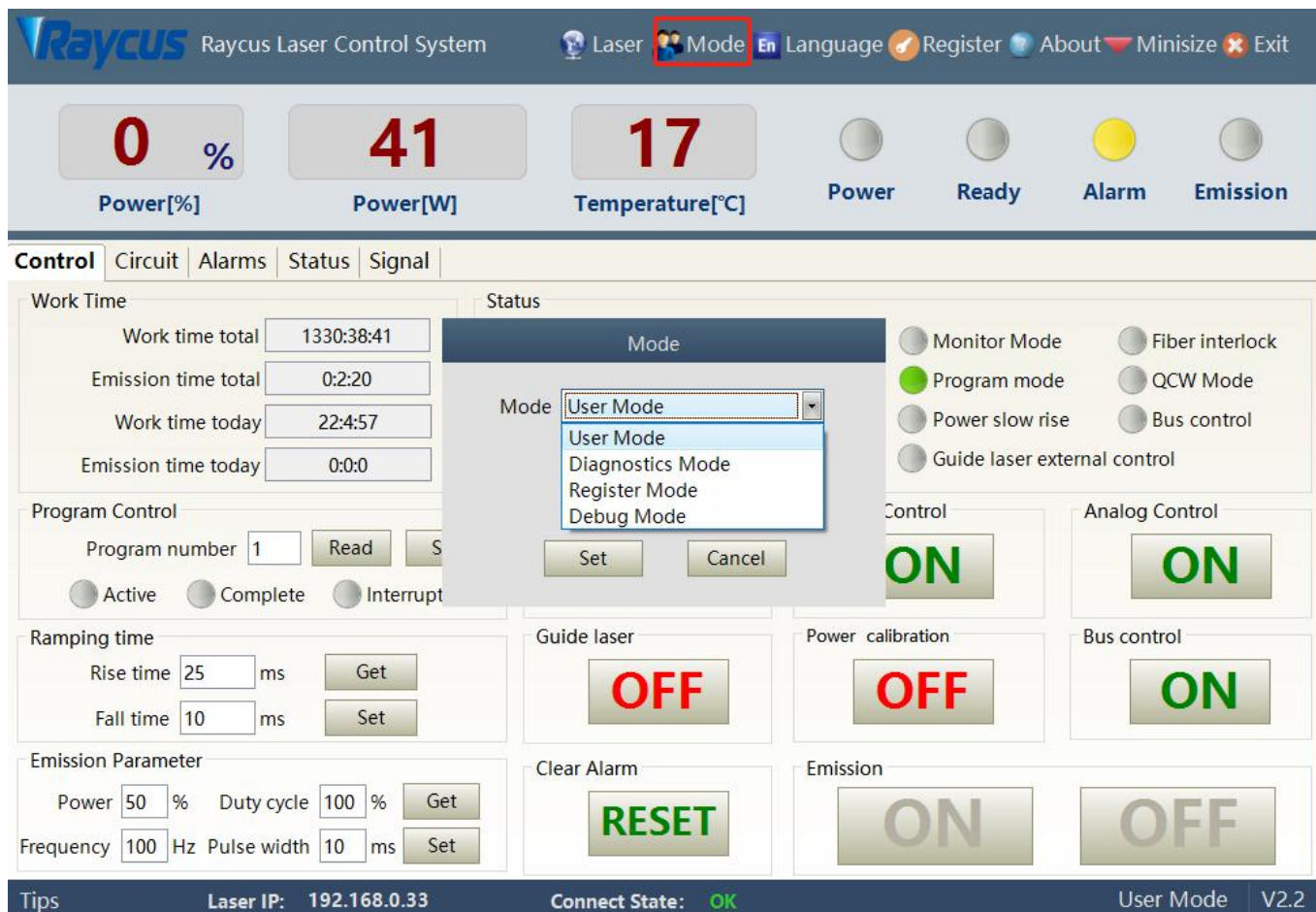


Figure 48 Laser operating mode selects the display area interface.

Table 16 Laser operating mode and explanation

Mode selection	Mode explanation
User mode	A concise software interface
Diagnostic mode	Displays laser status and parameters for diagnosis purposes
Authorization mode	Time-limited locking function can be set on laser
Debug mode	You can modify laser parameters (subject to valid password)

### 8.7 Language

Laser’s language selection interface is shown in figure 49. User can choose between simplified Chinese and English by clicking ‘setting language’. Setting effective after PC software restarted.

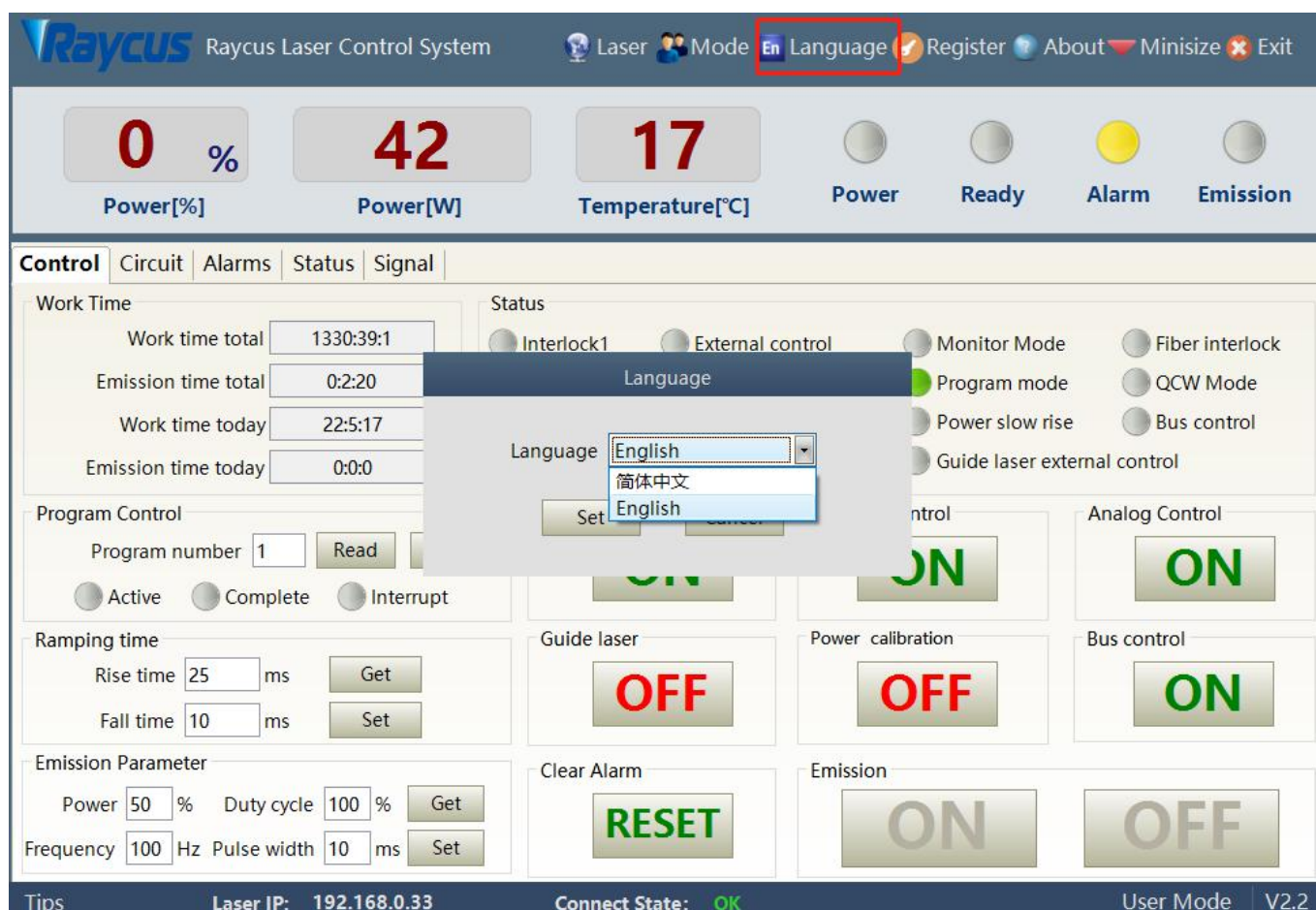


Figure 49 Language selection interface.

## 8.8 Authorization (time-limited locking)

### 8.8.1 Authorization on user mode

The authorization settings in user mode are shown in Figure 50. Laser can be locked and unlocked by valid authorization code.

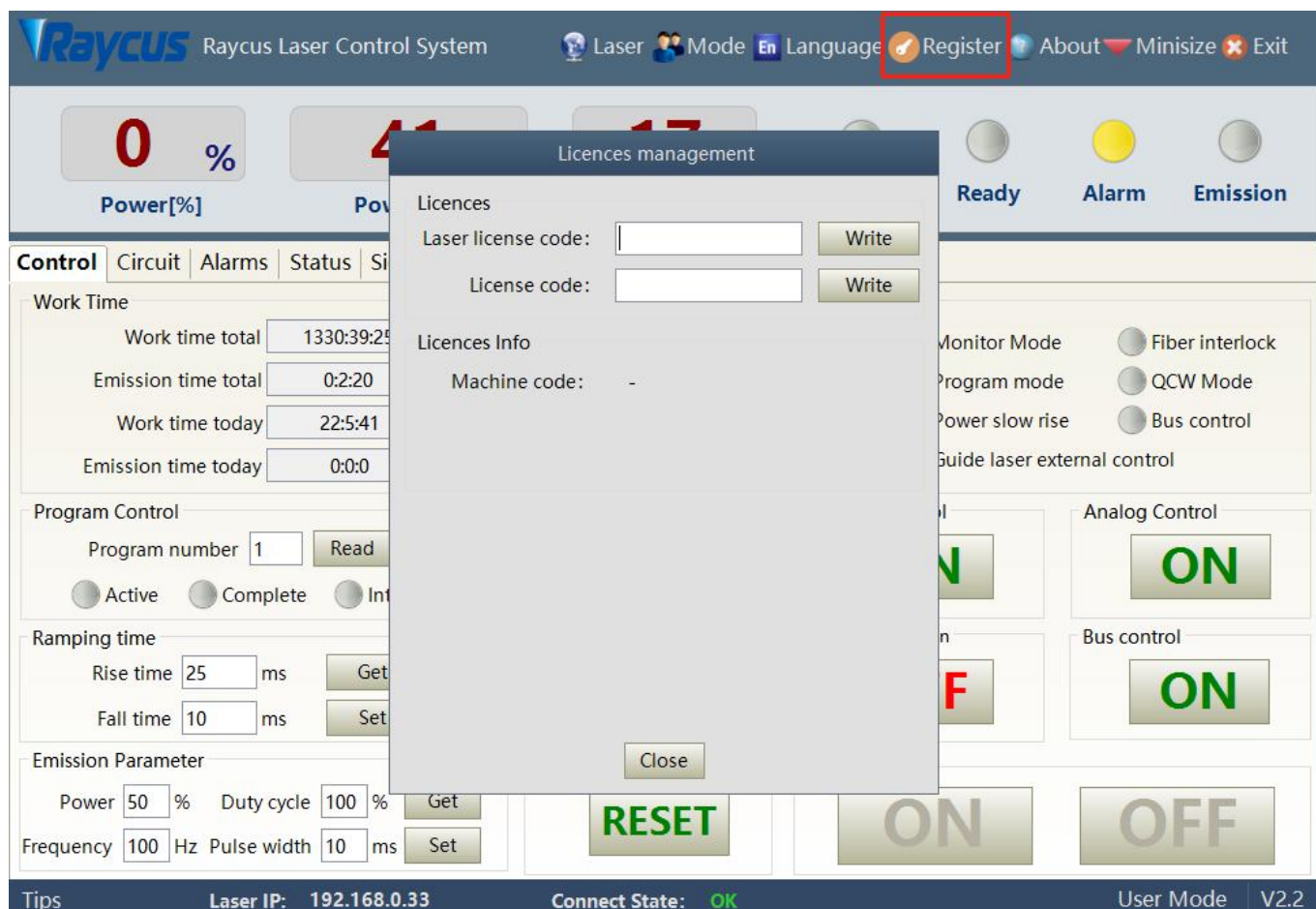


Figure 50 the authorization settings operating interface on user mode.

### 8.8.2 Authorization on authorization mode

The authorization settings in laser authorization mode are shown in Figure 51. This interface allows the customer to lock and unlock the machine and can also be used as an authorization code generator.

- a) The locking time setting can set the effective using time of laser.
- b) The terminal password is set for the laser locking party. The terminal code can only be set once, and no modification is allowed after its set. The terminal password is 8-byte here, e.g., 0123456789ABCDEF, no other characters are allowed.

- c) The software automatically calculates the authorization code when user click to generate an authorization code. Laser's limited time lock is achieved when user click again to set the authorization time.

Licences management

Licences

Laser license code:  Write

License code:  Write

Licences Info

Machine code: 0

Laser lock date: 2036-12-8

Lock date: not configured

Licences code

Lock date:  Year  Month  Day

Machine code:  0 Set

Terminal password:   Set

Licences code: - Generate Code

Close

Figure 51 Authorization settings operating interface on authorization mode.

## 8.9 About

Laser relevant information such as date of manufacture, model, serial number, controlling serial number, token version number, system information and other information can be queried in the PC software 'about' item. Specific interface is shown in Figure 52.

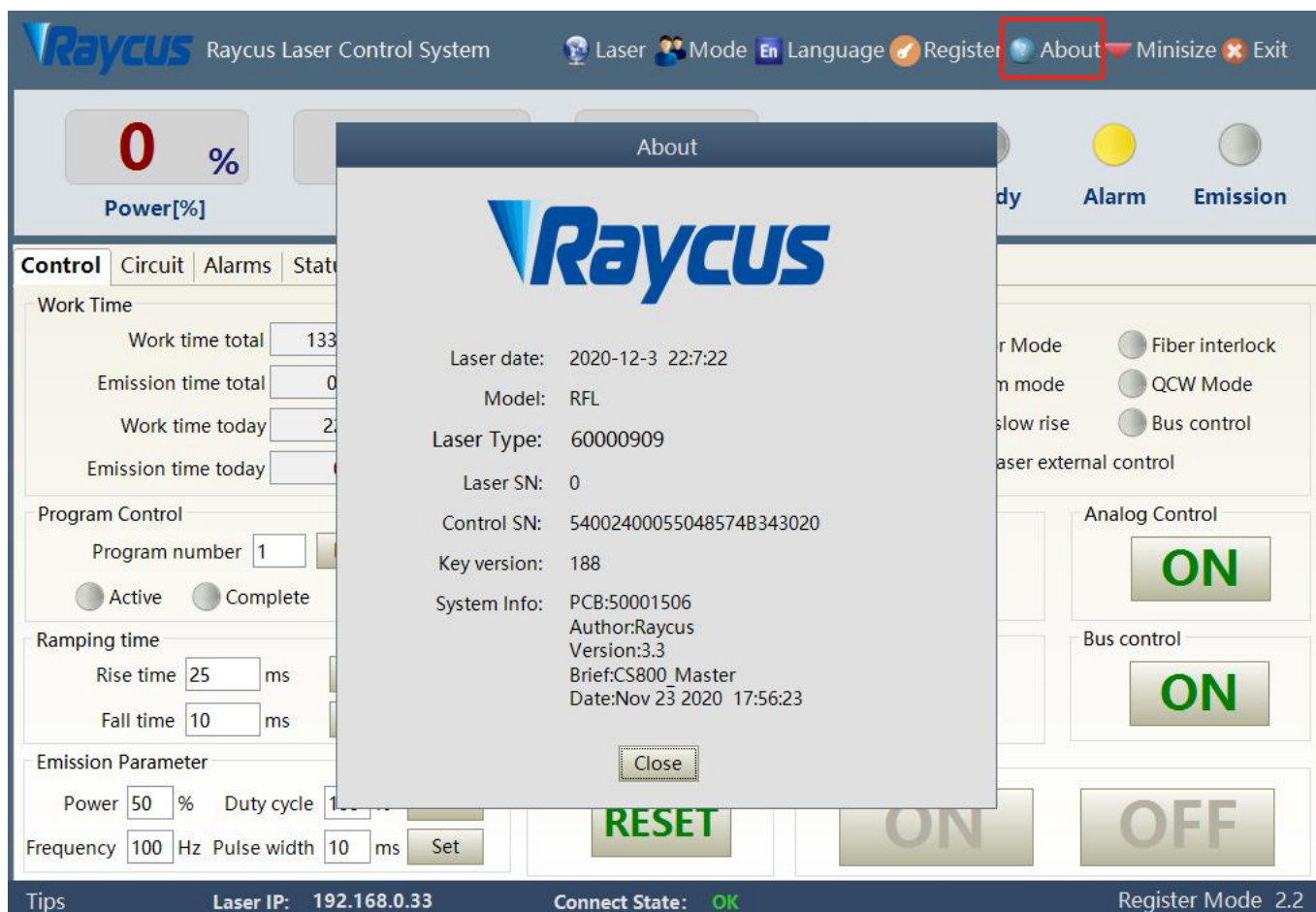


Figure 52 Laser relevant information query interface.

### 8.10 XP1 interface status indication (in diagnostic mode)

The laser interface status indicator interface is shown in Figure 53. It is convenient to view the interface status information which represents the input and output status of the XP1 interface on the back panel.

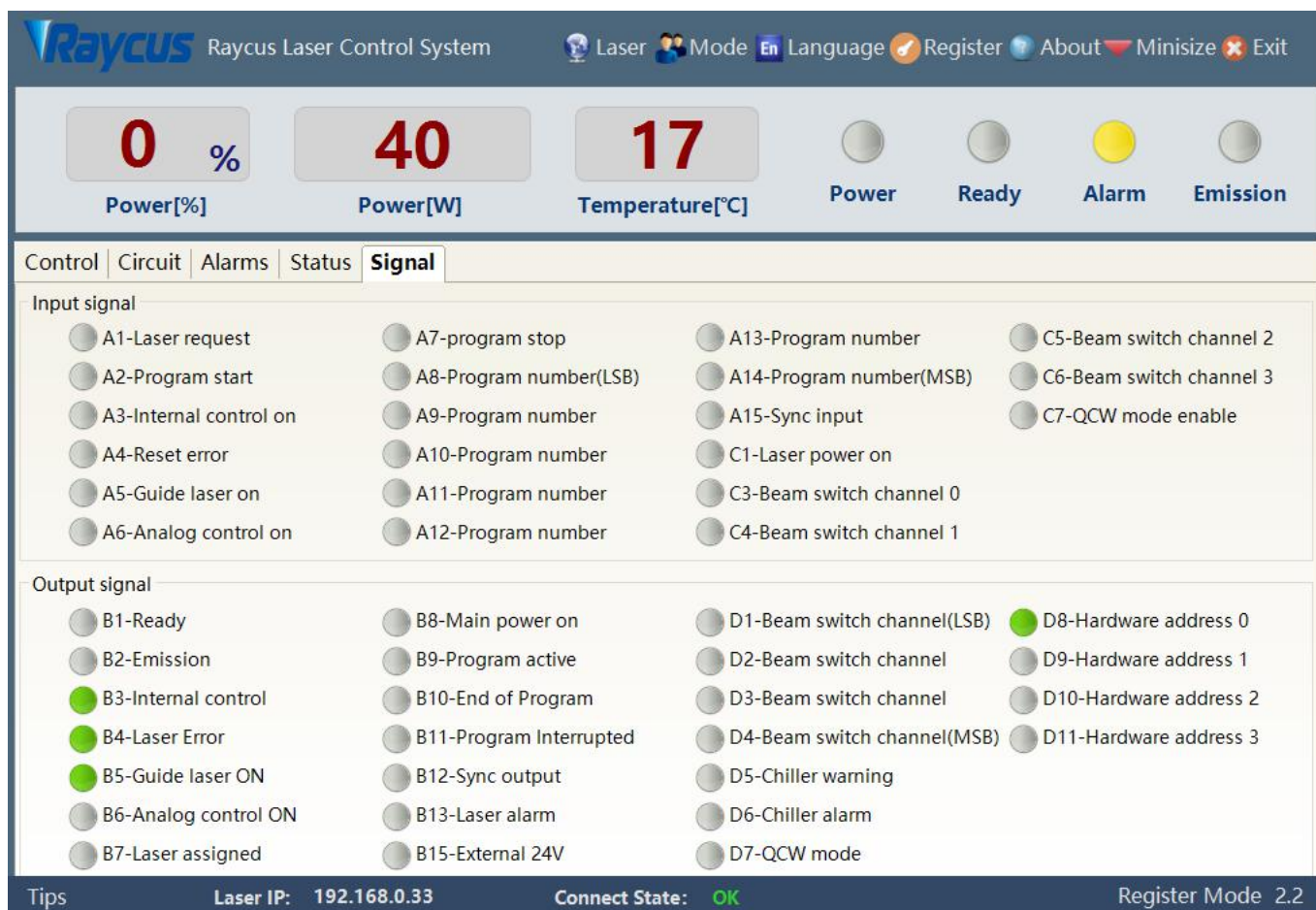


Figure 53 The interface status in diagnostic mode

### 8.11 Log (in diagnostic mode)

Laser’s working log interface is shown in Figure 54. User can query work log by entering the time to query and click on the ‘search’ button.



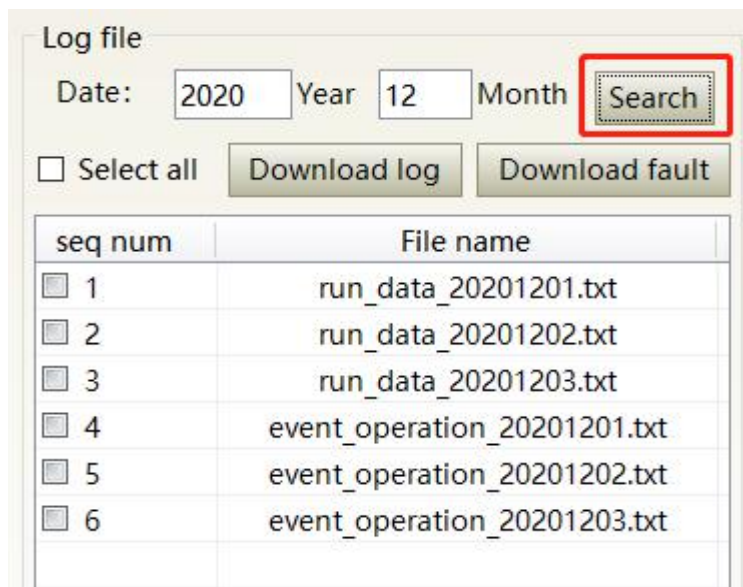


Figure 54 Laser's working log interface

### 8.11.1 Download log

Log download interface is shown in Figure 55.

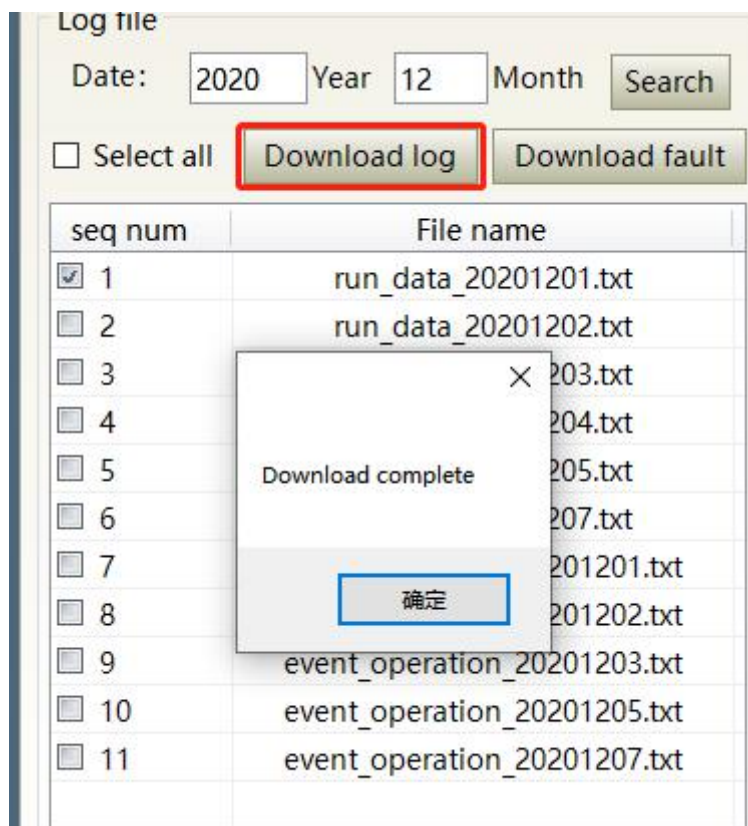


Figure 55 Log download interface

### 8.11.2 Download record of historical fault

Historical fault record download interface is shown in Figure 56.

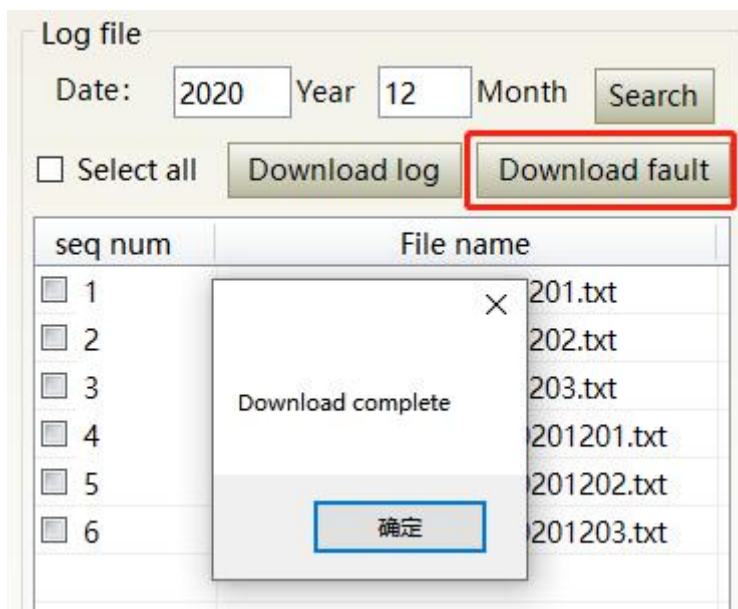


Figure 56 Historical fault record download interface

### 8.11.3 Downloaded file address

The file address query interface for all download information is shown in Figure 57.

名称	修改日期	类型	大小
2019	2020/5/22 10:14	文件夹	
2020	2020/5/22 10:14	文件夹	
event_alarm	2020/5/22 11:42	文本文档	1 KB

Figure 57 the file address query interface for all downloaded information

### 9.128.12 Module parameters (in diagnostic mode)

Laser module parameter query interface is show in Figure 58. The interface is for the parameter query in diagnostic mode from which Raycus technicians can analyze the cause of laser anomalies.

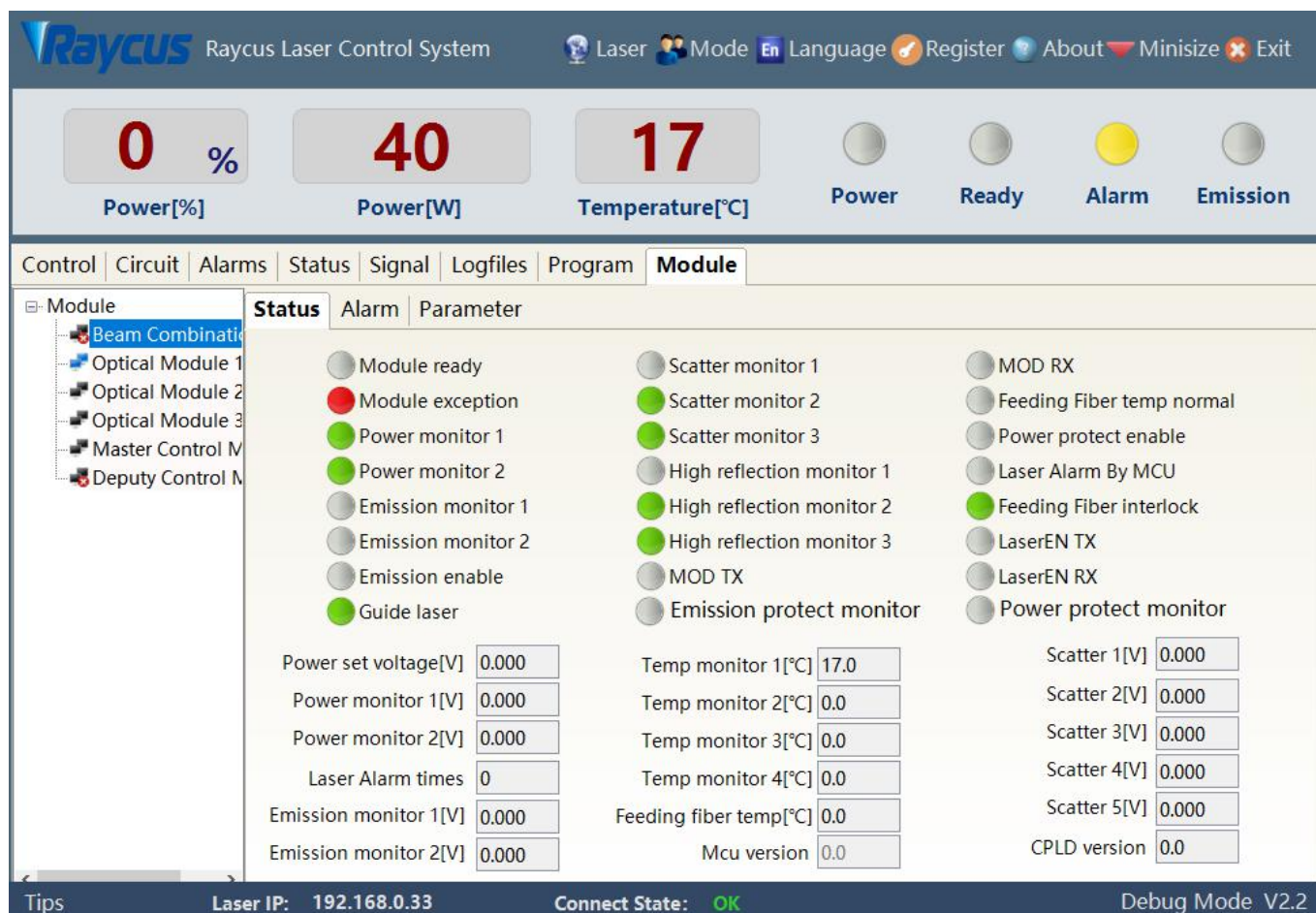


Figure 58 Module parameters query interface in diagnostic mode

### 9.138.13 Programming settings (programming editing)

The laser programming settings interface is shown in Figure 59.

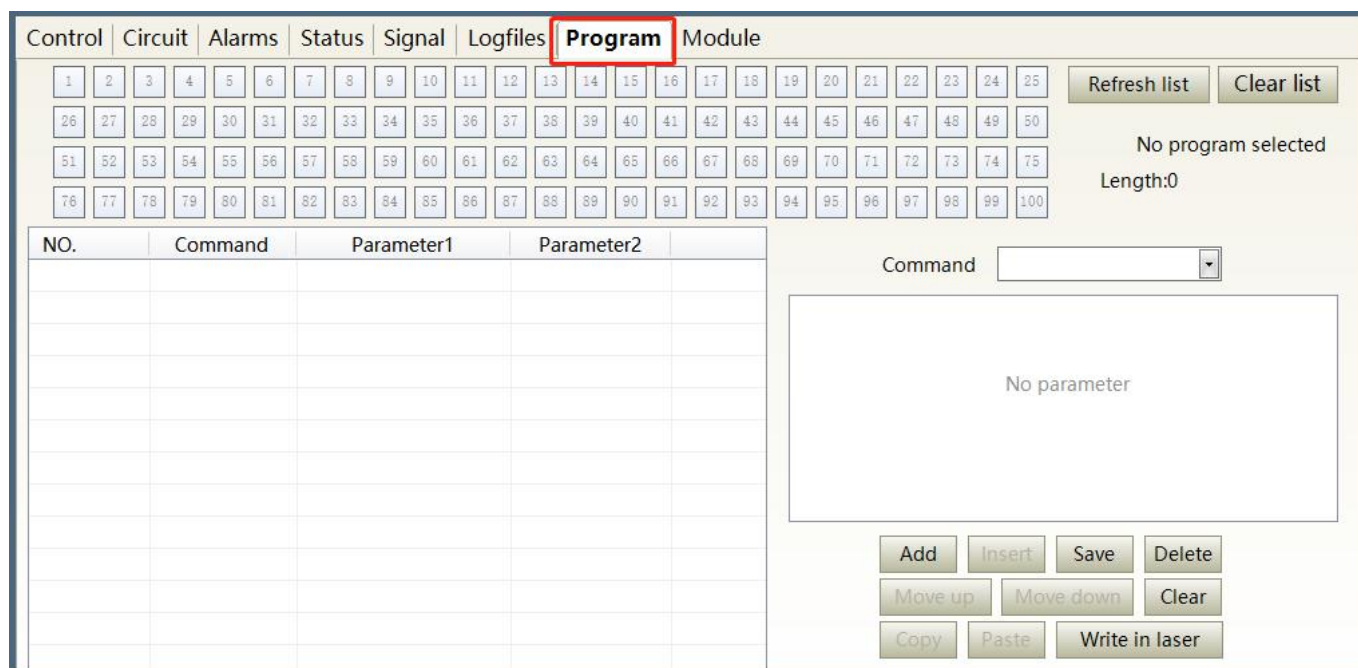


Figure 59 the programming interface in programming editing mode.

### 8.13.1 View the number of wave bars inside the current laser

Operating interfaces of viewing the number of wave bar stored inside the current laser is shown in Figure 60. The software automatically lists the number of wavelength bars that have been saved by clicking on the ‘Refresher List’ button. Green indicates the bar already has a program and white indicates that the bar is empty.

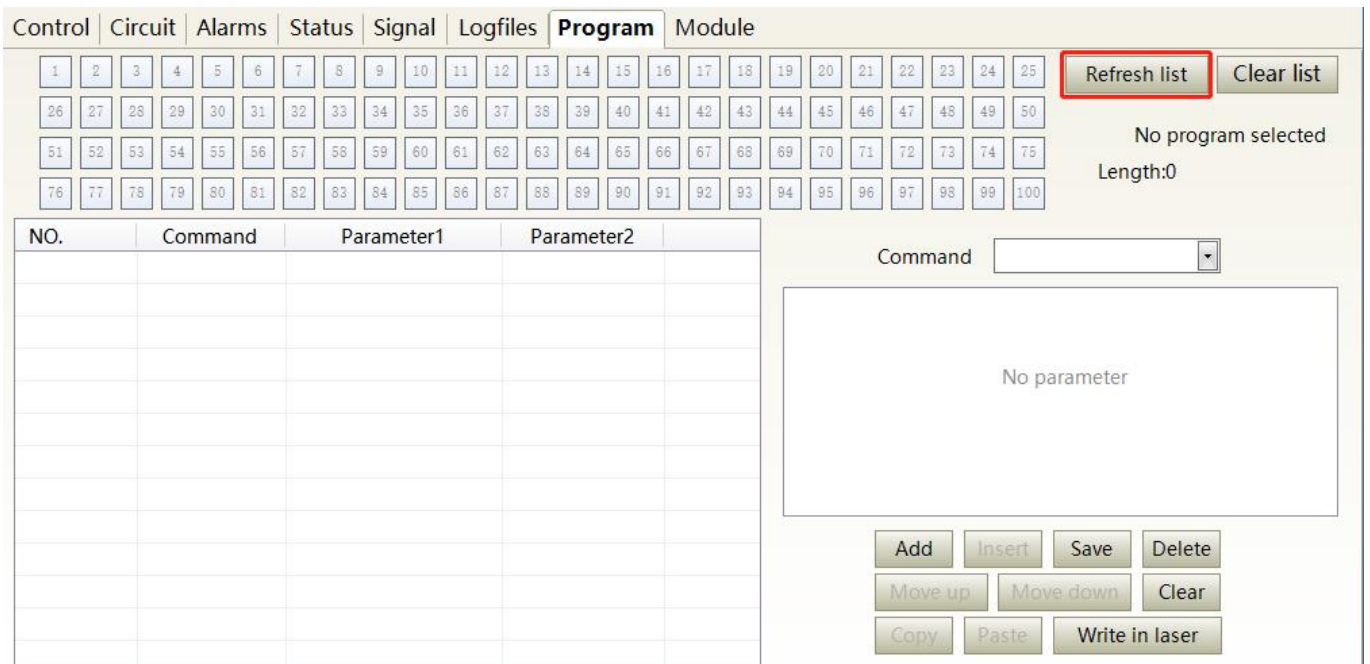


Figure 60 operating interfaces of wave bar stored inside the current laser.

### 8.13.2 Check programming content

To check the programming contents in the current laser programming mode is shown in Figure 61. The program automatically lists the original programming by clicking the programming number that needs to be checked.

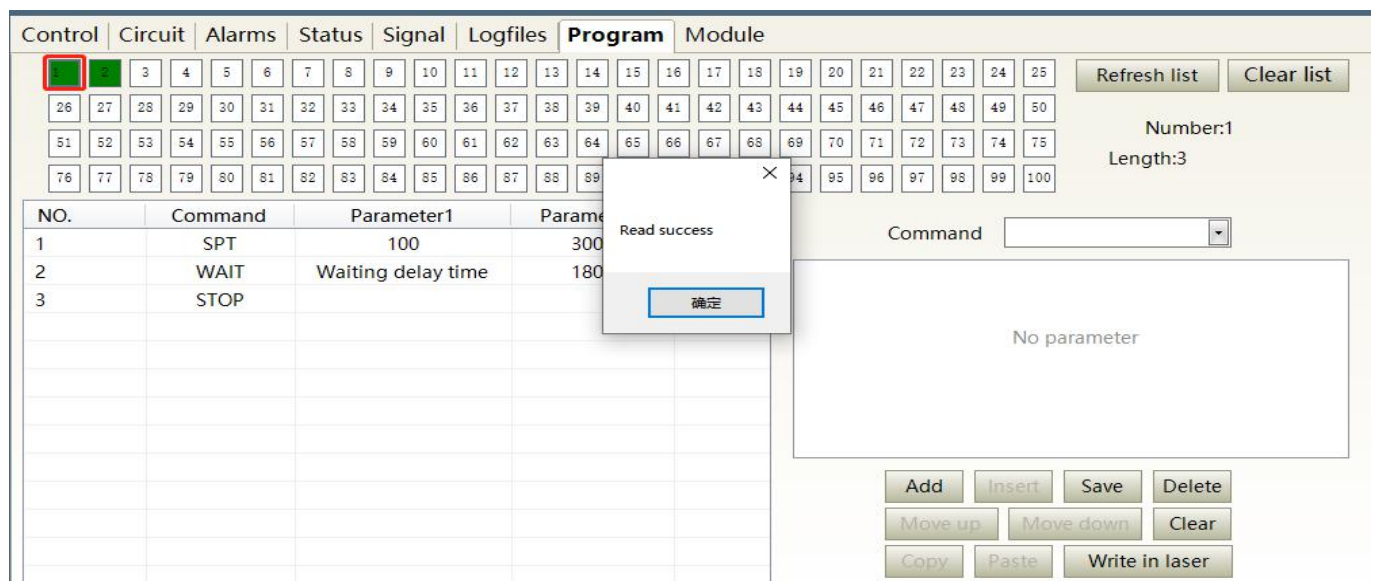


Figure 61 Programming content interface in the current laser programming mode.

### 8.13.3 Empty all programming

Empty all programming interfaces stored in the current laser programming mode , as shown in Figure 62. All programming stored inside the current laser will be emptied by clicking ‘Empty Program List’.

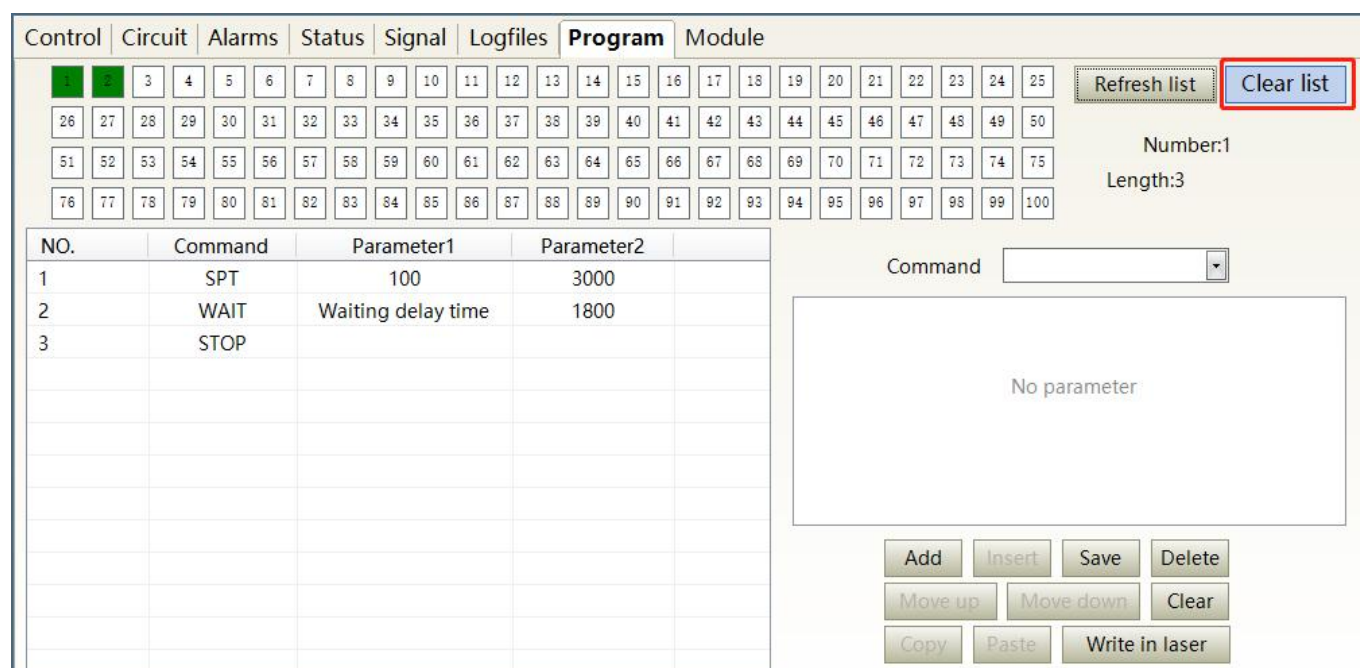


Figure 62 Interface of empty all programming stored in the current laser programming mode.

### 8.13.4 Edit Programming

Programming editing when the laser is working in programming mode as shown in Figure 63.

Step 1: left click the pre-edited programming number.

Step 2: select the command under the command type, click ‘Add’.

Step 3: enter the parameters and click ‘Save’. The instruction appears in the left program list immediately.

Step 4: after editing all commands, click ‘Write Laser’.

Step 5: the new programming number will turn green when user re-click the ‘refresher list’ button. Write successfully.

The screenshot shows the 'Program' tab of the software interface. It features a grid of 100 programming numbers (1-100). A red box highlights 'Number:2' with 'Length:0' below it. Below the grid is a table with columns for NO., Command, Parameter1, and Parameter2. To the right, there is a 'Command' dropdown menu and buttons for 'Refresh list' and 'Clear list'.

a) Select the pre-edited programming number.

The first screenshot shows the 'Command' dropdown menu open, displaying a list of command types: STOP, SPT, SPR, WAIT, GOTO, OUT, and EXTPOWER. The second screenshot shows the 'SPT' command selected in the dropdown. Below the dropdown, there are input fields for 'Time 1000 [ms] 1-65000' and 'Power 2000 [W] 0-65000'. Below these fields is a set of control buttons, with the 'Add' button highlighted by a red box.

b) add command type

NO.	Command	Parameter1	Parameter2
1	SPT	1000	2000

Command

Time  [ms] 1-65000

Power  [W] 0-65000

Add Insert **Save** Delete

Move up Move down Clear

Copy Paste Write in laser

C) save command

	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75
76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100

Refresh list Clear list

No program selected  
Length:0

Command

Time  [ms] 1-65000

Power  [W] 0-65000

Add Insert Save Delete

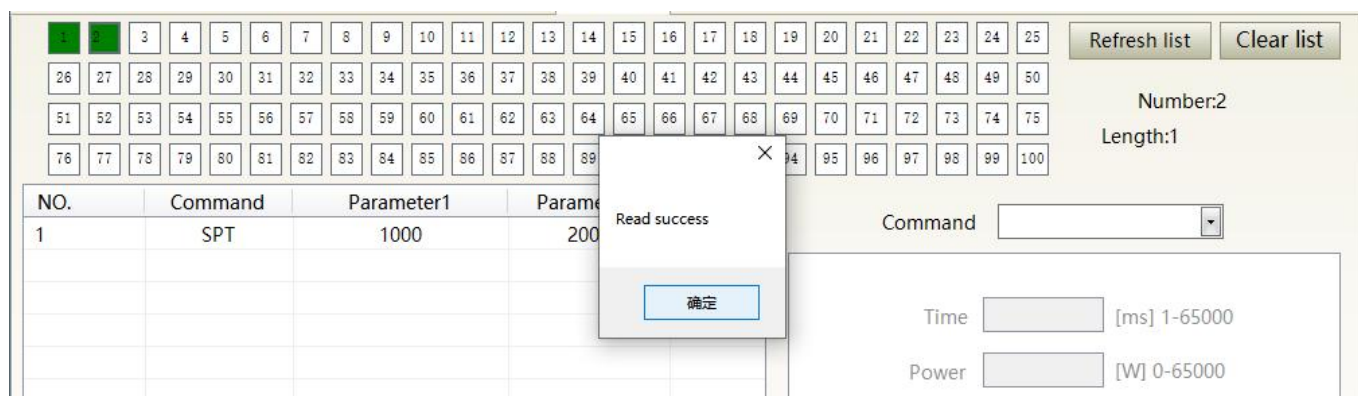
Move up Move down Clear

Copy Paste **Write in laser**

Write success  
确定

d) type the command code into laser





e) check effectiveness of instruction

Figure 63 A diagram of the programming editing operation in programming mode

### 8.13.5 Command Explanation

Command meaning in laser working status is shown in Table 17

Table 17 command meaning in laser working status

Code (1 Byte)		Parameter1(2 bytes)		Parameter 2 (4 bytes)	Note
1	Stop	none		none	The program end command. the last command must be this command.
2	SPT	0~65000 (MS)		0~65000(W)	Change power to 2 in time 1
3	SPR	0~65000 (W/MS)		0~65000(W)	Change power to 2 in power change ratio 1
4	WAIT	1	Wait for sync signal low level	Null	

		2	Wait for sync signal high level	Null		
		3	Wait for sync signal rising	Null		
		4	Wait for sync signal dropping	Null		
		5	Wait time	0~65000ms(int)		
5	GOTO	0~99	line	-1	Switch at low sync signal	Jump to different line when comply
		0~99	line	-2	Switch at high sync signal	Jump to different line when comply
		0~99	line	0 ~ 1000000	Times of jump to subject line	Times of loop jump to subject line
6	OUT	1	SO	1	Sync signal low level output	
				2	Sync signal high level output	
7	EXT Power	1	0~10V			
		2				

## 9 Warranty, Repair and Return

### 9.1 General Warranty

After all the products manufactured are delivered according to the order or specifications, Raycus will guarantee the products to be free from any material and technical problems and ensure that they meet the specifications under Normal use.

10.1 Raycus has the right to selectively repair or replace any products with material or technical problems during the warranty period. All products repaired or replaced during the warranty period are guaranteed free warranty only for those products with special problems. Raycus reserves the right to charge the payment for the products with problems under Normal use.

## 9.2 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 due to excessive use or not following the instructions caused by those who are not from Raycus. The 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 inform us within 31days 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.



**WARNING:** 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.

## 9.3 Service and Repair

- This product has no built-in parts for user maintenance, so all maintenance should be carried out by Raycus technical personnel.
- In case of any alarm during the use of the product, the technical personnel of Raycus shall be informed in time and troubleshooting shall be carried out.
- All repair or replacement products must be placed in the original packaging box provided by Raycus, otherwise any product damage caused by this will not be repaired free of charge by Raycus.
- When you receive Raycus products, please check whether the products are intact in time. If there is any abnormality, please contact the carrier or Raycus in time.

**Raycus will continue to develop new products. The product information listed in the manual is subject to change without further notice. All technical parameters are subject to the contract terms.**

**The above product warranty and service terms of Raycus are for users' reference only, and the formal service and warranty contents are subject to agreement in the contract.**

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