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英文版使用说明书

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受 控

武汉锐科

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



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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 observe the following cautions and warnings as well as other information within this manual.

### 1.1 Security Label


	<p><b>WARNING:</b> Describes a hazard that lead to severe injury or death to people.</p>	
	<p><b>CAUTION:</b> Describes a hazard that lead to general injury to people or damage to product.</p>	
<div data-bbox="212 1167 512 1310"> <p>AVOID EXPOSURE VISIBLE AND/OR INVISIBLE LASER RADIATION IS EMITTED FROM THIS APERTURE Per GB 7247.1-2012/IEC 60825-1:2007</p> </div> <p>English</p> <div data-bbox="212 1350 512 1494"> <p>激光窗口 避免受到从本窗口射出的 激光辐射的照射 GB 7247.1-2012/IEC 60825-1:2007</p> </div> <p>Chinese</p>	<div data-bbox="662 1160 967 1303"> <p>MAX.AVERAGE OUTPUT POWER:20000W CW WAVELENGTH RANGE:900-1200nm DANGER-VISIBLE AND/OR INVISIBLE LASER RADIATION AVOID EYE OR SKIN EXPOSURE TO DIRECT OR SCATTERED RADIATION CLASS 4 LASER PRODUCT Per IEC 60825-1:2014</p> </div> <p>English (20000W)</p> <div data-bbox="662 1350 967 1494"> <p>最大平均输出功率:20000W CW 波长范围:900-1200nm 可见及不可见激光辐射 避免眼或皮肤受到直射或散射辐射的照射 4类激光产品 GB 7247.1-2012/IEC 60825-1:2007</p> </div> <p>Chinese (20000W)</p>	<div data-bbox="1126 1167 1431 1310"> <p>MAX.AVERAGE OUTPUT POWER:1mW WAVELENGTH RANGE:600-700nm VISIBLE LASER RADIATION DO NOT STARE INTO THE BEAM OR VIEW DIRECTLY WITH OPTICAL INSTRUMENTS CLASS 2M LASER PRODUCT Per GB 7247.1-2012/IEC 60825-1:2007</p> </div> <p>English</p> <div data-bbox="1126 1350 1431 1494"> <p>最大平均输出功率:1mW 波长范围:600-700nm 可见激光辐射 勿直视或通过光学仪器直接观看光束 2M类激光产品 GB 7247.1-2012/IEC 60825-1:2007</p> </div> <p>Chinese</p>
<p>1:Laser Emit Head</p>	<p>2: Type 4 Laser Product</p>	<p>3: Class 2M Laser Product Label-2mW Red Laser</p>
		
<p>4: CE Authentication</p>	<p>5: ID Label (20000W)</p>	<p>6: Laser Radiation Hazard</p>



		
7:Electrical Hazard		


### 1.2 Laser Safety Grade

According to European Standard EN 60825-1, Clause 9, this series of lasers are Class 4 laser instruments. The product emits laser radiation at a wavelength of 1080 nm or around 1080 nm. 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, either directly or indirectly exposed to high power laser radiation to the eye or skin damage. Although the radiant laser is not visible, the beam will cause irreparable damage to the retina or cornea, so appropriate and certified laser safety glasses must be worn throughout the laser emitting.

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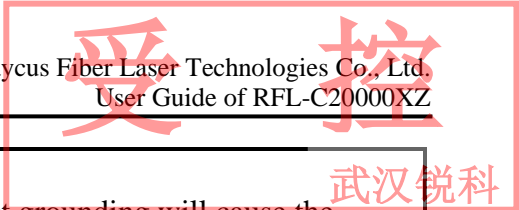
### 1.3 Optical Safety

Any dust on the end of the collimator assembly can damage the lens 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 product ground wire is effectively grounded, and the installation environment is safe and reliable.



**WARNING:** The disconnection of the product grounding will cause the product shell to become live, 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 an un recoverable damage to the laser device.

### 1.5 Other Safety Rules

- a) Do not view the laser output head directly when laser 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 document, 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 performed conducted by Raycus engineer. In order to prevent electric shock, please do not break the seal or uncover the shield. Failure to comply with this instruction will be treated as out of the void the warranty

## 2. Product Description

### 2.1 Features

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

Main Features:

- High beam quality
- High reliable
- Maintenance free operation
- High wall-plug efficiency
- Convenient control interface
- Fast modulation





Applications:

- Industrial cutting and welding
- Scientific research

## 2.2 Package Parts


Please refer to package accessories are in the packing box.

## 2.3 Unpacking and Inspection

Through the specially designed packaging materials and cabinets, 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 or 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 content 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 to make the fiber optic cable stay away from 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.

	<p><b>CAUTION:</b> The fiber optic cable and 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.</p>
---	---

## 2.4 Operation Environment

The operation conditions are listed as the following table:

Table 1: The Operation Environment Conditions 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.
- a) 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.
- b) Failure to follow the instructions when operating the laser may cause malfunction and damage.
- b) It is not allowed to install the output head when the laser is in operation.
- d) Do not look into the output head directly. Wear appropriate protective eye glasses all the time 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. Connecting failure of power supply 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) Safety keep the cap when using the laser. To avoid dust, make sure the opening direction of the cap is put down.
- e) Failure to follow the instructions may cause laser power loss, 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 Unstability	±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
Divergence angle (rad)	≤0.1	Nominal Output Power
Fiber core diameter (μm)	100	customizable
Delivery Cable Length(m)	20	customizable
Electrical characteristics		
Operating Voltage	Three-phase four-wire system AC340V~AC420V、 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 fiber laser are shown in Figure 1.

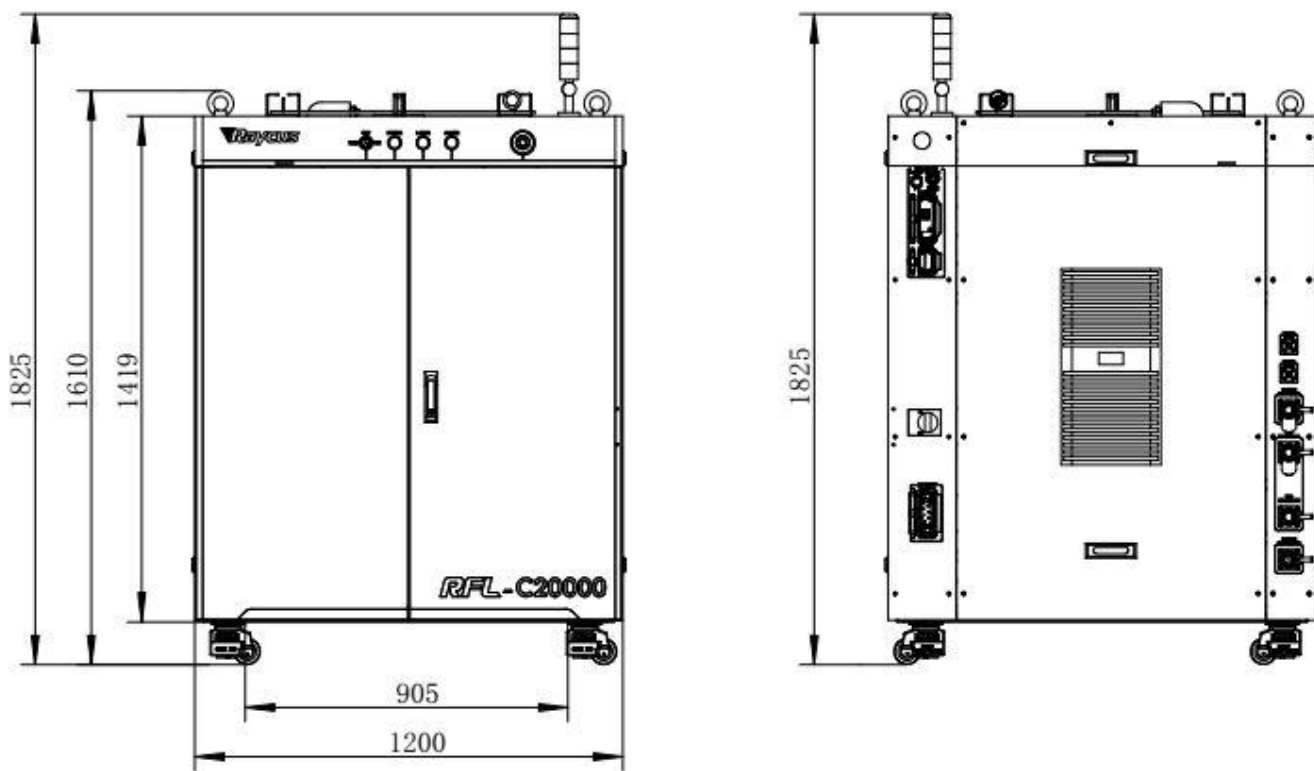


Figure 1-a Front and rear view of the laser.

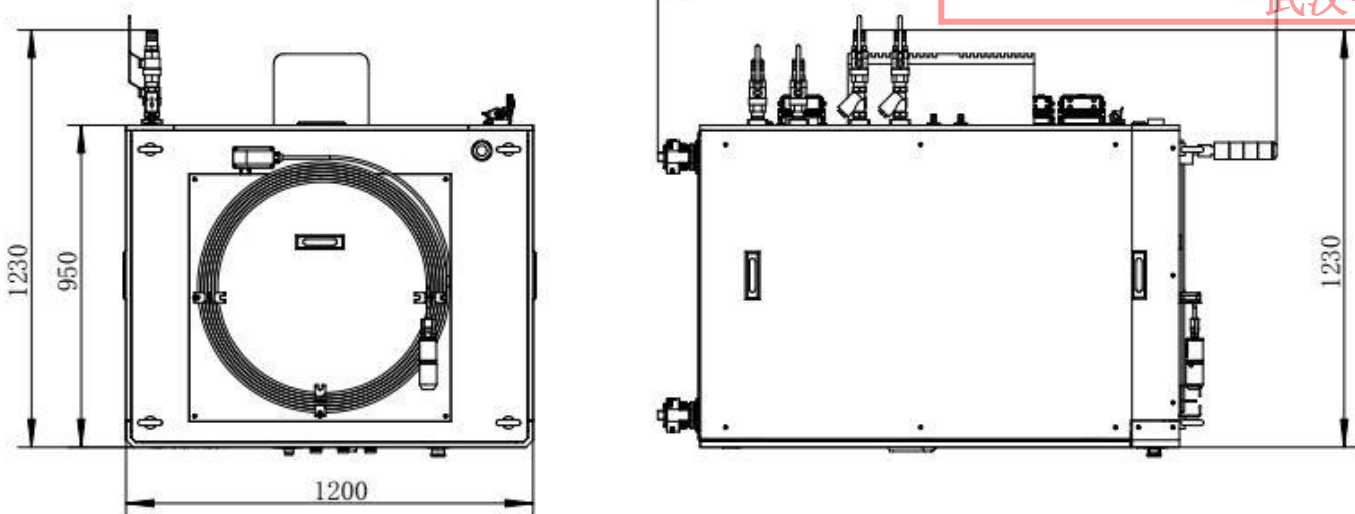


Figure 1-b Top and left view of the laser.

Figure 1 The dimensions of RFL-C20000XZ continuous fiber laser

The structure 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-HPQ output optical cable, and the external dimensions of the output optical cable head are shown in Figure 2.

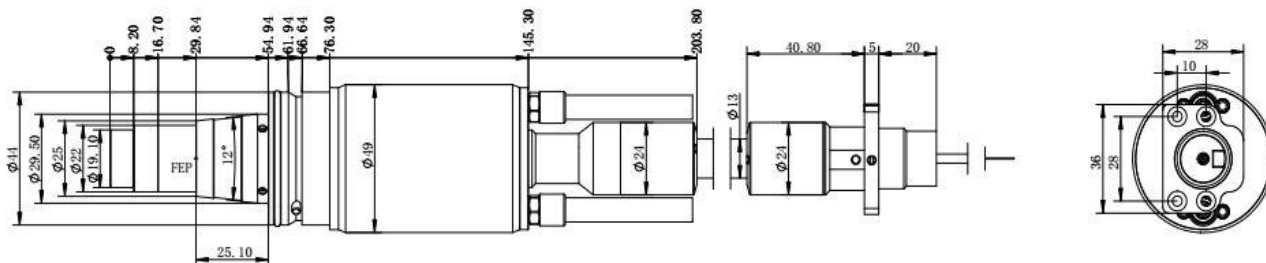


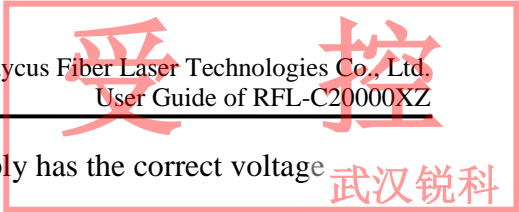
Figure 2 External dimensions of the RFL-HPQ output optical cable head (for 20kW)

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

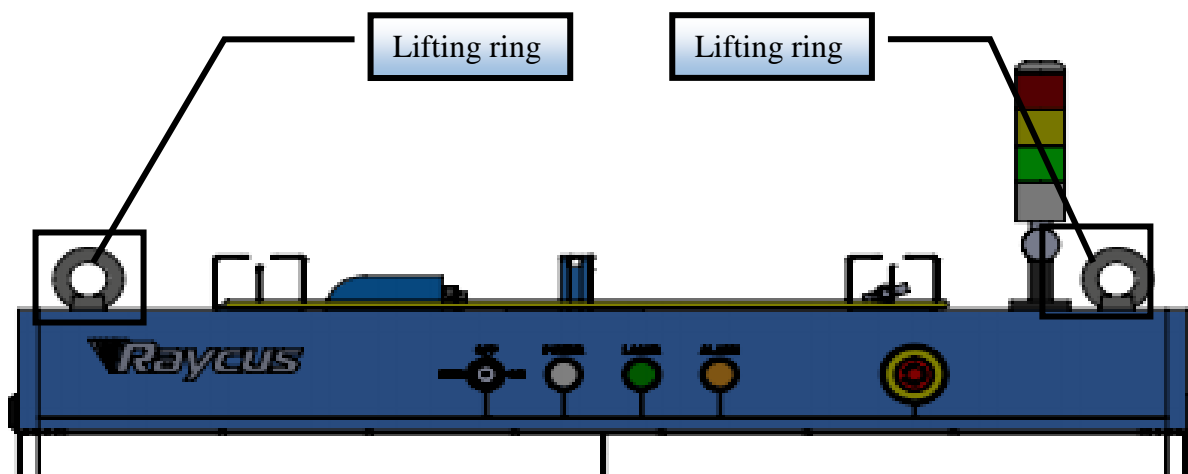
Before the laser works, make sure that the two copper contacts (Interlock pins) on the output head are shorted, otherwise the laser will not work properly. Before installing the output cable into the processing head, the lens of the output cable must be inspected. If the output cable lens is dirty, the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

### 3.2 Installation rule

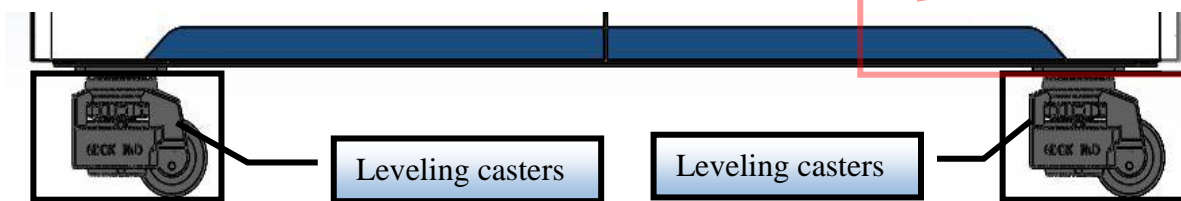
- a) Place the laser horizontally in a suitable position and fix it as necessary;



- b) Before the laser is powered on, Please check if the power supply has the correct voltage (380VAC $\pm$ 10%, 50/60Hz, See Table 2 Product Technical Data Sheet for details.), 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.

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

### 3.3 Cooling Requirements

Table 3 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 on Cooling Water:

- a) The laser source cooling water connection is shown in Figure 4, and the arrow direction indicates the water flow direction;

- b) Cooling water needs to use 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) If ambient temperature is between  $-10^{\circ}\text{C}$  and  $0^{\circ}\text{C}$ , must be used to use 30% alcohol (volume ratio), and replace it every 2 months;
- e) If ambient temperature is below  $-10^{\circ}\text{C}$ , the chiller with both heating and cooling functions must be used, and keep it in full-time operation.

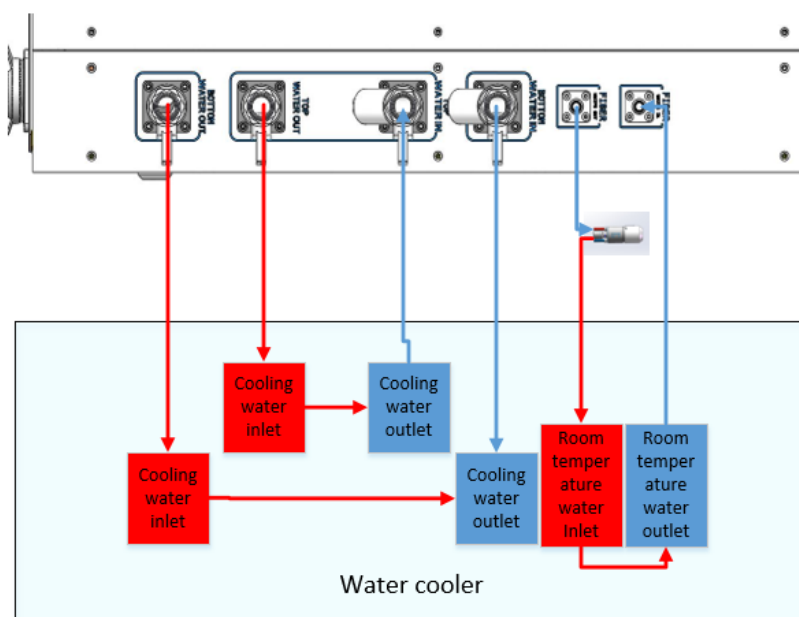


Figure 4 diagram of laser cooling system connection

Water cooling requirements for output optical cables:

- a) Water flow requirements: QP output cable water flow is greater than 3.0L/min;
- b) Water cooling pressure:  $0.4\sim 0.6\text{Mpa}$  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;
- f) PH value of cooling water:  $5.5\sim 9$ ;
- g) The water cooler needs to be equipped with a filter element whose filter particle size is less than 100um;
- h) Maximum cooling water temperature:  $35^{\circ}\text{C}$ ;
- i) The lowest cooling water temperature:  $5^{\circ}\text{C}$  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 20cm. When the laser is emitting, the minimum bending diameter shall not be less than 30cm;
- 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>
--	--

#### 4. Using the Product



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>

##### 4.1 Front Panel

Figure 5 shows the front panel.

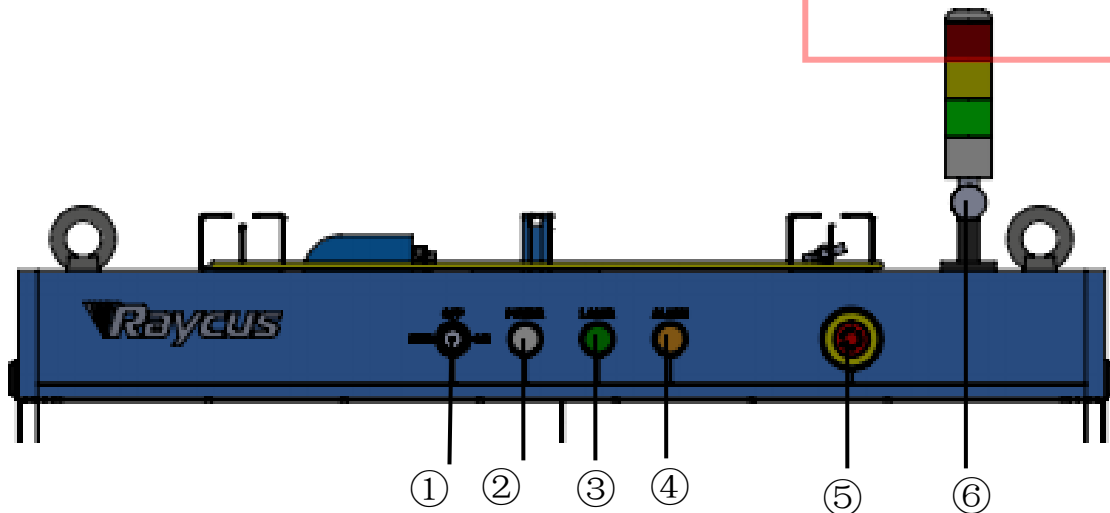


Figure 5 Front view of the panel

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

**REM/OFF/ON:** The key switch, 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 8 and 9 pins of the XP1 interface on the rear panel to realize 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:** INTERLCOK 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 powered 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 6 shows the rear 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.

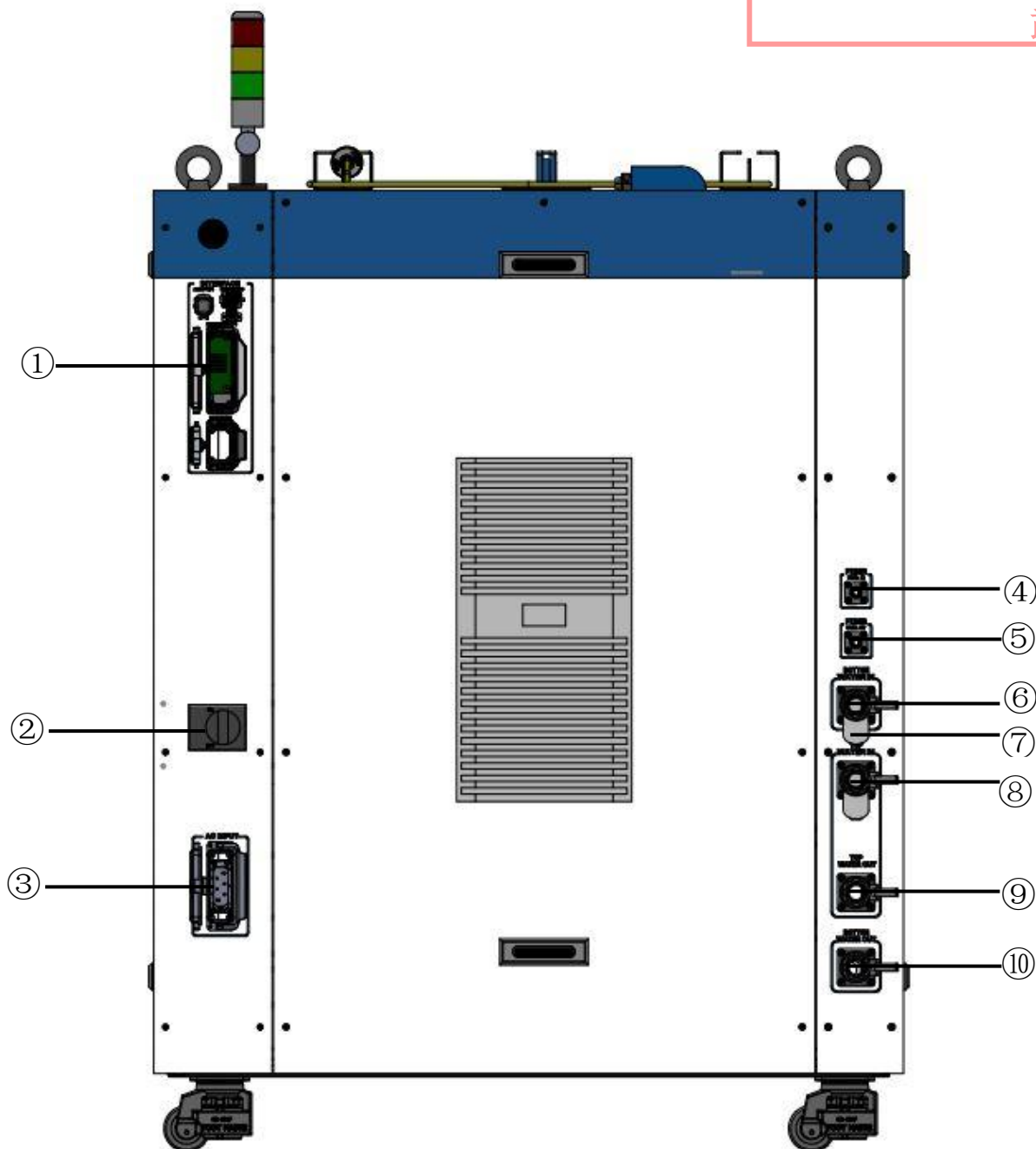


Figure 6 Rear view of product panel.

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 optical cable water outlet, this interface is connected to the output optical cable water inlet, connected to the  $\phi 13$  inner diameter water pipe.

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

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 water outlet of the cooling water of the water chiller, and connected to the  $\phi$  32 inner diameter water pipe.

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

### 4.3 Power connection



**CAUTION:**

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

Figure 7 Shown is the power cord provided by the company.



Figure 7 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 8.



Figure 8 RFL-C20000XZ physical picture of power cord plug 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 4.

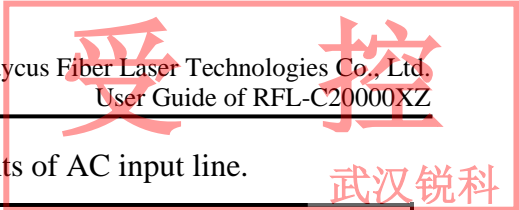


Table 4 The interface definition and parameter requirements of AC input line.

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	25mm <sup>2</sup>	Brown
3、4	AC380V-L2	L2	25mm <sup>2</sup>	Black
5、6	AC380V-L3	L3	25mm <sup>2</sup>	Gray
7	Protective	PE	25mm <sup>2</sup>	Yellow-green Earth
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 9.

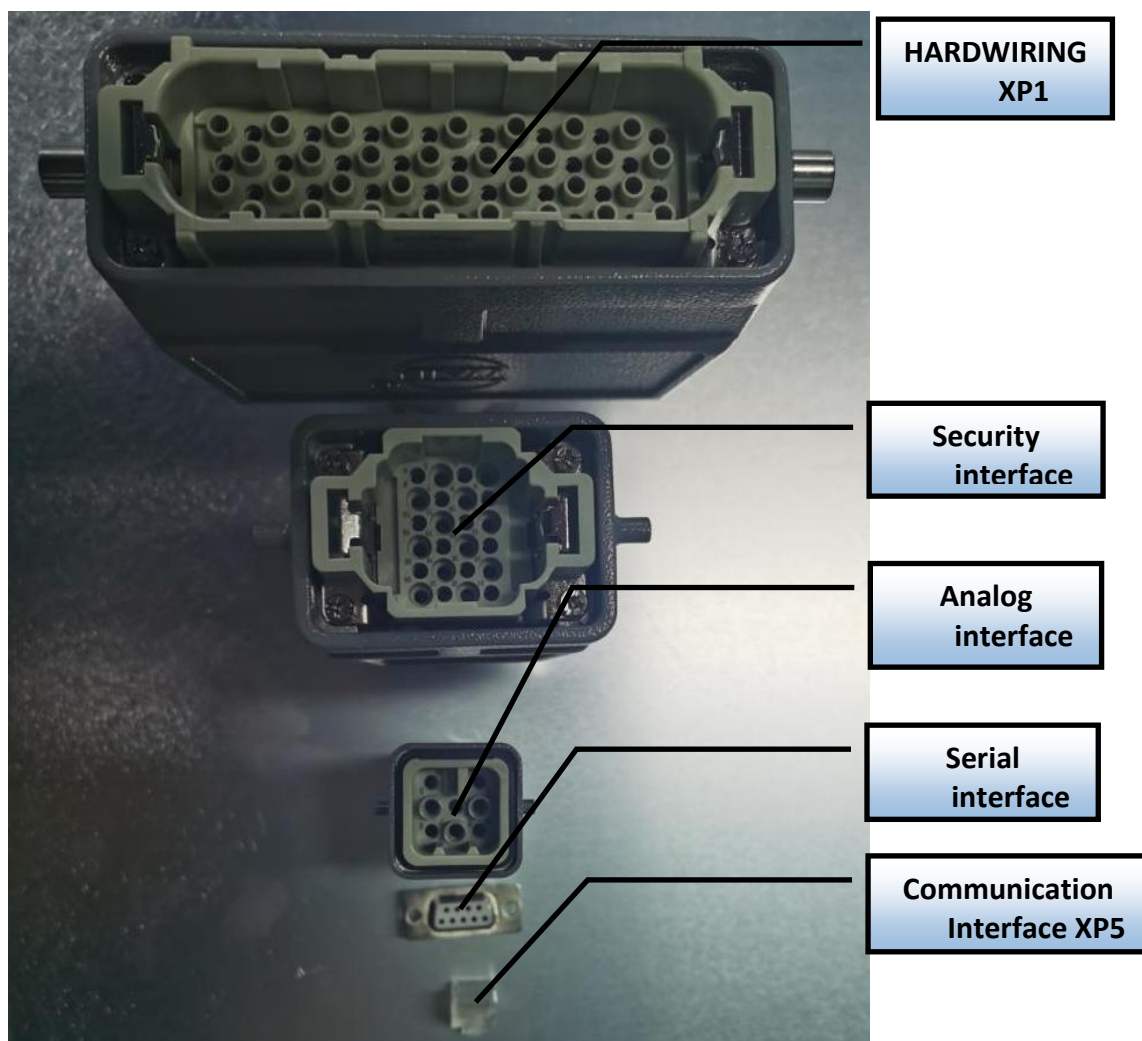


Figure 9 Control signal line



#### 4.4.1 SAFETYXP2 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 5.

Table 5 XP2 security interface definition

Pin number	type	description
1	MOD+	Output control, voltage input signal; laser ON: 4~30V;laser OFF: -3~2V
2	MOD-	
3	OUT (FET S 极)	Laser output indication,MOS pipe D、 S output; current<1A, Vds<30V
4	OUT (FET D 极)	
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. The main control board is powered on when 8 and 9 feet are closed
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;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;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<1A,Vds<30V
16	OUT(FET D pole)	
17	IN	Interlock1 import, Active contacts, normal short connection 17、 20
20	IN	
18	IN	Interlock2 import, Active contacts, normal short connection18、 19
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
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
24	OUT	





#### 4.4.2 HARDWIRING XP1

64 pin hard wire interface, control signal input and output interface of laser in remote mode. Specific interface definitions are shown in Table 6 below.

Table 6 XP1 Hardwire interface definitions

No. XP1	Interface requirements		type	description
	Pin	Pin definition		
XP1	A1	Laser request signal	Input signal	Import signal, request laser, this bit is valid before the laser receives other instructions
	A2	Waveform 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 is capable of simulating the input signal (Programnum = 0000000)
	A7	Stop waveform Mode	Input signal	Stop waveform 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 waveform signal
	A15	synchronous input	Input signal	backup



	A16	COM	Reference ground 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 (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	Input signal	Output signal, indicating that the laser is ready to produce light
	B2	Laser output	Input signal	Output signal, indicating that the laser is emitting light
	B3	The laser operates in internal mode	Input signal	Output signal indicating that the laser operates in internal mode
	B4	Laser anomalies	Input signal	Output signal indicating abnormal laser
	B5	Laser red light indication	Input signal	Output signal, indicating that the laser is red
	B6	AD mode	Input signal	output signal indicating that the laser operates in AD mode(A1)
	B7	Laser received request signal	Input signal	Output signal indicating that the laser receives a request signal
	B8	Main power supply in laser	Input signal	Output signal indicating that the main power supply of the laser is powered on



B9	The laser is operating in waveform mode	Input signal	Output signal indicating that the laser is performing waveform mode
B10	Waveform mode execution completed	Input signal	Output signal, indicating that the laser waveform mode is completed, the bit clears when the A2 is invalid
B11	Abnormal Wave Mode Termination	Input signal	output signal indicating that the laser waveform mode is abnormally terminated RESET (a4) cleared
B12	Synchronous output	Input signal	Output signal, high effective, low invalid
B13	Alarm output	Input 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	Input signal	Output signal indicating the actual channel position of the current gate; 0000-gate closed, channel 0001-1
D5	Water cooler alarm output	Input signal	Output signal indicating current water temperature warning
D6	Water cooler alarm output	Input signal	Output signal indicating current water temperature alarm
D7	QCW mode	Input signal	Output signal indicating that the current laser operates in QCW mode (only for lasers with QCW mode)
D8~D11	Laser hardware address	Input signal	Coding-Cable function ;0000-0 laser ,0001-1 laser; D8 low, D11 high
D12 ~	backup		



### 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 Ruike Company or the software of the upper computer which integrates the communication protocol of Ruike. The definitions are as follows.

Table 7 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 8 below.

Table 8 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 Ground
3	OUT	Power amplifier voltage output 0 V 0% laser power output 8 V 100% laser power output
4	Reference	Reference ground 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

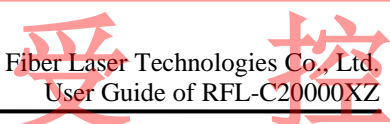


Table 9 XP5 Communication interface definitions.

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 can not be turned on at this time. 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 can not 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 10:

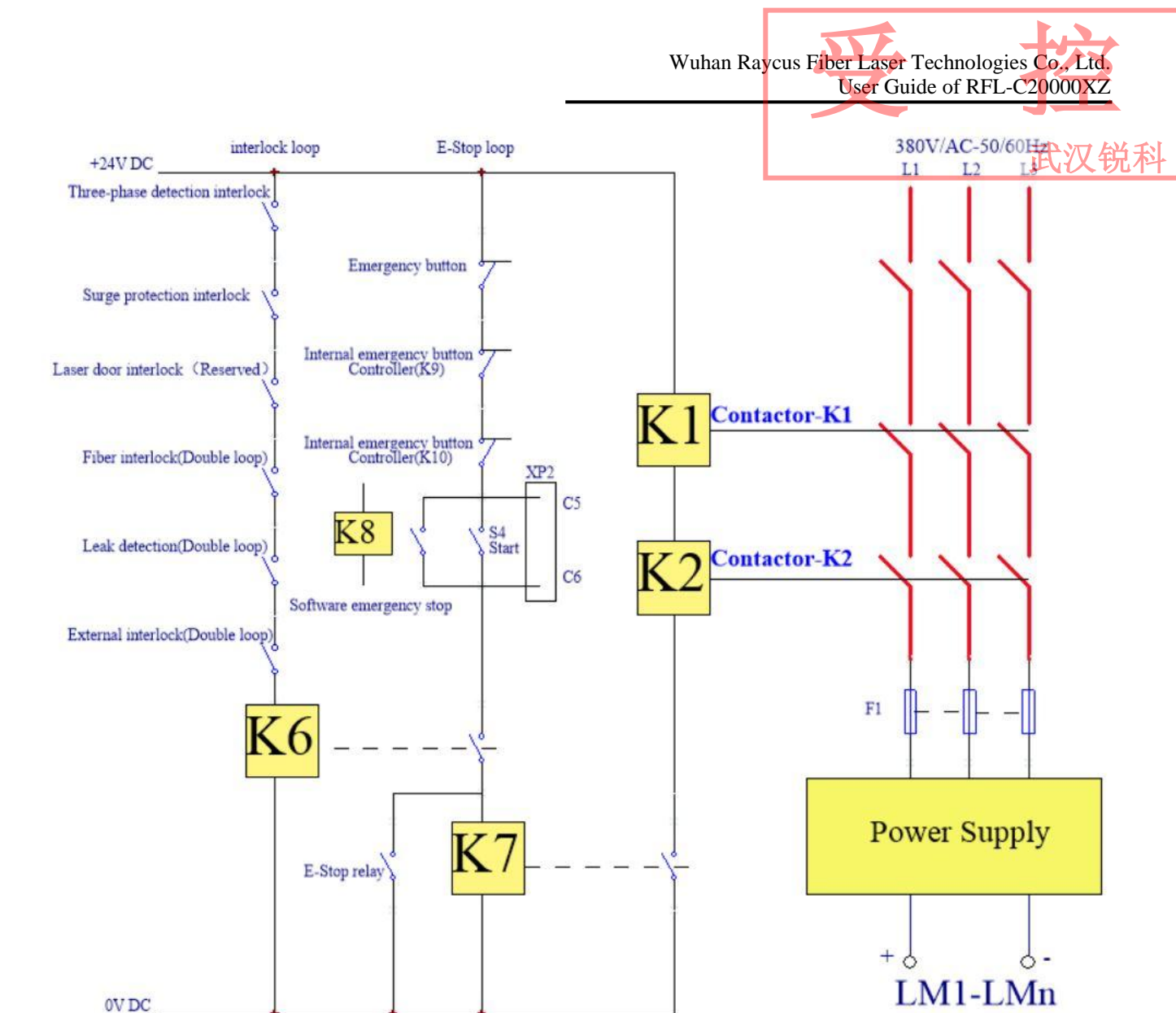


Figure 10 Schematic diagram of the internal electrical circuit of the laser

**Note: RFL-C20000XZ laser strong power control part contactor K1, K2 its po-wer part are 350 A contactors in parallel use, 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 a OFF state and the stop button on the front panel of the laser EMERGENCE 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, turn on the water cooler.

- d) Close the rear panel circuit breaker, release the laser front panel emergency stop switch; 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, start the main power supply waiting for the laser to Ready, the laser Ready, the tricolor green light above the machine, representing that the laser can light.

**Note: Raycus high power continuous laser with air conditioning, close the air switch, the air conditioning began to operate. When the working environment temperature and relative humidity of the laser are in the dew point area (blue), please let the air conditioning work for 30 minutes before operating the laser.**

## 5. Control Mode Selection

Raycus high power continuous laser has two control modes, ON mode and REM mode respectively, the user can select the mode that needs to enter through the key of the front panel. The specific operation is shown in Table 10.



Table 10 Raycus Selection of operating modes of high-power continuous lasers and their operating methods

	AD mode	Output remote	Programming mode	power	Laser emission and shutdown	Red guide beam
ON mode	Close1	Close2	-	Communication13	Communication11	Communication12
	Enable3	Close2	-	XP4-1/2Foot voltage	Communication11	Communication12
	Close1	Enable4	-	Communication13	XP2-1/2Foot level status	Communication12
	Enable3	Enable4	-	XP4-1/2Foot voltage	XP2-1/2Foot level status	Communication12
	Close5	Close6	Close7	Communication13	Communication11	Communication12
REM mode	Enable8	Close6	Close7	XP4-1/2Foot voltage	Communication11	XP1-A1/A5 high
	Close5	Enable9	Close7	Communication13	XP1-A1 Laser request high XP1-A2 Laser output energy XP2-1/2 input MOD signal	XP1-A1/A5 high
	Enable8	Enable9	Close7	XP4-1/2Foot voltage	XP1-A1 Laser request high XP1-A2 Laser output energy XP2-1、2 input MOD signal	XP1-A1/A5 high
	Close5	Enable9	Enable10	By programming instruction	XP1-A1 Laser request high XP1-A2 Upward initiation of implementation procedures	XP1-A1/A5 high

Note: 1~13operating methods:1: Send “DEC” ; 2: Send “DLE” ; 3: Send “EEC” ; 4: Send “ELE” ; 5: XP1-A1 high, XP1-A6 low or suspended; 6: XP1-A1 high, XP1-A3 high; 7: XP1-A1 high, XP1-A8~A14 low or suspended; 8: XP1-A1 high, XP1-A6 high; 9: XP1-A1 high, XP1-A3 low or suspended; 10: XP1-A1 high, XP1-A8~A14 low; 11: Communication sends "EMON" output laser, send" EMOFF" turn off laser;12: The communication sends "ABN" output red light, send" ABF" turn off red light;13: The communication sends "SDC XX" sets the power percentage, XX represents the power percentage.



## 5.1 ON Mode

During ON mode, the user can set different working modes through the host computer software or direct communication command, and the laser will remember the mode before the power is cut off after re-powering.

### 5.1.1 AD Mode enable

When the AD mode is enabled, the power of the laser is determined by the analog voltage of 1 or 2 feet of the XP4; if the AD mode is not enabled, the power of the laser can be set by the host computer software or the 'SDC 80' command is sent.

### 5.1.2 External light control enables

When the external control enable is produced, the laser emission is determined by the level state between the MOD, MOD- on the XP2; if the external control light is not enabled, the laser emission and shutdown are determined by the output button of the host computer software. Or communication sends "EMON" control laser emission, send 'EMOFF' control laser off.

### 5.1.3 Red light control

ON mode red light can only send 'ABN' turn on red light, 'ABF' turn off red light through host computer software or communication. After the red light is turned on, the laser will turn off the Ready output, and the green indicator at the top of the laser will turn off. After the red light is turned off, the laser Ready signal will resume output immediately, and the green indicator light at the top of the laser will be lit.

## 5.2 REM Mode

### 5.2.1 Red light control

When the upper computer software is used to select the red light external control, the red light opening and closing are controlled by the A5 pin voltage on the XP1 interface; when the upper computer software is used to select the red light internal control, Red light control button or communication red light control instruction (ABN '- turn on red light; ABF'- turn off red light).

After the red light is turned on, the laser will turn off the Ready output, and the green indicator on the top of the laser will turn off. After the red light is turned off, the laser Ready signal will resume output immediately, and the green indicator light at the top of the laser will be lit.



### 5.2.2 AD Mode

When the A1 and A6 of the XP1 are set high at the same time, the laser runs in AD mode, and the current laser rated power is determined by the analog voltage of 1 or 2 feet of the XP4. When the A6 of the laser is set low or suspended, the laser power is set by the host computer software or communication.

## 6. Wiring diagram

### 6.1 The laser works in software mode

There are two ways to enter the software mode, A first way of entering is to hit the key switch to ON", The wiring is shown in figure 11; If the key switch hits the REM", Set the A1 and A3 of the XP1 hardware interface in order (A8~A14 and low), The laser will also work in software mode, And the key switch hit 'ON', The wiring pattern is shown in figure 12 below.

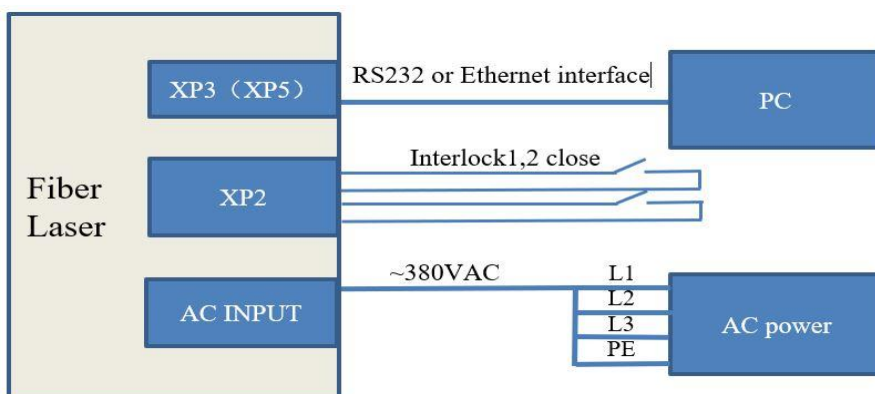


Figure 11 Key Switch 'Wiring Diagram in ON' Software Mode

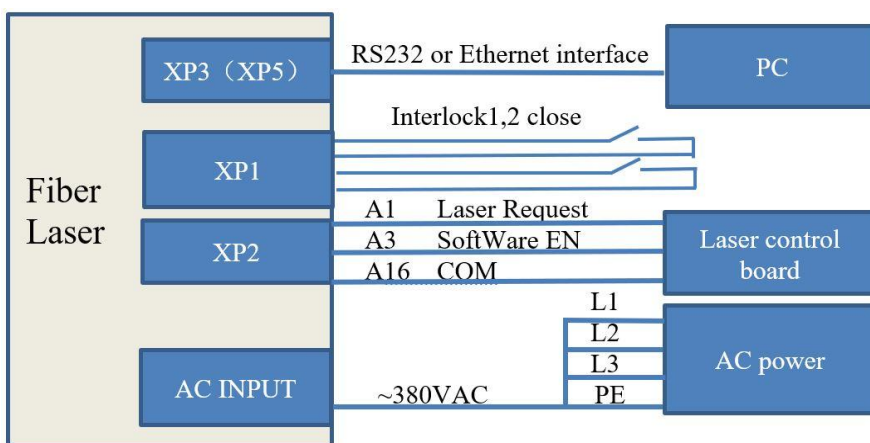


Figure 12 Key Switch 'Wiring Diagram in REM' Software Mode

When entering the software mode, the laser can be controlled by the Raycus host computer software or other upper computer software integrated with the Raycus communication protocol (such as setting the optical power, frequency, pulse width and controlling the red light and light, etc.).

Attention: in the key switch 'ON' software mode, Software can choose internal or external control of light, Internal control or external control mode has power-down memory function. Software mode light

needs software to select "internal control ". And when the key switch hits REM position, PC internal/external control button failed, Internal control is controlled only by A3, When the key switch is in the REM position, the output light control foot is the A2 of the XP1 interface and the MOD signal of the XP2 interface is high, The A2 pin of the general XP1 serves as a light enable signal, The MOD signal of the XP2 is used as the output signal.

## 6.2 The laser works in external control mode

The key switch is placed on ‘ON’, and the upper computer software selects external control, when the laser works in external control mode, its power, frequency, pulse width and other parameters are still set by the software, but the output light control is controlled by the MOD, MOD- signal on the XP2 interface. The external control mode wiring is shown in figure 13 below:

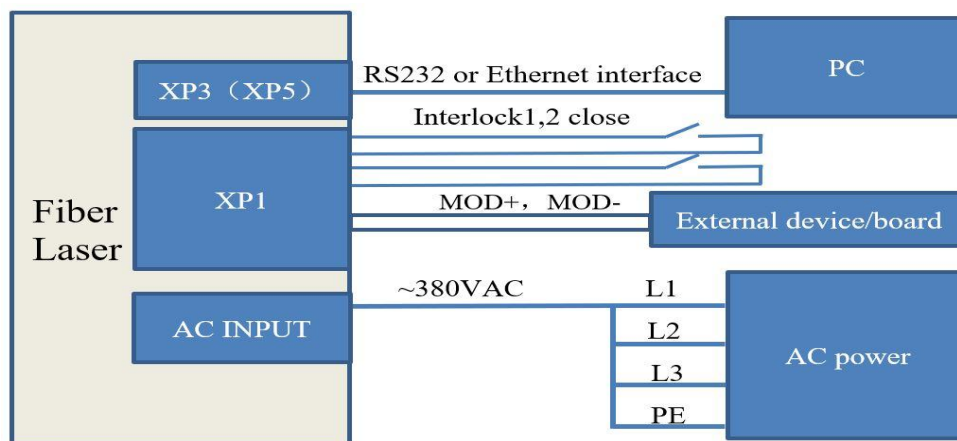


Figure 13 Laser operating in external control mode

## 6.3 The laser works in AD mode

There are also two ways to enter the AD mode according to the position of the key switch. When the key switch hits ‘ON’ position, you can use computer software can be used to click settings (or send ASCII code instruction EEC according to the Raycus protocol) to enter the AD mode.

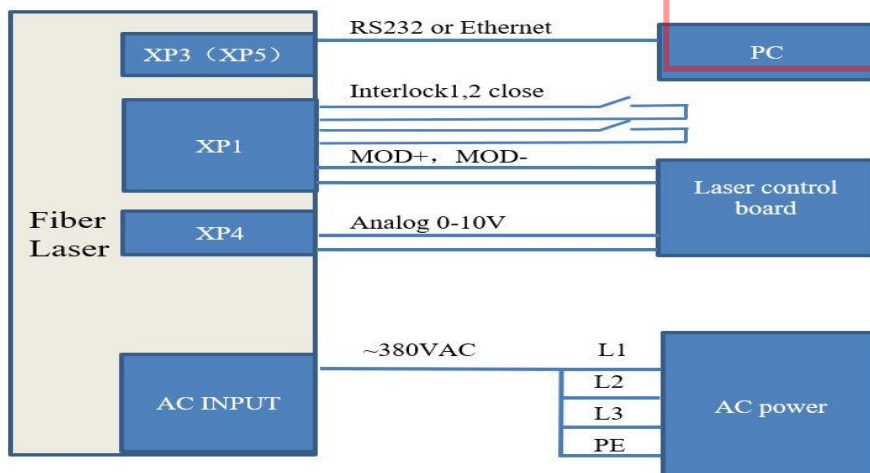


Figure 14 AD mode connection mode of key switch in "ON" mode

Note: if you want to use the above wiring mode for light control, you need to select external control in the Raycus PC (or the PC software that integrates the Raycus communication protocol). Only when external control is selected, the output is controlled by the MOD,MOD- of the XP2 interface.

When the key switch is placed in 'REM', the control of AD mode can be completely separated from the upper computer. At this time, the control mode of the laser is pure hard wire control mode, and the connection mode is shown in figure 15 below.

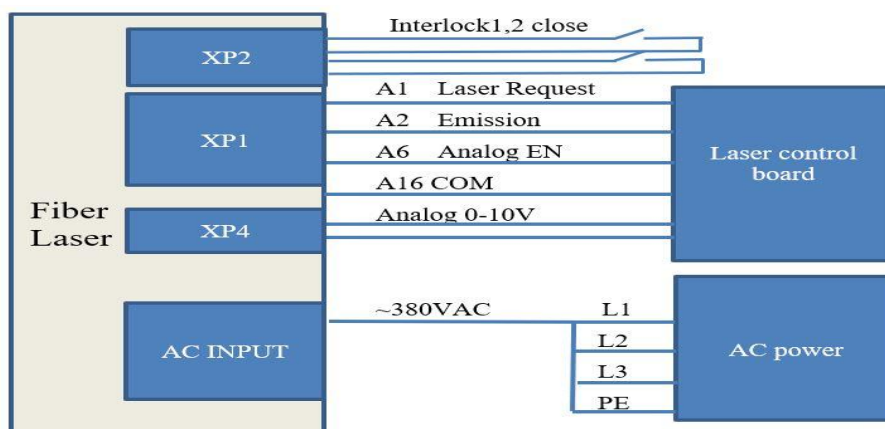


Figure 15 Key switch in REM AD mode wiring diagram

#### 6.4 The laser works in programming mode

Programming mode is a new function of Raycus high power laser. Customers can edit up to 100 waveforms according to their own needs. The control mode of programming mode is similar to the AD mode of key switch in 'REM' position. The programming mode needs to be edited and stored on the upper computer.

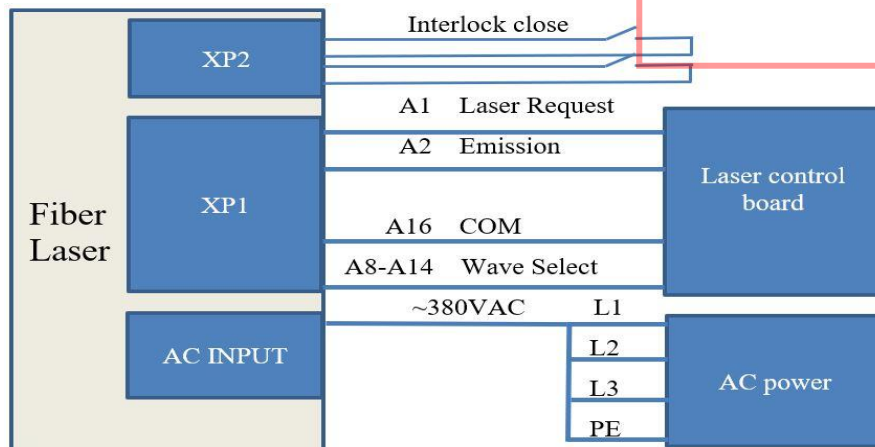


Figure 16 Programming Mode Wiring Diagram (key switch in REM)

## 7. Control timing

According to the self-checking logic of the laser and the above four control modes, the control sequence logic, the laser output logic and the alarm logic are given as follows:

**Note: the output time of the light signal to the laser in the following figure T1 slightly different according to the model and output power, but in principle  $T1 < 100 \mu s$ .**

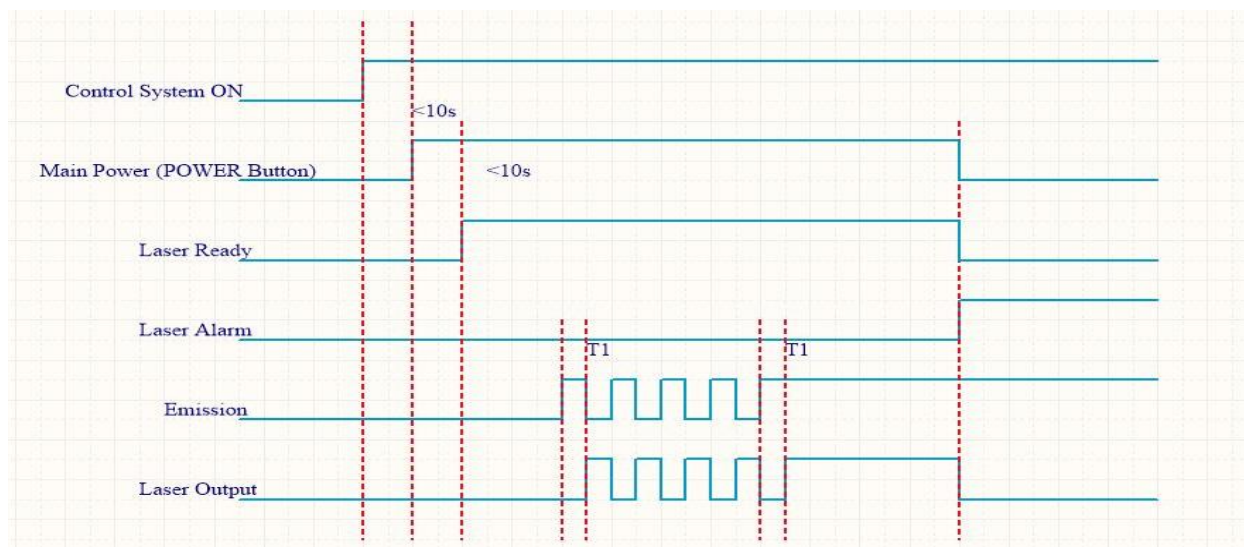


Figure 17 Laser output and alarm logic

### 7.1 Software Mode Optical Control Logic

The software mode has different wiring modes according to the key switch position, but the control logic is the same. The output control logic of the software mode is shown in figure 18 below.

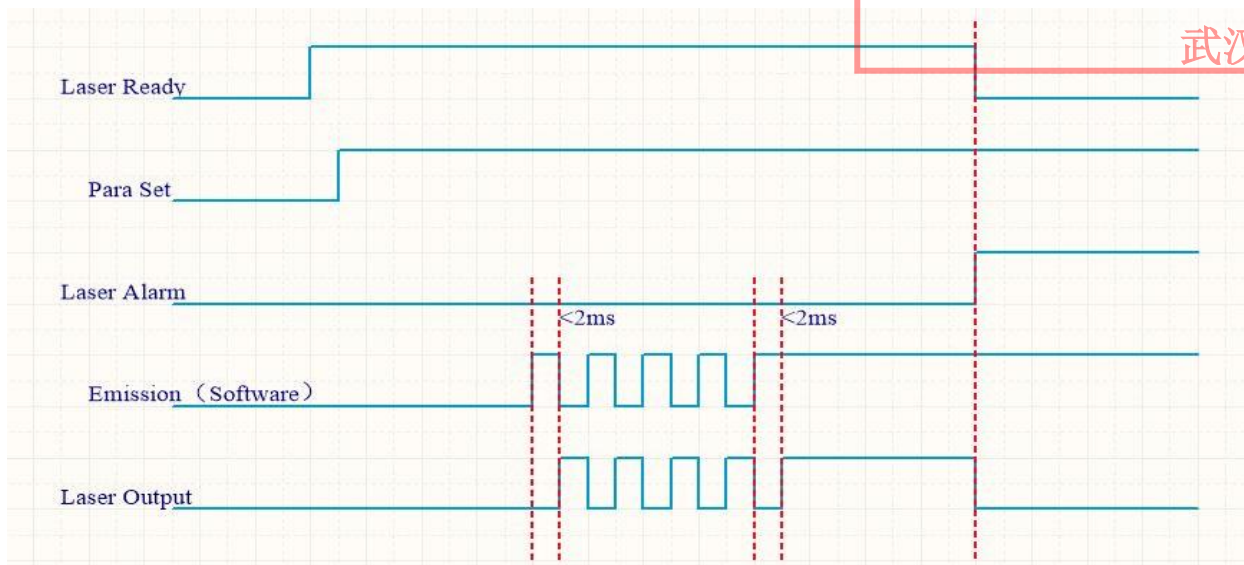


Figure 18 Optical Control Logic in Software Mode

## 7.2 Optical Control Logic of External Control Mode

During the external control mode, the laser key switch is placed on the 'ON', and the upper computer software selects the external control control logic of external control mode is shown in figure 19 below.

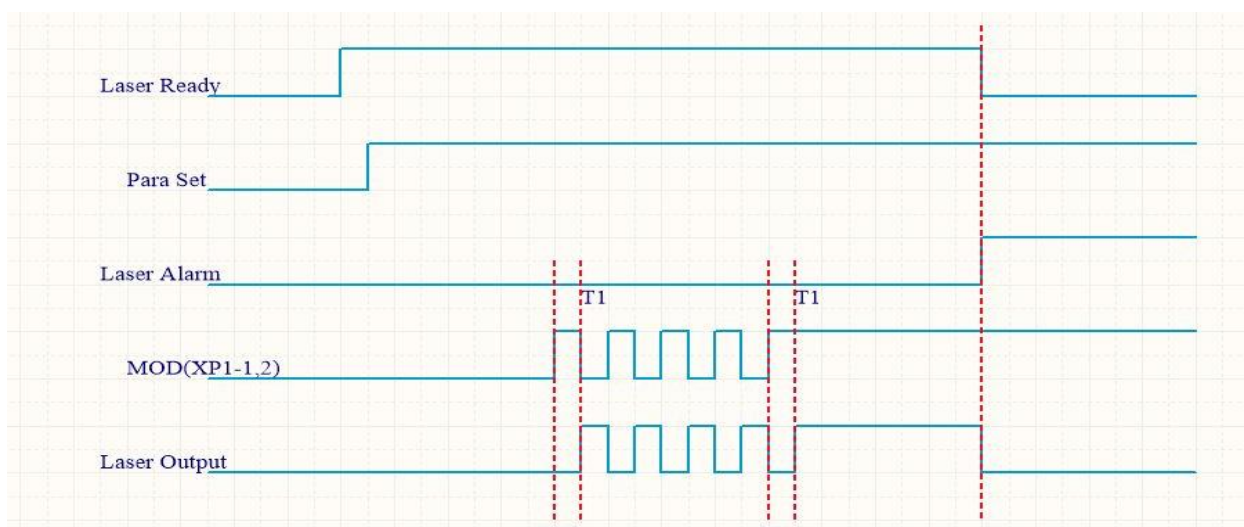


Figure 19 Out-of-light Control Logic of External Control

## 7.3 AD Mode Optical Control Logic

Different key switch position, AD mode wiring is different, control logic is different. Figures 20 and 21 below describe the output control logic of the laser when the key switch is placed in 'ON' and



in 'AD mode', respectively.

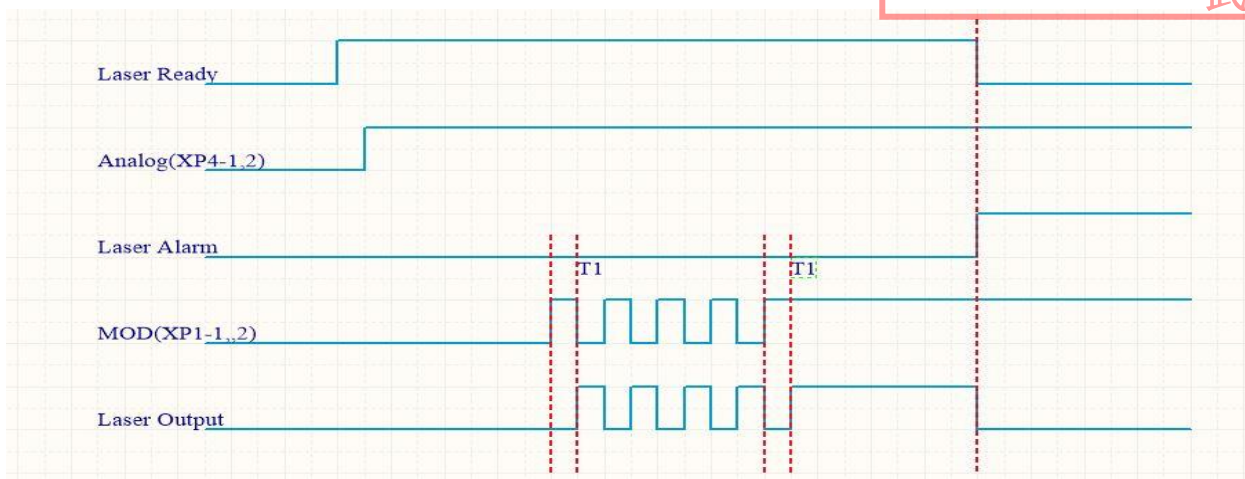


Figure 20 AD mode output light control logic when the key switch is placed in the 'ON' mode

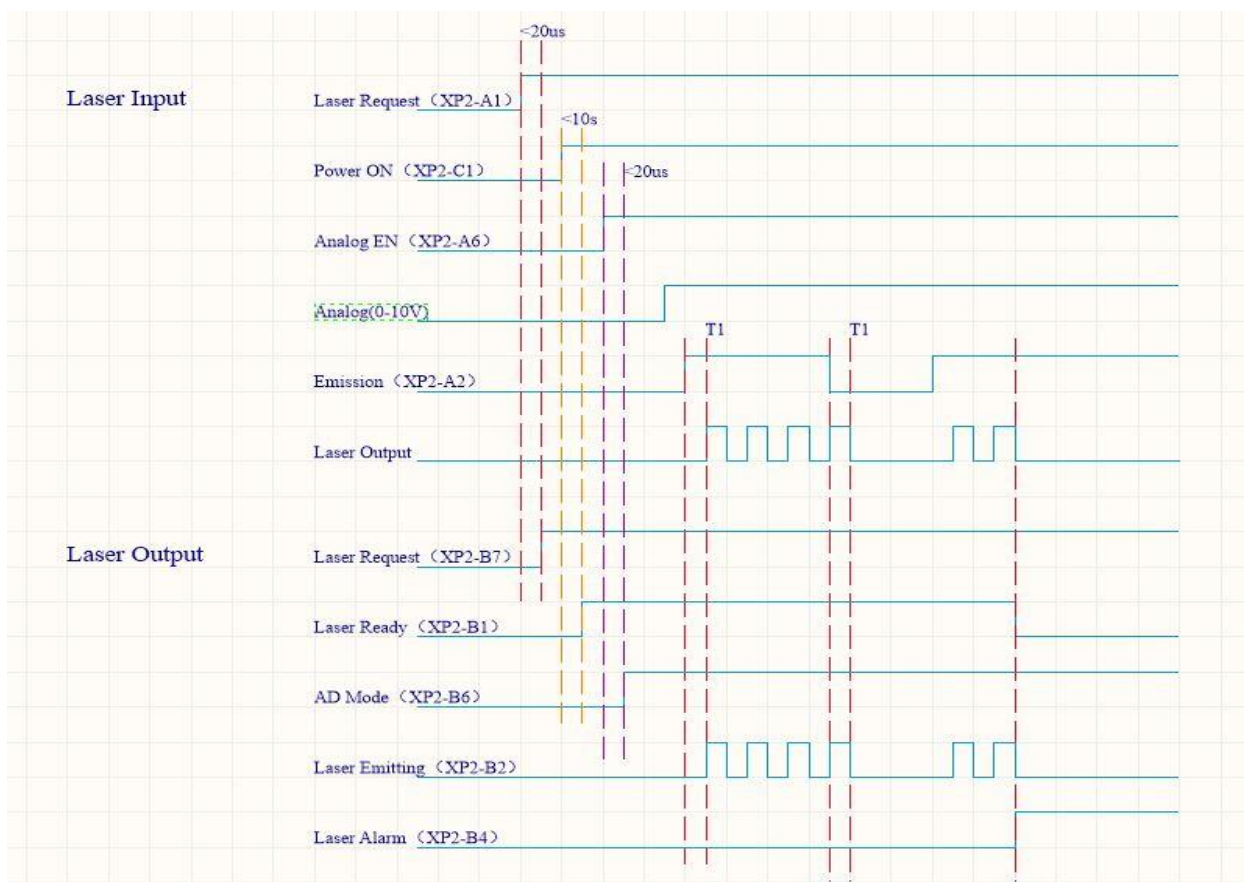


Figure 21 Key Switch under 'REM' AD Mode Out of Light Control Logic

Note: the above figure 19 shows the selection of external control mode of light output control, internal control mode to replace the MOD signal in the timing diagram with the upper computer light output instructions. There is a corresponding output signal for each input signal of the XP1 interface in figure 20. The premise of the signal output is B15,B16 access to 24V.



## 7.4 Waveformmode lasing control logic

The control mode of waveform mode is similar to that of output control logic and AD mode in hard-line mode, but it has more waveform selection control than AD mode. The output control logic is shown in figure 22 below.

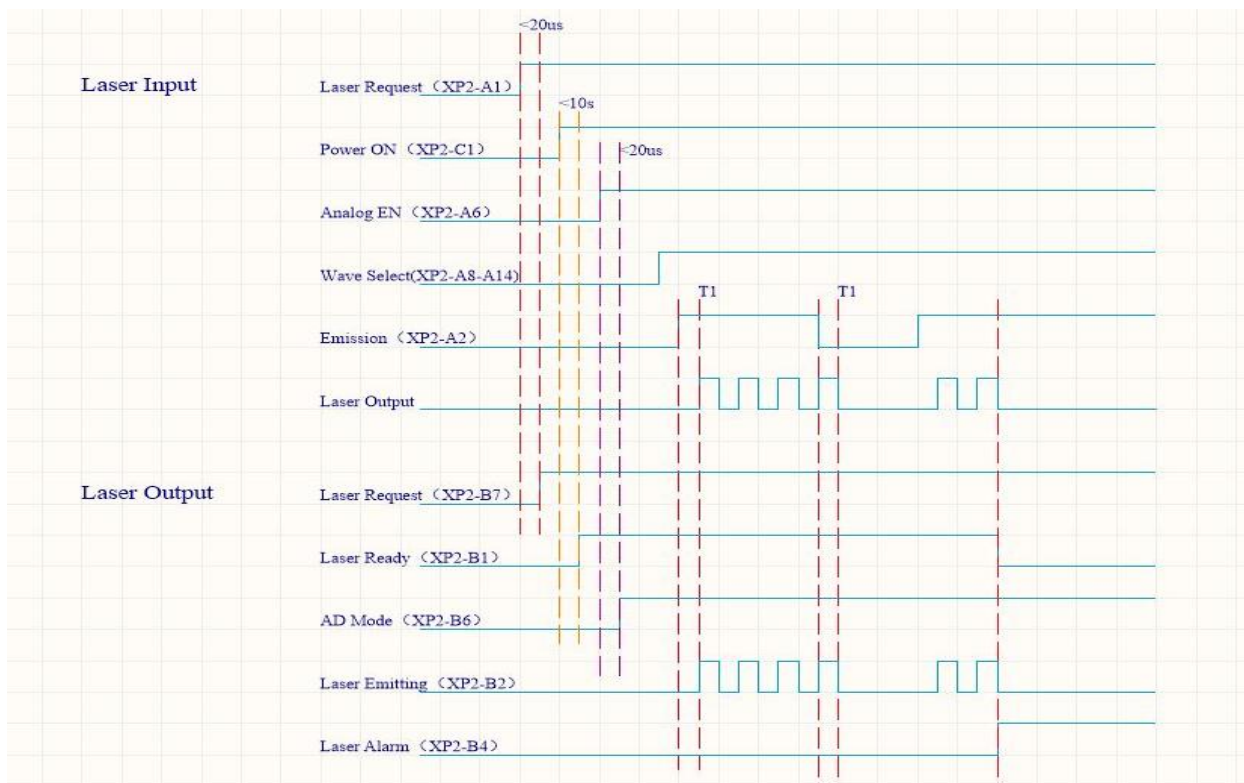


Figure 22 Optical control logic in programming mode

## 8. RS232 and INTERNET communication command

### 8.1 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

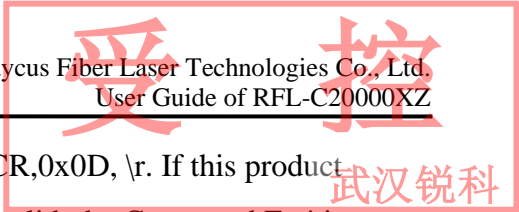
Laser port :10001

### 8.2 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 11.

Table 11 Specific Protocol Contents and Command Examples of Laser

Command	Description	Command example
ABF	Aiming Beam OFF –Turn off red	Send: ‘ABF\r’ Return: ‘ABF\r’
ABN	Aiming Beam ON – Turn on red	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	EnableHardwareEmissionControl	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' 'ERR: Duty Cycle too Low\r' 'SPW:100, Duty=100%\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 is 10Hz)
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'
RIP	Read IP	Send: 'RIP\r' Return: 'RIP:192.168.0.10\r'

RMASK	Read Subnet Mask	Send: 'RMASK\r' Return: 'RMASK:255.255.255.0\r'
SIP	Set IP	Send: 'SIP 192.168.0.10\r' Return: 'SIP:192.168.0.10\r'
SMASK	Set Subnet Mask – Set the subnet mask to attach a string with "." Decimal digits	Send: 'SMASK 255.255.255.0\r' Return: 'SMASK:255.255.255.0\r'
SIP	Set IP – For setting the IP address, attach a string "."Decimal digits	Send: 'SIP 10.0.0.231\r' Return: 'SIP:10.0.0.231\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'
	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):	
STA	Bit 0	normal operation Send: 'STA'



	Authorization time	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 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-modual 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
		Serge 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

**9. PC software instructions**

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



## 9.1 Maininterface of PC software

The PC software’s main interface shows as Figure 23.

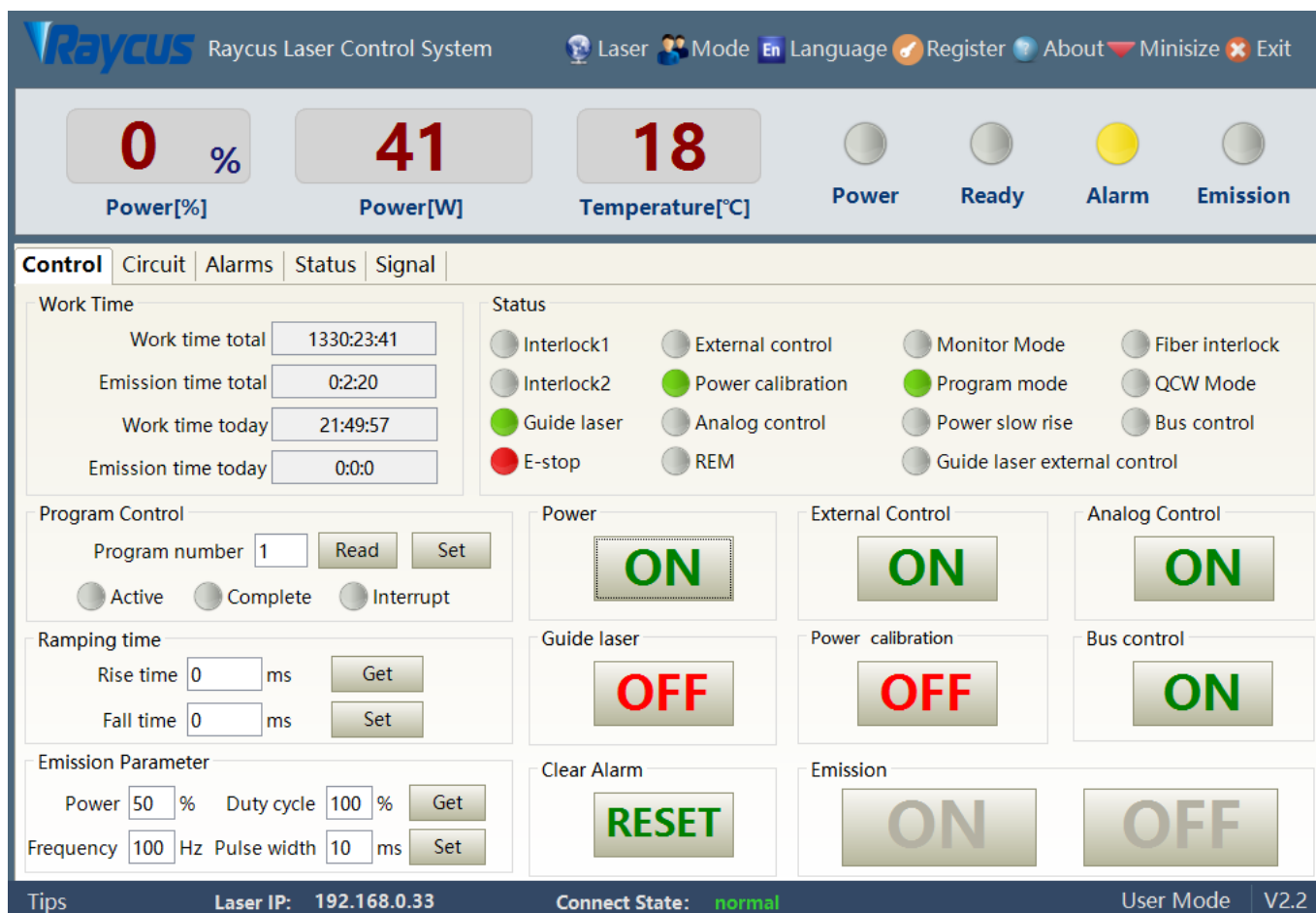


Figure 23 PC software display main interface

## 9.2 Multi-laser control area

Multi-laser control area is as Figure 24

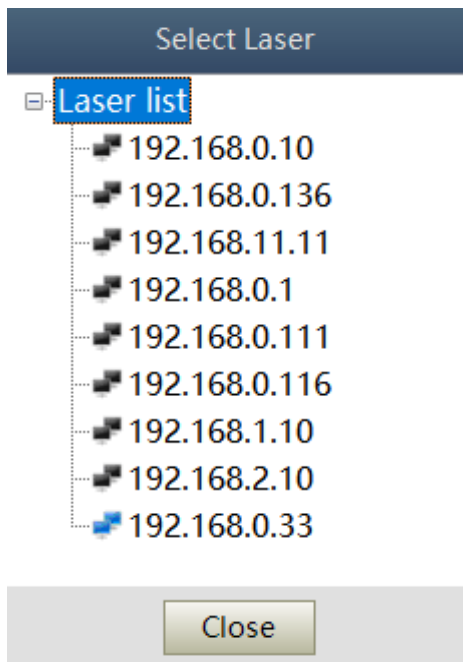


Figure 24 Multi-laser control area interface

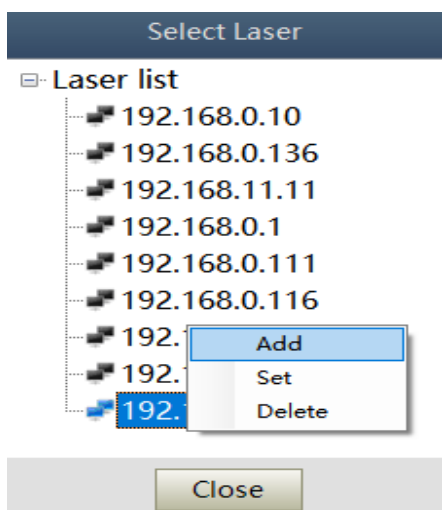
Select IP address of corresponding laser, then double click. PC software will take communication with selected laser. After the communication established, the lower left status display shows that the network connection is ok, as Figure 25.



Figure 25 communication status interface between PC software and laser

### 9.1 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 26.



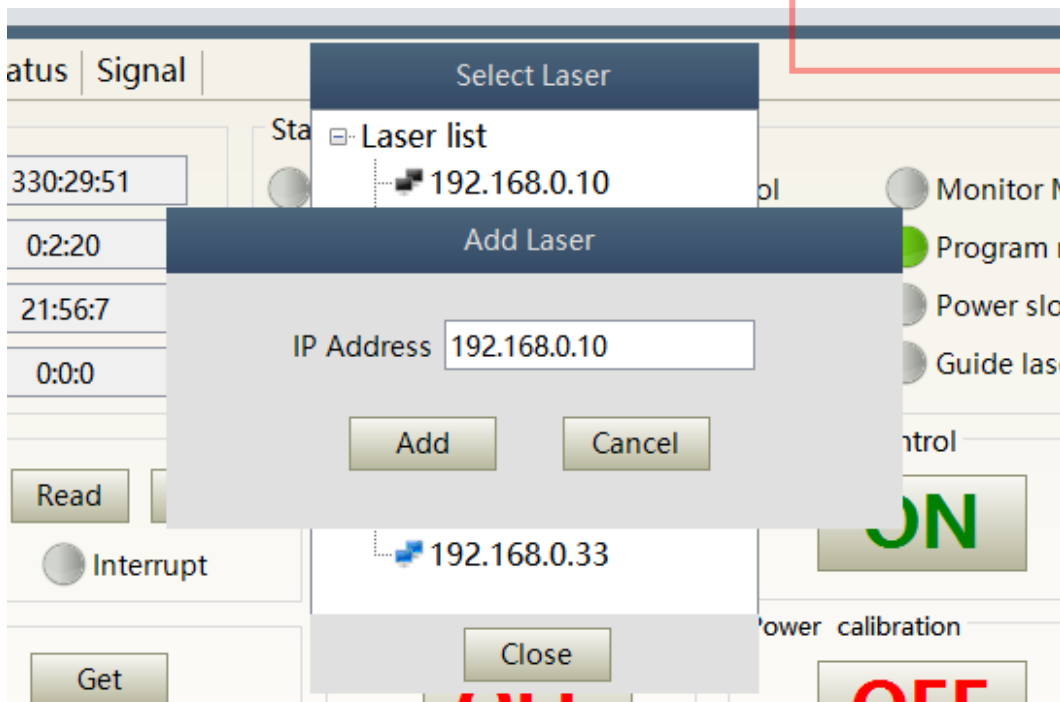
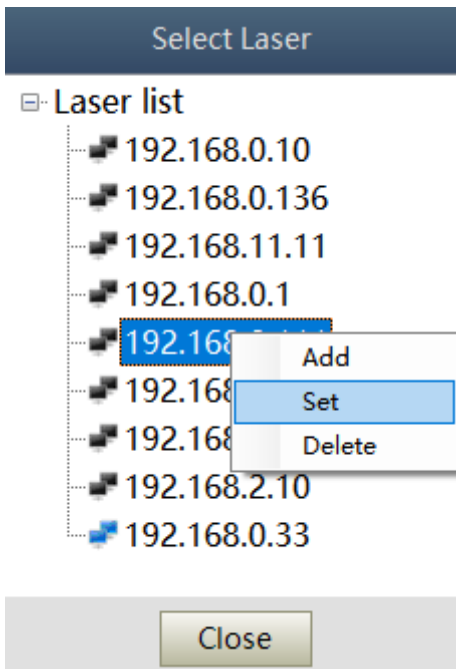


Figure 26 Procedure for adding a laser to the PC software

## 9.2 Modify laser IP

After the laser connection has established, select the IP address of current laser and right-click to set it up as Figure 27.





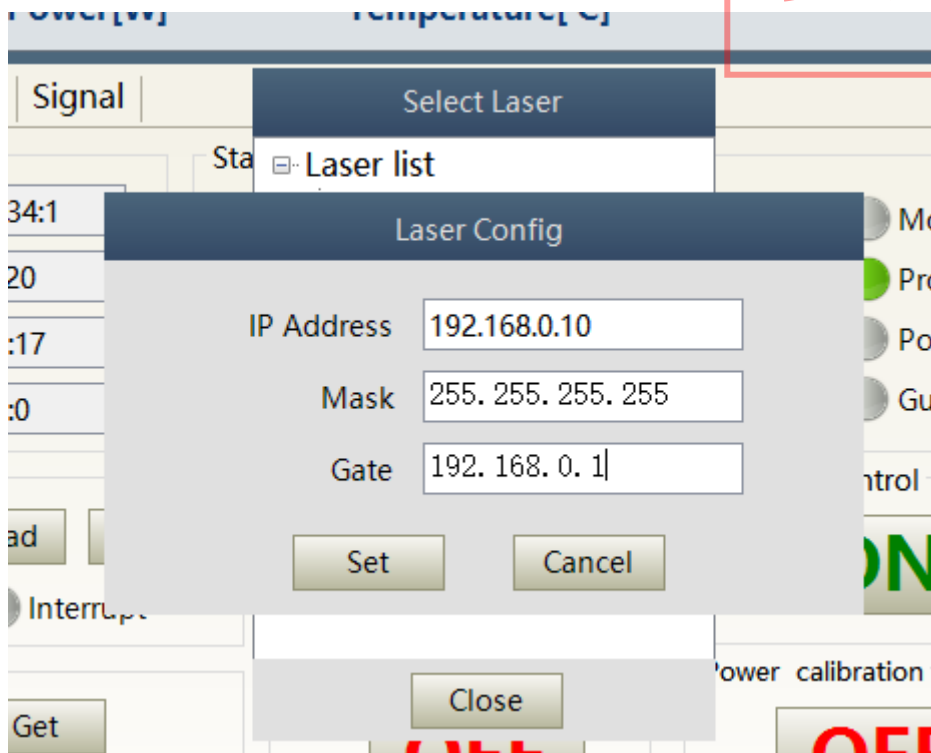


Figure 27 Modify the IP address of laser

### 9.3 Main working status display

The laser's main status display is as Figure 28, Table 12.

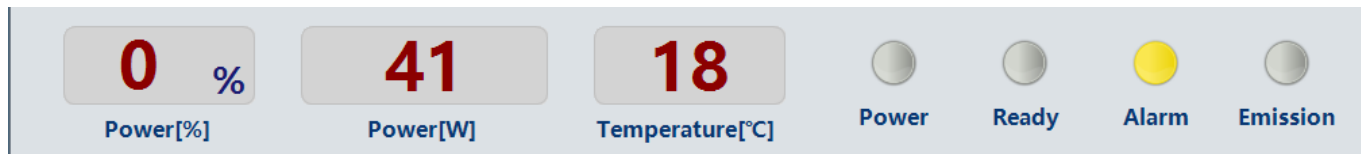


Figure 28 A diagram of the laser's main display area



Table 12 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

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

The laser’s cumulative operating time display is shown in Figure 29. 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.

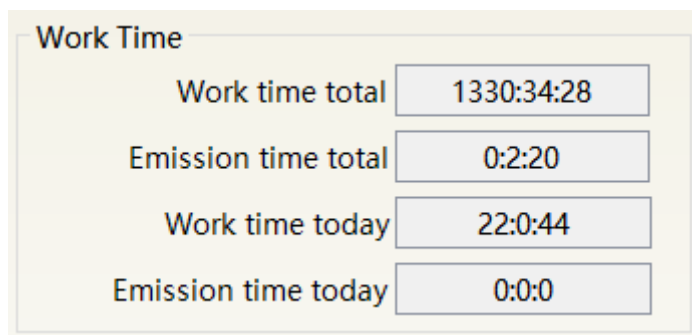


Figure 29 Laser cumulative operating time display interface

### 9.3.2 Laserworkingstatusdisplayarea

The laser working status display area is as Figure 30, Table 13.

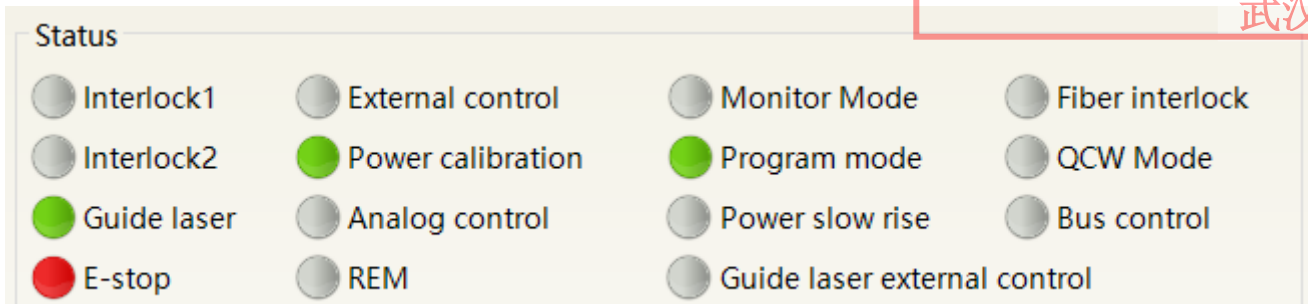


Figure 30 A diagram of the laser's working status display area

Table 13 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 17,18 on safty interface make Gray: XP2 leg 17,18 on safty interface break
InterLock2 make	Green: XP2 leg 19,20 on safty interface make Gray: XP2 leg 19,20 on safty 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



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

Laser power-up, mode selection, light out control display area is as in Figure 31, the display content is as in Table 14.

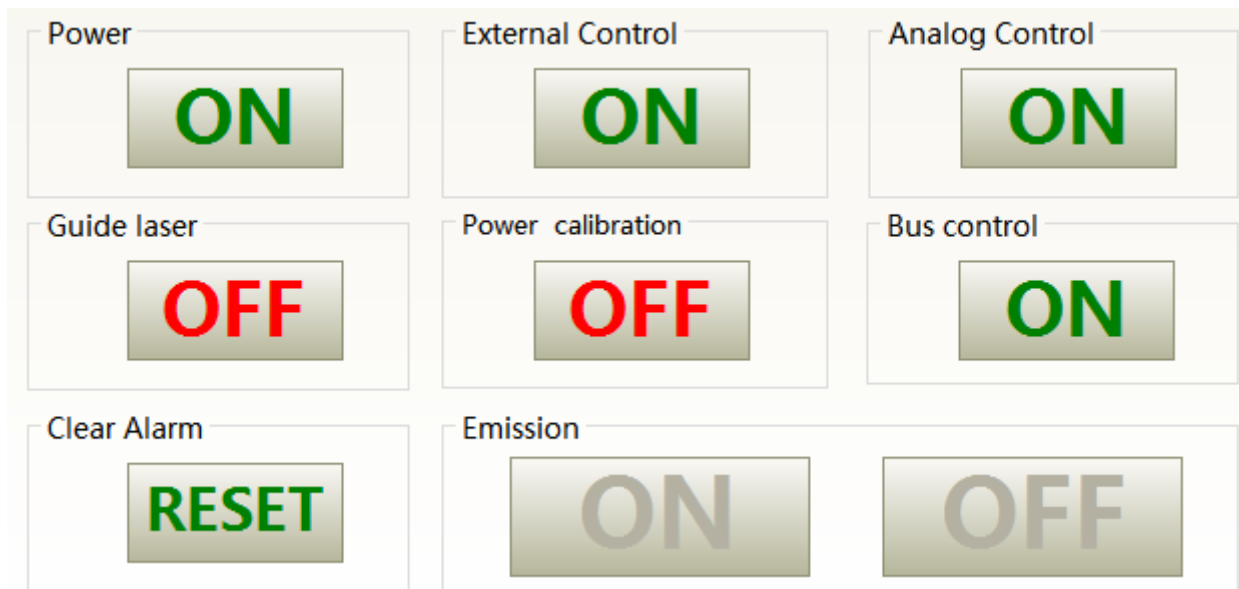


Figure 31 Laser power-on, mode selection, light out control display area

Table 14 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 beam 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

### 9.3.4 Programming mode test area

The laser programming mode test area interface is as Figure 32, in which the ‘START’ button is used to test the waveform of the programming mode. This function can only run internal mode (when external mode is turned off). Enter the current pre-tested waveform number in the digital text box and click the START button.

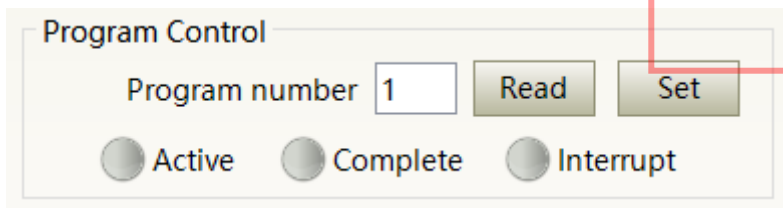


Figure 32 Laser programming mode test area display interface

### 9.3.5 Power slow rise&down parametersettingarea

The interface of the laser power slow rise & fall parameter setting area is as Figure 33. 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.

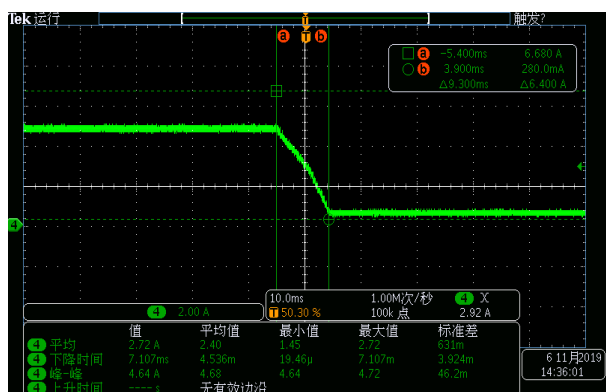
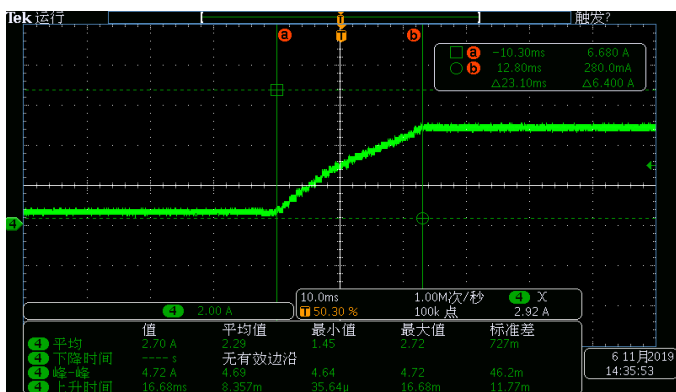
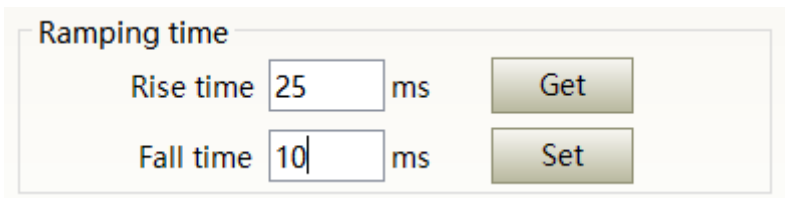


Figure 33 The power slow rise and fall setting area interface and measured waveforms

### 9.3.6 Laser output parameters read the settings area

Laser output parameter setting interface is as Figure 34. The output parameter setting is not valid when AD mode is on.

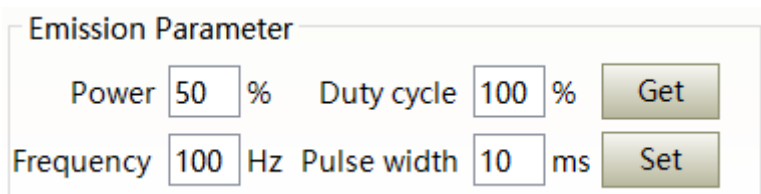


Figure 34 Laser output parameter setting area display interface



### 9.4 Laserparameterdisplayarea

The display interface for laser parameter display area is as Figure 35. 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 actually running in the current laser.

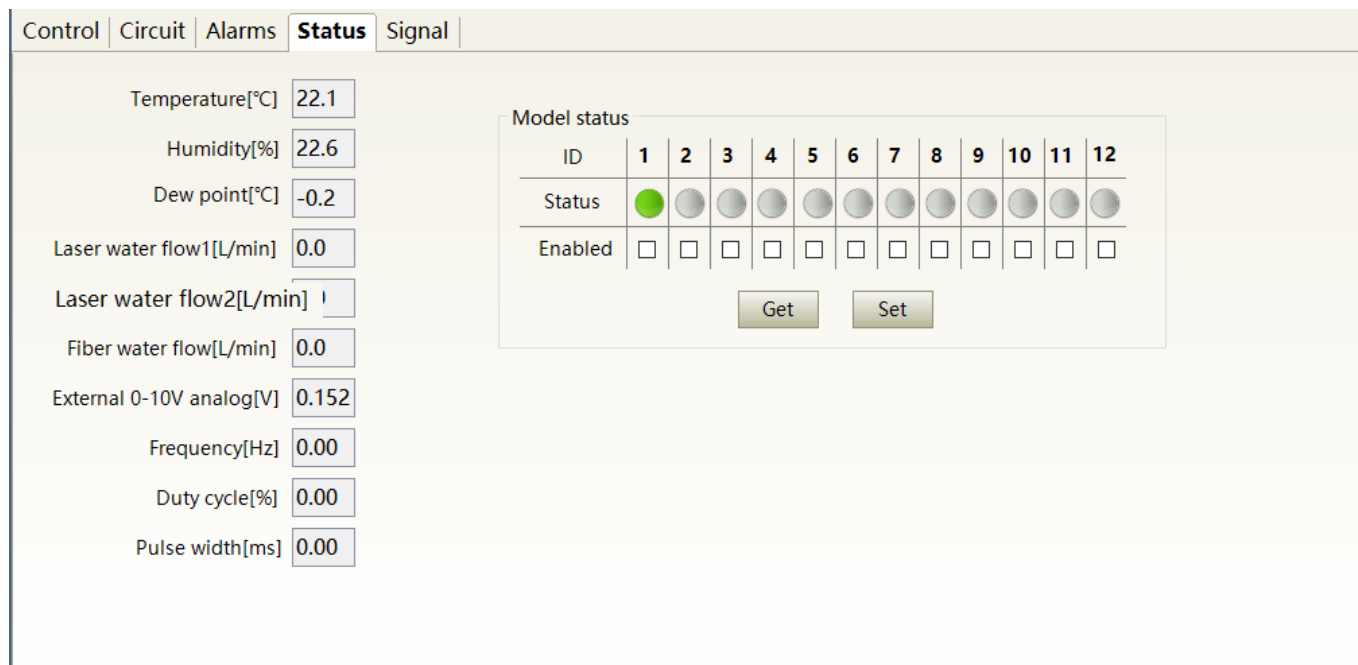


Figure 35 Laser parameter display area display interface

### 9.5 Alarm type display area

The laser alarm type display area interface is as Figure 36. This interface shows the cause of the alarm for the current laser.

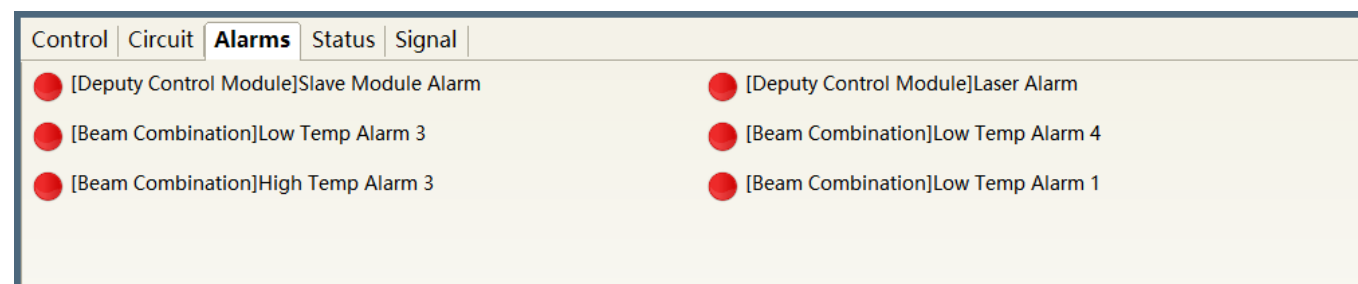


Figure 36 Laser alarm type display area interface

### 9.6 PC softwareoperatingmodeselection

The laser operating mode is set by the PC software. Its operating interface is as Figure 37. The interpretation of the various patterns can be found in Table 15. The waveform editing interface is displayed on the software only when programming mode is selected.

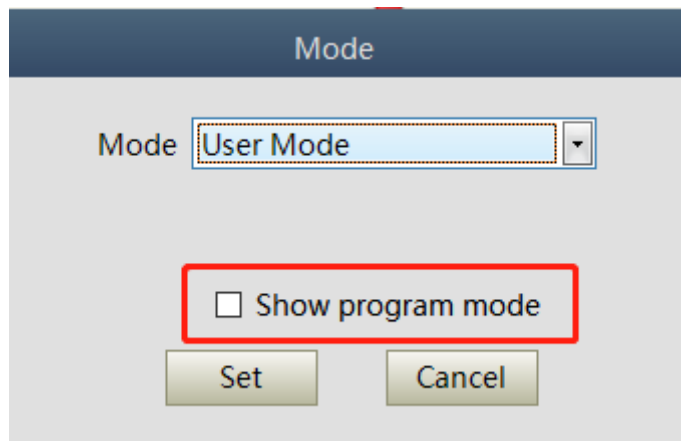
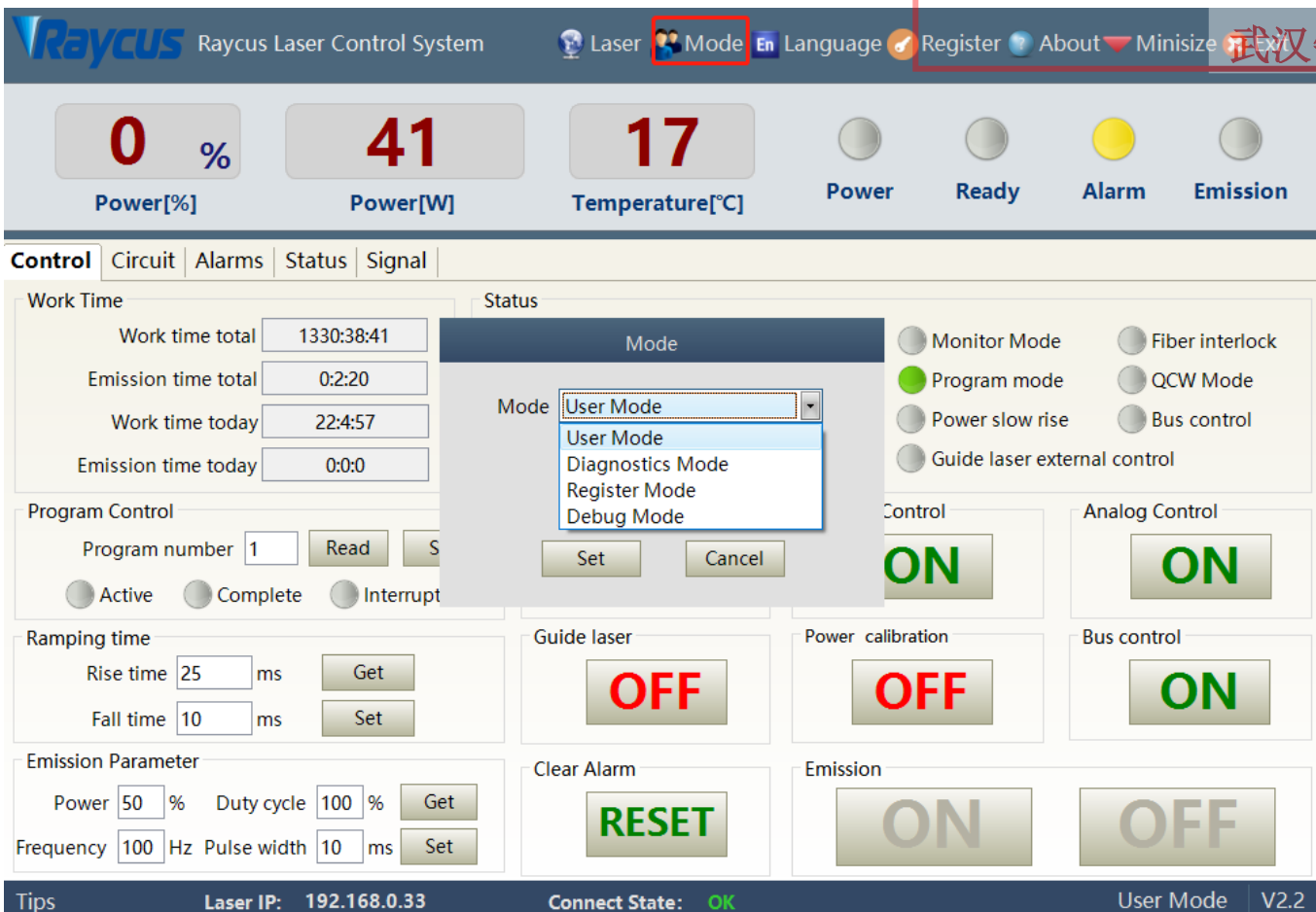


Figure 37 Laser operating mode selects the display area interface

Table 15 Laser operating mode and explanation

Mode selection	Mode explanation
User mode	A concise software interface
Diagnostic mode	Displays laser's all 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)



## 9.7 Language

Laser's language selection interface is as figure 38. User can choose between chinese simplified and English by click 'setting language'. Setting effective after PC software restarted.

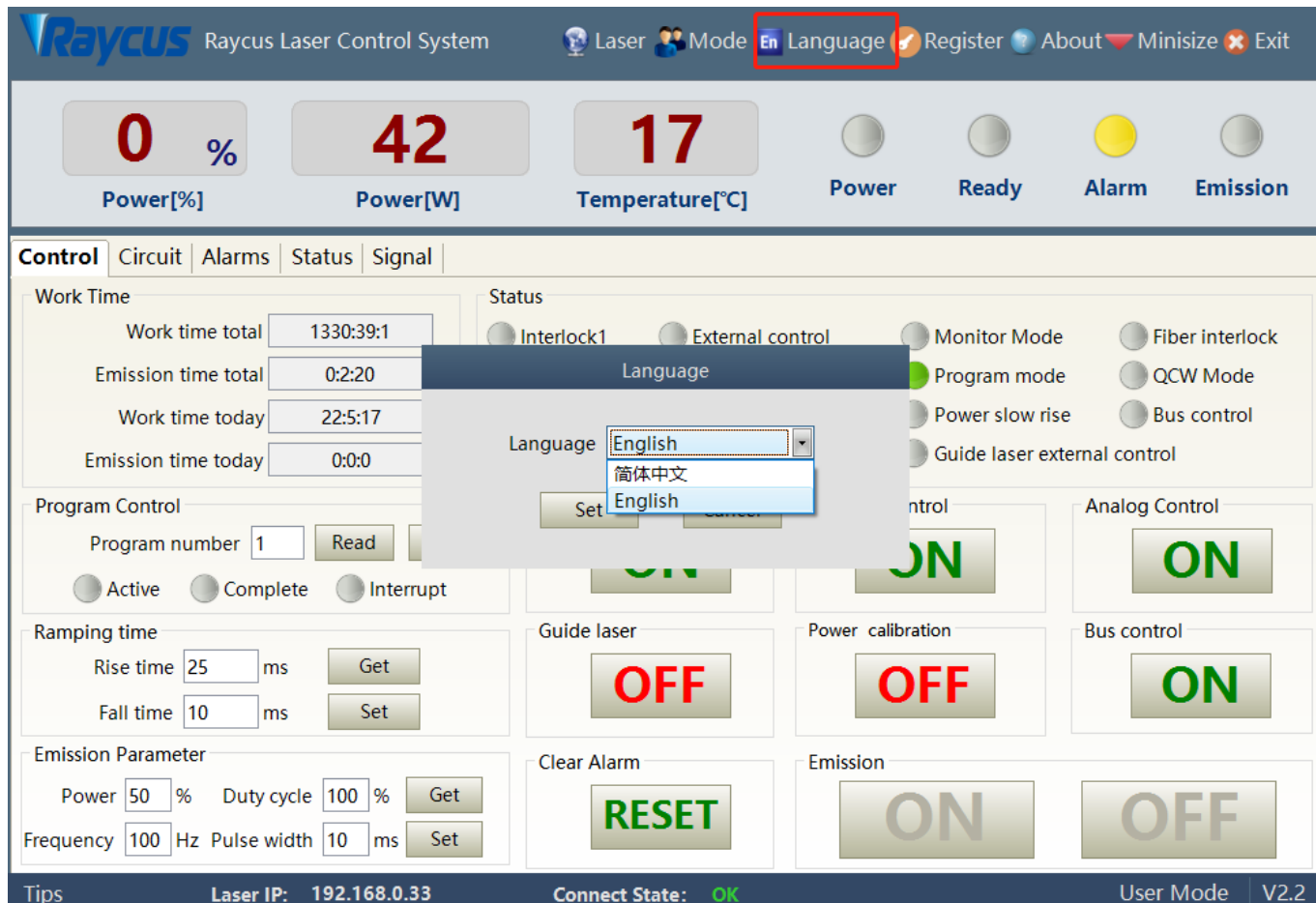


Figure 38 Language selection interface

## 9.8 Authorization (time-limited locking)

### 9.8.1 Authorization in user mode

The authorization settings in user mode are as Figure 39. Laser can be locked and unlocked by valid authorization code.



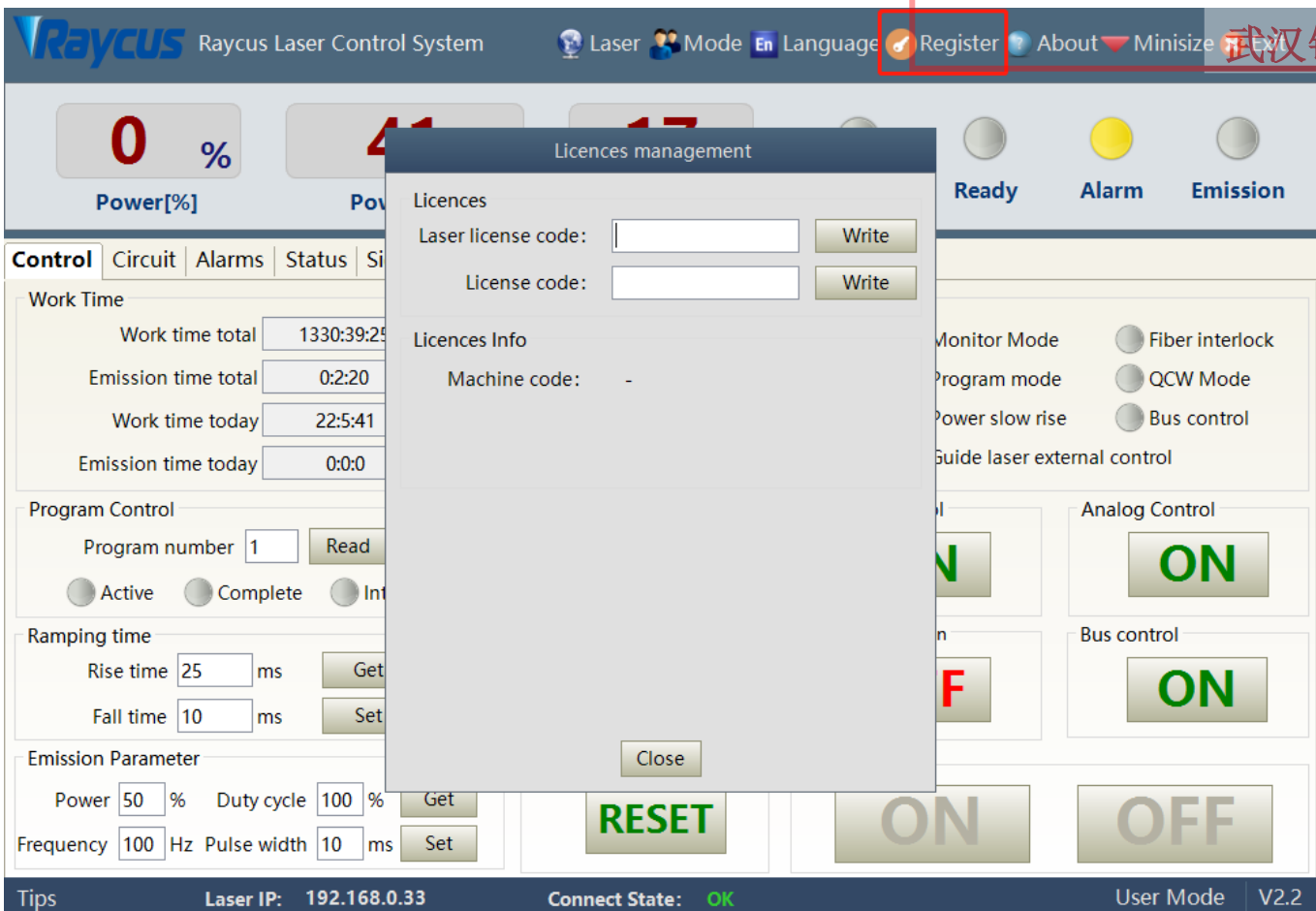


Figure 39 The authorization settings operating interface in user mode

### 9.8.2 Authorization in authorization mode

The authorization settings in laser authorization mode are as Figure 40. 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. For example, the locking time: May 21, 2020, indicating that the laser is locked until 0:00 on May 21, 2020. 0/0/2000 means the laser is permanently unlocked.
- 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:  Set

Terminal password:   Set

Licences code: - Generate Code

Close

Figure 40 Authorization settings operating interface in authorization mode

### 9.9 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 as Figure 41.

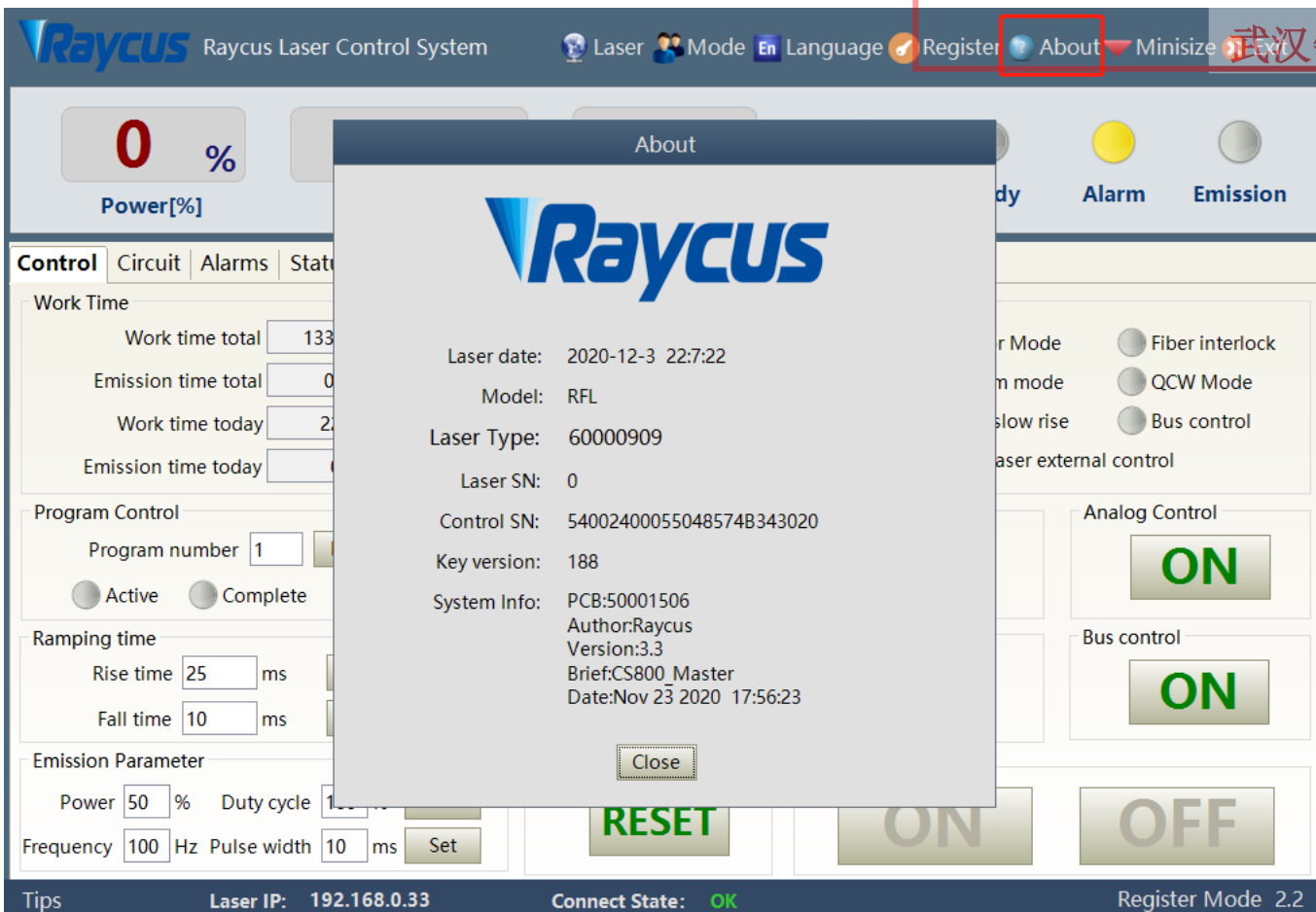


Figure 41 Laser relevant information query interface

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

The laser interface status indicator interface is as Figure 42. It is convenient to view the interface status information which represents the input and output status of the XP1 interface on the back panel.

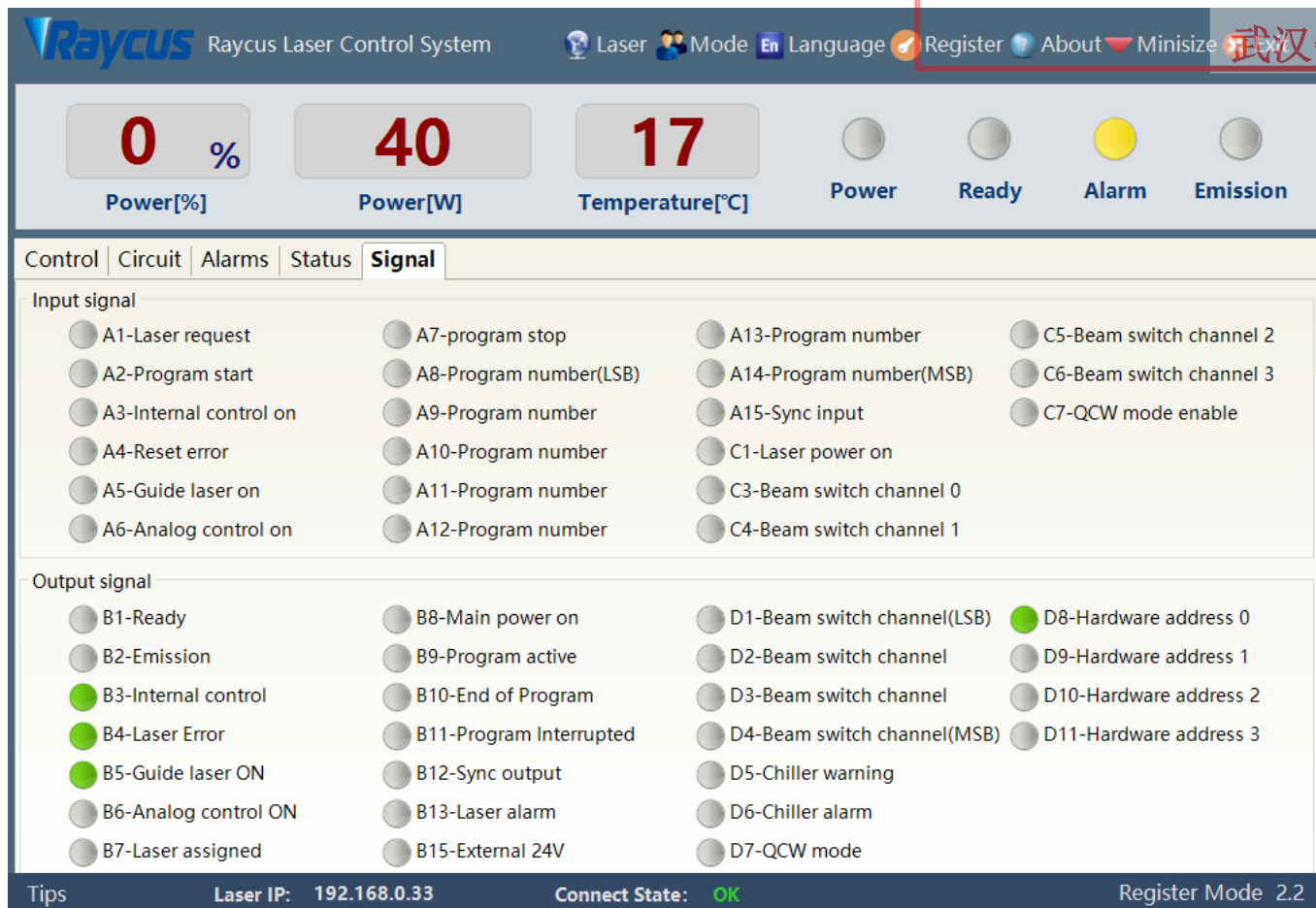


Figure 42 The interface status in diagnostic mode

### 9.11 Log (in diagnostic mode)

Laser's working log interface is as Figure 43. User can query work log by entering the time to query and click on the 'search' button.

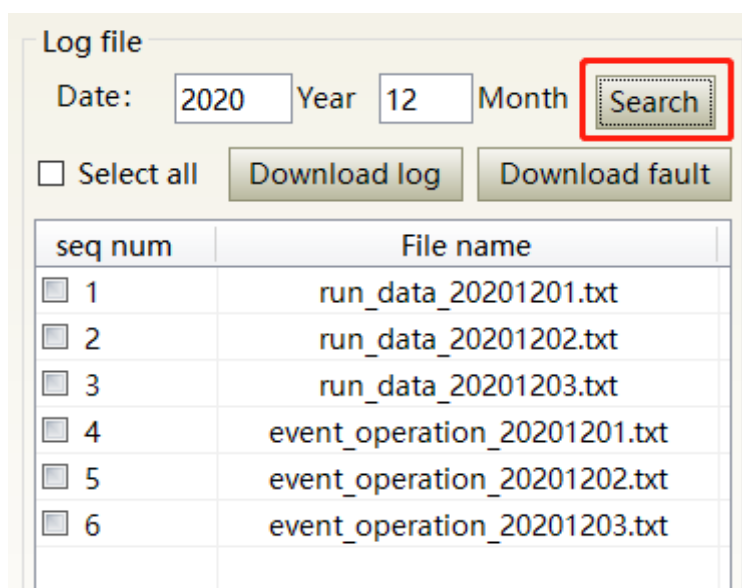


Figure 43 Laser's working log interface



### 9.11.1 Download log

Log download interface is as Figure 44.

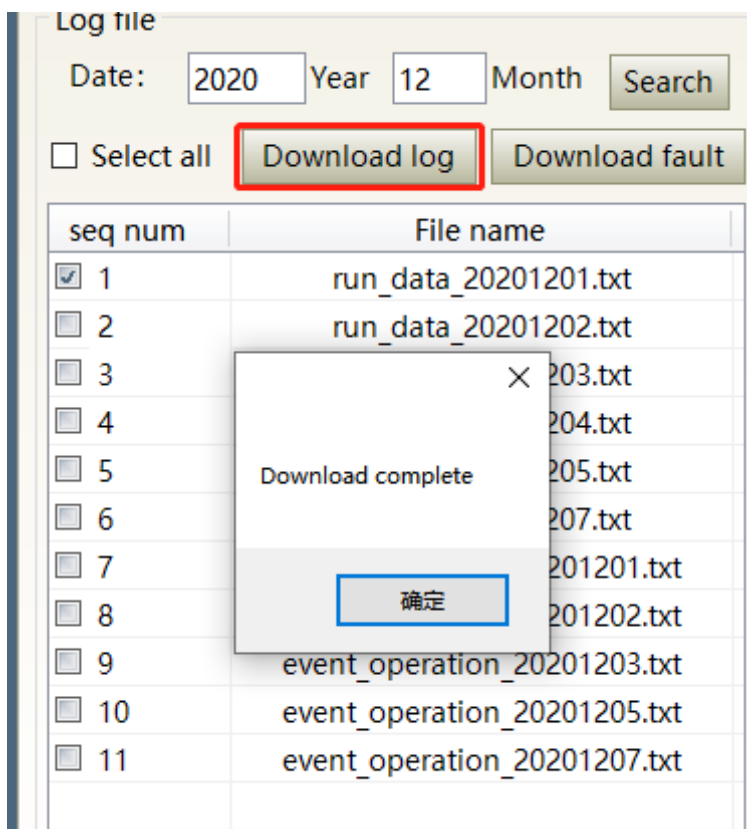


Figure 44 Log download interface

### 9.11.2 Download record of historical fault

Historical fault record download interface is as Figure 45.

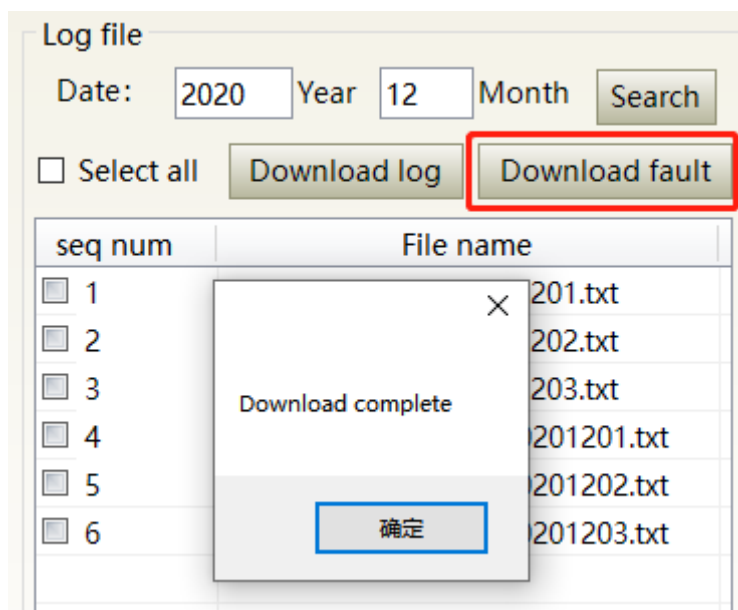


Figure 45 Historical fault record download interface



### 9.11.3 Downloaded file address

The file address query interface for all download information is as Figure 46.

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 46 The file address query interface for all downloaded information

### 9.12 Module parameters (in diagnostic mode)

Laser module parameter query interface is as Figure 47. The interface is for the parameter query in diagnostic mode from which Raycus technicians can analyze the cause of laser anomalies.

Parameter	Value
Power set voltage[V]	0.000
Power monitor 1[V]	0.000
Power monitor 2[V]	0.000
Laser Alarm times	0
Emission monitor 1[V]	0.000
Emission monitor 2[V]	0.000
Temp monitor 1[°C]	17.0
Temp monitor 2[°C]	0.0
Temp monitor 3[°C]	0.0
Temp monitor 4[°C]	0.0
Feeding fiber temp[°C]	0.0
Mcu version	0.0
Scatter 1[V]	0.000
Scatter 2[V]	0.000
Scatter 3[V]	0.000
Scatter 4[V]	0.000
Scatter 5[V]	0.000
CPLD version	0.0

Figure 47 Module parameters query interface in diagnostic mode

### 9.13 Programming settings (waveform editing)

The laser programming settings interface is as Figure 48.

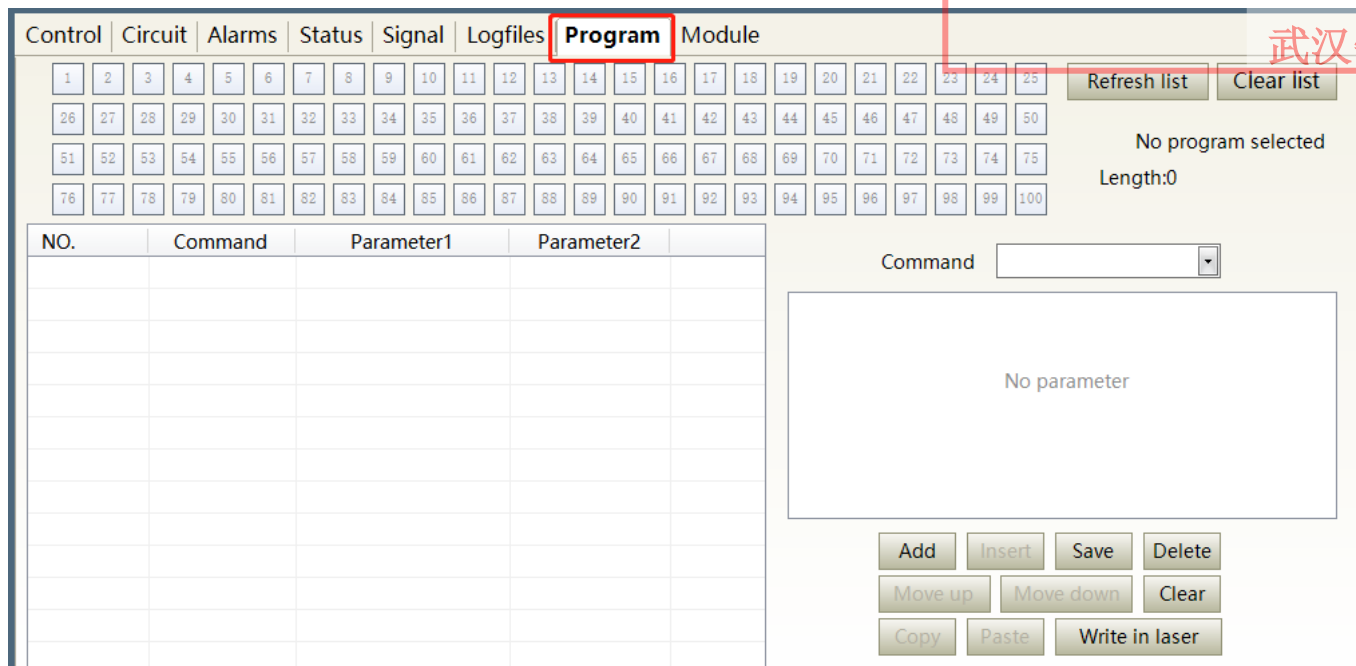
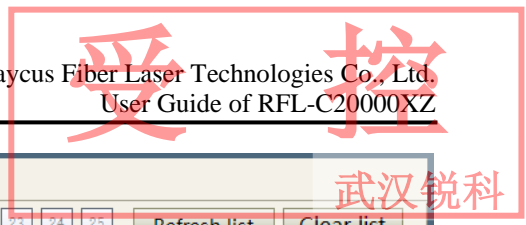


Figure 48 The programming interface in waveform editing mode

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

Operating interfaces of view the number of wave bar stored inside the current laser is as Figure 49. The software automatically lists the number of wavelength bars that have been saved by click on the ‘Refresher List’ button. Green indicates the bar already has a program and white indicates that the bar is empty.

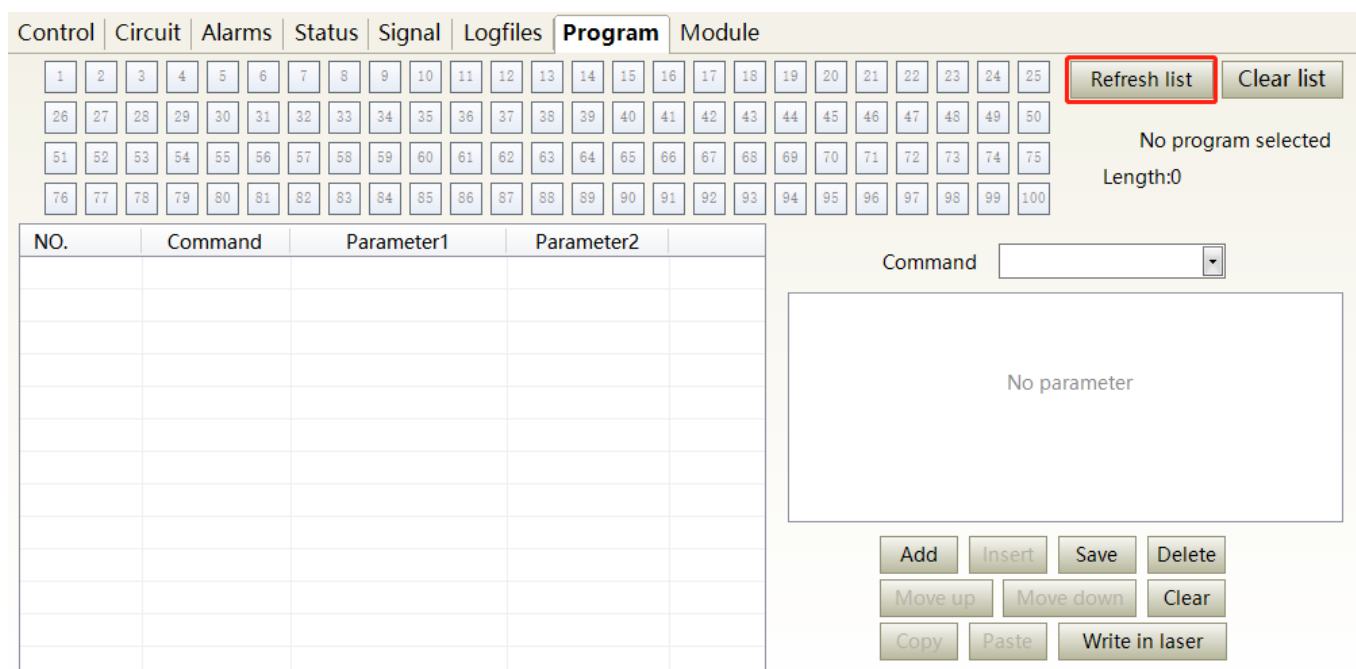


Figure 49 operating interfaces of wave bar stored inside the current laser



### 9.13.2 Check waveform content

To check the waveform contents in the current laser waveform mode is as Figure 50. The program automatically lists the original waveforms by click the waveform number that needs to be checked.

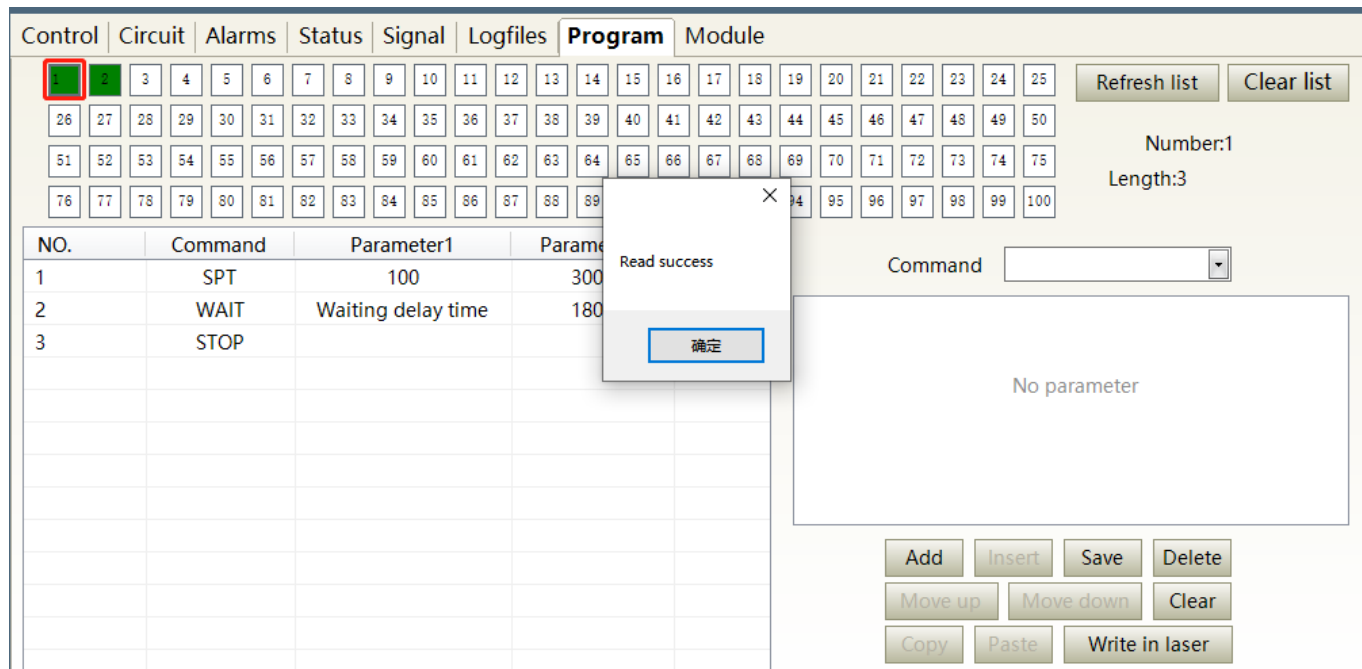


Figure 50 Waveform content interface in the current laser waveform mode

### 9.13.3 Empty all waveforms

Empty all waveform interfaces stored in the current laser waveform mode is as Figure 51. All waveforms stored inside the current laser. will emptied by click 'Empty Program List'.

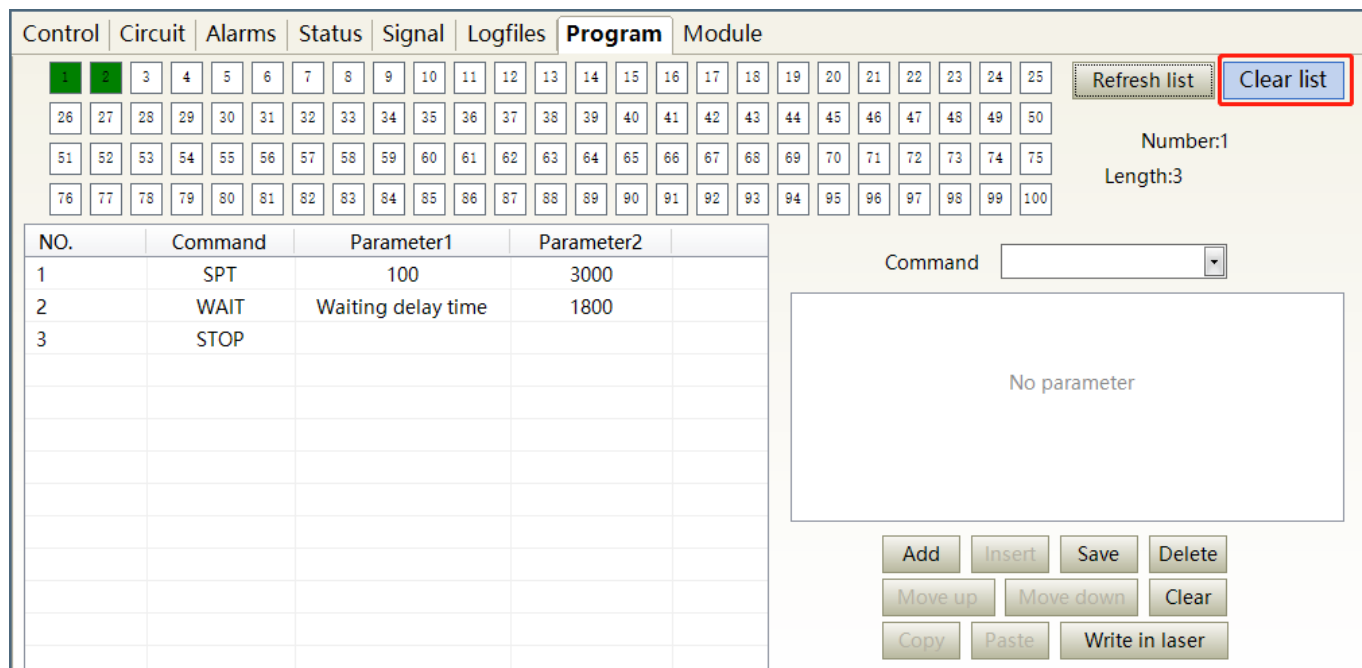


Figure 51 Interface of empty all waveform stored in the current laser waveform mode





### 9.13.4 Edit waveform

Waveform editing when the laser is working in waveform mode is as Figure 52.

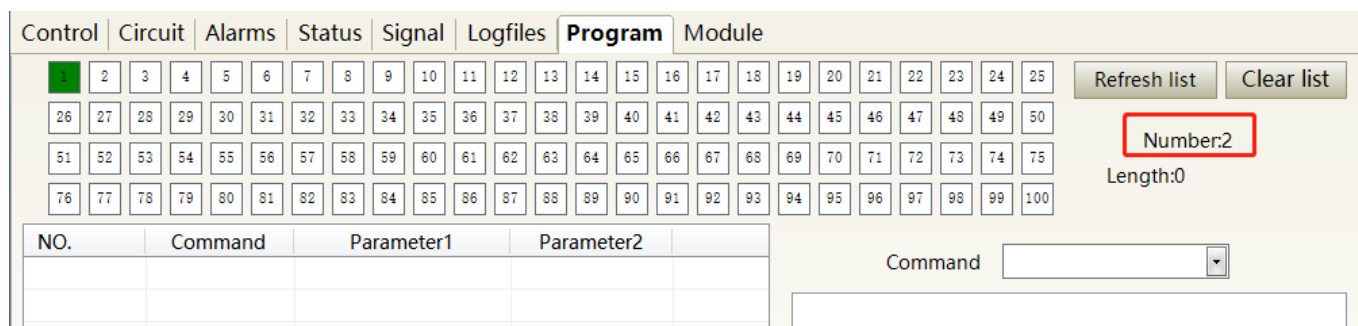
Step 1:left click the pre-edited waveform number.

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

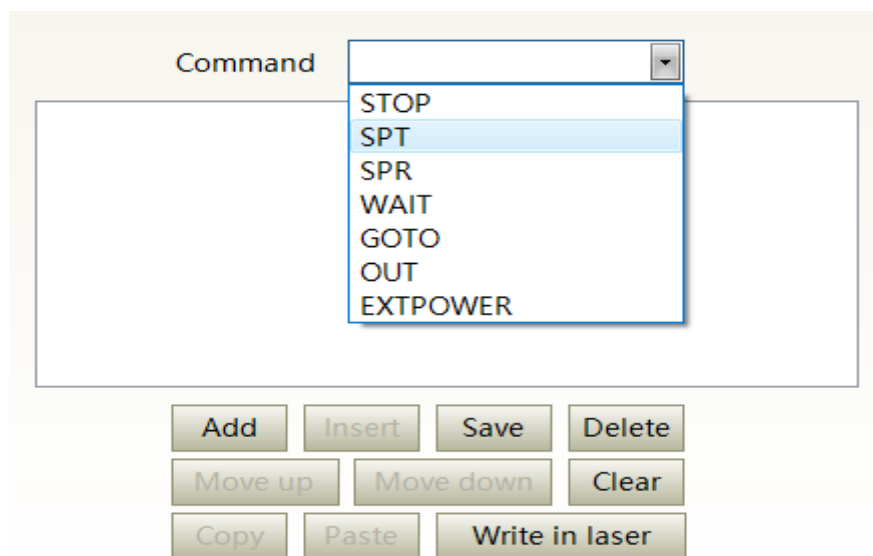
Step 3:enter the parameters and click ‘Save’. The instruction appears in the left program list immediately.

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

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



a) Select the pre-edited waveform number



Command SPT

Time 1000 [ms] 1-65000

Power 2000 [W] 0-65000

Add Insert Save Delete

Move up Move down Clear

Copy Paste Write in laser

b) add command type

NO.	Command	Parameter1	Parameter2
1	SPT	1000	2000

Command

Time [ms] 1-65000

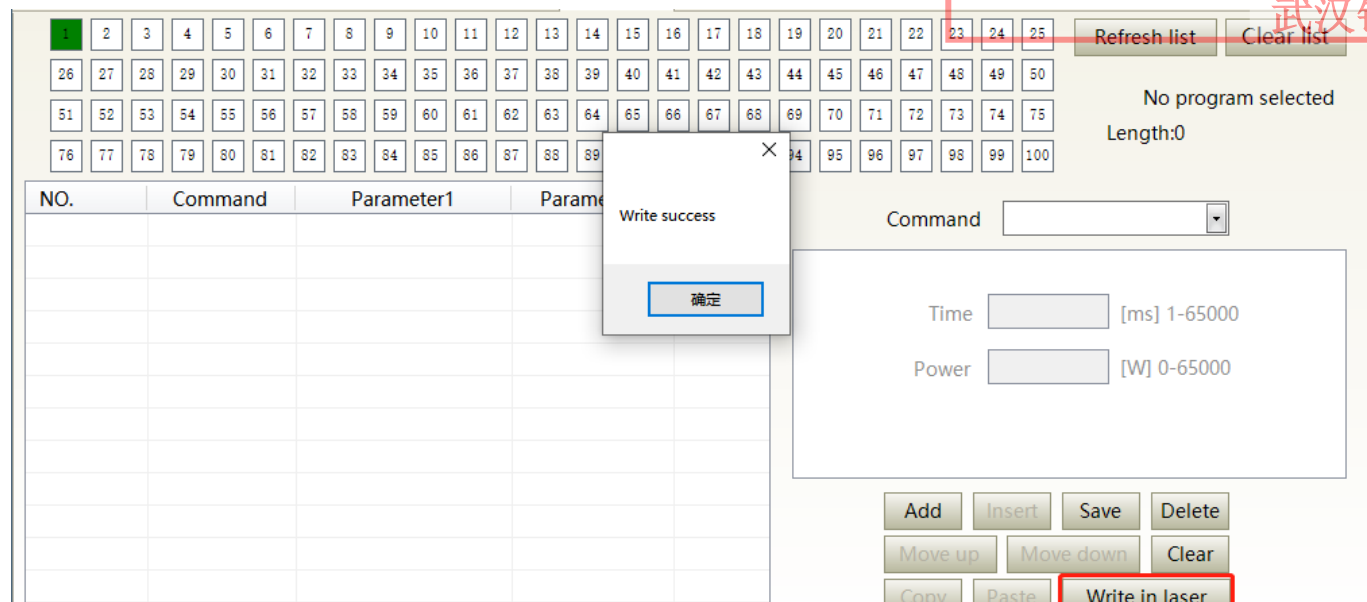
Power [W] 0-65000

Add Insert Save Delete

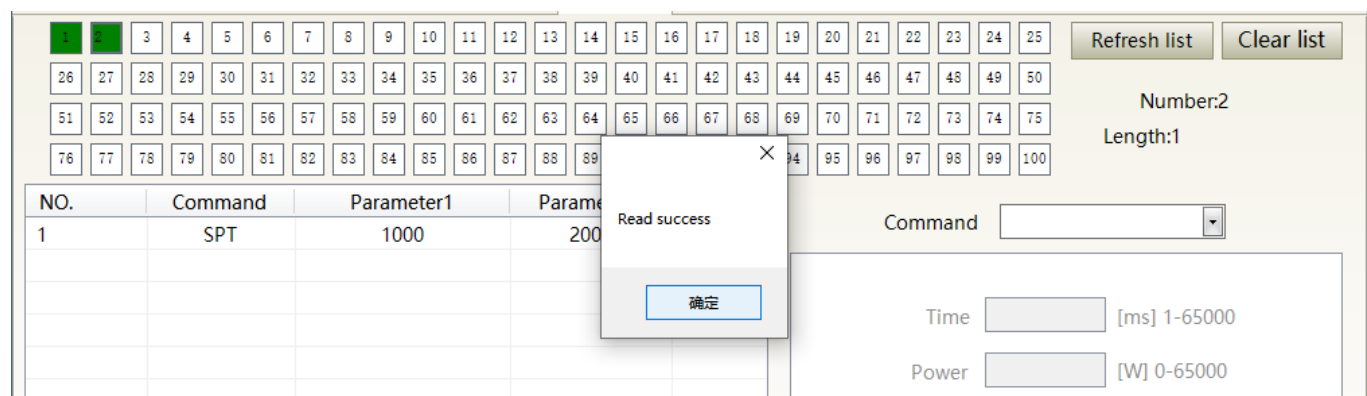
Move up Move down Clear

Copy Paste Write in laser

c) save command



d) type the command code into laser



e) check effectiveness of instruction

Figure 52 A diagram of the waveform editing operation in waveform mode

### 9.13.5 Command explanation

Command meaning in laser working status is as Table 16.



Table 16 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	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				



## 10. Warranty, Repair and Return

### 10.1 General Warranty


After all the lasers manufactured according to the standard or non-standard model production documents are shipped, Raycus guarantees the products with material and technical problems and guarantees that they meet the specifications under normal use.

Raycus has the right to selectively repair or replace any product that has a material or technical problem during the warranty period. All products repaired or replaced during the warranty period only provide free warranty services for products with special problems. Raycus reserves the right to collect payment for products that have problems under normal use.

### 10.2 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 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><b>WARNING:</b>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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### 10.3 Service and Repair

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.

Please contact Raycus as soon as possible when problems under warranty about maintenance happened to the product.

The product returned with permission should be placed in a suitable container.

If any damage happened to the product, please notify the carrier in document immediately.

Raycus 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 within warranty and service above provided by Raycus are for uses' reference; formal contents about warranty and service are subject to the contract.

Information contained in this document is subject to change without notice.

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