RFL-C12000S-HP

Continuous-Wave Fiber Laser

User Guide

Wuhan Raycus Fiber Laser Technologies Co., Ltd.

TABLE OF CONTENTS

1. Safety Information

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

1.1 Symbols Used in this User Guide

	◆ WARNING: Refers to a potential hazard that may leads to a personal injury or death.

	◆ CAUTION: Refers to potential a hazard that may leads to general personal injury or product damage.

1.2 Laser Classification

This series of lasers are classified as a high power Class 4 laser instrument according to the European Community standards EN 60825-1, clause 9. This product emits invisible laser radiation at or around a wavelength of 1080 nm, and the total power radiated from the laser is greater than 12000W (depending on model). Direct or indirect exposure of this level of light intensity may cause damage to the eyes or skin. Despite the radiation being invisible, the beam may cause irreversible damage to the retina and/or cornea. Appropriate and approved laser safety eyewear must be worn all the time while the laser is operating.

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

1.3 Safety Labels

The position of the safety labels on products varies depending on the model of the continuous-wave fiber laser, as shown in Figure 1:

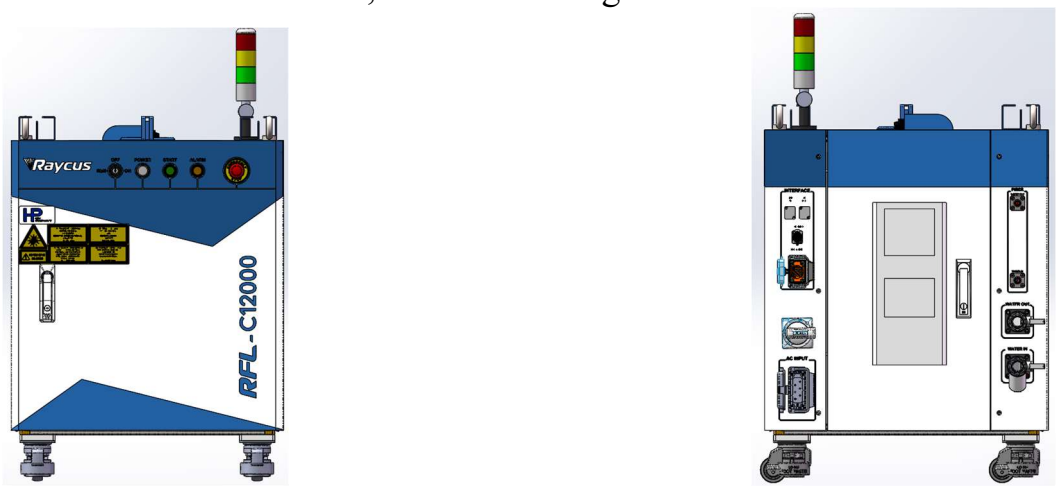
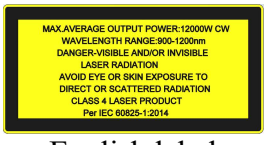
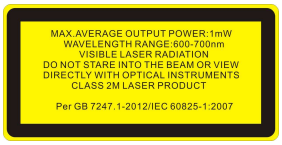
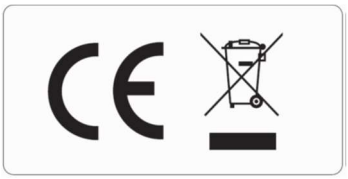


Figure 1 Safety Label Locations of RFL-C12000S-HP

These safety labels include warning labels, apertures through which laser radiation is emitted and labels of certification and identification, etc. Specifications of these labels are as follows:

Table 1: Specifications of Safety Labels

 English label  Chinese label	 English label  Chinese label	 English label  Chinese label
1.Aperture Label	2.Class 4 Laser Product	3.Class 2M Laser Product Label for Guide Laser

		
4. Identification Plate	5.Laser Radiation Hazard Label	6.Electrical Hazard
		
7. CE Compliance		

1.4 Optical Safety

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

	◆ CAUTION: If the output of the device is delivered through a lens with an anti-reflection coating, make sure that the lens is of good quality and clean.

1.5 Electrical Safety

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

	◆ WARNING: Any interruption from the protective earth will electrify the enclosure, which may result in personal injury.

b) Make sure that the correct voltage of the AC power source is used.

	◆ CAUTION: Failure to connect the correct voltage could damage the product.

1.6 Other Safety Rules

a) Never look directly into the laser output port when power is supplied to the laser.

b) Avoid using the laser in a dim or darkened environment.

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 operator serviceable parts inside, and all maintenance must be performed in Raycus or by qualified Raycus personnel. Do not try to remove covers, or electrical shock may be caused, and warranty will be void.

2 Product Description

2.1 Features

Compared with traditional lasers, Raycus CW fiber laser has higher efficiency electric-optical conversion, lower power consumption and excellent beam quality. The fiber laser is compact and ready to use. It can be used as a stand-alone unit or easily inserted into user's apparatus.

Main Features:

a) Excellent beam quality
b) High quality fiber output
c) High Power Stability
d) Continuously tunable output power, quick switching response
e) Slow rise and slow fall, Waveform editing
f) Maintenance free operation
g) High wall plug efficiency

Applications:

a) Cutting, Welding
b) 3D Printing

c) Scientific research

2.2 Package Contents

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

2.3 Unpacking and Inspection

Raycus CW fiber laser is shipped in a package designed to provide maximum protection. Upon delivery, please inspect all packaging for evidence of mishandling or damage. If you find any evidence of mishandling, please save the damaged material and contact the shipping agent and Raycus immediately.

Remove all the contents from the packing case. Take extra care when removing the unit out of the packing case to ensure that the fiber optic cable is not twisted, hauled or damaged. A comprehensive packing list is included with the system documentation. Check all items against the list and contact Raycus immediately if there is any missing item or evident damage to the unit. DO NOT attempt to install or operate the laser, if there is any evident or suspected damage to the unit.

It is recommended to keep the packing materials, as they will be necessary if you ever need to ship the unit back for service at a later date.

	◆ CAUTION: The fiber optic cable and output head is precise optic instrument, any vibration or impact to the output head, and twist or excessive bend to the cable will damage the instrument.

2.4 Operation Environment

The basic operation conditions are listed in the table below:

Table 2 Basic Operation Conditions for the Laser

Model	RFL-C12000S-HP
Supply Voltage(V)	380V AC 50/60Hz
Supply Capacity(kW)	38
Installation Requirements	Install on flat surface, no vibration or impact
Ambient Temperature(℃)	10~40
Relative Humidity(%)	10~90

Warning:

a) Ensure reliable grounded before using the laser.

b) The laser output is connected to the output cable. Please check the laser output carefully to prevent dust or other contamination. Use special paper when cleaning the laser output lens.

c) If the laser is used in accordance without the method specified in this manual, the laser may be in abnormal working state and cause damage.

d) It is strictly forbidden to install the laser output when the laser is in operation.

e) Do not look directly into the laser output. Be sure to wear protective glasses when operating the laser.

	◆ Do not expose this product to high humidity（＞95%） ◆ Do not let this product work below the ambient dew point temperature.(see Table 3)

Table 3 The Constant Dew Point Table

AMBIENT DEW POINT									
Room Temperature(℃)	Maximum Relative humidity								
	20%	30%	40%	50%	60%	70%	80%	90%	95%
20	-3.5	2	6	9	12	14.5	16.5	18	19
25	0.5	6	10.5	14	16.5	19	21	23	24
30	4.6	10.5	15	18.5	21.5	24	26	28	29
35	8.5	15	19.5	23	26	28.5	31	33	34
40	13	20	24	27.5	31	33.5	36	38	39
			Laser operating temperature range						

- Green area: The dew point temperature is 22℃that is lower than the laser cooling water temperature, which can be used safely;
- Red area: If the dew point temperature is higher than 22℃ and exceeds the laser cooling water temperature by 22℃, there must bedew condensation, and measures must be taken.
- Measure 1: Connecting clean and dry air from CDA port to reduce relative humidity, works for 10-15 minutes in standby mode;
- Measure 2: Installing cabinet air conditioner to reduce ambient temperature.

2.5 Precautions for Use

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

b) Failure to follow the instructions may cause malfunction and damage to the device, such damage is not covered by warranty.

c) It is very important to ensure the cleanness of the calibrated laser output head, otherwise it will cause irreparable damage to the laser.

d) Please inspect the output head carefully for dust or other contaminations. Use appropriate lens paper to clean it if necessary. Do not touch the output lens at any time; as well as remember to cap the output head when it is not in use, and make sure the cap is clean.

e) Failure to follow the specified instructions may result in the loss of laser power, and such loss will not be covered by the warranty.

2.6 Specifications

Table 4 Specifications

Number	Index	Standard value	Test Conditions
Fiber technical indicators			
1	Operation Mode	Continuous Wave / Modulated	Nominal Output Power
2	Polarization direction	random	
3	Nominal Output Power(W)	12100±100	Water Temperature 22±1℃
4	Emission Power Range(%)	10~100	Nominal Output Power
5	Emission Wavelength (nm)	1080±5	Nominal Output Power
6	Long-term power stability (%)	±1.0	The continuous running time of nominal output power ：≥5h Work Temperature: 22±1℃
7	Max. Modulation Frequency (Hz)	2000	Nominal Output Power
8	Red Guide Laser Power (mW)	0.5~1	
The output cable technical indicators			
9	Optical quality BPP （mm x mrad）	1.3-2.2	Nominal Output Power
10	Optical fiber core(μm)	50	Custom core
11	The output cable length(m)	20	Custom length
Voltage technical indicators			
12	Operating Voltage (VAC)	380V AC、50/60Hz	Nominal Output Power
13	Way to Control	EtherCAT/AD	
14	Max. Power (kW)	36	
Other technical indicators			
15	Water flow requirement (L/min)	>90	Nominal Output Power
16	Water Temperature	22±1	Nominal

	requirement (℃)		Output Power
17	Dimension (mm) W×D×H	698x1330x931	
18	Weight (kg)	300±20	
19	Operating Ambient Temperature (℃)	10~40	
20	Operating Ambient Humidity (%)	10~90	
21	Storage Temperature (℃)	-10~60	
22	Type of cooling	Water cooling	

3. Installation

3.1 Dimensions

Figure 2 shows dimensions of RFL-C12000S-HP.

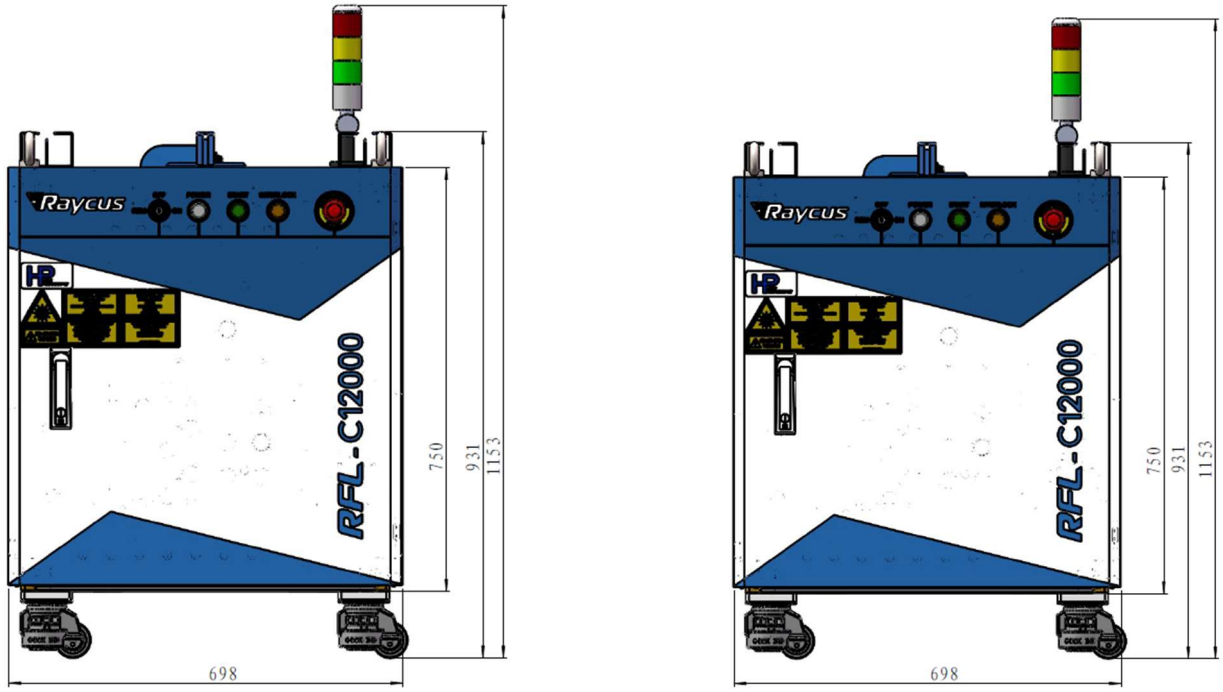


Figure 2a) Front and Rear panel view (unit: mm)

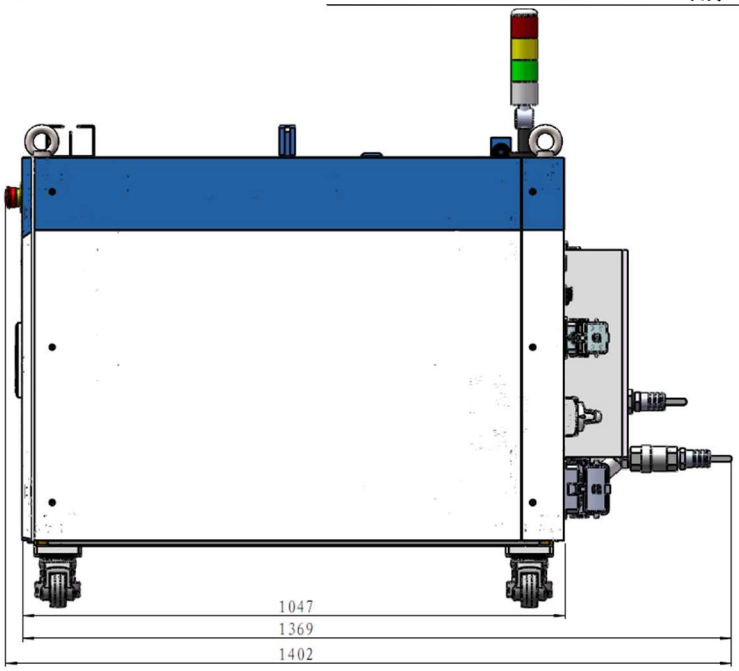


Figure 2b) Top and Side view (unit: mm)

3.2 Output Head and Installation

The laser output head of RFL-C12000S-HP is the standard QD interface. The specific appearance and dimensions are shown in Figure 3 above. Compared with other models, the size of the protective end cap of the fiber delivery cable of this model is lengthened.

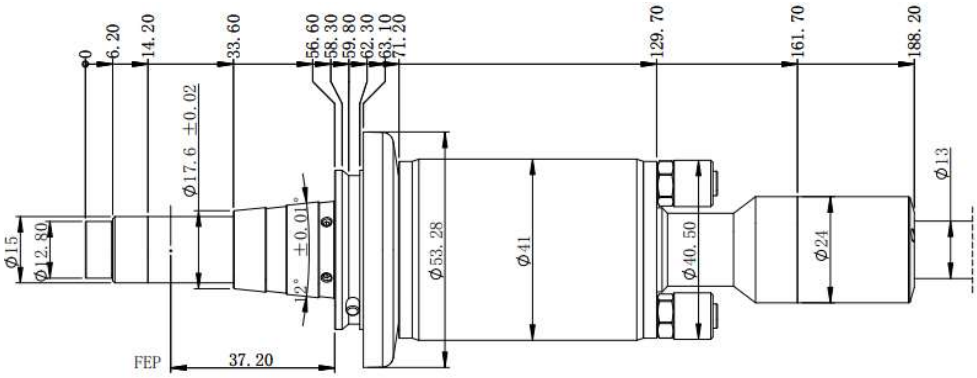


Figure 3 Dimensions of the QD fiber delivery cable (unit: mm)

	CAUTIONS: ◆ Inspect the output lens before installing the output head to the processing head. Clean the output lens if necessary. ◆ It is strictly prohibited to disassemble the output head by personnel not approved by Raycus, or the warranty is void.

3.3 Cooling Requirements

Table 5 Cooling Requirements

Model	RFL-C12000S-HP
Cooling Capability(W)	>30000
Minimum Flow(L/min)	90
Maximum Pressure(Bar)	6
Pipe Inner Diameter(mm)	32
Water temperature of cooling system(℃)	**22±1℃**

1) The water temperature setting of cooling system:

   22±1℃

2) Cooling system filter access requirements:

When the water quality of the laser cooling system is poor (more impurities), the laser water path is easy to be blocked, causing flow alarm or high temperature alarm, resulting in laser shutdown. In serious cases, the laser waterway will be scrapped. Therefore, RFL-C12000S-HP laser is equipped with water inlet filter module, as shown in Figure 4.

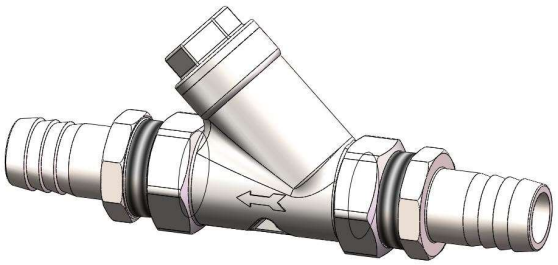


Figure 4 The inlet filter module

When the laser is installed and used, firstly connecting the water inlet filter module with the water outlet of the customer's on-site cooling water system according to the water flow direction indicated by the arrow in Figure 4, and then connect the water inlet filter module with the water inlet of the RFL-C12000S-HP laser, as shown in Figure 5.

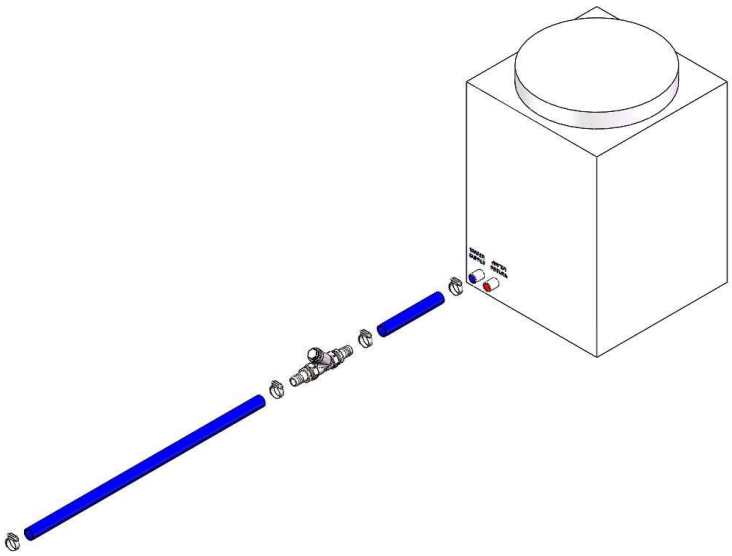


Figure 5 The water inlet filtration module is connected to the water cooling system

When the laser is in use, cleaning the Y-type filter of the inlet water filter module periodically according to the water quality of the cooling water system (opening the nut cover of the Y-type filter, taking out the filter screen, cleaning it, reinstall it, and tightening the nut cover), it is recommended that the cleaning frequency be no less than once a week.

3) Cooling water requirements:

- It is recommended to use purified water.
- In order to prevent mould growing that may lead to pipe blockage, we recommend to add alcohol about 10% of the total volume.
- If the product is used in an environment that ambient temperature is between -10℃ and 0℃, we recommend to use 30% alcohol, and replace it every two months.
- If the product is used in an environment that ambient temperature is below -10℃, please to use dual-system chillers (with heating function) and ensure uninterrupted operation of the cooling system.

4) Requirements for output cable cooling system:

- Rate of liquid flow: 1.7-2.0 L/min;
- Pressure of liquid flow: < 0.6 MPa at the inflow;
- Type of liquid exchange junction: SMC MS-5H-6:

- Type of tube: outer diameter6; inner diameter4;
- Direction of cooling liquid: unidirectional; connect the tube with the water-pipe strictly according to direction shown on the layer of the tube;
- Type of liquid: de-ionized water, condensed water, pure water;
- PH value of liquid: 5.5-9;
- Filter is needed for the cooling system, and the size of the solid residual practical should be within 100um;
- Maximum temperature of liquid: 45℃:
- Minimum temperature of liquid: greater than the saturated dew-point 5℃;
- Additive to the liquid: satisfies the requirements of PH value and size of solid residual practical as above;
- Radius of the bending of the armored pipe: off-work state (i.e. transportation and reservation): minimum radius of bending ≥ 20 cm; in-work state: minimum radius of bending ≥ 30 cm;
- Long-term vibration < 2 G; Impact action < 10 G.

5) Other requirements for chiller:

- When starting the cooling system for the first time, check the entire water system and the joint for water leakage. The external water pipe must be installed and connected according to the inlet (IN) and outlet (OUT) by the laser. Otherwise, the laser may not work properly.
- If you will not use the laser for a long time, water must be emptied from the product, and then both the inlet and outlet must be blocked with the nuts we provide. Failure to do so may lead unrecoverable equipment damage.

	**CAUTION:** Please set the water temperature in strictly accordance with the requirements above. Too low temperature may lead to condensation on the laser module and the output cable. This can cause serious damage to the equipment. **CAUTION:** Please clean the water inlet filter module in time. If the water inlet filter module is blocked, the laser flow alarm or high temperature alarm will be triggered.

	**CAUTION:** Make sure that the water temperature reaches the set point and the cooling system is working well before you start the laser. 〖summer：22±1℃； winter： 22±1℃〗

3.4 Installation Procedure

a) Place the product make the necessary fixes and stable position.

b) Check if the power supply has the correct voltage (See Table 4 for the laser model and corresponding input voltage), and the earth line is connected, make sure it is firm and reliable.

c) Connect the power cable and control cable to the product when power supply is OFF.

d) Insert the water pipes into the inlet and outlet.

e) Check the output head and clean it if necessary. This procedure must be performed by personnel of Raycus or authorized by Raycus. Make sure the environment is clean, or the output cable may be contaminated.

f) Prevent the delivery cable from treading, pinching or excessive bending during installation.

g) During the installation and disassembly process, please take care to handle the laser output head gently, avoiding any shock.

h) In the installation of laser output cable and output head process, please make sure that the surrounding environment is clean, otherwise it may pollute the output head (do not use fans, which actually may bring more dust).

i) The minimum bending radius of the output fiber cable of the laser should not be less than 20 cm under the non-working conditions, and the minimum bending radius should not be less than 30 cm when the laser is working.

	CAUTION: ◆ All the cables can only be connected when power supply is OFF. Hot plug may damage the laser.

	CAUTION: ◆ The laser output optical cable should be kept as natural as possible and not be distorted. ◆ The too small bending radius of the output fiber cable will damage the laser.

	CAUTION: ◆ Make sure the aperture and the cavity of the processing head is clean. ◆ Keep the protective cap properly, prevent it from contamination; Or the aperture will be contaminated when capped.

4 Using the Product

Please use the correct the latest PC software and the relevant manual.

4.1 Front Panel

Figure 6 shows the front panel of RFL-C12000S-HP：

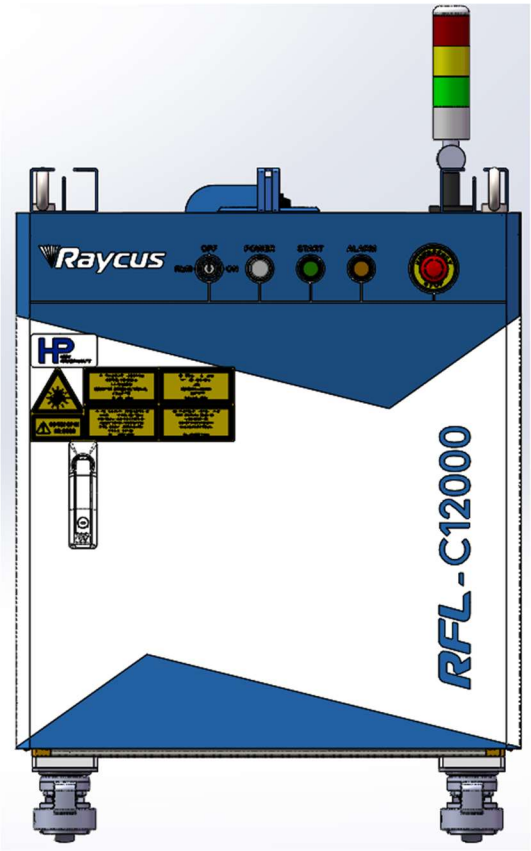


Figure 6 Front Panel of RFL-C12000S-HP

1) **REM/OFF/ON：** Key switch, the control system power switch of the laser. Insert the key; either turning the key clockwise to the 'ON' position or counterclockwise to 'REM' position (short-connect the Pin 8 and Pin 9 of Table 7) will power on the laser control system. Then the laser will enter a control mode depending on your previous setup on the 'CTRL-INTERFACE'. You can refer to【*4.8 Control Mode*】for more details.

2) **POWER：** The control system power, GREEN, indicates that the control system is switched on.
3) **START：** The green light is on, and the main power supply of the laser enters ready state.
4) **ALARM :** Alarm indicator, YELLOW, indicates an error condition.
5) **EMERGENCY STOP：** Press it down to stop the laser immediately. When the button is in the 'down' position, turn it clockwise to release, but the laser cannot start before it's powered on with key switch for a second time.
6) **Indicator lamp post：** When the main power supply of the laser is powered on, the green indicator is on when the laser is ready; When the laser light, red light; when there is a fault in the laser, the yellow indicator lights up and is accompanied by an alarm sound.

4.2 Rear Panel

Figure 7 shows the rear panel of RFL-C12000S-HP:

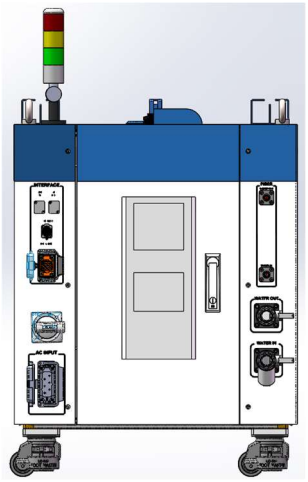


Figure 7 Rear Panel of RFL-C12000S-HP

1) **AC INPUT：** The socket for supply source input that can only be mated with the plug on the power cord we provided (See Table 4 product technical parameters for laser model and corresponding input voltage). Please use only the enclosed power cord provided by Raycus.

2) **CTRL-INTERFACE：** Control interface, CTRL-INTERFACE interface (DB-25), multi-function multiplex interface, users can set control mode, input analog voltage signal, modulate 24V signal, and it is also an alarm signal output interface.
3) **WATER：** Pipe connectors, the inlet and outlet for cooling water to flow in and return. (See Table 5 for the laser model and corresponding water pipe size for cooling system requirements)
4) **ETHERNET：** Ethernet interface. It can provide remote control and storage alarm information for the laser.
5) **FieldBUS:** Bus interface

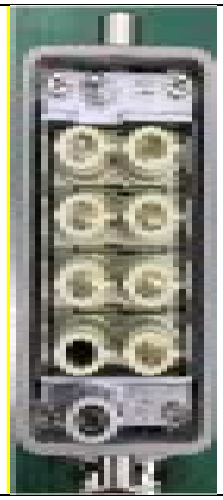
4.3 Power Connection

	CAUTION: Before connecting the product to AC supply source, you must check for sure that the AC supply you will apply is in accordance with the specifications provided in Table 2 or 4.

Table 6(a) Power Connection interface definition and parameter requirements

12kW Three kinds of laser AC input interface definition and parameter requirements				
1、2	AC380V-L1	L1	$6mm^2/6mm^2$	Brown
3、4	AC380V-L2	L2	$6mm^2/6mm^2$	Black
5、6	AC380V-L3	L3	$6mm^2/6mm^2$	Gray
7、8	Safe ground wire	PE	$6mm^2/6mm^2$	Kelly

Table 6(b) Power Connection Requirements

Model	RFL-C12000S-HP
Supply Source	380±15%VAC，50/60Hz
Power Cord	
One End of Power Cord	8 wires, each 2 wires are multiplexed, and the diameter of single wire is 6mm2, Four wires labeledL1，L2，L3and PE
Sign Description	L1，L2，L3-> Phase Line, PE-> Protective Earth
Power plug and socket	 
Note	One end of the power cord is a plug, insert it into the socket 'AC INPUT' on the rear panel. Notice that the plug is wrong-side preventing. After inserting it, lock it with the lever.

4.3.1 Control interface definition

Control is carried out using the CTRL-INTERFACE interface (24-pin), which is defined as follows：

Figure 8 CTRL-INTERFACE Schematic

Table 7 Definition of the 24-pin interface for laser control

Pin	Signal Name	Signal Type	Signal Level	Signal Drive	Typical Response Time	Description
1	Interlock Ch1A	Contact Closure Input	24Vdc	0.1A	<500ms	According to "EN954-1" or "ISO13849-1 Cat.3PLd". Passive contact, not to be connected to external voltage or earth.
2	Interlock Ch2A					
3	Interlock Ch2B					
4	Interlock Ch1B					
5	RS232Tx	---	---	---	120ms	Transmit Data
6	RS232Rx	---	---	---		Receive Data
7	RS232Com	Return	---	---		RS-232 Return
8	Remote Key Switch	Contact Closure Input	24Vdc	>1A (Contacts and cables)	20s	Starts the internal main control board power supply. Passive contact, not to be connected to external voltage or earth.
9						
10	Remote Start Button	Contact Closure Input	24Vdc	10mA	1s	Start the internal main power supply. Passive contact, no external voltage or earth connection.
11						
12	Analog Input to control	Analog Input	1-10 Vdc	1 mA	100µs	Current setting analog inputs. 1-10VDC = 10-100% current.
13	Analog Output Power Monitor	Analog output	0-8.0 Vdc	11mA	100µs	Analog output 0-8VDC=0-Pnom
14	Isolated Analog Com	Return	---	---	---	Return for signals on pins 12, 13
15	Modulation+	Digital Input	18- 24Vdc	6 mA	20µs	18-24VDC Input
16	Modulation-	Return	---	---	---	Return for signal on

						pin 15
17	Guide Control	Digital Input	18-24Vdc	6 mA	120ms	Positive edge turns On red guide laser in Guide laser external control mode
18	Emission Enable	Digital Input	18- 24Vdc	6 mA	120ms	Positive edge activates emission in external enable mode
19	Laser Error	Digital Output	24Vdc	100mA	120ms	High indicates a laser error status
20	System Common	Return	---	---	---	Return for signals on pins 17-19, 21-24
21	Error reset	Digital Input	18-24Vdc	6 mA	120ms	Positive edge resets all resettable errors
22	Laser ready	Digital Output	24Vdc	100mA	120ms	High indicates laser is ready
23	Main power on	Digital Output	24Vdc	100mA	120ms	High indicates Main powered on
24	Emission ON	Digital Output	24Vdc	100mA	1ms	High indicates laser is emitting

◆ Please check the level of the control signal to ensure that it meets the requirements. The laser may be damaged if the voltage exceeds or fluctuates.

The Interlock interface is 24 pin, pin 1 and 4, 2 and 3. If these two pins are disconnected, the laser will interrupt the output of light immediately, the laser Ready signal output will become low, and the laser will display Interlock abnormality.

When one of the Interlock channels is open circuited, it is impossible to start the main laser power supply until the other Interlock channel is also open circuited, and then close both channels before starting the main laser power supply.

For safety, pins 10 and 11 of the control interface cannot be shorted at the same time or in advance with pins 8 and 9，the control system inside the laser starts

to detect the rising edge of pins 10 and 11 and executes the power on command of the main power supply after the power on operation self-test is completed.

	◆ The Interlock interface shall not be connected to the active signal, otherwise the interface will be damaged and the laser will alarm; ◆ After all interlocks are closed, the main power supply is powered on after shorting the 10th and 11th pins of the CTRL-INTERFACE; If any Interlock is disconnected, the main power supply will be turned off immediately;

4.3.2 Ethernet TCP/IP interface settings

Table 8 Definition of Ethernet interface pins

Pin	Function	Description
1	TX+	Data transmission+
2	TX-	Data transmission-
3	RX+	Data reception+
4	N/C	No connection
5	N/C	No connection
6	RX-	Data reception-
7	N/C	No connection
8	N/C	No connection

If conditions permit, please give priority to this interface to obtain better communication stability. The laser and computer must be in the same LAN.

Table9 Laser IP address

Laser default IP address	
IP address	192.168.0.10
Subnet mask	255.255.255.0

IP configuration：

a) Open“Local Area Connection”on your PC, and then click “Properties”；

b) Select“Internet Protocol Version 4”(TCP/IP 4)；

c) Click“Properties”button；

d) Select "Use the following IP address:" to manually assign IP addresses;

e) Assign an IP address of 192.168.0. x (x cannot be 10, because 192.168.0.10 has been assigned to the laser), and then assign a subnet mask address, which is 255.255.255.0 by default;

f) Click “OK” to confirm the settings and exit. See Figure 7 for details.

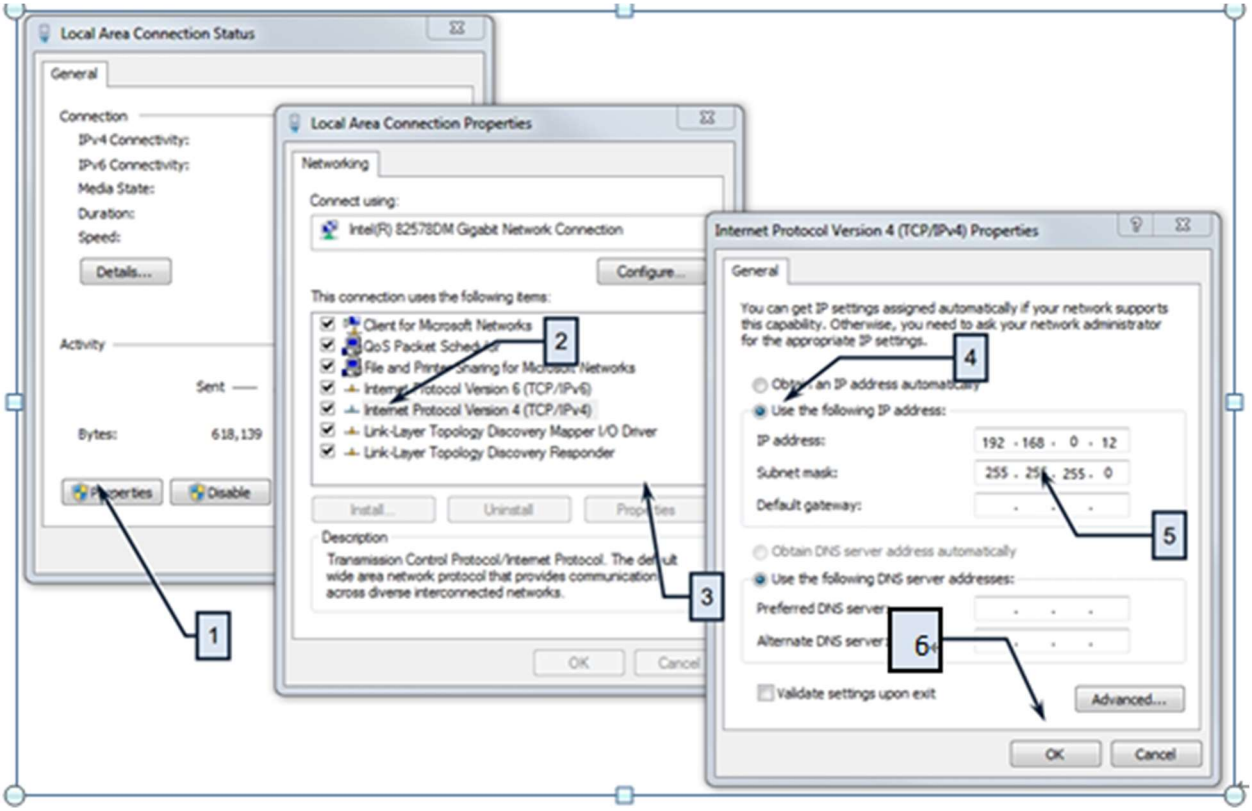


Figure 9 IP Settings on PC Side

After the IP setting is completed, open the Raycus software, and the connection status in the corresponding text box on the Raycus software menu shows: connected, indicating that the micro-controller program runs normally and the communication connection is normal. The display menu is shown in below Figure 10.

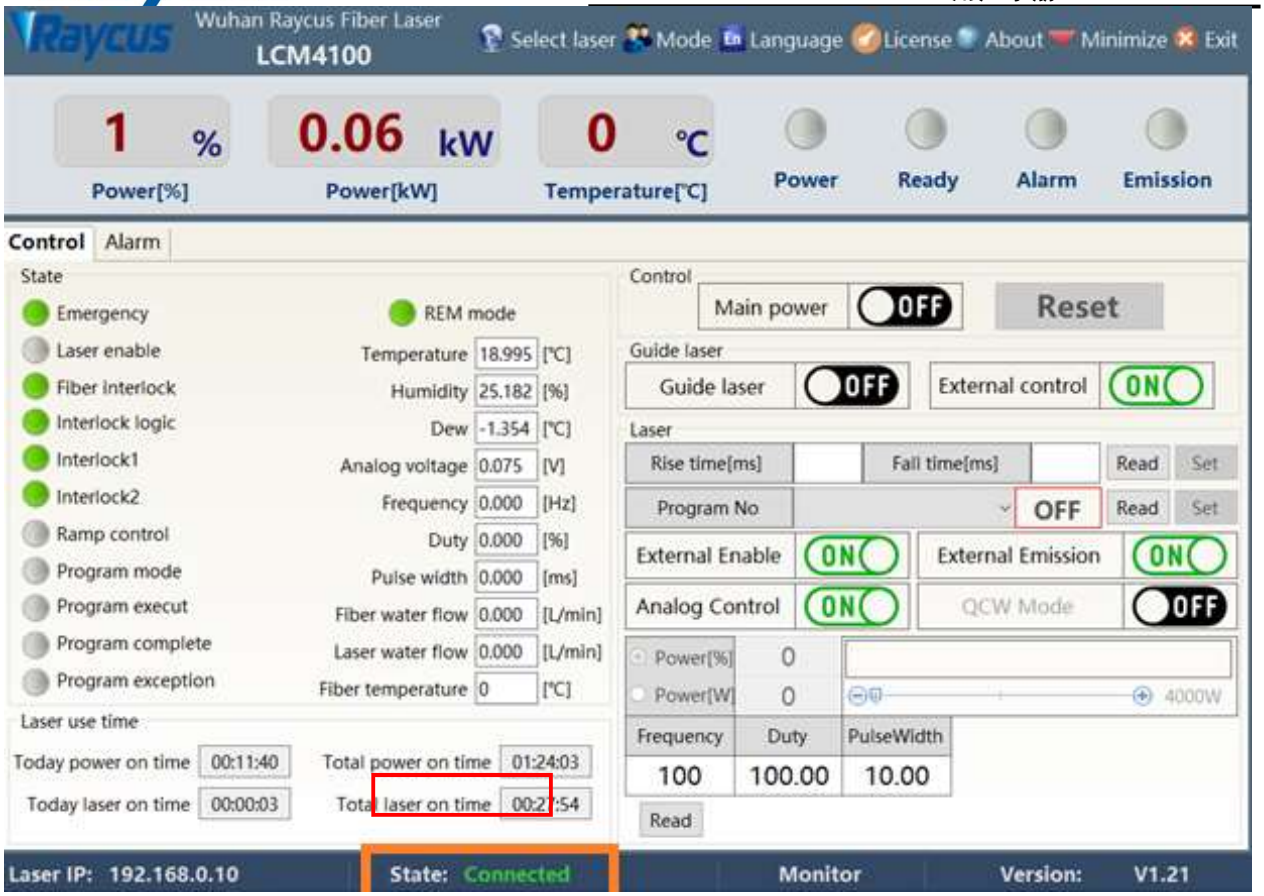


Figure10 Main menu of normal communication connection

4.3.3 RS232 and INTERNET communication command

4.3.3.1 Port configuration

RS-232 configuration as below：

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

Ethernet port configuration as below：

Laser default IP address：192.168.0.10

Laser TCP port：8099,10001

Laser UDP port：8098

4.3.3.2 Laser communication protocol (network port & serial port)

All commands and return values in this protocol are composed of ASCII characters. The following points should be noted when entering:

a) The command is generally composed of 3 or 4 letters, sometimes with additional values.

b) All commands and return values end with a carriage return character (CR, 0x0D, \r). If the product receives a string with a "carriage return" character, but the command is invalid, it will return "BCMD\r".

c) For easy identification, all commands are uppercase letters, but in fact, this product does not distinguish between uppercase and lowercase letters. To facilitate identification, a space is added between the command and the parameter.

d) The product will send a return value for each command received. The return value generally contains the command content itself. If the returned content contains numeric values or error types, ":" will be used to separate the returned command content from numeric values or error types.

Please see table 10 for specific agreement contents and command examples.

Table 10 Specific Agreement Contents and Command Examples of Laser

Command	Description	Command Example
ABF	Aiming Beam OFF –Turn off red beam	Send：“ABF\r” Return：“ABF\r”
ABN	Aiming Beam ON – Turn on red beam	Send：“ABN\r” Return：“ABN\r”
DEABC	Disable External Aiming Beam Control – Turn off the external red beam control	Send：“DEABC\r” Return：“DEABC\r”
EEABC	Enable External Aiming Beam Control – Switch to external red beam control	Send：“EEABC\r” Return：“EEABC\r”
DEC	Disable External Control – Turn off AD control mode	Send：“DEC\r” Return：“DEC\r”
EEC	Enable External Control – Switch to AD control mode	Send：“EEC\r” Return：“EEC\r”
DLE	Disable Hardware Emission Control –Forbid to enable the laser from the control interface	Send：“DLE\r” Return：“DLE\r”
ELE	Enable Hardware Emission Control – Allow to enable the laser from the control interface	Send：“ELE\r” Return：“ELE\r”
DGM	Disable Gate Mode – Turn off external modulation mode	Send：“DGM” Return：“DGM”
EGM	Enable Gate Mode – Turn on external modulation mode	Send：“EGM” Return：“EGM”

EMOFF	Stop Emission –Turn off the laser (or disable it)	Send：“EMOFF\r” Return：“EMOFF\r”
EMON	Start Emission – Turn on the laser (or enable it)	Send：“EMON\r” Return：“EMON\r”
MPWROFF	Main Power OFF – Turn off the main power	Send：“MPWROFF\r” Return：“MPWROFF\r”
MPWRON	Main Power ON – Turn on the main power	Send：“MPWRON\r” Return：“MPWRON\r”
SPW	Set Pulse Width	Send：“SPW 100\r” Return：“SPW：100\r” （Setpulsewidth100ms） Other return value： “ERR： input Err\r” （input pulse width<0.0001） “ERR：Out of Range\r” （Exceeds the maximum pulse width range） “ERR:Duty Cycle too High\r”（The set of duty cycle too high） “ERR：Duty Cycle too Low\r”（Set pulse width <0.02） “SPW：100,Duty=100%\r”
SPRR	Set Pulse Repetition Rate	Send：“SPRR 1000\r” Return：“SPRR：1000\r” Other return value： “ERR： input Err\r” （Input frequency <0） “ERR： Out of Range\r” （Exceeds the maximum pulse width range） “ERR:Duty Cycle too High\r”（The set of duty cycle too high） “ERR：Duty Cycle too Low\r”（Set pulse width <0.02） “SPW：100,Duty=100%\r”
SDC	Set Diode Current – Set the operating current of the optical module (unit: %). The setting value must be lower than 100% and higher than the minimum current setting value, which can be set to 0. If the set value is bigger than 100, the default is input 100.	Send：“SDC 100\r” Return：“SDC：100\r” Other return value： “ERR：Input Err\r” （input value <0） “Laser is worked in AD Mode\r” （Working in external AD mode, the command is invalid）
RCS	Read Current Set point	Send：“RCS\r” Return：“RCS：56.7\r” (Present current setting value is 56.7%)

RPRR	Read Pulse Repetition Rate	Send：“RPRR\r” Return：“RPRR：10\r” (Pulse Repetition Rate 10Hz)
RBT	Read Board Temperature	Send：“RBT\r” Return：“RBT：36.6\r”
RPW	Read Pulse Width	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”
ROP	Read Output Power – Reads the output power in watts.	Send：“ROP\r” Return：“ROP：4000.4\r”
RSN	Read Serial Number – Reads the serial number of the device.	Sent: “RSN” Return: “RSN:221200251\r”
PERR	Reset Errors –Clear internal errors	Send：“PERR\r” Return：“PERR\r”
RIP	Read IP – Read the current IP address	Send：“RIP\r” Return：“RIP：192.168.0.10\r“
RMASK	Read Subnet Mask – Read the current sub-net mask address	Send：“RMASK\r” Return：“RMASK：255.255.255.0\r”
SIP	Set IP – Set Laser IP	Send：“SIP 192.168.0.10\r” Return：“SIP：192.168.0.10\r”
SMASK	Set Subnet Mask – To set the sub-net mask, append a string of decimal digits with "."	Send：“SMASK 255.255.255.0\r” Return：“SMASK：255.255.255.0\r”
SIP	Set IP – To set the IP address, you need to attach a string of decimal digits with "."	Send：“SIP 10.0.0.231\r” Return：“SIP：10.0.0.231\r”
SUT	Set Up Time – Set power rise time (unit: ms)	Send：“SUT 50\r” Return：“SUT：50\r”
SDT	Set Down Time – Set power drop time (unit: ms)	Send：“SDT 50\r” Return：“SDT：50\r”
RUT	Read Up Time – Read power rise time (unit: ms)	Send：“RUT \r” Return：“RUT：50\r”
RDT	Read Down Time – Read power drop time (unit: 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
Other	Command error	Send：“BGM\r” Return：“BCMD\r”

STA	Read device status – Read the product status. The return value is 32Bit digital information. The meanings of each bit are as follows (undefined or "reserved" bits can be ignored):		Send：“STA” Return：“STA：4100” The return value 4100 (decimal) can be converted to 0x1004 (hexadecimal), and then converted to binary. It can be seen that Bits2 and 12 have been set. That means "Laser Enable" is turned on and "Modulation" mode is enabled
	Bit 0	0-Normal operation	
		1-Authorization time	
	Bit 1	0-Normal	
		1-Overheat	
	Bit 2	0-Laser not enabled	
		1-Laser enabled	
	Bit 3	0-Back Reflection OK	
		1-High Back Reflection Level	
	Bit 4	0-External AD mode=off	
		1-External AD mode=ON	
	Bit 5	Reserved	
		Reserved	
	Bit 6	0-Normal	
		1-Slave communication abnormal	
	Bit 7	Reserved	
		Reserved	
	Bit 8	0-Aiming Beam OFF	
		1-Aiming Beam ON	
	Bit 9	0-Laser not ready	
		1-Laser ready	
	Bit 10	0-QCW mode=off	
		1-QCW mode=on	
	Bit 11	0-main power supply=OFF	
		1-main power supply=ON	
	Bit 12	0-Modulation Disabled	
		1-Modulation Enabled	
	Bit 13	Reserved	
		Reserved	
	Bit 14	Reserved	
		Reserved	
	Bit 15	0-Laser does not emit beam	
		1-The laser is emitting beam	
	Bit 16	0-Gate Mode Disabled	
		1-Gate Mode Enabled	
	Bit 17	Reserved	

		Reserved	
	Bit 18	0-External enable mode=off	
		1-External enable mode=on	
	Bit 19	0-Normal	
		1-Laser is Error	
	Bit 20	0-Slow rise and slow drop mode off	
		1-Slow rise and slow drop mode ON	
	Bit 21	0-The laser operates in "ON"	
		1-The laser operates in	
	Bit 22	0-Programming mode off	
		1-Programming mode on	
	Bit 23	Reserved	
		Reserved	
	Bit 24	0-Normal	
		1-Low temperature fault	
	Bit 25	0-Normal	
		1-Humidity alarm	
	Bit 26	0-Normal	
		1-Flow alarm of water flow	
	Bit 27	0-Aimingbeam internal	
		1-Aimingbeamexternal	
	Bit 28	0-Normal	
		1-Flow alarm of water flow	
	Bit 29	0-Normal	
		1-Critical Error	
	Bit 30	0-Optical Interlock OK	
		1-Optical Interlock active	
	Bit 31	0-Normal	
		1-Average power is too high	

4.4 Laser installation sequence

a) Take out the laser carefully and move it to the installation position;

b) Remove the protective cap of the output cable head, and use strong light to check whether the lens at the output end has dust. If yes, please clean it before installation, and then cover the protective cap of the output head;

c) Install the output cable on the processing equipment according to the actual situation (install the cooling water pipe of the output head at the same time), pay

attention to sorting out the output optical cable, and protect the output head. Remove the protective cap, confirm whether the lens at the output end is clean again, and then install the output head;

d) Connect the cooling system, water inlet filter assembly and laser cooling water pipe;

e) Connect the control circuit and power supply according to the control mode.

4.5 Steps of Starting

a) Make sure the air switch is OFF , the whole of electrical connections must be finished before the laser is powered on；

b) Short the 1/4, 2/3 pins of CTRL-INTERFACE；

c) Turn on the chiller and check leakage. If there is no water leakage, turn off the chiller and wait for the laser to turn on；

d) Turn on the air switch on the rear panel；

e) Turn on the chiller；

f) Short the 8/9 pins of CTRL-INTERFACE and start the laser.

j) Turn on the key switch and activate the laser.

4.6 Functions of Raycus software

RFL-C12000S-HP Raycus software communicates with the main control board through UDP when it is working. Through the background program running in the software and the human-computer interaction operation, the laser parameters are read and set and the control functions are realized. The menu displayed by the software is divided according to functional categories, including control, alarm, about, language selection, authorization, working mode selection and other pages.

4.6.1 The control menu

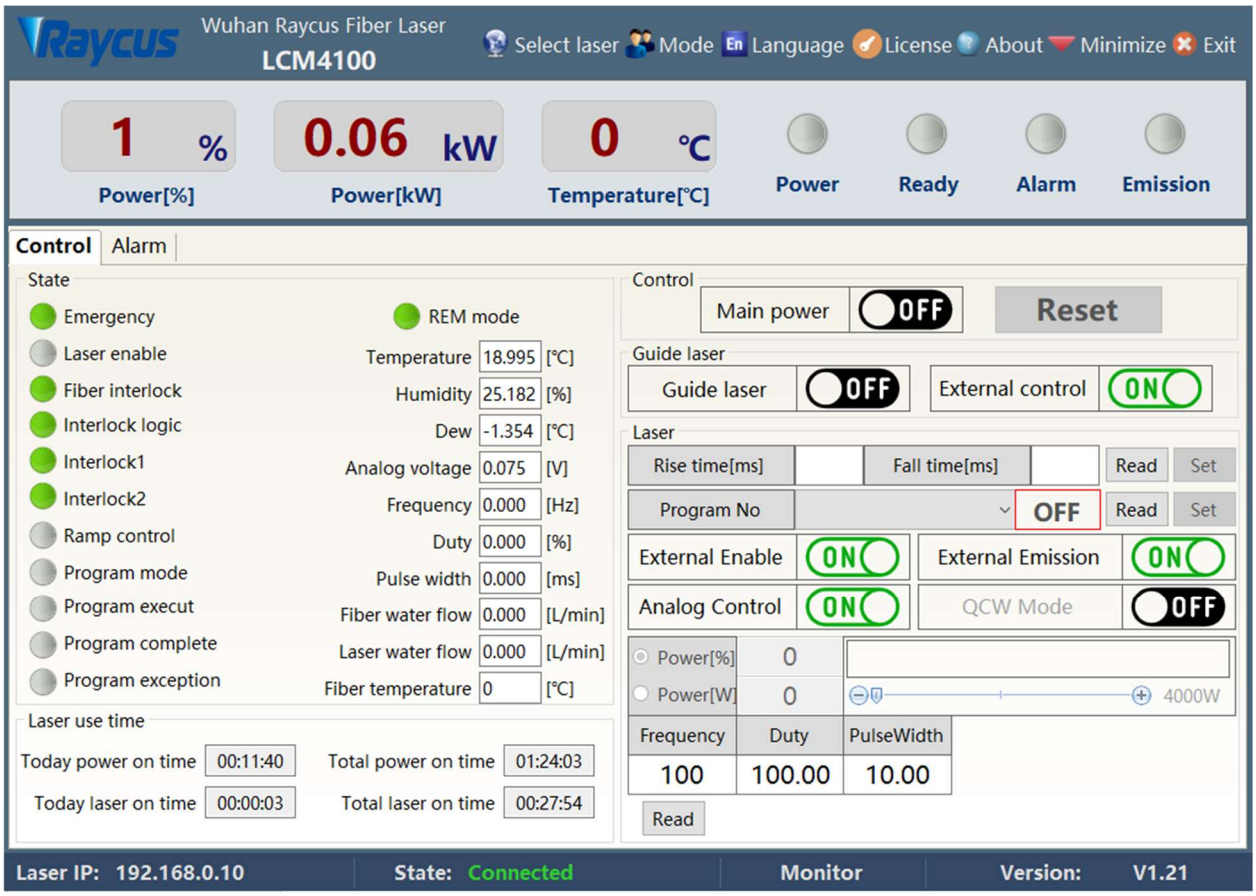


Figure 11 Raycus software control menu

Table 11 Description of the main status display area of the laser

Power [%]	display of the currently set power percentage
Power[kW]	display of the current average output power of the laser in kW
Temperature	display of the current water-cooled plate temperature of the laser, in degrees Celsius
Power indicator	Indicates the current status of the main power supply Green - main power is on Gray - main power is off
Ready indicator	Indicates the Ready status of the current laser Green - the laser is ready to emit laser beam Gray - the laser not ready
Alarm indicator	Indicates the current alarm state of the laser Yellow - the laser is abnormal Gray - the laser is not abnormal
Emission indicator	Indicates the current output state of the laser Red - the laser is outputting laser beam Gray - the laser is not outputting laser beam

Table 12 Description of laser working status display

Emergency	Red - indicates that the emergency stop button on the front panel of the laser is pressed Gray - Indicates that the emergency stop button on the front panel of the laser has been reset C3000S-C4000S-C6000S HP don't have this function
REM	Green - the laser works in REM mode Gray - the laser works in ON mode C3000S-C4000S-C6000S HP don't have this function
Laser Enable	Green - the laser is enabled Gray - the laser not enabled
Fiber Interlock	Green - The Interlock on output cable head is connected Gray - The Interlock on the output cable head is disconnected
Interlock1	Green - pins 1 and 4 on the control interface are connected Gray - pins 1 and 4 on the control interface are disconnected
Interlock2	Green - pins 2 and 3 on the control interface are connected Gray - pins 2 and 3 on the control interface are disconnected
Interlock Logic	Green - Interlock1& 2 meet logic requirements Gray - Interlock1& 2 do not meet logical requirements
Program Mode	Green - The laser is running in programming mode Gray - The laser is not running in programming mode
Ramp Control	Green - the laser is running in power ramp-up and ramp-down mode Gray - the laser is not running in power ramp-down mode
Program execute	Program is executing
Program complete	Program execution complete
Program exception	Abnormal program execution

Table 13 Description of Control Area Icons

Main Power	Click ON, the main power is power on Click OFF, the main power is power off
Guide Laser	Click ON, turn on the red guide beam Click OFF, turn off the red guide beam
Guide Laser External Control	Click ON, turn on the 17-pin red guide beam control function Click OFF, turn off the 17-pin red guide beam control function Mode power off automatic memory
External Enable	Click ON, turn on the 18-pin enable function Click OFF, turn off the 18-pin enable function Mode power off automatic memory
Analog Control	Click ON, turn on the AD analog mode Click OFF, turn off the AD analog mode Mode power off automatic memory
External Emission	Click ON, turn on the 15-pin laser control function Click OFF, turn off the 15-pin laser control function
Reset	Clear the alarm of the current laser
Emission ON	Emit laser
Emission OFF	No emit laser

4.6.2 Log menu

Display all alarm and fault information of the current laser on the log menu.

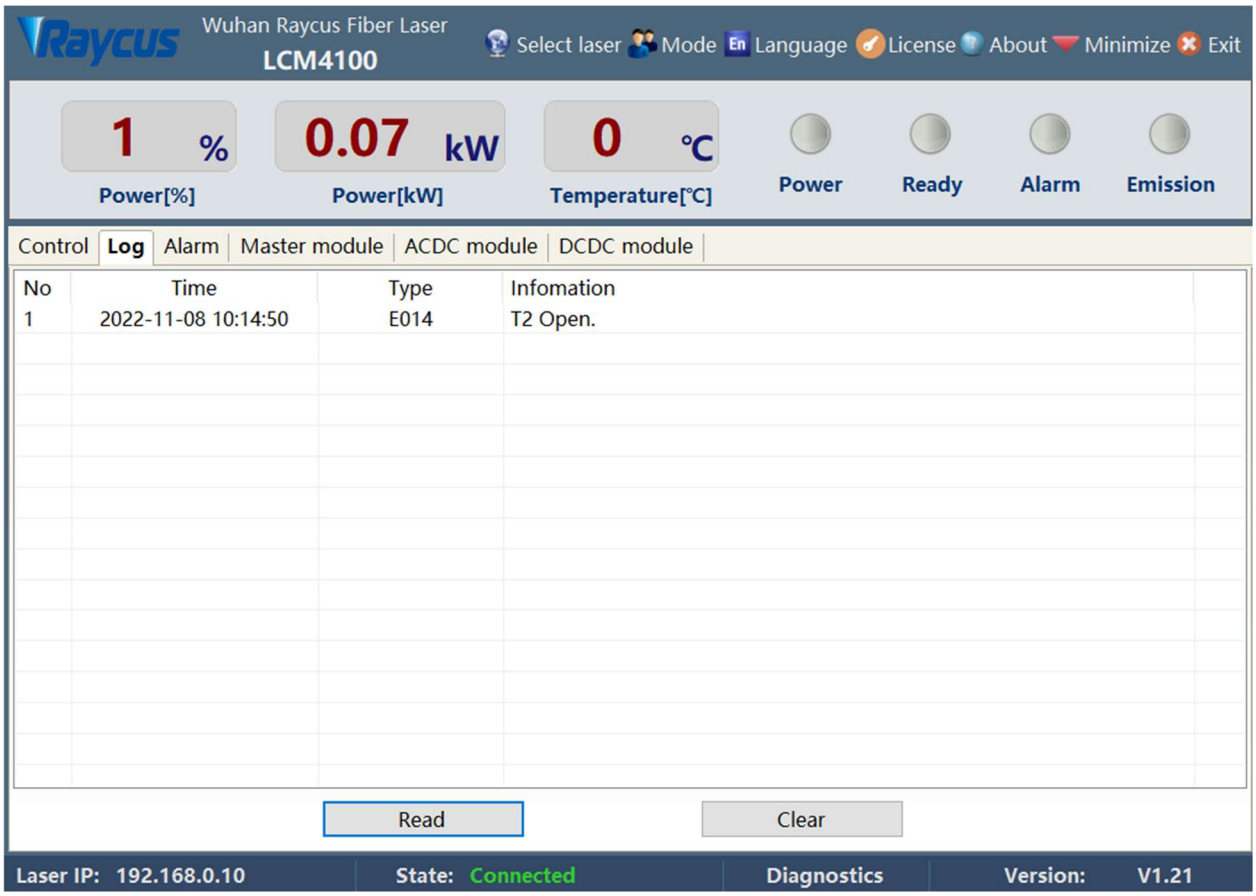


Figure 12 Raycus software log menu

4.6.3 “About” Menu

The laser time, model, serial number, main control serial number, key version number and system information are displayed in the about menu, and the Raycus software reads it once from the main control module when the “About” menu is opened.

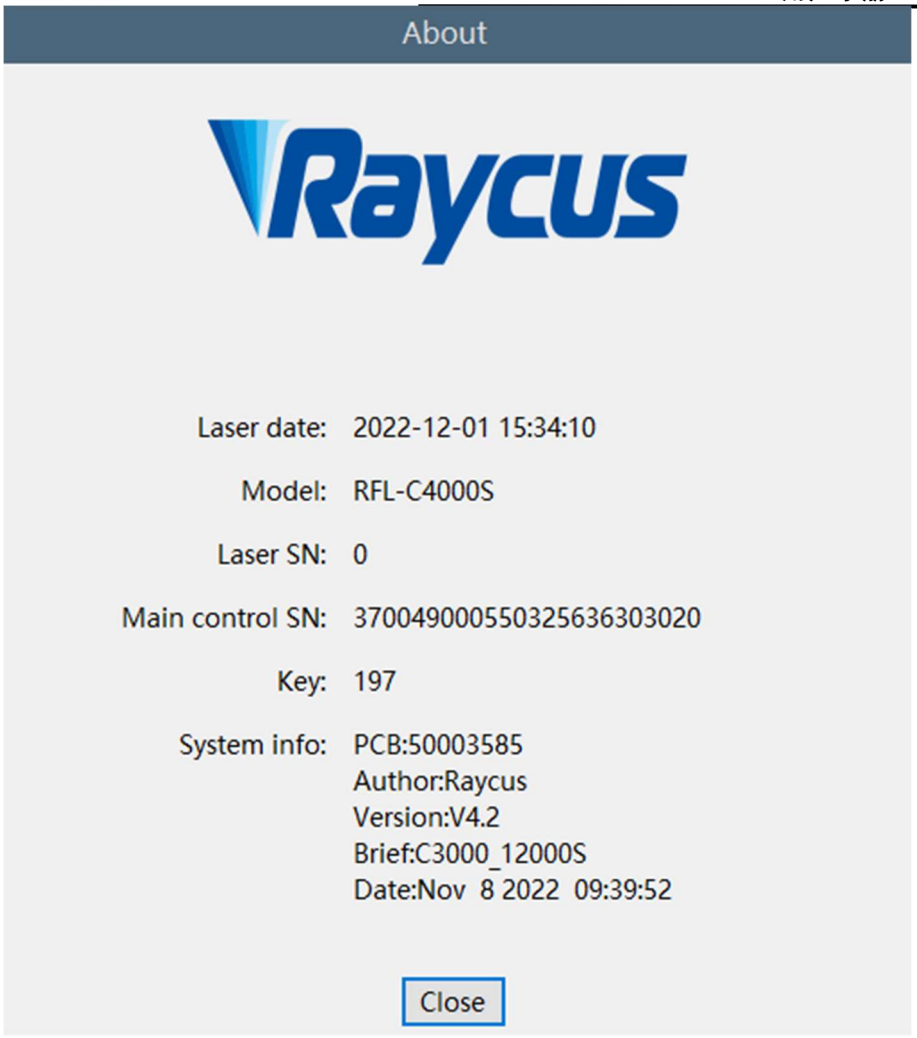


Figure 13 “About” menu

4.6.4 Select language

In the language selection menu, you can set the language used by the software. After selecting the language and clicking OK, the software will automatically convert the content displayed in the software to the language without restarting the software. At the same time, the currently selected language will be saved to the configuration file. When you start the software next time displays in the last language set.

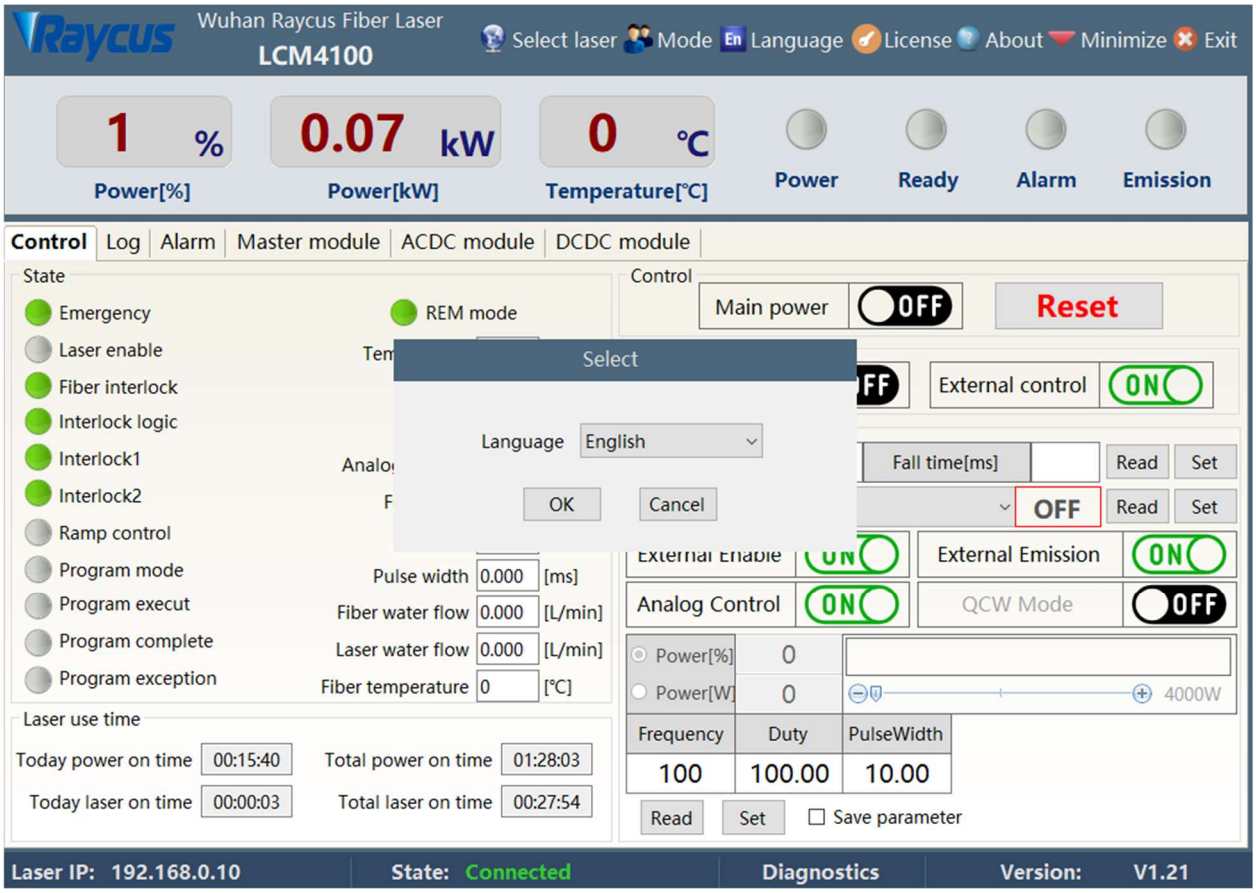


Figure 14 Select language menu

4.6.5 Authorization

The authorization menus used to control the time-limited lock of the laser. When the authorization menus opened, the machine code, laser lock time and lock time are loaded once. The laser lock time is Raycus' time-limited lock for integrators, and the lock time is for integrators to end customers. time-limited lock. On the authorization menu, only the authorization code of Raycus can be set, and the function of calculating the authorization code is implemented in the server, which has nothing to do with the Raycus software. The authorization code used by the integrator can be generated in the authorization menu.

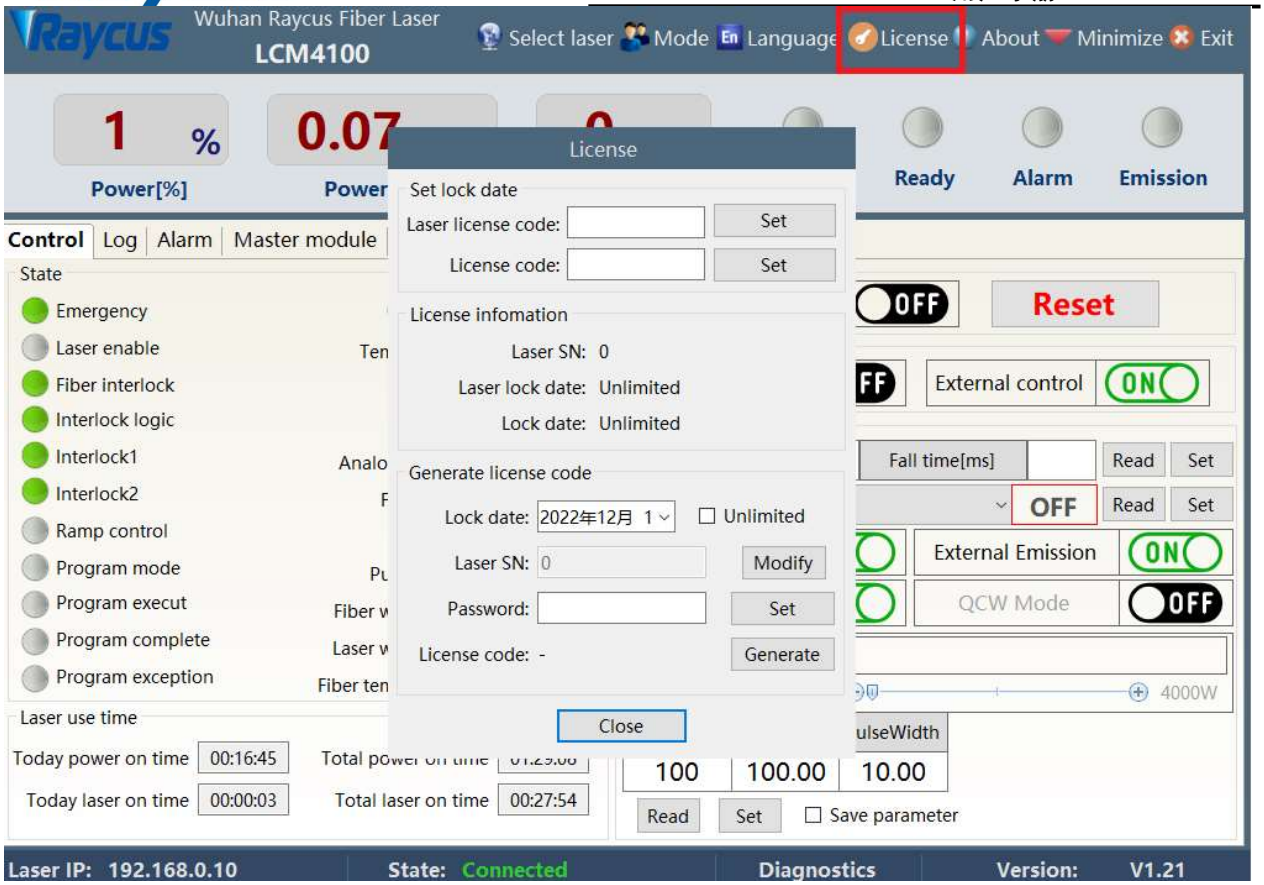


Figure 15 “Authorization” menu

4.6.6 Mode Selection

Mode selection is used to select the mode of the current software, including observation mode, control mode, diagnosis mode and debugging mode.

Observation mode: When the software is opened, the observation mode is selected by default. The most commonly used and concerned information is displayed on the software menu. The observation mode can be used without a password.

Control mode: The control mode adds the function of the operable control menu on the basis of the observation mode. A password is required to enter the control mode. The initial password is 81338818 (the password can be modified).

Debugging mode: On the basis of the diagnostic mode, the debugging mode adds a parameter setting menu, an encryption mode that only Raycus engineers can enter.

Diagnosis mode: When the laser fails and needs to be diagnosed remotely, or

the integrator needs to know more status information of the laser, it can enter the diagnosis mode. The diagnosis mode adds the status and alarm information of the main control module, slave control module, ACDC module and DCDC module on the basis of the observation mode. A password is required to enter the

4.6.7 Master module

The Master module contains all the status, alarm and system parameters of the main control module, and the status and alarm information are automatically refreshed.

Figure 16 Main control module status information menu

Connect to the network through the main control module system parameter menu：

AP mode: the laser is a WiFi hot-spot (hot-spot name and password can be configured), after the mobile phone is connected to the laser WiFi hot-spot, you can use the Raycus mobile APP to view the real-time status of the laser;

STA mode: The laser can automatically connect to the mobile phone hot-spot

or wireless router (the hot-spot name and password can be configured), the laser establishes a connection to Raycus' cloud server through WiFi, and sends real-time data, which can realize remote viewing and parameter setting functions.

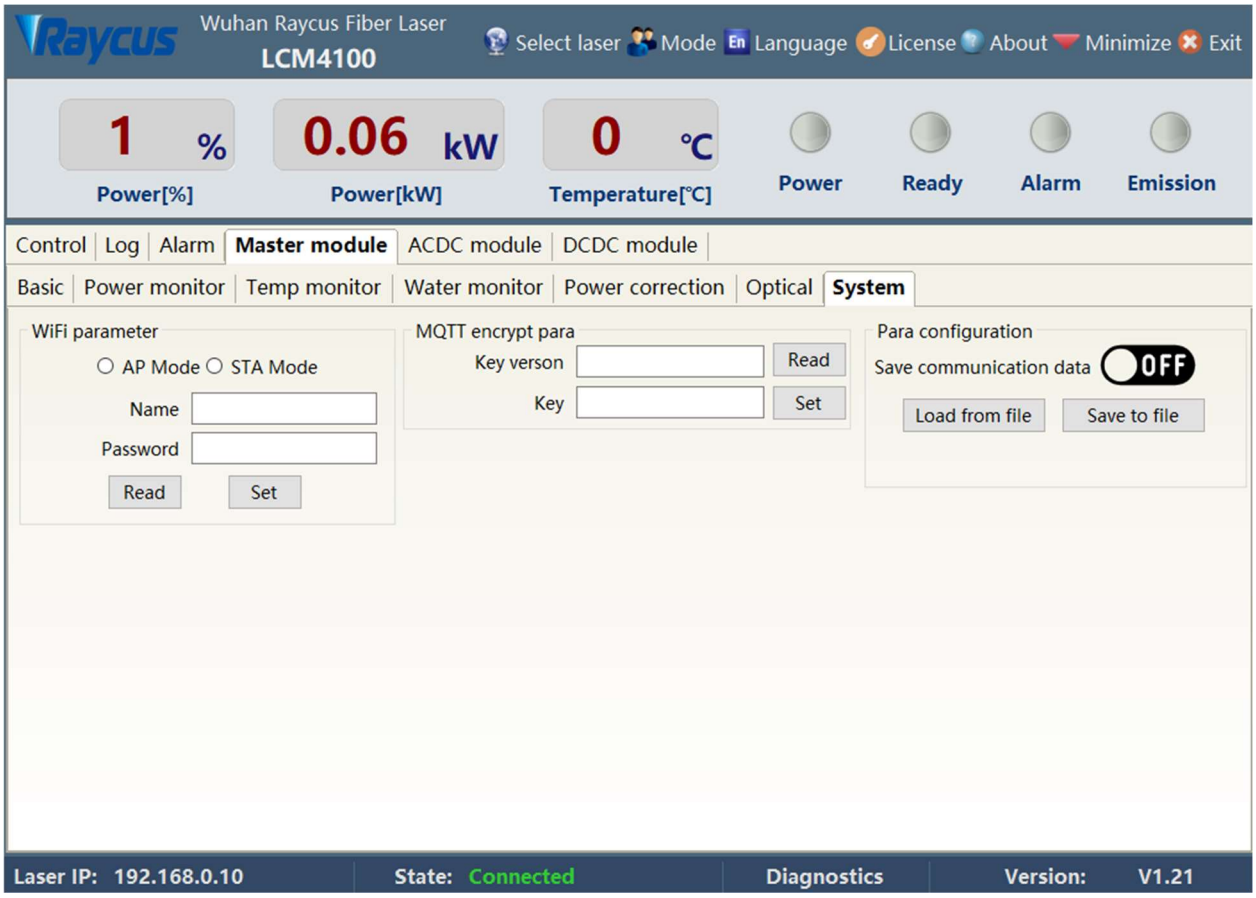


Figure 17 Main control module system parameter menu

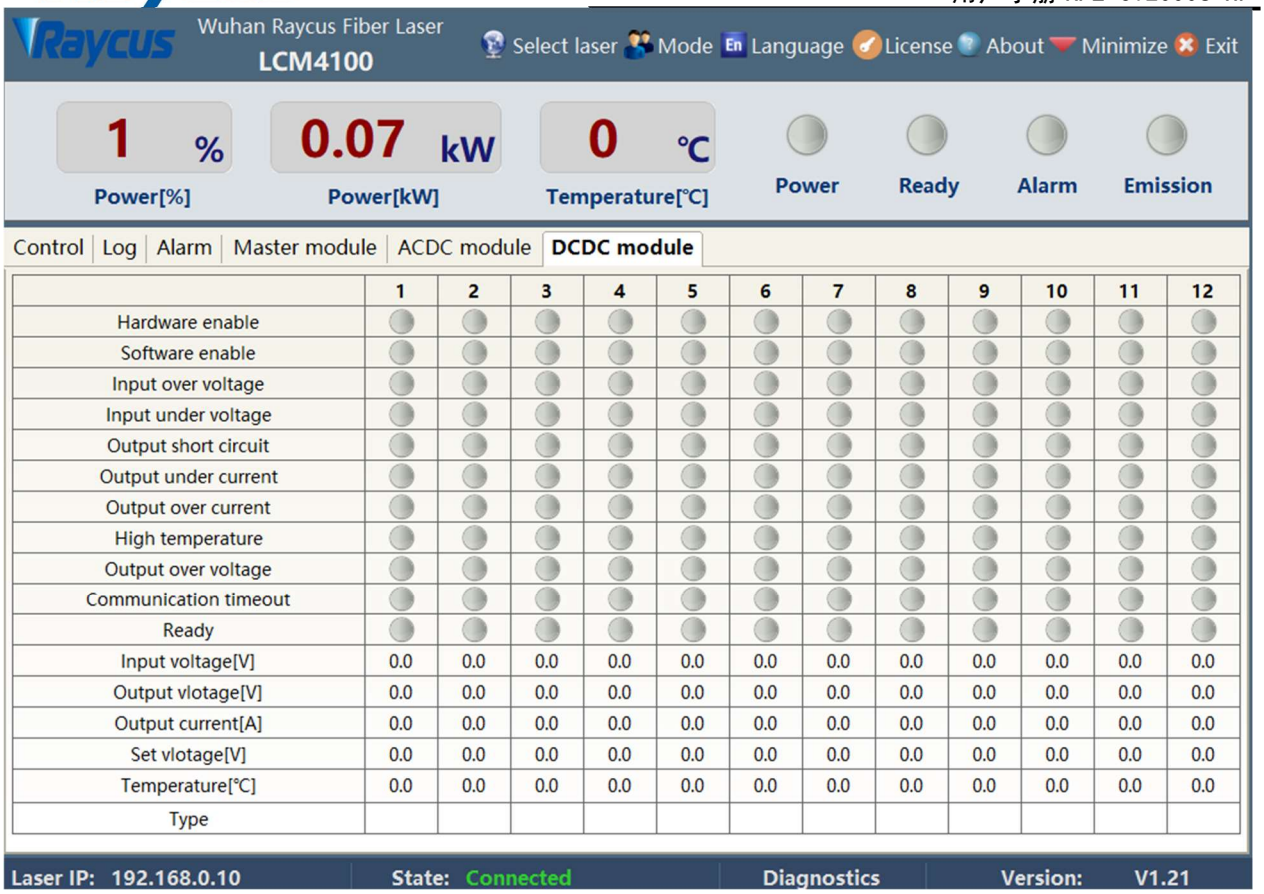
4.6.8 ACDC module

The ACDC module page contains the relevant status information of the ACDC module, and the refresh interval of the status information does not exceed 100ms.

Figure 18 ACDC module menu

4.6.9 DCDC module

The DCDC module page contains the relevant status information of the DCDC module, and the refresh interval of the status information does not exceed 100ms.



	1	2	3	4	5	6	7	8	9	10	11	12
Hardware enable												
Software enable												
Input over voltage												
Input under voltage												
Output short circuit												
Output under current												
Output over current												
High temperature												
Output over voltage												
Communication timeout												
Ready												
Input voltage[V]	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Output vlotage[V]	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Output current[A]	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Set vlotage[V]	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Temperature[℃]	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Type												

Figure 19 DCDC module menu

4.7 Control mode selection

a) AD mode

Table 14 AD mode settings

AD mode	Laser power
ON	INTERFACE 24-pin 12, 14-pin analog voltage 0~10V 0V——0% 10——100%
OFF	The Raycus software sets the power percentage or the communication command "SDC" setting

b) External enable

Table 15 External enable settings

External enabled	Laser enablement.	
ON	18, 20 foot rising edge of INTERFACE 24	
OFF	External light emission OFF	It is automatically enabled after the main power is powered on
	External light emission ON	The laser enable button in the upper computer software

c）External emit laser

Table 16 External enable settings

External light emission	Light output control MOD
ON	15, 16 foot rising edge of INTERFACE 24
OFF	The Client ware of laser emission ON Output laser
	The Client ware of laser emission OFF laser off

4.7.1 Full external control mode control mode wiring diagram (external analog/external enable/external emit laser)

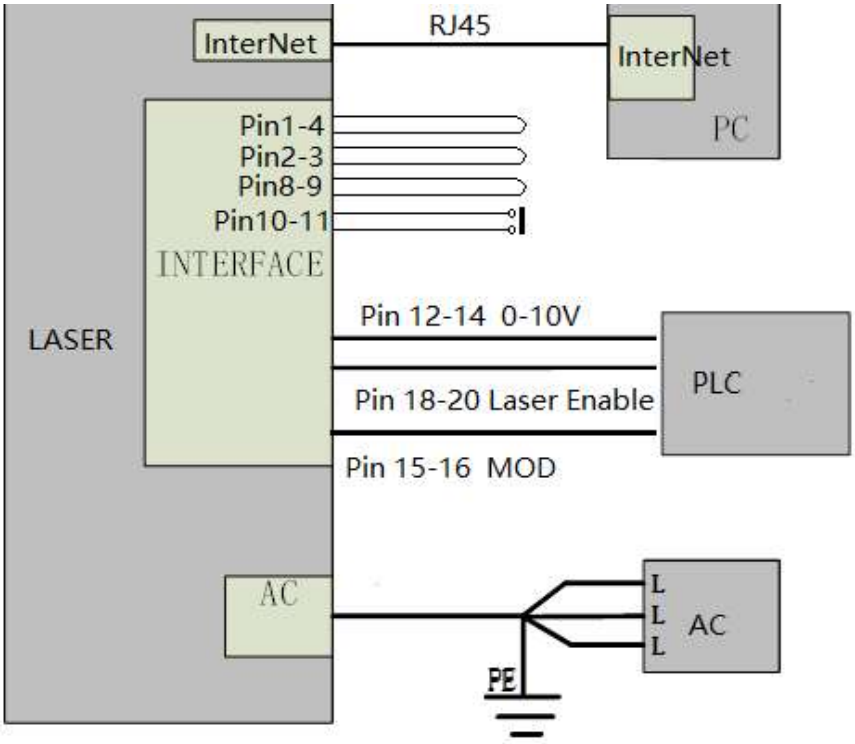


Figure 20 External control wiring diagram

4.7.2 Control Sequence Diagram

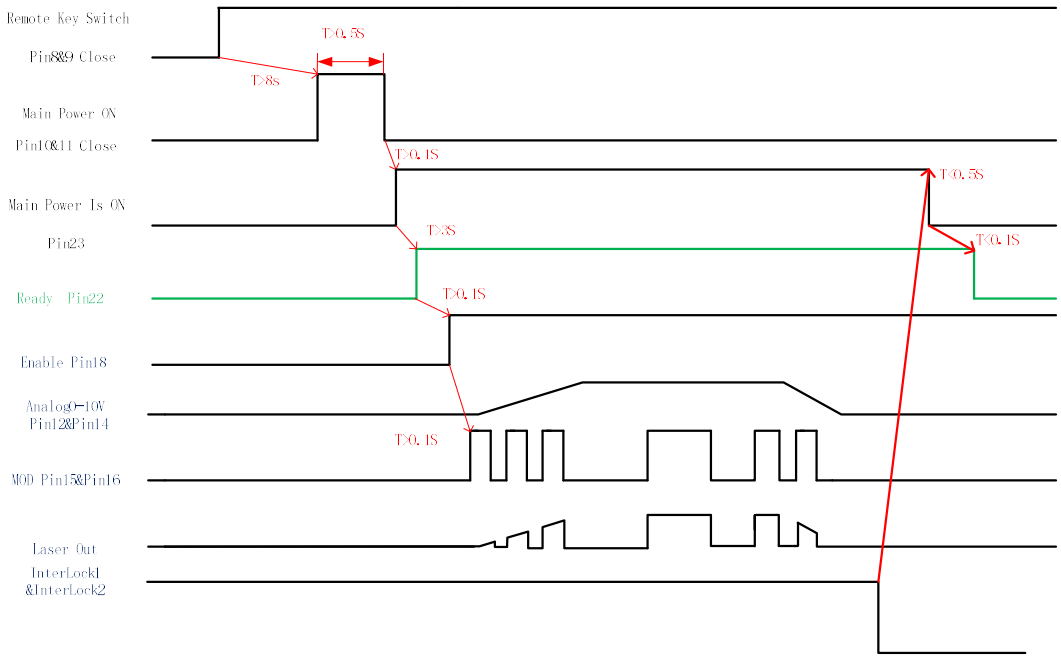


Figure 21 Control Timing Diagram

4.8 Red guide beam control

Table 17 Red guide beam external control mode

Red guide beam external control	
ON	17 pin of INTERFACE: Positive edge - turn on the red guide beam; Negative edge - turn off the red guide beam.
OFF	Host software: Red guide beam ON - turn on the red guide beam; Red guide beam OFF - turn off the red guide beam.

4.9 Laser power slow rise and fall mode

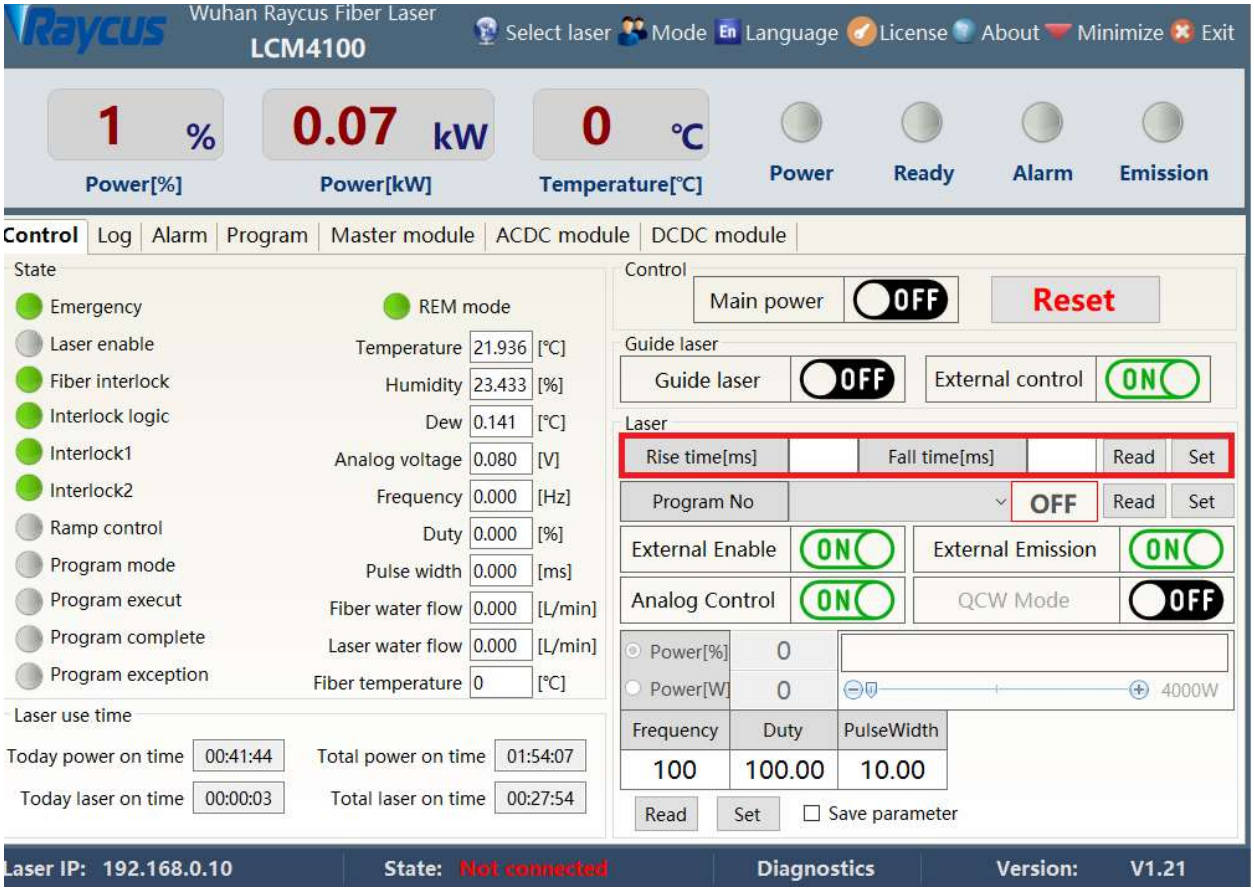


Figure 22 Slow rise and fall parameter menu

In the slow rise and fall setting, if any parameter is not 0, the laser will automatically enter the rise and fall mode, and if all the rise and fall parameters are 0, the rise and fall mode will be automatically turned off.

After the slow rise and fall mode is turned on, the laser performs the ramp-up program to the target power according to the set ramp-up time after the start of laser emission, and executes the ramp-down program to power 0 according to the set ramp-down time after turning off the laser.

4.10 Programming Mode (Waveform Editing)

4.10.1 Programming mode enabling method

In programming mode, the laser has waveform editing, storage and recall functions.

Table 18 Programming mode enable method

Programming mode	The laser emission is determined by the edited waveform
	Voltage of pins 15 and 16 of INTERFACE 24 pin: Rising edge - start the program to start executing Falling edge - terminate the program running
Closed: the current program number is 0	Do not execute programming

When the current program number of the laser is not 0, the laser is running in programming mode. Please use the Raycus software provided by Raycus to edit the waveform, and select the pre-running program number. The output waveform of the laser is determined by the edited waveform. When all the laser emission conditions are satisfied, the relationship between the laser emission and the programming waveform in the programming mode is as follows:

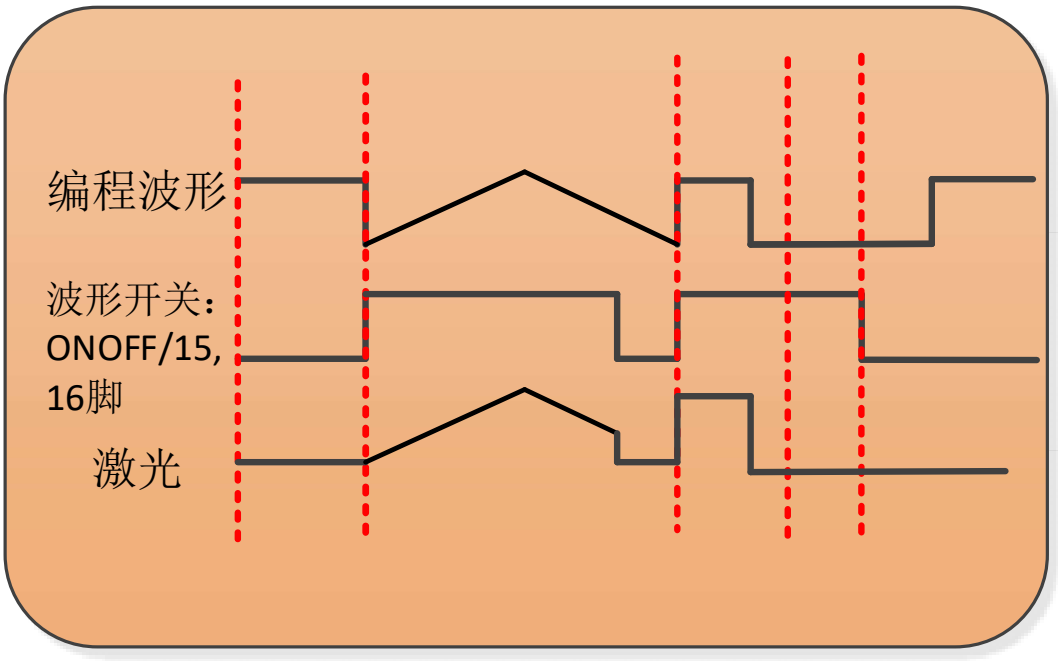


Figure 23 The relationship between laser emission and programming waveform in programming mode

4.10.2 Programming setting menu (waveform editing)

Check "Display Programming Mode" in the "Mode Selection" of the Raycus software.

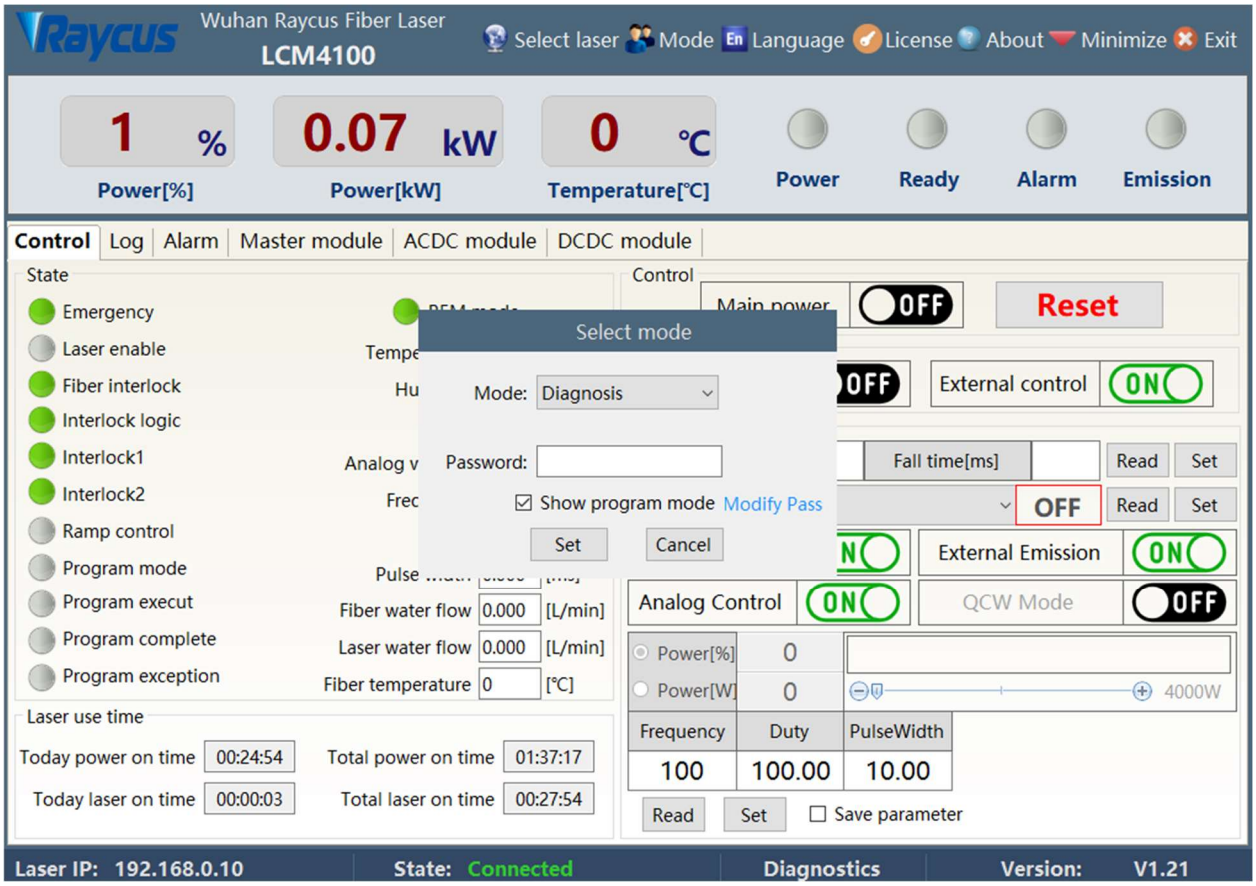


Figure 24 Check the display programming mode menu

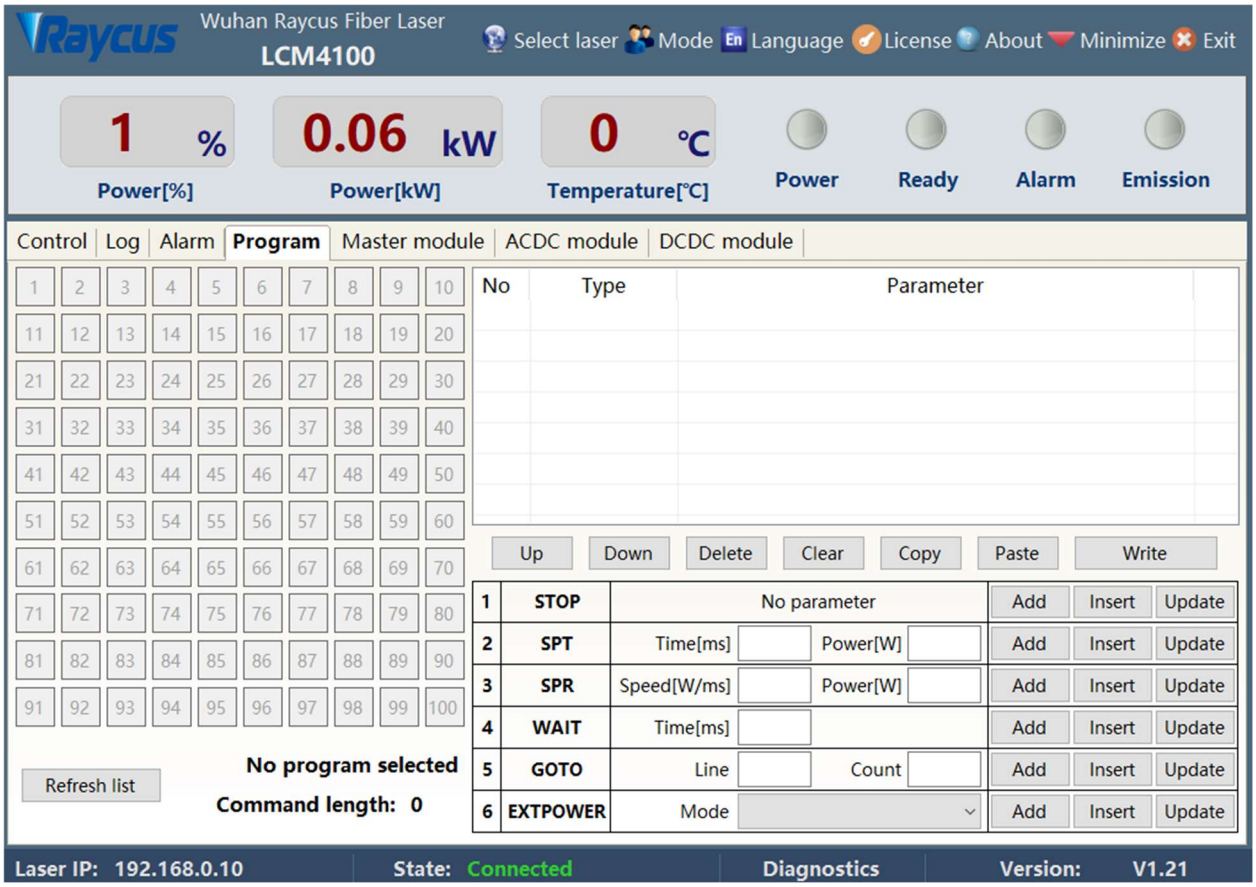


Figure 25 Programming mode menu

4.10.3 View the number of waveform

Figure 26 View the number of waveform bars

Click the "Refresh program list" button, the software will automatically list the number of waveform that have been saved, green indicates that this item has a program, and white indicates that this item is empty.

4.10.4 View waveform content

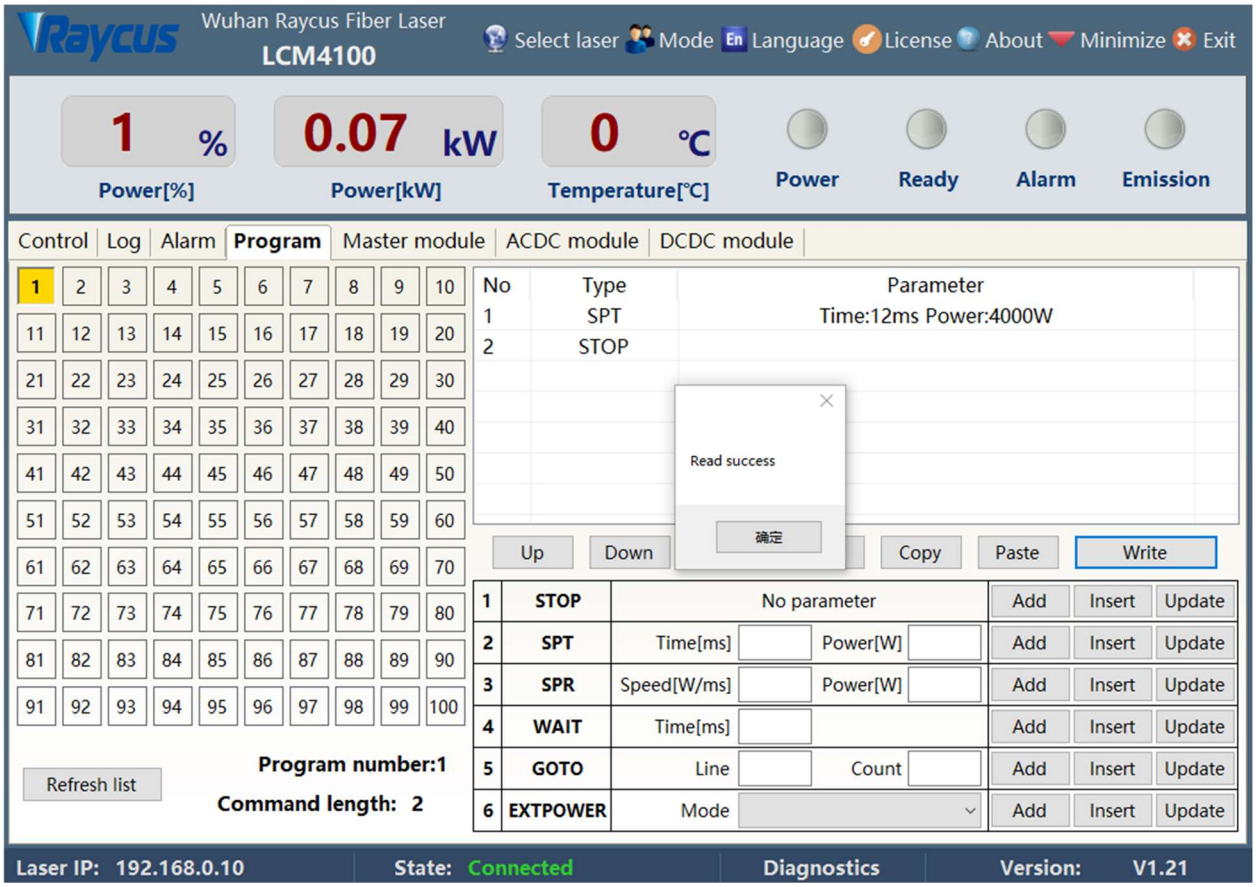


Figure 27 View waveform content

Click the waveform number to be read with the left mouse button, and the program will automatically list the original waveform list.

4.10.5 Clear all waveform

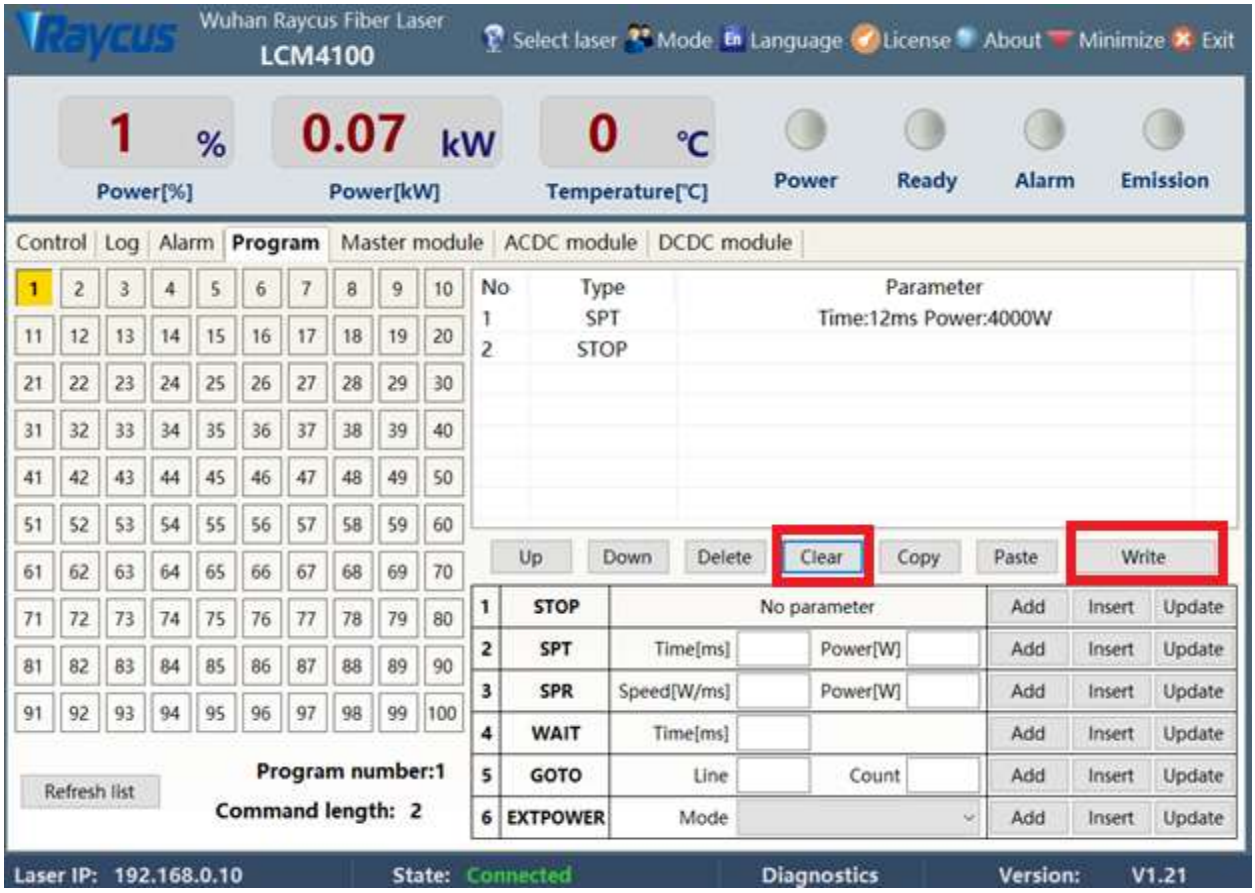


Figure 28 Clear the waveform

Click the program number that needs to be cleared, click "Clear", and then click "Write to Laser", the software will clear the waveform stored in the current laser.

4.10.6 Edit waveform

First left click on the pre-edited waveform number:

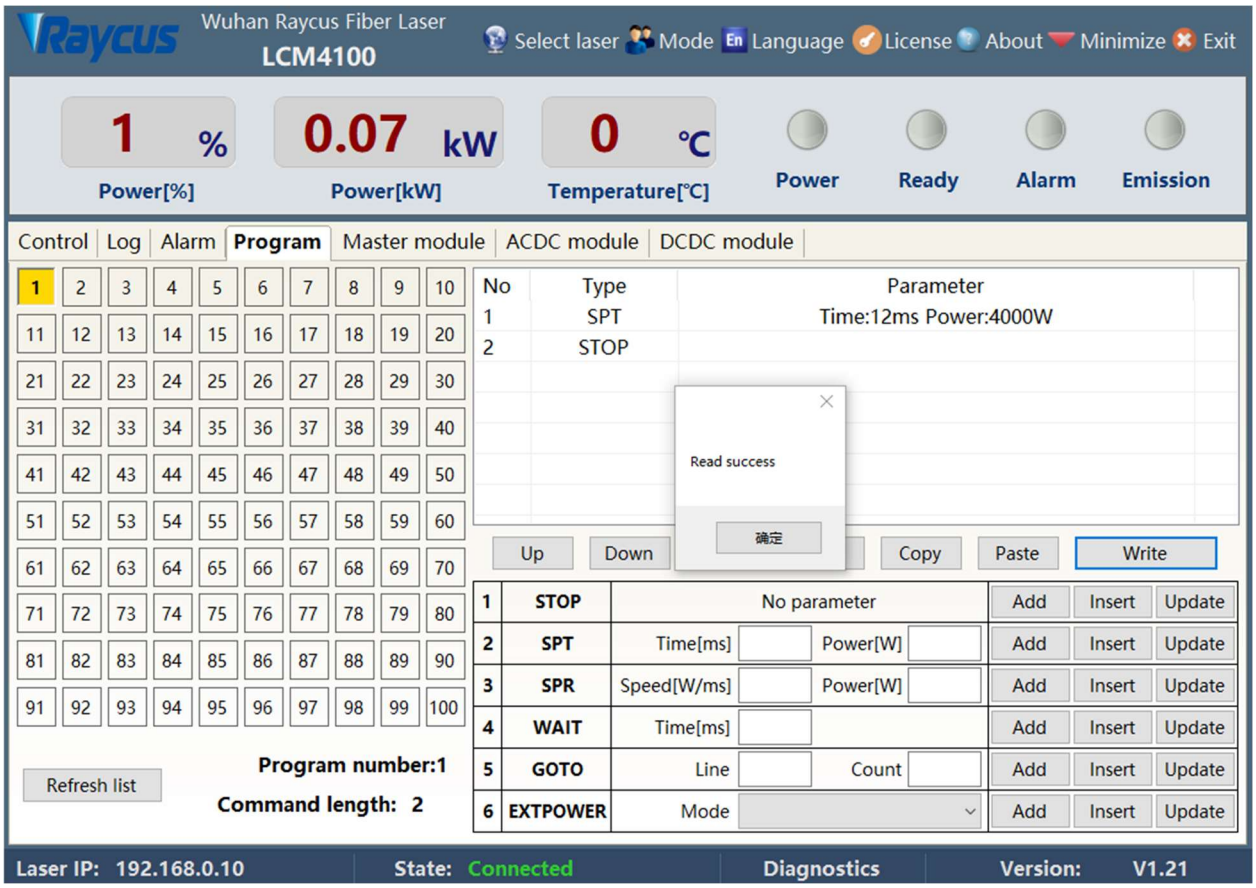


Figure 29 Edit the waveform

Select Command under Command Type, then write the command and click Add.

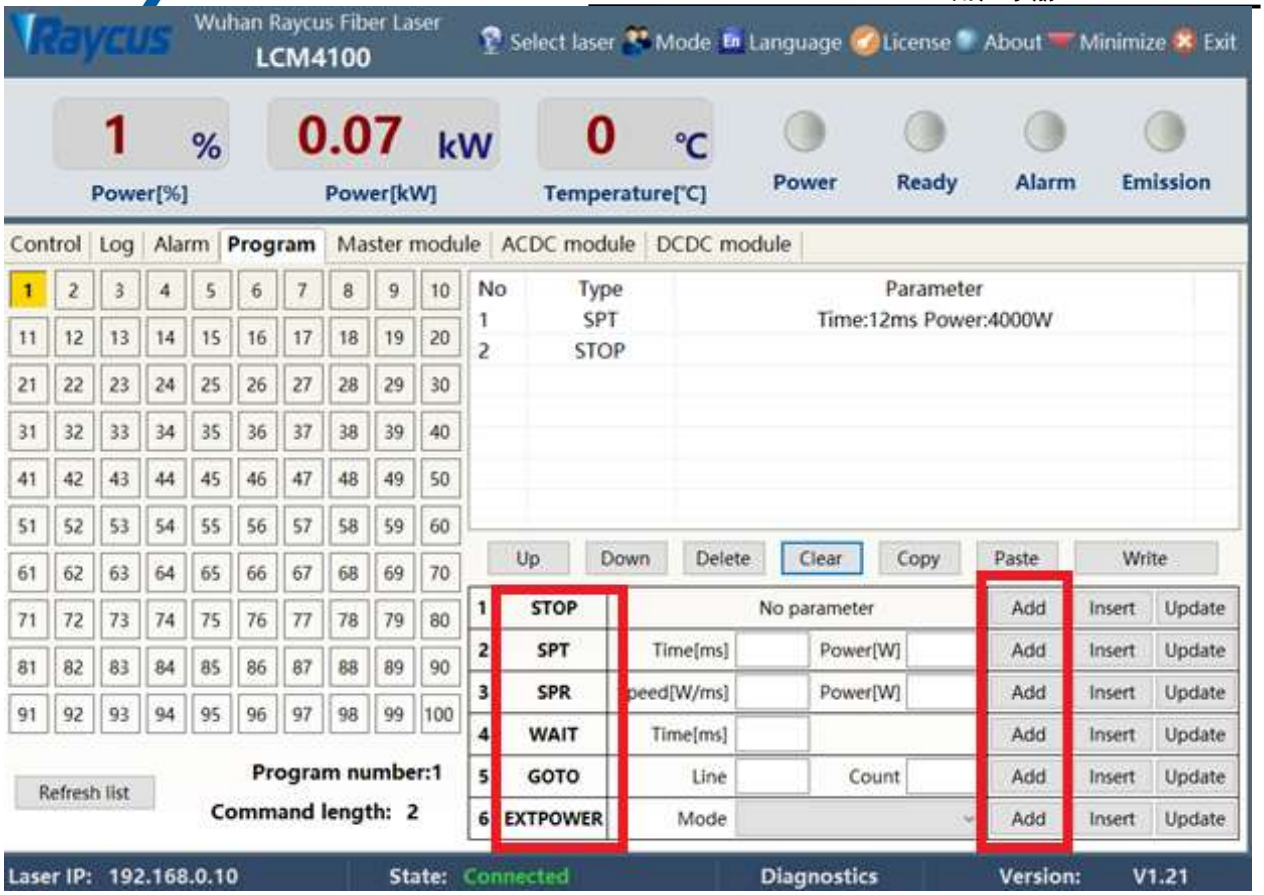


Figure 30 Select command

The command just now appears in the program list on the left. After editing all the commands, click "Write to Laser".

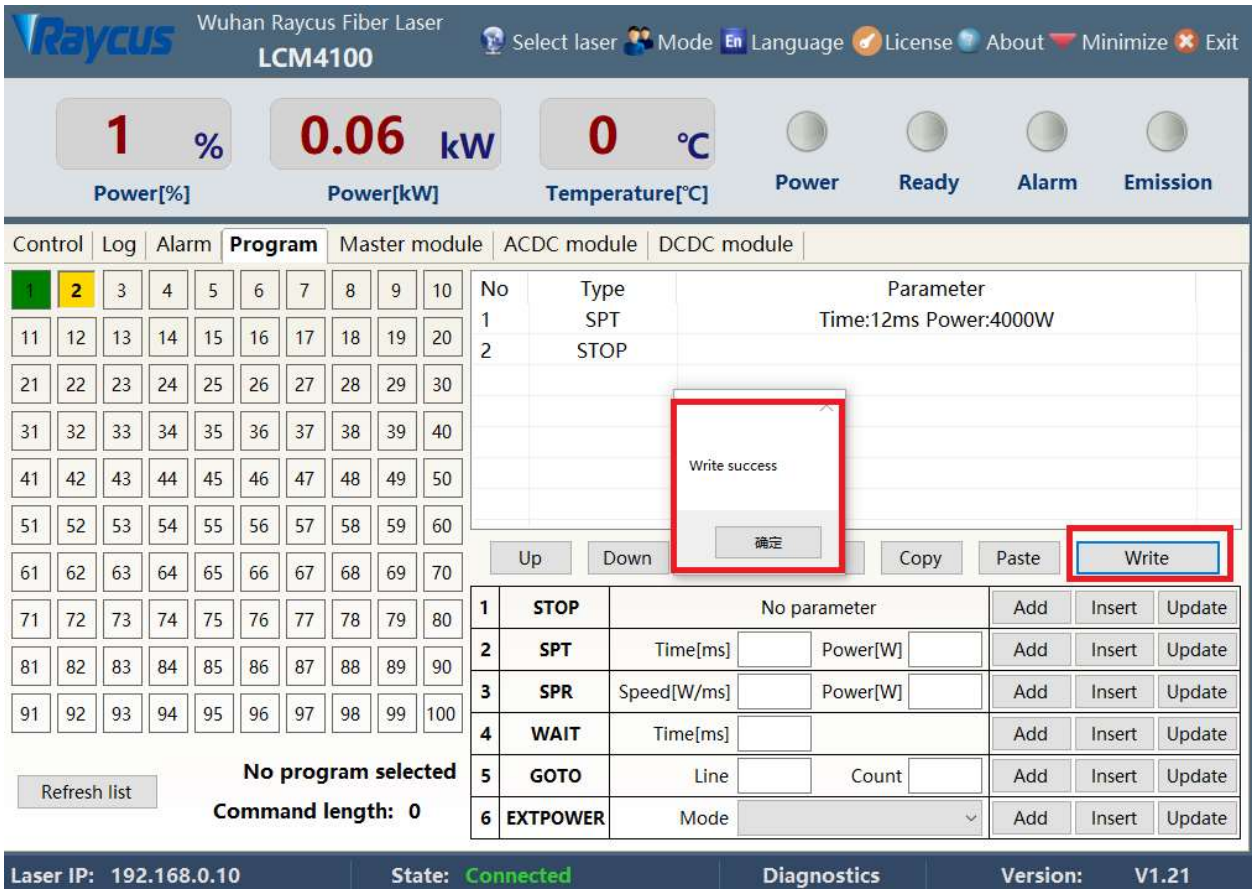


Figure 31 Waveform written successfully

Click "Refresh program list" again, and the newly added waveform number will turn green, indicating that the writing is successful. Click the program number, it will show that the read is successful;

4.10.7 Command interpretation

Table 19 detailed explanation of waveform command word

Command code (1 byte)		Parameter 1 (2 bytes)		Parameter 2 (4 bytes)		Description
1	STOP	None		None		The end-of-program command, which must be the last entry for each program
2	SPT	0-65000（ms）		0-65000(W)		It takes time for parameter 1 to change the power to parameter 2
3	SPR	0-65000（W/ms）		0-65000(W)		Change the power to parameter 2 by the rate of change of the power of parameter 1
4	WAIT	1	Wait time	0-65000ms(int)		
5	GOTO	0-99	line	0-10000	The number of times to jump to that row	The number of times the loop jumps to the line number
6	EXT Power	1	0-10V			

4.11 Steps of close

Turn off the lasers in the following orders:

a) Turn off the laser;

b) Disconnect the 1/4 and 2/3 pins of the CTRL-INTERFACE;

c) Disconnect the pins 8/9 of the CTRL-INTERFACE;

d) Turn off the chiller;

e) Disconnect the air switch;

f) Close the head protection cap.

5.Common alarms and handling measures

5.1 Alarm display

Connect to the computer and turn on the Raycus software, all alarm states of the laser can be displayed on the Raycus software menu, as shown in Figure 30.

The laser will alarm when the internal temperature of the laser is abnormal, the power is abnormal, the scattered light is abnormal, the power supply is abnormal, the condensation is abnormal, the flow is abnormal, etc.

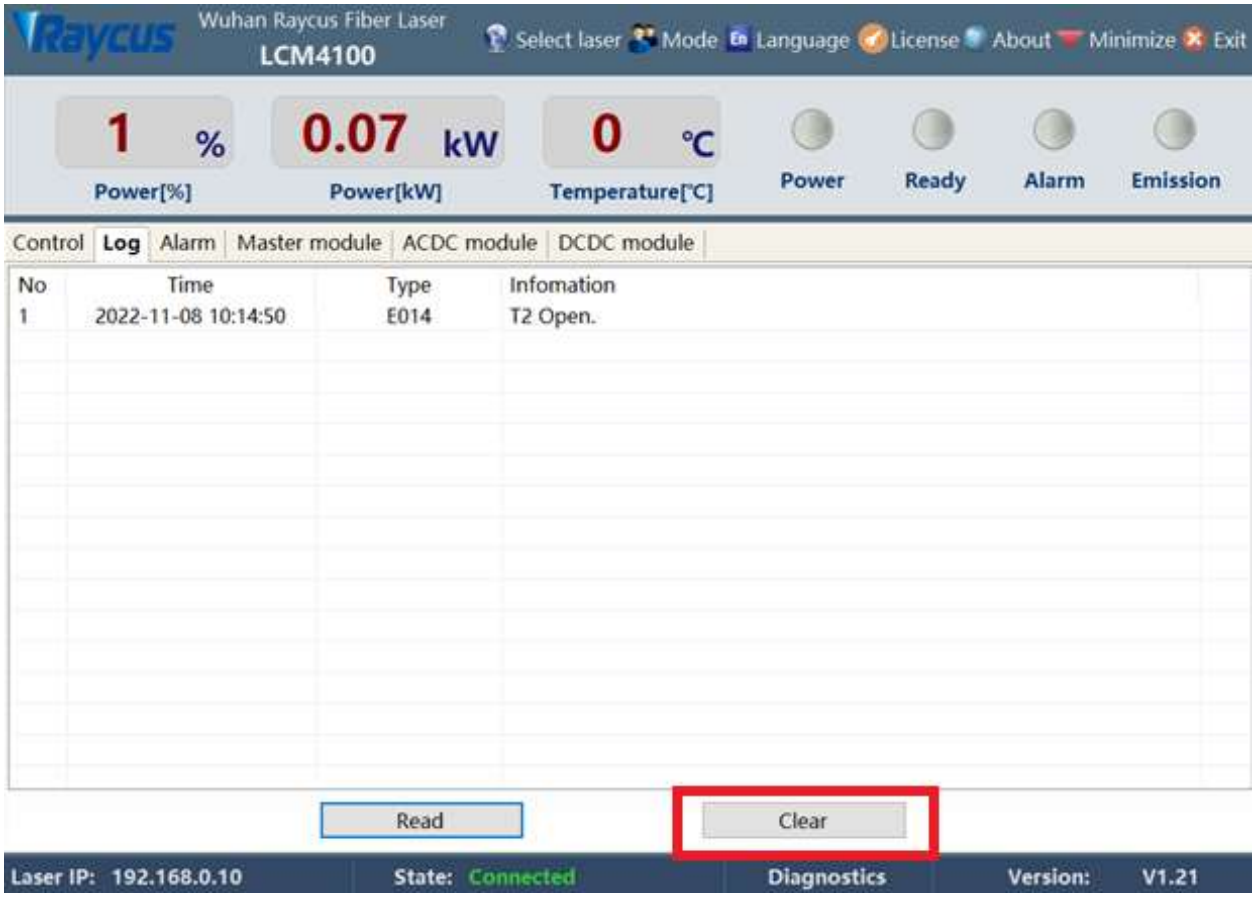


Figure 32 The main menu of the Raycus software

When the laser is running, any alarm occurs (except for the Interlock abnormality), the Raycus software menu will display the alarm, and the ALARM light (yellow one) on the front panel of the laser will light, and the laser will stop emitting light and lock.

When the Interlock abnormality occurs, the “laser output Ready” signal is low, and at the same time, the software indicates the Interlock abnormality, but the laser does not lock and the ALARM light (yellow) does not light up. Immediately after Interlock is normal, the laser will output a Ready signal to a high level.

5.2 Alarm Handling

Typical laser alarm descriptions and possible solutions are as follows:

Table 20 Laser alarm description and possible solutions

Alarm type	alarm description and possible solutions
T1/T2 Alarm（Temperature alarm - low temperature alarm and high temperature alarm）	**Alarm Description:** Laser low temperature/high temperature alarm, which occurs when the sensor inside detects an abnormal temperature inside the laser. A high temperature alarm is generated when the temperature of the monitoring point exceeds the set upper limit, and a low temperature alarm is generated when the set lower limit is exceeded. **Possible solutions:** In the event of a high temperature alarm, please check whether the water cooling system is turned on normally, whether the water temperature setting is correct, whether the chiller is working normally, whether the water connection is abnormal, etc. When the water cooling system is working normally and the water temperature drops below 30°C, please restart the laser to try. In the case of low temperature alarm, please check whether the actual water temperature of the chiller is too low. In addition, too low ambient temperature may also cause a low temperature alarm when the laser start at a cold machine state. If the above situation occurs, you need to wait until the chiller water temperature rises above 10 °C, and then restart the laser to try.
Hum Alarm（Condensation alarm）	**Alarm Description:** Laser internal condensation alarm means the laser detected the current laser internal dew point temperature < 22 °C, there is a risk of condensation. **Possible solutions:** Stop using the laser immediately. Please follow the operation requirements to induct cold and dry air from the CDA interface, drain moist air from the cabinet, or improve the working environment of the laser so that the ambient temperature is lower than the internal temperature of the laser, it is recommended to build a separate air-conditioned room for the laser.
Laser Water flow（Laser water flow alarm）	**Alarm Description:** Laser water flow alarm, the laser internally detected that the current water flow is lower than the required value, there is a safety risk. **Possible solutions:** Stop using the laser immediately. Please follow the laser operation requirements of [Section 3.3 Cooling System Installation and Requirements], check the output model and working status of the laser water cooler, and clean the laser inlet water filtration assembly. It is recommended to clean the water cooler and inlet filter assembly and replace the cooling water regularly.
Scattered Light Alarm	**Alarm Description:**

	Scattered light alarm, when the ambient light intensity of the laser exceeds the set value, the scattered light alarm is generated, and the laser light output function is locked (not unlockable). Scattered light alarms only occur when the laser is emitted. **Possible solutions:** Restart the laser, check the red light status indicated by the laser, read the scattered light monitoring voltage value through the "slave module" of the Raycus software, and contact Raycus.
Laser Power Alarm	**Alarm Description:** Power alarm, power alarm is generated when the output power of the laser cannot reach the set value. The power alarm only occurs when the laser is emitted. **Possible solutions:** Check the red light status and contact Raycus.
ACDC Alarm（Power alarm）	Alarm Description: Laser power alarm, laser power supply failure or sudden power supply restart of the power supply system may cause this alarm. Possible solutions: Check whether the input AC voltage is normal, restart the laser to try if input AC voltage is normal, and contact Raycus if the alarm continues to occur.
Current Driver Alarm（The current driver board alarm）	**Alarm Description:** The current drive board alarm, which occurs when the constant current drive board inside is abnormal. **Possible solutions:** Try rebooting the laser and contact Raycus if alarms continue to occur.

In addition to the above alarms, if there is any problem or alarm in the using the laser, Please contact Raycus for help.

6.Warranty, Return and Maintenance

6.1 General Warranty

Raycus warrants that all Raycus fiber laser products are conformed to applicable product specifications under normal use and are free from defects in materials and workmanship.

The warranties start on the date of shipment from Raycus for a period of time as set forth in the applicable purchase contracts or product specifications. Raycus has the right to selectively repair or replace any product that proves to be defective in materials and workmanship selectively during the warranty period. Only products with particular defects are under warranty. Raycus reserves the right to issue a credit note for any defective products produced in normal conditions.

6.2 Limitations of Warranty

The warranty does not cover the maintenance or reimbursement of our product of which the problem results from tampering, disassembling, misuse, accident, modification, unsuitable physical or operating environment, improper maintenance, damages 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 write to us within 31 days after the defect is discovered. This warranty does not involve any other party, including specified buyer, end-user or customer and any parts, equipment or other products produced by other companies.

	◆ 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 delivery fiber and connectors are not covered by this warranty.

6.3 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.

All repaired or replacement products must be placed in the original packaging box provided by Raycus, otherwise Raycus will have the right not to repair any product damage caused by the package.

When you receive Raycus products, please check whether the products are intact and undamaged in time, and contact the carrier or Raycus in time if there is any problem.

6.4 Scrapping Requirements

If the fiber laser has reached the service life or has serious failure and has no repair value or meets other scrapping conditions, the recycling treatment shall meet the "Regulations on the Administration of Recycling and Treatment of Waste Electrical and Electronic Products".

We reserve the right to make changes in design or constructions of any of our products at any time without incurring any obligation to make changes or install the same on units previously purchased.

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