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名称 RFL-C1500W~RFL-C6000W

连续光纤激光器英文说明书

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Continuous-Wave Fiber Laser

User Guide

RFL-C1500W~RFL-C6000W

Wuhan Raycus Fiber Laser Technologies Co., Ltd.

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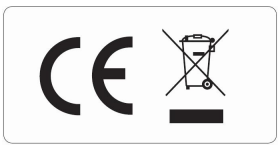
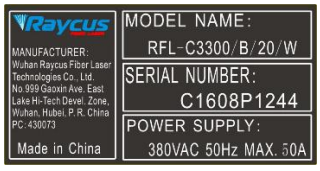
1 Safety Information

Thank you for choosing Raycus fiber laser. This User Guide provides important safety, operation, warranty and other information. Please read it carefully before 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 Security Identifier

	**WARNING:** Describes a hazard that lead to a personal injury or death.
	**CAUTION:** Describes a hazard that lead to a minor personal injury or product damage.

		
1: Laser Emit Head	2: Type 4 Laser Product	3: Class 2M Laser Product Label-2mW Red Laser
		
4: CE Authentication	5: ID Label	6: Laser Radiation Hazard
		
7: Electrical Hazard		

1.2 Laser Safety Grade

According to the European Community standards EN 60825-1, clause 9, this series of lasers are classified as a high power Class 4. This product emits invisible laser radiation at wavelength of 1080 nm, and the light power is 1500-6000W up to machine. Direct or indirect exposure of high power of laser radiation may cause damage to the eyes or skin. Despite the radiation being invisible, the beam may cause irreversible damage to the retina and cornea. Appropriate and approved laser goggles must be worn all the time during the laser device is opearting

	**WARNING:** Users must use appropriate laser goggles when operating this device. The laser goggles is selected according to the range of wavelength emitted from this product. Users must ensure that the pretect range of laser goggles over the entire range of laser wavelengths. Please do not directly view the laser output head when laser emitting.

1.3 Optical Safety

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

	**CAUTION:** DO NOT emit when the protective cap is not removed, otherwise the lens or crystal will be damaged.

1.4 Electrical Safety

1) Ensure the 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.

2) 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

1）Do not directly view the laser output head when laser emitting. Avoid using the laser in a dark environment.

2）Do not use fiber lasers in dark environments.

3）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.

4）There are no user serviceable parts, equipment or assemblies inside the product. All service and maintenance shall be performed by Raycus. In order to prevent electric shock, please do not break the seal or uncover the shield. Failure to comply with this instruction will void the warranty.

2 Product Description

2.1 Features

Raycus CW fiber laser is designed for industrial and scientific research applications with high pump conversion efficiency, low power consumption and excellent beam quality. It is compact and ready to use. It can be used as a stand-alone unit or easily inserted into user's apparatus.

Main Features:

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

Applications:

- Cutting
- Welding
- Scientific research

2.2 Package Parts

Please refer to package accessoriesare in the packing box.

2.3 Unpacking and Inspection

Raycus CW fiber laser is delivered in a package, which is designed to offer the maximal safety. Upon the delivery, please inspect all packaging for evidence of mishandling or damage. If you find any evidence of mishandling, please keep the damaged material and contact the shipping agent and Raycus immediately.

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

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.

	**CAUTION:** 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.

2.4 Operation Environment

The operation conditions are listed as the following table:

Table 1: The Operation Environment Conditions for the Laser

Model	**RFL-C1500**	**RFL-C2000**	**RFLC-3300**	**RFC-C4000**	**RFC-C6000**
Power Capacity	≥6kW	≥7kW	≥10.5kW	≥13.6kW	≥20.5kW
Installation Environment	Flat and no vibration				
Ambient Temperature	10℃~40℃				
Relative Humidity	≤70%				

(1) Make sure the product is properly grounded before use.

(2) 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.

(3) Failure to follow the instructions when operating the laser may cause malfunction and damage.

(4) It is not allowed to install the output head when the laser is in operation.

(5) Do not look into the output head directly. Wear appropriate protective eye glasses all the time when operating the laser.

It is recommended to install the product in an environment with air conditioning.

2.5 Attentions

(1) Make sure that the correct voltage of 380VAC is used. Failure to connectly connect power supply will damage the device.

(2) The output laser is collimated by the collimating lens, it is important to keep the collimating lens clean, otherwise it will damage the device.

(3) 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.

(4) Safety keep the cap when using the laser. To avoid dust, make sure the opening direction of the cap is put down.

(5) Failure to follow the instructions may cause laser power loss, such loss is not covered by warranty.

2.6 Specifications

Table 2 Product Specifications

Model	**RFL-C1500**	**RFL-C2200**	**RFL-C3300**	**RFL-C4000**	**RFL-C6000**	**Test Conditions**
Optical Characteristics						
Output Power(W)	1500	2200	3300	4000	6000	
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℃
Modulation Frequency(Hz)	50~20k		50~5k			Nominal Output Power
Red Guide Laser Power(mW)	0.5~1					
Optical Output Characteristics of QBH head						
Beam Quality (BPP, mm•mrad)	<2.3/<4.5		≤5			Nominal Output Power
Core Fiber(μm)	50/100		100			25、100、200 are optional

Delivery Cable Length(m)	20					10、15 are optional
Electrical Characteristics						
Power Supply	AC 380V±10%、50/60Hz、3L+N+PE					
Max. Power Consumption(W)	6000	7000	10500	13600	20500	
Control Mode	RS-232/AD					
Other Characteristics						
Dimensions(W×H×D)	650×900×980		650×900×1480		1200×953×1230	(inc. Handles 、lifting ring and air conditioner)
Weight(kg)	≤150		≤250	≤350	≤450	
Operating Ambient Temperature (℃)	10~40					
Humidity(%)	<70					
Storage Temperature(℃)	-10~60					
Cooling Method	Water Cooling					

3 Installation

3.1 Dimensions

Figure 1 shows dimensions of the product.

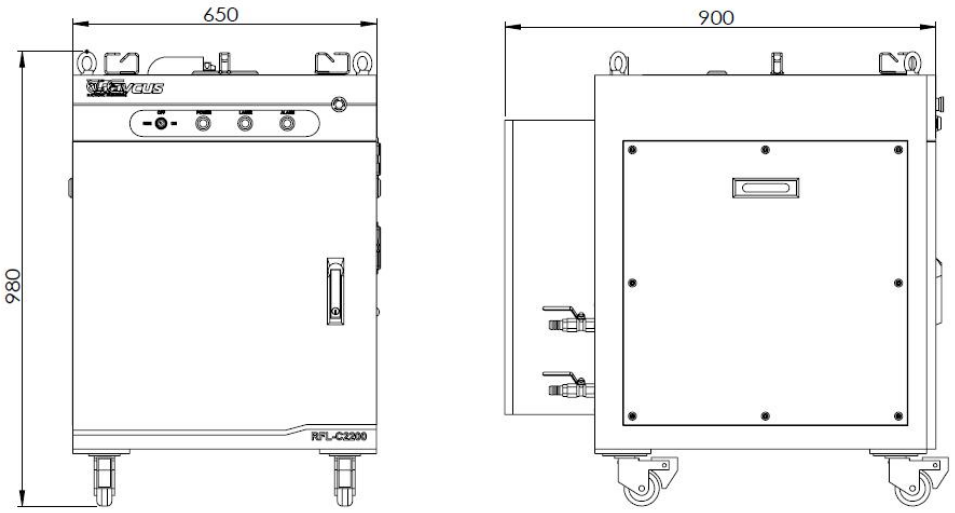


Figure 1(a) Dimensions of 1500/2200W Product (unit:mm)

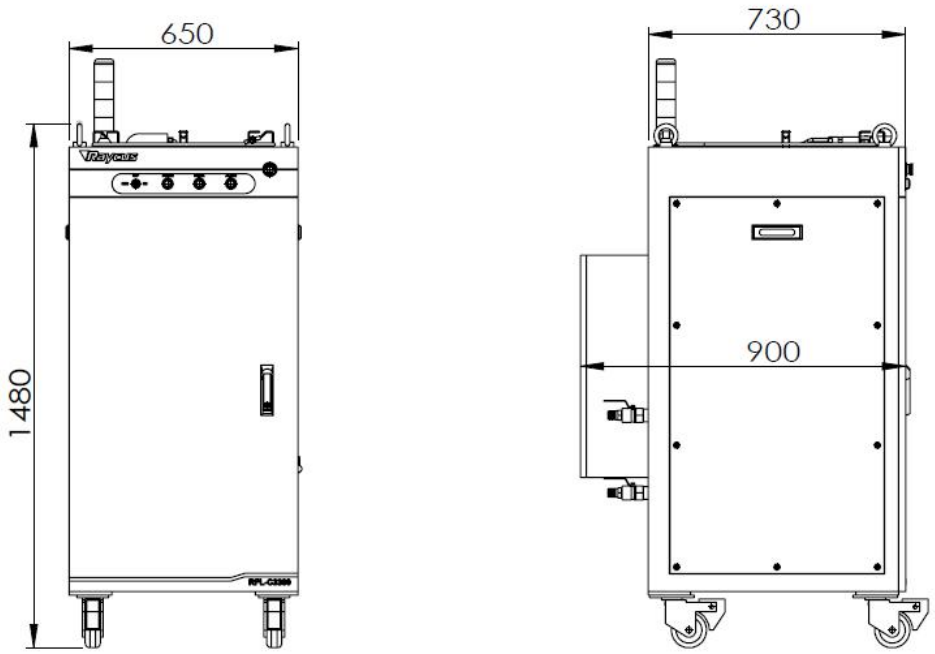


Figure 1(b) Dimensions of 3300/4000W Product (unit:mm)

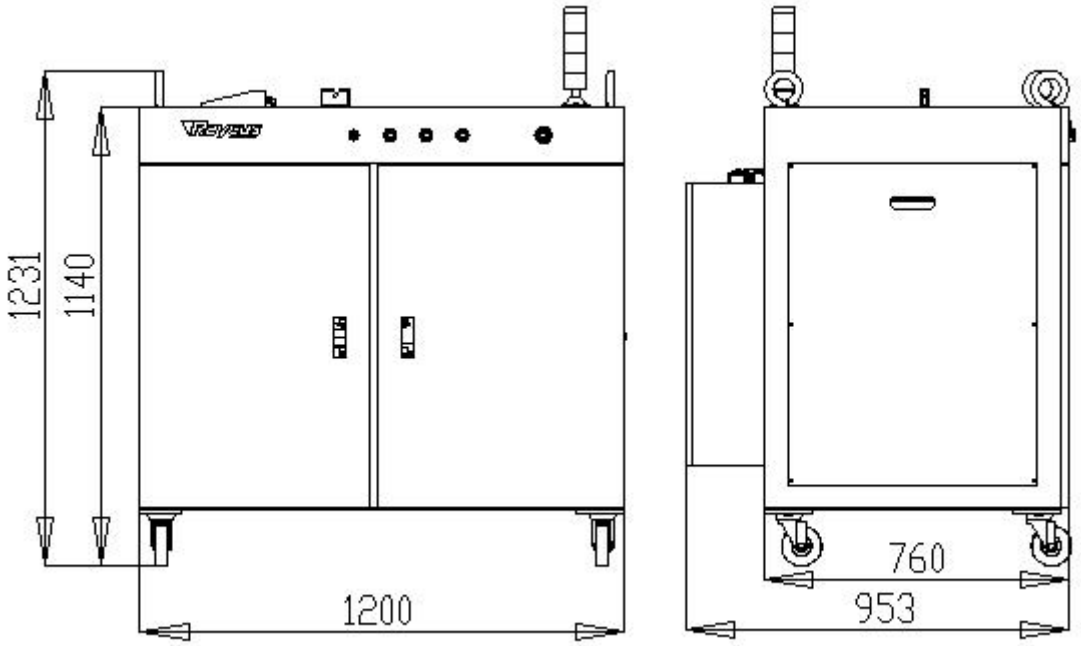


Figure 1(c) Dimensions of 6000W Product (unit:mm)

The output head is RFL-QBH or QCS, the following figure 2 and figure 3 show the details of the output head.

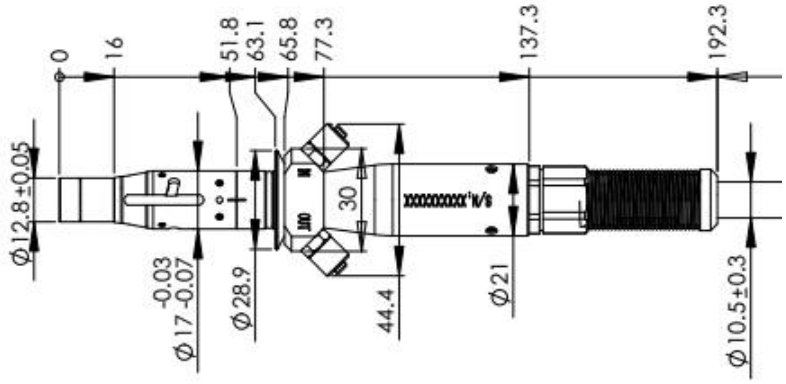


Figure 2: RFL-QBH Output head (unit: mm)

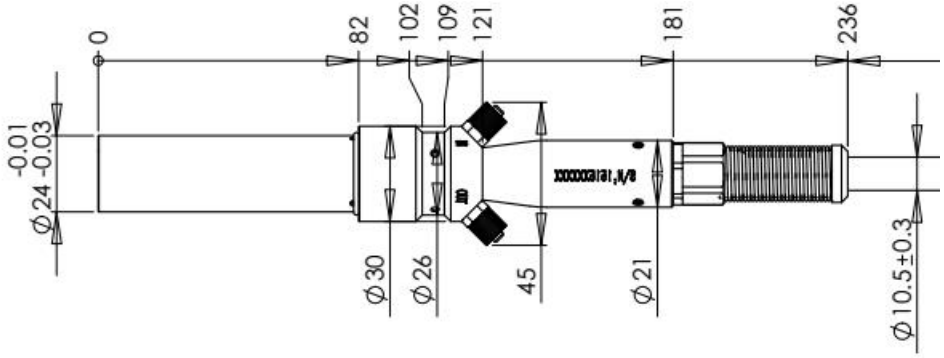


Figure 3: QCS Output head (unit: mm)

The two interlock pins on the output head must be shorted before the laser is turned on, otherwise the device can not work normally.

3.2 Installation rule

(1) Place the product in an appropriate position, immobilize it if necessary.

(2) Check if the power supply has the correct voltage (380VAC±10%，50/60Hz), and the earth line is connected, make sure it is firm and reliable.

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

(4) Clamp the water pipes ontopipe connector, run the chiller to check if there is any leakage in the water circulation.

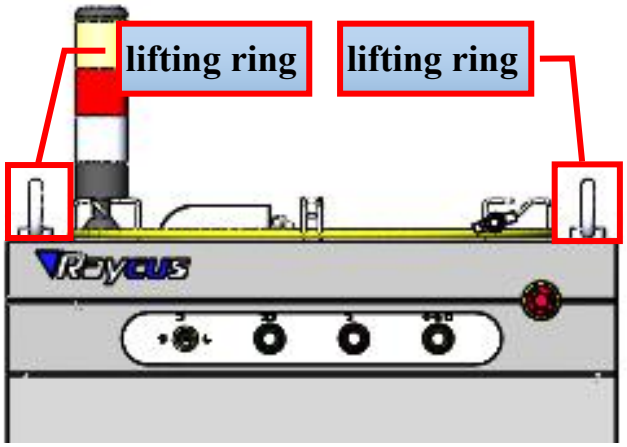
(5) Check the output head and clean it before installation. This procedure must be performed by Raycus personnel or person authorized by Raycus.

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

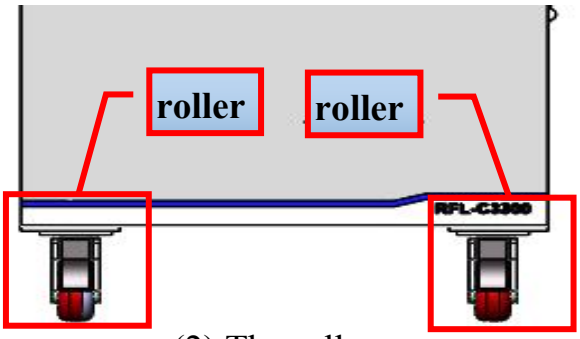
(7) Make sure the environment is clean, or the output head may be contaminated. It is prohibited to use fan during installation, which will cause dust in the air.

(8) The minimum bending diameter of the transmission cable of the laser shall not be less than 20cm in the non-working state (such as transport and storage). The minimum bending diameter should not be less than 30cm when the laser is work.

(9) Users can employ four lifting rings or rollers on the top or bottom of the device to carry or move it, as shown in figure 4 (please check whether the lifting rings are installed firmly and whether the rollers are fully mobile before transporting the device).



(1) the lifting ring



(2) The rollers

Figure 4 lifting rings and rollers on the top or bottom of the product

	**CAUTION:** All the cables can only be connected when power supply is off. Hot plug may damage the device.

	**CAUTION:** (1) Ensure that there are no fiber bends in radius less than 30cm when the product is installed. Avoid excessive twisting and tight bends during the robotic arm movements. (2) Tight bends will damage the laser delivery system.

	**CAUTION:** (1) Keep the protective cap properly, prevent it from contamination; Or the aperture will be contaminated when capped. (2) Make sure the aperture and the cavity of the processing head is

	clean.

3.3 Cooling Requirements

Table 3 Cooling Requirements

Parameter	Unit	1500W	2200W	3300W	4000W	RFL-C6000
Cooling Capability	kW	≥5	≥7	≥10	≥12	≥20
Minimum Flow	L/min	15	25	35	45	52
Maximum Pressure	Bar	7	7	7	7	7
Water-cooling pipe connector	mm	Pagoda-Typepipe connector,outside diameter 19mm				

Temperature setting of cooling water:

Summer (ambient temperature above 30℃): 29±0.5℃

Winter (ambient temperature below 30℃): 25±0.5℃

Requirements on Cooling Water:

(1) Purified water should be used.

(2) In order to prevent the growth of mould that may lead to blockage, adding alcohol solution to about 10% of the total volume is recommended.

(3) If ambient temperature is between -10℃ and 0℃, we recommend to use 30% alcohol(volume ratio), and replace it every 2 months.

(4) If ambient temperature is below -10 ℃, the chiller with both heating and cooling functions must be used, and keep it in full-time operation.

Other requirements:

(1) Before start the device, ensure that the flow and return connections are correct connected, and confirm that there is no leakage in all the water circuits. Any

abnormal condition in the water circuits may cause a failure to the operation of the laser.

(2) If the device is not use in a long time, water must be emptied from the device, and then both the inlet and outlet must be blocked with the caps. Failure to do so may cause damage to the device.

(3) 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.

	**CAUTION:** Please set the water temperature according to the requirements above. Setting the temperature too high may cause an abnormal performance; and liquid water may be condensed on the laser module or the output head if a too low temperature is set, which may cause serious damage to the device.

	**CAUTION:** The cooling system should be turned on first. Check any water leakage and make sure that the water temperature reaches the set point before you start the laser. (Summer: 29±0.5℃ Winter: 25±0.5℃)

4 Using the Product

4.1 Front Panel

Figure 5 shows the front panel.

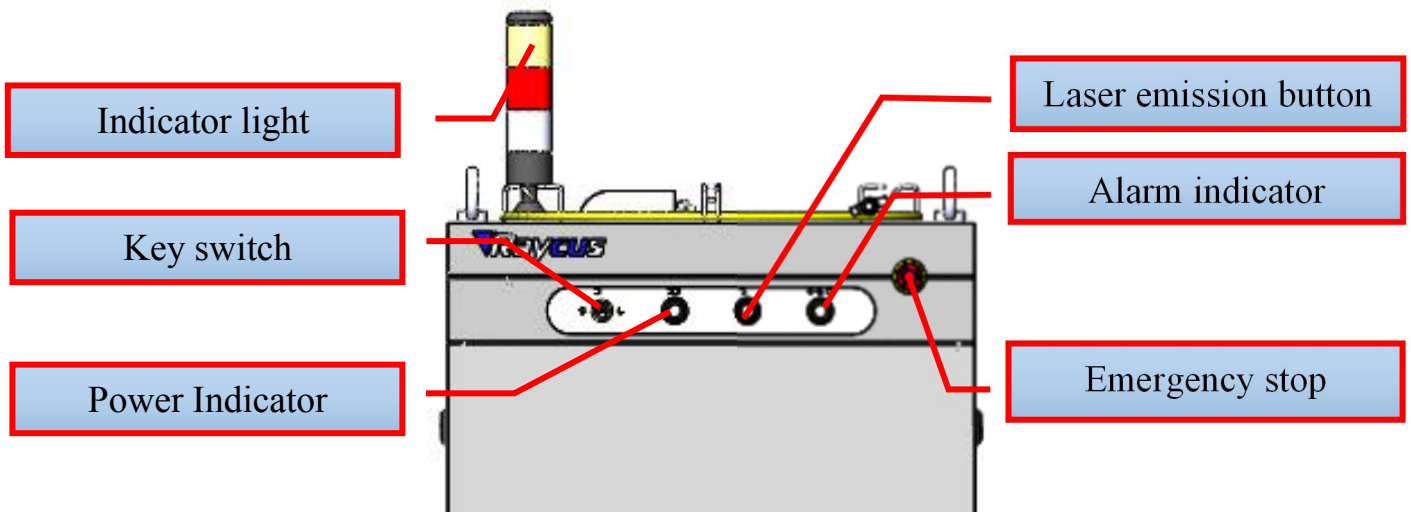


Figure 5: Front Panel View

REM/OFF/ON: Key switch, the power switch of the laser. Insert the key and then turn the key clockwise to the 'ON' position or counterclockwise to 'REM' position to active the laser. Then the laser will enter a control mode depending on your previous setup on the 'CTRL-INTERFACE'. You can refer to **4.6 Entering a Control Mode** for more details.

POWER: Power Indicator, indicates that the power is switched on when the green LED illumines.

LASER: Laser emission button, it's a button with an red LED indicator. In RS-232 mode and AD mode, when this button is pressed down, the product is ready to emit laser, and the LED illumines. Press again will release the button, and disable the laser emission.

ALARM: Alarm indicator, indicates a fault condition when the yellow LED illumines.

EMERGENCY STOP: Press it down to stop the laser immediately. Turn it clockwise to release, but the laser cannot start before it's powered on with key switch for a second time.

INDICATOR LIGHT： When the laser key switch hits "ON" or "REM", the green indicator light is ON.The red indicator light brights when the laser emitting.When the fault occurs, the yellow indicator light is on, accompanied by an alarm.

4.2 Rear Panel

Figure 6 shows the rear panel.

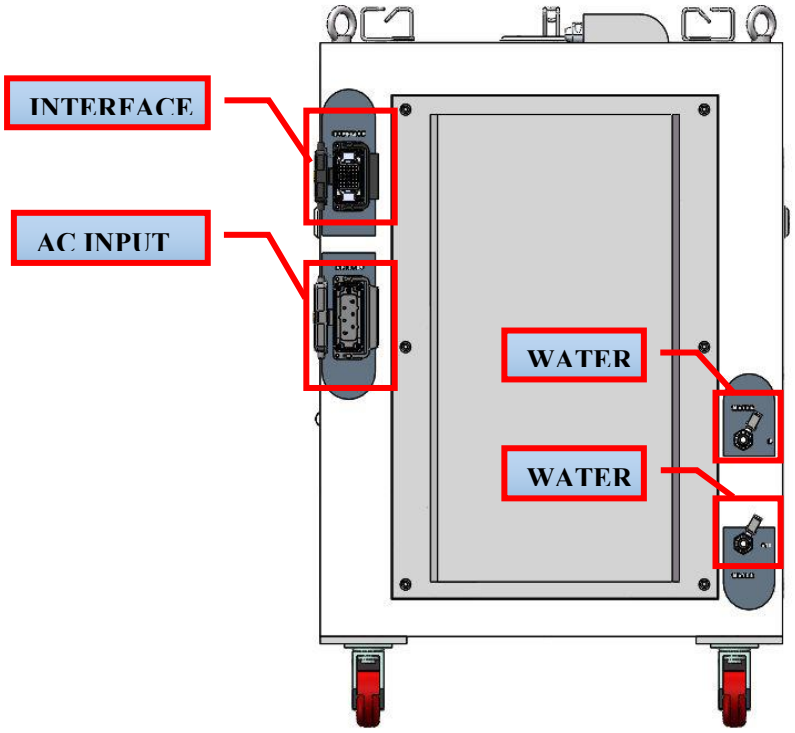


Figure 6(a): Rear Panel View of 1500/2200W Product

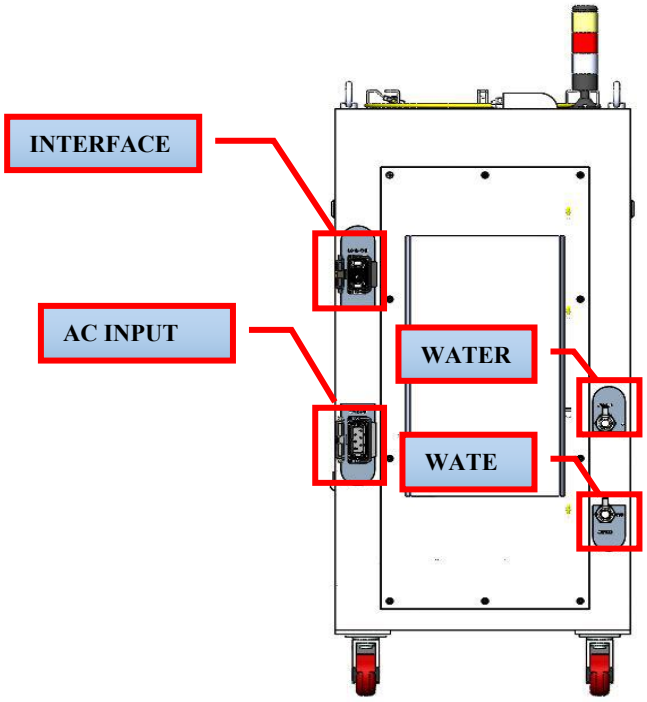


Figure 6(b): Rear Panel View of 3300/4000W Product

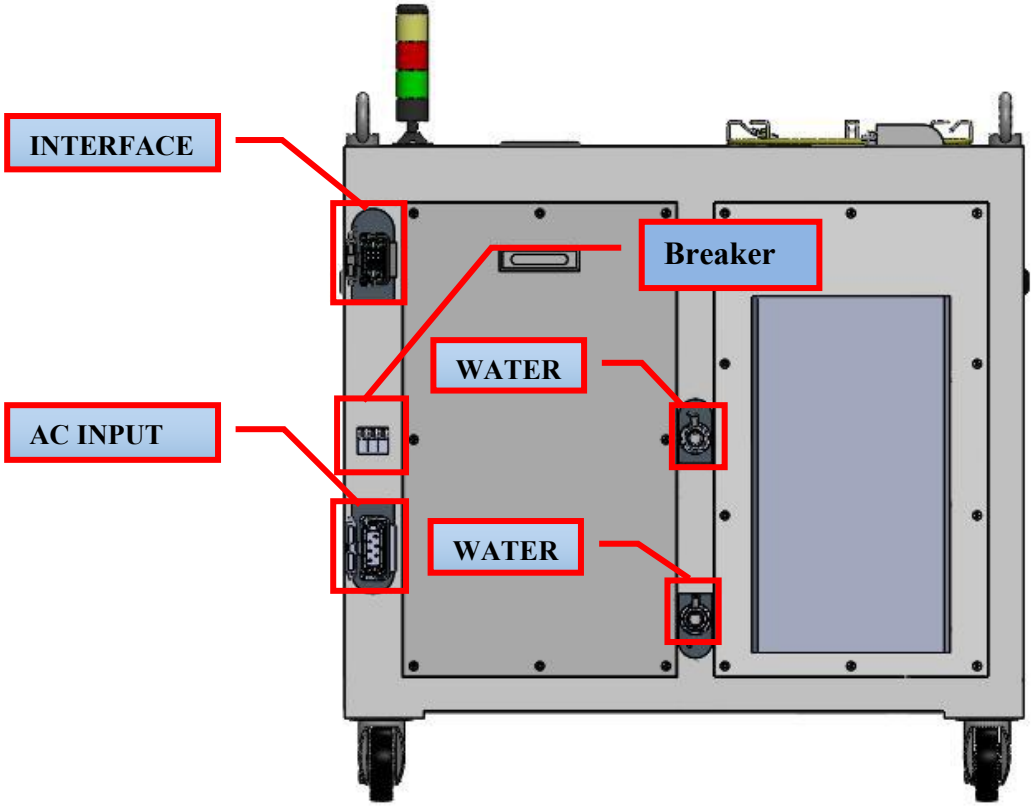


Figure 6(b): Rear Panel View of 6000W Product

AC INPUT: The socket for supply input that can be only mated with the plug on the power cord we provided. The socket is provided with a protective cover and a lock catch. Please use the protective cover and lock catch when not use the laser device.

INTERFACE: Control interface. This interface provides all control signals, including RS232 communication, laser switch control, laser remote control mode selection, analog control, modulation signal, Interlock interface. Please reference table 4 for specific definition of control line. The socket is provided with a protective cover and a lock catch. Please use the protective cover and lock catch when not use the laser device.

WATER: The pagoda type pipe connector. The intake and outlet are used for inflow and reflux cooling water.

The Circuit breaker which is located on the side panel is the power switch of the device, as shown in figure 7.

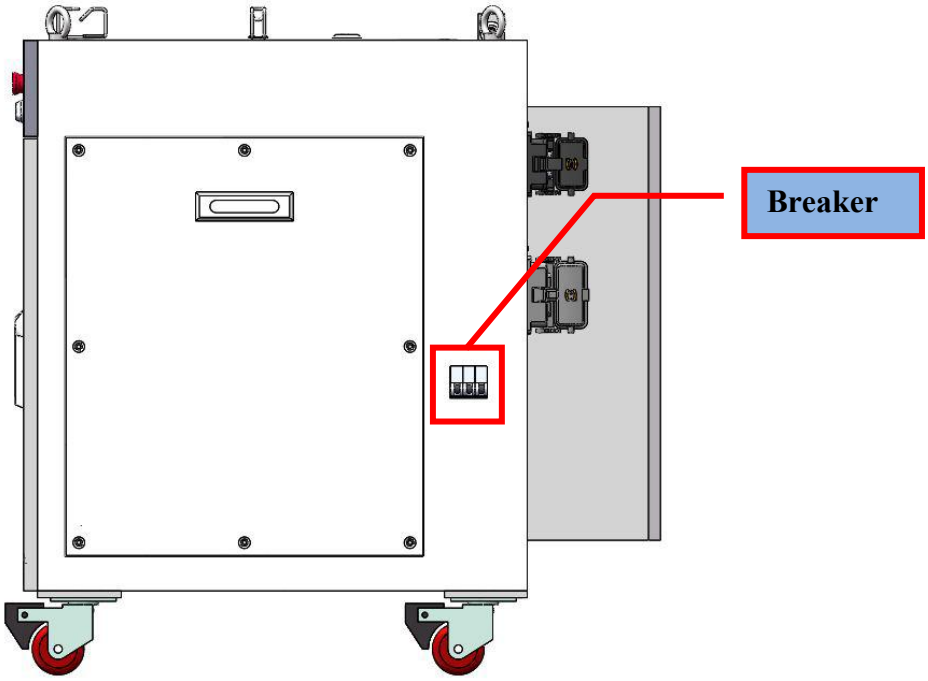


Figure 7: Side Panel View of 1500/2200W Product

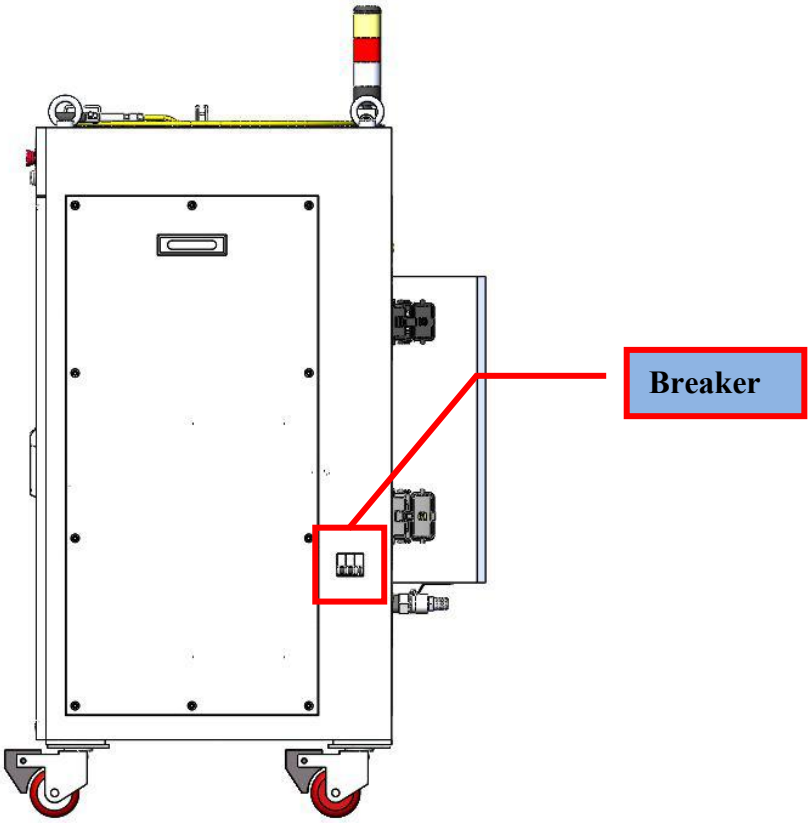


Figure 7: Side Panel View of 3300/4000W Product

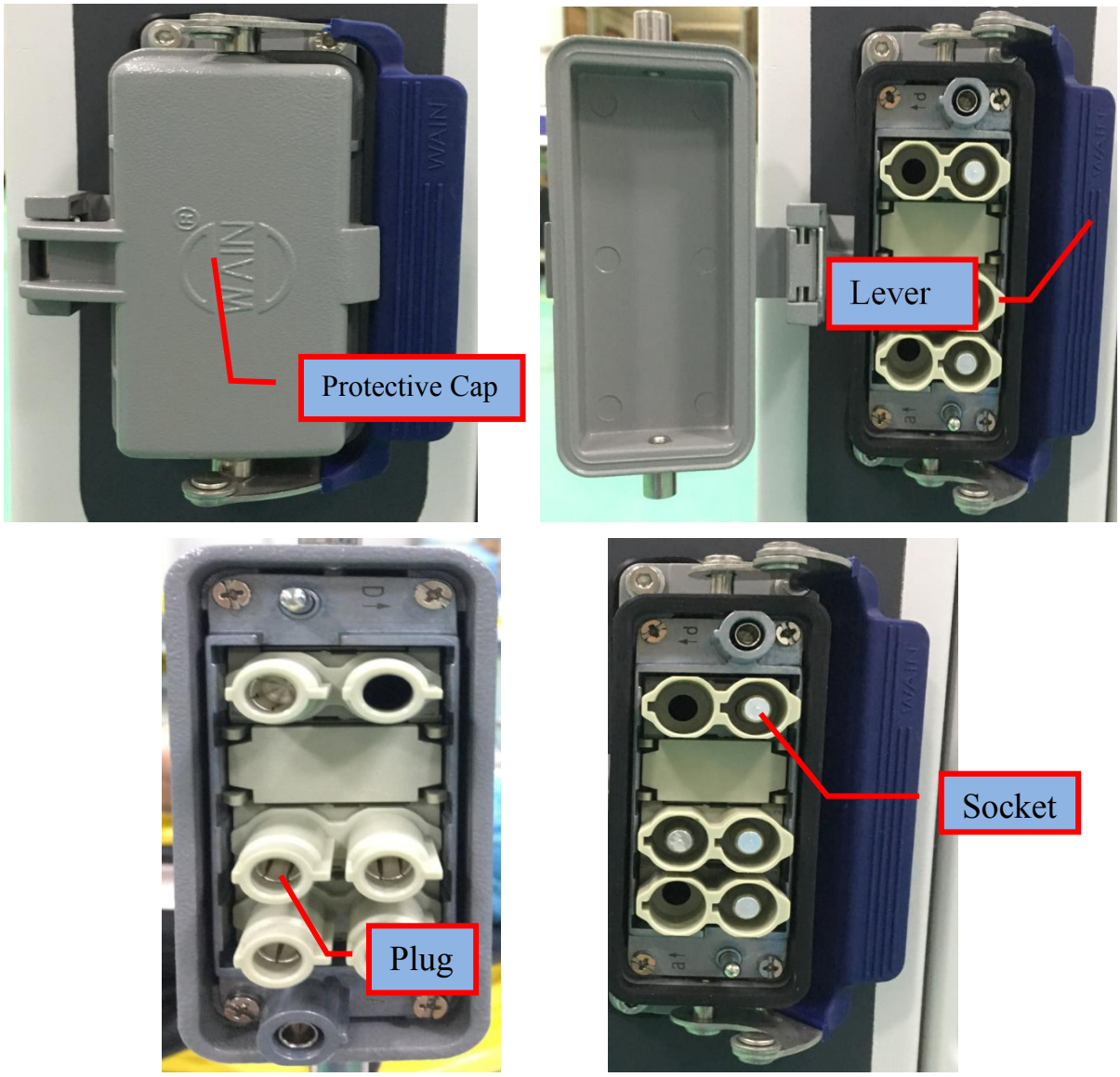
4.3 Power Connection

	**CAUTION:** (1) Before connect the product to AC power, you must check up that the AC supply you will apply is in accordance with the specifications provided in Table 1. (2) Failure to correctly connect the cable could damage the device. Please check whether the power cable and the control cable is correctly connected before usage.

A power cord is provided in the package, as in Figure 8

Figure 8: The Power Cord of the Laser

One end of the power cord is a plug; insert it into the socket 'AC INPUT' on the rear panel when using the laser. Notice that the plug is wrong-side preventing. After insert it, lock it with the lever. As shown in Figure 9.



1. Protective Cap； 2. Locker； 3. Plug； 4. Socket

Figure 9 Socket of power interface with the lever locked

The other end of the power cord is stripped off. There are five wires labeled L1, L2, L3, N and PE, respectively. You should connect the wires to the 380VAC power supply according to the labels:

Table 4 Definition of the power cord

Label	Pin #	Color	Definition
L1	2	Red	Phase Line 1
L2	3	Yellow	Phase Line 2

L3	4	Blue	Phase Line 3
N	6	Black	Neutral
PE	Protective Earth	Yellow-Green	Protective Earth

The length of supplied power cord provided is 5m.

4.4 Interface Definitions

All control signals are shown on the “INTERFACE” port located on the back side of the device. Figure 10 shows the control cord that we provide.

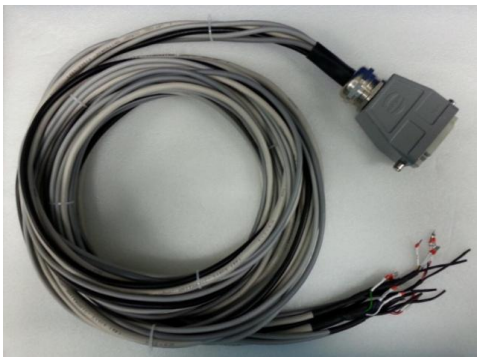
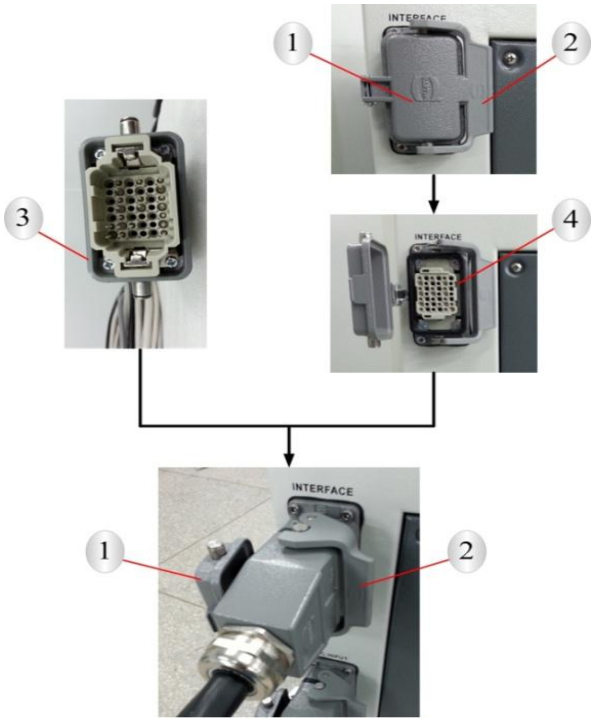


Figure 10 Control Cord

Please insert the control cord we supplied into the “INTERFACE” port on rear panel when using the product, and lock it with the lever, as Figure 11 shows.



1. Protective Cap； 2. Locker； 3. Plug； 4. Socket

Figure 11 Socket of control interface with the lever locked

The control cord of “INTERFACE” port consists of five different groups of cords. The definitions of the port are in the following table.

Table 5 Definitions of Control Cord

Label	Pin #	NOTE	Color	Definition	Comment
CONTROL	6	LAS_C	White	Remote emission control. When the level is high, the laser emission is ready, otherwise is disabled. The function is the same as the ‘LASER’ button on the front panel. ‘LASER’ and this control signal can’t work simultaneously. If you use ‘LASER’, left this pin disconnected; if you use this pin to control emission, keep the ‘LASER’ button up (0->Emission Disabled; 1->Emission Ready)	All refrence ground in “CONTROL” cord is “EGND”
	7	AD/RS	Green	Remote control mode setting. When 24V is applied, the remote control mode is set to AD mode; when this wire is left disconnected, the remote control mode is set to RS-232 mode.	
	8	RDY	Black	System Ready. When system check is finished, this signal is sent to indicate the system is ready for operation.	
	9	EGND	Blue	GND of control signal	
	20	EVCC	Red	External power supply for Fault Signal pull-up	
	24	S_ERR	Purple	Fault Signal, this signal cannot work without Pin 20 being connected to external power supply of 24V	
	\	PE	\	Protective Earth. Connecting the protective earth with the overall shield.	
AD	22	0-10V	Red	Analog signal for laser power control. Do not apply voltage signal higher than 10V.	Analog input cable
	25	AGND	Black	GND of Analog Voltage Signal	
	\	PE	\	Protective Earth.Connecting the protective earth with the overall shield.	

MODULATION	36	MOD+	Red	Input port of 24V modulation signal	\
	37	MOD-	Black		
	\	PE	\	Protective Earth.Connecting the protective earth with the overall shield.	
INTERLOCK	38	ITL_A	Red	Remote protection. “ITL_A” and “ITL_B” must be shorted when the laser is powered on. Failure to do this will cause the alarm of laser.	\
	39	ITL_B	Black		
RS-232	40	RX	Red	“RX” of RS232	RS232 control
	41	TX	Yellow	“TX” of RS232	
	42	GND	Blue	Groud of RS232	
	\	PE	\	Protective Earth.Connecting the protective with overall shield.	

CAUTION： Please check the control voltage level and ensure that the level is in accordance with the requirements. Over voltage and voltage ripple may damage the product.

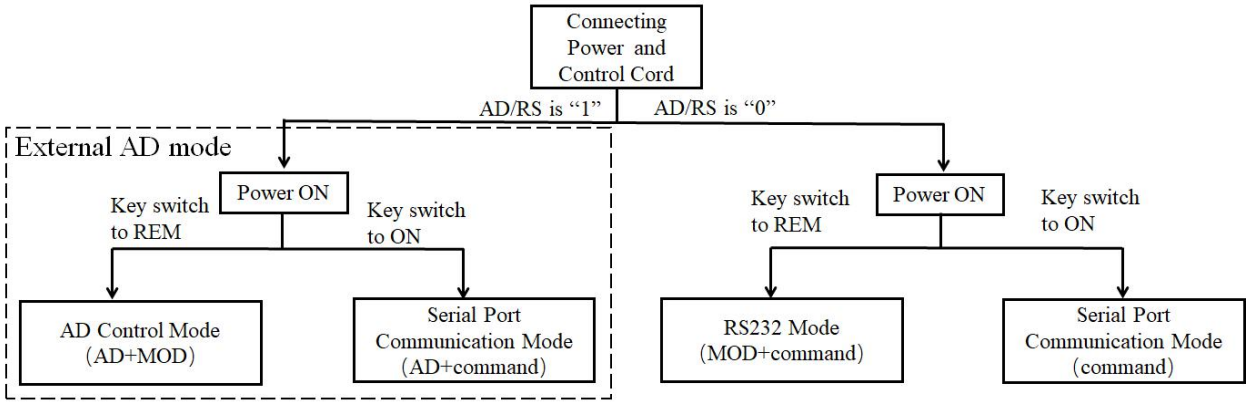
4.5 Operation Mode and Control

There are two different modes of operation-CW and modulation. In the CW mode, the laser emits continuously, and you can set the output power by percentage of output power. In the modulation mode, the laser emits in a waveform of pulses. The pulse can be set by the frequency, duty cycle and power percentage.

Laser power can be set in two ways: by communicating commands through a the serial port or by setting analog voltage through an external AD mode. At the same time, there are two ways of laser optical control: communication command through serial port or MODULATION signal control through the control interface.

4.6 Entering a Control Mode

The Figure 12 shows the process of entering a control mode.



The control modes can be divided into AD mode, serial port communication mode and RS232 mode (MOD+ command) according to the different control modes of the laser output and power. In the serial port communication mode, you can choose to send commands or external AD analog voltage Settings for power control.

The laser is AD mode when PIN 7 and 9 of the control interface are connected to 24V (high level); When PIN7 and 9 of the control interface are suspended or connected to 0V (low level), the laser enters the serial port communication mode. When the key switch is placed in REM, the laser enters the external control mode. At this time, the powering on and off of the laser is controlled by the modulated signal of the control interface. When the key switch is ON, it enters the internal control mode. At this time, the laser's power on and off is controlled through the serial port communication command.

4.7 Serial Port Communication Mode

In the serial port communication mode, according to communication protocol provided by RAYCUS, users can type in instruction through PC. Then operations such as setting parameters, reading laser state, and laser emission control can be executed. RAYCUS provides a software that we developed for users to check the laser state and debug simply. The installation environment of the laser client control software should be within the WINDOWS system and Microsoft.NET Framework 4.0.

4.7.1 Cable Connection of Serial Port Communication Mode

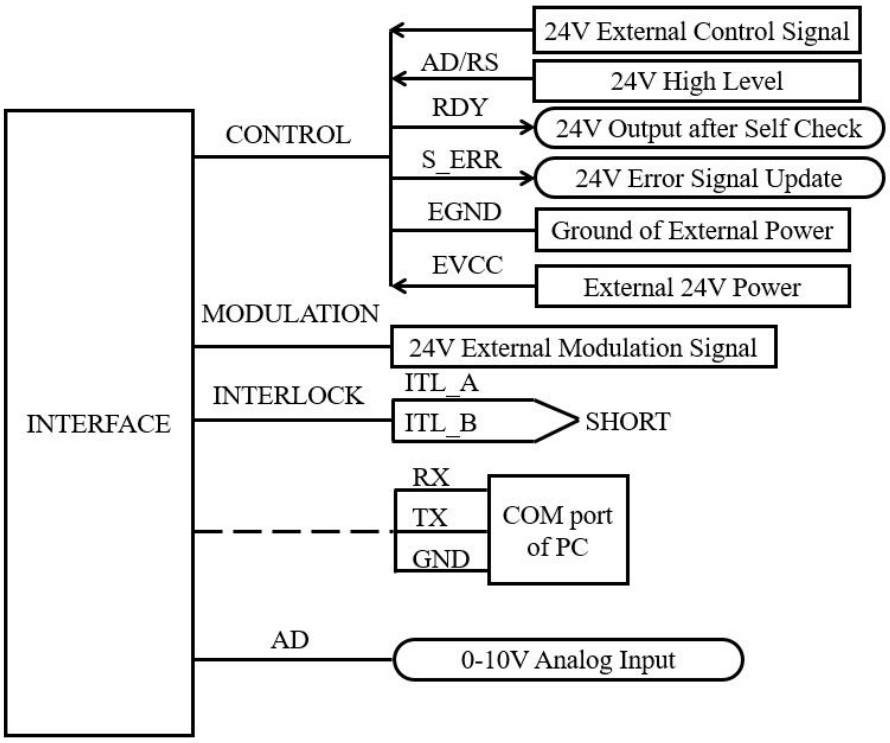


Figure 13 Wiring of Serial Port Communication Mode

4.7.2 Operations in Serial Port Communication Mode

Before the laser is powered on, check whether the laser status meets the following requirements:

(1) The power wiring and control wiring are connected correctly, and the voltage meets product requirements.

(2) Ensure the laser emission button on the front panel is released and the level of sixth pin “LAS_C” of “INTERFACE” port on the rear panel is low.

(3) Status of Interlock is correct..

(4) Make sure that the water cooling system is connected. The water cooler starts to work, and the temperature of the water is at the proper working temperature (about 25°C). Check whether there is any leakage issue whthin entire water cooling system and the joints.

(5) Turn the key to “ON” position, and power on the laser, then the green LED will illumine. Double click the RAYCUS laser client control software, then the following interface can be seen.

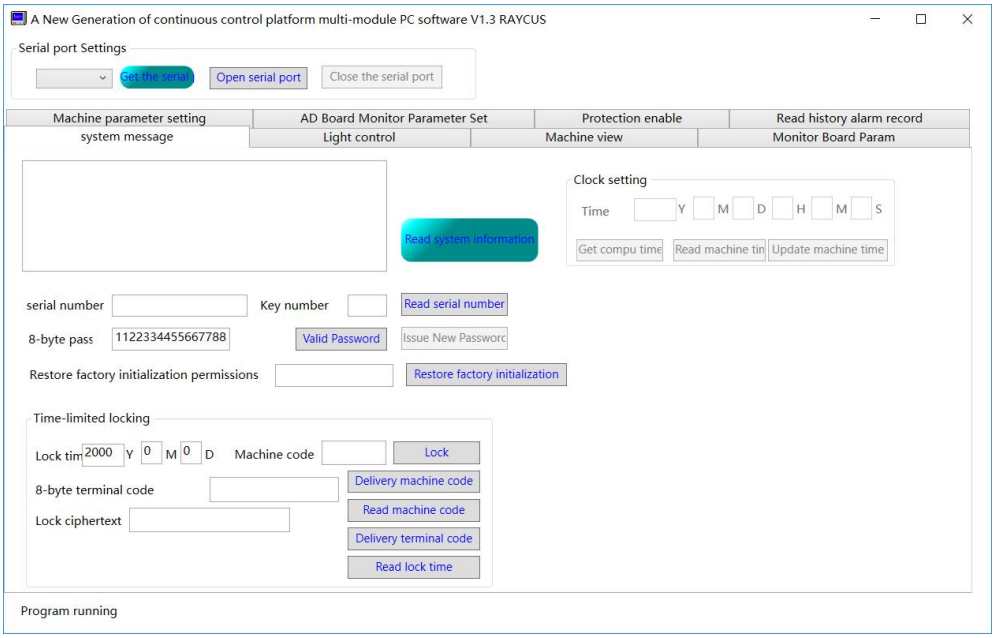


Figure 14 Inteface 1 of the RAYCUS laser client control software

After self-checking of 20 seconds, users can select the corresponding COM in the drop-down box and click “Open serial port”. Then click “Read system information”, and the relevant parameters of the laser can be read by the software and displayed on the main panel in 1 second, where the panel indicates the communication between the client control and the laser are normal. Then operations such as parameter setting、 laser state reading, and laser emission controlling can be executed.

(1) After connecting the serial port, select machine view and click “update parameter” to collect the laser state at present:

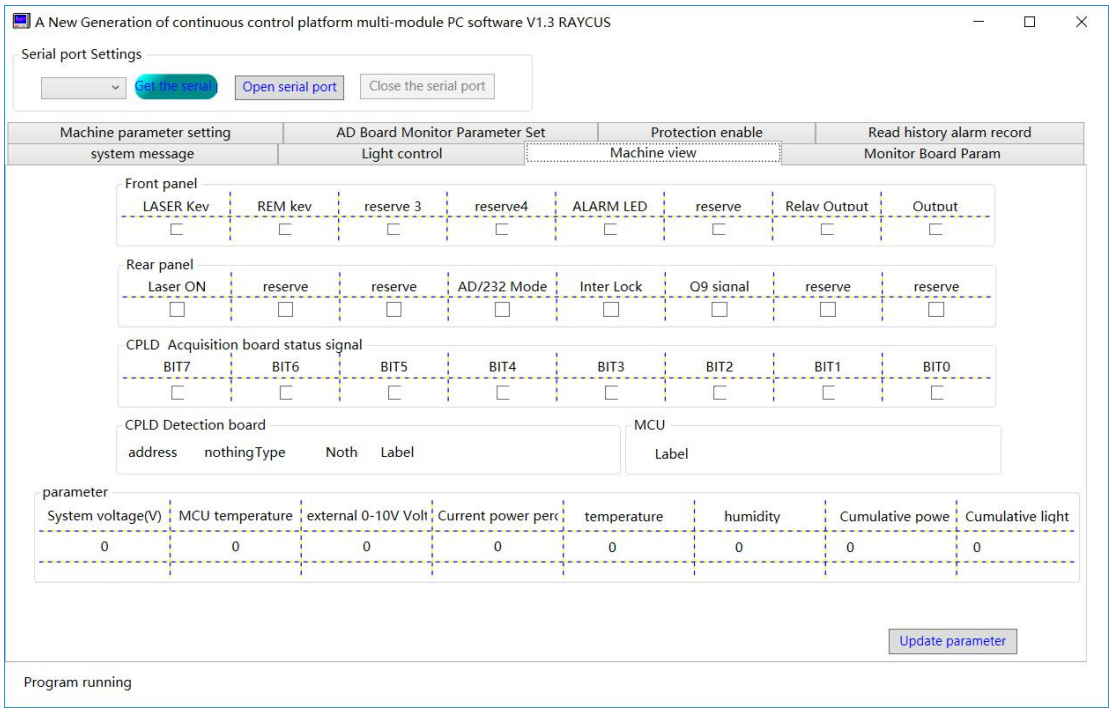


Figure 15 Inteface 2 of the RAYCUS laser client control software

Verify that the settings are correct (if the signal is sent from front and rear panel, the corresponding status signal will be ticked) and there is no alarm information. Users can adjust the light control interface to control the laser light. After entering the light control interface, the light mode and power can be set on the left side:

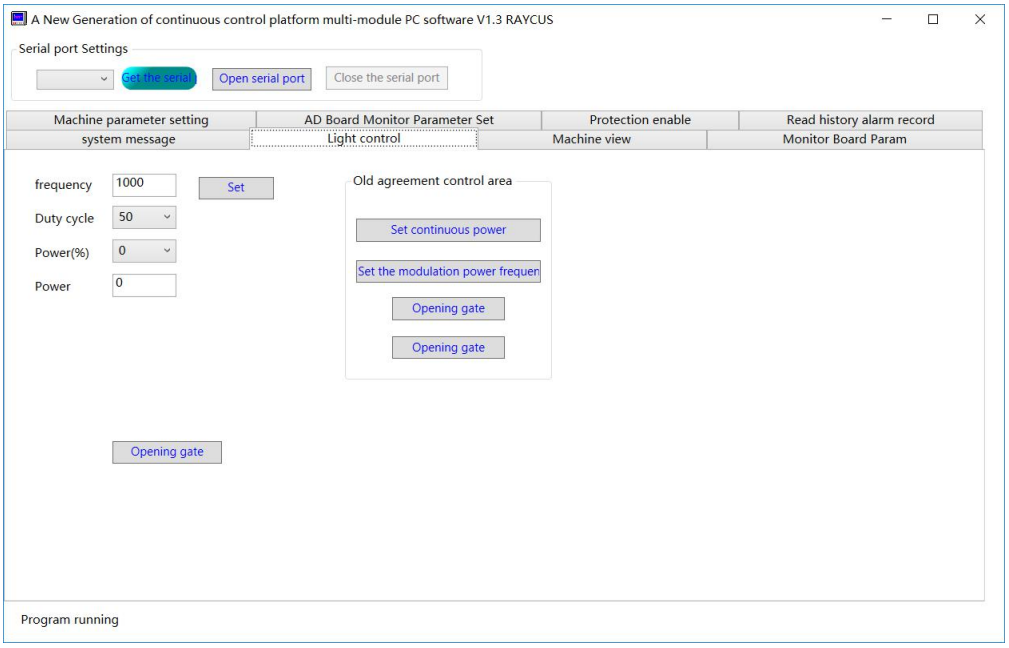


Figure 16 Inteface 3 of the RAYCUS laser client control software

If users want to continuously emit laser, set the duty ratio to 100% and set the required power percentage. By clicking the "set" button, a message about the successful setting should pop up. Then clicking the light switch and pressing the Laser button on the front panel, or giving the 6-pin Interface on the rear panel a 24V signal Laser, can both generate continuous laser with previously set power. The adjusting method of the pulse output light is similar, but the corresponding frequency and duty ratio need to be set (Note: the setting range of frequency is 50Hz to 20KHz).

4.8 RS-232 mode

RS-232 mode is a remote control mode. In this mode, we have a protocol for communication between the laser and the PC, and you can set emission parameters and the emission switch. In addition, an external modulation signal that is laser modulation signal input port (MOD port) on the rear panel is also required to control the emission.

4.8.1 Wiring in RS-232 Mode

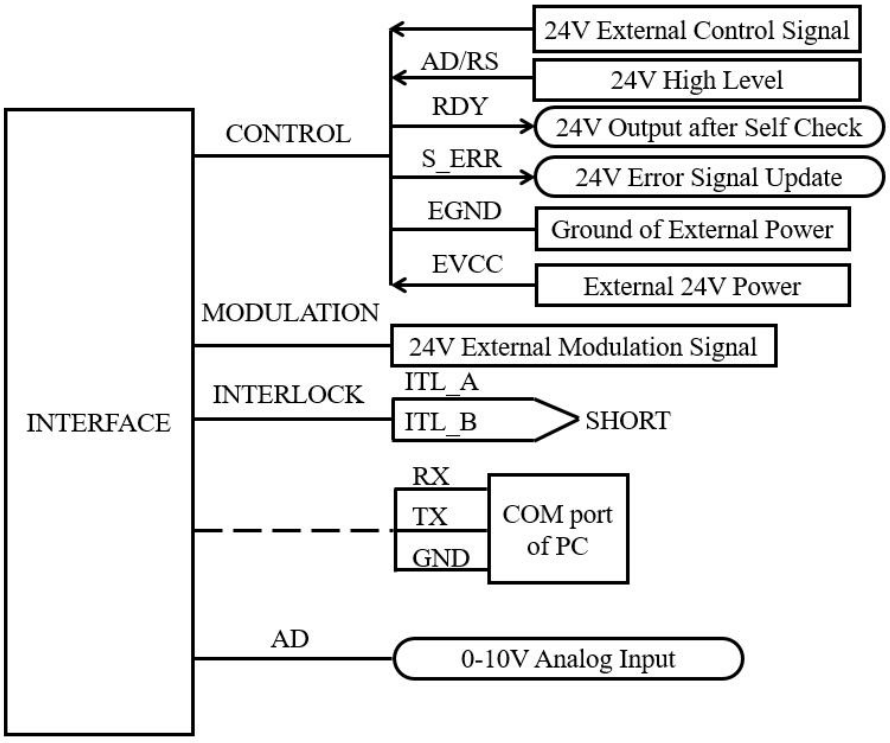


Figure 17 Wiring in RS-232 Mode

Please connect the RS-232 cable, control cable and the power cord according to Figure 17. Make sure that the interlocking signal “ITL_A” and “ITL_B” in “INTERFACE” port is shorted. Confirm that the laser emission button is released and “LAS_C” is hanging.

4.8.2 Communication Protocol

This device adopts a new communication protocol, but it is also compatible with the old communication protocol. This specific protocol is attached to “the Wuhan Raycus Laser Serial Port Communication Protocol -6kM”.

4.8.3 The Operation in RS-232 Mode

Before the laser is powered on, check the laser status meets the following requirements:

1) The power wiring and control wiring are connected correctly and the voltage meets product requirements.
2) Ensure Laser emission button on the front panel is released and the level of 6th pin “LAS_C” of “INTERFACE” port on the rear panel is low.
3) The Status of Interlock is correct..
4) Make sure the water cooling connection, the water cooler starts to work and the water temperature is already at the proper working temperature (about 25°C), and check leaks of the entire water system and joints.

Turn the key to ‘REM’ position. The laser is powered on and the "POWER" green indicator is lit. The systems start self-check in about 30 seconds, after that, the laser will be in RS-232 mode and “RDY” signal turn to be high level.

Remark: the system ’s self-check can not pass if the "LASER" button is pressed down, the level of “LAS_C” is high or Interlock is not shorted before self-check, and alarm LED will be lit. In this case, power off the laser and deal with the question above, then restart the laser.

After self-check passes, users can set operational parameters via the communication protocol.

In the RS-232 mode, the conditions of laser emission are: 1) shutter is open, 2) operational parameters are set, 3) input modulation signal is on the high level.

4.9 AD mode

AD mode is also an external control mode. In AD mode, the output power is controled by the external analog voltage signal.

4.9.1 Wiring in AD mode

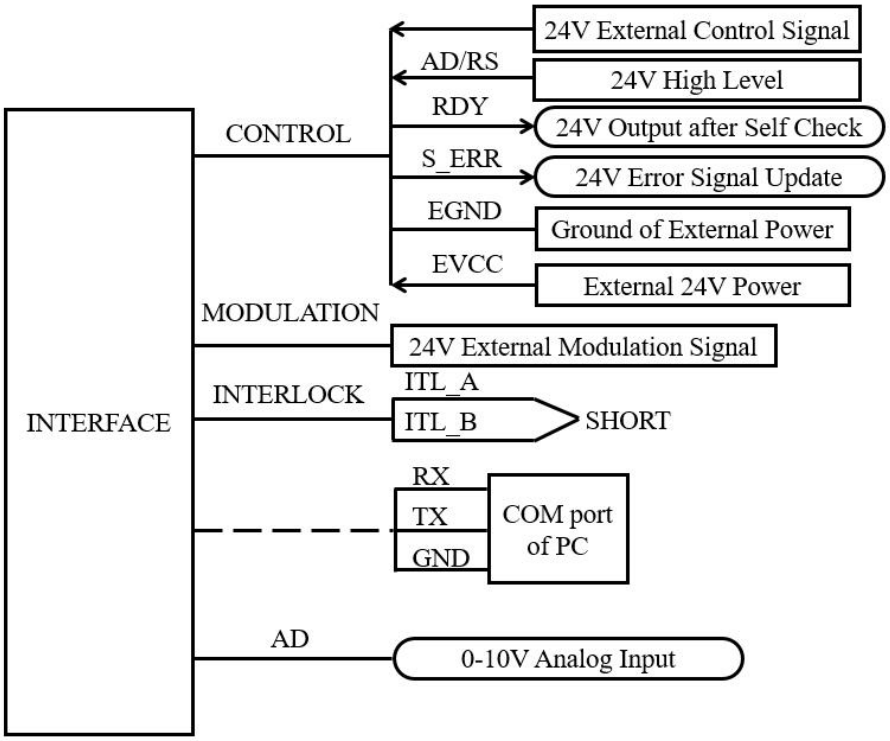


Figure 18 Wiring Diagram in RS-232 Mode

Please connect control cable and the power cord according to the Figure 18. Make sure that the “AD/RS” is on the high level, and the interlocking signal “ITL_A” and “ITL_B” in “INTERFACE” port is shorted.

In AD mode, monitoring of laser states can also be opened by connecting the RS-232 cable to PC.

4.9.2 The operations in AD mode

Before the laser is powered on, check whether the laser status meets the following requirements:

1) The power wiring and control wiring are connected correctly and the voltage meets product requirements.
2) The “LASER” button on the front panel is up and the 6th pin “LAS_C” of “INTERFACE” port on the rear panel is at the low level.
3) The interlock is shorted, and the analog signal “AD” of “INTERFACE” on the rear panel is 0V.
4) make sure the water cooling connection, the water cooler starts to work and the water temperature is already at the proper working temperature (about 25°C), and check leaks of the entire water system and joints.
5) Turn the key to ‘REM’ position. Power off the laser and the systems start self-check in about 30 seconds. After that, the “RDY” signal turns to be at high level, and the laser receives the analog and modulation signal.

The system self-check process cannot passe if the "LASER" button is pressed down, the“LAS_C” of “INTERFACE” port on the rear panel is on the 24V high level, and alarm LED will be lit in yellow. In this case, power off the laser and deal with the question above, then restart the laser.

In AD mode, the laser emits if: 1) ‘LASER’ button is pressed down, or the“LAS_C” of “INTERFACE” port on the rear panel is at 24V high level, 2) the control port of analog receives the analog signal, 3) external modulation signal is onn the high level.

	◆ **CAUTION：** Please ensure that the analog signal DOES NOT exceed 10V, or product may be damaged.

4.10 Red Light Control

In the series communication mode and the AD mode, Turn the key to “REM” or “ON” position. The laser is power on and “POWER” indicator is lit in green. The red indicator indicates emission. Press the laser "LASER" button down or open the shutter through the software by serial port control to close the red light.

In RS-232 mode, Press the laser "LASER" button on or close the shutter through the software by serial port control to open the red light.

	◆ **CAUTION:** Emission and red light cannot output simultaneously. If there is no red light, please check if "LASER" button pops up or the external control signal "LAS_C" at level high, or check if software controlled shutter is closed.

5 Common Alarms and solutions

5.1 Alarm display

When the laser is running, if an alarm occurs, the panel of software will also display the alarm. At the same time, the ALARM warning light (yellow) on the front panel of the laser is on, and the laser stops emitting. The laser lock will not be released until the laser is restarted.

After alarm occurs, check the client software to see whether the laser is powered on. Click “update parameter” on machine view when COM connecting successfully. The specific alarm of the laser can be displayed on the client software panel in the status bar of the CPLD data acquisition board.

If the device is powered off after an abnormal situation, the history alarm record can be read after powered on again in the interface of “Read history alarm record”. The alarm can be stored at most recent 150 records.

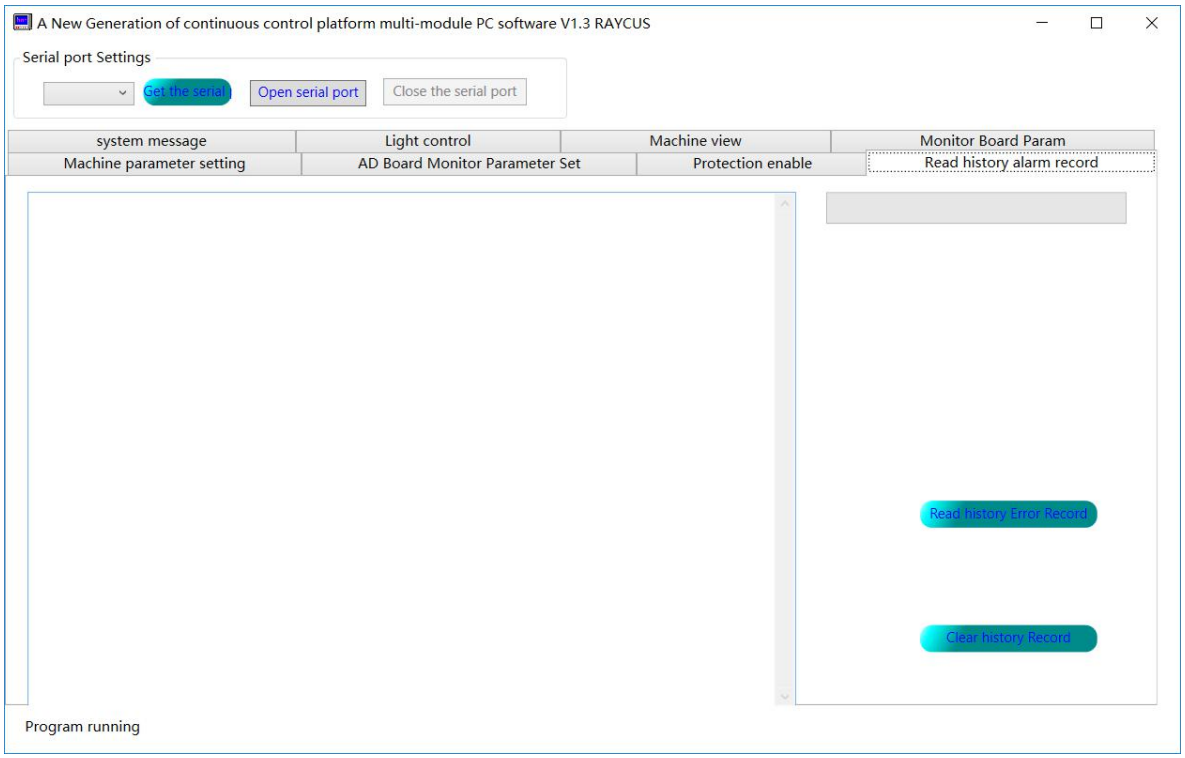


Figure 19 Inteface 3 of the RAYCUS laser client control software

5.2 Alarm processing

The instructions and possible solutions of alarms are as follows:

Table6 Error instructions and possible solutions

Alarm message	Error instructions and possible solutions
Temperature Error	**Instruction:** Low temperature/high temperature alarm of the laser. The four sensors:T1toT4 detect the temperature of the divice. A high-temperature / low-temperature error occurs when the temperature at the monitoring point exceeds the set upper / lower limit. **Solutions:** High temperature alarm. Check whether the water-cooling system is normally working, the water temperature is set correctly, and also the water connection is correct. When the water cooling system works normally and the water temperature drops below 30°C, restart the laser. If the alarm continues, please contact Raycus. Low temperature alarm,. Check whether the actual water temperature of the water is too low. In addition, a low ambient temperature may also cause a low temperature alarm when the laser is cold. Please wait until the water temperature of the water rises above 10°C and then re strate the divice. If the alarm continues, please contact Raycus.
Laser Power Error	**Instruction:** The error is generated when the emission of the laser cannot reach the set value. Power error occurs only when the laser is emitting light. **Solutions:** Restart the device. If this error continues to occur, please contact Raycus.
INTERLOCK Error	**Instruction:** Occurs when the laser InterLock is disconnected。 **Solutions:** Short the InterLock pins (reference the table 5, short the “ITL_A” and “ITL_B”) and restart the device. If this error continues to occur, please contact Raycus.
Laser Emiting Error	**Instruction:** The laser will get this error when it can not detect any laser light signal. Power error occurs only when the laser is emitting light **Solutions:** Restart the Device. If this error continues to occur, please

	contact Raycus.
AC/DC1 Error	**Instruction:** AC/DC1 Error. Laser power supply out of work or sudden power disconnect of the power supply system may cause the alarm. **Solutions:** Check the input AC voltage is normal. Restart the laser，If this error continues to occur, please contact Raycus.
AC/DC2 Error	**Instruction:** AC/DC2 Error. Overcurrent or overvoltage inside the device may cause this error. **Solutions:** Check whether the input AC voltage is normal. Restart the device. If this error continues to occur, please contact Raycus.

In addition to the above, if there are any other questions or errors, please contact Raycus to get help.

6 Warranty, Return and Maintenance

6.1 General Warranty

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

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

6.2 Limitations of Warranty

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

	**WARNING**: It is the customer's responsibility to understand and follow operating instructions in this User Guide and specifications prior to operation-failure to do so may void this warranty. Accessories and fiber connectors are not covered by this warranty.

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.
- 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.

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.