# RFL-P500H Pulsed Fiber LaserUser Guide

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 Warning

| | |
|---|---|
|  | **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. |

## 1.2 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 1064 nm, and the maximum power is 300W. 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 Safety Identification

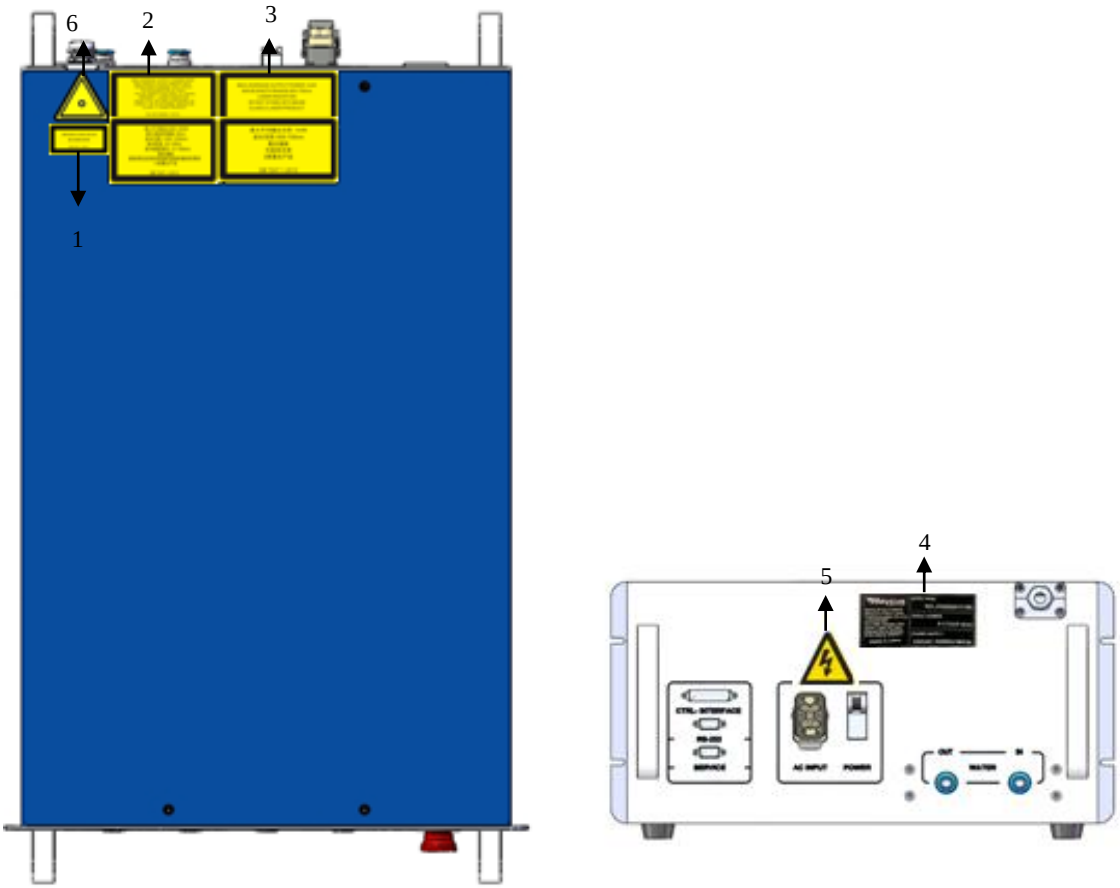


Figure 1 Safety identification position

| | | |
|---|---|---|
|  English Label  Chinese Lable |  English Label（300W）  Chinese Lable（300W） |  English Label  Chinese Lable |
| 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 | | |

## 1.4 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. |

## 1.5 Electrical Safety

a) 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. |

b) Ensure that the AC voltage is supplied normally.

| | |
|---|---|
|  | **CAUTION:**Wrong wiring mode or power supply voltage will cause an un recoverable damage to the laser device. |

## 1.6 Other Safety Rules

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

b) Do not use fiber lasers in dark environments.

c) If this device is used in a manner not specified in this document, the protection provided by the device may be impaired and the warranty will be voided.

d) There are no user serviceable parts, equipment or assemblies inside the product. All service and maintenance shall be performed 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 pulse 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:

- Uniform distribution of stop energy
- Fiber output
- High reliability, long-life
- Maintenance free operation
- High wall-plug efficiency

Applications:

- Laser cleaning
- Scientific research

## 2.2 Package Parts

Please refer to package accessoriesare in the packing box.

## 2.3 Unpacking and Inspection

Raycus 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

| | |
|---|---|
| Power Supply | AC 220V±10%、50/60Hz |
| Max. Power Consumption(W) | 2500W |
| Installation Environment | Flat and no vibration |
| Ambient Temperature | 10℃～40℃ |
| Relative Humidity | ≤70% |
| Weight(kg) | 56kg |

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

e) Do not look 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

a) Make sure that the correct voltage of 220VAC is used. Failure to connectly connect power supply will damage the device.

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

c) Please cap the output head when it is not in use. Do not touch the output lens at any time.Use appropriate lens paper to clean it if necessary.

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

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

## 2.6 Specifications

Table 2 Product Specifications

| Items | Test Condition | Value | Unit |
|---|---|---|---|
| **Optical Characteristics** | | | |
| Operation Mode | Pulse | | / |
| Polarization State | Random | | / |
| Output Power | RR=10kHz@100ns Pmax | 500≤P≤520 | W |
| | RR=13kHz@70ns Pmax | 500≤P≤520 | W |
| | RR=15kHz@50ns Pmax | 500≤P≤520 | W |
| | RR=25kHz@30ns Pmax | 500≤P≤520 | W |
| | RR=45kHz@20ns Pmax | 500≤P≤520 | W |
| Output Power Tunability | / | 10-100 | % |
| Emission Wavelength | RR=25kHz@30ns Pmax | 1064±5 | nm |

| | | | |
|---|---|---|---|
| Spectral Width | RR=25kHz@30ns Pmax | ≤10 | nm |
| Output Power Unstability | 5Hrs 后/RR=50kHz P=Pmax | ≤5 | % |
| Pulse length | RR=10kHz@100ns Pmax | 90-100 | ns |
| | RR=13kHz@70ns Pmax | 65-75 | ns |
| | RR=15kHz@50ns Pmax | 45-55 | ns |
| | RR=25kHz@30ns Pmax | 27-33 | ns |
| | RR=45kHz@20ns Pmax | 17-23 | ns |
| Pulse turn-off time | RR=50kHz P=100%～10%Pmax | <300 | us |
| Repetition frequency | / | 10-100 | kHz |
| Red Guide Laser Power | / | 0.1~1 | mW |
| **Optical Output Characteristics of IQB head** | | | |
| BPP | / | <25 | mm*mrad |
| Fiber core size | / | 400 | μm |
| Core Fiber | / | round | / |
| Delivery Cable Length* | IQB | 15 | m |
| **Electrical Characteristics** | | | |
| Power Supply | AC 220V±10%、50/60Hz | | V |
| Max. Power Consumption | RR=50kHz P=100%～10%Pmax | 2500 | W |
| Control Mode | DB25 | | / |
| **Other Characteristics** | | | |
| Dimensions(W×H×D) | 798×480×253 | | mm |
| Weight(kg) | 56 | | kg |
| Operating Ambient Temperature (℃) | 10~40 | | ℃ |
| Humidity(%) | ≤70 | | % |
| Storage Temperature(℃) | -20~60 | | ℃ |

| | | |
|---|---|---|
| Cooling Method | Water Cooling | / |

# 3 Installation

## 3.1 Dimensions

Figure 2 shows dimensions of the product.

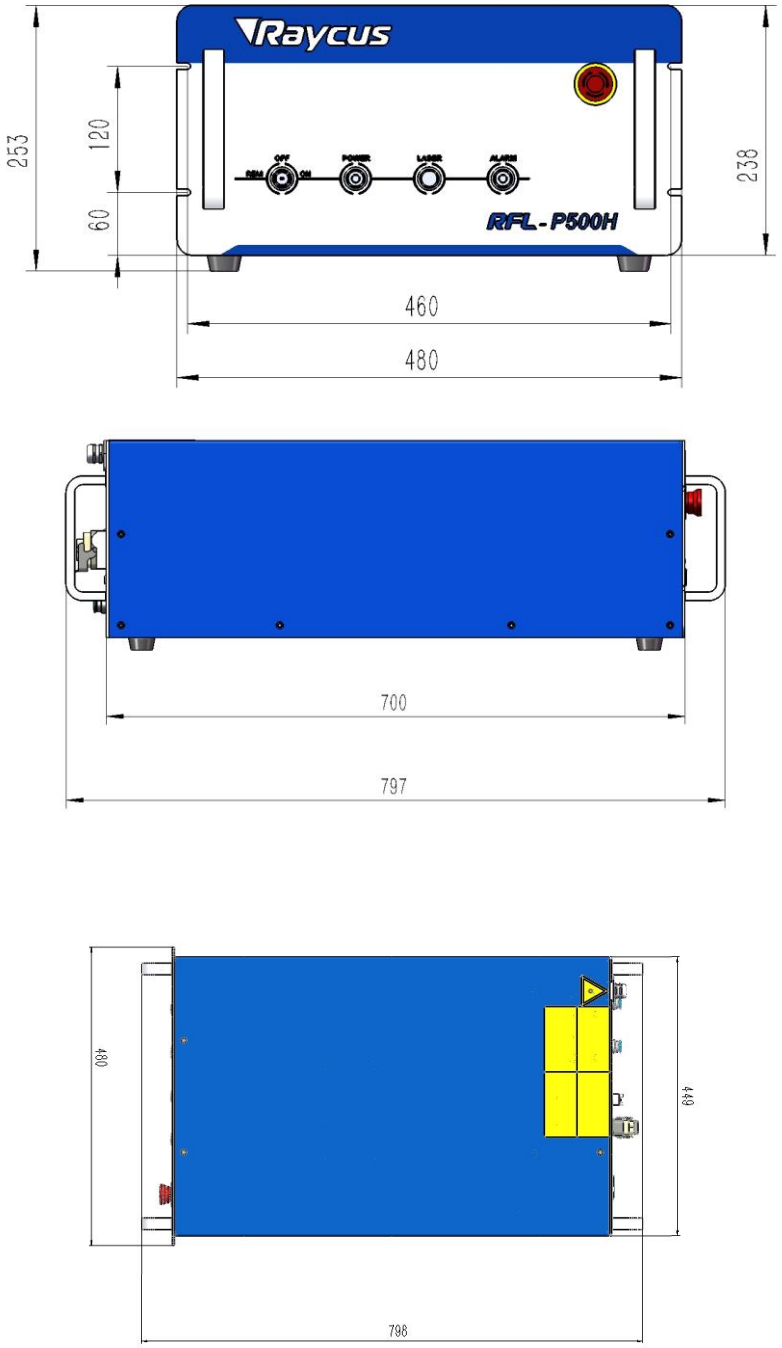


Figure 2 Dimensions of 500W Product (unit:mm)

The output head is IQB, the following figure 3 show the details of the IQB output head.

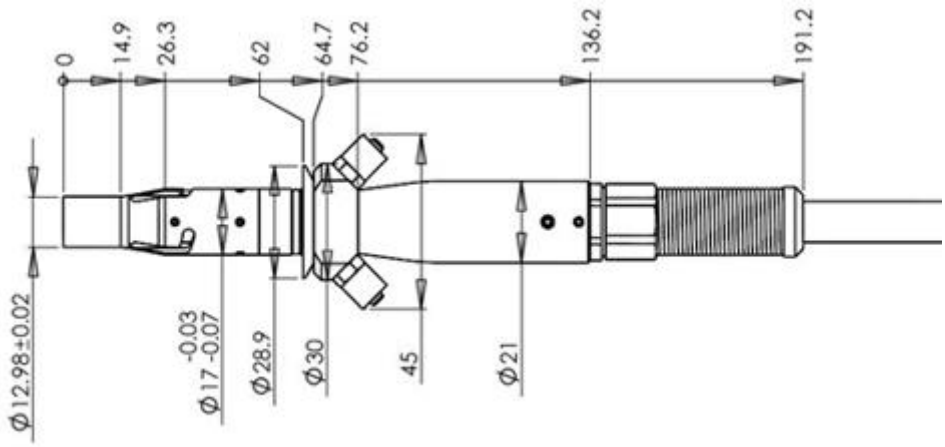


Figure 3 IQB Output head (unit: mm)

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

### 3.2 Cooling Requirements

Table 3 Cooling Requirements

| Parameter | Unit | Value |
|---|---|---|
| Cooling Capability | W | ≥2000 |
| Minimum Flow | L/min | 8 |
| Maximum Pressure | Bar | 8 |
| Water-cooling pipe connector | mm | Pagoda-Typepipe connector,outside diameter 12mm |

Temperaturesettingof cooling water:25±0.5℃

Requirements on Cooling Water:Purified water should be used.

a) 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.

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

c) 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:

a) 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.

b) 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.

c) Pleaseuse compressed gas below 0.5MPa when emptyingwaterfromthe 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 start the laser. (25±0.5℃) |

### 3.3 Installation rule

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

b) Check if the power supply has the correct voltage (220VAC±10%，50/60Hz), 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) Clamp the water pipes ontopipe connector, run the chiller to check if there is any leakage in the water circulation.

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

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

g) 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.

h) The minimum bending radius 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 radius should not be less than 30cm when the laser is work.

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

| | |
|---|---|
|  | **CAUTION:**<br>(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.<br>(2) Tight bends will damage the laser delivery system. |

| | |
|---|---|
|  | **CAUTION:**<br>(3) Keep the protective cap properly, prevent it from contamination; Or the aperture will be contaminated when capped.<br>(4) Make sure the aperture and the cavity of the processing head is clean. |

# 4 **Using the Product**

## **4.1** Front Panel

Figure 4 shows the front panel.

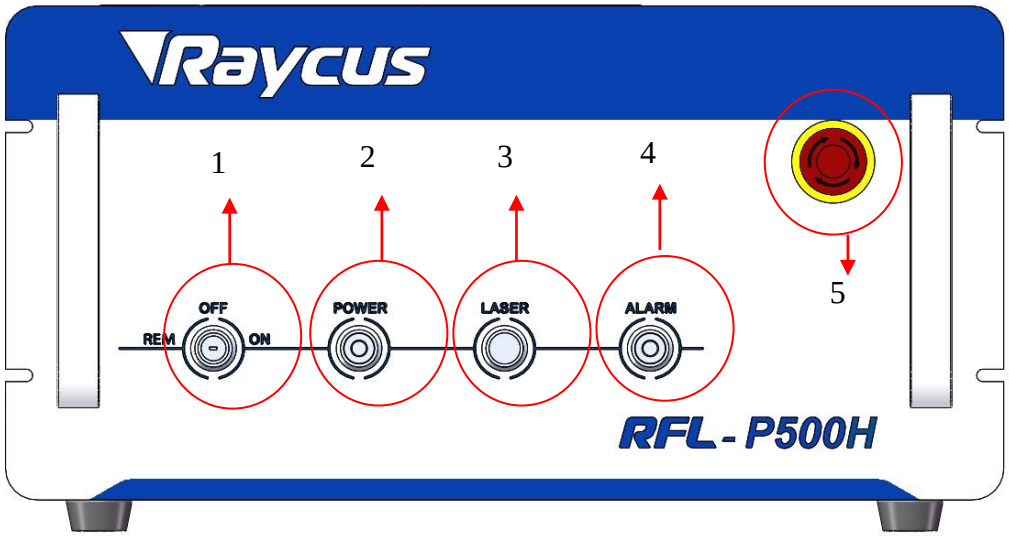


Figure 4 Front Panel View

1. **REM/OFF/ON:** Key switch, the power switch of the laser. Insert the key and then turn the key clockwise to 'ON' to active the laser or turn anti-clockwise to ‘REM’ to active remote control.
2. **POWER:**Power Indicator, indicates that the power is switched on when the green LED illumines.
3. **LASER:** Laser emission button, it’s a button with an red LED indicator.When this button is pressed down and the LED illumines, the product is ready to emit laser. Press again will release the button, and disable the laser emission.
4. **ALARM:** Alarm indicator, indicates a fault condition when the yellow LED illumines.
5. **EMERGENCY STOP:** Press it down to stop the laser immediately. Turn it clockwise to release, and the product can get back to normal.

## **4.2** Rear Panel

Figure 5 shows the rear panel:

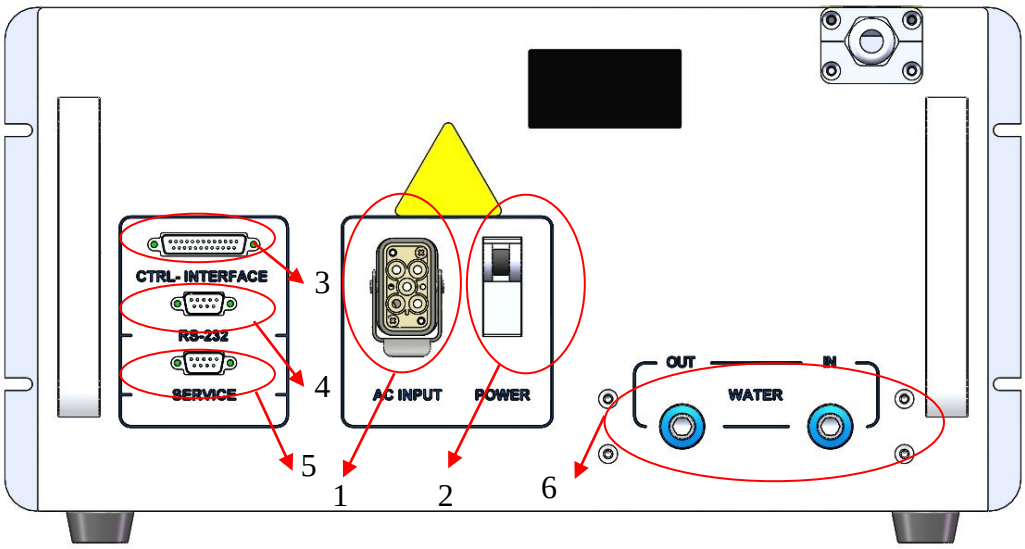


Figure 5 Rear Panel

1. **INPUT:** The socket for power supply input that can be only mated with the plug on the power cord Raycus 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.
2. **POWER:** Air switch. Controlling the on-off of AC.
3. **Control INTERFACE:** Control interface. Users can control the laser via this interface. Please reference table 4.4.2 for specific definition of control signal. 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.
4. **RS-232:** RS-232 interface. Users can control the laser by command via RS-232 communication protocol and get the basic information of the laser.
5. **SERVICE:**Provide some external functions for customers. See 4.4.1 Interface Specification for details.
6. **WATER：** The pagoda typepipe connector. The intake and outlet are used for inflow and reflux cooling water.

## 4.3 Power Connection

| | |
|---|---|
|  | **CAUTION:**<br>(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.<br>(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 6

Figure 6 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.

The other end of the power cord is stripped off， labeled L, N and PE, respectively. You should connect the wires to the 220V AC power supply according to the labels:

L – Live Line

N - Neutral Line

PE - Ground Wire

## 4.4 Interface Definitions

### 4.4.1 SERVICE

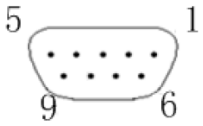


Figure 7 SERVICE Definitions

The pin definitions are shown in Table 4:

Table 4 SERVICE Definitions

| Unit | Definition | Comments |
|---|---|---|
| 1 | Remote key switch | Equivalent to front panel KEY SWITCH. |
| 2 | | |
| 6 | INTERLOCKA | The pin 6 and 7 needs to be short-jointed before the laser is powered on. |
| 7 | INTERLOCKB | |
| 8 | Remote Power ON | Equivalent to front panel LASER |
| 9 | | |

Other pins are unconnected。

SERVICE interface is a DB9 header. If the pins 6 and 7 are disconnected, the device will immediately interrupt the light, and the Yellow alarm lamp will be lit. The pin 6 and 7 needs to be short-jointed before the laser is powered on.

| | |
|---|---|
|  | **Interlock interface must not access active signal, otherwise it will cause interface damage and laser failure.** |

### 4.4.2 Control Interface

Figure 8 shows a schematic diagram of the DB25 control interface.：

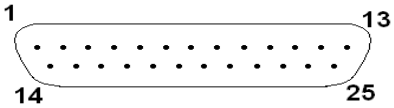


Figure 8 DB25 control interface

The DB25 behind the power module is the interface between the control system (such as marking machine) and the laser system. Be sure to connect reliably before working. The pins are defined as follows

Table 5 DB25 Control Interface Definition

| PIN | Function | Description |
|---|---|---|
| 1-8（D0-D7） | Power Settings | Data parallel transmission 8bit，D0 is the lowest level，D7 is the highest level；<br>Range：0-255<br>（Hexadecimal system：0X00-0XFF）；<br>0：Minimum power output；<br>255：Maximum output power |
| 10,13-15,24,25 | GND | Digital Grounding Aignal（Digital ） |
| 11,12,16,21 | Laser alarms status | See alarm codes in the table 7 |
| 17 | VCC | +5VDC power supply input.<br>Providing power for inside isolate chip of DB25 to ensure that the input and output signal are valid. |
| 18 | Pre-output optical signal | MO、PA Pre-output optical signal，<br>High level turn on, low level turn off |
| 19 | Output optical signal | High level turn on, low level turn off |
| 20 | Sync | Pulse Repetition Rate (Synchronization) input, square wave.10KHz-50KHz |
| 22 | Guide Laser signal | High level turn on, low level turn off |
| 23 | / | /Reserved PIN.<br>Unconnected in suspension |

a) The pump current of diode laser and the laser output power are controlled by setting the value of PIN1-PIN8 (TTL level). PIN1-PIN8 can be set from 0～255，corresponding to the laser output power from 0～100％ (the

actual laser power may not be strictly linear with the setting value). The relationship between PIN value and output power is shown in Table 6:

Table 6 Definition of power control PIN value

| | Setting1 | Setting 2 | Setting 3 | Setting 4 |
|---|---|---|---|---|
| PIN 1 | 0 | 0 | 0 | 0 |
| PIN 2 | 0 | 0 | 0 | 0 |
| PIN 3 | 0 | 0 | 0 | 0 |
| PIN 4 | 0 | 0 | 0 | 0 |
| PIN 5 | 0 | 0 | 0 | 1 |
| PIN 6 | 0 | 0 | 1 | 1 |
| PIN 7 | 0 | 1 | 1 | 1 |
| PIN 8 | 1 | 1 | 1 | 1 |
| Current | ~50 % | ~75 % | ~87.5 % | ~93.75 % |

b) Pin 10 and Pin 14are all digital GND.

c) Pin 17 is an external 5V DC voltage to provide power supply for inside isolate chip of DB25, thus the input and output signals are valid; the input current is more than 20mA.

d) Pin 18 is the start signal of the MO. Pin19 is the input for the optical output signal. The electrical level for both Pin18 and Pin19 are 5V. Before turning on Pin 19, MO signal must be switched ON, in other word, the signal of Pin 18 must be ahead of Pin 19 at least 5 ms, and otherwise the laser machine may be damaged.

e) Pin 20 provides control of the frequency. The frequency range should be 10kHz~100 kHz, depends on the varying power levels of different laser machines.

ATTENTION: The frequency signal must be ahead of the EM signal at least 5 ms, otherwise the laser machine may be damaged.

f) Below figure shows DB25 sequence diagram:

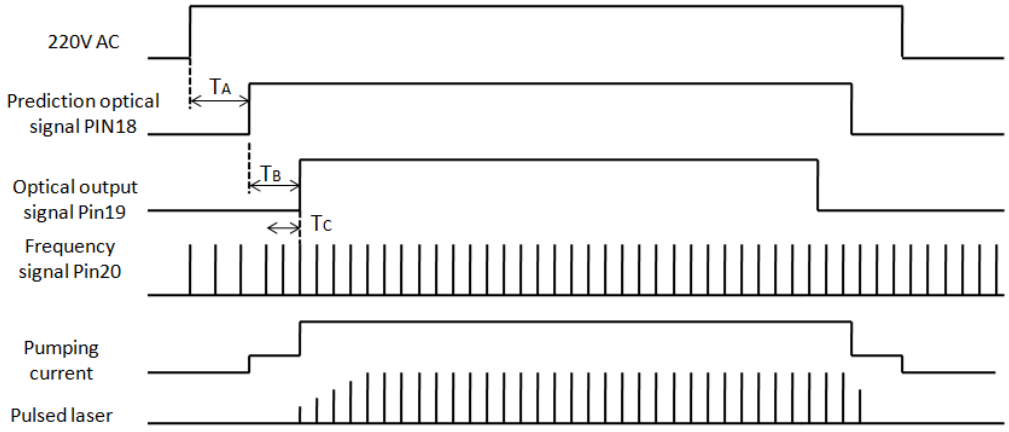


Figure 9 DB25 sequence diagram

1) $T_A$ represent the initialization time of the laser machine. The initialization time is less than 10s from power-on to perform initialization.
2) $T_B$ represent the pump recharge time, usually around 5ms.
3) $T_C$ represent the frequency switching time. Frequency needs to be adjusted before optical laser output, and the switching time should not less than 5ms.

g) Definition of alarm signal:

Table 7 Definition of alarm signal

| 12PIN | 11PIN | 16PIN | 21PIN | Alarm item |
|---|---|---|---|---|
| Spare | Low | Low | Low | Temperature alarm |
| Spare | High | Low | Low | Module Power failure |
| Spare | Low | Low | High | Normal |
| Spare | High | Low | High | Spare |
| Spare | Low | High | Low | Spare |
| Spare | Low | High | High | System failure |
| Spare | High | High | Low | Water alarm / Main power alarm |
| Spare | High | High | High | Spare |

h) Introduction of laser pulse duration control Pin2, 3, 16 and 22 on DB25 port not only used for the foundation control of the laser machine, but also achieves the pulse duration control as the extender.

Table 8 PIN Definition of Serial Communication

| Pin | Name | Description |
|---|---|---|
| 2 | Serial input | The setting of the data bits synchronize with rising edge of the serial clock. |
| 3 | Serial clock | Serial clock, frequency range: 10KHz～100KHz. |
| 14 | GND | Digital GND |
| 16 | SO | The output data bits synchronize with rising edge of the serial clock. |
| 22 | Pulse duration control Enable | High：Enable，Pin2 and Pin3 control the pulse duration;<br>Low or disconnected：Disable |

Table 9 Command format of setting the laser pulse duration

| Frame（1byte） | Command word (1 byte) | Pulse duration(2byte)ns |
|---|---|---|
| 0xA5 | 0x01 | Big Endian |

Table 10 Response format of setting the laser pulse duration

| Frame（1byte） | Pulse duration(2byte)ns |
|---|---|
| 0xA5 | Big Endian |

1) Marking machine sends the command to the laser machine by the Pin2 on the DB25 port, meanwhile sends the clock signal to the Pin3. The comment is the binary form, and delivers the most significant bit as the priority.
2) The order structure from marking machine to the laser machine is: 0xA5+instruction code.
3) 0xA5（A5h）is the comment byte to active the laser pulse duration control port. 0xA5 and the following data will be directly sent as the serial input form to the Pin2 on the DB25 port.
4) The input data length is 4 bytes: the first byte of instruction code should be 0x01（01h）,the second byte and the third byte are the value of the

binary coding of laser duration (for example: 100 is the decimal number of 0x0064, represents the setting pulse duration is 100ns).

5) Pin22 is the Enable signal. The Enable should achieve high state at least 10us before Pin2 and Pin3 changing. The Enable should achieve low state at least 10us after Pin2 and Pin3 changing. Figure 11 shows the adjustment process of laser duration control.
6) Pin19 should decrease to low state before adjusting laser pulse duration.
7) Optional pulse width :100\70\50\30\20ns.

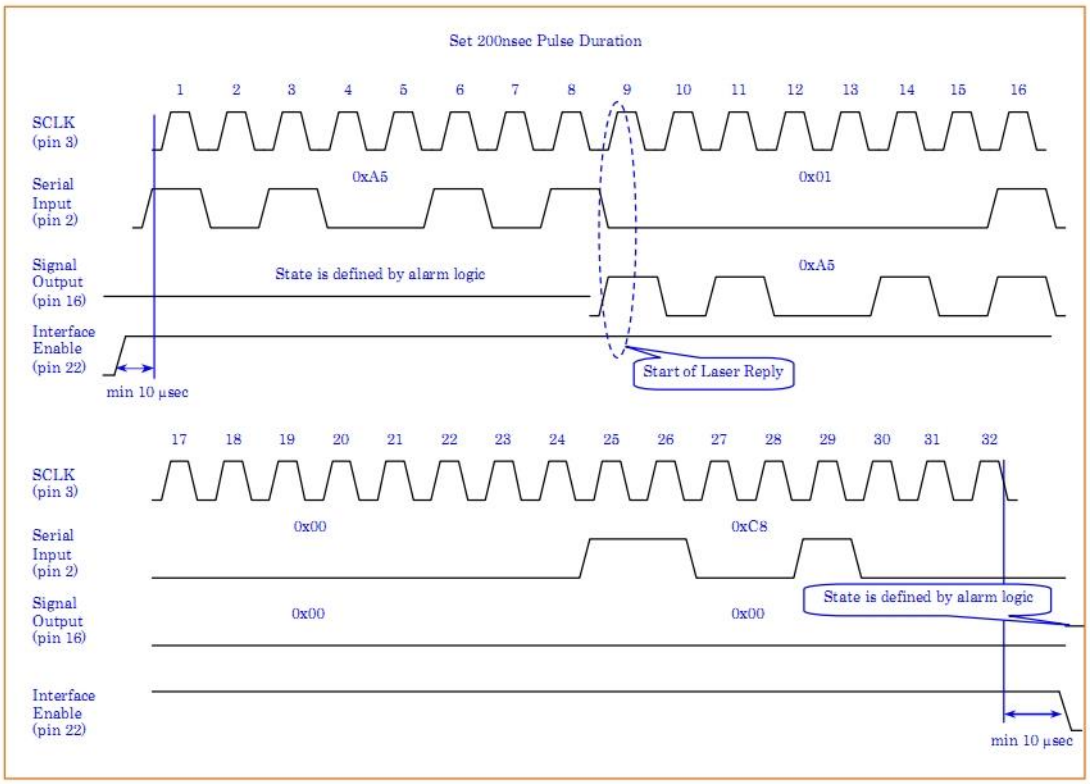


Figure 10 Schematic of laser pulse duration adjustment（200ns）

For example, if using Beijing JCZ Technology Co. marking card to adjust laser pulse duration, the setting processes are described as follows:

1) Make sure the power supply, DB25 cable, control card and computer are correctly connected, and then turn on the 220VAC power supply of the laser.
2）Open Ezcad2.7.6 (or other versions), then click ‘F3’, the configuration parameter should show up, select ‘Fiber’ in the category of the ‘Laser

Control' panel, follow that select 'IPG_YLPM', and then close this window.

3）Pulse duration can be modified by the 'Duration' on the right side of the window. If the setting duration is smaller than the limiting minimum value, the duration of output laser will be 20ns (minimum). If the setting duration is larger than the limiting maximum value, the duration of output laser will be continuous work (maximum). If the setting duration within the range, the duration of output laser will tend to the smaller side.

i) Schematic diagram of input signal interface circuit：

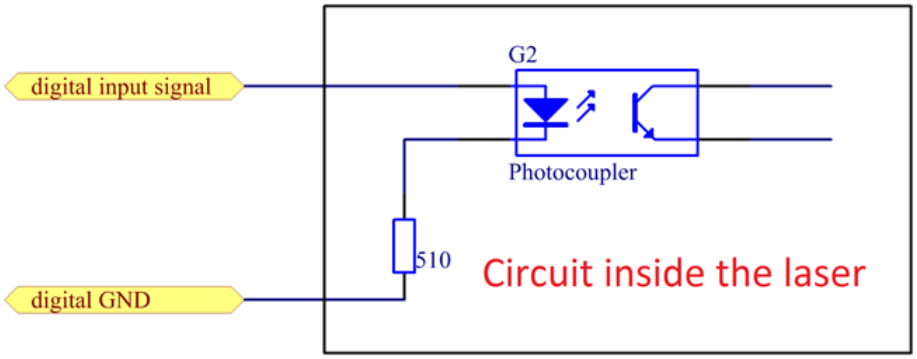


Figure 11 Schematic diagram of input signal interface circuit

j) Signal input needs to be able to provide at least 7 mA of current. The schematic diagram of the output signal interface circuit is shown in Fig. 8.

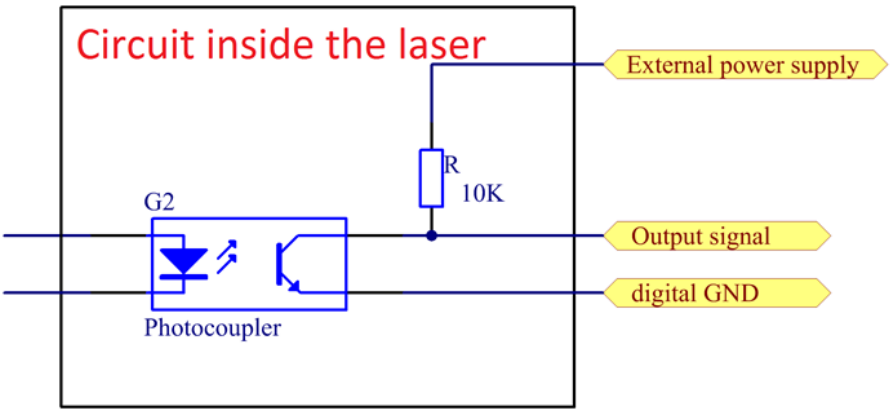


Figure 12 Interface circuit of output signal

### 4.4.3 RS-232 Serial Port

Figure 13shows the RS-232 serial port schematic diagram.

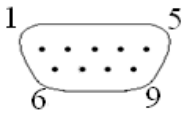


Figure 13 RS-232 serial port schematic diagram

The pins are defined as follows:

Table 11 PIN Definition of Serial Communication

| PIN | Function | Description |
|---|---|---|
| 2 | RXD | Laser Data Receiver |
| 3 | TXD | Laser data transmitter |
| 5 | GND | Laser data reference |
| Others | / | Unconnected in suspension |

RS232 interface is a special interface for Raycus internal personnel debugging.

## 4.5 Application Steps of Laser Device

### 4.5.1 Pre-inspection

a) Make sure the size and connection of water pipe are correct, mainly including water temperature, water flow rate, maximum input pressure, refrigeration capacity. Make surethe water cooler meets the system requirements (see Section 3.3 for details), and the water cooler valve is opened, etc., to ensure that the water cooler is in normal working state before the laser is opened.

b) Make sure the appearance of the laser device is normal and the output optical cable is bent or falling off.

c) Make sure there is no dust or other dirt in the protective lens of the output optical cable. Use compressed air to confirm whether it can be blown off. If not, wipe it gently with the lens paper dipped in alcohol, and then check it with a special flashlight.

d) Make sure the power supply and control signal of the laser are connected correctly.

e) Make sure the emergency stop switch is loose.

### 4.5.2 Operational Steps

a) Starting procedures

Power on the laser, turn on the air switch, turn on the key switch (the key switch is turned clockwise to ON position, the power indicator lights up, indicating that the main control board has been powered on), wait 10seconds and then press the laser switch (the red light of the indicator indicates that the power module of the laser has been powered on normally).

b) After the laser is turned on, Operating it to do laser cleaning

When the device is started normally, the laser power will be increased from 10% to 100% when the laser is first tested. Watching whether the laser is getting stronger and stronger on cleaning material.

### 4.5.3 Attention in the process of operation

a) The repetition frequency range of the laser should not exceed 10-100KHz.

b) Do not adjust the laser repetition frequency during marking.

c) Turn OFF the laser until the power to zero, then turn off the laser power supply, and finally turn off the water cooler.

## 5 Common Alarms and solutions

➢ Alarm display:

The instructions and possible solutions of alarms are as follows:

Table 12 Error instructions and possible solutions

| Unit | Potential factors | Preventive measure |
|---|---|---|
| 1 | The emergency stop button was not released before the laser came out will result the laser alarm | Make sure that the emergency stop button is released before the laser goes out (it can be rotated clockwise, if it is |

| | | |
|---|---|---|
| | | pressed before rotation, it can be released by clockwise rotation of about 1 to 2 circles), then re-energize and the alarm signal is released. |
| 2 | When the laser is working, the cleaning head is perpendicular to the surface of the material to be processed, resulting in a large number of feedback light directly into the optical module of the laser, resulting in laser damage. This alarm can only be repaired back to the factory. | Laser cleaning in vertical cleaning is inefficient, and it is easy to cause a large number of feedback light into the laser, resulting in laser burnout. |
| 3 | Dust and dirt exist in the protective lens of the laser output optical cable. The light output before cleaning will cause the laser to burn out, which will cause the laser to alarm and restart. | Check the output cable protective lens before laser on. |

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

# 6 Warranty, Return and Maintenance

## 6.1 General Warranty

Raycus warrants that all Raycus fiber laserproducts 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 productof 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 UserGuide 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 orassemblies for user in this product. All service and maintenance shall be performedby 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 anytime without incurring any obligation to make changes or install the same on units previouslypurchased.**

**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.**