User Guide for

Multi-Mode Continuous-Wave Fiber Laser

FMC6000/12000

Beijing Reci Laser Technology Co., Ltd.

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CONTENT

Chapter 1 Safety Information

Thank you for choosing the FMC series fiber laser from Reci laser.

In order to guarantee the fiber laser is operated safely (including personnel safety, equipment safety, production safety), ensure the product remain its best condition for a long time. We compile this document with important safety, operating, maintaining and other information. Please take time to read and understand this User's Guide and familiarize yourself with the operating and maintenance instructions before using the product.

1.1 Safety Conventions used in the User Guide

SYMBOLS	DESCRIPTION
	**WARNING :** ***Refers to a potential hazard that may leads to a personal injury or death.***
	**CAUTION :** ***Refers to a potential hazard on product, or a potential physical injury on personnel.***
NO SYMBOL	**IMPORTANT :** ***Refers to any information regarding the operation of the product. Please do not overlook this information.***

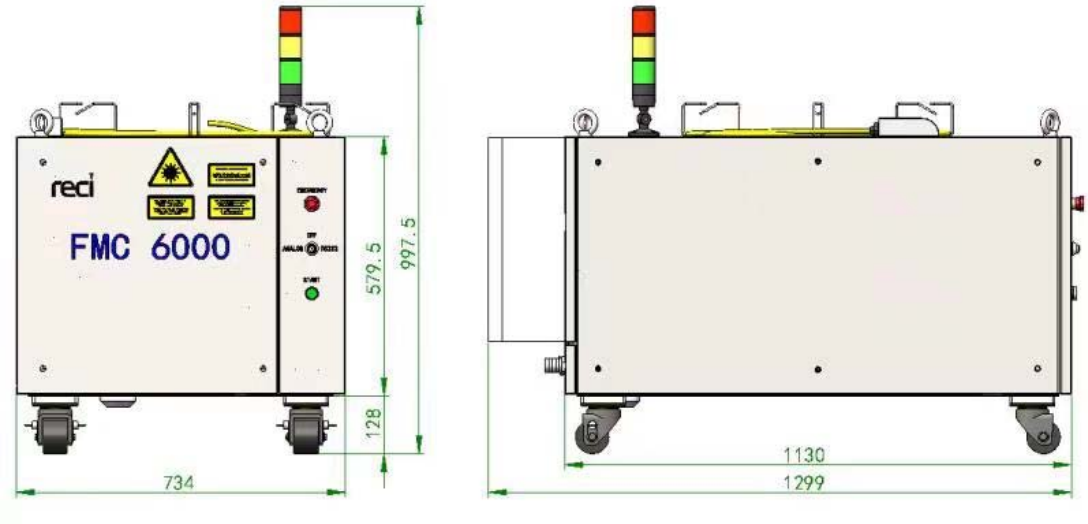
1.2 Laser Classification

This series of lasers emit invisible laser radiation around a wavelength of 1080 nm. The average power of the products is ranged from 10% to 100% at a maximum power about 6000W/12000W, which classifies the series of lasers Class 4 laser instrument. Direct or indirect exposure of this level of light intensity may cause very serious damage to the eyes or skin. ***In view of this, appropriate and approved laser safety protective glasses must be worn all the time while the laser is operating.***

	**WARNING :** ***The laser safety protective glasses are selected according to the wavelengths of the output laser. The users must ensure that the laser safety protective glasses covered the entire range of wavelengths of the laser emission.***

1.3 Labels on the Product

All safety warning symbols posted on the FMC6000 is shown below in Figure1.1:

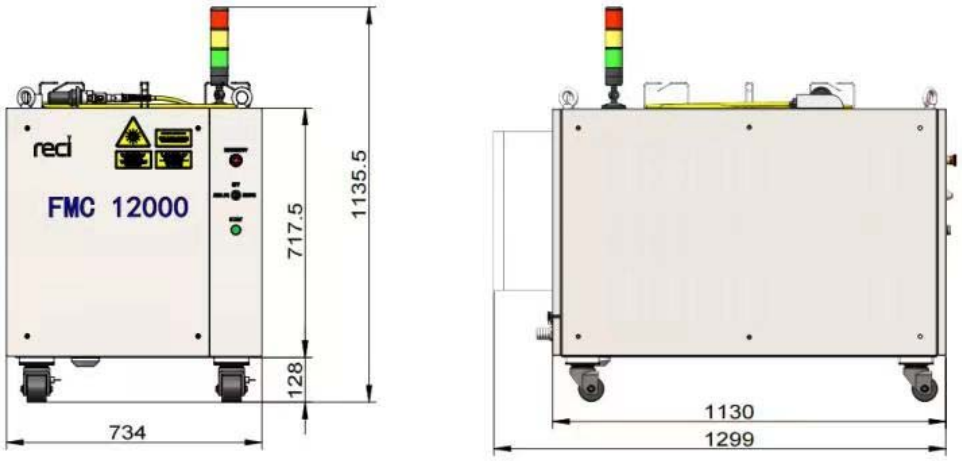


a) Front view of FMC6000 b) Rear view of FMC6000

Figure 1.1 Positions of the symbols on the series of lasers

Table 1.1 the details of the symbols

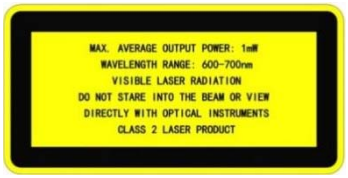
All safety warning symbols posted on the FMC12000 is shown below in Figure1.2:

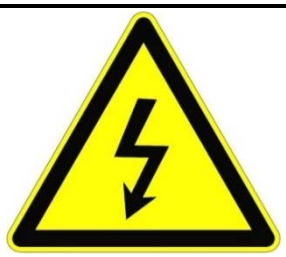


a) Front view of FMC12000 b) Rear view of FMC12000

Figure 1.2 Positions of the symbols on the series of lasers

Table 1.1 the details of the symbols

	
1: Class 2M Laser Product Label for Guide Laser	2: Class 4 Laser Product(take 12000W as example)

	
3: Laser Radiation Hazard Label	4: Electrical Hazard
	
5: Identification Plate of the device	

1.4 Safety Instructions for Optical Operation

We strongly recommend that you read the following procedures before operating the fiber laser:

(1) Never look directly into the optical output when the **Electrical switch** is on.

(2) Make sure that a pair of appropriate and approved laser safety protective glasses is worn all the time while the laser is operating.

(3) No eyes are on the path of the laser beam (direct or reflected light, scatter light from high reflective material, etc.), at the same time, the direction of laser output must be **Shelter by reliable objects**.

	**WARNING :** ***Even though the protective glasses are worn, staring into the optical output is forbidden absolutely while the electrical switch of the laser is on.***

(4) Make sure that the black cap of the QBH/QD is taken off when you are prepared to use the laser.

(5) Make sure the end surface of the quartz head and the protective window lens of the optical output is clean, if not, please clean it with dust-free lens paper soaked by high purity (≥99.8%) anhydrous ethanol under a microscope.

(6) Make sure that the processing devices can support a maximum laser power above 6000W and make sure that the processing devices can support a maximum laser power above 12000W. If you find that the processing equipment is being heated to a higher temperature, please stop processing immediately. ***An appropriate and approved processing system is needed.***

	**CAUTION :** ***A damage of the end surface of the QBH/QD or Processing lens may lead more serious hazard on product.***

1.5 Safety Instructions for Electrical Operation

We strongly recommend that you read the following procedures before operating the fiber laser:

(1) Make sure the power source connected to the equipment is properly grounded with PE wire. At the same time the shell of this equipment must be properly grounded. Any interruption of the ground loop may result in personal injury.

	**WARNING :** ***The input voltage of the fiber laser is three-phase AC current (380V AC), which may cause risk of electric shock. All the relevant cables and connection wires have potential hazards.***

(2) Make sure that the input AC voltage and capacity meet the requirements of the very series of lasers.

(3) If the air switch shut down frequently, please contact Reci as soon as possible to ensure the safety use of the equipment.

	**CAUTION :** ***(1) Any incorrect wiring method or AC voltage may cause damage to people or instrument.*** ***(2) The equipment does not have any part which can be maintained by operators, and all the maintenance operations must be finished by the professionals of Reci Co., Ltd.***

1.6 Other Safety Instructions

(1) There are often numerous secondary laser beams produced at various angles in the output port of the laser. These divergent beams are produced when the primary beam of laser reflects off a smooth surface, and they are called specular reflections. Although these secondary beams may be less powerful than the total power emitted from the primary beam, the intensity may be great enough to cause damage to the eyes and skin as well as surface of materials.

	**WARNING :** ***You must exercise caution to avoid/minimize specular reflections as these laser radiations are invisible!***

(2) Optical accessories relevant to the laser, such as light-sensitive elements that may be damaged from exposure to the laser light, video cameras, photomultipliers and photodiodes, need related protections.

	**CAUTION :** ***The Reci FMC laser is strong enough to cut or weld metal, burn skin, clothing and paint. In addition, this laser can ignite volatile substances such as alcohol, gasoline, ether and other solvents. During the operating process, the flammable materials around the laser must be isolated.***

(3) Please do not operate laser in darkened environments.

(4) Do not turn on the laser without an optical coupling fiber or the optical output connector.

(5) Carry out commissioning, calibration and focusing at low output power and then increase the output power gradually when the calibrating and focusing work is done.

(6) If the equipment is operated in a manner not specified in this document, the protection devices and performance of the equipment may be impaired and the warranty will be voided.

Chapter 2 Product Description

2.1 Property Introductions

As high power fiber lasers developed for industrial application, FMC Series fiber lasers are compact and efficient. The lasers are mainly applied to the fields of welding, cutting, brazing, etc.

Main Features:

- High wall-plug efficiency
- High power with Excellent beam quality
- High reliability, long service life, maintenance free
- All fiber structure, compact, rugged package
- Multiple anti-high-reflection

Applications:

- Industrial applications: Material cutting（major in metal processing）, metal welding, metal cladding.
- Scientific research, Military application.

2.2 Model description

As a series of lasers, its model name description is illustrated as the following figure 2.1, take FMC12000 as an example. Similarly, the FMC12000 means its maximum average power can reach 12000W:

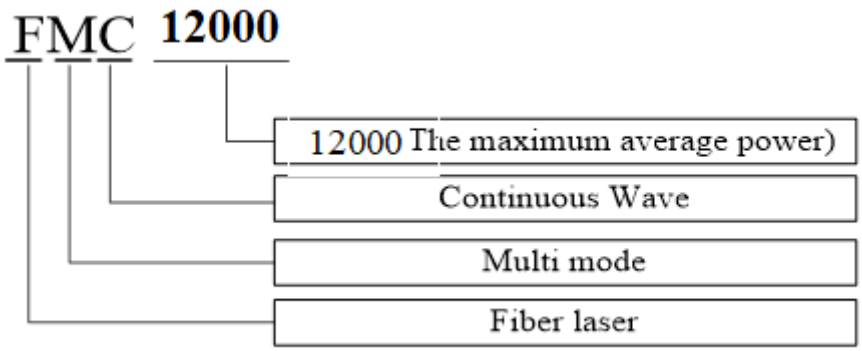


Figure 2.1 the meaning of the model names

2.3 Unpacking and inspection

Reci certifies that this equipment has been thoroughly tested and inspected and meets published specifications prior to shipping. We advise that the receiver should check the packaging, for there should be potential damage during the transport. Please do as follow:

(1) Check whether the packaging is placed correctly (Flat, upright) and no collision, crack, rain or water immersion outside the box.

(2) Please check actual items refer to the packing list.

If damage is apparent on the laser or part of its accessories in transit, please contact Reci and the carrier immediately.

	**CAUTION :** ***The fiber cable and output head are very precise optical devices, will cause irrecoverable damage to the laser while is be twisting, over bending. At the same time, strong vibration and impact on the output head are forbidden.***

2.4 Operation Conditions

The basic operation conditions are listed in the table followed:

Table 2.1 the operation conditions for the FMC series lasers

Item	Value
Supply Voltage(V)	380±10% V AC 50/60Hz
Placement	Flat, upright, no vibration and impact
Environment Temperature	5~40℃
Relative Humidity	30%RH~70%RH
Electromagnetic Environment	Avoid too strong electromagnetic interference, which may lead to false alarm of laser
Cooling water quality	QBH/QD and even the whole machine need deionized water to prevent scaling. At the absence of deionized water, pure water for drinking can be used. When the ambient temperature is lower than 0 ℃, antifreeze (30% volume ratio for alcohol) needs to be added to the cooling water.

Note:

(1) Never use the tap water or other cooling water with high ion concentration.

(2) The cooling water shall be replaced timely to prevent microorganism and ions growth.

(3) It is very easy to be damaged when the QBH/QD getting scaling, and there is no warranty in this case.

(4) The output of the laser is connected with the cable. Please check the end surface of the quartz head carefully to prevent dust or other pollution. Lens-cleansing paper must be used when cleaning is necessary.

(5) Never installing the laser output with the processing system when the equipment is power on.

(6) The protective glasses should be worn all the time.

	**CAUTION:** ***(1) When this product need work in high humidity（>95%）, please pour dry air into the machine shell in time.*** ***(2) Never let this product work below the ambient dew point temperature(like the table 2.2)***

Table 2.2 the Constant Dew Point Table

Maximum Relative humidity (%)	20	30	40	50	60	70	80	90	95
Room Temperature(℃)	Ambient Dew Point (Td-℃)								
10	-11.9	-7	-0.3	0	2.5	4.8	6.7	8.4	9.2
15	-7.9	-2.3	1.5	4.6	7.3	9.6	11.6	13.4	14.2
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
			Temperature range for laser operating						

NO SYMBOL	***IMPORTANT :*** ***The lifetime of the laser will be shortened and the output power will degrade while the cooling system working at a higher temperature for too long time. Please ensure the cooling system is enough and the temperature is suitable.***

2.5 Instructions for use

(1) Before supplying the power to the device, make sure the power supply and the connection of all wires are correct (See table 2.3 and subsection 4.3).

(2) Keep the outer black cap covered while the device is not in use, dust-proof should not be absent any time.

(3) There is no warranty in case of no following this instruction.

2.6 Characteristic Parameters

Table 2.3 Parameters of the FMC6000&FMC12000 Laser

	MODEL	FMC6000	FMC12000
Optical Specification	Output Power (W)	≥6000	≥12000
	Operating Mode	CW/Modulate	
	Polarization	Random	
	Power Range (%)	10~100	
	Central Wavelength (nm)	1080±3	
	Power Instability (%)	<3	
	Max. Modulation Frequency (kHz)	20	
	Red Laser power (mW)	>0.5	
	Beam Delivery Optics	QBH	QD
	Output Fiber Diameter (μm)	50/100	100
	BPP(Beam Parameter Product)	<4	
	Delivery Fiber Length (m)	20 (Customizable)	
Electric Specification	Operating Voltage (VAC)	3N-380V 50/60Hz	
	Power Consumption (W)	<20000	<40000
	Control Mode	Ext. RS 232/Ext. AD/Hyper terminal	
Other Specification	Dimensions W×H×D (mm^3)	734×1299×580	734×1299×718
	Weight (kg)	<400	<500
	Ambient Temperature (℃)	5~40	
	Ambient Humidity (%)	<70	
	Cooling Method	Water cooling	
	QBH Cooling Water Temperature (℃)	Room temperature (No condensation)	
	Cooling Water Temperature (℃)	25	
	Cooling Water Flow (L/min)	>60(With load)	>120(With load)
	Storage temperature (℃)	-10~60	

Chapter 3 Installation of the laser

3.1 Dimension of the machine

The dimension of the laser device is just below, figure 3.1 3.2 for FMC6000 and FMC12000

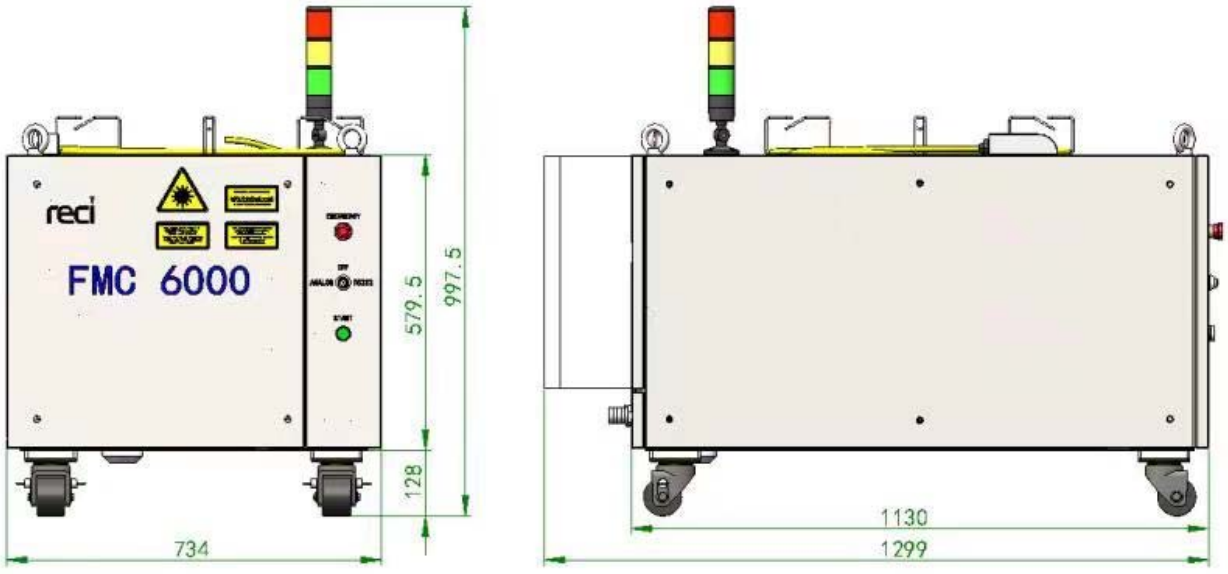


Figure 3.1 Front view and Side view of FMC12000（unit: mm）

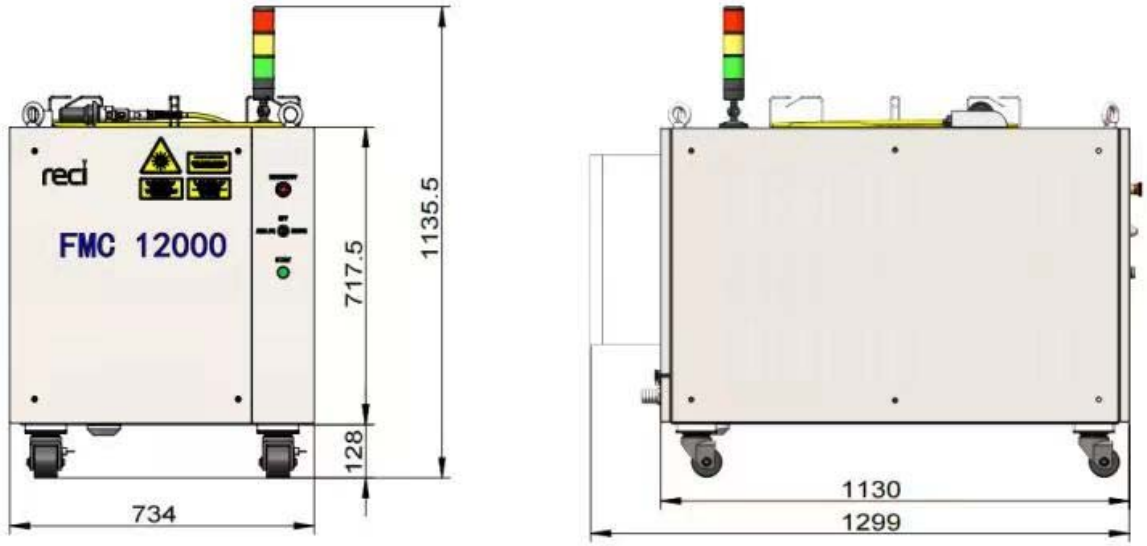


Figure 3.2 Front view and Side view of FMC12000（unit: mm）

3.2 The optical output head

A passive device named QBH was used as the optical output in the FMC6000 series laser, its dimensions are just as figures below.

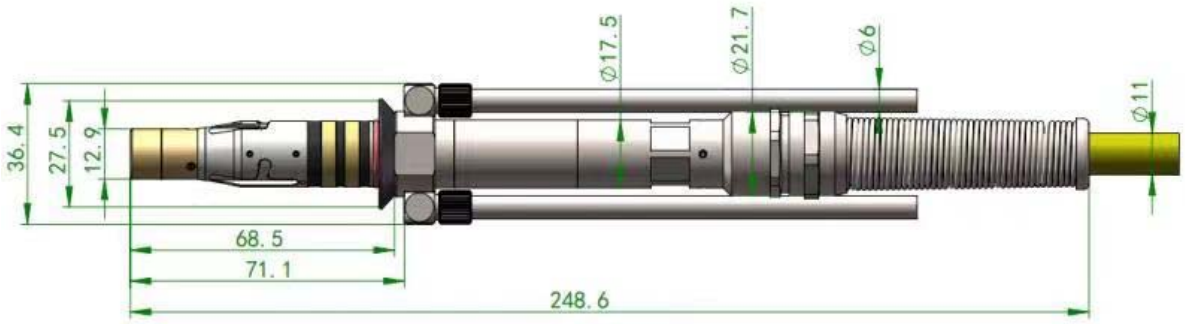


Figure 3.3 the view of the QBH (unit: mm)

A passive device named QD was used as the optical output in the FMC12000 series laser, its dimensions are just as figures below.

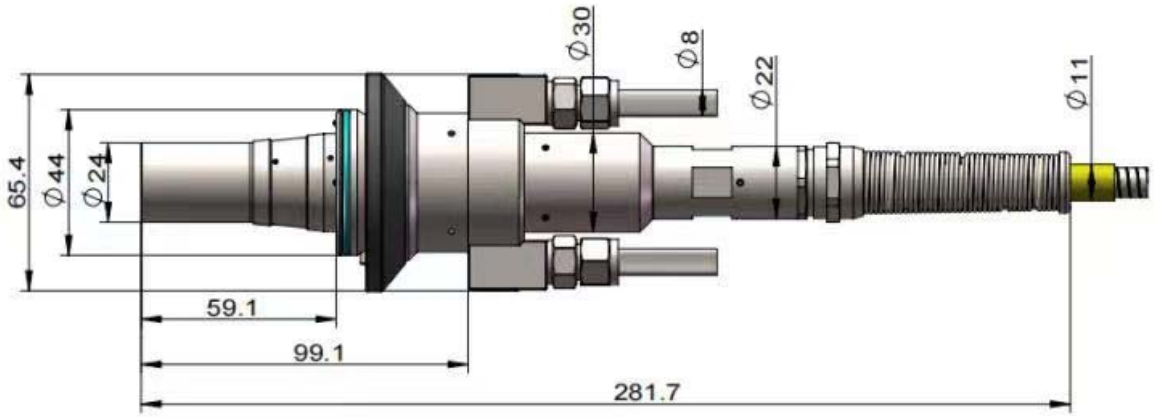


Figure 3.4 the view of the QD (unit: mm)

The slot size of QBH/QD is standard, matched well with most of processing heads from the market. During installation, you need to ensure the QBH/QD installed in place, and then establish a reliable connection between the ring contactor with the processing head's contactor; otherwise the laser will give an alarm.

Before the QBH/QD is installed, the end face of the QBH/QD must be checked. Of course, it must be cleaned when the end face is polluted (check under a microscope).

3.3 Connection and Requirements of the Cooling system

3.3.1 Connection of the cooling system

For FMC6000 ： A water cooler with dual temperature output is required. Pipe with inner diameter of 25.4mm is used for connecting the laser and the water cooler, and two segments of quick plug water pipes with outer diameter of 6 mm are for connection between QBH and the water cooler.

For FMC12000 ： A water cooler with dual temperature output is required. Pipe with inner diameter of 32.5mm is used for connecting the laser and the water cooler, and two segments of quick plug water pipes with outer diameter of 6 mm are for connection between QD and the water cooler.

The method is shown in Figure 3.5: the outlet of the water cooler is connected with the “WATER IN” of the laser, and the inlet of the water cooler is connected with the “WATER OUT” of the laser, and so is the QD.

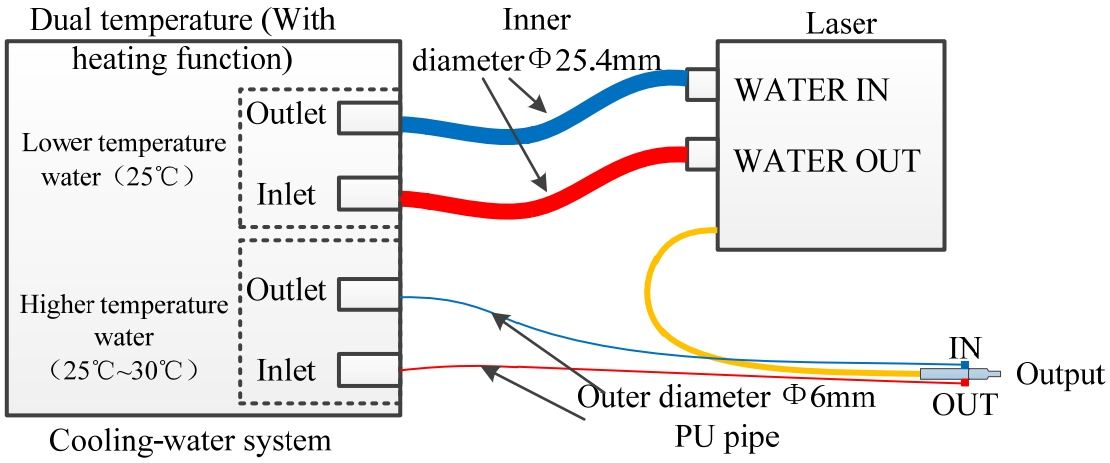


Figure 3.5 Sketch Map for the connection of the cooling system

If a water cooler with dual temperature output isn't ready there, an extra water cooler for QBH/QD specialized will be needed. And you'd better follow the notes below:

(1) Water with poor quality cannot be used, and the water temperature should not make QBH/ QD dewy.

(2) Just as the figure 3.5, the QBH/QD must be connected in the water way first, and then the processing head. Do not reverse or divide water in order to avoid cooling capacity lacked.

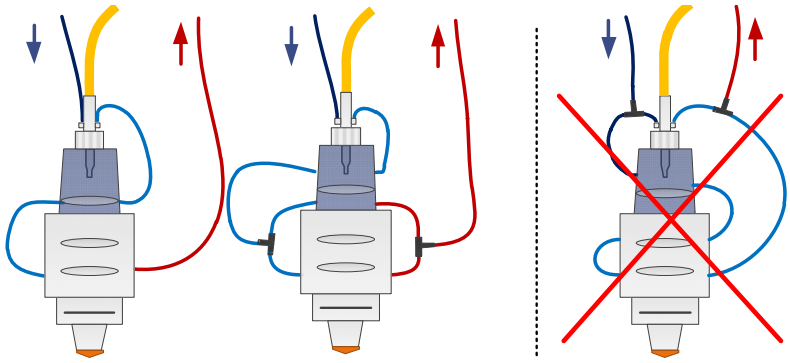


Figure 3.5 the connection of water way between QBH/QD and processing head

3.3.2 Requirement of the cooling system

The requirement of the cooling system is on display in the table below:

Table 3.1 the requirement of the cooling system for FMC6000& FMC12000

Item		Unit	FMC6000	FMC12000
Refrigerating capacity	For the laser machine	kW	>14	>30
	For QBH/QD		>0.5	>0.8
Water flow	For the laser machine	L/min	>60(With load)	>120 (With load)
	For QBH/QD		0.5~2.5(with load)	
Pump lift of the cooler	For the laser machine	m	≥53	
	For QBH/QD		≥20	

Maximum water pressure	For the laser machine	Bar	8	
	For QBH/QD		6	
Water temperature	For the laser machine	℃	25 (27 when it is summer)	
	For QBH/QD		Room temperature (No condensation)	
Diameter of the pipe	For the laser machine	mm	Φ25.4 (Inner diameter)	Φ32.5(Inner diameter)
	For QBH/QD		Φ6(Outer diameter)-Φ4(Inner diameter)	Φ8(Outer diameter)-Φ6(Inner diameter)

(1) Requirement for cooling fluid

(a) Make sure the water is pure enough-- the de-ionized water is the best choice, or you can also use purified water which is for drinking;

(b) Please pour some ethanol into the water in order to avoid the waterway stopped by the putrefaction, which is suggested about 10% of all.

(c) When the surrounding temperature is between -10℃~ 0℃, gain the ethanol proportion to 30%, and replace once two months.

(d) When the surrounding temperature is below -10℃, the water cooler with a heating system should never lay off all the time.

(2) The other requirement of the cooling system

(a) When the cooling machine works the first time, please make sure the waterway is unclogged and watertight, at the same time the water supply (outlet) is connected to the “WATER IN”， and return water (Inlet) is connected to the “WATER OUT”;

(b) If the laser is away from work for a long time, please empty the water in it.

	**CAUTION:**

	Set temperature for the cooling machine according to the surrounding temperature. Unsuitable temperature will lead bad results—too high temperature can lead the laser exceptional, even damaged, and the low temperature may cause badly condensation trouble both on the laser device and the QBH/QD.

	**CAUTION*:*** ***Make sure the cooling system works before the laser device does, and the temperature is required being 25 ℃, when you decide to turn on the laser device.***

3.4 Installation precautions

(1) The laser need to be placed horizontally and fixed, without inversion, side setting, vibration and impact.

(2) Ensure the power supply wire and the control wire with 16 pin connected without the electrical power is disconnected.

(3) When the laser is connected to the water cooler, recognize the water inlet and outlet signs and step after it.

(4) During the installation of QBH/QD, the surrounding environment must be cleaned, in order to protect the QBH/QD from polluted.

(5) Check the output head and clean it if necessary. If any dust on the QBH/QD end face cannot be cleaned, please contact Reci, and at the same time the cleaning procedure must be performed by personnel of Reci or authorized by Reci.

(6) Prevent the delivery cable from treading, excessive bending, smashing with heavy objects during installation. There would be no warranty if the cable is damaged due to external force.

	**CAUTION*:*** ***(1)Please make sure the laser optical output and the processing head are all dust-free before connecting them together.*** ***(2)Please take good care of the black protective cap of*** QBH/***QD from being polluted; otherwise, it will cause indirect pollution to*** QBH/***QD output head when the protective cap is put on.***

(7) After the installation or connection of the cooling system, optical system, electrical wires, remember to do a recheck: make sure the connection of the electrical system is correct (see section 4.3-4.5 for details), the capacity of the electrical supply power is the one (AC380V, 50Hz/60Hz), and the ground connection is available.

	**CAUTION*:*** ***Never do the recheck with any electrical switch on, especially the air switch for the AC 380V on the wall.***

(8) Handle gently with the QBH/QD while installing or removing it.

(9) Keep the deliver cable a minimum bending diameter of 400mm for storage, or 600mm for laser on.

	**CAUTION*:***

	(1)please make sure the laser optical output and the processing head cable should be kept as natural as possible and not be distorted ***(2) Too small bending diameter for the deliver cable will damage the device.***

Chapter 4 Using of the product

4.1 Front Panel

The layout of the front panel is shown in Figure 4.1. Take FMC12000 as an example.

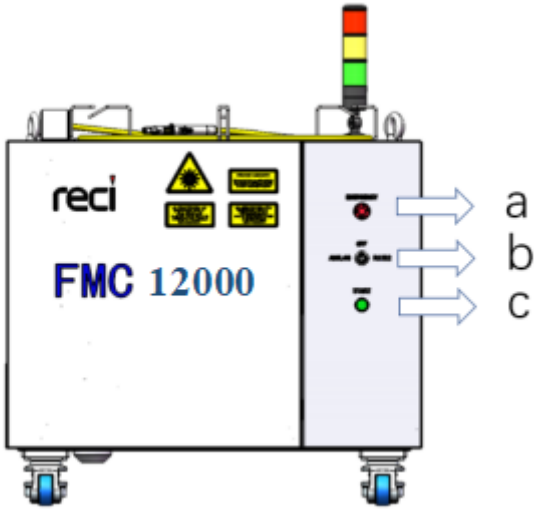


Figure 4.1 The layout of the font panel

The button functions of the front panel are as the table 4.1.

Table 4.1(a) Function of the button/switch on the Front Panel

NO	ITEMS	FUNCTION DESCRIPTION
a	Emergency Stop	Emergency stop. Press to turn the laser off and lock immediately, and turn it clockwise to release the button.
b	Key Switch	Mode switch of laser. Insert the key, rotating to ANALOG, means the laser is operating in the AD mode; rotating to RS232, means the laser is operating in RS232 mode; rotating to OFF, means the laser power is off.
c	Start	Start laser/ Laser module indicator. Local mode power-on button, after the laser source power supply air switch opened, need press the button again, then the laser source power supply can power-on and this indicator will turn on to green.

4.2 Back Panel Description

As shown in Figure 4.2, the rear panel styles of FMC12000 is respectively shown.

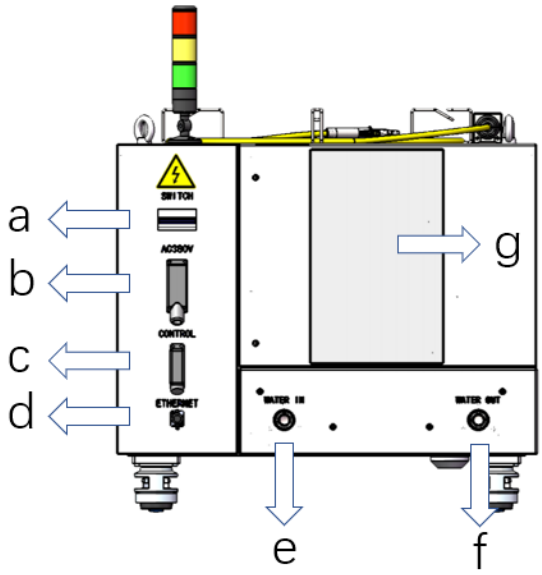


Figure 4.2 the Rear Panel of the FMC12000 fiber laser

The button functions of the rear panel are as the table 4.2

Table 4.2 Function of the button/switch on the rear Panel

NO	ITEMS	FUNCTION DESCRIPTION
a	AIR SWITCH	Power switch of 380V AC power Push on, open 380V AC power; push down, close the 380V AC power
b	AC INPUT	380VAC power input
c	CONTROL	Control signal connector Can be used for device program modification, providing RS-232 and ANALOG communication line.
d	ETHERNET	Network interface (reserved)
e	WATER-IN	Main water inlet
f	WATER-OUT	Main water outlet
g	AIR Conditioner	

4.3 Electric Power Connect

The power cord 5-pin aviation plug is inserted into the rear panel with the "AC INPUT" socket and the other end connected to the 380VAC power supply.

Figure 4.3 the wire for the AC source

The wiring definition is shown in the table 4.3

Table 4.3 definition of the AC wire

PIN	DESCRIPTION	PHASE LINE
1	L1	A
2	L2	B
3	L3	C
4	N	N
5	PE	GND

4.4 Control wire

This wire is used for inputting an analog signal ranged from 0V~10V to the laser, and RS-232 control signal.

Figure 4.4 The wire for the control connecting

Table 4.4 Definition of the control wire

PIN	DESCRIPTION	REMARK
1	Send	RS-232 Interface
2	Receive	
3	GND	
4	MOD	Reserve
5	LASER_EN+	24V High Level Effective，Laser Enable for AD Mode
6	Fault	Fault interface, need 24 V power supply from the machine tool, PIN6 for open leakage output, no fault output high level, fault output low level
7	Machine bed 24V	
8	Machine bed GND	
9	KEY_LOCK-	External Safety Lock-in Signal. KEY_LOCK fault will be reported after disconnection. (This function is enabled by background software settings)
10	KEY_LOCK+	
11	LASER_EN-	Match for No.5，Laser Enable for AD Mode
12	AD+	Analog voltage signal, AD mode power control signal，0~10V
13	AD-	
14	MOD_SW+	External modulation signal input, 24V High Level Effective
15	MOD_SW-	

4.5 USB to RS232 serial port wire

This wire is used to convert the RS232 to a USB. When use MOD RS-232，this wire is necessary.

Figure 4.5 the wire for the RS232 connecting

4.6 Laser Control

The laser control mode is divided into RS232 and AD, the difference between the two modes is that the output power control mode is different. The user can select the specific working mode through the RS232/off/AD key switch on the front panel. The RS232 mode is controlled by the instruction through RS232 serial port. The AD mode is controlled by the LASER_EN and AD ports.

AD: The output energy of the laser is controlled by the analog interface (analog + and analog -) of the control line. The input voltage range of the analog interface is 0 ~ 10V, and laser reach the maximum output power when the input voltage of the interface is 10 v.

4.7 RS232 Mode

4.7.1 Connections

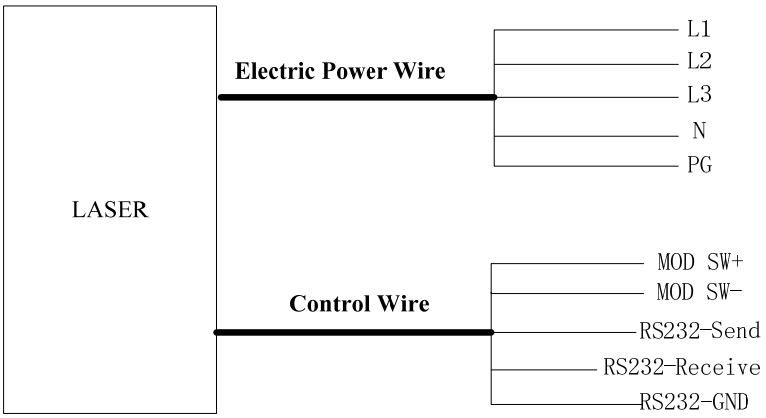


Figure 4.6 the connection for RS232 mode

4.7.2 Sequence of operations

(1) Taking FMC12000 as an example, Connect cooling water to the laser in right water flow direction of the laser, the water flow of the main water channel is greater than 120L/min (FMC6000 is greater than 60L/min), and the water flow of QD water channel is greater than 0.8L/min（For FMC6000 QBH is 0.6L/min）.

(2) Connect the cable according to figure 4.6 and turn on the power switch.

(3) Turn the Key Switch to the RS232 Mode.

(4) Press the Start Button on the front panel.

(5) Press the shutter button of the control card, the control card sends the enable command through the serial port, the three-color light of the cabinet is on, and the laser is in ready state.

(6) Press the ‘Light out’ or ‘Spot’ button, the modulation cable outputs 24 V high level, and the laser emits light. The output light energy is controlled by sending power command through serial port.

4.7.3 Communication Protocol

Table 4.5 Communication Protocol of RS232

CODE	DEFINITION	EXAMPLE
1B4F0D	Light on	Send: 1B4F0D Respond: 54 53 0D
1B530D	Light off	Send: 1B530D Respond: 54 53 0D
1B4350XX0D	XX is the percentage of power, from 0 to 100, hexadecimal	

4.8 AD Mode

4.8.1 Connections

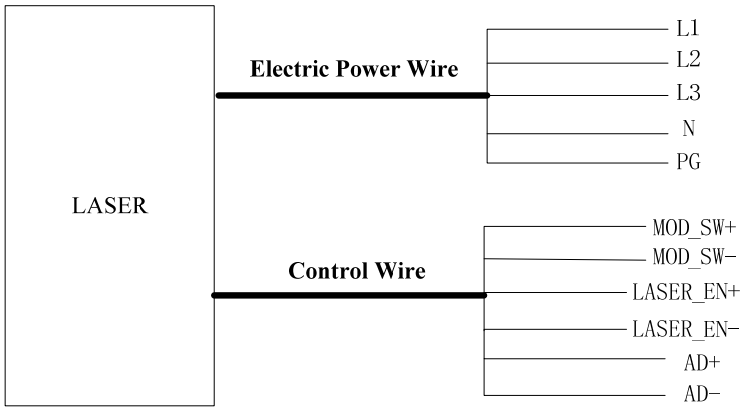


Figure 4.7 the connecting for AD mode

4.8.2 Sequence of operations

(1) Taking FMC12000 as an example, Connect cooling water to the laser in right water flow direction of the laser, the water flow of the main water channel is greater than 120L/min (FMC6000 is greater than 60L/min), and the water flow of QD water channel is greater than 0.8L/min（For FMC6000 QBH is 0.6L/min）.

(2) Connect the cable according to figure 4.7 and turn on the power switch.

(3) Turn the Key Switch to the ANALOG Mode.

(4) Press the Start Button on the front panel.

(5) Press the shutter button of the control card, LASER_EN cable output 24 V high level, the three-color light of the cabinet is on, and the laser is in ready state.

(6) Press the ‘Light out’ or ‘Spot’ button, the modulation cable outputs 24 V high level, and the laser emits light. The output light energy is controlled by voltage of AD cable(0~10V).

Chapter 5 Use of monitoring software

5.1 Introduction

The PC monitoring software is used to display the running information of the laser, such as fault information, parameters information and so on. Users have no need to open this software unless there is an alarm information occurring. Users need to install the RS232 Cable driver and LabVIEW running engine of the client's U disk when the monitoring software is installed for the first time. The functions of the monitoring software displayed as follows.

Figure 5.1 Page system control

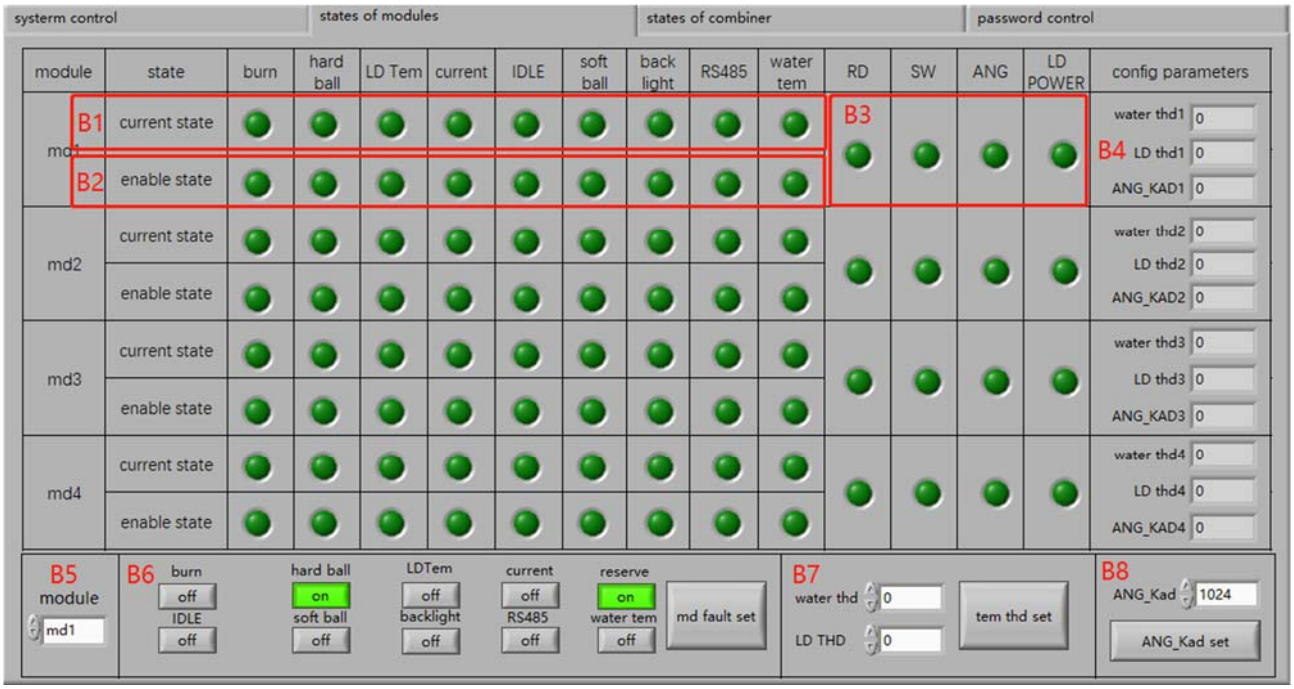


Figure 5.2 Page states of modules

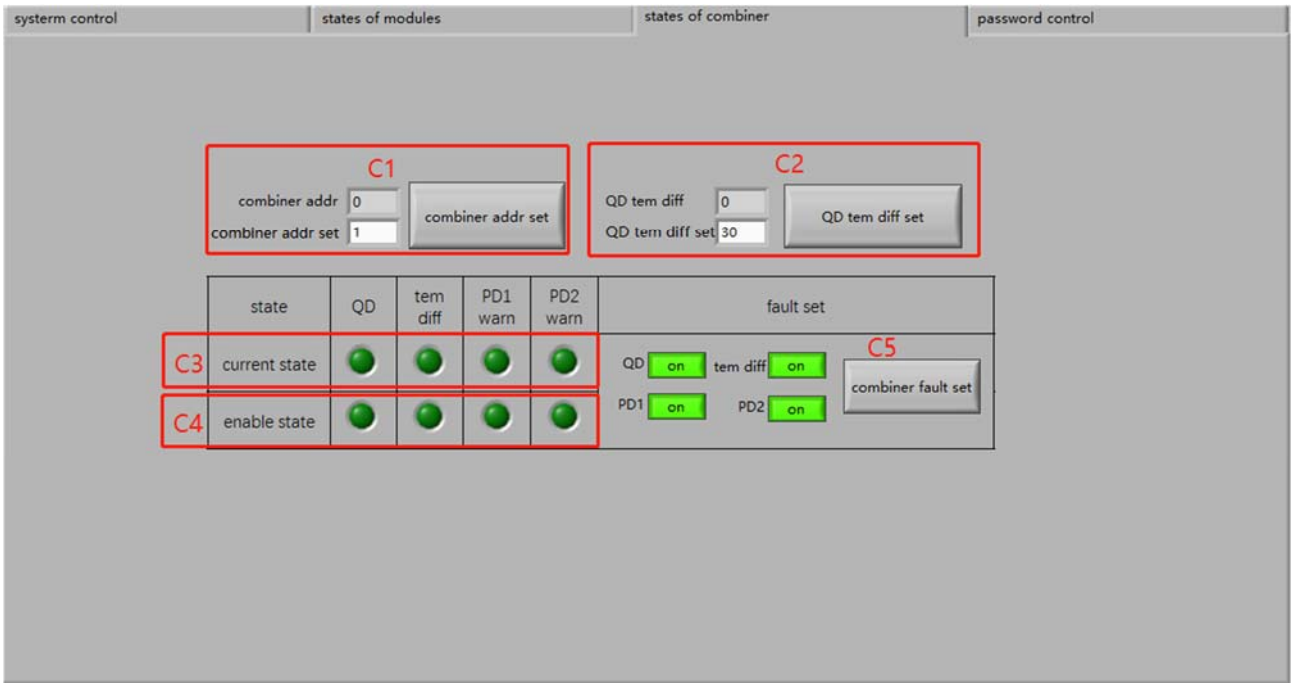


Figure 5.3 Page states of combiner

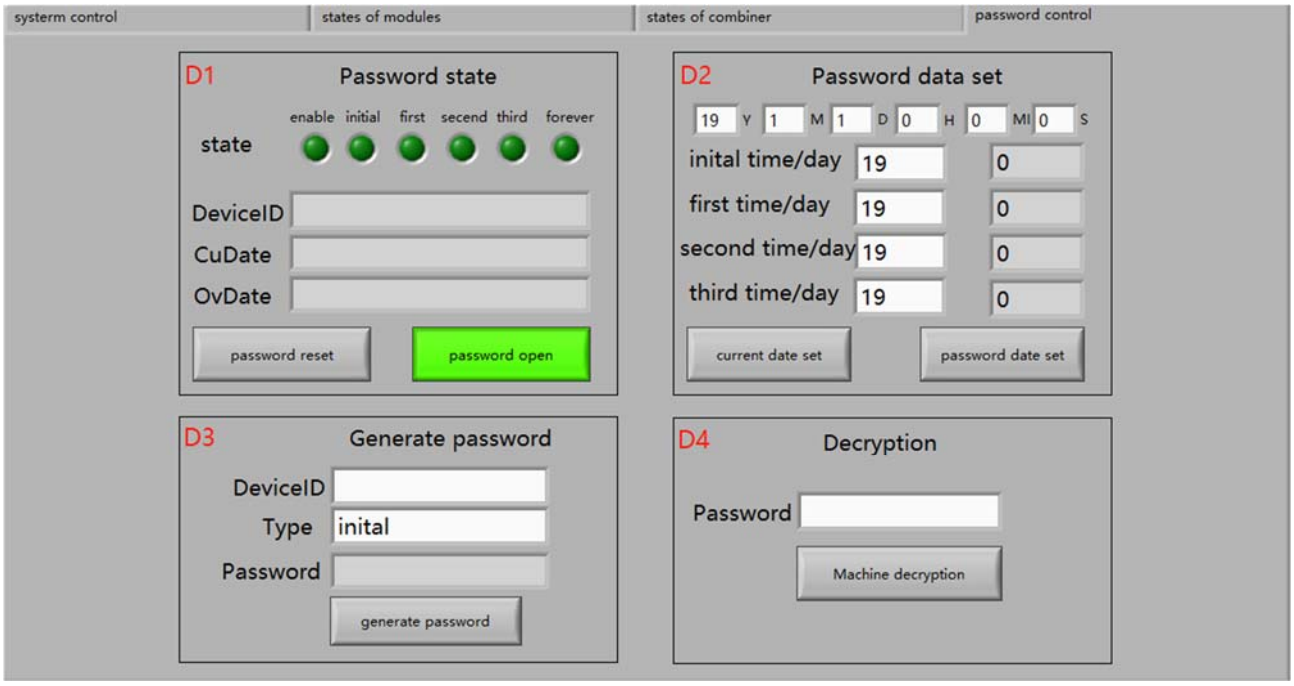


Figure 5.4 Page password control

5.2 operation

5.2.1 Functional area introduction

- **Page system control**

A1) serial port: Select serial port based on the RS232 Cable plugging in PC.

A2) work mode: Displays current work mode, the null indicator will turn on when users set RS232/OFF/AD key to OFF, the RS232 indicator will turn on when users set RS232/OFF/AD key to RS232, the AD indicator will turn on when users set RS232/OFF/AD key to AD.

A3) power and water flow: Power displays the power percent based on users settings，the machine will emit laser at full power if power displays 100. Water flow displays main water flow which needs to be greater than 45L/min when FMC12000 works normally and be greater than 120L/min when FMC6000 works normally.

A4) module settings: Users don’t need to operate this area.

A5) red laser settings: The indicator represents the number of the laser module in which the red laser is working. The user can enable red laser of the laser module through the check box, and click the red laser set button after the selection is completed. If users want the red laser to be emitted according to the current state next time, click the red laser set button and then click the save button.

A6) module enable settings: The indicator represents the number of the laser module that is enabled. Users can enable the laser module through the check box, and click the module enable set button after the selection is completed. If users want the laser

modules to be emitted according to the current state next time, click the module enable set button and then click the save button.

A7) internal control: Users don't need to operate this area.

A8) flow threshold and power coefficient: Users don't need to operate this area.

A9) fault settings: Users can operate this area to turn on and off fault detection. Users need to click the fault box to select the fault, click the enable box to select open or close, click the fault set button to open or close the fault. When the fault is enabled and there is no fault, the indicator will show green; when the fault is enabled and there is a fault, the indicator will show red; when the fault is closed, the indicator will show yellow.

A10) save parameters: After red laser setting, module enable setting and fault setting, click the save button to save the setting parameters and the laser will still operate according to the current setting parameters at next power on.

A11) module parameters display: The online column shows the communication status between the main controller and the laser module. When the communication is normal, it will be lit up; when the communication is abnormal, it shows the gray. The current column shows the current data of the laser module; the LD Tem column shows the temperature of the LD; the Water Tem column shows the value of the water temperature in the current module; the PD value shows the value of the current module PD(Power Detect in the module).

A12) combiner parameters display: The online column shows the communication status of the main controller and the combiner, CH1 and CH2 show the sampling data of photosensitive tube, Tin shows the input temperature of water flowing QD,

Tout shows the output temperature of water flowing QD, (if QBH is used, Tin and Tout show 0).

A13) state: Displays the control signal status of the current machine.

A14) global fault: Displays the fault status of the current machine.

➢ page states of modules

B1)current state: Displays whether the current module has a fault, and the red light indicates that a fault has occurred.

B2)enable state: Displays whether the fault is enabled, and the green light indicates the fault is enabled.

B3)the control signals of module: The green light indicates that the signal is given normally, and the four signals in this area are required to be given normally for the module to emit laser.

B4)config parameters: Display the alarm threshold of water temperature, LD temperature and the ANG_KAD value set by the current module.

B5、B6、B7、B8): Users don't need to operate this area.

➢ page states of combiner

C1)sets of combiner address: Users don't need to operate this area.

C2)sets of QD temperature difference: Users don't need to operate this area.

C3)current state: Shows whether the combiner has a fault and the red light indicates a fault has occurred.

C4) enable state: Displays whether the fault is enabled, and the green light indicates the fault is enabled.

C5) fault set : Users don’t need to operate this area.

- **page password control**

D1) Password state: Displays the current password status, enable led indicates the password function is enabled or not. If enable led is green, the other leds display whether there is a password fault or not. Green indicates that the current device is in normal decryption state, red indicates that the password has expired, and yellow indicates the phase to be decrypted.

D2) Password data set: Users don’t need to operate this area.

D3) Generate password: Users don’t need to operate this area.

D4) Decryption: After the expiration of the password, get the next password from the manufacturer and fill in the password box, then click the Machine decryption button to decrypt the device.

5.2.2 Clean up serious fault

Laser fault is divided into combiner fault, module burn fault, module integrating sphere fault and module backlight fault. When the above four kinds of fault occur, users need to restart the machine, and the fault will not disappear automatically. If users want this kind of fault cleaned up, you need to choose the critical fault in the fault box, choose "open" in the enable box, then click fault set button to remove such faults.

Chapter 6 Common faults treatment

6.1 Fault alarm and query

In case of fault alarm, the laser will automatically turn off by turning off the internal power supply. At the same time, the fault interface PIN6 (fault), PIN7 (Machine bed 24V) and PIN8 (Machine bed GND) of the control wire will simultaneously output the fault state to the machine bed, which is an OC output and requires the user to provide an external 24V power supply. PIN6 (fault) outputs low level in normal operation and high level in case of fault. The customers can make detailed query on the software fault query page when they need to know more detailed fault information.

6.2 Common faults solution

The failure instructions and possible solutions are as follows:：

Table 6.1 the failure instructions and possible solutions

NO	MESSAGE	DESCRIPTION	SOLUTION
1	QBH/QD fault	Contact between the QBH/QD and the cutting head is not in place.	Reconnect the QBH/QD and cutting head, restart the laser to see if the fault still occurs. If it does, pull out QBH/QD with the ring contactor short circuit connected, and then restart the laser source. If there is still a fault after all of above treatments, please contact our after-sales service personnel.
2	LD water fault	The rate of water flow is lower than required	Check whether the water cooler is working normally to ensure the water flow of LD main water is greater than 120L/min (FMC12000) and 60L/min (FMC6000)

NO	MESSAGE	DESCRIPTION	SOLUTION
3	Combiner fault	The combiner detected an unusually strong light signal	Restart the machine, clear up the serious fault, and check whether the equipment has red laser. If no red laser occurs, please contact the after-sales service personnel of our company
4	Module error	The laser module fault occurs	Look up the page states of module of monitoring software to see the special fault.
5	Hard ball/ Soft ball/ Backlight/ burn	Laser internal optical path detection failure	Contact our after-sales service personnel to see if you can continue to use lasers.
6	LD Tem	The temperature of the laser diode used as pump source exceeds the set value.	Check whether the water cooler is working properly; check whether the water temperature is set correctly or not. When the water cooler works normally and the water temperature drops to the set temperature, restart the laser source. If there is any trouble, please contact our after-sales service staff.
7	current	The laser module supply current exceeds the hardware threshold. (Located on the main drive circuit board)	Check if the 380V power supply of the laser is stable. If it is stable, reduce the peak output power of the laser. If the fault still occurs, please contact our after-sales service personnel.
8	Water Tem	The water temperature is too high, or the water flow is below the set value.	Check whether the water pipes are installed correctly. Ensure the cooler is working properly and the water flow meets the requirements. If a fault is still happening with everything qualified, please contact us.

NO	MESSAGE	DESCRIPTION	SOLUTION
9	IDLE	The current value of the slave drive board exceeds the upper limit when the laser is turned off.	Restart the laser. If it happens frequently, please contact our after-sales service personnel.
10	Water Flow fault	The water flow is below the set value	Increase water flow, if the fault is still happening, please contact us.

Chapter 7 Warranty and Return

7.1 General warranty

While all products manufactured according to the orders or specifications are delivered, the products with problems issued from materials and technologies shall be guaranteed by Reci, as long as the laser is used in accordance with specifications.

When a problem is found, the customers should do as below:

- Contact with the after-sales service personnel of Reci at the first time, then put forward the requirements in writing within a month (30 days) from finding the problems.
- In case of returning to the factory for maintenance, packaging and transportation shall be carried out in accordance with the requirements of this Guide.
- A third party will never covered by the warranty.

7.2 Limit of warranty

The following damages (including the overall damage of the machine, the damage of parts, optical fiber, etc.) are not covered by the warranty:

- Damages caused by tampering, opening, MIS installation, improvement intention, etc. without Reci personnel.
- Damage caused by inappropriate operations and negligence.
- Damage caused by using beyond the limit of the product.
- Damage caused by a violation the information and warning in the user guide.

	**CAUTION:** ***The customer has the responsibility to understand and operate according to the operation instructions in the user's guide. The damage caused by the wrong operation is not covered by the warranty.***

7.3 Transportation

- Before transportation, all machines to be repaired or replaced must be reliably packed with the original packaging boxes provided by Reci, otherwise any damage caused thereby will not be repaired free of charge.
- Please carry out inspection and acceptation according to the list when prepare to repairing or returning. If the machine to be repaired or replaced does not return accompanied with all its wires, Reci will not send the wires again.
- When the products will be transported in winter, please use high-pressure air (which must be dry and clean) to drain the cooling water inside the products (inside the machine and QBH/QD). If the products are frozen crack to water leakage, additional maintenance fees will be charged.