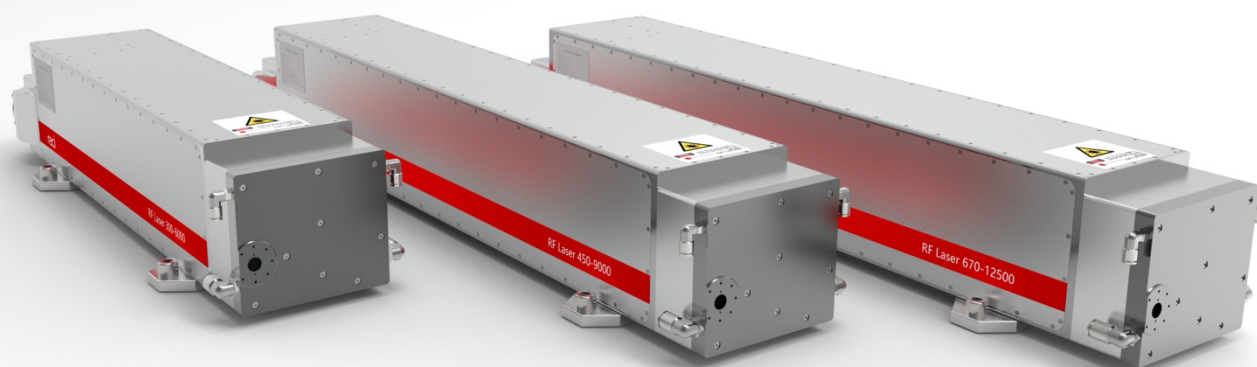




CO₂ RF Laser R40

Instruction Manual



Zhejiang Reci Laser Technology Co., Ltd.



Content

Chapter 1 Product Introduction	- 3 -
1.1 General Information	- 3 -
1.2 Description.....	- 3 -
Chapter 2 Specifications	- 3 -
2.1 Laser System Specification	- 3 -
2.2 Integrated RF Power Supply Specification	- 4 -
2.3 DC Power Supply Specification	- 4 -
2.4 Fixing locations	- 4 -
2.5 Technical Information.....	- 4 -
2.6 Environmental Specification	- 5 -
2.7 Coolant Specification	- 5 -
Chapter 3 The Installation and Options	- 7 -
3.1 Installation	- 7 -
Chapter 4 Pin Connection Description	- 9 -
4.1 DB9 and DB15 Connection Details.....	- 9 -
4.2 Communication Interface	- 10 -
4.3 Functions Reequipment	- 10 -
4.4 Common Problem.....	- 11 -
4.5 Serial Port Specification	- 11 -
Chapter 5 Operating Instruction	- 14 -



5.1 Button Description.....	- 14 -
5.2 Specific details for operation.....	- 14 -
5.3 Normal Problem	- 15 -
Chapter 6 Duty Cycle Description.....	- 16 -
6.1 Power Description	- 16 -
Chapter 7 Maintenance.....	- 16 -
7.1 General Cleaning	- 16 -
7.2 Replacing cooling water periodically	- 16 -
Chapter 8 Others.....	- 17 -

Chapter 1 Product Introduction

1.1 General Information

Before installing or operating R40 RF laser, all personnel must be familiar with the Health and Safety issues covered in the Safety Instructions and Precautions manual.

1.2 Description

The R40 RF laser assembly consists of sealed cavity, a water-cooling system, and a finely turned optical correction system.

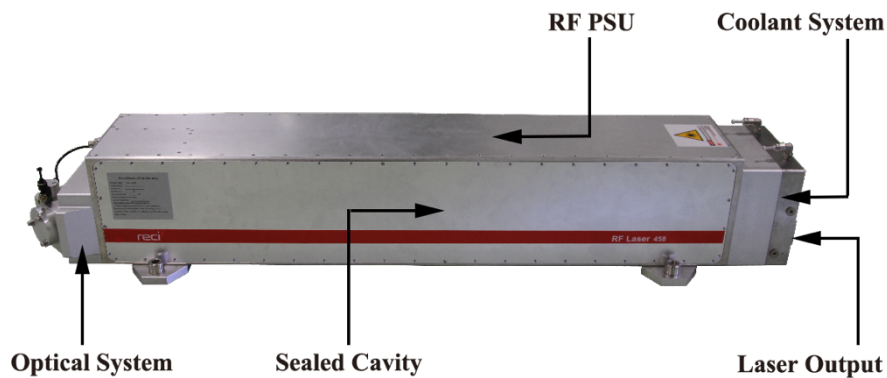


Figure 1 Laser Introduction

Chapter 2 Specifications

2.1 Laser System Specification

Laser tube	Sealed cavity, RF excited, diffusion cooled
Wavelength	10.6 μm (9.3 μm optional)
Power range Rated (Watts)	20 - 350W
Peak Power (Watts)	700 W
PO Power	300 W
Excitation frequency	81 MHz
Expected tube lifetime (This is an expectation not a guaranteed figure)	>20,000 hrs
Energy	10 - 200 mJ
Typical Power Stability (at start up)	< \pm 3.5%
External Dimensions	892 x 180 x 196 (mm)
Weight	45.5 Kg

Table 1 Laser System Specification

2.2 Integrated RF Power Supply Specification

Output power peak	3 kW (Frequency reaching 81.36MHz)
DC Input	50V+/-1V (imax=70A)
Pulse Width Range	0 – 520 μ s
Frequency	1 – 100 kHz (Maximum)
Duty Cycle (Range)	4—52%, 4—60%

Table 2 RF Power Supply Specification

2.3 DC Power Supply Specification

Output Voltage	50V DC +/- 1V
DC Output (Average)	60 A
DC Output (Peak)	100 A
Output Power (Maximum)	5 kW
Average Power at 50% load	3 kw

Table 3 DC Power Supply Specification

2.4 Fixing locations

Make sure the correct orientation of the RF laser while installing. And the laser output is not allowed upwards. If it is mounted vertically in this orientation, the optical surface inside the optical assembly tends to accumulate dust, which will shorten the life of the optical assembly, especially in dusty environment.

2.5 Technical Information

The technical information for the output beam is shown in the table below.

M ² (K)	<1.2 (>0.833)
Beam diameter	6mm \pm 0.5mm, at laser output optic
Beam Divergence	<2mrad, full angle far field
Beam Ellipticity	<1.2:1
Pointing Stability	<0.25mrad (Half angle)
Polarsation	Linear parallel to base

Table 4 Output Beam Specification

Note: In order to protect the laser, please do not cut high reflection material, such as mirror metal.

2.6 Environmental Specification

Ambient working temp	3 - 42 °C, (Air conditioner is recommended.)
Storage temperature	-10 - +70 °C
Humidity (Non-condensing)	10 - 85% relative humidity

Table 5 Environmental Specification

2.7 Coolant Specification

2.7.1 The specification for the coolant

(1) R40 Laser requires a liquid coolant source to operate correctly. The specification for the coolant is as follows.

Coolant flow rate	(L/min)
Minimum	13 L/min
Recommendation	14 L/min
Coolant Pressure(max)	4.0 bar (88 psi)
Dissipation	<5 kW
Refrigeration Capacity requirement	>6.5 kW
Connections	14mm outer diameter tube
Coolant Temperature	28-30 °C

Table 6 The coolant specification

Note: Optimum at 20°C- Increased temperature affects the power of the laser and shortens its life.

(2) Water Cooling Pipe Installation Diagram

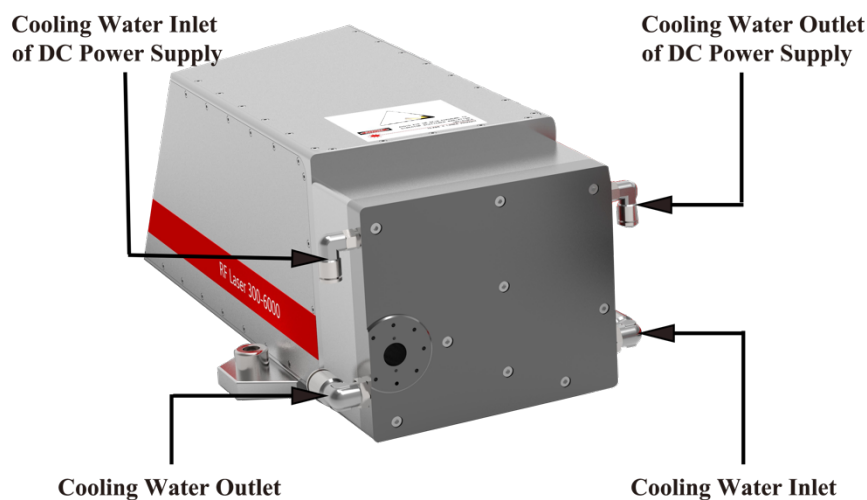


Figure 2 Water Cooling Installation

(3) Water cooling Circuits Precautions

Please be noted as below.

- The cooling circuit material must be selected to avoid corrosion.
- In order to avoid blockage caused by oxidation, the cooling circuit are not recommended to be made of aluminium, zinc, mild steel or cast iron.
- The cooling circuit are recommended to be made of stainless steel, copper, copper alloy and opaque plastic pipe, etc.
- It's better to recommend an opaque pipeline system to avoid bacteria or moss in the pipeline.
- The temperature of cooling liquid must be above dew point to avoid condensate on the inner assembly. The high purity. Nitrogen is needed to protect the laser system before cooling liquid.
- Before shipment or storage, drain off the contaminated cooling liquid.

2.7.2 Cooling Water Specification

To endure trouble-free operation of the laser and to prevent corrosion in the cooling circuit, the following requirements must be complied with:

(1) Quality of the cooling water

Use only de-mineralized, de-ionized or distilled water with an anti-corrosion additive. Ensure that the following limits on the water quality are met:

Conductivity	< 1000 μ S/cm
Total Hardness	< 10 ppm
pH value of the water	7 – 8.5
Bacterial Level	<1000 cfu/ml

Table 7 Water Quality Requirements

The pH value, conductivity and dissolved levels can be measured with a portable meters and the bacteria level can be checked with a test kit – for more information, please contact the local Reci Sales and Service Office.

(2) Suspended Particles

To remove particulate contamination, a filter with a pore size of 100 μ m must be used. The filter should be located as close as possible and in line with the cooling water inlet of the laser head and should be regularly checked for blockage and cleaned or replaced where necessary. This is particularly important after bacterial growth has been detected and treatment applied.

(3) Corrosion and Germ Formation Inhibitors

The corrosion and germ formation inhibitors depend on the total of the cooling water circuit to be used.

(4) Contaminated Cooling Water

If the cooling water is contaminated with bacteria or has been treated with other chemicals, it will be necessary to clean the cooling circuit.

(5) Frost Protection

If the cooling system or chiller which supplies the cooling for the laser system is located in the area where the temperature may be below 0°C, then the cooling water circuit must be equipped with a winter proof heating tank to prevent the cooling water temperature which drops below 15°C.

Chapter 3 The Installation and Options

3.1 Installation

3.3.1 Connecting the DC Supply Cables

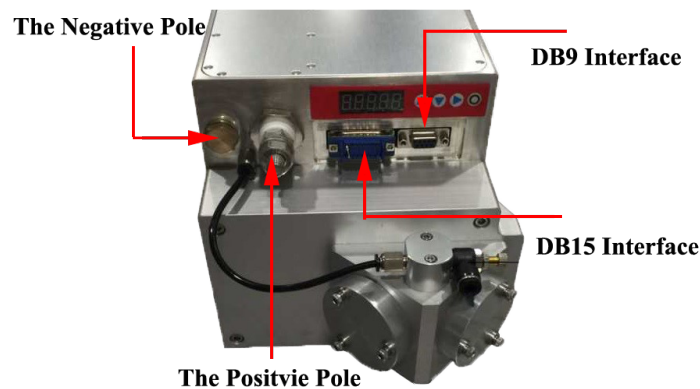


Figure 4 DC Supply Connection

- (1) Please connect the positive pole of the DC power supply to the respective positive pole of the laser as shown in the figure, and connect the negative pole of the DC power supply to the negative of the laser.
- (2) Extremely, the DC power supply should be on and checking with the multimeter to distinguish between the positive and negative poles of the power supply before installation.
- (3) Generally, the red cable means the positive, and the black cable means the negative.

Note

- (1) Please note the orientation of cable before installing and refer to the below figure to avoid short circuit.

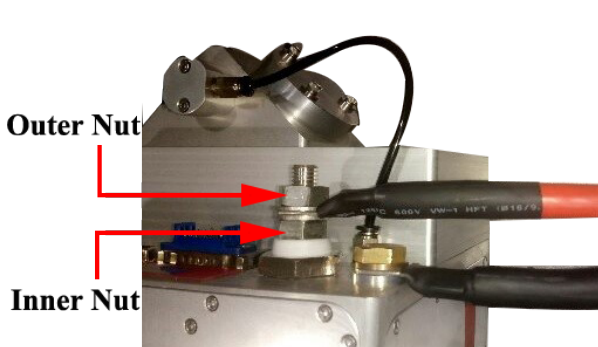


Figure 5 Correct cable installation diagram

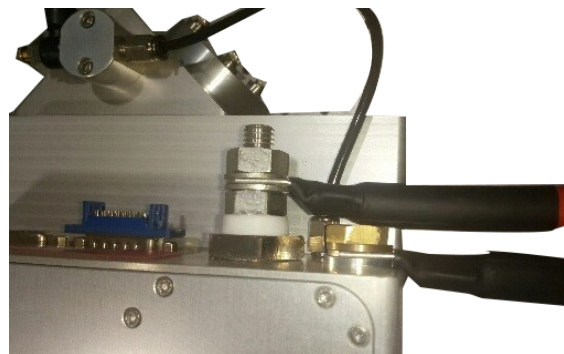


Figure 6 Wrong cable installation diagram

- (2) When connecting the DC power supply cable to the laser's positive filtering connector, please note that the inner nut can be tightened by hand to protect the internal components. Then use a wrench to clamp the

inner nut during tightening outer nut to avoid the rotation. And use two wrenches to prevent damaging the connector shown below.

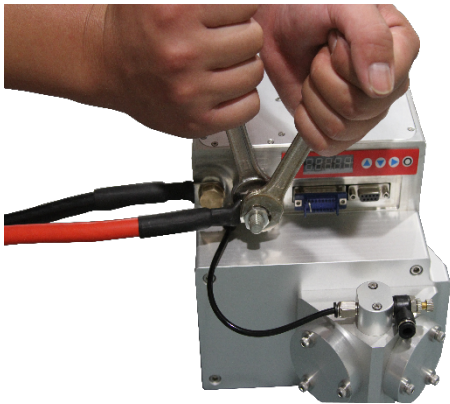


Figure 7 Correct installation diagram

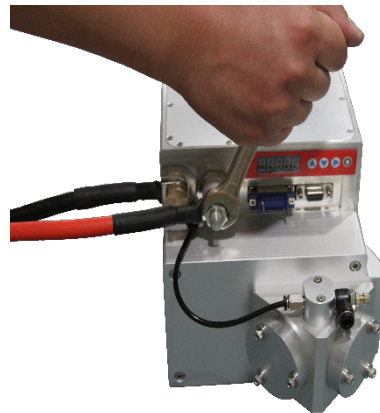


Figure 8 Wrong installation diagram

3.1.2 Installing DB15 and DB9

Installing DB15 and DB9 (Only for Communication), please refer to pin definition in next Chapter.

3.1.3 The Usage Time

When DC power supply turning on, the laser will be start with a short beep normally. The usage time will be displayed 10 seconds later after startup. If there is a problem, an alternate alarm will occur and the alarm code will be displayed. Please refer to FAQ in Operations chapter.

3.1.4 Self-testing

It will take 20 seconds for self-testing, then the interface will change from the usage time to parameters display. (Note that low power laser will be emitted during self-testing.) The normal standby state will be ready if no alarm. The parameters will be scrolling down the screen as below.

1.xxxx	Condensation parameter 1
2.xxxx	Condensation parameter 2
3.xxxx	Coolant plate temperature
4.xxxx	DC voltage
5.xxxx	Preionization value
6.xxx	Humidity
p.xxx	Duty Cycle
f.xxx	Frequency

Table 9 The Self-testing

3.1.5 The Enable Signal

After the standby, the laser will be ready. PWM signal must be inputted firstly with 10ms stop. Then Enable signal will make the laser working normally.

Chapter 4 Pin Connection Description



Figure 9 Pin Connection Description

4.1 DB9 and DB15 Connection Details

(1) Pin DB9 Connection Details

DB9 Pin No	Function	Parameters	Brief Description
1	GND (Ground)		Serial port line
2	Tx	Baud rate: 19200, Data bits:8 Stop bits:1 Parity: not	Tx
3	Rx	Baud rate: 19200, Data bits:8 Stop bits:1 Parity: not	Rx
4	-	-	-
5			
6			
7			
8	Can_H	Baud rate:1 Mhz	Can Port: H
9	Can_L	Baud rate:1 Mhz	Can Port: L

Table 10 Pin DB9 Connection Details

(2) Pin DB15 Connection Details



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DB15 Pin No	Function	Parameters	Brief Description
1			
2	CEN-	5V 10~15mA	Enable Cathode
3	CEN+	5V 10~15mA	Enable Positive
4	CMOD+	5V 10~15mA	PWM positive, 1~100 kHz Square wave, Duty cycle 3~60%, Avoid 2.2~4kHz.
5	CMOD-	5V 10~15mA	PWM Cathode
6			
7			
8	Interlock+	Interlock positive	Interlock+ must be low to enable the system
9			
10	-	-	-
11			
12	-	-	-
13	-	-	-
14	-	-	-
15	Interlock-	Interlock cathode	

Table 11 Pin DB15 Connection Details

4.2 Communication Interface

The communication interface is the DB9, which has 2 kinds of communications, Rs232 and CAN respectively. The communication is mainly about the parameters relating to core components inside, only for reference to connect to control system. If communication is not needed, there will be no connection and it will not affect the normal working of the laser.

4.3 Functions Reequipment

4.3.1 PWM

The power will be adjusted by the duty cycle, and the frequency is from 1 to 100kHz (Please avoid the frequency from 2-4kHz with noise.). The range of duty cycle is from 4% to 52%, and the current must be within 10-15mA. Otherwise, it will be deformed due to insufficient current.



4.3.2 The Enable

It is the signal for laser on or off. When enable pin reaches 5V, the laser will be output. Whereas no laser when enable pin is 0V. The enable time between on and off is recommended to be more than 20ms.

4.4 Common Problem

4.4.1 Disconnected communication

(1) Checking the communication settings, especially Baud rate. The simulation software is recommended to testing the connection.

(2) Please check if the cable is connected correctly or not.

4.4.2 No Laser

(1) Please check if the cable is connected correctly or not.

(2) Please check if the PWM working normally or not. The oscilloscope is recommended for testing. PWM+ can be connected to the positive pin of oscilloscope, and PWM- to the negative pin of oscilloscope. Then check whether the waveform is output based on the setting. If it is not square wave or the voltage of square wave is being low, the current is proved to be insufficient.

(3) Please check whether the voltage of the enable signal remains 5V. If the voltage is low, it is proved a short circuit or insufficient current.

4.5 Serial Port Specification

4.5.1 RS232 connecting to communication

RS232 is used for hardware interface. Please use the dedicated connection cable provided by us to connected the communication interface.

4.5.2 RS232 Settings

RS232 Settings: please input 19200 for Baud, 8 for data bits, 1 for stop bits and no parity.

4.5.3 Protocol Instruction

The protocol is available to check the working state of laser. The main mode is that a checking signal will be sent by the control system, such as computer. In response to the command, the laser will feedback its state.

Protocol Details

Computer ---> Laser 6E 61 31 6F 6F 6F

Laser ---> Computer

Date

Byte 1: 0xee (Start)

Byte 2: 0x00

Byte 3: 0x00

Byte 4: 0x00



Byte 5: 0x00
Byte 6: 0x00
Byte 7: 0x00
Byte 8: 0x00
Byte 9: 0xa0 (Date Start)
Byte 10: xx (status:1, Normal 2,Over-temperature.3,Interlock disconnect.
4, Over-voltage.5,Dew Formation .6,Over-reflect.7, Initializing failed.)
Byte 11: xx (Forward power High)
Byte 12: xx (Forward power Low)
Byte 13: xx (Reflect power High)
Byte 14: xx (Reflect power Low)
Byte 15: xx (Input duty ratio High)
Byte 16: xx (Input duty ratio Low)
Byte 17: xx (Input freq High)
Byte 18: xx (Input freq Low)
Byte 19: xx (Dew Para High)
Byte 20: xx (Dew Para Low)
Byte 21: xx (-)
Byte 22: xx (Temperature)
Byte 23: xx (Voltage)
Byte 24: 0x22
Byte 25: xx (Preionization High)
Byte 26: xx (Preionization Low)
Byte 27: 0x00
Byte 28: 0x00
Byte 29: 0x00
Byte 30: 0x00
Byte 31: 0x00
Byte 32: 0x00
Byte 33: xx (Run time x 1000)
Byte 34: xx (Run time x 100)
Byte 35: xx (Run time x 1)
Byte 32: 0xff (Stop)

Note: For example: Preionization =Preionization High x 100 + Preionization Low

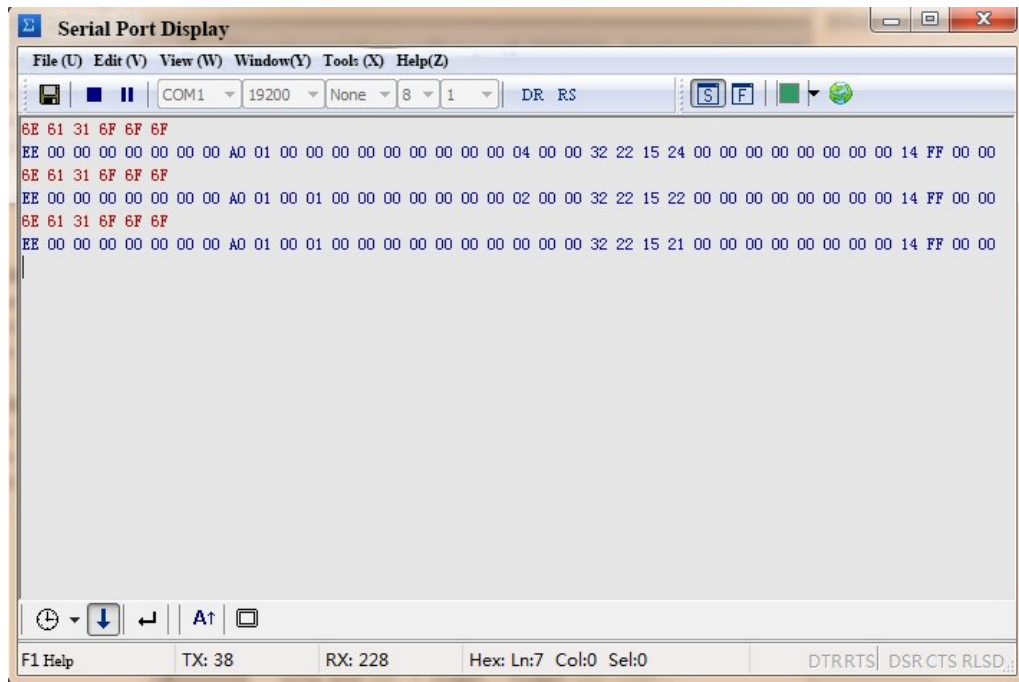


Figure 10 Serial Port Display

Chapter 5 Operating Instruction

5.1 Button Description

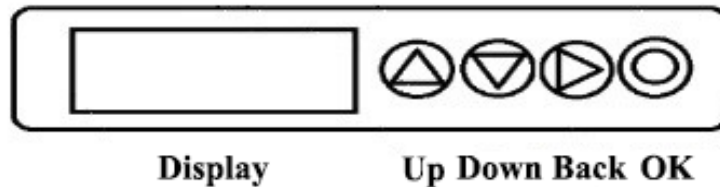


Figure 11 Button Description

There are four buttons on the laser, including Up, Down, Back, OK. Up and Down is for adjusting the parameters. Back is for returning to the previous step. OK is for authorizing the change or switch on the laser while hand-testing.

5.2 Specific details for operation

5.2.1 Cancel Time Operation

- (1) Press the OK button to enter the password setting, then P0000 will be shown on the display. Here the back button is used to select the digit. It is noted that the currently changed digit will be brighter than the others.
- (2) Press the Up and Down buttons to modify the value.
- (3) After modifying, press the OK button and 0 will be shown on the display to prove the correct inputting. Then press the OK button to enter the standby state.
- (4) The time limit will be cancelled after restarting the laser. And it will be used indefinitely. (The laser will be locked due to repeatedly entering the wrong password after a certain number of times.)

5.2.2 Laser Testing State

- (1) Press the OK button to enter the password setting, then P0000 will be shown on the display. Here the Back button is used to select the digit. It is noted that the currently changed digit will be brighter than the others.
- (2) Press the Up and Down buttons to modify the value to 1,000.
- (3) After pressing the OK Button, F-000 will be shown on the display for frequency setting. The frequency range can be adjusted from 0 to 100. (For example, F-10 means the frequency of PWM is 10 kHz.)
- (4) P-xxx will be shown on the display for duty cycle setting after pressing the OK button. The duty cycle range is 0~52%. (For example, P-10 means the duty cycle of PWM is 10%)
- (5) The laser testing state will be ready after pressing the OK button. Then press it again for laser on and release it for laser off. 8888 will be shown after long pressing the Back button for returning successfully.

Note: In the testing state, the laser cannot be controlled by the PWM and the enable directly. The testing state can be cancelled after long press the Back button more than 5 seconds and 8888 will be appeared on the display to prove returning successfully.

5.3 Normal Problem

5.3.1 Wrong Password

If failing to enter the password interface after pressing the OK button. This is because the wrong password has been inputted too many times, which causes inputting function locked. It will be available after one hour.

5.3.2 No laser beam after pressing the OK button.

- (1) The button may be damaged due to pressing by the nail for long time. So, it is recommended to press it with fingertips.
- (2) Pressing time is too shot to trigger the switch. In this way, long press the OK button in the testing state 2 till the numbers on the display disappeared.

Error Code	Descriptions
E 2	The machine temperature is too high.
E 3	Interlocked and disconnected.
E 4	Voltage error caused by power supply (Less than 48V or More than 52V)
E 5	Condensations
E 6	Over-reflection
E 7	Laser Pre-detection Fault (Please turn off the power and restarting. If it is invalid repeatedly, please contact us.)
E 8	Trial Time Expires

Table 11 Error Code

5.3.3 Password Input for Trial Time

- (1) Press the OK button to enter the password setting, then P0000 is shown on the display. Press the Back button to select the digit to be changed. The currently changed number will be brighter than the others.
- (2) Select the digits which needs to be changed, then press UP or Down button to modify the value to 3000.
- (3) After pressing the OK button, H-6 is shown on the display, which means the unlock time. Users can press UP or Down to change the unlocking time. H-6, H-12 and H-18 means separately unlocking time can be 6 months, 12 months and 18 months.
- (4) After pressing the OK button, F0000 is shown on the display. Please contact us to get the respective password for extending the usage time. If the password for 18 months, the laser will be no time limit. If the password for 6 months, then users need to get a new one when the alert will be pop-on after 6 months using. If the password is wrong, E-8 will be shown on the display. The password will be successful when 8888 is appearing on the display before restart.

Chapter 6 Duty Cycle Description

6.1 Power Description

The laser power is mainly adjusted by the duty cycle. (For example, if the frequency is firmly 5KHz, 280W require to adjust the duty cycle to 52%.)

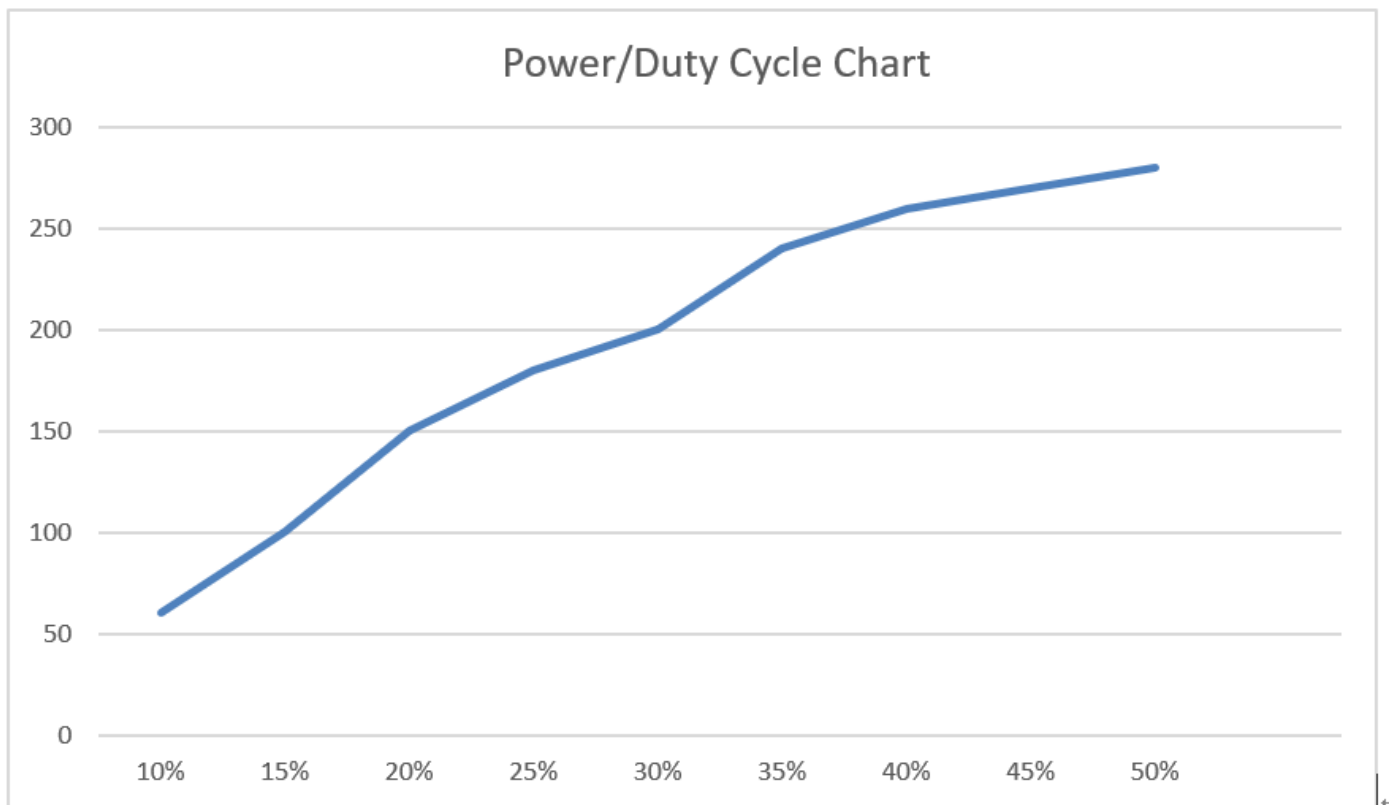


Figure 12 (Power/Duty Cycle Chart) Watt

Note: The diagram is only for reference.

Chapter 7 Maintenance

7.1 General Cleaning

Please always ensure that the system is turned off and isolated from the main power supply before attempting any cleaning procedures. The external surfaces of the system can be cleaned with a mild detergent, such as alcohol.

7.2 Replacing cooling water periodically

The cooling water must be replaced periodically. Otherwise it will cause damage to the internal waterway system of the laser.



Chapter 8 Others

In case of avoiding the interference caused by the current, it is recommended that the shielded cable should be used as the control cable.