

EAGLE SERIES LASER USER MANUAL V1.3



bcxaserCo., Ltd



Wu Han BCX Laser Technology Co.,Ltd

FORWARD

As a subsidiary company of BCXinternational, BCXphotonics is a pioneering developer as well as a leading manufacturing focusing on high power DPSS and fiber laser. BCXphotonics has developed 10-60W Q-switched pulsed IR, Green and UV lasers with its own well-designed and patented pumping modules, which provides high beam quality, longer lifetime and cost effective solutions for fine material micro-processing.

Our mission is to deliver high quality industrial lasers to meet the requirements of worldwide customers with sufficient laser solutions and comprehensive services within pre-sale, in sale and after sale, help you to solve the problem of laser processing.

Our vision is help our customers to succeed in their business with our high reliable, cost-effective products, good service and strong delivery capacity for mass production.

TECHNICAL SUPPORT AND SERVICE

You can obtain our technical support and after-sales service by the following ways:

E-mail: bcxlaser@bcxlaser.com

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USER MANUAL

Please read this manual carefully before attempting operation of your laser system. The troubleshooting and replacement procedures in this manual are only intended for use in conjunction with a training class offered by BCXPhotonics. By reading this manual, user can understand the configuration, installation and connection of the laser, and also get hold of the steps of laser operation and problems encountered in the processing and methods of maintenance.

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1 PREFACE

Before using this product, Please read this manual carefully before attempting operation of your laser system. This manual provides an important product operation, safety as well as other information to you for reference. The troubleshooting and replacement procedures in this manual are only intended for use in conjunction with a training class offered by BCXPhotonics.

1.1 Laser safety

We strongly recommend the use of protective eye wear during laser operation. Laser safety eyewear selection depends on the energy and wavelength of the laser beam as well as operation conditions. The Eagle series diode-pumped laser is a Class IV laser. Take precautions to prevent accidental exposure to both direct and reflected beams. Diffuse as well as specular beam reflections can cause severe eye or skin damage. Never look directly into laser beam. Avoid blocking the output beam or its reflection(s) with any part of the body.

WARNING: *Hazardous to persons. An action or circumstance which may potentially cause personal injury or loss of life. Mechanical damage may also result.*

CAUTION: *Hazardous to persons or equipment. To disregard the caution may cause mechanical damage, however it is not likely to cause serious injury or death.*

Precaution for the safe operation of class IV high power lasers

1. wear protective eyewear at all times: selection depends on the wavelength and intensity of the radiation, the conditions of use, and the visual function required.
2. maintain a high ambient light level in the laser operation area so the eye's pupil remains constricted, reducing the possibility of damage.
3. avoid looking at the output beam or its reflections with any parts of the body.

4. establish a controlled access area for laser operation. Limit access to those trained in the principles of laser safety.

5. enclose beam paths wherever possible.
6. post prominent warning signs near the laser operating area
7. set up experiments so the laser beam is either above or below eye level
8. set up shields to prevent any unnecessary specular reflections or beams from escaping the laser operation area.
9. set up a beam dump to capture the laser beam and prevent accidental exposure

!! Use of controls or adjustments, or performance of procedures other than those specified herein may result in hazardous radiation exposure.

!! Operating this laser without due regard for these precautions or in a manner that does not comply with recommended procedures may be dangerous. At all times during installation, maintenance or service of your laser, avoid unnecessary exposure to laser or collateral radiation that exceeds the accessible emission limits listed in “Performance standards for laser products,” United States Code of Federal Regulations, 21CFR1040.10(d).

1.2 Laser power supply safety

Technical specifications including electrical ratings and weight are included in the manual. The following classifications are standard for Eagle series:

- Indoor use only
- Ordinary Protection: This product is NOT protected against the harmful ingress of moisture.
- Mains supply voltage fluctuations are not to exceed $\pm 10\%$ of the nominal supply voltage.
- Pollution Degree II
- Installation (over voltage) Category II for transient over voltages
- Maximum Relative Humidity: $< 80\%$ RH, non-condensing
- Operating temperature range of $10\text{ }^{\circ}\text{C}$ to $40\text{ }^{\circ}\text{C}$
- Storage and transportation temperature of $-40\text{ }^{\circ}\text{C}$ to $70\text{ }^{\circ}\text{C}$
- Maximum altitude: 3000 m (9843 ft)

- This equipment is suitable for continuous operation.

1.3 Safety summary

The Eagle series diode-pumped laser is a Class VI laser as defined by the Federal Register 21 CFR 1040.10 Laser Safety Standard. The Standard requires that certain performance features and laser safety labels be provided on the product.

The American National Standards Institute publishes a laser safety standard for user entitled American National Standard for the Safe Use of Lasers (ANSI Z136.1). BCXphotonics strongly recommends that laser users obtain and follow the procedures described in this ANSI standard.

WARNING: Exposure to laser radiation can be harmful. Use of controls or adjustments other than those specified herein may result in hazardous radiation exposure. Take extreme care when working in areas where safety labels are placed. Take the suitable protection measures.

WARNING: Protect users' eyesight. Always wear protective eyewear suitable for 355nm, 532 nm and 1064 nm output if the beam is likely to be viewed. Enclose beam paths whenever possible. Care should be taken to avoid the use of flat reflecting surfaces which might cause hazardous specular reflections. Operate laser only under the direct supervision of a person knowledgeable in laser safety; limit access to the laser area by spectators unless supervised. Post the area with laser safety warning signs; Ensure that no beams are emitted through windows, doors, etc.

1.4 Laser emission levels

Eagle series laser wavelengths can run pulsed (Q-switched), and emission will be present. Eagle series laser wavelength are 355nm, 532 nm and 1064nm. The laser will emit less than 50 W at 15 kHz and are labeled as Class IV products. Pulse energy will not exceed 4 mJ, and the pulse width, measured full-width, half-maximum (FWHM), will be greater than 80+/-20ns at 15 kHz.

A complete specification for the Eagle series laser is given in Table 4- 1.

1.5 Precautions for safe operation of class IV lasers

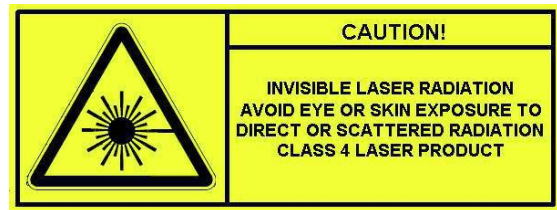
- Never look directly into laser beam, Even diffuse reflection are hazardous.
- Avoid blocking the output beam or its reflection with any part of the body.
- Set aside a controlled-access area for laser operation; limit access to those trained in the principles of laser safety.
- Post warning signs in prominent locations near the laser operation area, Enclose beam paths wherever possible.
- Set up experiments so the laser beam is below eye level.
- Maintain a high ambient light level in the laser operation area so that the eye's pupil remains constricted, reducing the possibility of retinal damage.
- Set up shields to prevent reflected beams from escaping the laser operation area.
- Any parts of the housing of a laser product that can be removed or displaced for service and which would allow access to laser radiation in excess of the AEL assigned and are not interlocked shall be secured in such a way that removal or displacement of the parts requires the use of tools.
- Give an audible or visible warning when it is switched on , Any visible warning device shall be clearly visible through protective eyewear specifically designed for the wavelength(s) of the emitted laser radiation.
- Take means to prevent any person activation of a laser hazard inside the working housing.
- Set up a warning device to provide adequate warning of emission of laser radiation to any person who might be within the working housing.

1.6 Safety labels

Reproductions of the labels on the Eagle series laser head are given below in Figure 1-3.

Safety Warning Label :

Located on the top of the laser head when facing the aperture. Label picture is for class 4 lasers.



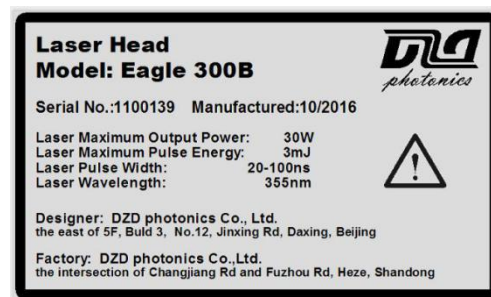
Aperture Label:

Located on top of the laser head when facing the laser aperture. Pointing to the laser output beam.



Laser head Identification Label:

Located on right of the Laser head. Includes Serial Number, Model Number, Manufactured Date, Manufacturers Name and Address.

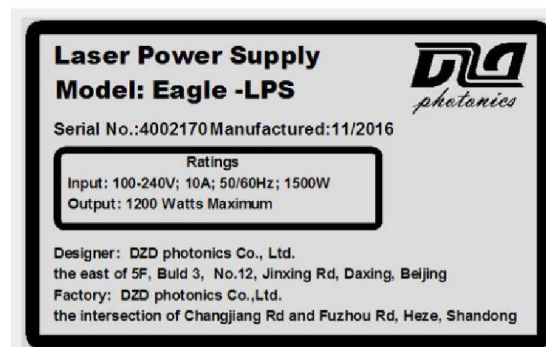


Tamper seal

Located on the seam of protective housing. Label picture is Tamper seal, opening the protective housing voids the warranty.



LPS identification and certification label



2 LASER INSTALLATION

2.1 Laser system configuration list Laser system

For Eagle series laser configuration list, pls refer to the following table 2-1.

Table 2-1 product configuration list

Item	Quantity	Picture
Laser head	1 unit	
Power supply	1 unit	
Chiller (Matching depends on demand)	1 unit	
Main cables (Including SMA cable, current cable, DB25 cable)	1 set	
Other cables (Including AC power cord, USB cable, water cable)	1 set	
Manual (Electronic version) Serial assistant installation kit	1 set	

2.2 Power supply interface description

For the front and rear panel features of power supply, pls refer to Fig.2-1 and Fig.2-2.

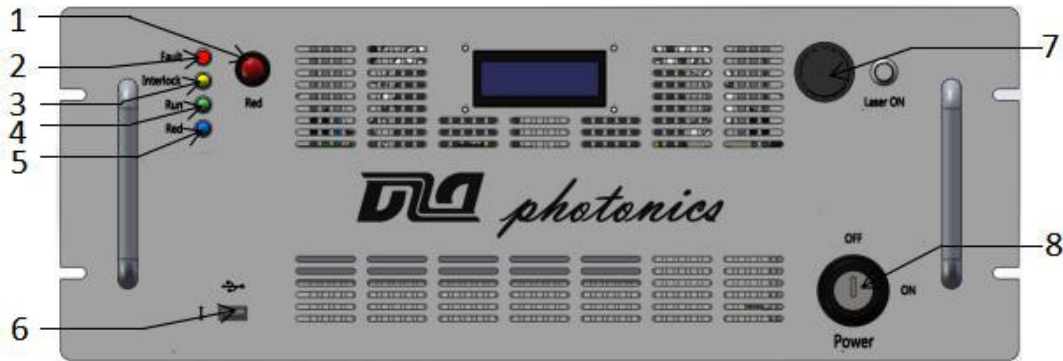


Fig.2-1 The front panel of power supply

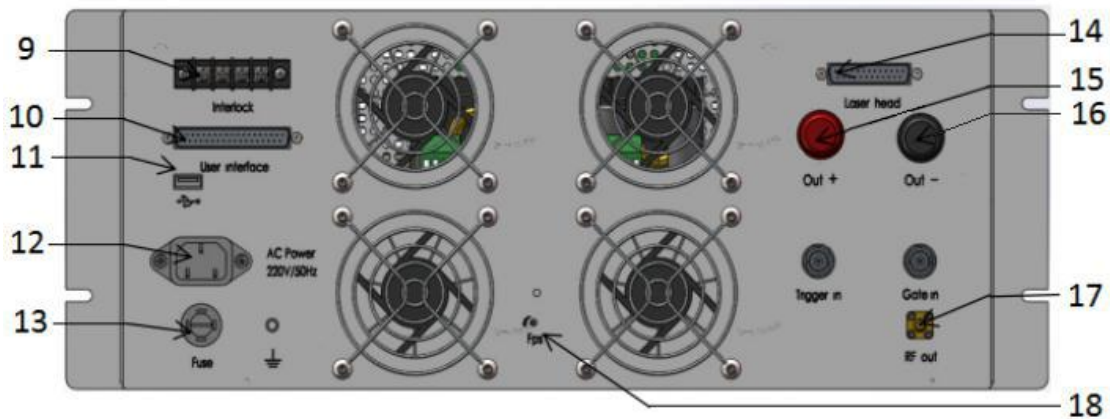


Fig. 2-2 The rear panel of power supply

These features are defined as follows:




Number	Item	Definition
1	Indicator Button	Press it, the laser indicator is on
2	Temperature Indicator	When frequency doubling crystal temperature is not stable, the indicator is on
3	Chiller Indicator	When chiller is in abnormal, the indicator is on
4	Current Loading Indicator	When current is loading, the indicator is on






5	Indicator light	When laser Indicator is turned on, this light is on
6	USB interface (front)	Connect with PC
7	Laser operation button	Push it, laser output
8	Power Supply Key Switch	Power supply key switch
9	Interlock	Left feet connect with chiller protection wire, power supply works when short circuit
10	DB37	External control interface. 1 foot GATE, 2 foot Trigger, 3 foot Ground
11	USB Interface (Rear)	Connect with PC
12	220V Power inlet	Connect with 220V AC cord
13	Earth Interface	Connect with ground wire
14	DB25 Interface	Connect with laser head
15	Power Positive pole	Red electrode, connect with laser head
16	Power negative pole	Black cathode, connect with laser head
17	RF Interface	SMA radio frequency interface
18	FPS	Adjust the first pulse suppression

Since there are different versions of the power supply, please pay attention to the connection position of USB data interface. If there are both front USB interface and the rear USB interface, please use the rear USB interface.

2.3 Power Supply Connection

2.3.1 Power supply rear panel cables connection

Power Supply Interface	Cables	Connection complete	Connection Method
 Laser head			Connect DB25 line to the laser head, and fasten

			<p>Current line, Connect red line to red bonding terminal, Connect black line to black bonding terminal, and fasten</p>
			<p>Connect the RF cable to the RF out connector, and fix to prevent the radio frequency leakage</p>
			<p>Connect the Chiller line to the left feet of the interlock, and user can define the right feet according to their own needs, need short-circuit if no connection</p>
			<p>Connect the power cord to the AC Power</p>

Completion of the power supply rear panel connection, as shown in the Fig.2-3, users need to connect DB37 external control interface. (This sample is USB front interface)

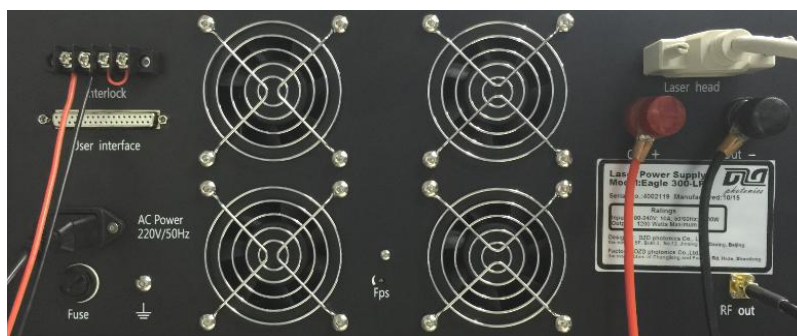






Figure 2-3 Power supply rear panel cables connection

2.3.2 Power Supply front panel cables connection

Power Supply Interface	Cables	Connection Complete	Connection Method
------------------------	--------	---------------------	-------------------

			Connect computer to the power supply by USB cable
			Trigger interface for external trigger signal reserved, do not need to connect generally

2.3.3 Laser head connection

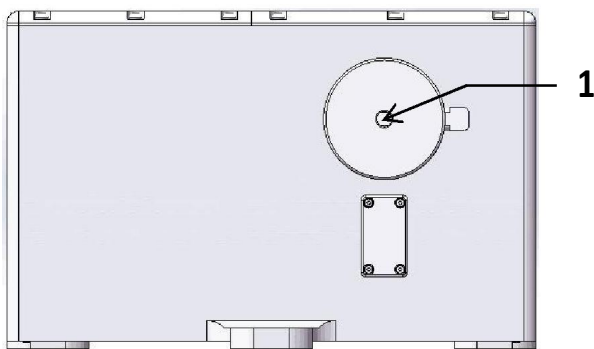


Fig.2-4 Laser head front View

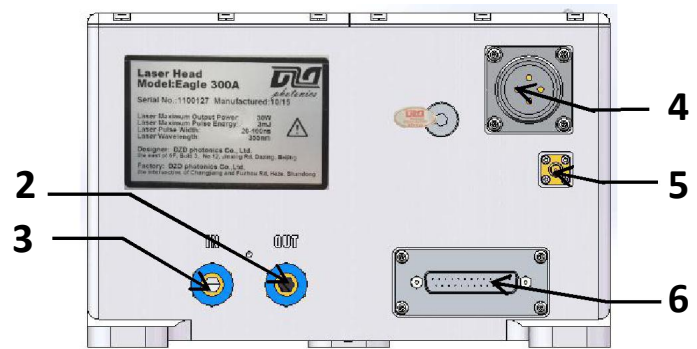


Fig.2-5 Laser head rear view

Interfaces are defined as follows:

Number	Item	Definition
1	Laser-blocking board	Before lasing, keep it open
2	Water outlet	Connect to inlet pipe of chiller
3	Water inlet	Connect to outlet pipe of chiller
4	Current cable socket	Connect to current cable plug
5	RF socket	Connect to RF cable
6	DB25	Connect to DB25 cable

The cables should be connected to laser head which include current line, SMA radio frequency line, DB25 line, water pipes (confirm the water flow in and out direction), the connections are as follows.

Fig.2-6 Laser head and cables connection

Connection between RF cable SMA connector and the laser head connector must be locked tightly, preventing the RF leakage.

2.3.4 Chiller Connection

Before using the chiller, injecting pure water firstly, the water level shall be in the green zone “NORMAL”, the power cord should be connected to AC POWER, the power protection line should be connected to the ALARM OUTLET, and then tighten them. Connections are shown in Fig. 2-6.



Fig.2-6 Chiller cables connection

2.3.5 Direction of cooling water circulation connection

The direction of cooling water circulation as shown in Fig.2-7.

Chiller outlet → Deionized filter inlet → Deionized filter outlet → PP cotton filter inlet → PP cotton filter outlet → Laser head inlet → Laser head outlet → Chiller inlet

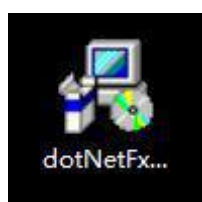


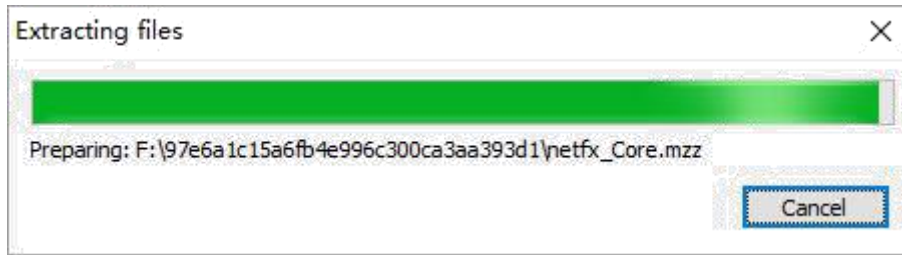
Fig.2-7 Cooling water circulation direction

2.4 Serial port software installation

2.4.1 Serial assistant installation steps

Open the system software "dotNetFx40_Full_x86_x64" for installation, as shown in the figure below.





If the system prompts the software have been installed, do not need to repeat the installation, can use the serial assistant directly.

If you have not prompted the installation of the software, need to install according to the installation suggestion of the dotNetFx40_Full_x86_x64 system software.



After installation, click "XCOM V2.0 " icon, enter the serial interface.

2.4.2 Serial assistant interface parameter settings

Using this assistant at the first time, you need to set the serial port parameters, the menu is at the right side of the interface,

Serial port selection“COM6: USB Serial Port”(Different computer COM port number is different)

The baud rate is 115200";

Stop bit 1";

Data bits 8";

Parity bit "no";

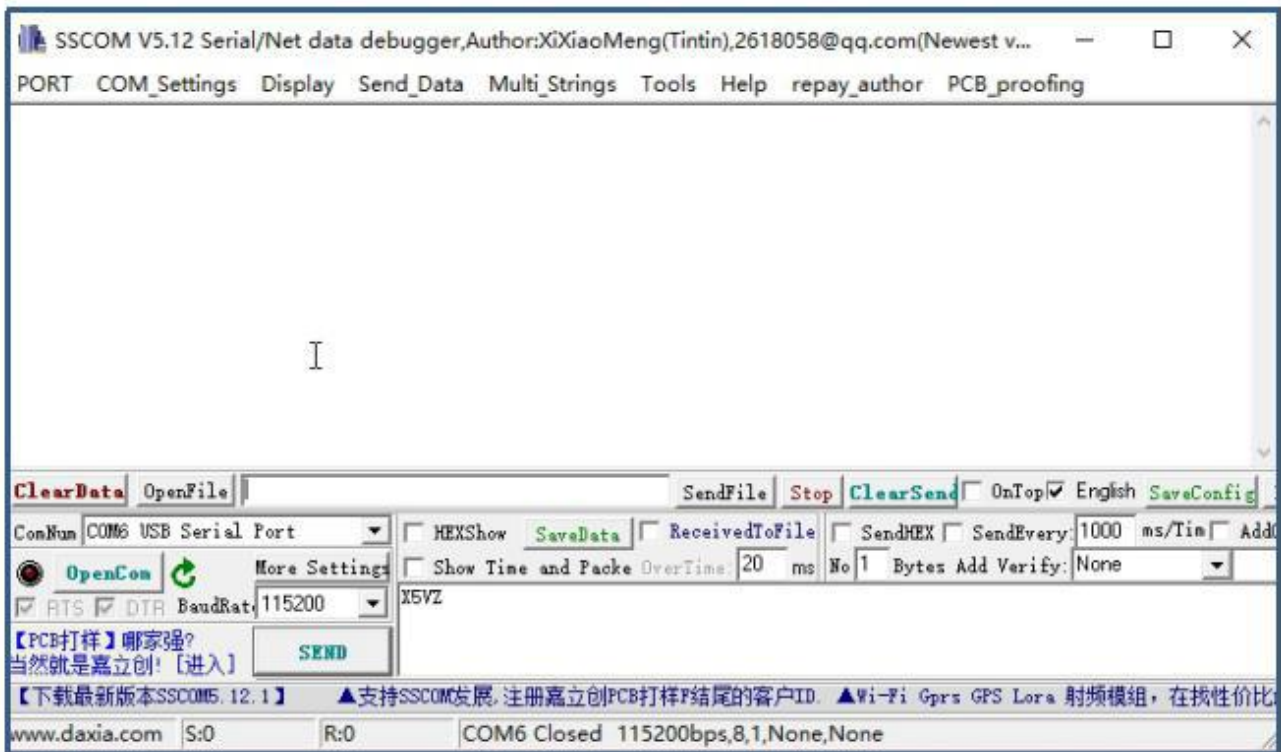
Serial port operation "open the serial port"; (red marked as operational state)

16 Hexadecimal display, white background and black text. RTS, DTR, time stamp, etc. are not selected by default.

The setting menu under the interface, timing to send, cycle, 16 hexadecimal send are not selected by default, only select “send a newline”.

In the middle of the interface, at the function menu, select "send a single", then input command in the blanks, click "send ", to achieve the communication between computer and power supply. Also

can select “send multiple”, select the commands to send, then click on the digital behind corresponding instructions, achieve communication between computer and power supply.



2.4.3 Directive rule

Each command has a initial X and last Z, for example, X2AZ, all in English capital letters, after input commands, click "send", the transmission complete.

3 LASER OPERATION

With the laser head set-up and all cables connected to the LPS and chiller properly, the laser can be started up. Before turning the laser on, make sure that personnels in the vicinity have proper protective eyewear and that the beam path will be well contained. In this section, basic control of the laser will be discussed.

3.1 Laser starting up

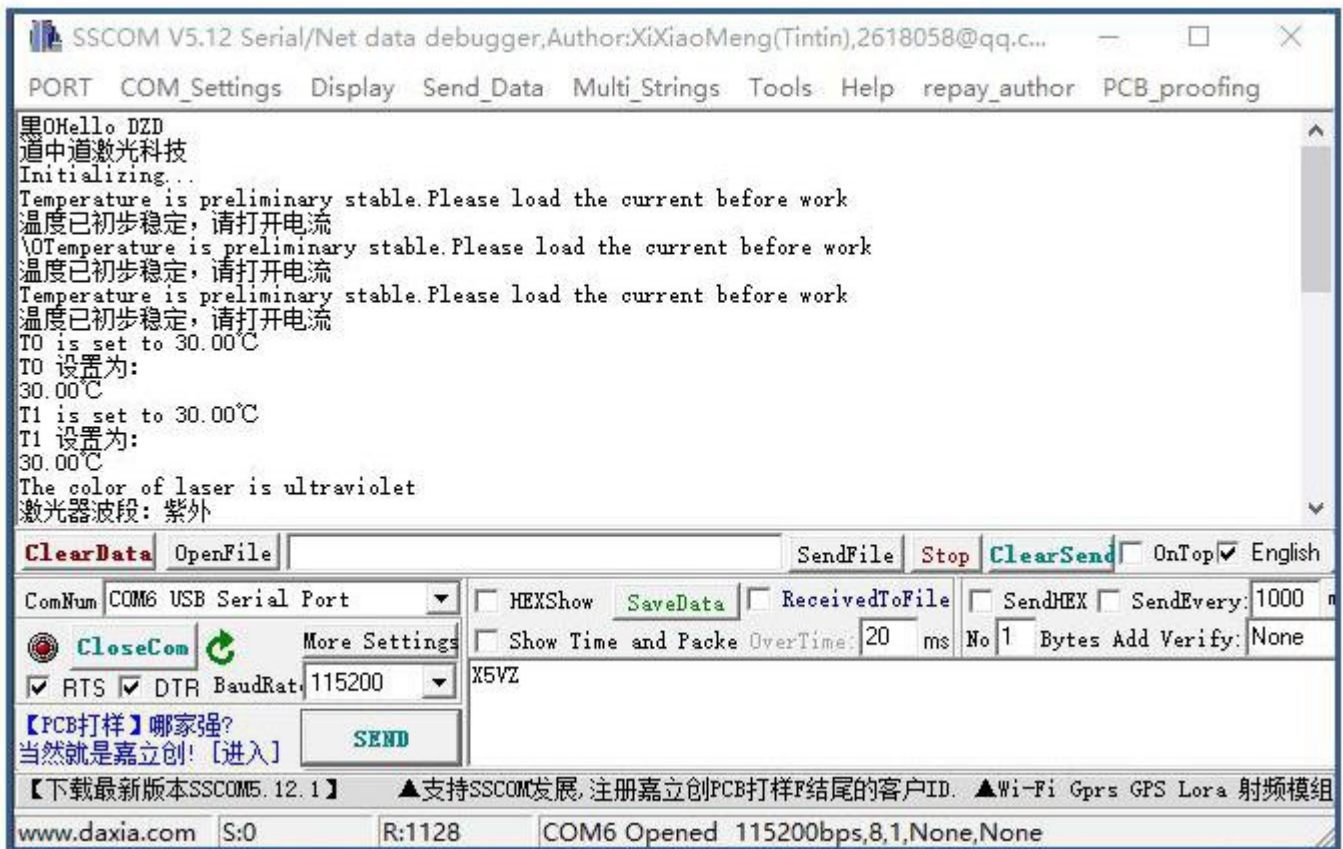
The basic process of laser starting-up is as follows:

- (1) All the cables connected correctly, then go to the next step.
- (2) Starting up chiller, set up cooling water temperature (with reference to the laser parameter table), then to the next step after temperature stability.
- (3) Starting up power supply, turn the key clockwise 90 degree to "on" position to start the system, the laser directly into the external control mode, Power supply display will have relevant tips, keep warm up not less than 30 min before starting.



Serial port software interface will be the tip of temperature (IR series please ignore T0, T1. GREEN series, please ignore the T1), Setting of T0 T1, pls refer to documents along with the laser, go to the

next operation when temperature stability.



(5) The Indicator function introduction

When using the laser, in order to facilitate the positioning of processing samples, the Indicator function is added to Eagle series laser.

The laser Indicator is divided into "low power" and "high power" according to different processing materials, the factory default is "low power". ("low power" is mainly used for sensitive processing materials, to prevent the sample surface damage due to the Indicator power too high. "high power" mainly used for other command materials, because the Indicator power is higher, so the observation is clear)

If the system comes with an external He-Ne red indicator, you do not need to set "Indicator" on the laser, directly do the laser marking operation on the standby state of laser.

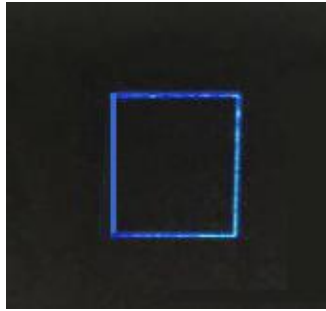
Take "golden orange" marking software as an example:

Press the "Red" button on the front panel of the power supply, then open the marking software,

click on the "red light", then can see the flash light box on the surface of processing samples.

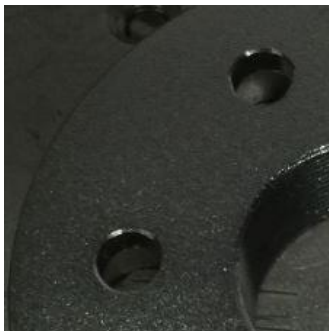
Or in the command input interface of serial port software, input the command "X2EZ", click "send", then open the marking software, click on "red light", then can see the flash light box on the surface of the processing sample.

Indicator box as shown in the following figure:

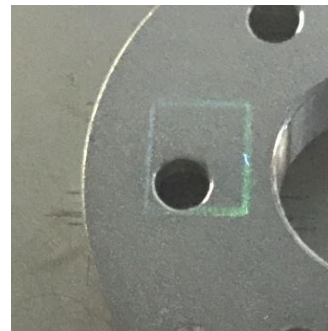


If the red light can not be observed clearly on some materials when using "low power" gear, user can switch the Indicator to "high power" gear via a serial port software according to the parameters setting of factory test report , the operation is as follows:

In the serial input interface of software, input command "XENCREATOR1Z X9F25Z", click "send", (25 for "high power" Indicator corresponding to the laser working current, the specific assignment pls based on the factory test report.)



"Low power" Indicator




"high power" Indicator

After the sample positioning is completed, press the "Red" button on the front panel of the power supply, exit the indicator function, and the laser into marking standby mode.


also can input command "X3EZ" in the serial port software interface, click "send" to exit the indicator function, then the laser into the marking standby state.

(5)Indicator on and off (Laser indicator)


Open the laser exit blocking plate, press the "laser on" button on the front panel of power supply, the LCD display will have related tips.

A blue rectangular LCD display with a black border, showing the text "Read for laser" in white serif font.

And then press "red" button on the front panel of power supply, the LCD display will have a prompt, laser into a infrared instructions state, laser will have a faint light, which is used to adjust the laser expander, the scanning mirror, the field lens and so on.

A blue rectangular LCD display with a black border, showing the text "Index is open" in white serif font.

Press the "Red" button on the front panel again, to exit the indicator procedure, laser will into the marking standby mode, the LCD display will have a promote.

A blue rectangular LCD display with a black border, showing the text "Read for laser" in white serif font.

Or input the command "X2EZ" in the serial software, and enter the indicator program, there will be a faint light, which is used to adjust the laser expander, the scanning mirror, the field lens and so on.

If do not enter the next step, input the command "X3AZ".

(6) Debugging external optical path(initial using of laser)

Recommend that user adjust the external optical path with the laser indicator.

(7) Using of Attenuator

The laser power is the maximum when leaving factory, in order to facilitate user to adjust the power for all kinds of materials,we introduce the using of attenuator.

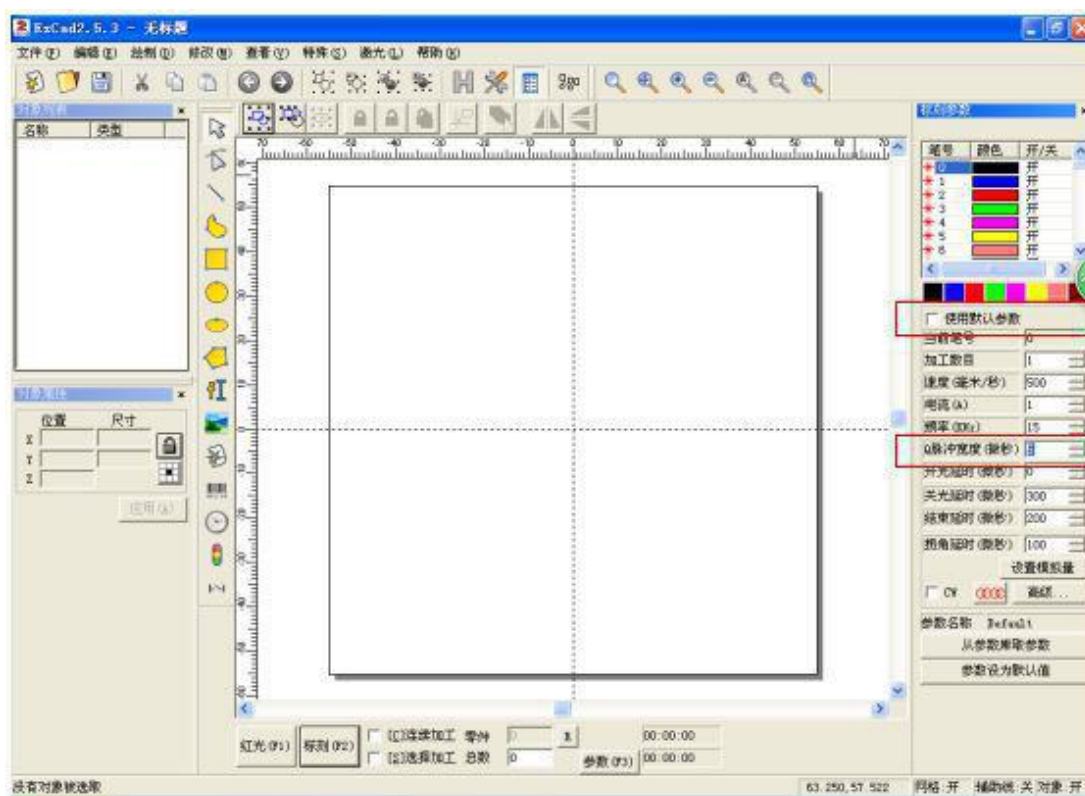
When the laser is stable after starting up, input command "X3KZ" in the serial port interface , reset the attenuator, the laser will output the maximum power.

Input command "X9KxxZ" in the serial port operation interface, which will adjust the output power to percentage of maximum power. Users could adjust the percentage of power according to requirement. "xx" in command "X9KxxZ" is arbitrary numbers of 0-100, output power is percentage of maximum power, for example input "X9K50Z", the output would be 50% of the maximum power. If want to restore to the maximum power, input reset command "X3KZ".

(8) The adjustment of the Q pulse width function introduction

When using the laser, in order to more flexible to adjust the laser power and pulse width for all kinds of laser application, the adjustment of the Q pulse width function is added to Eagle series laser. For example, the repetition frequency is 15khz, the adjustment range will be $1\mu\text{s}$ - $66\mu\text{s}$ under 15kHz. And the Q pulse width could be continuously adjustable in the reasonable range.

Take "golden orange" marking software as an example:



Set the "Use the default parameter" button to the select state in the first place, then modify the reasonable Q pulse width parameter in the "Q pulse width". And the laser power will be change with the Q pulse width parameter changes.

3.2 Procedure of turning off laser

(1) Turn off current

When the Laser is running in standby state, or indicator state, press "Laser on" button on the front panel of power supply, the current is off. Laser is in standby mode, the LCD display will have a prompt.



Or you can input command "X3AZ" in the serial interface, the current directly down to 0, then the current could be turned off, laser will be into the standby mode.

(2) Turn off power supply

Rotating the key switch to "off" position on the front panel of power supply, turn the power supply off.

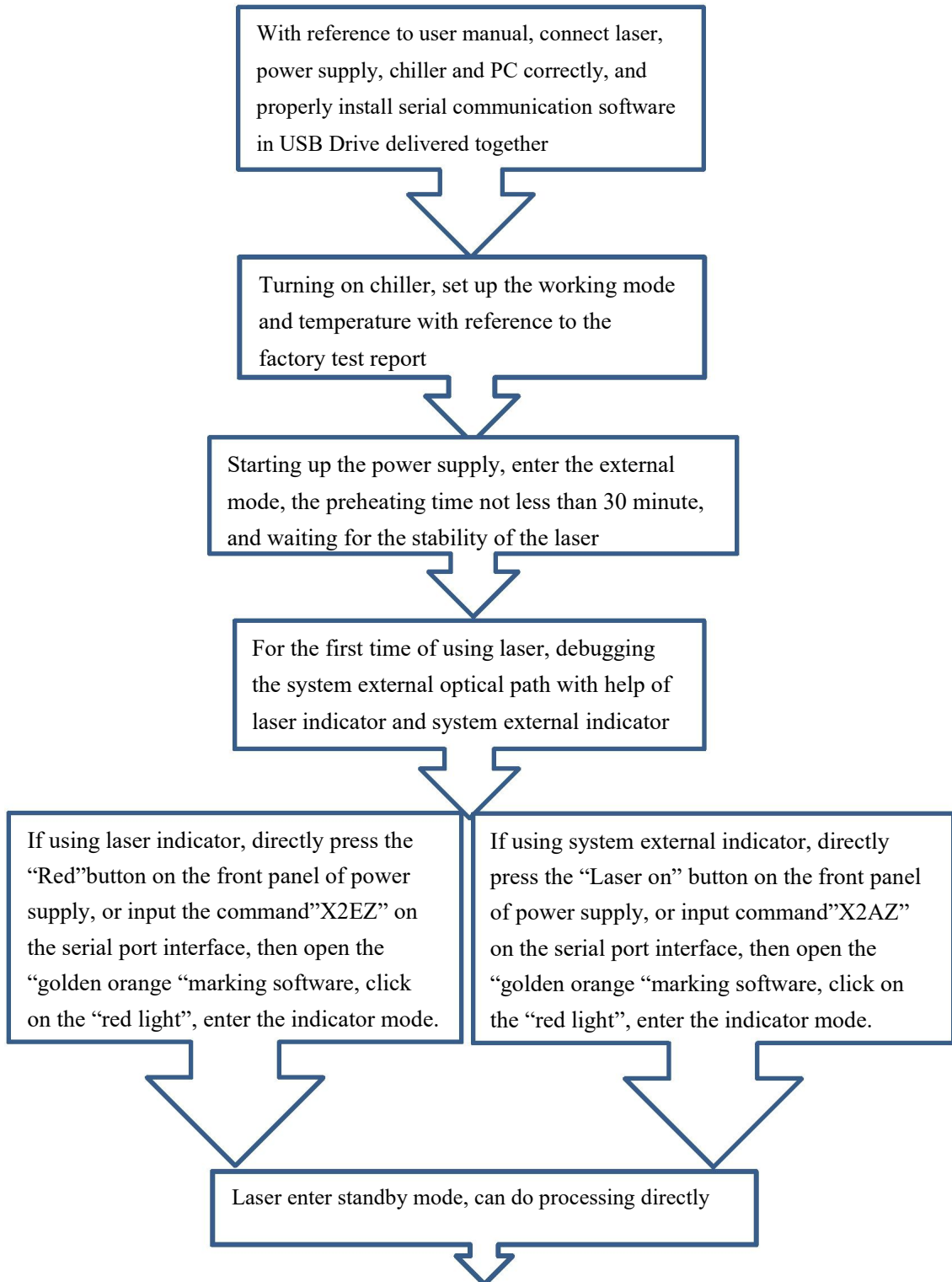
(3) Turn off Chiller

2 minutes after turning the power supply off, then turn off the marking power supply, and then turn off chiller.

3.3 Laser operation procedure

For the laser operation procedure, Pls refer to table 3-1.

Check the packaging of laser and power supply, if normal, open the packaging



Completing the processing, press “ Laser on” button on the front panel of power supply, and input “X3ZA” on the serial surface, then can turn off the current.

2 minutes after turning off power supply, then can turn off Chiller

Completing operation procedure

Fig.3-1 Laser operation flow chart

3.4 Another commonly serial communication command

3.4.1 Increasing the current manually

Input "X5AZ", laser default working current will be displayed on serial interface. If loading current and set the current value to 5A, inputting command "X2AZX9A5Z". Increasing current step by step with 1A, can input "X0A1Z", if increasing the working current to 25 A, directly input "X9A25", namely set the working current to 25A directly. (At the default current, laser is the most stable, please do not increase current at random). If checking the current Settings, inputting "X4AZ", a serial port interface will display it.

3.4.2 Decreasing the current manually

If inputting "X0A-1Z", the current will be decreased step by step with 1A, until the setting value is 0A, and then input “X3AZ” to close the current.

3.4.3 Adjusting working temperature and save

If checking the laser default working temperature, inputting "X5T0ZX5T1Z", the temperature will be displayed in serial port interface. Also can assign a value directly , which should be close to default value, can't deviate too much, such as input "X9T050Z X9T148Z". Fine-tuning in step 0.1 °C is available, such as increasing temperature input "X0T00.1Z"; decreasing temperature input

"X0T0-0.1Z". When the temperature is stable, input "X7T0Z X7T1Z", save temperature Settings. Checking the present temperature, input "X4T0ZX4T1Z", the temperature will be displayed in serial port interface.

3.4.4 Adjusting current and save

Assigning a current value, which should be close to default value, can not deviate too much, such as input "X9A29.4Z". Also can fine-tuning in step 0.1A directly, such as increasing current, input "X0A0.1Z"; decreasing current, input "X0A-0.1Z". Inputting "X7AZ", save current setting.

3.4.5 Adjusting the frequency

Input "X9Q10Z", the laser frequency is set to the 10kHz.

3.4.6 Internal control command

Input "XENCREATOR1Z XER1Z X9Q15Z X2QZ", laser is set to the internal control model, the frequency is 15kHz, and the laser is open.

3.4.7 External control command

Input "XENCREATOR1Z XER0Z ", laser is set to the external control model.

4 LASER PARAMETERS

The laser performance specification are shown in table 4-1.

Table 4-1 Laser Performance specifications

Product model	Eagle 100A	Eagle 100B	Eagle 100C	Eagle 100D	Eagle 100E	Eagle 200A	Eagle 200B	Eagle 200C	Eagle 200D	Eagle 300A	Eagle 300B	Eagle 300C	Eagle 300D
wavelength	1064nm	1064nm	1064nm	1064nm	1064nm	532nm	532nm	532nm	532nm	355nm	355nm	355nm	355nm
Laser crystal	Nd: YAG	Nd: YAG	Nd: YAG	Nd: YAG	Nd: YAG	Nd: YAG	Nd: YAG	Nd: YAG	Nd: YAG	Nd: YAG	Nd: YAG	Nd: YAG	Nd: YAG
Average power	>35 W @15kHz	>100 W @15kHz	>150 W @15kHz	>200 W @15kHz	>600 W @30kHz	>10 W @15kHz	>15 W @15kHz	>25W @15kHz	>40W @15kHz	>3 W @15kHz	>5W @15kHz	>10W @10kHz	>15W @15kHz
Max. Energy per pulse	3mJ	10mJ	10mJ	10mJ	20mJ	1mJ	2mJ	3mJ	5mJ	1 mJ	1mJ	2mJ	3mJ
Pulse Width	100±20ns	100±20ns	100±20ns	100±20ns	100-200ns	80±20ns	80±20ns	80±20ns	80±20ns	60± 20ns	60±20ns	60±20ns	60±20ns
Beam Quality M^2	< 1.3	< 4	< 4	< 4	< 4	< 1.3	< 1.3	< 1.3	< 1.3	< 1.3	< 1.3	< 1.3	< 1.3
Polarization ratio	>100:1	Random	Random	Random	Random	>100:1	>100:1	>100:1	>100:1	>100:1	>100:1	>100:1	>100:1
Product mode	Eagle 100A	Eagle 100B	Eagle 100C	Eagle 100D	Eagle 100E	Eagle 200A	Eagle 200B	Eagle 200C	Eagle 200D	Eagle 300A	Eagle 300B	Eagle 300C	Eagle 300D

Beam circularity	>95%	>95%	>95%	>95%	>90%	>90%	>90%	>90%	>90%	> 85%	> 85%	> 85%	> 85%
Beam Diameter	<1.2 mm	<3 mm	<3 mm	<3 mm	<6mm	<1.2 mm	<1.2 mm	<1.2 mm	<1.2 mm	< 1.2mm	< 1.2mm	< 1.2mm	< 1.2mm
Beam Divergence	≤1 mrad	≤1 mrad	≤1.5 mrad	≤1.5 mrad	≤3 mrad	≤0.5 mrad	≤0.5 mrad	≤0.5 mrad	≤0.5 mrad	≤ 0.3 mrad	≤ 0.3 mrad	≤ 0.3 mrad	≤ 0.3 mrad
Laser power modulator & range	Optional 0-100%	\	\	\	\	Optional 0-100%	Optional 0-100%	Optional 0-100%	Optional 0-100%	Optional 0-100%	Optional 0-100%	Optional 0-100%	Optional 0-100%
Optical fiber coupling	Optional	Optional	Optional	Optional	Optional	Optional	Optional	Optional	Optional	Optional	Optional	Optional	Optional
Beam pattern	TEM ₀₀	Approximate TEM ₀₀	Approximate TEM ₀₀	Approximate TEM ₀₀	Approximate TEM ₀₀	TEM ₀₀	TEM ₀₀	TEM ₀₀	TEM ₀₀	TEM ₀₀	TEM ₀₀	TEM ₀₀	TEM ₀₀
Repetition rate (Internal trigger)	1-50kHz	10-50kHz	15-50kHz	15-50kHz	10-50kHz	1-50kHz	1-50kHz	1-50kHz	1-50kHz	1-50kHz	1-50kHz	1-50kHz	1-50kHz
Repetition rate (External trigger)	1-50kHz	10-50kHz	15-50kHz	15-50kHz	10-50kHz	1-50kHz	1-50kHz	1-50kHz	1-50kHz	1-50kHz	1-50kHz	1-50kHz	1-50kHz
Average power stability	<±2%	<±2%	<±2%	<±2%	<±2%	<±2%	<±2%	<±2%	<±2%	<±2%	<±2%	<±2%	<±2%
Single pulse stability	<5%	<5%	<5%	<5%	<5%	<5%	<5%	<5%	<5%	<5%	<5%	<5%	<5%
Power Requirement								220V					
Working environment temperature								15-35°C					

5 FAULT MESSAGE

Laser fault message is shown in Table 5-1.

Table 5-1 Laser fault message

Fault message	Indicator of Power supply panel	Fault type	Operation
“Chiller error” display continually	Interlock indicator on	Chiller alarm	Check if the protection line of chiller is connected, or if Chiller is starting up
“User lock” display continually	Interlock indicator on	User lock alarm	If user lock is connected
“Trigger frequency error”	Interlock indicator on	External trigger signal frequency is too low	Check trigger signal frequency
“Current overload” display continually	Interlock indicator on	Current overload	Check if the current is overload, reduce the current in time
“Current err”	Interlock indicator on	Deviation between the actual current and the setting value is too large	Check the current line of electric load, restart the power supply
“Temperature out of gauge“	Interlock indicator on	Temperature out of gauge	Check DB25 temperature control line
“EEPROM time out”	Interlock indicator on	EEPROM communication timeout	Restart the power supply
“Heat time out. Please check The cable”	Interlock indicator on	preheat time more than 15 minutes	Check DB25 temperature control line

6 MAINTENANCE

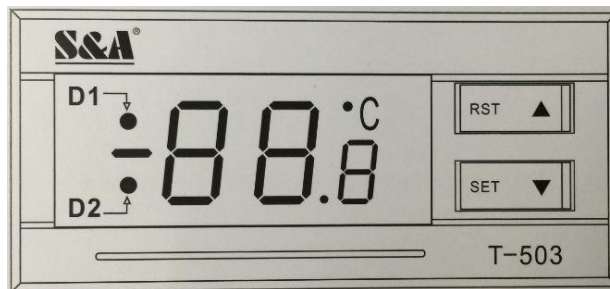
6.1 Cooling system

6.1.1 Cooling system configuration suggestions

Item	Unit	Value
Refrigeration capacity	W	>1000
Minimum flow	L/min	4
Maximum input pressure	Bar	3
Control accuracy	°C	+/-0.1
Diameter of pipe	mm	10

6.1.2 Temperature setting of cooling system

Temperature controller panel, as shown below



D1, D2 are the working status indicator of cooling system temperature controller. D1 keeps on, the controller working in intelligent control mode; D1 is not bright, the controller working in constant temperature control mode; D1 shiny, the controller working in the parameter setting mode or display room temperature mode.

When we use cooling system, the control mode should be constant temperature. If the chiller working in intelligent control mode, need to make the following setting, and change the mode to constant temperature control mode.

Hold down the “▲”key and press the “SET” key for 5 seconds to display 0. Then click “▲”button to select the password “8” (in factory settings), and press the “SET” key again to display F0 and into the setting state. Press“▼” key loop into the setting item , when display is F3, press “SET” key until to show 1 (1 is for intelligent control mode), press“▲”key. When the display is 0, press”SET” key to determine the parameters setting. Pressing “RST”key at any time, that could save the changes of parameters and exit the parameter setting. Returning temperature display, and run at new parameters.

Pls refer to the factory test report for the specific working temperature of cooling system.

6.1.3 Coolant

Coolant is deionized water, If there is no deionized water, pls replaced with pure water.

In order to prevent mold growth causing the loop blocking in the coolant, suggest that ethanol is added in the coolant, ethanol solution volume accounted for 10% of the total volume.

When the working environment temperature at $-10\text{ }^{\circ}\text{C} \sim 0\text{ }^{\circ}\text{C}$, ethanol must be added in the coolant, ethanol solution volume accounts for 30% of the total volume, and changing coolant at least every two months.

6.1.4 Other requirements of cooling system

Using the cooling system for the first time, pls check the whole water system and joint, and ensure there are not leakage phenomenon. The cooling water cycle must be connected in accordance with specified inlet, outlet and external pipe, otherwise the laser will not work properly.

If the laser does not work for a long time, the internal cooling water of system should be emptied, otherwise it will cause the laser machine non-recoverable damage.

6.2 Check the coolant water level

Check the coolant quantity once a week, and the water level should be in the green area. Pls add the water when the level below green area, DRAIN is for the discharge port.

6.3 Replacing filter

The replacement method is as follows:

Replacing the PP cotton filter every six weeks,

Step 1: Opening filter container, remove the old filter.

Step 2: Replacing the new filter.

Step 3: Tightening the cover of filter container.



Fig.6-1 Steps of replacing the PP cotton filter

Replacing the Deionized filter every four months,



Fig.6-2 Steps of replacing the Deionized filter

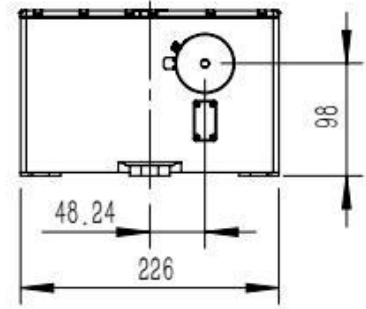
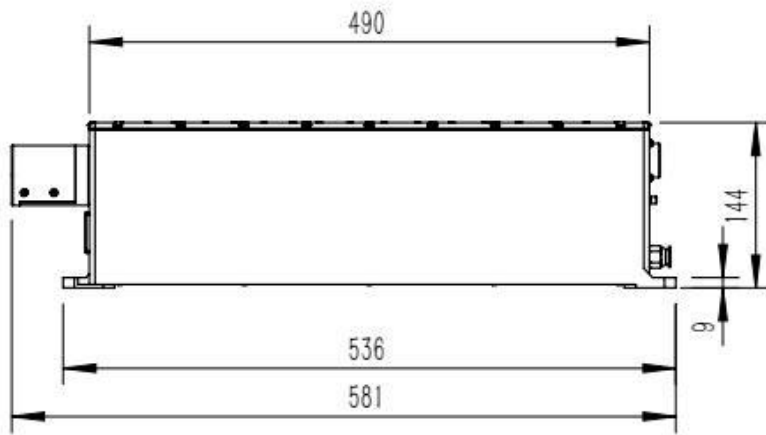
Step 1: Opening filter container, remove the old filter.

Step 2: Replacing the new filter.

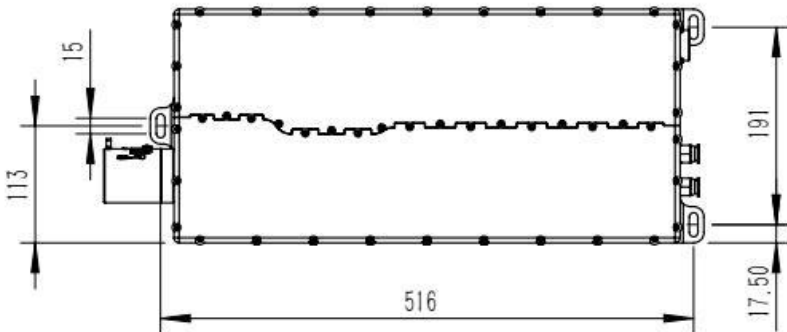
Step 3: Tightening the cover of filter container.

APPENDICES

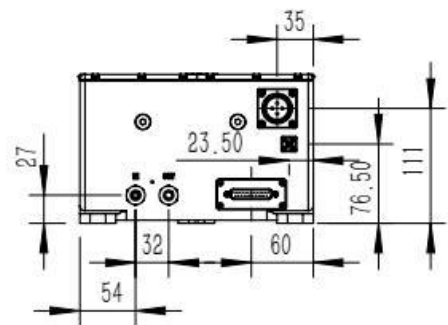
APPENDIX 1 LASER HEAD OUTLINE DRAWINGS



Right side view Front view

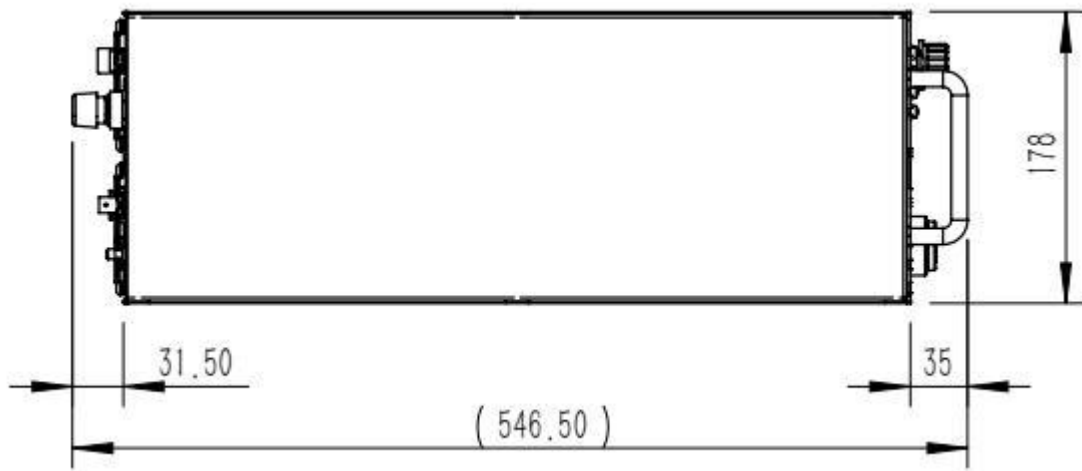


Top view

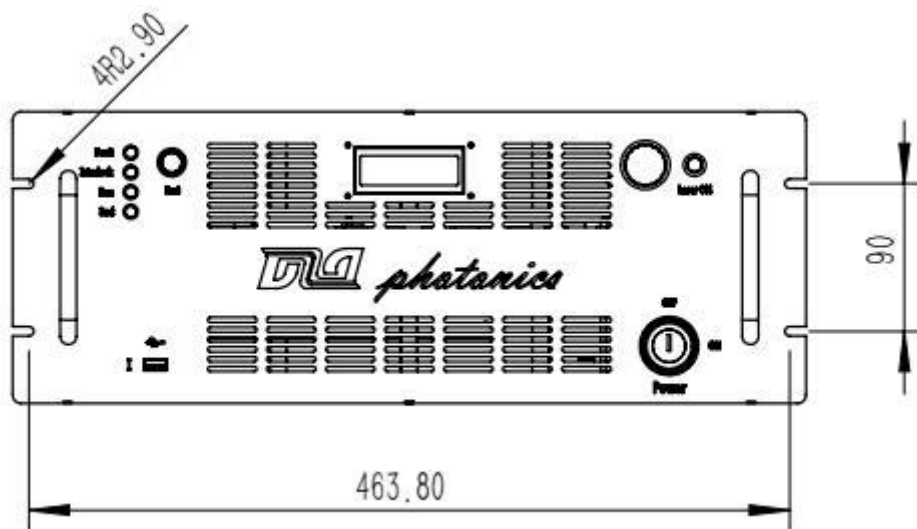


Rear view

APPENDIX 2 POWER SUPPLY OUTLINE DRAWINGS



Right side view



Front view

Top view

APPENDIX 3 DIMENSION AND WEIGHT OF LASER HEAD , POWER SUPPLY AND CHILLER

	Laser head	Power supply	Chiller
Dimensions (mm)	543 x 226 x 144	547 x 484 x 178	580 x 290 x 470
Weight (kg)	18	20	29

APPENDIX 4 SERVICE

Starting from the sale of the day, 1 years warranty (If any other agreement, pls refer to contract). If the product is out-of-warranty, you can still enjoy a discount on any repair works. Without permission, disassemble and repair is not allowed.

APPENDIX 5 PATENTS

Eagle series laser has applied for national patent protection, including national invention patent(application No. 201510179372.X, 2015108887677, 201610319013.4, 201610842044.8) and national utility model patent.

APPENDIX 6 LASER OPERATION CAUTIONS

Please read the manual carefully before using this product.

- The parameters of Laser, power supply and chiller (working current, frequency doubling temperature, water temperature, etc.) should be set up in accordance with factory test report delivered with product.
- Please pay attention to the connection of the cables: Connect the other cables firstly except the 220V power supply cord, which should be connected finally, and ensure the power outlet is safe.
- Please ensure the positive and negative pole of current line properly connected to the corresponding terminal by different color .
- Please remember the order of disconnecting the cables: Firstly, turn off the power supply. Secondly, cut off the 220V electrical connection. Thirdly, disconnect the 220V power line, and then disconnect other cables. Finally, ensure the 1, 3 terminal or 2, 4 terminal of laser head plug connected with short wiring protection.
- In the connection of cooling water circulation, ensure the filter is connected in series in circulating water. Please pay attention to the correction direction of the water inlet and outlet, and regular replacement of the filter core and coolant.
- In the first using chiller, please ensure that the chiller working in constant temperature mode.
- Before the laser operation, please open the chiller firstly, and then open the power supply.
- When turn off the laser, please turn off the power supply firstly, and then turn off the chiller 5 minutes later.
- When setting and optimizing the laser parameters, please refer to the relevant contents of the

factory test report, do not change the laser operating parameters.

- If the laser need to be returned to factory for maintenance, please ensure that the cooling water emptying, and install the water quick plug to the inlet and outlet connector. Please make sure that packing foam is same as the factory packing and filling completely.



Eagle series laser integrated imported diode laser chip, which is vulnerable to be electrostatic breakdown during transport, during the connection and disconnection of cables, and turn on/off. Even causing permanent damage, so you need to pay attention to the following matters:

- (1) In the connection of disconnection cables, handling the laser, please pay attention to wear anti-static Bracelet (earth resistance of 1 M) or anti static Electric gloves.
- (2) please make sure that all the equipment is grounded and the 220V socket is safe.
- (3) In the process of transportation and preservation of the laser, the rear panel of the aviation plug is kept short.
- (4) Please strictly abide by the order of connection, the order of disconnection, boot sequence, shutdown sequence.

High reliability

Cost-effective

Good Service

