Thunder Series

Fiber Laser User Manual

BWT Tianjin, Ltd.

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1. Introduction

Welcome to use the Thunder Series fiber lasers produced by BWT. This manual is for you to better use our fiber laser products with power from 12kW to 200kW.

This manual contains safety instructions, product description, installation and usage, maintenance as well as troubleshooting. Please read this manual carefully before installing and operating the product and also strictly follow the safety instructions in this manual, otherwise personal injury or equipment damage may occur.

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2. Safety Instructions

2.1. Laser Safety Level

This product is a Class 4 laser product. It outputs a high-power invisible laser beam with a wavelength of 1080± 10nm, which will cause damage to the eyes or skin if directly or indirectly exposed to this strong laser, and may also cause fire. Therefore, please strictly follow the EU EN60825-1:2014 standard, every operator or anyone who close to the laser must be aware of these special hazards and take adequate safety precautions.

2.2. Safety Labels

Laser safety labels are pasted on the laser. The details of these safety labels are shown in Table 1.

Table 1 Laser Safety Labels

Label	Description
	Dangerous Laser Radiation. Please wear laser protective glasses. It is strictly forbidden to expose any part of your body to the laser
	Laser Radiation. Please wear laser protective glasses. It is strictly forbidden to expose any part of your body to the laser
	Class 4 Laser Product. Avoid direct exposure to human eyes. Please wear laser protective glasses. It is strictly forbidden to expose any part of your body to the laser.
	2M Class Laser Product. Avoid direct exposure to human eyes. Please wear laser protective glasses. It is strictly forbidden to expose any part of your body to the laser.
	Hazardous Electrical Voltage. Confirm the electricity demand before use and pay attention to electricity safety

2.3. Other Safety Rules

1) Before the laser is powered on, make sure that the protective cap on the QF/QF-D output head has been removed, and carefully check and wipe to ensure that the quartz block surface of the QF/QF-D is clean to avoid damage to the laser.
2) Before the installation of QF/QF-D output head, make sure the power supply is disconnected.
3) Always wear the protective glasses when you work with the lasers, and do not see the output head directly.
4) After the aiming beam emits, it is strictly forbidden to expose the eyes to it to avoid any injury.
5) The laser is invisible infrared light. After the laser emits, it is strictly forbidden to expose any part of the body to the laser to avoid personal injury.
6) When installing and operating this product, special laser protective glasses must be worn. Please select laser protective glasses according to the laser wavelength range and power level. When the laser is powered on, it is strictly forbidden to directly see the output head even already wear laser protective glasses.
7) Please replace the cooling water in the chiller periodically to avoid the block of the laser water cooling module due to the water decay.
8) When operating the laser in winter, please add antifreeze to the cooling water with an appropriate proportion according to the local temperature, so as to avoid the internal damage of the laser caused by freezing.
9) If the laser is not going to be used for a long time, please empty the cooling water in the laser in time. Cover the output head protection cap to prevent dust.
10) Please ensure that the PE wire of the power cord is reliably grounded.
11) Ensure that the AC power supply is normal. The wrong wiring connection or power supply voltage will cause irreversible damage to the product.
12) There is no component that needs maintenance inside the laser, so please do not open the laser chassis to avoid personal injury.
13) Do not damage the tamper-evident label on the laser chassis to avoid loss of warranty.

3. Product Description

3.1. Product Advantages

Thunder Series fiber lasers, with power from 12kW to 200kW, have excellent beam quality, which makes them the perfect choice for processing. The two operation modes, continuous and modulated pulse, minimize the heat-affected zone. Reliable performance, modular and all fiber design, and robust case to enclose all optical and electronic components make the product used under strict industrial application conditions.

Thunder Series fiber lasers can be used in wide application like cutting, drilling, thick metal processing, etc. The laser can process various types of metals.

Features

- Cost effective and maintenance free
- Continuous and modulated pulse work modes to optimize the machining quality
- Excellent power stability
- Good beam quality for precision processing
- High electric-optic conversion efficiency
- Excellent system stability
- Maximum modulation frequency up to 5kHz
- Simple control interface

Applications

- Cutting
- Welding
- Drilling
- Sheet metal processing
- Cladding
- Research

3.2. Model Code

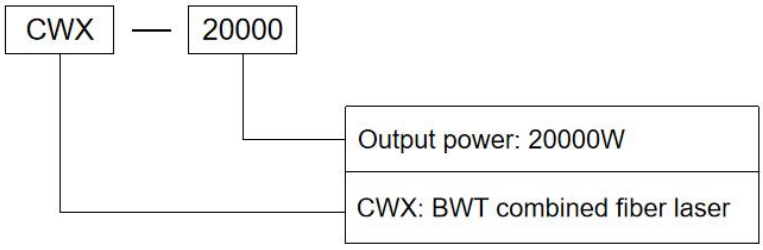


Figure 1 Thunder Series Fiber Laser Model Codes

3.3. Unpacking and Inspection

The laser is carefully packaged before shipping out from the factory for safe transportation, but in case of any unpredictable situation in transportation process, you need check the packaging box for the crack, soaking, etc., when you receive the laser. If any damage is found, please contact BWT representative in time.

If no damage on package, you can unpack the laser. After unpacking, please carefully check whether the contents in the box are consistent with the packing list.

When removing the packing foam, do not pull hard the output fiber. Remove the protective cap on the end of the output fiber, and check the end surface. There should be no stains or cracks on it. If there is any damage, please contact BWT representative in time. Please note, do not contaminate the output end surface when you check it.

When taking out the laser from the package box, avoid collision and strong vibration to the laser and the laser output head. When taking out the coiled output fiber, do not bend, twist or pull the output fiber. The fiber minimum bending diameter is 400mm.

The storage temperature of the laser is required in the range of -10~60℃. In winter, make sure the water has been drained out or use appropriate antifreeze to avoid the damage of laser due to freezing.

3.4. Product Specifications

The technical specifications of Thunder Series fiber lasers are shown in Table 2 below.

Table 2 Product Specifications

Model	CWX-12000	CWX-20000	CWX-30000	CWX-40000	CWX-60000	CWX-80000	CWX-100000	CWX-120000	CWX-135000	CWX-150000	CWX-200000
Power	12000 W	20000W	30000W	40000W	60000W	80000W	100000W	120000W	135000W	150000W	200000W
Wavelength	1080±10 nm										
Fiber Core Diameter	100μm	100μm	100μm	100μm	150μm	150μm	200μm	200μm	200μm	200μm	200μm
Cable Length	30m	30m	30m	30m	30m	25m	25m	25m	25m	25m	25m
Beam Delivery	QF or QF-D										
Aiming Beam	Red										
Operation Mode	CW or Modulated										
Polarization	Random										
Power adjustment scope	10-100%										
Power Stability	<±1.5% (2h)										
Max modulation frequency	5 kHz										

Net Weight	~195kg	~390kg	~500kg	~640kg	~850kg	~1050kg	~1200kg	~1700kg	~2000kg	~2300kg	<3000kg
Gross Weight	~230kg	~480kg	~600kg	~800kg	~1170kg	~1500kg	~1650kg	~2100kg	~2400kg	~2700kg	<3500kg
Dimension W*D*H, mm	570*960*670	600*1210*1085	800*1210*1085	950*1510*1190	1175*1510*1235	1550*1510*1260	1550*1510*1260	1800*1510*1740	1800*1510*1740	1800*1510*1740	2000*1710*1740
Voltage	Three Phase, 380±20 V, AC, PE, 50/60 Hz										
Power consumption	40kW	66kW	100kW	135kW	200kW	270kW	330kW	400kW	450kW	500kW	660kW
Control interface	RS232/AD										
Minimum water cooling capacity	⩾28kW	⩾45kW	⩾70kW	⩾80kW	⩾120kW	⩾160kW	⩾200kW	⩾270kW	⩾300kW	⩾350kW	⩾450kW
Temperature settings	22℃ (laser module), 30℃ (QF/QF-D)										
Cooling tubes size	2-φ32mm	2-φ38mm	2-φ38mm	2-φ50mm	4-φ50mm	4-φ50mm	4-φ50mm	8-φ50mm	8-φ50mm	8-φ50mm	8-φ63mm
Cooling water flow rate	120L/min	200L/min	300L/min	400L/min	600L/min	800L/min	1000L/min	1200L/min	1350L/min	1500L/min	2000L/min
QF/QF-D cooling water flow rate	3L/min										
Cable cooling water flow rare	/	/	/	/	1.5L/min	1.5L/min	1.5L/min	1.5L/min	1.5L/min	1.5L/min	1.5L/min
Note	You can also refer the other specifications if fiber core diameter or fiber cable length is customized.										

3.5. Packing List

Table 3 Packing List Example

Item	Qty	Note
Laser system	1	
Flash disk	1	Operation software, user manual, drivers, etc
Communication cable	1	RS232
Control cable	1	DB25
DB9 extension cable	1	10m
Key switch	1	
Quick Guide	1	
Clamp	1	6 pcs for 12-60kW, 12 pcs for 80-100kW, 24 pcs for 120-200kW
Cotton swab	1	For QF/QF-D cleaning
Dust-free cloth	5	For QF/QF-D cleaning
Rubber dust cover	2	
10 pin green terminal	1	
5 pin green terminal	1	
Test report	1	
Note	Packing list may be different in terms of configuration. Please refer the list delivered with laser.	

3.6. Front Panel Description

The front panel layout is shown in Figure 2.



Figure 2 Front Panel Layout

1) EMERGENCY STOP (E-STOP): push the E-STOP button in emergent situation, and then the laser is turned off.
2) KEY: there are three positions. In "Remote", the laser can only be controlled by processing equipment; in "Terminal", the laser can be controlled by either PC operating software (internal control mode) or processing

equipment (external control mode). These two modes can be switched. In "Off" means the laser is turned off.

3) START: after pushing this button, the green indicator lights up, and the laser can be controlled by PC operating software.

3.7. Rear Panel Description

The rear panel layout is shown in Figure 3 (please refer the layout of real laser).

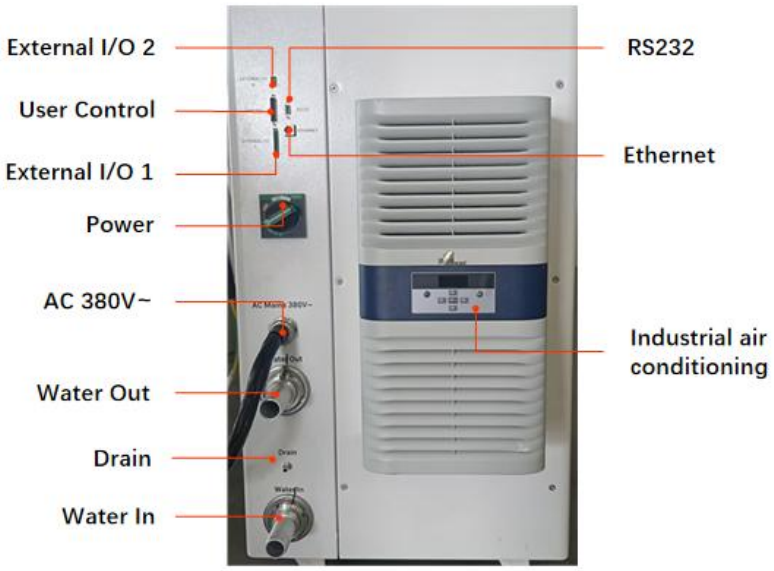


Figure 3 Rear panel layout

The definitions of the interfaces are as below:

1) External I/O: I/O 2
2) User Control: control interface
3) External I/O: I/O 1
4) Ethernet: Ethernet interface
5) RS232: communication / internal control interface
6) Power: power on/off the laser
7) Power Cable: AC 380V input
8) Water In: cooling water input
9) Water Out: cooling water output
10) Drain: water exit of dehumidifier
11) Industrial air conditioning

3.8. Definition of Control Interface

Control mode: As the rear panel shown in Figure 3, Thunder Series fiber laser includes communication interface and user control interface.

1) The definitions of communication interface are shown in Table 4:

Table 4 Definitions of Communication Interface

No.	Configuration parameters
Baud Rate	115200
Data Bits	8
Stop Bit	1
Polarity	N/A

2) The definitions of user control interface are listed in Table 5:

Table 5 Definitions of User Control Interface

PIN No.	Definition	Function	Drive capability	Note
7	fault signal-	Fault signal output GND		When there is some fault, ports 7 and 20 will be short-circuited. The maximum short-circuit current here should not exceed 1A. Please add the series resistance according to the actual operating condition; when the laser works well, ports 7 and 20 will be open-circuited.
20	fault signal+	Fault signal output+		
6	Enable-	External enable input signal GND	Input current≥ 5mA	High level 18V-24V valid.
19	Enable+	External enable input signal+		
8	PWM-	External modulation input signal GND	Input current≥ 5mA	Modulate output laser control, high level 18V-24V valid.
21	PWM+	External modulation input signal+		
14	AD-	Analog input GND	Input current≥ 1mA	1V-10V controls the output power of the laser, and 10V corresponds to 100% output power. Please ensure that the maximum analog voltage does not exceed 10.3V.
15	AD+	Analog input+		
10	Safety Interlock+	External on-off signal (normally on)		Client interlock signal, can be connected to the emergency stop button of the system.
23	Safety Interlock-			
12	Chiller interlock+	External on-off signal (normally on)		Connect the "fault signal+" and "fault signal-" of the chiller separately.
25	Chiller interlock-			
9	red light+	External control red light signal+	Input current≥ 5mA	External signal high red light mode: high level 18V-24V valid; external signal low red light mode: low level 0-5V valid
22	red light-	External control red light signal-		
	signal -	Connect to control board GND		Connect to the cover of processing equipment

Other		NC		N/A

3) The definition of External I/O interface are shown in Table 6 and Table 7

Table 6 Definitions of External I/O 1 Interface

PIN No.	Definition	Function	Note
1	External control+	External external control signal (normally on)	Client key switch signal, can be switched to external control mode
2	External control-		
3	Internal control+	External internal control signal (normally on)	Client key switch signal, can be switched to internal control mode
4	Internal control-		
5	E-stop+	External E-stop signal (normally on)	Client E-stop signal, can be connected to external E-stop
6	E-stop-		
7	Enable+	Remote enable	Connected to enable the laser externally
8	Enable-		
9	Safety Interlock+	External on-off signal (normally on)	This cannot be used when the pin 10 and 23 of User Control were used.
10	Safety Interlock-		

Table 7 Definitions of External I/O 2 Interface

PIN No.	Definition	Function	Note
1	24V +	24V positive	Back-up
2	Input signal	Flow meter signal	Back-up
3	24V -	24V negative	Back-up
4	Chiller interlock	External on-off signal (normally on)	This cannot be used when the pin 12 and 25 of User Control were used.
5	Chiller interlock		

3.9. Power Supply Requirements

The laser has a connected power supply cable already for getting AC380V/50-60Hz input. The input voltage is 380VAC±10%, frequency is 50-60Hz. The detailed line definitions are listed in Table 8.

Table 8 Definitions of Power Supply Connection

No.	Definition	Description
1	Live wire L1	Phase line 1
2	Live wire L2	Phase line 2
3	Live wire L3	Phase line 3
4	Ground wire PE	GND

If the connection is incorrect, the laser may be damaged, and the personnel injury will be occurred.

Use the PE wire for reliable grounding.

If the local voltage fluctuation exceeds ±5%, which means out of the limits required by the laser, please use a UPS with appropriate power.

3.10. Control Timing Program

The product control sequence can be seen in Figure 4 below.

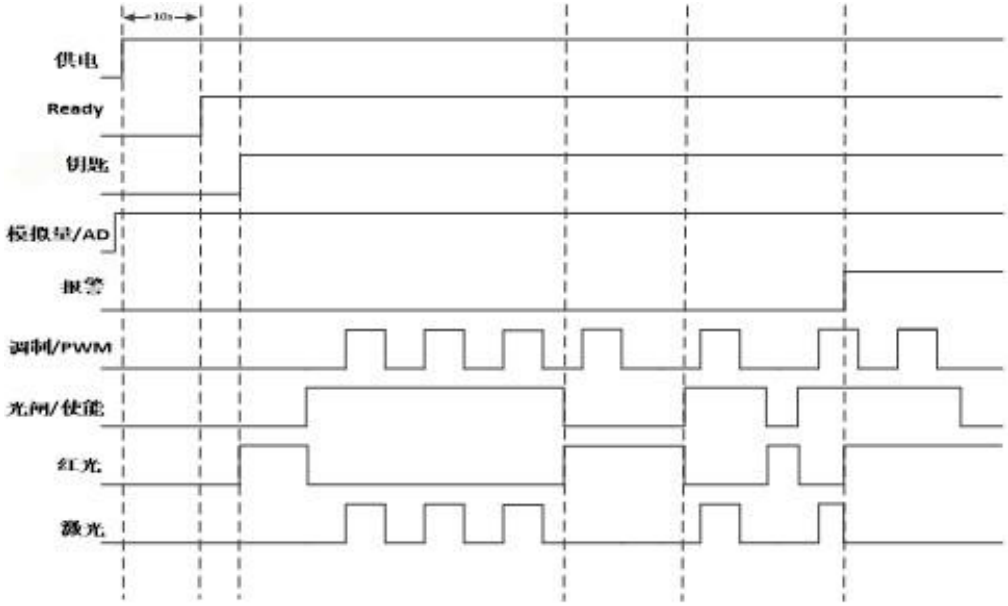


Figure 4 Control Timing Program - Continuous, Modulation

4. Laser Installation

4.1. Overall Size

The appearance and installation dimensions of Thunder Series fiber lasers are shown in below Figures.

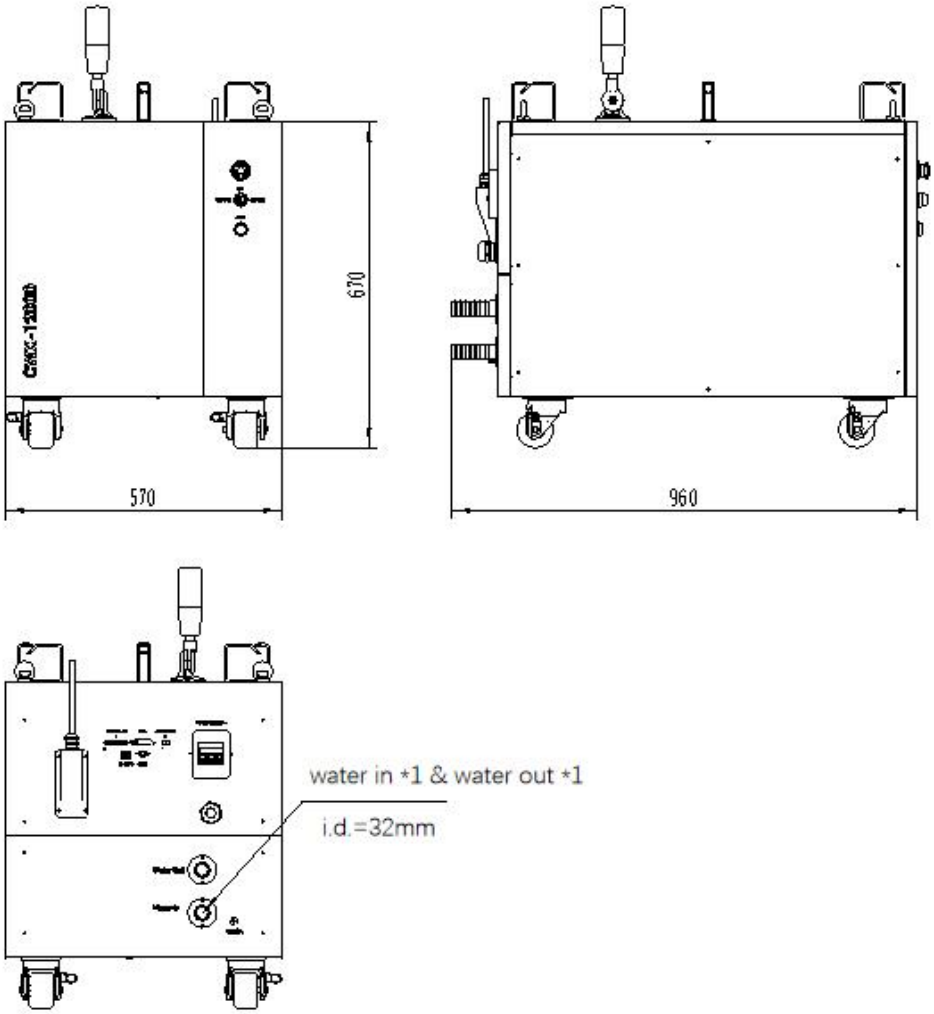


Figure 5 CWX-12000 Dimensions

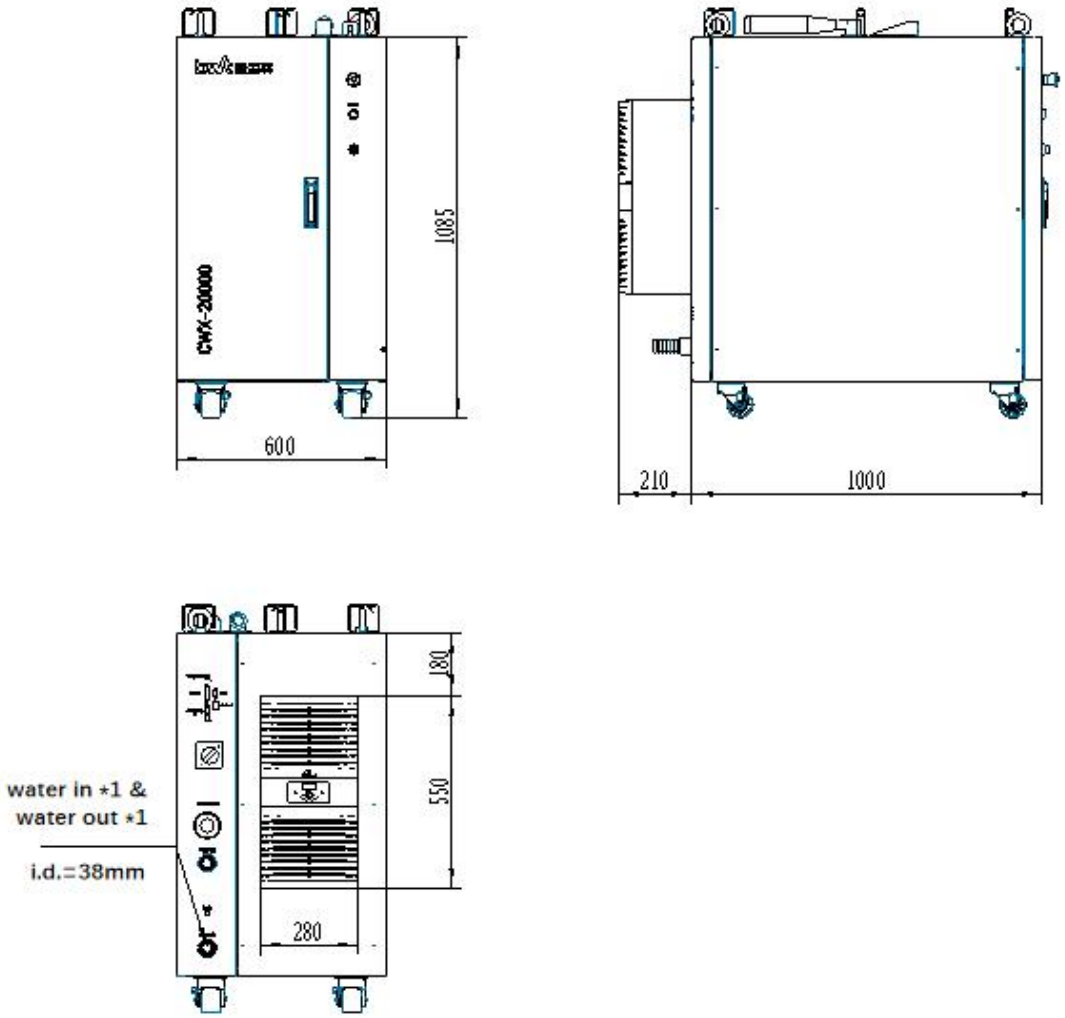


Figure 6 CWX-20000 Dimensions

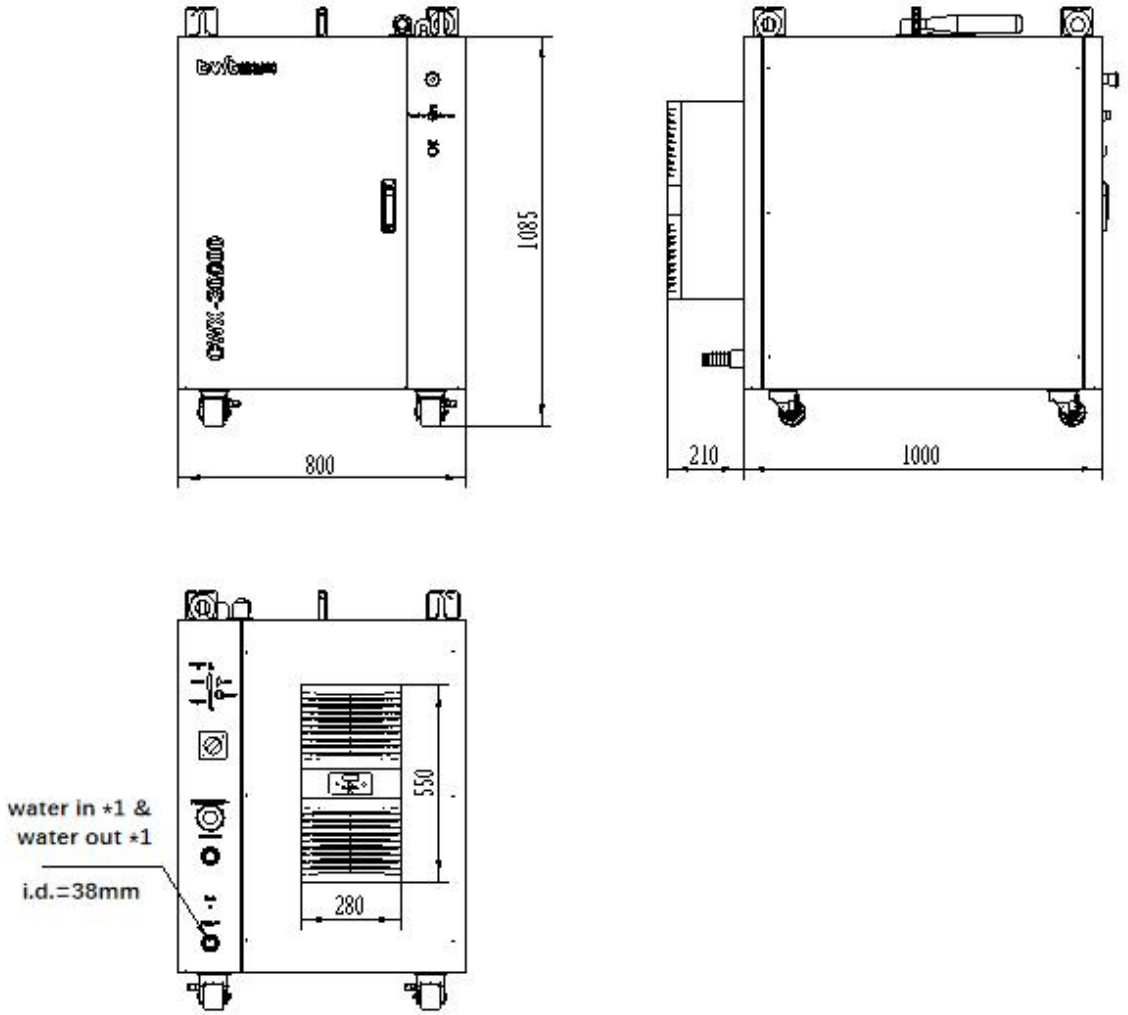


Figure 7 CWX-30000 Dimensions

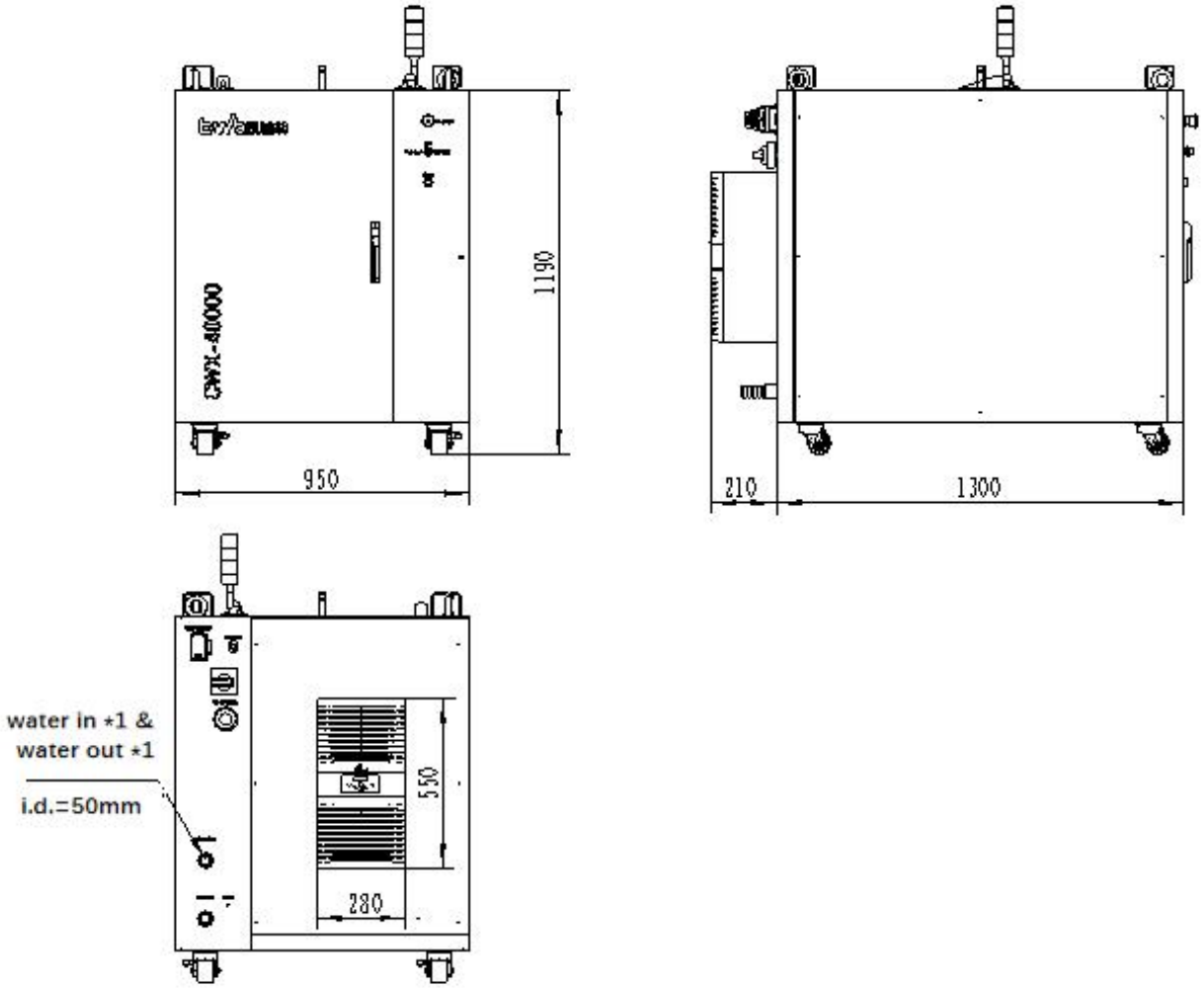


Figure 8 CWX-40000 Dimensions

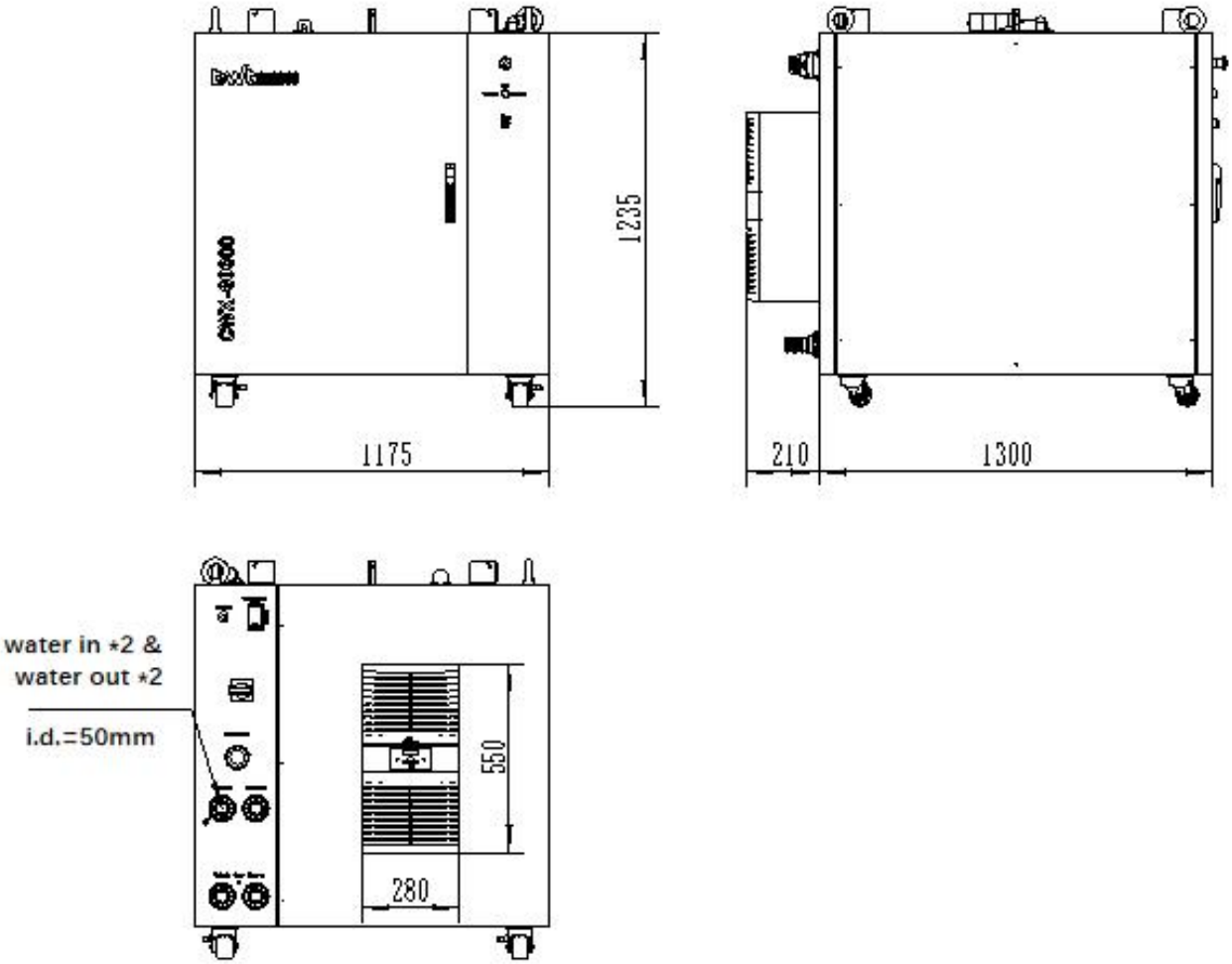


Figure 9 CWX-60000 Dimensions

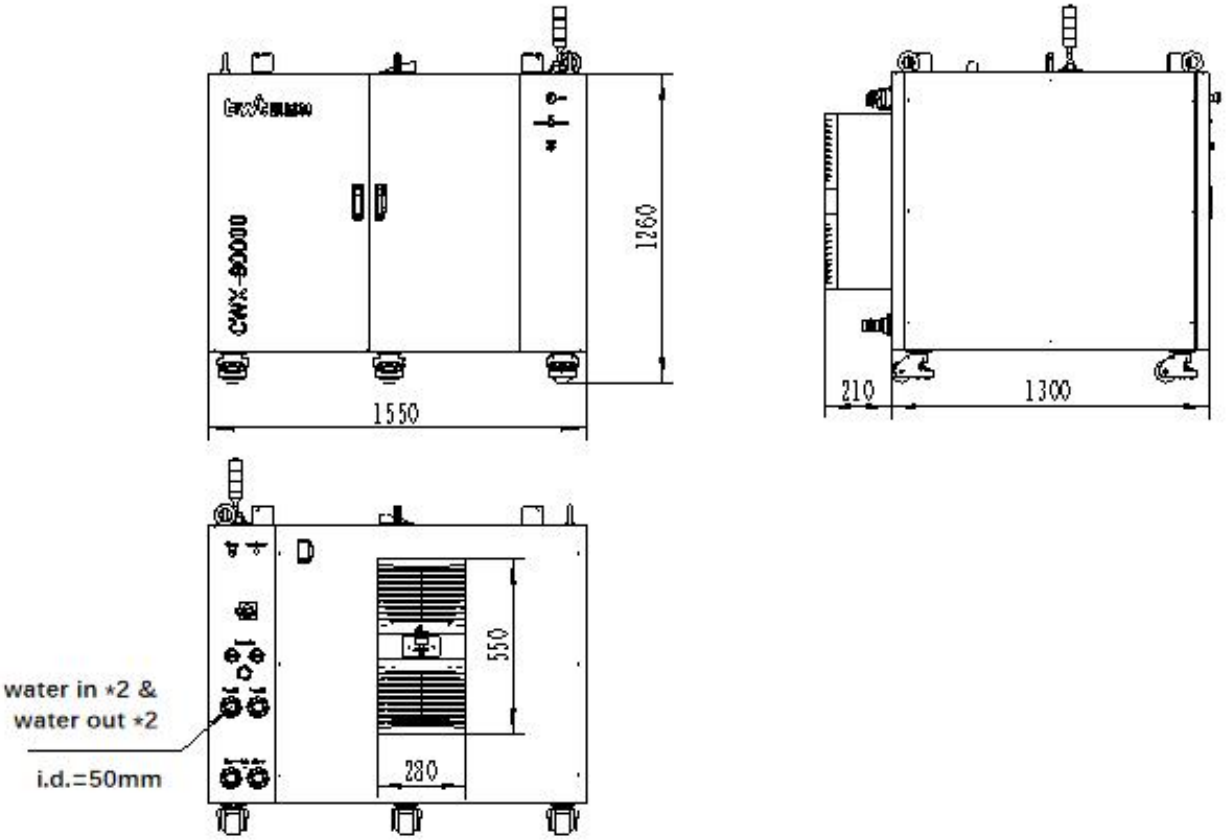


Figure 10 CWX-80000 Dimensions

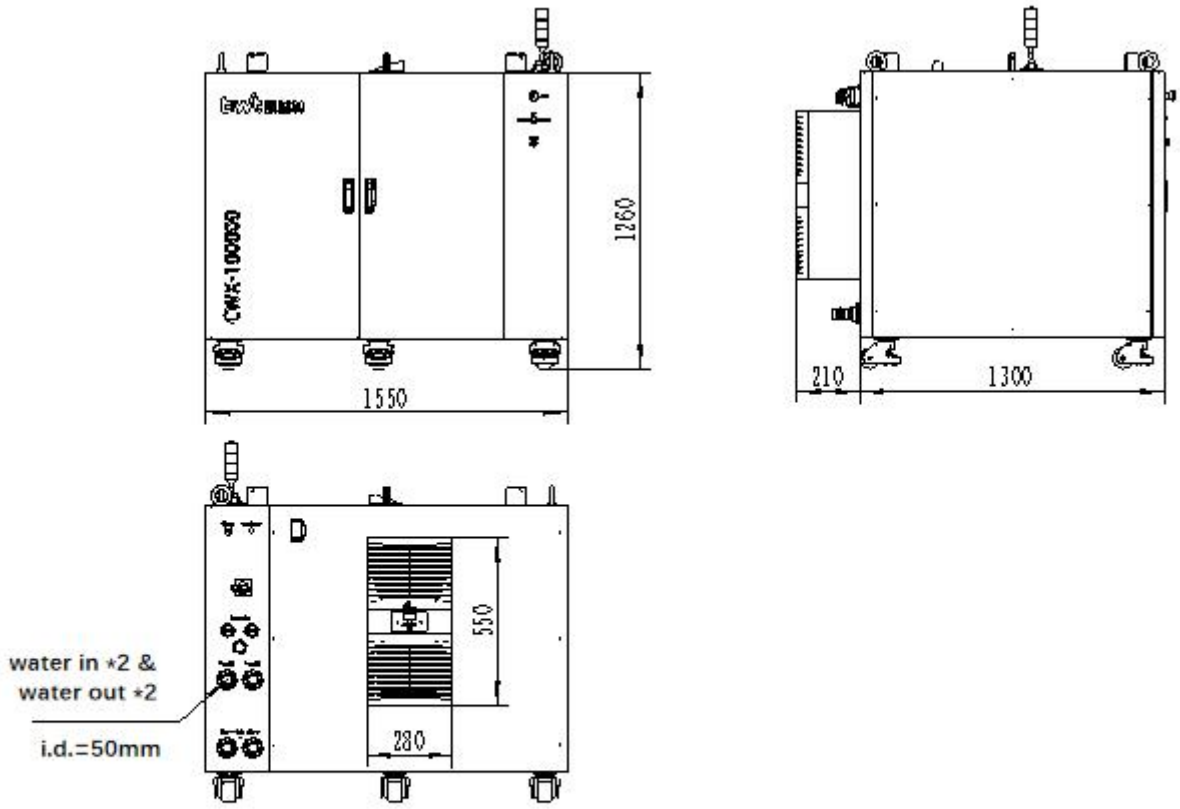


Figure 11 CWX-100000 Dimensions

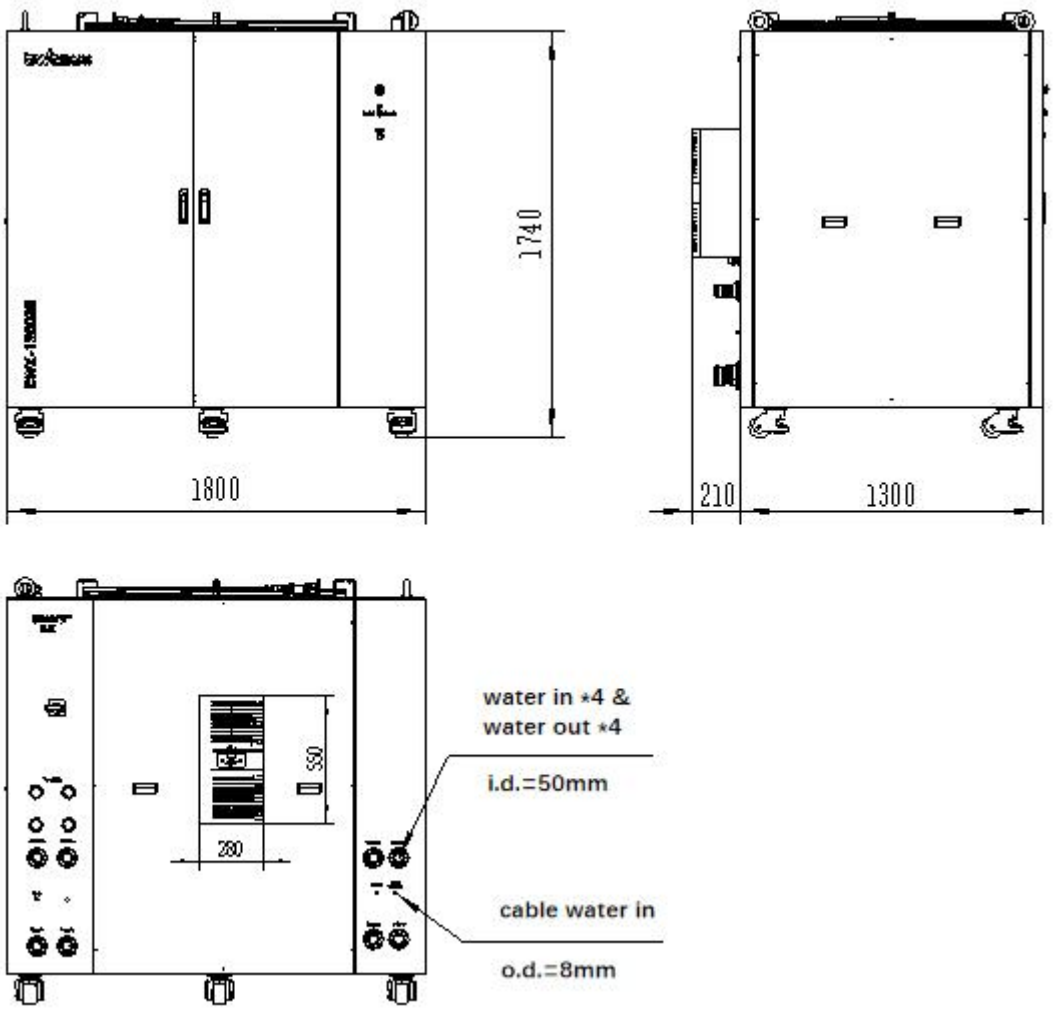


Figure 12 CWX-120000 Dimensions

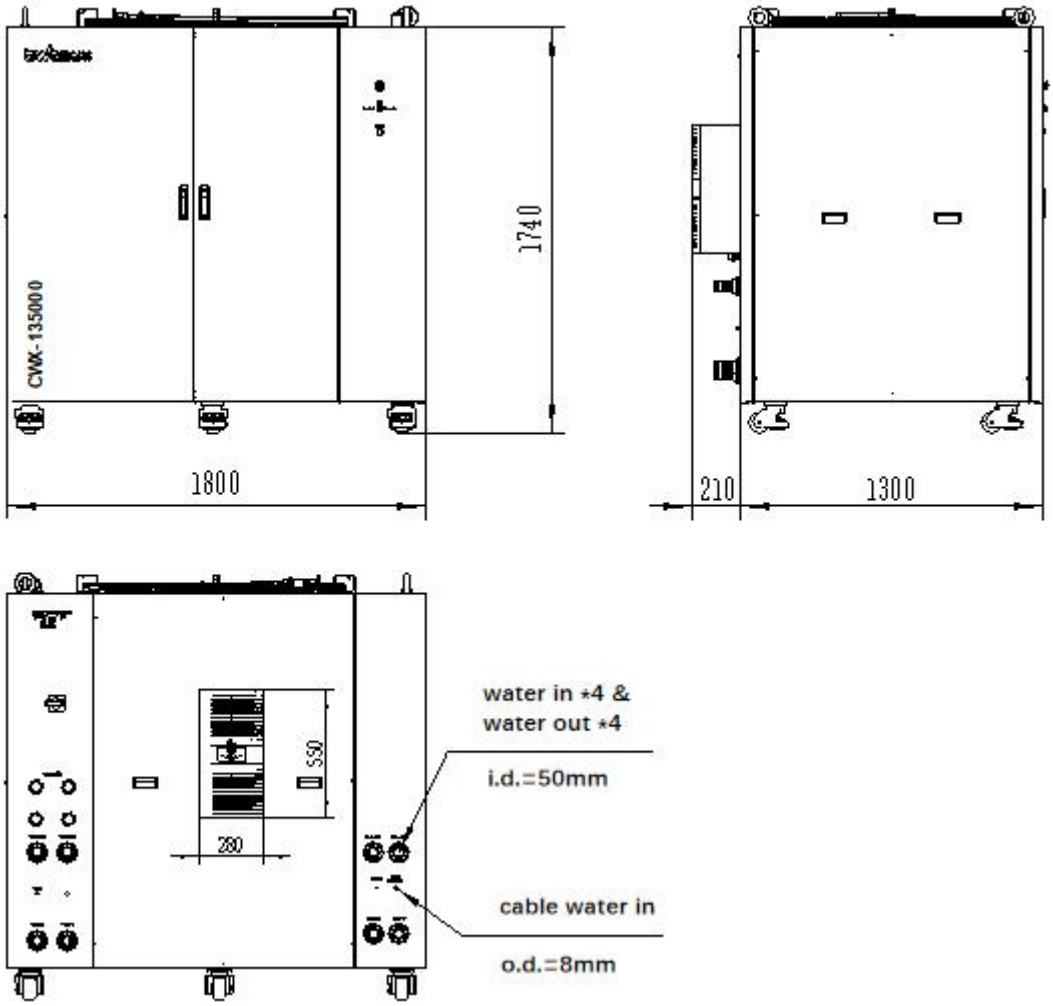


Figure 13 CWX-135000 Dimensions

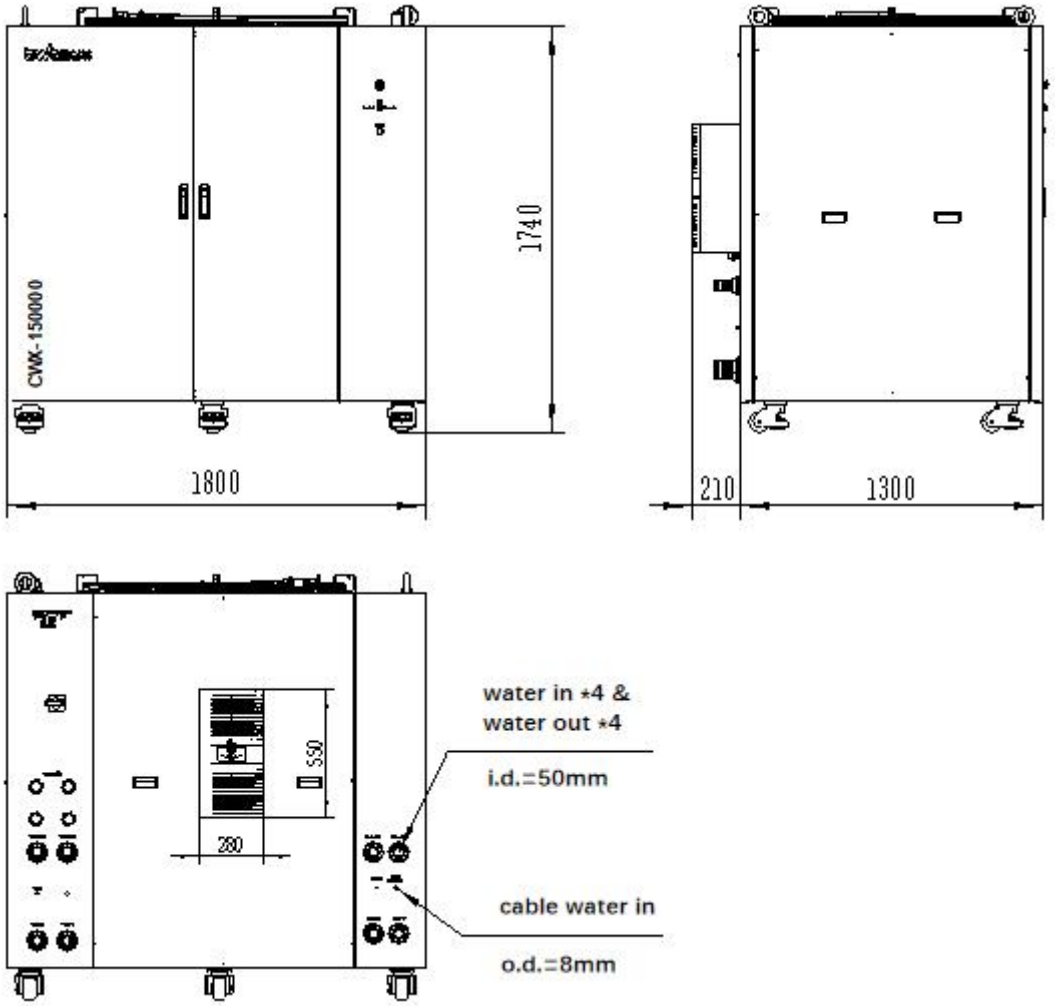


Figure 14 CWX-150000 Dimensions

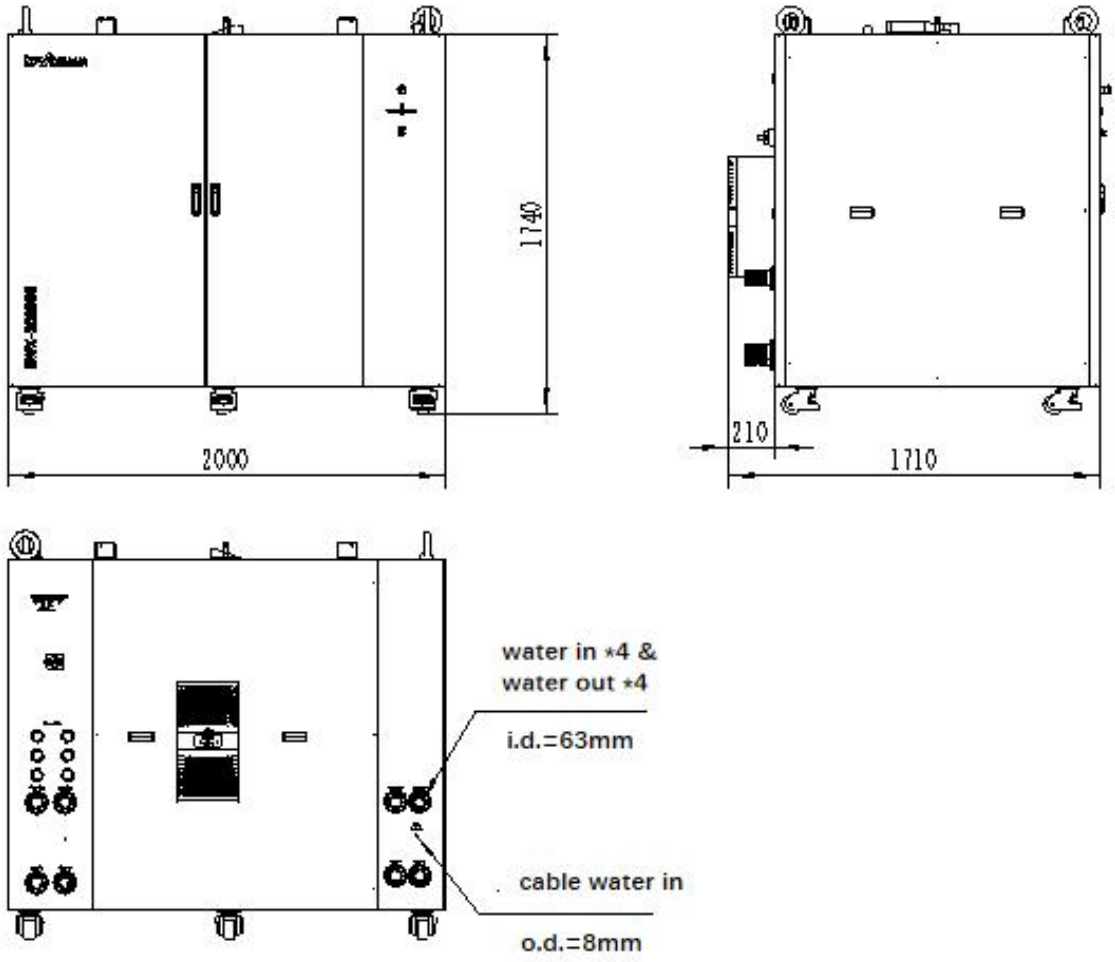


Figure 15 CWX-200000 Dimensions

4.2. Output Cable QF Size

The output cable of Thunder Series fiber laser has a QF or QF-D output head. The specific appearance and size are shown in Figure 16 and Figure 17.

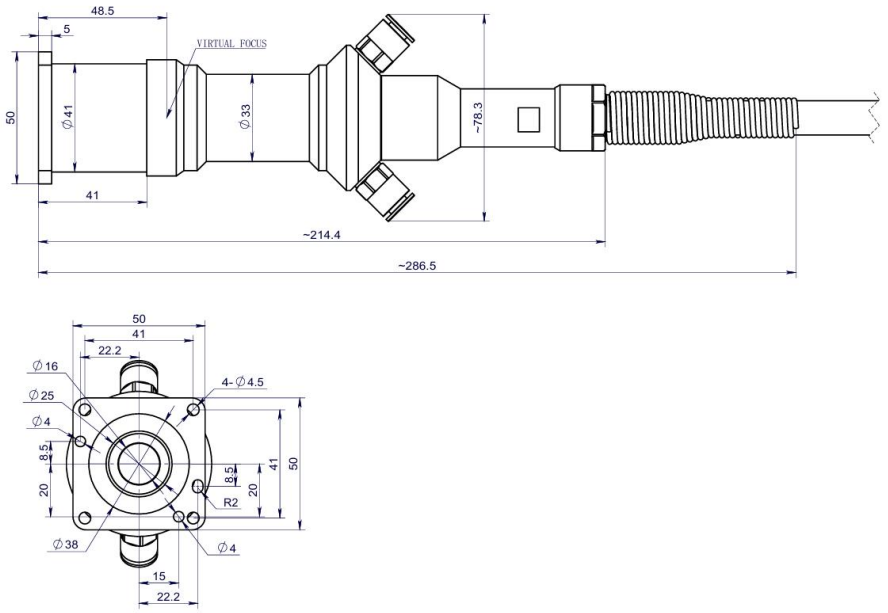


Figure 16 QF output head size

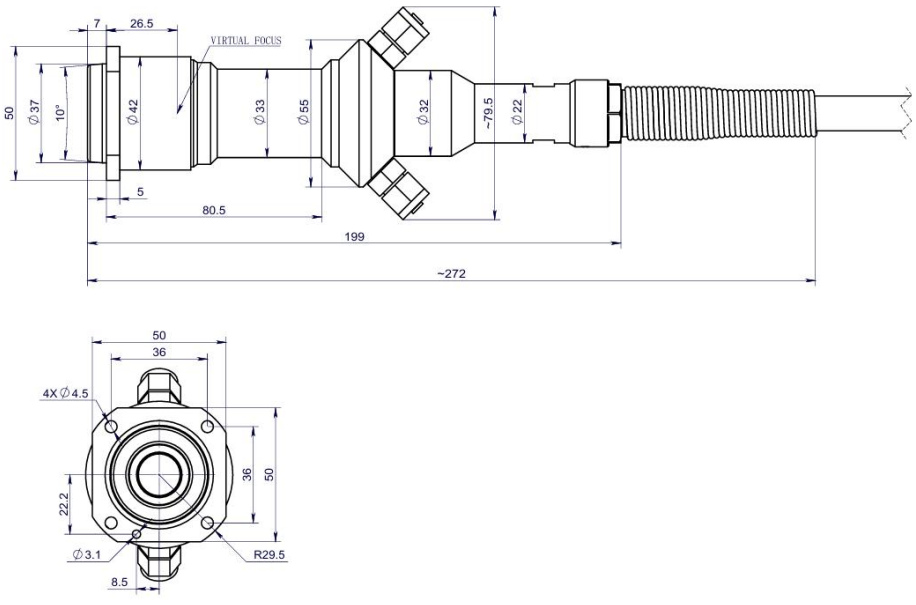


Figure 17 QF-D output head size

4.3. Installation Precautions

Before installation, please read the below precautions and follow the corresponding requirements.

1) Please check carefully whether the external circuit connections are correct and the power supply voltage meets the product requirements.
2) Do not expose the laser to high temperature and high humidity environment.
3) Check whether the temperature and flow rate of cooling water meet the requirements.
4) Before installing the output head (QF or QF-D) into the processing head, please carefully protect the output head.
5) Push the E-stop and disconnected the laser power supply, and then remove the protective cover of QF or QF-D, check the quartz surface. Clean the contaminants if there is any.
6) When operating the laser, please wear laser protective glasses of the corresponding wavelength and protection level.

4.4. QF or QF-D Cleaning

1) Cleaning tools required are listed in the Table 9, and some of them are shown in Figure 18.

Table 9 QF and QF-D cleaning tools

Cleaning Tools	Specification
Microscope	10~50X
Acetone or ethanol (w/o oil or water)	Purity more than 99.7%
Dust-free paper	Wiping paper
Cotton swab	Non-woven
Tip cotton swab	Degreasing cotton
Dust-proof film	Special for cutting head
Flashlight	Glare flashlight
Finger sleeves	Rubber finger sleeves
Hex key	
Tape	Masking tape or high-temp tape

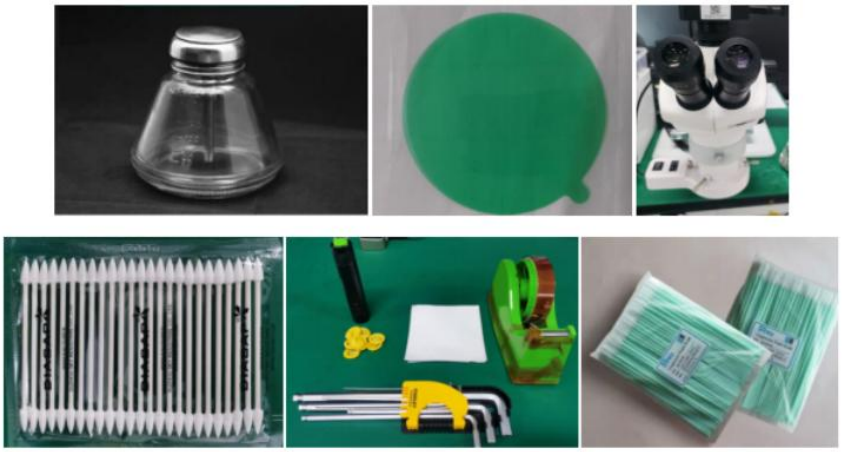
7) 

Figure 18 QF and QF-D cleaning tools

2) Cleaning processes

The QF and QF-D must be cleaned in clean room or equivalent environment, and the operator must wear rubber finger sleeves.

- **Adaptor appearance cleaning**

  Check the end and outside surface of adaptor. Clean the contaminants by wiping using non-woven cotton swabs w/ ethanol if there is any. Use the dust-free paper to clean the outside surface. Please note the 4 screw holes and 3 location holes must be cleaned as well.



Figure 19 Adaptor appearance cleaning

- **Adaptor internal cleaning**

  Check the inside of the adaptor carefully. Maximum the UV light intensity, and rotate the adaptor slowly to water the inside of the adaptor. Clean the contaminants by wiping using non-woven cotton swabs w/ ethanol if there is any.

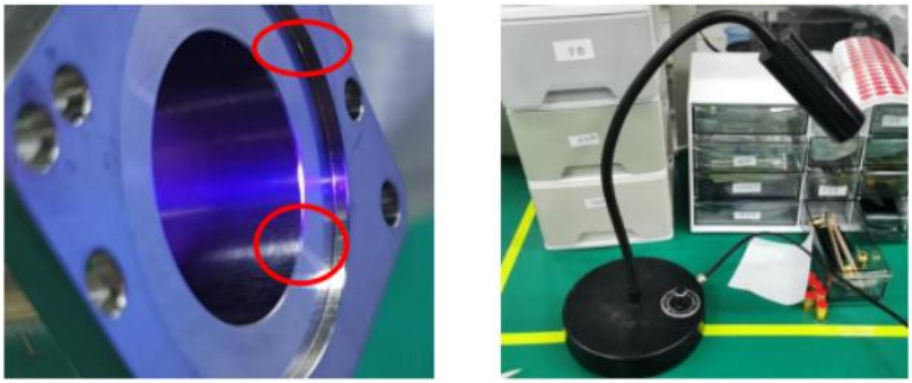


Figure 20 Adaptor inside cleaning

- **Quartz cleaning**

  Under 10X microscope, clean the end and side surface of quartz by using tip cotton swabs w/ ethanol. Adjust the microscope to focus on the end surface and see the end surface image clearly. Check the end surface assisted by glare flashlight. Clean the contaminants by wiping using tip cotton swabs w/ ethanol if there is any. After cleaning, adjust the microscope to 20X and check the end surface again to make sure it is clean. **Please note, do NOT touch the tip cotton swabs with naked fingers. Each tip cotton swabs can be used only one time. Each position on the swab can only be used one time**.

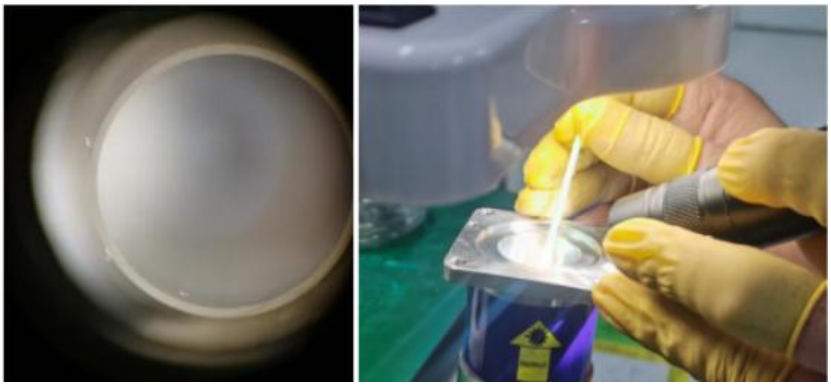


Figure 21 Quartz cleaning

- **Stick the dust-proof film**

  After quartz clean, stick the green dust-proof film on the adaptor to protect inside from contamination, as show in Figure 22.

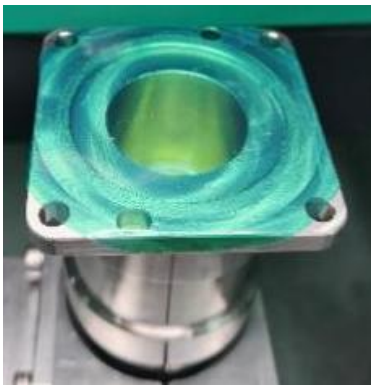


Figure 22 Dust-proof film

- **On-site cleaning of QF or QF-D**
  - ✓ Check the connection area of cutting head and O ring with glare flashlight, and clean the contaminants using cotton swabs w/ ethanol.
  - ✓ Following the installation precautions, remove the protective cap and dust-proof film from qualified QF or QF-D, connect it with cutting head, and lock the screws tightly.



Figure 23 installation of QF/QF-D with cutting head

- ✓ After installation, check the levelness of surfaces of QF/QF-D adaptor and cutting head using level gauge. Re-installation the QF/QF-D if it is not flat.



Figure 24 Levelness check after installation

- ✓ Use the masking tape (or high-temp tape) to cove the connection area of QF/QF-D adaptor and cutting head to protect it from dust.
- ✓ Install the cutting head on the cutting machine, check the red beam spot to see if there is any contaminants on the lens
- ✓ After the qualified installation of cutting head, the laser can be powered on.

4.5. Cooling System Requirements

For the stable and reliable operation of the laser, a dual-temperature-controlled chiller (with both heating and cooling functions) must be used and works uninterrupted.

The Thunder Series fiber lasers have two places that require cooling water for heat removing. One is the laser itself. The water in and water out interfaces locate on the real panel. The water temperature is required to be 22±2℃, the pressure is required to be less than 0.6MPa, and the flow rates are listed in Table 2. The other is the QF/QF-D. The water tube is o/d.=8mm plug-in tube. The flow rate is required to be 3L/min, and the pressure is required to be less than 0.5MPa.

Note: for 60kW and above, the cable is required to be cooled. The flow rate should be more than 1.5L/min, and the pressure should be less than 0.6MPa.

When installing and using the cooling system for the first time, please check the entire water loop and joints for any water leakage. The water tubes from the chiller must be connected correctly to the ports on the laser rear panel, otherwise the laser may not work normally.

Note: The deionized water or distilled water should be used and monthly replaced. Do not use tap water. The filter elements in the chiller should be replaced periodically. The filter must be added at the water out of the chiller or the water in of the laser, and replaced periodically.

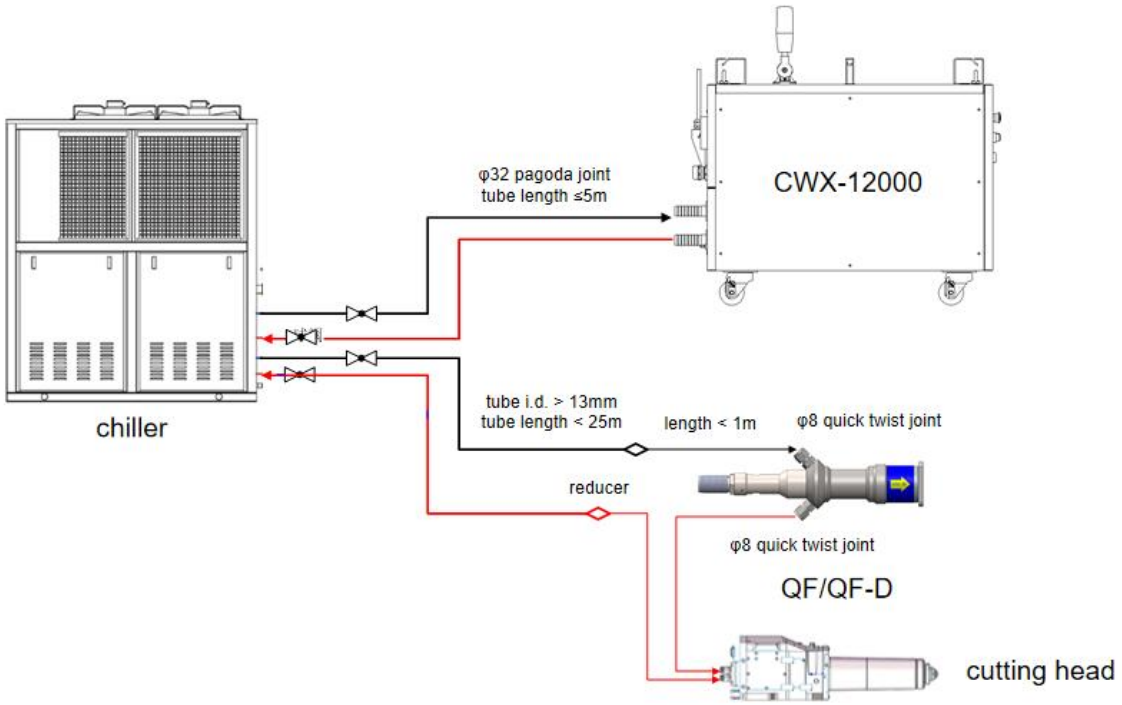


Figure 25 CWX-12000 water tube connection

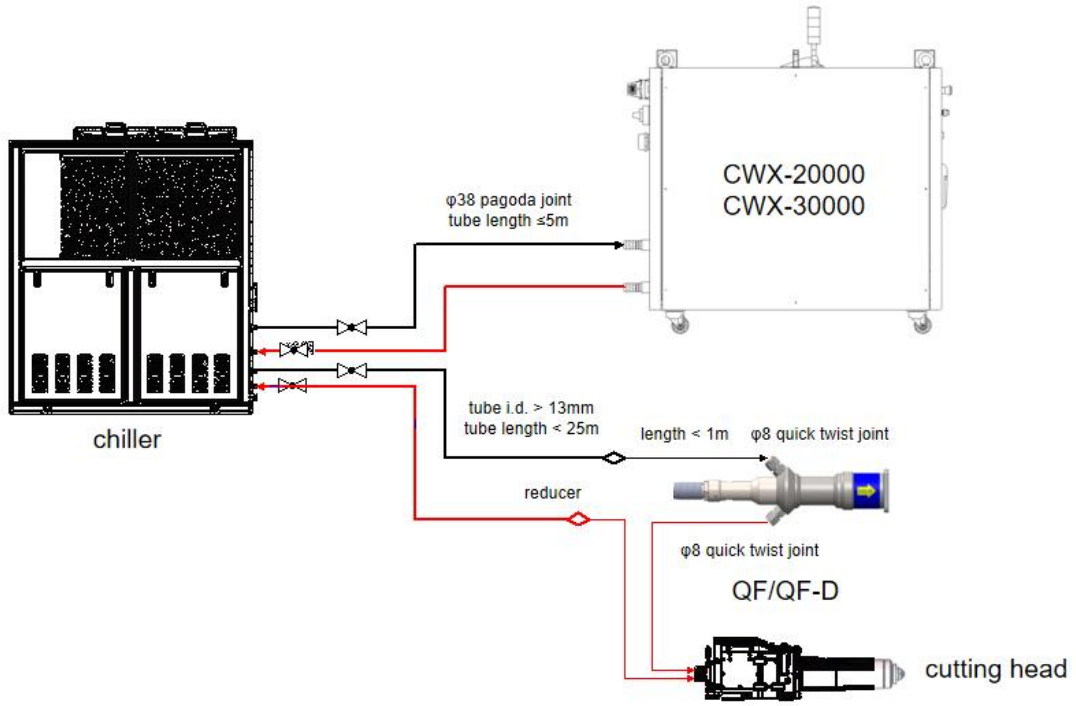


Figure 26 CWX-20000 and CWX-30000 water tube connection

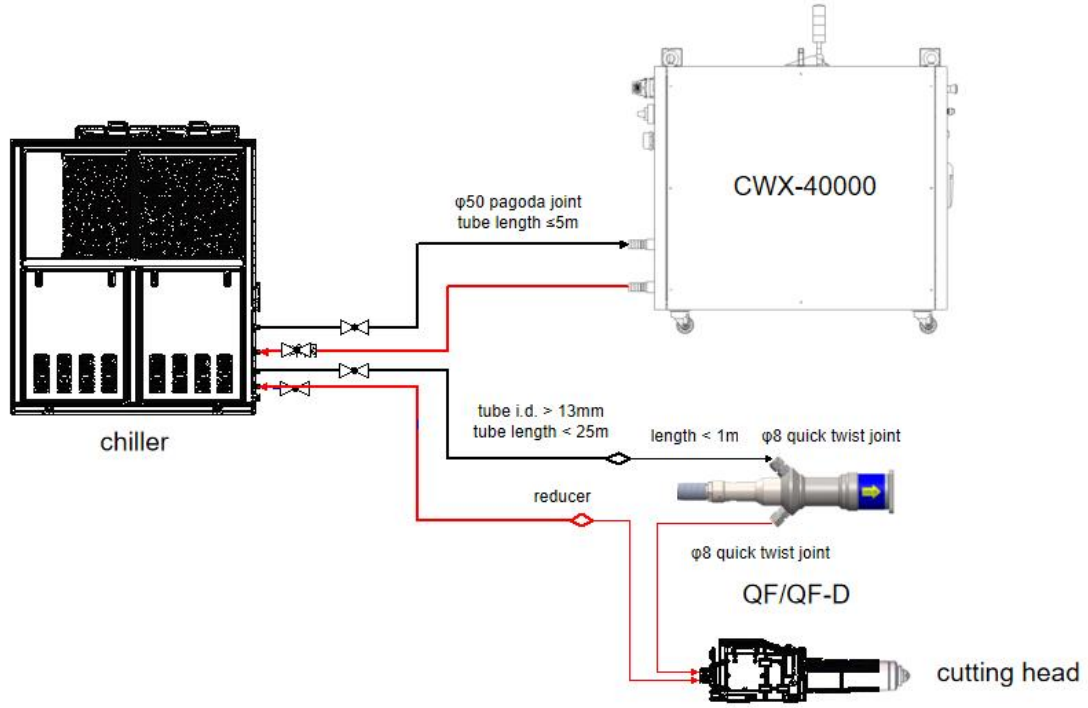


Figure 27 CWX-40000 water tube connection

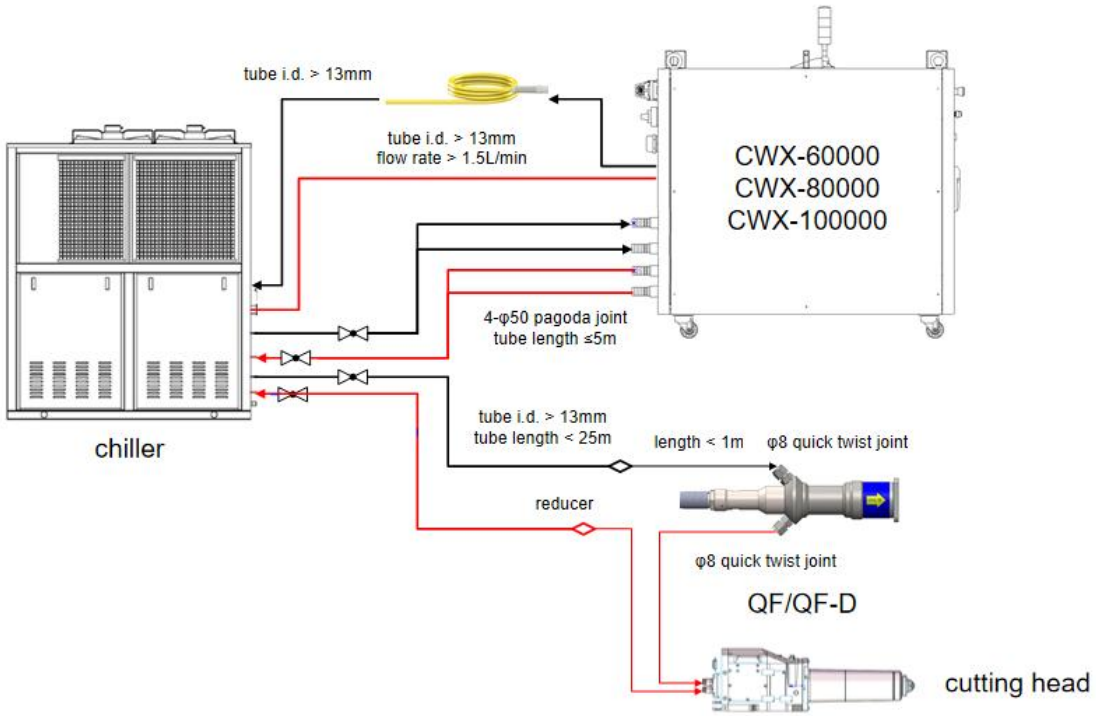


Figure 28 CWX-60000, CWX-80000 and CWX-100000 water tube connection

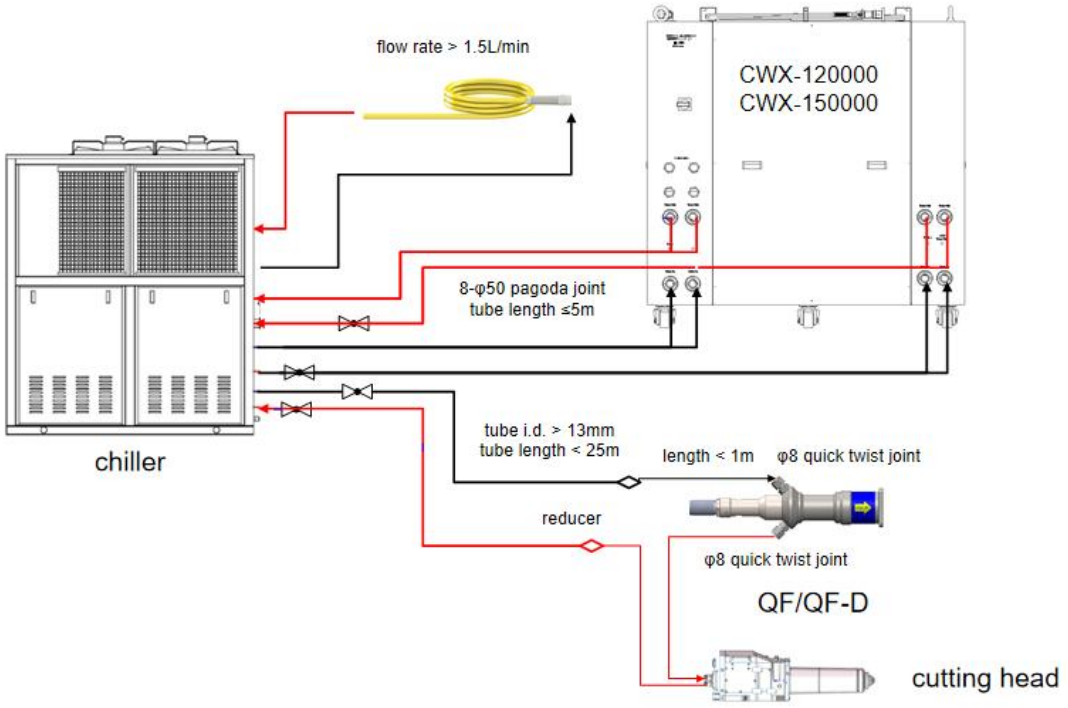


Figure 29 CWX-120000 and CWX-150000 water tube connection

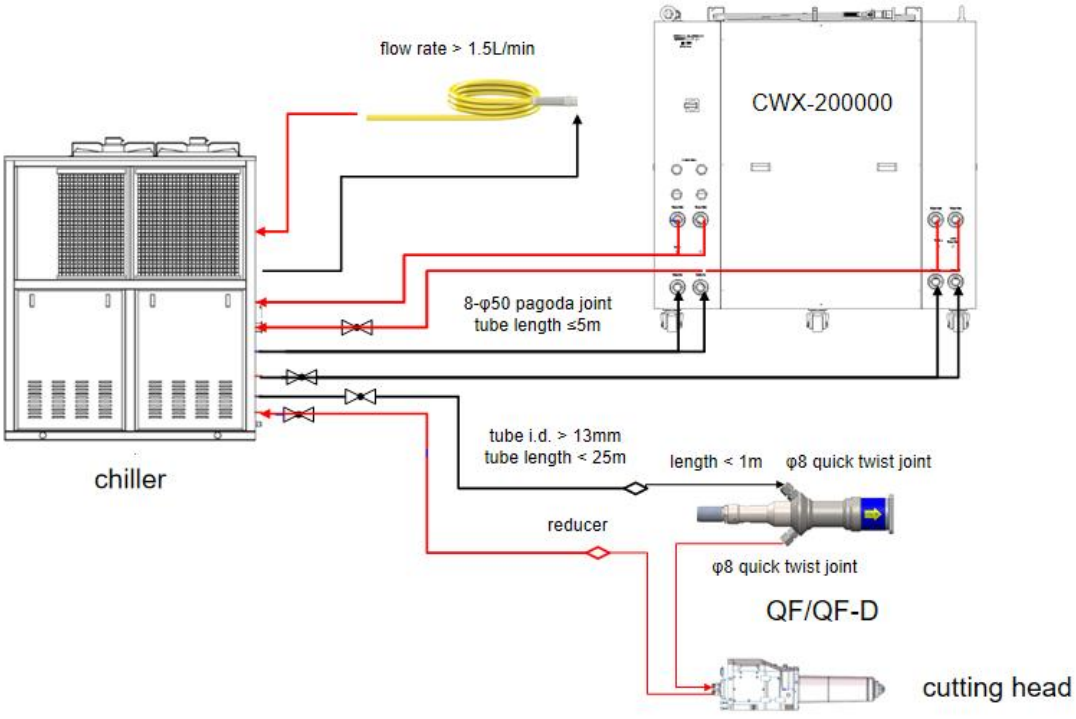


Figure 30 CWX-200000 water tube connection

In summer, condensation risk must be considered. Once the cooling temperature of the chiller is lower than the dew point of the environment inside the laser, the moisture in the air will condense on the electrical and optical modules, and then on laser appearance if without effective preventive actions. Therefore, once you see condensation on the laser cover, it means that condensation has occurred inside the laser, so you must power off the laser immediately, stop working and optimize the operating condition of the laser.

Table 10 Dew points at different ambient humidity

Ambient temperature	Dew point temperature at different relative humidity ℃								
	40%	50%	60%	70%	75%	80%	85%	90%	95%
16℃	2	6	8	11	12	13	13	14	15
18℃	4	7	10	12	13	14	15	16	17
20℃	6	9	12	14	15	16	17	18	19
22℃	8	11	14	16	17	18	19	20	21
24℃	10	13	16	18	19	20	21	22	23
26℃	11	15	18	20	21	22	23	24	25
28℃	13	17	19	22	23	24	25	26	27
30℃	15	18	21	24	25	26	27	28	29
32℃	17	20	23	26	27	28	29	30	31
34℃	18	22	25	28	29	30	31	32	33
36℃	20	24	27	30	31	32	33	34	35
38℃	22	26	29	32	33	34	35	36	37
40℃	24	28	31	33	35	36	37	38	39

Note: Laser damage caused by condensation is not covered by the warranty!

In winter, an appropriate amount of antifreeze should be added into the water to prevent the water loop in the laser and the chiller from any freezing. The freezing point of the antifreeze must be 5°C lower than the minimum ambient temperature.

When shutting down the laser for a long time, please empty the cooling water in the laser and QF/QF-D in time, otherwise the laser equipment may be damaged. When draining the water, the air pressure used must be less than 0.4MPa for laser and 0.1MPa for QF/QF-D as higher air pressure may cause the damage of fiber.

4.6. Turning On/Off the Laser

After the laser is turned on, it will enter the external control mode. In this mode, the output power is controlled by the external analog voltage signal. According to the ports on rear panel in Figure 3, connect the cooling water tubes to the ports. The power supply cable must be correctly connected power supply cable with reliable grounding. Connect the external control cable to the User Control interface, and the other end to the corresponding control interface of the processing machine.

Before powering on the laser, please check if the laser meets the following requirements:

1) Correct connection of power supply and control cable, respectively. The power supply voltage meets the product requirements;
2) The key is in the position of "OFF"

3) The emergency stop button is released;
4) The flow rate and temperature of cooling water meets the requirements in Table 2

Open the air switch or load handle, and the laser is powered on. Push the "start" button, and then the green indicator lights up. Turn the key from "Off" to "Remote", the green light of the-color light begin to flash. When the laser is ready, the green light is on , and the laser can work normally in external control mode.

4.7. Operating Software

This section describes the installation and usage of operating software (Win 10, 64 bit system as an example). The latest version software can be downloaded through official source.

Download the "BWT laser" program on the PC, right click and select "operating as administrator". Select the folder that you want to install the software to and follow the guide to complete the installation, and then reboot the PC.



Figure 31 Operating software installation program

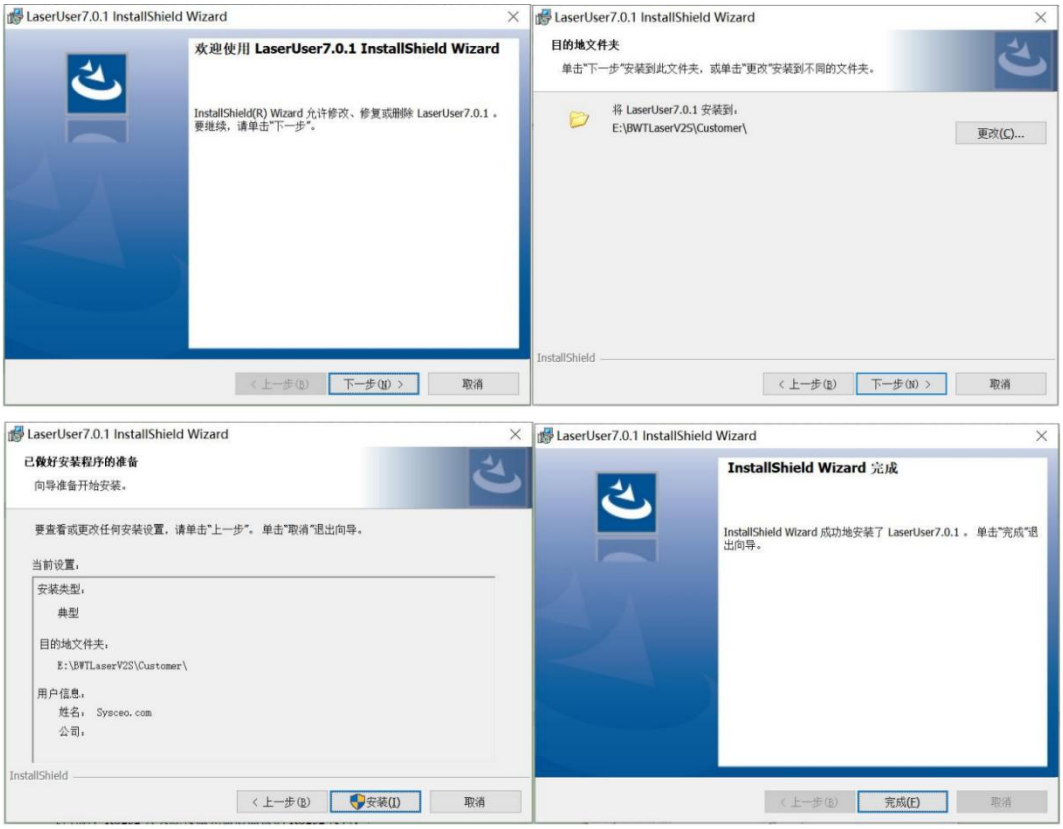


Figure 32 Software installation guidance

Find the USB to RS232 male wire and connected the PC with USB while RS232 to laser.

Turn the key of laser clockwise.

Double click the "BWTLaser.exe" in the installation folder selected.



Figure 33 Operating software installation program

If the dialog below pops up, it means the laser cannot find the right serial port, so please close the dialog, check the serial ports, and make sure the serial port driver program has been correctly installed. And then re-open the software.



Figure 34 Laser cannot find the serial port

Home Screen

After opening the software, the home screen displays as in Figure 35.

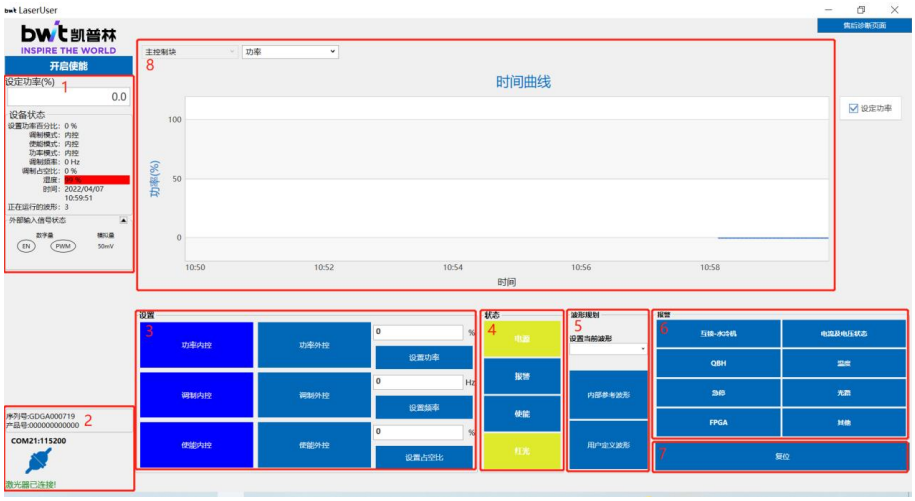


Figure 35 Home screen

1) Frame 1: enable button as well as device status including set power percentage, modulation, enable mode, power mode, frequency, duty cycle, humidity, time, running no. and extra input signal status.
2) Frame 2: click the blue serial port icon to connect or disconnect the laser and show the product ID, SN, serial port number and baud rate.

3) Frame 3: Setting, including modulate external and internal control, enable external and internal control, power external and internal control, and set power (%), set frequency (Hz), set duty cycle (%). Set the power, frequency and duty cycle under internal control mode.

Note: the parameters should be setting again after laser rebooting.

4) Frame 4. Status, displaying the status of power supply, warning, enable and red light. When there is an alarm, the alarm indicator lights up. It is red for alarm (cannot enable laser under alarm status) and yellow for warning. As in Figure 35, enable the laser output when the power supply and red light are ready, and then the red light button change back to blue, and the enable button becomes yellow.

5) Frame 5: power curve setting, which controls the output power through adjusting the analog signal. The client can select the power curve based on the application. More information please refer to *Power Curve Setting*.

6) Frame 6: alarms, showing the alarm status of interlock-water cooling, QBH, emergency stop, voltage & current status, optical path, temperature, etc. Click each button will pop up the detailed alarm message, as in Figure 36. Check the user manual for solution.



Figure 36 Alarm message

7) Frame 7: Reset button. It can reset the 2nd level alarm.

8) Frame 8: Curve of power or temperature. It can select power or temperature to display. When selecting temperature, different modules can be selected to show the temperature curve.

Service Diagnostic Screen

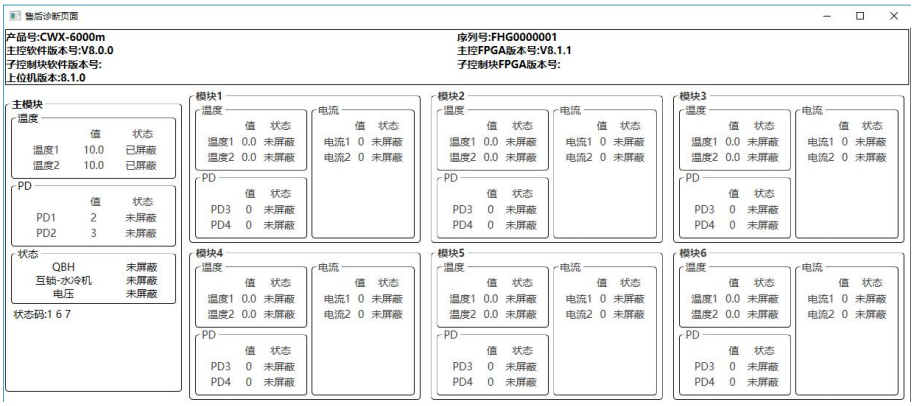


Figure 37 Service diagnostic screen

The operator can modify fault output signal status. Click the upper right checkbox in Figure 35, and then the dialog box pops up as in Figure 38. Click the enter or cancel button to save the change or not.

Time Reminding and Password

Click 'time reminding" and then the password expiration window pops up (Figure 38).



Figure 38 Password input window

If you need a new password, please contact BWT representative and provide the absolute date in the input window and product SN.

Note: new password can only be used on absolute date, otherwise you have to apply for the password again.

The laser parameters can be set when it is connected to PC through serial port. If connecting through Ethernet port, the laser parameters can be monitored but not set, that is you cannot set internal/external control, turn on/off laser, set laser power, frequency or duty cycle.

Waveform Description

1) Preset waveform

The user can select the preset waveform in terms of the application. Click the "Preset waveform", you can select the number to see the waveform, select the waveform you want and click "save and run", as in Figure 39. The laser beam enable is controlled by the waveform. When the waveform laser output completes, the power will be keep the same as the waveform completed.

Note: After laser is reboot, enable is controlled by the waveform selected before.

Two types of preset waveform are introduced here

① Waveform 0: it is the default waveform, and the enable is controlled by the external PWM signal, as Figure 39.

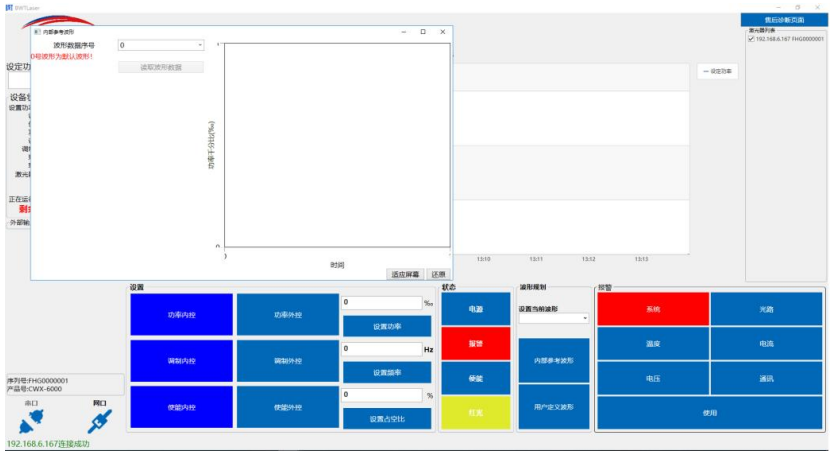


Figure 39 Waveform 0

② Waveform 1: it is for drilling application. After enabling the laser, the laser output power starts from 1065‰ of the set power and decrease slowly to 1000‰ within 50ms. Then the output power keeps the 1000‰ of set power. See Figure 40.

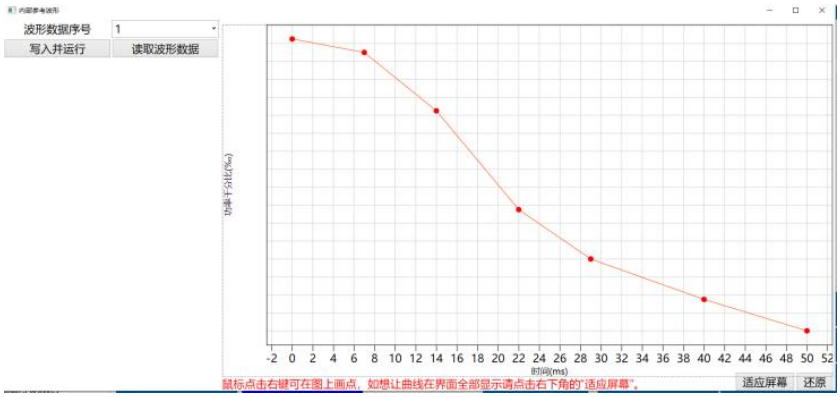


Figure 40 Waveform 1

2) User-defined waveform

Click the "User-define waveform". In the screen in Figure 41, the user can edit the waveform according the specific requirements and save it. The waveform will not be changed when the laser is turned off and on.

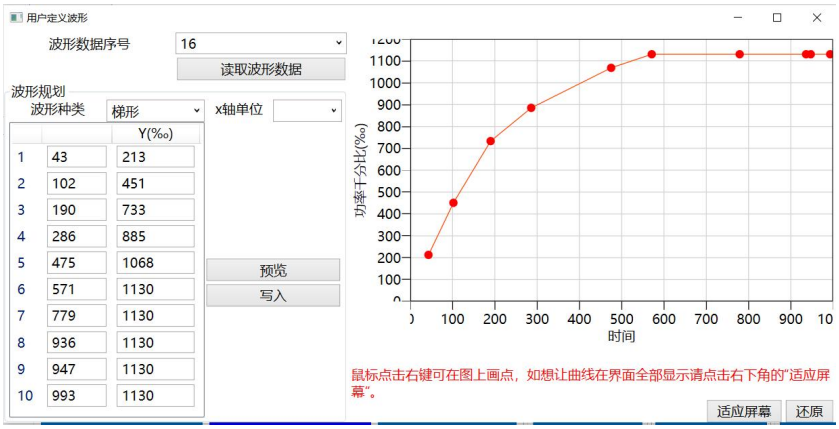


Figure 41 User-define waveform

Method to define the waveform: horizontal axis is time, and vertical axis is power percentage. The user can move the power-time point in the coordinates. When all the points have been set, click “read-in”, and then select this waveform in the “set current waveform” drop-down menu, as in Figure 42. Enable the laser and then run this user-defined waveform, as in Figure 43.

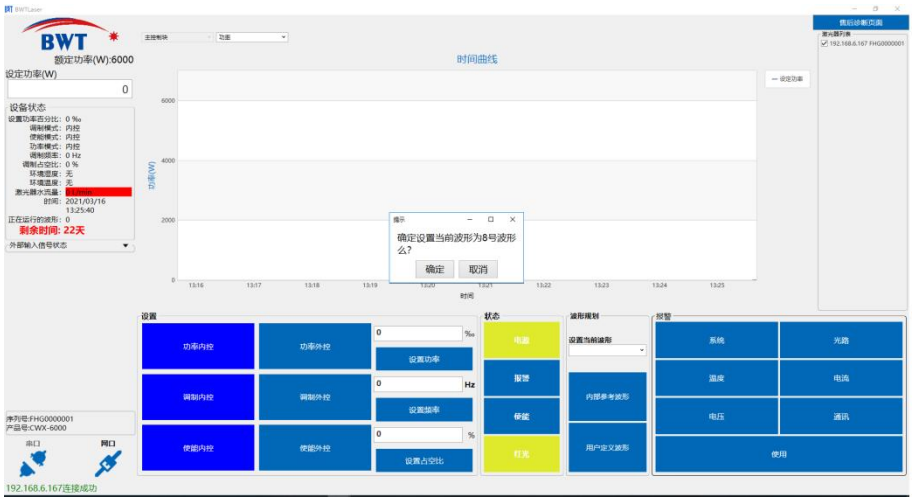


Figure 42 Selecting the user-defined waveform

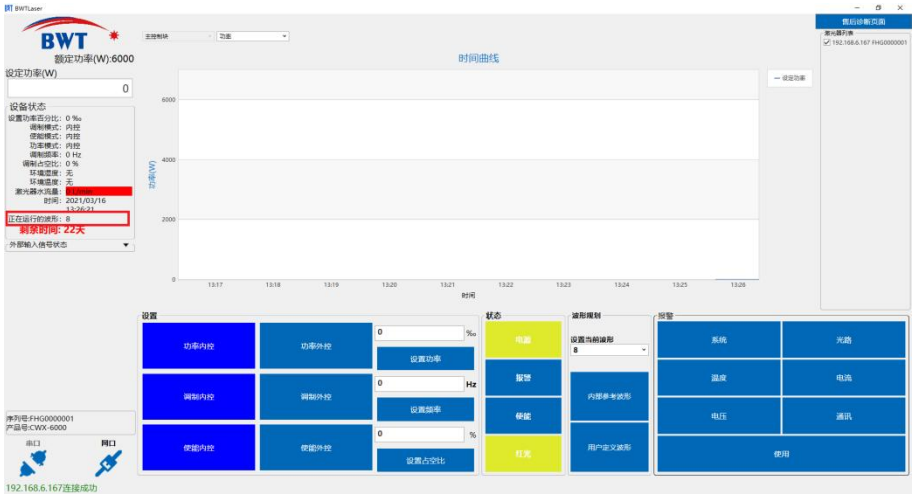


Figure 43 Running the user-defined waveform

Rules of define the waveform: when using the waveform edition function, the laser limits the output power less than 1030‰ of rated power. When the laser works with power less than full power, the output power cannot exceed the 1130‰ of the set power.

5. Troubleshooting

The laser has different sensors inside to measure optical path, temperature, current, input voltage, QF/QF-D, flow rate, etc. If there is an abnormality during the laser running, the fault will be displayed in the alarm area of operating software.

The common faults and solutions are listed in Table 11

Table 11 Common faults and solutions.

NO.	Fault	Description and Solution
1	Current alarm	Drive circuit output over-current alarm. Check the analog signal and make sure it is smaller than 10.5V.
2	Temperature alarm	This occurs when the internal temperature of laser is abnormal. Make sure the flow rate and temperature of cooling system meet the specifications required.
3	Optical path alarm	Optical path protection system detected the abnormal status. Re-power on the laser and then enable the red guide light. If it is normal, turn on the laser. If no red guide light output, contact BWT representative.
4	Voltage alarm	Laser internal control system detected the unstable voltage. Make sure the power supply voltage is stable. Re-power the laser to see if the alarm disappear.
5	System alarm	Include client interlock alarm, QF alarm and E-stop alarm. **Client interlock alarm**: it occurs when the "INT_A" and "INT_B" is not well jumped out. Re-power on laser after jumping out the "INT_A" and "INT_B". **QF/QF-D alarm**: check the cooling water tube connection and the flow rate, and then re-power the laser. **E-stop alarm**: it occurs when the emergency stop is pressed. Release the E-stop button and then re-power on the laser.
6	Operation alarm	Include cooling water flow rate alarm and chiller alarm. **Cooling water flow rate alarm**: it occurs when the flow rate is lower than the specification required. Check the flow rate. **Chiller alarm**: it occurs when the "WCL_A" and "WCL_B" is not well jumped out. Re-power on the laser after jumping out "WCL_A" and "WCL_B".
7	Communication alarm	Communication fault occurs between the modules in the laser. Contact the BWT representative.

If the fault cannot be fixed after above actions, please contact BWT representative.

6. Warranty and Repair

6.1. General Warranty

BWT provides warranty for all products manufactured within the warranty period in the contract, and has the right to selectively repair or replace any product with material or technical problems during the warranty period.

6.2. Limitation of Warranty

Products and components are not covered by the warranty in the following cases:

1) Damages due to tampering, opening, disassembly, misinstallation or modification by person not from BWT;
2) Damage caused by improper use, negligence or accident;
3) Damage caused by operating the laser beyond the scope of technical specification;
4) Indirect damage due to the failure of the customer's software or interface;
5) Damage caused by improper installation, maintenance or other improper operation which is not stated in the manual.

It is the customer's responsibility to understand the above information and use the laser in accordance with the user manual and specifications, otherwise the failure will no longer be covered by the warranty.

6.3. Service and Repair

In the warranty period, the client must notice BWT within 30 days of after the fault occurs. BWT has not authorized any third party partner to repair the product or component.

All products that need repairing or replacing repaired or replaced must be delivered in the original packaging box provided by BWT, otherwise BWT has the right not to provide free repair or replace.

When the client receives BWT products, please check whether the product is intact or not in time. If there is any abnormal situation, please contact the delivery company and BWT in time.

Please do not ship the product back if without communicating and confirming with BWT representative, otherwise it will be rejected and returned, and the client will .

BWT keeps upgrading and optimizing the products as to improve the performance. The information in the manual may be changed without prompt notice. All technical specifications are subject to the terms of the contract.

The warranty and service terms above are only for reference, and the official service and warranty content is subject to the agreement in the contract.