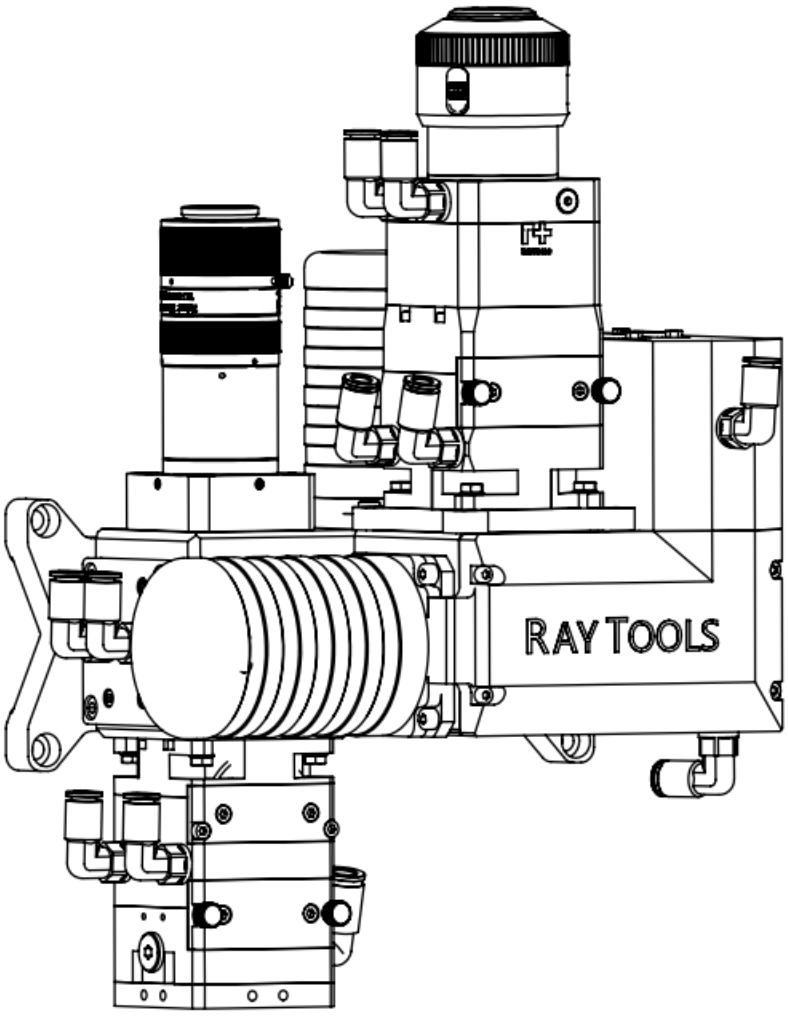
BF04K

4KW Wobble Laser Welding Head - User Manual



Document History

Edit date	Version	Topic, revision, action taken
2025/7/1	V1.0	First edition

Thank you for choosing our product!

This manual describes the installation and commissioning of laser welding head in details so that you can use this product quickly. You can consult us directly for more details.

Due to the continuous updating of product functions, the product you receive may differ from the introduction in this manual in some aspects.

If you find any errors in this document, please inform us as soon as possible. The data contained in this manual is only used to describe the product and shall not be regarded as a statement of security interest.

For the benefit of our customers, we will constantly try to ensure that the products we develop comply with the latest technology.

Raytools AG

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Disclaimer

- We reserve the right to change the design in order to improve the quality or expand the application or comply to manufacturing workmanship.
- We will not bear any responsibility for losses and accidents caused by wrong operation or improper handling of our products.
- Dismantling of product will lose all warranty claims excluding the normal replacement of worn parts and components required for maintenance or commissioning operations.
- Unauthorized modification of products or use of non-original spare parts will directly lead to the invalidation of warranty and liability exemption.
- It is recommended to only use the spare parts provided by us or submit them to us or the designated professional team for installation.

Use Regulations

- Ensure that the product is used in a dry environment.
- Ensure that the product is used in the environment required by EMC standards.
- The product is only allowed to run within the parameters specified in the technical data.

Personnel Responsibilities

- Be familiar with the basic provisions of work safety & accident prevention and have received equipment operation guidance.
- Read and understand basic safety instructions and operations.
- You must have studied the relevant regulations and safety instructions and understand the possible hazards.
- Comply with relevant regulations and implement corresponding protective measures.

Safety Instructions

Prevent Electric Shock

-  Parts of the laser head such as nozzle, sensor, sensor interface and attached fasteners may not be fully protected by the ground wire due to function fault. These parts may have low voltage. When installing electrical equipment, please pay attention to taking anti electric shock measures for relevant personnel.
-  Note that the equipment shall be grounded as specified.

Guard against Danger

- Never put your hands or other body under the laser head.
- Repair and maintenance work can only be carried out after the power is turned off.
- Do not exceed the specified maximum pressure.
- It must be ensured that the laser head is in normal condition at all times.
- All fasteners such as bolts and nuts must be tightened.

 **Laser Caution**

- Avoid direct laser radiation or scattering to the skin.
- Do not stare at the laser beam even when wearing optical equipment.
- Use special laser protective eyeglasses that meet the requirements of safety standards IEC 60825-1.

Prevent Waterway Corrosion

- In order to avoid corrosion, use the specified coolant and comply with relevant requirements and specified maintenance intervals.

Noise Prevention

- The corresponding measures shall be specified or explained and observed in order to prevent personnel from being harmed by noise when the cutting air pressure is high.

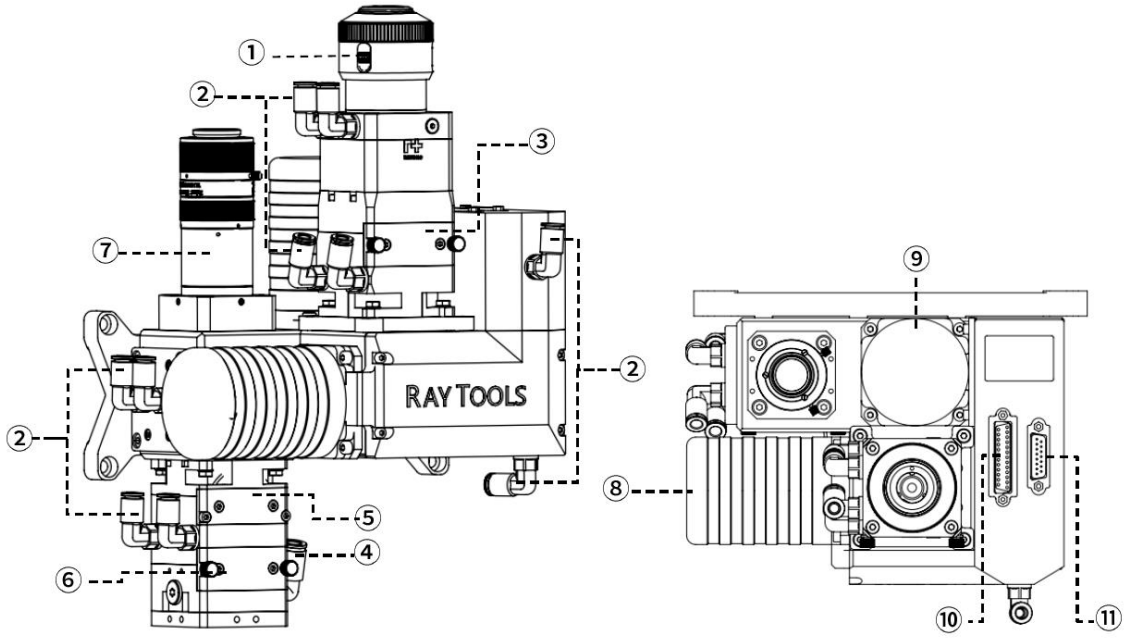
Storage and Transportation

- Observe the storage temperature range allowed by the technical data.
- Take reasonable measures to prevent fire, vibration or impact.
- Do not store in or near the magnetic field.

Contents

1 Product Summary

1.1 Structure (with QBH Interface)



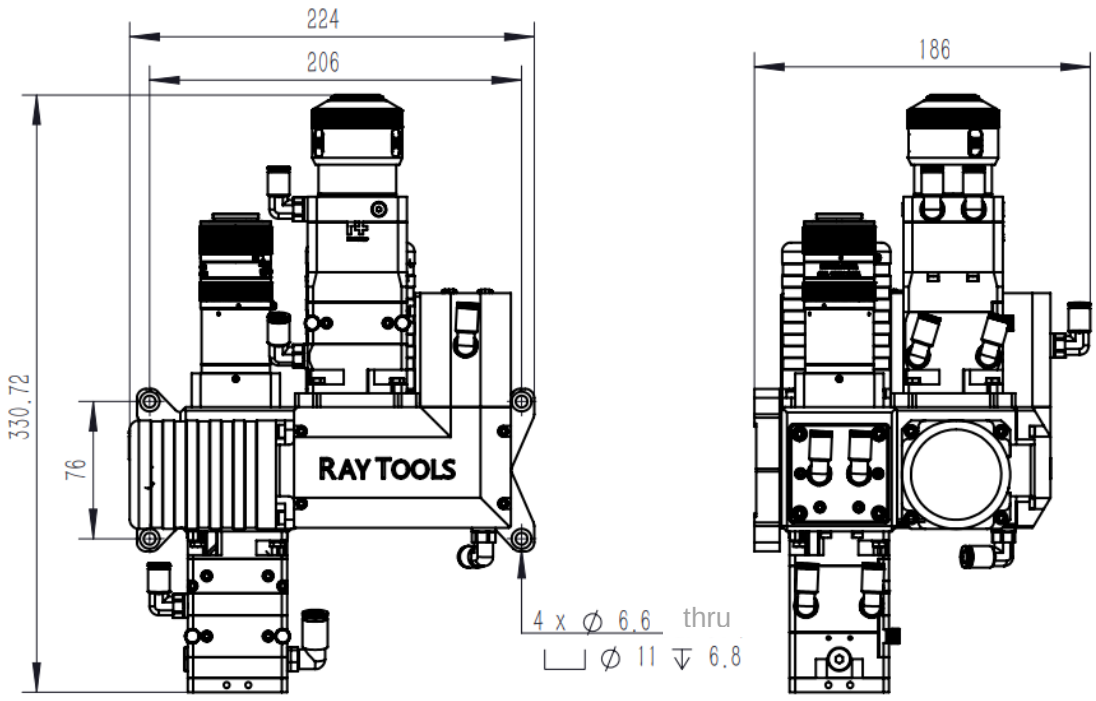
1 Fiber Interface
2 Water Cooling Interface
3 Top Cover Glass Holder
4 Assist Gas Interface
5 Focus Lens Holder
6 Bottom Cover Glass Holder
7 CCD Module
8 X-axis Motor Module
9 Y-axis Motor Module
10 DB25 Motor Signal Interface
11 DB15 Alarm Output Interface

1.2 Technical Datasheet

Model	BF04K
Wavelength	1064nm
Power Rating	≤4KW
Fiber Interface	QBH (standard) /QD (optional)
Clear Aperture	30mm
Collimation Length (fC)	100mm/125mm/150mm
Focusing Length (fF)	200mm/250mm/300mm/400mm
Cover Glass Specification	Ø37mm*5mm
CCD Module	C/CS interface
Water Cooling	Ø6mm
Assist Gas	Ø8mm
Size	323.3*160mm(F100)
Weight	~6.6kg
Power Supply	±15V,150W
Extensible Function	temperature detection of lens

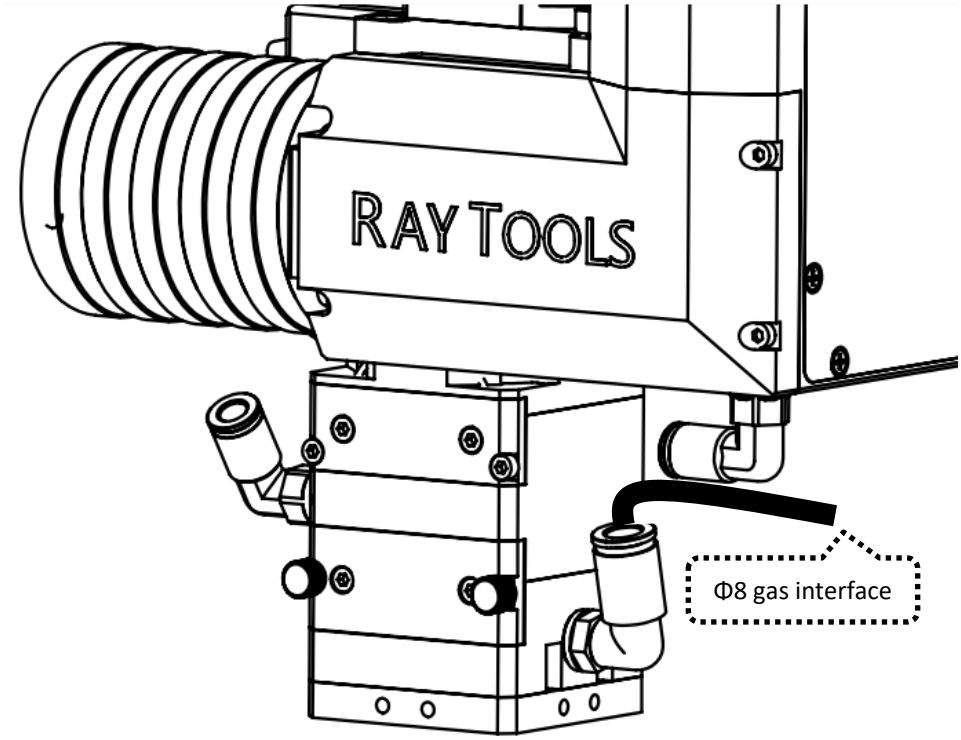
1.3 Mechanical Size

Collimation F100:
(Other specifications refer to appendix)

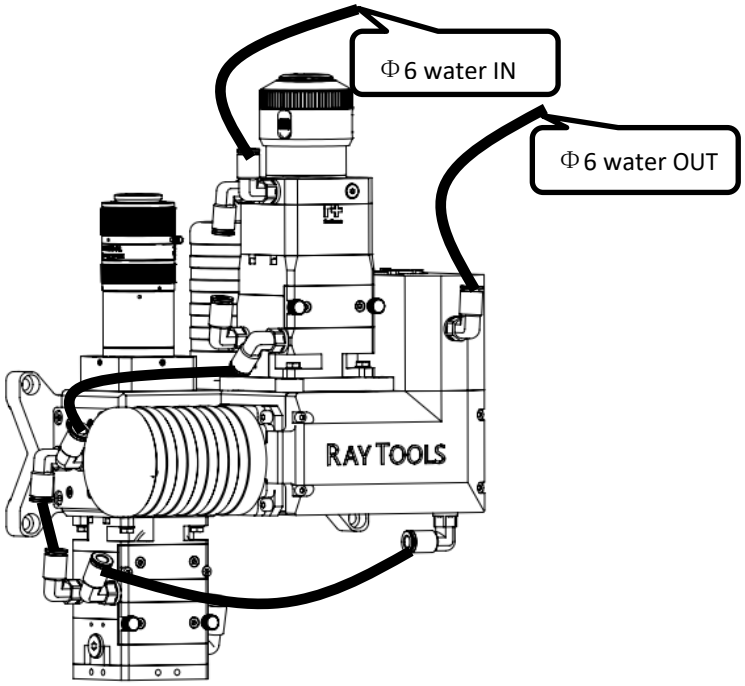


1.4 Connection of Assist Gas

Gas requirements:
Compressed air pressure: 0.4-0.6MPa
Nitrogen/Argon gas flow: 8-25L/min



1.5 Connection of Cooling Water



The coolant must be softened water, such as purified water, distilled water, or high-purity water.

Improper use of water may cause the following results:

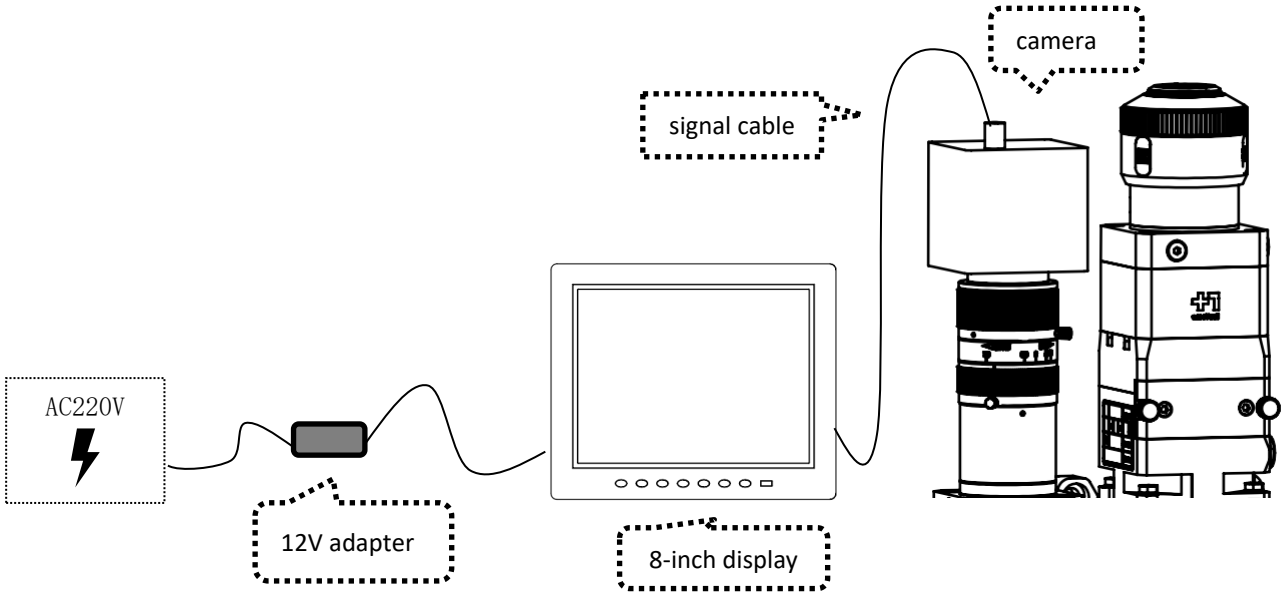
1. Scale formed by heating tap water or impure water at high temperatures will contaminate the laser head's internal structure and may cause damage.
2. Improper water can promote microbial growth in the water tank. These microbes can adhere to heat exchangers and lasers, reducing heat dissipation efficiency, causing block, and triggering high-temperature alarm.
3. If the water is too acidic or alkaline, it may corrode the cooling plates inside the laser.
   The resulting solid oxides may clog internal channel of the heat exchanger, leading to increased system pressure, potential leakage, and severe cooling capacity loss , even causing the laser to malfunction or shut down.

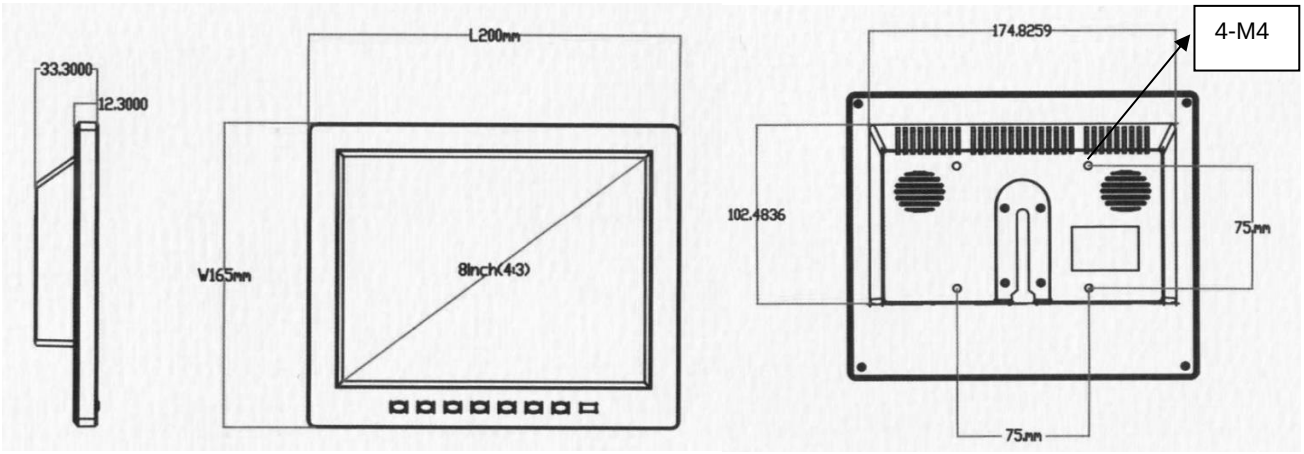
Cooling Method	Water Cooling	
Chillier Temp	Low-temperature water: Summer: 24℃-26℃	20℃-22℃
	Normal-temperature water: Summer: 28℃-30℃	24℃-26℃
	Add Antifreeze: cooling water temperature is 20℃.	
Water Pressure	2-6 bar	
Water Flow	2-4 L/min	
PH range	7.2 – 8.1	
Resistivity	⩾ 1 MΩ·cm (deionized water)	
Chloride ion	< 50 mg/L	

To prevent condensation, please adjust the temperature of the cooling water to room temperature.
Low-temperature cooling water is not allowed to cool the laser head!

1.6 Wiring

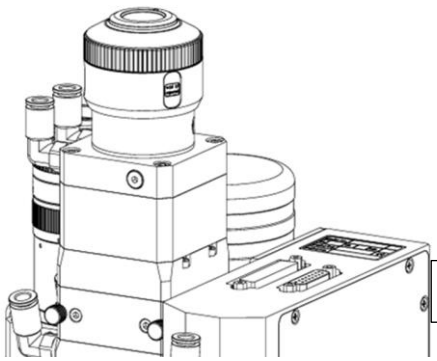
1.6.1 Connection of Display and Camera





Display Size

1.6.2 DB15 Interface



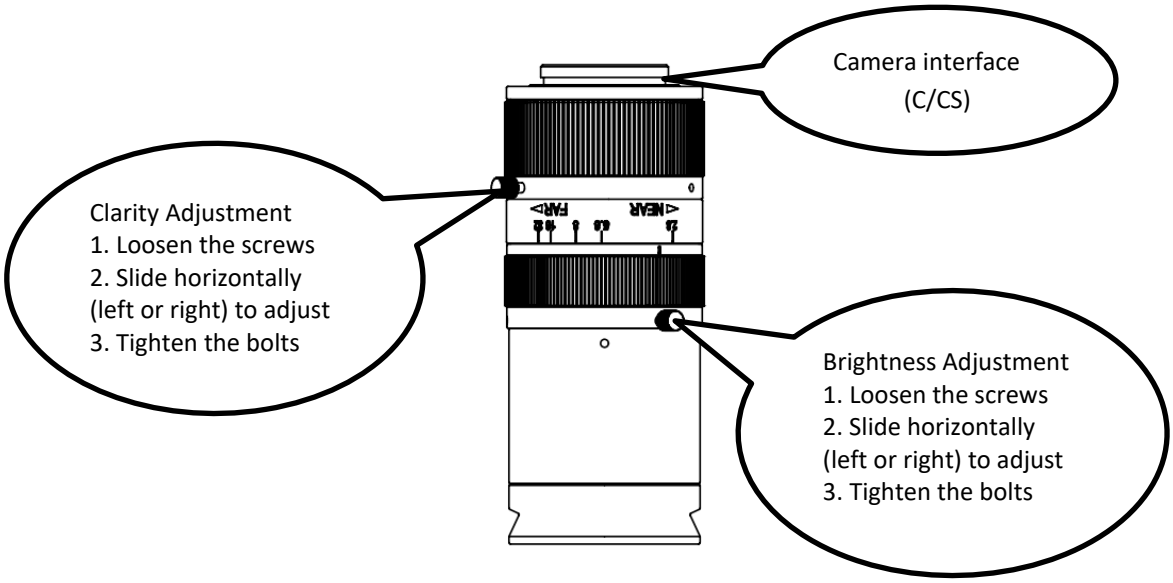
DB15 galvo alarm signal interface

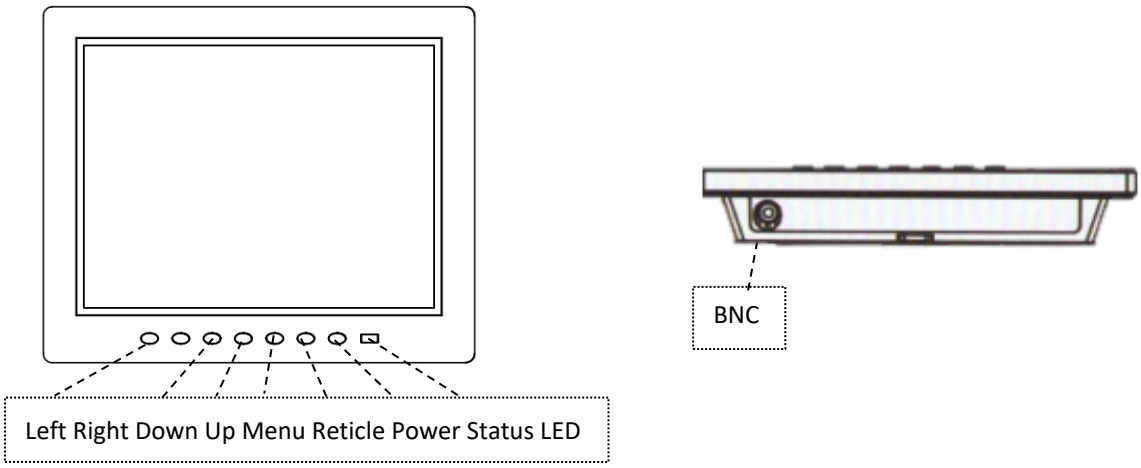
When an alarm occurs in the galvo driver, a signal is output through the DB15 interface.

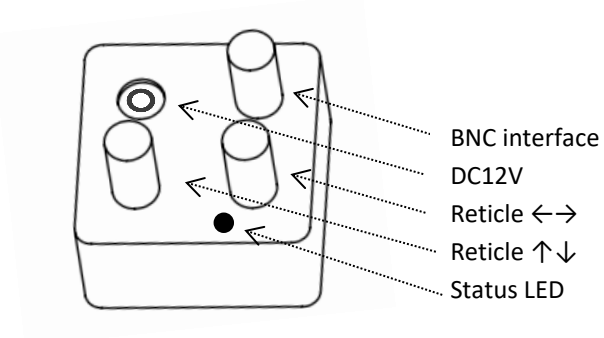
Normal: output 0V
Alarm: 0V output disconnected

DB15 Pin No.	Signal	Direction	Remark
1	VCC_24V	I	Optocoupler communication power supply input voltage: 24V
9	GND_24	I	Optocoupler communication power supply GND input voltage: 0V
2	PWR	0	Galvo power supply ±15V voltage status Normal:0V conductive; fault: disconnected
3	TMPE		Driver board temperature status (65℃) Normal:0V conductive; fault: disconnected
4	\		
5	\		
6	X_MOTOR		X motor signal status Normal:0V conductive; fault: disconnected
7	X_POS		Deviation between X-axis motor actual position and command ＜0.6V： 0V conductive; ＞0.6V:disconnected
8	\		Reserve
10	READY	0	Galvo ready signal output Normal:0V conductive; fault: disconnected
11	CMD	0	XY2-100 command signal receive status Normal:0V conductive; fault: disconnected
12	ERR	0	Inverted relative to Pin 10 READY
13	Y_MOTOR		Y motor signal status Normal:0V conductive; fault: disconnected
14	Y_POS		Deviation between Y-axis motor actual position and command ＜0.6V： 0V conductive; ＞0.6V:disconnected
15	\		

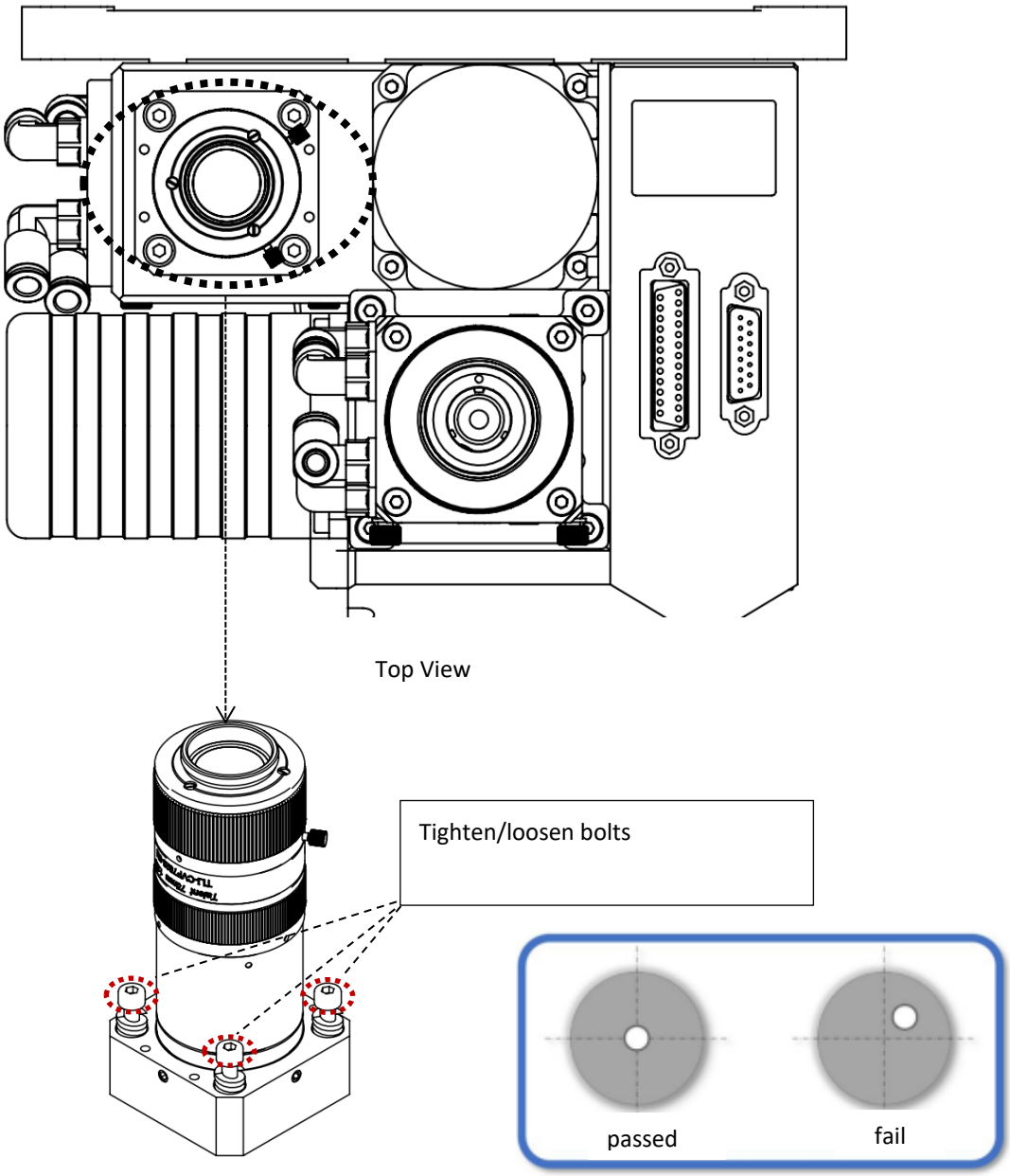
1.7 HMI Panel and Camera Interface





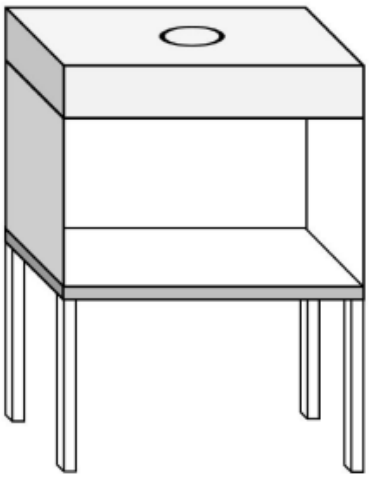


1.8 Field Center



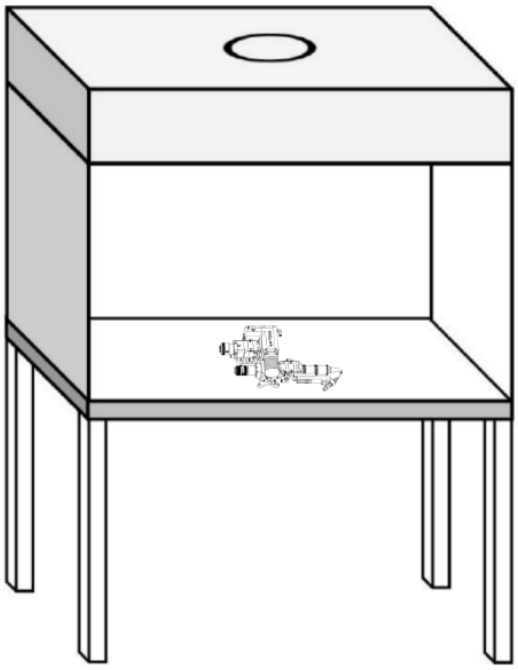
2 Mechanical Installation

1. Prepare the clean bench:
- Turn on the clean bench.
- Clean the surface of the clean bench.
- Lower the glass door, leaving a 10 cm gap.
- Run the device for 30 minutes

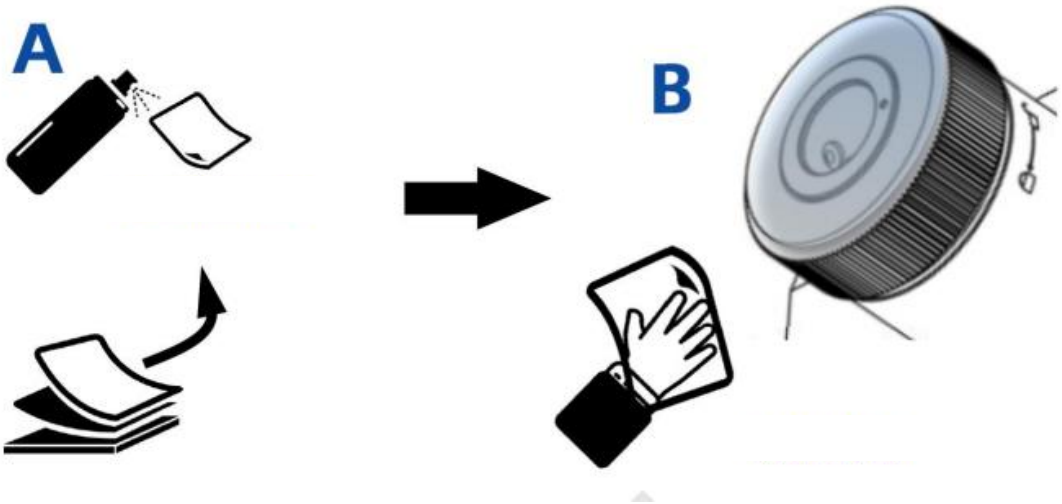


Type: Vertical Laminar Flow
Cleanliness Class: ISO Class 5 / Class 100
Average Air Velocity: ⩾ 0.4 m/s

2. Place the laser head on the clean bench horizontally.



3. Wipe with a dust-free cloth moistened with absolute ethanol.



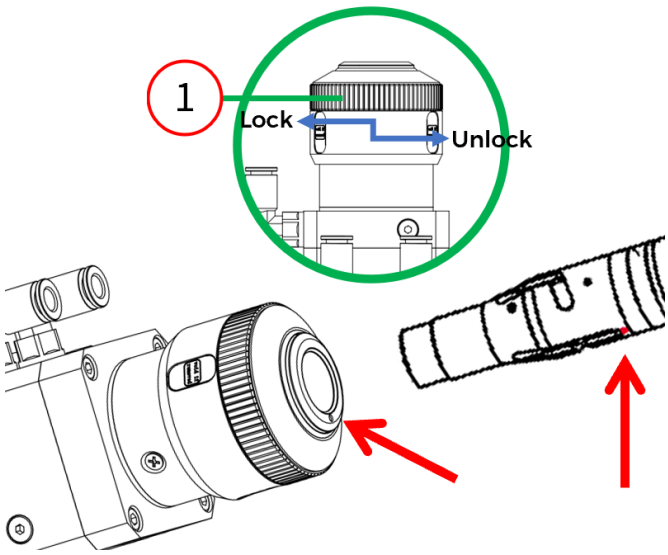
4. Check the cleanliness of the fiber

Mount the fiber connector onto the microscope

Use a clean cotton swab to wipe the cover glass

2.1 QBH Fiber Insertion

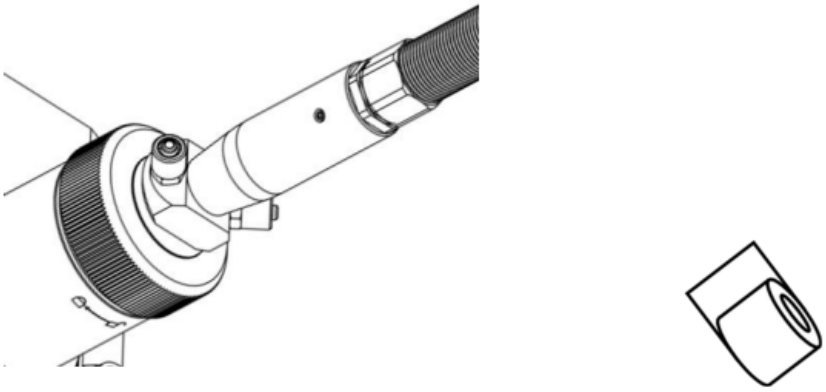
WARNING: The optical components must be dust free and all dusts must be cleaned before use. The fiber shall be horizontally inserted into fiber interface to prevent dust from entering the interface and falling on the surface of the lens. Upper limit in the fiber before fixing the laser head.



- Rotate QBH locking ring (1) in the direction of the arrow to unlock (Rotate counterclockwise 45°, press down the locking ring, then rotate 45° counterclockwise again.).
- Make sure that the fiber is dust free.
- Align the red mark of male fiber end to red mark on female QBH of laser head when you insert the fiber end straightly to bottom of QBH interface of laser head.
- Turn the QBH handwheel clockwise. It is in place when you hear the "Da" voice, then pull the handwheel up and turn clockwise to end.

2.2 Wrap with Protective Film

To ensure effective sealing, it is recommended to wrap the tape around at least three full turns .



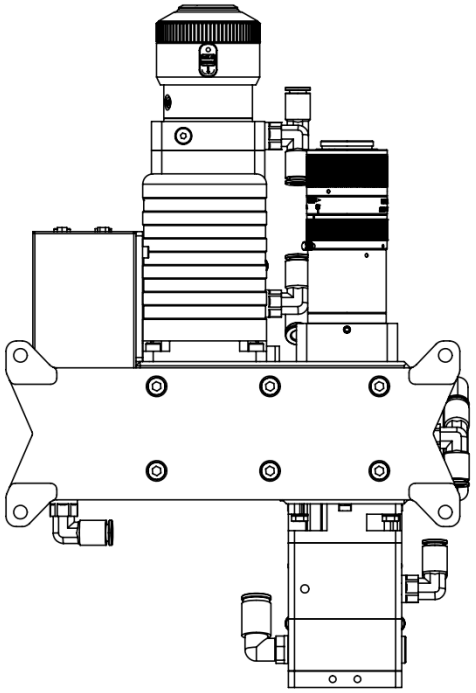
2.3 Mounting of Laser Welding Head

Mount the laser head using 4× M6×16 bolts (1-4) on the machine base or robot back panel. Ensure that the head is firmly locked in place with no vibration before use.

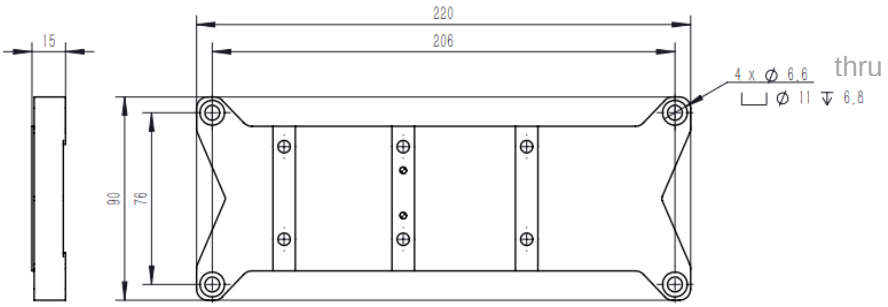
Make sure there is good electrical insulation between the machine and the laser head, to prevent electrical interference, short circuits, or signal transmission issues.

Insulating pad/washer
Use insulating pads made of high-temperature and corrosion-resistant materials such as ceramics, PTFE (Teflon), mica, or special engineering plastics, placed between the contact surfaces of the laser head and the machine.

Insulating sleeve
Install insulating sleeves (made of nylon or ceramic) over the bolts to prevent direct metal contact between the bolts and the laser head.



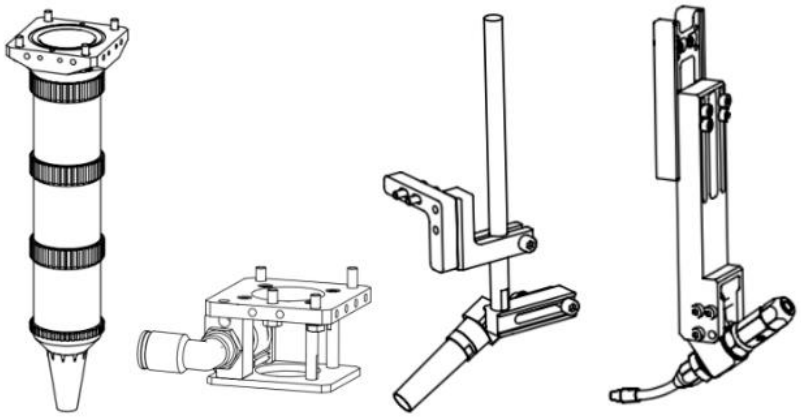
Rear View



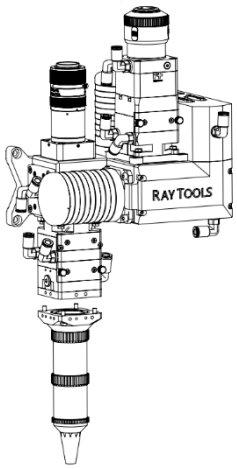
2.4 Mounting of Tip Assembly (Optional)

Before installation, confirm that coaxial air-blow assembly, side-blow assembly and wire feeding assembly are complete.

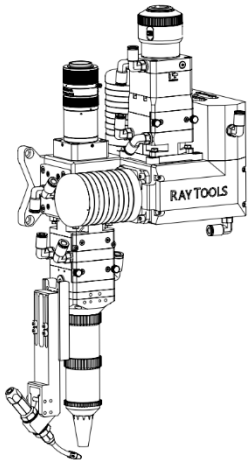
From left to right: F300 coaxial air-blow assembly, air knife assembly, side-blow assembly and wire feeding assembly,



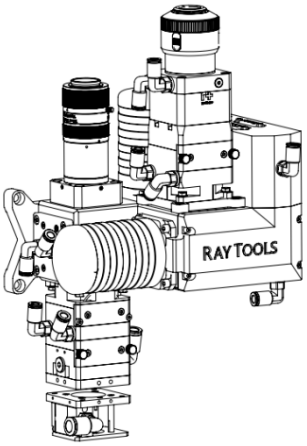
Installation method:



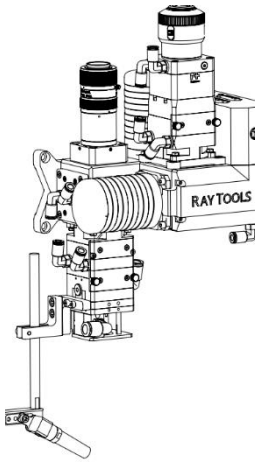
F250 coaxial air-blow assembly



F250 coaxial air-blow
+wire feeding assembly



air knife assembly



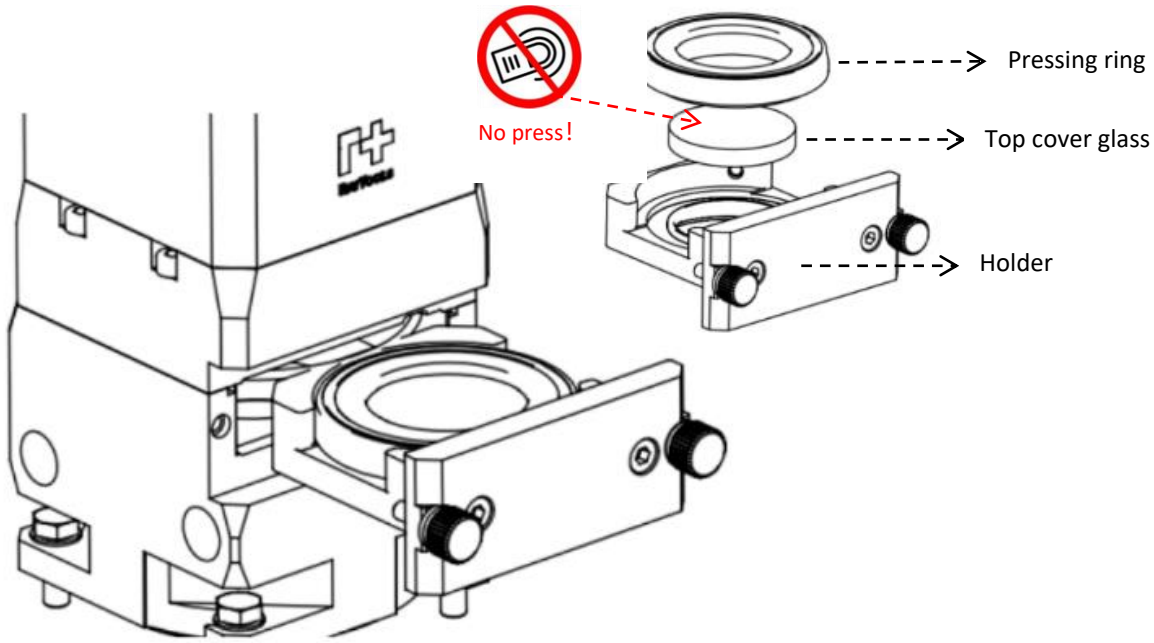
air knife + side-blow assembly

3 Maintenance

3.1 Removal and Installation of Lenses

The whole process needs to be completed in a dust free room. Wear dust-proof gloves or fingertips when removing or installing the lenses.

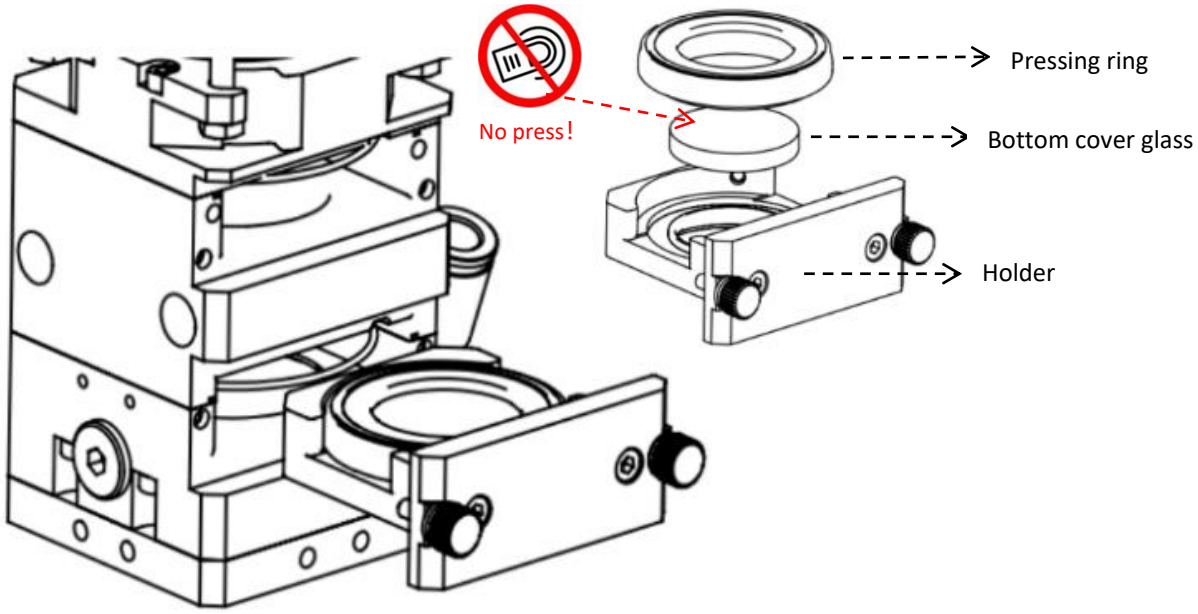
3.2 Removal and Installation of Top Cover Glass/Protection Glass



- As shown above, loose the bolts to pull out cover glass holder by pinching 2 edges of drawer type holder.
- Seal the mounting openings by textured tape immediately.
- Remove the pressing ring and cover glass after wearing fingertips
- Clean the cover glass holder.
- Install the cleaned or new cover glass (regardless of the front or back surface) into the holder of cover glass.
- Install the pressing ring.
- Insert the cover glass holder back to the laser head and tighten the bolts.

It is not allowed to pull out the edge of seal ring directly as it is very easy to damage the seal ring. Please wear the clean gloves or fingertips.

3.2.1 Removal and Installation of Bottom Cover Glass/Protection Glass

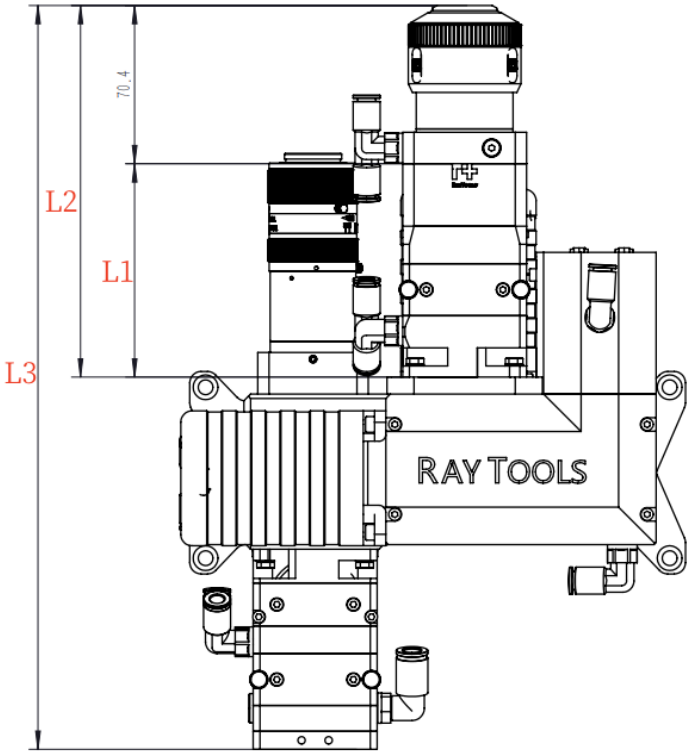


- As shown above, loose the bolts to pull out cover glass holder by pinching 2 edges of drawer type holder.
- Seal the mounting openings by textured tape immediately.
- Remove the pressing ring and cover glass after wearing fingertips
- Clean the cover glass holder.
- Install the cleaned or new cover glass (regardless of the front or back surface) into the holder of cover glass.
- Install the pressing ring.
- Insert the cover glass holder back to the laser head and tighten the bolts.

It is not allowed to pull out the edge of seal ring directly as it is very easy to damage the seal ring.
Please wear the clean gloves or fingertips.

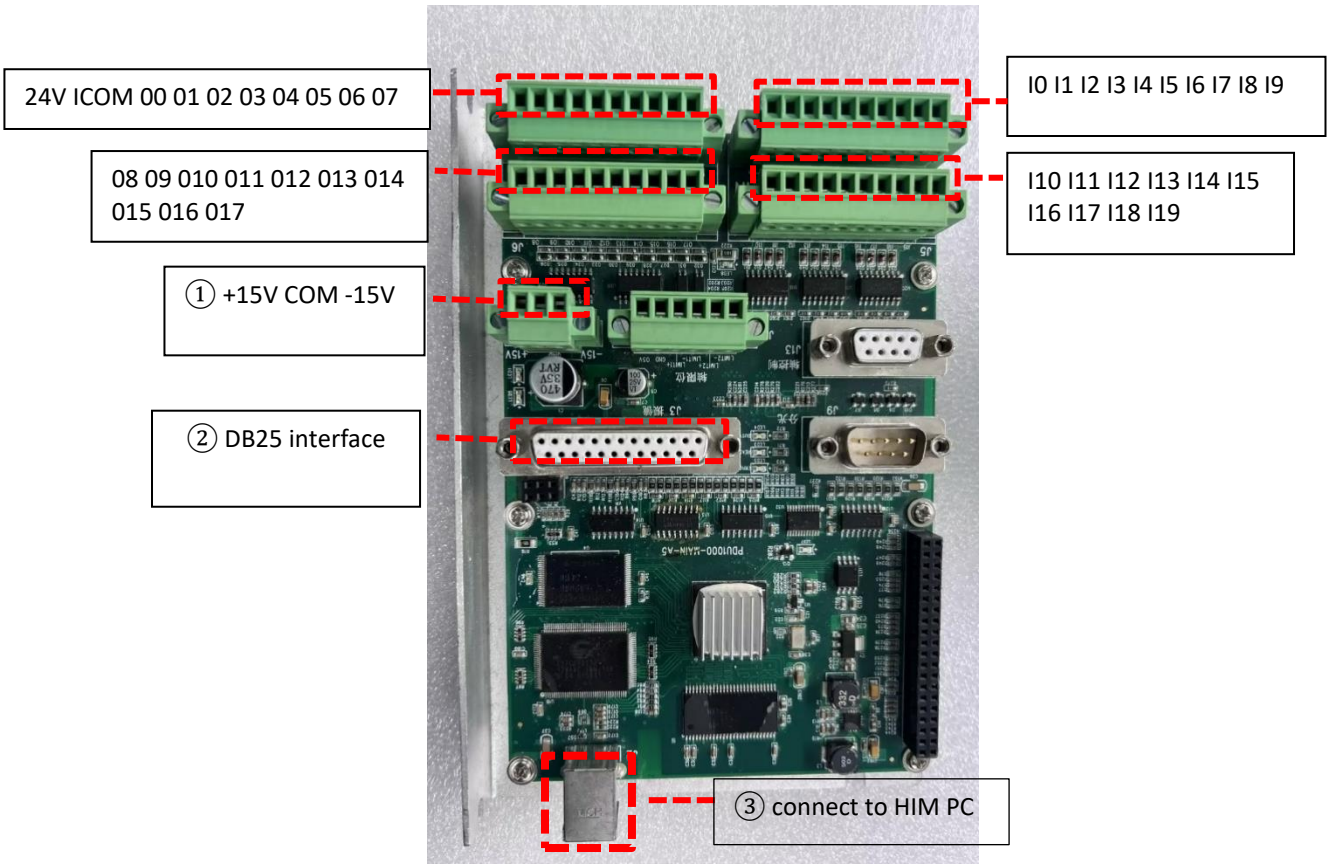
4 Appendix

4.1 Mechanical Size



Collimation Length (fC)	L1(mm)	L2(mm)	L3(mm)
F100	94.9	165.3	330.8
F125	119.4	189.8	355.3
F150	145.6	216	381.5

4.2 Use Guide of Control Card and Welding System



Power supply interface: used for power supply of control card and galvo.
DB25 female interface: used for galvo control and power supply of galvo.
Signal interface: USB2.0, communication interface between control card and HMI PC.

DB25 female interface (J3) definition:

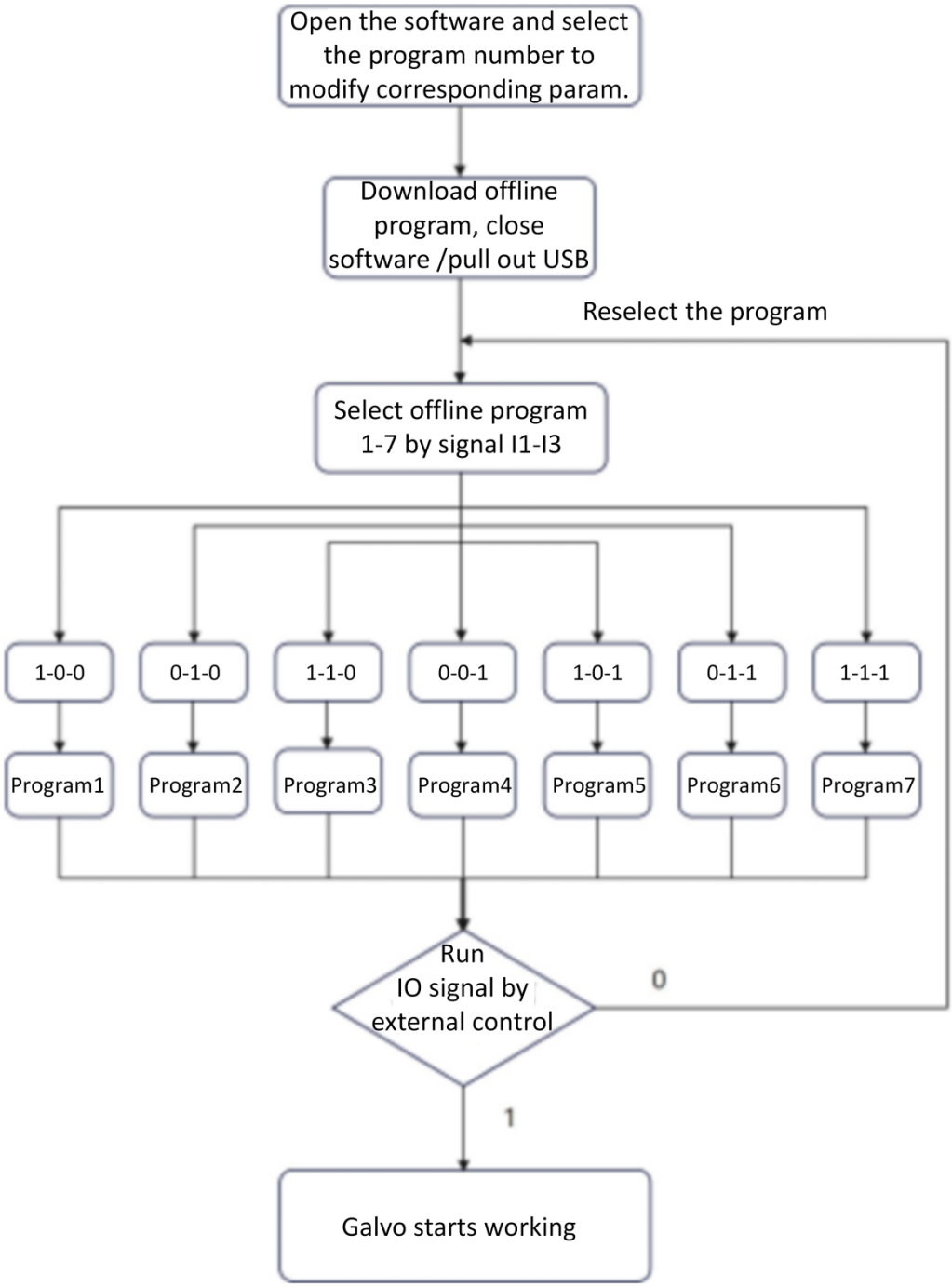
Pin No.	Signal	Definition		Pin No.	Signal	Definition
1	Clk-	Clock -		14	Clk+	Clock +
2	Sync-	Synchronizing -		15	Sync+	Synchronizing +
3	X_data-	X galvo -		16	X_data+	X galvo +
4	Y_data-	Y galvo -		17	Y_data+	Y galvo +
5	X_fb-	X galvo feedback -		18	X_fb+	X galvo feedback +
6	Y_fb-	Y galvo feedback -		19	Y_fb+	Y galvo feedback +
9/10/22	+15V	Galvo power supply +15V		11/23/24	GND	GND
12/13/25	-15V	Galvo power supply -15V		7/8/20/21	NC	Spare

I/O module function definition:

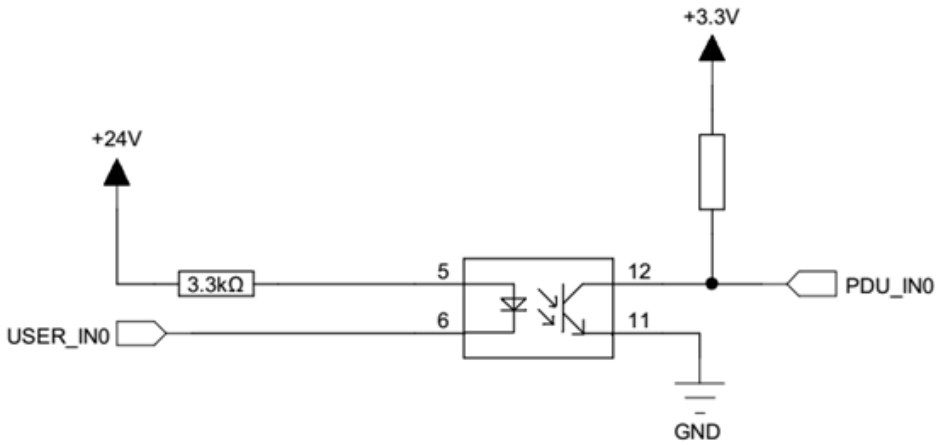
Signal	Type	IO No.	Definition	Signal Type
Running	Output	Out0	In running status	NPN
Error	Output	Out2	Running error of motion card	NPN
STOP	Input	I19	Emergency stop	NPN
Run	Input	I0	Trigger offline mode	NPN
DocApply	Input	I1~I3	Select offline program	NPN
I24V	Input	I24	I/O power supply	/
ICOM	Input	ICOM	I/O GND	/

1. Signal I1~I3 and external operation signal are NPN input active.
2. The galvo starts working when external operation signal inputs, and stops working when not inputting signal.
3. When the external operation signal is closed, the modification of offline program takes effect.

IN3	IN2	IN1	Program No.
0	0	0	0
0	0	1	1
0	1	0	2
0	1	1	3
1	0	0	4
1	0	1	5
1	1	0	6
1	1	1	7

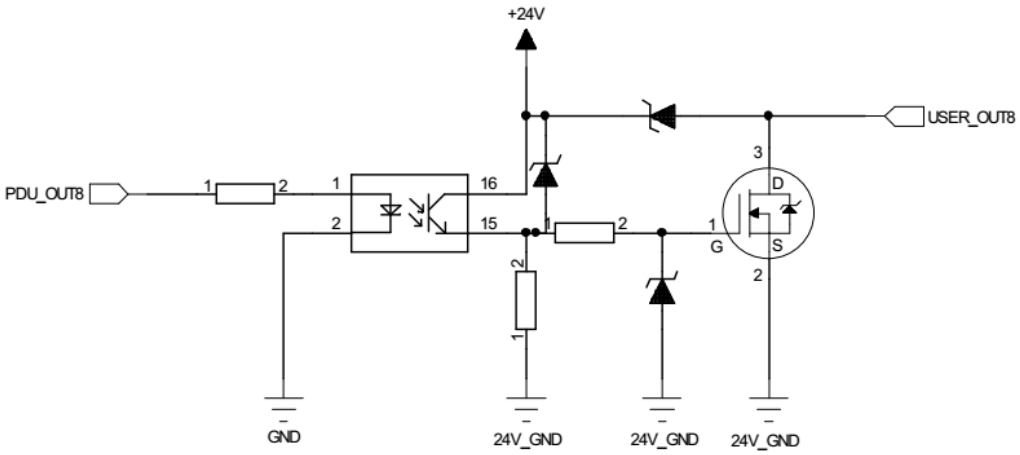

Open the software and select the program number to modify corresponding param.
Download offline program, close software /pull out USB
Reselect the program
Select offline program 1-7 by signal I1-I3
1-0-0
0-1-0
1-1-0
0-0-1
1-0-1
0-1-1
1-1-1
Program1
Program2
Program3
Program4
Program5
Program6
Program7
Run IO signal by external control
0
1
Galvo starts working

General I/O Input Circuit Diagram:



- The current shall be more than 2.5mA under NPN in order to receive signals normally (VCC-VinL>8V). The VinL shall be less than 15V if the power supply is 24V.
- The current shall be less than 0.25mA under PNP in order to receive signals normally (VCC-VinH<0.8V). The VinH shall be more than 23.2V if the power supply is 24V.

O0-O7 outputs 500mA with circuit diagram as shown below:



4.3 System Debugging by Internal Control

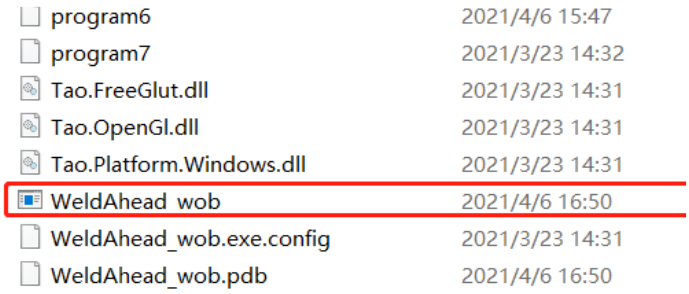
4.3.1 Communication Setting

Confirm system 64-bit or 32-bit to select driver.

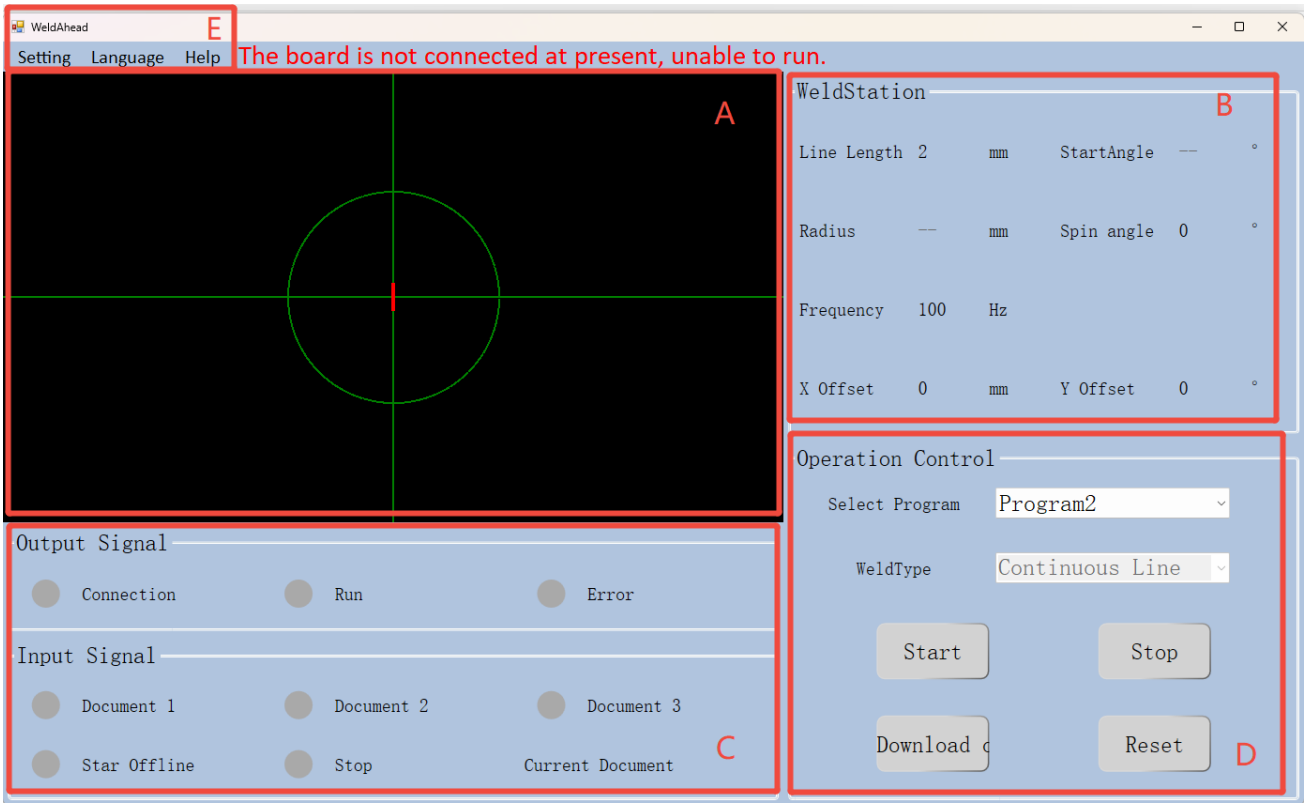
1. Unzip the software package.
2. Open the target folder.
3. Connect the control card to HMI PC.
4. Find out the path/V6 in the target folder.
5. Run the X64 (64-bit system) or X86 (32-bit system).
6. Open the installation package of driver and install drive program of galvo control card.
7. Drive program is installed completely. The card can be controlled by the software.

4.3.2 Startup

Open the folder: WOB and double-click on Debug. Select the software.



4.3.3 Main Interface



A. Welding Path Preview: to observe the set moving path.

B. Welding Status: to observe the set parameters.

C. System Status: to monitor the I/O signal status.

D. Operation Control : to select program number and buttons like “Start”, “Stop”, “Download offline” and “Reset”.

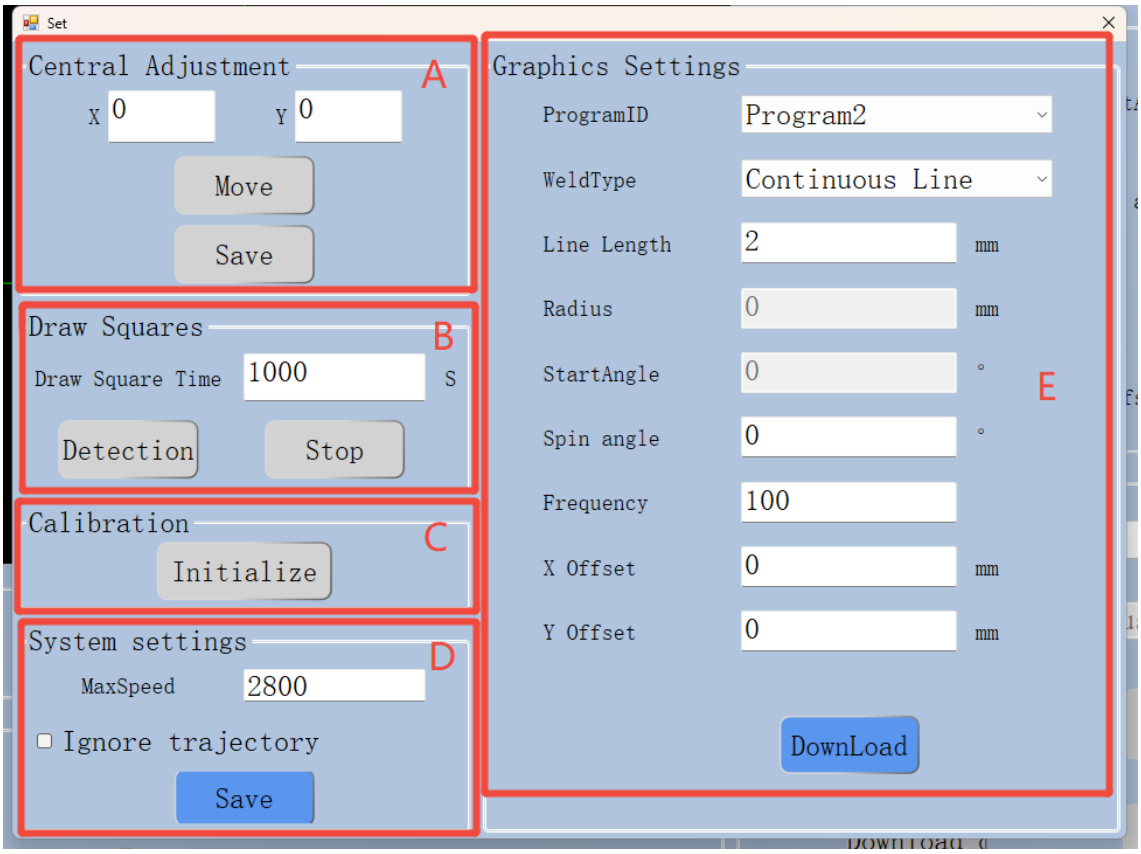
Start: activate galvo system to run set path.
Stop: stop the control of motion card.

Download offline: download all paths into the motion card.
Note: The downloaded paths will overlap the early downloaded and current paths. Ensure all set paths correct prior to download. The download may take some time and please keep patient.

Reset: clear the alarm when the error occurs to motion card.
Note: further operation is prohibited before the alarm is cleared by reset.

E. Menu: to set path parameters, do the calibration, select the language, and search for help.

4.3.4 Parameter Setting Interface



A. Center Adjustment: set the graphic center and laser beam alignment.

- Adjust the red beam to the center of air knife by adjusting X/Y value.
- Click “Move” to get beam spot reaching X/Y location.
- Click “Save” to record the center coordinate.

B. Draw Square: adjust the graphic size at focus point and calibrate the graphics size.

- Click the “Detection” button by red beam after the focus point is determined. It will draw a square.
- Check if it is a 4x4mm square. If not, to measure square size and fill the values (Length-X, Width-Y, with accuracy 0.1mm) into the auto calibration and save it.
- Draw square again to confirm if it is correct.

C. Calibration: clear the setting from center adjustment and draw square detection. Initialize to default calibration data.

D. System Setting

- Max Frequency: to set the max frequency as per required path to avoid position offset alarm.
- Ignore trajectory constraints: default path cannot be more than a circle with radius 5mm. If checking this option, the limit(constraint) is invalid.

E. Graphic Setting

- Program ID: set parameter ID (Program1- Program 7).
- Weld Type: set wobbling path, including continuous line, continuous circle, continuous 8 shape, continuous C type, continuous S type and continuous square type.

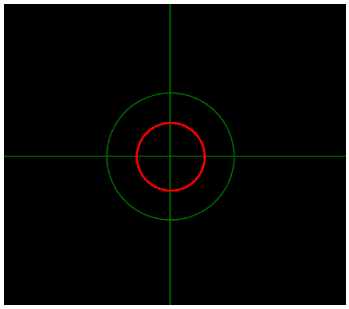
4.3.5 Welding Type and Parameter Setting

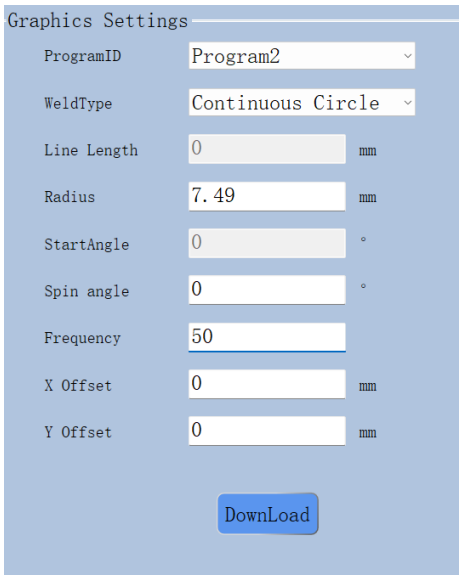
1. Continuous Circle

Set the diameter, frequency and X/Y offset (the offset adjustment is used to modify the position of circle center).

- Diameter: max. 10mm
- Relation between max. Frequency and Diameter: Frequency ≤ 2800÷Diameter÷π

Click “Download” after the setting is completed.



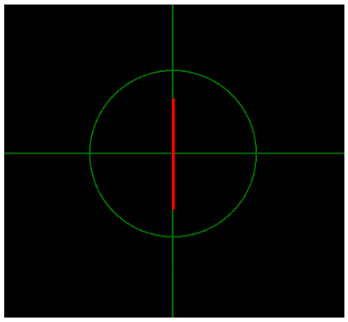


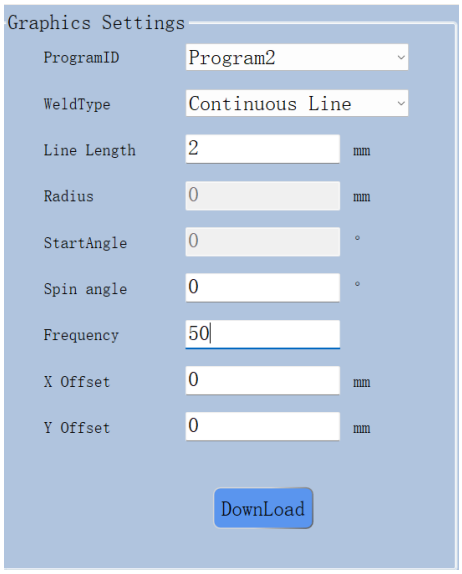
2. Continuous Line

Set the line length, frequency, spin angle and X/Y offset.

- Line length: max. 10mm
- X/Y Offset Range: ±5mm (modify according to the requirement)
- Relation between Frequency and max. Length: Frequency ≤ 2800÷Line length÷2

Click “Download” after the setting is completed.



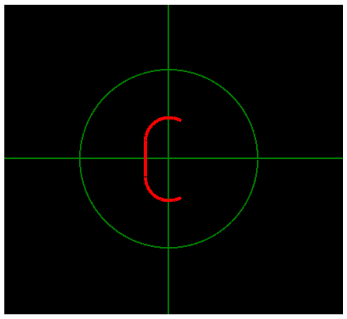


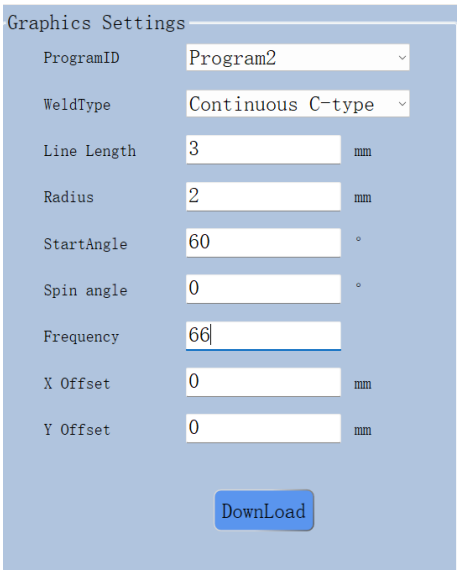
3. Continuous C Shape

Set the line length, diameter, frequency, spin angle and X/Y offset.

- Sum of Arc Length and Diameter: max. 10mm
- X/Y Offset Range: ±5mm (modify according to the requirement)

Click “Download” after the setting is completed.



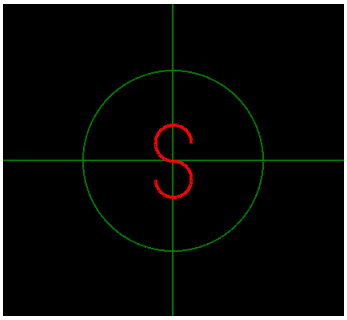


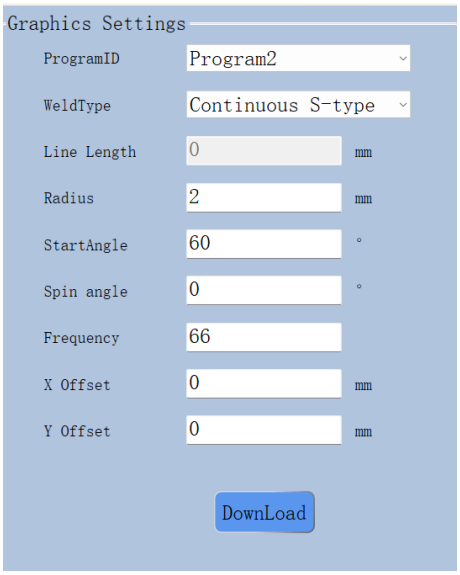
4. Continuous S Shape

Set the radius, frequency, spin angle and X/Y offset.

- Arc Diameter: max. 5mm
- X/Y Offset Range: ±5mm (modify according to the requirement)

Click “Download” after the setting is completed.



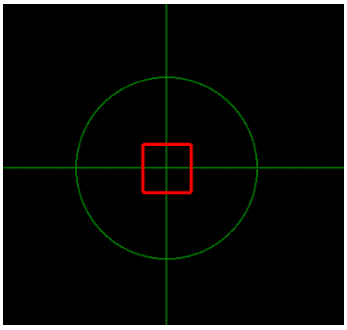


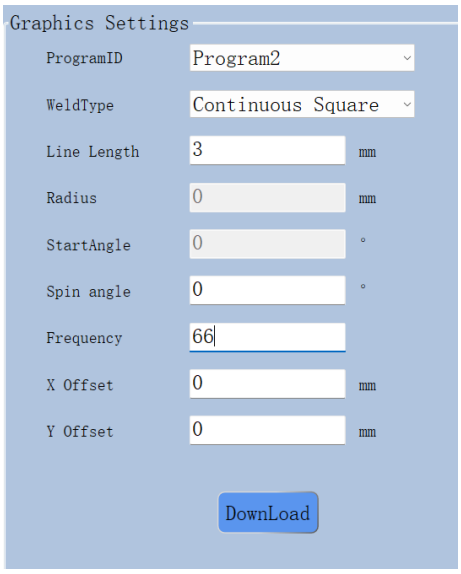
5. Continuous Square

Set the line length, spin angle, frequency and X/Y offset.

- Line Length: max. 10mm
- X/Y Offset Range: ±5mm (modify according to the requirement)

Click “Download” after the setting is completed.



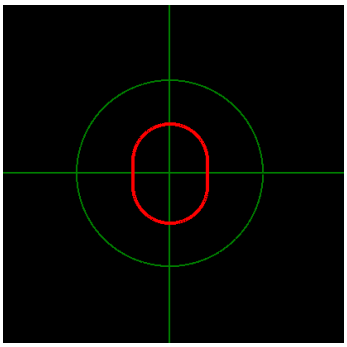


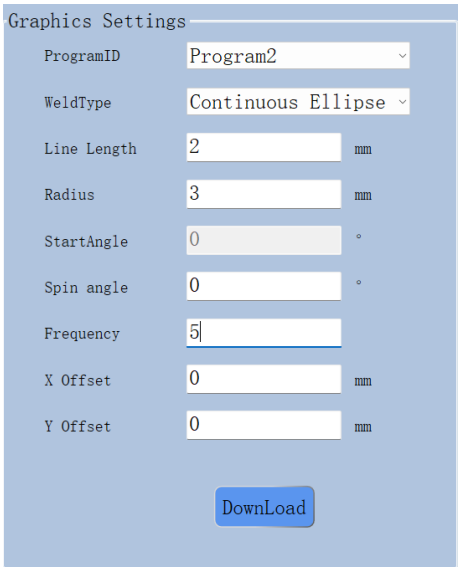
6. Ellipse

Set line length, radius, spin angle, X/Y offset and frequency.

- Line Length: max. 10mm
- Arc Length: max. 5mm
- X/Y Offset Range: ±5mm (modify according to the requirement)

Click “Download” after the setting is completed.



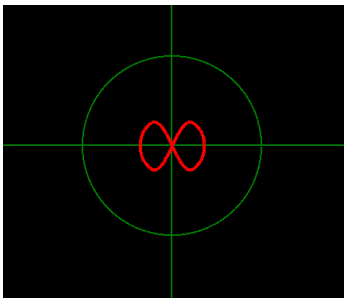


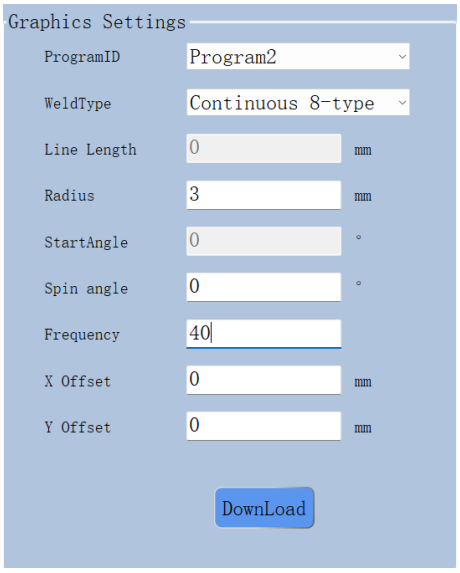
7. 8 Shape

Set arc radius, frequency, spin angle and X/Y offset.

- Arc Radius: max. 5mm
- X/Y Offset Range: ±5mm

Click “Download” after the setting is completed.





4.3.6 Internal and External Control Mode

Internal Control

Control the laser head by BF04K software. Select program 1-7 and click “Start” and “Stop”.

External Control

1. Download offline will download program 1 to 7. Ensure the correct path before download.
2. Offline running can be used after downloading offline.
3. Offline program could be selected by I1 to I3. The offline shall be triggered after the offline program is selected. While offline program is running, it is invalid to change unless it is stopped and select a new offline program to start a new offline running.
4. If not input program selection signal, it will trigger program 0 to do homing.
5. Ensure the software is closed when operating in external control mode.

Notice: When using external control offline, trigger program 0 first and turn off it, then select other offline programs.