SmartShop Fiber Laser DLP

LAGUNA

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Scope of This Manual

This manual outlines the basic procedures for SmartShop Fiber Laser DLP.

For detailed instructions and video, please go to www.lagunatools.com.

Customer Service

For technical support, please contact Laguna Tools:

By phone at 1-800-332-4094, or

Email Customer Service at customer_service@lagunatools.com. Please note the machine type in the subject line.

Revision 02 (10/##/2022)

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1.0 General Information and Safety

1.1 Overview

Please read and understand the entire owner's manual before operating the machine. Contact Laguna Tools with any concerns or questions before operation.

1.2 Safety Signs and Call-Outs

DANGER

An imminently hazardous situation which, if not avoided, will result in death or serious injury.

CAUTION

A potentially hazardous situation which, if not avoided, could result in death or serious injury.

WARNING

A potentially hazardous situation which, if not avoided, may result in minor or moderate injury.

NOTE

A helpful tip from our technical staff. Sometimes displayed as NOTICE instead.

1.3 Safety Requirements

Before operating the machine or performing routine maintenance, the operator must carefully read and understand this manual and comply with all safety precautions.

1. Personnel responsible for safety will determine the scope of duties for the operator of the SmartShop Fiber Laser DLP and provide training for the safe operation of the machine.
2. Designate a safe operating area for the SmartShop Fiber Laser DLP and post warning signs at the entrance and exit to this area. Warning signs should include laser processing power, laser type, prohibition of non-essential personnel, requirements for eye protection, and the name(s) of safety personnel.
3. The operator(s) of the SmartShop Fiber Laser DLP must be fully trained before operation of the machine.
4. The eyes and skin are most susceptible to injury by the machine laser. Burns may result if personnel are directly exposed to the laser. Avoid placing any part of the body in working light path of the laser device.
5. It is the responsibility of the customer to follow all laws and regulations dictated by state, local, and federal agencies. The requirements laid out by OSHA and the FDA are the customers' responsibility. These are facility requirements and are not guided or monitored by Laguna personnel.

1.4 Laser Safety Precautions

1. All personnel involved in the operation of the SmartShop Fiber Laser DLP must wear proper eye protection (safety glasses with a wavelength of 1064 µm or above).
2. In the area where the safety glasses are worn, there must be proper illumination to ensure safe operation by personnel.

⚠ CAUTION

Do not place any part of the body under the beam as it may result in serious or life-threatening injury.

3. Personnel should never face the aperture from which the laser is emitted.

4. When the shutter is open, all personnel, tools, and other objects should be removed from the path of the laser.
5. The operator should never leave during the operation of the machine.
6. If the operator notes any abnormality during operation, the machine should be immediately shut down using the Emergency Stop button.
7. The water temperature and auxiliary gas pressure should be monitored during use.

1.5 Laser Safety Protection

1. Observe all safety operation procedures.
2. Untrained personnel should never operate the SmartShop Fiber Laser DLP.
3. The SmartShop Fiber Laser DLP is a Class IV laser product. The fiber laser is not visible during operation.
4. The beam emitted by the lens, the reflection of the lens, and the diffuse reflection of the light may cause injury (especially to eyes).
5. All personnel involved the operation of the laser must wear safety glasses.

⚠ CAUTION

Exhaust gas generated during laser cutting can be harmful. Ensure that the dust collection device is working and properly ventilating the area.

1.6 Electrical Safety Precautions

⚠ CAUTION

Do not operate any switches with wet hands as electrical shock may result.

⚠ CAUTION

Use caution when operating or repairing high-voltage components such as the servo motor, transformer, and electrical cabinet door, etc.; electrical shock from high-voltage components can cause serious injury or death.

1. Review the Operator's Manual and electrical schematics thoroughly before operation.
2. Do not change the machine parameters. Changes must be approved and performed by Laguna Tools technicians. Parameter values should be recorded in the event the original must be restored.
3. Do not touch live components in the electrical cabinet during power-on (i.e., numerical control devices, servos, transformers, fans, etc.).

1.7 Post Operating Safety Procedures

1. Do not touch the terminal for at least five (5) minutes after powering down as a high voltage remains in the power line terminals even after power is removed.
2. Flammable and explosive materials should be removed from the work area prior to operations to reduce fire risks. Ensure a fire extinguisher or other fire prevention equipment is in place.

2.0 Preparation Materials Before Installation

Number	Name	Specification	Unit	Quantity	Notes(s)
1	Deionized Water/ Distilled Water/ Purified Water	18 Liters/Barrel	Liter	4	1. 500W-1500W: 40 liters 2. 2000W-3000W: 70 liters 3. 4000W: 120 liters 4. 6000W: 160 liters
2	Nitrogen	Nitrogen purity ≥99.9%	Batch	1	Not less than four (4) bottles.
3	Oxygen	Oxygen purity ≥99.9%	Batch	1	Not less than two (2) bottles.
4	Air Switch	4P/AC380V/63A	Piece	1	Machine Mains Power
5	Air Switch	3P/AC380V/50A	Piece	1	Chiller
6	Air Switch	3P/AC380V/32A	Set	1	Exhaust Fan
7	Power Supply	20KVA~100KVA~AC380V	Set	1	Laster Cutting Machine Power Input 1. 500W-750W: 20KVA. 2. 1000W-1500W: 30KVA. 3. 2000W-3000W: 50KVA. 4. 4000W: 80KVA. 5. 6000W: 100KVA.
8	Air Compressor	Need to remove oil and remove water.	Set	1	Output pressure ≥ 2Mpa.

Number	Name	Specification	Unit	Quantity	Notes(s)
9	Dryer	High precision oil water separator.	Set	1	
10	Ground Pin	Copper or Galvanized, length > 1.5 m, diameter > 15 mm.	Piece	3	The machine host needs 2 pieces; laser source need 1 piece.
11	Vaporizer	Meter/Minute, withstand Voltage 4.0 MPA.	Piece	2	Used in combination with liquid nitrogen and liquid oxygen.
12	Nitrogen Pressure reducing valve (used abroad)		Piece	1	Enter >=15MPa, Output: 0.2~3.0M
13	Oxygen pressure reducing valve (used aboard)		Piece	1	Enter: >15Mpa, Output: 0.05~1.5M

2.1 Assist Air Overview

Oxygen

37-353 SCFH @ 140 PSI

18 – 168 L/min @ 10 Bar

Nitrogen

323 – 3000 SCFH @ 300 PSI

151 – 1425 L/Min @ 20 Bar

These calculations are range from minimum to maximum assist gas consumption. There are hundreds of variables that will be associated with gas consumption. Nozzle, material, and finish edge quality. Pre- or post-gas dwell, pierces and pierce height, feed-rate most of these can be

changed to limit consumption as well as nozzle sizes. Single and dual stage regulators will affect this. Thinner gauge material does not require a lead or pierce time.

NOTE

All air switches above are recommended without leakage protection. If the leakage protection function is provided, the rated leakage protection current shall not be less than 300ma and it is recommended to be 500mA or more. A rated leakage protection current of less than 300 mA may cause leakage protection to trip.

2.2 Workshop Size Preparation Before Installation

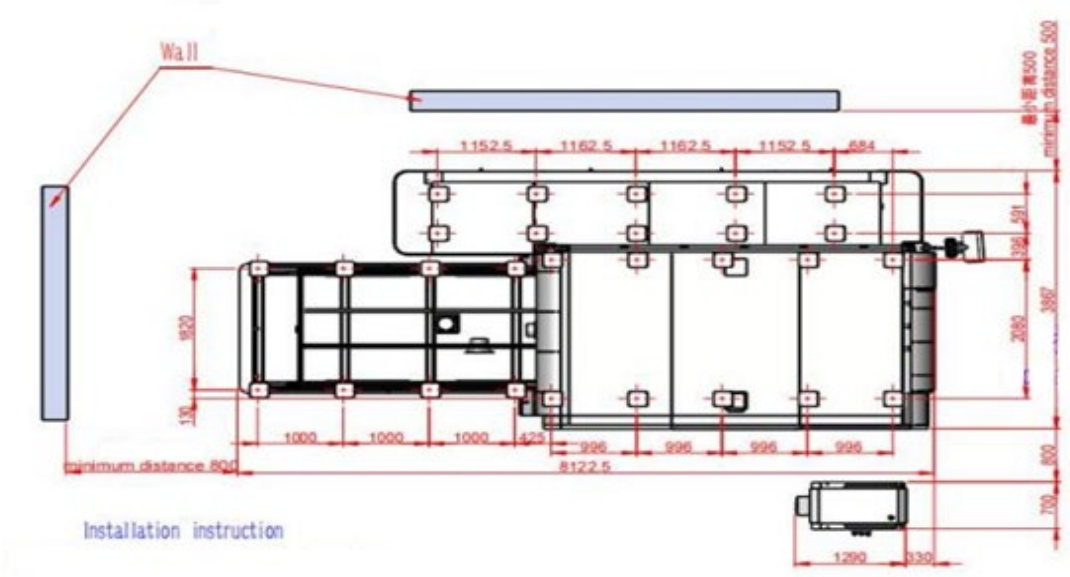


Figure 2-1: Workshop Size Preparation Before Installation (3 Meters Type or Optional 6 Meter Type)

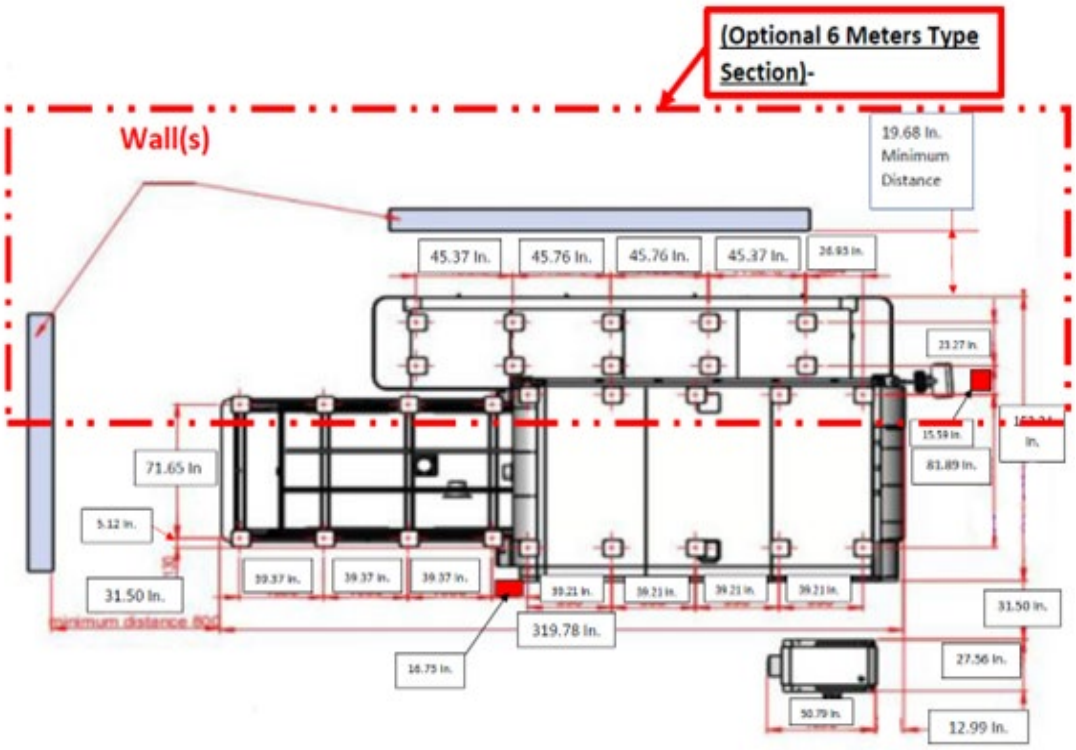


Figure 2-2: Workshop Size Preparation Before Installation (3 Meters Type)

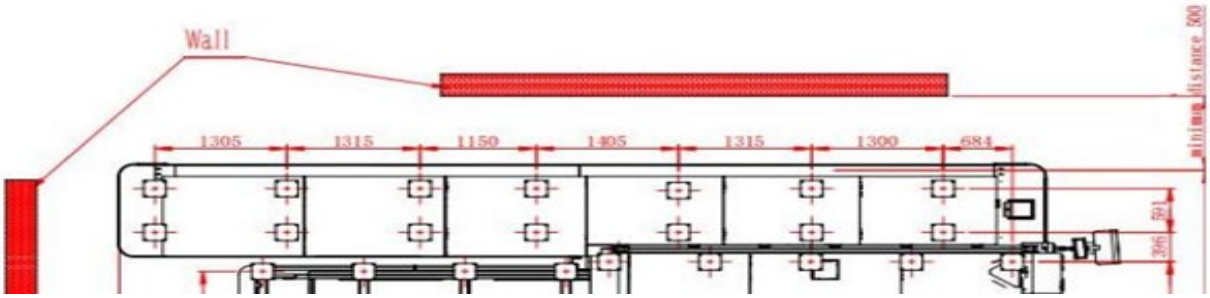


Figure 2-3: Workshop Size Preparation Before Installation (Optional 6 Meters Type)

NOTE

The ground level is not more than ±10 mm and can withstand more than six (6) tons of heavy objects. The thickness of the concrete on the entire installation surface of the bed and the table legs shall not be less than 200 mm, the compressive strength shall not be less than 30N/mm2, and the load shall be greater than 30KN/m2. Installation of the foundation requires no large vibrations around the ground. If so, a shock ditch will need to be released.

It is critical to maintain the proper pressure of oxygen and nitrogen when cutting. Failure to do will destroy the cutting head.

2.3 Power Supply Specifications

1. Quality – Three-phase unbalance <5%. Single phase 220V ± 5%. The machine must be equipped with a regulated power supply. The regulated supply can ensure the stability of the input voltage of the machine, so that the entire machine tool and laser work in a relatively good state. Air compressors and fans should not pass through the regulated power supply to prevent the instantaneous high current changes of high-power devices from interfering with the power output of the laser.

   Machine power must be balanced between legs within 5% and the use of power condition is required when needed.
   The motion of the machine requires voltages 208 -230 volts 3 phase. Power supplies 3000 watt and above require an additional circuit 400 – 480 volts.
   Amperage varies depending on the size of the power supply. 6000-watt chillers are run on 440 – 480 volts 3 phase on a separate drop.

   2000-watt and down system chillers require 208 – 230 volts

   Consult the service department for more detailed information prior to installation. Air compressors and fans should not pass through the regulated power supply to prevent the instantaneous high current changes of high-power devices from interfering with the power output of the laser.

2. Grounding Requirements – Set the grounding pin to the grounding wire one (1) meter away from the machine. The grounding resistance should be less than 4 ohms. The total number of ground needles is ≥3, the material is pure copper or galvanized, the ground needle diameter is ≥15 mm and the length is ≥1.5m.

   Set the grounding pin to the grounding wire one less than ten (10) feet away from the machine. The grounding resistance should be less than 4 ohms. Use of a ten (10) foot copper clad grounding rod is strongly recommended.

3. Environmental Requirements – A site with good ventilation, no dust, no corrosion, no pollution, no water leakage. The recommended ambient temperature is between +5 º C and +33 º C.

NOTE

Avoid thermal deformation due to direct sunlight.

4. Water Cooling System – The water-cooling machine is equipped with water for circulating flow. It is used to cool special equipment such as lasers and cutting heads. The circulating water needs to use High-Quality Pure Water or Distilled Water. It is strictly forbidden to use Mineral Water. When the ambient temperature is < 0 º C to avoid freezing damage to the equipment, please, pay special attention!

   The distance between the left and rear sides of the machine tool should be above 1.2M; the laser and water-cooling machine should be above 1.0M from the wall. The control unit, servo unit, and display and control panel are the core components of the machine tool, which have certain requirements on the environment, and should avoid electromagnetic interference from the machine tool, such as arc welding and electric discharge machine, so as not to affect the normal operation of the machine tool.

5. Fire Safety – To prevent the occurrence of fire, the processing site should be equipped with appropriate fire extinguishers and reserve certain fire exits.

6. Requirements for Gas Standards

   a. Oxygen – If liquid oxygen is used, a vaporizer must be added to raise to a normal temperature. High pressure liquid bottle withstand pressure 4.5MPA, vaporizer withstand pressure 4.5MPA, flow rate: 1.0 cubic meters/minute, output pressure: 2.0MPA.

b. Nitrogen – If liquid nitrogen is used, a vaporizer must be added to raise the liquid to a normal temperature. High pressure liquid bottle withstand pressure 4.5MPA, vaporizer withstand pressure 4.5MPA, flow rate: 1.0 cubic meters/minute, output pressure: 3.0MPA.\

c. Air – Compressed air requirements

Specs for using compressed air as assist gas are 250 PSI @ 99.8% clean/dry at a consumption rate of 20 CFM.
The Kaeser Aircenter (SM10T) will do 160psi @37.1cfm. Larger models can be higher.
For compressed air we recommend up to 200PSI. 300PSI is for nitrogen usage.

7. Precautions

Never use the gas completely. When the cylinder is returned, the residual pressure in the bottle must be at least one atmosphere above the air pressure. When the cutting oxygen gas pressure is low, the laser cutting machine control system will alarm. Please change in gas time.

It is critical to maintain the proper pressure of oxygen and nitrogen when cutting. Failure to do so will destroy the cutting head.

2.4 Unloading Requirements

The equipment is transported to the final destination site with a truck, which must be prepared and implemented by the user. The route of the machine to the installation site must be declared in time before delivery. It is necessary to check the size of the door opening, the height of the pillar, the height of the cable holder, and whether the armor can be used for the road surface. The scale of the machine marked on the drawing must be taken into consideration during transportation.

1. Auxiliary and Handling Tools

The following items must be prepared by the user:

a. Truck cranes for machine tools, lasers, and attachments. A hydraulic crane with a gravity of at least 10t; if a larger boom is required depending on local conditions, the truck crane must have a greater lifting capacity.

b. Forklift (capacity 10 tons).

c. Bridge crane: bearing capacity 10 tons.

d. Armored rollers (1 steerable, 2 solid).

e. At least two (2) hydraulic jacks with a lifting force of at least 5 ton (minimum height setting: 30 mm).

f. Crowbar (1 m) and extensions.

2. What the user should do:

a. Transportation of the machine must be carried out in accordance with all safety procedures.

b. Do not allow the machine to be placed on the floor without a bottom plate as components may be damaged. The bottom plate must be less than 100 mm from the ground

2.4.1 Machine Briefing

The SmartShop Fiber Laser DLP has the power and precision of our FC Laser with the addition of our pipe cutting system.

Fitting Pipes from 20mm – 200mm (.79” – 7.9”) and plentiful power options allow this laser to fit any manufacturing need.

2.4.2 Features

- IPG Power Supplies UP to 12KW
- Tube Cutting Option Available in 10 and 20 feet
- Optional Shuttle Table System
- Optional Enclosures
- 5 x 10 and 6 x 13 Table Size

2.4.3 Additional Features

- Re-positioning Accuracy: 0.02 mm
- Power Options: From 700 Watts to 6000 Watts
- G Power Supplies Up To 12 kw
- Tube Cutting Option Available in 10 and 20 feet
- Optional Shuttle Table System

- Optional Enclosures
- 5 x 10 and 6 x 13 Table Size
- Re-positioning Accuracy: 0.02 mm.
- Power Options: From 700 Watts to 6000 Watts
- Ray-Tools Laser Cutting Head
- CypCut Control System
- Japanese Yaskawa Servo Motors (X and Y Axes)
- Panasonic Servo Motors (Z-Axis)
- German Atlanta Gearwheel and Rack
- French Schneider Electronic Components
- 3 Meter Tube Cutting w/ Axis Turning (Optional 6 Meter available)
- TFLW Water Chiller

3.0 Before Turning on the Machine

Check the laser, water cooler, main power supply, and voltage stabilizer before powering on. Whether each wiring has been connected properly. Ensure that the lines are not reversed or loose.

Check the whole equipment before Power-On: check the trajectory of each moving part of the machine and whether there is any foreign object on the worktable.

If start-up assistance has been purchased, DO NOT POWER the machine before the arrival of Laguna technicians. Keep the IPG power supply in its shipping crate. Opening the power supply or cutting head will void warranty.

3.1 Daily Checks

Start the Total Power Supply Equipment: Total Power Switch, Voltage Regulator Equipment.

Open and Turn On the Main Switch

1. After power is on, use a multimeter to measure whether the voltage of the main power supply, voltage stabilizer, laser, and water cooler is within the specified voltage range.
2. Instructions for Operations

Use metal objects close to all the induction switches on the machine to check if they are normal (when a metal object approaches the sensor switch, the sensor switch will light up in red).

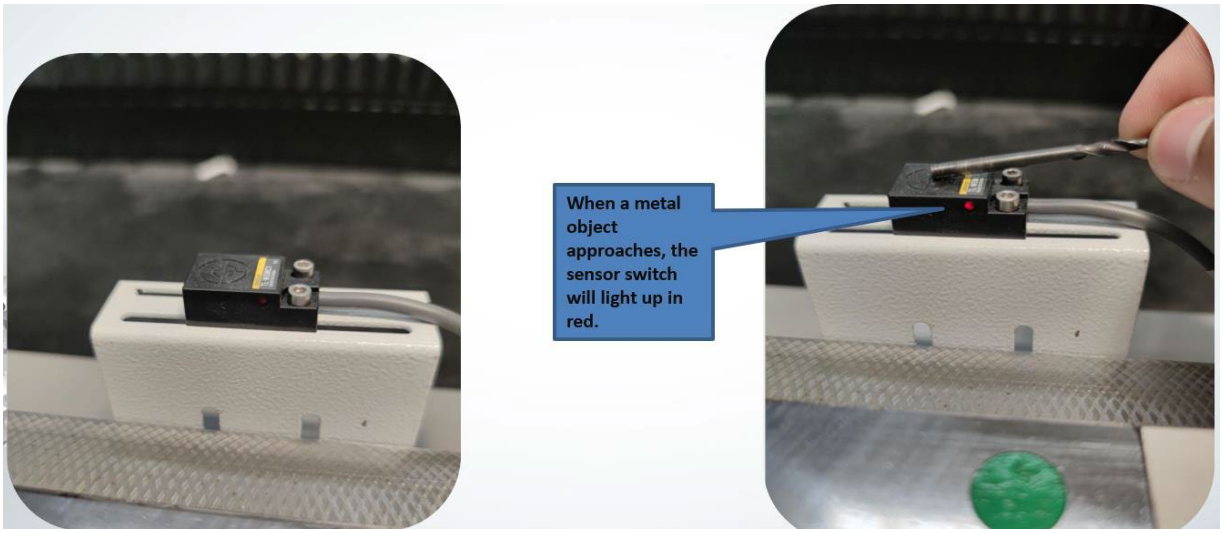


Figure 3-1: Sensor Switch

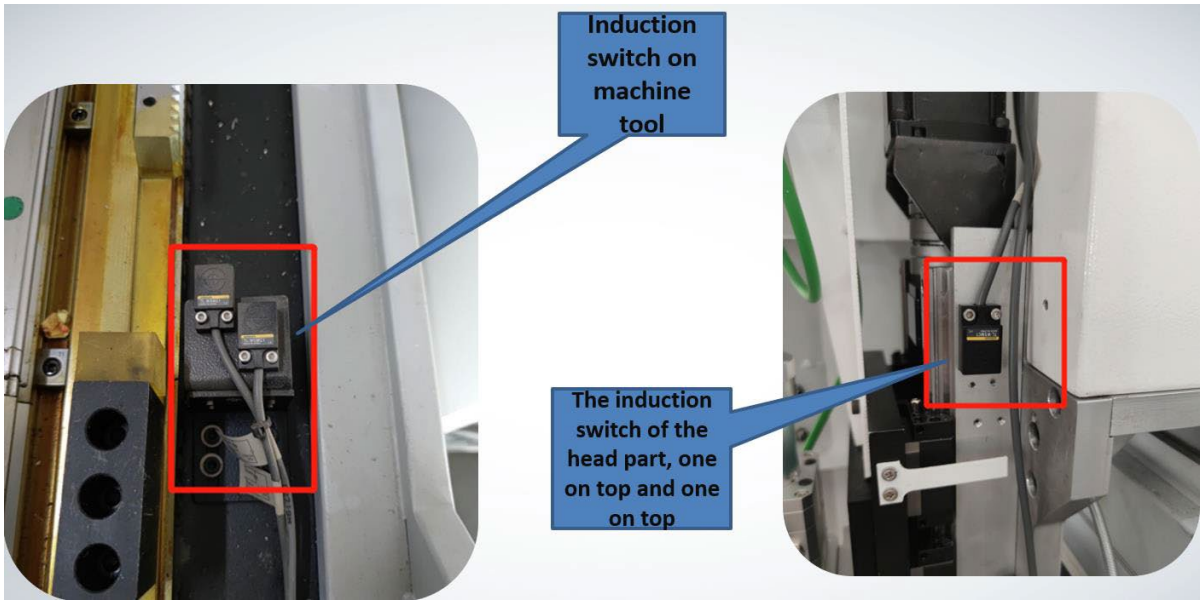


Figure 3-2: Induction Switches

3. Use metal objects close to all the induction switches on the machine to check if they are normal (when a metal object approaches the sensor switch, the sensor switch, the sensor switch will light up in red).

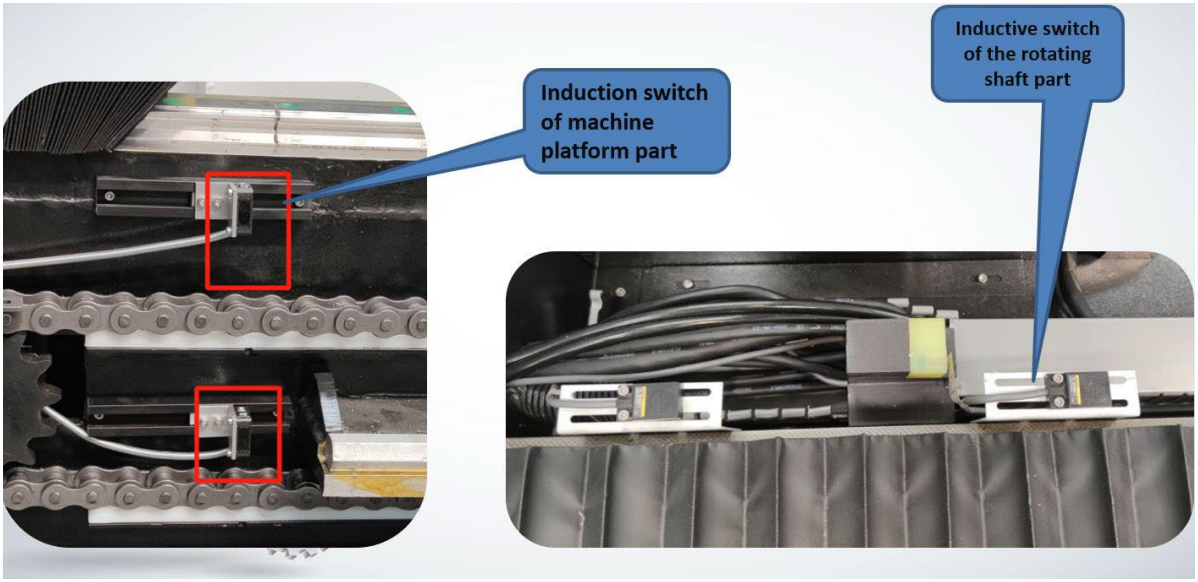


Figure 3-3: Induction Switches

4. Turn On the Chiller:

Figure 3-4: Chiller Switch

a. The Chiller Starts – Check whether the status is normal, whether the water supply is normal and whether there is water leakage in the waterway. Wait for the water

temperature to rise to 18ºC or 64.4 ºF. The Water Inlet and outlet of the water cooler are respectively connected to the water outlet and water inlet of the fiber optic.

b. The two (2) pipes for cooling the laser head can be connected to other water inlets and outlets of the water cooler.

c. The two (2) water pipes that are cooled by the laser head are connected to two (2) fiber outlet pipes and are respectively connect to the fiber head and the cutting head.

5. Turn On the main power supply of the Control Cabinet

Figure 3-5: Control Cabinet

6. Turn On the emergency stop button on the control cabinet, all the components in the control cabinet are powered on and started.

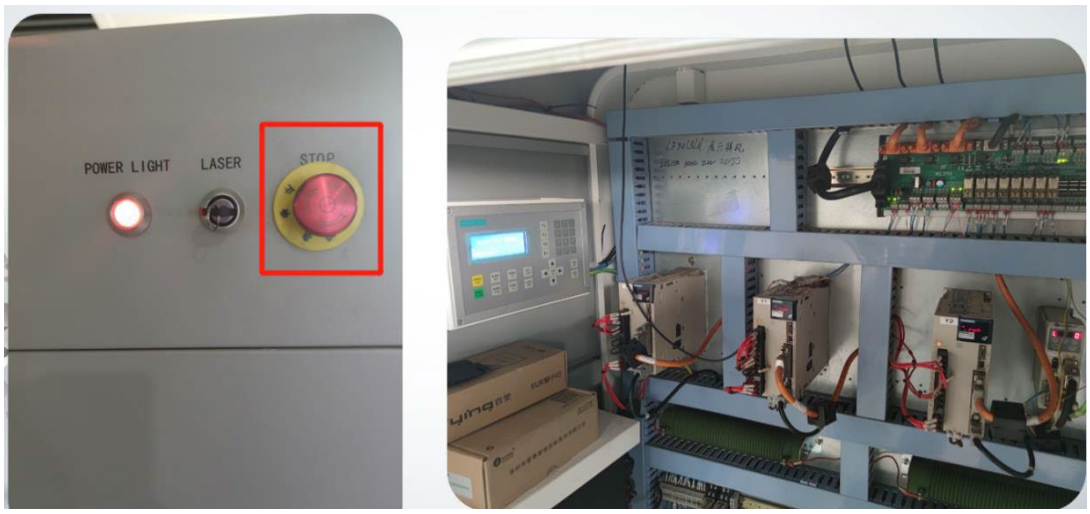


Figure 3-6: Emergency Stop

Start the host computer and open the software back to the remote point.

1. Press the Computer button on the control cabinet. Turn on the computer and the display will light up.

Figure 3-7: Computer Button

2. Check for abnormality when the laser starts, start the auxiliary gas, such as an air compressor. Open the required air supply valve, and check whether the status of each filter and device and each pressure gauge in the air circuit is normal.

When the temperature of the water cooler is above 19 ºC or 66.2 ºF, turn on the laser.

1. Fiber Optic/Laser Component – Turn on the Laser Key on the control cabinet, the green power light in front of the laser will be on.
2. Open the emergency stop on the machine.

3.1.1 Shutdown Steps/Procedure

1. Return to the Original Point. After clicking back to origin, the machine head part will return to the set zero point.
2. Turn off the Gas Discharge Pipeline Gas.
3. Turn off the Water Cooler.
4. Turn off the Computer Operating system.
5. Turn off the Fiber Laser.
6. Turn off the software Emergency Stop.
7. Turn off the Main Switch.

The start-up procedure of the laser cutting machine must be strictly observed. Start the laser in strict accordance with the laser start-up procedure.

3.1.2 Software Operation Process of Fiber Laser Cutting Machine Plate

Making graphic-data—importing-graphics—preprocessing—proces-setting—knife planning-pre-processing inspection—machining control

1. Import the Graphic – Click the **Open File**  button in the quick launch bar in the upper left corner of the interface to pop up the **Open File** dialog box, select the file. Open the Graphic. The right side of the **Open File** dialog provides a preview window.

   If you want to draw a part in the field with the CypCut software, click the **New** button and use the left. One can draw the buttons on the side drawing toolbar, see related chapters.

   2. Pre-Processing – While importing graphics, CypCut will automatically remove very small graphics, remove repetitive lines, merge connected lines, auto-smooth, sort and break up. In

general, process parameters can be started without other processing. If the automatic process does not meet requirements, open the **Menu File** – **User Parameters** to configure. In general, the software recognizes the graphics to be processed should be closed graphics. If the opened file contains unclosed graphics, the software may display a red prompt. This feature may be turned off to view the unclosed drawings on the drawing board. Click on the common menu bar **Show** button and buttons to highlight unclosed graphics. Unclosed graphics can be selected by clicking the large **Select** button on the leftmost side of the toolbar and then clicking **Select Unclosed Graphics**. If the graphic needs to be manually split, click on the **Split** Split button under the **Optimize** button under the common menu bar button, then click the mouse in the location to be split. To merge graphics, select the graphics to merge, then click Combine near **Combine Near** button.

3. Process Settings – In this step, most of the functions in the **Process Settings** column under the common menu bar, including setting introduction Lead Lines, Set Compensation, etc.

Large Size Lead button Lead can be used to set the lead-in lead, **Seal** Seal button, used to over cut, notch, or seal parameters. The **Compensate** Compensate button is for kerf compensation. The **Micro-Joint** Micro Joint for insert a small segment of the graph that is not cut. The **Reverse** Reverse button reverses the single graph. The **Cooling Point** Cooling Point button is used in the Graph. Set the cooling point in the shape.

Click the **Lead Pos** Lead Pos button. Click on the position intended as the starting point of the graph. This position can be changed by clicking outside the graph. A drop line can be manually drawn. Another method is to press Ctrl+A to select all graphics and click the Leader button. Set the parameters of the leader and click **OK**. The software automatically finds the appropriate position according to the settings line. Click the Small Triangle below the Leader and select **Check Import and Export** to check the legality of the lead-in line. Select Differentiate Internal and External Mode to automatically optimize the lead according to the internal and external modes. Detailed cutting process parameters can be set by Click the **Layer** Layer button on the right toolbar. The **Layer Parameter Settings** dialog contains almost all the parameters related to the cutting effect.

4. Toolpath Planning – In this step, the graphics are sorted as needed.

   Click the **Sort** button under the common or layout menu bar to sort automatically. Click the Small Triangle below the **Sort** button to select the sorting method. You can control whether the automatic sorting process can change the direction of the graph and whether the inner and outer modes are automatically distinguished. If the automatic sorting does not meet the requirements, click the button, on the left toolbar to enter the manual sort/mode. The order of processing is set by clicking the graph in order with the mouse. By holding down the mouse and drawing a line from one drawing to another, the order between the two (2) figures can be specified. Set the order of processing by clicking the graph in order with the mouse. By holding down the mouse and drawing a line from one drawing to another, the order between the two (2) figures.

   Select several images that have been sorted and then Click the **Group** button under the common or layout menu bar to fix their order. After that, automatic sorting and manual sorting will no longer affect the group. Internal graphics and groups will always be whole. To sort the graphs inside the group, select a group and right-click to select the sort within the group.

5. Pre-Processing Inspection – The machine path can be checked before the actual cutting. Click each alignment button to align the graphics accordingly. Drag the interactive preview progress bar (under the drawing menu bar) as shown below to quickly view the graphics processing order. Click the interactive preview button to view the graphics processing one by one order.

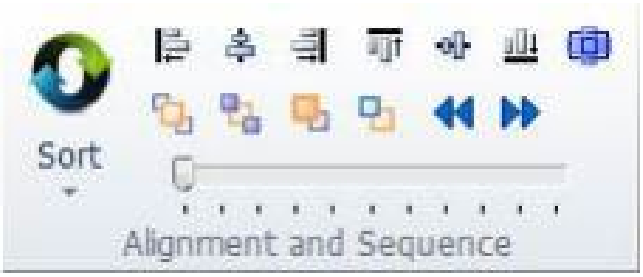


Figure 3-9: Alignment and Sequence

The simulation can be performed by clicking the **Simulate** 

button on the Console and the speed of the analog machining can be adjusted by the **Analog Speed** function on the **CNC** 

tab.

6. Actual Machining – Please not that this step must be run on the actual machine and must be supported by the dongle and control card. Before the formal processing, match the graphics on the screen and machine tool, click on the left side of the **Control Panel** arrow button. **Preview** 

. The button shows the relative positional relationship between the graphic to be machined and the machine's web on the screen, corresponding to the system is calculated by matching the stop mark on the screen with the position of the laser head on the machine. Figure 3-10 shows several coordinate markers that are common on the screen. When preview is clicked, the Stop will pan to the Laser Head Position, which visually shifts the image.

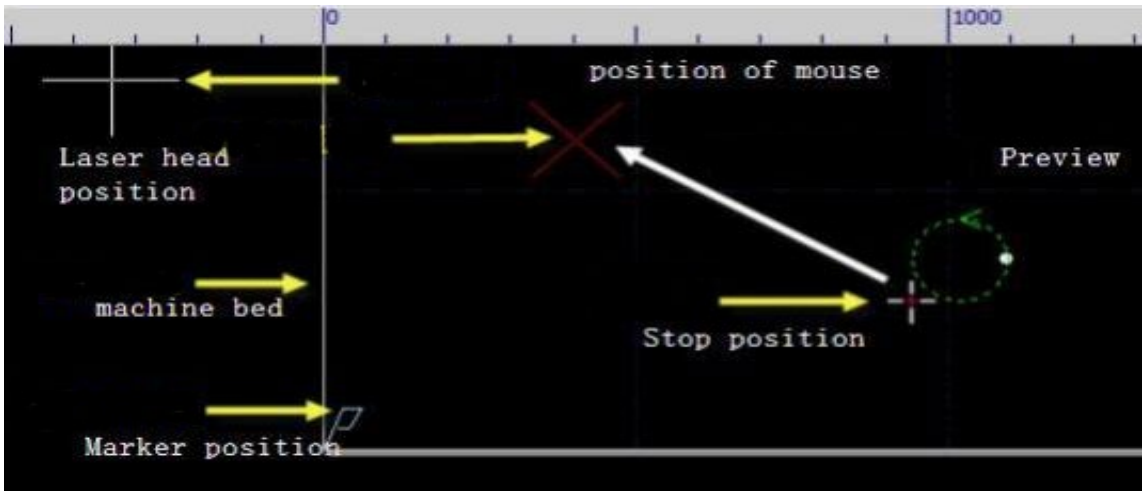
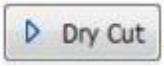


Figure 3-10: Coordinate Markers

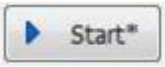
If the laser head position indicated by the red cross does not match the laser head position on the actual machine, please check if the machine origin position is correct and correct it by **CNC -> Return to origin**. If the preview finds that all or part of the graphic is outside the machine format, the materials may have exceeded the machining bed.

You can change the relative relationship between the graph and the stop by.

Clicking the **Ref** 

Dock button under the common menu bar. For example, the laser head is located for the lower left corner of the workpiece to the machined, set the stop point to on the Control System and the software will control the cutting head to be added. The outer frame of the work pattern is taken one turn at a time allowing the operator to check the machine position regularly. It is also possible to check the machining operation in more detailed manner by clicking the **Empty Walk** 

button to complete the operation of the graphic to be processed without opening the laser.

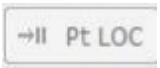
Finally click the **Start** 

button to start the formal processing. Click **Pause** 

button to pause the machining. During the pause, the laser, head lift, switch, gas, etc. can be manually controlled. The **Back and Forward** 

button is traced along the machining path. Click the **Resume** 

button to continue machining. Click the **Stop** 

button to abort the machining. According to the settings, the laser head can automatically return to the corresponding point only if the shape of the graphic has not been changed or a new round of processing has been started. Click the **Breakpoint Positioning** 

button and the software will allow you to locate it. Where it stops, click the **Breakpoint Continues** 

to continue processing from where is left off.

3.2 Software Operation Process of Fiber Laser Cutting

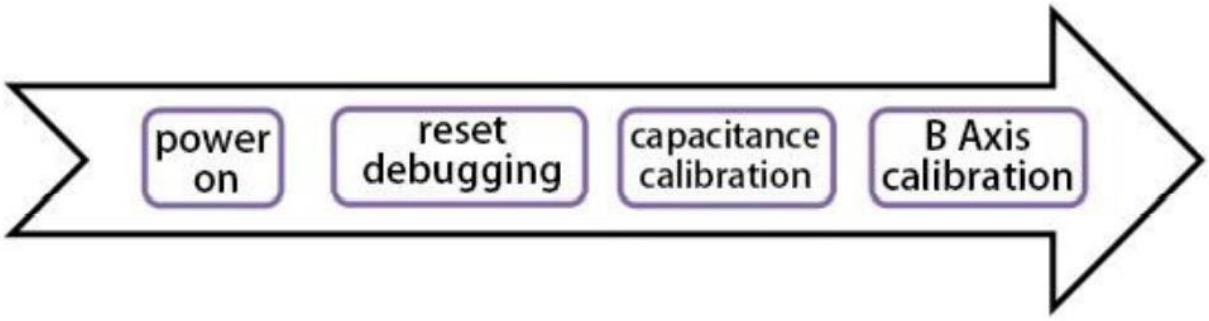
1. Software Quick Start

    a. Specific Features

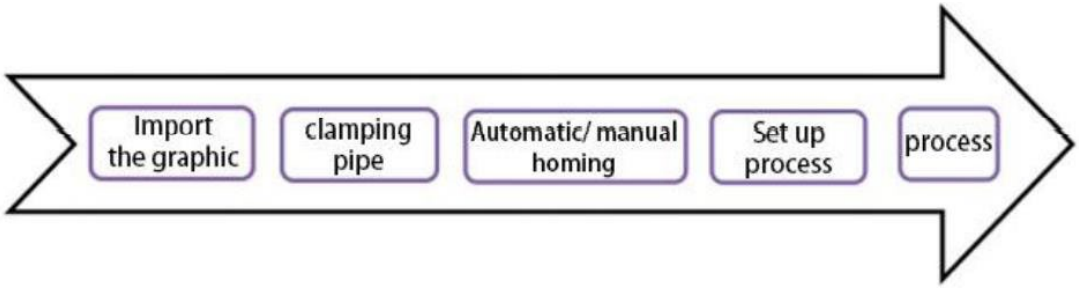
    - Support for IGES graphics data formats.
    - Supports cutting of any stretched body tube.
    - The unique one-button effect square tube level automatically locates the rotating center function of the pipe.
    - Introducing lead-out lines, kerf compensation, etc. in a WYSIWYG manner.

- Automatically distinguish between inner and outer molds and determine the direction of kerf compensation according to the inner and outer dies and perform lead inspection. Flexible and automatic sorting and manual sorting functions support fixed processing order through group part.
- Unique processing order browsing function, more interactive viewing processing order than simulation.
- Supports segmental perforation, progressive perforation, and to support separate laser power, frequency, laser form, gas type, air pressure, follow height, etc. for the perforation process and cutting process.
- Supports speed-dependent power adjustment, which can be set to separate lead-in line speed.
- A powerful material library function that allows all process parameters to be saved for reuse by the same material.
- Processing breakpoint memory, breakpoint advancements, and backtracking; allowing partial graphics processing.
- Supports positioning to any point during stop and pause, starting from any position, supporting fixed cutting, automatic edge finding, and off-board lifting and lifting.
- Powerful expansion capability, up to 15 PLC process edits, more than 30 programmable process programmable I/O ports, programmable alarm inputs.
- Support remote control of the system via wireless handsets and Ethernet4.

b. Debugging Process



c. Processing Process



3.2.1 The Use of Specific Features

1. Open the **TubePro Software**  and click the menu **[Return to origin] -> [All homing]** – The software pops back to the origin operation menu and the menu prompts the action to return to the origin process: bracket down -> Z-Axis homing -> X-Axis homing -> Y-Axis homing -> B-Axis homing -> B-Axis return to origin pre-state. Click the **Start Homing** button, the machine starts to perform the homing action, after returning to the original point, click Ok to exit.

NOTE

Before the first de-bugging or homing, please perform the single-axis homing test separately.

2. Clamping Material Steel Pipe - Click the Menu Bar [Manual Debugging] to pop up the chuck, bracket, and single-axis debug menu. Clamp the steel pipe to be machined by clicking on the clamping/releasing of the chuck. If the bracket is configured, the bracket can be clicked to raise and lower the clip with the growing tubing.

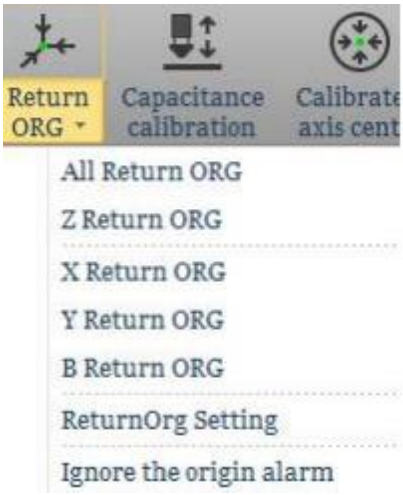


Figure 3-11: Return to Origin

3. Calibration Height Adjuster – By jogging the X/Y/B-Axis, move the rectangular steel tube below the cutting head nozzle and adjust the upper surface of the rectangular tube to a basic level, then move the cutting head nozzle close to the surface of the steel tube by jogging the Z-Axis. tubePro5000C system, please click the menu bar [One-Click Calibration]; tubePro5000A and 5000B system, please click [capacitor calibration], pop-up confirmation security dialog box to determine, then the height adjuster starts calibration.

4. Calibrate the B-Axis Center – By jogging the X/Y/B-Axis, move the rectangular steel tube below the cutting head nozzle and adjust the basic level of the upper surface of the rectangular tube. Click the menu [**Calibration B-Axis Enter**], enter the rectangular tube size and the click [**Start Calibration Center**]. When the measurement result is completed, click **Save** to exit.

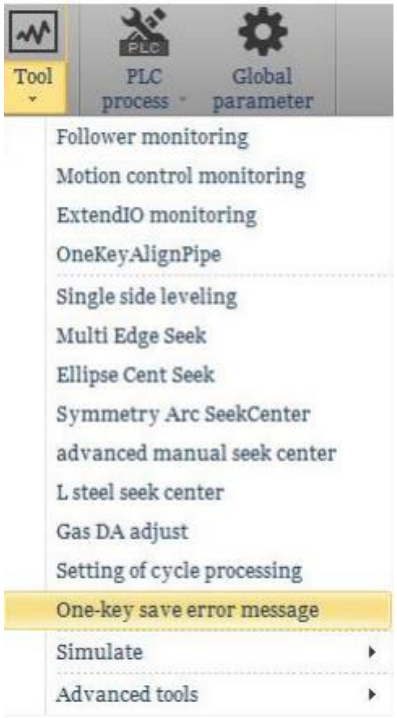


Figure 3-13: Tool Menu

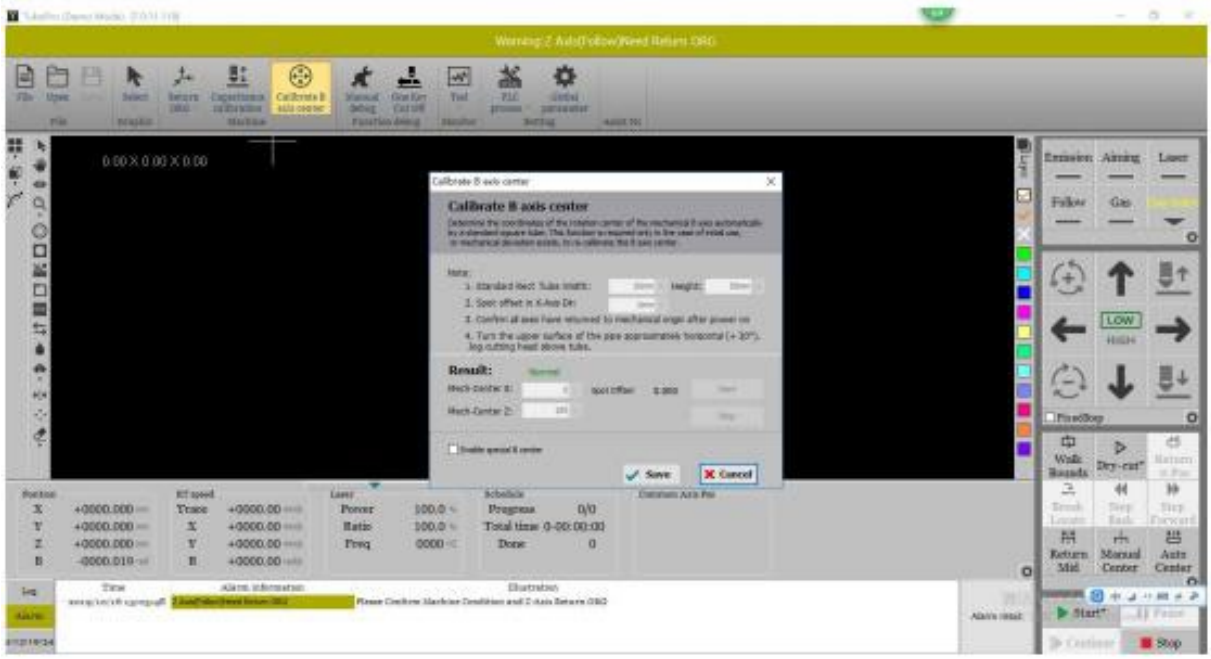


Figure 3-14: Calibrate the B-Axis

NOTE

Before calibrating the center of the B-Axis, accurate and reliable coordinates of the X/Z/B-Axis are required; that is, before calibrating the center of the B-Axis, perform a homing action on all axes performing the calibration of the standard pipe Axis Center.

5. Import graphic settings – click the **Open** menu and select the *.zzx file to be processed. Open the right side of the menu to preview the processed graphic and its dimensions.

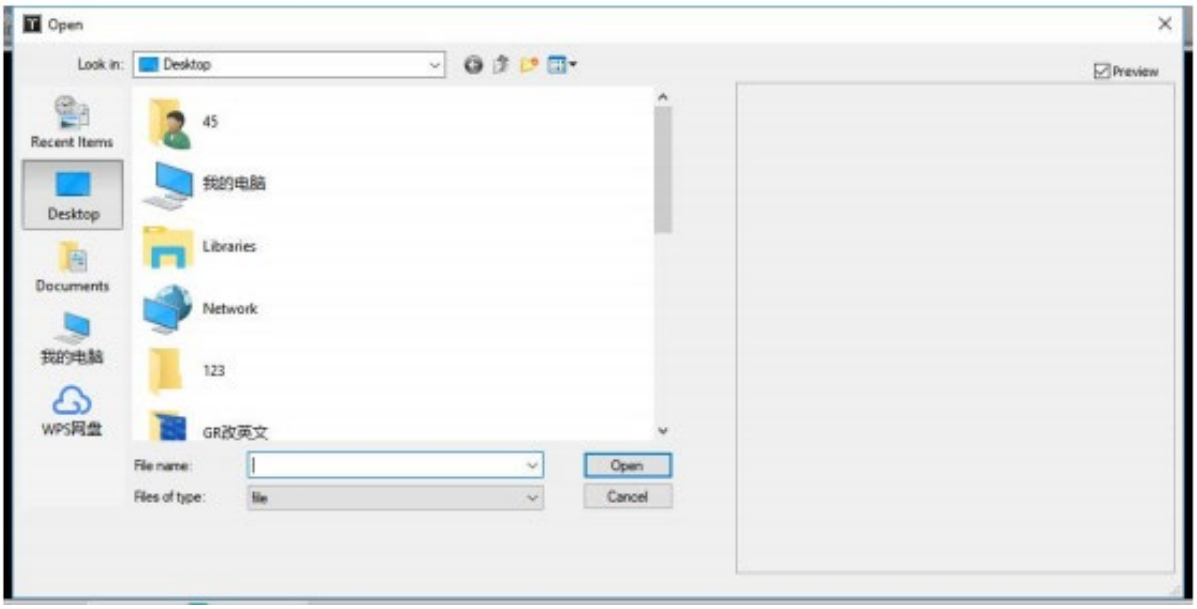


Figure 3-15: Open Menu

6. Set the **Layer Process** – Click the **Process Too**l button to set the process parameters of the layer. Click the Cut page, for example, set the cutting speed to 50 mm/sec, set the peak power to 53%, and enable real-time power adjustment and frequency adjustment. Click the **Punch** page to set the first level perforation progressive time 1000ms.

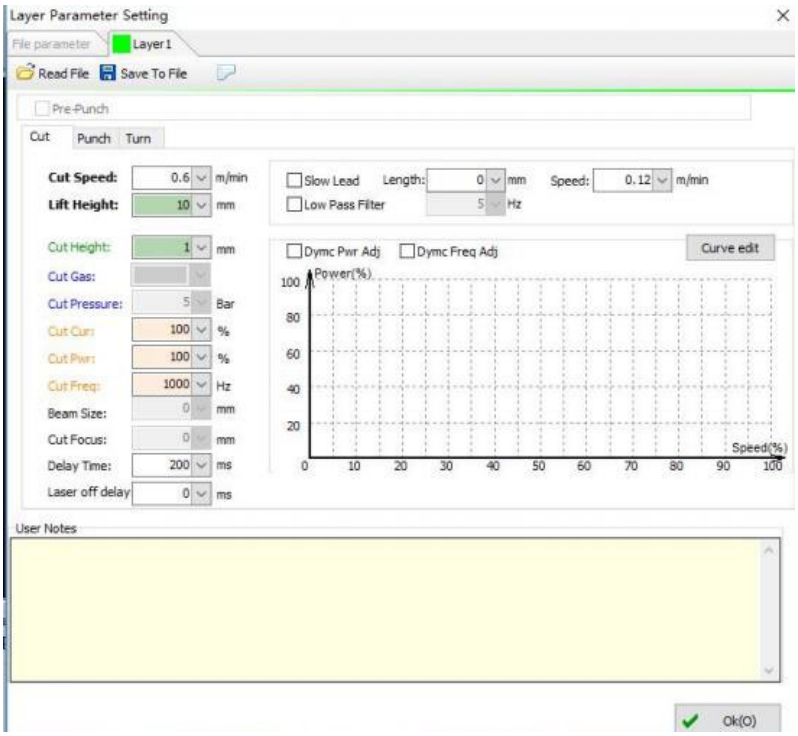


Figure 3-16: Cut Page

Click the **Punch** page to set the first level perforation progressive time 1000m.

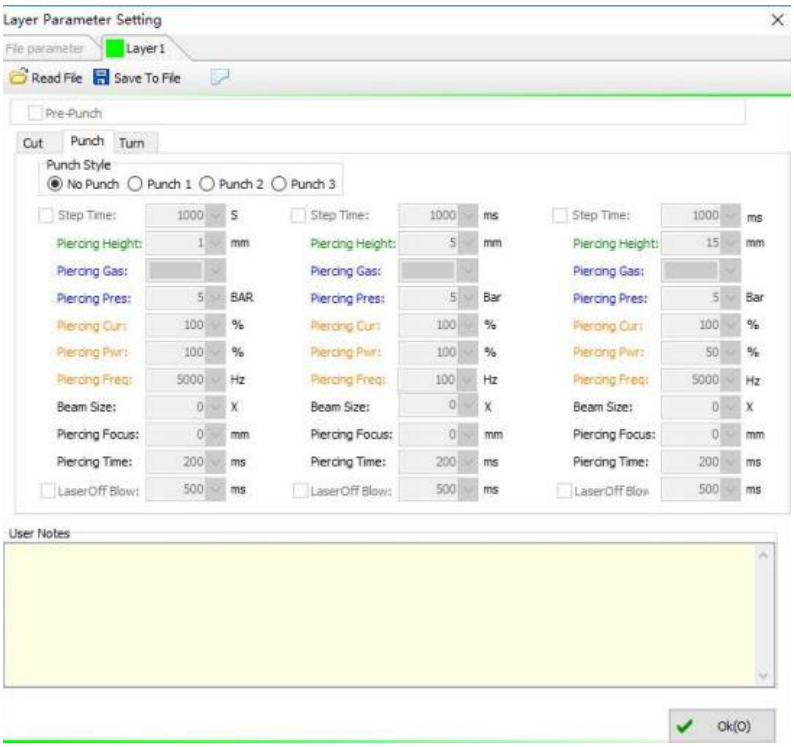


Figure 3-17: Punch Page

Click the tube corner page to enable the tube corner process such as cutting height correction 2mm, setting the duty cycle 40%.\

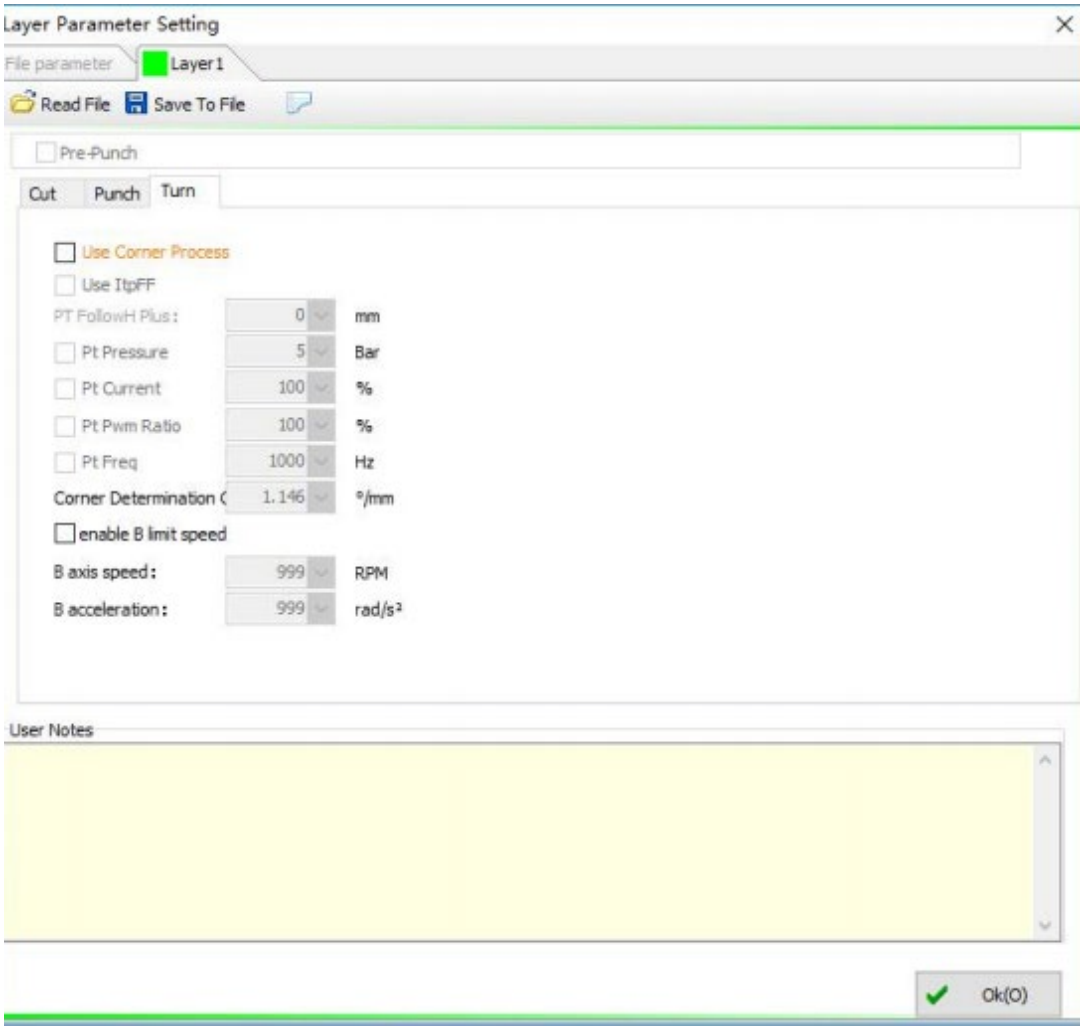


Figure 3-18: Tube Page

7. Start Processing – After importing the zzx file, the other pipe/rectangular pipe/round pipe/angle steel /channel steel, please **First Click Automatic** Search in the operation bar on the right side to confirm that the size of the pop-up window is the same as the actual steel pipe size, then click the Start **Search** button wait for the search to end, click **Save** to exit. The elliptical tube/runway/shaped tube cannot be automatically searched. Please fine-tune the rotary axis to make the tube and zzx patter match. Set the current position horizontal state on the manual centering pop-up window to ensure that the B-Axis zero point of the shaped tube is consistent with the graphic.

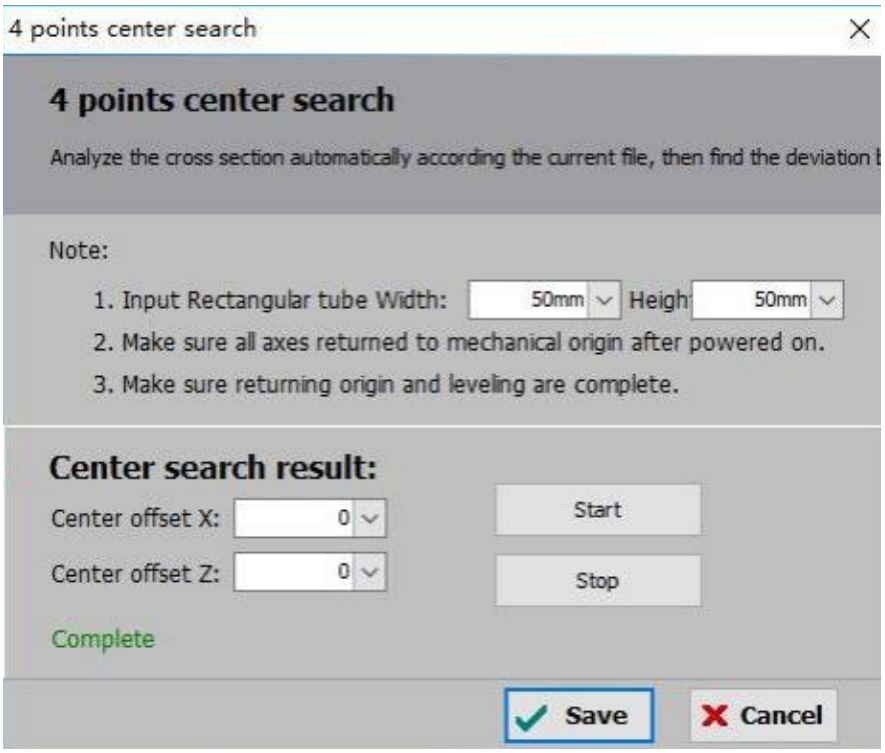


Figure 3-19: 4 Points Center Search

Click the **Start** button in the action bar to process the graph. The processing progress of the part can be seen in the status bar during processing.

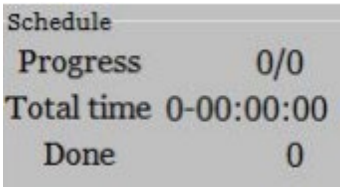


Figure 3-20: Schedule

8. Alarm Display – During the operation of the system, an alarm or warning will appear in the top alarm status column and the alarm time and related information will be displayed in the alarm description at the bottom.

Open the **Tools** menu -> **Motion Control Monitor** to view the status of the X-Axis. The current positive limit is triggered.

Open the **Tools** menu -> BCL4516E or other expansion board monitors to see the status of input.

Figure 3-21: Motion Control Monitor

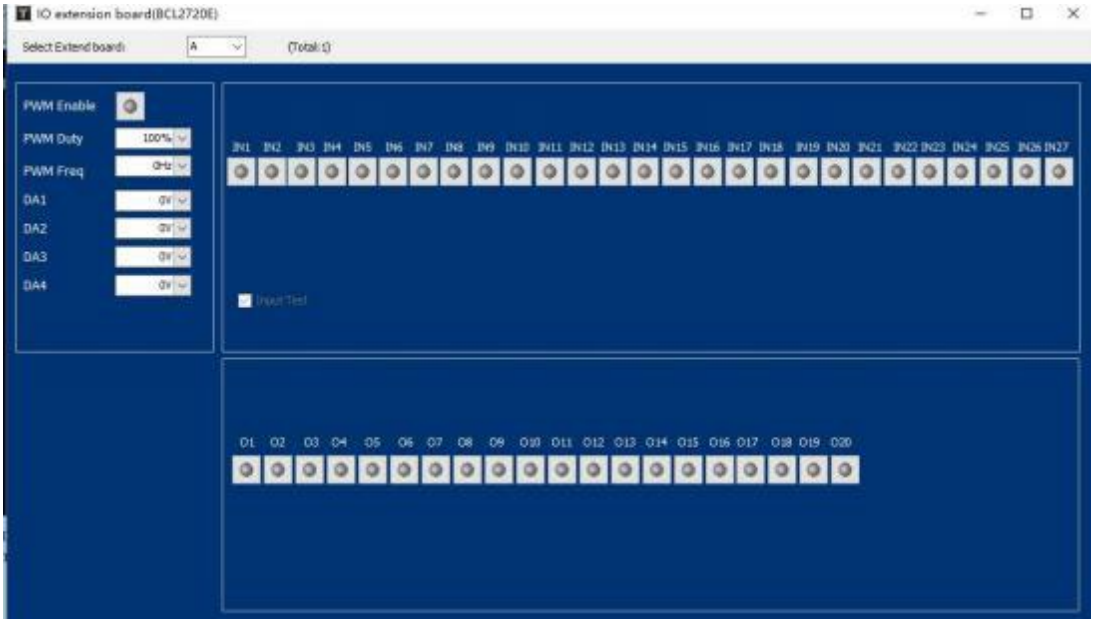


Figure 3-22: Alarm Display

9. Software Installation

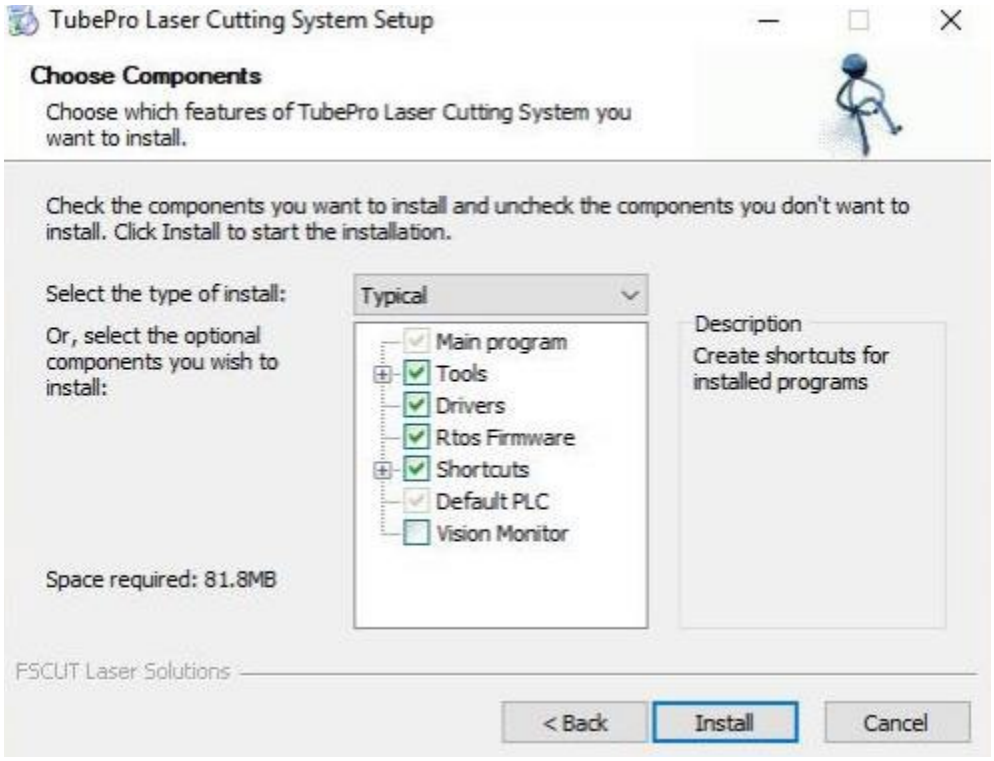


Figure 3-23: TubePro Laser Cutting System Setup

10. Shortcut Toolbar – The shortcut toolbar contains selection lines, select parts, drag, 3D view, zoom, kerf compensation, inside and outside, lead line, start point, micro connect, reverse, cooling point, weld compensation, seek, clear, **Display Tool** buttons such as Mode and View Selection.

    Detailed Instructions for Using the TubePro Software

    a.  Select a line and select the specified.

    b.  Select a part and select the specified part. Click the part area with the mouse to select all the graphics of the part at one time. The front side of the co-edge part will not be selected.

    c.  Click and drag the Graphic View or hold down the Ctrl + Mouse Wheel to drag the graphic view.

d.  3D View, 3D rotation view of the graph. Hold down the mouse wheel and drag the mouse to enter the 3D viewing mode. Hold down Shift + Mouse Wheel and drag to rotate the graphic around the center axis of the tube.

e.  Zoom – Zoom in and out of the graph. Alternately, zoom in by scrolling the mouse wheel.

f.  Slot Compensation set internal compensation or external compensation (Cancel Compensation/Automatic Judgement/Internal Reduction/Expansion) for the selected graphic and set the kerf width.

g.  Inside and outside, when the automatic judgement of the kerf compensation pattern is selected, the kerf compensation can be switched to internal compensation or external compensation, and the kerf width. Whether the position of the lead is the inner lead or the outer lead can be switched

h.  Lead the knife line - Set the track lead made and length in the graph.

i.  Start Point – Set the starting position of each track in the graph.

j.  Micro Connection – Set the micro connection distance and set the position of the micro connection.

k.  Reverse – The direction of motion of the track in the machined image.

l.  Cooling Point – The position of the cooling point during processing will stop blowing. The cooling point delay is configured in the global parameters.

m.  Weld Compensation – Set whether the graphic section position uses weld compensation.

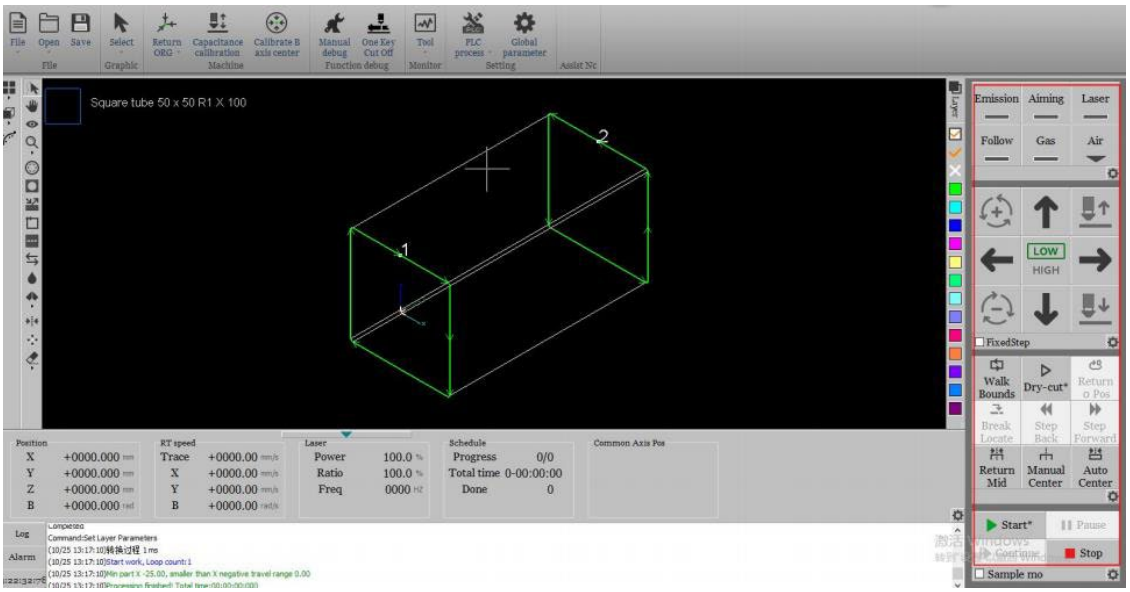
n.  To set the starting point of the drawing – Double-click the icon to automatically set the centering point by distance or set the centering point by part position. The search can be set for this position by selecting a curve separately.

o.  Clear – Optional to clear kerf compensation /lead/micro connect/cool point/seek/ clear all.

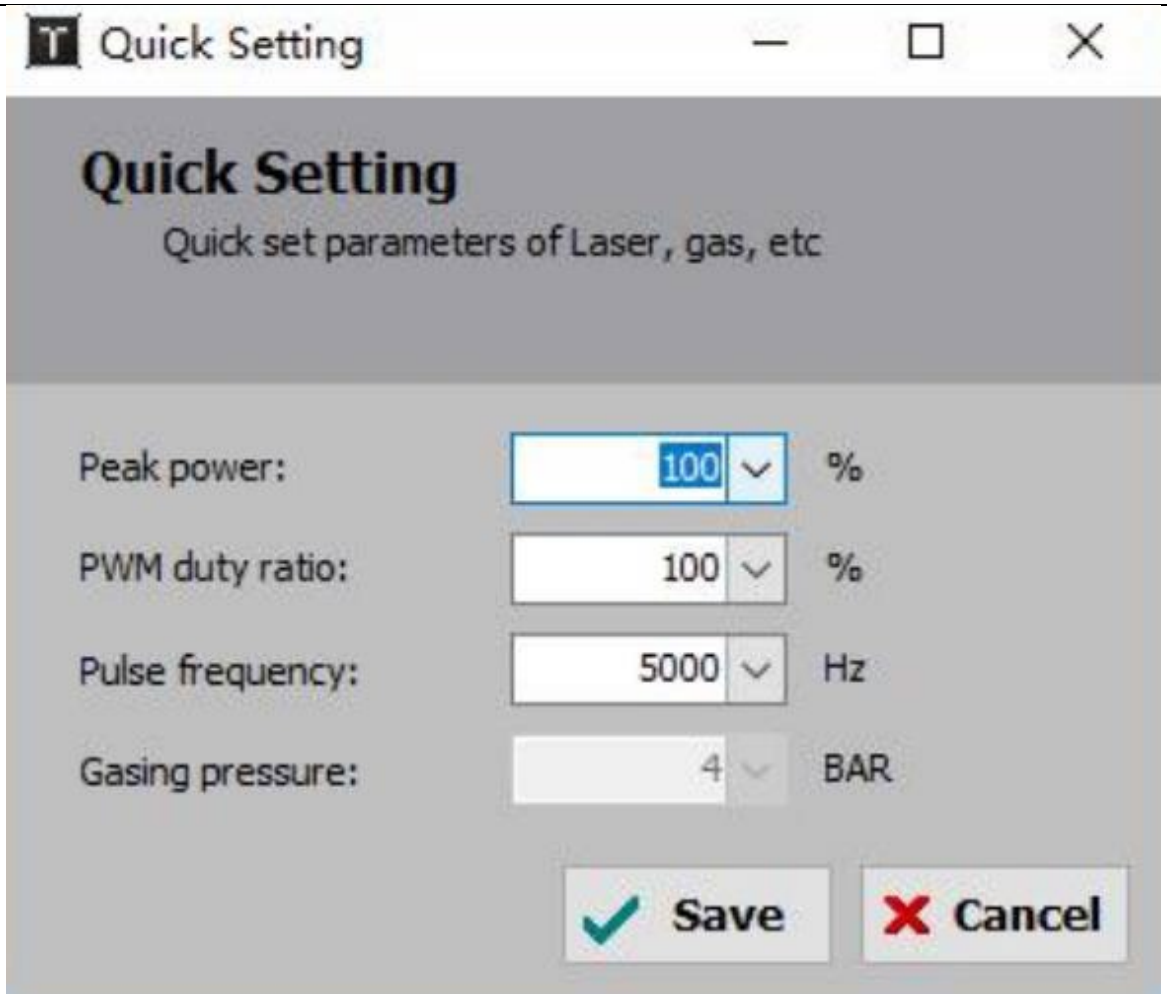
p.  Display Mode – Select display or not to display unclosed graphic/machining order/ trajectory start/trajectory direction/empty path/section/surface rendering/normal vector.

q.  Select View Mode – Choose the default view/top view/main view/bottom view/back view/right view/left view/southwest isometric view/northeast isometric view/southeast isometric view/southeast isometric view/northwest isometric view.

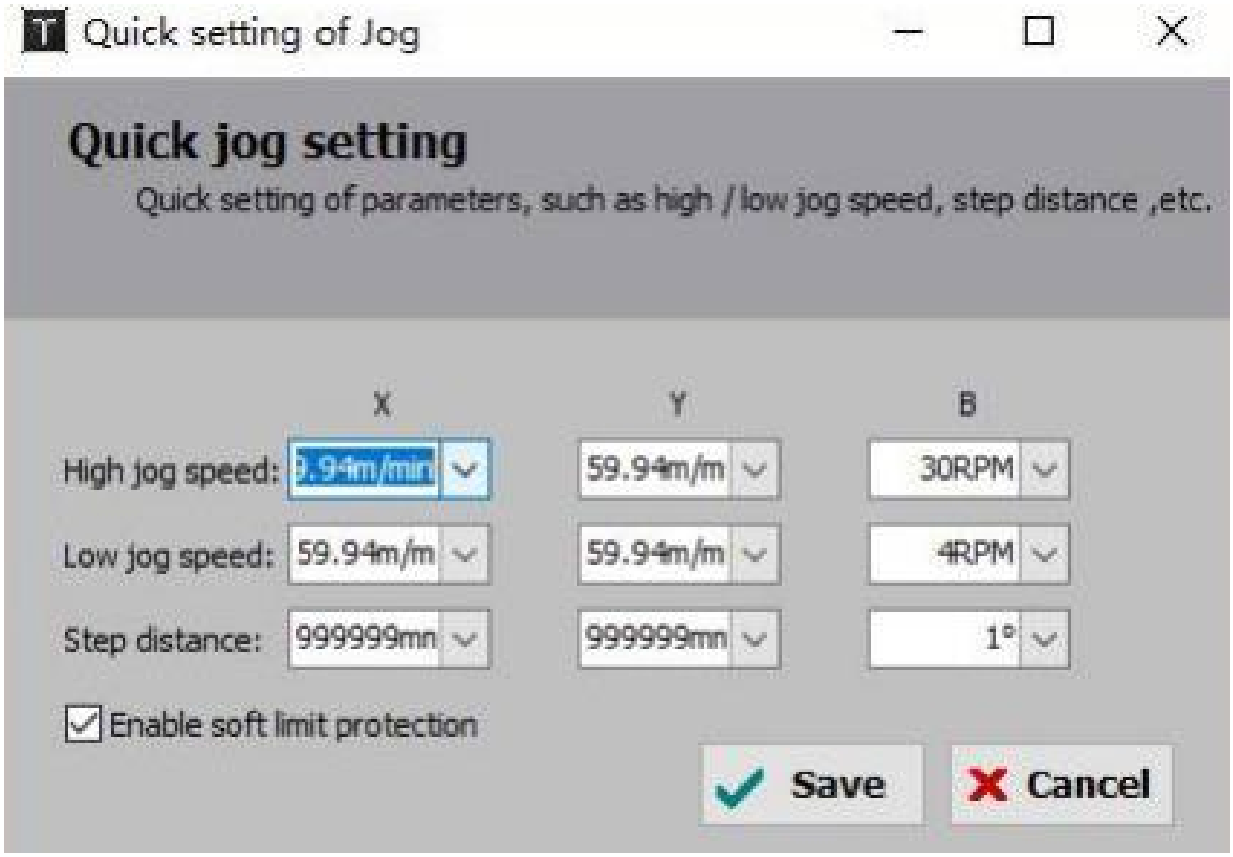
11. Processing Operation Bar
    a. Shooting Operation Bar
    b. Jog Operation Bar
    c. Machining Preparation Operation Column
    d. Machining Operation Column



Parameter Name	Meaning-Definition
Shutter	Laser Shutter
Red Light	Laser Red Light
Laser	The laser shoots. Left click is the laser shot, right click to open the laser continuously.
Follow	Height Adjuster
Blowing Gas	Press to turn on the Gas.
Gas Selection	Select the type of gas that can be used in the configuration.
Spot Shot Quick Set	Set the power, duty cycle, pulse frequency, gas pressure of the spotlight.

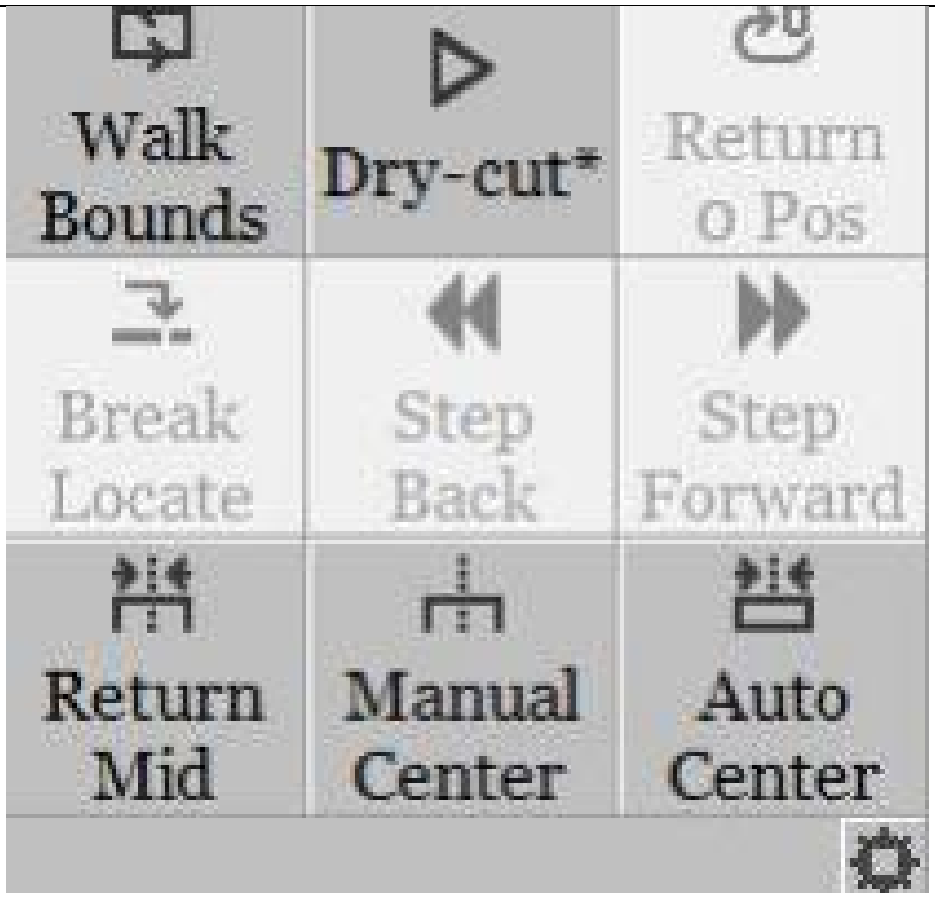


Parameter Name	Meaning-Definition
Peak Power	Spot laser power
PWM Duty Ratio	Laser signal duty cycle
Pulse Frequency	Spotted laser signal
Gassing Pressure	Blowing air pressure set



Parameter Name	Meaning-Definition
Jog Panel	X/Y/Z/B Axis jog or stepping.
LOW/HIGH	Set low speed/high speed jog or step.
Stepping	Check the step and jog the arrow to specify the axis to run in steps. Unchecked to move in jog mode.
Jog Quick Setting	Set the jog speed of the X/Y/Z/B Axis, jog low speed, step distance, and enable the soft limit.

Parameter Name	Meaning-Definition
Walk Bounds	According to the range of the graphic, a rectangular range is taken in the machine format.



Parameter Name	Meaning-Definition
Jog High Speed	Set X/Y/B high speed jog/stepping speed
Jog Low Speed	Set X/Y/B low speed jog/stepping speed
Step Distance	Set X/Y/B low speed stepping distance
Enable Soft Limit	Set whether the system enables soft limit protection and the software limit travel is set in the platform configuration tool.

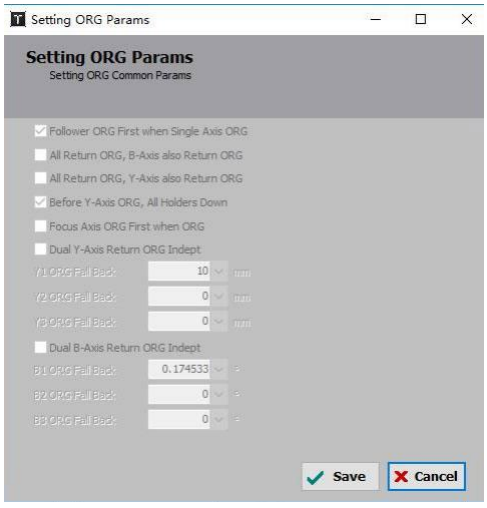
Parameter Name	Meaning-Definition
Dry-Cut*	The machine according to the graphics, but does not emit light, does not follow, does not vent.
Return 0 Pos	The machine moves to the zero point of the graph, where X, Y, Z, B will move.
Return Mid	Machine X, B-Axis moves to program zero (B-Axis calibration or manual centering results)
Break Locate	An abnormality occurs during the machining process. After the alarm is triggered and the stop is stopped, the position of the stop interruption can be located by the breakpoint positioning and then the machining is continued.
Step Forward/Step Back	After performing breakpoint positioning or pause operation, click Forward/Rewind to adjust the position of the machining point.

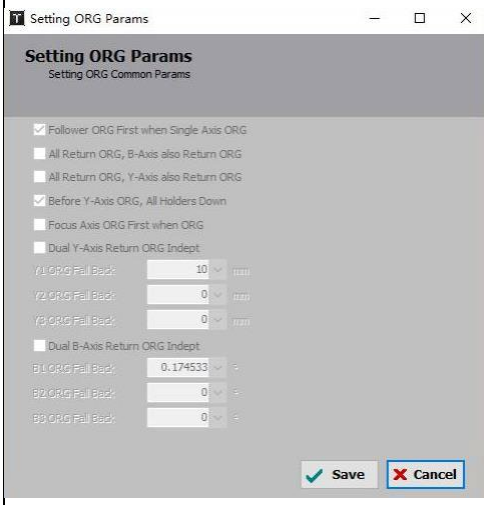
Parameter Name	Meaning-Definition
Manual Center	The horizontal position of the workpiece for the elliptical tube/waist tube/shaped tube and the deviation of the workpiece can be set through this interface.
Auto Center	The deviation of the rectangular tube/round tube/channel steel/angle steel can be determined by automatic searching to ensure the accuracy of the processing track during the machining process.
Walking Border	Set the speed value of the border.
Forward Retreat Distance	Set the forward and reverse distance. When the part is cut, the forward and backward can be used in conjunction with the breakpoint positioning for positioning to accurately position the position.
Central Search Method	According to the actual condition of the pipe clamped, choose the appropriate automatic search mode. The four-point search is faster than the five-point search, but the five-point search has a leveling function that is suitable for tube twist for deformation.

	Parameter Name	Meaning-Definition
	Start	Start Processing – Indicates that the graphic parameters have been modified; A – The automatic loading and unloading function is enabled F – The automatic feeding function is turned on. L – The circulating processing is turned on S – The seven-axis pulling function is turned on
	Suspend	Suspend execution of system instructions
	Continue	Continue to execute system instructions
	Stop	Stop current system command

Parameter Name	Meaning-Definition
ALL Return ORG	First execute the Z-Axis (adjuster)
Z Return ORG	Execute Z-Axis (adjuster) to the Origin
X Return O	If the Y-Axis synchronization is released and the homing is independent, all the Y-Axis will perform an independent homing. Otherwise, perform the Y-Axis synchronization homing.
B Return ORG	If the B-Axis synchronously released and the homing is independent, all B axes will perform independent homing and retreat their respective distances.

	Parameter Name	Meaning-Definition
	Y1/Y2/B1/B2/B3-Axis Origin	For the TubePro 5000A system, an independent axis can be specified to return to the origin. After returning to the origin, the associated logical axis will be decoupled.

	Parameter Name	Meaning-Definition
	Follower ORG, First when single Axis ORG	For safety, you can check the Z-Axis back to the origin, the Y-Axis back to the origin or the B-Axis to the origin. Check this option to let the Z-Axis return.
	All return ORG, B-Axis also return ORG	It is not checked by default. The B-Axis of some models does not have an origin switch installed, so the B-Axis homing cannot be performed when all the homing points are returned. This type of model cannot be checked. Some models of the two-wheel drive B-Axis are equipped When checking the independent homing point, unchecking this item is also recommended.
	All return ORG, Y-Axis also return ORG	Not check by default. If the user wants to return to the origin of the Y-Axis when performing all homing, check this option. It is recommended not to check this item to avoid all the homing action after the pipe is clamped, which will cause the chuck to hang down or fall under gravity.



Parameter Name	Meaning-Definition
Before Y-Axis ORG, All holders down	Checked by default. For safety reasons, the bracket is preferably lowered during the return of the Y-Axis to prevent the bracket from being bumped.
Dual Y-Axis return ORG indept	For the TubePro 5000A system, the Y1 and Y2 axes need to be independently homing, check this option. The Y1 and Y2 axes need to set their respective homing switches or homing limits.
Y1/Y2 homing return distance	For the TubePro 5000A system, the Y synchronization axis is used to cancel the synchronization and the homing is independent. Set the retraction distance of each the two (2) Y axes.
Dual B-Axis return ORG indept	For most double-clamp models, the origin switch is set for both the B1 and B2 axes. B1 and B2 will be out of sync with the two-wheel drive. In his case, the dual drive axes B1 and B2 need to be returned to the original position and then the set distance is retracted. This arrangement allows B1 and B2 to be at the same angle for easy installation of the steel tube, avoiding the need to artificially push the B-Axis for synchronization.

	Parameter Name	Meaning-Definition
	B1/B2/B3 homing return distance	The B-Axis is used to independently return to the origin and the respective retraction distances of B1/B2/B3 are such that they are just at the same level or at the same angle after returning to the origin.

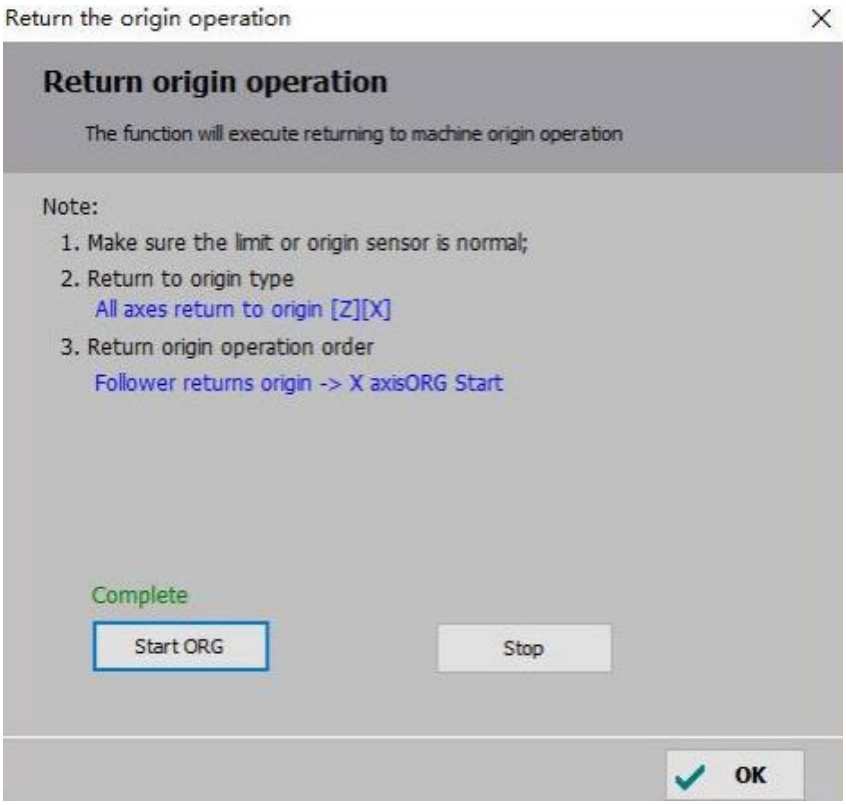


Figure 3-24: Return Origin Operation

12. Calibration Height Adjuster

The TubePro 5000A and 5000B use the BC2100E bus height adjuster. Before the calibration, the laser nozzle should be moved about 2mm above the surface of the metal pipe. Then click **Start Calibration** to wait for the calibration to succeed.

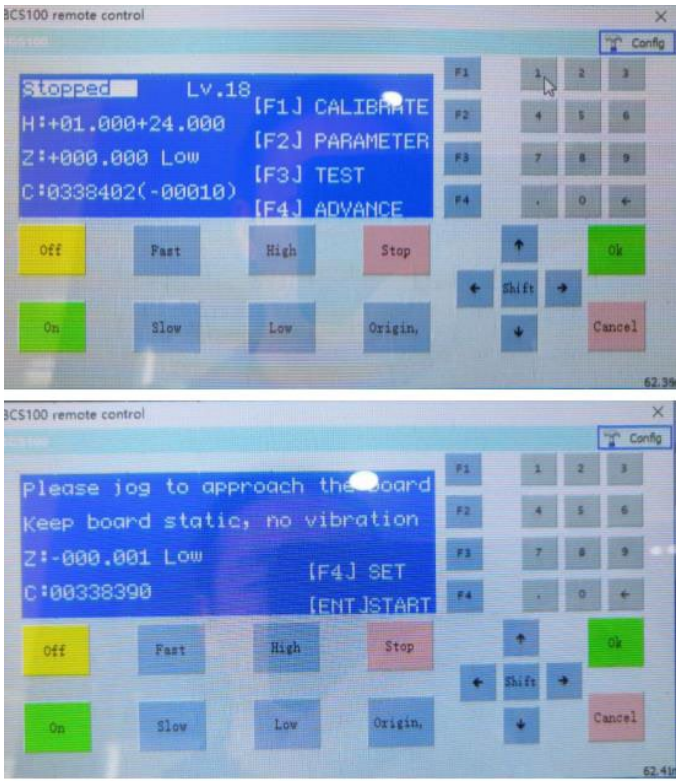


Figure 3-25: Start Calibration

The TubePro 5000C system uses the BCS100 height adjuster. Before the calibration, the laser nozzle should be moved about 2mm above the surface of the metal pipe. Click the one-button calibration to complete the calibration.

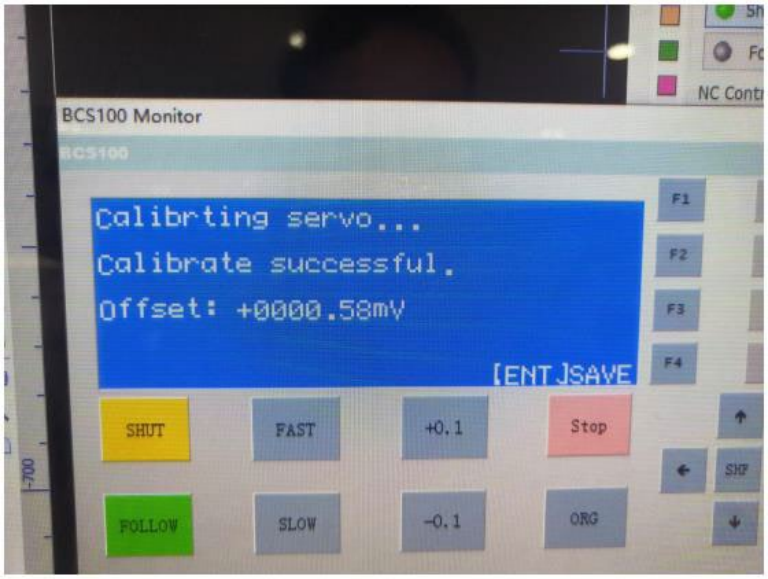


Figure 3-26: Complete Calibration

13. Calibration B-Axis Center – Mechanical System, the B-Axis has an inherent rotation coordinate. The coordinates of the center of the B-Axis can be determined by calibrating the center of the B-Axis. Measuring the center of the B-Axis requires a standard rectangular tube without chamfering.

    Before calibrating, verify the system X, Z, and B-Axes have returned to the origin, then move the cutting head nozzle over the standard tube, enter the standard tube width and height, and finally click to start the calibration enter. If there is no alarm in the middle, the calibration is complete. Click **Save**.

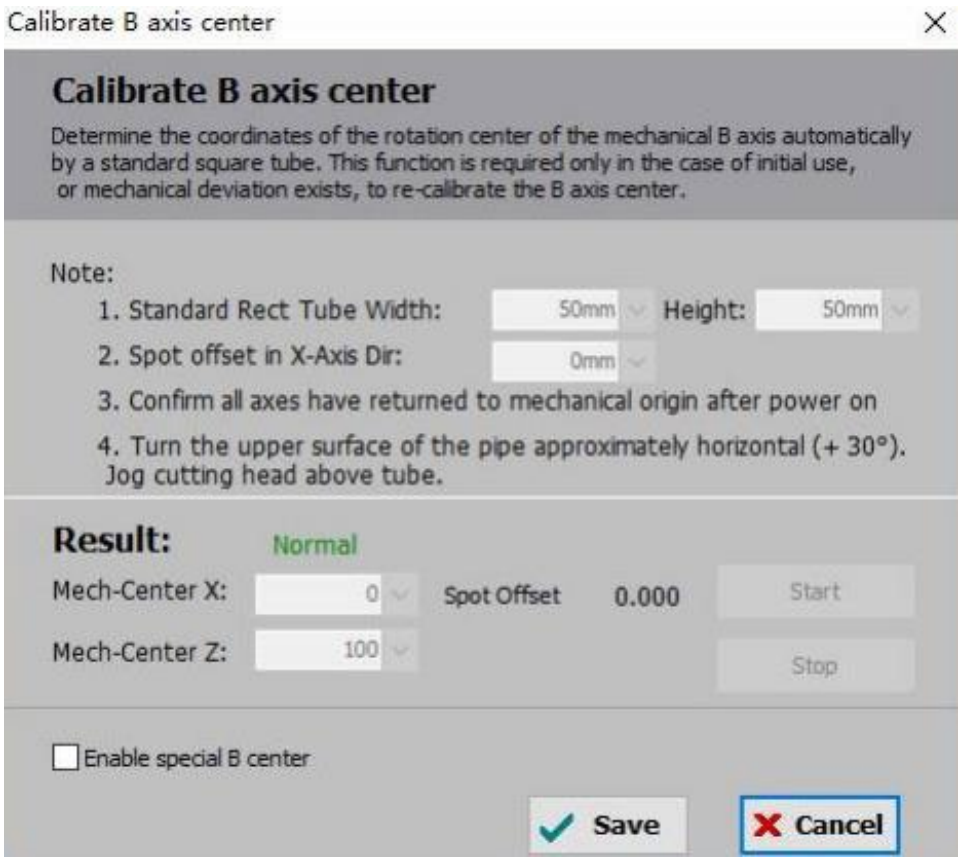


Figure 3-25: Calibrate B-Axis Center

Parameter Name	Meaning-Definition
Rectangular Tube Size	To set the width and height of a standard rectangular tube, it is recommended to use a standard rectangular tube without chamfering.
Spot Shift	Set the spot offset error of the current machine head. Application scenario: TubePro measures the center of the B-Axis based on the center of the nozzle. It is generally difficult to ensure that the laser spot is just at the center of the nozzle. Therefore, the cut has a certain deviation from the perforation. Dividing the deviation by two (2) fills the spot shift.
The Measurement Results	Displays the mechanical rotation center coordinate value.
Preserve/Cancel	Save will record the measurement result as the center of the B-Axis and cancel it will not save.

3.3 Function Debugging Software

1. Manual Chuck Debugging – When configuring the manual test chuck clamping/releasing action, use the stopwatch to measure the time required for the chuck to open and close. Next, configure the time into the chuck in-position time in the platform configuration tool. After the configuration is completed, test whether the in-place time is set properly. If the platform the configuration tool is configured with the middle card auxiliary chuck, the manual debugging interface will display the related button debugging function. If there is no configuration interface, the middle card auxiliary chuck will not be displayed.
2. Manual Bracket Debugging – The brackets in the safe area can be used debug the rise of the bracket and the function of the bracket.
3. Manual Single-Drive Debugging – The TubePro 5000B and 5000C systems first unlock the input password 61259023 for unlocking and can click the independent axis of the system for synchronization test and finally lock the synchronization. This function is a method for measuring the return distance of B1 and B2. The back-off distances of B1 and B2 are equal during the initial installation and the actual chuck are not synchronized. At this time, B1 and B2 are unlocked, then B1 and B2 can be leveled by jogging or stepping, then Locked. At this point you can open **[Tools] -> [Motion Control Monitor] -> [Motion Axis] -> [B-Axis]** to see how many radians of the mechanical coordinates of B1 and B2 differ and then convert the radians into angles (1 radians is approximately equal to 57.2974 degrees). The angle value of

the difference is the difference between the B1 and B2 back-off distances. For example, if the motion control monitor sees B1-B2=0.53 rad, that is, 0.53*57.2974≈30.3676º. If the setback distance of B1 is 40º, then the retraction distance of B2 should be 40º -30.3676º = 9.6324º.

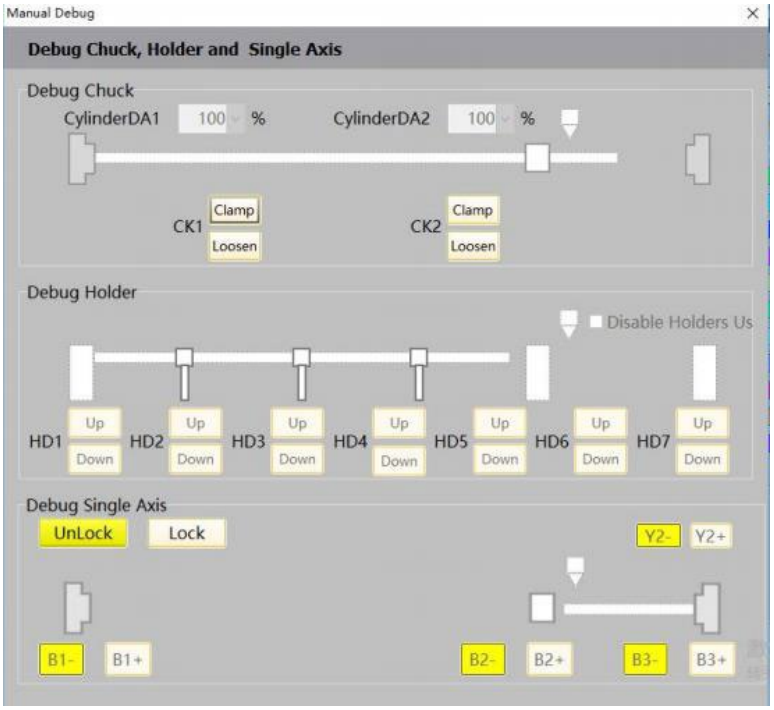


Figure 3-26: Debug Chuck, Holder, and Single Axis

The four (4) mode switching of the TubePro 5000A seven-axis system is a common operation, so the seven-axis debugging replaces the locking and unlocking box for single-axis debugging. Check the corresponding mode; there is no need to enter the password. When the B-Axis is out of synchronization warning pops up when it is back, switch the mode to Y2+B3 (back to medium mode) and then go back.

Figure 3-27: Mode

4. One-Button Cut – TubePro provides a one-button cut-off function that shuts down the position clockwise or counterclockwise. If the use of the starting point is checked, a starting point search will be performed before cutting.

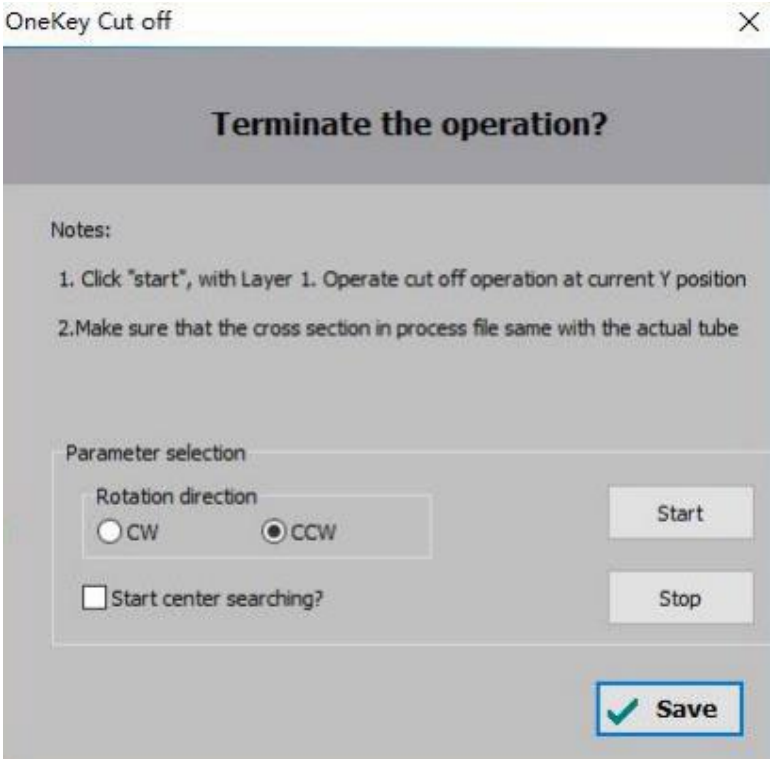


Figure 3-28: One-Button Cut

3.4 Monitoring Tools

1. Height Monitor – Monitoring here is a brief introduction to the BCS100E in the 5000A and 5000B systems. For the 5000C system height adjuster configuration, please refer to the BCS100 Standalone Capacitor Height User Manual V3.

Figure 3-29: Monitor

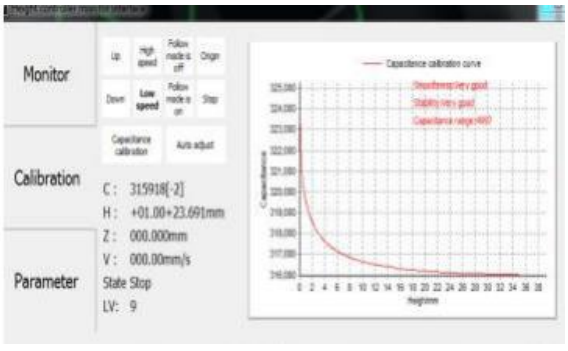


Figure 3-30: Calibration

Parameter Name	Meaning-Definition
Up and Down	Jog the Height Adjuster Z-Axis
Follow On/Off	Set to follow “On” or follow “Off”. Can set the following height to 1mm for testing.
Return to “Origin”	The Z-Axis is homed.
Stop	The height adjuster stops moving.
C	Height Adjuster capacitance.
H	Spacing between the nozzle and the sheet metal.
Z	Z-Axis Coordinate.
V	Z-Axis Speed.

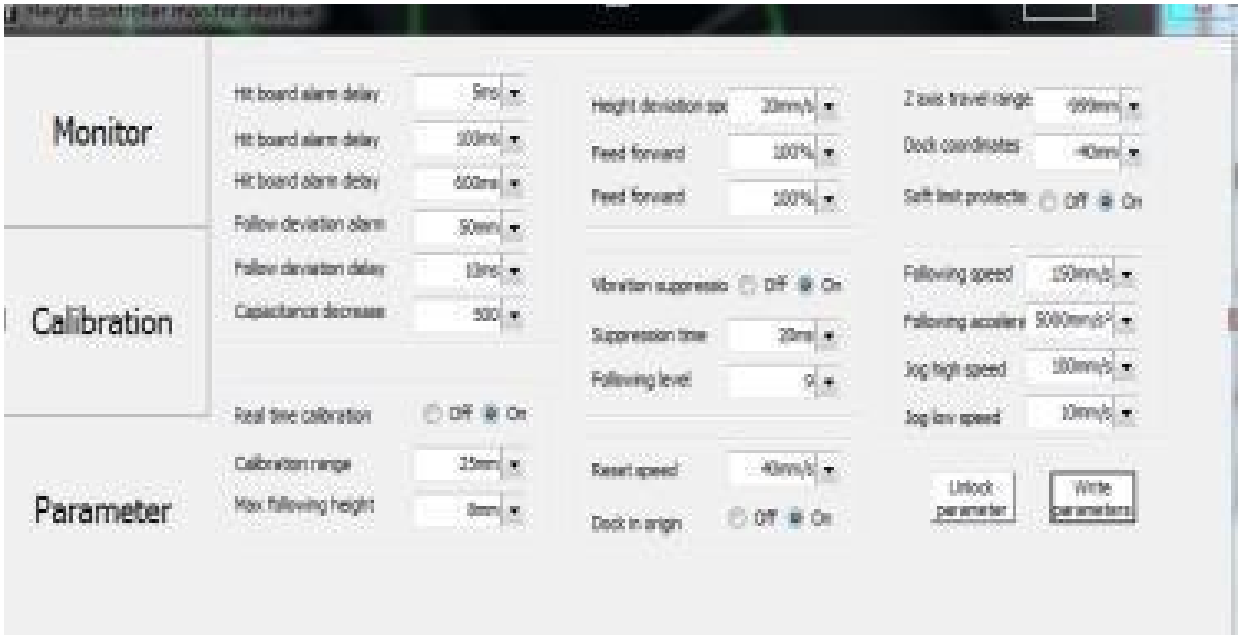


Figure 3-34: Parameter (1 of 2)

Parameter Name	Meaning-Definition
Empty Shifting Board Alarm Delay	When the system is stopped, if the duration of the touch panel reaches this time, the floating will automatically lift the protection and output an alarm signal.
Cutting the Board Alarm Delay	During the cutting process, if the duration of the touch panel (capacitance is 0) reaches this time, the floating head will automatically lift up the protection and output an alarm signal. When this value is set to 0, the touch panel alarm will no longer be triggered during the cutting process.
Punch Board Alarm Delay	During the piercing process, when the duration of the touch panel (capacitance is 0) reaches this time, the floating head will automatically lift up the protection and output an alarm signal. When this value is set to 0, the touch panel alarm will no longer be triggered during the cutting process.
Punch Board Alarm Delay	During the piercing process, when the duration of the touch panel (capacitance is 0) reaches this time, the floating head will automatically lift up the protection and output an alarm signal. If this value is set appropriately, it is possible to avoid false alarms caused by anti-slag during piercing. When this value is set to 0, the touch panel alarm is disabled when punching.
Follow Deviation Alarm	The maximum following error allowed by the BCS100. After the cutting head follows the position, the controller will generate an over-error warning when the following error exceeds the set alarm value due to the movement beyond the boundary of the sheet or the sharp vibration of the sheet.

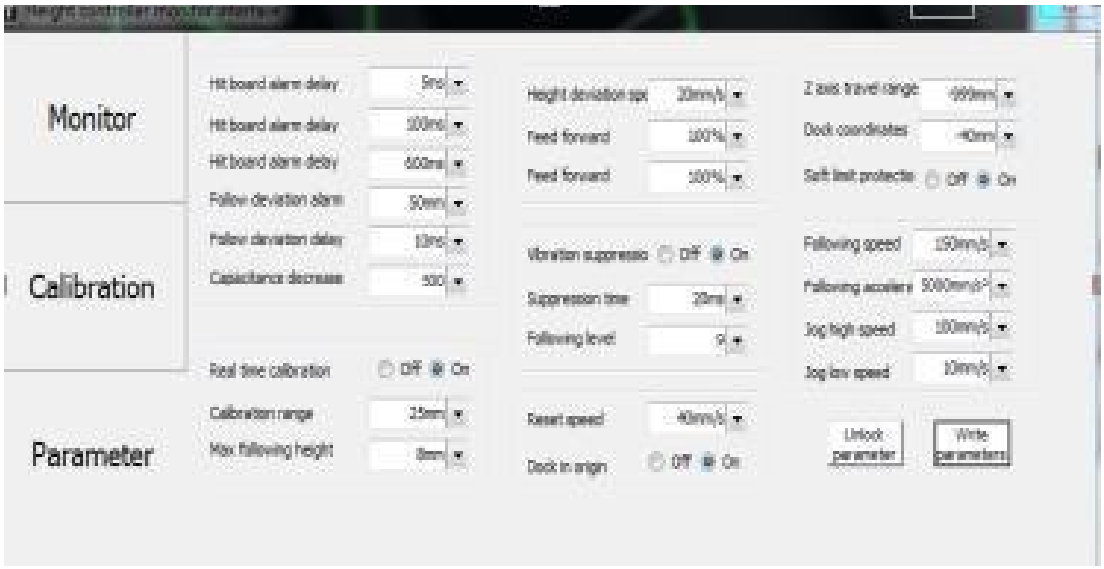


Figure 3-35: Parameter (2 of 2)

Parameter Name	Meaning-Definition
Following Deviation Delay	Set the filter time to follow the error alarm. The larger value, the longer the time allowed to generate the tracking error, and the stronger ability to filter out interference.
Real-Time Calibration	The real-time calibration function is turned on. The height adjuster will automatically calibrate the body capacitance of the cutting head after each machining to reduce the number of manual calibration of the height adjuster. When using this function, please ensure that the cutting head at the stop point is more than 30mm away from the board surface.
Calibration Range	The distance raised by the standard is recorded and the corresponding data is recorded. The default is 25mm.
Maximum Height to Follow	The maximum height directly followed. When the following height H exceeds this height, the height adjuster first follows to 1 mm and the back (H-1) mm.
Jitter Suppression	The vibration suppression function is turned on. This function can suppress the vibration caused by the cutting airflow disturbing the structurally weaker plate, thereby reducing the cross-sectional wave pattern. It can effectively suppress the jitter caused.

Parameter Name	Meaning-Definition
Inhibition Time	This parameter is the intensity of the vibration suppression function. The larger the value, the more obvious the vibration suppression function is, but it will reduce the response of the height adjuster. The default is 20ms and the recommended range is …
Following Level	The follow-up gain level is from 1 to 30 and the default is 17 levels. The larger the number of stages, the smaller the average error of follow-up, the faster the follow-up action, and the stronger the ability to climb the slope. But if the gain is too strong, the system will generate self-oscillation. This parameter can be obtained by (automatic) adjustment.
Reset Speed	Speed of Homing
Reset Back to Dock	Whether to return to the docking coordinates after returning to the …
Z-Axis Travel	Z-Axis travel range
Docking Coordinates	Z-Axis stop coordinates
Soft Limit Protection	Set whether the height adjuster enables soft limit protection.
Airspeed	Height Shifter
Airborne Acceleration	Air movement of the height adjuster
Jog High Speed	Set Jog high speed
Jog Low Speed	Set Jog low speed

2. Motion Control Monitoring – Motion control monitoring tool with motion axis monitoring and kernel status monitoring. On the motion axis monitoring page the operator may view the following: the enable status, alarm status, hardware limit status, software limit status, home switch status, screw compensation status, physical axis command position, feedback position, and mechanical coordinates of each servo axis.
   Movement Speed – At the same time, it can also send servo enable and disable enable commands, send pulse debugging, clear coordinates, and clear double drive alarm.

Parameter Name	Meaning-Definition
Axis Number	Configured Physical Axis Number
Encoder Feedback	Servo encoder feedback value, unit pulse.
Command Position	Command position, unit pulse.
Mechanical Coordinates	Machine Coordinate, the Coordinate Position of the System Command, in mm or rad.
Movement Speed	Current Servo real-time feedback speed.
Servo Alarm Status	Current Servo Alarm status
Negative Limit Switch Status	Current Negative hard limit input status.
Positive Limit Switch Status	Current positive limit input status
Origin Switch Status	Current origin input status
Negative Soft Limit Switch Status	Current origin input status
Positive Soft Limit Switch Status	Current negative software limit input status.
Positive Soft Limit Switch Status	Current positive software limit input status
Servo Status	Servo enable status, click to switch the servo enable status
Send Pulse	The specified pulse can be generated for testing when the system is stopped
Double Drive Error Clear	Clear double drive error
Mechanical Coordinate Clear	Set the physical axis coordinates to 0

On the kernel status monitoring page, the operator may view some of the more underlying kernel status information, such as Machine Coordinates, Program User Coordinates, Buffer

Quantity, and G-Code command information. The concept is more complicated and will not be described in detail here.

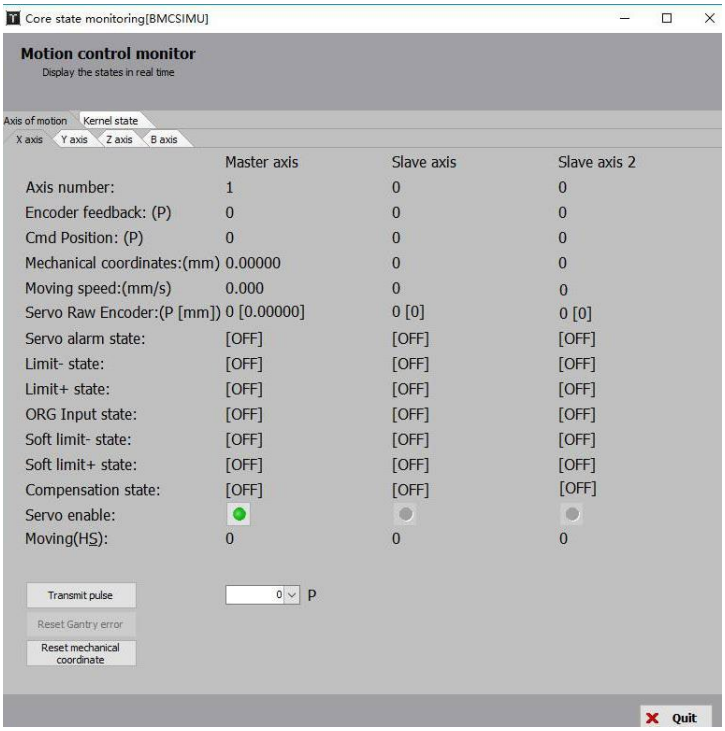


Figure 3-36: Motion Control Monitor

3. BCL4516/4516E/2720E Monitoring – Through the monitoring interface of the expansion board, the output port switch can be turned ON/OFF, the state of the input port can be monitored and the analog input port test can be completed. The expansion board monitoring interface allows the execution of debugging tests on PWM and DA to monitor the AD sampling results. In the case of the BCL4516e expansion board, jog tests and hard limit monitoring can also be performed on the focus axis.

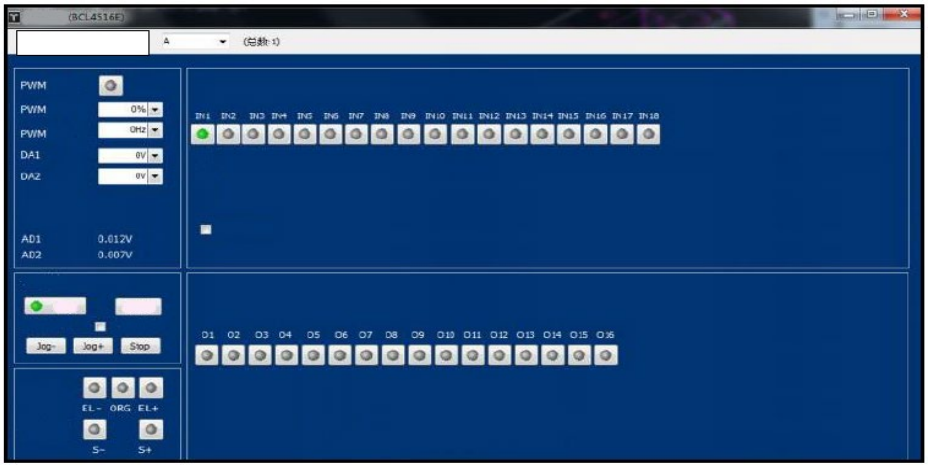


Figure 3-37: BCL4516/4516E/2720E Monitoring

3.5 Other Tools

1. Single-Sided Leveling – For profiled tube cutting, the normal method of searching cannot be applied normally. For example, only one surface is flat and the other surfaces are uneven. Single-Sided leveling can be used to level the shaped tube with a flat side and then cut. Ordinary D-Beams can be leveled in this way.

Parameter Name	Meaning-Definition
Gas Selection	Select the currently configured gas: Air/Oxygen/Nitrogen Select the currently configured gas: Air/Oxygen/Nitrogen
Open/Close Gas	Open/Close Gas
Set the number of Data Sets	Set the number of Data Linear Nodes
DA Automatically fills in	Equally set the DA distribution value automatically
DA output sequentially	Order the DA values in the data table in sequence
Output Next	Manually output the next DA value
DA output	DA Output
Actual Pressure	Actual Pressure

2. Gas Correction

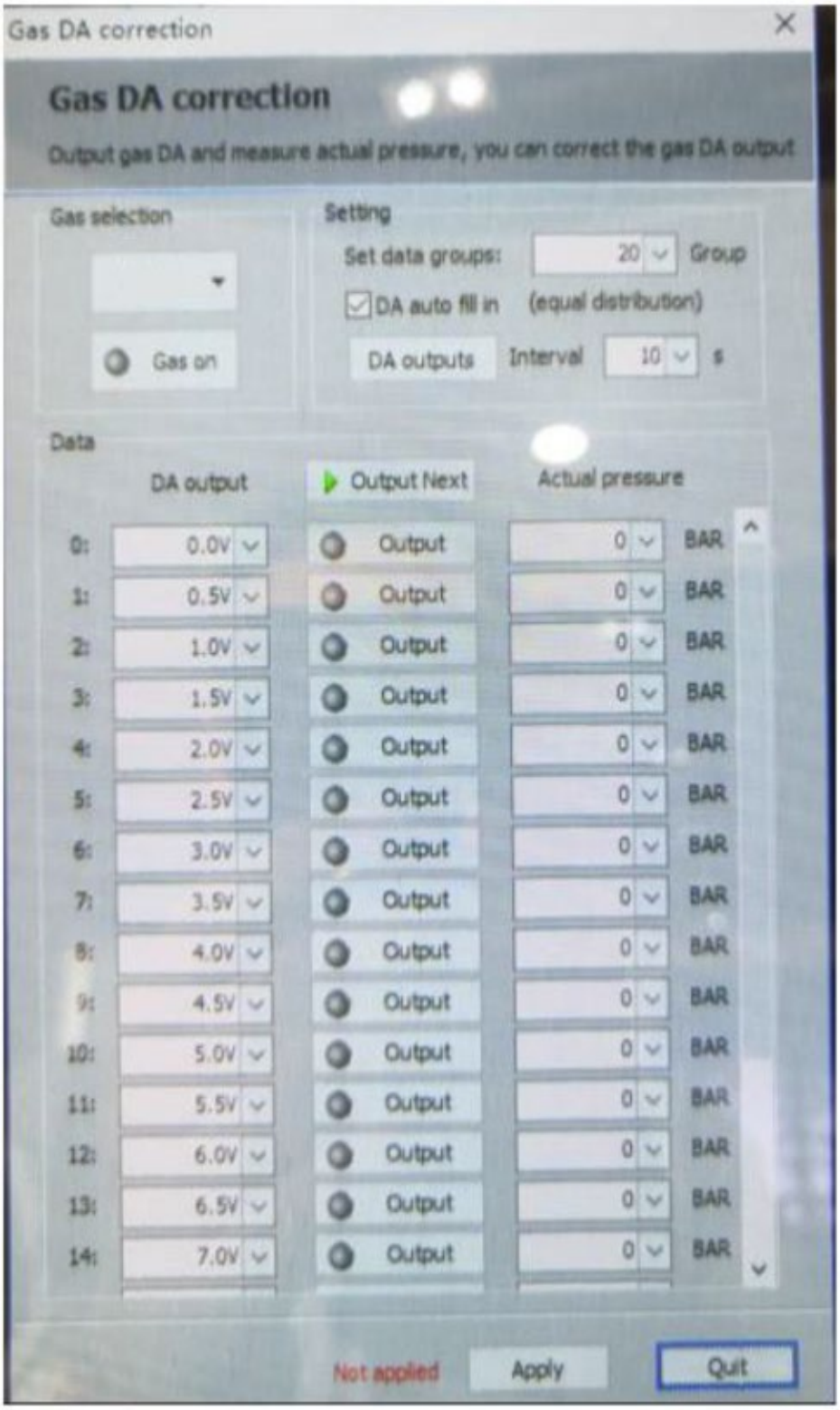


Figure 3-38: Gas DA Correction

Parameter Name	Meaning-Definition
Gas Selection	Select the currently configured gas: Air/Oxygen/Nitrogen Select the currently configured gas: Air/Oxygen/Nitrogen
Open/Close Gas	Open/Close Gas
Set the number of Data Sets	Set the number of Data Linear Nodes
DA Automatically fills in	Equally set the DA distribution value automatically
DA output sequentially	Order the DA values in the data table in sequence
Output Next	Manually output the next DA valve
DA Output	DA Output
Actual Pressure	Actual Pressure

3. Cycle Processing – Cyclic machining setting, used to solve the exhibition demonstration, it is necessary to cycle some graphics without light output; or with the automatic loading and unloading PLC, complete the cycle processing of the whole tube.

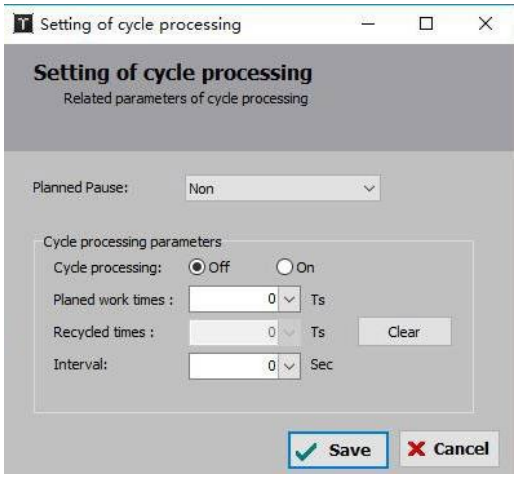


Figure 3-39: Setting of Cycle Processing

Figure 3-40: Gas DA adjust

Parameter Name	Meaning-Definition
Planned Supervision	Do not pause: Pause after machining the current track; pause after machining the current part; pause after processing the current file.
Cyclic Processing	Turn on cycle processing; turn off cycle processing
Planned Cycle Times	The number of cycles of processing
Cycle Interval	Interval between each cycle

4. Real-Time Monitoring – Real-Time monitoring, accurate sampling of servo axis command position, command speed, feedback position, feedback speed, feedback force, command position deviation, double drive position deviation, buffer quantity, height adjustment height in real time every millisecond. Each monitoring can select four (4) kinds of signals (Y1, Y2, Y3, Y4) for monitoring. The monitoring time range can be between five (5) seconds and twenty (20) minutes. Each monitoring can detect all the four (4) signals of the servo. By default, four (4) signal curves are drawn, passing through the bottom (Y1~Y4). Uncheck the box to display the signal you do not want to view or scale the specified curve separately within a certain range.

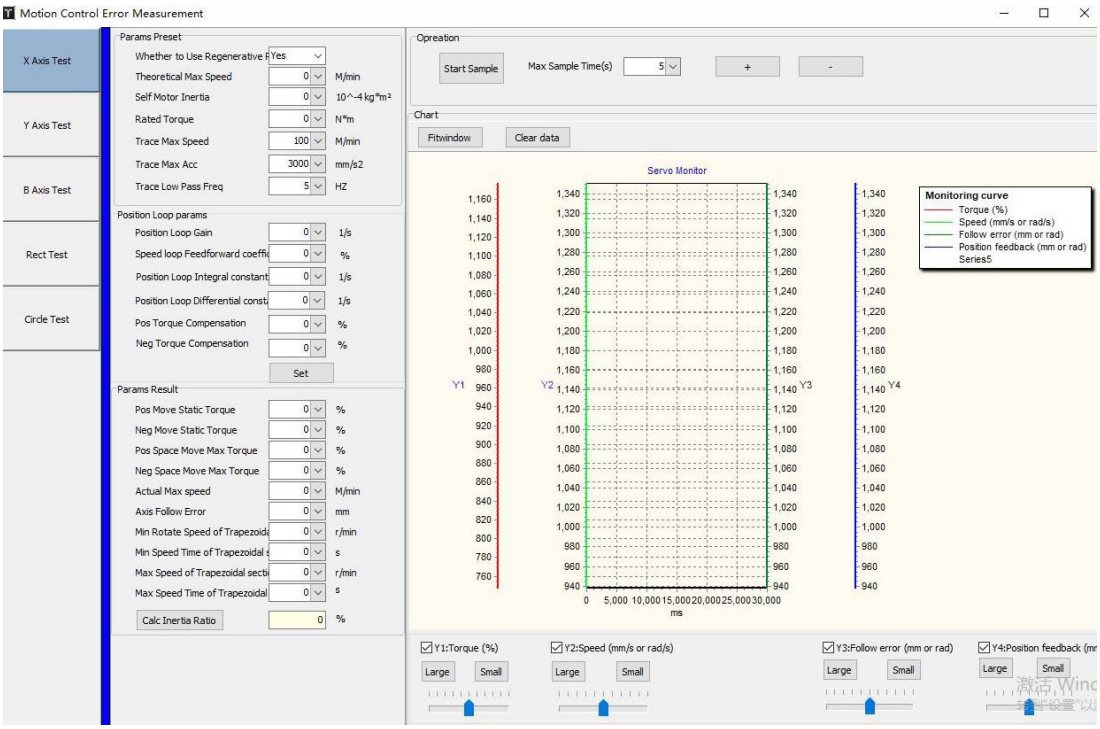


Figure 3-41: Motion Control Error Measurement

The vertical axis of the curve is scaled by the mouse's scroll wheel. The horizontal axis of the curve is zoomed by the right mouse button to select the curve within the specified time range. The graphic can be restored to the appropriate window by holding down the right mouse button and dragging it. Press and hold the left mouse button to pan the graph. Click the Left button of the mouse to display all the curve values at the position specified by the mouse. Click the Right button of the mouse to display all the curve values at the position specified by the mouse.

5. Error Measurement – The error measurement is divided into single axis test and X-Y plane linkage test. This feature is available for TubePro 5000A and TubePro5000B. The single-axis measurement is mainly used to check whether the inertia ratio of the single-axis servo is correct and whether the static torque is normal. The X-Y plane linkage test tests the command and feedback position error values for machining rectangular and circular paths.

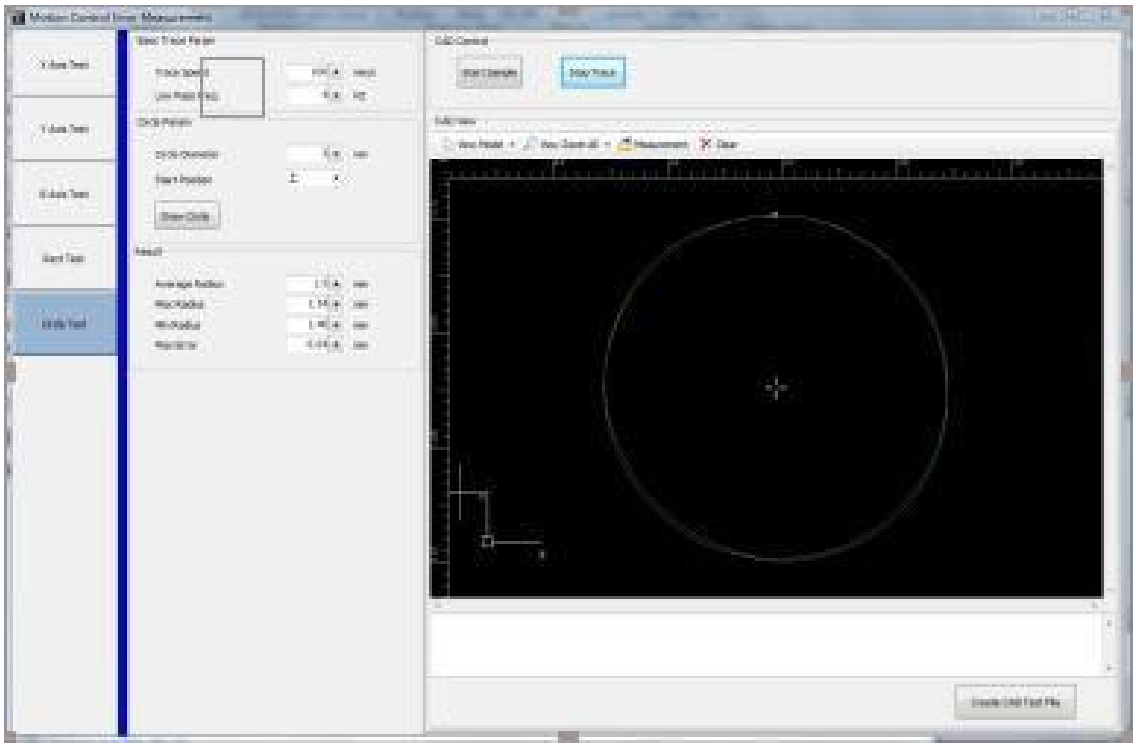


Figure 3-42: Circle Test

6. Generate CAD Test Graphics – To facilitate TubePro's ease of trial cutting, TubePro provides a CAD test tool for creating perforations on a rectangular tube. Users can quickly create a perforated graphic directly through it and then perform a simple test.

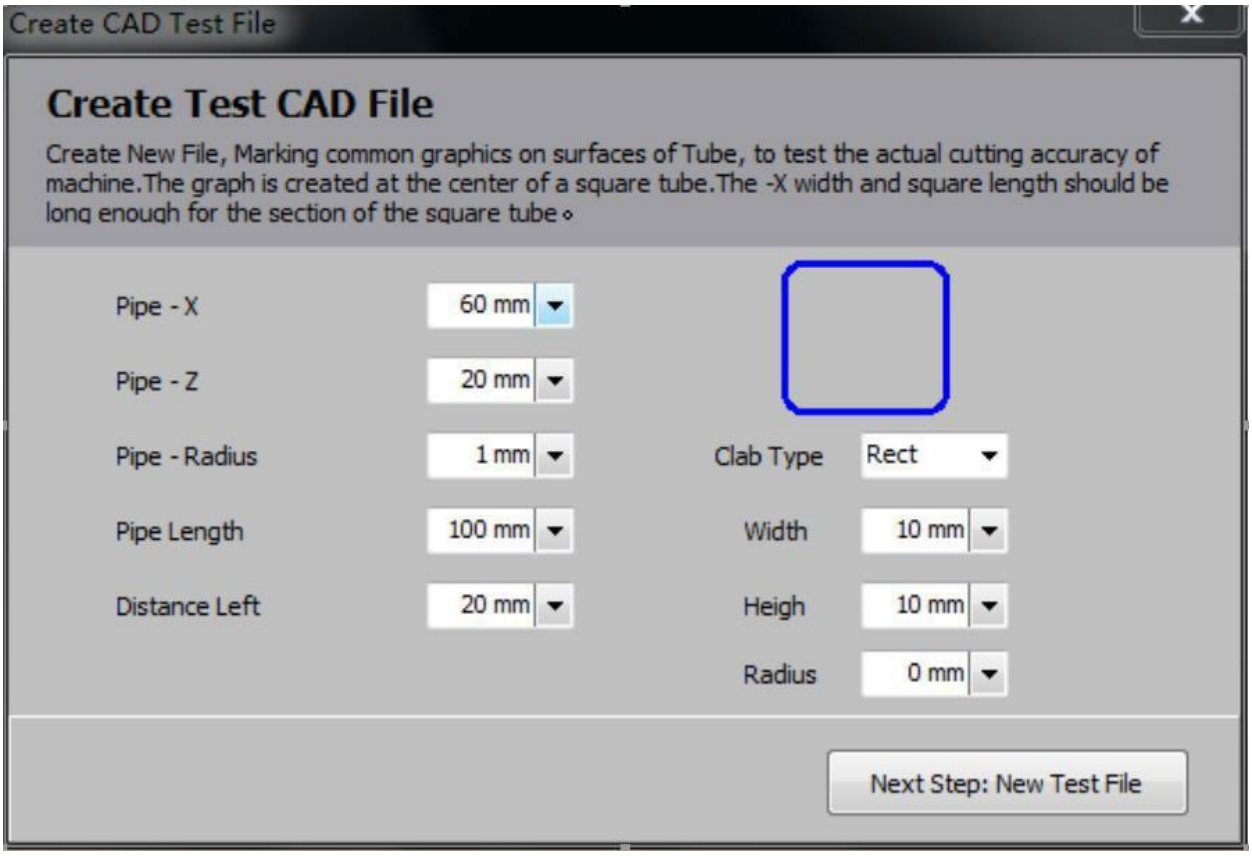


Figure 3-43: Create Test CAD File (1 of 2)

7. To facilitate TubePro's ease of trial cutting, TubePro provides a CAD test tool for creating perforations on a rectangular tube. Users can quickly create a perforated graphic directly through it and then perform a simple test.

Parameter Name	Meaning-Definition
Square Tube Section	X/Z Width, Chamfer Radius
Graphic Length	Generate the length of the Graphic
Plane Graphic Distance from near end face	Distance from Perforation to the Proximal End
Coated Type	Select a Circle/Rectangle for the Perforation and Set the Radius/Length and Width

8. Looking for the Middle – For L-Shaped and C-Shaped steel or rectangular tubes with uneven surface, the edge-finding method can be used for workpiece deviation measurement.

Figure 3-44: Create Test CAD File (2 of 2)

Parameter Name	Meaning-Definition
Modify the Edge Finding Scheme	Select 1-2 Face search/2-3 Face search/3-4 Face search/1-4 Face search in Four Ways
Rectangular Tube Size	Rectangular Tube Width and Height
Start Looking for	Start performing the search for edges
Search Results	Displays the eccentricity of the workpiece. The eccentricity value is equal to the workpiece center coordinate minus the rotation center coordinate value.
Save/Cancel	In the case of a successful or manual deviation value, save or cancel the application.

9. Square Tube Automatic Search – (Square Tube Five-Point Search) The square tube five-point search can complete the rapid flattening of the rectangular tube and the measurement of the workpiece deviation.

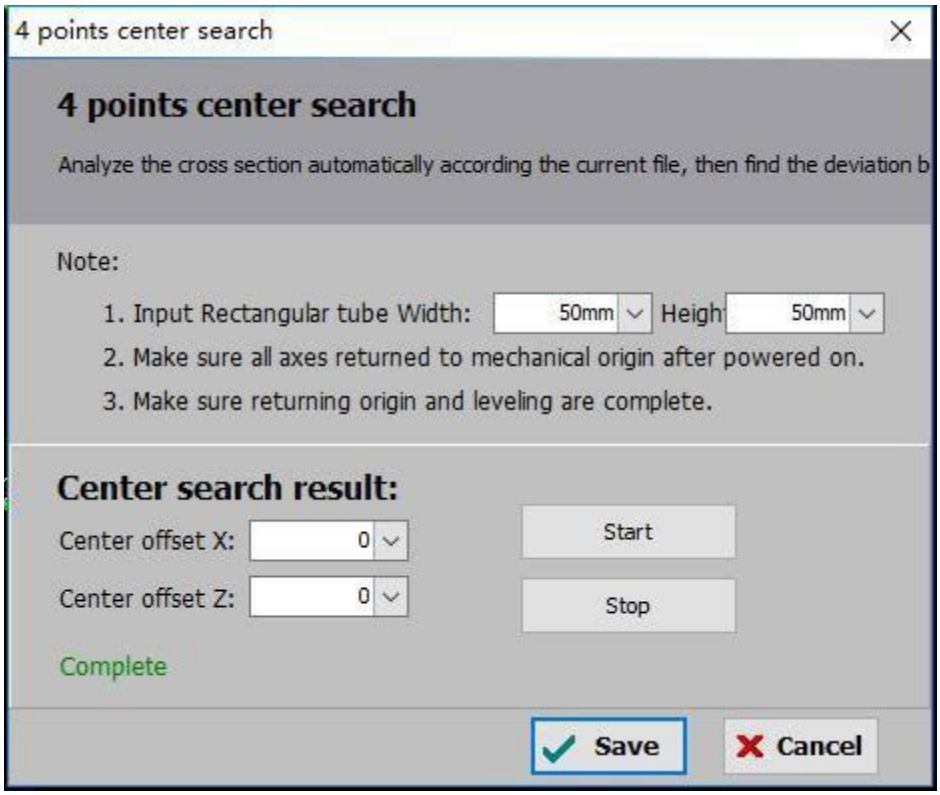


Figure 3-45: 4 Points Center Search

10. Square Tube/Round Tube/Runway Tube Four Points to Find – The square tube is found in four (4) points and the eccentricity measurement of the rectangular/circular can be completed.

Parameter Name	Meaning-Definition
Rectangular Tube Size	Rectangular Tube Width and Height
Start looking for	Start performing a Four-Point Search
Search Results	Displays the eccentricity of the workpiece. The eccentricity value is equal to the workpiece center coordinate minus the rotation center coordinate value.
Save/Cancel	In the case of a successful or manual deviation value, save or cancel the application.

11. Finding Repeated Tests – For the edge-finding performance test of the height adjuster, check whether the height adjuster performance is qualified. The maximum error of normal two-dimensional nozzle edge finding is within eight (8) wires and the three-dimensional nozzle is within twelve (12) wires.

Figure 3-46: Precision Analysis

Parameter Name	Meaning-Definition
Number of Edges	Set the Number of Repetitions of Edge Finding
Start looking for Edges	Start Performing Repeated Edge Finding
Edge finding result	The edge finding repeat result is displayed, each time checking the Coordinate Values of the left and right edges of the Rectangular Tube and the Maximum Error Value.

12. Square Tube Section Analysis – Through the section analysis, the appearance of the rectangular tube and test the deviation between the current real steel tube and the ideal rectangular tube can be viewed. Whether the right-angle deviation is greater than one (1) degree, the length and width of the rectangular tube and the error of the ideal length and width are large.

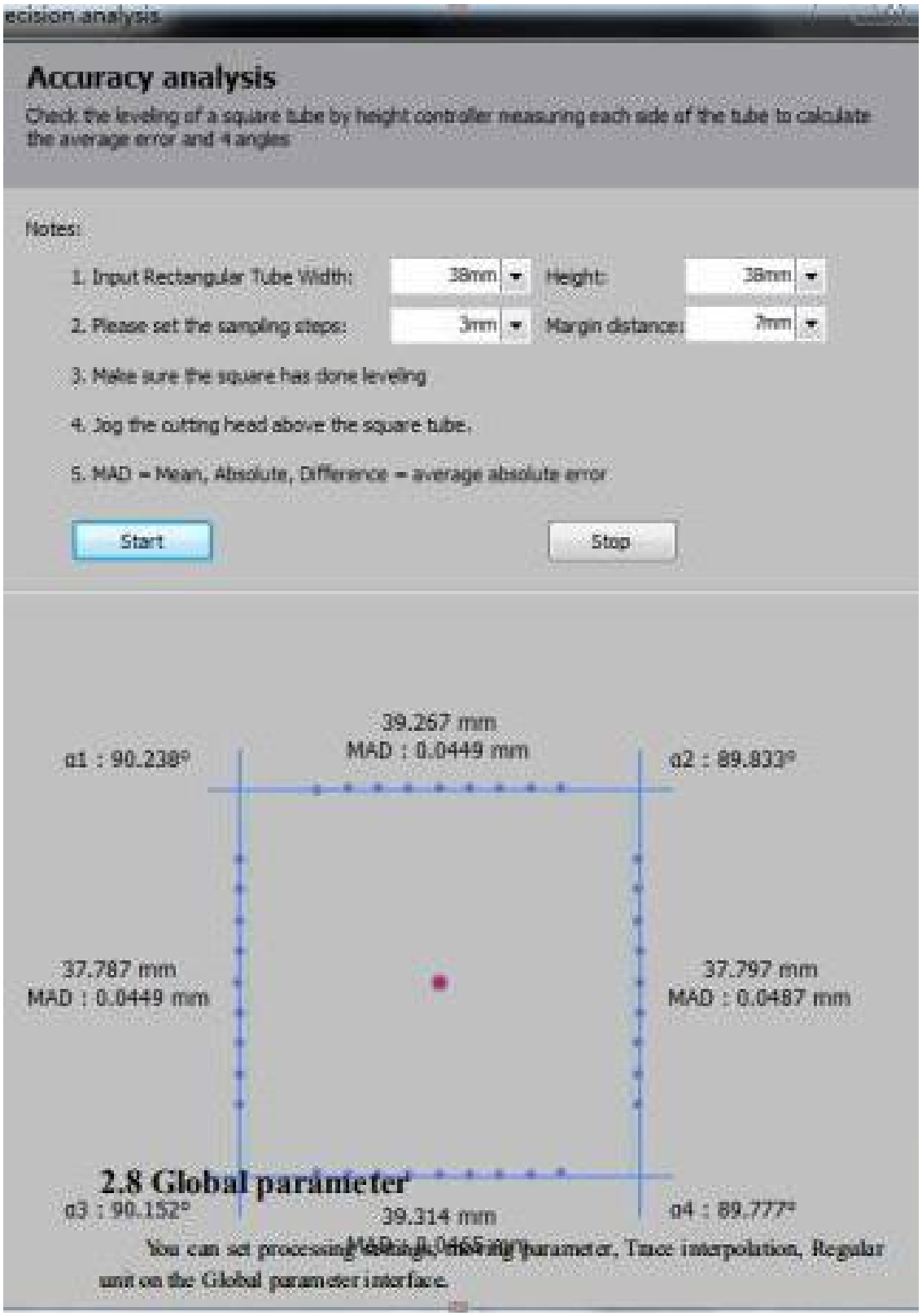


Figure 3-47: Accuracy Analysis

NOTES:

4.0 Global Parameters

The Global Parameters include settings for Machining Settings, Space Shift Parameters, Track Interpolation, and General Units.

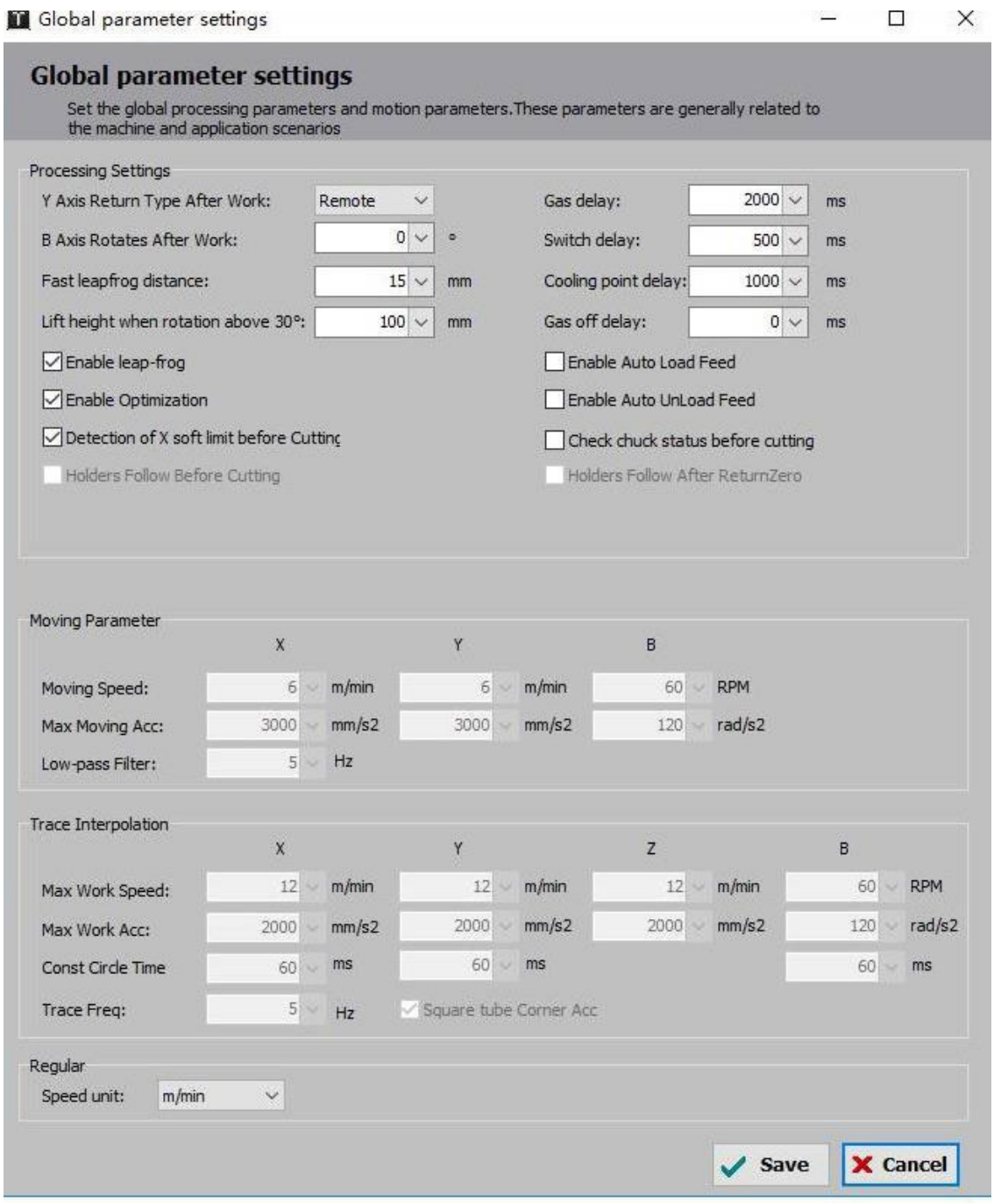


Figure 4-1: Global Parameter Settings

1. Process Settings

Parameter Name	Meaning-Definition
After machining Y-Axis return	Zero/Near End/Far End/End Point
After machining, the B-Axis is rotated	It is used for special machine processing, which is convenient for narrow-faced materials. It needs to be processed 90 degrees.
The way to find when processing	4-Point search/5 seek/find seek/B-Axis and square tube search
Air Release Delay	Time to ensure the arrival of new gas after opening a new gas path
Cooling Point Delay	Cooling Air Blowing Time
Delayed Gas	After the cutting is completed, the gas is turned off for a while. Accelerate short-distance
Reduce Re-Opening	Reduce re-opening
Fast Leapfrog Distance	Short-distance fast leapfrog for the same plane, shortening leap frog
Rotating height above 30 degrees	In the case of no space shift optimization, one of the safety height parameters for the face cutting and the height adjustment of …
Open the Leapfrog up	The idling process uses a leapfrog
Turn on null shift optimization	Using the air movement optimization, the height adjuster will be lifted according to the size of the steel pipe in the figure.
Pre-matching detection X-Axis soft limit	For large-diameter pipe cutting, the cutting process does not actually need to go to the frame and there is no need to check the soft limit.
Tun on automatic loading	Click to start machining, the file starts to be executed before the PLC
Turn on automatic cutting	After processing ends, the blanking PLC action after the end of the file

2. Air Shift Parameters

Parameter Name	Meaning-Definition
X/Y/B Air Movement Speed	Constraining single-axis machining speed
X/Y/Z/B Machining Acceleration	Constraining the acceleration of unixial machining.
X/Y/B Null Shift Low Pass Filter Frequency	Set the low-pass filtering frequency of the null shift. This parameter is related to the mechanical performance. The default is 5Hz. If the cutting error is large, the parameter can be changed.

3. Track Interpolation Parameters

Parameter Name	Meaning-Definition
X/Y/Z/B maximum processing speed	Constraining single-axis machining speed
X/Y/Z/B machining acceleration	Constraining the acceleration of uniaxial machining.
X/Y/Z/B turning acceleration	Constraining uniaxial turning
X/Y/Z/B turning acceleration factor	The default is 1
X/Y/Z/B processing low pass filter frequency	Processing low pass filter frequency, the default is 5Hz. The lower the filter frequency, the slower the speed and the higher the accuracy.

4. Speed Unit

Parameter Name	Meaning-Definition
Speed Unit	Mm/s m/s, m/min, in/min, in/s

4.1 Layer Parameters

If the drawing contains multiple layers, each layer contains a process that the user can set as needed.

1. Cutting Process – The cutting process can set parameters such as speed, air pressure, power, and delay the trajectory during processing.

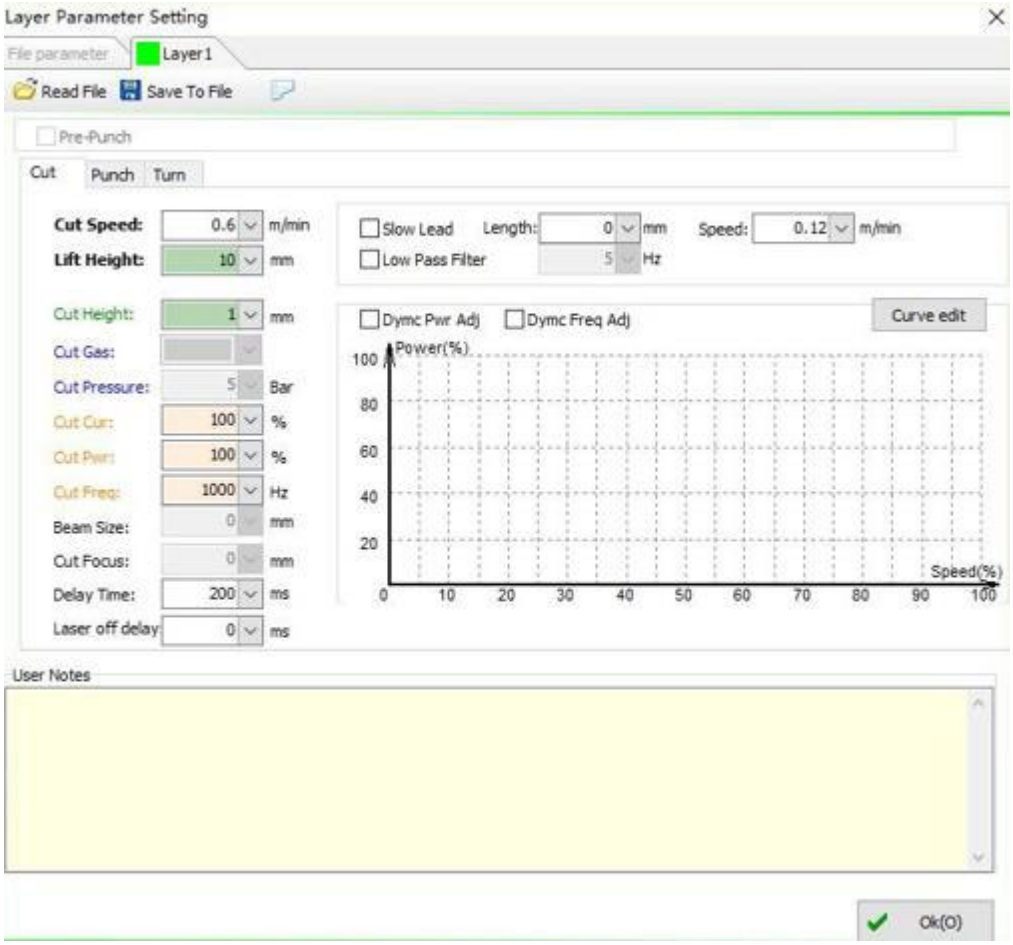


Figure 4-2: Layer Parameter Setting

Parameter Name	Meaning-Definition
Cutting Speed	Set the maximum speed of curve cutting when cutting.
Lifting Height	During normal machining, when the trajectory is cut, the height of the height adjuster is raised when the conventional air is moved to another curve.
Nozzle Height	The following height of the system when cutting.
Gas	Air/oxygen/nitrogen gas selected during processing.
Air Pressure	Pressure Value
Peak power	Set the peak power of the laser during the cutting process.
Duty Cycle	Set the duty cycle of the laser during the cutting process.
Pulse Frequency	Set the pulse frequency of the laser during the cutting process.
Spot Diameter	If the focus axis is used, the focus spot size can be set when cutting.
Focus Position	The focus position can be set when the focus is axis is used.
Residence Time	The time after the light is turned to the trajectory.
Delay Before Closing	Time from the end of the trajectory to the light.
Slow Start Distance	The distance from the beginning of each track is the starting segment.
Slow Start Speed	The set speed of the slow start section.
Slow Start Low Pass Filter Frequency	Set the filter frequency for slow start processing.
Adjust Power in Real Time	Setting the relationship between trajectory machining laser power and trajectory speed.
Adjust Frequency in Real Time	Setting the relationship between the trajectory processing laser frequency and the trajectory speed.

Double-Click on the **Curve Edit** to edit the power and frequency curves. On the left side click **Add Node** and select the smoothing type: Segmentation/Linear/Smooth.

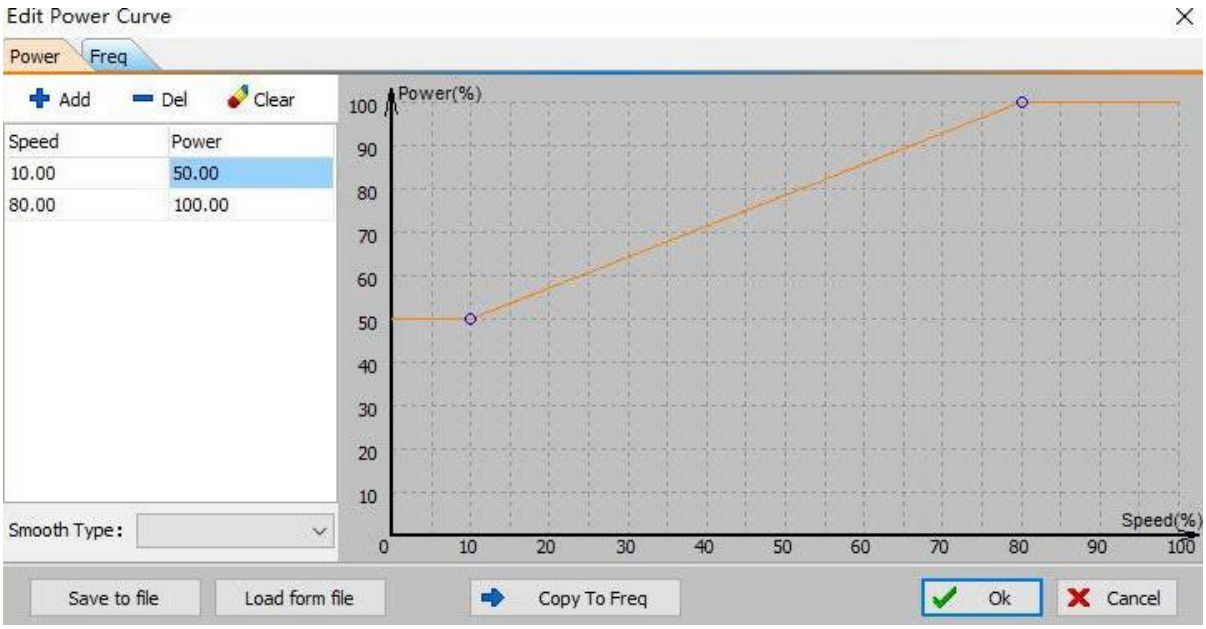


Figure 4-3: Edit Power Curve

Parameter Name	Meaning-Definition
Power/Frequency	Power/Frequency Curve Node Settings
Speed	Node's abscissa cutting speed
Power	The ordinate of the Node cuts the Laser Power.
Frequency	The ordinate of the Node cuts the Laser Frequency.
Smoothing Method	Segmentation/Linear/Smooth, Default is Linear.

2. Perforation Process – In the perforation process, the perforation mode can be set to be non-perforated, one-stage perforation, two-stage perforation, and three-stage perforation. Each level of perforation can be set with progressive perforation time, nozzle height, gas type, gas pressure, laser peak power, laser duty cycle, laser pulse frequency, set dwell time, and stop light blowing time. If the cutting head supports the focusing function, the spot diameter and focus position can also be set.

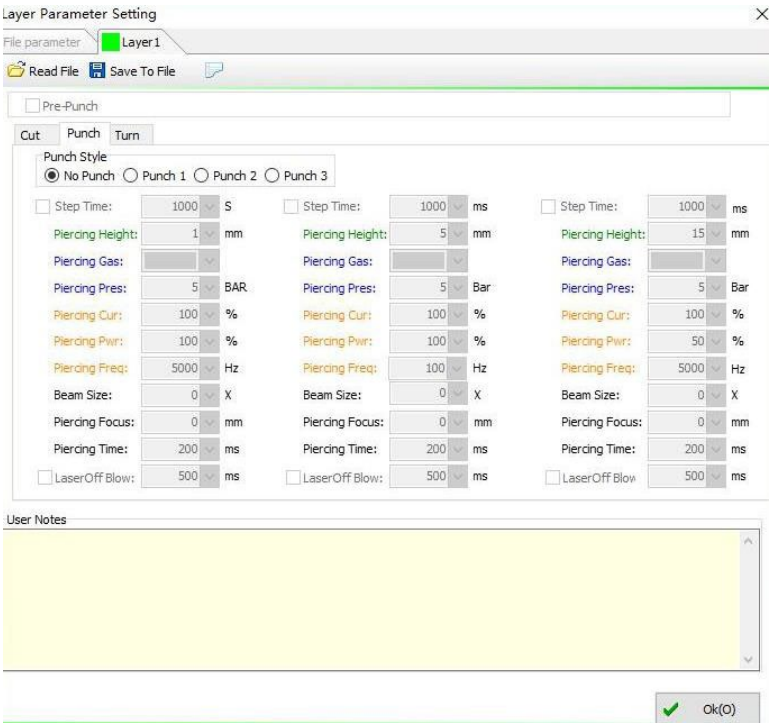


Figure 4-4: Layer Parameter Setting

Parameter Name	Meaning-Definition
Perforation Method	According to the thickness and material of the sheet metal, no perforation/first perforation/ secondary perforation/third perforation.
Progressive Time	At each stage of the perforation process, the nozzle height is slowly progressive.
Nozzle Height	Pierce process nozzle height.
Gas Type	Set the gas type for the perforation process.
Air Pressure	Set the air pressure during the piercing process.
Peak Power	Set the laser leak power of the punching process.

Parameter Name	Meaning-Definition
Duty Cycle	Set the laser duty cycle of the punching process.
Pulse Frequency	Set the laser frequency of the perforation process.
Spot Diameter	If the focusing axis is configured, the perforation spot diameter can be set.
Focus Position	If the focus axis is configured, the perforation focus position can be set.
Residence Time	The piercing time after the laser is turned on.
Stop Light Blowing	Stopping and blowing after piercing.

3. Corner Craft – Enabling the cornering process can make the rectangular tube corner cut better. In the corner process, the control unit is integrated, the corner air pressure, the peak power (need to configure the laser DA), the duty cycle, and the pulse frequency. Round tubes cannot be used in corner processes. The 5000A and 5000B support the integrated control and the 5000C does not enable the cornering process.

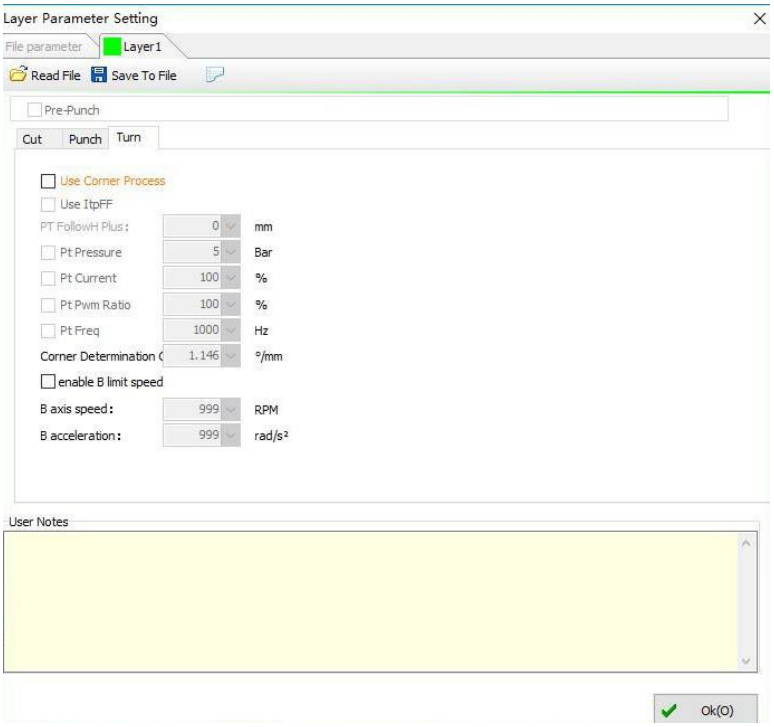
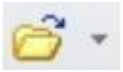


Figure 4-5: Layer Parameter Setting

4. Operation Process/Import Graphics – Click the **Open File**  button in the Quick Launch Bar in the upper left corner of the interface to bring up the Open File dialog box and select the graphic to be opened. The right side of the Open File dialog provides a quick preview window to help quickly find the files required.

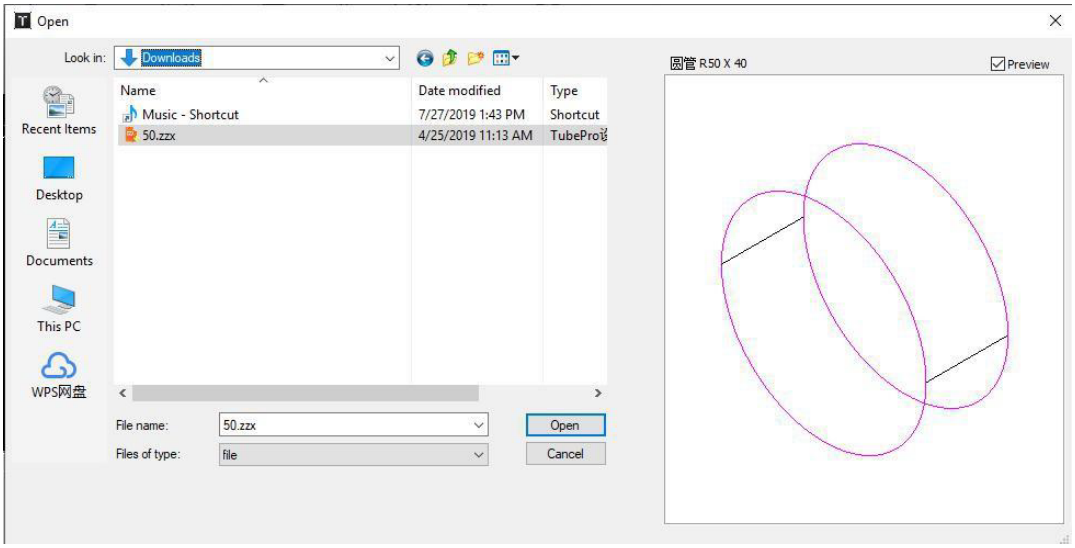


Figure 4-6: Open File

NOTE

Verify the imported graphics are oriented in the same direction as the drawing, otherwise it may cause incorrect import graphics. It is also recommended to introduce a small, rounded transition during drawing to make the machining rotation smoother.

The software will automatically recognize the contour trajectory needed in the process and the auxiliary lines that are identified as not needing to be processed are indicated by gray lines.

Before the formal processing map the graphics on the screen to the machine. After clamping the square tube part, place the cutting head on top of the tube and click the Automatic Edge Finding button on the wireless handheld box. The software will automatically calibrate the

square tube level and find center of rotation. Once the center of rotation is found, click the button on the software to record the center of rotation.

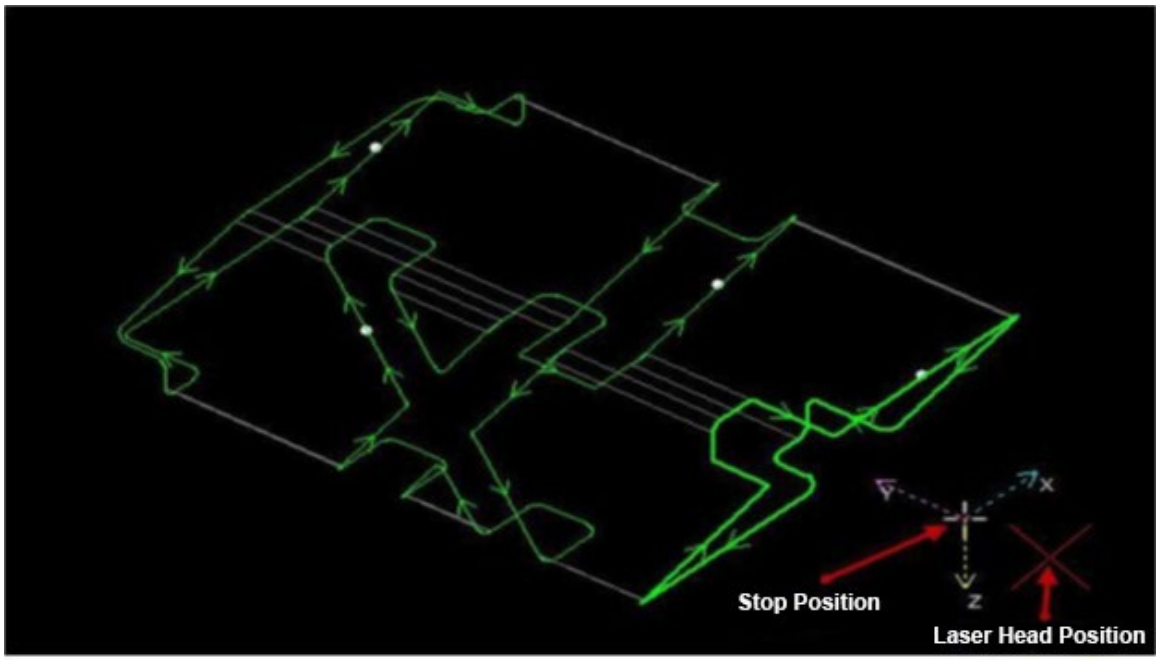


Figure 4-7: Stop Position and Laser Head Position

If the laser head position indicated by the red cross cursor does not match the laser head position on the actual machine, check if the program zero or mechanical zero is correct. The relative relationship between the graph and the stop can be changed by clicking the Dock button on the toolbar. For example, if the laser head is located at the nearest end of the workpiece to be machined, the part is machined from Y- to Y+; when most end is selected, the part is machined from Y+ to Y- direction.

The direction of the kerf compensation can be manually selected or it can be automatically judged according to the positive cutting and the negative cutting. The male cutting is compensated outward and the negative cutting is compensated inward.

For kerf compensation, choose whether to fill the corner with a rounded corner or a right angle, as shown in the following figure: the vertical line made at the corner of the original image. It can be seen from the figure that the compensation of both sides of the vertical line can ensure that the edge of the slit coincides with the original image, but the corner needs a transition. Usually, the rounded transition ensures that the edge of the kerf remains coincident with the original image during the transition and runs lighter. To cancel the compensation, select the graphic and click the **Clear** button and select **Cancel Compensation**.

5. Layer Parameters – the software provides fifteen (15) layers, each of which can be individually set to include process parameters such as cutting speed, laser power, air pressure, and cutting height. Click the **Layers** button on the toolbar to open the layer Parameter Settings dialog, which contains almost all the process parameters required for machining. The first page of the dialog is Global Parameters which is used to control parameters outside the layer, such as airspeed, spot power, etc. as well as speed and acceleration units. The other pages of the dialog box list all the layers currently in use. Click on each layer to set the parameters of the layer separately. Hold down the layer and drag to change the order between the layers. The previous layer is processed first.

NOTE

The contents of the Layer Parameter Settings dialog box may display different options depending on the laser used, the pipeline configuration, and the height adjuster used. The following figure is for reference only, please use the software. The actual display is correct.

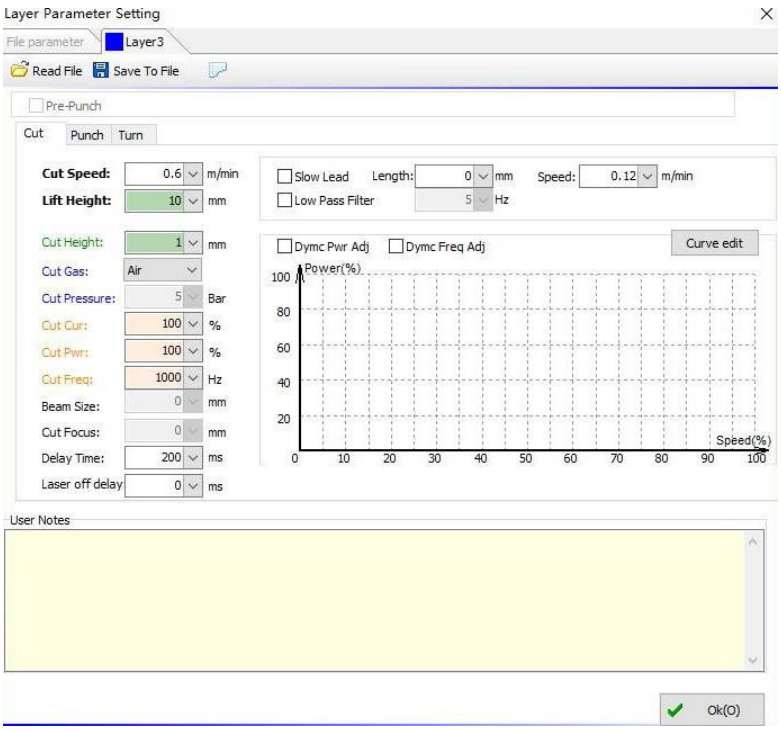


Figure 4-8: Layer Parameter Settings

Parameter Name	Meaning-Definition
Cutting Speed	Set the sections target speed of the cutting the actual tack and cut. The Due to bend. In the first and acceleration last and deceleration, the actual cutting speed is often less than this speed.
Piercing Time	The time required to break the cut sheet. Set according to the thickness and material of the actual board (the parameter can be set very small or even set to 0 when progressively puncturing).
Lifting Height	Set the height of the laser head up after cutting a curve. When the cutting is paused, the Z-Axis will also be lifted to a certain height, which is also the lifting height.
Peak Current	Set the peak current of the fiber laser which is the peak power. The peak power determines the maximum cutting power that the machine can achieve. For a 500W cutting machine, if the peak current is set to 80%, the peak power that can be achieved during cutting is 500W* 80%=400W.

Cutting Type	
Cutting Directly	Perforation and cutting use the same parameters, often used for sheet cutting.
Segment Perforation	Perforation and cutting use different parameters and are often used for thick plate cutting.

Cutting Type	
Progressive Perforation	Based on the segmented perforation, a perforation method with a variable defocusing amount which is slowly lowered while being perforated is used for thick plate cutting. The perforation time can be set very small during progressive perforation, such as 100ms, where the actual perforation time = 100ms + the time required to slowly descend from the perforation height to the cutting height.
Three-Level Perforation	Based on the perforation described above, the blasting height is reduced from the blasting height to the perforation height by a gradual or segmented method, which is often used for slab perforation.
Fixed Height Cutting	The first the following is set to the height of the cutting distance from the sheet, the closing is followed, and the Z-Axis coordinate is maintained for cutting.
Off-Board Follow	Cut directly into the board from the outside of the board without punching, often used for thick plates or high precision requirements. Part cutting, use the Save Reference Height function of the global parameters

Cutting Parameters	
Cutting Power	Set the laser power used for cutting, that is the duty cycle of the PWM modulation signal.
Cutting Height	Set the height of the laser head from the sheet when cutting.
Cutting Air Pressure	Set the air pressure of the auxiliary gas during cutting and use it with a proportional valve or a multi-valve valve.

Cutting Parameters	
Cutting Frequency	When setting the perforation, the carrier frequency of the PWM modulation signal is generally lower at the time of perforation, and pulse perforation is used to avoid blasting.
Cutting Gas	Set the type of assist gas used for cutting.

Perforation Parameter	
Progressive Speed	Sets the speed from the perforation height to the cutting height
Punch Power	Set the laser power used for the hole, that is, the duty cycle of the PWM modulation signal.
Piercing Height	Set the height of the laser head from the sheet when piercing.
Perforation Pressure	Set the air pressure of the auxiliary gas during perforation and use it with proportional valve or multi-valve.
Piercing Frequency	When setting the perforation, the carrier frequency of the PWM modulation signal is generally lower at the time of perforation and pulse perforation is used to avoid blasting.
Perforated Gas	Set the type of assist gas used for perforation.

The following table gives a brief description of some of the parameters in the layer:

Other Parameter	
Enable Short Distance Without Lifting	When this function is enabled, if the air movement distance between two (2) graphics is smaller than the setting value of the maximum air movement length of short distance not uplift in the global parameter, the Z-Axis will not be lifted after the previous graphics processing is completed and it is directly empty. Move to the beginning of the next drawing to start machining.
This layer does not follow	The height adjuster is used for cutting motion when cutting.
Film Cutting	For the part to be burned with a lower power at a higher follower height, then cut along the trajectory.
Adjust Power in Real Time based on Speed	When this function is enabled, the system will adjust the laser power (duty of the PWM signal) in real time according to the actual cutting speed during machining, which will greatly help to optimize the cutting quality of the corner.

NOTES:

5.0 The CypCut Laser Cutting Control System – Using and Programming

5.1 QuickStart

5.1.1 Features

- Supports AI, DXF, PLT, Gerber and other graphic data formats, and accept the international standard G-Code generated by Master Cam, Type3 and other software.
- To conduct automatic optimization when opening/importing DXF and other external files, including: to remove repetitive lines, merger connected lines, remove tiny graphics as well as automatically distinguish inside and outside dies and conduct sorting. Automatic optimization process can be defined and the above each function can also be carried out manually.
- To support common editing and typesetting functions, including zooming in and zooming out, rotation, alignment, copying, combination, smoothness, and connection and so on.
- To use the easiest way to set the lead, slotted compensation, micro connection, bridge connection, over cut, lead seal gap and so on.
- To distinguish the overcast and yang cut, determine the direction of slotted compensation in accordance with the overcast cut and yang cut and check the led.
- To support curve splitting and connection, curve smoothness, text-to-curve, component integration and exploding.
- With Flexible automatic sorting and manual sorting functions, to support the function to fix the processing order through group.
- With browsing capabilities of processing order, to check the processing order in a more interactive way than that of imitation.
- To support poly punching and incremental punching, pre-punching. To support the settings of separate laser power, frequency, laser form, type of gas, air pressure, and following height for punching process and cutting process.
- To support the speed capacity control and set separate lead velocity.
- With Powerful material library functions, to keep all processing parameters so that it can be provided again for the same material.

- With processing breakpoint memory, to trace the breakpoint forwards and backwards, to process some graphics.
- To be able to be positioned to any point in the process of stop or temporary stop; to start processing from any position.
- The same set of software supports round pipe cutting and plane cutting and the way of programming is the same; to support intersecting line cutting.
- To support Cover cut, auto seek edge, cutter starting and cutter lifting.
- With the powerful expansion capacity, as much as 15 PLC process edit and more than thirty (30) programmable process.
- Programmable input and output outlet, programmable alarm input. To support the remote control of the system through wireless teach box and Ethernet.

5.1.2 Obtaining and Installing the Software

Contact the supplier or customer service staff to obtain the software installation program. Before installing the software, please check whether your system meets the following minimum requirements of desktop/laptop:

- The operating system should be above Windows 2000.
- CPU with basic frequency above 1.0G.
- The VGA monitor should be more than fifteen (15) inches with a resolution of more than 1024*768 and it would be better to use 32-bit true color display.
- The memory should be 512mb at least.
- There should be two (2) USB interfaces at least.

If the operating system is vista-based (including Windows Vista, Windows 7, Windows 8, Windows 2008 server), please run the system as an administrator as much as possible, to avoid the possible errors.

After completing the inspection, start to install the software. Run the installer directly. To install the program in Vista-based operating system, administrator permission is required.

To prevent the program files from being modified during the installation process and ensure the normal installation of all drives, please close 360 security guards and anti-virus software in the system.

NOTE

360 security guards cannot guarantee that there are no viruses in the computer. If the computer has been infected by the viruses, while 360 security guards are running, it may point out that CypCut is a virus and then cause CypCut not to run normally.

5.1.3 Starting to Use CypCut Program

After installation, an icon shown on the right will appear on the desktop. The Cypcut laser cutting control system will run after.

Double-click shown icon  .

User Interface

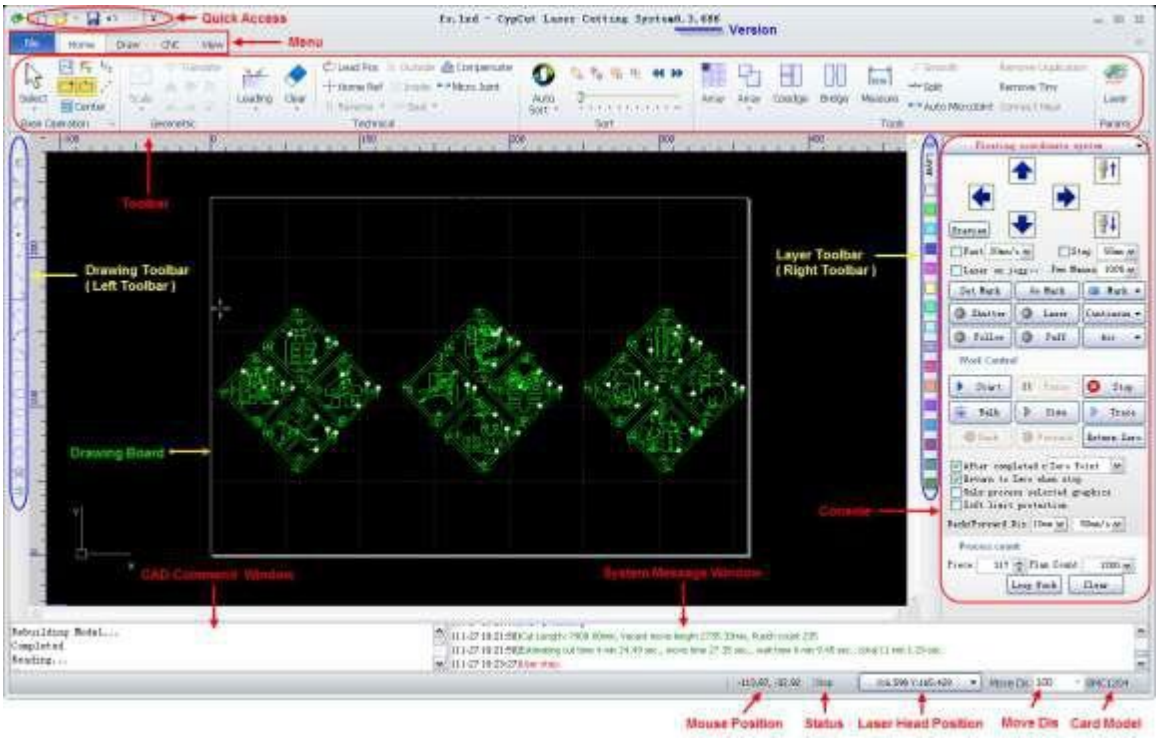


Figure 5-1: User Interface

The figure with black background in the center of the interface is the Drawing Board; while the white frame with shadows represents the machine breadth and it displays with grey grids. The staff gauges at the top and the left of the drawing area and the grey grids will change with the zooming of the views and in this way they can provide references for drawing.

Above the interface from top to bottom one by one are Title Bar, Menu Bar, and Toolbar. The toolbar is arranged with obvious large icons in grouping and most of the common functions can be found here. The menu bar includes the menu – **File**|| and four (4) toolbar menus, namely – **Start**||, -**Drawing**||, -Numerical control|| and -**View**||, and toolbar display can be switched through selecting these four (4) menus. There is a toolbar called – **Quick Access Bar**|| at the left of the title bar, which can be used for fast creating, opening, and saving a file; besides, undo and redo commands can also be finished quickly here.

At the left of the interface is – **Drawing Toolbar**||, which is called directly Left Toolbar|| in the following instructions. It provides the basic drawing functions and the first five (5) buttons are used to switch the graphics mode, which includes selecting, node editing, order editing, dragging, and zooming. The following other buttons respectively correspond to a graph and a new graph can be inserted in the drawing board by clicking these buttons.

At the right of the drawing area is -**Layer Toolbar**||, which is called directly **Right Toolbar**|| in the following introduction. It includes a -**Layer**|| button and sixteen (16) color square buttons.

-Layer|| dialog box can be opened by clicking the – **Layer**|| button, and then most of the parameters can be set.

Each of the sixteen (16) color square buttons corresponds to a layer and when a graph is selected, the selected graph can be moved to the specified layer by clicking these buttons, when no graphs are selected, it means to set the default for the next drawing by clicking these buttons. The first white square indicates a special layer. When -**Layer 0**|| is displayed, the graph on this layer will be shown in white and it cannot be processed.

There are two (2) scrolling displayed text windows below the interface. The left one is -**CAD Command Window**|| and input CAD instructions or coordinates. The related prompting messages of all the drawing instructions will be shown here. The right one is **– System Message Window**|| and other system messages all will be displayed here except drawing. Each message had time mark and they will be shown in different colors according to the importance of the message, which includes prompting, warning, alarming, and error and so on.

There is a Status Bar at the bottom of the interface, which can show different prompting messages according to different operations. There are some commonly used messages at the right of the status bar, including the locations of the mouse, processing status and the location of

the laser head. The last one is the fine-tuning distance parameter, which can move the graphs quickly be using direction keys. See the descriptions in related chapters.

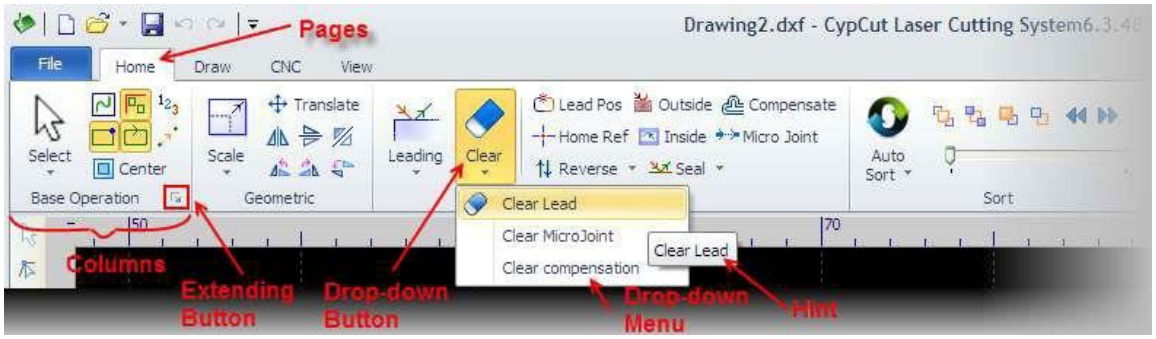


Figure 5-2: Status Bar

The rectangular area at the right of the interface is called **Console**|| and most common operations related to control will be done here. From top to bottom one by one are choices of coordinate system, manual control, work control, processing options, and processing count. In some versions, off-board cutting control is also included.

5.1.4 Toolbar

The toolbar of CypCut uses a style called Ribbon. It puts the common functions by column and area and applies many large-size buttons for easy operation.

The whole toolbar is divided into four (4) pages, which can be selected by the four (4) menus -**Start**||, -**Drawing**||, -**Numerical control**|| and -**View**||. When selecting text and other special objects, the pages related to the selected contents will appear. Furthermore, the page -Being Processed|| will appear during processing and it cannot be switched to other pages before stopping.

The toolbar of each page will be arranged again in multiple -Columns|| according to the functions, such as -**View**|| and -**Geometric transformation**||. The first buttons of the general columns are all in large size and there is a small button - || at the lower right corners of some columns, which is called -**Extending Button**|| and a related dialog box can be opened by clicking this button.

‘

NOTE

There are small triangles below some large-size buttons, which are called – Drop-Down buttons||, a related – Drop-Down Menu|| will appear after pressing the button, two (2) obviously different rectangles will appear, the corresponding function of the button can be directly executed by pressing the upper part of the button, while a menu can be opened by pressing the lower part of the button.

5.1.5 File Menu

There is a special menu called -**File Menu**|| at the upper let corner of the toolbar and it contains some menu items related to the files. The menu can be opened by clicking the File button as shown below:

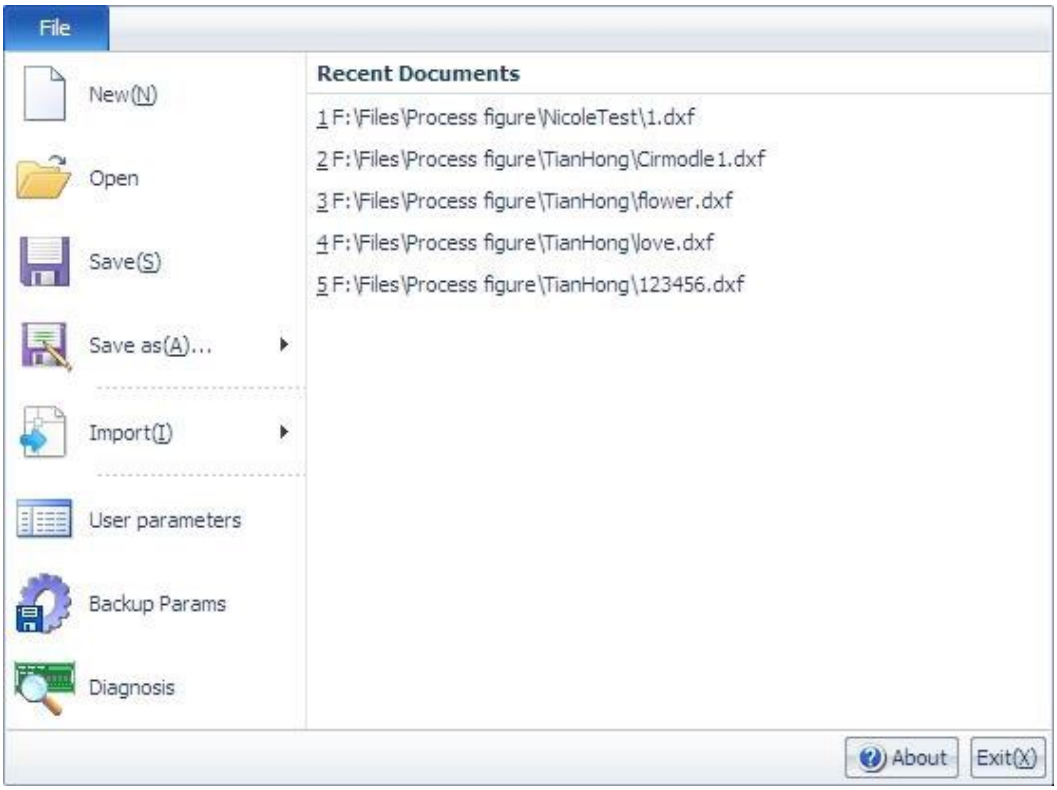


Figure 5-3: Recent Documents

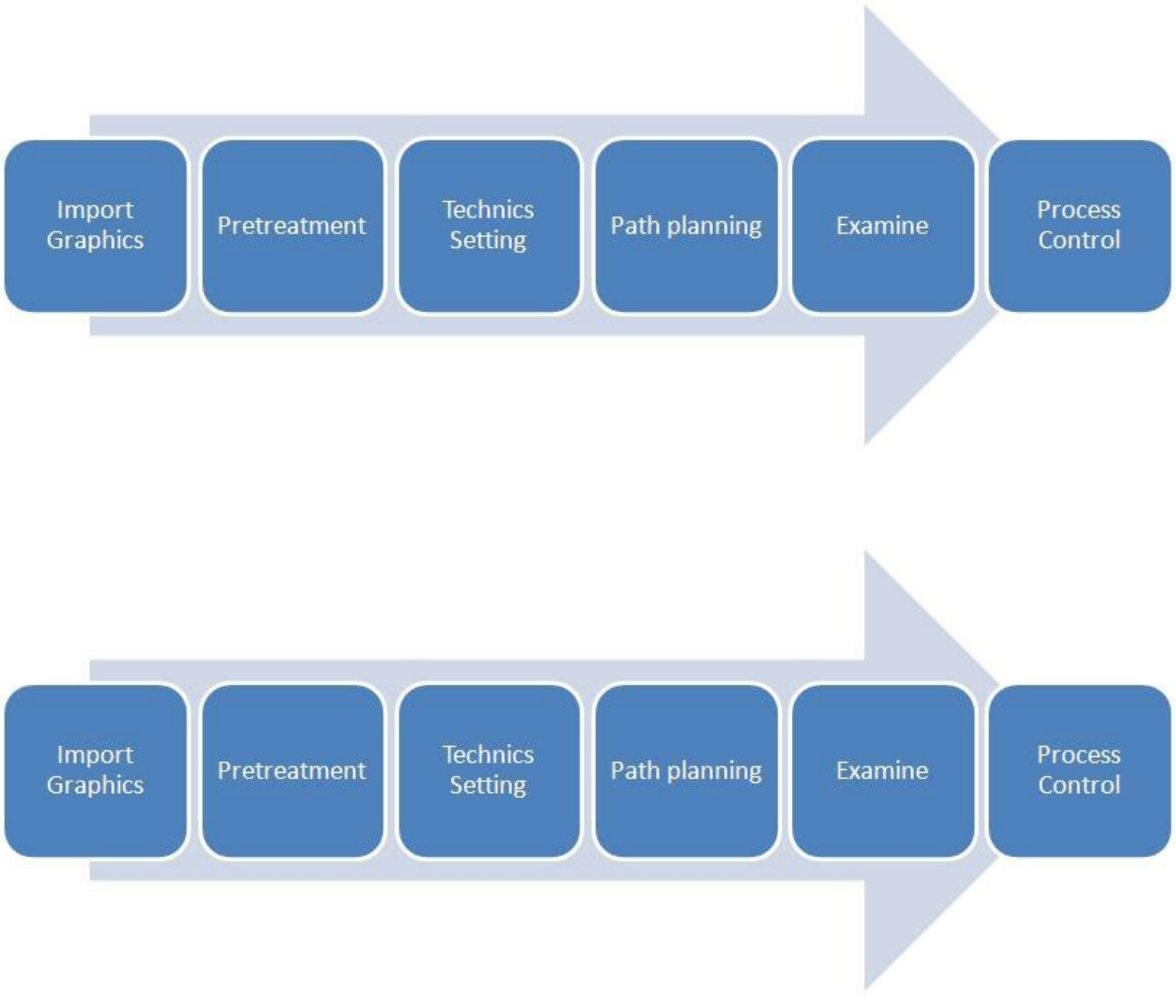
Please note that at the right of the menu the recently used files are listed. While the files saved by CypCut are marked with the icon -…|| and in this way it is convenient to find the designed documents of the last time.

The -**Import**|| in the menu can be used to import another document to the drawing board on the basis that the existing graphics are not cleared. Use -**Open**|| to directly open to an external file.

The menu -**User Parameters**|| is used to set some parameters related to the using habits; and the menu – **Parameters Backup**|| is used by users to backup all parameters as a compressed file, while the menu -**Diagnosis**|| is used for system diagnosis and monitoring.

Click -**About**|| at the lower right corner for detailed information of the CypCut software.

5.1.6 Operation Process



1. After clicking the button of opening files  in the quick launch bar at the upper left corner of the interface, the dialog box of opening files will be popped, and then choose the graphic to open. There is a quick preview window at the right of the opening file dialogue box and it can help to quickly find the file needed.

   To draw a part immediately through CypCut software, click the **Create** button and draw pictures with the buttons of the drawing toolbar at the left.
2. Preprocessing – When importing the graphics, CypCut will automatically remove tiny curves and duplicated lines, combine connected lines well as automatically distinguish the overcast cut and yang cut and conduct sorting at the same time. Parameters can normally be started without handlings. If the automatic processing cannot meet requirements, open the menu -**File**|| and -**User Parameters**|| for configuration.

   Generally, the graphics to be processed based on the requirements of software as closed curves. Therefore, if the files opened include unclosed curves, the software will prompt and the unclosed curves will be displayed in red. However, this function may be closed. To look over the unclosed curves in the drawing board, click the  buttons and  in the toolbar to highlight each. Click the big button.

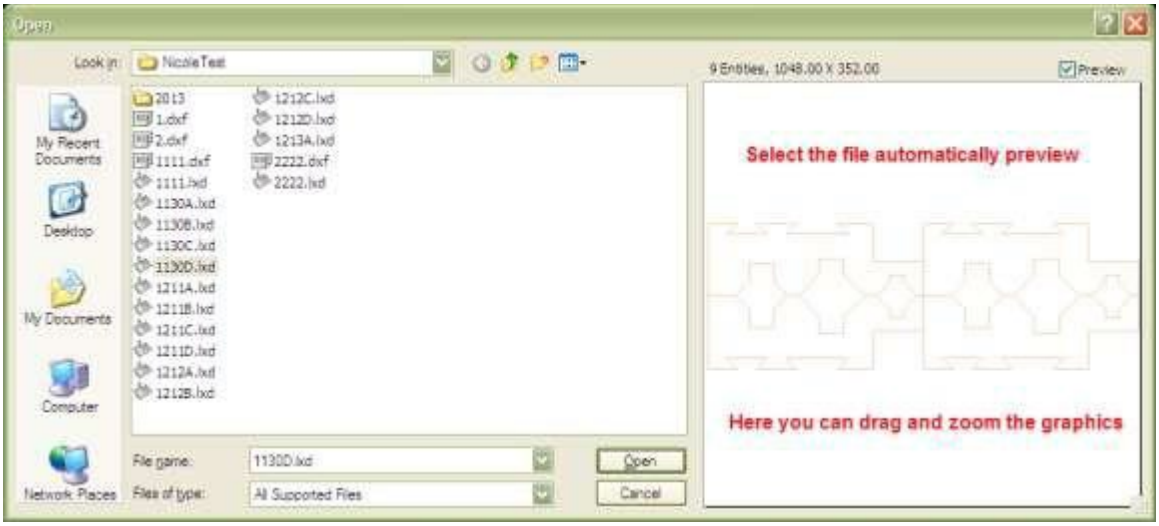


Figure 5-4: Open File

-**Selection**|| at the leftmost side of the toolbar and click -Select **Unclosed Curve**|| to choose all of them.

3. Preprocessing

In some cases, the graphics must be split manually, click the **Split** button in the toolbar and click the mouse in the position where the split is needed. To merge the graphics, select them and click the 

button.

4. Technical Parameter – In this step, the functions of the Technical Parameter are in the toolbar. This includes setting lead lines, setting compensation, and so on. The 

button can be used to set lead and the button side by side -  || is used to set lead seal over, lead seal gap or lead seal parameters. The 

button is used for cutting compensation, while the 

button can insert cannot let micro joint of not cutting into the graphics and the 

button can reverse a single graph. Clicking the 

button and then clicking the position where the start of the graphics are set, the start of the graphics can be set. Click outside the graphics twice and draw a lead-in manually. Press Ctrl+A to select all the graphic using quick start tutorial, then click the **Lead Lines**|| button and set the parameters of the lead lines and then click **OK**. In this way the software can search suitable positions to add the lead automatically. Conduct the Lead Lines Check by clicking the small triangle below the **Lead Lines**|| button and selecting -**Examine Lead**||. Set detailed cutting technical parameters by clicking the button -**Layer**|| in the toolbar at the right. The dialog box -**Layer Parameters Settings**|| contains almost all the parameters related to the cutting effect and it can be called up rapidly by pressing -**F6**|| for fast setting.
5. Lead Planning – In this step the graphics will be sorted as required. Conduct automatic sorting by clicking the  || button. Select the means of sorting and control whether it can change the direction of the graphics during the automatic sorting by clicking the small triangle under the button.

   If the automatic sorting cannot meet the requirements, click the  button in the toolbar at the left to enter the manual sorting mode and click the graphics with the mouse one by one and set the working order. Specify the order between these two (2) graphics through pressing the mouse and drawing a line from one graph to another.

   To fix the order of several sorted graphics by selecting each and then clicking -**Group**||. The following automatic sorting and manual sorting will not influence the graphics inside the -**Group**|| and the **Group**|| will always work as a whole.

   Conduct automatic sorting for the graphics within the group by selecting a -**Group**|| and then clicking the right key.
6. Inspection Before Processing – Before the actual cutting, check the working route. View the processing order quickly by dragging the interactive preview progress bar as shown below

and the processing order of the graphics can be viewed one by one by clicking the Interactive **Preview** button.

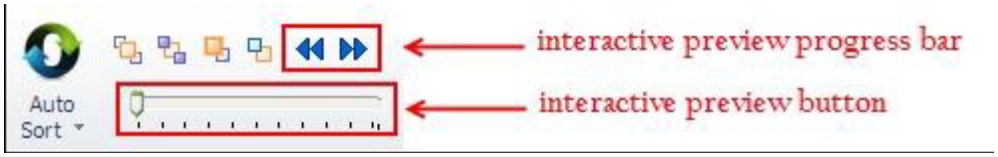


Figure 5-5: Preview (1 of 2)

To simulate the process, click the Simu || button on the console. Adjust the speed of the simulation processing through the function -**simulation speed**|| on the CNC || page.

7. Actual Processing – Note that this step must be done on the actual machine with the support of dongle and the control card. Before formal processing, match the graphics on the screen with the machine. To find the relative positional relationship between the upcoming processing graphics and the machine breadth on the screen by clicking the left Preview button|| above the -**Console**||. This corresponding relationship is calculated in accordance with the dock point markers on the screen and the position matches of the machine laser head. Some common coordinate markers on the screen are shown in the photo below. Click **Preview**|| the -**Dock Point**|| will be translated to the -**Laser Head Position**|| and visually parallel move occurs in the graphics overall.

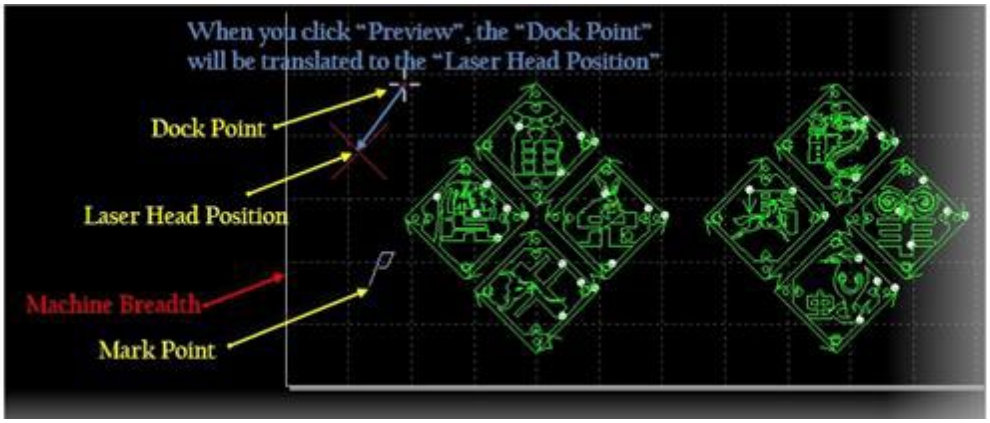
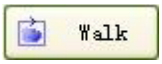


Figure 5-6: Preview (2 of 2)

If the -**Laser Head Position**|| shown by the red cross cursor does not match the actual laser head position of the machine, please check whether the position of the machine origin is correct and it can be corrected through -**Numerical Control**|| - - **Go Origin**||.

After previewing, if the graphics are outside the machine breadth wholly or partially, it may exceed the range of travel during processing. Change the relative relationship between the graphics and the dock points by clicking the 

button|| on the toolbar.
For example, if the laser head is at the lower left corner of the upcoming processing workpiece, the lower left corner can be set as the dock point.

If there is no error on the screen, click the 

button|| on the -**Console**|| and the system will control the machine to go around the outer frame of the upcoming processing graphics so the positions can be checked. Alternately, click the **Trace** button|| and the machine will run completely without laser so that the processing can be carefully checked. Finally, click the 

button to start the formal processing or click the 

button to suspend the processing. While suspended, the operator can manually move the laser head up and down, switch the laser and gas, and trace the working route with the 

buttons. Work can be continued with the 

button. Click the 

-|| button to stop the processing and the laser head will return to the zero point according to the settings. Without modification, there is no **-***|| on the 

|| button, the system will allow processing to continue from the last stopped position when -**Start**|| is clicked again.

NOTES:

6.0 Graphical Operation

CypCut provides the common drawing functions, which can be available easily from the drawing toolbar on the left. The use of these functions is similar to AutoCAD and is very intuitive. Thus, this manual will not explain each in detail. For questions, please contact customer service or Bochu Electron for assistance. Special graphical operations of CypCut software for laser cutting will be introduced.

6.1 Graphical Display Effect

The first column of the toolbar – **Base Operation** has multiple buttons which can help to control the display effect, as shown below.

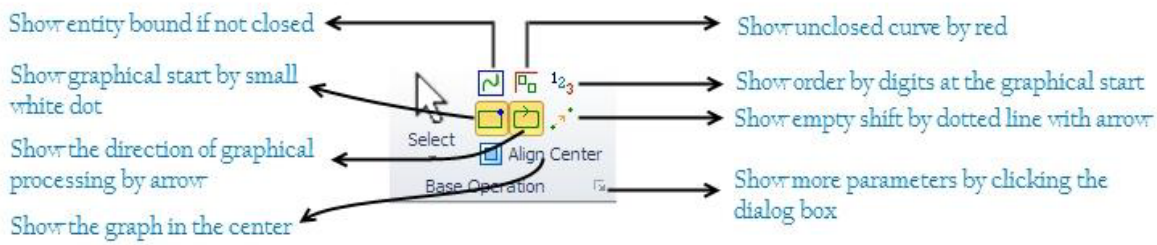


Figure 6-1: Base Operations

After clicking the buttons in Figure 6-1, the display will take effect immediately and display the effect in the drawing board. Pay attention to the display changes of the buttons. If the ground color is light yellow, the corresponding effect has begun. Otherwise, the display effect has not started.

For example, in the **On** state -  the arrow will display the direction of the graphical processing in the drawing board, while in the **Off** state -  the arrow will disappear.

When a graph is selected by clicking the - 

, the graph will be displayed in the center of the screen. If no graphs are chosen, please just click the button directly and the whole graphs will be displayed in the center.

Clicking the  button in the lower right corner of the column will open a dialog box. This allows more detailed control for the drawing board, including turning on and off the auto attach key points, turning on and off the ruler, and controlling the pick precision of the mouse.

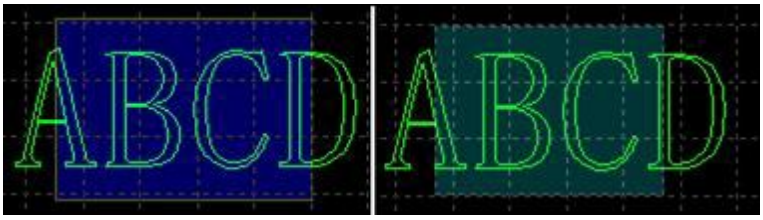
The views can be zoomed by scrolling the mouse wheel in the drawing board. By clicking **F3**, all the graphs will be shown in the center of the screen. By clicking **F4**, the machine breadth range

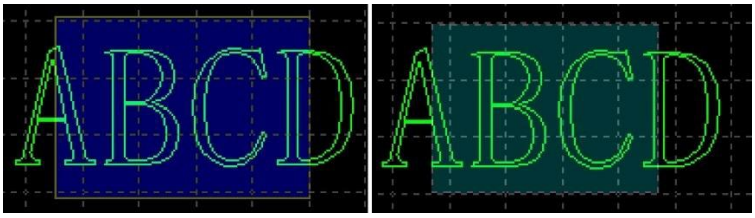
will be displayed in the center, while the selected graph will be centered in the screen by clicking **F5**. The above operations can be selected by clicking the right key of the mouse in the drawing board.

6.2 Selection of the Graphics

CypCut offers a variety of graphical selection methods. The basic operation is to click **Selection** and the graphs will be selected by clicking the mouse above the graph. Another more common is operation is **Box Selection**. By this way, a translucent box can be formed by dragging the mouse in the screen to select the graphs. There are two (2) kinds of box selection. When dragging the mouse from left to right, it shows a blue translucent rectangle with a solid line and only the graphs covered completely in the rectangle box can be selected. When dragging the mouse from right to left, a cyan translucent rectangle with the dotted line will appear and if any part of the graph is in the box, the graph will be selected.

The schematic diagram of these two (2) options is shown below. The image on the left is the option from left to right with BC selected. The image on the right if from right to left and ABCD will be selected. Flexible use of the two (2) methods can help choose the graphs needed.





When clicking **Selection** or **Box Selection** with **Shift** key, selected graphics can be added or cancelled without the need for clearing the original selection.

Clicking the **Selection** button will open a drop-down menu with senior selection operations including the selection of unclosed graphics and similar graphics.

Among these operations, Select **Similar Curve** allows the selection of all graphics which appear close to one another on the drawing board. For example, select all the circles with a diameter of 5mm by selecting one (1) circle with a diameter of 5mm and clicking **Select Similar Curve**.

6.3 Geometric Transformation

The column **Geometric Transformation** of the toolbar provides geometric transformation functions. Most of the commonly used geometric transformations can be completed only be clicking a button, for examples: mirror X, mirror Y, rotate for 90º.

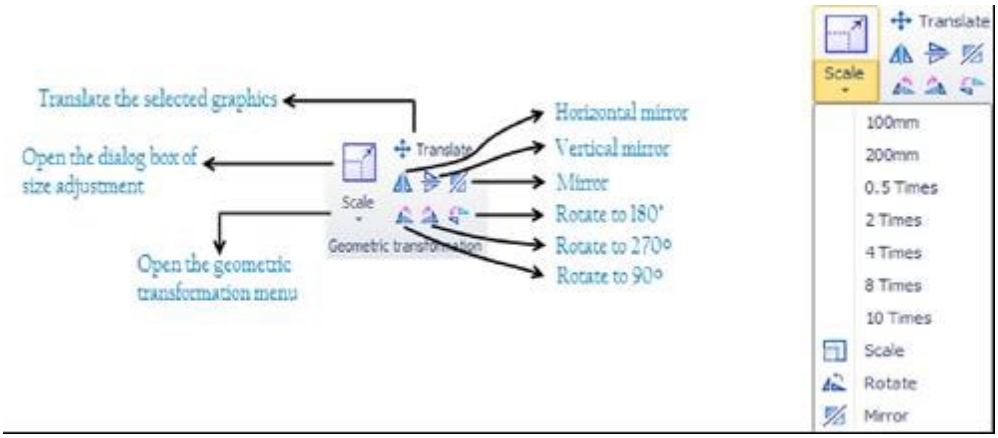


Figure 6-2: Geometric Transformation

Clicking the small triangle below the **Size** opens a dropdown menu providing more operations, including rotation and mirror (see Figure (6-2).

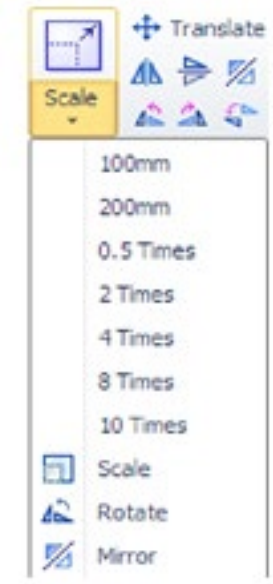


Figure 6-3: Size

6.3.1 Size Transformation

CypCut provides seven (7) fast size transformations, which can be completed by the dropdown menu below the **Size** button. For example: 100mm zooms graphics in equal proportion with a width of 100mm – 2 Times to zoom graphics in equal proportion by two (2) times.

To input accurate size, click the **Size** button to open a dialog box (Figure 6-4) and input the new size and complete the size transformation by clicking **OK.**

Figure 6-4: Modify Size

When the status of lock of the interface is  the length and width are locked as the proportion of the original graphics. To separately input length and width, cancel the cancel lock status by clicking the button  and the button will become  .

Zoom Center can determine the location relations between the new graphics and original graphics after being zoomed. For example, Select -**Upper Left** aligns the new graphics and original graphics in accordance with the upper left corner after the transformation and other parts are zoomed by using the upper left as the basis.

NOTE

The lead and slotted compensation set for graphics cannot be transformed at the same time and the numerical value of lead and slotted compensation will not change after the size is changed.

6.3.2 Interactive Geometric Transformation

CypCut provides three (3) kinds of interactive geometric transformation:

- Interactive Zooming
- Rotation
- Mirror

Before performing these operations, select the operation graphics, click the **Corresponding Menu** or button and conduct operations in accordance with the tips at the bottom of the screen.

For example, if you want to rotate a rectangle by using the lower left corner as a basis, proceed as follows:

1. Select the rectangle for operation.
2. Click the small triangle below the -**Size** to open the dropdown menu. Select -**Rotate**; a prompt will appear in the lower portion of the screen to Please Specify Base Point.
3. Move the mouse to the lower left corner and the mouse pointer will automatically attach (see Figure #-#).

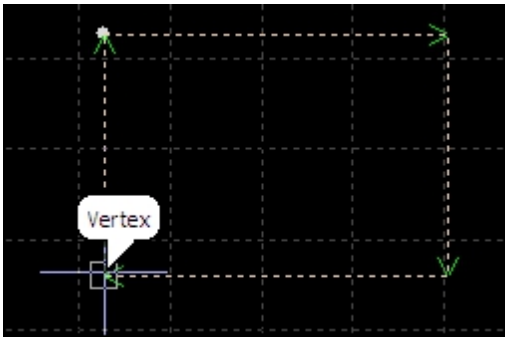


Figure 6-5: Vertex

4. Click to open a prompt -**Specify Start Point of Rotation or Input Rotation Angle** at the bottom of the screen.
5. Complete the operations by directly inputting “45” and clicking **Enter**.
6. To rotate the rectangle to a position aligning with another graphic if the angle of rotation is not known refer to Step 5.
7. Move the mouse to the lower left corner of the rectangle to form a horizontal line and take it as the start line of rotation.

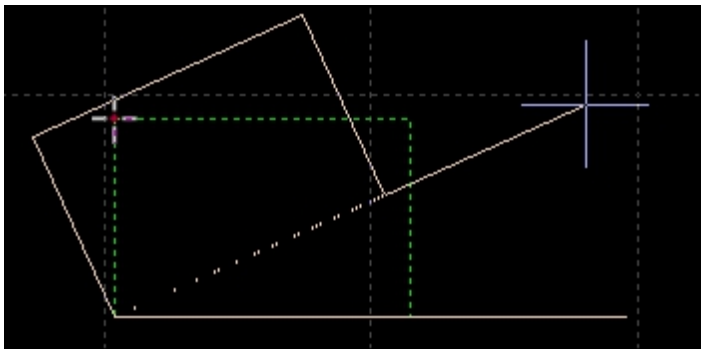
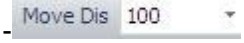


Figure 6-6: Start Line of Rotation

8. Click the screen to open the -**Please Specify End Point of Rotation** prompt. The graphics will rotate the mouse when the mouse is moved and complete the operations by clicking the mouse at the expected end point of rotation. The operations of interactive zooming and mirror are similar.

6.3.3 Quick Translation and Copy

CypCut software allows the operator to translate the graphics quickly by using the direction keys. Once the graphics are selected, when direction key is pressed the graphics will be translated to a distance in the corresponding direction and the distance parameters can be inputted in the window - 

at the lower right corner of the main interface. This function can help to shift away a graphic temporarily and quickly, then focus on the design of other graphics and later move it back to the original place rapidly. Since the fine-tune distance parameters can be controlled precisely, the deviation of the graphical position is precise. Copy the selected graphics by pressing **Ctrl** and the direction key simultaneously. For example, press -**Ctrl** + Rightward the selected graphics will be copied at the position with 100mm on the right.

6.3.4 Input of Coordinates and Parameters

In some cases, the operator may need to draw with precise coordinates. CypCut allows inputting coordinates directly and the input format of coordinates is as follows:

<X coordinate><comma,><Y coordinate>

For example, if you would like to input the coordinates (100,100), input only -100, 100. The inputted coordinates and parameters will be shown in blue.

Most of the drawing operations allow both mouse operation and inputting coordinates directly. The figure below depicts a drawing of a rounded rectangle with a length of 300mm and a width of 200mm and a fillet of 25mm.

1. Click the icon and -**Please Specify Start Point** will be prompted on the screen.
2. Input the coordinates -0, 0 and press Enter and then -**Please Specify Cross Point** will be shown on the screen.
3. To input the coordinates -300,200 and press **Enter** and then -**Please Specify Corner Radius** or **[Fillet (F)]** will be shown on the screen.
4. Input 50 and press **Enter**. All the operations are completed as follows:

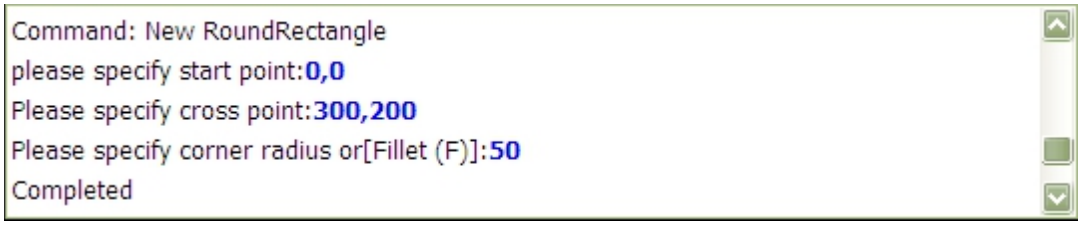


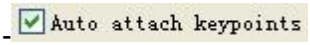
Figure 6-7: Coordinate Operations

6.3.5 Automatic Adsorption

CypCut will provide the functions of automatic adsorption during drawing according to the needs, including automatic adsorption to the grinds, adsorption to the critic points of the graphics, adsorption to the borders of the graphics and so on.

Close the functions of automatic adsorption and the operation steps are as follows:

Click the menu - 

, select -**User Parameters**, then select the tab – **Drawing Board** in the opened dialog box and finally cancel the option - 

. The precision of automatic adsorption can also be set in the above dialog box.

6.3.6 Text Input

CypCut supports text input and text conversion to curve. After clicking the button on the drawing toolbar at the left, insert into the desired position and the newly inserted text will be selected automatically.

After selecting the text at any moment, a new page -**Text** will appear in the toolbar and modify the content, the style, and the size of the text and using it.

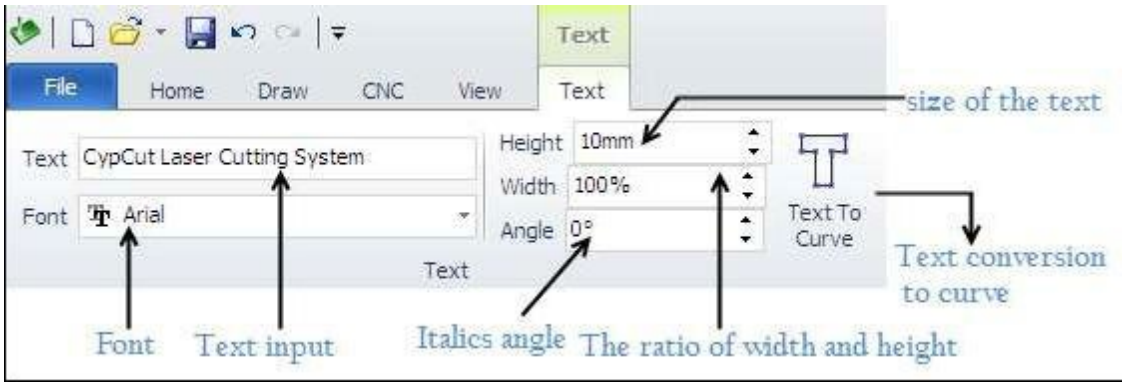


Figure 6-8: Text (1 of 2)

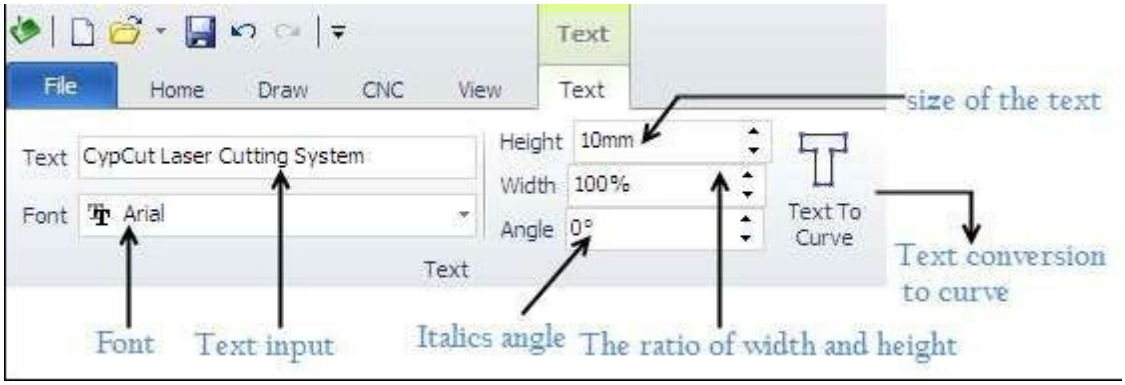


Figure 6-9: Text (2 of 2)

Please note that once the text is converted to the curves, the above option cannot be used any longer. To design a text with specific font and special effect, please convert it to curves after it is designed.

6.3.7 Graphical Optimization

When importing the external graphics, CypCut can optimize the graphics automatically. If you must optimize manually, use the right functions in the toolbar.

Figure 6-10: Toolbar Functions

Please select the graphics to be processed, click the corresponding buttons and then operate according to the prompts.

1. Smooth

   Please select the polylines to be optimized, then click Smooth on the Toolbar, a prompt – **Please Specify Fit Tolerance** will be shown on the command window. Please click the mouse directly or input the expected fit tolerance and the press **Enter**.

   The contrast between the original curve and the smoothed curve.

2. Split

   Split is to divide the closed graphic into two (2) graphics and the user can edit these two (2) graphics separately.

Figure 6-11: Split

Please click the Split button and click the position to be split. The process of the curve split can be carried out continuously as far as **Esc** – Cancels the command or it is switched to other commands.

3. Connect Near

   The graphics drawn by using AutoCAD often include the graphs which connect visually while do not connect. Combine the graphs by connecting near. Select the graphics to be merged, then click Connect Near and input merging accuracy, lastly confirm the operation.

NOTE

The end points of the graphics in visual may be not the ones in geometric and the excess backtrack lines may exist in the end point and these graphics need to be split and deleted firstly through -Split Curve and then can be combined.

4. Remove Tiny Objects

   Sometimes the imported graphics may include the curves which are visually imperceptible, which causes the display size to become very small or move to an abnormal position when processing. These graphics can be deleted through the function -**Remove Tiny Objects**. Click the -**Remove Tiny Objects**, set the size range of the graphics, and confirm the operation. The graphics smaller than this size will be deleted and other curves will be retained.

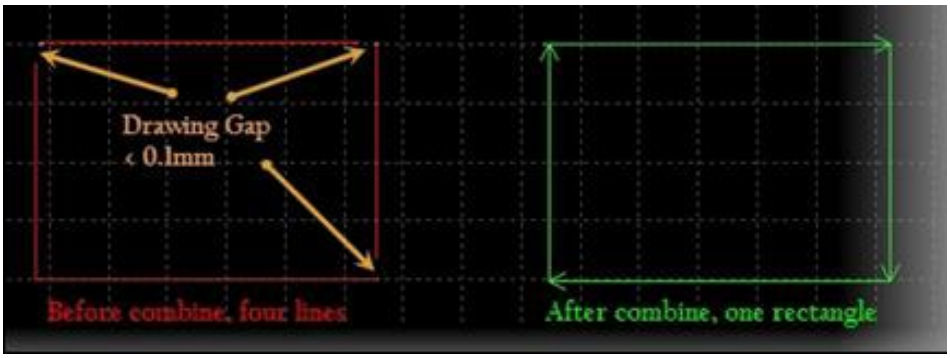


Figure 6-12: Remove Tiny Objects

5. Remove Duplicated Curves

   This function can be used to delete the visually overlapping lines and only leave one. The operator can search and clear all the graphics by clicking -**Remove Duplicated Lines.**

7.0 Technical Parameters

This chapter will describe the related functions of technical parameters provided by CypCut. Because most of the technical parameters direct relations with the materials to be cut, the used lasers and air pressure, set the parameters according to the actual technical requirements. All the parameters mentioned here including the ones in the graphics should be used as examples rather than being considered as guidance parameters.

⚠ WARNING

The inappropriate or incorrect parameters may result in poor cutting effect or even damage to the machine; please set the parameters carefully.

7.1 Lead Lines

1. Distinguish Overcast Cut and Yang Cut

   When opening the external files such as DXF and so on, CypCut can distinguish overcast cut and yang cut automatically. If the graphics are modified during editing and they result I the changes in the relationship between overcast cut and yang cut, click the -**Sort** button when the overcast cut and yang cut need to be distinguished again and then any way of sorting can distinguish them.

   CypCut distinguishes overcast cut and yang cut in accordance with the surrounded relations and it always takes the outmost layer as yang cut, while the next one as overcast cut, then yang cut, etc. An unclosed graphics cannot form a layer. To start a yang cut from one layer, choose all the graphics from this layer and inside it, group them, and then distinguish overcast cut and yang cut through -**Sort** in Group.

   When adding the lead lines, the external layer is yang cut, so it will be led in from the outside; the internal layer is overcast and will be led in from the inside.

   When setting an Overcast Cut and Yang Cut Manually, please select the graphics to be set and then click the - 

buttons on the toolbar.

2. Automatic Lead Lines

Please select the graphics to be set with lead lines, click the - 

icon on the toolbar, then set the lead lines parameters in the popped window.

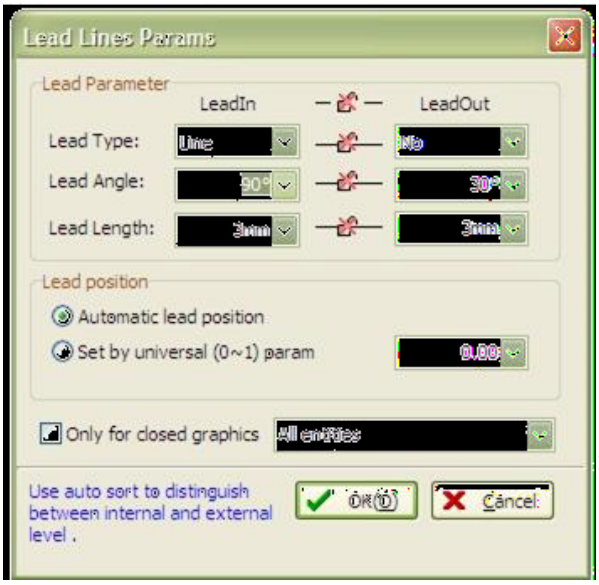


Figure 7-1: Lead Lines Params

The supported lead types include circular arc and straight lines while the supported parameters consist of lead type, lead angle, and lead length. Set the lead lines at the same time by clicking the  icon.

Select the circular arc leading, the end of the circular arc needs to keep in tangent with the graphics to be cut (no matter the size of the set angle). In fact, the angle set at this moment is an included angle between the connecting line of the start point and the end point of the lead line and the graphics to be cut. The lead out lines are similar.

Please note that the automatic lead lines will search the graphics to determine the most appropriate lead position, thus the previous parameters of the graphics such as lead position and type will be covered.

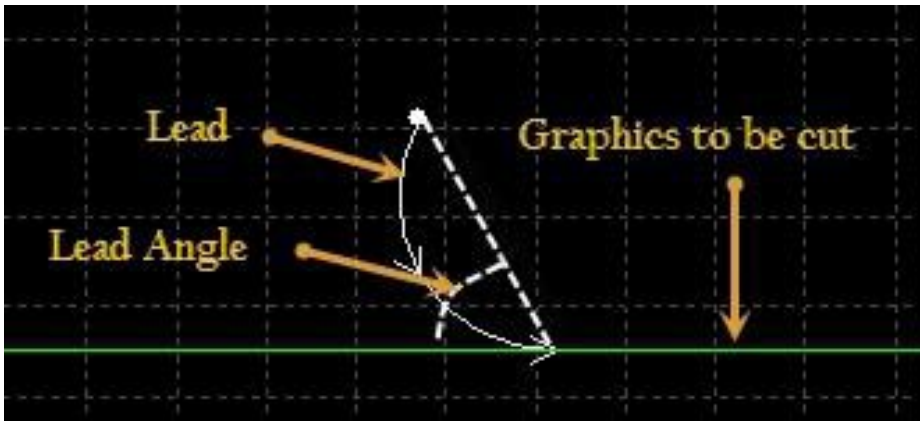


Figure 7-2: Lead Lines

3. Set Leading Manually

   Modify the leaning manually by clicking the - Lead Pos button on the toolbar. Clicking on the Graphics can change the position of the leading; however, the angle and the length cannot be modified.

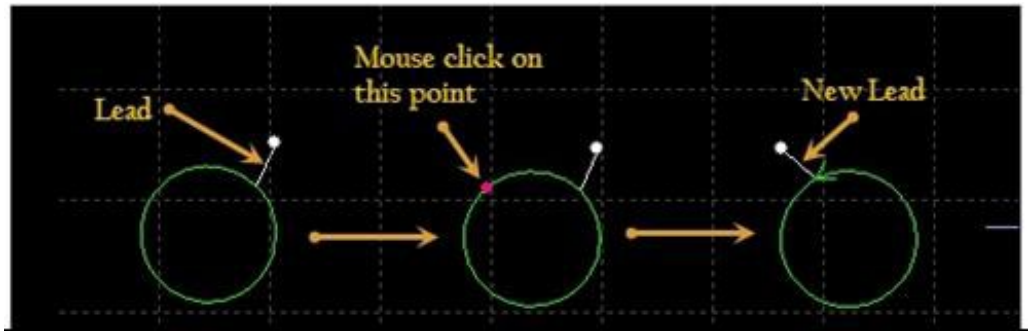


Figure 7-3: Drawing a Lead

   Click Outside the Graphics, then click on the Graphics, in this way the operator can draw a leading from point A to point B.

4. Check the Lead

   Click the small triangle below the **Lead Lines** button and select -**Check Lead** to check the lead lines already set. This function can shorten the lead lines with too much length and thus prevent them from intersecting with other graphics.

5. Lead Seal Over cut, Lead Seal Gap, and Lead Seal

The **Side-by-Side** buttons in the Toolbar of -**Technical Parameter** -  are used to set lead seal, lead seal gap, lead seal over cut, and size of -**Gaps** or Over Cut. Please select the graphics to set and click the corresponding buttons. The size set of -**Gaps** or **Overcut** can only be valid when resetting gaps or over cut later and the size which has been set before will remain unchanged.

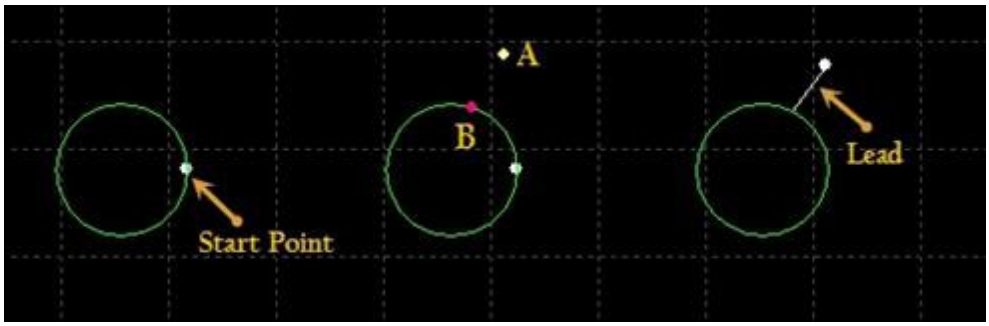


Figure 7-4: Lead Seal Over Cut, Lead Seal Gap, Lead Seal

6. Cutting Compensation

Please select the graphics to be compensated and click the 

button on the toolbar for cutting compensation. The cutting width will be obtained in accordance with the actual cutting results. The compensated track will be shown in white on the drawing board the system will run along the compensated track during processing. The compensated original drawing will not be processed and will be displayed on the drawing board only to facilitate operation.

The direction of cutting compensation can be selected manually. It can also be judged automatically according to yang cut or overcast cut. Yang cut needs outward compensation, while overcast cut needs inward compensation.

During the process of cutting compensation, select to translate the corner in the form of round angle or right angle.

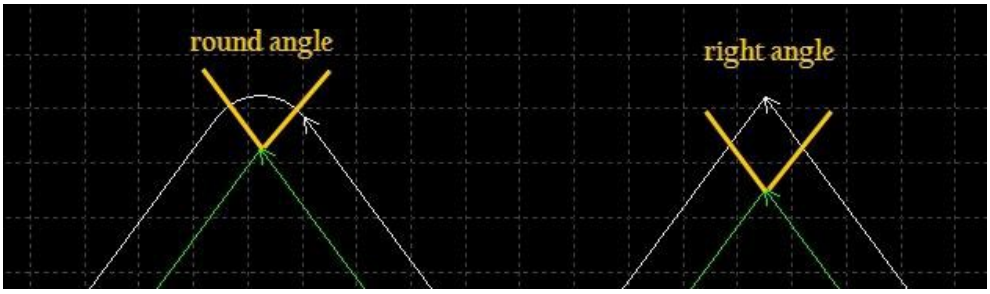


Figure 7-5: Cutting Compensation (1 of 2)

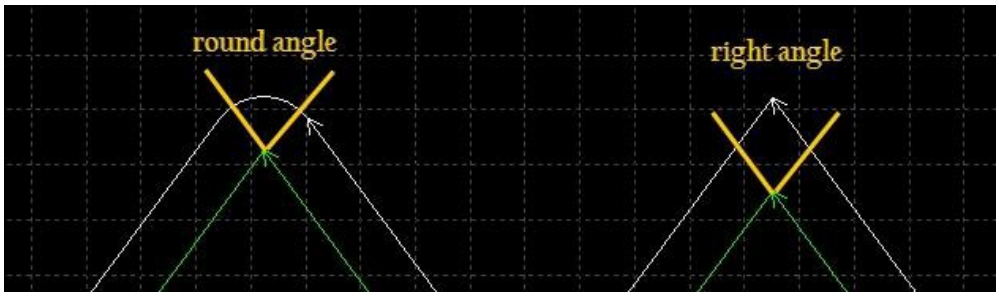


Figure 7-6: Cutting Compensation (2 of 2)

In the figures above the green is the original, the white is the compensated track, and the light yellow is the vertical lines drawn from the corner. The cutting edges can coincide with the original after both sides of the vertical lines are compensated, while the corner needs to transition. Usually, round angle transition can ensure the cutting edges can still coincide with the original and run more smoothly during transition.

To clear compensation, please select the needed graphics, then click the -**Clear** button and choose -**Clear Compensation**.

7.2 Micro Joint

-**Micro Joint** can be used to insert a micro joint into the track which will not be cut. When cutting to here, the laser will be closed; however, whether closing the gas and the follower is determined by the related parameters of short-distance vacant move during cutting. Micro joint is shown as a gap on the drawing board

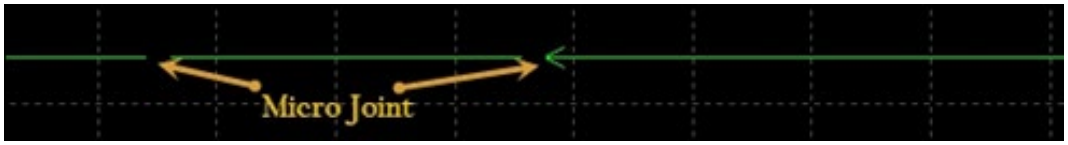


Figure 7-7: Micro Joint

Add a micro joint by clicking at the position of the graphics needed to add micro joints by clicking the 

button on the toolbar. The operator can insert multiple micro joints by clicking continuously until pressing **Esc** to cancel the command or switch it to other commands. Both the graphics and the compensated track to insert the micro joints.

The length parameter of the micro joint can be set by clicking the - button on the toolbar and the new parameters will be valid for the following operations. Except adding the micro joints manually, CypCut also provides the function of inserting micro joints automatically. The operator can click the Auto MicroJoint button, set the parameters in the popped dialog box and then confirm it. Select -**adding by quantity**, for example, to add ten (1) micro joints to each graphic or -**adding by distance** to insert a micro joint every 100mm.

To clear the micro joints, the operator needs to select the needed graphics, then click the -**Clear** button and choose -**Clear Micro Joint**.

7.3 Group

-**Group** in CypCut refers that multiple graphics and even multiple -**Groups** are combined to form a -**Group** and the entire -**Group** will be regarded. Within the -**Group**, the order, the positional relationship between the graphics and the layers are all fixed and they will not be influenced during sorting, dragging and other operations. Select the graphics which are needed to form a group and the click the Array button to combine the selected graphics to a group.

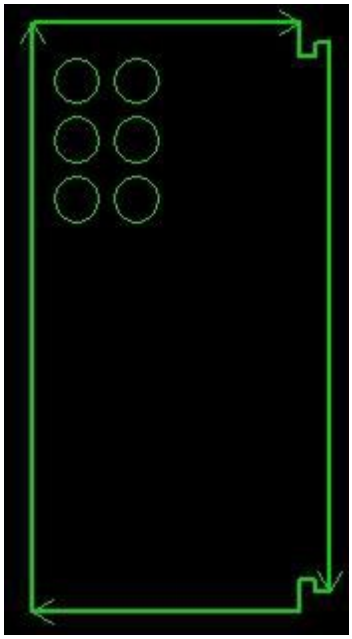


Figure 7-8: Group

To cancel the group, please select the group, and then click -**Cancel** on the toolbar. To explode all the groups on the drawing board, please click the small triangle below -**Group**, then select -**explode all groups**.

If there is a graphic which can contain all the other graphics in the group, it can be called the outer contour. The -**Group** with outer contour will be regarded as a -**Part**. The -**Outer Contour** of the -**Part** will be shown in bold on the drawing board.

A -**Part** should have -**Outer Contour** and -**Inner Hole**. This is the basis of stock layout between -Part and -**Part**. Although CypCut software allows the operator to group and operate any graphics, but the function of group -**logically** and only group the graphics which meet the logical conditions of the -part as much as possible. From now on use these two (2) -group and -**part indiscriminately.**

Note that the CypCut software will always group the graphics with -**Coedges** to ensure the integrity of these graphics. Furthermore, the result of bridging one -**Group** with other graphics or -Groups must be a -**Group** and it can also ensure the integrity of the graphics.

1. Sorting of Group

   The part will be regarded when being sorted and it will be involved in sorting with the outer contour or the first graphic as the basis. The graphical order within the part will not change during sorting.

   To sort the graphics within the group without exploding the group, select the group, clicking the Right Key, and choose -**Sort** in Group.

   The operation of -Sort in Group will not change the graphical order of the sub-group within the group. The order of -**Sort** in Group only has the relations with the geometrical properties of the graphics, while no relation with the layer to which it belongs. During the sorting, it will distinguish overcast cut and yang cut automatically according to the geometrical containing relations.

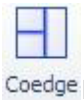
2. Processing of Groups

   The group (the part) will be considered during processing and it will be finished by continuous work. No other graphics will be inserted during processing. Even if the group (the part) includes the graphics at multiple layers, it will be processed successively.

   Note that regardless of the graphical order within the part, the outer contour of the part will always be processed finally.

7.4 Coedge

Merging the workpieces with the same edges can save processing length and improve efficiency. In CypCut, when the boundary distance between two (2) graphics is less than 0.1mm, the two (2) graphics can use the same edge. The function of automatic adsorption provided by CypCut will drage these two (2) graphics together for Codeging.

After selecting two (2) or more graphics to Coedge, click the 

button on the toolbar, CypCut will try to Coedge the selected graphics. If the selected graphics cannot meet the conditions of Coedge, the window -CAD messages at the lower left corner of the interface will display a prompted message. At present CypCut only supports to Coedge the four (4) sides of the graphics and it cannot Coedge the straight lines of the recesses within the graphics.

The graphics involved in Coedging will be combined to form a -**Group** after Codeging. If they meet the requirements of the -**Part**, the frames of them will be shown in bold like the right figure.

If the graphics involved in Coedging include other items such as small holes, combine the graphics and all the interior items together to form a group, then Coedge them. Otherwise, the relationship between the interior items and the Coedged group will become unrecognized and it will be difficult to determine the processing order and the relationship of the internal and external will be broken.

1. In CypCut, when the operator drags the graphics to the position where it may be Coedged, CypCut will try to absorb automatically and display the corresponding prompted message. The operator can drag two (2) graphics which need to Coedge very easily and the function of automatic adsorption will help to locate each quickly when they are close. Even when many graphics are selected and dragged together, it can also locate them rapidly. Once the two (2) graphics are dragged together and have the same edges, the Coedges can be finished by clicking the -**Coedge** button. To disconnect and continue to edit the Coedged -**Part** or set their order, please select -Part and the click -**Cancel** Group on the toolbar. The operator can combine them again through the -Group button after editing.

2. Compensated Coedge

   If the cutting compensation Coedging remains, compensate and coedge the needed graphics. -**Coedge** will keep the processing track unchanged. If the Coedged graphics contain compensation, the compensated track will be retained after -**Coedge** and the original will disappear.

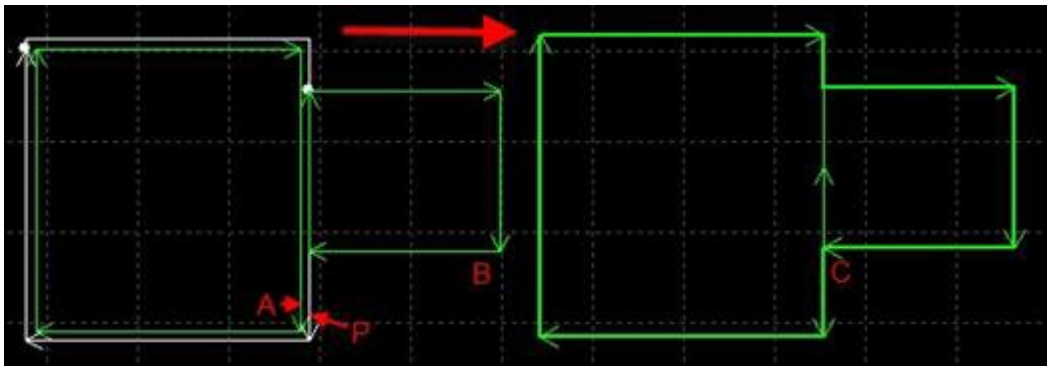


Figure 7-9: Compensated Coedge

The original A cannot be Coedged with the graphic B and only the compensated track P can be Coedged with it. If graphic B is moved to the position near to the original A, the Coedge cannot be changed because it is not a track to be processed.

7.5 Bridge

If a workpiece consists of many parts, the operator can connect the parts by clicking - 

. This function can also reduce the punch count. Multiple use of the function -**Bridge** can also achieve the effect of -**One-stroke for all the graphics**.

To bridge two (2) graphics, please click the -**Bridge** button and then draw line on the screen and all the graphics intersected with it will be bridged together 2 x 2.

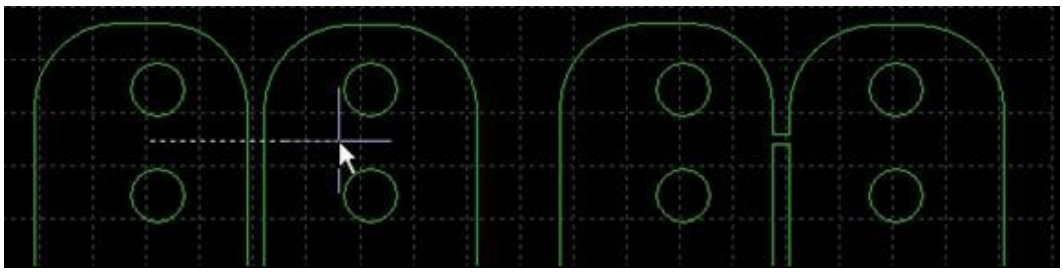


Figure 7-10: Bridge4

Bridge needs to specify two (2) parameters:

1. The first parameter specifies the Maximum distance between Two Adjacent Curves and bridge them when the distance between two (2) graphics is less than the specified parameter.
2. The second parameter specifies the Width of Bridge.

Please note that the graphics will become a whole after bridging. Maybe any part will not be cut before completing the -**One-stroke cutting**, pay attention to the change of the heat affecting.

7.6 Layer Parameters

CypCut provides fifteen (15) layers and every layer can set separately the technical parameters such as move speed, laser power, pressure, cut height, etc. Open the dialog box **-Layer Parameter Setting** by clicking the -**Layer**  button on the toolbar.

This dialog box includes almost all the technical parameters required for processing. The first page of the dialog box is -**Global** parameters and used to control the parameters outside the layers such as vacant move speed, burst power, etc. Speed and acceleration units can also be chosen. The other pages of the dialog box list all the currently used layers and the parameters. Set the parameters of this layer can be set separately by clicking every layer. Change the order

among the layers by pressing the -**Layer** button with the mouse and dragging it and the layer arrayed in the front will be processed first.

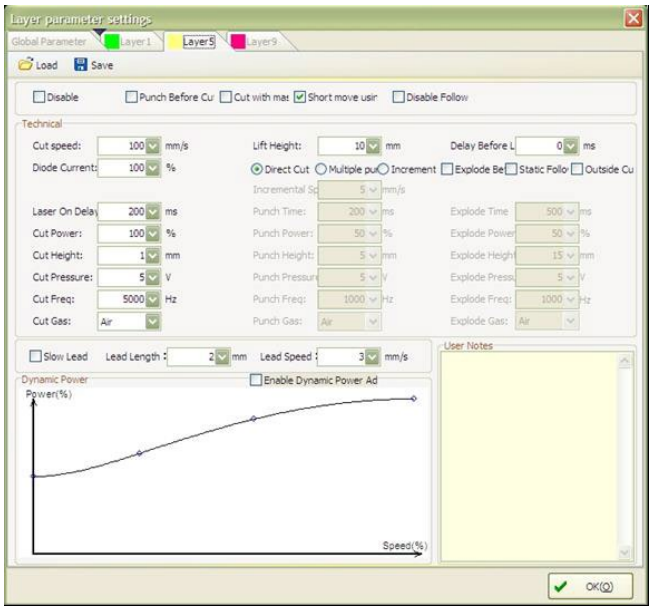


Figure 7-11: Layer Parameters Settings

NOTE

Different options may be displayed in the dialog -Layer Parameter Setting due to different lasers, different gas pipeline configurations and different followers. The following figure is only used for reference and the actual contents displayed in the software shall be taken as the criterion.

7.6.1 Descriptions of Parameters

Descriptions/Technical of Parameters	
Cutting Speed	Set the actual target speed of cutting. There are acceleration and deceleration at the first and last sections as well as the corners of cutting track, so the actual cutting speed is often less than the speed.
Punching Time	Time required for punching the cut board. Set the time according to the thickness and material of actual board (set the parameter to a small value or 0 during incremental punching).

Lift Height	Set the lift height of laser head after cutting a segment of curve. Z-Axis will lift to a certain height after suspending the cutting and the height is lift height.
Peak Current	Set the peak current of the fiber laser, i.e., diode power. Peak power determines the maximum cutting power that machines can reach. As for a cutting machine with a power of 500W, if its diode current is set to be 80%, the diode power it can reach during cutting is 500W*80%-400W.
Cutting Type	
Direct Cutting	Punching and cutting use the same parameters, which are commonly used for thin board cutting.
Multiple Punching	Set the height from the laser head to the board during cutting.
Incremental Punching	Based on multiple punching, the punching method of variable defocusing amount is used, i.e., slowly fall when punching and this method is commonly used for thick board cutting. During multiple punching, the punching time can be set to be a small value, such as 100MS. At this time, actual punching time = 100MS + the time required for slowly falling to the cutting height from the punching height.
Cutting Parameters	
Cutting Power	Set the laser power used to cutting, i.e. the duty ratio of PWM modulation signal.
Cutting Height	Set the height from the laser head to the board during cutting.
Cutting Parameters	
Cutting Pressure	Set the pressure of auxiliary gas during cutting and use it with proportional valves or multiple valves
Cutting Frequency	Set the carrier frequency of PWM modulation signal during cutting, i.e., the laser number within one second. The larger the valve is the more continuous the laser.
Cutting Gas	Set the type of auxiliary gas used in cutting.

Punching Parameters	
Incremental Speed	Set the speed for slowing falling down to the cutting height from punching height when using incremental speed.
Punching Power	Set the laser power used in punching, i.e., duty ratio of PWM modulation signals.
Punching Height	Set the height from laser head to board during punching.
Punching Gas	Set the pressure of auxiliary gas during punching and use it with proportional valves or multiple valves.
Punching Frequency	Set the carrier frequency of PWM modulation signal during punching. Generally, low frequency is used during punching and pulse punching is used to avoid burst.
Other Parameters	
Short Move Using Separate Laser Parameters	
Disable Follow	Not use follower for following movement during operation.
Enable Dynamic Power Adjusting	After starting the function, the system will conduct real-time adjustment for the laser power (duty ration of PWM) according to the actual cutting speed, to provide a great help for improving the cutting quality of optimized corner.
Lead In and Lead Out	
Lead In Speed	Set the processing speed of leading. The processing speed will become effective after being selected and cutting speed will be used when not being selected.

Lead Out Speed	Set the processing speed of lead-out. The processing speed will become effective when being selected and cutting speed will be used when not being selected.

7.6.2 Adjustment of Speed Following Power

After selecting 

, the cutting power will vary with the changes in speed in the cutting process and the specific changes are determined by the power curve. The power curve can be dragged and edited by using mouse.

The X-Coordinate of power curve represents cutting speed, while the Y-coordinate represents cutting power, with a unit of percentage. The table reflects the percentage of the actual power in cutting power when the actual movement reaches the turning and the speed drops to a few percent of target speed.

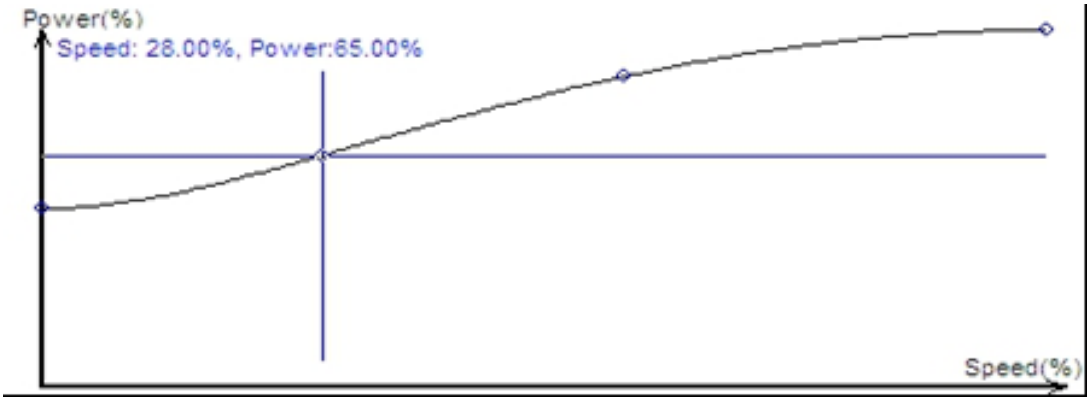


Figure 7-12: Power Curve

As shown below, if the laser power is 500W, after setting the cutting speed to be 100mm/s, peak current to be 90% and cutting power to be 80%, when the actual cutting speed drops down to 40mm/s, namely the red marker point, the power of laser:

500W x 90% x 80% 62.43% = 223.75W

Laser power X Peak current (percentage) X Cutting power (percentage) X Speed following power (percentage) = 500W x 90% x 80% x 62.43% = 223.75W.

However, the power cannot be less than a pre-set minimum value. Generally, it is set to be 10%, i.e., 50W.

If Enable Dynamic Power Adjusting is not selected, the power will remain unchanged in the cutting process. Referring the above example as a reference, the power in the cutting process is as follows: 500W x 90% x 80% = 360W.

7.6.3 Punching Ways

CypCut presets three (3) punching ways, namely direct cutting, multiple punching, and incremental punching. Multiple punching and the incremental punching can be achieved only with the support of BCS100 follower. The specific process of these three (3) punching ways will be controlled by the preset PLC process. According to the default settings, the punching process of -Direct Cutting is as follows:

- Follow to cut height
- Open gas
- Set cut press
- Gas Delay
- Set cut frequency
- Set cut power
- Set cut mode
- Laser on
- Punch delay

The processes of -**Multiple** punching and -**Incremental** punching are as follows:

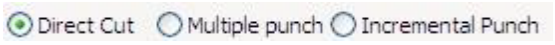
- Follow to punch height
- Hold
- Open gas
- Set punch press
- Gas delay
- Set punch frequency
- Set punch power
- Set punch mode
- Laser on

- Punch delay
- Incremental punching
- Follow to cut height
- Set cut press
- Set cut frequency
- Set cut mode
- Set cut power
- Delay

7.6.4 Pre-Punching

After selecting – 

, it will punch firstly at all the needed positions when processing this layer. The punching way will be specified by -



punch **Incremental Punch** in the layer. We do not recommend using -**Direct Cutting** because another punching will be performed while cutting and it is the punching process of -**Direct Cutting**.

7.6.5 Material Lib

After editing all the parameters of the layers, save to the material lib for the next project.

Save to the material lib by clicking the 

button and inputting the file name. It is recommended the operator set the file names by using the material properties as the name, such as 2mm carbon steel.

To use the material lib in the future, please click the button - 

and then select the file previously saved. CypCut will prompt -Whether Covering the Current Parameters and the system will import the parameters in material lib automatically when -**Yes** is clicked. To cancel the operation, click **-No**.

7.7 Sorting and Path Planning

Most of the functions of the path sorting can be found in -**Sort** on the toolbar. As shown below:

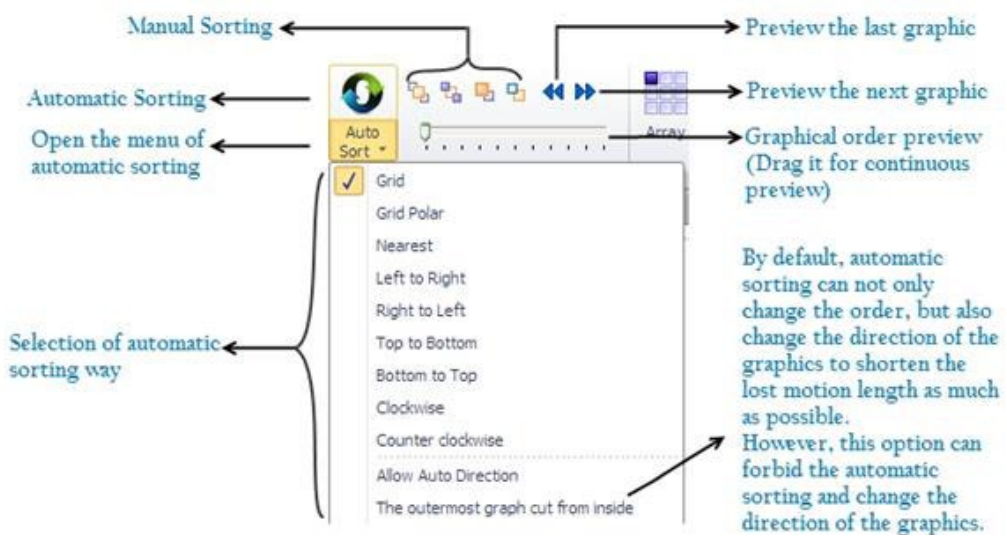


Figure 7-13: Path Sorting

If the window of CypCut is too small, the entire toolbar may not be visible. The column below in the page -**Drawing** of the toolbar. It includes all the functions listed in the above figure there are tools for graphical alignment at the top.

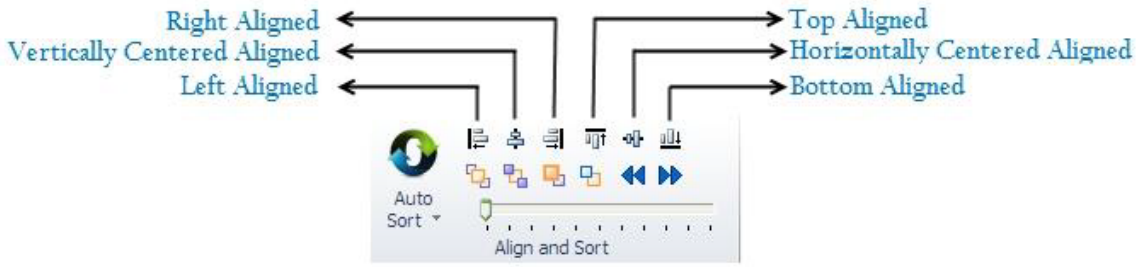


Figure 7-14: Group Sort

As for the rules of group sort, please see the chapter -**Group**. If there is no special requirement, select the way of -**Grid** Sorting.

1. Preview the processing order by dragging the progress bar -**Graphical Order Preview** or clicking the  button. The figure below demonstrates a screen when previewing the parts.

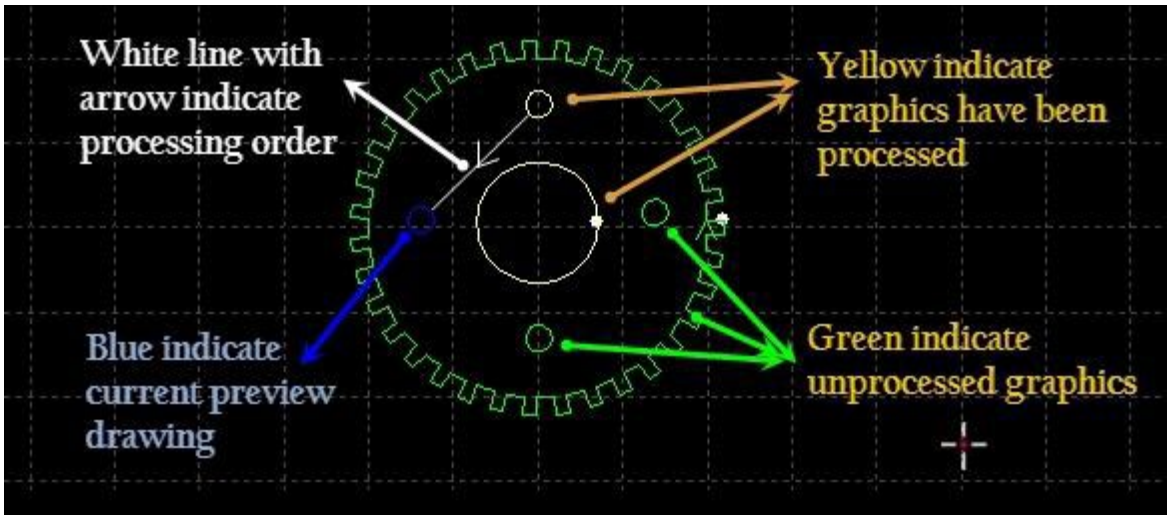


Figure 7-15: Graphical Order Preview

The order preview is fully interactive and it can be more easily controlled than simulation processing. The operator can also zoom in the position to be observed and preview forward and backward repeatedly. All the lost motion paths will be shown by clicking the button -… on the toolbar and will help review the processing order (see the contents in the chapter - **Graphical Display Effect**).

2. Manual Sorting

   To fine-tune the results of the automatic sort, use the manual sorting.

   Firstly, please select the graphics to be adjusted and click the  buttons.

   The functions of the four (4) buttons from left to right are as follows:

Moving to the first	Moving the selected graphic to the first one for processing.
Moving to the last	Moving the selected graphics to the last one for processing.
Moving to the prior	Moving the processing order of the selected graphic forwards.
Moving to the next	Moving the processing order of the selected graphics backwards

NOTE

However, the graphics are moved, the order of the graphics can only change within the layers to which they belong. The overall order between the layers can be adjusted in the dialog box -Layer Parameter Setting (see the Chapter -Layer Parameters.

Except the manual sort of fine-tuning, the operator can also perform the manual sort more intuitively through -**Manual Sorting Mode**. The system will enter the -**Manual Sorting Model** after clicking the -  button on the left toolbar of the main interface. The lost motion path and the digital display of the graphical order will be opened automatically on the screen. According to the expected order, the processing order of the graphics will be set after clicking each one by one. Clicking an incorrect position can be corrected by re-clicking the position or cancel the operation with the right mouse button. To adjust the order between the two (2) graphics, hold the mouse and draw a line from one graphic to another, then set the order between the two (2) graphics.

3. Partition Sorting

   After completing sorting, click -**Group** to fix the order of parts. The order between parts of remain unchanged. The subsequent manual sorting and automatic sorting will not influence the interior of the group.

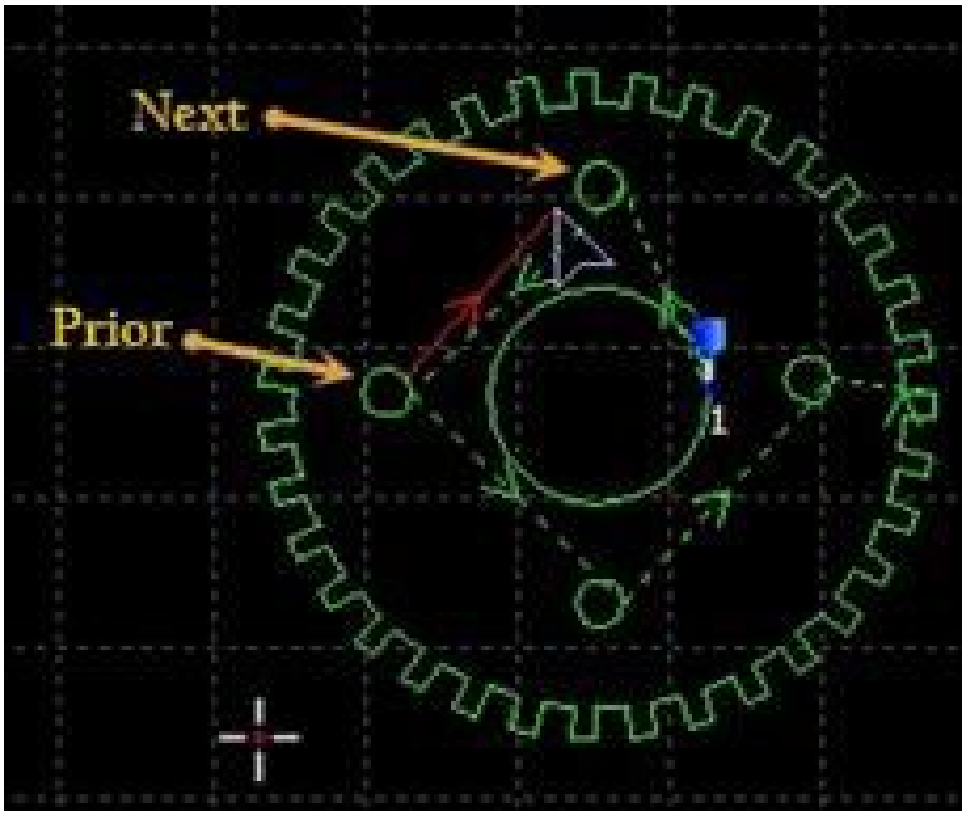


Figure 57-16: Partition Sorting

NOTE

After grouping, all the graphics within the group will be finished by continuous work from the first to the last, the graphics which are not included in the group will not be processed.

To perform automatic sort for the part of the graphics without influencing other parts, the operation can be completed through grouping. Select the graphics needed to be sorted automatically click -**Group** and the click -**Group** with the right mouse button, lastly select -**Sort in Group.**

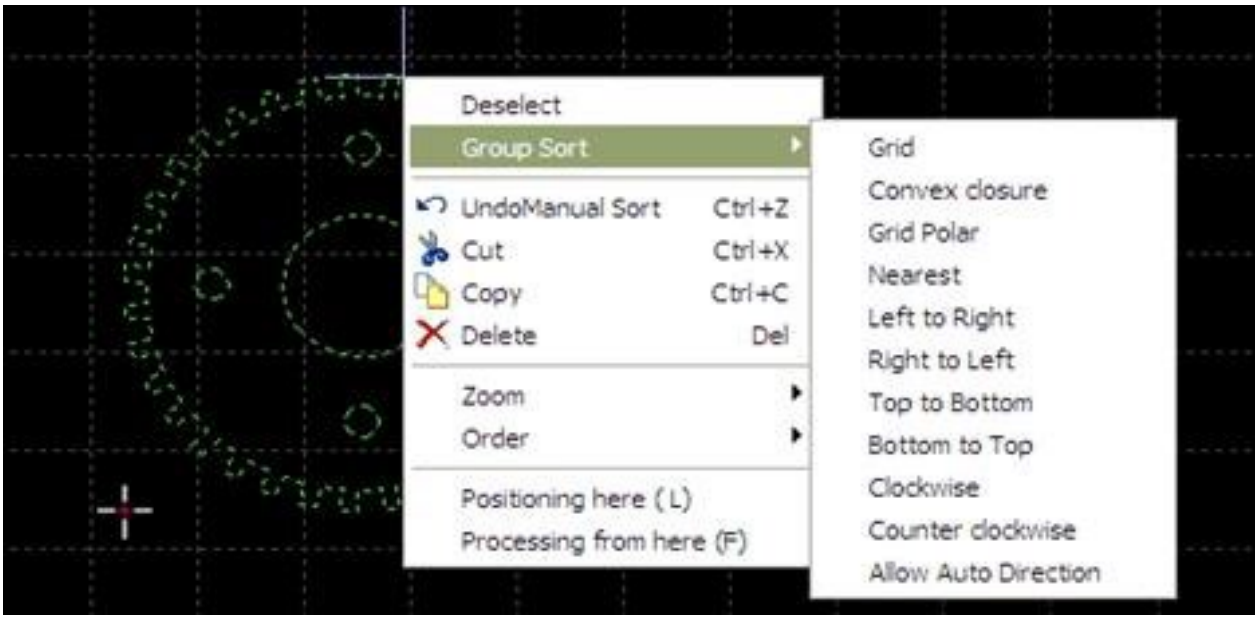
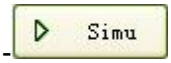


Figure 7-17: Group Sort

4. After finishing the sorting, simulate the process of the entire file through simulation processing and it can be done without the machine. In the simulation processing, the order between the graphics and process withing the graphics can be viewed. Start the simulation by clicking the - 

button on the console. The toolbar will jump automatically to the page -**Numerical Control** and the first column of the page -**Numerical Control** can adjust the speed of the simulation processing.

Figure 7-18: Numerical Control

7.8 Work Control

CypCut is a set of software combing design and work control together. As mentioned above, all the graphics and the parameters can be prepared without the machine tool, the files can be saved after finishing all the design and can be copied to the machine tool for processing.

7.8.1 Coordinate System

The -**Model Coordinate System** used in the graphical design has no relation with the machine and its zero point is marked by -  on the screen. However, the coordinate system used in the processing is related to the operating status of the machine. The correspondence of these two (2) coordinate systems is shown as below.

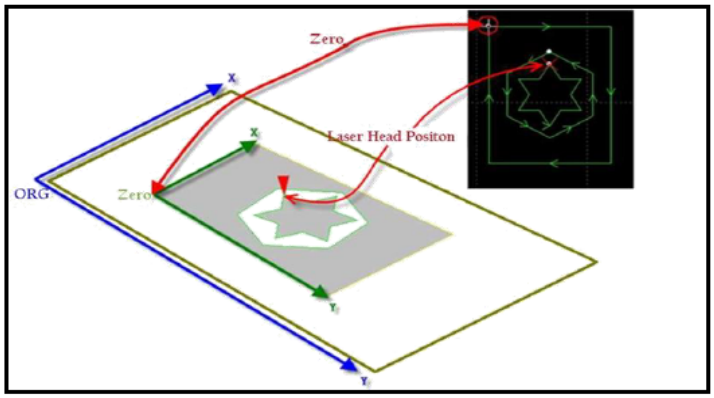


Figure 7-19: Model Coordinate System

The positional relation between the graphics and the machine tool breadth will be displayed on the screen after you click the button -**preview on the console**.

1. Mechanical Coordinate System

   The mechanical coordinate system is uniquely determined by the machine structure and the machine parameters. At any time, all the coordinate systems set through -**Return Origin** are consistent with each other. Reset the mechanical coordinate system through -**Return Origin** after completing the initial installation or when the mechanical coordinate system deviates because of the abnormal reasons.

   No matter which kind of mechanical structure is used, the definitions of CypCut for the coordinate systems are always consistent with each other. All the moves are the moves of the laser head relative to the workpiece. If the laser head is rightward, it is X positive direction, however, if the laser head is backward, it will be Y positive direction.

2. Program Coordinate System

   Because the coordinate system of machine tool is fixed, introduce the workpiece coordinate system for convenient use. The direction of each coordinate axis of all the program coordinate systems in CypCut is fully consistent with the machine coordinate system. Only the zero point of the coordinate system is different and it is called program zero point. The

program coordinate system is divided into the floating coordinate system and the workpiece coordinate system. The program coordinate system is divided into the floating coordinate system and the workpiece coordinate system.

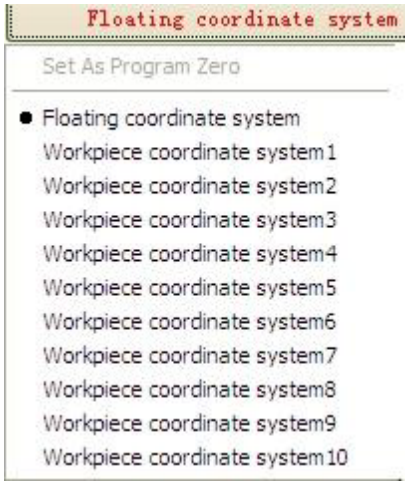


Figure 7-20: Floating Coordinate System

The button at the top of the console can be used to select the program coordinate system and it can also be used to select -**Floating Coordinate System** and ten (10) – Workpiece Coordinate Systems.

Usually, the floating coordinate system is used for informal processing and it can be considered that -Where the laser head moves, it will start to work from there. The zero point of its coordinate system is automatically set as the current position of the laser head when the users click -**Walk**, -**Dry Cut**, or -**Work**.

When selecting the workpiece coordinates 1~10, it is zero point will be set manually by the users through -**Set** the Current Point as the Zero Point. Once it is set, it will be saved forever until you reset it next time. Thus, the workpiece coordinate system is suitable for bulk production and its location is generally decided by the fixture. It can be maintained that every processing will be performed in the same position of the machine by using the workpiece coordinate system 1~10.

3. Searching Zero Point after Exception Occurs

   Case 1

   If the processing is interrupted only due to the exception of external equipment's such as the laser and auxiliary gas and they do not cause the coordinate system to deviate, click Directly -**Return Zero** to go to the zero point.

   Case 2

If the mechanical coordinate deviates due to suddenly power failure or servo alarm, we recommend the users to perform -**Return Origin**, reset the mechanical coordinate system and click -**Return Zero** to find the zero point.

7.9 Alarms

CypCut will monitor all the parts during the running of the machine. Once it monitors the alarms, it will display immediately the alarm in red title bar and take measures such as stopping the motion. Before the system alarms are removed, many operations will be forbidden and users need to check the machine and operate again after the alarms are cancelled.

Figure 7-21: Alarm

Except the title bar, the **-System Message Window** at the lower right corner of the interface can also display the alarm information. After the alarms are removed, the red display of the title bar will disappear, the information in the **-System Message Window** will be retained. The entire history can be viewed by double-clicking **-System Message Window** to display events that happened during the running of the machine. In addition to the alarms, if CypCut detects other operation exceptions, it will display the exceptions in different colors on the **-System Message Window** according to the exception levels, which include warning, reminding, message, etc. This information will not cause the machine to stop moving. It will recommend the operator note the information shown by the system to take any necessary actions as soon as possible.

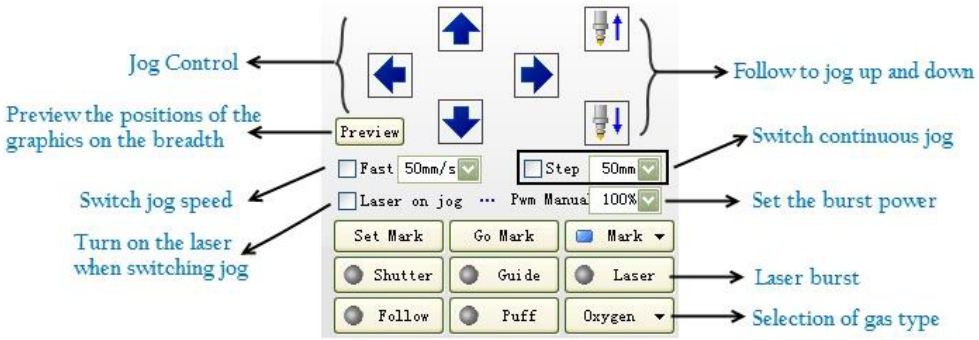


Figure 7-22: System Message Window

7.10 Manual Testing

The functions of the manual control on the console are as follows:

The  button will become  after the corresponding equipment is opened. Turn on the laser by pressing the **-Laser** button and turn off the laser by releasing it.

Press other buttons to switch on and release to turn off. Taking the **-Bowing** button as an example, blowing will start after pressing the button and it will stop after the button is pressed again.

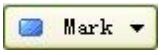
According to the differences of the lasers, the -**shutter** may become  after pressing the button and this state is read from the laser.

NOTE

All the button actions need the support of the corresponding parts on the machine. If the machine is not equipped with these parts or the platform parameter configuration is incorrect some buttons may become invalid.

The current position of the machine tool can be recorded by click - 

and the machine can return to the previously recorded by clicking - 

if required later. Six (6) positions can be recorded in total and they will be selected through the 

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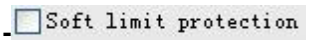
7.11 Soft Limit Protection

To protect the machine, CypCut is installed internally with the soft limit protection, which can be turned on and off through the option - 

on the console. It is enabled by default.

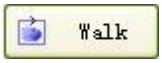
After the soft limit protection is enabled, if the system detects that the motion may exceed the travel range, it will prompt **-Motion is Out of the Range** and will not issue any motion commands to avoid the possible hits. At this moment, please check the positions of the graphics and the machine to ensure that there is no mistake before operation.

Apart from this, the system will also monitor the machine coordinates in real time during the motions of the machine. Once they are beyond the soft limits, the system will alarm at once and then stop all the motions.

NOTE

The soft limit protection depends on the machine coordinate system. If the coordinate system is not correct, the protection will also be incorrect. Thus, after the operations such as abnormal close of the system and modification of the machine parameters, users need to build the correct machine coordinate system through the operation -Go Origin.

7.12 Walk

The laser head will dry cut a rectangle along the frame of the graphic to be processed by clicking the 

button on the console, so the operator can determine the approximate size and position for processing the boards. The speed of walk can be set in the **-Layer Parameter Setting -Global Parameters -Walk Around Parameters**.

NOTE

If you look for the edges of the boards automatically using -Edge Finding, the laser head will move along the inclined rectangle during walking move along the actual frame which is corrected by the -Edge Seek (see -Edge Seek for details).

7.13 Processing and Dry Cut

Start processing by clicking the 

button on the console. During the processing, the monitoring screen will be displayed. It includes the information such as the coordinates, the speed, work time, follow height, etc.

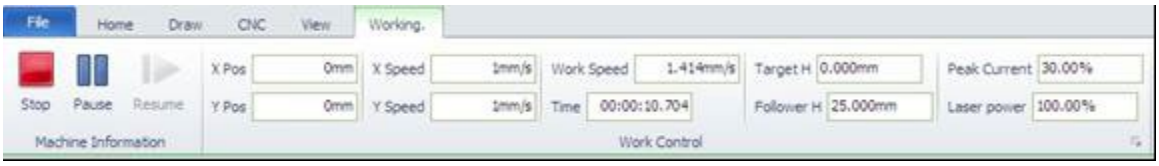


Figure 7-23: Monitoring Screen

When displaying the screen, it cannot be switched or other pages of the toolbar, to prevent from modifying the graphics during the processing. However, the menu **-File** can still be used. To modify the parameters during the processing, please pause firstly, and then click the **-Layer** button on the right toolbar of the interface.

The operation of the dry cut can be performed by clicking the 

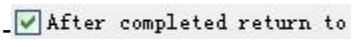
button on the console.

The difference between dry cut and the actual processing lies in that dry cut can select whether to follow without the need for turning on laser or gas. However, all the running tracks, including the lost motion, speed, process of acceleration and deceleration of **-Pre-Punching**, are exactly same to the actual processing. The same operations of pause, continue, forward, and backwards can be performed. The breakpoint memory after stopping is identical to that of the actual processing. Furthermore, the parameters can be modified after pausing and continue the operation of dry cut. Thus, the dry cut can used for the comprehensive inspection and simulation of the whole processing without cutting.

Select **-** 

to open **-Follow** during the dry cut.

By default, it will return to the zero point automatically after completing the processing. To return to the other position after the processing, select the needed position on the console. The supported positions include zero point, start point, end point, origin point, and specified point.

Cancelling **-** 

is equal to returning to the **-End Point** the laser will not move after the processing. Returning to the zero point after processing is recommended before using the **-Floating Coordinate System**. To return to the specified point after processing, jog to the position, click **-Select the Specified Point**, and confirm.

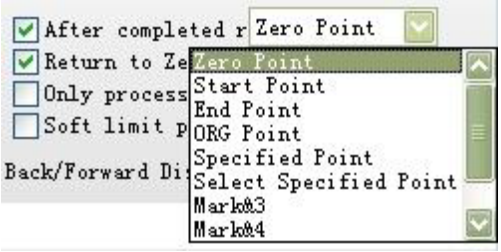


Figure 7-24: After Completed Return

When the processing is finished, the count on the console will add one (1). When the count reaches the preset times, a dialog box will prompt to allow control of the production. The counts can be cleared by clicking the Clear button. Click the Loop Work button for loop work.

7.14 Stop, Pause, and Resume

To stop the processing, click the button on the toolbar or the Stop button on the console. After stopping, the machine will return to the zero point. If you do not hope to go back to the zero point, cancel the selection of option Return to Zero when stop on the console.

Pause the process, click the button on the toolbar or the Pause button on the console. After pausing, modify the parameters clicking the **-Layer** button on the right toolbar. Operate partial functions the manual control on the console, including laser burst, switching the gas, and switching the follow. The operator cannot make the machine move.

Click the on the toolbar or the Resume button on the console to continue the button. If the parameters are modified during the pause, the -**Continue** will be marked with **-*** indicating the system needs to rebuild the processing commands. Depending on the size of the files to be processed, some time may be required after clicking the **-Continue** button.

During the pause, click the Back or Forward button so the machine can move backward or forward along the processing track. The distance and the speed of every motion can be set through the Back/Forward Dis: 10mm 50mm/s on the console.

7.15 Breakpoint Memory

If the processing is halted or suspended by accidents, the system will hold breakpoint memory. If the graphics or the parameters are not modified, the system will ask how to restore the process.

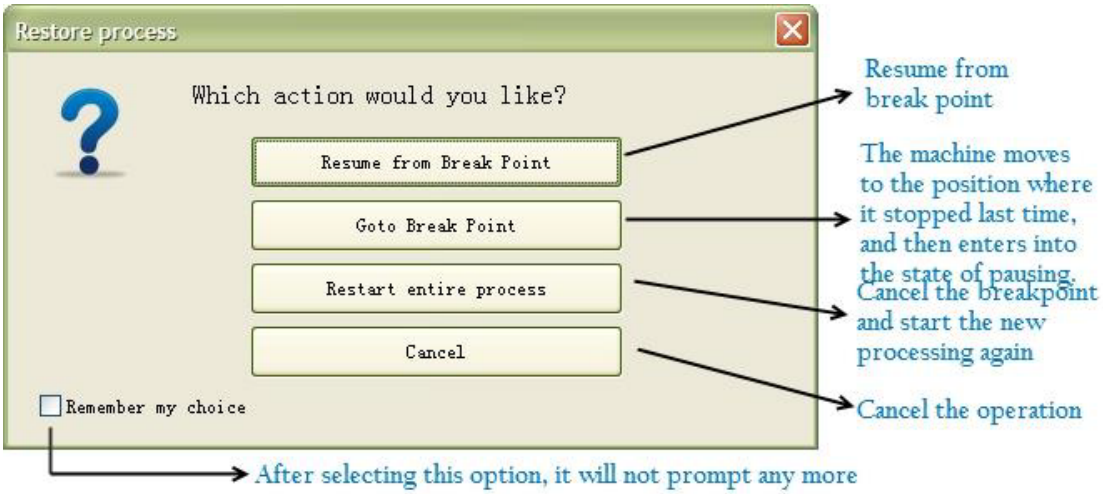


Figure 7-25: Restore Process

If the 

button includes the -*, the dialog box will not appear and the machine will begin working directly from the starting point by clicking the button.

7.16 Processing from Any Location

CypCut support the function to start processing from any specified position. Operators can right-click the start location and then select -**Processing from Here** (see Figure 7-26).

For safety reasons, a confirmation box will appear. Select Processing from Here and reconfirm. The system will move to the location specified and then start processing from there and the tracks in front of the specified location will not to be processed.

To move to a specified location without beginning processing, select -**Position Here**. Right-click the position and select -

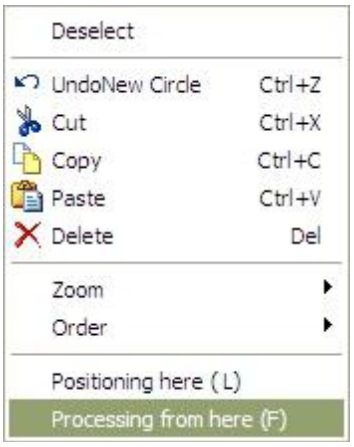
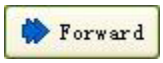


Figure 7-26: Processing from Any Location

Positioning Here until the operation is confirmed. Use the 

and 

buttons for precise positioning.

7.17 Global Parameters

Some movement control parameters are provided in the -**Global Parameters** tab of the -**Layer Parameter Adjustment** dialog box for adjustments. The adjustment parameters will influence the smoothness of mechanical running as well as processing effect and efficiency.

Some parameters of the tab – **Global Parameters**:

7.17.1 Descriptions of Parameters

Motion Parameters	
Lost Motion Speed	Speed during motion (not the speed during processing)
Working Speed	Speed of walking
Lost Motion Acceleration	The maximum acceleration of each shaft during lost motion. It needs to be used with move speed.
Processing Acceleration	The maximum acceleration of each shaft during track processing. It needs to be used with processing speed.
Turning Acceleration	The maximum allowable acceleration at the path turning during track processing. It is used to limit the turning speed at the corner of greater than 90 degrees. The turning speed of smaller than 90 degrees will be reduced to zero.
Turning Jerk	The maximum acceleration when curvature of smooth curve changes sharply during track processing (such as runway type, which has the transition from the arch to a straight line). It is used to limit the mechanic shock of smooth in the case of abrupt curvature changes.

Motion Parameters	
Processing Jerk	Change rate of acceleration at Segment S of S-Type acceleration and deceleration during track processing. The smaller the value is, the smaller the mechanical shock during track movement is and the smaller the acceleration is. Conversely, the greater the value is, the greater the mechanical shock during track movement is and the greater the acceleration is.
Lost Motion Jerk	Change rate of acceleration at Segment S of S-Type acceleration and deceleration during lost motion. The smaller the value is, the smaller the mechanical shock during movement is and the smaller the acceleration is. Conversely, the greater the value is, the greater the mechanical shock during lost motion is and the greater the acceleration is.
Speed of 10mm Reference Circle	It is used to limit the speeds of the figures with small arcs and curvature.
Default Parameters	
PWM Frequency	PWM frequency used by laser in manual mode.
Default Peak Current	Peak current used by laser in manual mode.
Default Pressure	Air pressure used in manual mode.
Delay for Gas On	Delay time used in step – Delay for Gas On of PLC during punching.
Delay for Retracting	Delay time for retracting when using IO follower in manual mode.

Advanced Parameters	
Fitting Frequency of Curve	Fitting precision when converting Spline/ Bezier to straight line for processing.
Maximum Lost Motion Length for Short Move without Lifting	If -Short Move Using A Separate Laser Parameters is checked, when lost motion length is less than this length, the laser needs to be shut down without lifting. The specific process is determined by Laser off process for short move.
Using Leapfrog Lift	After the Z-Coordinate lifts to the mid height, the X-Coordinate and Y-Coordinate will begin to shorten the time of lost motion.
Unit Selection	Selections can be made according to operator patterns and the units will be switched in the interface.

7.17.2 S-Shaped Acceleration and Deceleration

Characterized by the advantages of continuous changes of acceleration and torque, S-Shaped acceleration and deceleration is a flexible acceleration and deceleration algorithm and more suitable for servo motor control. CypCut uses S-Shaped acceleration and deceleration to control the changes in the speed of movement, to achieve a more stable control and better processing effect.

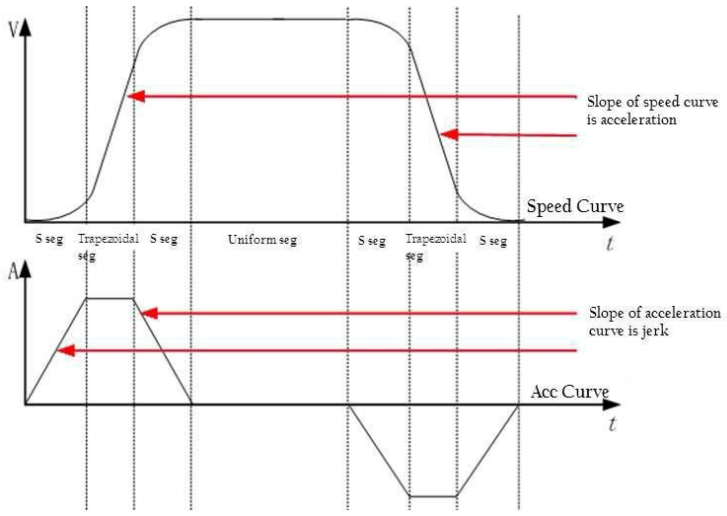


Figure 7-27: S-Shaped Acceleration and Deceleration

When the jerk is approaching infinity, S-Shaped acceleration and deceleration is equivalent to trapezoidal acceleration and deceleration. Jerk embodies torque, so we should set the jerk in comprehensive consideration of motor characteristics, machine load and other factors, and we should not seek after speed blindly.

7.18 Appendix of the CypCut

7.18.1 Example of Coedge Nesting

In Figure 7-28, the unclosed graphic is shown in red. All the graphics in the drawing are straight lines requiring coedge. The original drawing consists of ten (10) narrow parts below six (6) large parts and narrow workpieces (9x2=18) at right exactly occupying the space of a steel plate.

The three (3) parts in the original drawing are from a DXF drawing.

Select all the graphics of each part by using -**Group**|| function. After grouping, the outer contour of parts will be shown in bold.

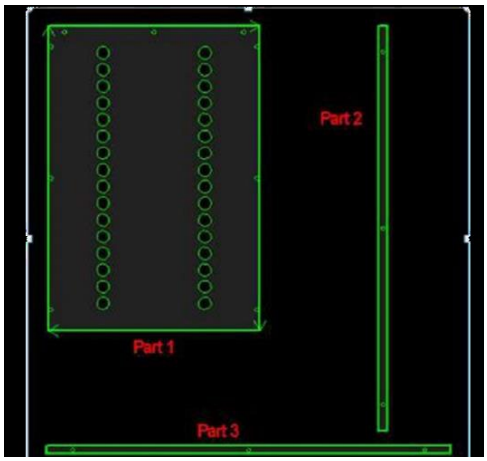


Figure 7-28: Unclosed Graphic

Figure 7-29: Menu

Select Part 1 and make an array with three (3) rows and two (2) columns (see Figure 7-30).

Select the six (6) arrayed parts and complete the coedge for the above six (6) parts by clicking -**Coedge**||.

After dragging Part 2 to the position close to the top right position of the above figure, the parts will be automatically adsorbed to the boundary of Part 1 and become top aligned.

Figure 7-30: Array

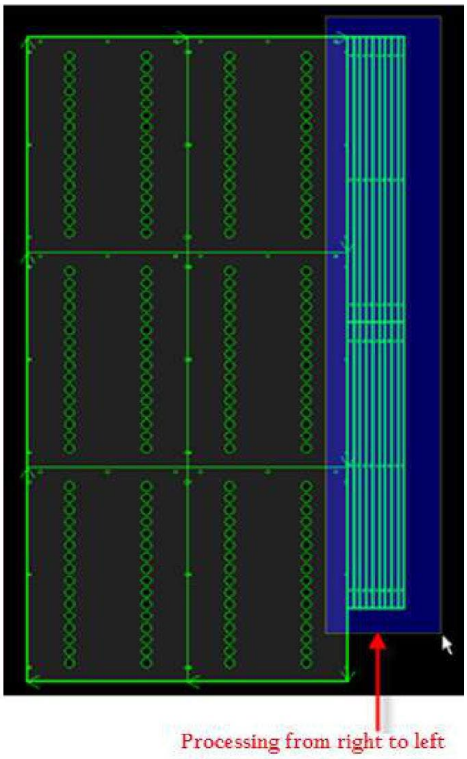


Figure 6Select All

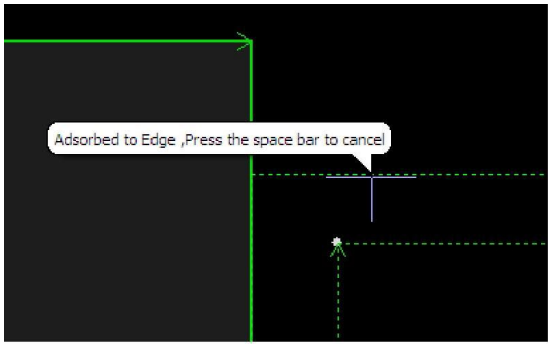


Figure 7-32: Select Array

Select Part 2, make an array with two (2) rows and nine (9) columns and then obtain the figure shown in Figure 7-30.

As shown in Figure 7-31, select all eighteen (18) Part 2 by pulling out a pale blue box from the upper left corner of the Part 2 to the lower right corner while Part 2 will not be selected.

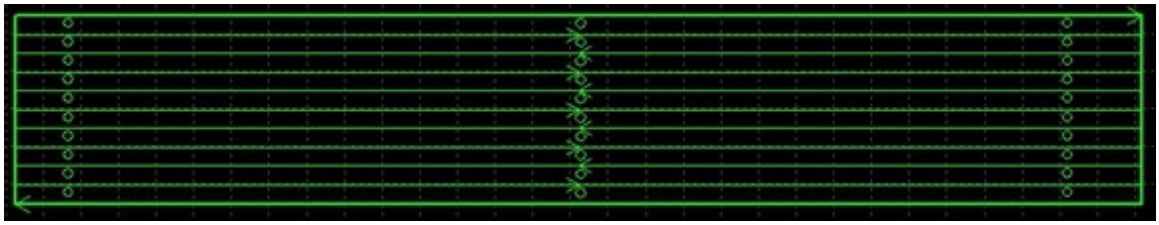


Figure 7-33: Complete the Coedge

Complete the coedge of eighteen (18) Part 2 by clicking -**Coedge**||. Please note that the processing order of Part 2 must be from right to left or steel plates will jitter or even deviate due to the lack of support.

Select coedge Part 2, click the right mouse button and select the right-to-left sorting from the pop-up menu.

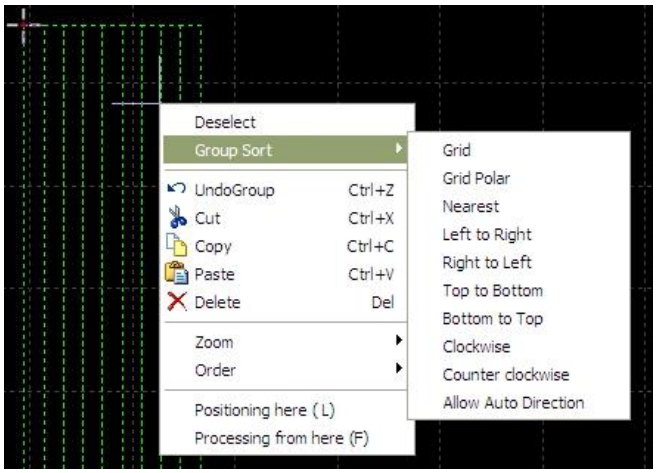


Figure 7-34: Group Sort

Attentive users may ask why the coedge needs to be conducted after dragging Part 2 to the boundary of Part 1 as it is difficult to conduct selection

The order can be exchanged. First conduct Coedge for Part 3 and the drag it to the position below Part 1.

Select Part 3, make an array with ten (10) rows and one (1) column and then retrieve the following.

After electing ten (10) Part 3 and clicking -Codege||, the coedge of Part 3 is completed and they become a whole. Please note that the thickness of the lines is different. Each Part 3 has a bold outline border before coedge, the whole outline border after coedge and the codedged line segments in it are all shown in thin lines.

When the mouse is suspended above Part 3 the corresponding prompt will be displayed indicating that it is a combination.

Figure 7-35: Insert Block

Similarly, we need to conduct a sorting for Part 3 from bottom to top, to prevent the steel plates from jittering and deviating due to the lack of support.

When selecting the overall Part 3 after Coedge and dragging it to the lower left of Part 1, the parts will be automatically absorbed to the boundary of Part 1 and become left aligned.

Figure 7-36: Select All Graphics

Next, select all the graphics to coedge all Part 1, Part 2, and Part 3. If you do not want to coedge Part 2 and Part 3 with Part 1, this step can be omitted. Part 2 and Part 3 should be slightly dragged from the boundary of Part 1.

7.18.2 Parameter Range

It is recommended operators should first estimate the load status of the system before adjusting the parameters, to facilitate the follow-up parameter setting and determination. The corresponding relationship between the load and inertial ratio of the system are as shown below.

Light Load	Moderate Load	Moderate Load
Inertia ratio< 150%	Inertia ratio 150% - 300%	Inertia ratio above 300%

Parameter Name	Default	Light Load	Moderate Load	Moderate Load
Lost Motion Jerk	4W	5W – 20W	2W – 5W	0.5W – 2W
Processing Jerk	2W	3W – 10W	1.5W – 3W	0.5W – 1.5W

Lost Motion Acceleration	1500	2000 – 5000	1200 – 2000	300 – 1200
Processing Acceleration	1200	1500 – 5000	800 – 1500	300 – 800
Turning Jerk	1.5W	1.5W – 4W	1W – 1.5W	0.3W – 1W
Turning Acceleration	600	700 – 1500	400 – 700	150 - 400

Parameter Name	Default	Light Load	Moderate Load	Moderate Load
Speed of 10mm Circle	60	80 – 120	50 – 80	20 – 50

7.18.3 Parameter Determination

Method of determination:

Process a rectangle and require that the size of the rectangle be large enough. Then conduct full acceleration and deceleration, accelerate it to the processing speed and see whether there are waves in the corner. If there are waves, it will be necessary to adjust the turning jerk.

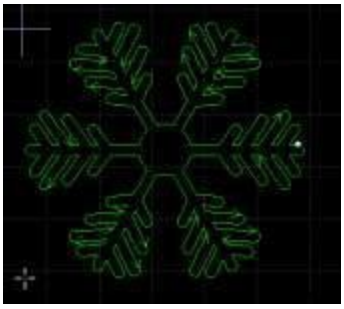


Figure 7-37: Example

7.18.4 Determination of Processing Acceleration

Method of Determination:

Process the same rectangle and observe the moment curve of the servo and modify the acceleration and keep the moment curve in the accelerating section not more than 60% generally.

Verify the settings of the parameter will not cause the vibration of the machine. If mechanical rigidity is poor, a large cutting deformation may be caused due to the setting of large acceleration.

This parameter may affect the cutting accuracy of the small circle.

7.18.5 Determination of Turning Acceleration

Turning acceleration only affects the speed of flex point with an angle of greater than 90 degrees. When turning is not greater than 90 degrees, the speed in the turning will decelerate to 0, which has no connection with the turning acceleration. The speed of the upper three (3) turnings are affected by turning acceleration.

Method of determination: After determining the processing acceleration and jerk parameters, cut a regular hexagon and regular dodecagon and reduce the turning acceleration until there are no waves in the corner.

7.18.6 Determination of Turning Jerk

When the track is smoothly connected and the size and direction of curvature changes suddenly, the change of moment may be caused.

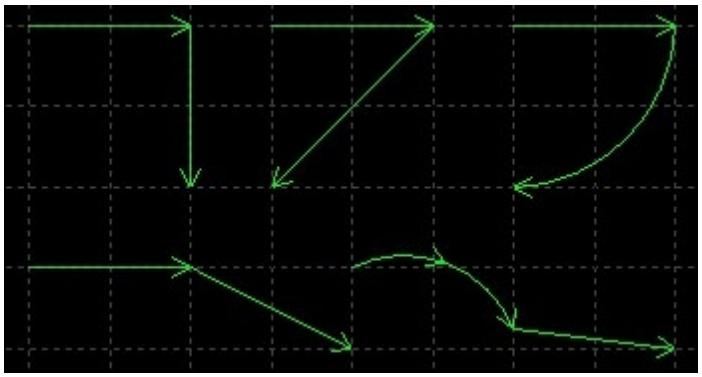


Figure 7-38: Determination of Turning Jerk

Therefore, it is necessarily to limit through -**Turning Jerk**||.

Method of determination:

Look for some instances, such as flat runway and snowflake, and then determine whether there are waves after the curve turns at a corner. Generally, the defaults provided in the -**Approximate Range of Parameters**|| can meet the requirements.

7.18.7 Determination of the Speed of 10mm Reference Circle

Method of determination:

Draw small circles with the radii 3 mm, 5 mm, 8 mm, 10 mm, etc. Improve the accuracy of each circle through modifying -**the Speed of 10mm Reference Circle**||.

If the following phenomena occur during the process of cutting small circles, adjust each according to the corresponding operations.

Phenomenon	Analysis and Solutions
Circle Turns into oval	1. The servo response time of X and Y is not consistent with each other. 2. Speed feed forward is not enough.
Deformation in Acceleration Segment and Deceleration Segment	Reduce the processing jerk; reduce the processing acceleration.
Turn into irregular Polygon	Reduce the speed of 10mm reference circle.
It Could Not be Cut into a Circle no Matter How Low the Speed is	Considerate the mechanical reversal clearance and installation errors.

7.19 Settings of Lost Motion Parameters

Lost motion acceleration and lost motion jerk through multiply the processing acceleration and processing jerk by 1.2-2 times directly. The operator must ensure there is no machine shock and the track precision is not demanded.

7.20 Integrated Debugging

To improve the precision: To reduce control error by adjusting servo and motion parameters and eliminate the track error caused by mechanical vibration; to reduce of actuators by using thread pitch compensation.

To solve the problem of firing angle: To reduce the acceleration and deceleration time by increasing the jerk and acceleration; to use real-time power adjustment and adjust the power curve according to the technological requirements.

7.21 Shortcut Key

The following table lists some of the commonly used shortcut keys. Some of them are used in specific conditions and they have been introduced in related chapters, so there is no need to list them here.

Shortcut Key	Effect	Service Conditions
Ctrl + A	Select all the graphics	None
Ctrl + C	Copy graphics to clipboard	Select graphics to be operated
Ctrl + Shift + C	Specify – Base Point and copy command	Select graphics to be operated
Ctrl + O	Open the file	None
Ctrl + P	Show/hide the graphic direction and lost motion track	None
Ctrl + P	Show/hide the graphic direction and lost motion track	None
Ctrl + V	Paste graphic in the clipboard to the drawing board	There are copied graphics in the clipboard
Ctrl + W	Adapt to window	None
Ctrl + X	Cut the graphics to Windows clipboard	Select graphics to be operated
Ctrl + Z	Cancel the orders just finished	There are finished commands
F3	Check all the graphics	None
F4	Check the whole machine range	None
F5	Check the graphics in the zone of selection	Select graphics to be operated

Shortcut Key	Effect	Service Conditions
F6	Open the dialogue box -Layer Parameters Settings	None
F7	Show/hide the processing path	None
F8	Show/hide the motion path	None
DEL (Delete)	Delete the selected graphics	Select graphics to be operated
SPACE (Space)	Repeat the last command	Last command can be repeated

7.22 Process Settings

Since most of the process parameters are directly related to the material being cut, the laser used, and the air pressure, please set it according to the actual process requirements. All the parameters mentioned here, including the parameters in the picture, are only examples and should not be considered as guiding parameters.

⚠ WARNING

Inappropriate or incorrect parameters may result in poor cutting or even damage to the machine. Please set carefully.

7.23 Introducing Lead Wires

1. Distinguish between internal and external modes
   When an external file such as IGES is opened, the software automatically distinguishes between the internal and external modules. The software distinguishes the inner and outer molds according to the enclosing relationship and always uses the outermost layer as the outer membrane, the lower layer of the outer membrane as the inner mold, the inner layer, and the outer layer, etc.
   When the lead is added, the outer film is masculine cut, introduced from the outside, and the inner mold is negatively cut and introduced from the inside. To manually set the cut and cut, select the graph want to set, then click the **Inside and Out** button on the toolbar.

2. Automatically Introduce Lead Lines

   Select the graph that needs to set the lead-out line and then click the Leader Line icon on the toolbar to set the parameters for introducing the lead-out line in the pop-up window.

   Please note that the automatic introduction of the leader line will search the graph to determine the most suitable lead-in position, so the parameters such as the lead-in position and type before the graph will be overwritten.

3. Check the Lead-in Line

   Click the small triangle under the **Cutter Line** button and select Check **Import and Export** to check the legality of the imported lead-out line. This function will shorten the lead with a length too long to avoid crossing with other graphics.

4. Cutting Seam Compensation

   Select the shape to compensate and click the **Compensation** button on the toolbar to perform the kerf compensation. The kerf width should be measured according to the actual cutting result. The compensated trajectory is indicated in white on the drawing board and will be operated with the compensated trajectory during processing; the compensated original image will not be processed, only in the drawing board. Easy to operate and display.

   The direction of the kerf compensation can be manually selected or it can be automatically judged according to the positive cutting and negative cutting. The male cutting is compensated outward and the negative cutting is compensated inward.

   For kerf compensation, choose whether to round or right angle the corner (see Figure 7-39).

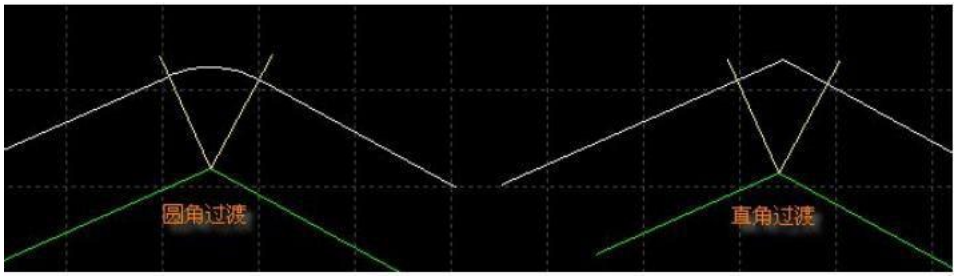
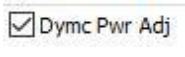


Figure 7-39: Kerf Compensation

In the figure green is the original image, white is the compensated trajectory, and pale. Yellow is the vertical line from the corner of the original image. It can be seen from the figure that the compensation of both sides of the vertical line can ensure that the edge of the slit coincides with the original image, but the corner needs a transition. Usually, the rounded transition ensures that the edge of the kerf remains coincident with the original image during the transition and runs lighter.

To cancel the compensation, select the graphic to cancel then click the **Clear** button and select **Cancel Compensation**.

5. Power Regulation

If 

is selected, the cutting power will change with the speed during the cutting process and the specific change value is determined by the power curve. The power curve can be dragged and edited with the mouse.

The abscissa of the power graph is the cutting speed and the ordinate is the cutting power in units of percentage. The table can reflect that when the actual movement to the corner is reduced to a few percent of the target speed; the actual power needs to drop to a few percent of the cutting power.

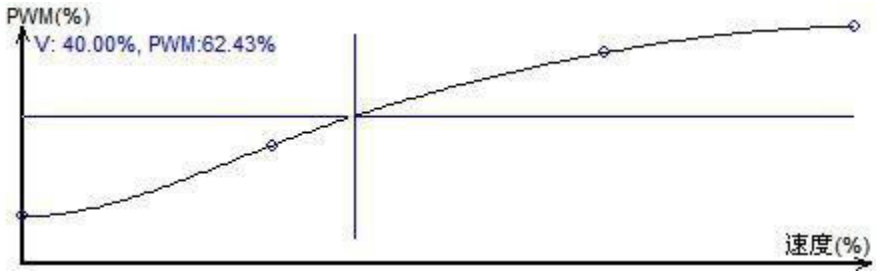
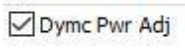


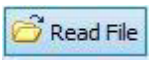
Figure 7-40: Power Graph

If the laser power is 500W the cutting speed is 100mm/s, the peak current is 90% and the cutting power is 80%. When the actual cutting speed drops to 40mm/s, the laser Power is: Laser Power X Peak Current (percent) X Cutting Power (percent X Speed Power Adjustment (percentage) = 500W X 90% X 80% X 62.43% = 223.75W, but no matter how the power is reduced it will not be low at a pre-set minimum value, typically 10% or 50W.

If 

is not selected, the power will remain unchanged during the cutting process. In the example, the power during the cutting process is 500W X 90% X 80% = 360W, after all the parameters have been edited, the user can save all the parameters in the layer to the material library for further use. Click the 

button and enter the file name to save it as a material library. It is recommended that the user set the file name with the material characteristics as the name, such as 2mm carbon steel.

Click 

and select the previously saved file to use the material library. The software will prompt the user to “Do you want to overwrite the current parameters”, please click “Yes” system will automatically import the material library parameters, “No” will abandon the read operation.

The control software is a set of software that assists in the design and processing control. All the drawings and parameters can be removed from the machine. After the design is completed, the file can be saved and then copied to the machine for processing.

6. Mechanical Coordinate System

   The machine coordinate system is uniquely determined by the machine structure and machine parameters. The coordinate system established by “return to the machine origin” is consistent at any time.

   Regardless of the mechanical structure used, the software defines the coordinate system to be consistent. All movements are the movement of the laser head relative to the workpiece. The laser head is X forward in the right direction and the Y head is backward in the laser head. That is, the lower left corner of the workpiece (steel plate) is the minimum coordinate and the upper right corner is the maximum coordinate.

   The rotation axis forms a difference complement with the Y-Axis, parallel to the Y-Axis. When looking at Y+ from the Y- direction, it rotates counterclockwise to forward rotation and clockwise rotation to reverse rotation.

7. Looking for Zero after an Abnormality Occurs

   a. Situation One

      If only a peripheral such as a laser or an auxiliary gas is abnormal, the processing is interrupted, and the coordinate system is not shifted. Click “zero back” directly to return to zero.

   b. Situation Two

      If sudden power failure, servo alarm, etc. will cause the mechanical coordinate system to become an offset abnormality, it is recommended that the user perform the “return to the mechanical origin” to reset the mechanical coordinate system. Then click “Zero” to find the zero point.

8. Alarm

   The software monitors all components during the operation of the machine. Once the alarm is detected, it is immediately displayed in the red title bar and measures such as stopping the movement are taken. Many operations will be disabled until the system alarm is cleared. Please check the machine until the alarm is cleared. The title bar disappears and the information in the System Message Window is retained. Double-click the System Message Window to open a view of all history to see what happened during system operation.

   In addition to the alarm, if the software detects other abnormalities, it will be displayed in the System Message Window in different colors according to the abnormal level, including warnings, reminders, messages, etc. This information does not cause the machine to stop moving, but it is still recommended that should pay attention to all kinds of messages displayed by the system in time to take necessary measures as soon as possible.

9. Manual Test

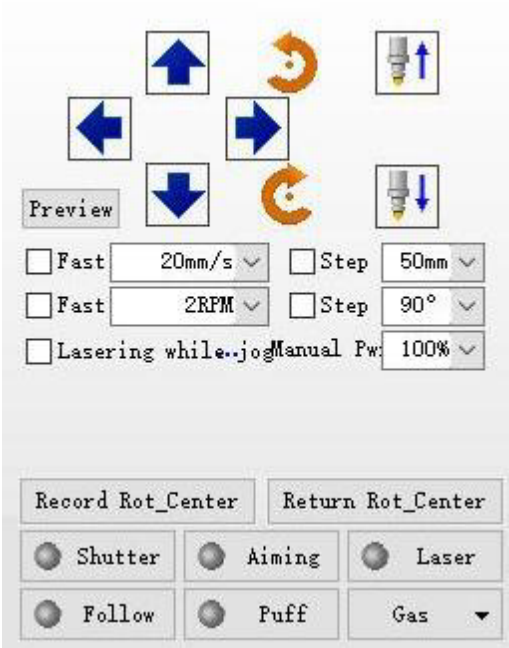
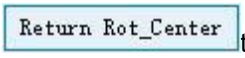


Figure 7-41: Manual Test

Buttons with the  icon will change to  after the corresponding device is turned on. The **Laser** button is pressed to turn on the laser, release to turn off the laser; the other buttons are pressed to switch, release without performing any action, such as Blowing, press the air, press again to close the air. Depending on the laser, the Gate may become  in a pattern after it is pressed and this state is read from the laser.

Please note that all button actions require the corresponding component support on the machine. If the machine does not have these components configured or if the platform parameters are not configured correctly, some of the buttons may not work.

Click  to record the current position of the machine as the W-Axis rotation center. Then, when needed, click  to return to the previously recorded position.

10. Soft Limit Protection

To protect the machine tool, the software has built-in soft limit protection, which can be turned on and off through the “” option on the console and is enabled by default.

After the soft limit protection is enabled if the system detects that the motion may exceed the travel range, it will prompt “The motion has exceeded the travel range” and no motion

command will be issued to prevent possible impact. In this case, check the graphics and machine position and confirm that is correct.

In addition, the system will monitor the machine coordinates in real time during the movement of the machine. Once the soft limit is exceeded, it will immediately alarm and stop all movements.

NOTE

The soft limit protection depends on the machine coordinate system. If the coordinate system is incorrect, the protection will also be incorrect. Therefore, when the system is abnormally closed, machine parameters are modified, etc. the correct machine coordinate system should be established by "return to origin" operation.

11. Walking the Border

Click on the 

button on the console and the laser head will take a rectangle along the frame of the graphic to be machined so the approximate size and position required to process the sheet can be determined. The speed of the border is set in the **Layer Parameter Settings – Global Parameters – Edge Detection Parameters**. Please note that it is important to verify that the center of rotation has been recorded before taking the border.

12. Processing and Travel

Click the 

button on the console to start machining. During the processing, the monitoring screen shown in the figure below will be displayed, including coordinates, speed, machining timing, and following height.

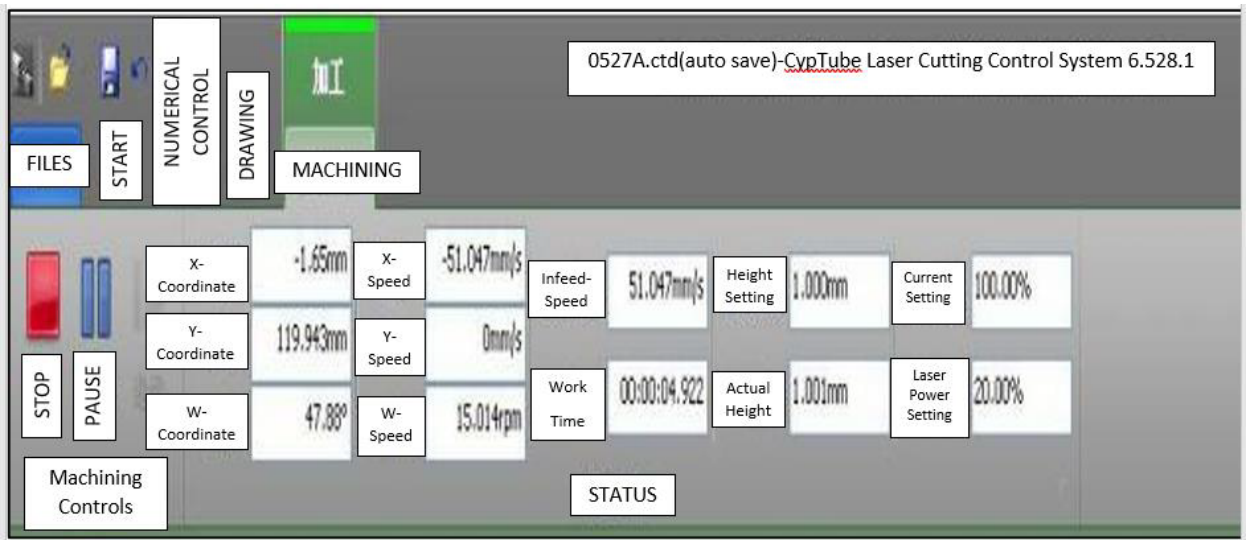


Figure 7-42: Monitoring Screen

When the above image is displayed, switching to other tabs will not be possible. This is to prevent the graphics from being modified during processing but the File menu is still available. To modify the parameters during machining, pause first, then click the Layers button on the toolbar on the right side of the interface.

Click the 

button on the console to open the air. The difference between the Travel walks and the actual machining is that the laser is not turned on, the gas is not turned on, and the follow-up can be selected. All the running tracks, including the “pre-perforation” air movement, the speed, and acceleration and deceleration processes are the same as the actual machining process, and can also be paused, continued, forwarded, and retracted. The break point memory after stopping is the same as the actual machining and parameters can be modified after the pause goes away. Therefore, Travel can be used to perform a comprehensive inspection and simulation of the overall machining process without cutting. Increments of one (1). After a preset Target number, a dialog box will pop up to control the output. Click the 

button to clear the count. For cycle processing, click the 

button.

13. Stop, Pause, and Continue

To stop machining, click  on the toolbar or the 

button on the console. After stopping, the machine will return to zero. Cancel the selection of the item on

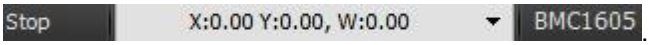
the console to prevent returning to zero. To pause the processing, click the  button on the toolbar or the 

button on the console.

After the pause, click the Layer button on the right toolbar to modify the parameters or operate the manual control section on the console. The functions include laser spotting, switching gas, switch following, etc. but cannot make the machine move. To continue processing, click the Continue button on the toolbar or the  button on the console. If the parameter is modified during the pause process the **Continue** button will be marked with an *; the system will need to regenerate the machining command. Processing may take some time for larger files.

During the pause process, click 

or 

to move the machine backwards or forwards along the machining path. The distance and speed of each movement are set at the console Stop 

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14. Breakpoint Memory

    If the machining process stops or the machining is aborted due to an accident, the system will memorize the breakpoint. If the graphic or parameter is not modified, click **Start** again, the system will ask whether to continue processing from the last stop.

    The dialog box shown above will only appear when the **Start** button is in the **Start** state. If the * appears in the 

button, clicking the button will start machining directly from the beginning.

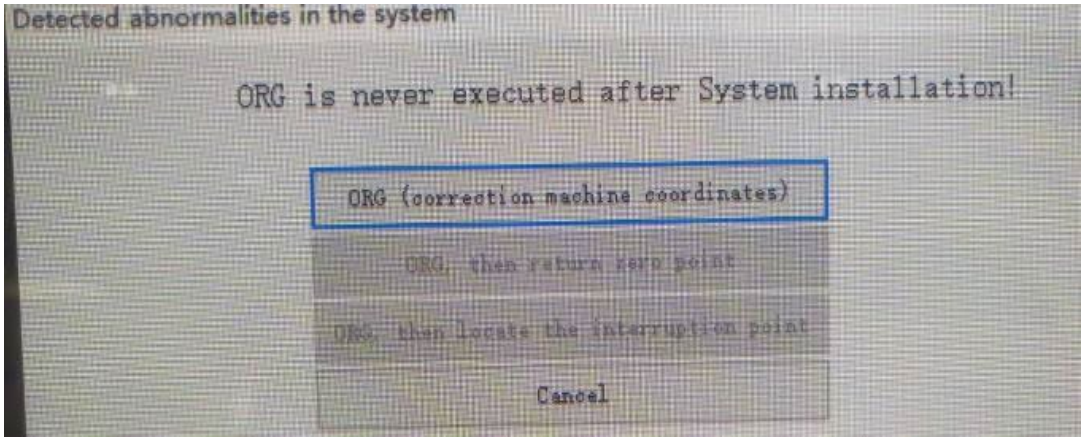
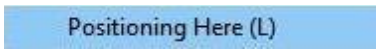


Figure 7-43: Dialog Box

15. Starting from Any Position

    The software supports machining from any specified location, right-clicking the start location and selecting **Start Machining from Here**.



    For safety reasons, after selecting **Start Machining from Here**, the system will display a dialog box requesting confirmation. After confirming the error, the system will first move to the original specified position and start machining from there. The track before the specified position will not be processed.

    To locate the specified position, do not start machining, select Locate Here, the system will move to the position specified and then enter the pause state. Right-click and select Locate here multiple times to confirm. Use the 

and 

buttons to locate a precise position.

16. Global Parameters

    Some of the motion parameters are available in the **Global Parameters** tab of the **Layer Parameter Adjustment** dialog box. Adjusting these parameters will affect the smoothness of the machine and the processing effect and efficiency.

17. Parameter Description

	The Speed of taking the Border
Maximum Speed of the rotating shaft during working	Please calculate the appropriate value according to the maximum speed of the servo motor combined with the reduction ratio. For example, the maximum motor speed is 3000r/min, the reduction ratio is 1:60. Then the maximum rotation axis Speed = 3000/50 = 50r/min during working.
Empty Shift Speed	When the motion is idling, the maximum acceleration of each axis is generally set to 1.2~2 times of the working acceleration.
Working Speed	The maximum acceleration of each axis during trajectory machining is used in conjunction with the working speed.
Turning Acceleration	The maximum acceleration allowed at the corner of the path during trajectory machining is used to limit the cornering speed greater than 90 degrees. The corner speed of 90 degrees or less is reduced to zero.
10 mm reference Circle Speed	Used to limit the speed of small arcs and small curvature graphs.

18. Default Parameter Description

Default Parameter	
Point Injection PWM Frequency	PWM frequency used by the laser in manual mode.
Point Peak Current	Peak current used by the laser in manual mode.
Default Pressure	Air Pressure in Manual Mode (required with Proportional Valve).
Air Release Delay	Delay time used by the PLC step “Opening Delay” during the piercing process.
First Air Opening Delay	The air-opening delay called by the first hole in the entire drawing process.
Ventilation Delay	Delay in switching different gases during the cutting process.
Directly Follow the Maximum Height	When the height is lower than the set value, direct follow is used; when the value is higher than the set value, follow the set height.

19. Advanced Parameter Description

Advanced Parameter	
Curve Fitting Agency	Edge Speed
Maximum Air Movement length does not lift up short distance	If Enable short distance is not raised is checked in the layer parameters. When the air movement length is less than this length, the light is off but not raised. The specific process is determined by the short-distance light-off process.
Use Leapfrog	The Z-Axis is lifted to half the height and the X, Y-Axis starts to move empty to achieve the purpose of shortening the movement time of the lost motion.
Enable follow-up when walking	By default, the Z-Axis will not move when it is empty. If it needs to follow when it is empty, the user can select this item.
Disable follow-up during Machining	By default, the Z-Axis is moving during machining. Select this item if machining is not needed.
Unit Selection	By default, the Z-Axis is moving during machining. Select this item to not follow during machining.
	According to usage habits, the interface will switch.

NOTES:

8.0 Appendix

8.1 Square Tube Debugging

Verify the tube is placed along the Y-Axis.

Adjust the Horizontal Direction. Adjust the height of the ends of the pipe AB at the same horizontal position. Debugging steps:

1. Jog the X and Y-Axis to move the laser head to the center of the tube axis. Click Auto Edge Search. If the AB surface is not placed in the horizontal direction (with Tilt Angle), this stop can adjust the AB Surface to the horizontal direction as follows:

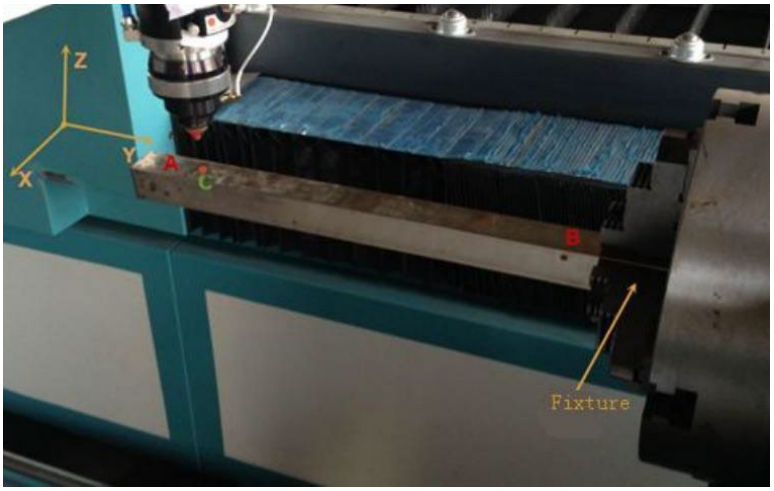


Figure 8-1: AB Surface

2. Open the BCL3764 Diagnostic Interface: Jog the Y-Axis, move the laser head to the position near the A end away from the end of the fixture, open the follow, record the coordinates of the Z-Axis at this time.

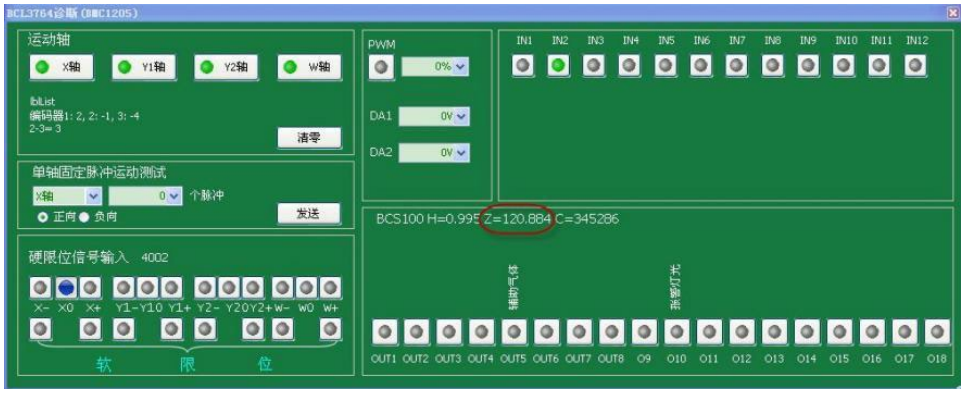


Figure 8-2: Diagnostic Interface (1 of 2)

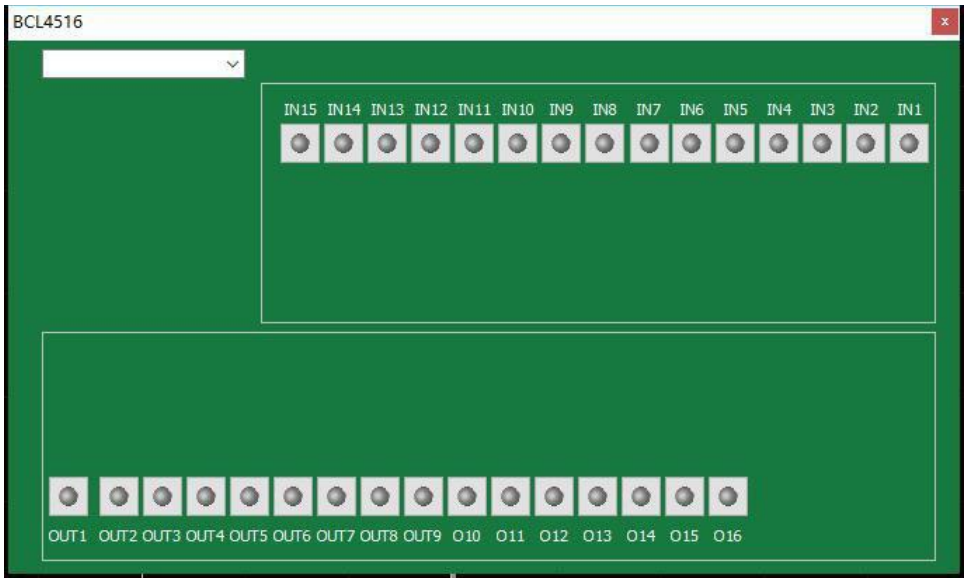


Figure 8-3: Diagnostic Interface (1 of 2)

3. Move along the upper surface of the pipe from the low end of the A end of the end B (near the end of the clamp and observe the change of the Z-Coordinate of the whole process.
4. Rotate 180 degrees and repeat Step C on the opposite of the AB side.
5. Adjust the placement of the pipe according to the following:

Fixture placement is not horizontal	If the Z values for steps b and c are both large to small, then the A end of the tubing is lower than the B end. Raising the clamp to the side near the A end is recommended. If the Z values of steps 2 and 3 are from small to large, then the A end of the tube is higher than the B end. In this case, lowering the side of the clamp near the A end is recommended.
Pipe placement is not horizontal	If the Z values of steps 2 and 3 are large to small and the other side is from small to large, then the A end of the tube is lower than the B end. In this case, it is recommended to raise the A end of the pipe, If the Z values of steps 2 and 3 are from small to large and the other side is from large to small, then the A end of the tube is higher than the B end. In this case, it is recommended to lower end of the pipe.

6. Repeat Steps a through d until the tube is placed horizontally.
7. Rotate the tubing by 90º and repeat Steps 1 through 5.
8. Tube Center – **Adjust** the tubing parallel to the Y-Axis to ensure the line moving from the A end to the B end is parallel to the Y-Axis. To debug:
    a. Jog the laser head to the edge of the sheet, jog from the low end of the A end to the end of the B, check the whole movement process, the red light indicates whether it is close to the edge of the pipe. If the above rules are not met, adjust the placement of the pipe.
    b. Repeat Step 1 until moving from the A end to the B end and the Red Light indicates that it is always close to the edge of the tube.
    c. Rotate the tubing by 90º and repeat Steps 1 and 2 above.
    d. After confirming the center of rotation, click the Record Rotation Center. (Method +1 Method +2).
9. Adjust the horizontal placement of the tubing according to steps 1 through 5 of Method 1.
10. Adjust the center of the tubing according to steps 1 and 2 of Method 2.
    - Empty Walk – **Import** the graphics, take the border, and verify the trajectory is correct after the flight is not exceeded.

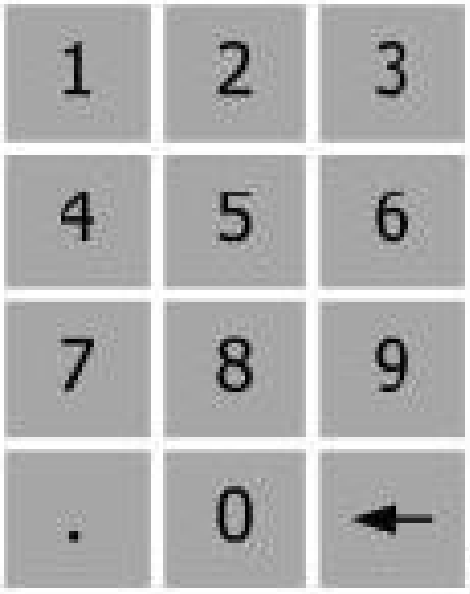
8.2 Hot Keys

The following table lists the shortcut keys commonly used by the software. Some shortcut keys need to be used under certain circumstances and have been listed in previous chapters.

Hot Key	Effect	Conditions of Use
Ctrl + A	Select all graphics	No
Ctrl + O	Open a File	No
Ctrl + W	Adapt to the window	No

Hot Key	Effect	Conditions of Use
Ctrl + X	Cut graphics to the Windows Clipboard	Select the graphic to operate
Ctrl + Y	Redo the command that was just revoked	Have a revoked order
Ctrl + Z	Undo the order just completed	Have executed the command
F3	View all graphics	No
F4	View the entire machine range	No
F5	View graphics in the selection area	Select the graphic to operate
F6	Open the Layer Parameter Settings Dialog	No
F7	Show/Hide Machining Path	No
F8	Delete selected graphic	No
DEL	Delete selected graphic	Select the graphic to operate
SPACE	Repeat the previous command	One command can be executed repeatedly

8.3 Operation of Capacitor Heightener

Keyboard	Function
Functional Key	 Achieve the functions prompted by the interface.
Number key Decimal point Backspace key	 Used for digital input and mainly for parameter
Arrow key	 Used for switching cursor and inching follower and the key of SHF can switch the jog speed

Control Key	 <SHUT>: The cutting head will automatically rise to the stop position while shutting the follower. <FOLLOW>: Open the following function. <FAST> and <SLOW>: Used for adjusting the following gain level. <+0.1> and <-0.1>: Used for adjusting the following height. <STOP>: Immediately stop all movements. <ORG>: Immediately implement the movement to go back to the origin and correct mechanical coordinates. <ENT>: Confirm the current operation. <ESC>: Cancel the operation and go back.

After the System Power-On Initialization is completed, it will automatically enter the [Main Interface].

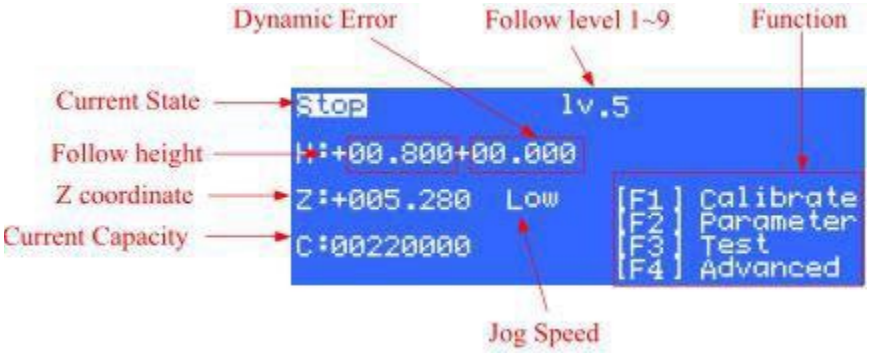


Figure 8-4: Main Interface

The display functions on the main interface include:

- Status – Displays the motion status of the current slave system.
- Stop – The Z-Axis is at rest.

1. Slow Stop – After receiving the stop command in the motion state, there will be a short slow transition state. After completely stopping, the status becomes “stop”.
2. In the air movement – The upward movement in the machining is the air movement of the Z-Axis. After the System Power-On Initialization is completed, it will automatically enter the [Main Interface].
3. Following – When piercing or cutting, the floating head is in the state of following the board being cut.
4. Reset – Return to the Z-Axis mechanical origin.
5. Jog – Manually jog the Z-Axis.
6. Back to Stop – The process of closing and lifting to the docking position.

   After the System Power-On Initialization is completed, it will automatically enter the [Main Interface].
7. Follow-Up Gain Level Lv: Follow-up gain level from 1~30, default 17 levels. The larger the number of stages, the smaller the average error of the follow-up, the faster the follow-up action, and the stronger the ability to climb the slope. However, if the gain is too strong, the system will generate self-oscillation. This parameter can be obtained by automatic adjustment.
8. Set following Height: Press <Follow> <Follow> on the main interface to adjust the actual following height in 0.1 mm steps. Press <Follow On> <Follow Off> to control whether to follow. After the switch is closed, the axis will automatically be lifted to the docking coordinates. After the System Power-On Initialization is completed, it will automatically enter the [Main Interface]. The default is Z=0, press <F2> to enter the Parameter Interface. The docking coordinates may also be modified. In addition, in the Ethernet Control Mode, the following height is controlled by CypCut Software.
9. Setting Dynamics Error – In the following state, this value reflects the real-time error during follow-up motion. Distance between the floating head and the board surface H: Within the capacitance measurement range (Calibration Range), the distance between the floating head and the board surface = “set following height” + “dynamic error” is always equal to the calibration range. Current Z-Axis coordinate: After homing, the Z-Axis establishes the mechanical coordinate system. The downward motion coordinates increase.

10. Current Capacitance Value C: The principle of system sampling is to obtain the distance by measuring the capacitance between the floating head and the plate. The close the floating head is to the plate, the larger the capacitance value. When the floating head hits the plate, the capacitance will change to zero (0).
11. Capacitance Change Value – This value is the difference between the current body capacitance value and the recorded body capacitance after the last floating head calibration. The square brackets indicate that the real-time calibration function is enabled and the parentheses that the function is not enabled. The real-time calibration function is described in Advanced Parameters.
12. Capacitance Change Value – This value is the difference between the current body capacitance value and the recorded body capacitance after the last floating head calibration. The square brackets indicate that the real-time calibration function is enabled and the parentheses indicate that the function is not enabled. The real-time calibration function is described in Advanced Parameters.

    Z-Axis Jog Speed – L jog low speed, H jog high speed. Press the <Shift> key to switch the jog speed position. Press the <↑><↓> keys to perform the jog. Main interface hidden function button function:

    a. <3> View the follow-up parameters (requires the manufacturer password to modify the parameters).
    b. <4> Follow the real-time Error Oscilloscope.
    c. <5> The capacitor monitors the oscilloscope in real-time.
    d. <6> Capacitance Calibration Curve Oscilloscope.
    e. <7> Record the current capacitance and use it to observe the historical change data of the capacitor.
    f. <9> Turns on the follow-up mode of the offboard cutting.
    g. <0> Set the current Z-Axis coordinate to 0.

8.4 Calibration

8.4.1 Calibration Interface

In the main interface, press <F1> to enter the [calibration interface].

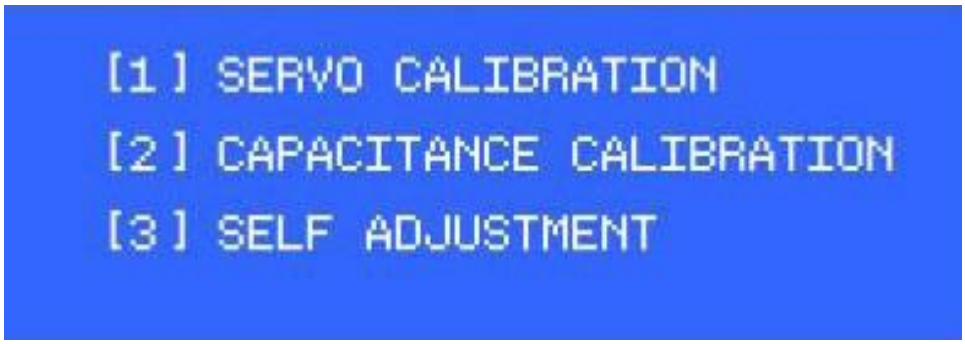


Figure 8-6: Calibration Interface

When using the BCS100 for the first time, perform Servo Calibration, then perform Floating Head Calibration and then make automatic adjustments. In subsequent use, if the capacitance changes due to temperature drift and other reasons, only need to do floating head calibration, servo calibration and automatic adjustments. In subsequent use, if the capacitance changes due to temperature drift and other reasons, only need to do floating head calibration, servo calibration and automatic adjustment can be done.

8.4.2 Servo Calibration

The purpose of servo calibration is to eliminate the zero drift of the servo motor. Press <1> to enter the [Servo Calibration] screen.

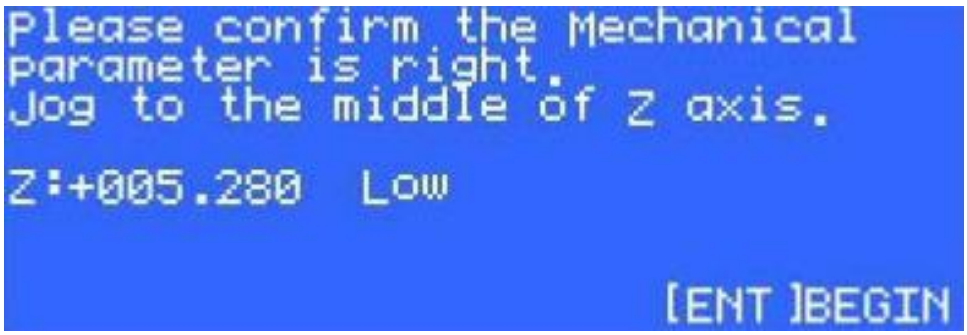


Figure 8-7: Servo Calibration

Due to the Servo Calibration, the motor will oscillate back and forth in small amplitudes. Therefore, jog to the middle of the stroke to prevent the stroke from exceeding the stroke range. Then press <ENT> to start the calibration.

Figure 8-8: Start the Calibration

After the system is automatically calibrated, return to the previous interface. If the Servo Zero Drift Value is incorrectly calibrated before, press <F4> to clear the Zero drift value interface.

Figure 8-9: Confirm Offset

After entering, press <ENT> to confirm the zero-drift value and return to the previous interface after completion.

8.4.3 Floating Head Calibration

The purpose of floating head calibration is to measure the correspondence between capacitance and position between the floating and the plate. Press <2> to enter the [Floating Head Calibration] screen.

Figure 8-10: Floating Head Calibration

Press the <F4> key to set the Calibration Parameters.

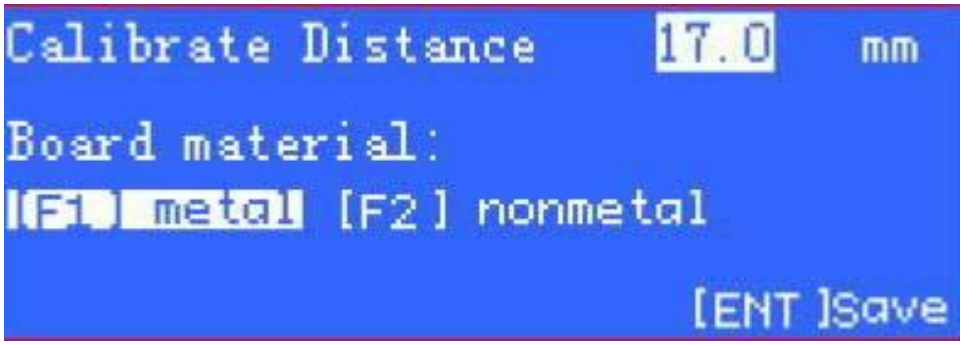


Figure 8-11: Calibration Parameters

8.4.4 Parameter Name Meaning

Calibration ranges the distance to be lifted and the corresponding data is recorded. The default is 25 mm. Tracking Object Sets the material of the tracking object. Press <ENT> to save the parameters and return to the previous interface. Before calibrating, first move the floating head to the surface of the board (about 1~5mm from the board surface) and keep the board surface and do not vibrate. Press <ENT> again to start calibration.

The calibration process is done automatically, which takes about a dozen seconds. During the calibration process, the user can press the Stop button to force the calibration to end. When the calibration is completed, there are two (2) indicators, each of which is represented by the following:

1. 1st Indicator
    a. “Excellent”

b. “Good”

2. 2nd Indicator

   a. “Medium”

   b. “Poor”

3. The Four (4) Levels

   The floating head calibration process is briefly divided into the following steps:

   a. The floating head slowly moves downward to detect to touch panel.

   b. After hitting the board, move up a distance to detect the stability of the sensor.

   c. The floating head moves slowly to detect the touch panel for the second time.

   d. After hitting the board, move the set calibration distance upwards to detect the smoothness and characteristic curve of the sensor.

If the above steps are not completed or the calibration process is terminated abnormally, there may be a problem with the hardware or the cable. A simple way to check if the hardware or connection is normal is to use a metal object to slowly approach the nozzle to see if the capacitance will change. If the capacitance becomes larger until the metal contacts the nozzle and becomes “0”, it means the hardware and connection are normal and the calibration can be calibrated.

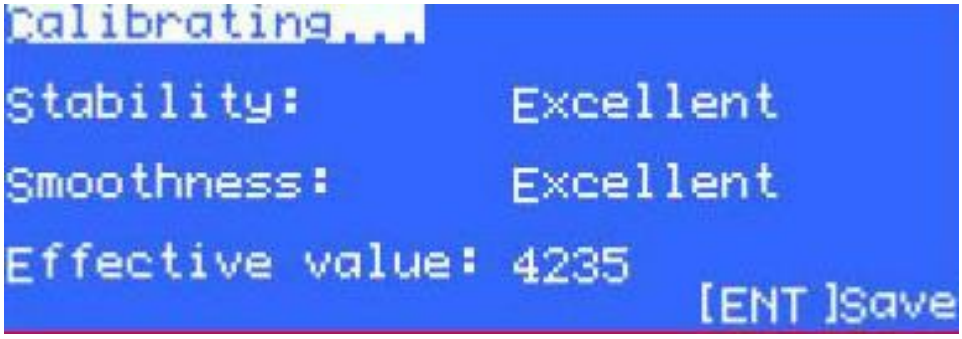


Figure 8-12: 7

Reflects the static characteristics of the capacitor. If the indicator is not ideal, it may be plate vibration or external interference.

1. Smoothness – Reflects the dynamics of the capacitance change during calibration The indicators calibrated by the above two (2) parameters need to be at least “medium”,

otherwise the system may not work properly. The ideal situation for these two (2) indicators is “excellent” or “good”.

2. RMS – The value of the capacitor from 0.5 mm to infinity. Reflects the measurements range of the nozzle sensing. The larger the measurement range of the nozzle sensing. The larger the measurement range, the better the accuracy and stability of tracking. When you press <ENT> to save the settings, the height-capacitance curve is displayed. The normal curve should be smooth.

If the curve is not smooth, there are undulations or burrs, indicating the result is not ideal and needs to be recalibrated. If the result after repeated calibration is still not satisfactory, the user needs to re-check the hardware installation and connection of the system. In addition, the calibration curve can be viewed on the main interface by pressing <6>. Floating head calibration if the calibration fails, various alarms will appear.

Calibration Alarm name meaning.

A touch panel detection timeout.

At the time of calibration, the touch panel was not detected for a long time. When this alarm occurs, first confirm the floating head connection before calibration. Near board (usually within 5 mm) and secondly, confirm the sensor is connected and working properly. When the cutting head is close to metal, the capacitance should change significantly.

Leave the board detection timeout.

If the first step of the calibration, the nozzle does not touch the board surface, directly lifts, and shows the departure board detects timeout, the system may think the nozzle is always in the collision state. First, confirm the sensor is connected and working properly.

The sampling timeout has been completed but not enough data has been collected. Please recalibrate. Always for the board status see the Leave Board Detection Timeout alarm.

When the floating head is close to the board surface, the capacitance does not gradually increase according to the law. Please start the calibration by moving the floating head to within 5mm of the board surface or refer to Touchpad Detection Timeout.

Auto Adjustment Press <3> to enter the [Auto Adjustment] interface (there is no Automatic Adjustment Function in 3D Mode).

Figure 8-13: Auto Adjustment Interface

Before automatic adjustment, ensure servo calibration is completed.

Once it has returned to the origin, the mechanical coordinates of the Z-Axis are correct. There is a board just below the floating head to follow.

The process of automatic adjustment is to fine-tune the position near the position and automatically optimize the internal parameters.

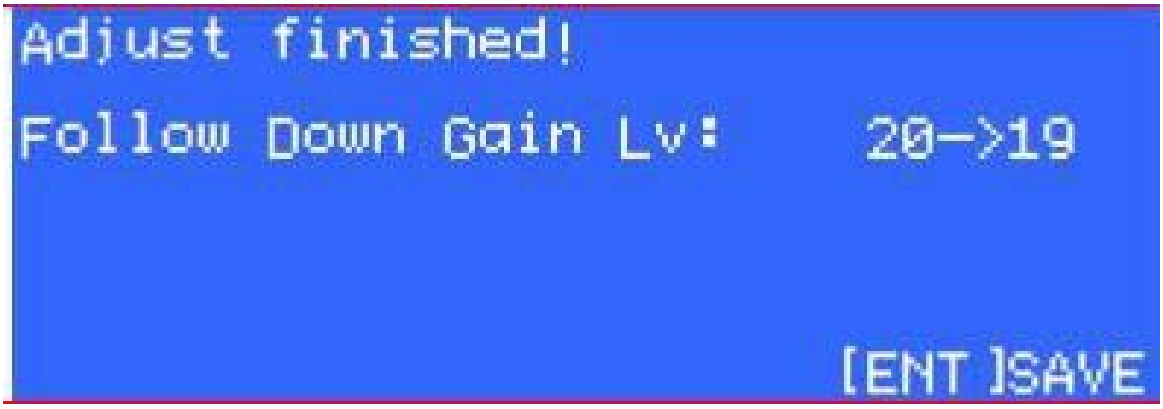


Figure 8-14: Save the Parameters

Press <ENT> to save the parameters. The parameters of the automatic adjustment have the following:

1. Follow-up Gain Level – The follow-up gain level is from 1 to 30 and the default is 17 levels. The larger the number of stages, the faster the following follow-up actions. If the gain is too large, it will cause following jitter. This parameter is automatically set after automatic adjustment (the main interface can also be modified manually).

2. Network Settings – Press <6> to enter the [Network Settings] interface.

Figure 8-15: Network Settings

When using our company's CypCut laser cutting software, it can easily realize advanced functions such as lifting any height, frog jumps up, segmentation perforation, flight path compensation, etc. through the network (see the description of the CypCut software for details).

Users who do not use the CypCut software should turn off the network function, otherwise the boot process will be slower. When connecting to a network, it is recommended to connect the PC and BCS100 through a crossover cable. The IP address of the PC side should be set in the same network segment as the BCS100 (10.1.1.xxx, which cannot be duplicated with the BCS1000). The gateway also needs to be set on this network segment and the last digit is 1, such as 10.1.1.1.

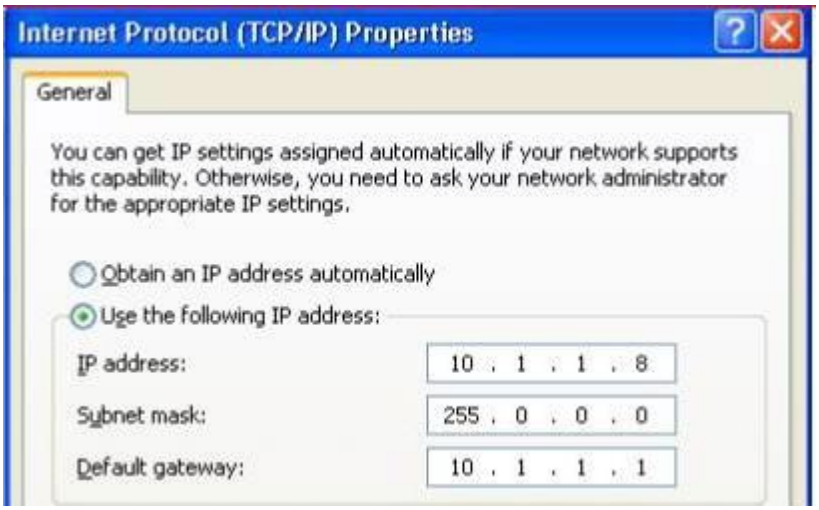


Figure 8-16: Internet Protocol Properties

NOTE

When the computer uses other network devices at the same time, such as IPG Fiber Laser (network connection method), each network connection must be set to a different network segment. For example, set to: 10.1.2.x, 192.168.1.x 2. After the computer's network card resets the IP, it must be re-disabled-enable the network card. Make the NIC's IP settings take effect.

8.4.5 The Cutting Head Debugging Method and Common Sense

The debugging of the machine tool needs to be carried out by professionals. It must be strictly implemented in accordance with the relevant regulations. Please understand the performance of the machine and read the relevant random technical data before commissioning. Correct debugging is the basis for ensuring the normal operation of the machine. If there is any ambiguity, please contact our company in time. We will give a satisfactory answer in the fastest time.

NOTE

This debugging method includes the debugging method after the machine is powered on.

The Fiber Laser of the machine is free of optical path debugging, but the operating fiber must be placed strictly in each axis of the towline and the bending radius must be greater than 200 mm. The motion radius prohibited to be less than 200 mm and the fixed radius is less than 100 mm.

The fiber is slowly unscrewed from the fiber frame and the fiber length is required along the machine fiber inlet and each axis towline measurement.

Verify the water pipe connections are normal and leak-free before starting the machine.

The QBH Head (QBH-Quartz Block Head) must be cleaned before QBH insertion. If there is a foreign matter, clean it. Use a special microscope assembly to observe the QBH Head, use special compressed air or professional cleaning agent (ethylene propanol) and cleaning tool fiber special cotton swab, special lens paper to clean the dirt such as QBH Head dust.

- It must be ensured that the QBH head is clean and free of contamination before it can be inserted into the cutting head expansion tube.
- Adjust the cutting head lens coaxial and focus, then try to cut. Repeatedly adjust to the best position.

Installation of optical fibers requires that trained personnel install fiber optics and non-professionals are prohibited from plugging and unplugging QBH.

NOTE

1. ***The surface of the optical lens such as focusing mirror, protective mirror and QBH head should not be touched directly by hand, which may cause scratch or corrosion of the mirror surface.***
2. ***If there is oil or dust on the mirror surface, it will seriously affect the use of the lens, and the lens should be cleaned in time.***
3. ***It is strictly forbidden to use water, detergent, or other cleaning on the surface of the optical lens. The surface of the lens is coated with a special film that can damage the surface of the lens if used.***
4. ***Do not place the lens in a dark, damp place, as this will age the lens surface.***
5. ***The surface of the lens must be clean, such as dust, dirt, or moisture, which is easy to absorb the laser to cause damage to the lens coating; lightly affects the quality of the laser beam and the laser beam cannot pass or reflect.***
6. ***When installing or replacing the mirror or focusing mirror, do not use too much pressure, otherwise it will cause deformation of the lens and affect the quality of the beam.***

8.5 How to Install or Replace Optical Lenses

1. Pay attention to the installation of optical lenses. The operator should:
    - Wear Clean Clothing
    - Wash hands with soap or detergent
    - Wear clean, light, white gloves
2. Do not touch any part of the hand with the lens.
3. Take the lens from the side of the lens.
4. Do not touch the surface of the lens coating directly.
5. When assembling the lens, do not blow the lens against the lens.
6. The lens should be placed on a clean table with professional papers placed underneath.
7. Care should be taken when taking the lens to prevent bumps and falls and it is not allowed to exert any force on the coated surface of the lens; the lens holder for mounting the lens should be clean and clean the dust and dirt in the lens holder with a clean air spray gun. Gently place the lens into the lens holder.
8. When the lens is mounted to the lens holder, do not use too much force to fix the lens to avoid deformation of the lens, thus affecting the quality of the beam.

8.6 Steps to Clean the Lens

Different lens cleaning methods are different. For example, the specific steps of the focusing mirror or collimating area as follows:

1. Cleaning the lens with lens paper:
    a. Use a clean air spray gun to blow off the dust on the surface of the lens.
    b. Use alcohol or lens paper to clean the surface of the lens.
    c. The smooth surface of the lens should be placed flat on the surface of the lens.
    d. Use three (3) drops of high-purity alcohol or high-purity acetone, slowly pull out the lens paper horizontally in the direction of the operator, repeat the above operation several times until the mirror surface is clean. Do not apply pressure on the lens as it may cause scratches when the lens is dirty. Repeat the above steps until the mirror is clean. Do not use a dry lens paper to pull directly on the mirror.
2. Cleaning the lens with a cotton swab:
    a. Blow off the dust on the mirror with a spray gun.
    b. Use a clean cotton swab to remove the dirt.
    c. Use a new cotton swab dipped with high-purity alcohol or acetone to move the lens from the center of the lens and scrub the lens.

d. After each week of cleaning, change another clean cotton swab and repeat the above operation until the lens is clean.
e. Take the cleaned lens to a well-lit area.
f. If the lens is well reflected, the lens is clean.
g. If the lens is not reflective, continue to clean the lens.
h. Place the lens on the lens holder according to the method described above.
i. Do not use a cotton swab for operation.

8.7 Storage of Optical Lenses

- The optical lens is properly stored to keep the quality of the lens intact.
- The storage environment temperature is 10~30ºC. Do not put the lens into the freezer or similar environment. Otherwise, it will condense and frost when it is taken out, which will easily damage the lens. The temperature of the storage environment should not exceed 30ºC, otherwise it will affect the coating on the lens surface.
- Keep the lens in the box, the lens should be placed in a non-vibrating environment, otherwise it will easily cause deformation of the lens, thus affecting the performance of the lens.

8.8 Fiber Access and Removal Methods

8.8.1 Quartz Block Head (QBH) Plug Insertion Operation Sequence

1. Remove the dust cover at the top of the chuck. Align the red mark on the plug with the red mark above the QBH chuck and lower it to the bottom. According to the marking procedure on the QBH collet nut, first turn the nut to the left, then lift it, then turn it to the left to complete the fixed locking procedure.
2. QBH plug removal operation sequence. The QBH plug is removed and installed in the opposite order. The QBH collet nut is rotated to the right, then pressed down and then rotated right. The plug is in a free state and can be removed from the QBH chuck. After removing the QBH plug, verify to cover the dust cover to prevent dust from entering.

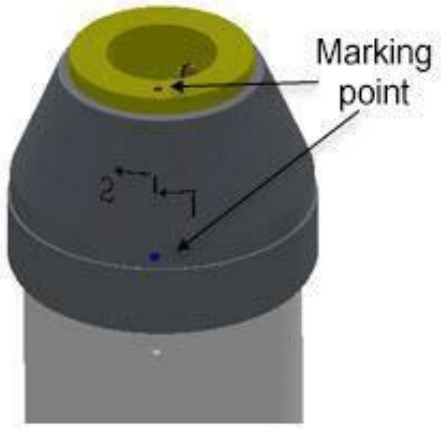


Figure 8-17: Marking Point

8.8.2 Focusing Method of Focusing Mirror

The focusing mechanism of the focusing mirror adopts the precision screw pulling focusing box to realize Z-Axis focusing, which has good self-locking performance and fine focusing function. Focusing module is electric focusing, focusing lens can be moved vertically according to the type of laser head.

8.8.3 The Function of Nozzle and the Adjustment of its Center

The design of nozzle and the condition of jet flow directly affect the quality of cutting and the manufacturing precision of nozzle is closely related to the quality of cutting and the manufacturing precision of nozzle is closely related to the quality of cutting. The main functions of the nozzle are preventing cutting weld stains and other debris bounce up into the cutting head damage focus lens. The nozzle can change the condition of gas exhalation, control the area and size of gas diffusion and thus affect the cutting quality. Adjust the nozzle to pass the laser through the center of the nozzle by sticking transparent tape on the nozzle first when dimming, pressing the **Tap** button on the handle appear 

on the tape. If not in the center of the nozzle by adjusting the two (2) knobs above the cutting head, make the point of light hit at the center of the nozzle.

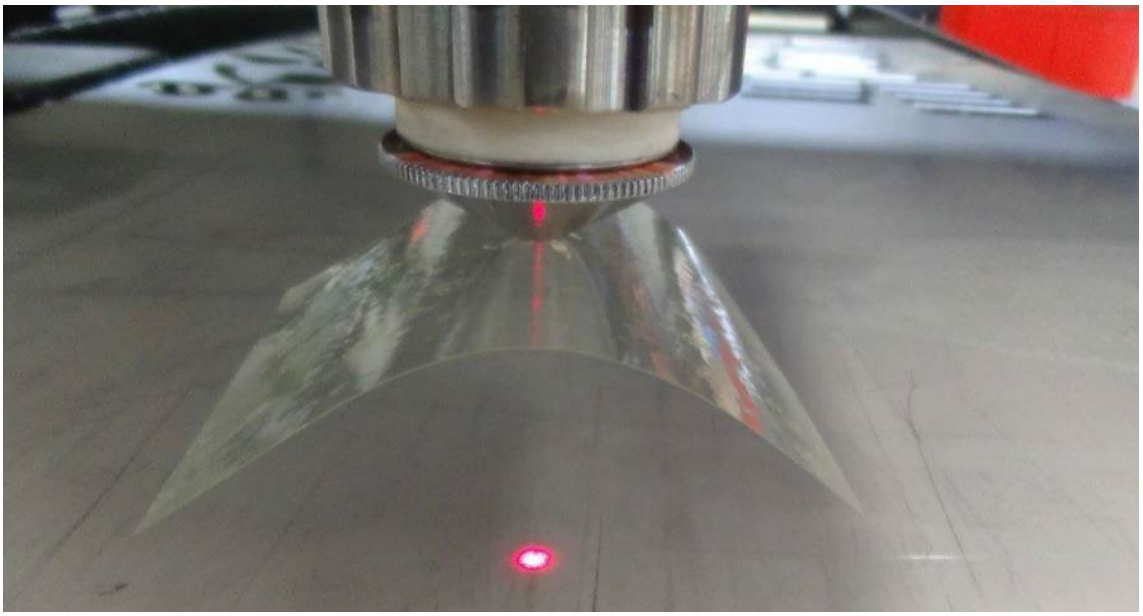


Figure 8-18: Light in Center of the Nozzle

8.8.4 Cutting Head Debugging Method and Common Sense

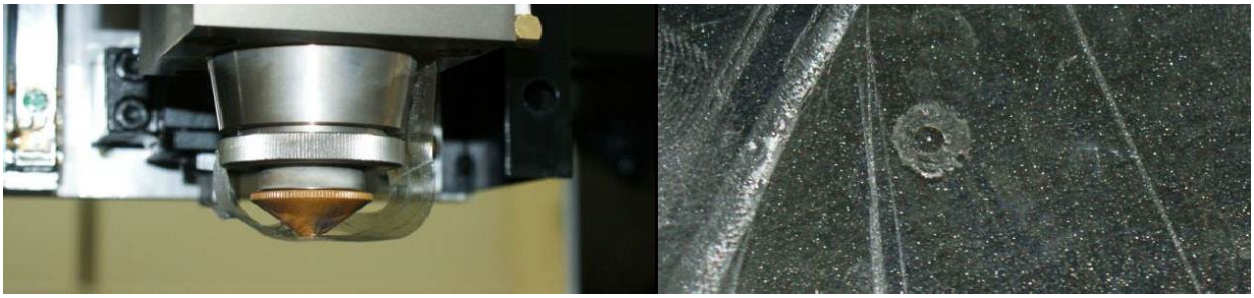


Figure 8-19: Cutting Head

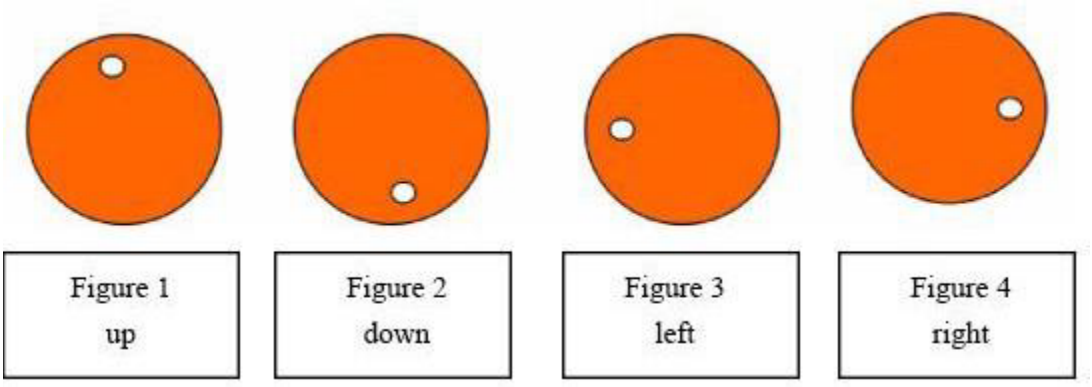


Figure 8-20: Nozzle

1. Move the nozzle to about the cutting height.
2. Coat the end face of the nozzle with printing mud and then paste the transparent tape on the end face.
3. Adjust the laser output power by 20W ~ 100W. After laser source light stops, take off the transparent tape and take care not to rotate its relative position. If the position of the nozzle is too different from the laser center, it will not be able to hit the center hole on the transparent tape. Because the laser center is fixed, it is necessary to change the center of the focus mirror by adjusting the adjusting screw on the handle of the lens cavity to make it correspond to the laser center. Repeat the above until the laser hole on the transparent tape coincides with the center of the nozzle, thus confirming that the laser center coincides with the nozzle center.

- Effect of different axes between the center of the nozzle and the center of the laser on the cutting quality.
- The cutting edge is affected and when the cutting gas is blown the amount of gas is not uniform, so that the cutting edge is easy to appear stain on one side and other side do not have or the surrounding quality of the part section is not consistent and sometimes the cutting section cannot be cut normally.
- The quality of the sharp corner is affected. When cutting a workpiece with a sharp angle or a small angle, it is easy to produce a partial melting phenomenon and when the thick plate is cut, it may not be cut.
- It affects the perforation, is not stable at the time of the perforation, the time is not easy to control, the penetration of the thick plate can cause the over-melting condition and the penetrating condition is not easy to master and the perforation effect on the thin plate is small

In conclusion, the concentricity of the center of the nozzle and the laser is one of the most important factors that cause the quality of the cutting, especially when the workpiece is thicker. Therefore, the concentricity of the center of the nozzle and the laser must be adjusted to achieve a better cutting cross-section.

NOTE

When nozzle is deformed or there is a solution stain on the nozzle, the effect of the nozzle on the cutting quality is as described above. Therefore, the nozzle shall be placed with care and shall not be damaged to avoid deformation; the surface of the nozzle shall be cleaned in time. The quality of the nozzle has a high precision requirement during manufacturer and the method is required to be correct at the time of installation. If the conditions are to be changed during cutting due to poor quality of the nozzle, the nozzle shall be replaced in time.

8.8.5 Selection of Nozzle Aperture

The difference in nozzle aperture is shown in the following 4-1 form.

Nozzle Aperture	Gas Flow Rate	Melt Removal Capacity
Small	Fast	Strength
Big	Slow	Week

8.9 Form 4-1: Table of Relationship between Aperture and Auxiliary Gas Velocity

The aperture of the nozzle has ф1.5mm, ф2.0mm, ф2.5mm, ф3.0mm, etc. three-dimensional cutting of the general thin plate using the thickness of 1.2 mm and the thickness of 1.5 mm it is enough. The different between both is:

1. Material thickness less than 2mm: use ф1.2mm, the cutting surface will be thinner; use ф1.5 mm, the cutting surface will be thicker.
2. Material thickness more than 2mm: because the cutting power is high, the relative head dissipation time is longer and the relative cutting time is also increased. With a gas diffusion area of ф1.2 mm and a small gas diffusion area, it is less stable in use. With a diameter of ф1.5 mm, the gas diffusion area is large and the gas flow rate is slow, so the cutting time is more stable.

In conclusion, the size of the nozzle aperture has a serious effect on the cutting quality and the perforation quality. At present, the laser three-dimensional cutting uses a nozzle with a ф1.2 mm and ф1.5 mm.

The larger the diameter of the nozzle, the more the protection of the opposing lens is, as the spark of the melt at the time of the cutting is splashed and the probability of the upward impact is large, so that the life of the lens is also shorter.

8.10 Beam Focus Adjustment

In the laser cutting process, the relative position of the focal point of the beam and the surface of the cutting plate has an influence on the quality of the cutting and the correct adjustment of the focus position is very important. The laser cutting machine is provided with a height automatic follow adjusting device and when the height of the plate is changed, the numerical control system

can automatically adjust the height of the nozzle and the plate surface to be constant and the position of the focus is ensured to be stable.

8.11 Manual Adjustment Method

Adjust the laser cutting head lower adjustment nut, so that the focus position to meet the cutting needs, provided that the position of zero focus is found. During the cutting process, the height adjustment of the operator panel can also be manually adjusted according to the situation to change the cutting height slightly. It takes enough experienced operators to adjust the height during the cutting process.

8.12 Beam Focus Adjustment

Automatically adjust the focus. Equipped with the automatic focus cutting head equipment, can automatically adjust the focus position according to the parameters, the advantage is that it can improve the processing efficiency, can make up for the change of focus position caused by the change of optical path. Can improve the product yield.

8.13 A Method of Finding 0-Focus

Place a flat stainless-steel plate on the table, draw a straight-line cut height setting of 1mm and then set the focus in turn 0.1-1-2-3 1 2 3, the focus of the laser is output laser on the stainless-steel plate in turn, the burn-out trace is present and the thinnest line of the burn-in is the 0-focus of the laser.

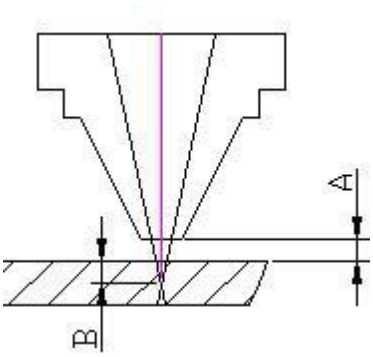


Figure 8-21: Focus

Description of the Relationship between the position of Focus and the Cutting Material and Section

The following table lists the laser cutting focus in different positions when cutting different plates, the impact on the perforating and cutting sections of the sheet and the selection of the focus position when cutting plates of different materials and thickness.

Name and Focus Location	Cutting Material and Section Characteristic
Zero Focus: The Laser Focus is on the upper surface of the cutting workpiece	Use in Sheet Cutting. Focus on the Upper Surface of the workpiece, the Upper Surface Cut Smooth, the Lower Surface is not smooth.
Positive Focus: Laser Focus on cut sheet surface	The use of Carbon Steel and other Materials. The focus is on the surface, so the range of smooth surface is larger, the slotting is wider than the zero focal length, the has flow rate is larger and the piercing time is longer than the zero focal length.

8.14 Laser Cutting Principle

Laser cutting is performed by focusing fiber laser cutting, transmitting through optical fiber, high degree of flexibility, fast speed, less failure point, low maintenance cost, convenient maintenance, high photoelectric conversion rate, and great cost performance advantage in system matching. Mainly used for cutting metal sheets within 20mm. The laser beam is not easily absorbed by the highly reflective material and the cutting effect on the highly reflective material is not ideal and the non-metallic material cannot be cut.

8.15 Main Process Control of Fiber Laser Cutting

1. Cutting Power – When laser cutting, the choice of laser power has an influence on the cutting quality. The cutting power needs to be determined according to the material of the cutting plate and the thickness of the plate. If the power is too large or too small, a good cutting section cannot be obtained. When laser cutting, the laser power is too small, which will make it impossible to cut.

   When the laser power setting is too large, the entire cutting surface is melted, the slit is too large and good cutting quality is not obtained. When the laser power setting is insufficient, cutting cracks are generated, and tumor defects are generated on the cut section. Proper laser power setting, combined with proper cutting gas and pressure, results in good cut quality without cracking.

2. Cutting Speed – The effect of too fast speed on the cutting quality may result in the inability to cut and sparks. Some areas can be cut, but some areas cannot be cut. Causes the entire cutting section to be thicker, but no cracks are produced. Speed is too fast, causing the plate could not be cut off in time, the cut section showed a diagonal stripe road, and the lower part produced a melt.

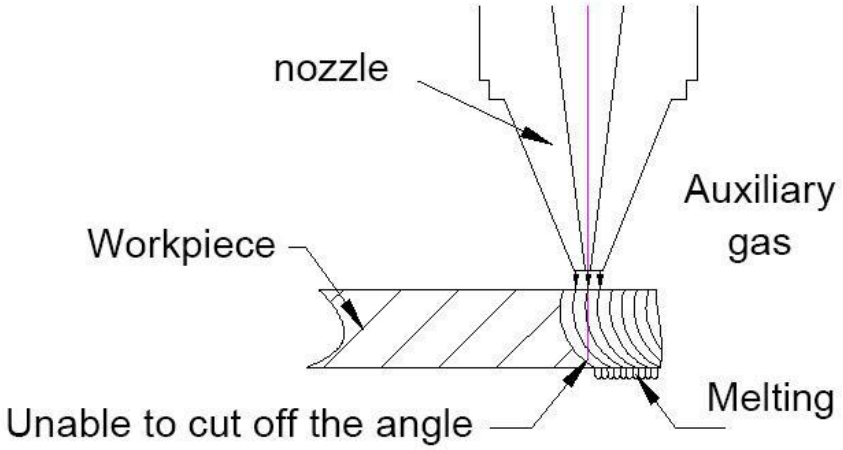


Figure 8-22: Cutting Speed

To judge the Cutting Speed by the Cutting Spark, the cutting spark spread from the top to the bottom, if the spark tilts, the speed is too fast. If the spark spread a little or not spread, condensed together, then speed is too slow. The cutting surface presents a relatively smooth line and the lower part is free from melting.

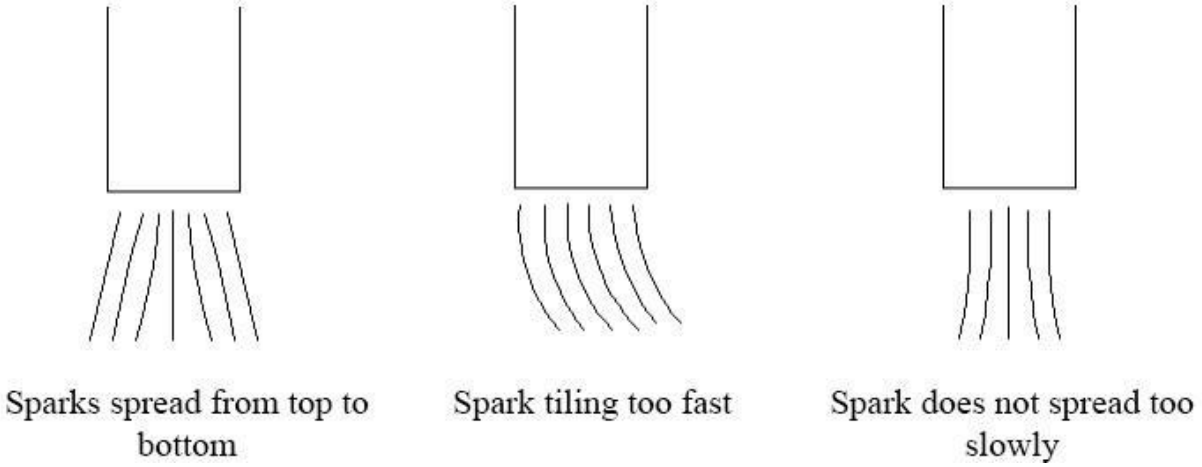
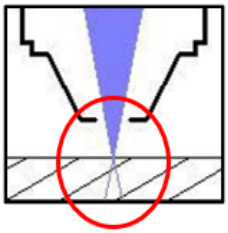
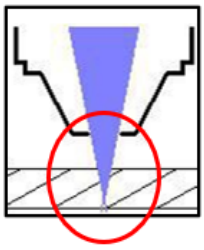


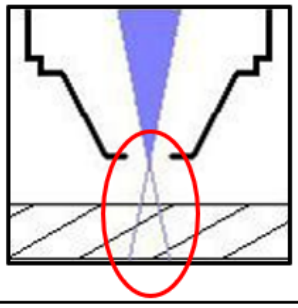
Figure 8-23: Sparks

3. Cutting Height – The cutting height has little influence on the cutting quality of the workpiece. Set it too low, the slag removal ability of the auxiliary air pressure is strong, but it is easy to reverse slag to the protective lens and damage the protective lens. Too high, poor slag removal ability need to increase air pressure, gas consumption increase. Generally, the

cutting height should be set between 0.5 and 1.5. There is a small amount of bead-like slag below the cutting workpiece and the cutting section grain is good.

4. Focus Point – The position of the focus point has an important effect on laser cutting, how to choose the focus, and the effect of the focus on plate punching and cutting section. Nitrogen cutting stainless steel general negative focus; Oxygen – cut carbon steel plates are generally in positive focus. Nitrogen cutting stainless steel general negative focus; Oxygen – cut carbon steel plates are generally in positive focus.

Name and Location on Focus	Cutting Material and Section Features
Zero Focal Length: The laser focus is on the cutting surface of the workpiece. 	Suitable for Thin Carbon Steel under 1 mm, etc. The focus is on the workpiece surface, the upper surface is cut smooth, the lower surface is not smooth.
Negative Focal Length: The laser focus is below the surface of the cutting part. 	Nitrogen Cutting Stainless Steel cutting method; The focus is below the plate surface, so the smooth surface has a wide range, the cutting slot is wider than the zero focal length slot, the cutting gas flow is larger, and the punching time is longer than the zero focal length slot.

Name and Location on Focus	Cutting Material and Section Features
Focal Length: The laser focus is above the cutting surface. 	Oxygen used for cutting Carbon Steel; Blackened surface, rough surface.

5. Nozzle – The nozzle commonly used aperture is ф 1.0, 1.5, ф. 2.0 ф. 2.5 two (2) kinds. Aperture size difference is cutting thin plate: use ф 1.5 nozzle, cut surface will be fine. Use ф

2 nozzle, cut surface coarser, corner place easy to melt. When cutting thick plate: because of high cutting power, relatively longer cooling time, relative cutting time also increases. Use ф 1.5 nozzle, gas diffusion area is small, so is not so stable when using. With above ф 2 nozzle, gas diffusion area is large, the gas flow velocity is slow, so the cutting is stable. Nozzle is divided into double layer nozzle and single layer generally use single layer nozzle within 3 mm thickness; 3-12 mm generally, use single-layer nozzle, use single-layer ф 1.5 below 2mm thickness, use single-layer 2.0 above 2mm thickness. The size of the nozzle aperture has an absolute influence on the cutting quality and the perforation quality. The larger the nozzle aperture is, the poorer the relative protection of the focusing lens will be. Because there is a large probability of the molten spark flying during cutting and the upward bounce, the shorter the life of the lens will be. At the same time, the quality of the nozzle is also an important factor affecting the cutting quality. The shape of the nozzle is shown in figure below.

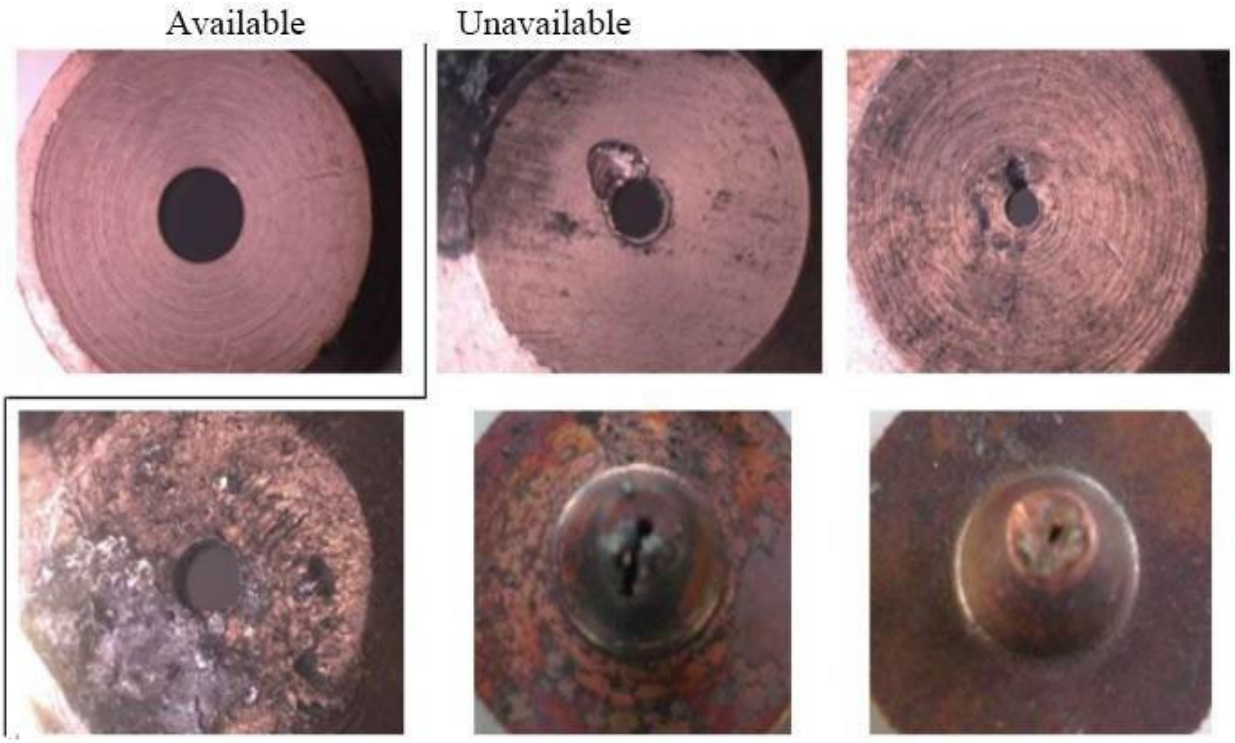
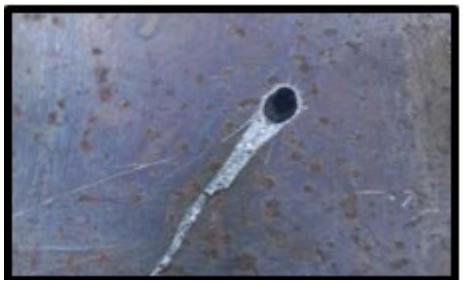


Figure 8-24: Shape of Nozzle

6. Air Pressure – The main function of cutting gas is cooling and protection. Oxygen can help to burn and dissipate heat, blow off the melt generated by cutting, prevent the cutting melt from

rebounding into the nozzle, protect the focusing lens and protect the mirror. The effect of cutting has and pressure on the quality of the cut: the cutting gas helps to cool the heat and combustion, blow off the melt, and obtain a better-quality cut section. When the pressure of the cutting gas is insufficient, the following effects are caused: the melting occurs during cutting; the cutting speed cannot be increased and the production efficiency is affected. When the pressure of the cutting gas is too high, the influence on the cutting quality: when the pressure is high, the airflow is too large, the cutting surface is rough and the slit is wide; when the airflow is too large, the cut section is partially melted and cannot be formed well. The influence of the pressure of the cutting gas on the perforation. When the gas pressure is too low, the laser does not easily penetrate the cutting plate and the drilling time increases, resulting in low productivity. When the has pressure is too high, the penetration point is melted and a blast hole is formed to form a large melting point, thereby affecting the quality of the cutting. When laser drilling, generally, a higher gas pressure is applied to the punching of the thin plate member and a lower gas pressure is applied to the punching of the thick plate member. Oxygen cuts ordinary carbon steel. The thicker the material, the lower the pressure of the cutting gas. Nitrogen cut stainless steel, the thicker the material, the higher the gas pressure, the cutting gas pressure is always above the high-pressure state of 1.2 mpa.

7. Lead In-line – A line connecting the punching position to the contour of the workpiece. The lead-in line is also called the lead-in line. The benefit of adding a lead-in: when the hole is blasted, the resulting workpiece scrap is reduced. The quality of the first cut surface can be improved. It can improve the appearance of the knife edge. It is easier to start the knife when cutting stainless steel. Stainless steel, carbon steel lead set requirements 2 mm stainless steel can use straight lead; 2 mm or more generally adopts straight line 3-5 mm plus R0.2 – R0.8 around small arc; carbon steel generally adopts straight line 3 – 5 mm plus R0.5 – The arc of R3 is introduced and the thicker the plate, the larger the R value. Oxygen cutting thick steel carbon steel 5 mm or more, cut small hole, it is recommended not to add.
8. Perforation Direct Cutting – Generally applicable to carbon steel plate below 1.2 mm, stainless steel perforation, small perforation aperture. Segmented perforation; generally applicable to carbon steel plates of 3 mm or less and stainless-steel perforation of 1.5 mm or more. Progressive perforation: generally applicable to carbon steel plate of 3 mm or more, perforation of 2 mm – 3 mm stainless steel, fast perforation speed, large perforation aperture (ф 2 – ф 3 mm), perforation height> 3 mm, pressure < 2 bar. According to the actual situation. Three-stage perforation: generally applicable to carbon thick steel plate more than 6 mm, stainless steel more than 5 mm. Thick carbon steel sheets have a long time for ordinary perforation are easy to explode. The purity of oxygen is at least 99.5%. The lens, protective mirror and nozzle have good materials. The laser mode is free of distortion and wastes time and the collision alarm is prone to occur. After the progressive perforation is used, the piercing time is greatly shortened and the blasting rate is lowered.

Problem	Possible Reason-Root Cause	Solution
Punch at the beginning of the punch 	1. The duty cycle is too high. 2. Punching power is too large. 3. Too much pressure. 4. The focus is wrong. 5. Punching is wrong.	1. Reduce power by 10% each time. 2. Reduce the duty cycle, 1% - 2% each time. 3. Reduce the air pressure, change the focus every 0.1 bar, check the punching mode every 0.1 – 0.2 mm, whether it is continuous wave drilling, etc.
Hole in the process of hole 	1. The Duty Cycle is too low. 2. Low Power. 3. The Focus is wrong 4. Low Air Pressure	1. Reduce speed. 2. Check the amount of defocus. 3. Increase Power, 5% - 10% each time. 4. Increase Air Pressure, 0.1 – 0.2 bar each time.
End of punching, blasting before cutting starts 	Insufficient Punching Time, Low Punching Power	1. Increase the Punch Time, 0.5 sec each time. 2. Increase the Punching Power, 5% each time. 3. Increase Duty Cycle, 1% - 2% each time. 4. Use slow speed.

9. In the process of production and processing, before the mass production, there must be a process of trial cutting, called Testing Knife. Through the test knife, the process parameters required for sheet cutting can be adjusted, but the test knife and the whole board cutting process will be slightly different and needs attention. Test knife: first select a circle to cut, the main purpose is check whether the parameters can be cut normally, whether the cutting section is qualified, know the deviation between the actual size and the size after cutting, to compensate the size in mass production and try to select the most complex contour in the machining pattern to test the knife.

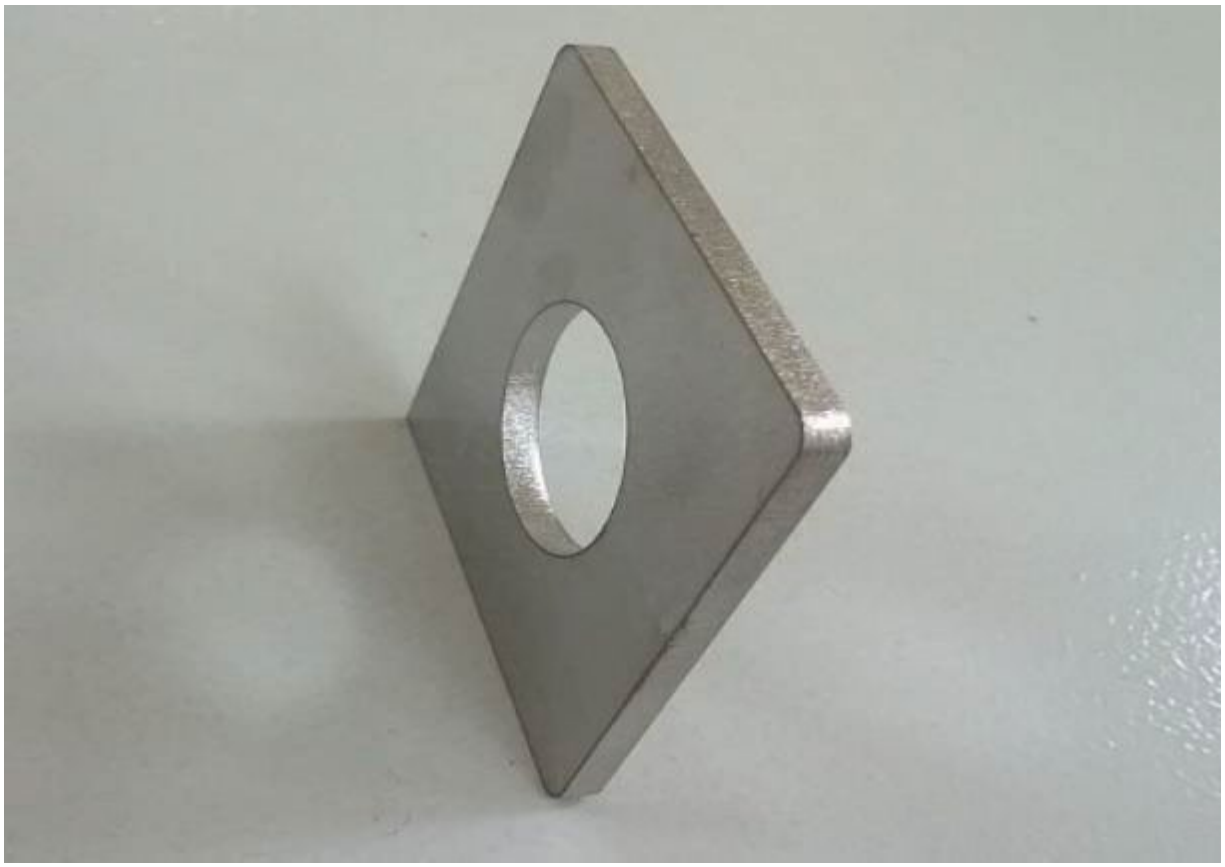


Figure 8-25: Circle Cut

8.16 Precautions for Mass Production after Test Knives

1. Pay attention to the limit of the machine tool. The plate should not be too close to the edge, pay attention to the starting position of the cutting head.

2. Pay attention to whether the direction of the graphic is consistent with the direction of the plate when cutting and the dimensional deviation when testing the tool should be compensated to the figure of mass production.

3. It is best to simulate the program once before cutting to ensure the correctness of the program.

4. The speed in mass production is 80% of the speed at which the knife is tested.

5. The first part to be cut during mass production must be measured to ensure that it is safe to be inspected and, if necessary, sampled during the cutting process.

6. Confirm the parts are turned over during mass production, it is easy to hit the cutting head, and an alarm is generated. It is necessary to suspend the cutting. Otherwise, collision will occur easily and the plate will be moved. The solution is to set the micro-connection to the cutting workpiece. The laser head needs to be recalibrated.

7. Before cutting, manually check whether the blowing is normal. During the cutting process, pay more attention to the use of gas to prevent the lack of gas in the middle, resulting in scrapped parts.

8. During the cutting process, the operator is not allowed to leave the console to avoid an emergency.

9. The starting point is set at the lower right of the part to reduce the error caused by the deformation during the cutting process.

10. The part is at least 10 mm from the edge of the board.

11. With Film Cutting – With the film side up, if there are films on both sides, the lower surface film must be torn off, otherwise the slag will be slag; according to the film condition, if the film is firmly attached, it can be cut normally; if the film is not attached. In case of hard work, it is necessary to use a snoring to remove the film and then cut it (recommended: high-viscosity, viscosity 120, black and white film with a thickness of 0.05 mm or less).

12. De-Filming – The cutting path is marked first and then cut. Simply put, the same path is repeatedly cut twice, once with a small power marking, the film is cut off, and the metal is cut again with high power. The height of the film can be adjusted by adjusting the degree of cut in the film removal parameter, and the wider the height, the smaller the probability that the film is blown up.

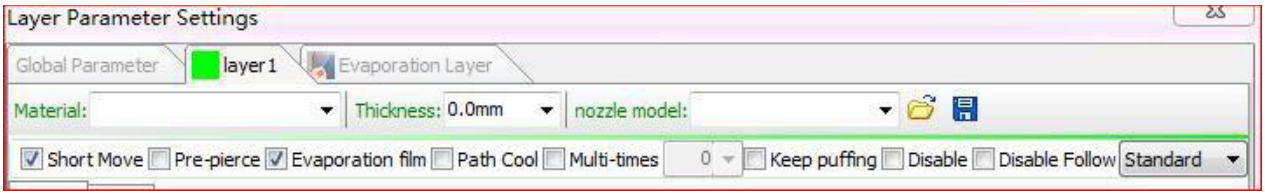


Figure 8-26: Layer Parameter Setting – Layer 1

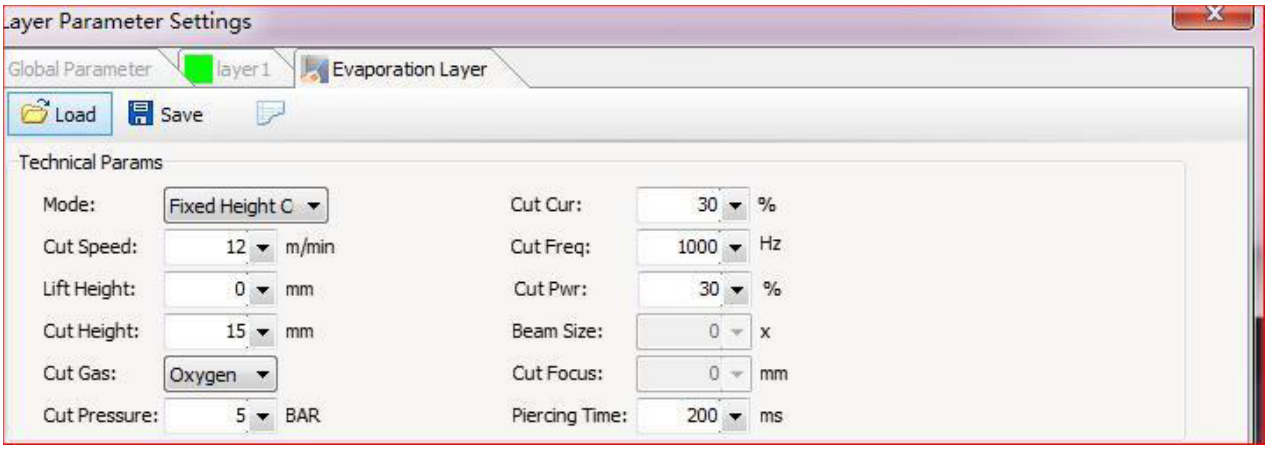


Figure 8-27: Layer Parameter Settings – Evaporation Layer

13. Carbon Steel Cutting Process – This material will get better results when cut with oxygen. When oxygen is used as the processing gas, the cutting edge is slightly oxidized. For plates up to 1 mm thick, high pressure cutting can be performed using nitrogen as a process gas. In this case, the cutting edge will not be oxidized. A plate having a thickness of 10 mm or more and oiling the surface of the workpiece during processing can obtain a good effect.

8.17 Overview of Different Material Methods

1. With the film facing up, if there are film on both sides, the lower surface film must be torn off or hang slag; according to the plate film. If the film is firmly attached, it can be cut normally. If the film is not firmly attached, it must be used Cutting after removing the film (recommended: high viscosity, black and white film with a viscosity of 120 and a thickness of 0.05 mm or less).
2. De-Filming – The cutting path is first marked and then cut. Simply speaking, the same path is repeatedly cut twice, once with a small power marking, the film is cut off, and the metal is cut at a high power again. The width of the film can be adjusted by adjusting the degree of cut in

the film removal parameter and the wider the width, the smaller the probability that the film is blown up.

3. Special Process Layered Cutting – The contours of each workpiece are not the same, some are easy to cut, but some are more difficult to cut, such as small holes, sharp corners and so on. To ensure the cutting quality and cutting efficiency of the whole workpiece, we adopted the layered cutting method, so that we can adopt different process parameters to control the cutting of different contours, which cannot only ensure the cutting quality of the difficult contour but also improve the cutting efficiency of the easy contour. Layered cutting is mainly divided into continuous wave cutting layer and pulse cutting layer.
4. Pulse Cutting Features – Low heat input, small deformation of the workpiece, slow cutting speed, high pressure, and rougher cutting section than continuous wave cutting.
5. Applications – Sharp corners, small contours, irregular lines (especially the lines broken up by the spline) and precision parts requiring less thermal deformation. Carbon Steel does not use pulse cutting more than 4 mm, stainless steel does not exceed 3 mm, aluminum alloy generally does not use pulse cutting.

9.0 Maintenance

9.1 Review

To ensure the normal use of the laser cutting machine, the equipment must be routinely maintained and maintained. Because the whole machine tool is made up of high -precision parts, it must be taken care of in the daily maintenance process, strictly in accordance with the operating procedures of each part and maintained by a special person and must be barbaric to avoid damage to components.

9.2 General Guidelines

Professional lubrication with the most suitable lubricant is the premise of maintaining the quality of machine tools. This avoids running failures and their consequences. In this sense, the following considerations should be noted.

9.2.1 Before Putting into Operation

Before the machine is put into operation, the machine must be carefully lubricated according to the lubrication instructions. If the machine has not been used for a long time (e.g., ocean transport), the lubrication of the entire machine must be checked.

9.2.2 Lubrication Precautions

Machine tool lubrication according to the lubrication diagram and the description of the lubrication diagram. Observe the following:

- Do not open the refueling and discharge ports for more than the specified time and keep them clean.
- Use only non-fibrous wipes for scrubbing oil grooves and lubrication points, do not use waste wool, do not use kerosene and gasoline and use a lean liquid spindle oil (Spray Lubricant).
- Synthetic lubricants are not allowed to be mixed with mineral oils or synthetic oils from other manufacturers. This is true even for synthetic oils of the same characteristics produced by other manufacturers.

9.2.3 Waste Oil

Waste oil can only be discharged when the machine is warm. Special attention must be paid to the innocent treatment of used oil.

9.2.4 Cleaning Precautions

The entire equipment must be thoroughly cleaned at specified intervals. Obvious dirt can be scrubbed or removed with an industrial vacuum cleaner.

9.2.5 Safety Tip

When performing maintenance work, the machine must be turned off by the main switch to turn it off. Safety regulations must be strictly observed to avoid accidents. Follow all local state and federal lock out tag out procedures.

9.2.6 The Maintenance Items that the user should keep are as follows:

- Acetone: a purity of 99.5%, water less than 0.3%, a bottle of 500ml capacity
- Absorbent cotton: 5 packs
- Alcohol: 500ml, purity 99.5% or more
- Lens paper: 5 copies
- Blowing Ball: one
- Dropper Needle: one (Medical)
- Plexiglass: 200 mm x 300 mm x 20 mm or 7.875 inches x 11.81 inches x .787 inches
- Ink slab (Red): one piece
- Cotton Swabs: two packs
- Multimeter: one (1)

9.3 Daily Maintenance and Maintenance of Peripheral Equipment

For routine maintenance of peripheral equipment such as chillers, voltage regulators, and lasers source, please take the corresponding instruction manual as reference.

The main function of the high-power chiller is to cool the laser source so that the laser is in a constant temperature working condition, thus good and regular maintenance is the key to ensure the normal operation of the machine. The circulating water of the chiller requires the use of distilled water. However, due to the water quality problem, certain impurities such as minerals and dust still exist in the circulating water, and the dust in the environment may also enter the circulating water in some operation steps, and the deposition of these impurities may cause blockage of water system and cutting machine components (such as metal filters, heat exchanger heads in the cutting machine), which seriously affect the cutting effect and even burn out the optical components. Dust and other debris in the environment accumulate on the radiator and water pump of the chiller, resulting in poor heat dissipation of the radiator and the pump, resulting in poor cooling, burning of the compressor, and burning of the pump. This will directly affect the cutting effect; therefore, cold water, the daily maintenance of the machine is particularly important; the daily maintenance of all types of chillers must be carried out in strict accordance with the respective chiller maintenance instructions (see Attached Table Below), for Facilities holding a Quality Systems Certification (Example: ISO/QS9000, etc.) incorporate maintenance instructions to Preventative Maintenance Program.

CWFL-2000 Dual Temperature and One		
Maintenance Period	**Maintenance Content**	**Maintenance Target**
Daily	Check if the chiller temperature setting is normal (set temperature 20±1ºC.	Ensure that the cooling water supplied to the
	Check whether the chiller waterway seal, water temperature and water pressure meet the requirements.	Ensure that the equipment
	The working environment of the chiller is kept dry, clean, and ventilated.	Conducive to the good operation of the chiller.
Monthly	Use neutral detergent or high-quality soap to remove dirt from the surface of the chiller. Do not use benzene, acid, milling, steel brush, hot water, etc.	Ensure the surface of the chiller is clean

	Check if the condenser is blocked by dirt. Please use compressed air or a brush to remove the dust from the condenser.	Ensure the normal operation of the condenser.
	Cleaning the Air Filter: 1. Open the panel of the air filter of the machine assembly, pull up the air filter and pull it out. 2. The dust on the filter net can be removed by using a vacuum cleaner, an air spray gun and a brush. After the cleaning is completed, if the filter is wet, shake it, and dry it before putting it back. 3. Cleaning once every two (2) weeks; more regularly if dirt is severe.	Prevents poor cooling, pumps, and compressors burns out which caused by poor heat dissipation.
	Check the water quality of the tank and follow up.	Good water quality ensures
	Check if the chiller pipeline any leakage or not.	Ensure that the chiller has
Every Three (3) Months	Check the electrical components (such as switches, terminals, etc.) and wipe then clean with a dry cloth.	Ensure that the surface of the electrical part of the chiller is clean and
	Replace the circulating water (Distilled Water) and clean the water tank and metal filter; if equipped with ROFIN laser, the cooling water can be replaced with cooling water can be replaced with cooling water after adding anti-corrosion inhibitor for half a year. If equipped with PRC laser, propylene glycol is added to the cooling water. The cooling water can be replaced once every six (6) months.	Verify the laser is operating properly.

NOTE

Requirements for Long-Term Suspension

1. ***Place the chiller and water pipe away from dust.***
2. ***Pull the power cord away from the socket and wipe the power cord clean.***
3. ***Cleaning the unit body: When cleaning the inside of the unit, do not let water splash on the electronic parts.***
4. ***Completely remove water.***

Machine Maintenance Schedule	
Maintenance Period	**Maintenance Content**
Daily	1. Clean the cutting head, protect lens, nozzle. 2. Verify machine go to origin. 3. Check laser and nozzle concentricity. 4. Check operation panel button, emergency stop button. 5. Check the cutting pressure. 6. Check the gas supply, check for gas leaks and pressure. 7. Check the chiller system, check for water leaks. 8. Check for water leakage. 9. Check the machine for abnormal noise. 10. Z-Axis screw guide manual oil injection two (2) times.
Weekly	1. Clean X, Y-Axis rack rails and Z-Axis screw guides. 2. Check if the exchange workbench chain is loose. 3. Check the filter for undischarged water. 4. Check the exchange table proximity switch and bracket impact block. 5. Check the surface of each proximity switch for foreign objects. 6. Clean up slag drawer. 7. Clean up foreign objects on the exchange guide and machine tool. 8. In summer, the chiller is replaced with pure water in time.

Every Three (3) Months	1. Check the connection of the cutting head. 2. Adjust the temperature of the chiller water (winter 20,25º, summer 25,28ºC). 3. Check the connection of the servo driver cables. 4. Check the air compressor is working properly. 5. Change the chiller water and the filter.
Every Six (6) Months	1. Check that the components in the cabinet are working properly and clean the dust. 2. Check the dustproof cloth of each shaft for damage. 3. Check whether there is looseness in the rear door panel fixing screw of the exchange table. 4. If you need an air compressor for maintenance. 5. Check if the air filter needs to be replaced. 6. Check focus lens, collimate lens if you need to replace.
Yearly	1. Clean water pipe or replace. 2. Check relay usage if needed and replace. 3. Cleaning the dust in the electrical cabinet. 4. Clean laser. 5. Check the cable contact of each line and it is not tight. 6. Check cutting blade if needed and replace. 7. Check focus lens, collimate lens if you need to replace.
Every Two (2) Years	1. Replace air filter. 2. Replace Chiller Water Filter. 3. Replace the aging pipe. 4. Check if ballscrew guide rail needs to be replaced. 5. Check whether the photoelectric switch and proximity switch need to be replaced.

Three (3) Years	1. Check if ballscrew guide rail needs to be replaced. 2. Check if you need to change the chain. 3. Chick if you need to change the gear. 4. Check whether it is necessary to replace the high-pressure gas pipe. 5. Check if safety relay needs to be replaced. 6. Check if you need to replace the computer host.	
Service Engineer:	Signature:	Date:

9.4 The Maintenance of Laser Source and Laser Cutting Head

1. Laser Source – The laser source is the core equipment in laser cutting machine. It provides cutting light source for laser cutting machine. To ensure the laser cutting machine is working normally with high quality, while ensuring reliable operation of the laser source and extending the service life of laser source. Check and maintain the laser regularly. Fiber lasers can basically be maintenance-free. Mainly need to take care of the observation of cooling water and cooling air conditioning is normal, whether the voltage is normal. If there is an abnormal alarm, contact Laguna Tools Customer Service immediately @ 1-800-234-1976.

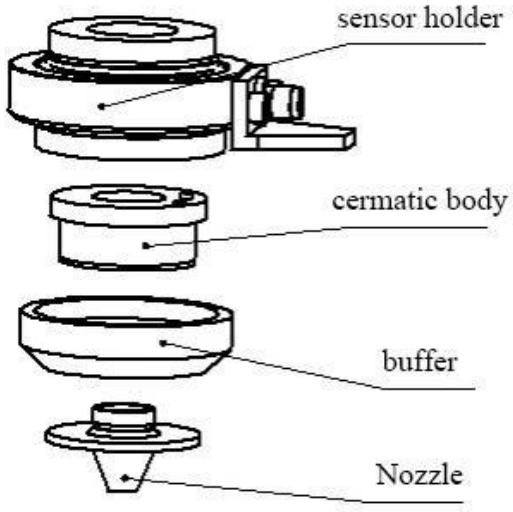


Figure 9-1: Laser Cutting Head

2. Laser Cutting Head Maintenance
   The protection lens is in the lower part of the centering mold and is susceptible to dust pollution. Weekly cleanings are recommended.
   a. Removal of the Protection Lens Box – Hold the drawer of the protection mirror box with thumb and index finger. Slowly pull out the protection mirror box and then seal the drawer with adhesive tape to prevent dust from contaminating the focusing lens.

b. Protection Mirror Box Installation – The protective lens is a flat mirror that can be placed into the mirror box. The procedure in which the lenses are mounted is reversed as when the lenses are removed. Press the lock button on the drawer with a finger and insert it into the drawer. When the lock button pops up, the assembly is completed.

9.4.1 Lens Cleaning – Prepare Tools

Dust gloves/finger cos, long fiber cotton wool, isopropyl alcohol, rubber gas blowing.

1. The left thumb and index finger with a finger cot.
2. Spray isopropyl alcohol onto the cotton wool stick.
3. Gently pinch the side edge of the protective lens with a thumb and forefinger.

NOTE

The fingertips should not touch the surface of the lens to avoid leaving marks.

4. The lens facing the eyes, the right hand with a cotton wool stick, from bottom to top or from left to right, gently wipe the lens in a single direction (do not wipe back and forth to avoid secondary pollution of the lens) and blow with rubber gas the surface of the lens. Both sides must be cleaned. After cleaning, re-confirm that there are no residues: detergent, cotton wool, foreign matter, and impurities.

   The cleaned lens should not be exposed to the air, installed as soon as possible or temporarily stored in a clean, sealed container.

9.4.2 Replacement of the Bottom Kit

1. Unscrew the mechanical part of the sensor and remove it.
2. Replace the new bottom kit and tighten.
3. Adjust the bottom kit to the right position.

9.4.3 Nozzle Replacement

Unscrew the nozzle by hand. Replace with a new nozzle and retighten it with the appropriate force. Calibrate the floating capacitor again after replacement.

9.4.4 Replacement of Ceramic Body

1. Remove the short cable, remove the mechanical part of the cutting head, and remove the nozzle.
2. Then unscrew the fastening nut of the ceramic body and take out the ceramic body.
3. Install the new ceramic body, it need aligned that two (2) positioning posts on the mechanical part of laser head.
4. Firmly lock the compression nut and reassemble it on the connector.

9.4.5 Precautions

To ensure the lens is used normally, the optical lens (protect mirror, focus lens, collimating mirror, etc.) should be checked in time. Do not touch the surface of the lens directly with hand during the check, otherwise the mirror surface will be easily scratched. If there is oil or dust on the mirror, please clean it.

1. Optical lenses are strictly prohibited from being cleaned with water, detergent, etc. The surface of the lens is coated with a special film, it will damage the surface of the lens if cleaned with water, detergent, etc.
2. Do not place the lens in a dark, damp place, as this will age the surface of the lens.
3. The surface of the lens is stained with dust, dirt, or water vapor, which easily absorbs the laser to damage the lens coating; it will affect the quality of the laser beam, if damaged lightly, there will be no laser beam, if damaged seriously.
4. When the lens has little damage, it should be sent to the supplier to repair in time. Try not to use the damaged lens, otherwise it will accelerate the damage to the lens which can be repaired before.
5. When installing or replacing the mirror or focusing lens, do not use too much pressure, otherwise it will cause deformation of the lens and affect the quality of the beam.

9.4.6 Method of Installing or Replacing an Optical Lens

1. Before installing the optical lens, wear cleanly, clean the heads with soap or detergent, and wear white clean and thin gloves; do not touch the lens with any part of the hand. When taking the lens, wear gloves and take the side of the lens and do not touch the lens coating surface directly.
2. When assembling the lens, do not blow on the lens. The lens should be placed on the clean table steadily and a few lens papers should be placed underneath. Care should be taken when taking the lens to prevent bumps and falls and no force should be applied to the coated surface of the lens. The lens holder for the lens should be cleaned and the dust and dirt in the lens holder should be cleaned with a clean air spray gun. Then, remove the lens and gently put it into the lens holder.
3. When mounting the lens to the lens holder, do not use too much force to fix the lens to avoid deformation of the lens, thus affecting the quality of the beam.
4. Precautions when replacing the optical lens. Be careful when removing the lens from the box to prevent the lens from being damaged; do not apply any pressure to the lens before the wrapping paper is opened. When the mirror and focus lens are taken from the box, wear clean gloves and hold from the sides of the lens. When removing the wrapping paper on the lens, avoid dust and other objects falling on the lens. Use a spray gun to remove dust from the mirror and put the lens on the special paper for optical lens. Clean the dust and dirt on the lens support frame and the fixing frame and no other objects are dropped on the lens during assembly. When the lens is mounted on the lens folder, do not use excessive force to avoid deformation of the lens. After assembly, clean the dust and foreign matter on the lens with a clean air spray gun.

9.4.7 Procedure of Clean the Lens

Different lenses have different cleaning methods. When the mirror is flat and has no lens holder, use lens paper clean it. For example: cleaning the reflection mirror. When the mirror is curved or with a mirror holder, use a cotton swab to clean, such as cleaning the focus lens.

1. Steps to clean the lens with lens paper:
    a. Use a clean air spray gun to blow off the dust on the lens surface.
    b. Use alcohol or lens paper to clean the surface of the lens.
    c. Never use a dry lens paper to pull directly on the mirror surface. Flatten the lens paper to the surface of the lens, drop 2-3 drops of high-purity alcohol or high purity

acetone and slowly pull out the lens paper horizontally to the direction of the operator.

d. Repeat the above operation several times until the mirror surface is clean, if the mirror surface is very dirty, fold the lens paper 2 – 3 times, repeat the above steps until the mirror is clean.

2. Steps to clean the lens with a cotton swab:

   a. Blow off the dust on the mirror with a spray gun.

   b. Use a clean cotton swab to remove the dirt.

   c. Move a new cotton swab dipped with high-purity alcohol or acetone from the center of the lens to the edge of lens making a circular motion.

   d. Scrub the lens. After each circle of cleaning, change another clean cotton swab and repeat the above operation until the lens is clean. Never use the cotton swab to operate it.

   e. Clean the lens with a clean cloth and remove the residue on the mirror.

   f. Be careful not to scratch the mirror surface; take the cleaned lens to a place with sufficient light. If the reflection of the lens is good, it indicates the lens is clean. If the lens is not reflective, continue to clean the lens. Put the cleaned lens on the lens holder in accordance with the method described above.

9.4.8 Storage of Optical Lenses

1. The optical lens is stored properly to keep the lens quality in a good condition.

2. The storage environment temperature is 10~30ºC. Do not put the lens into the freezer or similar environment. Otherwise, it will condense and frost when it is taken out, which will easily damage the lens. The temperature of the storage environment is not more than 30ºC, otherwise it will affect the coating on the lens surface.

3. Keep the lens in the box, the lens should be placed in a non-vibrating environment, otherwise it will easily cause deformation of the lens, thus affecting the performance of the lens.

   a. Maintenance during Long-term Storage - When the machine is not used for a long time, please apply butter on the moving parts of the machine and wrap the anti-embroidered paper. Check other parts regularly to see whether there is any rust and rust-proofing treatment of rusted parts (if the condition can be added with a dust cover) and regularly clean and check the machine.

b. Linear Slide and Rack and Gear Maintenance – Because different lubricant types used in the two (2) rails, the equipment also adopts two (2) different lubrication methods. The guide rail adopts the electric automatic refueling pump to refuel automatically. When the automatic oil pump is too low, the system will alarm automatically, join the Great Wall heavy-duty vehicle gear 90GL-5 lubricating oil at the oil filling port and reset after the oil filling is completed. The rack needs to add oil to the machine body days. The oil used is Mobil 00# lithium grease. If the linear slide is not properly lubricated, the friction of the rolling portion will increase and long-term use will become the main reason for shortening the life.

   The linear side and sprocket chain grease is a lithium-based grease. Tsutsui lithium grease MP-3 is recommended.

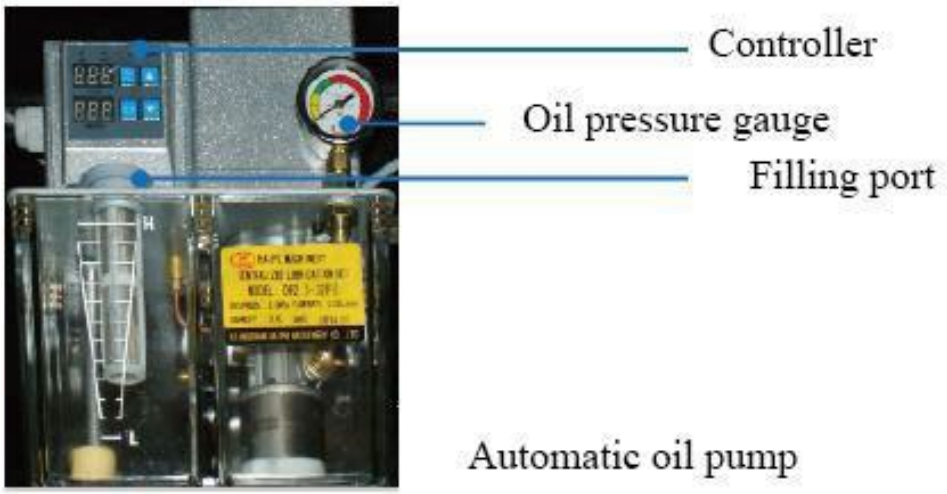


Figure 9-2: Automatic Oil Pump

c. Machine Cleaning and Maintenance - Mainly maintenance is the transmission part of the machine body and the cleaning of work surface.
   i. It is necessary to clean the work surface and the dust and debris on the worktable every day.
   ii. The dust and debris on the track dust cover must be cleaned every day to prevent the dust cover from being scratched and shorten its service life.

d. Water Tank Cleaning and Maintenance – The main function of the water tank is to protect the laser the cutting head by controlling the water temperature to ensure the normal operation of the laser equipment. It is an important accessory and must be cleaned and maintained.

i. It is necessary to clean the filter every day to ensure that the ventilation and heat dissipation are good and the water temperature is normal.

ii. The temperature of the water tank is generally maintained at 22ºC to 28ºC (in summer the high temperature can be set to 28 - 35ºC, the low temperature can be set to 26 – 29ºC, pay attention to the temperature difference between the equipment temperature and the external environment temperature cannot be greater than 5ºC, please adjust in summer. Otherwise, it will have a serious impact on the device.

iii. The temperature of the water tank

Figure 9-3: Water Temperature

iv. Change the water every week.

NOTE

Use only distilled water (Watson's Distilled Water), wash the water tank before changing the distilled water every time, recycle the dirty water in the equipment once the new distilled water and then inject distilled water again.

e. Cleaning Maintenance of the Electric Cabinet

i. The filter of the electrical cabinet is cleaned weekly and can be cleaned with compressed air or water. Replace the filter if dirty.

Figure 9-4: Electrical Cabinet Filter

ii. The electric cabinet will be cleaned once every three (3) months. If the environment is bad, the dust will be cleaned once a month. When the dust is cleaned, all the power supplies must be powered off and then the doors on both sides of the power supply cabinet are opened. Do not touch the electronic

components inside the cabinet directly. Clean the dust in the cabinet with a vacuum cleaner (do not use compressed air).

iii. Clean the computer host every six (6) months at minimum; every three (3) months if required by the environment. To clean the computer host, remove the fixing strip and the cover. The motion control card and memory module can be removed and cleaned. Use a clean, dry cloth.

9.5 Common Fault Analysis

9.5.1 Software enters the Demo Interface Failure

Check if the device manager finds the CypCut Electronic Motion Control Card and checks if the control driver is installed.

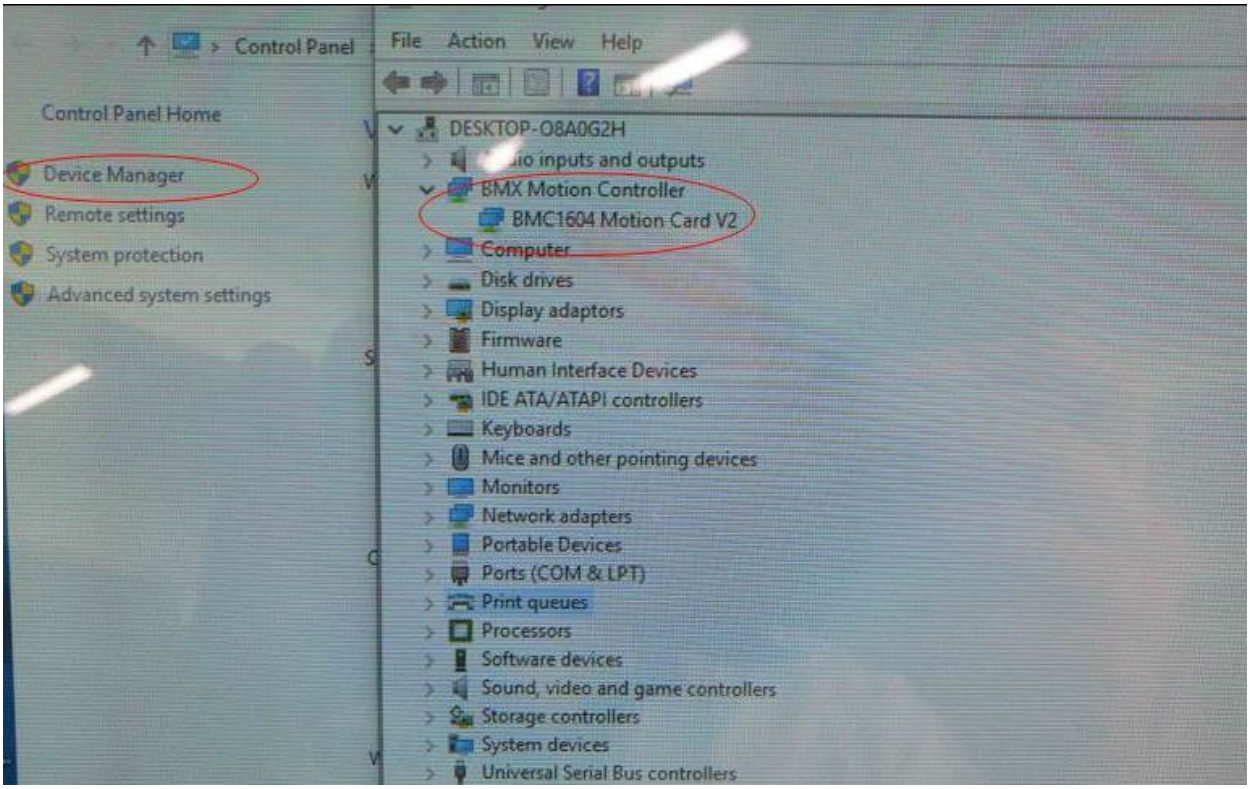


Figure 9-5: BMX Motion Controller

If the motion control card is not found in the device manager, please check the two (2) small lights (LED7, LED8) on the top of the control card to flash. If it does not flash alternately, the control card may be faulty and can be upgraded or sent back for repair.

Check the interface to see if the system has expired.

Figure 9-6: LED Lights

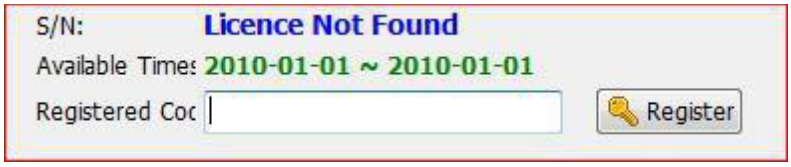


Figure 9-7: License Not Found

160X series control card, CypCut software requires 6.3.702.x version and above to support 60X series control card, check whether the serial number has multiple repeated codes such as ZZZZZ, re-plug the control card to see if the serial number changes and then re-encrypt and decrypt after the change.

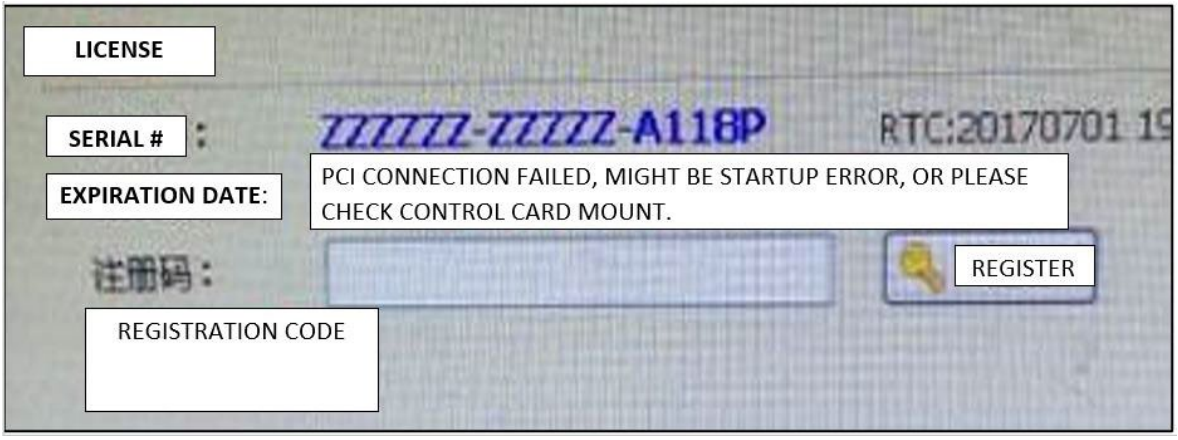


Figure 9-8: Control Card

External Dongle, check if the RTC time behind the serial number is the current time. If the time is wrong, the dongle may be damaged.

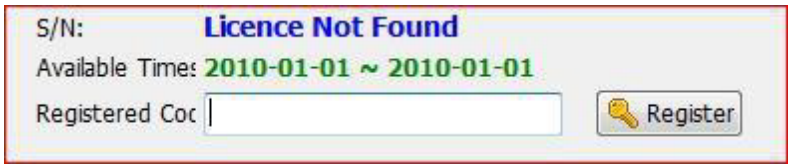


Figure 9-9: License not Found

9.5.2 The Laser Source does not have Light

If the laser shutter does not open, check if the output signal of the PWM (up to 4.1V or 22V when the duty ratio is 100%) and DA (0~10V) is normal on the terminal board. Relying on the communication-controlled laser, check the configuration of the network/COM port, whether it is connected. Check whether the external control module of the laser is faulty. The internal control can emit light. It does not mean that the external module is normal. The laser monitoring software is used to detect whether the laser receives control commands, such as DA and PWM signals.

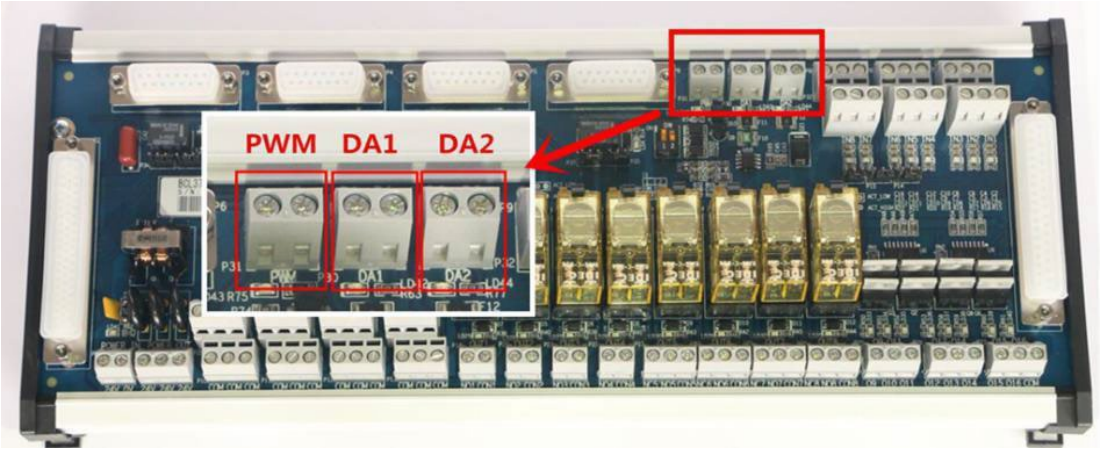


Figure 9-10: COM Port Configuration

9.5.3 The Light of Scanning and Cutting Out is not normal, Light Leakage

Send a pulse in the diagnosis window to check whether the encoder feedback is normal. If the direction is wrong, reverse the direction of the encoder in the platform configuration tool. If the number is incorrect, modify the servo feedback pulse and other related parameters.

Check the accuracy of the error measurement is not high enough, the servo stiffness setting is too low.

Sort the graph when generating the scan line, it is recommended to use the “Local Shortest Move” strategy.

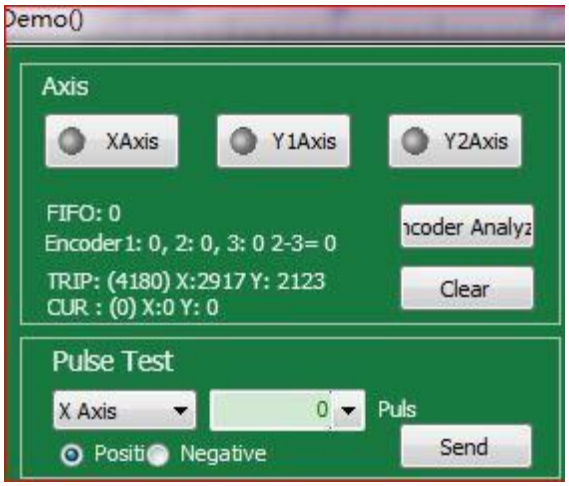


Figure 9-11: Check Encoder Pulse

If the light leakage is from IPG laser, the PWM signal is set to 5V and other lasers check whether the servo interferes with the board.

9.5.4 The Cutting Process is not the right size

Check if the size drawn on the original drawing is correct. The deviation of the size is about ten (10) filaments. Add the appropriate slit compensation. If the scale becomes larger or smaller, adjust the pulse equivalent in the servo and platform configuration tool.

Figure 9-12: Encoder Reverse

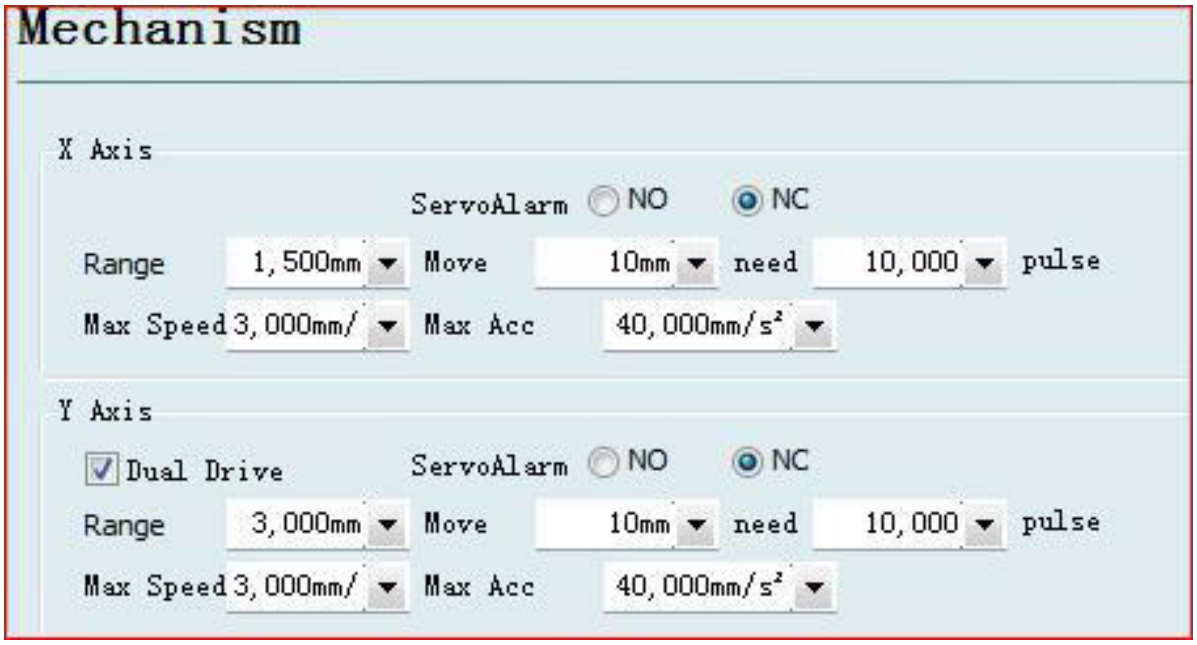


Figure 9-13: Mechanism

9.5.5 Cutting Deviation

- Check if the servo motor is correctly equipped with a regenerative resistor.
- Check whether the trajectory of the cut part is deformed. If the distance of the empty movement changes and the closed pattern of the cutting is normal, check whether there is looseners between the servo and the reducer.
- In the above case, the null acceleration and low pass filtering frequency are set to be low or the same as the cutting portion, which can be temporarily solved.

9.5.6 Cannot Perform Breakpoint Positioning after Power Failure or Restart

If the “only process selected graph” is checked, the processing breakpoint memory function will not be available.

In the process of using, the power should be returned to the origin at least once.

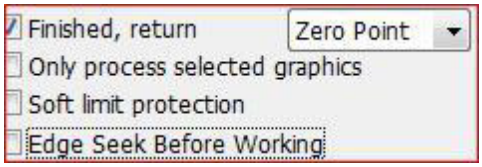


Figure 9-14: Finished, Return

- The state of power failure must be machining (this function is invalid if the frame is moved or moved).

- The file autosave.lxd is not damaged.
- The basic information of the machine tool has not been changed (such as pulse equivalent, origin direction, etc.).
- The processing time must be more than thirty (30) seconds.

Figure 9-15: IP

9.5.7 Height Adjuster Network Timeout

Verify the IP address of the tuner in the platform configuration tool is the same as that in the network parameters of the tuner itself.

Figure 9-16: Follower

Check whether the IPv4 address of the computer network card is consistent with the first three (3) segments and the adjuster and the last segment is inconsistent.

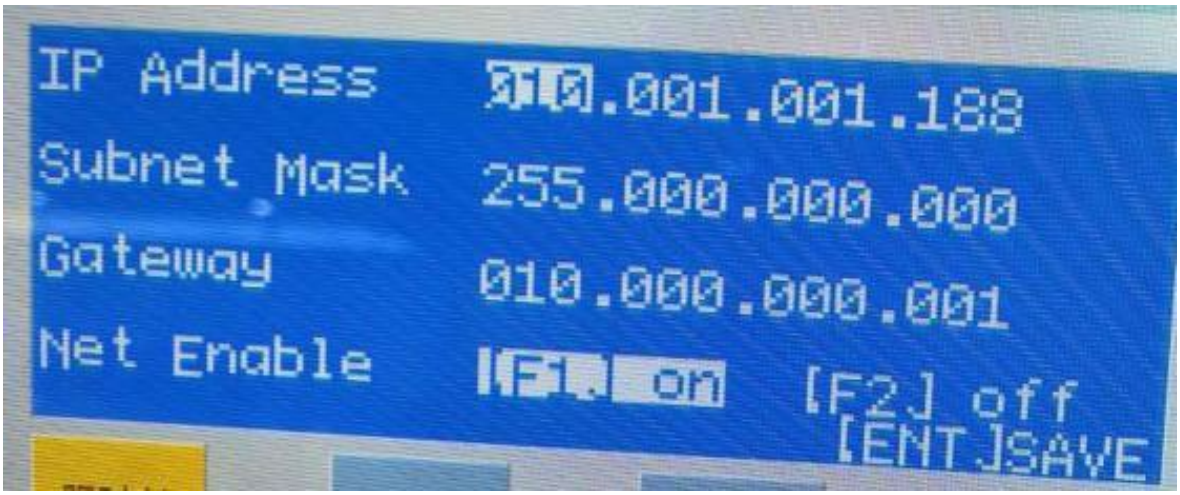


Figure 9-17: IP Address (1 of 3)

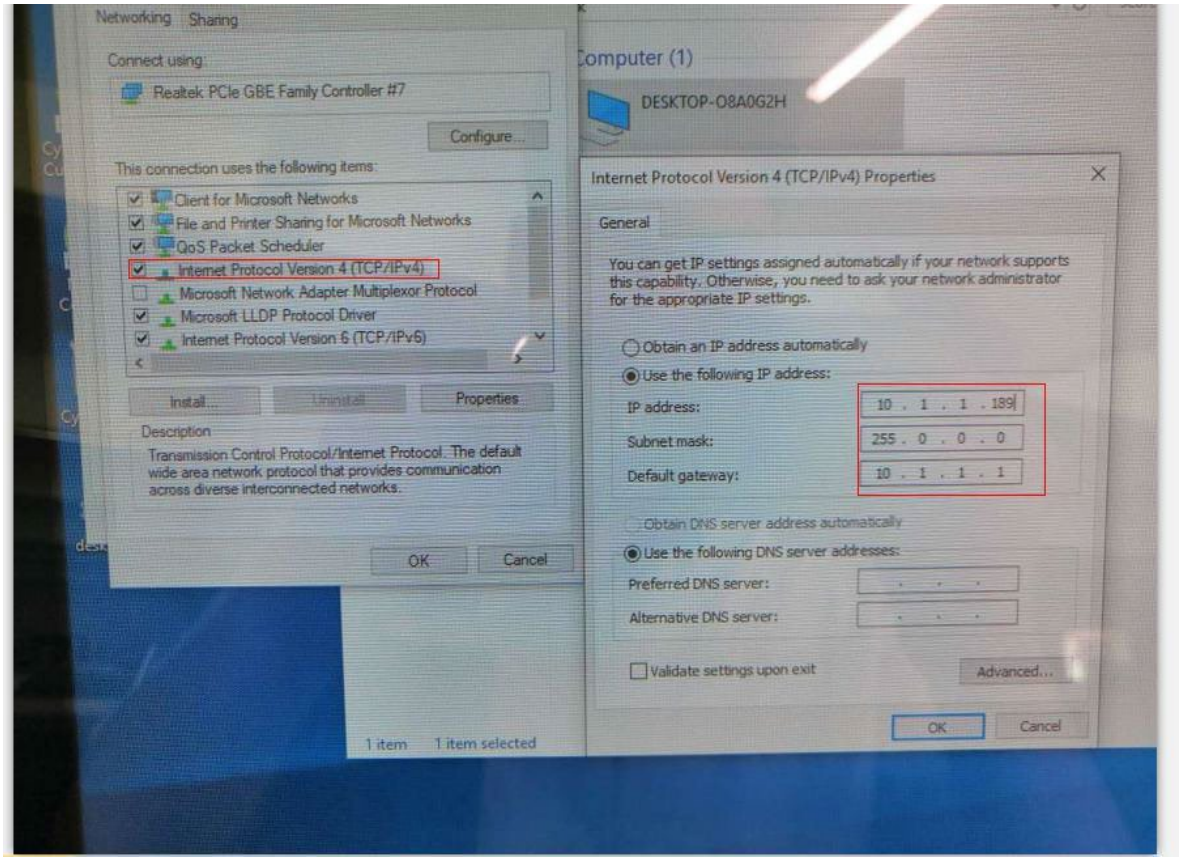


Figure 9-18: IP Address (2 of 3)

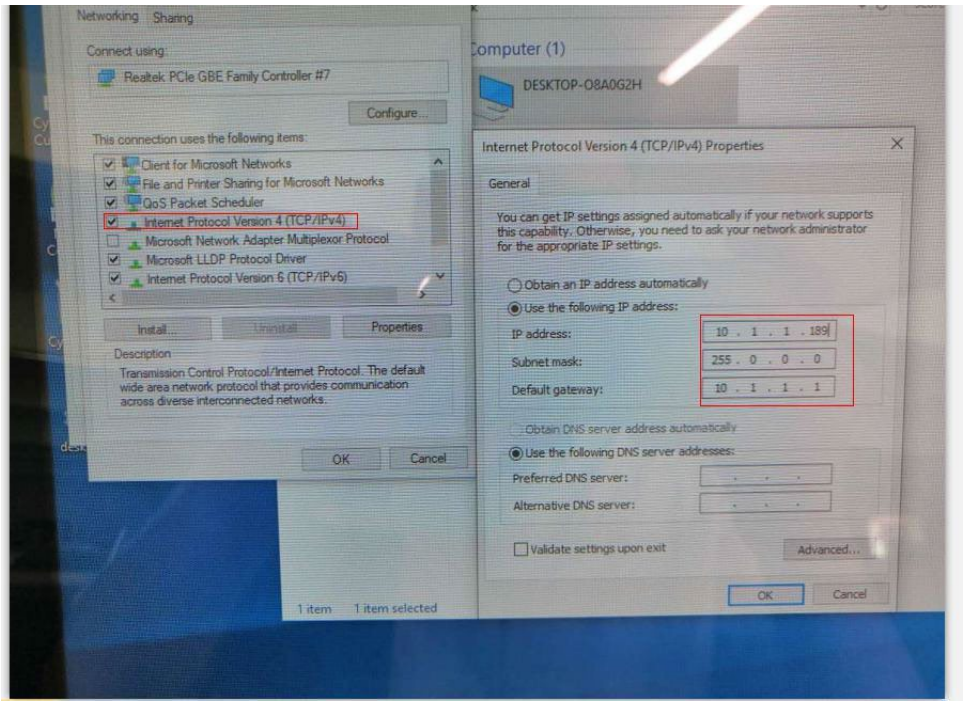


Figure 9-19: IP Address (3 of 3)

If the problem is not solved, please replace the network card.

9.5.8 Homing is not normal

Check whether the Z trust number is enabled in the parameter of the platform configuration tool back to the origin and the 15-core servo wire is not welded or falsely welded with the relevant encoder signal wire.

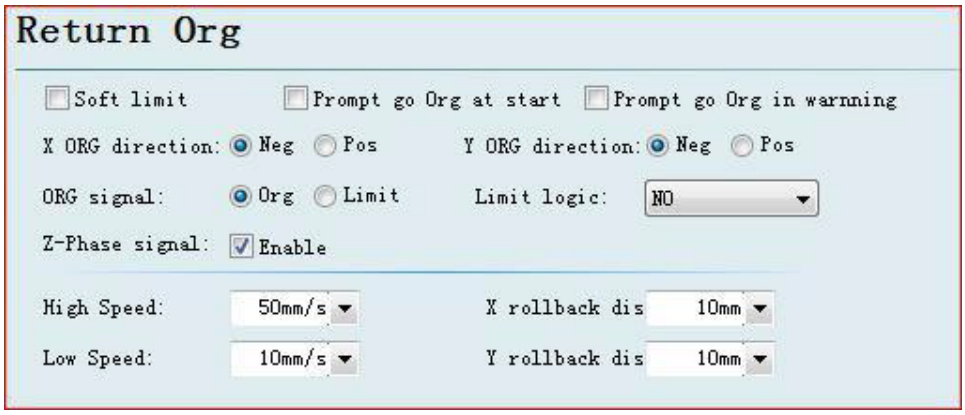


Figure 9-20: Return Org

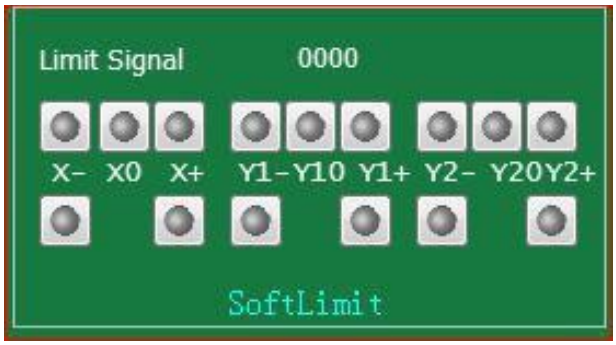


Figure 9-21: Soft Limit

9.5.9 Axis Movement is Not Normal

Check whether the 15-core wire and the 62-core wire are connected normally. No need to replace the board card. Exclude whether the board card damages the servo and whether the parameters are set incorrectly. This alarm is sent by the software to the height regulator, but the height regulator does not execute the instructions sent by the software within a certain period or does not respond after receiving the corresponding instructions from the height regulator. Check if there is any abnormal condition that affects the normal operation of the height regulator. Check whether the level of the height regulator is too low. It is recommended that the level of the v2.0 version should be upgraded to v1224 or above and the level of the 3.0 version should be upgraded to 3180 or above. If frequent occurrence can check whether the network connection is normal or after changing the network card, the test prompt “the height regulator did not complete (follow) instruction within the specified time” failure.

9.5.10 The Capacitance has always changed to 0-

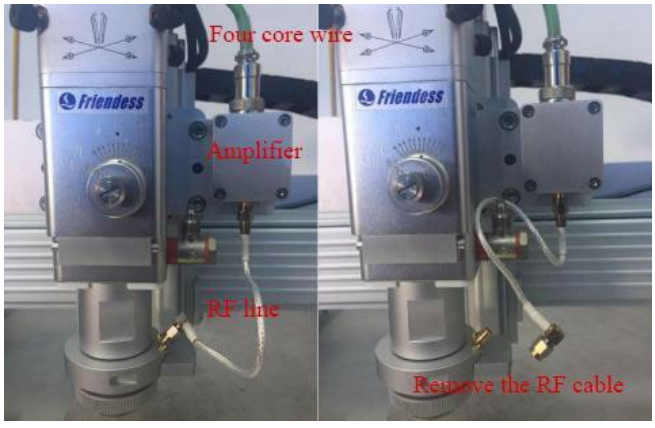


Figure 9-22: Capacity (1 of 5)9

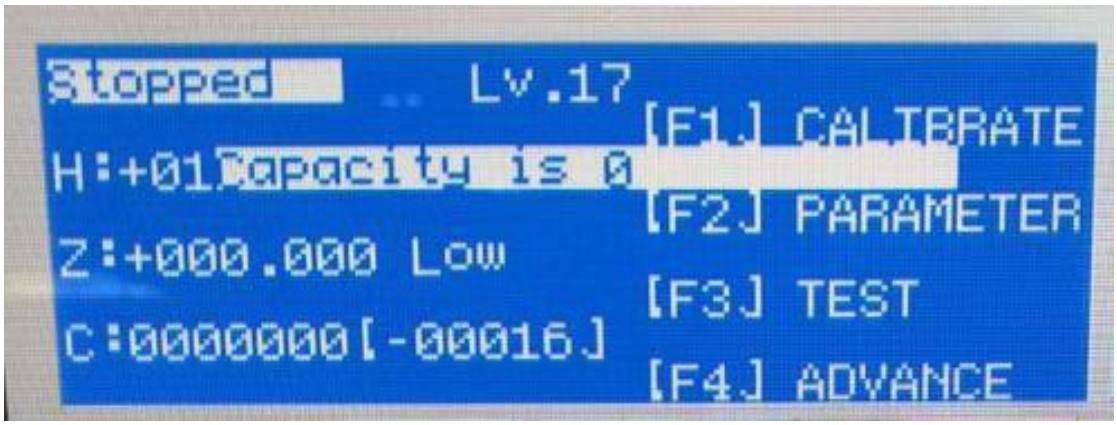


Figure 9-23: Capacity (2 of 5)

If it is still 0, replace the standard SPC-140 RF Cable of BCS100 height regulator, check whether the capacitor is restored and the recovery will be normal. Replace the amplifier and check if the capacitance is restored.

9.5.11 The Body Capacitance Becomes Smaller

Touch the nozzle and observe whether the capacitance changes to 0. If it does not change to 0, check whether the ceramic ring and nozzle of the cutting head are installed. Once the cutting head is processed, the alarm will be given to the “capacitance of the body decreases”.

When the ambient temperature decreases, the capacitance induction of the amplifier and the cutting head itself will decrease and the floating head needs to be calibrated again. When the calibration function is on, the parking point should be set above 300 mm of the plate surface.

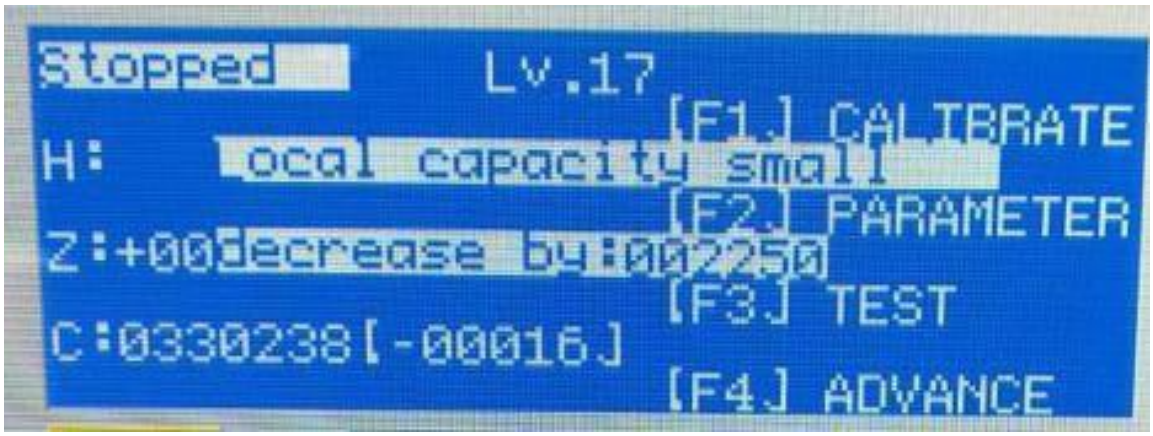


Figure 9-24: Capacity (3 of 5)

Figure 9-25: Capacity (4 of 5)

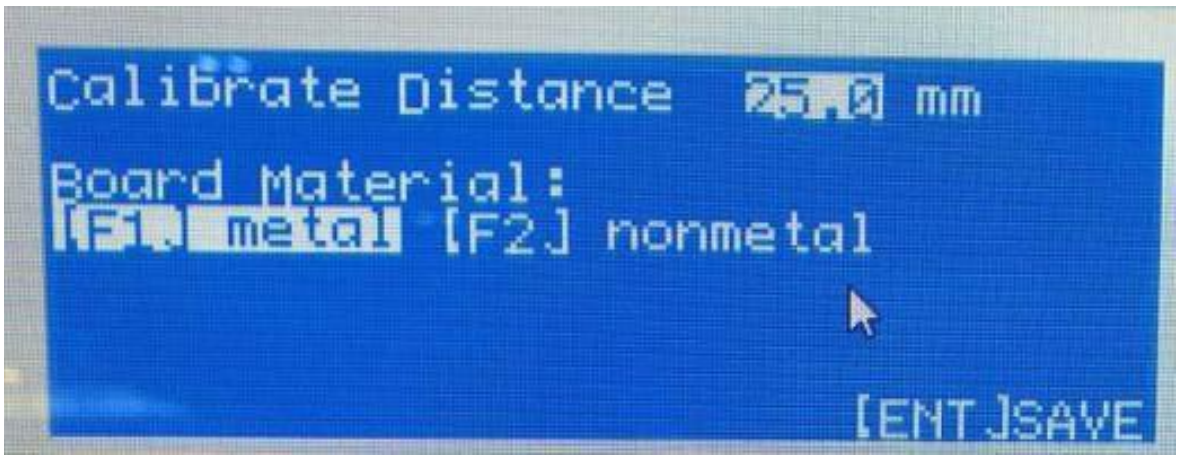


Figure 9-26: Capacity (5 of 5)

9.5.12 The Laser Head Direct Touch Board

The floating head calibration is performed again, whether the real-time calibration is started when the docking coordinate is set too low (the criterion is that the switch will be followed immediately after the calibration and the value in square shall not exceed 300 after the C value of the capacitor is checked).

Figure 9-27: Laser Head Direct Touch Board

9.5.13 Capacitance frequent Alarm during Processing

Check the block F2-7 alarm parameters of the touch panel alarm delay if abnormal, can be appropriately increase the touch panel cut hole or delay.

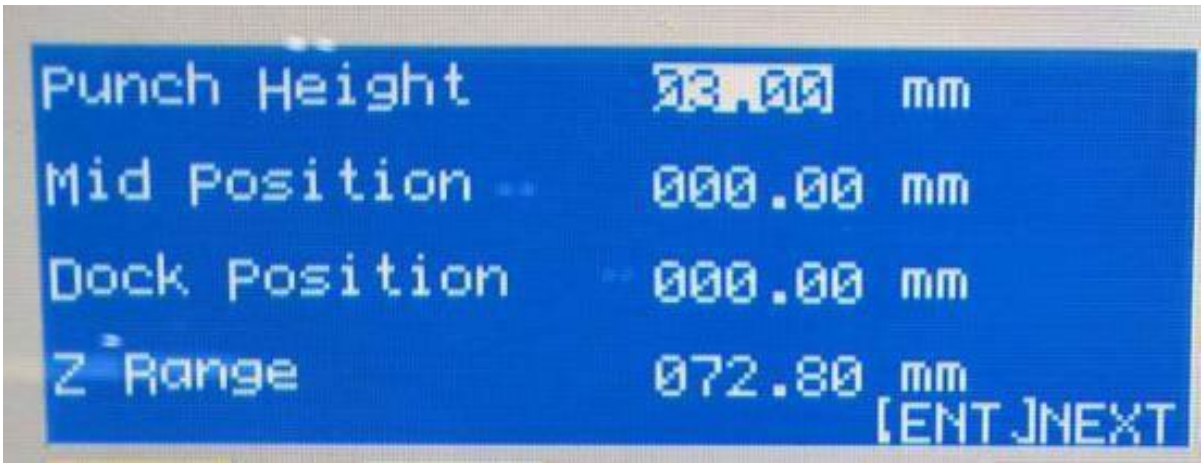


Figure 9-28: Alarm Parameters

Check whether the cutting head sensor head is not properly installed and whether there is light deviation.

9.5.14 Cutting Thin Plate, Thick Plate Edge Jitter

Turn on the vibration suppression function in the advanced parameters of the height regulator F2 –8. The recommended setting of vibration suppression time is between 10 and 50 ms. The higher the value is, the more obvious the suppression effect will be.

9.5.15 Following the Cutting Process is Getting Higher and Higher

Check the cutting head is hot or not and check whether the lens has stains. A cutting laser head that is hot will affect the capacitance collection of the induction.

9.5.16 The Lifting Height is Getting Lower and Lower During the Cutting Process

After the lifting stops, check whether the value of the height adjuster's Z coordinate is 0. If the value is 0, there is skidding between the Z-Axis motor and the coupling and check the mechanical problems.

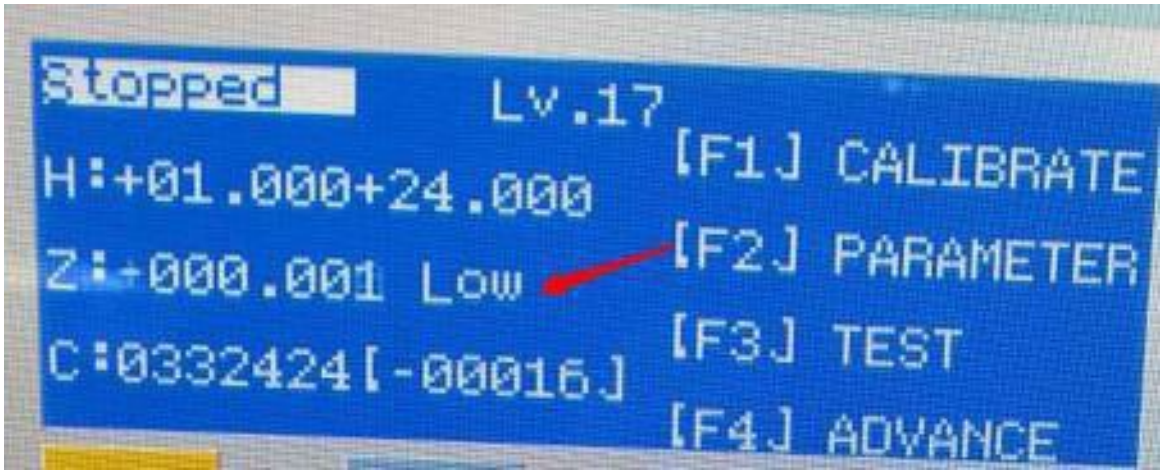


Figure 9-29: Z Coordinate

9.5.17 Floating Head Calibration Cannot Be Marked

Move the cutting head close to the sheet and click the number 5 key on the main interface of the height adjustor to observe the DIF value. If the value is above 30, power off the servo, laser, transformer, and other powerful successively and observe the DIF value. If it is judged that a strong current causes the DIF value to increase, it is necessary to check whether the strong current is well grounded and whether there is leakage and try to use single-terminal grounding for this equipment.

If the DIF is still large even after all the strong electricity has been turned off, check whether all the four (4) core wires are on, measure whether the enclosure of the amplifier and the bed of the machine are on and if the conductivity is not good, reduce the impedance by adding grounding wires at both ends.

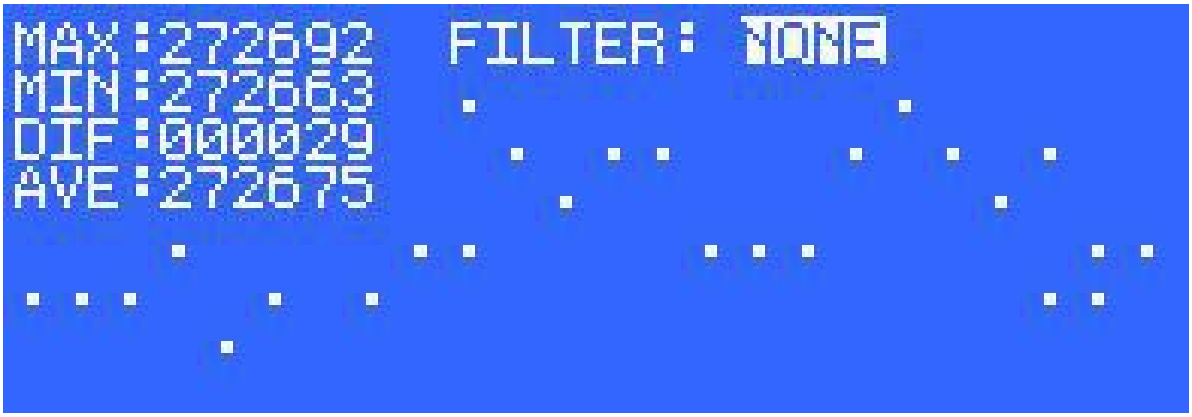


Figure 9-30: Floating Head Calibration

9.5.18 When the Piercing Height is Greater than 3 mm, the Piercing Process is not Performed

Direct cutting is normal. When the perforation height is more than 3 mm, it only follows the follow-up action and does not continue. Check whether the calibration range in F4 setting in the height adjuster floating head calibration interface is set to 3 mm and modify it to 25 mm.

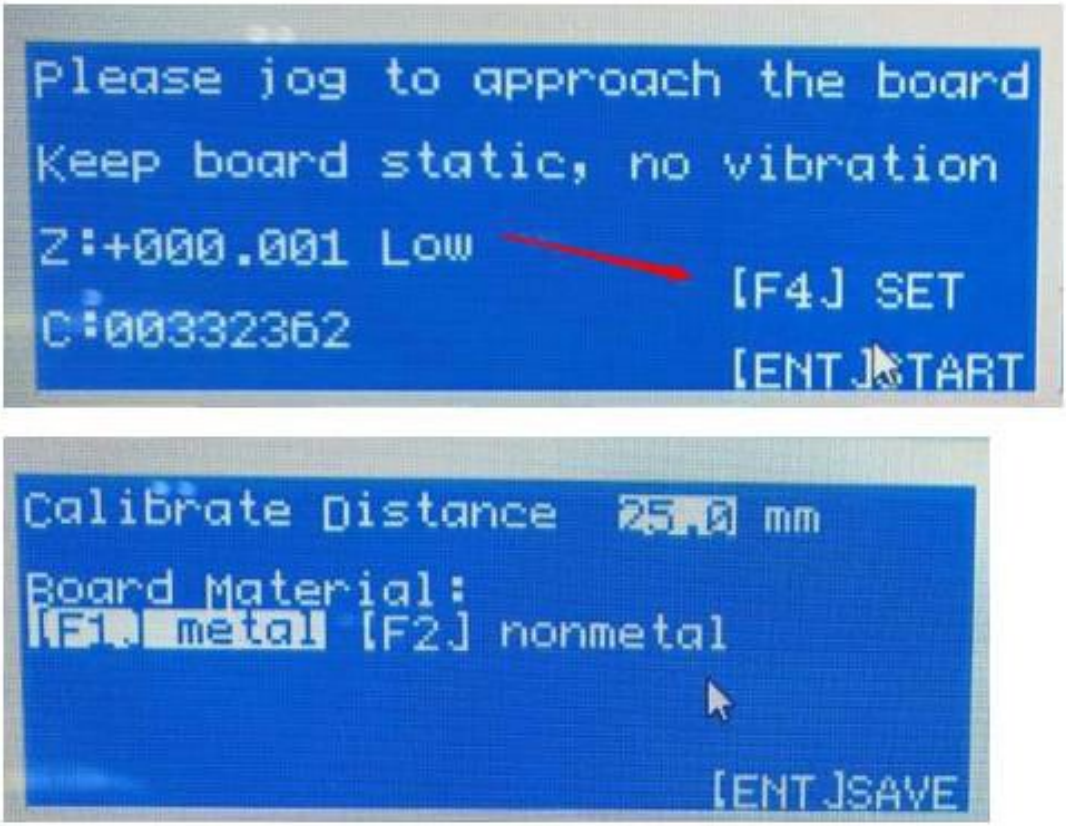


Figure 9-31: Piercing Height

9.5.19 Servo Overload Alarm after the Height Adjuster Returns to the Origin

Check the upper limit for failure.

Check whether the upper limit position is too close to the top of the screw rod and whether the speed to the origin is too fast.

9.5.20 The Up and Down Movement of the Height Adjuster Moves in One Direction

Check whether the servo zero drift is too large and then perform the servo calibration again after clearing the zero drift in the servo calibration interface.

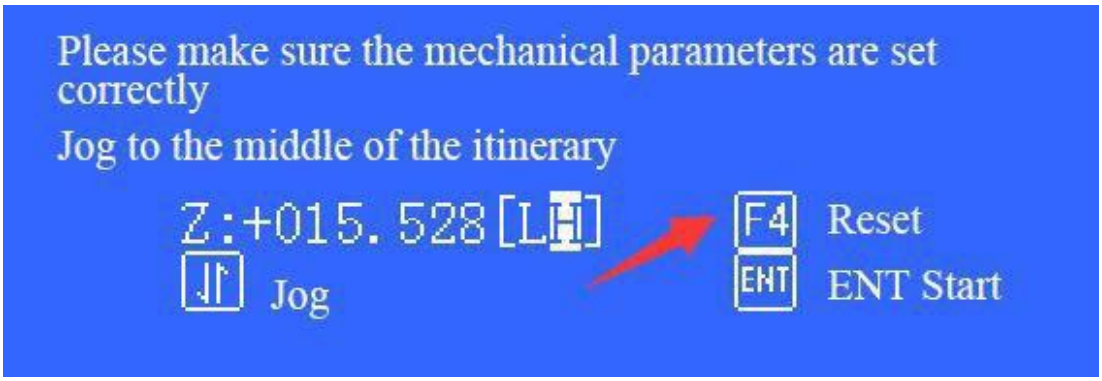


Figure 9-32: Reset

9.5.21 Adjuster Floating Head Calibration Failed

If the alarm indicates that the upper limit is valid, the height adjuster shall be returned to the origin and then the floating head calibration shall be carried out again. The alarm indicates that the capacitance is abnormal. Touch the nozzle by hand to check whether the capacitance changes to 0 or not. If the capacitance does not change to 0, check whether there is something wrong with the internal induction head of the cutting head.

The alarm indicates that the capacitor is always in the state of collision plate, then check whether the capacitor is 0, eliminate the problem so that the capacitor can be normally induced and then re-calibrate the float head.

9.5.22 Height Adjustor Prompts to Follow the Error Too Large Alarm

This alarm refers to that during the following process of the height regulator, the acquisition capacitance changes violently (such as plate shaking, more anti-slag, insufficient air pressure of cutting gas, etc.), which leads to a large deviation between the actual following height and the target following height, thus generating an alarm.

9.5.23 The Height Adjustor Prompts the Encoder to be Unresponsive

The encoder does not respond to send motion instructions for the height regulator and the motor does not move. Check whether the servo driver parameters are set correctly (check whether it is running in speed mode) on the 15-core wire (wiring definition is different from the XY axis, which is in analog quantity control mode). Whether the servo parameters are set correctly (check whether it is running in speed mode).

9.5.24 Encoder Abnormal Motion

The height regulator does not send motion instructions, but the motor is in motion, it is necessary to check whether there is zero drift in the motor or the motor falls due to gravity when the servo is not enabled.

9.6 Cutting Process – Problem of Cutting and Perforation

Any hot cutting technique, except in a few cases where it can start cutting at the edge of the plate, generally requires a small hole to be punched through the plate. In the past, the punching head of laser stamping composite was used to punch out a hole and then a laser start cut from the hole. There are two (2) basic methods for laser cutting machine without stamping device

1. Blasting Perforation – The material is irradiated by a continuous laser beam to form a pit in the center and then the melting material is quickly removed by a stream of oxygen to form a hole in the molten material. The size of the general hole is related to the thickness of the plate and the average diameter of blasting perforation is half of the thickness of the plate, so the hole diameter of the blasting perforation of the thicker plate is larger and not round, which is not suitable for the high precision parts and can only be used for waste materials. In addition, the oxygen pressure used for perforation is the same as that used for cutting; the splash is larger.
2. Pulse Perforation – Each pulsed laser only produces small jets of fine particles, which are gradually deepened, so the time perforation of thick plate needs a few seconds. Once the perforation is complete, the auxiliary gas is replaced with oxygen for cutting. In this way, the diameter of perforation is smaller and the quality of perforation is better than that of blasting. The laser source in use not only should have higher output power, but it is also more important is the time and space characteristics of the beam, so the general travers flow laser cannot meet the requirements of the laser cutting. In addition, a reliable air path control system is required for pulse perforation to realize the control of gas type, gas pressure switch and perforation time. In the case of pulse perforation, the transition technology from pulse perforation at rest to constant continuous cutting should be paid attention to obtain high quality incisions. In theory, the cutting conditions of the acceleration section obtain high quality incisions. In theory, the cutting conditions of the acceleration section usually can be changed, such as focal length, nozzle position, gas pressure, etc., but in fact, it is difficult to change the above conditions due to too short a time. It is practical to change the average power of laser in industrial production: change the pulse width, change the pulse frequency, and change the pulse width and frequency at the same time.

9.7 Analysis of Deformation of Cutting Small Holes (Small Diameter and Thick Plate)

Because the machine (only for high-power laser cutting machine) does not use blasting and perforation when making small holes, but by pulse perforation (soft piercing), which makes the laser energy concentrated in a small area. The non-processed area is also burnt, causing deformation of the hole, and affecting the processing quality. At this time, perforation (normal piercing) method in the processing program. For the smaller power laser cutting machine, the method is opposite. In the small hole processing, pulse perforation should be adopted to obtain a better surface finish.

9.8 Solution for Burr of Workpiece when Laser Cutting Low Carbon Steel

According to the work and design principle of laser cutting, the following reasons are the main reason for the burrs of the workpiece: the upper and lower positions of the laser focus are not correct, the focus position test needs to be done, and the offset is adjusted according to the focus. The output power of the laser is not enough. It is necessary to check whether the work of the laser generator is normal. If it is normal, observe whether the output value of the laser control button is correct and adjust it. If the line speed of cutting is too slow, the line speed needs to be increased during operation control. If the purity of the cutting gas is not good, it is necessary to provide high-quality cutting working gas. If the laser focus is offset, the focus position test needs to be performed and the offset is adjusted according to the focus. If the instability of the machine running time is too long, a shutdown and restart is required.

9.9 Analysis of Burrs on Workpieces when Laser-Cutting Stainless Steel and Aluminum-Zinc Plates

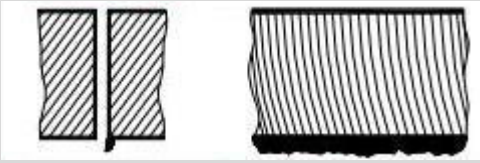
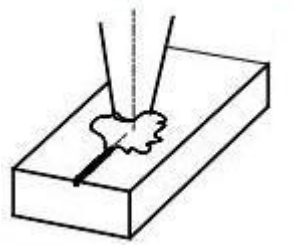
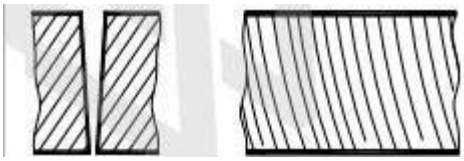
When the above problem happens, first consider the factors of burr when cutting carbon steel, but it is not simple to speed up the cutting speed, because the plate may not be cut when the speed is increased. At this time, should considering other factors of the machine, such as the replacement of the nozzle and the unstable movement of the guide rail.

9.10 Analysis of Laser Incompletely Cut Through State

This condition will affect the quality of the cut section finish of the part. At this time, if other parameters are normal, the following should be considered: the loss of the laser head nozzle should be replaced in time. In the case of no new nozzle replacement, the working has pressure

should be increased. The thread at the joint between the nozzle and the laser head is loose. At this point, the cutting should be paused immediately, the laser head connection status should be checked and the thread should be re-threaded.

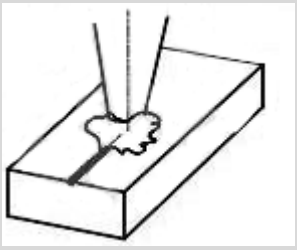
9.11 Summary of Cutting Process Defects

Phenomenon	Reason	Solve
Only have burrs on the bottom of cutting edge 	Nozzle center not good, nozzle is deformed	Adjust the center of nozzle, change nozzle
Have blue plasma gas come out and cannot cut through the metal plate 	Connect the false gas, speed too high, power too low	Use correct has, decrease speed and increase power
Cutting edge is irregular 	Gas pressure is too high, nozzle break, nozzle d is too big	Decrease gas pressure, change nozzle
No burrs, cutting route turn to right, the bottom of cutting edge become thin 	Speed too high	Decrease speed

There is corrosive pit on the cutting surface 	Gas pressure too high, speed too low focus too high, material has exist, impurity or too hot of material	Decrease has pressure, increase speed, decrease focus, use good material
Rough Cutting Edge 	Focus is too low, gas pressure is too high, speed too low, material is too hot	Cutting stainless steel by N1

9.12 Cutting Stainless with Nitrogen

Phenomenon	Reason	Solve
There is irregular burrs on the two sides of cutting edge button 	Focus is too low, speed is too high	Increase the focus position and decrease the cutting speed
There are long burrs on the two sides of cutting edge 	Speed is too low, focus is too high, gas pressure is too low, and material is too hot	Increase speed, decrease focus, increase gas pressure and cooling material
Only on the two sides of the cutting edge, there is long hours 	Nozzle is not in the center, focus is too high, and has pressure and speed is too low	Adjust nozzle, decrease the focus position, increase gas pressure and speed

Yellow color on the cutting edge	There is O2 in N2	Use high purity N2
Produce plasma gas, cannot cut through 	Speed too high, power and focus is too low	Decrease cutting speed, increase power and focus position
Bestrahlungsunterbrechung	Speed is too high, power, and focus position is too low	Decrease speed, increase power, increase focus position
Rough cutting edge	Nozzle break, lens being polluted	Change nozzle, clean, or change lens

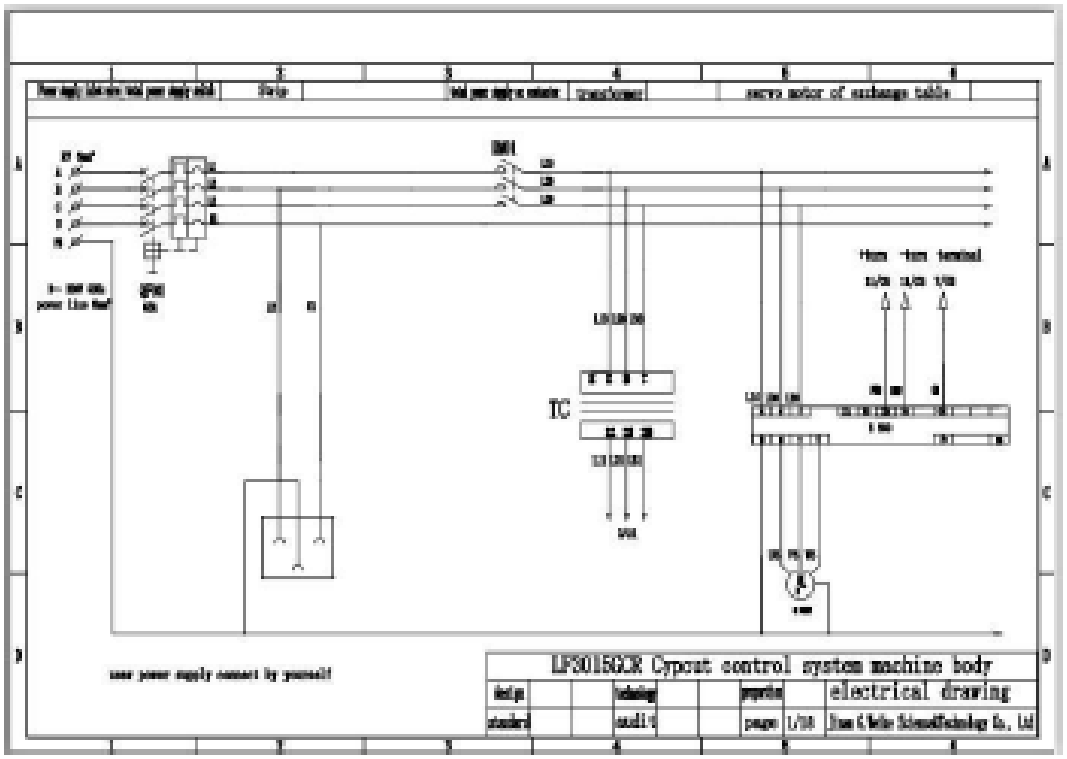
NOTES:

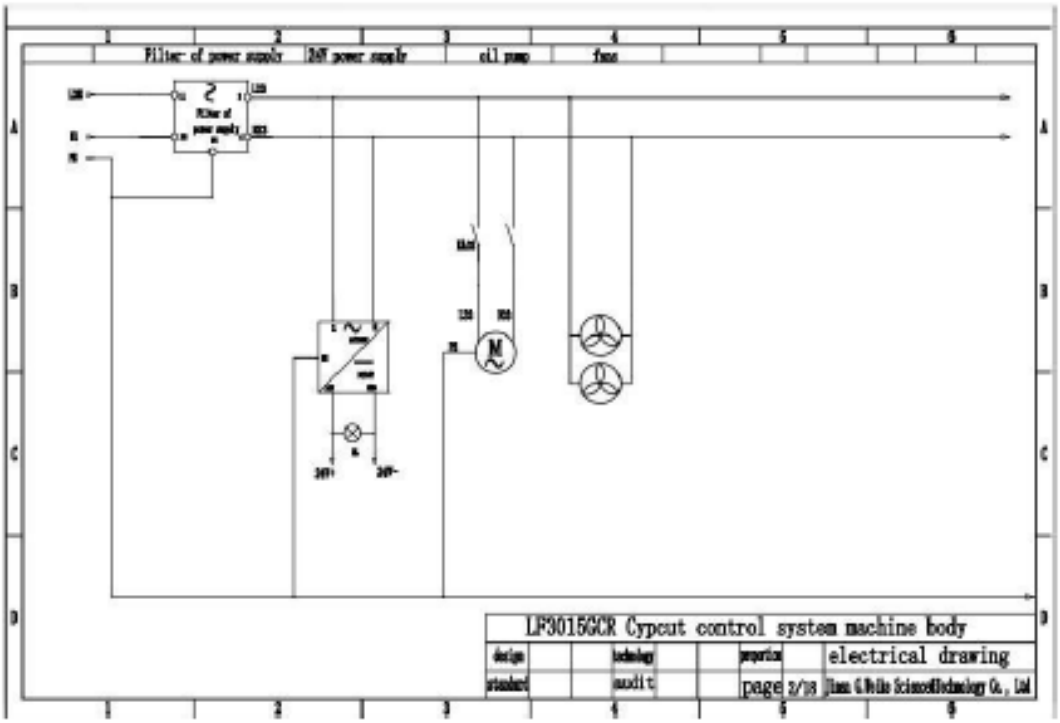
10.0 Maintenance Service

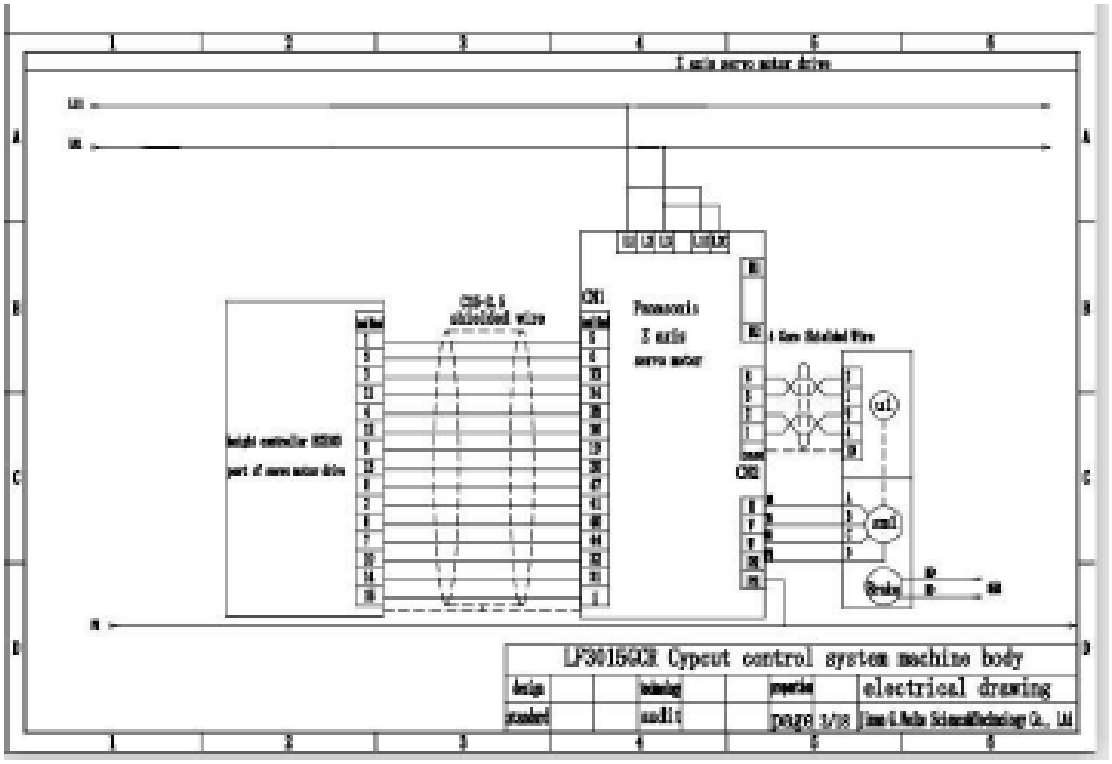
1. During the warranty, there is some parts is broken and need back to factory to repair, the buyer should pay for the transportation fee to factory. After testing in factory and found, the broken part is broken as itself quality problems (not man-made reason, not use environment reason), the factory will repair it for free or send the buyer a new one for free. At the same time, the factory will undertake the transportation fee to the buyer's company.
2. The back part should be test in Laguna Tools factory firstly, after testing and repairing by Laguna Tools after sale service department, then return it to the buyer.
3. During the warranty period, if the part is broken not as the products itself quality problems, the buyer should pay for the transportation fee to turn back the buyer's company.
4. During the warranty period, the buyer should pay for the transportation fee to repair the part.
5. The spare parts do not have warranty, such as reflective lens, focus lens, protect lens, collimating lens, laser head, ceramic ring, nozzle, etc.
6. The peripheral devices should be maintaining according to the devices' manufacturer and at the help of Laguna Tools, the devices have one year warranty. The warranty will be started to calculate from the date of production such as water chiller, exhaust fan, pimp, air compressor, industry computer, etc.

NOTES:

11.0 Circuit Diagrams



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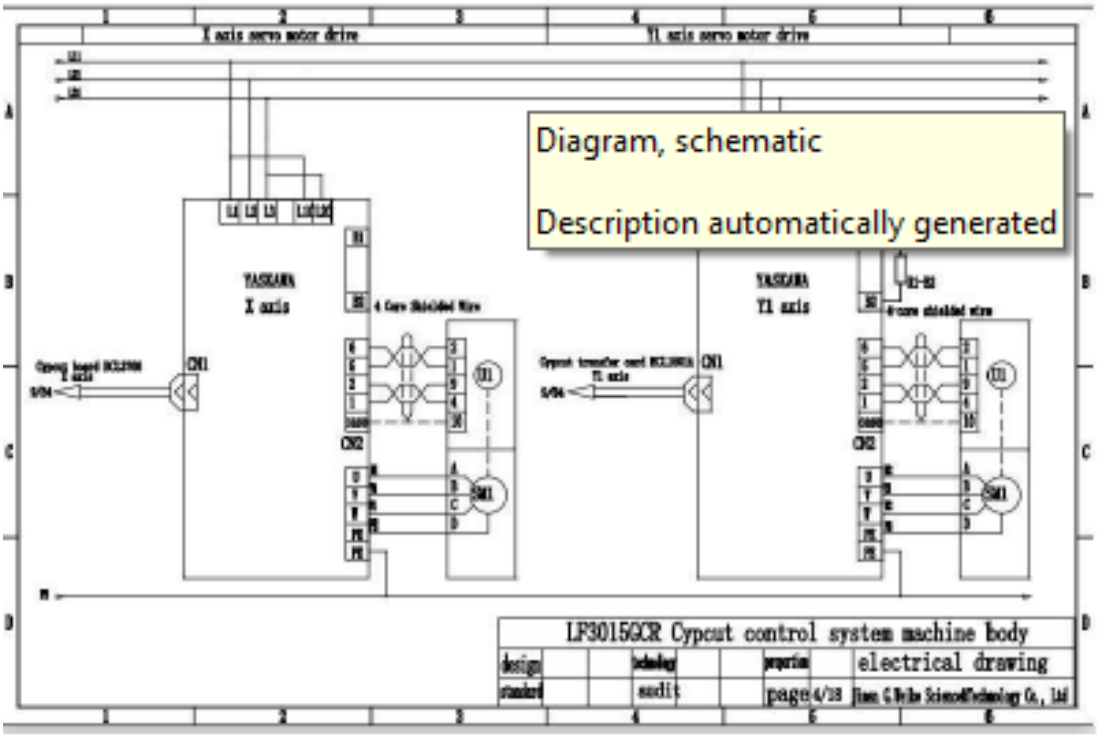
electrical drawing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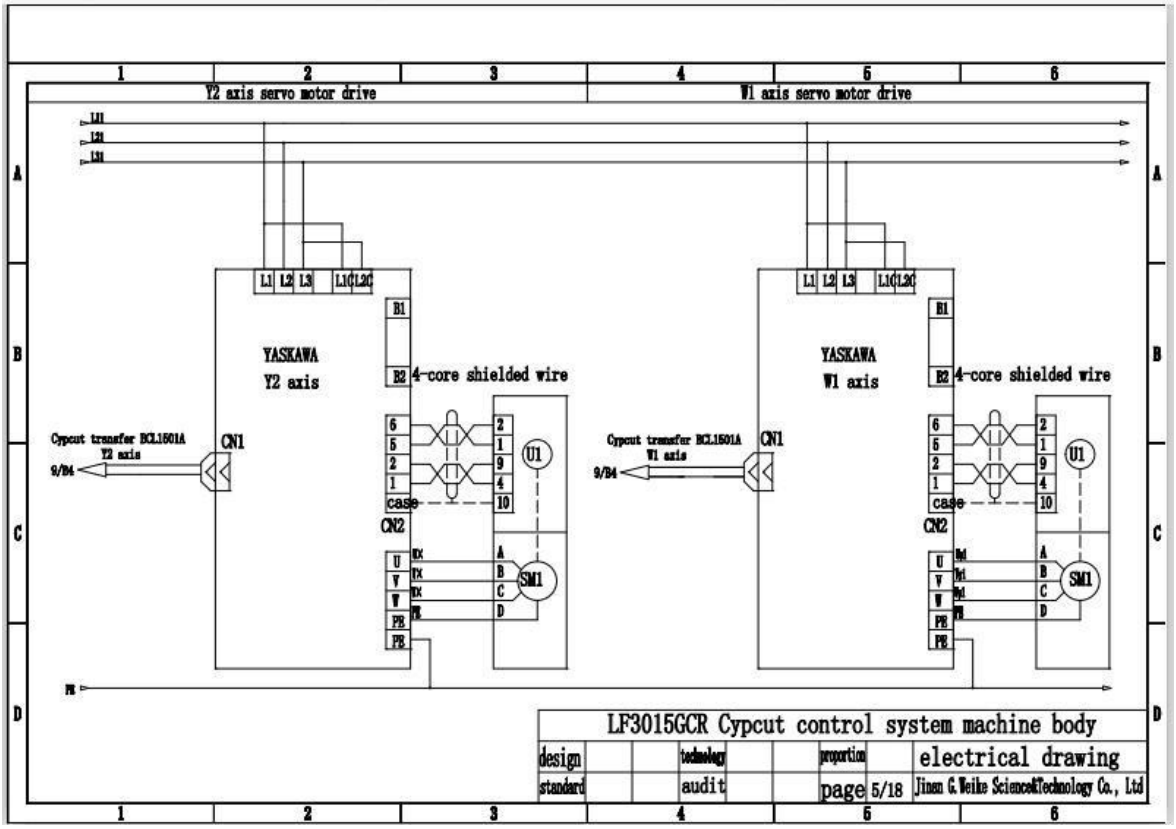
Y1 axis servo motor drive
Diagram, schematic
Description automatically generated
YASKAWA
X axis
YASKAWA
Y1 axis
LF3015GCR Cypcut control system machine body
electrical drawing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W1 axis servo motor drive
YASKAWA
Y2 axis
YASKAWA
W1 axis
4-core shielded wire
Cypcut transfer BCL1501A
Y2 axis
Cypcut transfer BCL1501A
W1 axis
CN1
CN2
U1
SM1
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electrical drawing
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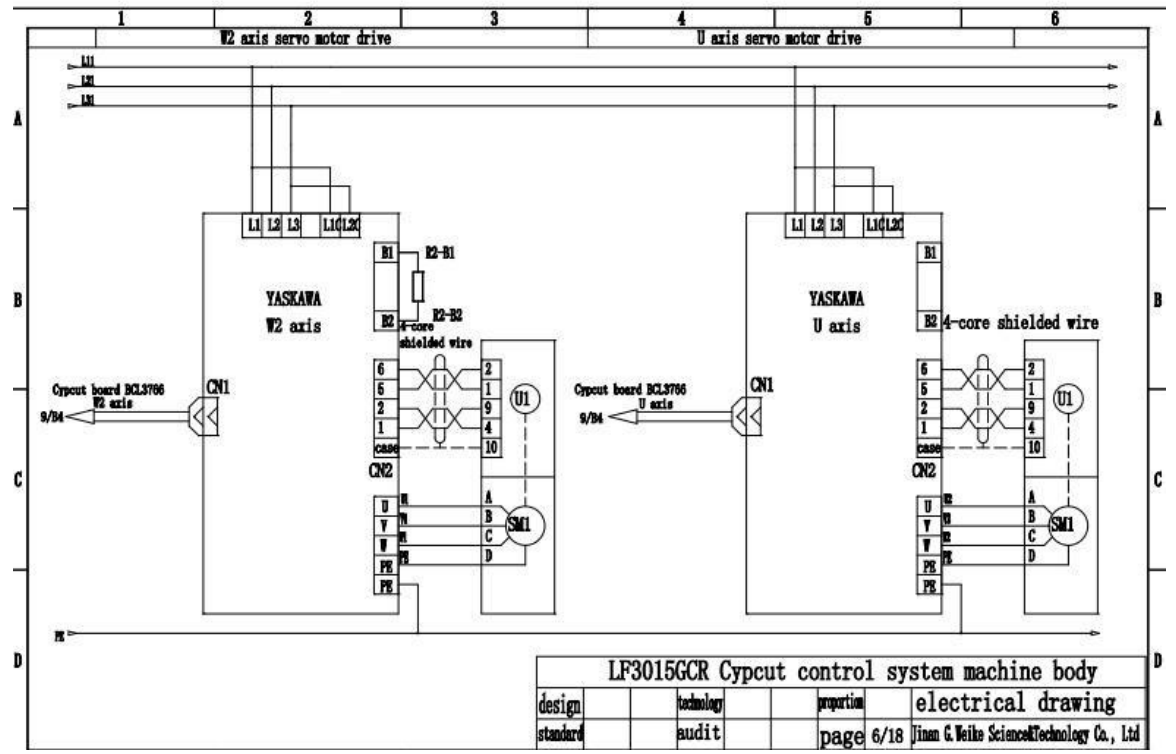
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U axis servo motor drive
YASKAWA
W2 axis
YASKAWA
U axis
4-core shielded wire
Cypcut board BCL3766
W2 axis
Cypcut board BCL3766
U axis
CN1
CN2
U1
SM1
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electrical drawing
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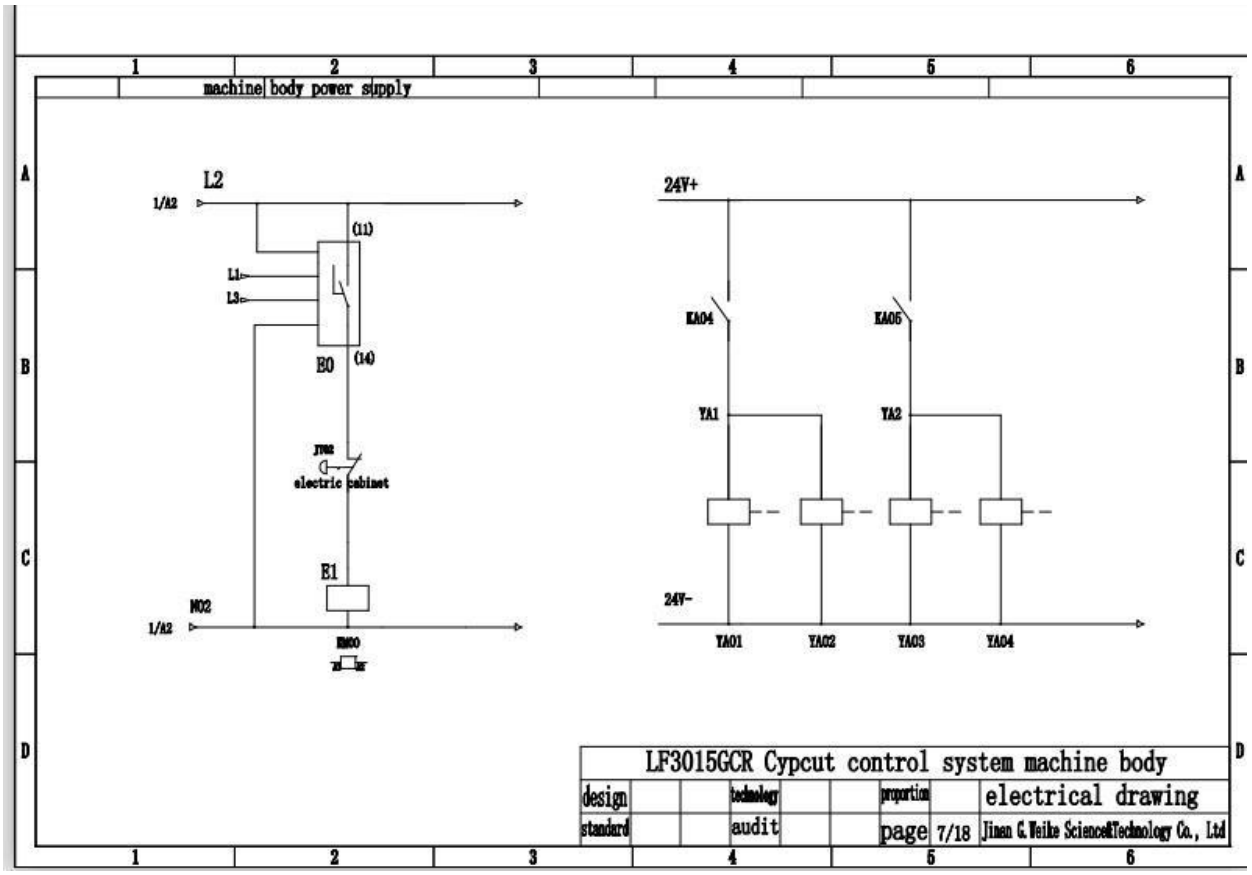
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1/A2
(11)
L1
L3
E0
(14)
electric cabinet
E1
N02
1/A2
24V+
KA04
KA05
YA1
YA2
24V-
YA01
YA02
YA03
YA04
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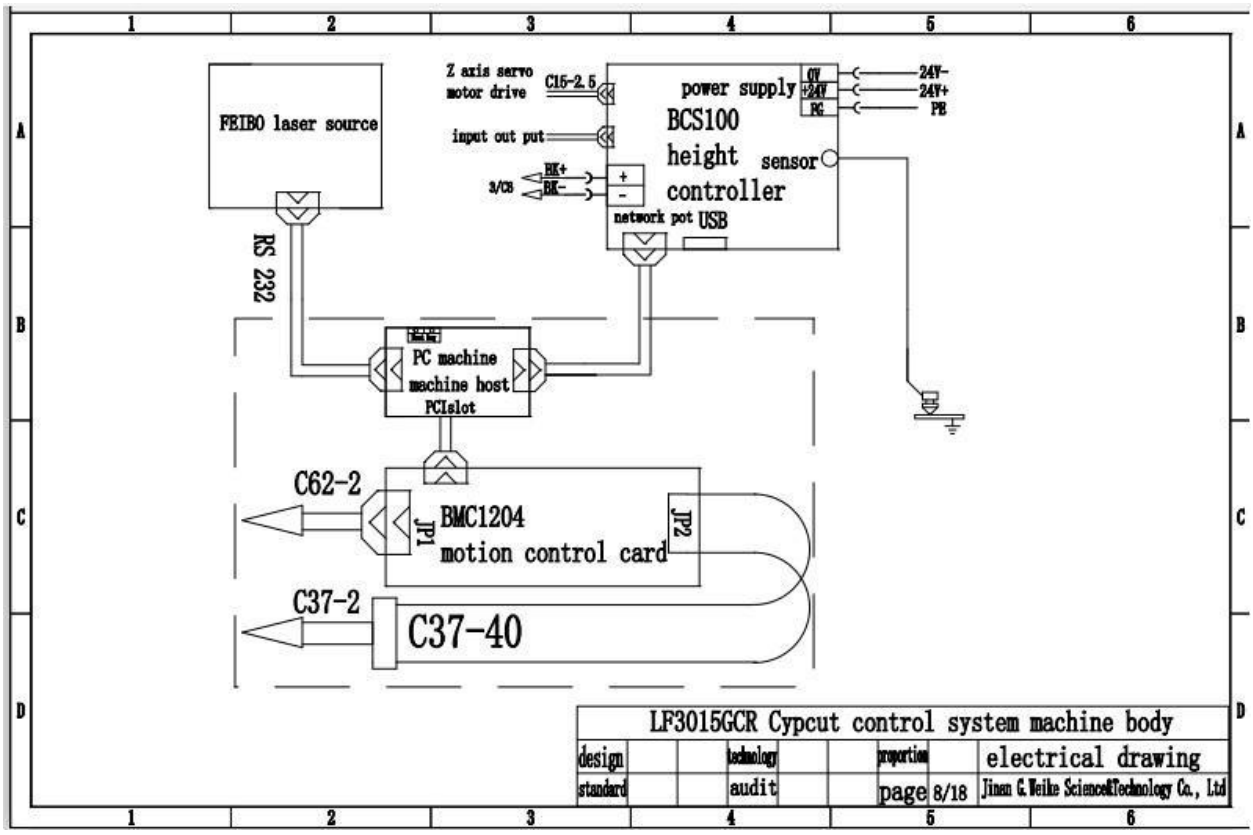
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Z axis servo motor drive
C15-2.5
input out put
power supply
BCS100
height sensor
controller
network pot USB
0V
+24V
PE
24V-
24V+
PE
RS 232
PC machine
machine host
PCIslot
C62-2
JP1
BMC1204
motion control card
JP2
C37-2
C37-40
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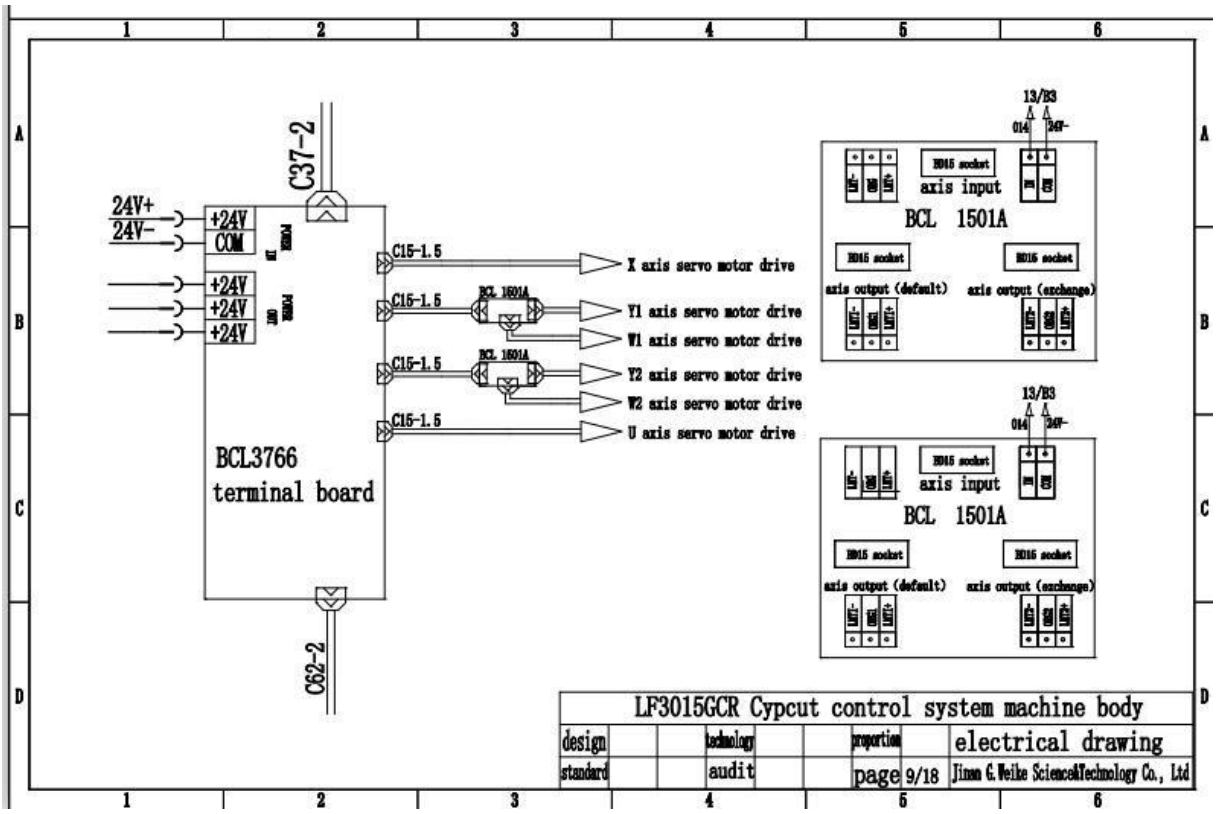
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24V+
24V-
+24V
COM
+24V
+24V
+24V
C15-1.5
C15-1.5
C15-1.5
C15-1.5
BCL 1501A
BCL 1501A
X axis servo motor drive
Y1 axis servo motor drive
W1 axis servo motor drive
Y2 axis servo motor drive
W2 axis servo motor drive
U axis servo motor drive
BCL3766
terminal board
C62-2
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34F-
axis input
BCL 1501A
axis output (default)
axis output (exchange)
13/B3
014
34F-
axis input
BCL 1501A
axis output (default)
axis output (exchange)
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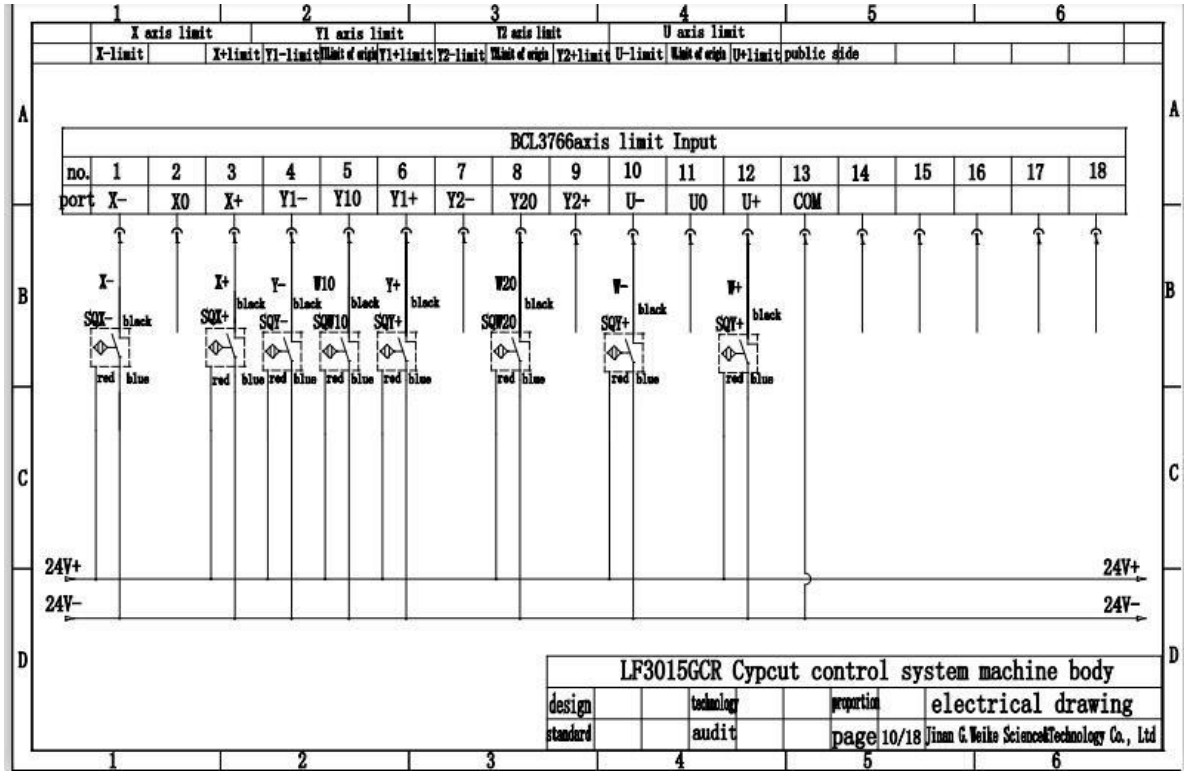
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Y1 axis limit
Y2 axis limit
U axis limit
X-limit
X+limit
Y1-limit
Y1+limit
Y2-limit
Y2+limit
U-limit
U+limit
public side
BCL3766axis limit Input
no. 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
port X- X0 X+ Y1- Y10 Y1+ Y2- Y20 Y2+ U- U0 U+ COM
X-
X+
Y-
W10
Y+
W20
W-
W+
SQX-
SQX+
SQY-
SQW10
SQY+
SQW20
SQY+
SQY+
black
red
blue
24V+
24V-
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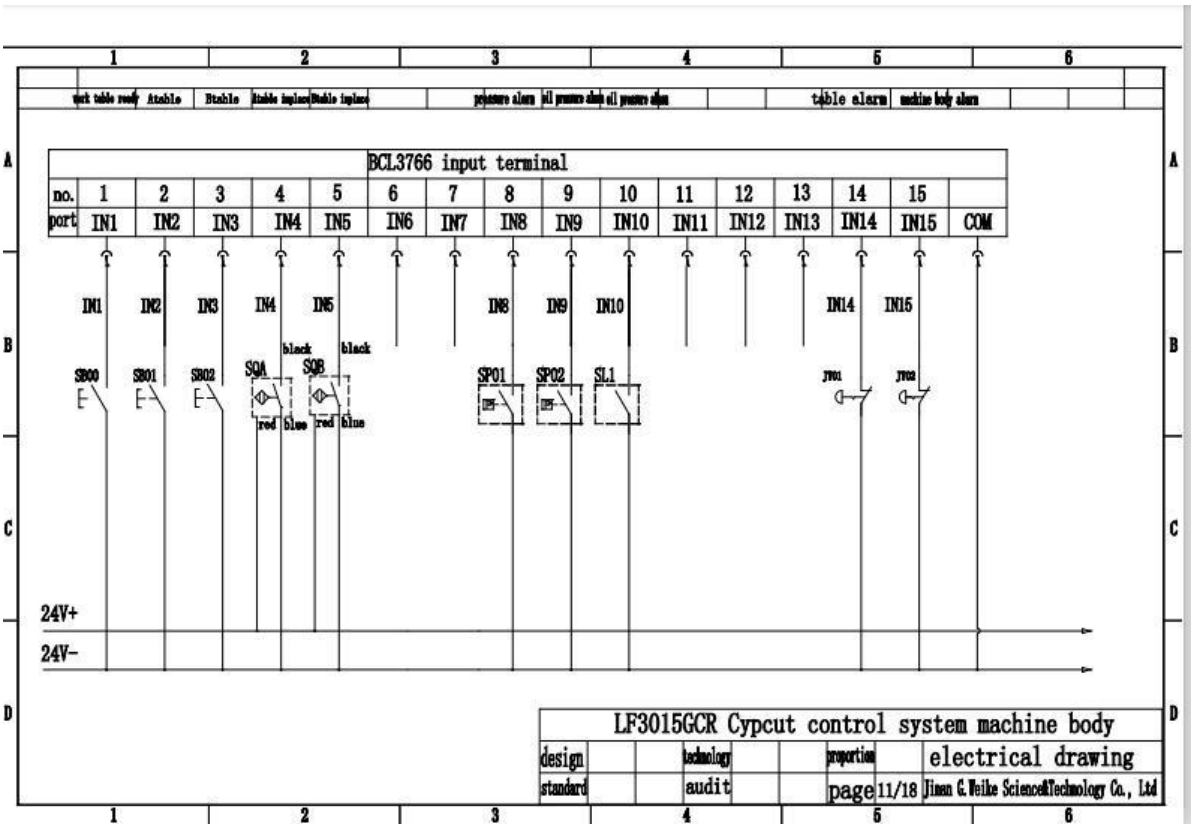
BCL3766 input terminal
no. 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
port IN1 IN2 IN3 IN4 IN5 IN6 IN7 IN8 IN9 IN10 IN11 IN12 IN13 IN14 IN15 COM
SB00 SB01 SB02 SQA SQB SP01 SP02 SL1
black black
red blue red blue
24V+
24V-
LF3015GCR Cypcut control system machine body
design technology proportion electrical drawing
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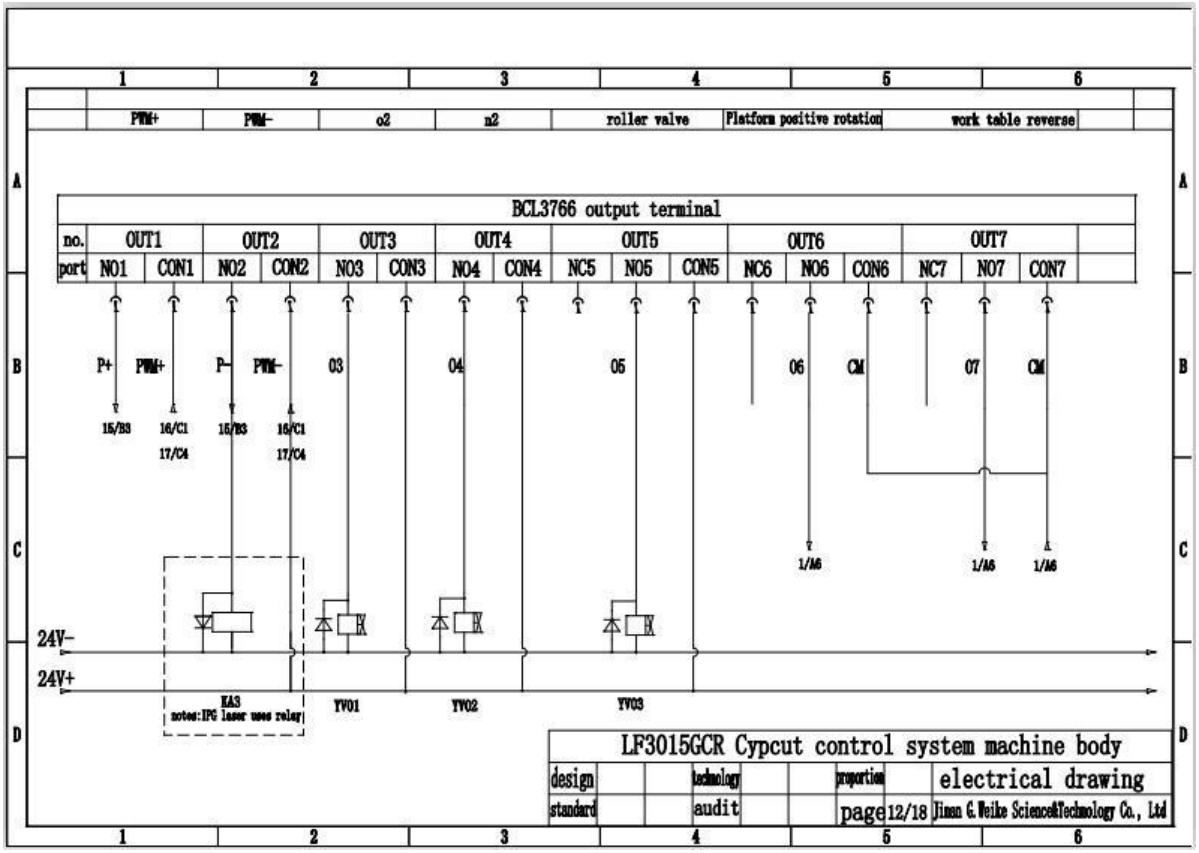
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BCL3766 output terminal
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port NO1 CON1 NO2 CON2 NO3 CON3 NO4 CON4 NC5 NO5 CON5 NC6 NO6 CON6 NC7 NO7 CON7
P+ PWM+ P- PWM- 03 04 05 06 CM 07 CM
15/B3 16/C1 17/C4 15/B3 16/C1 17/C4 1/A6 1/A6 1/A6
24V-
24V+
KA3
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YV01 YV02 YV03
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design technology proportion electrical drawing
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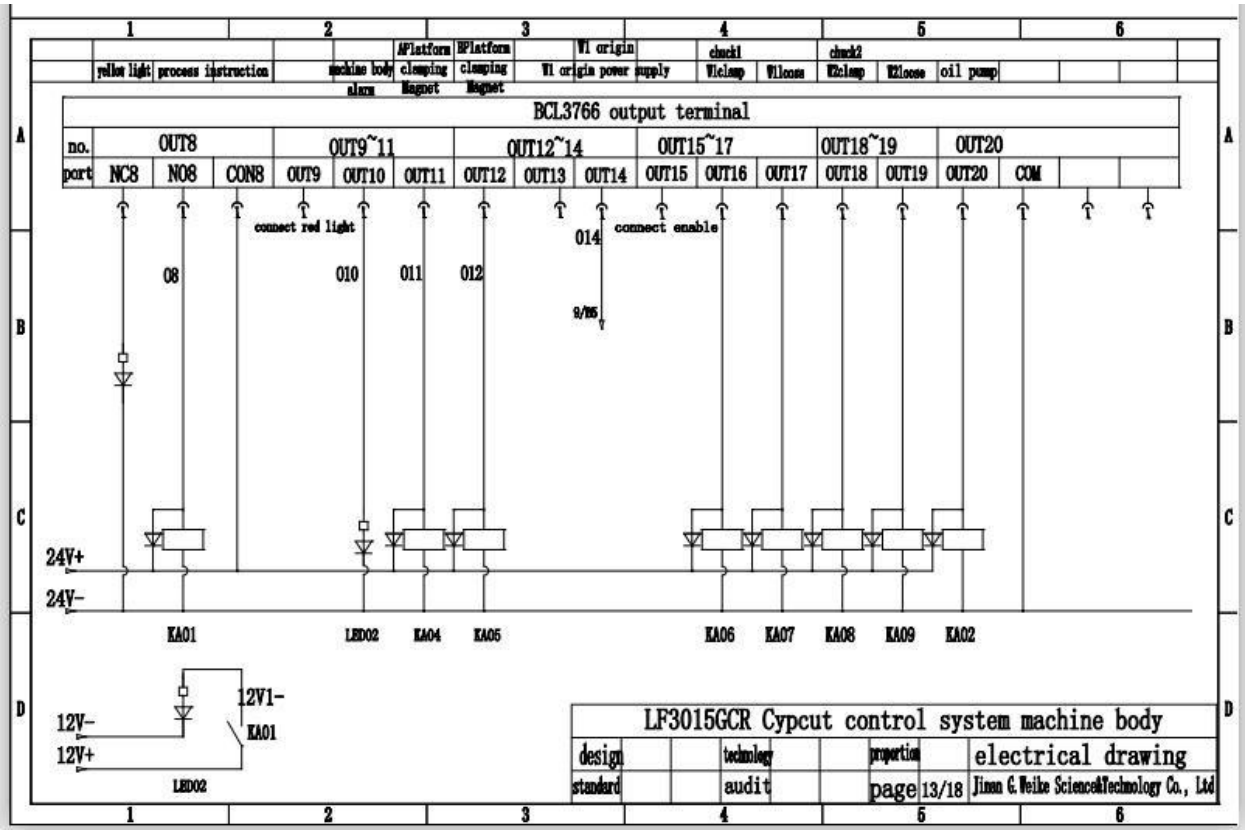
yellot light
process instruction
machine body alarm
APlatform clamping Magnet
BPlatform clamping Magnet
YL origin
YL origin power supply
chuck1
Yiclamp
Yiloose
chuck2
Ziclamp
Ziloose
oil pump
BCL3766 output terminal
no.
port
OUT8
NC8
NO8
CON8
OUT9~11
OUT9
OUT10
OUT11
OUT12~14
OUT12
OUT13
OUT14
OUT15~17
OUT15
OUT16
OUT17
OUT18~19
OUT18
OUT19
OUT20
OUT20
COM
connect red light
connect enable
08
010
011
012
014
24V+
24V-
KA01
LED02
KA04
KA05
KA06
KA07
KA08
KA09
KA02
12V1-
12V-
KA01
12V+
LED02
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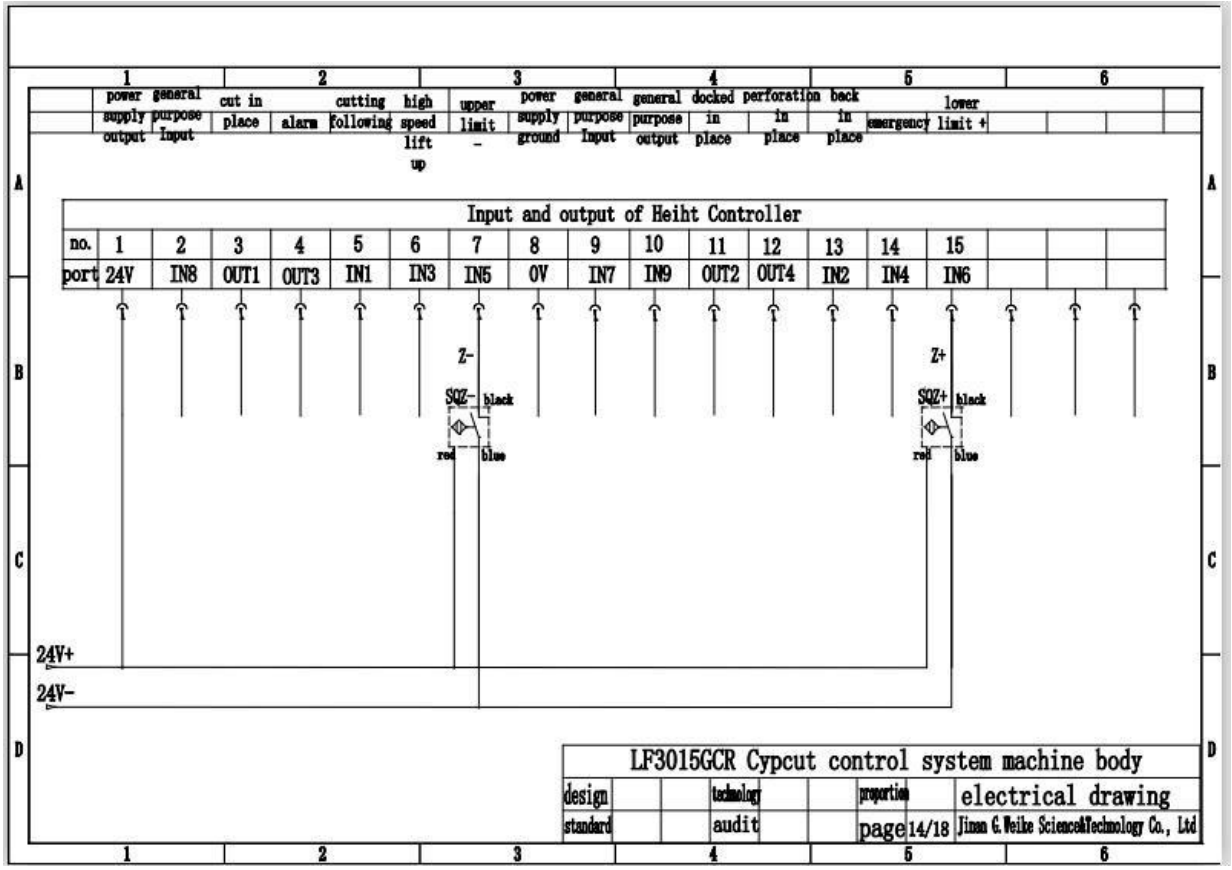
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general purpose Input
cut in place
alarm
cutting following
high speed lift up
upper limit -
power supply ground
general purpose Input
general purpose output
docked in place
perforation in place
back in place
lower emergency limit +
Input and output of Heiht Controller
no.
port
1 24V
2 IN8
3 OUT1
4 OUT3
5 IN1
6 IN3
7 IN5
8 0V
9 IN7
10 IN9
11 OUT2
12 OUT4
13 IN2
14 IN4
15 IN6
Z-
SQZ-
black
red
blue
Z+
SQZ+
black
red
blue
24V+
24V-
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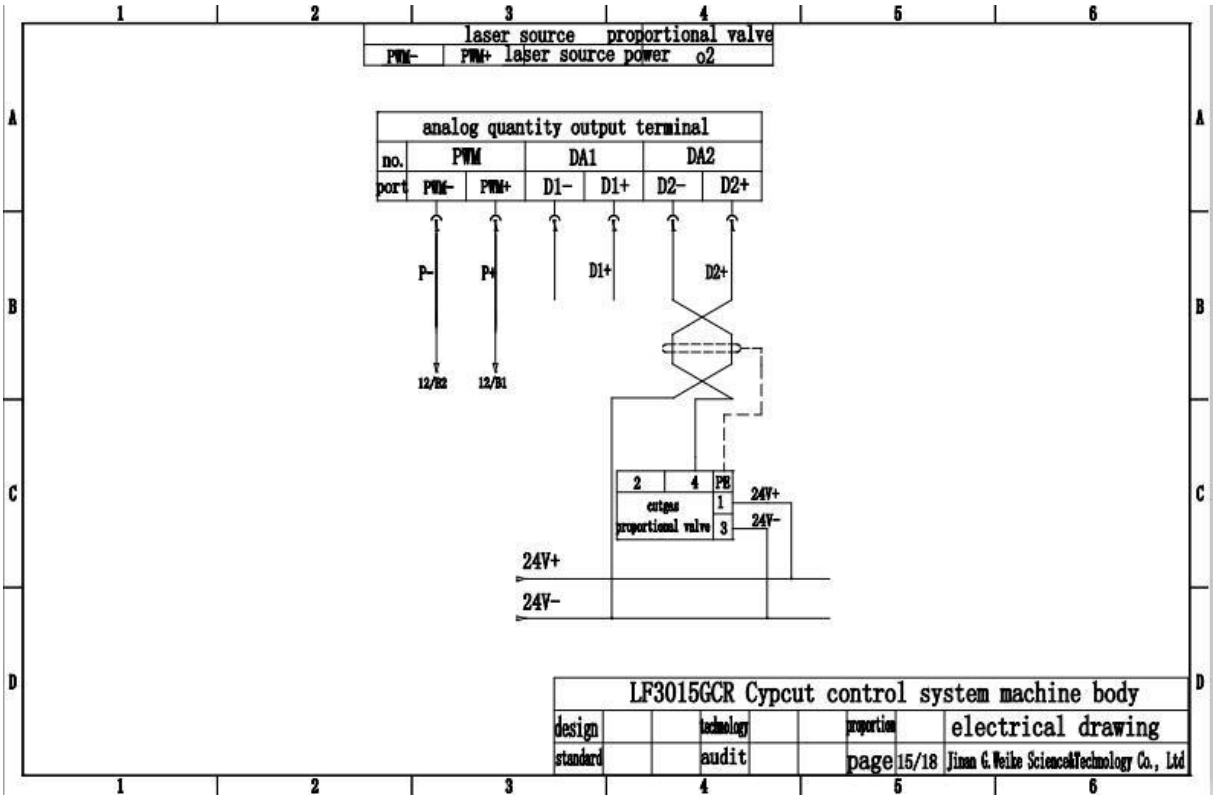
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PWM- PWM+ laser source power o2
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port PWM- PWM+ D1- D1+ D2- D2+
P- P+ D1+ D2+
12/B2 12/B1
2 4 PE
1
3
24V+
24V-
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design technology proportion electrical drawing
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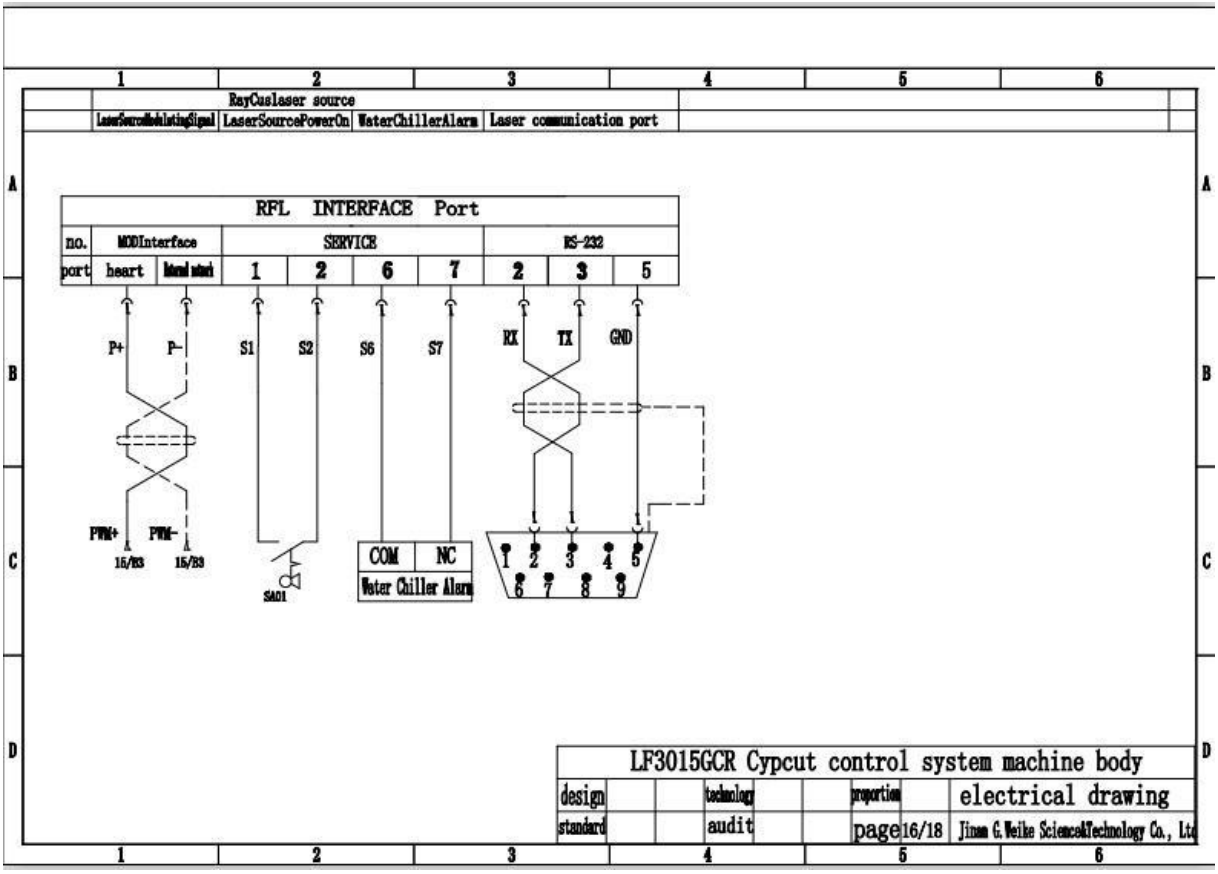
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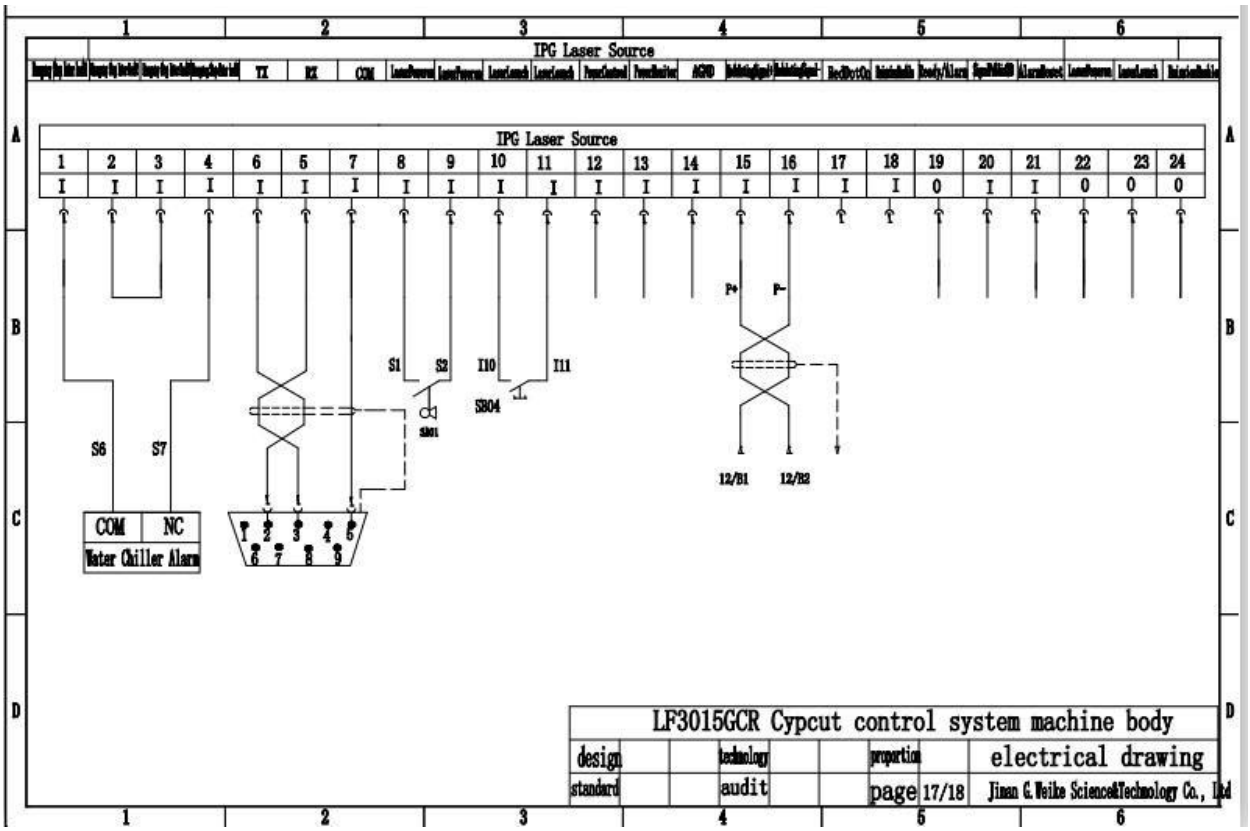
design technology proportion electrical drawing
standard audit page 16/18 Jinan G.Weike ScienceTechnology Co., Ltd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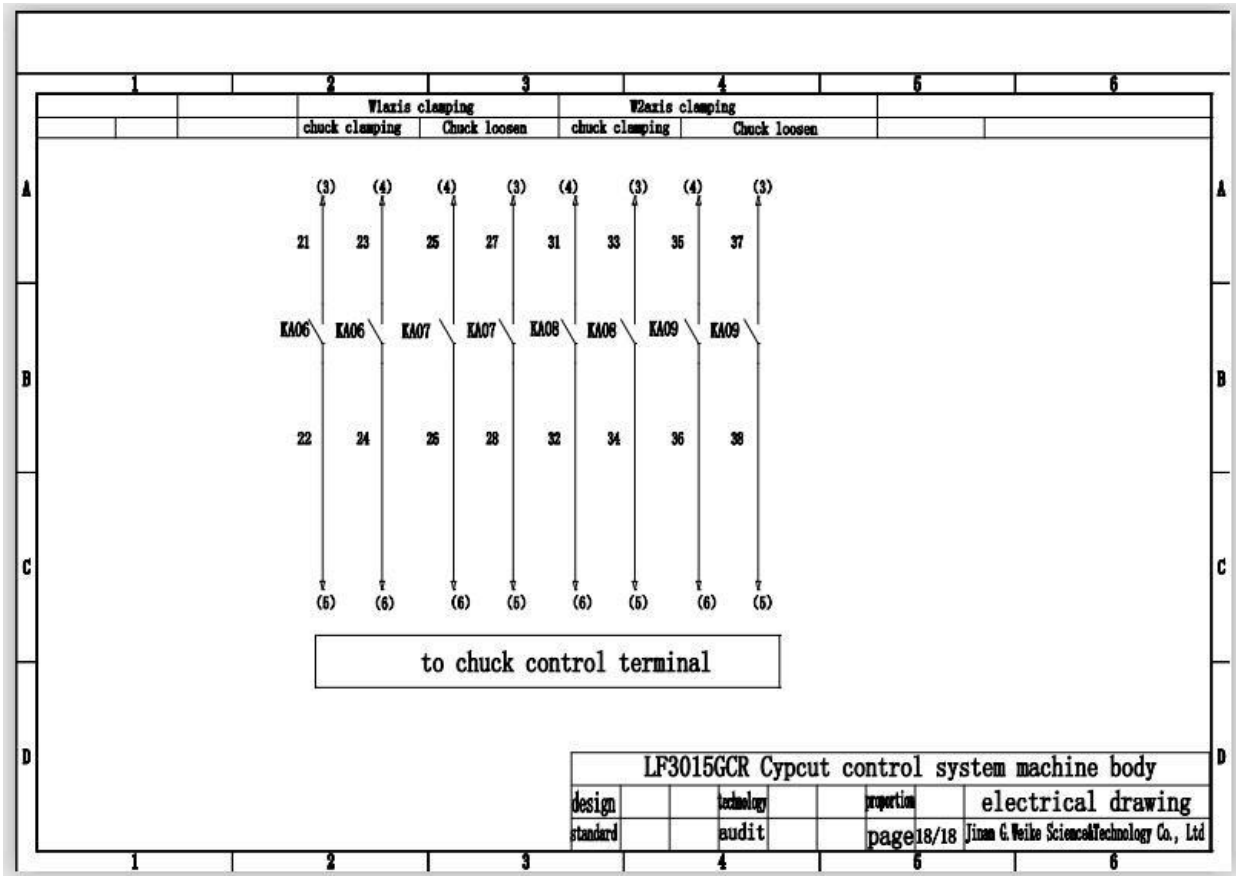
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LF3015GCR Cypcut control system machine body
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NOTES:

12.0 Warranties

Dealer Machinery Warranty

New woodworking machines sold by Laguna Tools carry a two-year warranty effective from the date of dealer invoice to customer/end-user. Machines sold through dealers must be registered with Laguna Tools within thirty (30) days of purchase to be covered by this warranty. Laguna Tools guarantees all new machines sold to be free of manufacturers' defective workmanship, parts, and materials. We will repair or replace, without charge, any parts determined by Laguna Tools, Inc. to be a manufacturer's defect. We require that the defective item/part be returned to Laguna Tools with the complaint. The end-user must request a Return Material Authorization (RMA) number from Customer Service. Include the RMA number with any and all returned parts/components requesting warranty coverage*. Any machines returned to Laguna Tools must be returned with packaging in the same manner in which it was received. A part or blade is being returned must have adequate packaging to ensure it is not damaged during shipping. In the event the item/part is determined to be damaged due to lack of maintenance, cleaning, or misuse/abuse, the customer will be responsible for the cost to replace the item/part, plus all related shipping charges. This limited warranty does not apply to natural disasters, acts of terrorism, normal wear and tear, product failure due to lack of maintenance or cleaning, damage caused by accident, neglect, lack of or inadequate dust collection, misuse/abuse or damage caused where repair or alterations have been made or attempted by others.

* The issue of an RMA number is for reference only; it DOES NOT indicate acceptance of the warranty claim.

CNC Limited Warranty

New CNC machines sold by Laguna Tools carry a one-year warranty effective from the date of shipping. Laguna Tools guarantees all new machines sold to be free of manufacturers' defective workmanship, parts, and materials. We will repair or replace, without charge, any parts determined by Laguna Tools, Inc. to be a manufacturer's defect. If the defective item/part is determined to be damaged due to lack of maintenance, cleaning or misuse/abuse, the customer will be responsible for the cost to replace the item/part, plus all related shipping charges. This limited warranty does not apply to natural disasters, acts of terrorism, normal wear and tear, product failure due to lack of maintenance or cleaning, damage caused by accident, neglect, lack of or inadequate dust collection, misuse/abuse or damage caused where repair or alterations have been made or attempted by others.

Laguna Tools, Inc. is not responsible for additional tools or modifications sold or performed (other than from/by Laguna Tools, Inc.) on any Laguna Tools, Inc. woodworking machine. Warranty may be voided upon the addition of such described tools and/or modifications, determined on a case-by-case basis. Software purchased through Laguna Tools, Inc., is not covered under this warranty and all technical support must be managed through the software provider. Normal user alignment, adjustment, tuning, and

machine settings are not covered by this warranty. It is the responsibility of the user to understand basic woodworking machinery settings and procedures and to properly maintain the equipment in accordance with the standards provided by the manufacturer.

Parts under warranty are shipped at Laguna Tools, Inc.'s cost either by common carrier, FEDEX ground service, or a similar method. Technical support to install replacement parts is primarily provided by phone, fax, e-mail or Laguna Tools Customer Support Website. The labor required to install replacement parts is the responsibility of the user. Laguna Tools is not responsible for damage or loss caused by a freight company or other circumstances not in our control. All claims for loss or damaged goods must be notified to Laguna Tools within twenty-four (24) hours of delivery.

Please contact our Customer Service Department for more information. Only NEW machines sold to the original owner are covered by this warranty.

Consumables such as nozzles, protective lenses, and ceramic insulations are not covered under warranty. Use of aftermarket consumables that are not Raytec or Presitec will void your head warranty with Laguna Tools.

For warranty repair information, call 1-800-332-4094.

No Modifications Allowed or Sold

Laguna Tools, Inc. is not responsible for additional tools or modifications sold or performed (other than from/by Laguna Tools, Inc.) on any Laguna Tools, Inc. woodworking machine. Warranty may be voided upon the addition of such described tools and/or modifications, determined on a case-by-case basis. Normal user alignment, adjustment, tuning, and machine settings are not covered by this warranty. It is the responsibility of the user to understand basic woodworking machinery settings and procedures and to properly maintain the equipment in accordance with the standards provided by the manufacturer. Parts, under warranty, are shipped at Laguna Tools, Inc.'s cost either by common carrier, FEDEX ground service or a similar method. Technical support to install replacement parts is primarily provided by phone, fax, e-mail, or Laguna Tools Customer Support Website. The labor required to install replacement parts is the responsibility of the user. Laguna Tools is not responsible for damage or loss caused by a freight company or other circumstances not in our control. All claims for loss or damaged goods must be notified to Laguna Tools within twenty-four (24) hours of delivery. Please contact our Customer Service Department for more information. Only new machines sold to the original owner are covered by this warranty.

For warranty repair information call 1-800-332-4094.

Laguna Tools Warranty

WARRANTY & REGISTRATION

THANK YOU!

Welcome to the Laguna Tools® group of discriminating woodworkers. We understand that you have a choice of where to purchase your machines and appreciate the confidence you have in the Laguna Tools® brand.

Through hands-on experience, Laguna Tools® is constantly working hard to make innovative, precision products. Products that inspire you to create works of art, are a joy to operate, and encourage your best work.

Laguna Tools®
Imagination, Innovation, and Invention at Work

WARRANTY & REGISTRATION

Every product sold is warranted to be free of manufacturers' defective workmanship, parts, and materials. For any questions about this product, the intended use or what it was designed for, customer service, or replacement parts, please contact our customer service department:

Laguna Tools® Customer Service
2072 Alton Parkway, Irvine, California 92606, USA
1-800-332-4049
customerservice@lagunatools.com
www.lagunatools.com/why/customer-service/
8AM. to 5PM PST, Monday through Friday

For warranty claims or to report damage upon receiving – please reach out to our warranty department:

Laguna Tools® Warranty Service
2072 Alton Parkway, Irvine, California 92606, USA
1-949-474-1200
customerservice@lagunatools.com
www.lagunatools.com/rpolicies/warranty
8AM to 5PM PST, Monday through Friday

REGISTRATION

To prevent voiding this warranty, all products sold must be registered within thirty (30) days of receiving the product. Registering the product will enable the original purchaser to receive notifications about important product changes, receive customer service, and be able to file a warranty claim against defective workmanship, parts, or materials.

REGISTER HERE!
https://lagunatools.com/policies/warranty/

WHO IS COVERED

The applicable warranty covers only the initial purchaser of the product from the date of receiving the product. To file such claims, the original purchaser must present the original receipt as proof of purchase.

WHAT IS COVERED

The warranty covers any defects in the workmanship of all parts and materials that make up the machine unless otherwise specified. Any part, determined by Laguna Tools®, to have a defect will be repaired or replaced (and shipped), without charge. The defective item/part must be returned to Laguna Tools® with the complaint and proof of purchase in the original packaging that it was received in. In the event the item/part is determined to be not covered by this warranty, the customer will be responsible for the cost to replace the item/part and all related shipping charges.

WARRANTY LIMITATIONS

This limited warranty does not apply to natural disasters, acts of terrorism, normal wear and tear, product failure due to lack of maintenance or cleaning, damage caused by accident, neglect, or lack-of inadequate dust collection. The warranty may be voided against proof of misuse/abuse, damage caused where repair or alterations have been made or attempted by others, using the product for purposes other than those described as intended use (unless with consent by Laguna Tools®), modification to the product, or use with an accessory that was not designed for the product. It is the responsibility of the user to understand basic woodworking machinery settings and procedures and to properly maintain the equipment in accordance with the standards provided in this manual.

LENGTH OF WARRANTY

All new machines and optional accessories sold through an authorized dealer carry a two-year warranty effective the date of receiving the product. Machines sold for either commercial or industrial use have a one-year warranty. Wearable parts like throat plates, bandsaw guides, etc., have a ninety-day warranty.

Table A-1 Warranty Lengths

2 Year – New Machines Sold Through an Authorized Dealer
2 Year – Accessories Sold as Machine Options (excluding blades)
1 Year – Machines Sold for Commercial or Industrial Use
1 Year – Blades and Accessories outside of Machine Options
90 Days – Wearable Parts

Aside from being free of defects upon receiving, consumable parts, like cutters and abrasives, are not covered by this warranty unless otherwise stated by Laguna Tools®. These parts are designed to be used at the expense of the operator and are available for replacement or inventory purchase. The determination of a consumable part will be made on a case-by-case basis by Laguna Tools®.

SHIPPING DAMAGE

Laguna Tools® is not responsible for damage or loss caused by a freight company or other circumstances not in the direct control of Laguna Tools®. All shipping-related claims for loss or damage goods must be made to Laguna Tools within twenty-four hours of delivery.

HOW TO RECEIVE SUPPORT

To file a warranty-claim please contact the warranty department at 1-949-474-1200. To receive customer service or technical support please contact the customer service department at 1-800-332-4094. Parts, under warranty, are shipped at the expense of Laguna Tools® either by common carrier, FedEx ground services or similar method. Technical support to install replacement parts is primarily provided by phone, fax, email, or the Laguna Tools Customer Support Website.

LAGUNA

Laguna Tools, Inc.
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Grand Prairie, TX 75050
800-234-1976
www.lagunatools.com