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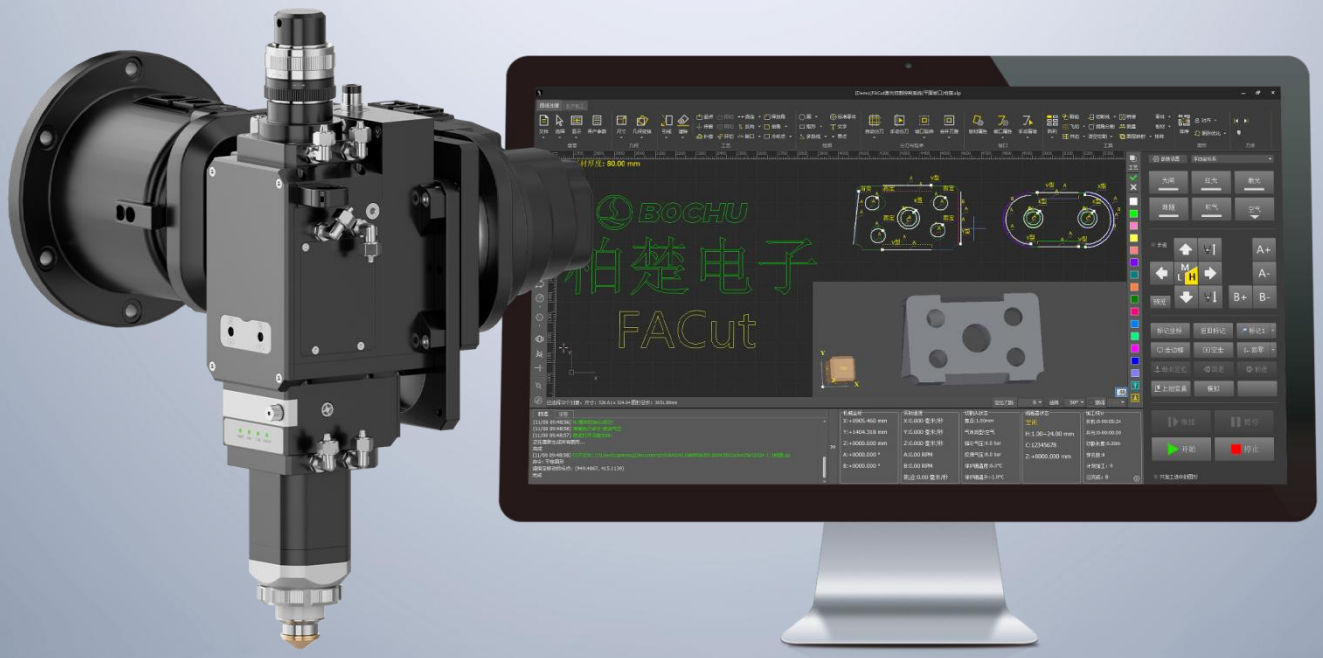

FSCUT9100

Installation User Manual

System: 9100

Software version: V1.12.2403.6

Document version: V1.5.0

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Foreword

Thank you for using Bochu's FSCUT9100 Bevel Laser Cutting Control System!

Bochu's FSCUT9100 Bevel Laser Cutting Control System (hereinafter referred as 9100 system) is a laser cutting system for bevels, featuring high precision and high efficiency. Its main functions include Visual Calibration, Pendulum Length Correction, Parameters Modification, Custom PLC, Simulation and accurate control for laser cutting.

Please note that this manual is only an instruction for the installation and wiring of 9100 system. For other tools or details required advanced permissions, please refer to other manuals or contact our technical support.

This user manual is written based on the 1.12.2403.6 version. Due to the continuous update of system functions, the 9100 system you are using may differ in some aspects from the statements in this manual. We've tried our best to ensure that the content of the user manual is applicable, but reserves the right of final interpretation. Changes in the content of this manual will not be explicitly notified.

Any questions or suggestions during use please contact us through the information provided.

Convention Symbol Explanation

Notice：Supplementary or explanatory information for the use if this product.

Caution：If not operated as specified, it may result in minor physical injury or equipment damage.

Warning：If not operated as specified, it may lead to death or serious physical injury.

Danger：If not operated as specified, it will cause death or serious physical injury.

Declaration

Operation of the machine tool and the laser cutting effect may directly relate to the material being cut, the laser used, the gas used, the gas pressure, and the various parameters you set. Please set various parameters carefully according to your cutting process requirements!

Improper parameter settings and operations may lead to poor cutting effect, damage to the laser head, or other machine tool components, and even personal injury. FSCUT9100 Bevel Laser Cutting Control System has tried its best to provide various protection measures. Laser equipment manufacturers and end users should try to follow operating procedures to avoid the occurrence of injury accidents.

Bochu do not bear any direct, indirect, incidental and/or consequential losses and liabilities resulting from improper use of this user manual or this product!

Revision History

Version No.	Date	Description
V1.4	2024/04/09	● Updated 1.2 Product Details. ● Added descriptions about HypTronic3 and BCL4568E.
V1.5	2024/10/14	● Updated 4 FACut Config ● Updated the map for 1.4 BCL4568E Wiring.

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Chapter 1 Overview

1.1 Introduction

FSCUT9100, a high-power EtherCAT CNC system specialized for 2D bevel cutting, is developed based on EtherCAT bus technology. The system is a perfect solution for high-end laser bevel-cutting CNC machine tools. This manual is for installation guidance only. For software usage and other information, please refer to the *FACut User Manual*.

1.2 Product

FSCUT9100 bus CNC system consists of HypTronic3 industrial host computer, BCL4568E IO board, WKB V6H wireless controller, BCS height adjuster, and related cables.

Table 1-1 FSCUT9100 Accessories

HypTronic3 Industrial Host Computer (1)	BCL4568E IO Board (1)	WKB V6H Wireless Controller (1)
		
PWE Cable (1)	**Network Cables (Several)**	
		

Notice: 9100 system is recommended to equip with a BOCI BLT bevel-cutting head. BCL4568E integrates a BLT specialized height adjuster module, which can work with our BLT series cutting head to realize the functions of height auto-tracking, auto-focusing, flash piercing, edge-seeking cutting, thick plate vibration suppression, and smooth micro-joint. For cutting heads of other brands, please use the BCS100E/E_PRO height adjuster and related cables.

Chapter 2 Wiring Instruction

2.1 HypTronic3 Wiring

HypTronic3 is a bus CNC host computer based on EtherCAT technology. The host computer is developed on the basis of EtherCAT bus technology, which has excellent performance and anti-interference capability.

Table 2-1 HypTronic3_3830E Technical Data

HypTronic Industrial Control Computer	
Processor	**12th Intel i3 (4 cores and 8 threads)** *12th Intel i7 (12 cores and 20 threads) for HypTronic3_3870E
Graphics Card	Intel UHD Graphics 730 *Intel UHD Graphics 770 for HypTronic3_3870E
RAM	8GB DDR4 *16GB DDR4 for HypTronic3_3870E
Drive	SSD 512GB
Real Time Ethernet Protocol	ECAT integrates EtherCAT master protocol
Network	4x Gigabit Ethernet interfaces
USB	8x USB3.0
Power	DC24V 3A (typical)，maximum 6A
Display	HDMI (DVI digital signal compatible)
Operating System	Windows 10 IOT LTSC（64-bit）
Power Consumption	Up to 144W
Dimension	337.4x220.4x70.5mm
Weight	2kg
Protection	IP20
Cooling	Air Cooling
Temperature	0~60℃

2.1.1 Interface Layout

The interface layout of HypTronic3 is shown in the figure below.

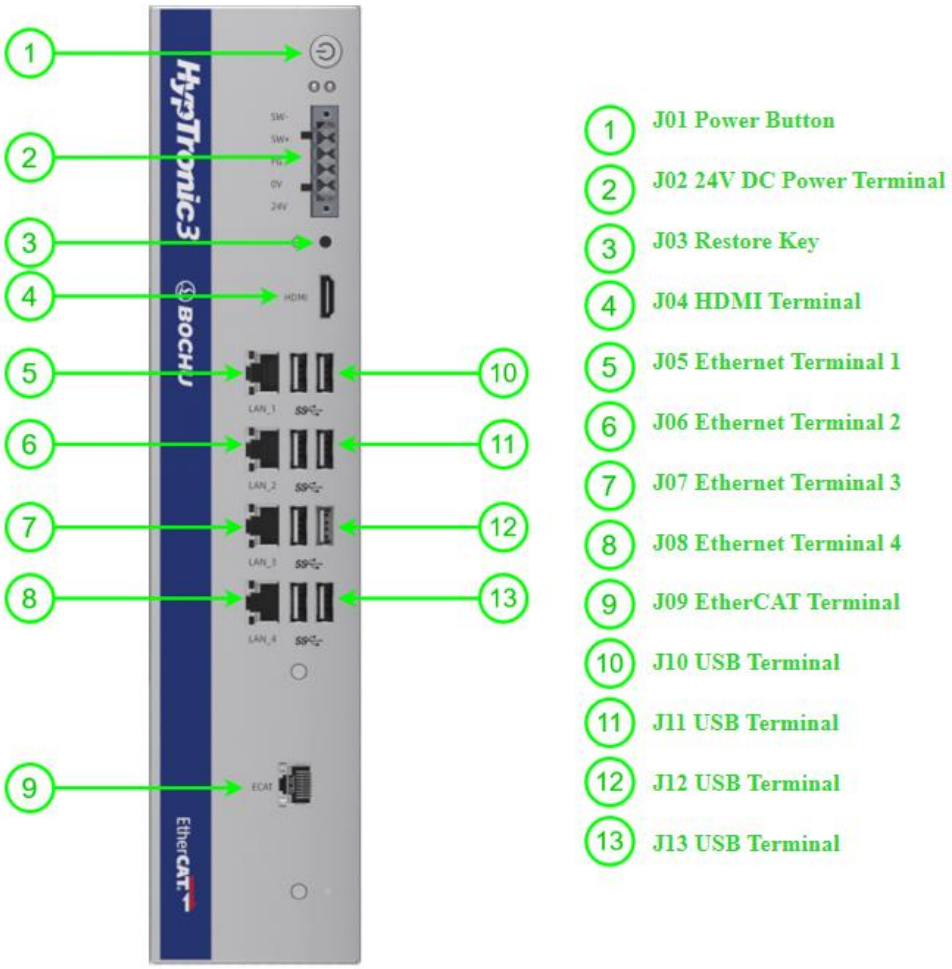


Figure 2-1 HypTronic3 Interface Layout

2.1.2 J01 Power Button

J01 is the power button of the host. When connected to 24V power, the host will boot up by default, or can be turned on/off by pressing this button.

2.1.3 J02 Power Terminal

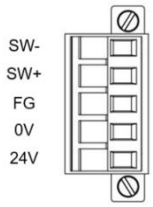


Figure 2-2 Top View of the Power Terminal

Detailed descriptions of the power supply terminals are shown in the table below.

Table 2-2 J02 Power Terminal

Pin	Description	Wiring
SW-	Power button, negative, (0V short-circuited)	Automatic reset switch (normally open type).
SW+	Power button, positive	
FG	Shield ground, case ground	Must be well grounded, ground wire has to be short and thick, grounding resistance no more than 4 Ω.
0V	24V power ground	Connect to 24V switch power supply.
24V	24V power positive	

2.1.4 J03 Restore Key

J03 is the restore button of the Host. You can enter the restore interface by long pressing this button when the device is turned on. This key has an anti-touch design, and can be pressed with a screwdriver, tweezers, or others.

You can also enter the restore interface by pressing the key ***ALT+F3*** in the BIOS interface, see Quick Start for more details.

2.1.5 J04 HDMI Terminal

J04 is a standard HDMI interface, compatible with DVI digital signals (using HDMI to DVI adapters to connect to DVI digital interface displays), but incompatible with analog signals such as VGA, and DVI-A.

2.1.6 J05/06/07/08 Ethernet Terminal

J05/06/07/08 are standard RJ45 interfaces that can be used to connect network devices (such as webcams, lasers with network communication, etc.), switches, and so on.

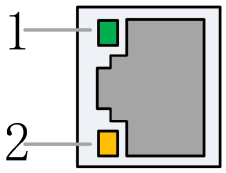


Figure 2-3 Terminal RJ45

The table below demonstrates the different connection statuses suggested by the LED status of the network terminal RJ45.

Table 2-3 RJ45 Connection Description

Label	Description	LED Color	Status	Description
1：Speed	Ethernet Connection Speed	Green	Off	10 Mbps Connection
			Off	100 Mbps Connection
		Orange	On	1000 Mbps Connection
2：Link	Ethernet Link Status	Yellow	Off	No Connection
			Blink	Connecting
			On	Connected

The standard network port should be connected with a network cable as required by the equipment, and it is recommended to use a shielded network cable of category 5 or above.

2.1.7 J09 EtherCAT Communication Terminal

J09 terminal, defined as an EtherCAT interface, is a standard RJ45 interface that can be used to connect EtherCAT slaves (such as servo drives, BCS100E, HPL2720E, etc.).

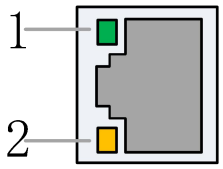


Figure 2-4 Terminal RJ45

The table below demonstrates the different connection statuses suggested by the LED status of the network terminal RJ45.

Table 2-4 RJ45 Connection Description

Label	Description	LED Color	Status	Description
1：Link	EtherCAT Bus Connection and Communication Status	Green	Off	No Connection
			On	Connected, No Communication
			Blink	Connected, with Communication
2：Status	EtherCAT Bus Link Status	Yellow	Off or Blink	Not in the OP State
			On	In the OP State

2.1.8 J10/11/12/13 USB Terminal

J10/11/12/13 are standard USB 3.0 interfaces that can be used to connect to USB devices.

Notice: When a longer USB extension cable is required, please choose an externally powered USB extension cable with a driver enhancement chip.

2.1.9 Wiring

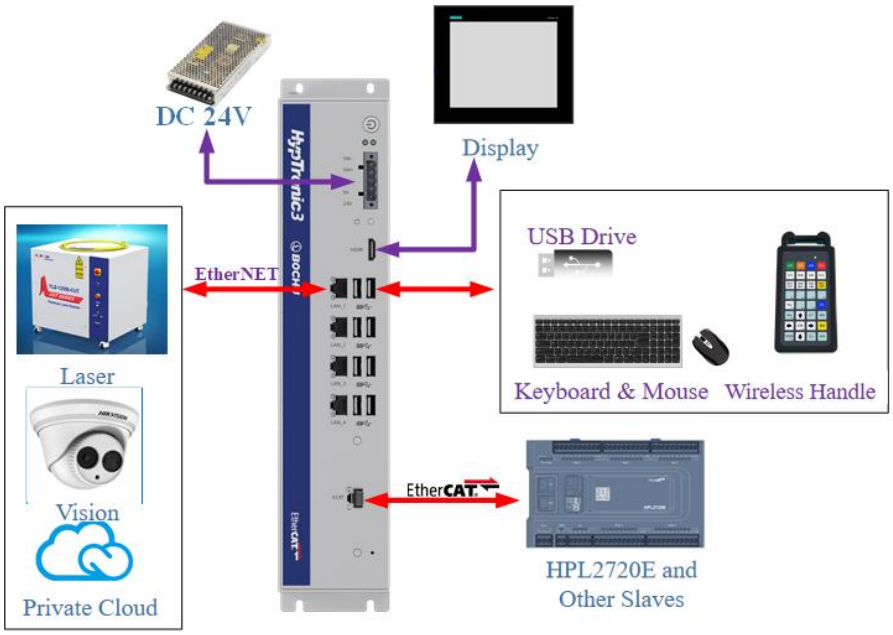


Figure 2-5 Wiring

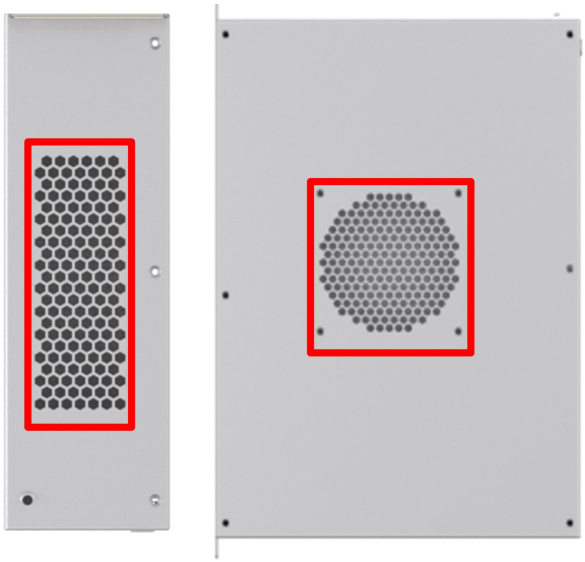


Figure 2-6 Cooling Holes

⚠ Caution: Regions marked with red boxes are cooling holes for ventilation and heat dissipation, do not cover!

2.2 BCL4568E Wiring

BCL4568E is an IO expansion board based on an EtherCAT bus, which can be connected with the peripheral resources required by the FSCUT9100 high-power cutting system.

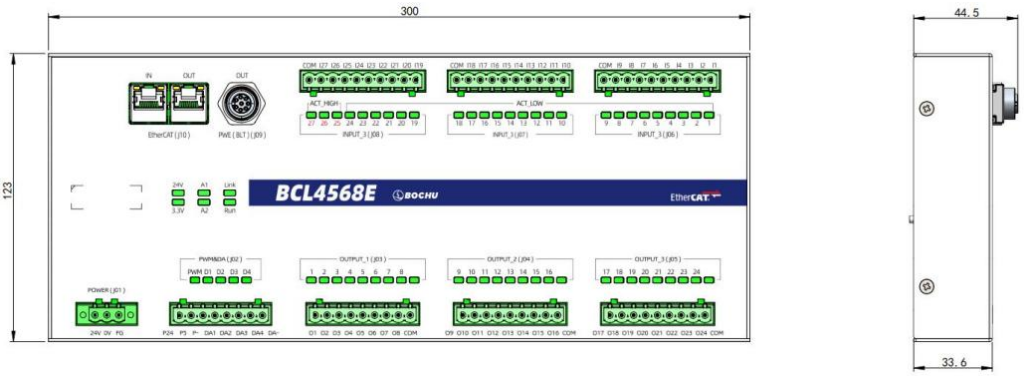


Figure 2-7 BCL4568E Dimension (mm)

The table below shows the hardware resources of BCL4568E.

Table 2-5 BCL4568E Hardware Resources

BCL4568E	

Module	Qty.	Description	Note
Power	/	24V DC /6A	
DA	4	0-10V, 12bit, accuracy: 50mV	
PWM	2	5V and 24V, accuracy: 5kHz 0.3%	Top to 50kHz， 3%
General Purpose Output	24	24V active high 1. The current of single output ≤ 0.7A 2. The current of all output ≤2.5A	
Dedicated Input	27	IN1-IN24, low level effective, 0~15V IN25-IN27, high level effective, 24~8V	Low level: 19~24V invalid High level: 0~4V invalid

Module	Qty.	Description	Note
Working Environment	/	Temperature: 0℃~60℃	
		Humidity: 10%~90%RH (no condensation)	
Dimension	/	300mm×123×34mm	
Weight	/	913g	

2.2.1 Interface Layout

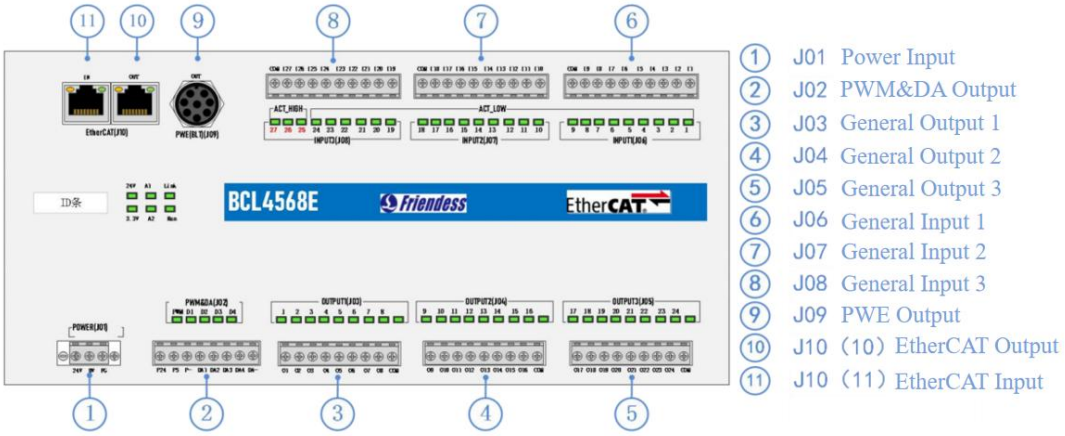


Figure 2-8 Detailed Interface Layout of BCL4568E Terminal

2.2.2 J01 Power Terminal

The machine's shell is the negative terminal of the capacitor measured. To ensure stable operation of the measuring circuit, the ***FG*** pin of the power supply interface must conduct well with the machine shell, and the preamplifier shell of the BCL4568E must also conduct well with the machine shell. Specific indicators are: DC resistance should always be less than 10 Ω, otherwise it might not be effective for electromagnetic compatibility.

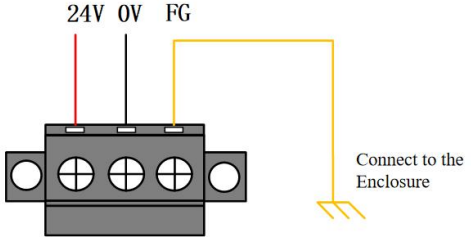


Figure 2-9 Power Wiring Terminals

2.2.3 J02 PWM/DA Wiring Terminal

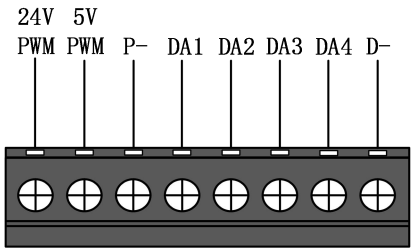


Figure 2-10 PWM/DA Wiring Terminal

BCL4568E has 2 PWM pulse width modulation signals. The left channel is 24V level PWM, while the right channel is 5V level PWM and P- is the negative terminal of the PWM signal. The duty cycle is adjustable from 0% to 100% with a maximum carrier frequency of 50 KHz. The signal output is shown in the figure below.

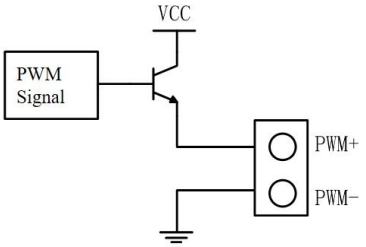


Figure 2-11 PWM Output Circuit

Caution:

1. There are dedicated enabling relays for PWM+ and PWM- signals, and there is no need for external relay isolation.

2. Wrong connection of the 5V/24V PWM signal may cause damage to the laser.

BCL4568E has 4 analog outputs from 0~10V, DA1/DA2/DA3/DA4 are positive terminals of analog, and D- is the negative terminal of analog. DA1/DA2/DA3/DA4 can be configured as control signals for laser peak power and gas proportional valves through the FACut Config as described in Chapter 4.

Table 2-6 BCL4568E Signals

Output Signal Range	0V~+10V
Maximum Output Load Capacity	50mA
Maximum Tolerance	+/-10mV
Resolution	2.7mV
Conversion Speed	400us

2.2.4 J03/J04/J05 Output Terminal

Take J03 as an example, the terminals are shown in the figure below:

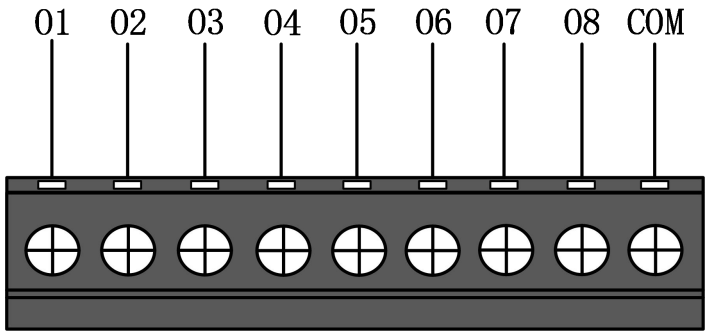


Figure 2-12 Output Wiring Terminals

There are 24 high-level (24V level) outputs for J03-J05, the figure above shows the wiring of J03. O1-O8 are positive ends of the output terminal, and COM is the negative end of the output terminal. Through FACut Config, the 24 outputs can be configured to work as the output port of ***Height Adjuster***, ***Laser***, ***Cutting Head***, ***Auxiliary Gas***, ***Alarm***, and ***Dual-Motor Pallet Changer***.

Caution:

1. The maximum current of one output port is 0.7A, or the short circuit protection will be triggered.
2. The maximum current of total output port is 2.5A, or the short circuit protection will be triggered.

2.2.5 J06/J07/J08 Input Terminal

Take J06 as an example, the terminals are shown in the figure below:

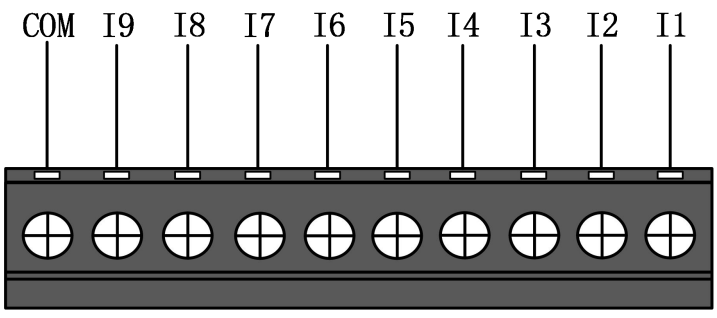


Figure 2-13 Input Wiring Terminals

J06-J08 has a total of 27 input ports. IN1-IN24: low level (0~15V) effective, high level (19-24V) invalid; IN25-IN27: high level (24~8V) effective, low level (0~4V) invalid. Take J06 as an example, I1-I9 are the positive ends of input terminals, and COM is the negative end of the input terminal.

The typical wiring of a photoelectric switch is shown below, NPN type 24V photoelectric switch shall be used.

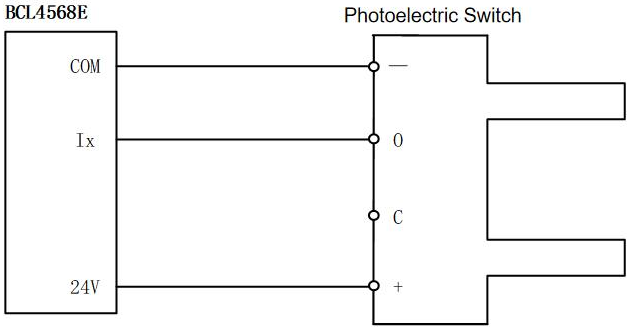


Figure 2-14 Photoelectric Switch Wiring

The typical wiring of the contact switch is shown below.

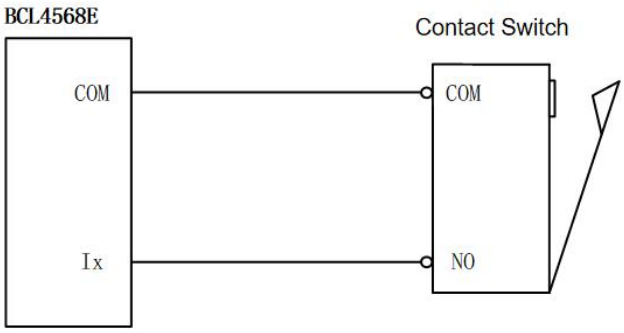


Figure 2-15 Contact Switch Wiring

The typical wiring of magnetic switch is shown below, NPN type 24V magnetic switch shall be used.

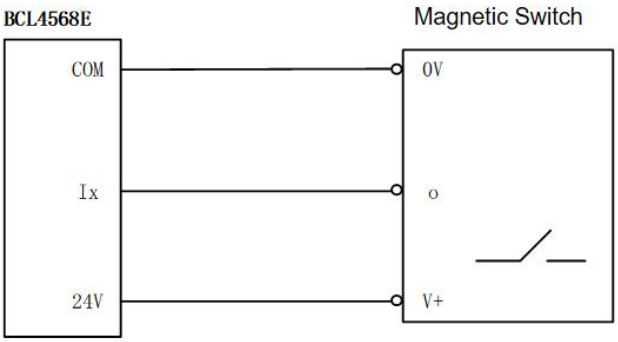


Figure 2-16 Magnetic Switch Wiring

2.2.6 J09 PWE Network Interface

J09 is a output interface that connects the Ethernet power. It supports 100Mbps network communication, and provides power and communication to the BLT series cutting heads via PWE cables.

Figure 2-17 PWE Interfaces

Figure 2-18 PWE Indicator

The table below shows the distinct connection status indicated by the PWE LEDs.

Table 2-7 PWE Network and Power Connection Status Sheet

Label	Description	LED Color	Status	Description
1：Link	Hardware Connection and Communication Status	Green	Off	PWE No Connection
			On	PWE Connected
			Blink	Connected, with Communication
2：Run	EtherCAT Bus Link Status	Green	Off or Blink	Not in the OP State
			On	In the OP State

2.2.7 J10 Network Interface

J10 is the output and input interface for EtherCAT network. It supports 100Mbps network communication, and is recommended to use CAT5E (or above) standard RJ45 network cable for bus communication.

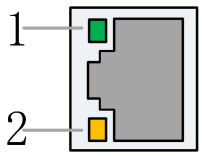


Figure 2-19 Network Terminal

Description of the connection status of network interface is shown in the table below.

Table 2-8 RJ45 Connection Status

Label	Description	LED Color	Status	Description
1：Link	EtherCAT Bus Connection and Communication Status	Green	Off	No Connection
			On	Connected, No Communication
			Blink	Connected, with Communication
2：Status	EtherCAT Bus Link Status	Yellow	Off or Blink	Not in the OP State
			On	In the OP State

2.2.8 Wiring Diagram

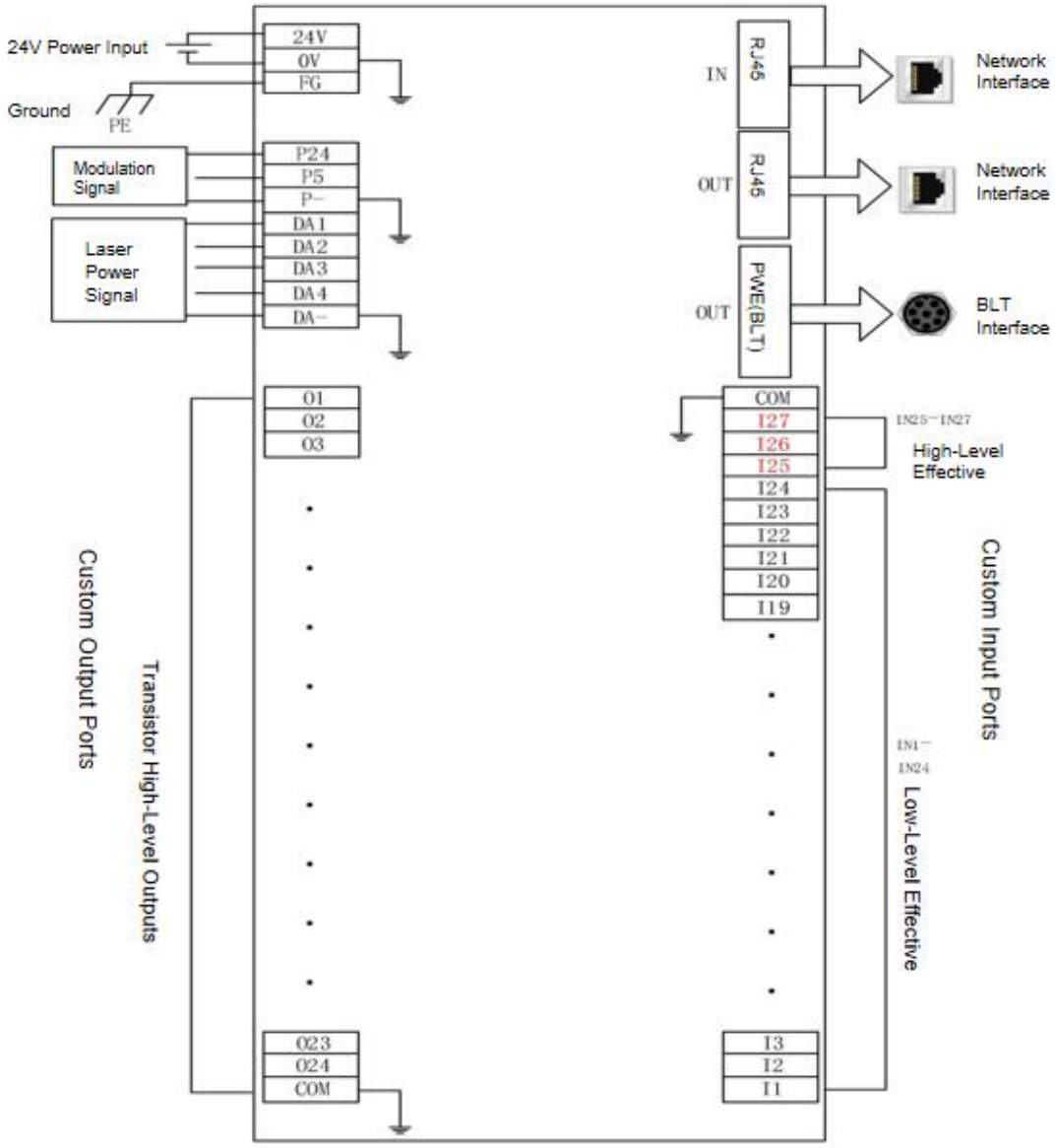


Figure 2-20 BCL4568E Wiring

2.3 BCS100E/E_PRO Wiring

BCS100E is a standard height adjuster based on the EtherCAT bus. BCS100E_PRO is the model that exclusively supports Precitec cutting heads and perfectly supports the full range of Precitec series cutting heads.

Table 2-9 BCS100E/E_Pro Parameters

Program	Description	
Power	24V DC/1A	
Capacitance Sampling	BCS100E	Four-core cable transmission, same as BCS100
	BCS100E_PRO	One-core cable transmission, BNC transmit
Temperature	0~60℃	
Humidity	10%~90% (no condensation)	
Dimension	136×123×34mm	

2.3.1 BCS100E/E_PRO Interface Layout

The detailed interface layout of the BCS100E/E_PRO terminal is shown in the figure below.

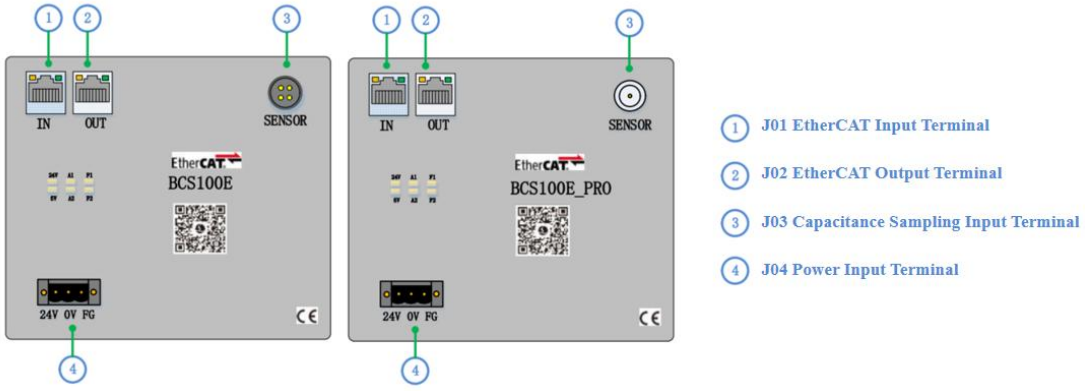


Figure 2-21 Detailed Interface Layout of BCS100E/E_PRO Terminal

2.3.2 BCS100E/E_PRO Power Interface

The machine's shell is the negative terminal of the capacitor measured. To ensure stable operation of the measuring circuit, the FG pin of the power supply interface must be reliably connected to the machine shell with a short and thick ground wire, and the preamplifier shell must also conduct well with the machine shell. Specific indicators are: DC resistance should always be less than 4 Ω, otherwise the actual follow effect may not be good.

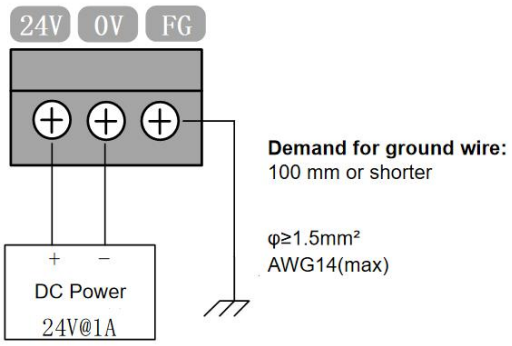


Figure 2-22 Power Interface Wiring

2.3.3 BCS100E/E_PRO Sensor Interface

The sensor interface of BCS100E is shown in the figure below:

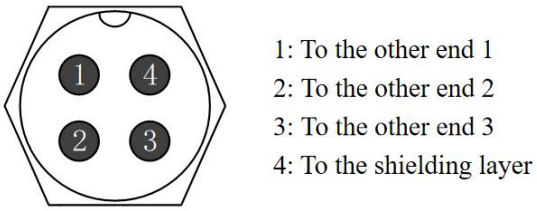


Figure 2-23 BCS100E Sensor Interface

The sensor interface of BCS100E_PRO is shown in the figure below:

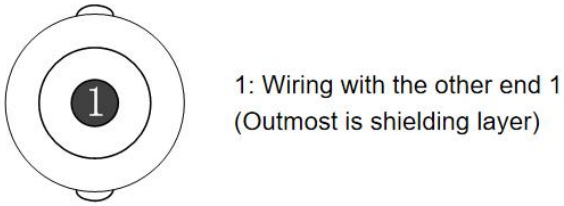


Figure 2-24 BCS100E/E_PRO Sensor Interface

2.4 Cutter Wiring

2.4.1 ProCutter Wiring

The connection of the ProCutter cutting head is shown in the figure below.

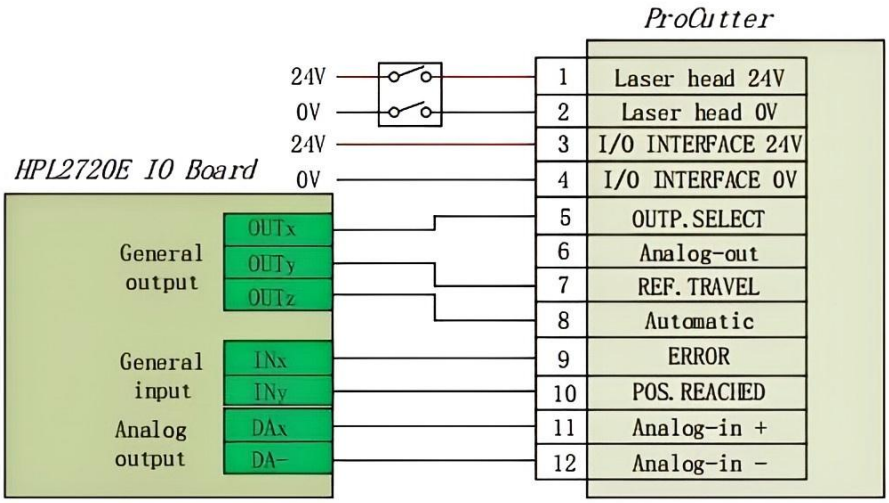


Figure 2-25 ProCutter Cutting Head Wiring

2.4.2 Highyag Wiring

The connection of the Highyag cutting head is shown in the figure below.

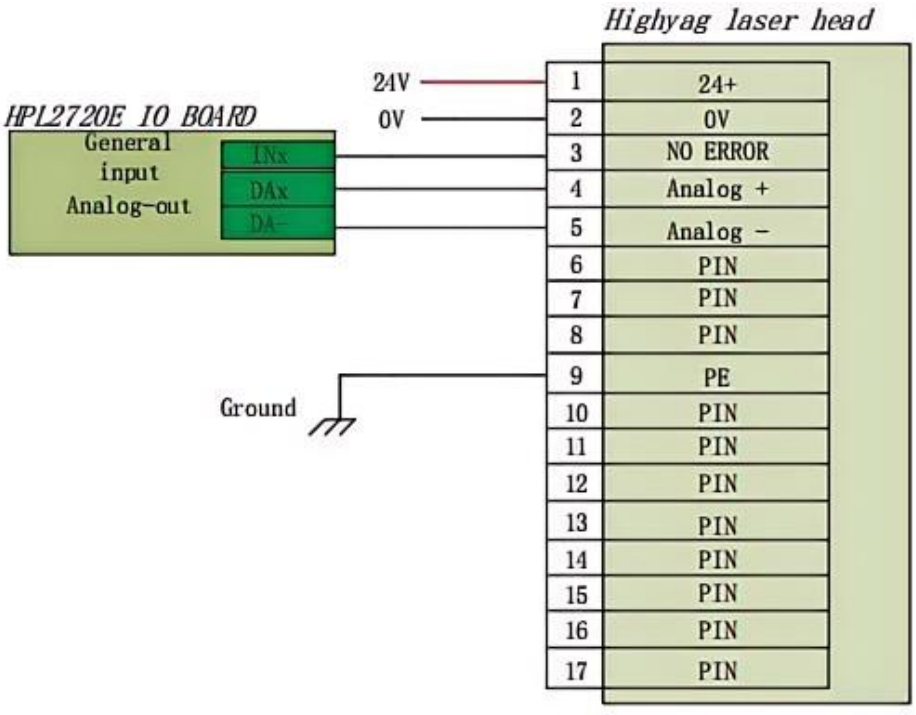


Figure 2-26 Highyag Cutting Head Wiring

2.5 Laser Wiring

2.5.1 IPG-YLS Network Communication Wiring

All IPG-YLS series lasers can be quickly connected to the laser following this method.

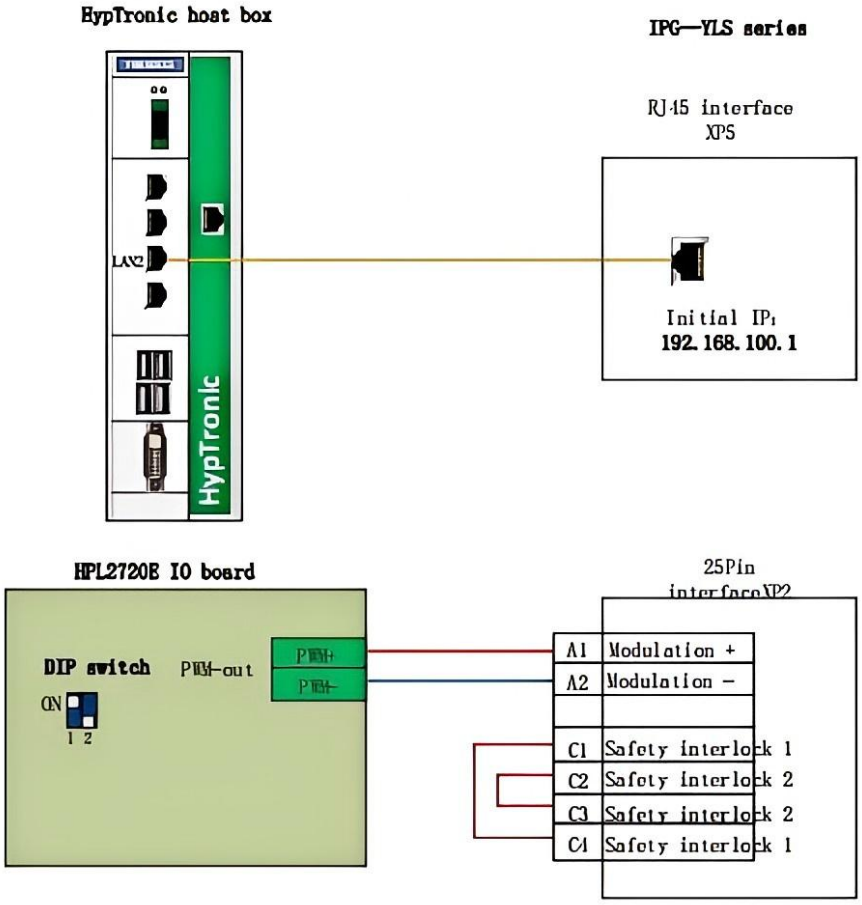


Figure 2-27 IPG-YLS Series Laser Wiring

2.5.2 IPG-German Non-Network Communication Wiring

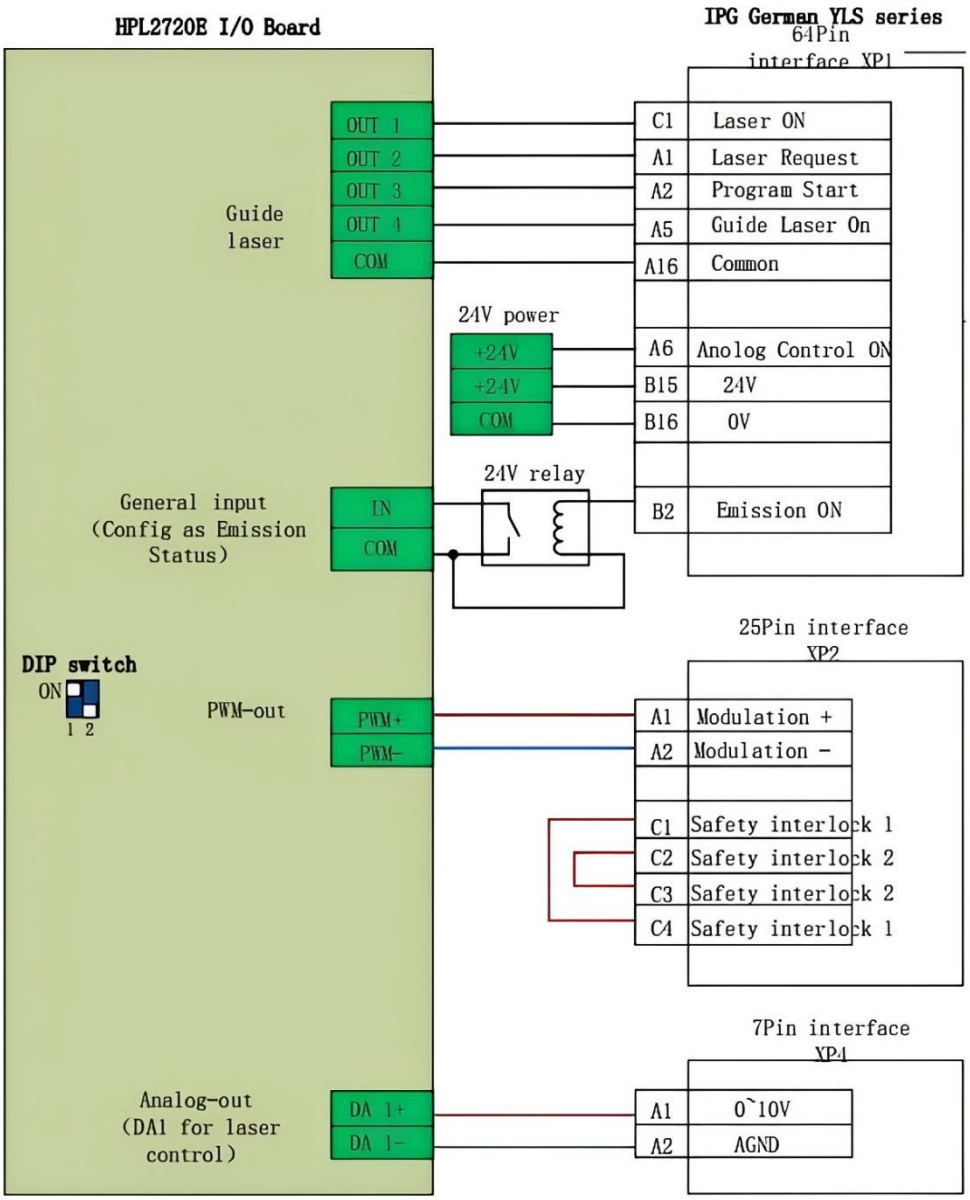


Figure 2-28 IPG-German Laser Wiring

2.5.3 IPG-American Non-Network Communication Wiring

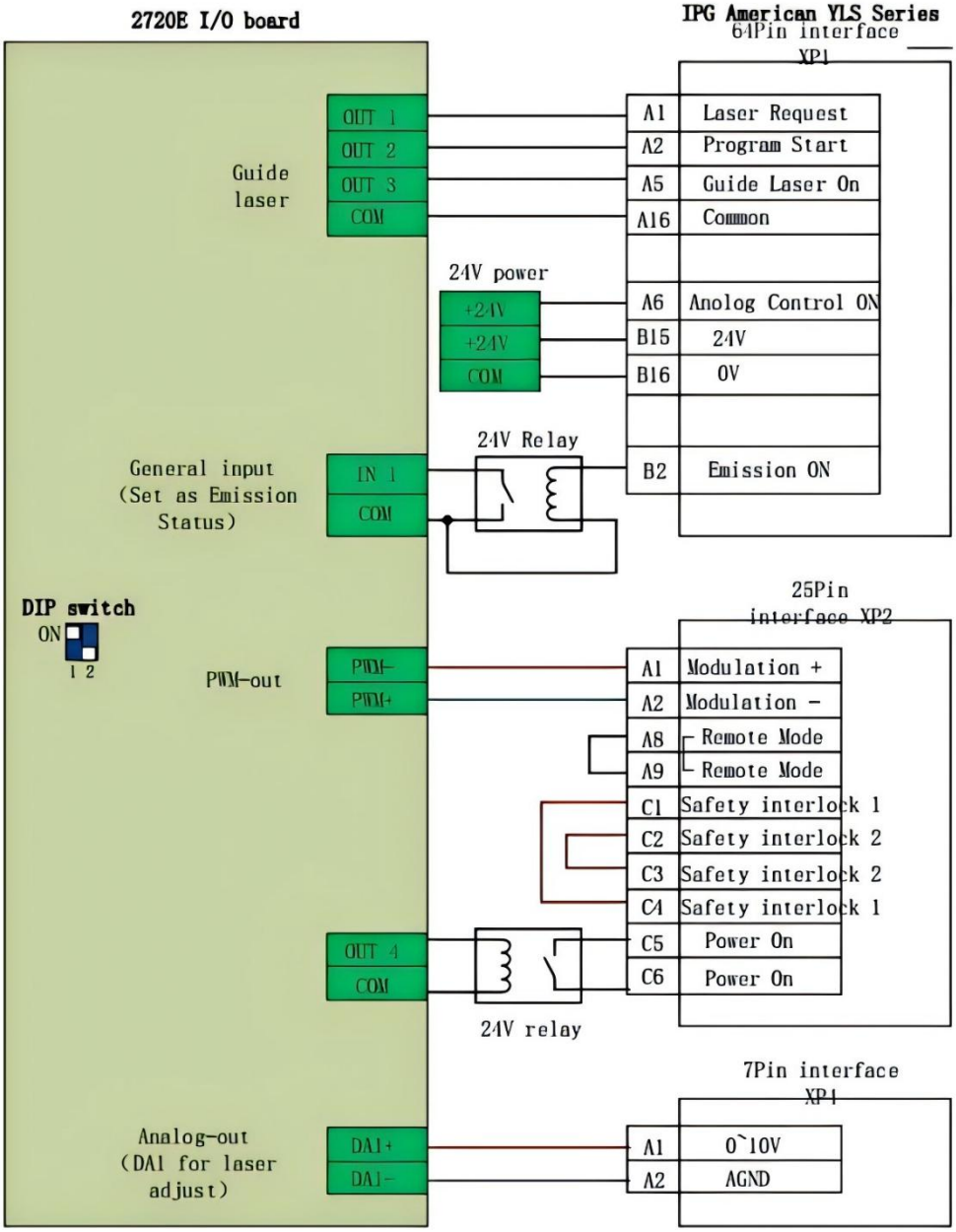


Figure 2-29 IPG-American Laser Wiring

2.5.4 RayCus Serial Communication Wiring

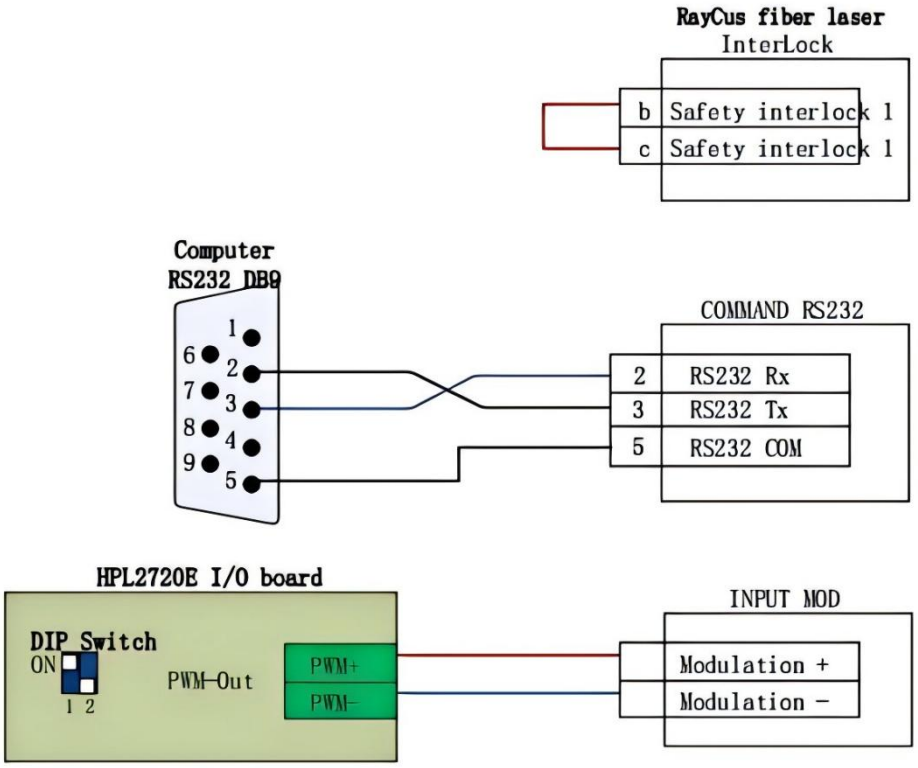


Figure 2-30 RayCus Laser Wiring

Notice: The HS232 interface has been removed from the HypTronic3 Host. If a serial port is required to control the Raycus laser, it is recommended to purchase a USB to RS232 module additionally.

2.5.5 Trumpf Serial Communication Wiring

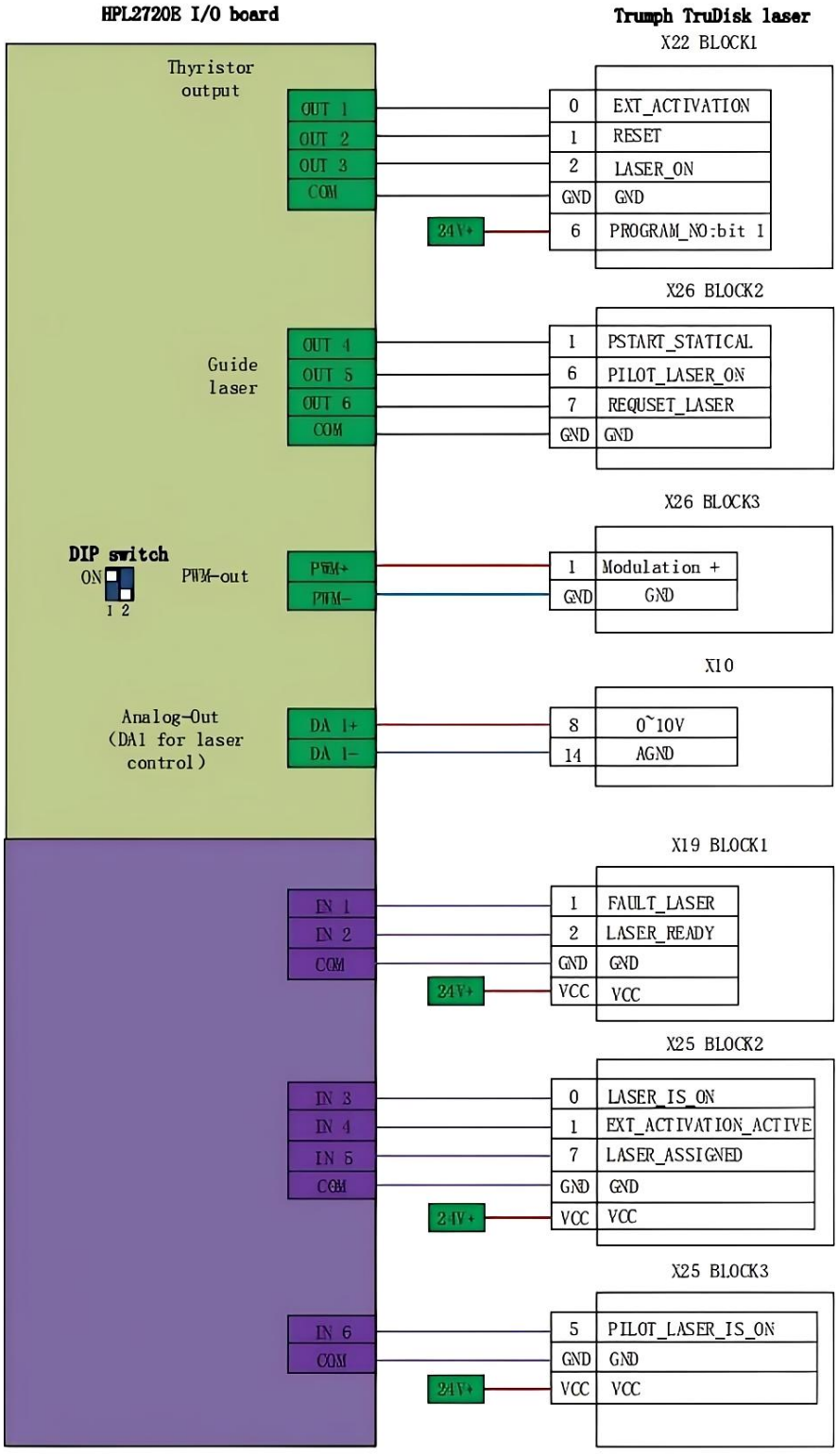


Figure 2-31 Trumpf Laser Wiring

2.5.6 Rofin Serial Communication Wiring

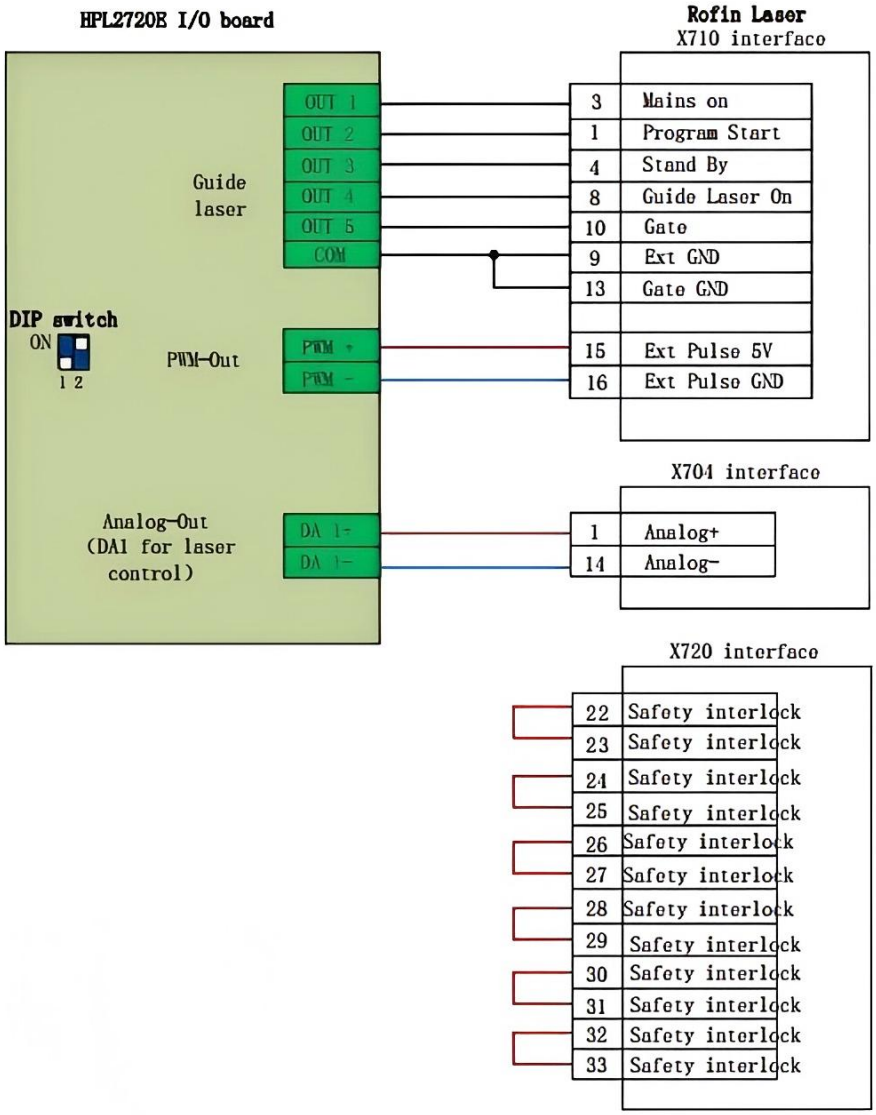


Figure 2-32 Rofin Laser Wiring

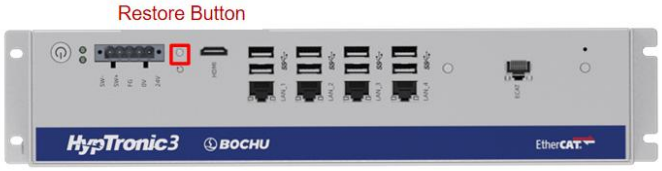
Chapter 3 Quick Start

3.1 System Restore

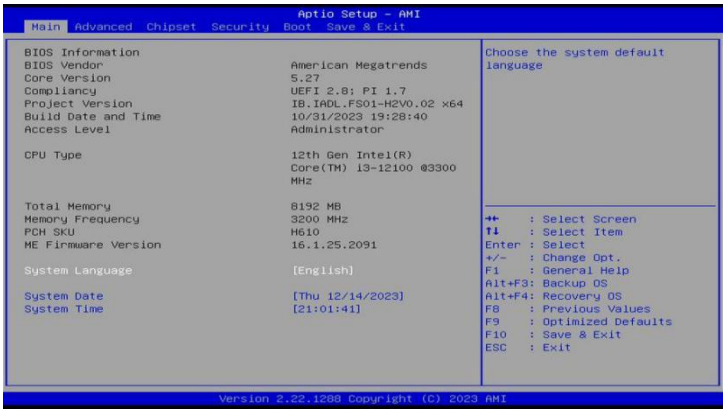
If the system is infected with a virus or is running slowly due to the installation of too many software programs, please follow the steps below to perform a system restore to the factory settings.

Step 1 Restart HypTronic3；

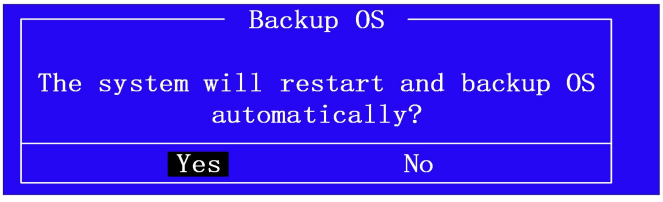
Step 2 Press and hold this restore button when the power on beeps, and release it when the screen lights up, then you can enter the restore interface in step 3;



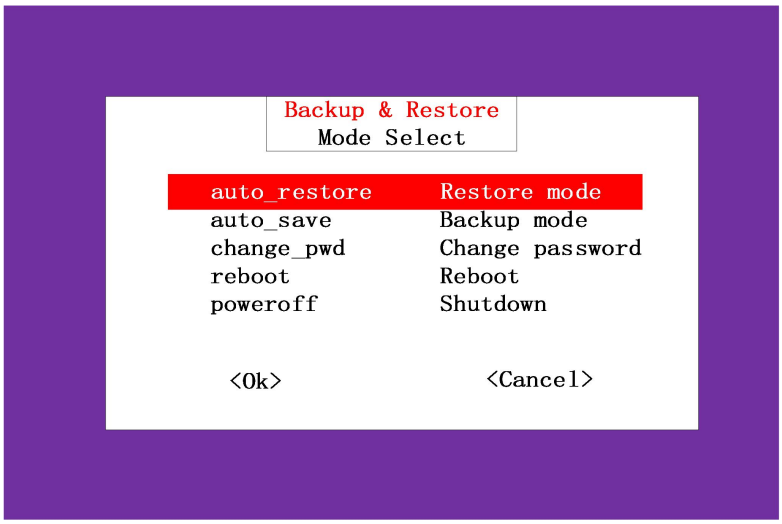
➢ You can also enter the following BIOS interface by pressing the ***Delete*** key first when you turn on the computer:



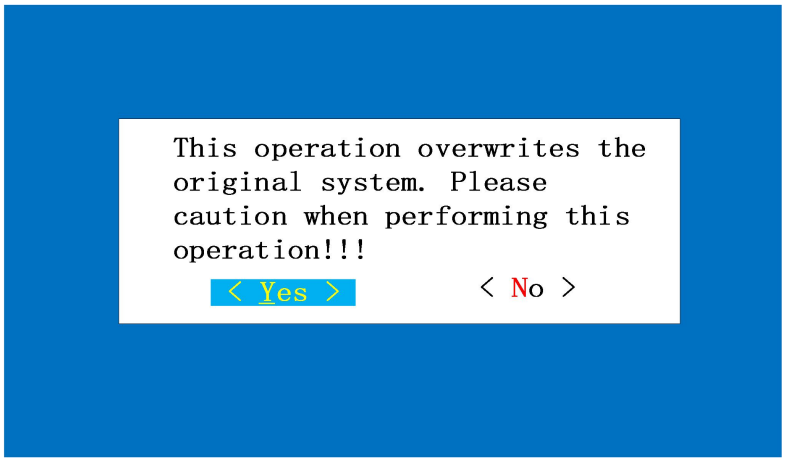
Then press the combination of ***ALT+F3*** in this interface, and the following window will pop up. Select ***Yes*** and press ***Enter***, the system will automatically reboot and enter the restore interface;



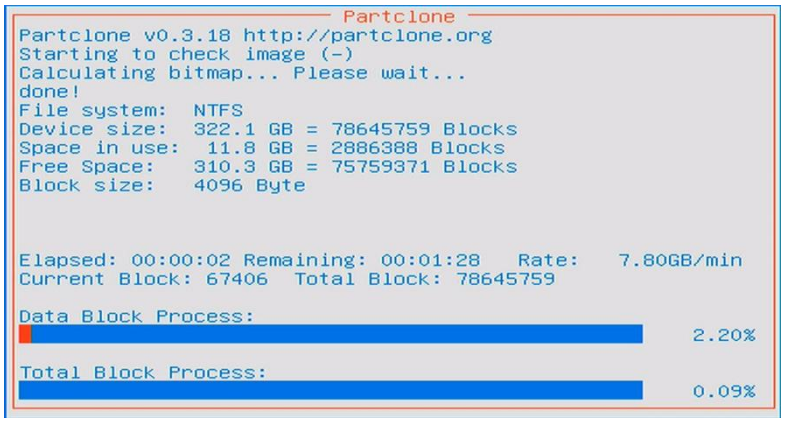
Step 3 Select ***auto_restore*** in the following restore interface, and then press ***Enter***;



Step 4 Select ***Yes*** in the pop-up window and press ***Enter***;



Step 5 The system restores automatically and will restart automatically when the progress bar finishes, after which the system recovery is complete.



Chapter 4 FACut Config

This chapter briefly introduces the FACut Config of the FSCUT9100 bevel-cutting system. Sections 4.1-4.10 involve the Machine Externals Config, and 4.11-4.22 are mainly about the Planar NC System.

4.1 Start FACut Config

FACut Config is installed by default along with the software FACut.

Click the ***Start*** menu, and the FACut Config can be opened in the ***FACut*** folder.

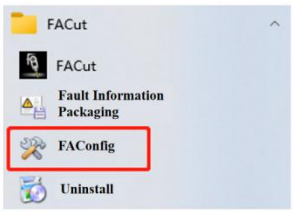


Figure 4-1 Open FACut Config by the Start Menu

Here is another way to open FACut Config. Right-click on the desktop shortcut icon of ***FACut***→ click ***Open File Location*** → double-click ***FACut Config.exe***.

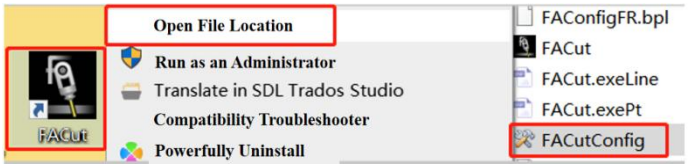


Figure 4-2 Open FACut Config by Desktop Shortcut

Before the FACut Config runs, a password box will pop up.

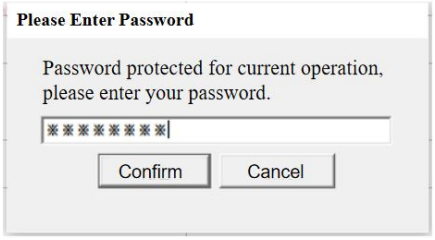


Figure 4-3 Please Enter Password

Enter password 61259023, and click ***Confirm*** to start FACut Config.

Caution: Users are advised to set the parameters based on the actual configuration of the cutting platform, as incorrect settings may lead to unpredictable consequences! In FACut Config, the orange background color represents the configuration of the input port, and the green background color represents the configuration of the output port.

4.2 User Interface

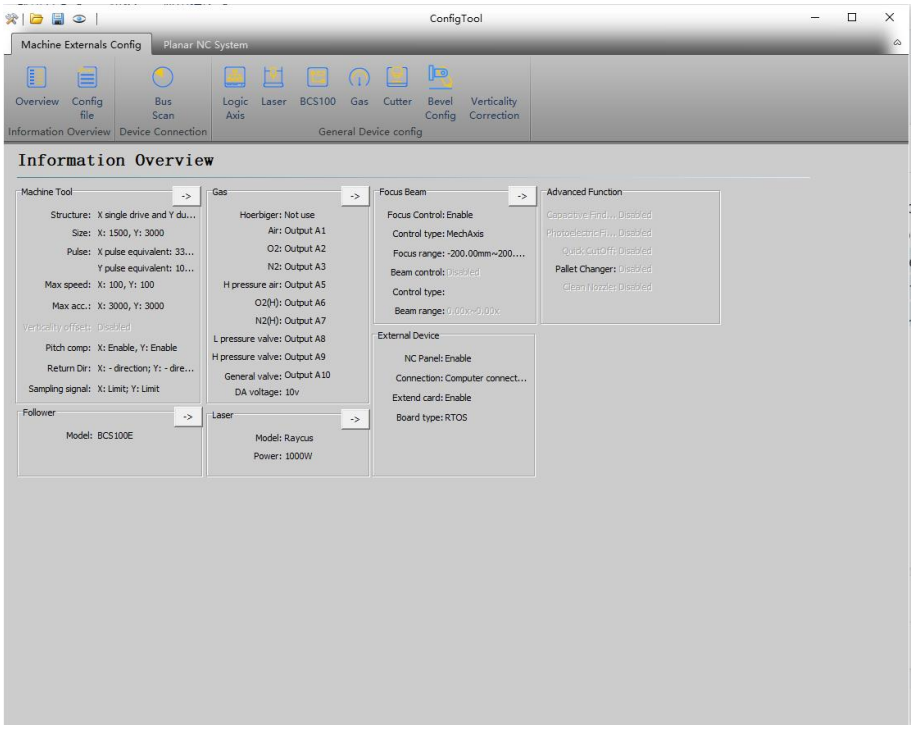


Figure 4-4 Machine Externals Config

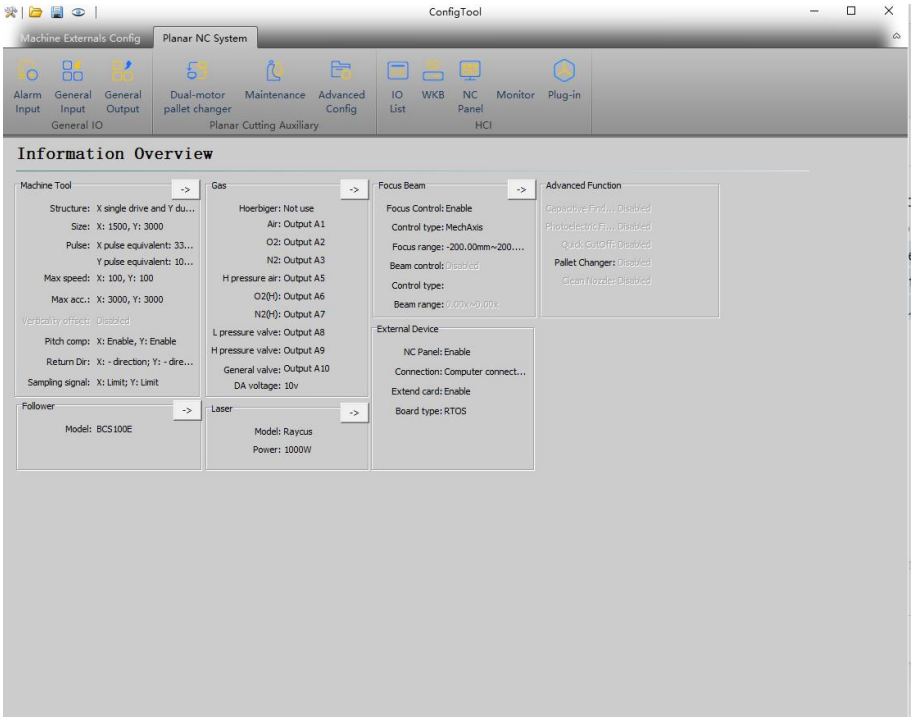
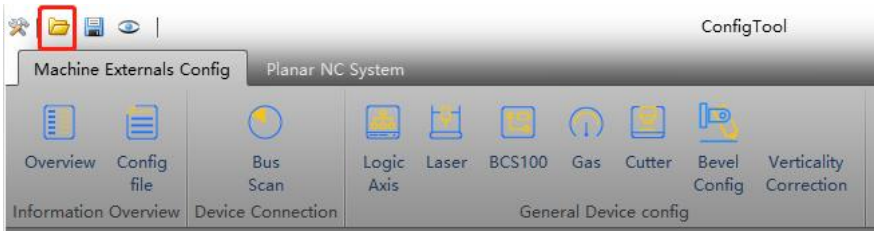


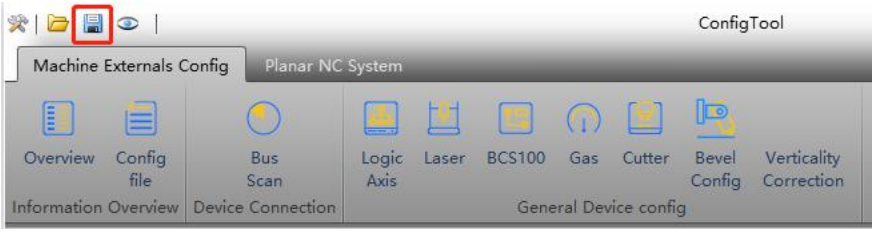
Figure 4-5 Planar NC System

FACut Config can be divided into two main parts, ***Machine Externals Config*** and ***Planar NC System***. The upper column of the FACut Config lists shortcut icons to enter each parameter setting interface, and you can enter the corresponding parameter setting interface with a single click.

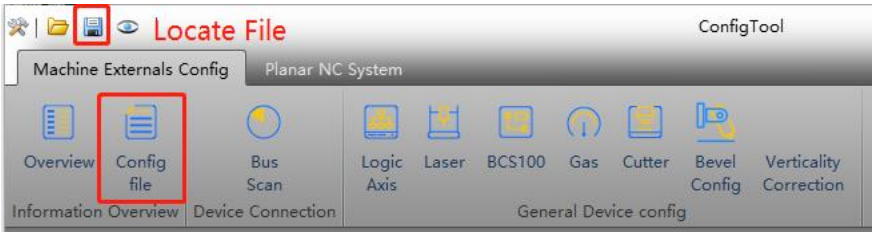
- Click ***Open File*** in upper left to import an existing machine tool parameter (*.cfgpkg file).



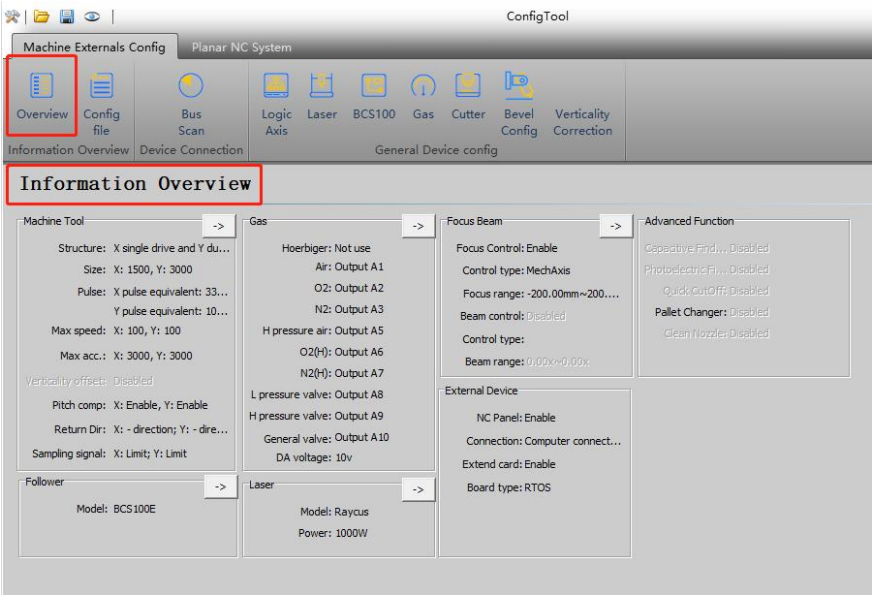
- Click ***Save*** to save current settings.



- Click ***Locate File*** to open the directory where the current machine tool configuration is located. ***Config File*** has the same function as ***Locate File***.



- Clicking on ***Overview*** displays the ***Information Overview*** interface, which showcases the basic information about the machine tool and its peripherals. Clicking the arrow in the upper right corner of each information module allows you to jump to the corresponding parameter setting interface.



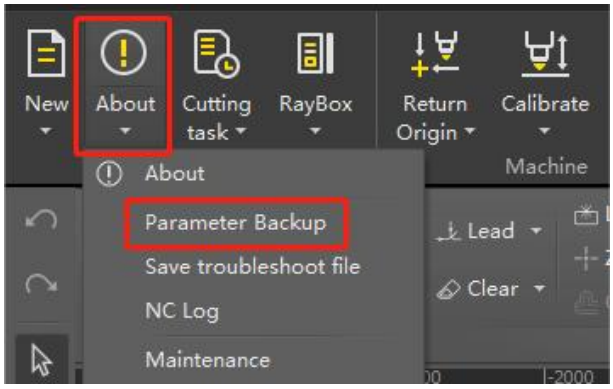
4.2.1 Machine Parameters Backup

To save the current machine tool parameter as a file, please follow these steps.

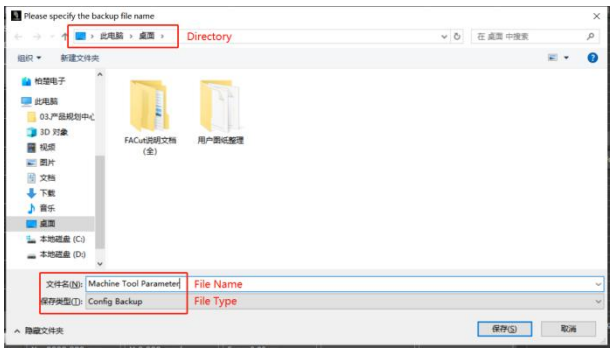
Step 1 Open FACut;

Step 2 Click the inverted triangle below the ***About*** icon to wake up the drop-down list;

Step 3 Click ***Parameter Backup***, and the system will pop up a file saving dialog box;



Step 4 In the dialog box, select the file type as ***Config Backup***, and specify the save path and file name. In this example, it is saved on the desktop and named Machine Tool Parameter;

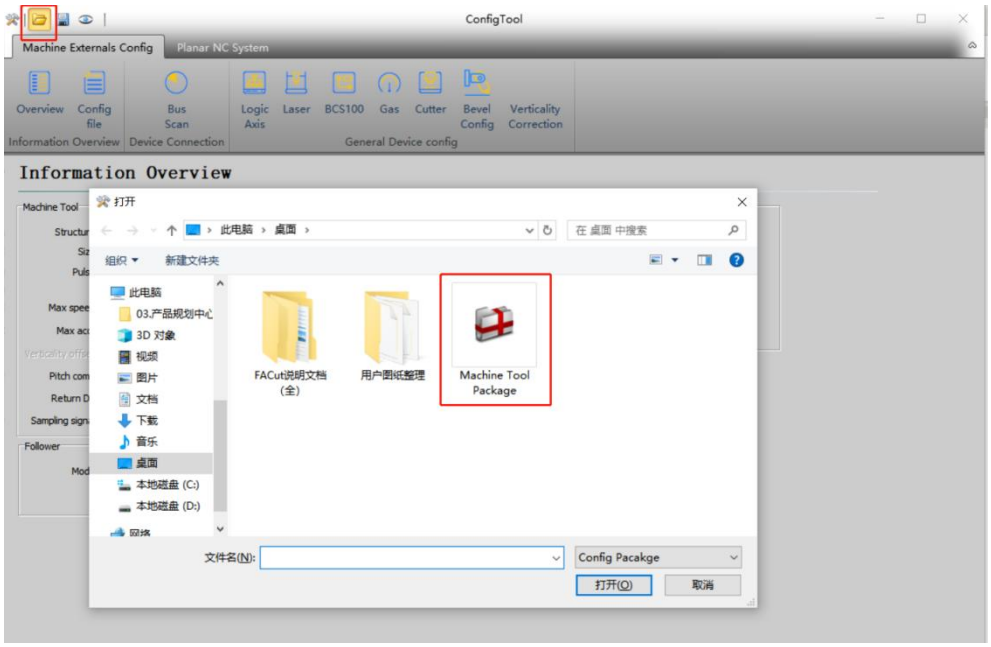


Step 5 Click ***Save***, and the machine tool file (*.cfgpkg) will be displayed in your specified directory in an icon like a medical package.

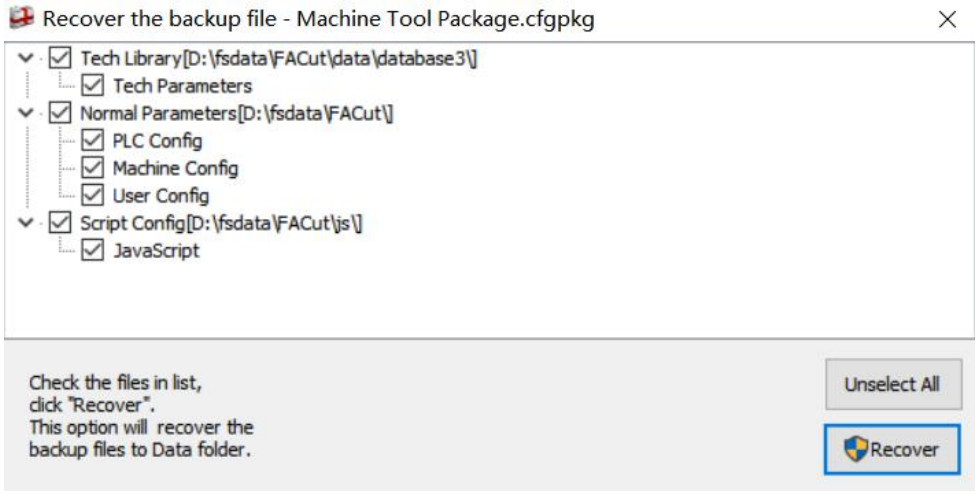
4.2.2 Machine Parameters Restoration

To restore the machine parameter, please try any of the following methods:

- Open FACut Config, click ***Open***, and choose the existing ****.cfgpkg*** file;



- Double-click the ****.cfgpkg*** file where the parameter file is saved (e.g., desktop), and follow the prompts to restore the configuration information as required.



4.3 Bus Scan

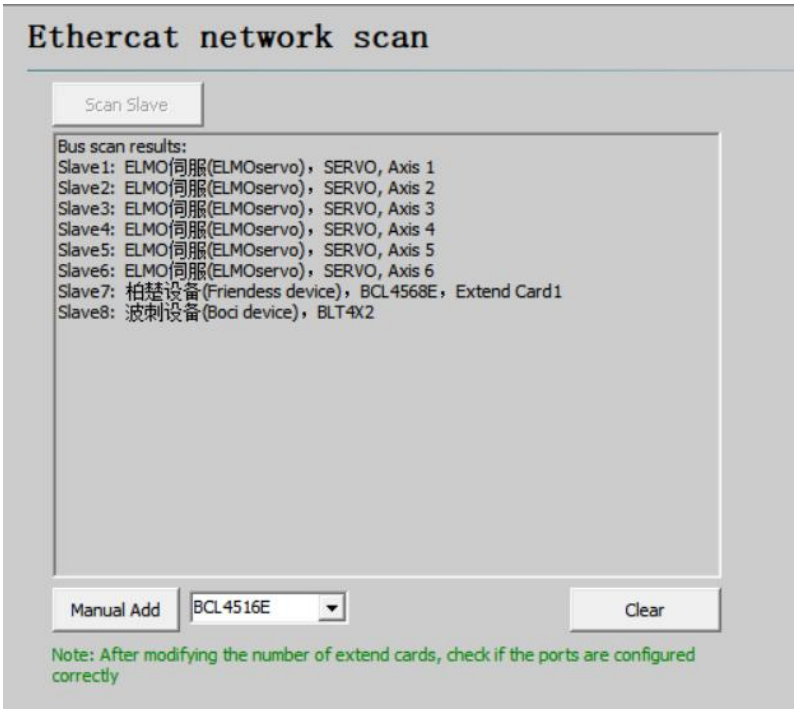


Figure 4-6 Bus Scan

Click ***Bus Scan*** on the ***Machine Externals Config*** interface to enter the EtherCAT network scan interface. Before bus scanning, please follow the steps below:

1. Confirm that all slaves are connected to the host in serial via the network cable, and ensure there is no alarm after power-on.

2. It is recommended to connect each EtherCAT slave in the following order: Host → X-axis → Y-axis → Z-axis → other axes → BCL4568E → other slaves.

3. After the scanning is completed, check whether the displayed number of slaves is consistent with the actual number of connections. If not, please check the connection and status of the missing slaves.

4. If the scan is successful and all slaves are correctly identified, proceed to the next step - the specific parameter configuration of each axis; if the scan fails, please inquire about the corresponding problem and solution according to the prompted error code.

⚠ Notice:

1. The FSCUT 9100 system currently comes standard with the IO expansion board BCL4568E, which integrates the BLT dedicated height adjustment module. When using this expansion board,

there is no need to add a height adjuster additionally;

2. When choosing BCS210E as the height adjuster, please pay attention to its interface configuration. BCS210E is equipped with standard network cable interfaces for connecting to the superior bus device. This interface is referred to as the IN port. It also has a dedicated PWE network cable interface for connecting to the BLT series intelligent cutting head. This interface is known as the OUT port. Due to the particularity of the PWE interface, BCS210E must be the penultimate slave station to ensure a correct connection to the cutting head.

4.4 Logic Axis

Logic axis configuration involves the configuration of mechanical parameters, brake switches, etc. The specific mechanical parameters need to be configured and written according to the actual mechanical structure. The brake switch needs to be configured according to the I/O port connected to the expansion board. Please configure the relevant parameters of the corresponding axis on each logical axis page.

X, Y, and Z axes have the following mechanical parameters:

- Transmit Mechanism: rack and pinion, leadscrew, linear motor, or other. Based on the transmission chosen, there will be prompts for filling in different mechanical parameters.
- Pitch Diameter: Pitch Diameter=modulus × number of teeth/cos β (helix angle). The helix angle of the straight teeth gear is 0° .
- Screwlead Range: The distance that the nut moves linearly for each full rotation of the screw. This should be filled as indicated on the nameplate.
- Pole Pitch: The distance between two adjacent electrodes in a linear motor. It is usually used to describe the structure and performance of a linear motor. The smaller the pole pitch of a linear motor, the higher its accuracy and speed. This should be filled as indicated on the nameplate.
- Transmit Lead: When the transmission used is not rack and pinion, screw, or servo, please fill in the corresponding transmission lead according to the type of transmission used.
- Range: The X and Y axis ranges correspond respectively to the width and height of the rectangular frame in the FACut drawing interface. They specify the maximum movement range of each axis in the axial direction when the soft limit protection is enabled. The Z-axis range defines the maximum movement range of the Z-axis in the axial direction.

When configuring the Y axis, note that this axis can be set as ***Single-Drive*** or ***Dual-Drive***. When selecting ***Dual-Drive***, the FSCUT 9100 system supports the ***Y Axis Checking*** (4.4.1). In addition, you can also ***Enable Follow-up Beam*** (4.4.3) for Y axis to adapt to specific mechanical structures or processing requirements.

Figure 4-7 Y-axis Parameter Settings

When configuring the Z-axis, note that this axis has ***Dual-Limit***.

The Z axis naturally has a vertical negative limit, which is similar to the negative limit of traditional planar machine tools and is used to prevent the Z axis from moving vertically downward beyond the safe range. This vertical negative limit is enabled by default.

When cutting a bevel, to meet the special safety requirements during deflection cutting, the Z axis is also equipped with a ***Bevel-Limit***. If the item ***Dual-Limit*** is checked, then during bevel cutting, the vertical negative limit of the Z-axis will not take effect. Instead, the ***Bevel-Limit*** and ***Bevel Axis Range*** will take effect.

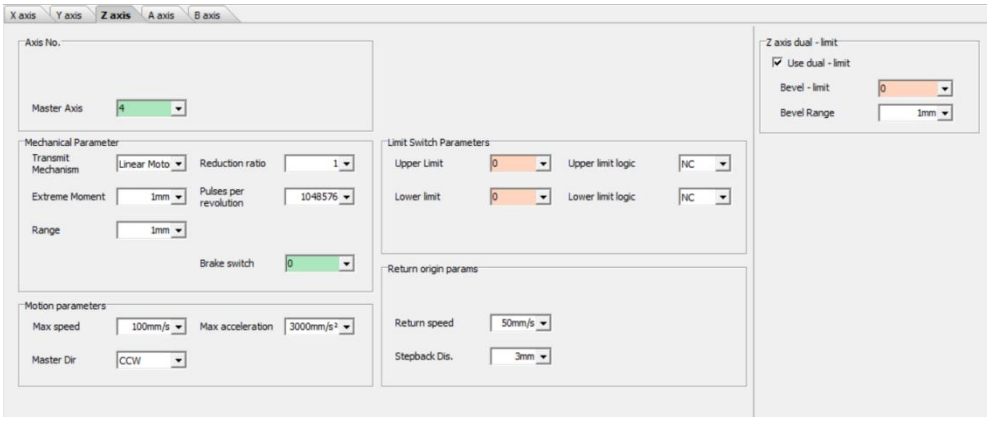


Figure 4-8 Z-axis Parameter Settings

For axes A and B, you can set their ***-Range*** and ***+Range*** respectively to adapt to different mechanical structures and processing requirements.

Figure 4-9 A-axis Parameter Settings

- Transmit Mechanism: Direct connection with reduction gear by default, cannot be modified.
- Transmission Lead: 360° by default, cannot be modified.
- +Range: The maximum angle at which axes A and B rotate in the positive direction. It can be set as needed to adapt to different mechanical structures and processing requirements.
- -Range: The maximum angle at which axes A and B rotate in the negative direction. It can be set as needed to adapt to different mechanical structures and processing requirements.

When using our original equipment, you can Set the ***Swing-Arm Parameters with One Click*** by using the BOCI standard swing-arm. Mechanical parameters of the swing arm will be automatically filled.

Currently supported driver brands include ***Yaskawa***, ***Veichi***, and ***S9***. When the original standard swing arms are detected during bus scanning, the window as shown in figure 4-10 will appear. After selecting the corresponding brand, click ***Confirm***, and the mechanical parameters of corresponding axes will be set accordingly.

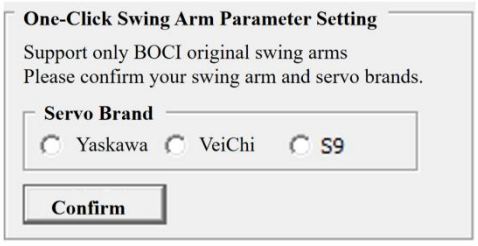


Figure 4-10 One-Click Setting

Versions of FACut 2024A and above support the configuration of the BC-axis swing arm structure

for section steel models. After selecting the corresponding item at ***Advanced Config***, the names on the Logic Axis will change accordingly.

For different swing arm structures, the system will also make corresponding changes to motion planning and pre-processing range detection.

In addition to the unique parameters of each type of axis mentioned above, the common parameters of each logical axis are as follows:

- Axis No.: Set the axis number of the logical axis, which corresponds to the order of the slaves connected during bus scanning.
- Reduction ratio: Set the correct reduction ratio. The reduction ratio can be confirmed through the accessory parameter table or the nameplate information on the reducer.
- Pulses per Revolution: Fill in the number of pulses per revolution of the drive motor corresponding to the model of each axis. Generally, it can be confirmed through the accessory parameter table or the nameplate information of the motor.
- Encoder Type: This should be selected in accordance with the actual type of motor encoder. Generally, X, Y, and Z axes use the relative encoder, while A and B axes use the absolute encoder.
- Max Speed/ Max Acceleration: Pre-designed maximum acceleration and speed of the machine. Any subsequent adjustment of the maximum speed and acceleration within the machining software must remain within these values.
- Master Dir: When the system issues a command to manipulate each axis to move in the positive/negative direction, this parameter determines the actual direction of axis movement. If you find that the actual direction of movement of the axes is opposite to the direction of movement displayed by the system, please modify this parameter.
- Limit/ Brake Switch/ Origin Switch: Limit/brake/home switch: Configure hard limit switches, brake signals and origin signals for each logic axis (no origin switch for Z-axis); NPN-type (low level active) normally closed signal sensor is recommended for limit switch; NPN-type normally open signal sensor is recommended for origin.
- Range Switch Logic: Select the correct limit and origin switch logic based on the limit and origin switch selection.

- Return Origin Params： Based on the actual origin position of the machine, set the correct homing direction, return origin sampling signal, return speed, fine positioning speed, stepback distance, and whether to use Z phase signal.
- Pitch Compensation: You can choose not compensate, backlash only, and full pitch compensation, and set a reasonable max compensation speed. Before compensation, you should measure the backlash or the pitch error.
- Use Z phase signal: Only motors using Z-phase signal can use Z-phase signal to return to the origin. After this option is enabled, you can set the dual drive synchronization in the ***Return Origin*** interface of FACut.

4.4.1 Y Axis Checking

Figure 4-11 Y Axis Checking

This is used to automatically measure the direction and state of motion of the dual-drive axes to eliminate torsion axes. Please follow the recommended steps in the ***Y Axis Checking*** to finish the inspection. When using dual-drive axes, please make sure the direction of the master and slave motors are in the same direction to prevent torsion. By default, the motion direction of the dual-drive motors is reverse. After selecting the Y-axis as dual-drive, you can set the ***Master Slave Direction*** of the ***Motion Parameters***.

4.4.2 Interferometer Compensation Data Import

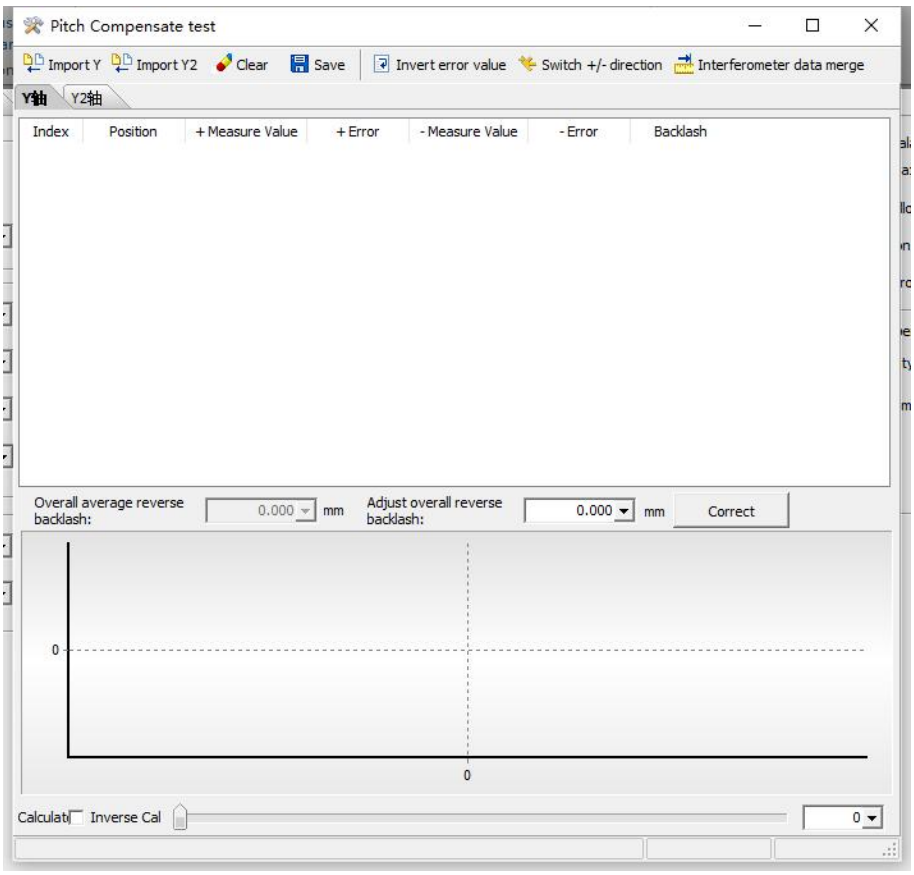


Figure 4-12 Import the Interferometer Compensation Data

When choosing full-pitch compensation, there will be a icon named ***View Comp Data*** in the logic axis configuration interface. Click it, and the interferometer compensation data can be imported in the pop-up interface named ***Pitch Compensate Test***.

For Y axis, you can write compensation data for the two axes separately.

4.4.3 Follow-Up Beam for Y Axis

The length of optical fibers are limited. For ultra-long format (30m or above) gantry rail machines, a carrier table moving in the Y direction is required to carry the laser and cutting head.

The axis where the cutting head is located is called the Y-axis (master axis), and the axis where the carrier table is located is called the Yp-axis (slave axis). Since the laser and the cutting head are connected by optical fiber, the distance between Y and Yp axes cannot be too large. This distance must be kept within a reasonable range for safety reasons.

When checking ***Enable Follow-up Beam*** in Y-axis configuration interface, there will be a new interface to configure Yp axis.

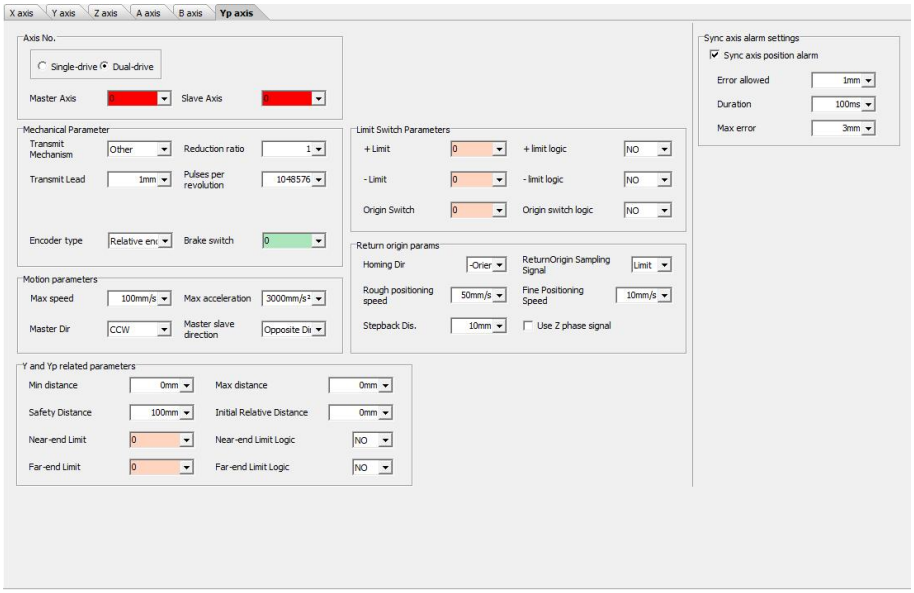


Figure 4-13 Yp-axis (follow-up beam) configuration interface

The basic configuration of the parameters of Yp axis is the same as other axes, and should be set in accordance with the actual configuration of Yp axes.

4.5 Laser

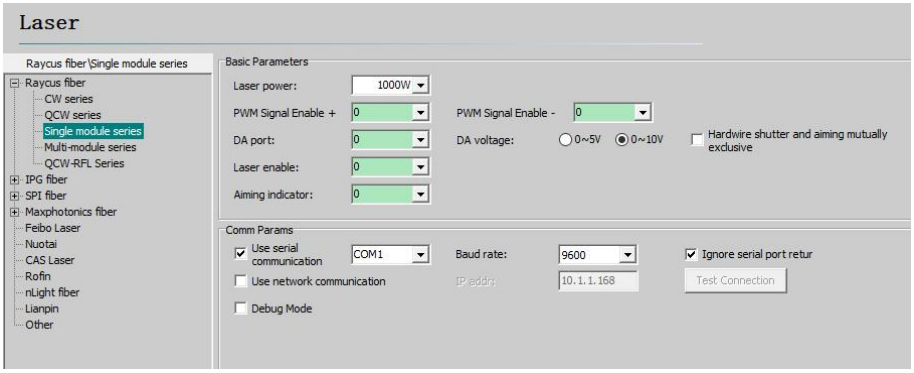


Figure 4-14 Laser Configuration

The following is a brief description of some of the parameters of the laser configuration interface.

- Laser: FSCUT9100 support Raycus, IPG, SPI, Maxphotonics firber, Feibo Laser, Nuotai, CAS Laser, Rofin, nLight, Lianpin, and other brands. Select the correct type of laser based on the laser that is paired with the equipment.
- Laser Power： Make sure to set the laser power correctly. The laser power control ratio in the system is based on this value.
- PWM Signal Enable +/-: The default PWM signal of the system has its own isolation relay to prevent light leakage. In most cases, there is no need for external PWM enable signal. If you need one, just configure the corresponding output control port.
- Comm Params: Support serial communication and network communication. Please configure the corresponding parameters according to the selected communication mode.

4.6 BCS100

Figure 4-15 Height Controller Configuration

By default, 9100 system uses Bochu's BCS bus height adjuster, and the height adjuster only needs to be connected as a slave station with a network cable. When using an analog height adjuster, the height adjuster alarm can be shield, which is commonly used in the equipment commissioning stage.

4.7 Gas

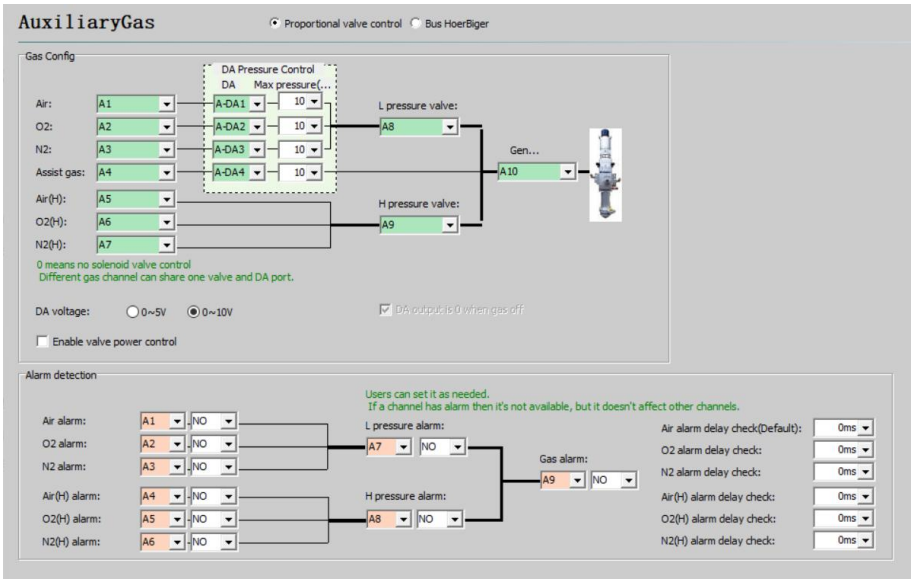


Figure 4-16 Gas Configuration

The type of proportional valve can be selected as either traditional analog + I/O ***Proportional Valve Control*** or ***Bus HoerBiger*** proportional valve. When configured as ***Proportional Valve Control***, the system presets the corresponding air circuit structure, and you can select the corresponding port according to the electrical schematic diagram and the actual interface. When configured as ***Bus HoerBiger*** proportional valve, there is no need to configure the air circuit structure, instead, the system automatically recognizes the air, oxygen, and nitrogen control modes of bus proportional valves.

Details of the gas configuration parameters are as follows.

- General Valve: Set the total outlet for switching the auxiliary gas.
- H/L Pressure Valve: Set the switch to the outlet for the high and low pressure gas.
- Air: select output for air switch.
- O^2: select output for oxygen switch.
- N^2: select output for nitrogen switch.
- Assist Gas: set the gas pressure from auxiliary gas path of the high-speed following nozzle.
- DA Pressure Control: Select the analog volumes of any channel on the BCL4568E to regulate the gas pressure.
- Alarm Detection: Select the alarm input corresponding to the gas and the gas alarm checking delay.

4.8 Laser Head Config

Supports BLT, Axisk (cutting heads that use the zoom axis for focus adjustment are Axisk type cutting heads), Precitec and similar zoom cutting heads capable of bus servo control.

4.8.1 BLT Cutter Config

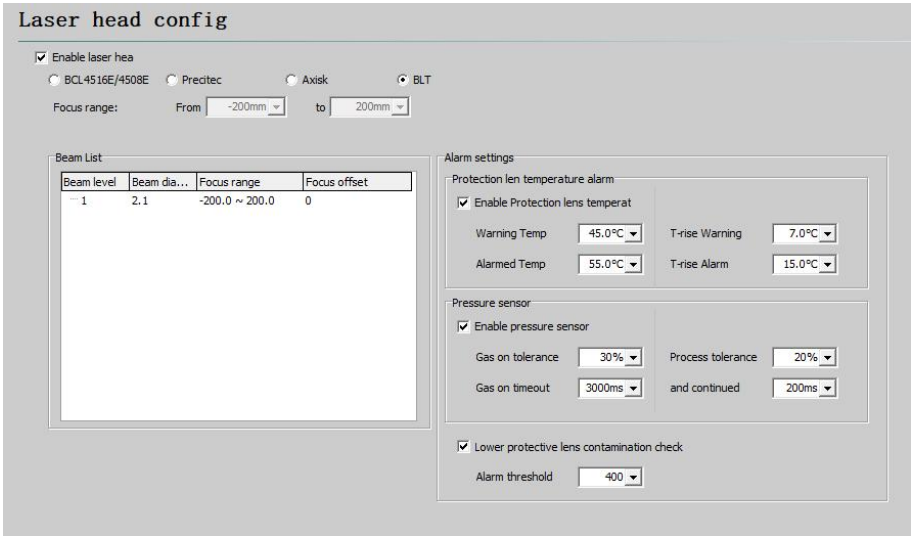


Figure 4-17 BLT Cutter Config

Details of BLT cutter configuration are as follows:

- Focus Range: The system presets the focus range of the cutter head, no need of manual setting.
- Beam List: The system presets the spot and the corresponding focus range, no need of manual setting.
- Alarm Settings: Enables and disables the sensor feedback in the BLT cutter. Also configures the warning and alarm thresholds for each sensor's feedback when the sensor is enabled.

4.8.2 Axisk Cutting Head Config

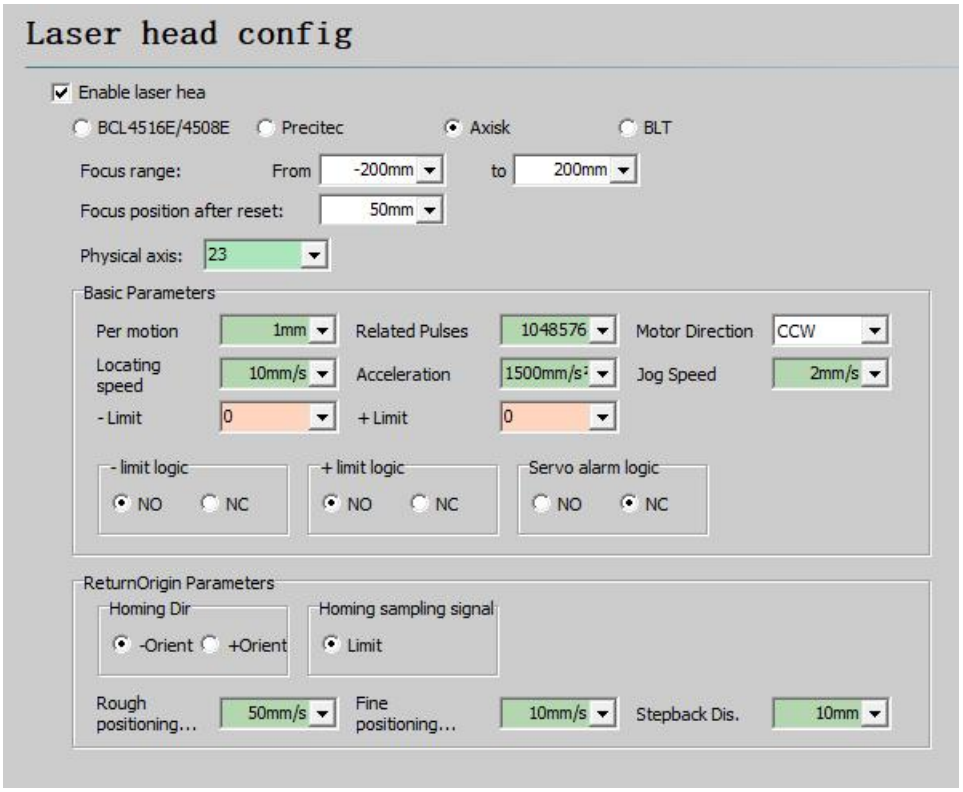


Figure 4-18 Axisk Cutter Config

Axisk cutter config is similar to the configuration of logic axes.

4.8.3 Precitec Cutting Head Config

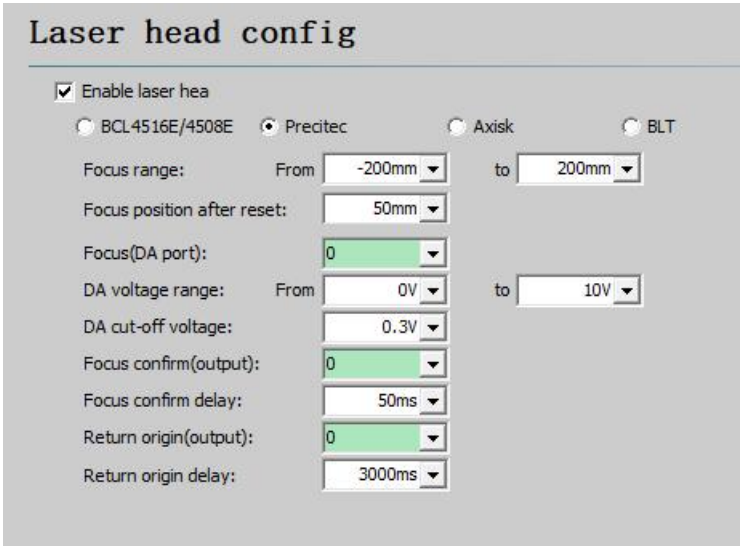


Figure 4-19 Precitec Cutter Config

Precitec cutter controls focusing with DA analog, which requires the configuration of ***DA Port***, ***Focus Confirm Output***, and ***Return Origin Output***.

4.9 **Bevel Config**

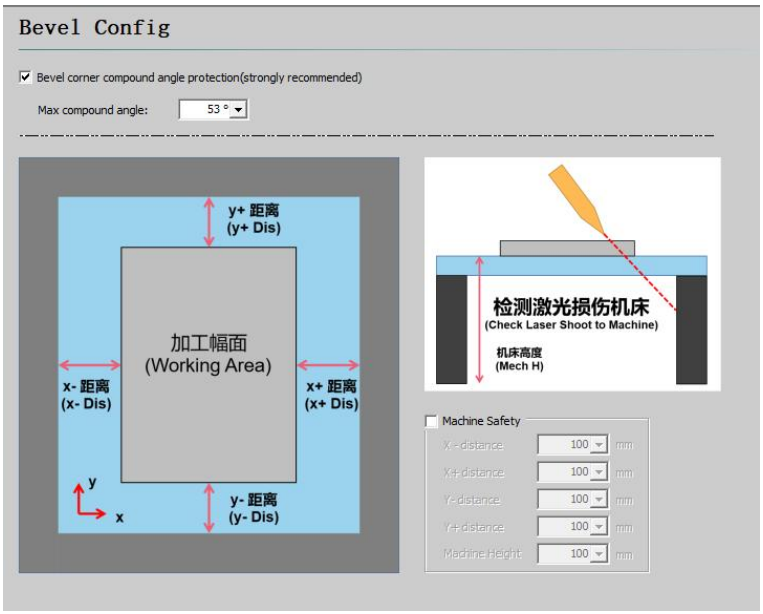


Figure 4-20 Bevel Config

Travel protection for general plane machine tools relies heavily on the X, Y, and Z axis travel limits to ensure the machine operates within a safe range. For planar beveling machines, there are additional A and B axes in addition to the X, Y, and Z axes, and the compound motion of these axes affects the travel range of the machine, so more complex travel protection logic is required.

4.9.1 Compound Angle Protection

Compound angle is a key concept in multi-axis machine tool processing, whose maximum range is directly related to the motor (axis) mounting position. When machining a beveled part, the A-axis and B-axis may swing at the same time, creating a vector superposition effect (as shown in the figure) that creates a compound angle, leading to the actual deflection angle of the cutting head exceeding the preset bevel angle. Proper control of the compound angle is critical to protect the machine from collision or overload damage. By controlling the compound angle, potential hazards and equipment damage caused by excessive cutter deflection can be avoided.

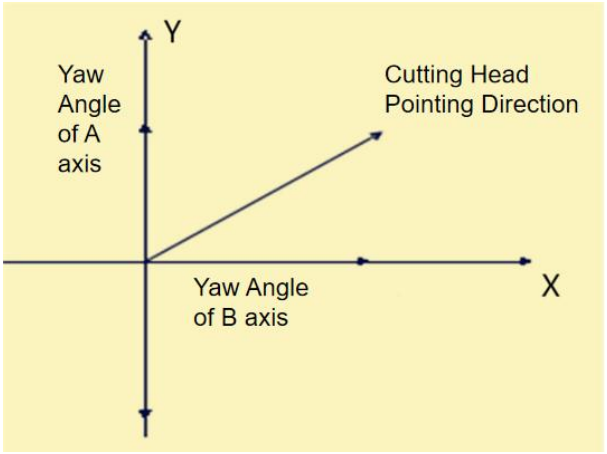


Figure 4-21 Vector Superposition

Thus, the 9100 system introduces the [Compound Angle Protection] function. This function is designed to restrict the deflection angle of the cutting head to ensure that it operates within a safe range. If the compound deflection angle in the command is monitored to exceed the set maximum value, the machine will automatically stop machining and issue an alarm. This mechanism effectively prevents the cutting head from excessive deflection, thereby protecting the machine equipment and operator safety. This angle setting not only takes into account the safe distance between the cutting head and the workpiece, but also ensures stability and precision during the cutting process.

After installation, the commissioner should confirm the composite angle range to ensure that the motor pendulum cutting head and the plate will not interfere, and fill in the maximum composite angle value according to the actual situation.

For the 9100 system, when equipped with the standard black pendulum, the maximum compound angle can typically be set to 53° when equipped with a 200-joule BLT 4-series cutting head mounted in the default hole of the pendulum, and 55° when equipped with a 300-joule BLT 4-series cutting head also mounted in the default hole of the pendulum (these values are indicative only).

4.9.2 Machine Safety

When the cutting head further deflects and cuts outward at a position close to the edge of the machine tool's format, there is a risk that the laser will damage the machine body. By enabling ***Machine Safety***, a separate safety distance can be set for the machine body. If there is a risk of the laser damaging the machine body during processing, the software will issue a prompt when clicking start.

As shown in the figure below, the angle formed by the cutter and the vertical direction is θ, the thickness of the workpiece is t, and the height of the machine tool body is h. It is necessary to satisfy WcsX+(h+t)tan θ <Xmax to ensure that the laser will not hit the machine body after penetrating the plate, so as to provide safety protection for the machine tool.

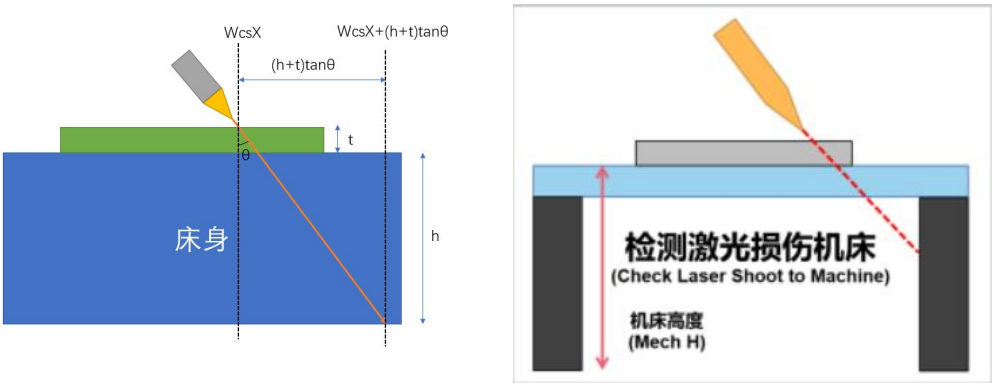


Figure 4-22 Laser Shoot to Machine

Caution: If the machine tool height is set too high, it will greatly reduce the machinable area of bevels. If protection against laser damage to the machine body is needed, it's recommended to fill in an appropriate value after actual testing.

4.10 Verticality Correction

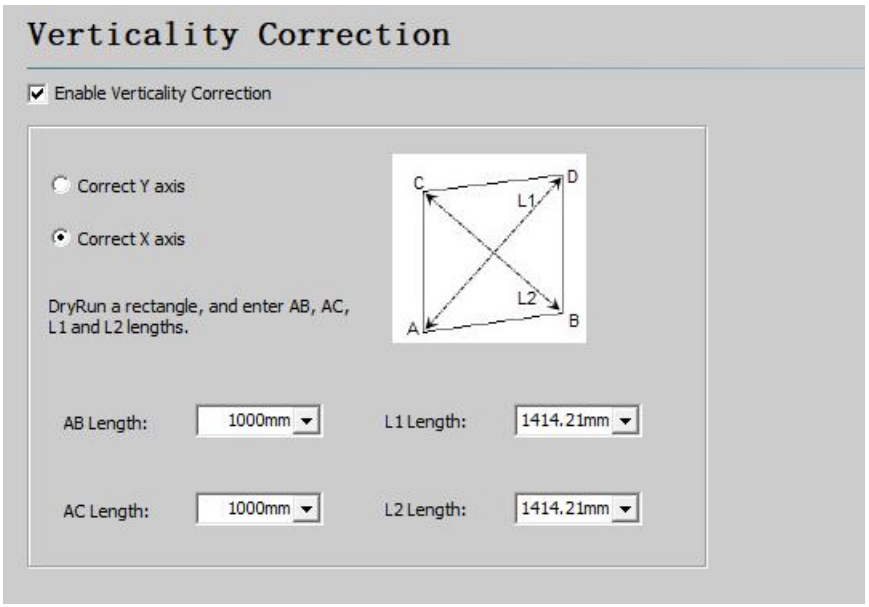


Figure 4-23 Verticality Correction

After enabling the ***Verticality Correction***, a large rectangle (recommended size not less than 1m×1m) can be marked. Record the data of the required side length and diagonal length, and fill in the corresponding parameters according to the schematic diagram to correct the verticality of the XY axes.

Above sections have introduced the Machine Externals Config, and we will enter ***Planar NC System*** module since next section.

4.11 Alarm Input

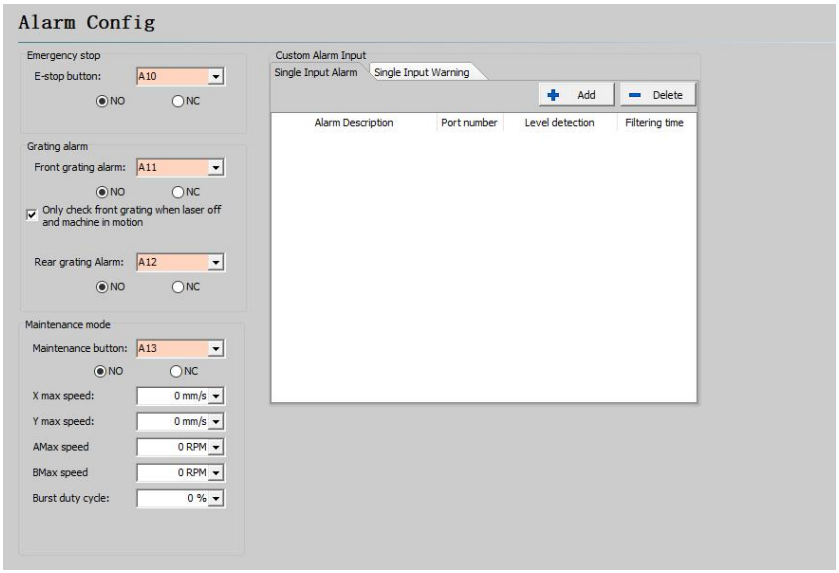


Figure 4-24 Alarm Input

Parameter description of alarm input interface is as follows:

- Emergency Stop: The port where separate emergency stop control button signals from external devices are routed to, e.g., separate emergency stop signal for pallet changer.
- Grating Alarm: Configuration port for encoder alarm system. If close observation is required during machining, please check the item ***Only Check Front Grating When Laser Off and Machine in Motion***.
- Maintenance Mode: The configuration port for the maintenance control switch required by CE Certification. When this port is activated, the device is limited to the maximum speed specified in the maintenance mode and the speed and power range specified in the spot duty circle.
- Custom Single Input Alarm: Configure the custom alarm display information, level detection, signal anti-touch filter time, and limits for alarms triggered by the corresponding input.
- Custom Single Input Warning: Configure the custom warning display information, level detection, and signal anti-touch filter time triggered by the corresponding output. If this signal is triggered, only a yellow warning will be shown and the machine's operation will not be limited.

4.12 General Input

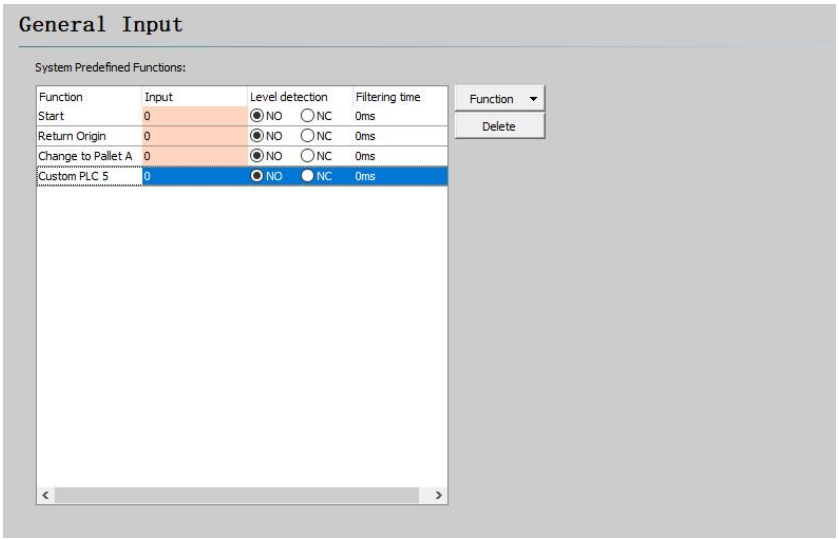


Figure 4-25 General Input

Click ***Function***, and the user can select the function name of the input port in the drop-down list, and then configure the corresponding input port and level detection (normally on/off).

4.13 General Output

- Indicator

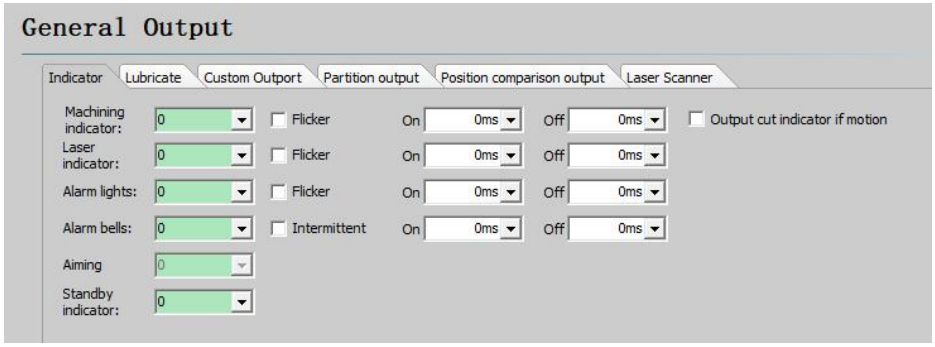


Figure 4-26 Indicator Configuration

Machine tool tricolor light control and alarm bell configuration port. When equip with tricolor light and buzzer, you can adjust the frequency of opening and closing to achieve the effect of flashing light and intermittent buzzer. It is recommended that the processing indication be yellow, the standby indication be green, and the alarm indication be red.

- Lubricate

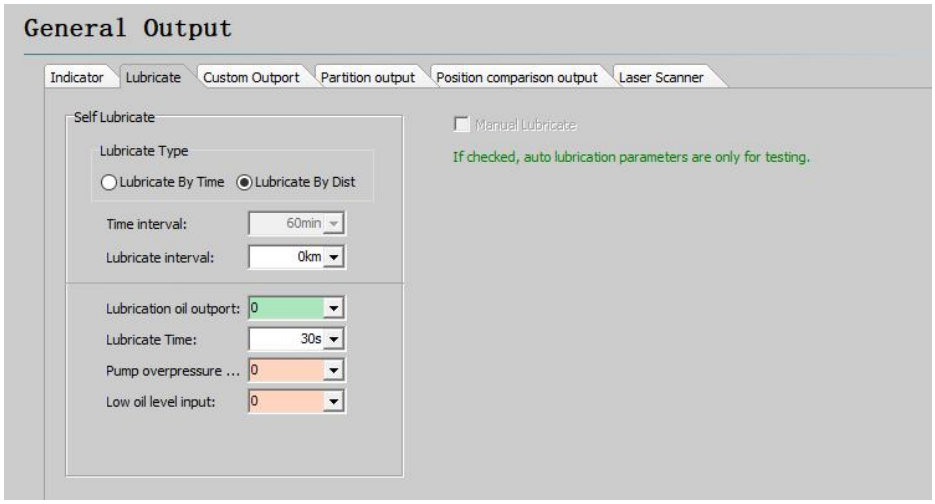


Figure 4-27 Lubricate Configuration

When this port is configured, ***Lubricate by Time*** can be set so that the beams and guide rails are automatically lubricated within a certain time interval after FACut is launched. ***Lubricate by Distance*** can also be set so that the lubrication output port is automatically activated after the system has reached the preset milage, and automatically shut down after the set output time has been sustained, so that the machine can be adequately lubricated in the continuous operation. Besides, 9100 system also support access to the pump overpressure and low oil level monitoring signals, so as to enhance the operation safety and maintenance convenience of the machine tool.

➢ Custom Output

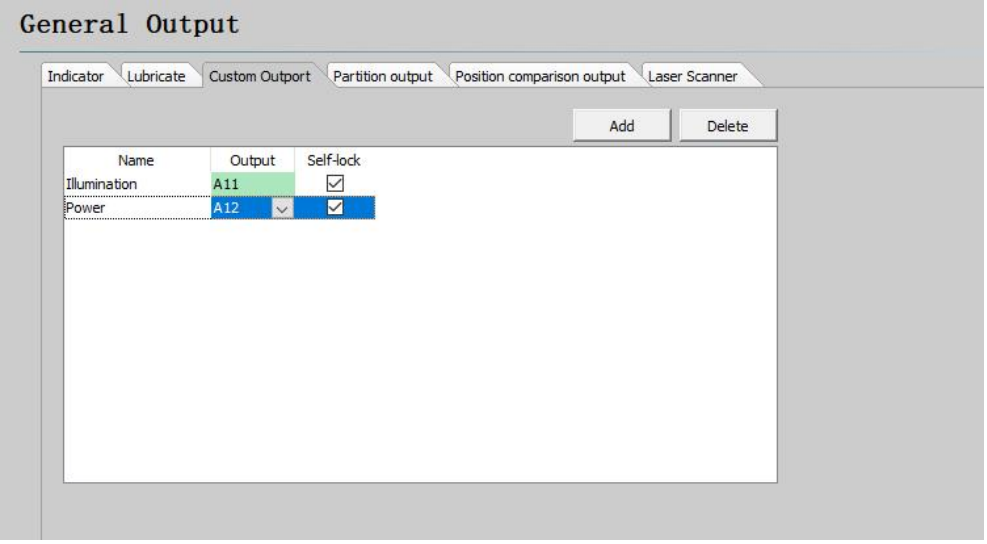


Figure 4-28 Custom Output Configuration

Configure the customized output ports, which can be controlled by self-lock or contact mode. After setting, it will displayed in FACut as ***Customized Output***, and the indicator light will be on when the corresponding port is enabled.

➢ Partition Output

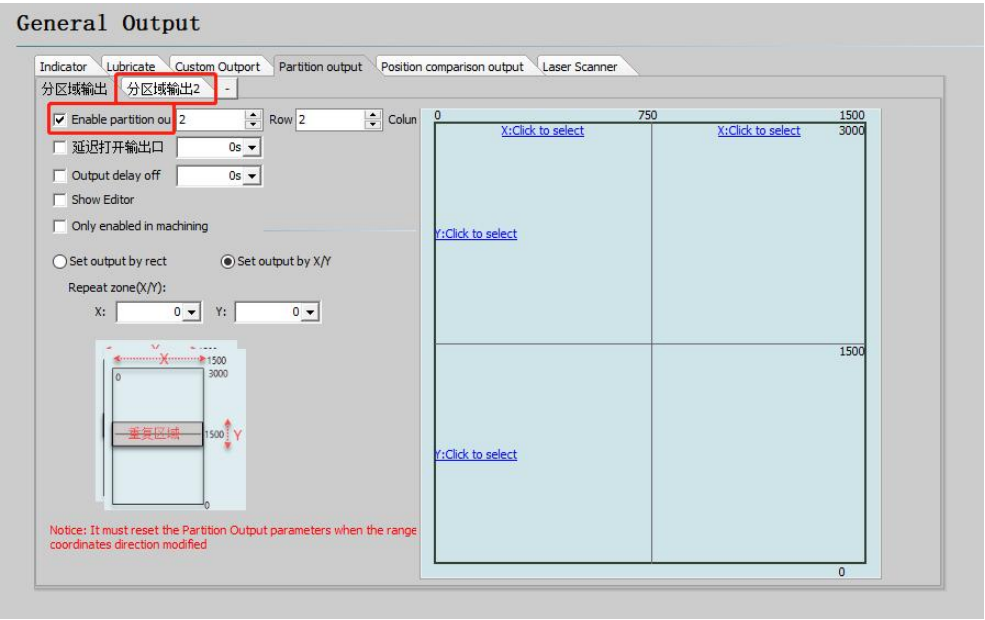


Figure 4-29 Partition Output

Partition output, also known as partition dust removal. This function will divide the machine travel into multiple zones. During machining, localized dust removal is performed on the area that the cutter moves to, so as to maintain a clean processing environment.

Currently, the 9100 system support configuring two sets of partition output, and can be configured

separately for partition dust removal corresponding to the control port and functional attributes.

When there is only one group of partition outputs, click + on the right side of ***Partition Output*** to add ***Partition Output 2***. Click - on the right side of Partition Output 2 can remove the new partition output module when the item ***Enable Partition Output*** remain unchecked. Otherwise, when deleting Partition Output 2, there will be a prompt saying *"Please turn off the enable of partition output 2"*. The two groups of outputs do not interfere with each other.

When the item ***Enable Partition Output*** is checked, users can partition the machine travel in accordance with the actual machining needs, and the preview graph is displayed on the right of the interface.

9100 System can ***Set Output by Rectangle*** and ***Set Output by X/Y***. You can configure the corresponding general output port by clicking ***Click to Select*** on the preview interface. By default, the machine width is divided evenly, and you can adjust the size of each partition by dragging the frame line of the preview. When ***Show Editor*** is checked, clicking the target frame line allows you to manually input coordinates for more accurate division.

In the actual cutting process, the system supports the setting of ***Delayed Opening***, ***Delayed Closing***, and ***Only Enabled in Machining*** of the outputs. Besides, you can also set a ***Repeat Zone*** so that when the cutting head is in the repetition area, the output ports of the two neighboring zones will be kept open, ensuring the stability of the cross-area processing.

- Position Comparison Output

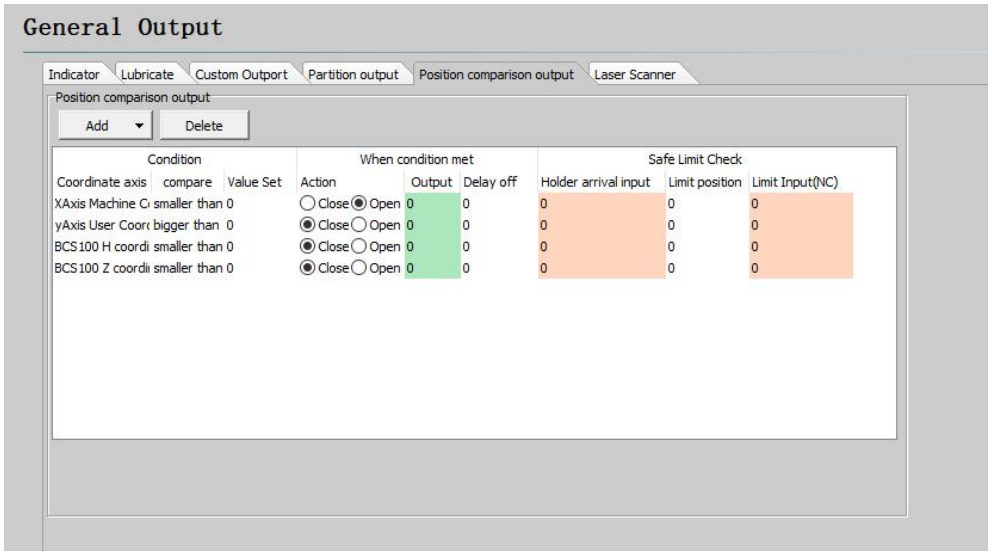


Figure 4-30 Position Comparison Output

Close or open the corresponding output port when the set coordinates reach a certain range. The ***Coordinate Axis*** can be X/Y axis machine coordinator/user coordinator, Z axis coordinator and BCS 100 coordinator.

- Laser Scanner

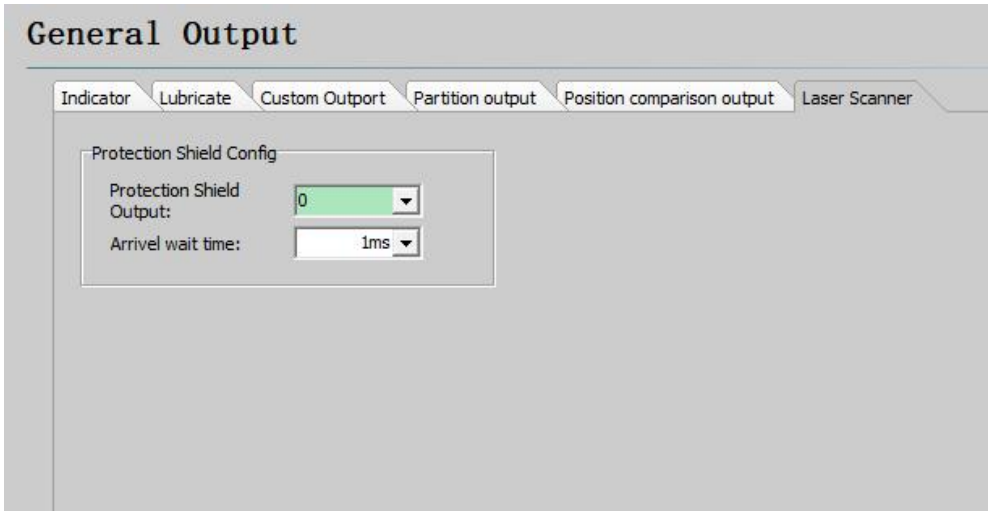


Figure 4-31 Laser Scanner

When properly configured, the protective shield can be automatically opened during laser scanning and closed after the scan, thus minimizing the consumption of protective mirrors.

4.14 Dual-Motor Pallet Changer

Figure 4-32 Dual-Motor Pallet Changer

9100 system support several pallet changer, such as ***Pallet AB***, ***IO Mode***, ***Hydraulic Lift Table***, ***Dual-Motor Pallet Changer***, etc. You may set the parameters according to your actual processing needs.

4.15 Auto Mark

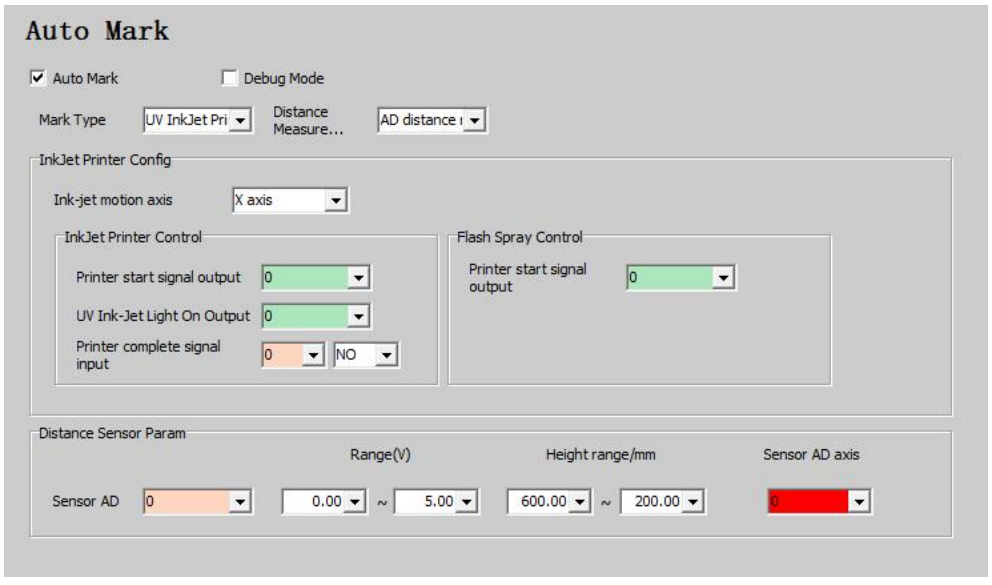


Figure 4-33 Auto Mark

Auto mark is currently supported by UV InkJet Printer.

4.16 **Maintenance**

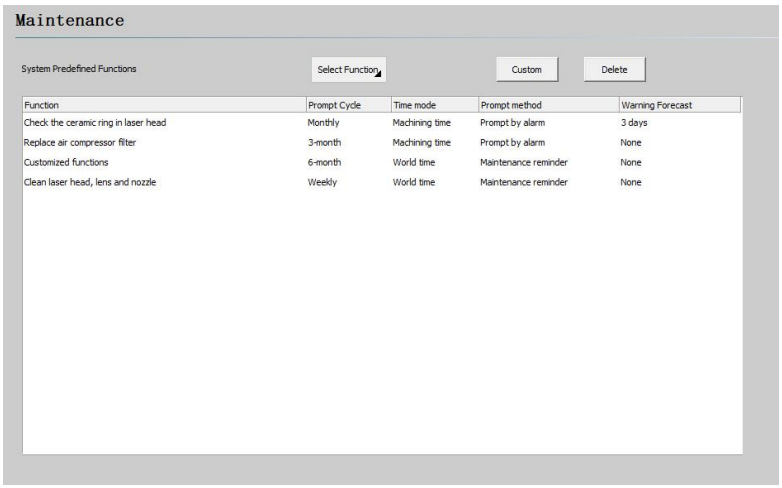


Figure 4-34 Maintenance

Maintenance module of the FACut Config provided several predefined functions, and can be divided into Clean, Check, and Action. You can add the functions by the drop-down list of ***Select Function***, or add customized functions by clicking ***Custom***.

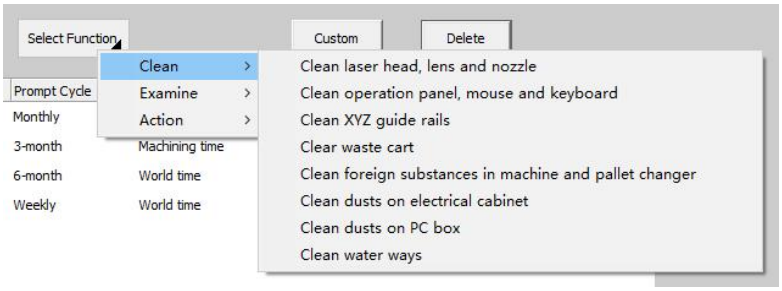


Figure 4-35 Clean

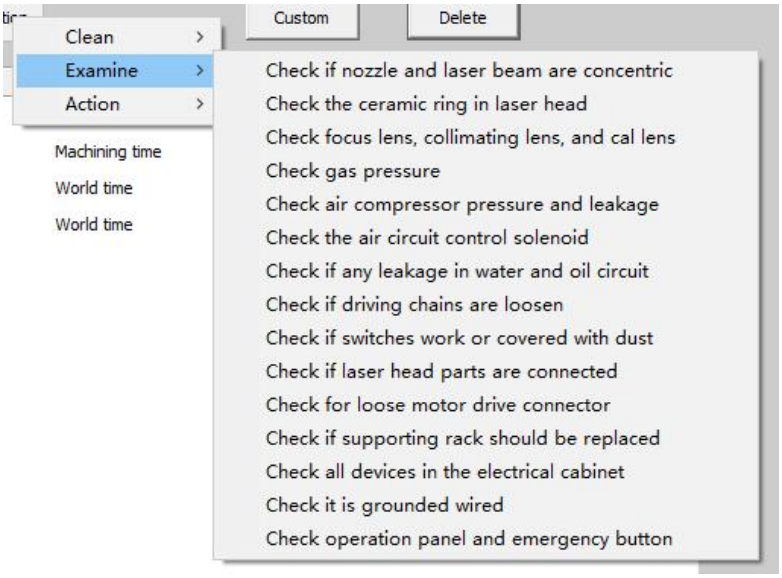


Figure 4-36 Examine

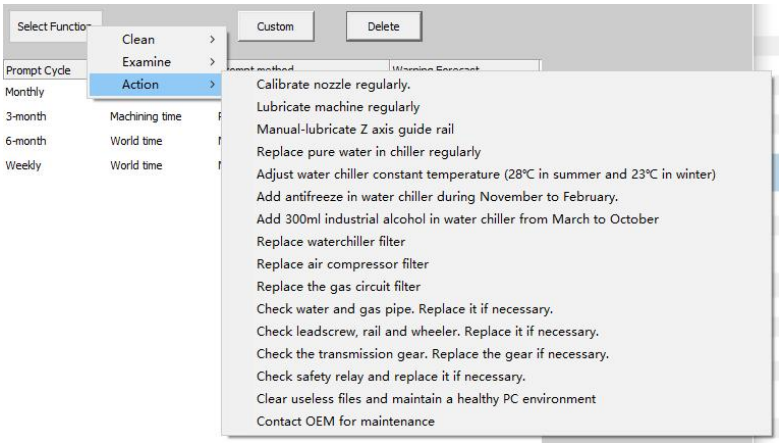


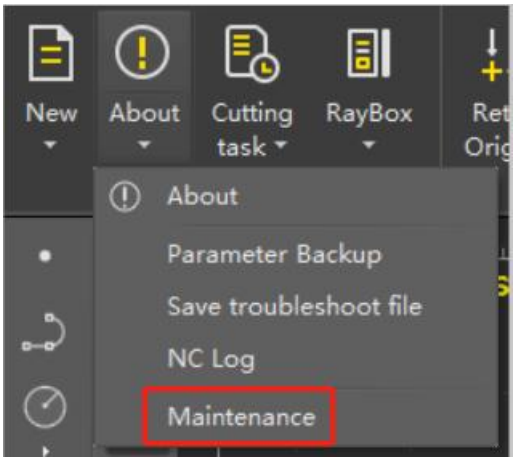
Figure 4-37 Action

When the maintenance functions are added, you can click the corresponding region to modify the ***Function Name***, ***Prompt Cycle***, ***Time Mode***, ***Prompt Method***, and ***Warning Forecast***. If you want to remove one of the functions, select it and click ***Delete***.

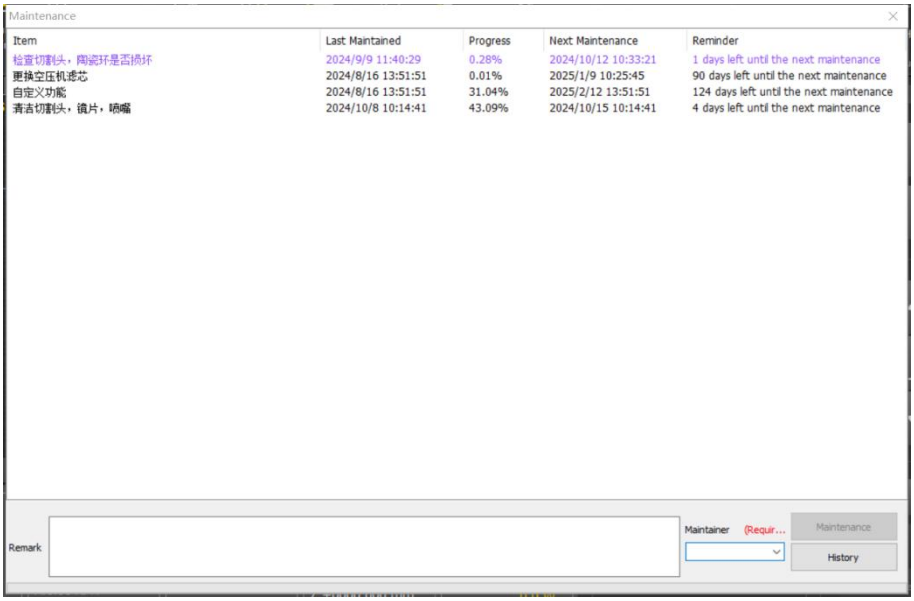
The maintenance alarm can be removed by regular maintenance, which should be performed as follows.

Step 1 Open FACut;

Step 2 Click the inverted triangle under the About icon to show the drop-down options;



Step 3 Click ***Maintenance***, and the maintenance dialog box will popup. Entries that indicate maintenance alarms are indicated in purple font;



Step 4 Click to select the corresponding maintenance entry, fill in or drop down to select the ***Maintainer***, and fill in the ***Remark*** as needed;

Step 5 Click ***Maintenance***, and the maintenance alarm will be removed.

4.17 Advanced Config

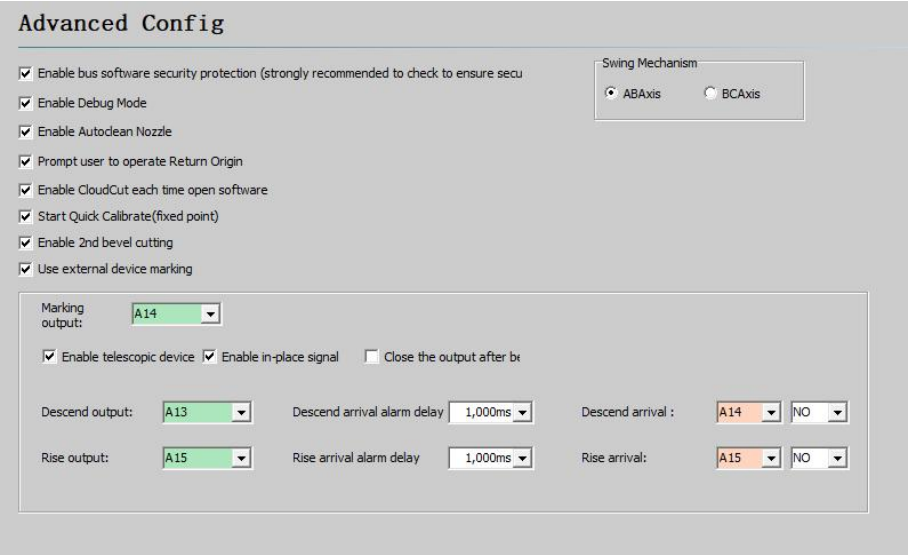


Figure 4-38 Advanced Config

Description of some of the advanced configuration parameters is given below.

- Enable Bus Software Security Protection: Recommended.
- Enable Debug Mode: Unchecked for normal use. When checked, you will not need to enter a password to open the FACut Config.
- Enable Autoclean Nozzle: A cleaning brush in a fixed position is needed.
- Prompt User to Operate Return Origin: When checked, every time you open FACut, it will trigger a return origin alarm, and the window of all return origin will pop up.
- Enable CloudCut each time open software: When checked, every time you open FACut, the CloudCut Assist will also be opened.
- Enable Quick Calibrate (fixed point): When checked, you can set a fixed coordinate for one-key calibration in the capacitance calibration interface of FACut.
- Use external device marking: When checked, during the configuration of marking output port, the corresponding output port on th expansion board should be connected to the external marking device. When the item ***Enable Telescopic Device*** is also checked, you can configure cylinders or independent height adjuster, and control the height of external marking device by IO communication.

4.18 IO List

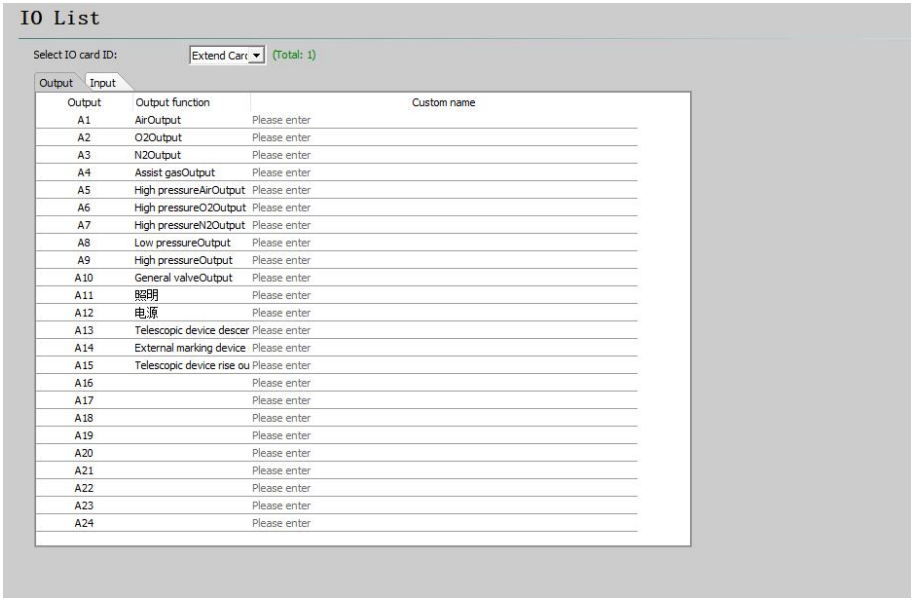


Figure 4-39 Output List

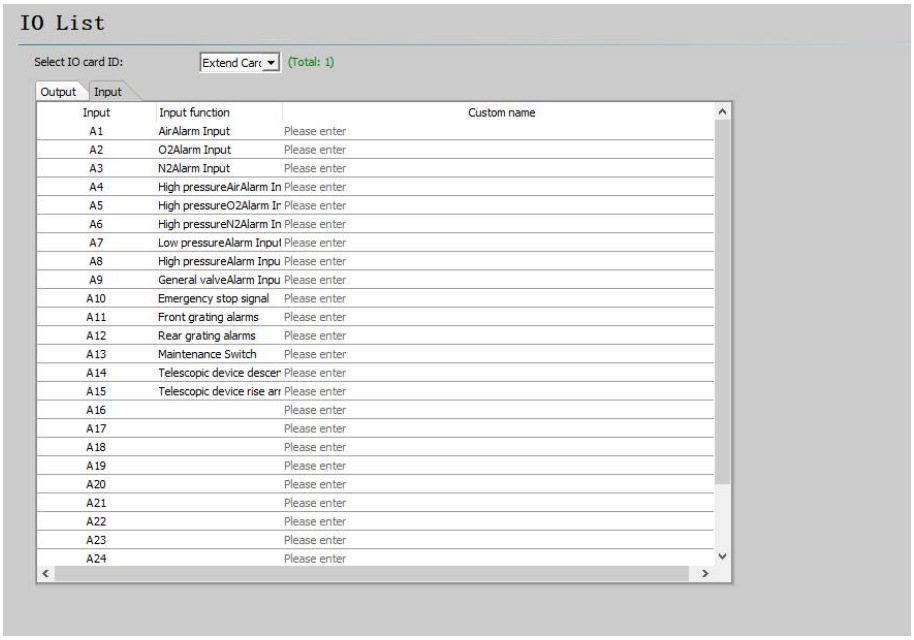


Figure 4-40 Input List

The total preview table of all I/O configuration of the machine. The system presets and customized I/O ports configured by the user in each module such as ***Logic Axis***, ***Bus Scan***, ***Alarm Input***, ***General Input***, and ***General Output*** will be displayed in this table. The I/O customized naming (shown in blue text) can be checked and revised in this table.

4.19 WKB

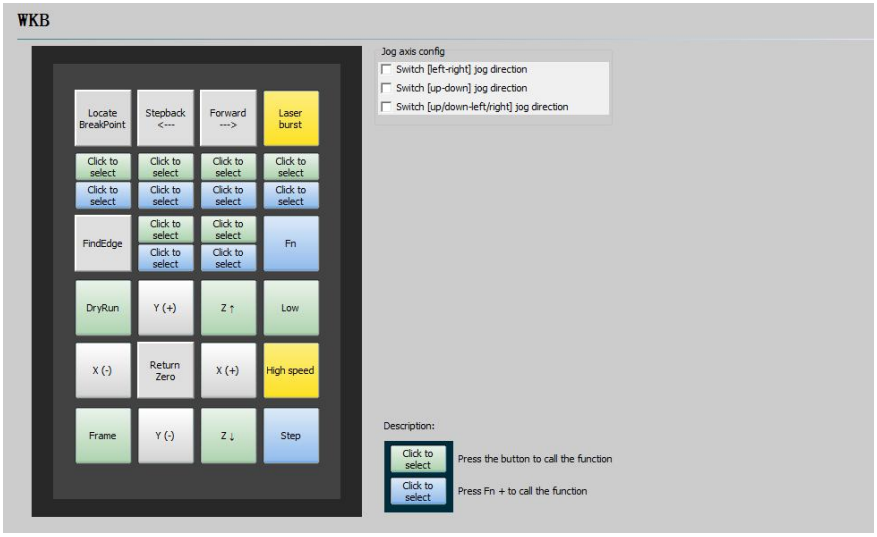


Figure 4-41 WKB

Configuration of the customized buttons on the hand-held box: Click to configure the functions corresponding to the 6 customized buttons on the hand-held box. At present, in addition to the basic machining control such as start and stop, it also provide functions such as return origin, jog axes, laser/ height/ gas control, common outport, dual-motor pallet changer, and invoking customized PLCs.

- Jog Axis Config: configure the orientation of the axis motion buttons on the handheld box.

4.20 NC Panel

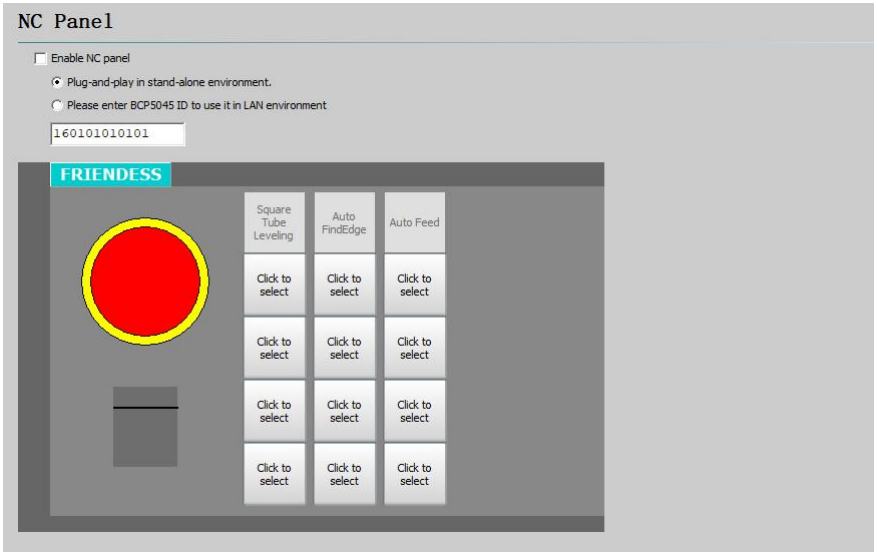


Figure 4-42 NC Panel

FACut support 5045 NC panel. The buttons can be configured as machining control, movement, and some functions related to machine peripherals.

4.21 Monitor

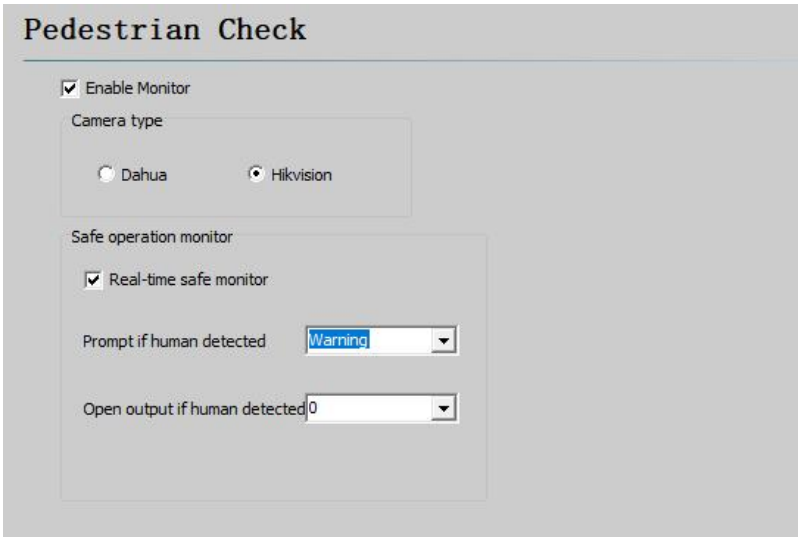


Figure 4-43 Warning

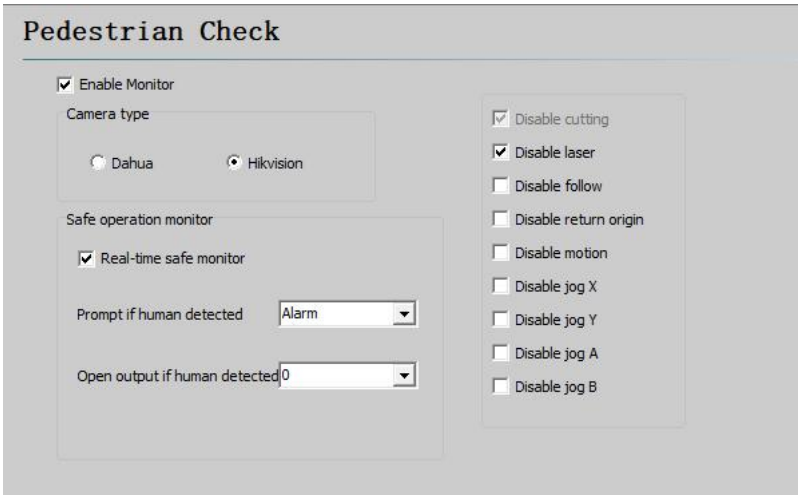


Figure 4-44 Alarm

After connecting to cameras with pedestrian detection function, you can enable the monitor in ***FACut Config*** → ***Planar NC System*** → ***Monitor***. When the item ***Enable Monitor*** is checked, choose the corresponding camera type. Check ***Real-Time Safe Monitor***, if the prompt show when human is detected is configured as ***Warning***, FACut will issue a warning when monitoring detects a person in the camera field of view, but will not restrict the machine movement. However, if the prompt is configured as Alarm, there will be alarm and restrict the machine movement when human is detected. Processing is not allowed by default when alarming, and the rest of the operation can be customized to prohibit or not, which is similar to the customized single input alarm permissions in ***Alarm Input***.

Besides, ***Open Output if Human Detected*** can be configured with an external device (e.g., a buzzer), so that the monitor automatically opens the set output port when it detects a person.

4.22 Plug-in

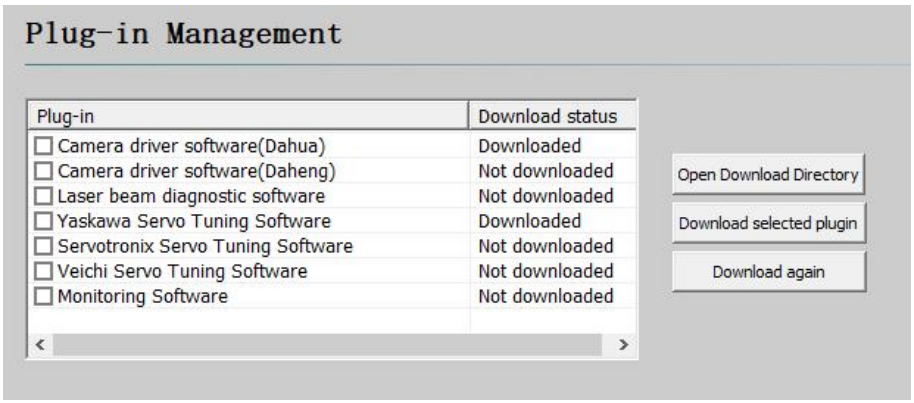


Figure 4-45 Plug-in Management

You can download plug-in needed in this ***Plug-in Management*** module.

Selecting the plug-in whose download status is ***Not Downloaded***, and click ***Download Selected Plugin***, then the download will start, showing ***Downloading***. When the downloading is done, the download status will be updated into ***OK***. Next time when you open FACut Config, the download status will be ***Downloaded***.

Click ***Open Download Directory***, you can open the directory that saves all the downloaded plug-ins. Every time open the FACut Config, the system will detect the download directory to update the download status of the plug-ins. If the corresponding files exist, then the download status of the plug-in will be shown as ***Downloaded***. If the files have been renamed, moved or deleted before opening FACut Config, then the status will be ***Not Downloaded***. Please note that the ***Download Selected Plugin*** is only effective for plug-ins with the status of ***Not Downloaded***, and the ***Download Again*** is only effective for plug-ins with the status of ***Downloaded***. After re-downloading, the original plug-in in the download directory will be overwritten.

Chapter 5 Precautions

5.1 **Wiring Precautions**

5.1.1 Drag Chain Wiring

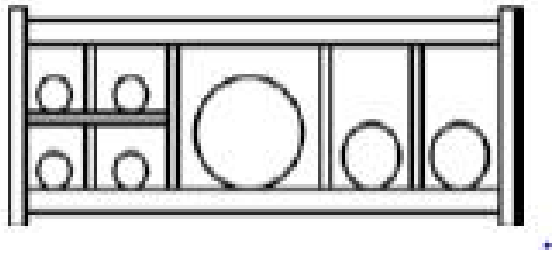
- When releasing the 4-pin cable from the coil, it is necessary to prevent the cable from twisting (the cable must be released along the tangential direction) and the cable must be laid straight. This should be done before laying the cables, to give the cables time for stress relief. Because the manufacturing process cannot completely guarantee that the cable is straight and free of distortion, the printed logo on the surface of the cable rotates in a tiny spiral.

Table 5-1 Cable Releasing

Correct	Incorrect
	

- Cables are not allowed to be twisted when installed in a closed space, and twisting during installation may cause damage to the core wire stranding. This effect is gradually strengthened during the operation of the cable, resulting in back-twisting, which eventually leads to the breakage of the core wire and failure.
- The cables must be laid loosely next to each other in the drag chain support. Spacers should be used to separate the cables as much as possible. The space between the cable and the spacer, separator, and the cable adjacent to it, shall be at least 10% of the diameter.

Table 5-2 Cable Laying

Correct	Incorrect
	

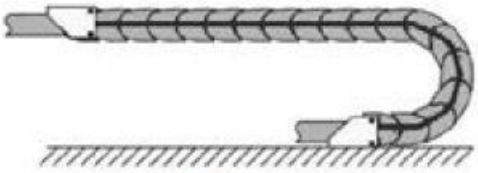
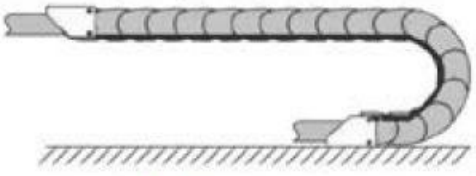
- The cables should be installed according to the weight and size of the cables. The larger diameter and heavier cables should be placed outside; the smaller diameter and lighter cables should be placed inside. The cables can also be placed from the inside out in descending order of size. Do not place one cable on top of another without using a spacer.
- For vertically suspended drag chains, keep more free space for the vertical support, because the cables will be stretched during operation. After a short run, it is necessary to check that the cables run along the center area and adjust them if necessary.
- For a self-supporting drag chain, cables are fastened to moving and fixed points. Suitable cable supports from the supplier are required. Cable ties have very limited applicability when operating at high accelerations. So you should not bundle multiple cables together. Cables should not be fixed or tied to any moving parts of the drag chain. The gap between the fixed point and the bending area should be wide enough.

Figure 5-2 Self-Supporting and Sliding

- It is recommended to fix the cable on the moving point for sliding drag chains. A small cable protection zone is required at the fixing point. (Refer to the instructions from the drag chain supplier)
- Please ensure that the cable runs along the center area with the desired bending radius. Do not apply tension to the cable (do not pull it too tightly), otherwise, the friction inside the drag chain will cause

the cable sheath to wear; do not let the cable be too loose in the drag chain, otherwise, it will easily cause abrasion of the cable and the inner wall of the drag chain, or tangled with other cables.

Table 5-3 Cable runs Along the Center Area of the Drag Chain

Correct	Incorrect
 Correct	 Wrong

- If the cable does not run smoothly, check whether it is twisted along the longitudinal axis during operation. The cable should slowly rotate at a certain fixed point until it runs freely.
- Given the size of cables and drag chains, their length characteristics vary considerably. During the first few hours, the cable naturally elongated. For drag chains, it takes more hours for this to happen. Such a large discrepancy can be remedied by regularly checking the cable installation locations. It is recommended to do regular inspections, every three months for the first year and at every maintenance thereafter. This includes checking that the cables are completely free to move within the intended bending radius and making adjustments if necessary.

5.1.2 Machine Tool Wiring

➢ Power Supply (Power) Wiring

- Strong Electricity
  - Strict separation of strong and weak electricity

Select the appropriate diameter for the power cable according to the power. The table below shows the cable diameter and its corresponding power.

Table 5-4 Cable Diameter and Corresponding Power

Cable Spec(mm2)	Cross Section （mm2）	25℃ Copper Wire Ampacity（A）	Single-Phase 220v Load Power（W）	Three-Phase 380v Load Power（W）
1.5	1.38	15	3300	9476.8
2.5	1.78	25	5500	13163.2
4	2.25	32	7040	16848.8
6	2.85	45	9900	23693.6
10	7*1.35	60	13200	31591.2
16	7*1.7	80	17600	42121.6
25	7*2.14	110	24200	57917.6

  - Add auxiliary devices such as short-circuit protectors and filters for strong electricity.
- Weak Electricity (DC24V for example)
  - Distinguish the positive and negative wires of the power supply in color, e.g., the red wire is connected to the positive pole, and the blue wire is connected to the negative pole.
  - Loads with relatively large interference (e.g., servos and solenoid valves) are powered separately from the controller.

➢ Grounding

- The ground wiring adopts the standard two-color wires, yellow and green.

- It is recommended to use multi-point grounding, for some high-frequency signals (PWM, pulse, encoder, capacitance, etc.) in the laser cutting machines.

- The machine tool uses galvanized grounding screws and a special grounding wire for grounding. The resistance between the grounded metal body and the main grounding point should be ≤ 0.1Ω。

➢ Signal (Control)

- Signal wire color, e.g., black.

- Choose the signal wire according to the power.

- DC 24V solenoid valve is recommended. Add absorption circuits at both ends of the solenoid valve, that is, connect a freewheeling diode in parallel at both ends of the solenoid valve (pay attention to the direction, withstand current, and withstand voltage), as shown in the figure below:

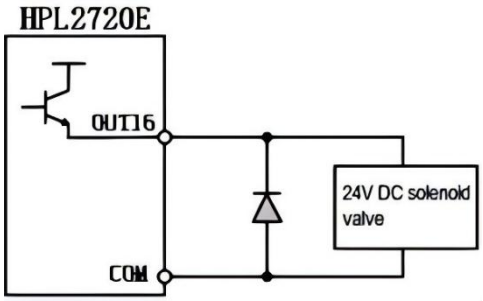


Figure 5-3 Connect a Freewheeling Diode in Parallel at both ends of the Solenoid Valve

- It is recommended that the digital signal (PWM) shielding layer be grounded at both ends, and the analog signal (DA) shielding layer be grounded at one end. Single-ended grounding can avoid low-frequency current noise on the shielding layer; double-ended grounding can effectively eliminate high-frequency interference. If the transmission cable is very long, it is recommended to ground at multiple points to ensure that the shielding layer is at the same potential.

- The resistance from the cutting head connected to the amplifier to the shell of the machine tool is ≤ 1Ω and the resistance to the grounding point of the electrical cabinet is ≤ 6Ω.

➢ Notes

- Each cable is marked clearly and accurately.

- Cables are parallel and not crossed, and the harnesses should be straight and leveled.

- If using the cables from Bochu, choose the appropriate cable according to the layout space, and do not pile up and circle it. All wiring must be firm to prevent sparking.

- Wiring should avoid loops and antenna effects. The current loop composed of signal source---transmission line---load is equivalent to a magnetic field antenna. As shown in the figure below, the wrong connection is on the left, and the correct connection is on the right.

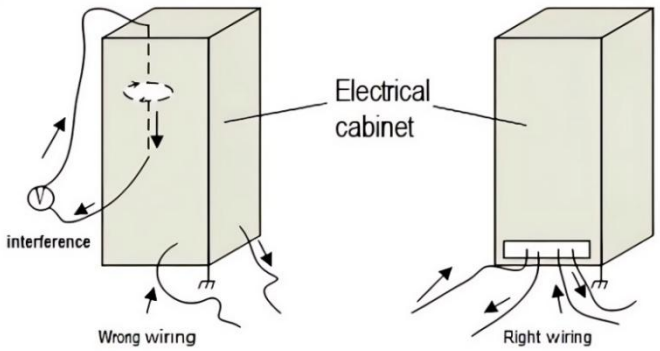


Figure 5-4 Cabinet Wiring

- It is recommended to use a star connection for wiring, not to use a serial connection, as shown in the following figure:

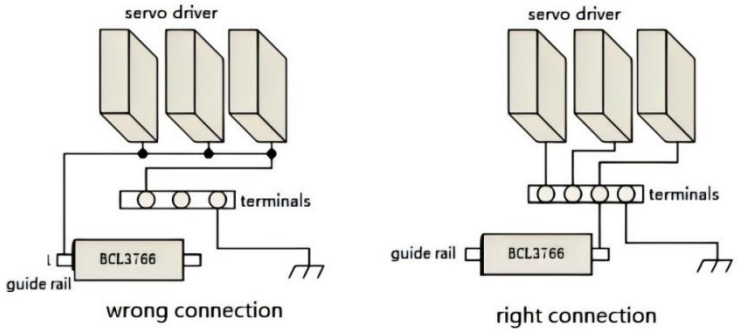


Figure 5-5 Star Connection

5.1.3 Assembly Requirements

Warning:

1. Handle with care. Please wear anti-static gloves or touch a grounded metal object to prevent static electricity from damaging the motion control card before touching the control card circuit or inserting/pulling the control card.

2. Except for the USB interface, plugging and unplugging with power is prohibited for other interfaces, which may cause internal components damaged.

3. Handle with care. Do not press the card. Pressing might cause the card to bend and its function damaged.

Chapter 6 FAQ

6.1 Host Failed to Enter the System

Here are the steps to solve this problem:

Step 1 Check the power LED status, and check if there is a “tick” when the computer boots. The power LED is green. When it is always on, it means the power supply is functioning well. The disk LED is yellow. When it blinks, it means the hard disk is recognized as normal;

Step 2 Check if the connectors of computer power and display are firmly connected, and whether the 24V voltage is regular;

Step 3 Check if standard cables are used and if the cable is firmly connected;

Step 4 Disconnect all other devices, only keep the power supply and display, and check if the computer can boot successfully;

Step 5 If the computer fails to power up, please get in touch with Bochu’s technical support.

6.2 System Corruption Caused by Virus or Excessive File Size.

Here is the step to solve this problem: follow system recovery operations.

6.3 BSOD

Here are the steps to solve this problem:

Step 1 Run anti-virus software to clean the system and see if the problem can be solved;

Step 2 Check whether uninstalling recently installed software or drivers can be solved. If this is the case, please confirm the compatibility with the software provider;

Step 3 Check if restoring the system can solve the problem;

Step 4 If all the above methods fail to work, please get in touch with Bochu’s technical support.

6.4 Control Card Identification Error

Here are the steps to solve this problem:

Step 1 Check whether the registration time is proper;

Step 2 Check the status of the Device Manager control card BMC228B. Rescan when BMC228B is not on the control card list; uninstall the control card and reboot if BMC228B is already on the list, then reconfirm if the card can be identified;

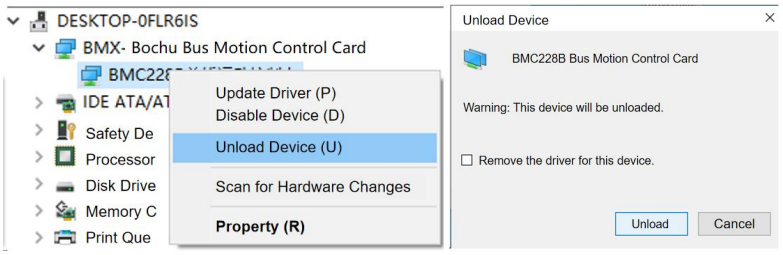


Figure 6-1 Unload Control Card

Step 3 Power off and reboot to confirm if the card can be identified;

Step 4 If you still can not find the control card, please get in touch with Bochu's technical support.

6.5 Bus Scan Error

Here are the steps to solve this problem:

Step 1 Check whether the EtherCAT bus servo and slave are powered up;

Step 2 Check whether the network cable is firmly connected;

Step 3 Check whether the bus slave device is a supported device of our system, if not, please contact our customer service. If it is, replace the corresponding slave and scan again;

Step 4 If the above measures still fail to scan the slave, please get in touch with Bochu's technical support.

6.6 Bus Network Alarm

Common bus network alarm symptoms and measures are shown in the table below:

Table 6-1 Measures to Solve Bus Alarm

Symptoms	Reason	Measure
Bus network alarm: Network cable not connected. Code: 0x9811002D	Slaves are not powered on or the network interface is incorrectly connected.	Check the power of slaves. Check network interface wiring.
Bus network alarm: Watchdog timeout alarm detected.	Communication timeout between software and BMC228X control card.	If the alarm lifted automatically, please ignore it. If it occurs during the processing operation, please record the operation steps and offer feedback to our customer service.
Bus network alarm: Network mismatch. Code: 0x9811001E	The cable between the computer EtherCAT port and the slave is loose or the slave has lost power connection.	1.Check the EtherCAT port wiring. 2.Organize the wiring to eliminate interference. 3.Check the slave power supply.
Bus network alarm: Frame loss. Code: 0x98110025	EtherCAT network communication data frame lost.	1.Check the EtherCAT port wiring 2.Organize the wiring to eliminate interference. 3.Check the slave power supply.
Bus network alarm: Slave not in OP.	The N^{th} slave may be defective, or the network cable between the $(N-1)^{th}$ slave and the Nth slave may be slack or disturbed.	1.Check the EtherCAT port wiring 2.Organize the wiring to eliminate interference. 3.Check the slave power supply.

Symptoms	Reason	Measure
Bus network alarm: Network timeout. Code: 0x98110010	Continuous loss of data frames in EtherCAT network communication.	1.Check the EtherCAT port wiring 2.Organize the wiring to eliminate interference. 3.Check the slave power supply.

6.7 USB Device Error

Here are the steps to solve this problem:

Step 1 Check whether the device is functioning well, replug the USB device, or replace the USB port and retest;

Step 2 Check if the USB extension cable is too long. HypTronic3 uses the standard USB3.0 interface, excessively long USB extension cables may not be able to recognize the USB device correctly. For longer extension cables, use active USB extension cables, and DTECH USB extension cables are recommended;

Step 3 USB 3.0 devices, such as USB drives and other adapters, may interfere with 2.4G wireless receivers, such as wireless keyboards and mice, resulting in lagging. This originates from the problem raised by Intel, that is, USB 3.0 devices with poor shielding effect will interfere with 2.4G devices. You can first check whether there is such a situation, i.e. whether USB 3.0 devices affect the normal operation of 2.4G wireless receivers. The following measures can be taken to solve the problem:

(1) Replace to USB device with a better shielding effect or a wired USB device;

(2) Connect USB3.0 devices or wireless devices to the USB2.0 extension cable;

(3) Keep USB3.0 devices away from wireless devices;

(4) If there is still a problem, please get in touch with Bochu's technical support.

6.8 Network Error

Here are the steps to solve this problem:

Step 1 Check whether the network IP and other settings are functioning well;

Step 2 Check whether the functions, settings and other settings of the connected network devices are functioning well;

Step 3 Check whether the network devices in the device manager and network settings are functioning well, with no exclamation mark or unusual number (4*EtherNet);

Figure 6-2 Network Settings

Figure 6-3 Network Adapter

Step 4 If there is still a problem, please get in touch with Bochu's technical support.

6.9 Visible Marking Artifacts and Noticeable End-Point Jitter in the Interpolation Follow Mode

After the error measurement debugging (driver gain adjustment), the rigidity level should be equal to or greater than 15 when the automatic adjustment is performed in the middle of the X-axis. If not, analyze the rigidity of the machine itself for the following possible causes:

- The Z-axis's structural parts are too long. It is recommended to keep it within 500mm, and if in longer length, please increase its structural strength;
- The screw stroke is too long. It is recommended to keep at about 300mm;
- The crossbeam is too long and with soft rigidity, and this is the case often happens when the crossbeam uses thinner material and with more hollowing out. Generally, the weakest rigidity part is in the middle of the X-axis travel. Touching the crossbeam by hand can feel its vibration or deformation during movement, thus assisting in determining the rigidity problem;
- The back plate is too thin;
- The sliders are placed narrowly, and are installed with the swing arm structure at both ends of the back plate;
- Connecting screws are not fastened.

6.10 In sufficient Roundness of the Ejector Pin Mark

After the error measurement debugging (driver gain adjustment), roundness is generally confirmed in the following ways:

- Conduct a yaw accuracy test, and observe whether the intersection point of the cross marking line is overlapped. If there is an obvious deviation, it is necessary to do the visual calibration and pendulum length correction again.
- Marking with pure interpolation and low-speed drawing circle to determine if the calibrated structural parameters are valid. This can also be determined by the parallelism of the two marking lines during ***Pendulum Length Correction***;
- Observe the curve monitor to confirm if the speed of any of the axes has been limited;
- Check the mounting accuracy of the three sides of the back plate;
- Make the visual calibration again and observe the shape and quality of the light spot at each angle. If the light spot is deformed at 40 degrees, then enable customized calibration to 30 degrees.

6.11 Detect Cutting is Slow While Cutting Without Detection is Inaccurate

Here are the steps to solve this problem:

Detect Cutting corrects the influence of plate deformation on machining accuracy by collecting capacitance. Enabling ***Real-time Plate Detect*** in the ***Global Parameter*** helps to omit the detection when machining the fixed attitude bevel toolpath, which can improve the cutting efficiency. The fixed attitude bevel toolpath means the cutter only yaws once before the machining, and the A and B axes stay still during the cutting process. Besides, if plate detection is a must, you can also check ***Use Customized Speed*** to make the plate detection faster.

6.12 Incorrect Cutting Dimension

After the Visual Calibration, if the cutting size is incorrect, the following ideas are generally used to confirm the cause:

- Check if the ***Swing Length Parameter*** is correct. Make sure to reset the swing length parameter after changing to a different length nozzle or re-performing ***Visual Calibration***.

- If two parts are narrowly placed, there will be a situation where the second cut approximates a hanging cut, making the capacitance sensing value inaccurate. This can be solved by enabling the ***Short Distance no Follow in the Global Parameter***.

- Check if the plate thickness is set correctly. If the thickness of the plate in the drawing is not consistent with the actual plate thickness, the actual cutting size will also be different from the size of the drawing.