FINGER CNC

Open Designs Customize The Future

# 8-Axis
# 3D Programming

## Compression Spring Machine Manual

**Version No：F202410SP8-3D-EN**

Guangzhou Finger Technology Co., Ltd

# CONTENTS

# 1.Document Overview

## 1.1 Revision History

| Modification Date | Note |
|---|---|
| 20241023 | Initial Draft |
| | |
| | |
| | |

## 1.2 About FINGER CNC

Guangzhou Finger Technology Co., Ltd. aims to develop high-performance open CNC systems that simplify automation development and make machine tool automation easily accessible. As one of China's high-performance controller manufacturers, Finger Technology focuses on customer needs, continuously pushing the boundaries of technological R&D to gradually form a comprehensive ecosystem of key automation technologies, providing customers with complete solutions and convenient services. We have established complete, professional, and efficient sales and service channels across various regions in China.

Finger Technology is dedicated to the R&D and production of CNC systems, motion controllers, edge computing controllers, Open CNC development platforms, CAD/CAM technologies, machine vision technologies, robotic control technologies, and industrial IoT technologies. Our industry-leading Open CNC development platform simplifies the customization of machinery and creates unique product value for our customers. Finger Technology proposes the integration of six core embedded technologies (motion control, HMI, PLC, machine vision, CAD/CAM, IoT) as part of our integrated product solutions, providing customers with optimal automation solutions. We have accumulated extensive

product experience and customer base in industries such as turning and milling centers, grinding machines, spring machines, tool machines, woodworking machinery, winding machines, spinning machines, pipe bending machines, and 3C electronics, continuously striving for excellence.

In the field of high-speed and high-precision, Finger Technology conducts in-depth research on various high-performance motion control algorithms, widely applicable to different industry needs. Especially in multi-axis linkage interpolation, RTCP five-axis linkage control, multi-axis multi-channel control, electronic cam, winding, and tension control technologies, we provide customers with a wider range of solutions.

Focusing on customer needs, emphasizing results, pursuing excellence in innovation, and respecting talent have been the core principles and values of Finger Technology since its inception. We remain dedicated to these principles, diligently advancing and consistently developing reliable, user-friendly automation products. By extending the Open CNC concept to customer endpoints, we create exclusive value for our clients.

# 2.Introduction

This manual strives to be as detailed and clear as possible. However, since the controller functions are constantly being upgraded, the manual may not always reflect the latest updates. If there are any discrepancies between the manual and the actual operations, or if anything is unclear, please feel free to contact us. This system is the most widely used and popular product, both in Taiwan and mainland China.

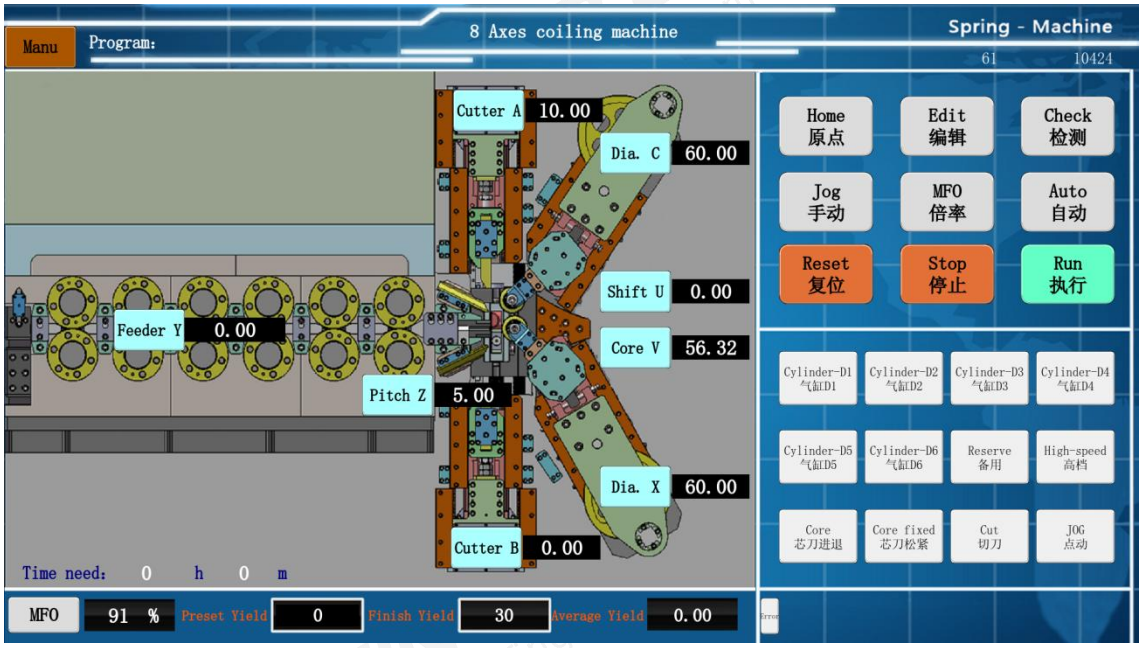
**Key Features:**

1. Closed-loop control system; maximum response speed of 4000 kpps. With a resolution of 1μm, the speed can reach up to 240 meters per minute.
2. Highly integrated hardware system reduces failure rates and significantly improves stability.

3. Customers can upgrade system software at any time through the controller's built-in USB interface. Optimized wiring offers external output signal boards for Relay (delay relay) and SSR (solid-state relay). The user-friendly operation method is easy to learn and use.
4. The processing program can be modified, and the machine speed adjusted using the handwheel without stopping the machine.
5. Simple repeat programming actions with adjustable probe speed, which significantly increases production efficiency, especially for applications like multi-cycle probe operations on flat springs.
6. Comprehensive safety design:
    1. Servo On signal is cut off during an emergency stop;
    2. Early warning system for motor overspeed;
    3. Safety door protection design;
    4. Material shortage or abnormal line rack shutdown protection;
    5. Automatic shutdown for fault alarms;
    6. Line rack synchronization.。
7. Stronger anti-interference capability compared to general PC-based controllers (during operation); the maximum voltage pulse within 0.01 seconds is 3000V per microsecond.
8. Better vibration resistance compared to general PC-based controllers (maximum of 0.075mm at 5Hz frequency) and a wider range of environmental temperature adaptability (operating at 0℃--55℃, storing or transporting at -20℃--45℃).

# 3.Main Interface Diagram and Key Descriptions

## 3.1Main Interface Diagram




## 3.2Computer Keyboard Diagram


Pressing this key at any time will stop the machine.

Note: Regardless of the machine's current operational state, pressing the "Reset" key will immediately halt the machine.


This key is the "Zeroing Mode" key. Pressing this key and selecting the zeroing axis (e.g., Origin X, Origin Z, Origin A, Origin B, Origin C, or Origin UV) will instruct the machine to execute the zeroing action on the selected axis.

Notes:

1. The X and C axes are for outer diameter control, the U axis is the transverse axis, the Z axis is the pitch axis, the A axis is the upper cutting blade axis, the B axis is the lower cutting blade axis, and the V axis controls the spindle movement. After starting the machine, all axes except the Y axis (which controls the wire feed) need to perform a homing action.
2. X and C Axes Zeroing Method: Move toward the origin sensor switch (negative direction) to zero.
3. Z Axis Zeroing Method: Same as the X axis.
4. A Axis Upper Cutter Zeroing Method: Move back to the topmost position of the upper cutter.
5. B Axis Lower Cutter Zeroing Method: Move back to the lowest position of the lower cutter.
6. Normally, the zeroing action is only required when a homing prompt appears on the computer. It is not necessary during routine machine adjustments.
7. After machine adjustment, if the X axis is not at the zero position, whether the operator runs "Check" mode or "Auto" mode, the computer will automatically return to the first line of the program. It will treat the X axis data from the first line as the "origin" and execute the program only after reaching that value. This applies to all other axes as well.
8. If there is an anomaly with the origin position, check if the proximity sensor is functioning correctly.。


In standby mode, press this button to enter the 3D programming mode. Enter values in the programming field to create a program. Simply input the spring dimensions, including the number of coils, outer diameter, and pitch, directly into the data table. A 3D representation of the spring will be automatically generated above the table. The closer the machine's parameter settings are to being precise, the more the actual spring will resemble the 3D model. A detailed introduction to machine parameter settings will follow.

Note: This button toggles the 3D programming mode. When turned off, it switches to standard programming mode.


In standby or programming mode, press this button to enter the program inspection mode. You must then press the "Execute" button to have the X-axis, C-axis, W-axis, P-axis, Z-axis, A-axis, B-axis, and V-axis automatically return to their starting positions (the Y-axis will automatically reset). Afterward, you can use the handwheel for production testing. In automatic execution mode, pressing this button will stop the machine immediately and switch it to program inspection mode, allowing you to use the handwheel for production testing.

Note: When using the handwheel in "Inspection" mode, the machine operates at the pace of the handwheel, which may be significantly slower than the current "Automatic" speed. This discrepancy can make it difficult to ensure that the products made in inspection mode are exactly the same as those produced in automatic execution mode.


After program editing is complete, press this button to enter the automatic startup mode.


Execute Command Button: In automatic mode, press this button to confirm startup. In test mode, pressing this button will enter the test standby state after zeroing. After modifying a program, press this button, and the system will execute the modified program after completing the final spring from the previous version of the program.


Stop Command Button: Used in automatic or test modes; the machine will stop after

completing the current cycle and enter standby mode.


In standby mode, press this button to enter manual mode. Select the axis you want to move, and turn the handwheel to rotate the selected axis (only one axis can be moved at a time; this button is ineffective in automatic execution mode).


Handwheel and Fast/Slow Speed Toggle Button: This button has two speed settings and is only effective in manual and test modes.


In automatic mode, press this button (the "Multiplier" on the main screen will light up), and turning the handwheel will change the machine's operating speed. Rotating forward increases the speed, while rotating backward decreases it. Once the desired speed is reached, press the button again to disable the function.


Four Cylinder Buttons: In manual or test mode, press each button once to open the corresponding cylinder, and press again to close it.


Two Cylinder Buttons: In any mode, press each button once to open the corresponding cylinder, and press again to close it. These are generally used for controlling the tension of the wire wheel.


The upper and lower cutters (A/B axes) can only be used in "Manual" mode when selected.

Note: Ensure the pitch axis has returned to the zero position and confirm safety before

executing this action, as it can be dangerous otherwise.


Core Knife In/Out Button: In manual or test mode, pressing the button once retracts the core knife, and pressing it again advances it.

Note: During automatic execution, the core knife must start in the advanced position, or the controller will not execute the operation and will issue an alarm warning.


Core Knife Tightening and Loosening


During detection execution, pressing and holding the jog button can simulate automatic execution. Once released, the program will pause, and you can use the handwheel for test execution.

## 3.3 3D editing screen are as follows：

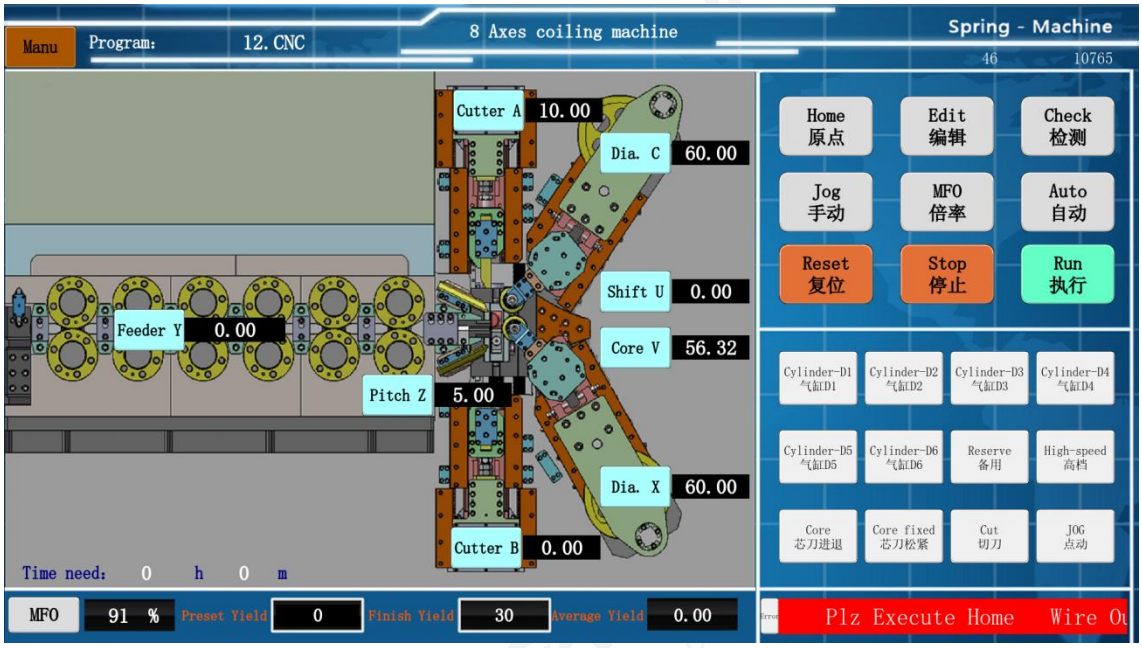
| | 送线长度 | 调整 | 总圈数 | 圈数 | 外径 | 间距 | 上切刀A | 下切刀B | 横移W | 横移P | 抽芯V | 探针 | 气缸 | 速度 | 停顿 | 循 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 27.80 | | 0.15 | 0.15 | 65.00 | 0.00 | 0.00 | | | | | | | | | |
| 2 | 26.82 | | 0.30 | 0.15 | 60.75 | 0.45 | | | | | | | | | | |
| 3 | 43.29 | | 0.55 | 0.25 | 61.38 | 2.10 | | | | | | | | | | |
| 4 | 43.81 | | 0.80 | 0.25 | 62.00 | 6.15 | | | | | | | | | | |
| 5 | 44.37 | | 1.05 | 0.25 | 62.63 | 10.35 | | | | | | | | | | |
| 6 | 45.23 | | 1.30 | 0.25 | 63.25 | 32.00 | | | | | | | | | | |
| 7 | 551.41 | | 4.15 | 2.85 | 70.38 | 17.00 | | | | | | | | | | |
| 8 | 622.27 | | 7.00 | 2.85 | 77.50 | 63.00 | | | | | | | | | | |
| 9 | 57.39 | | 7.25 | 0.25 | 78.13 | 9.75 | | | | | | | | | | |
| 10 | 56.98 | | 7.50 | 0.25 | 78.75 | 3.90 | | | | | | | | | | |
| 11 | 57.42 | | 7.75 | 0.25 | 79.38 | 0.45 | | | | | | | | | | |
| 12 | 57.90 | | 8.00 | 0.25 | 80.00 | 0.00 | | | | | | | | | | |

**Content Description:**

1. **Insert Row:** In programming mode, pressing this key will create a blank line above the current cursor position, allowing for the input of new programs. This function is disabled in programming modification mode.
2. **Delete Row:** In programming mode, pressing this key will delete the program line at the current cursor position. This function is disabled in programming modification mode.
3. **Get Coordinates:** Used to teach programming for obtaining coordinates in non-3D programming mode.
4. **Edit Modification:** This function allows for modifications to the program during its execution.
5. **Accumulate:** In programming mode, select the cell to be modified and click accumulate to choose how many rows of data in a column will be increased or decreased together.
6. **Clear Cell:** In programming mode, select the cell to be deleted and click to remove its data.
7. **Template Parameters:** This function is only available in 3D programming mode. In editing mode, users can click to select a spring template, set the corresponding parameters, and achieve automatic programming.

# 4.Setup Steps

## 4.1Power On to Standby Main Screen




Description:

Upon first powering on or when a system alarm occurs, the screen will flash “Please perform homing action!” At this point, the X, Z, A, B, C, U, and V axes must all be zeroed (axes that are not in use can be disabled in the parameter settings, eliminating the need for homing actions, and those disabled axes cannot be operated).

Program: Displays the number of the currently used program.。

1. X Y Z A B C U V: Dynamically displays the actual position of each axis.
2. Multiplier: Displays the speed multiplier during automatic operation. In standby or automatic mode, press the multiplier key and turn the handwheel to adjust the automatic multiplier, with a range of 1% to 300% (please check this value before starting the machine, as starting with too high a multiplier is not advisable).
3. Remaining Time: Displays the time required for the machine to continuously produce the preset output at the current speed.
4. Target Output: The target output can be set using the numeric keys and the input key.

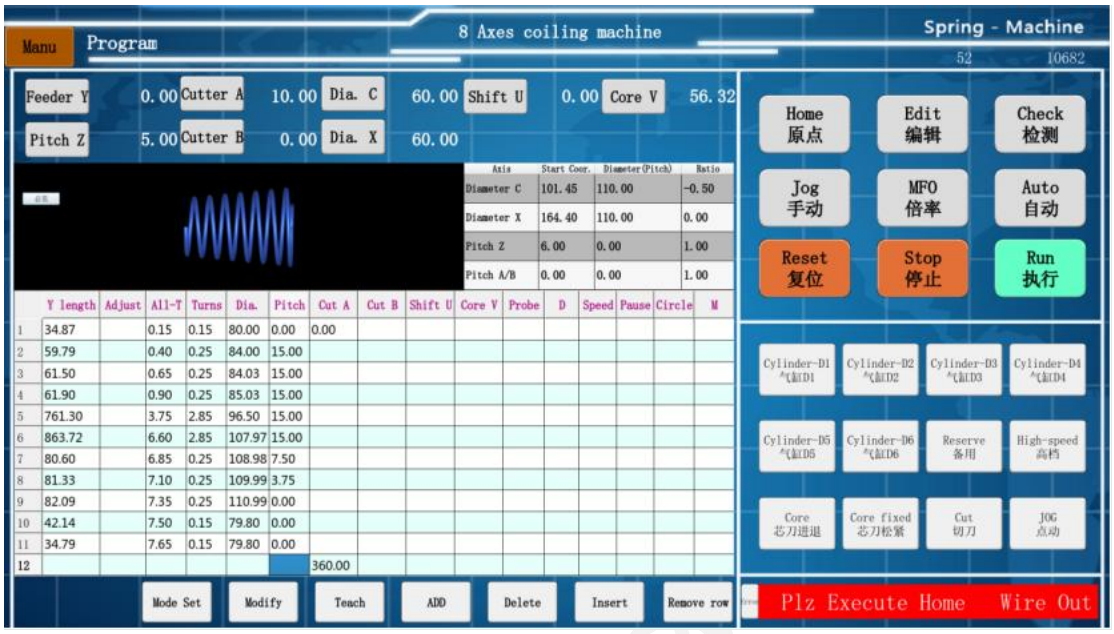
5. Completed Output: Dynamically displays the output that has been completed and can be changed using the numeric and input keys.
6. Average Output: Displays the average output produced by the machine at the current speed.
7. When there is a red alarm in the lower right corner, you can click to view the current alarms and historical alarms.

## 4.2Manual Inspection and Single Movement Cutting of the Cutter

Note: The single movement cutting of the cutter can only be performed in "Manual" mode; it is ineffective in any other mode.

Operation: In "Standby" mode, press the "Manual" key, select either the A axis or B axis, and then click "Cutter." The selected cutter axis (A axis or B axis) and the pitch axis will automatically return to zero simultaneously. After confirming safety, press the "Cutter" key to execute the cutting action. The stroke and speed of the cutter are set in the parameter interface.

# 4.3After Returning to Origin, Press "Edit" to Enter Programming Screen




**Content Description:**

At the top, the 3D programming data is displayed, depicting the 3D spring model.

Programming Table Description:

1. N ⇒ Program Line Number.
2. Feeding Length ⇒ The feeding length for this line calculated automatically by the system; it cannot be modified.
3. Adjustment ⇒ Adjusts the feeding length for this line, generally used for fine-tuning.
4. Total Turns ⇒ Automatically calculates the total number of turns for the spring from the beginning to this line; it cannot be modified.
5. Turns ⇒ Sets the number of turns for this segment of the spring.
6. Outer Diameter ⇒ Sets the outer diameter for this segment of the spring.
7. Pitch ⇒ Sets the pitch for this segment of the spring, in mm. Note: The pitch during winding is 0.
8. Upper Cutter A ⇒ Sets the angle value for the upper cutter axis.
9. Lower Cutter B ⇒ Sets the angle value for the lower cutter axis.
10. Lateral Movement U ⇒ Sets the lateral movement data for the outer diameter.

11. Core Withdrawal V ⇒ Sets the data for the servo core withdrawal and return.
12. Probe ⇒ Sets the length of the auxiliary feeding for the probe.
13. Cylinder ⇒ Sets the action of the cylinder; positive number opens it, negative number closes it.
14. Speed ⇒ Sets the percentage of the single-line running speed relative to the predetermined speed; the default value is 100% if left blank. The setting range is 1-300%.
15. Pause ⇒ Sets the pause time for a single line, in seconds. Filling in 1.00 means a pause of 1 second.
16. Loop ⇒ Sets the range for the loop; fill in 1 for the starting line and the number of times for the ending line.
17. Auxiliary ⇒ Sets which axis the current line's speed is based on; 1-6 correspond to XYZABC respectively.

Explanation of Parameters for Outer Diameter and Pitch in 3D Programming:

When using 3D programming, since the data represents the spring's size, the cam angle data must correspond to the actual dimensions of the spring. Once the tool is correctly installed, set the cam angles that correspond to the different outer diameters of the spring. Typically, you would set the starting coordinates for the smallest outer diameter and the corresponding X and C coordinates for the outer diameter tool, then adjust the scaling factor. For example, setting a value of -0.5 means that for every 1mm increase in outer diameter, the cam angle will retreat by 0.5 degrees.

The same method applies to setting the pitch axis. Typically, the starting coordinates are set for the winding operation (with a corresponding pitch of 0), and then an appropriate scaling factor is determined (i.e., for every 1mm increase in spring pitch, how much the pitch axis will move).

Note: The pitch A/B values only need to be filled in when the cutter axis is used for setting the pitch.

## 4.4Press “Detect” to Access the Detection Screen

**Content Description:**

Pressing the “Execute” button will keep the screen format unchanged. If any axis is not at its starting position, the machine will automatically return to the starting position before waiting. You can manually check by turning the hand wheel or press the “Jog” button for point detection. Once safety and program correctness are confirmed, press the “Auto” button to start automatic execution.

## 4.5Press the “Auto” Button to Access the Automatic Startup Screen

**Content Description:**

In standby mode, pressing the “Auto” button will automatically switch the screen to the automatic mode. Then, press the “Execute” button to automatically run the programmed sequence.

During the spring-making process, if minor issues arise (e.g., the wire is slightly too long or too short), adjustments can be made without stopping the machine by following the steps below.

## 4.6Press the “Programming Modification” Button in the Programming Interface to Enter Modification Mode

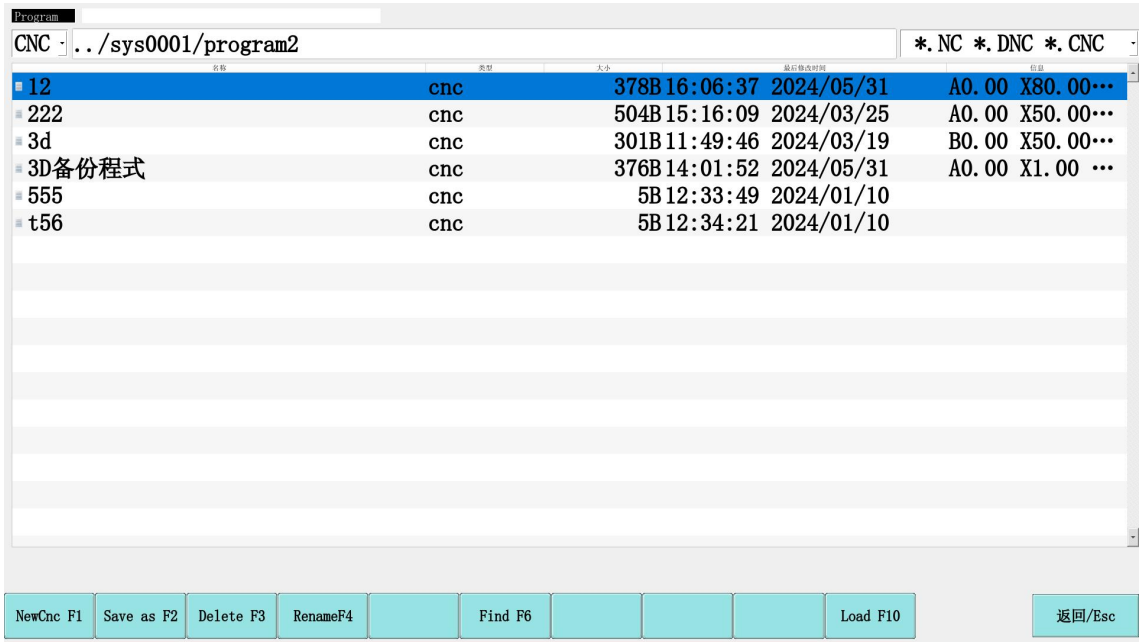
**Content Description:**

After pressing the programming modification button, the edit button will light up. Move the cursor to the position you wish to modify and enter the new data. Once all modifications are complete, press the execute button. The machine will execute the modified program

after completing the previous spring, and the working mode will switch to “Automatic.”

## 4.7Press the “Program Management” Button in the Top Left Corner of the Main Menu to Call Existing Old Programs

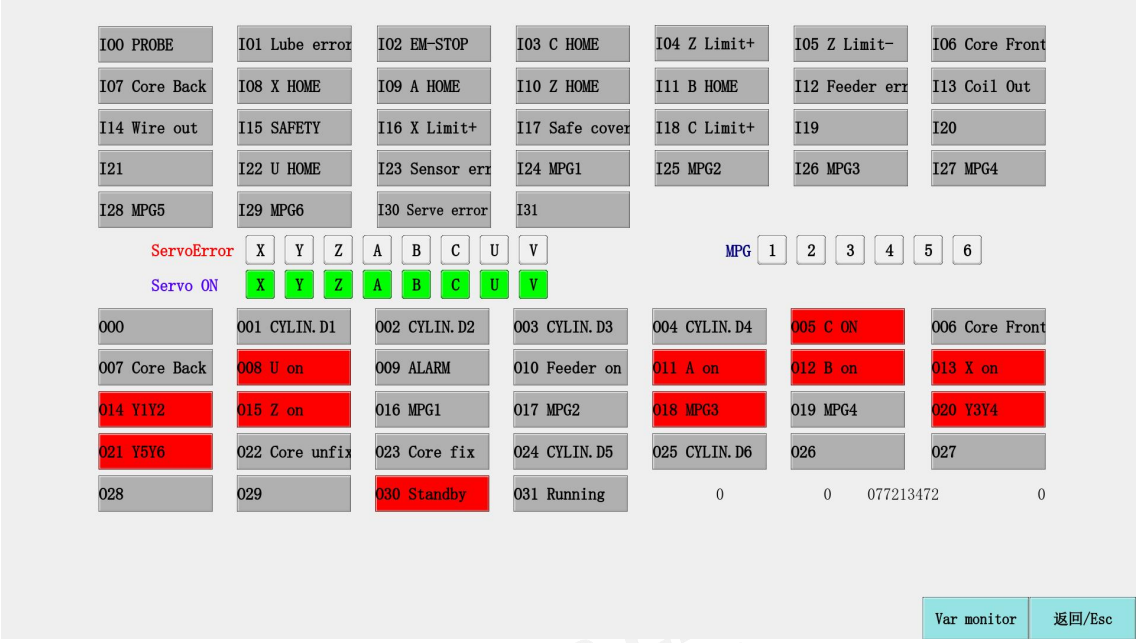
Pressing the program management button will take you to the program directory screen, which displays all program numbers.



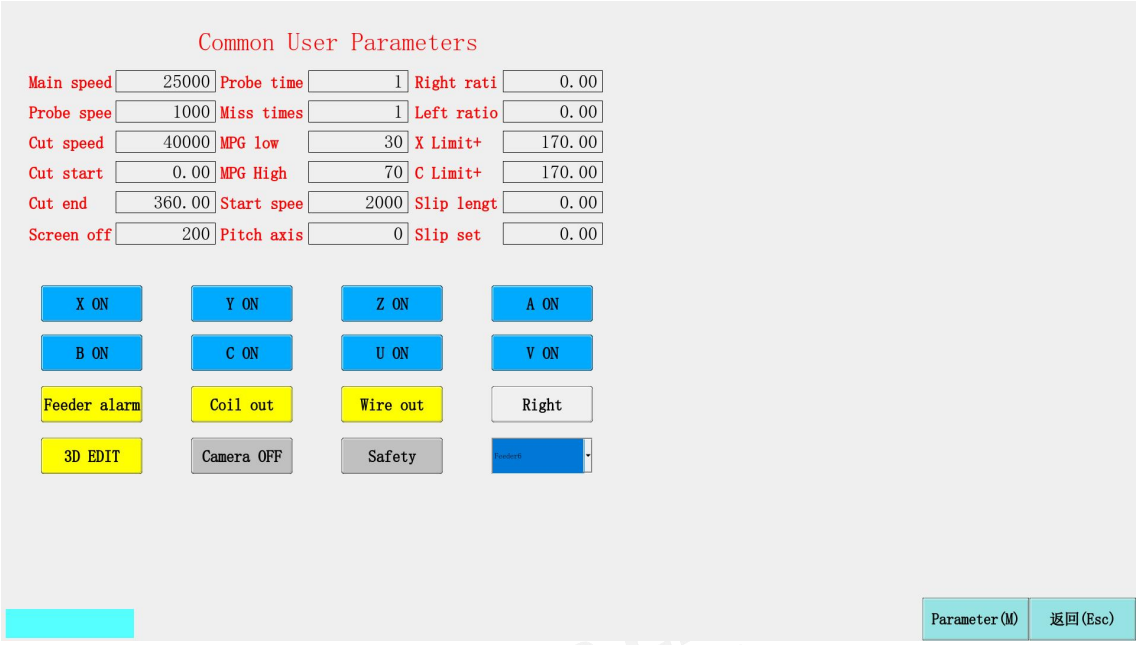

**Content Description:**

1. Load Program F10: Allows you to select the chosen program.
2. New Program F1: Create a new program with any desired name.
3. Save As F2: Save the current program under a new name for easier modification.
4. Delete F3: Delete the selected program; the current program cannot be deleted.
5. Rename F4: Rename the selected program; the current program cannot be renamed.
6. Search F6: You can enter keywords of the program name to search for similar program names based on prompts.

# 4.8The "I/O Monitoring" function key in the top left main menu allows you to view input/output monitoring



# 4.9The "Parameter Setting" function key in the top left main menu leads to related setting parameters



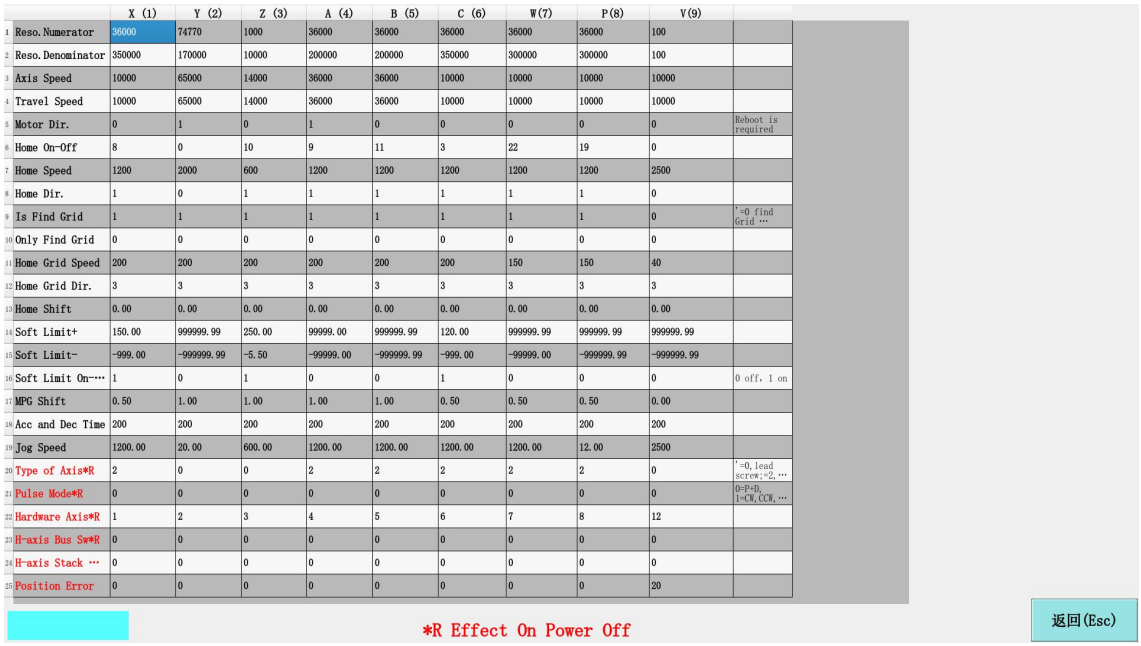

- This screen lists user parameters, among which the following items can be adjusted appropriately:

1. Internal Speed: Refers to the speed of the machine when the "automatic ratio" is set to 100%. It can be modified, with a range not exceeding one-third of the maximum feed speed of the active axis during automatic execution. The unit is degrees/minute (for rotating axes) or millimeters/minute (for linear axes). The default active axis in the program is the Y axis, meaning it fills one-third of the maximum feed speed of the Y axis.
2. Probe Speed: Refers to the speed at which the machine runs while probing (with the same unit and concept as internal speed). It can be modified, but the range must not exceed the internal speed value. When a probe (Yf) is set in the program, this speed applies during the auxiliary feeding segment of the program, with units being degrees/minute (for rotating axes) or millimeters/minute (for linear axes).
3. Pitch Axis Direction: Refers to the axial direction of the machine's pitch drive, which can be either the Z axis or the upper/lower cutting tool AB axes.

4. Cutter Speed: Refers to the execution speed of the upper and lower cutters during a single operation.
5. Cutter Start and End: Refers to the starting and ending angles of the upper and lower cutters during a single operation.
6. Left and Right Rotation Ratio: Refers to the ratio at which the transverse axis automatically follows the outer diameter changes during left and right rotation.
7. Manual Low Speed: Refers to the slow gear when using the handwheel, with a default value of 10 and a modification range of 1–100.
8. Manual High Speed: Refers to the fast gear when using the handwheel, with a default value of 30 and a modification range of 1–100.
9. Return to Zero Speed: Refers to the speed at which each tool returns to its starting point during detection execution.
10. Slip Error: Sets the maximum value for the feeding wheel's slip. If exceeded, an alarm will trigger and the machine will stop.。
11. Slip Setting: After powering on, at the origin, and for the Y axis, ensure that the feeding wheel is pressed tightly against the steel wire and that the anti-slip encoder is correctly installed. Manually feed about 200 mm, then set the slip parameter here to 1.00. The system will automatically record the relationship between the encoder and the feeding wheel to detect any slip and will automatically reset to zero. Note: The same type of wire and wheel only needs to be set once. When changing to different materials, the settings need to be adjusted again to ensure accurate slip data.

- Press "Mechanical Parameters" to enter the manufacturer parameters (manufacturer password is required to access; users cannot modify this without authorization!).

Note: The hydraulic parameter settings on the right must only be modified under the guidance of a professional, as the hydraulic system is complex and users are not advised to make adjustments themselves.



| | X (1) | Y (2) | Z (3) | A (4) | B (5) | C (6) | W(7) | P(8) | V(9) | |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 Reso. Numerator | 36000 | 74770 | 1000 | 36000 | 36000 | 36000 | 36000 | 36000 | 100 | |
| 2 Reso. Denominator | 350000 | 170000 | 10000 | 200000 | 200000 | 350000 | 300000 | 300000 | 100 | |
| 3 Axis Speed | 10000 | 65000 | 14000 | 36000 | 36000 | 10000 | 10000 | 10000 | 10000 | |
| 4 Travel Speed | 10000 | 65000 | 14000 | 36000 | 36000 | 10000 | 10000 | 10000 | 10000 | |
| 5 Motor Dir. | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | Reboot is required |
| 6 Home On-Off | 8 | 0 | 10 | 9 | 11 | 3 | 22 | 19 | 0 | |
| 7 Home Speed | 1200 | 2000 | 600 | 1200 | 1200 | 1200 | 1200 | 1200 | 2500 | |
| 8 Home Dir. | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | |
| 9 Is Find Grid | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | '=0 find Grid … |
| 10 Only Find Grid | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 11 Home Grid Speed | 200 | 200 | 200 | 200 | 200 | 200 | 150 | 150 | 40 | |
| 12 Home Grid Dir. | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | |
| 13 Home Shift | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | |
| 14 Soft Limit+ | 150.00 | 999999.99 | 250.00 | 99999.00 | 999999.99 | 120.00 | 999999.99 | 999999.99 | 999999.99 | |
| 15 Soft Limit- | -999.00 | -999999.99 | -5.50 | -99999.00 | -999999.99 | -999.00 | -99999.00 | -999999.99 | -999999.99 | |
| 16 Soft Limit On-… | 1 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 off, 1 on |
| 17 MPG Shift | 0.50 | 1.00 | 1.00 | 1.00 | 1.00 | 0.50 | 0.50 | 0.50 | 0.00 | |
| 18 Acc and Dec Time | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | |
| 19 Jog Speed | 1200.00 | 20.00 | 600.00 | 1200.00 | 1200.00 | 1200.00 | 1200.00 | 12.00 | 2500 | |
| 20 Type of Axis*R | 2 | 0 | 0 | 2 | 2 | 2 | 2 | 2 | 0 | '=0, lead screw;=2,… |
| 21 Pulse Mode*R | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0=P+D, 1=CW, CCW,… |
| 22 Hardware Axis*R | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 12 | |
| 23 H-axis Bus Sw*R | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 24 H-axis Stack … | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 25 Position Error | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 20 | |



## 1. Resolution Numerator

1) Rotary Axes (including cam shafts and spindle shafts):

Resolution Numerator = Angle of one full rotation of the rotary axis = 360 × 100 (unit: 0.01 degrees)

For example: For axis A (if it is a cam), the resolution numerator = 360 × 100 = 36,000.

2) Linear Axes using Feeding Wheel (Feeding Axis):

Resolution Numerator = Circumference of the feeding wheel = π × Diameter (unit: 0.01 mm)

Note: The set value should be in integer format, without decimals.

For example: For the Y axis, the resolution numerator = 3.14159 × 100 × 100 = 31,416. (31,416 is just a theoretical calculation value. Due to certain tolerances in the actual production of feeding wheels, adjustments can be made during setup based on actual conditions.)

3) Linear Axes using Lead Screws:

Resolution Numerator = Lead of the lead screw (unit: 0.01 mm)

For example: Assuming the lead screw pitch is 5 mm, then the resolution numerator = 5 × 100 = 500.

Z Axis Resolution Denominator = 2000 × 4 × 1 = 8000

Note: The resolution numerator and denominator are determined based on the mechanical axial drive mechanism and the resolution of the servo motor encoder, as well as the signal multiplier. Once set, please do not adjust arbitrarily.

**2. Feedback Multiplier**

Set the feedback signal multiplier for the target axis motor encoder, which can only be selected from the values 1, 2, or 4.

When selected as 1, the controller will treat the four signals from the servo motor (A, A-, B, B-) as one signal.

When selected as 2, the controller will treat the four signals as two signals.

When selected as 4, the controller will treat the four signals as four signals.

Choosing 4 provides the highest machine precision, but it requires the motor to have larger inertia; otherwise, it may cause machine vibration and increased noise. Considering the motor selection situation in the domestic market, it is generally recommended to select 4 for the signal multiplier. If adjustments are made, the corresponding resolution denominator for the axis must also be adjusted accordingly.

**3. Motor Direction**

Setting = 0: The rotation direction is positive.

Setting = 1: The rotation direction is negative.

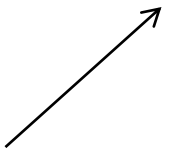
The machine design varies by manufacturer. After installing the servo motor, if the machine runs in the opposite direction, this parameter can be adjusted to correct the machine's direction.

**4. Maximum Feed Rate**

Set the maximum feed rate for the axis, with the setting value in integer format without decimal points.

1) For rotating axes:

Maximum Feed Rate=Maximum Servo Motor Speed ÷Gear Ratio × 360 × 0.95（Unit: degrees/minute）



(Recommended Maximum Value for Safety Considerations)

Example:

For the A-axis, the maximum feed rate can be calculated as follows:

Maximum Feed Rate＝1500÷10×360×0.95＝51300（highest limit）、

When setting the actual value, it can be set to 50000 for practical use.

2) Example for Linear Axis:

For the Y-axis, the maximum feed rate can be calculated as follows:

Maximum Feed Rate＝Servo Motor Maximum Speed÷Gear Ratio

×Circumference (Pitch) ×0.95

Using the provided values:

Y-axis Maximum Feed Rate＝2000÷6.25×314.16×0.95＝95504（highest limit）

When setting the actual value, it can be set to 95500 for practical use.

**5. Origin First Stage Speed and Origin GRID Speed**

In the FINGER CNC series controller, the rate for returning to the machine's origin is divided into three stages:

1) First Stage Speed:

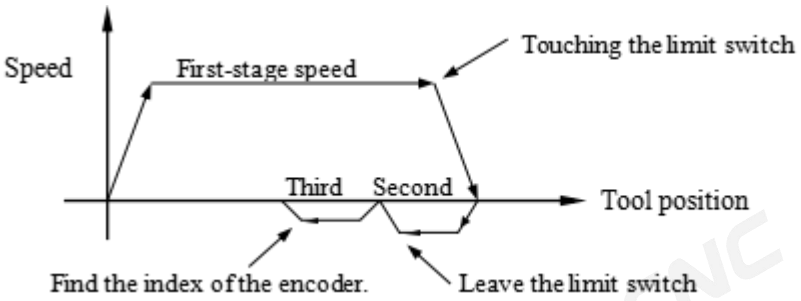
The first-stage speed for each axis is set by the parameter "Origin First Stage Speed", which specifies the initial speed for the machine to move from its current position toward the origin.。

2) Second Stage Speed:

When the first stage slows down to zero, the second stage is automatically set to one-fourth of the first stage speed.

3) Third Stage (GRID) Speed:

The speed for finding the feedback sensor's zero point (Grid) is set by the parameter "Origin GRID Speed".




**6. Origin Search Direction**

Set = 0 for the motor to return to the mechanical origin in the positive coordinate direction. Set = 1 for the motor to return to the mechanical origin in the negative coordinate direction.

**7. GRID Point Search Direction**

Set = 0 to indicate that during the return to the mechanical origin (HOME), the second and third stages leave the limit switch to find the zero point (GRID) in the opposite direction of the first stage.

Set = 256 to indicate that during the return to the mechanical origin (HOME), the second and third stages leave the limit switch to find the zero point (GRID) in the same direction as the first stage.

**8. Origin Offset Value**

This parameter sets the mechanical origin offset value for the target axis, in degrees (for rotational axes) or millimeters (for linear axes). When the machine returns to the mechanical origin, the motor will offset by the specified amount after reaching the original mechanical origin and stop at the new mechanical origin. The new origin coordinate will display as “0.” Offset values can be positive or negative, with positive values indicating an offset in the positive coordinate direction and negative values indicating an offset in the negative direction.

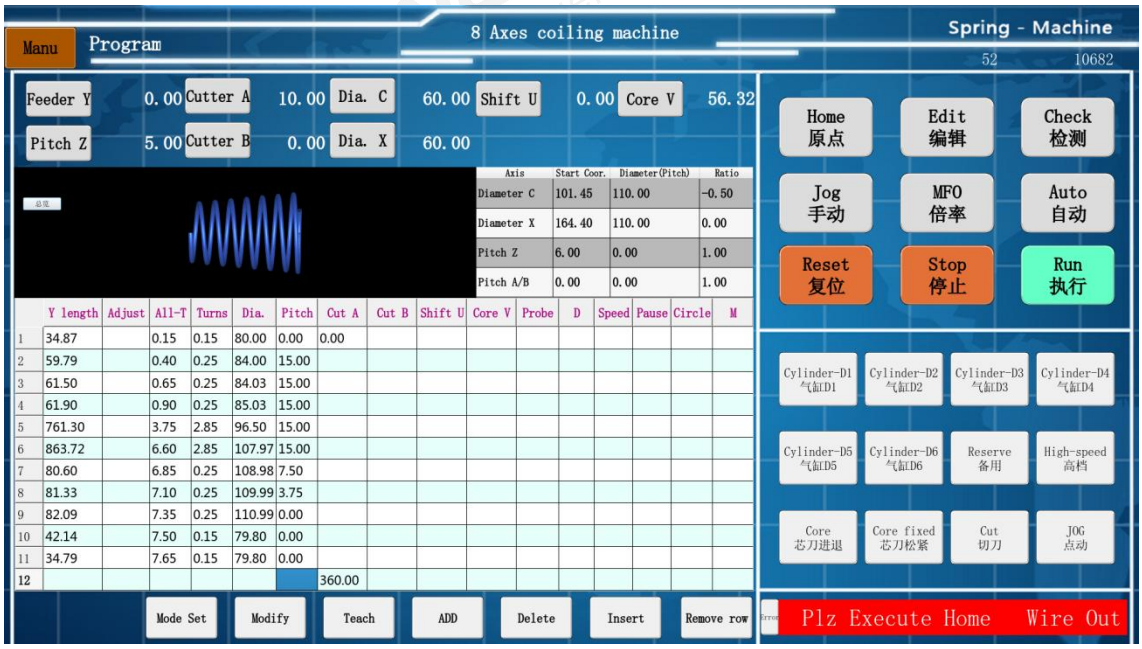
**9. Acceleration and Deceleration Time**

Setting range: 10–200 milliseconds, representing the acceleration and deceleration time of each axis’ servo during startup and braking. Typically, for machines with a few millimeters of wire diameter, this is set to a few dozen milliseconds (e.g., 50 ms for a 5 mm

model).

# 5.Program Example

Example: (This example does not use cylinders, probes, cycles, or core knives)




Explanation:

1. The X-axis and C-axis move first to the angle corresponding to an 80 mm outer diameter, and then the lead Z-axis moves to 0. Both the wire feed and lower cutting knife axes remain stationary.
2. The wire feed moves 0.15 turns, which equals 34.87 mm.
3. The lead pushes to a position with a 15 mm pitch from the starting point. Simultaneously, the Y-axis feeds the wire by 59.79 mm, and the outer diameter increases from 80 mm to 84 mm. The other axes remain stationary. The wire feed length is automatically calculated based on the outer diameter.
4. Following the same pattern, during wire feeding, the outer diameter and lead axes move synchronously.

5. The upper cutting knife (A-axis) moves from 0 to 360 to perform the cutting.
6. The upper cutting knife automatically returns to 0, and the lead returns to the starting position. The program ends.

# 6.System Status Alerts

Status alerts appear in the bottom right corner of the controller screen, displaying a flashing message. These alerts indicate the necessary actions or faults that require immediate attention. The following alerts may be displayed:

1. Please execute the homing action first! (Appears after powering on or when system alarms occur)
2. Probe failure, please address it! (Appears and stops the machine when the probe failure reaches the set threshold)
3. Out of wire, please address it! (Appears and stops the machine when the wire runs out or breaks)
4. Exceeded the first software limit! (Occurs when the axis data in the program exceeds the limit)
5. Servo alarm, please address it! (Check the alarm fault code on the drive)
6. Wire rack alarm, please address it! (Appears and stops the machine when there is a wire rack alarm)
7. Color mark sensor alarm! (Alarm triggered by a color mark sensor detecting an abnormality)
8. Wire feed roller slip alarm! (Triggered when the anti-slip function is enabled and the wire roller slips or the slip encoder has an issue)
9. Core seat locking abnormal! (The core seat locking signal is not in place)
10. Insufficient locking pressure! (The corresponding hydraulic locking pressure has not reached the set value)
11. Hydraulic servo alarm! (Check the hydraulic servo for fault codes)

12. Hydraulic system abnormal! (Check the hydraulic servo and pressure gauges, as prolonged insufficient system pressure will trigger an alarm)
13. Wire misalignment alarm, please address it! (Check for wire misalignment or if I14 is activated unexpectedly)

# 7.Alarm Causes and Resolutions

**1. Software Limit**

Cause: The set angle of the outer diameter tool is too large.

Resolution: Enter the parameters to check the X and C axis limits and the programming data.

**2. Motor Overheat Alarm**

Cause: Motor or driver malfunction.

Resolution:

① Check if the motor is overheating.

② Turn off the main power and check whether the machine runs smoothly; if not, troubleshoot the issue.

③ Manually rotate the motor shaft. If it turns, the driver is not sending signals to the motor. Open the control box under the machine and check the driver's display in the top-right corner. If the display is not showing a regular blinking cursor, contact maintenance staff.。

**3. Production Reached**

Cause: The preset production quantity has been completed.

Resolution: Move the cursor to reset the completed production counter to zero.

**4. Hydraulic System Abnormal**

Cause: A fault in the hydraulic system.

Resolution: Press the emergency stop to halt the hydraulic system, then release it to allow the system to reset automatically. Manually check each hydraulic circuit and ensure the

pressure is normal.

**5. Wire Feed Roller Slip Alarm**

Cause: The length detected by the encoder does not match the system's wire feed length.

Resolution: Check whether the wire feed roller is properly pressed, and if the pressure is normal. Also, check whether the encoder's passive roller is gripping the wire securely to avoid slippage.

**6. Program Memory Error**

Cause: If the computer fails to recover lost memory, the battery may be depleted.

Resolution: Replace the motherboard's CPU backup battery.

Cause: Program loss due to operator error or system initialization.

Resolution: Press the "Reset" key repeatedly and wait for two to three minutes. Then turn off and restart the computer; it will automatically recover the lost program.

**7. Emergency Stop, EM-STOP**

Cause: Emergency stop switch is triggered or I02 is disconnected.

Resolution: Release the emergency stop or check I02, then press the "Reset" key.

# 8.Common Fault Analysis

**1. Cannot Find Home Position**

1) The home position sensor does not signal or light up. Solution: Replace the sensor.
2) The IO board cannot receive the home position signal (no indication on the screen). Solution: Replace the IO board.
3) The home signal is normal, but the motor cannot find the home (Grid) position. Solution: Set the parameter to external home mode to skip searching for the motor home position.

**2. Abnormal Home Position**

1) In motor home mode, an abnormal home position indicates an unstable motor home signal or interference.

2) In external home mode, this suggests a loose home position sensor or an unstable sensor signal.

**3. Motor Automatically Moves When Computer is Powered On**

Incorrect wiring between the controller and the driver, or incorrect encoder wiring between the motor and the driver.

4. **Probe Not Sensitive**

1) Poor probe wiring, or mismatch between probe precision and speed settings.

2) Poor wire conductivity or too much dust on the surface of the material.

5. **Cylinder Not Extending**

The system uses a 24V cylinder. Solution: Check if the wiring to the O-board is correct.

6. **Wire Reversal or Protruding Wire**

Mismatch between motor driver parameter settings.

7. **Large Difference Between Testing and Automatic Mode**

Testing was not done using a potentiometer at high speed, causing significant differences between the manual wheel control speed and automatic execution speed.

8. **Excessive Motor Noise**

1) Continuous running noise: Adjust the motor rigidity or mechanical assembly rigidity.

2) Noise during motor start, stop, or direction changes: Adjust the system’s acceleration and deceleration time to reduce impacts.

**9. Inaccurate Cam Position**

1) Incorrect mechanical parameters.

2) Servo motor or hardware failure in the system's axial components.

3) Loose mechanical connections. This can be checked by observing the rotor position on the driver to determine if the issue is mechanical or system-related.

10. **Inaccurate Wire Feeding**

1) If the wire length discrepancy exceeds 1mm, consider whether the wire feed roller is slipping or if the motor is malfunctioning.

2) If the discrepancy is within 1mm, consider a mechanical precision issue.

**11. Machine Enters "Pause" During Operation**

There are generally two situations:：

1) When the wire material is finished or I13 is disconnected, a message will appear in the lower right corner of the computer saying "Please handle wire material shortage," and the machine will stop and enter a "paused" state.
2) When there is a wire rack alarm or an external interference signal affecting I12, a message will appear saying "Please handle wire rack alarm," and the machine will also stop and enter a "paused" state.

# 9.Disclaimer

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