



## RichAuto—AutoNow F136 motion control system User's manual

Applied on Turning & Engraving CNC lathe

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۳۶۶۱۹۳۹۰ - ۳۶۶۱۹۵۱۰ - ۳۳۵۳۲۱۹۴ - ۳۳۹۵۹۰۳۴ - ۳۳۹۵۹۷۵۶ - ۳۳۹۵۹۳۲۶



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**Thank you for choosing RichAuto products!**

This manual helps you be familiar with the company's products, and get information about systems' components, configuration etc.

This manual contains detailed knowledge of the system characteristics, operating procedures, installation & commissioning, and safety precautions. Please read this manual carefully before using the system and machine, which will help you to use it better.

**Cautions:**

1. It's strictly prohibited in the strong interference and strong magnetic field environment. Operating ambient temperature: 0-70 °C; Environment humidity: 0-90% (non-condensing).
2. Insert U disk in the correct direction. Do not pull out or insert 9-pin signal transmission cable when system is powered on.
4. During the process of reading U disk file, do not pull out the U disk to prevent the interruption of data transmission.
5. Strictly prohibited metal, dust, and other conductive substances drop into the handset.
6. The machine casing shall be well grounded to ensure work safety and avoid interference.
7. Unauthorized removal is strictly prohibited, no internal user repairable parts.
8. For long time not using, please power off and keep it properly.
9. Be careful to prevent it from water, dust, fire when using.
10. Do not use the corrosive chemical solvents to clean the device.
11. Spindle motor bearing life and its speed is inversely proportional.
12. The tool bit is very sharp. Do not touch when it is running, in order to avoid injury; Do not use handkerchiefs, scarves to approach it to prevent embroiled damage.

**Important statement:**

The Company shall not be responsible for any loss caused by improper using or failure to comply with the rules of operation.

Beijing RichAuto S&T Co., Ltd owns final interpretation of this manual, we reserves the rights to revise all information in this manual, including data, technical details, etc.

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# Foreword

## System Introduction:

**RichAuto-F136** 4-axis and 3 axis linkages Dual-head CNC Lathe Motion Control System is independently developed by Beijing RichAuto S&T Co., Ltd. It can be widely applied to woodworking lathe and soon in the industry machine control field.

**RichAuto-F136** uses DSP as the core, High processing and operation speed which are the microcontroller, PLC systems can't match; Embedded structure, high degree of integration, strong stability, easy installation and operation; support U disk, removable storage card reader, and FTP transport protocol .Adapt USB Interface, high speed transfer, plug and play . Fully offline work.

## Performance characteristics:

1. System standard configuration is X, Y, Z, A, four-axis and three axis linkages motion control method.
2. Multiple I/O ports control. Standard equipped with I/O signal node which has 16 inputs and 8 output signals.
3. Support the standard G code, PLT format instructions; support domestic and international mainstream CAM software, such as: Type3, Artcam, UG, Pro/E, MasterCAM, Cimatron, Ucamcam etc.
4. Provide with power failed protection. System automatically save the current processing information in the moment of sudden power down (file name, current line number, work speed, spindle state);After powered up and returned HOME position, the system automatically prompts the user to restore the processing before power down which makes processing operations become more humanity.
5. Support breakpoint memory, select file line No. processing. Can save 8 different breakpoint processing information.
6. Multi-coordinate memory function. Provide 9 working coordinate system. The User can switch among the 9 coordinates, each coordinate system can save a process origin information.
7. Support adjusting spindle operating frequency (or spindle rotate speed). The spindle frequency is divided into 8 shifts. During processing, user can adjust shifts directly by keys without suspend processing.
8. Support adjust speed ratio during operation. To adjust the speed ratio so as to change the processing speed and travel speed, speed ratio values from 0.1-1. Increasing or decreasing 0.1 per time.
9. Simple manual operate mode. In manual mode, the system provides 3 kinds of move modes, including continuous, step (crawl), distance, become more simple and convenient.
10. Identifies M code, F code and other extended instructions, and it can also open a special code based on user's needs.
11. Built-in 512 M memory. Adapt USB communication port with high efficiency for file transfer. Can read files in U disk and card reader directly.
12. Unique handheld structure which can be hold with one hand. With LCD display and

- 24 keys operation keyboard, intuitive and flexible operation, no longer rely on the computer, completely offline operation.
13. Self-detection function. The system comes with I/O ports signal detection function, easy remote maintenance.
  14. Multiple languages display. Support English, Russian, France, Traditional Chinese and Simplified Chinese. Other language can be customized.
  15. System can automatically update itself, easily remote operation and maintenance.
  16. Supports FTP network file transfer function. If the U disk is damaged, files can be quickly transferred to the system through the network cable.

**Product parameters:**

Model No.	RichAuto-F136		
<b>CPU</b>	DSP	<b>Power failure protection</b>	Support
<b>Built in memory</b>	512MB	<b>Breakpoint processing</b>	8
<b>Display screen</b>	128*64 Monochrome LCD	<b>External supply voltage</b>	DC 24V
<b>Communication port</b>	U disk	<b>Manual mode</b>	Continuous, step, distance
<b>Linkage axis</b>	3 axes linkages	<b>Interpolate method</b>	Straight line, arc, spline curve
<b>Control signal</b>	Differential signal	<b>Soft / hard limit</b>	Support
<b>Driving system</b>	Stepper / servo motor	<b>Maximum pulse frequency</b>	1MHz
<b>Min. input unit</b>	0.001mm	<b>Password protection</b>	Support
<b>Languages</b>	English, Simplified Chinese, Traditional Chinese, other languages can be customized		
<b>Standard confi</b>	Handle 1pc, data transmission cable 1 pc, I/O control board 1 pc		

**Model List:**

<b>AutoNow-</b> 3 inches monochrome screen F1X series motion control system	No.	Name
	F131	3-axis Linkages Motion Control System
	F135	3-axis Cylinder + Multi-spindle Motion Control System
	F136	Dual-head CNC Lathe Motion Control System
	F141	4-axis Linkages Motion Control System

# 1 RichAuto-F136 system composition

## 1.1 System composition

RichAuto-F136 motion control system contains the following parts: **Handset** (Hereinafter called “handle”), **control board**, **9-pin data transmission cable**, **USB extension cable**.

**RichAuto schematic diagram of system accessories**



**Handle**



**Control board**



**Data transmission cable**



**USB extension cable**

## 1.2 Components description

### 1.2.1 Handle

As shown below, including 4 parts.

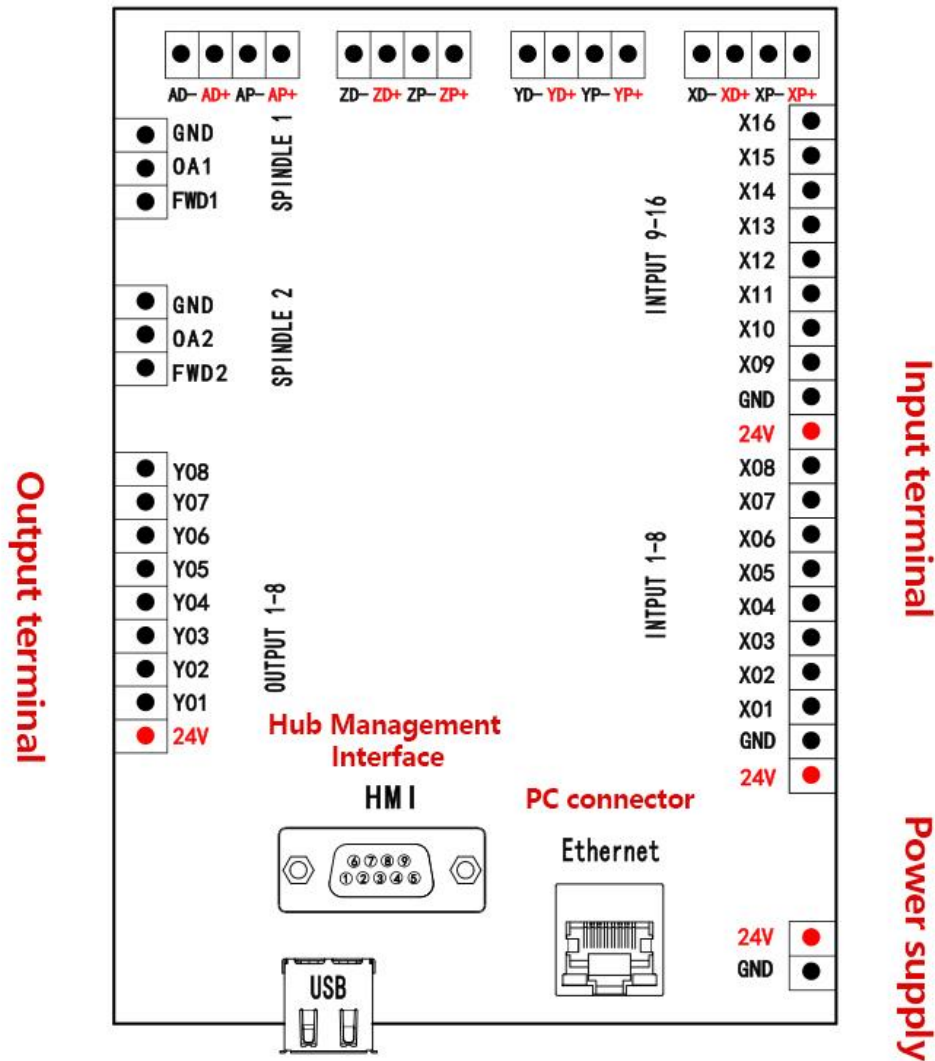


- 1) LCD screen: **128 \* 64** resolution LCD screen, displays the machine motion, system settings and other information.
- 2) Key section: Contains **24** buttons for system parameter settings and machine movement control.
- 3) RichAuto **LOGO**
- 4) Data transmission cable: The handle communicates with the control board through data transmission cable.

## 1.2.2 Control board

The connection between handle and machine tool rely on the wiring board. As shown below:

### Motor driver control output termianls



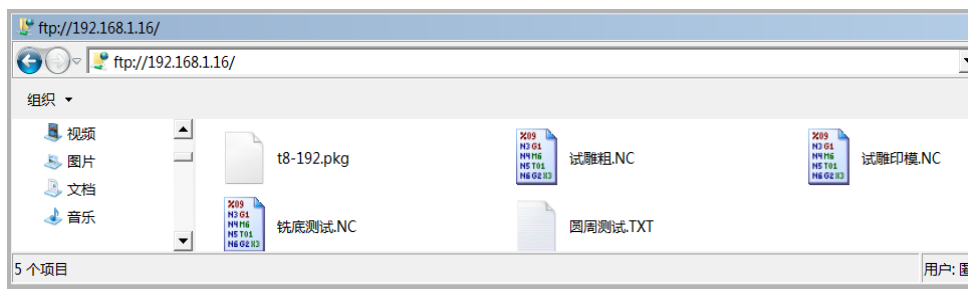
- 1) Data Transmission Cable: Signal given by the system is transmitted to the actuator through data transmission cable.
- 2) Output terminal: Including Spindle On/Off, Run lamp, Alarm lamp output signal ports etc.
- 3) Input terminal: Including HOME sensor, tool setter, driver alarm, hard limit, E-stop signal, foot pedal switch input signal ports.
- 4) Power supply terminal: DC 24V, 3A.

- 5) Motor driver control terminals: Motor drivers control signal output ports

### 1.2.3 FTP Access Internal Storage Space

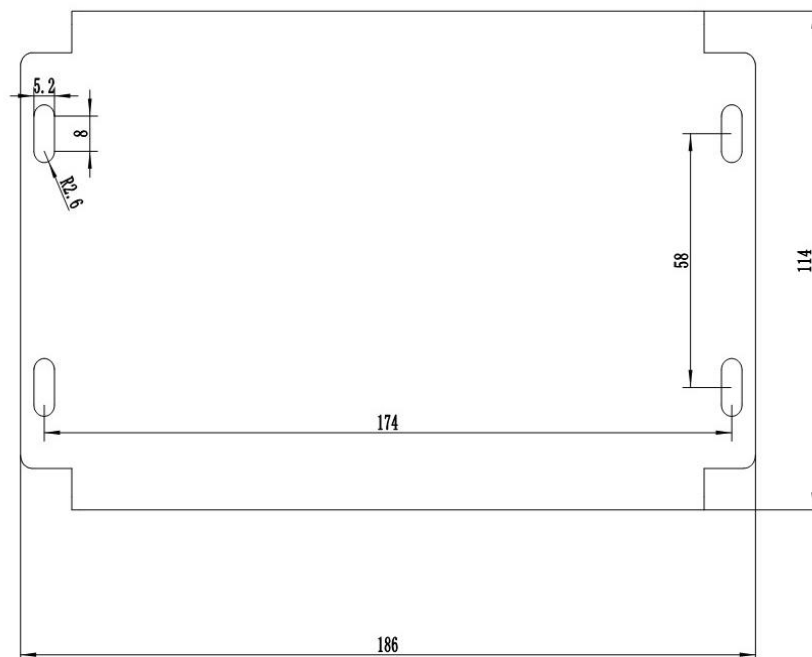
If the FTP server is setup on your PC, you can access the internal storage space of the system. To copy and paste the processing file through this method. The setting method is as shown below,

- 1) Enter the IP address (such as ftp://192.168.1.16) of the controller into the address bar of the Explorer, press Enter key;



- 2) User can upload, download, and rename the file after it entering into the controller inner space.

## 1.3 Control board installation dimensions



**Scale 1:1, Unit: mm**

## 1.4 System startup methods

**RichAuto-F136** Dual-head CNC lathe motion control system has 2 starting methods:

- 1) **Normal starting:** Normal power on the system, after boot, it will enter into HOME TYPE interface and manual control interface.
- 2) **Emergency starting:** If normal starting cannot show any words or manual interface, emergency starting is required.



Power off the system first, then push “回工件零 REF 确定 OK” and keep pressing, power on the controller

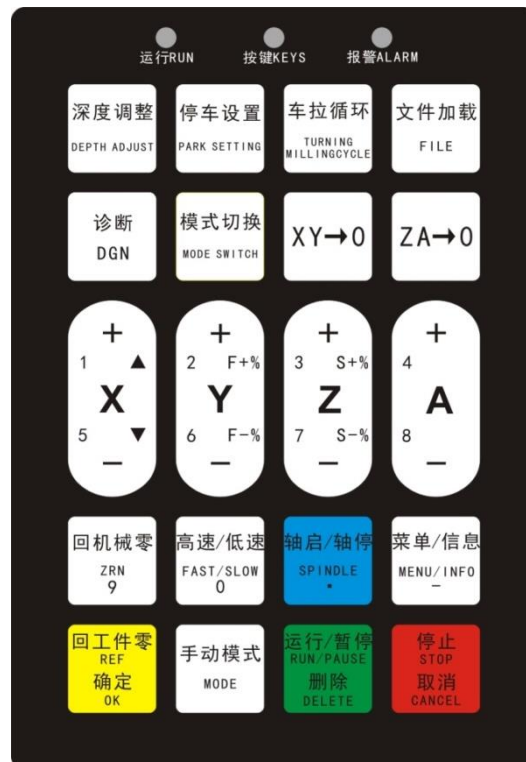


and waiting for 3-5 seconds. Release “回工件零 REF 确定 OK”, it will get into “Emergency State”, at that time user could either set network-upgrade system or just normal restart the system without select any option.

## 2 Handheld controller buttons introduction

### 2.1 Buttons introduction

**RichAuto-F136** handheld control system has defined 24 operation buttons, each one provides one or more functions in different working states:




Real photograph of pressing keys

## 2.2 Buttons Usage Methods


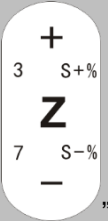



RichAuto-F136 provides 2 modes of button operations, including one-touch key & Combination keys.

- 1) **One-touch key:** Press 1 key on the handheld controller keypad is executing the single key operation.
- 2) **Combination keys:** Press 2 keys at the same time to achieve certain function is executing combination keys operation; The operation steps: press one **main function key** not release it, meanwhile press a second **auxiliary function key**, and then release the two buttons at the same time to realize the combination keys operation.

For instance, breakpoint processing combination keys are “” + “0-9 numeric key”.

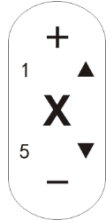
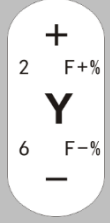
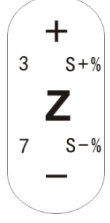
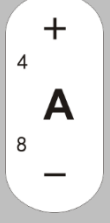





When operation, push the main function key “” first, and then push auxiliary function key “0-9 numeric key” then, at last release both of them at the same time.












### Common Used Combination Keys List

	Combination keys	Function
1	 + 	Switching spindle shifts in manual mode
2	 + “0-9” numeric key	Breakpoint processing
3	 + 	Exit keyboard detection interface

**Note:** Users can also find the corresponding combination keys operation list at the back of the handle.

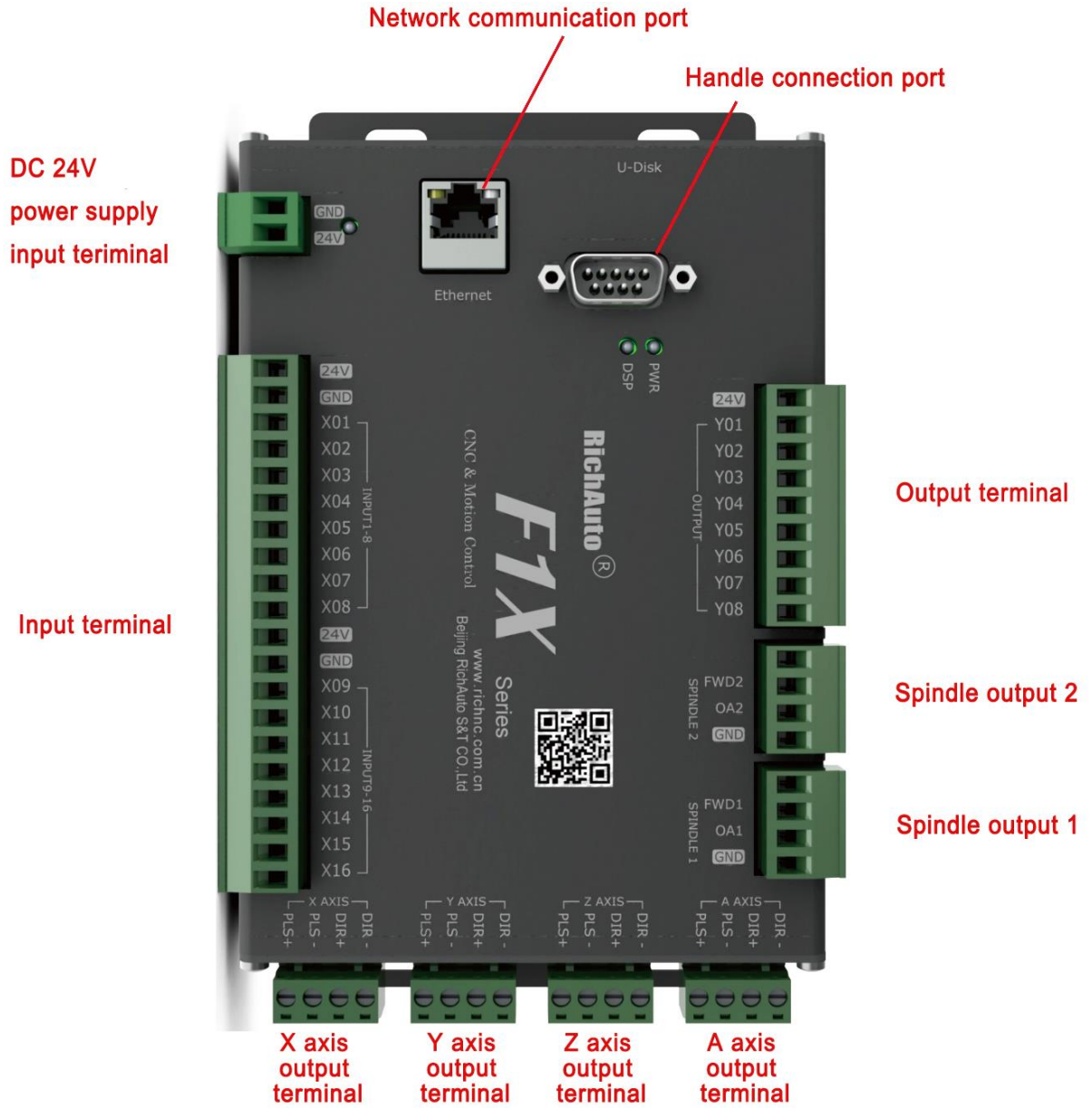
## 2.3 Buttons Function details

Name	Function
	X axis positive and negative movement, figure 1 and 5 input, Menu move up selection
	Y axis positive and negative movement, figure 2 and 6 input, work speed ratio increasing under AUTO mode
	Z axis positive and negative movement, figure 3 and 7 input, Spindle speed increasing under AUTO mode
	Z axis positive and negative movement, figure 4 and 8 input
	Set X ,Y, Z and A axis work origin
	Dual Head Lathe, Twist grooving, Carving
	Start "Break Work" function
	Set after processing parking position of each axis
	Enable file loading function

	Checking input and output signals .Checking keyboard
	Start “Turning&Milling Cycle”
	Figure 9 input, Return HOME operation in manual mode
	Parameters adjustment in MANU mode; Cancellation of various selections, inputs and operations in AUTO mode
	Figure 0 input, Manual speed High/Low switching, work/mechanical coordinates switching in AUTO mode
	Decimal point input, control spindle ON/OFF in MANU mode
	Enter into menu settings, minus input, view machining information during processing
	Return reference point(work origin); OK key of all selections, inputs and operation
	Manual motion states; Cnti, Step, Dist 3 modes switching in MANU mode
	RUN file or PAUSE the processing; DELETE the entered data; selections of different attributes in MENU
	System reserved function key

### 3 RichAuto Control board description

#### 3.1 Control board terminal description



### 3.2 I/O description

Terminal	Name	Pin definition	Pin definition and parameters
DC24V	24V+	Input power supply+	Provide 24V operating voltage for the control board after power up. Recommend to use DC 24V (current≥3A) current source
	24V-	Input power supply-	
X_AXIS	P+	X-axis pulse positive and differential signal	P + and P - are pulse differential pair signals. Using twisted pair can improve anti-jamming ability
	P-	X-axis pulse negative and differential Signal	
	D+	X-axis positive and differential signal	D + and D-are direction differential pair signals. Using twisted pair can improve anti-jamming ability
	D-	X-axis negative and differential Signal	
Y_AXIS	P+	Y-axis pulse positive and differential signal	P + and P - are pulse differential pair signals. Using twisted pair can improve anti-jamming ability
	P-	Y-axis pulse negative and differential Signal	
	D+	Y-axis positive and differential signal	D + and D-are direction differential pair signals. Using twisted pair can improve anti-jamming ability
	D-	Y-axis negative and differential Signal	
Z_AXIS	P+	Z-axis pulse positive and differential signal	P + and P - are pulse differential pair signals. Using twisted pair can improve anti-jamming ability
	P-	Z-axis pulse negative and differential Signal	
	D+	Z-axis positive and differential signal	D + and D-are direction differential pair signals. Using twisted pair can improve anti-jamming ability
	D-	Z-axis negative and	

		differential Signal	
<b>C_AXIS</b>	P+	C-axis pulse positive and differential signal	P + and P - are pulse differential pair signals. Using twisted pair can improve anti-jamming ability
	P-	C-axis pulse negative and differential Signal	
	D+	C-axis positive and differential signal	D + and D-are direction differential pair signals. Using twisted pair can improve anti-jamming ability
	D-	C-axis negative and differential signal	
<b>Spindle1</b>	FWD 1	Spindle forward signal	Support 0-10V analog quantity
	OA1	Analog output 1	
	GND	Ground signal	
<b>Spindle2</b>	FWD 2	Spindle forward signal	Support 0-10V analog quantity
	OA2	Analog output 2	
	GND	Ground signal	
<b>OUTPUT SIGNAL</b>	Y01	FDW/REV	No need to connect Y01 if the FWD and DCM is parallel connected
	Y02	Spindle speed 1	Logic low
	Y03	Spindle speed 2	Logic low
	Y03	Spindle speed 3	Logic low
	Y05	definable	Logic low
	Y06	definable	Logic low
	Y07	definable	Logic low
	Y08	definable	Logic low
	24V	Output DC 24V	Supply DC24V for indicators

<b>INPUT SIGNAL</b>	X01	X Machine zero	Logic low, support external connection with mechanical, photoelectrical or proximity switch
	X02	Y Machine zero	Logic low, support external connection with mechanical, photoelectrical or proximity switch
	X03	Z Machine zero	Logic low, support external connection with mechanical, photoelectrical or proximity switch
	X03	C Machine zero	Logic low, support external connection with mechanical, photoelectrical or proximity switch, X03 is the tool setting signal terminal when it is three-axis.
	X05	Toolset signal	Logic low, support tool setting and instrument.
	X06	Driver alarm	Logic low
	X07	Hard limit	Logic low
	X08	E-stop	Logic low
	X09	Definable	Logic low
	X10	Definable	Logic low
	X11	Definable	Logic low
	X12	Definable	Logic low
	X13	Definable	Logic low
	X13	Definable	Logic low
	X15	Definable	Logic low
	X16	Definable	Logic low
	COM	Common	Providing Grounding Signals for Active Sensors
	24V	Sensor power output	Providing 24V voltage for Active Sensors

### 3.3 Hardware wiring

Installation Requirements: Switching mode power supply (24V, 3A) , it's better to add a filter to prevent the electric field interference. If origin detecting switch is different power supply type, the special detecting switch power supply is needed. (Recommend 24V origin detecting switch).

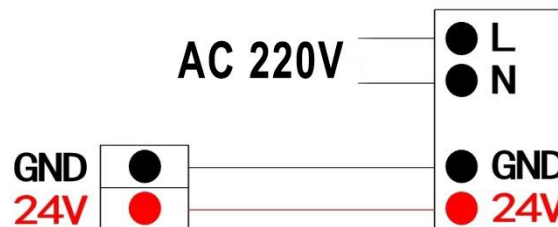
The control connection of **RichAuto-F136** is realized by connecting the control board with the CNC machine.

**Input terminal:** INPUT SIGNAL terminal; Main power supply terminal.

**Output terminal:** X, Y, Z, A, axis pulse signal output terminal; OUTPUT terminal.

#### 1) Main power supply wiring

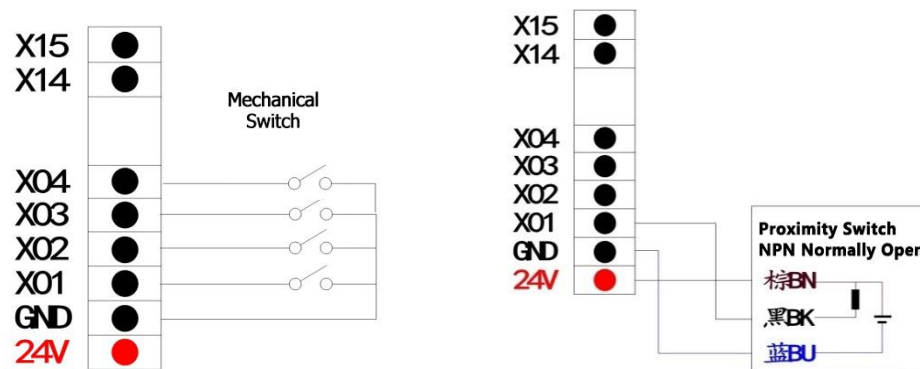
#### 24V switching power supply



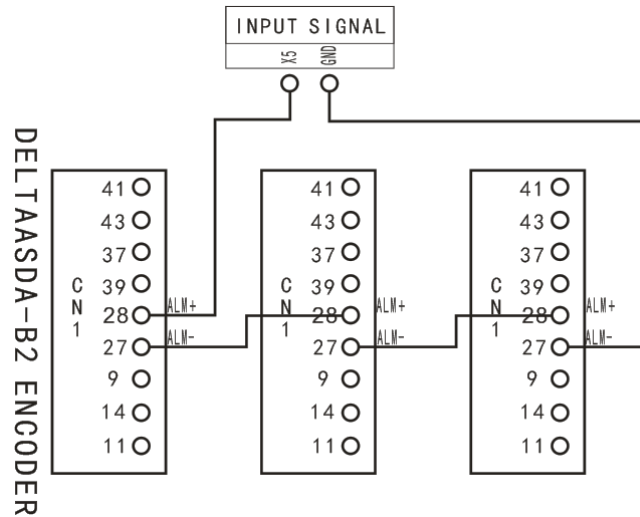
#### ◆ INPUT SIGNAL WIRING

1) ZERO point(HOME): X, Y, Z, A axis wiring methods are the same

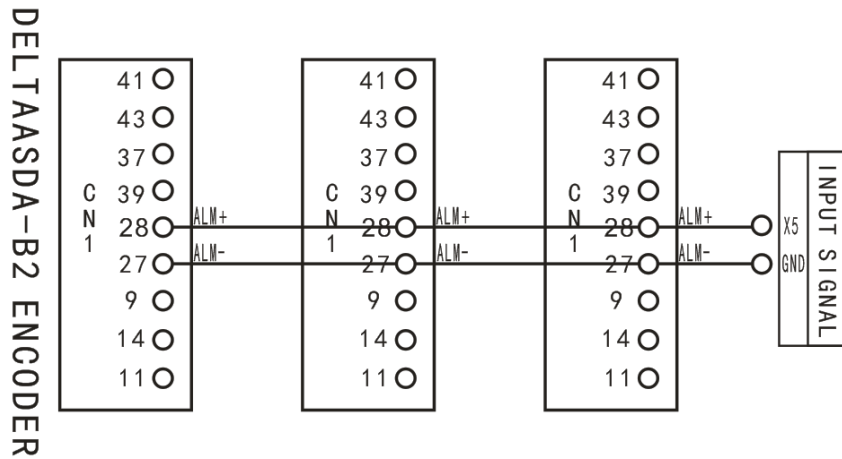
##### Mechanical HOME switch wiring



2) Alarm signal X6-X8: Default low level normally open. Take the driver alarm as example: If the alarm signal is normally closed, wiring method is series connection. Meanwhile, revise the “voltage level” of X6.



If the alarm signal is normally open, the wiring method is parallel connection.

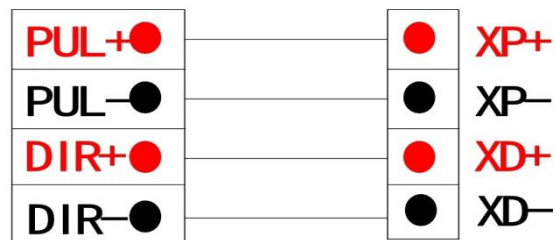


◆ **Output terminals:**

- 1) X axis pulse signal wiring (Y, and Z axis pulse signal wiring are the same)

Step drive:

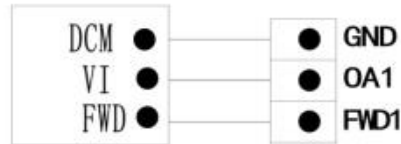
Stepper Driver Wiring Diagram



## 2) OUTPUT SIGNAL:Spindle output

Analog output

### Inverter




The machine tool and control system can be fully connected when the above connection are completed.

## 3.4 Commissioning of the machine and control system

- 1) Turn on the power, manually move each axis and confirm the motion direction. If the movement direction is opposite, user can change the motor phase sequence (A+,A- or B+,B-) or revise servo parameters (Refer to the servo driver user's manual).
- 2) According to the original location of the machine coordinates, user can enter into **Menu-Machine Setup-Home Setup- Home Dir** to reset it.



- 3) Press “”-Voltage Level (the top row stand for input voltage) to check whether the HOME switch is working normally or not (manually trigger the voltage level changes from L to H).

The machine is in good connection if all of the above work normal.

# 4 Menu Description

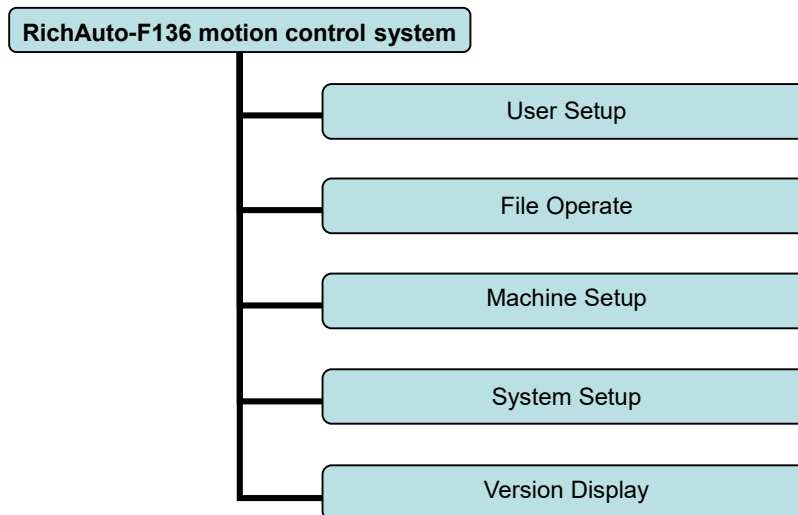
## 4.1 Menu Setup

**RichAuto-F136** Dual-head CNC motion control system divides its menu according to menu function:

Five user interface, include: **User Setup, File Operate, Machine Setup, System Setup, Version Display.**

- 1) User Setup: This menu is used to set processing parameters, G code attributes etc.
- 2) File Operate: Copy file from U disk to inner storage space and delete inner file.

- 3) Machine Setup: To set relative parameters about machine hardware.
- 4) System Setup: Change Chinese or English language, backup parameters and restore factory setting.
- 5) Version Display: Users can view information about the system hardware and software etc.

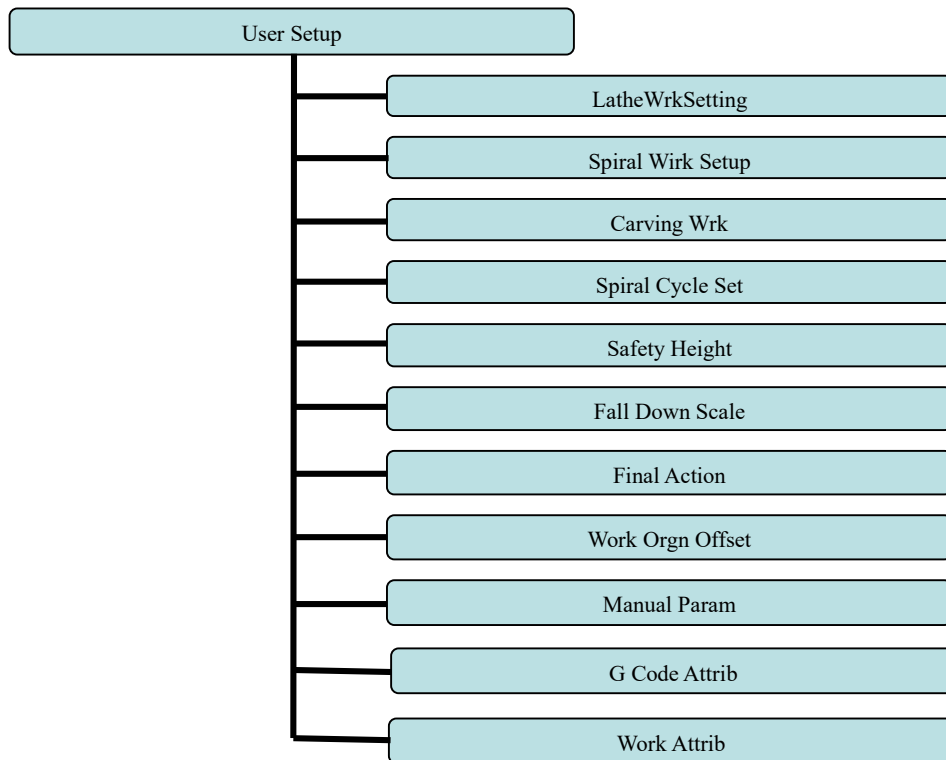


## 4.2 Menu details

### 4.2.1 User Setup

This menu is used to set processing parameters and G code reading attributes etc.

#### Menu Structure of User Setup



#### 1) LatheWrkSet:

##### Turning Speed

- ①WorkSpd: It is processing speed, system default is 3000 mm/minute.
- ②FastSpd: Moving speed during processing, system defaults 3000 mm/min.
- ③LastSpd: The last processing speed of the file, system defaults 600 mm/min.

##### DoubleCutterSet

- ①Rough Ratio: It refers to the proportion of eating cutter, 0.7 means that the proportion of rough cutter is 70% and fine cutter is 30%.
- ②ToolSpac: It refers to the distance between two cutters on the Y axis. Default is 10mm.
- ③ToolPosn: Spiral tool holder on top and side of machine tool.
- ④BootMode : First display mode, such as lathe mode, user can modify it by themselves.

**Layer Count:** Processing workpiece is finished by several times, default is 1, users can modify it by themselves..

#### **Batten Setup:**

- ①LogStart: Indicate the starting coordinates of the pasted log (calculated from the origin of the workpiece).It can be obtained from the processing file. Unit: mm.
- ②Log Len: Indicate the pasted log length. It can be input by the actual measurement of the numerical. Unit: mm.
- ③Log Thk: Indicate the pasted log thickness. It can be input by the actual measurement of the numerical. Unit: mm.
- ④Layering: Indicate feed times in pasted area. It is finished by several times.

#### **End Movement:**

- ①SkipDist: Distance to be re-machined for the last turning.
- ②BackDist: Distance to be machined back after turning.

#### **2) Spiral Wrk Setup:**

##### **Spiral Spd:**

- ①Spiral Spd: The processing speed from one twist spiral to the next.
- ②FastSpd: The fall speed between spiral and spiral.

##### **Spiral Wrk:**

- ①SpiralCnt: The number of spiral that need to be processed.
- ②SprlAngl: The angle at which a spiral rotates during processing.Default is 0
- ③SprlTime: The same spiral is processed by several times.(Same depth)
- ④SgleDir: Each Spiral is processed from the same side .(To avoid screw clearance)

#### **3) Carving Wrk:**

**Work Spd3000:** Processing program executes interpolation speed included G01, G02 and G03.Default is 3000 mm/minute.

**Fast Spd3000:** Processing program execute G00 movement speed .Default is 3000 mm/min.

#### **4) Spiral Cycle Set:**

**TurnCycl:** The processing file can be selected from the U disk or the system interior.

**SprlCycl:** The processing file can be selected from the U disk or the system interior.

#### **5) Safety Height:**

Safety Height: X,Y,Z,A axis lifting height during processing. System defaults Z axis 40.000mm. Other axis(X /Y/A axis) no need safe height, set 0.

### 6) Fall Down Scale:

**FallType:** ①Z only (It works when only the Z axis moves alone);

②Z move (It works as long as Z axis moves);

③Speed unlimited (It does not take effect when the tool is falling down).

**FallHght:** System default is 5.000mm. Fall down scale takes effect when the Z spindle falls to the fall height.

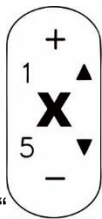
**FallSpd:** The maximum speed of Z axis when falling down, Unit: mm/min

**FallLmt:** ①All (The limit take effect as long as Z axis fall down during processing);



②First (The limit only take effect at first time falling down)

### 7) Final Action :

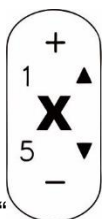
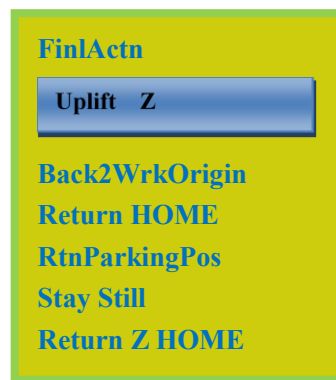
Stop position of axis: when the processing is finished. Including: pick up Z axis, back to work origin, back HOME, back position, none move. Set a special stop position:




Press “ ” move cursor to where user wants to modify, press “  ” and input new

coordinate values one by one, then press “  ” to save the changes. Press “  ” to enter into system

### Final Action list:



Press “ ” to move cursor to where user wants to modify, then press “  ” to save

the change. Return to the upper menu.

### 8) Work Orgn Offset:

**CurOriginOffset:** External offset is also named as workpiece offset, it is used to record the temporary adjustment value of the current workpiece origin and only works in the current coordinate.

**CmnOriginOffset:** External offset is also named as Common origin offset, it is used to record the temporary adjustment values of all the workpiece origin and works in all of the workpiece coordinates.

### 9) Manual Param:

**Manu Low:** In low-speed motion mode, the speed value of the manual mobile machine's axis is executed.

**Manu High:** In high-speed motion mode, the speed value of the manual mobile machine's axis is executed.

**Manu Dist:** ①Manual distance (Set distance in manual), ②Low speed grid (Point distance of working in low-speed mode), ③High speed grid (Point distance of working in high speed).

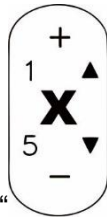
**Manual Type:** ①Tradition (traditional Manual motion), ②Point movement (Manual motion of pointing)


### 10) G Code Attrib:

Set special settings which are required during processing, to make changes according to the actual needs.

G Code Attrib	
I J K Mode	Reltv
F Code	Ignr F
S Code	Ignr S
T Code	Ignr T
Read G54	Ignr G54
Read G40	Ignr G40
Filter JD	Disabl
G83Space	0

PS: *Blue parts indicate system default attributes.*



**Setting:** Press “ ” move cursor to where needs to modify, press “  ” and

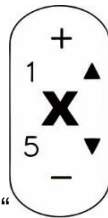


select, then press “ ” to save. Return to the upper menu.

### 11) Work Attrib:

Set special settings which are required during processing, to make changes according to the actual needs.

Work Attrib	
QuryPara	Query
Preprco	Disabl
LiftFPus	None
StopFPus	None
PausAdju	All
FastScl	None
Copy&Wrk	Standa
StepAdjt	Contns
AutoLaser	Off



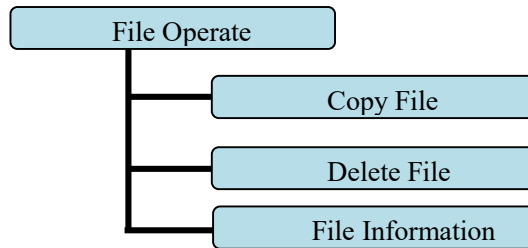
**Setting:** Press “ ” move cursor to where needs to modify, press “  ” and select,



then press “ ” to save. Return to the upper men

## 4.2.2 File Operate

### Menu Structure of File Operate



**Copy File:**

Copy file from U disk to inner storage space.

**Delete File:**

Delete inner file that copy from U disk.

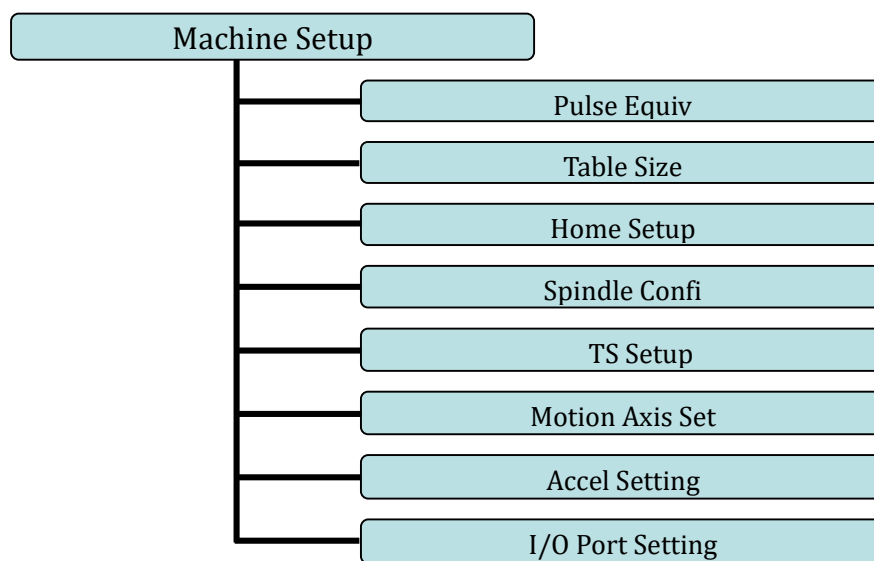
**File Information:**

It can calculate the total time of processing file and processing range.

## 4.2.3 Machine Setup

The manufacturer parameters which are under “Machine setup” can be set by machine producers according to their equipment types. After setting, if the size and pulse equivalent of the machine tool remain unchanged, no modification is needed. Users are required to change the machine parameters under the technician’s guidance of the machine produce.

### Menu Structure of Machine Setup



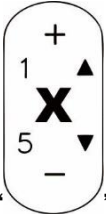

### 1) Pulse Equiv


**Linear axis:** The number of pulses required to send from the system when machine moves every 1mm. Unit: pulse / mm;


**Rotating axis:** The number of pulses required to send from the system when machine rotate every 1 degree. Unit: pulse / degree.

**Calculation method please refer to PS1**

Setting mode: Enter "**Pulse Equiv**", cursor is in the X axis pulse equivalent position,

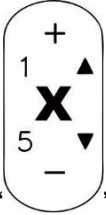

press " " to move cursor as required, press " " then, input a new value, and


press " " to save. To modify X, Y and Z axis value one by one in the same way,

press " " then save all changes and return to the "**Pulse equiv**" menu.

### 2) Table Size

**RichAuto-F136** system makes the table size as the soft limit values, in order to prevent machine over travel. Machine size must be less than or equal to the actual size of machine table..

Setting: Enter "Table Size, press " " to move cursor as required, press " ",

and input the new value, press " " to save the changes, To modify X, Y and Z axis

value one by one in the same way. Press " " Save all changes and go back to the "Table size" menu

### 3) Home Setup

**Home Speed:** The movement speed of each axis when go mechanical origin (ZERO), the system default X, Y axis home speed: 3000 mm/minute, Z axis home speed: 1800 mm/minute.





then press “” to finish modification. Return to upper menu.

## 5) Motion Axis Set

**Motor Dir:** Modify the direction of motor rotation.

**Axis Disable:** If the user's machine is a two-axis machine, the Z-axis can be forbidden here, then the screen will no longer display the Z-axis, and all Z-axis related parameters will no longer be meaningful.

**NegSpeedLimit:** Set the maximum speed in the negative direction of the machine tool, which limits all moving speed.

**PosSpeedLimit:** Set the maximum forward speed of the machine tool, which limits all moving speed

**Circle Limit :**

- Circle Limit (Maximum Processing Speed with Arc Instruction in Processing Program).
- Circle Diameter (diameter limited when arc instructions are available in the processing program)

## 6) Accel Setting

**Accel Type:**  Linear (Linear acceleration mode) ;  Curve (Curve acceleration mode) .

**Max Accel:** System default: linear acceleration is 800 mm/s<sup>2</sup>.

**Accel Jerk:** It refers to growth rate of acceleration, that is acceleration's incensement per unit time, which can alleviate the adverse effects caused by sudden acceleration and deceleration of machine tools .

**Skip Speed:** Start speed of motion axis from stationary state. Not starting from 0, but starting directly from a certain speed, so it can shorten the overall processing time, but this speed shouldn't be too high. Too high, it will cause the motor losing steps, jitter and even whistle; Set too small, it will reduce the operating speed of the entire graph. If the inertia of the moving axis is large (heavy spindle), to set too small start speed will affect the motion speed of the whole graph. If the inertia of the moving axis is small (light spindle), the start speed can be increased appropriately.

## 7) I/O PortsSetting

**Input Disable:** Enable or disable the input port. User can disable X6-X8 if there is no signal

on these ports. Prevent misoperation such as wiring error.

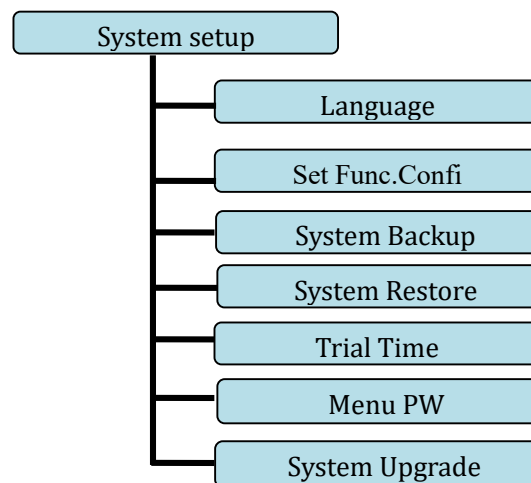
**Input List:** the functions list of the input ports, where users can view all the functions of the input ports.

**Output Disable:** To open or prohibit the output signal, if some ports of the control board are not connected with any signal, you can choose to prohibit the signals of these corresponding ports to prevent misoperation such as wiring errors.

**Output List:** The functions list of the output ports, where users can view all the functions of the output ports.

## 4.2.4 System Setup

### Menu structure of System Setup



#### 1) Languages

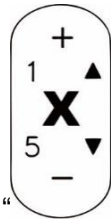
Change system display language, Chinese or English language.

#### 2) Set Func. Confi

Set whether the system retains a function or not, change it in accordance with the practical application. After the operation user has to restart the handheld controller.

Set func. confi	
OrgQuery	Query
ClearSep	SameT
ClearPrt	Disabl
StopAct	None
OrgnAct	None
Brk Type	CrtLineStrt
SpdCrtl	DfltSpdCrtl

*Blue parts indicate system default function*



Setting: Press “ ” to move the cursor, Press “ ” and select the function in



needs, then press “ ” to save the change. Return to the upper menu.

### 3) System Backup

Backup the system parameters and function configuration and to save into U disk or inner storage. The backup file format is data.bak and config.bak.

**Param Backup:** To backup all of the parameters of the machine tool, default format is data.bak.

**Function Backup:** To backup the function configuration of the machine tool, default format is config.bak.

### 4) System Restore

**Data Format:** After data initial system parameters will restore to factory setting (Machine size, pulse equivalent etc.)

**Internal Format:** Wipe the internal files, it will not remove the system parameters after inner format.

**Cache Initialize:** The system needs wipe cache when it has been using for a long time or after the system upgrading, it will ask to reboot after “Wipe Cache” operation.

**Func Restore:** Restore the backup system parameters by choosing the “**config.bak**” file from the U disk or internal storage area.

**Param Restore:** Restore the backup system parameters by choosing the “**data.bak**” file from the U disk or internal storage area.

### 5) Trial Time


To be used to set the trail time of the controller, counting by day from the date of setting. User should send the origin 20 digits to us, then get new 20 digits from us and enter them into the controller, after that, the trail time will take effect.

### 6) Menu PW

Encrypt the system menu. User should contact the factory to reset it if wants to change the settings in MENU.

### 7) System Upgrade

If we added new functions, we will offer upgrade file which extension name is **\*\*\*\*\*.PKG** format (File name is **rz-xxxx** or **q13-xxxx**). User could update the system through U disk..

Upgrade package format sample:  t8-188.pkg

## 4.2.5 Version Display

Users can view information about the system hardware and software, including:

Version	
Type:	F136
Update:	4975
HW No. :	F0039002
Axis:	3Axis
192.168.1.10	

- ✧ Type: for example Dual-head CNC Lathe Motion Control System F136
- ✧ Update: means update package number, such as 4975.pkg
- ✧ HW No.: refers to hardware version number, such as F0039002
- ✧ Axis: 3 Axis linkage
- ✧ 192.168.1.10 indicates the IP address of the current handle

# 5 Machine Operation

## 5.1 Return HOME

It will display “**all axis home**”, “**Z home only**”, “**none axis home**” after starting up the DSP handle. Returning Machine HOME can correct the coordinate system.

In some cases, such as after a normal power off, and then reboot to continue last operation, it is no need to go machine HOME, just choose “**none axis home**” to skip HOME operation. Because system automatically saves coordinate value when it exits normally.

## 5.2 Import processing file

Before processing, generally we should import files. **RichAuto-F136** system has 2 ways to import files: U disk file processing and inner file processing.

- 1) Directly import the processing file into U disk, and then run with the U disk inserting in the controller.
- 2) Copy the files to handle internal storage area via U disk, and then run the inner file without U disk.

## 5.3 Manual Processing Operation

Manual Processing Operation refers to move the machine tool by pressing the keypad. User can change the running speed and set the grid (step distance) in manual mode. System will enter Manual Operation state after returned home, and the screen displays,

Manual control interface:


Coordinate Number	1X	0.000	Lthe	Machine Mode
Motion axis	1Y	0.000	12K	Spindle Speed
Processing program	1Z	0.000	Fast	Speed Mode
	HORSE2.CNCC		Cnti	Manual Motion Mode


### 5.3.1 Manual speed switching and adjustment

#### 1) Speed mode switching


There are 2 speed modes: Fast speed and Slow speed. We can switch speed mode by

pressing “” key. The speed mode status show on screen determines the actual

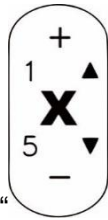
manual moving speed. If the current state is high-speed, press “”, the screen display will be changed from high-speed to low-speed. If the current state is low-speed,

press “”, the screen display will be changed from low-speed to high-speed. The speed state on the screen determines the manual speed.

#### 2) Speed adjusting

In manual mode, press “” enter into the current speed mode settings. For instance, suppose the current speed mode is SLOW, the screen displays:

Manu Low	
Set Dist	100.000
X Speed	1200.000
Y Speed	1200.000
Z Speed	1200.000
SlowGrid	0.100



The cursor is on "X speed", Press " " to the one needs to be modified, and press



"DELETE" then input new value, and next press " "



" " to confirm; Press " "



"CANCEL" to

exit the settings. If the input value is wrong, press " " to delete the last number and then input new numbers.

To ensure the accuracy of processing and debugging, the system introduces the concept of 'grid' which also called 'minimum feed'. Precision can reach to 0.001mm. When user switch to "STEP" mode, and press the direction keys of X, Y, Z axis, machine will move by grid distance.

"Fast speed" mode setting is the same to "Slow speed" mode.

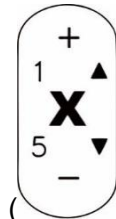
### 5.3.2 Manual processing mode

The system provides 3 manual movement modes: Continue, step, distance. User

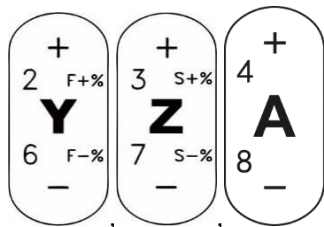


could press " " under manual mode to switch manual movement mode and view the current movement mode through the screen bottom display status.

#### 1) Continue (Continuous motion mode)



No specific data control, user could press motion direction key of each axis (



) the machine will move accordingly until the key is released.

The motion speed is determined by current manual speed mode.

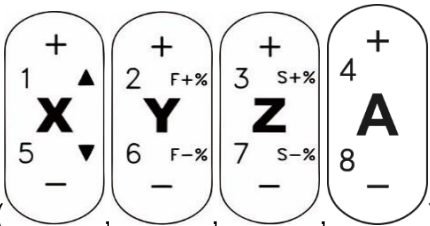
#### 2) Step motion mode

In step mode, move 1 grid every half second. The grid distance is determined by the current speed mode. It is suitable for precise adjusting the cutter or fine adjusting the

location of the mechanical coordinate.

### 3) Distance motion mode

It runs a certain distance according to the distance setting. Press direction keys

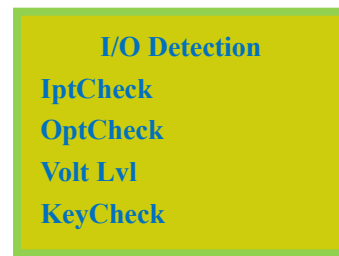

 ( , , , ), the machine will move accordingly.

**Note:** The movement will be carried out according to the current speed mode and the set distance, it is not affect by the 'grid', so it will not stop on grid point. To change

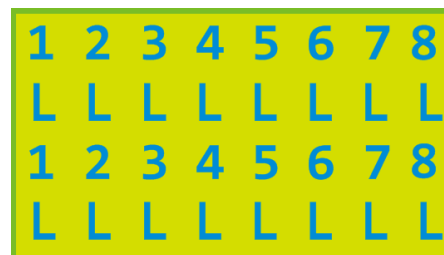
the distance value, press  and re-enter the desired distance value.

### 5.3.3 Manual testing input and output

Under the initial boot interface, pressing , the screen will displays as follow,

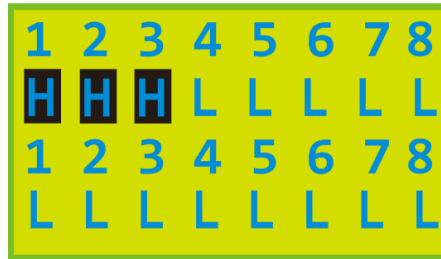


#### 1) IptCheck(Manual test input ports)



From left to right are respectively represent: X HOME, Y HOME, Z HOME, A HOME, tool setting, servo driver alarm, frequency converter alarm, emergency stop and foot switch. The port definitions will be a little different in individual custom system.

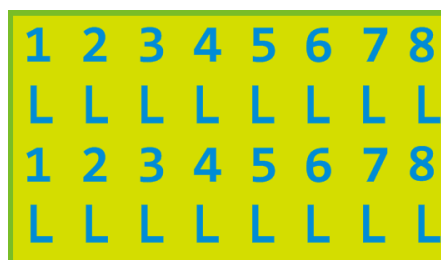
Manual trigger the corresponding signal, the corresponding signal **changed from L to H means the signal is in normal status**. If not, it is abnormal. User should check the corresponding switch, wiring and 50 pins cable.The screen will displays as follow.



To trigger X1 (X axis HOME switch), the corresponding letter changed, means X1 signal is normal, X2 to X8 detecting are in the same way.


**Note:** Do not confuse with “Voltage setup”.


## 2) OptCheck (Manual test input port)



In the bottom row, the former 4 numbers **0,1,2,3** corresponding to Spindle CW/CCW, reserved output, alarm lamp, run lamp signals, the latter 4 numbers 5,6,7,8 corresponding to buzzer, power lamp, lathe pull transformation, blow output signals. The port definitions will be a little different in individual custom system.

Manually control the corresponding output port by pressing “” to change the

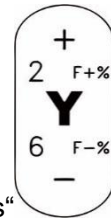
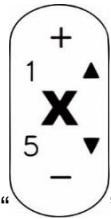
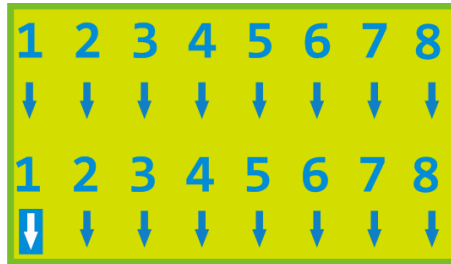
corresponding letter to H. For example, press “” to highlight number 0 position to

start the spindle, then press “” to change the corresponding letter to L, it means to stop the spindle.


## 3) Volt Lvl (Voltage Setup)

Used to set the input, output signal port normally open or normally closed port state, system defines “↓” as normal open; “↑” as normal closed.

Including 2 rows of arrows:





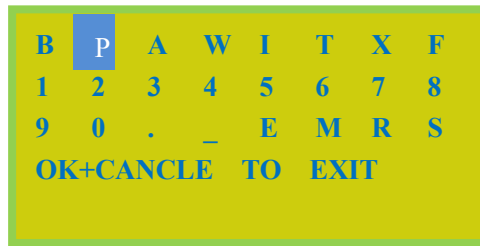
**Setting:** Press “ ” move to left or right in the row. Press“ ” can jump up and

down. Move the cursor to arrow which needs flip, and press “” to flip the arrow. Return to the upper menu.

#### 4) Key Check

Detect the keys are valid or not. Press every button, the screen will highlight it if the key is

valid, if not valid will not highlight. Use combination keys “” + “” to exit.



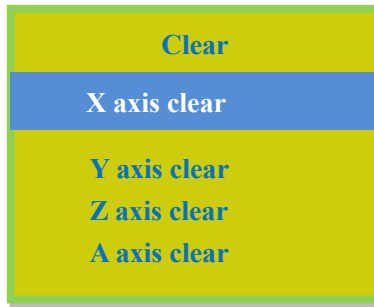
## 5.4 Auto processing operation

Auto processing refers to the system runs according to the instruction of the file in U disk or inner storage space, it also called “file processing”. Before auto processing, user must set the machine tool parameters and all of the system parameters correctly. Auto processing steps could refer to the following text.

### 5.4.1 Set workpiece origin

The origin coordinates of X, Y,Z and A axis in the processing program is workpiece origin. Before processing, we should pay attention to this position as well as the real position. Operation is as follow:

Move X, Y, Z and A to the position which will start to process the file on workpiece.

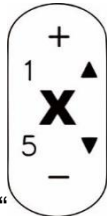
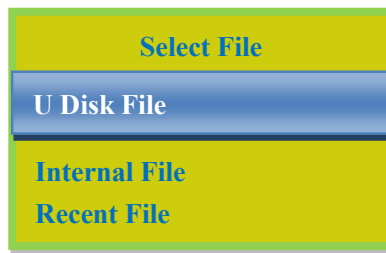


Afterwards, press zero clearing “ CLEAR ” can set the workpiece origin of corresponding axis.

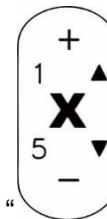
### 5.4.2 Choose processing file



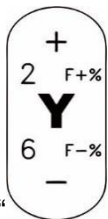
After determined the workpiece origin, press “ FILE ” will appears a dialog:



Press “ ” to move the cursor and choose, press “ ” to enter into the list, the



screen will display three file name, choose the file by pressing “ ”. Press




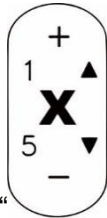
“ ” to open the next page. Press “ CANCEL ” to exit.

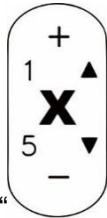

### 5.4.3 Set processing parameters

Set Work Param	
WorkSpd	1100.000
FastSpd	1200.000
SpdScale	0.8
FallSpd	600.000




After choosing the processing file please press “”, enter into processing parameters setting, it includes work speed, travel speed (or Fast speed), speed scale (speed ratio), fall down speed (or Z down ratio)




Press “” to move cursor to select different settings, press “” to set the



value (next value setting is in the same way), then press “” to save, the system will check the processing codes and start to run when the reviewing is completed.




The system code checking is auto mode, user can press “” to skip the checking and start to run immediately.




System will remember the checking only when the previous checking is a complete and correct checking. So that the system won't check the same code again next time.

During processing, the screen scrolling display real-time processing speed, operation

time and current line number. Press “” to display all processing information.



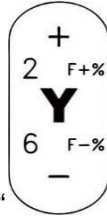
Press “” again to return to the coordinate display interface.

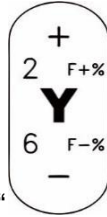


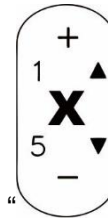
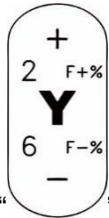
## 5.5 Operations during processing

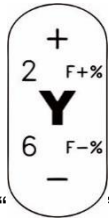
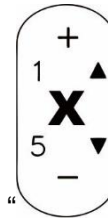
### 5.5.1 Speed ratio & spindle grade Adjusting

#### 1) Adjust speed ratio



During processing, press “” can directly change speed ratio, each push on

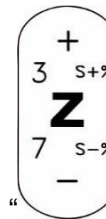
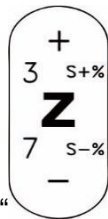


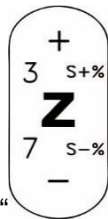
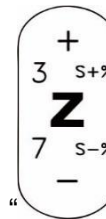
“”, the speed ratio will increase or decrease 0.1, each push on “” the speed ratio increases or decreases 0.01, Speed ratio: max 1.0, min 0.01; the displayed speed will change because of the speed ratio, but not affect the display of work time.

Current speed= work speed \* ratio

## 2) Adjust spindle shift


The handle is equipped with a shortcut keys to adjust the spindle speed during AUTO



processing. Press “” to change spindle speed. Each push on “” will go up or drop 1 shift in the range of F0 to F7.

## 5.5.2 Pause & adjust position



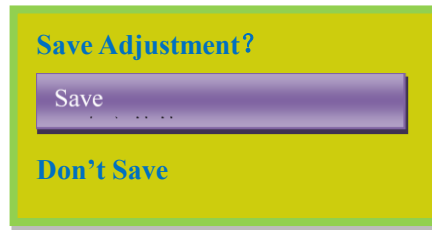
Press “” pause processing. The right upwards of screen will change from “MAUN” to “PAUZ” and machine paused processing except the rotating of spindle. Shown below,

1X	7.000	PAUS
1Y	8.000	S2
1Z	-2.000	Fast
Line No.	220	Step

At this moment, the user is allowed to adjust the position of X, Y, Z axis. The system default motion mode is STEP. So that user can fine adjust each axis distance. Machine moves one low or high speed grid distance in every step.



When the adjustment is finished, press “**DELETE**” again, screen shows below,



The system asks the user whether save the modified position. Press “**OK**” the



system will start processing in modified position, press “**CANCEL**”, system will go back to the previous position where before modifying.

## 5.6 Find Breakpoint Processing & Power Failure Protection

Find Breakpoint processing is a function developed to meet the special requirements of customers in operation. Find Breakpoint processing mainly includes: Find Breakpoint,


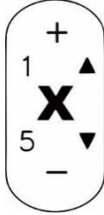



Break List, Part Work, PwrFlrProtect. Press “**BREAK WORK**” to start advanced processing, screen shown as below:

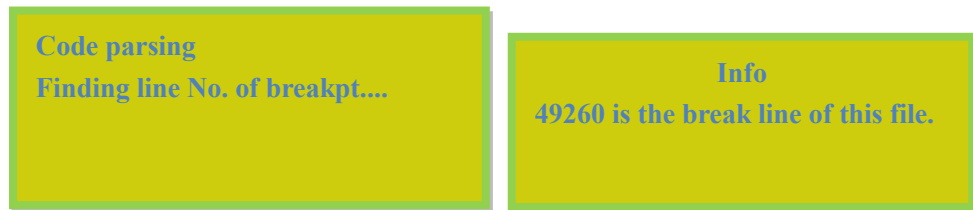


### 5.6.1 Find Breakpoint

If the tool broken unexpected in the process and no breakpoint is saved, stop processing and replace with a new tool. If the original workpiece was not destroyed, manually move X and Y to the position in front of the breaking place,

press “” to start advanced processing, then press “” to move cursor to Find Breakpoint,


Press “” to booting and pre-reading the code, the system will prompt as below:

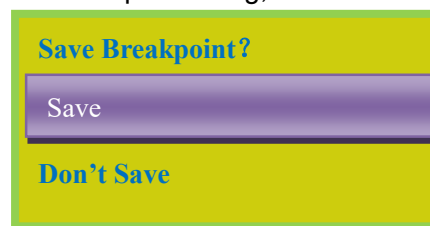


Press “” to start processing, press “” the screen displays the current position line number.

**Note:** Using this function user has to ensure the work coordinate the same as it was before.

## 5.6.2 Break List

If user presses “” during process of processing, the screen shows below:



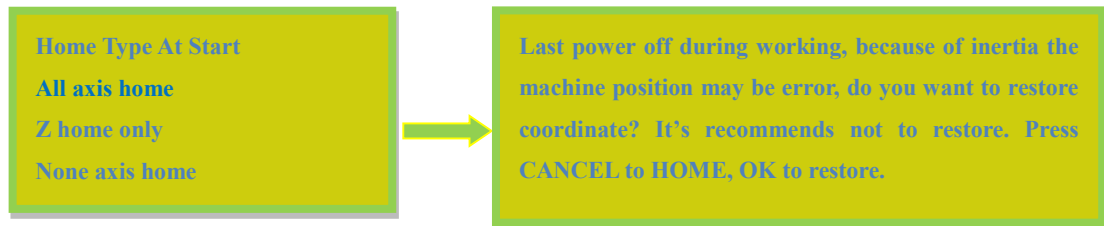
## 5.6.3 Part Work



Line Selection Processing is that the user can choose the G code line number to start and end processing, so that it can react subsection processing.

## 5.6.4 PwrFlrProtect

When there is a sudden power shut down during processing, system will save current coordinate and parameters, while power restart, process continue. Before that, system

must have go back to machine **HOME**. Shown as below



Press “” to continue unfinished processing. Press “” cancel the power failure protection.

## 5.7 Advanced Work

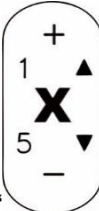

Advanced processing is designed for some special requests in operation, it contains: Array Work ,Scale Work, Mill Plane ,Auto Plane , Calc Border. The shortcut key is

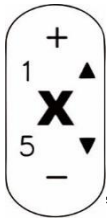
“” shown below,


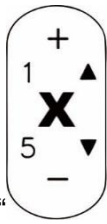



### 5.7.1 Array Work

Steps as below:

- 1) Press “” to move cursor to the Array work, press “” to enter, then press

“”to select different files list.

- 2) Press “” to enter file list, then press “”move the cursor to choose object file.
- 3) Set processing parameters, also can modify the array parameters in this step, or you can go to “AUTO PRO SETUP”, choose “Work Array” and modify the array parameters. The rest steps are similar to the normal processing. System will start to work according to the user’s setting.
- 4) In the processing of array work, you can view real time row number, volume number

etc. by pressing “”.

**Note:** Set interval value into a negative value if users want a manual control during array processing.

## 5.7.2 Scale Work

If the actual processing requires different sizes of the same file, user can use “scale work”, and enter a zoom in/out ratio.

**Steps:** Press“” to get into “Scale work”.



Choose desired processing file and input correct parameters:

	Scale	Work
X	Scale	1
Y	Scale	1
Z	Scale	1

### 5.7.3 Mill Plane

Include two types: Rectangle mill and circular mill.

#### ✓ Rectangle Mill

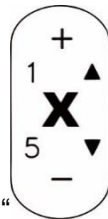
Mill Plane Param	
X Mill	100
Y Mill	100
Depth	5
Layer D	2
Dia	5
Plunge R	0.500



- 1) Press “ ” to move cursor to choose the mill type.



- 2) Press “ ” to enter the scan mill set, it includes: Scan type, Width, Height, Diameter, Depth, Z Step, T Ratio.



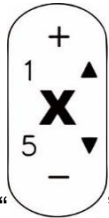
- 3) Press “ ” to move cursor on the option which need modify, press “ ” to choose mill type(X Scan or Y Scan), also press this button to modify the parameters.



Press “ ” after modified all the parameters to save them.

✓ **Circular Mill**

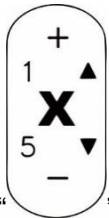
Mill Plane Param	
Mill RAD	100
Depth	5
Layer D	2
Dia	5
Plunge R	0.500



1) Press “ ” to move cursor to choose the mill type.



2) Press “ ” to enter the scan mill set, it includes: Scan type, Width, Height, Diameter, Depth, Z Step, T Ratio.



3) Press “ ” to move cursor on the option which need modify, press “ ” to



choose scan type, also press this button to modify the parameters. Press “ ” after modified all the parameters to save them.



### 5.7.4 Auto Center

Auto Center is to determine the central of the connection between two points which is used to find the central point of the workpiece embryo.

The specific steps of Auto Centre are as follows (X axis)



Press “ ” to enter into the interface of “Auto Center”, select MidPntAxis.

SelectMidPntAxis
X MidPoint
Y MidPoint



- 1) Manually move the tool to one side of the workpiece, press “ ” to record the first point , after recording success the screen display as below.

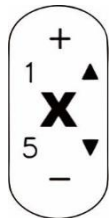


- 2) Then manually move the tool to the other side of the workpiece, press “ ” to record the second point , after recording success the screen display as below.  
 The operation of Y axis and Z axis is same of X axis.

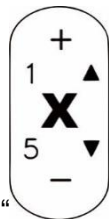


### 5.7.5 Calc Border

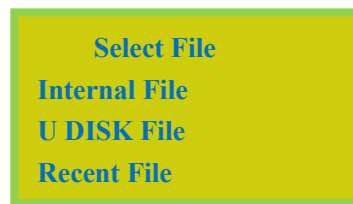
Calculate bound means user can check the size of processing, So as to avoid unnecessary waste of materials and processing errors. Steps as below:

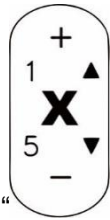


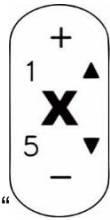

- 1) Press “ ” to move the cursor to Calculate bound ,press “ ” to enter,



then press “ ”to select file list, Press “ ”get into the file list





- 2) Press “”to choose file. Press “”, system start to read the file, after reading the file, the system will calculate the area.

## Appendix 1. Pulse equivalent calculation

### PS 1.1 Stepper motor drive

#### PS1.1.1 Linear axis

**Unit: Pul/mm**

**Formula = pulses per revolution / distance per revolution**

Numerator:

Pulses per revolution formula:  $(360^\circ / \text{stepper angle} * \text{Driver subdivision})$

(Some stepper drivers mark pulse number directly).

Denominator:

Distance/revolution formula:

- ▶ Screw drive = screw pitch\*mechanical transmission ratio(reduction ratio)
- ▶ Rack (straight) drive = rack module\*gear teeth number\* $\pi$ \*mechanical transmission ratio (reduction ratio)
- ▶ Rack (helical) drive = rack module\*gear teeth number\* $\pi$ \*mechanical transmission ratio(reduction ratio)/cos (helical angle)
- ▶ Pulley & belt drive =  $\pi$ \*pulley diameter\*mechanical transmission ratio(reduction ratio)
- ✓ **Screw drive:**



$$\text{pulse} = \frac{360^\circ}{\text{Stepper angle}} * \text{Driver subdivision} \\ \text{Screw pitch} * \text{transmission ratio}$$

Pulse/rev	SW5	SW6	SW7	SW8	MSTEP	SW5	SW6	SW7	SW8
400	ON	ON	ON	ON	2	ON	ON	ON	ON
800	OFF	ON	ON	ON	4	ON	OFF	ON	ON
1600	ON	OFF	ON	ON	8	ON	ON	OFF	ON
3200	OFF	OFF	ON	ON	16	ON	OFF	OFF	ON
6400	ON	ON	OFF	ON	32	ON	ON	ON	OFF
12800	OFF	ON	OFF	ON	64	ON	OFF	ON	OFF
25600	ON	OFF	OFF	ON	128	ON	ON	OFF	OFF
51200	OFF	OFF	OFF	ON	256	ON	OFF	OFF	OFF
1000	ON	ON	ON	OFF	5	OFF	ON	ON	ON
2000	OFF	ON	ON	OFF	10	OFF	OFF	ON	ON
4000	ON	OFF	ON	OFF	25	OFF	ON	OFF	ON
5000	OFF	OFF	ON	OFF	50	OFF	OFF	OFF	ON
8000	ON	ON	OFF	OFF	125	OFF	ON	ON	OFF
10000	OFF	ON	OFF	OFF	250	OFF	OFF	ON	OFF
20000	ON	OFF	OFF	OFF	DISABLE	OFF	ON	OFF	OFF
40000	OFF	OFF	OFF	OFF	DISABLE	OFF	OFF	OFF	OFF



E.g.1: Driver nameplate1

E.g.2:Driver nameplate2

Motor nameplate/ stepper angle=1.8°

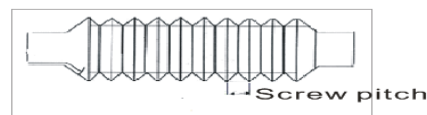
**Explain:** Stepper angle is the data of motor, means the angle of motor rotating for a single step. Driver subdivision is set in the driver.

In E.g.1, Pulse/rev is Pulses per revolution of stepper motor, so that the user only needs to select a relative value according to the actual dial code. For example: If user choose 3200 Pulse/rev, indicates  $(360^\circ/\text{stepper angle}) \times \text{Driver subdivision} = 3200$ .

In E.g.2, the MSTEP means subdivision number. So, if the stepper angle is  $1.8^\circ$ , selected subdivision is 16, then  $(360^\circ/\text{stepper angle}) \times \text{subdivision} = (360^\circ/1.8) \times 16 = 3200$ .

The use should use correct computational method according to the actual marks of stepper motor driver nameplate.

Screw pitch (above picture): The distance that the nut moves when the ball screw makes one rotation.



Transmission ratio: The reduction rate or angular velocity ratio of the front drive sprocket to the end driven wheel.

✓ **Rack drive:**

▶ **Straight teeth:**



$$\text{pulse} = \frac{360^\circ}{\text{Stepper angle}} \times \text{Driver subdivision} \\ \text{rack module} \times \text{gear teeth number} \times \pi \times \text{transmission ratio}$$

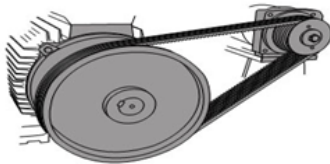
► Helical teeth:



$$\text{pulse} = \frac{\frac{360^\circ}{\text{Stepper angle}} \times \text{Driver subdivision} \times \cos(\text{helical angle})}{\text{rack module} \times \text{gear teeth number} \times \pi \times \text{transmission ratio}}$$

Explain: Rack module and gear teeth number are both the parameters of the rack. Rack module \* gear teeth number \* pi is the pitch circle circumference of the rack.

✓ **Pulley&belt drive:**



$$\text{pulse} = \frac{\frac{360^\circ}{\text{Stepper angle}} \times \text{Driver subdivision}}{\pi d \times \text{transmission ratio}}$$

d: Pulley diameter

### PS1.1.2 Linear axis pulse equivalent computing method

For example: the stepper motor driver dialed code is 1600 pulse/rev.

➤ **Screw drive**

$$\text{screw pitch}=5\text{mm}, \text{pulse equivalent} = \frac{1600}{5} = 320$$

➤ **Rack drive**

rack module:1.25, gear teeth number:23,  $\pi$ :3.131592653, transmission ratio:1/5(0.2)

helical angle:19°31'32" ( $\approx 19.52833333^\circ$ )

**Straight Arack**

$$\text{Pulse equivalent} = \frac{1600}{1.25 \times 23 \times 3.131592653 \times 0.2} = 88.573$$

**Helical rack**

$$\text{Pulse equivalent} = \frac{1600}{1.25 \times 23 \times 3.131592653 \times 0.2 \div \cos(19^\circ 31' 32'')}^\circ$$

$$= \frac{1600 \times \cos(19.52833333)}{1.25 \times 23 \times 3.131592653 \times 0.2} = 83.378$$

NOTES:  $1.25 \times 23 \times 3.131592653 \times 0.2 = 18.0631577605$

$$\cos(19.52833333) = 0.93237630503668681677372930102306$$

$$1.25 \times 23 \times 3.131592653 \times 0.2 \div \cos(19.52833333) = 19.1666969915 \approx 19.1667$$

### PS1.1.3 Rotary axis (pul/°)

Formula = pulses per revolution / angles per revolution (360°)



$$\text{pulse} = \frac{\frac{360^\circ}{\text{Stepper angle}} \times \text{Driver subdivision}}{360^\circ \times \text{transmission ratio}}$$

### PS1.1.4 Rotary axis pulse equivalent computing

E.g.: pulse/rev=1600, transmission ratio = 1/40

$$\text{Pulse equivalent} = \frac{1600}{360 \times 1/30} = 177.778 \text{ (result retains up to 3 decimal places)}$$

## PS 1.2 Servo driver

The pulse equivalent factory value X, Y and Z on the handle are all 400, which can be used as a constant or change a new value to set the electronic gear ratio on the servo motor driver. It can be reduction of a fraction.

**Electronic gear ratio molecules that represent the resolution of the encoder are found in the servo drive specification.**

**Denominator of electronic gear ratio:**

#### Linear axis

- ✓ Screw drive: pulse equivalent \* screw pitch \* mechanical transmission ratio
- ✓ Straight rack: pulse equivalent \* rack module \* gear teeth number \* π \* mechanical transmission ratio
- ✓ Helical rack: pulse equivalent \* rack module \* gear teeth number \* π \* mechanical

Transmission ratio/cos (helical angle)

- ✓ Pulley & belt drive: pulse equivalent  $\pi \times \text{pulley diameter} \times \text{mechanical transmission ratio}$

### Rotation axis

- ✓ pulse equivalent  $\times 360^\circ \times \text{mechanical transmission ratio}$

## Appendix 2. Common problems and troubleshooting

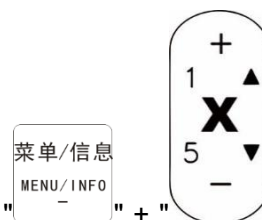
### PS2.1 Solutions for screen display faults



#### After powered on the “Screen flicker or automatically restart”


- 1) Switching mode power supply is insufficient. Check power supply if there are problems, and change high-quality power supply to solve the problems.
- 2) The local power grid unstable. Check local grid voltage stability or use the regulator filter device.
- 3) The power chip of the handle is ageing. This phenomenon also appears when the handle is powered through the USB cable to the computer. Please return back the handle to our company.
- 4) Temporary solution. Using standard 5V mobile phone charger, supply power through the USB cable to handle. Duplicate power supply for temporary emergency use.

#### Failed to set work piece origin during normal operation process

- 1) It is under the mechanical coordinate system. Check if the main interface displays AX



AY AZ, AA, if yes, should press "  " + "  " switching to work coordinate

system. Then it can set work origin. Press " + " is for going to mechanical coordinate system where cannot set work origin in there.

- 2) The buttons are broken. Press " and check whether the buttons are normal or not.

### Assertion error

Assertion error (occurred during the processing or after starting) is generally a software problem. User can boot the controller by entering "emergency state", or re-upgrade it. If can't be solved either, user should send back it for repairing.

### Unable to read U flash disk or read error occurs

- 1) Processing by U-disk, screen shows "there is no item in this option". Format U-disk to FAT32, change allocation unit to the default configuration size. Then re-import processing files, it will read normally.
- 2) U flash disk capacity is too large (16G, 32G or 64G etc.). Recommend replace U disks such as 2G ,4G, 8G.
- 3) There is something wrong with USB communicate port or U-disk interface is broken, change a new USB port or U-disk.
- 4) There is no any reaction while insert into the U-disk. Change a genuine brand of U-disk, such as SanDisk, FOUNDER U-disk etc.
- 5) If the U-disk interface is weak connection, user can copy files into inner memory space of the controller for temporary solution.
- 6) Program contains non-standard G codes, or some illegal characters. The system does not recognize them and interrupt handling. Recommend using professional simulation software to review the program whether there is an illegal character. Delete all illegal characters.

## **PS2.2 FAQ in practical operation**

### **After the machining, the cutting size doesn't match the actual size in processing file**

- 1) Pulse equivalent is wrong. Please contact the engraving machine manufacturer to get the correct values and modify them.
- 2) User has selected the wrong tool bit which is not the same as it set in process file.
- 3) Check if there is any problem with the path processing file.

### **The screen displays "exceed limit" during processing**

- 1) The machine hasn't returned ZERO, lead the system is unable to confirm the actual position. Solution is to go machine ZERO.
- 2) The reserved processing range is small than the actual file size after user set work piece origin. Confirm the actual file size and then set a correct working origin.
- 3) Set wrong working origin in the process of creating processing file path. Check the file path, and then generate the correct one.

### **Hard limit triggering**

- 1) If the machine has connected with hard limit, the hard limit switch maybe damaged or the voltage setup status on X6 is wrong.
- 2) System has not connected with hard limit signal: Confirm whether connect other signal wire to hard limit X6 port, if not, check voltage setup normal or not. If normal, user could go to "MACHINE SETUP"- "Input Confi" and DISABLE X6 port, then go to "SYSTEM SETUP"- "wipe cache". If still can't solve this problem, user can upgrade the system.

### **Z axis (spindle) fall down abnormally (too fast) and cause Z feed amount too much during processing**

- 1) Z axis working speed exceed the fastest speed cause Z axis loses its steps when moving up. " MACHINESETUP " - " Max Spd Limit ",set the safe speed.


- 2) The coupling is loosen or transmission mechanism slipping. Re-adjustment the connecting parts.
- 3) The signal wire connected between the control board and the motor driver has got interference. Adjust the circuit.
- 4) Processing file error. Check processing file, try to download the correct processing file to U disk or handle internal.
- 5) There is something wrong (plug loosen or wire damaged or wire diameter is too slimsy) with the lines connecting Z axis motor and motor driver. Replace the lines.

**Repeating the same processing file after returning back to the machine ZERO, Z axis cutting depths are not as same as each other**

- 1) Machining table is uneven or processing object not firmly fixed, re-milling the machine table to adjust the flatness.
- 2) Z-axis origin detection switch repeat positioning accuracy error, causing Z axis homing error each time. Replace a high-quality detection switch.
- 3) Too much interference in the Z-axis homing process to form a false Z origin. Re-adjust the wiring.

**The machine cannot stop after returning ZERO, and cause spindle hit the machine body**



Double press“  ”to check input signal (Origin detection switch signal). To do self-test. Detect whether the signal is triggered or disconnected.

- 1) The origin detection switch is broken. Replace a new one.
- 2) The distance of the origin detection switch detection sheet beyond the detection range(This problem is common occurs in optoelectronic and proximity switches) of the switch, adjust the position of the test piece.
- 3) The origin detection switch to the control board wiring aging or loosening. Check the connections again.

- 4) The control board is broken. Return back to us to repair.
- 5) 50-pin data cable is broken. Replace it with a new data cable.

### **The machine uniform moves to the reverse direction when backing to the machine ZERO**

- 1) The origin detection switch types do not match with the definition of the corresponding voltage level. Modify the voltage level in the controller. (Normally open type corresponds to a level defined the direction of the arrow down, normally closed type corresponds to the level defined arrow up).
- 2) The origin detection switch is broken. Replace a new one.
- 3) The origin detection switch connects control board not well. Refresh the cable to confirm the wiring is correct.
- 4) Too much interference, resulting in the illusion of the detection switch has been triggered. Recalibrated the whole circuit.
- 5) The control board is broken. Depot Repair.
- 6) 50-pin data cable is broken. Replace the data cable.

### **Abnormally running when processing or the actual file is different from theoretical file**

- 1) The system program disorder.
- 2) Too much external interference lead the controller cannot work normally. Re-adjust overall circuit. (The wires of weak current and strong current should be separately binding, the inverter and other components should be separated connected each GND of themselves).
- 3) There is something wrong while converting the file format and the program appears illegal characters or system unrecognized codes. Recommended to use third party simulation software to review the program paths.

### **Start automatic tool setting, the tool does not stop after touching C.A.D (Tool**

**sensor).**

- 1) The cutter signal cable connects X4 maybe broken circuit.
- 2) The "GND" signal port on the control board hasn't been connected with spindle housing or poor connection.
- 3) Go to "MACHINE SETUP"- "Input Confi" to confirm if X4 is enabled.

### **Coordinate value changes on screen, but the machine does not move**

- 1) If it is one axis not moving, it maybe wiring problem. Change another normal terminal to this axis wiring terminal, if it moves properly indicating the rear parts of motor driver have no problem. Check if there is something wrong with control board or 50-pin cable. If it is still not moving, it is necessary to detect the corresponding drive and motor.
- 2) If all axes are not moving, firstly, check if there are problems in the 50-pin cable and control board,; secondly, if the control board and 50-pin cable are normal, then user should check the power supply of the motor drivers.
- 3) If debugged all above parts, but the machine still not move, then the mechanical parts should be checked.

### **It is normal to the move from one position to another position, but when return from that position to the original position is not normal**

Mechanical assembly problem, guide screw may be not installed well.

### **Motor moving direction is wrong**

- 1) Exchange A+&A- or B+&B- cable of the stepper motor
- 2) Change motor direction mask (not recommend)

### **The machine vibrates when moves in arc or two-axis linkage movement**

- 1) Check whether the machine is placed horizontally
- 2) Check if the coupling units loose or not.

- 3) Increasing the “start speed”, avoid the resonance point.

## **PS2.3 Electrical components and wiring problem**

### **A single axis or multi axis can only in one direction after machine power on**

- 1) There is something wrong with the connecting between the control board and motor driver common anode end, check the connection.
- 2) Control board is broken. Replace the control board.
- 3) The motor driver is broken. Replace the driver.
- 4) Measure the direction voltage of that axis with a multimeter. Check if the direction is correct.

### **One axis motor does not move after handle power up**

- 1) Pulse cable and direction cable connect oppositely, adjust connection sequence..
- 2) 5V common anode end of the motor driver disconnected, check the connection.
- 3) The motor driver is broken (Performance as the motor moves when push it by hand), change a new one.
- 4) The interface chip of the control board is broken, no pulse signal output.
- 5) Switch this terminal with another normal terminal to check control board abnormal or driver abnormal.

### **Screen is not bright after power up, but connect the handle to computer with USB cable the screen displays normally**

- 1) The DC24V voltage of the handle is not available. Check if the DC24V power supply voltage output is normal or not. If normal, please check if the cable from the power supply to the control board is virtual connection.
- 2) The 50-pin cable is broken or 50 pin connecting plug hasn't connected well.

### **Screen is not bright neither after power up nor connect to computer by USB cable**

- 1) This phenomenon may due to the handle shocked by external force or fall on the ground, causing the crystal processor broken. Return back to repair.

- 2) Users connect high voltage power supply to the control board and cause the handle and control board broken. Return back to repair.

**The screen display “Spindle on”, actually the spindle off; the screen display “Spindle off”, actually the spindle on**

- 1) Line fault. Spindle on signal and COM port is short circuit. Check circuit line.
- 2) The output level definition reversed. Go to the “voltage setup” and modify the output level definition (modify the left first arrow direction in the second row).

**The handle screen doesn’t light up and shows nothing after power on**

- 1) The power supply voltage is too large or the + and – short circuit burned the chip. Return to us for repairing.
- 2) The power supply damaged, change a new one.
- 3) 50-pin cable is broken, replace it.
- 4) 50-pin socket broken, send back to us for repairing.


**System always alarm after the alarm signal has been connected**

Change the input level on X4 (normally open, wiring in parallel; normally closed, wiring in series).

**Press “spindle on” button, but spindle does not start**

- 1) Check wiring, if normal, check if the inverter has alarm, if the inverter is normal and its setting is correct, and then check if the spindle motor damaged or not.
- 2) Check if 50-pin cable is loose. Confirm the settings of inverter refer to its manual to debug one by one.

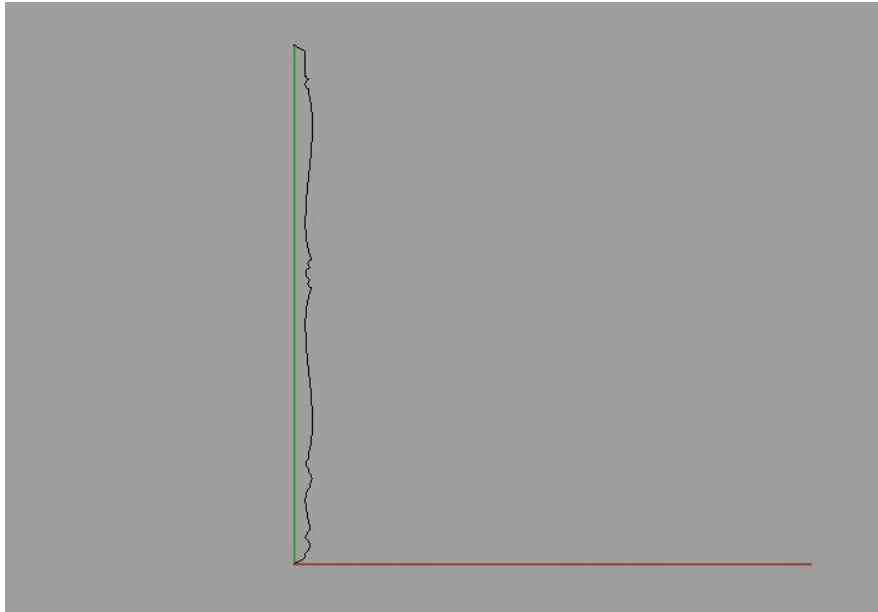


- 3) Check control board. Press “” to start spindle, use multimeter to measure Y1 and GND to see whether conducting, if not, control board or 50-pin cable is broken. To replace a new one for trouble clearing one by one.

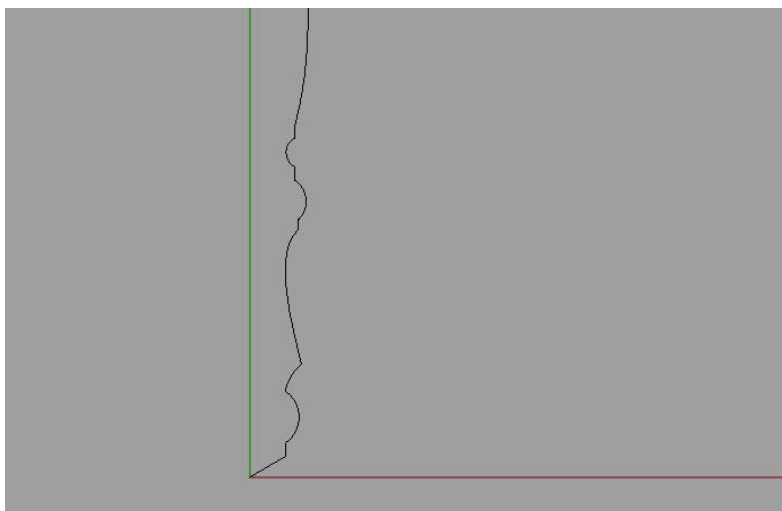
## Appendix 3. Detailed description of lathe drawing method

Lathe mapping tool for CAD, rhino software preservation format DXF (20002004, R12, R20 etc. version)

### 1) Examples of lathe drawing



The red line represents the direction of the X axis and the depth of the tool in processing; the green line represents the direction of the Y axis and the length in processing.

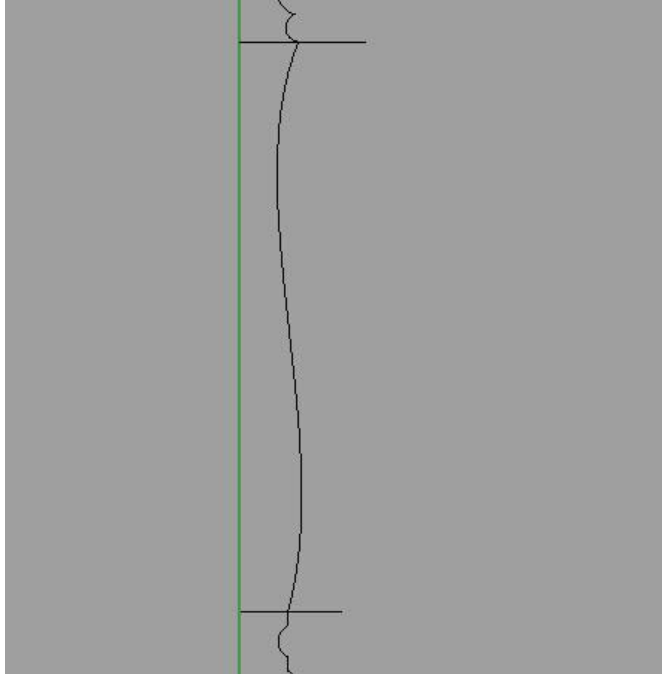


The starting point of graphics must in the (0, 0) position of coordinates.

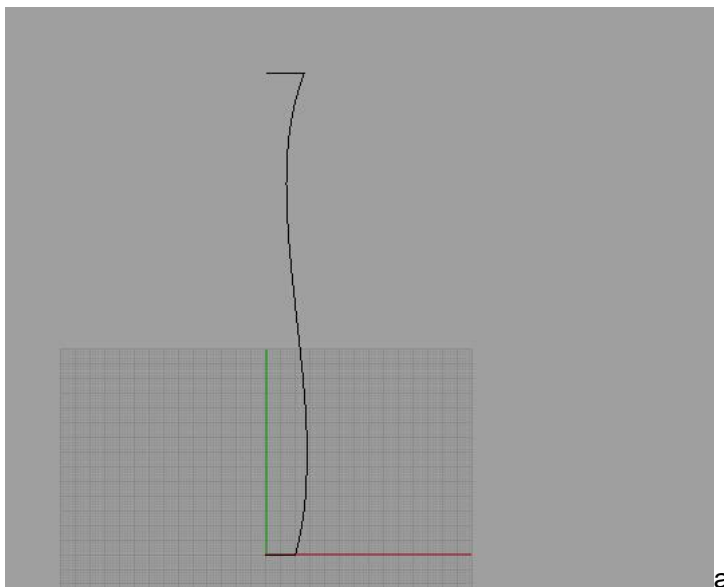
**When the drawing is finished, the file name is served as a file starting with D .And the**

system automatically transfers the file prefix D as turn working file during TurnCycle processing .For example,D1.dxf

## 2) Examples of spiral drawing



Where the wood needs to be processed, the corresponding position in the lathe graphic is intercepted. And resave a new file. (as shown below).



When the drawing is finished, the file name is served as a file starting with S .And the system automatically transfers the file prefix S as spiral working file during TurnCycle processing .For example,S1.dxf