RichAuto-AutoNow-B15 Motion Control System

User's Manual

Applied in B15 multi-spindle controller
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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 ℃；Environment humidity： 0-90% (non-condensing).

2. Insert U disk in the correct direction. Do not pull out or insert 50-pin signal transmission cable

when system is powered on.

3. During the perform processing in U disk file, do not pull out the U disk to prevent the

interruption of data transmission.

4. Strictly prohibited metal, dust, and other conductive substances drop into the handheld

controller shell.

5. The machine casing shall be well grounded to ensure work safety and prevent interference.

6. Unauthorized removal is strictly prohibited, no internal user repairable parts.

7. For long time not using, please power off and keep it properly.

8. Be careful to prevent it from water, dust, fire when using.

9. Do not use the corrosive chemical solvents to clean the device.

10. Spindle motor bearing life and its speed is inversely proportional.

11. Graver 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.

Content

Foreword

System introduction:

RichAuto CNC motion control systems are independently developed by Beijing RichAuto S&T Co., Ltd. It can be widely applied to machinery, advertisement, woodworking, mold engraving machines, laser, flame, plasma cutting machines, woodworking lathe, dispensing machine and soon in the industry machine control field.

RichAuto make DSP as the core control system，High-speed processing operation which are the microcontroller, PLC systems can't match；Embedded structure，High degree of integration, Strong stability, easy to installation and operation；support U disk, Removable storage card reader，With USB Interface，High speed transfer，Plug and play . Fully offline work.

Performance characteristics:

1. System standard configuration is X, Y, Z axis motion control method, and supports the rotation axis（C axis）control which enables the switch between rotary machining and plane processing . Can be extended to X, Y, Z, C four-axis motion control to realize 4 axes linkages control.

2. Multiple I/O ports control. Standard equipped with I/O signal node which has 8 inputs and 7 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, Ucancam 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.

Product parameters:

Model No.	RichAuto-B15		
CPU	DSP	Power down protection	Support
Built in memory	512MB	Breakpoint processing	8
Display screen	128*64Monochrome LCD	External supply voltage	DC 24V
Communication port	U disk	Manual mode	Continuous, step, distance
Linkage axis No.	3to 4axes	Interpolate method	Straight line, arc, spline curve
Control signal	5V common anode	Soft / hard limit	Support
Driving system	Stepper / servo motor	Maximum pulse frequency	1MHz
Minimum input unit	0.001mm	Password protection	Support
Languages	Simplified Chinese, English, traditional Chinese, other languages can be customized		
Standard layout	Handheld controller with USB adapter 1pc；50 pins cable 1 pc、I/O interface board 1 pc, USB data cable 1 pc		

Model List:

| AutoNow	Model No.	Name
3 inches Monochrome screen B1Xseries motion control system	B15	Cylinder multiple spindle

1. RichAuto system composition

1.1 System composition

RichAuto control system contains the following parts：1pc of hand-held controller (handle), 1pc of interface board, 1pc of 50-pin data transmission cable, 1pc of USB communication cable.

RichAuto schematic diagram of system accessories

Hand-held controller
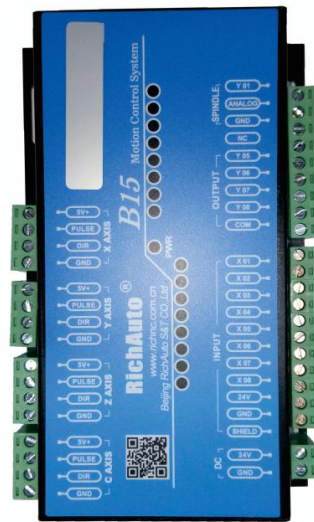
Interface board

Both ends tenon type
data transmission cable

USB communication cable

1.2 Components description

1.2.1 Handheld controller

As shown below，including 6 parts:

1) LCD screen: 128 * 64 resolution LCD display，to display the machine motion, system settings and other information.

2) Key area: Contains 24 buttons to set system parameter information and the machine movement control operation.

3) U disk adapter: External memory like U disk and the card reader throw-over access port. It can identify the files from external memory; System format is FAT16/32 format. This part can be removed separately if it is damaged.

4) RichAuto LOGO

5) 50-pin cable socket: To realize the connection between the system and the machine tool via 50-pin cable. The motion signal given by the system is transmitted to the machine tool motion actuator.

6) USB communication interface: The port of USB communication cable. It is used to connect the handle and computer.

1.2.2 Interface board

Between handle and machine tool is controlled by the interface board connection. The connection ports contain 5 parts, as shown in the following figure:
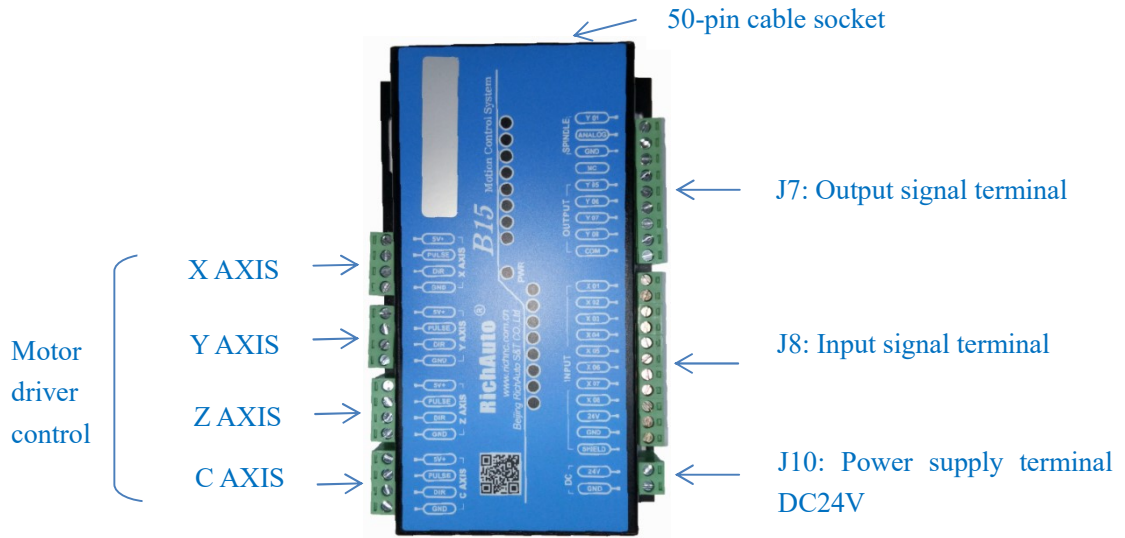
Interface board

◆ 50-pin cable socket:To connect the handle and machine tool via 50-pin cable, and transmit motion signal from system to the machine tool motion actuator.

◆ Output signal terminal: To control spindle ON/OFF and spindle speed shifts etc.

◆ Input signal terminal: The input end of machine origin, tool setting, servo driver alarm, hard limit, E-stop, foot switch signals.

◆ Power supply terminal: The input terminal of system switching mode power supply (DC 24V, 3A).

◆ Motor driver control terminal: Driver control signal output terminals.

1.3 Interface board installation dimensions
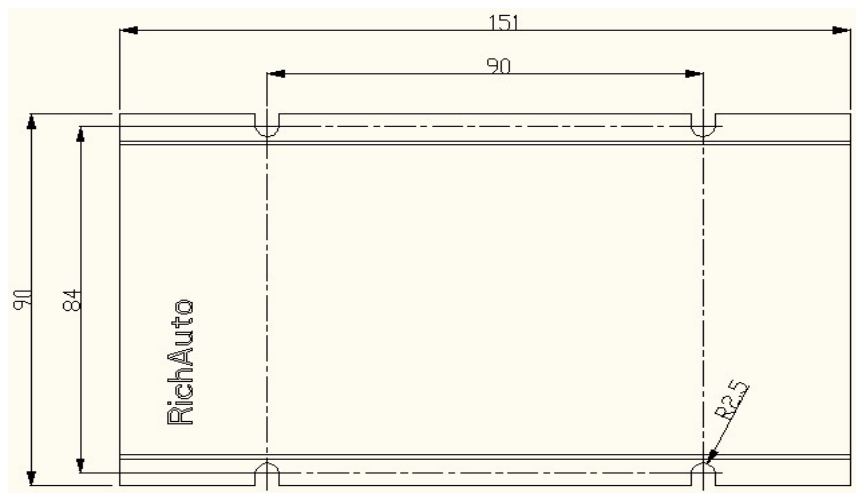
Scale 1:1, unit mm

1.4 System startup methods

RichAuto-B1X motion control system contains 2 starting methods:

Normal starting: Normal power on the system, after boot it will enter into HOME TYPE interface and manual control interface.

Emergency starting: If normal starting cannot show any words or manual interface, emergency starting is required.

Power off the system first, then push "归零 REF 确定 OK" and keep pressing, power on the controller

and waiting for 3-4 seconds. Release "归零 REF 确定 OK", will get into Emergency State interface, user could either select System Update or Format System or don't restart the system directly without any selection.

2. Handheld controller buttons introduction

2.1 Buttons introduction

RichAuto handheld control system has defined 24 operation buttons, each one provides one or more functions in different working states:
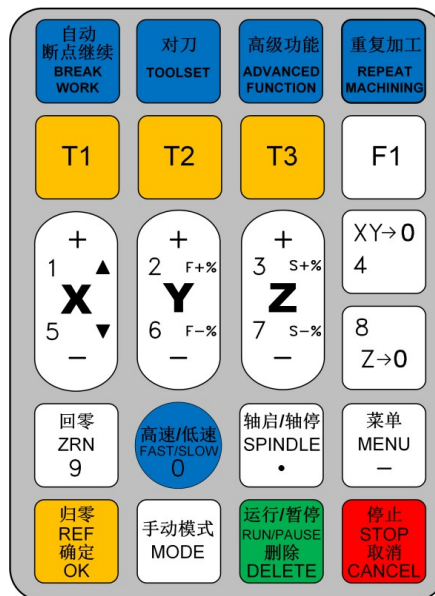
Real photograph of pressing keys

2.2 Usage mode

RichAuto provides 2 modes of button operations, including one-touch key & Combination keys.
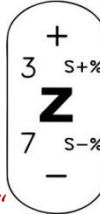
One-touch key：Press one key on the handheld controller keypad is executing the single key operation.

Combination keys：Press two 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, the system upgrade combination keys are "菜单 MENU —" + "归零 REF 确定 OK". When operation, user could push the main function key "菜单 MENU —" first, push auxiliary function key "归零 REF 确定 OK" then, at last release both of them at the same time.
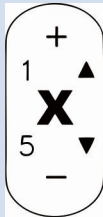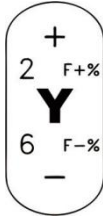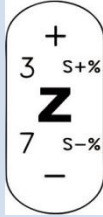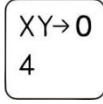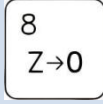
Commonly used combination keys:

	Combination Keys	Function
1	"菜单 MENU —"+"0-9" numeric key	Coordinates systems switching keys **0** is mechanical coordinate system **1-9** are working coordinate system
2	"轴启/轴停 SPINDLE •"+"3 S+% Z 7 S-%"	Switching spindle shifts in manual mode
3	"运行/暂停 RUN/PAUSE 删除 DELETE"+"回零 ZRN 9"	Repeat last processing
4	"手动模式 MODE"+"回零 ZRN 9"	Set current position as parking position
5	"菜单 MENU —"+"归零 REF 确定 OK"	System upgrade
6	"菜单 MENU —"+"手动模式 MODE"	Input coordinate parameter to move the equipment to that position
7	"归零 REF 确定 OK"+"停止 STOP 取消 CANCEL"	Exit keyboard detection interface

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

2.3 Detailed annotation for buttons

Key Name	Function
X 1 + ▲ 5 ▼ −	X axis positive/negative movement; Menu up/down selection; figure 1,5 input
Y 2 F+% 6 F−%	Y axis positive/negative movement; work speed up/down selection; figure 2, 6 input
Z 3 S+% 7 S−%	Z axis positive/negative movement; spindle speed up/down selection; figure 3,7 input
XY→0 4	Set X axis and Y axis work origin; figure 4 input
8 Z→0	Set work origin of Z axis; Figure 8 input
回零 ZRN 9	Operation of return machine zero point (HOME) in manual mode; Figure 8 input
高速/低速 FAST/SLOW 0	FAST/LOW motion state switching in manual mode; work coordinate/ mechanical coordinate switching in auto mode; figure 0 input
轴启/轴停 SPINDLE •	Decimal input; spindle ON/OFF in manual mode
菜单 MENU −	Enter MENU setting; View work information during processing; negative sign
归零 REF 确定 OK	Return reference point operation; OK key of all selections, inputs, operations

手动模式 MODE	Manual motion states; Continuous, step, distance 3 modes switching
运行/暂停 RUN/PAUSE 删除 DELETE	RUN/ PAUSE processing file; DELETE the input data; Selection of different attribute in MENU
停止 STOP 取消 CANCEL	Motion parameter adjustment in manual mode; processing termination; Cancellation of various options, inputs and operations during processing
T1	Switch to spindle No.1
T2	Switch to spindle No.2
T3	Switch to spindle No.3
F1	user-defined
对刀 TOOLSET	Enable Z axis automatic tool setting function
高级功能 ADVANCED FUNCTION	Enable advanced processing function
重复加工 REPEAT MACHINING	Repeat machining same processing file
自动 断点继续 BREAK WORK	Breakpoint processing combination main function key (support the figure 1 to 8)

3. Wiring description

3.1 Interface board terminal

Analog output terminal

Output signal connecting terminal

X axis signal output terminal

Y axis signal output terminal

Input signal connecting terminal

Z axis signal output terminal

C axis signal output terminal

24V power supply input terminal
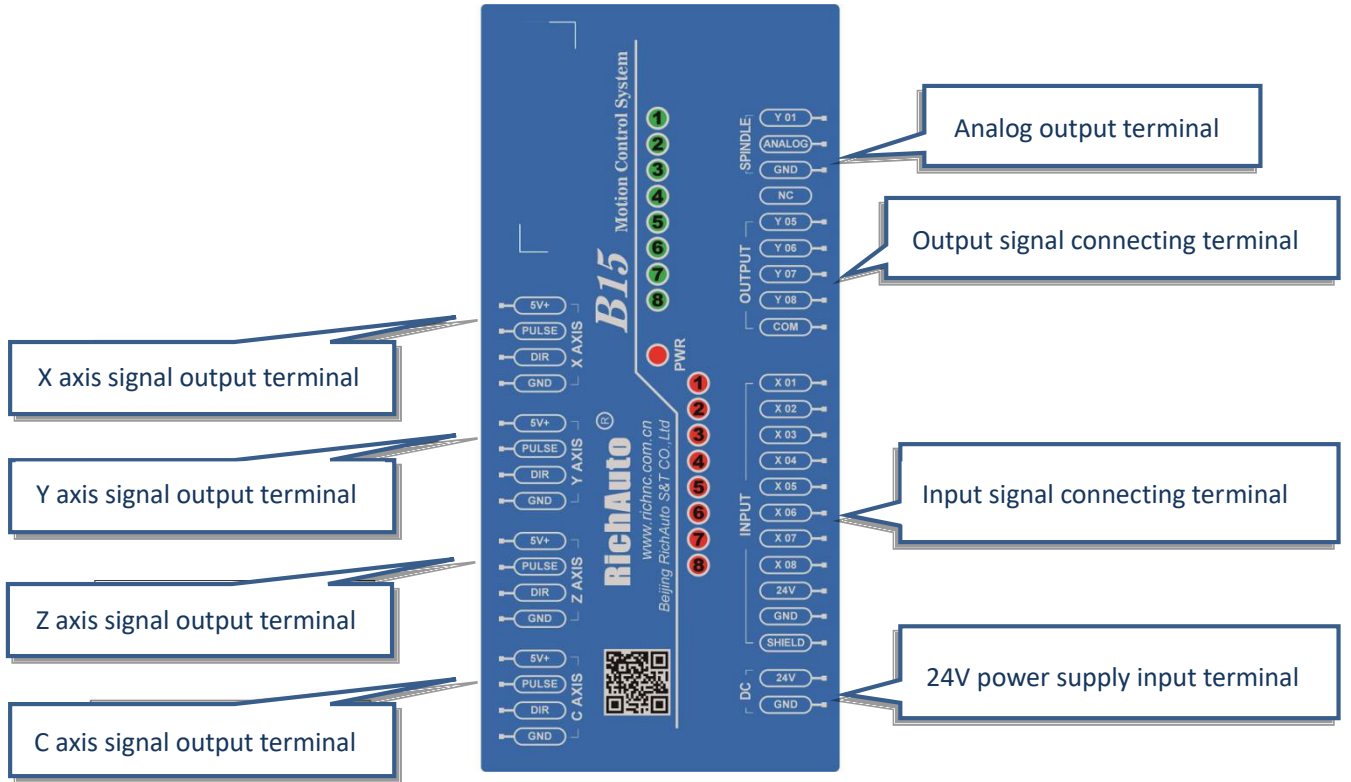
3.2 I/O ports

Terminal	Name	Pin definition	Pin functions and parameters	Attention matters
DC24V	24V+	Input power supply+	Provide 24V operating voltage for the interface board after power up.	Recommend to use DC 24V (current = 3A) current source
	GND	return circuit ground		
X_AXIS	5V	Xaxis common anode signal	X-axis driver common anode power supply terminal, 5V output	Do not impose any other voltage on this pin.
	PULSE	Xaxis pulse signal	Output voltage ≧3V; Drive current≦8mA	
	DIR	Xaxis direction signal	Output voltage≧3V; Drive current≦8mA	
	SHIELD	Shield signal	X-axis driver signal output shield wire	Do not impose any other voltage on this pin.
Y_AXIS	5V	Yaxis common anode signal	Y-axis driver common anode power supply terminal,5V output	Do not impose any other voltage on this pin.
	PULSE	Yaxis pulse signal	Output voltage≧3V; Drive current≦8mA	
	DIR	Yaxis direction signal	Output voltage≧3V; Drive current≦8mA	
	SHIELD	Shield signal	Y-axis driver signal output shield wire	Do not use this port as a ground port.
Z_AXIS	5V	Zaxis common anode signal	Z-axis driver common anode power supply terminal, 5V output	Do not impose any other voltage on this pin.
	PULSE	Zaxis pulse signal	Output voltage≧3V; Drive current≦8mA	
	DIR	Zaxis direction signal	Output voltage≧3V; Drive current≦8mA	
	SHIELD	Shield signal	Z-axis driver signal output shield wire	Do not use this port as a ground port.
C_AXIS	5V	C axis common anode signal	C-axis driver common anode power supply terminal, 5V output	Do not impose any other voltage on this pin.
	PULSE	C axis pulse signal	Output voltage≧3V; Drive current≦8mA	
	DIR	C axis direction signal	Output voltage≧3V; Drive current≦8mA	
	SHIELD	Shield signal	C-axis driver signal output shield wire	Do not use this port as a ground port.

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).

RichAuto motion control system realizes its control through the connection between the interface board and CNC machine. Interface board terminal can be divided into input terminal and output terminal：

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

Output terminal：X,Y,Z,C axis pulse signal output terminal; OUTPUT SIGNAL terminal.

Input terminal

Main power supply wiring:
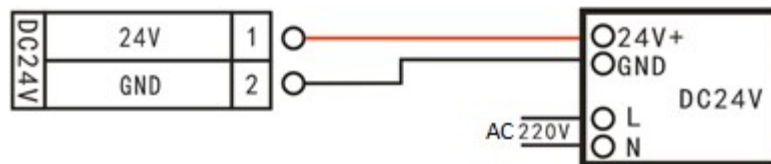
INPUT terminal wiring:

1) **Return ZERO point (HOME):** X, Y Z axis wiring methods are the same
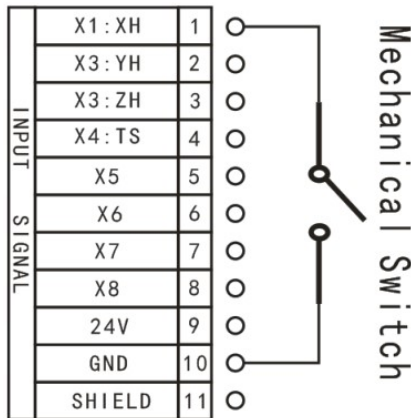
Mechanical switch   **NPN** normally open proximity switch
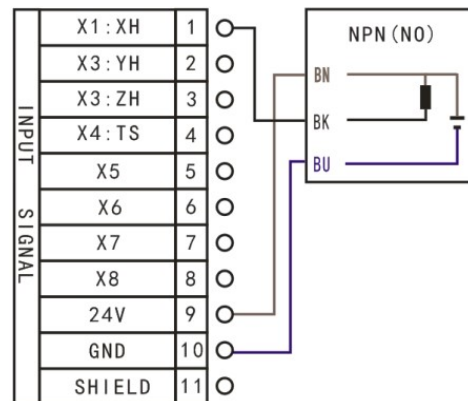
Example of PNP normally open proximity switch:
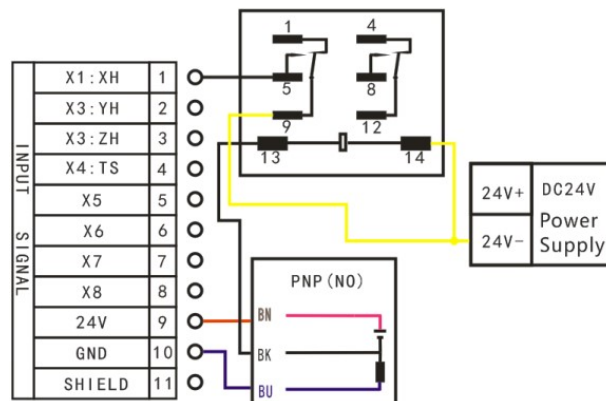
2) Tool setting: Simple constructed cutter touch-off plate
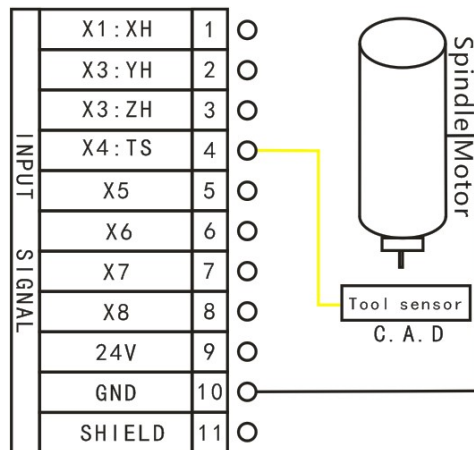
3) X5-X8: Default low level normally open

Take the driver alarm as example:

The alarm signal is normally closed, wiring method is series connection. Meanwhile, revise the voltage definition of X5.
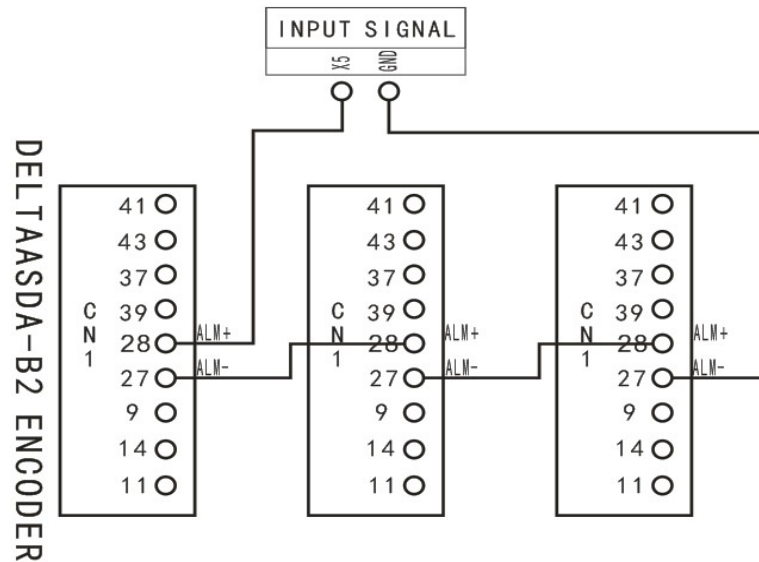
If the alarm signal is normally open, the wiring method is parallel connection. See as below,
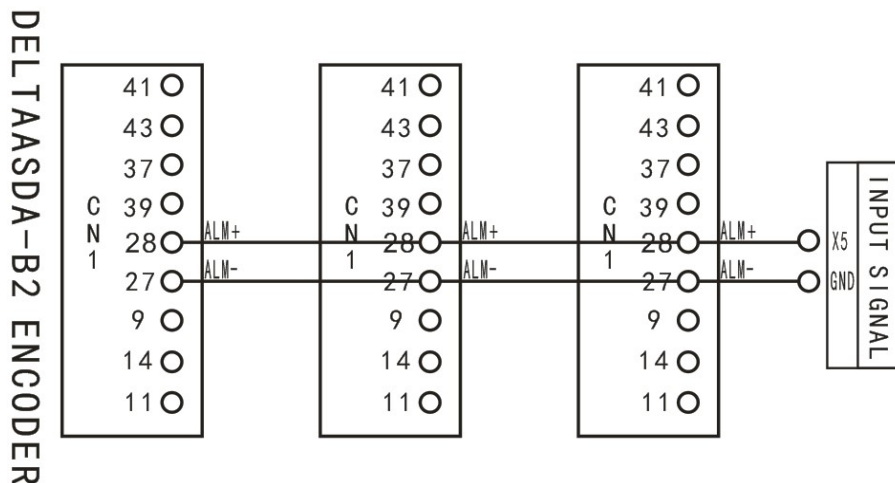
Output terminals wiring:

X axis pulse signal wiring (Y, Z axis pulse signal wiring is the same to X axis)

Step drive:
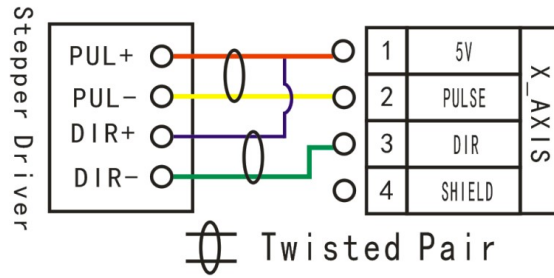
Servo drive: Σ-7 and Σ-V are the same wiring method
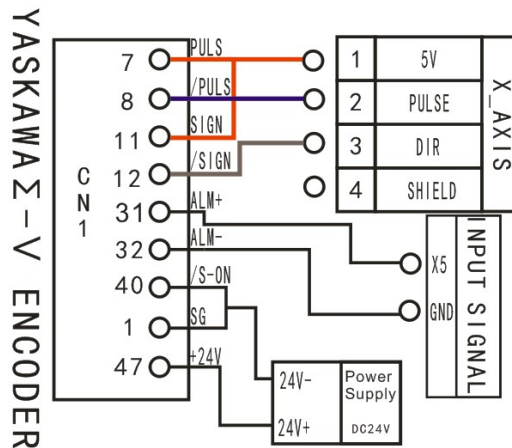
Brake wiring:

Yaskawa servo Σ-V series driver

参数		连接器针端子		含义	生效时间	类别
		＋端子	一端子			
Pn50F	n. □0□□	–	–	不使用 /BK 信号［出厂设定］。	再次接通电源后	设定
	n. □1□□	CN1-25	CN1-26	从 CN1-25/CN1-26 输出 /BK 信号。		
	n. □2□□	CN1-27	CN1-28	从 CN1-27/CN1-28 输出 /BK 信号。		
	n. □3□□	CN1-29	CN1-30	从 CN1-29/CN1-30 输出 /BK 信号。		

First, ensure that the brake output is enabled, and then set Pn50F to 0300, and select brake signal output terminal CN-29 and CN-30. Wiring is as follow,
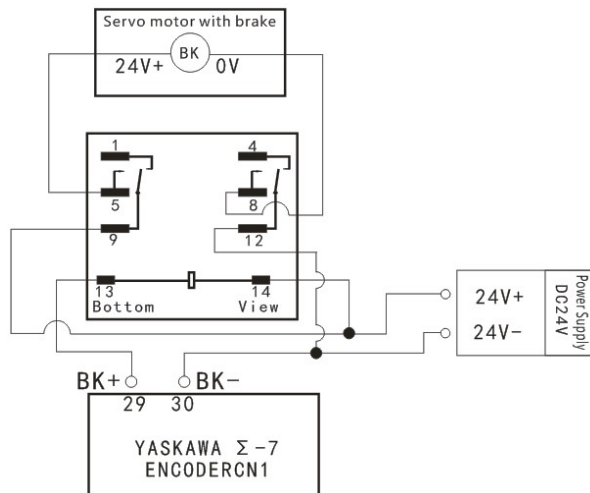
OUTPUT SIGNAL- spindle output

Here we only introduce the wiring method of double cylinders multi spindle cnc machine, since the 4 cylinders multi spindle cnc machine wiring is the same.

1) 2-spindle with a single frequency converter – Analog
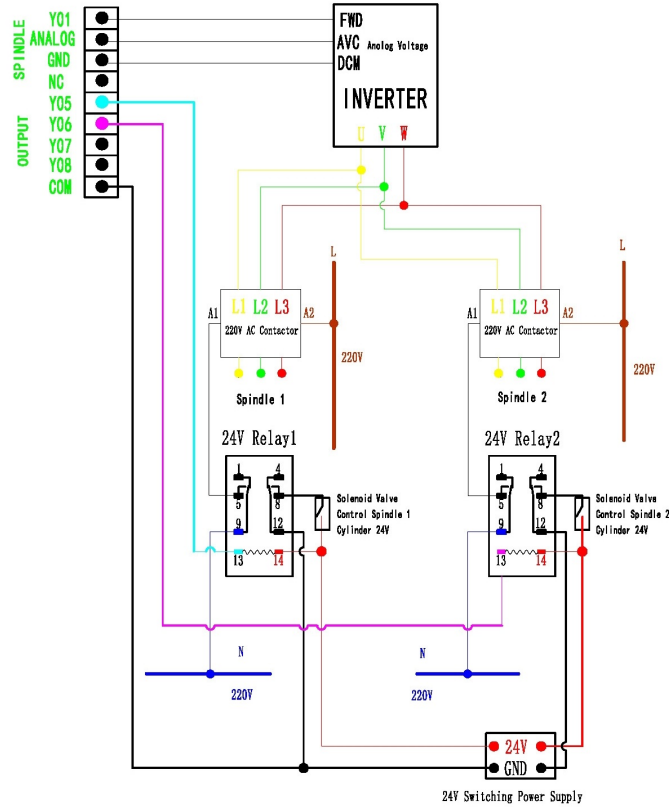
2) 2-spindle with 2 frequency converters – Analog wiring
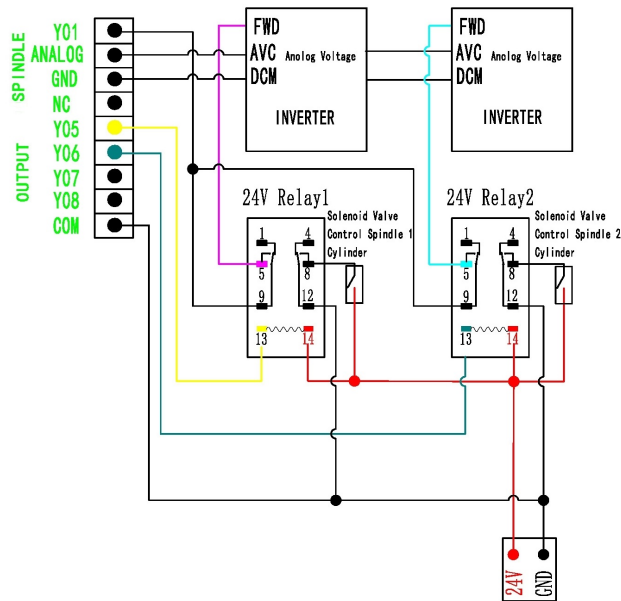
To complete the above wiring the machine and control system will be connected with each other.

3.4 Commissioning of machine tools and control systems

1) After turn on the power, manually move each axis and confirm the direction. If the movement direction and definition direction are opposite, should change the motor phase sequence (A+,A- or B+, B-) or modify the servo driver parameters (this could refer to servo driver manual).

2) According to the defined position of machine origin coordinate, enter into MENU –machine setup- Home setup- Home direction to set HOME direction.

3) Double press "菜单 MENU"-manual voltage setup (the upper arrows stand for input voltage) to check whether the home switch is working properly (manually trigger, arrow flip).

We could determine the machine has been properly connected if all above are ready.

4. MENU description

4.1 MENU classification

RichAuto-B15 motion control system has managed the menu according to its function type, see as below,
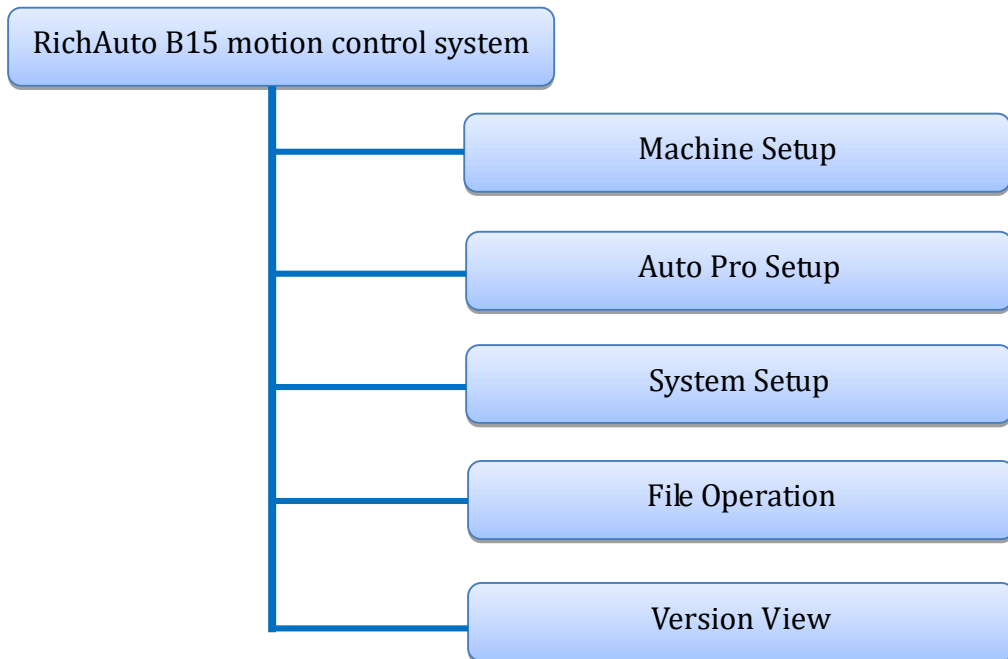
4.2 Menu details

4.2.1 Machine Setup

The menu "Machine Setup" is used to set machine hardware related parameters. It is set by machine producer according to equipment type. No need to modify if the machine hardware or electrical parameters have not changed; If user needs to change the setting, shall consult the equipment manufacturer and modify it under the guidance of the technical engineer.

Menu structure of Machine Setup

```
Machine Setup
    ├── Pulse Equiv
    ├── Table Size
    ├── Spindle Setup
    ├── Home Setup
    ├── Accel
    ├── Start speed
    ├── Voltage Setup
    ├── C.A.D. Thickness
    ├── Max. Speed Limit
    ├── Tool Count
    ├── Cylinder Delay time
    ├── DistTime Limit
    └── Input Confi
```
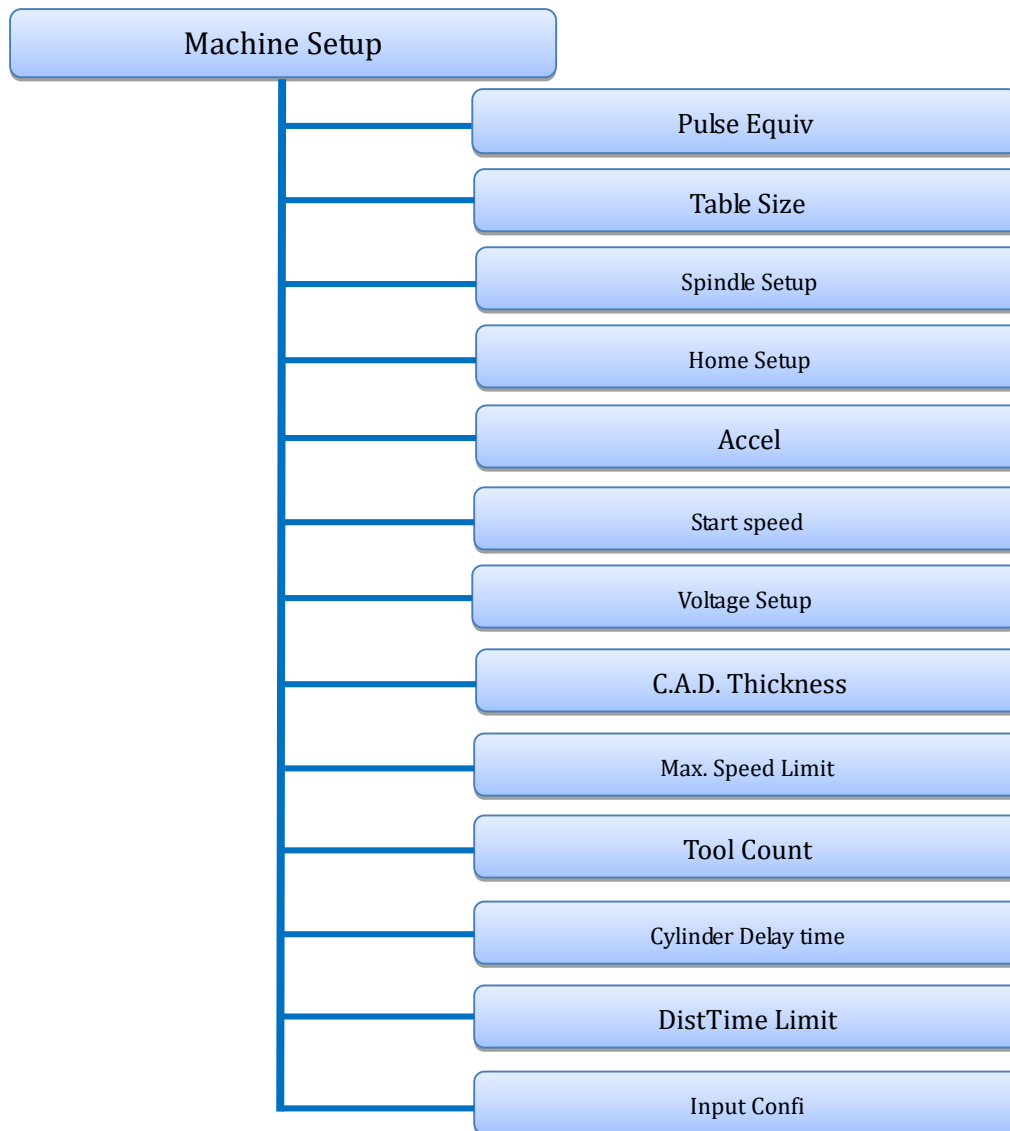
Pulse Equivalent

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.

For the computing method please see in SP7.

Setting mode：Enter "**Pulse Equiv**", cursor is in the X axis pulse equivalent position,
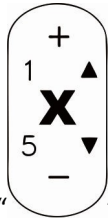
press" " to move cursor as required. Press" DELETE " then, input a new value, and press

" OK " to save. To modify X, Y and Z axis value one by one in the same way. Save all changes and return to the "**Pulse Equivalent**" menu.

Table size

RichAuto 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.
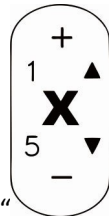
Setting：Enter "Table Size", press " "to move cursor as required. Press " DELETE " and

input the new value, press " OK " to save the changes. To modify X, Y and Z axis value one by one in the same way. Save all changes and go back to the "Table size" menu.

Spindle Setup

Spindle delay：Including start delay and stop delay(**Unit：ms)**.

Spindle state：To be used to set multi-speed control or simply spindle on/off signal control parameters. System defaults "3-line8-state", if user needs "1-line2-state (On/Off)", just change the number of lines to 1; See detailed settings at **OUTPUT SIGNAL spindle output wiring.**

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.

Home order：Motion sequence of each axis when executing return ZERO (return mechanical origin).

Including：

◆ Z,X and Y   Z,X,Y   Z,Y,X
◆ Z only   X and Y,Z   X,Y,Z
◆ Y,X,Z   XY zero   X zero then Y zero
◆ Y,X zero   None   X zero only   XZ and Y

Home direction：Movement direction of each axis when return ZERO. The directions are depend

on the real assembly position of HOME switches on the machine tool. If home switch is installed in the positive movement direction, then home direction should set as "**Positive**", if it is installed in the negative movement direction, the home direction shall set as "**Negative**".
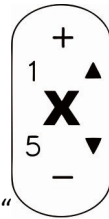
Setting mode: Enter"**Home direction**", press " " and move cursor as required.Press

"DELETE"to change home direction, then press"OK"to save the changes. Return to "**Home direction**" menu.

Acceleration (Unit: mm/s²)

The maximum acceleration value during acceleration and deceleration movement, improve (including straight and curved motion) processing capabilities. If acceleration value is too big, it may cause the motor losing steps, tremble and even squeak; Setting value too small, will cut down the operating speed of the entire graph.

System default: linear acceleration is 800 mm/s^2, curve acceleration is 1000mm/s^2, the proposed curve acceleration is 1-1.5 times of the linear acceleration value.

Start Speed (Unit: mm/min)

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 motion axes is heavy (shaft very heavy), can set a smaller starts peed; if the inertia of motion axes is light (shaft very light), can increase the start speed value.

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：

The upper arrows indicate the input level definition：Set input signal terminal status definition.

The first four:**0,1,2,3** are **X** axis ZERO、**Y** axis ZERO、**Z** axis ZERO、tool setting signal; The 5 to 8 positions are: **4,5,6,7** correspond driver alarm, hard limit, E-stop signal and foot switch input signals.

The under arrows indicate the output level definition：Set output signal terminal status definition.

The top four: 0、1、2、3 correspond to **spindle On/Off**, **multi-speed 1**,**multi-speed 2**,**multi-speed 3**output signals; The 5 to 6 positions are:**4, 5** correspond **alarm lamp, run lamp** output signals.

X1 X2 X3 X4 X5 X6 X7 X8

Input level

```
0 1 2 3 4 5 6 7
↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓
0 1 2 3 4 5 6 7
↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓
```

Output level

Y1 Y2 Y3 Y4 Y5 Y6 Y7 Y8
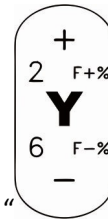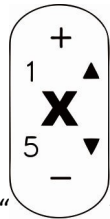
Setting：Press "▲"move to left or right in the row. Press "▼"can jump up and down.

Move the cursor to arrow which needs flip, and press "DELETE" to flip the arrow.

C.A.D. Thickness (Unit: mm)

The thickness should input actual value. If the input value is bigger than the actual thickness, Z axis may over cut; if smaller, Z axis tool bit can't reach workpiece surface. This parameter can only take effect when user uses auto tool setting function. Invalid when manual set workpiece origin (press XY→0, Z→0)

Max Spd Limit (Unit: mm/min)

Set the maximum movement speed of three axis positive and negative direction, the setting is only effect during processing, not affect the speed in manual mode;

System defaults max. speed X+/-,Y+/-are60000000 mm/min, Z+ is 1800mm/min, Z-is 3000 mm/min.

Tool Count

Tool count: Input tool count here. Max. 4 tools.

Tool offset: as below,

a) X,Y direction offset

Method 1: Input directly by measurement

Compared with the A15, the offset setting method of B15 is a little different. We take 2 cutters for example (the same setting method for 4 cutters). In A15, the offset value is set from T2 and no need to set T1 offset, because it regards the spindle No.1 position as reference position.

However, B15 has changed, user should set both X and Y offset on Spindle No.1 as 0, and the value cannot change at any time. For Z axis offset on spindle No.1, it can be set according to cutter's length and height. Z axis saves the value of mechanical coordinate value.

Take the X axis offset as example. All the spindles clamping center pointed knife, and then

double press "【菜单 MENU 一】" key, access I/O ports control interface, show as below,

X1 X2 X3 X4 X5 X6 X7 X8

Input level

Output level

Y1 Y2 Y3 Y4 Y5 Y6 Y7 Y8

Move the cursor to Y5 arrow, and press "【运行/暂停 RUN/PAUSE 删除 DELETE】" to flip up the arrow on Y5; Control relay of cylinder on spindle No.1 enabled; Spindle No.1 drops down towards the working table. After that, press "【+ 3 S+% Z 7 S-% 一】" move the Z axis to the workpiece surface and cut a point of knife mark, then press "【XY→0 4】" to set work origin of X and Y axis.
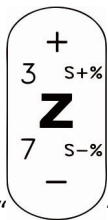
Manually lift up Spindle No.1, switch to spindle No.2, double press "【菜单 MENU 一】". Y5 arrow flips down, and control relay of Y5 enable is canceled. Move the tool nose of spindle No.2 to the position where spindle No.1 leaved a knife mark. If the X axis value displays 200.000, means that the distance between T1 and T2 is 200mm. The X axis offset of T2 should be input as follow;

No.2 spindle offset

X axis	-200.000
Y axis	0.000
Z axis	0.000

b) Z direction offset

Stressed: manual tool changing process will move Z up to the highest point (actually it's the Z axis zero point), and then it switches to another tool, the tool standing still. After manual tool changing mechanical coordinates may change, this is normal, because, if you move it to the same machine coordinate system position where previous tool located, you will find the tool nose can completely coincides.

◆ **Without auto tool touch-off plate**

Firstly, set tool setting type in to "**Manual**" under **System Setup – Function Confi –ToolSet**

(means tool setting method)**;** Then double press "菜单 MENU", flip up the arrow of Y5 under
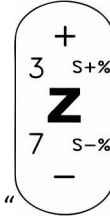
the I/O ports control interface, manual switch the current tool to T1, press "Z 3 S+% 7 S−%" move

Z axis to the measuring workpiece surface. At this time, the mechanical coordinate value of Z

is the Z axis offset value of T1. Press combination keys "运行/暂停 RUN/PAUSE 删除 DELETE" + "轴启/轴停 SPINDLE •", the Z offset

value will be automatically saved and shows on screen.

Information

Spindle 1 tool length offset set successfully !
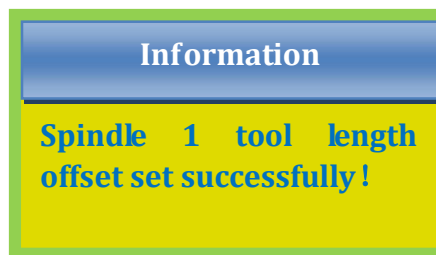
T2 offset measurement method is the same to T1, to be measured by I/O ports switching.

◆ **Equipped with an auto tool touch-off plate**

Firstly, set tool setting type into "Auto" under System Setup – Function Confi–ToolSet, this operation can be carried out independently on different cutter heads, but A15 must handle all of the tool heads simultaneously.

For B15, switch to the corresponding cutter head which needs offset value setting, and then manually move down Z axis to reference surface for measuring (Note: All cutter heads must use

the same measurement reference surface), press shortcut combination keys "运行/暂停 RUN/PAUSE 删除 DELETE" +

"轴启/轴停 SPINDLE •" to save the point as current Z offset. Generally, X, Y axis offset value for each tool is fixed. So we recommend using "manual" for setting X and Y axis offset. And then use "Auto" mode to set Z axis offset.

Cylinder delay time (Unit: ms)

The time for waiting the cylinder lift up or drop down.

Cylinder delay
DwnDelay   4000
UpDelay   4000

Distance Time Limit (Unit: s)

When the Distance mode was selected, it will automatically switch back to Continuous movement mode if there is no action for a certain time of period. To avoid the spindle hits against the machine body (Under this circumstance, such as the user have set a big Distance value and forgot to switch back to Continuous mode). The systems default Distance mode limit time is 30s.

Input Confi (Input Port Configuration)

Enable or disable each input port by the user. You could disable X5-X8 if there is no signal on these ports by yourself.

Input Configuration

Enable or Disable the input port signals. If X5-X8 have connect signal, could disable X5-X8 signal under this menu.

4.2.2 Auto Pro Setup

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

Menu structure of Auto Pro Setup
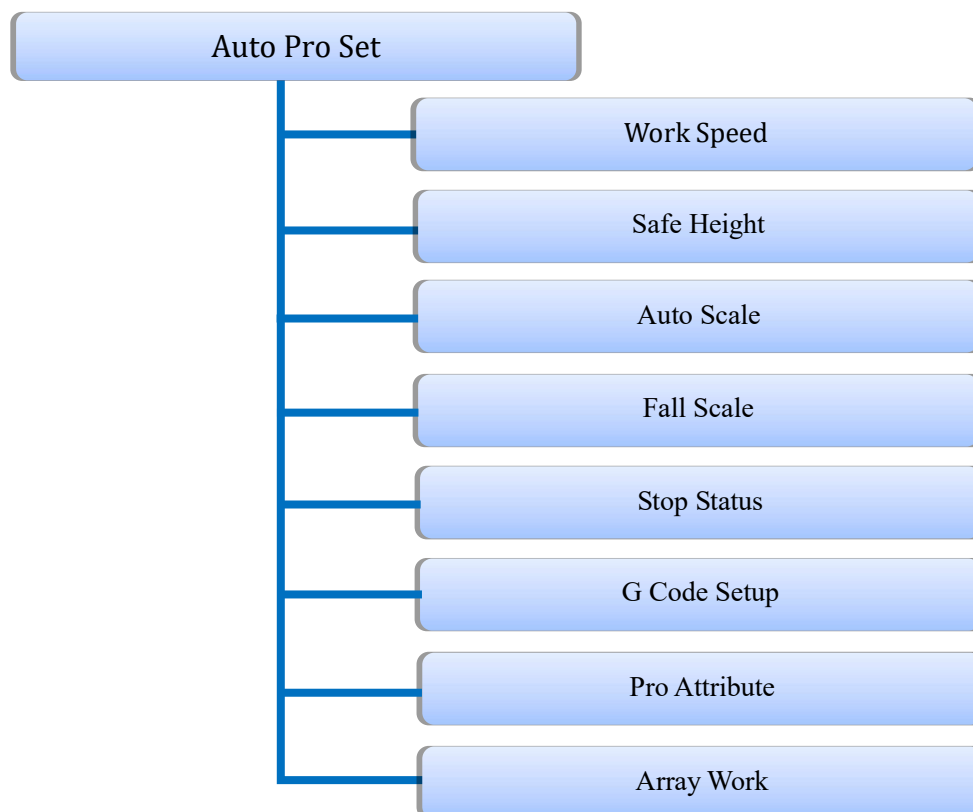
Work Speed (Unit: mm/min)

Including work speed and fast speed, system default is 3000 mm/minute.

Safe Height (Unit: mm)

Z axis lifting height during processing. System default is 40.000mm.

Auto Scale

Actual processing speed=work speed*auto scale. System default the auto scale doesn't affect the fast speed.

Fall Scale

System default the fall down scale is 0.200, Fall speed=fast speed*fall scale, the maximum fall speed is Z- axis limit speed*fall scale.

Fall height, system default is5.000mm. Fall down scale takes effect when the spindle falls to the fall height.
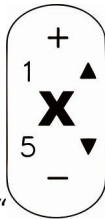
Stop Statue

Stop position when the processing is finished. You can set either a special location or system specified location.
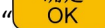
Work stop state

FinAct	Pick up Z
XCoordnt	0.000
YCoordnt	0.000
ZCoordnt	0.000

(FinAct=Final Action; Coordnt=coordinate)
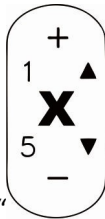
✓ Set a special stop position: Press " " move cursor to where user wants to modify. Press "DELETE", input new coordinate values one by one, then press "OK" to save the changes.

✓ Set system specified location: Move the cursor to the first row, and press"DELETE"to enter into system final position list:

FinAct

Pickup Z

Back To Work Org

Back Home

Back Position

None move

(FinAct=Finish Action，Org=Origin)

Press "　　" to move cursor to where user wants to modify, then press "　OK　" to save

the change. Return to the upper menu.

G Code Setup
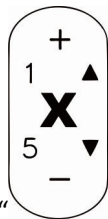
Set special G code attribute, according to the actual need to make changes.

Attribute Of G Code	
F Read	Ign F/Read F
AbsCntr	Off/On
T Read	Ign T/ Read T
Spindle	NTLLG/FORCE/INSTR
FilterJD	None/ Adj Z Filter
S Read	Ign S/ Read S
Read G54	Ign G54/ Read G54
Read G49	Ign G49/ Read G49
Read G40	Ign G40/ Read G40
CodeHead	Skip/NoSkip
Input TO	-1

(Ign=Ignore, Adj=Adjt=Adjust, AbsCntr= Absolute center)

PS: Blue parts indicate system default attributes.
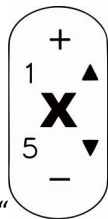
Setting: Press "　　" move cursor to where needs to modify, press "DELETE" and select,

then press "　OK　" to save. Return to the upper menu.

Pro Attribute

Work attribute	
Adj Z	Adj Z/Rev Z
Adjust WP	None/Adjt
Ignore Z	Read Z/ Ign Z
CirLmt	55.556
StepWork	Contns/Single
ATC Spld	Auto/None

Set some special settings in the process, according to the actual need to change.
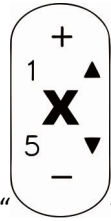
Setting: Press "▲▼" move cursor to where needs to modify, press "运行/暂停 RUN/PAUSE 删除 DELETE" and select,

then press "归零 REF 确定 OK" to save. Return to the upper menu.

Array work

Set array work parameters, including **columncount, Rowcount, Columnspace, Rowspace, Time Interval** (unit: ms)

Columnspace：The distance between the X trend of the file;

Rowspace: The distance between the Ytrend of the file;

Total Processing times= columncount* Rowcount

Time Interval: System default 0, it means not wait.

During processing, if user wants to change processing materials aftercompletion of each processing, needs to set time interval as a negative number.

Whenthe first time processing is completed, the screen prompt "Waiting for the next array processing…", at this moment, user should press any key to start the next array processing, if user doesn't press any key, the system will keep waiting.

Starting array work, press "高级功能 ADVANCED FUNCTION" the system prompts advanced processing list, then user could choose the array work from it.

4.2.3 System Setup

Menu structure of System Setup
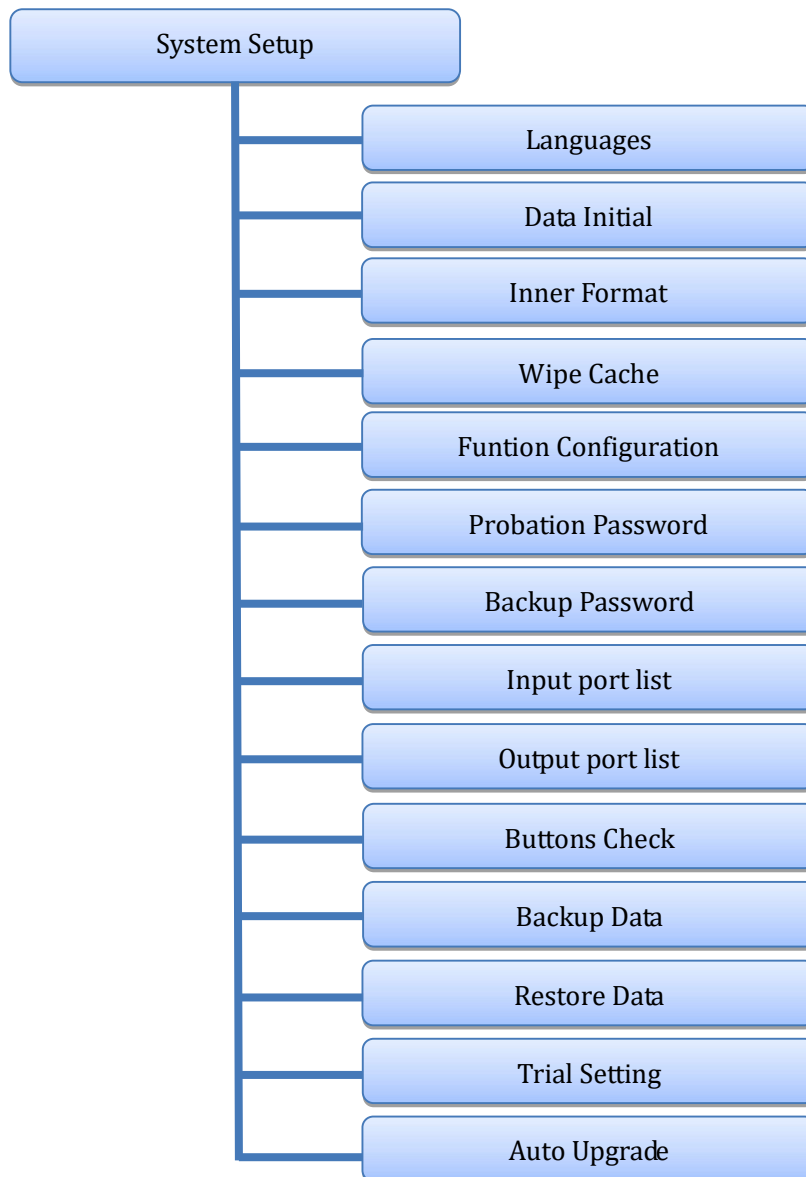
Languages

Change system display language, Chinese or English language.

Data Initial

After data initial system parameters will restore to factory setting

Inner Format

Wipe the internal files, it will not remove the system parameters after inner format.

Wipe Cache

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.

Function Configuration

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

Set function	
PausePkup	NoPick/**Pickup**
ScaleFast	None/**Affect**
Manual	**Step**/Trad
Pretrt	**Parse**/None
QuryPara	**Query**/None
StrtHome	**Query**/Auto/ZOnly/None
CopyWork	**Off**/On
RetOrgPZ	**Pick Z**/Z Stop
TolstAct	**Pickup**/Origin
PauseRstr	**All**/only Z

PS：Blue parts indicate system default function.

Setting: Press "DELETE" and select the function in needs, then press "OK" to save the change. Return to the upper menu.

Probation Password

In case of the CNC machine manufacturer has set passwords before delivery (including trial password and backup password)but forget the password when the password expired, the user could inform RichAuto the original 20 digits password which displays on the system screen, and then get new 20 digits from us to input into the controller to unlock all passwords.

Setting: Press "OK" to enter into 'Probation Password', input new password directly and then press "OK" to save.

Backup Password

In condition of system parameters are disordered, to avoid incorrect operation such as covering off the correct system parameters or backup parameters. Don't enter any number when it asks to input password, then press "OK" if user wants to cancel the backup password.

Input Port List

To be used to review the current input port configuration.

Number 1 to 3 are X,Y,Z ZERO input signal; Number 4 is tool setting input signal; Number 5 to 7 are Driver alarm, Hard limit, E-stop signal, Foot switch(Cycle switch) input signal.

Output Port List

To be used to review the current output port configuration.

Number 1 is Spindle on/off output signal; Number 2-4 is Spindle shifts output signal; Number 5 is Alarm lamp output signal; Number 6 is Run lamp output signal.

Buttons 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 "归零 REF 确定 OK" + "停止 STOP 取消 CANCEL" to exit.
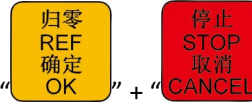
Backup Data

Backup the system parameters and send to U disk or inner space. The backup file format is **data.bak**
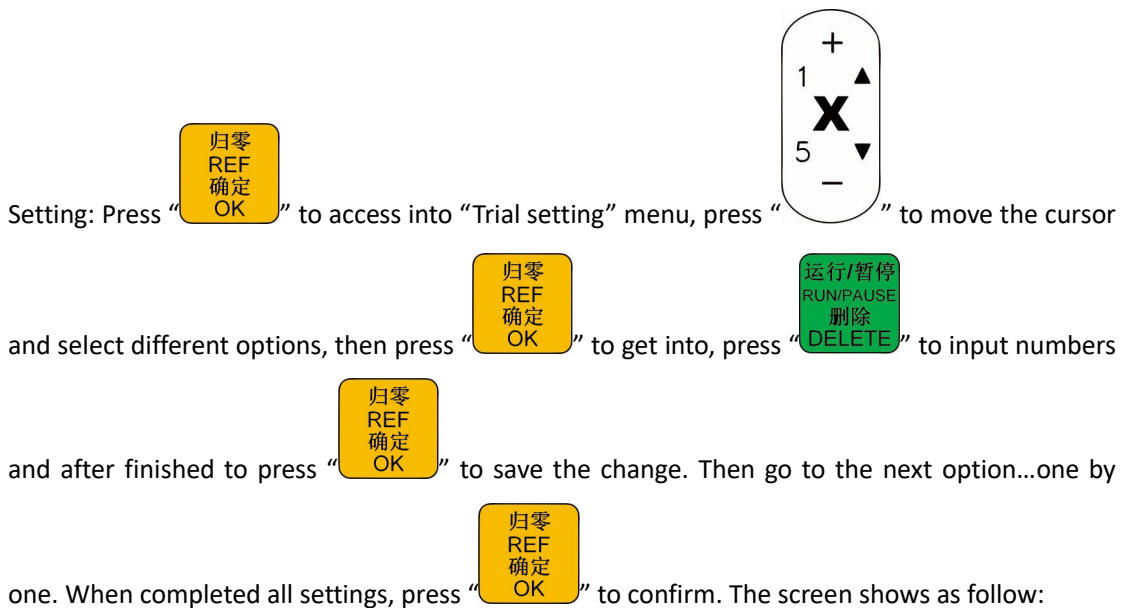
Restore Data
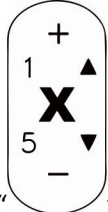
Restore the backup system parameters by choosing the "data.bak" file from the U disk or internal storage area.

Trial setting

There are 4 grades of password (Level 1, level 2, level 3 and level 4). Each level can be set password and use time. User can set 1-8 digits; Using time unit is Hour and the system defaults use time is 1h.

When the previous password expires, the next level of password will come into effect. The operation of Data Initial, Inner Format, Wipe cache and system upgrade are unable to remove 4-grade password.

Setting: Press "归零 REF 确定 OK" to access into "Trial setting" menu, press "1 X 5 + ▲ ▼ −" to move the cursor and select different options, then press "归零 REF 确定 OK" to get into, press "运行/暂停 RUN/PAUSE 删除 DELETE" to input numbers and after finished to press "归零 REF 确定 OK" to save the change. Then go to the next option…one by one. When completed all settings, press "归零 REF 确定 OK" to confirm. The screen shows as follow:
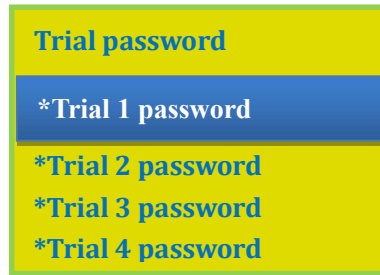
Only the punctuation '*' shows before each level of password indicates trial password has been set successfully. If the level doesn't have '*', the password will not work normally.

When the password is expires, the screen will display as below,
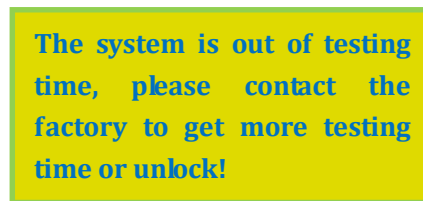
Contact the manufacturer to obtain the password, and press "" under this interface,

then input the new password directly then press ""to confirm. The screen will prompt as below,
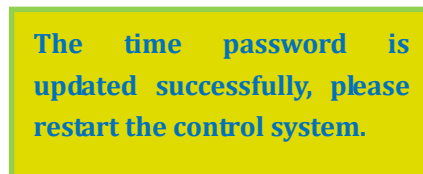
Restart the handheld controller, the system will work normally.

NOTE：If CNC machine manufacturers forgot all password, you can contact us and tell us 20-digit original password under "**System Setup--Probationpas**" menu, and then obtain new 20-digit password from us, enter the new numbers and press"" to remove 4-grade password and reset them.

Auto 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, for more details please see PS1. System updating doesn't remove the controller original parameters.

Upgrade package format sample:
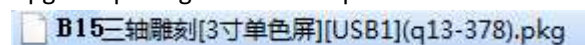
4.2.4 File Operate

Menu structure of Operate File

```
Operate File
    ├── Copy File
    ├── Delete File
    ├── View File
    ├── Pro Info
    └── Check Pro Time
```
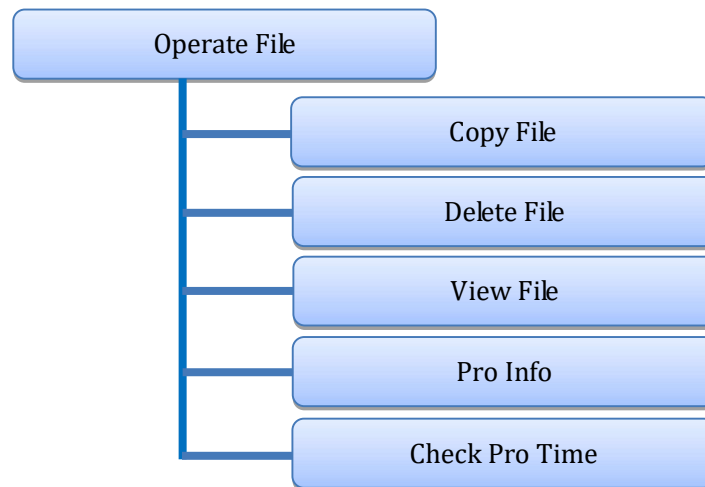
Copy file

Copy file from U disk to inner storage space.

Delete File

Delete inner file.

View File
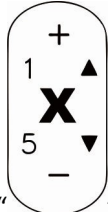
View each line G code of the file which is in the U disk or inner storage space.

Pro Info (Processing Information)

Count the file completely processing number of times and time spent by file name. The record will be cleared when power off.

Check Pro Time (Check Processing Time)

Calculate processing time in accordance with the work speed. After reading G code, the screen will display the processing time.
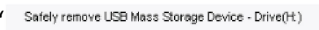
Operate method: Press "【归零 REF 确定 OK】" to enter into "Check Pro Time", then press "【X +▲ 1 5 ▼ −】" and select "U disk/ Internal/ Recent file", press "【归零 REF 确定 OK】" and then choose a file, press "【归零 REF 确定 OK】".

After reading the G code, the screen will display the processing time.

PS: Please pull out the U disk correctly after copying files from computer, otherwise may cause the handheld controller doesn't recognize U disk.

1) Win7 (32 bit) system: after copying files, press" ", then the lower right corner of the

screen will pop-up a dialog box" ", select Eject the corresponding U disk.

When you see this dialog box " "means the U disk has been removed safely from the computer.

2) Win XP system: after copying files, press " ", and click " ",

then click " " to remove U disk successfully.

4.2.5 Version View

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

✧ Update Version e.g.:P1.409/rz-xxxx/q13-802
✧ Product ID e.g.:A0020112
✧ Soft Version e.g.:A1.1936
✧ Emergency Version e.g.:A1.1920
✧ Soft type: 3-axis carving
✧ Hardware type: Support 3-inch screen Flash Disk Mode

5. Machine Operation

5.1 Return HOME (ZERO)

It will display "**all axis home**", "**Z home only**", "**none axis home**" after starting up the DSP handle. Choose any one you want. Machine return home can correct the coordinate of system. In some cases, such as after normal power off, reboot and continue last operation, no need to go machine ZERO, just choose "**none axis home**" to skip HOME operation. That is because system automatically saves coordinate value when the system exits normally.

5.2 Import processing file

Before processing, generally we should import files. RichAuto 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 state initial interface:

Coordinate Number → | 1 X   0.000   MAUN | ← Operation status
Axis → | 1 Y   0.000   F   2 | → Spindle status
| 1 Z   0.000   L   N1 | → Speed Mode
Manual mode → | Continue |
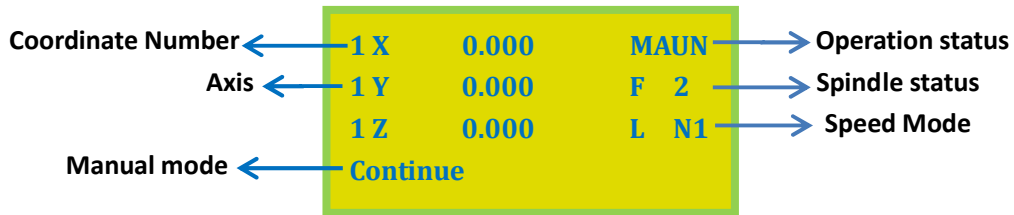
5.3.1 Manual speed switching and adjustment

1)   Speed mode switching

There are 2 speed modes: High speed and low speed. We can switch speed mode by pressing

" [高速/低速 FAST/SLOW 0] " key. The speed mode status show on screen determines the actual manual moving speed.

2)   Speed adjusting

In manual mode, press " [停止 STOP 取消 CANCEL] " enter into the current speed mode settings. For instance, suppose the current speed mode is LOW (screen shows 'L'), the screen displays:

Manual Param
X SLOW   1200.000
Y SLOW   1200.000
Z SLOW   1200.000
Slow Grid   0.100

[+ 1 X ▲ 5 ▼ −]
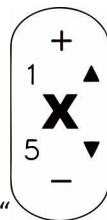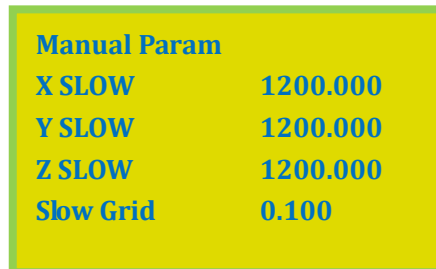
The cursor is on "X SLOW", Press " [ ] " to the one needs to be modified, and press

" [运行/暂停 RUN/PAUSE 删除 DELETE] " then input new value, and next press " [归零 REF 确定 OK] " to confirm; Press " [停止 STOP 取消 CANCEL] " to exit

the settings. If the input value is wrong, press " [运行/暂停 RUN/PAUSE 删除 DELETE] " 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 rate'. 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.

High speed mode setting is the same to low speed mode.

5.3.2 Manual processing mode

The system provides 3 manual movement modes: Conitnue, step, distance. User could press

"手动模式 MODE" 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
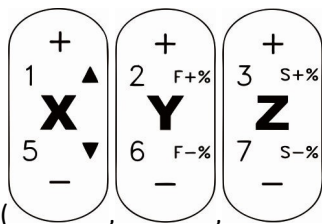
(, ,), the machine will move accordingly until the key is released. The motion speed is determined by current manual speed mode.

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 orfine adjusting the location of the mechanical coordinate.

3) Distance motion mode

It runs a certain distance according to the setting. Press motion direction keys
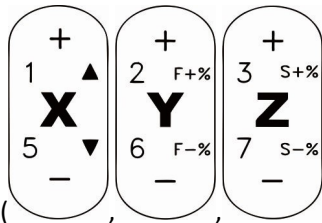
(, ,),the machine will move accordingly.

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,

triple press "手动模式 MODE" re-enter the 'Distance' value setting.

5.3.3 Manual testing input and output

Under the initial boot interface, that is screen displays as follow,

```
1 X      0.000      MAUN
1 Y      0.000      F   2
1 Z      0.000      L   N1
Continue
```

菜单
MENU

Double press "⎣ – ⎦", the screen will displays two rows of arrows which defaults all arrows are downwards "↓".

Upper arrows represent input signals: the former 4 numbers 0, 1, 2, 3 corresponding to X zero, Y zero, Z zero and tool setting. The 4th,5th,6thare driver alarm, hard limit, emergency stop and foot switch (cycle switch) input signals.

运行/暂停
RUN/PAUSE
删除
DELETE

Manual trigger the signal switch by pressing "⎣DELETE⎦", the corresponding **arrow flip up indicates that the signal is normal**. If not, user should check its switch, wiring and 50 pins cable.

Manual test input ports

Manual test output ports

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

Note: Do not confuse with "Voltage setup".

5.3.4 Manual switching coordinate system

Including **machine coordinate system** and **work coordinate system**.

Machine coordinate system is a fixed position, the origin point of machine coordinate is always a fixed position relative to the machine; its coordinate value is called mechanical values, the origin of coordinate is the origin of the machine or called reference point. So, at any time, a point in space can be uniquely determined by a mechanical coordinate system. Because of reference point is the calculation basis of machine coordinates movement, all of those operations such as power on the machine or abnormal release and so on have to return to the reference point which is refers to return machine ZERO.

Work coordinate system used more greatly than other coordinates system in processing. Usually, in processing, we describe a processing position is always relative to a certain point on the workpiece, whereas the workpiece on the machine tool's position relative to the mechanical origin is often change, so it is necessary to introduce a set of more convenient coordinate system during processing, that is work coordinate system. The origin of work coordinate system is a fixed point relative to the workpiece, but it is floating relative to the machine coordinate origin.

RichAuto-B15 provides 1 machine coordinate system and 8 work coordinate systems. Press

菜单
MENU

高速/低速
FAST/SLOW
0

"⎣ – ⎦" + "⓪" can switch the machine coordinate system and work coordinate system;

菜单
MENU

press "⎣ – ⎦" + "Number button 1-9" can switch among different work coordinate systems.

Schematic diagram of coordinate system:

AX	0.000	MAUN
AY	0.000	S 2
AZ	0.000	L SP
Continous		

Machine coordinate system

1X	0.000	MAUN
1Y	0.000	S 2
1Z	0.000	L SP
Continous		

Work coordinate system1

2X	0.000	MAUN
2Y	0.000	S 2
2Z	0.000	L SP
Continous		

Work coordinate system2

...

8X	0.000	MAUN
8Y	0.000	S 2
8Z	0.000	L SP
Continous		

Work coordinate system8

Note: The system cannot set workpiece origin under machine coordinate system. User should switch to work coordinate first, and then set workpiece origin.

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 and Z 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 and Z to the position which will start to process the file on workpiece. Afterwards, press zero clearing " XY→0 4 " can set the workpiece origin of X, Y axis. Press zero clearing " Z→0 8 " can set the origin of Z axis. It should be noted that if user have already used the automatically tool setting function which combination keys are " 菜单 MENU − " + " 轴启/轴停 SPINDLE • " will no need to press " Z→0 8 ".
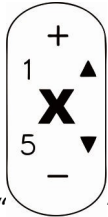
5.4.2 Select processing file

After determined the workpiece origin, press "运行/暂停 RUN/PAUSE 删除 DELETE", the screen shows:

> **SelectWorkFile**
> **U Disk File**
> **Internal File**
> **Recent File**
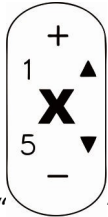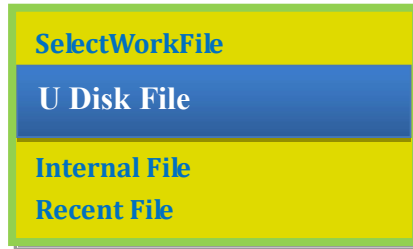
Press "X 1 ▲ 5 ▼ + −" move the cursor and choose, press "归零 REF 确定 OK" to enter into the list, the screen
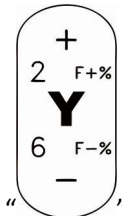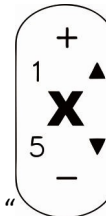
will display the first three file names, press "X 1 ▲ 5 ▼ + −" to move one by one; press "Y 2 F+% 6 F−% + −"

jump 2 lines to move the cursor; press "停止 STOP 取消 CANCEL" to exit.
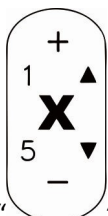
5.4.3 Set processing parameters

After selecting object file, press "归零 REF 确定 OK", the user can modify processing parameters, including "work speed", "fast speed", "speed scale" and "fall down(scale)".

> **Set Work Param**
> **WorkSpd**   3000.000
> **FastSpd**   3000.000
> **SpdScale**   1.000
> **FallDown**   0.200
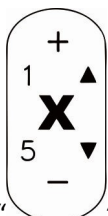
Press "X 1 ▲ 5 ▼ + −" move cursor to select different settings, press "运行/暂停 RUN/PAUSE 删除 DELETE" input values and then

press "归零 REF 确定 OK" to confirm the changes. The system starts to check the codes and machine

starts to process when the system finished the checking. The G code checking is system smart

check mode, press " " to stop the code checking and directly access to automatic processing.

System will remember the checking result only when it is a complete and correct checking. And the system will not check the same file again after complete and correct checking.

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

and current line number. Switching those options by pressing " ".

5.5 Processing operations

5.5.1 Speed ratio & spindle state adjusting

1) Speed ratio adjusting
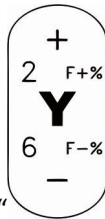
During processing, press " " adjust the speed ratio. The speed ratio increase/decrease 0.1
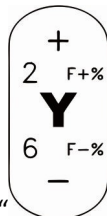
each press on " ". Speed scale (speed ratio): max. 1.0; min.0.1, speed values are also

changed accordingly except for the time. Current processing speed = work speed * speed scale

2) Adjust spindle state

If user has set multistep speed, the DSP handle can change the multistep speed
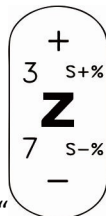
during processing. Press " " to change spindle shift from S1 to S8.

5.5.2 Suspend processing & position adjustment

Press " "pause processing. The top right corner of screen will change from "MAUN" to

"PAUS" and machine suspends processing except the rotating of spindle. Shown below:

```
1X       7.000      PAUS
1Y       8.000      S2
1Z      -2.000      H N1
User will start
```

At this moment, the user is allowed to adjust the position of X, Y and 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 every step. Meanwhile user can change the speed mode to high mode just press "[高速/低速 FAST/SLOW 0]".

When the adjustment is finished, press"[运行/暂停 RUN/PAUSE 删除 DELETE]" again, screen shows:

```
1X       7.200      PAUS
1Y      41.300      S2
1Z      -2.000      H SP
Restore Position?
```

The system asks the operator to confirm whether to save the modified position or not. Press "[归零 REF 确定 OK]"or"[运行/暂停 RUN/PAUSE 删除 DELETE]" key, the system will start processing at modified position; Press "[停止 STOP 取消 CANCEL]", the system will go back to the suspend position (before modifying).

5.5.3 Breakpoint processing &power failure recovery

1) Breakpoint processing

If user press "[停止 STOP 取消 CANCEL]" during machine running, the controller screen shows as below,

```
Save break?
Save break
Discard break
```

If you want to save the current machine location Press "[归零 REF 确定 OK]", the screen displays break list
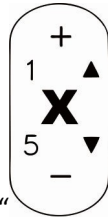
(From breakpoint 1 to 8), press " " move the cursor and select, and then press " 归零 REF 确定 OK " to save, system automatically move to workpiece origin. If the user needs continue processing from the breakpoint, could press the shortcut key" 自动 断点继续 BREAK WORK ", the system will restore the machining from corresponding breakpoint.

E.g.: To restore from breakpoint 1, could press shortcut key " 自动 断点继续 BREAK WORK ", the screen shows the file name of on breakpoint 1 as below,

Break list
1n Testfile.cnc
2: Empty
3: Empty
...
8: Empty

The G code file "Testfile.cnc" for example, it has totally 6705 lines g codes. Press " 归零 REF 确定 OK " the screen displays breakpoint line No. after pre-reading.
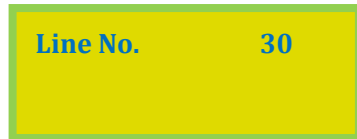
Line No.   30

Press" 归零 REF 确定 OK " popup machining parameters list, then revise as needed and press " 归零 REF 确定 OK ", the system will resume processing from breakpoint 1. However, if user needs to go backwards from this breakpoint, shall press " 运行/暂停 RUN/PAUSE 删除 DELETE ", then the screen shows as below,

Input (new line) No.:
File has   6705   ← Total line count

25   ← Input a new line No.
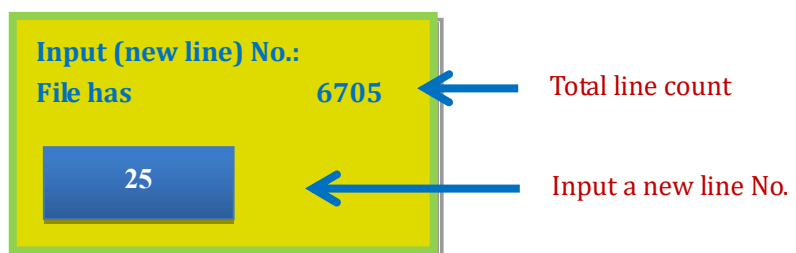
Input line number that needs to return to, and then press " 归零 REF 确定 OK ", the screen will shows new line number as below,

Line No.   30

Press " 归零 REF 确定 OK " popup machining parameters list, then revise as needed and press " 归零 REF 确定 OK " the system will start from the new line. The system must have an action of returning to workpiece origin before save breakpoint and machining.

2) Power off protection

When there is a sudden power failure during processing, system will save current coordinate and parameters, while power restart, process continues. Before that, system must have a HOME motion. Shown as below,

Home Type At Start	Last power off during working, because of inertia the machine position may be error, do you want to restore coordinate? It's recommends not to restore. Press CANCEL to HOME, OK to restore.
All axis home	
Z home only	
None axis home	
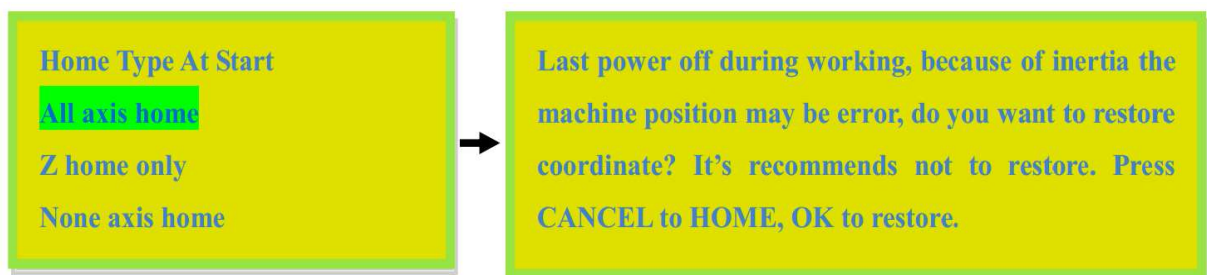
Press" 归零 REF 确定 OK " key to start processing the unfinished process, it will display stop line no., and the line no. also can be chosen. Press " 停止 STOP 取消 CANCEL " cancel the power off protection. If here the user wants to go backwards from current position, the operate method is the same to what has mentioned in breakpoint processing.

5.6 Advanced Processing Function
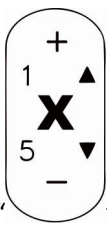
Advanced processing is designed for some special requests, it contains: **Array work, Resume work** (breakpoint processing), **Tool changing** (manual change tool bit), **Part work**, **Calculate bound**, **Mill plane**, **Calculate work time**, **Find break No.**, and **Scale work**. The shortcut key is" 高级功能 ADVANCED FUNCTION ". When the advanced Work is enabled, the screen show as below,
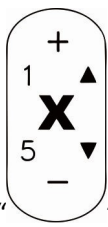
Advanced Work
Array work
Resume work
Tool changing
Part work
Calc bound
Auto center
Mill plane
Calc work time
Find break no.
Scale work
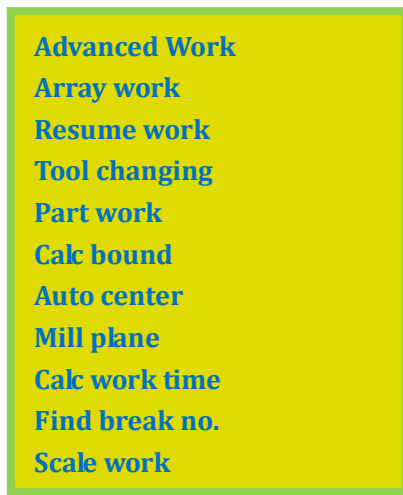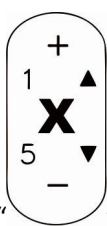
5.6.1 Array work

Steps as below：

1) Press " " to move cursor to the Array work, press " "to enter, and then press

" " again to select different listed files;

2) Press " " to enter file list, then press " " to move the cursor to choose target

file;

3) Set machining parameters, revise array parameters, or go to "MENU"--"AUTO PRO SETUP",

choose "Work Array" and modify the array parameters. The rest steps are similar to the normal

processing. After that, system will start the array work according to the user's settings.

4) During array work, press " " view real-time row number, column number and other

processing information.

Note: If user needs to manual control in array work, just change the setting of "Interval (unit:ms)"into a negative number.

5.6.2 Resume work (breakpoint processing)

Steps as below：
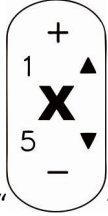
Press" " to move cursor to resume work, press " " to enter the breakpoint list, then move the cursor to the breakpoint position as needed, press " ", the system will resume work from the chosen breakpoint. If you want to return back towards from the breakpoint position, should press " " to input new line number and then press " ", system will start processing from the new line. For specification operation steps can review the contents in *5.5.3Breakpoint processing &power failure recover.*

5.6.3 Tool changing

It means manually loading or unloading the cutting tool in a certain position of the machine tool.

Press " " to get into the setup, after changing the tool bit press " " to move back to the previous location.

5.6.4 Part work

Park work means user can select a start line and stop line from G code, which can realize machining a part of G codes from the processing file. The operate steps are as follows：

1) Press" " to enter the setup, press " " to move the cursor and select a file and wait for the file reading process;

2) Press" " when the system ask to input start line no. and stop line no..Then the screen

displays codes of the first line. Press "运行/暂停 RUN/PAUSE 删除 DELETE", screen shows: input new line no.(and also shows the total lines count of the file). Input the start line number at the cursor and press "归零 REF 确定 OK" to confirm. If the input value is wrong, could press "运行/暂停 RUN/PAUSE 删除 DELETE" key and revise before confirm.

3) Once more press "归零 REF 确定 OK" to set the end line number, it will prompt：**Input end line number.** Press "归零 REF 确定 OK" the screen will show the modified start line number, so here press "运行/暂停 RUN/PAUSE 删除 DELETE" key, input an end line number and press "归零 REF 确定 OK" to save it. If the input value is wrong, could press "运行/暂停 RUN/PAUSE 删除 DELETE" key and revise before confirm.
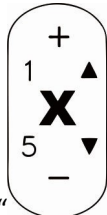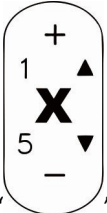
4) Set processing parameters. The rest steps are consistent with the common processing.

5.6.5 Calculate bound

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

1) Press "+ 1 X 5 −" to move the cursor to "calculate bound", press "归零 REF 确定 OK" to access in it. Then press "+ 1 X 5 −" to select a file and press "归零 REF 确定 OK";

2) Waiting for system file reading, and show the calculate result of file size.

5.6.6 Mill plane

Including two types: Scan milling and Encircle milling
a. Scan milling

```
Scan mill set
ScanType        X Scan
Width           100.000
Height          100.000
Diameter        10.000
Depth           0.00000
Z Step          0.100
T Ratio         0.800
```
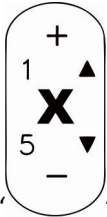
1) Press " X " to move the cursor and choose "scan mill".

2) Press " 归零 REF 确定 OK " to enter into the "scan mill set", it contains parameters: **Scan type, (Scan) width, (Scan) height, (Tool bit) diameter,(Scan) depth, Z Step(Z feed amount), T Ratio(feed ratio);**
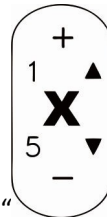
3) Press " X " to move the cursor and press " 运行/暂停 RUN/PAUSE 删除 DELETE " to modify parameters, press " 归零 REF 确定 OK " to save all the changes.

b. Encircle milling

```
Scan mill set
ScanType        AC(anticlockwise)
Width           100.000
Height          100.000
Diameter        10.000
Depth           0.00000
Z Step          0.100
T Ratio         0.800
```
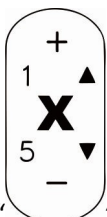
1) Press " X " to move cursor to choose the mill type as "Encircle milling".

2) Press "归零 REF 确定 OK" to enter the "scan mill set", it includes: Scan type, Scan Width, Scan Height, Cutter Tool Diameter, Scan Depth, Z Step and T Ratio.
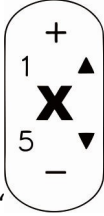
3) Press "X" to move the cursor and press "运行/暂停 RUN/PAUSE 删除 DELETE" to selcect scan type (**anticlockwise or C.W.**) and modify parameters, press "归零 REF 确定 OK" to save all the changes.

5.6.7 Calculate work time

Calculate the total processing time according to the system "work speed". After reading the processing file, the screen displays processing time, different work speed correspond to different processing time.

5.6.8 Find break No.

During processing, if accidentally tool damaged and user hasn't saved the break point, stop working and replace cutter tool. After that, user can manually move X, Y axis to the nearest point where the cutter was broken (recommend to move a little further), press "运行/暂停 RUN/PAUSE 删除 DELETE" + "高速/低速 FAST/SLOW 0" to start advanced work, move cursor to "Find break no.", then press "ORIGIN OK" to enter in. After guide and reading code, the system prompts:

> **Query**
> **Press enter key to continue working from searching position, press other key only show the line number!**
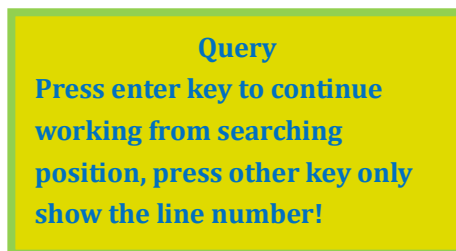
Press "归零 REF 确定 OK" to start processing, press "停止 STOP 取消 CANCEL" key, the screen shows the current position line number as below:

> **Info**
> **35422 is the break line number of this file.**
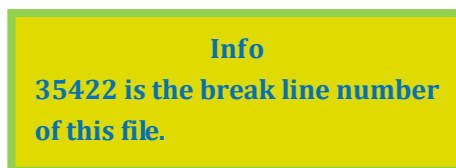
Note: When using the "fine break no." function, must at the same work coordinate system.

5.6.9 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 "归零 REF 确定 OK" to get into "Scale work":

Scale work param
X scale   1.000
Y scale   1.000
Z scale   1.000

After changing all the value, user could start the "scale work" machining.

PS1. System upgrade operation

During using, system software may have updated version which can upgrade the handheld controller, operation as follow:

Upgrade with **.PKG file from U disk

Way 1:

1) Store the **.PKG file (Upgrade package) into U disk, and insert the U disk in the top right port on handheld controller. The upgrade pack name in the controller is rz-xxxx or qxx-xxx.

2) Press "菜单 MENU", select "System Setup" and press "归零 REF 确定 OK". Move the cursor and choose "Auto upgrade". The screen shows as follow,
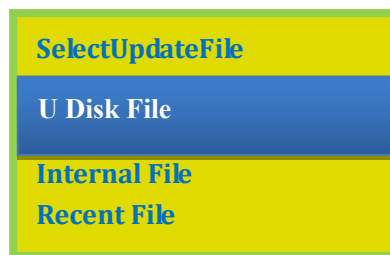
SelectUpdateFile

U Disk File

Internal File
Recent File

3) Choose "U disk file" and press "归零 REF 确定 OK" to access in U disk storage area and select relative

upgrade pack then press "归零 REF 确定 OK", the system will complete the updating automatically.

4) When the upgrading is successful, user should restart the controller.

Way 2:

1) Store the **.PKG file(Upgrade package) into U disk, and insert the U disk in the top right port on handheld controller. The upgrade pack name in the controller is rz-xxxx or qxx-xxx.

2) press "菜单 MENU" + "归零 REF 确定 OK", the screen shows:

SelectUpdateFile

U Disk File

Internal File
Recent File
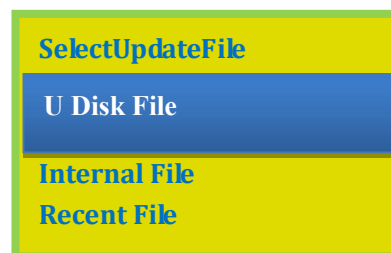
3) Choose "U disk file" and press "归零 REF 确定 OK" to access in U disk storage area and select relative

upgrade pack then press "归零 REF 确定 OK", the system will complete the updating automatically.

4) When the upgrading is successful, user should restart the controller.

PS2. "U disk mode" function introduction

RichAuto adds "U flash disk mode" to A1X and B1X which hardware number start from **A010******
(E.g.: A0101203), & Update Version from rz-1967 (the system needs to update if the update
version number lower than 1967). Connect handle and computer by USB cable, find portable
storage device on the computer, and then copy processing files from computer to handle inner.
This function can ensure that if USB port of the handle is broken or there is no U disk, the
machine can still work normally.

Operation step：

1) Press any two buttons at the same time （ for example:" 归零 REF 确定 OK "+" 手动模式 MODE "） .

2) Connect handle and computer by USB cable， it means that the handleis powered by
computer， loosen the buttons after the power supply.

3) Handle screen display:

优盘模式

Flash disk mode

The handle is connected with the computer successfully.

4) Open" 此电脑 ", could find a removable storage device" A0131482 (G:) 457 MB 可用，共 464 MB "A0131482(G:)
is the handle storage space area. User can copy files first and then paste them to A0131482(G:).

5) Connect handle and machine, Choose internal file to start processing.

Note: Users can view the hardware support capability in "version view", if it supports "U disk
mode" means it can realize U disk storage function.

PS3. Servo wiring and parameters setting

PS3.1 YASKAWA Σ-7, Σ-series driver

1. **Wiring**（**Y、Z same to X**）**Set the driver as internal enable. No need to connect pin-40, settings please see Pn50A which is in following table (parameter setting).**
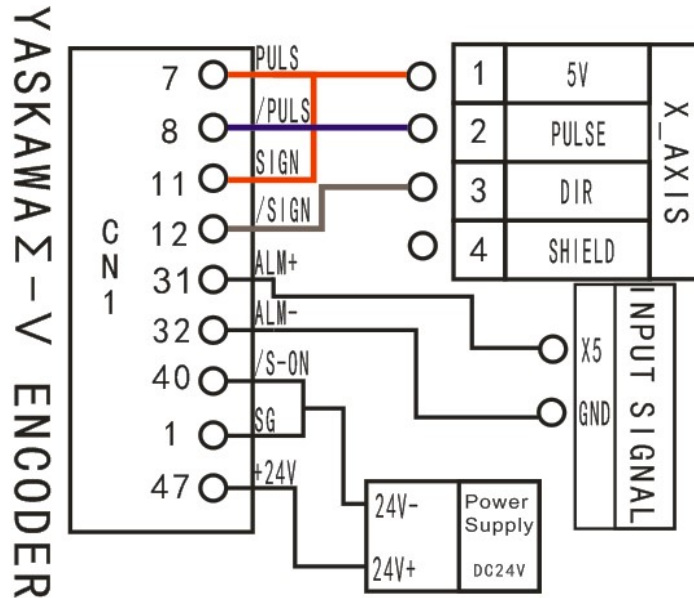
Motor brake：
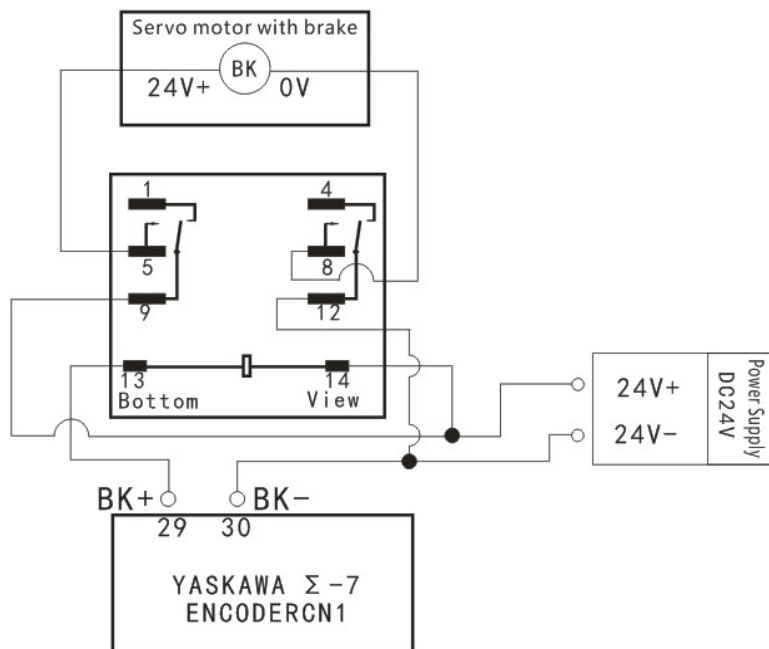
Σ-7 same as Σ-V

2. Parameter setting

Para. No.	Function	Value	Description
*Pn000	Function selection basic switch 0	0010	Bit 0：Set 0,positive rotation at positive rotation command Bit 1：Set 1,position control mode(pulse sequence command)
*Pn200	Format seletion switch of position control command	0005	Bit 0：Set 5,select the instruction mode as "pulse+direction",negative logic
*Pn20E	Electronic gear ratio(numerator)	Need calculation	$Z1$ = Encoder pulse count per revolution×4; $Z2$ = Pulse equivalent×Screwpitch×Transmission ratio
*Pn210	Electronic gear ratio(denominator)	Need calculation	e.g. Pulse equivalent 1000，Screw pitch 10mm, Encoder resolution 5000，Transmission ratio 1 $Z1/Z2$= 5000×4/1000×10×1=2/1 set Pn20E=2,set Pn210=1. The numerator and denominator of electronic gear ratio is reducible to set the value of Pn20E and Pn210 as a integer in the range of 1~65536.
*Pn50A	Input signal selection 1	8170	Bit 1：Set 7,servo on all the time. Bit 3：Set 8,positive rotation not used and signal input(P-OT)prohibited
*Pn50F	Output signal selection 2	0300	Set it when servo motor with brakes. Bit 2：Set 3,brake interlock signal "/BK"is output from CN1-29,CN1-30 to control 24V relay used for brake
*Pn50E	Output signal selection 1	0211	Set it when servo motor with brakes. To avoid of CN1-29 and CN1-30 being used for other function and leading to brake ineffective,3 is not allowed to appear in the 4 digits.

NOTE：

1. Data bit description:

   ⋯ Bit3 Bit2 Bit1 Bit0
   ⋯ X   XXX

2. For parameters No. which has a prefix of "*", refers to the parameter will take effect when power on again. If it has not connected the brake, then no need to set Pn50E and Pn50F.

3. The servo alarm signal corresponds to the pin number ALM+：pin-31; ALM-：pin-32; Signal type default normal close. The default alarm input terminal of B11, B12, B15 is on X5 port

B18 is on X6 port.

User needs to access to "Machine Setup"-"Voltage Setup", and modify level of X5(or X6 on B18 model) to normally closed(Press " [运行/暂停 RUN/PAUSE 删除 DELETE] " and flip the arrow to go upwards).

Arrow downwards ↓ : normally open; Arrow upwards ↑ : normally closed

PS3.2 PANASONIC MINAS A5 series servo driver

1. **Wiring（Y、Z same as X）Set the driver as internal Enable. No need to connect pin-29, settings please see Pr4.05 which is in the following table of "parameter setting".**
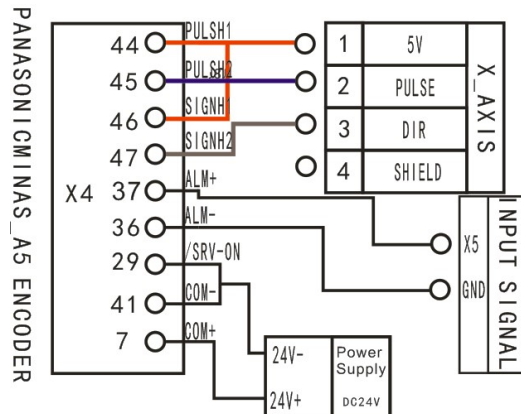
Motor brake：

2. Parameter settings

Para. No.	Function	Value	Description
*Pr0.00	Settingthe direction of rotation	0	If the motor rotation direction opposite to the actual needs, set 1.
*Pr0.01	Select control mode	0	0:Position mode,1：velocity mode,2：torque mode
*Pr0.05	Selection of command pulse input	0	0:Photo-coupler input （PULS1,PULS2,SIGN1,SIGN2） 1:Exclusive input for line driver （PULSH1,PULSH2,SIGNH1,SIGNH2)
*Pr0.07	Command pulse input mode setup	3	Set command pulse input mode:commandpulse+command direction, negative logic.
*Pr0.08	Command pulse No. per motor circle	0	When it is set to "0",parameters Pr0.09 and Pr0.10 are valid
Pr0.09	1st numerator of command pulse frequency multiplication	Need calculation Range:0~2^{30}	$Z1$ = Encoder resolution $Z2$ = Pulse equivalent×Screwpitch×Transmission ratio e.g. Pulse equivalent 1000，Screw pitch 10mm, Encoder resolution 10000，Transmission ratio 1 $Z1/Z2$= 10000/1000×10×1=1/1
Pr0.10	Denominator of the command pulse frequency multiplication	Need calculation Range:0~2^{30}	set Pr0.09=1,set Pr0.10=1. The numerator and denominator of electronic gear ratio is reducibleto set the value of Pr0.09 and Pr0.10as integer,range: 0~2^{30}.
*Pr4.05	Function setting for digital input pin SI6	8618883	Bit1,0:Set 83,servo on all the time.

Note:

1. Data bit description:

　⋯　Bit3　Bit2　Bit1　Bit0
　⋯　X　　XXX

2. For parameters No. which has a prefix of "*", refers to the parameter will take effect when power on again.

3. The servo alarm signal corresponds to the pin number ALM+：pin-37; ALM-：pin-36; Signal type default normally closed.

PS3.3 DELTA ASDA-A2&B2series servo driver

1. **Wiring（Y、Z same as X）Set the driver as internal Enable. No need to connect pin-9, settings please see P2-10 which is in the following table of "parameter setting".**
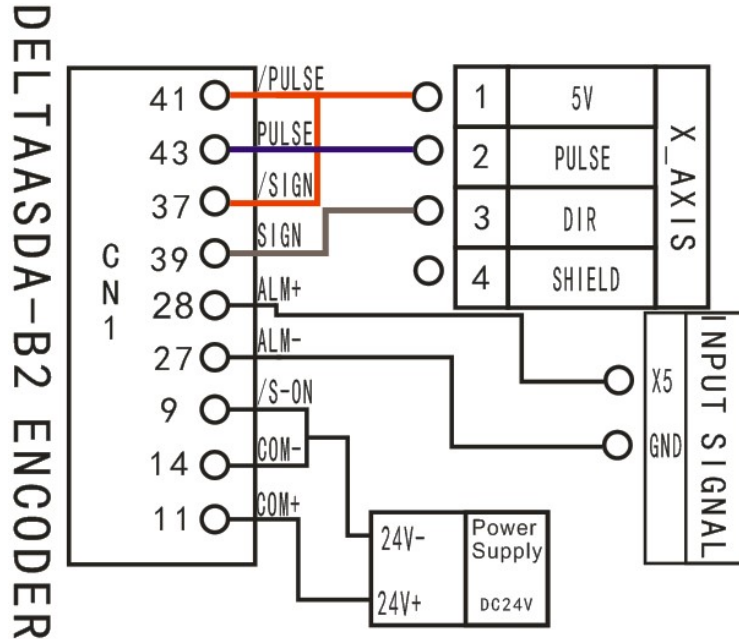
Note: A2 series PULSE, /PULSE, SIGN, /SIGN correspond pin-43,41, 36, 37;
COM- corresponds pin-45/47/49.

Motor brake：
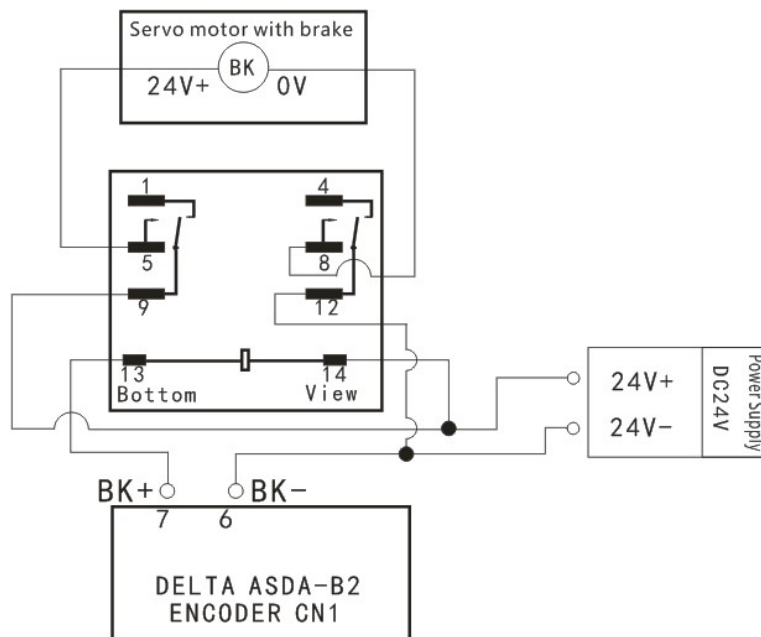
A2 series BK-, BK+ correspond CN1-1, 26

2. DELTA ASDA-B2Parameter settings

Para No.	Function	Value	Description
P1-00	External pulse train input type	102	Bit 0：2--pulse+direction Bit 2：1--negative logic
***P1-01**	Set control mode	0000	Bit 3：Maintaining the set value.Since switching control mode is not used,bit 3--0. Bit 2：0--forward rotation(CCW)(from the view of load) Bit 1,0：00--position control mode
P1-44	Electronic gear ratio(numerator)(Z1)	Need calculation	Range：1~32767； Z1 =Encoder pulses×4； Z2 =Pulse equivalent×Screwpitch×Transmission ratio
P1-45	Electronic gear ratio(denominator)(Z2)	Need calculation	e.g. Pulse equivalent 1000 ，Screw pitch 10mm,encoder pulses 5000，Transmission ratio 1，then Z1/Z2=5000×4/1000×10×1=2/1 ， set P1-44=2,P1-45=1. The numerator and denominator of electronic gear ratio is reducible.
P2-10	Function setting for digital input pin DI1	1	Bit 0：Set 1,servo on all the time. If connect external enable signal: Bit1,0: set 01 refers to the input digit input DI1 as SON, correspond CN1 PIN-9; Bit2: set 1 indicate input DI1 as normally open a-contact point.
P2-18	Function setting for digital output pin DO1	108	DO1 corresponds to pin-6 & pin-7,used as clamping-position brake signal of Z-axis Bit1,0：08--set pin-6 and pin-7 as BK- and BK+respectively. Bit2：0--set DO15 output as normally closed b-contact point, 1--as normally open a-contact point.
P2-22	Function setting for digital output pin	007	DO5 corresponds to pin-28 & pin-27,used as servo alarm signal Bit1,0：07--set pin-28 and pin-27 as ALRM+

	DO5		andALRM- respectively. Bit2：0--set DO5 output as normally closed b-contact point, 1--as normally open a-contact point.

Note:

1. Data bit description:

    ⋯ Bit3 Bit2 Bit1 Bit0
    ⋯ X XXX

2. For parameters No. which has a prefix of "*", refers to the parameter will take effect when power on again.

DELTA A2 series parameter settings

Para No.	Function	Value	Description
P1-00	External pulse train input type	102	Bit 0：2--pulse+direction Bit 2：1--negative logic
***P1-01**	Set control mode	0000	Bit 3：Maintaining the set value.Since switching control mode is not used,bit 3--0. Bit 2：0--forward rotation(CCW)(from the view of load) Bit 1,0：00--position control mode
P1-44	Electronic gear ratio(numerator)(Z1)	Need calculation	Range：1~32767； Z1 =Encoder pulses×4； Z2 =Pulse equivalent×Screw pitch×Transmission ratio
P1-45	Electronic gear ratio(denominator) (Z2)	Need calculation	e.g. Pulse equivalent 1000 ，Screw pitch 10mm,encoder pulses5000，Transmission ratio 1, then Z1/Z2=5000×4/1000×10×1=2/1. Pn1-44=2，Pn1-45=1；The numerator and denominator of electronic gear ratio is reducible.
P2-10	Function setting for digital input pin DI1	1	Bit 0：Set 1,servo on all the time.If connect external enable signal: Bit1,0: set 01 refers to the input digit input DI1 as SON, correspond CN1 PIN-9; Bit2: set 1 indicate input DI1 as normally open a-contact point.
	Function setting for		Bit1,0 ：08--set pin-1 and pin-26 as BK- and

P2-21	digital output pin DO1	108	BK+respectively. Bit2：1--set DO1 output as normally opena-contact point, 0--as normally closed b- contact point.
P2-22	Function setting for digital output pin DO5	007	DO5 corresponds to pin-28 & pin-27,used as servo alarm signal Bit1,0：07--set pin-28 and pin-27 as ALRM+ andALRM- respectively. Bit2：0--set DO5 output as normally closed b-contact point, 0--as normally open a-contact point.

Note:

3. Data bit description:
    ```
    …   Bit3   Bit2   Bit1   Bit0
        ▲      ▲      ▲      ▲
    …   X      XXX
    ```

4. For parameters No. which has a prefix of "*", refers to the parameter will take effect when power on again.

PS4. G code reference list

G code list of A1X &A5X	
G00	Rapid positioning
G01	Linearinterpolation
G02	Circular interpolation CW
G03	Circular interpolation CCW
G04	Dwell (Unit: millisecond)
G17	Selection of XY coordinate plane
G18	Selection of ZX coordinate plane
G19	Selection of YZ coordinate plane
G20	Input in inch
G21	Input in metric
G28	Auto back to reference point
G30	Back to secondary reference point
G40	Cancel tool radius compensation
G41	Left tool compensation(the tool offsets radius distance on the left side of tool moving direction)
G42	Right tool compensation(the tool offsets radius distance on the right side of tool moving direction)
G43	Tool length compensation (compensation along positive direction)

G44	Tool length compensation (compensation along negative direction)
G49	Cancel tool length compensation
G54	Work coordinate system 1
G55	Work coordinate system 2
G56	Work coordinate system 3
G57	Work coordinate system 4
G58	Work coordinate system 5
G59	Work coordinate system 6
G73	High-speed peck drilling cycle for deep holes
G80	Canned cycle cancel
G81	Drilling cycle
G82	Drilling cycle of dwell at bottom of hole
G83	Peck drilling cycle for deep holes
G84	Righthand tapping cycle
G90	Absolute programming
G91	Incremental programming
G98	Return to initial point
G99	Return to point R
G101	Move with processing speed until the signal is triggered.Meanwhile Rollback and pinpoint signal edge (similar to backing home)
G102	Move with fast speed until the signal is triggered.Meanwhile Rollback and pinpoint signal edge (similar to backing home)
G103	Move with processing speed until the signal is triggered.
G104	Move with fast speed until the signal is triggered.
M03	Spindle on(CW rotation)
M04	Spindle on(CCW rotation)
M05	Spindle stop
M06	Tool change
M08	Coolant on (Flood)
M09	Coolant off
M30	End of program,and return to program top
M37	Spindle on(CW rotation)
M38	Spindle on(CCW rotation)
M129	4th spindle on
M208	Cycle machining
M210	Set outputlogic low level
M211	Set outputlogic high level
M214	Run the next line ofG codeafter waiting for the specified input signallogic low
M215	Run the next line ofG codeafter waiting for the specified input signallogic high
M216	Run the next line ofG code after waiting until all the specified input signal logic high
M217	Run the next line ofG code after waiting until anyone of all the specified input

	signal logic high
M220	Set Y1 logic low level
M221	Set Y1 logic high level
M222	Set Y2 logic low level
M223	Set Y2 logic high level
M224	Set Y3 logic low level
M225	Set Y3 logic high level
M226	Set Y4 logic low level
M227	Set Y4 logic high level
M350	Set the extension output logic low level
M351	Set the extension output logic high level
T	Tool function
S	Spindle speed
F	Feed rate
H	Tool length offset

PS5. Tool setting methods detailed explanation

The process of tool setting is process of setting work coordinate system specific location in the machine tool coordinate system.

There are 3 kinds of tool settings: **Direct tool setting**, **Fixed calibration** and **Mobile calibration**.
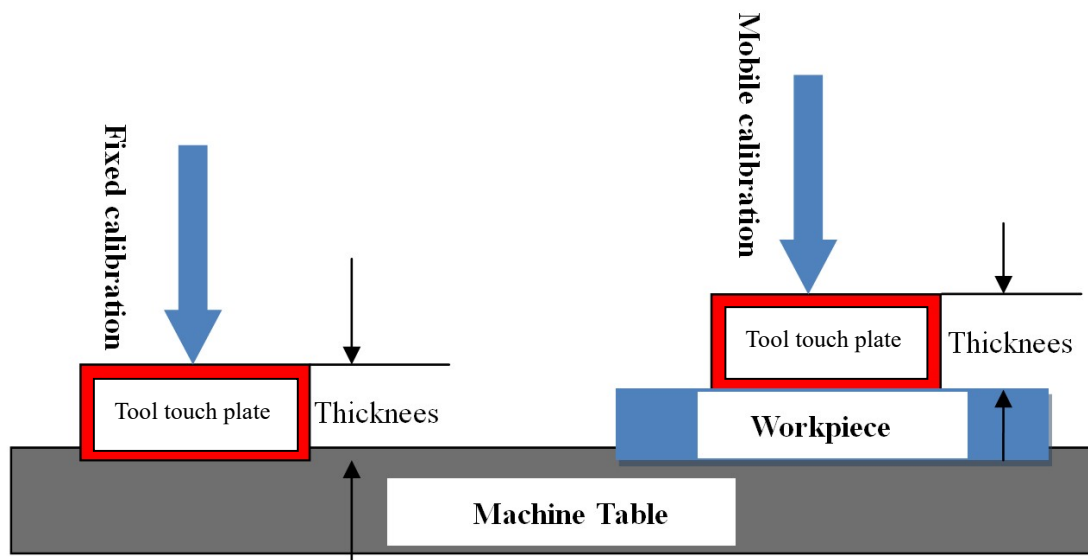
Microset, tool touch plate working sketch

PS5.1 Direct tool setting

Z axis move down towards directly and the cutter tool touches the material surface. Of course, user should reduce the motion speed of Z axis when the cutter is the most nearest the plane.

To confirm the contact position between the tool and the workpiece by eye-measurement or tool bit touch the workpiece surface. Then press "Z→0" to finish the tool setting.

PS5.2 Fixed calibration

Microset electrical wiring diagram:
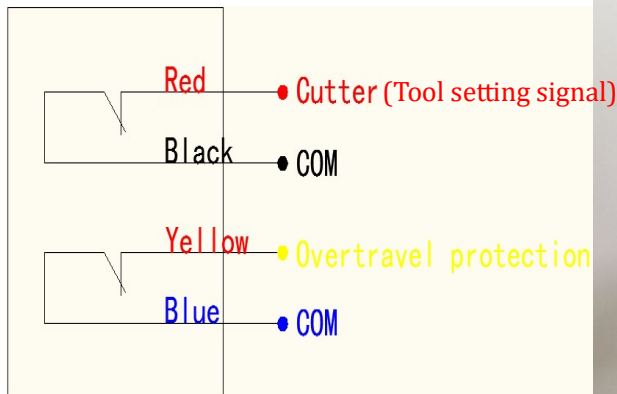
| Wiring diagram | Microset actual picture |

Microset wiring: The dsp controller tool setting input signal (X4) is normally open state when ex-factory.

Normally open type：The microset signal CUTTER should be connected to the wiring board input port --X4, COM connects to GND-INPUT SIGNAL.

X4: system default normally open.

Normally closed：Firstly, modify the input voltage level of X4 to normally closed, then connect CUTTER signal to X4, COM to GND-INPUT SIGNAL.

The Over travel protection signal wiring method is similar to CUTTER signal. It can be connected to X7-E-stop signal.

Fixed calibration diagram:
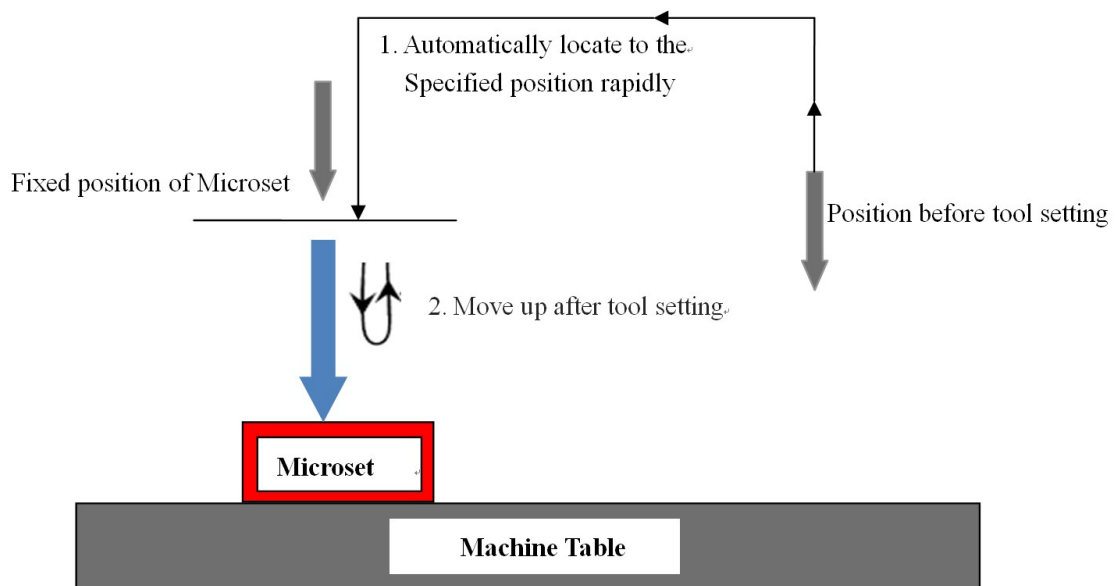
Fixed calibration: Means to execute tool setting operation at a certain fixed position on the machine table.

During machining, the cutter tool wear or fracture that needs replacement. However, the blade length and tool clamping position will change after tool changing. The system can execute "fixed calibration" to re-confirm the tool offset value.

Instructions：

1) Set microset position

Get into "MACHINESETUP--C.A.D Position" to set microset position, including "Inplace"&"Inposition".

In position(positioning): Press"归零 REF 确定 OK", screen displays "Press OK key to set point position by manual mode, it's very simple but not accurate, press cancel to set by number". Recommend to choose manual mode.

In place: Move X,Y axis to the place where is over the microset, press "对刀 TOOLSET".

2) First time tool setting / Tool setting after tool changing

Manual move Z axis to the surface of workpiece, and set workpiece origin of X,Y,Z axis.

Press "对刀 TOOLSET" execute the first time tool setting. The system will record value of offset automatically.

Start the processing after first time tool setting.
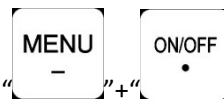
After the tool changed or tool bit broken, press "MENU −"+"ON/OFF •" to start second time tool setting, system will automatically restore to current Z axis workpiece coordinate origin.

Second time tool setting completed, start processing.

Note: After the tool changed or tool bit broken, the system can automatically calculate Z offset and save it when executes the tool setting command, after tool setting user can start processing directly without press "Z→0".

PS5.3 Mobile calibration

Mobile calibration is suitable for materials such as wood working, acrylic, plastic, aluminum, iron, steel etc.

Generally, the tool touch-off plate can be used to do the mobile calibration, as it is economical, simple and convenient.

Tool touch-off plate wiring:

1. The white wire connects to X4(TS) input port on the wiring board.

2. The black wire connects to GND on the input terminal of the wiring board.
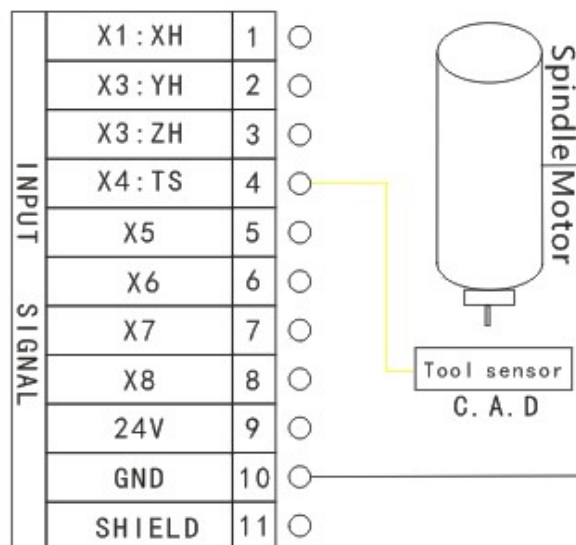
Usage method:

Connect the wire to the wiring board(X4 port), and connect the alligator clip to GND port on the interface board input terminal (or clamp it to the spindle, and ensure the spindle has been connected to earth wire).

Put the tool touch-off plate on the surface of the workpiece, move X Y axis over the tool plate,

press "【对刀 TOOLSET】", Z axis will move down slowly until touches the plate and feedback its tool setting dignal to the controller, then Z axis automatically lift up, tool setting complete.

Note:

After connected the tool touch-off plate, start the machine (don't start the spindle). Don't put alligator clip on the spindle immediately, but to start automatically tool setting function first, and then use the alligator clip touch the tool touch-off plate quickly, in order to check whether Z axis has the action of tool setting. To ensure there is no problem with the spindle, and then realize the automatically tool setting.

The system "C.A.D thickness" value is default as 0, so the user should measure the real thickness of the tool touch-off plate and input the value into the system, under "Machine setup"—"C.A.D thickness", after that user could use mobile calibration.

PS6. Pulse equivalent calculation

PS6.1 Stepper motor drive

PS6.1.1 Linear axis
Unit：Pul/mm
Formula = pulses per revolution / distance per revolution
Numerator：

Pulses per revolution formula: (360 °/stepper angle* 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*π*mechanical transmission ratio
   (reduction ratio)

► Rack（helical）drive = rack module*gear teeth number*π*mechanical transmission
   ratio(reduction ratio)/cos（helical angle）

► Pulley & belt drive = π*pulley diameter*mechanical transmission ratio(reduction ratio)

✓ **Screw drive：**

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

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 nameplate 1   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 °/stepper angle)* Driver subdivision=3200.

In E.g.2, the MSTEP means subdivision number. So, if the stepper angle is 1.8°, selected subdivision is 16, then (360 °/stepper angle)* subdivision=(360°/1.8)*16=3200.

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

Screw pitch (above picture): The distance that the nut moves when the ball screw makes one rotation.
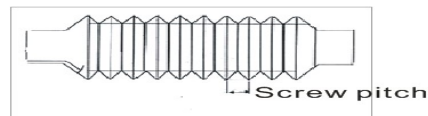
Transmission ratio: The reduction rate or angular velocity ratio of the front drive sprocket to the end driven wheel.

✓ **Rack drive：**

► Straight teeth：

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

► Helical teeth：

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

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**：
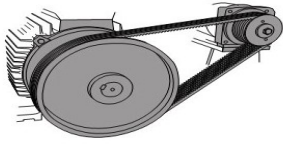
$$pulse = \frac{\frac{360\,°}{Stepper\ angle} \times Driver\ subdivision}{\pi d \times transmission\ ratio}$$

d：Pulley diameter

PS6.1.2 Linear axis pulse equivalent computing method

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

➢   **Screw drive**

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

➢   **Rack drive**

rack module：1.25, gear teeth number：23, π：3.141592654, transmission ratio：1/5(0.2)

helical angle：19°31'42"（≈19.52833333°）

Straighttrack

Pulse equivalent= $\frac{1600}{1.25 \times 23 \times 3.141592654 \times 0.2}$ = 88.573

Helical rack

Pulse equivalent= $\frac{1600}{1.25 \times 23 \times 3.141592654 \times 0.2 \div \cos（19°31'42"）}$

= $\frac{1600 \times \cos（19.52833333）}{1.25 \times 23 \times 3.141592654 \times 0.2}$ = 83.478

NOTES：1.25×23×3.141592654×0.2= 18.0641577605

cos（19.52833333）= 0.9424763050466868167737 2940102406

1.25×23×3.141592654×0.2÷cos（19.52833333）=19.1666969915≈19.1667

PS6.1.3 Rotary axis (pul/ °)

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

$$pulse = \frac{\frac{360°}{Stepper\ angle} \times Driver\ subdivision}{360° \times transmission\ ratio}$$

PS6.1.4 Rotary axis pulse equivalent computing

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

Pulse equivalent=$\dfrac{1600}{360 \times 1/40}$ =177.778 (result retains up to 3 decimal places)

PS6.2 Servo motor drive

Electronic gear ratio numerator: resolution of the encoder, can be found in the servo driver manual.
Electronic gear ratio denominator:

PS6.2.1 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 *π*pulley diameter*mechanical transmission ratio

PS6.2.2 Calculate electronic gear ratio according to fixed pulse equivalent value

E.g.: Pulse equivalent of handle=1000

1. YASKAWA-Numerator Pn20E

YASKAWA∑—7:Encoder resolution=16777216（2^{24}）Set **Pn20E**=16777216

YASKAWA∑—V:Encoder resolution=1048576（2^{20}）Set **Pn20E**=1048576

YASKAWA- numerator Pn20E can set to 1048576

YASKAWA-denominator Pn210

➢ Screw drive

screw pitch=5mm，Pn210= 1000×5=5000

➢ Rack drive

rack module：1.25, gear teeth number：23, π：3.141592654, transmission ratio：1⁄5(0.2)

helical angle：19°31'42"（≈19.52833333°）

◆ Straight rack

Pn210 = 1000×1.25×23×3.141592654×0.2=18064

◆ Helical rack

Pn210 = 1000×1.25×23×3.141592654×0.2÷cos（19.52833333）=19167

2. DELTA ASDA-B2&A2

B2: Encoder pulses equivalent default--N=160000

A2: Encoder pulses equivalent default--N=1280000

E.g.: B2 series N=160000

➢ Screw drive

screw pitch=5mm，Denominator M=1000×5 = 5000

Electronic gear ratio= $\dfrac{N}{M} = \dfrac{160000}{5000} = \dfrac{32}{1}$

Set P1-44=32，P1-45=1

➢ Rack drive

rack module：1.25,gear teeth number：23,π：3.141592654,transmission ratio：1⁄5(0.2)

helical angle：19°31'42"（≈19.52833333°）

◆ Straight rack

Denominator M=1000×1.25×23×3.141592654×0.2=18064

Electronic gear ratio = $\dfrac{N}{M} = \dfrac{160000}{18064} = \dfrac{10000}{1129}$

Set P1-44=10000，P1-45=1129

◆ Helical rack

Denominator M=1000×1.25×23×3.141592654×0.2÷cos（19.52833333）=19167

Electronic gear ratio = $\dfrac{N}{M} = \dfrac{160000}{19167}$

Set P1-44=160000，P1-45=19167

PS6.2.3 Calculate pulse equivalent according to fixed electronic gear ratio

DELTA ASDA-B2: Electronic gear ratio default--16/10，

A2: Electronic gear ratio default--N=128/10

E.g. B2：Set P1-44=1, P1-45=1, Encoder pulses equivalent 2500×4=10000

➢ Screw drive

screw pitch=5mm，pulse equivalent =$\dfrac{10000}{5}$= 2000

➢ Rack drive

rack module：1.25, gear teeth number：23, π：3.141592654, transmission ratio：1/5(0.2)

helical angle：19°31′42″（≈19.52833333°）

◆ Straight rack (results retain up to three decimal places)

Pulse equivalent= $\dfrac{10000}{1.25\times23\times3.141592654\times0.2}$= 553.582

◆ Helical rack(results retain up to three decimal places)

Pulse equivalent=$\dfrac{10000}{1.25\times23\times3.141592654\times0.2\div\cos（19°31'42''）}$

$=\dfrac{10000\times\cos（19.52833333）}{1.25\times23\times3.141592654\times0.2}$

= 521.738

PS6.2.4 Rotation axis

Electronic gear ratio denominator：Pulse equivalent *360 * transmission ratio(reduction ratio)

1) Pulse equivalent of handle fixed to1000

YASKAWA Same to linear axis

YASKAWA∑—7 electronic gear ratio numerator

Pn20E=16777216,

YASKAWA∑—V electronic gear ratio numerator

Pn20E=1048576

transmission ratio =1/40，electronic gear ratio denominator **Pn210**=1000×360×1/40=9000

DELTA Same to linear axis

DELTA ASDA--B2 Encoder pulses default--N=160000

A2 Encoder pulses default--N=1280000

E.g. B2：Electronic gear ratio numerator N=160000

Electronic gear ratio denominator M=1000×360×1/40=9000,

Electronic gear ratio = $\dfrac{N}{M}=\dfrac{160000}{9000}=\dfrac{160}{9}$

Set P1-44=160，P1-45=9

2) Calculate pulse equivalent according to fixed electronic gear ratio，setP1-44=1，P1-45=1

Encoder pulse count per revolution 2500×4=10000

Pulse equivalent=$\dfrac{10000}{360\times 1/40}$ =1111.111(results retain up to three decimal places)

PS6.3 Proportion calculation method

If there is an error when calculate it according to the formula or cannot get relevant data to calculate, it can be calculated according to the proportion method. Suppose handle pulse equivalent is A, press "MODE" switching to distance mode, set a distance B, measuring the number of actual moving distance C, then the actual pulse equivalent = A × B ÷ C.

For example: Suppose handle pulse equivalent A = 400, distance B = 100, actual distance C = 80, then the actual pulse equivalent = 400 × 100 ÷ 80 = 500

Repeat calculation for several times until you get the correct pulse equivalent value.

PS7. Common problems and troubleshooting

PS7.1 Solutions for screen display faults

1. After powered on the "Screen flicker or automatically restart"
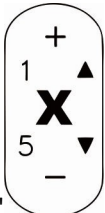
1) Switching mode power supply is insufficient. Check power supply if there are problems, and change high-quality power supply to solve the problems.

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.

2. 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, if yes, should press "菜单 MENU −" + " X 1 5 " switching to work coordinate system. Then it can set work origin. Press "菜单 MENU −" + " 高速/低速 FAST/SLOW 0 " is for going to mechanical coordinate system where cannot set work origin in there.

2) The buttons are broken. Go to "SYSTEM SETUP"-"Buttons Check" menu to check whether the buttons are normal or not.

3. 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.

4. 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.

PS7.2 FAQ in practical operation

1. After the machining, the cutting size doesn't match the actual size in processing file

1) Pulse equivalent is wrong.

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.

2. 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.

3. 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.

4. 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 interface 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.

5. 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.

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

Double press"$\boxed{\text{MENU}}$"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 interface board wiring aging or loosening. Check the connections again.

4) The interface board is broken. Return back o us to repair.

5) 50-pin data cable is broken. Replace it with a new data cable.

7. 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 interface 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 interface board is broken. Depot Repair.

6) 50-pin data cable is broken. Replace the data cable.

8. 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.

9. 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 interface board hasn't been connected with spindle housing or poor connection.

3) Go to "MACHINE SETUP"-"Input Confi" to confirm if X4 is enabled.

10. 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 interface 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

interface board,; secondly, if the interface 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.

11. 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.

12. Motor moving direction is wrong

1) Exchange A+&A- or B+&B- cable of the stepper motor

2) Change motor direction mask (not recommend)

13. 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.

PS7.3 Electrical components and wiring problem

1. 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 interface board and motor driver common anode end, check the connection.

2) Interface board is broken. Replace the interface 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.

2. 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 interface board is broken, no pulse signal output.

5) Switch this terminal with another normal terminal to check interface board abnormal or driver abnormal.

3. 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 interface board is virtual connection.

2) The 50-pin cable is broken or 50 pin connecting plug hasn't connected well.

4. 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 interface board and cause the handle and interface board broken. Return back to repair.

5. 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).

6. 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.

7. System always alarm after the alarm signal has been connected

Change the input level on X5 (normally open, wiring in parallel; normally closed, wiring in series).

8. 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 interface board. Press"

ON/OFF

" to start spindle, use multimeter to measure Y1 and GND to see whether conducting, if not, interface board or 50-pin cable is broken. To replace a new one for trouble clearing one by one.

Thank you for your support！