# Preface

Thank you for choosing our products.

This manual will acquaint you with such detailed information of NK300BX CNC system as functions, operations and maintenance, etc.

Please keep this manual safe in order to be referred at any time as necessary.

Because of continuous updating, the products you bought may differ from the written in this manual, and we apologize for this situation.

Company address, phone number and our website are listed here for your convenience. Any questions, please feel free to contact us. We will always be here and welcome you.

| | |
|---|---|
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## Precautions:

### ◆ Storage and Transportation

| Attention |
| --- |
| ➢ The products should be transported properly in terms of the weight;<br>➢ Excess of specified quantity of stacking products is prohibited;<br>➢ Climbing, standing or placing heavy loads on the products is prohibited;<br>➢ Dragging or carrying the products via cables or devices connected to them is prohibited;<br>➢ Keep the products free from moisture during storage and transportation. |

### ◆ After Opening the Package

| Attention |
| --- |
| ➢ Please make sure whether the products are what you have ordered;<br>➢ Check if the products are damaged in transit;<br>➢ Check if the components and accessories are damaged or missing in terms of the detailed list;<br>➢ Please contact us promptly if product discrepancy, accessory missing or transit damage occurs. |

## ◆ Installation Notices

| Attention |
| --- |
| ➢ Only when this equipment installed in the qualified electricity cabinet can it be used. The construction of the cabinet must reach IP54 grade of protection.<br>➢ Paste sealing strips on the joint of the cabinet to seal all the cracks;<br>➢ Cable entry should be sealed while easy-to-open on the spot;<br>➢ A fan or heat exchanger should be adopted for the heat dissipation and air convection of the cabinet;<br>➢ If a fan is adopted, air strainer is a must in air inlet or air outlet;<br>➢ Dust or cutting fluids may have access to the CNC device via the tiny cracks and tuyere. Therefore it is necessary to pay attention to the surroundings and air flow direction of the air vent to make sure that the outflow gas is towards pollution source.<br>➢ 100 mm space should be preserved between the back of the CNC device and the cabinet wall for plugging cable connected with the device and the ventilation & heat dissipation in the cabinet.<br>➢ Space between this device and other equipments should also be preserved according to the requirements.<br>➢ The product should be installed firmly and without vibration. During installing, casting, knocking, striking, or loading on the product is forbidden.<br>➢ To reduce electromagnetic interference, power-supply components used should be above AC or DC 50V and the space between cable and CNC device should be preserved above 100mm.<br>➢ It will be better if CNC device is installed at a position facilitating debugging and maintenance. |

## ◆ Wiring Notices

| Attention |
|---|
| ➢ Only qualified people are allowed to participate in the wiring and checking.<br>➢ The CNC device should be grounded reliably and grounding resistance should be less than 4 ohm. Neutral line is absolutely not allowed to replace earth wire. Otherwise, the device may be likely to work improperly due to the interference.<br>➢ Wiring should be firm and steady, or misoperation may occur.<br>➢ Voltage values and positive & negative polarity of any connection plug should be in accordance with the manual, or such breakdowns as short circuit and device permanent damage may occur.<br>➢ To guard against electric shock or CNC device damage, fingers should keep dry before plugging or touching switch.<br>➢ The connecting wire should not be damaged and squeezed, or the leakage or short circuit may occur.<br>➢ It is prohibited to plug or open the chassis of CNC device when power on. |

## ◆ Running & Debugging Notices

| Attention |
|---|
| ➢ Parameters setting should be checked before running, since wrong setting may lead to accidental movements.<br>➢ Modification to parameters should be within the allowable range, or such breakdowns as unsteady running and machine damage will occur. |

## ◆ Precautions in Use

| Attention |
|---|
| ➢ Before power-on, please make sure that the switch is on blackout to avoid occasional start-up.<br>➢ Please check the electromagnetic compatibility during electrical design in order to avoid or reduce electromagnetic interference to the CNC device. A low pass filter should be employed to reduce electromagnetic interference if there are other electrical devices nearby.<br>➢ It is not allowed to frequently power on and power off. It is recommended 1 minute interval at least after power failure or blackout before power on. |

# Contents

# 1 Summarization

## 1.1 System Configuration

NK300BX-H integrated CNC system consists of the following components:

- One NK300BX host
- One WH106A3 operation panel and one KB1A1 keyboard panel
- One Lambda 4S series controller
- Two DB9M/F cables (40cm)
- One DB9M/F cable (length optional)
- Handwheel NK-MPG-06 (optional)

NK300BX-V integrated CNC system consists of the following components:

- One NK300BX host
- One WH108A1 operation panel
- One Lambda 4S series controller
- One DBM/F cable (40cm)
- One DB9M/F cable (length optional)
- Handwheel NK-MPG-06 (optional)

## 1.2 An Introduction to NK300BX

NK300BX is divided into NK300BX-H and NK300BX-V according to the layout of the monitor and the keyboard. The machine picture and dimensional drawing of these two types are listed below respectively.

### 1.2.1 Structure Specification

◆ **A Picture of NK300BX**


Fig. 1-1 A picture of NK300BX-H

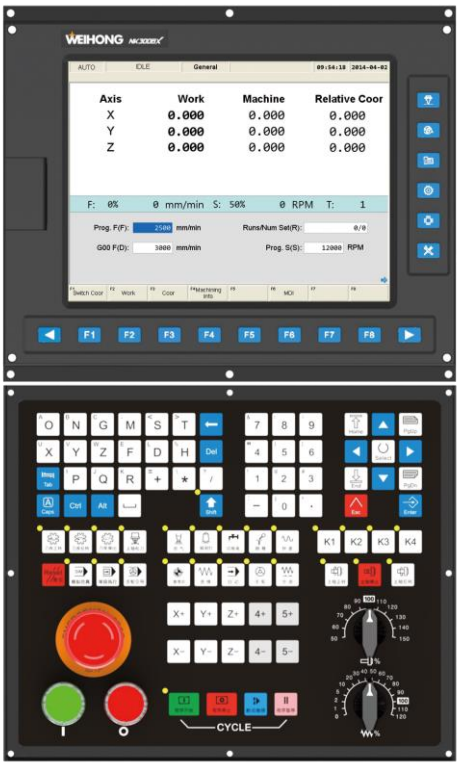
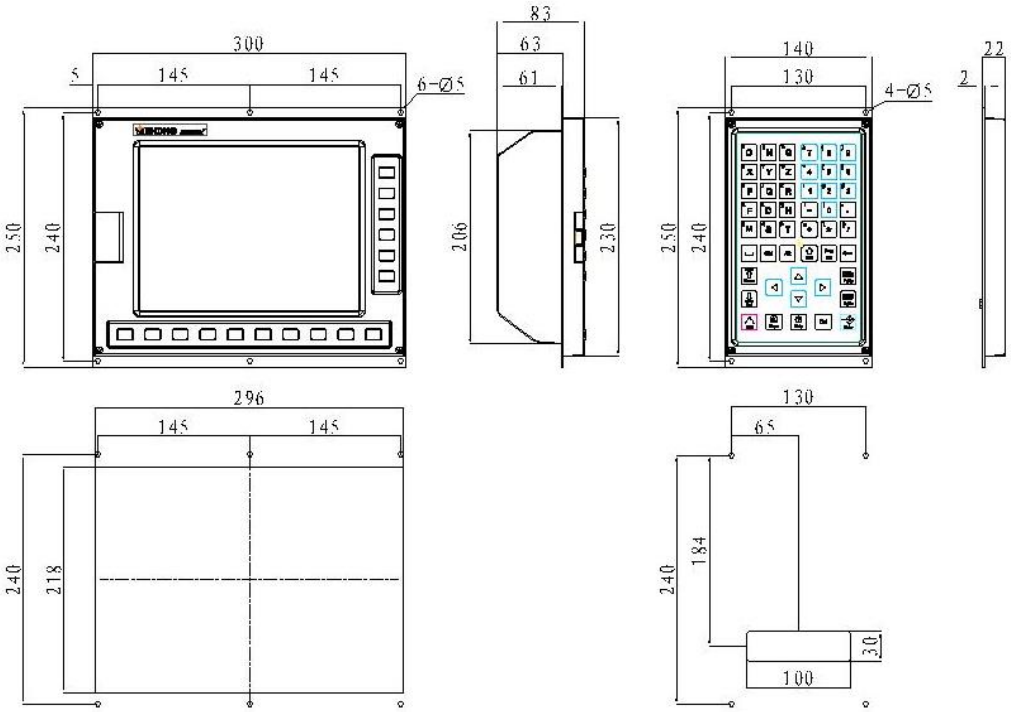



Fig. 1-2 A picture of NK300BX-V

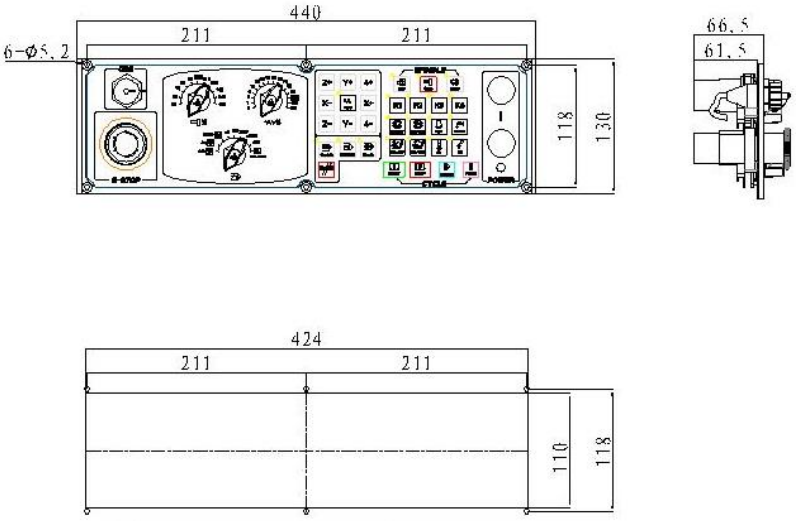
## ◆ Mounting Dimension

After NK300BX is installed on the machine, 100 mm space should be preserved in its surrounding for wiring convenience and ventilation. And the dimensional drawing of NK300BX-H is as shown in Fig. 1-3:




Host Machine Dimensional Drawing & Cut-out Drawing

Keyboard Panel Dimensional Drawing & Cut-out Drawing




Cut-out Drawing of WH106A3 Operation Panel

Operation Panel Dimensional Drawing & Cut-out Drawing

Fig. 1-3 Dimensional drawing of NK300BX-H

The dimensional drawing of NK300BX-V is as shown in Fig. 1-4.

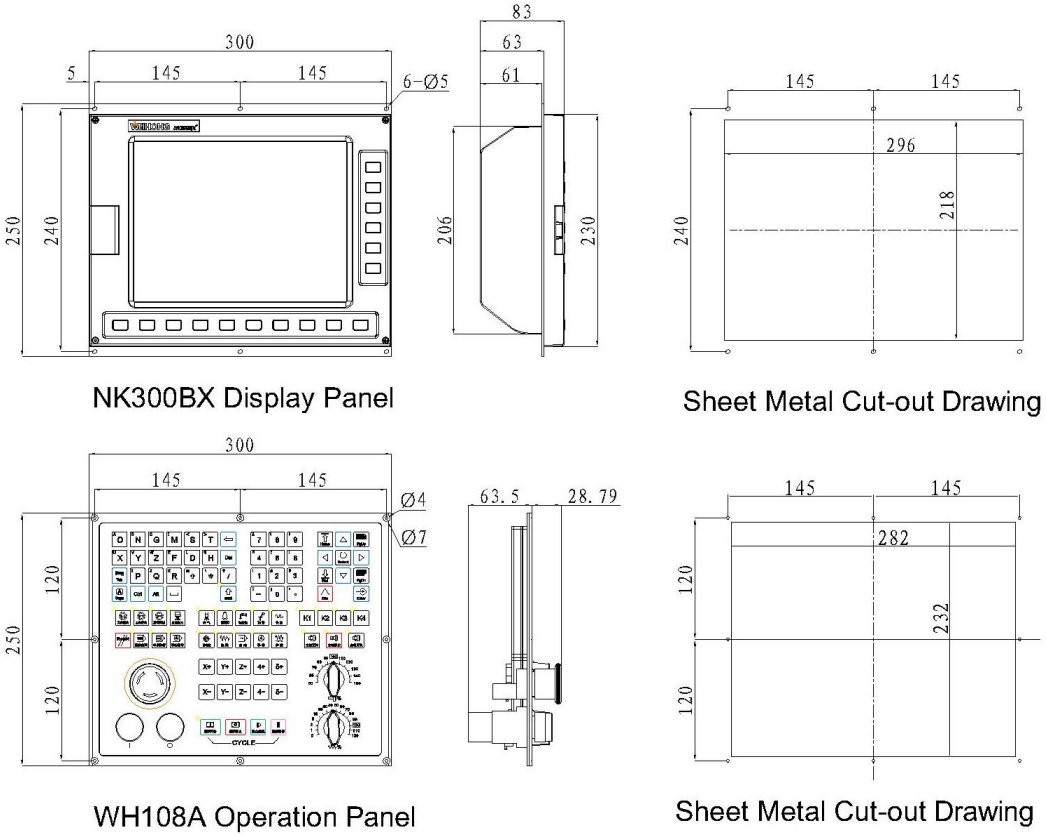



Fig. 1-4 Dimensional drawing of NK300BX-V

◆ **Front View**

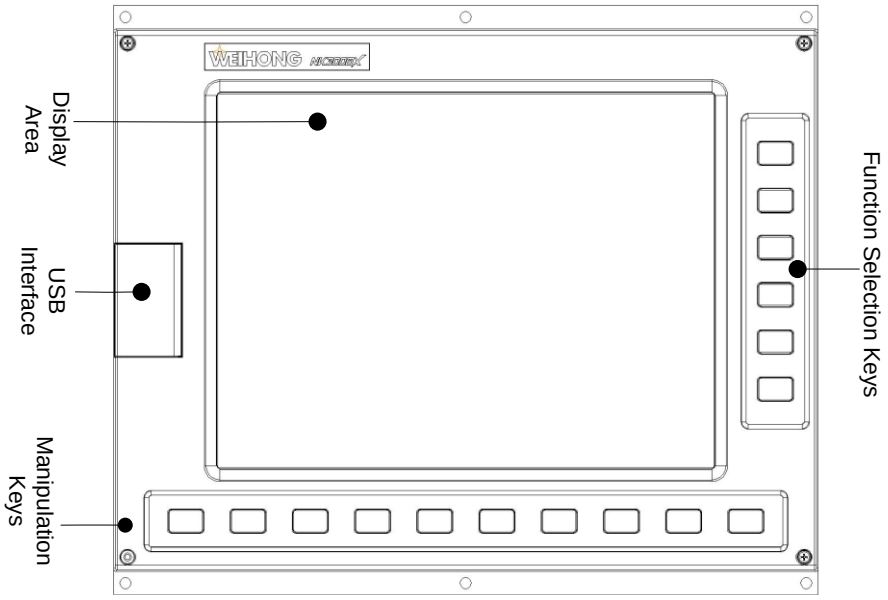



Fig. 1-5 Front view of NK300BX

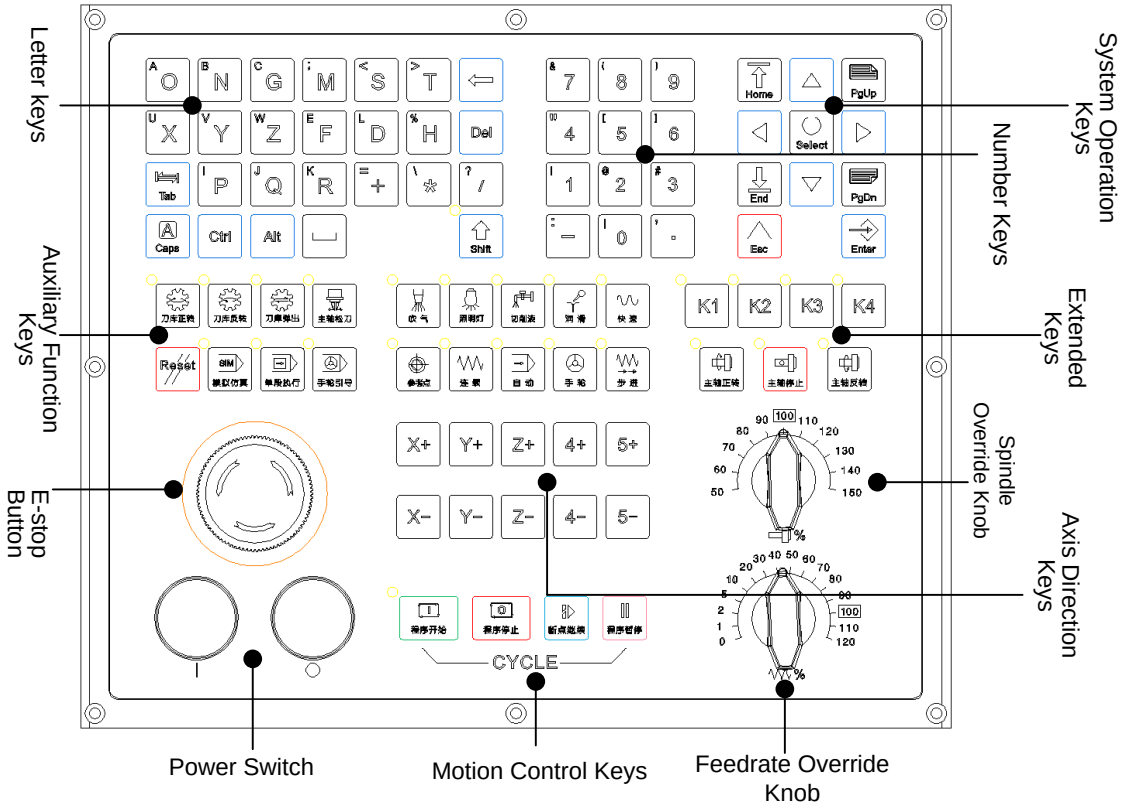



Fig. 1-6 View of operation panel WH108A1

## ◆ Rear View

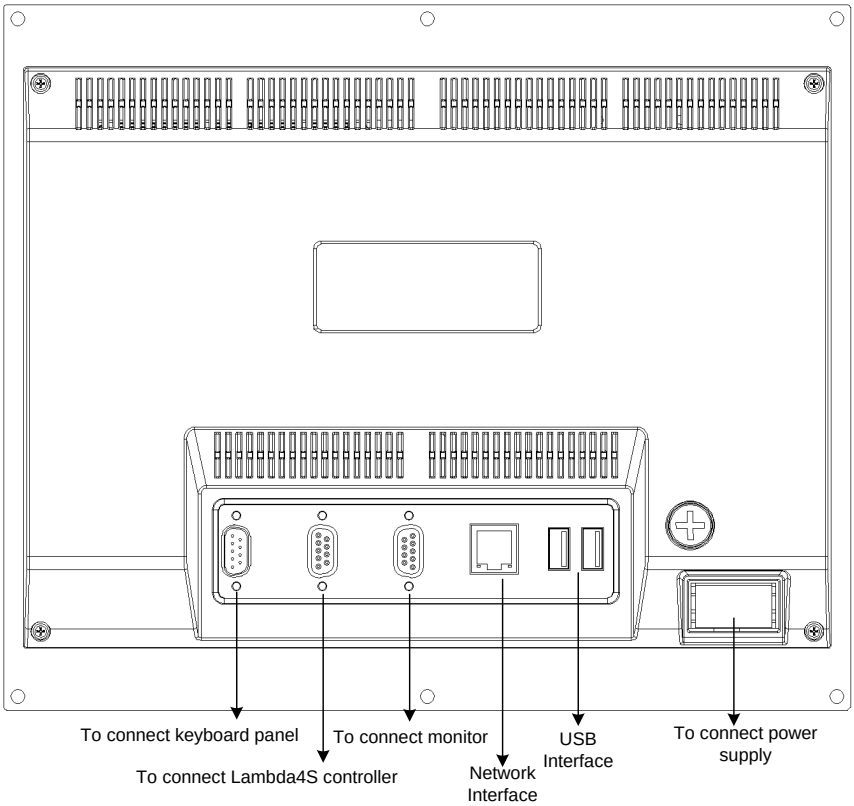



Fig. 1-7 Rear view

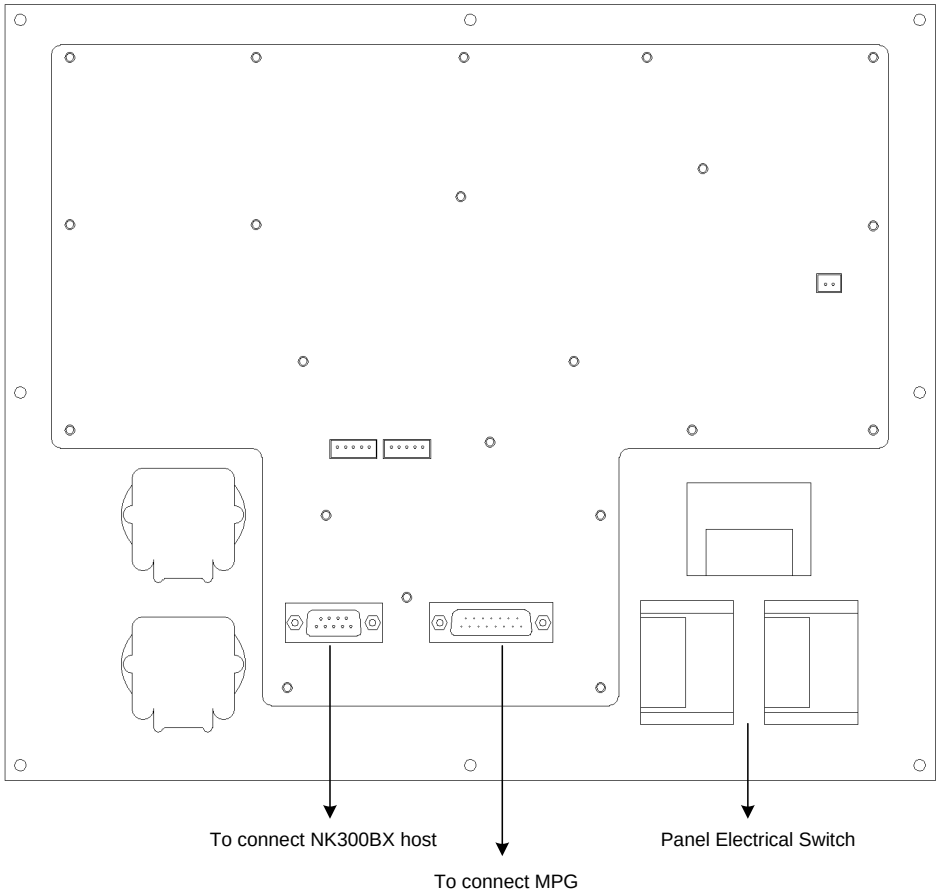



Fig. 1-8 Rear view of operation panel WH108A1

## 1.2.2 Overall Connection Diagram

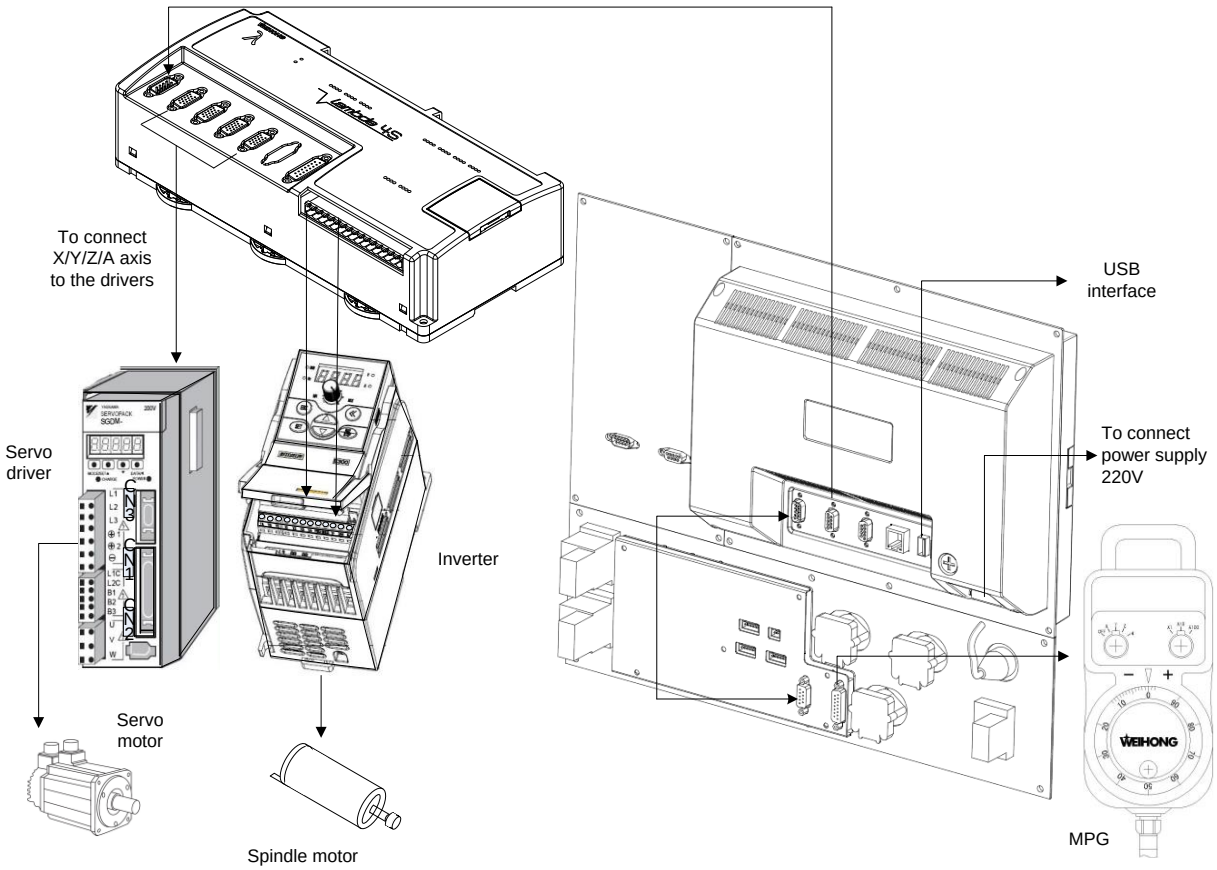



Fig. 1-9 Overall connection diagram of NK300BX-H

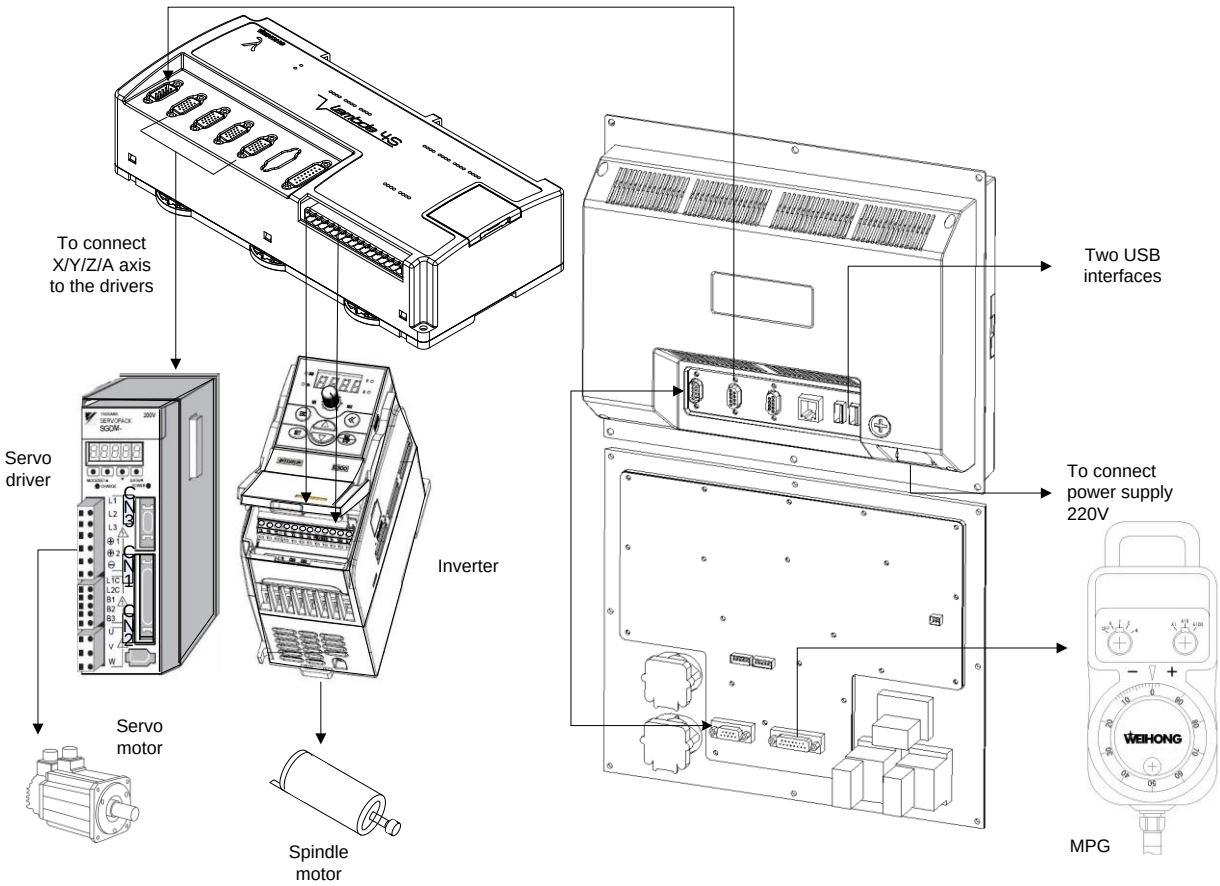



Fig. 1-10 Overall connection diagram of NK300BX-V

# 2 Wiring

# 2.1 Basic Concepts of Signal

## 2.1.1 Signal Types

The signal types of NK300BX system can be divided into the following 4 types: binary input signal, relay output signal and differential output signal and analog signal.

◆ **Binary Input Signal**

Binary input signal is active low/high. Conducting to GND (i.e. grounding signal) in NO connection means signal detected, while disconnecting with GND in NC connection means signal detected.

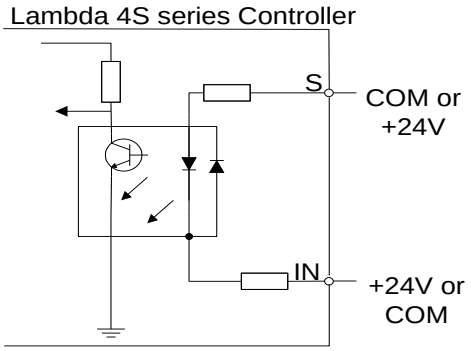



Fig. 2-1 Connection of binary input and mechanical switch

> Note:
>
> NK300BX system supports inputs active high/low. When the common port S on the Lambda 4S controller is connected to COM, inputs are active high after they are connected to +24V; when connected to +24V, inputs are active low after they are connected to COM.

◆ **Relay Output Signal**

The outputs on the Lambda 4S controller are relay outputs, and the relay output contact points have load capacity—7A/250VAC and 7A/30VDC, to control 220V AC load of low power. If high power load is needed, a contactor can be used. See Fig. 2-2.

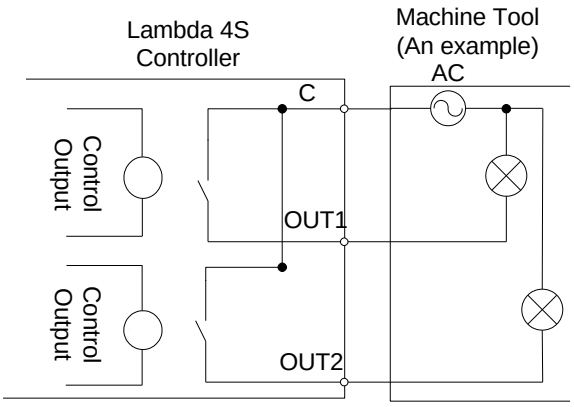



Fig. 2-2 Connection of relay output and contactor

◆ **Differential Output Signal**

Pulse command format to control driver motion is pulse + direction, negative logic. The max. pulse frequency is 1MHz. See Fig. 2-3 for pulse mode.

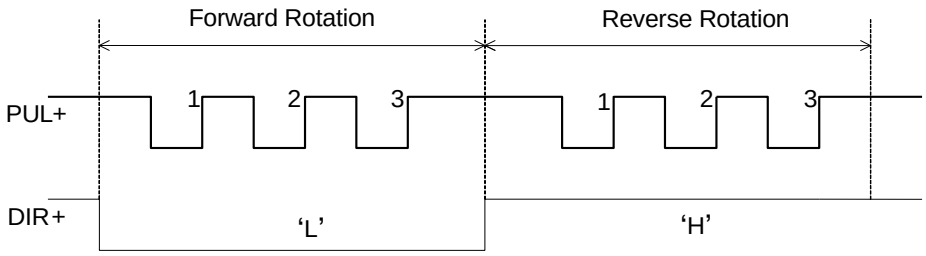



Fig. 2-3 Pulse command output mode

See Fig. 2-4 for differential signal output mode.

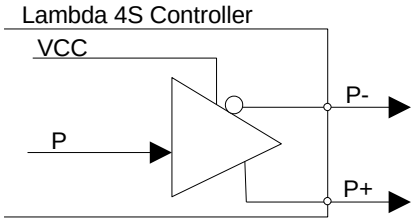



Fig. 2-4 Pulse command output circuit

◆ **Analog Output Signal**

SVC port, externally connected with the inverter analog voltage frequency command input port, can output voltage controlled from 0V to 10V. And it can control inverter frequency by voltage change in order to master spindle speed.

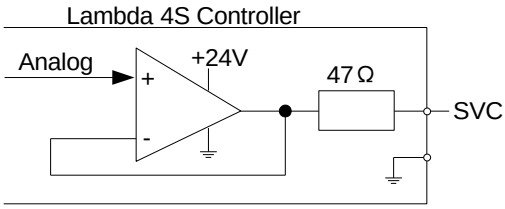



Fig. 2-5 Analog output signal circuit

## 2.2 Electrical Switch Wiring Diagram of Control Panel

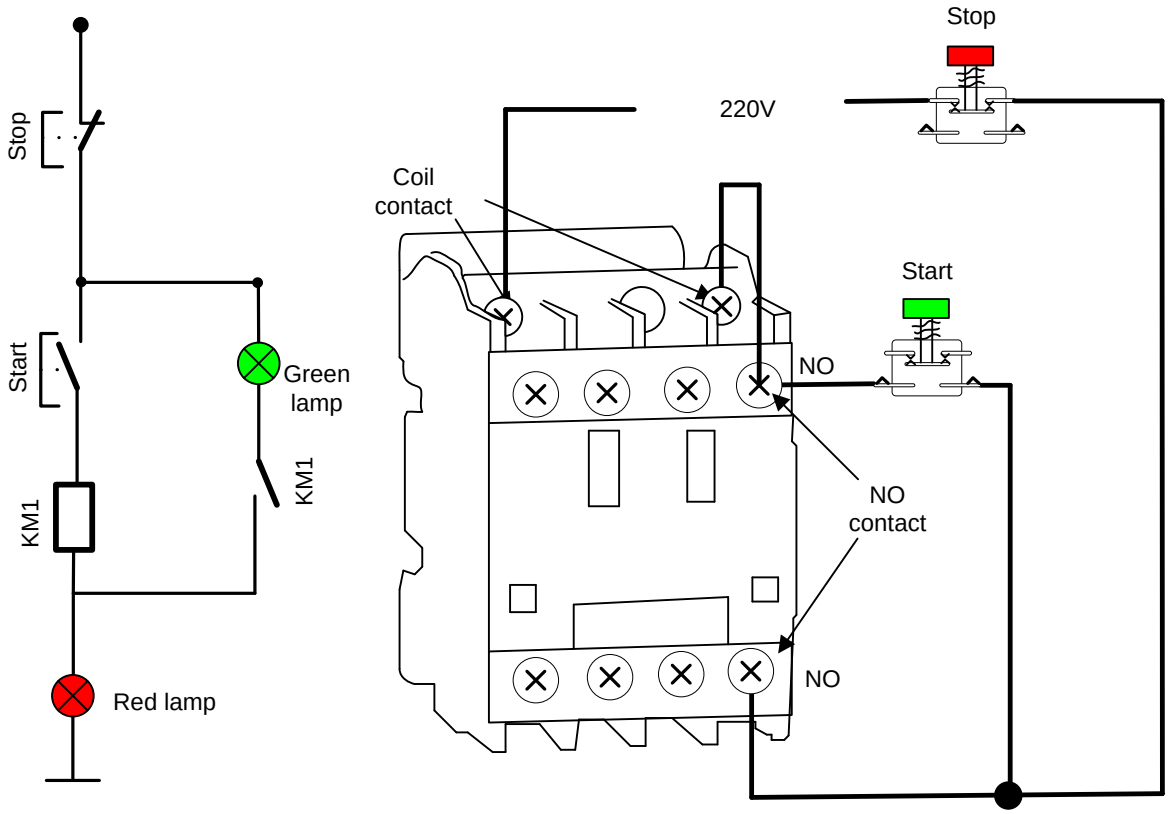



Fig. 2-6 Wiring diagram of electrical switch on 106 panel

## 2.3 Terminal Wiring Specification

NK300BX system is equipped with Lambda 4S controller as standard, with optional terminal board—EX31A1 for cascade connection and EX27A3 for non-cascade connection, to expand inputs and outputs. Lambda 4S controller and extended terminal board EX31A1 and EX27A2 both support active high/low.

A red LED indicator next to each input on the Lambda 4S controller is used to tell whether the input port receives the input signal or not. The concrete method: taking a NO switch as an example, press down the switch to send the signal to the corresponding port; if the LED near the port is on, it indicates the signal is successfully sent to the input port; if not, check whether the input is wrongly connected.

To test whether a port is damaged, open the software for test. For details, refer to chapter 3.3. .

In addition, the flash frequency of the LED indicator for system (LED next to the SYSTEM port) can be used to tell the state of system communication. Here are several situations, for reference only.

- When physical connection is interrupted, the LED indicator flash on and off in turn: ON 0.25s and OFF 0.25, and etc.
- If physical connection is normal while data connection is interrupted, with no upload block of logical data or data, the indicator flash on and off in turn at a lower frequency: ON 1.5s and OFF 1.5 s, etc.
- If physical connection is normal, namely data connection and transmission is normal, the indicator flash on and off in turn: ON 0.25s and OFF 0.25s, etc.
- When system abnormal occurs, such as crc confirmation error, full pulses, hardware encryption error and the like, the indicator flash on and off in turn: ON 0.05s and OFF 0.05s.
- When hardware failure occurs, such as under voltage, hardware damage, false weld and short circuit and the like, the indicator will be completely OFF or completely ON.
- For Lambda 4S/5S serial controller, when PC logical data or physical connection is interrupted, the I/O ports state of both the controller and extended terminal boards will remain unchanged.

### 2.3.1 Wiring Diagram of Lambda 4S Controller

To secure a normal communication of electrical circuit, a protective circuit is added to terminals Y00/C00, Y01/C01 (marked with ★ in the wiring diagrams below) on Lambda 4S controller, which is used for brake function. Therefore, the two groups of terminals should only be connected with load of voltage lower than or equal to 24V, otherwise, they will be damaged and cannot work due to burn-out of the piezoresistor.

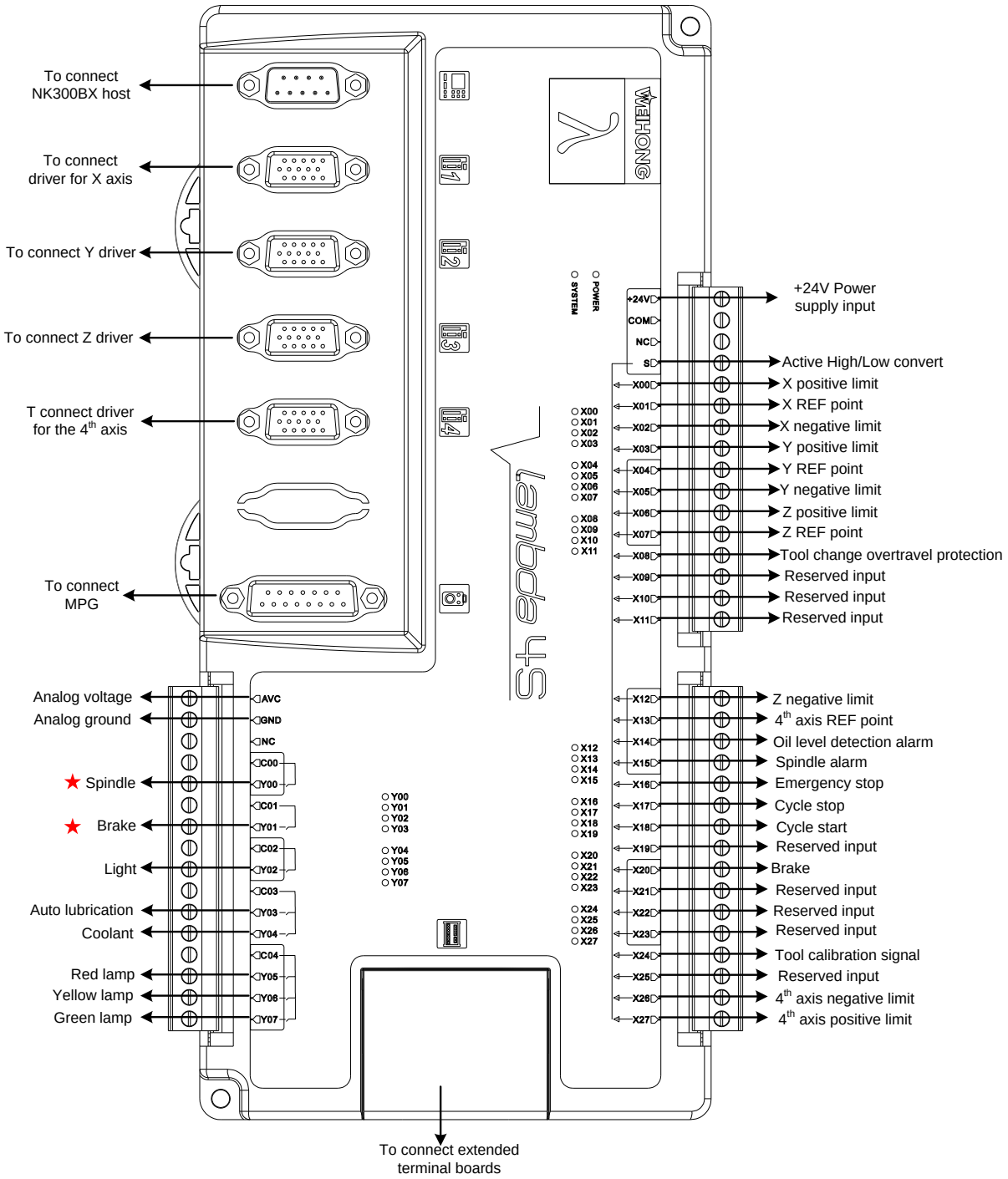



Fig. 2-7 Wiring diagram of Lambda 5 controller

Note:

The “Brake” output port should be connected with 24V voltage.

MPG connection is controlled by parameter N52030. When it set to “0”, the connection with Lambda controller is enabled, while set to “1”, the connection with NK300BX host is enabled.

Lambda controllers used is varied because of different types of extended terminal boards. For cascade extended terminal EX31A1, Lambda 4S (LD5S) controller is used, while for non-cascade extended terminal board, Lambda 4S controller is used, please note that.

For turntable configuration of three axes, the rotary Y axis is outputted through the fourth port by default; while for double Y axes configuration of three axes, the Y2 axis is outputted through the fourth axis port by default.

### 2.3.2 IO Specification of Lambda 4S Controller

Table 1 Port specification of Lambda 5 controller

| Classification | Pin No. | Description | Remark |
|---|---|---|---|
| **External power** | +24V | DC 24V power | Powered by external power supply. |
| | COM | | |
| **Common** | S | S port | When the common S is connected with COM port, it is active high; while connected with +24V, it is active low. |
| **Origin signal** | X01 | Reference point of X-axis | Binary input, connects to home switch of X-axis |
| | X04 | Reference point of Y-axis | Binary input, connects to home switch of Y-axis |
| | X07 | Reference point of Z-axis | Binary input, connects to home switch of Z-axis |
| | X13 | Reference point of 4th-axis | Binary input, connects to home switch of 4th-axis |
| **Limit signal** | X00 | Positive limit of X-axis | Binary input, connects to positive limit switch of X-axis |
| | X02 | Negative limit of X-axis | Binary input, connects to negative limit switch of X-axis |
| | X03 | Positive limit of Y-axis | Binary input, connects to positive limit switch of Y-axis |
| | X05 | Negative limit of Y-axis | Binary input, connects to negative limit switch of Y-axis |
| | X06 | Positive limit of Z-axis | Binary input, connects to positive limit switch of Z-axis |
| | X12 | Negative limit of Z-axis | Binary input, connects to negative limit switch of Z-axis |
| | X26 | Negative limit of 4th-axis | Binary input, connects to negative limit switch of 4th-axis |
| | X27 | Positive limit of 4th-axis | Binary input, connects to positive limit switch of 4th-axis |
| **Commonly used inputs** | X08 | Too change over-travel protection | Binary input signal, connects to tool change over-travel switch |
| | X13 | Pressure alarm | Binary input signal, connects to pressure alarm switch |
| | X14 | Oil level detection alarm | Binary input signal, connects to oil level sensor |

| Classification | Pin No. | Description | Remark |
|---|---|---|---|
| | X15 | Spindle alarm | Binary input signal, connects to spindle alarm switch |
| | X16 | Emergency | Binary input signal, connects to E-stop button on the operation panel |
| | X17 | Stop | For external connection with a reset switch |
| | X18 | Start | For external connection with a reset switch |
| | X20 | Brake | Connects to brake coil of servo driver |
| | X24 | Tool presetter signal | Binary input signal, connects to tool presetter |
| **Reserved inputs** | X09~X11 | Reserved | Reserved for user-defined inputs |
| | X21~X23 | Reserved | |
| **Outputs** | SVC | Spindle rotational speed control | $\frac{\text{Actual Spindle Rotational Speed}}{\text{Max. Spindle Rotational Speed}} = \frac{\text{SVC}}{10\text{V}}$ |
| | GND | Analog ground | |
| | Y00 | SPIN | Controls spindle ON and OFF |
| | Y01 | Brake | Connects to brake coil of servo driver |
| | Y02 | Light | For external connection with a illuminating lamp |
| | Y03 | Auto lubrication | Controls auto lubrication; relay contact output, LED on during lubrication and off when lubrication stops |
| | Y04 | Coolant | Relay contact output, two terminals equaling to a switch; connects to workpiece cooling switch |
| | Y05 | Red | Red light on when machining ends regularly or during E-stop |
| | Y06 | Yellow | Yellow light on during idle state after machining ends or during wait state |
| | Y07 | Green | Light on during normal working state of machine |

## 2.3.3 Wiring Diagram of Terminal Board EX31A1

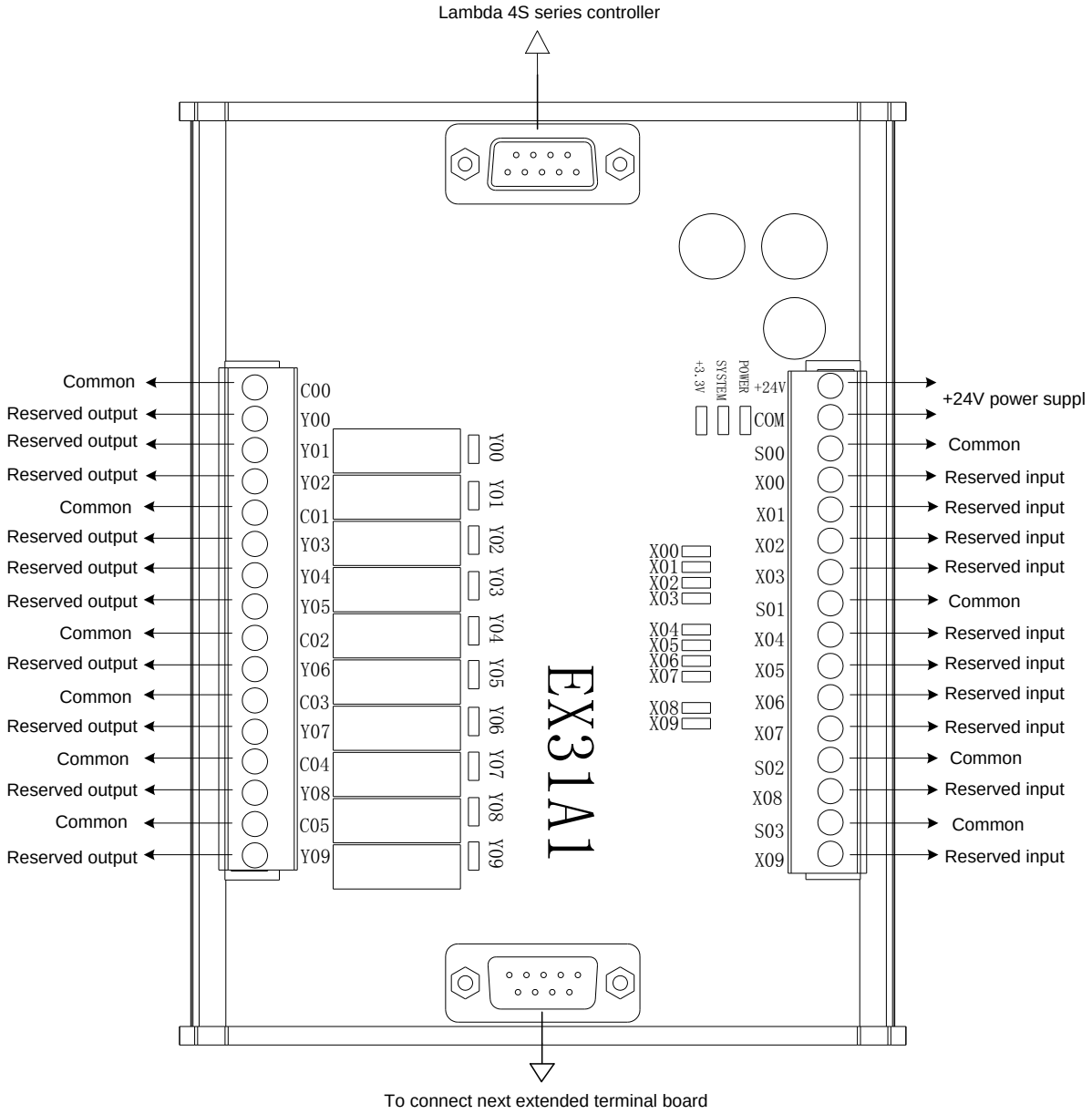



Fig. 2-8 Wiring diagram of terminal board EX31A1

Note:

When common port is connected with +24 V power supply, X00 ~ X09 are active low; while common port is connected with COM, X00~X09 are active high.

EX31A1 is used together with Lambda 4S (LD5S) controller.

### 2.3.4 Wiring Diagram of Terminal Board EX27A3

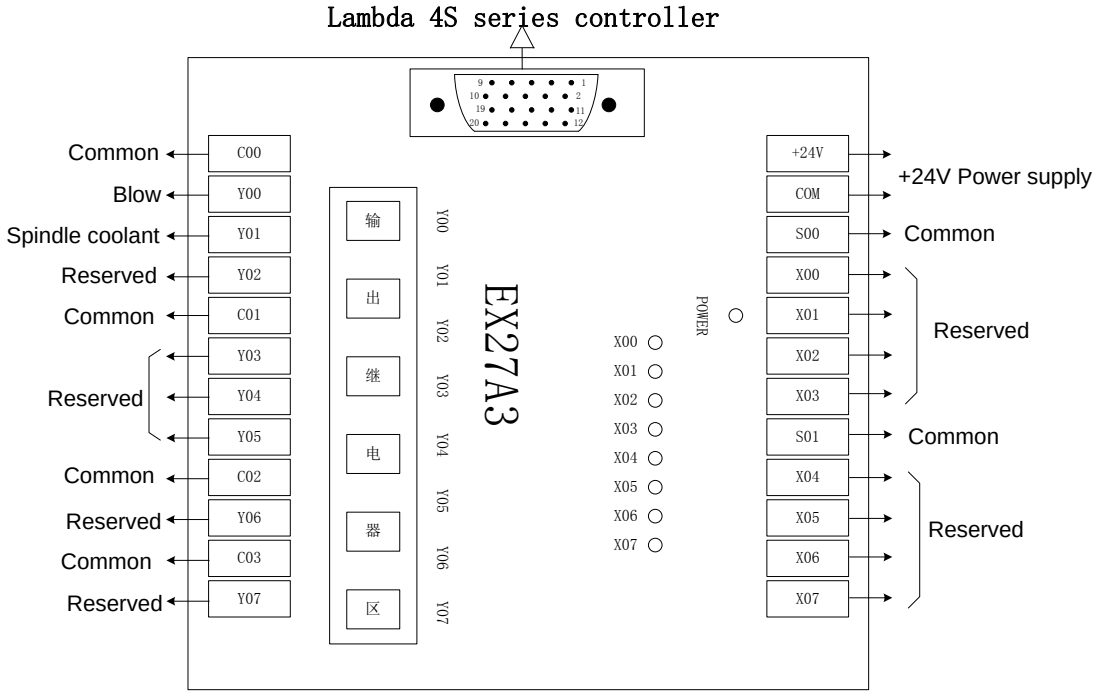



Fig. 2-9 Wiring diagram of terminal board EX27A3

Note:

X00~X07 correspond to PLC addresses of port 00216~00223 in the software.

When common port is connected with +24V, X00~X07 are active low; while connected with COM, they are active high.

EX27A3 is used together with Lambda 4S controller.

## 2.4 Port Definition and Wiring Specification

### 2.4.1 Driver Interface Definition

NK300BX system provides 4 pulse feed driver interfaces. The type of the 4 interfaces is 15-pin D-type socket (DB15 pins). The pins definition as follow:

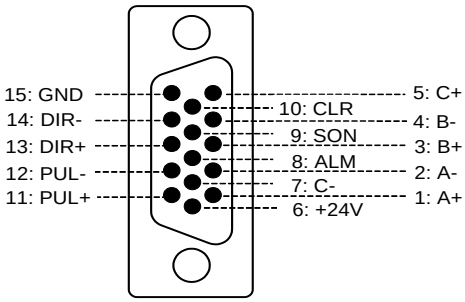



Fig. 2-10 Driver interface definition

Table 2 Driver interface description

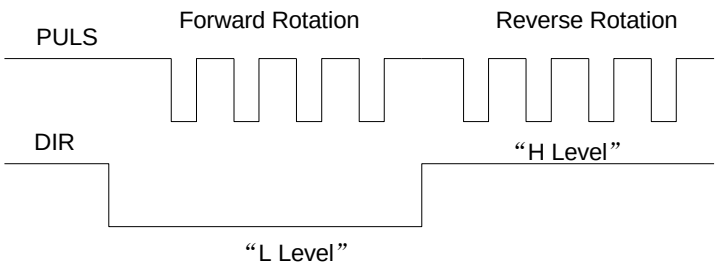
| Name | Definition | Input /Output | Description |
|---|---|---|---|
| A+, A- | Feedback signal of encoder phase A | Input, differential signal transmission mode | Receive the differential output from encoder signal (phase A, B, C) of driver frequency divider (equaling to RS422). |
| B+, B- | Feedback signal of encoder phase B | Input, differential signal transmission mode | |
| C+, C- | Feedback signal of encoder phase C | Input, differential signal transmission mode | |
| ALM | Driver alarm signal | Input | When breakdown occurs in driver, the output (transistor) will be closed or disconnected. |
| SON | Servo ON signal | Output | This signal is used for opening (power on) and closing (power off) servo motor. When this signal is connected to COM-, dynamic brake will be released and thus the driver is allowed to work (servo enabled). |
| CLR | Driver alarm clear signal | Output | This signal is used for alarm/warning status clear, and can only remove the alarms that can be removed. |
| PUL+, PUL- | Pulse output | Output, differential signal transmission mode | |
| DIR+, DIR- | Direction output | Output, differential signal transmission mode | |
| +24V, GND | DC 24V power | Output | Connected to driver |

Notice:

SON signal will be effective in 2 seconds after connecting of power supply. Don't try to drive the motor through the external servo ON or servo OFF drive signal at any time, since the software will control the power-up state of the servo motor.

◆ **Technical Specifications**

| Technical parameters | Description |
|---|---|
| Max. pulse frequency | 1M |
| Encoder power | +5V, 150mA |
| Encoder signal | RS422 level |
| Signal output | Differential signal output, both pulse and direction signals adopt differential signal transmission mode. |
| Pulse format | Pulse + direction, negative logic. The "pulse + direction" output wave form of NK300BX is shown as follows: |

| Technical parameters | Description |
|---|---|
| |  |

## 2.4.2 Handwheel Interface Definition

NK300BX can be externally connected to a manual pulse generator (MPG, or called handwheel). The interface consists of DB15-pins dual-in-line holes, and the pins definition is as shown in Fig. 2-11.

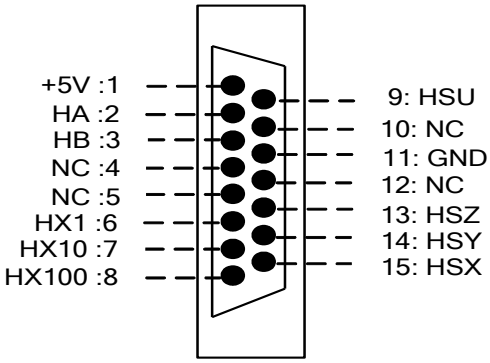



Fig. 2-11 Handwheel interface definition

Table 3 Handwheel interface description

| Pin No. | Definition | Description |
|---|---|---|
| 1 | +5V | Power on handwheel |
| 2 | HA | Encoder phase A signal |
| 3 | HB | Encoder phase B signal |
| 4 | NC | |
| 5 | NC | |
| 6 | HX1 | Selection of X1 override |
| 7 | HX10 | Selection of X10 override |
| 8 | HX100 | Selection of X100 override |
| 9 | HSU | Selection of the 4th axis |
| 10 | NC | |
| 11 | GND | Digital ground |
| 12 | NC | |
| 13 | HSZ | Selection of Z-axis |
| 14 | HSY | Selection of Y-axis |
| 15 | HSX | Selection of X-axis |

### 2.4.3 USB Interface Definition

There are two USB interfaces at the back of NK300BX host, another one on the front for external connection of an USB device (E.g. U disk).

# 3 Manipulation

# 3.1 Debugging Steps

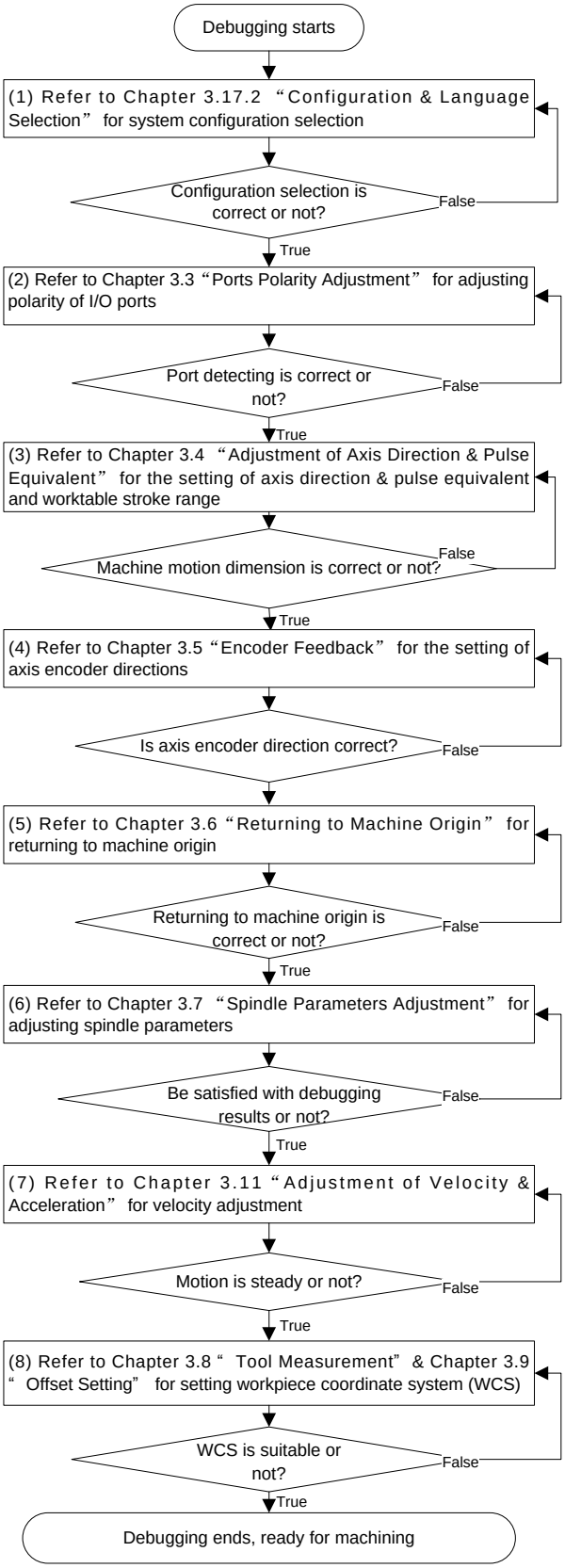



Fig. 3-1 Debugging steps

## 3.2 Operational Interfaces Toggle

Catering to operational habits of different users, the NK300BX software offers two types of interfaces. With the help of parameter setting, users can decide the main interface style.

The classic main interface is shown in Fig. 3-2.


Fig. 3-2 Classic main interface of NK300BX software

The new main interface of the software is shown below:

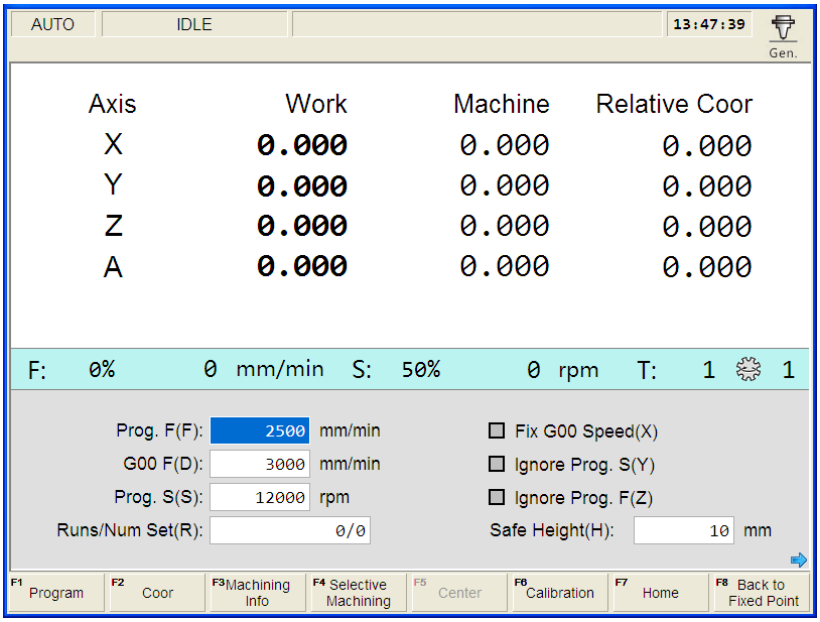



Fig. 3-3 New interface of NK300BX software

Because most operations and methods are same for the classic and new interfaces, the following chapters will introduce operations of the NK300BX system taking the classic interface with an example. Explanations will be made for the difference, please note that.

To toggle between the classic and new interfaces, press function button  to access the parameters area, press next button  under the monitor to open the next manipulation buttons bar, and then press F1 button to open [Software Option] tab. With the help of arrow keys “↑” “↓”, move the cursor onto the parameter N80030, and press Enter key to open a dialog box for modifying parameter value, as shown in Fig. 3-4. Choose “Yes” to activate the classic interfaces while choose “No” to activate the new interfaces. The modification takes effect after the software is restarted.

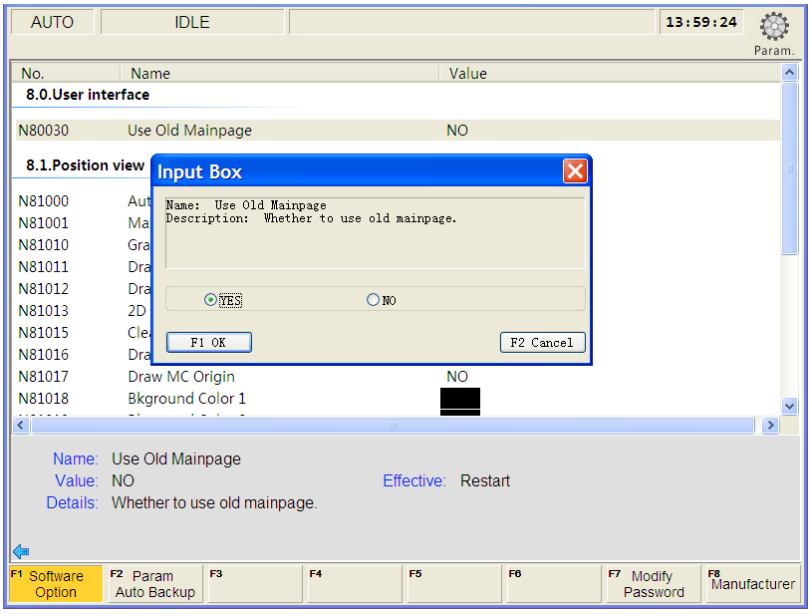



Fig. 3-4 Parameter setting for interface switchover

## 3.3 Ports Polarity Adjustment

The polarities of input/ output ports in the software are specified in terms of the switch type: the polarity of normally closed switches should be “NC”; the polarity of normally open switches should be “NO”. In the software interface, the ports with preceding filled dot ● are input ports, while the ones with hollow point ○ are output ports.

After the connection of a machine tool and power on, the dots should be in red in front of reference point, E-stop, cycle start, cycle stop and tool presetter signal indicating these signals are invalid, or it is necessary to check whether the connection is correct. If there is no problem with the connection, the polarity of the corresponding port should be changed.

After the change of polarity, if the dot still does not change its color from green to red, it’s time to check whether the port on the controller is damaged.

The method of modifying polarity: press the diagnosis function selection key  to access [Diagnosis] interface after opening NcStudio→ press F3 to enter [I/O Port] window → select the target I/O port for modification by pressing the Up and Down keys→ press F4 [Invert Polarity]. Restart to validate the modification to port polarity.

[I/O Port] screen is as shown in Fig. 3-5, and some function screens need password before operation, such as [Test On], [Test Off], [Cancel All], [Invert Polarity], [Change Property] [Display All ] and [Watch Port].

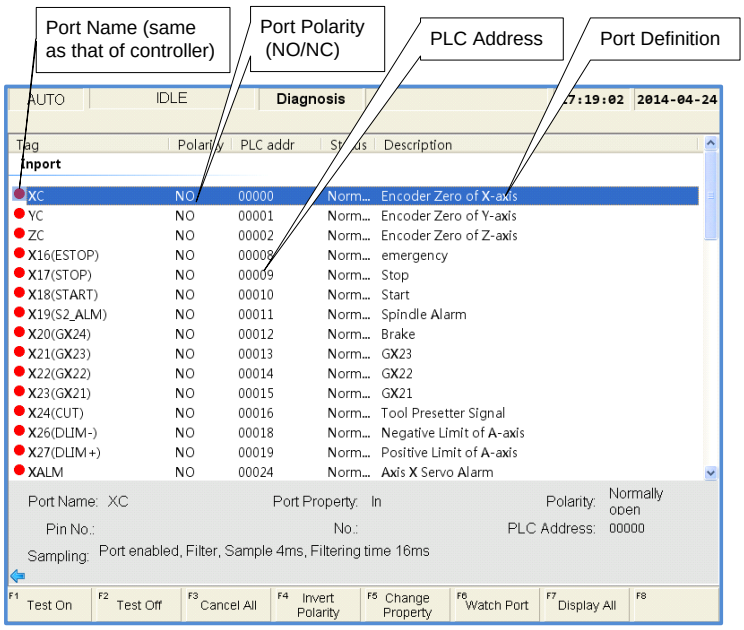



Fig. 3-5 I/O port screen

◆ **[Test On], [Test Off]**

The shortcut keys are F1 and F2 respectively, which are only available under [I/O Port] screen.

Pressing down F1 or F2 will make the indicator light before the port selected shift between green and red. Green light means there is signal in the port; red light means there is no signal in the port.

This group of buttons is mainly used for simulating hardware signal, which is for simulation test.

> Note:
>
> The indicator lights before ports are slightly different in test mode and in practice:
>
> Green light in test mode: Red light in test mode:
>
> Green light in practice: Red light in practice:

◆ **[Cancel All]**

The shortcut key is F3, which is only available under [I/O Port] screen.

Pressing F3 will cancel simulation test and signals to replace analog signals with real hardware signals.

◆ **[Invert Polarity]**

The shortcut key is F4, which is only available under [I/O Port] screen.

Pressing F4 will change port polarity between NO and NC.

The polarities of feedrate override, spindle override, mode switch, handwheel and encoder zero should be “NO”.

Except for particularly defined ones, the polarities of output ports are generally “NO”.

◆ **[Change Property]**

The shortcut key is F5, which is only available under [I/O Port] screen.

After F5 is pressed, a new manipulation dialog will appear, as shown in Fig. 3-6.

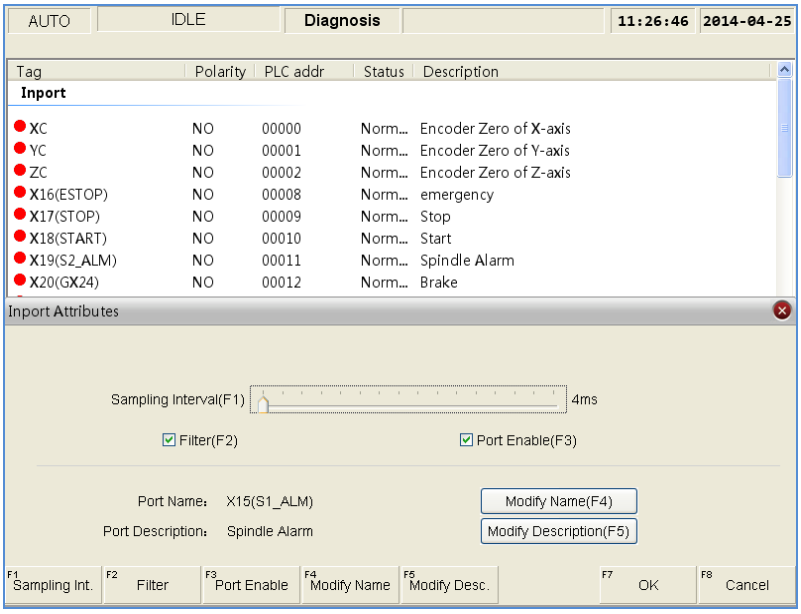



Fig. 3-6 Setting window of port property

In this port attribute dialog, you can set sampling interval (Press “F1” to activate interval adjustment, and press PageUp/ PageDown keys to adjust interval time), filter function and port enable function, and modify port name and port description.

◆ **[Watch Port]**

After selecting one port, press the shortcut key F6 to enable the monitor function of this port, refer to Chapter 3.14.2 [Diagnosis] window for detail.

◆ **[Display All]**

Pressing F7 will display all the input and output ports (including the undefined ports concealed in ex-factory setting). And pressing F7 again will hide all the unused input and output ports.

# 3.4 Adjustment of Axis Direction and Pulse Equivalent

## 3.4.1 Axis Direction Adjustment

The first thing to do in machine debugging is to confirm the positive direction of each axis. The coordinate system of right-hand rule is as shown in Fig. 3-7.

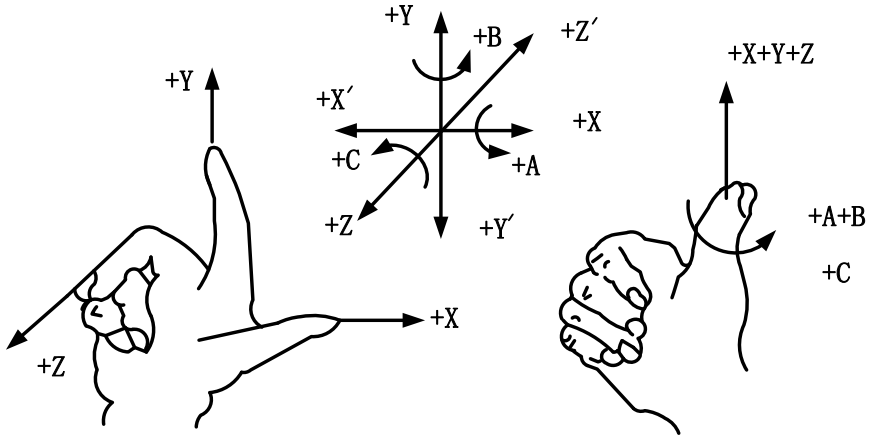



Fig. 3-7 Standard coordinate system of right hand principle

The axis directions of a machine are decided by both the type of the machine tool and the layout of each component. The basic coordinate axes of engraving & milling machines/ routers are X-, Y-, and Z-axis:

——Z-axis is coincidental with spindle axis and the direction of the cutter moving away from workpiece is the positive direction of Z-axis (+Z).

——X-axis is perpendicular to Z-axis and parallel to the clamped surface of workpiece. For a single column vertical milling machine, if the user faces the spindle and looks in the column direction, right moving direction is the positive direction of X-axis (+X).

——The positive direction of Y-axis is the cutter moving away from the operator (+Y).

◆ **Related Parameters (Under "Axis Parameter")**

| Parameter | | Definition | Setting Range |
|---|---|---|---|
| **N10000** | Axis Direction (X/Y/Z) | It specifies the motion direction of each axis. | "1" and "-1" represent the two motion directions of each axis. |
| Fix the positive direction of each axis following the right-hand rule, and then manually operate the machine to check if the axis moves in the correct direction. If the direction is opposite, modify the value of N10000. Take X-axis as an example, manually move X-axis, just to find it moves oppositely, just change the X value of N10000 from "-1" ("1") to "1" ("-1"). | | | |

### 3.4.2 Pulse Equivalent Adjustment

Pulse equivalent (p) : the moving distance of workbench or rotation degree of rotary axis per pulse sent by the CNC device, the minimum available distance controlled by the CNC system as well. Pulse equivalent can be calculated in terms of screw pitch, electronic gear ratio, mechanical deceleration ratio and other relevant info.

The smaller the pulse equivalent is, the higher the machining precision and surface quality will be. The large, the faster feedrate will be. Therefore, lower pulse equivalent should be set under condition of meeting the demand of feedrate. The relationship between maximum feedrate and pulse equivalent is as following:

$$\text{Max. Feedrate} = \text{pulse equivalent} \times 60 \times \text{frequency}$$

For example, the hardware frequency of NK300BX is 1MHz, and provided the pulse equivalent is 0.001mm/p, then:

$$\text{Max. Feedrate} = 0.001 \times 60 \times 1000000 = 60\text{m/min}$$

Mechanical deceleration ratio (m/n): the ratio of reducer input speed to output speed, equal to the ratio of the teeth number of driven wheel to that of driving wheel. When applied in CNC machines, it specifies the ratio of motor speed to screw speed.

$$\text{Mechanical deceleration} = \frac{\text{reducer input speed}}{\text{reducer output speed}} = \frac{\text{teeth number of driven wheel}}{\text{teeth number of driving wheel}} = \frac{\text{motor speed}}{\text{screw speed}}$$

Pitch (d): The axial distance between the corresponding points of two adjacent teeth on the threads.

The calculation of pulse equivalent varies with different motor systems.

◆ **Stepping Motor**

In general, firstly set the subdivision and then calculate the pulse equivalent. You can also set the pulse equivalent before calculating subdivision. Their relationship can be shown as:

$$\frac{d}{p} = \frac{360}{\theta} \times x \times \frac{m}{n}$$

Hereinto, p stands for pulse equivalent, x represents subdivision of stepping motor while θ refers to stepping angle. Therefore,

$$\text{Pulse equivalent} = \frac{\text{screw pitch}}{\frac{360}{\text{stepping angle}} \times \text{subdivision} \times \text{mechanical deceleration ratio}}$$

For instance, the selected screw lead of X-axis for a certain type of machine tool is 5mm, the stepping angle of stepping motor is 1.8 degree, with “10” subdivision and motor directly connected with screw

by coupling. Thus, the pulse equivalent of X-axis is:

$$\text{Pulse equivalent}=\frac{5\text{mm}}{\frac{360}{1.8}\times 10\times 1}=0.0025\text{mm/p}$$

◆ **Servo Motor**

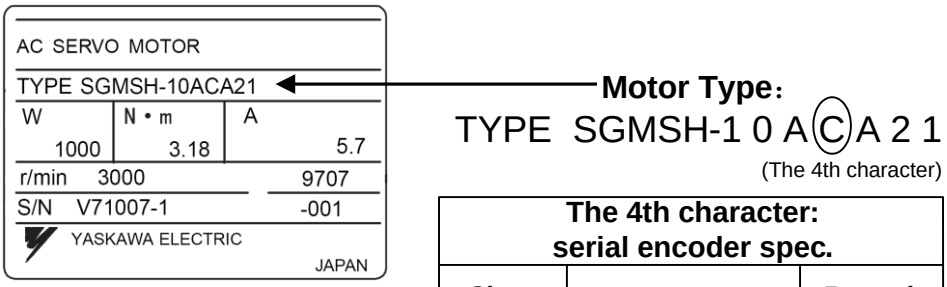
In general, set the default value of pulse equivalent (p) as 0.001mm/p and calculate electronic gear ratio (B/A). Their relationship can be shown as:

$$\text{Electronic gear ratio}\ \frac{B}{A}=\frac{\text{encoder resolution}}{\frac{\text{screw pitch}}{\text{pulse equivalent}}}\times\text{mechanical deceleration ratio}$$

Namely, $\frac{B}{A}=\frac{F\times p}{d}\times\frac{m}{n}$

Electronic gear ratio: if servo motor makes one circle per every 5000 pulse commands sent by the system, setting electronic gear ratio of servo motor can make servo rotate twice with the same amount of pulse commands (please refer to parameters setting of the specific servo).

Please see the servo motor label plate compared to the corresponding manual to confirm its encoder resolution. A label plate of YASKAWA SGMSH type servo is as shown below, and the 4th character in motor type is the serial encoder specification, with resolution of $2^{17}$, i.e. 131072.




| The 4th character: serial encoder spec. | | |
|---|---|---|
| **Sign** | **Spec.** | **Remark** |
| 2 | 17-bit absolute | Standard |
| C | 17-bit incremental | Standard |

Fig. 3-8 Servo motor brand-encoder resolution

For instance: (an example of YASKAWA servo) screw pitch of a certain type of machine is 5mm, with 17 bit encoder resolution, “0.0002mm/p” pulse equivalent and “1:1” deceleration ratio.

$$\text{Electronic gear ratio}=\frac{PN202}{PN203}=\frac{2^{17}}{5/0.0002}\times 1=\frac{131072}{5/0.0002}=\frac{16384}{3125}$$

◆ **Rotary Axis**

The pulse equivalent of rotary axis refers to the rotation degree of the axis clamping the workpiece corresponding to each pulse. The rotated degree of workpiece per revolution of motor equals to screw

pitch.

- For Stepping Motor

$$\text{Pulse equivalent} = \frac{360}{\frac{360}{\text{stepping angle}} \times \text{subdivision} \times \text{mechanical deceleration ratio}}$$

- For Servo Motor

$$\text{Electronic gear ratio } \frac{B}{A} = \frac{\text{encoder resolution} \times \text{pulse equivalent}}{360} \times \text{mechanical deceleration ratio}$$

◆ **Related Parameters (Under "Axis Parameter")**

| Parameter | | Definition | Setting Range |
|---|---|---|---|
| **N10010** | Pulse Equivalent (X/Y/Z/4th axis) | It refers to the displacement or angle generated on the relative feed axis per control pulse. | -0.0000009 ~999 |

Note:

The setting of pulse equivalent must be matching with the electronic gear ratio of servo driver or subdivision of stepping driver.

## 3.4.3 Upper & Lower Limit Setting of Worktable Stroke

Worktable stroke refers to the valid machining stroke range of a machine tool in the X, Y, and Z directions, and the system will carry out soft limit in terms of this range in order to protect the machine.

◆ **Related Parameters (Under "Axis Parameter")**

| Parameter | | Definition | Setting Range |
|---|---|---|---|
| **N10020** | Travel Limits-Negative(X/Y/Z) | It sets the machine coordinate of the allowable lower limit of worktable when the parameter N10040 is valid. | -99999 ~99999 |
| **N10030** | Travel Limits-Positive(X/Y/Z) | It sets the machine coordinate of the allowable upper limit of worktable when the parameter N10040 is valid. | -99999 ~99999 |
| **N10040** | Enable Travel Limits (X/Y/Z) | It sets whether to check the stroke range of worktable. | NO: Invalid<br>YES: Valid |
| **N67000** | Negative Change Tool Travel Limits (X/Y/Z) | It sets the machine coordinate of the allowable lower limit of travel in tool change. | -99999 ~99999 |
| **N67010** | Positive Change Tool Travel Limits (X/Y/Z) | It sets the machine coordinate of the allowable upper limit of travel in tool | -99999 ~99999 |

| | | | |
|---|---|---|---|
| | | change. | |

Note:

In the first setting of the upper & lower limit of worktable stroke, please verify the actually valid range of machine motion in case of accident.

# 3.5 Encoder Feedback

## 3.5.1 Direction Setting for Axis Encoder

You can find the parameter N11110 “Axis Encoder Dir” following operations: [Parameter] function area → F8 [Axis Parameter]→ 1.1 Encoders.

There are two methods to decide and set the axis encoder direction, namely setting via operation and setting via reasoning.

◆ **Setting via Operation**

Taking X axis as an example, manually move X axis towards positive direction, and during the process, press E-stop button. If the coordinate value after adjustment is larger than the value before adjustment, it tells that the current [Axis Encoder Dir] is correct, otherwise, incorrect.

Likewise, manually move X axis towards negative direction, and during the process, press E-stop button. If the coordinate value after adjustment is smaller than the value before adjustment, it tells that the current [Axis Encoder Dir] is correct, otherwise, incorrect.

It is the same operation with other axes.

◆ **Setting via Reasoning**

On condition that the axis direction and pulse equivalent settings are correct:

$$\text{Axis Encoder Direction} = \text{Axis Direction} \times \text{Logical Direction}$$

For example, setting X axis direction to -1, and pulse to “Pulse + Direction, Negative Logic”. The value of parameter N11110 will be 1=[(-1)*(-1)].

> Note:
>
> Please refer to Chapter 3.4.1 for axis direction setting, and refer to Chapter 3.4.2 for pulse direction setting.

◆ **PG Frequency Division (×4) Setting**

Parameter N11160 “Frequency Division Pulse of PG (×4)” refers to the feedback pulses number when motor rotates one revolution without any acceleration or deceleration settings, or the feedback pulses the linear axis moves one-pitch-distance. During debugging in the field, please refer to the manuals for drivers of varied brands.

## 3.5.2 Related Parameters

| Parameter | | Definition | Setting Range |
|---|---|---|---|
| **N11304** | Encoder Feedback | Whether to enable encoder feedback function or not. | Yes: Enable;<br>No: Disabled |

| | | | |
|---|---|---|---|
| **N80004** | Print Info | Whether to show debugging info or not. | Yes: Show;<br>No: Not show |
| **N11110** | Axis Encoder Dir | It specifies the direction of encoder. | 1: positive<br>-1: negative |
| **N11130** | Check Encoder Error | Whether to check the encoder error between feedback value and output value or not. | Yes: check;<br>No: not check |
| **N11140** | Static Tolerance | When the axis is steady, if the difference between the feedback value and output value is bigger than this value, alarm will occur. | 1~999999 |
| **N11150** | Dynamic Tolerance | When the axis is dynamic, if the difference between the feedback value and output value is bigger than this value, alarm will occur. | 1~99999 |
| **N11160** | Frequency Division Pulses of PG (*4) | It specifies the encoder feedback pulse number via frequency division of servo per revolution of motor. | 1~99999 |

Encoder feedback function is used to detect and feedback the angular or linear displacement of servo motor. When the parameter is set to “No”, please refer to Chapter 3.6.1 for the principle and process of returning to the reference point; when it is set to “Yes”, please refer to the principle and process of returning to the reference point in Chapter 3.6.4.

Only when parameter N11304 is set to “Yes”, the parameter N80004 can be set to “Yes”.

Encoder error refers to the absolute difference value of pulse number sent and fed back. (E.g. value of |Un00C – Un00D| in YASKAWA servo) when the detected value is larger than the allowable value set by the parameter, the system will stop emergently and report “(X/Y/Z) Axis dynamic / static error alarm”.

The dynamic encoder error refers to the error in running. Dynamic error = Motion speed / Position loop gain. (Assuming that the feedrate of X axis is 6000mm/min, or 100mm/s, position loop gain of servo driver is $100s^{-1}$, the X axis dynamic error will be 100mm/s $\div 100s^{-1}$=1mm. If the pulse equivalent is 0.001mm/p, the dynamic of X axis at 6000mm/min will be 1000p. At this time, if the parameter setting value is lower than 1000p, and X axis has already returned to the REF point, the system will alarm and stop. In other words, the system will prompt X axis dynamic error exceeding setting value and the X axis will make relative adjustment.)

Static error refers to the encoder error when the system is in idle (with idle time longer than 8s). Default setting is 500.

# 3.6 Returning to Machine Origin

Origin of Machine Coordinate System (inherent coordinate system of a machine tool), also called mechanical origin, and home, is a fixed point assigned by design, manufacturing and debugging before the machine tool leaving factory. After startup of the CNC system, it is necessary to back to machine origin (home all axes) manually or automatically.

> The necessity of returning to machine origin: these below functions will not be activated until backing to machine origin completed: soft limit, setting fixed point and tool change.

### ◆ The Process of Returning to Machine Origin

The processes of returning to machine origin of X, Y, Z axis are included and identical, as shown in Fig. 3-9 (an example of X-axis).

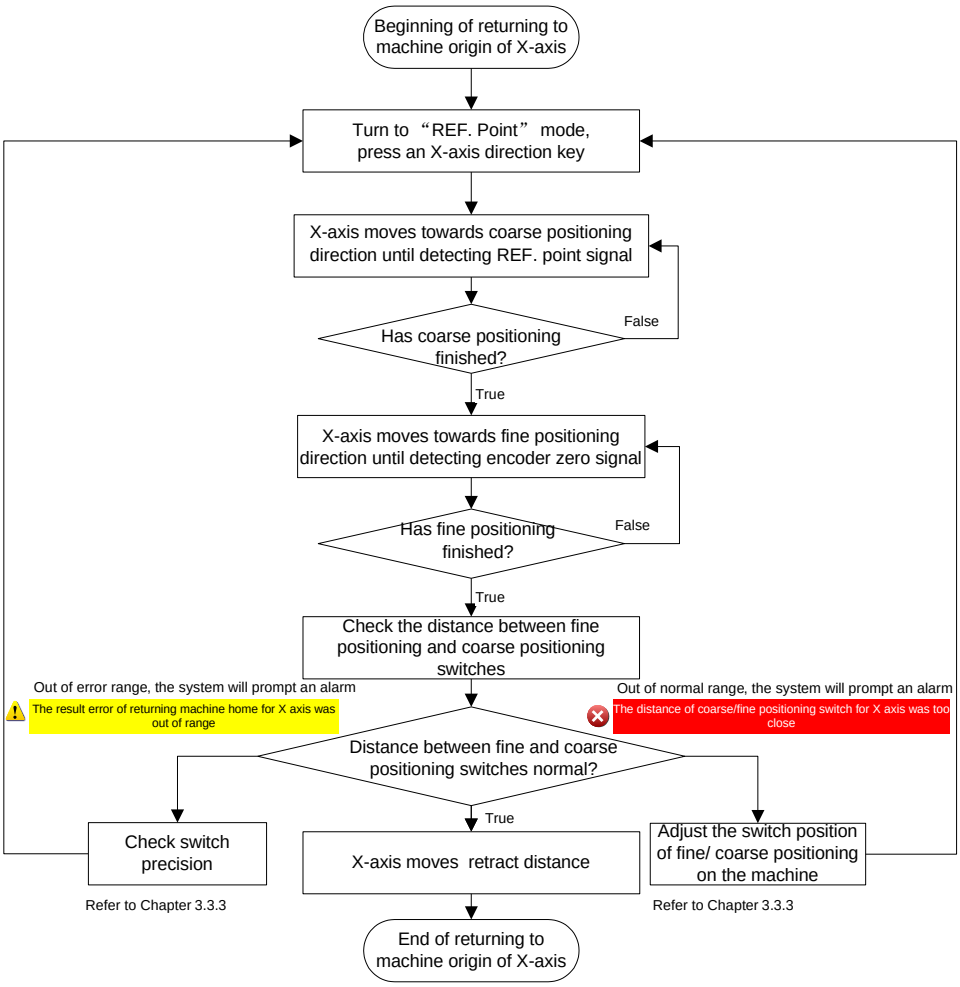



Fig. 3-9 The process of returning to machine origin (X-axis)

### 3.6.1 Returning to Machine Origin Operations under Three Axes Configuration

When the three axes configuration is active, turn the system into REF point mode, press function button  to enter the following interfaces, one for classic interface and one for new interface.

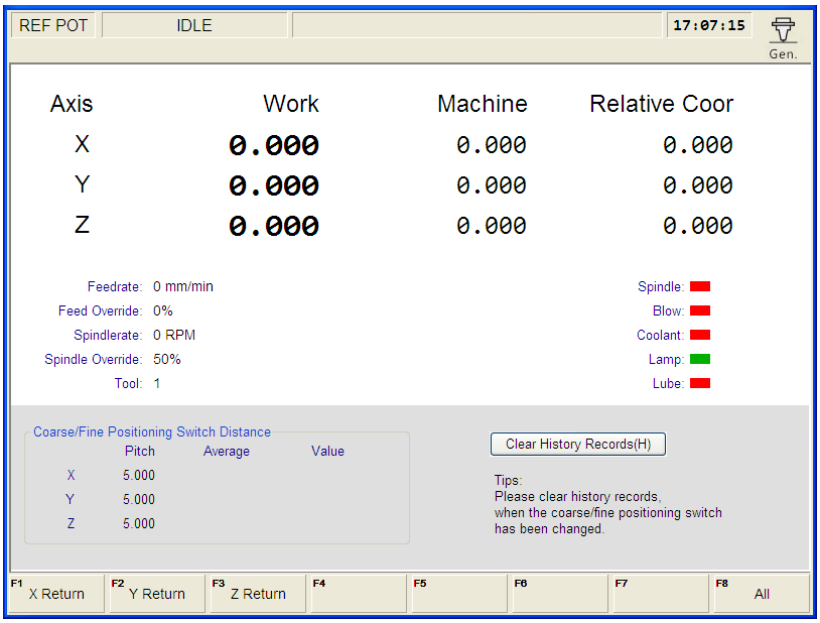



Fig. 3-10 Classic interface in REF mode---Three axes configuration

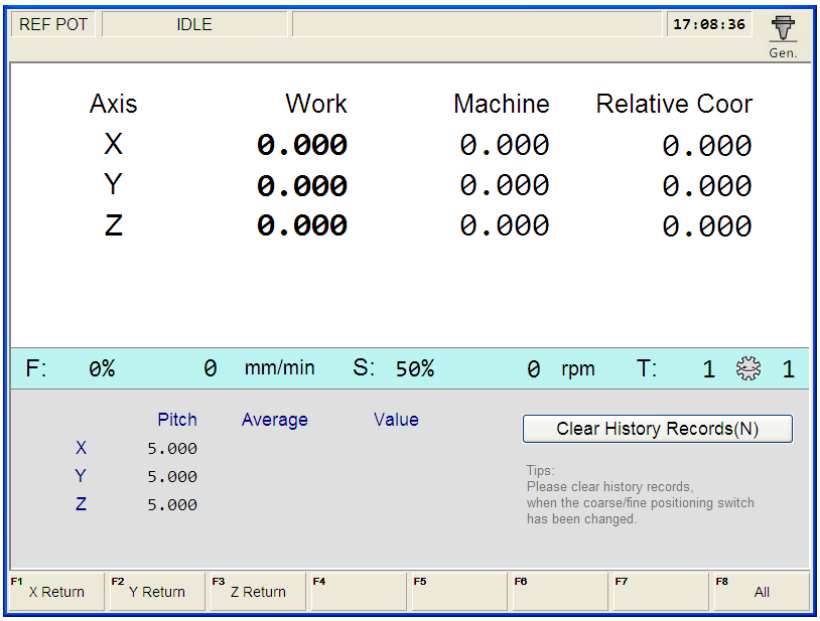



Fig. 3-11 New interface in REF mode---Three axes configuration

◆ **All Axes Returning to the Machine Origin**

Press F8 [All] to execute the operation. For safety, Z axis will return to REF point before other axes returning.

◆ **Single Axis Returning to the Machine Origin**

Press shortcut keys F1/F2/F3 to return a single axis to the REF point at a time.

The system entitles Z axis the highest priority in returning home by default. If Z axis is returned first, a prompt box will pop up, as shown below. Select “No” to exit the operation and “Yes” to make the selected axis return to the REF point.

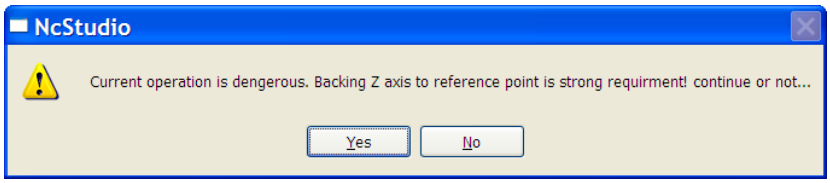



Fig. 3-12 Dangerous operation prompt

## 3.6.2 Returning to Machine Origin Operations under Four Axes Configuration

When four axes configuration is active, turn the system into REF point mode and access the operation interfaces, as shown in Fig. 3-13 and Fig. 3-14.


Fig. 3-13 Classic interface in REF mode---Four axes configuration

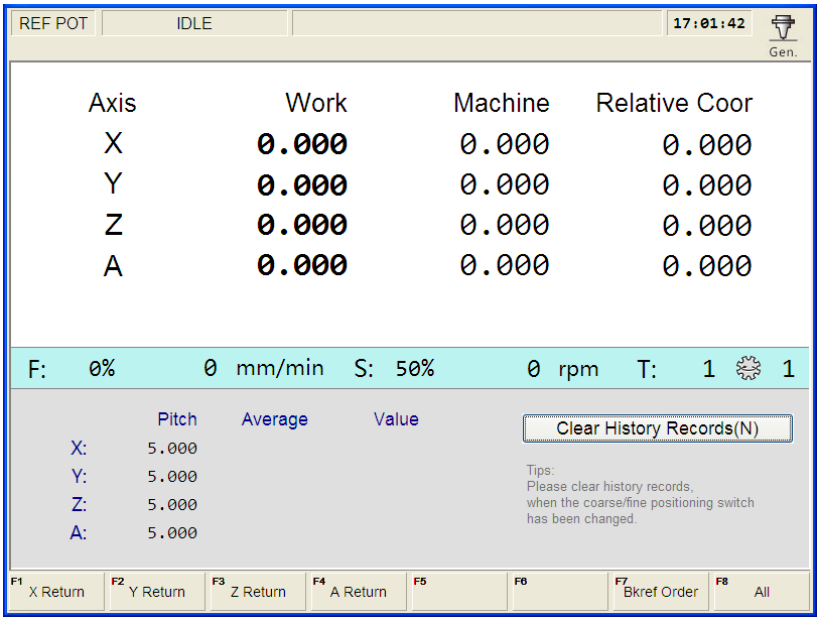



Fig. 3-14 New interface in REF mode---Four axes configuration

Compared with that under three axes configuration, users can freely define the returning order of axes. Press F7 [Bkref Order] to open setting dialog box, as shown below.

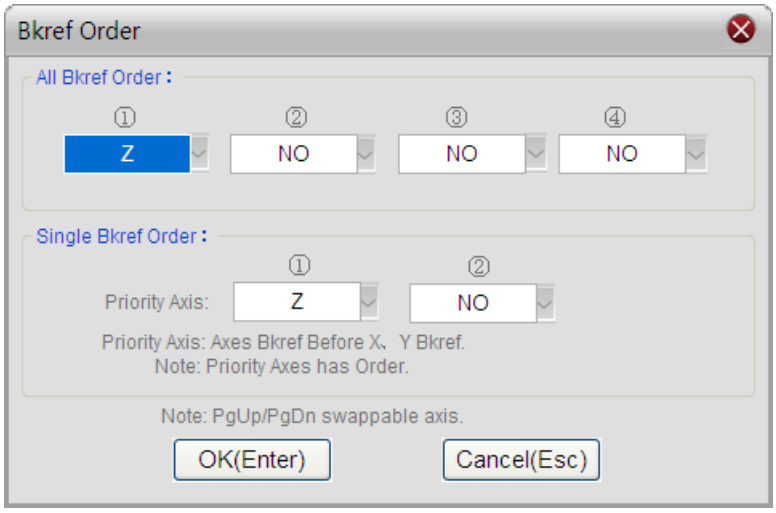



Fig. 3-15 Returning order setting dialog box

### ◆ All Axes Returning to Machine Origin

According to demand in the field, you can set returning order in the dialog box named “Bkref Order”, where you can press arrow keys to move the cursor, and press “PageUp” and “PageDown” keys to switch among options for each order position. See Fig. 3-16. When settings are done, press Enter for confirmation and back to the main interface in REF mode. Press F8 [All] to make all axes returning to the REF point according to the order you have set.

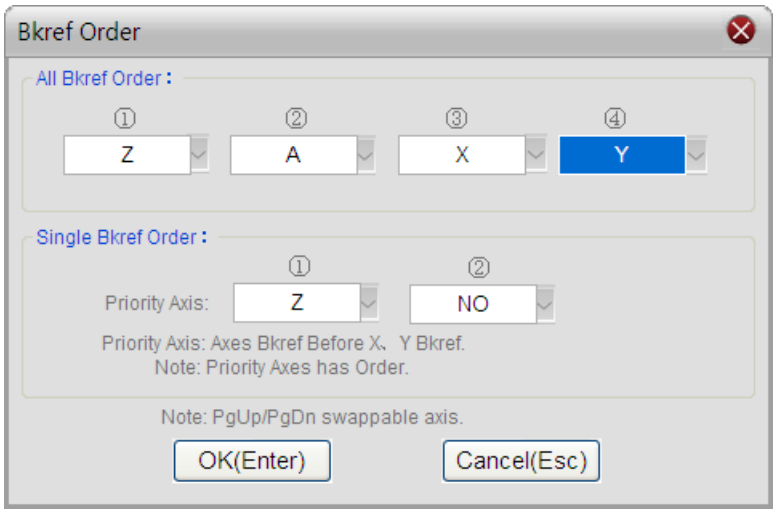



Fig. 3-16 All axes returning to the REF point

### ◆ Single Axis Returning to Machine Origin

Before returning single X/Y axis to the REF point, you can define one axis with priority, to avoid possible machine damage caused by mal-operations.

Likewise, users can make a prior axis returning before X/Y axis returning. Press arrow keys to locate the cursor and press PageUp and PageDown keys to switch among options for each order.

For example, users want A axis returning before X/Y returning, press PageUp and PageDown keys to select A axis for the first order. See below.

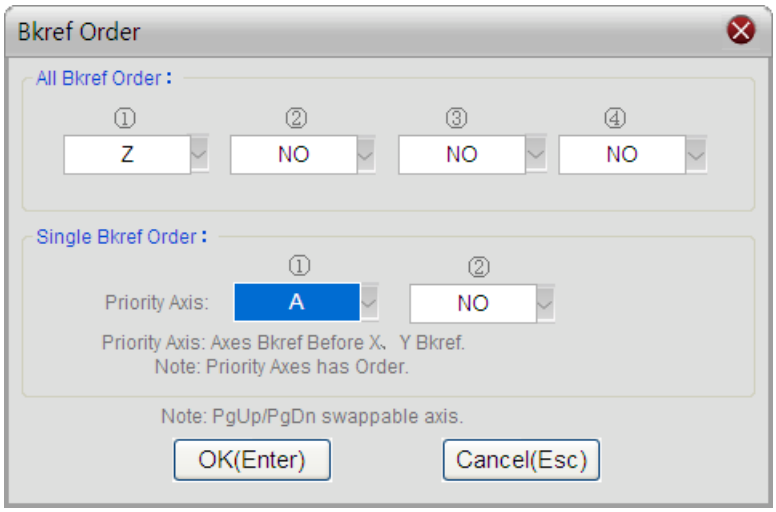



Fig. 3-17 Single axis returning order

After setting, press Enter for confirmation and turn to the main interface as Fig. 3-13, select single axis to return. The system will pop up prompt dialog box as shown in Fig. 3-18.

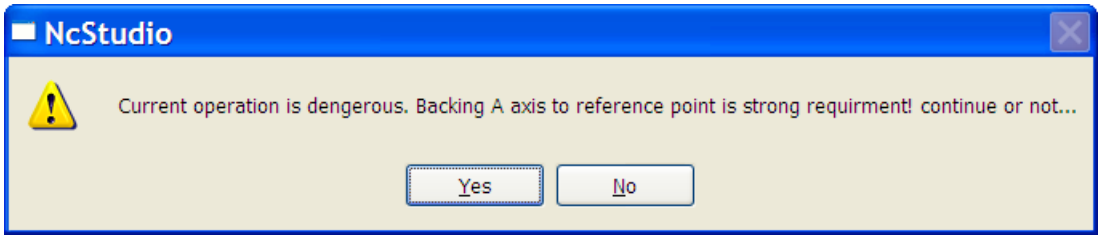



Fig. 3-18 Dangerous prompt

> Note:
>
> The system assumes Z axis returning as the priority by default. That is, if no modification has been made, the system will prompt Z axis returning first.

### 3.6.3 Principle of Returning to Machine Origin (without Encoder Feedback)

The encoder feedback function is involved in the system, specified by parameter N11304. The sketch map of returning to machine origin with servo motor is as below (without encoder feedback):

◆ **Coarse Positioning Stage**

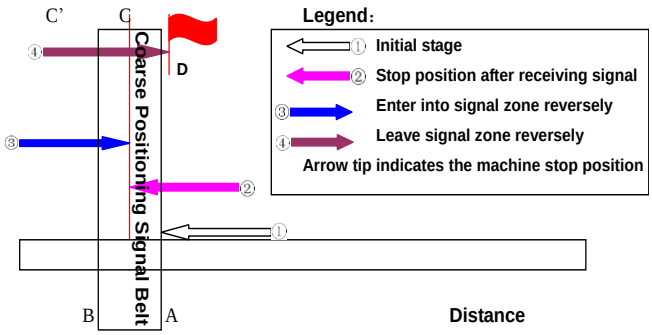



Fig. 3-19 Sketch map of coarse positioning (stopping within the signal belt after receiving coarse positioning signal)

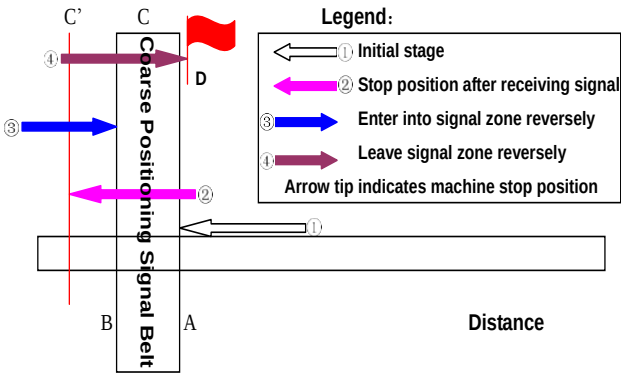



Fig. 3-20 Sketch map of coarse positioning (stopping out of the signal belt after receiving coarse positioning signal)

1) When the machine keeps moving until receiving REF. point signal at place A, it should stop immediately, but it may stop at place C or C' due to time lag and inertia.

2) The machine keeps moving reversely at one third of coarse positioning speed until receiving REF. point signal (if the machine has stayed in the signal belt in the above step 1, it will make no motion in this step).

3) The machine keeps moving reversely at one-tenth of coarse positioning speed until the REF. point signal disappears (across the signal belt).

4) The machine halts at the red flag place D after the end of this stage.

◆ **Fine positioning Stage**

The process of fine positioning stage is identical with that of coarse positioning stage.

After coarse positioning, the machine will move to encoder zero rapidly, executing slow positioning several times.

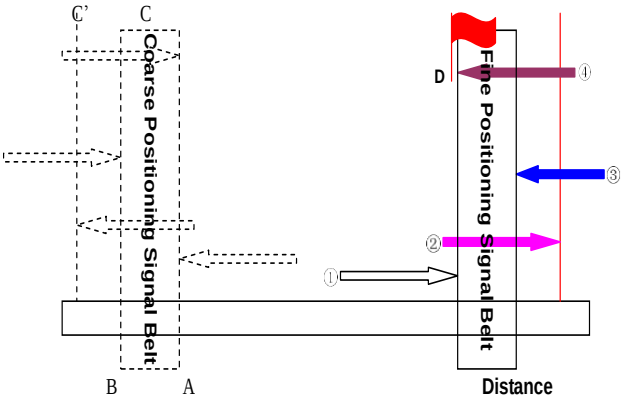



Fig. 3-21 The process of fine positioning

◆ **Retracting Stage**

After finishing the fine positioning stage, the system will execute retracting motion once with recommended retract distance as half of the screw pitch. The sketch map is shown in Fig. 3-22.

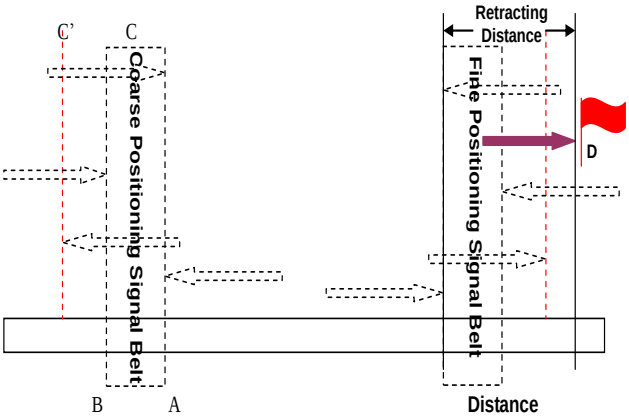



Fig. 3-22 Retracting stage

### 3.6.4 Principle of Returning to Machine Origin (with Encoder Feedback)

With encoder feedback function, the system will execute coarse positioning and fine positioning only once in returning to machine origin. The retracting distance after fine positioning is the actual retracting distance adjusted in terms of actual situation. And the concrete process is as below:

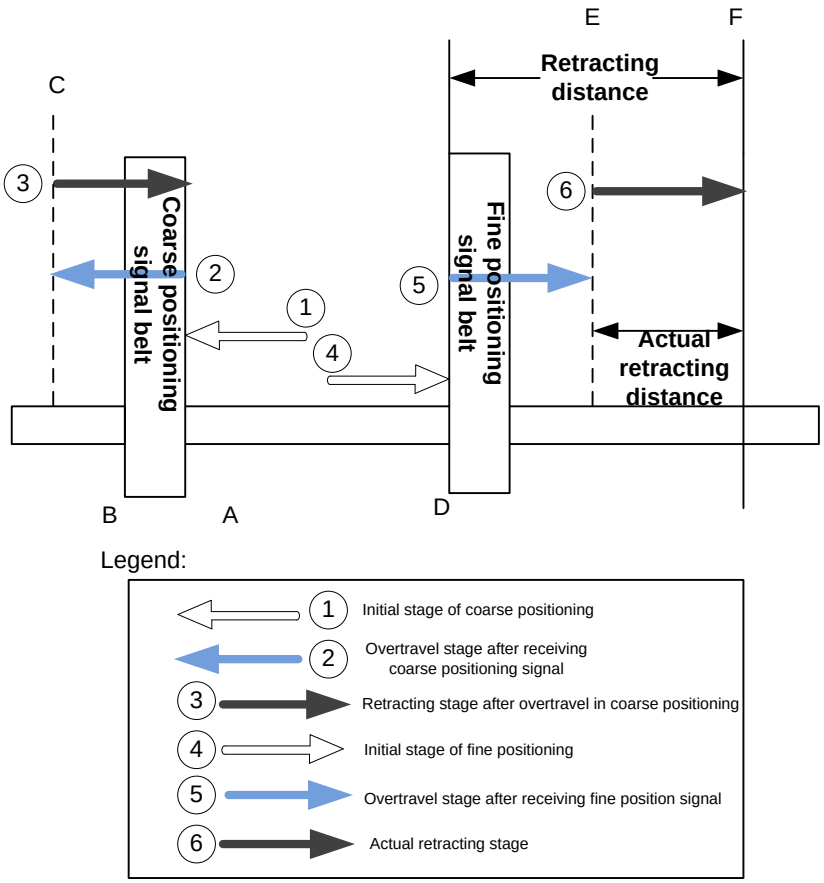



Fig. 3-23 The process of returning to machine origin

1) In coarse positioning stage, the machine tool should stop immediately at place “A” when receiving REF. point signal, but it may stop at place “C” due to over-travel caused by inertia and time-lag.

2) The machine executes retracting stage of coarse positioning.

3) In fine positioning stage, the machine tool moves reversely and should stop at place “D” immediately when receiving encoder zero signal; at the mean time, the feedback data of encoder will be latched, but the machine will generate over-travel and stop at place E due to inertia and time-lag. And the displacement between encoder zero signal and stop position (i.e. DE) is the across distance of signal deceleration.

4) In terms of the retracting distance and across distance calculated, calculate the actual retracting distance, and use this actual distance to make the machine move and stop at place F, keeping it free from the signal source.

### 3.6.5 Parameters Specifications

◆ **Related Parameters of Safe Operations:**

| Parameter | | Definition | Setting Range |
|---|---|---|---|
| **N74000** | Cancel REF Sign when Reset | Once reset operation is executed in machining, whether to remove the mark of backing to machine origin. | YES : Cleared<br>NO: Not cleared |
| **N74001** | Back to REF Required | Whether backing to machine origin before machining is required or not. | YES: Required<br>NO: Not required |
| **N74002** | Cancel REF Sign when Estop | Whether the mark of backing to machine origin will be cleared or not once E-stop occurs. | YES: Cleared<br>NO: Not cleared |
| Returning to machine origin before machining can avoid machining offset to ensure position precision. Setting “YES” for N74002 and N74000 is recommended so that once E-stop or reset operation occurs in the process of machining, the mark will be cleared, and the system will remind to home all the axes again. When N74001 is set to “YES”, if there is no backing to machine origin mark “⊕” before each axis, the machine is not allowed to move until returning to REF. point is completed. N74001 can be set to “NO” when failure to return to machine origin is caused by home switch fault.<br>When encoder feedback function is enabled, it is suggested to set N74002 to “NO”, since the system will correct the position automatically after E-stop by synchronizing the data in the system with the actual position of the machine tool, but N74000 is still suggested to set to “YES”. | | | |

◆ **Related Parameters in the Process of Backing to Machine Origin (N74090 under “Operation”, others under “Axis Parameter”)**

| Parameter | | Definition | Setting Range |
|---|---|---|---|
| **N74090** | Home Latch Count | Times of fine positioning in returning to machine origin, with default setting of “1” | 1~100 |
| **N11110** | Axis Encoder Dir | Change direction of encoder during positive movement of machine | 1: Increase of encoder value<br>-1: Decrease of encoder value |
| **N11130** | Check Encoder Error | Whether to enable the check of encoder error | YES: Check<br>NO: Not check |
| **N11140** | Static Tolerance | The tolerance for the difference between kernel position and feedback position when the machine keeps still. A steady-state error alarm will be reported if the difference out of the tolerance. | 1~999999 |

| Parameter | | Definition | Setting Range |
|---|---|---|---|
| **N11150** | Dynamic Tolerance | The tolerance for the difference between kernel position and feedback position when the machine is moving. A dynamic error alarm will be reported if the difference out of the tolerance. | 1~999999 |
| **N11160** | Frequency Division Pulses of PG (X4) | Feedback pulses of encoder per screw pitch in the axis | 1~ 999999 |
| **N74010** | Home Offset | Machine coordinate of machine origin, with default setting of “0” | 0 ~ Upper limit of workbench stroke |
| **N74020** | Home Search Dir | The moving direction of machine at any point towards home switch | -1: Negative direction<br>1: Positive direction |
| **N74030** | Home Search Velocity | Moving speed of machine towards home switch (coarse positioning speed) | 0.001 ~ 10000 |
| **N74050** | Home Latch Dir | The moving direction of machine at any point towards encoder zero | 1: Positive direction<br>-1: Negative direction |
| **N74060** | Home Latch Velocity | Moving speed of machine towards encoder zero (fine positioning speed) | 0.001 ~ 10000 |
| **N74080** | Back Off Distance | The additional moving distance after the end of fine positioning in returning to machine origin, i.e. retract distance to move away from signal sensitive zone. | -1000 ~ 1000 |

When parameter N11304 “Encoder Feedback” is set as “NO”, parameter N74090 is valid while parameters N11110 and N11160 are invalid.

When parameter N11304 “Encoder Feedback” is set as “YES”, parameter N74090 is invalid while parameters N11110 and N11160 are valid.

In order to establish a machine coordinate system (MCS) correctly for machining, at machine start-up, generally returning to reference point will be executed automatically or manually, i.e. the machine tool will return to its measuring beginning (X, Y, Z=0) to establish the machine coordinate system. Machine reference point can be coincident with machine origin (in default system setting), or not, and the distance between reference point and machine origin can be specified by parameter N74010.

When home switches work normally, if the spindle moves away from home switch direction in the process of returning to machine origin (homing), the value of N74020 (coarse positioning direction), opposite to that in fine positioning stage, should be modified, please refer to question No. 2 in chapter 3.6.6 when the moving direction of machine is incorrect during backing to machine origin. If the speed of returning to machine origin is too low, properly adjust the value of N74030 (coarse positioning speed). “Back Off Distance” refers to a certain moving distance away from REF. point to leave the signal sensitive zone of home switches after backing to machine origin completed.

◆ **Related Parameters to Detect Distance between Coarse and Fine Positioning Switches (N74120 under "Operation", others under "Axis Parameter")**

| Parameter | | Definition | Setting Range |
|---|---|---|---|
| **N74100** | Leadscrew Pitch | For analysis of switch distance of fine and coarse positioning in backing to machine origin | 0 ~ 360 |
| **N74110** | Coarse/ Fine Switches Min Dist | To detect whether the switches of fine/coarse positioning are too close in backing to machine origin | 0 ~ One half of screw pitch |
| **N74120** | Coarse/Fine Pos Distance Tolerance | The allowable error range by comparison of current result of backing to machine origin with history average record | 0 ~ 100 |

Too close distance between home switch and encoder zero switch may lead to deviation of one screw pitch in REF. point positioning during returning to machine origin, and the system will check if this offset is reasonable or not via parameter N74110 with setting range of "0 ~ one half of screw pitch" (unit: mm). The normal range of switch distance between fine and coarse positioning is (0+ value of N74110, screw pitch- value of N74110), and the switch distance will be automatically measured in returning to origin. An alarm of " The distance of coarse/fine positioning switch for Z axis was too close " will occur if the distance is out of the above range. To remove this error, adjust the home switch position or check if the setting of parameter N74110 is reasonable or not.

With comparison between current measured value and history average value, the percentage of "(current measured value – history average value) / history average value" should be within the setting value of N74120; if not, this measured value is invalid. And the system will prompt alarm of " The result error of returning machine home for Z axis was out of range ". Click the shortcut key N " Clear History Records(N) " to clear the measured history record after changing the home switch.

Related to the specific machine tool, N74100 should be set after measured in actual operation.

## 3.6.6 FAQ & Troubleshooting

1) REF. point signal cannot be detected in the process of returning to machine origin.

It is generally caused by home switch fault. The adjusting & debugging steps are as shown in Fig. 3-24.

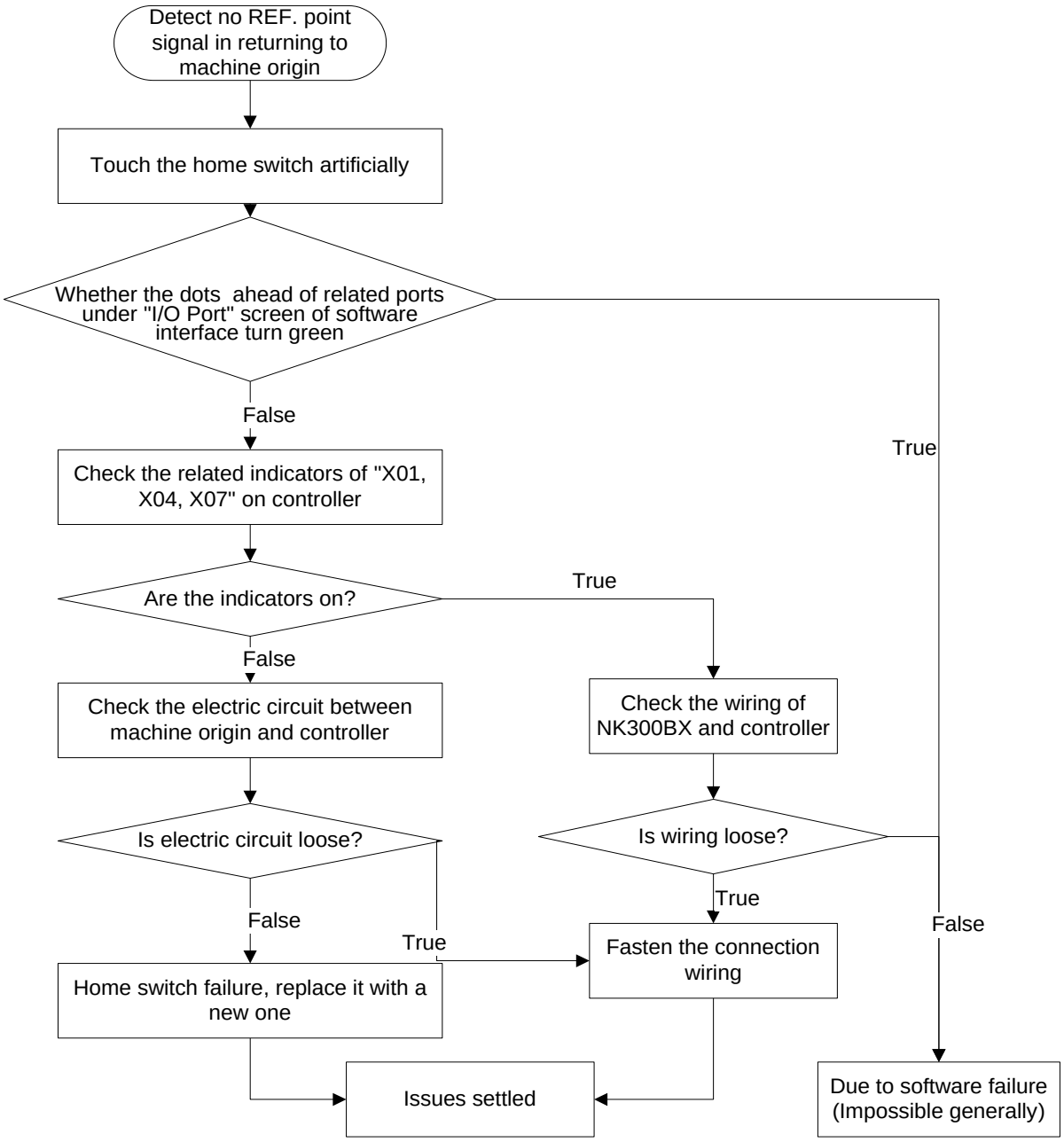



Fig. 3-24 Debugging steps

2) Incorrect motion direction of machine in returning to machine origin may be caused by the following reasons:

- Incorrect polarity of REF. point signal: when the home switch is normally open, the polarity is “NO”; when normally closed, the polarity should be “NC”.
- Incorrect parameter setting: check the parameter N74020 “Home Search Dir”, and adjust the related parameters.

3) Too slow coarse positioning speed in returning to machine origin may be caused by the below reasons:

- The setting value of N74030 “Home Search Velocity” is too small.

- The polarity setting of REF. point signal in the software is mismatching with the home switch type. If a NC-type home switch is adopted and the polarity of REF. point signal is NO, the REF. point signal is valid at beginning of backing to machine origin, so the machine will slowly move away from machine origin at the speed of fine positioning.

4) The distance between fine and coarse positioning is out of normal range, the system prompting an alarm "The distance of coarse/fine positioning switch for Z axis was tool close", which may be caused by too close switch distance between fine and coarse positioning, so the actual position of home switch and encoder zero should be readjusted to make the distance within the range of (0+ value of N74110, screw pitch- value of N74110).

5) The distance between fine and coarse positioning is out of the allowable error range, the system prompting an alarm "The result error of returning machine home for Z axis was out of range", with possible causes as below:

- The accuracy error of home switch: check home switch precision.
- The accuracy error of encoder zero: check whether encoder zero signal in the system is correct or not.
- After a home switch is reinstalled, the detecting environment changes in returning to machine origin: press the shortcut key N to clear the history record of measurement.

# 3.7 Spindle Parameters Adjustment

## 3.7.1 Spindle Speed Setting

In auto mode, press  to enter the interface as shown in Fig. 3-25, in which spindle speed can be set directly.

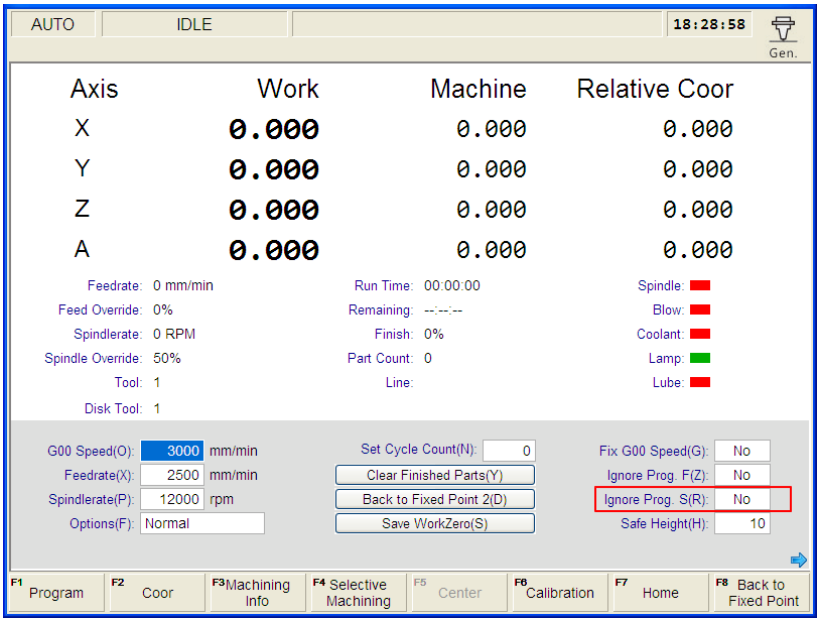



Fig. 3-25 Spindle speed setting on classic interface

Spindle speed can be directly set in the parameter setting area above the manipulation button bar. When parameter N72002 “Ignore Programmed Spindlerate” is set to “YES”, spindle speed in auto machining will adopt the system setting value, i.e. the value of “Prog.S”; when set to “NO”, spindle speed in auto machining will adopt the specified spindle speed in the machining file.

There are two ways for changing parameters under [Coordinate-auto screen]:

1) Press “↑”, “↓”, “→” or “←” to move the cursor onto the desired parameter, and then press “Enter” to eject an input box.

2) Press the corresponding shortcut key to eject an input box. For instance, for “Prog.S(S)”, pressing the letter key “S” on the operation panel will eject an input box for entering a value.

> Note:
>
> Concrete setting methods on the new operation interface are the same with that on classic interface; however, shortcut letter next to each parameter may be different on two interfaces. The counterpart on the new interface is shown as below.

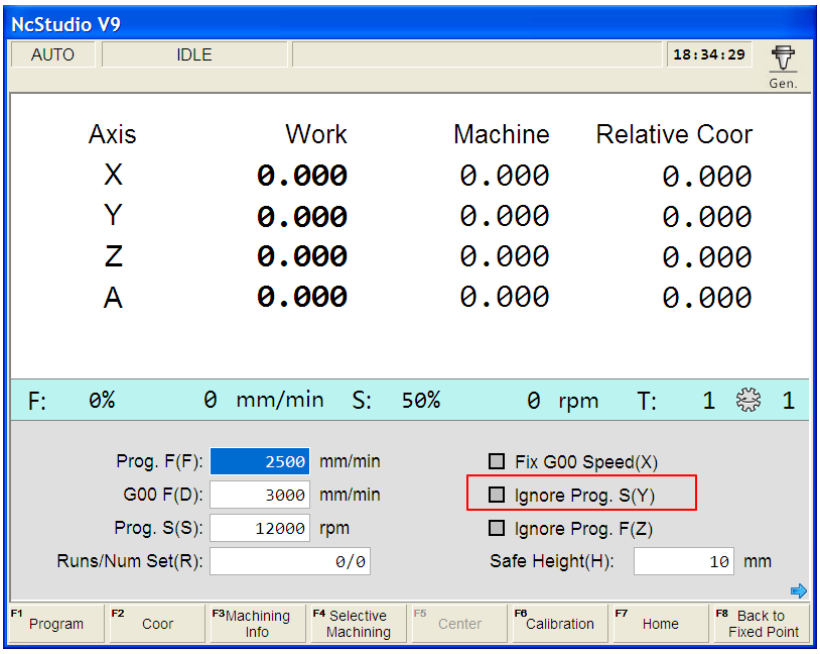



Fig. 3-26 Spindle speed setting on the new interface

Spindle speed can be controlled by adjusting spindle override. Their relationship is as following:

$$\text{Current spindle speed} = \text{Spindle speed} \times \text{Current spindle override}$$

Spindle override knob is on the operation panel, as shown in Fig. 3-27.

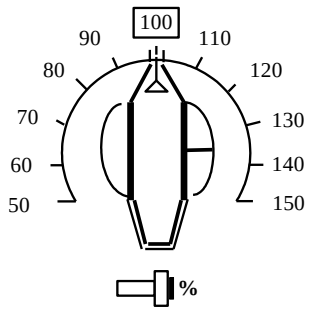



Fig. 3-27 Spindle override knob

The least unit of ruler of spindle override is 10% (10% for each scale), with setting range of spindle override “50% ~ 150%”.

◆ **Related Parameters**

| Parameter | | Definition | Setting Range |
|---|---|---|---|
| **N20001** | Max Spindle Speed | The max. allowable rotation speed of spindle (matched with the inverter setting) | 0~ 999999 |
| **N20003** | Spindle On/Off Delay Time | Delay time after spindle receiving “start” or “stop” command | 0~ 60 |
| **N20005** | SpindleCool Off Delay Time | Delay time of closing spindle cooling pump after spindle stop | 0~ 600 |
| The value of ”Prog.S” under [Coordinate-auto] must be less than that of N20001; the max. setting | | | |

value of N20001 is corresponding to analog SVC 10V; when the inverter reaches the max. voltage 10V, the corresponding rotary speed of inverter is the max. spindle speed, i.e. the value of N20001.

$$\text{Real-time voltage of analog SVC} = \frac{\text{Current spindle speed}}{\text{N20001}} \times 10\text{V} \times \text{Spindle override}$$

Parameter N20003 sets the delay time of spindle on/ off, due to a certain time is needed before spindle reaches rated rotary speed since start-up or stops until reaching zero speed; if machining begins before the machine reaching rated rotary speed or other operation is executed before spindle stops completely, it's possible to damage the tool or produce a scrap.

◆ **Related Parameters**

| Parameter | | Definition | Setting Range |
|---|---|---|---|
| **N72004** | Spindle Off when Cycle Stop | Whether spindle will automatically stop when machining stops regularly | YES: Stop<br>NO: Not stop |
| **N72008** | Spindle On when Cycle Start | Whether spindle will automatically rotate when machining begins | YES: Start<br>NO: Not start |
| **N73005** | Stop Spindle on Pause | Whether spindle will automatically stop when machining pauses | YES: Stop<br>NO: Not stop |
| This group of parameters sets the spindle action when commands of machining stop/ start/ pause are executed. | | | |

## 3.8 Tool Measurement

The process of tool measurement refers to the process of establishing the concrete position of workpiece coordinate system (WCS) in the machine coordinate system (MCS).

When the parameter N11304 “Encoder Feedback” is set to “Yes”, tool measurement with encoder feedback function will be used; while it is set to “No”, tool measurement without encoder feedback (or the traditional one) will be used.

With the help of a tool presetter, tool measurement is realized. As shown in Fig. 3-28, there are ports on the controller corresponding to CUT and COM on the tool presetter. If necessary, such port as “Over-travel Protection” can be added on the controller according to customers’ needs. According to the different installation positions of a tool presetter, tool measurement is divided into mobile calibration and fixed calibration, first calibration and calibration after tool change.

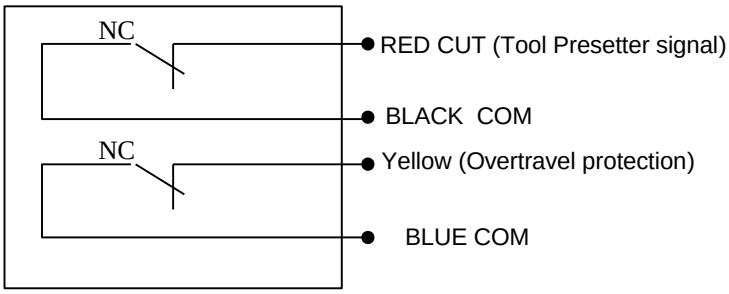



Fig. 3-28 Electrical wiring diagram of a WEIHONG tool presetter

Fig. 3-29 is the sketch map of tool calibration using of a tool presetter.

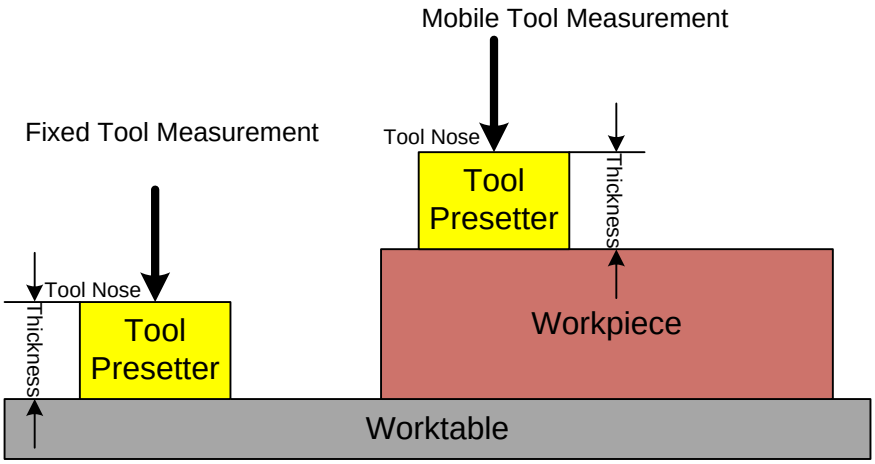



Fig. 3-29 Sketch map of using a tool presetter

### 3.8.1 Software Interface

Press  to access the [State] function area, and then press F6 “Calibration” to enter the tool measurement interface, as shown in Fig. 3-30. Pressing a shortcut key will select the corresponding

measurement type under this interface.

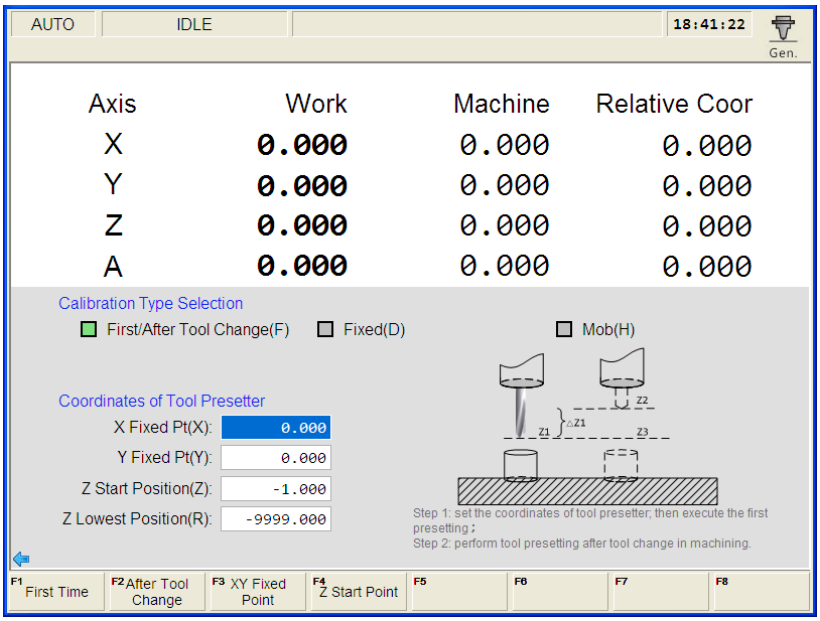
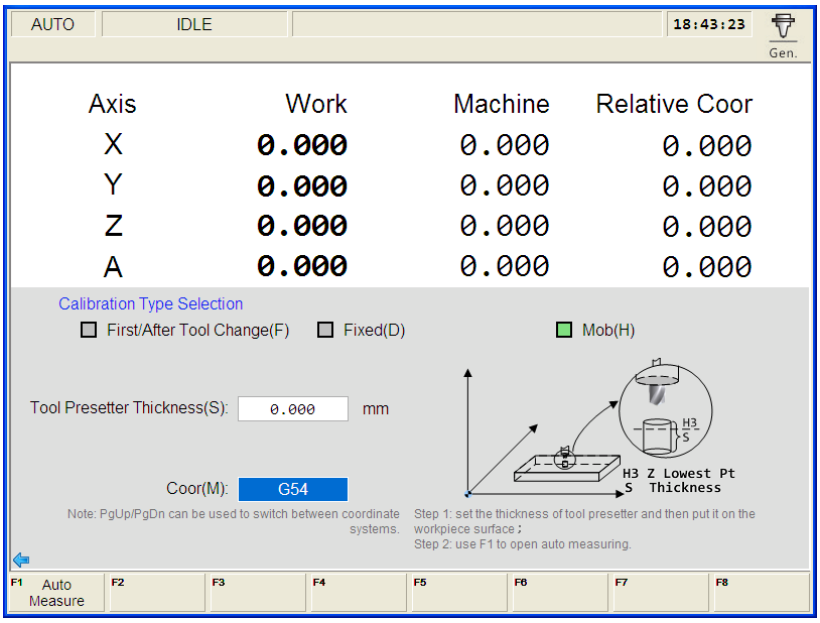



Fig. 3-30 Sub-screen of tool measurement

## 3.8.2 Mobile Tool Measurement

Press  => F6 “Calibration” to access the tool measurement interface, and then press the letter key “H” to select “Mob” tool measurement, namely, mobile calibration.




Mobile tool calibration can be used to set workpiece origin of Z-axis by executing calibration at the current position, the thickness of the tool presetter decided by parameter N75100. After mobile tool calibration, the system will automatically set workpiece offset.

$$\text{Workpiece offset} = \text{Machine coordinate} - \text{Thickness of tool presetter} - \text{Public offset} - \text{Tool offset}$$

Generally, the default setting values of public offset and tool offset are both “0”.

See Fig. 3-31 and Fig. 3-32 for the sketch map of the process of mobile tool calibration.

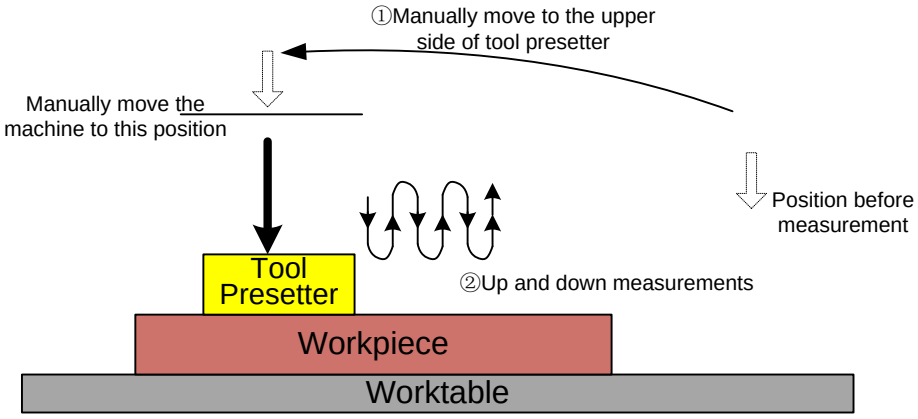



Fig. 3-31 The process of mobile calibration without encoder feedback function

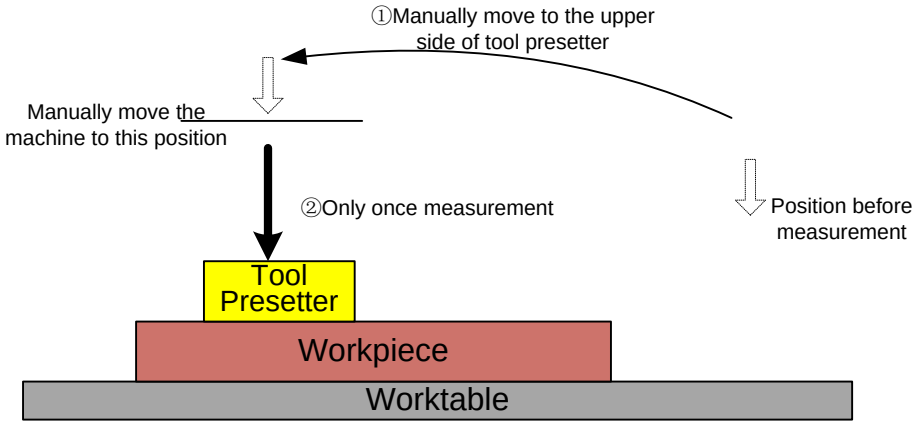



Fig. 3-32 The process of mobile calibration with encoder feedback function

◆ **Related Parameters**

| Parameter | | Definition | Setting Range |
|---|---|---|---|
| **N75100** | Mobile Surface to WCS Z0 Distance | Height difference from top surface of a tool presetter to its bottom | -1000 ~1000 |

The measurement method of this parameter is as follows:

- Manually move Z-axis to a certain point over workpiece surface→ shift down the tool nose until reaching workpiece surface→ record the current coordinate of Z-axis (Z1).
- Uplift Z-axis→ put a tool presetter on workpiece surface→ shift down Z-axis slowly until reaching the presetter and getting the tool presetter signal→ record the current coordinate of Z-axis (Z2).
- Z2- Z1, and its result equals to the thickness of the tool presetter. Manually enter this result into parameter N75100.

◆ **Related Parameters (N10050 and N10055 under "Axis Parameter")**

| Parameter | | Definition | Setting Range |
|---|---|---|---|
| **N75001** | Fine Preset Speed | Tool speed when approaching the presetter surface in tool measurement | / |
| **N75002** | Fine Preset Count | The times of repeated up & down measurements after receiving tool presetter signal when the tool approaches the presetter surface in tool measurement | / |
| **N75020** | Preset Result Tolerance | The max. allowable error value of tool measurement in multiple tool measurements | 0 ~ 10 |
| **N10050** | Change Tool Workbench Range Upper Limit | Machine coordinate of upper limit of worktable range in tool measurement | -99999~ 99999 |
| **N10055** | Change Tool Workbench Range Lower Limit | Machine coordinate of lower limit of worktable range in tool measurement | -99999~ 99999 |
| Parameter N75020 refers to the max. allowable error of tool measurement set in the system, relative to the average error value of repeated tool measurements in the process of measurement; if average error value is less than N75020, tool measurement succeeds, or measurement fails. | | | |

## 3.8.3 Fixed Calibration

Fixed calibration refers to the measurement operation on a certain fixed position of a machine tool due to tool damage or other causes, frequently used in multi-tool mode. The length of a tool and the clamping position may vary, thus tool offset should be reconfirmed by fixed tool calibration. See Fig. 3-33 and Fig. 3-34 for the sketch map of fixed tool calibration.

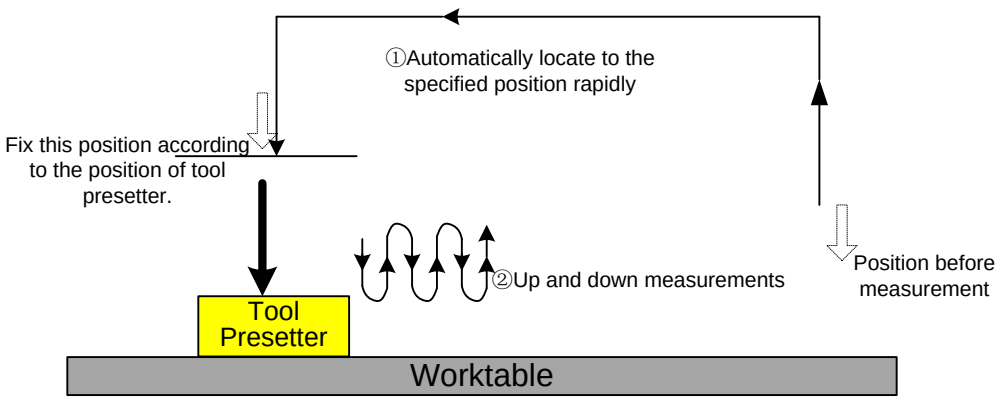



Fig. 3-33 The process of fixed calibration without encoder feedback function

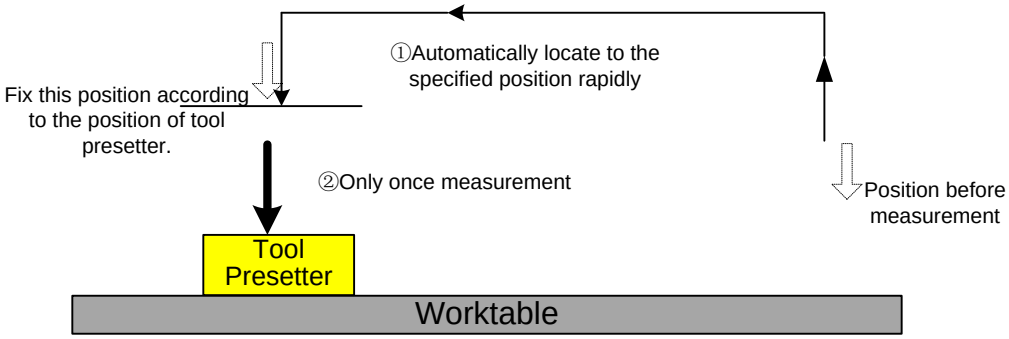



Fig. 3-34 The process of fixed measurement with encoder feedback function

The process of fixed calibration records the machine coordinate when the tool nose touches the surface of the tool presetter. Tool offset is the thickness of the tool presetter subtracted from the recorded machine coordinate.

Tool offset= Machine coordinate – Thickness of tool presetter

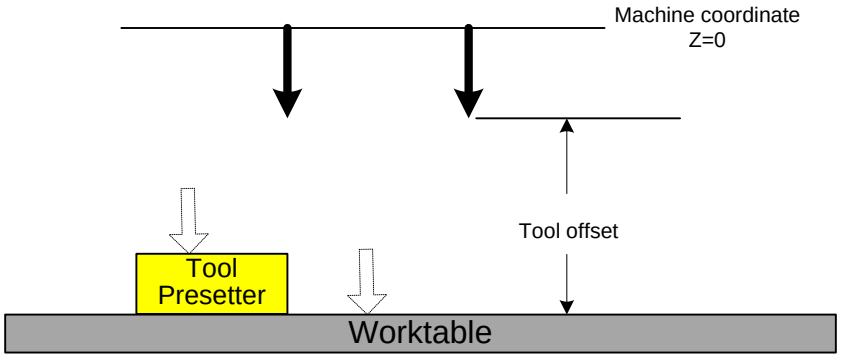



Fig. 3-35 The sketch map of tool offset

◆ **How to Set the Position of Fixed Tool Presetter**

Press  =⇒ F6 “Calibration” to access the tool measurement interface, and press letter key D to activate the fixed calibration.

Before calibration begins, manually move the spindle and make the tool nose onto the tool presetter, press F5 “XY Fixed Point”. The system will automatically record the current coordinate of X and Y axis to the fixed point in X and Y directions. According to actual situation, move Z axis onto a reasonable height above the presetter, and press F6 “Z Start Point” to set the beginning coordinate of fixed calibration.

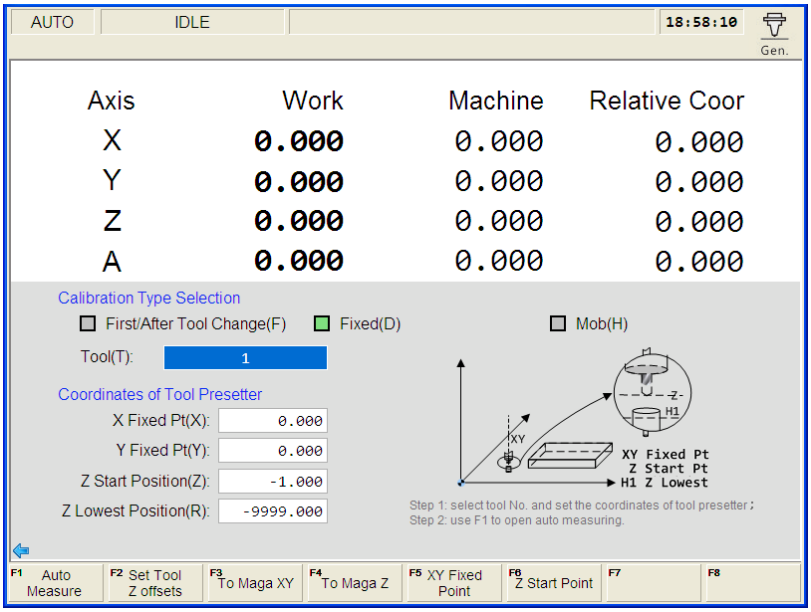



Fig. 3-36 Fixed calibration sub-screen

The steps of fixed calibration are as below:

1) Select a tool according to tool No.;

2) Execute fixed calibration to the selected tool and record the tool offset. When tool presetter is available, press F1 “Auto Measure” to enable auto calibration; while tool presetter is absent in this step, you can press F2 “Set Tool Z Offsets” to manually set the tool offset in Z axis.

3) Record tool offset values.

4) Execute step 1 and 2 to each tool;

5) Select any tool to move to workpiece surface for clearing.

> Note:
>
> Only when linear tool magazine is used, pressing F3 “To Maga XY” in Fig. 3-36 will make the current X and Y machine coordinates the X and Y machine coordinates of the spindle tool in linear magazine. And pressing F4 “To Maga Z” will make the current Z machine coordinate the Z machine coordinate of the spindle tool in linear magazine. Please note that it is only available for linear magazine.
>
> Before pressing F3 “To Maga XY” or F4 “To Maga Z”, please make sure that the tool number in the spindle is the same as that tool number setting.

◆ **Related Parameters**

| Parameter | | Definition | Setting Range |
|---|---|---|---|
| **N75201** | Fixed Presetter Surface to WCS Z0 | The distance between tool presetter surface and worktable surface in fixed measurement | |
| **N75203** | Fixed Preset Speed | Moving speed from the top point to the initial height in fixed | |

| | | | |
|---|---|---|---|
| | | measurement | |
| **N75025** | Enable Preset Overtravel Alarm | Whether to enable over-travel protection in tool measurement | YES: Valid<br>NO: Invalid |

The measurement method for parameter N75201 is as below:

- Manually move Z-axis to a certain point over workpiece surface→ shift down the tool nose until reaching the surface of workpiece→ record the current coordinate Z1 of Z-axis.
- Uplift Z-axis→ put the fixed tool presetter on workpiece surface→ shift down Z-axis slowly until touching the presetter and getting the tool presetter signal→ record the current coordinate Z2
- Z2- Z1, and the result equals to the thickness of the tool presetter. Manually enter this result into parameter N75201.

For other related parameters in fixed measurement, such as N75001, N75002, N75020, N10050 and N10055, refer to Chapter 3.6.1.

## 3.8.4 First Tool Calibration / Calibration after Tool Change

Press  ==> F6 “Calibration” to access the tool measurement interface, and press letter key F to activate the first calibration/calibration after tool change. See Fig. 3-37.

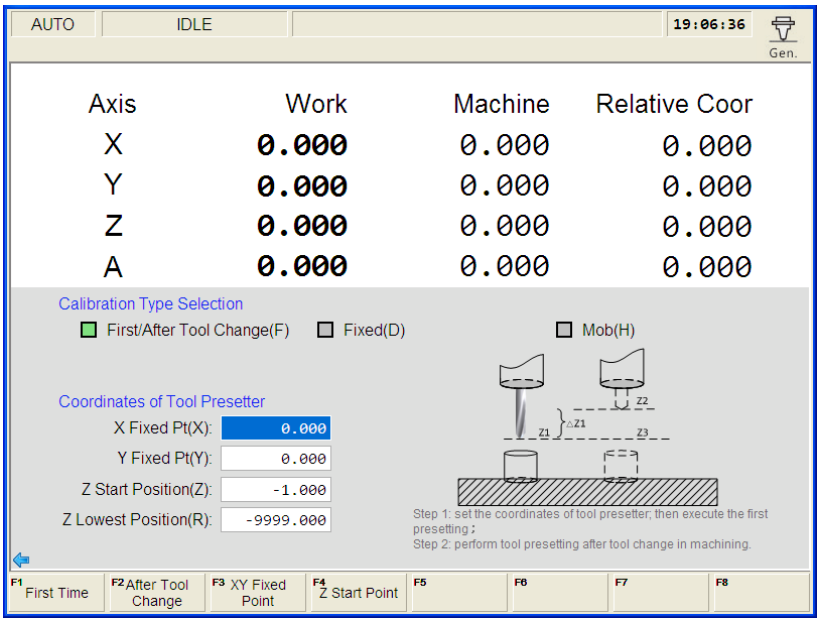



Fig. 3-37 First calibration/calibration after tool change

Before calibration begins, manually move the spindle and make the tool nose onto the tool presetter, press F3 “XY Fixed Point”. The system will automatically record the current coordinate of X and Y axis to the fixed point in X and Y directions. According to actual situation, move Z axis onto a reasonable height above the presetter, and press F4 “Z Start Point” to set the beginning coordinate of fixed calibration.

The operation steps are as below:

- Firstly, manually move Z axis to workpiece surface, and then confirm workpiece origin by mobile calibration or manual clear (the method for manual clear: pressing  ==> F2 [Coor] ==> F2 “Clear” ==> F3 “Clear Z”).

- Secondly, pressing  ==> F6 [Calibration] ==> letter key F to activate this calibration method. Press F1 “First Time”, and the system will automatically record the current machine coordinate of Z axis. The process is as shown below, and automatically completed by the system.

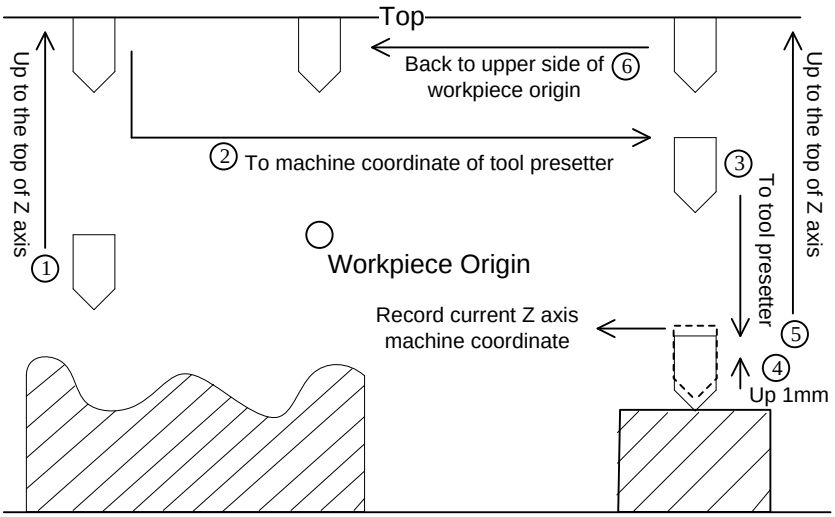



Fig. 3-38 First tool measurement

- Start machining after first tool calibration completed.

- After tool change or tool break, press F2 “After Tool Change” in Fig. 3-37 to execute calibration after tool change. The process is as shown below, and automatically completed by the system.

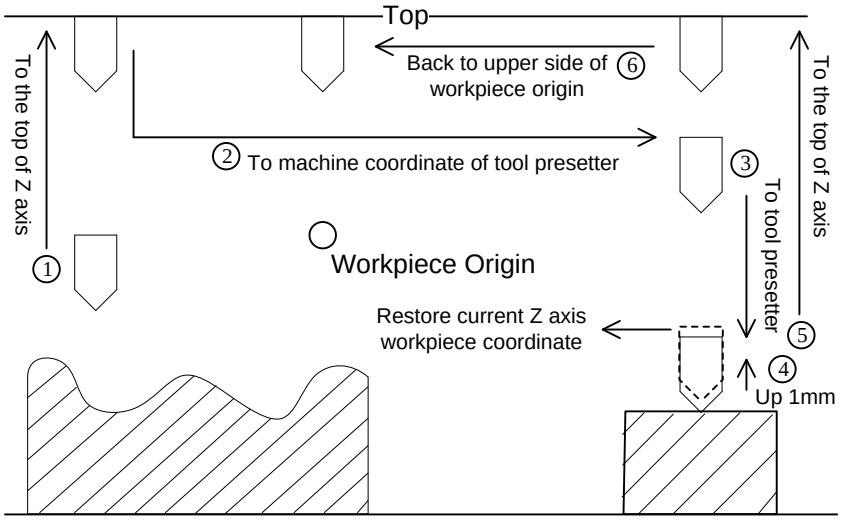



Fig. 3-39 Measurement after tool change

- Start machining after calibration after tool change completed.

# 3.9 Offset Setting

## 3.9.1 WCS (Workpiece Coordinate System)

In programming, programmers select a certain given point on workpiece as origin (also called program origin) to establish a new coordinate system (i.e. workpiece coordinate system), also a set of right-hand coordinate system. The origin of WCS, i.e. workpiece origin, is fixed relative to a certain point on workpiece and mobile relative to machine origin. The selection of origin of WCS should meet the conditions of simple programming, simple dimensional conversion, and small caused machining error, etc.

The corresponding coordinate systems of work offset are G55, G56, G57, G58, G59 and G54 (the default coordinate system). And the relationship of work offset and machine coordinate system is as shown in Fig. 3-40.

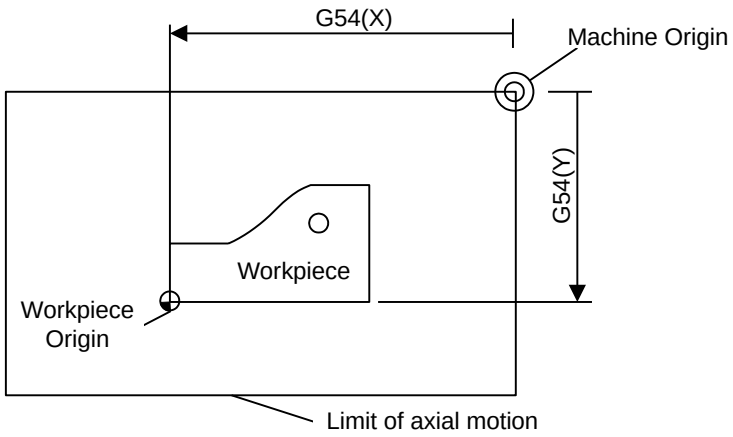



Fig. 3-40 The relationship of work offset and machine coordinate system

One, two or multi-work offset can be used in machining program. As shown in Fig. 3-41, if three workpieces are installed on the worktable, then each workpiece holds a workpiece origin relative to G code of WCS. The programming example is as follows: drill one hole on each of the three workpieces, with calculation height Z-0.14.

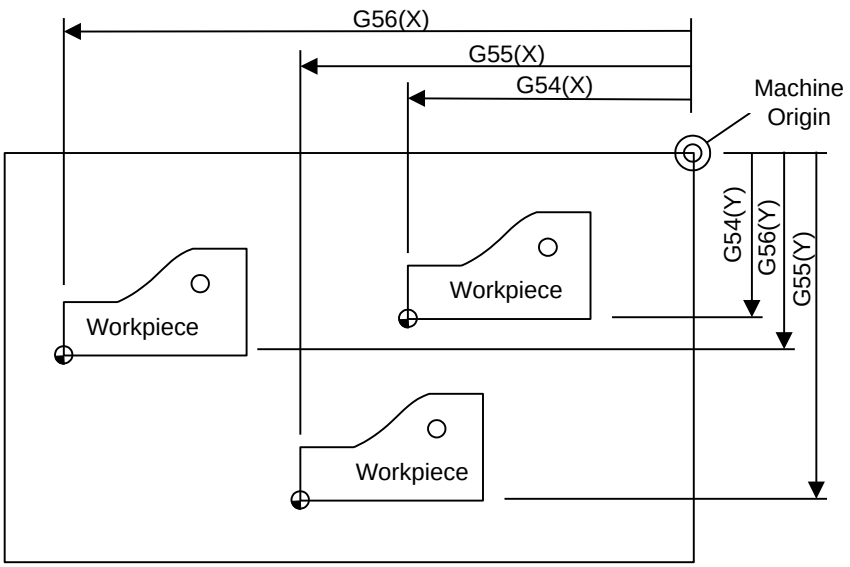



Fig. 3-41 Sketch map

```
O1801
N1 G20
N2 G17 G40 G80
N3 G90 G54 G00 X5.5 Y3.1 S1000 M03          （Select G54）
N4 G43 Z0.1 H01 M08
N5 G99 G82 R0.1 Z-0.14 P100 F8.0
N6 G55 X5.5 Y3.1                            （Switch to G55）
N7 G56 X5.5 Y3.1                            （Switch to G56）
N8 G80 Z1.0 M09
N9 G91 G54 G28 Z0 M05                       （Switch to G54）
N10 M01
…
```

Program segments N3 ~ N5, within WCS of G54, are related to the first workpiece; Segment N6 will drill the hole on the second workpiece of the same batch in WCS of G55, while segment N7 will drill the hole on the third workpiece of the same batch in WCS of G56.

Aiming at all WCSs, public offset is used for adjusting workpiece origin of X-, Y-, and Z-axis, but will not change the offset value of “G54 ~G59”.

The related formula of work offset, tool offset and public offset is as below:

Workpiece coordinate= Machine coordinate – Work offset - Tool offset – Public offset

## 3.9.2 Extended Coordinate System

With up to 120 extended coordinate systems (also known as additional coordinate systems) provided, the total number of WCS is 126 (6+120) in NK300BX system. 126 work offsets are optional in programming. The extended coordinate systems are the extension for G54, from G54P0 to G54P119.

To view or change the setting of these systems, “PgUp” and “PgDn” are used for page turning while “Home” and “End” for page heading and page footing.

Command G54 Px: Select an extended coordinate system, and “x” here refers to a number within [0, 119].

Example:

| | |
|---|---|
| G54 P0 | Select extended coordinate system 1 |
| G54 P1 | Select extended coordinate system 2 |
| G54 P2 | Select extended coordinate system 3 |
| G54 Px | Select extended coordinate system (x + 1) |
| G54 P119 | Select extended coordinate system 120 |

◆ **Related Parameters**

| Parameter | | Definition | Setting Range |
|---|---|---|---|
| **N80002** | Support Extension Workpiece Offset | To display the 120 groups of extended WCS (G54 P0~G54 P119) on the [Coordinate Management Interface] screen or not. | YES: Support<br>NO: Not support |
| The default parameter setting is “NO”. When above 6 workpieces are clamped on a worktable, set this parameter to “YES” to support the extended coordinate systems of work offset, so as to save multi-group of work offsets, which is user-friendly. | | | |

## 3.9.3 Software Interface

Press  ==> F2 “Coor” to access coordinate system management interface, as shown in Fig. 3-42. This interface displays currently being edited WCS and its corresponding work offset and public offset.

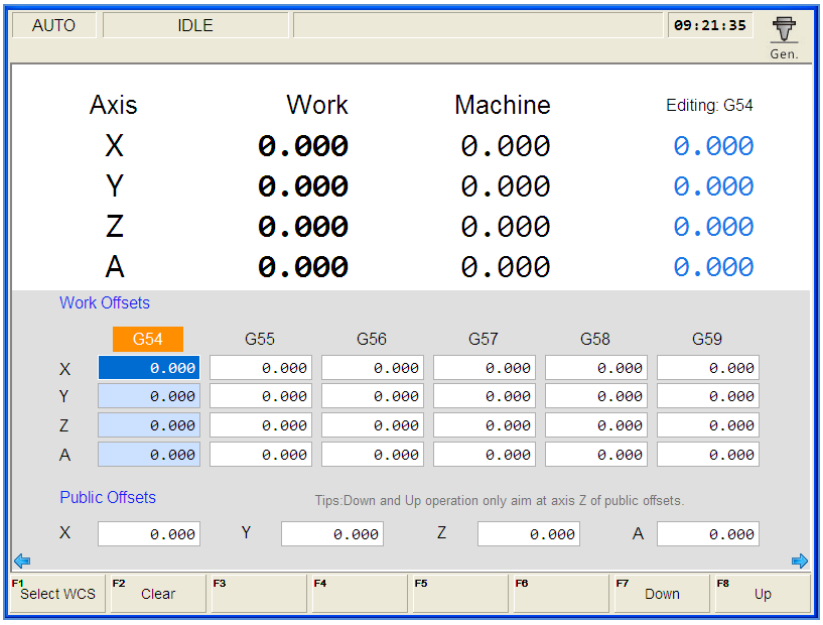



Fig. 3-42 Coordinate system management interface

Press the arrow keys to move cursor onto the work offset, or to public offset, and then press the Enter key to modify workpiece offset or public offset. Or you can press F7 “Down” or F8 “Up” to change the public offset of Z axis.

◆ **Select WCS**

Press arrow keys “←” or “→” to move cursor to the desired WCS, and then press F1 “Select WCS” to set the currently being edited coordinate system as current WCS.

◆ **Clear X, Clear Y, Clear Z**

As shown in Fig. 3-42, Pressing F2 “Clear” to open the secondary manipulation buttons bar. Active F1~F6 buttons correspond to “Clear X/Y/Z/A/XY/All” respectively. Pressing F1~F3 will respectively set the value of current machine coordinate to X/Y/Z work offset in the current WCS, while the corresponding machine coordinate will not change.

◆ **Clear XY**

As said above, pressing shortcut key F5 in the secondary buttons bar will set the value of current machine coordinates to XY work offsets in the current WCS as, while Z work offset will remain the same.

◆ **Clear All**

Pressing shortcut key F6 in the secondary buttons bar will set XYZ work offsets in the current WCS as the value of current machine coordinates.

◆ **Down**

In Fig. 3-42, press F7 “Down” to eject an input box→ input the adjusting value of Z feed → press Enter, Z-axis workpiece origin to move down specified distance.

◆ **Up**

In Fig. 3-42, press F8 “Up” to eject an input box→ input the adjusting value of Z feed → press Enter, Z-axis workpiece origin to move up specified distance.

Both “Up” and “Down” only modify public offset of Z-axis.

◆ **Save WorkZero**

In Fig. 3-42, press  to turn to the next buttons bar. Active F1~F2 are “Save WorkZero” and “Coordinate Backup”. Pressing F1 “Save WorkZero” will save the current workpiece origin to machining file, which can be called and used when next time machining file being loaded.

◆ **Coordinate Backup**

In Fig. 3-42, press  to turn to the next buttons bar. Pressing F2 “Coordinate Backup” to open coordinate backup sub-screen, as shown below. On this sub-screen, you can save the current workpiece offsets into the system.

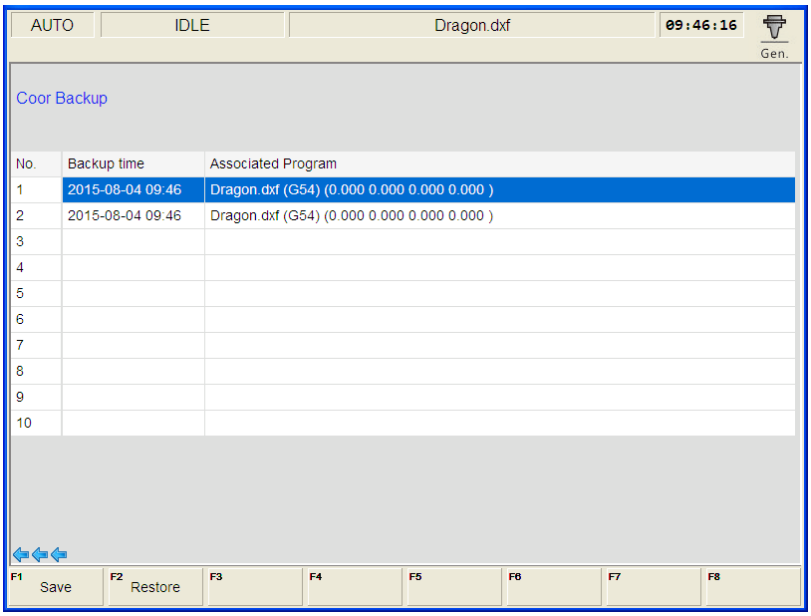



Fig. 3-43 Coordinate backup

With workpiece offsets saved before, anytime a new machining program file has been loaded, you can press arrow keys “ ↑ ” “ ↓ ” to select the desired offsets and press F2 “Restore” on the sub-screen to restore the offsets into the current WCS. Before restoring, a dialog box of prompt as below will show up.

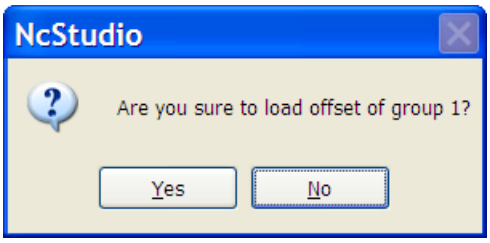



Fig. 3-44 Work offset restore prompt

Furthermore, after you choose to restore and load the offsets, a new dialog box will show up, asking whether to change Z offset too. As shown in Fig. 3-45. If “Yes”, Z axis offset will be changed too, if “No”, offsets of axes except Z axis will restore.

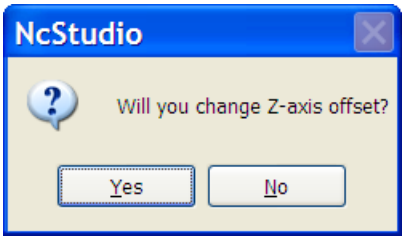



Fig. 3-45 Prompt to change Z offset or not

## 3.10 Centering

Centering is a way to find the center point on a part and make it the part zero (or workpiece origin). The system supports manual and auto centering. In auto centering, the spindle does not rotate. Manual centering is divided into “Manual Center (two-point centering) and “Circle Center”. An edge finder can be used for accurate centering. Centering operation is only available in manual mode or MPG mode, and on most occasions, MPG is used.

When the parameter “N81004 Allow Spindle-On when centering” is set to “YES”, before executing manual centering, press “F7 ENBL EdgeFinder” to make it turn to orange and start spindle, spindle speed decided by the parameter “N20006 Spindle Speed when Centering”, whose value is 500 by default and should not be set too large.

When the parameter “N81004 Allow Spindle-On when centering” is set to “NO”, “F7 ENBL EdgeFinder” is not available. To turn on spindle, press “Spindle CW” or “Spindle CCW” at spindle speed set in the software.

### 3.10.1 Manual Center

Manual center, i.e. two-point centering, refers to the process of locating the midpoint of a line connected by two points, mainly used for locating the center of a blank.

In manual mode, press  ==> F5 “Center” to access the centering interface, as shown below. In this interface, press the letter key “F” to select “Manual Center(F)”.

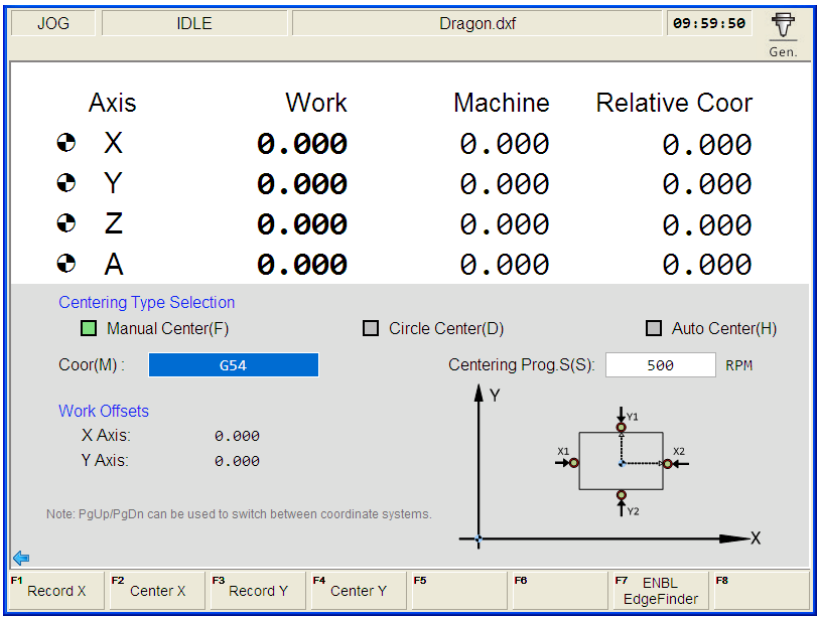



Fig. 3-46 Centering interface---Manual Center

The operation steps of manual centering are as below (An example of X-axis):

1) With the help of MPG usually, manually move the cutter to one side of workpiece, and then press F1 [Record X] to record the machine coordinate of current point.

2) Move the cutter to the other side of workpiece, and then press F2 [Center X] to calculate the midpoint coordinate based on the coordinate of current position and last recorded value and set it as workpiece origin.

> Note:
>
> In the process of centering of a certain axis, the other coordinate axis should keep motionless.

## 3.10.2 Circle Center

Circle center, i.e. three-point centering, means automatic calculation of center point coordinates (generally set as workpiece origin) of a circular blank in terms of the three recorded circle coordinates.

In manual mode, press  ==> F5 “Center” to access the centering interface. Press the letter key “D” to select “Circle Center (D)”, as shown below.

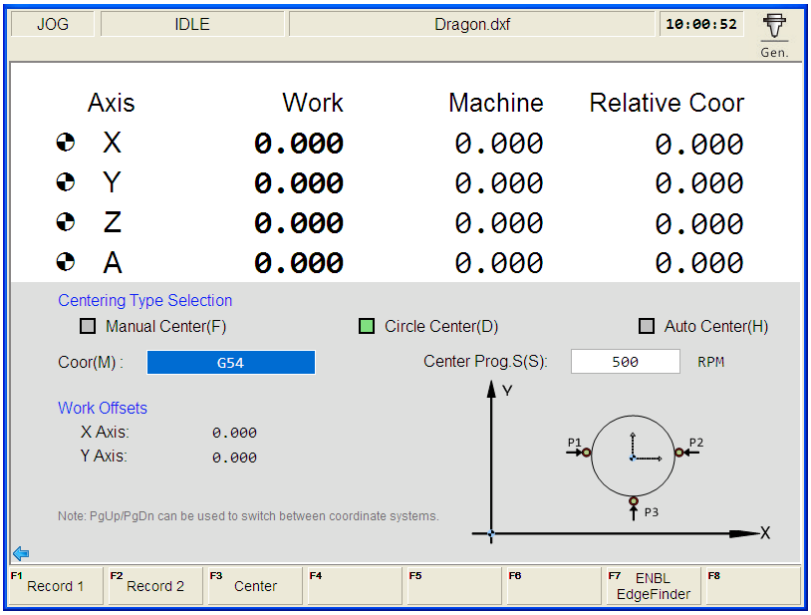



Fig. 3-47 Circle centering interface

The steps of circle centering are as below:

1) Manually move the cutter to one point on the circumference of a circular blank, and then press F1 [Record 1] to record the machine coordinates of current point as the first group of coordinate;

2) Move the cutter to another point on the circumference, and then press F2 [Record 2] to record the machine coordinates of current point as the second group of coordinate;

3) Move the cutter to the third point on the circumference, and then press F3 [Center] to calculate the circle center coordinates and set it as workpiece origin based on the current machine coordinates and the two groups of coordinate recorded previously.

### 3.10.3 Auto Center

In manual mode, press  ==> F5 “Center” to access the centering interface. Press the letter key “H” to select “Auto Center (H)”, as shown in Fig. 3-48.

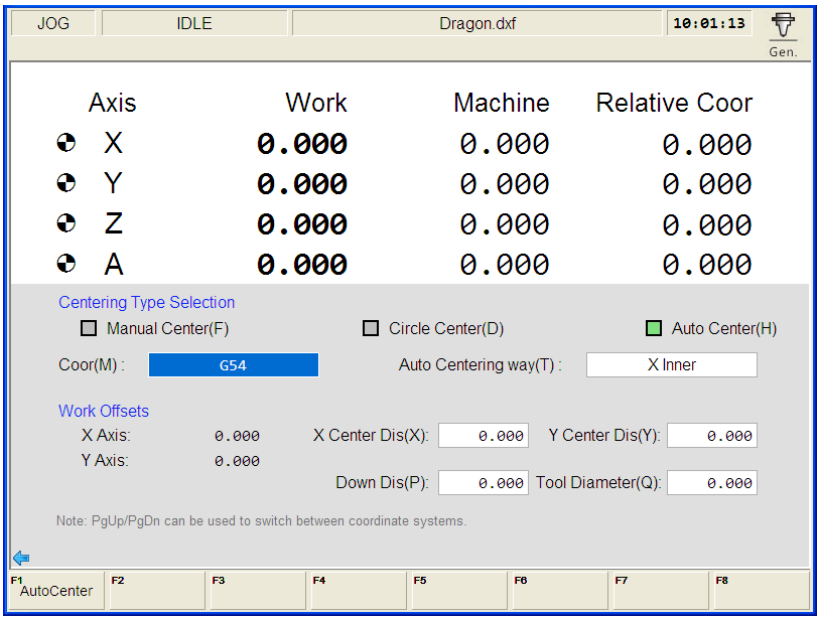



Fig. 3-48 Auto centering sub-screen

On auto centering screen, you can press letter key M to open a input dialog box, where you can set the WCSs, or you can directly press PageUp/PageDown keys to switch among the options.

Pressing letter key T can choose the auto centering way. There are altogether 10 types of auto centering, including “X Positive” “X Negative” “Y Positive” “Y Negative” “X Inner” “X Outer” “Y Inner” “Y Outer” “XY Inner” and “XY Outer”, which will be specifically introduced later.

- X Center Dis: the distance from midpoint of workpiece to X boundary. It must be a little larger than its actual value in outer center, while a litter smaller in inner center.
- Y Center Dis: the distance from midpoint of workpiece to Y boundary. It must be a little larger than its actual value in outer center, while a little smaller in inner center.
- Down Dis: tool down / up distance in tool measurement; in inner center, it must be smaller than the distance from the tool nose to workpiece surface, while larger in outer center.
- Tool Diameter: actual diameter of a tool.

The system offers three kinds of auto centering— inner center, outer center and boundary center (positive/ negative), switched by pressing the letter key “T” or clicking on the input box. Taking X-axis as an example:

◆ **X Outer Center**

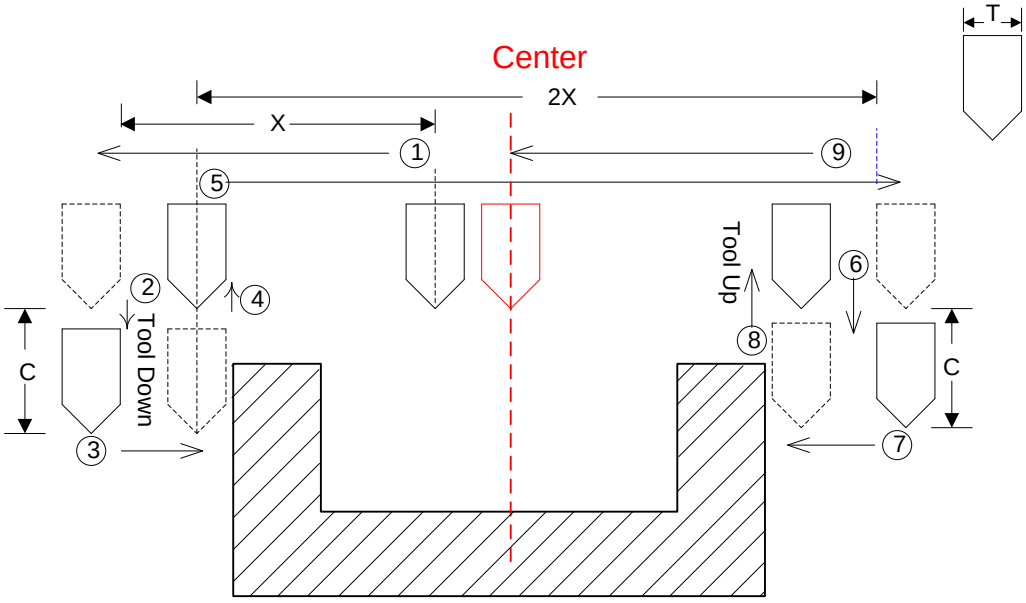



Fig. 3-49 The process of X outer center

Place the conducting workpiece (copper, iron, aluminum) on the insulated worktable, and connect it to the port CUT on the controller, while the cutter to COM. Put the cutter over the predicted center point position, press “H” to select “Auto Center(H)”, press “T” to switch to “X Outer”, and then press F1 “Auto Center” to start automatic centering. The cutter will move “X Center Distance”, shift down “Down Distance” and translate towards the workpiece a short distance until reaching the conducting workpiece so as to conduct the circuit and transfer the signal. At this time, the system will automatically record the current axial coordinate X1. Then the cutter will raise “Down Distance”, move two “Center Distance”, move down “Down Distance”, and translate towards the workpiece a short distance until reaching the conducting workpiece so as to conduct the circuit and transfer the signal. At this time, the system will automatically record the current axial coordinate X2 to calculate the coordinate of center point of workpiece and then move the cutter to this center point.

## ◆ X Inner Center

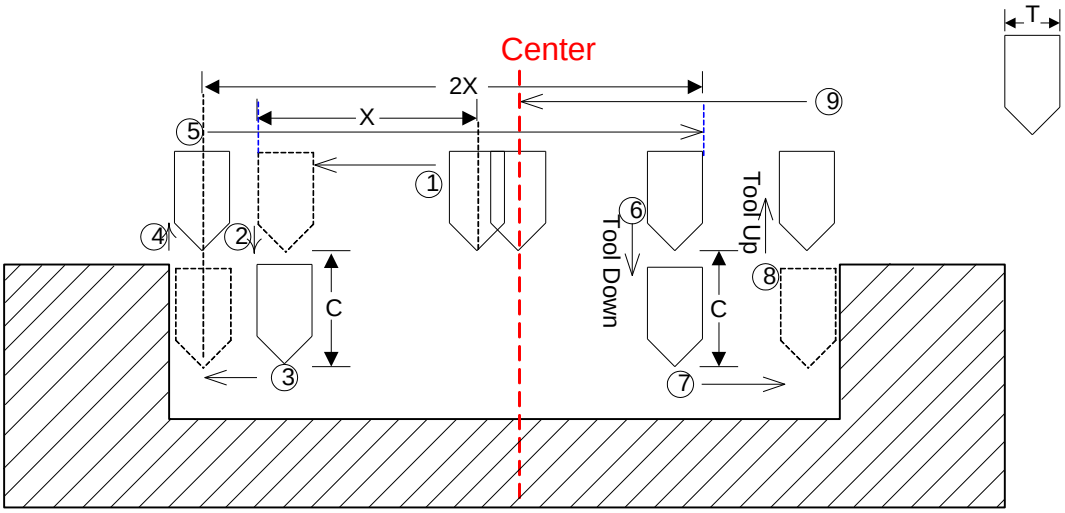



Fig. 3-50 Sketch map of X inner center

Note:

Before automatic centering, the tool nose must be over the predicted center position, and the value of center distance, down distance and tool diameter must be specified in advance.

Besides, the inner center distance must be smaller than workpiece radius, while the outer center distance must be larger than the workpiece radius.

When centering operation is used, it is recommended to use the active low.

## ◆ Boundary Center

Boundary center refers to setting the boundary point as workpiece origin, involving positive and negative boundary center, the process as shown in Fig. 3-51.

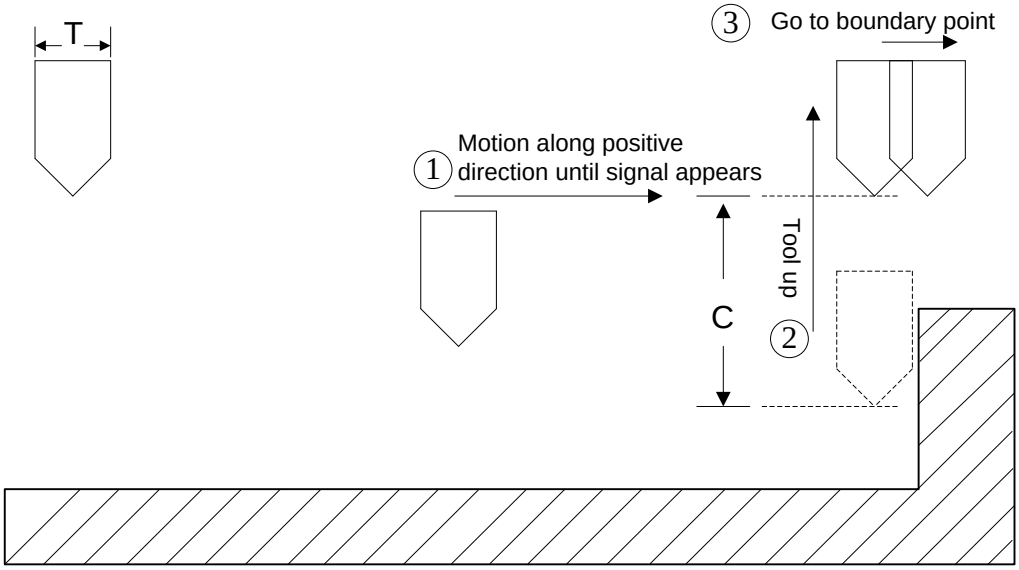



Fig. 3-51 Process of boundary center

## 3.11 Adjustment of Velocity & Acceleration

### 3.11.1 Feedrate Setting

Feedrate (feed speed) can be set directly in the system interface.

In auto mode, press  to access the coordinate-auto interface. Feedrate can be directly set in the parameter setting zone above the manipulation button bar, as shown in Fig. 3-52. When the parameter N72001 “Ignore Programmed Feedrate” is set to “YES”, the system will adopt feedrate set in the system, i.e. the value of “Prog.F”. When set to “NO”, the system will adopt the feedrate specified in the machining file.

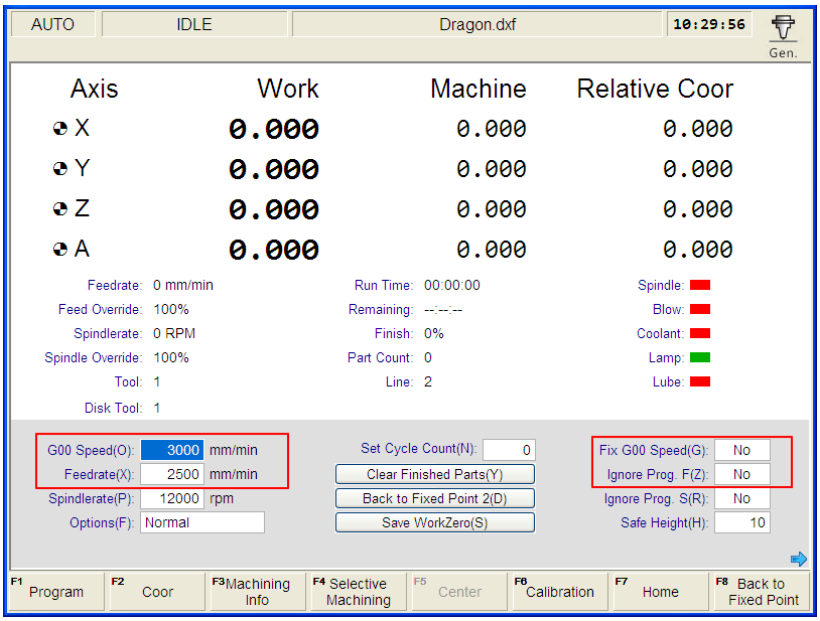



Fig. 3-52 Parameters setting zone-feedrate setting

There are two methods to select and set a parameter:

- Press “↑” or “↓” to move cursor to the corresponding parameter, and then press Enter to eject an input box.
- Press the corresponding shortcut key behind the desired parameter to eject an input box. Take “Prog.F(F)” as an example, pressing “F” will eject an input box for entering the desired value.

Feedrate is also related with current feedrate override, so it can be controlled by adjusting the current feedrate override, and the formula is as below:

$$\text{Current feedrate} = \text{Setting feedrate} \times \text{Current feedrate override}$$

Feedrate override knob is on the operation panel, as shown in Fig. 3-53.

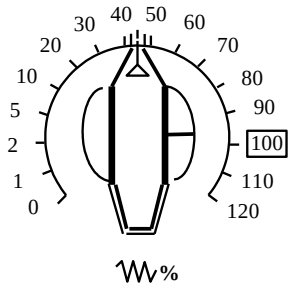



Fig. 3-53 Feedrate override knob

The adjusting range of feedrate override is “0% ~ 120%”.

> Note:
>
> For feedrate settings on the new interface, operations and setting methods are the same while related shortcut keys next to each parameter may be different. See for new interface counterpart.

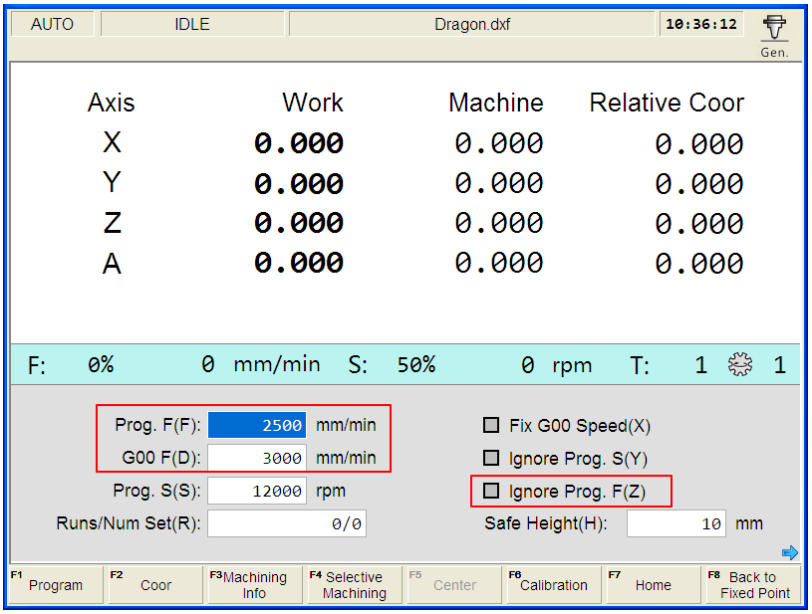



Fig. 3-54 Feedrate setting zone on new interface

## 3.11.2 G00 Speed Setting

G00 speed refers to the running speed of a machine tool under G00 command.

Similar to feedrate, G00 speed can also be set directly in the system interface. When the parameter N72003 “Fix Traverse Rate Override” is set to “YES”, the running speed of a machine tool under G00 command is fixed, i.e. the value of “G00 F”; when set to “NO”, the running speed of a machine tool under G00 command varies with the setting of feedrate override knob.

The concrete setting method is the same as that of feedrate.

## 3.11.3 Jog Speed/ Rapid Jog Speed

In manual-jog mode, press  to access the coordinate-jog interface. “Manual Low Speed” (jog

speed) and “Manual High Speed” (rapid jog speed) can be set directly in the parameter setting zone above the manipulation button bar. See Fig. 3-55.

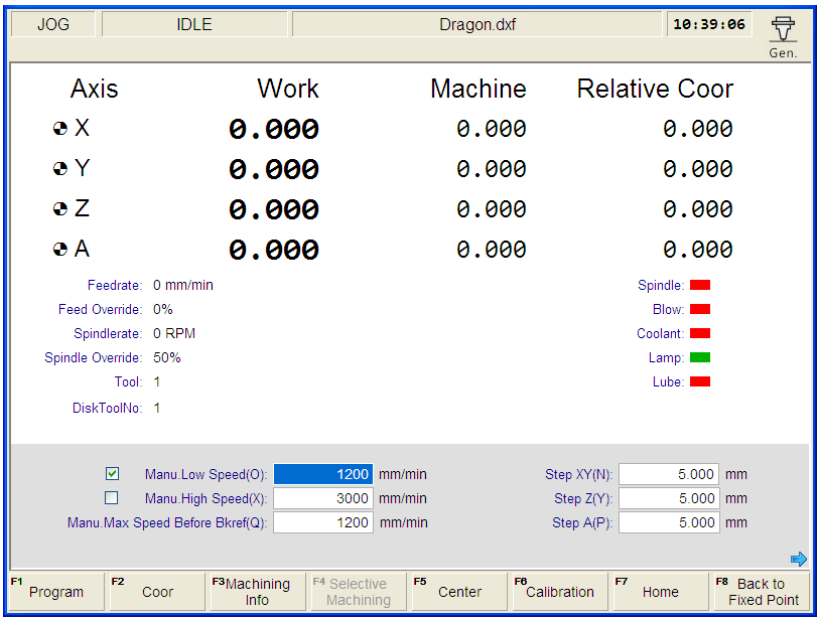



Fig. 3-55 Setting of jog speed and rapid jog speed

In manual-INC mode, step size can be user-defined, as shown below.


Fig. 3-56 Setting of step size

The concrete setting method is the same as that of feedrate.

For new interfaces, corresponding operations and setting methods are the same, which will be skipped here to avoid too much repetition.

## 3.11.4 Parameters Specification

Except for feedrate and G00 speed, the other involved parameters can be divided into following 5 types: velocity, acceleration, reference circle & circular speed limit, interpolation algorithm, and smooth setting.

◆ **Related Parameters for Velocity**

| Parameter | | Definition | Setting Range |
|---|---|---|---|
| **N64000** | Startup Speed | The max. achievable speed of a stepping motor in startup without acceleration | 0 ~ 100000 |
| **N64020** | Traverse Rate | The default speed of a machine tool in positioning (not in machining) | 0 ~ 100000 |

| | | | |
|---|---|---|---|
| **N64060** | Max Feedrate | The max. speed of a machine tool in machining | 0 ~ 100000 |
| **N71000** | Slow Jog Speed | There are two kinds of speed for option under manual mode: jog speed (Slow Jog Speed) and rapid jog speed, which can be switched by pressing the acceleration key on the operation panel. The system default running speed mode is jog speed. | 0 ~ Rapid Jog Speed |
| **N71001** | Rapid Jog Speed | | Slow Jog Speed~ Max Feedrate |

Parameter N64000 “startup speed” applies to the startup frequency of a stepping & a servo driver, zero in default setting of driver. The startup frequency refers to the highest frequency of direct working startup without acceleration of motor.

Reasonable setting of this parameter will improve machining efficiency, and avoid low speed segment with bad motion feature of motor. “Startup frequency” is generally included in the ex-factory parameters, but after installation, it will vary, especially in loading motion, thus, it should be set based on the actual measurement of motor power and inertia of a machine tool.

Parameter confirmation method: set a lower value at first, and repeatedly make the machine execute typical motion & multi-axis synchronization motion, and then gradually increase this value until fixing the max. startup speed. The actual setting value of this parameter is half of the max. startup speed, with general setting range “300 ~ 400”.

◆ **Related Parameters for Acceleration**

| Parameter | | Definition | Setting Range |
|---|---|---|---|
| **N64100** | Axis Acceleration | Description of the acceleration/ deceleration capability of each feed axis, in “mm/s$^2$” | 0.001 ~100000 |
| **N64101** | Rapid Motion Axial Acceleration | The max. acceleration of each feed axis in machine positioning | 0.001 ~100000 |
| **N64102** | Z Axis Acceleration | The max. acceleration of Z-axis | 0.001 ~100000 |
| **N64120** | Acceleration for Corners | The max. acceleration of feed motion on adjacent axes | 0.001 ~100000 |
| **N64150** | Axial Jerk | The change rate of acceleration of a single axis (acceleration’s acceleration) | 0.001 ~100000 |
| **N64204** | Acc or Dec Time after Interpolation | The larger the value is, the smoother the speed will be. This parameter has no effect on track precision. | 0 ~ 99999 |

“Axis Acceleration” is used to describe the acceleration/ deceleration capability of each feed axis, in “mm/s$^2$”, depending on the physical feature of a machine, such as quality of motion part, torque, cutting load and resistance of the feed motor. The larger the value is, the less time the machine will spend in acceleration/ deceleration during motion process, the higher the efficiency is. Generally, for a servo motor system, it should be within “600 ~ 3500”. Set a smaller value at first, and repeatedly execute typical motion for a period of time. If there is no abnormal situation, gradually increase the value. If abnormal condition occurs, reduce the value, with “50% ~ 100%” insurance

| Parameter | Definition | Setting Range |
|---|---|---|
| allowance.<br>“Acceleration for Corners” refers to the max. acceleration of feed motion on adjacent axes, and “1 ~4” times of “Axis Acceleration” is recommended, generally within “1200 ~ 5000”. For higher speed requirement, “2 ~ 4” times of “Axis Acceleration” is recommended.<br>“Axial Jerk” refers to growth rate of acceleration, i.e. the increment of acceleration in unit time, with unit “mm/s$^3$”. It is available for S_type and LEP_type acceleration & deceleration, used to mitigate the bad effect caused by abrupt acceleration & deceleration of a machine. | | |

◆ **Related Parameters for Reference Circle and Circular Speed Limit**

| Parameter | | Definition | Setting Range |
|---|---|---|---|
| **N64207** | Arc Velocity Limit | Only when this parameter is set to “YES” do N64208 and N64209 work. | YES: Valid<br>NO: Invalid |
| **N64208** | MAX Velocity of REF Circle | Reference circle is the reference of a machine in processing a circular workpiece. The max. speed of reference circle refers to the max. allowable speed of a machine in processing this circle without strong vibration. | 0.001 ~ 100000 |
| **N64209** | MIN velocity of REF Circle | Limit circular motion speed to avoid too low speed | 0.001 ~ 100000 |
| After installation of a machine completed, you can make the machine process a circle, in which vibration will occur due to centrifugal force. The higher the speed is, the stronger the vibration will be. Gradually increase the feed speed to see the state of vibration of the machine tool until the max. circular speed is achieved, i.e. the max. allowable speed of the machine tool without strong vibration. This circle is regarded as the reference circle, and its max. allowable speed is the max. speed of reference circle. Encountering other circles in machining, the system will calculate their max. centripetal acceleration in terms of the reference circle and its max speed to ensure the centrifugal force is within the debugging value, i.e. the vibration will not be stronger than that during ex-factory debugging.<br>In processing a circle with small radius, even quite low feed speed of the circle will generate very high centripetal acceleration, thus the machining speed will be quite low caused by circle speed limit to limit the centripetal acceleration. To ensure machining efficiency, when the speed calculated by the system is lower than the setting value of N64209, the setting value of N64209 will be adopted in machining. | | | |

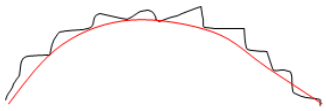
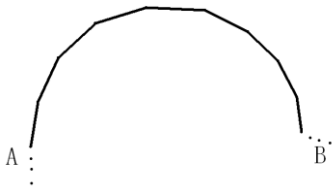
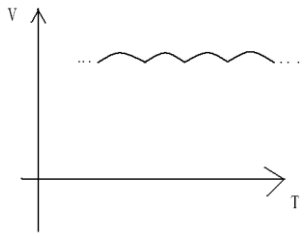
◆ **Related Parameters for Interpolation Algorithm**

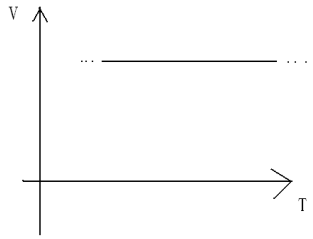
| Parameter | | Definition | Setting Range |
|---|---|---|---|
| **N64203** | Path Interpolation Algorithm | Select the most suitable interpolation algorithm to reduce error after debugging. | 0: Trapezoid algorithm<br>1: S_type algorithm<br>2: LEP algorithm |

| | | | |
|---|---|---|---|
| | | | 3: Acceleration trapezoid algorithm |
| **N64205** | MIN Velocity in LEP | The min. velocity in LEP algorithm interpolation | 0 ~ 100000 |
| N64203 is used for algorithm selection. The system currently supports trapezoid, S_type, LEP, acceleration trapezoid algorithms. Among them, trapezoid algorithm & S_type algorithm hold the highest efficiency, while LEP algorithm holds the highest machining quality in three-dimensional machining. When S_type algorithm is adopted, the max. acceleration of the system will reach the twice of single axis acceleration set in the system, so setting a smaller value for N64100 is recommended in S_type algorithm.<br>“Acceleration Trapezoid Algorithm” means acceleration curve is a trapezoid. The relationship of acceleration and time: accelerate to the max. acceleration at “axial jerk”, then keep this acceleration constant, and then decelerate to “0” at “axial jerk”. Generally, if this algorithm is used, N64150 “axial jerk” can be set within “100000 ~ 200000” (mm/s$^3$). The flexibility of acceleration and deceleration in this algorithm is better. | | | |

◆ **Related Parameters for Smooth Setting**

| Parameter | | Definition | Setting Range |
|---|---|---|---|
| **N63002** | Delay for Exact Stop | During machining, because of different inertia of each axis, the servo system may meet lag phenomenon at sharp turning corners. This parameter is used to overcome the lag phenomenon produced by the servo system by setting an extra stop time. | 0.0 ~ 999 |
| **N63006** | Path Smoothing Time | The larger the value of the parameter is, the smoother the workpiece surface will be. But if the value of the parameter is too large, it will affect the dimension of the workpiece. For a mold machine, it generally should be within 0.01, for a woodworking machine, within 0.03. | 0.0 ~ 0.064 |
| **N64200** | Smoothing the Path Velocity | If set to “NO”, each motion instruction starts and ends at zero speed. If set to “YES”, the system will set a proper start speed and end speed for each motion instruction according to the specific tool path to ensure smoothness of high speed machining. | YES: Valid<br>NO: Invalid |
| **N64201** | MAX Angle Smooth Velocity | The max. angle for the execution of “Smoothing the Path Velocity” | 0 ~ 180 |
| **N64240** | Smoothing Time Factor | It is used to specify the ratio of unit processing time to control periodic time when the speed is smooth. | 0.01 ~ 10 |
| | The larger the value is, the more ambiguous the details of workpiece are, i.e. the workpiece is smoother. But it will lead to reduction of arc radius in machining an arc. And | | |

| Parameter | | Definition | Setting Range |
|---|---|---|---|
| | it will also dwarf wave peak in machining workpiece resembling waves, as following. The range within 0.05s is recommended.  | | |
| **N64241** | ConnectSpeed decreased at MaxConnetAngle | Whether to decelerate when the connection angle is approaching its max. value | YES: Valid<br>NO: Invalid |
| **N64245** | Prepared number of path for optimizing performance | Segments for performance optimization, having no effect on the result of velocity planning. | 1 ~ 2000 |
| **N64246** | Slide speed for small lines | Eliminating velocity fluctuation when machining short segments. | YES: Valid<br>NO: Invalid |
| **N64247** | Reference length of slide speed for small lines | Segments shorter than the value of this parameter will be executed speed smoothing. | 0.001 ~ 10 |
| | In machining an arc (or other curves) composed of short segments, velocity fluctuation, like frequent acceleration and deceleration obvious in our S-type algorithm, will occur at places where curvature is relatively large, as follows:   Assume that each segments is very short, and the curvature from A to B is large, the actual velocity planning will probably be as follows:   The above velocity curve (acceleration→ deceleration→ acceleration…) will lead to oscillation of a machine tool. At this time, the parameter “Slide speed for small lines” should be set to “YES”, and the value of the parameter “Reference length of slide speed for small lines” should be set larger than the length of short segments in the tool path. When the short segments in the tool path are shorter than the reference length, the velocity will be executed smooth treatment. Otherwise, there is no treatment. The velocity after treatment is as follows: | | | |

| Parameter | Definition | Setting Range |
|---|---|---|
| |  <br>In this way, frequent acceleration and deceleration is avoided, oscillation of a machine tool is eliminated, and machining quality is improved. | |

## 3.12 Simulation & Track

### 3.12.1 Simulation

The function of simulation provides a fast but lifelike simulation machining environment.

Running under the simulation mode, the system will not drive a machine tool to do the relative actions but only show the moving track of the cutter at high speed in the track window. By simulation, you can see the moving form of the machine tool in advance, avoiding machine tool damage due to programming mistakes in the machining file. And you can also learn other additional information.

Press  to access the program function area, where you can load a machining file into the system.

Press  ==> F3 “Machining Info” ==> F1 “Simu” to start simulation. You can see the whole machining track in the track window, and learn other info on the right side.

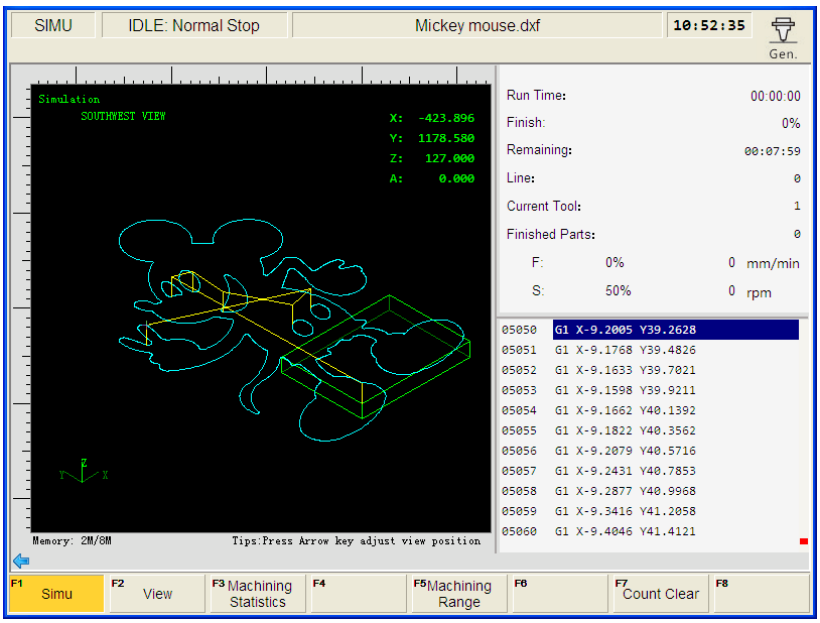



Fig. 3-57 Simulation and Track window

### 3.12.2 Motion Track

The track window displays the moving track of the cutter in real time. 3D display enables that you can view the tool path more intuitionally so as to ensure the accuracy of the loaded machining file. In the 3D tracking mode, abundant operation methods are offered by the system for the convenience of viewing the motion track from different perspectives and in an appropriate scaling.

By pressing the letter key “G” in the “Track window”, you can see the pop-up “View Adjustment” window, as shown in Fig. 3-58, and press the displayed shortcut keys to view the machining track from

a proper perspective.

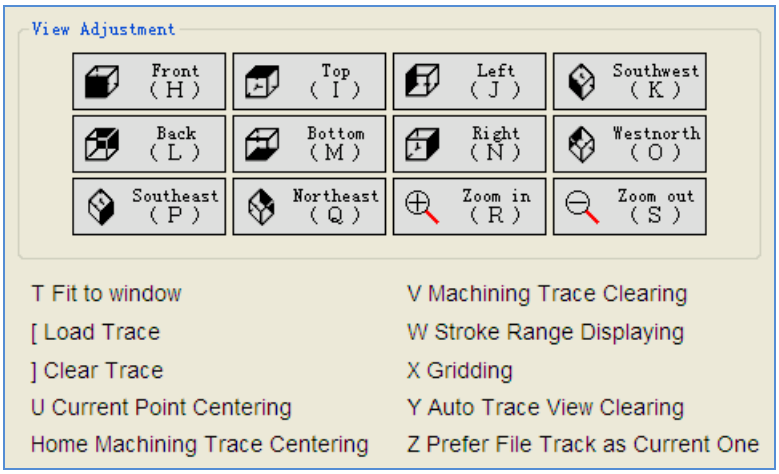



Fig. 3-58 View adjustment

### 3.12.3 Machining Statistics

As shown in Fig. 3-57, press F3 “Machining Statistics” to open the dialog box. This window mainly displays statistics info of all the previously processed machining files, including the machining file currently loaded. See Fig. 3-59. The upper part of the window displays the statistics info about the machining file currently loaded, such as name, start time, finished parts, total parts, run time, part run time, finished length and part total length. When a new file is loaded, all the statistics will be cleared.

The lower part displays the statistics info about all the previously processed machining files, including name, start time, total time, total length and count.

Pressing the shortcut key F1 “Clear” will clear the selected history statistics in the list.

Pressing the shortcut key F3 “Save” will save the current history statistics to a txt file, with default name as “PartStat.txt”, under D:\Naiky\NK-300A\Config\std (varies with system configurations). The statistics of the machining file currently loaded will not be saved to the lower list, while those of processed machining files will be saved to the lower list automatically.

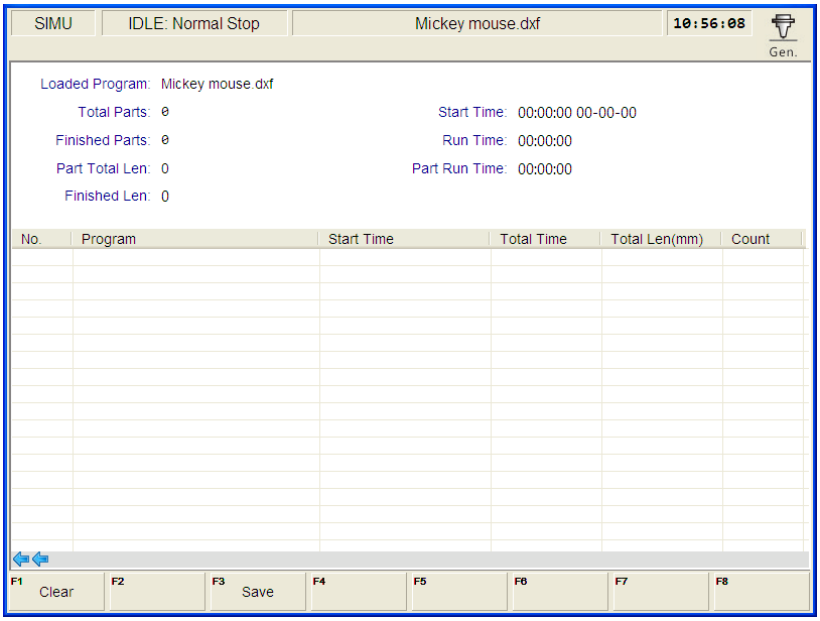



Fig. 3-59 Machining statistics window

## 3.12.4 Related Parameters

◆ **Involved Parameters (Under "Software Option")**

| Parameter | | Meaning | Setting Range |
|---|---|---|---|
| **N81000** | Auto Load Graph | It sets whether the system will analyze the machining track automatically after a machining file is loaded. | NO: Not analyze<br>YES: Analyze |
| **N81001** | Max File Size | It sets the file size limit in auto track loading. Only when the file size is smaller than or equal to this value can its track be loaded automatically, i.e. "Auto Load Graph" works. | 0~10000 |
| **N81010** | Gradient Fill | Setting whether to use gradient color fill in the track window | NO: Not use<br>YES: Use |
| **N81011** | Draw Workbench | Setting whether to draw the boarder of the worktable in the track window | NO: Not draw<br>YES: Draw |
| **N81012** | Draw Grid | Setting whether to draw grid in the track window | NO: Not draw<br>YES: Draw |
| **N81013** | 2D Mode | Setting whether to use 2D mode to view the track in the track window | NO: Not use<br>YES: Use |
| **N81015** | Clear on Loading | Setting whether to clear the contents of the current view when a new file is loaded | NO: Not clear<br>YES: Clear |
| **N81016** | Draw WC Origin | Setting whether to display workpiece origin in the track window | NO: Not display<br>YES: Display |
| **N81017** | Draw MC Origin | Setting whether to display machine origin in the track window | NO: Not display<br>YES: Display |

| Parameter | | Meaning | Setting Range |
|---|---|---|---|
| **N81018** | Bkground Color 1 | Setting the background color for the track window | Select a color |
| **N81019** | Bkground Color 2 | Setting the background color for the track window | Select a color |
| **N81020 ~ N81023** | G00/G01/G02/G03 Color (running) | Setting the color for motion track commanded by G00/G01/G02/G03 when running | Select a color |
| **N81032 ~ N81035** | G00/G01/G02/G03 Color (loading) | Setting the color for motion track commanded by G00/G01/G02/G03 when loading | Select a color |
| **N81045** | Grid Color | Setting grid color in the track window | Select a color |
| **N81046** | Coordinate Color | Setting coordinate color in the track window | Select a color |
| **N81049** | WC Origin Color | Setting a color for workpiece origin in the track window | Select a color |
| **N81050** | MC Origin Color | Setting a color for machine origin in the track window | Select a color |

All these parameters are related with the attribute setting of the track window.

## 3.13 Compensation

Pressing the advanced function selection key  will access the following compensation interface, in which tool compensation, work compensation and screw compensation are available.

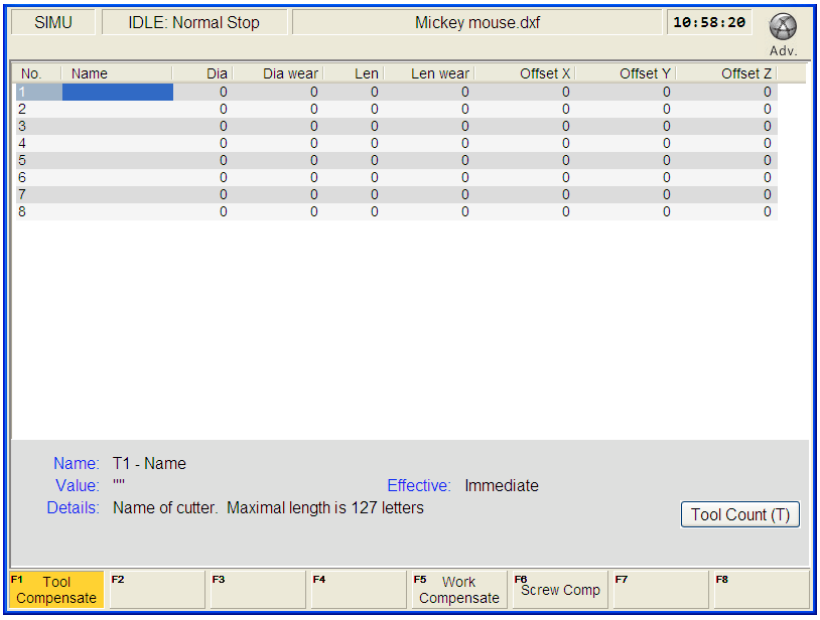



Fig. 3-60 Compensation interface

### 3.13.1 Tool Compensation

In CNC machining, the CNC system actually controls the tool center or the related point of the tool rest whose motion track is controlled directly to realize profile processing for the actual parts.

The cutting part actually used is the tool nose or the cutting edge which has dimensional variation with the tool center or the related point of the tool rest, so the CNC system has to compute the corresponding coordinates of the tool center or the related point of the tool rest according to the actual coordinate position of the tool rest or the cutting edge (namely the actual coordinate position of the part profile), which is called tool compensation.

Input the new tool parameter values in the tool compensation interface (see Fig. 3-60) if the tool nose radius is altered due to tool wear, tool sharpening or tool change, avoiding the trouble to modify the programmed machining file.

To make tool compensation (including tool radius compensation and tool length compensation) effective, parameter “N62410 Enable Cutter Compensation” should be set to “YES”. G43 (positive offset) and G44 (negative offset) are used for tool diameter compensation while G41 and G42 for tool radius compensation.

◆ **Involved parameters are:**

| Parameter | | Meaning | Setting Range |
|---|---|---|---|
| **N62410** | Enable Cutter Compensation | Setting whether to perform tool compensation | YES: Valid<br>NO: Invalid |
| **N62411** | Cutter Compensation Type | The type to establish and cancel cutter compensation | 1: Normal type<br>2: Intersect type<br>3: Insert type |
| **N62412** | Cutter Compensation Direction | Specifying the direction of tool compensation | 0: No tool compensation<br>1: Left compensation<br>2: Right compensation |
| **N62413** | Num of Intervene Detected Graphics | See below for explanation. | 1~5 |
| | Interference here refers to over-cut caused by too large tool radius. Parameter N62413 decides interference detection among how many adjacent shapes. When interference phenomena detected, an interference alarm will be given. Generally, setting a smaller tool diameter will relieve the alarm. Note the default value of this parameter is 3. When set to 1, there is no interference detection and alarm. | | |
| **N65206** | Force to Use Tool Compensation | If it is set to “YES”, when parameter “Enable Cutter Compensation” is set to “YES”, translation of an ENG file calls codes about tool length compensation or tool radius compensation; if it is set to “NO”, even though parameter “Enable Cutter Compensation” is set to “YES”, translation of an ENG file does not call codes about tool length compensation or tool radius compensation. | YES: Force to use<br>NO: Not force to use |

### 3.13.1.1 Compensation Type

Tool (cutter) compensation should be established before executed, and cancelled after workpiece machining completed. To establish tool compensation is moving the tool to the edge of workpiece in a reasonable way, while to cancel tool compensation is moving the tool to the specified point from the edge of workpiece.

This software offers 3 types to establish and cancel tool compensation:

1) Normal type: this type sets the end point of tool compensation establishment segment (red one) as the start point of next offset, not available to arc command.

2) Intersect type: this type generates the tool compensation path on the basis of the calculated point

of intersection of the tool compensation establishment segment (red one) after offset and first machining segment after offset, i.e. the point of intersection of green segments 1 and 2.

3) Insert type: this type inserts a segment from the start point of tool compensation establishment segment before offset to the start point of establishment segment after offset, available to arc command, but the efficiency will be affected since an extra segment needs to be completed.

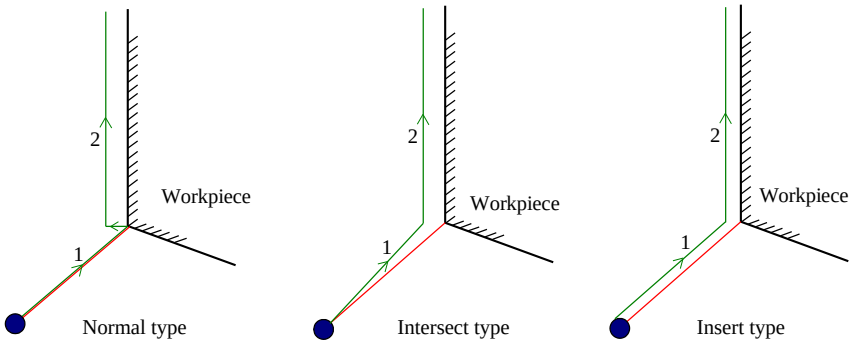



Fig. 3-61 Type to establish tool compensation

### 3.13.1.2 Compensation Direction

The schematic diagram of tool compensation direction is as shown in Fig. 3-62.

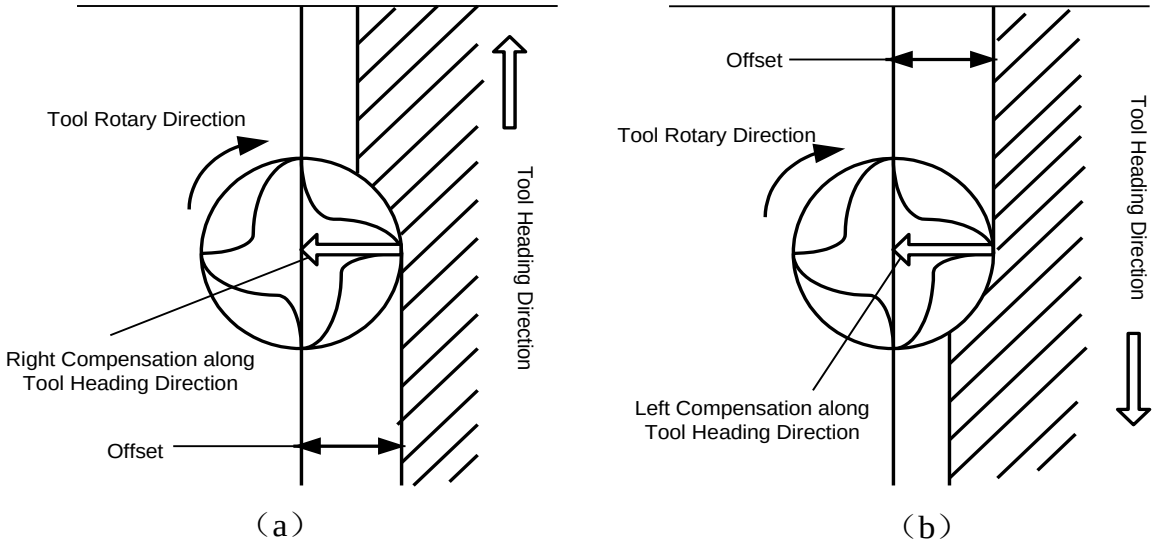



Fig. 3-62 Direction of tool compensation (A: left compensation B: right compensation)

Programming for tool radius compensation is as shown in Fig. 3-63:

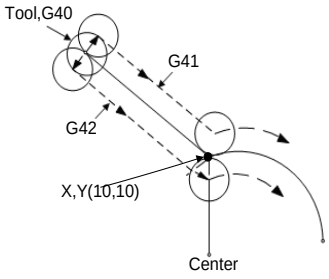



Fig. 3-63 Schematic diagram of tool compensation machining

G17 G01 G41(G42) X10 Y10 F1000 D01 ’linear interpolation and tool radius compensation

G02 X_ Y_ I_ J_ ’circular interpolation

Among the above programming, G41 means left compensation, namely the tool will deviate a distance towards the left side of tool heading direction and this distance is tool radius; G42 means right compensation, namely the tool will deviate a distance towards the right side of tool heading direction and this distance is tool radius. X10Y10 is the endpoint coordinates of linear motion. F1000 represents the tool moves at the speed of 1000. D01 is the parameter of G41/G42, namely the tool compensation number. From D00 to D07, they have their own corresponding radius compensation value in the tool compensation table.

For the details of programming of tool compensation instruction, see *Programming Manual*.

## 3.13.2 Work Compensation

The system includes single compensation and array compensation, as shown in Fig. 3-64. In single compensation, each workpiece is compensated separately, i.e. the compensation offset of each machining file can be different. In array compensation, the same rows or columns are compensated the same offset. Taking X01Y01 as an example, it compensates the first rows and columns.

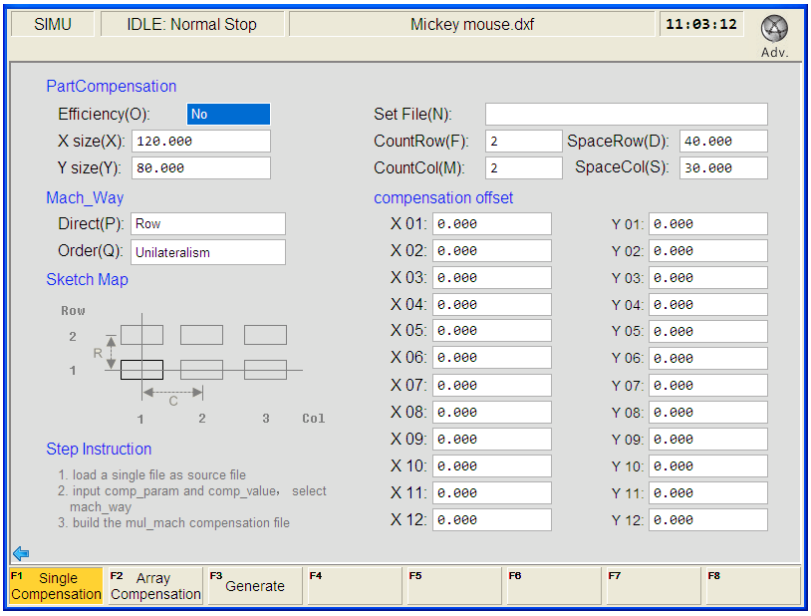



Fig. 3-64 Work compensation interface

To enable work compensation, set “Efficiency(O) to “Yes”.

Set File(N): load the desired single workpiece file into the system firstly, and then turn to this interface and press “Set File(N)” to load the file for work compensation. If the file is not loaded into the system firstly, pressing “N” will eject an error prompt, as shown in Fig. 3-65.

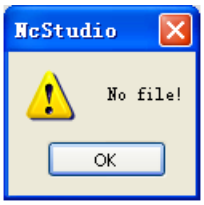



Fig. 3-65 Source file error prompt

After manually entering workpiece size (X size and Y size), rows (CountRow), columns (CountCol), row space (SpaceRow) and column space (SpaceCol), set machining direction and order to determine machining sequence of each workpiece, then enter the compensation offset for each workpiece, and then press F3 “Generate” to generate a multi-workpiece file. Enter the file name, and then press Enter to load the file into the system automatically. The new file is saved to “D:\NcFiles”.

> Note:
>
> After the file is loaded for work compensation, the source file in the system will be deleted automatically, since the final machining file loaded into the system will be the compensation file newly generated.
>
> G28, G29, G65, G92, M30 and M2, etc. are not supported in scale and array functions, neither are subprograms in the tool path. If there are codes mentioned before, the system will prompt manual or automatic deletion.

## 3.13.3 Screw Error Compensation

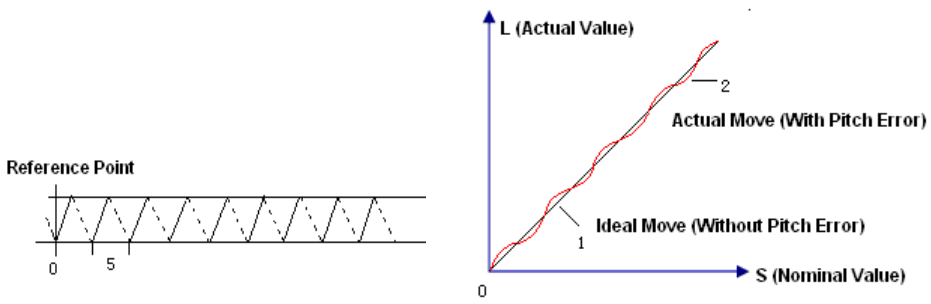
### 3.13.3.1 Causes of Screw Error and Compensation Method

Screw error consists of screw pitch error and errors caused by backlash. Generally, these two errors don’t need compensation, but backlash compensation is needed in high precision required situation, if higher precision is required, both the two compensations are needed.

◆ **Pitch Compensation:**

Pitch error is caused by screw defect and long-term wear, etc. In order to improve precision, pitch compensation is needed to meet the requirement. The sketch of a screw is shown in Fig. 3-66 (A). A coordinate system is established, based on “0” point on the screw as the reference point, nominal value as X-coordinate, and actual value as Y-coordinate. Then the ideal moving curve is as curve “1” in Fig. 3-66 (B), however, the actual curve will be curve “2” due to pitch error. That is to say, the Actual value is not the same as its corresponding Nominal value, the actual moving curve deviating from the ideal one, and their difference is called error, i.e.:

Error = Nominal machine coordinate – Actual machine coordinate




(A) Sketch of screw (B) Picture of moving curve

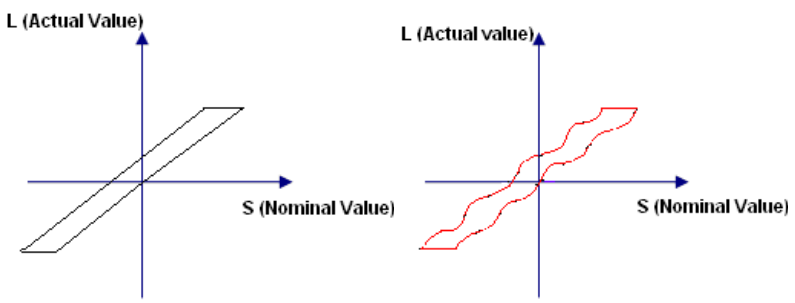
Fig. 3-66 Analysis of pitch error

◆ **Compensation Method:**

In pitch compensation, generally pitch error value isn't related to feed direction. That is, when the pitch is too small in positive feed, additional pulse is needed, and thus, when negative feed passes the same position, the same amount of feed pulse should be added. But if the pitch is large, deduction of pulse is needed, and neither is the reducing amount related to feed direction. In software compensation, correction of each point on the error curve should be tabulated and saved to the system memory. Then auto compensation for coordinates of each point is available in running, so as to improve machine precision.

◆ **Backlash Compensation:**

Hysteresis feature is caused by forward and reverse clearance. Assume that driving shaft drives driven shaft in negative (CW) rotation, servo motor will be idling without moving worktable because of mechanical driving chain backlash, when the driving shaft suddenly begins CCW rotation (positive motion). After staying at a certain position for some time, the worktable will move backward with the driving shaft; when the direction of the driving shaft changes again, the situation is the same, which is called Hysteresis. If pitch error doesn't exist, under ideal condition, the moving curve of worktable is shown in Fig. 3-67 (A), in which the curve of horizontal section is during the idling of servo motor without worktable movement. The actual moving curve of worktable is shown in Fig. 3-67 (B).




(A) Hysteresis feature (B) Actual moving curve

Fig. 3-67 Analysis of backlash

The popular explanation is: because spindle is generally fixed on the screw whose outer wire and the

inner wire on the outer wire can not be completely matched, backlash compensation compensates the clearance between the screw of last direction that the spindle needs to finish after reversing its moving direction.

◆ **Measuring Method and Compensation Method**

Backlash can be measured by a specialized gauge. Firstly, fix the instrument nearby the spindle. Secondly, make the watch hand at the zero point position (machine origin). Thirdly, manually move “a” centimillimeter, then move back “a” centimillimeter, and then see the actual moving distance of watch hand- “b” centimillimeter. Therefore, the backlash is measured, namely (a-b) centimillimeter.
If one axis moves from positive to negative, “+Q” pulse will be output before reversal; conversely, from negative to positive, “-Q” pulse will be output before reversal (Q is backlash, preset by the program).

### 3.13.3.2 Screw Error Compensation Operation

Actually the system has already combined the above two errors (screw pitch error and backlash) to deal with and will execute error compensation automatically based on the error data in the file after the backward error and forward error of the corresponding nominal coordinate of each coordinate axis are listed into the screw error compensation file.
The name of the screw error compensation file is **axeserr.dat**, found under the installation directory, i.e. under D:\Naiky\NK-300A\Config\std (varies with system configurations). Modification to the data in the screw error compensation file will become valid after the software is restarted.
The file format is:

1) Firstly specify length unit, currently the supported length unit is mm and the style of writing is: unit = mm
2) Then specify error sequence of each axis. To work properly, the contents in this sequence must be in the ascending order of nominal machine coordinate value. Refer to Table 3-1 for details.
3) Annotation: it must be in a separate line and started with a semicolon. Its syntax is:

;<Annotation contents>
Note that a semicolon must be the first character of the separate line, that is, no other character should be in front of the semicolon, even blank space.

Table 3-1 Explanation about axis error sequence

| Item | Specification | Remark |
|---|---|---|
| **Axis Name** | X, Y, Z, (Case-insensitive) | |
| **Nominal Machine** | It is the machine coordinate with a sign with respect to reference | |

| | | |
|---|---|---|
| **Coordinate** | point, which is calculated by the given pitch and pulse equivalent (i.e. the length calculated based on the nominal pitch, not on the actual physical one), arranged in ascending order. Nominal machine coordinate must be within the stroke range, or the compensation is invalid. | |
| **Backward Error** | The error generated by the motion towards decreasing direction of coordinate value. | |
| **Forward Error** | The error generated by the motion towards growing direction of coordinate value. | |

The style of writing of each axis error sequence:
[Axis Name]
<Nominal Machine Coordinate>, < Forward Error>, < Backward Error>
<Nominal Machine Coordinate>, < Forward Error >, < Backward Error >
<Nominal Machine Coordinate>, < Forward Error >, < Backward Error >
The sign of nominal machine coordinate and actual machine coordinate
Pay special attention to the sign of nominal machine coordinate and actual machine coordinate, especially when equipment like laser interferometer is used to measure the length. Calculate after the measured length is converted to the corresponding machine coordinates, or a wrong result may occur.

Table 3-2 Example of screw error compensation file format

| Condition | Example | Remark |
|---|---|---|
| **Common cases** | ;unit=mm<br>[X]<br>-570.025, 0.027, 0.083<br>-450.020, 0.025, 0.077<br>-330.015, 0.015, 0.068<br>-210.010, 0.000, 0.057 | |
| **A certain axis only needs backlash compensation** | ;unit=mm<br>[Y]<br>0.000, 0.000, 0.030<br>1000.00, 0.000, 0.030 | Only the data of start point and end point of this axis needs writing down. |

◆ **Related parameters are:**

| Parameter | | Meaning | Setting Range |
|---|---|---|---|
| **N12000** | Screw Error Comp | It sets whether to enable screw error compensation and decides compensation type. | 0, 1, 2 |
| **N12001** | Backlash Compensation Only | It sets whether to enable backlash compensation. | YES: Valid<br>NO: Invalid |

There are three options for parameter N12000, which are 0 (no compensation), 1 (unidirectional compensation) and 2 (bidirectional compensation).

◆ **No compensation**

To disable compensation, set set N12000 to “0”, and N12001 to “NO”.

◆ **Unidirectional compensation**

To compensate by reading “Err Pos.” data (unidirectional error data) and backlash value in the screw compensation interface, set N12000 to “1” and N12001 to “YES”.
To compensate by only reading “Err Pos.” data (unidirectional error data) in the screw compensation interface, set N12000 to “1” and N12001 to “NO”.

◆ **Bidirectional compensation**

To enable bidirectional compensation, i.e. to compensate by reading “Err Pos.” (forward error) and “Err nEG.” (backward error) data in the screw compensation interface, set N12000 to “2”.

When parameter N12001 is set to “YES”, it means to enable the backlash compensation; when it is set to “NO”, it means that backlash compensation will not be enabled and comprehensive compensation will be made by reading backlash value and pitch error data from the error file.

### 3.13.3.3 Software Interface and Operation

Press the advanced function selection key  to access parameters interfaces, where you can find parameter N12000 “Screw Error Comp”. set the parameter and decide which compensation type is to be enabled.

Press  ==> F6 “Screw Comp” to access the compensation interfaces, unidirectional or bidirectional compensation interfaces, which is decided by the setting of the parameter N12000 “Screw Error Comp”.

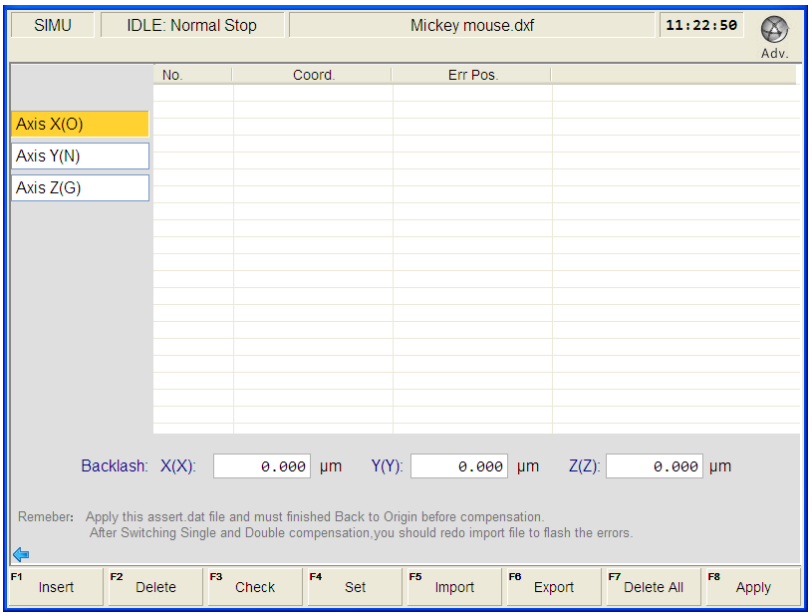



Fig. 3-68 Unidirectional compensation interface

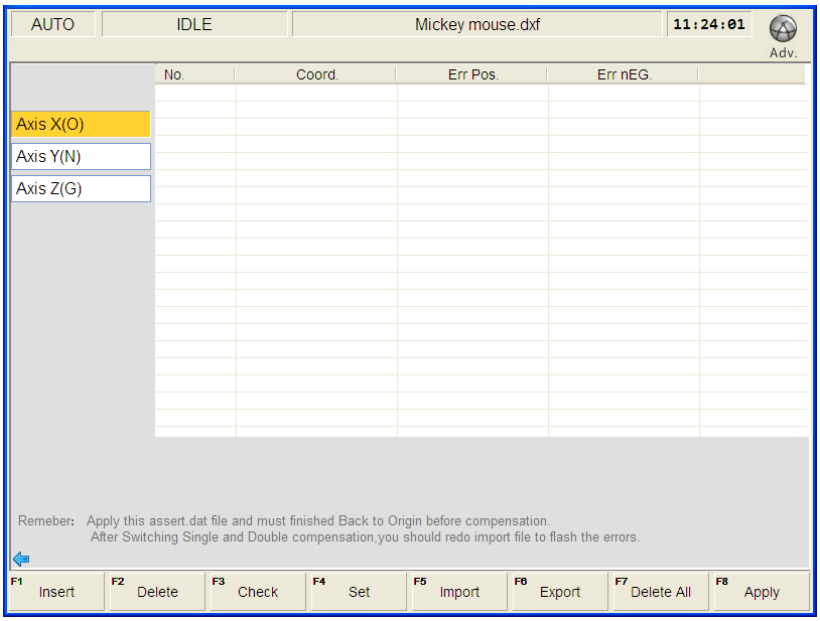



Fig. 3-69 Bidirectional compensation interface

Unidirectional compensation is fit for the situation that the forward error and backward error are relatively stable. If forward direction is the first in measure, enter the forward error (default) into “Err Pos.”; if backward direction the first in measure, enter the backward error into “Err Pos.” Backlash of each axis can be used together.

Bidirectional compensation reads forward error and backward error to execute comprehensive compensation, fit for the situation that forward error and backward error are not stable. Backlash is not available in the screw compensation interface when bidirectional compensation is enabled.

◆ **Unit**

Coord. (Position coordinate): mm

Err Pos. (unidirectional error), Err Pos. (forward error), Err nEG. (backward error), backlash: μm

◆ **Import and file format**

Three types of file can be imported from a USB disk. They are .lin, .rtl and axeserr.dat.

> Note:
>
> Check whether the .lin or .rtl file to be imported is generated correctly.
>
> After manually modifying the axeserr.dat file, check whether the data of each axis is arranged in ascending order or descending order, and whether the data, including nominal coordinate, forward error, and backward error, are correct compared to the backlash of each axis.
>
> After switching from unidirectional compensation to bidirectional compensation and restarting the software, load the file again to refresh the forward error and backward error of bidirectional compensation.
>
> To improve the precision of the imported file, the data should be the average of multi-measurement (at least two times) on the same coordinate position.
>
> Compensation error data= Measured error data- Error data of machine origin

◆ **Delete All**

This key is used for deleting all data.

◆ **Apply**

After this key is pressed, the compensation data will be written into the drive, and the axeserr.dat file will be saved to the D disk.

> Note:
>
> After modification to Coord. (position coordinate), Err Pos. (unidirectional error), Err Pos. (forward error), Err nEG. (backward error), backlash, parameters N12000 and N12001 and execution of “Apply”, there is a must to return to machine origin first to ensure compensation accuracy.

◆ **Remarks:**

- Error value= Actual machine coordinate- Nominal machine coordinate
- Ascending sequence and descending sequence can be set.
- Check whether there is any invalid data in the axeserr.dat file after opening the software and importing the file.

## 3.13.4 Across Quadrant Error Compensation

Across quadrant error compensation, also called friction compensation, refers to the distortion, the most commonly seen is a spike, at the conversion part of two adjacent quadrants in circle machining of a machine tool.

To eliminate this kind of distortion, error compensation is necessary.

Across quadrant compensation parameters are used for spike compensation when machining arc passes across quadrants. The setting method along positive and negative directions of X/Y/Z is similar.

◆ **Involved Parameters:**

For there are 6 groups of parameters “time”, “distance” (compensation amount), “delay” and “intensity”, only one of them is listed in the following table.

| Parameter | | Meaning | Setting Range |
|---|---|---|---|
| **N12020** | Turn On AQE Compensation | Setting whether to enable across quadrant compensation | YES: Valid<br>NO: Invalid |
| **N12030** | Time | The bigger the value is, the larger the area will be influenced by the compensation. The recommended value is about 0.02 s. | 0~10 |
| **N12031** | Distance | | 0~10 |
| **N12032** | Delay | | 0~10 |
| **N12033** | Intensity | | 0~10 |

To make across quadrant compensation effective, parameter N12020 should be set to “YES”.
The larger the value of “Distance” is, the more obvious the compensation result will be. But note that too large value will make the arc concave, and too small value can not decrease the arc height effectively. The recommended setting value is 0.3~3 times of the actual height of the spike measured by a measuring device like a laser interferometer (compensation result and compensation time are related to compensation intensity).
Delay: the spike may not exactly appear at the conversion part on some machine tools due to the difference of mechanical property of each machine tool, but a distance away from the quadrant point. Estimate the time for finishing this distance and set it as the value of the “Delay”.
Intensity has an influence on the compensation result: the bigger the value is, the more obvious the result will be.

# 3.14 Log and Diagnosis

## 3.14.1 Log

To access the log interface, press the diagnosis function selection key  ==> F2 “Log”.

The log interface records important operations and system events. Not only can the log info since this time start-up be browsed, but also history records can be viewed. See Fig. 3-70.

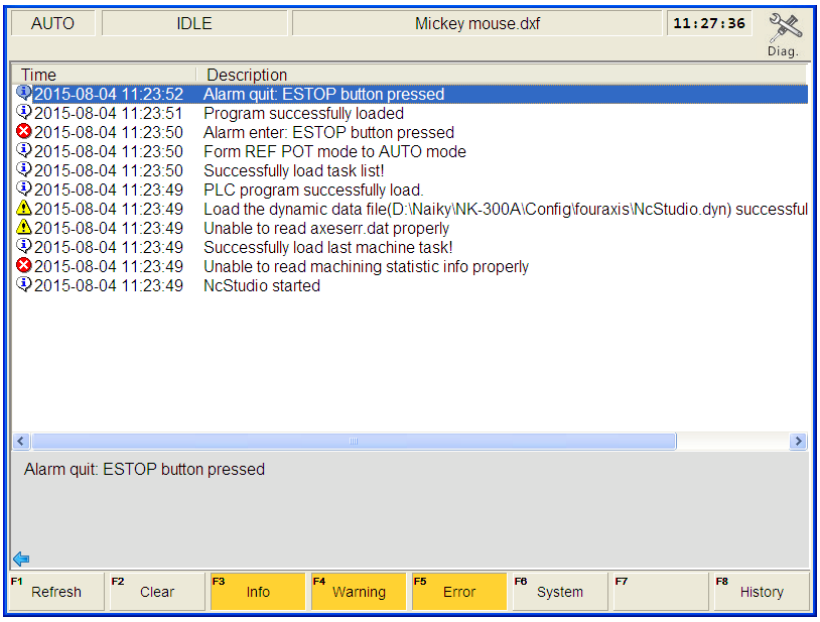



Fig. 3-70 Log interface

◆ **Refresh**

Pressing the shortcut key F1 will refresh the log list to make it synchronize with the system.

◆ **Clear**

Pressing the shortcut key F2 will clear all the current log information.

◆ **Info, Warning and Error**

Their shortcut keys are F3, F4 and F5 respectively.

Their default state is checked highlighted in yellow, namely the system displays normal info, warning info and error info by default. If you don’t need certain info displayed, you just need to press the corresponding shortcut key to eliminate the yellow highlight. For example, pressing F5 (shortcut key of [Error]) will make the button bounced and the system hide the error info.

◆ **System**

Pressing F6 can view the system info, which needs password.

◆ **History**

Pressing the shortcut key F8 will display all the logs since recording.

## 3.14.2 Diagnosis

To access the diagnosis interface, press the diagnosis function selection key  ==> F5 “Diagnosis”.

The diagnosis interface displays current feedback machine coordinates of each axis. After inputting a valid sampling port into the channel and setting sampling interval, press F1 “Start” to diagnose the corresponding port. See Fig. 3-71.

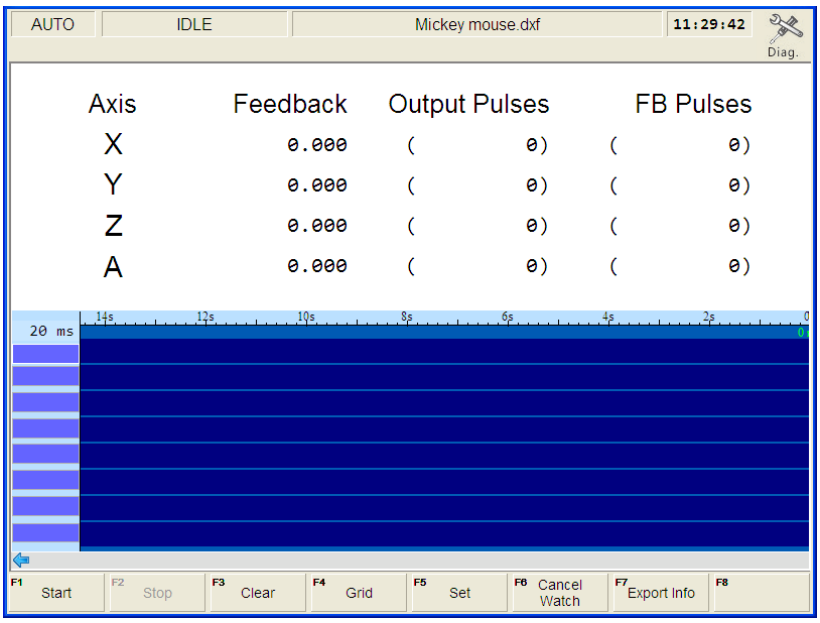



Fig. 3-71 Diagnosis interface

◆ **Start**

Pressing the shortcut key F1 will start diagnosing the corresponding port.

◆ **Stop**

Pressing the shortcut key F2 will stop diagnosing the corresponding port.

◆ **Clear**

Pressing the shortcut key F3 will clear the diagnosis result of the corresponding port.

◆ **Grid**

Pressing the shortcut key F4 will bring grid lines into the sampling window.

◆ **Set**

Sampling interval can be set after the shortcut key F5 is pressed, as shown in Fig. 3-72.

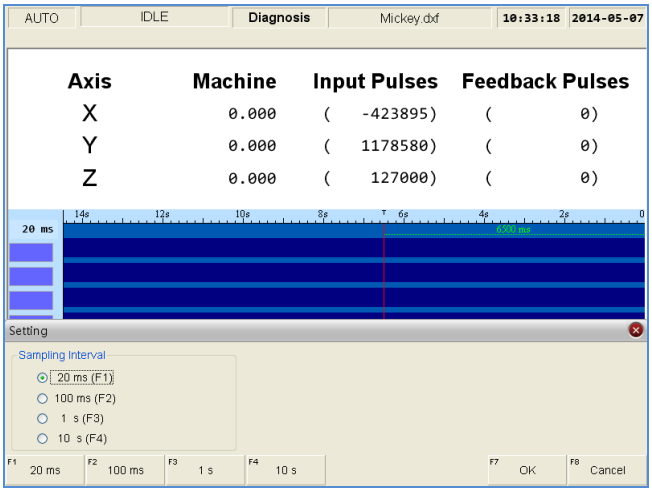



Fig. 3-72 Setting screen

Press F7 “OK” to confirm it after a sampling interval is selected (20ms, 100ms, 1s and 20s). And then the corresponding port or PLC address can be sampled periodically, realizing tracking detection to the port.

### ◆ Cancel Watch

Pressing the shortcut key F6 will cancel the monitoring to the corresponding port.

### ◆ Export Info

Pressing the shortcut key F7 will export the system information to D:\Naiky\NK-300A\Config\std (varies with system configurations), or to the removable disk if it is inserted.

## 3.15 Program File Management

Program file management manages the machining files in the system, related to operation of machining program.

### 3.15.1 Machining Wizard

NK300BX offers 5 basic machining program wizards: circular contour, circular pocket, rectangular contour, rectangular pocket and screw compensation. You just need to input some simple parameters to complete the operation of circular contour and rectangular contour, etc. Take circular contour milling as an example in the following:

Press  ==>  ==> F1 “Program Wizard” to enter the wizard screen, with the circular contour wizard screen as the default one, as shown in Fig. 3-73. To switch to other wizards, press the corresponding shortcut keys. To achieve the desired results, you can set parameters for the selected machining shape, such as milling inner contour or outer contour (milling inner contour mills the region inside, and milling outer contour mills along the contour), workpiece diameter, initial (workpiece) coordinate X/Y, layer depth (of each cutting), engraving depth (of several accumulated cutting) and cutter diameter. After parameters are set, it is suggested to save them before loading the wizard into the system.

The operation method and parameter setting principle of circular pocket, rectangular contour and rectangular pocket are the same as those of circular contour, except for some parameters.

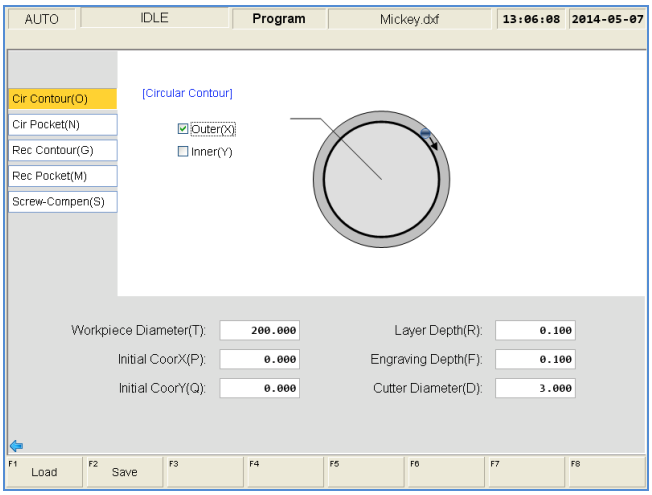



Fig. 3-73 Circular contour milling screen

Fig. 3-74 is the screw compensation measuring screen, where you can set relevant parameters for wizard to measure screw error via laser interferometer. After all parameters set, you can press F2 “Save” to save a file to the directory D:\NcFiles\Wizards. At this time, press F1 “Load” to load the file into the system. Or you can press F1 “Load” after parameter settings directly. After the first time setting,

each time you modify the parameter values, a prompt will show up, as shown in . Select “Yes” to save and load the new generated file.

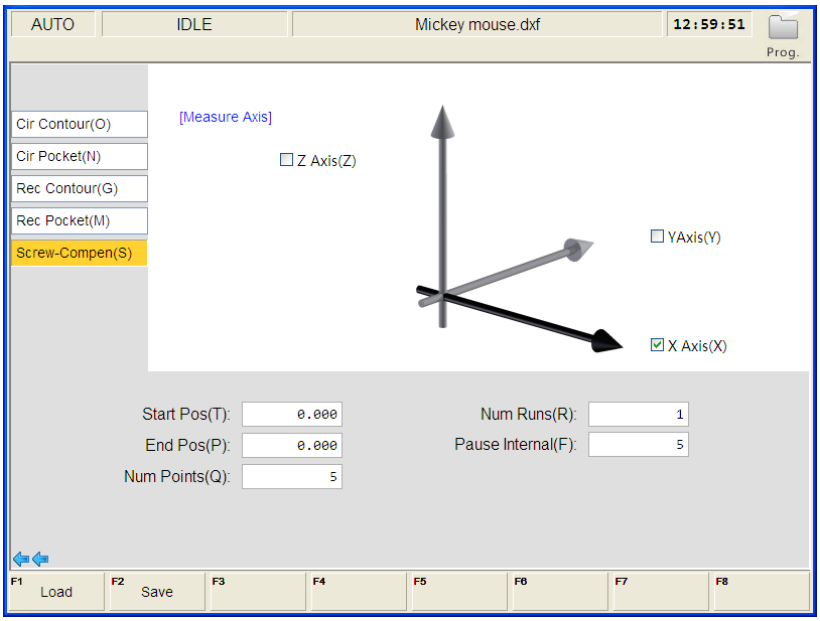



Fig. 3-74 Screw compensation screen

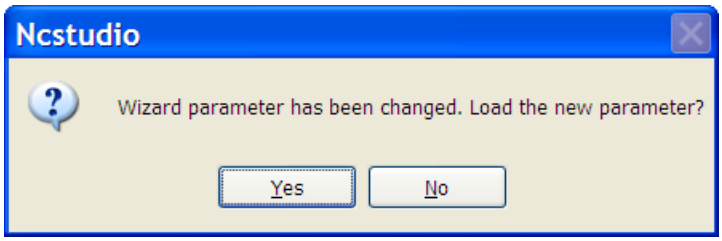



Fig. 3-75 Prompt for new parameter file

Note:

To begin with the operation, an axis should be selected, besides, X/Y/Z axis can only be selected alone at one time.

The “Start Pos” and “End Pos” should be located within the travel range and the latter must be larger than the former in absolute value.

One cycle refers to the process from the starting position to end position, during which, interferometer will record a group of data. However, a mean value will be used when written into the screw error file.

Measuring interval = (End position-Start position) / (Num of measuring points-1). To get an accurate measuring result, the starting position and end position should be calculated precisely and the number of measuring points should be an integer.

## 3.15.2 Program File

Pressing the program function selection key  will enter the machining file screen, and then pressing F1\F2 will switch between local disk program and removable disk program. See Fig. 3-76.

### ◆ Programs in Local Disk

Press F1 to open a list of local program files, under the root directory D:\NcFiles. The upper part of this screen is a file list box, while the lower part prompts the path of the currently selected file and available space of the driver. To load a file into the system, press "↑" or "↓" to move the cursor onto the desired file, and then press "Enter", the loading progress displayed on the information bar. At the same time, the system will check the file being loaded. If an error found in the file, a specific prompt about the error will be displayed on the information bar. After successful loading, other operations can be executed.

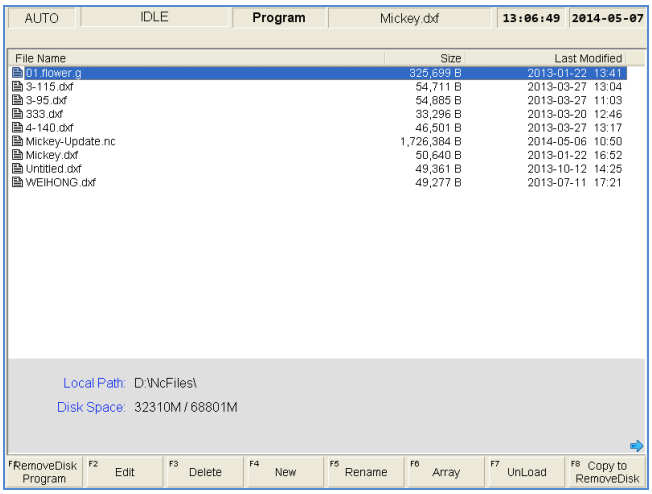



Fig. 3-76 Local program list screen

You can find the machining files under the default path of the hard disk (D:\NcFiles) and execute such operations as load, edit, delete and rename, etc. on them. In addition, you can create a new machining file under the default path and edit it.

### ◆ Programs in Removable Disk

Press F2 to open a program file list of removable disk.

### ◆ Programs on the Net

Press F3 to access program files which are allowable to visit among several machines sharing the same LAN. The "Network Program" sub-screen displays program files on the system or shared within the LAN. As shown in Fig. 3-77, press letter key N to open the file path.

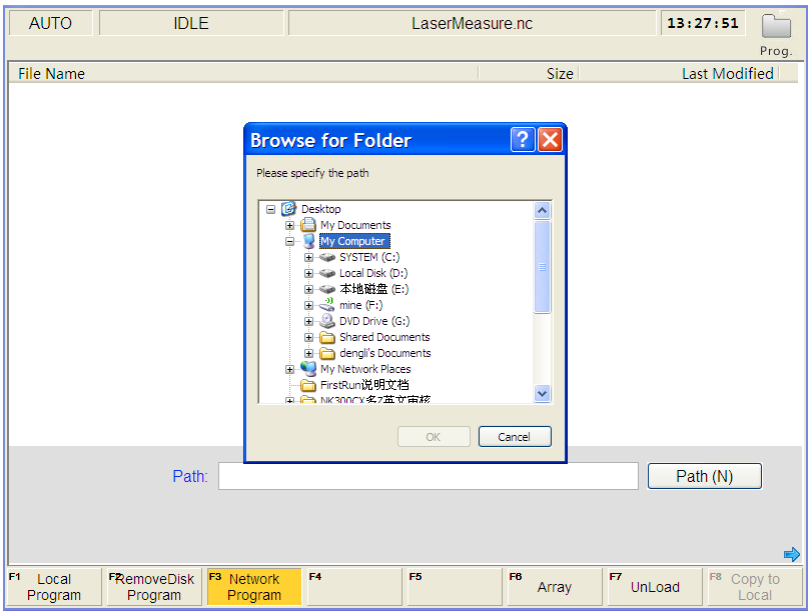



Fig. 3-77 Network program

> Note:
>
> Folder NcFiles is the default folder for sharing files or open files, for convenience of easy access to several machines.
>
> To avoid mal-operations, delete function is beyond available for network programs. If you need to make any modification to files on the network, you can copy it to the local first before any further operations.
>
> When the network is disconnected, program files loaded from the LAN network to the local (not copy) will be un-readable after power off or restart of the system or the software.

◆ **Edit**

After a machining file is selected, pressing the shortcut key F4 will make the system eject its embedded program editor automatically, in which you can do the following operations to the file, like “insert line”, “delete line”, “copy line”, “goto line”, “find”, “replace” and “save”.

> Note:
>
> Currently loaded file cannot be edited. Unload it before editing if necessary.

◆ **Delete**

After selecting a file, press F5 to eject a prompt box asking whether to delete the file.

> Note:
>
> If the selected file is under the state of being loaded, edited or processed, deleting it is prohibited.

◆ **New**

After the shortcut key F4 (on the next buttons bar) is pressed, the system will create a .nc file under the path D:\NCFILES with the default file name “Untitle1.nc”. The system will then automatically enter the program editor for your programming.

### ◆ Rename

After selecting a machining file, press the shortcut key F5 (on the next buttons bar) to eject a file name input box. After entering the new name, press F1 “OK” to complete the operation.

### ◆ Array

This function executes array machining for a machining file. Pressing the shortcut key F6 will display a new manipulation button bar, as shown in Fig. 3-78.

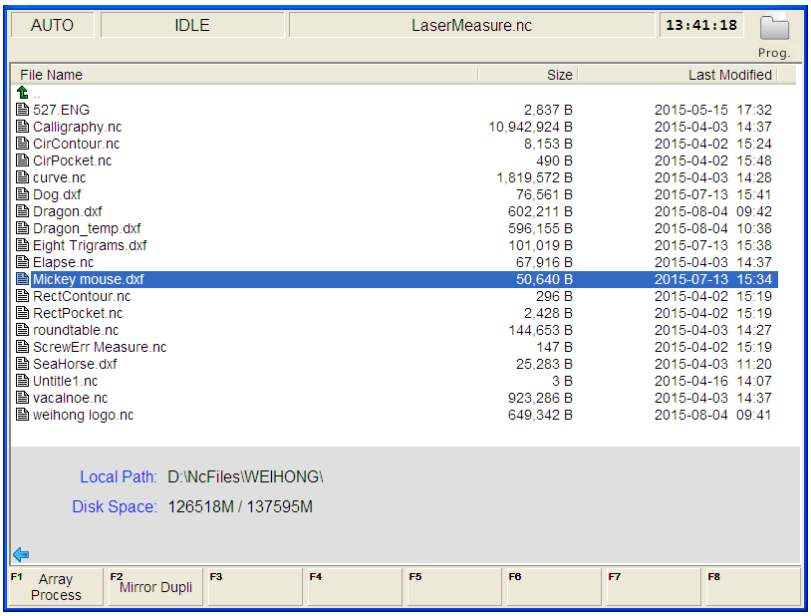



Fig. 3-78 Array machining

Press F1 “Array Process” to open a lower hanging dialog box, where you can set the rows, columns, row space and column space, etc. After parameter settings, press F7 “Generate” to generate a file, whose name can be user defined. After confirmation, the new generated file will appear in the programs list.

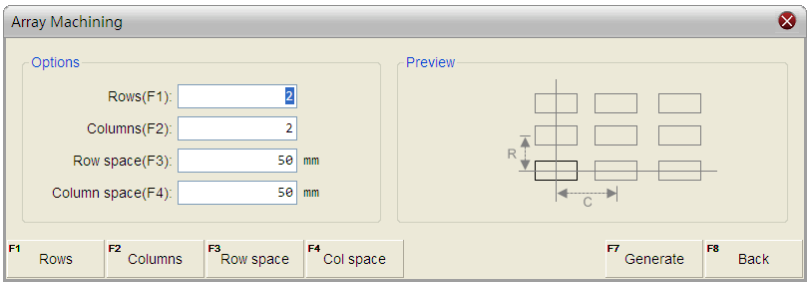



Fig. 3-79 Array machining

In Fig. 3-78, press F2 “Mirror Dupli” to enable image mirror function. As shown below. Set the parameters and generate new files as you wish.

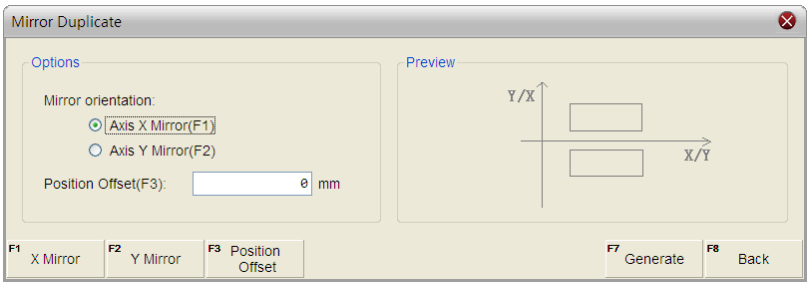



Fig. 3-80 Mirror and duplication

◆ **Unload and Copy to RemoveDisk**

Pressing the shortcut key F7 will unload the currently loaded machining file, opposite to the operation of “Load”.

Pressing the shortcut key F8 (the premise is that a removable disk has already been inserted) will copy the file selected to the removable disk.

Apart from NC files, the system also supports PLT files, DXF files and ENG files.

## 3.15.3 Multi-tasking Machining

To meet the users’ demand in the field, multi-tasking can be enabled by simple parameter setting.

Press  ==>  ==> F1 “Software Option” ==> F8 “Manufacturer” to show parameters of MFR’s access. Find parameter N80003 “Support Program Task”, set its value to “Yes” and restart the software.

Press  ==>  ==> F3 “Task List” to open the setting dialog box, see Fig. 3-81.

The upper part of the screen shows the file list for the current machining task, while the lower part shows the files in the local disk.

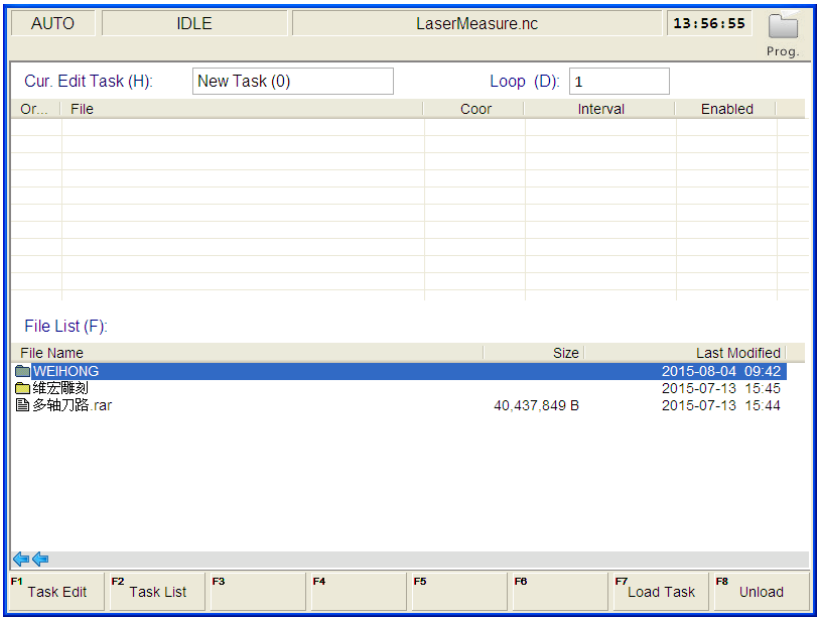



Fig. 3-81 Task list sub-screen

In Fig. 3-81, press F2 “Task List” to open a pop-up dialog box hanging over the lower part of the screen. As shown below, pressing F7 “Open Task” can open the selected task and jump to the Fig. 3-81. Pressing F1/F2/F3 can create/delete/rename a machining task.

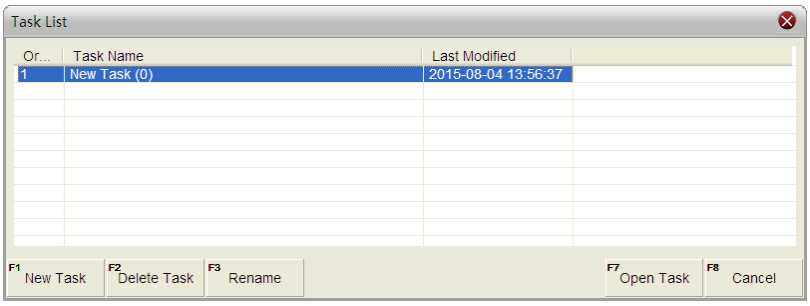



Fig. 3-82 Open task

In Fig. 3-81, press F1 “Task Edit” to turn to the task editing screen, see Fig. 3-83. Select a program in the files list and press F1 “Add File”. A dialog box will pop up, as shown in Fig. 3-84, where you can select the WCS and extended WCS for the file of current task.

In Fig. 3-83, pressing F4 “Set Interval” can set the time period from the end of the selected program file to the beginning of next program file machining. Unit for the interval is second (s).

In Fig. 3-83, pressing F3 “Set Coor” can modify the WCS for the selected file. Pressing F5/F6 “Up” and “Down” can arrange the file in the current task list. Pressing F7 “Save” can save the settings.

In real practices, the system will conduct machining according to the sequence of file in the task list. When one program is completed, the system will automatically check the remaining programs, wait the time period specified by “Task Interval” and continue next program machining, until all programs in the task list are completed.

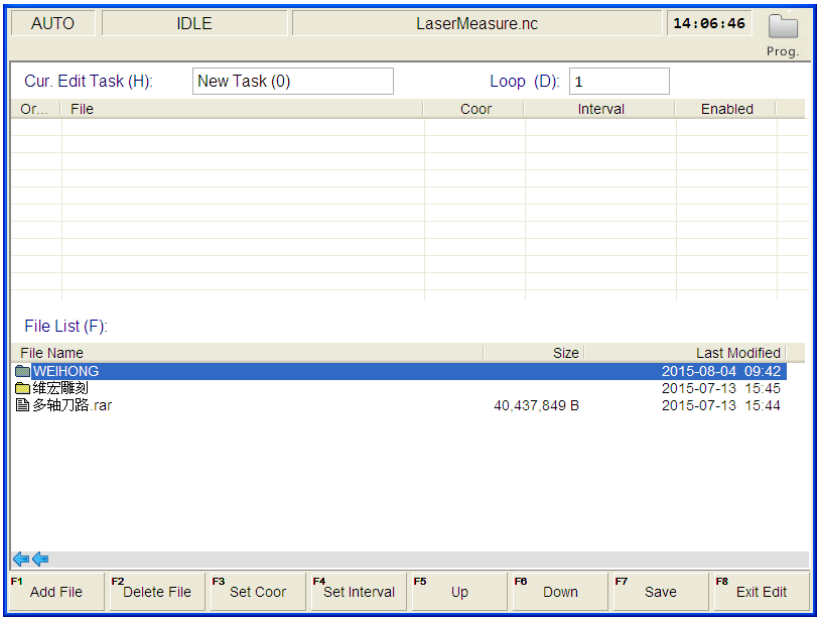



Fig. 3-83 Task editing

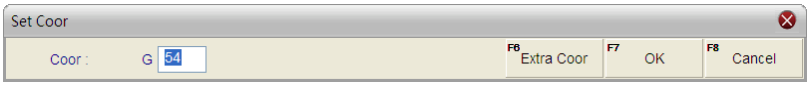



Fig. 3-84 Set WCS for file in the task

◆ **Involved Parameters: PLT file translation**

| Parameter | | Meaning | Setting Range |
|---|---|---|---|
| **N65000** | Retract | It sets the tool lifting height during rapid traverse. | 0~99999 |
| **N65001** | PLT Units | Normally, 1plt=40.195mm, which can be magnified or reduced by setting this parameter. | 0.001~99999 |
| **N65002** | Tool Offset | To process the workpiece adequately, tool spacing set needs to make the parts between the adjacent tool paths overlapped based on the tool diameter. Tool offset here refers to the tool spacing in PLT file machining. | 0.0001~99999 |
| **N65003** | Cutting Depth | It specifies the machining depth for 2D files. | -99999~0 |
| PLT file translation parameters are applied to translation of PLT files. PLT is a format of 2D machining files defined by an American company Hewlett Packard (HP), usually used in embossment and advertising carving, including such parameters as “retract”, “PLT units”, “tool offset” and “cutting depth”. At the same time, PLT is a kind of unit. Normally, 1plt=40.195mm, which can be magnified or reduced by setting the parameter N65001. | | | |

◆ **Involved Parameters: DXF file translation**

| Parameter | | Meaning | Setting Range |
|---|---|---|---|
| **N65100** | Retract | It sets the tool lifting height during rapid traverse. | 0~99999 |
| **N65101** | Cutting Depth | It specifies the machining depth for 2D files. | -99999~0 |
| **N65102** | Layer Depth | It decides the cutting depth each time in 2D machining. | -99999~0 |
| **N65103** | First Point as Origin | It sets whether to set the firstly met coordinate point as zero point when a DXF file is processed. | YES: Use the first point as zero point<br>NO: Not use the first point as zero point |
| **N65104** | By Contour | | YES: Valid<br>NO: Invalid |
| **N65105** | Enable Bottom Cutting | Valve operation is enabled only when [3D cutting] is on the workpiece surface. | YES: Valid<br>NO: Invalid |
| **N65106** | Use Metric | It forcibly sets a DXF file in metric size. | YES: Forcibly set in metric size<br>NO: Not forcibly set in metric size |
| DXF file translation parameters are applied to translation of DXF files, including “retract”, “cutting depth”, “layer depth”, “first point as origin” and “by contour”, etc.<br>When processing a Dxf file, the system treats the action of tool lifting as the separate mark for the adjacent shapes. If there is no tool lifting, the system will consider only one shape is being processed. If tool lifting occurs, it indicates the processing of a complete shape is finished. For example, process several circles adjacent to each other, but not overlapped. The depth of each circle is 10mm, and each feed depth of Z axis is 2mm. If parameter N65104 is set to YES, the machine tool will process the current circle 5 times, lift its tool, and then go to process the next circle. If it is set to NO, the machine tool will process the current circle once, lift its tool, and then go to process the next circle. After all the circles are processed once, this process will be re-executed 4 times to finish processing all the shapes. | | | |

◆ **Involved Parameters: ENG file translation**

| Parameter | | Meaning | Setting Range |
|---|---|---|---|
| **N65200** | Retract | It sets the tool lifting height of Z axis when a machine tool processes an ENG file in rapid traverse. | 0~99999 |
| **N65201** | Prompt for Tool Change | If it is set to YES, when tool change command is encountered, the machine tool will suspend machining and uplift its Z axis, and the prompt bar in the system will prompt tool change. At this time, | NO: Invalid<br>YES: Valid |

| Parameter | | Meaning | Setting Range |
|---|---|---|---|
| | | you can perform the operation of tool change. If it is set to NO, when tool change command is encountered, the machine tool will not suspend machining, but the prompt bar in the system will still prompt tool change. | |
| **N65203** | Cutting by Tool Number | If this parameter is set to YES, opening an Eng file will eject a dialog box asking to select a tool (the tool specified in the Eng file instead of the system default tool) for machining based on the machining program. | NO: Not use<br>YES: Use |
| ENG file translation parameters are applied to translation of ENG files, including “retract”, “prompt for tool change”, etc. | | | |

◆ **And**

| Parameter | | Meaning | Setting Range |
|---|---|---|---|
| **N65204** | Deep Hole Cutting Type | It sets the manner for processing deep holes. | 0: Reciprocating chip removal<br>1: High-speed reciprocating chip removal<br>2: Up to safe height |
| **N65205** | Lifting Distance | It indicates the retract value after feed each time in the manner of high-speed reciprocating chip removal for deep hole drilling. | 0~99999 |
| These two parameters are related to processing of deep holes. | | | |

# 3.16 Handwheel Operation

## 3.16.1 Handwheel Mode

The system supports three operation modes—auto mode, reference point mode and manual mode, and manual mode is subdivided into jog mode, stepping mode and handle (handwheel) mode. You can turn the mode selection knob on the operation panel to “Handle”, i.e. to handwheel mode, as shown in Fig. 3-85.

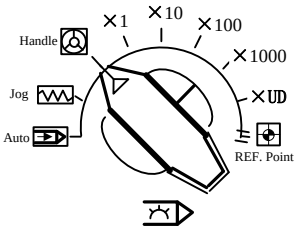



Fig. 3-85 Mode selection knob

In handwheel mode, you can configure a handwheel to control the machine tool. As shown in Fig. 3-86, select a motion axis by rotating “Axis Selection Button”, select handwheel override gear by rotating “Gear Selection Button”, and control the selected axis running at the selected handwheel override gear by rotating “Handwheel Control Rotation Disk”. Handwheel override gear regulates the displacement (linear displacement or rotation angle) of moving parts of a machine tool with each case turning of a handwheel. The displacement is set by parameters N52003, N52004 and N52005.


Fig. 3-86 A handwheel

◆ **Involved Parameters:**

| Parameter | | Meaning | Setting Range |
|---|---|---|---|
| **N52001** | Precise Pulse Counting | When it is set as valid, the motion distance of a machine tool will correspond to handwheel counts strictly. | NO: Invalid<br>YES: Valid |
| If it is set as valid, when a handwheel turns too fast, even though handwheel stops, a machine tool will still move quite a long time since the driver receives all the pulse signals sent by the handwheel. If it is set as invalid, the system can respond to the turning of the handwheel rapidly. But if the handwheel turns too fast, the motion distance of the machine tool may not be in accordance with that indicated by the handwheel. | | | |

◆ **And:**

| Parameter | | Meaning | Setting Range |
|---|---|---|---|
| **N52002** | Handwheel Direction | Positive/negative motion direction of a machine tool when turning a handwheel | 1: Maintain the original machine motion direction in handwheel turning<br>-1: Reverse the original machine motion direction in handwheel turning |
| **N52003** | Multiple at X1 | The system will interpret 1 pulse is received when a handwheel sends 1 pulse. | 0.001~10 |
| **N52004** | Multiple at X10 | The system will interpret 10 pulses are received when a handwheel sends 1 pulse. | 0.001~10 |
| **N52005** | Multiple at X100 | The system will interpret 100 pulses are received when a handwheel sends 1 pulse. | 0.001~10 |
| **N52010** | Handwheel Acceleration | It sets the acceleration during handwheel mode (the smaller the value is, the more stable the motion will be). | 1~1000 |
| **N52012** | Deceleration when Switching Axis | If set to “YES”, oscillation of a machine tool may be reduced, but over-travel may occur. Otherwise, oscillation of the machine tool may occur. | YES: Decelerate; NO: Not decelerate |

## 3.16.2 Handwheel Guide Control

NK300BX system supports handwheel guide control function.

Handwheel guide refers to a way of operation that the automatic execution speed of a machining program is manually controlled during auto processing so as to guard against dangers caused by a wrongly loaded program or an inappropriate tool path.

In Auto mode, press the handwheel guide control key 

on the operation panel. If the top-left indicator on, it means the function is activated. After machining starts, the system will execute the machining file with clockwise turning of the handwheel and stop machining with the stop of the handwheel. Machining speed varies with the handwheel turning speed.

NK300BX also holds the function of handwheel guide reverse control. Turn the handwheel anticlockwise when an error is found in machining to make the machine tool reverse along the previous machining track.

◆ **Involved Parameters:**

| Parameter | | Meaning | Setting Range |
|---|---|---|---|
| **N52006** | HW Lead Gear (Numerator) | This ratio is used to control the feed speed of a machine tool in handwheel mode. | 1~1000 |
| **N52007** | HW Lead Gear (Denominator) | | |

## 3.17 System Management

To access the system info function section, press the system function selection key  . Under the function section, you can view system info, do system maintenance and switch to other configurations.

### 3.17.1 System Info

In the system info functions section, the default interface displays system info, including CNC software info and hardware info. Pressing F1 “Hardware” will eject a new manipulation button bar, in which “Register” can be found. See Fig. 3-87. For more details about register, refer to Chapter 3.17.4 Register.

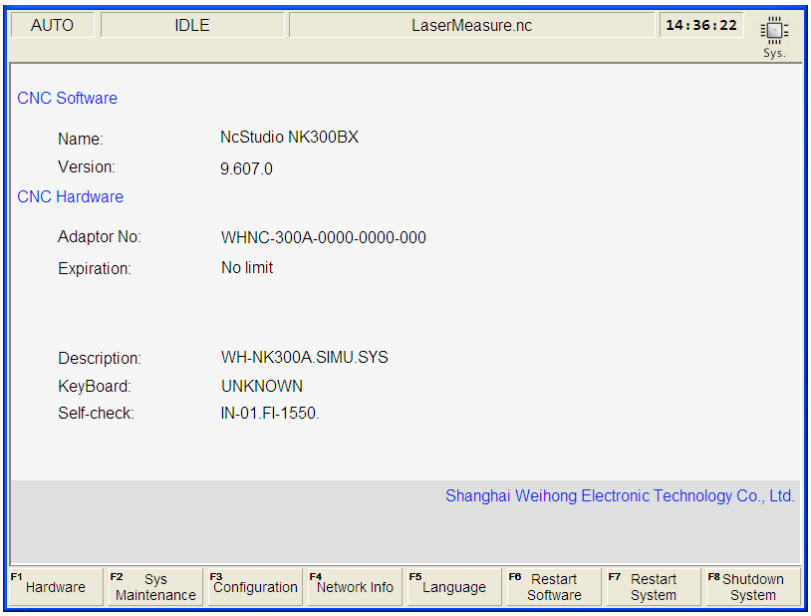



Fig. 3-87 System info

### 3.17.2 Configuration and Language Selection

◆ **Configuration Selection**

Currently NK300BX has two configurations for option—“ThreeAxisConfig” and “FourAxisConfig”. In addition, configurations can be added according to the user’s requirements. To switch between “ThreeAxisConfig” and “FourAxisConfig”, press F3 “Configuration” in the system info function section. See Fig. 3-88.

Three axes configuration contains standard, turntable and double Y axes configurations. While four axes configuration contains XYZA, XYZB and XYZC types.

To switch to other configurations, press “↑” or “↓” to move the cursor to the desired one, and then press the shortcut key F1 “Select”, the system ejecting a dialog box asking “Configuration changes may

cause damage to your machine, are you sure to change it". Selecting "Yes" will eject a new dialog box showing "New active configuration has been selected, please restart NcStudio to make it valid, do you want to go on?". After "Yes" is selected this time, the system will be restarted to enable configuration switchover. After system restarted, you need to set relevant parameters again.

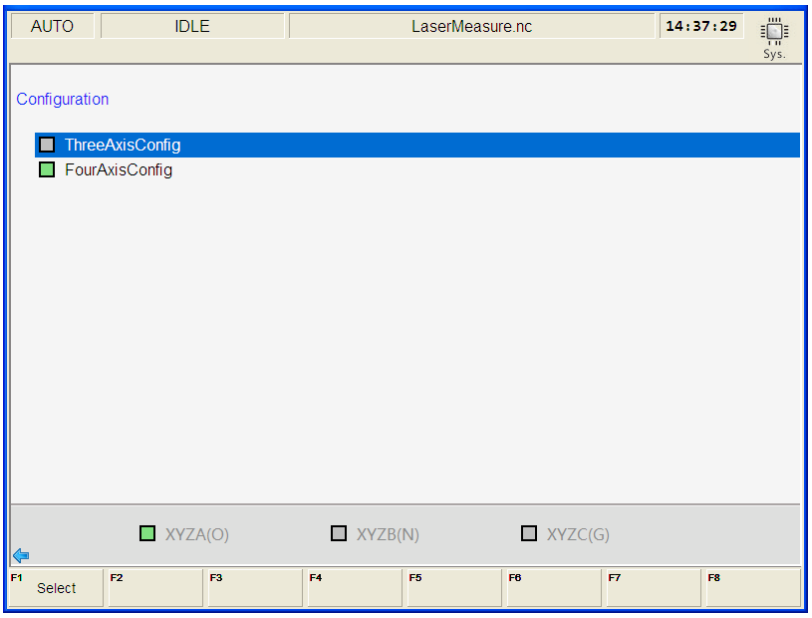



Fig. 3-88 Configuration management screen

◆ **Language Selection**

To access the language selection interface, press F5 "Language" in the system info function section. At present, there are two languages for option—"Chinese" and "English". You can run the system in a familiar language by pressing "↑" or "↓" to move the cursor onto the desired language and then pressing F1 "Select". The system will then give a prompt "Succeeded! Restart the software to take effect." Press Enter for confirmation.

## 3.17.3 IP Setting

NK300BX supports network connection. You can obtain IP address automatically or set it manually.

◆ **Auto Obtain**

DHCP function is enabled here. In the system info function section, pressing F4 "Network Info" will access the network info interface. To access the network settings interface, press the letter key G. You can obtain IP address automatically. See Fig. 3-89. The system will obtain IP address automatically.

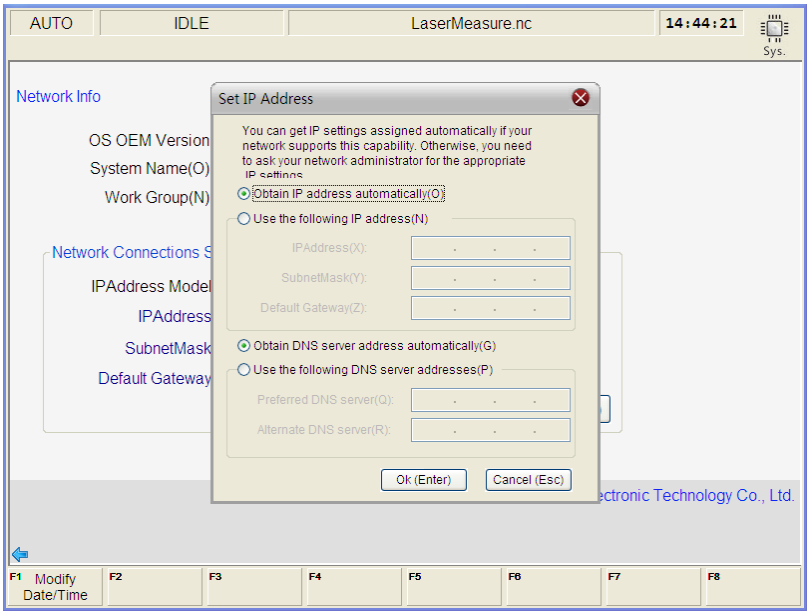



Fig. 3-89 IP address settings

◆ **Manual Setting**

In Fig. 3-89, press letter key N to manually set the IP address.

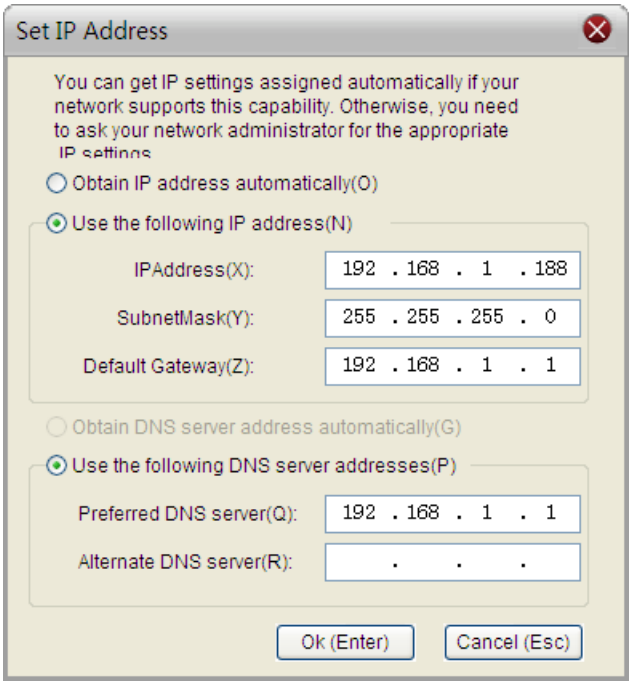



Fig. 3-90 Manual setting

As shown in Fig. 3-90, input the IP address manually：

IP address: 192.168.1.188 (within the same range of that of the computer)

Subnet Mask: 255.255.255.0 (same with that of the computer)

Default Gateway: 192.168.1.1 (same with that of the computer)

After setting, press Enter for confirmation. And you can turn to the [Network Info] screen to view the setting.

Note:

Manual setting of NK300BX IP will reset the IP of the computer, please note that.

### 3.17.4 Register

"Register" under "Hardware" in the system info function section is used to decide system service time with the help of a registration code generated by the registration code maker.

The system supports register per hour or per day. Both two ways of register count service time according to system internal clocking, no matter whether the system is power off or not.

The steps to generate a registration code are as follows:

1) Turn to system info interface to get the adaptor serial number, as shown in Fig. 3-91. Or you can press F1 "Register" in Fig. 3-91 and get the serial number in the pop-up dialog box, as shown in Fig. 3-92.

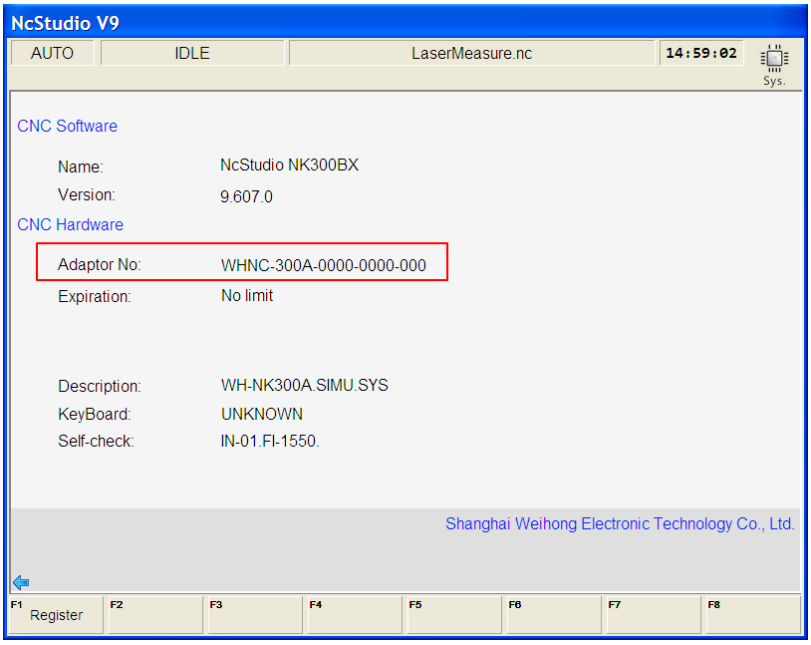



Fig. 3-91 Board serial number

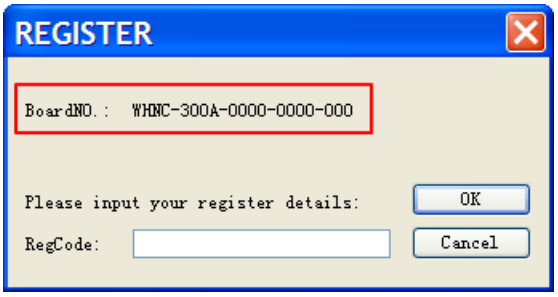



Fig. 3-92 Board serial number in the pop-up dialog box

2) Double click the registration code maker "GetRegCode.exe", and then enter the password "ncstudio" (revisable) in the dialog box as shown in Fig. 3-93. Then press Enter, input control card serial number, registered times and limited service time, and then click "Generate" to generate a new code displayed on the lower part, as shown in Fig. 3-94. If service time does not need limiting,

input “-1” in the limited service time box to generate an unlimited code.

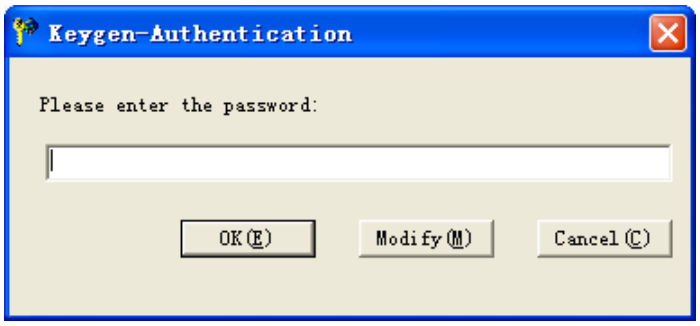



Fig. 3-93 Registration code maker-1

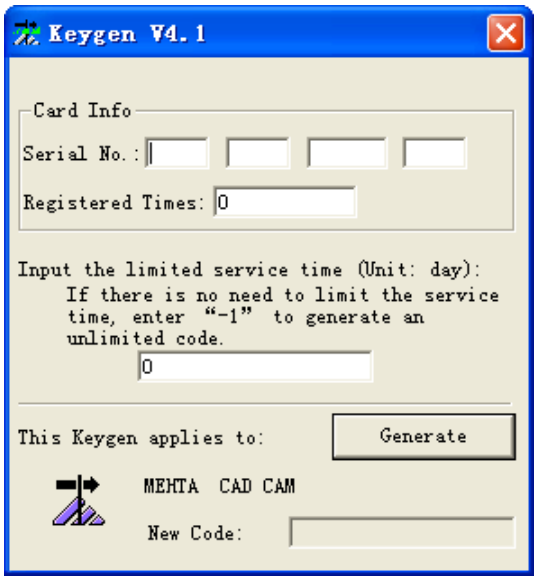



Fig. 3-94 Registration code maker-2

3) Press F1 “Register” under F1 “Hardware” in the system info function section, and then input the registration code generated in the first step into the input box, and then press Enter.

4) The system prompts “Register successfully”.

> Note:
>
> Registration code maker are owned by machine tool builder.
>
> ID of board varies as the registration times increases, which can be tell from the last three number of the serial number. For example, when registration times is 0, the last three number of the SN is 000, when registration times is 1, 001.

# 3.18 Auxiliary Function

## 3.18.1 Single Block Execution

You can set the machining task to be executed in single step mode, facilitating error diagnosis and failure recovery. Once in single block mode, the system stops machining when resultant velocity of each axis is “0”.

When the single block key on the operation panel is pressed, the system will only execute the machining file for one line each time the START button is pressed, and then enter into the pause state. To go to the next line, you need to press the START button again.

## 3.18.2 Back to Workpiece Origin

The origin of WCS (workpiece coordinate system), i.e. workpiece origin, is fixed with respect to a certain point on the workpiece, while mobile with respect to machine origin. The selection of workpiece origin should meet the demands of simple programming, easy dimension conversion and small caused machining error, etc.

To back to workpiece origin, press the general function selection key  , and then press F7 “Home” will make the spindle return to workpiece origin automatically from the current position.

## 3.18.3 Jiggle

If machining is found not in position in auto machining, suspend machining and execute manual jiggle. Jiggle result is only available for the machining task this time, and becomes ineffective after machining stops.

Jiggle function can be found by pressing  ==>  ==> F3 “Jiggle”. After pressing the Pause key in auto machining, press F3 “Jiggle” to access the jiggle interface, as shown in Fig. 3-95, in which set a proper step, and then press an axis direction key to jiggle the corresponding axis. After satisfying jiggle result is obtained, press the START key to continue machining.

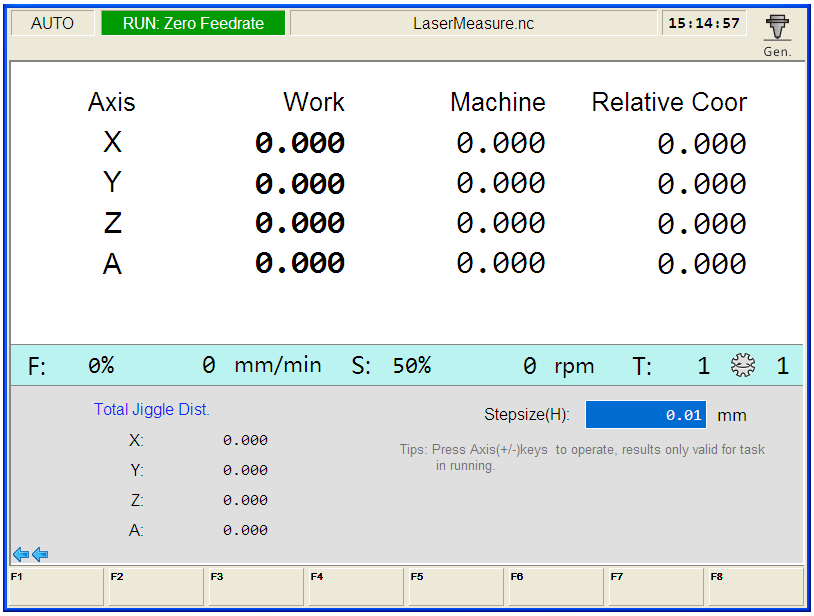



Fig. 3-95 Jiggle setup

## 3.18.4 Selective Machining

This function can select any blocks for machining.

Selective machining function can be found by pressing  and F4 “Selective Machining” to access the selective machining input box, as shown in Fig. 3-96. Enter the desired start line number and end line number, and then press Enter for confirmation. At this time, pressing the START key will start machining the selected blocks.

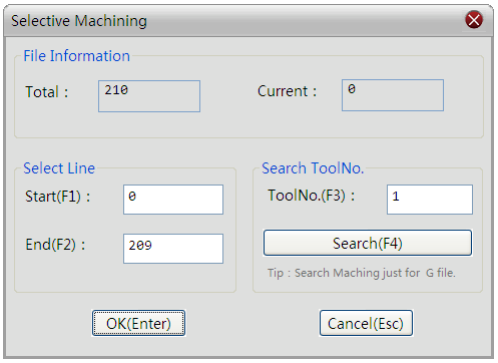



Fig. 3-96 Selective machining

## 3.18.5 Mirror and Rotation

This function can execute mirror and rotation on a machining file.

Mirror and rotation function can be set on the interface by pressing  . As shown in Fig. 3-97.


Fig. 3-97 Mirror and rotate setting on the main interface

Press letter key F to open the mirror and rotation machining dialog box, as shown in Fig. 3-98. Enter the sequence number of the desired machining mode into the machining mode input box, and then press Enter for confirmation.

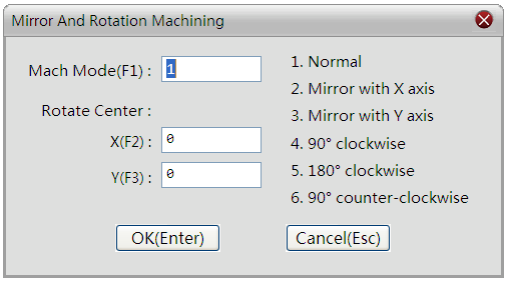



Fig. 3-98 Mirror and rotation interface

You can set rotating center in Fig. 3-98, if no center is specified, the workpiece origin will be the rotating center by default.

> Note:
>
> The above introduction is for the classic interfaces, those for new interfaces may differ slightly while operations methods are the same.

## 3.18.6 Breakpoint Resume

This function is executed by pressing the breakpoint resume key on the operation panel, which will make the system resume machining from the stop line number of last time machining automatically.

If power failure or emergency stop occurs during machining, and you are sure about the accuracy of the workpiece coordinates, you can execute this function to make a machine tool rapidly move to the breakpoint and resume machining, to save machining time.

### 3.18.7 Workpiece Length Sensing

Workpiece length can be sensed by the system.

The system senses workpiece length by workpiece coordinates. For instance, to sense the workpiece length in the X direction, the steps are as following:

1) Press  ==>  ==> F1 “Switch Coor” to switch to “Relative Coor Mode”;

2) Manually move the X axis to one side of workpiece, and then press F2 “Work” and F1 “Clear X Relative” in turn;

3) Manually move the X axis to the other side of workpiece. Workpiece length in the X direction is the X axis “Relative Coor” displayed on the interface.

> Note:
>
> Relative clear has no effect on absolute coordinates and machine coordinates, so you can still use the original coordinates for machining.

### 3.18.8 Parameter Auto Backup

The system boasts the function of parameter auto backup. If you forget to save the set parameters, you can switch to this screen, in which you can restore parameters from the ex-factory date to system last shutdown.

Parameter auto back screen can be found by pressing the parameter selection key  ==>  ==> F2 “Param Auto Backup”, as shown in Fig. 3-99, in which press the Up or Down key to move the cursor to an active backup and press F1 “Restore” to restore the selected backup parameters.

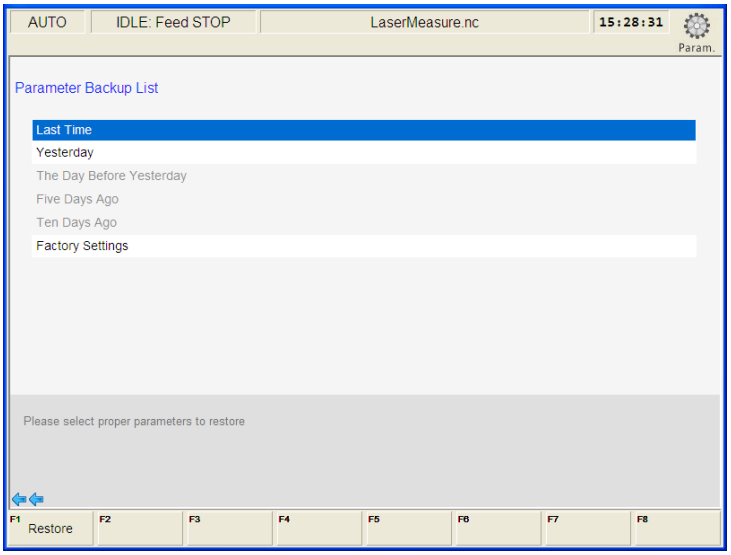



Fig. 3-99 Parameter auto backup

## 3.18.9 Manual Data Input (MDI)

Press  ==>  ==> F4 “MDI” in turn to access the MDI interface. See Fig. 3-100.

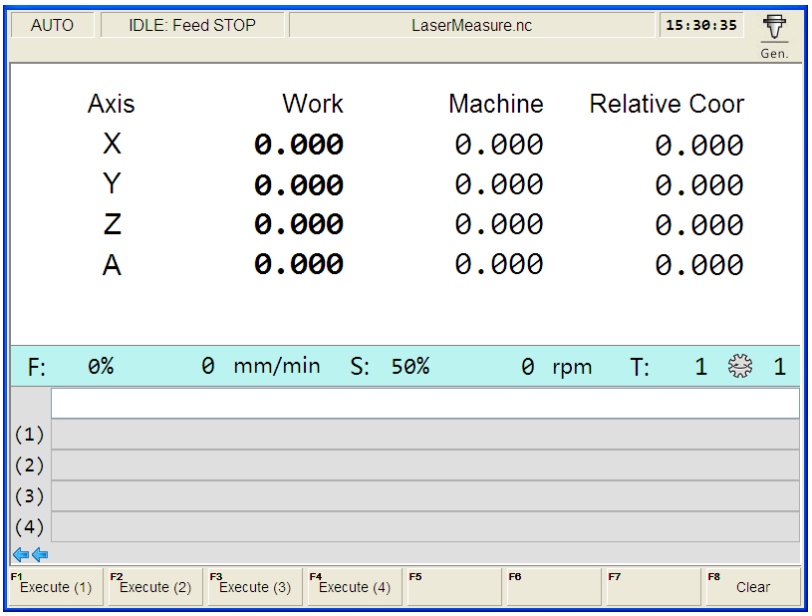



Fig. 3-100 Manual data input screen

At the upper part of the screen, displayed are machine coordinates and workpiece coordinates of each axis, while at the lower part of the screen, there are 4 input boxes for entering instructions. The newly entered instruction is at the top.

After entering the new instruction in the white input box, press Enter, and then press F1 “Execute (1) to execute the entered instruction. The system can save 4 newly entered instructions, and pressing F1, F2, F3 or F4 will execute an instruction in the corresponding input box.

# 3.19 Tool Magazine

## 3.19.1 Auto Tool Change of Linear Tool Magazine

Linear tool magazine stores tools in the form of array. For example, if a customer has 12 tools, he can select a 1-line 12-row tool magazine, or a 2-line 6-row tool magazine, etc. Auto tool change is realized by programming in the **public.dat** file according to the related information learned from the customer. The process of auto tool change for a linear tool magazine is as following:

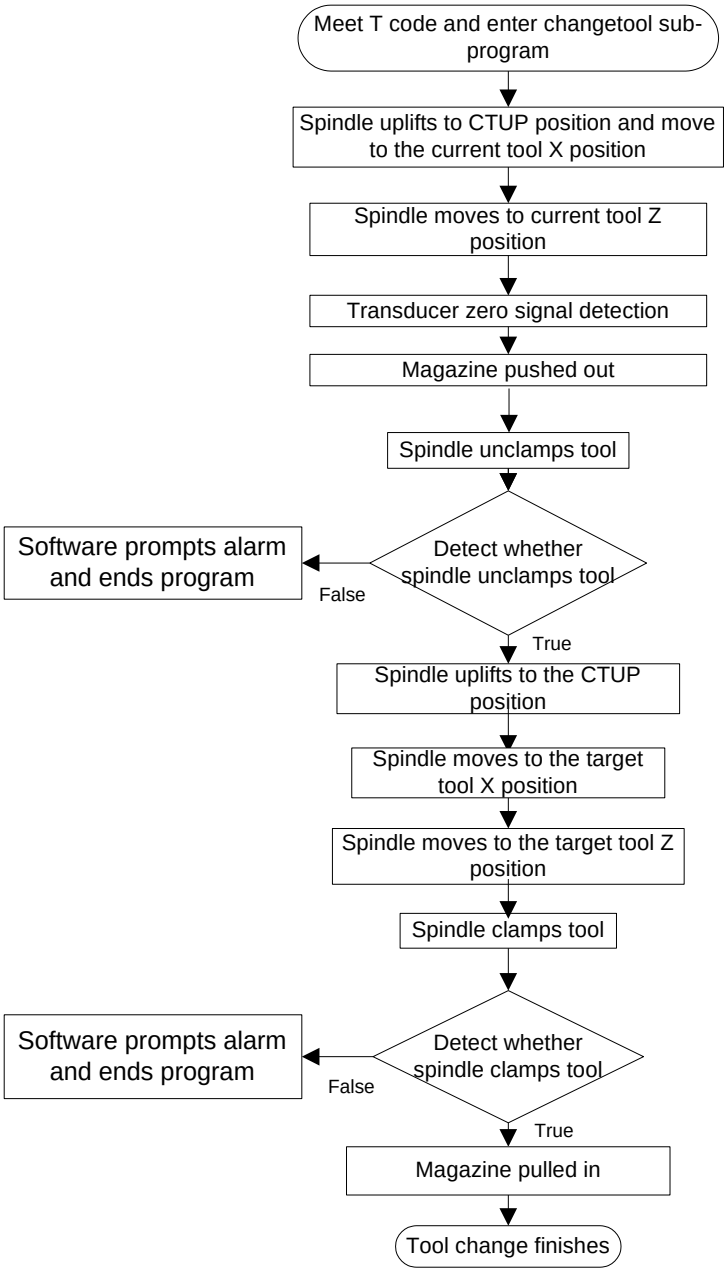



Fig. 3-101 Process of auto tool change for a linear tool magazine

◆ **Involved Parameters Are:**

| Parameter | | Meaning | Setting Range |
|---|---|---|---|
| **N66034** | Group 1 Tool Position (X) | Machine coordinate value of X axis of No. 1 tool | / |
| **N66035** | Group 1 Tool Position (Y) | Machine coordinate value of Y axis of No. 1 tool | / |
| **N66036** | Group 1 Tool Position (Z) | Machine coordinate value of Z axis of No. 1 tool | / |

Many tool coordinate positions are provided for selection, which will not be listed here.

## 3.19.2 Auto Tool Change of Circular Tool Magazine

When a machine tool is with the function of a circular tool magazine and auto tool change is needed during file machining, the process of auto tool change is as following:

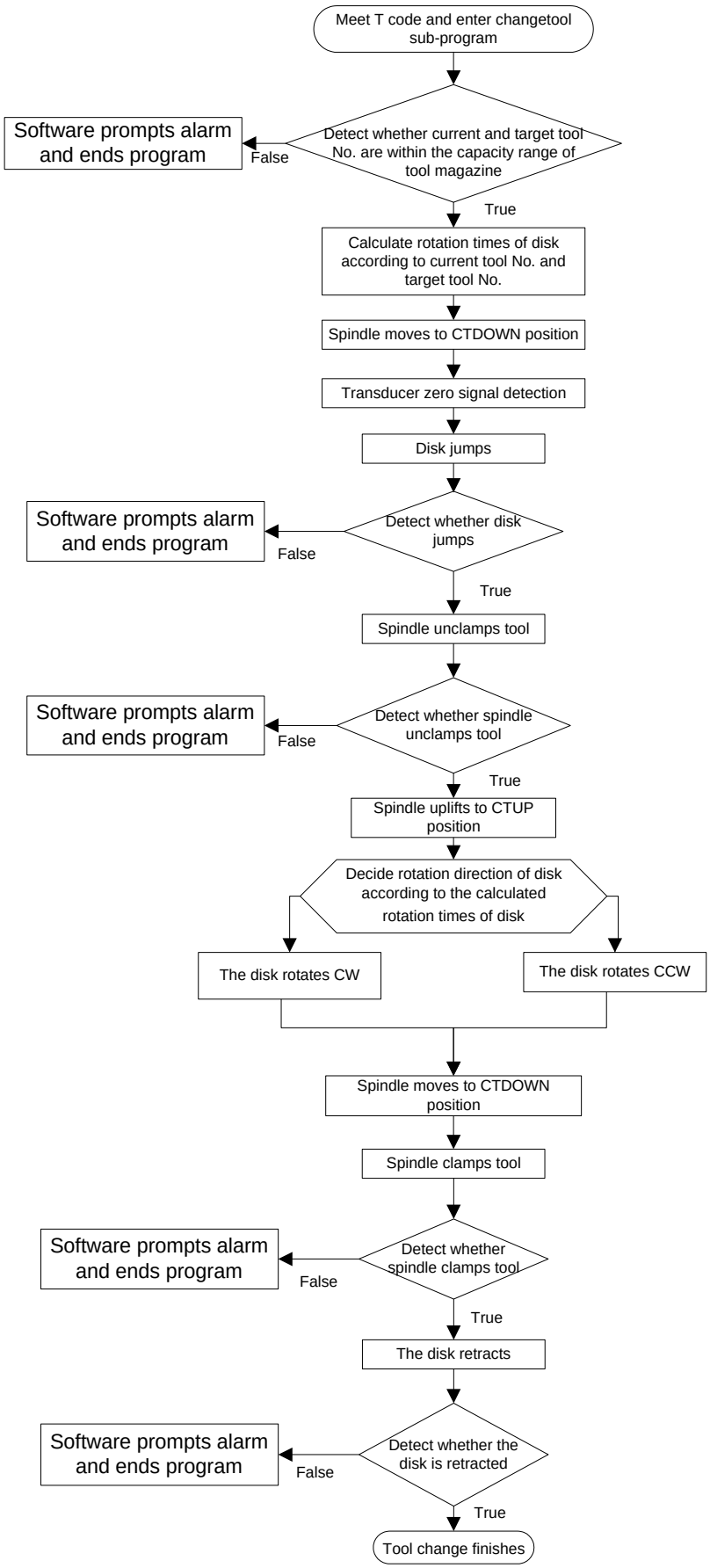



Fig. 3-102 Process of auto tool change for circular tool magazine

### 3.19.3 Involved Parameters

| Parameter | | Meaning | Setting Range |
|---|---|---|---|
| **N31000** | Tool Magazine Capacity | The capacity of tool magazine | 1~255 |
| **N31003** | Check Change ToolNo | Whether to check tool number in tool change is proper or not | YES: The tool number must be within (0, 256) in tool change command.<br>NO: The range of the tool number is not limited, and the tool number remains the same. |
| **N66012** | DiscToolNumber | Current tool No. in the disk | 0~ Tool Magazine Capacity |
| **N67000 ~ N67002** | Change Tool Workbench Range Lower Limit X/Y/Z | Machine coordinate value of worktable stroke lower limit of X/Y/Z during tool change | / |
| **N67010 ~ N67012** | Change Tool Workbench Range Upper Limit X/Y/Z | Machine coordinate value of worktable stroke upper limit of X/Y/Z during tool change | / |
| This group of parameters sets the worktable stroke range for tool change to avoid tool damage caused by over travel during tool change. | | | |

◆ **And:**

| Parameter | | Meaning | Setting Range |
|---|---|---|---|
| **N66000** | Prompt for Tool Change | Whether to pause and prompt tool change when meeting tool change command. | NO: Invalid;<br>YES: Valid |
| **N66005** | Upper Position | Z-axis machine coordinate when a tool moves to tool magazine for tool change, or CTUP position | -99999~99999 |
| **N66006** | Lower Position | Z-axis machine coordinate of tool change position when a tool moves downwards from Upper Position, or CTDOWN position | -99999~99999 |
| **N66007** | Spindle Position X/Y/Z | Machine coordinate value when spindle changing a tool, usually used for circular tool magazine parameter setting. | -99999~99999 |
| **N66017** | Deceleration Position X/Y/Z | Machine coordinate value of spindle position before tool change | -99999~100000 |
| **N66028** | Tool Change Speed | Movement speed of spindle during tool change | 0~100000 |

| Parameter | | Meaning | Setting Range |
|---|---|---|---|
| **N66029** | Z Axis Speed | The speed of Z axis moving to Upper and Lower Position during tool change | 0~13740 |
| **N66030** | Automatic Tool Measure | Whether to execute auto tool measurement after tool change | NO: Not execute<br>YES: Execute |

# 4 Maintenance

## 4.1 Installation and Package of NcStudio

When NK300BX leaves factory, operating system and software have been installed and setup, which are ready for use. If any failure occurs, you are entitled to restore system to leaving factory state.

### 4.1.1 Preparation

An USB flash disk (above 1G)

The backup and restore kit

### 4.1.2 Setup

◆ **Creating USB Startup Disk**

To create a USB startup disk to help the system access DOS interface, in order to back up and restore the system SSD.

Operation steps are as follows:

1st, Insert a USB into the PC, and double click the application named “HPUSBFW.EXE" in file folder “hpUpgsh” on the desktop. Interface as shown below will pop up.

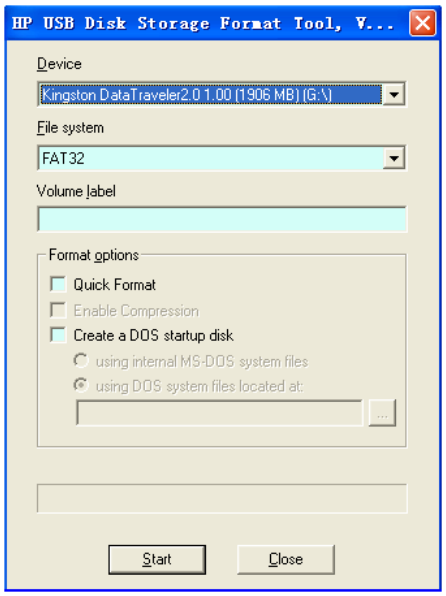



Fig. 4-1 USB format tool

- In Fig. 4-1, select the target USB flash disk which needs to be formatted.
- File system sets to FAT32 by default.
- Check items “Quick Format” and “Create a DOS startup disk”.
- Below the item “using DOS system files located…”, specify and locate the path “Desktop\hpUpgsh\boot”.

- Click “Start” to initiate formatting. After two successive confirmation, creation of USB startup disk is successful.

2nd, On the desktop of PC, double click the application “USB backup and restore tool kit”, and interface as shown in Fig. 4-2 will show up.

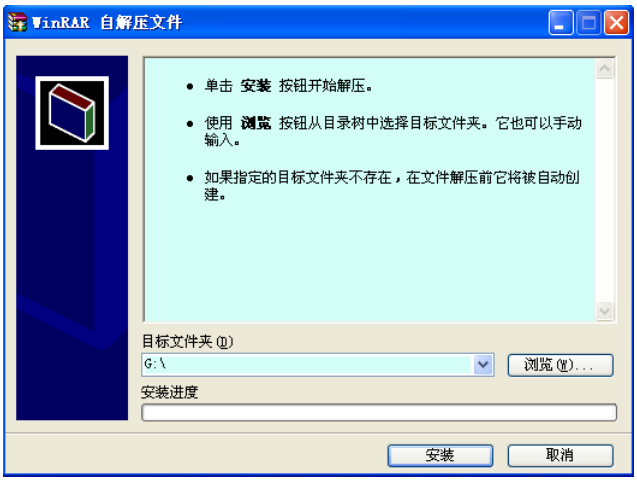



Fig. 4-2 USB restore tool kit

3rd, Locate the USB startup disk which has been created successfully in the target file box, and then click “Install”. After installation, all files contained in “USB backup and restore tool kit” will be unzipped into this USB.

4th, Conduct anti-virus operation to the USB to secure it is clean.

### 4.1.3 Restore System

Restore system refers to the process of mirror image installation of the system SSD. USB well created before and a system SSD is needed.

1st, Insert the USB flash disk to the USB slot.

2nd, Restart the system, and press Delete key to enter BIOS interface. Accessing “Advanced Bios Features--->Hard Disk Boot Priority”, and set order for USB disk: USB devices/Cho M/Cho S (for reference only).

3rd, After order set, press F4 to save it and restart. After normal startup, interface like below will show up.

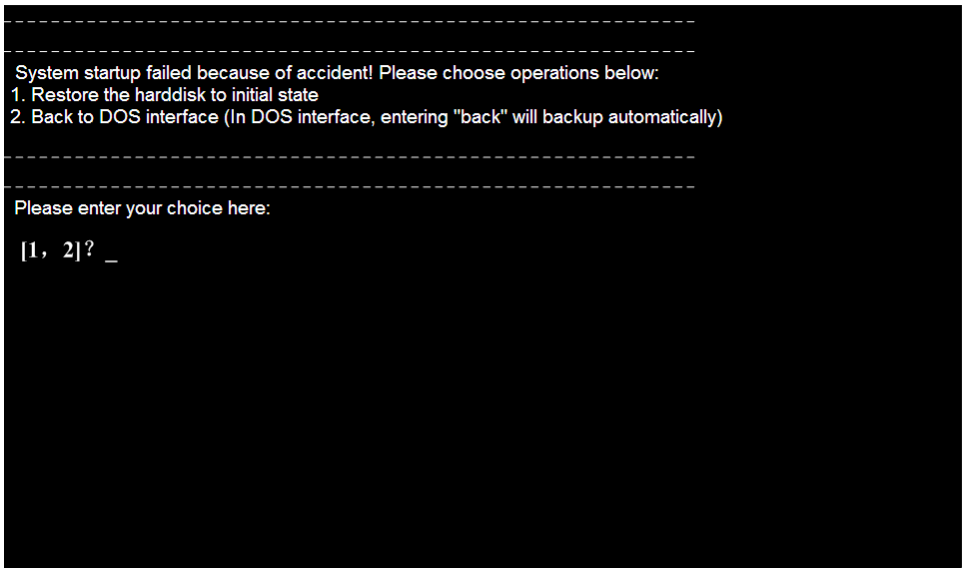



Fig. 4-3 DOS startup interface

4th, Enter 1 in Fig. 4-3, and Fig. 4-4 will pop up.

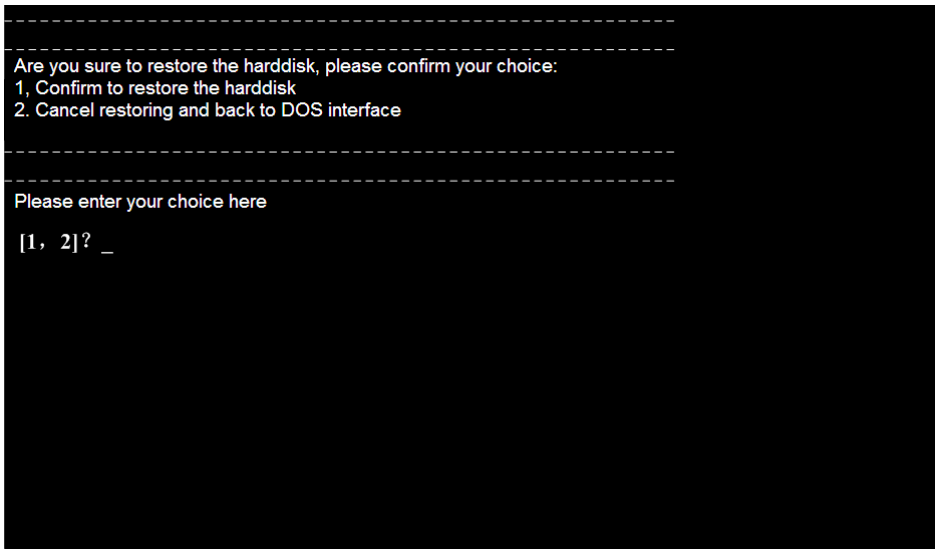



Fig. 4-4 DOS confirmation interface

5th, Enter 1 again, and the system will conduct Ghost restoration. Plug the USB disk instantly when the system restarts. At this time, whole system is installed and setup.

### 4.1.4 Backup System to USB disk

Back up the system to USB disk as follows:

1st, Insert the USB flash disk to the USB slot.

2nd, Restart the system, and press Delete key to enter BIOS interface. Accessing “Advanced Bios Features--->Hard Disk Boot Priority”, and set order for USB disk: USB devices/Cho M/Cho S (for reference only).

3rd, After order set, press F10 to save it and restart. After normal startup, interface like below will show up.

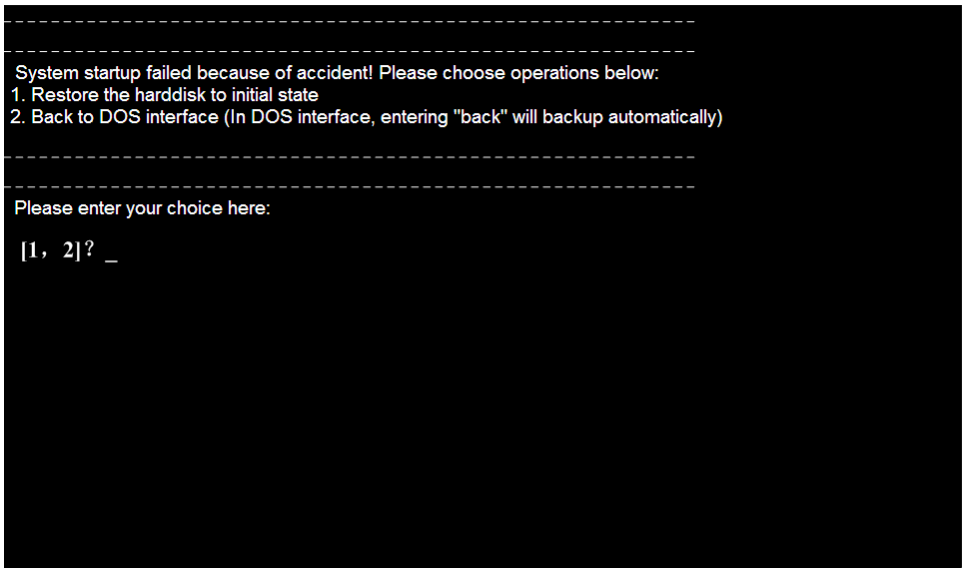



Fig. 4-5 DOS startup interface

4th, Enter 2, and the system will conduct Ghost backup process. When it is finished, turn off the power, and plug the USB disk. At this time, whole system backup is completed.

### 4.1.5 System Backup and Restore

Backup of OS has been completed before leaving factory, if any problem occurs in use, you can use ONE-KEY restoration to restore the system setting to leaving factory state.

Back up the system as following steps:

1st, Access the operation interface, and select “操作系统 一键还原”, as shown in Fig. 4-6.


Fig. 4-6 ONE KEY restore confirmation

2nd, Select “取消” in Fig. 4-6 to cancel the restoration. And interface as Fig. 4-7 will pop up.


Fig. 4-7 Twice backup

3rd, Select “2 重新备份” in Fig. 4-7.

4th, After confirmation, backup progressing indictor will show up. When it finishes, backup is completed.

When ONE KEY restoration is needed, select “还原（R）” in Fig. 4-6, and do as the tips to restore to the leaving factory state.

Note:

When exceptions occur during system backup and restore, you need to exclude the following causes at priority.

- ✓ Is the guidance order of hardware in BIOS is correct or not?
- ✓ Is problem occurred in system backup process?
- ✓ Is storage of USB disk is enough or not?
- ✓ During system backup, if there is mirror image file in USB disk, the process will exit.

For possible situations listed above, it is recommended to conduct examination and repair during system backup and restoration, otherwise, it may have a bad effect on system performance, so as to data disk.

## 4.2 NcStudio System Maintenance

### 4.2.1 Software Installation

Software installation can be divided into following steps:

1st, Accessing the desktop of NK300BX. Press combination key “Ctrl + Alt + Delete” to enter the task manager interface ==> press “Alt + F” key to select “New Task” ==> in the new task dialog, input “explorer” and press “Enter” ==> press “Alt + Tab” to switch to NcStudio ==> press “Alt + F4” to close it and enter the desktop.

2nd, Insert the USB flash disk with the saved software into the USB interface on the operation panel of NK300BX host. Enter the desktop as operations in step one. Find the software to install in My Computer and double click it to initiate installation. First step in software installation is the language selection, as shown in Fig. 4-8, which decides the running language of the system. You can make your own choice here. Of course, language can be switched in the software later in use.


Fig. 4-8 Language selection dialog box

3rd, To avoid the interference of last version of the software to the current software installation, before formal installation begins, a dialog box prompting previous parameter setting saving will show up. As shown in Fig. 4-9. Choose “Yes” to save the parameters and delete the old version software before current software installation.

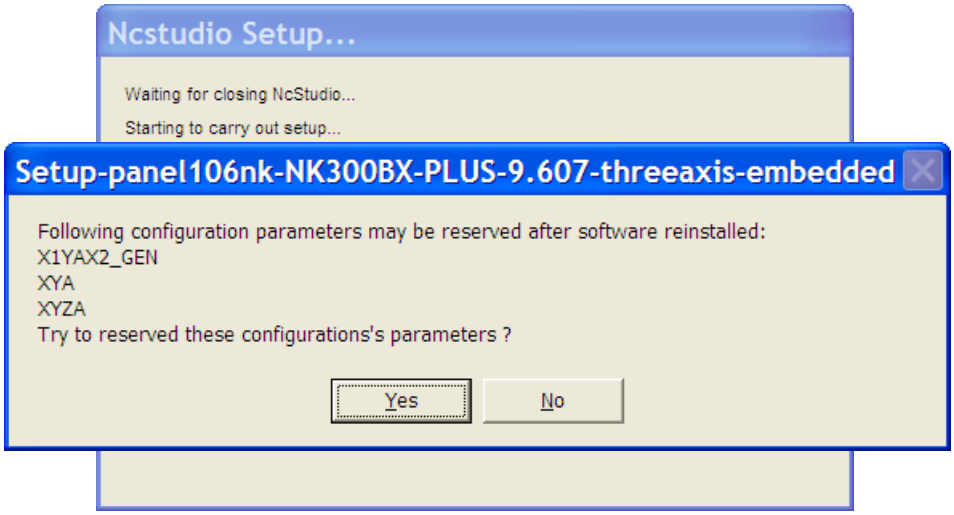



Fig. 4-9 Prompt for parameter saving

4th, the following is the progressing picture of installation. The system will be installed under directory C:\Naiky.

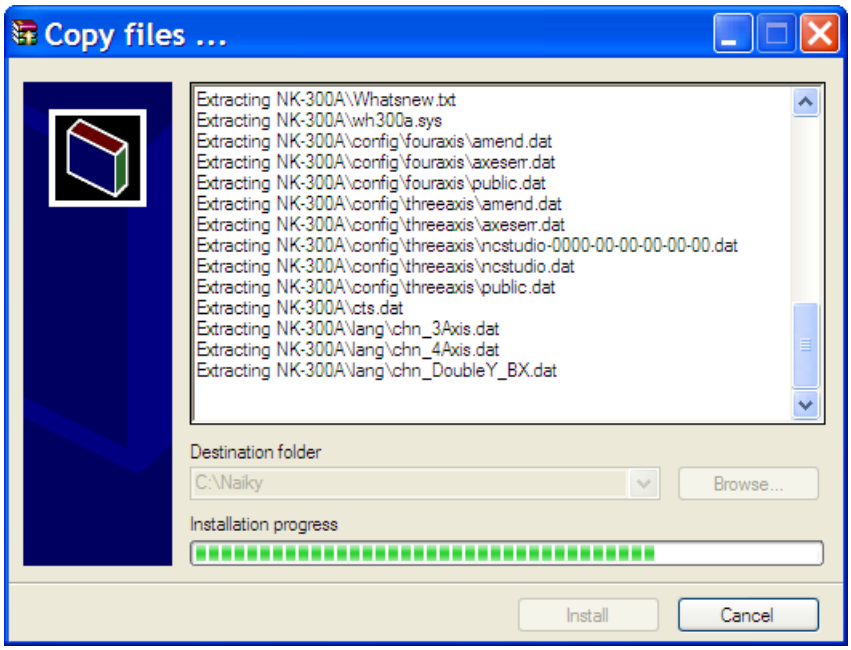



Fig. 4-10 Installation progressing

5th, software installation is completed.

> Note:
>
> The above installation introduction is for situation where the software has been damaged and cannot work normally. If the software can be launched normally, please refer to 4.2.2 to upgrade software instead of newly installing one.

## 4.2.2 Package and Upgrade

The system holds the function of software backup. After installing the software and setting various parameters corresponding to a specific machine tool, you can backup and save the software with

proper parameter settings as the original data. And the backup software can be directly installed on a machine tool of the same type. This function is realized in system maintenance. The following will introduce the system maintenance in detail.

Press  to enter the system info function section, and then press F2 “Sys Maintenance” to enter the system maintenance screen, as shown in Fig. 4-11.

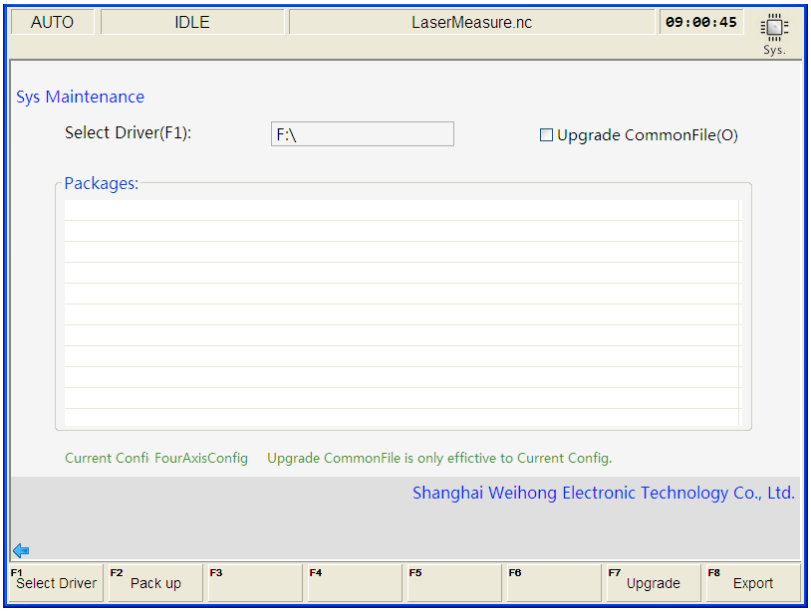



Fig. 4-11 System maintenance screen

Pressing F1 “Select Drive” will eject an input box for entering the drive letter of the removable disk with the update package.

Pressing F2 “Pack Up” will pack the software automatically and save the packaged software to the selected disk.

All the update packages are listed in “Packages”. Press “↑” or “↓” to move the cursor to the desired one, and then press F7 “Upgrade” to start software installation.

Pressing F8 “Export” can export the public file such as amend.dat, ncstudio.plc, ncstudio.string, and public.dat files to removable disk. Prompt for successful exportation will pop up if it succeeded.

Pressing shortcut key O can display all public files for the system in the list of “Packages”, where you can select desired files to save them to the directory of removable disk. As shown below, select the public file you need to upgrade.

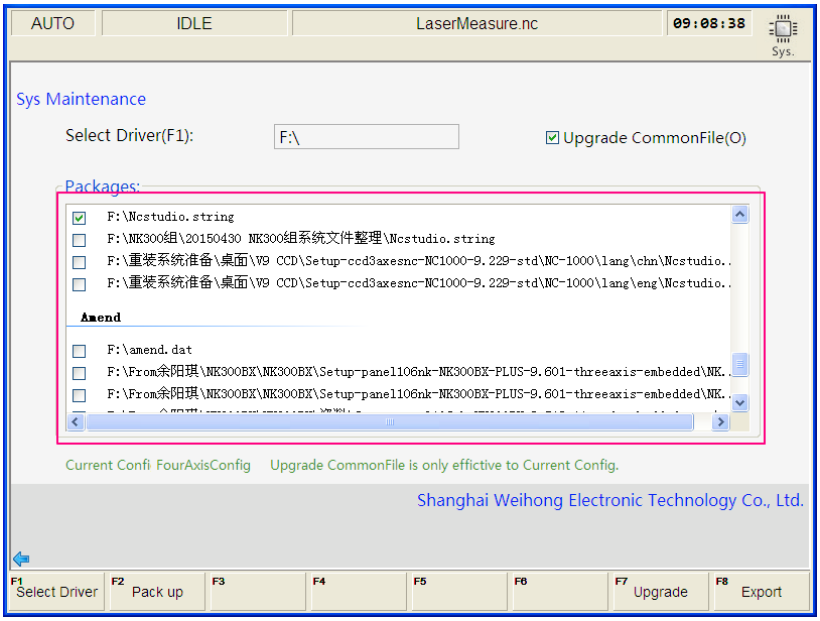



Fig. 4-12 Public file upgrade

Check in the check box in front of the public files you need to upgrade, and press F7 “Upgrade” to initiate. After confirmation, upgrading succeeds after restart the system.

If the public files to upgrade contains amend.dat file, before final upgrading, a prompt dialog box will show up, as shown below. Choose “Yes” to confirm and continue upgrading and choose “No” to cancel it.

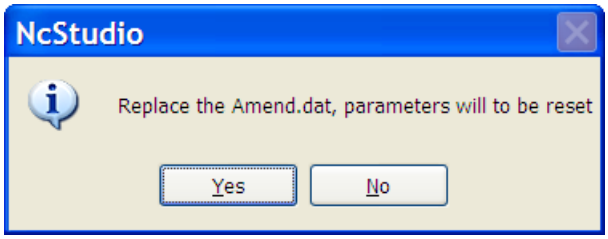



Fig. 4-13 Prompt before amend.dat file upgrading

Note:

Function “Upgrade Common File” is only effective for the current configuration, please notice that.

## 4.3 Warning Information

| Type | Warning Content | Causes | Solution |
|---|---|---|---|
| Warning | "Simulation results showed that the motion of the program exceeded machining bounds." | The scope of machining file exceeds upper and lower limits of worktable, decided by setting "N10020"& "N10030". | Modify the value of "N10020" and "N10030" to expand stroke range of worktable (see Chapter 3.4.3). |
| | "Returning machine home was not finished!" | The system has not returned to machine origin yet. If "N74001" is set to "YES", returning to machine origin before machining is required. | Back to machine origin before using this function. |
| | "The result error of returning machine home for X/Y/Z axis was out of range" | An error in the precision of home switch | Detect the precision of home switch. |
| | | An error in the precision of encoder origin | Detect if the system encoder zero signal is correct. |
| | "Unable to perform the action under the current mode" | An illegal operation is executed in machining, such as changing the setting of a parameter. | Stop machining, and execute the operation under idle state. |
| | "Unable to perform the action under simulation mode" | An illegal operation is executed in simulation mode, such as changing the setting of a parameter or pressing a shortcut key | Quit simulation mode, and execute the operation under idle state. |
| Limit alarm | "Limit of X+/X-/Y+/Y-/Z+/Z-" | The polarity of port Positive/Negative Limit of X-/Y-/Z-axis is not right. | Enter [I/O Port] screen under [Diagnosis], and modify the port polarity (refer to Chapter 3.3). |
| | | X-/Y-/Z-axis runs into the limit switch directly in movement. | Manually move X-/Y-/Z-axis away from the limit switch. |
| | | There is an error in the limit switch itself. | Check if the limit switch works normally. |
| Back to REF. point alarm | "The distance of coarse/fine positioning switch for X/Y/Z axis was too close" | The actual installation distance between coarse and fine positioning switches is smaller than the setting value of parameter "N74110". | Re-adjust the actual position of home switch and encoder zero to make the space within the range (0 + "N74110", screw pitch – "N74110") (see Chapter 3.3). |

| Type | Warning Content | Causes | Solution |
|---|---|---|---|
| **Servo alarm** | "Servo alarm of X/Y/Z axis" | The polarity of port Axis X/Y/Z Servo Alarm is wrong. | Enter [I/O Port] screen under [Diagnosis], and modify the port polarity (refer to Chapter 3.3). |
| | | There is an error in the X/Y/Z axis servo driver itself. | Check if the X/Y/Z axis servo driver works normally. |
| **E-stop alarm** | "ESTOP button pressed" | The polarity of port Emergency Stop is wrong. | Enter [I/O Port] screen under [Diagnosis], and modify the port polarity (refer to Chapter 3.3). |
| | | The E-stop button is pressed down. | Turn the E-stop button clockwise to make it pop-up. |
| **Oil level alarm** | "lube level low alarm" | The polarity of port Lubrication Position Test Alarm is wrong. | Enter [I/O Port] screen under [Diagnosis], and modify the port polarity (see Chapter 3.3). |
| | | When the oil level line in the oil pump is below a certain value, a signal will be sent to the system to give an alarm. | Check if the oil mass is too small in the oil pump. |
| **Spindle alarm** | "Spindle alarm" | The polarity of port Spindle Alarm is wrong. | Enter [I/O Port] screen under [Diagnosis], and modify the port polarity (see Chapter 3.3). |
| | | There is an error in the inverter. | Check if the inverter works normally. |
| **File error** | "Machining program not loaded yet" | Start file machining with no file loaded in advance. | Load a machining file in advance. |
| **Pulse feedback alarm** | "Axis X/Y/Z Encoder Steady/Dynamic Error"; "Axis X/Y/Z Serious Following Error" | It is used to detect if the D-value between sent pulses and received pulses exceeds the setting value of the corresponding parameter. | Check if the servo system is stable or if the motor encoder is damaged. |
| **Change tool over-travel alarm** | Alarm for over-travel in tool change | Alarm signal occurs in tool change over-travel protection port | Check if the tool presetter works normally.<br>During tool changing, Z axis keeps moving downward for receiving no calibration signal, and triggers the |

| Type | Warning Content | Causes | Solution |
|---|---|---|---|
| | | | over-travel protection port.<br>Hardware faulty, which may result in continuous signal of the port. |
| **Terminal board not connected** | The terminal board is not well connected with the NK300BX system | Wiring is not well or hardware fault of Lambda controller. | Re-plug the connection wire and restart the software.<br>Something wrong with the port polarity. Invert the polarity and restart the software.<br>Analyze possible causes according to the state of SYSTEM LED indicator.<br>Change a new Lambda controller. |
| **Panel not connected** | Operational panel is not well connected | Something wrong with the port polarity.<br>Wiring is not well.<br>Operation panel fault. | Something wrong with the port polarity. Invert the polarity and restart the software.<br>Re-plug the connection wire and restart the software.<br>change a new operational panel. |

## 4.4 Common Troubleshooting

### 4.4.1 What should you do if the spindle does not rotate?

1) Check if the software can work regularly. Press the Spindle CW/CCW button and see if the dot before the output port “SPIN” in [I/O Port] screen under [Diagnosis] becomes green. If it does, the software works regularly.

2) Start spindle, and check if the spindle start indicator lamp on the controller is on. If not, check whether the connection cable of the controller becomes loose. Close the host machine and power off the machine tool, and then re-plug the connection cable of the controller. If it still does not light, check if the cable of the controller, the controller or the system goes wrong. If it lights, measure if the SPIN port is conducted with a multimeter. If conducted, the spindle start output port (Y00) works normally; if it is not conducted, there is an error in the relay of spindle start.

3) Test whether the analog voltage output is normal between SVC and GND with a multimeter. If not, check if the connection cable of the controller becomes loose. Still not, check if the cable of the controller, the controller or the system goes wrong.

4) Check whether the parameter setting of the inverter is right, whether the spindle and the inverter have been damaged, or whether the wiring of the spindle and the inverter is correct.

### 4.4.2 What should you do if an axis does not move?

1) Check if there is output for the “Axis × Servo Enable” output port (in green) in [I/O Port] screen under [Diagnosis]. If there is output, the software works regularly. Check if the port polarity (it should be NO) is set correctly.

2) Check if the parameter setting of servo driver is correct (like setting control mode as position control, selecting a pulse input port for Panasonic driver, etc.).

3) Check if the servo cable of this axis is well contacted at the joint with the system host machine and the servo driver.

4) Check if something is wrong with servo driver, motor, servo cable or control system (e.g. exchange servo cable and servo driver with those of other axes working normally).

### 4.4.3 What should you do if servo motor Z-axis brake does not work?

Start the system and power on the machine tool (removing system alarm signal), and see if the brake output indicator lamp on the controller turns light.

1) If light, test whether there is 24V voltage between brake output ports (Y01-C01) with a multimeter. If there is 24V voltage, check whether the wiring of motor brake cable is correct. The motor brake cable should be connected to brake output port on the controller directly.

2) If not, directly conduct the brake input ports on the controller with a conducting wire. If light at this

time, check whether the servo driver is enabled, whether the parameter setting related to brake output of servo driver is right, and whether brake output line of driver is correctly wired to the controller (black line is wired to COM, and only X20 is connected to with only one line); if still not light, please change the controller.

### 4.4.4 What should you do if homing is abnormal?

- Limit alarm or servo driver alarm occurs during homing (backing to machine origin).

1) See whether “Home Search Dir” “Home Latch Dir” and “Back Off Distance” in “Return Machine Home” are set properly. Sign of “Home Latch Dir” and “Back Off Distance” should be the same, but opposite to that of “Home Search Dir”.

2) Check if the software can receive the reference point signal of the axis. Trigger the home switch, while observing if the color of the dot before the “Reference Point of × axis” changes from red to green. If there is no color change, it indicates the software can’t receive the reference point signal, needing to check if there is an error in the home switch or in the wiring of home switch. To see if the system failure occurs, directly conduct the reference point signal and COM port on the controller with a conducting wire, while observing whether the color of the dot before “Reference Point of × axis” changes in [I/O Port] screen.

3) Check whether the position of home switch is appropriate to avoid the following three situations: the distance between home switch and limit switch is too small; the home switch is installed behind the limit switch; or the position of home switch is out of the mechanical stroke of a machine tool.

- When backing to machine origin, the machine tool motions towards a certain direction at a relatively low speed (ten percent of the speed of coarse positioning) until limit is triggered.

See if the polarity of input port “Reference Point of × axis” is correct in [I/O Port] screen under [Diagnosis]. When the home switch is triggered, i.e. there is signal input, the color of the dot should be green. Otherwise, it is red.

- A certain axis moves a very long distance or keeps moving at a rather low speed towards the reverse direction after coarse positioning during backing to machine origin.

The cause of the above phenomenon is that the system can’t detect the encoder zero signal of this axis. The solutions are as below:

1) See if the servo cable of this axis is well contacted at the joints with the system host machine and servo driver.

2) Set the value of driver parameter “pre-scaler (frequency divider) of encoder” as 1/2 or 1/4 of the original one if YASKAWA or TECO, etc. driver is used.

3) Check if there is an error in the driver, motor, servo cable, or the control system (e.g. exchange servo cable and servo driver with those of other axes able to return to machine origin normally).

### 4.4.5 What should you do if a machine tool moves upward after arriving at the position of tool presetter in measurement?

View and tell whether the polarity of “Tool Presetter Signal” is right in [I/O Port] screen under [Diagnosis]. The color of the dot before the “Tool Presetter Signal” is red when the system does not receive tool measurement signal.

Manually press the tool presetter and check the color of the dot before the “Tool Presetter Signal” changes or not. If it remains the same, it tells that the tool presetter has been damaged.

# 5 Driver

## 5.1 Driver Parameters

Parameters listed in this chapter can only make a machine work normally instead of ensuring the best machining results. Relevant parameters need adjusting according to the specific machine type.

### 5.1.1 Parameters Setting of WISE Servo Driver

| Para. No. | Function | Value | Description |
|---|---|---|---|
| **Pr528** | LED initial status | 6 | Monitor if the number of sent and received pulses is correct by setting this parameter. In Weihong control system, the correct quantity of pulses sent by control card is detected by pulse inspection in order to determine whether there is electrical interference. |
| **Pr008** | Command pulse No. per motor circle | 0 | When it is set to “0”, parameters Pr009 and Pr010 are valid. |
| **Pr009** | 1st numerator of command pulse frequency division/ multiplication | Need calculation | Range: 0~$2^{30}$<br>Typical value: pitch 5 mm, encoder resolution 10000, deceleration ratio 1:1, pulse equivalent 0.001 mm:<br>Pr009＝10000<br>Pr010＝pitch 5mm/ pulse equivalent 0.001mm＝5000<br>Pr009/Pr010=10000/5000=2/1 |
| **Pr010** | Denominator of command pulse frequency division/multiplication | Need calculation | |
| **Pr100** | 1st position loop gain | 480 (default) | Unit: 0.1/s. Set it according to the actual situation. |
| **Pr101** | 1st velocity loop gain | 270 (default) | Unit: 0.1Hz. Set it according to the actual situation. |
| **Pr102** | 1st velocity loop integrated time constant | 210 (default) | Unit: 0.1ms. Set it according to the actual situation. |

When the value of Pr008 is not “0”, it can be calculated in terms of the following formula:

$$\text{Command pulse No. per motor circle} = \frac{\text{Screw pitch}}{\text{Pulse equivalent} \times \text{Mechanical deceleration ratio}} = \frac{5\text{mm}}{0.001\text{mm}/p} = 5000$$

When screw pitch is 5mm and pulse equivalent 0.001, the value of Pr008 is “5000”.

◆ **Attachment List: the relationship among parameters Pr008, Pr009 and Pr010.**

| Pr008 | Pr009 | Pr010 | Description |
|---|---|---|---|
| $0\sim2^{20}$ | –<br>(no influence) | –<br>(no influence) | Command Pulse Input → [Encoder Resolution / Setting Value of Pr008] → Position Command<br>As shown above, the process is undergone in terms of the setting value of Pr008, not affected by the settings of Pr009 and Pr010. |
| 0 | 0 | $0\sim2^{30}$ | Command Pulse Input → [Encoder Resolution / Setting Value of Pr010] → Position Command<br>When the values of Pr008 and Pr009 are both set to “0”, as shown above, the process is undergone in terms of the setting value of Pr010. |
| | $0\sim2^{30}$ | $0\sim2^{30}$ | Command Pulse Input → [Setting Value of Pr009 / Setting Value of Pr010] → Position Command<br>When the value of Pr008 is “0”, but the value of Pr009 is not “0”, as shown above, the process is undergone in terms of the setting values of Pr009 and Pr010. |

## 5.1.2 Parameters Setting of YASKAWA Σ–Ⅱ Servo Driver

| Para. No. | Function | Value | Description |
|---|---|---|---|
| **Fn010** | Set password (to prevent arbitrary modification to parameters) | 0000 | Set [0000]:<br>modification to user parameters [PnXXX] and part of auxiliary function parameters [FnXXX] permitted;<br>Set [0001]:<br>modification to user parameters [PnXXX] and part of auxiliary function parameters [FnXXX] prohibited. |
| **Un00C** | Pulse counter of input command | LXXXX (Hexadecimal system) | Monitor if the number of sent and received pulse is correct by setting this parameter. In Weihong control system, the correct quantity of pulse sent by control card is detected by pulse inspection in order to determine whether there is electrical interference. |
| **Pn000** | Direction selection<br>Control mode selection | 0010 | Bit 0: Set 0, “CCW” is forward rotation (viewed from the load end of screw ball); Set 1, the rotation direction of the motor is reversed.<br>Bit 1: Set 1, position control mode (calculate pulse instruction all the time). |

<table>
<tr><th>Para. No.</th><th>Function</th><th>Value</th><th colspan="3">Description</th></tr>
<tr><td>Pn200</td><td>Select pulse instruction mode</td><td>0005</td><td colspan="3">Bit 0: Set 5, select the instruction input mode as “pulse + direction”, negative logic.<br>Bit 3: Set 0, input differential signal into filter.</td></tr>
<tr><td>Pn50A</td><td>Selection function</td><td>8100</td><td colspan="3">Bit 1: Set 0, Servo ON /S-ON, input from 40th pin; Set 7, Servo ON all the time.<br>Bit 3: Set 8, positive rotation not used and signal input (P-OT) prohibited.</td></tr>
<tr><td>Pn50B</td><td>Selection function</td><td>6548</td><td colspan="3">Bit 0: Set 8, reverse rotation not used and signal input (N-OT) prohibited.</td></tr>
<tr><td>Pn50F</td><td>Selection function</td><td>0300</td><td colspan="3">Set it when servo motor with brakes.<br>Bit 2: Set 3, brake interlock signal “/BK” is output from CN1-29, CN1-30 to control 24V relay for brake</td></tr>
<tr><td>Pn50E</td><td>Selection function</td><td>0211</td><td colspan="3">Set it when servo motor with brakes<br>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.</td></tr>
<tr><td>Pn506</td><td>Servo off, time delay of brake when motor stops</td><td>Depended</td><td colspan="3">Set it when motor with brakes<br>Default setting is “0”, setting unit is 10ms.</td></tr>
<tr><td rowspan="4">Pn201</td><td rowspan="4">Encoder cycle-divided ratio<br>(Pulse output No. per motor cycle by encoder after cycle-divided)</td><td rowspan="4">Right-side</td><td rowspan="4">Gain Encoder</td><td>Type</td><td>Encoder Pulse No. per Motor Circle (pulses/ revolution)</td></tr>
<tr><td>A</td><td>13bit 2048</td></tr>
<tr><td>B</td><td>16bit 16384</td></tr>
<tr><td>C</td><td>17bit 32768</td></tr>
<tr><td>Pn202</td><td>Electronic gear ratio (numerator)</td><td>Need Calculation</td><td colspan="3" rowspan="2">Pn202 = pulse No. of each encoder circle × 4 × mechanical deceleration ratio.<br>Pn203 = (screw pitch/ pulse equivalent).<br>Typical value: pitch 5mm, encoder 17-bit, coaxial connection between motor and screw, pulse equivalent 0.001mm, Pn202＝16384; Pn203＝625.<br>Pitch 5mm, encoder 17-bit, coaxial connection between motor and screw, pulse equivalent 0.0005mm, Pn202＝8192; Pn203＝625.</td></tr>
<tr><td>Pn203</td><td>Electronic gear ratio (denominator)</td><td>Need Calculation</td></tr>
</table>

### 5.1.3 Parameter Setting of YASKAWA Σ-Ⅴ Servo Driver

| Para. No. | Function | Value | Description |
|---|---|---|---|
| **Fn010** | Parameter input prohibition setting | 0000 | Set [0000]:<br>modification to user parameters [PnXXX] and part of auxiliary function parameters [FnXXX] permitted;<br>Set [0001]:<br>modification to user parameters [PnXXX] and part of auxiliary function parameters [FnXXX] prohibited. |
| **Pn000** | Function selection basic switch 0 | 0010 | Bit 0: Set 0, positive rotation at positive rotation command<br>Bit 1: Set 1, position control mode (pulse sequence command) |
| **Pn200** | Format selection switch of position control command | 0005 | Bit 0: Set 5, select the instruction mode as “pulse + direction”, negative logic. |
| **Pn50A** | Input signal selection 1 | 8100 | Bit 1: Set 0, Servo ON /S-ON, input from the 40th pin; Set 7, Servo ON all the time.<br>Bit 3: Set 8, positive rotation not used and signal input (P-OT) prohibited. |
| **Pn50B** | Input signal selection 2 | 6548 | Bit 0: Set 8, negative rotation not used and signal input (N-OT) prohibited. |
| **Pn50F** | Output signal selection 2 | 0300 | Set it when servo motor with brakes.<br>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<br>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. |
| **Pn506** | Brake instruction-servo OFF and time delay | Depended | Set it when motor with brakes<br>Default setting is “0”, setting unit is ms. |
| **Pn20E** | Electronic gear ratio (numerator) | Need Calculation | $\frac{Pn20E}{Pn210} = \frac{\text{Encoder resolution} \times \text{Pulse equivalent} \times \text{Decelerati on ratio}}{\text{Screw pitch}}$<br>Both numerator and denominator of electronic gear ratio should be reduced. The value of Pn20E and Pn210 are integers within [1, 65535].<br>For example, screw pitch 5mm, 20-bit encoder, |
| **Pn210** | Electronic gear ratio (denominator) | Need Calculation | |

| Para. No. | Function | Value | Description |
|---|---|---|---|
| | | | coupling direct drag, pulse equivalent 0.001mm,<br>$\frac{Pn20E}{Pn210}=\frac{2^{20}\times 0.001}{5}=\frac{1048576}{5000}=\frac{131072}{625}\approx\frac{210}{1}$<br>When screw pitch is 10mm,<br>$\frac{\mathrm{PN20E}}{\mathrm{PN210}}=\frac{1048576}{10000}=\frac{65536}{625}\approx\frac{105}{1}$<br>For a rotary axis with 13-bit encoder and deceleration ratio as 60,<br>$\frac{Pn20E}{Pn210}=\frac{2^{13}\times 0.001\times 60}{360}=\frac{8192}{6000}=\frac{512}{375}$ |

### 5.1.4 Parameter Setting of PANASONIC MINAS A4 Servo Driver

| Para. No. | Function | Value | Description |
|---|---|---|---|
| **Pr01** | LED initial status | 12 | Monitor if the number of sent and received pulse is correct by setting this parameter. In Weihong control system, the correct quantity of pulse sent by control card is detected by pulse inspection in order to determine whether there is electrical interference. |
| **Pr02** | Select control mode | 0 | 0: position mode<br>1: velocity mode<br>2: torque mode |
| **Pr40** | Selection of command pulse input | 1 | 1: input by differential exclusive circuit |
| **Pr42** | Select command pulse input mode | 3 | Set command pulse input mode: command pulse + command direction, negative logic |
| **Pr48** | 1st numerator of command pulse frequency multiplication | Need calculation<br>Range: 1~10000 | Typical value: pitch 5 mm, encoder resolution 10000, shaft coupling direct drag, pulse equivalent 0.001 mm:<br>Pr48＝10000<br>Pr4B＝pitch 5mm / pulse equivalent 0.001mm＝5000<br>Pr48/Pr4B=10000/5000=2/1 |
| **Pr4B** | Denominator of the command pulse frequency multiplication | Need calculation<br>Range: 1~10000 | |

### 5.1.5 Parameter Setting of PANASONIC MINAS A5 Servo Driver

| Para. No. | Function | Value | Description |
|---|---|---|---|
| **Pr5.28** | LED initial status | 6 | Monitor if the number of sent and received pulse is correct by setting this parameter. In Weihong control system, the correct quantity of pulse sent by control card is detected by pulse inspection in order to determine whether there is electrical interference. |
| **Pr0.01** | Select control mode | 0 | 0: position mode<br>1: velocity mode<br>2: torque mode |
| **Pr0.05** | Selection of command pulse input | XX | 0: Photo-coupler input (PULS1,PULS2,SIGN1,SIGN2)<br>1: Exclusive input for line driver (PULSH1, PULSH2, SIGNH1,SIGNH2)<br>Note: generally, “1” is selected for this parameter. |
| **Pr0.07** | Command pulse input mode setup | 3 | Set command pulse input mode: command pulse + 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: $0\sim2^{30}$ | Typical value: pitch 5 mm, encoder resolution 10000, shaft coupling direct drag, pulse equivalent 0.001 mm:<br>Pr0.09＝10000<br>Pr0.10＝pitch 5mm/ pulse equivalent 0.001mm＝5000<br>Pr0.09/Pr0.10=10000/5000=2/1 |
| **Pr0.10** | Denominator of the command pulse frequency multiplication | Need calculation Range: $0\sim2^{30}$ | |
| When the value of Pr0.08 is not “0”, it can be calculated in terms of the following formula:<br>$\text{Command pulse No. per motor circle} = \frac{\text{Screw pitch}}{\text{Pulse equivalent} \times \text{Mechanical deceleration ratio}} = \frac{5\text{mm}}{0.001\text{mm}/p} = 5000$<br>When screw pitch is 5mm and pulse equivalent 0.001, the value of Pr0.08 is “5000”. | | | |

◆ **Attached List: the relationship among parameters Pr0.08, Pr0.09 and Pr0.10.**

| Pr0.08 | Pr0.09 | Pr0.10 | Description |
|---|---|---|---|
| $0\sim2^{20}$ | _<br>(no influence) | _<br>(no influence) | Command Pulse Input → [Encoder Resolution / [Setting Value of Pr0.08]] → Position Command → |

| Pr0.08 | Pr0.09 | Pr0.10 | Description |
|---|---|---|---|
| | | | As shown above, the process is undergone in terms of the setting value of Pr0.08, not affected by the settings of Pr0.09 and Pr0.10. |
| 0 | 0 | $0\sim2^{30}$ | Command Pulse Input → [Encoder Resolution / [Setting Value of Pr0.10]] → Position Command<br>When the values of Pr0.08 and Pr0.09 are both set to “0”, as shown above, the process is undergone in terms of the setting value of Pr0.10. |
| | $0\sim2^{30}$ | $0\sim2^{30}$ | Command Pulse Input → [[Setting Value of Pr0.09] / [Setting Value of Pr0.10]] → Position Command<br>When the value of Pr0.08 is “0”, but the value of Pr0.09 is not “0”, as shown above, the process is underdone in terms of the setting values of Pr0.09 and Pr0.10. |

### 5.1.6 Parameter Setting of MITSUBISHI MR-JE Servo Driver

| Para. No. | Code | Function | Value | description |
|---|---|---|---|---|
| **PA01** | *STY | Operation mode | XXX0 | _ _ _x: select position control mode. |
| **PD24** | MBR | Output assignation to CN1-23 pin | XX05 | _ _ xx: select MBR (electromagnetic brake interlock). |
| **PA06** | CMX | Electronic gear numerator | Need calculation | CMX/CDV=command unit × servo motor resolution × mechanical deceleration ratio / pitch of screw. E.G., pitch 5 mm, encoder resolution 10000, deceleration ratio 1:1, pulse equivalent 0.001 mm,<br>CMX/CDV=10000×0.001/5 = 2/1;<br>When pulse equivalent = 0.0005mm, CMX/CDV = 1/1.<br>Electronic gear ratio range: 1/50 ~ 500 |
| **PA07** | CDV | Electronic gear denominator | Need calculation | |
| **PC36** | *DMD | Status display selection | 00XX | _ _xx: status display selection at power-on.<br>This is used to select a status display shown at power-on.<br>00: cumulative feedback pulses<br>01: servo motor speed<br>02: droop pulses<br>03: cumulative command pulses<br>04: command pulse frequency |
| **PA13** | *PLSS | Command pulse input form | 0011 | Set command pulse input form: pulse train+ sign, negative logic. |
| **PA15** | *ENR | Encoder output pulses | Need calculation | Range: 1~65535, set according to the parameter setting of “Frequency Division Pulses of PG (X4)”. Typical value: pulse equivalent 0.001, screw pitch 10mm without a reduction box, PA15=2500; screw pitch 5mm, PA15=1250. |
| **PD03** | *DI1L | Input assignation to CN1-15 pin | XX02 | _ _xx: select SON under position control mode. |

### 5.1.7 Parameter Setting of MITSUBISHI MR-E Servo Driver

| Para. No. | Code | Function | Value | Description |
|---|---|---|---|---|
| **0** | *STY | Control mode selection and regenerative fittings | X0X0 | Bit 0: set 0: select position control mode.<br>Bit 1, select motor series: 0: HC-KFE; 1:HC-SFE;<br>Bit 3, select regenerative apparatus, set 0: not use.<br>Bit 4, select motor power. |
| **1** | MBR | Function selection 1 | 001X | Bit 0: input signal filter. If external input signal causes chattering due to noises, etc., input filter is used to suppress it. Bit 1: CN1-12 function selection, set “1”: electromagnetic brake interlock (MBR); set “0”: zero speed detection signal. |
| **3** | CMX | Electronic gear numerator | Need calculation | CMX/CDV=command unit × servo motor resolution × mechanical deceleration ratio / pitch of screw. E.G., pitch 5 mm, encoder resolution 10000, shaft coupling direct drag, pulse equivalent 0.001 mm,<br>CMX/CDV=10000×0.001/5 = 2/1;<br>When pulse equivalent = 0.0005mm, CMX/CDV = 1/1.<br>Electronic gear ratio range: 1/50 ~ 500 |
| **4** | CDV | Electronic gear denominator | Need calculation | |
| **18** | *DMD | Status display selection | 00XX | 3: cumulative command pulses E: load inertia<br>When the parameter is set [3], monitor if the number of sent and received pulse is correct by setting this parameter. In Weihong control system, the correct quantity of pulse sent by control card is detected by pulse inspection to determine if there is electrical interference. |
| **21** | *OP3 | Function selection 3 (command pulse format selection) | 0001 | Set pulse command input form: pulse train+ sign, negative logic |
| **41** | *DIA | Signal input SON-ON, LSP-ON and LSN-ON automatically selection | 0110 | Bit 0: Servo-ON selection. [0]: servo on by external input; [1]: servo on all the time inside.<br>Bit 1: last signal of positive rotation range (LSP): [1]: auto servo on inside, without external wiring.<br>Bit 3: last signal of negative rotation range (LSN): [1]: auto servo on inside and no need of external wiring. |

### 5.1.8 Parameter Setting of DELTA ASDA-A Servo Driver

| Para. No. | Function | Format & Range | Value | Description |
|---|---|---|---|---|
| **P0-02** | Driver status display | | 02 | Monitor if the number of sent and received pulse is correct by setting this parameter. In Weihong control system, the correct quantity of pulse sent by control card is detected by pulse inspection to determine if there is electrical interference. |
| **P1-00** | External pulse input type | ZYX | 102 | X=2: pulse + direction;<br>Z=1: negative logic |
| **P1-01** | Control mode setup | ZYX1X0 | 0000 | Z=0: during control mode switching, DIO is maintaining the set value. Since switching control mode is not used, Z=0<br>Y=0: forward rotation (CCW) (in terms of load);<br>Y=1: the rotation direction is reversed.<br>X1X0=00: position control mode |
| **P1-32** | Motor stop mode selection | YX | 00 | Y=0: when there is no servo enabled, motor dynamic brake occurs; Y=1: motor is free.<br>X=0: motor stops instantly, X=1: motor stops with deceleration. |
| **P1-44** | Electronic Gear Ratio (Numerator) (N1) | 1~32767 | Need calculation | N1/M= encoder pulses × 4× pulse equivalent× mechanical deceleration ratio/ pitch.<br>Representative value: encoder pulses =2500, pitch=5mm, pulse equivalent=0.001mm/p, deceleration ratio=1, calculation as below:<br>N1/M= 2500×4×0.001/5 = 2 / 1, N1=2, M=1;<br>When the multi-electronic gear ratio is not used, P2-60~ P2-62 are not required. |
| **P1-45** | Electronic Gear Ratio (Denominator) (M) | 1~32767 | Need calculation | |
| **P2-10** | Digital Input Pin DI1 | X2X1X0 | 101 | X1X0=01: digital input (DI1=SON) corresponds to 9th pin of CN1.<br>X2 = 1: set DI1 input as NO (normally open) a-contact point. |
| **P2-15** | Digital Input pin DI6 | X2X1X0 | 100 | Default factory setting of DI6 and DI7 are NC (normally closed) limit signal input pins; driver can't run without being connected to pin 32 and pin 31 of CN1.<br>X2=1: set DI6 and DI7 inputs as NO (normally open) a-contact points; X1X0=00, limit signal input of the driver is not used. |
| **P2-16** | Digital Input Pin DI7 | X2X1X0 | 100 | |

| Para. No. | Function | Format & Range | Value | Description |
|---|---|---|---|---|
| **P2-17** | Function setting for digital input pin DI8 | X2X1X0 | 100 | External EMG stop input is not used. |
| **P2-21** | Function setting for digital output pin DO4 | X2X1X0 | 108 | DO4 corresponds to pin 1 & pin 26, used as clamping-position brake signal of Z-axis;<br>X2=1: set DO4 output as NO (normally open) a-contact point; X2=0: set DO4 output as NC (normally closed) b-contact point;<br>X1X0=08: set pin 1 and pin 26 as BK+ and BK- respectively. |
| **P2-22** | Function setting for digital output pin DO5 | X2X1X0 | 007 | DO5 corresponds to pin 28 & pin 27, used as servo alarm signal.<br>X2=0: set DO5 output as NC b-contact point.<br>X1X0=07: set pin 28 and pin 27 as ALRM+ and ALRM- respectively. |
| **P2-51** | Servo ON (SON) setup | | 0 | 0: Servo ON must be triggered by numerical input signal.<br>1: when servo is powered, if there is no alarm signal, servo will be automatically on. Set 1 when there is no SON signal wire. |

### 5.1.9 Parameter Setting of DELTA ASDA-A2 Servo Driver

| Para. No. | Function | Format & Range | Value | Description |
|---|---|---|---|---|
| **P0-02** | Driver status display | | 02 | Monitor if the number of sent and received pulse is correct by setting this parameter. In Weihong control system, the correct quantity of pulse sent by control card is detected by pulse inspection in order to determine whether there is electrical interference. |
| **P1-00** | External pulse train input type | ZYX | 102 | X=2: pulse + direction;<br>Z=1: negative logic |
| **P1-01** | Set control mode | ZYX1X0 | 0000 | Z=0: during control mode switching, DIO is maintaining the set value. Since switching control mode is not used, Z=0;<br>Y=0: forward rotation (CCW) (from the view of load);<br>Y=1: the rotation direction is reversed.<br>X1X0=00: position control mode |
| **P1-44** | Electronic Gear Ratio (Numerator)(N1) | 1~32767 | Need calculation | $\frac{P1-44}{p1-45}=\frac{\text{Encoder resolution}\times\text{Pulse equivalent}\times\text{Deceleration ratio}}{\text{Screw pitch}}$<br>When encoder resolution is 1280000, screw pitch 5mm, pulse equivalent 0.001, in direct coupling,<br>$\frac{P1-44}{P1-45}=\frac{1280000\times 0.001}{5}=\frac{256}{1}$<br>When the multi-electronic gear ratio is not used, P2-60 ~P2-62 are not required. |
| **P1-45** | Electronic Gear Ratio (Denominator)(M) | 1~32767 | Need calculation | |
| **P2-10** | Digital Input Pin 1 (DI1) | X2X1X0 | 101 | X1X0=01: digital input (DI1 = SON) corresponds to 9th pin of CN1.<br>X2=1: set DI1 input as NO (normally open) a-contact point. |
| **P2-15** | Function setting for digital input pin DI6 | X2X1X0 | 100 | Default factory setting of DI6 and DI7 is NC (normally closed) limit signal input; driver can't run without being connected to pin 32 and pin 31 of CN1.<br>X2=1: set DI6 and DI7 inputs as NO a-contact points.<br>X1X0=00, limit input of driver is not used. |

| Para. No. | Function | Format & Range | Value | Description |
|---|---|---|---|---|
| **P2-16** | Function setting for digital input pin DI7 | X2X1X0 | 100 | |
| **P2-17** | Function setting for digital input pin DI8 | X2X1X0 | 100 | External EMG stop input is not used. |
| **P2-21** | Function setting for digital output pin DO4 | X2X1X0 | 108 | DO4 corresponds to pin 1 & pin 26, used as clamping-position brake signal of Z-axis;<br>X2=1: set DO4 output as NO (normally open) a-contact point; X2=0: set DO4 output as NC (normally closed) b-contact point;<br>X1X0=08: set pin 1 and pin 26 as BK+ and BK- respectively. |
| **P2-22** | Function setting for digital output pin DO5 | X2X1X0 | 007 | DO5 corresponds to pin 28 & pin 27, used as servo alarm signal.<br>X2=0: set DO5 output as NC b-contact point.<br>X1X0=07: set pin 28 and pin 27 as ALRM+ and ALRM- respectively. |

## 5.1.10 Parameter Setting of DELTA ASDA-B Servo Driver

| Para. No. | Function | Format & Range | Value | Description |
|---|---|---|---|---|
| **P0-02** | Driver status display | | 02 | Monitor if the number of sent and received pulse is correct by setting this parameter. In Weihong control system, the correct quantity of pulse sent by control card is detected by pulse inspection in order to determine whether there is electrical interference. |
| **P1-00** | External pulse train input type | ZYX | 102 | X=2: pulse + direction;<br>Z=1: negative logic |
| **P1-01** | Set control mode | YX1X0 | 000 | Y=0: forward rotation (CCW) (from the view of load);<br>Y=1: the rotation direction is reversed.<br>X1X0=00: position control mode |
| **P1-32** | Motor stop mode | YX | 00 | Y=0: when there is no servo enabled, motor dynamic brake occurs; Y=1: motor is free.<br>X=0: motor stops instantly,<br>X=1: motor stops with deceleration. |
| **P1-44** | Electronic Gear Ratio<br>( Numerator)(N1) | 1~32767 | Need calculation | N1/M= mechanical deceleration ratio × 4 × encoder pulses × pulse equivalent / pitch.<br>Representative value: encoder pulses=2500, pitch =5mm, pulse equivalent=0.001 mm/p, deceleration ratio = 1, calculation as below:<br>N1 / M = 2500×4×0.001/5 = 2/1, N1=2, M=1;<br>When the multi-electronic gear ratio is not used, P2-60 ~P2-62 are not required. |
| **P1-45** | Electronic Gear Ratio (Denominator)(M) | 1~32767 | Need calculation | |
| **P2-10** | Function setting for digital input pin DI1 | X2X1X0 | 101 | X1X0=01: digital input (DI1 = SON) corresponds to 17th pin of CN1.<br>X2=1: set DI1 input as NO (normally open) a-contact point. |
| **P2-15** | Function setting for digital input pin DI6 | X2X1X0 | 100 | Default factory setting of DI6 is NC (normally closed) limit signal input; driver can’t run without being connected to pin 32 and pin 31 of CN1.<br>X2=1: set DI6 input as NO a-contact |

| Para. No. | Function | Format & Range | Value | Description |
|---|---|---|---|---|
| | | | | point.<br>X1X0=00, limit input of the driver is not used. |
| **P2-18** | Function setting for digital output pin DO1 | X2X1X0 | 108 | DO1 corresponds to 16th pin, as clamping-position brake signal of Z-axis;<br>X2=1: set DO1 output as NO a-contact point;<br>X2=0: set DO1 output as NC b-contact point;<br>X1X0=08: set 16th pin as BK+. |
| **P2-20** | Function setting for digital output pin DO3 | X2X1X0 | 007 | DO3 corresponds to pin 1, used as servo alarm signal.<br>X2=0: set DO3 as NC b-contact point.<br>X1X0=07: set pin 1 as ALRM+. |

### 5.1.11 Parameter Setting of DELTA ASDA-B2 Servo Driver

| Para. No. | Function | Format & Range | Value | Description |
|---|---|---|---|---|
| **P0-02** | Driver status display | | 02 | Monitor if the number of sent and received pulse is correct by setting this parameter. In Weihong control system, the correct quantity of pulse sent by control card is detected by pulse inspection in order to determine whether there is electrical interference. |
| **P1-00** | External pulse train input type | ZYX | 102 | X=2: pulse + direction;<br>Z=1: negative logic |
| **P1-01** | Set control mode | ZYX1X0 | 0000 | Z=0: during control mode switching, DIO is maintaining the set value. Since switching control mode is not used, Z=0;<br>Y=0: forward rotation (CCW) (from the view of load);<br>Y=1: the rotation direction is reversed.<br>X1X0=00: position control mode |
| **P1-44** | Electronic Gear Ratio<br>( Numerator)(N1) | 1~32767 | Need calculation | N1/M= mechanical deceleration ratio × 4 × encoder pulses × pulse equivalent/ pitch<br>Representative value:<br>encoder pulses =40000, pitch =5mm, pulse equivalent=0.001, deceleration ratio = 1, calculation as below:<br>N1 / M = 40000×4×0.001/5 = 32/1, N1=32, M=1;<br>When the multi-electronic gear ratio is not used, P2-60 ~P2-62 are not required. |
| **P1-45** | Electronic Gear Ratio<br>(Denominator)(M) | 1~32767 | Need calculation | |
| **P2-10** | Function setting for digital input pin DI1 | X2X1X0 | 101 | X1X0=01: digital input (DI1 = SON) corresponds to 9th pin of CN1.<br>X2=1: set DI1 input as NO (normally open) a-contact point. |
| **P2-15** | Function setting for digital input pin DI6 | X2X1X0 | 100 | Default factory setting of DI6 and DI7 is NC (normally closed) limit signal input; driver can't run without being connected to pin 32 and pin 31 of CN1.<br>X2=1: set DI6 and DI7 inputs as NO a-contact points.<br>X1X0=00, limit input of the driver is not used. |

| Para. No. | Function | Format & Range | Value | Description |
|---|---|---|---|---|
| **P2-16** | Function setting for digital input pin DI7 | X2X1X0 | 100 | |
| **P2-17** | Function setting for digital input pin DI8 | X2X1X0 | 100 | External EMG stop input is not used. |
| **P2-18** | Function setting for digital output pin DO1 | X2X1X0 | 108 | DO1 corresponds to pin 6 & pin 7, used as clamping-position brake signal of Z-axis;<br>X2=1: set DO1 output as NO (normally open) a-contact point; X2=0: set DO1 output as NC (normally closed) b-contact point;<br>X1X0=08: set pin 6 and pin 7 as BK- and BK+ respectively. |
| **P2-22** | Function setting for digital output pin DO5 | X2X1X0 | 007 | DO5 corresponds to pin 28 & pin 27, used as servo alarm signal.<br>X2=0: set DO5 output as NC b-contact point.<br>X1X0=07: set pin 28 and pin 27 as ALRM+ and ALRM- respectively. |

## 5.1.12 Parameter Setting of SANYO PY Servo Driver

| Para. No. | Abbr. | Name | Standard Value | Setting Range | Unit | Remark |
|---|---|---|---|---|---|---|
| **1-2** | EGER | Electronic gear ratio | 4/1 | 1/32767 to 32767/1 | | Depends on the specific encoder resolution. The formula of electronic gear ratio of servo driver is as below:<br>Electronic gear ratio numerator =mechanical deceleration ratio × 4× pulse No. per encoder circle;<br>Electronic gear ratio denominator = (screw pitch / pulse equivalent)<br>E.G. In Weihong system, the default pulse equivalent is 0.001mm/p, screw pitch is 5mm, pulse number per encoder circle is 2000 shaft coupling direct drag, currently the numerator of the electronic gear ratio is 8, and the denominator is 5. (Select an incremental type encoder) |
| **1-16** | MENP | Pulse amount of the motor encoder<br>1. Set the pulse amount of the motor encoder;<br>2. Standard configuration of the encoder pulse No. is as below.<br>Incremental encoder omitting wiring: --2000P/R<br>Absolute encoder:--2048P/R | | 500 to 65535 | P/R | |
| **2-0** | PMOD | Pulse format of position command:<br>Our system uses: direction + pulse format, the parameters are shown as following: | | | | |

<table>
<tr><th>Para. No.</th><th>Abbr.</th><th>Name</th><th>Standard Value</th><th>Setting Range</th><th>Unit</th><th>Remark</th></tr>
<tr><td></td><td></td><td colspan="5">PMOD

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|

When bit 7=0

| Bit 1 | Bit 0 | Command Pulse Input Digital Filter<br>Min. Pulse Width |
|---|---|---|
| 0 | 0 | 0.8μs |
| 0 | 1 | 0.2μs |
| 1 | 0 | 0.4μs |
| 1 | 1 | 1.6μs |

When bit 7=1

| Bit 1 | Bit 0 | Command Pulse Input Digital Filter<br>Min. Pulse Width |
|---|---|---|
| 0 | 0 | 3.2μs |
| 0 | 1 | 0.8μs |
| 1 | 0 | 1.6μs |
| 1 | 1 | 6.4μs |

| Bit6 | Bit5 | Command Pulse Format |
|---|---|---|
| 1 | 0 | Direction + Pulse |

Switch of Digital Filter

| | |
|---|---|
| 0 | High Speed |
| 1 | Low Speed (1/4) |
</td></tr>
<tr><td>4-3</td><td>TYPE</td><td colspan="3">Control mode:<br>*Select one control mode from position, velocity, and torque modes.

| Selection Item | Content |
|---|---|
| Position | Position control mode |
| Velocity | Velocity control mode |
| Torque | Torque control mode |
| Velo ↔Torq | Velocity ↔ Torque switch mode |
| Posi ↔Torq | Position↔Torque switch mode |
| Posi ↔Velo | Position↔Velocity switch mode |

Referring to the switch type, the requisite control mode can be selected from pin 36 or 35 of the CN1.<br>Func3, set Bit7 as 0: pin 36 is enabled.<br>set Bit7 as 1:pin 35 is enabled.<br>＄＄＄: standard value varies with the reset setup (leave factory setting).</td><td>6 types</td><td>Our system selects position control mode.</td></tr>
</table>

### 5.1.13 Parameter Setting of SANYO R Servo Driver

| Para. No. | Parameter Name | Set Value | Remarks |
|---|---|---|---|
| Group 0, parameter setting of tuning mode | | | |
| **00** | Setting of the tuning mode | 00 | Set as auto tuning mode |
| Group 8, setting of the control parameters | | | |
| **00** | Polarity of position input | 00 | Position command mode: positive rotation effective |
| **11** | Input command mode | 02 | Pulse + negative logic |
| **15** | Setting of electronic gear | 8/5 | It depends on the resolution of the specific encoder. E.G.: incremental encoder 2000, motor needs 2000 ×4=8000 pulses per circle. And pulse equivalent of Weihong control card is 0.001mm/p, it needs 1000 pulses to move 1mm along line, in other words, if the screw pitch is 5, so, to move 5mm along line needs 5000 pulses, so F=8000/5000=8/5. |
| Group 9, setting of function effective | | | |
| **05** | Servo ON selection | 02 | Select servo ON state. |
| **02** | Servo alarm elimination | 10 | Make the function of servo alarm effective |
| Setting of the system parameters | | | |
| **02** | Encoder selection | 00 | Standard incremental encoder. The parameter depends on the specific situation, what we list is only the representative one. |
| **03** | Encoder resolution | 2000 | 500－65535, set the encoder resolution manually. |
| **08** | Control mode selection | 02 | Select position control mode |

## 5.1.14 Parameter Setting of SANYO Q Servo Driver

| Para. No. | Parameter Name | Set Value | Remarks |
|---|---|---|---|
| Group 1 | | | |
| **GER1** | Electronic gear ratio 1 | 1/1 | Set electronic gear ratio for position command pulse. E.G., incremental encoder 2000, motor needs 2000 ×4=8000 pulses per circle. And pulse equivalent of Weihong control card is 0.001mm/p, it needs 1000 pulses to move 1mm along line, in other words, if the screw pitch is 5, so, to move 5mm along line needs 5000 pulses, so F=8000/5000=8/5. |
| **GER2** | Electronic gear ratio 2 | 1/1 | This setting is the same as that of electronic gear ratio 1 and activated during electronic gear switching. |
| Group 4 | | | |
| **PA400** | Command pulse selection | 00H | Set position command pulse as “pulse + direction”. |
| Group 8 | | | |
| **S-ON** | Servo ON | 02H | Select servo ON state. |
| **AL-RST** | Alarm reset | 10H | Make the function of servo alarm effective |
| Setting of the system parameters | | | |
| **01** | Encoder selection | 00 | Standard incremental encoder. The parameter depends on the specific situation, what we list is only the representative one. |
| **03** | Incremental encoder resolution | 2000 | 500－65535, set the encoder resolution manually. |
| **08** | Control mode selection | 02 | Select position control mode. |

### 5.1.15 Parameter Setting of KT270 Servo Driver

| Para. No. | Parameter Name | Value | Description |
|---|---|---|---|
| **PA4** | Control mode selection | 0 | The control mode of the driver can be set through this parameter:<br>0: position control mode; 1: speed control mode;<br>2: trial run control mode; 3: JOG control mode. |
| **PA12** | Numerator of position command pulse ratio | 2 | Set the ratio of the position command pulse (electronic gear).<br>Under position control mode, with the setting of the PA12 and PA13, it is convenient to match with pulse source of each type, which can reach the user's perfect control resolution (that is angle/pulse)<br>Expression: $P \times G = N \times C \times 4$<br>P: pulse amount of the input command;<br>G: electronic gear ratio, G=ratio numerator / ratio denominator.<br>N: circle number that the motor rotates;<br>C: each circle line number of photo electricity encoder,<br>C of our system =2500.<br>E.G.: input 6000 command pulses to make the servo motor rotate one circle,<br>$G = \frac{N \times C \times 4}{P} = \frac{1 \times 2500 \times 4}{6000} = \frac{5}{3}$<br>So set PA12 as 5 and PA13 as 3.<br>We recommend the range of electronic gear ratio as: $\frac{1}{50} \le G \le 50$ |
| **PA13** | Denominator of position command pulse ratio | 1 | Refer to parameter PA12. |
| **PA14** | Input mode of the position command pulse | 0 | Set the input mode of the position command pulse; there are following three modes can be selected by setting the parameter:<br>0: pulse + symbol;<br>1: positive rotation pulse/negative rotation pulse;<br>2: two orthogonal pulses inputs<br>Default setting is 0: pulse + symbol, negative logic. |

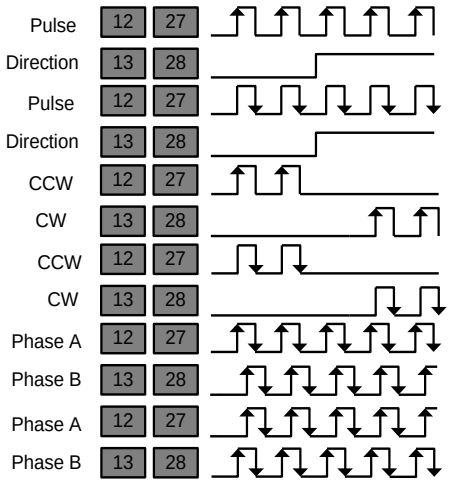
| Para. No. | Parameter Name | Value | Description |
|---|---|---|---|
| **PA20** | Invalid input on the end of the stroke | 1 | 0: Valid stroke end of LSP, LSN positive rotation, negative rotation.<br>When switch LSP is connected, driving of the positive rotation is allowed; When switch LSP is disconnected, driving of the positive rotation is prohibited (torque of the positive direction is 0). LSN is the same as LSP. If LSP and LSN are all disconnected, the abnormal alarming of driving prohibited (NO.7) will occur.<br><br>1: Invalid stroke end of LSP, LSN positive rotation, negative rotation.<br>No matter which state of the switch LSP and LSN is in, driving of positive rotation and negative rotation are all allowed. Simultaneously, even if LSP and LSN are all disconnected, abnormal alarming of driving prohibited (NO.7) will not occur.<br><br>2: Invalid stroke end of LSP, LSN positive rotation, negative rotation, and SON is forced to be effective. (Note: SON forcedly effective is only used for motor debugging. In normal use, we suggest controlling the state of SON by input port.)<br><br>3: Valid stroke end of LSP, LSN positive rotation, negative rotation.<br>When switch LSP is connected, driving of the positive rotation is allowed; When switch LSP is disconnected, driving of the positive rotation is prohibited (the speed of positive direction is 0, but the torque is not 0). LSN is the same as LSP. When LSP and LSN are all disconnected, abnormal alarming of driving prohibited (NO.7) will not occur. |

## 5.1.16 Parameter Setting of FUJI FALDIC-β Servo Driver

| Para. No. | Name | Value | Description |
|---|---|---|---|
| **01** | Command pulse numerator α | Need calculation 1~32767 | Command pulse numerator and denominator are also equal to those of the electronic gear ratio.<br>α/ β=encoder resolution× pulse equivalent× mechanical deceleration ratio / screw pitch.<br>Typical value: encoder resolution 65536, pitch 5mm, pulse equivalent 0.001, mechanical deceleration ratio 1,<br>α / β=65536×0.001 / 5=8192 / 625,<br>So α=8192, β=625. |
| **02** | Command pulse denominator β | Need calculation 1~32767 | |
| **03** | Pulse string input form | 0 | Set the input mode of pulse string as: instruction + symbol, that is 'pulse + direction'. |
| **04** | Direction of rotation switch | 0 or 1 | Set 0: Positive direction: Forward rotation (CCW);<br>Set 1: Positive direction: Reverse rotation (CW). |
| **10** | CONT1 signal distribution | 1 | CONT1 is distributed as RUN (i.e. SON); if not distributed, CONT1 will be auto ON if there is no alarming when powered. |
| **11** | CONT2 signal distribution | 2 | CONT2 is distributed as RST (i.e. servo alarming clearance CLR).<br>When 12, 13, 14 are 0, that is CONT3, CONT4 and CONT5 can't be distributed as OT over-travel or EMG (external emergency stop). |
| **15** | OUT1 signal distribution | 1 | Set 1, OUT1 is distributed as a-contact point of alarming output;<br>Set 2, OUT1 is distributed as b-contact point of alarming detection. |
| **27** | Parameter write-protection | 0 or 1 | Set 0, write-enable.<br>Set 1, write-protected. |
| **74** | CONT Always ON 1 | 1 | Its initial value is 0, and it is set "1" here to enable servo (RUN). |

## 5.1.17 Parameter Setting of STONE GS Servo Driver

<table>
<tr><th>Para. No.</th><th>Para. Name</th><th>Value</th><th>Description</th></tr>
<tr><td>F0f</td><td>Electronic gear ratio numerator</td><td>2</td><td rowspan="2">Electronic gear ratio of position mode: 4× pulse frequency fed back by servo encoder = command pulse frequency× F0f / F10; value of F0f / F10 must be within 1/100~100. (calculation with pitch 10mm)</td></tr>
<tr><td>F10</td><td>Electronic gear ratio denominator</td><td>1</td></tr>
<tr><td>F00</td><td>Control mode selection</td><td>2</td><td>0: External speed running mode; make sure the value and direction of motor speed according to the external analog -10V ~ +10V signal of CN2-16, 17;<br>1: Internal speed running mode; make sure the value and direction of motor speed according to the setting of parameter F33, F35, F37, F39 and the port status of CN2-9, CN2-25;<br>2: Position pulse running mode; accept the input of external position pulse and direction level signal;<br>3: Jog mode; make sure the motor speed in terms of parameter setting of F3b, and control the rotation direction by the direction keystroke ▼ and ▲;<br>4: Torque mode; make sure the value and direction of motor torque according to the external analog -10V ~ +10V signal of CN2-43, 1;<br>5~10: Mixed mode; select mode according to the port input status of CN2-24:
<table>
<tr><th rowspan="2">F00 Value</th><th colspan="2">CN2-24 Interface Status</th></tr>
<tr><th>OFF (Mode One)</th><th>ON (Mode Two)</th></tr>
<tr><td>5</td><td>Position Pulse Mode</td><td>External Speed Running Mode</td></tr>
<tr><td>6</td><td>Position Pulse Mode</td><td>Internal Speed Running Mode</td></tr>
<tr><td>7</td><td>Position Pulse Mode</td><td>Torque Mode</td></tr>
<tr><td>8</td><td>Internal Speed Running Mode</td><td>External Speed Running Mode</td></tr>
<tr><td>9</td><td>Internal Speed Running Mode</td><td>Torque Mode</td></tr>
<tr><td>10</td><td>External Speed Running Mode</td><td>Torque Mode</td></tr>
</table></td></tr>
</table>

| Para. No. | Para. Name | Value | Description |
|---|---|---|---|
| **F2e** | Pulse input mode selection | 2 | Command pulse string mode selection of position mode:<br>1 – Single pulse train positive logic<br>2 – Single pulse train negative logic<br>3 – Double pulse train positive logic<br>4 – Double pulse train negative logic<br>5 – Orthogonal pulse positive logic<br>6 – Orthogonal pulse negative logic<br>  |

## 5.1.18 Parameter Setting of TECO TSDA Servo Driver

<table>
<tr><th>Para. No.</th><th>Function</th><th>Value</th><th colspan="3">Description</th></tr>
<tr><td rowspan="8">Pn010-1</td><td rowspan="8">Set control mode</td><td rowspan="8">1</td><td rowspan="2">Value</td><td colspan="2">Control mode</td></tr>
<tr><td>CN1 Pin12 open circuit</td><td>CN1 Pin12 closed circuit</td></tr>
<tr><td>0</td><td>Speed control</td><td>Speed control</td></tr>
<tr><td>1</td><td>Position control</td><td>Position control</td></tr>
<tr><td>2</td><td>Torque control</td><td>Torque control</td></tr>
<tr><td>3</td><td>Speed control</td><td>Speed control</td></tr>
<tr><td>4</td><td>Position control</td><td>Position control</td></tr>
<tr><td>5</td><td>Torque control</td><td>Torque control</td></tr>
<tr><td rowspan="4">Pn010-2</td><td rowspan="4">Set the pulse input format under position control mode</td><td rowspan="4">0</td><td>Value</td><td colspan="2">The format of pulse input</td></tr>
<tr><td>0</td><td colspan="2">Pulse + direction</td></tr>
<tr><td>1</td><td colspan="2">Dipulse</td></tr>
<tr><td>2</td><td colspan="2">A/B phase difference</td></tr>
<tr><td rowspan="3">Pn010-3</td><td rowspan="3">Set rotation direction of motor</td><td rowspan="3">1</td><td>Value</td><td colspan="2">Function</td></tr>
<tr><td>0</td><td colspan="2">Motor rotates anti-clockwise with the input of positive command.</td></tr>
<tr><td>1</td><td colspan="2">Motor rotates clockwise with the input of positive command.</td></tr>
<tr><td>Pn021</td><td>Electronic gear ratio numerator</td><td>5</td><td colspan="3" rowspan="2">The input pulse amount will be multiplied by the ratio before output. Ratio range of parameter 21 to 22: 1/127＜parameter 21/ parameter 22＜127</td></tr>
<tr><td>Pn022</td><td>Electronic gear ratio denominator</td><td>1</td></tr>
<tr><td rowspan="3">Pn011-4</td><td rowspan="3">Set the value of Pin20 of CN1</td><td rowspan="3">1</td><td>Value</td><td colspan="2">Function</td></tr>
<tr><td>0</td><td colspan="2">Output of “0” speed signal</td></tr>
<tr><td>1</td><td colspan="2">Output of brake signal</td></tr>
<tr><td>Pn013-1</td><td>Set the maximum pulse frequency received by the driver under position control mode</td><td>7</td><td colspan="3">It can correct the phenomenon of unauthorized over-travel. Received frequency is divided into 8 segments from 500Kpps to 200Kpps. “0” indicates 500Kpps while “7” 200Kpps.</td></tr>
</table>

Note:

For the parameter setting of a specific driver, refer to the driver manual of the specific brand.

## 5.2 Wiring Diagram of Driver and Terminal Board

Wiring diagrams in this part are the wiring diagrams of CNC system-axes control-driver motion. When it is required to use one axis of the CNC system to control the motion of two drivers, the wiring diagram is as shown in Figure 2 in Chapter 5.2.1 and Figure 4 in Chapter 5.2.6 (taking YASKAWA driver and DELTA driver as an example; for YASKAWA server, its alarm signal wiring is NC type, while for DELTA server, its alarm signal wiring is NO type).

### 5.2.1 Wiring Diagram of WISE Servo Driver

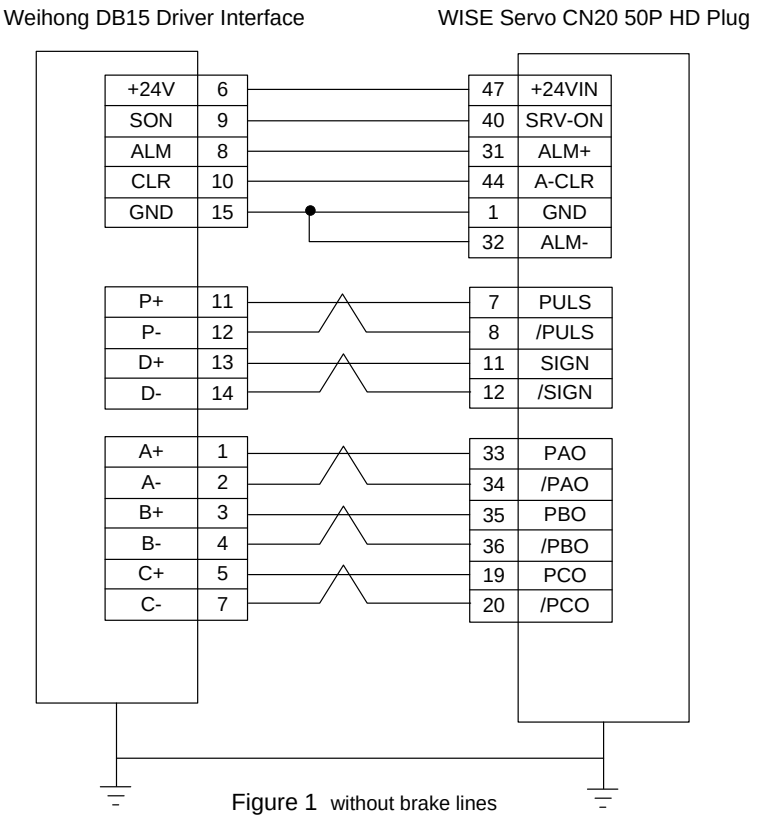



Figure 1 without brake lines

Note: twisted pair for differential signals

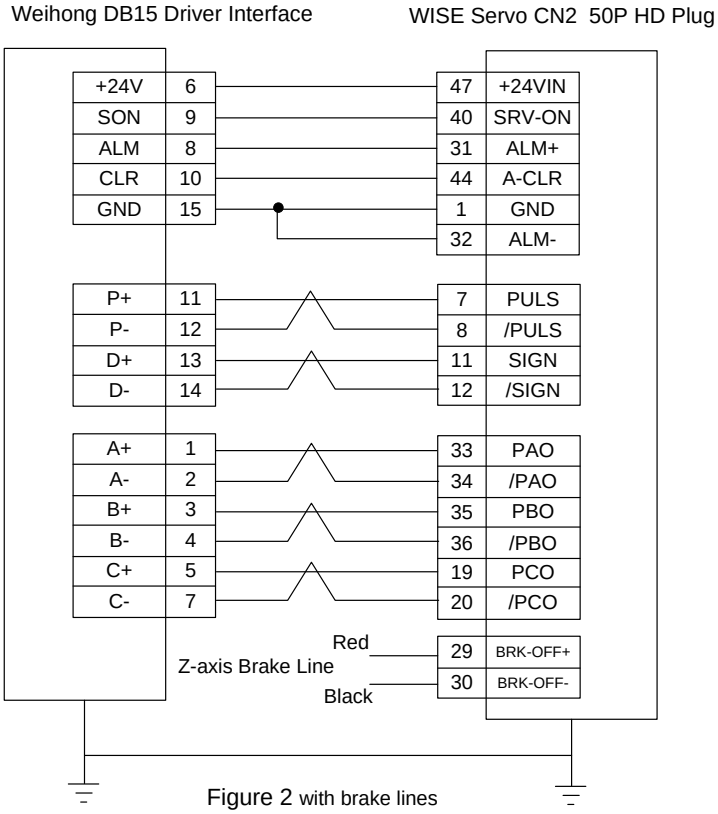
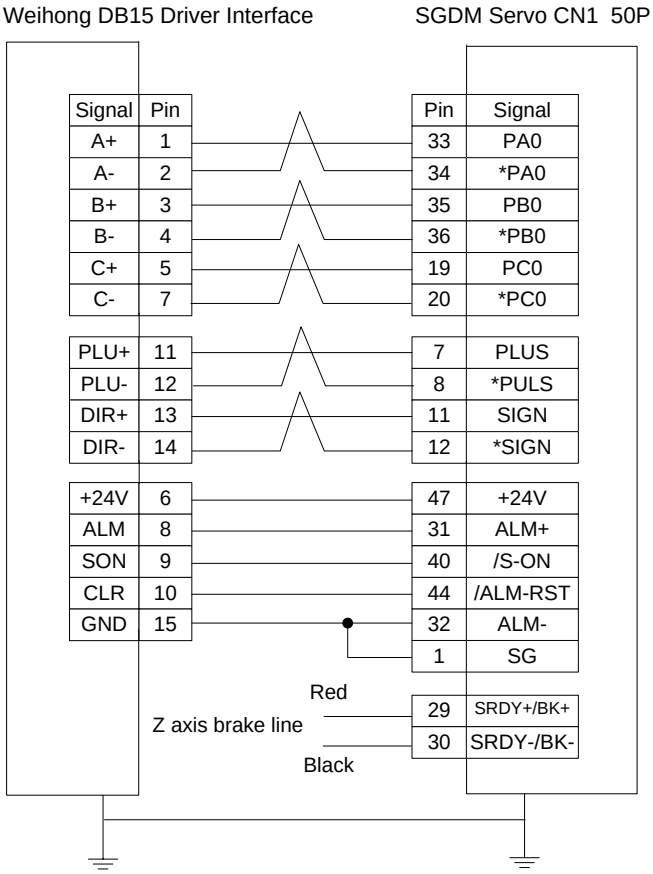
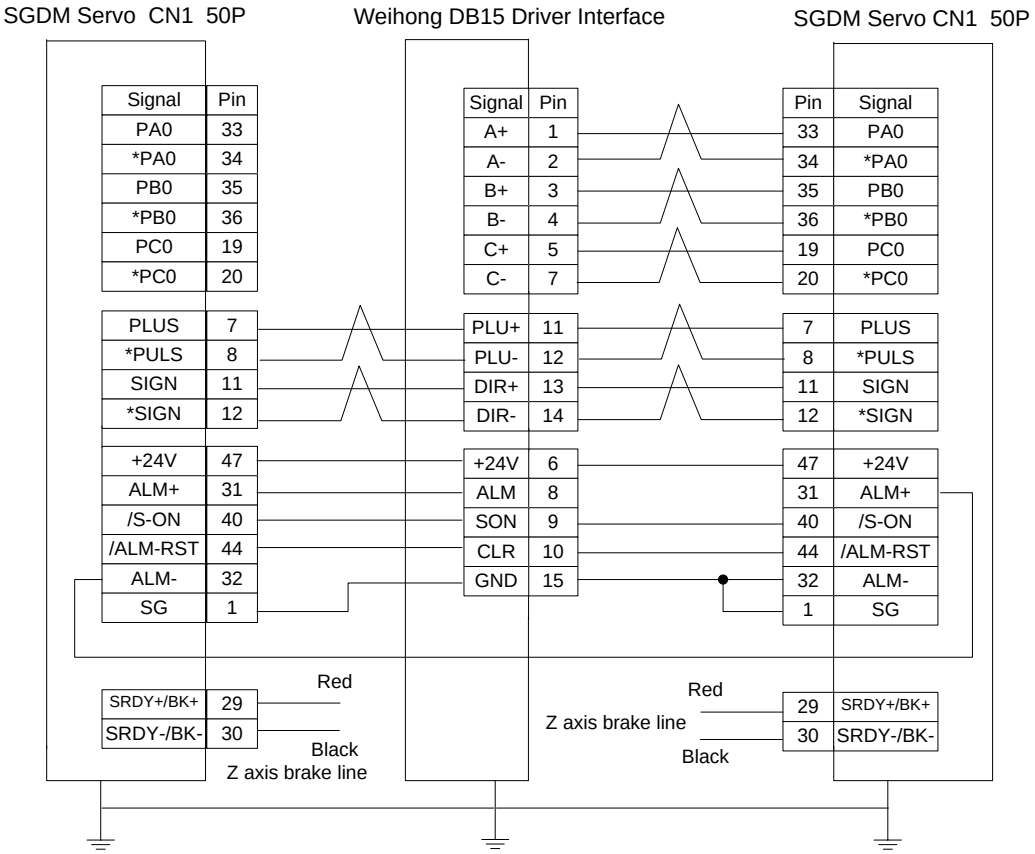



Figure 2 with brake lines

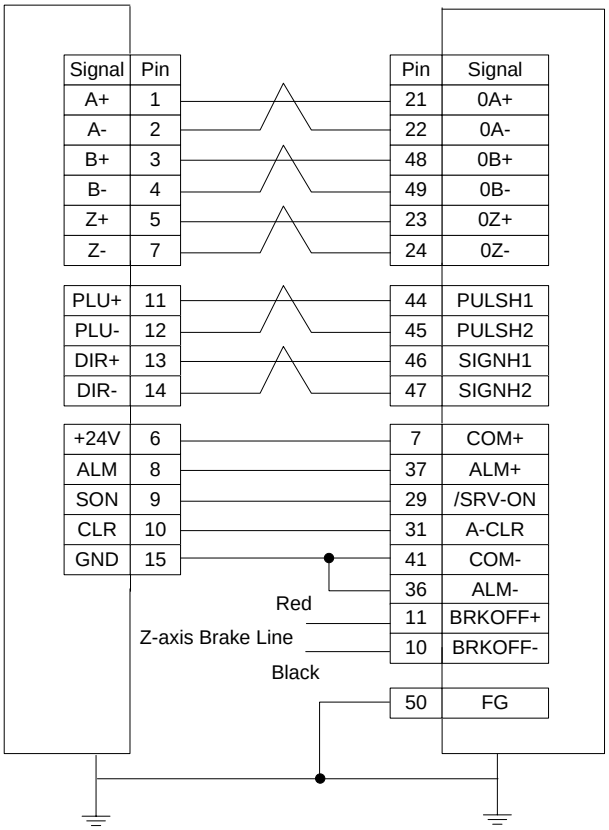
Note: twisted pair for differential signals.

## 5.2.2 Wiring Diagram of YASKAWA AC Servo Driver






## 5.2.3 Wiring Diagram of PANASONIC AC Servo Driver



## 5.2.4 Wiring Diagram of MITSUBISHI MR-JE Servo Driver

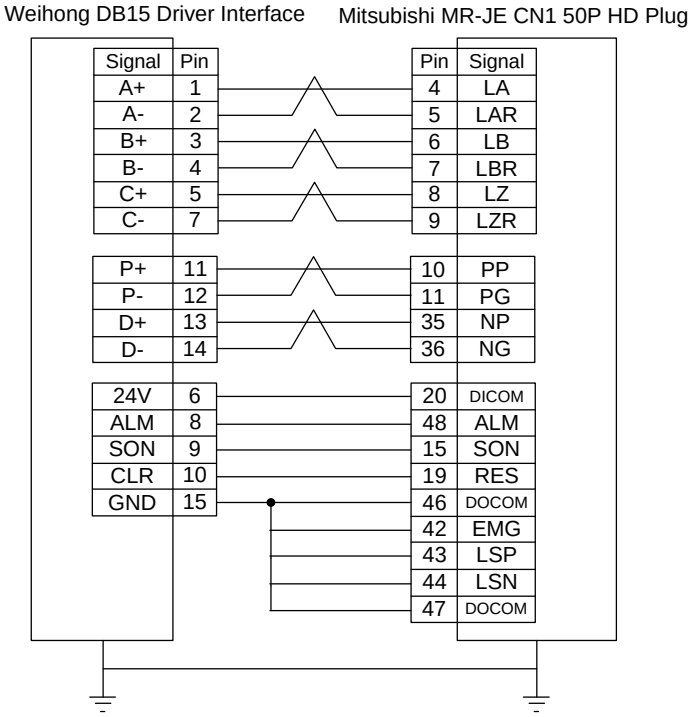



Figure 1 without brake lines

Note: twisted pair for differential signals.

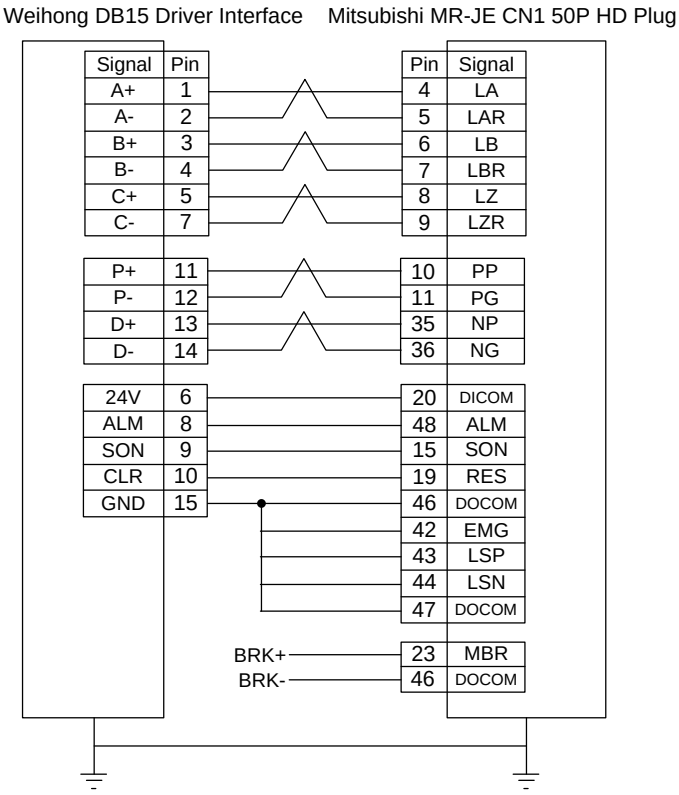
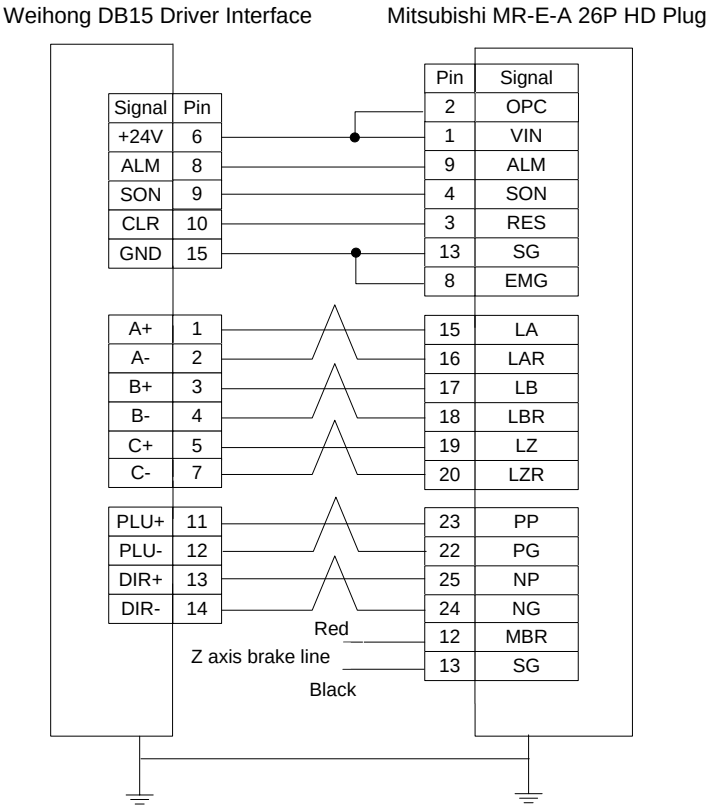



Figure 2 with brake lines

Note: twisted pair for differential signals.

## 5.2.5 Wiring Diagram of MITSUBISHI MR-E Servo Driver




## 5.2.6 Wiring Diagram of DELTA Servo Driver

DELTA ASDA-A, ASDA-A2 and ASDA-AB use the same cable. Among them, the wiring pins of ASDA-A2 and ASDA-AB are totally the same. As for ASDA-A, with PULSE as 41 and /PULSE as 43, its pulse signal pins are opposite to those of ASDA-A2 and ASDA-AB, but the other wiring pins are totally the same. For the detailed parameters settings, see Chapter 5.1.8 and Chapter 5.1.9.

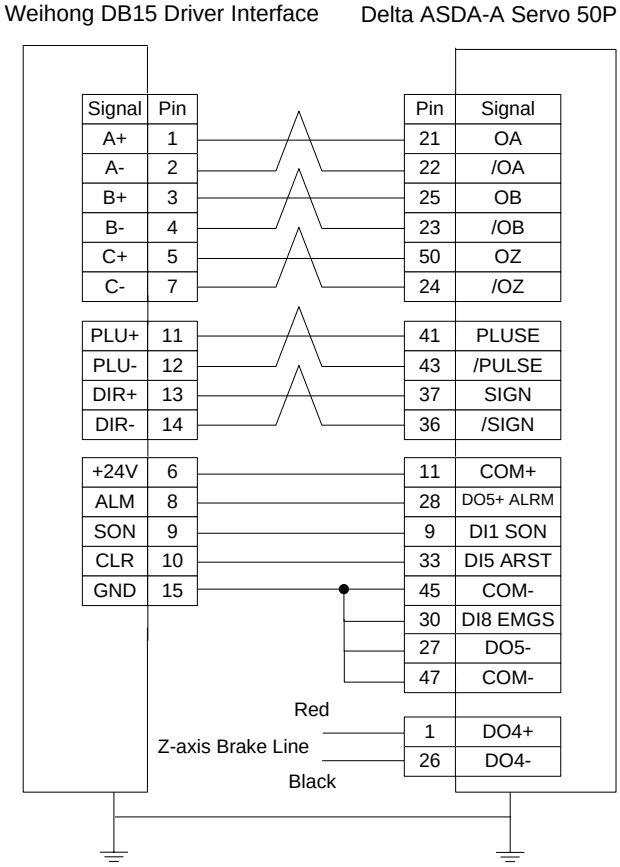



Figure 1

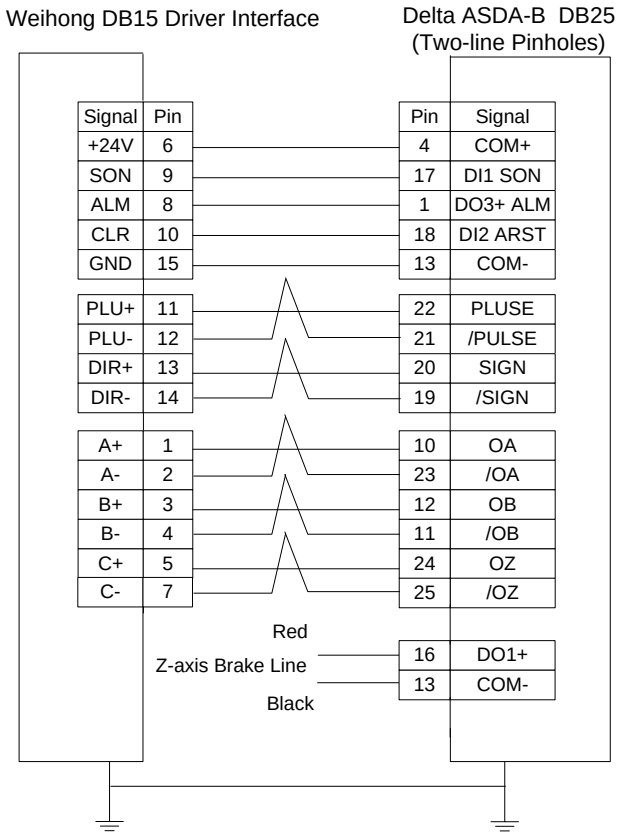



Figure 2

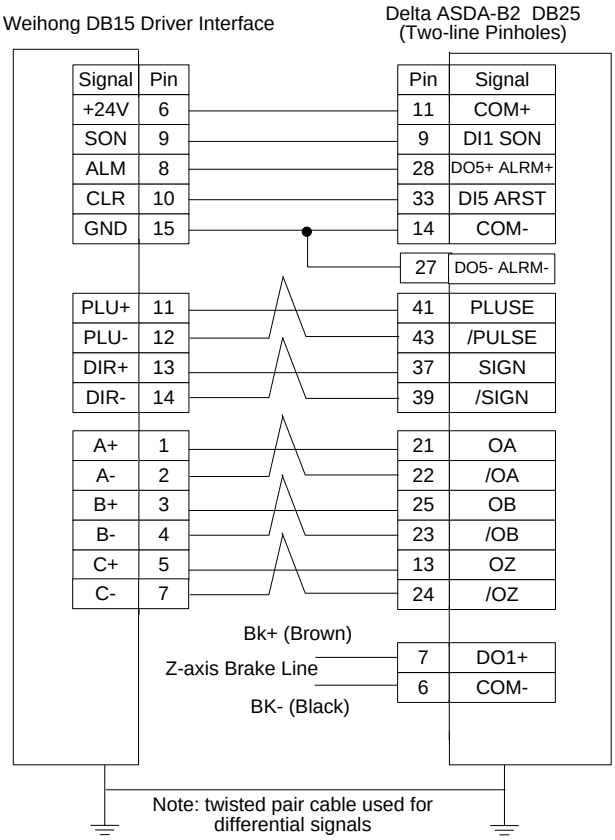



Figure 3

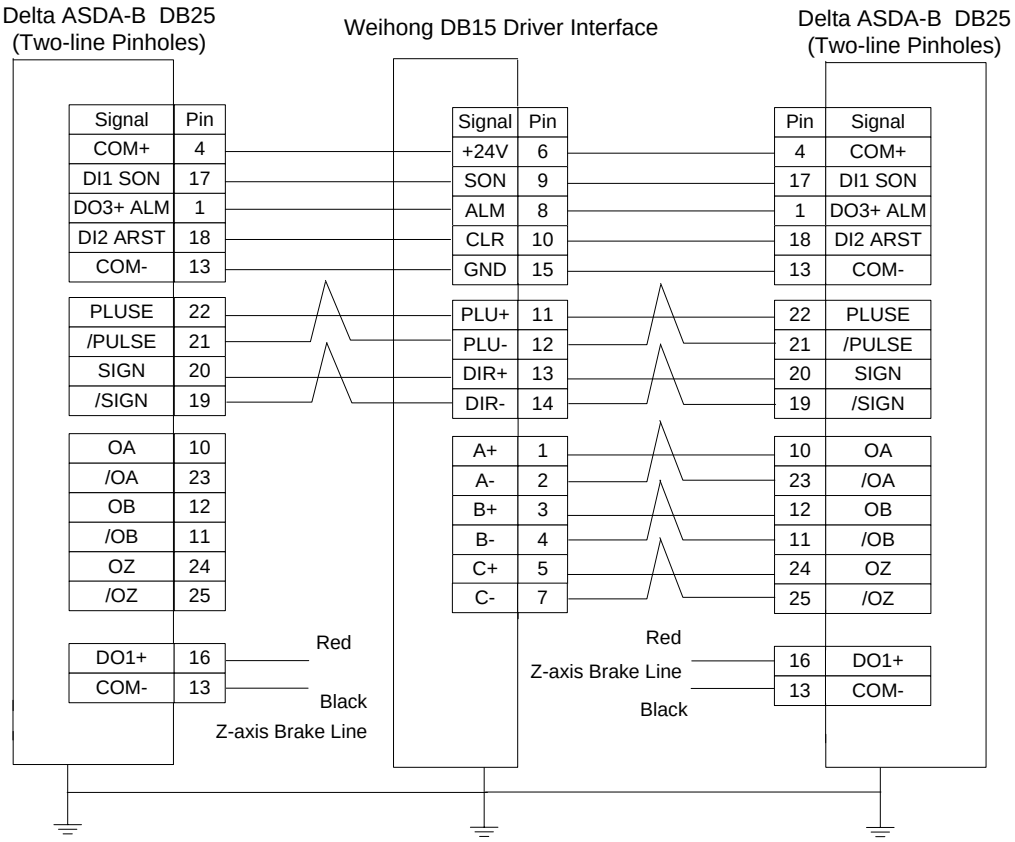
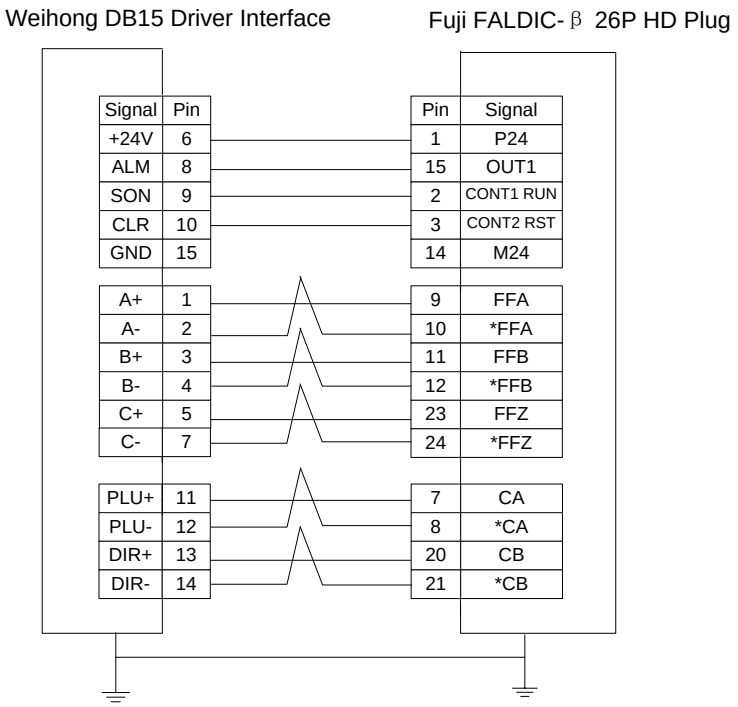


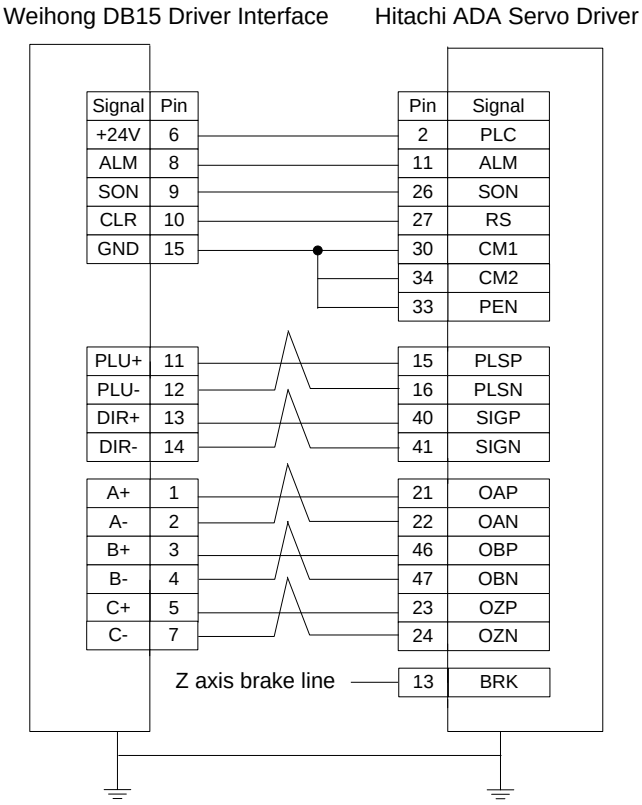

Figure 4

## 5.2.7 Wiring Diagram of FUJI Servo Driver

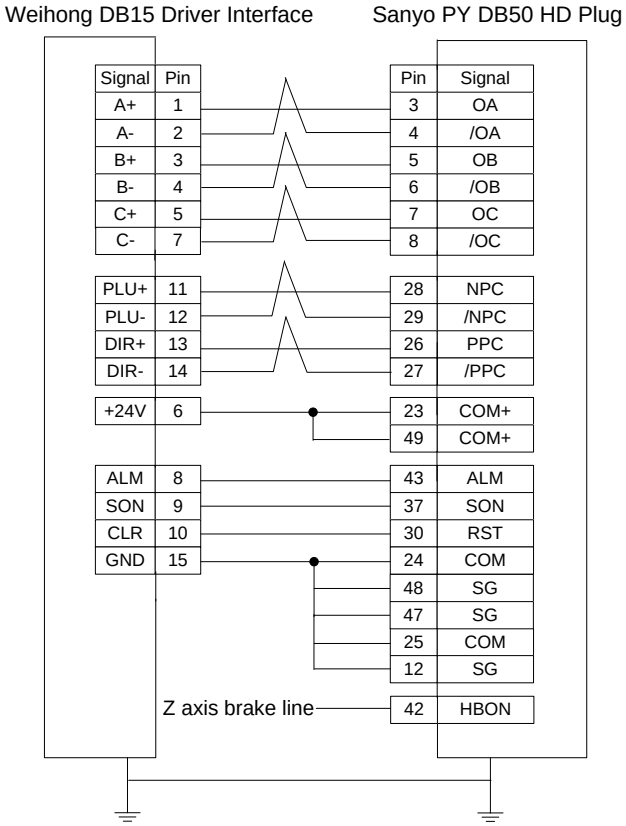



Remark: twisted pair cable adopted for differential signal transmission. Brake unavailable.

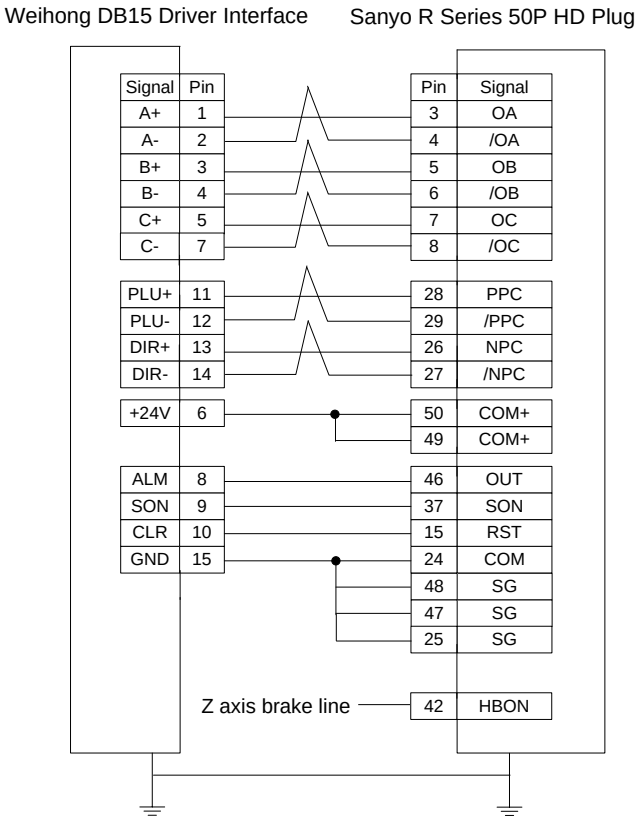
## 5.2.8 Wiring Diagram of HITACHI Servo Driver



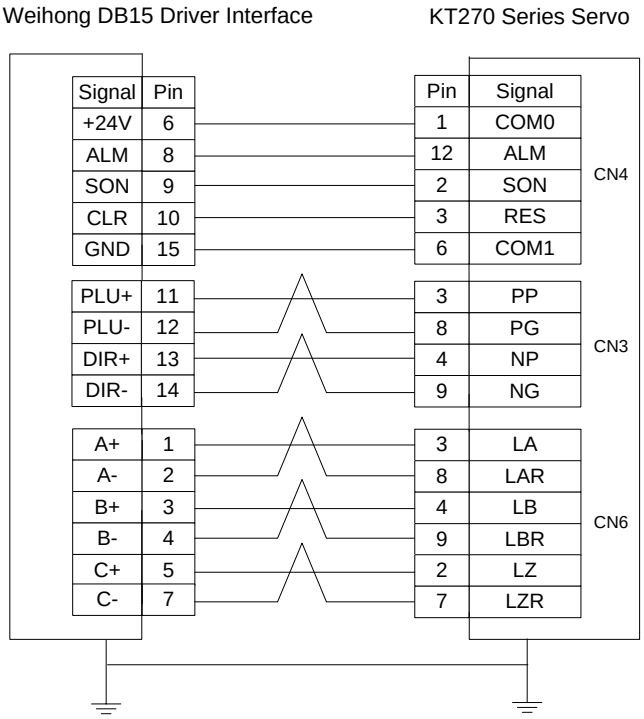
## 5.2.9 Wiring Diagram of SANYO PY Servo Driver



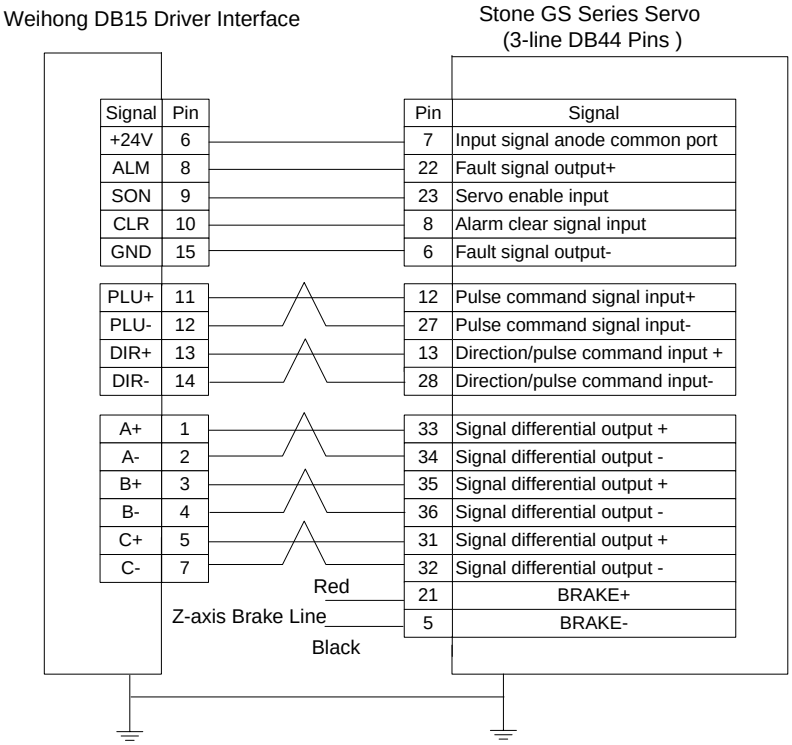

## 5.2.10 Wiring Diagram of SANYO R Servo Driver



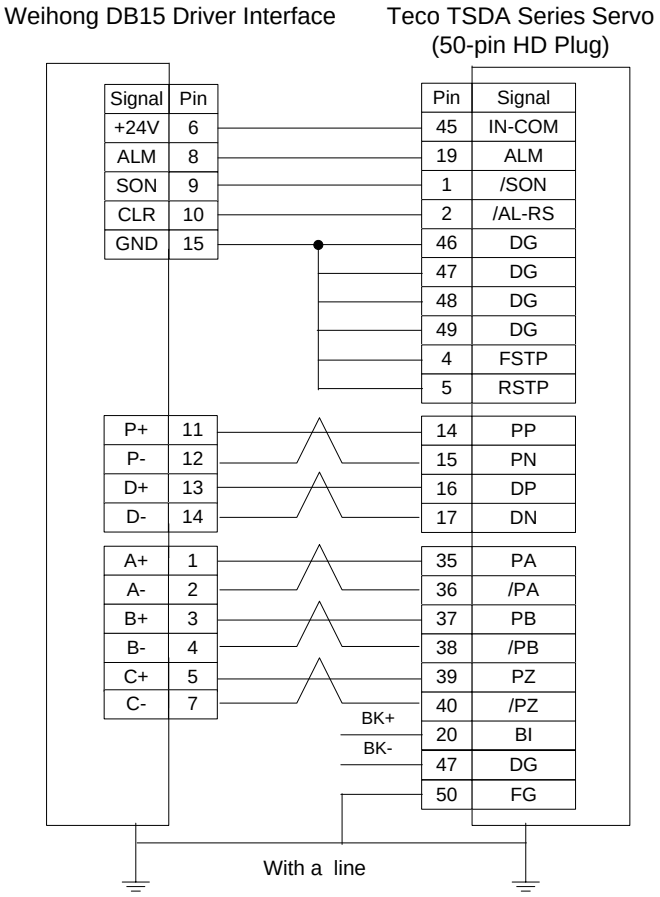
## 5.2.11 Wiring Diagram of KT270 Servo Driver



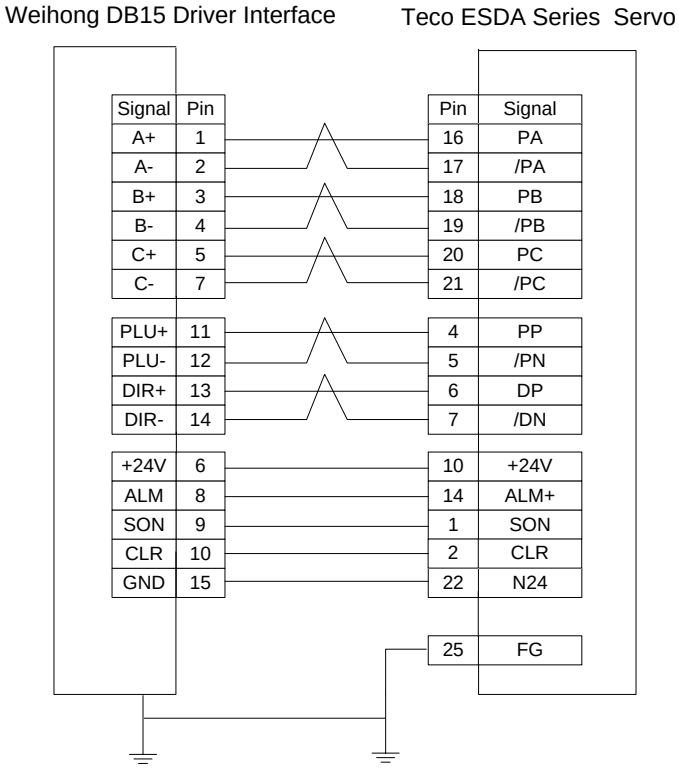

## 5.2.12 Wiring Diagram of STONE GS Servo Driver



## 5.2.13 Wiring Diagram of TECO TSDA Servo Driver




## 5.2.14 Wiring Diagram of TECO ESDA Servo Driver



# 6 Parameter Overview

| Para. No. | Name | Setting Range | Default Value | Valid Time | Refer-ence |
|---|---|---|---|---|---|
| 1.0 Axis | | | | | |
| **N10000** | Axis Direction (X/Y/Z) | 1: Positive direction<br>-1: Negative direction | -1 | After restart | 3.4.1 |
| **N10010** | Pulse Equivalent (X/Y/Z) | -0.0000009~999 (mm/p) | 0.001 | After restart | 3.4.2 |
| **N10020** | Table Travel Lower Limit (X/Y/Z) | -99999~99999 (mm) | X: 0<br>Y: 0<br>Z: -100 | After restart | 3.4.3 |
| **N10030** | Table Travel Upper Limit (X/Y/Z) | -99999~99999（mm） | X: 800<br>Y: 600<br>Z: 0 | After restart | 3.4.3 |
| **N10040** | Check Table Travel Limits (X/Y/Z) | NO: Invalid<br>YES: Valid | YES | After restart | 3.4.3 |
| **N10050** | Change Tool Workbench Range Upper Limit (X/Y/Z) | -99999~99999 (mm) | 9999 | After restart | 3.8.1 |
| **N10060** | Change Tool Workbench Range Lower Limit (X/Y/Z) | -99999~99999 (mm) | -9999 | After restart | 3.8.1 |
| **N10080** | Enable Change Tool Travel Range | NO: Invalid<br>YES: Valid | NO | After restart | 3.8.1 |
| 1.1 Encoders | | | | | |
| **N11110** | Axis Encoder Dir | 1: Increasing encoder value; -1: Decreasing encoder value | 1 | After restart | 3.4.3 |
| **N11130** | Check Encoder Error | NO: Invalid<br>YES: Valid | YES | After restart | 3.4.3 |
| **N11140** | Static Tolerance | 1~999999 | 500 | After restart | 3.4.3 |
| **N11150** | Dynamic Tolerance | 1~999999 | 500 | After restart | 3.4.3 |
| **N11160** | Frequency Division Pulses of PG (X4) | 1~999999 | 10000 | After restart | 3.4.3 |
| **N11303** | Delay for Stopping OnEstop | 0.001~10 (s) | 1 | Immediately | - |
| | The time for a machine stops completely after E-stop. | | | | |

| Para. No. | Name | Setting Range | Default Value | Valid Time | Refer-ence |
|---|---|---|---|---|---|
| **N11304** | Encoder Feedback | NO: Invalid<br>YES: Valid | YES | After restart | 3.4.3 |
| **N11309** | Delay in Setting REF Sign | 0.5~5 | 0.5 | Immediately | - |
| | The wait time for a machine tool stopping completely after backing to machine origin completed. The REF. Point mark will not be set until after the wait time. | | | | |
| 1.2 Compensation | | | | | |
| **N12000** | Screw Error Comp | 0, 1, 2 | 1 | After restart | 3.13.1 |
| **N12001** | Backlash Compensation Only | NO: Invalid<br>YES: Valid | YES | After restart | 3.13.1 |
| **N12020** | Turn On AQE Compensation | NO: Invalid<br>YES: Valid | NO | After restart | 3.13.3 |
| **N12030** | Time | 0~10 (sec) | 0 | After restart | 3.13.3 |
| **N12040** | | | | | |
| **N12050** | | | | | |
| **N12060** | | | | | |
| **N12070** | | | | | |
| **N12080** | | | | | |
| **N12031** | Distance | 0~10 (mm) | 0 | After restart | 3.13.3 |
| **N12041** | | | | | |
| **N12051** | | | | | |
| **N12061** | | | | | |
| **N12071** | | | | | |
| **N12081** | | | | | |
| **N12032** | Delay | 0~10 (sec) | 0 | After restart | 3.13.3 |

| Para. No. | Name | Setting Range | Default Value | Valid Time | Refer-ence |
|---|---|---|---|---|---|
| **N12042** | | | | | |
| **N12052** | | | | | |
| **N12062** | | | | | |
| **N12072** | | | | | |
| **N12082** | | | | | |
| **N12033** | | | | | |
| **N12043** | | | | | |
| **N12053** | Intensity | 0.01~0.99 | 0.75 | After restart | 3.13.3 |
| **N12063** | | | | | |
| **N12073** | | | | | |
| **N12083** | | | | | |
| 1.3 Velo/Acc limits | | | | | |
| **N13000** | Max Axis Velocity (X/Y/Z) | 0.001~100000 (mm/min) | 48000 | Immediately | 3.11.1 |
| 1.4 Rotary axis | | | | | |
| **N14001** | Programming Units | 0: deg; 1: mm | 1 | Immediately | - |
| **N14002** | Workpiece Diameter | 1~3000 (mm) | 10 | Immediately | - |
| **N14003** | Rotary Y Max Velocity | 0.001~9999 (rpm) | 600 | After restart | - |
| **N14004** | Angular Acceleration | (deg/$s^2$) | 500 | After restart | - |
| **N14005** | Coordinate Units | 0: deg<br>1: mm | 1 | Immediately | - |
| 2.0 Spindle | | | | | |
| **N20001** | Max Spindle Speed | 0~999999 (rpm) | 24000 | After restart | 3.7.1 |

| Para. No. | Name | Setting Range | Default Value | Valid Time | Refer-ence |
|---|---|---|---|---|---|
| **N20003** | Spindle On/Off Delay Time | 0~60 (sec) | 5 | Immediately | 3.7.1 |
| **N20005** | Spindle Cool Off Delay Time | 0~600 (sec) | 5 | Immediately | 3.7.1 |
| **N20006** | Spindle Speed when Centering | 0~999999 (rpm) | 500 | Immediately | 3.10.3 |
| 3.1 Tool library | | | | | |
| **N31000** | Tool Magazine Capacity | 0~255 | 8 | Immediately | 3.17.3 |
| **N31003** | Check Change ToolNo | YES; NO | YES | Immediately | 3.17.3 |
| 4.1 Lubricate | | | | | |
| **N41000** | Auto Lubricate | NO: Not auto on<br>YES: Auto on | NO | Immediately | - |
| | It sets whether the system automatically opens lubrication pump periodically and fills lube. | | | | |
| **N41001** | Lubricating Interval | 3.6~3.6*106 (sec) | 18000 | Immediately | - |
| | It is the time interval between two start-ups of lubrication pump. | | | | |
| **N41002** | Lubricating Duration | 1~100 (sec) | 5 | Immediately | - |
| | It is the filling time of lubrication pump each time. | | | | |
| 4.2 | | | | | |
| **N42000** | Cycle End Inform Type | 0, 1, 2 | 2 | Immediately | - |
| | 0: Red light not on; 1: Red light on for about 3s; 2: Red light always on until there is any input from mouse or keyboard. | | | | |
| **N42001** | G28 Enable | YES; NO | YES | Immediately | - |
| **N42002** | Modify Popedom Check | YES; NO | NO | Immediately | - |
| **N42004** | Showmachiningrangetype | 0; 1 | 0 | Immediately | - |
| **N42007** | Select Tool Mode | 0; 1 | 0 | Immediately | - |
| 5.2 Handwheel | | | | | |
| **N52001** | Precise Pulse Counting | NO: Not adopt<br>YES: Adopt | NO | After restart | 3.16.2 |
| **N52002** | Handwheel Direction | | 1 | After restart | 3.16.2 |
| | Setting range:1: Maintain the original motion direction of a machine tool in handwheel turning | | | | |

| Para. No. | Name | Setting Range | Default Value | Valid Time | Refer-ence |
|---|---|---|---|---|---|
| | -1: Reverse the original motion direction of a machine tool in handwheel turning | | | | |
| **N52003** | Multiple At X1 | 0.001~10 (mm) | 0.001 | After restart | 3.16.2 |
| **N52004** | Multiple At X10 | 0.001~10 (mm) | 0.01 | After restart | 3.16.2 |
| **N52005** | Multiple At X100 | 0.001~10 (mm) | 0.1 | After restart | 3.16.2 |
| **N52006** | HW Lead Gear (Numerator) | 1~1000 | 1 | After restart | 3.16.2 |
| **N52007** | HW Lead Gear (Denominator) | 1~1000 | 1 | After restart | 3.16.2 |
| **N52010** | Handwheel Acceleration | 1~1000 (mm/s$^2$) | 200 | After restart | 3.16.2 |
| **N52012** | Deceleration when Switching Axis | YES; NO | YES | After restart | - |
| 5.3 Operation panel | | | | | |
| **N53004** | Enable Jog Override | YES; NO | YES | After restart | - |
| 6.2 G code options | | | | | |
| **N62000** | Deceleration Distance | 0~999 (mm) | 2 | Immediately | 3.15.2 |
| **N62001** | Approach Speed | 0.001~99999 (mm/min) | 300 | Immediately | 3.15.2 |
| **N62020** | Enable Arc IJK Programming | NO: Invalid<br>YES: Valid | YES | Immediately | 3.15.2 |
| **N62021** | Arc Radius Tolerance | 0~9999 (mm) | 1 | Immediately | 3.15.2 |
| **N62022** | Tool Selection For G Code | YES; NO | NO | Reload program | - |
| **N62090** | Exact Stop Tolerance (X/Y/Z) | 0~99 (mm) | 0.001 | Immediately | - |
| | G09 exact stop tolerance. This parameter is used together with G09 exact stop command, and can also be used together with pulse equivalent and other parameters. | | | | |
| **N62410** | Enable Cutter Compensation | NO: Invalid<br>YES: Valid | NO | Immediately | 3.13.2 |
| **N62411** | Cutter Compensation Type | 1: Normal type; 2: Intersect type; 3: Insert type | 1 | Immediately | 3.13.1 |
| **N62412** | Cutter Compensation Direction | 0: No compensation<br>1: Left compensation | 1 | Immediately | 3.13.1 |

| Para. No. | Name | Setting Range | Default Value | Valid Time | Refer-ence |
|---|---|---|---|---|---|
| | | 2: Right compensation | | | |
| **N62413** | Num Of Intervene Detected Graphics | 1~5 | 3 | Immediately | 3.13.1 |
| **N62730** | G73_G83 Lifting Distance | -99999~99999 (mm) | 0 | Immediately | 3.15.2 |
| **N62760** | G76_G87 Stop Orientation | 0: G17 +X 1: G17 -X<br>2: G17 +Y 3: G17 -Y | 0 | Immediately | 3.15.2 |
| 6.3 Trajectory | | | | | |
| **N63000** | LEP Look Ahead Distance | 0~999 | 0.5 | Immediately | - |
| **N63001** | Connect Speed LEP Look Ahead Distance | 0 ~ 0.05 | 0 | Immediately | - |
| **N63002** | Delay for Exact Stop | 0~999 (s) | 0 | Immediately | - |
| **N63003** | MAX_CONN_ANGLE_NUM | 1~1000 | 100 | Immediately | - |
| **N63006** | Path Smoothing Time | 0~0.064 (s) | 0 | Immediately | - |
| **N63007** | Trace Pretreatment Options | 0, 1, 2 | 0 | Immediately | - |
| **N63008** | Trace Pretreatment Precision | 0~0.1 | 0 | Immediately | - |
| **N63009** | Max Angle Of Trace Pretreatment | 0~180 (degrees) | 180 | Immediately | - |
| 6.4 Speed/Acc | | | | | |
| **N64000** | Startup Speed | 0~100000 (mm/min) | 0 | Immediately | 3.11.4 |
| **N64020** | Traverse Rate | 0~100000 (mm/min) | 3000 | Immediately | - |
| **N64060** | Max Feedrate | 0~100000 (mm/min) | 48000 | Immediately | 3.11.4 |
| **N64100** | Axial Acceleration | 0.001~100000 ($mm/s^2$) | 800 | Immediately | 3.11.4 |
| **N64101** | Rapid Motion Axial Acceleration | 0.001~100000 ($mm/s^2$) | 800 | Immediately | 3.11.4 |
| **N64102** | Z Axis Acceleration | 0.001~100000 ($mm/s^2$) | 800 | Immediately | 3.11.4 |

| Para. No. | Name | Setting Range | Default Value | Valid Time | Refer-ence |
|---|---|---|---|---|---|
| **N64120** | Acceleration for Corners | 0.001~100000 ($mm/s^2$) | 3800 | Immediately | 3.11.4 |
| **N64150** | Axial Jerk | ($mm/s^2$) | 200000 | Immediately | 3.11.4 |
| **N64200** | Smoothing The Path Velocity | NO: Disabled<br>YES: Enabled | YES | Immediately | 3.11.4 |
| **N64201** | MAX Angle Smooth Velocity | 0~180 | 90 | Immediately | 3.11.4 |
| | When the connection angle of two segments is larger than the value of the parameter, the system will start at startup speed, instead of smoothing the path velocity. | | | | |
| **N64203** | Path Interpolation Algorithm | 1, 2, 3 | 3 | Immediately | 3.11.4 |
| | Its setting range: 0: trapezoid algorithm 1: S-type algorithm 2: LEP algorithm 3: acceleration trapezoid algorithm. | | | | |
| **N64204** | Acc or Dec time after Interpolation | 0~99999 | 0.005 | Immediately | - |
| | The longer the time is, the smoother the velocity will be. This parameter has no effect on the track precision. | | | | |
| **N64205** | MIN Velocity in LEP | 0~100000 | 60 | Immediately | 3.11.4 |
| **N64207** | Arc Velocity Limit | YES: Enabled<br>NO: Disabled | YES | Immediately | 3.11.4 |
| **N64208** | MAX Velocity of REF Circle | 0.001~100000 (mm/min) | 2500 | Immediately | 3.11.4 |
| **N64209** | MIN Velocity of Arc | 0.001~100000 (mm/min) | 180 | Immediately | 3.11.4 |
| **N64240** | Smooth Time Factor | 0.01~10 | 1 | Immediately | 3.11.4 |
| **N64241** | ConnectSpeed decreased at MaxConnetAngle | YES: Enabled<br>NO: Disabled | YES | Immediately | 3.11.4 |
| **N64245** | Prepared number of path when optimizing performance | 1~2000 | 300 | Immediately | 3.11.4 |
| **N64246** | Slide speed for small lines | YES: Enabled<br>NO: Disabled | NO | Immediately | 3.11.4 |
| **N64247** | Reference length of slide speed for small lines | 0.001~10 | 1 | Immediately | 3.11.4 |
| 6.5 File translation | | | | | |

| Para. No. | Name | Setting Range | Default Value | Valid Time | Refer-ence |
|---|---|---|---|---|---|
| **N65000** | Retract (PLT) | 0~99999 (mm) | 5 | Reload program | 3.15.2 |
| **N65001** | PLT Units | 0.001~99999 | 40 | Reload program | 3.15.2 |
| **N65002** | Tool Offset | 0.0001~99999 (mm) | 0.025 | Reload program | 3.15.2 |
| **N65003** | Cutting Depth | -99999~0 (mm) | 0 | Reload program | 3.15.2 |
| **N65100** | Retract (DXF) | 0~99999 (mm) | 5 | Reload program | 3.15.2 |
| **N65101** | Cutting Depth | -99999~0 (mm) | 0 | Reload program | 3.15.2 |
| **N65102** | Layer Depth | -99999~0 (mm) | 0 | Reload program | 3.15.2 |
| **N65103** | First Point As Origin | NO: Not use<br>YES: Use | YES | Reload program | 3.15.2 |
| **N65104** | By Contour | NO: Invalid<br>YES: Valid | NO | Reload program | 3.15.2 |
| **N65105** | Enable Bottom Cutting | NO: Invalid<br>YES: Valid | NO | Reload program | 3.15.2 |
| **N65106** | Use Metric | NO: Not forcibly use<br>YES: Forcibly use | NO | Reload program | 3.15.2 |
| **N65200** | Retract (ENG) | 0~99999 (mm) | 5 | Reload program | 3.15.2 |
| **N65201** | Prompt For Tool Change | NO, YES | YES | Reload program | 3.15.2 |
| **N65203** | Cutting By Tool Number | NO: Not use<br>YES: Use | NO | Reload program | 3.15.2 |
| **N65204** | Deep Hole Cutting Type | 0: Reciprocating chip removal<br>1: High-speed reciprocating chip removal | 0 | Reload program | 3.15.2 |
| **N65205** | Lifting Distance | 0~99999 | 1 | Reload program | 3.15.2 |
| **N65206** | Force To Use Tool Compensation | NO: Not forcibly use<br>YES: Forcibly use | YES | Reload program | 3.13.1 |
| **N65207** | Modify By Tool Number | NO: Disabled<br>YES: Enabled | NO | Reload program | 3.13.1 |

| Para. No. | Name | Setting Range | Default Value | Valid Time | Refer-ence |
|---|---|---|---|---|---|
| **N65208** | ToolDeepen Type | 0; 1 | 1 | Reload program | 3.13.1 |
| | The type of Z-axis downward feed at the beginning of machining an ENG file:<br>0: From safe height; 1: From the highest point (N10030 Table Travel Upper Limit -1) | | | | |
| **N65209** | Lifts When Change Tool | NO: Disabled<br>YES: Enabled | YES | Reload program | 3.13.1 |
| 6.6 Change tool | | | | | |
| **N66000** | Prompt For Tool Change | NO: Invalid<br>YES: Valid | NO | Immediately | 3.8/ 3.19 |
| **N66001** | Upper Position | -99999~99999 (mm) | 0 | Immediately | 3.8/ 3.19 |
| **N66002** | Lower Position | -99999~99999 (mm) | 0 | Immediately | 3.8/ 3.19 |
| **N66003 ~ N66005** | Spindle Position (X/Y/Z) | -99999~99999 (mm) | 9999 | Immediately | 3.8/ 3.19 |
| **N66006 ~ N66008** | Deceleration Position (X/Y/Z) | -99999~100000 (mm) | 0 | Immediately | 3.8/ 3.19 |
| **N66009** | Tool Change Speed | 0~100000 (mm/min) | 3000 | Immediately | 3.8/ 3.19 |
| **N66010** | Z Axis Speed | 0~60000 (mm/min) | 1800 | Immediately | 3.8/ 3.19 |
| **N66011** | Automatic Tool Measure | NO: No auto tool measure; YES: Auto tool measure | YES | Immediately | 3.8/ 3.19 |
| **N66012** | Disc Tool Number | 0~8 | 1 | Immediately | 3.8/ 3.19 |
| **N66034 ~ N66036** | Group 1 Tool Position (X/Y/Z) | (mm) | 0 | Immediately | 3.8/ 3.19 |
| The tool positions of group 2 to 21 are omitted here. | | | | | |
| 6.7 | | | | | |
| **N67000 ~ N67002** | Change Tool Workbench Range Lower Limit (X/Y/Z) | (mm) | -10000 | Immediately | 3.8/ 3.19 |

| Para. No. | Name | Setting Range | Default Value | Valid Time | Refer-ence |
|---|---|---|---|---|---|
| **N67010 ~ N67012** | Change Tool Workbench Range Upper Limit (X/Y/Z) | (mm) | 10000 | Immediately | 3.8/ 3.19 |
| **N67020** | WhetherToCheckChangeToolWorkRange | NO: Not check<br>YES: Check | NO | After restart | 3.8/ 3.19 |
| 7.1 Manu | | | | | |
| **N71000** | Slow Jog Speed | 0~N71001 (mm/min) | 1200 | Immediately | 3.11.3 |
| **N71001** | Rapid Jog Speed | 0~N13000 (mm/min) | 3000 | Immediately | 3.11.3 |
| **N71002** | Max Jog Speed Before Back To REF Point | 0 ~ “Rapid Jog Speed” | 1200 | Immediately | 3.11.3 |
| 7.2 Auto | | | | | |
| **N72001** | Ignore Programed Feedrate | YES: Ignore<br>NO: Not ignore | No | Immediately | 3.11.1 |
| **N72002** | Ignore Programed Spindlerate | YES: Ignore<br>NO: Not ignore | No | Immediately | 3.7.1 |
| **N72003** | Fix Traverse Rate Override | YES: Fix<br>NO: Not fix | No | Immediately | 3.11.1 |
| **N72004** | Spindle Off when Cycle Stop | NO: On<br>YES: Off | YES | Immediately | - |
| **N72008** | Spindle On when Cycle Start | NO: Off<br>YES: On | YES | Immediately | - |
| **N72009** | Cycle Machining Interval | 0~1000 | 10 | Immediately | 3.13.2 |
| **N72010** | Check Work Coordinate Limits | NO: Invalid<br>YES: Valid | NO | Immediately | 3.9.1 |
| **N72020** | Min Work Coordinates | (mm) | -99999 | Immediately | 3.9.1 |
| **N72030** | Max Work Coordinates | (mm) | 99999 | Immediately | 3.9.1 |
| 7.3 Pause | | | | | |
| **N73000** | Z Axis Return Feedrate after Pause | 0~100000 (mm/min) | 600 | Immediately | - |
| **N73001** | Z Axis Lifting Feedrate on Pause | 0~100000 (mm/min) | 600 | Immediately | - |
| **N73002** | Z Axis Liting Mode on Pause | 0, 1, 2, 3 | 0 | Immediately | - |
| | Its setting range: | | | | |

| Para. No. | Name | Setting Range | Default Value | Valid Time | Refer-ence |
|---|---|---|---|---|---|
| | 0: to the specified lifting distance 1: to the specified WCS coordinate 2: to the specified MCS coordinate 3: to the specified fixed position | | | | |
| **N73003** | Z Axis Lifting Pos in WCS | 0~9999 (mm) | 10 | Immediately | - |
| **N73004** | Lifting Distance on Pause | 0~500 (mm) | 10 | Immediately | - |
| **N73005** | Stop Spindle On Pause | NO: Not stop<br>YES: Stop | YES | Immediately | - |
| **N73006** | Z Axis Lifting Pos in MCS | -100~0 (mm) | 0 | Immediately | - |
| **N73007 ~ N73009** | Return To Fixture On Pause (X/Y/Z) | -99999~99999 | 0 | Immediately | - |
| 7.4 Return machine home | | | | | |
| **N74000** | Cancel REF Sign when Reset | NO: Not cancel<br>YES: Cancel | YES | Immediately | 3.6.5 |
| **N74001** | Back to REF Required | NO: Not required<br>YES: Required | YES | Immediately | 3.6.5 |
| **N74002** | Cancel REF Sign when Estop | NO: Not cancel<br>YES: Cancel | YES | Immediately | 3.6.5 |
| **N74010** | Home Offset (X/Y/Z) | 0~N10030 (mm) | 0 | After restart | 3.6.5 |
| **N74020** | Home Search Dir (X/Y/Z) | 1: Positive direction<br>-1: Negative direction | X:-1 Y:-1 Z:1 | Immediately | 3.6.5 |
| **N74030** | Home Search Velocity (X/Y/Z) | 0.001~10000 (mm/min) | X:1800<br>Y:1800<br>Z:1800 | Immediately | 3.6.5 |
| **N74040** | Home Switch Inport Address | X: 00117<br>Y: 00120<br>Z: 00123 | X: 00117<br>Y: 00120<br>Z: 00123 | Immediately | - |
| | The PLC addresses of input port of coarse positioning switch (i.e. home switch) in each axis. | | | | |
| **N74050** | Home Latch Dir (X/Y/Z) | 1: Positive direction<br>-1: Negative direction | X: 1 Y: 1 Z: -1 | Immediately | 3.6.5 |
| **N74060** | Home Latch Velocity (X/Y/Z) | 0.001~10000 (mm/min) | X:60 Y:60 Z:60 | Immediately | 3.6.5 |
| **N74070** | Index Pulse Inport Address | X: 00000<br>Y: 00001<br>Z:00002 | X: 00000<br>Y: 00001<br>Z:00002 | Immediately | - |

| Para. No. | Name | Setting Range | Default Value | Valid Time | Refer-ence |
|---|---|---|---|---|---|
| | The PLC addresses of input port of fine positioning switch (i.e. encoder) in each axis. | | | | |
| **N74080** | Back Off Distance (X/Y/Z) | -1000~1000 (mm) | X: 2 Y: 2 Z: 2 | Immediately | 3.6.5 |
| **N74090** | Home Latch Count | 1~100 | 1 | Immediately | 3.6.5 |
| **N74100** | Leadscrew Pitch | 0~100 (mm) | X: 5 Y: 5 Z: 5 | Immediately | 3.6.5 |
| **N74110** | Coarse/Fine Switches Min Dist | 0~2.5 (mm) | X: 1 Y: 1 Z: 1 | Immediately | 3.6.5 |
| **N74120** | Coarse/Fine Pos Distance Tolerance | 0~100 (%) | 10 | Immediately | 3.6.5 |
| 7.5 Measure | | | | | |
| **N75000** | Presetter Input Port Addr | 00016 | 00016 | Immediately | - |
| | The PLC address of the input port tool presetter signal. | | | | |
| **N75001** | Fine Preset Speed | (mm/min) | 60 | Immediately | 3.8 |
| **N75002** | Fine Preset Count | | 1 | Immediately | 3.8 |
| **N75020** | Preset Result Tolerance | 0~10 | 0.1 | Immediately | 3.8 |
| **N75023** | Disconnect Presetter Port Addr | -1, 1 | -1 | Immediately | - |
| | Specifying whether the software with the function of disconnecting with the wire of tool presetter. If there is this function, this port will be given a signal to disconnect with the wire of tool presetter in machining, while connecting with the wire in tool measurement. 1: Without the function of disconnecting with the wire of tool presetter; -1: With the function of disconnecting with the wire of tool presetter | | | | |
| **N75024** | Preset Overtravel Port Addr | 00124 | 00124 | Immediately | - |
| | The PLC address of the tool presetter over-travel protection port. | | | | |
| **N75025** | Enable Preset Overtravel Alarm | NO: Invalid<br>YES: Valid | YES | Immediately | 3.8 |
| **N75100** | Mobile Surface to WCS Z0 Distance | -1000~1000 (mm) | 0 | Immediately | 3.8.1 |
| **N75201** | Fixed Presetter Surface to WCS Z0 | (mm) | 10 | Immediately | 3.8.2 |
| **N75203** | Fixed Preset Speed | (mm/min) | 300 | Immediately | 3.8.2 |

| Para. No. | Name | Setting Range | Default Value | Valid Time | Refer-ence |
|---|---|---|---|---|---|
| 7.9 Operation others | | | | | |
| **N79000** | Z Down Feedrate Limitation Mode | 0~2 | 0 | Immediately | - |
| | Its setting range: 0: not dispose 1: only Z axis downward motion valid<br>2: Z axis downward included motion valid | | | | |
| **N79001** | Z Down Feedrate Limitation | 0~100000 (mm/min) | 480 | Immediately | - |
| **N79003** | Safe Height | 0~1000 (mm) | 10 | Immediately | - |
| **N79004** | Forced To Use The Z Feed | YES, NO | YES | Immediately | - |
| **N79100** | Stop Mode when Cycle Completed | 0: Keep still<br>1: Back to fixed point<br>2: Back to workpiece origin | 0 | Immediately | - |
| **N79101** | Run T and M3, M4, M5 Code Before Resume | YES, NO | NO | Immediately | - |
| | Whether to insert the previous tool change command and spindle command before breakpoint resuming or selective machining. | | | | |
| **N79110** | Fixed Point Position | -99999~99999 (mm) | X: 0 Y: 0<br>Z: 0 | Immediately | - |
| 8.0 User interface | | | | | |
| **N80002** | Support Extension Workpiece Offset | NO: Not support<br>YES: Support | NO | After restart | 3.9.3 |
| **N80003** | Support Program Task | YES: Support<br>No: Not support | NO | After restart | 3.15.3 |
| **N80004** | Print Info | YES: Support<br>No: Not support | NO | Immediately | - |
| 8.1 Position view | | | | | |
| **N81000** | Auto Load Graph | NO: Not load automatically<br>YES: Load automatically | NO | Immediately | 3.12.4 |
| **N81001** | Max File Size | (KB) | 1000 | Immediately | 3.12.4 |
| **N81004** | Allow Spindle-On When Centering | YES, NO | YES | After restart | 3.10 |
| **N81010** | Gradient Fill | YES, NO | YES | Immediately | 3.12.4 |

| Para. No. | Name | Setting Range | Default Value | Valid Time | Refer-ence |
|---|---|---|---|---|---|
| **N81011** | Draw Workbench | YES, NO | NO | Immediately | 3.12.4 |
| **N81012** | Draw Grid | YES, NO | NO | Immediately | 3.12.4 |
| **N81013** | 2D Mode | YES, NO | NO | Immediately | 3.12.4 |
| **N81015** | Clear On Loading | YES, NO | YES | Immediately | 3.12.4 |
| **N81016** | Draw WC Origin | YES, NO | NO | Immediately | 3.12.4 |
| **N81017** | Draw MC Origin | YES, NO | NO | Immediately | 3.12.4 |
| **N81018** | Bkground Color 1 | Select a color | 0×00000000 | Immediately | 3.12.4 |
| **N81019** | Bkground Color 2 | Select a color | 0×00000000 | Immediately | 3.12.4 |
| **N81020** | G00 Color (running) | Select a color | 0×0000FFFF | Immediately | 3.12.4 |
| **N81021** | G01 Color (running) | Select a color | 0×00FFFF00 | Immediately | 3.12.4 |
| **N81022** | G02 Color (running) | Select a color | 0×00FFFF00 | Immediately | 3.12.4 |
| **N81023** | G03 Color (running) | Select a color | 0×00FFFF00 | Immediately | 3.12.4 |
| **N81032** | G00 Color (loading) | Select a color | 0×04000000 | Immediately | 3.12.4 |
| **N81033** | G01 Color (loading) | Select a color | 0×00600000 | Immediately | 3.12.4 |
| **N81034** | G02 Color (loading) | Select a color | 0×00600000 | Immediately | 3.12.4 |
| **N81035** | G03 Color (loading) | Select a color | 0×00600000 | Immediately | 3.12.4 |
| **N81045** | Grid Color | Select a color | 0×00800080 | Immediately | 3.12.4 |
| **N81046** | Coordinate Color | Select a color | 0×0000FF00 | Immediately | 3.12.4 |
| **N81049** | WC Origin Color | Select a color | 0×0000FFFF | Immediately | 3.12.4 |
| **N81050** | MC Origin Color | Select a color | 0×0000FFFF | Immediately | 3.12.4 |

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