Preface

Thank you for choosing our products.

This manual will acquaint you with such detailed information of NK260 series CNC integrated system as system function, maintenance and operation, etc.

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

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

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; ➢ Excess of specified quantity of stacking products is prohibited; ➢ Climbing, standing or placing heavy loads on the products is prohibited; ➢ Dragging or carrying the products via cables or devices connected to them is prohibited; ➢ 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; ➢ Check if the products are damaged in transit; ➢ Check if the components and accessories are damaged or missing in terms of the detailed list; ➢ Please contact us promptly if product discrepancy, accessory missing or transit damage occurs.

◆ Installation Notices

Attention
➢ Only when this equipment is installed in the qualified electricity cabinet can it be used. The construction of the cabinet must reach IP54 grade of protection. ➢ Paste sealing strips on the joint of the cabinet to seal all the cracks; ➢ Cable entry should be sealed while easy-to-open on the spot ; ➢ Fan or heat exchanger should be adopted for the heat dissipation and air convection of the cabinet; ➢ If fan is adopted, air strainer is a must in air inlet or air outlet; ➢ 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. ➢ 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 for the ventilation & heat dissipation in the cabinet. ➢ Space between this device and other equipments should also be preserved according to the requirements. ➢ The product should be installed firmly and without vibration. During installing, casting, knocking, striking, or loading on the product is forbidden. ➢ To reduce electromagnetic interference, power-supply components used should be above AC or DC 50V and the space between cable and the CNC device should be preserved above 100mm. ➢ It will be better if the CNC device is installed on the position facilitating debugging and maintenance.

◆ **Wiring Notices**

Attention
➢ Only qualified people are allowed to participate in the wiring and checking. ➢ The CNC device should be grounded reliably and the 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. ➢ Wiring should be firm and steady, or misoperation may occur. ➢ 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. ➢ To guard against electric shock or the CNC device damage, fingers should keep dry before plugging or touching switch. ➢ The connecting wire should not be damaged and squeezed, or the leakage or short circuit may occur. ➢ 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. ➢ 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. ➢ 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. ➢ 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 again.

Contents

1. Summarization

1.1. System Configuration

NK260 integrated system consists of the following components:

- One chassis of NK260
- One EX9A2 terminal board
- One DB9M/F cable (5m)
- Panasonic A4 cables (3m) (one with brake line, while two without brake line)

1.2. An Introduction to Hardware

1.2.1. Structure Specification

◆ **A Picture of Machine**

Fig. 1-1 A picture of the complete machine

◆ **Mounting Dimension**

After NK260 is installed on the machine tool, 100 mm space should be preserved in its surrounding for wiring convenience and for ensuring ventilation in the cabinet. And the mounting dimension is shown in Fig. 1-2:

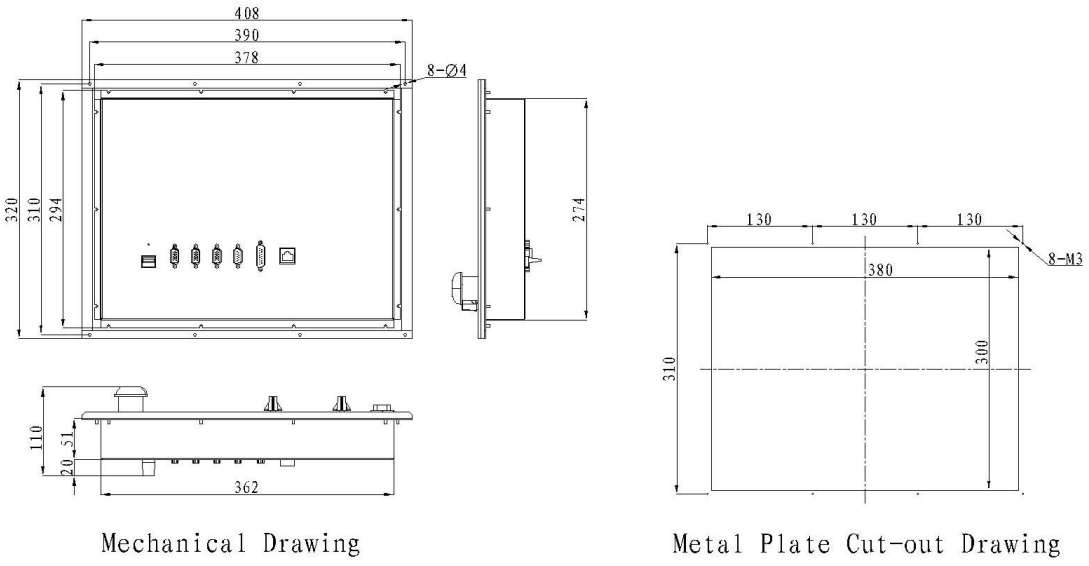


Fig. 1-2 Mounting dimension of NK260 integrated system

◆ Front View of NK260

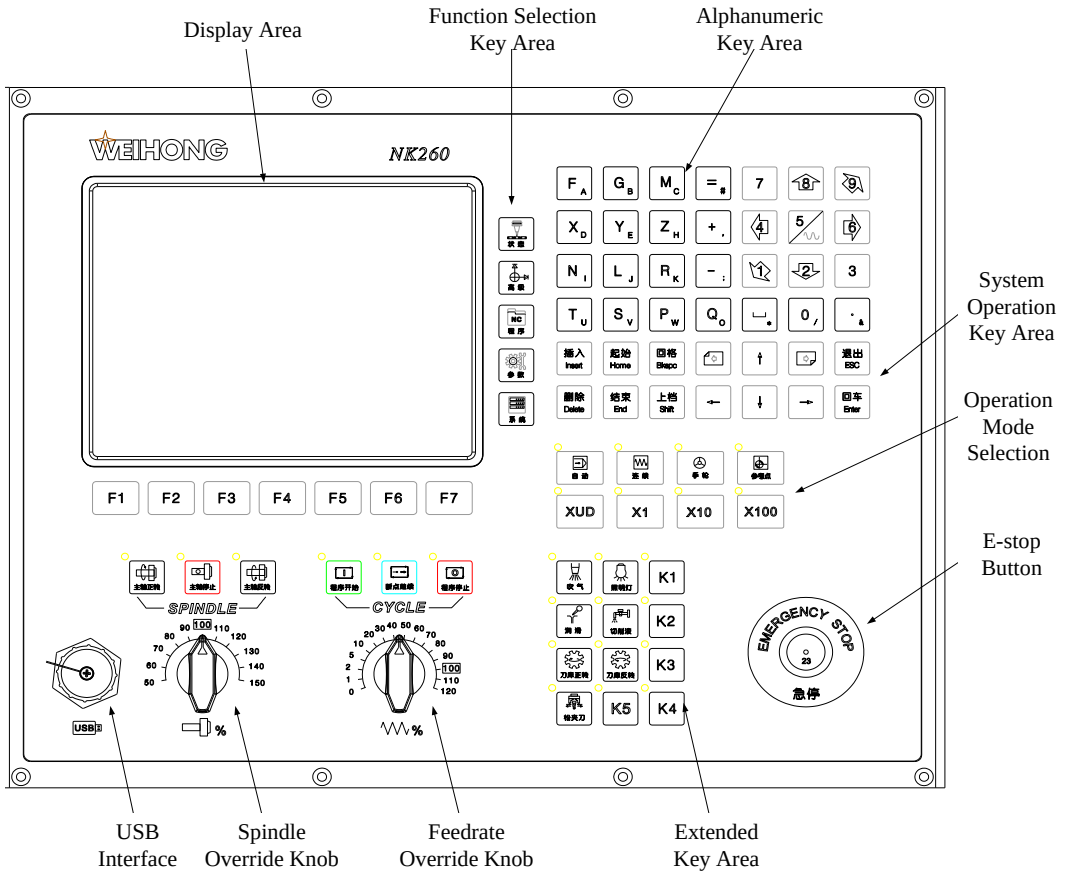


Fig. 1-3 Front view of NK260

◆ Rear View of NK260

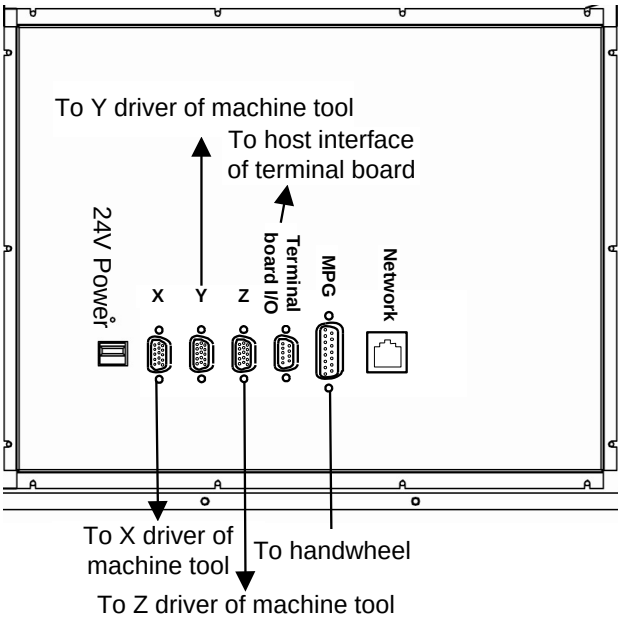


Fig. 1-4 Rear view of NK260

1.2.2. Connection Schematic Diagram

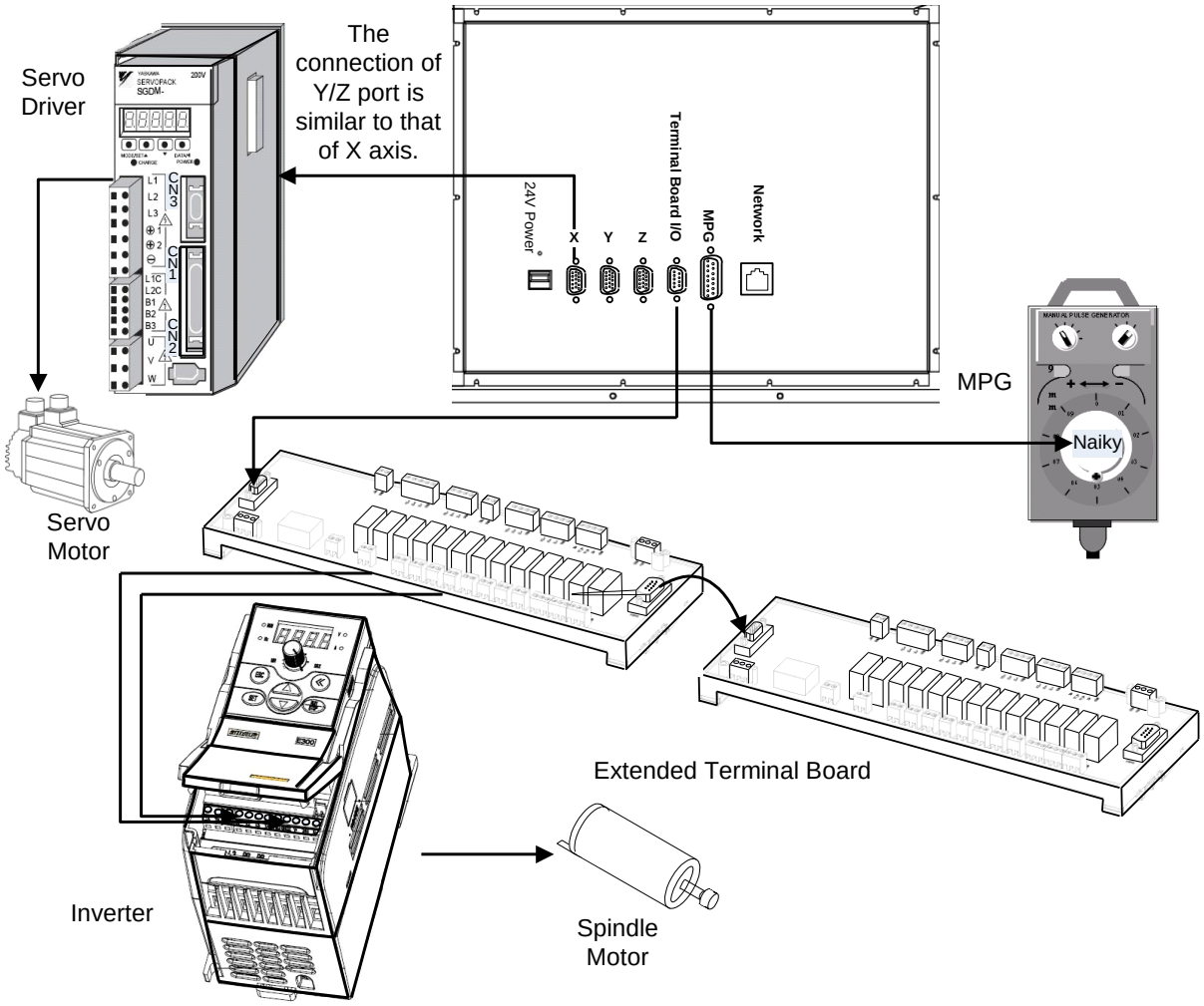


Fig. 1-5 Connection schematic diagram

2. Wiring

2.1. Basic Concepts of Signal

2.1.1. Signal Types

The signal types of NK260 system can be divided into the following 3 types: binary input signal, relay output signal and differential output signal.

◆ **Binary Input Signal**

Binary input signal is active low and supports NO and NC input signals (through modifying input port polarity in the software). Conducting to GND (i.e. grounding signal) in NO connection means signal detected, and disconnecting with GND in NC connection means signal detected.

> Note:
>
> NK260 system also supports high level effective, if this function is needed, please choose the related terminal board NK300-EX4-PTN; at this time, conducting to 24V in NO connection means signal detected, and disconnecting with 24V in NC connection means signal detected.

◆ **Relay Output Signal**

The relay output contact points on the terminal board have load capacity: 10A/250VAC and 10A/30VDC, which can control 220V AC load of low power. If high power load is needed, a contactor can be used. Please see Fig. 2-1.

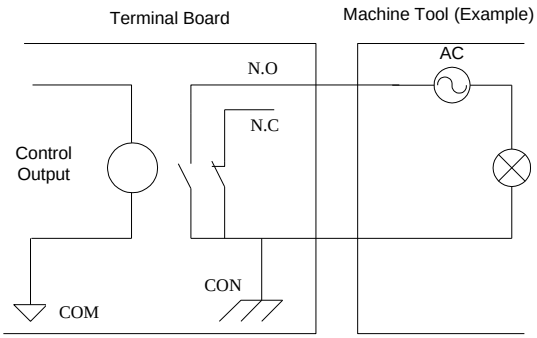


Fig. 2-1 Connection of relay output and contactor

◆ **Differential Output Signal**

Differential signal refers to two equivalent signals with opposite phases sent by driving end, and the voltage difference of these two signals is used for deciding whether the logical status of differential signal is “0” or “1”.

Pulse command format of controlling driver motion is pulse + direction, negative logic. And this signal adopts differential signal transmission mode.

2.1.2. Binary Input

◆ **Connection of Binary Input and External Circuit**

The wiring method between binary input signal and a mechanical switch is shown in Fig. 2-2:

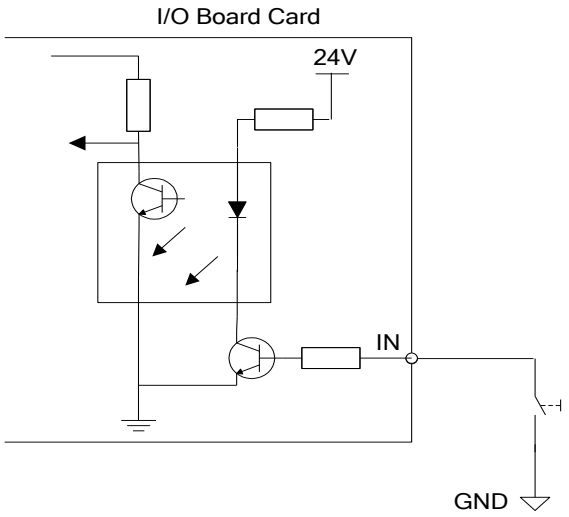


Fig. 2-2 Connection of mechanical switch and binary input

Binary input signal can be connected with a photoelectric switch or a proximity switch of NPN (NO or NC) type. Its joining method is as below. And users can use switch of PNP type by simply adopting the related terminal board NK300-EX4-PTN.

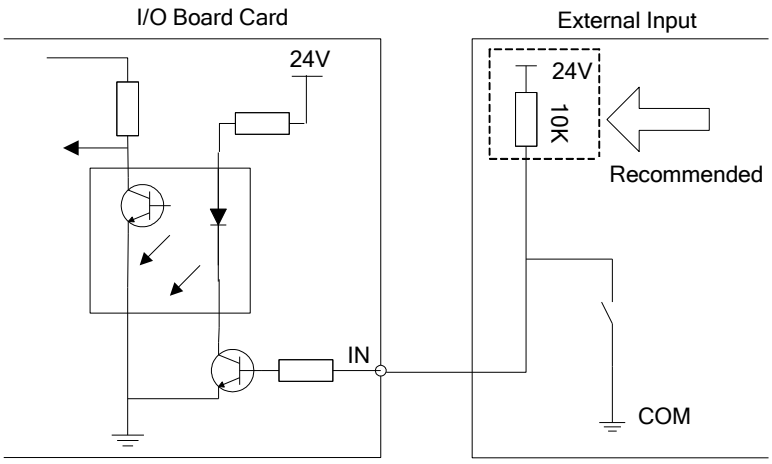


Fig. 2-3 Binary input of NPN type connecting with photoelectric switch or proximity switch

◆ **Power Requirement**

It is recommended to adopt DC24V/4.5A switch power for relays on the termina board. If there are a great many DC 24V relays controlled by binary output signal, users can appropriately expand the power source capacity or add extra power (forcibly sharing ground with external power supply). Z-axis brake and solenoid valve also need DC24V instead of external power to the greatest extent to reduce the interference to CNC device by solenoid valve, etc.

2.1.3. Binary Output

◆ **Signal Signature**

The internal equivalent circuit of binary output is shown in Fig. 2-4.

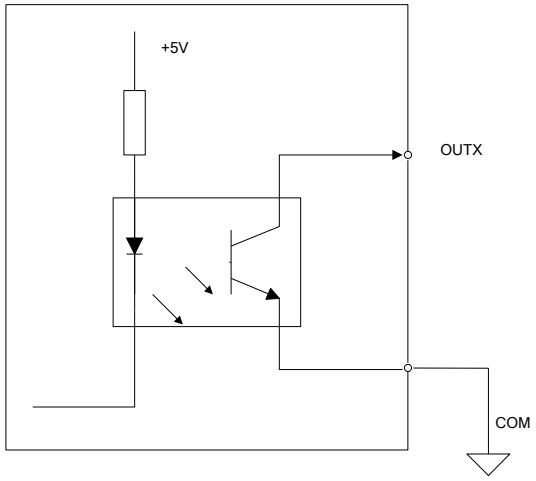


Fig. 2-4 Equivalent circuit of binary output interface

◆ **Technical Parameter**

1) Supply voltage: 24VDC

2) Binary open-collector output

OC (open-collector) outputs drive capability with maximum allowable operating voltage 30VDC and maximum allowable current 20mADC; so when the output terminal is active low, the maximum allowable sucked current is 20mA.

◆ **Connection of Binary Output and External Circuit**

The connection of solid-state relay and binary output is shown in Fig. 2-5.

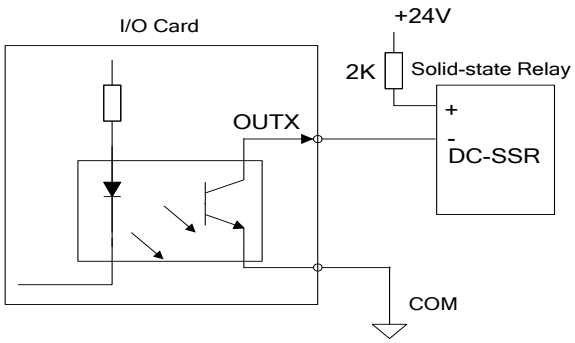


Fig. 2-5 Connection of solid-state relay and binary output

The connection of binary output and optical coupler is shown in Fig. 2-6.

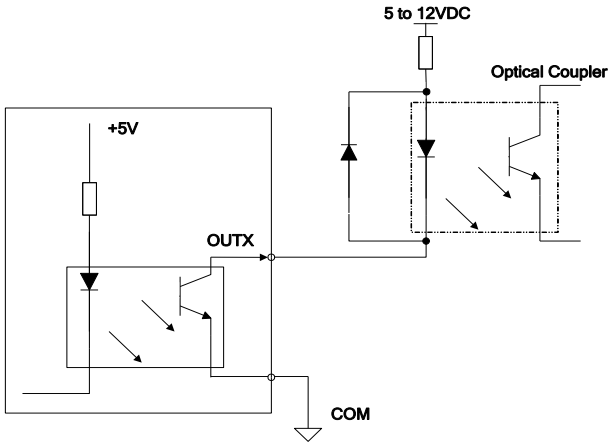


Fig. 2-6 Connection of binary output and optical coupler

Note:

The max. allowable voltage of optical coupling open collector output is: 30VDC, with max. allowable current 50mA.

2.1.4. Output Analog

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

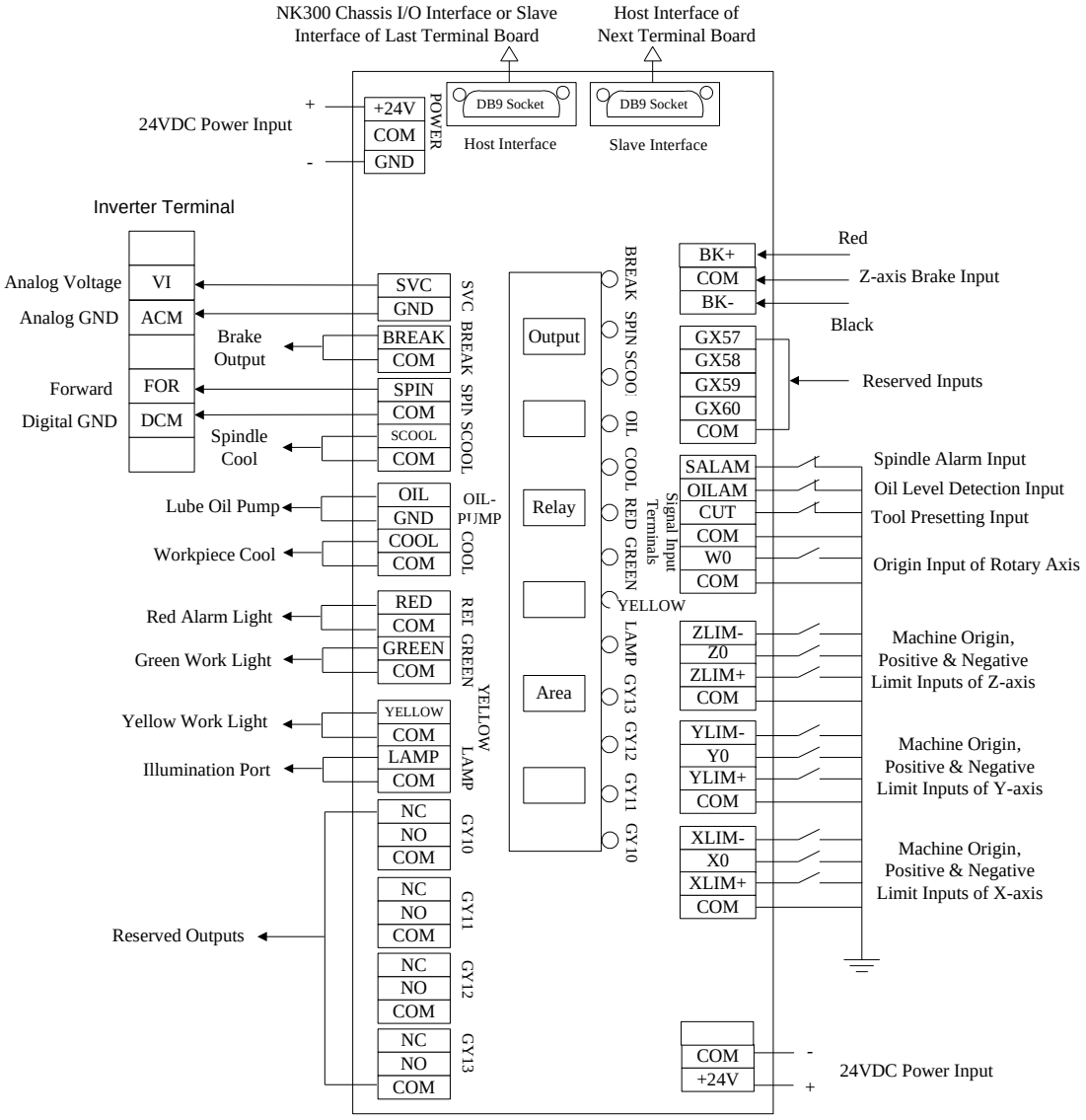
2.2. Wiring Specification of Terminal Board

EX9A2 is the terminal board for NK260 as standard, and other option is NK300-EX5, used for I/O ports expansion. Except for EX9A2, 5 terminal boards can be expanded by at most for NK260, i.e. I/O=80/80 ports can be expanded by.

There is a red LED indicator light near each input port on EX9A2, used for indicating whether port wiring is correct in machine tool debugging. The concrete method is: press the switch to give the corresponding port signal. If the LED near this port is on, the wiring is right; if not, check whether the wiring is wrong.

To check whether the port is damaged, open the software and test. For details, refer to chapter 3.5 Port Polarity Adjustment.

2.2.1. Wiring Diagram of Terminal Board



Note: NO ports are normally open while NC ports normally closed.

Fig. 2-7 Wiring diagram of terminal board EX9A2

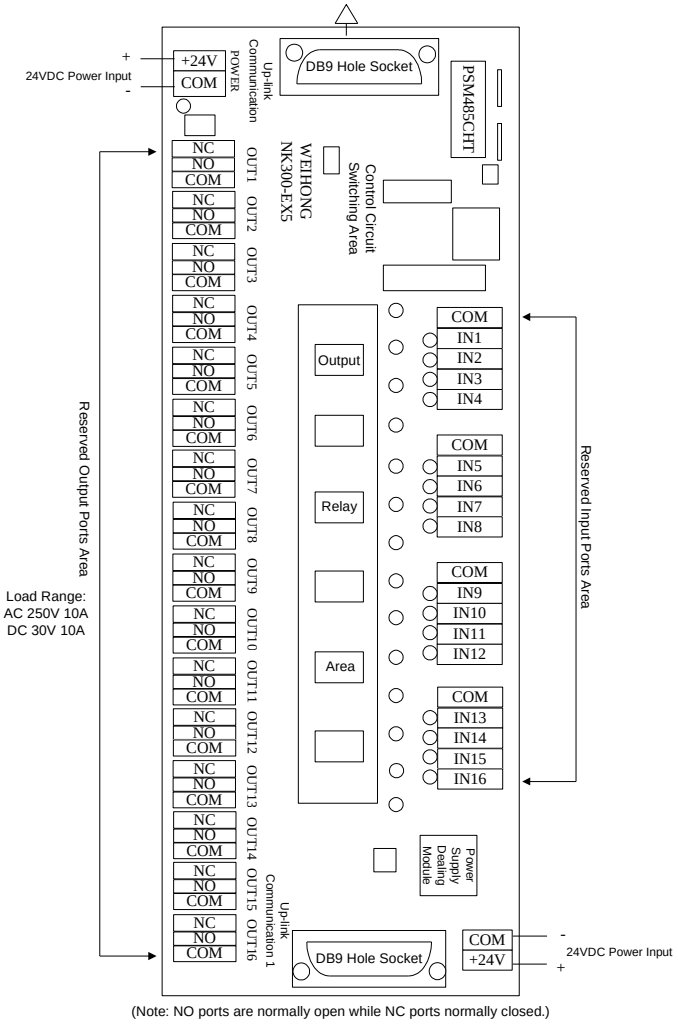


Fig. 2-8 Wiring diagram of terminal board NK300-EX5

2.2.2. Port Specification of Terminal Board

Name	Pin No.	Definition	Description
External power	+24V	DC 24V power	Terminal board should be powered by external power supply.
	COM		
Origin signal	X0	X machine origin	Binary input, low level effective; connected to origin switch of X-axis
	Y0	Y machine origin	Binary input, low level effective; connected to origin switch of Y-axis
	Z0	Z machine origin	Binary input, low level effective; connected to origin switch of Z-axis
	W0	Rotary axis origin	Binary input, low level effective; connected to origin switch of rotary axis
	COM	Common port	Signal common port
Limit signal	XLAM+	X positive limit	Binary input, low level effective; connected to positive limit switch of X-axis

Name	Pin No.	Definition	Description
	XLAM-	X negative limit	Binary input, low level effective; connected to negative limit switch of X-axis
	YLAM+	Y positive limit	Binary input, low level effective; connected to positive limit switch of Y-axis
	YLAM-	Y negative limit	Binary input, low level effective; connected to negative limit switch of Y-axis
	ZLAM+	Z positive limit	Binary input, low level effective; connected to positive limit switch of Z-axis
	ZLAM-	Z negative limit	Binary input, low level effective; connected to negative limit switch of Z-axis
	COM	Common port	Common port of digital signal
Commonly used input	SALAM	Spindle alarm	Binary input signal, connected to spindle alarm switch
	OILAM	Oil level detection	Binary input signal, connected to sense switch of oil level
	CUT	Tool presetting	Binary input signal, connected to calibration signal
	COM	Common port	Common port of digital signals
Spindle control	SVC	Signal output of analog voltage (from 0 to 10V)	Control the spindle motor speed by controlling inverter frequency due to voltage change. Externally connected to the command input port of analog voltage frequency of inverter (i.e. AVI/VI).
	GND	Analog voltage ground	Connected to analog ground of inverter (generally known as ACM)
	SPIN	Spindle start/ stop	Relay output, its two terminals separately connected to the digital ground of inverter (i.e. DCM) and the forward rotation input port of inverter (i.e. FOR).
Z-axis brake	BREAK	Brake control	Relay output signal. Powered by 24V of terminal board, “Brake” port is directly connected to break coil, forming a brake circuit. The two terminals of “Brake” will be conductive after the servo of machine tool is normally on, and Z brake will be valid.
	BK+、BK-	Two ends of brake input	There are two cables for Z-axis, red or blue one for brake signal of servo output (open-collector output), black for grounding. And red or blue line should be connected to “BK+”, while black line to “BK-”.
Signal	RED	Red alarm lamp	Red light on when machining ends or during

Name	Pin No.	Definition	Description
light			E-stop
	GREEN	Green work lamp	Light on during normal working state of machine
	YELLOW	Yellow work lamp	Yellow light on during idle state after machining ends or during waiting state
Commonly used output	OIL	Lubrication on	Control auto lubrication with relay contact output, LED on during lubrication and off when lubrication stops
	COOL	Workpiece cooling	Relay contact output, two terminals equaling to a switch, connected to workpiece cooling switch
	SCOOL	Spindle cool	Relay contact output, two terminals equaling to a switch, connected to spindle cooling switch
Reserved input	IN1-IN4	Reserved input port	Available for custom reserved input
Reserved output	OUT1-OUT4	Reserved output port	Available for custom reserved output

2.3. Port Definition and Wiring Specification

2.3.1. Driver Interface Definition

NK260 system provides 3 pulses to feed the gang socket of driver interface, i.e. X, Y and Z respectively. The type of gang socket is 15-core D socket (DB15 pins). The pin definition is as follows:

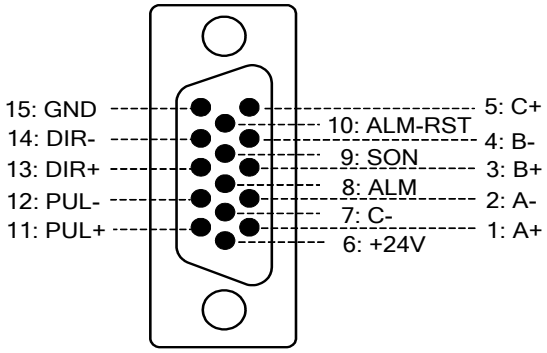


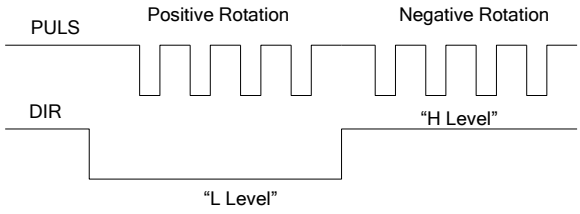
Fig. 2-9 Driver interface definition

Name	Definition	Input /Output	Description
A+, A-	Feedback signal of encoder phase A	Input, differential signal transmission mode	Receive the differential output of encoder signal (phase A, B,C) from driver frequency divider (equal 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, this output (transistor) switch 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).
ALM-RST	Driver alarm clear signal	Output	The alarm state will be cleared when this signal keeps closed with COM- for above 120ms.
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 at 2 seconds after power on. 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 enabling 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 NK260 controller is shown as follows: 

2.3.2. Handwheel Interface Definition

NK260 is available of an external manual pulse generator, with DB15 core dual-in-line holes joint. Its pin definition is as shown in Fig. 2-10.

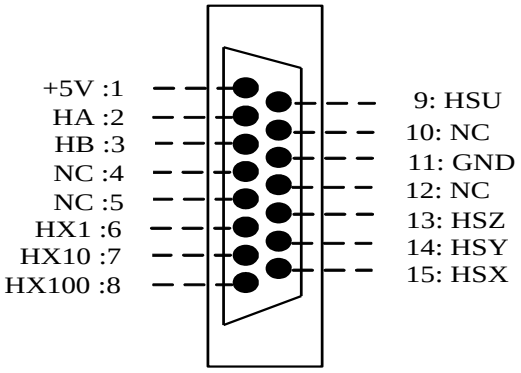


Fig. 2-10 Handwheel interface definition

Pin No.	Definition	Description
1	+5V	Power on handwheel encoder
2	HA	Encoder phase A signal
3	HB	Encoder phase B signal
4	NC	
5	NC	
6	HX1	Selection of X1 override

Pin No.	Definition	Description
7	HX10	Selection of X10 override
8	HX100	Selection of X100 override
9	HSU	Selection of 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

3. Manipulation

3.1. Debugging Steps

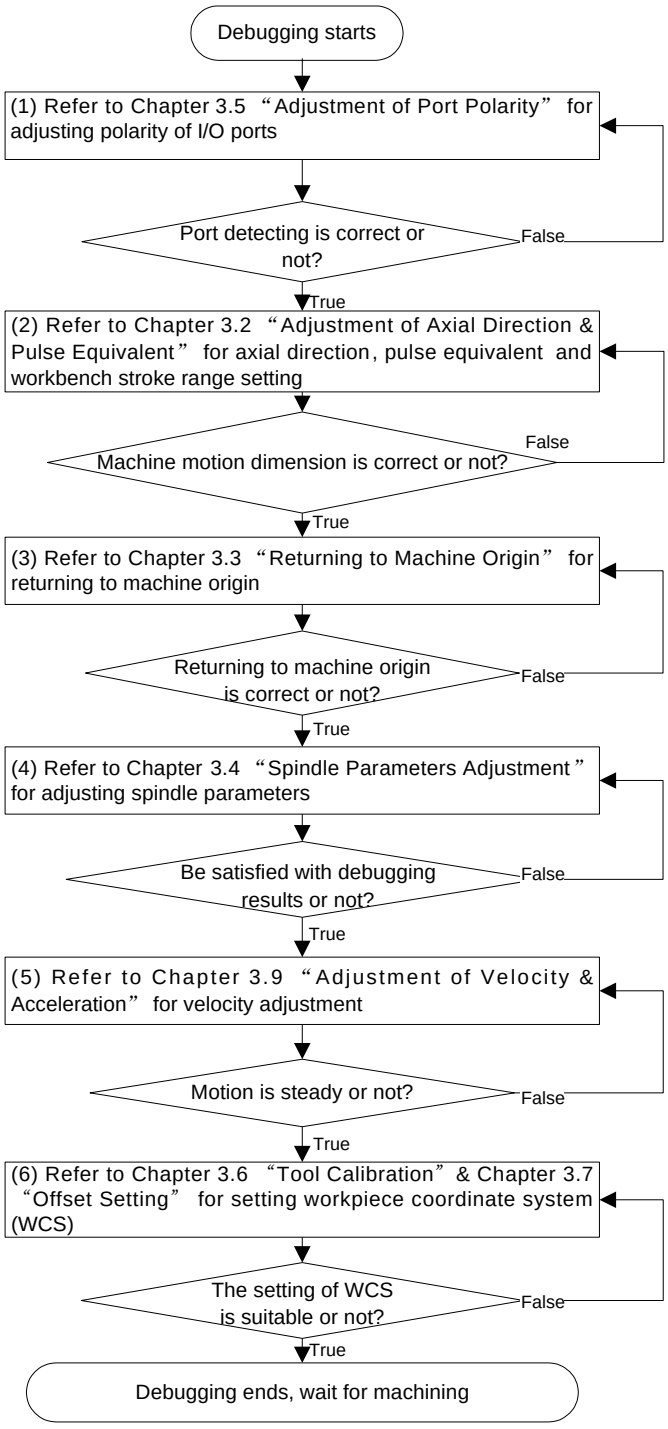


Fig. 3-1 Debugging steps

3.2. Adjustment of Axial Direction and Pulse Equivalent

3.2.1. Axial Direction Adjustment

Firstly confirm the positive direction of each axis in terms of right-hand rule during the process of machine debugging, i.e. the feed motion direction of cutter is relative to the workpiece which is supposed to be still. The coordinate system of the right-hand rule is shown in Fig. 3-2.

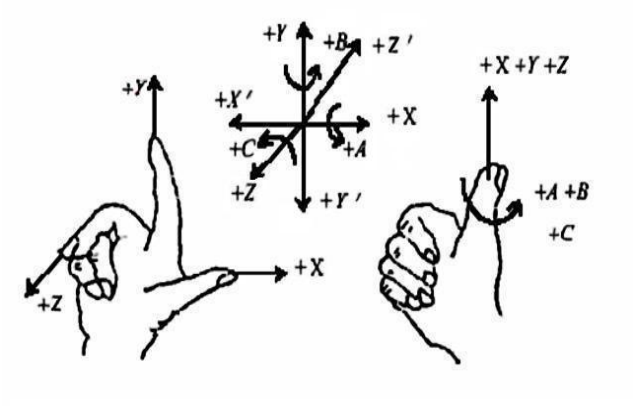


Fig. 3-2 The coordinate system of the right hand principle

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

——Z-axis is coincidental with spindle axis and the direction of 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 the single column vertical milling machine, if users face the spindle and look in the column direction, right moving direction is the positive direction of X-axis (+X).

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

◆ **Related Parameters**

Parameter		Definition	Setting Range
1033	X-axis output direction	It specifies the motion direction of each axis.	“1”, “-1” represents the two motion directions of each axis.
1034	Y-axis output direction		
1035	Z-axis output direction		
Fix the positive direction of each axis following the right-hand rules, and then manually operate the machine to check if the axis moves correctly. If the direction is opposite, please modify the corresponding axis parameter in “1033~1035”. Take X-axis as an example, manually move X-axis, and find it moves oppositely, just change the value of parameter “1033” to “-1”, if its value is “1” currently.			

3.2.2. Pulse Equivalent Adjustment

Pulse equivalent: the moving distance of workbench or rotation degree of rotary axis corresponding one pulse sent by CNC device, the minimum available distance controlled by CNC system as well. This item can be calculated in terms of information of screw pitch, electronic gear ratio, mechanical deceleration ratio, etc.

The smaller the pulse equivalent is, the higher the machining precision and surface quality will be. At the meanwhile, the setting value of pulse equivalent decides the max. feed speed, and lower pulse equivalent should be set under the condition of meeting the demand of feedrate.

The hardware frequency of NK260 is 320 KHz, thus,

Max. Feedrate= pulse equivalent X 60 X frequency (i.e. 320000 Hz)

The calculation of pulse equivalent varies with different motor systems.

◆ **Stepping Motor**

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

Hereinto, mechanical deceleration ratio= rotary speed input in reducer / rotary speed output =teeth number of driven gear / teeth number of driving gear.

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

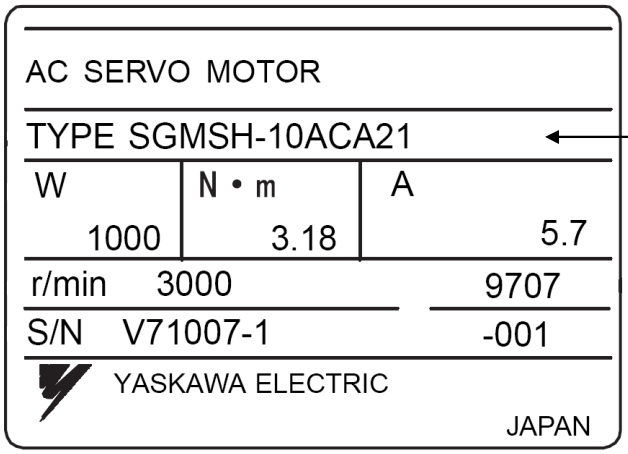
$$\text{Pulse equivalent} = \frac{5\text{mm}}{\frac{360}{1.8} \times 10 \times 1} = 0.0025\text{mm/p}$$

◆ **Servo Motor**

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

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 each server brand).

Please see the servo motor label plate and then refer to the corresponding manual to confirm its encoder resolution. A label plate of YASKAWA SGMSH type motor is as below, and the 4th character in motor type is the serial encoder specification, so the resolution of this motor is 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. 3-3 Name plate of servo motor-encoder resolution

For instance: (an example of YASKAWA servo) lead screw pitch of a certain type of machine is 5mm, with 17 bit encoder resolution, “0.0001mm/p” pulse equivalent and “1:1” deceleration ratio.

$$\text{Electronic gear ratio } \frac{PN202}{PN203}=\frac{2^{17}}{5/0.0001}\times 1=\frac{131072}{5/0.0001}\times 1=\frac{8192}{3125}$$

◆ **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 lead 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**

Parameter		Definition	Setting Range
1011	Pulse equivalent of X-axis	It refers to the displacement or angle generated on the relative feed axis per control pulse.	-0.00009 ~999
1012	Pulse equivalent of Y-axis		
1013	Pulse equivalent of Z-axis		

Note:

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

3.2.3. Upper & Lower Limit Setting of Workbench Stroke

Workbench stroke refers to the valid machining stroke range of machine tool along X, Y, and Z direction, and the system will carry out software limit in terms of this range in order to protect the machine.

◆ **Related Parameters**

Parameter		Definition	Setting Range
1021	X-axis workbench range upper limit	They set the allowable mechanical coordinate values for the upper limit of the worktable.	Related to the specific machine tool
1022	Y-axis workbench range upper limit		
1023	Z-axis workbench range upper limit		
1024	X-axis workbench range lower limit	They set the allowable mechanical coordinate values for the lower limit of the worktable.	Related to the specific machine tool
1025	Y-axis workbench range lower limit		
1026	Z-axis workbench range lower limit		

Note:

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

3.3. Returning to Machine Origin

Origin of Machine Coordinate System (inherent coordinate system of machine tool), also called mechanical origin or mechanical zero, is fixed after design, manufacturing and debugging before machine tool leaving factory. After startup of control system, it is necessary to execute the operation of returning to machine origin automatically or manually.

The necessity of returning to machine origin:

These below functions will be available only after returning to machine origin: software limit enabled, setting the fixed point, and tool change.

◆ **The Process of Returning to Machine Origin**

The processes of returning to machine origin of X, Y, and Z axes are included and identical, shown in Fig. 3-4 (take X-axis as an example).

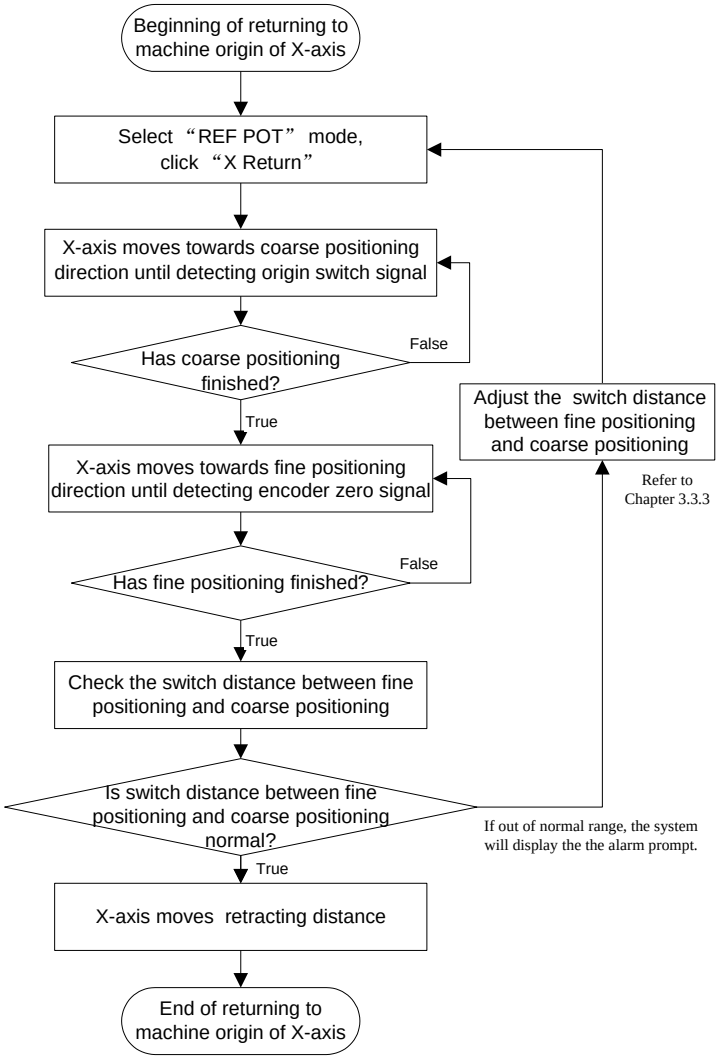


Fig. 3-4 The process of returning to machine origin (X-axis)

3.3.1. Principle of Motion of Returning to Machine Origin

The sketch map of returning to machine origin with servo motor is as below:

◆ **Coarse Positioning Stage**

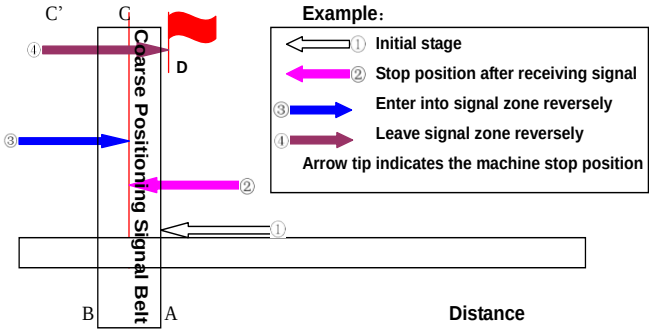


Fig. 3-5 Sketch map of coarse positioning (stopping within the signal belt after receiving coarse positioning signal)

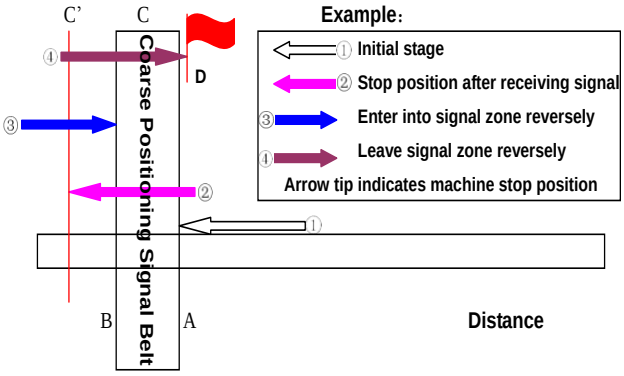


Fig. 3-6 Sketch map of coarse positioning (stopping out of the signal belt after receiving coarse positioning signal)

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

3) The machine will keep moving reversely at one-ninth of coarse positioning speed until the origin signal disappears (across the signal belt).

4) The machine will halt at the 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 origin rapidly, executing slow positioning several times.

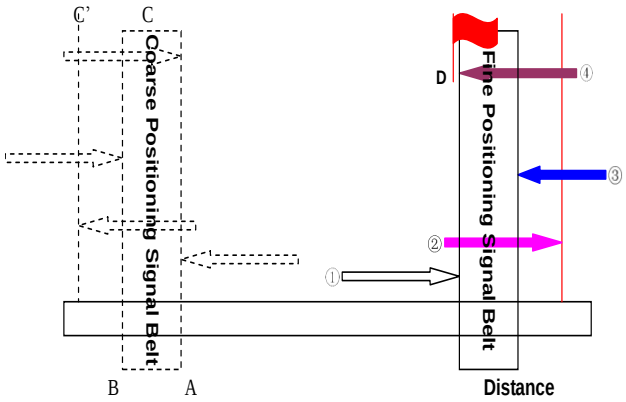


Fig. 3-7 The process of fine positioning

◆ **Retracting Stage**

After finishing the fine positioning stage, system will execute retracting motion once with the recommended retract distance as half of the screw pitch. The sketch map is shown in Fig. 3-8.

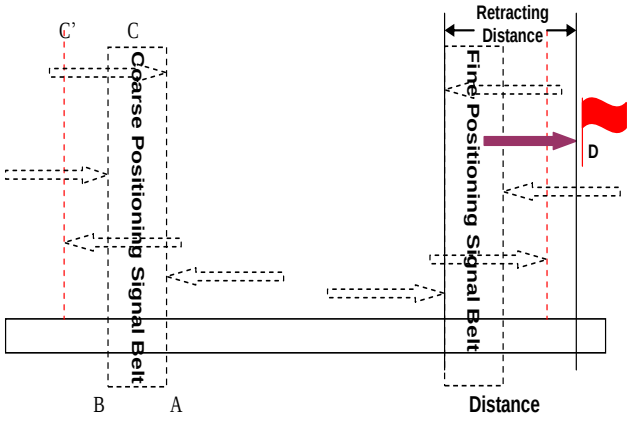


Fig. 3-8 Retracting stage

3.3.2. Parameters Specifications

◆ **Related Parameters of Safe Operations:**

Parameter		Definition	Setting Range
1065	Back to reference point before mach	Whether backing to machine origin before machining is a must or not.	True: Forced False: Not forced
1066	Whether to cancel the mark of backing	Whether the mark of backing to the machine origin will be cleared or not once E-stop occurs.	True: Cleared False: Not cleared
Returning to the machine origin before machining can prevent machining offset, ensuring position precision. It is recommended to set “True” for parameter “1066” so that once E-stop occurs, the mark will be cleared, and the system will remind users to back to machine origin. If “1065” is set “True” and there is no mark “⊕” before each axis, the machine is not allowed to move until			

Parameter	Definition	Setting Range
backing to machine origin is finished. “1065” can be set “False” when returning to machine origin is impossible due to origin switch error.		

◆ **Related Parameters in the Process of Backing to Machine Origin**

Parameter		Definition	Setting Range
1095	X direction in backing to reference point	They set the direction of each axis in coarse positioning stage, i.e. the motion direction of machine tool towards the origin switch from any point.	1: positive direction -1: negative direction
1096	Y direction in backing to reference point		
1097	Z direction in backing to reference point		
1098	Retract distance of X-axis	They set the additional distance after fine positioning of backing to the machine origin. Positive value means positive motion direction and negative value negative motion direction.	-1000~1000
1099	Retract distance of Y-axis		
1100	Retract distance of Z-axis		
1101	X speed in backing to reference point	They are the motion speed of machine tool towards the origin switch at the stage of coarse positioning.	0.001~10000
1102	Y speed in backing to reference point		
1103	Z speed in backing to reference point		
In order to establish a machine coordinate system correctly during machine working period, a machine reference point (measuring beginning) will be set within the moving range of each coordinate axis. In machine start-up, generally returning to the reference point will be executed automatically or manually, i.e. 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 the machine origin (in the default system setting), or not. When origin switch works normally, if spindle moves away from origin switch direction in the process of returning to the machine origin, the value of “1095~1097” (coarse positioning direction) should be modified, please refer to question No. 2 in chapter 3.3.3 when the moving direction of machine is incorrect during backing to the machine origin. If the speed of returning to the machine origin is quite low, users can adjust the value of “1101~1103” (coarse positioning speed) properly. “Retracting” refers to a certain moving distance away from origin to leave the signal sensitive zone of origin switch after backing to machine origin ends.			

◆ **Related Parameters to Detect Distance between Coarse and Fine Positioning Switches**

Parameter		Definition	Setting Range
1107	X-axis screw pitch	For analysis of switch distance of fine and coarse positioning in backing to the machine	0.001~9999.999
1108	Y-axis screw pitch		0.001~9999.999

Parameter		Definition	Setting Range
1109	Z-axis screw pitch	origin	0.001~9999.999
Related to specific machine tool, lead screw pitch of “1107~1109” should be set after being measured in actual operation.			

3.3.3. FAQ & Troubleshooting

1) Origin signal can not be detected in the process of returning to machine origin.

It is generally caused by origin switch. The debugging & adjusting steps are shown in Fig. 3-9.

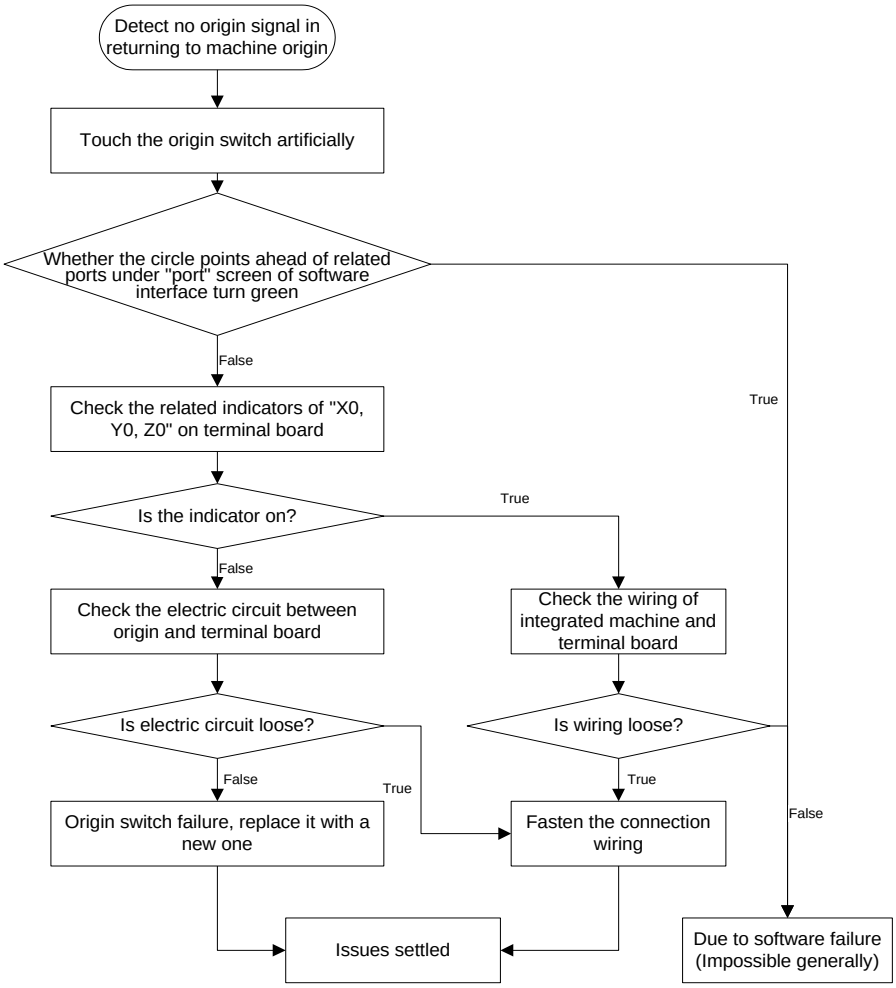


Fig. 3-9 Debugging steps

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

- Incorrect polarity of origin signal: when the origin switch is normally open, the polarity is “N”; when the origin switch is normally closed, the polarity should be “P”.
- Incorrect parameter settings: please check the parameters “1095~1097 X/Y/Z direction in backing to reference point“ and modify the corresponding parameters.

3) Low coarse positioning speed in returning to machine origin may be caused by the below

reasons:

- The setting value of parameter “1101~1103 X/Y/Z speed in backing to reference point” is too small.
- The polarity setting of origin signal in software is mismatching with the origin switch type. If the NC-type origin switch is adopted and the polarity of origin signal is N, the origin signal is valid at the beginning of backing to machine origin, so the machine will slowly move away from origin at the speed of fine positioning.

3.4. Spindle Parameters Adjustment

3.4.1. Spindle Speed Setting

Users can directly set spindle speed on the system interface.

In auto mode, press function button “State” to enter the default sub-function screen [Coor-Auto] of [Processing State], shown in Fig. 3-10.

Fig. 3-10 Coordinate-auto screen

Users can directly set the spindle speed in the parameters setting region above the manipulation button bar, shown in Fig. 3-11.

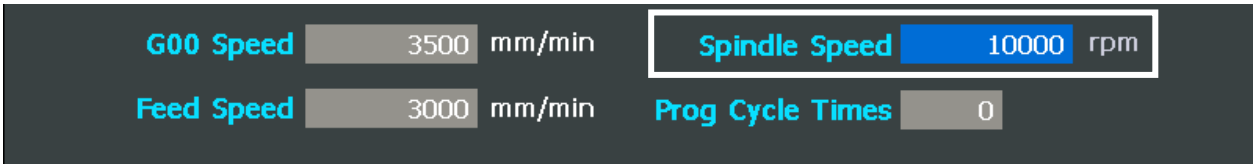


Fig. 3-11 Parameters setting region-spindle speed setting

Press “↑”, “↓” direction key to move to the corresponding parameter setting dialogue, and then press Enter key to eject a parameter input box.

Spindle speed is controlled by adjusting current spindle override. The formula is as below:

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

Spindle override selection button is on the operation panel, shown in Fig. 3-12.

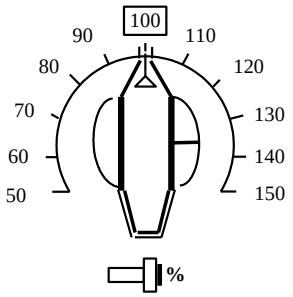


Fig. 3-12 Spindle override selection switch

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

◆ **Related Parameters**

Parameter		Definition	Setting Range
1085	Max. spindle speed	The max. allowable rotation speed of spindle (matched with the setting value of inverter)	0~ 999999
The value of ”spindle setting speed” must be less than that of Para. 1085; the max. setting value of rotary speed of Para. 1085 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 of parameter 1085. $\text{Real-time voltage of analog SVC} = \frac{\text{spindle setting speed}}{\text{max. spindle speed}} \times 10\text{V} \times \text{spindle override}$			

◆ **Related Parameters**

Parameter		Definition	Setting Range
1086	Spindle start/stop time	Delay time after spindle receiving “start” or “stop” command	0~60
1087	The action of spindle after process	After machining, spindle can be set to keep still or return to the workpiece origin or to the fixed point.	0~2
1088	The X axis coordinate of the fixed point	When the parameter 1087 is set as 1 “to return to the fixed point after process”, the spindle will stop at the coordinate of the fixed point.	Lower limit of operating range of each axis~Upper limit of operating range of each axis
1089	The Y axis coordinate of the fixed point		
1090	The Z axis coordinate of the fixed point		
Parameter 1086 sets the delay time of spindle on/ off, because a certain time is needed before spindle reaches the rated rotary speed since start-up or stops until reaching zero speed; if machining begins before machine reaching the rated rotary speed or other operation is executed before spindle completely stops, it’s possible to damage the tool or produce a scrap. Backing to the fixed point applies to mass production, thus, the spindle will stop at the fixed position after each machining for the convenience to place a new workpiece.			

◆ **Related Parameters**

Parameter		Definition	Setting Range
1083	Stop spindle while stopping	Whether spindle will automatically stop when machining stops	True: Stop False: Not stop
1082	Stop spindle while pausing	Whether spindle will automatically stop when machining pauses	True: Stop False: Not stop
This group of parameters sets the spindle action when commands of machining stop/ pause are executed.			

3.5. Port Polarity Adjustment

3.5.1. Port Polarity

The polarity of input/ output ports in software is specified in terms of the switch type: the polarity of normally closed-type switch is “P”; the polarity of normally open-type switch is “N”. In the software interface, the ports with preceding filled dot ● are input ports, while the ones with hollow point ◎ are output ports.

After wiring and power on, the red dots in front of input ports like zero signals of axes, E-stop signal, program start, program stop, and tool presetting indicate they are invalid currently, otherwise, the electrical circuit and signal polarity should be checked. If there is no problem with the electrical circuit, change the polarity of corresponding port so as to show red dots in front of the above-mentioned input ports.

If the dot in front of signal still does not change after polarity change, examine whether the port is damaged on the terminal board.

The method of modifying polarity is: press “System” function button to enter the default window [Port (A)] of [System] function section, and then use the up and down direction keys to select the I/O ports to be modified, and then press F1 to validate the port modification instantly.

[Port (A)] screen is shown in Fig. 3-13, and the following function screens need password before operation, such as [Test On], [Test Off], [Cancel Test], and [Modify Polarity].

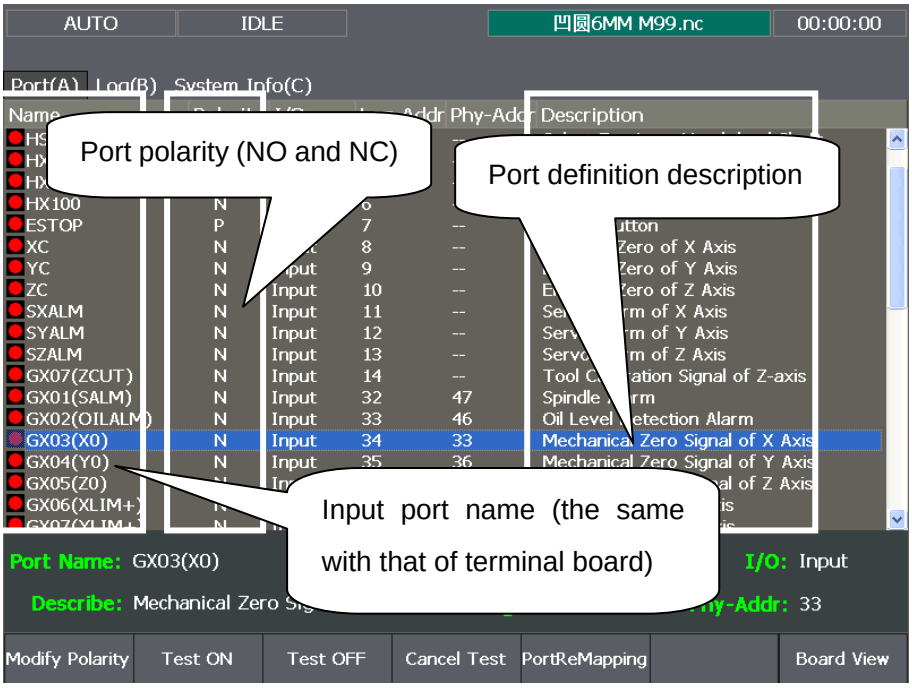


Fig. 3-13 Ports screen

◆ **[Modify Polarity]**

The shortcut key is F1, which is only available under [Port (A)] screen.

Press F1 to modify the port polarity (N / P).

The polarities of “feedrate override”, “spindle override”, “mode switch”, “handwheel” and “encoder zero” should be “N”.

Except the special definition, the polarities of output ports are generally “N”.

◆ **[Test On], [Test Off]**

The shortcut keys are F2 and F3 respectively, which are only available under [Port (A)] screen.

Pressing down F2 or F3 will make indicator light before the port selected shift between green and red. And 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 analog hardware signal, which is for simulation test.

> Notice:
>
> The indicator lights before ports are slight 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 Test]**

The shortcut key is F4, which is only available under [Port (A)] screen.

Press F4 to cancel simulation test and signal to replace analog signal with real hardware signal.

◆ **[Port Remapping]**

The shortcut key is F5, which is only available under [Port (A)] screen.

To modify port mapping is actually modifying the physical address corresponding to the port logical address. This button is used to change the function of a certain port on the terminal board.

◆ **[Board View]**

The shortcut key is F7, which is only available under [Port (A)] screen.

Pressing F7 will display the terminal board screen.

3.6. Tool Presetting

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

With the help of a tool presetter, tool presetting is realized. As shown in Fig. 3-14, there are ports on the terminal board corresponding to CUT and COM on the tool presetter. If necessary, such port as “Over-travel Protection” can be added to the terminal board according to customers’ needs. According to the different installation positions of tool presetter, presetting is divided into floating presetting and fixed presetting.

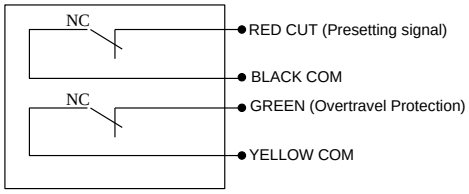


Fig. 3-14 Electrical wiring diagram of tool presetter

Fig. 3-15 is the sketch map for the using of tool presetter.

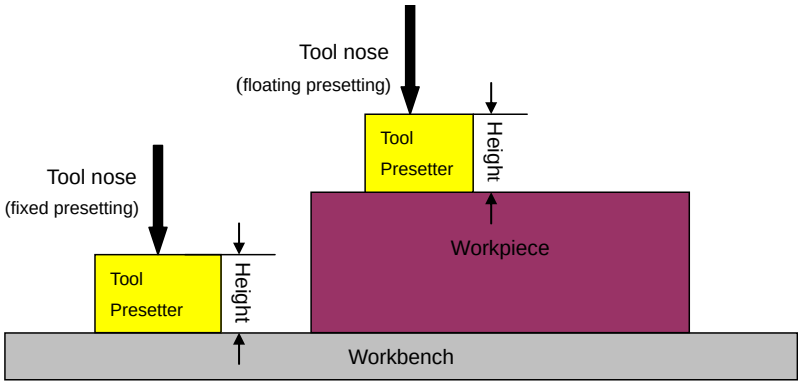


Fig. 3-15 Sketch map of using tool presetter

3.6.1. Software Interface

In auto mode, press F5 to enter “calibration interface” in [Coor-Auto (A)] sub-screen of [Processing State], shown in Fig. 3-16, and then pressing “F1, F2, and F5” will execute “first calibration”, “second calibration” and “floating presetting” respectively.

Fig. 3-16 Sub-screen of tool presetting

3.6.2. Floating Presetting

Floating presetting can be used to set the workpiece origin of Z-axis, and the thickness of tool presetter is determined by parameter [75100]. System will automatically set the workpiece offset after floating presetting.

Workpiece offset = machine coordinate – thickness of tool presetter – public offset – tool offset

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

The sketch map of the process of floating presetting is shown in Fig. 3-17.

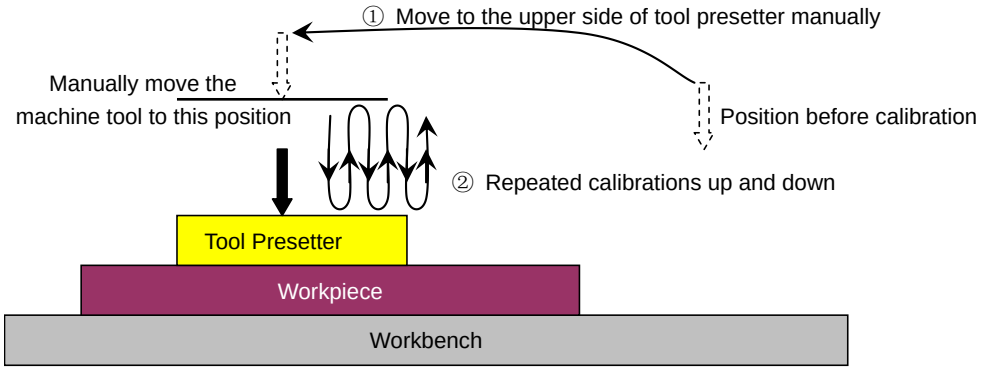


Fig. 3-17 The process of floating presetting

◆ **Related Parameters**

Parameter		Definition	Setting Range
1051	Cali block thickness	Height difference from the top surface of tool presetter to its bottom surface	-1000~1000

The measurement method of this parameter is:

- Manually move the Z-axis to the certain point on workpiece surface→ shift down its tool nose until reaching the surface of workpiece→ system will record the current coordinate Z1 of Z-axis.
- Uplift Z-axis→ put the tool presetter on workpiece surface→ shift down Z-axis slowly until reaching the tool presetter and getting the calibration signal→ system will record the current coordinate Z2 of Z-axis
- Z2 subtracts Z1, and its result equals to the thickness of tool presetter. Manually enter this value into parameter 1051.

3.6.3. Fixed Presetting

Fixed presetting refers to the calibration operation on a certain fixed position of machine tool due to tool damage or other causes, frequently used in multi-tool mode. The length of tool and the clamping position may vary, thus tool offset should be reconfirmed by fixed presetting and the sketch map of fixed presetting is shown in Fig. 3-18.

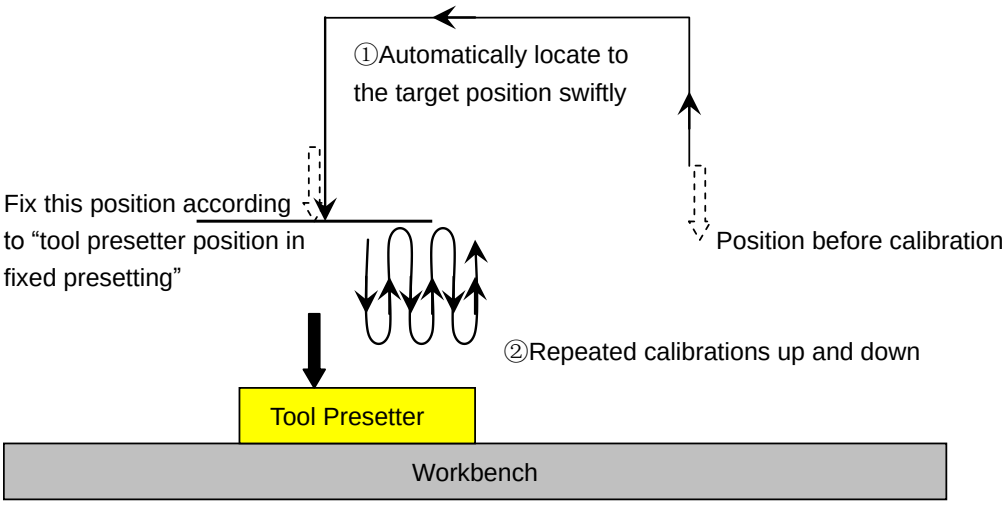


Fig. 3-18 The process of fixed presetting

The process of fixed presetting refers to input of the D-value of the recorded machine coordinate of tool nose when reaching the tool presetter surface subtracting the thickness of tool presetter into “tool offset”.

Tool offset= Machine coordinate – Thickness of tool presetter

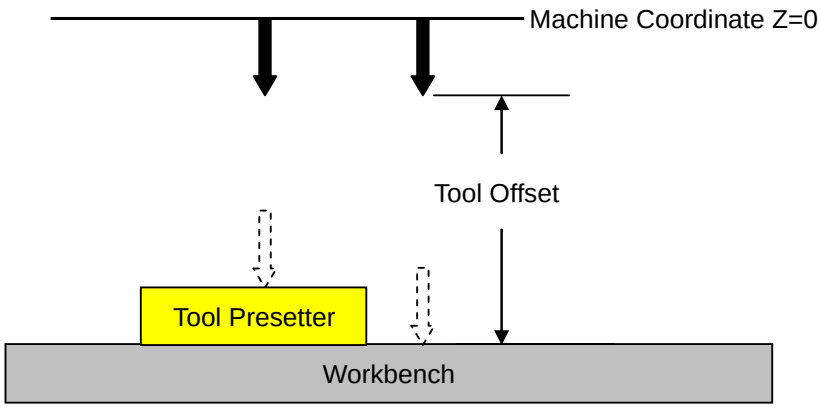


Fig. 3-19 The sketch map of tool offset

The steps of fixed presetting are as below:

1) Select tool according to tool No.;

2) Execute fixed presetting to the selected tool and record the tool offset;

3) Execute step 1 and 2 to each tool;

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

◆ **Related Parameters**

Parameter		Definition	Setting Range
1051	Cali block thickness	The height of tool presetter surface in fixed presetting to the workbench surface	0~200
1052	X mechanical coor of fixed cali block	Machine coordinate of tool presetter position in fixed presetting	Lower limit of operating range of X/Y/Z axis~ Upper limit of operating range of X/Y/Z axis
1053	Y mechanical coor of fixed cali block		
1054	Z mechanical coor of fixed cali block		

The measurement method for parameter “1051” is as below:

- Manually move the Z-axis to the certain point on the workbench surface→ shift down its tool nose until reaching the surface of workbench→ system will record the current coordinate Z1 of Z-axis.
- Uplift Z-axis→ put the tool presetter on the workbench surface→ shift down Z-axis slowly until reaching the tool presetter and getting the calibration signal→ system will record the current coordinate Z2 of Z axis
- Z2 subtracts Z1, and the result equals to the thickness of tool presetter in fixed presetting. Manually enter this value into parameter 1051.

3.6.4. First Presetting/ Tool presetting after Tool Change

The operation steps are as below:

- Firstly, manually move Z axis to workpiece surface, and then confirm the workpiece origin by floating presetting or manual clear (the method for manual clear: press F6 [Clear], and then press F3 [Z Clear] in the new pop-up manipulation button bar).
- Secondly, press F4 [Preset], and then press F4 [First Time] to execute the first presetting in the new pop-up manipulation button bar, and the system will record the current workpiece coordinate value of Z axis automatically, as shown in Fig. 3-20. The system ends this process automatically.

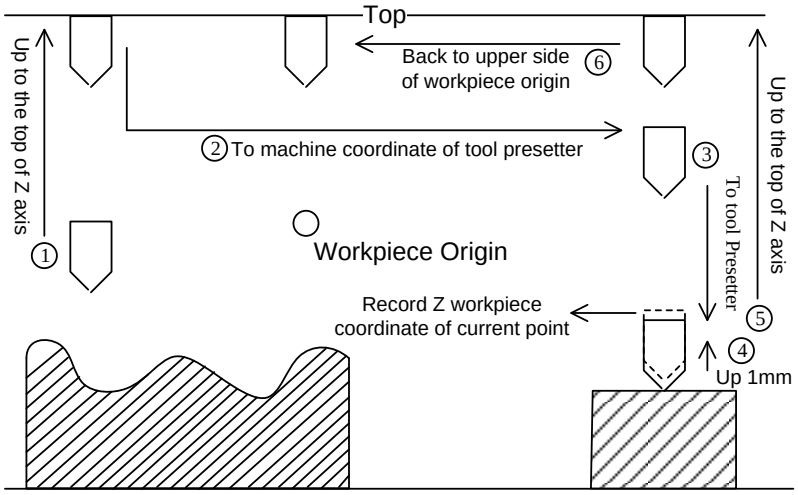


Fig. 3-20 First presetting

- The first presetting finishes, and workpiece machining begins.
- After tool change or tool break, press F4 [Preset], and then press F5 [After Tool Change] in the new pop-up manipulation button bar to restore the Z workpiece coordinate value of current point, as shown in Fig. 3-21. The system ends this process automatically.

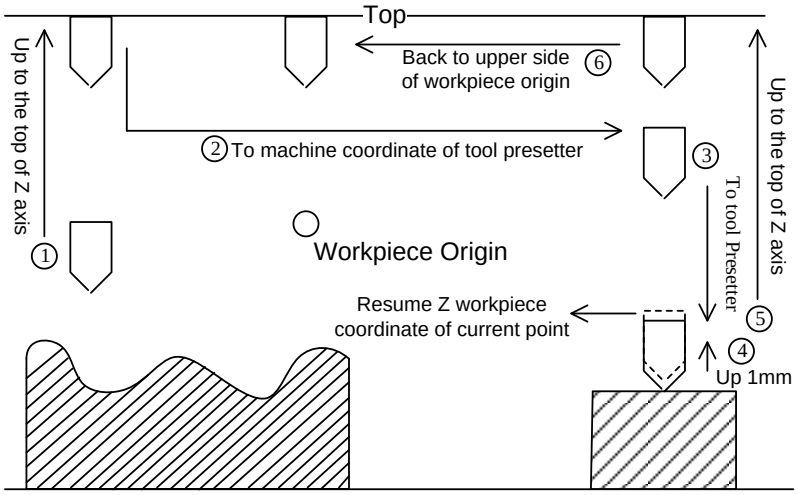


Fig. 3-21 Presetting after tool change

- Tool presetting ends, and workpiece machining begins.

3.7. Offset Setting

3.7.1. WCS (Workpiece Coordinate System)

In programming, programmers select one certain given point on workpiece as origin (also called programming 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 floating relative to the machine origin. The selection of origin of WCS should meet the conditions of simple programming, simple dimensional conversion, and small caused machining error.

The corresponding coordinate systems of workpiece offset are G55, G56, G57, G58, G59 and G54 (the default coordinate system after the system is opened). And the relationship of workpiece offset and machine coordinate system is shown in Fig. 3-22.

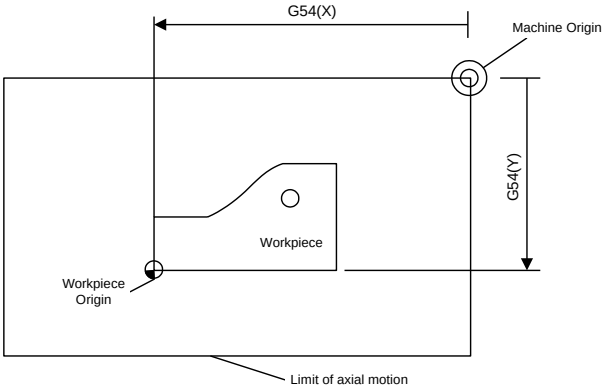


Fig. 3-22 The relationship of workpiece offset and machine coordinate system

One, two or multi-workpiece offset can be used in machining program. As shown in Fig. 3-23, if three workpieces are installed on the workbench, 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 depth as Z-0.14.

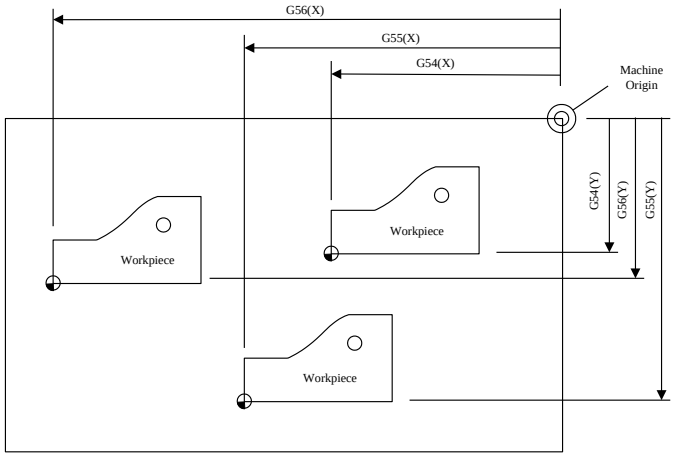


Fig. 3-23 Sketch map

```
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
…
```

The program segment N3 ~ N5, within WCS of G54, is 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 the coordinate systems, public offset is used for adjusting the workpiece origin of X-, Y-, Z-axis, but will not change the offset value of “G54 ~G59”.

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

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

3.8. Centering

3.8.1. Manual Centering

Centering refers to the process of locating the midpoint of the line connected by two points, mainly used for locating the center of workpiece blank.

[Centering] sub-function screen is under [Coordinate] function section, shown in Fig. 3-24.

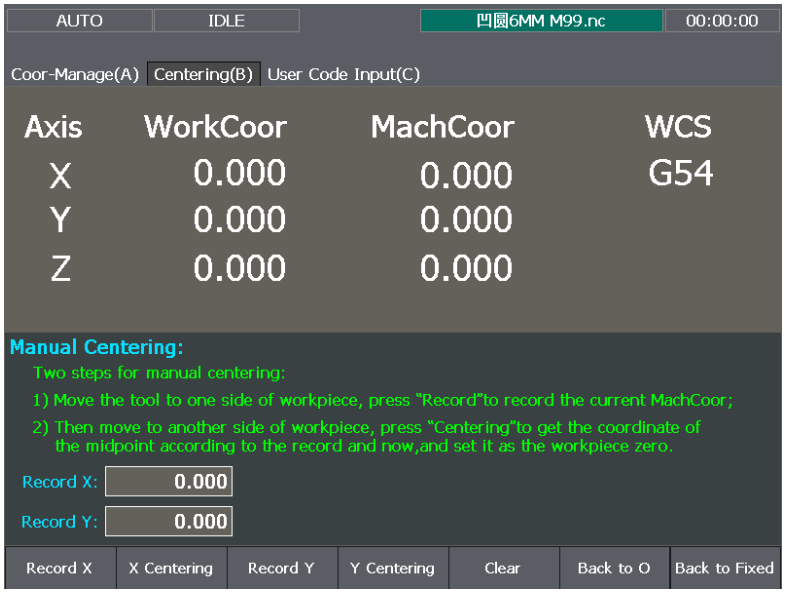


Fig. 3-24 Centering window

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

- First, manually move the cutter to one side of workpiece at first, and then press [Record X] button to record the machine coordinate of current point.
- Second, move the cutter to the other side of workpiece, and then press [X Centering] button 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 unchanged.

3.9. Adjustment of Velocity & Acceleration

3.9.1. Feedrate Setting

Feedrate can be set directly on the system interface.

In the function section of [Processing State] under auto mode, the feed rate can be directly specified on the parameters setting region above the manipulation button bar, shown in Fig. 3-25.

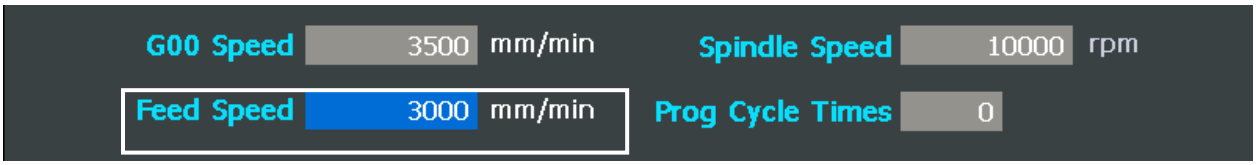


Fig. 3-25 Parameters setting section-feed speed setting

Press "↑", "↓" direction key to move to the corresponding parameter setting frame, and then press Enter key to eject the parameter input box.

The feed rate is also related with current feedrate override, which can be controlled by adjusting the current feedrate override, and the formula is as below:

Current feed rate (feed speed) = Rated feed value X Current feedrate override

The feedrate override selection button is on operation panel, shown in Fig. 3-26.

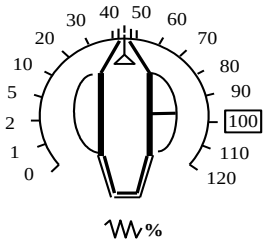


Fig. 3-26 Feedrate override selection button

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

3.9.2. Traverse Speed Setting

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

Similar to feed speed, traverse speed can also be set directly on the system interface, as shown in Fig. 3-27.

Fig. 3-27 Parameters setting area-G00 speed setting

Its concrete setting method is the same as that of feed speed, which will be omitted.

3.9.3. Parameters Specification

Except for the feed rate and traverse speed, the other involved parameters can be divided into following 4 types: velocity, acceleration, reference circle & circular speed limit, and interpolation algorithm.

- **Velocity**
- **Related Parameters**

Parameter		Definition	Setting Range
1045	Startup speed	The max. achievable speed of stepping motor in startup without acceleration	0~100000
1061	Full feedrate for G00	When it is set as “True”, G00 override will be not controlled by the override switch.	True: Valid False: Invalid
1062	Feedrate is valid for manual mode	When it is set as “True”, feed speed is controlled by feedrate override in manual operation.	True: Valid False: Invalid
1063	Use default speed	It specifies whether to adopt the default feed speed.	True: Valid False: Invalid
1064	User default spindle speed	It specifies whether to adopt the default spindle speed.	True: Valid False: Invalid
1071	Max. Z-axis speed	It specifies the max. allowable speed of Z axis.	0.01~1000000
1001	Manual high speed	There are two modes for option under manual mode: low speed and high speed, which can be switched by pressing acceleration key. The system default running speed mode is manual low speed.	Setting value of manual low speed~ Max. feed speed
1002	Manual low speed		0~Setting value of manual high speed
1076	Limit max velocity for small lines	None	True: Valid False: Invalid
1077	Length for limit max velocity	It adjusts the intensity for the limit of max. speed of short line segments.	0.001~100000
1072	Z deceleration distance	To protect tools, the machine tool will decelerate (at [approach speed]) when approaching the target position during positioning. This parameter is used to specify the distance from the decelerating position to the target position.	0~999
1073	Z approach speed	It is the feed speed when the distance between the tool and the workpiece is smaller than “deceleration distance” during positioning.	0~Machining speed
Parameter 1045 “startup speed” aims at the startup frequency of stepping & servo driver, and in driver this parameter should be set zero. The startup speed refers to the highest frequency of direct			

Parameter	Definition	Setting Range
working startup without acceleration of motor. Reasonable selection of this parameter will improve the machining efficiency, and avoid the low speed segment with bad motion feature of motor. “Startup frequency” is generally included in the motor ex-factory parameters, but after installation, its value will vary especially in loading motion, thus, it should be set based on the actual measurement of motor power and inertia of machine tool. Parameter confirmation method: set a lower value at first, and repeatedly make the machine execute typical motion & multi-axis synchronization motion, gradually increase this value until fix the max. startup speed. The actual setting value of this parameter is half of the max. startup speed, with general setting range “300 ~ 400”.		

- **Acceleration**
- **Related Parameters**

Parameter		Definition	Setting Range
1042	Single axis acc	Description of the acceleration/ deceleration capability of each feed axis, with unit “mm/s^2”	0.001 ~100000
1043	Max turning acceleration	The max. acceleration of feed motion on adjacent axes	0.001 ~100000
1044	Jerk	The change rate of acceleration of single axis (acceleration’s acceleration)	0.001 ~100000
“Single axis acceleration” is used to describe the acceleration/ deceleration capability of each feed axis, with unit “mm/s^2”, depending on the physical feature of machine, such as the quality of motion part, torque, cutting load and resistance of the feed motor. The larger the value of the parameter is, the less time the machine will spend in acceleration/ deceleration during motion process, the higher the efficiency is. Generally, for servo motor system, it should be within “600 ~ 3500”. Set a smaller value at first, and then 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 allowance. “Turning acceleration” refers to the max. acceleration of feed motion on adjacent axes, and “1 ~4” times of the “Single axis acceleration” is recommended, generally within “1200 ~ 5000”. For higher speed requirement, “2 ~ 4” times of the “Single axis acceleration” is recommended. “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 algorithm acceleration & deceleration, used to mitigate the bad effects caused by abrupt acceleration & deceleration of machine.			

- **Reference Circle, Circular Speed Limit**
- **Related Parameters**

Parameter		Definition	Setting Range
1074	Reference circle speed	Reference circle is the reference of machine in processing circular workpiece. The max. speed of reference circle refers to the max. allowable speed of	0.001 ~ 100000

Parameter		Definition	Setting Range
		machine in processing this circle without strong vibration.	
1075	Reference circle radius	None	0.001 ~ 100000

After installation of machine, users can make the machine process an arc, 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 machine tool until the max. circular speed is achieved, i.e. the max. allowable speed of machine tool without strong vibration. This arc is regarded as the reference circle, and its max. allowable speed is the max. speed of reference circle. Max. centripetal acceleration "a" can be calculated in terms of the reference circle radius and its max speed. The formula is as follows: V_0 and R_0 are the speed and radius of reference circle respectively, while V_x and R_x are the speed and radius of the arc to be processed. After R_x is confirmed, when the arc processing speed is larger than V_x calculated, the system will limit the arc processing speed automatically to ensure it is within the debugging value, i.e. the vibration will not be stronger than that during ex-factory debugging.

$$a = \frac{V_0^2}{R_0} = \frac{V_x^2}{R_x}$$

In processing a circle with a small radius, even quite low feed speed of 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 1074, the setting value of 1074 will be regarded as the machining speed.

- **Interpolation Algorithm**

- **Related Parameters**

Parameter		Definition	Setting Range
1069	Whether to use type S algorithm	If it is set as "True", the system will adopt the S-type algorithm for interpolation.	True: Use S-type algorithm False: Use trapezoid algorithm

Currently, the system supports trapezoid algorithm and type S algorithm. When type S algorithm is adopted, the max. acceleration of system will reach the twice of the single axis acceleration set in the system, so setting a smaller value for parameter "1042 single axis acc" is recommended.

3.10. Simulation & Track

3.10.1. Simulation

The function of simulating provides a fast but lifelike simulated processing environment for users.

Running under the mode of simulating, the system will not drive the machine tool to do the relative actions but only show the processing trace of the cutter in high speed in the trace window. By simulating, users see moving form of the machine tool in advance, avoiding machine tool damage due to programming mistakes in processing procedure. And they can also know other additional information.

The steps of simulation are as below:

1) Press "↑" and "↓" shift keys under [Local Program (A)] of [Program] function section to select a machining file, and then press F1 [Load] to load the file;

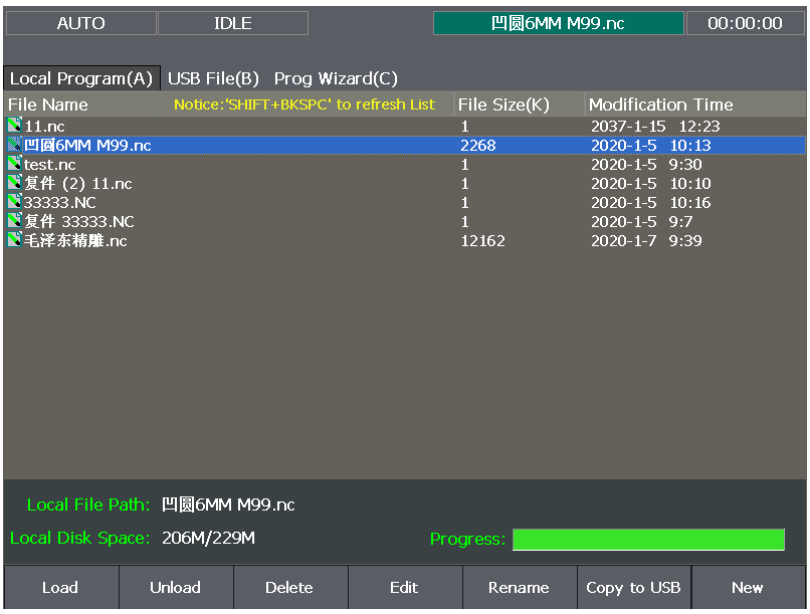


Fig. 3-28 Program file window

2) Press F1 [Simulate] under [Motion Trace (B)] sub-function screen of [State] function section to begin simulation, in which tool machining path can also be viewed. At the same time, such information as processing range and estimate processing time can be viewed under [Current Program (C)] sub-function screen.

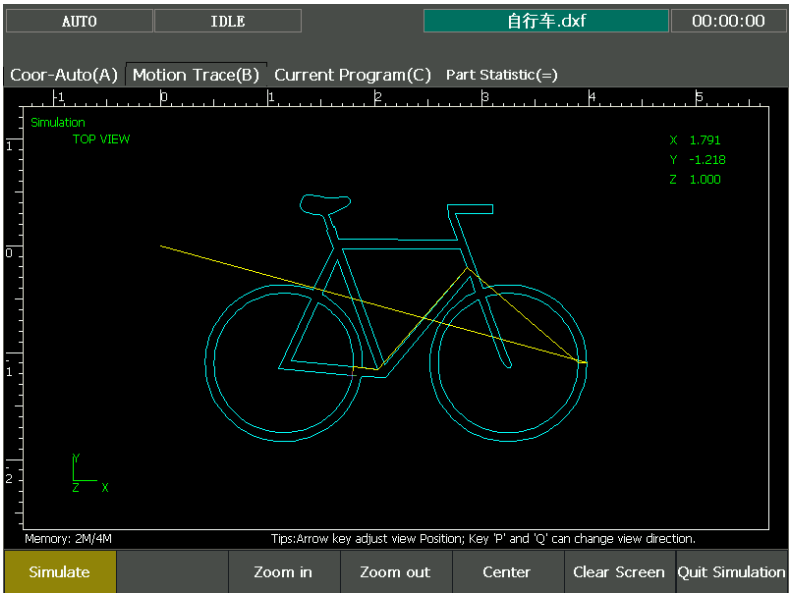


Fig. 3-29 Simulation track

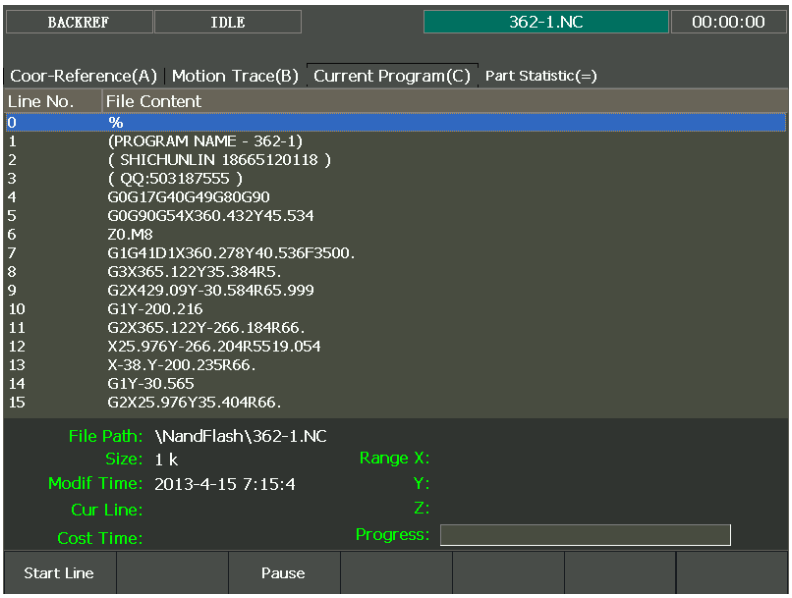


Fig. 3-30 Current program screen

Pressing F7 [Quit Simulation] will exit from simulation.

3.10.2. Motion Trace

[Motion Trace] screen can give a 3D display on the processing track followed in real time, with which users can view the tool path more intuitionally so as to ensure the accuracy of processing program. In 3D tracking mode, abundant operation methods are offered by the system for the convenience of users to view the motion track from different viewing angles and in an appropriate scaling. P and Q keys can be used to switch the angle of view.

3.11. Compensation

3.11.1. Lead Screw Error Compensation

◆ **Related parameters are:**

Parameter		Meaning	Setting Range
1121	Screw error comp	Decides whether to execute lead screw error compensation, including unilateral compensation and two-way compensation.	0: No compensation; 1: Single compensation; 2: Double compensation
1122	Backlash compensation valid	It sets whether only backlash compensation is valid.	True: Valid False: Invalid
Press F7 (Leadscrew button) under Compensation (=) interface	Backlash	It sets the value of backlash of each axis, only valid when parameter [Backlash compensation only] is set "True".	0~1 (mm)
If parameter "1121 Screw error comp" is set as "0", and parameter "1122 Backlash compensation valid" as "True", only backlash compensation is activated. If 1121 is set as "1", and 1122 as "True", backlash compensation and unilateral error compensation are activated, used when backlash is relatively constant. If 1121 is set as "2", forward error compensation and backward error compensation are executed together, used when backlash is not constant.			

◆ **Concept and Principle**

Lead screw error consists of screw pitch error and errors caused by backlash.

◆ **Pitch Compensation:**

Pitch error is caused by defect in manufacturing of lead screw and long-term wear, etc. In order to improve precision, pitch compensation is needed. The sketch of lead screw is shown in Fig. 3-32. A coordinate system is established, based on "0" point on the lead screw as the reference point, nominal value as X-coordinate, and actual value as Y-coordinate. Then ideal moving curve is as curve "1" in Fig. 3-33, however, 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, actual moving curve deviating from the ideal one, and their difference is called error, i.e.:

Error = nominal mechanical coordinate – actual mechanical coordinate

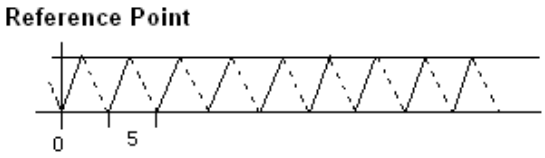


Fig. 3-31 Sketch of lead screw

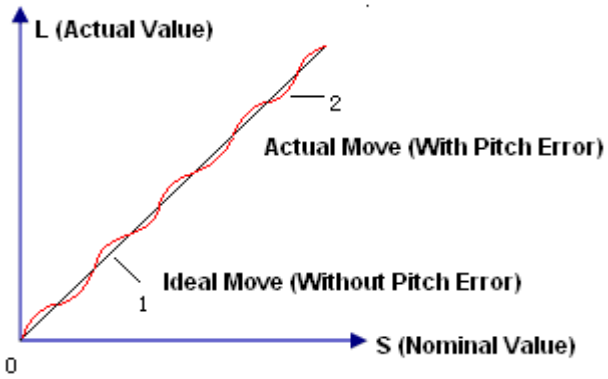


Fig. 3-32 Picture of moving curve

◆ **Compensation Method:**

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

◆ **Backlash Compensation:**

Hysteresis feature is caused by forward and reverse clearance. Assumed that CW rotation of driving shaft is negative motion, leading the driven shaft to counter motion, 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, worktable will move along the negative direction with the driving shaft; when the direction of the driving shaft changes again, the situation is the same, which is called Hysteresis. If there were no pitch error under ideal condition, the moving curve of worktable is shown in Fig. 3-34, and 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. 3-35.

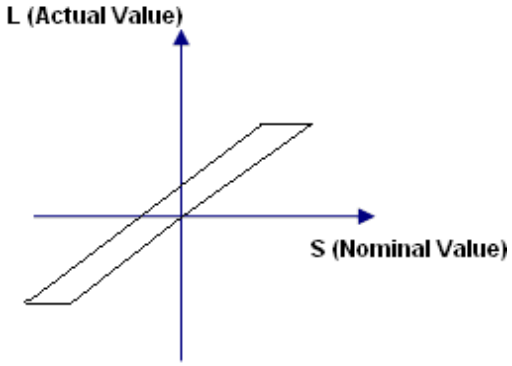


Fig. 3-33 Hysteresis feature

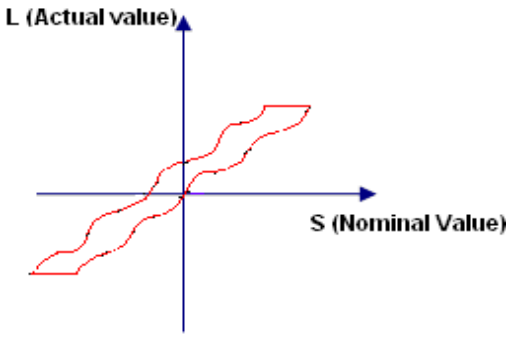


Fig. 3-34 Actual moving curve

The popular explanation is: because the slider is generally fixed on the lead screw whose outer wire and the inner wire on the outer wire can not be completely matched, backlash compensation compensates the clearance between the lead screw of last direction that the slider needs to finish after reversing its moving direction.

◆ **Measuring 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. Thirdly, manually move “a” centimillimeter, then move “a” centimillimeter back, and then see the actual moving distance of watch hand: “b” centimillimeter. Therefore, the backlash is measured, namely (a-b) centimillimeter.

◆ **Compensation Method**

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 program).

◆ **Lead Screw Error Compensation File**

Actually the system has already combined the above two errors for treatment.

The name of lead screw error compensation file is axeserr.dat, which can be copied to a U disk via the “Outport” function in the system. Modification to the data in the lead screw error compensation file will become valid after the software is restarted.

The file format is:

1) Firstly specify length unit, the length unit currently supported is mm and the style of writing is: unit = mm

2) Then specify the error sequence of each axis. To work properly, the contents in this sequence must be arranged in the ascending order of nominal mechanical coordinate value.

See the following for the format of a bilateral compensation file:

[Axis.<Axis Name>]

<Nominal Mechanical Coordinate>, <Forward Error>, <Backward Error>

<Nominal Mechanical Coordinate>, <Forward Error>, <Backward Error>

<Nominal Mechanical Coordinate>, <Forward Error>, <Backward Error>

The format of a unilateral compensation file is as follows:

[Axis.<Axis Name>]

<Nominal Mechanical Coordinate>, <Unilateral Error>, <Backlash>

<Nominal Mechanical Coordinate>, <Unilateral Error>, <Backlash>

<Nominal Mechanical Coordinate>, <Unilateral Error>, <Backlash>

Among them, <Axis Name> is X, Y, Z… (Case-insensitive)

- Nominal mechanical value: it is the mechanical coordinate with sign corresponding to reference point, which is calculated by given pitch and pulse equivalent (i.e. the length calculated based on nominal pitch, not actual physical one), arranged in ascending order. Nominal mechanical coordinate must be within the stroke range, or the compensation is invalid.

Every nominal mechanical coordinate does not need evenly spaced, with no limits to the record density and points.

- 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.

> Note:
>
> Pay special attention to the sign of nominal mechanical coordinate and actual mechanical coordinate, especially when equipment like laser interferometer is used to measure the length. Calculate after the measured length is converted to the corresponding mechanical coordinates, or a wrong result may occur.

3) Annotation: it must be in a separate line and started with semicolon. Its syntax is:

;<Annotation contents>

Note that 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.

- An example of lead screw error compensation file format:

;unit=mm

[X]

-570.025, 0.027, 0.083

-450.020, 0.025, 0.077

-330.015, 0.015, 0.068

-210.010, 0.000, 0.057

◆ **Compensation Method**

Generally the value of lead screw error compensation can be measured by a laser interferometer, with two ways for compensation.

1) File compensation. Save the measured value into the file and name it “axeserr.dat”, then save it to the root directory of the USB flash disk. The system will then perform compensation automatically in processing based on the data in the file. For the format of lead screw error compensation file, refer to its introduction in section 3.11.1.

2) Directly setting compensation on the interface. Turn to [Compensation (=)] screen under [Parameters] function section, then press F7 (Leadscrew button), and then press F3 to set the compensation parameters, as shown in Fig. 3-35.

Fig. 3-35 Compensation parameters setting

Insert: continuous inserting of multi-blank-line prohibited; next inserting is allowed after previous one is completed.

Import & Outport: compensation files can be copied from or to a U disk or other external storage.

Apply: i.e. save. After parameters are set, press Apply before restarting the software. Reboot is needed to validate the modification of backlash data. If the system is not rebooted, the modified value does not take effect, while it is the previous backlash data that still works.

The compensation data can be in an ascending or descending order. Positive interval indicates ascending order

while negative interval descending order.

Backlash can only be set in unilateral compensation, and hidden in bilateral compensation.

Remember to press the Apply button after modification of lead screw error compensation data. Before machining, homing should be executed, because the system only sends the compensation data of the homed axes to the driver.

After switchover between unilateral compensation and bilateral compensation, it is necessary to load the desired file again and apply it. Otherwise, it is the previous compensation mode and data before modification that still work.

3.11.2. Tool Compensation

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

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

Input the new tool parameter values in [Compensation (=)] input interface (as shown in Fig. 3-36) if tool nose radius is altered after tool wear, tool sharpening or tool change, avoiding the trouble to modify the programmed processing procedure.

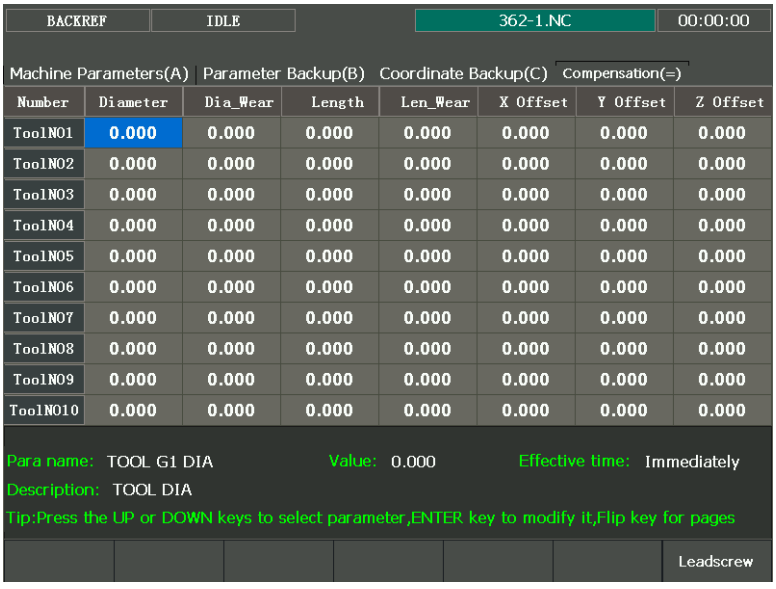


Fig. 3-36 Tool parameters screen

To make tool compensation (including tool diameter compensation and tool length compensation) effective, parameter “1500 turn on radius compensation” should be set as “true”. Code G43 (positive offset) and G44 (negative offset) are used for tool diameter compensation while G41 and G42 for tool radius compensation.

◆ **Involved Parameters:**

Parameter		Meaning	Setting Range
1500	Turn on radius compensation	Setting whether to perform tool compensation	True: Valid False: Invalid
1501	Specify the type of tool compensation	1: General mode; 2: Intersect mode; 3: Insert mode	1~3
Under "Compensation (=)" Interface	Diameter	Tool diameter	0.000~9999.000 (mm)
	Dia_Wear	The system can compensate the tool diameter according to the input value of this parameter after measurement.	0.000~9999.000 (mm)
	Length	Tool length	0.000~9999.000 (mm)
	Len_Wear	The system can compensate the tool length according to the input value of this parameter after measurement.	0.000~9999.000 (mm)

The schematic diagram of tool compensation direction is as shown in Fig. 3-37.

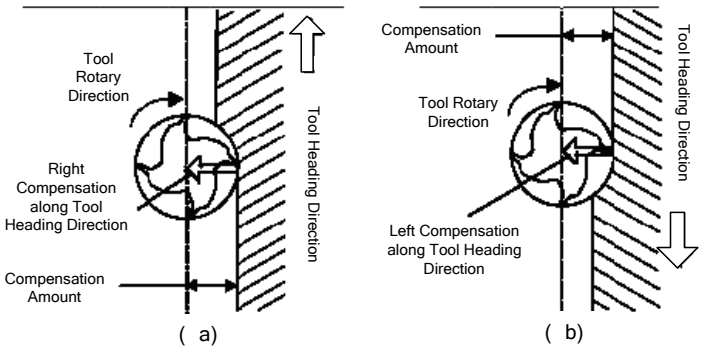


Fig. 3-37 Direction of tool compensation (a: left compensation b: right compensation)

Programming for tool radius compensation is as shown in Fig. 3-38:

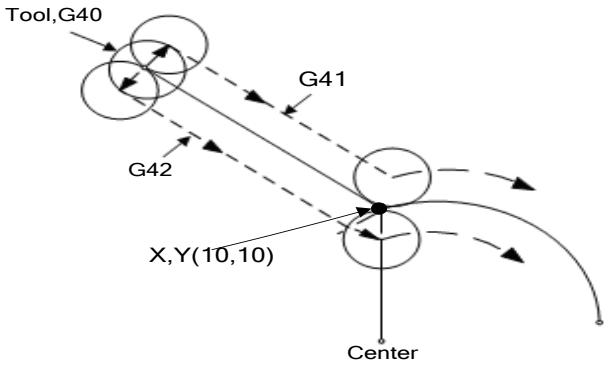


Fig. 3-38 Schematic diagram of tool compensation processing

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

G02 X_ Y_ I_ J_ ' circular interpolation

Among the above in shadow, 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*.

3.11.3. Across Quadrant Error (AQE) Compensation

When machining a circle, distortion, like a spike, may occur at the transition position from one quadrant to another one. AQE (across quadrant error) compensation is used to eliminate this kind of distortion.

AQE compensation includes parameters to eliminate the spike near the transition position from one quadrant to another one in circular machining. The settings of each axis in positive and negative directions are all similar.

◆ **Involved Parameters:**

There are altogether 6 groups of compensation parameters, each of which includes time, length, delay time and intensity. Group 0 is listed below for reference.

Parameter		Meaning	Setting Range
1123	Enable AQE compensation	Whether to enable AQE compensation	True: Valid False: Invalid
1124	AQE compensation time		0 ~ 0.3 (sec)
1125	AQE compensation length		0 ~ 10 (mm)
1126	Delay time of AQE compensation		0 ~ 10 (sec)
1127	Intensity of AQE compensation		0 ~ 1
To enable AQE compensation, set parameter 1123 as “True”. Compensation time: the larger the value is, the larger the compensation-affected area will be. Recommended value is 0.02 sec. Compensation length: the larger its value is, the more obvious the compensation result will be. However, note that too large value will make the arc concaved, while too small value will not suppress the spike effectively. It is suggested to measure the actual height of the spike with a laser interferometer or other measuring device in debugging, and then set this parameter as 0.3 to 3 times of spike height. Compensation result is also related with compensation time and			

Parameter	Meaning	Setting Range
intensity. Compensation delay time: the spikes may not appear exactly at the four quadrant positions due to mechanical properties of machine tool, but a little distance away from the quadrant points. Estimate the time to travel this distance and then set the time as the value of this parameter. Compensation intensity: the larger the value is, the more obvious the compensation result will be.		

3.12. Log and Diagnosis

3.12.1. Log

Press “System” function key to enter [System] function section, and then press letter key B to enter [Log] sub-function screen.

As shown in Fig. 3-39, [Log] screen under [System] function section records important operations and system events, and users can not only browse the log information since this time start-up but also view the history records.

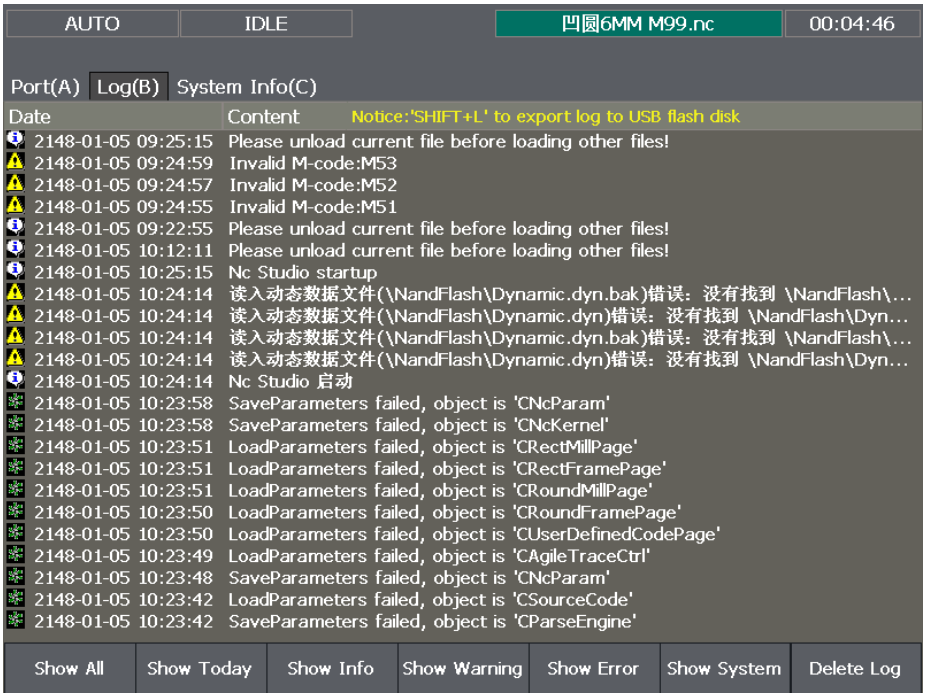


Fig. 3-39 Log screen

- **Show Info, Show Warning and Show Error**

Their shortcut keys are F3, F4 and F5 respectively.

The three buttons correspond to the three kinds of information accordingly, namely general information, warning information and error information.

- **Show System**

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

- **Delete Log**

Pressing shortcut key F7 will delete all the logs.

3.13. Program File Management

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

3.13.1. Program Wizard

NK260 offers 5 basic processing program wizards: circular frame, circular pocket, rectangular frame, rectangular pocket and laser measure. Users just need to input some simple parameters to complete the milling operation of circular frame and rectangular frame, etc. Take laser measure as an example in the following:

Press “Program” key to enter [Local Program] screen, and then press letter key C to enter [Prog Wizard] screen, and then press shortcut key L to switch to laser measure screen, as shown below. Users can set parameters for the selected object as required to achive the desired result.

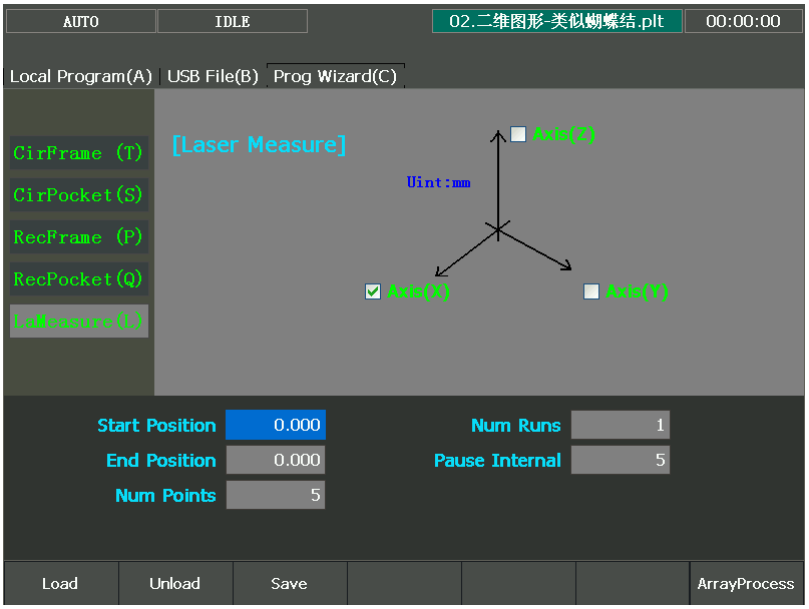


Fig. 3-40 Laser measure screen

[LaMesure]: the wizard for lead screw error measured by a laser interferometer. The data file generated with this wizard can be used for backlash compensation.

After the input of Start Position, End Position, Num Points, Num Runs and Pause Interval, the system will automatically record the error of each num point (measure point) and then output the compensation file by the laser interferometer.

After parameter values are entered, press F3 to save them, the system automatically generating the program, then press F1 to load the program, and then press “Program Start” to begin measuring.

Select an axis first, and only one axis can be selected at one time.

Start Position and End Position should be both within the stroke range, and the latter one should be larger than

the former one.

One Num Run refers to the process from Start Position to End Position and to Start Position again. The laser interferometer will record a group of data in each Num Run. The lead screw error compensation file uses their average value.

Measuring interval = (End Position – Start Position)/ (Num Points -1). If precise measuring is needed, Start and End Position should be calculated accurately so as to ensure the coordinates of measured points are integers.

3.13.2. Part Statistic

This screen mainly displays the statistics of current machining file and previously machined files.

Press [State] button in Auto mode, and then press "=" to enter [Part Statistic] screen, as shown in Fig. 3-41. The upper part of this screen displays the machining info about the machined files, including file name, total machining time, total machining length and machined times, while the lower part shows the info about current machining file, like name, single time, total time, single length, total length, cycles and part count. Among them, the counterpart of "Cycles" is the "Prog Cycle Times" under "Coor-Auto (A)" screen.

Pressing F1 will clear all historical statistics records on the list.

Pressing F2 can export statistics of all machined program files to a U disk or other external storage in .txt format.

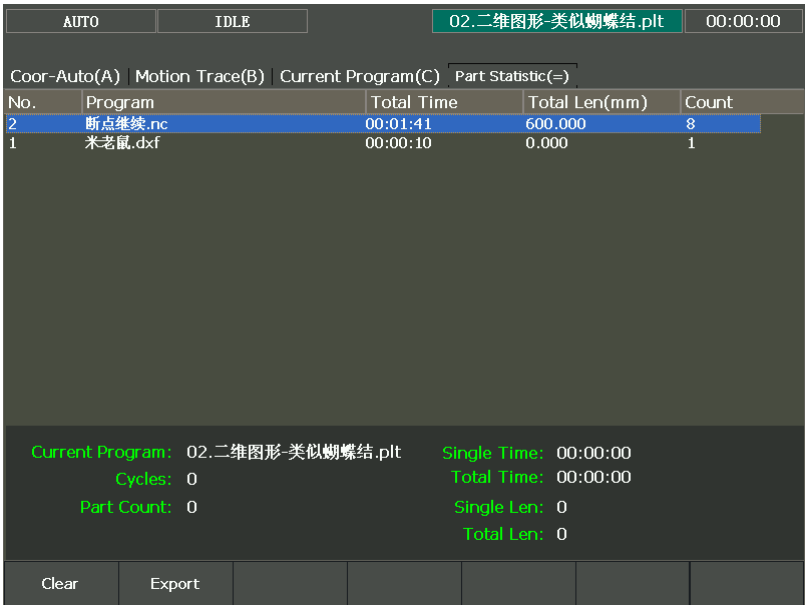


Fig. 3-41 Part statistic screen

3.13.3. Program File

Press function key "Program" to enter [Program File] function section, mainly including [Local Program (A)] and [USB File (B)] to be introduced.

[Local Program] is the default screen after entering [Program File] function section, as shown in

Fig. 3-42. On the upper part of this screen, there is file list box displaying the processing files under the path D:\NCFILES. On the lower part, the prompt box shows the path of the currently selected file and the available space of driver. “Progress” bar displays the schedule of “Load” and “Unload” operations. Folders can be opened by pressing “Enter”.

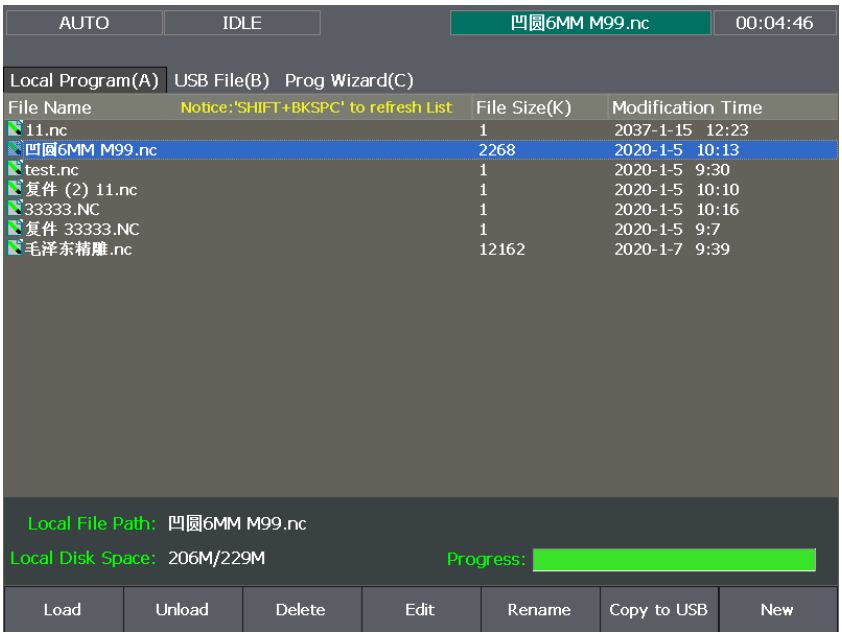


Fig. 3-42 Local program screen

Users can find the processing files under the default path of hard disk and execute such operations as loading, editing, deleting and renaming them. In addition, users can create a new processing file under the default path D:\NCFILES and edit it.

◆ **Load**

After the processing file is selected (press “↑“ or “↓” key to move cursor to the target file), pressing shortcut key F1 will make the system load the file automatically, progress bar on the lower right part displaying the schedule. After loading finishes, other operations are available.

◆ **Delete**

After selecting a file, press F3 to eject a prompt box asking users whether to delete the file.

Note:

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

◆ **Edit**

After the processing file is selected, pressing shortcut key F4 will make the system eject its embedded program editor automatically, in which users can edit the contents in the file. After editing, press F1 to save and confirm the modification and return to [Local Program] interface automatically.

Note: The file being loaded can not be edited. Unload it before editing it if necessary.

◆ **Rename**

After selecting a processing file, press shortcut key F5 to eject a file name input box asking users to input the new name, and then pressing F1 will complete the operation.

◆ **New**

After shortcut key F7 is pressed, the system will create a .nc file under the path D:\NCFILES with default file name “Untitle1.nc”. After new file creation, the system will automatically enter program editor, in which users can directly input the program.

◆ **Unload and Copy to USB**

Pressing shortcut key F2 will unload the file currently being processed, corresponding to the operation of “Load”.

Pressing shortcut key F6 (the premise is that a removable disk has already been inserted) will copy the file selected to the removable disk.

Press letter key B to enter [USB File] screen, as shown in Fig. 3-43, in which files in the USB flash disk can be read in. Users can also do the following operations to them, like “Load”, “unload”, “Edit”, “Delete”, “New”, “Rename”, and “Copy to local”.

Fig. 3-43 USB file screen

The layout of [USB File] is the same as that of [Local Program], so is its operation, which will not be introduced here.

◆ **Involved Parameters are: Translation Parameters of DXF File**

Parameter		Meaning	Setting Range
1148	Tool lifting height	It sets the tool lifting height during rapid traverse.	0~99999
1149	Machining depth	It specifies the processing depth for 2D files.	-99999~0
1150	Use first point as zero point	It sets whether to set the firstly met coordinate point as zero point when DXF file is processed.	True: Use the first point as zero point False: Not use the first point as zero point
1151	Shape separate processing_valid	It sets whether the system will completely process the last workpiece before machining the next one(s).	True: Valid False: Invalid
1152	Bottom machining valid	Valve operation is enabled only when [2D cutting] is on the workpiece surface.	True: Valid False: Invalid
1153	Use dxf file as metric size	It forcibly sets dxf file as metric size.	True: Forcibly set as metric size False: Not forcibly set as metric size

Translation parameters of DXF file are applied to translation for DXF files, including “Tool lifting height”, “Machining depth”, “Layer depth”, “Use first point as zero point” and “Shape separate processing _valid”, etc.

When processing Dxf files, 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. The depth of each circle is 10mm, and each feed depth of Z axis is 2mm. If parameter 1143 is set as true, machine tool will process the current circle 5 times, then uplift the tool, and then go to process the next circle. If it is set as false, machine tool will process the current circle once, then lift its tool, and then go to process the other circles. After all the circles are processed once, this process will be re-executed 4 times to finish processing all the shapes.

◆ **Translation Parameters of ENG File**

Parameter		Meaning	Setting Range
1154	Select tool for ENG	If this parameter is set as true, opening an Eng file will eject a dialog box asking users to select a tool (the tool specified in the Eng file instead of the system default tool) for processing based on the processing program.	False: Not use True: Use
1155	Select tool for ENG	Only available for ENG5.50 and 5.53.	False: Not use True: Use
1156	Tool change	If it is set as true, when tool change command is	False: Invalid

Parameter		Meaning	Setting Range
	prompt	encountered, machine tool will suspend processing and uplift its Z axis, and prompt bar in the system will prompt tool change. At this time, users can perform the operation of tool change. If it is set as false, when tool change command is encountered, machine tool will not suspend processing, but the prompt bar in the system will still prompt tool change.	True: Valid
1157	Tool lifting height	It sets the tool lifting height of Z axis during rapid traverse of machine tool when an ENG file is being processed.	0~99999
1159	Cycle times of ENG processing	It sets the cycle times to process an Eng file.	1~99999
Translation parameters of ENG file are applied to translation for ENG files, including “Tool lifting height”, “Tool change prompt”, etc.			

◆ **And**

Parameter		Meaning	Setting Range
1158	Retract amount	It indicates the retract value after feed each time in the manner of high-speed reciprocating chip removal for deep hole drilling.	0~99999
1160	Deep hole machining manner	It sets the manner for processing deep holes.	0: Reciprocating chip removal 1: High-speed reciprocating chip removal
These two parameters are related to processing of deep holes.			

3.14. Handwheel Operation

3.14.1. Handwheel Mode

The system supports three operation modes: auto mode, reference point mode and manual mode, and manual mode is subdivided into jog, stepping and handwheel. Users can select handwheel mode by pressing “Handwheel” button on the operation panel.

Under handwheel mode, users can configure a handwheel to control the machine tool. As shown in Fig. 3-44, select the 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 pulse equivalent sent to the machine tool from the system according to the each case turning of handwheel, and the displacement (linear displacement or rotation angle) of moving parts of machine tool can be calculated based on the pulse equivalent.

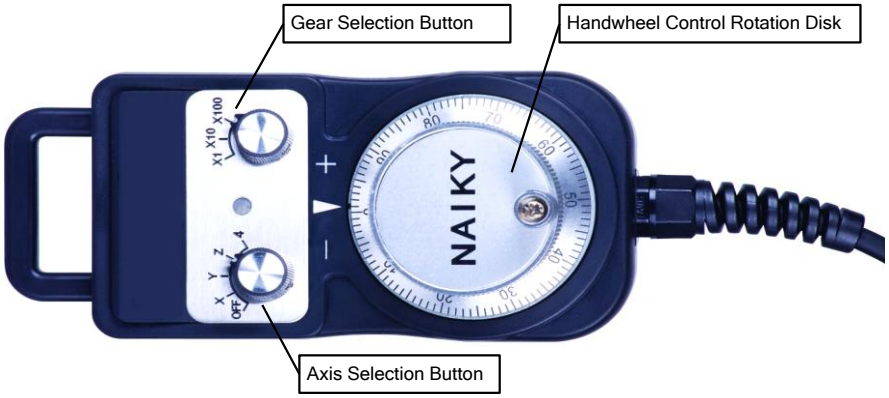


Fig. 3-44 Handwheel

3.14.2. Handwheel Guide

NK260 system supports handwheel guide.

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

Fig. 3-45 is the software interface of handwheel guide, in which press F1 [HW Guide] button to activate handwheel guide. After machining starts, the system will execute the processing program with clockwise turning of handwheel and stop processing with the stop of handwheel. Processing speed varies with the handwheel turning speed.

Fig. 3-45 Handwheel lead interface

3.15. System Management

3.15.1. System Info

As shown in Fig. 3-46, view the related information (including CNC software information and CNC hardware information) of NcStudio in [System Info (C)] screen of [System] function section. Pressing letter key C will enter [System Info] function screen.

Fig. 3-46 System info screen

3.15.2. Network Connection

NK260 supports network connection. For details, refer to chapter 3.16.

3.15.3. Language

Press F3 under [System Info] sub-function screen of [System] function section to switch between languages. To validate the language switching, it is necessary to reboot the system.

3.15.4. Register

In [System Info] screen of [System] function section, “registration code” can be used to register the system and limit the system service time. Registration code is generated by registration code maker. Its generation steps are:

1) Double click the registration code maker “GetRegCode.exe”, and then enter the password “ncstudio” (revisable) in the dialog box as shown in Fig. 3-47. Then press “OK”, input control card serial number and limited service time, and then click “Generate” to generate the new code displayed at the lower part, as shown in Fig. 3-48. If service time does not need limiting, input “-1” in the “limited time” bar to generate an unlimited code.

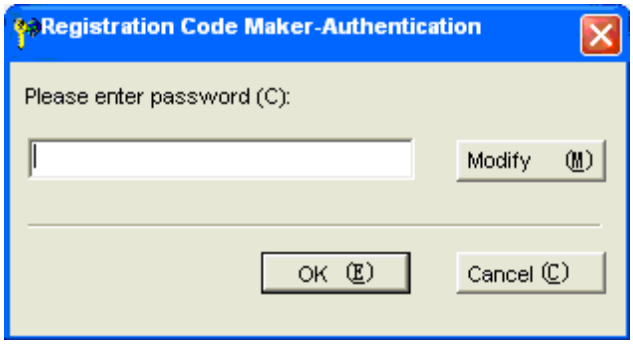


Fig. 3-47 Registration code maker-1

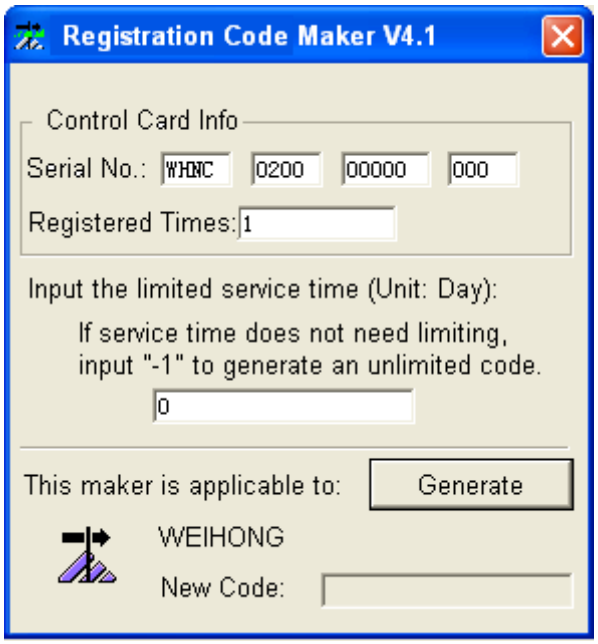


Fig. 3-48 Registration code maker-2

2) Press F1 [Register] in [System Info (C)] screen of [System] function section, then input the registration code generated in the first step into the pop-up dialog, and then click “OK”.

3) System prompts “register successfully”.

> Note:
>
> The ID of control card varies with the change of registration times, reflected by the last three figures of control card. When registration times is “0”, the last three figures are “000”; when “1”, the last three figures are “001”.
>
> Card ID (registration times) must be entered.

3.16. Network Connection and Share

To enable network connection function of NK260, the computer and NK260 should be connected in the same local area network via a network cable, ensuring the computer able to ping with NK260.

3.16.1. IP Setup

After opening NK260, set IP address to establish a network connection channel between the computer and NK260, requiring the computer in the same subnet with NK260. For instance, if the subnet mask is 255.255.255.0, 192.168.1.0 ~ 192.168.1.255 are in the same subnet.

3.16.1.1. Direct Connection or Switch Connection

◆ **NK260 IP Setup**

Click the letter key C to enter [System Info(C)] screen, as shown in Fig. 3-49.

Fig. 3-49 Network information

Clicking “Net Info” will eject a dialog as shown below.

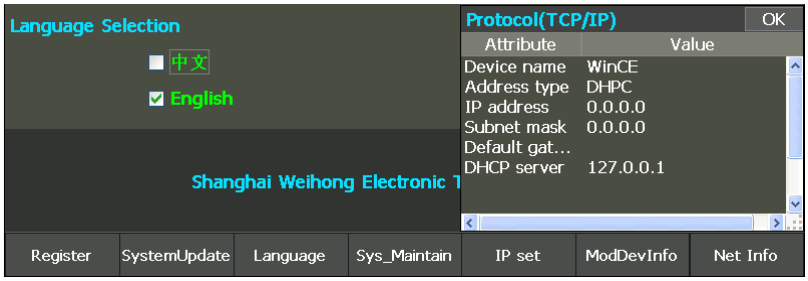


Fig. 3-50 System Info screen- Net Info

Clicking “IP set” will eject a dialog requiring input of password, as shown in Fig. 3-51.

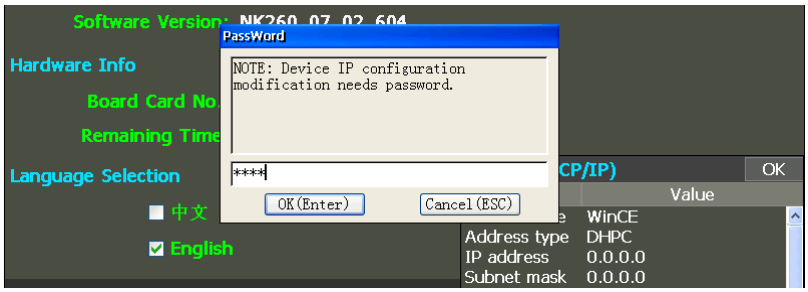


Fig. 3-51 System Info screen- Password input

After password is entered correctly, IP setup page will be accessed, as shown in Fig. 3-52.

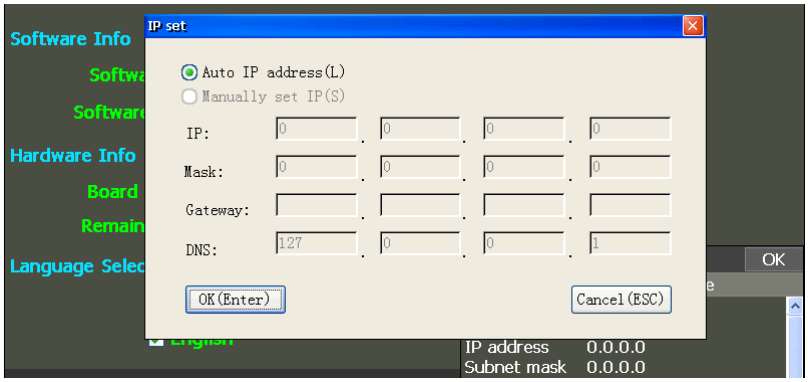


Fig. 3-52 IP setup page- Obtain IP address automatically

Pressing the letter key S will select “Set IP address Manually”, as shown in Fig. 3-53.

Fig. 3-53 IP setup page- Set IP address manually

Enter the following three address types in Fig. 3-53.

- IP address: 192.168.1.188 (the settings of the first three groups should be the same as those of the computer.)
- Subnet mask: 255.255.255.0 (the same as that of the computer)
- Default gateway: 192.168.1.1 (the same as that of the computer)

After the setting IP address, press “Enter” to confirm modification. The net info is as shown in Fig. 3-54. (For the first time setting, it is necessary to power off and restart NK260.)

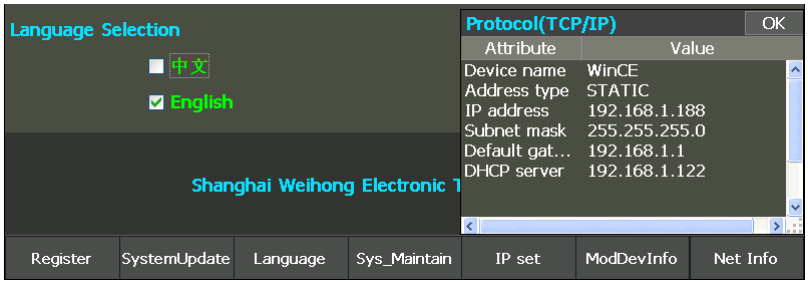


Fig. 3-54 System Info screen- new net info

◆ **PC IP Setup**

Find “internet Protocol (TCP/IP) in Fig. 3-55, and then double click it to enter Fig. 3-56. Take “Use the following IP address” as an example.

- IP address: 192.168.1.189
- Subnet mask: 255.255.255.0
- Default gateway: 192.168.1.1 (The first three groups should be the same as those of IP address.)

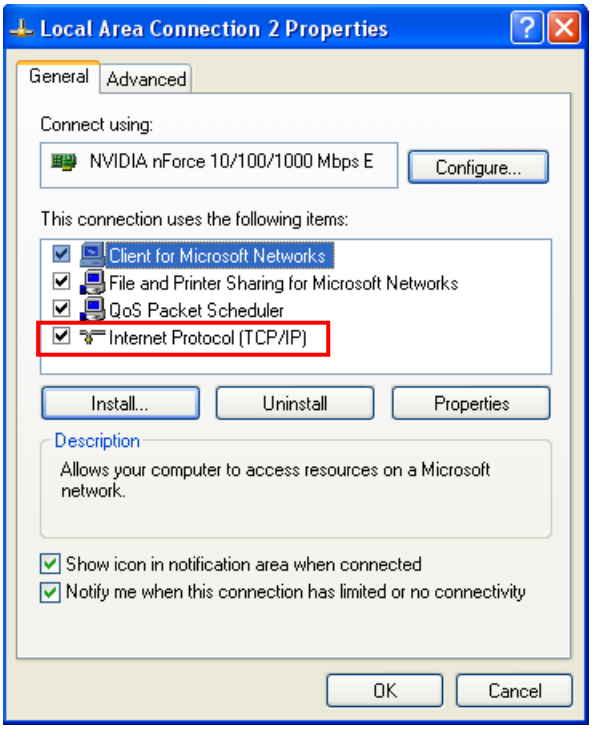


Fig. 3-55 Local area connection-properties

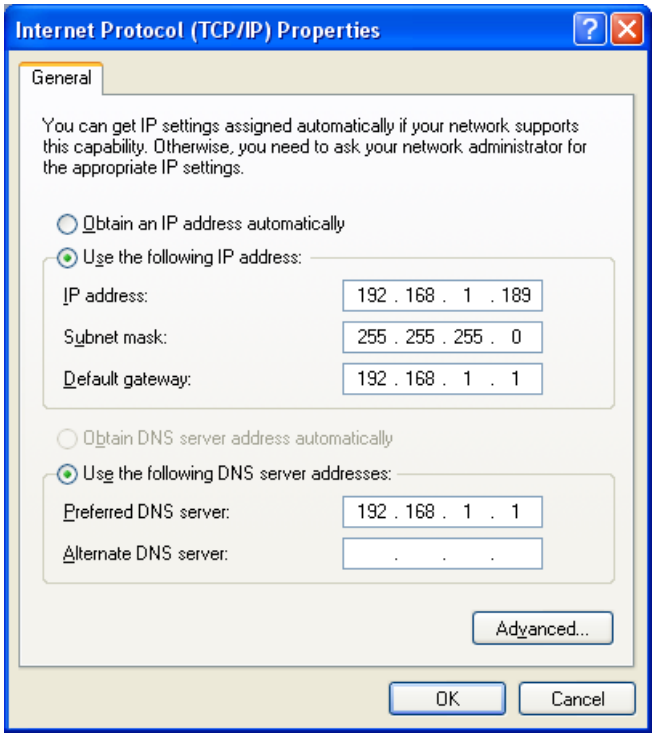


Fig. 3-56 PC IP setup

3.16.1.2. Router Connection

Router connection is available after the router opens DHCP function to enable obtaining IP address automatically. Otherwise, only direct connection or switch connection is available as described in 3.16.1.1.

Press the letter key L to select “obtain IP address automatically, as shown in Fig. 3-57.

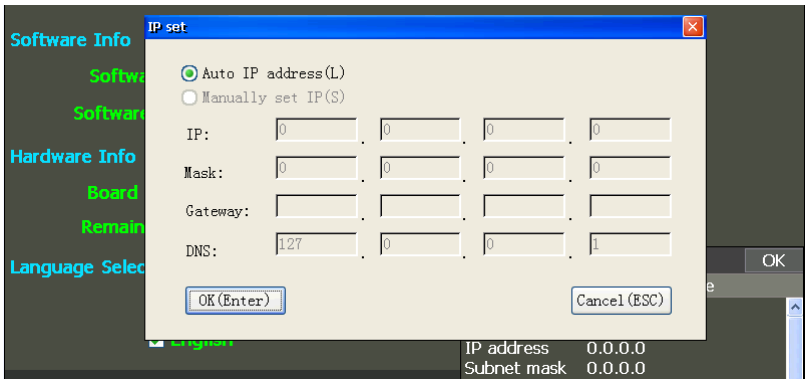


Fig. 3-57 Obtain IP address automatically

The system will then obtain an IP address automatically. For the first time setting, power off and restart are required.

In addition, setting IP address manually is also available. (The method is the same as that of direct connection.)

- IP address: 192.168.1.182 (The settings of the first three groups should be the same as those of the router gateway.)

- Subnet mask: 255.255.255.0
- Default gateway: 192.168.1.1 (The settings of the first three groups should be the same as those of IP address.)

PC IP and NK260 IP must be in the same subnet, which can be completed via manual setting or via automatic obtaining.

3.16.1.3. Multiple NK260 Connection

If there are multiple NK260, the IP address of each of them should not be the same. If the same, manually reset the IP address (the first three groups should be the same). MAC address of each of them should not be the same, either. If the same, modify them per the following steps:

1) Enter [System Info(C)] screen, as shown in Fig. 3-49;

2) Click “Net Info” to display network info, as shown in Fig. 3-50;

3) Click “ModDevice” to access the password input interface, as shown in Fig. 3-58.

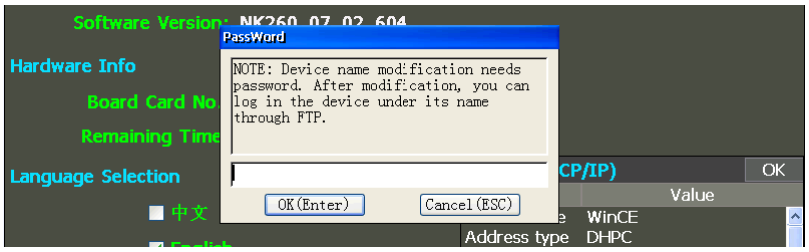


Fig. 3-58 Device info modification- password input

4) Enter the password to access the device info modification interface, as shown in Fig. 3-59.

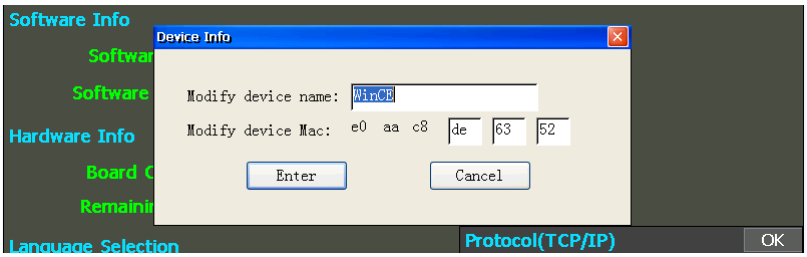


Fig. 3-59 Device info modification interface

5) The name of device can be changed to WinCE01, WinCE02, WinCE03……

6) Device MAC can be changed to any hexadecimal data.

3.16.2. Connection Verification Setup

After IP setup complete, click “Start” → “Run…” on the computer, and then enter cmd in the run dialog to access command line prompt dialog, and then enter “ping IP address”, for example, ping 192.168.1.182, to check whether the computer can ping with NK260. If pinged, the result is as shown in Fig. 3-60.

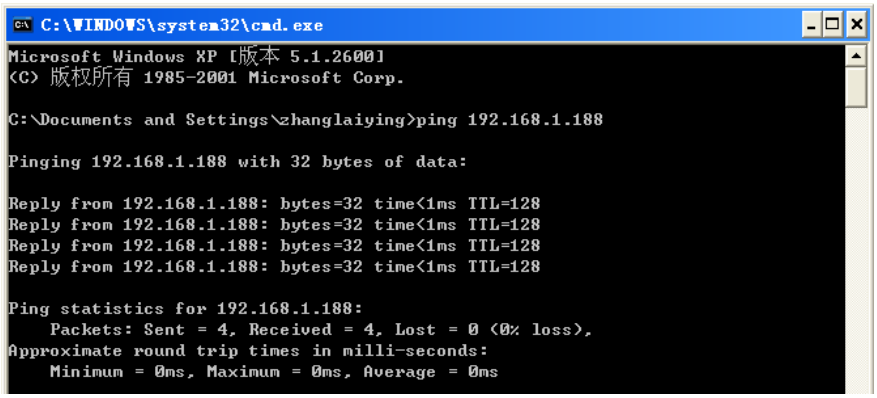


Fig. 3-60 Check network connection—successful

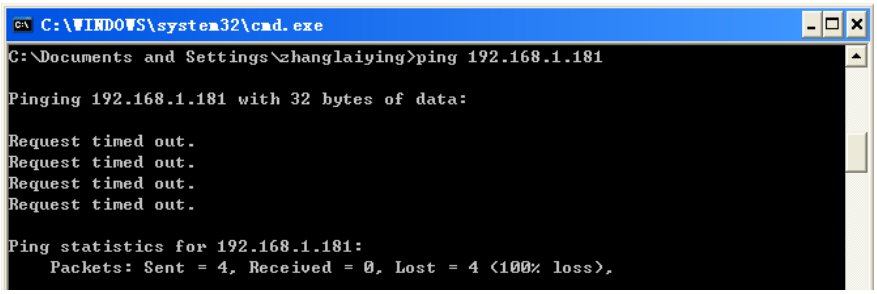


Fig. 3-61 Check network connection—failed

If failed, check whether physical connection is normal, and whether the settings above-mentioned are right.

3.16.3. NK260 Network Files Management by PC via FTP

Entering **"Ftp://192.168.1.188"** in the address bar of resource management will open NK260 network files, and FTP operations like upload, download and rename can be realized.

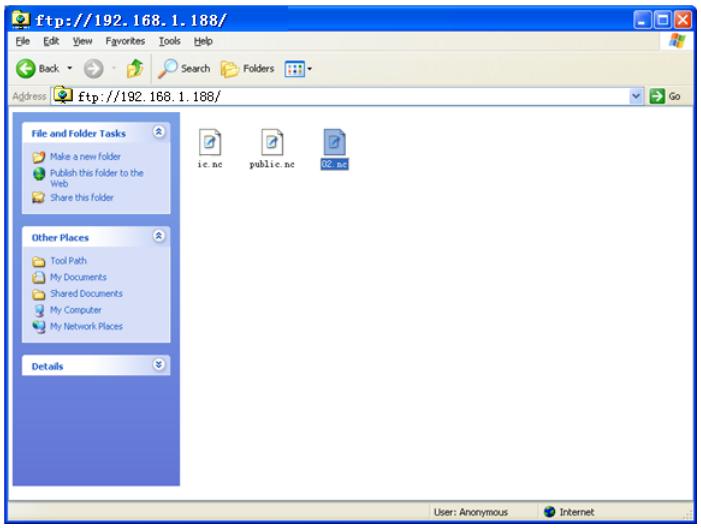


Fig. 3-62 NK260 network files managed by PC via FTP

3.16.4. NK260 Network Files Management by PC via Network Sharing

Click “Start” → “Run…” on the computer, and then enter **“\\192.168.1.188”** in the run dialog, and then press “Enter” to access NK260 network sharing interface, in which **“Sharedocs”** is the NK260 network folder. After opening it by double click, users can transfer files to NK260, or administrate the existing files, like edit, delete, and copy, as convenient as administrating local files.

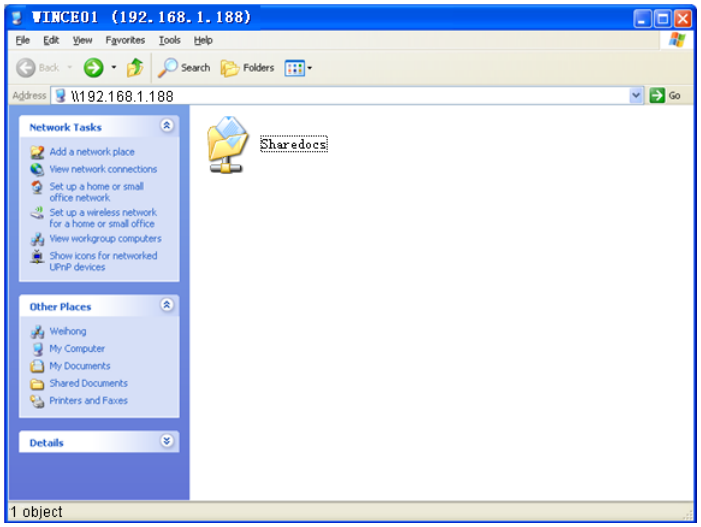


Fig. 3-63 NK260 network files management by PC via network sharing- 1

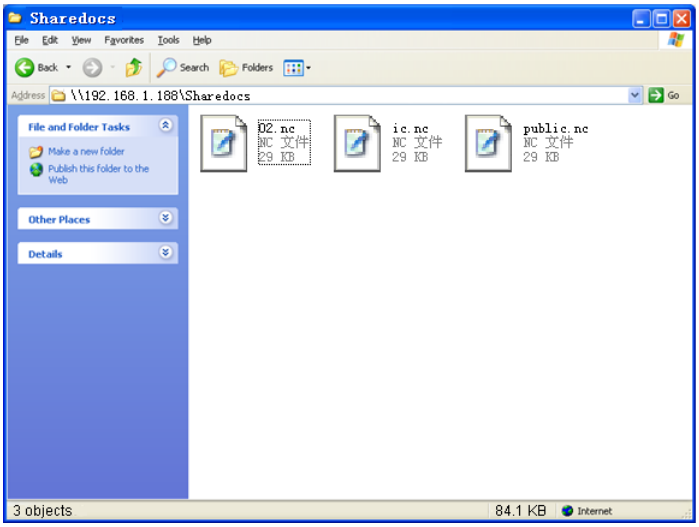


Fig. 3-64 NK260 network files management by PC via network sharing- 2

The above-mentioned steps realize NK260 network files management by PC. The change of network files can also be observed in [Program]→ [Local Program(A)]. Pressing “Shift + Backspace” will refresh the files in the list. The network files are marked with “Net” behind, as shown in Fig. 3-65.

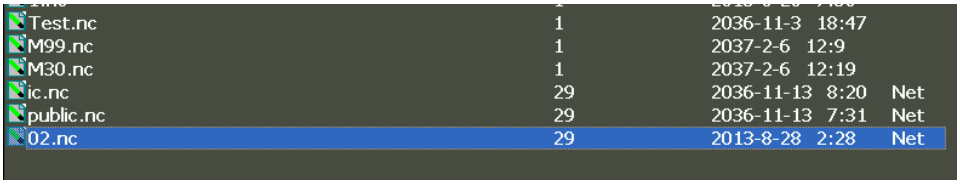


Fig. 3-65 Network files

3.17. Auxiliary Function

3.17.1. Start Line (Selective Processing)

This function is used to select desired program blocks for execution.

In [Coor-Auto] of [State] function section under Auto mode, press F2 [Start Line] to eject a “Start Line” screen, as shown in Fig. 3-66.

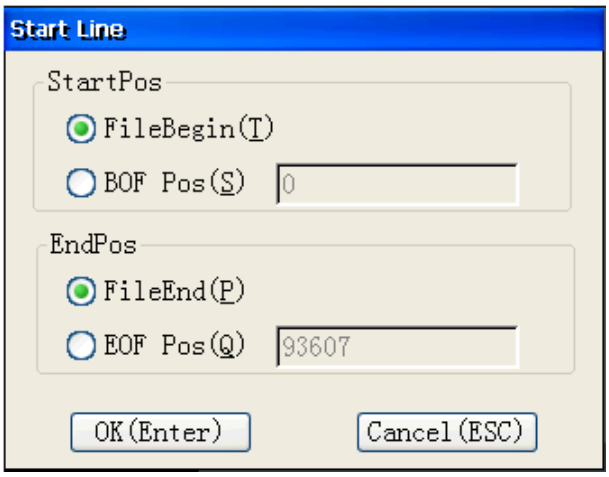


Fig. 3-66 Selective machining

Users can process the specified program segment to be executed by entering its start and end line number. With this function, users can process any segment freely.

3.17.2. Breakpoint Resume

Press [Breakpoint Resume] button on the operation panel to select this function, and then the system will continue processing from the last stop line number.

If power failure or emergency stop occurs during processing, and users are sure about the accuracy of the workpiece coordinates, they can select this function to make the machine tool rapidly move to the breakpoint for continues processing, which can save them processing time.

3.17.3. Parameter Auto Backup

The system holds the function of parameter auto backup. If users forget to save the set parameters, they can switch to this screen, in which parameters from the ex-factory date to system last shutdown can be restored.

[Parameter Backup (B)] sub-function screen under [Parameter] function section is as shown in Fig. 3-67: in this screen, press “↑” and “↓” direction keys to select an effective backup parameter, and then press F1 and F7 to restore or delete the selected backup parameter. By pressing F2 and F3 respectively, the selected backup parameter can be exported to the USB device or the parameter in the USB device can be imported to the system.

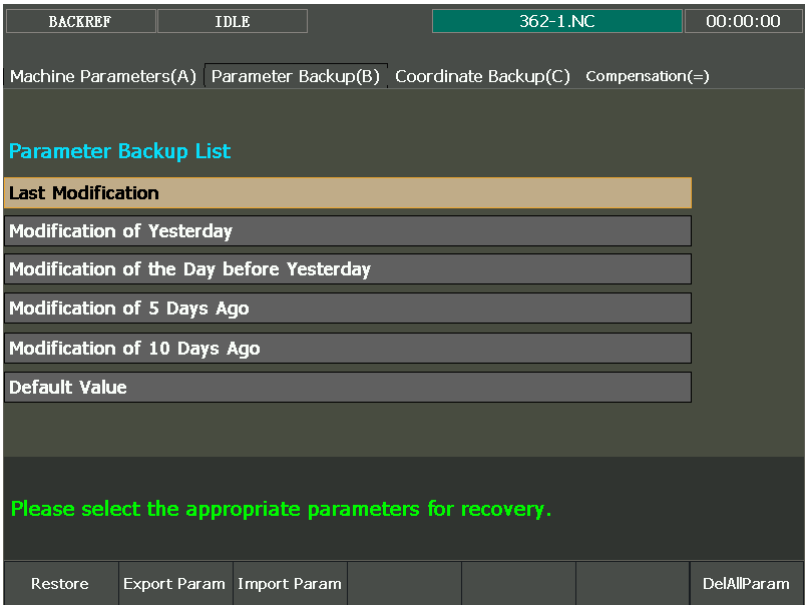


Fig. 3-67 Parameter auto backup

3.17.4. User Code Input

[User Code Input (C)] screen under [Program] function section is as shown in Fig. 3-68.

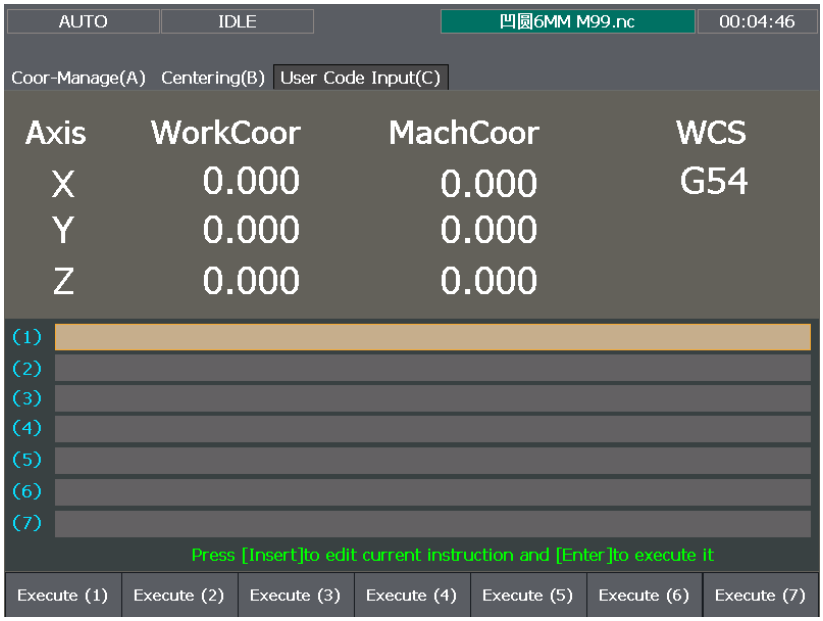


Fig. 3-68 User code input screen

On the upper part of the screen, mechanical coordinates and workpiece coordinates of each axis are displayed, while on the lower part, there are 7 items of user command box, in which users can input commands and execute them.

Move the identification bar to the command to be edited or executed by pressing “↑” and “↓” direction keys, input a new instruction in the pop-up input box by pressing “Insert” key, and execute the selected instruction by pressing “Enter” key.

Pressing F1~ F7 can select and execute the corresponding user command.

3.18. Tool Magazine

3.18.1. 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. To realize auto tool change, our programming is done according to the related information provided by users in advance (realized in public.dat).

The system offers multi-tool coordinate positions for option, which will not be listed here.

The process of auto tool change for linear tool magazine is as follows:

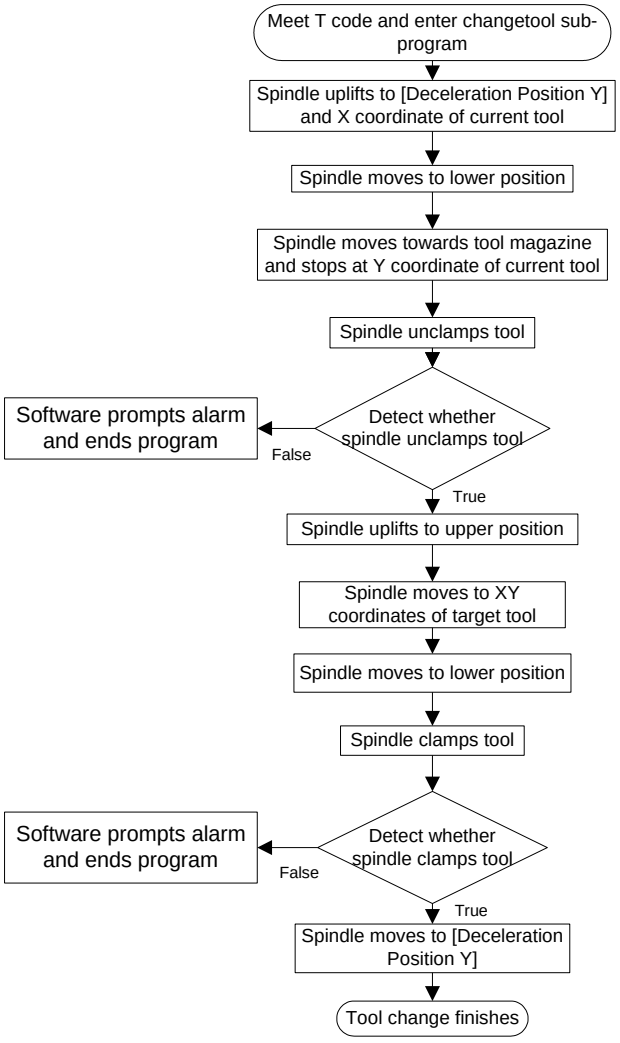


Fig. 3-69 Process of auto tool change for linear tool magazine

3.18.2. Auto Tool Change of Circular Tool Magazine

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

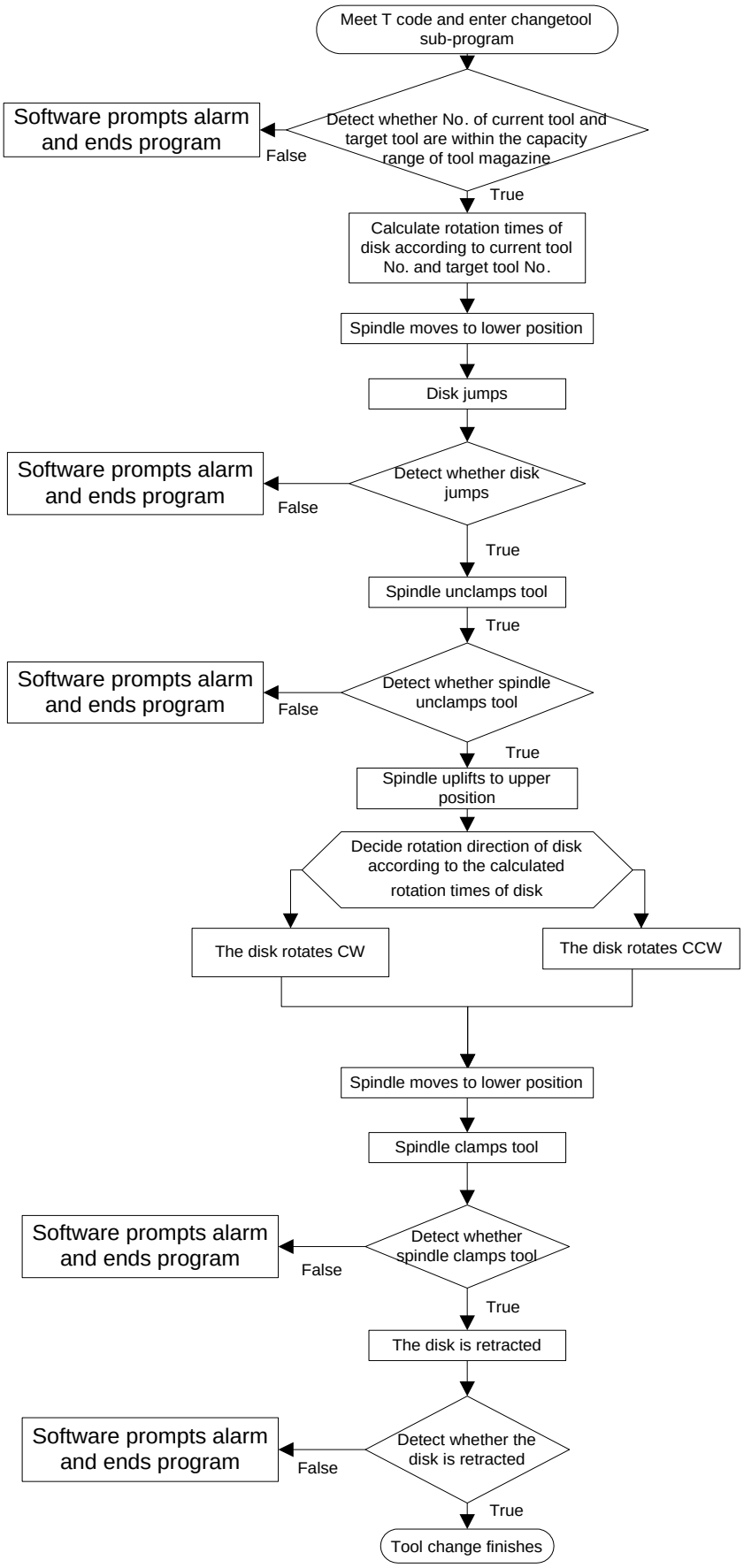


Fig. 3-70 Process of auto tool change for circular tool magazine

3.18.3. Involved Parameters

Parameter		Meaning	Setting Range
1502	Tool magazine capacity	The largest tool number that can be saved in the tool magazine. To set the corresponding tool coordinate, the system needs rebooting after tool magazine capacity modification.	0~20
1503	Current tool No.	Tool No. being used	None
1506	Tool change prompt	Whether the system will suspend and prompt tool change when tool change command is encountered	False: Invalid True: Valid
Under "Compensation (=) Screen	X offset	When floating presetting is executed and tool length is set, the system will save the tool offset into these parameters.	None
	Y offset		None
	Z offset		None
Z–axis offset is tool offset, and the system will save the too offset value to parameter "Z offset" after F4 [Set Tool Length] and F5 [Mobile Cali] are pressed under [Tool Cali] sub-menu.			

4. Maintenance

4.1. Operating System Maintenance

When users get NK260 integrated system, the system has already been well installed and can be used directly. In case of failure, users can restore it to leave factory state by system recovery.

When the system is damaged and cannot be booted, it is time to update system. When the system can be booted, users only need to upgrade or re-install the software.

4.1.1. System Update

When the system is damaged and cannot be booted, users need to update system, which refers to updating mirror image and software here, according to the following steps:

1) Insert the USB flash disk with the system mirror image file NK.nb0 and the new software into NK260. The software is composed of five files; they are “CHN”, “Config”, “ENG”, “Font”, and “NewNK200” and should be under the root directory of USB disk.

2) Power on NK260 while pressing M key several times until entering system update interface, which includes 4 kinds of update:

   F) Update FPGA; T) Update system; S) Update BOOT; G) Update LOGO

3) Press letter key T to select “Update system” under this interface, at this time, the interface will display reading the file NK.nb0 from the USB flash disk. And this process will last for about 3 minutes.

4) After mirror image update finishes, USB equipment identification will be started. After identification succeeds, the software update interface will be accessed, as following:

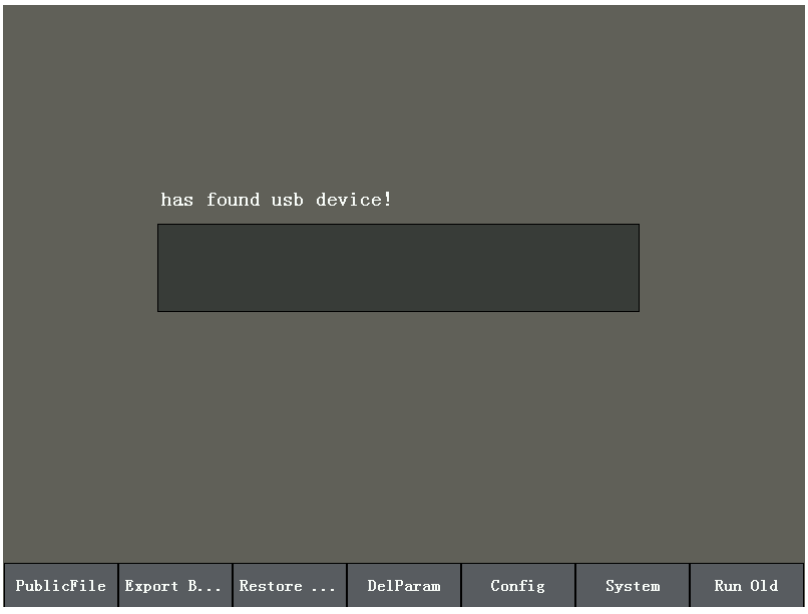


Fig. 4-1 Software update interface

5) Press F6 to start updating the software. The interface during updating is as shown in Fig. 4-2.

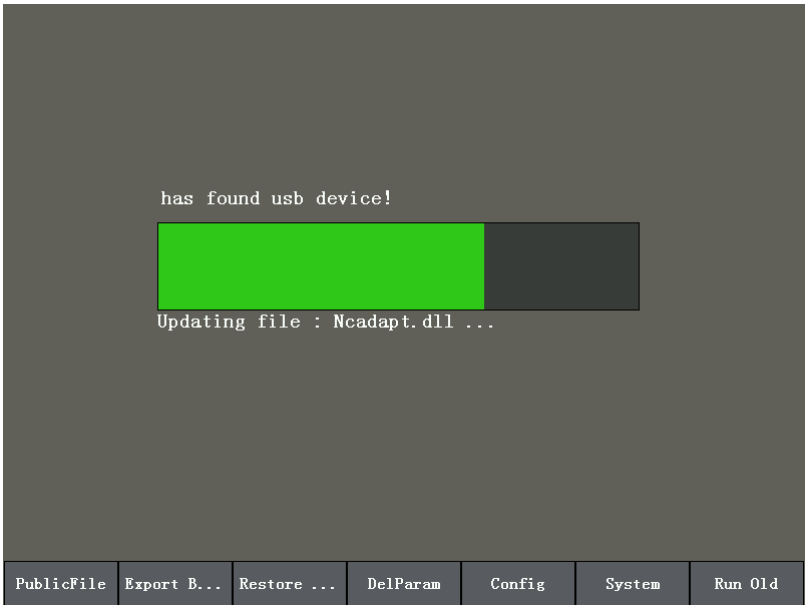


Fig. 4-2 Updating the software

6) After software update completed, the new software will be accessed.

Fig. 4-3 Booting the software

4.1.2. Software Update

Update steps can be divided into two kinds according to software version, see follows.

◆ **When the original software is NK260_06_04 or later, update steps are as following:**

1) Insert the USB flash disk with the new software into NK260. The new software consists of 5 files, which are “CHN”, “Config”, “ENG”, “Font” and “NewNK200” and should be placed under the root directory of USB disk.

2) In [System Info] screen of [System] function section, pressing F2 will eject a prompt dialog box asking to confirm that there is the new software in the USB. After confirmation, close NK260.

3) Power on NK260 while pressing G key several times until entering USB equipment identification interface. After identification succeeds, the software update interface will be accessed, as shown in Fig. 4-1.

4) Press F6 to update the software. Updating process is as shown in Fig. 4-2.

5) After update complete, the new software will be accessed. Fig. 4-3 is the interface booting the new software.

◆ **When the original software is NK260_05_XX and the new software is NK260_06_XX, update steps are as following:**

1) Press F2 to export system parameters to an USB disk under [Parameter Backup (B)] screen of [Parameter] function section.

2) Insert the USB flash disk with the new software into NK260. The new software consists of 5 files, which are “CHN”, “Config”, “ENG”, “Font” and “NewNK200” and should be placed under the root directory of USB disk.

3) In [System Info] screen of [System] function section, pressing F2 will eject a prompt dialog box asking to confirm that there is the new software in the USB. After confirmation, close NK260.

4) Power on NK260 while pressing G key several times until entering USB equipment identification interface. After identification succeeds, the system will enter software update interface, as shown in Fig. 4-1.

5) Press F6 to update the software. Updating process is as shown in Fig. 4-2.

6) After update complete, the new software will be accessed. Fig. 4-3 is the interface booting the new software.

7) Switch to [Parameter Backup (B)] screen of [Parameter] function section, and then press F3 to import previously exported system parameters in the USB disk to the new software.

4.2. Warning Information

Type	Warning Content	Cause	Solution
Warning message			
Limit alarm	Positive (negative) limit of X (Y\Z) axis	The polarity of X-axis positive limit port is wrong.	Enter [Port] function screen under [System], and modify the port polarity (refer to chapter 3.5.1).
		X-axis runs into limit switch directly during motion.	Manually move X-axis away from limit switch.
		There is an error in limit switch itself.	Check if limit switch works normally.
Servo alarm	Servo alarm of X (Y\Z) axis	The polarity of X-axis servo alarm port is wrong.	Enter [Port] function screen under [System], and modify the port polarity (refer to chapter 3.5.1).
		There is an error in X-axis servo driver itself.	Check if X-axis servo driver works normally.
E-stop alarm	E-stop button is pressed.	The polarity of E-stop port is wrong.	Enter [Port] function screen under [System], and modify the port polarity (refer to chapter 3.5.1).
		The E-stop button is pressed.	Turn the E-stop button clockwise to make it bounced.
Oil level alarm	Oil level alarm	The polarity of oil level alarm port is wrong.	Enter [Port] function screen under [System], and modify the port polarity (see chapter 3.5.1).
		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 spindle alarm port is wrong.	Enter [Port] function screen under [System], and modify the port polarity (see chapter 3.5.1).
		There is an error in inverter.	Check if the inverter works normally.
Error message			

Type	Warning Content	Cause	Solution
Related operations of backing to machine origin	The system has not retuned to the machine origin, failed to execute the operation!	The system has not returned to machine origin. Whether the system has to back to machine origin is decide by parameter 1065 “Back to reference point before mach”. If it is set as “true”, it is a must to back to the machine origin before machining.	Use this function after executing backing to machine origin.
	The system is busy, this operation can’t be executed.	Some illegal operations are performed under machining state.	Stop machining, and execute some operations under idle state.
Related errors of state	Please exit from simulation mode in the status page before changing the state!	It is possible that some illegal operations are performed under simulation mode, like modifying a parameter or pressing some shortcut keys.	Stop simulation and execute some operations under idle state.
	Please switch to Auto mode first.	Perform some operations only available under Auto mode in Manual and Reference Point modes, like pressing “Program Start” under Manual mode.	Switch to Auto mode and then perform the corresponding operation.
	Breakpoint resuming can’t be executed under current state.	“Breakpoint Resuming” button is pressed in the process of machining.	Breakpoint resuming can be performed to continue machining in case of power failure, manually pressing “Program Stop” button, and E-stop in machining.
File error	There is no file loaded in the current parser.	Start file machining with no file loaded in the system.	Load a machining file before start machining.
	Failed to read the machining file, and check if the path of this file is changed.	The file loaded originally is deleted.	It is necessary to re-load the machining file.

4.3. Common Troubleshooting

4.3.1. What should users do if the spindle does not rotate?

1) Check if there is an error in the software. Press [Spindle Start] button and see if the dot before the “spindle” in [Port] screen under [System] becomes green. If it does, the software works normally.

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

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

4.3.2. What should users do if an axis does not move?

1) Check if there is output (in green) for “× servo enable” signal of output port in [Port] screen under [System]. If there is output, the software works normally. Check if the port polarity (it should be NO “N”) is set correctly.

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

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

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

4.3.3. What should users do if servo motor Z brake can’t be opened?

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

1) If light, test whether there is 24V voltage between brake output ports (BRAKE-COM) 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 terminal board directly.

2) If not, directly conduct the brake input ports (K+, K-) on terminal board with a conducting wire. If

light at this time, check whether the servo driver is enabled, the parameter setting related to brake output of servo driver is right, and break output line of driver is correctly wired to terminal board (black line is wired to K-, and only K+ is connected to with only one line); if still not light, please change the terminal board.

4.3.4. What should users do if machine tool returns to the machine origin abnormally?

- Limit alarm or servo driver alarm occurs during backing to the machine origin.

1) Check if the software can receive the origin signal of this axis. The method is: trigger the origin switch, and then see if the color of the dot before the "× machine origin" changes from red to green in [Port] screen under [System]. If there is no color change, it indicates the software can't receive the origin signal, needing to check if there is an error in the origin switch (if the terminal board is NK300-EX9A, the switch type should be NPN; if NK300-EX4PTN, the switch type should be PNP) or in the wiring of origin switch. To see if the system failure occurs, make the origin signal on the terminal board and COM port into conduction directly with a conducting wire, and then check whether the color of the dot before "× machine origin" changes in [Port] screen.

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

- When backing to the 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 "× machine origin" input port is correct in [Port] screen under [System]. When this origin 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 origin signal of this axis.

1) See if the servo cable of this axis is well contacted at the joints with 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, servo cable, motor cable or the control system (e.g. exchange servo cable and servo driver with those of other axes able to return to the machine origin normally).

4.3.5. What should users do if the machine tool motions upward

after arriving at the position of tool presetter during presetting?

View and tell whether the polarity of “tool presetting signal” is right in [Port] screen under [System]. The color of the dot before the “tool presetting” signal is red when the system does not receive tool presetting signal.

4.3.6. What should users do if offset occurs during machining?

1) See if workpiece coordinate is modified because of maloperation by checking if there is record of improper alteration of workpiece coordinate in system log.

2) Check whether machining is continued without backing to the machine origin at start-up or after E-stop by seeing if there are records of reboot, E-stop in log. In addition, check if the parameters “back to machine origin before machining” and “clear back to machine origin mark after E-stop” are set “True”.

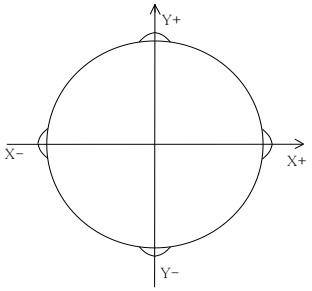
3) Interference of electrical circuit: it is a shielded line (pulse/ direction transmission line), well contacted with metal shell and shielding layer at both ends of shielded line well contacted with metal shell, that must connect the whole circuit from the system to motor driver, and the power input port of inverter must be connected to π-type power filter, whose electric parameters are matching with those of inverter. The wiring of strong and weak electricity must be separate to avoid parallel wiring. Detecting the pulse number received by driver can be used to tell whether the offset is caused by electric part, and the method is : set the initial display status of driver as pulse command input (eg.: set YASKAWA driver “Un00C”, Pr5.28 of PANASONIC A5 driver “06”, P0-02 of DELTA “02”, see driver parameter setting commonly used chapter.), then write down the pulse number displayed by driver at workpiece origin, and then back to workpiece origin after a time of processing to see if the pulse number is changed (for YASKAWA driver, etc., its change range is within “4”). If not, check the mechanical part.

4.3.7. How to remove the bottom mark perpendicular to tool path in the process of machining concave ball along 45° or 135°?

Generally this is caused by backlash. Firstly measure backlash “A” of Z axis with measuring apparatus, and input the value A to parameter “Backlash of Z axis” in the control system, and then set “Backlash compensation valid” as “True”, and then restart the software.

4.3.8. In cutting cylinder, how to solve the spikes occurring at 4 reversal points or processed circle smaller than ideal one?

The machining result is as following:



- Possible causes:

1) Backlash of X/ Y axis exists.

2) Weak servo response in servo reversing points leads to short time-lag when an axis begins to move from a direction to another one.

3) Torque of driver motor is not enough, which causes cohesive stop because of friction direction change in reversing position.

- Reference solutions:

1) First, confirm if there is backlash for X/Y axis and then adjust the machine tool.

2) Cross quadrant compensation: measure cross quadrant compensation quantity, input it to the software parameter and then observe the machining effect.

4.3.9. What are the causes leading to low machining surface finish quality?

The quality of machining surface finish depends on material, cutter selection, knife edge sharpness, machinery rigidity (if machine oscillates during machining), matching of driver parameters and CNC system (including stepping driver and servo driver), parameter adjustment of CNC system, etc. Good machining effect is related to every element, and the causes of the occurring problem depend on the concrete situations.

5. Driver

5.1. Driver Parameters

Parameters listed in this chapter can make the machine work normally without ensuring machining results. Relevant parameters need adjusting according to the specific machine type.

5.1.1. 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]: modification to user parameters [PnXXX] and part of auxiliary function parameters [FnXXX] permitted; Set [0001]: modification to user parameters [PnXXX] and part of auxiliary function parameters [FnXXX] prohibited.
Un00C	Surveillance mode	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 Control mode selection	0010	Bit 0: Set 0, “CCW” rotation is forward rotation (viewed from the load end of screw ball); Set 1, the rotation direction of the motor is reversed. Bit 1: Set 1, position control mode (calculate pulse instruction all the time).
Pn200	Select pulse instruction mode	0005	Bit 0: Set 5, select the instruction input mode as “pulse + direction”, negative logic. Bit3: Set 0, input differential signal into filter.
Pn50A	Selection function	8100	Bit 1: Set 0, Servo ON /S-ON, input from the 40th pin; Set 7, Servo ON all the time. Bit 3: Set 8, forward rotation not used and signal input (P-OT) prohibited.
Pn50B	Selection function	6548	Bit 0: Set 8, reverse rotation not used and signal input (N-OT) prohibited.
Pn50F	Selection function	0300	Set it when servo motor with brakes. Bit 2: Set 3, brake interlock signal “/BK” is output from CN1-29, CN1-30 to control 24V relay for brake.
Pn50E	Selection function	0211	Set it when servo motor with brakes. To avoid of CN1-29 and CN1-30 being used for

<table>
<tr><th>Para. No.</th><th>Function</th><th>Value</th><th colspan="3">Description</th></tr>
<tr><td></td><td></td><td></td><td colspan="3">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.
Default setting is “0”, setting unit is 10ms.</td></tr>
<tr><td rowspan="4">Pn201</td><td rowspan="4">Encoder cycle-divided ratio
(Pulse output No. per motor cycle after cycle-divided)</td><td rowspan="4">See right-side</td><td rowspan="4">Gain Encoder</td><td>Type</td><td>Pulse No. per Motor Circle (PPR)</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.
Pn203 = (lead screw pitch/ pulse equivalent).
Typical value: pitch 5mm, encoder 17-bit, coaxial connection between motor and screw, pulse equivalent 0.001mm, Pn202＝16384; Pn203＝625.
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>

5.1.2. Parameter Setting of YASKAWA Σ-Ⅴ Servo Driver

Para. No.	Function	Value	Description
Fn010	Parameter input prohibition setting	0000	Set [0000]: modification to user parameters [PnXXX] and part of auxiliary function parameters [FnXXX] permitted; Set [0001]: 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 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. 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. Bit 2: Set 3, brake interlock signal “/BK” is output from CN1-29, CN1-30 to control 24V relay used for brake.
Pn50E	Output signal selection 1	0211	Set it when servo motor with brakes. To avoid of CN1-29 and CN1-30 being used for other function and leading to brake ineffective, 3 is not allowed to appear in the 4 digits.
Pn506	Brake instruction- servo OFF time delay	Depended	Set it when motor with brakes Default setting is “0”, setting unit is ms.
Pn20E	Electronic gear ratio (numerator)	Need Calculation	Pn20E = pulse No. of each encoder circle × 4 × mechanical deceleration ratio. Pn210 = (lead screw pitch/ pulse equivalent). Typical value: pitch 5mm, encoder 17-bit, shaft coupler direct drag, pulse equivalent 0.001mm, Pn20E＝16384; Pn210＝625. Pitch 5mm, encoder 17-bit, shaft coupler direct drag, pulse equivalent 0.0005mm, Pn20E＝8192; Pn210＝625.
Pn210	Electronic gear ratio (denominator)	Need Calculation	

5.1.3. Parameter Setting of PANASONIC MINAS A4 Servo Driver

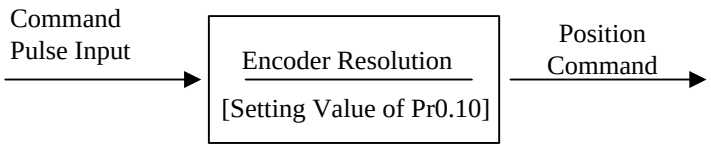
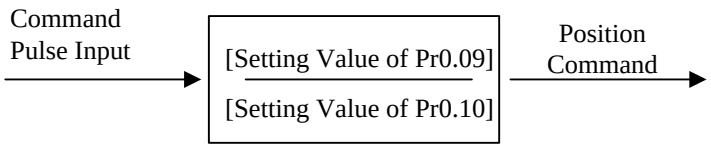
Para. No.	Function	Value	Description
Pr01	LED initial status	12	Monitor if the number of sent and received pulse is correct by setting this parameter. In Weihong control system, the correct quantity of pulse sent by control card is detected by pulse inspection in order to determine whether there is electrical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

5.1.4. 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 1: velocity mode 2: torque mode
Pr0.05	Selection of command pulse input	XX	0: Photo-coupler input (PULS1, PULS2, SIGN1, SIGN2) 1: Exclusive input for line driver (PULSH1, PULSH2, SIGNH1,SIGNH2) Note: generally, "1" is selected for this parameter.
Pr0.07	Command pulse input mode setup	3	Set command pulse input mode: pulse + direction, negative logic.
Pr0.08	Command pulse counts per one motor revolution	0	When it is set as "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: Pr0.09＝10000 Pr0.10＝pitch 5mm/ pulse equivalent 0.001mm＝5000 Pr0.09/Pr0.10=10000/5000=2/1
Pr0.10	Denominator of 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: $\text{Command pulse No. per motor circle} = \frac{\text{Screw pitch}}{\text{Pulse equivalent} \times \text{Mechanical deceleration ratio}} = \frac{5\text{mm}}{0.001\text{mm}/\,p} = 5000$ When screw pitch is 5mm and pulse equivalent 0.001, the value of Pr0.08 is "5000".			

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

Pr0.08	Pr0.09	Pr0.10	Description
$0\sim2^{20}$	— (no influence)	— (no influence)	Command Pulse Input → Encoder Resolution / [Setting Value of Pr0.08] → Position Command As shown above, the process is undergone in terms of the setting

Pr0.08	Pr0.09	Pr0.10	Description
			value of Pr0.08, not affected by the settings of Pr0.09 and Pr0.10.
0	0	0~2^{30}	 When the values of Pr0.08 and Pr0.09 are both set as “0”, as shown above, the process is undergone in terms of the setting value of Pr0.10.
	0~2^{30}	0~2^{30}	 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.

5.1.5. 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. Bit 1, select motor series: 0: HC-KFE; 1:HC-SFE; Bit 3, select regenerative apparatus, set 0: not use. 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 lead screw. E.G., pitch 5 mm, encoder resolution 10000, shaft coupling direct drag, pulse equivalent 0.001 mm, CMX/CDV=10000×0.001/5 = 2/1; When pulse equivalent = 0.0005mm, CMX/CDV = 1/1. 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 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. Bit 1: last signal of positive rotation range (LSP): [1]: auto servo on inside, without external wiring. Bit 3: last signal of negative rotation range (LSN): [1]: auto servo on inside and no need of external wiring.

5.1.6. 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	002	X=2: pulse + direction; Z=0: positive 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 Y=0: forward rotation (CCW) (in terms of load); Y=1: the rotation direction is reversed. 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. 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 Representative value: encoder pulses=2500, pitch=5mm, pulse equivalent=0.001, deceleration ratio=1, calculation as below: N1/M= 2500×4×0.001/5 = 2 / 1, N1=2, M=1; 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. 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. X2=1: set DI6 and DI7 inputs as NO (normally open) a-contact points; X1X0=00,
P2-16	Digital Input Pin DI7	X2X1X0	100	

Para. No.	Function	Format & Range	Value	Description
				limit signal input of the driver is not used.
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; X2=1: set DO4 output as NO (normally open) a-contact point; X2=0: set DO4 output as NC (normally closed) b-contact point; 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. X2=0: set DO5 output as NC (normally closed) b-contact point. 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. 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.

5.1.7. 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	002	X=2: pulse + direction; Z=0: positive logic
P1-01	Set control mode	YX1X0	000	Y=0: forward rotation (CCW) (from the view of load) Y=1: the rotation direction is reversed. 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. X=0: motor stops instantly; X=1: motor stops with deceleration.
P1-44	Electronic Gear Ratio (Numerator) (N1)	1~32767	Need calculation	N1/M= mechanical deceleration ratio × 4 × encoder pulses × pulse equivalent / pitch. Representative value: encoder pulses=2500, pitch =5mm, pulse equivalent=0.001 mm/p, deceleration ratio = 1, calculation as below: N1 / M = 2500×4×0.001/5 = 2/1, N1=2, M=1; 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 17th pin of CN1. 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. X2=1: set DI6 input as NO a-contact point. X1X0=00, limit input of driver is not used.

Para. No.	Function	Format & Range	Value	Description
P2-18	Function setting for digital output pin DO1	X2X1X0	108	DO1 corresponds to the 16th pin, as clamping-position brake signal of Z-axis; X2=1: set DO1 output as NO a-contact point; X2=0: set DO1 output as NC b-contact point; X1X0=08: set the 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. X2=0: set DO3 output as NC b-contact point. X1X0=07: set pin 1 as ALRM+.

5.1.8. 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	002	X=2: pulse + direction; Z=0: positive 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; Y=0: positive rotation (CCW) (from the view of load); Y=1: negative rotation (CCW) X1X0=00: position control mode
P1-44	Electronic Gear Ratio (Numerator)(N 1)	1~32767	Need calculatio n	N1/M= mechanical deceleration ratio × 4 × encoder pulses × pulse equivalent / pitch. Representative value: encoder pulses=2500, pitch =5mm, pulse equivalent=0.001, deceleration ratio = 1, calculation as below: N1 / M = 2500×4×0.001/5 = 2/1, N1=2, M=1; 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 calculatio n	
P2-10	Digital Input Pin 1 (DI1)	X2X1X0	101	X1X0=01: digital input (DI1 = SON) corresponds to 9th pin of CN1. 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. X2=1: set DI6 and DI7 input as NO a-contact points. X1X0=00, limit input of driver is not used.
P2-16	Function setting for 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; X2=1: set DO4 output as NO (normally open) a-contact point; X2=0: set DO4 output as NC (normally closed) b-contact point; 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. X2=0: set DO5 output as NC b-contact point. X1X0=07: set pin 28 and pin 27 as ALRM+ and ALRM- respectively.

5.1.9. 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	002	X=2: pulse + direction; Z=1: positive 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; Y=0: forward rotation (CCW) (from the view of load); Y=1: the rotation direction is reversed. X1X0=00: position control mode
P1-44	Electronic Gear Ratio (Numerator)(N1)	1~32767	Need calculation	N1/M= mechanical deceleration ratio × 4 × encoder pulses × pulse equivalent / pitch. Representative value: encoder pulses=40000, pitch =5mm, pulse equivalent=0.001, deceleration ratio = 1, calculation as below: N1 / M = 40000×4×0.001/5 = 32/1, N1=32, M=1; 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. 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. X2=1: set DI6 and DI7 inputs as NO a-contact point. 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.
P2-18	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; X2=1: set DO1 output as NO (normally open) a-contact point; X2=0: set DO1 output as NC (normally closed) b-contact point; 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. X2=0: set DO5 output as NC b-contact point. X1X0=07: set pin 28 and pin 27 as ALRM+ and ALRM- respectively.

5.1.10. 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: Electronic gear ratio numerator =mechanical deceleration ratio × 4× pulse No. per encoder circle; Electronic gear ratio denominator = (screw pitch / pulse equivalent) 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 incremental type encoder)
1-16	MENP	Pulse amount of the motor encoder 1. Set the pulse amount of the motor encoder; 2. Standard configuration of the encoder pulse No. is as below. Incremental encoder omitting wiring: --2000P/R Absolute encoder:--2048P/R		500 to 65535	P/R	
2-0	PMOD	Pulse format of position command: 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
<table>
<tr><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td></tr>
</table>
When bit 7=0
<table>
<tr><th>Bit 1</th><th>Bit 0</th><th>Command Pulse Input Digital Filter
Min. Pulse Width</th></tr>
<tr><td>0</td><td>0</td><td>0.8μs</td></tr>
<tr><td>0</td><td>1</td><td>0.2μs</td></tr>
<tr><td>1</td><td>0</td><td>0.4μs</td></tr>
<tr><td>1</td><td>1</td><td>1.6μs</td></tr>
</table>
When bit 7=1
<table>
<tr><th>Bit 1</th><th>Bit 0</th><th>Command Pulse Input Digital Filter
Min. Pulse Width</th></tr>
<tr><td>0</td><td>0</td><td>3.2μs</td></tr>
<tr><td>0</td><td>1</td><td>0.8μs</td></tr>
<tr><td>1</td><td>0</td><td>1.6μs</td></tr>
<tr><td>1</td><td>1</td><td>6.4μs</td></tr>
</table>
<table>
<tr><th>Bit6</th><th>Bit5</th><th>Command Pulse Format</th></tr>
<tr><td>1</td><td>0</td><td>Direction + Pulse</td></tr>
</table>
Switch of Digital Filter
<table>
<tr><td>0</td><td>High Speed</td></tr>
<tr><td>1</td><td>Low Speed (1/4)</td></tr>
</table>
</td></tr>
<tr><td>4-3</td><td>TYPE</td><td colspan="3">Control mode:
*Select one control mode from position, velocity, and torque modes.
<table>
<tr><th>Selection Item</th><th>Content</th></tr>
<tr><td>Position</td><td>Position control mode</td></tr>
<tr><td>Velocity</td><td>Velocity control mode</td></tr>
<tr><td>Torque</td><td>Torque control mode</td></tr>
<tr><td>Velo ↔Torq</td><td>Velocity↔Torque switch mode</td></tr>
<tr><td>Posi↔Torq</td><td>Position↔Torque switch mode</td></tr>
<tr><td>Posi↔Velo</td><td>Position↔Velocity switch mode</td></tr>
</table>
Referring to the switch type, the requisite control mode can be selected from pin 36 or 35 of the CN1.
Func3, set Bit7 as 0: pin 36 is enabled.
set Bit7 as 1:pin 35 is enabled.
$ $ $: 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>

5.1.11. 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 train + negative logic, 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

5.1.12. 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

5.1.13. 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: 0: position control mode; 1: speed control mode; 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). 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 users' perfect control resolution (that is angle/pulse) Expression: $P \times G = N \times C \times 4$ P: pulse amount of the input command; G: electronic gear ratio, G=ratio numerator / ratio denominator. N: circle number that the motor rotates; C: each circle line number of photo electricity encoder, C of our system =2500. E.G.: input 6000 command pulses to make the servo motor rotate one circle, $G = \frac{N \times C \times 4}{P} = \frac{1 \times 2500 \times 4}{6000} = \frac{5}{3}$ So set PA12 as 5 and PA13 as 3. We recommend the range of electronic gear ratio as: $\frac{1}{50} \le G \le 50$
PA13	Denominator of the 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: 0: pulse + symbol; 1: positive rotation pulse/ negative rotation pulse; 2: two orthogonal pulses inputs Default setting is 0: pulse + symbol, negative logic.
PA20	Invalid input on the end of the stroke	1	0: Valid stroke end of LSP, LSN positive rotation, negative rotation. When switch LSP is connected, driving of the positive rotation is allowed; When switch LSP is disconnected,

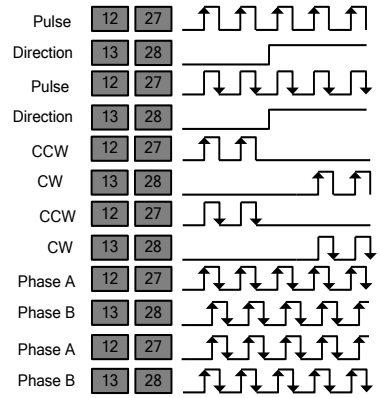
Para. No.	Parameter Name	Value	Description
			driving of the positive rotation is prohibited (torque of the positive direction is 0). LSN is the same as LSP. If LSP and LSN are all disconnected, the abnormal alarming of driving prohibited will occur (NO.7). 1: Invalid stroke end of LSP, LSN positive rotation, negative rotation. 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 will not occur (NO.7). 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.) 3: Valid stroke end of LSP, LSN positive rotation, negative rotation. 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 will not occur (NO.7).

5.1.14. 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 equal to those of the electronic gear ratio. α/ β=encoder resolution× pulse equivalent× mechanical deceleration ratio / screw pitch. Typical value: encoder resolution 65536, pitch 5mm, pulse equivalent 0.001, mechanical deceleration ratio 1, α / β=65536×0.001 / 5=8192 / 625, 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) Set1: 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). 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; Set 2, OUT1 is distributed as b-contact point of alarming detection.
27	Parameter write-protection	0 or 1	Set 0, write-enable. Set 1, write-protected.
74	CONT always ON 1	1	Initial value: 0. when set "1", servo is activated (RUN).

5.1.15. 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;
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;
2: Position pulse running mode; accept the input of external position pulse and direction level signal;
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 ▲;
4: Torque mode; make sure the value and direction of motor torque according to the external analog -10V ~ +10V signal of CN2-43, 1;
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>
<tr><td>F2e</td><td>Pulse input mode selection</td><td>2</td><td>Command pulse string mode selection of position mode:</td></tr>
</table>

Para. No.	Para. Name	Value	Description
			1 - Single pulse train positive logic 2 - Single pulse train negative logic 3 - Double pulse train positive logic 4 - Double pulse train negative logic 5 - Orthogonal pulse positive logic 6 - Orthogonal pulse negative logic 

5.1.16. Parameter Setting of TECO TSDA Servo Driver

Para. No.	Function	Value	Description		
Pn010-1	Set control mode	1	Value	Control mode	
				CN1 Pin12 open circuit	CN1 Pin12 closed circuit
			0	Speed control	Speed control
			1	Position control	Position control
			2	Torque control	Torque control
			3	Speed control	Speed control
			4	Position control	Position control
			5	Torque control	Torque control
Pn010-2	Set the pulse input format under position control mode	0	Value	The format of pulse input	
			0	Pulse + direction	
			1	Dipulse	
			2	A/B phase difference	
Pn010-3	Set rotation direction of motor	1	Value	Function	
			0	Input positive order, motor rotates CCW.	
			1	Input positive order, motor rotates CW.	
Pn021	Electronic gear ratio numerator	Need calculation	The input pulse amount will be multiplied with this number before output. Ratio range of parameter 21 to 22: 1/127＜parameter 21/ parameter 22＜127		
Pn022	Electronic gear ratio denominator		The input pulse amount will be multiplied with this number before output. Ratio range of parameter 21 to 22: 1/127＜parameter 21/ parameter 22＜127		
Pn011-4	Set the value of Pin20 of CN1	1	Value	Function	
			0	Output of “0” speed signal	
			1	Output of brake signal	
Pn013-1	Set the maximum pulse frequency received by the driver under position control mode	7	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.		

Note:

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

5.2. Wiring Diagram of Terminal Board and Differential Input Stepping Driver

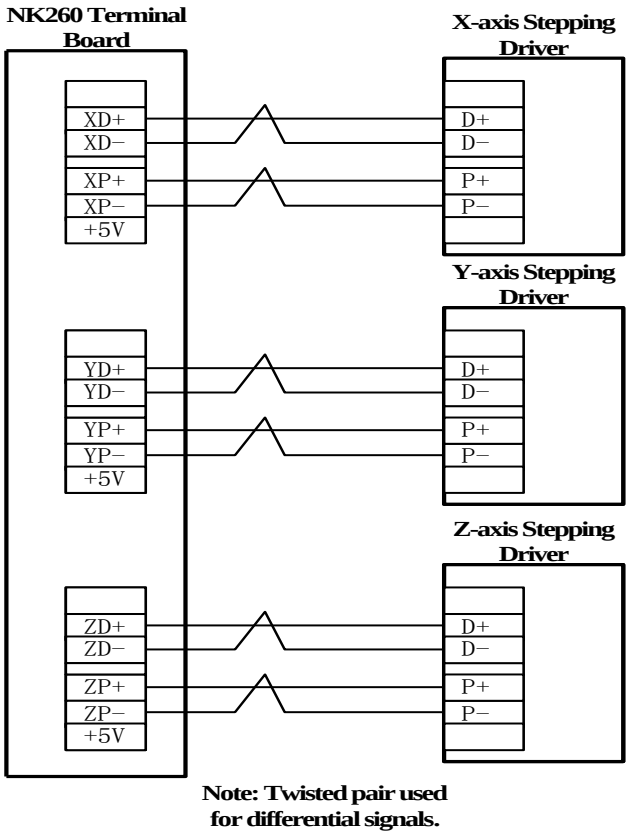


Fig. 5-1 Wiring diagram of terminal board and differential input stepping driver

5.3. Wiring Diagram of Driver and Terminal Board

Wiring diagrams in this part are the wiring diagrams of control system-axes control-driver motion. When users want to use one axis of the control system to control the motion of two drivers, the wiring diagram is as shown in Figure 2 in chapter 5.3.1 and Figure 3 in chapter 5.3.4 (take 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).

5.3.1. Wiring Diagram of YASKAWA AC Servo Driver

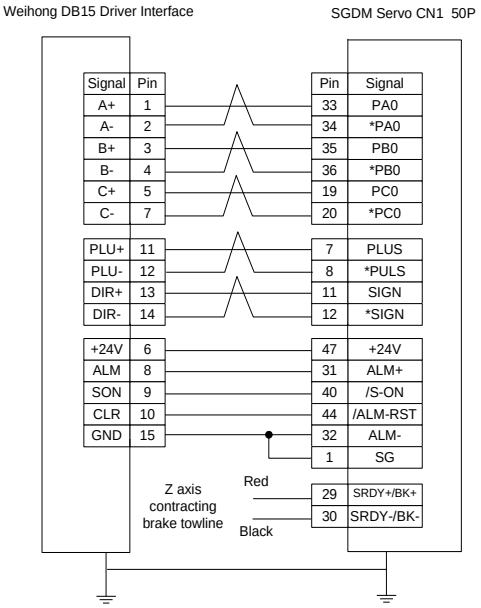


Figure 1

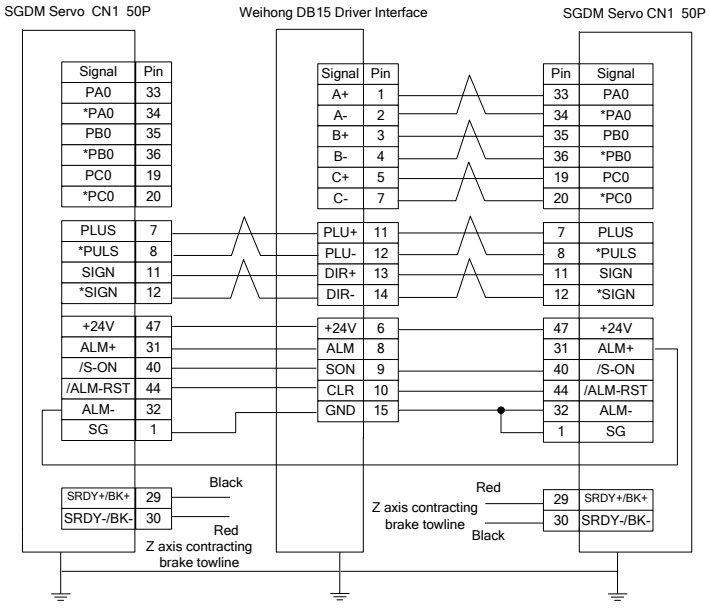
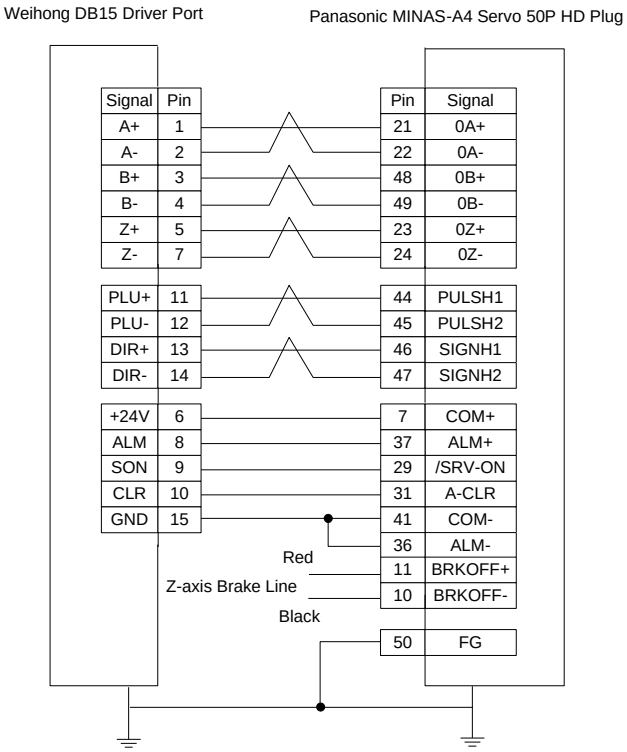
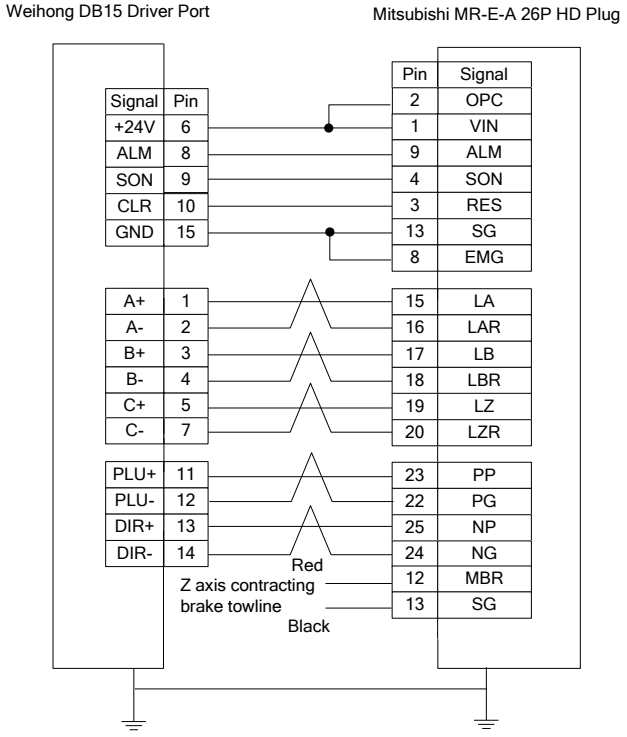


Figure 2

5.3.2. Wiring Diagram of PANASONIC AC Servo Driver



5.3.3. Wiring Diagram of MITSUBISHI MR-E Servo Driver



5.3.4. Wiring Diagram of DELTA Servo Driver

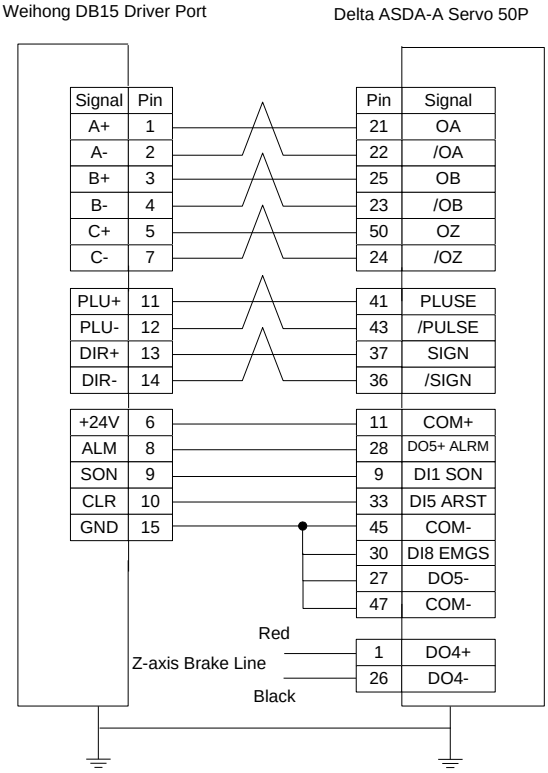


Figure 1

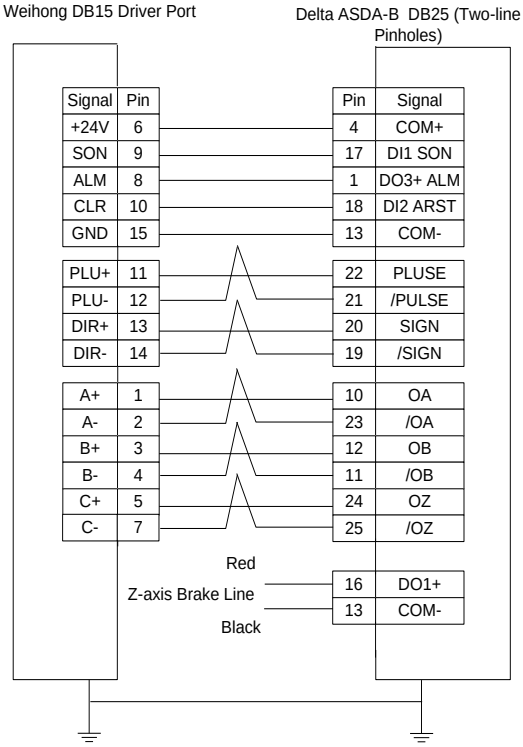


Figure 2

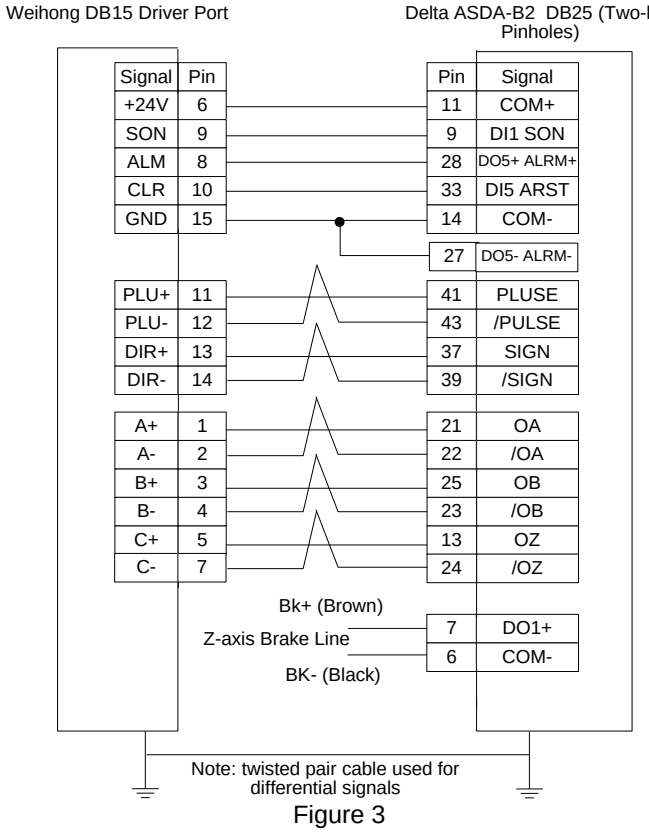


Figure 3

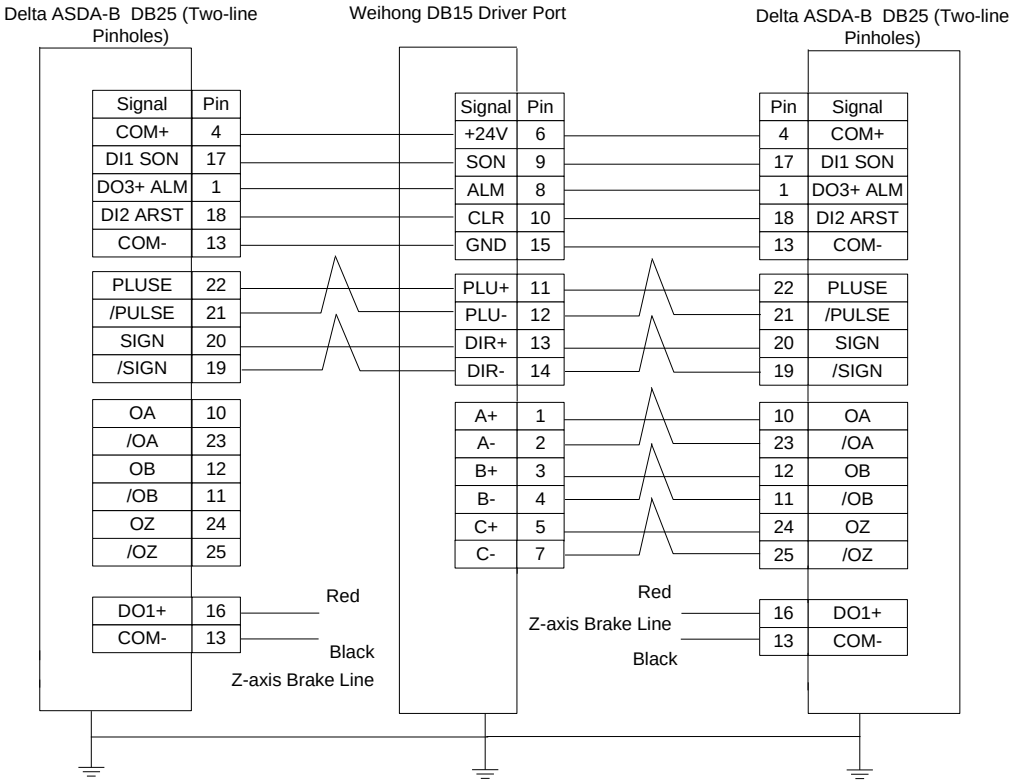
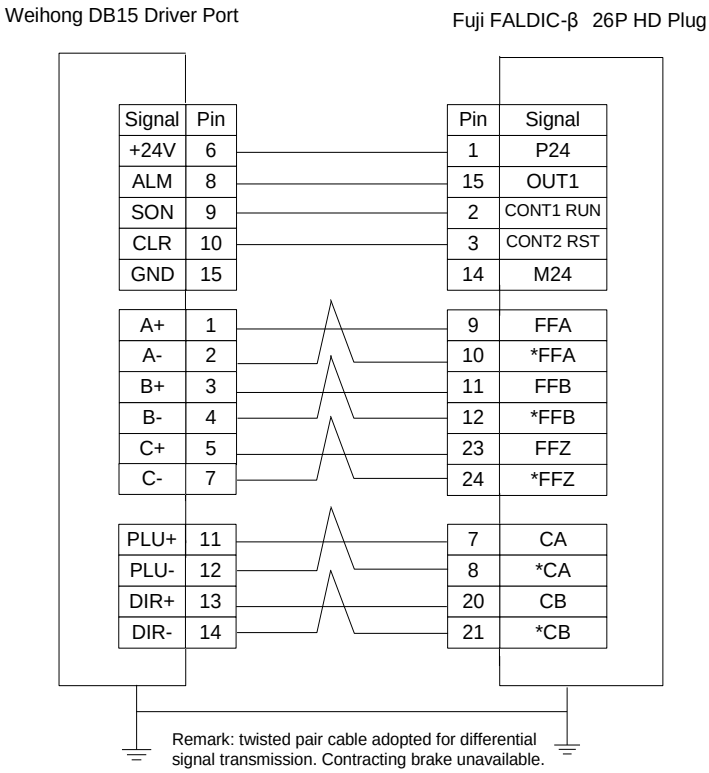
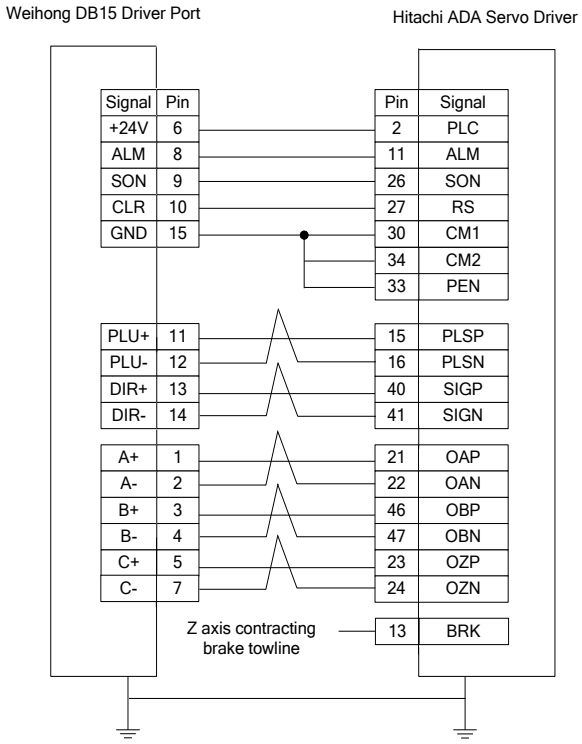


Figure 4

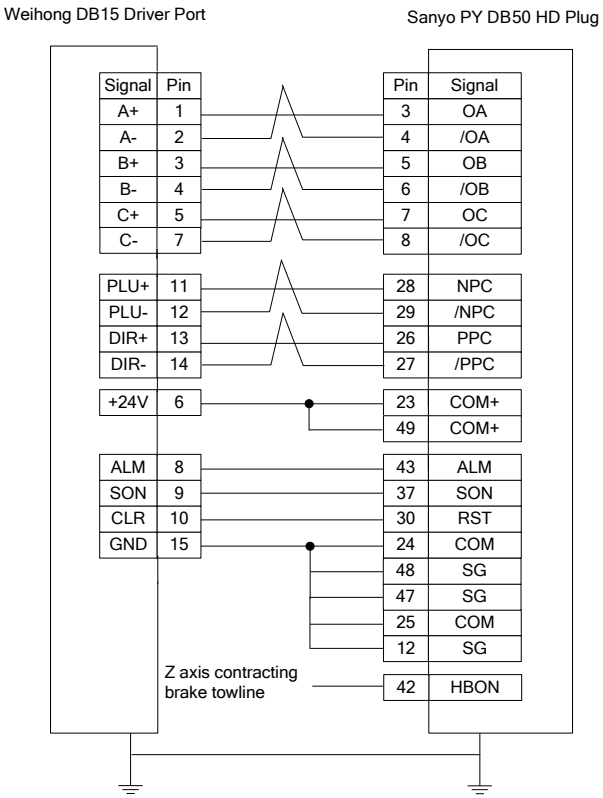
5.3.5. Wiring Diagram of FUJI Servo Driver



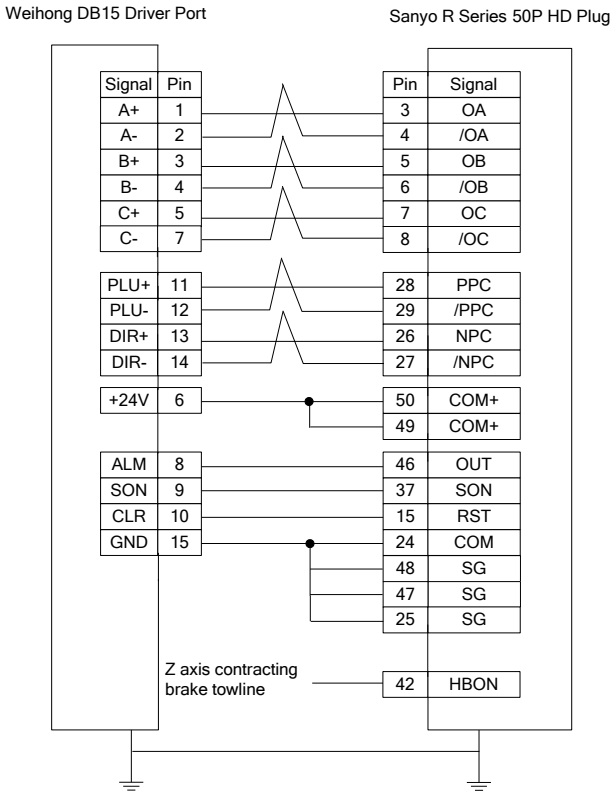
5.3.6. Wiring Diagram of HITACHI Servo Driver



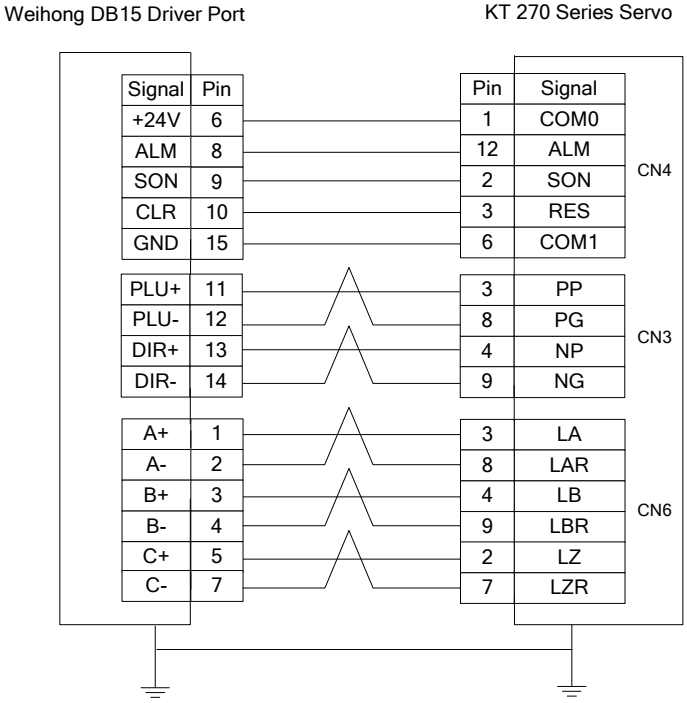
5.3.7. Wiring Diagram of SANYO PY Servo Driver



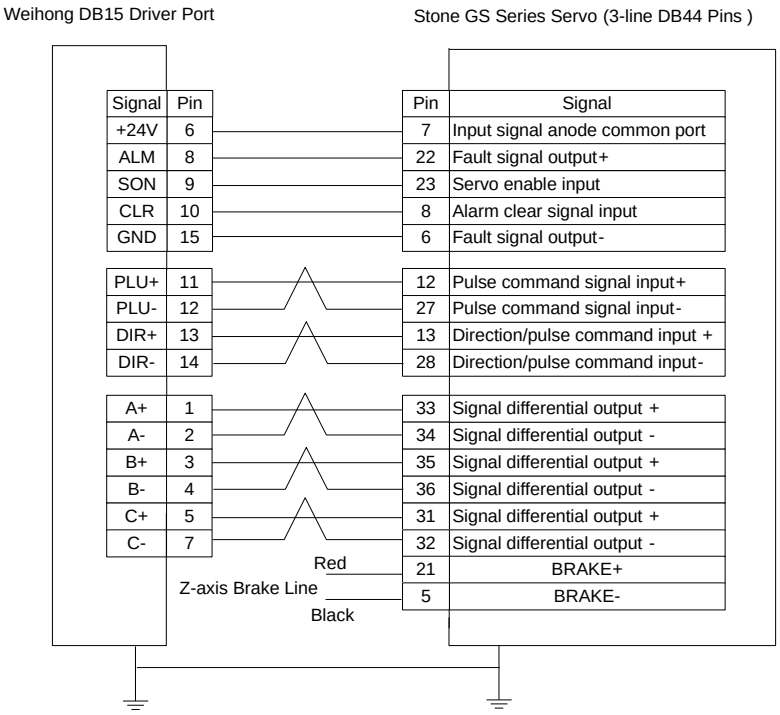
5.3.8. Wiring Diagram of SANYO R Servo Driver



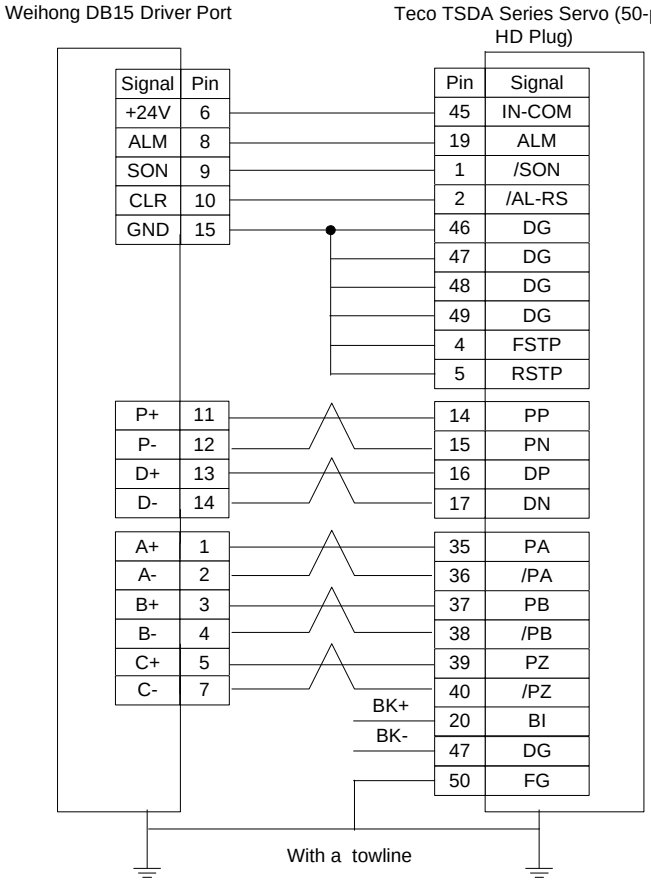
5.3.9. Wiring Diagram of KT270 Servo Driver



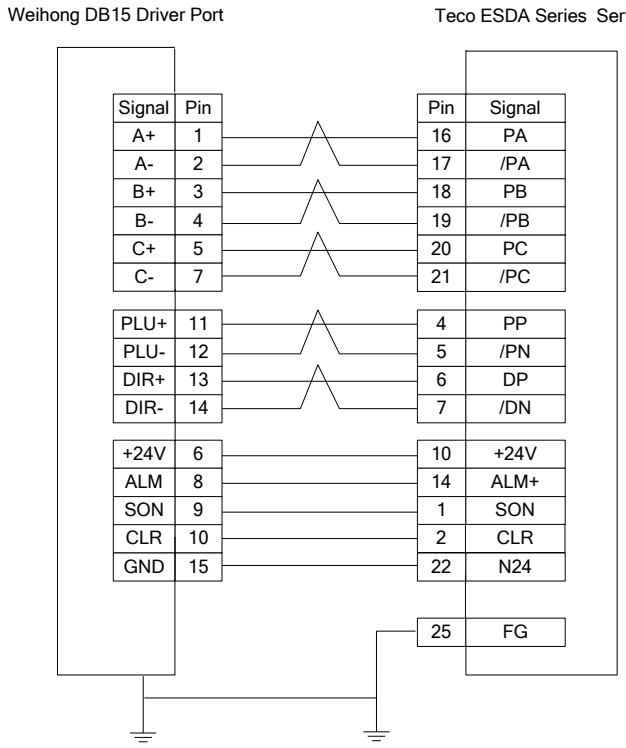
5.3.10. Wiring Diagram of STONE GS Servo Driver



5.3.11. Wiring Diagram of TECO TSDA Servo Driver



5.3.12. Wiring Diagram of TECO ESDA Servo Driver



6. Parameter Overview

Para. No.	Name	Setting Range	Default Value	Valid Time	Refer-ence
1. Op-Param (Operation Parameter)					
1001	Manual high speed	0~ Max. feed speed (mm/min)	3500	Immediately	3.9.3
1002	Manual low speed	0~Manual high speed (mm/min)	1500	Immediately	3.9.3
1003	Dry running speed	0~100000 (mm/min)	3500	Immediately	3.9.2
1004	Machining speed	0~G00 speed (mm/min)	3000	Immediately	3.9.3
1041	Save height	9e-005~5000.0 (mm)	10	Immediately	-
1042	Single axis acc	0.001~1e+005 (mm/ s^2)	1200	Immediately	3.9.3
1043	Max turning acceleration	0.001~1e+005 (mm/ s^2)	3000	Immediately	3.9.3
1044	Jerk	0.001~1e+005 (mm/s^3)	8000	Immediately	3.9.3
1045	Startup speed	1e+017~Feed speed (mm/ s^2)	100	Immediately	3.9.3
1050	Rough speed of Cali	0~3500 (mm/min)	400	Immediately	-
1051	Cali block thickness	0~1000 (mm)	10	Immediately	3.6.2
1052	X mechanical coor of fixed cali block	Lower limit of operating range of X/Y/Z axis~ Upper limit of operating range of X/Y/Z axis	0.0	Immediately	3.6.3
1053	Y mechanical coor of fixed cali block			Immediately	3.6.3
1054	Z mechanical coor of fixed cali block		-1.0	Immediately	3.6.3
1058	Handwheel output direction	-1: Opposed to axis output direction 1: Same as axis output direction	1	Restart	3.14.2
1059	Handwheel in strict accordance with	True: Valid False: Invalid	False	Restart	3.14.2
1060	Acceleration of the handwheel	-	200	Restart	3.14.2
1061	Full feedrate for G00	True: Use False: Not use	False	Restart	3.9.3
1062	Feedrate is valid for manual mode	True: Valid False: Invalid	True	Restart	3.9.3
1063	Use default speed	True: Valid False: Invalid	True	Immediately	3.9.3
1064	Use default spindle speed	True: Valid False: Invalid	True	Immediately	3.9.3
1065	Back to reference point	True: Valid	True	Immediately	3.3.2

Para. No.	Name	Setting Range	Default Value	Valid Time	Refer-ence
	before mach	False: Invalid			
1066	Whether to cancel the mark of backing	True: Valid False: Invalid	True	Immediately	3.3.2
1068	Whether to use type S algorithm	True: Use False: Not use	True	Immediately	3.9.3
1069	Use Z down speed	True: Valid False: Invalid	False	Immediately	-
1070	Z down speed	0.0 ~ 100000.0 (mm/ s)	300.0	Immediately	-
1071	Max. Z-axis speed	(mm)	100000.0	Immediately	3.9.3
1072	Z deceleration distance	(mm)	10.0	Immediately	3.9.3
1073	Z approach speed	0~Machining speed	600.0	Immediately	3.9.3
1074	Reference circle speed	0~99999 (mm/min)	3000	Immediately	3.9.3
1075	Reference circle radius	0.001~100000.0	5.0	Immediately	3.9.3
1076	Limit max velocity for small lines	True: Valid False: Invalid	True	Immediately	3.9.3
1077	Length for limit max velocity	0.001~100000 (mm)	0.5	Immediately	3.9.3
1078	Path smoothing time	0~2 (sec)	0	Immediately	-
1079	Arc radius tolerance	0~999 (mm)	2	Immediately	-
1080	Enable IJK increment mode	True: Valid False: Invalid	True	Immediately	-
1081	Predicted segment No.	0~100	50	Immediately	-
1082	Stop spindle while pausing	True: Valid False: Invalid	True	Restart	3.4.1
1083	Stop spindle while stopping	True: Valid False: Invalid	True	Restart	3.4.1
1084	Whether to stop spindle at end	True: Stop False: Not stop	True	Immediately	3.4.1
1085	Max. spindle speed	0~999999 (r/min)	24000	Restart	3.4.1
1086	Spindle start/stop time	0~60000 (ms)	5000	Immediately	3.4.1
1087	The action of spindle after process	0~2	0	Immediately	3.4.1
1088	Prompt after machining ends	0: No prompt 1: Red light on for 3s 2: Red light on until there is key operation	0	Immediately	-
1089	The X axis coordinate of the (fixed point)	Lower limit of operating range of each axis~	0.0	Immediately	3.4.1

Para. No.	Name	Setting Range	Default Value	Valid Time	Refer-ence
1090	The Y axis coordinate of the (fixed point)	Upper limit of operating range of each axis	0.0	Immediately	3.4.1
1091	The Z axis coordinate of the (fixed point)		-1.0	Immediately	3.4.1
1092	G73_G83 retract amount	0.000~0.000	0.0	Immediately	-
This parameter is used under both G73 command and G83 command with different meanings. When G73 command is used, this parameter means the uplifting distance after each peck. When G83 is executed, this parameter refers to the distance between the feed plane where the cutter changes from G00 to Gxx and the previous peck depth. See *Programming Manual* for the details of G73 and G83.					
1093	Pause Z offset	(mm)	10	Restart	-
1110	Open auto lubrication	True: Valid False: Invalid	False	Immediately	-
1111	Interval of opening lubrication pump	0~34560000(sec)	18000	Immediately	-
1112	Opening time of lubrication pump	0~34560000(sec)	5	Immediately	-
1113	Cycle machining interval	(s)	0	Immediately	-
2. Axis Param					
1011	Pulse equivalent of X axis	0.00009~999 (mm/p)	0.001	Restart	3.2.2
1012	Pulse equivalent of Y axis		0.001	Restart	3.2.2
1013	Pulse equivalent of Z axis		0.001	Restart	3.2.2
1021	Workbench range upper limit of X axis	Depending on the specific machine tool	400	Restart	3.2.3
1022	Workbench range upper limit of Y axis		400	Restart	3.2.3
1023	Workbench range upper limit of Z axis		0	Restart	3.2.3
1024	Workbench range lower limit of X axis	Depending on the specific machine tool	0	Restart	3.2.3
1025	Workbench range lower limit of Y axis		0	Restart	3.2.3
1026	Workbench range lower limit of Z axis		-100	Restart	3.2.3
1027	Change tool range upper limit of X axis	0~67110	400	Restart	3.2.3
1028	Change tool range upper limit of Y axis			Restart	3.2.3

Para. No.	Name	Setting Range	Default Value	Valid Time	Refer-ence
1029	Change tool range upper limit of Z axis	-100~67110	0	Restart	3.2.3
1030	Change tool range lower limit of X axis	-67110~67110	0	Restart	3.2.3
1031	Change tool range lower limit of Y axis			Restart	3.2.3
1032	Change tool range lower limit of Z axis		-100	Restart	3.2.3
1033	X axis output direction	-1 1	1	Restart	3.2.1
1034	Y axis output direction		1	Restart	3.2.1
1035	Z axis output direction		1	Restart	3.2.1
1114	Enable Y as revolving axis	True: Valid False: Invalid	False	Restart	-
1115	MM as revolving axis unit	True: mm False: degree	False	Restart	-
1116	Pulse equivalent of Y revolving axis	(deg/p)	0.006	Restart	-
1117	Revolving workpiece radius	(mm)	10	Restart	-
1118	Startup speed of revolving axis	(rad/s)	0.2909	Immediately	-
1119	Acceleration speed of revolving axis	0.001~100000 (mm/ s^2)	6.9813	Immediately	-
1120	Machining speed of revolving	0.001~100000 (mm/ s^2)	30	Immediately	-
1121	Screw error comp	0: No compensation 1: Unilateral 2: Bilateral	0	Restart	3.11.1
1122	Backlash compensation valid	True: Valid False: Invalid	False	Restart	3.11.1
1123	Enable AQE compensation	True: Valid False: Invalid	False	Restart	3.11.3
1124	AQE compensation time	0~0.3 (sec)	0	Restart	3.11.3
1125	AQE compensation length	0~10 (mm)	0	Restart	3.11.3
1126	Delay time of AQE compensation	0~10 (sec)	0	Restart	3.11.3
1127	Intensity of AQE compensation	0~1	0.75	Restart	3.11.3
3. File Param					
Dxf file translation parameters					

Para. No.	Name	Setting Range	Default Value	Valid Time	Refer-ence
1148	Tool lifting height	0~100000 (mm)	1	Immediately	3.13.2
1149	Machining depth	-100000~0 (mm)	-1	Immediately	3.13.2
1150	Use first point as zero point	True: Valid False: Invalid	True	Immediately	3.13.2
1151	Shape separate processing _valid	True: Valid False: Invalid	False	Immediately	3.13.2
1152	Bottom machining valid	True: Valid False: Invalid	False	Immediately	3.13.2
1153	Use dxf file as metric size	True: Metric False: Inch	False	Immediately	3.13.2
Eng file translation parameters					
1154	Select tool for ENG	True: Valid False: Invalid	True	Immediately	3.13.2
1155	Select tool for ENG	True: Valid False: Invalid	True	Immediately	
1156	Tool change prompt	True: Valid False: Invalid	True	Immediately	3.13.2
1157	Tool lifting height	0~100000 (mm)	1	Immediately	3.13.2
1158	Retract amount	(mm)	1	Immediately	3.13.2
1159	Cycle times of ENG processing	-	1	Immediately	3.13.2
1160	Deep hole machining manner	0: Reciprocating chip removal 1: High speed reciprocating chip removal	0	Immediately	3.13.2
Plt file translation parameters					
1161	Tool lifting height	(mm)	5	Immediately	3.13.3
1162	Plt unit	(mm)	10	Immediately	3.13.3
1163	Tool step	(mm)	0.025	Immediately	3.13.3
1164	Machining depth	(mm)	-1	Immediately	3.13.3
4. Origin Param					
1095	X direction in backing to reference point	-1~1	-1	Immediately	3.3.2
1096	Y direction in backing to reference point	-1~1	-1	Immediately	3.3.2
1097	Z direction in backing to reference point	-1~1	1	Immediately	3.3.2
1098	Retract distance of X-axis	(mm)	2	Immediately	3.3.2
1099	Retract distance of	(mm)	2	Immediately	3.3.2

Para. No.	Name	Setting Range	Default Value	Valid Time	Refer-ence
	Y-axis				
1100	Retract distance of Z-axis	(mm)	-2	Immediately	3.3.2
1101	X speed in backing to reference point	0.001~Feed speed (mm)	1800	Immediately	3.3.2
1102	Y speed in backing to reference point	0.001~Feed speed (mm)	1800	Immediately	3.3.2
1103	Z speed in backing to reference point	0.001~Feed speed (mm)	1500	Immediately	3.3.2
1104	X speed in exact positioning	0.001~19200 (mm/min)	200	Immediately	3.3.1
1105	Y speed in exact positioning	0.001~19200 (mm/min)	200	Immediately	3.3.1
1106	Z speed in exact positioning	0.001~19200 (mm/min)	100	Immediately	3.3.1
1107	X-axis screw pitch	0.001~9999.999 (mm)	5	Immediately	3.3.2
1108	Y-axis screw pitch	0.001~9999.999 (mm)	5	Immediately	3.3.2
1109	Z-axis screw pitch	0.001~9999.999 (mm)	5	Immediately	3.3.2
5. ToolPak Param					
1500	Turn on radius compensation	True: Valid False: Invalid	False	Immediately	3.11.2
1501	Specify the type of tool compensation	1: Normal type 2: Intersect type 3: Insert type	1	Immediately	3.11.2
1502	Tool magazine capacity	0~20	10	Restart	3.17.3
1503	Current tool No.	0~10000	1	Immediately	3.17.3
1504	Currently tool pan No.	-	1	Immediately	-
1505	Spindle winding counts	-	0	Immediately	-
1506	Tool change prompt	True: Prompt False: Not prompt	False	Immediately	3.17.3
1507	Calibrate cutter after tool change	True: Calibrate False: Not calibrate	False	Immediately	3.17.3
1508	Tool change upper position	(mm)	-1	Immediately	3.17.3
1509	Tool change lower position	(mm)	0	Immediately	3.17.3
1510	X change tool position	(mm)	0	Immediately	3.11.2
1511	Y change tool position	(mm)	0	Immediately	3.11.2
1512	X coordinate of tool change ahead	(mm)	0	Immediately	3.11.2
1513	Y coordinate of tool	(mm)	0	Immediately	3.11.2

Para. No.	Name	Setting Range	Default Value	Valid Time	Refer-ence
	change ahead				
1514	Z coordinate of tool change ahead	(mm)	0	Immediately	3.11.2
1515	Tool change speed	0.001~19200.000 (mm)	3000	Immediately	3.11.2
1516	Z-axis CTup and CTdown speed	0.001~3000 (mm/min)	60	Immediately	-
1517	Traversing speed in/out tool magaz	(mm/min)	60	Immediately	3.6
1518	Tool change delay	0~600000 (ms)	500	Immediately	3.6.4
1519	Move to origin position after change tool	True: Valid False: Invalid	False	Immediately	3.6.4
1520	X-axis machincoor	(mm)	0	Immediately	-
1521	Y-axis machincoor	(mm)	0	Immediately	-
1522	Z-axis machincoor	(mm)	0	Immediately	-