NK280 Integrated CNC System

Manufacturers' Manual

2nd Edition

Weihong Electronic Technology Co., Ltd.

Preface

About This Manual

This manual is intended for manufacturers and end-users. If you use the CNC system for the first time, you need to read through the manual. If you are experienced with the system, you can search for the desired info via the contents.

With 8 chapters, this manual can be divided into 5 parts, as follows:

1) Precautions part. This part mainly lists the notices of storage and transportation, installation and wiring, usage and so on. Users should read them carefully to ensure safe operation.

2) Hardware part, including chapter 1, 2 and 6. Chapter 1 and 2 mainly talk about product configuration and hardware introduction of NK280. While chapter 6 refers to driver parameters and terminal board wiring diagrams of different brands.

3) Software operation part. Chapter 3 and 4 introduces software interface and operation corresponding to each function and lists related parameters and setting notes. After reading through this part, users will learn the operation menus and commands.

4) Maintenance part. Chapter 5 talks about maintenance information so that users can take corresponding steps in case of breakdown.

5) Appendix part, including chapter 7 and 8. Chapter 7 lists all the parameters while chapter 8 contains the software license agreement.

Applicable Product Models

This manual is applicable to NK280 integrated CNC system. Refer to the table below for details.

Product Model	Remarks
NK280 integrated CNC system	Abbreviated as NK280; system in this manual refers to NK280 integrated CNC system, if there is no particular explanation. Nk280 integrated CNC system, as introduced in this manual, can serve as control system for standard four axes system (namely, for machines with X/Y/Z/A axes) as well as Dual Z axes system (namely, for machines with X/Y/Z1/Z2 axes). Furthermore, through continuous market research and exploration, Weihong Company has successfully upgraded NK280 system into control system for key cutting machine and knife grinder machine. If you are interested, please contact us for more information.

Contact Us

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Revision History

You can refer to the following table for the revision records of each edition. Please note that content in this manual is subjected to change.

Date	Edition	Revision
2016.02	R2	Contact information updated.
2015.07	R1	Released for the first time.

Precautions

Precautions can be divided into caution and warning according to the degree of loss or injury in case of negligence or omission of precautions stipulated in this manual.

⚠ CAUTION : general info, mainly for informing, such as supplementary instructions and conditions to enable a function. In case of negligence or omission of this kind of precautions, you may not activate a function. Note that in some circumstances, negligence or omission of even this kind of precautions could cause physical injury or machine damage.

⚠ WARNING : warning info which you must comply with. In case of negligence or omission of this kind of precautions, you may suffer physical injury, or even death, machine damage or other losses.

⚠ WARNING

1) Precautions Related to Storage and Transportation

➢ The products should be transported properly in terms of the weight;

➢ An 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;

2) Precautions Related to Installation

➢ Only when this equipment installed in the qualified electricity cabinet can it be used. The construction of the cabinet must reach IP54 grade of protection;

➢ 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;

➢ A fan or heat exchanger should be adopted for the heat dissipation and air convection of the cabinet;

➢ If a 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 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 CNC device should be preserved above 100mm;

➢ It will be better if CNC device is installed at a position facilitating debugging and maintenance.

3) Precautions Related to Wiring

➢ Only qualified people are allowed to participate in the wiring and checking;

➢ The CNC device should be grounded reliably and grounding resistance should be less than 4 ohm. Neutral line is absolutely not allowed to replace earth wire. Otherwise, it may result in malfunction of the device 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 specifications set forth in the manual, or it may result in breakdowns such as short circuit and permanent damage to the device;

➢ To guard against electric shock or 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;

⚠ WARNING

> It is prohibited to plug or open the chassis of CNC device when power on.

4) Precautions Related to Running & Debugging

> 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.

5) Precautions in Use

> 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 to power up the machine again at least one (1) minute later after power failure or blackout.

⚠ CAUTION

1) Precautions Related to Product and Manual

> Matters related to restrictions and functions available stipulated in the manuals issued by the machine manufacturer is prior to those in this manual;

> This manual assumes adding all optional functions, which you must confirm through manuals issued by the machine manufacturer;

> Please refer to manuals issued by the machine manufacturer for the instructions of machine tools;

> Functions, and software interfaces vary with the system and the version of software. Before using the system, you must confirm specifications.

2) Precautions When Opening the Package

> 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.

Contents

                                        Specialized, Concentrated, Focused

1 Summarization

1.1 Hardware Introduction

1.1.1 A Picture of NK280

Fig. 1-1 A picture of NK280

1.1.2 System configuration

NK280 integrated system consists of the following components:

➢ One host of NK280
➢ One EX9A4 or EX24A2 terminal board
➢ One DB9M/F cable (length custom)
➢ Servo cable (brand, length and quantity decided by customers)
➢ NK-MPG-06 Handwheel (optional)

> Note:
>
> The above lists the system components of standard configuration and the final receiving should be subject to the receipt list.
>
> The extended terminal board EX26A is optional.

1.1.3 Mounting Dimension

After NK280 is installed on the machine tool, 100 mm space should be preserved in its surrounding for wiring convenience. Please ensure ventilation in the cabinet. And the mounting dimension is shown in Fig. 1-2:
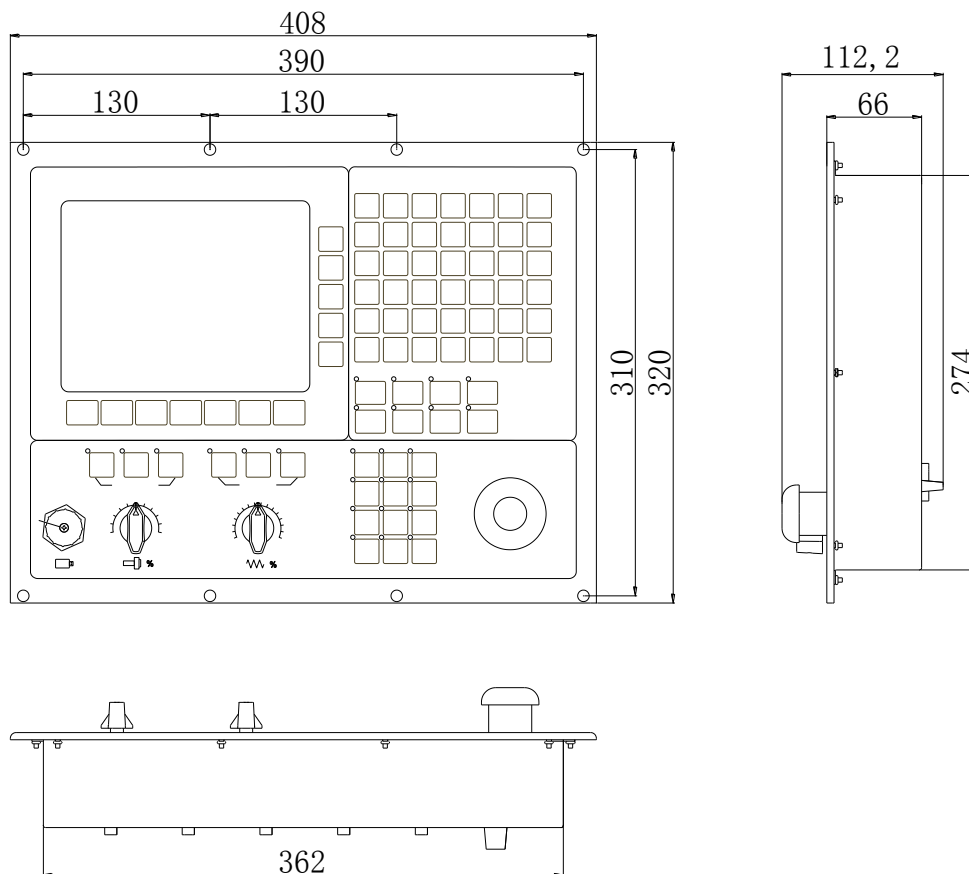
Fig. 1-2 Mounting dimension of NK280 integrated system

1.1.4   Host of NK280

◆ **Front View of NK280**
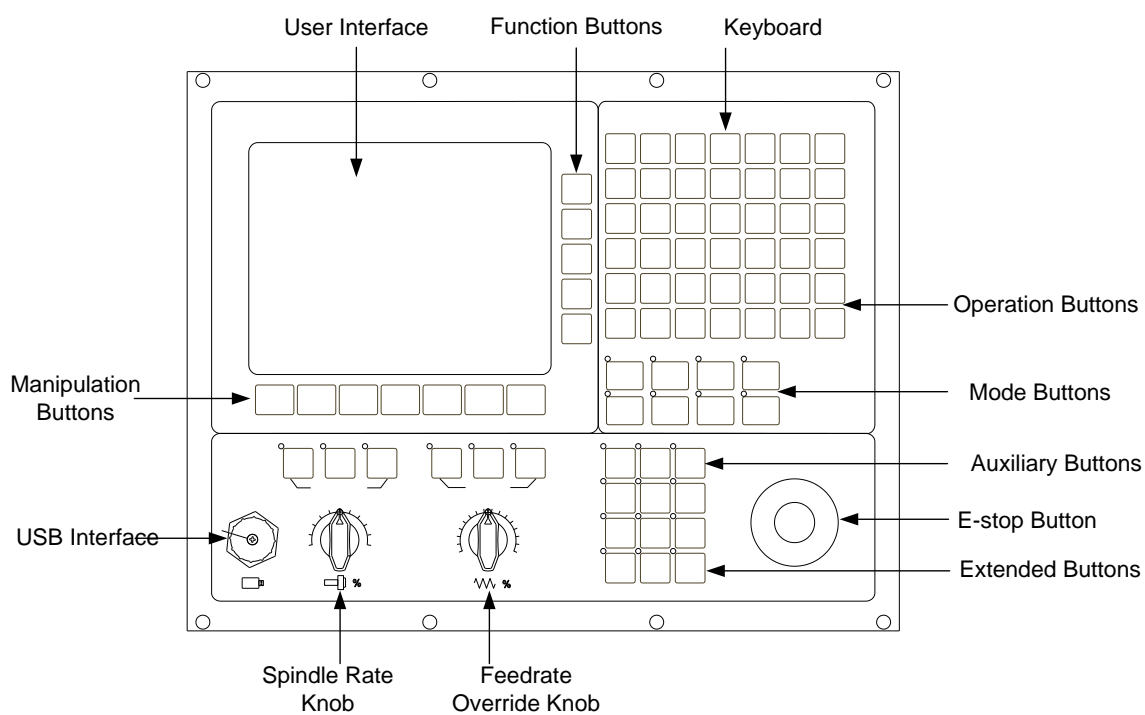
Fig. 1-3 Front view of NK280

➢ User interface: interactive, simple and user-friendly design, featuring convenient operation.

➢ Operation buttons: including "State", "Advanced", "Program", "Parameters", and "System".

➢ Keyboard: each letter key contains one bigger letter and smaller letter, the smaller locating at the top left while bigger one, which supports capital entering only, at the lower right. If you want to enter the bigger letter, just press the corresponding letter key; for the smaller one, pressing the shift key and the letter key simultaneously is required.

The Num keys can also work as axis feeding buttons, as follows:
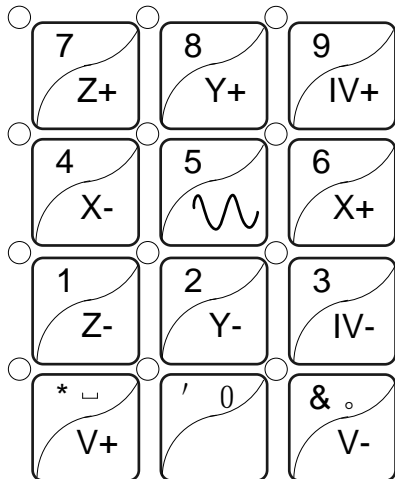
In auto and home mode, the Num buttons are used to enter number.

In manual, jog and stepping mode, the Num keys are used to manipulate the movement of corresponding axes. Among them, the num key "5" is used to switch between the manual high speed and manual low speed.

➢ System operation buttons: including insert, back space, delete and so on.

➢ Mode selection buttons: shown as below:
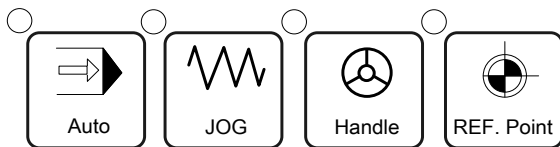
The operation mode can be divided into 4 types: auto mode, manu mode and REF. point mode. The manu mode can be further divided into jog mode, stepping mode and handwheel mode.

Stepping mode buttons

XUD：custom step length.

X1：step length of 0.001 mm or inch。

X10：step length 0.01 mm or inch。

X100：step length of 0.1 mm or inch。
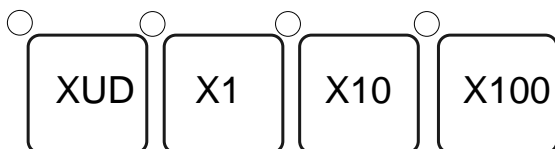
➢ Auxiliary buttons: mainly including:
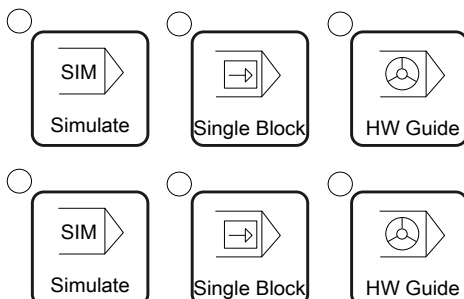
Used for simulation, single block and handwheel guide respectively.

Controlling workpiece cooling, air and lubrication switch respectively.

ATC CW	ATC CCW	Light

CW	Stop	CCW
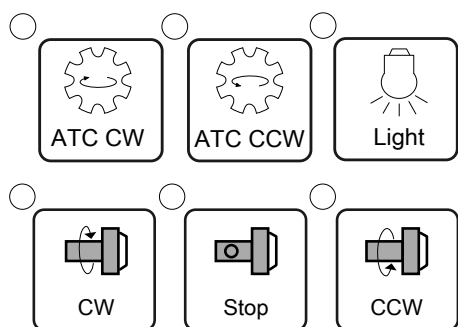
Tool magazine manipulation buttons, controlling tool magazine CW/CCW.

Light, used to control the lamp on/off.

Controlling the spindle start/stop.

➢ E-stop button: in case of danger, pressing this button will power off and stop the machine to ensure the safety of the operators and machines. Press down this button to make machine stop immediately and turn the button in clockwise direction to cancel E-stop.

➢ Extended buttons: used for extended functions, including [K1], [K2], [K3], available for the extension of custom functions.

➢ Feedrate override knob / spindle rate knob: used to adjust the feedrate override and spindle rotational speed. For details, refer to chapter 3.4 and 3.9.1.

➢ USB interface: take off the nut cap and connect USB equipment.

➢ Manipulation buttons: including F1~F7.

Note:

When the indicator light at the top left is on, it means the corresponding function is activated.

◆ **Rear View of NK280**

The rear view of NK280 with its interface definition is shown as below.
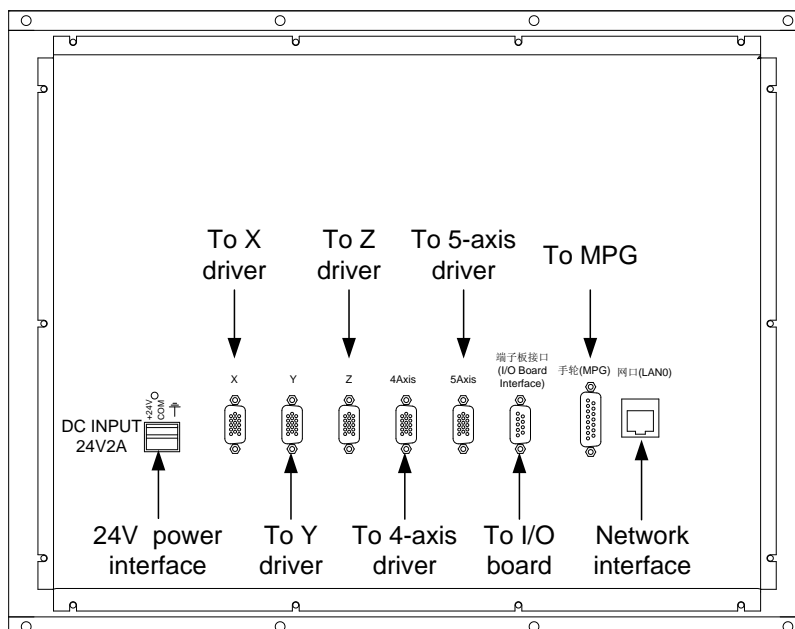
Fig. 1-4 Rear view of NK280

➢ 24V power interface: connected to 24V DC power.

➢ To X driver: connected to the driver of X axis.

➢ To Y driver: connected to the driver of Y axis.

➢ To Z driver: connected to the driver of Z axis.

➢ To 4-axis driver: connected to the driver of the fourth axis;

➢ To 5-axis driver: connected to the driver of the fifth axis.

➢ To I/O board: connected to the terminal board. Refer to chapter 2.2 for the terminal board specifications.

➢ To MPG: connected to the handwheel.

➢ Network interface: connected to the PC via the network cable.

1.1.5   Connection Schematic Diagram

The connection of Y/Z/4-axis/5-axis port is similar to that of X axis.

Servo Driver

To 24V

MPG

Servo Motor

Terminal Board EX9A4

Extended Terminal Board EX26A3

Inverter

Spindle Motor
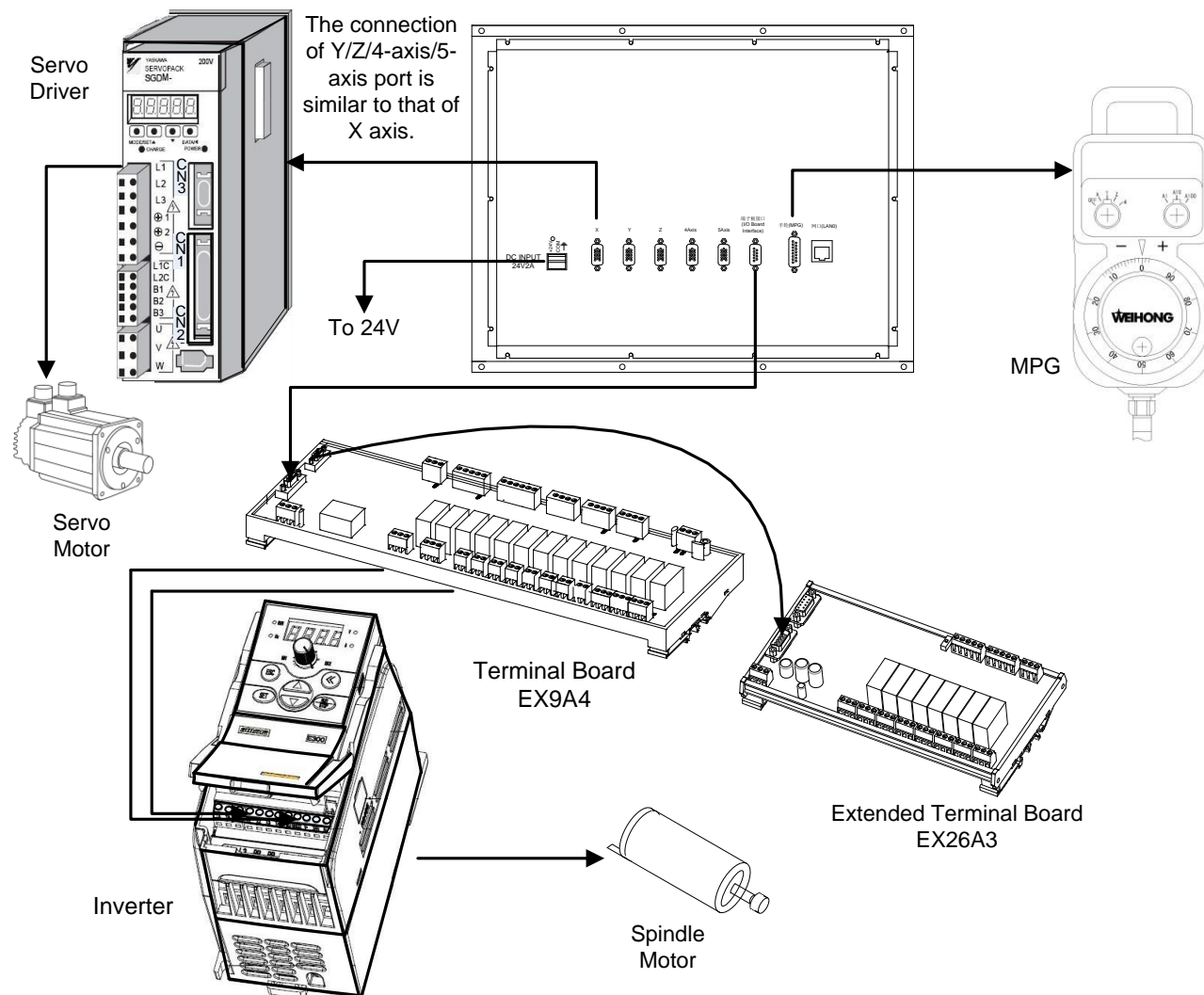
Fig. 1-5 Connection schematic diagram

1.2 Software Introduction

Based on embedded operating system, NK280 can be used as 4-axis system, dual Z axes system, system for key cutting machine and system for knife grinder machine respectively according to different hardware configurations and software versions. This manual takes the standard 4-axis system as an example as a whole, and the unique features of other systems will be introduced separately.

The software user interface consists of five function areas, which can be chosen and switched through the function buttons at the right of the interface. Here just lists the brief introduction to each function area. For more details, please refer to the following chapters.

◆ **State**

Including [Coor], [Motion Trace], [Current Program] and [Part Statistic] altogether 4 screens. You can set frequently used parameters, execute common and auxiliary operations, view the machining path and statistics in this function area.

◆ **Advanced**

Including [Coor-Manage], [Centering], [User Code Input] three screens. Coordinate-related operations can be done here, such as building and choosing coordinate system, offset operation, centering operation, backing to the fixed point and machine origin, direct input of command and so on.

◆ **Program**

Including [Local Program], [USB File], [Program Wizard] altogether 3 screens. In this area, you can manage all the program files both in local disk and in movable disk. Besides, program wizard is provided to generate standard program file by simple setting of parameters.

◆ **Parameter**

Including [Machine Parameter], [Parameter Backup], [Coordinate Backup], [Compensation] 4 screens. In this area, you can view, set and back up parameters, save and load workpiece coordinate, set tool compensation and screw error compensation.

◆ **System**

Including [Port], [Log], [System info], this area provides ports information, log information and system information.

2 Wiring

2.1   Basic Concepts of Signal

2.1.1   Signal Types

The signal types of NK280 system can be divided into the following 4 types: binary input signal, relay output signal, differential output signal and analog 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:
>
> 1) NK280 standard 4-axis system also supports high level effective, if this function is needed, please choose the related terminal board EX6A4; at this time, conducting to 24V in NO connection means signal detected, and disconnecting with 24V in NC connection means signal detected.
>
> 2) NK280 dual Z system, system for key cutting machine and system for knife grinder machine do not support high level effective.

◆ 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.
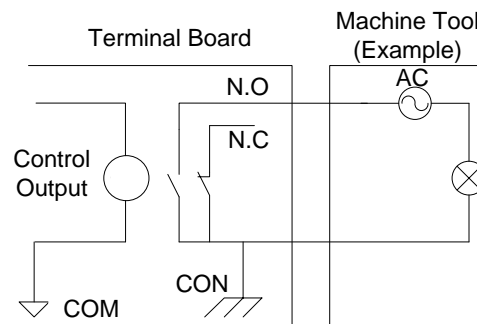
Fig. 2-1 Connection of relay output and contactor

◆ 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.

◆ Analog Output Signal

SVC is controllable voltage output of 0~10V and externally connected with analog voltage frequency command inputs of inverter. Therefore altering the controllable voltage leads to inverter frequency change and a change of inverter frequency will change the spindle speed.
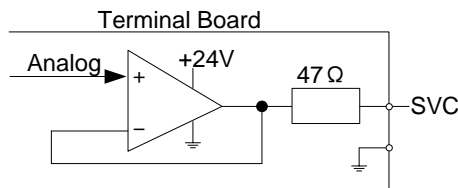
Fig. 2-2 Electric circuit of analog output signal

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. 2-3:
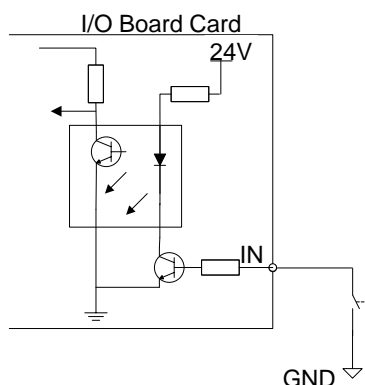
Fig. 2-3 Connection of mechanical switch and binary input

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 EX6A4.
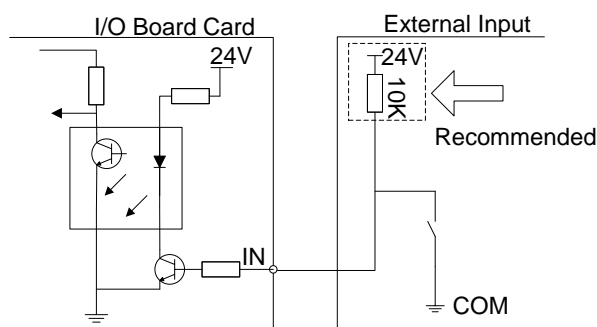
Fig. 2-4 Binary input of NPN type connecting with photoelectric switch or proximity switch

◆ **Power Requirement**

It is recommended to adopt DC24V/4.5A switch power for relays on the terminal 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. 2-5.
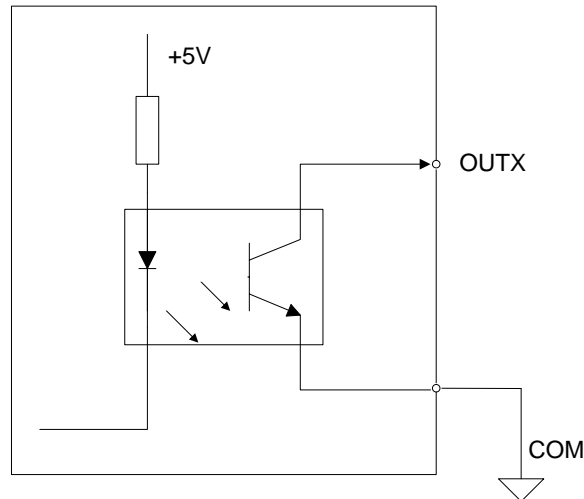
Fig. 2-5 Equivalent circuit of binary output interface

◆ **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. 2-6.
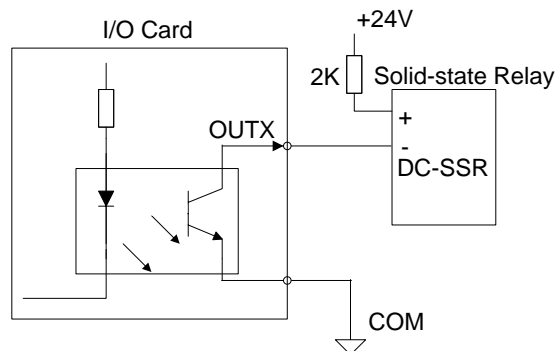
Fig. 2-6 Connection of solid-state relay and binary output

The connection of binary output and optical coupler is shown in Fig. 2-7.
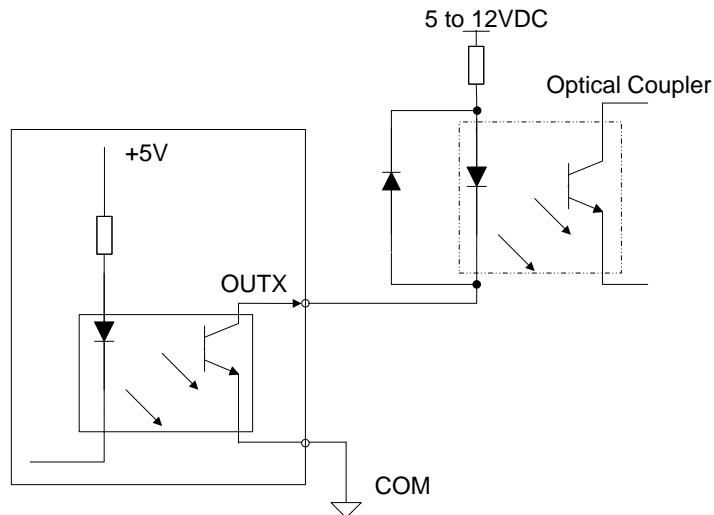
Fig. 2-7 Connection of binary output and optical coupler

Note:

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

2.1.4 Analog Output

Externally connected to the Analog voltage frequency command input of the inverter, SCV refers to controllable voltage output ranging from 0V to 10V. The inverter frequency changes along with the voltage, thus controlling the spindle rotating speed.

2.2 Wiring Specification of Terminal Board

EX9A4 is the terminal board for NK280 standard 4-axis system while EX24A2 for dual Z system, system for key cutting machine and system for knife grinder machine. Another option is EX26A3, used for I/O ports expansion. Except for one piece of EX9A4/EX24A2, up to four pieces of terminal board EX26A3 can be connected for expanding I/Os by 40/32.

There is a red LED indicator light next to each input port on terminal board, 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 indicator light next to 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

The wiring diagrams between NK280 and terminal board are shown as follows:

◆   **Standard 4-axis system**
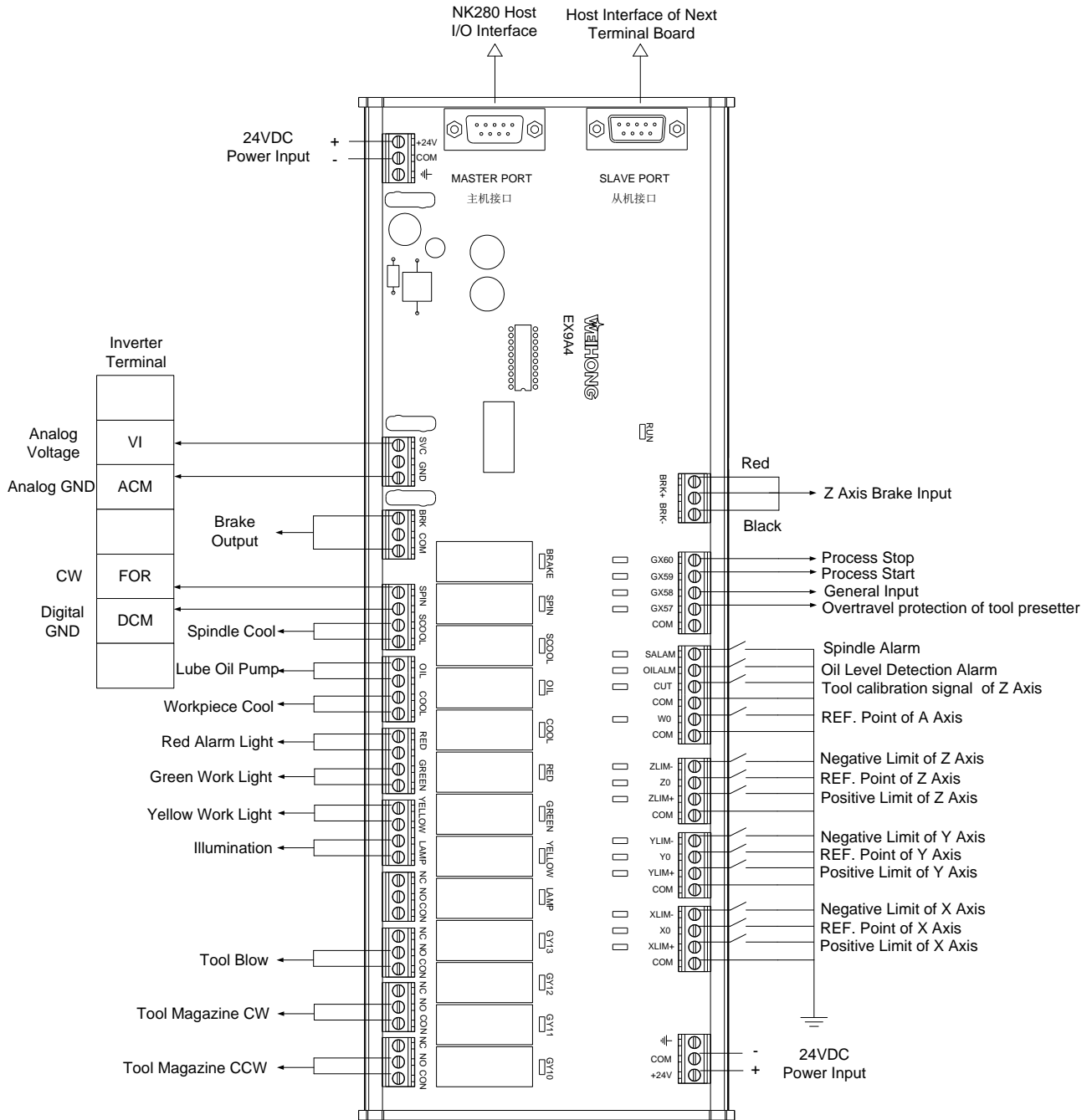
Note: NO ports are normally open while NC ports are normally closed.

Fig. 2-8 Wiring diagram of terminal board EX9A4-standard 4-axis system

◆ **Dual Z System**
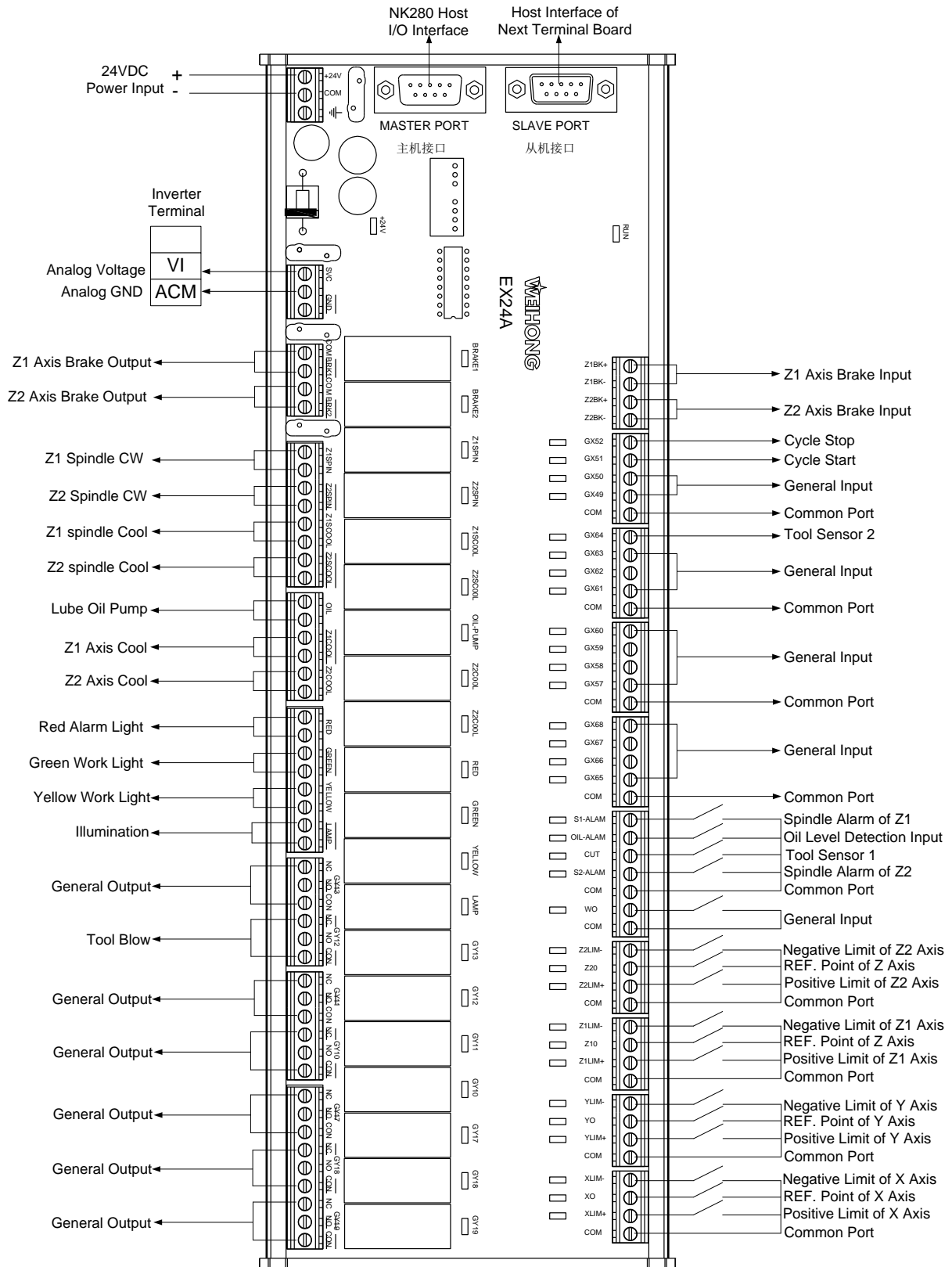
Note: NO ports are normally open while NC ports are normally closed.

Fig. 2-9 Wiring diagram of terminal board EX24A-dual Z system

◆ **Extended terminal board**
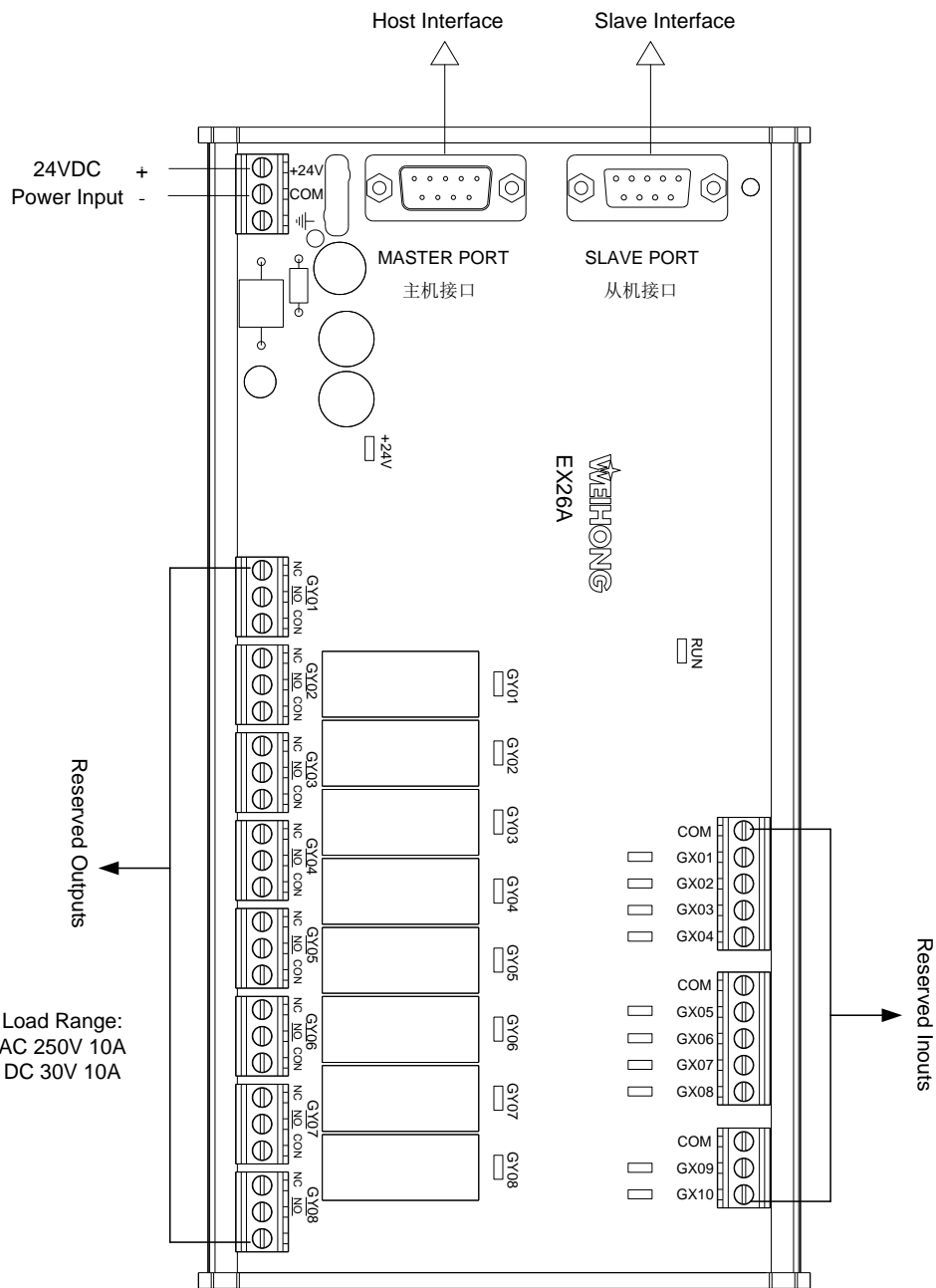
(Note: NO ports are normally open while NC normally closed.)

Fig. 2-10 Wiring diagram of terminal board EX26A3

2.2.2   Port Specification of Terminal Board

2.2.2.1 Standard 4-axis System

Group	Silk-printed Name	Software Definition	Description
External power	+24V	DC 24V power	Terminal board should be powered by external power supply.
	COM		
REF. point signal	X0	X machine origin	Binary input, low level effective; connected to home switch of X-axis.
	Y0	Y machine origin	Binary input, low level effective; connected to home switch of Y-axis.
	Z0	Z machine origin	Binary input, low level effective; connected to home switch of Z-axis.
	W0	A machine origin	Binary input, low level effective; connected to home switch of A-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.
	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 signals.
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 sensor	Binary input signal, connected to tool sensor signal (tool presetter signal).
	GX57	Tool Over-travel Protection	
	GX59	Cycle start	Connected to cycle start button.
	GX60	Cycle stop	Connected to cycle stop button.
Spindle control	SVC	Signal output of analog voltage (from 0 to 10V)	Actual spindle speed/MAX. spindle speed=SVC/10V.
	GND	Analog voltage ground	
	SPIN	Spindle CW	Controlling the spindle to rotate forward.
	SCOOL	Spindle cool	Connected to spindle coolant switch.

Group	Silk-printed Name	Software Definition	Description
Z-axis brake	BRAKE	Brake control	Connected to the brake output signal of the servo driver.
	BK+, BK-	Two ends of brake input	Controlling the 24V on/off of the motor brake line.
Signal light	RED	Red alarm lamp	Red light on when machining ends or during 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	Controlling lubrication pump on/off.
	COOL	Workpiece cooling	Controlling the workpiece cooling switch.
	LAMP	Illumination	Controlling the on/off of the illuminating lamp.
	GY13	Spindle CCW	Controlling the switch of spindle CCW rotating.
	GY12	Tool blow	Controlling the switch to blow the tool.
	GY11	Tool magazine CW	Controlling the switch of tool magazine CW.
	GY10	Tool magazine CCW	Controlling the switch of tool magazine CCW.
Reserved input	GX58	Reserved input	Available for custom reserved input.

2.2.2.2 Dual Z System

Group	Silk-printed Name	Software Definition	Description
External power	+24V	DC 24V power	Terminal board should be powered by external power supply.
	COM		
REF. point signal	X0	X machine origin	Binary input, low level effective; connected to home switch of X-axis.
	Y0	Y machine origin	Binary input, low level effective; connected to home switch of Y-axis.
	Z10	Z1 machine origin	Binary input, low level effective; connected to home switch of Z1-axis.
	Z20	Z2 machine origin	Binary input, low level effective; connected to home switch of Z2-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.
	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.

Group	Silk-printed Name	Software Definition	Description
	Z1LAM+	Z1 positive limit	Binary input, low level effective; connected to positive limit switch of Z1-axis.
	Z1LAM-	Z1 negative limit	Binary input, low level effective; connected to negative limit switch of Z1-axis.
	Z2LAM+	Z2 positive limit	Binary input, low level effective; connected to positive limit switch of Z2-axis.
	Z2LAM-	Z22 negative limit	Binary input, low level effective; connected to negative limit switch of Z2-axis.
	COM	Common port	Common port of digital signals.
Commonly used input	S1ALAM	Spindle alarm of Z1	Binary input signal, connected to spindle alarm switch of Z1.
	S2ALAM	Spindle alarm of Z2	Binary input signal, connected to spindle alarm switch of Z1.
	OILALAM	Oil level detection	Binary input signal, connected to sense switch of oil level.
	CUT	Tool sensor 1	Binary input signal, connected to tool sensor 1 signal (tool presetter signal).
	GX64	Tool sensor 2	Binary input signal, connected to tool sensor 2 signal (tool presetter signal).
	GX51	Cycle start	Connected to cycle start button.
	GX52	Cycle stop	Connected to cycle stop button.
Spindle control	SVC	Signal output of analog voltage (from 0 to 10V)	Actual spindle speed/MAX. spindle speed=SVC/10V.
	GND	Analog voltage ground	
	Z1SPIN	Spindle Z1 CW	Controlling the spindle Z1 to rotate forward.
	Z2SPIN	Spindle Z2 CW	Controlling the spindle Z2 to rotate forward.
	Z1SCOOL	Spindle Z1 cool	Connected to spindle Z1 coolant switch.
	Z2SCOOL	Spindle Z2 cool	Connected to spindle Z2 coolant switch.
Z-axis brake	BRK1	Brake control of Z1	Connected to the Z1 brake output signal of the servo driver.
	BRK2	Brake control of Z2	Connected to the Z2 brake output signal of the servo driver.
	BK+、BK-	Two ends of brake input	Controlling the 24V on/off of the motor brake line.
Signal light	RED	Red alarm lamp	Red light on when machining ends or during E-stop.
	GREEN	Green work lamp	Light on during normal working state of machine.

Group	Silk-printed Name	Software Definition	Description
	YELLOW	Yellow work lamp	Yellow light on during idle state after machining ends or during waiting state.
Commonly used output	OIL	Lubrication on	Controlling lubrication pump on/off.
	Z1COOL	Z1 cooling	Controlling the on/off of the Z1 cooling pump.
	Z2COOL	Z2 cooling	Controlling the on/off of the Z2 cooling pump.
	LAMP	Illumination	Controlling the on/off of the illuminating lamp.
	GY12	Tool blow	Connected to tool blow switch.
Reserved input	WO	Reserved input	Available for custom reserved input.
	GX49	Reserved input	
	GX50	Reserved input	
	GX57	Reserved input	
	GX58	Reserved input	
	GX59	Reserved input	
	GX60	Reserved input	
	GX61	Reserved input	
	GX62	Reserved input	
	GX63	Reserved input	
	GX65	Reserved input	
	GX66	Reserved input	
	GX67	Reserved input	
	GX68	Reserved input	
Reserved output	GY10	Reserved output	Available for custom reserved output.
	GY11	Reserved output	
	GY13	Reserved output	
	GY17	Reserved output	
	GY18	Reserved output	
	GY19	Reserved output	

2.3   Port Definition and Wiring Specification

2.3.1   Driver Interface Definition

NK280 host provides 4 pulse-feed driver interfaces, i.e. X, Y, Z and A axes driver interfaces. The type of driver interface is 15-core D socket (DB15 pins). The pin definition is as follows:
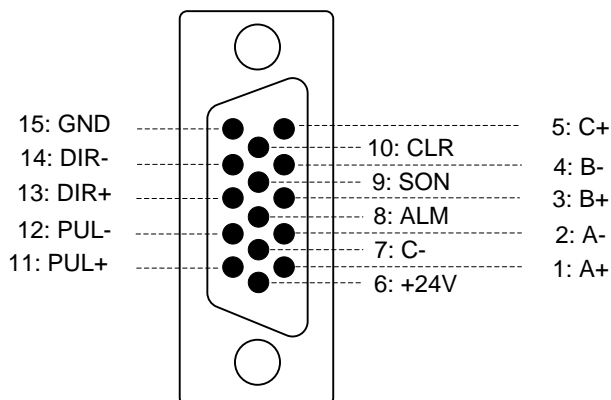
Fig. 2-11 Driver interface definition

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 disconnected.
SON	Servo ON signal	Output	This signal used for opening (power on) and closing (power off) servo motor. When it is connected to COM-, dynamic brake will be released and the driver is allowed to work (servo enabled).
CLR	Driver alarm clearance signal	Output	This signal is used to discard alarming or warning state of those alarms that could be reset.
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

Note:

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.

2.3.2 Handwheel Interface Definition

NK280 can be externally connected with a manual pulse generator (MPG, also called handwheel), supporting 6-axis MPG at most, via the DB15 core dual-in-line holes interface. Its pin definition is as shown in Fig. 2-12.

```
1:+5V            9: HSU
2:HA             10: HSA
3:HB             11: GND
4:NC             12: HSB
5:NC             13: HSZ
6:HX1            14: HSY
7:HX10           15: HSX
8:HX100
```
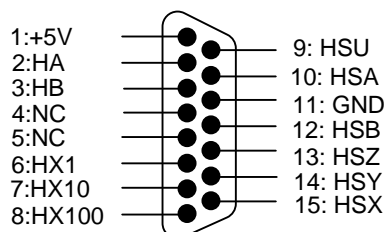
Fig. 2-12 Handwheel interface definition

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

3 Manipulation

3.1 Debugging Steps

Debugging starts

(1) Refer to Chapter 3.5 "Adjustment of Port Polarity" for adjusting polarity of I/O ports

Port detecting is correct or not? —— False

True

(2) Refer to Chapter 3.2 "Adjustment of Axial Direction & Pulse Equivalent" for axial direction, pulse equivalent and workbench stroke range setting

Machine motion dimension is correct or not? —— False

True

(3) Refer to Chapter 3.3 "Returning to Machine Origin" for returning to machine origin

Returning to machine origin is correct or not? —— False

True

(4) Refer to Chapter 3.4 "Spindle Parameters Adjustment" for adjusting spindle parameters

Be satisfied with debugging results or not? —— False

True

(5) Refer to Chapter 3.9 "Adjustment of Velocity & Acceleration" for velocity adjustment

Motion is steady or not? —— False

True

(6) Refer to Chapter 3.6 "Tool Measurement" & Chapter 3.7 "Offset Setting" for setting workpiece coordinate system (WCS)

The setting of WCS is suitable or not? —— False

True

Debugging ends, ready for machining

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. The coordinate system of the right-hand rule is shown in Fig. 3-2.
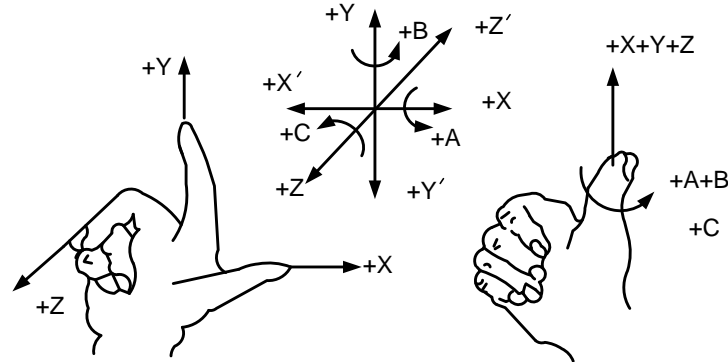
Fig. 3-2 The coordinate system of the right hand principle

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 Name	Definition	Setting Range
X-axis Output Direction	It specifies the motion direction of each axis.	"1", "-1" represents the two motion directions of each axis, 1 for positive direction and -1 for negative direction.
Y-axis Output Direction		
Z-axis Output Direction		
A-axis Output Direction		

3.2.2 Pulse Equivalent Adjustment

Pulse equivalent (p): the moving distance of workbench or rotation degree of rotary axis corresponding to one pulse sent by CNC device, the minimum available distance controlled by CNC system as well.

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

Max. Feedrate= pulse equivalent X 60 X frequency

For example, the hardware frequency of NK280 is 320 KHz and provided the pulse equivalent is 0.001 mm/p, then:

Max. feedrate=0.001 X 60 X 320000= 19.2m/min

Mechanical deceleration (m/n): the ratio of reducer input speed to output speed, equal to the ratio of

the teeth number of driven wheel to that of driving wheel. When applied in CNC machines, it specifies the ratio of motor speed to screw speed.

$$\text{Mechanical deceleration} = \frac{\text{Reducer input speed}}{\text{Reducer output speed}} = \frac{\text{Driven wheel teeth number}}{\text{Driving wheel teeth number}} = \frac{\text{Motor speed}}{\text{Screw speed}}$$

Pitch (d): The axial distance between the corresponding points of two adjacent teeth on the threads. The calculation of pulse equivalent varies with different motor systems.

◆ **Stepping Motor**

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

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

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

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

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

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

◆ **Servo Motor**

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

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

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

Electronic gear ratio (B/A): the parameter of servo driver (take YASKAWA driver as an example, B is PN202 while A PN203). This ratio represents servo scales up or down the pulse frequency sent by CNC system. When B is larger than A, it means scaling up and vice versa. For example, provided the pulse frequency sent by CNC system is 100HZ, if the numerator of electronic gear ratio (B) is set as 1 while the denominator 2, the actual running speed of servo is 50HZ. On the contrary, if the numerator is set as 2 while denominator 1, the actual running speed turns to 200HZ.

Encoder Resolution (F): needed pulse number for one circle of servo motor. 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.

AC SERVO MOTOR		
TYPE SGMSH-10ACA21		
W	N · m	A
1000	3.18	5.7
r/min 3000		9707
S/N V71007-1		-001
YASKAWA ELECTRIC		JAPAN

Motor Type：
TYPE SGMSH-1 0 A C A 2 1
(The 4th character)

The 4th character: serial encoder spec.		
Sign	Spec.	Remark
2	17-bit absolute	Standard
C	17-bit increment	Standard
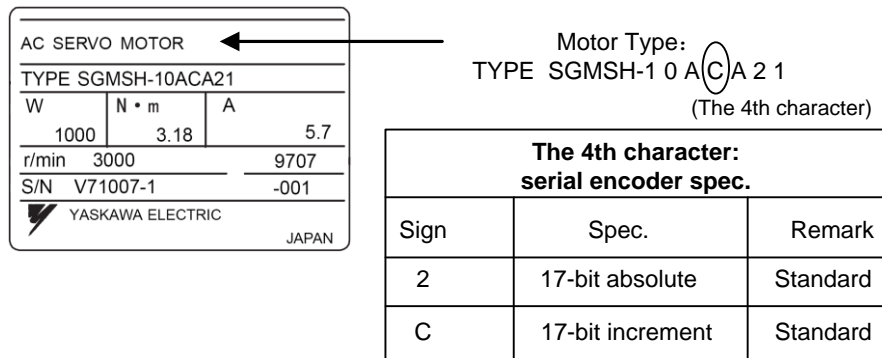
Fig. 3-3 Name plate of servo motor-encoder resolution

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

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

◆ **Rotary Axis**

The pulse equivalent of rotary axis refers to the rotation degree of the axis clamping the workpiece corresponding to each pulse. The difference of rotary axis movement from linear axis movement lies in that the screw pitch of rotary axis is 360 degrees. Therefore, in calculating rotary axis pulse equivalent, you just need to replace screw pitch with 360.

➢ For Stepping Motor

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

➢ For Servo Motor

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

◆ **Related Parameters**

Parameter	Definition	Setting Range
Pulse Equivalent (X)	It refers to the displacement or angle generated on the relative feed axis per control pulse.	0.0001~999 (mm/p)
Pulse Equivalent (Y)		
Pulse Equivalent (Z)		
Pulse Equivalent (A)		

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 on X / Y / Z / A axis 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
Workbench range upper limit (X)	They set the allowable machine coordinate values for the upper limit of the worktable.	Related to actual specifications of the machine
Workbench range upper limit (Y)		
Workbench range upper limit (Z)		
Workbench range upper limit (A)		
Workbench range lower limit (X)	They set the allowable machine coordinate values for the lower limit of the worktable.	Related to actual specifications of the machine
Workbench range lower limit (Y)		
Workbench range lower limit (Z)		
Workbench range lower limit (A)		

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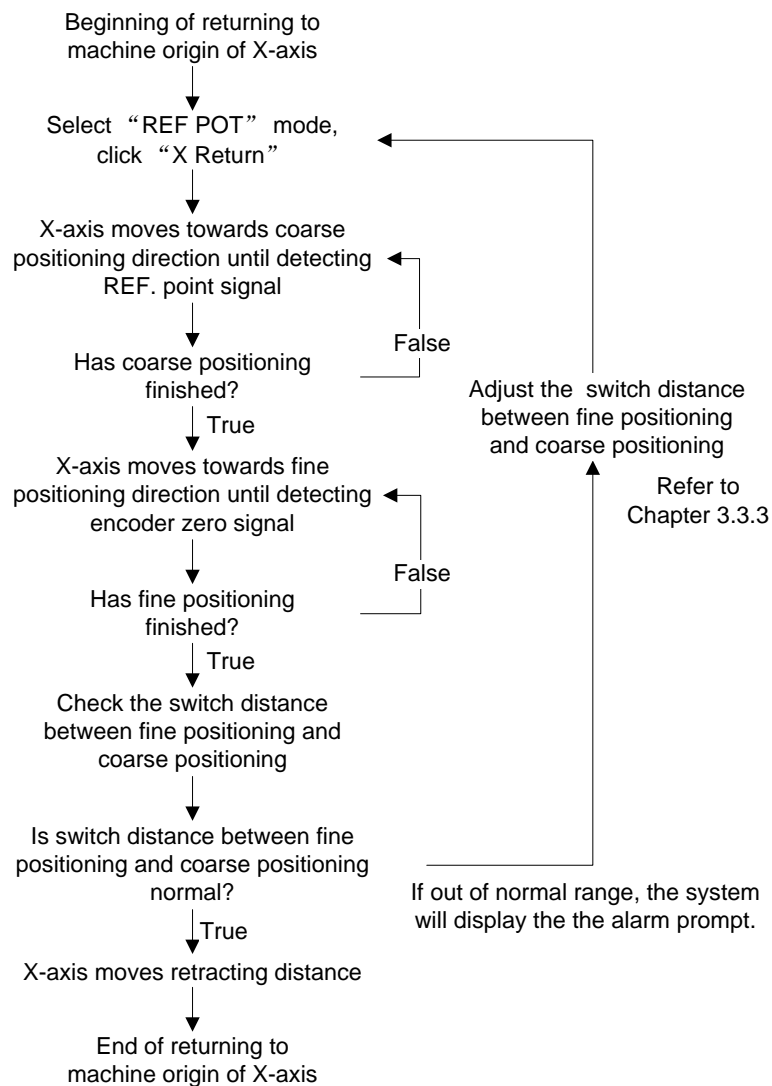
Fig. 3-4 The process of returning to machine origin (X-axis)

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**
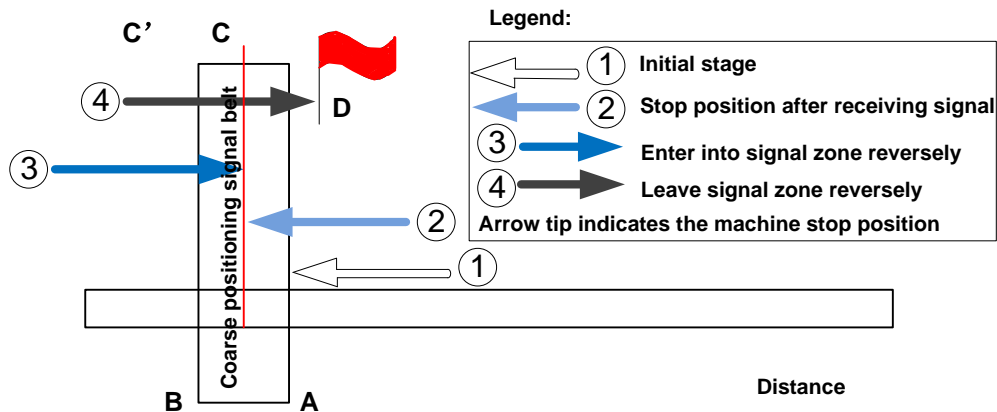
Fig. 3-5 Sketch map of coarse positioning (stopping within the signal belt after receiving coarse positioning signal)
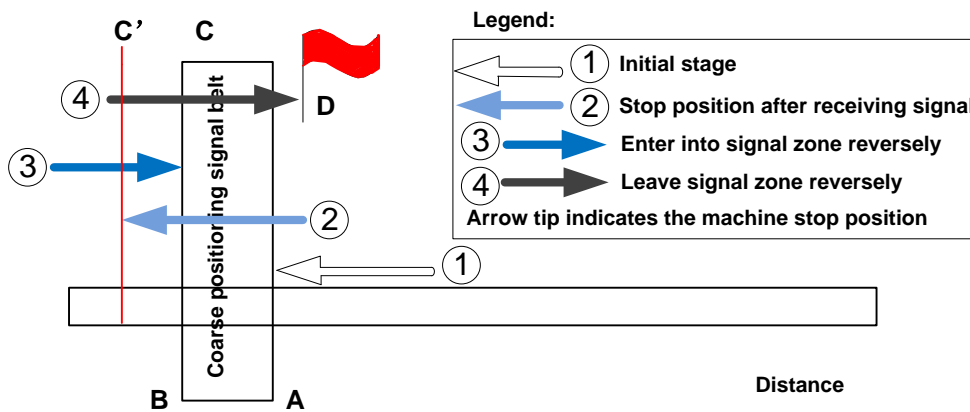
Fig. 3-6 Sketch map of coarse positioning (stopping out of the signal belt after receiving coarse positioning signal)

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

2) The machine will keep moving reversely at one third of coarse positioning speed until receiving REF. point 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 REF. point 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.
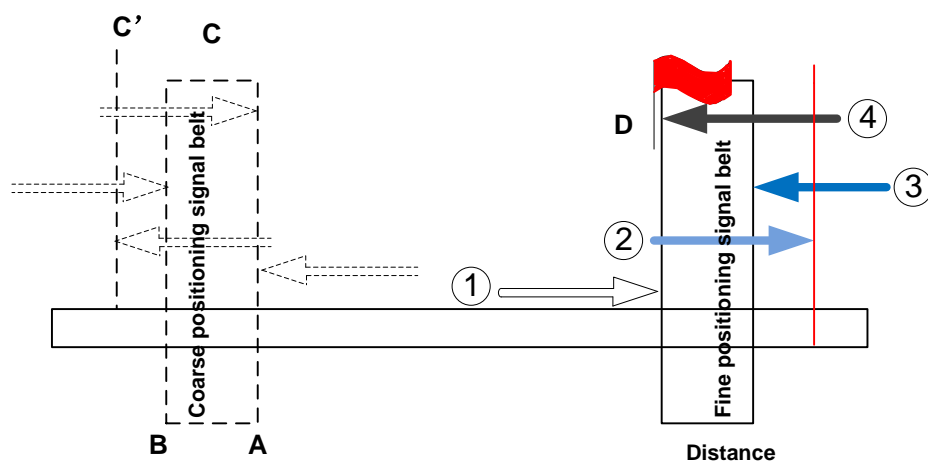
Fig. 3-7 The process of fine positioning

◆ **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.
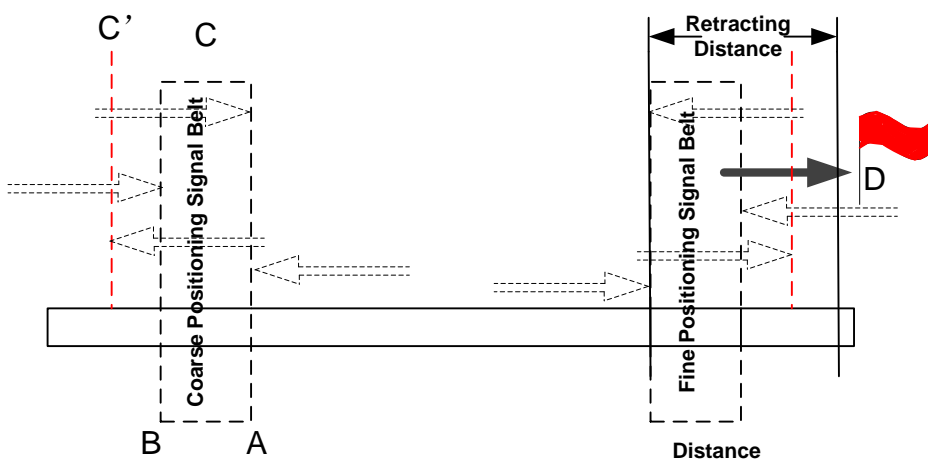
Fig. 3-8 Retracting stage

3.3.2   Parameters Specifications

◆   **Related Parameters of Safe Operations:**

Parameter	Definition	Setting Range
Back to reference point before machining	Whether backing to machine origin before machining is a must or not.	Yes: Required No: Not required
Cancel REF Sign on Estop	Whether the mark of backing to the machine origin will be cleared or not once E-stop occurs.	Yes: Cleared No: Not cleared
Returning to the machine origin before machining can prevent machining offset, ensuring position precision. It is recommended to set "Yes" for parameter "Cancel REF Sign on Estop" so that once E-stop occurs, the mark will be cleared, and the system will remind users to back to machine origin. If "Back to reference point before machining" is set "Yes" and there is no mark "⬤" before each axis, the machine is not allowed to move until backing to machine origin is finished. The parameter can be set "No" when returning to machine origin is impossible due to home switch error.		

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

Parameter	Definition	Setting Range
X direction in backing to reference point Y direction in backing to reference point Z direction in backing to reference point A 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 home switch from any point.	1: positive direction -1: negative direction
Retract distance of X axis Retract distance of Y axis Retract distance of Z axis Retract distance of A 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.	/
X speed in backing to reference point Y speed in backing to reference point Z speed in backing to reference point A speed in backing to reference point	They are the motion speed of machine tool towards the home switch at the stage of coarse positioning.	0.001~MAX Axial Velocity (mm/min)
X speed in exact positioning Y speed in exact positioning Z speed in exact positioning A speed in exact positioning	They are the motion speed of machine tool away from the home switch at the stage of fine positioning.	0.001~MAX Axial Velocity (mm/min)
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		

Parameter	Definition	Setting Range
establish the machine coordinate system. Machine reference point can be coincident with the machine origin (in the default system setting), or not.		

When home switch works normally, if spindle moves away from home switch direction in the process of returning to the machine origin, the value of "X/Y/Z/A direction in backing to reference point" (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 "X/Y/Z/A speed in backing to reference point" (coarse positioning speed) properly. "Retract Distance" refers to a certain moving distance away from origin to leave the signal sensitive zone of home switch after backing to machine origin ends. |||

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

Parameter	Definition	Setting Range
X axis screw pitch	For analysis of the distance between home switch and encoder zero in backing to the machine origin	0.001~9999.9 (mm)
Y axis screw pitch		
Z axis screw pitch		
A axis screw pitch		
Related to specific machine tool, screw pitch of "X/Y/Z/A" should be set after being measured in actual operation.		

3.3.3   FAQ & Troubleshooting

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

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

Detect no REF. point signal in returning to machine origin

↓

Touch the home switch artificially

↓

Whether the circle points ahead of related ports under "port" screen of software interface turn green

True →

False ↓

Check the related indicators of "X0, Y0, Z0, W0" on terminal board

↓

Is the indicator on?

True →

False ↓

Check the home switch between origin and terminal board

Check the wiring of NK280 host and terminal board

↓

Is electric circuit loose?

True

Is wiring loose?

False

True ↓

False ↓

Home switch failure, replace it with a new one

Fasten the connection wiring

Issues settled

Due to software failure (Impossible generally)

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 REF. point signal: when the home switch is normally open, the polarity is "N"; when the home switch is normally closed, the polarity should be "P".

➢ Incorrect parameter settings: please check the parameters "X/Y/Z/A 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 "X/Y/Z/A speed in backing to reference point" is too small.

➢ The polarity setting of REF. point signal in software is mismatching with the home switch type. If the NC-type home switch is adopted and the polarity of REF. point signal is N, the REF. point 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

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 [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:

$$Current\ spindle\ speed = spindle\ speed \times current\ spindle\ override$$

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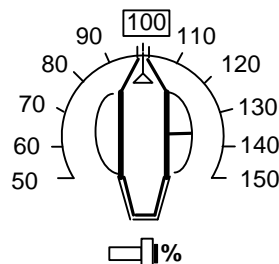
Fig. 3-12 Spindle override selection knob

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
MAX Spindle Speed	The max. allowable rotation speed of spindle (matched with the setting value of inverter)	10000~ 999999 (r/min)
The value of "Spindle Speed" must be less than that of Para. "Max spindle speed"; the max. setting value of rotary speed of the parameter 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 the parameter. $$\text{Real - time voltage of analog SVC} = \frac{\text{spindle setting speed}}{\text{max. spindle speed}} \times 10V \times \text{spindle override}$$			

◆　**Related Parameters**

Parameter	Definition	Setting Range
Spindle start/stop time	Delay time after spindle receiving "start" or "stop" command	0~60000 (ms)
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, 1, 2
X coordinate of fixed point	When the parameter "The action of spindle after process" is set as 1 "move to fixed point", the spindle will stop at the coordinates of the fixed point.	-67108.864~ 67108.864
Y coordinate of fixed point		
Z coordinate of fixed point		
A coordinate of fixed point		
Parameter "Spindle start/stop time" 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 replace a new workpiece.			

◆　**Related Parameters**

Parameter	Definition	Setting Range
Stop spindle while pausing	Whether spindle will automatically stop when machining pauses	Yes: Stop No: Not stop
Stop spindle while stopping	Whether spindle will automatically stop when machining stops	Yes: Stop No: Not stop
Whether to stop spindle at end	Whether spindle will automatically stop when machining task ends	Yes: Stop No: Not stop
This group of parameters sets the spindle action when commands of machining stop/ pause are executed.			

3.5   Port Polarity Adjustment

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 presetter 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 screen [Port (A)] of [System] function area, 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].
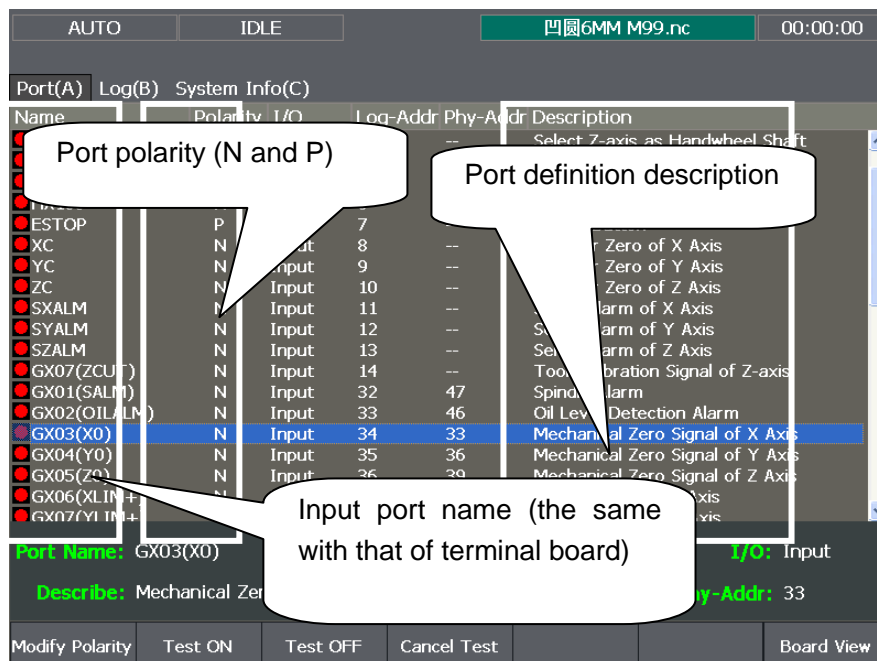
Fig. 3-13 Ports screen

◆ **[Modify Polarity]**

The shortcut key is F1, which is only available on [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 on [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.

> Note:
>
> The indicator lights before ports are slight different in test mode and in real 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 on [Port (A)] screen.

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

◆ **[Board View]**

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

Pressing F7 will display the terminal board screen.

3.6 Tool Measurement

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

With the help of a tool presetter (also called tool sensor or calibration block), tool measurement 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, tool measurement is divided into mobile calibration, fixed calibration, first calibration/calibration after tool change.
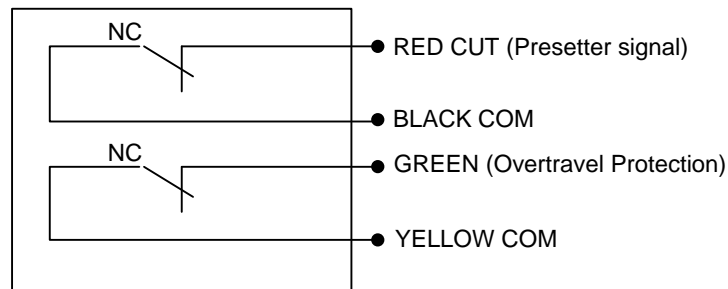
Fig. 3-14 Electrical wiring diagram of tool presetter
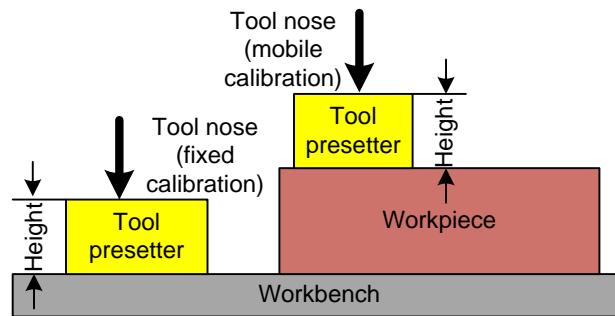
Fig. 3-15 Sketch map of using tool presetter

3.6.1 Software Interface

In auto mode, turn to [Coor-Auto (A)] sub-screen under [State], and press F5 "Tool cali" button to open the "calibration interface", shown in Fig. 3-16, and then pressing "F1, F2, and F5" will execute "first calibration", "second calibration" and "mobile calibration" respectively.

Fig. 3-16 Sub-screen of tool calibration

3.6.2 Mobile Calibration

Mobile calibration can be used to set the workpiece origin of Z-axis, and the thickness of tool presetter is determined by parameter "Cali Block Thickness". System will automatically set the workpiece offset after mobile calibration.

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 mobile calibration is shown in Fig. 3-17.
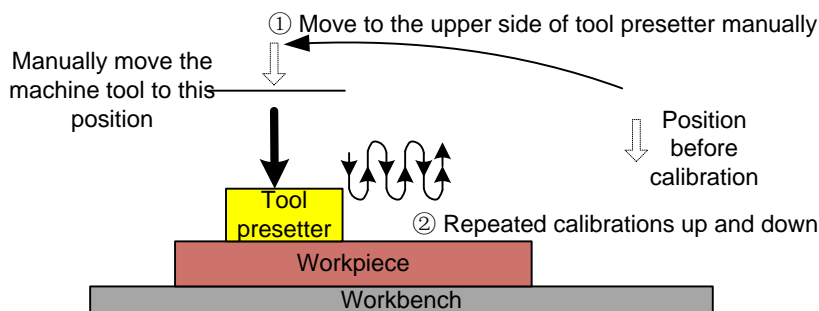
Fig. 3-17 The process of mobile calibration

◆ **Related Parameters**

Parameter	Definition	Setting Range
Cali Block Thickness	Height difference from the top surface of tool presetter to its bottom surface	0~100 (mm)
The measurement method of this parameter is: ➢ Manually move the Z-axis to a certain point over workpiece surface→ shift down its tool nose until reaching the surface of workpiece→ the 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 presetter signal→ system will record the current		

Parameter	Definition	Setting Range
coordinate Z2 of Z-axis		

> Subtract Z1 from Z2, and its result equals to the thickness of tool presetter. Manually enter this value into this parameter.

3.6.3　Fixed Calibration

Fixed calibration 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 calibration and the sketch map of fixed calibration is shown in Fig. 3-18.
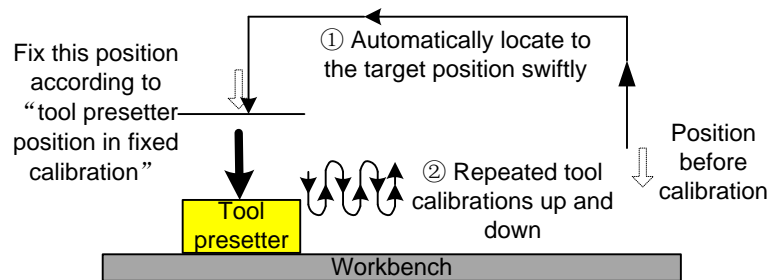
Fig. 3-18 The process of fixed calibration

The process of fixed calibration 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
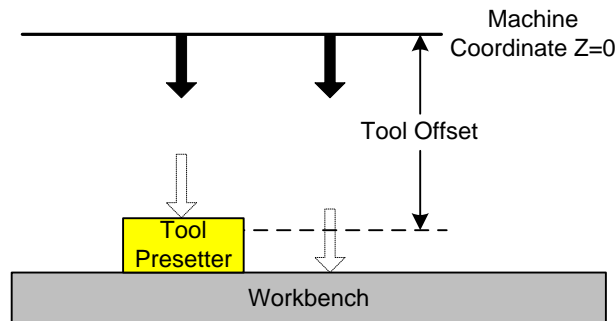
Fig. 3-19 The sketch map of tool offset

The steps of fixed calibration are as below:

1) Select tool according to tool No.;

2) Execute fixed calibration 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
Cali Block Thickness	The height of tool presetter surface in fixed calibration to the workbench surface	0~100 (mm)
X coordinate of fixed cali	The machine coordinates of tool	Negative Travel Limit (MCS) ~

Parameter	Definition	Setting Range
block	presetter position in fixed calibration	Positive Travel Limit (MCS)
Y coordinate of fixed cali block		
Z coordinate of fixed cali block		

The measurement method for parameter "Cali Block Thickness" is as below:
- Manually move the Z-axis to a certain point over the workbench surface→ shift down its tool nose until reaching the surface of workbench→ the system will record 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 presetter signal→ the system will record the current coordinate Z2 of Z axis
- Subtract Z1 from Z2, and the result equals to the thickness of tool presetter in fixed calibration. Manually enter this value into this parameter.

3.6.4 First Calibration/ Tool Calibration after Tool Change

The operation steps are as below:
- Firstly, manually move Z axis to workpiece surface, and then confirm the workpiece origin by mobile calibration or manual clear (the method for manual clear: press F6 [Clear], and then press F4 [Z Clear] in the new pop-up manipulation button bar).
- Secondly, press F5 [Preset], and then press F1 [First Time] to execute the first calibration in the new pop-up manipulation button bar, and the system will record the current machine coordinate value of Z axis automatically, as shown in Fig. 3-20. The system ends this process automatically.
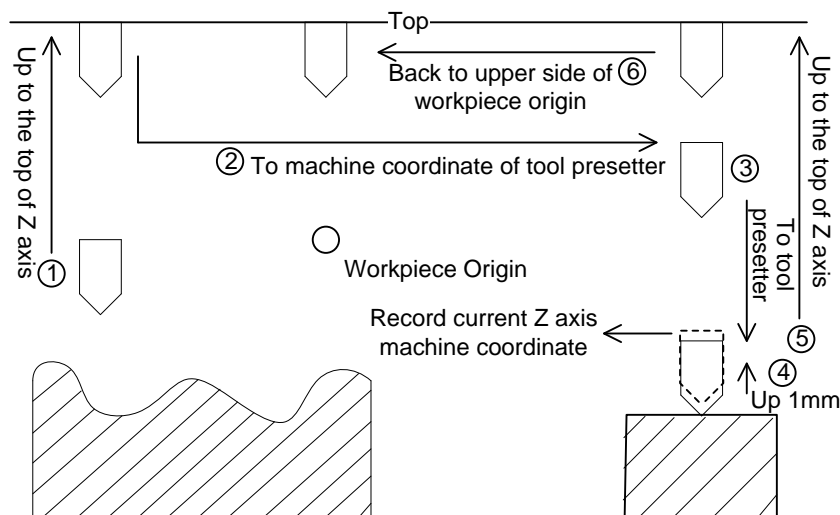
Fig. 3-20 First calibration

- The first calibration finishes and workpiece machining begins.
- After tool change or tool break, press F5 [Preset], and then press F2 [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.
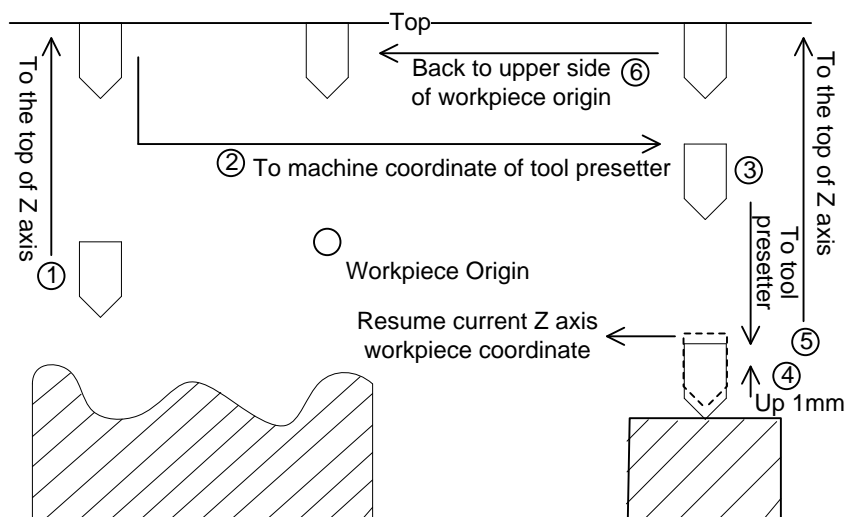
Fig. 3-21 Calibration after tool change

➢ Tool calibration 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 the relationship of workpiece offset and machine coordinate system is shown in Fig. 3-22.
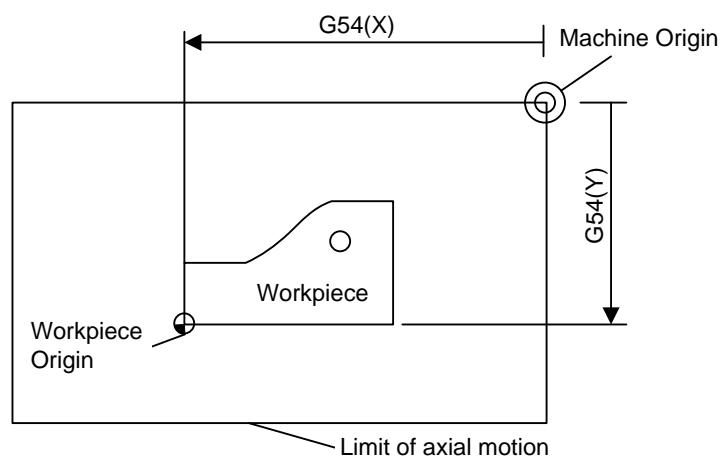
Fig. 3-22 The relationship of workpiece offset and machine coordinate system

One, two or multi-workpiece offset can be used in machining program. As shown in Fig. 3-23, if three workpieces are installed or setup 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.
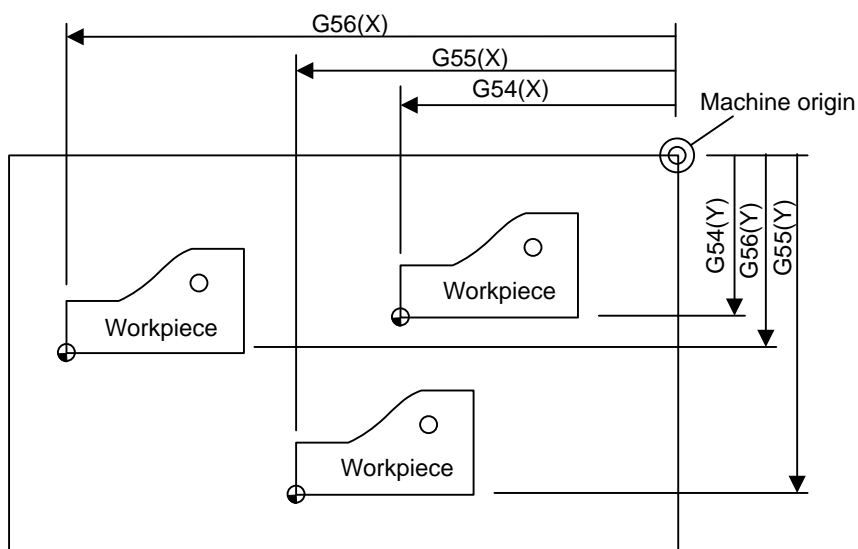
Fig. 3-23 Sketch map

```
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-, and Z-axis, but will not change the workpiece offset value.

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

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

3.7.2   Extended WCS

The NK280 system offers as many as 20 groups of extended WCSs, also called additional WCSs. That means, totally 26 (6+20) WCSs can be supported. To put it in other words, there are 26 WCSs can be defined in programming. Besides, the extended WCSs is additional WCSs for G54, from G54 P0 to G54 P19.

You can use PgUp and PgDn keys to view all extended WCSs on [Coor-Manage(A)] screen.

G54 Px command can be used to select the extended WCS, and "x" here refers to number 0~19.

E.g,

G54 P0   Select the extended WCS 1, corresponding to G154 on the screen.
G54 P1   Select the extended WCS 2, corresponding to G155 on the screen.
G54 P2   Select the extended WCS 3, corresponding to G156 on the screen.
G54 Px   Select the extended WCS (x+1), corresponding to G(154+x) on the screen.
G54 P19   Select the extended WCS 20, corresponding to G173 on the screen.

3.7.3   Software Interface

Press [Advanced], and then press A to enter the [Coor-Manage] screen, as shown in Fig. 3-24. This screen is mainly for selecting current WCS and modifying workpiece offset and public offset.

Fig. 3-24 Coor-Manage screen

NK280 altogether supports 26 WCSSs, i.e. G54 ~ G59 and G154 ~ G173. In [Coor-Manage] screen, the displayed WCSSs are G54 ~ G59 by default. To switch to G154 ~ G173, you can press the PgUp and PgDn keys. If you want to change the value of workpiece offset and public offset, you can press " ↑ ", " ↓ ", "←" and "→" to move the cursor onto the value, press Enter and then input the desired value into the input box. For Z-axis public offset, you can also directly press F6 or F7 on the host to modify its value.

See below for the details of the manipulation buttons on the [Coor-Management] screen.

◆ **Select WCS**

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

◆ **Set X, Set Y, Set Z, Set A**

Press F2 [Set Workpiece] button in Fig. 3-24 to open the secondary manipulation buttons on the lower part, as shown in Fig. 3-25.

Fig. 3-25 Set Workpiece on [Coor-Manage(A)] screen

Pressing shortcut keys F1, F2, F3, F4 will pop out an input box for entering X/Y/Z/A workpiece offset.

Press F7 to return to the previous screen.

◆ **SelectDistance, Deepen, Lift**

Pressing the shortcut key F5 of "SelectDistance" in Fig. 3-24 will change the value of "Lift and Deepen Height of Z-axis", with five options, which are 0.01mm, 0.10mm, 0.50mm, 1.00mm and 5.00mm.

Pressing the shortcut key F6 of "Deepen" in Fig. 3-24 will move down Z-axis workpiece origin by "Lift and Deepen Height of Z-axis" distance. The moving distance will be accumulated accordingly with the press times of F6.

Pressing the shortcut key F7 of "Lift" will move up Z-axis workpiece origin by "Lift and Deepen Height of Z-axis" distance. The moving distance will be accumulated accordingly with the press times of F7.

Both "Deepen" and "Lift" only modify public offset of Z-axis.

3.8   Centering

NK280 system only supports line centering.

Line centering, i.e. two-point centering, refers to the process of locating the midpoint of a line connected by two points, mainly used for locating the center of a regular workpiece and make it the part origin (also called workpiece origin) in machining.

In manual mode, usually in handwheel mode (because on most occasions, operators use handwheel to conduct centering operation), press [Advanced], and then the letter "B" to enter the "Centering (B)" screen. See Fig. 3-26.

Fig. 3-26 Centering interface

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

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

2) Move the cutter to the other side of workpiece, and then press F2 [X Centering] to calculate the midpoint coordinate based on the coordinate of current position and the 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 still.

3.9　Adjustment of Velocity & Acceleration

3.9.1　Feedrate Setting

Feedrate can be set directly on the system interface, or through changing the value of parameter "Machining Speed (GXX)".

In the function area of [State] in auto mode, the feed rate can be directly specified on the parameters setting region above the manipulation button bar, shown in Fig. 3-27.
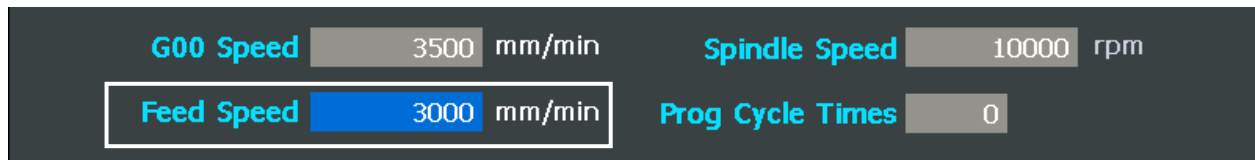
Fig. 3-27 Parameters setting area-feed speed setting

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

When the parameter "Use Default Speed" is set to "YES", the system will use the feedrate set in the system, i.e. the value of "Feed Speed"; when set to "NO", the system will use the feedrate specified by the F code in the loaded machining file.

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) = Set feed value X Current feedrate override

The feedrate override selection knob is on operation panel, shown in Fig. 3-28.
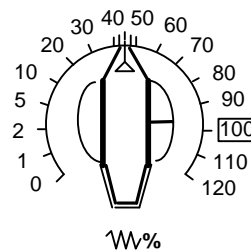
Fig. 3-28 Feedrate override selection knob

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

3.9.2　Traverse Speed Setting (G00 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. 3-29, or through changing the value of parameter "Dry running speed (G00)".

Fig. 3-29 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.

◆ **Related Parameters of Velocity**

Parameter	Definition	Setting Range
Manual High Speed	There are two speed modes for option under manual mode: jog feedrate and rapid jog feedrate, which can be switched by pressing the acceleration key. The system default running speed mode is jog feedrate mode.	Manual Low Speed ~ MAX Axial Velocity (mm/min)
Manual Low Speed		0.001~ Manual High Speed (mm/min)
Dry running speed (G00)	It refers to the feedrate specified by command G00.	-
Machining Speed (Gxx)	It refers to the feedrate specified by command Gxx.	-
Startup Speed	The minimum speed in machining.	0~Z-axis Approach Speed (mm/min)
Full feedrate for G00	When it is set as "Yes", G00 override will be not controlled by the override switch, but fixed at 100%.	Yes: Valid No: Invalid
Feedrate is valid for manual mode	When it is set as "Yes", feedrate override is adjusted in manual operation; "No", feedrate override is fixed at 100%.	Yes: Valid No: Invalid
Use Default Speed	When it is set as "Yes", the system will not adopt feedrate specified by the F code in the loaded machining file, but use the feed speed set in the system.	Yes: Valid No: Invalid
Use Default Spindle Speed	When it is set as "Yes", the system will not adopt spindle speed specified by the S code in the loaded machining file, but use the spindle speed set in the system.	Yes: Valid No: Invalid
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 (mm)
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~Default Feedrate (mm/min)
MAX Axial Velocity (X)	It specifies the max. allowable speed of X axis.	0~6000000 (mm/min)
MAX Axial Velocity (Y)	It specifies the max. allowable speed of Y axis.	0~6000000 (mm/min)
MAX Axial Velocity (Z)	It specifies the max. allowable speed of Z axis.	Z Down Feedrate Limitation~6000000 (mm/min)
Limit Max Velocity for small line	When it is set as "Yes", the system will eliminate the fluctuation of speed when machining short line segments.	Yes: Valid No: Invalid
Length for Limit Max Velocity	Short line segments shorter than the value of this parameter will be treated with velocity smoothing.	0.001~100000 (mm)
Parameter "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 working startup without acceleration of motor.		

Parameter	Definition	Setting Range
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". 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.		

◆ **Related Parameters of Acceleration**

Parameter	Definition	Setting Range
Single Axis Acc	The max. acceleration of each axis in machining.	$0.001 \sim 100000$ (mm/s^2)
Single axis acceleration includes "Axis Acceleration" and "Dry Run Acceleration", 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.		

◆ **Related Parameters of Reference Circle, Circular Speed Limit**

Parameter	Definition	Setting Range
Reference Circle Speed	The max. velocity when machining a circle 10mm in diameter.	$5 \sim 99999$(mm/min)
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. $$a = \frac{V_0^2}{R_0} = \frac{V_x^2}{R_x}$$		

◆ **Related Parameters of Interpolation Algorithm**

Parameter	Definition	Setting Range
Whether to use type S algorithm	Whether to enable the type S algorithm or not in interpolation.	Yes: enable; No: not enable
Currently, the system supports velocity triangle algorithm and velocity S-type algorithm. When S-type algorithm is adopted, the system max. acceleration will reach the twice of the single axis acceleration set in the system. At this time, setting a smaller value for parameter "Single Axis Acc" is recommended.		

3.10 Simulation & Track

3.10.1 Simulation

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

Running in 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 on [Local Program (A)] screen under [Program] function area to select a machining file, and then press F1 [Load] to load the file;

| AUTO | IDLE | 凹圆6MM M99.nc | 00:00:00 |

Local Program(A) USB File(B) Prog Wizard(C)

File Name	Notice:'SHIFT+BKSPC' to refresh List	File Size(K)	Modification Time
11.nc		1	2037-1-15 12:23
凹圆6MM M99.nc		2268	2020-1-5 10:13
test.nc		1	2020-1-5 9:30
复件 (2) 11.nc		1	2020-1-5 10:10
33333.NC		1	2020-1-5 10:16
复件 33333.NC		1	2020-1-5 9:7
毛泽东精雕.nc		12162	2020-1-7 9:39

Local File Path: 凹圆6MM M99.nc
Local Disk Space: 206M/229M   Progress:

| Load | Unload | Delete | Edit | Rename | Copy to USB | New |

Fig. 3-30 Program file window

2) Press F1 [Simulate] under [Motion Trace (B)] sub-function screen of [State] function area 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.
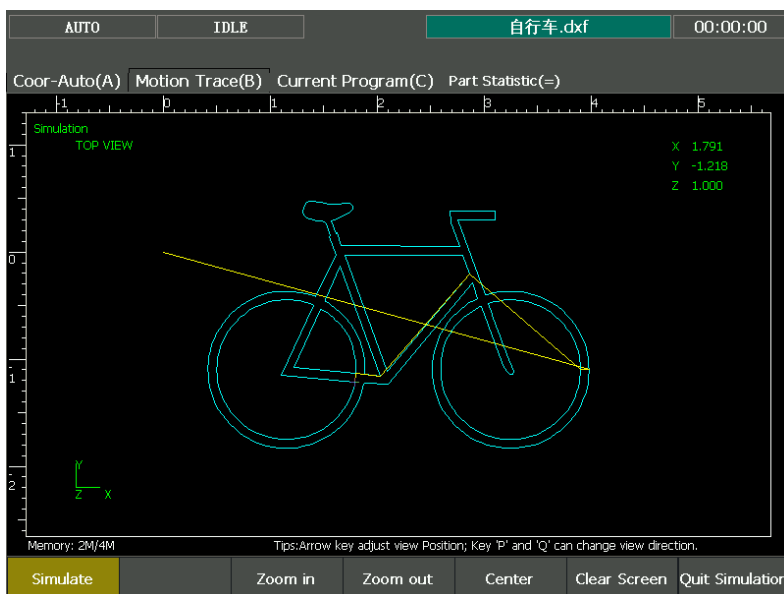
Fig. 3-31 Simulation track
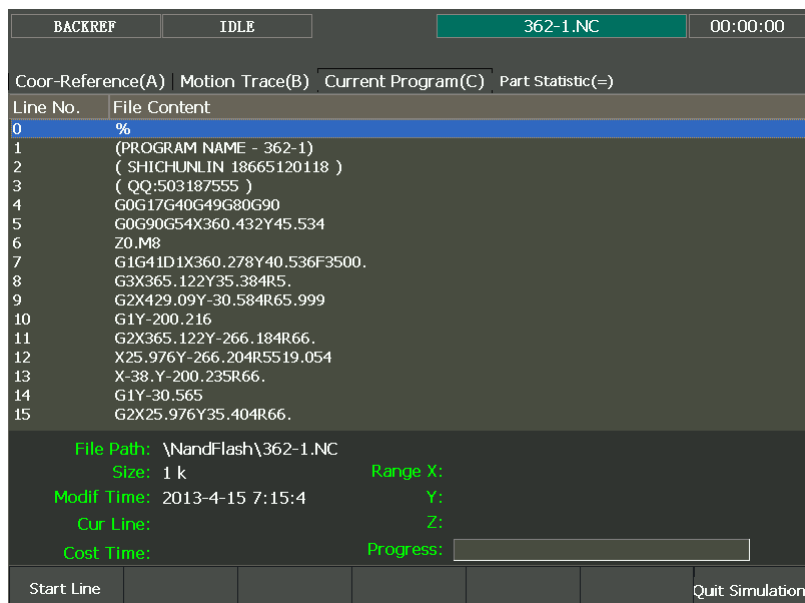
Fig. 3-32 Current program screen

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 Screw Error Compensation

◆ **Related parameters are:**

Parameter	Meaning	Setting Range
Screw Error Comp	Decides whether to execute screw error compensation, including unilateral compensation and two-way compensation.	0: No compensation; 1: Single compensation; 2: Double compensation
Backlash Compensation valid	It sets whether to enable backlash compensation.	Yes: Valid No: Invalid
Backlash	It sets the value of backlash of each axis, only valid when parameter "Backlash Compensation Valid" is set "Yes".	0~1000 (μm)
If parameter "Screw Error Comp" is set as "0", and parameter "Backlash Compensation valid" as "Yes", only backlash compensation is activated.		
If parameter "Screw Error Comp" is set as "1", and "Backlash Compensation valid" as "Yes", backlash compensation and unilateral error compensation are activated, used when backlash is relatively constant; if "Screw Error Comp" is "2", forward error compensation and backward error compensation are executed together, used when backlash is not constant.		

◆ **Concept and Principle**

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

◆ **Pitch Compensation:**

Pitch error is caused by defect in manufacturing of screw and long-term wear, etc. In order to improve precision, pitch compensation is needed. The sketch of screw is shown in Fig. 3-33. A coordinate system is established, based on "0" point on the screw as the reference point, nominal value as X-coordinate, and actual value as Y-coordinate. Then ideal moving curve is as curve "1" in Fig. 3-34, 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
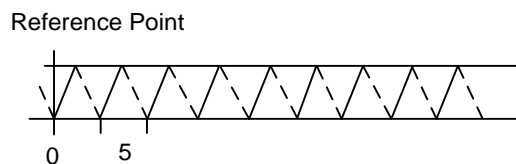
Fig. 3-33 Sketch of screw
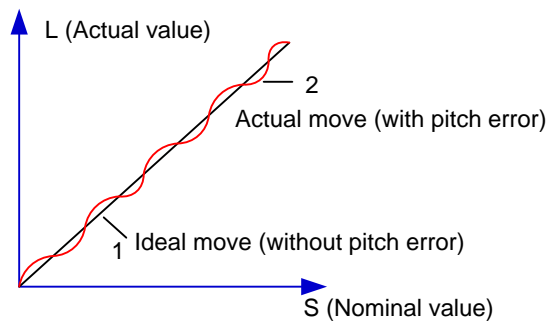
Fig. 3-34 Picture of moving curve

◆ **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. 3-35, and the curve of horizontal area is during the idling of servo motor without worktable movement. The actual moving curve of worktable is shown in Fig. 3-36.
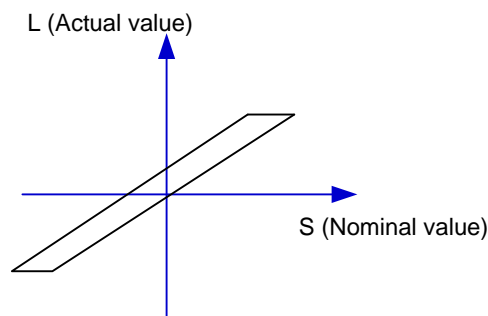
Fig. 3-35 Hysteresis feature
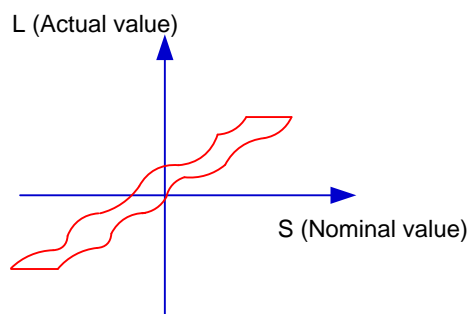
Fig. 3-36 Actual moving curve

The popular explanation is: because the slider is generally fixed on the screw whose outer wire and the inner wire on the outer wire cannot be completely matched, backlash compensation compensates the clearance between the 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).

◆ **Screw Error Compensation File**

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

The name of 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 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 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 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 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 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 screw error compensation file, refer to its introduction in 3.11.1.

2) Directly setting compensation on the interface. Turn to [Compensation (=)] screen under [Parameters] function area, then press F7 (Leadscrew button), and then press F3 to set the compensation parameters, as shown in Fig. 3-37.

Fig. 3-37 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.

> Note:
>
> 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 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.
>
> You can generate a measuring and test tool path file to assist laser interferometer working with the help of "Laser Screw Wizard" function on [Program Wizard] screen under [Program] function area.

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. 3-38) if tool nose radius is altered after tool wear, tool sharpening or tool change, avoiding the trouble to modify the programmed processing procedure.

Number	Diameter	Dia_Wear	Length	Len_Wear	X Offset	Y Offset	Z Offset
ToolN01	0.000	0.000	0.000	0.000	0.000	0.000	0.000
ToolN02	0.000	0.000	0.000	0.000	0.000	0.000	0.000
ToolN03	0.000	0.000	0.000	0.000	0.000	0.000	0.000
ToolN04	0.000	0.000	0.000	0.000	0.000	0.000	0.000
ToolN05	0.000	0.000	0.000	0.000	0.000	0.000	0.000
ToolN06	0.000	0.000	0.000	0.000	0.000	0.000	0.000
ToolN07	0.000	0.000	0.000	0.000	0.000	0.000	0.000
ToolN08	0.000	0.000	0.000	0.000	0.000	0.000	0.000
ToolN09	0.000	0.000	0.000	0.000	0.000	0.000	0.000
ToolN010	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Para name: TOOL G1 DIA   Value: 0.000   Effective time: Immediately
Description: TOOL DIA
Tip:Press the UP or DOWN keys to select parameter,ENTER key to modify it,Flip key for pages

Fig. 3-38 Tool parameters screen

To make tool compensation (including tool diameter compensation and tool length compensation) effective, parameter "4500 turn on radius compensation" should be set as "Yes". Code G43 (positive offset) and G44 (negative offset) are used for tool length compensation; G41 (left compensation) and G42 (right compensation) for tool radius compensation; G40 (cancel tool radius compensation) and G49 (cancel tool length compensation) are used for canceling tool compensation.

Only when tool compensation codes and G00/G01 are used together can the tool compensation be enabled.

◆ **Related Parameters:**

Parameter	Meaning	Setting Range
Turn on radius compensation	Setting whether to perform tool compensation	Yes: Valid No: Invalid
Specify the type of tool compensation	1: General mode; 2: Intersect mode; 3: Insert mode	1,2,3
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)

◆ **Tool compensation types**

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

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

1) Normal type: this type sets the end point of tool compensation establishment segment (segment3) as the start point of next offset, not available to arc command.

2) Intersect type: this type generates the tool compensation path on the basis of the calculated point of interarea of the tool compensation establishment segment (segment 3) after offset and first machining segment after offset, i.e. the point of interarea of green segments 1 and 2.

3) Insert type: this type inserts a segment from the start point of tool compensation establishment segment before offset to the start point of establishment segment after offset. It is available to arc command as well, but machining efficiency will be affected since an extra segment needs to be completed.
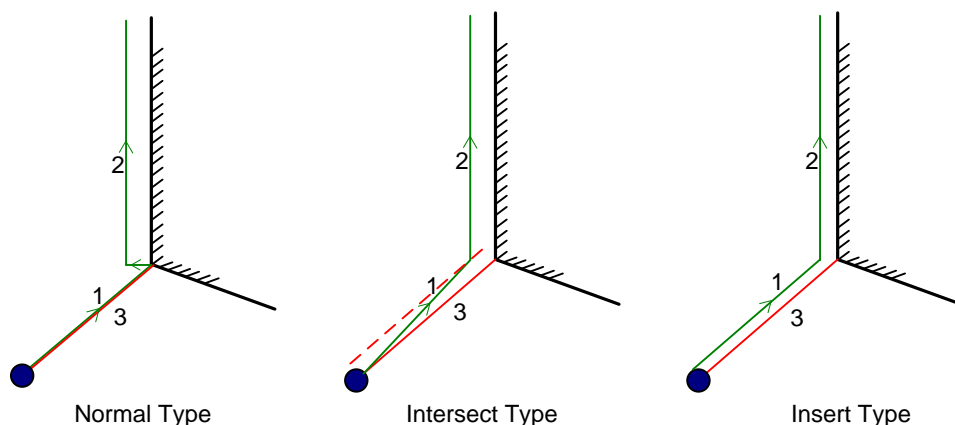
Fig. 3-39 Types of enabling tool compensation

◆ **Direction of tool compensation**

The schematic diagram of tool compensation direction is as shown in Fig. 3-40.
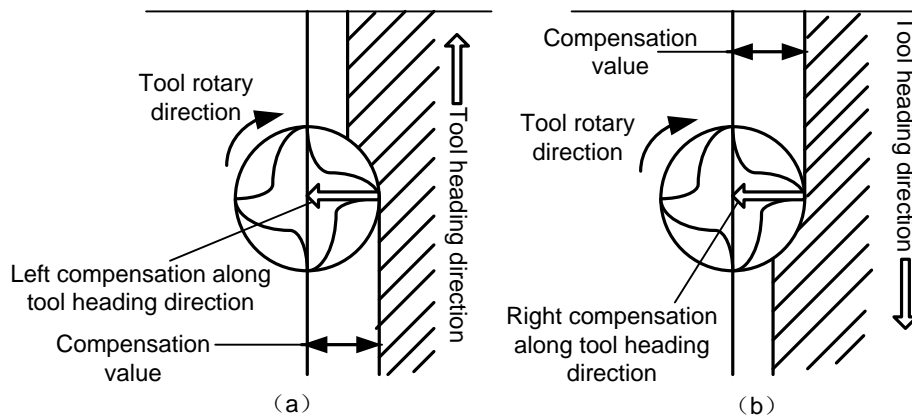
Fig. 3-40 Direction of tool compensation (a: left compensation b: right compensation)

Programming for tool radius compensation is as shown in Fig. 3-41:
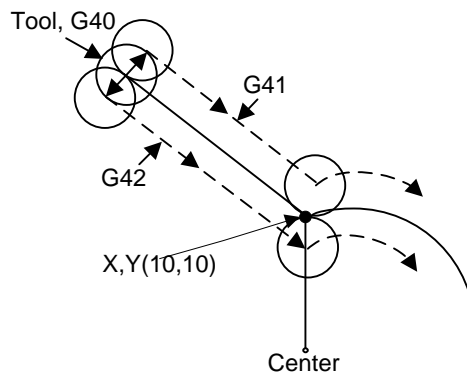
Fig. 3-41 Schematic diagram of tool compensation processing

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 mm/min. 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 a circle is processed, distortion, like a spike, may occur at the transition position from one quadrant to another one. AQE (across quadrant error) compensation can solve 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.

◆   **Related Parameters:**

There are altogether 12 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
Enable AQE compensation	Whether to enable AQE compensation	Yes: Valid No: Invalid
AQE compensation time	-	0 ~ 0.3 (sec)
AQE compensation length	-	0 ~ 10 (mm)
Delay time of AQE compensation	-	0 ~ 10 (sec)
Intensity of AQE compensation	-	0 ~ 1

To enable AQE compensation, set parameter "Enable AQE compensation" as "Yes".

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 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 area, and then press letter key B to enter [Log] sub-function screen.

As shown in Fig. 3-42, [Log] screen under [System] function area 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. 3-42 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

NK280 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 achieve the desired result.
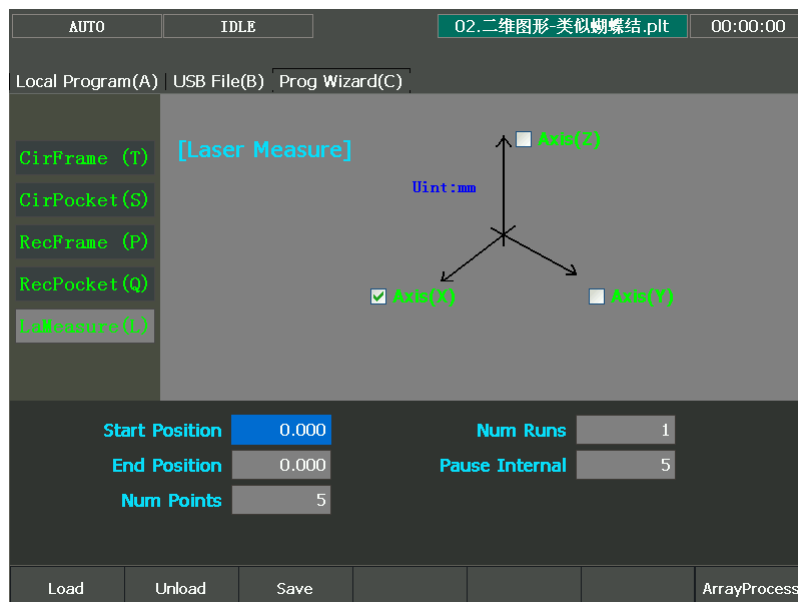
Fig. 3-43 Laser measure screen

[LaMeasure]: the wizard for 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.

> Note:
>
> 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 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. 3-44. 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. 3-44 Part statistic screen

3.13.3 Program File

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

[Local Program] is the default screen after entering [Program File] function area, as shown in Fig. 3-45. 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". Besides, you can press combination key "Shift+Bkspc" to refresh the file list on the screen.

Fig. 3-45 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 cannot 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 switch to edit page. You can enter the program here. See Fig. 3-46.
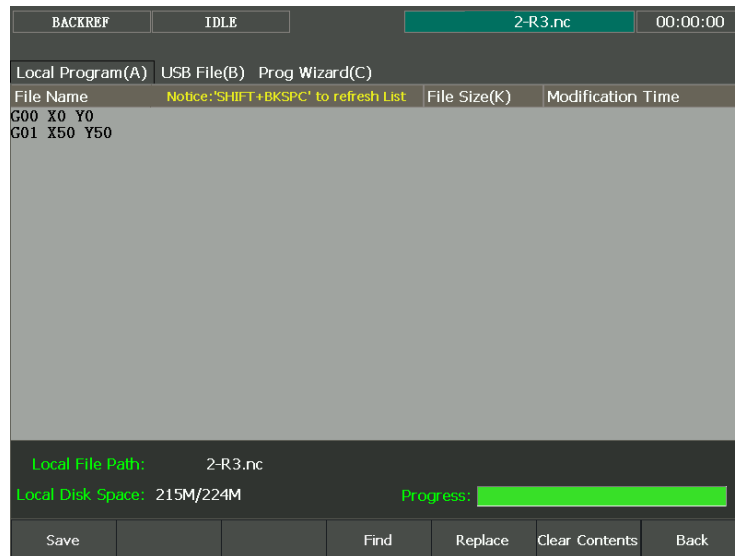
Fig. 3-46 New program

After finishing entering the program, you can press F1 "Save" to save the program. Enter the program name (all in capital letters) in the pop-up dialog, as shown in Fig. 3-47, and then press Enter for confirmation.
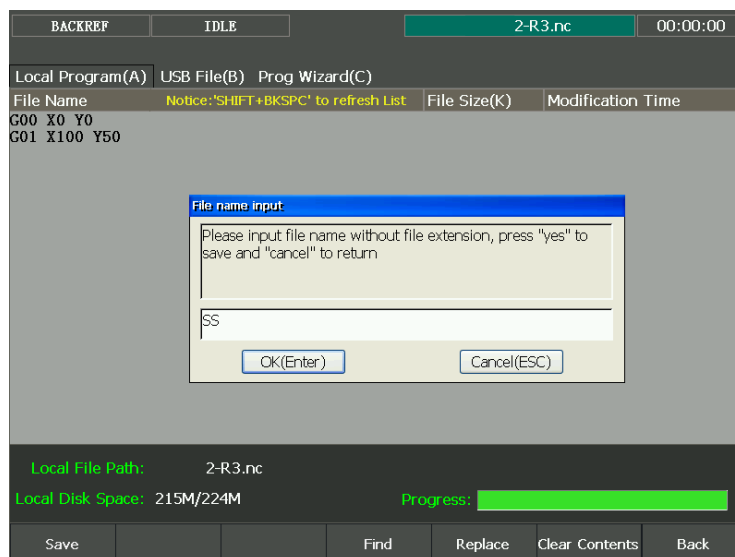
Fig. 3-47 Save program

If you want to look for a certain program block, you can press F4 "Find". Enter the find content, and then press "Enter". In the "Find" page, you can press F5 "Next" to look for the next one, or F7 "Back" to go back. See Fig. 3-48.
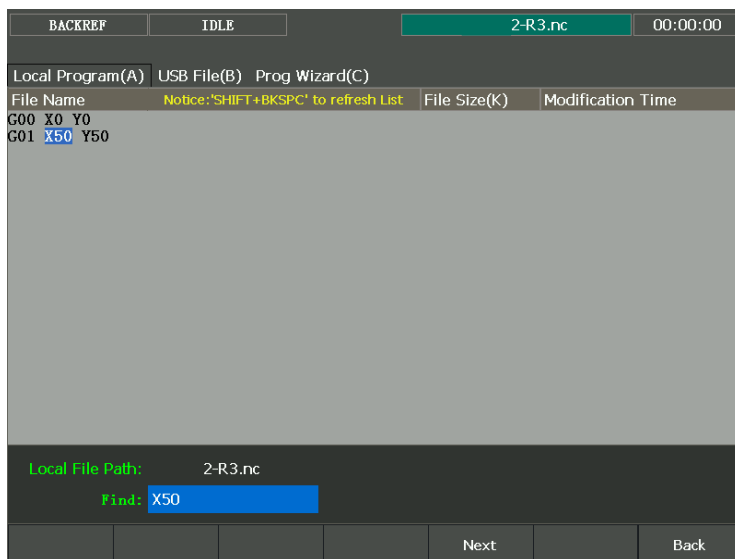
Fig. 3-48 Find page

If you want to replace a certain program block, you can press F5 "Replace". Enter the find content and replace content, and then press "Enter". In the replace page, press F6 "Replace" to replace the find content with the replace content, and then press F5 "Next" to find the next place, and then press F6 to execute replacement. You can continue this process until all the find content are replaced by the replace content, or press F7 "Back" to go back. See Fig. 3-49.
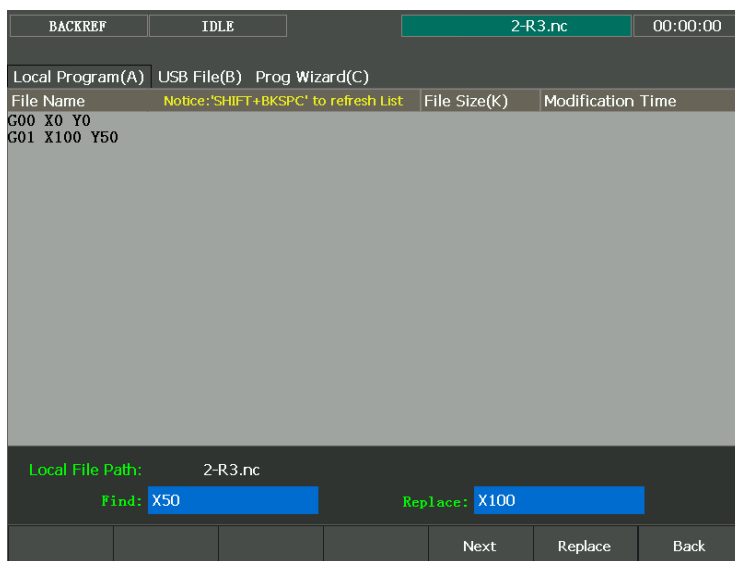
Fig. 3-49 Replace page

If you want to clear the contents in the edit page, you can press F6 "Clear Contents".

◆ **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 (B)] screen, as shown in Fig. 3-50, 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". Folders can be opened by pressing "Enter".

Fig. 3-50 USB file screen

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

Parameter	Meaning	Setting Range
Tool lifting height	It sets the tool lifting height during rapid traverse.	0~99999 (mm)
Machining depth	It specifies the processing depth for 2D files.	-99999~0 (mm)
Use first point as zero point	It sets whether to set the firstly met coordinate point as zero point when DXF file is processed.	Yes: Use the first point as zero point No: Not use the first point as zero point
Shape separate processing_valid	It sets whether the system will completely process the last workpiece before machining the next one(s).	Yes: Valid No: Invalid
Bottom machining valid	Valve operation is enabled only when [2D cutting] is on the workpiece surface.	Yes: Valid No: Invalid
Use dxf file as metric size	It forcibly sets dxf file as metric size.	Yes: Forcibly set as metric size No: 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 "Shape separate processing valid" is set as Yes, 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 No, 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
Select tool for ENG	If this parameter is set as Yes, 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.	No: Not use Yes: Use
Select tool for ENG	Only available for ENG5.50 and 5.53.	No: Not use Yes: Use
Tool change prompt	If it is set as Yes, when tool change command is 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 No, when tool change command is encountered, machine tool will not suspend processing, but the prompt bar in the system will still prompt tool change.	No: Invalid Yes: Valid
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.	0~100000 (mm)
Retract amount	It indicates the retract value after feed each time in manner of high-speed reciprocating chip removal for deep hole drilling.	0~100000 (mm)
Cycle times of ENG processing	It sets the cycle times to process an Eng file.	/
Deep hole machining manner	It sets the manner for processing deep holes.	0: Reciprocating chip removal 1: High-speed reciprocating chip removal
Translation parameters of ENG file are applied to translation for ENG files, including "Tool lifting height", "Tool change prompt", etc.		

◆ **Translation Parameters of PLT File**

Parameter	Meaning	Setting Range
Tool lifting height	It sets the tool lifting height during rapid traverse.	0~100000 (mm)
Plt unit	Normally, 1plt=40.195mm, which can be magnified or reduced by setting this parameter.	0~100000 (mm)
Tool step	To process the workpiece adequately, tool spacing set needs to make the parts between the adjacent tool paths overlapped based on the tool diameter. Tool step here refers to the tool spacing in PLT file machining.	0~100000 (mm)
Machining depth	It specifies the machining depth for 2D files.	/
PLT file translation parameters are applied to translation of PLT files. PLT is a format of 2D machining files defined by an American company Hewlett Packard (HP), usually used in embossment and advertising carving, including such parameters as "retract", "PLT units", "tool offset" and "cutting depth". At the same time, PLT is a kind of unit. Normally, 1plt=40.195mm, which can be magnified or reduced by setting the parameter "PLT unit".		

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.

In handwheel mode, users can configure a handwheel to control the machine tool. As shown in Fig. 3-51, 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. 3-51 Handwheel

3.14.2　Handwheel Guide

NK280 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. 3-52 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. 3-52 Handwheel guide interface

3.15　System Management

3.15.1　System Info

As shown in Fig. 3-53, view the related information (including CNC software information and CNC hardware information) of NcStudio in [System Info (C)] screen of [System] function area. Pressing letter key C will enter [System Info] function screen.
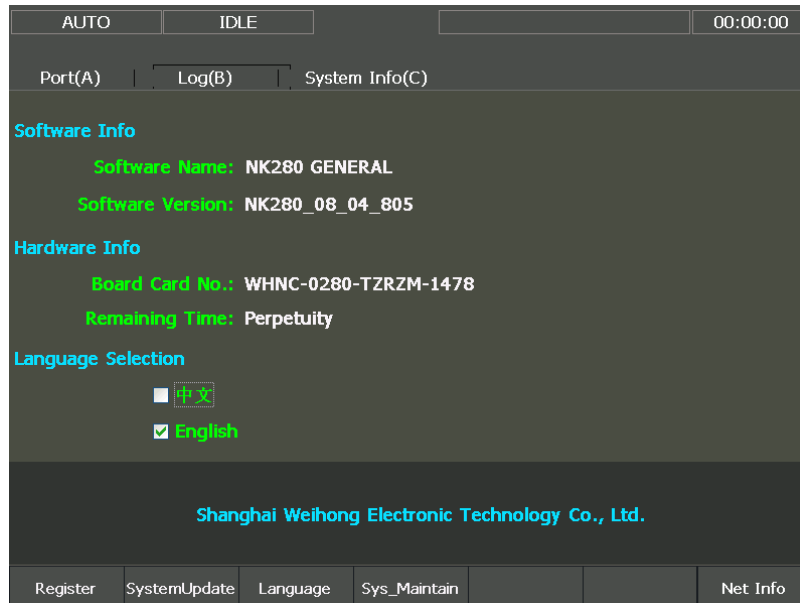
Fig. 3-53 System info screen

3.15.2　Network Connection

NK280 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 area 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 area, "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) Learn the info of board card no. in [System Info (C)] of [System]. See Fig. 3-53.

2) Double click the registration code maker "GetRegCode.exe", and then enter the password "ncstudio" (revisable) in the dialog box as shown in Fig. 3-54. Then press "OK", input board card no., registered times and limited service time, and then click "Generate" to generate the new code displayed at the lower part, as shown in Fig. 3-55. If service time does not need limiting, input "-1" in the "limited time" bar to generate an unlimited code.
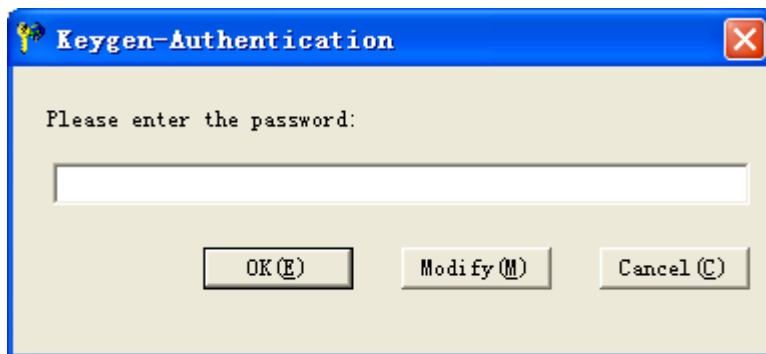
Fig. 3-54 Registration code maker-1

Fig. 3-55 Registration code maker-2

3)   Press F1 [Register] in [System Info (C)] screen of [System] function area, then input the registration code generated in the second step into the pop-up dialog, and then click "OK".

4)   The system prompts "register successfully". You can restart the system according to the tip. After restarted, you can check and view the remaining usage time under [System Info(C)] screen.

> Note:
>
> The ID of NK280 varies with the change of registration times, reflected by the last three figures of serial number. When registration times is "0", the last three figures are "000"; when "1", the last three figures are "001".
>
> ID (registered times) must be entered.

3.16 Network Connection and Share

To enable network connection function of NK280, the computer and NK280 should be connected in the same local area network via a network cable, ensuring the computer able to ping with NK280.

3.16.1 IP Setup

After opening NK280, set IP address to establish a network connection channel between the computer and NK280, requiring the computer in the same subnet with NK280. 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

◆ **NK280 IP Setup**

Click the letter key C to enter [System Info(C)] screen, as shown in Fig. 3-56.
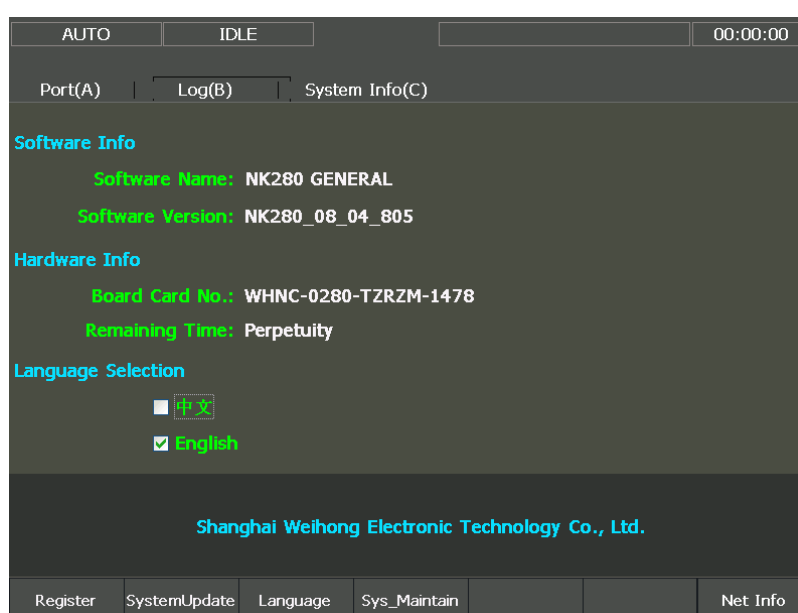
Fig. 3-56 system information

Clicking "Net Info" will eject a dialog as shown below.

Fig. 3-57 System Info screen- Net Info

Clicking "IP set" will eject a dialog requiring input of password, as shown in Fig. 3-58.
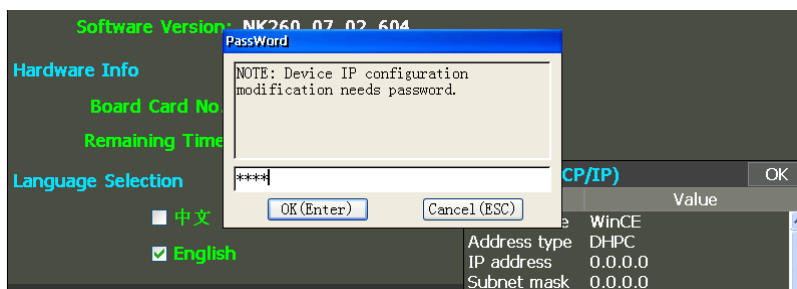
Fig. 3-58 System Info screen- Password input

After password is entered correctly, IP setup page will be accessed, as shown in Fig. 3-59.
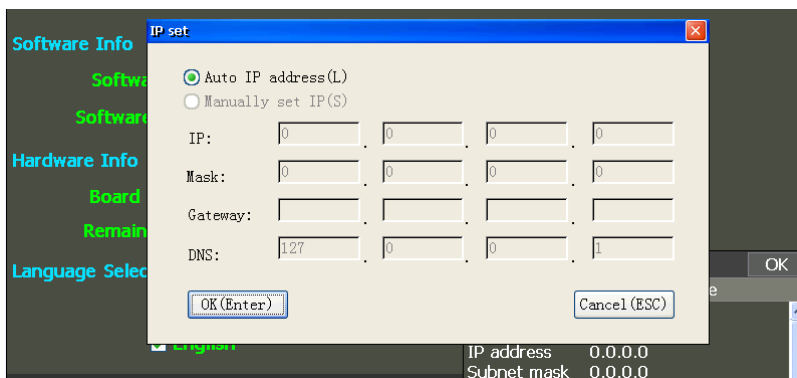
Fig. 3-59 IP setup page- Obtain IP address automatically

Pressing the letter key S will select "Set IP address Manually", as shown in Fig. 3-60.
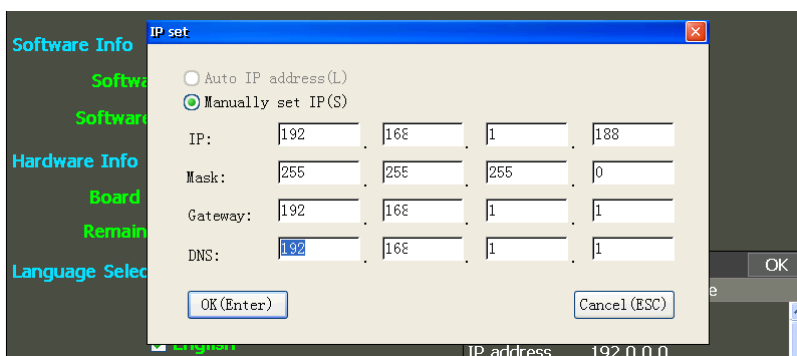
Fig. 3-60 IP setup page- Set IP address manually

Enter the following three address types in Fig. 3-60.

➢ 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. 3-61. (For the first time setting, it is necessary to power off and to restart NK280.)

Fig. 3-61 System Info screen- new net info

◆ **PC IP Setup**

Find "internet Protocol (TCP/IP) in Fig. 3-62, and then double click it to enter Fig. 3-63. 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.)
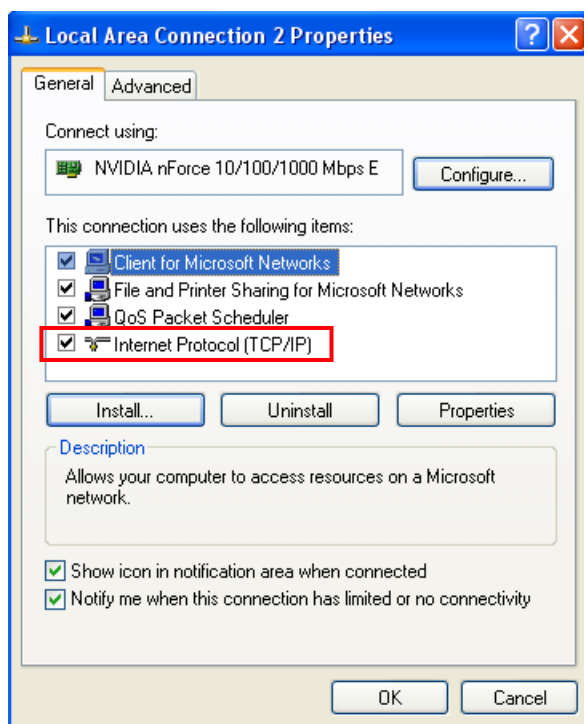
Fig. 3-62 Local area connection-properties
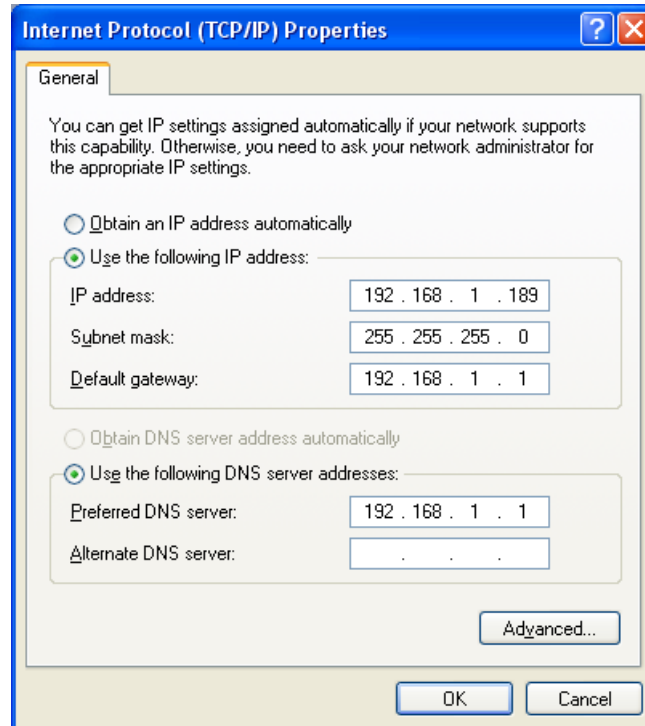
Fig. 3-63 PC IP setup

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. 3-64.
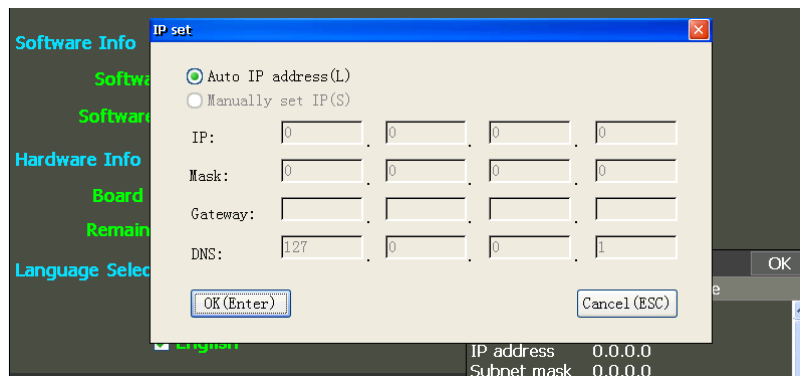
Fig. 3-64 Obtain IP address automatically

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 NK280 IP must be in the same subnet, which can be completed via manual setting or via

automatic obtaining.

3.16.1.3 Multiple NK280 Connection

If there are several NK280, 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. 3-56;

2) Click "Net Info" to display network info, as shown in Fig. 3-57;

3) Click "ModDevice" to access the password input interface, as shown in Fig. 3-65.
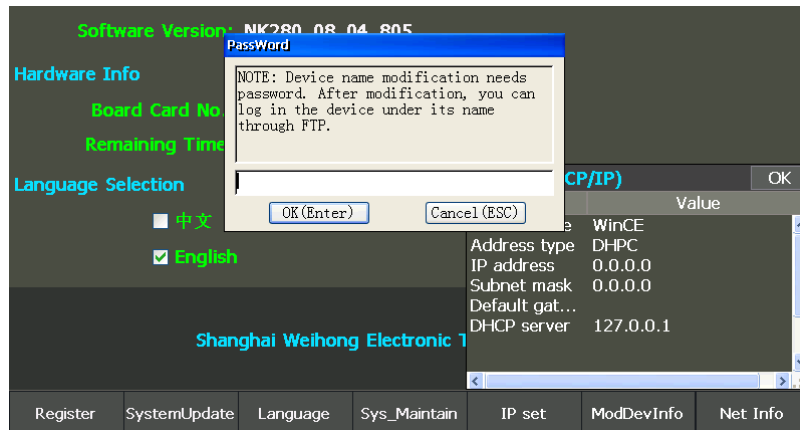
Fig. 3-65 Device info modification- password input

4) Enter the password to access the device info modification interface, as shown in Fig. 3-66.
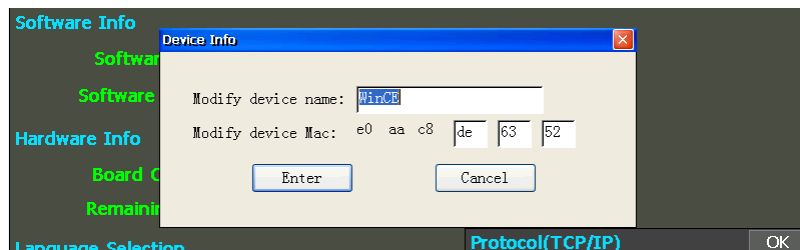
Fig. 3-66 Device info modification interface

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 NK280. If pinged, the result is as shown in Fig. 3-67.
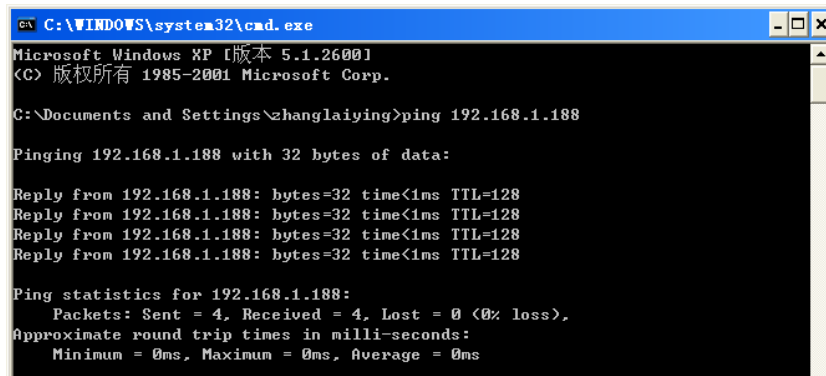
Fig. 3-67 Check network connection—successful
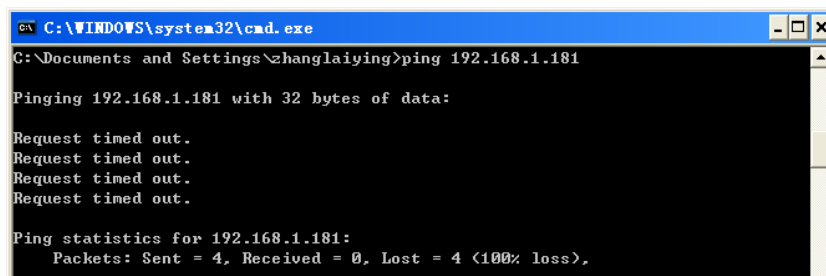
Fig. 3-68 Check network connection—failed

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

3.16.3 NK280 Network Files Management by PC via FTP

Entering **"Ftp://192.168.1.188"** in the address bar of resource management will open NK280 network files, and FTP operations like upload, download and rename can be realized.
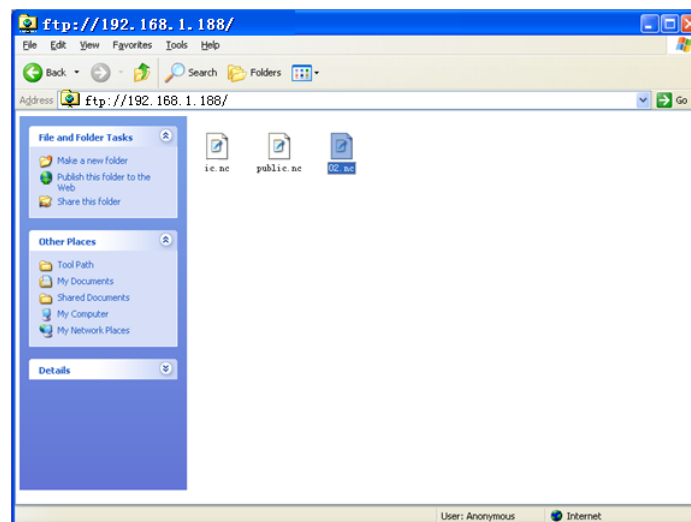
Fig. 3-69 NK280 network files managed by PC via FTP

3.16.4 NK280 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 NK280 network sharing interface, in which **"Sharedocs"** is the NK280 network folder. After opening it by double click, users can transfer files to NK280, or administrate the existing files, like edit, delete, and copy, as convenient as administrating local files.
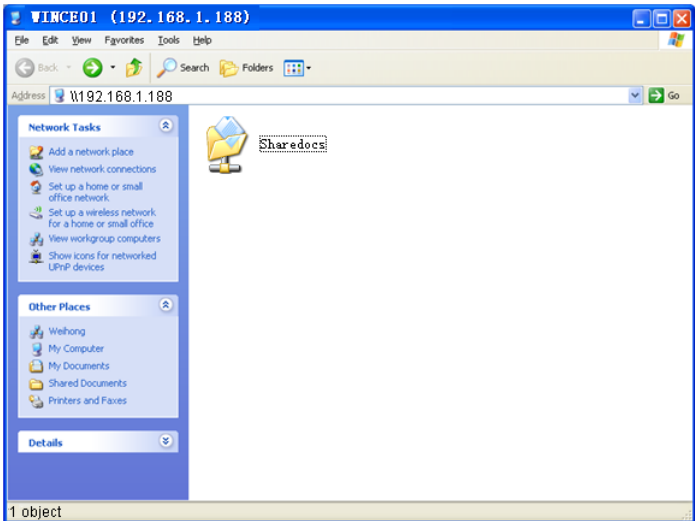
Fig. 3-70 NK280 network files management by PC via network sharing- 1
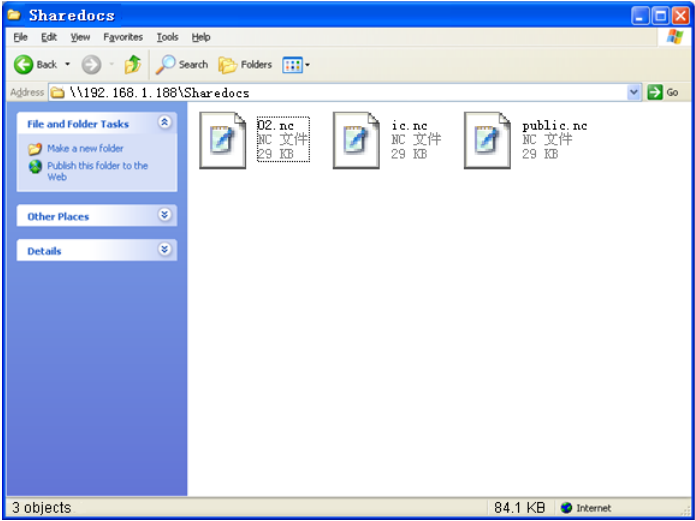
Fig. 3-71 NK280 network files management by PC via network sharing- 2

The above-mentioned steps realize NK280 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. 3-72.

Fig. 3-72 Network files

3.17 Auxiliary Function

3.17.1 Single Block

Users can enable single block function for the machining task to be executed, which will facilitate the error diagnosis and trouble shooting. Once the single block function is activated, the program processing will stop the moment axial feedrate is 0.

Press "Single Block" button to activate it. Every time the "Cycle Start" button is pressed, the system will execute one block of the program and enter into "Pause" state. Users should press "Cycle Start" button again to execute next block until whole program has been executed.

3.17.2 Start Line (Selective Processing)

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

On [Coor-Auto] screen of [State] function area in Auto mode, press F2 [Start Line] to eject a "Start Line" screen, as shown in Fig. 3-73.
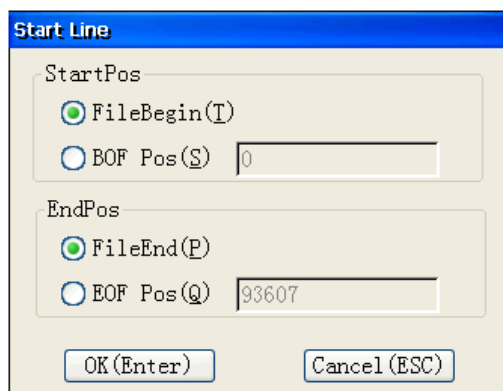
Fig. 3-73 Selective machining

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.

3.17.3 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.

3.17.4 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 area is as shown in Fig. 3-74: 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.
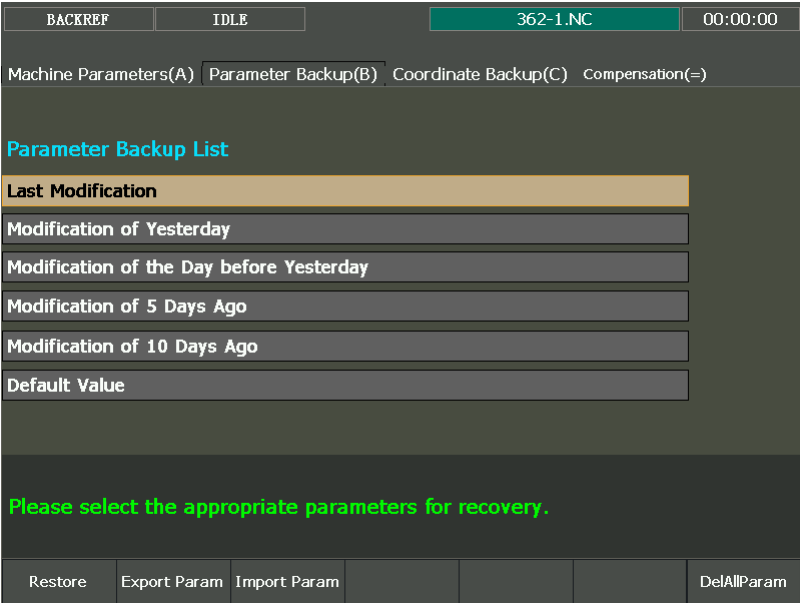
Fig. 3-74 Parameter auto backup

3.17.5 User Code Input (MDI)

[User Code Input (C)] screen under [Advanced] function area is as shown in Fig. 3-75.
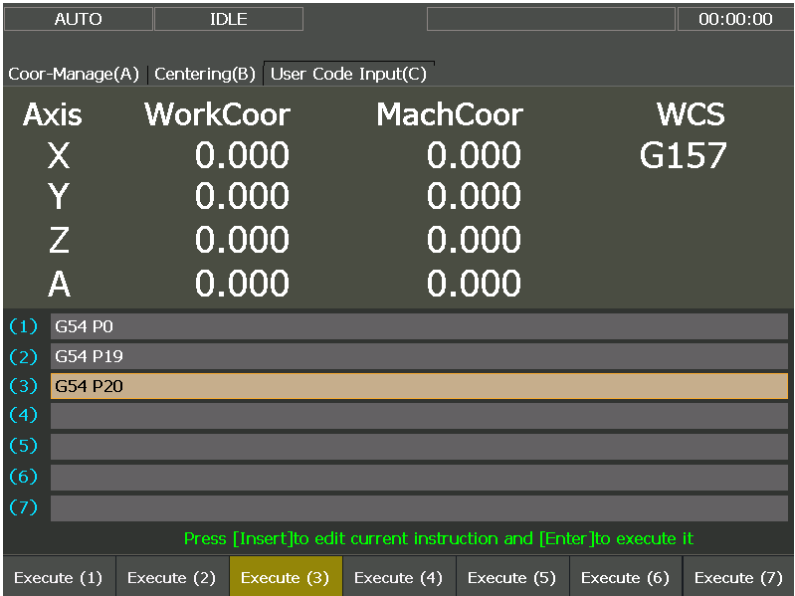
Fig. 3-75 User code input screen

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.

3.17.6 Coordinate Backup

[Coordinate Backup (C)] screen under [Parameter] function area is as shown in Fig. 3-76.
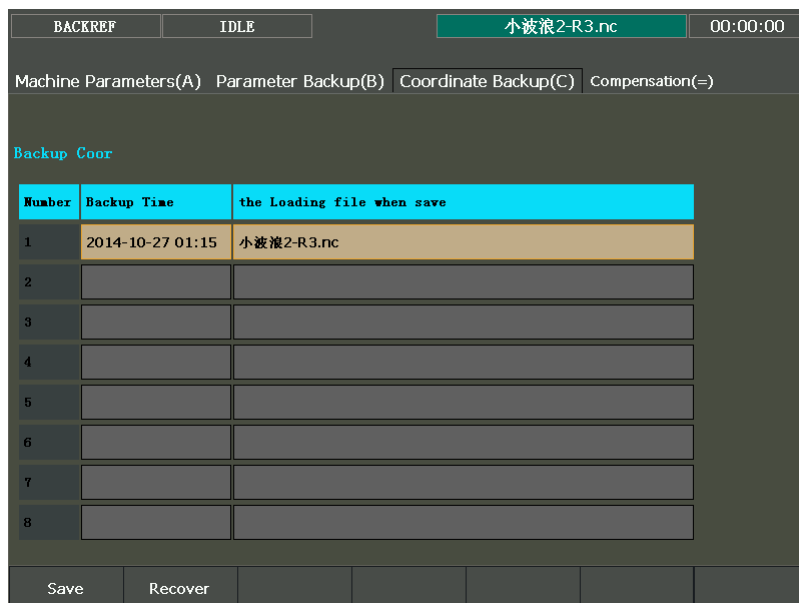
Fig. 3-76 Coordinate backup interface

F1 "Save" can be pressed to save the current workpiece offset. After loading a machining file into the system, you can press "↑" and "↓" to select the desired workpiece offset, and then press F2 "Recover" to load the selected offset into the current WCS. See Fig. 3-77.
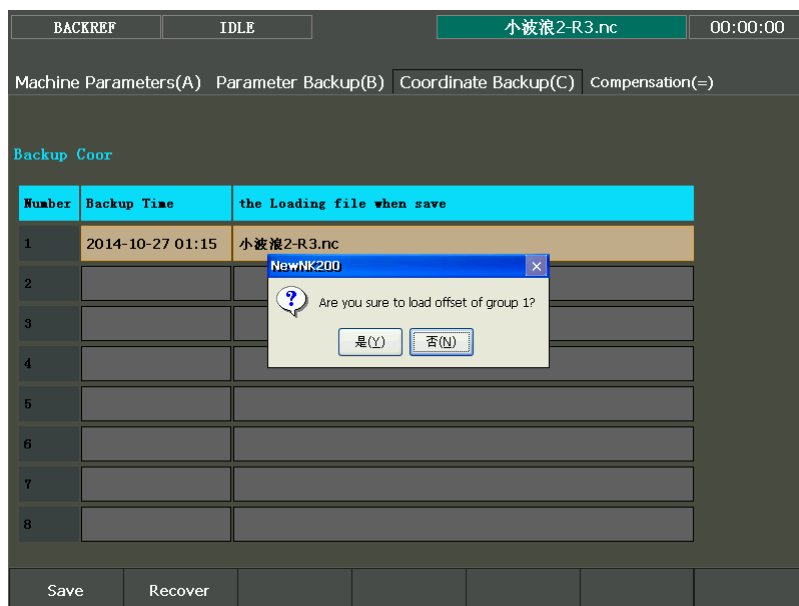
Fig. 3-77 Restore workpiece offset

After "是(Y)" (是 means Yes) is selected in Fig. 3-77, a new dialog will pop up asking whether to modify Z-axis offset, as shown in Fig. 3-78. You can select "是(Y)" if you want to restore Z-axis offset, too. Otherwise, offset of all other axes will be restored, except for Z-axis.
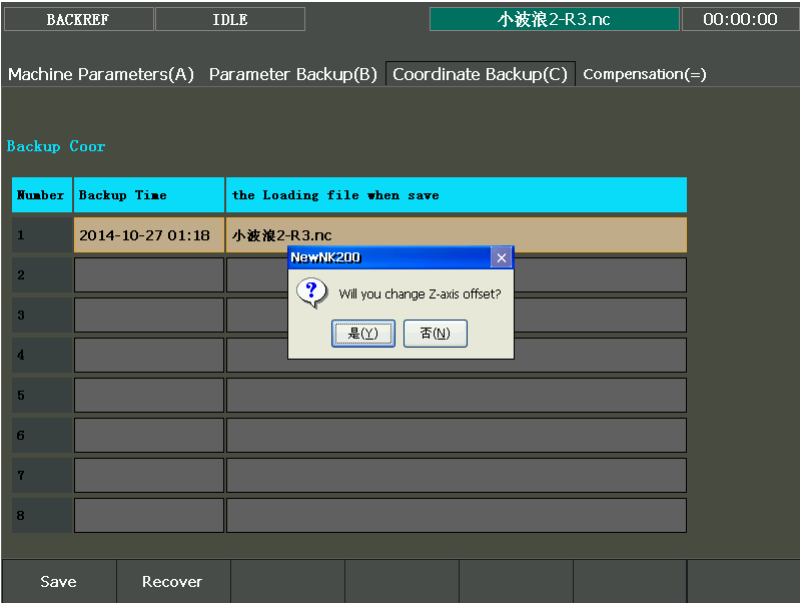
Fig. 3-78 Whether to change Z-axis workpiece offset

3.18 Tool Magazine

3.18.1 Auto Tool Change of Linear Tool Magazine

Meet T code and enter changetool sub-program

Check parameter 4519

True → Record workpiece coordinate before tool change

Spindle uplifts to upper position, and moves to X coordinate of current tool and Y coordinate of tool change ahead point

Spindle moves to Z coordinate and then Y coordinate of current tool

Spindle unclamps tool

Detect whether spindle unclamps tool — False → Software prompts alarm and ends program

True

Spindle uplifts to upper position

Spindle moves to X, Y coordinate and then Z coordinate of target tool

Spindle clamps tool

Detect whether spindle clamps tool — False → Software prompts alarm and ends program

True

Spindle moves to Y coordinate of tool change ahead point

Spindle returns to upper position

Check parameter 4519

True → Spindle returns to the position before tool change

Tool change finishes

Fig. 3-79 Process of auto tool change for linear tool magazine

See Fig. 3-79 for the process of auto tool change for linear tool magazine (taking multi-workpiece and a tool magazine parallel to X axis as an example).

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, which will not be listed here.

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:

Meet T code and enter changetool sub-program

Detect whether No. of current tool and target tool are within the capacity range of tool magazine — False → Software prompts alarm and ends program

True

Calculate rotation times of disk according to current tool No. and target tool No.

Spindle moves to lower position

Disk jumps

Detect whether disk jumps — False → Software prompts alarm and ends program

True

Spindle unclamps tool

Detect whether spindle unclamps tool — False → Software prompts alarm and ends program

True

Spindle uplifts to upper position

Decide rotation direction of disk according to the calculated rotation times of disk

The disk rotates CW / The disk rotates CCW

Spindle moves to lower position

Spindle clamps tool

Detect whether spindle clamps tool — False → Software prompts alarm and ends program

True

Disk retracts

Detect whether disk retracts — False → Software prompts alarm and ends program

True

Tool change finishes

Fig. 3-80 Process of auto tool change for circular tool magazine

Note:

Since mechanical configuration of tool magazine varies, the process mentioned above is just applied to the general situation. In case of any difference, please turn to manufacturer to make corresponding adjustment based on actual situation.

3.18.3 Related Parameters

Parameter	Meaning	Setting Range
Turn On Radius Compensation	Whether to enable tool radius compensation function or not.	Yes: enable No: not enable
Specify Cutter Compensation Type	It specifies the cutter compensation type. 1 for normal type, 2 for intersect type and 3 for insert type.	1;2;3
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.	1~20
Current tool No.	Tool No. being used	0~ Tool magazine capacity
Current Tool Pan No.	The current tool magazine No.	1~20
Tool change prompt	Whether the system will suspend and prompt tool change when tool change command is encountered	No: Invalid Yes: Valid
T0 Handle Mode	0: invalid; 1: to be no-tool state; 2: first tool index is 0	0;1;2
Tool change upper position	The mechanical coordinate of Z axis of the CT_UP position in tool change.	-
Tool change lower position	The mechanical coordinate of Z axis of the CT_DOWN position in tool change.	-
X change tool position	The mechanical coordinate of X axis of change tool position.	-
Y change tool position	The mechanical coordinate of Y axis of change tool position.	-
X coordinate of tool change ahead position	They specify the position where the spindle starts decelerating before entering tool magazine.	-
Y coordinate of tool change ahead position	The position where the spindle starts decelerating before entering tool magazine.	-
Z coordinate of tool change ahead position		-
Tool change speed	The feedrate used in tool change process.	0.001~15000
Z axis CTup and CTdown speed	The feedrate the spindle moves from the CT_up position to CT_down position.	0.001~3000
Traversing speed in/out tool magazine	The feedrate when the spindle moves into /out of tool magazine in tool change.	0.001~3000
Tool change delay	Pause time in tool change.	0~600000
Move to origin position after tool change	Whether to move to the origin or not after tool changed.	Yes: move to the origin No: not move to the origin
X axis machine coordinate	The machine coordinate of X axis of T1.	-
Y axis machine coordinate	The machine coordinate of Y axis of T1	-
Z axis machine coordinate	The machine coordinate of Z axis of T1	-
There are altogether 10 groups of coordinates info of tools. The above one is only an example.		

4 NK280 for Dual Z-axes Machine

4.1　Multiple Z axes Control

NK280 can serves as a dual Z axes CNC system for dual Z axes machine. Compared with standard four axes system, dual Z axes system shares a lot in common in terms of interfaces and operations. The main difference between two systems lies in that for standard four axes system, four axes are X/Y/Z/A (A as the rotary axis), while for dual Z axes system, four axes are X/Y/Z1/Z2. To avoid too much repetition, you can turn to introductions to general four axes system in chapter 3 for most operations of dual Z axes system. The following part will focus on the special functions and points of the dual Z axes system, please note that.

4.1.1　Mode Selection

At present, for the system with dual Z axes, there are two modes for selection, namely, linkage mode ("Union" mode on the screen, in which multiple Z axes can move synchronously or simultaneously) and alternative mode ("Turn" mode on the screen, in which only one Z axis can move at one moment). Under [Advanced] function area, press shortcut key "=" to enter the sub-screen [Multi- Z Control(=)], as shown in Fig. 4-1 . Users can press shortcut key S/T to switchover between the linkage mode and alternative mode.

Fig. 4-1 Multiple Z axes control---Mode selection

◆　**Linkage (Union) Mode**

In this mode, press F1 [Z1 active], F2 [Z2 active] or F3 [Z1Z2 active] to activate the target Z axis (axes). Before the activation, machine will lift the Z1/Z2 axis to the position "AREAMAX-1" (the position "Workbench range upper limit-1").

When switch to [Z1Z2 active], two Z axes will obtain the same workpiece coordinates as result.

◆　**Alternative (Turn) Mode**

In this mode, function [Z1Z2 active] is unavailable.

When pressing F1 or F2 to activate [Z1 active] or [Z2 active], the current Z axis will lift to the "AREAMAX-1" position first before the other Z axis is activated. For instance, the current Z axis is Z1 axis, and now, it needs to switch to the Z2 axis. At this time, Z1 axis will raise to the position

"AREAMAX-1", then Z2 axis will be activated.

In alternative mode, machine will execute the following actions if T command is met.

1) Z1 axis stops;
2) Z1 axis raise to the position "AREAMAX-1";
3) Z1 axis is disabled;
4) Z2 axis is enabled and selected.

Note:

In linkage mode, at least one Z axis is activated, while in alternative mode, only (at most) one Z axis can be activated.

4.1.2   Tool Measurement

In Dual Z-axes system, tool measurement can be divided into first calibration/calibration after tool change ("Second calibration" on the screen), set Z1Z2 tool length (also known as fixed calibration) and mobile calibration.

On the sub-screen [Multi-Z Control(=)] under [Coor] function area , press F4 [Tool cali] to enter tool measurement screen. Specific operational steps are similar to the introduction in chapter 3.6. You can turn to chapter 3.6 for details.

Fig. 4-2 Multiple Z axes control---Tool measurement

Note:

If both Z1 and Z2 axes are active, when tool measurement is being executed:

1) With dual tool presetter, two Z axes will raise to the position "AREAMAX-1", and then execute tool calibration.

2) With only one tool presetter, two Z axes will raise to the position "AREAMAX-1", then Z1 axis will execute tool calibration first.   Tool calibration in Z2 axis will be executed after calibration in Z1 axis is finished.

4.2   Special Parameters

For dual Z axes system and standard four axes system, most parameters share the same parameter name while their parameter number may be different. The following parameters are those specifically exist in dual Z axes. And for those in common, please refer to chapter 7 to view all parameters in standard four axes system.

Parameter	Meaning	Setting Range
Pulse Equivalent of Z1-axis	It sets the pulse equivalent of Z1 axis.	0.0001~999
Pulse Equivalent of Z2-axis	It sets the pulse equivalent of Z2 axis.	0.0001~999
Z1-axis Workbench Upper Limit	The upper limit of the workbench range in Z1 axis.	-100~67108.8640
Z2-axis Workbench Upper Limit	The upper limit of the workbench range in Z2 axis.	-100~67108.8640
Z1-axis Workbench Lower Limit	The lower limit of the workbench range in Z1 axis.	-67108.8640~0
Z2-axis Workbench Lower Limit	The lower limit of the workbench range in Z2 axis.	-67108.8640~0
Z1-axis Change Tool Range Upper Limit	The upper limit of change tool travel in Z 1 axis.	-100~67108.8640
Z2-axis Change Tool Range Upper Limit	The upper limit of change tool travel in Z 2 axis.	-100~67108.8640
Z1-axis Change Tool Lower Limit	The lower limit of change tool travel in Z1 axis.	-67108.8640~0
Z2-axis Change Tool Lower Limit	The lower limit of change tool travel in Z2 axis.	-67108.8640~0
Z1-axis Output Direction	The output direction of Z1 axis. 1 for positive direction and -1 for negative.	1;-1
Z2-axis Output Direction	The output direction of Z2 axis. 1 for positive direction and -1 for negative.	1;-1
Max Turning Acceleration	The maximum feedrate at the corner.	0.001~100000(mm/s^2)
Cali Process Type	0: with multiple fixed calibration block (fixed tool presetter), Z axes calibrate together; 1: with only one fixed calibration block (fixed tool presetter), Z axes calibrate in turn.	0;1
Force Homing (Double Z)	Whether to force Z1Z2 axes to return home.	Yes: valid; No: invalid
Reference Circle Speed	The maximal velocity of circle with 10mm diameter. The value is used to calculate the maximal velocity of circle.	-
Z1-axis Coordinate of Fixed Point	It specifies the coordinate of Z1 axis of the fixed point.	-67108.8640~67108.8640
Z2-axis Coordinate of Fixed Point	It specifies the coordinate of Z2 axis of the fixed point.	-67108.8640~67108.8640
Z1 Direction in Backing Home	It specifies the Z1 direction in coarse positioning when homing. 1 for positive and -1 for negative.	-1;1
Z2 Direction in Backing Home	It specifies the Z2 direction in coarse positioning when homing. 1 for positive and -1 for negative.	-1;1
Retract Distance of Z1-axis	The retracted distance of Z1 axis after backing to the mechanical origin.	-
Retract Distance of Z2-axis	The retracted distance of Z1 axis after backing to the mechanical origin.	-
Z1 Speed in Backing Home	Z1 feedrate in coarse positioning when homing.	0.001~15000
Z2 Speed in Backing Home	Z2 feedrate in coarse positioning when homing.	0.001~15000
Z1 Speed in Exact Positioning	Z1 feedrate in fine positioning when homing.	0.001~15000
Z2 Speed in Exact Positioning	Z2 feedrate in fine positioning when homing.	0.001~15000
Z1-axis Screw Pitch	It specifies the screw pitch of Z1 axis.	0.001~9999.9
Z2-axis Screw Pitch	It specifies the screw pitch of Z2 axis.	0.001~9999.9

5 Maintenance

5.1 Operating System Maintenance

When users get NK280 integrated system, the system has already been well installed and can be used directly. In case of failure, users can restore it to leaving factory state by system recovery. Please choose corresponding updating method of system recovery according to actual situation.

Power on and start the operating system, then press key "M" repeatedly and simultaneously to enter the system updating interface, as shown below:

```
    *****************************************
F) Update FPGA
T) Update OS
S) Update BOOT
G) Update LOGO
R) Read Version Number
X) Register Reset
P) System Repair（Do it when OS can't start normally）
    *****************************************
Enter your selection：
```
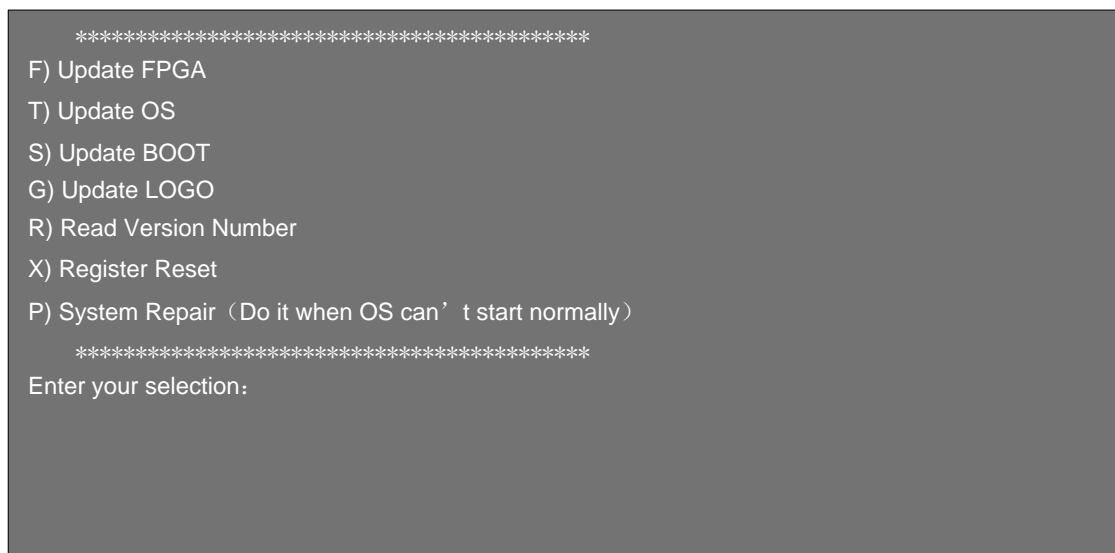
Fig. 5-1 System EBOOT interface

The system provides 7 kinds of updating method, with corresponding short-cut key before each of them. To press the short-cut key will operate the updating.

◆ **F) Update FPGA**

To update FPGA programs.

◆ **T) Update OS**

The "Update OS" here refers to system mirror image update in nature. When the system is damaged and cannot be booted, select this item.

◆ **S) Update BOOT**

To update BOOT programs.

◆ **G) Update LOGO**

Update the LOGO picture in the interface when the system initiates. .

◆ **R) Read version**

Read and obtain the versions of current BOOT and OS (operating system).

◆ **Register Reset**

Clear and empty the contents which have been written into the system registry, and restore to the default leaving factory state.

Taking system IP address as an example, users can set IP address in [System info] interface for network connection, and this address will be then written into the system registry. If "Register Reset" item is executed, the IP address will be reset to default value 0.0.0.0.

◆ **System Repair**

When the system can be booted while the software cannot be launched normally, users can select this item. The system will execute self-recovery. After system recovery, software can be launched after power on.

When the system is damaged and cannot be booted, users need to update system, which refers to updating mirror image and software here. The following fives detailed introduction of this two process.

5.1.1 Updating Mirror Image

The essence of updating system is updating mirror image, which is used when the system is damaged and cannot be booted. Its operation procedure is as follows:

1) Insert the USB flash disk with the system mirror image file *NK280_NK_Rx.x.x.nb0* and the new software into NK280.

2) Power on NK280 while pressing M key several times until entering system update interface.

3) Press letter key T to select "Update system" under this interface, at this time, the interface will display reading the file NK280_NK_Rx.x.x.nb0 from the USB flash disk. And this process will last for about 3 minutes until mirror image is updated successfully.

After this, there is a need to install software since the system is not equipped with any applications after mirror image update. The operations are shown as below.

5.1.2 System update

◆ **Software installation after mirror image update**

1) Insert the USB flash disk with the new software of *.weihong* format into NK280.

2) After mirror image update, USB flash disk will be recognized automatically. Recognition succeeded, BOOT interface will be accessed.

Reading your USB device...

BOOT V1.3.1

Tip: Press S key to show the current Boot version.
     Press T key to update Boot then restart.

| PublicFile | Backup | Restore | DelParam | Config | System | Run Old |
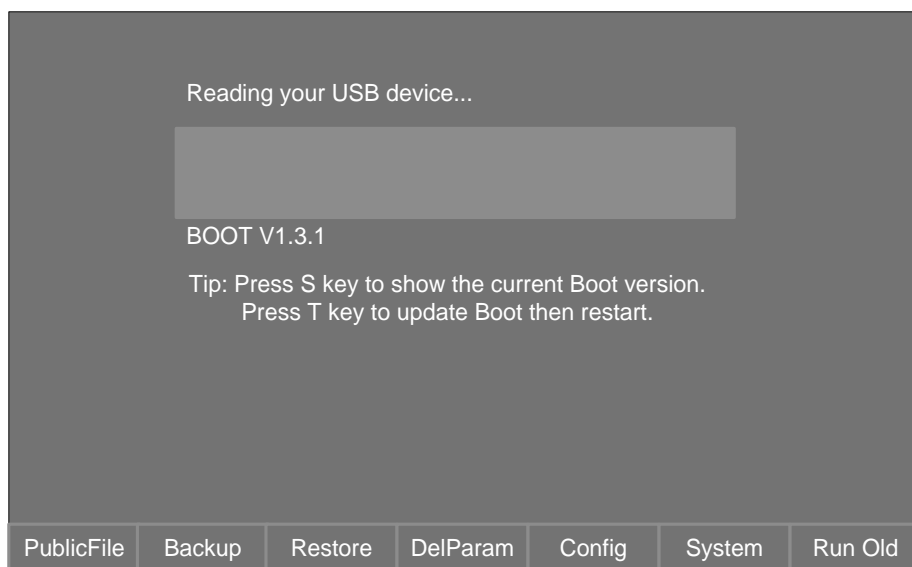
Fig. 5-2 BOOT system update interface

3) In the popup USB list, as shown in Fig. 5-3, select the software to be installed, and press F6 to update the software, with processing bar indicating the installation progress, see Fig. 5-4.
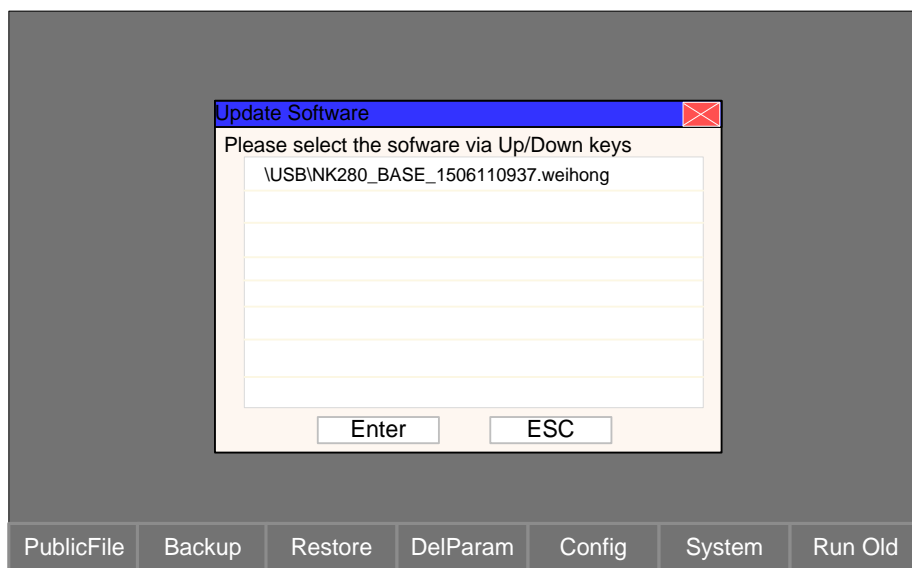
Fig. 5-3 USB list
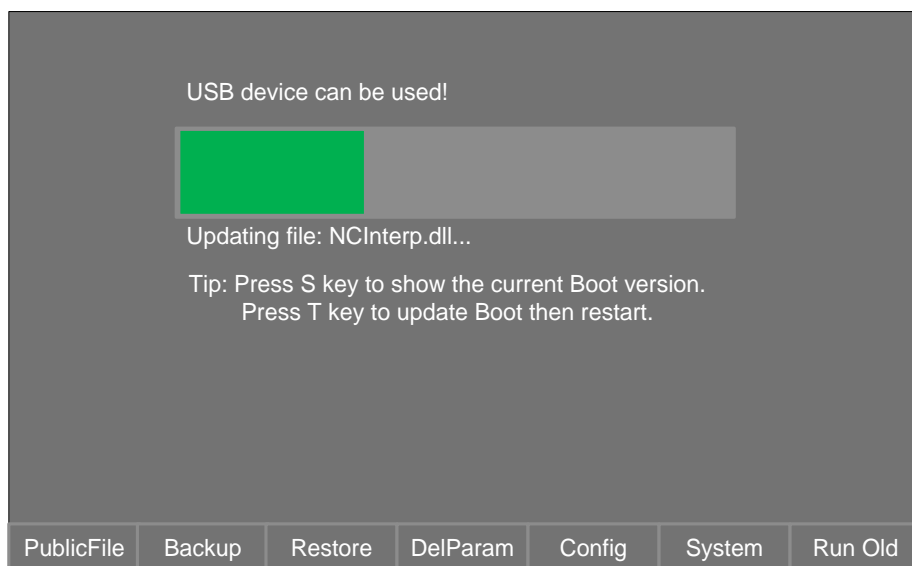
Fig. 5-4 Software updating process

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

Fig. 5-5 System booting interface

◆ **Software update when the system has already installed one.**

1) Insert the USB flash disk with the new software of *.weihong* format into NK280.

2) Enter the update BOOT interface shown as in two ways:

One, on [System Info] screen of [System] function area, pressing F2 will eject a prompt dialog box asking to confirm that "to update the system, please ensure that there is software install already?". After confirmation, close NK280. Power on, the system entering the USB flash disk recognizing interface. Recognition succeeded, BOOT interface will be accessed.

Two, at any time, Power on NK280 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

3) Select the software to be installed, and press F6 to update the software, with processing bar indicating the installation progress.

4) After update complete, the new software will be accessed. Fig. 5-2 is the interface booting the new software.

Note:

Since update system interface is accessed automatically after mirror image is updated, both mirror image file *NK280_NK_Rx.x.x.nb0* and installation software of *.weihong* format should be saved under the root directory of USB flash disk.

In updating or installing software, the software under the root directory of USB flash disk should be in the format of *.weihong*, or it cannot be identified by the system.

The above two notes are valid when BOOT version is the latest one (V1.1 or above). If the mirror image is in old version (V1.0 or below), instead of the software of *.weihong* format, five file portfolios including *CHN*, *Config*, *ENG*, *Font*, *NewNK200* are saved under the root directory of USB flash disk.

5.1.3 BOOT Update Interface

Since BOOT update interface is involved in updating mirror image and software, the following gives a brief introduction to it.
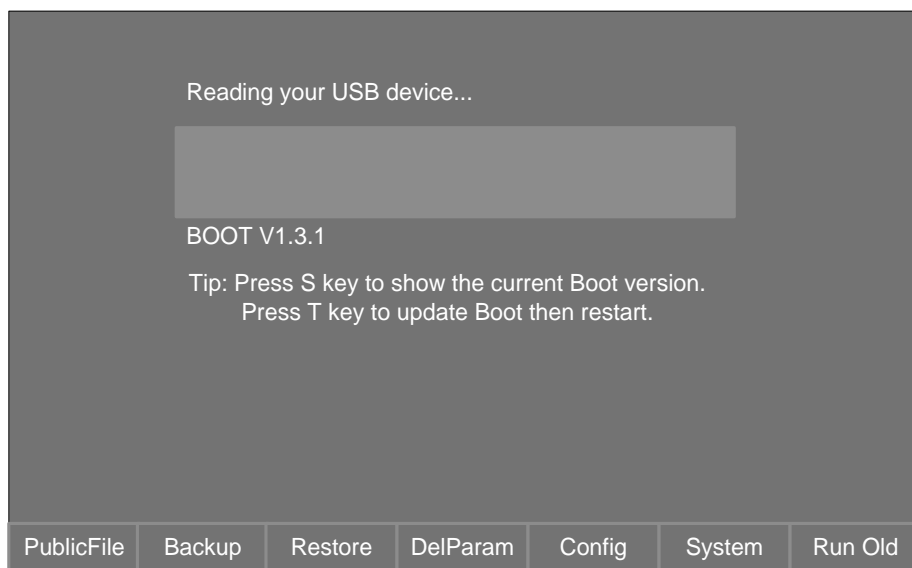
Fig. 5-6 Update BOOT interface

◆ **Public Files**

Updating the public files, i.e. calling the new PUBLIC files in USB flash disk, which are saved in *CHN\files* and *ENG\files* in root directory of USB.

◆ **Backup**

Exporting the backup parameters files and corresponding software into *NK280Backup* file folder in the root directory of USB flash disk. Since each backup software name contains the exporting time, for the same software, several software applications can be backed up for different parameter settings.

◆ **Restore**

With this button selected, the list shows the backup software, which are also in the *NK280Backup* file folder.

◆ **Delete Parameters**

Updating or installing software requires deleting the parameters settings of the last version. But if you need to save the set parameters, this step is not needed.

◆ **Configuration**

It means using the new system configuration file, i.e. *Config* file.

◆ **System**

It refers to updating the software in nature, upgrading it to the latest version or installing a new one. The new BOOT mirror image can only identify the software files of *.weihong* format.

◆ **Run Old**

Start the pre-updated system, namely the previous system before updating.

5.2　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.	Find the reason based on the alarm type of inverter.
❌ Error message			
❌ **Related operations of backing to machine origin**	The system has not returned 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 "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.

Type	Warning Content	Cause	Solution
Related errors of state	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.
	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.

5.3   Common Troubleshooting

5.3.1   What should users do if the spindle does not rotate?

1) Check if there is an error in software. Press [Spindle Start] button and see if the dot before the "Spindle" in [Port] screen under [Diagnosis] 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 connected with a multimeter. If it is connected, the spindle start output port works normally; if it is not conducted, there is an error in the relay of spindle start.

3) Test whether the analog voltage output is normal between SVC and GND with a multimeter. If not, check if the connection cable of terminal board becomes loose. Still not, 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 has been damaged, or the wiring of the spindle and inverter is correct.

5.3.2   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).

5.3.3   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.

5.3.4   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 REF. point signal of this axis. The method is: trigger the home 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 REF. point signal, needing to check if there is an error in the home switch (if the terminal board is EX9A4 and EX24A2, the switch type should be NPN; if EX6A4, the switch type should be PNP) or in the wiring of home switch. To see if the system failure occurs, make the REF. point 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 home switch is appropriate to avoid the following three situations: the distance between home switch and limit switch is too small; the home switch is installed behind the limit switch; or the position of home switch is out of the mechanical stroke of 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 home switch is triggered, i.e. there is signal input, the color of the dot should be green. Otherwise, it is red.

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

The cause of the above phenomenon is that the system can't detect the encoder REF. point signal of this axis.

1) Move the machine manually and check if the encoder zero signal in [Port] activated;

2) See if the servo cable of this axis is well contacted at the joints with NK280 host and servo driver;

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

5.3.5   What should users do if the machine tool motions upward after arriving at the position of tool presetter during calibration?

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

6 Driver

6.1 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.

6.1.1 Parameter Setting of WISE Servo Driver

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

◆ **Attached list: the relationship among parameters Pr0008, Pr0009 and Pr010**

Pr008	Pr009	Pr010	Description
0~2^{20}	─ (no influence)	─ (no influence)	Command Pulse Input → $\dfrac{\text{Encoder Resolution}}{\text{Setting Value of Pr008}}$ → Position Command As shown above, the process is undergone in terms of the setting value of Pr008, not affected by the settings of Pr009 and Pr010.
0	0	0~2^{30}	Command Pulse Input → $\dfrac{\text{Encoder Resolution}}{\text{Setting Value of Pr010}}$ → Position Command When the values of Pr008 and Pr009 are both set to "0", as shown above, the process is undergone in terms of the setting value of Pr010.
	0~2^{30}	0~2^{30}	Command Pulse Input → $\dfrac{\text{Setting Value of Pr009}}{\text{Setting Value of Pr010}}$ → Position Command When the value of Pr008 is "0", but the value of Pr009 is not "0", as shown above, the process is undergone in terms of the setting values of Pr009 and Pr010.

6.1.2   Parameter 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 other function and leading to brake ineffective, "3" is not allowed to appear in the 4 digits.
Pn506	Servo off, time delay of brake when motor stops	Depended	Set it when motor with brakes. Default setting is "0", setting unit is 10ms.
Pn201	Encoder cycle-divided ratio (Pulse output No. per motor cycle after cycle-divided)	See right-side	Gain Encoder Type / Pulse No. per Motor Circle (PPR) ; A 13bit 2048 ; B 16bit 16384 ; C 17bit 32768
Pn202	Electronic gear ratio (numerator)	Need Calculation	Pn202 = pulse No. of each encoder circle × 4 × mechanical deceleration ratio. Pn203 = (screw pitch/ pulse equivalent). Typical value: pitch 5mm, encoder 17-bit, coaxial

Para. No.	Function	Value	Description
Pn203	Electronic gear ratio (denominator)	Need Calculation	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.

6.1.3   Parameter Setting of YASKAWA Σ-Ⅴ/Σ-7 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	$\dfrac{Pn20E}{Pn210} = \dfrac{\text{Encoder resolution} \times \text{Pulse equivalent} \times \text{Deceleration ratio}}{\text{Screw pitch}}$ For example, screw pitch 5mm, 20-bit encoder, coupling direct drag, pulse equivalent 0.001mm, $\dfrac{Pn20E}{Pn210} = \dfrac{2^{20} \times 0.001}{5} = \dfrac{1048576}{5000} = \dfrac{131072}{625}$
Pn210	Electronic gear ratio (denominator)	Need Calculation	When screw pitch is 10mm, $\dfrac{PN20E}{PN210} = \dfrac{1048576}{10000} = \dfrac{65536}{625}$ For a rotary axis with 13-bit encoder and deceleration ratio as 60, $\dfrac{Pn20E}{Pn210} = \dfrac{2^{13} \times 0.001 \times 60}{360} = \dfrac{8192}{6000} = \dfrac{512}{375}$
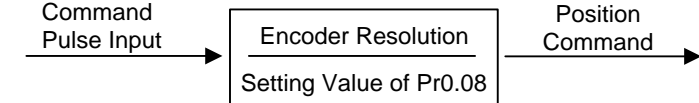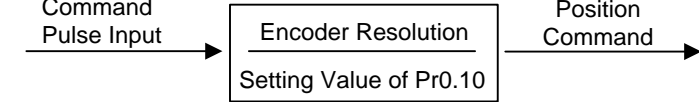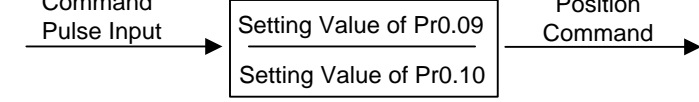
6.1.4 Parameter Setting of PANASONIC MINAS A4 Servo Driver

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

6.1.5 Parameter Setting of PANASONIC MINAS A5 Servo Driver

Para. No.	Function	Value	Description
Pr5.28	LED initial status	6	Monitor if the number of sent and received pulse is correct by setting this parameter. In Weihong control system, the correct quantity of pulse sent by control card is detected by pulse inspection in order to determine whether there is electrical interference.
Pr0.01	Select control mode	0	0: position mode 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: $0 \sim 2^{30}$	Typical value: pitch 5 mm, encoder resolution 10000, shaft coupling direct drag, pulse equivalent 0.001 mm: Pr0.09＝10000
Pr0.10	Denominator of command pulse frequency multiplication	Need calculation Range: $0 \sim 2^{30}$	Pr0.10＝pitch 5mm/ pulse equivalent 0.001mm＝5000 Pr0.09/Pr0.10=10000/5000=2/1
When the value of Pr0.08 is not "0", it can be calculated in terms of the following formula: $$\text{Command pulse No. per motor circle} = \frac{\text{Screw pitch}}{\text{Pulse equivalent} \times \text{Mechanical deceleration ratio}} = \frac{5mm}{0.001mm/p} = 5000$$ 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 → $\dfrac{\text{Encoder Resolution}}{\text{Setting Value of Pr0.08}}$ → Position Command The process shown above is undergone in terms of the setting value of Pr0.08, not affected by the settings of Pr0.09 and Pr0.10.
0	0	$0\sim2^{30}$	Command Pulse Input → $\dfrac{\text{Encoder Resolution}}{\text{Setting Value of Pr0.10}}$ → Position Command 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.
	$0\sim2^{30}$	$0\sim2^{30}$	Command Pulse Input → $\dfrac{\text{Setting Value of Pr0.09}}{\text{Setting Value of Pr0.10}}$ → Position Command 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.

6.1.6   Parameter Setting of MITSUBISHI MR-JE Servo Driver

Para. No.	Code	Function	Value	description
PA01	*STY	Operation mode	XXX0	_ _ _x: select position control mode.
PD24	MBR	Output assignation to CN1-23 pin	XX05	_ _ xx: select MBR (electromagnetic brake interlock).
PA06	CMX	Electronic gear numerator	Need calculation	CMX/CDV=command unit × servo motor resolution × mechanical deceleration ratio / pitch of screw. E.G., pitch 5 mm, encoder resolution 10000, deceleration ratio 1:1, pulse equivalent 0.001 mm, CMX/CDV=10000×0.001/5 = 2/1;
PA07	CDV	Electronic gear denominator	Need calculation	When pulse equivalent = 0.0005mm, CMX/CDV = 1/1. Electronic gear ratio range: 1/50 ~ 500
PC36	*DMD	Status display selection	00XX	_ _xx: status display selection at power-on. This is used to select a status display shown at power-on. 00: cumulative feedback pulses 01: servo motor speed 02: droop pulses 03: cumulative command pulses 04: command pulse frequency
PA13	*PLSS	Command pulse input form	0011	Set command pulse input form: pulse train+ sign, negative logic.
PD03	*DI1L	Input assignation to CN1-15 pin	XX02	_ _xx: select SON under position control mode.

6.1.7 Parameter Setting of MITSUBISHI MR-E Servo Driver

Para. No.	Code	Function	Value	Description
0	*STY	Control mode selection and regenerative fittings	X0X0	Bit 0: set 0: select position control mode. 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 / screw pitch. 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;
4	CDV	Electronic gear denominator	Need calculation	When pulse equivalent = 0.0005mm, CMX/CDV = 1/1. Electronic gear ratio range: 1/50 ~ 500
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.

6.1.8   Parameter Setting of DELTA ASDA-A Servo Driver

Para. No.	Function	Format & Range	Value	Description
P0-02	Driver status display		02	Monitor if the number of sent and received pulse is correct by setting this parameter. In Weihong control system, the correct quantity of pulse sent by control card is detected by pulse inspection to determine if there is electrical interference.
P1-00	External pulse input type	ZYX	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
P1-45	Electronic Gear Ratio (Denominator) (M)	1~32767	Need calculation	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.
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, limit signal input of the driver is not used.
P2-16	Digital Input Pin DI7	X2X1X0	100	
P2-17	Function setting for digital input pin DI8	X2X1X0	100	External EMG stop input is not used.
P2-21	Function setting for digital output pin DO4	X2X1X0	108	DO4 corresponds to pin 1 & pin 26, used as clamping-position brake signal of Z-axis; X2=1: set DO4 output as NO (normally

Para. No.	Function	Format & Range	Value	Description
				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.

6.1.9   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.
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+.

6.1.10 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) (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, 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 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	
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

Para. No.	Function	Format & Range	Value	Description
				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.

6.1.11 Parameter Setting of DELTA ASDA-B2 Servo Driver

Para. No.	Function	Format & Range	Value	Description
P0-02	Driver status display		02	Monitor if the number of sent and received pulse is correct by setting this parameter. In Weihong control system, the correct quantity of pulse sent by control card is detected by pulse inspection in order to determine whether there is electrical interference.
P1-00	External pulse train input type	ZYX	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	000	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=0: set DI6 and DI7 inputs as NC b-contact point. X1X0=00, limit input of driver is not used.
P2-16	Function setting for digital input pin DI7	X2X1X0	000	
P2-17	Function setting for digital input pin DI8	X2X1X0	000	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.

Para. No.	Function	Format & Range	Value	Description
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.

6.1.12 Parameter Setting of SANYO PY Servo Driver

Para. No.	Abbr.	Name	Standard Value	Setting Range	Unit	Remark
1-2	EGER	Electronic gear ratio	4/1	1/32767 to 32767/1		Depends on the specific encoder resolution. The formula of electronic gear ratio of servo driver is as below: 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:				

Para. No.	Abbr.	Name	Standard Value	Setting Range	Unit	Remark

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

When bit 7=0

Bit 1	Bit 0	Command Pulse Input Digital Filter Min. Pulse Width
0	0	0.8µs
0	1	0.2µs
1	0	0.4µs
1	1	1.6µs

When bit 7=1

Bit 1	Bit 0	Command Pulse Input Digital Filter Min. Pulse Width
0	0	3.2µs
0	1	0.8µs
1	0	1.6µs
1	1	6.4µs

Bit6	Bit5	Command Pulse Format
1	0	Direction + Pulse

Switch of Digital Filter

0	High Speed
1	Low Speed (1/4)

Para. No.	Abbr.	Name	Standard Value	Setting Range	Unit	Remark
4-3	TYPE	Control mode: *Select one control mode from position, velocity, and torque modes. (table below) 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).			6 types	Our system selects position control mode.

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

6.1.13 Parameter Setting of SANYO R Servo Driver

Para. No.	Parameter Name	Set Value	Remarks
Group 0, parameter setting of tuning mode			
00	Setting of 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

6.1.14 Parameter Setting of SANYO Q Servo Driver

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

6.1.15 Parameter Setting of KT270 Servo Driver

Para. No.	Parameter Name	Value	Description
PA4	Control mode selection	0	The control mode of the driver can be set through this parameter: 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, $G = \dfrac{N \times C \times 4}{P} = \dfrac{1 \times 2500 \times 4}{6000} = \dfrac{5}{3}$ So set PA12 as 5 and PA13 as 3. We recommend the range of electronic gear ratio as: $\dfrac{1}{50} \le G \le 50$
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, 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

Para. No.	Parameter Name	Value	Description
			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).

6.1.16 Parameter Setting of FUJI FALDIC-β Servo Driver

Para. No.	Name	Value	Description
01	Command pulse numerator α	Need calculation 1~32767	Command pulse numerator and denominator are 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).

6.1.17 Parameter Setting of STONE GS Servo Driver

Para. No.	Para. Name	Value	Description
F0f	Electronic gear ratio numerator	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)
F10	Electronic gear ratio denominator	1	
F00	Control mode selection	2	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:

F00 Value	CN2-24 Interface Status	
	OFF (Mode One)	ON (Mode Two)
5	Position Pulse Mode	External Speed Running Mode
6	Position Pulse Mode	Internal Speed Running Mode
7	Position Pulse Mode	Torque Mode
8	Internal Speed Running Mode	External Speed Running Mode
9	Internal Speed Running Mode	Torque Mode
10	External Speed Running Mode	Torque Mode

Para. No.	Para. Name	Value	Description
F2e	Pulse input mode selection	2	Command pulse string mode selection of position mode: 1 – Single pulse train positive logic — Pulse 12 27, Direction 13 28 2 – Single pulse train negative logic — Pulse 12 27, Direction 13 28 3 – Double pulse train positive logic — CCW 12 27, CW 13 28 4 – Double pulse train negative logic — CCW 12 27, CW 13 28 5 – Orthogonal pulse positive logic — Phase A 12 27, Phase B 13 28 6 – Orthogonal pulse negative logic — Phase A 12 27, Phase B 13 28

6.1.18　Parameter Setting of TECO TSDA Servo Driver

Para. No.	Function	Value	Description		
Pn010-1	Set control mode	1	Value	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.

6.2 Wiring Diagram of NK280 Host and Differential Input Stepping Driver
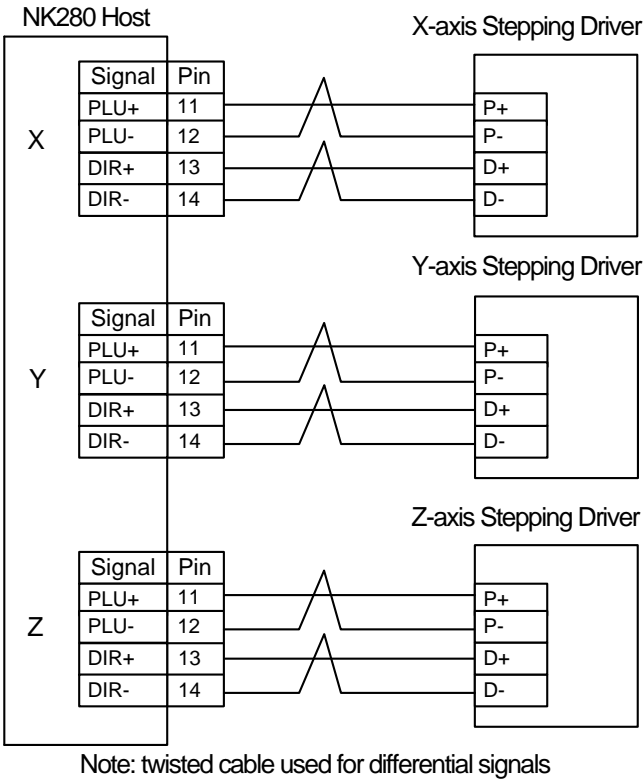
Fig. 6-1 Wiring diagram of terminal board and differential input stepping driver

6.3 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 6.3.2 and Figure 4 in chapter 6.3.6 (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).

6.3.1 Wiring Diagram of WISE Servo Driver
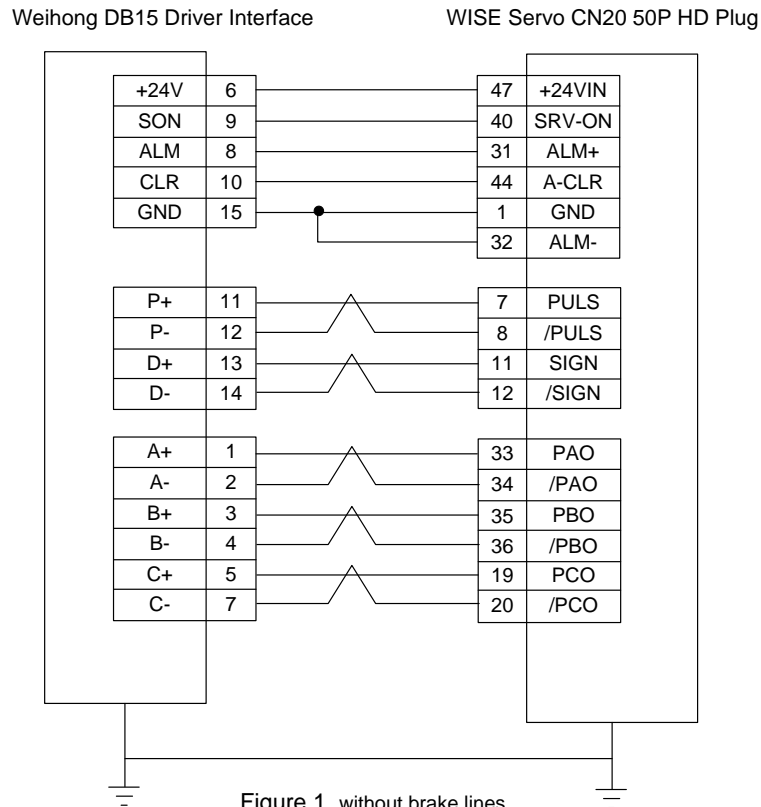
Figure 1 without brake lines

Note: twisted pair for differential signals

Weihong DB15 Driver Interface   WISE Servo CN2 50P HD Plug

Signal	Pin		Pin	Signal
+24V	6		47	+24VIN
SON	9		40	SRV-ON
ALM	8		31	ALM+
CLR	10		44	A-CLR
GND	15		1	GND
			32	ALM-
P+	11		7	PULS
P-	12		8	/PULS
D+	13		11	SIGN
D-	14		12	/SIGN
A+	1		33	PAO
A-	2		34	/PAO
B+	3		35	PBO
B-	4		36	/PBO
C+	5		19	PCO
C-	7		20	/PCO

Red   29 BRK-OFF+
Z-axis Brake Line
Black   30 BRK-OFF-

Figure 2 with brake lines
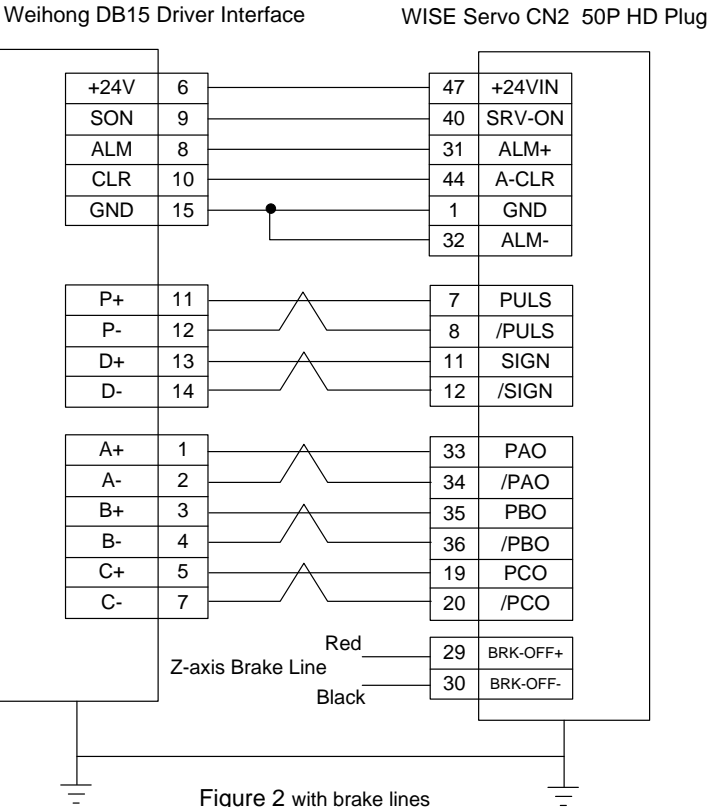
Note: twisted pair for differential signals.

6.3.2   Wiring Diagram of YASKAWA AC Servo Driver

Weihong DB15 Driver Interface   SGDM Servo CN1 50P

Signal	Pin		Pin	Signal
A+	1		33	PA0
A-	2		34	*PA0
B+	3		35	PB0
B-	4		36	*PB0
C+	5		19	PC0
C-	7		20	*PC0
PLU+	11		7	PLUS
PLU-	12		8	*PULS
DIR+	13		11	SIGN
DIR-	14		12	*SIGN
+24V	6		47	+24V
ALM	8		31	ALM+
SON	9		40	/S-ON
CLR	10		44	/ALM-RST
GND	15		32	ALM-
			1	SG

Red   29 SRDY+/BK+
Z axis brake line
Black   30 SRDY-/BK-

SGDM Servo CN1 50P

Signal	Pin
PA0	33
*PA0	34
PB0	35
*PB0	36
PC0	19
*PC0	20
PLUS	7
*PULS	8
SIGN	11
*SIGN	12
+24V	47
ALM+	31
/S-ON	40
/ALM-RST	44
ALM-	32
SG	1

| SRDY+/BK+ | 29 |
| SRDY-/BK- | 30 |

Black
Red
Z axis brake line

Weihong DB15 Driver Interface

Signal	Pin
A+	1
A-	2
B+	3
B-	4
C+	5
C-	7
PLU+	11
PLU-	12
DIR+	13
DIR-	14
+24V	6
ALM	8
SON	9
CLR	10
GND	15

SGDM Servo CN1 50P

Pin	Signal
33	PA0
34	*PA0
35	PB0
36	*PB0
19	PC0
20	*PC0
7	PLUS
8	*PULS
11	SIGN
12	*SIGN
47	+24V
31	ALM+
40	/S-ON
44	/ALM-RST
32	ALM-
1	SG

| 29 | SRDY+/BK+ |
| 30 | SRDY-/BK- |

Red
Z axis brake line
Black

6.3.3   Wiring Diagram of PANASONIC AC Servo Driver

Weihong DB15 Driver interface

Panasonic MINAS-A4 Servo 50P HD Plug

Signal	Pin
A+	1
A-	2
B+	3
B-	4
Z+	5
Z-	7
PLU+	11
PLU-	12
DIR+	13
DIR-	14
+24V	6
ALM	8
SON	9
CLR	10
GND	15

Pin	Signal
21	0A+
22	0A-
48	0B+
49	0B-
23	0Z+
24	0Z-
44	PULSH1
45	PULSH2
46	SIGNH1
47	SIGNH2
7	COM+
37	ALM+
29	/SRV-ON
31	A-CLR
41	COM-
36	ALM-
11	BRKOFF+
10	BRKOFF-
50	FG

Red
Z-axis Brake Line
Black
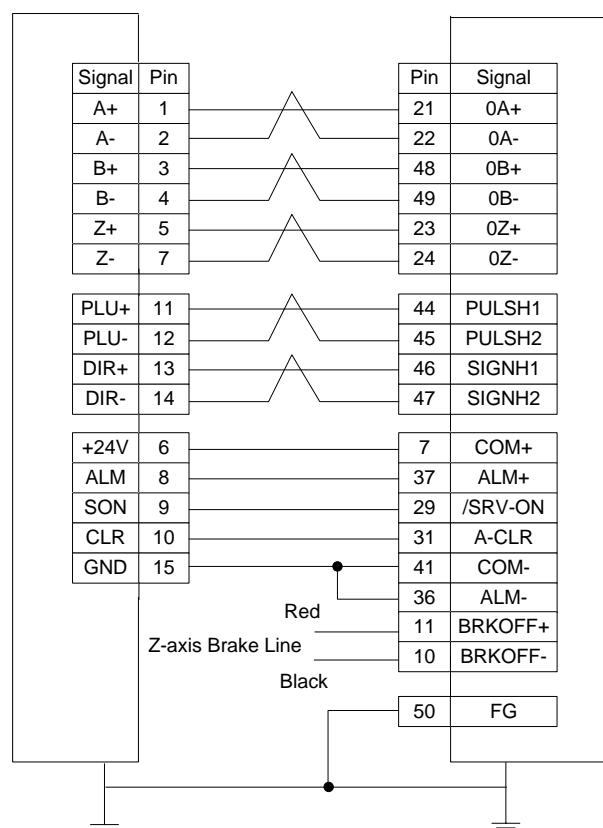
6.3.4 Wiring Diagram of MITSUBISHI MR-JE Servo Driver

Weihong DB15 Driver Interface   Mitsubishi MR-JE CN1 50P HD Plug
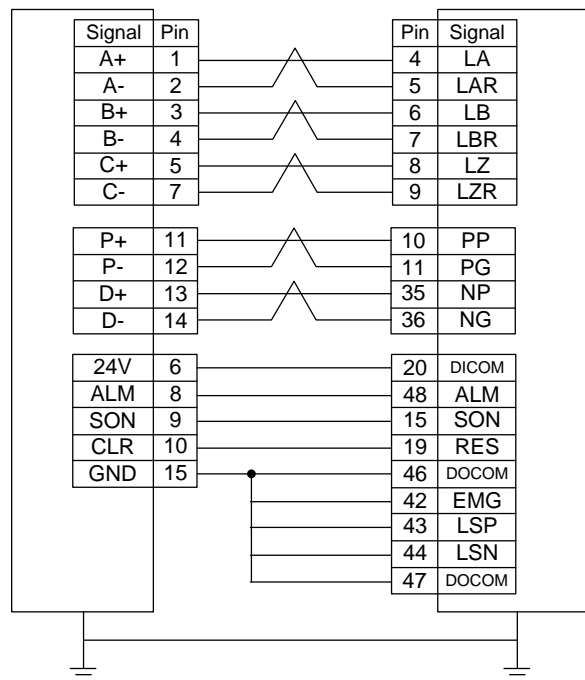
Signal	Pin		Pin	Signal
A+	1		4	LA
A-	2		5	LAR
B+	3		6	LB
B-	4		7	LBR
C+	5		8	LZ
C-	7		9	LZR
P+	11		10	PP
P-	12		11	PG
D+	13		35	NP
D-	14		36	NG
24V	6		20	DICOM
ALM	8		48	ALM
SON	9		15	SON
CLR	10		19	RES
GND	15		46	DOCOM
			42	EMG
			43	LSP
			44	LSN
			47	DOCOM

Figure 1 without brake lines

Note: twisted pair for differential signals.

Weihong DB15 Driver Interface   Mitsubishi MR-JE CN1 50P HD Plug

Signal	Pin		Pin	Signal
A+	1		4	LA
A-	2		5	LAR
B+	3		6	LB
B-	4		7	LBR
C+	5		8	LZ
C-	7		9	LZR
P+	11		10	PP
P-	12		11	PG
D+	13		35	NP
D-	14		36	NG
24V	6		20	DICOM
ALM	8		48	ALM
SON	9		15	SON
CLR	10		19	RES
GND	15		46	DOCOM
			42	EMG
			43	LSP
			44	LSN
			47	DOCOM
BRK+			23	MBR
BRK-			46	DOCOM
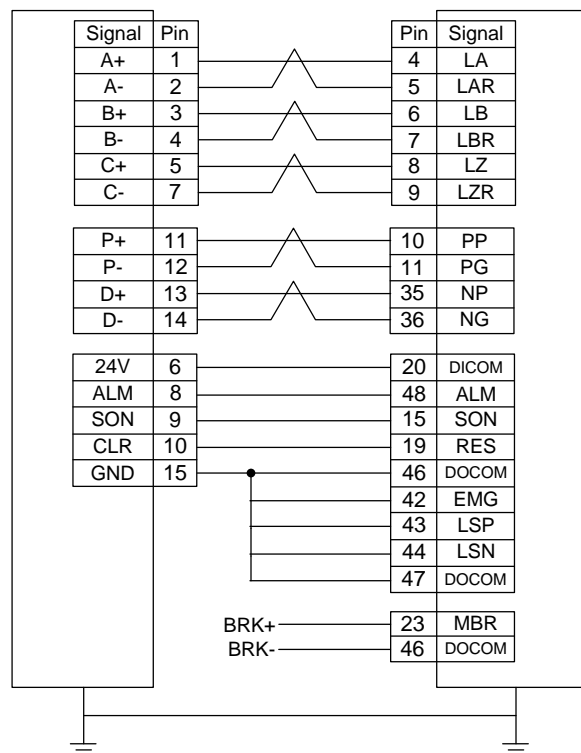
Figure 2 with brake lines

Note: twisted pair for differential signals.

6.3.5 Wiring Diagram of MITSUBISHI MR-E Servo Driver

Weihong DB15 Driver Interface   Mitsubishi MR-E-A 26P HD Plug

Signal	Pin
+24V	6
ALM	8
SON	9
CLR	10
GND	15

Signal	Pin
A+	1
A-	2
B+	3
B-	4
C+	5
C-	7

Signal	Pin
PLU+	11
PLU-	12
DIR+	13
DIR-	14

Pin	Signal
2	OPC
1	VIN
9	ALM
4	SON
3	RES
13	SG
8	EMG

Pin	Signal
15	LA
16	LAR
17	LB
18	LBR
19	LZ
20	LZR

Pin	Signal
23	PP
22	PG
25	NP
24	NG
12	MBR
13	SG

Red

Z axis brake line

Black
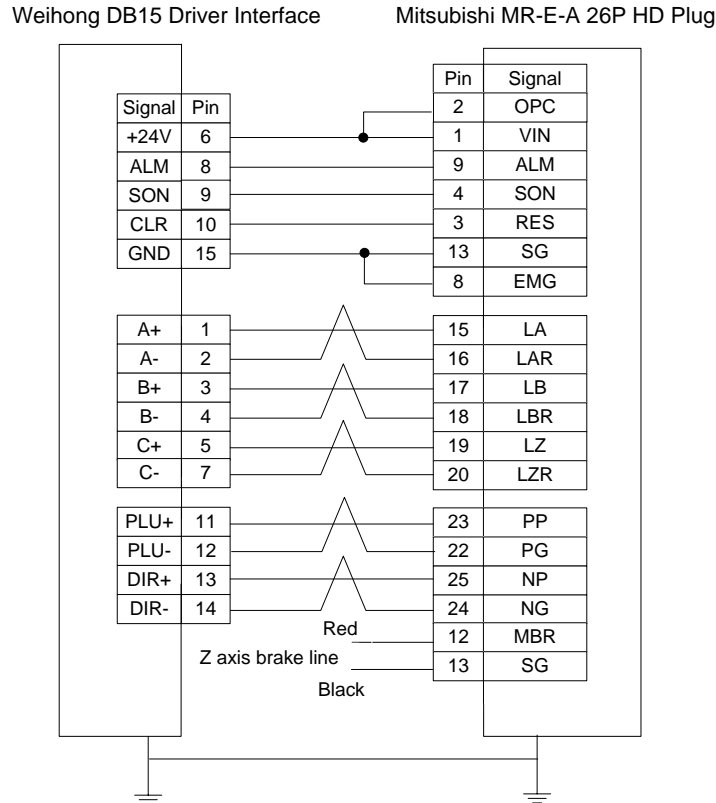
6.3.6 Wiring Diagram of DELTA Servo Driver

DELTA ASDA-A, ASDA-A2, ASDA-AB share the same wire. Among them, ASDA-A2 and ASDA-AB have the same wiring pin while ASDA-A has the contrary pulse pin, with PULSE 41, /PULSE 43. For detailed parameter setting, refer to chapter 6.1.8 and chapter 6.1.10.

Weihong DB15 Driver Interface   Delta ASDA-A Servo 50P

Signal	Pin			Pin	Signal
A+	1			21	OA
A-	2			22	/OA
B+	3			25	OB
B-	4			23	/OB
C+	5			50	OZ
C-	7			24	/OZ
PLU+	11			41	PLUSE
PLU-	12			43	/PULSE
DIR+	13			37	SIGN
DIR-	14			36	/SIGN
+24V	6			11	COM+
ALM	8			28	DO5+ ALRM
SON	9			9	DI1 SON
CLR	10			33	DI5 ARST
GND	15			45	COM-
				30	DI8 EMGS
				27	DO5-
				47	COM-

Red

Z-axis Brake Line

		1	DO4+
		26	DO4-

Black

Figure 1

Weihong DB15 Driver Interface   Delta ASDA-B DB25
(Two-line Pinholes)

Signal	Pin			Pin	Signal
+24V	6			4	COM+
SON	9			17	DI1 SON
ALM	8			1	DO3+ ALM
CLR	10			18	DI2 ARST
GND	15			13	COM-
PLU+	11			22	PLUSE
PLU-	12			21	/PULSE
DIR+	13			20	SIGN
DIR-	14			19	/SIGN
A+	1			10	OA
A-	2			23	/OA
B+	3			12	OB
B-	4			11	/OB
C+	5			24	OZ
C-	7			25	/OZ

Red

Z-axis Brake Line

		16	DO1+
		13	COM-

Black

Figure 2

Weihong DB15 Driver Interface

**Delta ASDA-B2 DB25
(Two-line Pinholes)**

Signal	Pin		Pin	Signal
+24V	6		11	COM+
SON	9		9	DI1 SON
ALM	8		28	DO5+ ALRM+
CLR	10		33	DI5 ARST
GND	15		14	COM-
			27	DO5- ALRM-
PLU+	11		41	PLUSE
PLU-	12		43	/PULSE
DIR+	13		37	SIGN
DIR-	14		39	/SIGN
A+	1		21	OA
A-	2		22	/OA
B+	3		25	OB
B-	4		23	/OB
C+	5		13	OZ
C-	7		24	/OZ

Bk+ (Brown)

Z-axis Brake Line	7	DO1+
	6	COM-

BK- (Black)

Note: twisted pair cable used for differential signals

Figure 3

**Delta ASDA-B DB25
(Two-line Pinholes)**

Weihong DB15 Driver Interface

**Delta ASDA-B DB25
(Two-line Pinholes)**

Signal	Pin		Signal	Pin		Pin	Signal
COM+	4		+24V	6		4	COM+
DI1 SON	17		SON	9		17	DI1 SON
DO3+ ALM	1		ALM	8		1	DO3+ ALM
DI2 ARST	18		CLR	10		18	DI2 ARST
COM-	13		GND	15		13	COM-
PLUSE	22		PLU+	11		22	PLUSE
/PULSE	21		PLU-	12		21	/PULSE
SIGN	20		DIR+	13		20	SIGN
/SIGN	19		DIR-	14		19	/SIGN
OA	10		A+	1		10	OA
/OA	23		A-	2		23	/OA
OB	12		B+	3		12	OB
/OB	11		B-	4		11	/OB
OZ	24		C+	5		24	OZ
/OZ	25		C-	7		25	/OZ

Red

DO1+	16	
COM-	13	

Black

Z-axis Brake Line

Red

Z-axis Brake Line	16	DO1+
	13	COM-

Black

Figure 4

6.3.7 Wiring Diagram of FUJI Servo Driver

Weihong DB15 Driver Interface   Fuji FALDIC-β 26P HD Plug

Signal	Pin		Pin	Signal
+24V	6		1	P24
ALM	8		15	OUT1
SON	9		2	CONT1 RUN
CLR	10		3	CONT2 RST
GND	15		14	M24
A+	1		9	FFA
A-	2		10	*FFA
B+	3		11	FFB
B-	4		12	*FFB
C+	5		23	FFZ
C-	7		24	*FFZ
PLU+	11		7	CA
PLU-	12		8	*CA
DIR+	13		20	CB
DIR-	14		21	*CB

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

6.3.8 Wiring Diagram of HITACHI Servo Driver

Weihong DB15 Driver Interface   Hitachi ADA Servo Driver

Signal	Pin		Pin	Signal
+24V	6		2	PLC
ALM	8		11	ALM
SON	9		26	SON
CLR	10		27	RS
GND	15		30	CM1
			34	CM2
			33	PEN
PLU+	11		15	PLSP
PLU-	12		16	PLSN
DIR+	13		40	SIGP
DIR-	14		41	SIGN
A+	1		21	OAP
A-	2		22	OAN
B+	3		46	OBP
B-	4		47	OBN
C+	5		23	OZP
C-	7		24	OZN
Z axis brake line			13	BRK

6.3.9   Wiring Diagram of SANYO PY Servo Driver

Weihong DB15 Driver Interface   Sanyo PY DB50 HD Plug

Signal	Pin		Pin	Signal
A+	1		3	OA
A-	2		4	/OA
B+	3		5	OB
B-	4		6	/OB
C+	5		7	OC
C-	7		8	/OC
PLU+	11		28	NPC
PLU-	12		29	/NPC
DIR+	13		26	PPC
DIR-	14		27	/PPC
+24V	6		23	COM+
			49	COM+
ALM	8		43	ALM
SON	9		37	SON
CLR	10		30	RST
GND	15		24	COM
			48	SG
			47	SG
			25	COM
			12	SG

Z axis brake line —— 42 HBON

6.3.10   Wiring Diagram of SANYO R Servo Driver

Weihong DB15 Driver Interface   Sanyo R Series 50P HD Plug

Signal	Pin		Pin	Signal
A+	1		3	OA
A-	2		4	/OA
B+	3		5	OB
B-	4		6	/OB
C+	5		7	OC
C-	7		8	/OC
PLU+	11		28	PPC
PLU-	12		29	/PPC
DIR+	13		26	NPC
DIR-	14		27	/NPC
+24V	6		50	COM+
			49	COM+
ALM	8		46	OUT
SON	9		37	SON
CLR	10		15	RST
GND	15		24	COM
			48	SG
			47	SG
			25	SG

Z axis brake line —— 42 HBON

6.3.11 Wiring Diagram of KT270 Servo Driver

Weihong DB15 Driver Interface   KT270 Series Servo

Signal	Pin		Pin	Signal	
+24V	6		1	COM0	
ALM	8		12	ALM	CN4
SON	9		2	SON	
CLR	10		3	RES	
GND	15		6	COM1	
PLU+	11		3	PP	
PLU-	12		8	PG	CN3
DIR+	13		4	NP	
DIR-	14		9	NG	
A+	1		3	LA	
A-	2		8	LAR	
B+	3		4	LB	CN6
B-	4		9	LBR	
C+	5		2	LZ	
C-	7		7	LZR	

6.3.12 Wiring Diagram of STONE GS Servo Driver

Weihong DB15 Driver Interface   Stone GS Series Servo (3-line DB44 Pins)

Signal	Pin		Pin	Signal
+24V	6		7	Input signal anode common port
ALM	8		22	Fault signal output+
SON	9		23	Servo enable input
CLR	10		8	Alarm clear signal input
GND	15		6	Fault signal output-
PLU+	11		12	Pulse command signal input+
PLU-	12		27	Pulse command signal input-
DIR+	13		13	Direction/pulse command input +
DIR-	14		28	Direction/pulse command input-
A+	1		33	Signal differential output +
A-	2		34	Signal differential output -
B+	3		35	Signal differential output +
B-	4		36	Signal differential output -
C+	5		31	Signal differential output +
C-	7		32	Signal differential output -
		Red	21	BRAKE+
	Z-axis Brake Line	Black	5	BRAKE-

6.3.13 Wiring Diagram of TECO TSDA Servo Driver

Weihong DB15 Driver Interface

Teco TSDA Series Servo
(50-pin HD Plug)

Signal	Pin		Pin	Signal
+24V	6		45	IN-COM
ALM	8		19	ALM
SON	9		1	/SON
CLR	10		2	/AL-RS
GND	15		46	DG
			47	DG
			48	DG
			49	DG
			4	FSTP
			5	RSTP
P+	11		14	PP
P-	12		15	PN
D+	13		16	DP
D-	14		17	DN
A+	1		35	PA
A-	2		36	/PA
B+	3		37	PB
B-	4		38	/PB
C+	5		39	PZ
C-	7		40	/PZ
		BK+	20	BI
		BK-	47	DG
			50	FG

With a line

6.3.14 Wiring Diagram of TECO ESDA Servo Driver

Weihong DB15 Driver Interface

Teco ESDA Series Servo

Signal	Pin		Pin	Signal
A+	1		16	PA
A-	2		17	/PA
B+	3		18	PB
B-	4		19	/PB
C+	5		20	PC
C-	7		21	/PC
PLU+	11		4	PP
PLU-	12		5	/PN
DIR+	13		6	DP
DIR-	14		7	/DN
+24V	6		10	+24V
ALM	8		14	ALM+
SON	9		1	SON
CLR	10		2	CLR
GND	15		22	N24
			25	FG

7 Parameter Overview

Here are overall parameters in NK280 general four axes system of manufacturers' access. Parameters are listed according to their sequences under [All View] tab of [Machine Parameters (A)] screen.

Name	Setting Range	Default Value	When Enabled	Refer-ence
Manual High Speed	15000~15000 (mm/min)	3500	Immediately	3.9.3
Manual Low Speed	0 ~ Manual High Speed (mm/min)	1500	Immediately	3.9.3
Dry Running Speed (G00)	Machining Speed ~ MAX Axial Velocity (mm/min)	3500	Immediately	3.9.3
Machining Speed (GXX)	Z-axis Approach Speed ~ MAX Axial Velocity (mm/min)	3000	Immediately	3.9.3
Pulse Equivalent (X)	0.0001~1 (mm/p)	0.001	After restart	3.2.2
Pulse Equivalent (Y)	0.0001~1 (mm/p)	0.001	After restart	3.2.2
Pulse Equivalent (Z)	0.0001~1 (mm/p)	0.001	After restart	3.2.2
Pulse Equivalent (A)	0.0001~1 (mm/p)	0.001	After restart	3.2.2
Workbench range upper limit (X)	0~67108.8640(mm)	400	After restart	3.2.3
Workbench range upper limit (Y)	0~67108.8640(mm)	400	After restart	3.2.3
Workbench range upper limit (Z)	-100~67108.8640(mm)	0	After restart	3.2.3
Workbench range upper limit (A)	-50~11712.7603(mm)	50		3.2.3
Workbench range lower limit (X)	-67108.8640~Workbench range upper limit (mm)	0	After restart	3.2.3
Workbench range lower limit (Y)	-67108.8640~Workbench range upper limit (mm)	0	After restart	3.2.3
Workbench range lower limit (Z)	-67108.8640~Workbench range upper limit (mm)	-100	After restart	3.2.3
Workbench range lower limit (A)	-67108.8640~Workbench range upper limit (mm)	-50	After restart	3.2.3
Change tool range upper limit (X)	0~67108.8640(mm)	400	After restart	3.2.3
Change tool range upper limit (Y)	0~67108.8640(mm)	400	After restart	3.2.3
Change tool range upper limit (Z)	-100~67108.8640(mm)	0	After restart	3.2.3
Change tool range upper limit (A)	0~11712.7063(mm)	0	After restart	3.2.3
Change tool range lower limit (X)	-67108.8640~Change tool range upper limit (mm)	0	After restart	3.2.3
Change tool range lower limit (Y)	-67108.8640~Change tool range upper limit (mm)	0	After restart	3.2.3
Change tool range lower limit (Z)	-67108.8640~Change tool range upper limit (mm)	-100	After restart	3.2.3
Change tool range lower limit (A)	-11712.7603~Change tool range upper limit (mm)	0	After restart	3.2.3
Axis output direction (X)	1: Positive direction -1: Negative direction	1	After restart	3.2.1
Axis output direction (Y)	1: Positive direction	1	After restart	3.2.1

Name	Setting Range	Default Value	When Enabled	Refer-ence
	-1: Negative direction			
Axis output direction (Z)	1: Positive direction -1: Negative direction	1	After restart	3.2.1
Axis output direction (A)	1: Positive direction -1: Negative direction	1	After restart	3.2.1
Safety Height	0~5000 (mm)	10	Immediately	3.2.1
Single Axis Acc	0.001~100000 (mm/ s^2)	1200	Immediately	3.9.3
Delay time of acute angle motion	-(ms)	0	Immediately	-
Startup Speed	0~Z-axis Approach Speed (mm/min)	100	Immediately	3.9.3
Rough Speed of Calibration	1 ~ Rapid JOG Feedrate (mm/min)	400	Immediately	3.9.3
Calibration Block Thickness	0~100 (mm)	10	Immediately	3.6
X Coor of Fixed Cali Block	Negative Travel Limit (MCS) ~	0	Immediately	3.6
Y Coor of Fixed Cali Block	Positive Travel Limit (MCS)	0	Immediately	3.6
Z Coor of Fixed Cali Block	(mm)	-1.0	Immediately	3.6
Handwheel Output Direction	-1: Opposed to axis output direction 1: Same as axis output direction	1	After restart	3.14.2
Handwheel in strict accordance with the pulse counting	Yes: Valid No: Invalid	No	After restart	3.14.2
Acceleration of handwheel	0~100000	200	After restart	3.14.2
Full Feedrate for G00	Yes: Fixed No: Not fixed	Yes	After restart	3.9.3
Feedrate is Valid for Manual Mode	Yes: Valid No: Invalid	Yes	After restart	3.9.3
Use Default Speed	Yes: Valid No: Invalid	Yes	Immediately	3.9.3
Use Default Spindle Speed	Yes: Valid No: Invalid	Yes	Immediately	3.9.3
Back to REF before machining	Yes: Valid No: Invalid	Yes	Immediately	3.3.2
Cancel REF Sign on Estop	Yes: Valid No: Invalid	Yes	Immediately	3.3.2
Is reset SVON when estop	Yes: Valid No: Invalid	No	Immediately	3.3.2
MAX Angle of Joining High Speed	0~180.001 (deg)	120	Immediately	-
Corner Trace Pretreatment Options	0: Not disposed 1: Curve smooth 2: Arc smooth	0	Immediately	-
Corner tolerance	0~0.5 (mm)	0.1	Immediately	-
Connect speed look ahead distance	0~0.05 (mm)	0.05	Immediately	-
Predicted segment No.	1~100	50	Immediately	3.9.3
Whether to Use S-type Algorithm	Yes: Valid; No: Invalid	1	Immediately	3.9.3
Plunge Speed Options	0: No limitation 1: Z Down Feedrate Limitation valid with only Z-axis downward	0	Immediately	-

Name	Setting Range	Default Value	When Enabled	Refer-ence
	movement 2: Z Down Feedrate Limitation valid with Z-axis downward movement included			
Z Down Speed	0.0 ~ MAX Axial Velocity (Z) (mm/ min)	300	Immediately	3.9.3
Z Deceleration Distance	0~999 (mm)	10	Immediately	3.9.3
Z Approach Speed	0~ Default Feedrate (mm/min)	600	Immediately	3.9.3
MAX X axis speed	6~15000 (mm/min)	10000	After restart	3.9.3
MAX Y axis speed	6~15000 (mm/min)	10000	After restart	3.9.3
MAX Z axis speed	Z Down Feedrate Limitation ~ 6000000 (mm/min)	10000	After restart	3.9.3
Reference Velocity in Corner	0.1667~10000(mm/min)	500	After restart	3.9.3
X axis Reference Velocity in Corner	0.1667~10000(mm/min)	500	After restart	3.9.3
Y axis Reference Velocity in Corner	0.1667~10000(mm/min)	500	After restart	3.9.3
Z axis Reference Velocity in Corner	0.1667~10000(mm/min)	500	After restart	3.9.3
A axis Reference Velocity in Corner	0.1667~10000(mm/min)	500	After restart	3.9.3
Reference Circular Speed	Yes: Valid No: Invalid	Yes	Immediately	3.9.3
Reference Circle Speed	5~99999 (mm/min)	3500	Immediately	3.9.3
Limit Max Velocity for Small Line	Yes: Valid No: Invalid	Yes	Immediately	-
Length for Limit Max Velocity	0.001~100000 (mm)	2	Immediately	-
Path Smoothing Time	0~2 (sec)	0	Immediately	-
Arc Radius Tolerance	0~999 (mm)	2	Immediately	-
Enable Arc IJK incremental mode	Yes: Valid No: Invalid	Yes	Immediately	-
Spindle Off while Pausing	Yes: Valid No: Invalid	Yes	After restart	3.4
Spindle Off while Stopping	Yes: Valid No: Invalid	Yes	After restart	-
Is open coolant while starting	Yes: Valid No: Invalid	No	After restart	-
Is close coolant while stopping	Yes: Valid No: Invalid	No	After restart	3.4
Spindle Off when Cycle Completed	Yes: Stop No: Not stop	Yes	Immediately	3.4
MAX Spindle Speed	10000~999999 (r/min)	24000	After restart	3.4
Spindle start/stop time	0~60000 (ms)	5000	Immediately	3.4
Spindle Action Options when Cycle Completed	0:Not move 1: Back to fixed point 2: Back to workpiece origin	0	Immediately	3.4
Prompt after machining ends	0: Red light not on 1: Red light on for 3s 2: Red light not off until there is	0	Immediately	3.4

Name	Setting Range	Default Value	When Enabled	Reference
	mouse or keyboard input			
X axis coordinate of the fixed point	The upper limit of table travel~ The lower limit of table travel (mm)	0	Immediately	3.4
Y axis coordinate of the fixed point		0	Immediately	3.4
Z axis coordinate of the fixed point		-1	Immediately	3.4
A axis coordinate of the fixed point		-1	Immediately	3.4
G73_G83 retract amount	0~9999.9 (mm)	0	Immediately	3.4
Pause Z Offset	-(mm)	10	After restart	3.4
X direction in backing to reference point	-1,1	-1	Immediately	3.3.2
Y direction in backing to reference point	-1,1	-1	Immediately	3.3.2
Z direction in backing to reference point	-1,1	-1	Immediately	3.3.2
A direction in backing to reference point	-1,1	-1	Immediately	3.3.2
Retract distance of X axis	-(mm)	2	Immediately	3.3.2
Retract distance of Y axis	-(mm)	2	Immediately	3.3.2
Retract distance of Z axis	-(mm)	-2	Immediately	3.3.2
Retract distance of A axis	-(mm)	-2	Immediately	3.3.2
X speed in backing to reference point	0.001~MAX Axial Velocity (mm/min)	1800	Immediately	3.3.2
Y speed in backing to reference point	0.001~MAX Axial Velocity (mm/min)	1800	Immediately	3.3.2
Z speed in backing to reference point	0.001~MAX Axial Velocity (mm/min)	1500	Immediately	3.3.2
A speed in backing to reference point	0.001~MAX Axial Velocity (mm/min)	1500	Immediately	3.3.2
X speed in exact positioning	0.001~15000(mm/min)	200	Immediately	3.3.2
Y speed in exact positioning	0.001~15000(mm/min)	200	Immediately	3.3.2
Z speed in exact positioning	0.001~15000(mm/min)	100	Immediately	3.3.2
A speed in exact positioning	0.001~15000(mm/min)	100	Immediately	3.3.2
X axis screw pitch	0.001~9999.9 (mm)	5	Immediately	3.3.2
Y axis screw pitch	0.001~9999.9 (mm)	5	Immediately	3.3.2
Z axis screw pitch	0.001~9999.9 (mm)	5	Immediately	3.3.2
A axis screw pitch	0.001~9999.9(mm)	5	Immediately	3.3.2
Open auto lubrication	Yes: Valid No: Invalid	No	Immediately	-
Interval of opening lubrication	0~34560000(sec)	18000	Immediately	-
Opening time of lubrication pump	0~34560000(sec)	5	Immediately	-
Cycle machining interval	0~3600000(sec)	0	Immediately	-
Enable Y as revolving axis	Yes: Valid No: Invalid	No	After restart	-

Name	Setting Range	Default Value	When Enabled	Refer-ence
MM as revolving axis unit	Yes: mm No: degree	No	After restart	-
Pulse Equivalent of Y revolving axis	0.0001~1 (deg/p)	0.006	After restart	-
Revolving Workpiece radius	0~100000 (mm)	10	After restart	-
Startup speed of revolving axis	0~100000(rad/s)	0.2909	Immediately	-
Acceleration speed of revolving axis	0 ~100000 (mm/ s^2)	6.9813	Immediately	-
MAX speed of revolving axis	0.06~250 (Related to pulse equivalent setting) (n/min)	30	Immediately	-
A axis program unit	0:degree 1:mm	0	Restart	-
Startup speed of A axis	0~100000	0.3	Immediately	-
Acceleration speed of A axis	0.001~100000	6.9813	Immediately	-
Max speed of A axis	0.06~41.66667	30	Immediately	-
Control radius of A axis	0~100000	10	Immediately	-
Screw Error Comp	0: No compensation 1: Unilateral 2: Bilateral	0	After restart	3.11.1
Backlash Compensation Valid	Yes: Valid No: Invalid	No	After restart	3.11.1
Enable AQE Compensation	Yes: Valid No: Invalid	No	After restart	3.11.3
AQE Compensation Time	0~0.3015 (sec)	0	After restart	3.11.3
AQE Compensation Length	0~10 (mm)	0	After restart	3.11.3
Delay of AQE Compensation	0~10 (sec)	0	After restart	3.11.3
Intensity of AQE Compensation	0~1	0.75	After restart	3.11.3
Lift Height for DXF	0~99999 (mm)	1	Immediately	3.13.3
Cutting Depth for DXF	-99999~0 (mm)	-1	Immediately	3.13.3
Enable First Point as WCS Zero	Yes: Valid No: Invalid	Yes	Immediately	3.13.3
Enable Single Shape Cutting	Yes: Valid No: Invalid	No	Immediately	3.13.3
Enable Flat Bottom Cutting	Yes: Valid No: Invalid	No	Immediately	3.13.3
Force Metric Unit in DXF	Yes: Metric No: Inch	No	Immediately	3.13.3
Enable ENG Tool Selection	Yes: Valid No: Invalid	Yes	Immediately	3.13.3
Enable ENG Tool No. Change	Yes: Valid No: Invalid	Yes	Immediately	3.13.3
Tool Change Notification	Yes: Valid No: Invalid	Yes	Immediately	3.13.3
Lift Height for ENG	0~100000 (mm)	1	Immediately	3.13.3
Retract Distance	0~100000 (mm)	1	Immediately	3.13.3
Cycle Times for ENG	-	1	Immediately	3.13.3
Deep hole machining	0: Reciprocating chips removal	0	Immediately	3.13.3

Name	Setting Range	Default Value	When Enabled	Refer-ence
manner	1: High speed reciprocating chips removal			
Lift Height for PLT	0~100000 (mm)	5	Immediately	3.13.3
Plt Unit	0~100000 (mm)	40	Immediately	3.13.3
Tool step	0~100000 (mm)	0.025	Immediately	3.13.3
Machining depth	-	-1	Immediately	3.13.3
Turn on radius compensation	Yes: Valid No: Invalid	No	Immediately	3.11.2
Specify Type of Tool Compensation	1: Normal type 2: Intersect type 3: Insert type	1	Immediately	3.11.2
Tool Mag. Capacity	1~20	10	After restart	3.18.3
Current Tool No.	1~ Tool Mag. Capacity	1	Immediately	3.18.3
Currently Tool Mag. No.	1~ Tool Mag. Capacity	1	Immediately	3.18.3
Tool Change Notification	Yes: Prompt No: Not prompt	No	Immediately	3.18.3
Automatic Tool Meas. after Tool Change	Yes: Measure No: Not Measure	No	Immediately	3.18.3
T0 Handle Mode	0: Disable T0; 1: Discharge Loaded tool to magazine and keep empty; 2: Set initial tool No. from 0	0	After restart	3.18.3
Tool change upper position	- (mm)	-1	Immediately	3.18.3
Tool change lower position	- (mm)	0	Immediately	3.18.3
X change tool position	- (mm)	0	Immediately	3.18.3
Y change tool position	- (mm)	0	Immediately	3.18.3
X coordinate of tool change	- (mm)	0	Immediately	3.18.3
Y coordinate of tool change	- (mm)	0	Immediately	3.18.3
Z coordinate of tool change	- (mm)	0	Immediately	3.18.3
Tool change speed	0.001~MAX Axial Velocity (mm/min)	3000	Immediately	3.18.3
Z axis CTup and CTdown speed	0.001~ Rapid Traverse Speed in Tool Change (mm/min)	60	Immediately	3.18.3
Traversing speed in/out tool magazine	0.001~ Rapid Traverse Speed in Tool Change (mm/min)	60	Immediately	3.18.3
Tool change delay	0~600000 (ms)	500	Immediately	3.18.3
Return Prior Position after tool change	Yes: Valid No: Invalid	No	Immediately	3.18.3
T1 Position (X) in MCS	- (mm)	0	Immediately	3.18.3
T1 Position (Y) in MCS	- (mm)	0	Immediately	3.18.3
T1 Position (Z) in MCS	- (mm)	0	Immediately	3.18.3

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