In this user manual we have tried to describe the matters concerning the operation of this CNC system to the greatest extent. However, it is impossible to give particular descriptions for all unnecessary or unallowable operations due to length limitation and products application conditions; Therefore, the items not presented herein should be regarded as "impossible" or "unallowable".

Preface

Dear Users,

We are honored by your purchase of this GSK928TEa Turning CNC System made by GSK CNC Equipment Co., Ltd.

The manual describes the programming, operation, installation and connection of this system in details.

To ensure safe and effective running, please read this manual carefully before installation and operation.

Notes before operation:

- Connect the emergency stop button of the system firmly and correctly, otherwise an emergency stop alarm will occur when the system is switched on, and the system cannot work properly (it does not belong to system fault).
- Set the program reference point of the system according to the actual mounting position of the tool of the machine.

Warning

Accident may occur by improper connection and operation！ This system can only be operated by authorized and qualified personnel.

Special caution:

The power supply fixed on/in the cabinet is exclusively used for the CNC system made by GSK.

It can't be applied to other purposes, or else it may cause serious danger!

ANNOUNCEMENT!

- **This manual describes various possibilities as much as possible. However, operations allowable or unallowable cannot be explained one by one due to so many possibilities that may involve with, so the contents that are not specially stated in this manual shall be regarded as unallowable.**

WARNING!

- **Please read this manual and a manual from machine tool builder carefully before installation, programming and operation, and strictly observe the requirements. Otherwise, products and machine may be damaged, workpiece be scrapped or the user be injured.**

CAUTION!

- **Functions, technical indexes (such as precision and speed) described in this user manual are only for this system. Actual function configuration and technical performance of a machine tool with this CNC system are determined by machine tool builder's design, so functions and technical indexes are subject to the user manual from machine tool builder.**
- **Though this system adopts standard operation panel, the functions of the keys on the panel are defined by PLC program (ladder diagram). It should be noted that the keys functions described herein are for the standard PLC program (ladder diagram).**
- **For functions and effects of keys on control panel, please refer to the user manual from machine tool builder.**

This manual is subject to change without further notice.

Suggestions for Safety

The user must carefully read the suggestions for the system before installing and operating the system.

The user must follow the suggestions of the system to ensure that the person is not hurt and the equipments are not damaged.

The user must follow the related suggestions for safety described in the user manual, and must not operate it until the manual is read completely.

The user must follow the suggestions of safety described in the user manual from the machine manufacture.

The user can operate the machine or compile the program to control the machine after completely reading the manual and the one from the machine manufacturer.

I. Graphic symbol

Caution Operation against the instructions may cause the operator serious injuries.

Alarm Wrong operation may injure the operator and damage the system.

Warning Improper operation may result in damage to the machine, as well its products.

! Important information

II. Notes

1) Check before acceptance

Warning ● The damaged or defect product must not be used.

2) Delivery and storage

Warning ●Moistureproof measures are needed while the system is delivered and stored. Never climb the packing box, stand on it, or place heavy items on it. Do not put over five packing boxes in piles. Take particular care of the front panel and the display of the system.

3) Installation

Warning ●Protect the system from sunlight and raindrops. The shell of the system is not waterproof.

Warning ●Prevent dust, corrosive air, liquid, conductors and inflammable substances from entering the system.

●Keep the system away from inflammable and explosive substances. Avoid places where there is powerful electromagnetic interference.

●Install the system firmly without vibration.

4) Wiring

Caution ●Only qualified persons can connect the system or check the connection. The connecting wires cannot be damaged. Do not press or open the cover of the system with power on.

Caution ●The voltage and the polarity of connecting plugs must accord with the user manual.

●Wet hands are dangerous to grasp the plug or the switch.

Warning ●The connection must be proper and firm.

●The system must be earthed.

5) Debugging

Warning ●Make sure that the parameters of the system is correct before the system runs.

●No parameter is beyond the setting limit in the manual.

6) Operation

Caution ●Only qualified operators can operate the system.

●Ensure the switch is OFF before connecting the power supply.

Warning ●The operator cannot leave the system to work alone.

●Do not switch on the system until making sure the connection is correct.

●The emergency stop button is able to disconnect all power supplies when the system breaks down. Do not switch on/off the system frequently

Warning ●Prevent the system from the environmental interference.

7) Troubleshooting

Caution ●Unqualified persons cannot repair the system.

Warning ●After alarms, do not restart the system until the breakdown is fixed.

III. Safety suggestions for programming

1) Setting a coordinate system

Incorrect coordinate system may cause the machine not to work as expected even if the program is correct, which may injure the operator, and damage the machine as well as its tool and workpiece.

2） Rapid traverse (positioning)

When G00 rapid traverse performs the positioning (nonlinear motion to position between its starting point and end point), make sure that the path for the tool is safe before programming. The positioning is to perform the rapid traverse, and when the tool and the workpiece are interfered, the tool, the machine and the workpiece may be damaged, and even the operator injured.

3） Applicability of user manual

The manual introduces in detail all functions of the system, including optional functions and max. controllable ranges, which are subject to change with the machine. If there is any doubt, please read the instruction for the machine.

4） Functions of CNC system and machine

CNC machines depend on CNC systems, but also power voltage cabinets, servo systems, CNC and the operator panels. It is hard to explain all the integrated functions, programming and operation. Do not use integrated instructions not included in the manual until they have been tested successfully.

IV. Notes and Safety Suggestions for Operating Machine

1) Test the machine without workpiece or tools. Make sure that the machine runs well before it starts to work.

2) Check the input data of the system carefully before operating the machine. Incorrect input data may cause the machine to work improperly, and damage the workpiece and the tool, as well as injure the operator.

3) Make sure that the input feedrate of the system is suitable for the expected operation. Feedrate has a maximum for each machine, and the amount of the feed rate is subject to change with operation. Choose the maximum according to the instructions of the machine. Improper feedrate leads the machine to work wrongly, and damage the workpiece and the tool, as well as injure the operator.

4) When offset is needed, check the direction and the amount of the compensation. Improper compensation causes the machine to work wrongly, and damage the workpiece and the tool, as well as injure the operator.

5) If the machine is to run in JOG working mode, check the current position of the tool and the workpiece, and correctly specify the moving axis, moving direction and the feedrate. MPG(Handwheel) control with great override, such as 100, may damage the machine and its tool, even injure the operator.

6) If the tool is return to the reference point, make sure that the machine has been equipped with the device to detect the reference point; otherwise, the tool cannot reach the reference point, which may damage the machine and its tool, and even injure the operator.

Safety Responsibility

Manufacturer's Responsibility

——Be responsible for the danger which should be eliminated and/or controlled on design and configuration of the provided CNC systems and accessories.
——Be responsible for the safety of the provided CNC systems and accessories.
——Be responsible for the provided information and advice for the users.

User's Responsibility

——Be trained with the safety operation of CNC system and familiar with the safety operation procedures.
——Be responsible for the dangers caused by adding, changing or altering on original CNC systems and the accessories.
——Be responsible for the failure to observe the provisions for operation, adjustment, maintenance, installation and storage in the manual.

This manual is reserved by end user.

We are full of heartfelt gratitude for your support by using GSK's products.

Operation

Introduces operation methods, technical specifications and parameter settings of GSK928TEa Turning CNC System.

Programming

Introduces command codes and program format of GSK928TEa Turning CNC System.

Connection

Introduces installation and connection methods of GSK928TEa Turning CNC System.

Appendix

Introduces supplementary information to installation and connection of GSK928TEa Turning CNC System.

CONTENTS

OPERATION

Chapter 1 Overview

With 480×234 lattice TFT color graphic LCD, GSK 928TEa CNC system takes as key control the high-speed CPU and the complex programmable logic device of super-large-scale integrated circuit CPLD. ISO CNC code is used to write part programs. The system is characterized by a full screen editing, Chinese/English operation interface, real time demonstration of the machining process, simple operation. The system can be matched with stepper motors or AC servo drive unit to machine outer cylinders, end faces, grooves, tapers, circular arcs and threads with high cost-performance.

Technical Specifications:

- ✓ **X, Z link to realize the short linear high-speed smooth interpolation, 0.001mm interpolation precision, max. rapid traverse speed 30m/min**
- ✓ **Optional to Y(set by the parameter), Y not only realizes the rapid traverse, feed(JOG/STEP/MPG feed) motion, alone tapping motion, but also sets the coordinate system, program zero return, manual machine zero return and other operations**
- ✓ **Control servo spindle**
- ✓ **Flexible and convenient programming with statement programming function**
- ✓ **USB interface communication to get the convenient and fast operation**
- ✓ **Least command unit 0.001mm, command electronic gear ratio (1～99999) /(1～99999)**
- ✓ **Control all kinds of automatic tool post, spindle automatic shifting gear**
- ✓ **Pitch error compensation, backlash compensation, tool length compensation, tool radius C compensation function**
- ✓ **Exponential acceleration/deceleration control used to high-speed, high precise machining**
- ✓ **Automatic chamfering function**
- ✓ **Tapping function**
- ✓ **Course monitoring function**
- ✓ **Cutting metric/inch thread, end face thread, variable pitch thread, continuous thread; thread high-speed run-out**
- ✓ **Full editing part programs, storing 255 machining programs; No. 253 program up to 4MB**
- ✓ **Big screen color LCD, color configuration is selected by the parameter**
- ✓ **MSTE state real-time display in machining**
- ✓ **Multi-level operation password to conveniently manage devices**
- ✓ **Parameter backup function**
- ✓ **Parameter, offset data communication function**
- ✓ **Bilateral communication between CNC and CNC, between CNC and PC, serial upgrade CNC software**

- ✓ **Bilateral communication between CNC and USB, CNC is upgraded by USB**
- ✓ **Installation dimension, electric characteristics, some interfaces are compatible to GSK928TC Turning CNC System**

Chapter 2 Technical Specifications

2.1 928TEa Technical specifications

Motion control	Controlled axes: X, Y, Z; simultaneous controlled axes(interpolation axes): 2 (X, Z)
	Interpolation: X, Z linear, arc interpolation，Z/Y or X/Y linear interpolation
	Position command range:-9999.999 mm～9999.999mm; least command unit: 0.001mm
	Command multiplex coefficient 1～99999，command division coefficient 1～99999
	Rapid traverse speed：up to 30000mm/min; rapid override：F25%, 50%, 75%, 100% real-time regulation
	Cutting feedrate: up to 15000mm/min; feedrate override：0～150% 16 grades real-time regulation
	MANUAL feedrate:： 0mm/min～1260mm/min 16-grade real-time regulation or it is defined extemporarily
	MPG feed：0.001mm, 0.01mm, 0.1mm
	Acceleration/deceleration: cutting feed can select exponential/linear acceleration/deceleration
G command	32 commands：G00, G01, G02, G03, G04, G05, G26, G28, G30, G31, G32, G33, G34, G40, G41, G42, G50, G51, G71, G72, G73, G74, G75, G76, G90, G92, G94, G96, G97, G98, G99
Thread machining	Tapping: metric/inch single/multiple straight thread, taper thread, end face thread; variable pitch thread; thread run out length, angle and speed can be set, executing the high-speed thread run-out; pitch: 0.001mm～500mm or 0.06tooth/inch～25400tooth/inch; tapping function
	Spindle encoder: lines can be set (100p/r～5000p/r); Drive ratio between encoder and spindle is 1:1
Precision compensation	Backlash compensation: 0 mm～10.000mm
	Pitch error compensation: 300 compensation points for each axis; use constant distance or inflection point to create data; the system executes the delicate linear compensation
	Tool offset: Tool length compensation and tool nose radius compensation (offset C) for 16 tools, 64 tool groups Tool setting methods: fixed-point, trial cutting Tool offset execution: during coordinate modification or tool post movement.
M command	M00, M02, M20, M30, M03, M04, M05, M08, M09, M10, M11, M12, M32, M33, M41, M42, M43, M44, M47, M48, M87, M88, M78, M79, M80, M96, M97, M98, M99, M91, M92, M93, M94, M21, M22, M23, M24; M commands are defined by operator: M60～M74 realize the special function control
T command	Up to 16 tools (T01□□～T16□□) ，setting tool post type, parameters to select too change course Tool post type is set to 0 when the line-up tool is used
Spindle speed control	Speed switching value control: S 4-gear directly controlling output range is S01～S04; or 16-gear BCD output range is S00～S15
	Speed analog voltage control: S specifies the spindle speed per minute or the cutting surface speed (constant surface speed) , outputs 0～10V voltage to spindle converter, supports 4-gear spindle speed M41～M44 with stepless shifting gear
	Support DAP03 servo spindle speed/position control mode switch, realize spindle, Z or X link function
I/O function	I/O function diagnosis display
	I/O interface：23 input/18 output interfaces
Statement programming	Assignment statement: complete assignment, many arithmetic and logic operations
	Conditional statement: complete conditional judgment and skip
Display window	Display: 480×234 lattice, color LCD，LED or CCFL light in poor
	Display method: Chinese or English window set by a parameter, displaying machining path of workpiece in real-time
Program edit	Program capacity: max. 255 programs, No. 0～252, 254 with 800KB, No.253 with 4MB(FLASH)
	Edit method: edit in full screen, relative/absolute coordinate and compound program call, subprogram multi-level embedding
	Program drawing check
Communication	USB, RS232 interface; bidirectionally transmitting programs, parameters and offset between CNC and USB, CNC and PC, CNC and CNC Supporting software RS232, USB to download and upgrade
Optional drive unit	DA98 Series Digital AC Servo or DY3 Series Stepper Drive unit with pulse + direction signal input

2.2 Functional differences between 928TEa and 928TCa turning CNC system

The manual is applied to two types of system: 928TEa, 928TCa. Functions of 928TCa turning CNC system are less than those of 928TEa, shown as follows:

Functional difference item	928TEa	928TCa	Remark
Controllable axis	X, Y, Z	X, Z	
Rapid traverse speed	Max. 30000 mm /min	Max. 15000 mm /min	
Cutting speed	(0.001～15000) mm/min	(0.001～4000) mm/min	
Max. radius of arc	Max. machining: 1000m	Max. machining: 100m	
Tool nose radius compensation	C tool radius compensation, **PROGRAMMING, Chapter 5 Tool Nose Radius Compensation**	N/A	
Pitch error compensation	Fine linear pitch error compensation, **PROGRAMMING, Chapter 6 Pitch Error Compensation**	N/A	
Automatic chamfer function	Automatic chamfer function, **PROGRAMMING, Chapter 4.4 Chamfer Function**	N/A	
Variable pitch thread	Variable pitch thread G34, **PROGRAMMING, Chapter 4.5.2 G34-Variable Pitch Thread Cutting**	N/A	
Thread repair function	Thread repair function	N/A	
Manual tapping function	Manual tapping function, **OPERATION, Chapter 4.4.12 Spindle Rotation Function**	N/A	
Spindle position control	Switch position control and speed control, **OPERATION, Chapter 4.4.3.4 Setting Spindle Working State**	N/A	
External MPG control	Support external MPG control function, **OPERATION, Chapter 4.4.9.4 External MPG Operation**	N/A	
Statement programming function	Statement programming function, **OPERATION, Chapter 9 Statement Programming**	N/A	
Program solid with big capacity	No. 253 program solid with big capacity, **OPERATION, Chapter 4.3.4.9 No.253 Program Operation**	N/A	
Graph analog function of program run path, graph zoom out function	Program movement path graph analog function, graph zoom out function, **OPERATION, Chapter 4.3.6.2 hp3 Analog Graph**	N/A	
M miscellaneous function	Set Y permitted forbidding working state (M47/M48), **OPERATION, Chapter 4.4.3.4 Setting Spindle Working State**	N/A	

M customize command	Support M60～M74 customize to realize special function control, **PROGRAMMING, Chapter 10 Customize Command Programming**	N/A	

Chapter 3 Operation Panel

The turning CNC system(system or CNC) uses the aluminum alloy three-D operation panel and its appearance is as follows:

3.1 LCD Display

LCD display: CNC man-machine dialogue interface. Resolution 480×234 lattice TFT color LCD display.

3.2 LED Status Indicator

LED indicates that the current working state of the system. There are 16 function keys with LED indicators, the function executed by the corresponding key is valid when LED is ON, and it is invalid when LED is OFF.

3.3 Keyboard

Based on GB/T 3168-1993 Numerical Control of Machine-Symbol, the system sets the following symbol function keys that complete the corresponding functions when they are pressed as follows:

3.3.1 Character keys

Character keys include numbers, letter, and some other symbols.
In EDIT working mode, each letter key can switch into 2 or 3 letter keys; in other working mode, each

letter key only expresses one letter key. (For example, I and I are on one key, the operator directly press the key when “I” or “P” is required, and the system automatically indentifies other letters.)

Numeric keys: input data(0～9) ;

Letter keys: input letters;

Symbolic keys: input +(plus) , -(minus) , *(multiply) , /(devide) , +(positive) , -(negative) , .(decimal point) , ＞(larger than) , ＝(equal to) , ＜(smaller than) , and, or , (), etc.

3.3.2 Working mode selection key

Marking with the symbols and characters, the working mode selection keys are pressed to complete the corresponding function, and their definitions are as follows:

: select EDIT working mode

: select JOG working mode

: select AUTO working mode

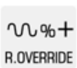
: select PARAMETER working mode

: select OFFSET working mode

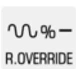
: select DIAGNOSIS working mode

3.3.3 Function keys

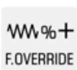
Press function keys with the visualization symbol and letter to complete the corresponding functions and each symbol definition is as follows:



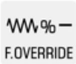
INCREASING RAPID OVERRIDE Increase rapid traverse override in JOG working mode and G00 rapid traverse override in AUTO working mode.



REDUCING RAPID OVERRIDE: Reduce rapid traverse override in JOG working mode and G00 rapid traverse override in AUTO working mode.



INCREASING FEEDRATE OVERRIDE: Increase feedrate override in JOG working mode and G01 feedrate override in AUTO working mode.



REDUCING FEEDATE OVERRIDE: Reduce feedrate override in JOG working mode and G01 feedrate override in AUTO working mode.

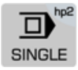
X PROGRAM REFERENCE POINT (PROGRAM ZERO) RETURN: It is valid in JOG /AUTO working mode. (Program zero is called program reference point in the user manual.)

Z PROGRAM REFERENCE POINT (PROGRAM ZERO) RETURN: It is valid in JOG /AUTO working mode.

X MACHINE ZERO (MACHINE ZERO) RETURN: It is valid in JOG /AUTO working mode. (Machine zero is called machine reference point in the user manual.)

Z or Y MACHINE ZERO (MACHINE REFERENCE POINT) RETURN: It is valid in JOG /AUTO working mode.

DRY RUN: In AUTO working mode, whether M, S, T are valid is determined by the parameter (bit parameter **P401_d7**), each axis coordinates automatically recover to the previous ones before the system enters the DRY RUN working mode.



SINGLE BLOCK: A single block runs in AUTO working mode. It is **hp** function in other working modes.

3.3.4 Cycle start and cycle pause (feed hold) key

Start and pause programs in AUTO working mode and each key symbol definition are as follows:

CYCLE START: Start to run programs in AUTO working mode; move coordinate axis in JOG working mode.

CYCLE PAUSE (FEED HOLD): pause the running in JOG or AUTO working mode; **hp** function in other working modes.

【Note】

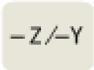
There is "hp(help) at top right on some keys, and there are 7 help keys hp0～hp6; hp is valid when the main key is invalid in different working modes.

3.3.5 Manual axis control key

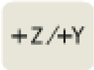
Manual key symbol definitions in JOG working mode are as follows:

X axis moves negatively in JOG working mode.

X axis moves positively in JOG working mode.



Z or Y moves negatively in JOG working mode.



Z or Y moves positively in JOG working mode.

RAPID TRAVERSE/FEED Switching rapid traverse and feed in JOG working mode.

JOG **STEP** Select each step width or MPG feed in STEP/ MPG(Handwheel) working mode; **hp** function in other working modes.

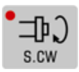
MPG (Handwheel) MPG control selection and axis selection in JOG working mode; **hp** function in other working modes.

Z/Y selection in JOG working mode; **hp** function in other working modes.

STEP/JOG mode Switch STEP/JOG mode in JOG working mode.

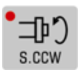
3.3.6 Manual auxiliary function key

The following press keys are used to controlling and completing all miscellaneous function of the machine and each key symbol definition is as follows:



Spindle rotation (CW) Spindle rotates clockwise. (View from tailstock to chuck along the spindle)

Spindle stop Spindle stops.



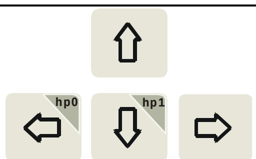
Spindle rotation (CCW) Spindle rotates counterclockwise (view from tailstock to chuck along the spindle)

Cooling control Switch cooling ON/OFF.

Spindle gear shifting Select the speed of each gear when the machine is equipped with multi-gear (up to 16 gears) spindle motor and control loops.

T.CHANGE **Tool change** Select the next tool number neighboring to the current one.

3.3.7 Edit keys

Press key	**Name**	**Function explanation**
ENTER	ENTER key	Press it after the corresponding operation is performed.
INPUT	INPUT key	Input the required content.
ALTER	ALTER key	Switch character insert/alter state in EDIT working mode; Special definition in other working modes.
DELETE	DELETE key	Delete character, letter, block or whole program in EDIT working mode; Special definition in other working modes.
ESC	ESCAPE key	Cancel the current input data or exit from the working state; exit from the current operation or setting.
DRY	HOME key	“DRY RUN” in AUTO working mode; Cursor moving the end of the line in EDIT working mode.
STEP	END key	“STEP” in JOG working mode; Cursor moving the end of the line in EDIT working mode.
hp2 SINGLE	SINGLE BLOCK key	“SINGLE/CONTINUOUS” executing programs in AUTO working mode; “SINGLE/CONTINUOUS” analog executing programs in AUTO working mode; **hp** function in other working modes.
	Cursor movement key	Control cursor movement in EDIT/PARAMETER/OFFSET working mode; **Hp** function or other special definitions in other working modes.
	PAGE UP/DOWN	Display page up/down in EDIT/PARAMETER/OFFSET; Special definition in JOG /AUTO working mode.

3.3.8 Reset key

 **Reset** Validate the reset state of the system.

Chapter 4 System Operation

This chapter introduces operations and notes of the system. Please read carefully before operation.

4.1 System ON/OFF, Initial State, Modal, and Safe Protection

4.1.1 Power on

There is not a power switch on the operation panel of the system. The operator installs it according to the different machine to avoid bad effects to CNC system owing to the impaction of power supply.

Check before the system is turned on:

1) Ensure the machine state is normal;
2) Ensure the voltage meets the requirements;
3) Ensure the wiring is correct and firm.

The system is turned on as follows:

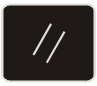
1) The master power switch of machine is turned on.
Switch on the power switch of the CNC system, and the system displays as Fig. 4-1. Press any keys except for  , and the system enters into EDIT working mode.

Fig. 4-1 System initialization display window

2) The system orderly completes the following work after power-on:
- The system controls the program loading.
- The system automatically checks itself and executes the initialization.
- The system loads and checks parameters.
- I/O interface initialization.
- The system loads and checks the operator programs.

【Note】

1) Must not press any keys on the system panel when the system is turned on, press RESET key when the system enters the press key test window at the moment.

4.1.2 Power off

The system is turned off as follows:

1) The power switch of the CNC is turned off.

2) The power switch of the machine is turned off.

Check before the system is turned off:

1) X, Z, Y are in the stop state;
2) Miscellaneous function(spindle, cooling) OFF;
3) Turn off the power supply.

【Note】

1) The system should be checked itself and initialized when it is turned on at first (it is completed by the machine manufacturer, and the operator cannot execute the operation, otherwise, the parameter set by the machine manufacture will lose).

2) Operations related to turn off the machine power supply are referred to the operator manual machine manufacturer.

4.1.3 System, program initial and modal

4.1.3.1 Initial and modal

The initial mode of the system is defined to be a special initial state of all functions set by itself when the system is turned on; all auxiliary functions do not execute the actual output.

The modal of the system is defined to be their kept states after the system executes all functions.

Initial mode and modal of the system:

System state	Initial mode	Modal
Machine coordinate system of the system	Keep last power-on state	Keep till being changed
Tool nose coordinate system of the system	Keep last power-on state	Keep till being changed
Cutting feedrate：F	In Auto mode：30mm/min In JOG mode: Keep last power-on state	Keep till being changed
Conversion spindle speed：S	Keep last power-on state	Keep till being changed
Spindle gear	Shifting gear spindle gear：S0 Conversion spindle gear：M41	Keep till being changed
MANUAL slow feed/rapid feed state	Slow feed	Keep till being changed
Feedrate override	Keep last power-on state	Keep till being changed
Rapid override	Keep last power-on state	Keep till being changed
Spindle state	M05 spindle stop	Keep till being changed
Cooling state	M09 cooling OFF	Keep till being changed
Chuck state	M11 chuck release	Keep till being changed
Lubricating state	M33 lubricating OFF	Keep till being changed
T number state	Keep last power-on state	Keep till being changed
Tailstock state	M79 tailstock run-out state	Keep till being changed
Set spindle speed/position mode	M48	Keep till being changed

4.1.3.2 Initial mode and modal of program

The initial mode is the automatic initialization setting state before the system executes the machining program; i.e. the initial default state of the default programming word and speed word.

Program initialization state of the system:

G command：G00, G40, G97, G98;

Cutting speed：30mm/min;

Miscellaneous function: current state;

System coordinates: current coordinates are those of the last automatic executing program or manual operation

G modal is always valid till it is changed by other modal commands in the same group after the word is set. After the modal meaning is set, the G command may not be input again when the same function is used in the later block.

There are four groups of G command with modal characteristics, and there is only one command in the modal state:

Group 1：G00, G01, G02, G03, G05;   (initial mode：G00) ;

Group 2：G40, G41, G42;   (initial mode：G40) ;

Group 3：G96, G97;   (initial mode：G97) ;

Group 4：G98, G99;   (initial mode：G98 F30) ;

The command without modal characteristics has effect in the block and must be defined to use every time.

【Note】

In AUTO working mode, the system automatically recovers to the program initial mode when it executes the first command of workpiece program or executes the first block command after M20, or selects the middle block as the first command.

4.1.4 Safe protection

The CNC system set a perfect protection measure to prevent the operator from danger and the machine from being damaged.

4.1.4.1 Hardware limit protection

The system can check the travel limit switch installed on the machined. When the machine slide moves to press the travel limit switch, the system stops feeding instead of closing other miscellaneous functions, and the program stops running and the system displays the hardware limit alarm information of corresponding axis.

After the travel limit switch alarms, the system can select JOG working mode, the key for axis movement which is reversed to the limited direction is pressed, i.e. the system exits the travel limit and the travel limit switch alarm automatically disappears on the screen.

【Explanation】

1）X, Y, Z positive limit check shares one pin LT+, and their negative limit check shares one pin LT-; when the positive limit alarms, all axes cannot move positively but move negatively; and vice versa.

2）When the travel limit switch runs across the limit block, the limit signal appears; the valid length of limit block signal is more than 30mm or more to avoid rush out the valid area of the signal.

3）When the parameter is set to “limit emergency stop” mode (bit parameter **P402_d7=1),** and the system runs across the limit block, there may be great deviation between the coordinates displayed by the system and the actual position. Adjust the machine coordinates.

【Relative parameters】

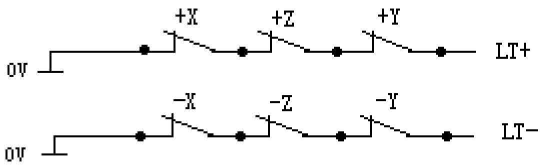
Bit parameters: P402_d7, P404_d6, P404_d1.

Bit parameter **P402_d7** sets the hardware limit alarm mode;

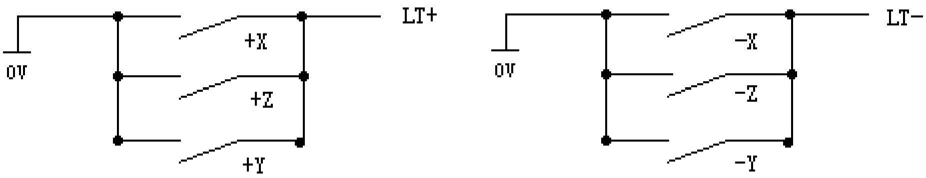
Bit parameter **P402_d6** sets whether the hardware limit alarm checks;

Bit parameter **P402_d1** sets the hardware limit alarm level of each axis;

When **P404_d1=1** is high level alarm, the positive limit switch +X, +Y, +Z of each axis are normally closed contact, are connected to X/Z/Y positive limit input interface +LT (they are open and the system alarms) in serial; the negative limit switch -X, -Y, -Z of each axis are normally closed contact, are connected to X/Z/Y negative limit input interface -LT (it is off and the system alarms) in serial; it is suggested that the operator should select in prior the hardware limit to the normally closed contact of each axis as follows:



When **P404_d1=0** is low level alarm, the positive limit switch +X, +Y, +Z of each axis are normally open contact, are connected to X/Z/Y positive limit input interface +LT (they are closed and the system alarms) in serial; the negative limit switch -X, -Y, -Z of each axis are normally open contact, are connected to X/Z/Y negative limit input interface -LT (it is off and the system alarms) in serial; it is suggested that the operator should select in prior the hardware limit to the normally closed contact of each axis as follows:



4.1.4.2 Software limit safe protection

1） Mechanical software limit safe protection

The mechanical software limit safe protection is to limit machine coordinate motion range to avoid slide to exceed the motion range. The mechanical software limit alarms when the machine position (machine coordinates) exceeds the range.

Releasing overtravel alarm methods: reversely movement in JOG working mode (negatively moves for positive overtravel; positively moves for negative overtravel).

2） Tool nose software limit safe protection

The tool nose software limit safe protection is to limit tool nose coordinate motion range to avoid the tool nose to exceed the motion range. The tool nose software limit alarms when the machine position (tool nose coordinates) exceeds the range.

Releasing overtravel alarm methods: reversely movement in JOG working mode (negatively moves for positive overtravel; positively moves for negative overtravel).

【Explanation】

1) The coordinate axis decelerates to stop when the coordinates exceed the software limit range during the motion.

【Relative parameters】

P009, P010: max. travel of Z positive, negative tool nose software limit; P011, P012: max. travel of X positive, negative tool nose software limit;

P013, P014: max. travel of Y positive, negative too nose software limit; P015, P016: max. travel of Z positive, negative mechanical software limit;

P009, P010: max. travel of Z positive, negative mechanical software limit; P009, P010: max. travel of Y positive, negative mechanical software limit;

Bit parameter **P404_d4, P404_d3** separately sets whether the mechanical, tool nose software limit alarm are valid.

4.1.4.3 Emergency stop alarm (emergently stopping the system)

When there is the external emergency stop input terminal ESP in the system input interface, the operator should connect the emergency stop button Normally closed contact on the machine panel with the emergency stop input terminal. Press Emergency stop button and the system enters the emergency stop state. The system stops all feed, turn OFF the spindle and the cooling function, and "Emergency Stop Alarm" is displayed (if there are other pop-up windows on the screen, the "Emergency Stop Alarm" will be delayed.)

After the emergency stop condition is released, the operator should rotate the emergency stop button clockwise based on the up arrow, the button automatically releases to cancel the emergency stop signal.

When the system is in the emergency stop alarm state and the external emergency stop signal is cancelled, and the MANUAL, AUTO, DIAGNOSIS modes are forbidden; you can press the "RESET" key to remove the alarm and switch to EDIT, PARAMETER, or TOOL OFFSET mode; to return the previous working mode.

When the system is in the emergency stop alarm state and the external emergency stop signal is not cancelled, and the MANUAL, AUTO, DIAGNOSIS modes are forbidden; you can press the "RESET" key to remove the alarm and switch to EDIT, PARAMETER, or TOOL OFFSET mode; Then press RESET to clear the emergency stop alarm window in EDIT, PARAMETER and OFFSET working modes, and the system will allow the operation after the alarm is removed.

There is the Emergency stop in the movement, there may be great deviation between the coordinates displayed the system and the actual position, and the operator must correct the machine coordinates.

When emergency button is pressed, there are a series of procedures to be handled:

1) During emergency stop, the system stops all feed, and terminates program execution; the spindle stops rotating; cooling and lubricating function is turned OFF.

2）During emergency stop, the system automatically sets the internal stored chuck and tailstock states to M11 and M79. After the emergency is released, when the foot switch of chuck or tailstock is pressed for the first time, the states become M10, M78.

3）During emergency stop, if such commands as tool exchanging, tailstock, chuck, gear changing is being executed, the execution should be stopped immediately (cancel the tool post CCW/CW signal; tailstock signal and chuck signal are depends on parameter setting); at this time, the system assumes that the tool post, chuck, tailstock and gear are not in the proper position, and red indicator is flickering; only when the emergency stop alarm is released, and above execution is repeated or after system power-on, can the system resume the normal state.

4）During emergency stop, if the output signal of MDLY interface remains the same, interface control signals other than MDLY, spindle , cooling, lubricating are set by parameters. If P403_d3 is 0, then, only output signals for spindle, cooling and lubricating are turned off; if P403_d3 is 1, all interface control signals including chuck and tailstock signals are turned off.

5）After the emergency stop alarm is cleared, in AUTO mode, the system will exit from dry run state if it was; in MANUAL mode, the system will turn from rapid traverse state to feed state; if the set F value is not changed, the spindle analog voltage output remains the same; except for that, other functions of the system are in initial state.

6）After the emergency stop alarm is released, time counting of the low-pressure detection function and auto-lubricating control function are restarted.

【Special Attention】

1）The standard emergency stop function is actually to set the output signals to “ON” or “OFF”. It can be like this: In MANUAL/AUTO mode, when emergency stop button is pressed, the standard emergency stop is executed, in addition, M74 user-defined command is also executed (it is executed only when there is already a M74 command in the system). This function is applicable to some special machine parts under the requirements of keeping some output signals ON while turning OFF some others. If any similar alarm occurs during the execution of M74, the execution stops. During emergency stop, if the M74 command is executed, and axis movement or tool change is being carried out, the system will stop M74 execution automatically.

2）In MANUAL/AUTO mode, when the parameter sets that M74 can be executed during emergency stop, the pop-up window displays “+M74”. (When there is already a M74 command in the system.)

3）For more details of M74, please refer to Chapter 10 .

4）Please pay special attention that M74 function is only suitable for some special machine tools.

【Relative parameters】

The external emergency stop signal function is valid when **P404_d7** is set to 0.

The external emergency stop signal function is invalid when **P404_d7** is set to 1.

The parameter is for debugging the system, and must be set to valid in the power-on state; otherwise, it cannot have the protective effect.

4.1.4.4 Drive unit alarm

When the system is connected with the alarm output signal of a drive unit and appears Drive unit alarms, the system automatically closes all feed and prompts Z/X/Y drive unit alarms. All axes immediately stop motion, and the program stops running. At the moment, check the drive unit and relative device to troubleshooting and the system is turned on again.

When there is the alarm in the course of motion, there may be great deviation between the coordinates displayed the system and the actual position, and the operator must correct the machine coordinates.

In JOG working mode, the system prohibits all axes moving when there is the alarm.

In AUTO working mode, the system prohibits the program starting run when there is the alarm.

【Relative parameters】

The drive unit alarm checks when **P404_d5** is set to 0.

P405_d4, P405_d3, P405_d2 separately sets alarm level of Z, X, Y drive unit.

4.1.4.5 Other alarms

When the system appears other alarms, Chinese characters prompts, at the moment, the operator can perform the troubleshooting based on **PROGRAMMING, Chapter 8 Alarm Message**.

4.1.4.6 Switching off power supply

The machine power supply is switched off immediately to avoid the accidence in the danger or other emergency cases when the machine is running.

Note: When the coordinate axis is moving and the power supply is switched off, after the machine is switched on again, there may be great deviation between the displayed coordinates and the actual position, and so the operator must execute the machine zero return or other ways to regulate the machine coordinates to ensure that the displayed coordinates are the same those of the actual.

4.1.4.7 Reset operation

When the system outputs abnormally and the coordinate axis moves abnormally, the operator should press 

to make the system be the reset state as follows:

1) All axis motions decelerate to stop;
2) S function output is invalid;
3) Whether M function output is valid is set by **P403_d2.**
4) The automatic run ends, the modal function and state keep.

【Relative parameters】

P403_d2=0: the system closes M03, M04, M08, M32 output signals when the reset key is pressed.

P403_d2=1: the system does not close M03, M04, M08, M32 output signals when the reset key is pressed.

4.2 CNC Working Mode Selection

The system uses the working mode key to directly select the all working modes. All working modes can direct switch to get the simple and convenient operations.

The display is as Fig. 4-1 after the system is turned on, and the display state keeps till the other key is pressed to enter the EDIT working mode.

4.3 EDIT Working Mode

EDIT working mode: it is the working mode to execute the part program by the operation panel. There is the corresponding intelligent prompt message for each operation. At the same time, the operator can press the prompt key- hp2 at the top right to learn the operation key list in EDIT working mode.

The relative setting or operation key format and sample descriptions in the user manual are as follows: meanings and uses of all required functions are described at the beginning of the corresponding chapter; all required letter and digit keys are expressed with underlines; the system prompt messages are expressed with borders.

In executing some setting or input or man-machine dialogue, press ESC key to exit the current operation before ESC key is not pressed.

◆ Main functions in Edit mode include:

☆ select, create, rename, copy and delete part programs;

☆ input, insert, modify and delete the content of the selected part program;

☆ transmit part programs between U disc and the system by the **USB** interface;

☆ transmit part program between the external PC and the system by **RS232** communication interface;

☆ transmit part program in two systems by **RS232** communication interface;

☆ compile and save program;

program motion path drawing analog;

☆input variable and macro character string.

Press EDIT to enter the EDIT working mode. The EDIT working mode includes two main window: program catalog search window and program edit window. The program catalog search window is as Fig. 4-3:

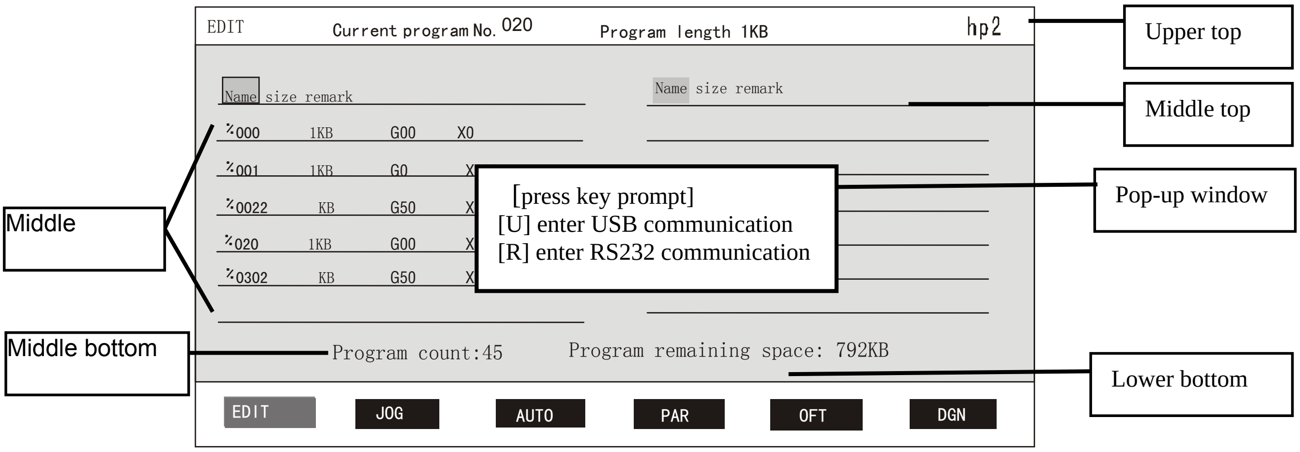


Fig. 4-3 program catalog search

◆ Display content in window area:

Upper top: program number and capacity of current program(program length), the system function operation method prompt key hp2;

Middle top: orderly arrange program name, capacity, latest remark;

Middle: display program name, capacity and remark;

Middle bottom: operation prompt message;

Lower bottom: display current stored part program quantity (up to 255) and surplus stored space;

Pop-up window: display operation prompt message.

【Note】

Press **hp2** key, and the system prompts “ Program catalog window message prompt”, introducing the used press key functions.

4.3.1 Part program catalog search

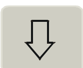
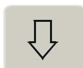
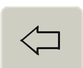
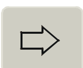
Program catalog search window displays the current stored program quantity, and all programs sorts as follows:

1) name: program number from top to bottom, from left to right;

2) size: program stored space from top to bottom, from left to right;

3) remark: the first 12 characters of the first line of the program from top to bottom, from left to right;

4) the last: input time sequence from top to bottom, from left to right.

Press ,  and , , the system searches all part programs, displaying 12 program on each window; press  to the first page of program,  to the last. Press ,  to sort all programs according to their name, size, remark and last distribution.

4.3.2 Selecting, creating, deleting, renaming and copying a part program

Select, create, delete, rename and copy part programs

【Note】

1）The system executes most %000～%254 programs, 255 program names. The system prompts **E160 input program error** when the executed program name is more than 254.

2）There is no part program or the system is not used firstly, the system automatically creates and selects %000 program as the current program. When there are programs, the system sorts the program according to part program quantity and program names in the last power-off.

3）The system supports many input, the leading zero cannot be input. Example, inputting %003 program. Press INPUT, input 0 0 3 ; also input 0 3 ; or input 3.

4.3.2.1 Selecting and creating a part program

The operations to select a part program or create a new program are as follows:

① Press INPUT key in EDIT working mode;

② Input the required program number by the board key, or input a program number which is not in the program catalog list as the new program number;

③ Press ENTER key;

④ Select or create a part program, display the content of the part program, and the system enters the program edit window.

【Note】

1) When a program is selected, it is changed by the above steps; it cannot be changed once it is confirmed.

2) When a program number which is not exist in the part program catalog, the newly created program is taken as the current program.

【Example】

Example 1：there is no %20 part program in the part program catalog, creating it is as follows:

Press keys to input: INPUT 2 0 ENTER. The new program %020 has been created and the system enters %020 program edit window.

Example 2：there is no %20 part program in the part program catalog, creating it is as follows:

Press keys to input: INPUT 1 0 ENTER. The new program %001 has been created and the system enters %001 program edit window.

4.3.2.2 Delete a part program

Delete a part program is as follows:

① Press INPUT key in Edit working mode;

② Input the required program number to delete by the key board;

③ Press DELETE key, the system prompts: Enter-confirm the deletion Esc-escape the deletion .

④ Press ENTER to delete the part program which program number is input. Press ESC not to execute the deletion operation and return to EDIT working mode.

【Note】

1) The system displays **E100 the program to be deleted is not exist** when there is no the program to be deleted;

2) When the program which is to delete exists: when it is not the current program, the system deletes the program from the program list; when it is the current program, the system deletes the program from the program list, and searches the program which program number is the smallest to be the current program; when there is no programs, the system creates one program number 000 as the current program.

【Example】

Example: delete %003 operation is as follows:

Input by the press key: INPUT 3 DELETE ENTER.

4.3.2.3 Deleting all part programs

Clear the program area in the program catalog search window, and all programs in the system are deleted as follows:

① Press INPUT in the part program catalog search state;

② Input −/+ , 0 by the key board; −/+ , 0 ;

③ Press DELETE , the system prompts: Enter-delete all programs Esc-escape the deletion .

④ Press ENTER to delete all part programs; press ESC not to execute the deletion operation and return EDIT working mode.

【Note】

The system creates a program number 000 as the current program after all part programs are deleted.

4.3.2.4 Renaming a part program

The program name of the current program is renamed as another new one. The new is taken as the current program is as follows:

① Press INPUT key;

② Input the program number which is not in the program list, press ALTER and the current program number is rewritten to the input program number.

【Note】

When the input program exists, the system prompts **E166 required renaming program already exists**.

【Example】

Example: the current program %000 is renamed to %005 as follows:

Press key input: INPUT 5 RENAME . And the renaming is completed.

4.3.2.5 Copying a part program

Copy the current program content to another one new and the new becomes the current program as follows:

① Press INPUT key;

② Inputting the program name which is not in the program list, press INPUT key and the current program content is copied to the new program. The new program is taken the current one.

【Note】

When the input program name exists, the system prompts **E161 program to be copied already exists** and waits the prompt losing to input a new one.

【Example】

Example: copy the current program %000 to %005 as follows:

Press key input: INPUT 5 INPUT. The copy operation is completed.

4.3.3 Part program communication

The communication of part programming includes the sending and receiving the part program. The sending is divided into: the system outputs to PC(CNC→PC) , one system outputs to another one(CNC→CNC) , and the system outputs to U disc (CNC→USB) ;

Press hp6 in the program catalog search window, the system prompts the part program communication window.

4.3.3.1 Sending part programs(**CNC→PC, CNC→USB, CNC→CNC**)

Method 1：RS232 serial communication;

1) Before file transmission, the system sets **P414_d7, P414_d6** communication baud rate. The communication baud rate is determined by the sending setting. The setting range: 9600, 19200, 38400(unit：bps) . Setting communication baud rate is referred to **OPERATION, 4.6 Parameter Working mode.**

2) Part programs stored in the system are output to another one as follows:

① Connect communication cable when the system is power-off; then turn on the power again.

② In program search page, press key to input：hp6 → R → hp2 ;

③ Select the required program to send according to the system hp2 help message;

④ press ENTER to send;

⑤ The external PC or another system are in the receiving mode;(refer to **OPERATION, Chapter 5 RS232 and USB System Communication**)

⑥ The system outputs the selected programs and displays the sending process till the sending is completed; when the selected programs are so many, the system sends the programs from the small to the big of their program number till the sending is completed;

⑦ Press ESC to interrupt the sending in the course of sending.

Method 2：USB communication;

1） After entering USB communication mode, the system firstly checks whether U disc has inserted, if not, it displays the prompt box Have not inserted USB. If the disc has inserted, it has “C928PRO” file, and USB file catalog lists “CNCxxx.TXT”. when U disc has “C928PRO” where has no“CNCxxx.TXT”, USB catalog box displays the blank. When U disc has no “C928PRO”, USB file catalog box is not displayed.

2） Output the part program stored the system to U disc as follows:

① Insert U disc in the system USB;

② The system automatically open U file catalog(create a file in the U disc: C928PRO，file format CNCxxx.TXT) . The system creates “C001PRO” when there is no “C928PRO” in the U disc root catalog.

③ In program search page, press key to input ：hp6 → U ;

④ Select the required programs to send according to the system hp2 help message.

⑤ Press ENTER to send and the system prompts to select the sending mode;

⑥ The system outputs the selected programs based on the selected sending mode and displays the sending process till the sending is completed;

⑦ Select ESC to exit from U disc.

4.3.3.2 Receiving part programs(PC→CNC, USB→CNC, CNC→CNC)

Method 1: RS232 serial communication;

1) Set the communication software baud and communication terminals (Setting communication baud rate is referred to **OPERATION, 4.6 Parameter Working mode**).

2) Input the part program stored in the external PC to the system or transmit part programs between two systems as follows:

① Connect communication cable when the system is power-off; then turn on the power again.

② In program search page, press key to input: hp6 → R → edit ;

③ Select the receiving mode according to the system prompt;

④ Programs in the external PC or another system are input to the CNC system;

⑤ The system selects the receiving mode and inputs the programs, displays the receiving process till the receiving is completed;

⑥ Press ESC to interrupt the receiving in the course of receiving.

Method 2:USB communication;

1） After entering USB communication mode, the system firstly checks U disc, and opens “C928PRO” existed in the U disc and lists “CNCxxx.TXT” file.

2） Output part program stored in U disc to the CNC system as follows:

① Insert U disc in the system USB interface;

② Press key to input：hp6 → U;

③ The system automatically opens U disc file catalog;

④ Select the required programs to receive according to the system hp2 help message;

⑤ Press ENTER to receive and select the sending mode according to the system prompt;

⑥ Input the programs according the selected receiving mode, display the receiving process till the receiving is completed;

⑦ Select ESC to exit from the U disc.

【Note】

1) If the stored program name is the same as the sent program name, a prompt will be displayed for you to determine whether to replace the original program or not. If you choose yes, the original program will be replaced by the received one.

4.3.3.3 TXT part program standard format in PC

Use TXT, LST text to edit part program in PC, but the file name must be compiled based on the standard format required by the system to be sent to the system as follow:

1) Name the file name of the part program to TXT or LST suffix, such as “CNC008.TXT”; it is suggested that the operator uses TXT suffix to conveniently execute part programs on the PC.

2) The first line of TXT file content must specify the program number, its format is “% XXX”, i.e. percent sign follows the digit 1, 2 or 3, its range is 0~254, and the first line cannot have other content. Its range must be 0~254 because the program number created and stored by the system is 0~254, otherwise, the system cannot receive the programs and prompts the corresponding mistaken message. The program numbers received by the CNC are determined by two methods (USB and RS232):

- ◆ In RS232 communication, the program names are taken the program number of the first line as the standard; i.e. the character string XXX digit of “%XXX” in the first line sent by PC.
- ◆ The program number sent by the system USB is CNCxxx.TXT xxx digit in“C928PRO” file in the U disc root catalog.

Note: in USB communication, the character string XXX digit of %XXX” in the first line should be the same that of xxx digit of CNCxxx.TXT. When they are different, the xxx digit of CNCxxx.TXT is taken as the standard.

3) The blocks start from the second block. The block must meet its format. Each block cannot

exceed 250 characters, ends with the ENTER key, otherwise, the system prompts the error: Block too long in received programs.

4) The annotation area has Chinese annotation in the block.

5) Max. TXT file length cannot exceed the program stored space limit of the system.

Part program communication standard format in PC:

TXT file format	Explanation
%099 N0000 G50 X100 Z100 ; setting coordinate system N0010 G00 X20 Z90 ; rapidly positioning G01 X10 Z80 ; linearly cutting …… /N0250 G02 X30 Z20 R5 ; arc cutting N0260 ; T22 ; tool change N0262 M05 N0270 G04 D8 …… M20	**1. There must be program name %099 when the system receives programs; the first line must the 3-digit 0~254+.** **2. "N****" are the blocks with the line number, and others are the blocks without the line numbers;** **3. The hone of each line must be blank;** **4. there is a space between the line number and the command for the program with the line number;** **5. / block skip;** **6. ; the following is the annotation.**

4.3.4 Part program content input and edit

Each input part program consists of many block, and each block is composed of block number, command and data. The program format must meet the general programming rules, and there is no prompt in program compiling, and the alarm prompts are referred to **PROGRAMMING**, **Chapter 8 Alarm Message**. The qualified parts can be machined only according to the technology requirements and orderly input correct program contents.

The edit mode of the system is full screen. The program edit window is displayed as Fig. 4-4:

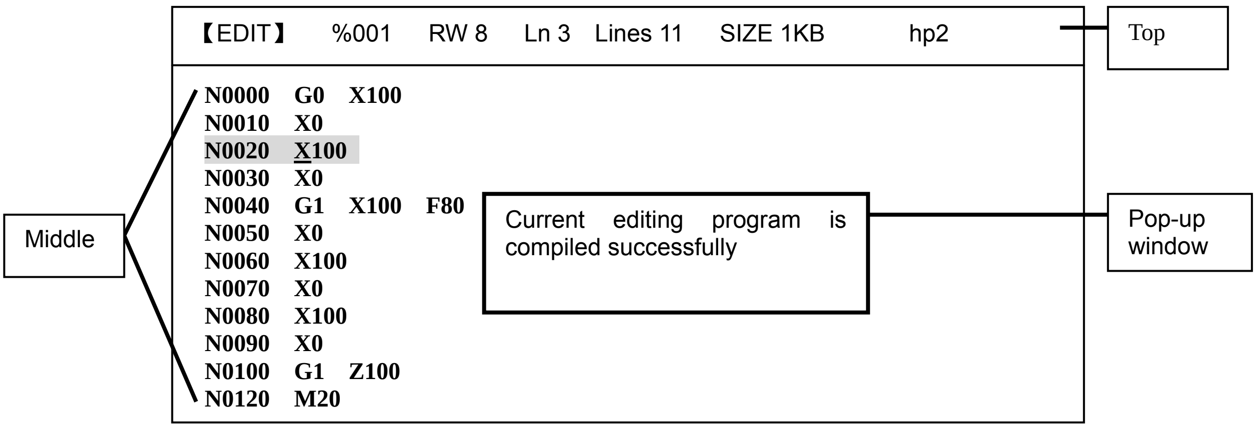


Fig. 4-4 program edit

◆Display content in window area:

Upper top: program number, program capacity(program length) and program line quantity of current program, edit cursor line and row (prompt symbol of current editable character position), and the system function operation prompt key hp2;

Middle: program edit window;

Pop-up window: display operation prompt message.

【Note】

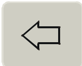
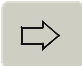
1. Press hp2, the system prompts "Program edit help message prompt", introducing

all help key explanation.

2. When P416_d0 is set to 1, the system forbids pressing key to edit and modify programs, and prompts the alarm E174：machining programs are locked and are forbidden to modify; when the system edits and modifies the programs, P416_d0 should be set to 0.

Edit key meanings and use in program edit window:

1)  ,  cursor UP, DOWN move key: Press the move key every time, and the cursor moves up(down) till the top (the bottom) line. Keep pressing the moving key and the cursor continuously moves up(down) till the first(last) line or the move key is releases. In the character string search function(hp5) , the operator can search the required character string up and down.

2)  ,  cursor LEFT, RIGHT movement key: Press the move key every time, and the cursor moves left(right) one character. Keep pressing the moving key and the cursor continuously moves left(right) till the first(last) character or the move key is releases.

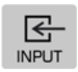
3) 

Home key: the cursor rapidly moves to the home or the first field head of the line. Press continuously the head key, and the cursor switches between the head and the first field of the line. The compound of the head key and the deletion key can delete the current line.

End key: the cursor rapidly moves to the end of the line.

4) 

insert/alter: Changing edit input mode: switch the insert and the alter after pressing it once. The cursor also changes correspondingly and the insert mode cursor flashes to be one horizontal line, and the alter mode cursor flashes to be the high light square.

5) 

input key: The program edit state is switched into the program catalog search state, and the system prompts Input program number： .

6)   Page Up, Page Down: Paging to display the program content. In hp5, the cursor directly moves the home/the end window; in hp3, the system can zoom out/down the graph.

7) 

Enter key: When the cursor is in the first line or the last line, press ENTER, it will locate to the new line; when the cursor is in other positions, press ENTER, it will move to the head of next block.

8) 

delete key: Delete all blocks or characters in the block.

9) 

hp2 key：program edit help message prompt; switch Single/Continuous mode in motion path analog drawing.

hp3 key：current program compiling and analog drawing current program graph.

10) 

hp4 key：MPG controls the cursor moving.

hp5 key: System help and part program character string search. If the current program number is 253 or 254, then, this program will be executed.

hp6 key：prompt the displayed macro character string list.

Multi-function definition key input must obey the following rules:

1) When the first letter is capital in the line, the first key value is prior; when it is the lowercase, the 3rd or 2nd key value is prior.
2) The system automatically creates the blank space when the letter or character following the digit (0~9) is input.
3) The cursor stays the position where the input is convenient after the character string is input.

Multi-function definition key value list:

Panel display	**1st key value**	**2nd key value**	**3rd key value**	**Panel display**	**1st key value**	**2nd key value**	**3rd key value**
G r	G	r		F N ( )	F	N	( )
M H =	M	H	=	I P	I	P	
X J >	X	J	>	K ␣	K	Blank space	
Z Q <	Z	Q	<	D V and	D	V	and
S if	S	if		R Y or	R	Y	or
T L then	T	L	then	. *	.	*	
U E else	U	E	else	– +	-	+	
W / ;	W	/	;				

4.3.4.1 Inputting program content

Note: P333 is set to 10 (the system automatically creates the block number, and the following is the same).

In program edit window, inputting the part program content is as follows:

① create a new program according to the operations of creating new part program;

② input one line content after the block **N0000** is displayed;

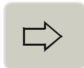
③ press ENTER key after inputting one line programs to end the line input;

④ the system automatically creates the next block number and continuously input the program content;

⑤ press ESC to complete the program content input after the last line programs are input.

【Note】

1） The first row of every line only displays the blank space;

2） Each block only displays 60 characters, and only the first 60 characters are displayed when there are more than 60 characters, you can press  to left move one character.

3） The serial number of the first row blank is 0, the last is 251, and the system only displays the cursor instead of the character; there are up to 250 characters in the edit line; i. e. the first blank bit +250 characters+ the last cursor bit character=252.

4.3.4.2 Inserting program line

Insert one or many program line between two program lines or in the front of the current block as follows:

① Move the cursor to the first block end or the last block home of the two blocks;

② Press ENTER, and the system automatically creates a new block number between the current block and the next (the serial number increment is P333 parameter 1/4 integer, the next block number can be modified when the above the increment is not enough) and remains a blank line.

③ Input the required block content;

④ After all content is input and many line are required to insert, ENTER is pressed, which is not done when one line is required to insert.

【Example】

Example: insert a new block **M3** between **N0020** and **N0030** as follows:

Move the cursor to the end of block **N0020** or the beginning of block **N0030**; Press ENTER key, and input M3.

4.3.4.3 Deleting a block

Delete all content in one line as follows:

① move the cursor the hone of the required line;

② press DELETE;

③ delete all content of the selected line.

4.3.4.4 Inserting a character in a block

Insert a character in one block as follows:

① Press ALTER, switch the input mode to insert mode, i.e. the cursor is displayed to the down horizontal line;

② Move the cursor to the character following the required insert position;

③ Input the required insert content;

④ Insert the input content before the character pointed by the cursor.

【Note】

The CNC system requires there is a blank space between fields in the program line. In editing program, the system can automatically judge and create a blank space, but cannot automatically judge in the insert operation, and at the moment, the operator should input a blank to get the complete program.

【Example】

Example: insert **1** between **X** and **0** in **N0020 G0 X0.0 Z0.0**. As follows:

The cursor moves the under **0** following **X** input **1**, displaying **N0020 G0** $\boxed{\textbf{X10.0}}$ **Z0.0**

4.3.4.5 Deleting a character in a block

Delete the content which is not needed as follows:

① Move the cursor to the character position which is needed to delete;

② Press DELETE to delete the character.

4.3.4.6 Modifying a block content

Modify the content of the block into the new, which can be complete according the input mode(insert/alter).

In INSERT mode, use the insert and deletion as follows:

① Move the cursor the character which needs to be modified;

② Input the new content;

③ Press DELETE to delete the required content.

In REWRITE mode, directly modify the content as follows:

① Press ALTER; the cursor switches into the alter mode(the character position pointed by the cursor is high light square);

② Move the cursor to the character which needs to be modified;

③ Input the new content. The cursor points the next character.

【Example】

Example: alter **X** in **N0020 G0 X0.0 Z0.0** into **U** as follows:

Switch the input mode into ALTER mode, move the cursor to the down of X and input **U** .

Alter to N0020 G0 U 0.0 Z0.0 .

4.3.4.7 Inserting a macro character string

Insert macro character string content in program edit window as follows:

① press hp6 and the system displays macro character string list;

② select the required input content according to the prompts;

【Example】

Example: press hp6 and then G , the program content input: **r = r * r / r** , the cursor stops the following of **r**.

【Note】

Concrete variable and statement programming are referred to **PROGRAMMING, Chapter 9 Statement Programming**.

4.3.4.8 Program stored space

For programs No. 0～252, No. 254, the system provides 400K memory space, so theoretically, the size of a single program can be up to 400K. For No. 253 program, the system provides 4M FLASH memory space.

【Explanation】

1) The system displays the program leftover space and prompts the leftover stored space size.
2) When the current edit No. 0～252, No.254 program size are more than all stored space(max. 800K), the programs cannot be saved, and the system prompts the storage space has full: Overflow in edit area. Delete the old programs when the leftover space is not enough.
3) Max. edit space of No. 253 program is up to 4M, and is only saved to the system FLASH.
4) In saving programs, the program capacity is big and saving the programs need long time, and the operator needs to wait.

4.3.4.9 No. 253 program operation

Because No. 253 program is up to 4M, its solidifying and read are special as follows:

1） Only be saved to a fixed FLASH;
2） Select No. 253 program, press hp5 and then 4 to save it to the FLASH in program edit window;
3） Use USB or RS232 to complete the communication.

【Note】

1) Program No. 253 cannot be saved automatically, and should be complied and set after editing; otherwise, it cannot be saved and be lost after power-off. However, if the program No. 253 is transmitted from USB or RS232 successfully, the system will automatically save this program.
2) Program No. 253 cannot be copied or renamed.
3) Longer time may be needed when the saved program No. 253 is large.

4.3.4.10 No. 254 program operation

For No. 254 program, press hp5 in program edit window, the system prompts the help message prompt box how to compile, solidify and read No. 254 as follows:

1) Press 5 to compile and solidify No. 254 program:

Edit No.254 program. The system alarms when the edit is wrong; the system saves it to the FLASH area when it is compiled successfully.

2) Press 4 and read No. 254 program:

Read No. 254 program saved in FLASH area to the edit buffer zone, and update it.

3) Press ESC to exit the current state.

4.3.5 hp5 function

hp5 help key including the system command help, relative parameter help for arc, line number sort, character string replacing, cursor positioning and MPG controlling cursor moving and so on.
When the current program is No. 253 or No. 254, hp5 help key adds its operation prompt.

4.3.5.1 Part program command help

In program edit window, press hp5 1 , the system prompts “Command help introduction” window; the function can search all commands of the system including G, M, S, T, F as follows:

1) G , M , S , T , F separately introduces G, M, S, T, F command.

2) press INPUT and input the command number to search; the system displays the definition, the function, the format and the explanation of the command number.

【Example】

Example: search G05 command help.

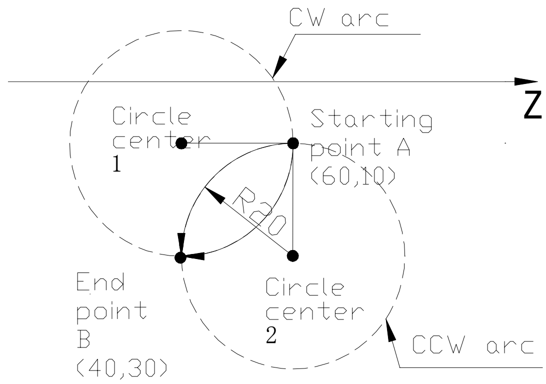
Press ：hp5 1 INPUT G 05 ENTRE, the system displays G05 definition, function, format and explanation.

4.3.5.2 Relative parameter help for arc

Press hp5 2 in the program edit window, the system prompts “Input relative arc parameters” window; the function can search arc parameters.
Input ［starting point coordinates］, ［end point coordinates］, ［circle radius］, the system automatically counts the relative parameters of arc.

【Example】

Starting point A coordinates(60, 10), end point B coordinates (40, 30) as follows:



[Input relative arc parameters]
[Starting point coordinates] Z： 60 X： 10
[End point coordinates] Z： 40 X： 30
[Circle radius] R： 20
Input the above data, and the system automatically counts the following data:
CW circle center 1: Z： 40 X：10 (Z, X：CW circle 1 coordinates.)
CCW circle center 2 : Z : 60 X :30 (Z, X：CCW circle 2 coordinates.)
Starting point->circle center 1: Z: -20 X: 0 (Z, X：Z, X vector of starting point A pointing to circle center 1.)
Starting point->circle center 1: Z: 0 X: -20 (Z, X: Z, X vector of starting point A pointing to circle center 1.)
End point->circle center 2: Z: 0 X: 20 (Z, X：Z, X vector of end point B pointing to circle center 1.)
Starting point->circle center 2: Z: 20 X: 0 (Z, X: Z, X vector of starting point A pointing to circle center 2.)

4.3.5.3 Line number sort

Press hp5 3 in the program edit window, and the system sort again the programs, and the sorted block number increases in 10 times. (**P333** value is set to 10.**)**

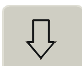
【Note】

1） After sorting the block number again, the program skip error appears when the program skip command is used in programming.
2） Program sorting function is invalid when P333 is set to 0.

4.3.5.4 Replacing character string

Press hp5 R in the program edit window, and the system prompts " Character string replacing" window; the operator can execute the operation according to the system prompts. All characters which need to be replaced are replaced from the character where the cursor is to the last character.

4.3.5.5 Cursor position

The system provides the character string search function, i.e position the content needed by the operator, which is convenient for operator to search the required content. Press hp5, and the system prompts , , , , F operation functions as follows:

1) Press  and the cursor positions to the first page of the current program.
2) press and the cursor positions to the last page of the current program.
3) press F, input the character which is needed to search of the current program, press ENTER, the cursor positions the character.

4) press ⇧, ⇩ to search the character of current program according to the system prompt. The system prompts Searching is completed and there is no character string when there is the character which is needed to search of the current program.

4.3.5.6 MPG controlling cursor moving

After the system is connected with MPG, the operator presses MPG , rotates MPG to control the cursor movement when the MPG key LED is light on the operation panel. Press MPG repeatedly, MPG operation is invalid when MPG key LED is OFF. The concrete MPG connection is referred to **CONNECTION**.

4.3.6 Part program compiling

The system provides hp3 compiling command key to compile part programs, check the syntax error, logic error of programs and coordinate data overtravel according to part program execution path to reduce the alarm error in Auto mode and improve the safety of executing part programs.

Press compiling command key and the system orderly checks and compiles part programs from the first line block, and creates convenient target command according to the execution path. When the system finds out the mistaken operator programs, it stops the compiling, displaying the mistaken field position and number in the line of the source program, prompting the operator to modify till the mistaken is corrected.

4.3.6.1 hp3 compiling command

In program edit window, press hp3 and the system orderly compile the current program. The system pops up a window『Program alarm』when it finds out a mistaken message. The system displays Current edited program compiling is completed successfully when all command compiling are correct.

『Program alarm』message includes as follows:

Error: mistaken command(refer to **PROGRAMMING**, **Chapter 8 Alarm Message** according to the commands);

Line: line where the mistaken block is in the program;

Program: content of mistaken block;

Position: mistaken letter or field of mistaken block.

【Explanation】

1) Program which is compiled successfully by hp3 can run in AUTO working mode.
2) The system automatically completes the compile when it switches from EDIT working mode to other working modes.
3) Press hp3 to complete compile to appear『Program alarm』, and then press any keys and the

edit cursor automatically points to the mistaken block.

4) Executing hp3 compiling, the system assumes that the machine coordinate axis takes the current workpiece coordinate position as the starting point, starts the execution from the first block of the current program. So, for some special programs, each axis stopping position has effect on the compiling; it is suggested that each coordinate axis should stop in advance in the starting point of the machining.

4.3.6.2 hp3 analog drawing

hp3 is firstly is pressed in the program edit window and the current program is not mistaken, the user presses it again to execute the analog drawing of the program path. When the current program is mistaken, the system finds out the mistaken message and pops up a window『Program alarm』.

The system draws the current program graph after hp3 is pressed twice when the current program is not mistaken as Fig. 4-5.

◆ Setting graph display area:

The system executes the analog drawing the motion path in the range (X min. coordinate—X max. coordinate, Z min. coordinate—Z max. coordinate)

Generally, the preset range value of the system is the full drawing of program motion path which is not modified, ENTER is pressed and the system enters into the program analog execution state.

Press ⇧, ⇩ to select the required data which is needed to modify, directly input data(not use ENTER key); pressing ENTER meaning all modifications are completed and the system enters the program analog execution state.

◆ Motion path drawing:

Analog execution of a program can be SINGLE mode or CONTINUOUS mode; when the initial state is single mode, press SINGLE key to switch between these two modes. In SINGLE mode, one block is executed when ENTER key is pressed once; in CONTINUOUS mode, the whole program will be executed automatically.

◆ Motion path graph color explanation:

Workpiece programming path: green;

Tool center path: white in rapid traverse; yellow in feed cutting;

Tool contour path: brown in rapid traverse; red in feed cutting;

Current tool center position: dot in grey

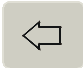
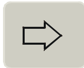
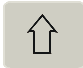
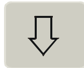
Last tool center position: dot in blue

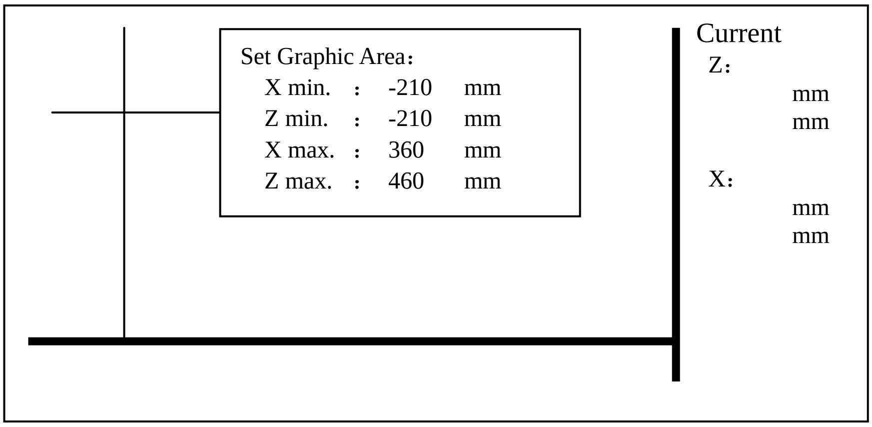
Z/X coordinate line: white

Horizontal scroll bar under graph: blue

Vertical scroll bar right to graph: blue

◆ graph motion path zoom out/in:

Press ,  to zoom out or zoom in graph. The operator can see the local area after it is zoomed out. The position and length of scroll bar indicate the position and the covered proportion of visual area in the full graph. Press , , ,  to move the scroll bar and see other areas.



【Note】

The program analog drawing function only executes the analog to program run path instead of fully display the actual cutting path and machining result. For example, there is difference between G33, G34, G92 analog drawing display path and the actual thread cutting path.

4.3.6.3 Program compiling result analysis

In program edit window, the program compiling error creates two types of alarm: ［**Program alarm**］ and［**Program compound check alarm**］. The program compiling is completed successfully there is no the above alarm.

Program alarm: there are mistaken commands in programming to cause the alarm, and the correct command is input to clear the alarm, which is not related to the parameter setting.

Program compound check alarm: program command check causes the alarm, which is resolved by the setting of all auxiliary parameters and interface parameters to analyze the program, and then by modifying program and parameters to clear the alarm.

【Example】

［**Program alarm example**］:

In compiling program, press hp3 and the alarm display is as follow:

［Program alarm］
Error E206：missing message
Line：11
Program：N0100 G92 Z300 P1
Position： P

［**Program compound check alarm example**］:

Press hp3, and the current edit program compiling is completed successfully, when the system is switched from EDIT working mode to AUTO working mode, the alarm display is as follows.

［Program compound check alarm］ Error E610：have illegally used M78 The command function is invalid

4.3.6.4 Program compound check prompt

After the program is compiled, the program is executed in AUTO working mode when there is no error. The system displays the program compound check prompt as follows:

1) tool nose coordinate software limit, machine coordinate software limit exceeding range

In executing programs, the system displays the program compound check prompt when the tool nose software limit and machine coordinate software limit exceeds the setting range set by the parameter from EDIT working mode to AUTO working mode.

2) do not correspond to tool setting record

In executing programs, the system displays the program compound check prompt when the tool setting record does not correspond to the command from EDIT working mode to AUTO working mode.

【Example】

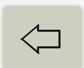
［**Program compound check prompt example**］:

It is T0408 in tool setting, T0308 in editing programs which does not correspond to the tool setting record; when **P403_d4** is set to 1, the system is switched from EDIT working mode to AUTO working mode and pops up the warning message: T0308 does not correspond to the tool setting record T0408.

4.4 JOG Working Mode

In JOG working mode, the operator can directly press the function key to execute some operation, and also press the letter key execute the some setting or execute some operation; the system provides the corresponding prompt message for each operation.

The relative setting or operation input format and example are as follows: the required function key is expressed with icon; the required input letter or digit key is expressed with the underline; the system prompt is expressed with the frame.

Press  to clear the mistaken digit and input it again when the mistaken digit is input in the course of inputting letter or digit.

Press 

to exit the current operation before the confirmation when the operator sets some operation or executes the input or man-machine dialog process.

In JOG working mode, the system displays [key icon] in the top right. Press it and the system pops up one window, displaying the operation key catalog in JOG working mode; press it again and the window is closed; directly press other functions and the window automatically closes.

Press [JOG key] to enter JOG working mode.

For the CNC machine, its electricity part installation debugging, motion performance debugging, coordinate system creation and tool preparation are completed in JOG working mode.

In JOG working window, the system must combine the operator parameter list, offset value to perform the analysis and precheck. When the system finds out the manual operation to cause the serious result, it closes the manual operation function and pops up the window display alarm message; the operator firstly modifies the parameter and then executes the manual operation according to the alarm message.

The system provides many part program execution mode. The operator can execute many necessary settings in JOG working mode before run to get the safe machining process.

◆ Main function in JOG working mode including:

☆ Coordinate axis moves in JOG mode, STEP mode and MPG mode

☆ Coordinate axis moves in absolute movement mode, relative movement mode

☆ Create machine coordinate system, workpiece coordinate system

☆ Spindle, chuck, cooling, tool post and other miscellaneous function operation

☆ Tool setting operation

☆ Machine real-time state display, pop up real-time alarm

JOG window display is as Fig. 4-6:

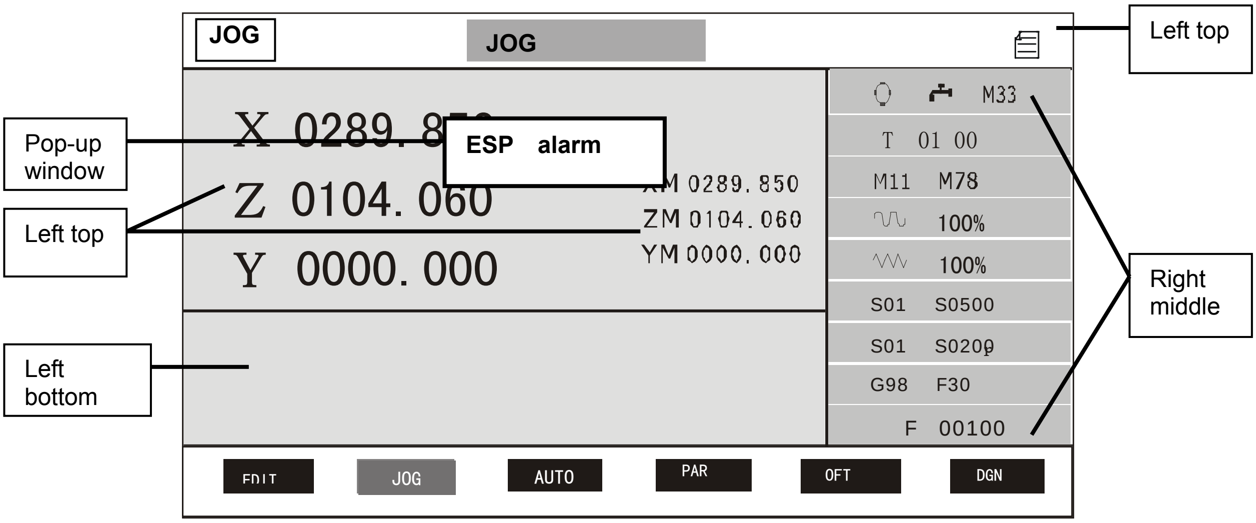


Fig. 4-6 JOG working mode

◆ window area display content:

Upper top: display manual feed operation mode, including JOG, STEP, X/Z/Y MPG; the system function operation way prompt key [key icon];

Left top: display tool nose coordinate and machine coordinate;

Left bottom: MDI input and alarm prompt area;

Right middle: display machine's current state including spindle, cooling, lubricating, tool post, chuck, tailstock, speed, cutting speed and so on;

Pop-up window: display system's alarm message.

◆ Miscellaneous function state display:

1) miscellaneous function state uses the icon or correspond command symbol display;
2) black sign indicates the current state: spindle, cooling;
3) red sign indicates the function is being executed and is not completed;
4) red flash indicates the last execution is failure or broken in midcourse(reset, emergency stop operation), and the system takes the corresponding function is in the unconfirmed state. When the tool or chuck is in the unconfirmed state, the system cannot start the machining program; the system recovers the normal state when it executes successful operation or is switched on again.
5) the green sign indicates the check is normal and the yellow sign indicates the check is abnormal;
6) the S following the spindle gear indicates the real-time checking spindle speed;
7) the pressure check icon △: it is green when it is normal, it is yellow in half when it is low, yellow in full when the time of low pressure exceeds the time set by P332;
8) G96/G97 and S indicate whether the system is in the constant surface speed cutting mode; S is the linear speed or rotation speed, unit: m/min, r/min;
9) G98/G99 is the feed/rev or feed/minute mode; F is the set cutting speed;
10) F indicates the actual speed of the coordinate axis.

4.4.1 Coordinate axis movement

Confirm the traverse speed and movement distance before executing the coordinate movement. Press the emergency stop button immediately when there is the unexpected accidence.

4.4.1.1 JOG movement

Press 

the system is switched from STEP or MPG mode into JOG mode.

【JOG TRAVERSE】is to keep pressing the coordinate axis move key, and the machine slider continuously moves; release the key, and the slider decelerates to stop. The traverse speed is executed according to the rapid or feedrate.

Coordinate axis move key meanings are as follows:

X negative move key

X positive move key

Z/Y negative move key(it is Y when indicator is ON)

Z positive move key(it is Y when indicator is ON)

◆ Z/Y coordinate axis switch:

Press Z/Y SWITCH to the cycle switch of Z or Y operation; Z/Y SWITCH INDICATOR ON indicates Y operation.

When the machine is switched into Y operation, the program reference point return and the machine zero return are valid in Y axis.

【Note】

1) When the motor rotates with high speed and the feed key is released, the machine slider continuously moves and does not stop immediately because of the automatic acceleration/ deceleration. The movement length is determined by the max. motor speed, the acceleration/ deceleration time, and the feed override. The longer the acceleration/ deceleration time and the higher the speed is, the longer the distance between sliders are; on the contrary, the shorter the distance is.

4.4.1.2 Step movement

Press and the system is switched from JOG or MPG to STEP mode.

【STEP TRAVERSE】: press the coordinate axis move key and the machine slier moves the preset step width. The traverse speed is executed by the selected rapid or feedrate.

Press continuously the key, the machine slider will continuously feed the step width till the key is released and the slider has moved the last step width. The step width in the single step movement is displayed in the black background.

The step width of single step movement is **0.001 0.01 0.1 1.0 10.0 50.0. the system can gradually select them according to STEP REGULATION.**

【Note】

1) In STEP mode, press CYCLE START to stop slider moving. When the key is pressed down, the slider stops and the unfinished step will not be reserved, and then the feed key is pressed to execute the next step feed. X step width is the moving distance in diameter.

2) When the manual feed key is pressed, the external spindle and the feed hold knob are permitted to feed, the slider moves. When the manual step feed key is pressed, the slider does not move in the state of feed hold.

3）When the slider is moving and the feed hold knob rotates to the feed hold position, the slider will decelerate to stop and the unfinished step width will not be reserved.

4.4.1.3 MPG control

Press to switch from MPG mode to JOG or STEP mode, and the indicator ON is selected.

【MPG movement】: the system receives the pulse signal generated by MPG(handwheel) to control the movement of coordinate axis.

◆ preset each movement of scale of MPG:

The MPG dial rotates one case, and the coordinate axis moves one step width. The step width has three gears: 0.001mm, 0.01mm, 0.1mm, which can be switched circularly according to the STEP REGULATION.

◆ preset MPG coordinate axis:

Press MPG to select MPG coordinate axis to X or Z/Y, which can be switched circularly. The coordinate of the selected coordinate axis is in the high light state. When Y/Z SWITCH indicator is ON, pressing MPG control axis switches X, Y mutually.

Rotate MPG after the required coordinate axis is selected, and the selected axis moves according to MPG rotating.

Rotate CW MPG and the coordinate axis moves positively. Rotate CCW MPG and it moves negatively.

【Note】

1) The MPG speed of should be less than 5 r/s; otherwise, the motor will not stop even if the MPG stops, that will cause inconsistence in the slider movement distance and MPG scale.
2) In MPG mode, all the functions related to the axis moving including JOG or STEP movement function, program zero point return and machine zero point return are invalid,.
3) In MPG mode, when axis movement related functions are executed, and the relative/absolute movement of field is input, MPG is forbidden temporarily and the LED flickers. After the above functions are executed, MPG function recovers automatically.
4) When the bigger override (X 0.1) is selected, the motor will rapidly traverse if the MPG is rotated rapidly. At the moment, because the system automatically accelerates/ decelerate, the motor will traverse not to stop although the MPG stops. The actual moving distance is determined by max. speed of motor, the acceleration/ deceleration time, the feedrate override and the MPG speed. The rapider the speed is, the longer the acceleration/deceleration time is and the rapider the MPG speed is, the longer the moving distance of motor decelerating is, otherwise the shorter the moving distance of motor is.
5) **P400_d4=0**: the step width 0.1 is valid; **P400_d4=1**, the step width 0.1 is invalid.
6) When **P400_d1** is set to 1, the external MPG control button is valid, Y/Z selection axis, and the step regulation key are invalid.

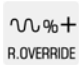
4.4.1.4 Rapid traverse speed selection

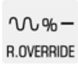
◆ Manual rapid traverse and low feed state selection

In JOG mode, the negative/positive movement speed of each axis can select rapid traverse and cutting feed(low speed movement). Press 

to switch the rapid traverse and low speed feed states. The speed indicator ON is to select the rapid traverse state.

◆ Rapid override

Rapid override is divided into the four gears: 25%, 50%, 75%, 100%. 

increases to one gear till 100%. 

reduces one gear till 25%.

Z actual traverse speed = P100 x rapid override

X actual traverse speed = P101 x rapid override

Y actual traverse speed = P102 x rapid override

◆ Manual operations influenced by rapid override and feed override are as followed:

JOG MOVEMENT operation: when the speed indicator is NO, it is influenced by the rapid override; when it is OFF, it is influenced by the feedrate override;

STEP MOVEMENT operation: when the speed indicator is NO, it is influenced by the rapid override; When it is OFF, it is influenced by the feedrate override;

INPUT FIELD MOVEMENT operation: when the speed indicator is NO, it is influenced by the rapid override; when it is OFF, it is influenced by the feedrate override;

Program reference point return operation: it is influenced by the rapid override; machine zero return operation: it is influenced by the rapid override;

【Note】

1) Firstly select the rapid override and press the coordinate axis movement key in JOG working mode.

2) select the rapid override in STEP working mode, and regulate the rapid override in the course of movement, and the traverse speed changes.

4.4.1.5 Low speed feed speed selection

Press 

and the speed indicator is OFF, which is the selected low speed feed state.

◆ **System embedding feedrate**

When the input field F is 0, the system uses the embedding speed feed.

The manual feedrate override has 16-gear **0%～150%**, the corresponding embedding feedrate of each gear is as follows:

Feedrate override	feedrate(mm/ min)	Feedrate override	feedrate(mm/ min)
0%	0	80%	240
10%	7.5	90%	300
20%	22	100%	420
30%	38	110%	525
40%	60	120%	675
50%	82	130%	850
60%	110	140%	1000
70%	180	150%	1260

【Note】

1) There are some differences between actual speed and data in this table, and the actual speed should prevail.

2) When the feedrate override is 0, the system prompts "Feedrate override is 0", which indicates the command is in execution state, and the machine slider is in stop state. The slider will move as soon as the override is adjusted to a non-zero value.

◆ Feedrate override

The manual feedrate override has 16 gears **0%～150%** ; press ΛΛΛ%+ F.OVERRIDE and the feedrate override increase one gear till 150%; press ΛΛΛ%− F.OVERRIDE and the feedrate override reduces one gear till **0%**.

4.4.1.6 Inputting field moving, setting feedrate

In JOG working mode, the coordinate axis moves according to the input length and direction, or directly moves from the current position to the input coordinate position instead of the set step width as follows:

◆ Relative field of movement

Corresponding operation of each coordinate axis:

X move_X field(X position), or U field(X relative movement) ;

Y move_Y field(X position), or V field(Y relative movement) ;

Z move_Z field(X position), or W field(Z relative movement) ;

X, Z, Y, U, W, V range: -99999.999mm～99999.999mm;

Feedrate_F field (F0000～F15000，the leading zero can be omitted, unit: mm/min)

【Move field format】

Z(W)_ F_ ; Z moves, its speed is determined by the rapid/feed state when F is omitted. (The same as in the followings.)

Y(V)_ F_ ; Y feeds

Z(W)_ X(U)_ F_ ; Z/X feed simultaneously

X(U)_ Y(V)_ F_ ; X/Y feed simultaneously

Z(W)_ Y(V)_ F_ ; Z/Y feed simultaneously

【Note】

1) In JOG working mode, most 2 axes move simultaneously at the currently selected manual traverse speed.

2) input Y(V) when Y set by the system parameter is valid.

【Example 1】

Input: ：W MOVE W –5.2 ENTER RUN? START(or ESC cancel) ; it means Z negatively **5.2mm**.

Input: ：X MOVE X 40 ENTER RUN? START(or ESC cancel) ; it means X negatively **40mm**.

【Example 2】

Input: **Z200 U50** ; Z moves to 200, X positively moves 50. its speed is not specified and determined by RAPID/FEED state.

Input: **U20 W-50 F80**; X positively moves 20, Z negatively moves to 50. the feedrate is 80 and is influenced by the feedrate override.

Input: F200; the set feedrate is 200. the system is switched into feed state.

Input: **F0**; the set feedrate is 0, the system is switched into feed state and uses the embedded speed.

◆ traverse speed explanation:

1) When field F is input, the system will automatically switch to low-speed feeding state and the speed indicator is OFF; the gear of feedrate override is the current gear; when the input F field is larger than P113, P113 should prevail.

2) When the input F field is 0, the system will adopt the internal speed as the feedrate.

3) When the JOG or STEP is performed, it is under control of F filed even when the speed indicator is OFF.

4) Under the condition that no F field is input, when the speed indicator is ON, the movement is rapid traverse and affected by the rapid traverse override; when the indicator is OFF, the movement is low-speed traverse and is affected by feedrate override.

5) Under the condition that on F field is input, when the indicator is OFF, the speed of low-speed traverse is limited by P113 (maximum cutting feedrate); when the speed is higher than P113, the speed set by P113 should prevail.

6) Under the condition that no F field is input, when the indicator is OFF, the movement and AUTO mode of two-axis feed is the same to G01 (interpolation feed). These two axes move simultaneously at a proportional speed and stop at the same time.

7) Under the condition that no F field is input, when the indicator is ON, the movement speed of single-axis feed is determined by parameters P100~P102 and rapid traverse override.

8) Under the condition that no F field is input, when the indicator is ON, the movement of two-axis rapid traverse is determined by P400_d3, and it is the same to the execution of G00 in AUTO mode. When P400_d3=0, the movement is performed separately. The resultant speed displayed on the screen is larger than the maximum rapid traverse speed of each axis. When P400_d3=1, the movement is in interpolation mode and these two axes move simultaneously at a proportional speed and stop at the same time. The movement parameters and slope of the distance will be taken into consideration so as to ensure that there is no stall during the movement. Different slopes may correspond to different rapid traverse speed.

9) When the feedrate override is 0, and the system is in low-speed feeding mode or F field exists, movement is forbidden. Press ENTER, a prompt “feedrate override is 0” will be displayed till the override is adjusted to other value.

10) The input of F field is specified by G98 command; G99 command cannot be input in the system.

◆ Call field execution

The system automatically saves the last 8 times executed command record in inputting field moving.

Press , and the system pops up the window list record; the operator can input according to the digit serial number to modify or directly execute the operation.

4.4.1.7 Drive unit enabling control

Set P416_d4 to 1, continuously press DELETE in JOG and AUTO mode, and the drive unit is closed and the motor is in free state. Press DELETE in the drive unit closing state, and the drive unit is started, and the motor is in working mode.

4.4.1.8 Coordinate axis motion alarm prompt

In executing the axis motion, when the current motion axis meets the tool nose coordinate software limit points(tool nose software limit point), the axis cannot continuously move and moves reversely, and the system displays the alarm prompt. When the axis meets the machine coordinate software limit point, it only moves reversely. But the manual zero return function is not control by the software limit value range.

【Note】

In JOG or STEP mode, when the moving axis reaches the soft limit, soft limit alarm is prompted. When the Z/X axis movement is commanded by input fields, if the setting value exceeds the range, limit alarm message is displayed and the execution is inhabited. Whether machine soft limit alarm and tool nose soft limit alarm is enabled is set by P404_d4, P404_d3.

4.4.2 Creating coordinate system

4.4.2.1 Creating machine coordinate system_machine zero return(machine reference point return)

◆ Machine zero:

Machine coordinate system fixed on the machine is the reference coordinate system for CNC counting the coordinate position. After the system is installed, the operator should firstly create the machine coordinate system.

The reference point of the machine coordinate system is called machine zero(or machine reference point or machine zero). Some fixed point on each machine is taken as the machine reference point, and the system firstly returns to the machine zero and then returns to the machining starting point to eliminate the machine coordinate system deviation caused by the power-off and step-out; executing the zero return instead of tool setting again after power-off accidentally can find the machine coordinate system and workpiece coordinate system to continuously machine the workpiece.

In most conditions, the system looks for the machine reference point by the deceleration switch and zero switch installed on the machine; or by the one-turn signal of servo motor as the zero signal only with the deceleration switch. The deceleration switch is generally installed near to the max. travel of positive Z/X//Y coordinate axis.

◆ Machine zero return operations:

Press 

, and X execute the machine zero return;

Press  , and Z execute the machine zero return; Z/Y switch indicator lighting means Y is being executed.

Press  in JOG Working mode, Z moves to Z machine zero at the selected rapid traverse speed in the zero return direction.

◆ Zero return process as follows:

Zero return mode 1: when there is the deceleration signal and zero signal, the system executes the zero return mode 1; the zero return process is as follow:

Step 1: the coordinate axis moves to the specified direction at the rapid speed till the block presses down the deceleration switch and the system has checked the starting point of the deceleration signal to decelerate to stop moving;

Step 2: the coordinate axis reversely moves at the set zero return speed till the system has checked the starting point of deceleration signal to decelerate and to stop moving;

Step 3: when the set zero offset is not zero, the system continuously moves one zero offset value;

Step 4: the coordinate axis continuously moves at the set zero return speed, and starts checking the zero signal till the system has checked the zero signal to decelerate to stop moving;

Step 5: the above operations have completed the zero return motion and check processes; at last, the system automatically modifies the current machine coordinate into the "Zero coordinate" set by the parameter.

Zero return mode 2: when there is the only deceleration signal without the zero signal, the system executes the zero return mode 2.

Because there is no zero signal, the system reduces the above the Step 3 and Step 4 compared to the zero return mode 1; the system only executes the above Step 1, Step 2 and Step 5 to complete the zero return process, which zero return precision is worse than the zero return mode 1.

Zero return mode 3: when there is the zero signal without the deceleration signal, the system execute the zero return mode 3.

Because there is no deceleration signal, the system reduces the above the Step 1, Step 2 and Step 3 compared to the zero return mode 1; the system only executes the above Step 4, and Step 5 to complete the zero return process. In the mode, the manual operation moves the coordinate axis to a special position and then the system executes the zero return, otherwise, the result is not correct.

Zero return mode 4: the system executes the zero return mode 4 when there is no deceleration and zero signal.

When there is no machine zero check device installed on the machine, the relative parameters are set to 0; at the moment, when the system executes the machine zero return function, it does not check the zero signal and deceleration signal till it returns to the zero coordinate position of the axis.

【Note】

1) The direction of machine zero return points to the zero-return direction, if this direction is positive, then, the axis should in the negative direction.
2) In the machine zero return, the rapid traverse speed of the coordinate axis is controlled by the rapid override.
3) In the machine zero return, the coordinate axis motion is not limited by the software limit parameter.
4) Parameter related to the machine zero return is referred to PROGRAMMING, Parameter Setting Working Mode.
5) Connection related to the machine zero return and zero return mode are referred to CONNECTION, Machine Zero Function and Connection.
6) After the system executes the machine zero return, the blue icon of the machine zero return after the corresponding machine coordinates are displayed as the prompt.

4.4.2.2 Creating machine coordinate system_without machine zero(no machine reference point)

(Prompt: the coordinate axis with the zero check device cannot execute the operation.)

The coordinate axis without the zero check device(without deceleration signal and zero signal), can create the machine coordinate system as follows:

【Format】

Input: INPUT **U** NEW COORDINATE VALUE ENTER. The current X machine coordinate is modified into the new coordinate value.

Input: INPUT **V** NEW COORDINATE VALUE ENTER. The current Y machine coordinate is modified into the new coordinate value.

Input: INPUT **W** NEW COORDINATE VALUE ENTER. The current Z machine coordinate is modified into the new coordinate value.

4.4.2.3 Setting workpiece coordinate system

The system uses the floating workpiece coordinate system. The workpiece coordinate system is the reference to tool setting and relative dimension. After the machine coordinate system is confirmed, the workpiece coordinate system should be set.

【Format】

Input: INPUT **X** NEW COORDINATE VALUE ENTER. The current X tool nose coordinate is modified into the new coordinate value.

Input: INPUT **Y** NEW COORDINATE VALUE ENTER. The current Y tool nose coordinate is modified into the new coordinate value.

Input: INPUT **Z** NEW COORDINATE VALUE ENTER. The current Z tool nose coordinate is modified into the new coordinate value.

◆ Actual operation steps of setting workpiece coordinate system are as follows:

Install the trial cutting workpiece on the machine and select any one tool(generally use the first tool in the machining).

1. Setting X workpiece coordinate:

1) Select the proper spindle speed and start the spindle.

2) Traverse the tool to cut a little sidestep on the workpiece, and X does not move.

3) The tool in Z direction moves to the safe position, the spindle stops rotating. The system measures the diameter of cut sidestep.

4) Press INPUT and the system displays SETTING, and press X and the system displays , the operator inputs measured diameter value(input the radius for the radius programming); press ENTER, and the system automatically set X workpiece coordinate system.

2. Setting Z workpiece coordinate:

1) Start the spindle, traverse the tool to cut a little sidestep on the workpiece. X does not move.

2) Move the tool to a safe position along with X direction and stop the spindle rotation.

Select a point as a reference point (a fixed point on the machine is better, for example, the chuck surface or other reference plane, so that the new workpiece coordinate system overlaps on the original workpiece coordinate system). Then, measure the distance from the cutting surface to the selected reference point in Z direction.

3) Press INPUT, and the system displays SETTING, press Z and the system displays SETTING WORKPICE COORDINATE SYSTEM Z, input the measured data and press ENTER, the system automatically set Z workpiece coordinate.

Note: The system workpiece coordinate system has been created after the above operations are completed.

【Explanation】

1) Setting the workpiece coordinate system operation only modifies the tool nose coordinates of current point without changing the offset and the machine coordinates. The operation result is that the offset between the workpiece coordinate system and the machine coordinate system is set again.

2) Setting the workpiece coordinate system operation is executed once and is not set later after the system is initialized or the workpiece type is changed(all offset values are cleared to zero).

【Note】

The operator should set again the workpiece when the actual position of the tool is not consistent with the workpiece coordinate system position because of the step-out caused by some reasons. After the step-out, not only the workpiece coordinate system position changes but also the machine coordinate system position also changes. In the case, only correcting the workpiece coordinate system instead of modifying the machine coordinate system maybe bring the unexpected “Machine coordinate software limit alarm”.

Proper operations after motor stepping-out as follows:

1) Select the reference point (the tool nose easily reaches and the operator can conveniently observe it) for one couple of tool, measure Z, X coordinates of the point.

2) Move the tool nose to some reference point(the known reference point coordinates);

3) Continuously press twice DELETE and close the drive unit when the tool nose coordinates are not consistent with the reference point coordinates;

4) Input the field to move and make the tool nose coordinates be consistent with the reference point coordinates(the coordinates change and the actual tool nose does not);

5) Press DELETE to start the drive unit.

So, the machine coordinate system and the workpiece coordinate system are corrected simultaneously.

4.4.2.4 Setting program reference point

In the machine coordinate system, the operator should confirm one position where the tool change can be executed safely when the tool post stops here, and where the workpiece is installed conveniently. The program reference point can be set when the tool post stops at the position which is called the program reference point(Program zero). The program reference point coordinates are relative to the machine coordinate system.

【Format】

Press INPUT and the system displays SETTING, press **0** and the system displays Setting program reference point?, at the moment, press ENTER, the system confirms Z/X/Y to be the program reference point.

When the operator sets again the workpiece coordinates after setting the program reference point, the previous reference point coordinates do not change in the new workpiece coordinate system, at the moment, the operator should set again the program reference point. The initial value of the program reference point is X=150 Z=150.

After the operator sets the program reference point, the program reference point return command G26 and the program zero return operation by the system panel return to the point no matter what the machine slide stops anywhere.

4.4.2.5 Program reference point return

Must confirm the program reference point position before the operator executes the program reference point return, otherwise, the unexpected result brings.

In JOG working mode, the operator directly press the function key to execute the operation. After the key is pressed, the corresponding coordinate axis rapidly returns to the program reference point. When the axis change indicator lighting means Y operation is being executed.

Press 

and X rapidly returns the program reference point from the current point.

Press 

and Z(or Y) rapidly returns the program reference point from the current point.

【Note】

1) Generally, each axis should stop at the program reference point in waiting for the machining.

2) After the system executes the program reference point return, the green icon  of the

program reference point return before the corresponding machine coordinates are displayed as the prompt.

4.4.2.6 Recovering the workpiece coordinate system and program reference point

In JOG working mode, the workpiece coordinate system and the program reference point have been set. In AUTO working mode, when all executed blocks include G50, the workpiece coordinate system and program reference point have been changed. The operator can use the following operations to recover the workpiece coordinate system and program reference point set in JOG working mode.

【Format】

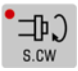
Input: **G** **5** **1** **ENTER**. Recover the workpiece coordinate system and program reference point set in JOG working mode.

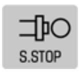
4.4.3 Spindle control function

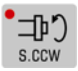
4.4.3.1 Spindle starting/stopping control

◆ Spindle starting/stopping as follows:

In JOG working mode, the operator can directly operate the function keys on the panel or input M03/ M04/ M05 to control the spindle rotation (CW/CCW) and stop). (feed/spindle hold is invalid in JOG working mode).

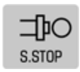
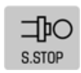
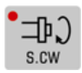
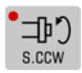
Press  or input M 3 ENTER; the spindle rotates CW. The system displays the spindle state and LED lights.

Press  or input M 5 ENTER; the spindle stops rotation.

Press  or input M 4 ENTER; the spindle rotates CCW. The system displays the spindle state and LED lights.

◆ Spindle JOG control

The spindle stop key can switch the spindle JOG control state.

In the spindle stop state, press  and the Spindle state icon is displayed in the highlight on the screen and the system is switched to the spindle JOG control state. Press  again, the system is switched to the normal-regular state. In the spindle manual state, press  or  , the spindle rotates at the specified speed in the specified time and then stops.(when the specified time is too long, the operator can press  to stop the rotation). In the spindle manual state, MDI inputting the spindle control command M03, M04, M05 are invalid. The spindle manual speed is specified by P309, the manual rotation time is specified by P308, and the spindle stops and LED indicator is OFF when the manual time ends.

◆ Interlock between the spindle starting/stopping and chuck:

P402_d5=0: interlock relationship between the hydraulic chuck control and the spindle control

1) When the chuck clamps, the system forbids starting the spindle; otherwise, the system alarms "The chuck clamps and the system forbids starting the spindle".

2) When the spindle rotates CW, the system forbids the chuck operations, otherwise, the system alarms "The spindle does not stop and the system forbids operating the chuck".

◆ Interlock between the spindle starting/stopping and tailstock:

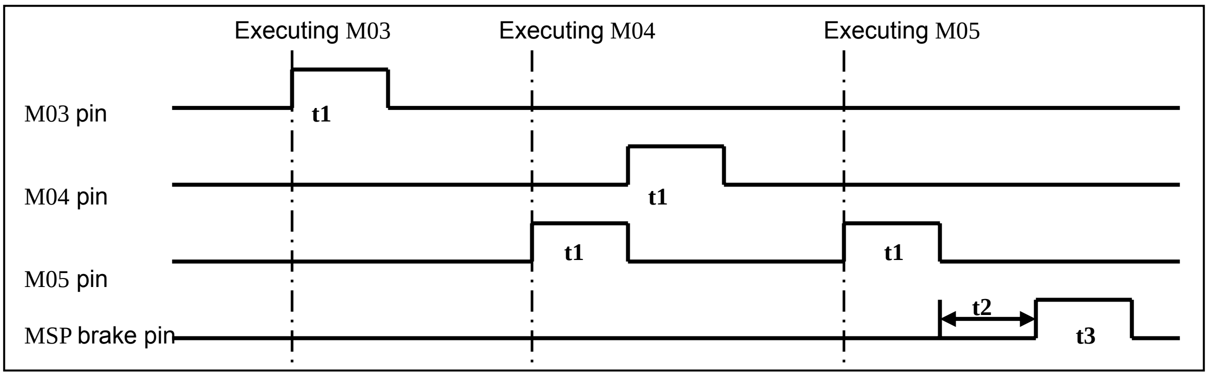
P402_d3=0: Interlock between the tailstock control and the spindle control:

The system forbids operating the tailstock when the spindle is rotating; otherwise, the system alarms "The spindle does not stop and the system forbids operating the tailstock".

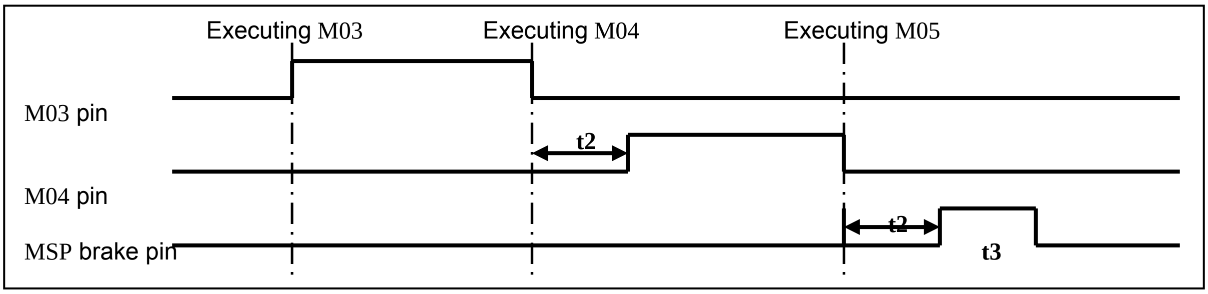
◆ Spindle starting/stopping execution process and signal output time sequence:

Note: Select the spindle control output signal by P410_d7. When P410_d7 is set to 0, the spindle controls the level output. When P410_d7 is set to 1, the spindle controls the pulse output. The time sequence between the spindle brake signal MSP and the spindle starting, stopping signal as follows:

1） In pulse control mode, M3, M4, M5, MSP output time sequence:



2) In level control mode, M3, M4, M5, MSP output time sequence(it is used to other when M5 pin does not output):



t1: In pulse control mode, the hold time output by M3, M4, M5 is set by P326;

t2: The spindle stop brake delay time is set by P315;

t3: The durable time output by the spindle brake signal MSP is set by P316.

4.4.3.2 Spindle S command _gear shifting control

(Prompt: it is not necessary to read the chapter for the operator using the frequency spindle.)

When the spindle does not use the frequency spindle, **P410_d6** is set to 0 and S function executes the spindle gear shifting. S standard format consists of S+2-bit digit. 2-bit digit means the spindle gear number.

【S format 】

Sx ;

Sxx ;

【Operation example】

Select No. 2 gear spindle speed:

Input: S 0 2 ENTER ; the system outputs S02 and the system displays the gear state S02 .

【Explanation】

1) When **P410_d5** is set to 0, the gear control signal directly outputs by the bit, S range is S00～S04. One gear signal corresponds to one gear signal. S0 means all output is invalid.

2) When **P410_d5** is set to 1, the gear control signal outputs in code, S range is S00～S15. The detailed code output is as follows:

Output point \ Code	S00	S01	S02	S03	S04	S05	S06	S07	S08	S09	S10	S11	S12	S13	S14	S15
S01		★		★		★		★		★		★		★		★
S02			★	★			★	★			★	★			★	★
S03					★	★	★	★					★	★	★	★
S04									★	★	★	★	★	★	★	★

Note: "★" in the above table means the output of the corresponding output point is valid.

3) Lines controlled by the Actual output of spindle gear is specified by P310.

P310=4，actual output controlling points are S01, S02, S03, S04;

P310=3，actual output controlling points are S01, S02, S03; releasing S04, as other use;

P310=2，actual output controlling points are S01, S02; releasing S04, S03, as other use;

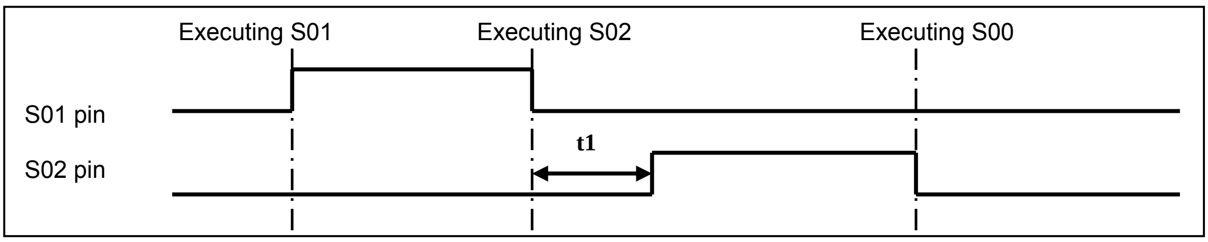
P310=1，actual output controlling points is S01, releasing S04, S03, S02, as other use;

P310=0，S does not output; releasing S04, S03, S02 , S01 as other use.

4) When the gear controls the signal code output (**P410_d5** is set to 1) and the controlled lines specified by P310 are less than 4, only the low gear control is valid, and the high code control is released and is not controlled by the gear.

◆ Execution process and signal output time sequence of spindle S gear shifting:

When the system is turned on, it defaults S00, S01～S04 output are invalid. When the system executes any one of S01, S02, S03, S04, the corresponding S signal output is valid and keeps, and at the same time, the output of other 3 signals is cancelled. When the system executes S00, it cancels S01～S04 output and one of S01～S04 is valid.



t1：spindle gear switch interval time (P313).

◆ Spindle gear shifting function operations:

Besides the above method to execute the spindle gear shifting, the operator can change the spindle gear by pressing the spindle gear shifting .

Press once and the spindle speed circularly output according to S01～S04, or S00～S15 (in code output) . When there are four-gear spindle speed, the operator presses three times after S02, and the system is switched from S02 to S01.

4.4.3.3 Spindle S_ speed control

(Prompt: it is not necessary to read the chapter for the operator using the frequency spindle.)

When the machine uses the frequency spindle, **P410_d6** is set to 1. To resolve the converter with low torque, the system should 4-gear automatic gear shifting output signal to match the converter working in the high frequency to make the machine get the low speed and big cutting torque. The system uses M41/M42/M43/M44 to control the spindle gear control; S controls the spindle speed.

◆ Frequency spindle gear control

【Format】

M41 ;
M42 ;
M43 ;
M44 ;

【Explanation】

1) M41, M42, M43, M44 output gear control signal. Each gear signal corresponds to one output point S01, S02, S03, S04.
2) Actual output controlled lines of spindle gear are specified by P310.
   P310=4: actual output controlled point are S01, S02, S03, S04 ;
   P310=3: actual output controlled point are S01, S02, S03; the system releases S04 as other use.
   P310=2: actual output controlled point are S01, S02,; the system releases S04, S03 as other use.
   P310=1: actual output controlled point are S01; the system releases S04, S03, S02 as other use.
   P310=0: actual all point doe not output; the system releases S04, S03, S02 , S01 as other use.
3) The initial gear state of the system ON is M41.

【Execution process and signal output time sequence of spindle M gear shifting:

When the CNC is turn on, it states is controlled by **P400_d6** (spindle gear memory) to whether it memories the spindle gear or not.

1) When **P400_d6** is 0, the system is turned on after it is turned off, the spindle gear is not memorized and the system default the 1st gear of the spindle, and M41～M44 do not output;

2) When is **P400_d6**, the system is turned on after it is turned off, the spindle gear is memorized. The system does not execute the gear shifting when the specified gear is consistent with the

current gear. If not, the system executes the gear shifting as follows:

① Execute one of M41, M42, M43, M44, the value (unit: millivolt)set by P314 (output voltage in the spindle gear shifting) is output to the analog voltage to the spindle servo or the converter.

② The system closes the previous gear output signal after it delays P311 (frequency spindle gear shifting time 1) ;

③ The system outputs the new gear signal after it delays P313 (frequency spindle gear shifting interval time);

④ When the system is connected with the checking gear shifting in-position input signal M41I, M42I, M43I, M44I, and the gear shifting is not in-position, it always waits the gear shifting in-position signal to execute the next step; when the system is not connected with the checking gear shifting in-position input signal and directly executes the next step; M41I～M44I input signals are defined by the interface parameters;

⑤ The system delays P312 (frequency spindle gear shifting time 2), and outputs the spindle analog voltage according to the current gear based on **P300～P303** (corresponding to gear 1～4), and the gear shifting ends.

◆ Speed control of frequency spindle

When the machine uses the frequency spindle, S controls the speed. The spindle standard format consists of S+4-digit digital, 2-digit means the spindle gear number. There are 2 methods to input the spindle speed input.

1) S sets the fixed speed of the spindle (r/min); when S is not changed, the spindle speed is not changed, which is called **Constant speed control**.

2) S sets the tangent speed(m/min) of the tool relative to the workpiece outer, which is called constant surface speed control. In the constant surface control, the spindle speed changes as X tool nose coordinate value changing in cutting feed. The detailed is referred to **PROGRAMMING Constant Surface Control G96, Constant Surface Speed Control Cancel G97.**

【Command format】

G96	;	set the constant surface speed cutting state;
G96 S__	;	set the constant surface speed cutting state and specify the surface value; range: 0～9999 m /min;
G97	;	cancel the constant surface state; G97 is modal
G97 S__	;	cancel the constant surface state and specify the speed value; range: 0～9999 r /min;
S__	;	It is determined by the current state; it can be speed value or surface speed value cutting.

【Operation example】

Input: S 2 0 0 ENTER; the system switches the speed into **0～10V** analog voltage to output the converter.

【Explanation】

1) In executing S, the system takes the max. spindle speed value of the current spindle gear as the reference, counts the analog voltage value corresponding to the specified speed, and then outputs to the spindle servo or the converter.

2) To make the spindle actual speed be consistent with the speed set by S, **P300**～**P303** should set the actual max. spindle speed value(output analog voltage is 10V) of each gear; the setting method: input S_ according to the setting value of **P300**～**P303**, and modify **P300**～**P303** setting according to the actual displayed spindle speed value.

3) When the system is turned on, the analogy voltage output is 0v, the system outputs corresponding analog voltage value after it executes S; it always keeps later(except for the cutting feed state in the constant surface speed control and X coordinate value is not changed). After S0 is executed, the analog voltage output is 0V. CNC resets in the emergency stop, the analog voltage output keeps.

4.4.3.4 Servo spindle working state setting

The system switches the spindle working mode when the spindle uses the GSK DAP03 servo drive unit.

【Relative parameter】

P405_d1: P405_d1=1: the function is valid when the controllable axis has Y,

P410_d4 (relationship between the spindle and Y): it is not switched when it is 0, which means the spindle operation is not related to Y; it is switched when it is 1, which means the spindle operation is related to Y operation, and is interlock but they cannot be operated simultaneously, and the system selects their working mode by the command in advance.

When the spindle is switched into the position control mode(**P410_d4=1**) , the spindle speed is controlled by Y feedrate, S is ignored in machining in AUTO working mode, executing S prompts the execution is mistaken in JOG working mode.

M47/M48 is valid when **P410_d4** is set to 1.

◆working mode setting operations between the spindle and Y:

In JOG working mode, the operator can input M47/M48 to set the working state between and the spindle and Y.

Input: M 47 ENTER ; set Y permissive working mode. It can be operated when the spindle is in stop state, otherwise, the system alarms.

Input: M 48 ENTER ; set Y forbidden working mode. It can be operated when the spindle is in stop state, otherwise, the system alarms.

When the system executes M47, it outputs APO level signal and checks API signal; when API level is "0", the system set Y working mode, displays Y operation icon ; in the state, the system permits Y motion operations, forbids the spindle start/stop (M03/M04/05 is invalid and the system prompts the alarm message).

When the system executes M48, it outputs APO signal and checks API signal; when API level is "1", the system set spindle working mode, disappears; in the state, the system forbids Y motion operations, permits the spindle start/stop (Y motion in AUTO working mode causes the alarm). The concrete connections of APO and API signals are referred to **CONNECTION**.

【M47 instruction】

1) After the execution of M47, the system will exit from M47 state after you press emergency stop key, and it won't be affected even when RESET key is pressed.

2) During the execution of M47, pressing RESET or EMERGENCY STOP will enable the system exit from M47 state.

4.4.3.5 Spindle orientation control

Command M87/M88 is used for spindle orientation control. The main functions are:

1) When spindle inverter is designed with the function of spindle orientation at any angle. M87 can be used to sent a orientation command through RS232 interface to inverter according to Modbus communication protocol. Then an orientation signal is output.

2) M87 can be used to output orientation signal and control the DAP03 Serial Spindle Servo Drive Unit, so as to realize single-point or multi-point orientation.

【Relevant parameters and instructions】

Auxiliary parameter: **P342**: M87 communication delay (ms)

P342 is the delay time from communication completion to APO control signal output.

Auxiliary parameter: **P343**: M87 communication address (decimal system)

P343 is the communication address of the inverter to which the system sent angle Q during the execution of M87.

For example, the communication address of the inverter is H1202 (hexadecimal system), change it to decimal system: （1×4096）＋（2×256）＋（0×16）＋1＝4609, so the P343 should be set to 4609.

When P343 is 0, M87/M88 is invalid while M47/M48 is valid; When P343 is 99999, during the execution of M87, communication is skipped (See the execution process of M87). When P343 is neither 0 nor 99999 (its range is 0~99999), M87/M88 is valid while M47/M48 is invalid;

【M87/M88 code format and instructions】

M87 Q_	; Performs orientation and check whether it is finished; go to the next command if yes.
M87 Q_ H1	; Performs orientation and does not check whether it is finished; the system can execute other commands and check the orientation later.
M87	; Check whether the orientation is finished; go to the next if yes.
M88	; Cancel the orientation signal and exit form orientation state.

Instruction:

1） M87 Q is the combination of M87 Q H1 and M87 .

2）The value range of Q is（-360.000～+360.000）; 0 is positive direction, 360.000 equals to 0.

3）The symbol in front of Q represents the rotation direction during spindle orientation. The angle is the absolute value of Q.

【**M87/M88 execution process**】

The execution process of M87 Q or M87 Q H1 is:

① Sents message according to ModBus communication protocol, and waits the delay time set by P342; (if P343 is 99999, or a same value equal to Q has been sent before, this step is skipped); Re-sent the message if the communication fails.

② Outputs orientation enable signal APO, and waits delay time 10ms.

③ If the spindle is in M05 state, the signal is output according to the symbol of Q: When Q≥0, M03 signal is output; when Q＜0, M04 signal is output; (if there is no reverse rotation signal, M03 is output regardless the state of M04.

④ If M87 is followed by H1, the execution is finished; otherwise, the system goes to next step.

⑤ After 10ms delay time, check orientation completion signal API.

⑥ The execution is finished.

The execution process of M87: (without parameter)

① Check orientation completion signal API;

② The execution is finished.

The execution process of M88:

Exit from M87 orientation mode if it was:

① Cancels M03/M04 signal, waits 6ms delay time;

② Cancels orientation enable signal APO, waits 6ms delay time;

Skip the above steps if the system was not in M87 orientation mode:

Instruction:

1) After the execution of M87, the orientation enable signal APO and spindle CW/CCW signal are the same, so during the continuous execution of M87, the CCW signal will be automatically OFF.

2）In orientation mode, the CW/CCW indicator on the panel is ON/OFF according to the output signal, regardless the spindle rotation state.

3）The spindle is in orientation mode after the execution of M87, so the spindle operation is forbidden; press EMERGENCY STOP., the system will exit from orientation mode, while RESET key has no effect on it.

4）During the execution of M87, if RESET or EMERGENCY STOP is pressed, the system will exit from M87 state.

5）During communication, if the timeout or abnormality happens, try again later.

6）In M88 state, M87 detection is invalid.

【**Alarms and prompts during the execution of M87/M88**】

The following two alarms may occur:

1） Spindle operation is forbidden in M87 state;

2） M87/M88 function is unavailable;

The following prompts may occur:

1) “Connection abnormal”: after signal is sent, abnormal response occurs; it may be caused by incorrect setting of P343 or other interferences.

2） “ Unconnected, no response”: after the signal is sent, no response is received; it may be caused by circuit failure or wrong communication baudrate.

3) “ Re-connecting…”: the system is trying to re-sent the signal.

【Spindle state prompt】

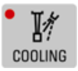
1) Red represents the state of M03/M04: Spindle orientation is being executed (under the command of M87 Q H1, it may be finished);

2）Blue represents the state of M05: The spindle is in orientation state and orientation has been completed.

3）Normal color: The spindle has exited from orientation state.

4.4.4 Cooling control

In JOG working mode, directly operate the function on the panel or input M08/M09 to control the cooling ON/OFF.

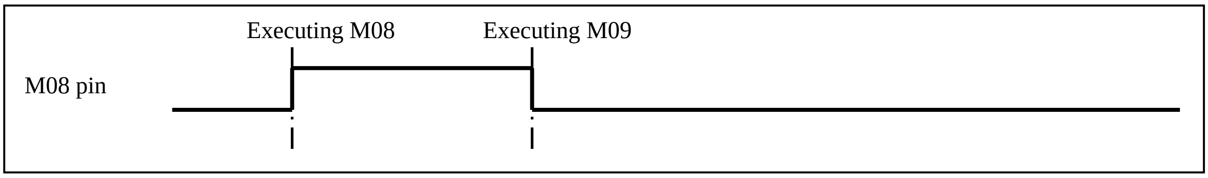
Press 

to switch cooling ON/OFF; the State icon on the screen and LED indicator indicate its corresponding state.

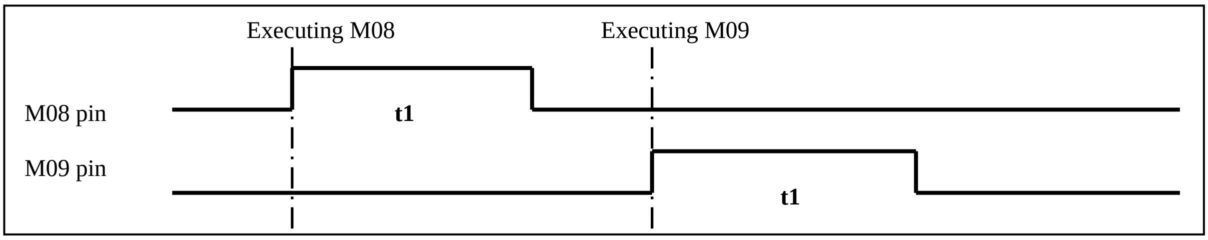
Input: M 8 ENTER ; cooling ON.

Input: M 9 ENTER ; cooling OFF.

1） In level control mode, M8, M9 output time sequence: (it is used to others when M9 does not output)



2) In pulse control mode, M8, M9 output time sequence:



t1：in pulse control mode, M08, M09 output hold time is set by P326.

【Relative parameter】

P410_d7: **P410_d7=1:** the system pulse output controls the cooling; **P410_d7=0:** the system level output controls the cooling. The bit parameter shares with the spindle controlling output bit parameter.

4.4.5 Manual tool change control

In JOG working mode, the operator can directly operate the tool change function key on the operation panel or input T command to execute the tool change control.

◆ Tool change function operation

Press 

once, and the tool post rotates to the next tool number, and the system displays the corresponding tool number (is set to "Confirm" and the operator presses <u>ENTER</u> to execute the operation).

◆ Input format of T command

The standard format of the tool function field consists of T+4-digit, the first 2-digit is the tool number, and the second 2-digit is the tool offset number. It is not necessary to input the complete 4-digit or to use the 2~4-digit.

【Format】

Txx ____ the first 1-digit is the tool number, the second 1-digit is the tool offset number;

Txxx ____ the first 1-digit is the tool number, the latter 2-digit is the tool offset number;

Txxxx ____ the first 2-digit is the tool number and the second 2-digit is the tool offset number.

【Explanation】

Tool number range is decided by P319 (max. tool number: 1～16; when P319 is 4, the tool number range is 0～4.

The input tool number is 0, which means the system keeps the current tool number.

The offset number range: 0～64; the input tool offset number is 0, which means the system cancels the offset.

【Example】

Input: <u>T</u> <u>4</u> <u>6</u> <u>ENTER</u> , execute No. 4 tool and No. 6 offset

Input: <u>T</u> <u>3</u> <u>0</u> <u>ENTER</u> , execute No. 3 tool and cancel the offset

Input: <u>T</u> <u>0</u> <u>6</u> <u>ENTER</u> , keep the current tool and execute No. 6 offset

Input: <u>T</u> <u>8</u> <u>1</u> 2 <u>ENTER</u> , execute No. 8 tool and No. 12 offset

Input: <u>T</u> <u>4</u> <u>0</u> <u>5</u> <u>ENTER</u> , execute No. 4 tool and No. 5 offset

Input: <u>T</u> <u>0</u> <u>6</u> <u>0</u> <u>8</u> <u>ENTER</u> , execute No. 6 tool and No. 8 offset

Input: <u>T</u> <u>0</u> <u>0</u> <u>ENTER</u> , do not execute the tool exchange and cancel the offset

Input: <u>T</u> <u>0</u> <u>4</u> <u>0</u> <u>ENTER</u>; keep the current tool and execute No. 40 offset

【Note】

1) Example: inputting T400 means the system executes No. 4 tool change and cancels the offset.(note: cannot input T040).
2) When the electromotive tool post is failure, the system displays "Check tool signal overtime", which means the system cannot find the corresponding tool number in the specified time.
3) The system uses the absolute too change mode, each position on the tool post is fixed when the system uses the electromotive tool post, the operator confirms the tool number on the tool post to be consistent with the one displayed on the screen.
4) Set P318 to 0, and there is no tool change signal output in selecting the line-up tool post.

5) There are two options for tool offset: move the machine slider or change coordinate system. The method is set by parameter P403_d6.

P403_d6 is set to 1: when tool offset is performed, the slider is moved and coordinates are not change;

P403_d6 is set to 0: when tool offset is performed, the slider is not moved and coordinates are changed.

6) Set **P403_d6** to 1, move the machine slider but do not change the coordinates in executing the offset.

Set **P403_d6** to 0, modify the coordinate display instead of moving machine slider.

7) When the tool change is failure or is broken in the tool change(reset, emergency stop), the system confirms the tool is in the unconfirmed position and prompts the tool number flashing in red, at the moment, the operator cannot start the machining program; the system can recover the normal state when it executes one successful tool change operation and it is turned on again.

8) When the system executes the tool change and the target tool number is the current one, the system does not execute the tool change output operation but modifies the offset except for the followings:

- After the tool change is failure, the tool displaying the red flash means that the displayed tool number is not consistent with the actual tool; when the target tool number in next executing the tool change is the current one, the system executes one tool change;
- After the system is turned on and executes the first tool change, and when the target tool number is the current one displayed by the system, the system executes once tool change.

◆ Execution process and signal output time sequence of T command:

The system has many tool change methods and the detail is referred to **CONNECTION, 3.4 Tool Change Control Function and Connection**.

4.4.6 Manual tool setting operation

Machining one workpiece needs several different tools. Because of the tool installation and tool shape deviation, its tool nose position is not complete consistent and has some offset when each tool rotates to the cutting position,

Tool setting is called that the system automatically memorizes the Offset to the specified tool Offset number.

After the tool setting, the operator is only based on the part drawing and machining technology to compile the workpiece program without considering the tool deviation, and only specifies the corresponding Offset number in the tool change in machining program.

The offset table can record 64 groups of tool offset, each tool offset number corresponds to one group from 1～64. Each group separately records Z offset, X offset, tool radius, imagery tool nose number and tool setting record (refer to offset working mode).

Modify the specified Z offset, X offset and tool setting in the tool setting operation. Fill in advance the tool radius, imaginary tool nose number because the system must refer to them in tool setting, otherwise, which causes the unexpected result (when the system uses the ball tool, tool radius, imaginary tool nose number should be set to 0. Refer to OFFSET working mode.)

Tool setting record is the system executes the tool setting of the Offset number, it automatically records the current Tool number. For the safety, the system scans the workpiece by the tool setting record. Example: the tool setting is T0409, and the workpiece program has T0309, which is not consistent with the Tool setting record and which is danger, and the system pops-up the alarm message.

【Notes before tool setting】

1) According to the above, confirm the Offset to the Offset number, and confirm the content of Imaginary tool nose number in advance.

2) For the same tool nose, memorize Z offset value and X offset value to the same one offset number, otherwise, it causes the serious result.

3) Generally, it is better to use the sequence for No. 1 Offset number with No. 1 tool, No. 2 Offset number with No. 2 tool, which is convenient to memorize them.

4) Firstly execute the Offset number, and then tool setting. Example, firstly execute the T49 command when the system memorizes the Offset in No. 4 tool to No. 9 Offset number.

5) The system executes the tool setting when the workpiece coordinate system is normal, otherwise, the result is not correct.

The system has the trial cutting tool setting and fixed-point tool setting as follows:

◆ **Trial tool setting method(method 1):**

【Format】

Input: **I** MEASURED VALUE ENTER [TOOL OFFSET NUMBER] ENTER. Modify the current X tool nose coordinate into the new one.

Input: **k** MEASURED VALUE ENTER [TOOL OFFSET NUMBER] ENTER. Modify the current Z tool nose coordinate into the new one.

【**Actual operation steps of tool setting as follows:**】

Install the trial cutting workpiece on the machine, execute the toolset ting operation of each tool through the above process till the tool setting of all tools are performed. The operation is fast and convenient when a tool is regulated.

1. X tool setting:

1) Install the trial workpiece reliably on the machine, and select a tool (usually select the first one used in machining).

2) Select the proper spindle speed, and then start the spindle. Traverse the tool in JOG Working mode, and cut a small sidestep of the workpiece.

3) X does not move but Z does to the safe position, and stop the spindle. Measure the diameter of the cut sidestep.

4) Press **I** , and the system displays **Tool setting X** ; input the measured diameter vale and press ENTER.

5) The system prompts **Confirm tool offset number：XX** ; it automatically presets one offset number, and the operator directly presses ENTER when the offset number is consistent with the input. Otherwise the operator presses ENTER after inputting offset number. The system automatically counts X tool offset value and stores it to the specified offset number.

2. Z tool setting:

1) Start the spindle again, traverse the tool to cut a small sidestep of the workpiece.

2) Z does not move but X does to the safe position, and stop the spindle.

3) Select one point as the reference point, measure Z distance from the cut end face to the selected reference point.

4) Press K and the system display Tool setting Z to input the measured data, and press ENTER.

5) The system prompts **Confirm tool offset number：XX** ; it automatically presets one offset number, and the operator directly presses ENTER when the offset number is consistent with the input. Otherwise the operator presses ENTER after inputting offset number. The system automatically counts X tool offset value and stores it to the specified offset number.

◆ **Trial cutting tool setting method (method 2):**

【**Operation step as follows:**】

1. X tool setting:

1) Install the trial workpiece reliably on the machine, and select a tool (usually select the first one used in machining).

2) Select the proper spindle speed, and then start the spindle. Traverse the tool in JOG Working mode, and cut a small sidestep of the workpiece.

3) X does not move, the operator presses and the system automatically memorizes the tool nose position, and displays the tool setting icon flashing; and then X moves out the safe position and the spindle stops rotating. Measure the diameter of the cut sidestep.

4) Press I and the system display Tool setting X to input the measured data, and press ENTER

5) The system prompts **Confirm tool offset number：XX** ; it automatically presets one offset number, and the operator directly presses ENTER when the offset number is consistent with the input. Otherwise the operator presses ENTER after inputting offset number. The system automatically counts X tool offset value and stores it to the specified offset number; the system automatically cancel the tool setting icon.

2. Z tool setting:

1) Start the spindle again, traverse the tool to cut a end face of the workpiece.

2) Z does not move, the operator presses ⇦ and the system automatically memorizes the tool nose position, and displays the tool setting icon flashing; and then Z moves out the safe position and the spindle stops rotating.

3) Select one point as the reference point, measure Z distance from the cut end face to the selected reference point.

4) Press K and the system display Tool setting Z to input the measured data, and press ENTER. The system prompts **Confirm tool offset number：XX** ; it automatically presets one offset number, and the operator directly presses ENTER when the offset number is consistent with the input. Otherwise the operator presses ENTER after inputting offset number. The system automatically counts X tool offset value and stores it to the specified offset number.

【Explanation】

1) In tool setting icon flashing, the operator can execute the spindle start/stop, the coordinate moving; in tool change, the system automatically cancels the tool setting icon and does not memorize the previous tool setting point.

2) Without the tool setting icon, the operator directly presses **K** or **I** , and the system takes the current point as the tool setting point.

◆ **Fixed-point tool setting mode:**

Find one reference point on the machine or the workpiece. First set the reference point coordinates (Z, X). Move all tool nose to the reference point to get the coordinates, and the system automatically memorizes the tool Offset value. The tool setting method is called the fixed-point tool setting. i.e. execute "MDI reference point coordinates" or "Modify reference point coordinates" to confirm the coordinates; and then move the tool nose to the reference point, and execute "Fixed-point tool setting" to complete the tool setting.

【Press **hp1** to execute the fixed-point tool setting operation】

1) Inputting reference point coordinates::

Input the current tool nose coordinates as the reference point coordinates; use the method when the operator does not know the reference point coordinates and confirms the tool nose coordinates of the current tool. Move the tool nose to the reference point, execute "Input reference point coordinates", i.e. the MDI operation is completed, and the system automatically saves the current tool nose point coordinates as the reference point coordinates. When the tool is damaged or some tool is installed, any one which has executed the tool setting can be taken as the reference point.

2) Modify reference point coordinates:

Input Z/X reference point coordinates and press ENTER, and the reference point coordinates are modified; generally, use the method when the operator knows the reference point coordinates.

3) Fixed-point tool setting:

Move the tool which needs the tool setting to the reference point, execute "Fixed-point tool setting", press ENTER, i.e. the system completes the tool setting operation of the current tool and automatically creates the tool offset.

【Note】

1) When the system uses the optical tool setting instrument, it must not start the spindle to place the tool setting point to the intersection of tool setting instrument, other operations are the same.
2) The system automatically creates the tool offset which can be displayed and modified in OFFSET working mode. Refer to OFFSET working mode.
3) When the system uses the line-up tool setting, and the tool is at the side of one workpiece, the input X measured value should be negative in trial cutting tool setting.

4.4.7 Hydraulic chuck control function

◆ Chuck operation

In JOG working mode, input M10/M11 to control the chuck clamping/releasing.

Input: M 1 0 ENTER ; chuck clamps. The system displays the spindle state.

Input: M 1 1 ENTER ; chuck releases.

Input: M 1 2 ENTER ; cancel the chuck control signal. (use M12 for special chuck device).

【Relative parameters】

P409_d7= 0: the system has the hydraulic chuck control function.

P402_d5=0: interlock between the hydraulic chuck control and the spindle control.

P402_d4=0: the consecutive check of the chuck respond signal is close;

P402_d4=1: the consecutive check of the chuck respond signal is open

P409_d6=0: the hydraulic chuck is outer;

P409_d6=1: the hydraulic chuck is inner.

P409_d5=1: the hydraulic chuck needs the respond check; it is green when the respond signal is normal, otherwise, it is yellow.

P409_d5=0: the hydraulic chuck does not need the respond check.

P409_d3=0: the hydraulic chuck control signal is controlled by the level;

P409_d3=1: the hydraulic chuck control signal is pulse control; the pulse width is defined by **P327** time.

P409_d1=0: the hydraulic chuck foot switch input is valid; **P409_d1**=1, the hydraulic chuck foot switch input is invalid.

◆ Execution process of chuck command:

In outer chuck mode, After M10 is executed, the system outputs the chuck clamping signal from M10 pin (the output pulse or the level signal is selected by the parameter) and the chuck clamping operation ends without needing the respond check signal; when needing the respond signal, the system waits the chuck clamping in-position; after it has checked the chuck clamping in-position signal (interface pin RM10 is at low level and RM11 is at high level) in the set time (P329: M responds check time specifying), otherwise the system prompts "**Alarm for chuck clamping respond check overtime**";

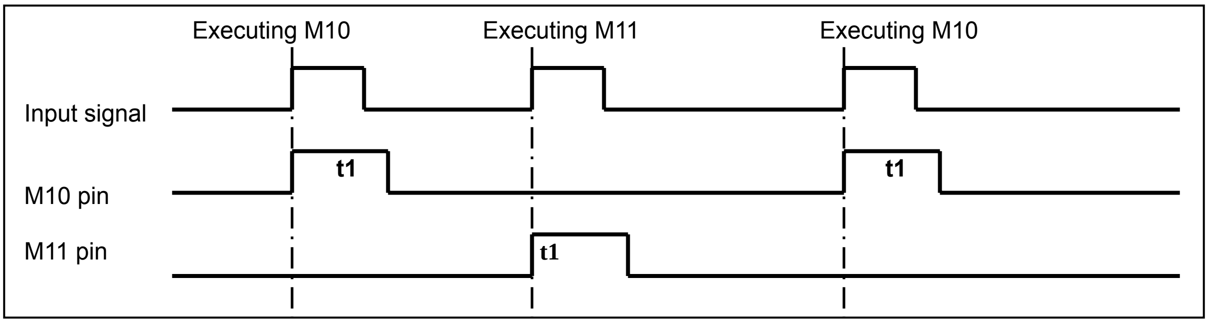
After M11 is executed, the system outputs the chuck releasing signal from M11 pin (the output pulse or the level signal is selected by the parameter) and the chuck clamping operation ends without needing the respond check signal; when needing the respond signal, the system waits the chuck releasing in-position; after it has checked the chuck releasing in-position signal(interface pin RM11 is at low level and RM10 is at high level) in the set time (P329: M responds check time specifying), otherwise the system prompts "**Alarm for chuck releasing respond check overtime**";

In inner chuck mode: after M10 is executed, the system outputs the chuck clamping signal from M11 pin; after M11 is executed, the system outputs the chuck releasing signal from M10 pin, which is opposite to the output pin in the outer chuck mode, and others are the same.

Besides using commands, the external foot switch also can control the hydraulic chuck. The system switches the chuck clamping/releasing by M10/M11 when the foot switch is stepped once. "Chuck foot switch" releases before the system is switched from other working mode to JOG or AUTO working mode, otherwise, the system alarms.

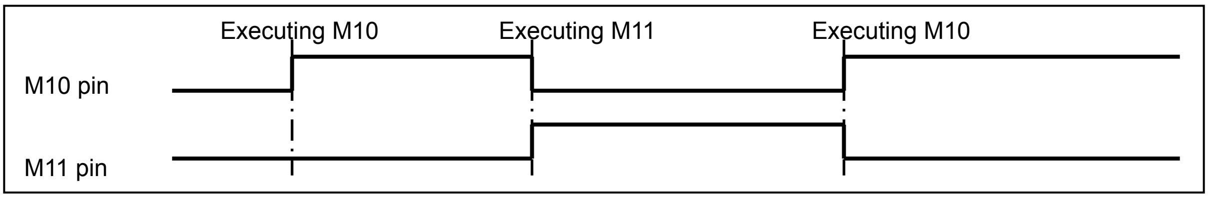
◆ Time sequence of hydraulic chuck control signal output:

1) M10, M11 output time sequence in pulse control mode:



t1：M10, M11 signal output hold time is set by P327 in pulse control mode;

2) M10, M11 output time sequence in level control mode:



【Note】

1) When the hydraulic chuck control is valid, the system defaults the chuck releasing after power on or emergency stop, the first control input of chuck is valid and the system outputs the signal of chuck clamping.
2) When it is the interlock protection between the chuck and the spindle: in the spindle running, the system forbids operating the chuck, otherwise, it alarms; in the chuck releasing, the system forbids starting the spindle, otherwise, it alarms.
3) In automatic continuous run, the foot switch operation is invalid no matter what the spindle rotates.
4) When the chuck operation is failure or interrupted(reset, emergency stop), the system takes the chuck is in the unconfirmed position, prompts the chuck flashing in red (M10 or M11), at

the moment, the system cannot start the machining programs; the system recovers the normal state when the chuck operation is executed once again or the system is turned on again.

5) The chuck respond signal consecutive check is to continuously check whether the chuck abnormally releases in the normal or machining state. If the above is set the alarm(**P402_d4**=1), the system stops the program machining and closes the spindle when the chuck releases in machining.

6) When the chuck signal cancels (M12), the chuck state (M10 or M11) is displayed with the underline, i.e. M10 M11.

4.4.8 Hydraulic tailstock control function

◆ Tailstock operation

In JOG working mode, input M78/M79 to control the tailstock forward/backward.

Input: M 7 8 ENTER ; the tailstock goes forward.

Input: M 7 9 ENTER ; the tailstock goes backward.

Input: M 8 0 ENTER ; cancel the tailstock control signal. (use M80 for the special tailstock device).

【Relative parameters】

P409_d4 is set to 0: the system has the hydraulic tailstock control function.

P402_d3=0: interlock between the hydraulic tailstock control and the spindle control.

P402_d2=0: the consecutive check of the hydraulic tailstock respond signal is close;

P402_d2=1: the consecutive check of the hydraulic tailstock respond signal is open

P409_d2=0: the hydraulic tailstock control signal is the level;

P409_d2=1: the hydraulic tailstock control signal is pulse control; the pulse width is defined by **P328** time.

P409_d0=0: the hydraulic tailstock foot switch input is valid;

P409_d0=1: the hydraulic tailstock foot switch input is invalid;

◆Time sequence of execution process and signal output of tailstock command:

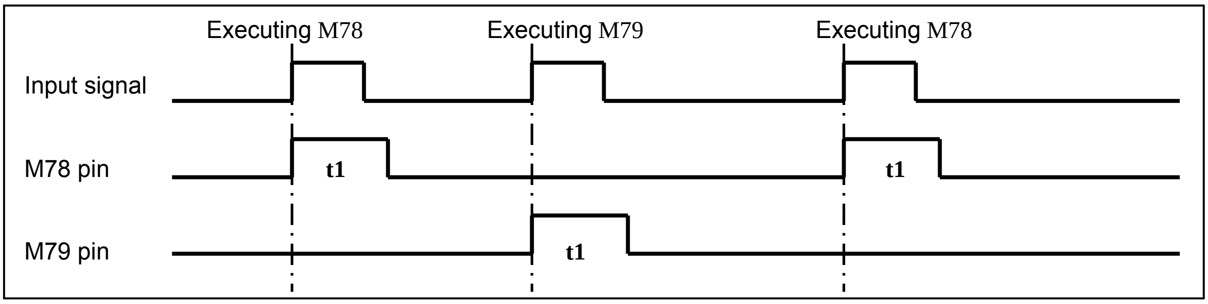
Define RM78 or RM79 in P519, P520 when the tailstock in-position signal is needed to check. After M78 is executed, the system outputs the tailstock forward signal from M78 pin (the output pulse or the level signal is selected by the parameter) and the tailstock forward operation ends without needing the respond check signal; when needing the respond signal, the system waits the tailstock forward in-position; after it has checked the tailstock forward in-position signal (interface pin RM78 is at low level and RM79 is at high level) in the set time (P329: M responds check time specifying), otherwise the system prompts "**Alarm for tailstock forward in-position respond check overtime**";

After M79 is executed, the system outputs the tailstock backward signal from M79 pin (the output pulse or the level signal is selected by the parameter) and the tailstock backward operation ends without needing the respond check signal; when needing the respond signal, the system waits the tailstock backward in-position; after it has checked the tailstock backward in-position signal (interface pin RM78 is at low level and RM79 is at high level) in the set time (P329: M responds check time specifying), otherwise the system prompts "**Alarm for tailstock backward in-position respond check overtime** ";

Besides using commands, the external foot switch also can control the hydraulic tailstock. The system switches the forward/backward by M78/M79 when the foot switch is stepped once.

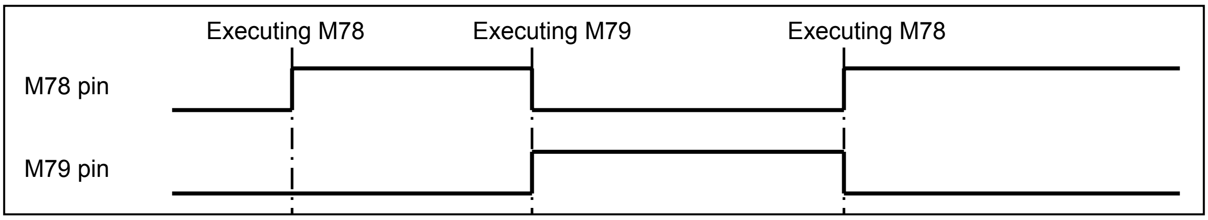
"Tailstock foot switch" releases before the system is switched from other working mode to JOG or AUTO working mode, otherwise, the system alarms normally.

1) M78, M79 output time sequence in pulse control mode:



t1：M78, M79 output hold time is set by P328 in pulse control mode;

2) M78, M79 output time sequence in level control mode:



【Note】

1) When the hydraulic tailstock control is valid, the system defaults the tailstock backward after power on or emergency stop, the first control input of chuck is valid and the system outputs the signal of tailstock forward.
2) When it is the interlock protection between the tailstock and the spindle: in the spindle running, the system forbids operating the tailstock, otherwise, it alarms.
3) In automatic continuous run, the tailstock control input is invalid no matter what the spindle rotates.
4) When the tailstock operation is failure or interrupted(reset, emergency stop), the system takes the tailstock is in the unconfirmed position, prompts the tailstock flashing in red (M78 or M79), at the moment, the system cannot start the machining programs; the system recovers the normal state when the tailstock operation is executed once again or the system is turned on again.
5) The tailstock respond signal consecutive check is to continuously check whether the tailstock abnormally releases in the normal or machining state. If the above is set the

alarm(**P402_d2**=1), the system stops the program machining and closes the spindle when the chuck releases in machining.

6) When the tailstock signal cancels (M80), the tailstock state (M78 or M79) is displayed with the underline, i.e. M78 or M79.

4.4.9 Other option functions

Option function is the non-standard pin input/output control.

When the system needs some function, the operator defines its pin in the interface parameter and correctly connects with the wirings. The detailed interface parameter definitions are referred to ***OPERATION 4.6 Parameter Working mode***; the detailed wiring connection is referred to ***CONNECTION Chapter 3 CNC Device Connection***.

【Warning】

Pin definition must be performed by the machine manufacturer; the improper definition maybe damage the system and the machine electricity.

4.4.9.1 Three-color indicator control

When the system needs the function, the operator should define its output pin in the interface parameter and correctly connects with wiring; the system output the signal in the corresponding pin.

P502：LMP3：green lamp (program run signal indicator 3);

P503：LMP2：yellow lamp (Alarm lamp control signal 2) ;

P504：LMP1：red lamp, alarm lamp (Alarm lamp control signal 1) .

【Functional description】

1) It is valid in JOG /AUTO working mode; in other working modes, it is invalid.
2) The green indicator light means the program normally runs.
3) The green indicator closes and the red lights when the system alarms.
4) The red and green indicators close and the yellow indicator lights when the program stops running without alarm.

4.4.9.2 Lubricating control

When the system needs the function, the operator should define its output pin in the interface parameter and correctly connects with wiring; the system output the signal in the corresponding pin.

P506：M320： lubricating controls the output signal.

【Functional description】

1) Non-auto lubricating:

P330 is set to 0: non-automatic lubricating is controlled by the command about the lubricating ON/OFF.

In JOG /AUTO working mode, input lubricating ON/OFF M32/M33 is valid.

After M32 is executed, lubricating outputs; after M33 is executed, the lubricating output is cancelled.

2) Automatic lubricating:

It is the automatic lubricating at regular time when P330 is set to other except for 0.

The system can set Lubricating starting time and Lubricating interval time. After the system is turned on, it executes the lubricating in the time set by P330, then stops the output, executes the cycle lubricating after the set time is performed. In automatic lubricating, M32, M33 are invalid.

【Note】

When the system starts the automatic lubricating function, P330 and P331 values are more than 1s; when they are less than 1s, the system takes them as 1s.

4.4.9.3 Machine electricity delay power-on control

When the system needs the function, the operator should define its output pin in the interface parameter and correctly connects with wiring; the system output the signal in the corresponding pin.

P505：**MDLY**： machine electricity delay power-on control signal.

【Functional description】

When machine electrical power-on delay control signal is defined in interface parameters, the system will wait 3s delay time after power-on, and outputs that signal from self-defined pins. The operation keys are invalid during the 3 seconds.

4.4.9.4 External MPG operation

When the system needs the function, the operator should define its output pin in the interface parameter and correctly connects with wiring; the system output the signal in the corresponding pin.

Relative parameter: when **P400_d1** is set to 1, the external MPG control knob is valid, Y/Z axis option key, step width regulation key are invalid.

In JOG working mode, press MPG to switch to MPG mode, the indicator lights and the system displays the external MPG control knob, axis option knob and movement knob state. The coordinates of selected coordinate axis is displayed in highlight.

Simultaneously display the external MPG icon on the screen.

1) Axis option knob of MPG:

WsZ external MPG axis option Z: select Z when it is connected;

WsX external MPG axis option X: select X when it is connected;

WsY external MPG axis option Y: select Y when it is connected;

When WsZ , WsX , WsY are not connected, the system cancels the coordinate axis in the highlight state; the MPG is invalid.

2) Each movement knob of MPG graduation:

Wbk1 external MPG override 1: when it is connected, the system selects 0.100 gear; (when the parameter setting the gear is invalid, it is 0.001 gear);

Wbk2 external MPG override 2: when it is connected, the system selects 0.010 gear;

Wbk2 and Wbk1 are not connected, the system selects 0.001 gear;

3) MGP emergency stop button:

Wsp external MPG emergency stop signal: the system should use the normally-closed contact; the function is equal to the system ESP signal.

4.4.9.5 Safety door check function

When the system needs the function, the operator should define its output pin in the interface parameter and correctly connects with wiring; the system output the signal in the corresponding pin.

P511：**SAGT**： safety door check signal.

【Functional description】

1) SAGT is connected with 0V, CNC confirms that the safety door closes;
2) In AUTO Working mode, the system alarms Alarm for safety door not be closed” when it has checked that the safety door opens.
3) In automatic run, when the system has checked the safety door has opened, the axis feed stops, the cooling closes and the system alarms;
4) The safety door check function is valid in AUTO working mode.

4.4.9.6 Pressure low alarm check function

【Relative parameters】

P412_d5=1: pressure low check function. **P412_d4** sets pressure low alarm level; **P412_d4**=1: low level alarm, **P412_d4**=0: high level alarm.

P332 sets the durable pressure low alarm time.

【Functional description】

1) When the system selects the pressure low alarm check function, it displays the press check icon at right-hand side in JOG Working mode and AUTO working mode, the icon is green solid triangular▲ when the pressure is normal. Once the system has checked that pressure low alarm signal PRES is valid, the durable pressure low alarm time is not more than the half of the set time by P332, the icon is a yellow hollow triangular△; when the pressure low durable time exceeds the half, the icon is a red hollow triangular △ and the system alarms “Pressure low alarm “ ; at the moment, the axis feed pauses, the spindle stops rotating and the automatic cycle cannot start;
2) After the system creates “Pressure alarm”, the operator press RESET and system clears out the alarm and counts the time again to check the pressure low alarm signal;
3) After the system is turned off, the system counts the time to check the pressure low alarm signal.

4.4.10 Searching run message in JOG working mode

The detailed is referred to OPERATION, AUTO working mode 4.5.8.

4.4.11 Appendix:

4.4.11.1 MDI input controlling M command table MDI

◆ Execution M commands in JOG working mode:

Sort	Command	Function	Remark
Spindle control	M03, M04, M05	CW, CCW, stop	Function interlock, state keeping
Cooling ON	M08, M09	Cooling ON, OFF	
Chuck	M10, M11, M12	Clamping, releasing, canceling chuck output signal	
Lubricating	M32, M33	Lubricating ON, OFF	Function interlock, state keeping
Tailstock	M78, M79, M80	Tailstock forward, backward, cancel tailstock output signal	
Operator output 1	M21, M22		Function interlock, state keeping
Operator output 2	M23, M24		Function interlock, state keeping
Spindle gear	M41, M42, M43, M44	Spindle gear shifting gear 1, 2, 3, 4	Function interlock, state keeping
Operator customized command	M60 ~ M74		
Set the spindle working mode	M47, M48		

Note: When the operator inputs M command and the first digit is 0, it can be omitted. The command functions are the same those of AUTO Working mode. The detailed is referred to PROGRAMMING.

4.4.12 Spindle turn function

Manual tapping function is to manually turn the spindle and the selected coordinate axis links along the spindle to realize the tapping and thread run-out when the spindle stops.

In JOG working mode, the spindle stops stably. Press  and the system enters the spindle turn function state and prompts: "Inputting tapping axis (X/Y/Z)."

After pressing X/Y/Z to select the motion axis and pressing ENTER to enter the next operation, the system prompts "Input tapping pitch (mm))", input the pitch to press ENTER, the system enters the manual tapping state. At the moment, the operator can manually control the spindle rotation, and the tapping axis can rotate along the spindle rotation.

In manual tapping state, press ESC to exit the manual tapping state, the motion axis decelerates to stop when the tapping axis exits from the motion state.

【Functional description】

The function is valid in JOG working mode, the tapping in manual tapping state moves along the spindle rotation.

The axis motion speed is determined by the spindle speed and the pitch, the axis motion direction is determined by the pitch sign as follows:

When P is positive and the spindle turns CCW, the coordinate axis moves negatively; When the spindle turns CW, the coordinate axis moves positively

When P is negative and the spindle turns CCW, the coordinate axis moves positively; When the spindle turns CW, the coordinate axis moves negatively.

【Note】

1) When the speed in tapping is too fast or there is the limit alarm, the system automatically exits the tapping and alarms.

2) The pitch P is expressed with the metric, range: 0.001mm～500.000mm(the negative sign is added to the front of the range, i.e. "dextrorotaion" or "levorotation" tapping) .

3） Z/X/Y axis manual tapind speed is restricted by parameter P100, P101, P102 respectively.

4.5 AUTO Working Mode

In **AUTO** working mode, the relative setting or input format and example descriptions are as follows: the required input letter key, or digit key are expressed with the underline; the system prompts the message is expressed with the frame.

In AUTO working mode, the system displays at the top right. Press it and the system pops-up the operation key catalog in AUTO working mode; press it and the window closes; directly press other function keys, and the window automatically closes.

Press and the system enter AUTO Working mode. The system completes the part machining of the specified machining program in AUTO Working mode; the system runs from the first line of the selected workpiece program, and gradually executes till the program ends.

The system combines the operator parameter table, offset value to analyze and precheck the part programs. When the system prechecks the problem, executing the machining program causes the serious result and the system closes the Cycle start key. In the condition, pressing CYCLE START key is invalid and the system refuses to execute the program; the system can execute after the program or the parameter is modified according to the alarm message.

The system provides many part program execution modes, and the operator must set before running to get the safety of machining process.

◆ Main functions in AUTO Working mode:

1) Set **SINGLE/CONTINUOUS** run program
2) Set DRY RUN(without output) check run, and the system accelerates to execute the program in DRY RUN mode.
3) Precheck the **software limit alarm** before running programs
4) Set **blocks** and execute the middle of the program
5) Spindle, cooling press key control
6) Execute machining programs by **pause**, **block stop**, **end stop**, **cycle stop**
7) Tune **cutting speed override** proportion
8) Correct offset in execution process
9) Real-time state display of machine, pop-up window real-time alarm

◆ display content on screen as Fig. 4-7:

Upper Top: display the execution mode (**SINGLE/ CONTINUOUS**, **DRY RUN**), current program number, workpiece count, machining time; system function operation method prompt key ;

Left top: display tool nose coordinates and machine coordinates, or tool nose path graph or workpiece contour graph;

Left bottom: display machining block (pointer points to the current block);

Right middle: display the current state of machine, including spindle, cooling, lubricating, tool post, chuck, tailstock, speed, cutting speed and so on;

Pop-up window: display alarm message of execution program.

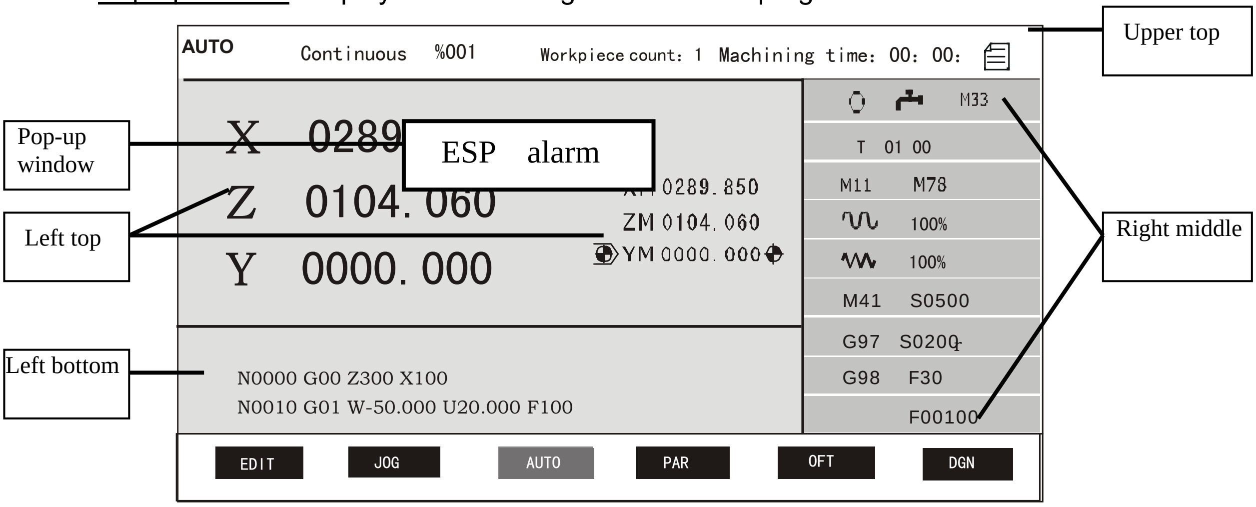


Fig 4-7 AUTO working mode

4.5.1 System working mode in AUTO working mode

In AUTO working mode, the system is in several mode according to execute workpiece programs; when the system is in different states, it permits the functions are different; there are several states as follows:

Initial state: it is the execution pointer of the program points to the first line but the system has not executed; the system is just now switched from other mode to AUTO Working mode to enter the initial state or returns the initial state after the program is executed or the system alarms.

Run state: the system is executing the block and the coordinate axis is moving.

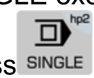
Pause state: the current block has not executed completely in the course of executing the axis motion command to pause; the system waits the operator presses the key to execute the operation.

Block stop state: the current block has been executed and the next has not executed, the system waits the operator presses the key to execute the operation.

4.5.2 Function key operation in AUTO working mode

4.5.2.1 SINGLE execution and CONTINUOUS execution switch

SINGLE execution and CONTINUOUS execution switch:

Press  and the system switches **SINGLE/CONTINUOUS** circularly; (it is valid in any states).

In continuous execution, press the key and the system switches to SINGLE working mode, after the current block is executed, the system stops, and continuously executes after CYCLE START is pressed.

In CONTINUOUS working mode, press CYCLE START, and the program is executed from the beginning to the end.

In SINGLE working mode, press CYCLE START key once and the system executes one block (for the cycle command, the system only executes one operation; press CYCLE START, and the system executes one operation).

4.5.2.2 Dry run and machining run switch

Check all content of machining programs in dry run, which can ensure the machining workpiece is not discarded because of some programming data error in the program.

Dry run/ machining run switch

Press  , and the system switches **dry run/automatic machining run** mode

In DRY working mode, whether M, S,T is valid is set by the parameter, coordinates of each axis automatically recover the previous before the Dry working mode.

Relative parameters in DRY Run working mode:

P401_d7：

0：When the system executes the miscellaneous command, it must output the signal, check the signal, which is the same that of the normal machining.

1：The system does not output the signal and check the signal when the system executes the miscellaneous command.

P401_d6：

0：The execution speed of feed command is set by the program, which is the same that of the normal machining.

1：The execution speed of feed command is not set by the program, max. speed (P113) of cutting feed displays the program path.

【Notes】

1) The dry run key is valid when the program is executed in the initial state. In the course of program execution, the key is invalid and cannot be switched when the program does not end and the system has not exited the execution state.

2) **P401_d7=0**: in DRY RUN working mode, all miscellaneous command M, S, T are executed; the system recovers to the previous state when it exits from the dry run state.

3) **P401_d7=1**: in DRY RUN working mode, the system does not output and check the signal when it executes the miscellaneous function; when the system executes T function, the tool offset number is executed (when the previous is T11, it becomes T13 after T33 is executed), the system recovers to the previous after it exits from the DRY RUN working mode.

4）In DRY RUN working state, all macro command and M60～M74 are normally executed; after the system modifies the offset and the system exits from the DRY RUN working mode, the tool nose coordinates of corresponding tool offset number are changed.

5）The workpiece counter does not automatically add 1 in DRY RUN working mode.

4.5.2.3 Switch between coordinate system and graph display

The function is valid in any states in AUTO working mode

The system enters AUTO working mode after it is turned on firstly, and it automatically selects the coordinate display.

In AUTO working mode, press T to switch coordinate display and graph display.

In graph display mode, press Z to switch tool path display and workpiece solid graph display.

4.5.2.4 Running a part program from the first block

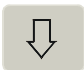
After entering AUTO working mode, the system enters the initial state, and the program pointer points to the first block of the current program, and CYCLE START key is pressed to start the program to automatically run.

The being executed block displays and flashes in poor color; the first line is the executed block, and the 3rd line is to be executed; when the machining program is the conditional command, the skip or call target is not well-defined, and the 3rd line may not be displayed.

4.5.2.5 Running a part program from a specified block

In some special conditions, it is necessary to start to run from some block in a part program. This system allows starting any one block of current part program. (it is valid in initial state)

1) Press INPUT, and the system pops-up the program browse window, displays the current program and the pointer points to the first block of program.

2) Pressing , , , , and the system displays the content of the top(down) block or up(down) page. Press ESC and the system exits from the selected and displays the previous block.

3) When the pointer points to the required block, ENTER is pressed and the system prompts "Run?" to wait the next execution.

4) At the moment, press CYCLE START and the system executes the program from the block pointed by the pointer; press ESC and the system exits the selection and the pointer points to the first block.

【Notes】

1) The specified block cannot be in canned cycles, compound cycle bodies or subprograms, otherwise there is the unexpected run. The system selects G00 or the tool change command before G00.

2) When the system runs the program from the specified block, the selected block should be the linear movement or S. M. T. When the system selects G02/G03/G05, the coordinates of the tool and the system must be placed on the starting point of arc, otherwise the machined arc may be not qualified.

3) In the course of program execution, press INPUT and the system pops-up the browse and forbids executing the selected block.

4.5.3 Displaying in a part program running

When the part program is running, this system displays the running state, the dynamic run coordinate, the workpiece planar solid graph, and the path of tool nose in the course of program running, which is very convenient to monitor the running state of the machine and the program.

The display as follows:

- The dynamic coordinates or the dynamic tool nose movement path graph or workpiece contour graph.
- Current block content.
- Spindle, cooling, lubricating, tool, speed, chuck, tailstock, and machine miscellaneous function state.
- Feedrate override, rapid override.
- Machining time.
- Workpiece count.

4.5.3.1 Graphic display data definition

Because the display area of this system is limited, the different scale is employed to display the whole graph of part. The length, the diameter of blank, the initial offset of tool and the display scale are defined by the system. Press  to define the above-mentioned data when the system is in initial state as Fig. 4-8:

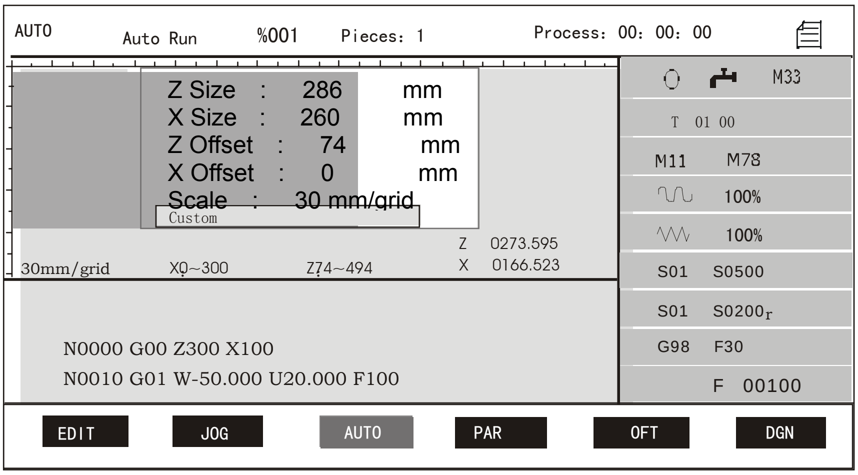


Fig. 4-8 graph display data definition

In graph display, the horizontal scale graduation line means Z coordinate dimension, the vertical scale graduation line means X coordinate dimension; firstly confirm the display graph area, the customized graph display area is as follow:

Z： (Z offset ～ Z offset +display proportion ×14) ;

X： (X offset ～ X offset + display proportion ×5×2) ;

Example：X：300 ← 600 Z：-200 ← 220

1) Intersection coordinates between Z scale graduation line and X scale graduation line are called Z offset and X offset(unit: mm).
2) Z scale graduation line is divided into 14.5 grids. X scale graduation line is divided into 5 grids, and each grid is divided into two small grids.
3) Each grid length is called the display proportion, the display proportion is to confirm the displayed workpiece shape proportion which is not related to the actual machining proportion.

4) When the workpiece dimension is too big, the system selects the proportion zoom in, when it is too small, the system selects the proportion zoom out to get the excellent display effect.

5) Actual range of X/Z offset: -9999~9999

After the system enters the part contour graph, the machining workpiece blank lengths of Z scale graduation line and X scale graduation line are Z length and X length (unit: mm):

Z: display proportion x Z grids of workpiece contour graph;

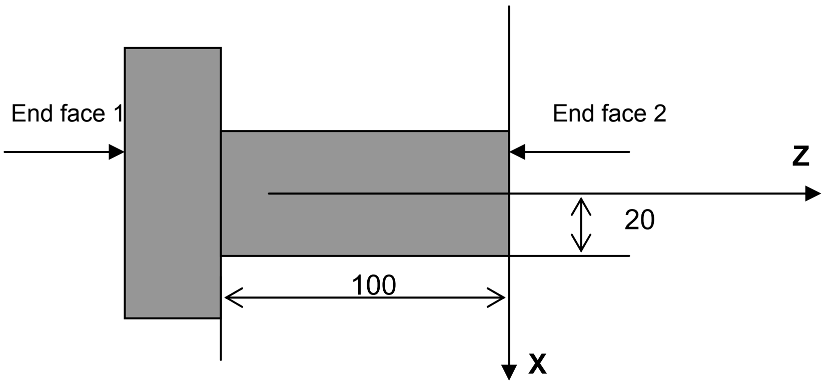
X: display proportion x X grids of workpiece contour graph x 2

The graph area is created by the customizing and the program. When the system the customizing, the length, the offset, and the proportion can be modified; when the system selects the program creation, they cannot be modified, at the moment, the area range preset by the system is the full graph of program motion path, the length, the offset and the proportion cannot be modified and the system enters the program setting execution state.

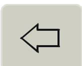
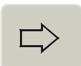
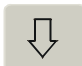
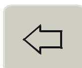
【Example】

Example: part blank length: 100mm; end face 2 is intersection of Z and X.

In the customizing mode, the set Z length is 100, X length is 40; Z offset is -100, X offset is 0; proportion is 10.



4.5.3.2 Inputting data of graph display

In AUTO working mode without motion, press  and the graph display data is as follows. Press  or  to select the graph area to be "Custom". press  or  to select the required modifying data. The system displays the previous defined displayed data is the following figure, and the cursor points to the required data to be modify. Press  to delete the previous data and input the data to modify.

Z size: 200 mm (blank)
X size: 200 mm (blank)
Z offset: -200 mm
X offset: -200 mm
Scale: 50 mm/grid
Custom program create

Fig. 4-9 graph data display

- Input data (without decimal point) and press ⇦ to delete the previous data, and then input the new data. Press ▤ continuously and the graph data displays the window cycle.

- Scale modification. When the cursor points to scale, press ⇦ or ⇨ to make the Scale to circularly reduce or enlarge.

  The system decided scale has 5, 10, 20, 30, 40, 50, 60, 70, 80, 90, 100, 200, 300, 400, 500, 600. The user can select the proper display scale to get the best effect according to the actual condition.

- Two kinds of selection of graph area: customizing and program creation. Press ⇦ or ⇨ to select them. When the system selects the program creation: the modified data becomes the changing state and the operator inputs the new data according to the need.

  After rewriting the data, press ESC or ENTER and the system returns to AUTO working mode, the system updates the displaying range of blank according to the set display data in the graphics display mode.

  When the set display data exceeds the screen displaying range, the system prompts X/Z overlimit, and the display data must be rewritten again.

【Notes】

1) To correctly display the tool path, the initial position of the tool should be out of the display range of the workpiece blank, otherwise, the system cannot correctly display the machining process.
2) In program running, when the coordinate display is switched to the planar solid, the system cannot normally display the workpiece shape until the next cycle start.

4.5.3.3 Machining workpiece count and timing

Workpiece count: when the program being executed once means the program ends (M02, M20, M30), the machining quantity count adds 1, and max. count range is 99999, and the count becomes 0 when it exceeds 0.

Machining time: record machining program execution time. When CYCLE START is pressed and the system executes the program, the timing does not end till the program ends. In running, the system pauses, and at the same time, the timing stops. In SINGLE working mode, the system only records the run time of each block. The system displays max. machining time range: 99 hours, 59 minutes and 59 seconds. When the machining time reaches the max. value, it automatically becomes zero and continuously runs program and executes the timing again.

Workpiece count and machining time clearing: in initial state, continuously press  twice and the workpiece count clears; continuously press  twice, and the machining time clears.

4.5.4 Manual operation of miscellaneous function

In AUTO working mode, press function keys to execute some miscellaneous function operation of the machine, and the other functions are the same in JOG working mode.

1) Cooling ON/OFF is valid in any states.

2) When **P400_d5** is set to 0, spindle CW, CCW, stop key are valid:(invalid in run state).

3) In initial state, the spindle gear shifting key(speed change key) is valid.

4) In initial state, when the hydraulic chuck control function is valid, the external button or foot switch controls the hydraulic chuck clamping/releasing which interlocks with the spindle.

5) In initial state, when the hydraulic tailstock control function is valid, the external button or foot switch controls the hydraulic tailstock forward/backward which interlocks with the spindle.

4.5.5 Speed override tune in AUTO working mode

4.5.5.1 Speed override tune

In AUTO working mode, the feedrate override and rapid override keys in any state are valid.

In AUTO working mode, the system can set the speed without changing the program and parameter. Change the program running speed by changing the speed override.

● **feedrate override** speed word F setting value in tuning the program:

Actual feedrate speed = Fx feedrate

The feedrate override has 16 gears 0%～150% (increment of 10%), all commands controlled by the feedrate is controlled by the feedrate override.

● **Rapid override** G00 rapid traverse command speed in tuning programs.

Z actual rapid traverse speed = P100×rapid override

X actual rapid traverse speed = P101×rapid override

Y actual rapid traverse speed = P102×rapid override

The rapid traverse override is divided into **25%, 50%, 75%, 100%**. All rapid traverse commands and the operations are controlled by the rapid traverse override.

Whether programs are running or not, pressing rapid override +/-, feedrate override +/- keys can change the speed override. The actual traverse speed of the machine slider changes if the speed override is changed when the programs are running.

In program running, the program stops running when the feedrate override is 0, the system prompts: **Feedrate override be zero.** The program continuously runs when the feedrate override is not zero.

4.5.5.2 MPG speed control

In AUTO working mode, using MPG controls rapid/feedrate override. **P402_d1**=1: MPG controlling rapid/feedrate override is valid, and the actual feedrate and the rapid speed are as follows:

Actual feedrate= F x feedrate override x MPG override

Z actual feedrate= P100 x rapid override x MPG override

X actual feedrate= P101 x rapid override x MPG override

Y actual feedrate= P102 x rapid override x MPG override

MPG override range：0% ~ 100%.

MPG controlling rapid/feedrate override:

◆ **method 1:**

When parameter **P402_d0=0**, the system enables MPG control rapid traverse/feedrate override in method 1; the system set the current position (A point) to 0% of MPG override. From point A to 100 scale, every 1 scale in CW direction means an increase of 1% of MPG override; every 1 scale in CCW direction means an decrease of 1% of MPG override.

◆ **Method 2:**

When **P402_d0**=1, the system enters MPG controlling rapid/feedrate override according to method 2; when MPG override is set 0%, MPG override changes along MPG CW rotation, MPG CW rotation becomes gradually fast, MPG override is regulated 0%~ 100%. To avoid machine to be impacted by uneven speed of MPG, and the regulation range is less than 10% every time. MPG stops after it CW rotates, MPG override becomes 0%. After MPG CW rotates and rotates CCW(or CCW rotates and then stops), MPG override keeps the CCW instant override till MPG CW rotates (CW rotates and then stops).

MPG controlling rapid/feedrate override explanation:

In AUTO working mode, before the machine program is not executed or the program pauses, single block stops, the cycle stops or the feed holds (including spindle/feed hold), 【MPG】indicator lights after pressing it means the system is in MPG controlling rapid/feedrate override. At right top, the yellow means MPG control mode and current MPG override. The system automatically cancels MPG controlling rapid/feedrate override mode after each program is executed.

【Note】

In the thread machining commands (G32, G33, G34, G92) , the feedrate is determined by the spindle speed instead of F value, and MPG override is invalid here.

4.5.6 Interference operation in program execution process

4.5.6.1 Press key interference in program execution

Interference operations in program execution:

EMERGENCY STOP: immediately stops not continuously start the execution.

PAUSE: press to continuously execute.

SINGLE BLOCK STOP: press CYCLE START to continuously execute the program after the block is completed and the system stops.

CYCLE STOP: press CYCLE START to continuously execute the program after the cycle is completed and the system pauses.

◆ **Pause**

1) Press CYCLE START and the system pauses in executing the command. After the system responds, each motion axis decelerates to stop, which Pause is displayed on the bottom-left.
2) In pause state, press CYCLE START, and the system recovers the program to continuously execute the left; press ESC, the program exits and the system returns to the auto Initial state, and the pointer points to the first block of the current program.

【**Notes**】

1) After the pause, the system can control the spindle, the chuck and the tailstock; before CYCLE START is pressed, ensure the spindle is started, the chuck and the tailstock have been ready, otherwise, which maybe damage the machine and hurt the persons.
2) When the system follows the blocks for the spindle machining thread in executing G32, G33, G34, G92, the press key is invalid.
3) For details about the pause or single block stop function, refer to Section 10.2.2 "Explanation of Customized Command Storage " in OPERATION.

◆ Single block stop

1) In continuously executing the program, press SINGLE and the system is switched to the single block execution mode, and when the current block is executed, the system displays Single block stop.
2) After the single block stops, press CYCLE START and the program continuously runs. Press ESC and the system returns to the auto initial state and the pointer points to the first block of the current program.

【**Note**】

1) In executing the fixed cycle command, the single block stop is valid after each step of the fixed cycle is completed.

◆ Cycle end stop

1) In continuously executing the program, press **hp6** and the system displays CYCLE STOP: ON , and the system displays CYCLE STOP after M20 is executed.

4.5.6.2 External feed hold knob

The external feed hold knob is valid in AUTO working mode.

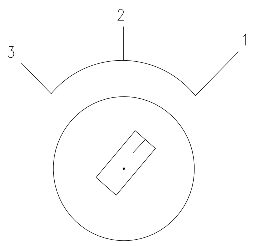
Whether the external feed hold knob is valid is controlled by **P412_d6**.

P412_d6=1: the system external feed hold knob is valid; the input signal is received by MXZ1, MXZ2.

P412_d6=0: the system external feed hold knob is invalid; the pin of input signal can be used as others.

◆ **feed hold knob introduction:**

The system has an external interface of feed/spindle hold knob. Move or stop the spindle and the slider when the knob is placed on the different position. Use the knob to control conveniently the starting/stopping of spindle and the slide in debugging the program. There are three positions of feed hold knob and its function as follows:



Note: see the specific symbol specification of feed hold knob from the machine manufacture.

Feed hold knob

Position 1: permit the spindle to rotate and the slider to traverse.

Position 2: permit the spindle to rotate and forbid the slider to traverse.

Position 3: forbid the spindle to rotate and the slider to traverse.

◆ **feed hold knob use:**

Before program running:

Press the correspond key to control the spindle starting/stopping when the feed hold knob is placed to the position 1 and 2; but the spindle cannot be started when it is placed to the position 3.

In SINGLE working mode:

When the knob is placed to the position 1, all commands run normally; when it is placed to the position 2, the control commands for spindle run but the motion commands of X, Z do not run until the knob is placed to the position 1, when it is placed to the position 3, no blocks run.

In CONTINUOUS run mode:

After the system starts programs, the feed hold knob can be rotated any time to control the spindle and the slider.

When the knob is placed to the position 1, programs run normally.

When the knob is rotated from 1 to 2, the slider stops and the spindle still keeps the previous state.

When the knob is rotated from 2 to 3, the spindle stops.

When the knob is rotated from 3 to 2, the spindle recovers the previous state.

When the knob is rotated from 2 to 1, the slider starts to run.

The system will automatically exits from the auto initial state after ESC or RESET is pressed in the course of the feed hold and the spindle stopping. The previous state of spindle and the unfinished commands cannot be reserved. Programs are restarted if the machining is executed continuously.

4.5.6.3 External start and pause signal

External cycle start/pause signal is valid in AUTO working mode. Whether the external start/pause signal is valid is controlled by **P412_7**.

P412_d7=1: the system external start/pause signal is valid; the input signal is received by ST, SP pin.

P412_d7=0: the system external feed hold knob is invalid; the pin of input signal can be used as others.

The external pause operation key signal (SP) has the same function with that of the feed hold key (cycle pause key) on the system panel; the external cycle start key signal (ST) has the same function with that of the cycle start key on the system panel. SP, ST are input to the system from the machine, and they are valid when the low level is connected.

Before the system is switched from other working mode to AUTO working mode, “External start button” and “External pause” button are released (power-off), otherwise, the system alarms.

The detailed circuit connection method is referred to **CONNECTION, Chapter 3 CNC Device Connection**.

4.5.6.4 Feed device alarm function

When the system needs the function, the input pin is defined in the interface parameter and is correctly connected; the system checks the signal on the corresponding pin.

P512： **Dalm：** feed device alarm check signal.

【Functional description】

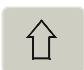
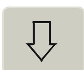
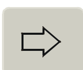
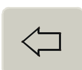
1) When the system checks the signal in M20, it automatically stops and alarms.
2) Use M02, M03 instead of M20 to terminate the program, the feed device alarm function is invalid.

4.5.7 Modifying offset in program run

The system pops-up the window to modify the offset value in machining and the operator must be careful.

4.5.7.1 Modifying offset method in program run

◆ Modifying offset method:

1) In automatic running, press OFFSET and the system pop-up the window to display the modifying offset, press it again and the system closes the window.
2) Press ,  or ,  to select the required modification tool offset number; press  and  to select the required modification tool offset, and the detailed operations are referred to **OPERATION, 4.7 OFFSET Working Mode.**
3) Press INPUT to input data. Press ENTER to replaces the previous data. Press ALTER to add on the previous data. Press ESC to cancel the input data.

4) Press OFFSET or press ESC to exit the offset display window after the input is completed.

【Notes】

1) During data inputting, you can switch to AUTO mode display page, and when you switch back, the original input data that have been stored by pressing key ENTER remain the same, you can continue to input data.

2) In offset display window, pause, modifying feedrate override operations are valid in AUTO working mode. In pause, the system can be switched to the offset display window to modify the offset.

4.5.7.2 Modifying tool compensation validity in program running

【Notes】

The modified offset data is valid when the system executes the tool change. When the modified is the offset data corresponding to the current tool offset number, the modified value is valid in the next tool change. When the modified is the tool compensation value corresponding to the unexecuted tool offset number, the modified value is value in this execution.

When the program has no the tool exchange command but the system has modified the offset value current tool offset number, after the system executes M02, M30, M20, "RESET" and stops, the modified offset is valid.

4.5.8 Searching run message in AUTO working mode

The function is valid in any states in AUTO and JOG working mode.

In automatically machining part programs, the system pops-up the window to search the macro variable, I/O variable and others in running process as follows:

Variable: search all common variable used in the program, and modify the common variable value;

I/O variable: search the interface variable value (i.e. the system interface state);

Others: search the executed block quantity, the spindle wave range in the thread machining, program nested call layers and program cycle in executing subprogram.

◆ operation method as follows:

1) In automatic running, press ⇧ and the system pops-up the window to display the variable, I/O variable and others), press ESC again and the system closes the window.

2) Press ⇧, ⇩ to select the required searching items and the selected item is displayed in black.

3) When there are many variables are searched, press ⇨ to select the variable(it is pointed by the pointer), at the moment, the macro variable cannot be changed; press ⇧ or

to search the front or the latter one macro variable; press or to search the variable in the page up or page down with 7 lines in each page; press to exit, at the moment, the macro variable is displayed in black.

4) In auto initial state, press ENTER and the common variable r100～r199 pointed by the pointer can be modified.

5) Press ESC to exit the display window.

【Explanation 】

1) Macro variable: display the running common variable edited to the program, including variable number, variable name, variable value and state. The variable value is displayed in the dynamic along the program changing in running, the number and variable name are sorted from the small to the big. Variable r001～r040 are displayed in brown, r041～r99 in orange, r100～r199 in green.

2) I/O variable: display in dynamic the interface state of current running program. Two kinds of state value of input interface variable: 0 (LOW) or 1 (HIGH); the external signal valid and the pin is connected with 0V in LOW; it is invalid in HIGH. The out interface variable state: when the system output "0", the external forms the conductive loop; when the system output "1", the system is in high-resistance, and the external cannot form the conductive loop. r1001～r1032 are the input interface states; r2001～r2032 are the output interface states; 8 groups to display, the first line displays the first group: r1008, r1007, r1006, r1005, r1004, r1003, r1002, r1001 and others is in order reason by analogy.

3) Others: search the executed block quantity, the spindle wave range in the thread machining, program nested call layers and program cycle in executing subprogram.

4) Before the system does not start the machining program, macro variable can be modified manually, the modification method is to select the required modification macro variable, the operator presses ENTER to input the value to change, presses ENTER again and the modification is completed.

5) See Chapter 9 "Statement Programming" for the explanation of variables.

4.5.9 Program reference point return in AUTO working mode

The function is valid in initial state of AUTO working mode

After the system sets the workpiece coordinate system and program reference point, it starts the machining program when the machine slider stops any position. At the moment, the first movement command of the machining program must be in G00, must execute X, Z absolute coordinate positioning. In the condition, press program zero return or G command and the system can return the set program reference point. After G command is executed, the machining is continuously executed, the system must use G00 two-axis absolute coordinate to position simultaneously to get the correct machining.

After the system returns to the program zero by manual press key, it automatically points to the first block of the program. At the moment, press CYCLE START and the system starts running the fist block.

4.5.10 System reset and emergence stop signal processing in AUTO working mode

1. Pressing reset key

1) The motion of all axes decelerates to stop;

2) Whether M function output is hold by the parameter setting (is controlled by **P403_d2**); after the automatic run ends, the modal function and the state keep.

2. Pressing emergency stop button

Press the emergency stop button in the danger or emergency stop condition in the machining running and the CNC immediately enters the emergency stop state, at the moment, the machine movement immediately stops, all output (spindle rotation, cooling) closes.

【Notes】

1) Confirm the fault has been resolved before the emergency stop alarm is released;

2) Press the emergency stop button to reduce the impact on the device before power-on and power-off;

3) After the emergency stop alarm is released, the system again executes the machine zero return to get the correct coordinate position (when the machine has not installed the machine zero, the system does not execute the machine zero return);

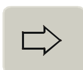
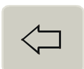
4) The emergency stop is valid when **P404_d7** is set to 0.

4.5.11 Regulating LCD brightness in AUTO, JOG working mode

The function is valid in the initial state in AUTO working mode.

◆ Operation method as follow:

1) Press continuously 9 twice and the system pops-up the brightness regulation window, any key except for the brightness regulation is pressed and the system closes the window.

2) The brightness regulation window has 0～10 grade: 0 grade is the darkest, 10 grade is the brightest; press the brightness regulation key  increases LCD brightness, press  to reduce LCD brightness.

【Notes】

1) When LCD is LED in poor, the brightness regulation function is valid to LCD; when LCD is CCFL in poor, the brightness regulation function is valid to LCD.

2) There is no operation in it when the brightness regulation window closes automatically in 10 seconds.

3) LCD brightness can be regulated in JOG working mode, and its regulation method is the same with that in AUTO working mode.

4.5.12 Display of M command execution state in AUTO, MANUAL mode

The displayed M commands are divided into following 6 groups: M21/22, M23/24, M61/62, M63/64, M65/66 and other M commands: M60, M67~M74, M81/M82/M83. In MANUAL/AUTO mode, when the above mentioned M commands are executed, corresponding prompts will be displayed on the screen. Red means M command is being executed; green means finished; yellow means suspended.

4.5.13 Operations in AUTO mode

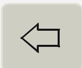
In AUTO mode, when spindle and chuck are interlocked, if M3 is executed to turn ON the spindle, there are two choices after alarm occurs:

1) Press ESC to exit to the initial state of AUTO mode;
2) Use foot switch to execute M10; press CYCLE START to turn on the spindle (M3); press ESC to exit to the initial state of AUTO mode.

4.6 Parameter Working Mode

PARAMETER working mode function includes parameter input, parameter draw, parameter solidifying; the system prompts intellectively each operation. At the same time, the operator can press <u>hp2</u> at the top right to learn the parameter operation key catalog.

The relative settings, operation input formats and example descriptions are as follows: all required function keys are expressed with icons; all input letter keys, or digit keys are expressed with <u>underline</u>; the system prompting message is expressed with frame.

Press  to cancel the mistaken input when the input letter or digit is wrong.

Press 

to exit the current operation before confirmation when the operator executes some setting or some operation or man-machine dialog.

Note: before the operator modifies the parameter, all parameter setting values in the system must be saved(save them to personal PC). Once the parameter is changed by mistake or the system, the system can recover by the saved data.

The system classifies the parameters: reference point coordinate parameter, motion parameter, transmission parameter, miscellaneous function parameter, interface parameter, variable initial value parameter and pitch parameter.

Press 

to enter PARAMETER working mode. (the system pops-up the window to require inputting the password, the operator inputs the password or directly presses ENTER to enter the parameter window).

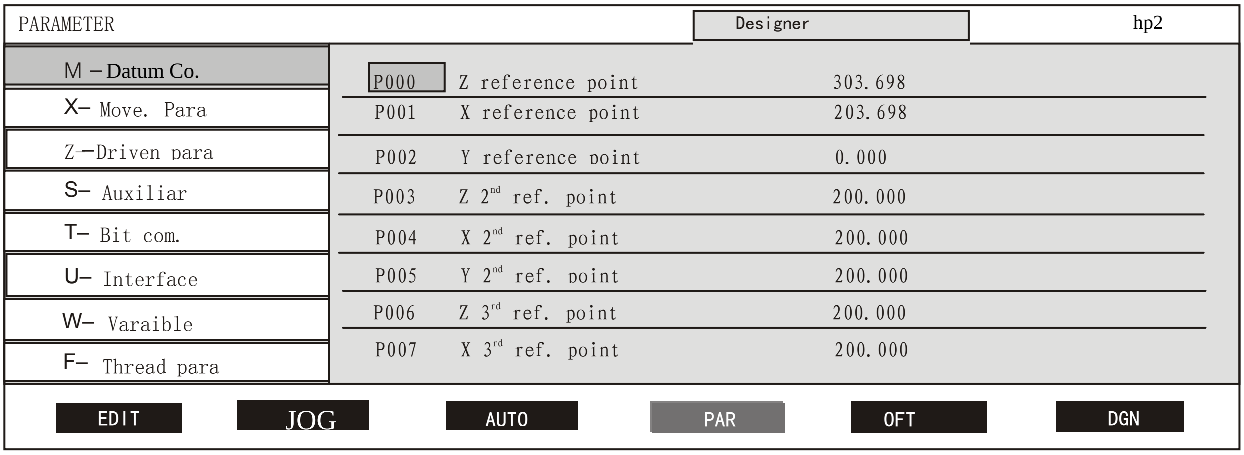


Fig. 4-10 parameter working mode

4.6.1 Parameter overview

Parameter operation characteristics including:

1) Press the parameter password level input by the operator to modify the corresponding level parameter.
2) When the operator directly presses ENTER instead inputting the password, the operation level is 4 to enter the parameter window in which the operator only reads but cannot modify the parameter.
3) For the parameter input and display format, the decimal must has the decimal point, and the negative number must has the negative sign; the system limits the valid digits to get the convenient operation and using safety.
4) The operator can open the prompt message window of parameter data input range.
5) The system automatically checks the parameter data after power-on and automatically prompts the initialization when it finds out the data in disorder.
6) The system set the applicable safety parameters and the operator can reduce the accidences caused by the mistaken operation by the proper parameter setting.

4.6.1.1 Parameter privilege

The parameter privilege is to modify the parameter password level. To get the convenient management, the system provides the parameter privilege setting function, the current operation level is displayed on the top prompt bar in the parameter window.

Parameter password level settings from high to low are as follows:

0 level: **** set by the program designer, can modify the parameter range: parameter level >=0; (all parameters)

1 level: *** set by the machine manufacturer, can modify the parameter range: parameter level >=1;

2 level: *** set by the device administrator, can modify the parameter range: parameter level >=2

3 level: *** set by the machine operator, can modify the parameter range: parameter level >= 3;

4 level: *** not be input, can modify the parameter range: parameter level >=4.

The parameter level is referred to the parameter lists in APPENDIX.

4.6.1.2 Entering operation level

Entering the operation level is as follows:

① Enter the parameter password input window;

② Input the operation password(the system adds one * when one number is input to the password);

③ Press ENTER after the input is completed, i.e. the system enters the operation level corresponding password.

4.6.1.3 Parameter management

The parameter management includes the parameter display, the parameter privilege, initializing, solidifying, draw, sending and receiving the parameter according to the privilege.

【Parameter display】

Parameter color definitions:

The parameter permitted to modify by the system is displayed in yellow and the forbidden is displayed in white in the current privilege.

In the parameter window, some operation option is related to the privilege; press hp6 and the forbidden functions are displayed in grey.

Prompt message display:

The parameter value range can be opened or closed through **P415_d7** when the operator input the parameter.

other display:

When the input exceeds the modification parameter, the system prompts No modification authority in the parameter setting area.

In the parameter window, when the successfully modified parameter has a remark "*" before it parameter number, the system prompts the modification is completed successfully.

After the system executes some operations in hp6, the system displays the operation results and the successfully modified parameter has a remark "*" before it parameter number to prompt the modification having been completed successfully.

【Parameter privilege】

For the different privilege, the parameter which can be modified is displayed in yellow, the forbidden is displayed in white. The parameter update (using the serial, USB to transmit the parameters) is to modify the parameter data in the current privilege.

Privilege modification

The icon  ahead of the parameter indicates the parameter is alterable under the current password level privilege;  indicates the parameter is unalterable.

The privilege modification is controlled by the password, and the password input is executed when the system enters the parameter password input window. Whether the password can be memorized is controlled by **P416_d7**. **P416_d7**=0: it is not memorized, and the system enters the parameter window in other working modes and the parameter password input window is displayed as follows:

1) Modify **P416_d7**=0;

2) Press the menu key in any working modes except for PARAMETER working mode;

3) Press PARAMETER to enter the parameter password input window;

4) Directly input the operation privilege password;

5) Press ENTER after the input is completed, and the system enters the operation level corresponding to the password.

【Parameter save】

The successfully modified parameters are automatically saved to the system, and all parameters are saved when the system exits from the parameter window (entering the window in the other working mode by press key). When the system is turned on every time, it reads the saved parameter data. When the saved data in read exceeds the range, it is rewritten to the minimum in the range and the system prompts it. The read parameter in disorder in power-on, the system prompts whether the previous solidified parameter is read; when the parameters have not been solidified, the system prompts to select the stepper/servo parameter to execute the parameter initialization and to save them to the system. The main differences between the stepper and servo parameter are the different of the motion parameter values.

4.6.2 Parameter modification

The system parameter has been initialized before the factory delivery. The operator can modify and regulate correspondingly the parameters according to the actual conditions of the machine.

The system displays the selected parameter number in highlight after the parameter is selected.

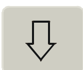
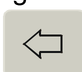
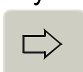
4.6.2.1 Parameter search

The parameter search is to search the required parameter as follows:

Method 1:

- Selected the required parameter in the parameter window: **M-reference parameter, X-motion parameter, Z-transmission parameter, S-auxiliary parameter, T-bit parameter, U-interface parameter, W-variable initial value, F-pitch parameter**.

  Example: select **M-reference parameter**, press **M** to enter the **reference parameter** window.

- Press ,  or ,  to move the highlight display to the parameter number which needs to search; the bit parameter: press ,  to left or right move the cursor to select the different bit, and the bit definition of the selected bit changes.

Method 2:

Directly position to the required parameter as follows:

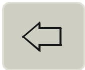
Press P and input the required parameter number which needs to search, and then press ENTER. The system displays the parameter in highlight. Example: for searching P208, firstly input P, and then input 2 0 8, press ENTER and the parameter P208 has been found.

4.6.2.2 Parameter modification

Modifying the parameter as follows:

① Search the parameter to modify it according to the above parameter search method.

② Press INPUT, and input the parameter data; or directly input the parameter data.

③ Press  to delete the mistaken data and input again the correct data.

④ Press ENTER to confirm the operation.

【Notes】

1) When the input data exceeds the parameter limit range, the input data is valid and the parameter content does not change..

2) After the data is input , ESC is pressed and the input data is invalid.

3) Bit parameter input is as follows:

① After the required parameter which needs to modify is selected, the operator can modify the parameter bit by the left/right direction key (prompt the current bit explanation at the bottom screen) .

② Single bit modification: directly input the data which needs to modify(“0” or “1”: pressing other keys to input are invalid).

③ Modifying all bit: it is the same that of general parameter manual setting from left to right to input. For example: input 11, the parameter after the operator presses ENTER is modified into: 00000011; input 11000000, the parameter after the operator presses ENTER is modified into: 11000000;

④ Bit parameter **P411_d6**: when it is changed, the pitch compensation parameter P1000～P1899 is initialized to 0, and the previous pitch compensation parameter values are changed to 0.

4.6.3 Parameter hp6 function

Press hp6 in parameter window and the display is as follows:

Input U – USB interface
Input R – RS232 interface
Input I – para draw
Input K – para solidify
Input F – update software
Input D – update memory

The operator can perform the communication, draw, solidifying, upgrade the system software, and update the whole memory according to the password level; select “I” parameter to perform the draw; select “K” to solidify the parameter; select “F” to upgrade the software (or by USB or RS232 to upgrade the software); select “D” to update the whole memory.

When the system executes the data solidifying and draw, it must not be turned off, and the operator cannot execute the other operations before the operation is performed. The data solidifying and draw do not influence the part programs in the system.

4.6.3.1 Parameter communication and standard format

According to the requirement to select the parameter transmission direction, the communication has two kinds: parameter sending and receiving. The parameter receiving includes: **PC→CNC, USB→CNC, CNC→CNC**; the parameter sending includes: **CNC→PC, CNC→USB, CNC→CNC**

Parameter sending: (operation level: all level)

The operator in all level can send the parameter to U or send to PC by RS232 serial.

Parameter receiving: (operation level: program designer, machine manufacturer, device administrator, machine operator).

The operator with more than 3-level can receive the parameters from U or PC, but he with the corresponding level modifying the parameter is valid.

The system RS232 transmission software is referred to **OPERATION: Chapter RS232 and USB System Communication**, GSK928_COM.EXE can realize the sending and receive between PC and CNC, which is simple with high communication rate and reliability.

RS232 and USB interface function: realize the parameter data unload.

Press R to transmit the data by RS232 communication mode.

RS232 parameter receiving：PC→CNC, CNC→CNC

1. Set communication software baud rate and communication terminal; the detailed one
2. Input the external parameter value to the system; or send the parameter value between two CNC systems.

(1) In power off, connect the communication cable between the CNC system and PC; or between two systems.

(2) The system is turned on and the parameter setting working mode is set. The operator sets the corresponding privilege, the receiving parameter only modifies the corresponding privilege parameter; when the operator does not input the password, CNC forbids receiving the parameter; note: the sending between two systems only sends the parameters with the same level password.

(3) Press hp6 first, then press R .

(4) Press 1 to receive the parameter.

(5) The system prompts the receiving done successfully after the operation is completed.

RS232 parameter sending：CNC→PC, CNC→CNC

1. RS232 baud rate setting:

   Set **P414_d7** and **P414_d6** communication baud rate before file transmission. The communication baud rate is determined by the sender setting. Setting range: 9600, 19200, 38400(unit:bps) . The standard setting in delivery: 9600 bps.

2. Input the external parameter value to the CNC system; or send the parameter value between two CNC systems.

(1) In power-off, connect the communication cable between the CNC system and PC; or between two systems.

(2) The CNC system enters the parameter window after the system is turned on.

(3) Press hp6 first, then press R .

(4) Press 2 to send the parameter.

(5) The system prompts the sending is successfully completed after the operation is completed.

USB operation：USB→CNC, CNC→USB

Press hp6 first, then press U to transmit the data by USB communication mode. The operator selects the transmission direction according to the requirements.

When the parameter transmission is executed by U disc, the U disc root catalog needs to create one file "C928PAR" , the parameter sending and receiving are executed in the file. The file name format: "PAR"+file number(3-bit) +".TXT"

Standard format of TXT parameter file on PC：

In PC, the operator can use TXT, LST text to edit the parameter file, but the file name and file content must be compiled according to the required standard format to correctly send to the system. Refer to the parameter file format of the system outputting as follows:

1) In PC, the operator should rename the parameter file name to TXT or LST suffix, such as "**PAR099.TXT**"; it is suggested the operator should use the TXT suffix to conveniently operate the parameter file on PC.
2) The home of TXT file content must be the parameter mark: "CNC_GSKC001"; the item must exist.
3) The second line is the annotation, the front must have "//"; the item must exist.
4) The third line is the parameter content. The parameter content must meet its standard format requirement.

   Example: **P000**：00000.000 // Z program reference point

   P000: it is the parameter number, its format is "P + number + ：" which is the parameter number. The three parts are indivisible to consist of the parameter, the parameter number is not correct when it lacks one. 00000.000 is the parameter content, "//" is the parameter annotation.
5) The file content can be some of all parameters.
6) The pitch compensation parameter is divided into the constant pitch compensation parameter and invariable pitch compensation parameter. Select the proper pitch compensation parameter format according to the pitch compensation parameter type which needs to update. The pitch compensation parameter format selection is related to **P411_d6**: **P411_d6**=0 means the pitch compensation is not constant(variable), **P411_d6**=1 means the pitch compensation is constant. Updating the pitch compensation parameter must select the pitch compensation parameter format corresponding to **P411_d6.** When the selected pitch compensation parameter does not match with **P411_d6,** the new pitch compensation parameter cannot be successfully updated. Its format is as follows:

   ◆ Constant pitch compensation parameter format:

   // pitch compensation parameter, start with P1000 in TXT file
   P1000： 0，0，0，0，0，0，0，0，0，0
   P1010： 0，0，0，0，0，0，0，0，0，0
   P1020： 0，0，0，0，0，0，0，0，0，0
   ……

P1880： 0，0，0，0，0，0，0，0，0，0
P1890： 0，0，0，0，0，0，0，0，0，0
P1900： 0 // Machine coordinate of Z axis starting point
P1901： 0 // Machine coordinate of X axis starting point
P1902： 0 // Machine coordinate of Y axis starting point
P1903： 0 // Z pitch compensation interval
P1904： 0 // X pitch compensation interval
P1905： 0 // Y pitch compensation interval

◆variable pitch compensation parameter format:

// Pitch compensation parameter starts with P2000 in TXT file
P2000： 00000.000，0，00000.000，0，00000.000，0，00000.000，0，00000.000，0
P2010： 00000.000，0，00000.000，0，00000.000，0，00000.000，0，00000.000，0
……
P2880： 00000.000，0，00000.000，0，00000.000，0，00000.000，0，00000.000，0
P2890： 00000.000，0，00000.000，0，00000.000，0，00000.000，0，00000.000，0
P2900： 00000.000 // Machine coordinate of Z axis starting point
P2901： 00000.000 // Machine coordinate of X axis starting point
P2902： 00000.000 // Machine coordinate of Y axis starting point
P2903： 00000.000 // Z pitch compensation interval
P2904： 00000.000 // X pitch compensation interval
P2905： 00000.000 // Y pitch compensation interval

7) Standard format of parameter file communication on PC:

TXT file format	Remark
CNC_GSKC001 //reference coordinate; P000： 00200.000 // Z program reference point …… P026： 0 // Y zero offset //motion parameter; P100： 6000 // Z max. traverse speed …… P209： 1200 // spindle encoder lines //miscellaneous function; P300： 1000 // max. speed of M41 gear …… P342： 254 // no privilege color //bit control parameter; P400： 00000000 // running setting …… //interface parameter; P512： 0 // feed device alarm check Dalm …… //variable initial value; P600： 0 // variable r01 …… //pitch compensation parameter; P1000： 0，0，0，0，0，0，0，0，0，0 …… …… P1905： 0 //Y pitch compensation interval	**Mark for checking parameter is necessary.** **// following the annotation content is necessary.** **PXXX parameter number, P000: the first parameter is necessary.** **PXXX: the parameter number following the fist is necessary, which is taken as the parameter following the first.** **0: the parameter content is necessary.** **PXXX: parameter number and colon "：" which cannot be separated.** **……： means other parameters and the table does not list all parameter. The parameter receiving can be some of all parameters.**

4.6.3.2 Parameter draw and solidifying

The parameter seen in the window are saved to the system SRAM storage which has the power-down protection function; when the main board battery has problem, the parameter loses.

The system has the parameter initialization function; according to the differences of the matched motor drive unit, the system can execute the different initialization operation; the system matched with DA98 series drive unit should execute the servo initialization, the system matched with DY3 series drive unit should execute the stepper initialization. The main differences of the initial parameter of the servo and the stepper are X-motion parameter and others are the same. The differences of servo/stepper initialization value are referred to the motion parameter list in the appendix.

The initial parameter does not meet all machine and the machine manufacturer should modify the spindle, the tool post and other parameters according to the detailed configuration of the machine.

To avoid the parameter loss, the system should execute the solidifying command, i.e. the modified parameter is solidified to the system FLASH storage to backup, the FLASH storage without the battery has the permanent save function. When the current parameter loses, the system extracts the solidified parameter to recover it.

The system pops-up the dialog box of relative operations about the parameter draw, solidifying, and the operator executes the option operation according to the corresponding dialog box. The parameter draw command includes: stepper parameter initialization, servo parameter initialization and machine manufacturer parameter draw.

【Explanation】

1) Before executing the parameter solidifying operation, the system should check the corresponding parameter, and the system prompts the alarm message to require the operator to modify the corresponding parameter when the system find the parameter problem exists; after the parameter passes the check, it is saved to the system FLSAH to solidify.
2) The parameter solidifying operation must be executed before the solidified parameter draw.

4.6.3.3 System software upgrade and memory update

The system software upgrade is to replace the new system software, i.e. the old software version is replaced by the new; the main aim is to perfect the system function.

The system upgrade is to update the system software and to get the more stable. But the mistaken operations cause the system upgrade failure. The direct result of the upgrade failure cannot turn on the system and the system cannot be used.

The system memory whole update is to replace the memory including the system software covering memory.

The result of the memory whole update failure is more serious. It is suggested that the operator cannot use personally and that our personnel provides the service.

There are two methods to perform the system upgrade and the memory whole update: USB and RS232; only the program designer has the privilege to operate the two.

1) System software upgrade by USB:

After U disc is inserted, the system automatically performs the software upgrade according to the system prompt to execute the operation. When the system software uses USB mode to upgrade, U disc root needs creates one file “C928DATA”, the command sending and receiving must be in the file. The file name format: “DATA”+ file number (3-digit) +“.TXT”. file name range: 0~254.

2) System software upgrade by RS232:

The system performs the upgrade by the communication software GSK928_COM.EXE. The system using RS232 transmission communication software is referred to **OPERATION, Chapter 5 RS232 and USB System Communication**.

When the memory whole update uses USB, U disc root catalog needs to create the file “C928MEMO”, the command sending and receiving are executed in the file. The file name format: “MEMO”+file number(3-digit) +“.TXT”. File number range: 0~254.

The memory whole update uses RS232 to perform the operation by the communication software GSK928_COM.EXE.

【Note】

1) When the system uses USB software upgrade, the operator presses ESC or RESET to return EDIT working mode to edit the current program once after the upgrade is completed successfully, otherwise, the system alarms.

4.6.3.4 Functional command privilege

In PARAMETER window, some operation functional option is related to the privilege, the forbidden operation functional option is displayed in grey.

The followings are the functional option and password privilege:

Operation / privilege / Operation option	0-level Program designer	1-level Machine manufacturer	2-level Device administrator	3-level Machine operator	4-level Not input password
Stepper, servo parameter initialization	★	★			
Extracting parameter of machine manufacturer	★	★	★	★	
Executing parameter solidifying operation	★	★	★	★	
Parameter received by USB and RS232	All	Based on parameter level	Based on parameter level	Based on parameter level	Based on parameter level
Parameter sent by USB and RS232	All	All	All	All	All
System software update and memory whole update	★	★			

“★” in the above table means the option uses the privilege; the blank means the option has no use privilege.

4.6.4 Parameter explanation

The parameters are described according to the functions and uses and their detailed definitions are the followings.

4.6.4.1 Reference point, software limit parameter bit parameter __ P000～P020

The reference point parameters include all important coordinate positions of machine Z/X/Y, and the each axis motion is based on these positions.

【Z/X/Y program reference point】__reference coordinate parameter P000, P001, P002

This parameter is used to set the position of program reference point. In AUTO/MANUAL mode, the machine returns to this position after program reference point return. The program reference point can be modified by inputting command (in MANUAL mode) or executing G50 command (in AUTO mode).

The coordinate value of program reference point is the coordinates of the machine is not influenced by the tool offset value.

【2nd, 3rd program reference point of Z/X/Y】__reference coordinate parameter P003, P004, P005, P006, P007, P008

The 2nd and 3rd program reference point is similar to program reference point; In AUTO mode, after a specified axis performs G30, it returns to 2nd or 3rd program reference point commanded by G30. See Section 4.11 for details.

【Positive/negative tool nose software limit of Z/X/Y】__reference coordinate parameter P009, P010, P011, P012, P013, P014

The parameter is used to limiting the motion range of tool nose coordinates. It confirms the max. positive/negative travel of tool post in Z, X, Y.

In JOG /AUTO working mode, the tool nose coordinates of Z, X, Y are more than or equal to the positive tool nose software limit value, the axes only executes the negative instead of the positive motion. Otherwise, the system alarms: positive tool nose software limit alarm. The negative motion is also so.

【Positive/negative machine software limit of Z/X/Y】__reference coordinate parameter P015, P016, P017, P018, P019, P020

The parameter is used to limiting the motion range of tool nose coordinates. It confirms the max. negative travel of tool post in Z, X, Y.

In JOG /AUTO working mode, the machine coordinates of Z, X, Y are more than or equal to the positive mechanical software limit value, the axes only executes the negative instead of the positive motion. Otherwise, the system alarms: positive mechanical software limit alarm. The negative motion is also so.

4.6.4.2 Parameters related to zero return function __ P021～P026, P109～P111, P406～P407

【Machine zero coordinates of Z/X/Y】__reference coordinate parameter P021, P022, P023

The parameter confirms the coordinates of machine zero position.

When the machine installs the machine zero check device and **P407_d1=0**, after the operator executes the “Machine zero return (or G28) in JOG /AUTO working mode and the system has detected the “zero signal”, the system changes the current machine coordinate to the setting value of P021/P022P023.

【Zero offset value of Z/X/Y】__ reference coordinate parameter P024, P025, P026

When the system uses the servo motor, checking the deceleration signal and the zero turn signal of the motor mask are taken the zero return check; The deceleration signal installed on the coordinate axis coincides with the zero turn signal, which can influence the zero return precision; the operator should set the offset value to 2mm and avoid the 2mm to execute the check.

【Zero return low-speed of Z/X/Y】__ motion parameter P109, P110, P111

Zero-point return speed is the movement speed of coordinate axis when the zero-point signal detection being performed in the process of machine zero return. No matter this speed is higher or lower than the initial speed, the lower one should be used; Do not modified this speed after it is set; otherwise, the precision may be affected.

【Zero setting 1】__ bit parameter P406(password class ：1)

d7	d6	d 5	d 4	d 3	d2	reserved	reserved

d7__ Z has or not deceleration signal

d6__ X has or not deceleration signal

d5__ Y has or not deceleration signal

0： none. // it is set to 0 when the deceleration switch and block are not installed on the machine;

1： have. // it is set to 1 when the deceleration switch and block are installed on the machine.

d4__ Z has or not zero signal

d3__ X has or not zero signal

d2__ Y has or not zero signal

0： none. // it is set to 0 when the machine zero switch and block are not installed on the machine;

1： have. // it is set to 1 when the machine zero switch and block are installed on the machine.

// The system has four kinds of zero return method and the detailed connection methods are referred to CONNECTION as follows:

Zero return method	Deceleration signal	Zero signal	Remark
1	Have	Have	**Use the deceleration signal and zero return signal to return the zero coordinates of machine zero**
2	Have	None	**Use the deceleration signal to return to machine zero**
3	None	Have	**Use zero signal to return machine zero**
4	None	None	**Return to zero coordinates set by the parameter(no machine zero)**

D0__ Without zero, zero return key is

0: Disabled. //When the system has no machine zero, it is invalid to press “Machine Zero Return key” on the panel, but program G28 zero return is still valid.

1: Enabled. //When the system has no machine zero, it is valid to press “Machine Zero Return key” on the panel. The system returns to the machine zero according to the 4th zero return mode.

//When there is neither a machine zero switch and block nor a deceleration switch and block installed on the machine, the system returns to the machine zero (i.e. returning to the zero coordinates set by parameters when there is no machine zero) according to the 4th zero return mode.

【zero setting 2】__bit parameter P407(password class：1)

d7	d6	d 5	d 4	d 3	d2	d1	reserved

d7__ Z zero return direction

d6__ X zero return direction

d5__ Y zero return direction

0： positive. // when the deceleration switch is installed on the positive end of the coordinate axis, it is set to 0, and the system positively moves the check zero;

1： negative. // when the deceleration switch is installed on the negative end of the coordinate axis, it is set to 0, and the system negatively moves the check zero;

d4__ Z deceleration signal level

d3__ X deceleration signal level

d2__ Y deceleration signal level

0：LOW. // The system reduces speed after it has checked the deceleration signal to be LOW in the coordinate axis zero return.

1：HIGH. // The system reduces speed after it has checked the deceleration signal to be HIGH in the coordinate axis zero return.

d1__after the machine zero return is executed, whether the machine coordinates are modified.

0： modifying machine coordinates // generally, it is set to 0, the system modifies the machine coordinates after it executes the zero return.

1： not modifying machine coordinates // in debugging zero return function, it is set to 1 to learn the zero return precision.

4.6.4.3 Traverse speed, acceleration time parameter __P100～P108, P112～P119

Regulating P100～P116 to make the system meet the motor with the different type and the machine with the different load to improve the machining efficiency.

Example: regulate the parameter value to the low to avoid the step-out when the system uses the stepper motor; properly increase the parameter value when the system uses the servo motor.

The detailed is referred to **OPERATION, 4.6.5 Appendix**, the difference between the stepper initial value and servo initial value in the motion parameter list.

【Rapid traverse speed limit of Z/X/Y】__motion parameter P100, P101, P102

P100, P101, P102 confirm the rapid traverse speed of Z, X, Y in manual rapid and G00, the actual rapid traverse speed in Z, X, Y is controlled by the rapid override.

Z actual rapid speed =P100x rapid override (unit: mm/min)

X actual rapid speed =P101x rapid override (unit: mm/min)

Y actual rapid speed =P102x rapid override (unit: mm/min)

【Lowest initial speed of Z/X/Y】__motion parameter P103, P104, P105

P103, P104, P105 define the lowest initial speed of Z, X, Y in MANUAL or AUTO mode. When Z, X, Y speed are lower than the setting value of **P103, P104, P105**, the setting value should prevail.

【Rapid feed acceleration/deceleration time of Z/X/Y(ms) 】__ motion parameter P106, P107, P108

P106, P107, P108 define the time of Z, X, Y linearly increasing speed from 0 to 15m/min in MANUAL or AUTO mode (X axis is programmed in diameter). The larger **P106, P107, P108** values are, the longest the acceleration processes of Z, X, Y are. The operator should reduce **P106, P107, P108** values to improve the machining efficiency based on meeting the load characteristics. In X radius programming, the time spent is from 0m/min to 15m/min (unit: ms).

【Cutting feed initial speed】__ motion parameter P112

P112 feed initial speed. **P112** defines the initial speed of G01, G02, G03, G05 in automatic machining process. (Unit: mm/min)

【Max. speed limit of cutting feed】__ motion parameter P113

P113 max. speed of cutting speed. **P113** defines the max. speed of G01, G02, G03, G05 in automatic machining process. When the specified F speed is larger than the setting value of P113, the setting value is valid; when the thread cutting speed is higher than the setting value of P113, the thread cutting is suspended. (Unit: mm/min)

【Linear/exponential acceleration/deceleration of cutting feed(ms) 】__ motion parameter P114, P115

P114 feed linear acceleration/deceleration time; **P115** feed exponential acceleration/deceleration time;

P114, P115 define the time spent from 0 speed to 15m/min of G01, G02, G03, G05 in automatic machining.

【Acceleration/deceleration time of thread cutting(ms) 】__ motion parameter P116

P116 defines the time spent from 0 speed to **15**m/min of thread cutting axis. the smaller P116 value is, the shorter the inconstant is. When **P116** is too small, the stepper motor maybe cause the step-out. (unit: ms).

【Acceleration/deceleration time of thread run-out(ms) 】__ motion parameter P117

P11 defines the acceleration/deceleration time in thread run-out: the time spent from 0 speed to 15m/min. The smaller P117 value is, the steeper the thread run-out is, which causes the step-out of the stepper motor.

【G99 initial lines】__ motion parameter P118

When the parameter is not 0 and the system executes G99 every time, it checks the spindle encode lines till the lines reaches the value set by P118, i.e. the spindle rotates some angle to execute the other commands following G99.

When the parameter setting value is 0, the system does not check the encoder lines till it executes other commands following G99.

The lines checked by the system is quadruplication of the spindle encoder.

Example: when the encoder lines are 1200, the lines checked by the system circularly changes in 0～4800, and the parameter setting is in 0～4800, otherwise G99 always waits.

【Delay time when orientation is switched to cutting（ms）】__Motion parameter P119

If the last command is a rapid positioning command, and the current one is a cutting command, the delay time set in P119 is automatically inserted between these two commands; this parameter is also valid when rapid positioning in the compound commands like G90 and G94 is switched to cutting. (unit: ms)

This parameter aims at preventing the taper streak on the workpiece due to the fast command transition. If the parameter is set too large, the working efficiency may be affected. In general, it should be set between 0～100.

Example 1:

G00 U-50 ；Rapid positioning

G01 W-10 F100 ；The command following it is a cutting command, so the delay time set in P119 is inserted before executing this command; which prevents taper streak on the front end.

Example 2：

G00 U-50 ；Rapid positioning

S1000

G01 W-10 F100 ； As it does not follow the rapid positioning command directly (another command eparate them) , the delay time will not be inserted automatically.

4.6.4.4 Parameters related to transmission and compensation__ P200～P209, P411, P1000～P1905

【Z/X/Y command pulse multiplication ratio】__transmission parameter P203, P205, P207

【Z/X/Y command pulse division coefficient】__ transmission parameter P204, P206, P208

P203 — Z multiplication: Z electronic gear numerator. (range: 1～99999).

P204 — Z division: Z electronic gear denominator (range: 1～99999).

P205 — X multiplication: X electronic gear numerator. (range: 1～99999).

P206 — X division: X electronic gear denominator (range: 1～99999).

P207 — Y multiplication: Y electronic gear numerator. (range: 1～99999).

P208 — Y division: Y electronic gear denominator (range: 1～99999).

【Notes】

1) In setting the related parameters of the transmission, the ratio between the multiplication coefficient and division coefficient is 1/128 ～128, otherwise, the system alarms.

2) Ratio between the multiplication coefficient and division coefficient is 1:1 as follows:

Z/Y: the system outputs 1 pulse when it moves 0.001mm every time;

X: the system outputs 2 pulses when its moves 0.001mm every time in radius programming. (the system outputs 1 pulse when its moves 0.001mm every time in diameter programming)

3) Ratio between multiplication coefficient and division coefficient is 1:1 as follows:

Z/Y: the system outputs the pulse in movement of 0.001mm: multiplication/division;

X: the system outputs the pulse in movement of 0.001mm: multiplication*2/division in radius programming. (the system outputs the pulse in movement of 0.001mm: multiplication/division in diameter programming) .

4) When the system max. pulse output frequency is 511pps/ms, the frequency cannot exceed the value, otherwise, the system alarms in movement. i.e. P00 (max. traverse speed) x multiplication/division should not be more than 30000mm/min.

【Spindle encoder lines】__ transmission parameter P209

The parameter defines the spindle encoder lines, it setting range: 100～5000. When the spindle is ON, on the initial page of DIAGNOSIS mode, if the setting value is not consistent with the spindle encoder lines, the diagnosis prompts in DIAGNOSIS working mode: Encoder lines are not consistent with the parameter. Unit: line/r.

【Z/X/Y backlash value】__ transmission parameter P200, P201, P202

The parameter defines the backlash value of Z, X, Y mechanical transmission. Unit: mm.

There are backlash clearances in the lead screw, the decelerator and other driving device, which cause the error in the repeated motion of tool post. To avoid the error, set P200, P201, P202 which make CNC system automatically compensate the error when the machine changes its moving direction.

Measurement method of mechanically-driven backlash (taking example of Z):

1) Select the proper feedrate in JOG working mode.
2) Install the dial indicator on the proper position of the machine, move the tool post to the probe of the dial indicator and set its pointer to zero.
3) Select STEP working mode with the step size 1.0 mm.
4) Press Z axis movement key to move the tool post to the dial indicator and make it point to zero when rotating one circle.
5) Press Z axis movement key to move reversely and the pointer of dial indicator turns around. The pointer cannot return to zero because of the backlash. At the moment, D-value between the pointed position of pointer and zero is Z backlash value.

【Notes】

1) Repeat the above-mentioned operations many times to gain the exact measurement value.
2) The measurement method of X backlash is the same that of Z, but the measured value must multiply 2 to convert to the diameter value.
3) Z, X, Y backlash compensation speed is to compensate with the speed set by **P411_d1**.

【Precision compensation】__bit parameter P411(password level：2)

d7	d6	d5	d4	Reserved	Reserved	d 1	Reserved

d7__pitch error compensation function

0：invalid. // pitch error compensation function is invalid.

1： valid // pitch error compensation function is invalid.

d6__pitch compensation value expression method

0： variable interval. // called the inflection point description method, each axis can be input

150 groups of inflection point.

1： constant interval. // called the constant description method, each axis can be input 300 compensation points; the interval between two points is equal.

See Section 4.4.3.2 Spindle S command—Gear Shift Control and Section 4.4.3.3 Spindle S Command—Rotation Speed Control for details.

d5__tool nose radius compensation function

0： invalid. // tool nose radius compensation command G41, G42 are invalid.

1： valid. // tool nose radius compensation command G41, G42 are valid.

d4__tool radius compensation mode

0： linearity transition. // the system executing the closed angle mode is the linearity transition in executing the tool nose radius compensation.

1： arc transition. // the system executing the closed angle mode is the arc transition in executing the tool nose radius compensation.

d1__backlash compensation mode

0： low-speed. // Z/X/Y executes the backlash at the low speed, the low speed value is P103, P104, P105.

1： fast. // Z/X/Y executes the backlash at the fast, the fast value is P100, P101, P102.

【F—pitch parameter】__pitch compensation parameter P1000～P1905

The pitch compensation parameters are divided into variable and constant interval according to the setting of **P411_d6**.

The detailed is referred to PROGRAMMING Chapter 6 Pitch Error Compensation.

4.6.4.5 Parameters related to spindle, cooling __ P300～P317, P326, P329, P341, P410

【Spindle configuration】__bit parameter P410(password level：1)

d7	d6	d 5	d 4	d 3	d 2	Reserved	reserved

d7__spindle controlling output

0： level. // the system level output controls the spindle(M03/M04/M05) , cooling(M08/M09) .

1： pulse. // the system level output controls the spindle(M03/M04/M05) , cooling(M08/M09) . P326 is the pulse width.

d6__spindle S control

0： gear shifting. // the spindle is the gear shifting spindle, and the system uses S to execute the gear shifting; forbid M41～M44.

1： frequency. // the spindle is the frequency, S is the spindle speed, M41～M44 gear.

// For details, see Section 4.4.3.2 “Spindle S Command—Gear Shifting Control” and Section 4.4.3.3 “Spindle S command—Speed Control”.

d5__S gear shifting output

0： direct. // the control signal of spindle gear is to directly output S01～S04, forbid S05～S15.

1： encoder. // the control signal of spindle gear is the encode output S00～S15.

// the parameter and P310 (spindle gear control covered lines) are used together. When the setting is the direct output, each control line controls one gear, and the all gear quantity and P310 quantity are consistent; when the encode output is according to the used control line quantity, the controlled total gear quantity is 2^{P310}; max. setting 4-channel control line output is taken as the gear control signal.

d4__switching the spindle and Y

0： do not switch. // the spindle does not work in the position control mode, forbid M47/M48.

1： switch. // the spindle switches between the position control mode and the speed control mode, use M47/M48.

d3__spindle brake signal output

0： use. // output the brake signal MSP in executing M5.

1： do not use. // do not output the brake signal MSP in executing M5, MSP signal interface is used to other interfaces control.

d2__spindle CCW signal output

0： use. // output the spindle rotation (CCW) signal M04

1： do not use. // forbid outputting the spindle (CCW) signal M04

When the spindle configuration is set to the frequency, M41, M42, M43, M44 execute the gear shifting;

The system does not execute the gear shifting when the specified gear is consistent with the current gear. The system executes the gear shifting when the specified gear is not consistent with the current gear. Executing M41 outputs the analog voltage according to the parameter value; after delaying (frequency spindle gear shifting time 1: parameter P311), close the previous gear output signal and output the new gear shifting signal; execute the next block after the system has checked the gear shifting in-position signal; delaying (frequency spindle gear shifting time 2: P312), output the spindle analog voltage according to the current gear setting value, and the gear shifting ends.

When the spindle configuration setting is the gear shifting, S00～S15 execute the gear shifting;

S gear shifting encoder output: execute 2, 3, 4 bit encode according to the spindle gear controlling the covered line quantity.

【max. speed of M41, M42, M43, M44】__ auxiliary parameter P300, P301, P302, P303

The parameter is max. spindle speed of M41, M42, M43, M44. When the system uses the converter controlling the spindle and the spindle gear is M41, M42, M43, M44 and the system outputs 10V analog voltage, it corresponds to the max. speed of the machine. P300 P301 P302 P303 are invalid when the spindle multi-gear switching controls the spindle. (unit: r/min)

【Lowest speed of spindle with constant surface】__ auxiliary parameter P304

The parameter defines the lowest speed in the constant surface cutting, the calculation formula according to the constant surface cutting speed:

Surface speed=spindle speed *|X|*π/1000(X unit：mm，spindle speed unit: r/min)

X in the formula is the tool nose coordinate value on X axis. When X is less than some value and the calculated spindle speed is less than P304 value, the spindle speed keeps P304 speed to execute the machining.

【**Max. spindle speed with constant surface speed**】**__ auxiliary parameter** P305

The parameter defines the max. speed in the constant surface cutting, the calculation formula according to the constant surface cutting speed:

Surface speed=spindle speed *|X|*π/1000(X unit：mm，spindle speed unit: r/min)

X in the formula is the tool nose coordinate value on X axis. When X is more than some value and the calculated spindle speed is more than P305 value, the spindle speed keeps P305 speed to execute the machining.

【**Thread smooth speed borderline**】**__ auxiliary parameter** P306

The system has two method in machining thread: high-speed and low-speed machining. P306 is the borderline of the two machining speed (unit: r/min). generally, P306 should be more than 100.

P306=300, before the system executes the thread machining, it should judge according to the current actual checked spindle speed. When the actual speed is more than 300, the system uses the high-speed machining, otherwise, it uses the low-speed machining mode.

In high-speed machining, the system has the strongest following to the spindle speed wave, but the stability of the motor running reduces; when the spindle speed wave is strong, there is the wave on the machining surface and the stepper motor causes the step-out.

In low-speed machining, the system has the poorer following to the spindle speed wave, but the stability of the motor running increases; when the spindle speed wave is strong, the wave on the machining surface is worse and the stepper motor does not cause easily the step-out.

【**thread spindle wave alarm**】**__ auxiliary parameter** P307

During thread cutting, when the spindle rotation fluctuation exceeds the setting value of P307, an alarm is raised after the current thread cutting block is finished and machining is suspended; press CYCLE START to go to next step of the machining.

When the spindle speed wave exceeds P307 in thread cutting, the system alarms. (unit: r/min)

The parameter is valid to G33, G92, G32, G34.

【**Spindle JOG time 1(ms)** 】**__ auxiliary parameter** P308

The time for starting the spindle and the spindle automatically stops in the time in the spindle JOG working mode. (unit: ms)

【**Speed in spindle JOG**】**__ auxiliary parameter** P309

The spindle speed after pressing the spindle start key when the spindle is in JOG state. (unit: r/min)

P309=0: the JOG output speed is the same that of M30/M04.

【Used lines for the spindle gear control】**__ auxiliary parameter** P310

The parameter limits the used output controlled line quantity of spindle gear control, up to 4 control lines. When the control line quantity is less than 4, the system only uses the low-bit control line, and the used high-big control line is used to others.

The used line quantity=0, the system does not output.

The used line quantity=1, only **S01** outputs.

The used line quantity=2, only S02, S01 output.

The used line quantity=3, only S03, S02, S01 output.

The used line quantity=4: S04, S03, S02, S01 output.

【Frequency spindle gear shifting time 1, 2(ms) 】__ auxiliary parameter P311, P312;

When the spindle is the frequency, M41~M44 spindle gear shifting time. (unit: ms). Refer to **OPERATION 4.4 JOG working mode**.

【Spindle gear shifting interval time(ms) 】__ auxiliary parameter P313

This parameter set the interval from original gear signal being cancelled to new gear signal being output. (unit: ms)

【Output voltage in spindle gear shifting(mV) 】__ auxiliary parameter P314

Output voltage in the spindle gear shifting. (Unit: mV)

【Brake delaying time in spindle stop(ms) 】__ auxiliary parameter P315

The parameter defines the delay time from sending the spindle stop signal to the spindle brake signal. (unit: ms)

【Output time in spindle brake(ms) 】__ auxiliary parameter P316

The parameter means the output time of brake signal, and the time is set from the spindle motor brake starting to its exact stop

【Max. speed limit of spindle】__ auxiliary parameter P317

The parameter limits max. speed of the spindle

【Pulse time controlled by the spindle(ms) 】__ auxiliary parameter P326

The parameter defines the durable time of the pulse signal when the system executing the spindle(M03/M04/M05) and cooling (M08/M09) output are the pulse control mode

【M respond check time(ms) 】__ auxiliary parameter P329

The parameter defines the upper limit of M respond check time, the system alarms when it has not checked the M respond signal in the time. (unit: ms). For example: execute M10 in JOG working mode to wait P329 time, and the system alarms Alarm for chuck clamping responding check overtime when it has not checked the chuck clamping responding signal (**P409_d5**=1).

【Cutting enabled when **rotation speed reach certain percentage】__ auxiliary parameter P341**

If the cutting is started when the spindle is just turned ON or gear shift is just finished, as the preset rotation speed is not reached, the cutting will affect the tool life and workpiece.

This parameter is used to identify spindle rotation speed reached or not. For example, P341=80 means the spindle actual speed should not exceeds the preset rotation speed range (100%±20%); When the program is S2000, the actual speed should not exceeds the range 1600~2400.

When P341=0, this function is invalid. When P341 is not zero, in MANUAL or AUTO mode, the actual speed is detected automatically and displayed on the screen; if the spindle speed Sxxxx is displayed in yellow, it means the preset range is not reached; if the spindle speed is displayed in green, it means the preset range is reached.

Usage: This parameter is valid when inverter spindle or gear-shift spindle is used.

When inverter spindle is used, the system compares the programmed speed S with the actual speed.

When gear-shift spindle is used, as S represents the gear, S1~S4 gear spindle rotation speed corresponds to the setting value of P300~P303; if the gear is S1, the system compares the setting value of P300 with the actual speed. P341 is invalid to other gears, so the cutting will not be affected by it.

This parameter is valid only for cutting command such as G01, G02, G33 etc. This parameter is also valid in complex commands. When cutting commands are executed continuously, only the first one is detected. If the spindle rotation speed is displayed in yellow, and the cutting is not performed, it means the system is waiting for the spindle reaching the preset speed.

4.6.4.6 Parameters related to tool post __ P318～P325, P408

【Tool post setting】__bit parameter bit parameter P408(password level password level：2)

d7	d6	d 5	d 4	d 3	d2	reserved	reserved

d7__tool selection signal check mode

0: Default **//** Preset detection method for tool position signal in the system;

1: Refer to relevant table// To some special tool post, relevant table may be used. Parameters P541~P556 set tool position detection signal. See Section 3.4.4 in CONNCTION for details;

d6__tool post lock in-position signal

0： none. // no tool post lock in-position signal(release input interface 9).

1： have. // tool post lock in-position signal(cover input interface 9).

d5__tool post lock signal level

0： LOW // tool post lock signal LOW is valid.

1： HIGH // tool post lock signal HIGH is valid.

d4__tool post overheat check level (this parameter is invalid)

0： LOW // tool post temperature control switch(TGR signal) LOW is valid.

1： HIGH // tool post temperature control switch(TGR signal) HIGH is valid.

d3__strobe signal level

0： LOW // encoder strobe signal LOW of tool post is valid.

1： HIGH // encoder strobe signal HIGH of tool post is valid.

d2__pre-graduation in-position check level

0： LOW // pregraduation switch LOW of tool post is valid.

1： HIGH // pregraduation switch HIGH of tool post is valid.

【Tool post type】__ auxiliary parameter P318(max. value is 9)

The parameter is defined by the tool post type installed on the machine, and the system executes the tool change mode according to the parameter.

P318=0，the line-up tool post installed on the machine does not cover any input/output terminal of the system.

P318=1 or 2，the general electronic turret tool post has been installed in the machine; execute the tool change mode 1 or 2.

P318=3，applied to Hengyang turning CLT-63~CLT300 series 8 tool selection tool post in Taiwan; execute the tool change mode 3. **P318**=4，applied to near positive and negative tool change type; execute the tool change mode 4.

P318=9，use M60 customized command tool change, refer to examples in **CONNECTION 3.4 Tool Change Function and Connection.**

When P318 is not the above digit, the system executes the tool change based on the tool change mode 1.

【Max. tool selection number】__ auxiliary parameter P319

The parameter defines max. tool selection number of the tool post. The standard configuration of the system CNC is 8 tool selection electronic tool post. The tool selection signal can extend to 12～16 tool selections tool post according to the special encode input. Refer to **CONNECTION, 3.4 Tool Change Control Function and Connection**.

【Line quantity covered by tool selection signal】__ auxiliary parameter P320

This parameter determines the quantity of input interfaces of the system covered by the tool number signals. The maximum is 8, i.e. up to 8 input interfaces can be covered. In general, it is set along with the maximum tool selection number. The states of the input interfaces are displayed on the diagnosis mode.

【Tool change T1 T2 T3 time(ms) 】__ auxiliary parameter P321, P322, P323

T1__The delay time from “CW stop” to “Tool post CCW start” after tool position signal is detected. (unit:ms)

T2__During the process of tool post CCW, to detect the tool post lock in-position signal TCP, P322 should set the time from “tool position lock signal has been detected” to “tool post CCW signal stop” as the delay time. (unit: ms) See Section 3.4.3.2 in CONNECTION for details.

T3__ Not used. (unit:ms)

【Tool post CCW rotation lock time (ms) 】__ auxiliary parameter P324

The time set by P324 is tool post CCW rotation signal duration if the tool post lock in-position signal TCP is not to be detected; otherwise, the time is the maximum tool post CCW rotation lock time. (unit: ms).

Note: P324 value should be debugged to the proper value with the different electronic tool post. When the parameter value is too big, the tool post motor becomes hot to be damaged. When the parameter value is too small, the tool post cannot be locked, so, use the different value in debugging to select the proper parameter value.

【Time upper limit of tool change indexing(ms) 】__ auxiliary parameter P325

The parameter defines max. durable time in the electronic or line-up tool post executing the tool change. (unit:ms)

The following parameters are specially for tool change method 3. See Section 3.4.3.4 in CONNCTION for details.

【Tool post worktable output: TZD】__interface parameter P507

This parameter control tool post motor braking device.

【Tool post worktable pregraduation output: TFD】__ interface parameter P508

The parameter controls the pregraduation proximity switch.

【Pregraduation in-position check TFDC】__ interface parameter P528

The parameter checks the pregraduation proximity switch in-position signal.

【Tool selection strobe signal TXT】__ interface parameter P529

The parameter is the strobe signal of tool post encoder. The binary absolute value and strobe signal control together the tool selection number output. They can control up to 12 tool selections.

【Tool post overheat check: TGR】__ interface parameter P530 (this parameter is invalid)

The parameter checks the temperature control switch signal of tool post. When the temperature is more than 120℃, the temperature control switch is turned off.

4.6.4.7 Parameters related to chuck tailstock __ P327～P328, P409

【Chuck control pulse time(ms) 】__auxiliary parameter P327

When the chuck is pulse control mode, the parameter defines the durable time of the chuck execution command (M10/M11) outputting pulse signal. (unit: ms)

【Tailstock control pulse time(ms) 】__ auxiliary parameter P328

When the tailstock is the pulse control mode, the parameter defines the durable time of tailstock execution command outputting pulse signal. (unit: ms)

【Chuck tailstock】__bit parameter bit parameter P409(password level password level：1)

d7	d6	d 5	d 4	d 3	d2	d1	d0

d7__chuck control function

0： **valid.** // the system has the hydraulic chuck control function.

1： **invalid.** // the chuck control function is invalid, forbids M10/M11.

d6__chuck clamping mode

0： **outer.** // the hydraulic chuck is outer mode.

1： **inner.** // the hydraulic chuck is inner mode. Executing M10/M11 is referred to **OPERATION, JOG Working Mode**.

d5__chuck respond check

0： **do not check.**.

1： **check.** // when the system needs the respond check, input interface RM10 and RM11 are separately taken the clamping and releasing in-position signal input.

d4__tailstock control function

0： **valid.** // the system has the hydraulic tailstock control function.

1： **invalid.** // the system forbids M78/M79 without the hydraulic tailstock control function.

d3__chuck control output

0： **level.** // control M10/M11 output in level mode.

1： **pulse.** // the hold time of M10, M11 in pulse control mode is determined by P327.

d2__tailstock control output

0： **level.** // control M78/M79 output in level mode.

1： **pulse.** // the hold time of M78, M79 in pulse control mode is determined by P328.

d1__hydraulic chuck foot switch input

0：**do.** // besides using the command to control the hydraulic chuck, the operator can use the external foot switch to control the hydraulic chuck.

1： **do not.**

d0__hydraulic tailstock foot switch input

0：**do.** // besides using the command to control the hydraulic chuck, the operator can use the external foot switch to control the hydraulic chuck.

1：**do not.**

4.6.4.8 Run and efficiency bit parameter __ P400～P401

【run setting】**__bit parameter P400 (password level：3)**

reserved	d 6	d 5	d 4	d 3	d 2	d 1	Reserved

D7__Arc surface

0: Smooth //The machined surface is smooth; the initial setting is 0.

1: Even // Different interpolation resulted in different surface.

d6__spindle gear memory

0： **invalid.** // the spindle gear M41～M44 cannot be memorized in JOG and AUTO working mode, it is M41 after power-on again.

1： **valid.** // the spindle gear M41～M44 can be memorized in JOG and AUTO working mode, it is the previous gear before last power-off after power-on again.

d5__spindle in AUTO working mode

0： **controlled by the key.** // In AUTO mode no program running state, pressing the spindle CW, spindle CCW, spindle stop key is valid.

1： **not be controlled by the key.** // In AUTO mode, pressing the spindle CW, spindle CCW, spindle stop key is invalid.

d4__MPG 0.1mm step width

0： **valid.** // select the big override (x0.1mm gear) to rotate the MPG in JOG working mode.

1： **invalid.** // cannot select the big override (x0.1mm gear) to rotate the MPG in JOG working mode.

d3__rapid position mode

0： **alone traverse.** // each axis rapidly positions separately in G00.

1： interpolation traverse. // rapidly position in the proportion mode in G00.

d2__arc across high point processing mode

0： precise. // execute the precise processing the backlash in arc across the high point.

1： smooth. // execute the smooth processing the backlash in arc across the high point..

d1__MPG axis selection

0： keyboard axis selection. // keyboard axis selection is valid.

1： external axis selection. // the external MPG control knob is valid and the keyboard axis selection key is invalid.

// In JOG working mode, press MPG to switch MPG mode and the indicator lights and the system displays states of the external MPG control knob, the axis selection knob and the movement knob. The coordinates of the selected coordinate axis is displayed in highlight state.

【Efficiency setting 】__bit parameter P401(password level：3)

d7	d6	d 5	d 4	d 3	d 2	reserved	reserved

d7__TMS command in DRY RUN working mode

0： Execution. // in DRY RUN working mode, output and check the signal in executing the miscellaneous command, which is the same in the normal machining.

1： skip. // in DRY RUN working mode, do not output and check the signal in executing the miscellaneous command.

d6__feed command in DRY RUN

0： constant speed. // in DRY RUN working mode, the execution speed of feed command is set by the program, which is the same in the normal machining.

1： acceleration. // in DRY RUN working mode, the execution speed of feed command is not controlled by the program and the max. speed (P113) of cutting feed demonstrates the program path.

d5__short linear high-speed

0： high-speed connection. // the short linear connection transition uses the high-speed connection.

1： do not use. // the short linear connection transition does not use the high-speed connection.

// **P401_d5**=0: for the short movement, the continuous short linearity (without blank line, annotation line or other block between blocks) with rapid execution, CNC uses the prospective control mode to realize the best speed connection transition, max. preread blocks reach 80.

d4__cutting command

0： continuous smooth transition.

1： decelerate to zero.

// In G01, G02, G03 cutting feed, when bit parameter **P401_d4**=0, the system uses the post acceleration/deceleration processing, and forms an arc transition at the path intersection point of the neighboring two cutting feed blocks, which cannot exactly position the intersection of the two paths and there is the contour error between the actual path and the programmed path. To avoid the contour error, the operator can insert G04 (delay command) between two blocks or set **P401_d4** to 1. At the moment, when the previous block moves to the end point of the block, it decelerates to zero and exactly positions to the end point of the block and then executes the next cutting feed block; in the mode, because each block accelerates from the initial speed, decelerates to zero in the end point to execute the next, the program run time increases and the machining efficiency reduces.

d3__multi-command execution sequence in the same block

0： Substep.

1： Synchronism. / there is many commands in one block, called the multi-command in one block. These commands are almost executed and the system executes the next block till all are completed.

// **P401_d3**=0: the commands are executed in substep; the execution sequence: after one functional command is executed, the system executes the next one till all are completed.

// **P401_d3**=1: synchronous execution; in the mode, the command which are not relative each other are almost executed, do not follow the substep execution sequence till each is completed. The system automatically arranges the execution sequence for M with the interlock relationship.

d2__rapid skip block execution function

0： close.

1： open. // **P401_d3**=1: **P401_d2**=1 is valid. **P401_d2**=1: the system permits the skip block execution. In the mode, after the axis motion command of current block is executed(the system does not wait for M, S, T having been done), it rapidly skip to the next block to execute.

d1__G92 Retraction

0: Optimized //The axis directly return to the start point of G92 as long as I exist; it can improve efficiency and effect.

1: Normal //Retraction is performed according to G92 method in 4.14.2 in PROGRAMMING.

d0__Cutting efficiency

0：Normal // The cutting feedrate is the normal value of command F.

1：Optimized // Improve the efficiency by 5%; it applicable to situations that F command is not modified while efficiency is to be improve.

4.6.4.9 Relationship between path and run, efficiency parameter

1) P401_ d4=0: the cutting command executes the continuous and smooth transition and the post acceleration/deceleration function is valid:

G01 processing:：

P401_ d5=0: G01 has the front acceleration/deceleration function, G01 and G01 perform the connection transition with the best speed; and the system executes the post acceleration/deceleration processing; when the cutting speed is high, the linearity path is precise and the transition point is smooth. At the moment, the post acceleration/deceleration function does not greatly influence the path precision.

P401_ d5=1: G01 does not use the high-speed connection and execute the front acceleration/deceleration processing, and directly executes the post acceleration/deceleration processing.

Arc processing:

P400_ d2=0: the system executes the arc precision process when the arc crosses the high point. The arc command has the front acceleration/deceleration function, reduces speed to the initial speed across the quadrant, and then executes the backlash, and the machining path transits to the next quadrant, raises speed, and reduces speed before the machining is completed. And the system executes the post acceleration/deceleration processing.

P400_ d2=1: the cutting command executes the continuous and smooth transition; the arc command directly executes the post acceleration/deceleration processing instead of the front acceleration/deceleration processing.

2) P401_ d4=1: the cutting command decelerates to zero; the post acceleration/deceleration function is invalid:

G01 processing:

P401_ d5=0: G01 has the front acceleration/deceleration function, G01 and G01 perform the connection transition with the best speed; all G01 moves to the end point of the block and decelerates to zero, exactly positions the end point of the block; when the cutting speed is high, the linearity path is precise and the transition point is smooth. At the moment, the post acceleration/deceleration function does not greatly influence the path precision.

P401_ d5=1:G01 has the front acceleration/deceleration processing, decelerates to zero after each cutting command is executed.

Arc processing:

P400_ d2=0: the system executes the arc precision process when the arc crosses the high point. The arc command has the front acceleration/deceleration function, reduces speed to the initial speed across the quadrant, and then executes the backlash, and the machining path transits to the next quadrant, raises speed, and reduces speed before the machining is completed. And the system executes the post acceleration/deceleration processing.

P400_ d2=1: the system executes the arc precision process when the arc crosses the high point. The arc command has the front acceleration/deceleration function; when the backlash is 0, the machining does not decelerate across the quadrant.

4.6.4.10 Safety and debugging bit parameter __ P402～P404, P419

【Safety setting 1】__bit parameter P402(password level：3)

d7	d6	d 5	d 4	d 3	d 2	d 1	d0

d7__hardware limit alarm

// the parameter specifies its using mode when the system has checked the hardware limit alarm signal in the axis motion process.

0： deceleration. // when it is set 0, it meets the hardware limit alarm, the motion axis decelerates to stop, and the coordinates are consistent with the actual position;

1： emergency stop. // when it is set 1, it meets the hardware limit alarm, the motion axis decelerates to stop, and the coordinates are not consistent with the actual position;

d6__spindle abnormal stop rotation check

0： check. // the system stops the feed, closes the spindle and alarms in cutting.

1： do not check.

// In JOG /AUTO working mode, after the spindle starts, the system automatically check the spindle speed, it prompts "spindle rotation abnormality" when the spindle starts abnormally. When the system stops rotating accidently in cutting feed, the system stops the feed, interrupts the program execution, closes the spindle and alarms.

// When the spindle works in the low speed (less than 1 r/min), the system alarms, at the moment, the parameter should be set to "1". For the frequency spindle ,when the programming speed is less than S0, the system does not check and alarm.

d5__interlock between chuck and spindle

0： interlock. //when the chuck and the spindle are interlock, the spindle stops but the chuck cannot be controlled; the chuck releases but the spindle cannot be started.

1： releasing interlock.//when the chuck is not interlock with the spindle, starting the spindle is not influenced by the chuck state, controlling the chuck is not influenced by the spindle state.

d4__chuck respond signal consecutive check

0： do not alarm.

1： alarm. // the bit means whether the system real-time check the chuck state, and alarms when the chuck releases. The control bit is valid when the chuck has the respond signal.

d3__interlock between tailstock and spindle

0： interlock. // /when the tailstock and the spindle are interlock, the spindle stops but the tailstock cannot be controlled; the tailstock releases but the spindle cannot be started.

1： releasing interlock. // when the tailstock is not interlock with the spindle, starting the spindle is not influenced by the tailstock state, controlling the tailstock is not influenced by the spindle state.

d2__tailstock respond signal consecutive check

0： do not alarm.

1： alarm. // the bit means whether the system real-time check the tailstock state, and alarms when the tailstock releases. The control bit is valid when the tailstock has the respond signal.

d1__Automatic MPG control

0： **invalid.** // using MPG to control rapid/feedrate override is invalid in AUTO working mode.

1： **valid.** // using MPG to control rapid/feedrate override is valid in AUTO working mode.

d0__Automatic MPG mode

0： **mode 1.** // use the mode 1 to control MPG rapid/feedrate override.

1： **mode 2.** // use the mode 2 to control MPG rapid/feedrate override. Mode 1 and 2 are referred to **OPERATION, Chapter 4.5 AUTO Working Mode**.

【Safety setting 2】__bit parameter P403 (password level：3)

d7	d6	d 5	d 4	Reserved	d 2	d 1	d 0

d7__tool change operation

0： **permit.** // permit tool change in JOG and AUTO working mode.

1： **forbid.** // forbid tool change in JOG and AUTO working mode.

d6__executing offset

0： **modifying coordinates.**// executing the offset is to modify the machine coordinates in JOG working mode.

1： **tool post movement.** // executing the offset is to move the tool post in JOG working mode.

d5__tool change in JOG working mode

0： **press key to confirm.** // execute the tool change in JOG working mode and the system prompts " Confirm the tool change ?", press ENTER and the system executes the operation.

1： **immediate execution.** // the tool change is executed immediately in JOG working mode.

d4__tool setting record check

0： **close.** // the system does not display the program comprehensive check prompt alarm which is not consistent with the tool setting record.

1： **open.** // the tool offset number has been set and the tool setting exist; when other tool number still uses the tool offset number, the system displays [program comprehensive check prompt alarm]. Example: T0205 is not consistent with the tool setting record T0105.

d3__M output during emergency stop

0: Only spindle and cooling are turned off. // When the emergency stop alarm is valid, the system only turns off the signals of the spindle, coolant and lubricant.

1: All are turned off. // When the emergency stop alarm is valid, the system turns off all the auxiliary function output signals.

d2__Spindle and coolant in pressing reset key.

0： **close.** //after the reset key is pressed, the system closes M03, M04, M08, M32 output signal.

1： **do not close.** // after the reset key is pressed, the system does not close M03, M04, M08, M32 output signal.

d1__M function alarm

0: **terminating program.** //program terminates when **M10 M11 M78 M79 Txx** alarm.

1: **prompt selection.** //the system prompts whether the operator tries again when **M10 M11 M78 M79 Txx functions alarm.**

// When the system meets **P401_d3=0** (substep execution for many commands in one block) and **P403_d1=1** (prompt in M function alarm), the trial again function is valid. The system alarms and terminates the machining programs when the relative commands have not been completed.

The trail again commands include: T, chuck control(M10/M11) and tailstock control (M78//M79).

When the system executes these commands, it has not checked the corresponding valid input signals, and has not completed the command operations in the limit time, the system prompts whether the operator tries again. The system is in pause state when it prompts the trial message; at the moment, the operator should check the relative input signal and execute the troubleshooting.

After the failure is resolved, the operator presses R key execute again the command which is just now failure. After the re-execution is completed, the system is in pause state, and the operator presses "CYCLE START" to continuously the machine. When the re-execution is not correction, the operator should press "ESC" to exit the machining program.

d0__wait for stable speed before machining the thread

0:do not wait // whether the system checks the spindle speed is stable before machining thread.

1: wait // the system automatically checks whether the spindle speed is stable before machining thread, and waits the stable speed to machine thread.

// The parameter is valid to G33, G92, G32, G34.

// The system checks the spindle speed instantaneously; when the spindle raises speed or reduces speed, the system waits for the process to end and then machines the thread. When the system executes immediately the thread command after changing the speed, maybe the checking spindle speed function is invalid.

Example: in S1000 stable state, the system executes S200, and immediately executes G33, the system immediately executes the program for check speed being stable, at the moment, the system judges by mistake in S1000 stable state it is "having been stability"; because there is the time difference between the system command and the spindle speed. It should suggest that the operator should delay 0.3s between S200 and G33.

When the spindle with the low speed (below 10r/min) executes the thread cutting, the system cannot have checked the spindle speed stability for a long time; at the moment, the parameter should be set to "0" to cancel the function.

【Safety setting 3】__Bit parameter 419（Password level: 3）

d7	d6	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved

d7__ Whether turn OFF the spindle or not when drive unit alarm occurs:

0: **No** // When a drive unit alarm is detected, the spindle is not turned OFF.

1: **Yes** // When a drive unit alarm is detected, the spindle is turned OFF.

d6__ The M state change is:

0： Not prompted // The state change of spindle, chuck and tailstock is not prompted in the system.

1： Prompted // The state change of spindle, chuck and tailstock is prompted in the system.

// During AUTO machining, if you want to stop in the madhining process, you need to turn OFF the spindle, and later turn ON it, then, press CYCLE START to continue. Sometimes you may forget to turn ON the spindle, which may cause accident. Set P419_d6 to 1 can prevent such thing from happening.

// When P419_d6=1, in the initial state of single block or stop, the state of spindle（M3/M4/M5）, chuck（M10/M11） and tailstock（M78/M79）are stored in the system. Press CYCLE START, the system will first identiy whether the state is the same with the previous one. If not, a pop-up window is displayed prompting the changed contents. You can press Y to continue or press N to exit.

【Debugging setting】**__bit parameter P404(password level：2)**

d7	d6	d 5	d 4	d 3	d 2	d 1	d 0

The parameter is set for being convenient to the system being debugging, must be set to the valid state in power-on, otherwise, it cannot play a role in protection.

d7__emergency stop alarm

0： check. // the external emergency stop signal function is valid.

1： shield. // the external emergency stop signal function is invalid.

d6__hardware limit alarm

0： check. // the hardware limit alarm function is valid.

1： shield. // the hardware limit alarm function is invalid.

d5__drive unit alarm

0： check. // the drive unit alarm function is valid.

1： shield. // the drive unit alarm function is invalid.

d4__mechanical software limit alarm

0： valid. // the mechanical software limit alarm function is valid.

1： invalid. // the mechanical software limit alarm function is invalid.

d3__tool nose software limit alarm

0： valid. // the tool nose software limit alarm function is valid.

1： invalid. // the tool nose software limit alarm function is invalid.

d2__254 program limit

0： forbidding motion command. // M60～M74 blocks forbid all G command (except for G04) .

1： permitting. // M60～M74 are the user customized commands. The block permits G commands according to the program format to compile programs.

d1__hardware limit alarm level

0：LOW. // the hardware limit alarm LOW is valid.

1： HIGH. // the hardware limit alarm HIGH is valid.

d0__254 program solidifying limit

0： forbidding. // forbid modifying and solidifying No. 254 program, i.e. forbid modifying the customized command.

1： permitting. // permit modifying and solidifying No. 254 program, i.e. permit modifying the customized command.

Whether the system permits modifying the solidified program and then solidifies is determined by the machine manufacturer.

4.6.4.11 Motor drive bit parameter __ P405

【Motor drive】__bit parameter P405(password level：2)

d7	d6	d 5	d 4	d 3	d 2	d 1	d 0

The parameter sets whether the motor working state is controlled by Y.

d7__Z motor direction;

d6__X motor direction;

d5__Y motor direction;

0： positive.

1： negative. // setting the motor direction parameter can change the motor rotation direction without changing others. The tool post actual movement direction is the same with the system defining direction.

d4__Z drive unit alarm level;

d3__X drive unit alarm level;

d2__Y drive unit alarm level;

0： HIGH. // "Drive unit alarms" when Z, X, Y drive unit alarm input signal is HIGH.

1： LOW. // "Drive unit alarms" when Z, X, Y drive unit alarm input signal is LOW.

d1__controllable axis

0： without Y. // forbid using Y movement command.

1： with Y. // the controllable axis has Y, permits Y movement command.

d0__motor raising speed control

0： linear. // the motor reducing speed uses the linear control.

1： exponential. // the motor raising speed curve is the exponential curve or the tuned exponential curve.

4.6.4.12 Parameters related to other interfaces __ P412, P330～P332

【Relative interfaces】__bit parameter P412(password level：2)

d7	d6	d 5	d 4	reserved	d2	d 1	d0

d7__external start/pause signal

0： none. // the external start and pause signals are invalid.

1： have. // the external start and pause signals are valid.

d6__external feed hold knob

0： none. // the system external feed/spindle hold knob interface is invalid.

1： have. // the system external feed/spindle hold knob interface is valid.

d5__pressure low check function

0： none.

1： have. // the system has the pressure low check function; **P412_d4** sets the alarm level.

d4__pressure low alarm level

0： HIGH. // it is not connected with 0V.

1： LOW. // it is connected with 0V. when the system pressure low alarm check function is selected, the system has checked the pressure low alarm signal PRES is valid and the signal hold time exceeds P332 setting value, the system prompts "Pressure low alarm; at the moment, the axis feed pauses, the spindle stops and the automatic cycle cannot start.

d2__ M73 in MANUAL/AUTO reset is

0: Not performed. // In MANUAL/AUTO operation mode, when the emergency alarm is valid, the system only executes the standard alarm stop function.

1: Performed. // In MANUAL/AUTO operation mode, when the emergency alarm is valid, the system executes the solidified M73 custom command after executing the standard emergency stop alarm. Refer to Section 4.1.4.7 "Reset Operation" for details.

d1__ M74 in MANUAL/AUTO reset is

0: Not Performed. // In MANUAL/AUTO operation mode, when the emergency alarm is valid, the system only executes the standard alarm stop function.

1: Performed. // In MANUAL/AUTO operation mode, when the emergency alarm is valid, the system executes the solidified M74 custom command after executing the standard emergency stop alarm. Refer to Section 4.1.4.3 "Emergency Stop Alarm" for details.

d0__miscellaneous function input pin macro programming

0： do not permit. // forbid the statement programming to the defined standard input signal pin, execute the statement programming to the "UI" pin displayed in the diagnosis window.

1： permit. // permit executing the statement programming to all input signal pin.

【Automatic lubricating start time(s) 】__auxiliary parameter P330：

The parameter defines the lubricating start time. (unit: s)

【Automatic lubricating interval time(s) 】__auxiliary parameter P331

The parameter defines the automatic lubricating time interval (unit: s)

【Durable pressure low alarm time(s) 】__ auxiliary parameter P332

The parameter defines the hold pressure low alarm time. (unit: s)

4.6.4.13 Auxiliary parameter __ P413～P416, P333

【Window language 】__bit parameter P413(password level：2)

d7	d6	d 5	Reserved	d 3	Reserved	Reserved	Reserved

d7__window language

0：Chinese. // display in Chinese.

1：English. // display in English. (the option is invalid presently)

d6__system parameter and programming

0：diameter. // X command value is input in diameter, and X coordinate is displayed in diameter.

1：radius. // X command value is input in radius, and X coordinate is displayed in radius.

// X coordinate value is expressed in radius and diameter. When the bit parameter is modified, the system prompts whether it changes the parameter, if done, it changes the reference coordinate parameters P001, P004, P007, P011, P012, P017, P018, P022, P025.

// After the bit parameter is modified, the system executes tool setting and programming again, otherwise, X data is not correct.

d5__coordinate system setting

0：front tool post. // the front tool post coordinate system definition: as **PROGRAMMING Chapter One Fig. 1-1**.

1：rear tool post. // the rear tool post coordinate system definition: as **PROGRAMMING, Chapter One Fig. 1-1**.

// the parameter is used to displaying the imaginary tool nose number icon in manual tool setting; in the manual tool setting, the system uses the parameter to judge whether the operator uses the front or rear tool post coordinate system to correctly display the position relationship between the tool nose center and imaginary tool nose.

d3__least command unit

0：metric. // the command value unit is mm.

1：inch. // the command value unit is inch. (the option is invalid presently)

【Display window】__bit parameter P415(password level：3)

d7	reserved	reserved	reserved	d3	reserved	reserved	reserved

d7__parameter window prompt range

0：close. // close the parameter value range prompt;

1：open. // open the parameter value range prompt;

d3__diagnosis window prompt

0： close. // close the prompt message in DIAGNOSIS working mode.

1： open. // open the prompt message in DIAGNOSIS working mode.

【Communication interface】__bit parameter P414(password level：2)

d7	d6	Reserved	Reserved	Reserved	Reserved	Reserved	d0

d7__baud rate selection(P414_d6=0 valid)

0： 9600.

1： 19200.

d6__baud rate selection(prior)

0： it is determined by d7.

1： 38400.

Bit selection	Baud rate
d7 =0， d6 =0	9600
d7 =1， d6 =0	19200
d7 =0，d6=1 d7 =1，d6=1	38400

d0__debugging function bit

0： normal state. // the user is generally set to the normal state.

1： debugging state. // use in debugging software.

【Function switch】__bit parameter P416(password level：3)

d7	d6	d 5	d 4	reserved	reserved	reserved	d0

d7__memorize current password level

0： do not memorize. // do not memorize the password level，the system displays Please input user password when the system enters the parameter password input window.

1： memorize. // **memorize the parameter** password level, enter the previous memorized parameter setting window.

d6__delete all program operation in EDIT working mode

0： permit. // permit to delete all programs in EDIT working mode.

1： forbid. // forbid to delete all programs in EDIT working mode.

d5__clear all offset operations in OFFSET working mode

0： permit. // permit to delete all offset values in OFFSET working mode.

1： forbid. // forbid to delete all offset values in OFFSET working mode.

d4__close drive unit enabling in JOG working mode

0：forbid. // press “Delete” in JOG working mode, forbid closing the drive unit.

1： permit. // press “Delete” in JOG working mode, permit closing the drive unit.

d1__Parameter display selection

0: All are displayed. //Both the alterable and unalterable parameters are displayed according to the parameter password level.

1:Alterable items are displayed. // Only the alterable parameters are displayed according to the parameter password level.

d0__modify machining programs in EDIT working mode

0： **permit.** // program lock function is invalid, permit modifying the machining program on the operation panel in EDIT working mode.

1： **forbid.** // program lock function is valid, forbid modifying the machining program on the operation panel in EDIT working mode, otherwise, the system alarms.

【Automatic interval of line number】__ auxiliary parameter P333

The parameter defines the incremental value of the block number before and after the system automatically creates the block number, i.e. the different value between two line numbers in EDIT working mode.

【Y axis reverse reset coordinates】__ Reference coordinate parameter P027

When Y axis is used for spindle or worktable reverse control, the reversed coordinate should be set within the range of this parameter. For example, when Y axis performs 360 degree reverse rotation, P027 should be set to 360.000; when Y axis moves, its tool nose coordinate and machine coordinate vary between 0～359.999.

When P027 is zero, this coordinate reset function is invalid; the range of setting is 0~9999.

【Record alarm】__bit parameter P417（password level：2）

d7	d6	d 5	d 4	d3	reserved	reserved	reserved

This parameter set whether the alarm is recorded. When it is set to 0, alarm is recorded; in following occasions alarm should be recorded: program changed, emergency stop, alarm in MANUAL/AUTO mode. Alarm messages can be divided into:

P417 bit parameter (record or not)	P418 bit parameter (display or not)	Message
d7	d7	Alarm in parameter/tool offset mode (E001~E099)
d6	d6	Alarm in EDIT mode (E101~E199)
d5	d5	Program related alarm (E201~E299, E601~E699)
d4	d4	M03/M04/M05 start/stop
d3	d3	Tool change
	d0	Emergency stop alarm, alarm in MANUAL/AUTO mode (E301~E499)
		Change program in EDIT mode

d7__ Record parameter/tool offset alarm or not:

0： **Record** // Record the alarms in parameter/tool offset mode;

1：**Not record** // Does not record the alarms in parameter/tool offset mode;

d6, d5, d4, d3__ Record EDIT/program/ spindle/ tool change alarm or not:

0: Yes

1: No

【Alarm display】__bit parameter P418（password level: 3）

d7	d6	d 5	d 4	d 3	reserved	reserved	d0

This parameter set whether the recorded alarm message is to be displayed or not; when it is set to 0, alarm is displayed; messages for program change are all displayed; the displayed contents are:

d7__ display parameter/tool offset :

0: Yes // Displays all alarms in parameter/tool offset mode;

1: No // Does not display all alarms in parameter/tool offset mode;

d6, d5, d4, d3, d0__ Display EDIT/program/ spindle/ tool change alarm or not:

0: Yes

1: No

【Note】

Alarm record is just a look-up function in special occasions; do not use it in normal circumstances.

4.6.4.14 Interface parameter __P500～P556

The system has the main devices including the spindle, the chuck, the tailstock, the tool post control and function, and the additional device control and check function. The former has the fixed signal pin, and the system does not set the fixed signal pin for the additional device determined by the manufacturer according to the actual condition of the machine.

When the unused signal of the main device has been released, the system adds the signal required by the additional device by setting the interface parameter, so, the system can control and check the additional device.

The system judge whether the interface parameter covers the input and output interface. P500～P510 are output interface parameter, and P511～P540 are input interface parameter.

P541～P556 are used the tool selection signal encode. When **P408_d7** is set to 1 (tool position signal detection method: table look-up), P541～P556 are used to setting tool selection check signal.

The interface parameter value is 0, i.e. covering the input or output interface; the setting value is the serial number of general signal name, i.e. pin corresponding to the covered input or output general signal name. The interface initial value is 0, i.e. the system does not use the parameter function, i.e. does not cover the pin.

When the input/output pin has been used by other functions, the interface parameter cannot be set to regular signal name and the system prompts: ［Parameter alarm］- illegal I/O setting, input or output pin has been covered.

Search some pins have not been covered in DIAGNOSIS working mode, which are displayed in white, and which names are displayed in the general signal names. Input/output pin serial number in the diagnosis window: increase from the number 1 from top to bottom, from left to right.

Standard definition and function of interface parameter are referred to **OPERATION, Appendix 4.6.5.8 Interface Parameter List**.

【Example】

When P511 SAGT is set to 5, SAGT covers the input interface UI05; UI05 pin inputs the safety door check function.

When P506 M320 is set to 9, M320 covers the output interface UO09; UO09 pin outputs the lubricating control function.

4.6.4.15 Variable initial value __P600～P639

The initial value of variable parameter P600～P639 correspond to the variable initial value r001～r040; the concrete variable explanation is referred to **PROGRAMMING, Chapter 9 Statement Programming**.

4.6.4.16 Related parameter of G76 __P336～P339

When G76 is executed, the related parameters of G76 can get the relative information of the thread machining in advance, and the system automatically arrange the thread cutting and finally machines the qualified thread .

【G76 tool angle P】__auxiliary parameter P336

The parameter determines the angle of the neighboring two teeth. The actual angle is determined by the tool angle and so P336 angle should be same that of the tool. Unit: degree.

【G76 finishing times L】__auxiliary parameter P337

The parameter determines the thread finishing times.

【G76 finishing cutting amount R】__ auxiliary parameter P338

The parameter determines the cutting amount of thread finishing. Unit:mm.

【G76 least cutting amount Q in roughing】__auxiliary parameter P339

The parameter determines the least cutting amount of thread roughing. Unit: mm.

【Note】

1) When the system executes G76 ①，it automatically loads separately the values of P, L, R, Q fields in G76 ① to P336, P337, P338, P339, because it must need these parameters in executing ②.
2) When some or all of P, L, R, Q in G76 ① are ignored，it executes G76② according to P336, P337, P338, P339 setting values.

4.6.4.17 M87/M88 related parameter__P342, P343

See Section 4.4.3.5 in PROGRAMMING for details.

4.6.5 Appendix: parameter list

4.6.5.1 Reference parameter list

Parameter No.	Level	Name	Unit	Initial value	Range	Operator backup
P000	3	Z program reference point	mm	200.000	-99999.999～+99999.999	
P001	3	X program reference point	mm	150.000		
P002	3	Y program reference point	mm	100.000		
P003	3	Z 2nd program reference point	mm	210.000		
P004	3	X 2nd program reference point	mm	160.000		
P005	3	Y 2nd program reference point	mm	110.000		
P006	3	Z 3rd program reference point	mm	220.000		

P007	3	X 3rd program reference point	mm	170.000		
P008	3	Y 3rd program reference point	mm	120.000		
P009	3	Z tool positive(tool nose) software limit	mm	8000.000		
P010	3	Z tool negative software limit	mm	-8000.000		
P011	3	X tool positive software limit	mm	8000.000		
P012	3	X tool negative software limit	mm	-8000.000		
P013	3	Y tool positive software limit	mm	8000.000		
P014	3	Y tool negative software limit	mm	-8000.000		
P015	2	Z positive(mechanical) software limit	mm	8000.000		
P016	2	Z negative software limit	mm	-8000.000		
P017	2	X positive software limit	mm	8000.000		
P018	2	X negative software limit	mm	-8000.000		
P019	2	Y positive software limit	mm	8000.000		
P020	2	Y negative software limit	mm	-8000.000		
P021	1	Z zero coordinate	mm	300.000		
P022	1	X zero coordinate	mm	200.000		
P023	1	Y zero coordinate	mm	200.000		
P024	2	Z zero offset value	mm	0	0～10	
P025	2	X zero offset value	mm	0	0～10	
P026	2	Y zero offset value	mm	0	0～10	
P027	2	Y axis return zeroing coordinate		0	0～9999	

4.6.5.2 Motion parameter list

Parameter No.	Parameter level	Parameter name	Unit	Stepper initial value	Servo initial value	Range	User backup
P100	2	Z rapid traverse speed limit	mm/min	5000	7600	1～30000	
P101	2	X rapid traverse speed limit	mm/min	2500	3800	1～30000	
P102	2	Y rapid traverse speed limit	mm/min	5000	6000	1～30000	
P103	2	Z lowest initial speed	mm/min	300	600	1～10000	
P104	2	X lowest initial speed	mm/min	150	300	1～10000	
P105	2	Y lowest initial speed	mm/min	300	600	1～10000	
P106	2	Z rapid feed acceleration/ deceleration time(ms)	ms	400	200	1～8000	
P107	2	X rapid feed acceleration/ deceleration time(ms)	ms	400	200	1～8000	
P108	2	Y rapid feed acceleration/ deceleration time(ms)	ms	400	200	1～8000	
P109	1	Z zero return low speed	mm/min	100	100	0～2000	
P110	1	X zero return low speed	mm/min	100	100	0～2000	
P111	1	Y zero return low speed	mm/min	100	100	0～2000	
P112	2	Initial speed in cutting feed	mm/min	100	200	1～9999	
P113	2	Max. speed limit in cutting feed	mm/min	4000	5000	1～15000	
P114	2	Linear acceleration/ deceleration time in cutting feed(ms)	ms	500	300	1～8000	
P115	2	Exponential acceleration/ deceleration time in cutting feed(ms)	ms	500	300	1～8000	
P116	2	acceleration/ deceleration time in thread cutting(ms)	ms	400	200	1～8000	
P117	2	acceleration/ deceleration time in thread run-out ms)	ms	300	200	1～8000	
P118	2	G99 initial lines		0	0	0～30000	
P119	2	Delay time when orientation is switched to cutting（ms）	ms	100	100	0～1000	

4.6.5.3 Transmission parameter list

Parameter No.	Parameter level	Parameter name	Unit	Initial value	Range	User backup
P200	2	Z backlash	mm	0.000	0～10.000	
P201	2	X backlash	mm	0.000		

P202	2	Y backlash	mm	0.000		
P203	1	Z command pulse multiplication ratio		1	1～99999	
P204	1	Z command pulse division coefficient		1		
P205	1	X command pulse multiplication ratio		1		
P206	1	X command pulse division coefficient		1		
P207	1	Y command pulse multiplication ratio		1		
P208	1	Y command pulse division coefficient		1		
P209	1	Spindle encoder lines		1200	100～5000	
P210	0	Undefined(reserved)		0.000	-1.000～1.000	

4.6.5.4 Auxiliary parameter list

Parameter No.	Parameter level	Parameter name	Unit	Initial value	Range	User backup
P300	2	Max. speed of spindle M41	r/min	1000	0～99999	
P301	2	Max. speed of spindle M42	r/min	2000		
P302	2	Max. speed of spindle M43	r/min	3000		
P303	2	Max. speed of spindle M44	r/min	4000		
P304	2	Lowest speed limit of constant surface speed	r/min	100		
P305	2	Max. speed limit of constant surface speed	r/min	8000		
P306	2	Thread smooth speed borderline	r/min	100	1～9999	
P307	2	Thread spindle wave alarm	r/min	100	1～99999	
P308	2	Spindle JOG time 1(ms)	ms	0	1～99999	
P309	2	Speed in spindle JOG	r/min	200	0～99999	
P310	1	Covered line of spindle gear control		4	0～4	
P311	2	Frequency spindle gear shifting time 1 (ms)	ms	100	1～99999	
P312	2	Frequency spindle gear shifting time 2 (ms)	ms	100	1～99999	
P313	2	Spindle gear switch interval time(ms)	ms	100	1～99999	
P314	2	Output voltage in spindle gear shifting(mV)	mV	0	0～10000	
P315	2	Spindle stop brake delay time(ms)	ms	100	1～99999	
P316	2	Spindle brake output time(ms)	ms	1000	1～99999	
P317	2	Spindle max. speed limit	r/min	8000	1～99999	
P318	1	Tool post type(0__9)		1	0～9	
P319	1	Max. tool number		4	1～16	
P320	1	Covered line quantity of tool signal		4	1～8	
P321	2	Too change T1 time(ms)	ms	100	1～99999	
P322	2	Too change T2 time(ms)	ms	100	1～99999	
P323	2	Too change T3 time(ms)	ms	100	1～99999	
P324	2	Tool post CCW locking time(ms)	ms	1000	1～99999	
P325	2	Tool change indexing time upper (ms)	ms	10000	1～99999	
P326	2	Spindle controlling pulse time(ms)	ms	10	1～99999	
P327	2	Chuck controlling pulse time(ms)	ms	10	1～99999	
P328	2	Tailstock controlling pulse time(ms)	ms	10	1～99999	
P329	2	M respond check time(ms)	ms	5000	1～99999	
P330	3	Automatic lubricating start time(s)	s	60	0～99999.999	

P331	3	Automatic lubricating interval time(s)	s	600	0～99999.999	
P332	3	Durable pressure low alarm time(s)	s	600	0.001 ～ 99999.999	
P333	3	Program line number automatic interval		10	0～100	
P336	3	G76 tool angle P	degree	0.000	0～99.000	
P337	3	G76 time of finishing L		1	1～99	
P338	3	G76 cutting value during finishing R	mm	0.000	0～99.999	
P339	3	G76 min. cutting value during roughing Q	mm	0.000	0～99.999	
P341	2	Cutting enabled when a percentage of rotation speed is reached		0	0～90	
P342	2	M87 communication delay（ms）	ms	0	0～2000	
P343	2	M87 communication address (decimal system)		0	0～99999	

4.6.5.5 Bit parameter

Set the corresponding bit to 0 or 1 to realize the different control functions and to meet all kinds of requirements of different machines.

Parameter number	Parameter level	Parameter name	Initial value	Range	User backup
P400	3	Running setting	00000100	00000000～11111111	
P401	3	Efficiency setting	00000000		
P402	2	Safety setting 1	01000000		
P403	2	Safety setting 2	00100001		
P404	2	Debugging setting	00000000		
P405	2	Motor drive	00011100		
P406	1	Zero setting 1	00000000		
P407	1	Zero setting 2	00000000		
P408	2	Tool post setting	00000000		
P409	1	Chuck tailstock (hydraulic system)	00000000		
P410	1	Spindle configuration	00000000		
P411	2	Precision compensation	00000010		
P412	2	Other interfaces	00000000		
P413	2	Interface language	00000000		
P414	2	Communication interface	00000000		
P415	3	Display window	10001000		
P416	3	Functional switch	00000000		
P417	2	Record alarm	00000000		
P418	3	Alarm display	00000000		
P419	2	Safety setting 3	00000000		

4.6.5.6 Interface parameter list

Parameter No.	Parameter level	Signal name	Function	Standard definition and function	I/O	Initial value	Range	Backup
P500	1	M210	User command output		**O**	0		
P501	1	M230	User command output		**O**	0		
P502	1	LMP3	Program run signal indicator 3	Applied to three-color light control(green)	**O**	0		
P503	1	LMP2	Alarm indicator control signal 2	Applied to three-co	**O**	0		
P504	1	LMP1	Alarm indicator control signal 1	Applied to three-color light control(red))	**O**	0		

P505	1	MDLY	Machine electricity delay Power-on control signal		**O**	0		
P506	1	M320	Lubricating control switch	Control lubricating switch on machine	**O**	0		
P507	1	TZD	Tool post worktable brake output	Applied to SWD120, AK31, SBWD-80 tool post	**O**	0		
P508	1	TFD	Tool post worktable pregraduation output	Applied to AK31, SBWD-80 tool post	**O**	0		
P509	1	A001	Reserved		**O**	0		
P510	1	A002	Reserved		**O**	0		
P511	1	SAGT	Safety door check	Check the machine safety door state	**I**	0		
P512	1	Dalm	Feed device alarm check	Check feed device state in M20	**I**	0		
P513	1	M41I	Gear shifting in-position signal	Use frequency spindle in-position check signal M41	**I**	0		
P514	1	M42I	Gear shifting in-position signal	Use frequency spindle in-position check signal M42	**1**	0		
P515	1	M43I	Gear shifting in-position signal	Use frequency spindle in-position check signal M43	**I**	0		
P516	1	M44I	Gear shifting in-position signal	Use frequency spindle in-position check signal M44	**I**	0		
P517	1	M91I	User command input		**I**	0		
P518	1	M93I	User command input		**I**	0		
P519	1	RM78	Tailstock forward in-position check	Use in using hydraulic tailstock	**I**	0		
P520	1	RM79	Tailstock backward in-position check	Use in using hydraulic tailstock	**I**	0		
P521	1	Wsp	External MPG emergency stop	Applied to external MPG	**I**	0		
P522	1	WsY	External MPG axis selection Y	Applied to external MPG	**I**	0		
P523	1	WsX	External MPG axis selection X	Applied to external MPG	**I**	0		
P524	1	WsZ	External MPG axis selection Z	Applied to external MPG	**I**	0		
P525	1	Wbk2	External MPG override 2	Applied to external MPG	**I**	0		
P526	1	Wbk1	External MPG override 1	Applied to external MPG	**I**	0		
P527			Reserved					
P528	1	TFDC	Pre-graduation in-position check	Applied to AK31, SBWD-80 tool post	**I**	0		
P529	1	TXT	Tool selection strobe signal	Applied to AK31, SBWD-80 tool post	**I**	0		
P530	1	TGR	Tool post overheat check	Applied to AK31, SBWD-80 tool post	**I**	0		
P531		B001	Reserved					
P532	1	G31I	G31 input check	Define G31 input interface，G31 function is valid	**I**	0		
P533 ～ P540	1	B003 ～ B010	Reserved		**I**	0		
P541 ～ P556	1		No. 1～16 tool selection check signal	Used for multi-tool selection signal encode	**I**	0	0～255	

【Notes】

1) Bit parameter P409_d4 =1：when the tailstock control function is valid; the tailstock forward in-position check RM78, RM79 interface are invalid.

2) Bit parameter P410_d6 =0：when spindle S gear shifting controls; gear shifting in-position signal M41I, M42I, M43I, M44I interfaces are invalid**.**

4.6.5.7 Variable initial value list

Parameter number	Parameter level	Parameter name	Initial value	range	User backup
P600～P639	3	r001～r040	0	-99999999～99999999	

4.6.5.8 Pitch compensation parameter list

Parameter No.	Name(constant interval mode)	Range	Name (variable interval mode)	Range
P1000	Compensation value(um)	-1000～+1000	Z 1st compensation position point(mm)	0～9999.999
P1001	Compensation value(um)	-1000～+1000	Z 1st point compensation value(um)	-1000 ～ +1000
P1002 ～ P1299	Compensation value(um)	-1000～+1000	Z compensation position point(mm) ～ Z compensation value(um)	0-9999.999 ～ -1000 ～ +1000
P1300	Compensation value (um)	-1000～+1000	X 1st compensation position point(mm)	0-9999.999
P1301	Compensation value(um)	-1000～+1000	X 1st point compensation value(um)	-1000 ～ +1000
P1600	Compensation value (um)	-1000～+1000	Y 1st compensation position point(mm)	0～9999.999
P1601	Compensation value(um)	-1000～+1000	Y1st point compensation value(um)	-1000 ～ +1000
P1900	Z pitch measured starting point position in machine coordinate system	-9999.999~9999.999	It is same as the left parameter name	It is same as the left parameter range
P1901	X pitch starting point position in machine coordinate system(mm)	-9999.999~9999.999		
P1902	Y pitch starting point position in machine coordinate system(mm)	-9999.999~9999.999		
P1903	Z pitch compensation interval(mm)	0～999.999		
P1904	X pitch compensation interval(mm)	0～999.999		
P1905	Y pitch compensation interval(mm)	0～999.999		

【Notes】: 1. Pitch compensation parameter is 1 level.

2. P1903～P1905 pitch compensation interval range：0～999.999，but the interval should not be less than 0.256mm.

4.6.5.9 Parameter list related to command forbidden

Some command names related to some parameter setting are forbidden; once the parameter setting makes the command name forbidden conditions are created, the system forbids all corresponding commands and functions. Parameters which are related to the command forbidden are as follows:

Command name	Command function	Note: commands are forbidden when the following are valid
M41～M44	Automatic spindle gear shifting control	P410_d6 =0：spindle S control: gear shifting
S05～S16	Spindle S control	P410_d6=0 and P410_d5=0： Only input S00～S04 in spindle gear shifting output
M47～M48		P410_d4=0：do not switch the spindle and Y
M32～M33	Lubricating function	Interface P506=0
M04	Spindle rotation CCW	P410_d2=1：do not use the spindle CCW signal output
M10～M11	Workpiece clamped/ released	P409_d7=1：chuck control function is invalid
M78～M79	Tailstock forward/ backward	P409_d4=1：tailstock control function is invalid
Commands related to Y		P405_d1=0：without Y
Pin programming command	r1001～r1032	P412_d0=0 ：forbid the pin programming in miscellaneous function input

4.6.5.10 Parameter list related to output interface release

The parameter setting can ensure the interfaces are not used for the standard signals, at the moment, the interface release can be used for the general output interface; the interface parameters can be defined to the released output interface. Parameters related to output interface release are as follows.

Standard signal name	Function	General I/O	Variable name	Note: the parameter defines the release to be the variable
M79	Tailstock backward	UO16	r2016	P409_d4=1: tailstock control function is invalid
M78	Tailstock forward	UO15	r2015	P409_d4=1: tailstock control function is invalid
M10	Chuck clamping	UO14	r2014	P409_d7=1: chuck control function is invalid
M11	Chuck releasing	UO13	r2013	P409_d7=1: chuck control function is invalid
TL+	Tool post CW output	UO12	r2012	P318=0: line-up tool P318=9：M60 customizes the command to tool change
TL-	Tool post CCW output	UO11	r2011	P318=0: line-up tool P318=9：M60 customizes the command to tool change
M8	Cooling ON	UO10	r2010	
M9	Cooling OFF	UO09	r2009	P410_d7=0: spindle control: level mode
MSP	Spindle brake signal	UO08	r2008	P410_d3=1: spindle brake signal output none
M3	Spindle rotation CW	UO07	r2007	
M4	Spindle rotation CCW	UO06	r2006	P410_d2=1: spindle CCW rotation signal needless
M5	Spindle stop	UO05	r2005	P410_d7=0: spindle control: level mode
S04/M44	Spindle gear output	UO04	r2004	P310<4: release the signal cover 0/1/2/3 channel
S03/M43	Spindle gear output	UO03	r2003	P310<3 release the signal cover 0/1/2 channel
S02/M42	Spindle gear output	UO02	r2002	P310<2: release the signal cover 0/1 channel
S01/M41	Spindle gear output	UO01	r2001	P310=0: release the signal cover 0 channel

4.6.5.11 Parameter list related to input interface release

The parameter setting can ensure the interfaces are not used for the standard signals, at the moment, the interface release can be used for the general input interface; the interface parameters can be defined to the released input interface. Parameters related to input interface release are as follows:

Standard signal name	Function	General I/O name	Variable name	Note: the parameter defines the release to be the variable
+LT	Z/X/Y positive limit	UI32	r1032	P404_d6=1: shield hardware limit alarm
-LT	Z/X/Y negative limit	UI31	r1031	P404_d6=1: shield hardware limit alarm
DecY	Y axis deceleration signal	UI30	r1030	P405_d1=0: without Y P406_d5=0: without Y machine deceleration switch
DecX	X axis deceleration signal	UI29	r1029	P406_d6=0: without X machine deceleration switch
DecZ	Z axis deceleration signal	UI28	r1028	P406_d7=0: without Z machine deceleration switch
SP	External pause signal	UI27	r1027	P412_d7=0: without external start/ pause signal
ST	External cycle start signal	UI26	r1026	P412_d7=0: without external start/ pause signal
MXZ1	Feed hold signal	UI16	r1016	P412_d6=0: without external feed hold knob
MXZ2	External spindle/feed hold signal	UI15	r1015	P412_d6=0: without external feed hold knob
RM10	Chuck clamping in-position check	UI14	r1014	P409_d7=1: chuck control function is invalid P409_d5=0: do not need the chuck respond check
RM11	Chuck releasing in-position check	UI13	r1013	P409_d7=1: chuck control function is invalid P409_d5=0: do not need the chuck respond check
TPS	Hydraulic tailstock foot switch input	UI12	r1012	P409_d4=1: tailstock control function is invalid P409_d0=1: no hydraulic tailstock foot switch input
SHL	Hydraulic chuck foot switch input	UI11	r1011	P409_d7=1: chuck function control function is invalid P409_d1=1: no hydraulic chuck foot switch input
PRES	Pressure low check	UI10	r1010	P412_d5=0: without pressure low check
TCP	Tool post locking in-position signal	UI09	r1009	P318=0: line-up tool post P318=9：M60 customizes the command tool change P408_d6=0: without tool post lock in-position signal
T1	Tool post position signal T1	UI01	r1001	P318=0 or 9
T2	Tool post position signal T2	UI02	r1002	P318=0 or 9: P320<2 release
T3	Tool post position signal T3	UI03	r1003	P318=0 or 9: P320<3 release
T4	Tool post position signal T4	UI04	r1004	P318=0 or 9: P320<4 release
T5	Tool post position signal T5	UI05	r1005	P318=0 or 9: P320<5 release
T6	Tool post position signal T6	UI06	r1006	P318=0 or 9: P320<6 release
T7	Tool post position signal T7	UI07	r1007	P318=0 or 9: P320<7 release
T8	Tool post position signal T8	UI08	r1008	P318=0 or 9: P320<8 release

4.7 OFFSET Working Mode

OFFSET working mode: the system executes the compensation to the tool offset. The system prompts the corresponding intellective prompt message for each operation. At the same time, the operator can press the prompt key hp2 at the right top, and the detailed offset operation key.

The relative settings, operation input formats and example descriptions are as follows: all required function keys are expressed with icons; all input letter keys, or digit keys are expressed with underline; the system prompting message is expressed with frame.

Press  to cancel the mistaken input when the input letters or digits are wrong.

Press 

to exit the current operation before confirmation when the operator executes some setting or some operation or man-machine dialog.

The system sets 64 groups of tool offset value T01～T64, each tool offset number corresponds to one group. Each group separately records Z offset value, X offset value, R tool radius, T tool shape, S tool setting record. The operator can make the number of tool offset groups and the total number of used tools the same through manual tool setting. The other tool offset data can only be input from the keyboard. Whether the Y offset input is valid is set by bit parameter **P405_d1**; when **P405_d1=0**, Y offset value cannot be operated, which is displayed in grey on the screen.

◆ Main functions in OFFSET working mode include:

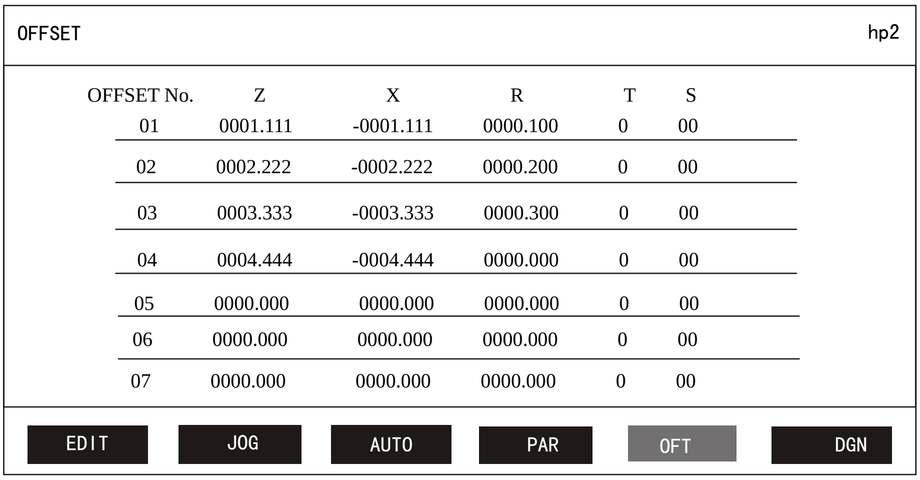
☆ Select, modify, clear tool offset data;

☆ Transmit tool offset data between U disc and CNC system by USB interface;

☆Transmit tool offset data between PC and CNC system by **RS232** communication interface;

☆Transmit tool offset data between two CNC systems by RS232 communication interface;

Press OFFSET to enter OFFSET working mode as Fig. 4-11:



OFFSET No.	Z	X	R	T	S
01	0001.111	-0001.111	0000.100	0	00
02	0002.222	-0002.222	0000.200	0	00
03	0003.333	-0003.333	0000.300	0	00
04	0004.444	-0004.444	0000.000	0	00
05	0000.000	0000.000	0000.000	0	00
06	0000.000	0000.000	0000.000	0	00
07	0000.000	0000.000	0000.000	0	00

Fig. 4-11 OFFSET working mode

4.7.1 Tool offset value search

The tool offset value search, i.e. search the required tool offset value as follows:

Method 1: scan

The operator can search the concrete content of each tool offset value in OFFSET working mode.

Press ⇧, ⇩ to search the previous or the next tool offset value. Press , to search the offset value on the previous page or the next page and there are 7 lines in each page.

Method 2: search

P + offset number + ENTER.

4.7.2 Input tool offset data by keyboard key

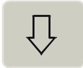
X, Z field range -8000.000 mm～8000.000mm; R field range: 0～8000.000mm;

T field range; integer 0～8 ; S field range: integer 0～16.

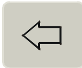
Input tool offset data method by the keyboard : absolute input and relative input as follows:

Absolute input of tool offset data:

1) Select OFFSET working mode.

2) Press , , ,  to move the highlight to the required tool offset number; or use the search method to find out the required tool offset number; press to move the highlight to the required Z offset value, X offset value, R tool radius, T tool shape, S tool setting record.

3) Press INPUT, or directly input the required data.

4) Input the required data by keyboard. Press  to cancel the mistaken input and input the correct again.

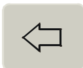
5) Press ENTER to confirm the input, save the input data to the current selected too offset number parameter area.

6) The data which has been modified has "*" before it , which means the modification is successfully executed.

Relative input of tool offset data:

1) Select the OFFSET working mode; move the highlight to the required changing data.

2) Press INPUT or directly input the required data.

3) Input data by keyboard. Press  to cancel the mistaken input data and input the correct. Press ALTER and the system operates the input data and the previous number value of the selected parameter. When the input is positive, the system adds the input data to the previous number value of the selected parameter to save the parameter area.

4.7.3 Offset value in each group clear

Offset value in each group clears as follows:

1） Select the tool OFFSET working mode.

2） Move the highlight to S tool setting record data which requires to clear.

3） Press delete to clear Z offset value, X offset value, R tool radius, T tool shape, S tool setting record.

4.7.4 Tool offset hp6 function

Press hp6 in OFFSET working mode and the display is as follows:

U – USB interface
R – RS232 interface
Z – OFT clear zero
ESC – exit

4.7.4.1 Communication and standard format of tool offset data

1. **USB interface transmitting offset data:**

U disc root catalogue needs to create the file "C928OFT", the tool offset file name rule "OFT+file number (3-digit)+ ".TXT" ten characters. The file number cannot be more than 254, otherwise, the system does not list it when it reads U disc. The tool offset file must be placed in C928OFT file.

2. RS232 interface transmitting offset data

The system transmits the software by RS232, the detailed is referred to **OPERATION, Chapter 5 RS232 and USB System Communication**.

3. Standard format of tool offset file on PC:

On PC, use TXT, LST text to edit the offset file, but the file name and file content must be compiled according to the required standard format and then are sent to the system, the concrete rules are as follows:

1) On PC, the offset file name should be named to TXT or LST suffix, such for "**OFT088.TXT**"; it is suggested that the user should use TXT suffix to operate the parameter file on PC.
2) The home of the file content must the offset mark: "CNC_GSKC001"; the item must exist. TXT
3) "//" is followed by annotation; the offset number, Z offset value, X offset value, tool radius, tool shape, tool setting record and Y axis offset value are listed.
4) The offset contents must be meet the standard format requirements.

   For example: T01： 00000.000， 00000.000， 00000.000， 0， 00， 00000.000

   - ◆ too number range(01～64) exceeds which is taken as the mistake;
   - ◆ Offset number format: T + number(01～64) + : ， they are necessary;
   - ◆ The offset data for each line must be separated by the comma;
   - ◆ There should be 6 offset data in each line at most, otherwise, the illegal character in the offset data.
   - ◆ When some line has not enough offset data(it is not composed of Z offset value,+ X offset value + R tool radius + T tool shape + S tool setting record), the offset processing arranges the offset data from left to right: Z offset value, X offset value , R tool radius , T tool shape , S tool setting record; the data before each line must be correct when the system updates the data following each line. Z, X, R values do not excess its separate range.

【Example】

CNC_GSKC001

//tool No.	Z tool offset	X tool offset	tool nose radius	imaginary tool nose	locking tool No.	Y offset
T01:	00000.000,	00000.000,	00002.000,	0,	00,	00002.000
T02:	00000.000,	00000.000,	00000.000,	0,	00,	00000.000
T03:	00000.000,	00000.000,	00000.000,	0,	00,	00000.000
T04:	00000.000,	00000.000,	00000.000,	0,	00,	00000.000
T05:	00000.000,	00000.000,	00000.000,	0,	00,	00000.000
T06:	00000.000,	00000.000,	00000.000,	0,	00,	00000.000
T07:	00000.000,	00000.000,	00000.000,	0,	00,	00000.000
……						
T63:	00000.000,	00000.000,	00000.000,	0,	00,	00000.000
T64:	00000.000,	00000.000,	00000.000,	0,	00,	00000.000

4.7.4.2 Offset data clear

P416_d5=0： the system permits to clear all offset value in OFFSET working mode, and the operators first presses hp6, and then z to clear all offset data.

4.8 **Diagnosis Working Mode**

In DIAGNOSIS working mode: the system real-time checks and displays the input/output interface state, spindle speed, encoder lines. Press hp2 at the top right to learn about the diagnosis operation keys

◆ Main functions in DIAGNOSIS working mode include:

☆ Auto diagnosis function;

☆ display the external signal states of input/output(I/O)interface;

☆ Diagnosis of spindle control function input, output signal;

☆ Diagnosis of tool post control function input, output signal;

☆ Diagnosis of each axis hardware limit signal;

☆ Diagnosis of each machine zero(machine reference point)signal;

☆ Diagnosis of spindle speed and encode lines.

Press 

to enter the DIAGNOSIS working mode and the display is as Fig.4-12:：

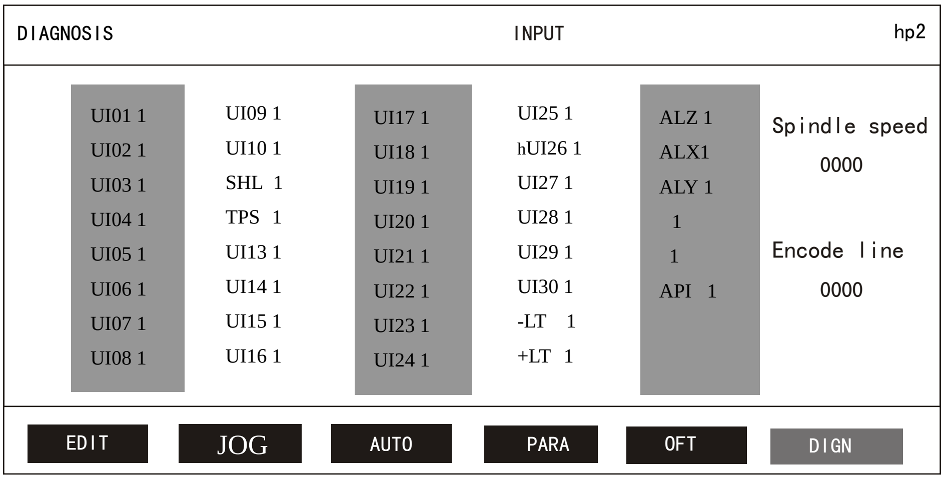
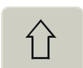
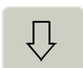
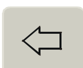
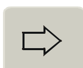


Fig. 4-12 Diagnosis working mode

4.8.1 Interface signal search

Firstly set **P415_d3**=1: search Chinese concrete content in each I/O in DIAGNOSIS working mode according the prompt in diagnosis window; when the parameter setting is closed, the operator cannot see the concrete Chinese content.

Press , , ,  to search each I/O, and the searched I/O is displayed in highlight.

Press  or  to display the input/output interface alternately.

4.8.2 Interface signal name display explanations

The system has 23-channel switching input signals, 18-channel switching output signals; each signal has one name, which means to be the signal definition.

General signal name: the input signal names are UI01~UI32, the output signal names are UO01~ UO32, each signal corresponds to one pin. UI17~UI25 are not exported and UO19~ UO32 are not exported in interfaces.

Standard signal name: is called exclusive signal name. For a special machine, once some signal is covered by some special function, it has special name used for memory. The system set the standard exclusive signal name for the used signal of all functions.

In the diagnosis display window, the signals used by the special functions are expressed with the standard signal name; it means the set function is valid in the parameter. The initial parameter has used most miscellaneous functions, so the displayed most pin signal number is the standard signal name, the displayed unused signal are the general signal name.

Detailed explanation and connection method of general signal name and standard signal name are referred to **CONNECTION.**

4.8.3 Input interface diagnosis explanation

In input interface diagnosis display, when one external signal is valid, the corresponding bit display is 0; when it is invalid, the display is 1. The input interface signal diagnosis is executed circularly, the system anytime displays the current signal state.

Input interface signal definition is defined by the parameter, changing corresponding setting of the parameter can change the input interface signal definition.

【Example】

When the standard configuration of the electronic tool post is 4 tool selections.

When the system allocates the electronic tool post with 4 tool selections, the diagnosis message is as follows:

P320 is set to 4; P319 is set to 4; P318 is set 1：electronic tool post.

The top left displays T1 ~ T4 diagnosis message in the diagnosis input interface window.

4.8.4 Output interface diagnosis explanation

Each bit display is 0 in the output interface diagnosis, the corresponding bit output is valid. When the display is 1, the corresponding bit output is invalid. The output interface diagnosis display is the current each output big hold state. When the signal is pulse, the bit is still 1 although the output is valid.

Output interface signal definition is defined by the parameter, and changing the corresponding setting of the parameter can change the definition of output interface signal.

4.8.5 Output interface operation function

Move the cursor by the direction key to the required writing output signal, press 1 or 0 to change the output signal value where the cursor is, when it is different with the current value, it is displayed in red; and it is the same with the current value, it is displayed in yellow.

【Note】

When the diagnosis output interface operation is used in the system debugging, the parameter password level is more than 2 to perform the operations.

4.8.6 Spindle encoder and spindle speed check

The system can check and display the pulse per rev of the spindle encoder, and the check result automatically displays the encoder lines.

The encoder lines mean the pulse per rev of the encoder.

The spindle speed means the current spindle actual speed(unit: r/min).

【Explanations】

1) When the spindle is not started, the displayed spindle speed is zero.

2) On initial page in DIAGNOSIS mode, when the spindle is started, if the checked encoder lines are not consistent with the P209 spindle encoder lines, the system prompts: [Diagnosis check prompts]: the encoder lines are not consistent with the parameter.

3) When the spindle encoder rotates synchronously with the spindle, i.e. when the spindle rotates one circle, the encoder rotates one circle; otherwise, the checked spindle speed is not consistent with the actual value.

4.8.7 Diagnosis hp6 function

Press hp6 in DIAGNOSIS screen, the following prompt is displayed:

Key 0 – See alarm message	Key 1 –See color code
Key 2 –Go to keyboard test	Key 3 –See CPLD pulse number
Key 4 – See version info.	Key 5 –Memory import/export
ESC -–Exit	

Key 0 – To see alarm message: display alarm record;

Key 1 – To see color code: Display 256 colors and codes; for example, 00 is black, FF is white;

Key 2 – Go to keyboard test: to test the keyboard;

Key 3 –See CPLD pulse number: Display X/Z/Y pulse number;

Key 4 – See version information: display system version information including software, CPLD version, and software version loading;

Key 5 – Memory import/export: The system memory is transmitted through U disc or RS232.

1. USB interface transmits memory data:

Create a folder named “C001RAM” under the root directory of U disc; the file name should be “RAM”+file number (3 digits)+”TXT” (10 characters in total). The file number should not larger than 999, otherwise, it will not be listed in U disc. The memory file should be in the folder of C001RAM.

2. RS232 interface transmits memory data:

RS232 can be used in this system for data transmission. The process is prompted step by step.

【**Note**】

1） **Key hp6 is not advised to use.**

2） **For security, the memory and version updating can only be done when the password level is above 2.**

4.8.7.1 Alarm record display

In DIAGNOSIS mode, press key hp6, then, press 0, the alarm record is displayed; shown in fig. 4-13;

Alarm record function: Record alarm information. Every operation corresponds to a prompt. Meanwhile, you can press key ph2 to see details.

4031 alarm messages can be recorded at most; when the number exceeds 4031, the new alarm will replace an old one. So you need to download the alarm record in case of that.

◆ Main functions of alarm record are:

☆ Search for times of power on, alarm message;

☆ Display the total alarm number; display the alarm number to be listed; display the current alarm number;

☆ Transmit alarm record to U disc through USB interface;

☆ Transmit alarm record to external computer through RS232.

Total number: 890	Displayed amount: 220	number	hp2
NO.125	90:59:02	E346 Tailstock retraction detection overtime alarm	
	1001:20:59	M05 Spindle stop	
	2001:05:59	%028 Change machining program	
NO.126	00:01:59	E367 Chuck unclamping in-position signal abnormal	
	01:11:20	E606 M91 used illegally：M91 pin is not defined;	
	01:21:59	E302 Z Drive unit alarm	
NO.129	00:40:20	E303 X drive unit alarm	
	120:40:20	E317 X tool nose software limit alarm in negative direction	

Fig. 4-13 Alarm record display

【Example】

A new alarm record: 120:40:20 E317 X tool nose software limit alarm in negative direction

The times of power-on is No. 129 displayed in the last alarm record. It means that this alarm record (number 220) happens after 120 hours 40 minutes 20 seconds later after the 129th power-on. The alarm contents are: “E317 X tool nose software limit alarm in negative direction”.

【Note】

1) During program changing, the number of the program is displayed on the alarm record; for example, %028 in Fig. 4-13 means that after 2001 hours 05 minutes and 59 seconds of the 125th power-on, the changed program number is %028.

2) The maximum displayed duration is 99999 H 59 Min 59 Sec; the largest displayed times

of power on is 999.

3) The current alarm record is highlighted and the scroll bar on the right side of the screen shows the current position among all the alarm records.

4) Alarm record is a special search function; do not use it in normal circumstances.

4.8.7.2 Alarm record search

The alarm record search is to find a specified alarm record, to view some identical alarms and to count the total number of record that is equal to the current alarm number. There are three ways to find specified alarm record:

Method 1: Scan

View the record details in alarm record screen. Press or to view last or next record. Press or to view the last page or next page. There are 8 lines in one page at most.

Method 2: Positioning

P+ **record number** + **Enter** (record number is the sequence number of alarm record).

Method 3: others

F+**search type**+**number** + Enter

The search type includes: E—through error number, M—through spindle command, T—through too change number, P—through program number;

You can also view the identical alarm records by pressing or .

Press to count the quantity of records that are identical with the current alarm records; the display window disapprears in 5 seconds or disappears immediately after you press other keys.

【Relevant parameters】

Alarm record related parameters are : P417, P418.

4.8.7.3 Alarm record hp6 function

Press hp6 in alarm record screen, the following information is displayed:

Record transmission method:
Key U – through USB interface
Key R – through RS232 interface
Key ESC – Return

1. Through USB interface

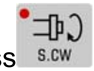
The alarm record that are transmitted through USB interface are stored in folder “C001ERR” in the root directory of U disc. The file should be named according to the rule “ ERR+file name (3 characters)+ TXT” 10 charaters in total, and the file number should not be larger than 999.

2. Through RS232 interface

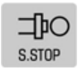
The transmission of alarm record through RS232 interface is described in *Chapter 5 RS232 and USB System Communication.*

4.8.8 Machine miscellaneous function control

Operate the miscellaneous function keys on the operation panel instead of the input commands in DIAGNOSIS working mode to execute the machine miscellaneous function.

Press 

: the spindle rotates clockwise. **P410_d7=0**: LED indicator lights, M3 corresponding bit in the output interface is displayed to 0. (**P410_d7=1**: LED indicator lights, M3 output in the output interface is first value, and after the pulse output is completed, M3 corresponding bit is displayed to 1).

Press 

: the spindle stops. (**P410_d7=1**: the diagnosis output interface window displays M5.)

Press 

: the spindle rotates counterclockwise. **P410_d7=0, P410_d2=0**: LED indicator lights, M4 corresponding bit in the output interface is displayed to 0. (**P410_d7=0, P410_d2=0**: LED indicator lights, M4 output is first valid in the output interface, value, and after the pulse output is completed, M4 corresponding bit is displayed to 1. **P410_d2=1**: the diagnosis output interface window does not display M4).

Press 

: switch cooling ON/OFF once. When the bit parameter **P410_d**7=0, and the cooling is ON, LED indicator lights, M8 corresponding bit in the output interface is displayed to 0; when the cooling is OFF, LED indicator is OFF and M8 corresponding bit in the output interface is displayed to 1. (When bit parameter P410_d7=1 and the cooling is ON, the LED indicator is ON, and the M8 output is valid. After the pulse output is finished, M8 is 1. When the cooling is OFF, LED indicator is OFF and M9 output is valid; after the pulse output is finished, M9 is 1.)

Press 

: the spindle motor circularly executes S01～S04 or S00～S15 (specified according to **P410_d6 and P410_D5** setting)

Press 

: the tool post rotates to next tool selection, and the system displays the tool selection state in the corresponding position of the input interface T1～T4.

Chapter 5 RS232 and USB System Communication

The system transmits part programs, system parameters, system software, offset and so on by RS232 and USB interface; the concrete operation methods of the system and the part program transmission are referred to **OPERATION, 4.3.3 EDIT Working mode**; the concrete operations of tool offset transmission is referred to **OPERATION, 4.7.4 OFFSET Working mode**.

5.1 **RS232 Communication**

RS232 communication is the serial interface communication mode, and the system realizes the data exchange between CNC and PC, CNC and CNC by the serial communication cables.

5.1.1 Communication between CNC and PC

Sending and receiving file between CNC and PC can be realized by the communication software GSK928_COM.EX, which is simple and convenient, and has the high communication efficiency and stability.

1) Requirements of PC:

Hardware: general PC with RS232, serial communication cable(three-line);

Operation system: Microsoft Windows 98/2000/2003/XP.

2) GSK928_COM.EXE communication software introduction:

The detailed is referred to communication software GSK928_COM.EXE on PC.

【Ready operations before communication】

1) Connect the communication cable when PC and CNC are OFF: insert DB9 socket into the front cover RS232 communication interface of the CNC, and insert another DB9 socket into PC pin 9 serial interface (COM1 or COM2);
2) PC selects the port and baud rate for communication. The communication baud rate is determined by the sender setting.

   ◆**GSK928_COM.EXE** communication software port setting on **PC**:

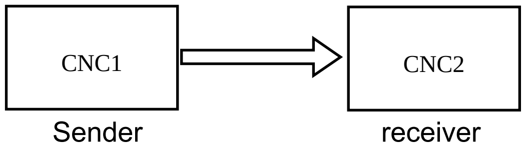
   Click "Port number" by left key to select the communication serial port after the communication software runs.

   ◆**GSK928_COM.EXE** communication software baud setting on **PC**:

   After the system runs the communication software, the user can click the left key to select the "Baud rate"(setting: 38200 (unit: b/s)).
3) The CNC sets **P414_d7**, **P414_d6** communication baud: the concrete parameter setting is referred to **OPERATION 4.6 PARAMETER Working mode**.

5.1.2 Communication between CNC and CNC

For being convenient to the user, the system permits the mutual data transmission between two CNC systems (they are both GSK928TEa), the CNC system to send the data is the sender, and the one to receive the data is the receiver as follows:



【Ready operations before communication】

1) Connect the communication cable when the two CNC systems are OFF: insert DB9 socket into the front cover RS232 communication interface of the CNC, and insert another DB9 socket into PC pin 9 serial interface (COM1 or COM2);
2) PC selects the port and baud rate for communication. The communication baud rate is determined by the sender setting. The CNC system sets **P414_d7**, **P414_d6** communication baud rate: the concrete parameter setting method is referred to **OPERATION, 4.6 PARAMETER Working Mode.**

【Data transmission notes between two CNC systems】

1) The sender and the receiver must be in the same working mode(EDIT, PARAMETER, OFFSET);
2) The sender and the receiver must enter the corresponding operation privilege when the system sends or receives the parameter;
3) The operation steps are the same those of “data sending” and data receiving” of communication software.

【Notes】

1) Press “Cancel” button when the system stops the transmission; press RESET or ESC on the CNC system.
2) Must not execute the power-off when the system executes the data transmission.
3) The communication cable between CNC and PC is the same that of the one between two CNC systems.

5.2 USB Communication

The system supports USB communication mode, exchange the data between CNC and U disc by USB interface.

5.2.1 USB operation

For the USB operation, the user directly inserts the U disc into the USB interface of the system panel, and the system automatically identifies and opens the U disc when the U disc requires to create the file and the file name in the root catalog according to the system file catalog. At the same time, the system window displays USB icon.

【Notes】

1) After the U disc is used, the user must firstly press ESC to close the U disc before pulling out it,

at the moment, the system displaying USB icon disappears, and then the user can pull out the U disc from USB interface, otherwise, the mistaken operation damages the system hardware and the U disc.

2) Must not pull out the U disc when its indicator flashes, because it is reading or writing the data, otherwise it can cause hardware damage or data loss.

3) The U disc has the write protect switch, and the user switches it before inserting the U disc and cannot do it when the U disc is working .

4) The user should reduce the storage content in the U disc, otherwise, it influences the communication speed between the system and the U disc. It is suggested the user not use large removable storage devices (exceeds 8G) on other USB interface; otherwise, it will cause damage to system hardware or removable storage devices.

5) When the U disc operation is fail, the user should press RESET and insert the U disc to operate it again.

5.2.2 USB file catalog requirements

In USB communication, for transmitting the different data, the system requires the USB file names are different, and the user creates the file name in the U disc catalog as follows:

Data / Name category	Part program	Parameter data	Offset data	System software upgrade
File name in U disc root catalog	C001PRO	C001PAR	C001OFT	C001DATA
File name in folder	CNCxxx.TXT	PARxxx.TXT	OFTxxx.TXT	DATAxxx.TXT
xxx range in file name	0~254	0~254	0~254	0~254

Data / Name category	Memory whole update	Alarm record	Syst0em RAM
File name in U disc root catalog	C001MEMO	C001ERR	C001RAM
File name in folder	MEMOxxx.TXT	ERR xxx.TXT	RAMxxx.TXT
xxx range in file name	0～254	0～999	0～999

PROGRAMMING

Chapter 1 Programming Fundamental

The automatic machining of CNC machine is the course of edited part programs automatically running. The programming is defined that the drawing and the technology of machining workpiece are described with CNC language and are edited to the part programs.

Here describes the definition of command and the programming mode of CNC part programs. Please read carefully these contents before programming.

1.1 Coordinate Axis and its Direction

This system has defined the controlled axis and its motion according to GB/T 19660—2005/ISO 841:2001 ***Industrial Automation System and Integration-Numerical Control of Machines-Coordinate System and Motion Nomenclature.*** The two coordinate axes are named with X and Z, which are perpendicular each other to form X—Z plane rectangular coordinate system as Fig. 1-1:

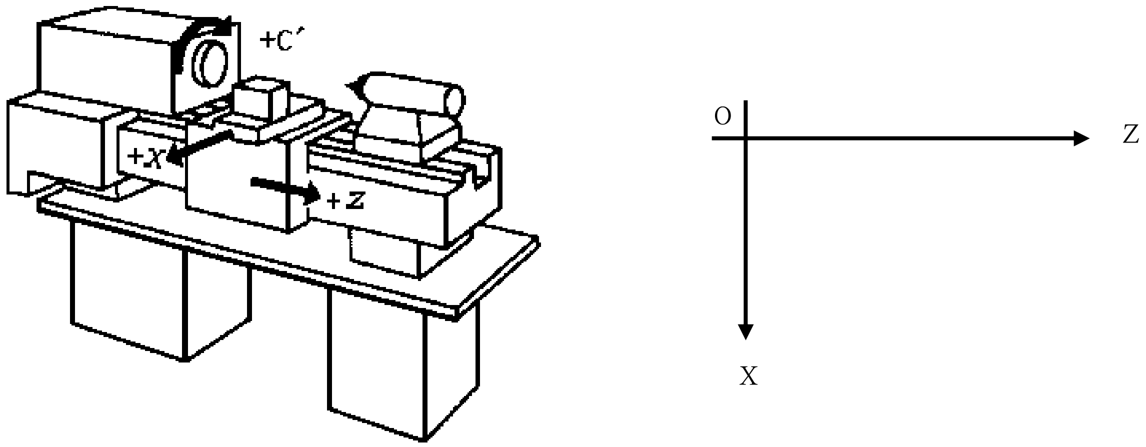


Fig. 1-1 X—Z plane rectangular coordinate system 1（front tool post coordinate system）

X：It is defined to be perpendicular with the rotary centerline of spindle. X positive direction is the one that the tool leaves from the rotary center of spindle.

Z：It is defined to be coincident with the rotary centerline of spindle and Z positive direction is the one that the tool leaves from the headstock.

Fig. 1-2 X—Z plane rectangular coordinate system 2 （rear tool post coordinate system）

The coordinate system in the manual defines X, Z based on Fig. 1-1(front tool post coordinate system). Some commands of G codes must be converse when Fig.1-2(rear tool post coordinate system) defines X, Z:

1) When G02 programming based on Fig.1-1，Fig. 1-2 uses G03 programming; when G03 programming based on Fig.1-1, Fig.1-2 uses G02 programming.

2) When G41 programming based on Fig.1-1，Fig. 1-2 uses G42 programming; when G42 programming based on Fig.1-1, Fig.1-2 uses G41 programming.

1.2 Machine Coordinate System, Machine Zero

Machine coordinate system is reference for the system to count coordinates, and is fixed on the machine.

Machine zero (or **machine reference point**) is a fixed point on the machine. Generally, it is set at the position of X, Z max. stroke with the machine zero check device, and do not use the machine zero return function or set bit parameters **P406_d7, P406_d6, P406_d5, P406_d4, P406_d3, P406_d2** to 0, i.e. “no machine zero” when the machine zero check device is not installed.

1.3 Program Reference Point

In machine coordinate system, the operator should set a position where the tool post stops, the tool changed is executed safely and installing workpiece is convenient. Program reference point is set when the tool post stops at the position which is called program reference point(or **program zero**). Program reference point coordinate is relative to machine coordinate system.

Once the reference point is defined, the tool can return to the reference point by executing the reference point return function in JOG working mode or AUTO working mode. Even if the system is switched off, the reference point still exists. If the stepper motor is employed, there is slight error caused by the motor vibrating after the system is switched on again. Execute the reference point return again to avoid the error.

The program reference point is automatically set to X=150, Z=150 without setting the program reference point after the system is switched on firstly.

1.4 Machine 2nd, 3rd Program Reference Point

In the machine coordinate system, the operator can also set the 2nd, 3rd program reference point. Their functions are similar to the program reference point, and the system has corresponding commands to move the worktable to the 2nd, 3rd program reference point.

1.5 Workpiece Coordinate System

The workpiece coordinate system is defined that some point on the workpiece is considered as the coordinate origin to create the coordinate system. Its axes are separately parallel with X, Z axis in the same direction.

After the workpiece coordinates is created, all absolute coordinate values in programming are the position values in the workpiece coordinate system. Generally, Z workpiece coordinate system is set on the rotary center of workpiece.

According to the actual condition in programming, define the workpiece coordinate origin, i.e. the programming origin in the workpiece drawing and the coordinate origin of CNC system command. The workpiece coordinate system is created by setting a workpiece coordinate.

1.6 Programming Coordinate

Programming coordinate is for workpiece coordinate system.

GSK928TEa programming uses absolute coordinates (**X, Z**) ， incremental (relative) coordinates(**U, W**) or compound coordinates(**X/W, U/Z**) .

1.6.1 Absolute Coordinate Values

The absolute coordinate value is the distance to the coordinate origin, i.e. the coordinate position of the tool traversing to the end point as Fig. 1-3

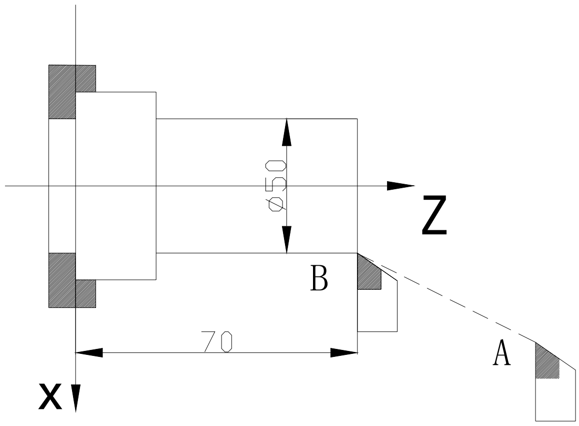


Fig.1-3 absolute coordinate value

Tool traversing from A to B uses B coordinate values as follows: **X 50 Z 70**.

1.6.2 Incremental (Relative)Coordinate Values

The incremental coordinate value is the distance from the previous position to the next one, i.e. the actual traversing distance of tool as Fig. 1-4:

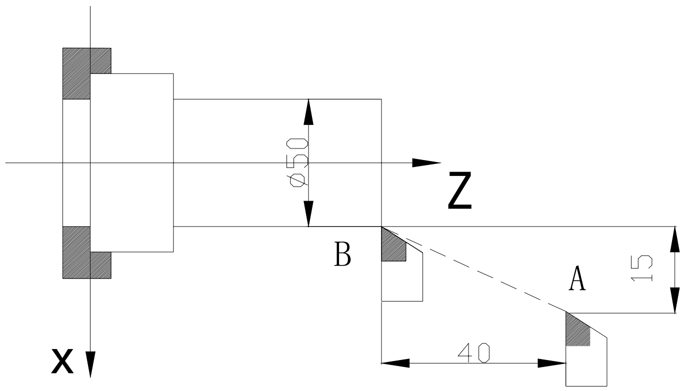


Fig.1-4 incremental coordinate values

Tool traversing from A to B uses the incremental coordinates as follows: **U -30 W -40** (X with diameter programming)

1.6.3 Compound Coordinate Values

The incremental coordinates and the absolute coordinates can be applied at the same time, but one coordinate axis in one block can only be defined by one method, i.e. **X , W** or **U , Z** can be applied, but the X ,U or Z ,W cannot be applied.

Tool traversing from A to B as Fig. 1-4, X is applied with the absolute coordinate and Z with the incremental coordinate as : **X 5 0 W - 4 0**.

1.7 Diameter Programming and Radius Programming

X coordinate value is input with diameter or radius in programming: **diameter programming, radius programming**.

Diameter programming: when **P413_d6** bit is set to 0, X value is input with diameter, and X coordinate is with diameter and its traverse speed is with radius in the system (program, parameter, tool offset, coordinates).

Radius programming: when **P413_d6** bit is set to 1, X value is input with radius, and X coordinate is with radius and its traverse speed is with radius in the system (program, parameter, tool offset, coordinates).

【**Notes**】

1) Diameter programming rules in the manual are described except for special explanations.
2) Arc radius is unrelated to diameter programming or radius programming.
3) Execute the tool setting and programming again after **P413_d6** is modified, otherwise, X data is not correct.

1.8 Interpolation Function

Interpolation is defined as a planar or three dimensional contour formed by path of 2 or multiple axes moving at the same time, also called **Contour control**. The controlled moving axis is called link axis when the interpolation is executed. The moving distance, direction and speed of it are controlled synchronously in the course of running to form the required Composite motion path. Positioning control is defined that motion end point of one axis or multiple axes instead of the motion path in the course of running is controlled.

X and Z are link axes, Y moves alone and so GSK928TEa belongs 2 axes link CNC system. The system includes linear, circular and thread interpolation function.

Linear interpolation: Composite motion path of X, Z axis is a straight line from starting point to end point.

Circular interpolation: Composite motion path of X, Z axis is arc radius defined by R or the circle center (I, K) from starting point to end point.

Thread interpolation: Movement of X or Z or X and Z is defined by rotation angle of spindle to form spiral cutting path on the workpiece surface to realize the thread cutting. For thread interpolation, the feed axis rotates along with the spindle, the long axis moves one pitch when the spindle rotates one rev, and the short axis and the long axis directly interpolate.

Chapter 2 Program Structure

CNC command set edited according to the requirement of machine moving is named as **program**. According to the sequence of command, the tool traverses along the straight line and the circular arc, or the spindle starts/stops, cooling is ON/OFF. The sequence of command is edited according to the technology requirement of workpiece.

2.1 Character

Character is the basic unit to compose the program. The character includes English letters, digits and other symbols.

English letters are address character of each command or data：**D E F G H I J K L M N P Q R S T U V W X Y Z r**

Digit is the specific data of each address character: **0，1，2，3，4，5，6，7，8，9**

Macro：**If then else and or = < > ()**

If then else : select statement; example：**If(x>y) then (z=0) else(z=1);**

and ： logic and ;

or ： logic or ;

> ： more than ;

< ： less than;

= ： equal to ;

Sign：**% - + * . ⊔ / ;**

% ： start sign of program name ;

— ： negative data or reduction;

+ ： addition;

***** ： multiplication or modification;

. ： decimal point;

/ ： division in assignment statement, block skip sign in others ⊔：blank space.

; ： comment

2.2 Block

A word consists of an address character and the following numerical command. For example: N000 12.8 W-23.45. Rules as follows:

Each word must have an address character (English letter) and the following number character string.

The invalid 0 of digital character string can be omitted.

The leading zero of command can be omitted. For example: G00 can be written to G0.

The positive sign must be omitted, but the negative sign must not be omitted.

2.3 Block Number

Block number is divided into two formats, i.e. it is with line number and without line number; block number is a line number of block number which is automatically created and also manually input and modified. A block number consists of the letter N and the following 4-digit integer(range: 0000-9999) . Block sequence can be at will, its interval also can be unequal. It is suggested to increase or decrease the block number progressively based on programming sequence in order to conveniently search or analyze programs.

When manual input is executed, block number N * * * * (* is 0～9) is directly input at the beginning of program line. When the integer following block number N is modified, please refer to the block content modification mode in OPERATION 4.1 *Edit Operation Mode* to modify the integer of block number.

When automatically creating a block number is executed, and **P333** is not set to 0, the line number can automatically create, otherwise, it cannot create automatically the line number. Please refer to **OPERATION 4.6 Parameter Operation Mode** about parameter setting; each program includes many blocks, and each block begins with block number“ N**** ”. after a new program is created, the system automatically creates the first block number “ N0000 ” , and after each block is input to press ENTER, the system automatically creates the next block number. The program number increment is defined by **P333** content. The system automatically creates block number for increment according to 1/4 integer of **P333** content.

【Note】

1) When the system finds that current row has no line number, it will automatically create “N1000”.
2) When the commands M98, M97, M91, M92, M93, M94 related to block number are executed, there should be no repetitive block number, otherwise, the system will alarm. A block number can be repetitive without executing the above commands.

2.4 Block

A block with line number is composed of block number and many words; a block without line number has no block number. One block can contain 255 characters at most (including space between words). It is necessary to have the block number generated automatically by the system and can be modified in EDIT working mode.

A block can have or no many words. When a block has many words, one or more blank space must be input between words.

A complete block is as follows:

N0120 G1 X130 W-40 F50 Enter

N0120	block number
G1	ready function
X130 W-40	motion data
F50	motion speed
Enter	end of block, displayed in the screen. But each program ends after pressing ENTER.

【Notes】

1) Each word of block is separated with a blank space generated automatically by the system,

but it is necessary to input the blank space manually by user when this system cannot distinguish words.

2) A word can be placed on any position in a block.

2.5 Block Skip Symbol and Comment

Insert skip symbol "/" or comment symbol ";" before a block which is not executed (which is not deleted) . The system skips not to execute the block in program being executed.

When each block adds comment symbol, it can adds comments which are edit by only English letters and digitals on CNC; which can be edit by Chinese on PC, and CNC displays Chinese comments after programs are downloaded to CNC.

The system skips the block with "/"at the row beginning to execute the next one.

The system skips the block with ";"at the row beginning or block beginning to execute the next one.

Input ";"at the end of row and then input simple comments.

【Notes】

1) Press "W" to insert ";" or "/".
2) Blocks following ";" will become green.
3) Insert "/" in front of the head of the block, the block will turn into green.
4) Besides the above first condition, the block at which the cursor becomes light green, and becomes orange in other condition.
5) Chinese comments following ";"are input by only serial or USB instead of the system keyboard, but the system can display Chinese. 5)
6) ";" must be input in SBC(single byte character) case when Chinese comments are input by serial or USB, and the system does not support DBC (double byte character) case.

2.6 Program Structure

A **block** consists of commands arraying of one or several technology operations in the course of machining. A part program consists of some blocks according to the machining technology orderly. A **block number** (**line number**) is used for identifying blocks. A **program name** is used for identifying programs.

Each part program consists of one program number and blocks. A program contains 9999 blocks at most. A block number is composed of N and the following 4-digit integer. A program name is comprised of % and program number (3-digit integer). General structure of program is as follows Fig.2-1.

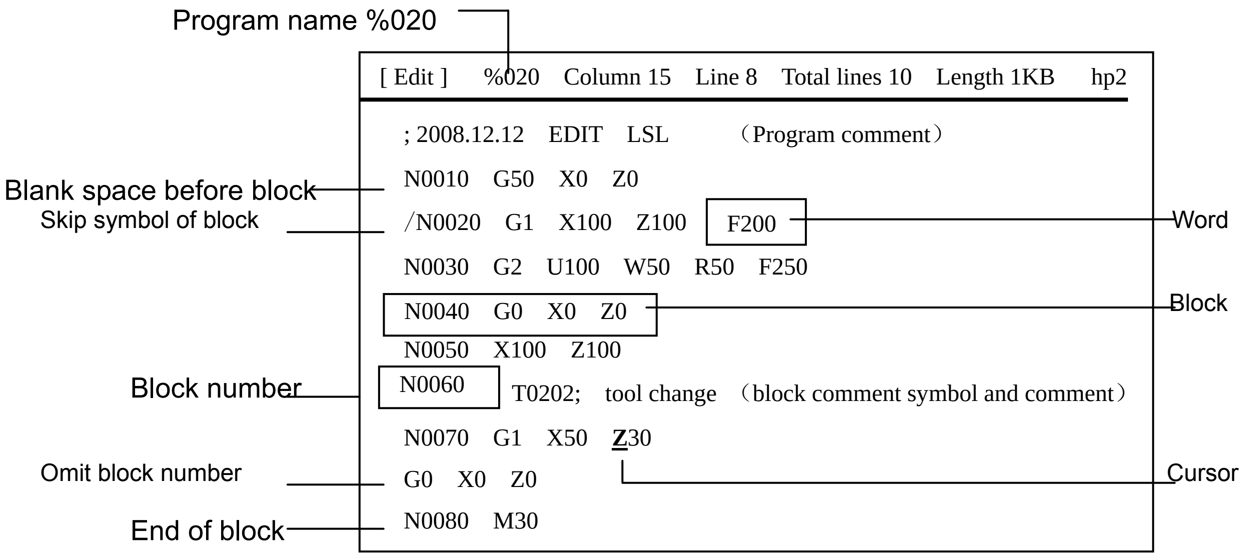


Fig. 2-1 Program structure

A program consists of program comments, blocks; each block begins with block number (it can be omitted), follows characters, words; a block has block skip symbol and comments.

【Example】

Program(program name：%012)	Remark
N0000 G50 X200 Z300 G00 X200 Z200 N0020 T11 N0030 ; G00 X100 Z100 /N0040 G02 X150 Z150 R50 N0030 G01 X100 Z100 ; 2008 N0050 M30	Having N****is the block with line number, no having N****is the block without line number; Home of each row is blank space; There is a blank space between line number and code for the program with line number; / block skip ; the followings are comments .

Chapter 3 MSTF Commands and Functions

This chapter introduces in detailed all **MSTF** functions and explanations of GSK928TEa.

3.1 M — Miscellaneous Function (Command List)

M function is used to control some operations ON/OFF of machine and run sequence of machine program, and consists of address symbol M and its following two-digit integer. The used M functions in the system are as follows:

Command	Function	Programming format	Explanation
M00	Pause to wait for starting	M00	Press CYCLE START
M02	End of program	M02	Return to No.1 block
M20	End of program	M20 L	Return to No. 1 block to execute cycle machine, L being cycle machine times
M30	End of program for spindle OFF and cooling OFF	M30	
M03	Spindle CW	M03	
M04	Spindle CCW	M04	
M05	Spindle OFF	M05	
M08	Cooling ON	M08	
M09	Cooling OFF	M09	
M10	Workpiece clamp	M10	
M11	Workpiece release	M11	
M12	Chuck output signal cancel	M12	
M32	Lubricating ON	M32	
M33	Lubricating OFF	M33	
M41	Spindle gearing No. 1	M41	
M42	Spindle gearing No. 2	M42	
M43	Spindle gearing No. 3	M43	
M44	Spindle gearing No. 4	M44	
M78	Tailstock forward	M78	
M79	Tailstock backward	M79	
M80	Tailstock output signal cancel	M80	
M96	Call cycle execution	M96 P Q L	
M97	Program transfer	M97 P	Transfer entry block number specified by P
M98	Subprogram call	M98 P L	
M99	Subprogram return	M99	M98/M99 specify call times
M21	Set No. 1 user output to be valid	M21 D	Output signal keeping for the time specified by D
M22	Set No. user output to be invalid	M22 D	Signal cancel after the time arrival
M23	Set No. 2 user output to be valid	M23 D	
M24	Set No. 2 user output to be invalid	M24 D	
M91	No. 1 user input is invalid until input is invalid.	M91 P	Transfer entry block number specified by P
M92	Wait till No. 1 user input is valid	M92 P	Transfer entry block number specified by P
M93	Wait till No. 2 user input is valid	M93 P	Transfer entry block number specified by P
M94	Wait till No. 2 user input is valid	M94 P	Transfer entry block number specified by P

M47	Set permissive operation state of Y	M47	
M48	Set inhibited operation state of Y	M48	
M87	Spindle orientation control	**See Section 4.4.3.5 in OPERATION for details.**	
M88	Cancel spindle orientation control		
M60~M74	Customized commands	Refer to **PROGRAMMING, Chapter 10 Customized Command Programming**	
M81	Control according to input signal state	See Section 3.2 in PROGRAMMING for introduction of M81, M82, M83.	
M82	Output control and detection		
M83	Control according to output signal state		

【Note】

1) Leading zero of M can be omitted; Example: M00 can be written to M0, M0 and M00 are valid.
2) Bit parameter **P403_d2** setting: whether M function output is closed when the reset key is pressed; **P403_d2**=0 indicates that the system does not close M03, M04, M08, M32 output signals after the reset key is pressed.
3) M commands are not in the same block with other commands as follows:

   M00, M02, M20, M30, M96, M97, M98, M99;
   M21, M22, M23, M24;
   M91, M92, M93, M94;
   M47, M48;
   M60～M74. (can be in the same block with F, S command)

3.1.1 M00 — Pause

【Command format】

M00 ; program pause

【Explanation】

M00 pauses not to execute the program and the system prompts “PAUSE” in flash and program continuously runs after CYCLE START is pressed.

Press ESC to exit from program running.

M00 functions are different from that of CYCLE START key. M00 is used to pause before some block which is specified in advance, and CYCLE START is used to pause at random.

3.1.2 M02 — End of Program

【Command format】

M02 ; end of program

【Explanation】

M02 indicates that program ends, and the system returns to the first block to wait.

3.1.3 M20 — End of Program Cycle Machine

【Command format】

M20 **L** ; return to the first block to execute the cycle machine, L is the cycle machine times, range:

【Explanation】

L is the cycle machine times(when L is equal to 3, the actual machined workpiece is 4PCS)

The system defaults the limitless cycle machine when L is omitted.

M20 indicates that the program ends and the system returns to the first block to execute repetitively, and is used when the system or machine is checked.

3.1.4 M30 — End of Program Spindle OFF Cooling OFF

【Command format】

M30 ; Endo of program, spindle OFF, cooling OFF

【Explanation】

M30 indicates the program ends, spindle is OFF and cooling is OFF and the system returns to the first block to wait.

3.1.5 M03, M04, M05 —Spindle Control

【Command format】

M03 ; spindle CW

M04 ; spindle CCW

M05 ; spindle stop

【Explanation】

The system is in M05 state after power-on. When M03/M04 is performed, M03/M04 output is valid and the spindle ON state remains unchanged. Turn OFF the spindle when M05 is executed. Cancel M03/M04 signal output.

See Section 4.4.3.1 in OPERATION for details.

3.1.6 M08, M09 — Cooling control

【Command format】

M08 ; Cooling ON

M09 ; Cooling OFF

【Explanation】

M09 valid and M09 output is invalid when the system is turned on. When M08 is executed, its output is valid, and the cooling is ON; M09 is executed, M08 output is cancelled, and the cooling is OFF. M09 has no corresponding output signal, and the system releases M08 output interface when M09 is executed.

M08 signal output is closed when the system appears emergency stop. In Jog, Auto or Diagnosis mode, the COOLING key on the operation panel can control cooling ON/OFF, see **OPERATION, 4.4 JOG Working Mode**.

3.1.7 M10，M11, M12 — clamping/releasing workpiece, cancelling chuck output signal

【Command format】

M10 ; clamping workpiece

M11 ; releasing workpiece

M12 ; cancelling chuck output signal;(only some special check device can use M12)

【Explanation】

M11 is valid and M11 output is invalid when the system is turned on.

The parameter can set M10/M11 to be valid/invalid, to be checked or not, to be pulse or level control output, and to be inner or outer control mode. Interlock between chuck and spindle is decided by **P402_d5**: **P402_d5=**0, they are interlocked; **P402_d5=1,** their interlock is released. See **OPERATION, 4.4 JOG Working Mode**.

3.1.8 M32, M33 — Lubricating ON/OFF

【Command format】

M32 ; lubricating ON

M33 ; lubricating OFF

【Explanation】

After the system is turned on, M33 is valid and M32 output is invalid. Parameter P330 sets whether the system automatically controls lubricating.

See OPERATION, 4.4 JOG Working Mode.

3.1.9 M41, M42, M44, M43 — Spindle Automatic Gear Shifting Control

【Command format】

M41 ; Spindle automatically shifting to No. 1 gear in conversion

M42 ; Spindle automatically shifting to No. 2 gear in conversion

M43 ; Spindle automatically shifting to No. 3 gear in conversion

M44 ; Spindle automatically shifting to No. 4 gear in conversion

【Explanation】

M41, M42, M43, M44 can be used when the machine uses the spindle with the conversion. See **OPERATION, 4.4 JOG Working Mode.**

3.1.10 M78, M79, M80 —Tailstock going forward and retreating backward, cancelling tailstock output signal

【Command format】

M78 ; tailstock going forward

M79 ; tailstock retreating backward

M80 ; cancelling tailstock output signal(only some special tailstock device can use M80)

【Explanation】

M78, M79 is set by the parameter to be valid or not, to respond the check or not, to be the pulse control output or level control output. They are interlock with the spindle. See **OPERATION, 4.4 JOG Working Mode.**

3.1.11 M96 —Cycle execution call

【Command format】

M96 **P**＊＊＊＊ **Q**＊＊＊＊ **L** ＊＊＊＊ ; call cycle execution

【Field】

P — inlet block number for calling program. The leading zero of the block can be omitted.

Q — call last block number. The leading zero can be omitted.

L — call times. Omit L or call it one time when L is 1. L value is 1～9999 times.

【Explanation】

Program group called by M96 can have M96, M98/M99, G22/G80 which can be embedded.

M96, M97 are embedded to avoid that the program returns to M96 to again run one time after M96 is executed.

【Example】

Method 1	Method 2
N0010 G00 X100 Z100	N0010 G00 X100 Z100
N0020 M96 P70 Q80 L3	N0020 M96 P40 Q50 L3
N0030 G01 W-5	N0030 M97 P0060
N0040 U5 W-5	N0040 G02 U5 W-5 R5 F300
N0050 W-5	N0050 G03 U5 W-5 R5
N0060 M30	N0060 G01 W-5
N0070 G02 U5 W-5 R5 F300	N0070 U5 W-5
N0080 G03 U5 W-5 R5	N0080 W-5
	N0090 M30

Method 1: after M96 specifies the call specified program three times, the cursor returns to N0030 and continuously runs till the program ends.

Method 2: after M96 specifies the call specified program three times, the cursor returns to N0030 and then the system uses M97 to continuously runs till the program ends. The results of method 1 and method 2 are the same.

3.1.12 M97 — Program transfer

【Command format】

M97 **P** ; program transfer

【Field】

P —transfer to block number. The leading zero of the block number can be omitted.

【Explanation】

M97 commands the program to transfer from the block to the program specified by P. Block number specified by P appears in the block, otherwise the program alarms "E215：line number miss"

The block number specified by P is M97 block.

Generally, the death cycle must not be created in M97.

【Example】

N0030 G00 X100

N0040 M98 P0060

N0050 M97 P0090

N0060 G01 U2

N0070 W-5

N0080 M99

N0090 M02

Execute N0050 to directly do N0090 instead of N0060.

3.1.13 M98, M99 — Subprogram call and subprogram return

【Command format】

M98 **P** ＊＊＊＊ **L** ＊＊

M99

【Field】

P — block which is in subprogram. Leading zero of the block number can be omitted.

L — call times of subprogram. Omit L or it is called one time when L is 1. L is 1～9999.

【Explanation】

Some fixed sequence which appears repetitively in the program is taken as a subprogram, so it can be called instead of being compiled when it needs again.

When M98 calls the subprogram and there is M99 in the execution of the subprogram, the subprogram call ends and the program returns to the main program to call the next block.

The subprogram generally follows M02 of the main program, and the last block of the subprogram must be the subprogram return command M99. When the subprogram does not follow the main program, it must command M97 to transfer the program.

【Notes】

1）M98 is used together with M99, and the subprogram call one time instead of L(L＞1) times is executed when M98 is used alone.

2）When the program has M99 without M98, the program does not end till M99.

3）M98/M99 is executed in the subprogram call, i.e. they can be embedded; the embedding can up to 18-layer.

4）Subprogram is usually behind M02/M30 of the main program, and the last block of this program should be M99. If the subprogram is not behind the main program, M97 command should be used for program transfer. (shown in the following example)

【Example】

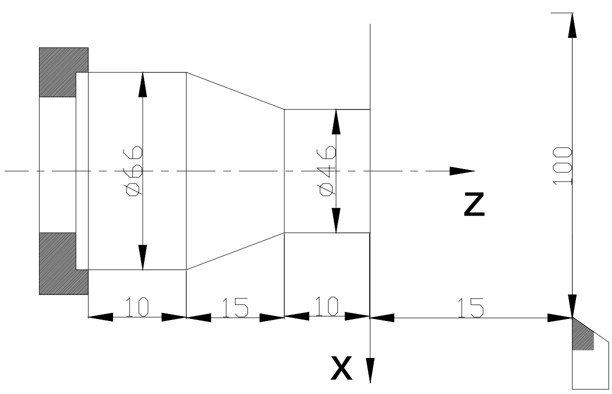


Fig. 3-1 M98 M99 subprogram call cutting example

Two programming methods as Fig.3-1:

Method 1		Method 2	
N0010 G00 X100 Z50		N0010 G00 X100 Z50	
N0020 M03 S01		N0020 M03 S01	
N0030 G0 X50 Z15 F500		N0030 G0 X50 Z15 F500	
N0040 M98 P0060 L5	Call subprogram	N0040 M98 P0080 L5	Call subprogram
N0050 M97 P0130	Transfer program	N0050 G0 X100 Z50	
N0060 G0 U-4	Insert the subprogram in the main program	N0060 M05	
N0070 G01 Z-10 F80		N0070 M02	End of main program
N0080 U20 Z-25		N0080 G0 U-4	Subprogram follows the main program
N0090 Z-35		N0090 G01 Z-10 F80	
N0100 G0 U2 Z1		N0100 U20 Z-25	
N0110 U-22		N0110 Z-35	
N0120 M99		N0120 G0 U2 Z1	
N0130 G0 X100 Z50		N0130 U-22	
N0140 M05		N0140 M99	
N0140 M02	End of main program		
Transfer the program with M97, otherwise the program does not meet the actual machining		The subprogram must follow the main program without M97	

Method 1: When the system executes N0040, calls the subprogram and executes N006 0－N0120 five times, and then executes N0050，the program skips to N0130 at the moment and executes the following blocks.

Method 2: When the system executes N0040, it calls subprogram and executes N006 0－N0120 five times, and then executes blocks from N0050 to N007, and so the program ends.

3.1.14 M21, M22, M23, M24 —User Output Control

【Command format】

M21	**D**	; output of No.1 user output signal is valid(output LOW)
M22	**D**	; output of No.1 user output signal is invalid(output OFF)
M23	**D**	; output of No.2 user output signal is valid(output LOW)
M24	**D**	; output of No.2 user output signal is invalid(output OFF)

【Field】

D — signal hold time.(unit: s 0～9999.999). When D is omitted, the output signal is being held.

【Explanation】

M21, M22, M23, M24 have not the concrete definition specified the system, and the user can specify according to the concrete requirements. They separately correspond to the output signals defined by the two users, and the corresponding commands can change the states of output signals.

User 1, user 2 output signals are defined in the interface parameter (**M210, M230**). See **CONNECTION** after the output interfaces are defined.

【Notes】

2) M21～M24 can have D: when M21～M24 are executed with D, the corresponding output is executed, the time specified D delays and the previous output is cancelled. When the command has no D, the output signal is being kept.

3.1.15 M91, M92, M93, M94 — User input

【Command format】

M91 **P** ;
M92 **P** ;
M93 **P** ;
M94 **P** ;

【Field】

P—block which skips to the target block. It does not skip when P is omitted. The leading zero of the block specified by P can be omitted.

【Explanation】

The definitions of input signals which correspond to M91, M92, M93, M94 are not confirmed, and are defined by the user according to the requirements. They separately correspond to input signals defined by the two user. User 1, user 2 input signals are defined in the interface parameter (**M911, M931**). See Connection after the output interfaces are defined.

When P is omitted, the system orderly executes the next block when the state of the check input signal meets the command requirement, and always waits when it does not meet.

P≠0：the system skips to the block specified P when the input signal state meets the command requirement, otherwise orderly executes the next block.

P is omitted:

M91：check the state of No. 1 user. When the state is valid (the input terminal is connected with 0V), wait till the input is invalid.

M92：check the state of No. 1 user. When the state is invalid (the input terminal is broken with 0V), wait till the input is valid.

M93：check the state of No. 2 user. When the state is valid (the input terminal is connected with 0V), wait till the input is invalid.

M94：check the state of No. 2 user. When the state is invalid (the input terminal is broken with 0V), wait till the input is valid.

when P≠0：

M91：check the state of No. 1 user. When the state is valid (input terminal connects with 0V), skip to the block specified by P, otherwise the next block is executed.

M92: check the state of No. 1 user, when the state is invalid (input terminal cuts off 0V), skip to the block specified by P, otherwise the next block is executed.

M93: check the state of No. 2 user, when the state is valid (input terminal connects with 0V), skip to the block specified by P, otherwise the next block is executed.

M94: check the state of No. 2 user, when the state is invalid (input terminal cuts off 0V), skip to the block specified by P, otherwise the next block is executed.

3.1.16 M47, M48 — Set spindle working state

【Command format】

M47 ;

M48 ;

【Explanation】

See OPERATION, 4.4 JOG Working Mode.

3.1.17 M87, M88 — Spindle orientation control

【Command format】

M87 ;

M88 ;

【Explanation】

See OPERATION, 4.4.3.5 Spindle Orientation Control

3.1.18 M60~M74 — Customized commands

【Command format】

M60 ;

…

M74 ;

【Explanation】

See PROGRAMMING, Chapter 10 Customized Command Programming.

3.2 M81, M82, M83—User input/output condition control

M81, M82, M83 are a group of condition control commands based on input/output signal state.

Representations of signal point, level and holding time are: for example: 18.1, Q17.0, R18.0, D5 etc.

1) Letters I, Q, R represents input signal, output signal and output signal state respectively (two states: when 0 is output, conducted circuit is formed externally; when 1 is output, it means high impedance state, conducted circuit cannot be formed externally;) D represents signal holding time.

2) The integral part after letters represents signal points, corresponding input signal UIxx or output signal UOxx pin; the range is 1~32 point.

3) **.0** behind the decimal point represents low level (0 can be omitted as it is default value); **.1** represents high level.

4) D: signal holding time; (unit: s range: 0~9999.999); when D is omitted, output signal remains the same.

5) Relevant parameter: bit parameter **P412_d0**. M81, M82, M83 are affected by this parameter.

3.2.1 M82—output control and detection

【Code format. Example】

M82 Q17.0 ; UO17 pin outputs low level (conducted)

M82 Q17.1 ; UO17 pin output high level (high-impedance)

M82 Q17.0 D3 ; UO17 pin outputs low level, and output cancelled after delay time D.

M82 Q17.0 I8.0 ; UO17 output low level, and goes to nest till UI18 is at low level;

M82 Q17.0 I8.0 D3 ; UO17 pin outputs low level, after delay time D, cancels the output; goes to next command till UI08 is low level;

【Note. Example】

M81, M83 cannot be executed in MANUAL mode, M82 can be executed in following two formats:

M82 Q17.0 D3 or M82 Q17.0

For example: M82 Q17.0 D5 ; UO17 pin outputs low level (conducted), then cancels the output after 5 seconds delay time. In MANUAL mode, it can be M Q 1 7 D 5.

3.2.2 M81—Control according to input signal state

【Code format. Example】

M81 I8.0 ; If the input UI08 pin is at low level, the system goes to the next command; otherwise, it keeps waiting.

M81 I8.1 ; If the input UI08 pin is at high level, the system goes to the next command; otherwise, it keeps waiting.

M81 I8.0 P1000 ; If the input UI08 pin is at low level, the system goes to P1000; otherwise, it goes to the next command.

M81 I8.0 Q17.0 ; If UI08=0, then, UO17 outputs 0, and system goes to the next command; otherwise, it keeps waiting.

M81 I8.0 Q17.0 D3 ; If UI08=8, then UO17 outputs 0, signal remains D3, and the system goes to next command; otherwise, it keeps waiting.

3.2.3 M83—Control according to output signal state

【Code format. Example】

M83 R8.0 ; If the input UO8 pin is at low level, the system goes to the next command; otherwise, it keeps waiting.

M83 R8.0 P1000 ; If the input UO8 pin is at low level, the system goes to P1000; otherwise, it goes to the next command.

M83 R8.0 Q17.0 ; If UO8=0, then, UO17 outputs 0, and system goes to the next command; otherwise, it keeps waiting.

M83 R8.0 Q17.0 D3 ; If UO8=8, then UO17 outputs 0, signal remains D3, and the system goes to next command; otherwise, it keeps waiting.

3.3 **S function** — Spindle Function

S and the following data are used to controlling the spindle speed and there are two modes as follows:

1) Spindle speed switch value control mode: Sx or Sxx, the system outputs the gear signal to the machine to realize the gear shift of spindle speed.

2) Spindle speed analog voltage control mode: Sxxxx specifies the actual speed, and outputs 0~10V analog voltage signal to spindle servo device or converter to realize the spindle speed change.

According to the machine's configuration with **P410_d6** setting, the spindle function is used to controlled multi-speed or conversion motor.

3.3.1 Gear shifting controlling spindle motor

【Command format】

S01 ~ S04	; 4-gear directly outputs, leading zero can be omitted.
S00 ~ S15	; 16-gear BCD code outputs, leading zero can be omitted.

【Explanation】

P410_d6=0: S function controls multi-speed spindle motor; when it controls the multi-speed spindle motor, it selects the direct 4-gear control signal or outputs 16-gear BCD code signal.

P410_d5=0: spindle control is the 4-gear direct controlling output S01～S04, each gear corresponds one output signal.

P410_d5=1 spindle control is 16-gear BCD code output S00～S15.

3.3.2 Spindle controlling conversion motor

P410_d6=1: S function controls the conversion motor. The system outputs 0～10V DC analog voltage signal controlling inverter to realize the stepless speed regulating of the spindle motor

◆ Gear control of conversion spindle

【Command format】

M41	; corresponding output signal S01
M42	; corresponding output signal S02
M43	; corresponding output signal S03
M44	; corresponding output signal S04

【Command format】

G96	; setting constant surface cutting state;
G96 S__	; setting constant surface cutting state, and specifying the surface speed value:
G97	; cancelling constant surface speed state;
G97 S__	; cancelling constant surface speed state, specifying speed value:
S__	; according to the current state; speed value or surface cutting.

【Explanation】

1) In JOG and AUTO working mode, the system displays the actual spindle speed S_.

2) In JOG and AUTO working mode, the system displays the cutting constant surface control G96 S___m，or constant speed control G97 S___r.

3) Parameters are related to the spindle speed analog voltage control as follows:
Data parameter **P305:** max. spindle speed of constant surface speed;
Data parameter **P304**: lowest spindle speed of constant surface speed;
Data parameter **P300**～**P303:**max. speed of spindle in the spindle gear 1～4 (corresponding to M41～M44).

4) See **OPERATION, 4.4 JOG Working Mode.**

3.4 T function — Tool Function

Machining one workpiece needs several different tools. The motor tool post with 4～8 tool selections can be controlled by the system. To avoid the error caused by the installation or the wear and tear, each tool is placed in the different position when it is cutting the workpiece, the tool change and the tool compensation are employed in the programming.

Tool setting operation is executed before machining receives the position offset data of each tool(called as **tool offset)**. T command is executed in program running, the system automatically executes the tool offset. So, each tool in programming according to the workpiece drawing dimension is compiled instead of considering the position among each tool in the machine coordinate system. The deviation of machining dimension caused by tool wear can be changed according to the dimension deviation to modify the tool deviation.

【Command format】

Txx ____ the first 1- digit is the tool number, the second is the tool offset number;
Txxx ____ the first 1-digit is the tool number, the following 2-digit is the tool offset number;
Txxxx ____ the first 2-digit is tool number and the second 2-digit is tool offset number.

【Field】

Tool number r: it is determined by **P319**(most tool number: 1～16); Example: **P319** is 4, the tool number is 0～4; when the input tool number is 0, it is the current tool number.

1）Tool offset number: 0～64; the input tool offset number is 0, it is to cancel the tool compensation.

【Explanation】

1) The system can select 16 tools and **P319** sets the most tool number.
2) When the system executes the manual tool setting operation, it automatically matches the tool offset number to the tool number and save it to the tool compensation table. When **P403_d4** is set to 1, the system automatically identifies the tool setting record, the tool number of tool change, and relationship of tool numbers; when there is fault, the system alarms to display the program check prompt but does not lock the program running.
3) The system executes the tool setting operation based on the trial cutting or fixed point tool setting in Jog mode. See **OPERATION, 4.4 JOG Working Mode.**

3.4.1 Tool offset execution mode-moving slide

When T command is executed, the system executes the tool change to T tool, and executes its tool compensation, at the moment, modifies the tool nose coordinates. The system uses two methods.

P403_d6 = 0: after the system executes the tool compensation and modifies the tool nose coordinates, it does not execute the slide movement, i.e. the execution is completed;

P403_d6 =1: after the system executes the tool compensation and modifies the tool nose coordinates, it executes the slide movement and makes the too nose coordinate recover(move to the position which is the previous and ensure the tool nose coordinates is not changed).

Move the machine slide:

1) Move the slide in JOG working mode to make the tool nose coordinates recover. X, Y rapidly move simultaneously.
2) In AUTO working mode, when the T command is an alone block, its execution mode is the same that of JOG working mode, i.e. the system executes the slide movement to make the tool nose coordinates recover. X, Y rapidly move simultaneously.
3) In AUTO working mode, when T and G00/G01 are the same block, the system executes the tool change, and then adds the tool compensation value to X, Z coordinates of G00/G01 to complete the movement. The system performs the rapid traverse in G00 and cutting speed in G01.

3.4.2 Tool offset execution mode- modifying coordinates

When **P403_d6**=0, the tool compensation execution is to modify the system coordinates.

In JOG and AUTO working mode, the slide does not move after the system executes the tool compensation and modifies the tool nose coordinates.

In AUTO working mode, after the system executes the tool compensation, the workpiece program is in undefined state when the tool nose coordinates are changed and does not be recovered. The troubleshooting is the followings when the system appears the different consecutive commands:

1) When the consecutive command is G00 Z/X absolute coordinate positioning, the tool directly traverses to G00 positioning point;
2) When the consecutive command is G00 W/U relative coordinate movement, the tool directly traverses one relative amount;
3) When the consecutive command is G00 single-axis positioning, the other axis does not move.

【Notes】

1) Correct programming method: after the system executes the tool change, uses G00 to execute

Z/X positioning again, or uses G00 single-axis to orderly complete the positioning again.

2) To improve the machining efficiency, T command and G0 must be in the same block. For example, 0 X100 Z200 T0202.

3) Adding the tool compensation to program command value is executed when G0/G1 and the tool compensation command are in the same block.

4) G0/G1 in the compound cycle, there is no T in one block.

3.5 F function — Feedrate Function

It defines the feedrate of tool function i.e. the feedrate function(G98/G99, F command).

【Command format】

G98 **F**＊＊＊＊＊．＊＊＊ ; Feedrate per minute

G99 **F**＊＊＊＊＊．＊＊＊ ; Feedrate per rev

【Explanation】

Cutting feed: The system can control X, Z motion contributed that the motion path of tool and the defined path by commands (straight line, arc) is consistent, and also instantaneous speed on the tangent of motion path and F word is consistent, which motion control is called **cutting feed** or **interpolation**. The cutting feedrate is specified by F, the system divides the cutting feedrate specified by F according to the programming path into X , Z direction, also controls X, Z instantaneous speed to contribute that the combined speed of X, Z vector is equal to F command value.

$$f_x = \frac{d_x}{\sqrt{d_x^{\,2} + d_z^{\,2}}} \bullet F$$

$$f_z = \frac{d_z}{\sqrt{d_x^{\,2} + d_z^{\,2}}} \bullet F$$

F is the combined speed of vector of X/Y instantaneous speed;
d_x is the X instantaneous(d_t) increment,
f_x is the X instantaneous speed in X direction;
d_z is the Z instantaneous(d_t) increment ,
f_z is the Z instantaneous speed.

The command determines the cutting feedrate of the tool.

Feedrate function in feed per minute (G98) is expressed with F＊＊＊＊＊.＊＊＊＊＊.(range: 0～15000.000 unit：mm/min)

Feedrate function in feed per rev (G99) is expressed with F＊＊＊＊＊.＊＊＊＊＊.(range: 0～15000.000 unit：mm/r)

F is modal. It cannot be rewritten once it is specified. It is the feed per minute (G98) and the tool actual traverse speed is controlled by F and feedrate override.

Tool actual cutting speed = Fx feedrate override (mm/min)

Tool actual cutting speed = Fx spindle speed x feedrate override (mm/r)

Reduction formula of feed between per rev and per min: $\mathbf{F_m = F_r \times S}$

F_m: feed per min (mm/min);

F_r: feed per rev (mm/r);

S: spindle speed (r/min)

After the system is switched on, the feedrate is 0 and F value is reserved after F is commanded. The feedrate is 0 after F0 is executed. F value is reserved when the system resets and emergently stops.

The system supplies 16 steps for spindle override (0%～150%, increment of 10%). The feed override key on the system panel can regulate real-time, the actual feedrate override steps can be regulated in 0～150% and is reserved even if the system is switched off. The feedrate override regulation is referred to **OPERATION, 4.4.1.5 JOG Working Mode**.

【Relative parameters】

1) System parameter **P112**: the initial speed in cutting feed.
2) System parameter **P113**: max. speed limit of cutting feed.
3) System parameter **P114**: linear acceleration/deceleration of cutting feed.
4) System parameter **P115**: exponential acceleration/deceleration of cutting feed.
5) System parameter **P118**: G99 initial lines.

【Note】

Note: There is the uneven cutting feedrate when the spindle speed is lower than 1 r/min (in G99); there is the follow error in the actual cutting feedrate when there is the swing in the spindle speed. To gain the high machining quality, it is recommended that the selected spindle speed should be not lower than min. speed of the spindle servo or the converter.

Chapter 4 G Commands and Functions

Here describes the functions and the explanations of all G commands of the system

4.1 **G00** —Rapid Traverse (Positioning)

The tool rapidly traverses to the specified position in G00.

【Command format】

G00 Z(W)_ X(U)_ Y(V)_ ; three axes rapidly move

G00 Z(W)_ X(U)_ ; two axes rapidly move, i.e. Z/X, Z/Y, X/Y

G00 Z(W)_ ; Z alone rapidly moves, or Z, X, Y alone moves.

G00 Y(V)_ ; Y alone rapidly moves. Y

【Field】

X, Z, Y： absolute coordinates of end point;

U, W, V：relative movement from starting point to end point;

Use relative or absolute coordinates, omit the coordinates which are not moved with G00 and coordinate field.

【Field range】

X, Z, Y, U, W, V：(-9999.999～9999.999) mm

X, Z, Y, U, W, V：(-9999.999～9999.999) mm

【Explanation】

One, both or all of Z/X/Y move simultaneously.

When the tool change is executed, the tool compensation command and G00 are the same block, adding the tool compensation value to G00 movement value are executed to improve the work efficiency, so the tool change, tool compensation and G00 should be in the same one block.

G00 actual run speed is controlled by the rapid override. For example, when G00 rapidly traverses in the alone movement mode, the actual speed is set by **P100, P101, P102**.

Z actual rapid speed = P100 × rapid override

X actual rapid speed = P101 ×rapid override

Y actual rapid speed = P102 ×rapid override

The actual max. speed of the machine is defined by its actual condition and matched motor. For particular parameters, please see the manual from machine manufacture. G00 is the modal command and can be omitted in the next same block. G00 can be omitted to G0, and G0 and G00 are equivalent.

【Relative parameters】

Parameters related to G00: **P100, P101, P102, P103, P104, P105, P106, P107, P108, P112, P114, P400_d3.**

Each axis separately rapidly moves or simultaneously rapidly moves according to the proportion, and their movement mode is defined by **P400_d3**: **P400_d3**=0, each axis rapidly positions (alone movement mode) in G00 in the separately rapid mode; **P400_d3**=1, each axis rapidly positions (interpolation movement mode)simultaneously in G00 in the proportion mode. **P400_d3**=0, the alone movement mode is executed as follows(taking an example of Z)

① Raising speed stage: Z raises speed at the initial speed of **P103**;

② Raise speed to max. speed set by **P100**; the acceleration time in the raising speed phase is **P106**.

Each axis moves at the rapid speed, the actual speed displayed by the system is the compound rapid traverse speed, and the displayed actual rapid speed of two axes moving simultaneously is more than the value set by **P100, P101, P102**.

P400_d3=1: interpolation movement mode is executed as follows:

① Raising speed stage: raises speed at the initial speed of **P112**;

② The acceleration time in the raising speed phase is **P114**.

③ Resultant speed of rapid interpolation is 10000.000 mm/min, the movement axes rapidly move according to the proportion, and their actual speeds are controlled by **P100, P101, P102.**

【Note】

Ensure the tool is placed on the safe position to avoid the tools shocking each other when G00 is executed.

【Example】

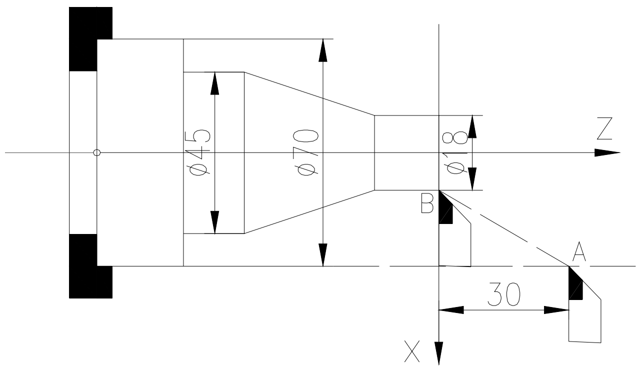


Fig. 4-1 G00 rapidly positioning

As Fig.4-1, the tool traverses from A to B.

Absolute programming: N0010 G00 X18 Z0 **;**

Relative programming: N0100 G00 U-52 W-30 **;**

4.2 G01 — Linear Interpolation

【Command format】

G01 Z(W)_ X(U)_ Y(V)_ F_ ; Z/X/Y feeds simultaneously

G01 Z(W)_ X(U)_ F_ ; Z/X feeds simultaneously, or Z/X, Z/Y, X/Y do

G01 Z(W)_ F_ ; Z feeds, or Z, or, X or Y does.

G01 Y(V)_ F_ ; Y feeds

The tool traverses at the set feedrate in **G01** from the current point to connection line of the specified point X(U),Z(W) or Y(V).

【Field】

X, Z, Y: absolute coordinates of end point;

U, W, V: relative movement from starting point to end point.

F: cutting feedrate. F value is modal, and can be omitted when it is not changed. At the same time, it is controlled by the feedrate override.

【Field range】

X, Z, Y, U, W, V：(-9999.999～9999.999) mm

F：0.001mm/min～15000mm/min

【Explanation】

Z/X/Y can execute single-axis, two-axis or three-axis feed simultaneously.

G01 traverse speed is specified by F and controlled by the feedrate override.

Actual feedrate = F × feedrate override

G01 is the modal command and can be omitted in the next block.G01 can be omitted to G1, and G1 and G01 are equivalent.

【Relative parameters】

Parameters related to G01: P112, P113, P114, P401_d5, P401_d4

Interpolation traverse execution as follows:

① Raising speed stage: raises speed at the initial speed of **P112**;

② The acceleration time of raising speed stage is **P114**; at the same time, the system checks whether the feedrate (Fx feedrate override) exceeds **P113** limit, if it does, the feedrate is P113.

P401_d5, P401_d4 set in the cutting machining: the system uses high-speed connection mode, continuous smooth transition or reducing speed to zero.

【Example】

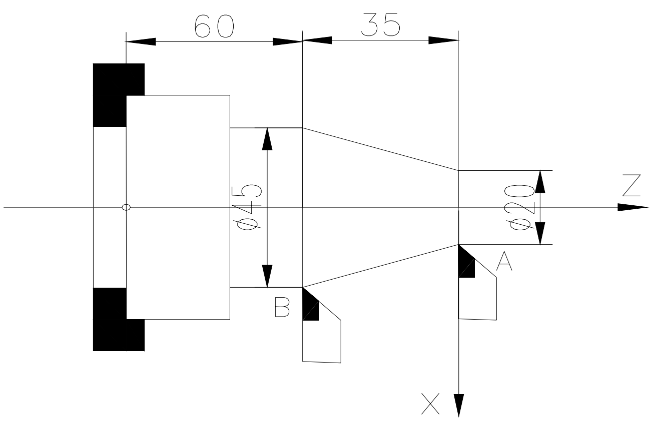


Fig. 4-2 G01 linear interpolation

The tool traverses from A to B in G01 at the speed 150 mm/min as Fig. 4-2:

Absolute programming: N0100 G01 X45 Z-35 F150 ;

Relative programming: N0100 G01 U25 W-35 F150 ;

【Note】

F cutting feed is executed with feed per minute(G98) except for special explanations; it is 0 when the system uses F programming, at the moment, the system alarms in running programs: feedrate is zero.

4.3 G02, G03, G05 —Circular interpolation

【Command format】

G02 Z(W)_ X(U)_ I_ K_ F_ ; circle center coordinates programming, CCW arc

G02 Z(W)_ X(U)_ R_ F_ ; arc radius program, CCW arc

G03 Z(W)_ X(U)_ I_ K_ F_ ; circle center coordinates programming, CW arc

G03 Z(W)_ X(U)_ R_ F_ ; arc radius program, CW arc

G05 Z(W)_ X(U)_ I_ K_ F_ ; arbitrary point(I, K) on arc programming

The tool traverses from the current point X(U), Z(W) to the specified arc in **G02, G03, G05** at the set speed, the arc radius is R or the distance vector from the circle center to starting point is I, K(G02, G03), or arbitrary point I, K(G05) on the arc.

【Field 】

X, Z ：absolute coordinates of end point;

U, W ：relative movement from starting point to end point;

F：cutting feedrate;

R：arc radius;

K：it is Z different value between circle center and starting point of arc in G02/G03;

It is Z coordinate value of arbitrary point and starting point of arc in G05;

I：it is X different value between circle center and starting point of arc in G02/G03;

It is X coordinate value of arbitrary point and starting point of arc in G05.

【Field range】

X, Z, U, W：-9999.999 mm～9999.999mm

I, K： -1000000.000 mm～1000000.000mm in G02/G03; -9999.999 mm～9999.999mm in G05

F：0.001 mm/min～15000mm/min

R：0＜R≤1000000.000mm

【Explanation】

Z/X programming in **G02, G03, G05**; the traverse speed is set by F and controlled by the feedrate override.

F value is modal, and can be omitted when it is not changed. At the same time, it is controlled by the feedrate override.

Actual feedrate=Fx feedrate override

G02, G03, G05 are modal, and can be omitted when there are the same in the next block. G02 can be written to G2 and they are equivalent; G03 can be written to G3 and they are equivalent; G05 can be written to G5 and they are equivalent. The fields are explained as follows:

Table **4-1**

Field	Specified content	Meaning
G02	Arc rotation direction	CCW arc in front tool post coordinate system/ CW arc in rear tool post coordinate system
G03	Arc rotation direction	CW arc in front tool post coordinate system/ CCW arc in rear tool post coordinate system
X,Z	Absolute coordinate	Absolute coordinates of arc end point
U,W	Relative coordinate	Distance between starting point and end point of arc
I,K (G02,G03)	Circle center coordinates	Vector between circle center and starting point of arc in G02 ,G03
R	Arc radius	Distance between any point and circle center
F	Feedrate	Arc cutting speed
I,K (G05)	One point on arc	Arbitrary point on arc(three points consists of one circle)

The tool traverses at the set speed in the specified arc path in G02, G03. G02/G03 arc direction definition is referred to the circle center, their directions are reverse in the front/rear tool post coordinate system as follows:

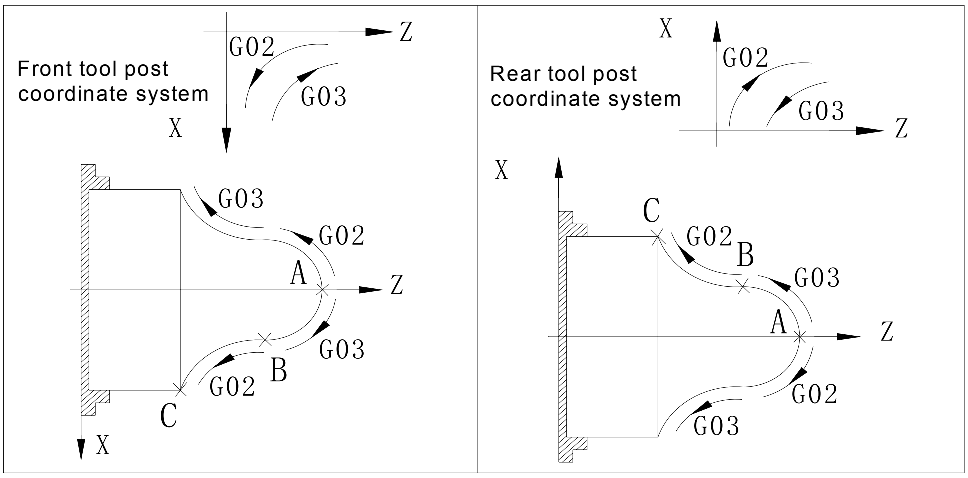


Fig .4-3 G02/G03 arc direction definition

X,Z or U, W specify the end point of arc. The end point is presented with absolute or relative coordinates. The relative coordinate is the distance from the starting point to the end point of arc.

G02/G03: **I,K** specify the circle center coordinates of arc. **I, K** separately correspond to **X, Z** vector from the starting point as the origin point to the circle center. **I** is **X** vector (in diameter), **K** is **Z** component. K is positive when **I, K** directions are the same those of **X, Z**. otherwise, it is negative. Use **R** programming without using **I, K** programming.

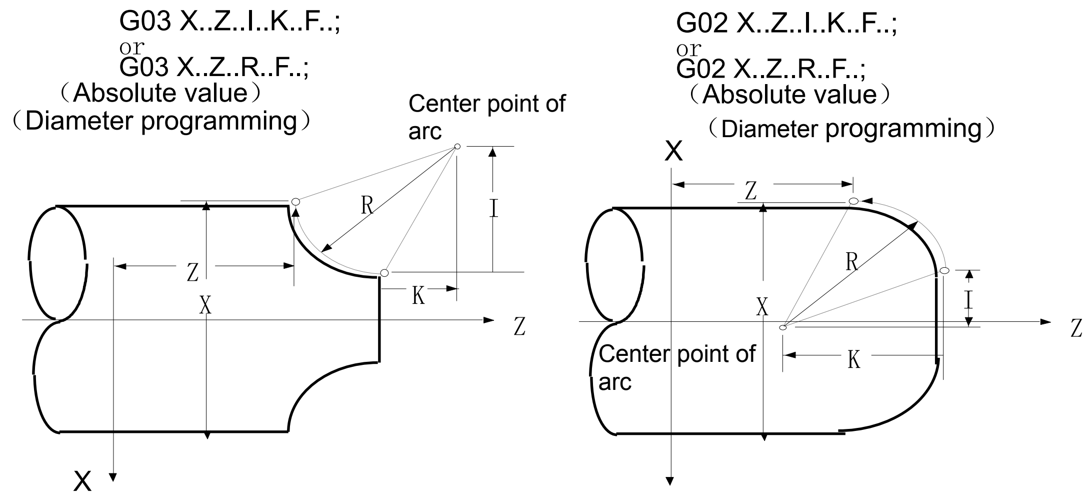


Fig. 4-4 circle coordinate definition

G05: **I, K** specify the coordinates of arbitrary point on the arc. Three points consist of one circle: starting point, end point and arbitrary point on arc as Fig. 4-5:

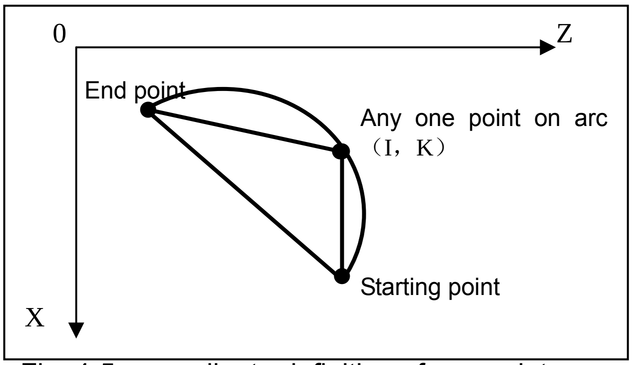


Fig. 4-5　coordinate definition of one point on arc

【Related parameters】

Parameters related to arc interpolation: **P112, P113, P114, P401_d4, P400_d2.**

Interpolation movement execution as follows:

① Raising speed stage: raises speed at the initial speed of **P112**;

② The acceleration time of raising speed stage is **P114**; at the same time, the system checks whether the feedrate (Fx feedrate override) exceeds **P113** limit, if it does, the feedrate is P113.

P401_d4, P400_d2 set in the cutting machining: the system uses continuous smooth transition , deceleration to zero, front/post acceleration/deceleration or arc crossing top precision execution.

【Note】

1） I value is expressed with the diameter. The general drawing uses the radius value. Multiplex 2 in programming.

2） Max. arc radius is not more than 1000000mm, otherwise, it may be wrong in the system.

3） For the arc with very small R with great value of programming speed x feedrate, the stepping angle in interpolation is not more than 1.5 degree, otherwise, the system automatically decelerates and there is the difference value between the actual feedrate and programmed speed.

4） The system automatically decelerates with great programmed speed in machining small arc.

5） Using K, I programming in G02, G03, the system checks the current coordinates(starting point), end point coordinates and circle center coordinates; when the end point is not on the circle, and Z deviation is more than 0.005mm or X deviation is more than 0.01mm, the system alarms: Distances between E238 circle center to two point are not equal.

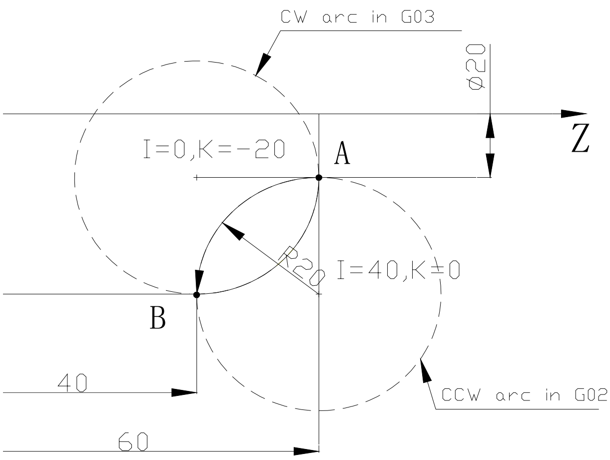
6） the system checks the current coordinates(starting point), end point coordinates and circle center coordinates in using G05 programming; the system alarms: E239 three points are in one line and cannot consist of one arc when the three points cannot define one triangle..

7） The system alarms: E237 chord length is more than the diameter when the diameter 2R is less than the distance between the current point(starting point) and end point in R programming.

8） G02, G03, G05 must not be with T in one block. The system alarms: E205 is incompatible.

9） The arc cannot be more than 180° in R programming.

【Example 1】



Draw the full circle along the arc direction to judge whether the machining arc is CCW or CW interpolation. When it is CW, the system executes G03; when it is CCW, the system does G02.

Fig. 4-6 arc interpolation

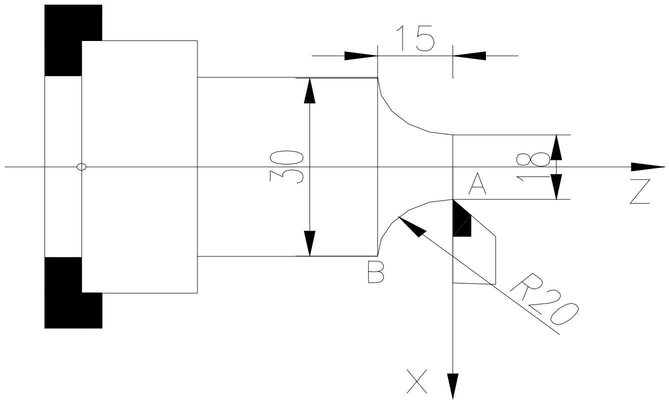
Clockwise interpolation from A to B at feedrate 100mm/min as Fig. 4-6:

N0100 G00 X20 Z60 ; rapidly position to machining starting point
N0110 G03 X60 Z40 I0 K-20 F100 ; Circle center programming.
N0110 G03 X60 Z40 R20 F100 ; Radius programming.
or N0110 G03 U40 W-20 I0 K-200 F100 ;
N0110 G03 U40 W-20 R20 F100 ;

Counterclockwise interpolation from A to B at feedrate 100mm/min

N0100 G00 X20 Z60 ; rapidly position to machining starting point of arc
N0110 G02 X60 Z40 I40 K0 F100 ; Circle center programming.
N0110 G02 X60 Z40 R20 F100 ; Radius programming.
or N0110 G02 U40 W-20 I40 K0 F100 ;
N0110 G02 U40 W-20 R20 F100 ;

【Example 2】



Absolute programming:
N0000 G0 X18 Z0 ;
N0010 G02 X30 Z-15 R20 F100 ;
N0020 M30

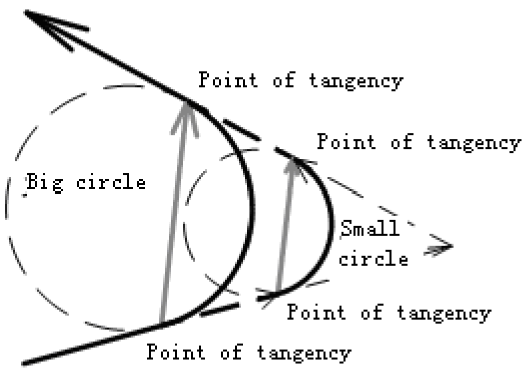
Relative programming:
N0000 G0 X18 Z0 ;
N0010 G02 U12 W-15 R20 F100 ;
N0020 M30

Fig. 4-7 circular interpolation

4.4 Chamfering Function

Chamfering function is to insert one straight line or circular between two contours to make the tool smoothly transmit from one contour to another one. The system uses the linear and circular chamfering functions but only uses Z/X programming.

Two contours includes: the linear to the linear, the linear to the arc, the arc to the linear, the arc to the arc. The linear to the linear is as the following figure. Firstly two straight lines to be tangent with one circle(the circle can be properly adjusted) creates two tangent points, which are connected by a straight line, i.e. the linear chamfering, and which are connected by a arc, i.e. arc chamfering.



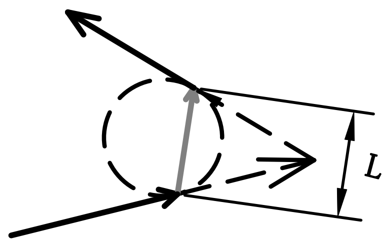
4.4.1 Linear chamfering

Linear chamfering: insert one straight line in the linear contours, arc contours, linear contour and arc contour. The command address of linear chamfering is L, behind which data is the length of chamfering straight line. The linear chamfering must be used in G01, G02, G03 or G05 command.

1) Linear to linear

Command format: G01 X(U)_ Z(W)_ L_ ;
G01 X(U)_ Z(W)_ ;

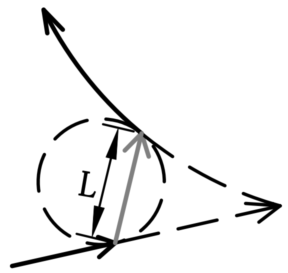
Command function: insert one straight line between two linear interpolation blocks.



2) Linear to circular

Command format: G01 X(U)_ Z(W)_ L_;
G02/G03 X(U)_ Z(W)_ R_;
Or
G01 X(U)_ Z(W)_ L_;
G02/G03/G05 X(U)_ Z(W)_ I_ K_;

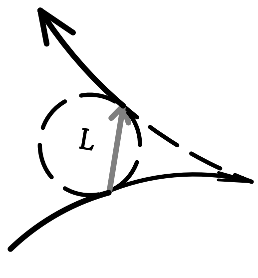
Command function: insert one straight line between the linear and circular interpolation blocks.



3) Circular to circular

Command format: G02/G03 X(U)_ Z(W)_ R_ L_;
G02/G03 X(U)_ Z(W)_ R_; (or G02/G03/G05 X(U)_ Z(W)_ I_ K_;)
Or
G02/G03/G05 X(U)_ Z(W)_ I_ K_ L_;
G02/G03/G05 X(U)_ Z(W)_ I_ K_; (or G02/G03 X(U)_ Z(W)_ R_;)

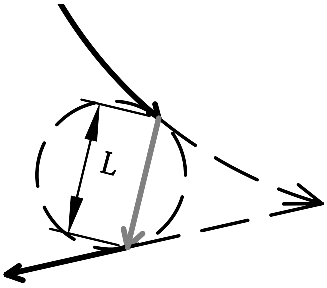
Command function: insert one straight line between two circular interpolation blocks



4) Circular to linear

Command format: G02/G03 X(U)_ Z(W)_ R_ L_;
G01 X(U)_ Z(W)_;
Or
G02/G03/G05 X(U)_ Z(W)_ I_ K_ L_;
G01 X(U)_ Z(W)_;

Command function: insert one straight line block between circular and linear interpolation block.



4.4.2 Circular chamfering

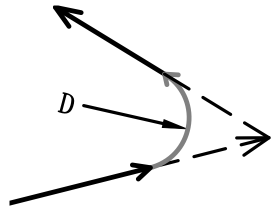
Circular chamfering: insert one circular between linear contours, circular contours, linear contour and circular contour, the circular and the contour line are transited by the tangent. The command of circular chamfering is D, and the data behind the command is the radius of chamfering circular. The circular chamfering must be used in G01, G02, G03 or G05.

1) Linear to linear

Command format: G01 X(U)_ Z(W)_ D_;

G01 X(U)_ Z(W)_;

Command function: insert one circular between two straight lines, the inserted circular block and two straight lines are tangent, the radius is the data behind the command address D.



2) Linear to circular

Command format: G01 X(U)_ Z(W)_ D_;

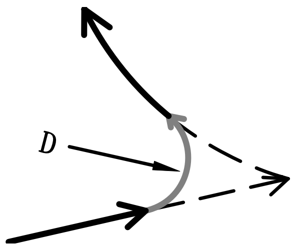
G02/G03 X(U)_ Z(W)_ R_;

or

G01 X(U)_ Z(W)_ D_;

G02/G03/G05 X(U)_ Z(W)_ I_ K_;

Command function: insert one circular between linear and circular, the inserted circular is tangent to the linear and the circular, and the radius is the data behind the command address D.



3) Circular to circular

Command format: G02/G03 X(U)_ Z(W)_ R_ D_;

G02/G03 X(U)_ Z(W)_ R_;

Or

G02/G03 X(U)_ Z(W)_ R_ D_;

G02/G03/G05 X(U)_ Z(W)_ I_ K_;

Or

G02/G03/G05 X(U)_ Z(W)_ I_ K_ D_;

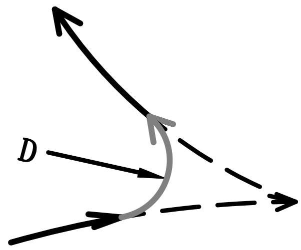
G02/G03/G05 X(U)_ Z(W)_ I_ K_;

Or

G02/G03/G05 X(U)_ Z(W)_ I_ K_ D_;

G02/G03 X(U)_ Z(W)_ R_;

Command function: insert one circular between two circular blocks, the inserted circular is tangent to the two circular blocks, and the radius is the data behind the command address D.



4) Circular to linear

Command format: G02/G03 X(U)_ Z(W)_ R_ D_;

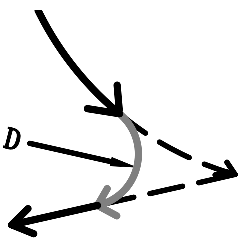
G01 X(U)_ Z(W)_;

Or

G02/G03/G05 X(U)_ Z(W)_ I_ K_ D_;

G01 X(U)_ Z(W)_;

Command function: insert one circular block between the circular and the linear, the inserted circular block is tangent to the circular and the linear, and the radius is the data behind the command address D.

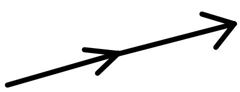


4.4.3 Special cases

The chamfering function is invalid or the system alarms as follows:

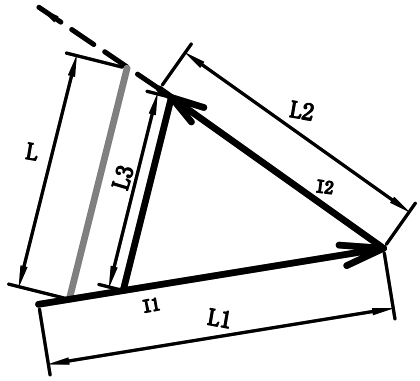
1) Linear chamfering

A. The chamfering function is invalid when two interpolation straight lines are in the same linear.

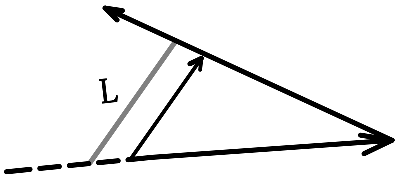


B. **Linear to linear:** CNC alarms when the chamfering linear is too long.

L1 i is the linear 1, and the length is $L_{1;}$ l_2 is the linear 2, its length is 2; the length of the chamfering straight line which is formed by the interpolation connection is L3, CNC alarms when the chamfering straight line length L is bigger than L3 and other end of L is not in the interpolation linear L2(in the extension line of interpolation line) as follows:

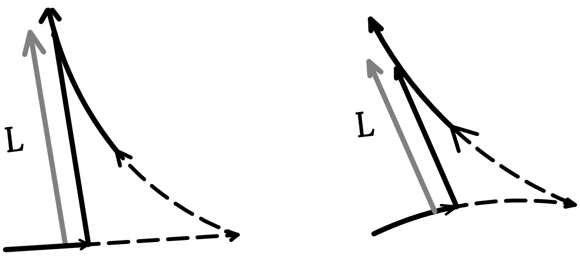


CNC alarms when other end of the chamfering straight line is not in the interpolation linear(in the extension line of the interpolation linear) as follows.



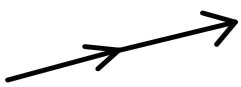
C. Linear(arc) to arc: CNC alarms when the chamfering straight line length is too long.

CNC alarms when the chamfering straight line length is L, other end of the caculated chamfering straight line is not in the interpolation line.



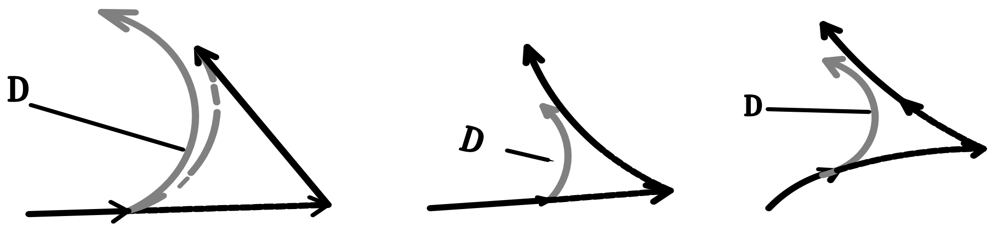
2) Circular chamfering

A. The circular chamfering function is invalid when two interpolation straight lines are in the same block.



B. CNC alarms when the chamfering circular radius is too big.

CNC alarms when the chamfering circular radius is D, other end of the caculated chamfering arc is not in the interpolation line or arc as follows.

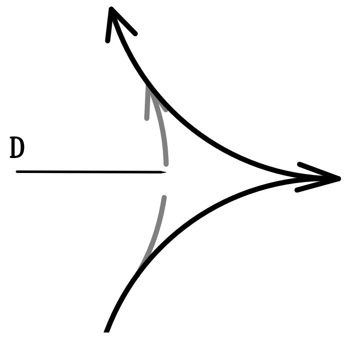


Linear to linear   linear to arc   arc to arc

C. The circular chamfering function is invalid when the linear and the circular, or the circular and the linear are tangential

D. The circular chamfering function is invalid when one circular and another one are tangential.

The circular chamfering function is valid when the circular tangency is as follows:



4.4.4 Chamfer supplementary explanation

1) The chamfer function is invalid when D, L is less than 0.01;

2) The system continuously executes the chamfer;

3) the system does not execute the chamfer function when the next block is not G01, G02, G03, G05;

4) Do not use the chamfer command in the compound command (G71, G72);

5) The chamfer function is invalid in G41/G42;

6) The chamfer function is invalid when **P401_d5=0**;

7) The chamfer function is valid in Z/X plane and is not related to Y.

4.5 Thread Cutting Command

The CNC system can execute many kinds of thread cutting function including machining inch/metric single, multi-thread, variable pitch thread and tapping cycle; the thread run-out length and the angle can be changed, the cycle thread cutting executes the unilateral cutting, which can protect the tool and improve the surface finish. The thread function includes: continuous thread cutting command G33, variable pitch thread cutting command G34, tapping cycle cutting command G32, thread cycle cutting command G92, multiple thread cutting cycle command group G76.

The machine with the thread cutting function must be installed with the spindle encoder which lines is set by P209. In thread cutting, X or Z moves to execute the thread machining after the system receives the one-turn signal of the spindle encoder, so the system can execute the roughing, finishing for many times to complete the thread machining without changing the spindle speed.

The system has many kinds of thread cutting function used to machining the thread without the tool retraction groove, there is great pitch error in the thread cutting start and end when the system executes X, Z acceleration/deceleration, so the system leaves the thread lead length and the tool retraction distance in the actual starting point and the end.

When the thread pitch is confirmed, X, Z speed is determined by the spindle speed and is not related to feedrate override. When the spindle override control in the thread cutting is valid and the spindle speed changes, the pitch has the error because of X, Z acceleration/deceleration, so, the system does not execute the spindle speed regulation and does not stop the spindle, otherwise, which damages the tool and workpiece. The thread cutting command are Z/X programming.

4.5.1 G33 —thread cutting

【**Command format**】

G33 X(U) _ Z(W) _ P(E) _ K_ I_ Q_ H_ ; thread cutting

G33 Z(W) _ P(E) _ K_ I_ Q_ H_ ; axial straight-thread cutting

G33 X(U) _ P(E) _ K_ I_ Q_ H_ ; end face straight-thread cutting

【Field】

P —— metric thread lead.

E —— inch thread lead.

It is the axial thread and Z is the thread axis when P/E is positive value; it is the end face thread and X is the thread axis when it is negative value.

X(U) /Z(W) —— absolute/relative coordinates of thread end point.

For the axis thread, Z movement is not 0; it is the axial straight-thread when X is omitted.

For the end face thread, X movement is not 0; it is the end face thread when Z is omitted.

K —— it is the length from the thread run-out starting point to the end point in the thread machining axis.

K cannot be negative and must be less than the movement of thread machining axis.

I —— movement of thread run-out axis direction when the thread runs-out. (there is no thread run-out when it is omitted).

For straight-thread, the thread runs-out positively when I is positive; the thread runs-out negatively when it is negative.

For taper thread, the thread run-out direction is same that of the taper, I symbol does not have effect.

For axial taper thread, the thread runs-out positively when U is positive; the thread runs-out negatively when U is negative.

For end face thread, the thread runs-out positively when W is positive; the thread runs-out negatively when it is negative.

Q —— initial angle. It is used to thread part when it is specified to 0°.

H ——(H_d7 ~ H_d2：reserved) ; it is used to selecting the thread run-out point.

H_d0 = 0:Retraction is limited by K value; the system default is zero;

H_d0 =1:thread run-out when the thread cutting axis reduces speed, which is not controlled b K value.

H_d1: it is continuous thread machining raising/reducing speed mode, and the system default to zero;

H_d1 = 0: in continuous thread cutting, between the neighboring two threads, the axis that performs thread cutting reduces speed from the machining speed to the initial speed, and then raises speed to the thread machining speed. The thread pitch length changes in the raising and the reducing speed.

H_d1 = 1: in continuous thread cutting, between the neighboring two threads, the machining speed of the block suddenly skips to the one of the next thread without the process from the thread machining speed reducing speed to the initial speed and from the initial speed raising speed to the thread machining speed. So, when the difference between two block thread pitches is great, there maybe make the motor step-out, which does not meet the machining.

【Field range】

X,Z,U,W：-9999.999mm～9999.999mm

I：-9999.999mm～9999.999mm

K：0～9999.998mm

P：0.001mm～500.000mm(the negative sign can be added to the front of the range. The positive value means to the axial thread, and the negative value means to the end face thread.)

E：(0.060～25400.000) tooth/inch(the negative sign can be added to the front of the range. The positive value means to the axial thread, and the negative value means to the end face thread.)

Q：0°～360.000°

H：00000000～11111111

【Relative parameters】

Parameters related to G33: **P100, P101, P103, P104, P106, P107, P113, P116, P117, P209, P306, P307, P403_d0.**

Taking example of axis thread, parameters related to G33:

① Before the system enters raising speed, it firstly checks whether the thread cutting speed exceeds **P113**, if it does, the system alarms to terminate the thread machining;

② Raising speed phrase: Z raises speed at **P103** initial speed; Acceleration time of raising speed phase is **P116**;

③ When the system executes the thread run-out, X executes rapidly the thread run-out at P101 speed, Z decelerates to the initial speed **P103**;

④ When the system executes the thread run-out, its acceleration time is **P117**;

⑤ The boundary of thread two machining modes is **P306**;

⑥ During thread cutting, the system detects the spindle speed through spindle encoder line number P209. If the spindle rotation speed exceeds P307, an alarm raised after the current threading cutting is finished, and machining suspended; press CYCLE START key to go to next step.

⑦ **P403_d0=0:** the system does not check whether the spindle speed is stable before the thread machining.

P403_d0=1: the system checks whether the spindle speed is stable before the thread machining.

【G33 execution process】

G33 execution process is as follows (taking example of axial thread cutting):

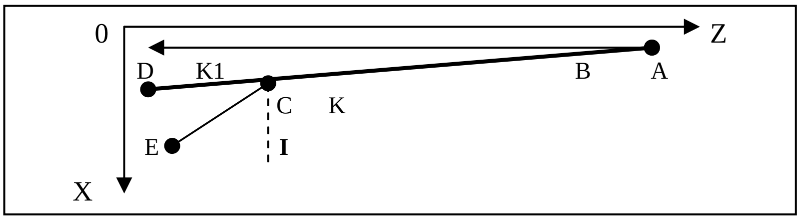


Fig. 4-8a G33 path 1

I=0, the end of thread without run-out:

① Check the spindle speed, count the reference speed of thread machining according to the speed and the lead P. When the counted result exceeds P113(max. cutting feedrate), the system alarms. Before it, the user must confirm the spindle speed is stable; otherwise, there may be confused machining tooth.

② Check one-turn signal of coder from the initial angle; Z raises speed from the current position A(G33 starting point), which makes the traverse speed reach the reference speed, at the moment, Z moves to B; the lead of AB section maybe be not standard (in the actual machining, the front of AB section must reserve a empty block which does not touch the workpiece), the higher the reference speed is, the longer AB section is.

③ The system follows the spindle speed from B to execute the cutting to C; the cutting speed changes when the spindle speed changes; the lead of BC section is standard.

④ Z reduces speed from C till D position Z(W); CD lead maybe be not standard, CD length is equal to AB(when the reference speed is lower than the initial speed, the system does not execute raising/reducing speed, the lengths of CD and AB are 0); so X should execute the thread run-out in advance when the end of thread has no the thread run-out groove.

I≠0，thread end with thread run-out:

① Z movement is the same with the above; X executes the thread run-out in advance according to the different position of H; X thread run-out speed is based on G00 speed with the raising speed, constant speed and reducing speed; the bigger X distance I is, the better the result is. The speed should be more than 40mm when the conditions are permitted.

② When H_d0=1, and Z moves to the reducing speed point C, X executes the thread run-out in advance, which is not limited by K; it finally moves to E.

③ H_d0=0 and Z move the distance which leaves the distance K(K point) to the end point D, X executes the thread run-out in advance. When K is big, the system executes the thread run-out in the middle of BC section, The path is as Fig. 4-8b; when K is small, the system executes the thread run-out in the middle of CD section.

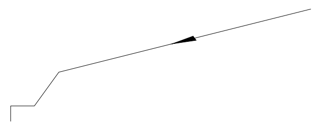


Fig. 4-8b G33 execution path 2

【Explanation】

1) G33 can machine metric/inch constant straight, taper and outer thread.
2) In the spindle rotating clockwise, the positive cutting is right-hand thread, and the negative is the left-hand thread, and the spindle rotates counterclockwise, they are reverse.
3) Generally, the machining repeats the thread cutting many times in the same path from the roughing to the finish turning when the thread is machined. The thread cutting starts after receiving 1-turn signal from the spindle coder, and so the cutting points on the circle of machining workpiece are the same when repeating the thread cutting many times, the spindle speed must not be changed at the same time, otherwise there is the error of thread cutting.
4) The thread machining cutting speed is controlled by P113(max. cutting feedrate); when the above speed exceeds the max. feedrate, the system alarms. It is suggested that the thread machining cutting speed should be less than 3000 mm/min; when the speed is too big, the motor cannot response to cause the confused thread tooth.

Thread feedrate format is as follows:

inch thread speed ＝N×25.4 / E

metric thread speed＝N×P

N — speed (unit：r/min) max. speed is less than 2000r/min.

P — thread lead (unit：mm) it is switched into the metric unit to count when it is the inch thread.

5) In thread cutting start and end, the lead is not correct because of raising/reducing speed, so, the commanded thread length should be longer than the actual required length. Generally, the length in the raising speed > 1.3 mm.
6) For axial taper thread, the pitch P/E is the pitch of the thread axis(Z); for the end face thread, it is the pitch of the thread axis(X).

【Note】

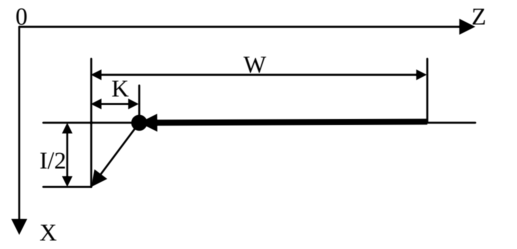
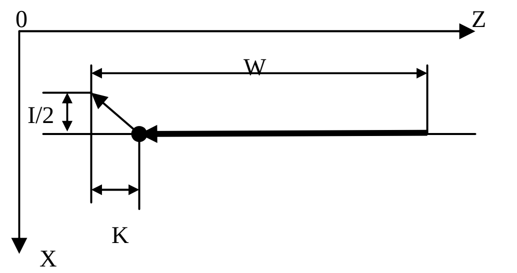
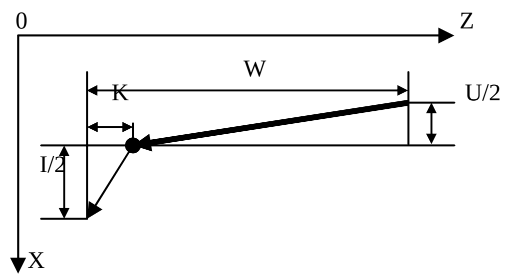
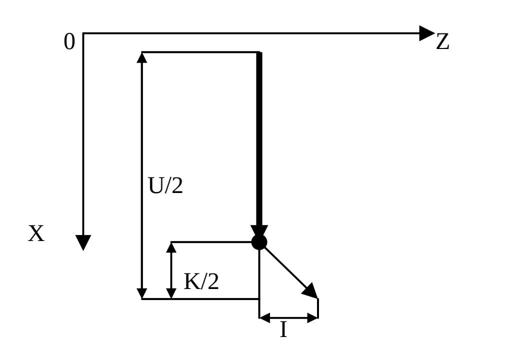
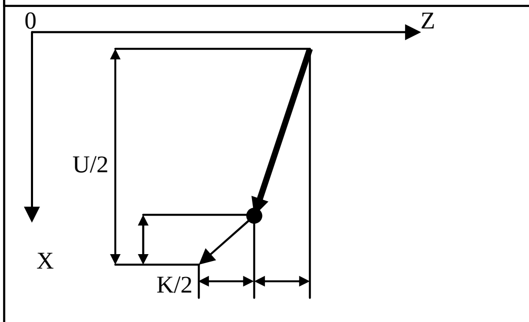
1） Start the spindle before machining the thread; otherwise, the system always waits and is not fault.
2） The feed hold key and the feedrate override are invalid, the spindle stops and the feed also stops in the course of thread cutting.
3） When the spindle starts just now, the system cannot machine the thread because of the unstable spindle speed, otherwise, it influences the thread machining precision.
4） The photoelectric coder with 1200 or 1024 lines must be installed to rotate with the spindle synchronously. The selected coder lines are the same as the actual installed ones. When the coder lines are 1200, P209 is set to 1200; when the coder lines are 1024, P209 is set to 1024. If P209 setting is wrong, the pitch will be mistake when the thread is machined.
5） For the thread with the thread run-out, the spindle speed, the pitch, the acceleration time of the thread run-out axis, the initial speed and I value affect the thread run-out. The higher the speed

is, the bigger the pitch is; the longer the acceleration time is; the lower the initial speed is, the smaller I value is, worse the thread run-out effect is.

6） When the previous block and the current one are the thread cutting command, the system does not detect the thread head signal (only one per revolution) but directly starts the cutting feed. Example: G33 W-20 P3; the system detects 1-turn signal when the thread cutting is executed. G33 W-30 P2; the system does not detect 1-turn signal when the thread cutting is executed.

7） The command must not be other command in the same block.

G33 thread cutting programming forms (diameter programming)

	1） G33 axial straight thread: P is positive; I sign decides the direction of the thread run-out; there is no the thread run-out when I is omitted; Example：G00 Z100 X100 G33 W-40 K1 I5 P2 M30 End point (Z60，X105)
	2）G33 axial straight thread: P is positive; I sign decides the direction of the thread run-out; there is no the thread run-out when I is omitted; Example：G00 Z100 X100 G33 W-40 K1 I-5 P2 M30 End point (Z60，X95)
	3）G33 axial taper thread： P is positive; U sign decides the direction of the thread run-out; I sign is invalid; Example：G00 Z100 X20 G33 U6.2 W-40 K3 I5 P2 M30 End point (Z60，X31.20)
	4）G33 end face straight thread： P is negative; I sign decide the direction of the thread run-out; when I is omitted, there is no the thread run-out; Example ：G00 Z100 X20 G33 U20.7 K3 I1.6 P-2 M30 End point (Z101.60，X40.70)
	5）G33 end face taper thread： P is negative; W sign decide the direction of the thread run-out; I sign is invalid; Example：G00 Z100 X20 G33 U20.7 W-8.3 K3 I1.6 P-2 M30 End point (Z90.10，X40.70)

【Example】

1) G33 axial straight thread: as Fig. 4-9

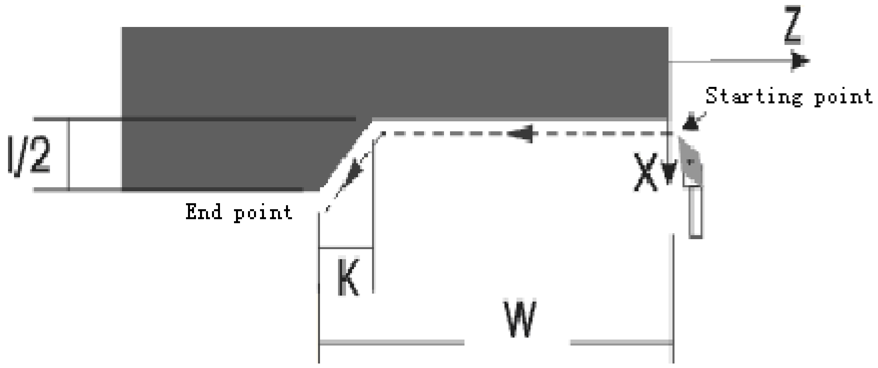


Fig. 4-9

I sign decides the direction of the thread run-out; there is no the thread run-out when I is omitted;

Example：G00 X100 Z100

G33 W-40 K3 I5 P2 ; end point(Z60，X105)

M30

2) G33 axial taper thread: as Fig. 4-10

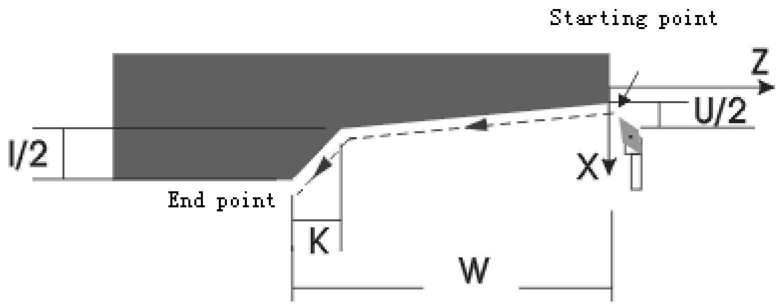


Fig. 4-10

U sign decide the direction of the thread run-out; I sign is invalid;

Example：G00 Z100 X20

G33 U6.2 W-40 K3 I5 P2 ; end point(Z60，X31.20)

M30

3) G33 end face taper thread: as Fig. 4-11

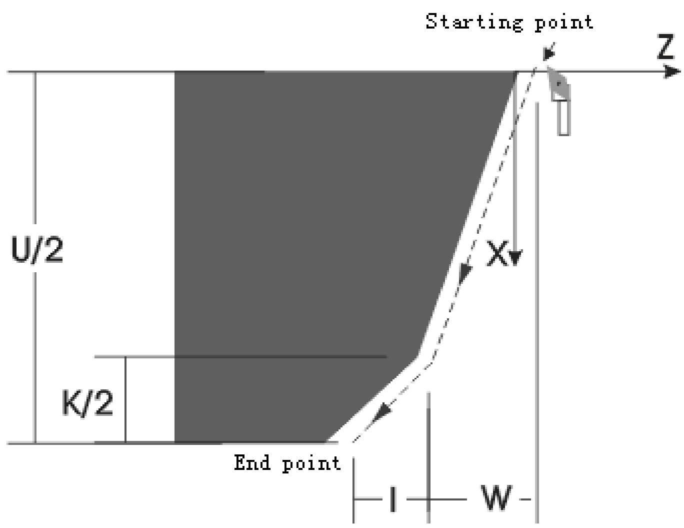


Fig. 4-11

P is negative; W sign decide the direction of the thread run-out; I sign is invalid;

Example：G00 Z100 X20

G33 U20.7 W-8.3 K3 I1.6 P-2 ; end point(Z90.10，X40.70)

M30

4) G33 end face straight thread: as Fig. 4-12

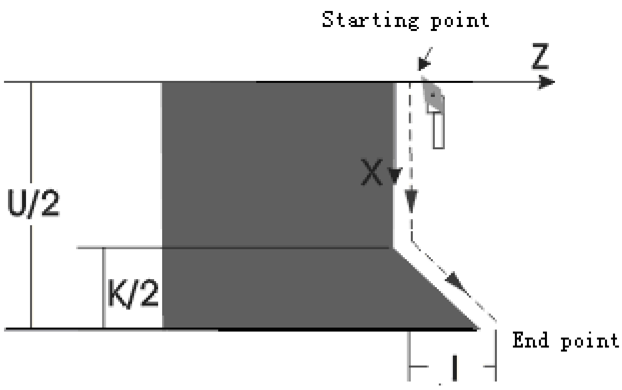


Fig. 4-12

P is negative; I sign decide the direction of the thread run-out; there is no the thread run-out when I is omitted;

Example：G00 Z100 X20

G33 U20.7 K3 I1.6 P-2 ; end point(Z101.60，X40.70)

M30

5) Comprehensive example: as Fig. 4-13

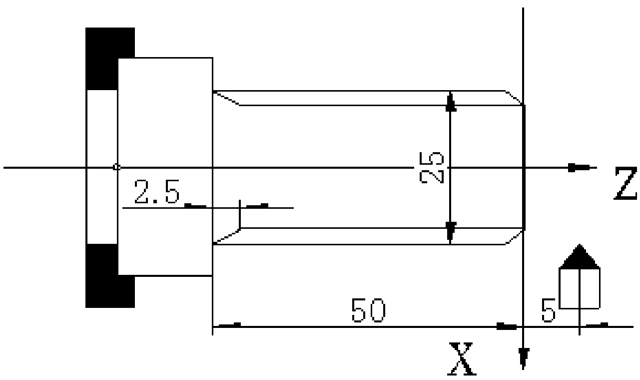


Fig. 4-13 thread cutting

Example：thread lead: 2mm, cutting depth: 2.5mm(diameter value，cutting twice) as Fig. 4-13:

```
N0000  G00  X25  Z5                 ; approach workpiece
N0010  G01  X23.5  F100             ; tool infeed 1.5 mm (diameter programming)
N0020  G33  Z-50  P2  K2.5  I5.0    ; the first thread cutting
N0030  G00  X26                     ;
N0040  Z5                           ; return to the starting point
N0050  G01  X22.5                   ; the second tool infeeding 1 mm
N0060  G33  Z-50  P2  K2.5  I5.0    ; the second thread cutting
N0070  G00  X26                     ;
N0080  Z5                           ; z returns to starting point
N0090  M30
```

4.5.2 G34 — variable pitch thread cutting

【Command format】

G34 X(U) _ Z(W) _ P(E) _ K_ I_ Q_ R_ H_ ; variable pitch thread cutting

G34 Z(W) _ P(E) _ K_ I_ Q_ R_ H_ ; variable pitch axial straight thread cutting

G34 X(U) _ P(E) _ K_ I_ Q_ R_ H_ ; variable pitch end face straight thread cutting

【Field】

P —— metric thread lead.

E —— inch thread lead.

When P/E is the positive, it means the axial thread, and Z is the thread axis, it is the negative, it means the end face thread, and X is the thread axis.

X(U) /Z(W) ——absolute/relative coordinates of thread end point.

Z movement of axial thread cannot be 0; X movement of end face thread cannot be 0.

K ——length from the starting point to the end point of thread run-out in the thread machining axis.

K cannot be negative and must be less than the movement of thread machining axis.

I ——movement of the run-out axis direction in the thread run-out. (there is no run-out when it is omitted).

For the straight thread, I being positive means to execute the thread run-out positively; I being negative means to execute the thread run-out negatively.

R —— pitch incremental or reducing value per revolution of the spindle. The pitch decreases when R is negative; the pitch increases when R is positive.

H —— command bit parameter (H_d7 ~ H_d2：reserved)

H_d0 = 0，the system defaults it to zero;

H_d0 = 1，thread run-out when the long-axis reduces speed, and K is invalid.

H_d1 = 0，pitch skip increases or reduces after the spindle rotates one turn. H_d1 = 1，the pitch even increases or reduce after the spindle rotates some angle.

【Field】

X,Z,U,W：-9999.999mm～9999.999mm

I：-9999.999mm～9999.999mm

K：0～9999.998mm

P：0.001mm～500.000mm(the negative sign is added to the front of the range, When it is the positive, it means the axial thread; When it is the negative, it means the end face thread) ,

E：(0.060～25400.000) tooth/inch

Q：0°～360.000°

R：-500 mm/pitch～+500.00 mm/pitch(metric thread)

R=0 means the pitch is the same.

H：00000000～11111111

【Explanation】

Difference between G34 and G33:

1．When the previous block is G34, and the current is also G34, the two need to check the thread head signal (one per rev).

2．Bit parameter H definitions in G34 and G33 are different.

3．G33 is used to machining the constant pitch thread and G34 to machining variable pitch thread; others are the same, and the user can refer to G33.

In G34, R is the pitch incremental value or reducing value per revolution of the spindle, R=P2-P1，R with the direction; P1>P2: the pitch decreases when R is negative; P1<P2: the pitch increases when R is positive(as Fig. 4-14).

R range: metric thread: 0.000 mm/pitch～+500.000 mm/pitch; inch thread: +0.060 tooth/inch～+25400.000 tooth/inch, -25400.000 tooth/inch～-0.060 tooth/inch; R=0: the pitch is not changed.

When the pitch becomes negative or exceeds the permitted range due to the decrease/increase of R (the system will pre-count the increase/decrease path in advance), an alarm will occur.

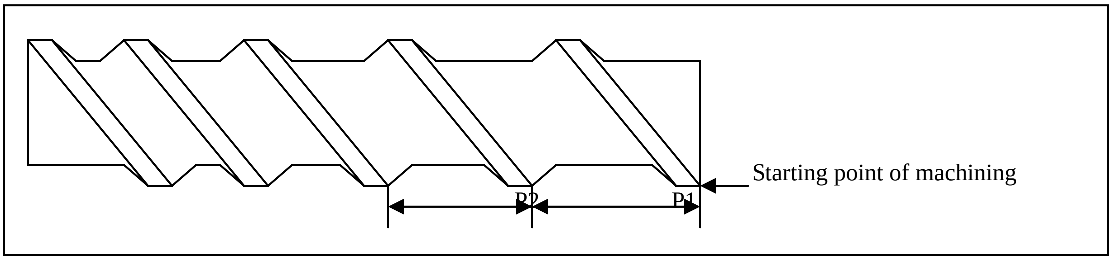


Fig. 4-14 variable pitch thread

4.6 **G32** —Tapping Cycle

【Command format】

G32 Z(W) _ P(E) _ H_ ; Z tapping to the specified position

G32 Y(V) _ P(E) _ H_ ; Y tapping, only single-axis feeds

【Field】

Z(W) ,Y(V) ：end point coordinates of tapping or tapping length; Z/Y is separate Z/Y absolute coordinate, W/V is separate Z/Y relative coordinate; the user only uses one of the relative and the absolute coordinate, and the relative coordinate is relative to the movement of the current position.

P：metric thread lead;

E：inch thread lead;

H：execution method

【Field】

Y, Z, V, W：-9999.999mm～9999.999mm

P：0.001mm～500.000mm

E：0.060 tooth/inch～25400.000 tooth/inch

H：0 or 1(reserved(invalid))

【Relative parameters】

parameters related to G32: **P100, P102, P103, P105, P106, P108, P112, P113, P114.**

【Explanation】

G32 Z tapping cycle execution process:

① Spindle rotation starts; Z axis infeed tapping.

② Close the spindle.

③ Wait the spindle to exactly stop.

④ The spindle rotates counterclockwise(reverse to the previous rotation direction)

⑤ Z tool retraction to the starting point of the cycle.

⑥ The spindle stops.

【Note】

1）Determine the spindle direction according to the possible tapping direction before tapping. The spindle will stop after the tapping ends. Restart the spindle when continuously machining.

2）There is a deceleration time after the spindle is closed, at the moment, Z/Y rotates along with the spindle till the spindle stops completely. Therefore, the actual bottom hole of machining is deeper than the actual required. The actual depth should be determined by the spindle speed in tapping and by whether the spindle's brake is installed or not.

3）The system forbids executing G32 when the system is in DRY RUN mode.

4）The other cautions are the same those of G33.

【Example】

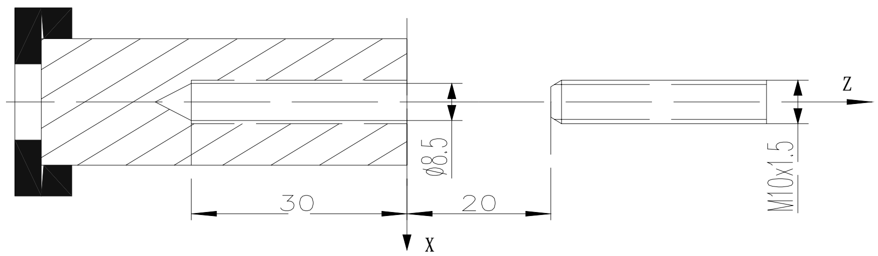


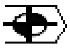
Fig. 4-15 tapping

Example：Single thread with 1.5 mm lead

N0010 G00 X0 Z20	; rapidly positioning the starting point of workpiece
N0020 M3 S01	; spindle CW
N0030 G01 Z2 F500	; Z approaches the workpiece
N0040 G32 Z-30 P1.5	; Z infeed tool tapping
N0050 G00 Z20	; leave the workpiece and return to program starting point
N0060 M02	; end of program

4.7 **G50** — Setting a Workpiece Coordinate System

The system directly modifies the current tool nose coordinates into the coordinate values set by G50 in G50 and sets the current machine coordinates to the program reference point.

After the system executes G50, the front of the machine coordinates of the corresponding axis has green icon  , which is taken as the program reference point return prompt.

The coordinate system created by G50 is taken as the workpiece coordinate system. After the coordinate system is created, the position of absolute coordinate in the following command is the coordinate values in the coordinate system.

Z of the workpiece coordinate system is defined in the rotary center of the workpiece when the system creates the workpiece coordinate system, X is defined in the end face of the chuck or the workpiece.

【Command format】

G50 Z_ X_ Y_ ; three-axis workpiece coordinate system setting

G50 Z_ X_ ; two-axis workpiece coordinate system setting

G50 X_ ; X workpiece coordinate system setting

G50 S_ ; max. spindle speed limit in constant surface speed refer to G96, G97 mode,

【Field】

Z, X, Y are absolute coordinate values. S is to limit max. spindle speed(r/min), refer to G96, G97.

【Field range】

X, Z, Y：-9999.999mm～9999.999mm

【Explanation】

1) Z/X/Y cannot be in the same block with S. Z/X/Y can select single-axis, two-axis or three-axis to set the workpiece coordinate system.
2) G50 is alone in one block and cannot be in one block with other commands.
3) Because the system has created one workpiece coordinate system and one program reference point, it uses the new workpiece coordinate system and the program reference point in Auto and Jog working mode till it is replaced after the system executes G50.

【Relative parameter】

Parameters related to G50: **P000, P001, P002**.

【Example】

G50 X100 Z100 Y100 **;** three-axis creating workpiece coordinate system

4.8 **G51** — Recovering Workpiece Coordinate System Setting

【Command format】

G51

【Explanation】

G51 is alone in one block without other commands.

Set the workpiece coordinate system and the program reference point in recovering Jog working mode. When the set workpiece coordinate and the program reference point in Jog working mode are replaced after G50 is executed, the recovering can use G51. After recovering, the system uses the previous workpiece coordinate system and the program reference point in Jog working mode and Auto workpiece mode till it is replaced.

4.9 **G26 — X, Z, Y Reference Point Return**

return to the program reference point through the middle point, rapidly traverse in G00.

【Command format】

G26 Z(W) _ X(U) _ ; Z/X rapidly moves to the program reference point through the middle point

G26 Z(W) _; Z rapidly moves to the program reference point through the middle point, and other axes do not move

G26 Y(V) _; Y rapidly moves to the program reference point through the middle point, and other axes do not move

【Field】

X, Z, Y： absolute coordinates of middle point;

U, W, V：relative movement from the starting point to middle point.

【Field range】

X, Z, U, W, Y, V：-9999.999mm～9999.999mm

【Explanation】

1） After the command is executed, all specified coordinate axes move to the point defined by G50. they moves the program reference point defined in the Jog working mode without using G50. After the corresponding axes execute the reference point return, the fronts of their machine coordinates have the blue icons as the prompts.

2） The command and other commands cannot in the same block.

3） The execution mode of the command is the same that of G00; Relative parameter is referred to G00, G50.

4） Z/X/Y can select single-axis, two-axis or three-axis simultaneously to execute the program reference point return.

【Example】

G26 Z150 X100 Y100 ; return to program reference point through the middle point (Z150，X100，Y100)

G26 U0 ; X directly returns to program reference point and other axes do not move

4.10 **G28** — Return to Machine Zero(Machine Reference Point)

【Command format】

G28 Z(W) _ ; Z rapidly moves to machine zero through the middle point and other axes do not move

G28 X(U) _ ; X rapidly moves to machine zero through the middle point and other axes do not move

G28 Y(V) _ ; Y rapidly moves to machine zero through the middle point and other axes do not move

【Field】

X, Z, Y：absolute coordinates of middle point;

U, W, V：relative movement from starting point to middle point.

【Field range】

X, Z, U, W, Y, V：-9999.999mm～9999.999mm

【Relative parameter】

Main parameters related to G28: P021～P026, P109, P110, P111, P406 and P407.

【Explanation】

1） When the machine zero check devices(zero switch and deceleration switch) are not installed on the corresponding coordinate axis, P406 corresponding bit parameter is set to 0; in executing G28, the system does not check the zero signal and deceleration signal, and the axis moves the middle point and returns to its zero coordinate position.

2） When the machine zero check devices(zero switch and deceleration switch) are installed on the corresponding coordinate axis, P406 corresponding bit parameter is set to 1; in executing G28, the axis rapidly moves to the machine zero from the starting point and does not go through the middle point; i.e. the above machine zero return is the same that of Jog working mode.

3） The machine zero return in G28 is referred to PROGRAMMING, 4.4 Machine Zero Return in JOG working mode.

4） G28 is non-modal G command, its execution is the same that of G00; other relative parameters are referred to G00.

5） After the corresponding axes execute the machine zero return, there is blue icons as the prompts following machine coordinates.

6） The command and other commands cannot in the same block.

7） Z/X/Y only executes the single-axis machine zero return.

【Example】

G28 U0 ; X rapidly moves to machine zero through the middle point and other axes do not move

G28 W0 ; Z rapidly moves to machine zero through the middle point and other axes do not move

G28 V0 ; Y rapidly moves to machine zero through the middle point and other axes do not move

4.11 **G30** — 2nd, 3rd Program Reference Point Return

【Command format】

G30 P2 Z(W) _ X(U) _ ; Z/X rapidly moves to execute the 2nd program reference point return through the middle point

G30 P3 Z(W) _ X(U) _ ; Z/X rapidly moves to execute the 3rd program reference point return through the middle point

G30 P2 Z(W) _ ; Z rapidly moves to execute the 2nd program reference point return and other axes do not move

G30 P2 Y(V) _ ; Y rapidly moves to execute the 2nd program reference point return and other axes do not move

【Field】

X, Z, Y： absolute coordinates of middle point;

U, W, V：relative movement from starting point to middle point.

P2 specifies 2nd program reference point; P3 specifies 3rd program reference point..

【Field range】

X, Z, U, W, Y, V：-9999.999mm～9999.999mm

P：2 or 3

【Relative parameters】

Main parameters related to G30: **P003～P008.**

【Explanation】

1）The execution mode of the command is the same that of G00; Relative parameter is referred to G00.

2）The command and other commands cannot in the same block.

3）Z/X/Y can select single-axis, two-axis or three-axis simultaneously to execute 2nd, 3rd program reference point return.

【Example】

G30 P2 Z150 X100 **;** return to 2nd program reference point through the middle point (Z150，X100)

G30 P3 Z150 X100 **;** return to 3rd program reference point through the middle point (Z150，X100)

G30 P3 W0 **;** Z rapidly returns to 3rd program reference point directly.

4.12 **G04** — Dwell

【Command format】

G04 D__ ; dwell

【Field】

D — dwell time. (unit：s) G04 defines the meantime between two blocks.

【Field range】

D：0～9999.999 s

【Explanation】

1） G04 cannot be in the same block with other command except for S, F command.

2） In G04, press CYCLE START and the dwell ends and the system orderly executes the next command.

【Example】

Example ：G04 D2.5 **; dwell 2.5s**

4.13 G96 —Constant Surface Speed Control, G97 —Constant Surface Speed Cancel

【Command format】

G96 S ; constant surface speed control

G97 S ; cancel constant surface speed control

【Field】

S specifies the constant surface speed in G96. (unit: m/min)

S specifies to cancel the constant surface speed in G97.(unit: r/min)

【Field range】

S：0～9999 r/min

0～9999 m/min

0～4(multi-gear spindle)

【Explanation】

G96, G97 are the modal word in the same group but one of them is valid. G97 is the initial word and the system defaults G97 is valid when the system is switched on.

When the machine tool is turning it, the workpiece rotates based on the axes of spindle as the center line, the cutting point of tool cutting workpiece is a circle motion around the axes, and the instantaneous speed in the circle tangent direction is called **cutting surface** (for short **surface speed**). There are different surface speed for the different workpiece and tool with different material.

When the spindle speed controlled by the analog voltage is valid, the constant surface control is valid. The spindle speed is changed along with the absolute value of X absolute coordinates of programming path in the constant speed control. If the absolute value of X absolute coordinates adds, the spindle speed reduces, and vice verse, which make the cutting surface speed as S command value. The constant speed control to cut the workpiece makes sure all smooth finish on the surface of workpiece with diameter changing.

Surface speed=spindle speed × |X| × π ÷1000 (m/min)

Spindle speed: r/min

|X|: absolute value of X absolute coordinate value, mm

π ≈3.14

In G96, the spindle speed is changed along with the absolute value of X absolute coordinates value of programming path in cutting feed (interpolation), but it is not changed in G00 because there is no actual cutting and is counted based on the surface speed of end point in the program block.

In G96 (constant surface speed control), Z coordinate axis of workpiece system must consist with the axes of spindle (rotary axis of workpiece), otherwise, there is different between the actual surface speed and the defined one.

In G96, G50 S_ can limit max. spindle speed (r/min). The spindle actual speed is the limit value of max. speed when the spindle speed counted by the surface speed and X coordinates value is more than the max. spindle speed set by G50 S_. After the system is switched on, max. spindle speed limit value is **P305**(max. spindle speed of constant surface speed).

Max. spindle speed limit value defined by G50 S_ is reserved before it is defined again and its function is valid in G96. Max. spindle speed defined by G50 S_ is invalid in G97 but its limit value is reserved.

【Relative parameters】

Main parameters related to G96, G97: **P410_d6, P304**, **P305;**

P410_d6 setting determines whether the system executes the constant surface speed control in G96;

Min. and Max. speed limit **P304**, **P305** of constant surface speed control.

【Note】

1) The system alarms S value cannot be zero in E272- G50 in programming G50 S0.
2) The spindle speed is controlled actually by the constant surface speed control function when the system adopts the spindle controlled by the converter, i.e. **P410_d6** = 1. Do not execute the constant surface speed control in G96 if the system uses the gear shifting spindle.
3) The constant surface speed control is executed anytime in G00, G01, G02, G03, G05, G90, G94, G71, G72; the constant surface speed control is invalid in G32, G33, G34、G76, G92; when X coordinate is changed in G50 or executing the tool offset, the spindle speed is valid in the next command.
4) Min., max. speed of constant surface speed control is set by **P304, P305**.
5) The rotary axis in the constant surface speed must be set in Z(X=0) of the workpiece coordinate.
6) G96 is modal command. When G96 is valid, the single S command is taken as the new surface speed data.
7) In DRY RUN mode, the constant surface speed control is valid. Whether the single S command renews the previous surface speed is controlled in Dry run by **P401_d7: P401_d7**= 0: T, M, S command can be executed; **P401_d7**=1: do not execute T, M, S command.
8) The constant surface speed control is invalid to get the constant spindle speed in thread cutting.
9) In G96, when the system defaults S field, the system automatically counts the surface speed as S value according to the current spindle speed(the last speed is taken as the current speed when the spindle does not start, the spindle initial speed is taken as the current speed when the system is switched on just now) and X absolute coordinate value of tool nose.
10) The system automatically count the speed as S value according to the current constant surface linear speed and X absolute value of tool nose when the system defaults S field in G97.
11) In AUTO working mode and the initial state of the program execution in G96, the system automatically changes G96 into G97 after CYCLE START key is pressed, the constant surface

cutting is valid in machining the arc and the straight line in the course of machining.

12) In Jog working mode, move X coordinate in feed state (rapid/feed indicator OFF) in G96, G96 is valid, the spindle speed changes along X coordinate value, and is invalid in rapidly feed state(rapid/feed indicator ON).

13) S value of G96 is limited by S value of G50 Sxxxx and P304, P305, S initialization of G50 is P305, their limit relationship is as follows:

●G50 Sxxx<**P304:** G50 Sxxx is invalid, the spindle speed is regulated in G50 Sxxx<**P304 in G96 .**

●G50 Sxxx>=**P304:** G50 Sxxx is valid, min. spindle speed range is limited by P304 and max. speed range is limited by the smaller between G50 Sxxx and **P305**.

【Example】

P304 value is the lower limit of the spindle speed in constant surface control. When the spindle speed counted by the surface speed and X coordinate value is lower than P304 value, the lower limit of the spindle speed is the actual spindle speed.

Example：as Fig. 4-17; surface speed is 300m/min which can count the spindle speed annotated in Table 4-2.

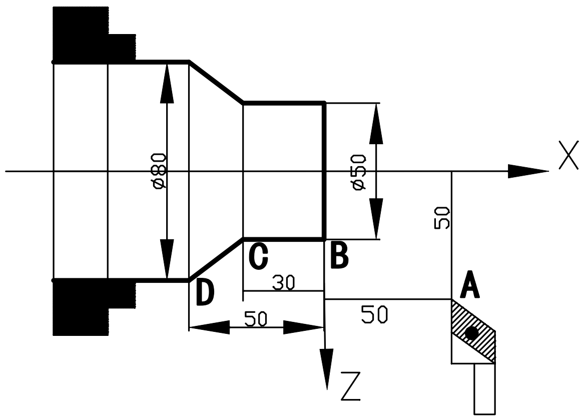


Fig. 4-17

Table 4-2：

N0010	M3 G96 S300;	(Spindle rotates clockwise, the constant surface speed control is valid and the surface speed is 300 m/min)
N0020	G0 X100 Z100;	(Rapidly traverse to A point with spindle speed 955 r/min)
N0030	G0 X50 Z0;	(Rapidly traverse to B point with spindle speed 1910 r/min)
N0040	G1 W-30 F200;	(Cut from B to C with spindle speed 1910 r/min)
N0050	X80 W-20 F150;	(Cut from C to D with spindle speed 1910 r/min and surface speed 1194 r/min)
N0060	G0 X100 Z100;	(Rapidly retract to A point with spindle speed 955 r/min)
N0110	M30;	(End of program, spindle stopping and coolant OFF)

4.14 Single Canned Cycle

It is necessary to cut repeatedly the same machining path in the course of some special roughing. To simplify the programming, improve the programming and the machining efficiency, the canned cycle is set. The tool will automatically return to the coordinate position before execution when executing the canned cycle once. If the cycle is executed again, do not alter the cycle commands but execute the programming of feeding data again. Return to the starting point of cycle after the system executes the cycle. If other commands G are contained in the block behind the cycle ones, the cycle automatically ends. The single canned cycle only uses Z/X programming.

4.14.1 G90 —outer cylinder face turning cycle (axial cutting cycle)

【Command format】

G90 Z(W) _ X(U) _ R_ F_ ; inner/outer cylinder face turning cycle;

X(U) _ F_ ; G90 cycle consecutive command; cycles once G90 contour.

【Field】

X(U) Z(W) — cylinder(taper) end point; two axis coordinates should be given;

R —diameter difference between the starting point and the end point of cycle. It is the axis surface cutting if R is omitted.

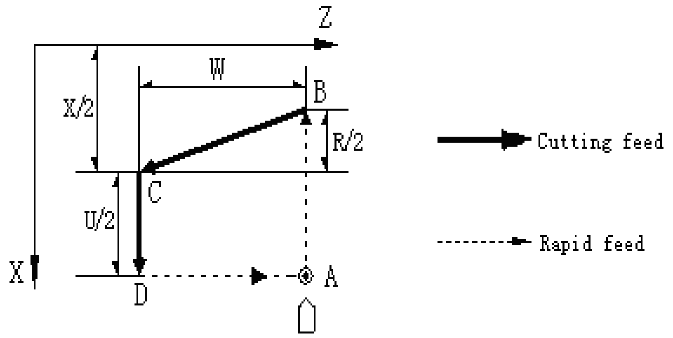
F —feedrate.

【Field range】

X,Z,U,W,R：-9999.999mm～9999.999mm

F：0.001mm/min～15000mm/min

【Command execution process】



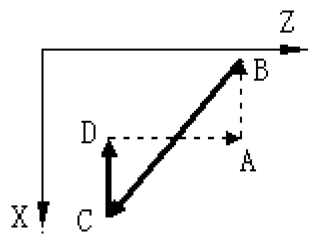


Fig. 4-18a outer/inner cylinder (taper) face turning cycle Fig. 4-18b the system alarms in mistaken programming contour

G90 cycle process：(Fig. 4-18a)

① X rapidly moves from A to B. .

② The tool cuts at F speed from B to C of X, Z (X does not move without R).

③ The tool cuts at F speed from C to D of X axis.

④ Z rapidly moves from D to A.

【Relative parameter】

In G90, the relative parameter of rapid traverse is referred to G00, the cutting feed is referred to G01.

【Explanation】

1） The directions of inner, outer machining and cutting are determined automatically by the position of the cycle start and X, Z coordinates.

2） The tool stops the cycle starting point after the cycle ends. U sign is determined by X from A to

B when the system uses the relative coordinates. W sign is determined by Z from B to C. In taper cutting cycle, R is determined by X from C to B.

3） In programming, A B C D must consist orderly of one quadrangle or a triangle; i.e. B, C must be the same side of the linearity AB, otherwise, the system alarms(Fig. 4-18b). When C coincides with D or A coincides with B, they consist of a triangle.

4） G90 can be followed by the cycle consecutive commands, which sets again X end point coordinate, and the system executes the cycle once based on G90 contour; U in the consecutive command is relative to the cycle starting point. For example, when the system only defines again X end point coordinate (X/U), it executes the above cycle according to the new X(U) coordinates. The cycle contour of the consecutive command must be consistent with the direction of G90, otherwise, the system alarm.

5） There is only the single X(U) field (with F command) in the cycle consecutive command; the next block of the consecutive command can follow the consecutive command; when the next block is not the single X(U) instead but other G command, the system cancels the cycle; when the next block is not the single X(U) but M, S, T, the system prompts the alarm message.

6） When G41/G42 are compiled with G90 in the same block, the system executes the tool nose radius compensation in G90; the system automatically executes the compensation according to the motion path, which is referred to PROGRAM Chapter 5 Tool Nose Radius Compensation.

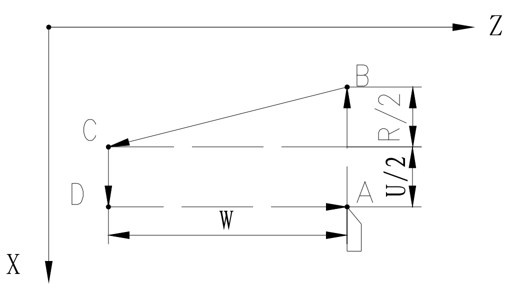
7） In single block running, press CYCLE START to execute one cycle step. The single block stops at the end point of each step.

8） Besides G41, G42, the command is in the alone block without other commands.

9） Explanations of G94, G92 cycle contour are the same those of G90.

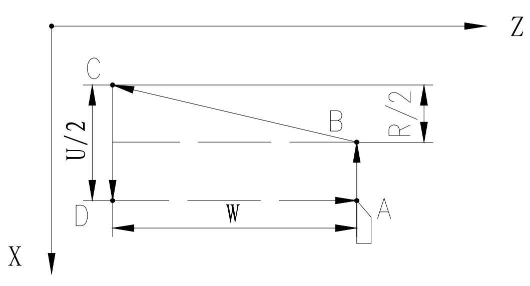
10) Relationships between the data behind U, W, R and the tool path are as follows:

(1)U＜0, W＜0, R＜0



X from A to B is negative, so U<0;
Z from B to C is negative, so W<0;
X from C to B is negative, so R<0.

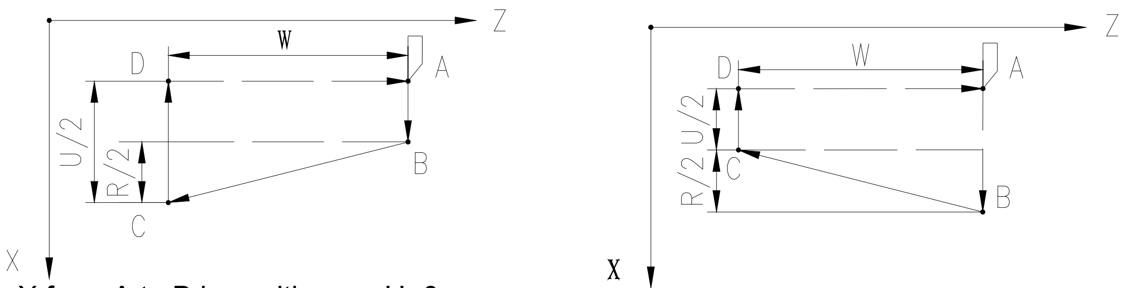
(2)U＜0, W＜0, R＞0



X from A to B is negative, so U<0;
Z from B to C is negative, so W<0;
X from C to B is positive, so R>0.

(3)U＞0, W＜0, R＜0

(4)U＜0, W＜0, R＞0



X from A to B is positive, so U>0;
Z from B to C is negative, so W<0;
X from C to B is negative, so R<0.

X from A to B is positive, so U>0;
Z from B to C is negative, so W<0;
X from C to B is positive, so R>0.

Fig. 4-19 Relationships between signs of U, W, R and tool path in G90

【Example】

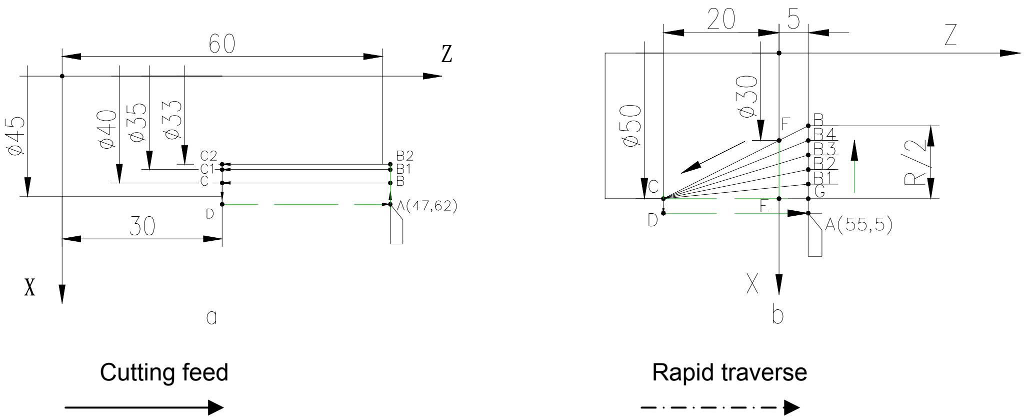


Fig. 4-20 G90 cutting example

Example 1: Fig. 4-20a outer cylindrical face: the first cutting feed= 5 mm, the second cutting feed= 2 mm, F=100 mm/min.

N0010 G00 X47 Z62 ; rapidly position to A

N0020 G90 X40 Z30 F100 ; cycle once A B C D A

N0030 X35 ; the first tool infeed to cycle once A B1 C1 D A

N0040 X33 ; the second tool infeed to cycle once A B2 C2 D A

N0050 M30

The tool is still on A after executing the above-mentioned blocks.

Example 2: Fig. 20b taper surface: the cutting feed R=- 5 mm once, F=100 mm/min.

N0010 G00 X55 Z5 ; rapidly position to A

N0020 G90 X50 Z-20 R-5 F100 ; cycle A B1 C D A

N0030 G90 X50 Z-20 R-10 ; cycle A B2 C D A

N0040 G90 X50 Z-20 R-15 ; cycle A B3 C D A

N0050 G90 X50 Z-20 R-20 ; cycle A B4 C D A

N0060 G90 X50 Z-20 R-25 ; cycle A B C D A

The tool is still on A after executing the above blocks.

4.14.2 G92 —Thread cutting cycle

G92 executes the thread cycle cutting. The system executes the thread cycle cutting from the starting point, and finally returns to the starting point.

【Command format】

G92 X(U) _ Z(W) _ P(E) _ K_ I_ R_ L_ H_ ; thread cutting cycle.

【Field】

P —— metric thread lead; E —— inch thread lead.

When P/E is positive, the system executes the axial thread and Z is the thread axis; it is negative, the system executes the end face thread and X is the thread axis.

X(U), Z(W)——Absolute/relative coordinate of the thread end point;

Z movement of axial thread cannot be 0; X movement of end face thread cannot be 0.

R ——For the axial thread, it is the different value (radius value) of X absolute coordinate between end point and start point of cutting(it is the straight thread when R is omitted).

For the end face thread, it is Z coordinate difference between the starting point and the end point of the thread.

For taper thread, R determines the direction of the thread run-out; i.e. the direction is positive when R is negative, the direction is negative when it is positive.

K ——It is the length from the starting point of the thread run-out to the thread end point in thread machining axis.

K cannot be negative and must less than the movement of thread machining axis.

I —— It is the movement of the thread run-out in thread run-out.(there is no thread run-out when it is omitted).

For the straight thread, the thread run-out is positive when I is positive; the thread run-out is negative when I is negative.

For taper thread, the direction of thread run-out is the same that of the taper; I sign is invalid.

L —— thread head quantity of multi-thread(it is single thread when L is omitted).

H —— It commands the bit parameter(H_d7 ~ H_d2：reserved) ; the system defaults it to be zero when it is omitted.

H_d0=1: thread run-out when the long axis reduces speed, which is not limited by K value.

H_d1=1: the system executes the thread run-out according to the proportional between K and I. (one of K, I is 0, the bit is invalid; H_d1 is prior to H_d0).

Note: When the system executes the thread run-out according to K and I proportion, and I/K ratio is big, the thread run-out speed raises rapidly, which can cause the stepper motor step-out, and the alarm of the servo motor.

H_d2=1: indicates precession; The programming rules for the thread precession function (feeding from the middle of the workpiece) are as follows:

1) In G92 command, I, K indicate the depth of precession, which are not omissible.

2) H_d1=1 in G92: When the run-out is performed using I, K linkage mode, the conditions of precession are the same as those of run-out.
3) H_d1=0 in G92: When the run-out is performed respectively using I, K rapid traverse mode, the conditions of precession differ from those of run-out.

【Field range】

X,Z,U,W,R：-9999.999mm～9999.999mm

I：-9999.999mm～9999.999mm;

K：0～9999.998mm

P：0.001mm～500.000mm(the front of the range can have the negative sign. The positive means the axial thread, the negative means the end face thread.)

E：(0.060～25400.000) tooth/inch(the front of the range can have the negative sign. The positive means the axial thread, the negative means the end face thread.)

L：1～99

H：00000000～11111111

【Command execution process】

The execution process of G92 thread cycle is as Fig. (taking example of axial thread cutting)

① Check the spindle speed, count the reference speed of thread machining according to the speed and the pitch. The system alarms when the value exceeds P113 value(max. cutting feed speed). Before it, the user must ensure the spindle speed must be stable, otherwise, it can cause to be the disorder thread tooth.

② X rapidly moves from A to B: X(U) +R position(starting point B of thread).

③ X，Z execute the thread cutting from B to C.(including thread run-out); the process is the same that of G33.

④ X rapidly returns to D.

⑤ Z rapidly returns to A(starting point).

⑥ Multi-thread, repeat the above step 2～4 to execute the multi-thread cutting

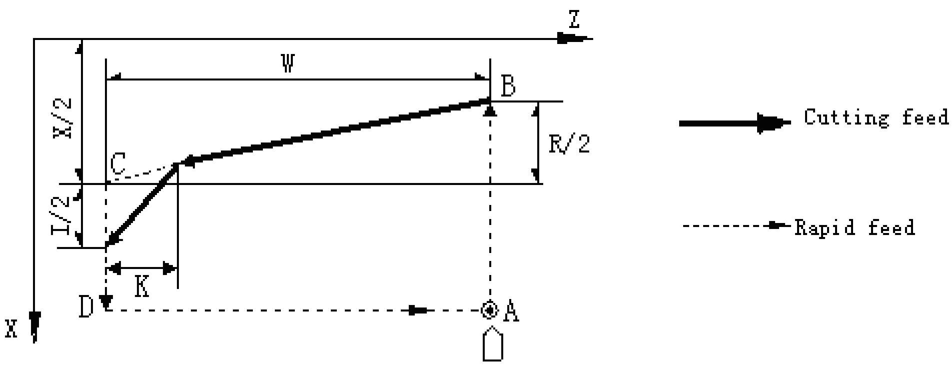


Fig. 4-21 G92 thread cutting cycle

【Relative parameter】

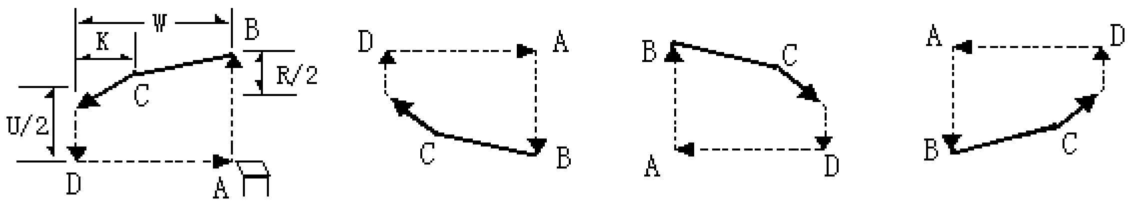
In G92, the relative parameter for rapid traverse is referred to G00, the one for thread cutting is referred to G33.

【Explanation】

1) It is necessary to execute the cutting feed many times, at the moment, only alter X coordinate value of end point of cutting feed (or the increment value compared to the starting point). The coordinate position is still on the starting point when the thread cycle ends.
2) The command cannot be in the same block with other command.
3) G92 recycle consecutive command means the system executes one time the contour in G92; when P(E) is positive, G92 recycle consecutive command is only X(U) ; when P(E) is negative, G92 recycle consecutive command is only Z(W) .
4) The axial thread machining is limited by the diameter difference between the starting point and the end point of the thread in cutting taper thread; it is limited by Z coordinate difference between the starting point and end point of the cycle in cutting taper thread.
5) Notes are the same those of G33 thread cutting.
6) For axial taper thread, the pitch P/E is the pitch in the thread axis(Z); for the end face thread, it is the pitch in the thread axis(X).
7) The relationship between R, K, P and tool path is as follows:

◆ **P/E is positive(axial thread, Z is the thread axis) ：**

1) U<0，W<0，R<0 2) U>0，W<0，R>0 3) U<0，W>0，R<0 4) U>0，W>0，R>0



5) U<0，W<0，R>0 6) U>0，W<0，R<0 7) U<0，W>0，R>0 8) U>0，W>0，R<0

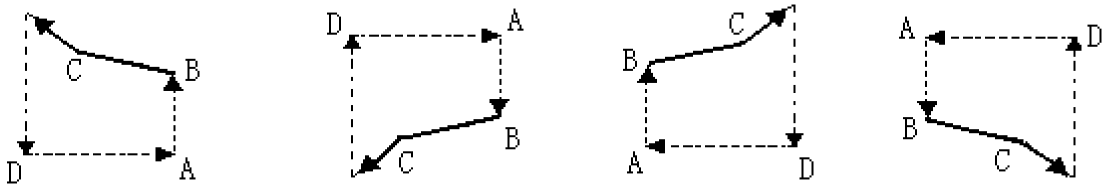
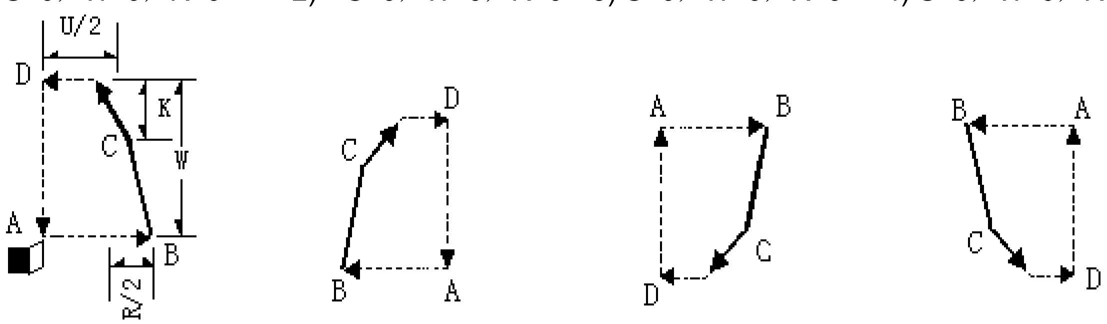


Fig. 4-22 G92 thread cutting tool path

◆ **P/E is negative (end face thread, X is the thread axis) ：**

1) U<0，W>0，R>0 2) U<0，W<0，R<0 3) U>0，W>0，R>0 4) U>0，W<0，R<0



5) U<0，W>0，R<0 6) U<0，W<0，R>0 7) U>0，W>0，R<0 8) U>0，W<0，R>0

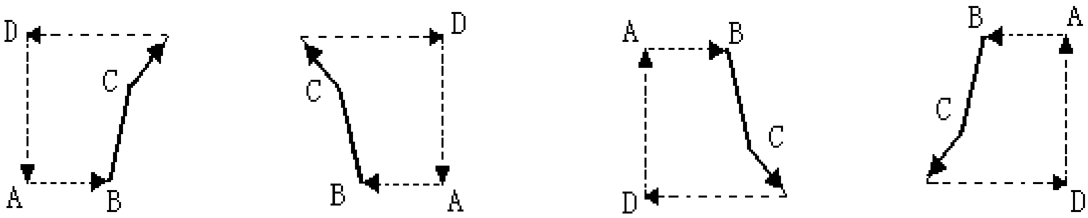
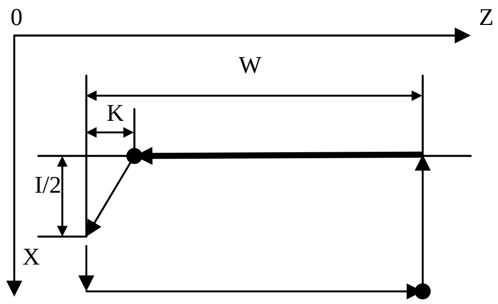
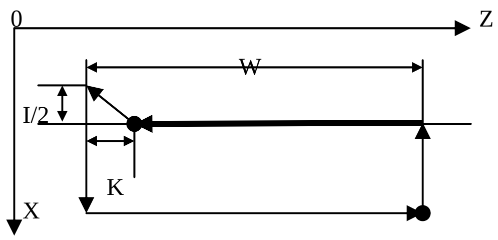


Fig. 4-23 G92 thread cutting tool path

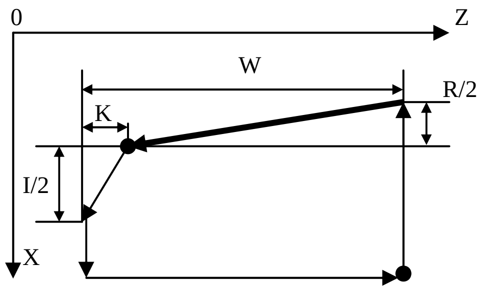
G92 thread cutting programming forms: (diameter programming)



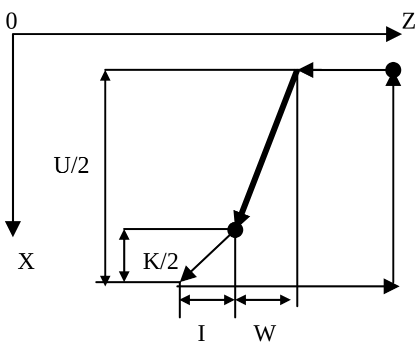
1）G92 axial straight thread:
P is positive;
R=0;
U<0;
The thread run-out is in the positive direction when I is positive; there is no thread run –out when there is no I; the end position does not change;



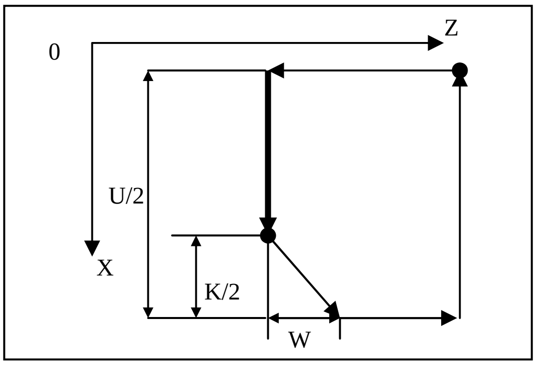
2）G92 axial straight thread：
P is positive;
R=0;
U<0;
The thread run-out is in the negative direction when I is negative; there is no thread run –out when there is no I; the end position does not change; ;



3）G92 axial taper thread：
P is positive;
The thread run-out is in the positive direction when R is negative;
U<0;
Example ：G00 Z100 X100
G92 W-60 U-50 R-10 K3 I6 P2
U-51
M30

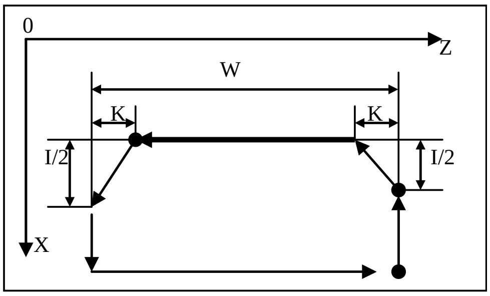


4）G92 end face taper thread：
P is negative;
R is positive;
There is no the thread run-out when there is no I;
Example ：G00 Z100 X10
G92 W-10 U60 R10 K3 I1.5 P-2
W-10.5
W-11
M30



5）G92 end face thread：
P is negative;
R=0;
The thread run-out is in the positive direction when I is positive;
Example：G00 Z100 X10
G92 W-30 U80 K5 I2.5 P-2
W-31.5
W-32
M30

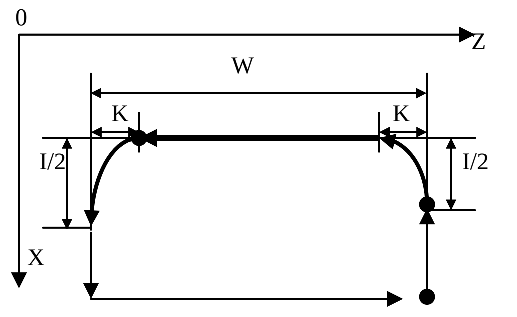
The programming example of G92 thread precession function machining is as follows:



1. G92 axial precession straight thread:

P is a positive value; the sign of I determines the direction of run-out; I and K are not omissible; the linkage precession and linkage run-out are performed by I/K proportion.

E.g. G00 Z100 X100
G92 W-60 U-50 K3 I6 P2 H00000110
M30



2.G92 axial precession straight thread：

P is a positive value; the sign of I determines the direction of run-out, I and K are not omissible; rapid precession and rapid run-out.

E.g. G00 Z100 X100
G92 W-60 U-50 K3 I6 P2 H00000100
M30

【Example】

1) G92 axial straight thread: as Fig. 4-24

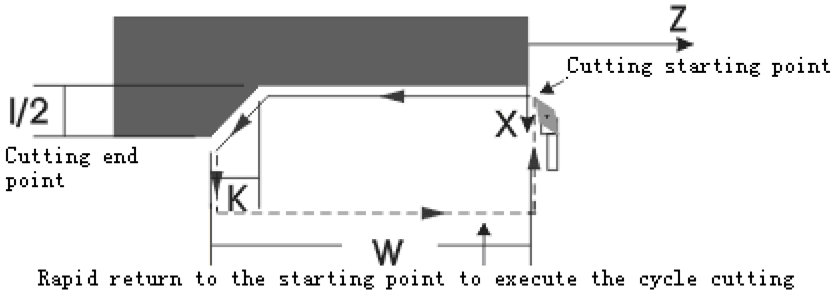


Fig. 4-24

P is positive; I sign determines the direction of thread run-out; there is no the thread run-out when I is omitted;

2) G92 axial taper thread: as Fig. 4-25

P is positive; R sign determines the direction of the thread run-out; I sign is invalid.

Example：G00 Z100 X100

G92 W-60 U-50 R-10 K3 I6 P2

U-50.5

U-51

M30

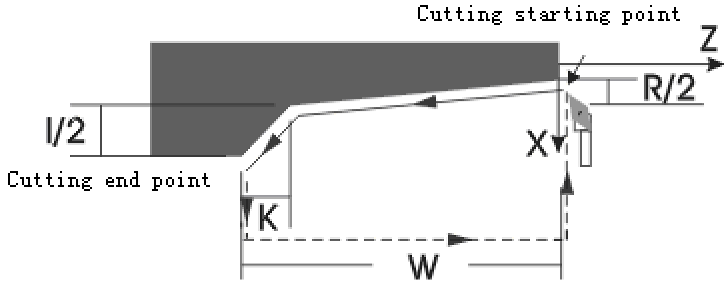


Fig. 4-25

3) G92 end face taper thread: as Fig. 4-26

P is negative; R sign determines the direction of the thread run-out; I sign is invalid.

Example：G00 Z100 X10

G92 W-10 U60 R10 K3 I1.5 P-2

W-10.5

W-11

M30

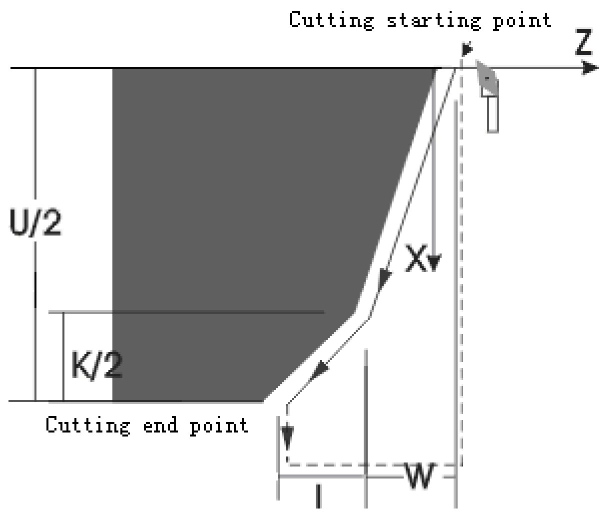


Fig. 4-26

4) ,G92 end face thread: as Fig 4-27

I is negative; I sign determines the direction of the thread run-out; there is no the thread run-out when I is omitted.

Example：G00 Z100 X10

G92 W-30 U80 K5 I2.5 P-2

W-31.5

W-32

M30

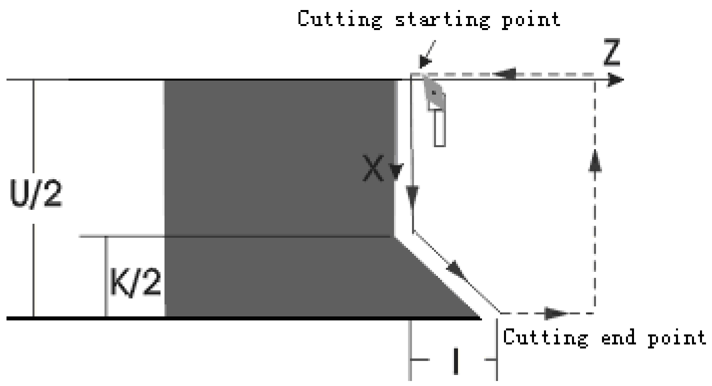


Fig. 4-27

5) Compound example：as Fig. 4-28

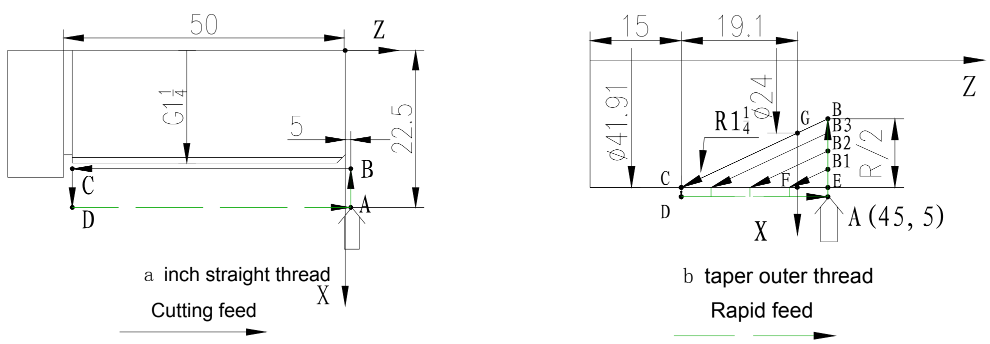


Fig. 4-28

Example 1： Metric straight thread as Fig. 4-28 a.(G1$\frac{1}{4}$:11 teeth，D=41.910, D2=40.431, D1=38.952)

N0010 G00 X45 Z5	; rapidly position A
N0020 M03 S600	; spindle CW, 600 rev/min
N0030 G92 X41 Z-50 E11	; the first tool infeed, cutting 0.91 cm
N0040 X40.2	; the second cutting 0.8 cm
N0050 X39.6	; the third cutting 0.6 cm
N0060 X39.2	; the fourth cutting 0.4 cm
N0070 X38.952	; the fifth cutting to the required dimension
N0080 M30	

The tool is still on A after executing the above-mentioned blocks.

Example 2： Outer taper thread as Fig. 4-28 b (R1$\frac{1}{4}$: D=41.910, D2=40.431, D1=28.952, P=2.309, the valid length of thread is 19.1)

N0010 G00 X45 Z5	; rapidly position A
N0020 M03 S600	; spindle CW, 600 rev/ min
N0030 G92 X40 Z-19.1 P2.309 R-22.6	; the first tool infeed to cut
N0040 X36	; the second tool infeed to cut
N0050 X32	; the third tool infeed to cut
N0060 X28.952	; the fourth tool infeed to cut
N0070 M30	

The tool is still on A after executing the above-mentioned blocks.

4.14.3 G94 —Inner/outer end face (taper) turning cycle

【Command format】

G94 Z(W) _ X(U) _ R_ F_ ; end point coordinate. The coordinates of two axes must be given and the incremental coordinates cannot be zero.

Z(W)_ F_ ; G94 recycle consecutive command; expresses the system executes the recycle once according G94 contour

【Field】

X(U) Z(W) —end point coordinate. The coordinates of two axes must be given.

R —Z coordinate difference between the starting point and the end point. It is the face cutting if R is omitted.

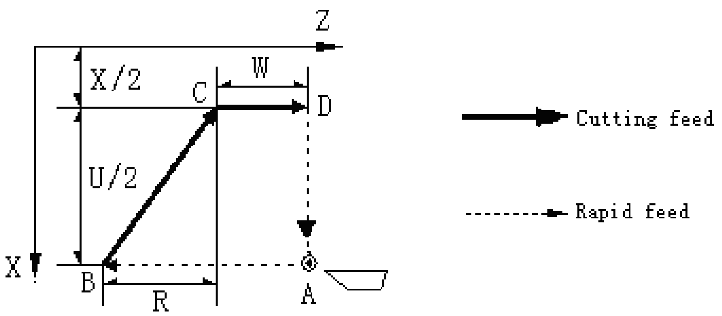
F — cutting speed

【Field range】

X, Z, U, W, R：-9999.999mm～9999.999mm

F：0.001mm/min～15000mm/min

【Command execution process】



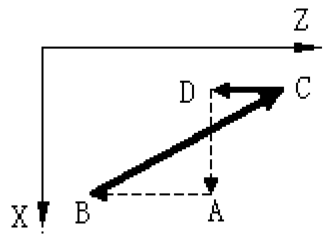


Fig. 4-29a G94 end face turning cycle   Fig. 4-29b the system alarms because of mistaken programmed contour

G94 cycle execution process(Fig. 4-29a):

① Z rapidly moves from A to B.

② X, Z move at F speed from B to C(Z does not move without R) .

③ Z moves at F speed from C to D.

④ X rapidly moves from D to A.

【Relative parameter】

In G94, the relative parameter of rapid traverse is referred to G00, the cutting feed is referred to G01.

【Explanation】

1） G94 follows the re-cycle consecutive command to set again Z end point coordinate, the system executes the cycle once according to G94 contour; W in the consecutive command is relative to the cycle starting point. For example, after the system redefines Z end point coordinate(Z/W), it executes the cycle process repeatedly according to the new Z(W) coordinates. The consecutive command cycle contour must be consistent with that of G94, otherwise, the system alarms.

2）There is the alone Z(W) in the cycle consecutive command; the next block of the consecutive command can follow the consecutive command; when the next block is not the alone Z(W) but other G command, the cycle is cancelled; when it is not the alone Z(W) but M,S,T, the system prompts the alarm message.

3）When G41/G42 and G94 are compiled in the same block, the system executes the tool nose radius compensation in G94; the system automatically compensates according to the motion path, which is referred to **PROGRAMMING, Chapter 5 Tool Nose Radius Compensation.**

4）G94 is in the alone block except for G41, G42 without other commands.

5）Other explanations of G94 are the same those of G90.

6）Relationships between the data behind U, W, R and the tool path are as follows:

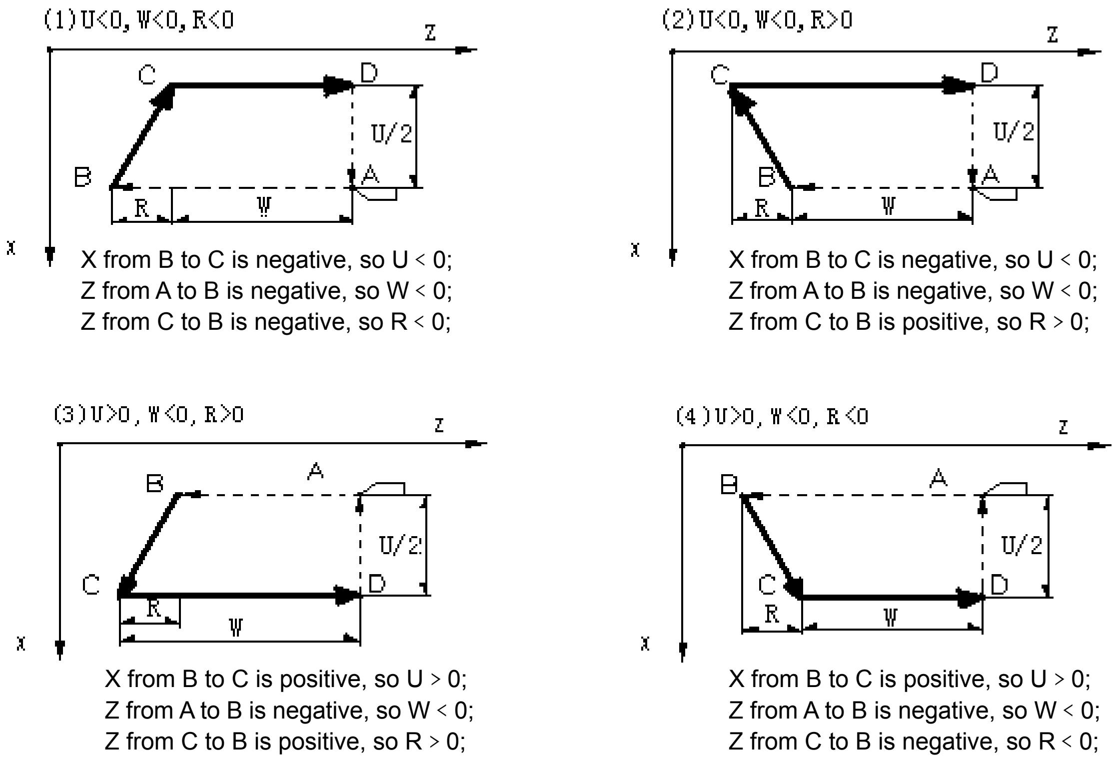


Fig. 4-30 G94 relationship between U, W, R sign and tool path

【Example】

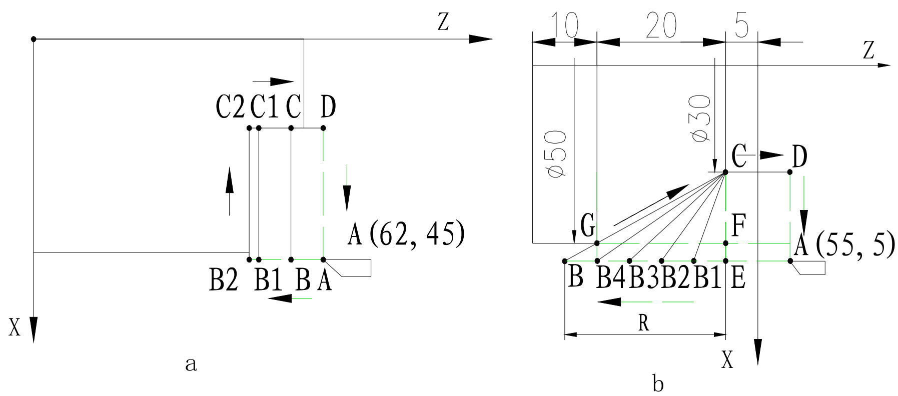


Fig. 4-31 G94 cutting example

Example 1：Fig. 4-31a, the first feed= -5 mm, the second feed= 1.5 mm, F=80 mm/min, and its programming as follows：

N0010 G00 X62 Z45 ; rapidly position to A point
N0020 G94 X25 Z40 F80 ; the first cycle A B C D A
N0030 Z35 ; tool infeed 5mm, the 2nd cycle A B1 C1 D A
N0040 Z33.5 ; tool infeed 1.5m, the 3rd cycle A B2 C2 D A
N0050 M30

Example 2: Fig. 4-31b, feed R=-5 mm once, feedrate=100 mm/min and its programming as follows：

N0010 G00 X55 Z5 ; rapidly position to A point
N0020 G94 X30 Z-5 R-5 F100 ; the first cycle A B1 C D A
N0030 G94 X30 Z-5 R-10 ; tool infeed 5mm, the 2nd cycle A B2 C D A
N0040 G94 X30 Z-5 R-15 ; tool infeed 5mm, the 3rd cycle A B3 C D A
N0050 G94 X30 Z-5 R-20 ; tool infeed 5mm, the 4th cycle A B4 C D A
N0060 G94 X30 Z-5 R-25 ; tool infeed 5mm, the 5th cycle A B C D A

4.14.4 G74 —Deep hole machining cycle on end face

【Command format】

G74 X(U) _ Z(W) _ I_ K_ R_ E_ F_ ; Deep Hole Machining Cycle on End Face

【Field】

X(U) Z(W) —coordinates of hole bottom. It is the deep hole drilling cycle when X coordinate is omitted.

I —Z tool infeed once(Z axis)

K — Z tool retraction once(Z axis)

R —pecking cycle or deep hole cycle. When R is omitted or R=0, the distance of retraction is only K, i.e. pecking cycle. When R=1, retract to the starting point of the first drilling hole once, i.e. deep hole drilling cycle

E —X offset value once(diameter value) .

F — feedrate.

【Field range】

X, Z, U, W：-9999.999mm～9999.999mm

I, K：0～9999.999mm

E：deep hole drilling cycle is 0～9999.999 mm; end face deep hold machining cycle is 0.001～9999.999 mm

R：0 or 1

F：0.001mm/min～15000mm/min

【Explanation】

R=1，G74 cycle process as follows:

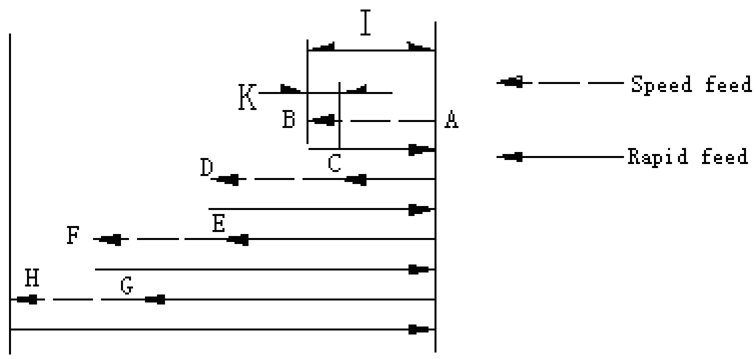


Fig. 4-33 G74 cycle- deep hole drilling cycle(R=1)

1. Z feeds at F speed from A to B.
2. Z returns to A at the rapid traverse speed.
3. Z feeds to C at the rapid traverse speed.
4. Z feeds at F speed from C to D.
5. Z returns to A at rapid traverse speed.
6. Z feeds to E at the rapid traverse speed.
7. Z feeds at F speed from E to F.
8. Z returns to A at the rapid traverse speed.
9. Z feeds to G at the rapid traverse speed.
10. Z feeds at F speed from G to H.
11. Z returns to A at the rapid traverse speed.

Omitting R or R=0, G74 end face deep hole machining cycle execution process as follow:

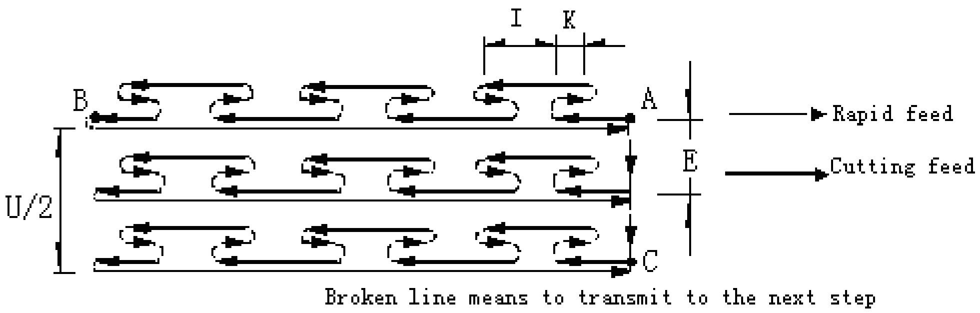


Fig. 4-32 G74 end face deep hole machining cycle

① Z feeds the distance I from A point at F speed.

② Z retracts the distance K.

③ Z feeds the distance I+K at F speed.

④ Z repeats the above-mentioned steps 2～3 until feeding to B.

⑤ Z rapidly retracts to A.

⑥ X≠0: X rapidly offsets the distance E.

⑦ X and Z axes the above-mentioned steps 1～4 until feeding to D.

⑧ Z rapidly returns to C and, then X to A.

⑨ The tool still stops the starting point of the cycle when G74 cycle ends.

【Relative parameter】

In G74, the relative parameter of rapid traverse is referred to G00, the cutting feed is referred to G01.

【Note】

1) In G74, the system is not relative to the tool width, the end point X should be the actual subtracting or adding the tool width(it is determined by the tool infeed direction).
2) I, K, E are no sign. The system executes the operation according to K =I when K is more than I.
3) G74 is in the alone block without other commands.
4) In the end face deep hole machining cycle, E cannot be 0, otherwise, the system appears E269 alarm; in the deep hole drilling cycle, E can be 0, which is valid.

【Example】

The end face deep hole machining cycle as Fig. 4-34: tool width= 5 mm, tool infeed =6 mm once, tool retraction= 2 mm, offset= 5 mm once, F=100 mm/min.

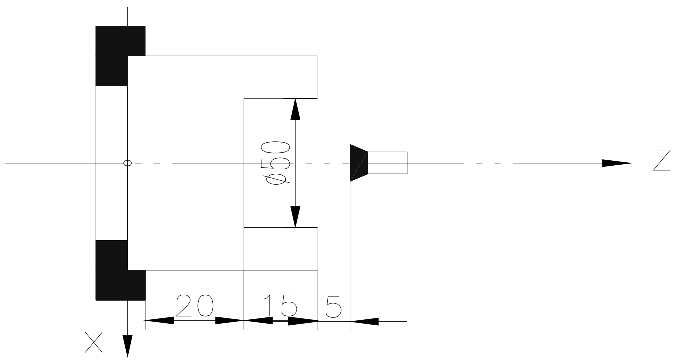


Fig. 4-34 end face deep hole machining cycle example(R=0)

N0010 G0 X0 Z40 ; position to the tool infeed point;

N0020 G74 X22.5 Z20 I6 K2 E5 F100 ; end face machining cycle. The end point of programming is defined that X end point coordinate adds the width of tool.

N0030 M30

4.14.5 G75 —Grooving cycle

【Command format】

G75 X(U) _ Z(W) _ I_ K_ E_ F_ ; Grooving Cycle

【Field】

X(U) Z(W) —end point coordinate of slot. It is the cutoff cycle when Z coordinate is omitted.

I —X tool infeed once.

K —X tool retraction once.

E — Z offset once

F — feedrate.

【Field range】

X, Z, U, W：-9999.999mm～9999.999mm

I, K, E：0～9999.999mm

F：0.001mm/min～15000mm/min

【Explanation】

G75 grooving cycle process as Fig. 4-35:

① X feeds the distance I from A point at F speed.

② X rapidly retracts the distance K.

③ X feeds the distance I+K at F speed.

④ X feeds to B by repeating the steps 2～3.

⑤ X rapidly retracts to A.

⑥ Z≠0: Z rapidly offsets the distance E.

⑦ X and Z axes the above-mentioned steps 1～4 until feeding to D.

⑧ X rapidly returns to C and then Z to A.

⑨ The tool still stops the starting point of the cycle after G75 is completed.

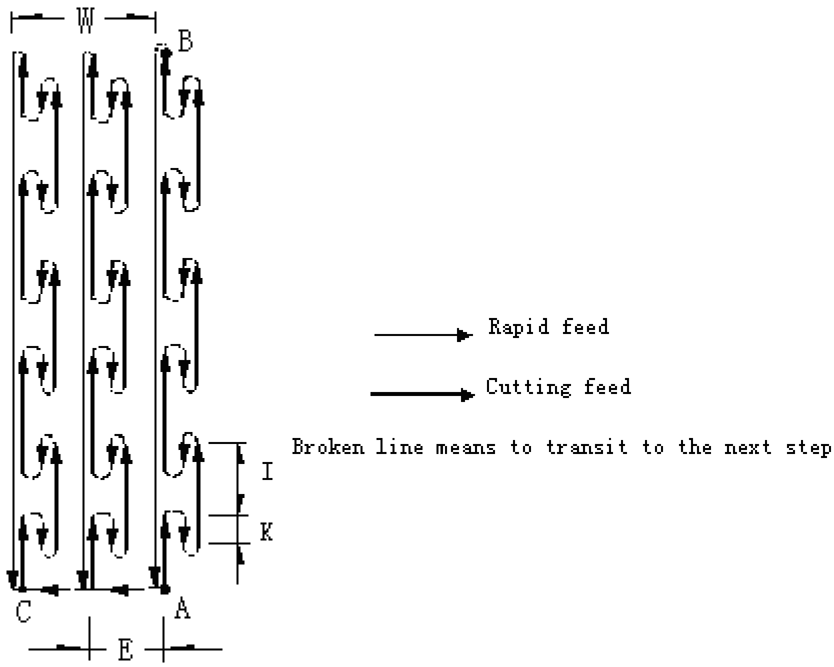


Fig. 4-35 G75 grooving cycle

【Relative parameter】

It is the same that of G74.

【Note】

1) In G75, the system is not relative to the tool width, the end point Z should be the actual subtracting or adding the tool width(it is determined by the tool infeed direction).

2) I, K, E are no sign. The system executes the operation according to K =I when K is more than I.

3) G75 is in the alone block without other commands.

4) In the outer grooving cycle, E cannot be 0, otherwise, the system appears E269 alarm; in the outer cutting cycle, E can be 0, which is valid.

【Example】

Fig. 4-36 grooving cycle: tool width= 5 mm，tool infeed once= 6 mm，retracting= 2mm once，offset= 5 mm once，F=150 mm/min.

N0010 G0 X125 Z100 ; position to the starting point;

N0020 G75 X80 Z35 I6 K2 E5 F150 ; grooving cycle. The width of tool is added to the end point coordinates.

N0030 M30

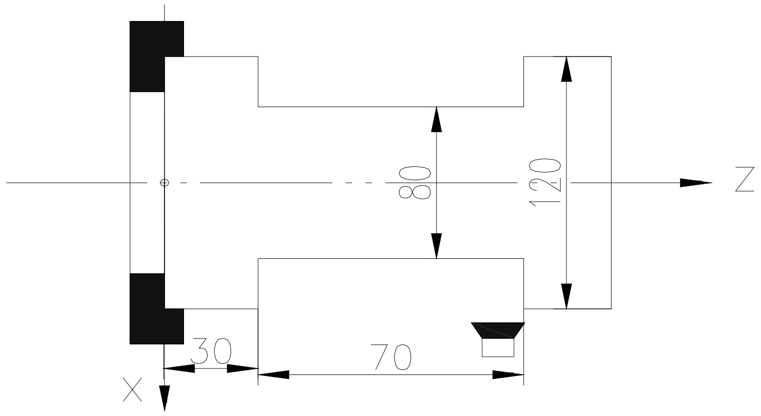


Fig. 4-36 grooving cycle

4.15 Compound Cycle

To simply the programming and reduce the counting, the compound cycle is applied. Although the system only defines the path of finish machining in programming, it can automatically specify the tool path in the course of roughing.

4.15.1 G71 —axial plane roughing compound cycle

Using the command can realize the compound cycle cutting of one group of slope command collection. The system firstly starts from the starting point to rough the blank along the axial (the tool is parallel to Z axis), and then cut along the command group path, and at last returns to the starting point, and the roughing is completed. When the roughing offset value(roughing allowance) is set in advance before executing the roughing command, the system automatically offsets one offset to execute the roughing. The finishing tool can be used before executing the roughing command. Use G710 to execute the finishing.

G71 includes the following 3 commands:

① G71 U W ; use U, W to specify roughing offset value

② G71 X(U) I K F P Q ; G71 axial roughing cycle

③ G710 X(U) P Q F ; G710 finishing

The following introduces separately the above 3 commands.

◆ G71 — axial roughing cycle

G71② is called the axial roughing cycle command to realize the compound cycle roughing of one group of slop command group. The system executes the gradual roughing along the axial(called sidestep roughing), and execute the cutting along the command group path(called as contour first turning), and at last returns to the initial point, and the roughing is completed. The chapter describes the execution process of G71 roughing command.(imagine the offset value of ① roughing is: W0, U0) .

【Command format】

G71 X(U) _ I_ K_ F_ P_ Q_ ; Inner/outer roughing compound cycle

【Field】

X(U) — X coordinate value of finishing contour starting point

I — X tool infeed once without sign; I cannot be 0. K — X tool retraction once without sign.

P, Q — finishing contour starting and final path block line.

F — roughing cutting speed.

【Field range】

X,U：-9999.999mm～9999.999mm

I：0.001mm～9999.999mm

K：0～9999.999mm

P,Q：1～9999

F：0.001mm/min～15000mm/min

【Command execution process】

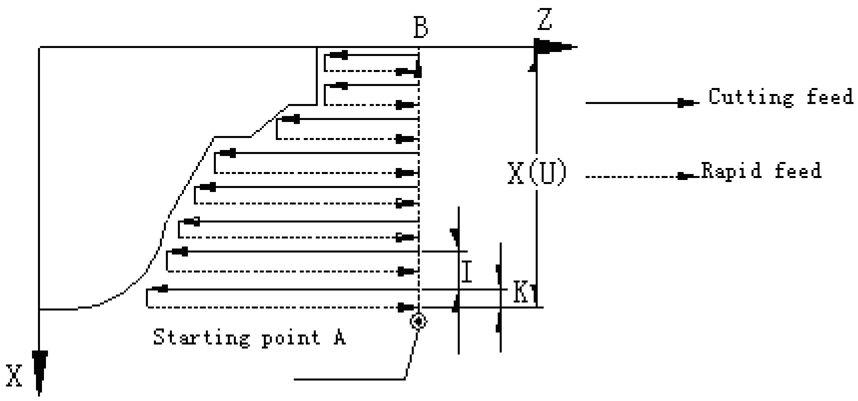


Fig. 4-37 Inner/outer roughing compound cycle

G71 execution process:

① X rapidly traverse distance I from starting point A in G71.

② Z executes the cutting feed at F speed to the end point counted by the system.

③ X at F speed retracts K distance.

④ Z rapidly returns to the starting point.

⑤ X feeds I+K distance again.

⑥ Repeat the above step ② ～ ⑤ and gradually cut till X reaches the specified finishing contour starting point.

⑦ X, Z executes the cutting at the separately specified speed according to the final path and machine the shape described by the final path.

⑧ Last, Z rapidly returns to starting point, and X rapidly returns to the starting point.

【Relative parameters】

In G71, the relative parameter of rapid traverse is referred to G00, the cutting feed is referred to G01.

【Explanation】

1) When the system executes G71, it can automatically searches and executes P～Q blocks; after executing them, it executes the next program following G71. But, when P～Q are complied following G71, the system returns to the starting point and then executes the block following Q.

2) Before roughing, the system will calculate the rough turning point according to program contour profile. To avoid imprint on roughing points, there should be allowance between roughing point and the contour profile: 0.03 in X direction, 0.05 in Z direction.

3) In P～Q, there are only G command: G00, G01, G02, G03, G05, G04, G96, G97, G98, G99; the system permits the general input/output to control M command instead of other commands (T, transfer, call command). The system only uses Z/X programming. The path quantity in P～Q cannot exceed 1000.

4) F, S in P～Q are invalid when it executes the roughing, and they are valid in the final path; so F speed should be specified in advance or F is programmed with G71 in the same block.

5) In P～Q, X, Z dimension data must change monotonously in the slope (always increasing or reducing) ; X starts from the finishing contour starting point B to monotonously change to G71 starting point A.

6) The address I, K have no sign, the tool infeed direction is automatically determined by the system, the smaller I is, the more the roughing layer is.

7) I range is related to X(U); I, U range meets that U/I must be less than 10000.

8) When the system executes the single, it pauses after it runs the end point of the current step path.

9) When G41/G42 is compiled with G71 in the same block, the system executes the tool nose radius compensation in roughing the blank and cutting the final path; the system automatically compensates according to the motion path, which is referred to PROGRAMMING Chapter Tool Nose Radius Compensation.

10) Besides G41, G42, the command is in an alone block without other commands.

11) G71 cutting has the following four shapes as Fig. 4-45; the tool cuts from G71 starting point A and the tool parallels with Z to rough the blank till B.

12) Generally, X of BCD section should be in the range between B and A; when D exceeds A, the system does not rough the exceeding.

13) Do not use the chamfer command in the compound cycle command (G71, G72, G76), otherwise, the system alarms.

14) There are four shaper in G71: Fig. 4-38, A is G71 starting point, B is the starting point, D is end point, BCD section is the finishing path.

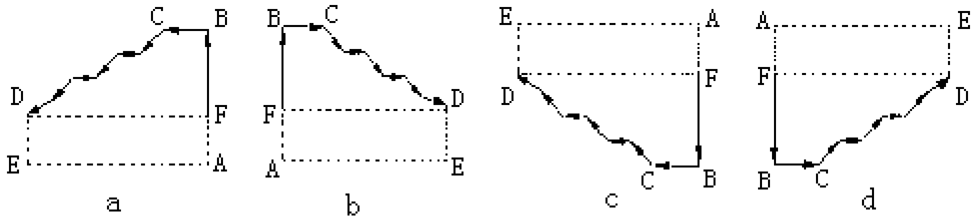


Fig. 4-38

【Example】

As Fig. 4-39: rod Φ82，tool infeed = 4 mm once, tool retraction= 2.5 mm once, F= 60mm/min

```
N0000  G00  X115  Z155                          ; position to the starting point
N0010  M3   S02                                 ; start the spindle, set to the high speed
N0020  M8                                       ; cooling ON
N0030  G00  X83                                 ; X tool infeed approaches workpiece
N0040  G71  X0  I4  K2.5  F100  P0090  Q0160    ; define roughing cycle parameter
N0050  G00  X115  Z155                          ; return to tool starting point
N0060  M5                                       ; stop the spindle
N0070  M9                                       ; cooling OFF
N0080  M2                                       ; end of program
N0090  G01  Z145  F60                           ;  ┐
N0100  X15                                      ;  │
N0110  W-30                                     ;  │
N0120  G03  X55  W-20  I0  K-20                 ;  ├ Define the final path
N0130  G01  W-25                                ;  │
N0140  G01  X80  W-20                           ;  │
N0150  W-50                                     ;  ┘
N0160  X81                                      ;
```

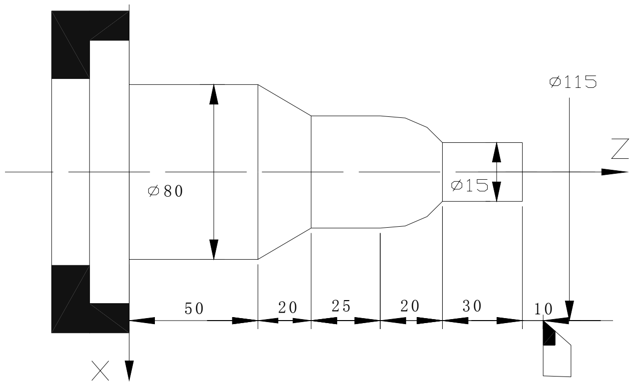


Fig. 4-39 G71 cutting example

◆ G71 roughing offset command and G710 finishing command

G71 includes 3 commands. When using ① sets the roughing offset value(roughing allowance) before the roughing command ② is executed, the coordinate axis firstly offsets automatically one offset value to execute the roughing path, i.e. the roughing path creates the whole offset to leave the allowance for the next finishing. When ① is ignored, the roughing offset value is W0,U0. After the roughing, the finishing tool can be changed and the command ③ is executed to the finishing.

【Command ① format and definition】

G71 U_ W_ ; specify roughing offset value;

U— X offset value; U：-9999.999mm～9999.999mm;

W— Z offset value; W：-9999.999mm～9999.999mm.

【Command ③ format and definition】

G710 X(U) _ P_ Q_ F_ ; G710 finishing

Or **G710** ; the consecutive word is ignored, which means it is consistent with the roughing command ②.

X(U) — X coordinate value of starting point in finishing contour.

P,Q — line number of block from the initial to the final of finishing contour.

F — finishing cutting speed.

【Explanation】

1） In the command ①, the coordinate has no the actual motion, the system automatically memorizes the offset value to the internal and is always valid; it is defaulted to 0 when it is not specified.

2） The offset value in G71 ① only effects on G71 ②.

3） U, W in G71 ① must be specified simultaneously.

4） X(U), P, Q in G71 ③ should be the same those of G71 ②; when they are input, they must be the whole. And the field range must the same that②.

5） In G71 ③, the command program rules in P～Q are the same those of G71 ②.

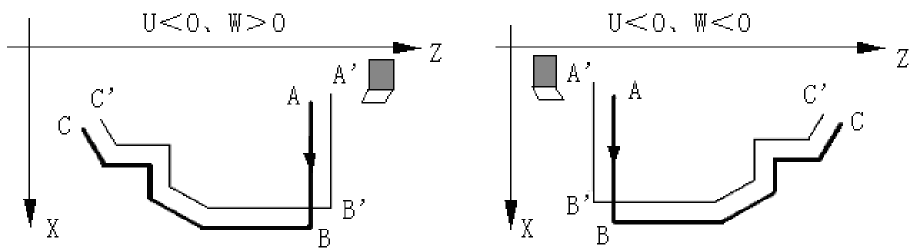
6） When the system executes the roughing G71 ②， it automatically memorizes X(U),P,Q data of last G71 and directly refers the data of the internal memory. So, the field following G710 can be omitted when the system executes the finishing to the last roughing G71 path.

7） When the system executes G710 finishing, it performs the cutting along the command group path, and at last returns to the initial point, so the finishing is completed.

8） The tool nose position before executing G710 finishing should be the consistent with that before G71 roughing.

9） G710 is the same with G71 ②， and their internal can execute the tool nose radius compensation, and its programming rules and format are same those of G71 ②.

10) Coordinate offset direction in left roughing allowance: U,W in ① expresses the coordinate offset and cut-in direction in finishing, U, W sign compound is as Fig. 4-40: B→C is finishing path, B'→C' is roughing contour, A is the start-up point.



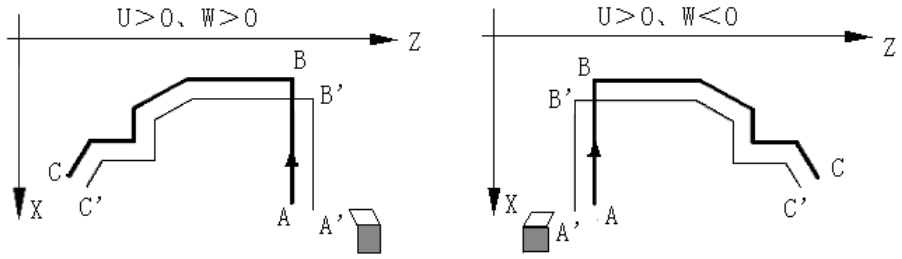


Fig. 4-40

4.15.2 G72 —End face roughing cycle

Using the command can realize the compound cycle cutting of one group of slope comma ˙ collection. The system firstly starts from the starting point to rough the blank along the axial, and then cut) along the command group path, and at last returns to the starting point, and the roughing is completed. When the roughing offset value(roughing allowance) is set in advance before executing the roughing command, the system automatically offsets one offset to execute the roughing. The finishing tool can be used before executing the roughing command. Use G720 to execute the finishing.

G72 command group includes 3 commands:

① G72 U W ; U, W specify roughing offset value

② G72 Z(W) I K F P Q ; G72 end face roughing cycle

③ G720 Z(W) P Q F ; G720 finishing

The followings are introduced separately.

◆ **G72** —end face roughing cycle

G72② is called the axial roughing cycle command to realize the compound cycle roughing of one group of slop command group. The system executes the gradual roughing along the axial(called sidestep roughing), and execute the cutting along the command group path(called as contour first turning), and at last returns to the initial point, and the roughing is completed. The chapter describes the execution process of G72 roughing command.(imagine the offset value of ① roughing is: W0, U0) .

【Command format】

G72 Z(W) _ I_ K_ F_ P_ Q_ ; End Face Roughing Cycle

【Field】

Z(W) —Z starting point coordinate of finishing.

I — Z tool infeed once without sign; I cannot be 0.

K — Z tool reaction once without sign.

P, Q — line number to describe finishing initial and final path. F — roughing cutting feedrate.

【Field range】

Z,W：-9999.999mm～9999.999mm

I：0.001mm～9999.999mm

K：0～9999.999mm

P, Q：1～9999

F：0.001mm/min～15000mm/min

【Relative parameter】

It is the same that of G71.

【Explanation】

1) G72 is to cut the blank according to the tool parallel to X.
2) Other explanations are the same those of G71.

【Command execution process】

G72 cycle execution process as Fig. 4-40：

① Start from G72 starting point A, Z rapidly traverse the distance I.

② X cuts feed and its end point being defined automatically by the system.

③ Z retracts the distance K at F speed.

④ rapidly retracts to the starting point.

⑤ Z rapidly feeds the distance I+K.

⑥ repeat the above steps ② — ⑤ till Z reaches the starting point B of finishing contour specified by Z.

⑦ Execute the final path to machine the shape described by the final path at the specified speed.

⑧ Last, X rapidly returns to the starting point and then Z rapidly returns to the starting point.

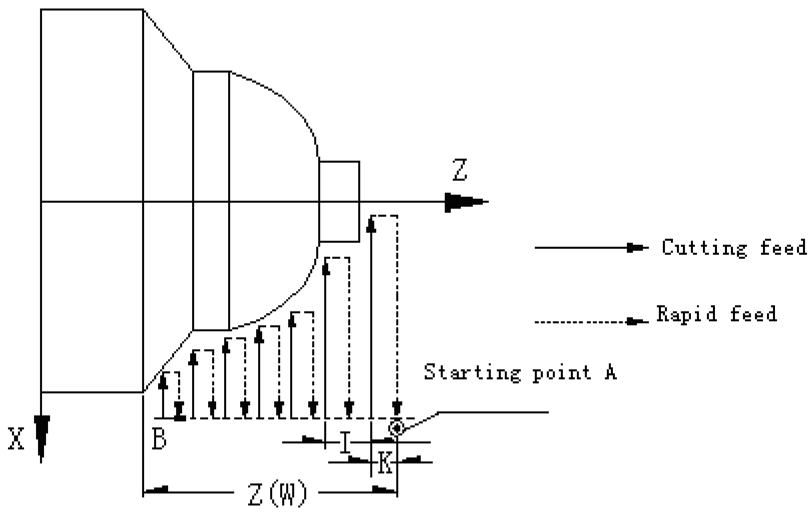


Fig. 4-41 G72 end face roughing compound cycle

【Example】

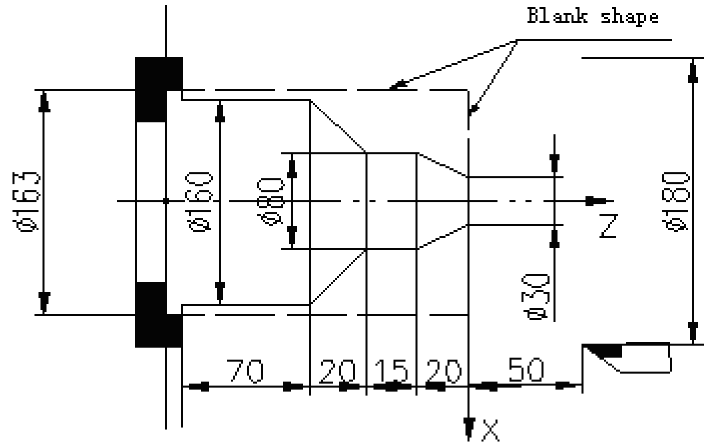


Fig. 4-42 G72 cutting example

As Fig. 4-42 : rod Φ163: tool infeed 5mm once, tool retraction 3 mm once, F=80mm/m

```
N0000  G00  X180  Z50                              ; position to the starting point
N0010  M3  S02                                     ; start the spindle, set to the spindle speed 2
N0020  M8                                          ; cooling ON
N0030  G00  X165  Z5                               ; tool infeed approaches workpiece
N0040  G72  Z-125  I5  K3  F80  P0100  Q0150       ; define roughing cycle parameter
N0050  G00  Z50                                    ; Z returns to the starting point of machining
N0060  X180                                        ; X returns to the starting point of machining
N0070  M5                                          ; stop the spindle
N0080  M9                                          ; cooling OFF
N0090  M2                                          ; end of program
N0100  G01  X160                                   ;
N0110  Z-55                                        ;
N0120  X80  Z-35                                   ;    Define the final path
N0130  Z-20                                        ;
N0140  X30  Z0                                     ;
N0150  X0                                          ;
```

◆ G72 roughing offset command and G720 finishing command

G72 includes 3 commands. When using ① sets the roughing offset value(roughing allowance) before the roughing command ② is executed, the coordinate axis firstly offsets automatically one offset value to execute the roughing path, i.e. the roughing path creates the whole offset to leave the allowance for the next finishing. When ① is ignored, the roughing offset value is W0,U0. After the roughing, the finishing tool can be changed and the command ③ is executed to the finishing.

【Command ① format and meaning 】

G72 U_ W_ ; specify roughing offset value

U — X offset value; U range：-9999.999mm～9999.999mm;

W — Z offset value; W range：-9999.999mm～9999.999mm.

【Command ③ format and meaning 】

G720 Z(W) _ P_ Q_ F_ ; G720 finishing

Or **G720** ; consecutive word being ignored means to be consistent with the roughing command ②

Z(W) — Z coordinate value of starting point of finishing contour.

P,Q — line number of block from finishing contour initial to final path.

F — finishing cutting speed.

【Explanation】

1） G720 gradually cuts the workpiece according to the tool being parallel with X.

2） G720 other explanations are same those of G71 and G710.

3） Coordinate offset direction in left roughing allowance: U,W in ① expresses the coordinate offset and cut-in direction in finishing, U, W sign compound is as Fig. 4-43: B→C is finishing path, B'→C' is roughing contour, A is the start-up point.

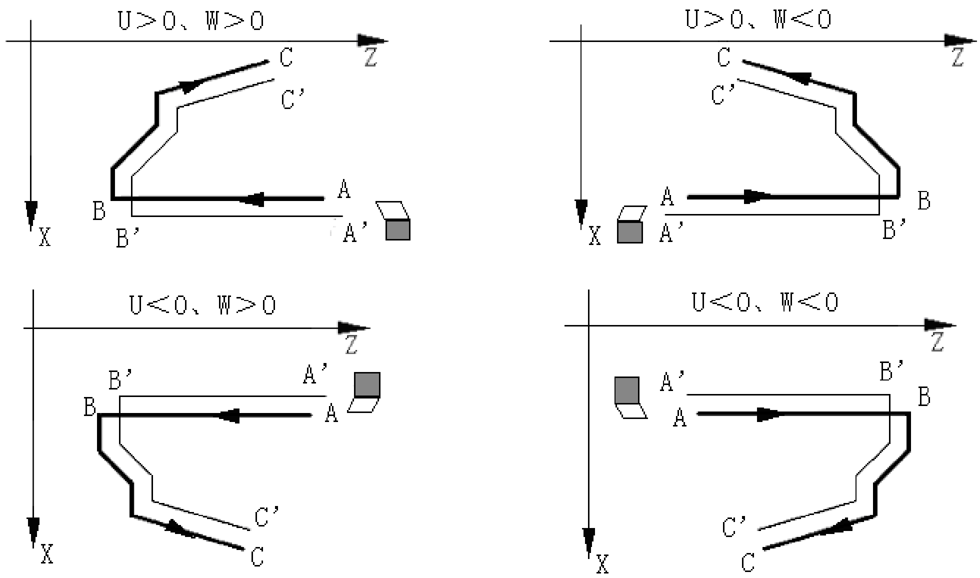


Fig. 4-43

4.15.3 G73 — closed cutting cycle command group

Using the command can realize the closed compound cycle roughing and finishing. The system gradually cuts the blank and cuts along the command group path, and at last returns to the starting point, and the roughing is completed. When the roughing offset value(roughing allowance) is set in advance before executing the roughing command, the system automatically offsets one offset to execute the roughing. The finishing tool can be used before executing the roughing command. Use G730 to execute the finishing.

G73 starting point is the same with the end point, and the command is applied to the roughing of formed blank. G73 is non-modal and its path is as Fig. 4-44.

G73 command group includes 3 commands:

① G73 U W ; U,W specify the roughing offset value

② G73 X(U) Z(W) I K F P Q L ; G73 closed roughing cycle

③ G730 X(U) Z(W) P Q F ; G730 finishing

The followings are separately introduced.

◆ **G73** — closed roughing cycle

G73 ② is called the closed roughing cycle command to realize the compound cycle roughing of one group of close command group. The system firstly executes from the starting point to gradually cut the blank(called step roughing), and cuts along the command group path(called contour first turning) and returns to the initial point, and the roughing is completed.

The chapter describes the execution process of G73 roughing(imagine the command ① roughing offset value is W=0,U=0) .

【Command format】

G73 X(U)_ Z(W) _ I_ K_ L_ P_ Q_ F_ ; closed roughing cycle

【Field definition】

X(U) — X coordinate value of starting point B of contour in roughing.

Z(W) — Z coordinate value of starting point B of contour in roughing.

P —line number of initial block in roughing contour.

Q —line number of the last block in roughing contour.

F — cutting feedrate in roughing.

I — Retraction value on X axis during the first roughing (with signed number). Refer to the distance I in Fig. 4-44.

K —Retraction value on Z axis during the first roughing (with signed number). Refer to the distance K in Fig. 4-44.

L — cutting times, i.e. gradual cutting layer quantity.

X(U) ,Z(W) ,P,Q describe ABCA closed path, i.e. the tool rapidly positions from A to B, and then C when the system executes PQ block, and rapidly returns to A. ABCA is the path of the last roughing.

I, K describe the system firstly offsets IK value and then executes the first roughing; i.e. executes $A_1B_1C_1$ A_2 path.

L describes the L layers from the first roughing, and the system executes the last roughing; the cutting amount of each layer should be even, i.e. X is I/L, Z is K/L, and the cutting is executed from $A_1B_1C_1$to ABC. The actual cutting times is L+1.

【Field range】

X,U,Z,W：-9999.999mm～9999.999mm

I,K：-9999.999mm～9999.999mm

P,Q ：1～9999

L：1～9999

F：0.001mm/min～15000mm/min

【Execution process】 as Fig.4-44. Suppose L=2 layers.

① $A \rightarrow A_1$：rapidly traverse, offset I, K, to A_1;

② the first roughing, $A_1 \rightarrow B_1 \rightarrow C_1$ ：

$A_1 \rightarrow B_1$：rapidly traverse to B_1;

$B_1 \rightarrow C_1$：cutting feed;

③ $C_1 \rightarrow A_2$：rapidly traverse;

④ **the second roughing**，$A_2 \rightarrow B_2 \rightarrow C_2$ ：

$A_2 \rightarrow B_2$：rapidly traverse;

$B_2 \rightarrow C_2$：cutting feed;

$C_2 \rightarrow A$：rapidly traverse;

The last roughing：

$A \rightarrow B$：rapidly traverse;

$B \rightarrow C$：cutting feed;

$C \rightarrow A$：rapidly traverse to starting point.

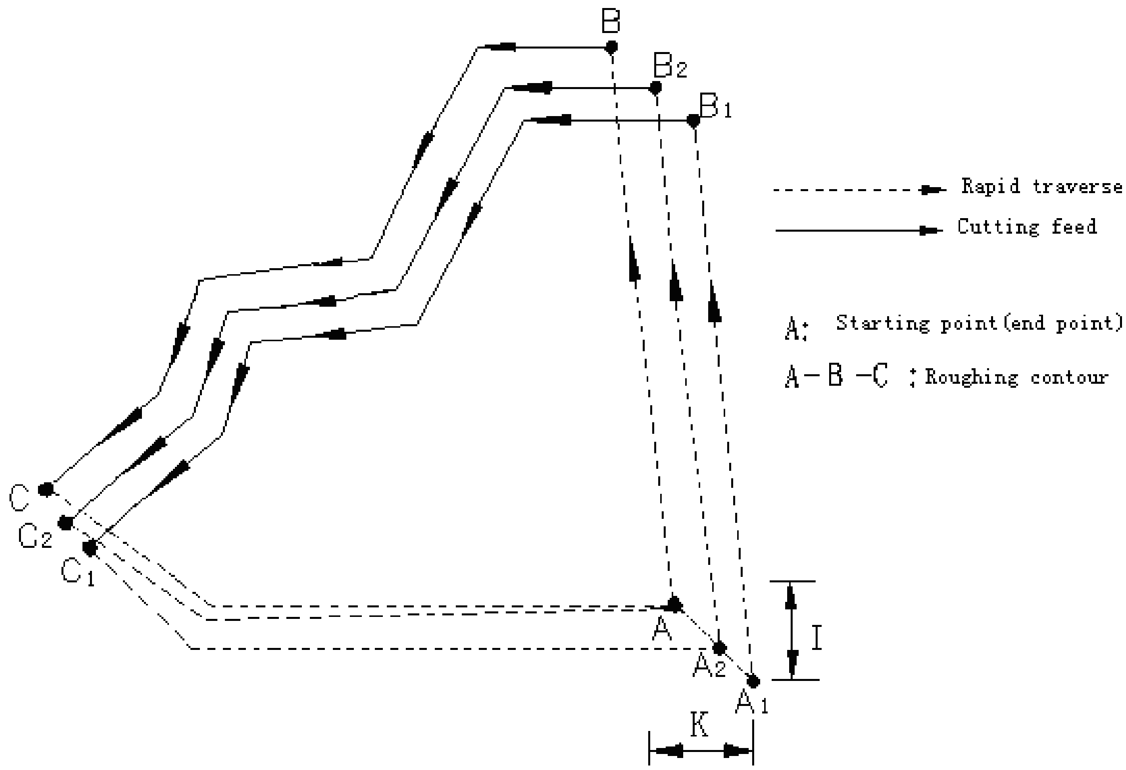


Fig. 4-44 G73 run path

【Command explanation】

1） In P～Q blocks, it is different with G71/G72，which cannot ensure X, Z dimension data monotonously changes.

2) The tool retraction direction is determined by I, K signs.

3) The F, S commands in P~Q blocks are valid for both workblank roughing and finishing.

4) The tool nose radius compensation usages in G73 command group are different with G71/G72;

the tool nose radius compensation command G41/G42 cannot be compiled with G73 in the same block; the system can create, cancel or use them together in P～Q blocks; the system alarms when it cancels the tool nose radius compensation in other blocks except for P～Q.

5) After the tool nose radius compensation is created in P～Q，the roughing and finishing are valid in G73.
6) Other explanations are referred to G71, G72.

◆ G73 roughing offset command and G730 finishing command

G71 includes 3 commands. When using ① sets the roughing offset value(roughing allowance) before the roughing command ② is executed, the coordinate axis firstly offsets automatically one offset value to execute the roughing path, i.e. the roughing path creates the whole offset to leave the allowance for the next finishing. When ① is ignored, the roughing offset value is W0, U0. After the roughing, the finishing tool can be changed and the command ③ is executed to the finishing.

【Command ① format】

G73 U_ W_ ; specify the roughing offset value

U— X offset value; U range：-9999.999mm～9999.999mm;

W— Z offset value; W range：-9999.999mm～9999.999mm.

【Command ① field definition】

U：X offset value (roughing allowance) means X coordinate offset of the last roughing path relative to the finishing path;

W： Z offset value (roughing allowance) means X coordinate offset of the last roughing path relative to the finishing path.

【Command ③ format and definition】

G730 X(U) _ Z(W) _ P_ Q_ F_ ; G730 finishing

Or **G730** ; ignoring it means to be consistent with the roughing command ②

X(U) — X coordinate value of contour starting point in finishing.

Z(W) — Z coordinate value of contour starting point in finishing.

P,Q — line number of the block from the initial to the final in finishing contour.

F — finishing cutting feedrate.

【Explanation】

1） G730 other explanations are same those of G71, G72 roughing offset commands and G710, G720 finishing commands.
2） When the system executes G730, it cuts along the command group path and returns to the starting point, the finishing is completed.
3） G73 command group finishing positioning point is different with the roughing positioning point, the tool movement path automatically coincides.

4) Coordinate offset direction in left roughing allowance:

I, K, U, W express the coordinate offset and cut-in direction in roughing and finishing; generally, K and W signs are consistent each other, and there are four kinds of composition as Fig. 4-45: A is start-up tool point, B→C is the workpiece contour, B'→C' is the roughing contour, and B''→C'' is the finishing path.

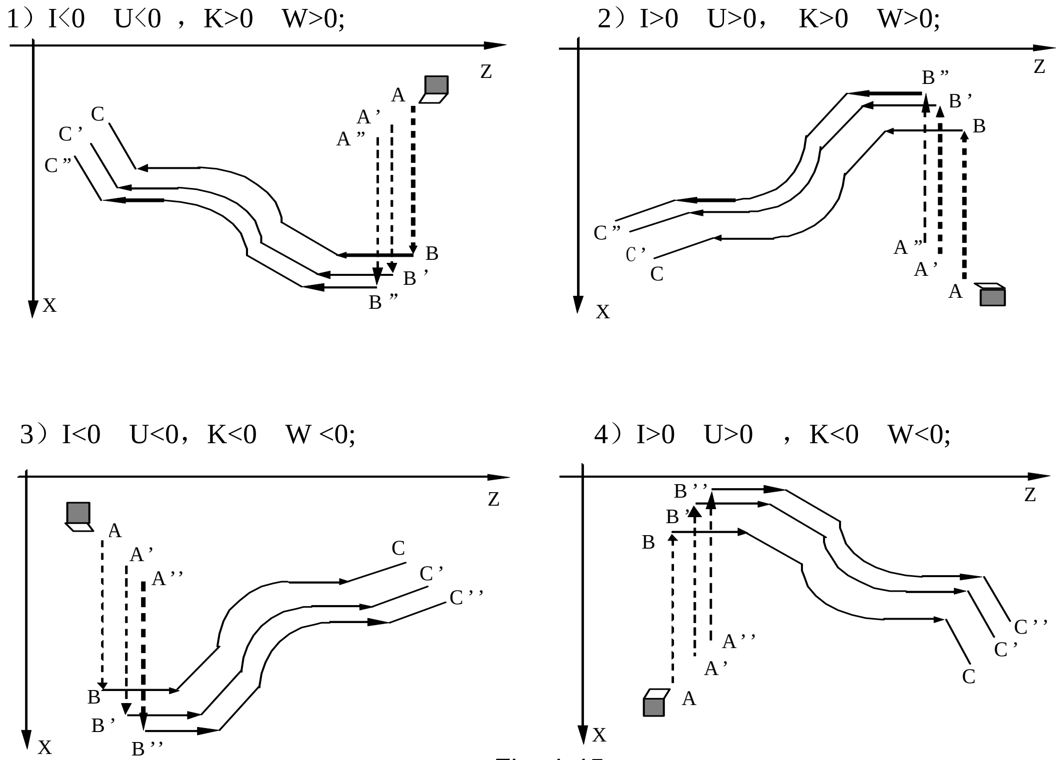


Fig. 4-45

【Example】

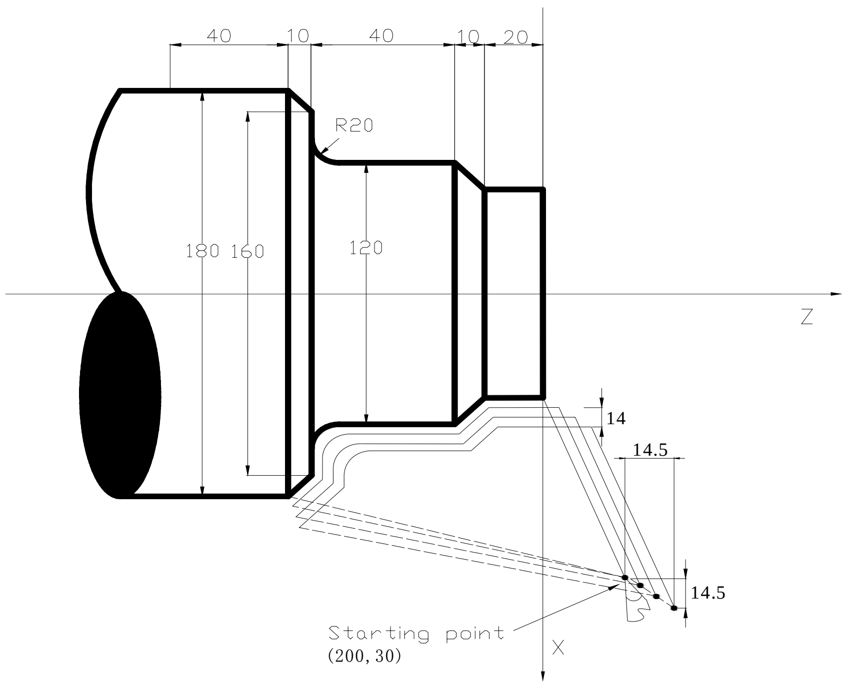


Fig. 4-46

Cutting shape is as Fig.4-46.

```
N0010  T11
N0020  G00  X200  Z30                          ; start point of positioning
N0022  M03  S500                               ;  start the spindle
N0030  G73  U0.5  W0.5                         ; X 0.5mm，Z 0.5mm finishing allowance
N0040  G73  X80 Z0 P50 Q100 I14 K14 L5 F300; X tool retraction 14mm，Z 14mm in roughing
N0050  G01  Z-20  F100
N0070  X120  Z-30
N0080  Z-50                                    ; blocks for workpiece shape
N0090  G02  X160  Z-70  R20
N0100  G01 X180  Z-80
N0110  T22
N0120  G00  X200  Z30
N0130  G730                                    ; finishing with finishing tool
M30
```

4.15.4 G76 — multi thread cutting cycle command group

G76 thread cycle cutting path is the same that of G92. The difference is that G92 completes the cutting depth by the consecutive command but G76 informs the last cutting face and the gradual cutting depth information in advance and is arranged by the system to execute the gradual cutting-depth and to machine the qualified thread.

G76 command group includes 2 commands:

① G76 D_ I_ Q_ P_ L_ R_ ; G76 cycle information

② G76 X(U) _ Z(W) _ P(E) _ I_ K_ R_ L _ H_ ; G76 thread cutting

The followings are introduced separately.

◆ **G76** — multi thread cutting cycle command ②

G76 ② is called the multi thread cutting cycle command to realize the multi thread cutting.

When the thread angle is 0°, each thread cycle is from the starting point to the cut-in point, the thread axis does not move, and the single axis of the non thread axis moves to the cut-in point, and the cut path is the completely same with that of G92.

【Command ② format】

G76 X(U) _ Z(W) _ P(E) _ I_ K_ R_ L _ H_ ; G76 thread cutting

【Command ② definition explanations】

Field definitions, data range are the same those of G92 as Fig. 4-47:

Starting point(end point) :position before the block runs and after the run stops, is expressed with A.

Thread end point: the thread cutting end point defined by X(U) __ Z(W) __ is expressed with C.

Thread starting point: Z absolute coordinate is same that of A, the difference between X absolute coordinate and that of C is the thread taper, expressed with

E. When the defined thread angle is not 0° , the tool cannot reach E in cutting.

Tool retraction end point: after the thread cutting is completed in each thread roughing cycle and finishing cycle, the end point of the radial(X) tool retraction is expressed with D.

◆ **G76** — multi thread cutting cycle command ①

G76 ① can inform some thread cutting information in advance.

【Command ① format and definition】

G76 D_ I_ Q_ P_ L_ R_ ; G76 cycle information

D —tooth depth, total depth range:(0.001～9999.999) mm ; do not default; D cannot be negative

I — the first cut depth in roughing range:(0.001～9999.999) mm ; do not default; I cannot be negative

Q — least cutting value in roughing range：(0～99.999) mm ; default，correspond to P339

P — tool angle range：(0～99.000) degree ; default，correspond to P336

L — times in finishing range：1～99 ; default，correspond to P337

R —cutting amount in finishing range：(0～99.999) mm ; default，correspond to P338

【Command ① relative definitions 】

D：it is the thread tooth height, and the thread total cut depth, the system alarms when D is not input.

I： it is the first thread cutting depth, the system alarms when I is not input.

Q：it is the least cutting amount in thread roughing, n is the cycle times in the current roughing; when I×$\sqrt{n}$ - the last cut depth) ＜Q, Q is taken as the cutting amount of this roughing, i.e. the thread cut depth is(the last cut depth+Q) . setting Q is to avoid the small roughing cutting amount and too many roughing times because of thread cutting amount gradually decreasing.

P：it is the angle between neighboring two threads. The actual thread angle is determined by the tool angle, and so P value should be consistent with the tool angle.

L：Thread finishing times.

R：cutting amount in thread finishing is equal to the difference between the thread finishing cut-in point B_e and X absolute coordinate of the last thread roughing cut-in point B_f. In the thread finishing, the first cutting amount is R and the following finishing amount is 0.

【Command ① explanation】

1) When the system executes the command, it loads P, L, R, Q values to their corresponding parameter, because the several parameters must be used when the system executes the command ②.

2) When the system executes the command, D, I are memorized to the system internal and are used in G76②.

3) The system must firstly execute one G76① command，and then can execute one or more G76 ② commands, otherwise, it alarms because of lacking some necessary information.

4) P, L, R, Q can be omitted all. When they are omitted, the system runs according to P336, P337, P338, P339 setting values in executing G76②; but D, I cannot be omitted.

Relative definitions：(as Fig. 4-47)

Thread cut depth reference point: Z absolute coordinate of the thread cut depth reference point is the same that of E, the difference between X absolute coordinate and X absolute coordinate of E is D (total cut depth of the thread), which is expressed with B. B thread cut depth is 0, and is the reference point of the system counting each thread cut depth.

Thread cut depth: the cut depth of each thread cut cycle. It is the intersection between the inverse extension line of each thread cut path and the linear BE, the difference value(no sign) between the intersection and X absolute coordinate of B. the thread cut depth of each roughing is $\sqrt{n}$ ×I, n is the current roughing cycle times, and I is the thread cut depth of the first roughing.

Thread cut amount: the difference between the thread cut depth and the last: ($\sqrt{n}$ - $\sqrt{n-1}$) ×I. Cut amount cannot be less than the least cut amount Q.

Thread cut-in point: the actual start thread cut point in each thread roughing and finishing is expressed with Bn (n is the current roughing cycle times), B1 is the first thread roughing cut-in point, Bf is the last thread roughing cut-in point, Be is the thread finishing cut-in point. The replacement formula of Bn relative to X, Z of B is as follows:

$$\mathrm{tg}\frac{p}{2} = \frac{|\text{Z axis replacement}|}{|\text{X axis replacement}|}$$

P：thread angle

【Command ② execution process】

① Rapidly traverse to B_1 from the starting point, the first thread cut depth is I. P=0: only X moves; P≠0:，X and Z move simultaneously, and their movement directions are the same that of A→C;

② The thread in a parallel with E→C cuts to the insect of C→D(when there is the thread run-out, there is the thread run-out process) ;

③ X rapidly traverses to D;

④ Z rapidly traverses to A，and the single roughing cycle is completed;

⑤ Rapidly traverse again to B_n(n is the current roughing cycle times) ，cut depth($\sqrt{n}$ ×I) ,the bigger value in (the last cut depth +Q) ，when the cut depth is less than(D-R) ，the system executes ②; when the cut depth is more than or equal to(D-R) ，the tool infeed is executed in the cut depth(D-R) to B_f，and the system executes ⑥the last thread roughing;

⑥ The thread in a parallel with E→C cuts to the insect of C→D(when there is the thread run-out, there is the thread run-out process) ;

⑦ X rapidly moves to D;

⑧ Z rapidly moves to A，the thread roughing cycle is completed to start the thread finishing;

⑨ The thread finishing is executed after the tool rapidly moves to B_e(thread cut depth is D, the cut depth is R) ，and the last the system returns to A to complete the thread finishing cycle;

⑩ When the finishing cycle times is L, the system executes ⑨ to complete the finishing cycle, the thread cut depth is D, the cut amount is 0; when the finishing cycle times is L, G76 compound thread machining cycle is completed.

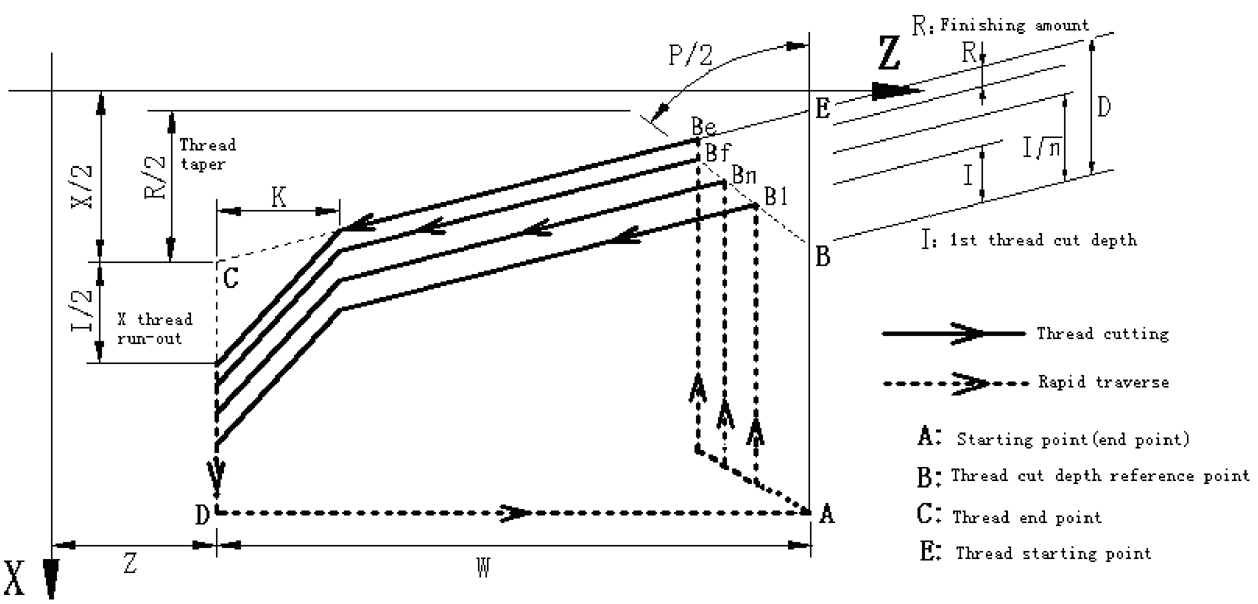


Fig. 4-47

The cut-in method is as Fig. 4-48:

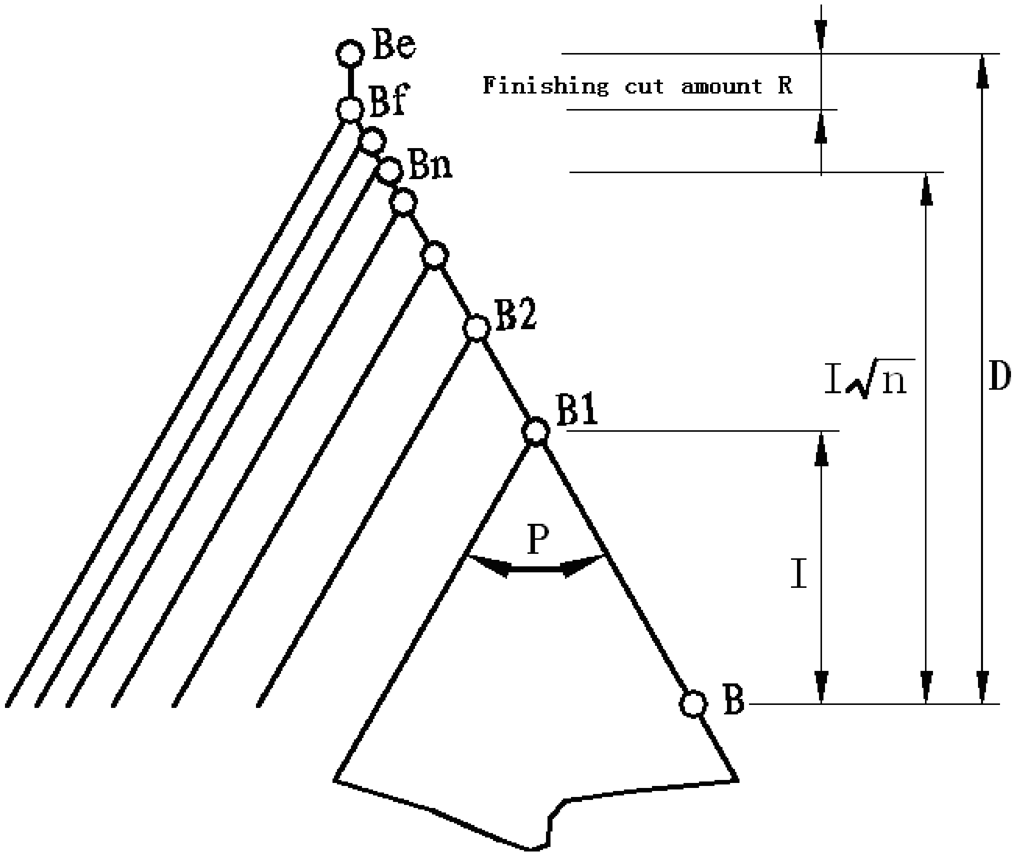


Fig. 4-48

【Command ② explanation】

1. Using G76 thread cycle cutting command group can complete the specified tooth height(total cut depth) of the thread cutting by multi thread roughing and finishing; when the thread angle defined by the command ① is not 0°, the cut-in point of thread roughing moves to the thread tooth bottom from the thread tool top and the angle between neighboring two teeth is the defined thread angle.
2. G76 command group can machine the straight and taper thread with the thread run-out to realize the one-sided tool edge thread cutting which can reduce the tool wear and improve the thread precision.
3. G76 command group can machine multi-head thread, end face thread. When G76 machines the multi-head thread and the tool executes one time the cut depth, the tool cuts each thread with the same cut depth, and it executes the next cut depth till the multi-head thread cut is completed.
4. When the thread angle defined by G76 ① is not 0, X, Z move simultaneously, the thread axis reaches the cut-in point, and then the single-axis for non-thread axis moves to the cut-in point in G76 ② thread cycle from the starting point to the cut-in point; other cut path is the same that of G92 as Fig. 4-47.

【Example】

Example：Fig. 4-49，thread is M68×6.

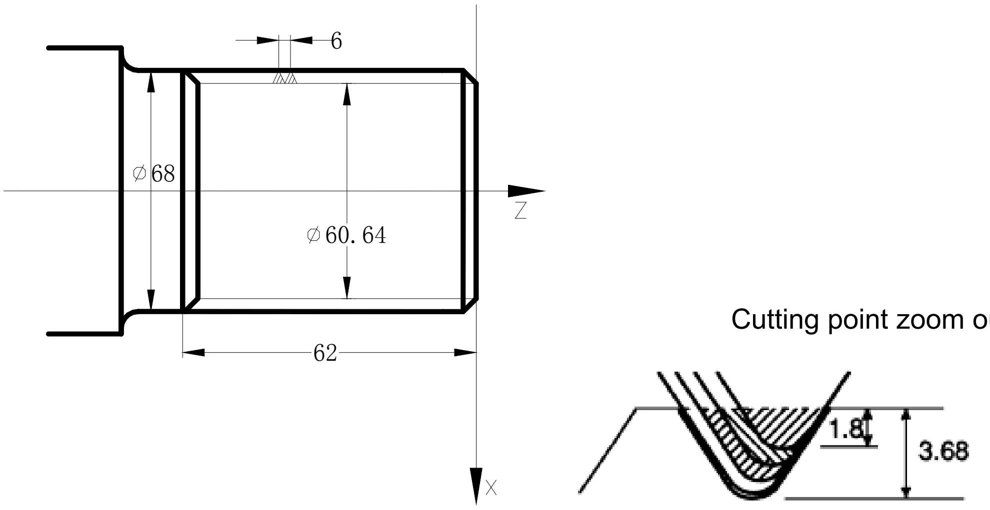


Fig. 4-49

Program：

G50 X100 Z50 M3 S300 ; set workpiece coordinate system, start the spindle and specify its speed
G00 X80 Z10 ; rapidly move to the machine starting point
G76 D7.36 I3.6 Q0.3 P60 L2 R0.2; thread tooth height 7.36，the 1st thread cut depth 3.6;
; the least cut-in depth 0.3，tool angle 60°，
; repetitive finishing 2 times, finishing cutting amount 0.2.
G76 X60.64 Z-62 P6 I0.5 L3 ; pitch 6，3-head thread
G00 X100 Z50 ; return to program starting point
M30 ; end of program

4.16 G22, G80 —Program Part Cycle

In the course of actual machining, for the part of workpiece or the formed parts, the part cycle command is employed to simplify the programming. The cycle body of part cycle is defined by part programming. The coordinates of end point are determined after executing this cycle.

【Command format】

G22 L_

Cycle body program …… …… ……

G80

【Field】

G22 defines the starting of cycle body;

L： defines the cycle times, range 1～9999;

G80 defines the end of cycle body.

【Explanation】

Command execution process：

① G22 defines the starting of cycle body and L defines the cycle times.

② Execute the cycle body program.

③ Cycle times L subtracts 1 when G80 cycle body ends. Execute the cycle body program again when L ≠0; when L=0 , the cycle ends and the following program is executed.

【Note】

1） G22 and G80 must be used at the same time; G22 and G80 can be embedded;

2） The subprogram can be called in the loop body. It can have M96 and M97. Regarding as the component which shape has already determined and needs to the roughing, using G22 and G80 programming is very convenient and can improve the processing efficiency.

3） For axis needing creating the cycle offset, the program in the cycle body uses the relative programming. There is the offset between the exit coordinates and inlet coordinates of the cycle body to get the same cycle program and machining contour, and the different machining path every time.

4） G22, G80 can embed G90, G92, G94, G71, G72 and other cycle command.

【Example】

Machining the workpiece as Fig. 4-42a cycle programming with G22, G80 as follows:

```
N0000  G50  X100  Z100     ;  Define a coordinate system
N0010  M3  S01             ; Start the spindle, set to the low speed
N0020  M8                  ; Cooling ON
N0030  G00  X10  Z30       ; Rapidly position to the starting point of the cycle
N0040  G22  L3             ; Program cycles three times
N0050  G01  W-5  F50       ; Z negatively cuts 5mm,  F=50mm/min
N0060  U5  W-5             ; X positively cuts 5mm,  Z negatively cuts 5mm
N0070  G80                 ; End of cycle body
N0080  G26                 ; X, Z rapidly retracts to program reference point
N0090  M5                  ; Stop the spindle
N0100  M9                  ; Cooling OFF
N0110  M2                  ; End of program
```

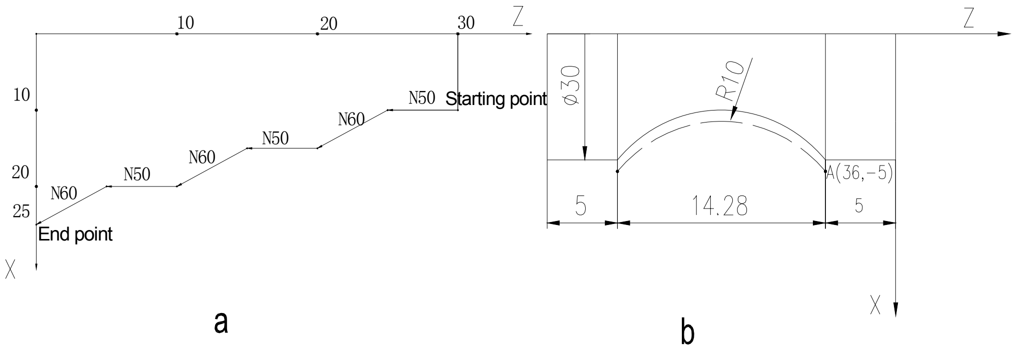


Fig. 4-42

Machining the arc as Fig. 4-42b the cycle programming with G22, G80 as follows:

```
N0000  G00  X36  Z-5          ; Rapidly position to the starting point of arc
N0010  G22  L3                ; Program cycle three times
N0020  G01  U-2  F50          ; X executes the tool infeed 2mm
N0030  G03  W-14.28  R10      ; X, Z executes the tool infeed, cutting concave arc
N0040  G01  W14.28  F500      ; Z executes the tool retraction to starting point of arc
N0050  G80                    ; End of cycle body
N0060  M30
```

The above two examples are programmed according to the actual shape, Fig. 4-42a: its programming can be used to the roughing including smithing and moulding, which can improve the machining efficiency. Fig. 4-42b: it can be used to machining the rod

4.17 G98 —Feed per Minute(feed/m) , G99 —Feed per Rev(feed/r)

【Command format】

G98 **F*******.*** ; feed per minute

G99 **F*******.*** ; feed per rev

【Field】

G98 F＊＊＊＊＊. ＊＊＊ ; F unit：mm/min;

F —define the feedrate of its following interpolation command, its unit: mm/min.

G99 F＊＊＊＊＊. ＊＊＊ ; F unit：mm/r;

F — define the feedrate of its following interpolation command, its unit: mm/r.

【Field range】

F：0～15000.000mm/min

0～15000.000mm/r

【Note】

1) G98/G99 must be matched with F word，otherwise the system alarms：“F leaves out information”.
2) G98/G99 is the modal command and it is valid before being changed. The single F can be taken as the new feedrate.
3) G98 is the initial state of system and the system automatically sets as G98 (mm/min).
4) F=0: the system alarms and prompts the alarm message when it executes the machining programs.
5) In G99, when the spindle speed is 0, the feed automatically pauses and the system displays “Pause: the spindle speed is 0”, keeps the state till the spindle speed is not zero, then, press CYCLE START again, the system recovers the execution.
6) In G99, generally, when the spindle is started just now, the system should delay time properly to wait the spindle speed stably and executes the cutting, otherwise, the system has not checked the spindle speed, displays “Pause: the spindle speed is 0”.

【Example】

```
…
N0100   G98 F800    ; define the feed per minute，F feedrate: 800 mm/min;
…
N0160   F50         ; F feedrate: 50 mm/min;
…
N0200   G99 F2.1    ; set the feed per rev，F feedrate: 2.1 mm/rev;
…
N0250   F0.56       ; F feedrate: 0.56 mm/rev.
…
```

4.18 **G31 — Skip**

The execution of G31 is the same that of G01, and the difference is that G31 constantly check the external input interface signal(G31I) state. When the signal meets the condition, the coordinate axis stops the feed and continuously executes the next command, otherwise, the coordinate axis feeds to the end point, then the system goes to the next command.

【Command format】

G31 Z(W) _ X(U) _ Y(V) _ F_ H_ ; Z/X/Y three-axis feed simultaneously

G31 Z(W) _ X(U) _ F_ H_ ; Z/X two-axis feed simultaneously, or Z/X, Z/Y, X/Y two-axis feed simultaneously

G31 Y(V) _ F_ H_ ; Y single-axis feeds

【Field】

X, Z, Y： end point coordinates after the command ends.

U, W, V： incremental value counted by the theory end point.

F：feedrate. F is modal and can be omitted when it is not changed; it is controlled by the feedrate override.

H：command bit parameter(H_d7 ~ H_d1：reserved) ; the system defaults it to be 0 when it defaults.

H_d0=0: G31I LOW meets the skip condition;

H_d0=1: G31I HIGH meets the skip condition;

【Field range】

X, Z, Y, U, W, V：(-9999.999～9999.999) mm

F：0.001mm/min～15000mm/min

【Explanation】

Z/X/Y can execute single-axis, two-axis, or three-axis feed simultaneously.

G31 traverse speed is specified by F and controlled by the feedrate override.

Actual feedrate =F x feedrate override

G31 is non-modal command, and can be omitted in the next block when it is the same.

【Note】

1）G31 input check function is non-standard pin input control; when the function is needed, the user can define its pin in the interface parameter P5532(G31I) and correctly connects with the wirings. The concrete interface parameter definitions are referred to **OPERATION, 4.6 Parameter Working Mode**; the concrete wiring connection is referred to **CONNECTION, Chapter 3 CNC Device Connection**.

2）To get the exact position, the run decelerates once the system has checked the external input interface signal change. So, the actual feedrate in G31 is not too high and it is suggested that it should be less than 1000mm/min, otherwise, G31 cannot realize the skip function because it cannot check the interface signal.

【Relative parameter】

Interface parameter P532 defines the input interface pin.

The relative parameter of cutting feed is referred to G01.

【Example】

Current: X=100 Z=100;

G31 Z30 F500;

The move distance is Z70, Z moves at 500mm/min continuously to Z30 when G31**I** signal cannot meet the skip condition; Z＝68.37: G31**I** meets the skip condition and Z immediately stops running and the system executes the next command.

4.19 G52 — rotary axis coordinate clearing integer

When Y is used to control the rotary axis, in MANUAL or AUTO mode, the system can use G52 to clear the integer and keep the remainder.

In G52, when "absolute values of tool nose coordinate of the current Y ≥ the rotary angle, the system clears the integer coordinate value and leaves the remainder. The machine coordinate of Y also clears the corresponding coordinate value.

【Command format】

G52 Y(V)_ ; rotary axis coordinate clearing

【Field definition】

Y：absolute coordinate of rotary axis;

V：relative movement of rotary axis.

【Field range】

Y,V：-9999.999mm～9999.999mm (sign of value is meaningless)

【Explanation】

1) when the system parameter sets Y(**P405_d1**=1) ，G52 is valid.

2) G52 is only in the single block and cannot be in the block with other commands.

3) absolute value of the number following Y(V) means the rotary angle per revolution. When it is 0, it defaults to be 360.000 degree.

4) there is no data field following G52, the system defaults to be G52 Y360.000.

【Relative parameter】

Parameter related to G52: **P405_d1.**

【Example】

G00 Y20

G01 Y136.6

G52 Y100 **;** rotary axis coordinate clearing the integer 100，Y coordinate value is 36.6

4.20 G66—Store the current coordinates, G67—Return to the stored coordinates

【Command format】

G66	; To store the current coordinate of tool nose on Z, X, Y axes;
G67 W0 U0 V0	; To return to the stored position. The uncommanded axis does not move;

【Instruction】

X, Z, Y: If they are specified in absolute coordinates, it means the axes should rapidly traverse to those points.

U, W, V: If the relative coordinates is not 0, it means the axes rapidly traverse to the relative new coordinates.

Z/X/Y can perform rapid traverse, two-axis or three-axis movement. Absolute coordinates and relative coordinates cannot be used at the same time. The axis that does not move can be omitted, but G67 cannot be specified alone.

G66 is to store the current tool nose coordinates; G67 is to command the axis to move to the coordinates.

G67 should be used only when G66 has been used once. When G66 is used several times, the latest coordinate is stored.

G66, G67 can only be specified without other commands. The movement path of G67 is the same as G00.

【Example】

N0010	**G00 Z350 X280 Y600**	; Define the machining original point and position to this point;
N0010	T11	
N0100	**G00 Z102 X120**	;
N0200	**G66**	; Z102, X120 Store the current coordinates;
N0200	T22	; The tool nose coordinate is uncertain after tool changing;
N0300	**G67 X120 W10**	; X axis moves to 120, and Z axis move to 102+10.
N0200	M02	

4.21 Additional Axis(Y) Function

4.21.1 Additional axis(Y) start

Whether the additional axis(Y) function is valid is determined by **P405_d1**; **P405_d1**=1: the additional axis(Y) function is valid.

【Main relative parameters】

The main relative parameters setting the additional axis: **P405_d1, P410_d4.**

4.21.2 Additional axis(Y) realizing motion

1) realize rapid traverse：G00 Y(V) _ ;

2) realize feed motion： G01 Y(V) _ F_ ;

3) realize tapping motion： G32 Y(V) _ P(E) _ H_ ;

4) program reference point return：G26 Y(V) _ ;

5) machine zero return：G28 Y(V) _ ;

6) 2nd, 3rd program reference point return of machine：G30 P2(3) Y(V) _ ;

7) coordinate system set by G50：G50 Y_ ;

8) realize skip function：G31 Y_ H_ ;

9) realize JOG/STEP/MPG feed, manual program zero return, manual machine zero return in JOG working mode.

【Note】

1) Absolute coordinate programming of additional axis(Y) uses Y, relative coordinate programming uses V;

2) Y and X/Z execute the interpolation motion in G01, G31;

3) Y(V) and X(U) , Z(W) can be in the same block in G00, G01, G31, G26, G30 ;

4) Y and X, Z can be in the same block in G50;

5) Y(V) and X(U) ,Z(W) cannot in the same block in G32, G28, otherwise, the system alarms;

6) Y traverse speed in G01 uses X/Z modal F value when it is not specified.

4.22 Appendix: G function and its Explanation Table

Table 4-3 G word list

Code	Programming format and explanation	Function	Group	Remark
G40	G40	Cancel tool nose radius compensation	1	Initial G
G41	G41	Tool nose radius compensation		Modal G
G42	G42			
G00	G00 X(U) Z(W) Y(V) (single, 2 or 3-axis) three-axis)	Rapid traverse	2	Initial G
G01	G01 X(U) Z(W) Y(V) F (single, 2 or 3-axis) F：0.001 mm/min～15000mm/min	Linear interpolation		Modal G
G02	G02 X(U) Z(W) R F G02 X(U) Z(W) I K F F：0.001 mm/min～15000mm/min R：≤1000000.000mm	Interpolation(CCW)		
G03	G03 X(U) Z(W) R F G03 X(U) Z(W) I K F F：0.001 mm/min～15000mm/min R：≤1000000.000mm	Interpolation(CW)		
G05	G05 X(U) Z(W) I K F (I，K) along the arc	Arc interpolation		
G32	G32 Z(W) P(E) H G32 Y(V) P(E) H	Tapping cycle	3	Non-modal G
G33	G33 X(U) Z(W) P(E) I K Q H E：0.060 tooth/inch～25400.000 tooth/inch P：0.001mm～500.000mm Q：initial angel, range 0～360000(unit：0.001°) Q is 0° when it is not specified	Constant thread cutting		
G34	G34 X (U) Z (W) P (E) I K Q R H	Variable pitch thread		
G26	G26 X(U) Z(W) (single, 2 or 3-axis) Cross the middle point and return to the program reference point; rapid traverse in G00.	Program reference point return		None
G28	G28 X(U) or G28 Z(W) or G28 Y(V)	Machine zero return		None
G30	G30 P2 X(U) Z(W) (single, 2 or 3-axis) G30 P3 X(U) Z(W)	2^{nd}, 3^{rd} program reference point return		None
G50	G50 X Z Y (single, 2 or 3-axis)	Workpiece coordinate system setting		Non-modal G
G51	G51	Workpiece coordinate system recovery		Non-modal G
G52	G52 Y(V)	Rotary axis coordinate clearing integer		Non-modal G
G31	G01 X(U) Z(W) Y(V) F H(single, 2 or 3-axis)	Skip function		Non-modal G
G74	G74 X(U) Z(W) I K R E F	End face drilling cycle	5	Non-modal G
G75	G75 X(U) Z(W) I K E F	Outer/inner grooving cycle		
G90	G90 X(U) Z(W) R F	Outer/inner cylinder face cycle		
G92	G92 X(U) Z(W) P(E) I K R L H	Thread cutting cycle		
G94	G94 X(U) Z(W) R F	Outer/inner taper cycle		
G22	G22 L	Local cycle start	4	Non-modal G
G80	G80	Local cycle end		Non-modal G
G04	G04 D	Dwell	7	Non-modal G
G71	G71 U W G71 X(U) I K F P Q G710 X(U) P Q F	Outer roughing, finishing cycle	6	
G72	G72 U W G72 Z(W) I K F P Q G720 Z(W) P Q F	End face roughing, finishing cycle		

G73	G73 U W G73 X(U) Z(W) I K F P Q L G730 X(U) Z(W) P Q F	Closed cutting cycle command group		
G76	G76 D I Q P L R G76 X(U) Z(W) P(E) I K R L H	Multi thread cutting cycle command group		
G96	G96 S	Constant surface speed ON	8	Modal G
G97	G97 S	Constant surface speed OFF		Initial G
G98	G98 F	Feed per minute	9	Initial G
G99	G99 F	Feed per rev		Modal G

Note: the system is in G00，G40，G97，G98 when it is switched on and reset.

4.23 Appendix：G and its Relative Parameter Explanation

Table 4-4 G code and it Relative Parameter Table

Word	Function	Relative parameter explanation	Remark
G40	Cancel tool nose radius compensation	P411_d4, P411_d5, P413_d5	
G41	Cancel tool nose radius compensation left		
G42	Cancel tool nose radius compensation		
G00	Rapid traverse	P100～P108, P112, P114, P400_d3	
G01	Linear interpolation	P112, P113, P114, P401_d5, P401_d4	
G02	interpolation(CCW)	P112, P113, P114, P401_d4, P400_d2	
G03	interpolation(CW)		
G05	Arc interpolation		
G32	Tapping cycle	P100, P102, P103, P105, P106, P108, P112, P113, P114	
G33	Constant thread cutting	P100, P101, P103, P104, P106, P107, P113, P116, P117, P209, P306, P307, P403_d0	
G34	Variable pitch thread	The same that of G33	
G26	Program reference point return	Refer to G00 and G50	
G28	Machine zero return	P021～P026, P109, P110, P111, P406 & P407, others are referred to G00	
G30	2nd, 3rd program reference point return	P003～P008, others are referred to G00	
G50	Workpiece coordinate system setting	P000, P001, P002	
G51	Workpiece coordinate system recovery		
G74	Skip function	Refer to G00 and G01	
G75	End face drilling cycle	The same that of G74	
G90	Outer/inner grooving cycle	Refer to G00 and G01	
G92	Outer/inner cylinder face cycle	Refer to G00 and G33	
G94	Thread cutting cycle	Refer to G00 and G01	
G22	Outer/inner taper cycle		
G80	Local cycle start		
G04	Local cycle end		
G71	Dwell	Relative parameter of rapid traverse is referred to G00; relative parameter of cutting feed to linear and arc interpolation	
G72	Outer roughing cycle	The same that of G71	
G96	End face roughing cycle	P410_d6, P304, P305	
G97	Constant surface speed ON		
G98	Constant surface speed OFF		
G99	Feed per minute		
G31	Feed per rev	P532, others are referred to G01	
Y	Additional Y axis	P405_d1, P410_d4	
G66	Storing the current coordinates,		
G67	Return to the stored coordinates		

Chapter 5 Tool Nose Radius Compensation (G41,G42)

5.1 Application

5.1.1 Overview

Part program is compiled generally for one point of tool according to a workpiece contour. The point is generally regarded as the tool nose A point in an imaginary state (there is no imaginary tool nose point in fact and the tool nose radius can be omitted when using the imaginary tool nose point to program) or as the center point of tool nose arc (as Fig. 5-1). Its nose of turning tool is not the imaginary point but one arc owing to the processing and other requirement in the practical machining. There is an error between the actual cutting point and the desired cutting point, which will cause the over- or under-cutting affecting the part precision. So a tool nose radius compensation is needed in machining to improve the part precision.

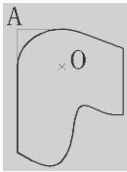


Fig.5-1 tool

B tool compensation is defined that a workpiece contour path is offset one tool nose radius, which cause there is excessive cutting at an intersection of two programs because of executing motion path of next after completing the previous block.

To avoid the above-mentioned ones, the system uses C tool compensation method (namely, tool nose radius compensation). The system will read the next block instead of executing it immediately after reading a block in C tool compensation method, and count corresponding motion path according to intersection of blocks. Contour can be compensated precisely because reading two blocks are pretreated as Fig. 5-2.

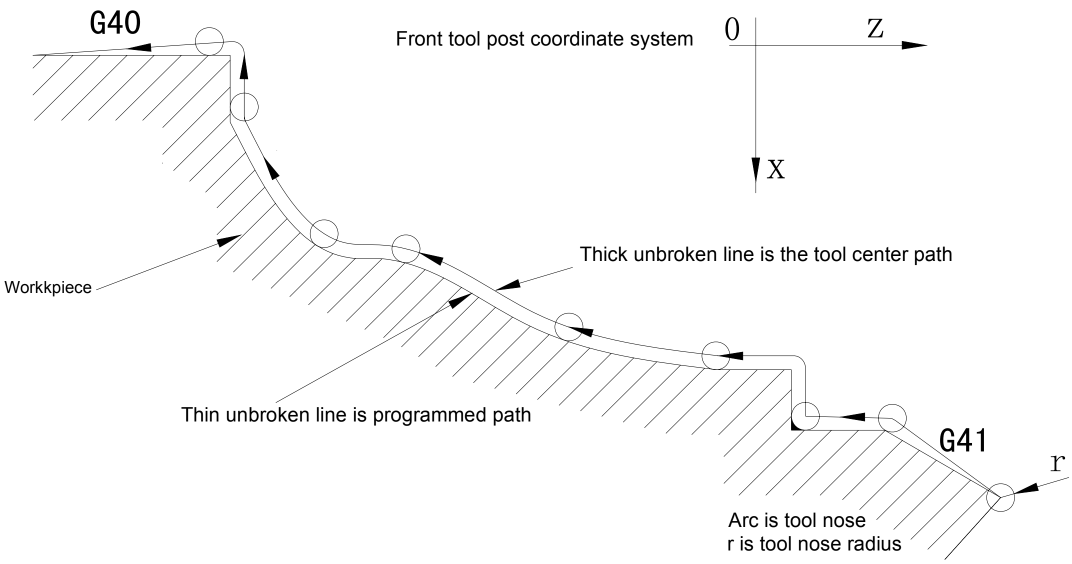


Fig. 5-2 compensation contour

【Explanation】

1) Whether the tool nose radius compensation function is valid is set by **P411_d5**: 0: it is invalid; 1: it is valid.

2) The tool nose transition mode is set by **P413_d4**: 0: linear transmission; 1: arc transition.

3) The front t/rear tool pose coordinate system is set by **P413_d5**.(position relationship between tool nose center and imaginary tool nose.)

4) The system uses C tool radius compensation mode.

5) For the ball tool using tool nose radius compensation, the displayed is the imaginary tool nose coordinates, the graph is the path.

6) Tool nose radius R≤0.001mm: the tool radius compensation function is invalid.

5.1.2 Command format

$$\left\{\begin{matrix}\text{G40}\\ \text{G41}\\ \text{G42}\end{matrix}\right\}\left\{\begin{matrix}\text{G00}\\ \text{G01}\end{matrix}\right\}\quad X\_\_\quad Z\_\_\quad ;$$

Command	Function explanation(compensation direction is referred to the next chapter)
G40	Cancel tool nose radius
G41	G41 specifies left tool compensation in rear tool post coordinate system, G41 specifies right tool compensation in front tool post coordinate system
G42	G42 specifies right tool compensation in rear tool post coordinate system, G42 specifies left tool compensation in front tool post coordinate system

5.1.3 Compensation direction

The tool radius compensation application must determines the compensation direction according to the relative position between the tool nose and the workpiece as Fig. 5-3:

The tool nose radius compensation is created by the first movement command following G41/G42. observe from the starting point to the programming path of the command as follows:

In front tool post coordinate system:

1) In G41, the tool center cuts one tool nose radius in the right of the programming path direction, at the moment, the tool center is in the right of the programmed path.

2) In G42, the tool center cuts one tool nose radius in the left of the programming path direction, at the moment, the tool center is in the left of the programmed path.

In rear tool post coordinate system:

1) In G41, the tool center cuts one tool nose radius in the left of the programming path direction, at the moment, the tool center is in the left of the programmed path.

2) In G42, the tool center cuts one tool nose radius in the right of the programming path direction, at the moment, the tool center is in the right of the programmed path.

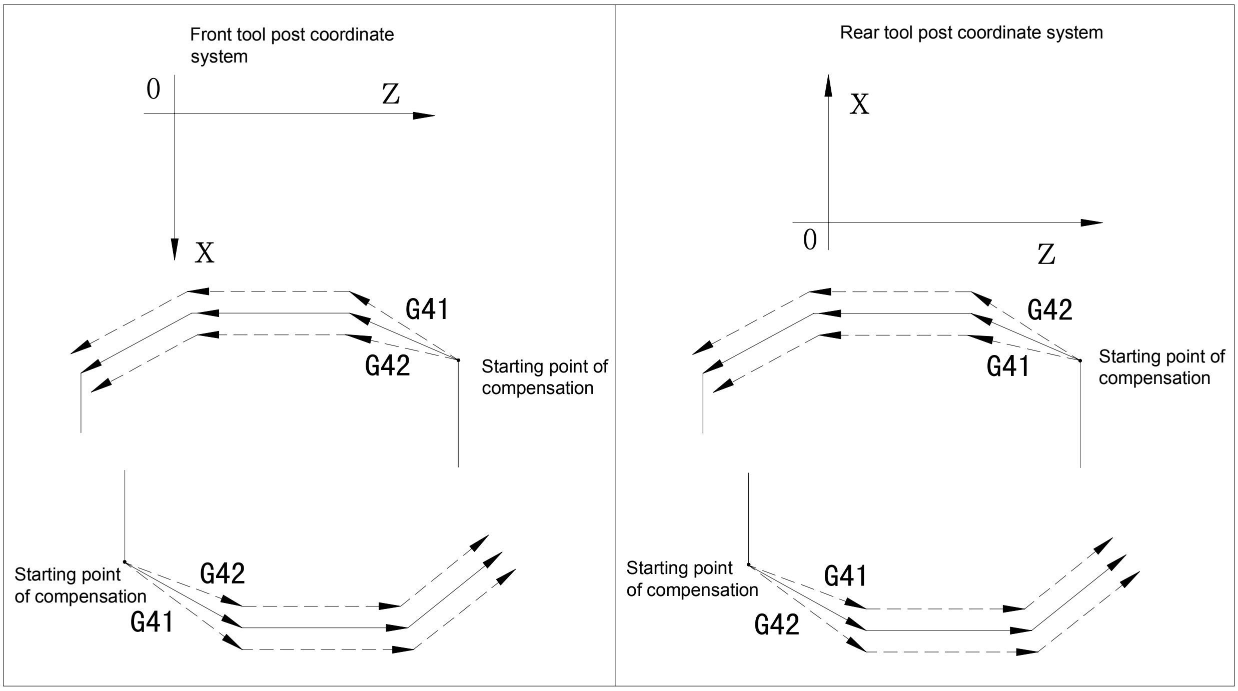


Fig. 5-3 compensation direction

5.1.4 Programming rules

In initial state, the tool nose radius compensation is cancelled; when G41 or G42 command is executed, tool nose radius compensation is used.

When the compensation starts, the system pre-reads 2 block, and stores the next block into buffer when the current block is being executed. The following rules should be followed:

【Programming rules】

1) Before creating the radius compensation, Z/X should confirm the initial position; otherwise, which causes the identifying compensation direction of the system is abnormal.

2) Creating the tool nose radius, the motion command following G41/G42 (or in the same block) only uses G00 or G01 instead of G02 or G03 or G05; otherwise, the system alarms E251 only use " G00/G01 to create the radius compensation" And G00 or G01 has enough movement to create the radius compensation(the movement is more than or equal to the tool nose radius) to avoid the system alarming.

3) In radius compensation state, only G00, G01, G02, G03, G05 can be permitted to execute, otherwise the system alarms "E248 does not cancel the tool nose radius compensation".

4) In radius compensation state, the system permits the call, the transfer, M, S, F command; it does not execute T command, otherwise, the system alarms "Forbidding the tool change in E249 tool nose radius compensation".

5) After G40 cancelling compensation command (or in the same block), the system only uses G00 or G01; otherwise, the system alarms "E250 only uses G00/G01 to cancel the radius compensation. G00 or G01 has enough movement to cancel the radius compensation to avoid the system alarming.

6) Before executing M30, M02, M20, the system must firstly cancel the tool nose radius

compensation.

7) In G90, G94, G71, G72, the system executes the tool radius compensation; the compensation is compiled with G41/G42 in the same block.

8) In radius compensation state, G00, G01 permits Y programming, the compensation axis is only Z/X.

9) G40, G41, G42 must not be in the same block with T.

10) In executing G41/G42, the system cannot directly switch G42/G41; when they are switched, the system must use G40 to cancel the current compensation direction to execute the switch.

【Programming format sample】

```
G00 Z X        ; imaginary tool nose moves to Z/X position
G42(G41)       ; specify the tool nose radius compensation mode, left or right
G01 Z   X      ; create the tool nose radius compensation; the tool center offsets
               ; the tool center does not move to the Z/X of the command, the side of the tool
                 moves to the position
G01            ;
……
G02            ;
G40            ; specify the tool nose radius compensation cancel
G00 Z   X      ; cancel the tool nose radius compensation
……
G41 G71        ; before switching the compensation direction(from G42 to G41), the system uses
                 G40 to cancel the tool nose radius compensation
……
M02            ;
```

5.1.5 Application example

Machine the workpiece as Fig. 5-4. Use the tool number T0101, the tool nose radius R=2, imaginary tool nose number T=3.

The tool setting is completed in the offset cancel mode, Z offsets one tool nose radius value, and the tool direction is related to the tool setting point based on the imaginary tool nose direction, otherwise, the system overcuts one tool nose radius value in starting tool.

```
Program:
%110
T0101              ; tool change
G00 X100 Z50       ; tool center moves to (Z50.0, X100.0)
G00 X0 Z3          ; tool center offsets, actually moves to (Z3.0, X0)
G42                ; create  the tool nose radius compensation
G01 Z0 F300        ; start cutting, and actual move to (Z0, X-4.0)
X16                ; move to (Z-2.0, X16.0)
Z-14 F200          ; move to (Z-16.0, X16.0)
G02 X28 W-6 R6     ; move to (Z-22.0，X28.0)
G01 W-7            ; move to (Z-27.0, X28.0)
X32                ; move to (Z-29.0, X32.0)
Z-35               ; move to (Z-37.0, X32.0)
G40                ; cancel tool nose radius compensation
```

G00 X90 ; move to (Z-35.0, X90.0)
G00 X100 Z50 ; move to (Z50.0, X100.0)
M02

Because there is the tool nose radius, the imaginary tool nose does not stop at the coordinates on the block after one block is executed, which is caused by that the system uses the best tool center motion path calculation instead of the program execution error.

In OFFSET working mode, the setting between the tool radius R and imaginary tool nose direction:

Tool offset number	Z	X	R	T	S
001			2.000	3	
002	…	…	…	…	…
…	…	…	…	…	…
006	…	…	…	…	…
007	…	…	…	…	…

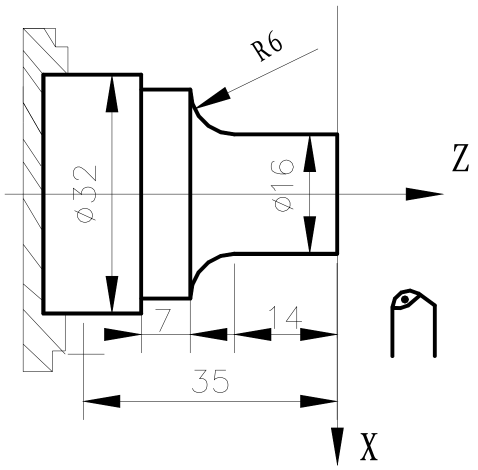


Fig. 5-4 machining example

5.1.6 Tool setting and tool nose number of ball tool

For the ball tool, the displayed by the system is the coordinates of the imaginary tool nose. But in fact, the system cannot move the tool nose radius center to the tool setting point, so, it imagines one "tool nose which is to move to the tool setting point. The position relationship between the tool nose radius and imaginary tool nose corresponds to the one between the tool nose radius center and the tool setting point.

In the actual tool setting, there are 9 kinds of position relationship between the tool nose center and imaginary tool nose, and the system uses the imaginary tool nose number 0～8.

The tool nose number 0 means the tool nose center is consistent with the imaginary tool nose.

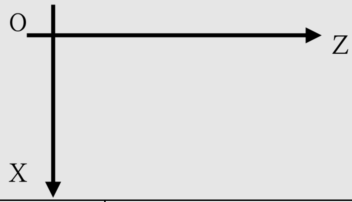
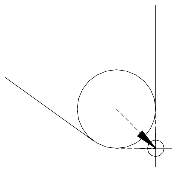
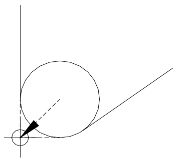
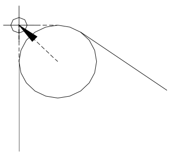
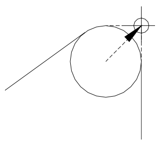
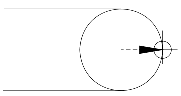
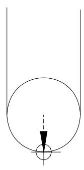
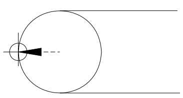
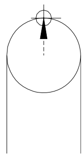
The following table is the tool nose number 0～8 conditions, explaining the position relationship between the tool nose center and imaginary tool nose, the arrowhead end point is the imaginary tool nose.

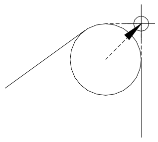
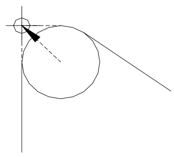
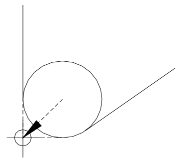
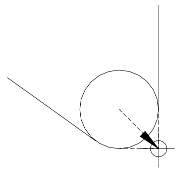
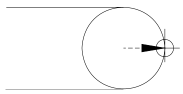
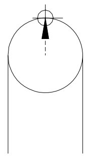
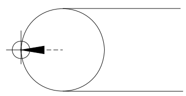
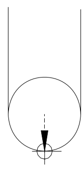
【Explanation】

1) Before the ball tool setting, the imaginary tool nose number and the tool nose radius value of each tool must be preset in the tool compensation table. In the tool compensation table, R is the tool nose radius value, and T is the imaginary tool nose number.
2) In the ball tool setting, the user should move the "imaginary tool nose point" to the tool setting

point, and then input the actual coordinates of K/I tool setting. In executing the program, the system automatically executes the tool nose radius compensation according to the preset imaginary tool nose number and the tool nose radius value in advance .

3) When the system executes the tool nose radius compensation, its motion path is directly related to T imaginary tool nose number; only inputting the correct imaginary tool nose number can get the expected compensation result.

<table>
<tr><td colspan="2">Position relationship between tool nose center and imaginary tool nose (front tool post coordinate system)</td></tr>
<tr><td colspan="2">front tool post coordinate system 
</td></tr>
<tr><td>
Tool nose number 1
The tool nose center in X, Z negative direction of the imaginary tool nose.</td><td>
Tool nose number 2
The tool nose center in X negative direction and Z positive direction of the imaginary tool nose.</td></tr>
<tr><td>Tool nose

number 3
The tool nose center in X, Z positive direction of the imaginary tool nose.</td><td>
Tool nose number 4
The tool nose center in X positive direction and Z negative direction of the imaginary tool nose</td></tr>
<tr><td>
Tool nose number 5
The tool nose center coincides with X and is in Z negative direction of the imaginary tool nose.</td><td>
Tool nose number 6
The tool nose center coincides with Z and is in X negative direction of the imaginary tool nose.</td></tr>
<tr><td>
Tool nose number 7
The tool nose center coincides with X and is in Z positive direction of the imaginary tool nose.</td><td>
Tool nose number 8
The tool nose center coincides with Z, and is in X positive direction of the imaginary tool nose.</td></tr>
<tr><td colspan="2">Position relationship between tool nose center and imaginary tool nose (rear tool post coordinate system)</td></tr>
<tr><td colspan="2">rear tool post coordinate system 
</td></tr>
</table>

 Tool nose number 1 The tool nose center in X, Z negative direction of the imaginary tool nose.	 Tool nose number 2 The tool nose center in X negative direction and Z positive direction of the imaginary tool nose.
 Tool nose number 3 The tool nose center in X, Z positive direction of the imaginary tool nose.	 Tool nose number 4 The tool nose center in X positive direction and Z negative direction of the imaginary tool nose
 Tool nose number 5 The tool nose center coincides with X and is in Z negative direction of the imaginary tool nose.	 Tool nose number 6 The tool nose center coincides with Z and is in X negative direction of the imaginary tool nose.
 Tool nose number 7 The tool nose center coincides with X and is in Z positive direction of the imaginary tool nose.	 Tool nose number 8 The tool nose center coincides with Z, and is in X positive direction of the imaginary tool nose.

5.2 Tool Nose Radius Compensation Offset Path Explanation

5.2.1 Inner and outer side

Inside is defined that an angle on workpiece side at intersection of two motion blocks is more than or equal to 180°; **Outside** is 0~180°.

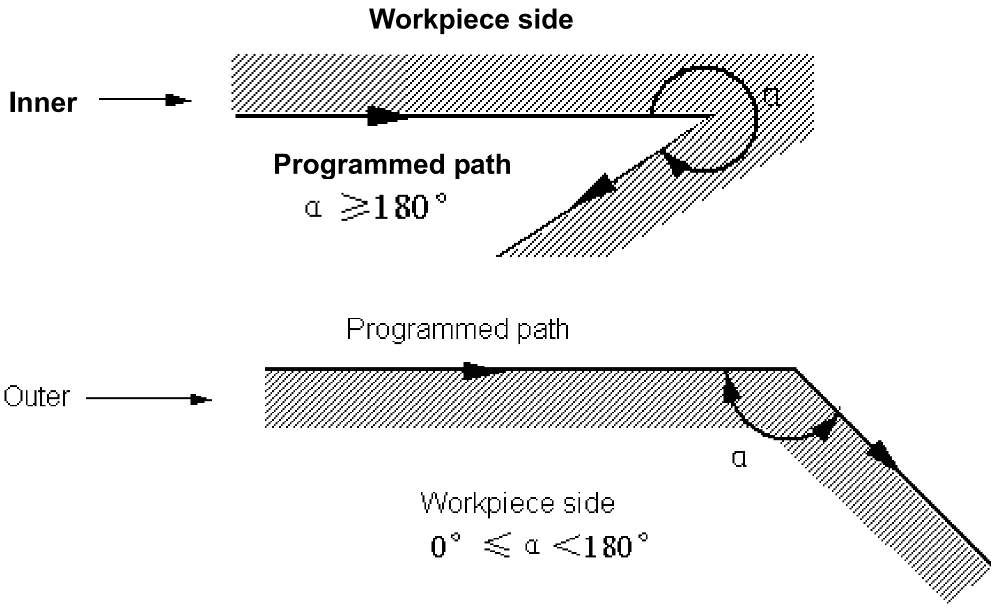


Fig. 5-5 inner, outer side definition

5.2.2 Tool movement in start-up

3 steps to execute tool nose radius compensation: tool compensation creation, tool compensation execution and tool compensation canceling. Tool traverse is called tool compensation creation (starting tool) from offset canceling to G41 or G42 execution.

Note 1: The tool nose transition method is set by P411_d4.

Note 2: Meanings of S, L, C in the following figures are as follows:

S——Stop point of single block; L——linear; C——circular.

(a) Tool movement around an inner side of a corner (α≥180°)

1) Linear —linear

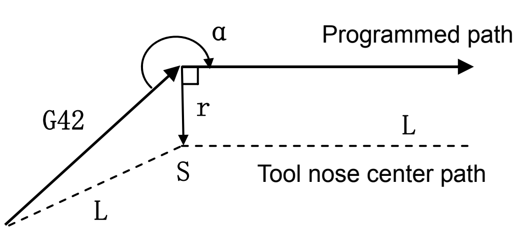


Fig.5-6a Linear —linear(start-up I inner side)

2) Linear —circular

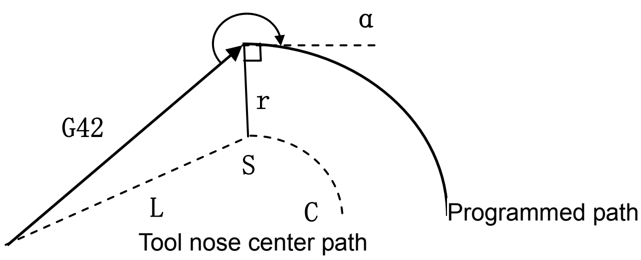


Fig. 5-6b Linear —circular（start-up I inner side）

(b) Tool movement around an outer side of a corner (180°＞α≥0°)

1) Linear → Linear

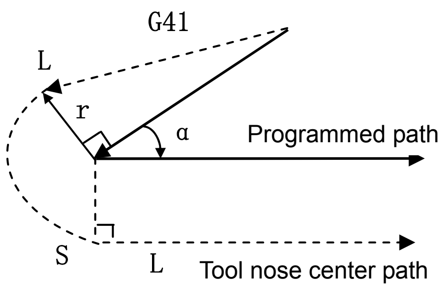


Fig.5-7a （start-up outer side）arc transition at angle

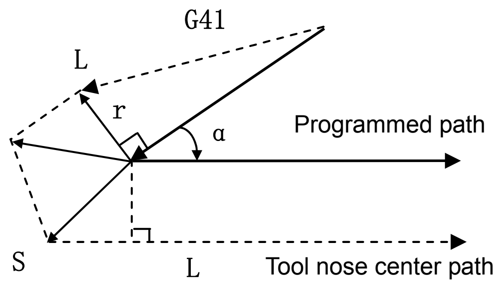


Fig.5-7b（start-up I outer side）linear transition at angle

2) Linear → Circular

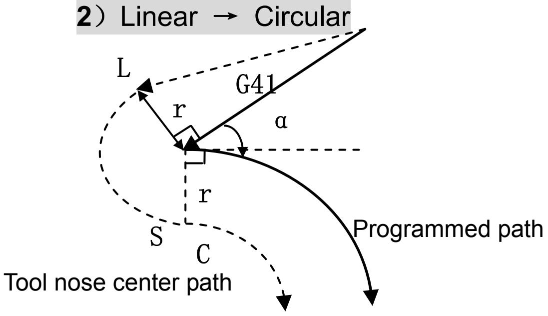


Fig.5-8a （start-up outer side）arc transition at angle

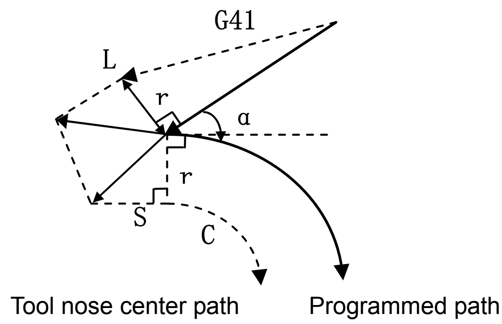


Fig.5-8b （start-up outer side）linear transition at

5.2.3 Tool movement in OFFSET mode

Offset mode is called to ones after creating tool nose radius compensation and before canceling it. The offset path of the tool nose radius compensation is as follows:

（a） Tool movement around an inner side of a corner(α≥180°)

1）Linear —linear

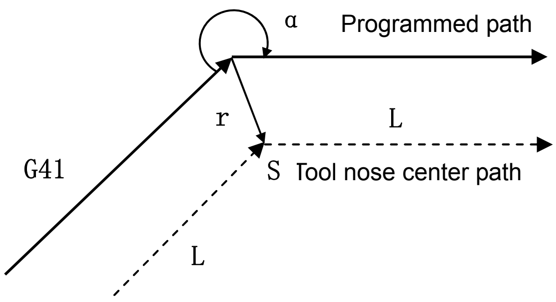


Fig. 5-9a Linear —linear (movement inner side)

2）Linear —arc

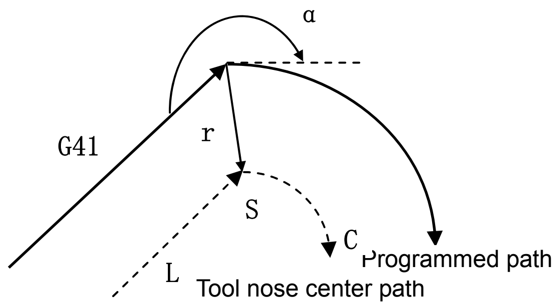


Fig. 5-9b Linear —linear (movement inner side)

3）Circular—linear

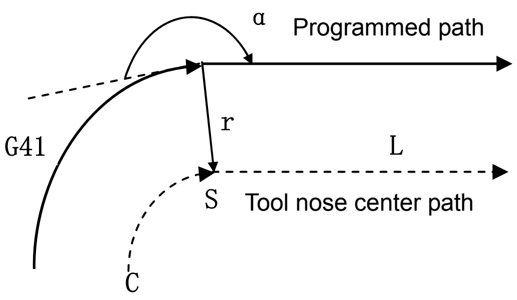


Fig. 5-9c Circular —linear (movement inner side)

4）Circular—linear

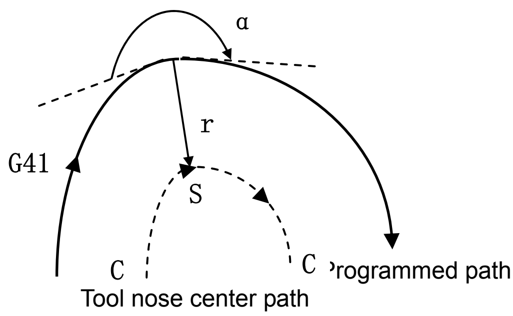


Fig. 5-9d Circular —circular movement inner side)

(b) Tool movement around an outer side of a corner (180°＞α≥90°)

1) Linear —linear

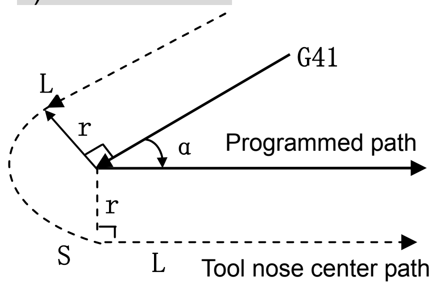


Fig.5-10a arc transition at angle

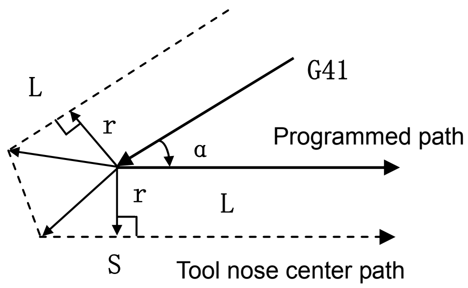


Fig.5-10b linear transition at angle

2) Linear —Circular

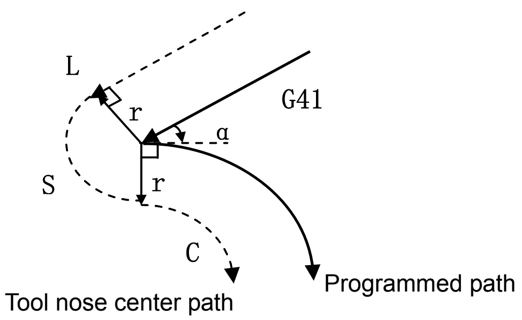


Fig.5-11a arc transition at angle

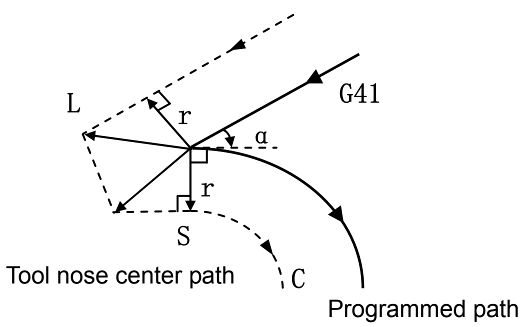


Fig.5-11b linear transition at angle

3) Circular—Linear

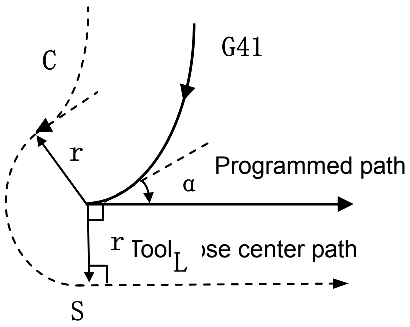


Fig. 5-12a arc transition at angle

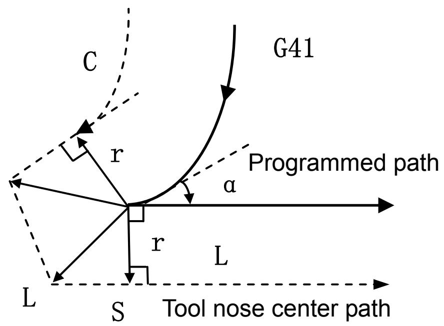


Fig.5-12b linear transition at angle

4) Circular—Circular

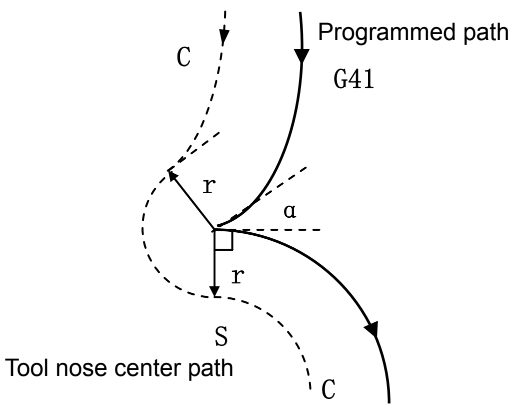


Fig. 5-13a arc transition at angle

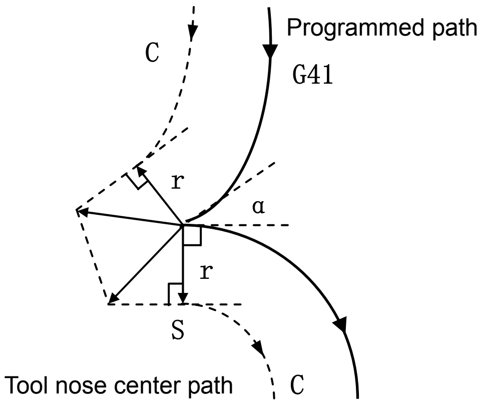
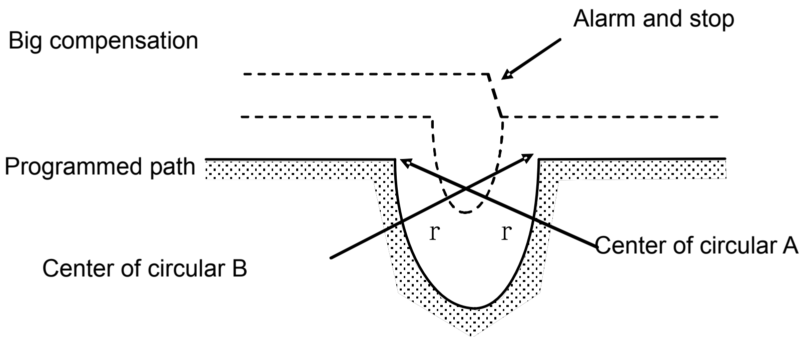


Fig. 5-13b linear transition at angle

(c) Special cutting

Without intersection



There is no intersection of compensation paths when the tool radius is small; no one when the radius is big and the tool stops at the end point of previous block and the system alarms.

Fig. 5-14 Paths without intersection after offset

5.2.4 Tool movement in OFFSET canceling

In compensation mode, when the block uses G40, CNC enters the compensation cancel mode, and the block operation is called the compensation cancel.

In C compensation cancel, the system cannot use G02, G03 and G05. When there is the arc commands , the system alarms and stops running.

In compensation cancel mode, the system controls the block execution and the block which is in the tool nose radius compensation buffer register. At the moment, the system stops after executing one block in SINGLE working mode. Press CYCLE START and the system executes the next block instead of reading the next block. In the following compensation cancel mode, the next block which is to be executed reads to the buffer register and the system does not read the following block to the tool nose radius compensation buffer.

(a) Tool movement around an inner side of a corner (α≥180°)

1) Linear→Linear

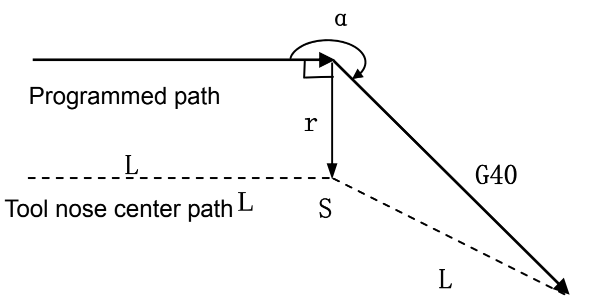


Fig.5-15a Linear—Linear 1（inner side, canceling offset）

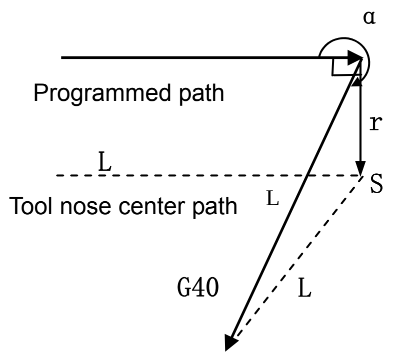


Fig.5-15b Linear—Linear 2（inner side, canceling offset）

2) Circular→Linear

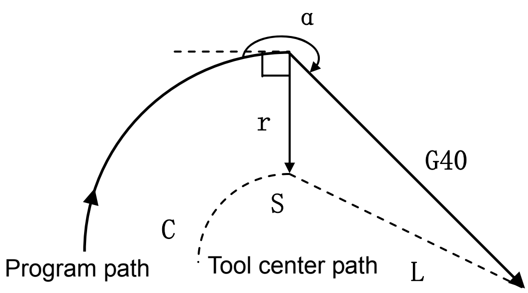


Fig.5-15c Circular—Linear 1（inner side, canceling offset）

(b) Tool movement around an outer side of a corner(180°＞α≥0°)

1) Linear →Linear

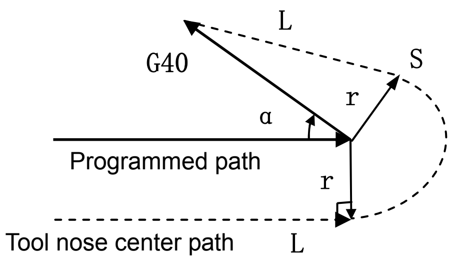


Fig.5-16a （acute angle, outer side, canceling offset）arc transition at angle

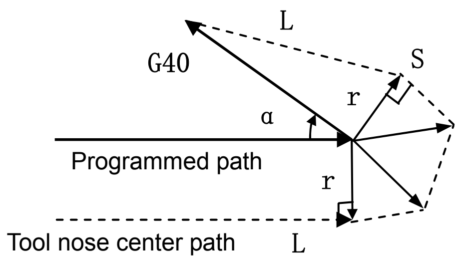


Fig. 5-16b （acute angle, outer side, canceling offset）linear transition at angle

2) Circular → Linear

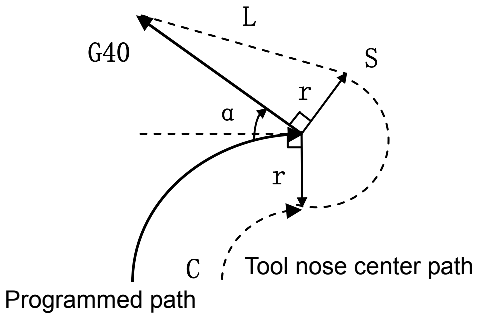


Fig.5-17a (acute angle, outer side, canceling offset) arc transition at angle

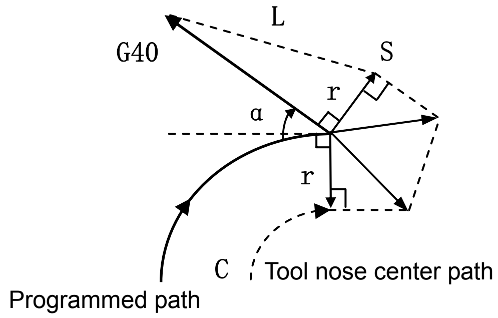


Fig. 5-17b (acute angle, outer side, canceling offset) linear transition at angle

5.2.5 Tool interference check

"Interference" is defined that the tool cuts workpiece excessively and it can find out excessive cutting in advance, the interference check is executed even if the excessive cutting is not created, but the system cannot find out all tool interferences.

A. Fundamental conditions

1) The tool path direction is different that of program path (angle is 90°~270°).

2) There is a big difference (α>180°) for two angles between starting point and end point of tool nose center path, and between starting point and end point of program path.

Example : linear machining

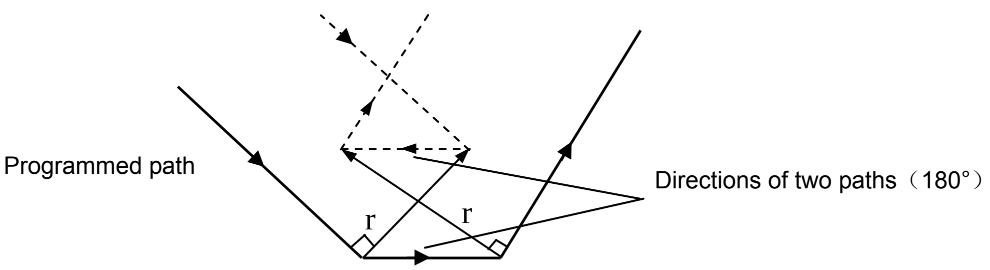


Fig. 5-18a machining interference（1）

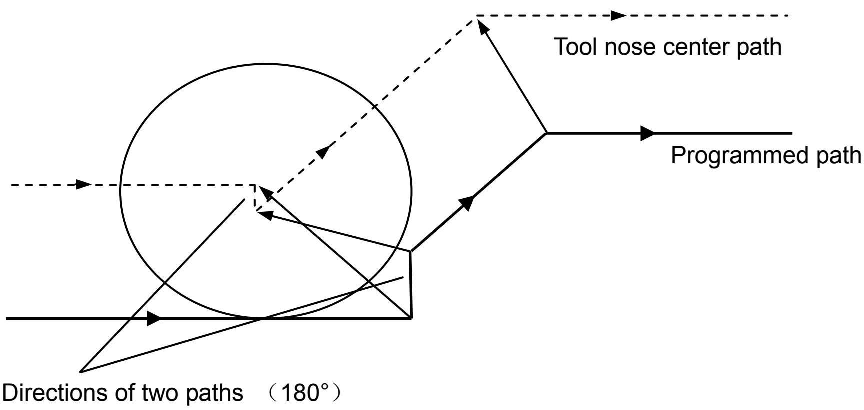


Fig. 5-18b machining interference (2)

B. Executing it without actual interference

1) Concave groove less than compensation value

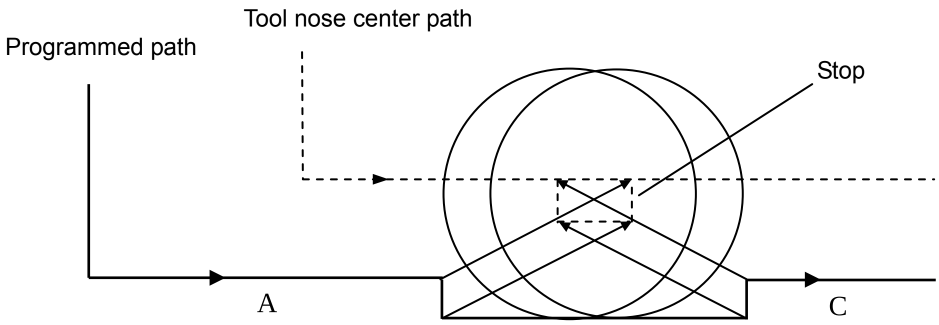


Fig. 5-19a Special execution conditions in interference (1)

Directions of block B and tool nose radius compensation path are opposite without the actual interference, the tools stops and the system alarms.

2) Concave channel less than compensation value

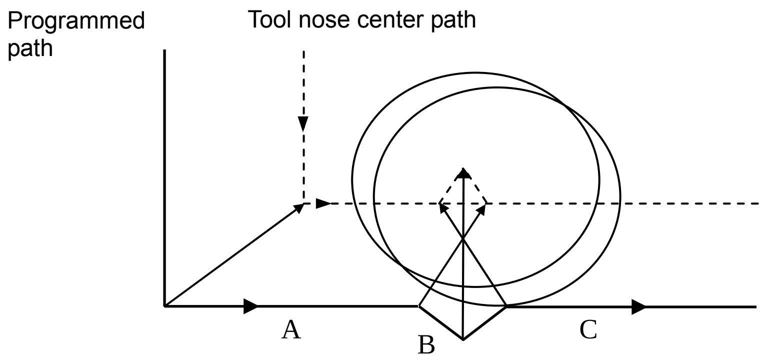


Fig. 5-19b Special execution conditions in interference (2)

Directions of block B and tool nose radius compensation path are opposite without the actual interference, the tools stops and the system alarms.

5.2.6 Particulars

1) Inner side chamfer machining less than tool nose radius

At the moment, the tool inner side offset causes an excessive cutting. The tool stops and the system alarms (P/S41) when starting the previous block or chamfer moving. But the tool stops the end point of previous block when **SINGLE** is ON.

2) Machining concave less than tool nose diameter

There is an excessive cutting when the tool nose center path is opposite to program path caused by tool nose radius compensation. At the moment, the tool stops and the system alarms when starting the previous block or chamfer moving.

3) Machining sidestep less than tool nose radius

The tool center path can be opposite to program path when the sidestep is less than tool nose radius and is an circular in program. At the moment, the system automatically ignores the first vector and directly moves end point of second vector linearly. The program stops at the end point in single block and otherwise the cycle machining is continuously executed. If the sidestep is a linear, compensation is executed correctly and the system does not alarm (but the not-cutting is still reserved).

4) End point of programming circular out of circular

The tool stops and the system alarms and displays “End point of circular is not on circular” when the end point of circular is not on circular in programs.

5.2.7 Radius compensation of compound cycle command

The tool radius compensation can be executed in the internal of G90, G94, G71, G72, G73. These commands should be in the same block with G41/G42, which means G41/G42 executes the tool radius compensation in the internal of the compound cycle. G41/G42 is invalid when the compound cycle ends.

(1) Compensation methods of G90, G94 executing the tool nose radius compensation:

A. For all paths of the cycle, the tool nose center path is parallel with the program path.

B. The offset directions in G41/G42 are the same as the following figures.

C. The system executes the compensation based on the imaginary tool nose direction(T0～T9 imaginary tool nose direction) , and the motion path deviates the tool nose radius vector, and the intersection should be counted in the cycle.

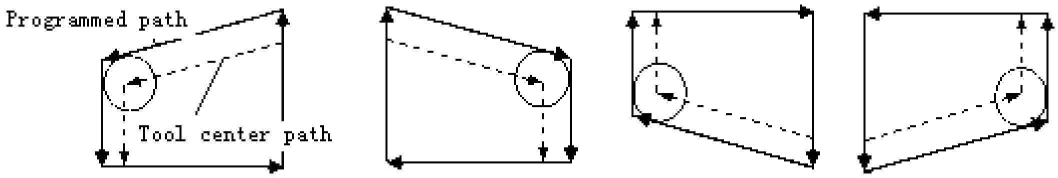


Fig. 5-20a Offset of tool nose radius compensation in G90

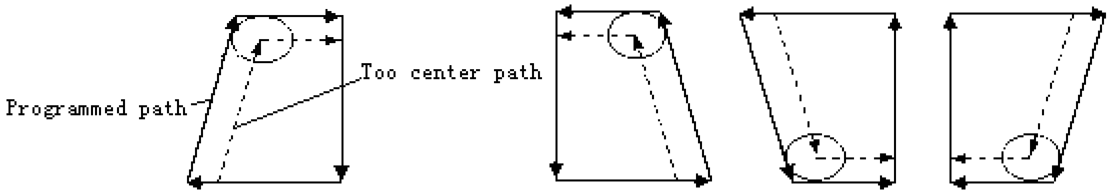


Fig. 5-20b Offset of tool nose radius compensation in G94

(2) Compensation methods of G71, G72 executing the tool nose radius compensation(G73 is referred to G71, G72) :

A. Gradually machine the blank and reserve the tool nose radius; execute the tool nose radius compensation in the finishing contour.

B. The offset directions in G41/G42 are the same as the following figures.

C. The system executes the compensation based on the imaginary tool nose direction(T0～T9 imaginary tool nose direction) , and the motion path deviates the tool nose radius vector, and the intersection should be counted in the cycle.

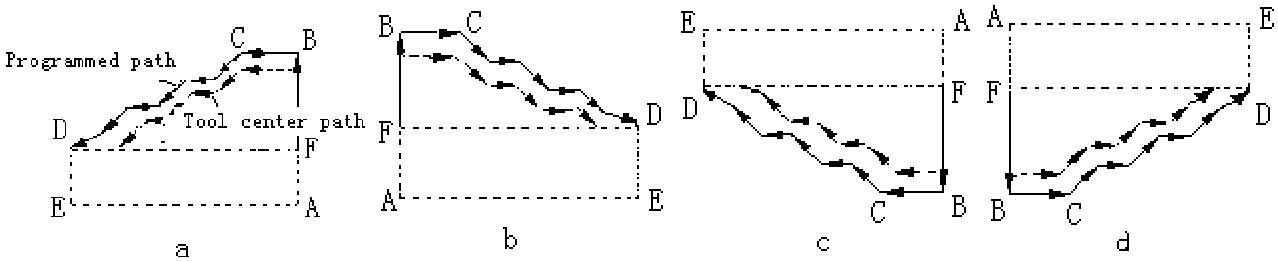


Fig. 5-21a offset of tool nose radius compensation in G71

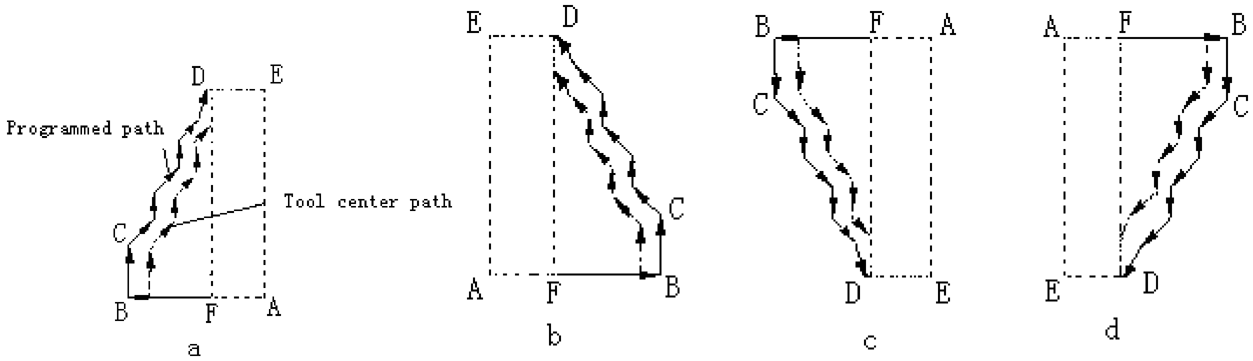


Fig. 5-21b offset of tool nose radius compensation in G72

Chapter 6 Pitch Error Compensation

The memory pitch error compensation function is used to compensating the affect on the machine transmission precision caused by the pitch error. The system compensates the controllable axis Z, X, Y.

The chapter describes the pitch error measure, pitch information description method, pitch error compensation method and notes.

6.1 Leading-Screw Error Curve

Measuring the pitch error should be executed after the machine geometrical precision(machine horizontal parallel and vertical conditions) are regulated to reduce the affect on the positioning precision caused by the geometrical precision.

Measure the pitch error of the leading-screw should use the precise instrument(such as laser interferometer), take the terminal in the leading-screw direction as the measure starting point, and measure the leading-screw error curve in the positive direction of the axis, draft the revised curve according to the error curve, select the proper compensation interval to input the compensation value of each point to the pitch compensation parameter table. The system revises the compensation according the pitch compensation parameter table in executing the axis motion.

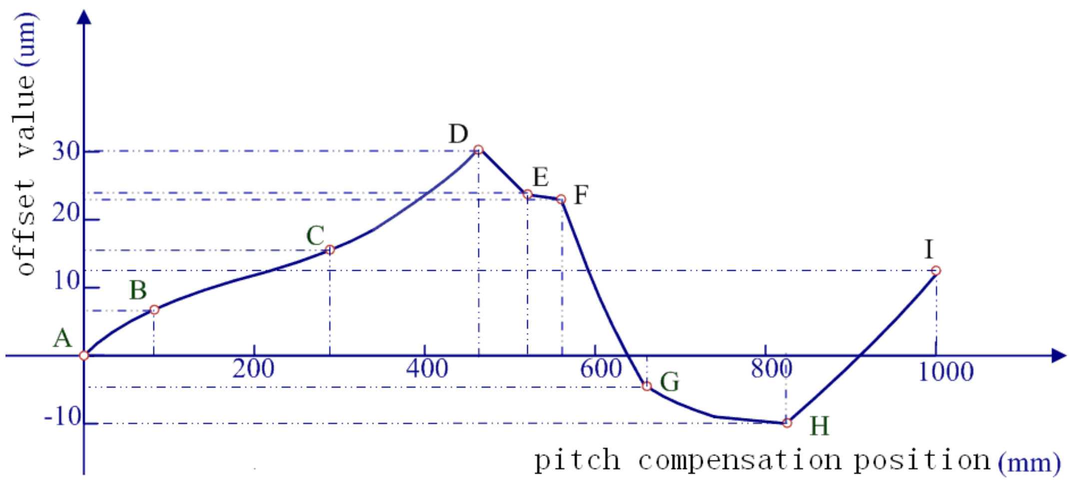


Fig. 6-1 leading-screw error curve

As the above figure, A is taken as the measure starting point and the measured length of leading-screw is 1000 mm. When the deviation value is positive, the actual measured distance of the leading-screw moving to the current point from the measured starting point is more than the theory; when the deviation value is negative, the actual measured distance of the leading-screw moving to the current point from the measured starting point is less than the theory.

As the above figure: the theory distance from D to the measured starting point is 460mm, and the deviation value is 30um.

the theory distance from H to the measured starting point is 820mm, and the deviation value is -10um.

【Relative parameter】

1) Whether the pitch error compensation function is valid is set by **P411_d7**: 0: inactive; 1: active.

2) Pitch value description method is set by **P411_d6**: 0: inconstant interval; 1: constant interval.
3) Pitch compensation parameter value: **P1000～P1905**.

【Note】

1) The pitch compensation function should be closed when the system measures the pitch error, otherwise, the measure is not correct when there is the data in the pitch compensation parameter table.
2) The pitch compensation point must be in the positive direction related to the measured starting point in the machine coordinate system.

6.2 Constant Interval Description Method

The pitch compensation parameter table uses two methods to describe the data, i.e. constant interval and inflection point description method(set by **P411_d6**).

In the constant interval description method, each axis is up to 300 compensation point; the interval between two points is equal, which is called the compensation interval. The compensation interval is generally referred to max. machine travel which is up to 1000mm, the compensation interval is set to 4mm (1000mm/300 points=3.33, valuing is the integer 4), the compensation interval is 4, each axis only uses 250 compensation points and other compensation point cannot be used temporarily.

Parameter definition in the pitch compensation table in the constant interval description method:

P1000～P1299：deviation value of Z 300 points;

P1300～P1599：deviation value of X 300 points;

P1600～P1899：deviation value of Y 300 points.

【Example】

P1903=4.0 ; Taking example of z, the valid length of leading-screw is 1000mm, and the compensation interval is set to 4mm;
P1000=1 ; deviation value to the measured starting point 4mm is 1um; (the first point which is the nearest to the measured starting point)
P1001=1 ; deviation value to the measured starting point 8mm is 1um;
P1002=1 ; deviation value to the measured starting point 16mm is 2um;
P1003=2 ; deviation value to the measured starting point 16mm is 2um;
……
P1072=15 ; deviation value to the measured starting point 292mm is 15um;;
……
P1249=12 ; deviation value to the measured starting point 1000mm is 12um;
P1250=12 ; do not use the points P1250～P1299，which are the same values as the positive end point.
……
P1900=-20.0 ; the concrete position of Z measured starting point in the machine coordinate system is -20.000 mm.

【Explanation】

1) P1900～P1905 must be set in the constant interval description method.
2) P1903～P1905 compensation interval is 0.256 mm～999.999mm in the constant interval description method, otherwise, the input is invalid.
3) Max. compensation length cannot be more than 10m.
4) The detailed parameter setting method is referred to OPERATION , Parameter Working Mode.

6.3 Inflection Point Description Method

The constant interval description method inputs too much data but cannot describe the inflection point information of leading-screw error curve, and so it is suggested that the inflection point description point should be used.

Each axis can input 150 groups of inflection point information in the inflection point description method. Each group inflection point information includes: the distance from the point to the measured starting point and the deviation value of the point.

parameter definitions in the pitch compensation table:

P1000_P1299：Z 150 groups of inflection point information;

P1300_P1599：X 150 groups of inflection point information;

P1600_P1899：Y150 groups of inflection point information;

Even number parameter is the distance to the measured starting point and the odd number parameter is the deviation value.

【Example】

Taking example of Z, the valid leading-screw length is 1000mm;

P1000=80.000 ; deviation value from B to the measured starting point 80mm is 6um; (the first point which is the nearest to the measured starting point) ;

P1001= 6 ;

P1002=290.000 ; deviation value from C to the measured starting point 290mm is 15um;

P1003=15 ;

P1004=450.000 ; deviation value from D to the measured starting point 450mm is 30um;

P1005=30 ;

……

P1014=1000.000 ; deviation value from B to the measured starting point 1000mm is 12um;

P1015=12 ;

P1016=0.000 ; end mark(the distance from the compensation point which is not the first being 0 means the end of pitch compensation point setting);

……

P1900=-20.0 ; the concrete position of Z measured starting point in the machine coordinate system is -20.000 mm.

【Explanation】

1) P1900～P1902must be set in the inflection point description method, and P1903～P1905 does not(the are invalid and valid in the constant interval description method).
2) The pitch compensation interval between the neighboring two points in the inflection point description method is 0.256 mm～999.999mm, otherwise, the system prompts the alarm. The interval is too long and it is divided into many small block to describe.
3) The distance from the pitch compensation point to the measured starting point cannot be less than the one from last pitch compensation to the measured starting point; when they are the same, their deviation values must be the same one, otherwise, the system prompts "E027: the axis pitch compensation is invalid".
4) Except the distance from the pitch compensation point of the first pitch compensation point parameter to the measured starting point can be 0, and being 0 from other pitch compensation point to the measured starting point is taken as the end of pitch compensation point input.
5) Max. compensable length cannot be more than 10m, otherwise, the system prompts the input is invalid and the pitch compensation data is invalid.

6.4 Pitch Compensation Execution Method

The constant interval or the inflection point description method executes the pitch compensation method after the system performs the sampling of some point in the measured leading-screw error curve; the difference of their calculation methods is whether their compensation intervals are equal; the point intervals in the constant interval description method are equal and they may not be equal in the inflection point description method.

The system creates the **error curve** according to the input data, and executes the super-compact compensation in 0.256 interval unit according to the **error curve trend** in the actual pitch error compensation.

【Example 1】

Suppose that Z leading-screw error curve is as Fig. 6-1, Z electronic gear ratio setting is 1:1.

Sampling point A, B, C, D, E as follows:

Sample point	**A**	**B**	**C**	**D**	**E**
Displayed machine coordinates (mm)	0	80	290	450	520
Leading-screw theory position(mm)	0	80	290	450	520
Actual measured data(mm)	0	80.006	290.015	450.030	520.024
Deviation value(um)	0	6	15	30	24

When the pitch compensation function is valid, the system uses the inflection point, and executes the input according to the lead theory position and offset value in the pitch compensation parameter.

P1000=80，P1001=6; (the previous data is the theory position value of the measured lead, the following data is the offset value between the actual and the theory value)

P1002=290，P1003=15;

P1004=450，P1005=30;

P1006=520，P1007=24;

…

When the pitch compensation is valid, the system divides the data of each pitch compensation point in the linear mode. The user can learn the pulse quantity change sent by the system through observing the data of servo drive unit pulse. The coordinate axis separately moves to B, C, E from A and the system sends the actual pulse as follows:

	Theory value to the leading-screw starting point (mm)	Displayed machine coordinates when Z moving to each point	Output pulse quantity when pitch compensation function is invalid	Output pulse quantity when pitch compensation function is valid	Deviation value (um)
A	0	0	000	000	0
	40	40	40000	39997	3
B	80	80	80000	79994	6
	145	145	145000	144991	9
	225	225	225000	224987	13
	260	260	260000	259986	14
…	…	…	…	…	…
C	290	290	290000	289985	15
…	…	…	…	…	…
D	450	450	450000	449970	30
…	…	…	…	…	…
E	520	520	520000	519976	24
…	…	…	…	…	…

Note: compensation value in the interval unit 0.256mm cannot exceed 7um, otherwise, the system alarms: E027：axis pitch compensation is invalid.

【Example 2】

Suppose that X leading-screw error curve is as Fig.6-1, X is in diameter programming mode(**P413_d6**=0), X electronic gear ratio is set to 1：1.

Sampling point A, B, C, D, E are as follows:

Sampling point	**A**	**B**	**C**	**D**	**E**
Displayed machine coordinates(mm)	0	160	580	900	1040
Leading-screw theory position(mm)	0	80	290	450	520
Actual measured data(mm)	0	80.006	290.015	450.030	520.024
Deviation value(um)	0	6	15	30	24

When the pitch compensation function is valid, the system uses the inflection point description method; in the pitch compensation parameter, the system executes the input according to the leading-screw position and deviation value:

P1300=80，P1301=6; (the fore data is the theory position value of the measured leading-screw, the later is the deviation value between the actual and the theory of leading-screw)

P1302=290，P1303=15;

P1304=450，P1305=30;

P1306=520，P1307=24;

…

The coordinate axis moves separately from A to B, C, E and the system sends the actual pulse as follows:

	Theory value to leading-screw measured starting point (mm)	Displayed machine coordinates (they are the half of the following setting value in radius mode) when X moves to each point	The output pulse quantity when the pitch compensation is invalid	The output pulse quantity when the pitch compensation is valid	Deviation value(um)
A	0	0	000	000	0
	40	80	80000	79994	3
B	80	160	160000	159988	6
	145	290	290000	289982	9
	225	450	450000	449975	12.5
	260	520	520000	519972	14
…	…	…	…	…	…
C	290	580	580000	579970	15
…	…	…	…	…	…
D	450	900	900000	899940	30
…	…	…	…	…	…
E	520	1040	1040000	1039952	24
…	…	…	…	…	…

Note: When the system parameter and programming setting are in the radius mode, and X coordinate movement is equal to the input deviation data, the system compensates fully the deviation value of the point; when it is in the diameter mode and X coordinate movement is the double of the input deviation point data, the system compensates fully the deviation value because the actual movement is only the half of the displayed coordinate value.

Chapter 7 General Programming Rules and Examples

7.1 General Programming Rules

The command compiling must meet the rules in one block, which can be convenient to the system identifying them; it is suggested that the command character should be in the fore and the data field should be in the later. The system executes the Programming Rule Check, and the program meeting the programming rules can be compiled; alarm will occur when there is wrong.

1) There is no repetitive command in one block, otherwise, the system alarms “E202: Repetitive command”;

   Mistaken example：N0200 G00 G00 Z30;

2) The command character must be followed by the valid digital command, otherwise, the system alarms “E201, Illegal command”;

   Mistaken example： N0200 G23 Z30 ; no the command.

3) There must not be the repetitive data field in one block, otherwise, the system alarms “E234: the data field is repetitive” ;

   Mistaken example：N0200 G00 Z20 Z30;

4) There must not be the mutually contradictory data field, otherwise the system alarms “E210; the excessive fields”;

   Mistaken example：N0200 G00 Z20 W30;

5) The command character and field character must be followed by the valid digit without the blank space, otherwise the system alarms “E204: the command format error”;

   Mistaken example：N0200 G00 Z 20 ;

   N0200 G 00 Z30 ; there is no blank space between G and 00

6) The required data in the block cannot be omitted, otherwise, the system alarms “E206: leakage message”;

   Mistaken example：N0200 G90 X100 ;

7) There must not be the fields, letters and digits unrelated to the command, otherwise, the system alarms “E203: illegal message”;

   Mistaken example：N0200 G00 X W 100 ; surplus character W

8) The number of the data field must be in the valid range, otherwise, the system alarms “E211: the data exceeds the range”

   Mistaken example：N0200 G00 X100 Z99999 ; the data 9999 exceeds the range.

9) It can be omitted when the first digit is zero in the command.

   Example: G00 can be written to G0.

7.2 Programming Rules for Commands in One Block

Programming rules for commands in one block mean that there are many commands in one block simultaneously, but all commands are not in the same block. The system executes Programming rule check, and the programs meeting the programming rules can pass the compiling; the system alarms and prompts Some command need to be used independently. And the rules are as follows:

1) commands only in single block:

G50, G51, G26, G28, G30, G31;
G32, G33, G34;
G04;
Program lock cycle: G22, G80;
Single fixed cycle：G92, G74, G75;
Single fixed cycle：G90, G94; (can be in the same block with G41/G42) ;
Compound cycle：G71, G72; (can be in the same block with G41/G42) ;
M00, M02, M20, M30, M96, M97, M98, M99;
M21, M22, M23, M24;
M91, M92, M93, M94;
M47, M48;
M60～M74.

2) The system cannot judge them when some commands have mutually contradictory operations and the same data. To avoid the above, M, G commands which cannot be in the same block are divided into many groups and the commands in the different group can be in the same block as follows:

M commands which can be in the same block are divided into many groups as follows:

Group 1：M03, M04, M05;
Group 2：M08, M09;
Group 3：M10, M11, M12;
Group 4：M78, M79, M80;
Group 5：M32, M33;
Group 6：M41, M42, M43, M44.

G commands which can be in the same block are divided into many groups as follows:

Group 1：G00, G01, G02, G03, G05; (G02, G03, G05 cannot be in the same block with T command)
Group 2：G40, G41, G42; (they cannot be in the same block with T command)
Group 3：G96, G97;
Group 4：G98, G99.

【Note】

1) The commands which can be in the alone block cannot be in the same block with other commands, otherwise, the system alarms “E205: there are not compatible commands”, and they do not meet the rules for the commands in the same block;
2) The commands in the same group cannot be in the same block, otherwise, the system alarms “E205: there are not compatible commands”;
3) T command cannot be in the same block with G02, G03, G05, G40, G41, G42, otherwise, the system alarms “E205: there are not compatible commands”; and they do not meet the rules for the commands in the same block;
4) T command automatically calls M60 when the tool type is 9, so, T command is only in the alone block, otherwise, the system alarms.

5) G41, G42 can be in the same block with G90, G94, G71, G72; the detailed is referred to Programming Chapter 5 Tool Nose Radius Compensation.

7.3 Command Execution Sequence

【Relative parameters】

P401 efficiency setting (3-level)

P401_d3： execution sequence of many commands in the same block: 0-sublevel 1-synchronism

P401_d2：0-close 1-open rapid skip execution function:

◆ substep execution for many commands in the same block

P401_d3=0，sublevel; at the moment, **P401_d2** is not active.

When many commands in the same block are executed, their execution sequences are as follows: after one functional command is executed, the system executes the next one till all are performed.

Table 7-1：Command execution sequence table

Command execution sequence(from top to down)	Function
M32	Cooling ON
M10	Chuck clamping
M78	Tailstock going forward
M41, M42, M43, M44	Spindle gear shifting 1st, 2nd, 3rd, 4th gear
S function	Spindle gear shifting or rotating speed
M03, M04	Spindle ON
M08	Cooling ON
G98/G99 F function	
G96/G97 S function	
T function	Tool change
G40/G41/G42	
G00/G01/G02/G03/G05	Motion command
M05	Spindle OFF
M09	Cooling OFF
M33	Lubricating OFF
M79	Tailstock going backward
M11	Releasing workpiece
M12	
M80	

【Example】

N1000 T11 M03 M10 G00 X50 M08

Sublevel execution sequence: M10, M03, M08, T11, G00 ;

All used time for executing the whole block is equal to the sum of single command execution time.

◆ Synchronous execution for many commands in the same block

P401_d3=1，synchronism; **P401_d2**=0: forbid rapidly jumping block to execution

In the synchronous execution, M, S, T before the motion command must be executed with the motion command, M command after the motion command cannot be executed till the motion command is executed, and the system executes the next block after all are executed.

The commands which are not relative each other are almost executed simultaneously, are not executed orderly. The system automatically orderly executes M command which is interlock according to the parameters.

【Example】

N1000 T11 M03 M10 G00 X50 M08

When the parameter is set to firstly and then start the spindle(**P402_d5**=0), the system follows the interlock relationship and its execution process is as follows:

1) Simultaneously start executing T11/ G00 X50/M10/M08;

2) Execute M03 after M10 is executed;

3) Execute the next block after all are executed.

When the parameter is set to the spindle without firstly be clamped, the execution process is as follows:

1) Simultaneously start executing T11/ G00/M10/M08/ M03;

2) Execute the next block after all are executed.

All used time for executing the whole block is equal to the longest single execution time.

◆ Synchronous execution for many commands in the same block and rapidly jumping block to execution

P401_d3=1，synchronism; **P401_d2**=1，rapidly jumping block to execution

In the mode, the system rapidly skips to the next block after the axis motion commands of the current block are (do not wait other M, S, T having been executed).

【Note】

1) The system follows the rule: wait the others to be executed when other commands in the same group are executed.

2) The system meets “The command only in an alone block” , it waits to execute it after the previous is executed; and it executes the next block after “The command only in an alone block” is executed.

3) When the user needs to execute the next after the previous all commands are executed, he needs to insert one G04 D0 command.

4) When rapid block skip is executed, please pay attention to the distance between tool changing point and workpiece in case of workpiece crash.

7.4 Programming Example

The following programming example uses the tool as Fig. 7-1:

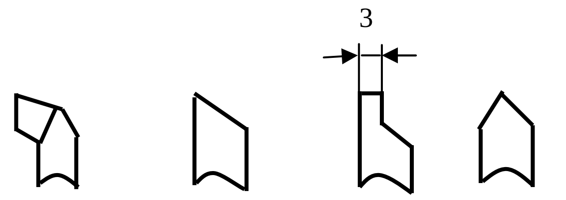


Fig. 7-1 Programming example tool shape

7.4.1 Outer machining example

Example 1：workpiece in Fig. 7-2. Rod: Φ64×105 mm. No. 1 tool is used for roughing, No. 2 for finishing.(G90 inner/outer cylindrical surface turning cycle) .

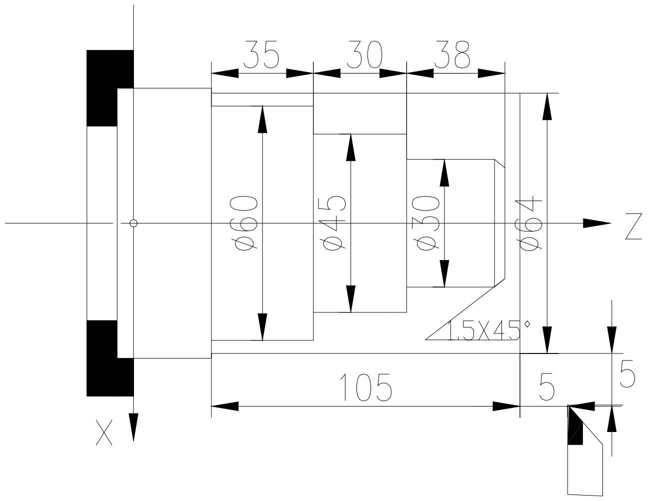


Fig. 7-2 outer machining example

N0000 G00 X100 Z150	;	set a the workpiece coordinate system
N0010 M3 S1	;	start the spindle and set to the spindle speed gear 1
N0020 M8	;	cooling ON
N0030 T11	;	execute NO.1 tool change and execute its compensation
N0040 G00 Z103 X65	;	tool rapidly approaches the workpiece
N0050 G01 X0 F60	;	cut the end face with 60mm/min
N0060 G00 Z105	;	tool leaves the end face of workpiece
N0070 X60.5	;	position the tool with the allowance 0.5mm
N0080 G01 Z0 F60	;	turn outer Φ60.5
N0090 G00 X62	;	tool leaves the surface of workpiece
N0100 Z105	;	tool rapidly traverses to the workpiece
N0110 X60.5	;	
N0120 G90 X56.5 Z35 F100	;	turn Φ45mm with cylindrical surface cycle command
N0130 X52.5	;	tool infeed 4mm and cycle again
N0140 X48.5	;	tool infeed 4mm and cycle again

```
N0150  X45.5                  ;  tool infeed 3mm and cycle again
N0155  G00  X45.5             ;  X rapidly traverses the starting point of next cycle
N0160  G90  X40.5  Z65        ;  turn Φ30mm with cylindrical surface cycle command
N0170  X35.5                  ;  tool infeed 5mm and cycle again
N0180  X30.5                  ;  tool infeed 5mm and cycle again
N0190  G00  X100  Z150        ;  retract tool to safety position
N0200  T22                    ;  execute No.2 tool change
N0210  S2                     ;  set to the spindle high speed
N0220  G00  Z103              ;  tool approaches the workpiece
N0230  X32                    ;
N0240  G01  X27               ;  tool infeed to starting point of chamfer
N0250  X30  Z101.5  F60       ;  finish chamfer 1.5mm
N0260  Z65                    ;  finish outer 30mm
N0270  X45                    ;
N0280  Z35                    ;  finish outer Φ45mm
N0290  X60                    ;
N0300  Z0                     ;  finish outer Φ60mm
N0310  G00  X100  Z150        ;  tool returns the origin point
N0320  M5                     ;  close the spindle
N0330  M9                     ;  cooling OFF
N0340  M2                     ;  end of program
```

7.4.2 Thread machining example

Example 2： as Fig. 34. Rod: Φ30×100 mm, No. 1 is roughing tool, No. 3 is parting tool, No. 4 for 60° threading tool. .

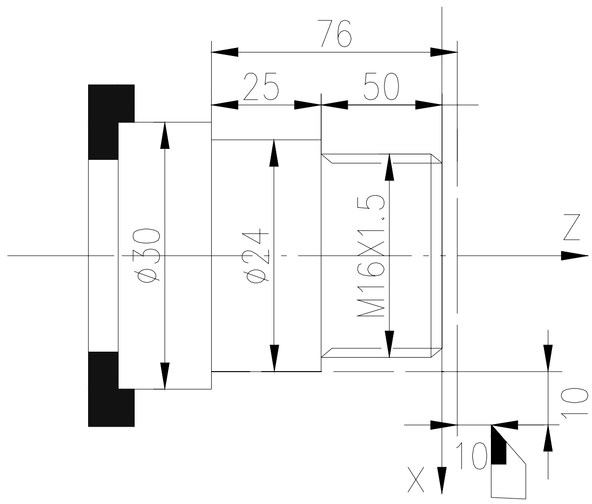


Fig. 7-3 thread machining example

```
N0000  G00  X50  Z11          ;  set a workpiece coordinate system
N0010  M3  S2                 ;  start the spindle, set the spindle speed to No.2 gear
N0020  M8                     ;  cooling ON
N0030  T11                    ;  execute No. 1 tool change and execute its tool
                                 compensation
N0040  G00  Z0  X35           ;  tool approaches the workpiece
N0050  G01  X0  F60           ;  cut the end face with 60mm/min
```

```
N0060   G00   W2                    ;   tool leaves the end face of workpiece
N0070   X24                         ;   tool approaches the workpiece
N0080   G01   Z-78   F60            ;   turn outer Φ24 and reserve the cut width
N0090   G00   X26                   ;   tool leaves the workpiece surface
N0100   Z0                          ;   tool approaches the workpiece
N0110   X24                         ;
N0120   G90   X21   Z-50   F100     ;   turn outer Φ16mm with cylindrical surface cycle
                                        command
N0130   X18                         ;   tool infeed 3mm and cycle again
N0140   X15.9                       ;   tool infeed 2.1mm and cycle again, outer is less than
                                        0.1mm
N0150   G01   X14   Z0              ;   tool positions to the starting point of chamfer
N0160   X16   W-1                   ;   cut a chamfer
N0170   G00   X50   Z50             ;   retract the tool to safety position
N0180   T44                         ;   change No.4 thread tool
N0190   S2                          ;   set the spindle to high speed(the speed is not more
                                        than 800n/min)
N0200   G00   X19   Z2              ;   position to the thread starting point of the first tool
N0220   G92   X15   Z-50   P1.5   K2 ;  machine the thread, length of run out of thread 2mm
N0230   X14.2                       ;   tool infeed 0.8mm to the 2nd thread machining
N0240   X13.8                       ;   tool infeed 0.4mm to the 3rd thread machining
N0250   X13.6                       ;   tool infeed 0.2mm to the 4th thread machining
N0260   G00   X60   Z50             ;   retract the tool to the safety position
N0270   T33                         ;   change No. 3 tool with its width 3mm
N0280   G00   X26   Z-78            ;   position to the cut point
N0290   G01   X0   F50              ;   cut
N0300   G26  X100   Z100            ;   X, Z returns to the starting point of machining
N0310   M9                          ;   cooling OFF
N0320   M5                          ;   close the spindle
N0330   M2                          ;   end of program
```

Example 3：Cut the multiple threads with M98, M99 subprogram call and its return instruction. Fig. 7-4a: metric multiple thread. Fig. 7-4b: inch multiple thread. Example: the thread heads is 3 as follows:

a(Metric multiple threads) ：

```
N0010   G00   X100   Z50            ; set a workpiece coordinate system
N0020   M03   S600                  ; Spindle rotates (CW) with 600 r/min
N0030   T44                         ; change No. 4 tool and execute its offset
N0040   G00   X25   Z5              ; rapidly approach the workpiece
N0050   G92   X19.5   Z-30   P4.5  L3 ; execute No. 1 thread cycle，P= thread lead
N0060   X19                         ; tool infeed 0.5mm, execute the 2nd thread machining
N0070   X18.5                       ; tool feed 0.5mm, execute the 3rd thread machining
N0080   X18.35                      ; tool feed 0.15mm and execute the 4th thread machining
N0090   G00   X100   Z50            ; rapidly return to program origin
N0100   M05                         ; stop the spindle
N0110   M02                         ; end of program
```

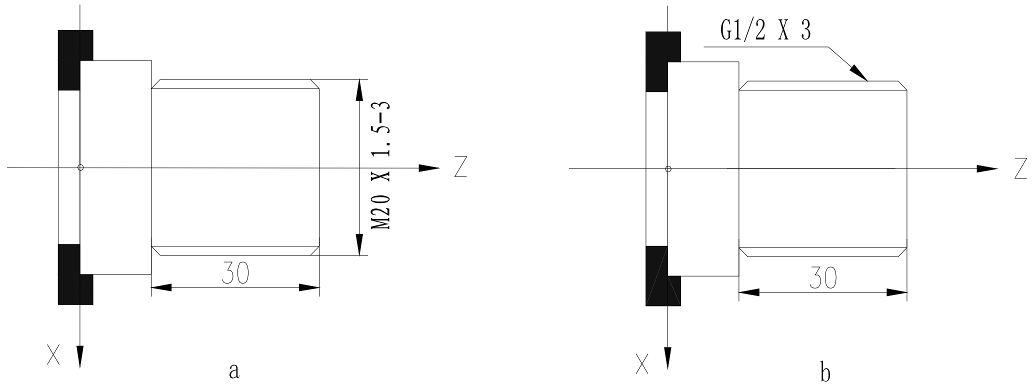


Fig. 7-4 multi-head thread cutting example

b(Inch multiple threads) ：

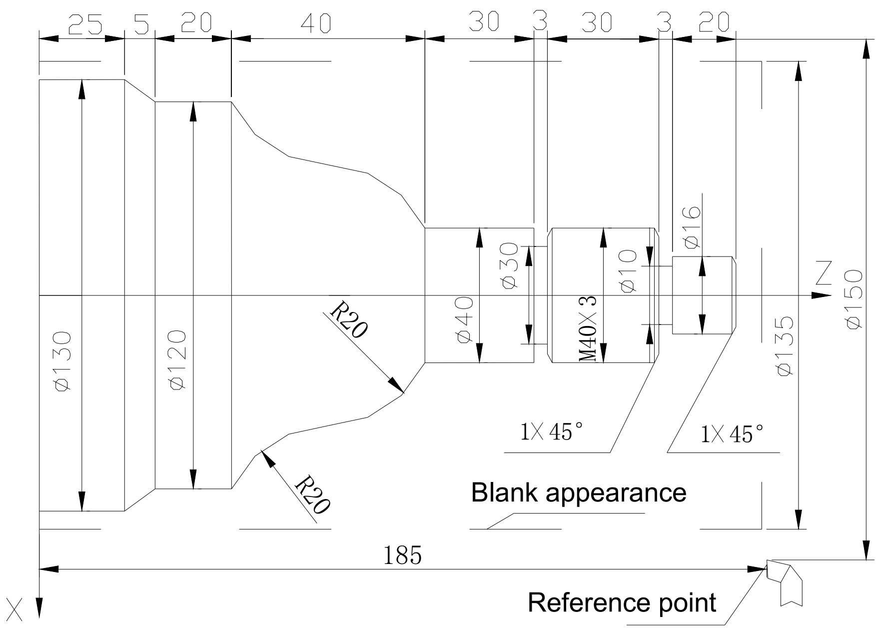
```
N0010  G00  X100  Z50                 ; set a workpiece coordinate system
N0020  M03  S600                      ; spindle rotates(CW) with 600n/min
N0030  T44                            ; change No. 4 tool and execute its offset
N0040  G00  X25  Z5                   ; rapid approach the workpiece
N0050  G92  X19.5  Z-30  E4.667  L3   ; execute the 1st thread cycle
N0060  X19                            ; tool infeed 0.5mm, execute the 2nd thread machining
N0070  X18.5                          ; tool infeed 0.5mm, execute the 3rd thread machining
N0080  X18.35                         ; tool infeed 0.15mm, execute the 4th thread machining
N0090  G00  X100  Z50                 ; rapidly return to program reference point
N0100  M05                            ; stop the spindle
N0110  M02                            ; end of program
```

7.4.3 Compound machining example

Example 4：Compound machining as Fig. 7-5(G71, G92).

Rod Φ135×178 mm . use 4 tools:

No. 1 is outer roughing tool; No.2 is outer finishing tool; No.3 for grooving with 3mm width; No.4 is 60° threading tool. The machining allowance in finish machining is defined by the offset parameter T8.



Fi.g 7-5 machining example

```
N0000  G00  X150  Z250               ; set a workpiece coordinate system
N0010  M3  S01                       ; start the spindle and set its speed to gear 1
N0020  M8                            ; cooling ON
N0030  T08                           ; execute the tool compensation with machining allowance
N0040  G00  X136  Z180               ; approach the workpiece
N0050  G71  X0  I4  K2.5  L10  F80 ; outer compound cycle
N0060  G01  W-4                      ; approach the face of workpiece
N0070  X16                           ; turn the end face
N0080  W-23                          ; turn outer Φ16
N0090  X40                           ; turn the end face
N0100  W-63                          ; turn outer Φ40
N0110  G02  X80  W-20  R20           ; turn convex arc
N0120  G03  X120  W-20  R20          ; turn concave arc
N0130  G01  W-20                     ; turn outer Φ120
N0140  G01  X130  W-5                ; turn taper
N0150  G01  W-25                     ; turn outer Φ130
N0155  G00  X150                     ;
N0160  G26  X136  Z180               ; return to the starting point after roughing
N0180  T22                           ; change No. 2 tool to finish the outer
N0190  S02                           ; set to the spindle to high speed
N0200  G00  X0  Z178                 ; rapidly approach the workpiece
N0210  G01  Z176  F50                ; approach the end face of workpiece
N0220  G01  X14                      ; turn the end face to the chamfer
N0230  X16  W-1                      ; chamfer 1×45°
N0240  W-22                          ; finish outer Φ16
N0250  X37                           ; finish the end face Φ40
N0260  X40  W-1.5                    ; chamfer 1×45°
N0270  W-61.5                        ; finish outer Φ40
N0280  G02  X80  W-20  I0  K-20      ; finish convex circle
N0290  G03  X120  W-20  I40  K0      ; finish concave circle
N0300  G01  W-20                     ; turn outer Φ120
N0310  X130  W-5                     ; turn taper
N0320  W-25                          ; finish outer Φ130
N0325  G00  X150                     ; X rapidly retracts the tool
N0330  G26  X136  Z180               ; return to the starting point of machining
N0340  T33                           ; change No. 3 tool to groove
N0350  G00  X42  Z120                ; approach the workpiece
N0360  G01  X30  F50                 ; groove Φ30
N0370  G01  X40                      ; retract the tool
N0380  G01  Z121.5                   ; position to the starting point of chamfer
N0390  X37  Z121.5                   ; chamfer 1×45°
N0400  X41                           ; retract the tool
N0410  G00  Z153                     ; rapidly traverse
N0414  G01  X20  F200                ; approach the workpiece
N0418  X10  F50                      ; groove Φ10
N0420  G00  X100                     ; X rapidly retracts the tool
N0425  G26  X136  Z180               ; return to the starting point of machining
N0430  T44  S01                      ; change No. 4 tool to cut the thread and set to the spindle
```

low speed

```
N0440   G00   X42   Z155              ; approach the workpiece
N0460   G92   X39   W-34   P3         ; execute the thread machining cycle
N0470   X38.2                         ; feed 0.8 and execute the 2nd tool machining
N0480   X37.7                         ; feed 0.5 and execute the 3rd tool machining
N0485   G00   X100                    ; X rapidly retracts the tool
N0490   G26  X136   Z180              ; return to the starting point of machining
N0500   T11                           ; change No. 1 tool
N0510   M05                           ; close the spindle
N0520   M09                           ; cooling OFF
N0530   M02                           ; end of program
```

Example 5：Fig. 7-6. Rod: Φ50×100. Machining with 3 tools：No.1: outer turning tool; No.2: pointed tool; No.3: grooving tool with 3mm width.

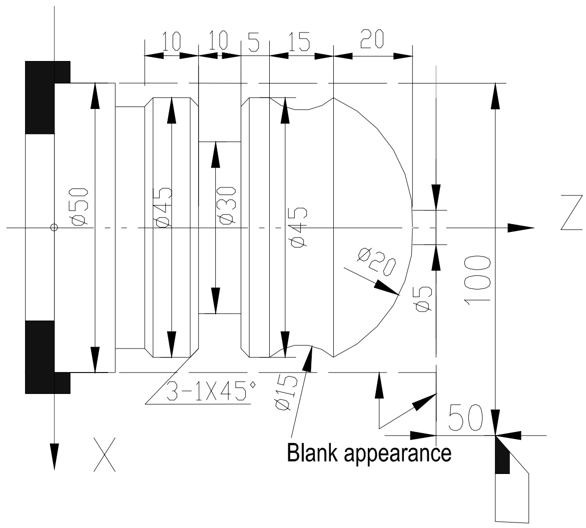


Fig. 7-6 machining example

```
N0010 G00 X100 Z50                     ; set a workpiece coordinate system
N0020 M3 S600                          ; spindle rotates(CW) with 600 rev/min
N0030 T11                              ; change No.1 tool and execute its offset
N0040 M 8                              ; cooling ON
N0050 G00 X50 Z3                       ; approach the workpiece
N0060 G71 X0 I3 K2   P0070   Q0100   F50; execute the outer compound cycle
N0070 G01 Z0                           ; approach the workpiece
N0080 X5                               ; turn the end face
N0090 G02 X45 Z-20 R20                 ; turn the arc R20
N0100 G01 Z-65                         ; turn the outer Φ45
N0110 G00 X50                          ; rapidly traverse to X50 safety position
N0111 G26 X100   Z50                   ; rapidly return to reference point (program starting
                                         point X100 Z50)
N0120 T22                              ; change No. 2 and execute its offset
N0130 G00 X51 Z-20                     ; rapidly traverse
N0140 M98 P0160 L3                     ; call subprogram
N0150 M97 P0200                        ; program skips to N0200
N0160 G01 U-2 F40                      ; X feeds 2，approaches to workpiece
```

```
N0170 G02 U0 W-15 R7.5 F35          ; Turn R7.5 arc
N0180 G01 W15 F500                  ; Return to arc starting point
N0190 M99                           ; End of subprogram
N0200 G26   X100                    ; X rapidly returns to program reference point(i.e. X100)
N0210 G26   Z50                     ; Z rapidly returns to program reference point(i.e. Z50)
N0220 T33                           ; Use No. 3 grooving tool and execute its tool offset
N0230 G00 X50 Z-43                  ; Rapidly position to cycle starting point(tool width 3mm)
N0240 G75 X30 Z-50 I5 K2 E3 F50     ; Execute the grooving cycle command
N0250 G01 X45 Z-42 F50              ; Chamfer
N0260 X43 Z-43                      ;Chamfer
N0270 X30                           ; Move to X30 outer to execute finishing
N0280 Z-50                          ; Turn Φ30 outer
N0290 G00 X45                       ; Position to the chamfer position
N0300 G01 Z-51   F50
N0310 X43 Z-50                      ; Chamfer
N0320 G00 X46                       ; Position the cut-down point
N0330 Z-62
N0340 G01 X42 Z-63 F50              ; Chamfer
N0350 X0
N0360 G26   X100                    ; Return to X reference point
N0370 G26   Z50                     ; Return to Z reference point
N0380 T10                           ; Use the reference tool T10
N0390 M5                            ; Spindle OFF
N0400 M9                            ; Cooling OFF
N0400 M2                            ; End of program
```

Chapter 8 Alarm Message

All the warning information in this CNC system are simply prompted in the screen by Chinese characters, making corresponding disposal according to the prompting content. Each alarm meaning is shown in the following table. “Workpiece program” is also named as “machining program” in the following table.

The alarm number starts by uppercase letter E and the following is three numbers. The classification is as follows:

E001~E009: Alarm in PARAMETER, OFFSET working mode;

E100~ E199：Alarm in EDIT working mode;

E200~ E299：Alarm in PROGRAM COMMAND;

E600~ E699：Alarm in PROGRAM CHECK;

E300~ E399：Alarm in JOG, AUTO working mode executing relative operation;

E400~ E499：Related Alarm in JOG, AUTO working mode executing relative statement.

8.1 Emergency Alarm

The stop operation in system emergency, please refer the details in **OPERATION, 4.1.4.3 Emergency Alarm**.

8.2 Alarm Table in PARAMETER, OFFSET Working Mode(**i.e.** E001~E009)

Alarm No.	Alarm prompt	Alarm reason	Troubleshooting
E001	Not support USB	USB device isn’t supported by this system software	Use USB device supported by the system
E002	Remove USB suddenly	Device is removed suddenly in making USB device check	Wrong operation, forbid this operation
E003	No insert USB	Don’t insert USB device	Insert USB device
E004	Fail to find valid content or file	USB device doesn’t create the specified catalogue and file	Create the valid catalogue and file in USB device
E005	USB save file fail	USB saving failure	Save again or check USB device
E006	No enough memory in USB	No enough U disc rest room	Change the bigger U disc or check U disc to release more space
E007	Create content fail	U disc failure in creating the specified catalogue	Check USB device and create the appointed catalogue again
E008	Create file fail	Failure in creating file	Check USB device or create the specified format file again
E009	USB read file fail	USB is failed in reading file	Check the USB device or read file again
E010	Fail to find dedicated content or file	USB is failed in reading catalogue list	Check the USB device or create this catalogue again
E011	File is too big	Too large file	File is too large, modify the file
E012	Fail to open file	Can’t open the file in specified catalogue or file is destroyed	Check the file name ,suffix if they can match the rule or check the USB equipment, create the file again
E013	No dedicated file	The file in specified list does not exist or has been destroyed	Create the file in specified file
E014	Invalid Para NO	Parameter number exceeds the allowed range	Change the parameter number into the available parameter number range
E015	Para NO not standard	Invalid character in parameter number, does not meet the standard	Delete the invalid character in the parameter number

Alarm No.	Alarm prompt	Alarm reason	Troubleshooting
E016	Specify Para NO before data	Must have parameter number in the first parameter	Add the parameter number of the first parameter
E017	Error in Para data	Parameter data exceeds the system specified range	Modify the parameter data
E018	Repeatedly input Para NO	Parameter number can't be input repeatedly	Check and delete the repeat parameter number
E019	Invalid characters in the data	Can't have illegal character in file	Delete the illegal character
E020	Wrong Para file formula	Parameter file format can't meet the requirement	Create the parameter file according to the parameter file format or add the parameter file sign
E021	S-upgrade code proof error	Software promoting command checking error	Contact the supplier
E022	Stop communication	Delete manual, stop transmission, RS232 communication is failed in sending and receiving	Check the command control unit serial software tool or hardware connection
E023	Illegal I/O port set pin NO out of range	Interface parameter setting exceeds the maximal I/O pin number	Modify the I/O to the specified range
E024	Illegal I/O port set input pin NO which used	Parameter setting and I/O input pin collision	Release this I/O or use other I/O pin
E025	Illegal I/O port set output pin NO which used (33)	Parameter setting and I/O input pin collision	Release this I/O or use other I/O pin
E027 ~ E029	Z/X/Y thread invalid	Z/X/Y axis pitch setting value is wrong, doesn't meet the standard	Check the pitch compensation position and modify
E030	Fail to read Para, initialization	Failure in SRAM saving parameter, can't read	Save again
E031	Illegal character OFT.	Illegal character in offset number of tool compensation transmission file	Delete the illegal character
E032	Tool compensation NO not standard	There is no tool compensation number behind the T of tool compensation transmission file, or the offset number lack T sign	Completing the number behind the T sign in file, or add the sign of offset number
E034	OFT. NO exceed 1—64	The tool offset number in tool compensation transmission file exceeds (1~64) range	Modify or delete the exceeded tool compensation number, change them to the specified range
E035	Illegal data	Tool compensation data in tool compensation transmission file has illegal character in	Delete the illegal character
E036	Input data error	The tool compensation input data in tool compensation transmission file has mistake	Check data according the tool compensation communication file format and correct it
E037	File symbol error	File type mark in tool compensation transition file is wrong	Modify the file type according to the tool compensation file format
E038	Send OFT fail	sending tool compensation file failure or be manually cancelled	Sending tool compensation file according to the correct tool compensation file format and operation method
E039	Receive OFT fail	Fail in receiving tool compensation file or delete manual	Receive the tool compensation file according the correct tool compensation file format and operation mode
E040	File is too big	The length of received file is out of the maximal length of buffer zone	Modify the file according the file format, correct the received file according the requirement

Alarm No.	Alarm prompt	Alarm reason	Troubleshooting
E041 ~ E043	Z/X/Y pitch compensation value out of range	Known from system internal arithmetic, in the 0.254mm length of Z/X/Y axis, the calculated departure value is out of 7um	Change the pitch compensation value of pitch compensation parameter to small
E044 ~ E046	Ratio of magnify & coefficient exceed (1/128-128)	Ratio between multiplication and division is out of (1/128～128) range	Modify parameter: multiplication or division
E047	Para set conflict, input port was used	The corresponding pin in function is occupied	Release the occupied input pin in interface parameter, or set other free input pin
E048	Para set conflict, output port was used (33)	The corresponding pin in inputting function is occupied	Release the occupied output pin in interface parameter, or set other free output pin
E049	Abnormal, ESC	In reading the USB process, it is disordered	Operate the USB device over again
E050	Not support USB file formula	The system only reads FAT16 or FAT32 file format	Check or change USB device
E051	USB memory is too big	The system only supports the maximal 8G USB device	Change the USB device
E053	USB fails to transmit, reset	Failure in USB data transmission process	Press system reset key and try again, or operate the USB device again

8.3 General Chart of Alarm in Working Mode(**i.e.** E100~ E199**)**

Alarm No.	Alarm prompt	Alarm reason	Troubleshooting
E100	Program which will delete doesn't exist	The program list hasn't the program to be deleted	wrong operation
E101	Block is too long in received program	There are blocks exceeded the length in the program of system sent	Modify the program to be sent
E102	Program which will send doesn't exist	The program catalogue hasn't the program to be sent	Rebuilt the program to be sent
E103	No specified program	Don't choose program in program catalogue	Choose the needed program in program catalogue
E110	RS232-fail to send program	RS232- failure in communication sending	Check the command control unit serial system tool or hardware interface
E111	Received program NO is wrong	The program number range doesn't in (0~254)	Check the receiving program's number
E112	Received program is void	No content in program	Check and modify the program
E113	RS232-fail to receive program	RS232- failure in communication receiving	Check the command control unit serial system tool or hardware interface
E120	Not support USB	The system can't identify this USB device	Use the USD equipment which can be identified by the system
E121	USB is removed	The system is identifying the USB equipment, the equipment is moved suddenly	wrong operation, forbidden these operation
E122	Not insert USB	Don't insert the USB equipment	Insert the USB device
E123	Stop opening USB	Manual operation, press emergency or reset key	Manual operation, stop to open the USB device
E124	Fail to save program in USB	The USB is failed in saving program	Check the USB device
E126	Surplus space in USB is not enough	The U disc doesn't have enough rest room	Change the bigger U disc or tidy U disc to release more room

Alarm No.	Alarm prompt	Alarm reason	Troubleshooting
E127	Contents fail	The U disc creates specified catalogue failure	Check the USB device
E128	Fail to set specified content	The program in specified catalogue can't be opened	Check the USB device or the program is destroyed and must to be created over again
E129	Fail to set program	The U disc is failed in creating program	Check the USB device
E130	Stop sending program	Manual operation, press emergency or reset key	Manual operation, exit the sending
E131	No specified content in USB: C928PRO	The USB device doesn't have the specified catalogue: C928PRO	Create this catalogue
E132	USB fails to transmit & to send now	The USB device communication error	Press reset key and then insert the USB device again
E133	Stop receiving files	Manual operation, press emergency or reset key	Manual operation, exit the receiving
E134	Fail to read program in USB	The USB is failed in reading program	Check the USB device or create this program
E136	Program is too big	The communication program capacity is too large	The program is too large, modify the program
E137	Fail to open program	Can't open program, maybe it's destroyed	Check the USB device or create this program
E142	Program is too long, delete extra part	Program error	Check the program error again
E143	Program is too long, delete it	Program error	Check the program error again
E144	Current program is void, so can't rename	The current program is empty and can't change the name	Edit the program first
E145	USB-program to receive doesn't exist	The USB receiving program does not exist	No this program in the USB equipment, create this program again
E147	Not support file system in USB, use FAT32	The U disc isn't FAT16 or FAT32 file system	Suggest using FAT32 file system
E160	Program NO is wrong	Only (000～254) program can be input	Modify the input program number
E161	Copied program exist	The program to be copied has existed	The program has existed, this operation can't go on
E162	Program is void & can't copy	The current program is empty and can't be copied	Edit the program first
E163	Editing 253 program exceed memory	The 4M program editing storage room is full	Can't go on the next edit, except the editing program can release some storage room
E164	Exceed program memory, fail to save	Power-off protection program storage area is full and can't protect any more	Delete some programs in system
E165	No deleting all programs	The system parameter enactment can't delete all program	Modify the enactment parameter according to the privilege
E166	Renamed program exist	The program to be changed the name has been existed, can't change the name	Please delete the old program firstly
E167	Fail to erase FLASH	System hardware: storage CMOS chip has problem	Contact the supplier, change the storage CMOS chip
E168	Fail to write FLASH	System hardware: storage CMOS chip has problem	Contact the supplier, change the storage CMOS chip
E169	Editing program exceeds memory	The storage room of 800k program editing area is full	Can't go on the next edit, except the editing program can release some storage room
E171	No command in help	Command input error, or don't support this command	Check the command to be looking for, input the correct command

Alarm No.	Alarm prompt	Alarm reason	Troubleshooting
			again
E172	Program line too long	Edit and replace error	Check the replacing content again
E173	Replace failed, no content replace	Edit and replace error	Check the replacing content again
E174	Processing program locked, no rewriting	Set the bit parameter P416_d0 to be 1	Set the bit parameter P416_d0 to be 0
E175	Para set no line number, no arrange again	Set the P333 to be 0, the system compositor again function is invalid	Set the P333 to be non zero value again

8.4 Emergency Alarm Program Alarm Table (i.e.E200~ E299, E600~ E699)

The type of alarm in program is divided to: Alarm in PROGRAM COMMAND, Alarm in PROGRAM CHECK two kinds.

8.4.1 Alarm in program command (i.e. E200~299)

Alarm in program command, means there is wrong command in working program and then alarm, it can be eliminated by inputting the correct command, and it has little relation to the parameter.

Alarm List in programming command

Alarm No.	Alarm prompt	Alarm reason	Troubleshooting
E201	Illegal command	The system undefined command appears in block	Input again according system command list
E202	Command repeat	The same command is input repeatedly in the program	Delete the repeated command
E203	Illegal information	The system unidentified command appears in block	Delete the wrong command, Input the correct command
E204	Command format wrong	The command format is wrong in the block	Input again according the correct command format
E205	Command isn't compatible	Two or more commands incompatibility appear in the same block	Delete the unwanted command or line input
E206	Lack of information	Missed the command needed content in the block	Input the command needed content according the correct format
E207	Tool tip radius too much	tool nose radius is too big or path is too short, can't make the tool nose radius compensation	Modify program or tool nose radius(happen in running)
E208	Brackets is miss	Without brackets in the statement	Brackets are added to the source program
E209	Too many commands & characters	The command character in same block is over 20	Modify source program, or line input
E210	Surplus characters	Unwanted field is input in the block	Delete the unwanted field in the block
E211	Data exceeding range	The value in the block is over the specified range	Modify the is wrong data again
E212	Errors in data	The data don't meet the standard	Modify the is wrong data again
E213	Single block is too long	The whole line number of part program is over the range	Modify the workpiece program
E214	Use command independently	some commands are in an alone block without others	Modify the source program
E215	Lack of line number	The specified program line number of command G71, G72, M96, M97, M98 doesn't exist in this program i.e. the system has not found the line number for the call or the transfer	Modify the source program, input the correct block line number

Alarm No.	Alarm prompt	Alarm reason	Troubleshooting
E216	Line number repeat	Repeated program line number in program makes the block G71/G72/M96/M97/M98 not be identified i.e. the program has more than two call or transfer needed line number	There is repeated program line number in modifying program
E217	Program stock data has err	System EMS memory error or program error	Need the professional to check the system all sided
E218	Errors in variable NO	The variable number exceeds the set range	Using the usable variable number
E219	Edit area is unusable	System battery is shortage	Need to clear out program, Edit the program again
E220	Sentences calculate, divisor is 0	In the statement operation, the divisor is zero	Modify the divisor in macro command, not to be zero
E221	Not assign a value to variable	Input interface variable is read only, can't evaluate it i.e. input	Modify source program
E222	Program executes, information lost	The data has problem in program translate and edit process	Power on again
E224	Buffer area file too big	The editing single program is too big	Modify source program
E225	Orbit data can't compensate	Edit error, can't make the tool nose radius compensation	Modify source program
E226	Coordinate fields repeat	Coordinate field repeat	Delete one field of them
E227	Data format wrong	Data format error (such as: F1r1, G1r, M1r, T2r), or commands like G1r, M1r, T2r are used.	Modify source program
E228	Program hasn't end command	The program don't have the ending command M02 or M20 or M30	Modify source program, add the ending command
E232	Errors in command data after G92	The followed command data don't meet the format	Modify source program
E233	No user-defined command	At first make program for the needed user-defined command M60, then harden it	Write M60 program, then harden it
E234	Data field repeat	The same field in block is input repeatedly	Delete the repeat data field
E235	G71/G72 not inc & dec relations	The coordinate data in block which is followed command G71/G72 doesn't meet the condition of increase or decrease by degrees	Modify source program
E236	Forbid com exist G71/G72 (forbid commands exist in G71/G72)	The block followed G71/G72 command doesn't include the motion command beside G01/G02/G03	Modify source program
E237	Chord is longer than diameter	Arc uses R program, the distance from starting point to end point is longer than diameter	Modify source program
E238	Dis (cen to 2 points) not equal (distances from center to 2 points aren't equal)	When the arc command G02 and G03 use K.I program, the data can't form the correct arc section	Modify source program
E239	G05 data cannot form arc	The data by G05 can't form the correct arc section	Modify source program
E240	Too many program nested calling layers	Excessive nested call in the program	Modify source program
E241	#254 not use traverse com	254 program has used motion command	Modify command or system parameter
E243	Too many data after	The data behind the decimal point	At most three data is behind

Alarm No.	Alarm prompt	Alarm reason	Troubleshooting
	decimal	exceeds the limited range	the decimal point
E244	Too many decimal in data	Wrong data is input i.e. 0.343.44	Modify data
E245	Lack of data after decimal	The decimal point is input, but no data followed	Delete the decimal point
E246	Not input nega (negative) NO in the field	The negative is used in this field	Check the notebook, modify the data
E247	Too much leading zero	The data like 000033 is used	Omit the needless zero in the front
E248	Not cancel tool radius compensation	Don't cancel the tool nose radius compensation function before using compound command	The cancel command G40 is added in the proper place
E249	No change in tip radius compensation	In the state of tool nose radius compensation, there is operation of changing tool	Delete the radius compensation, then change the tool
E250	G00/G01 cancel radius compensation	The command beside G00/G01 is used to delete the tool nose radius compensation	Modify source command
E251	G00/G01 sets radius compensation	The command beside G00/G01 is used to create the tool nose radius compensation	Modify source command
E252	No replacing variable in M command	Commands such as M81 Ir1 are used.	Modify source command
E253	No orbit com (command) in G71/G72 cycle	The command which can produce the comparatively moving coordinate is lacked in cycle	Check the block P, Q in G71, G72 are correct or not
E254	Forbidden M3/M4 com in M47	The M3/M4 command is used in M47 state	Using the command after change the state
E255	Spindle allows to use M47	The spindle don't stop	Stop the spindle
E256	Lack of module G command	When compound command is consecutively cancelled, the G command is not used	G command is added
E257	No using the type of variable	In the special situation, this kind of variable is used in illegal	Modify source command
E258	Beveling data is too big	So large chamfer data can't be carried in this path	Reduce the chamfer data
E259	Editing is cut off	Reset key is pressed in program	
E260	No Y axis traverse in M48	When the Y axis has exchanged the spindle, the moving command can't be used in Y axis	Modify the program according to the real situation
E261	Drawing is cut off	The reset key is stopped in the drawing demonstration	
E262	No chamfering to full circle	Whole circle is used in chamfer	Divide into two semi-circles
E263	Use pointer variable wrongly	The pointer variable has special explanation, it must be used carefully	Modify program
E264	Arc radius is too big	The arc radius by I/K program is over the range	Modify program
E265	No calling in monitor macro	Call command is used in process monitor r7000 ~r7009 commands	Using jumping P or other method to control
E266	Pointer variable points invalid NO	The pointer variable points to the forbidden variable	Check the program, then modify it
E267	no compensate (compensating) to full circle C	Tool nose radius compensation, the program path has the whole circle program	Divide into two semi-circles
E268	Traverse is 0, retract	When making the G90 and G94 command	Modify program

Alarm No.	Alarm prompt	Alarm reason	Troubleshooting
	too big (traverse amount is 0 or retraction is too big)	program, the starting point and end point don't meet the regulation	
E269	Traverse amount but no offset (amount)	When making the G74 and G75 command program, it doesn't meet the regulation	Modify program
E270	Orbit (amount) bigger than (stipulated) value	When making G71 and G72 command program, the path exceeds the specified data	Modify program
E271	Start & orbit points not meet (the requirements)	When making the G71 and G72 command program, it doesn't meet the regulation	Modify program
E272	S value can't be 0 in G50	Used the G50 command, it doesn't meet the program regulation	Modify the S value
E273	Macro value is negative	The variable value is negative, but the command need it be positive number	Modify program
E275	Center of cycle isn't in coordinate	When the arc interpolation uses R program, the circle center doesn't in the stated range	Modify program
E276	Roughing blocks exceed specified value	Not conforming to the programming regulation in compound command programming	Modify program
E278	Forbidden command in G73 canned cycle	Not conforming to the programming regulation in G73 command programming.	Modify program
E279	Nesting call in this command forbidden	Not conforming to the programming regulation in G73 command programming.	Modify program
E280	No relevant command in executed program	When executing G66/G67, G67 can be executed only after G66 is executed at least once; or G67 can be used when G66 is used at least once in programming,	Re-select program; or modify program
E281	R must be 0 when using precession function	Not conforming to the programming regulation When using precession function in G92 command	Modify program
E282	Calling command of this type not allowed in No. 254 program	Custom command forbids motion command codes. Not conforming to the programming regulation	Modify program or parameter
E283	Floating point not allowed in operation of this tyep	The floating point cannot be involved in the logic operation. Not conforming to the programming regulation	Modify program
E284	Data in G76 not meet requirements	Data in G76 does not conform to the programming regulation	Modify program

8.4.2 Alarm in program command (i.e. E600~699)

Alarm in program check, means in the workpiece program the explanation of the command which is collided with system parameter. When the workpiece program is treated isolated, there is no problem. It needs to analyze the program from the whole auxiliary parameter and the setting of interface parameter, then to modify the program and parameter setting to eliminate the alarm.

List of alarm in program check

Alarm No.	Alarm prompt	Alarm reason	Troubleshooting
E601	Illegal use Sxxxx：Sxxxx out of gear range	The Sxxxx command is over the parameter assured gear position range	Modify it to the gear position value in correct range or modify the P410 parameter

Alarm No.	Alarm prompt	Alarm reason	Troubleshooting
E602	Illegal use M21：No define M21 pin Para	The M21 interface parameter doesn't specify the exact chip pin	Set the interface parameter P500 is effective, or change the program command
E603	Illegal use M22：No define M22 pin Para	The M22 interface parameter doesn't specify the exact chip pin	Set the interface parameter P500 is effective, or change the program command
E604	Illegal use M23：No define M23 pin Para	The M23 interface parameter doesn't specify the exact chip pin	Set the interface parameter P501 is effective, or change the program command
E605	Illegal use M24：No define M24 pin Para	The M24 interface parameter doesn't specify the exact chip pin	Set the interface parameter P501 is effective, or change the program command
E606	Illegal use M91：No define M91 pin Para	The M91 interface parameter doesn't specify the exact chip pin	Set the interface parameter P517 is effective, or change the program command
E607	Illegal use M92：No define M92 pin Para	The M92 interface parameter doesn't specify the exact chip pin	Set the interface parameter P517 is effective, or change the program command
E608	Illegal use M93：No define M93 pin Para	The M93 interface parameter doesn't specify the exact chip pin	Set the interface parameter P518 is effective, or change the program command
E609	Illegal use M94：No define M94 pin Para	The M94 interface parameter doesn't specify the exact chip pin	Set the interface parameter P518 is effective, or change the program command
E610	Illegal use M78：Command invalid	The function of M78 is set to be invalid	Set the interface parameter P409_d4 is effective, or change the program command
E611	Illegal use M79：Command invalid	The function of M79 is set to be invalid	Set the interface parameter P409_d4 is effective, or change the program command
E612	Illegal use M41：Command invalid	The function of M41 is set to be invalid	Modify P410_d6=1(frequency conversion) or P410_d7=0(electrical level), or change the program command
E613	Illegal use M42：Command invalid	The function of M42 is set to be invalid	Modify P410_d6=1(frequency conversion) or P410_d7=0(electrical level), or change the program command
E614	Illegal use M43：Command invalid	The M43 function is set to be invalid	Modify P410_d6=1(frequency conversion) or P410_d7=0(electrical level), or change the program command
E615	Illegal use M44：Command invalid	The M44 function is set to be invalid	Modify P410_d6=1(frequency conversion) or P410_d7=0(electrical level), or change the program command
E616	Illegal use M32：Command invalid	The M32 function is not expanded to be effective	Set P506=1, or change the program command
E617	Illegal use M33：Command invalid	The M33 function is not expanded to be effective	Set P506=1, or change the program command
E618	Illegal use M10：Command invalid	The M10 function is set to be invalid	Modify P409_d7 to be effective , or change the program command
E619	Illegal use M11：Command invalid	The M10 function is set to be invalid	Modify P409_d7 to be effective , or change the program command
E620	Illegal use r10xx：No program pin	The input chip pin by variable is occupied by other function, or the parameter forbids to use the input chip pin statement program	Modify P412_d1 to be effective, or change the variable corresponding input chip pin or change the program command

Alarm No.	Alarm prompt	Alarm reason	Troubleshooting
E621	Illegal use r20xx：No program pin	The input chip pin by variable is occupied by other function, or the parameter forbids to use the output chip pin statement program , or used the user-defined changing tool method	Modify P412_d1 to be effective, or change the variable corresponding input chip pin or change the program command, or modify parameter P318=9
E622	No traverse command in M61 program	The parameter setting: the M61 program forbids the motion command	Change the position parameter P404_d2 to be allowed, or change the program to don't include motion command
E623	Illegal use M47	The switch setting in spindle and Y axis is not	Modify P404_d4=1, or change the program command
E624	Illegal use M48	The switch setting in spindle and Y axis is not	Modify P404_d4=1, or change the program command
E625	Illegal use M04	The spindle reversion signal is set to be without	Modify P404_d2=1, or change the program command
E628	Tool type is 9, T command need single block	When the tool post type is 9, the T command doesn't have separate section	Modify program
E629	Illegal use Y command	The control axis is set to be Y axis	Modify P405_d1=1, or change the program command
E630	Cut NO. exceed	In the program the tool number is over the setting range	Modify P319, or change the program command
E631	Illegal use G96	When the spindle S control is set to be gear shifting mode, the constant line speed cutting	Modify P410_d6=1, or change the program command
E632	No define G31I input interface, invalid	Don't set the G311 interface parameter, or the setting is wrong	Set the P532 to be effective, or change the program command
E637	Chuck control disabled, forbidden to call M12	It is forbidden to control the chuck due to parameter setting.	Modify **P409_d7** =0 to enable the chuck control, or modify program
E638	Tailstock control disabled, forbidden to call M80	It is forbidden to control the tailstock due to parameter setting.	Modify **P409_d4** =0 to enable the tailstock control, or modify program

8.5 Alarm Table in JOG OR AUTO Working Mode (i.e.E300~ E499)

The Alarm type in JOG and AUTO is divided to: Alarm in executing relative operation and The relative Alarm in executing statement two kinds

8.5.1 Alarm in Executing Relative Operations (i.e E300~E399)

Alarm No.	Alarm prompt	Alarm reason	Troubleshooting
E302	Z driver unit alarm	Z drive unit alarm	Check Z axis drive unit, resolve the failure to power-on again
E303	X driver unit alarm	X drive unit alarm	Check t X axis drive unit, resolve the failure to power-on again
E304	Y driver unit alarm	Y drive unit alarm	Check Y axis drive unit, resolve the failure to power-on again
E305	Positive hardware limit alarm	X or Z positive limit switch is closed	X or Z negatively moves in JOG working mode till the alarm is released
E306	Negative hardware limit alarm	X or Z negative limit switch is closed	X or Z positively moves in JOG working mode till the alarm is released
E307	Z machine (+) software limit alarm	Z machine coordinate(Zm) exceeds the positive software limit alarm value (P015)	X or Z positively moves in JOG working mode, or set the machine coordinate to zero again, release the alarm

Alarm No.	Alarm prompt	Alarm reason	Troubleshooting
E308	X machine (+) software limit alarm	X machine coordinate(Zm) exceeds the positive software limit alarm value\(P017)	X negatively moves in JOG working mode, or set the machine coordinate to zero again, release the alarm
E309	Y machine (+) software limit alarm	Y machine coordinate(Zm) exceeds the positive software limit alarm value(P019)	Y negatively moves in JOG working mode, or set the machine coordinate to zero again, release the alarm
E310	Z machine (-) software limit alarm	X machine coordinate(Zm) exceeds the negative software limit alarm value(P016)	Z positively moves in JOG working mode, or set the machine coordinate to zero again, release the alarm
E311	X machine (-) software limit alarm	X machine coordinate(Zm) exceeds the negative software limit alarm value(P018)	X positively moves in JOG working mode, or set the machine coordinate to zero again, release the alarm
E312	Y machine (-) software limit alarm	Y machine coordinate(Zm) exceeds the negative software limit alarm value(P020)	Y positively moves in JOG working mode, or set the machine coordinate/machine zero return again, release the alarm
E313	Z nose (+) software limit alarm	Z tool nose coordinate exceeds the positive limit alarm value(P009)	Z negatively moves in JOG working mode, or execute the tool setting/program reference point return again, release the alarm
E314	X nose (+)software limit alarm	X tool nose coordinate exceeds the positive limit alarm value(P011)	X axis negatively moves in JOG working mode, or execute the tool setting/program reference point return again, release the alarm
E315	Y nose (+) software limit alarm	Y tool nose coordinate exceeds the positive limit alarm value(P013)	Y negatively moves in JOG working mode, or execute the tool setting/program reference point return again, release the alarm
E316	E316: Z nose (-)software limit alarm	Z tool nose coordinate exceeds the negative limit alarm value(P010)	Y positively moves in JOG working mode, or execute the tool setting/program reference point return again, release the alarm
E317	X nose (-)software limit alarm	X tool nose coordinate exceeds the negative limit alarm value(P012)	X positively moves in JOG working mode, or execute the tool setting/program reference point return again, release the alarm
E318	E318:Y nose (-) software limit alarm	Y tool nose coordinate exceeds the negative limit alarm value(P014)	Y positively moves in JOG working mode, or execute the tool setting/program reference point return again, release the alarm
E319	Output frequency too high	Z/X/Y pulse output frequency exceeds the system specified range	Reduce the moving speed or modify the pulse multiplication ratio, division coefficient(P203, P204) to the proper value
E320	Thread spindle speed too high	the value of spindle speed multiplying the thread pitch(P) is more than max. speed limit of cutting feed (P113)	Reduce the feedrate or modify P113 value to the enough
E321	Can't execute G32 in DRY	The system cannot execute G32 in DRY RUN working mode	Deleted G32, then execute the program in DRY RUN working mode
E322	G34: Screw pitch is out of range	Before G34 thread machining, the pitch is changing, and it exceeds the permitted range or be a negative value when the end point is reached.	Modify the machining program
E330	Tool lock signal does not use	The set tool post type need the clamping signal, but the parameter P408_d6 doesn't set it to be the clamping signal	Set P408_d6 to be the using tool post clamping signal
E331	Chuck release P507 not define	The system has not defined the tool post using releasing signal (P507)	Set the parameter P507 to be the corresponding interface signal

Alarm No.	Alarm prompt	Alarm reason	Troubleshooting
E332	Chuck in-position P508 not define	The system has not defined the tool post in-position using signal(P508)	Set the parameter P508 to be the corresponding interface signal
E333	Tool-post gating P529 not define	The system has not defined the tool selection using strobe signal (P529)	Set the parameter P529 to be the corresponding interface signal
E334	Tool-post locking is overtime	In tool post rotation(CCW) time in tool change, it can't inspect the tool post champing signal	Check the tool post champing signal is in normal or not, or delay the reversion time(P324)
E335	Tool-post NO alarm	After tool change completed, the tool selection number isn't the target number	Check the target tool selection signal is in normal or not
E336	No changing tool	The parameter set the tool changing forbidden	Modify the forbidden tool changing parameter P403_d7
E337	Detect tool post signal overtime	In tool post rotation (CCW) time in tool change, it can't inspect the tool selection number	Check the target tool selection signal is in normal or not, or delay the time for tool changing in properly
E338	Chuck doesn't clamp, no spindle	Forbid starting the spindle when the chuck is released in spindle and chuck locking each other	Execute the chuck clamping operation to clamp the workpiece
E339	Spindle doesn't stop, no chuck	When the spindle and chuck are locking each other, don't operate the spindle without stopped the spindle	Stop the spindle, then operate the chuck
E340	Forbid function of chuck	The parameter set chuck control forbidden	Modify parameter P409_d7
E341	Spindle doesn't stop, no tail	When the spindle and chuck are locking each other, don't operate the tailstock without stopped the spindle	Stop the spindle, the operate the tailstock
E342	Forbid function of tail stock	The parameter set tailstock control forbidden	Modify the parameter P409_d4
E343	M10 no respond	The system cannot check the valid chuck champing in position signal RM10 in controlling chuck champing	Check the chuck clamp selection signal is in normal or not
E344	M11 no respond	The system cannot check the valid chuck releasing selection signal RM11 in controlling chuck releasing	Check the chuck releasing selection signal is in normal or not
E345	M78 no respond	the system cannot check the valid tailstock going-forward in-position signal RM78 in controlling tailstock going-forward	Check the tailstock signal is in normal or not
E346	M79 no respond	The system cannot check the valid tailstock going-backward in-position signal alarm 79 in controlling tailstock going-backward	Check the tailstock going-backward signal is in normal or not
E347	The non-frequency spindle	The system can't execute the constant surface speed command G96 or gear shifting command M41~M44 in non-frequency spindle	Modify the spindle collocated parameter P410_d6
E348	The program is not ready	Program error, execution is forbidden	Modify the program, resolve error
E349	Use 【return machine zero】 key	When the machine is back to zero function, the modifying manual is forbidden	Using " MACHINE ZERO RETURN" key to zero
E350	S exceed limit	The Sxxx value exceeds the gear shifting range in the non-frequency spindle gear shifting	Modify the S value to the correct gear value
E351	Spindle is controlled by Y axis	When the spindle is controlled by Y axis, the start and stop of the spindle can't be controlled in JOG	Execute M48 to get back the spindle function

Alarm No.	Alarm prompt	Alarm reason	Troubleshooting
E352	Spindle Y, levels can't be changed	The spindle can't execute the gear shifting command when it is controlled by Y axis	Execute M48 to get back the spindle function
E353	M47/M48 function doesn't work	The M47/M48 function forbidden is set in parameter when there is no Y axis(P405_d1) or Y axis can't be changed (P410_d4)	Modify parameter P405_d1 and P410_d4
E354	Spindle doesn't stop, no M47/M48	The M47/M48 is forbidden to execute when the spindle don't stop	Stop the spindle, then execute M47/M48
E355	254 program error	254 program error, the machining program is forbidden to execute	Modify 254 program, resolve error
E357	Feeding override is 0.	The override is zero in feedrate	Adjusted to feedrate override nonzero
E358	Spindle running is abnormal.	The spindle rotate speed is checked to be zero after the spindle is started	Check the spindle relative part, resolve the error or modify parameter **P402_d6** to forbid its function
E359	Alarm: pressure is low.	The system has checked the low pressure and lasted the parameter P332 specified time	Check the hydraulic pressure equipment, resolve the error
E360	Alarm: protecting door isn't closed	The safety door don't close in AUTO	Close the safety door
E361	Material convey alarm	The system has checked it's out of rod in M20, automatism stop alarm	Change the rod, then go on the machining
E362	Lubricating doesn't start	The system executes the M32/M33 command without lubricating function	Set the parameter P506 to be the corresponding lubricating control interface
E363	E363：Tool NO exceeds limit	The target tool number exceeds the parameter P319 specified value in changing tool	Modify tool number or modify P319 to be the maxima system l tool number
E364	Tool post release overtime	The tool pose champing signal is effective always in tool changing and releasing tool post	Check the tool pose champing signal and resolve error
E365	Y axis is speed control mode	The spindle and Y axis allow change(P410_d4), but the system don't allow to control the Y axis moving in current spindle non-position control mode	Execute M47 first, change the spindle to location control mode
E366	Clamp in-position signal abnormal	When the following chuck respond signal checking alarm function is open, the chuck champing in-position signal is invalidation	Control the chuck champing again or resolve the chuck error
E367	Release in-position signal abnormal	When the following chuck respond signal checking alarm function is open, the chuck champing in-position signal is invalidation	Control the chuck champing again or resolve the chuck error
E368	Tail stock FW signal abnormal	When the following tailstock respond signal checking alarm function is open, the tailstock going-forward in-position signal is invalidation	Control the tailstock going-forward again or resolve the chuck error
E369	Tail stock BK signal abnormal	When the following tailstock respond signal checking alarm function is open, the tailstock going-backward in-position signal is invalidation	Control the tailstock going-backward again or resolve the chuck error
E370	P319 (number of tools) and P320 (tool position signal number) are not equal	The parameter setting P319≠P320 in tool changing, the position parameter **P408_d7**=0	Set the parameter **P408_d7**=0-1 again or let P319 equal to P320
E371	External start signal abnormal	The outside starting key always isn't released when the system changes to JOG or AUTO working mode	Check the outside startup signal and resolve the error

Alarm No.	Alarm prompt	Alarm reason	Troubleshooting
E372	Chuck foot switch signal abnormal	The chuck foot switch always isn't released when the system changes to JOG or AUTO working mode	Check the chuck foot switch signal and resolve the error
E373	Tail foot switch signal abnormal	The tailstock foot switch always isn't released when the system changes to JOG or AUTO working mode	Check the tailstock foot switch signal and resolve the error
E374	G31 monitor interface undefined	The parameter P532 is undefined(G31 input checking)	Set interface parameter P532 as a fixed pin
E375	Spindle doesn't stop	When the system is in the tapping in JOG working mode, the spindle doesn't stop or the rotate speed isn't zero	It's allowed to enter the tapping in JOG working mode when the spindle has stopped and the rotate speed is zero
E376	Manual tapping speed is too high	The manual tapping rotate speed is too fast	Reduce the tapping rotate speed in properly
E377	Commands have been undefined	Used the undefined command M60~M74	Modify the program
E378	External pause signal abnormal	The external pause key is not released during MANUAL/AUTO mode switching	Check the external pause signal
E379	Feed hold switch is not reset	Workpiece program cannot be executed when the feed hold switch is not cancelled	Check feed hold signal
E380	Spindle/feed hold switch is not reset	Workpiece program cannot be executed when the spindle/feed hold switch is not cancelled	Check spindle/feed hold signal
E382	Tailstock is not ready; spindle operation is forbidden	Spindle is operated when tailstock is not ready	Check the tailstock
E383	Spindle operation is forbidden in M87 mode	Spindle is operated in M87 orientation state	Perform M88 first, then start the spindle after the system is exit from M87 state
E384	M87/M88 function unavailable	Parameter P343 is set to 0, M87/M88 is unavailable	Set parameter P343 correctly to turn ON M87/M88 function

8.5.2 Relative alarm in executing statement (i.e.E400~ E499)

Alarm in statement program means in the program by statement, the alarm is made by the wrong statement command in executing the workpiece program, the alarm can be resolved by inputting the correct command.

Alarm No.	Alarm prompt	Alarm reason	Troubleshooting
E400	Monitor variable not initialize	The system doesn't evaluate and set the judgment condition to the process monitor before startup	Modify workpiece program
E401	In macro, divisor is 0	The divisor is zero in statement operation	Modify the divisor in macro command, let it don't be zero
E402	not support monitor calculation	The process monitor assignment statement has assignment operation which is not supported by the system, i.e. square root, sine operation	Modify program
E403	r5008 data error	Evaluate the variable r5008 illegal value	Modify program
E404	Variable data r6xxx error	Illegally used the undefined r6xxx series variable	Modify program
E405	Variable data r4xxx error	Illegally used the undefined r4xxx series variable	Modify program

Alarm No.	Alarm prompt	Alarm reason	Troubleshooting
E406	r4003 can't be written	The illegal written operation is made to variable r4003(spindle real-time speed)	Modify program
E407	r4007 can't be written	The illegal written operation is made to variable r4007(spindle real-time speed)	Modify program
E408	r4008 can't be written	The illegal written operation is made to variable r4008(spindle real-time speed)	Modify program
E409	Not assign a value to r6xxx in monitor	The condition statement in process monitor evaluates the r6xxx series variable	Modify program
E410	r711x Invalid data	Write the undefined value to r711x series variable	Modify program
E411	r4002 can't be written	Written operation is made to the read only machining time variable r4002	Modify program
E412	The variable doesn't support this kind of operation	The system nonsupported operator is used in the assignment statement	Modify program
E413	The unknown process monitor description	The system nonsupported judgment condition is used in the statement of process monitor description	Modify program
E414	Unknown pointer variable	The pointer variable points to the non-common variable or the exceeded range pointer variable is used	Modify program
E415	The variable r4004 can't be written	Making written operation to reading variable r4004	Modify program
E416	The variable r4012 can't be written	Making written operation to reading variable r4012	Modify program

Chapter 9 Statement Programming

This system has provided the program method similar to the advance language, it can realize the variable assignment, arithmetic operation, logic judgment and conditional transfer. Using the statement and variable program can come true the function which can't be made by the common G and M command.

9.1 Variable

9.1.1 Variable expression method

The variable value can be set by the program command assignment or by key directly. Multi-variable can be used in a program and they can be distinguished by variable number.

The variable expression method

Using small letter "r" + variable number(four digit integer) to express, the precursor zero can be omitted. Such as:

r5: named number 5 variable; r1003: named number 1003 variable

9.1.2 Classification of variable

The variable in this system can be divided by function and purpose as: common variable, pointer variable, input/output interface variable, special variable in system inner, register variable of key scan command, register variable of showing command, register variable of command, process monitor/ process monitor management variable, pulse signal/pulse signal monitor management variable etc.

Different variable has different function and purpose, its explanation and value range are different too. Following is the instruction in classify.

Variable type	Variable range	Remark
Common variable	r001～r299	
pointer variable	r9000～r9049	
input interface variable	r1001～r1032	
output interface variable	r2001～r2032	
register variable	r5001～r5004, r5008	
system variable	r4001～r4012, r6001～r6006, r6101～r6164, r6201～r6264	
process monitor variable	r7000～r7009	
process monitor management variable	r7010～r7019	
pulse signal monitor variable	r7100～r7103	
pulse signal monitor management variable	r7110～r7113	
variable transfer register variable	r7900	

9.1.2.1 Command variable

The variable number range of common variable is from 001 to 299 , the total is 299 pieces.

The common variable is used to store a data which can participate in operation and also be quoted by data field of G command etc.

The data value range of command variable: -999999999～999999999

◆ **common variable reference**

In the workpiece program, the system uses the variable to change the data field value

Format: <address> + “ri”, means to treat the variable value as field value

For example: Fr003: when r003 equals 15000, its function is same to F15 command

Zr010: when r010 equals 2500, its function is same to Z-2.5 command

K r 010 ; when r010 equals 2500, its function is same to K2.5 command

S r 003 ; when r003 equals 2000000, its function is same to Sr003 command

【For example】

```
N0010 r001=-3700          N0010 r001=-3700
N0020 r002=150000         N0020 r002=150000
N0030 G00 Z100 X80        N0030 G00 Z100 X80
N0040 G01 Ur001 Fr002     ; same to U-3.700   F150.000 command function
N0050 G01 Wr001            N0050 G01 Wr001
N0060 M02                 N0060 M02
```

【Explanation】

1) The variable value doesn’t include decimal point, the variable value is get from representative value riding 1000, when it is replaced to the coordinate etc field with decimal point, the variable value divides 100, then the coordinate date including three decimal is get;
2) In the command symbol G, M, T the variable can’t be quoted; Gr003 can’t be used for program;
3) The field of program line number (i.e. P, Q etc) can’t quote variable;
4) The field L showing times and field H showing location sign can’t quote the variable;
5) Only the common variable can be quoted by command field, otherwise alarm;
6) When the program is in AUTO working mode, when the variable is used in main program and also the transferred subprogram(i.e.: M60~M74 command), please pay attention that the variable in the intercross using and changing of main program and subprogram will impact the result of program running.

◆ **The characteristic of common variable：**

When the system executes the program in AUTO working mode, the variable value may change along with the program path. The common variable has following characteristics:

1) The system makes different initiation disposal according to the different variable section number.

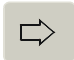
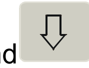
   Among them: r001～r040：the variable parameter table offers the initial value for it (set by the user according to the requirement)

   r041～r099：The initial value of this group is 0 in AUTO mode when the program is started.

   r100～r199：never to clear except the boot-strap.

2) In the AUTO working mode, before executing the first program and pressing the CYCLE START key, the system will put the parameter table P600 ~P639 into variable r001~r040 as the initial value in AUTO; the variable r041~r099 is cleared.

3) After executed M20, in the recycle, r001～r040 are evaluated the initial value by the P600～P639 in parameter table again; r041～r099 and r100～r199 are not cleared.

4) The initial value of r100～r199 is zero after power-on, later it won't be cleared by itself. But it can change their value in JOG or AUTO working mode immediately. Their initial value can be set by the following method(using this variable in program, when the variable initial value isn't evaluated before using, the program won't have the confirmation state, suggest the user carefully). When the user is using these variable and needs the initial value, the initial value of r100~r199 can be set in JOG working mode. In the JOG or AUTO working mode and non running the program, press  will call the macro variable display window and express all the macro variable in the program, press  and ,  will let the pointer pointing the needed modifying variable, press ENTER key to choose the variable and input the data, then press ENTER key to confirm again. The variable value is forbidden to modify in the program running process.

◆Double-precision floating-point variable__common variable r200~r299

Double-precision floating-point variable belongs to common variable; its range is 200~299, 100 in total.

As data flow may easily occur during common variable (r001~r199) calculation, the use of double-precision floating-point variable can solve this problem.

【Instruction】

1）Double-precision floating-point variable cannot be in code field, otherwise, an alarm will occur.

2）Refer to instruction of common variable (r001~r199).

【Characteristics】

In AUTO mode, double-precision floating-point variable may vary with program path. It has following characteristics:

1) In AUTO mode, in the initial state of execution, the variables are 0.

2）After the execution of M20, the variable is not cleared when it is cycled.

3) In MANUAL or AUTO mode, press  to call macro variable; the window does not display double-precision floating-point variables.

9.1.2.2 Pointer variable

The variable number range of pointer variable is from 9000 to 9049, total 50 pieces.

The pointer variable is specially to point the address of a common variable. To evaluate it means to evaluate all it pointed common variable; and using its value means to use all it pointed common variable's value. The pointer variable can participate the operation or reading judgment.

◆ **The method of creating and changing pointer**

The pointer must be created correctly and points to a certain given common variable before using the pointer variable. The pointing sign are "-" and ">" and a blank is allowed between them.

The variable format of creating and changing pointer:

Pointer variable name -> expression

Such as: r 9001 -> 1 ; expression of the r9001 pointer variable pointing to r001 common variable;

r 9002 -> 199 ; expression of the r9002 pointer variable pointing to r199 common variable;

r 9003 -> r100 ; when r100 equals to five, it's the expression of r9003 pointing to r005 common variable

r 9003 -> r 9003+1 ; expression of r9003 pointing to next common variable, when it points r5 at first, then now it points to r6;

r 9003 -> r 9003-1 ; expression of r9003 pointing to previous common variable, when it points r6 at first, then now it points to r5;

◆The characteristic of pointer variable:

1) At first set up the pointer variable and let it point to a certain specified common variable, then make the read/ written operation to it or use for judgment, otherwise alarm;
2) In setting up the pointer variable, the value range of is from 1 to 199(it is to say it can point r1 to r199), when it's exceeded, it will alarm;
3) The statement about setting up or changing the pointer variable, only can be written in a separate section, otherwise alarm; the expression in the right side of pointing symbol can be the addition and subtraction operation between two of them;
4) The pointer variable only can be used in the numerical value operation, can't be quoted by the data field like G etc command; such as Ur9000, alarm;
5) In the statement of assignment, conditional judge , to evaluate the pointer variable expresses to evaluate the common variable which is pointed by it; however reading the pointer variable expressed to read the value of the common variable which is pointed by it.

◆The explanation of pointer variable:

【program demonstration】

In the following program, Z/X axis will store the coordinate of the position to the common variable in moving each position, it totally has stored 10 set coordinate; then take out them one by one and go back to the initial position by the original path. The following is come true by the pointer variable.

```
N0000   G00 Z200 X200       ;
N0010   r9000 -> 1          ; expression of the r9001 pointer variable pointing to r001
                              common variable;
N0020   M98 L10 P1000       ;
N0030   M98 L10 P2000       ;
N0040   M02                 ;
N1000   r9000= r6004        ; In the first calling, store the Z coordinate in this position to r1
N1010   r9000 -> r9000+1    ; In the first calling, the pointer +1 points to r2
N1020   r9000= r6005        ; In the first calling, store the Z coordinate in this position to r2
N1030   r9000 -> r9000+1    ; In the first calling, the pointer +1 points to r3
N1040   G00 W-25            ;
N1050   G00 U-15            ;
N1060   M99
```

N2000	r9000 -> r9000-1	;In the first calling, the pointer +1 points to r20
N2010	r190= r9000	; In the first calling, take out the reciprocal second X coordinate from r20 and store it to r190
N2020	r9000 -> r9000-1	; In the first calling, the pointer +1 points to r19
N2030	r191= r9000	; In the first calling, take out the reciprocal second Z coordinate from r20 and store it to r191
N2040	G01 Xr190 F1000	;
N2050	G01 Zr191	;
N2060	M99	

9.1.2.3 Interface variable

This variable is correspond to input and output pin, specially is used to check and control the input/output pin signal of the system. The interface variable is divided into input interface variable and output interface variable.

◆Input interface variable (read)

The system has 32 input interface variable, each variable is correspond to a input signal pin (the variable number r1001 ~r1032 is correspond to the signal pin number U1001~U1032 in ranking)

Attention: the variable number r1000 is the integer state of 32 input interface; corresponding signal pin U1001 ~U1032 from low to high.

The second state value of interface variable is 0 (low level) or 1(high level). The low level means the effective outside signal, express the pin contacted with 0V; the high level means ineffective.

The input interface variable is a set of read variable, can't be evaluated (input), otherwise alarm.

Through the program, read the value of input interface signal r1001~r1032 can know the pin corresponding signal level, then it can be a judgment condition for the system to make the program skip. It doesn't mean all the input signal pin can be read; when the parameter **P412_d1** equals to zero, it only can make the statement program to pin with "UI" in the diagnosis interface , when it makes program to the defined input signal pin, it alarms.

【For example:】

r8=r1002 ; read UI02 pin level; r8=0 or 1.

if (r1009=0) then(P1600) ; if the UI09 pin is read to be low level, then go to P1600.

r1007= r8 ; system alarm: " Assignment cannot be done to read-only variables".

◆Output interface variable (read/write)

The system has 32 output interface variable, each variable is correspond to a output signal pin (the variable number r1001 ~r1032 is correspond to the signal pin number U1001~U1032 in ranking). The assignment on output interface variable can change the corresponding pin output state.:

When the system outputs "0", the outside can form the conductive loop;

When the system output "1", in the high resistance, the outside can't form the conductive loop.

Read the output interface variable, the current assignment state of the output interface can be get.

【For example】

R2002=0 ; expression of outputting "1" to UO02 pin, the outside can form the conductive loop.

R2016=1 ; expression of output “0” to UO16 pin, in the high resistance, the outside can’t form the conductive loop .

r2007= r8 ; confirm the UO07 output state by the content of r8(zero or non zero)

if (r2016=1) then(P0100) ; if the output of current UO16 is read to be “1”, it will go to P0100.

【Explanation】

1) Only the output pin which is released by the standard function definition allows to the variable assignment output because of the system limitation, otherwise alarm; it only can make the statement program to pin with “UO” in the diagnosis interface , when it makes program to the defined input signal pin, it alarms.

2) In the system boot-strap and power-on beginning, the system will set r2001～r2032 to be “1”, the outside can’t form the conductive loop.

9.1.2.4 Keyboard scan register r5001

Keyboard scan register r5001 value range: 32 digit without sign

The different numerical value which is written by register has different meanings; the system executes the relative command according to the written numerical value. Please refer the below table:

The gathered table of r5001 executing keyboard scan commands: (the system forbids to use this variable in the process monitor description sentence)

Command No.	Meaning
1	keyboard scan once; When the key is pressed, the r5001 equals to the input value ; when there is no key pressed, r5001 equals to zero;
2	waiting for the keyboard input a character ; waiting until the key is pressed, and record it to r5001;
3	waiting for the keyboard to input a character, with cursor and character display; the key isn’t released, the cursor clue; the key is released, the value is recorded to r5001;
4	Waiting for the keyboard input a character and releasing press key;
5	Waiting for the keyboard input a character and releasing press key, with cursor and character display;
6	Waiting for the keyboard input a numerical value, and finished by ENTER; giving up by press ESC, then the input value will be zero.
Note: When the assignment is outside 1~6, it will be ineffective.	

【Explanation】

R5001 assignment is the working mode for setting keyboard register, the input value which is get after executed the command is stored in register r5001, it can be read or use for the conditional judge .

【For example】

r5001=4; the system is waiting for the keyboard input a character, it will be executed until the key is released

if (r5001=51) then P1500; if press “3” , it turn to P1500 (the ASCII value of “3” is 51)

【Explanation】

1) When the keyboard scan command 3 or 5 is chosen, the key will be displayed in the window when the display is open, but when the display don’t open, the key won’t be display after this operation.

2) In waiting for pressing, when the ESC is pressed, it will cancel the press key input, and executes the next statement.

3) The acceptable key symbol is as the below table, the other key input is ineffective. Notes : The input value is the corresponding ASCII value of this key symbol.

The r5001 acceptable key symbol and the input value corresponding table:

Input symbol	0	1	2	3	4	5	6	7	8	9	.	-	ENTER	ESC
input value	48	49	50	51	52	53	54	55	56	57	45	46	13	01
Input symbol	G	M	X	Z	S	T	U	W	F	I	K	D	R	
Input value	71	77	88	90	83	84	85	87	70	73	75	68	82	

9.1.2.5 Display window register r5002

Display window register: r5002 (the system forbids to use this variable in the process monitor description statement)

Through the operation to the display window register, the system can construct a window in the display screen and used to prompt the program execution step, alarm etc information.

The different value is written in the register has different meanings; the system executes the relative command according to the written value. Please refer the following table:

The r5002 execution command table:

Command number	meaning(the user information only can be displayed in the display window
0	close the display window;
1	Open an empty display window;
2	when the window is not opened, call the display window which has opened last time;
10	Set the cursor position, the cursor points to the first line home;
11	Set the cursor position, the cursor points to the next line home;
12	Erasure the content from the current cursor position to the line end; the cursor position don't change;
13	Erasure all the content in window, the cursor points to the first line home;
32～126	Sending an ASCII character to the display window; (see ASCII command table)
201～209	The cursor is positioned to the specified line, the range is from 1 to 9;
210～230	The cursor is positioned to the specified line, the range is from 10 to 30;
1000～1099	send a set of character string to the display window; the mantissa 00~99 are character string number, it at most can display 100 sets character string;
2000～2999	Send a alarm number to the display window: display "alarm XXX", the range of XXX is from 0 to 999;
110001～110009	Set the line number of the display window (line 1 to 9); (the system windows default is 6)
110010～110040	Set the displayed character number in each line (10 to 40); (the system windows default is 30)
120000～120255	Set the window grounding or character grounding, 0 to 255 can be chose; (the system defaults white, the value is 255)
130000～130255	Set the character color, 0 to 255 are available (the system defaults black, the value is 0)
140000	Set the size of the character: 16*16
140001	Set the size of the character:: 8*16 (system widows default)
Note: when the assignment exceed the range, it is ineffective.	

【Explanation】

R5002 assignment is to set the display window register command; the data is uncertainly when read the register, it can't be used for the conditional judge .

【Example】

r5002=1 ; open an empty display window

r5002=49 ; send the character “1” to display window

r5002=49+r3 ; send the character which has deflected r3 position with “1” to the display window

r5002=2001 ; the display window displays “ alarm 001”

【Explanation】

1) Set the size and color of the window before opening the display window; otherwise it’s the system windows default;

2) When the window is opened, when the window size etc parameter is reinstalled, the window content will be cleared automatism, the new setting is effective;

3) The reference of grounding and font color refers to the attached table in this chapter: the corresponding table of usually used color and command value;

4) In the AUTO running sect mode, when there is display character window currently, the key ENTER is pressed, the window will be closed, the program will exit the running.

◆Expression of character string:

In the block, one of the below two expression can be used to input the character string:

1) common expression

Format: serial number+ blank + “S” + “display character string” ;

Example: when the character string 00 want to display “ 1~9 please press the key to choose the need repeated working procedure:”, the block content is as following:

N5000 00 S 1～9 please press the key to choose the needed repeated working procedure

N5010 r5002=1000 ; display the set 0 character string r5010

1）ASCII code decimal expression

Format: serial number + blank + “D” + character code =blank +character code +blank +character code…

Example: when the 04 character string displays “1-9 GongXu：”, the block content is as following:

N5000 04 D 49 95 57 32 71 111 110 103 88 117 58
N5010 r5002=1004 ; display the fourth character string

【Explanation】

1) the serial number must be two digit figure, the range is from 00 to 99, total 100 set character string, and the lowered two digit command must correspond with the serial number, then it can display the content of this character string;

2) Behind the S blank, the system treats the content as character string; it can’t add the note behind the character string;

3) Each set of character string won’t exceed 40 characters (20 Chinese characters)

4)The character string can written before or behind the program; it generally is written in the end and won’t impact the program execution speed.

【Program Example】

It mainly demonstrate the explanation of keyboard scan register, display window register in the following program. Suppose there are three working procedure which each of them is moved to different position from start, then goes back to start. But the three working procedures are not executed by turn, they are chosen by press key temporarily according to the pop-up window prompt.

```
%101
N0000 G00 Z0 X0
N0010 G00 Z100 X100
N0020 r5002 = 110003                ; set the line number of the display window
N0030 r5002 = 110016                ; set the display character number of each line
N0200 r5002 = 1                     ; open an empty display window
N0210 r5002 = 140001                ; 8*16    set the character size: 8*16
N0220 r5002 = 130000                ; set the character color: black
N0230 r5002 = 1004                  ; set the 004 character string
N0240 r5002 = 11                    ; set the cursor position, the cursor points to the home of
                                      next line
N0250 r5002 = 140000                ; 16*16 set the character size: 16*16
N0260 r5002 = 1006                  ; display the 006 character string
N0270 r5002 = 11                    ; change line
N0280 r5002 = 130006                ; change color :blue
N0290 r5002 = 1005                  ; display the 005 character string
N0300 r5002 = 130168                ; change the color: red
N0500 r5001 = 4                     ; Waiting for the keyboard input a character, release the
                                      key and then execute the next block
N0510 if(r5001 = 49) then(P1000)    ; If the character “1” is input, executes P1000
N0520 if(r5001 = 50) then(P2000)    ; If the character “2” is input, executes P1000
N0530 if(r5001 = 51) then(P3000     ; If the character “3” is input, executes P1000
N0540 if(r5001 = 48) then(P600      ; If the character “0” is input, executes P1000, ending
N0550 M97 P500
N0600 M02
N1000 r5002 = r5001                 ; display the keyboard input character “1”
N1020 G01 Z50 X10 F2000
N1030 G00 Z100 X100
N1040 M97 P200
N2000 r5002 = r5001                 ; display the keyboard input character “2”
N2020 G01 Z120 X50 F2000
N2030 G00 Z100 X100
N2040 M97 P200
N3000 r5002 = r5001                 ; display the keyboard input character “3”
N3010 G01 Z160 X90 F2000
N3020 G00 Z100 X100
N3040 M97 P200
N4000   ; the note can’t be added behind the character string
N4000   ; the character string can be written finally, it won’t impact the execution speed
N5000 04 D 49 95 51 32 71 111 110 103 88 117 58
N5010 05 SINPUT
N5030 06 S        total three working procedure
```

9.1.2.6 Display value register r5003

Display value register: r5003 (in the description of process monitor statement, this variable is forbidden to use)

【Explanation】

The r5003 assignment is a command to display this value(it can be seen when the display window is open), the data is uncertainty when read the register, it can't be used for the conditional judge .

【Example】

r5003=r032 ; display the value in r032

r5003=r03+r01 ; display the value of r03 adding r01

9.1.2.7 Graph update register r5004

Graph update register: r5004 (in the description of process monitor statement, this variable is forbidden to use)

【Explanation】

The r5004 assignment is a command to clear the process graph display region ((it can be seen when the graph display window is open). Write the random number to r5004, clear the content of the system process graph display area.

【Example】

Clear the display area content, it also is the process graph path

Note: In the cycle process, the last process graph isn't cleared; in order to let the user observe the new process path and graph in conveniently, in the ending of the process program, execute the command, the next process path and graph will be displayed again.

9.1.2.8 Program control register r5008

Program control register: r008 (usually used for program description during monitoring, do not used in common programs). If data is uncertain when reading this register, it cannot be used.

Different values written in the register have different meanings and correspond to different functional commands.

Available commands in r5008

No.	Meaning
1	Pause: movement stops (equals to key CYCLE PAUSE); press CYCLE START to resume;
2	Switch between SINGLE/CONTINOUS mode (equals to key SINGLE); press CYCLE START to resume; (usually used for program description during monitoring. If it is used in common program, M00 command is advised.)
3	Stop after cycle (movement stop after M20); press CYCLE START to resume;
4	Cycle starts (equals to key CYCLE START); usually used for description of process monitoring;
5	Set to SINGLE mode; press CYCLE START to resume;
6	Set to CONTINUOUS mode
11	Foot switch is allowed for chuck operation afterwards; M10/M11 switching; If spindle and chuck are interlocked, it is valid only under M05 command;
12	Foot switch is allowed for chuck operation afterwards; M10/M11 switching; If spindle and chuck are interlocked, it is valid only under M05 command and the actual speed is 0;
13	Foot switch is not allowed for chuck operation afterwards (except for SINGLE PAUSE); if the chuck operation is not finished yet, the next program cannot be executed;

14	Foot switch is allowed for chuck operation afterwards; M78/M79 switching; If spindle and chuck are interlocked, it is valid only under M05 command;
15	Foot switch is allowed for chuck operation afterwards; M78/M79 switching; If spindle and chuck are interlocked, it is valid only under M05 command and the actual speed is 0;
16	Foot switch is not allowed for chuck operation afterwards (except for SINGLE PAUSE); if the chuck operation is not finished yet, the next program cannot be executed;
17	Goes to next program if M10 is not finished; does not take up time;
18	Goes to next program if M11 is not finished; does not take up time;
19	Goes to next program if M12 is not finished; does not take up time;
20	Goes to next program if M78 is not finished; does not take up time;
21	Goes to next program if M79 is not finished; does not take up time;
22	Goes to next program if M80 is not finished; does not take up time;
23	Goes to next program if M3 is not finished; does not take up time;
24	Goes to next program if M4 is not finished; does not take up time;
25	Goes to next program if M5 is not finished; does not take up time;
40	Does not go to next program till all M commands are finished;

【Instruction】

1）During program execution, the operation of chuck and tailstock controlled by foot switch equals to inserting a work during the machining process. It does not take up time. If command in the same group is executed, it is invalid; the operation can be done only after the execution.

2）In statement or all-monitoring state, the operation of chuck and tailstock controlled by r5008 does not take up time;

3）Sometimes, the operation of chuck and tailstock controlled by r5008 will be invalid; for instance, when M11 is being executed, the operation is invalid;

4) If spindle and chuck or tailstock is not interlock, the operation of chuck and tailstock controlled by r5008 is valid regardless the spindle state and spindle speed.

5) In program end, reset, emergency stop state, the current command is cancelled automatically.

【Usage】

Assignment to r5008 means to choose program pause and start mode; usually it is used together with monitoring description; see the example;

【Example】

r5008=1 ; Program pauses immediately; press CYCLE START to resume;

r5008=3 ; Pause after cycle ends; press CYCLE START to resume;

9.1.2.9 System special variable set 1

System special variable set 1: read/ write (in the process monitor description statement, read only, write forbidden).

Variable number	meaning
r6001	Z machine coordinate
r6002	X machine coordinate
r6003	Y machine coordinate
r6004	Z tool nose coordinate
r6005	X tool nose coordinate
r6006	Y tool nose coordinate
r6101…6164	Z tool offset 01…64
r6201…6264	X tool offset 01…64

【Explanation】

For the written variable, the assignment is a command to modify the parameter, in the same time it has kept the assignment and can be used for the read or conditional judge . In the common situation, don't use the system inner special variable. The system inner special variable must be used carefully.

【Example】

r6001=150000 ; modify the current Z axis machine coordinate to 150.000
if (r6005>3000) then P1500 ; if the current X tool nose coordinate is over 3.000, then turn to P1500
r6201= r6201+20 ; add 0.020 to the X tool compensation of the first set tool offset number

The system inner special variable value range: 32 digit with symbol

9.1.2.10 System special variable set 2

System special variable set 2 (used for the monitor description)

Variable number	Meaning	Property
r4001	Workpiece counter: the displayed workpiece on screen In the program execution, the counter will add 1 in auto when it meet a M02 or M30 or M20.	Read/ write
r4002	Time counter: workpiece processing time; unit: ms	Read
r4003	Spindle rotate speed recorder : the system checked current rotate speed; unit: r/min	Read
r4004	Spindle program rotate speed recorder : in execute the S command, the system will input the variable for automatism program rotate speed at first;	read
r4005	Target tool position number recorder: the system will input the tool position number to this variable automatically in executing T command;	Read/ write
r4006	The target tool offset number recorder: the system will input the tool offset number to this variable automatically in executing T command; 0≤tool offset number≤64	Read/write
r4007	The current tool position number recorder: after the tool changing finished every time, the system will input the tool position number to this variable automatically.	Read
r4008	The current tool offset number recorder: after the tool changing finished every time, the system will input the tool position number to this variable automatically. 0≤tool offset number≤64;	Read
r4009	instantaneous interference recorder: In the AUTO working mode, when the system has checked the recently press key "G" or "M", it will input the corresponding ASCII value 71/77 to r4009; and display the character on the top left corner of the screen. Write random number except the 71/77, or press X key, or enter the AUTO working mode, the variable value will be cleared to zero. Using r4009, it can increase the function of two program branch transfer, used in the temporally specified man interference of machining process.	Read/ write
r4010	timer ： In the AUTO working mode, when the variable value isn't zero, each ms will reduce one automatically, until the zero; it can be the time for conditional judge ;	Read/ write
r4011	timer： In the AUTO working mode, when the variable value isn't zero, each ms will reduce one automatically, until the zero;	Read/write
r4012	spindle coder ： Read the spindle coder and it's value range: among 0~ (four times of real coder LINE); when the coder LINE (parameter P209) is set to be 1200, the value range will be 0~4800.	Read

【Explanation】

For the written variable, the assignment is a command to modify the parameter, in the same time the variable has kept its assignment, and it can be read or condition judgment.

【Example】

if (r4008=1) then P0060 ; If the current is No. 1 tool offset, it turns to P0060
if (r4001=1000) then P1500 ; If the process number equals to 1000, it turns to P1500000

if (r4009=71) then P0050 ; If the current special transfer function key is "G", it turns P0050 to execute

【Explanation】

1) The workpiece recorder can be read and written.
2) When the program has used r4009 in instantaneous interference function, then the "G" or "M" character or blank in the top left corner of display screen to show which program branch transfer function is in current; display "G" expresses r4009=71, "M" expresses r4009=77, the blank expresses r4009=0. Here the "G" or "M" has no relationship with command M, it only is the sign of instantaneous interference function key. Evaluating r4009 the 71 or 77 equals to press the key "G" or "M", the branch transfer is effective in same.
3) The r4010 and r4011 can't evaluate negative, the zero assignment is insignificance, the most assignment range is 0~9999999(i.e. 9999.999s), it can be used for read or conditional judge . Such as: r1=r4010 or if(r4010>1000) then P0020.
4) In generally the r4005~r4008 is used for tool changing distinguishing. Such as: using in M60 user-defined tool changing program(parameter P318=9)

9.2 Statement

This system has assignment operation statement and conditional judge statement, they will be introduced as following.

9.2.1 Assignment statement

This system offered assignment statement can come true the operation between two variable or value, the detail expression and operation are as below table:

Gathered table of assignment operation statement 9-1:

Command format	Function	Definition
rN=rA	assignment	give the rA assignment to rN variable
rN=rA + rB	Decimal addition operation	
rN=rA - rB	Decimal subtraction operation	
rN=rA * rB	Decimal multiplication operation	
rN=rA / rB	Decimal division operation	
rN=rA or rB	Binary or operation	
rN=rA and rB	Binary and operation	
rN=rA xor rB	Binary or operation	
rN=sqr (rA)	Decimal square root	rN = $\sqrt{rA}$ (rA don't support negative)
rN=abs(rA)	Decimal absolute value	rN= | rA |
rN=rA % rB	Decimal remainder	rN = the remainder of (rA ÷rB)
rN = rA*rB/rC	Decimal multiplying and dividing operation	
rN=sqrf (rA rB)	Compound square root	rN = $\sqrt{rA^2 + rB^2}$
rN=rA*sin(rB)	sine	
rN=rA*cos(rB)	cosine	
rN=rA*tan(rB)	tangent	
rN=rA*atan(rB/ rC)	arc tangent	

In the above table: rN express the variable name of storing operation result; rA, rB, rC express the variable for running the operation, they can be constant too.

【Explanation】

1) The value, variable value, operation result don't have decimal point, the unit is 0.001;
For example: the assignment of Angle 45° must be rB=45000.

2) In the Angle assignment operation statement the rA can't be omitted, otherwise alarm; it can be written rN=1*sine(rB).

3) In the PROGRAM EDITION working mode, all the special expressions can be get by pressing the HP6 key in the faceplate.

4) Each assignment statement only can has one operator (except the multiply operation first, dividing operation later)

Wrong example: r001= r002 + r003 – r004.

The right writing is : r001 = r002 + r003

r001 = r001 – r004

【Example】

r3=r2*r41	;	the result of r2 multiplying r41 gives to r3
r2=sqr (100)	;	the date of 100 draw gives to r2
r1=0	;	the initialization r1 is Angle 0°
r51=1000*sin(r1)	;	the sine value of Angle r1 multiplying 1000 gives to r51
r1=r1+1000	;	the Angle adds 1°

9.2.2 Conditional statement

The conditional statement can form the branch structure. It makes judgment according to the given condition, in order that it decide to execute which branch block.

the basic format of when condition is:

if(relationship expression) then statement 1 else statement 2

Its meaning is: when the expression is exist, execute the statement 1 behind the then, otherwise execute the statement 2 behind the else.

【Explanation】

1) In the relation expression, the relation operation has **<**, >, **=** ; (less than, more than, equal to);

such as : rA< rB, rA> rB, rA= rB;

2) The statement 1 and statement 2 can be transfer statement P, calling statement H, or assignment statement, but only can be one of them;

3) The transfer symbol P and calling symbol H

4) The operator in assignment statement only can be +, - (addition, subtraction); such as rN=rC + rD, rN=rC – rD.

【The basic format and signification of if statement:】

if (rA= rB) then P1 else P2	**; if rA=rB, execute P1, otherwise execute P2;**
if (rA = rB) then P1 else rN=rC + rD	**; if rA=rB, execute P1, otherwise execute rN=rC+rD**
if (rA = rB) then rN=rC + rD else P2	**; if rA=rB, execute rN=rC+rD, otherwise execute P2;**

Among them:

rN： variable name;

rA, rB, rC, rD： variable name, constant too;

P1, P2： transferred block line number ;

H1, H2： The called block line number(in the above format, the place which is transferred by P also can use call).

9.2.3 Statement program example

【program example 1】

In the following program, it mainly demonstrates the method of automatically modifying tool compensation in the program. In the batch machining, suppose each machining 20 piece, the tool T11 will fray one thread in the X direction regularly ; when the workpiece recorder is the integer double, the program will make the tool compensation modification automatically.

```
N0010 G00 Z200 X100
……
N1000 r1=r4001 % 20          ; get the remainder of workpiece recorder dividing 20
N1010 if(r1=0) then P1030    ; if the remainder is zero, it will be the integer double of 20
N1020 M20
N1030 r6201=r6201-10         ; No.1 X tool offset reduce one thread
N1040 M20                    ; recycle
```

【Program Example 2】

In the following program, it mainly demonstrates the method of temporary press interference and call in the program. Suppose the pin of UO31 and UO32 control a . In the batch cycle machining, when the handlers want to make the random sample to the workpiece, press G key, the loader collects a sample in automatically.

```
%104
N0010 G00 Z200 X100          ;
N0020 G00 Z180 X80           ;
N0030 G01 Z100 F200          ; cut outer circle
N1000 if (r4009=71)  then  H2000; If "G" key is pressed in forestall, then call program with H2000
                               as its head block number
N1010 G01 X0 F200            ; cut off
N1020 r2031=1                ; loader returns to original position
N1030 r2032=1                ;
N1040 M20
N2000 r2031=0                ; loader goes forward
N2010 r2032=0                ;
N2010 r4009=0                ; clear "G" state
N2020 M99
```

【Program example 3】

In the following program, it mainly demonstrates the function operation. According to the elliptic parameter equation finger out that the point in ellipse are moving along the ellipse path by short line approaching method.

The parameter equation of ellipse is X=50*sin(a)，Z=100*cos(a); because the X is diameter program, so X=100*sin(a).

```
%103
N0010 G00 Z0 X0
N0020 G00 Z200 X200
N0022 G00 Z190 X110             ; confirm the start point of G01 path
N0030 r1=0000                   ; the initial value of r1 is 0°
N0040 r12=100000*sin(r1)        ; 100000 the angle sine value multiplies 100000
N0050 r13=100000*cos(r1)        ; 100000 the angle cosine value multiplies 100000
N0060 r12=r12-110000            ;  finger out the relative difference of ellipse start point path
                                   and G01 start point
N0070 r13=r13-190000
N1000 r2=100000*sin(r1)         ; The angel sine value multiply 100000 giving to r2
N1010 r3=100000*cos(r1)         ; The angel cosine value multiply 100000 giving to r3
N1020 r2 = r2 - r12
N1030 r3 = r3 - r13
N1040 G1 Xr2 Zr3 F500           ; Moving along the ellipse path
N1050 if(r1=360000) then P1080  ; If the angel equals to 360°, then exit
N1060 r1=r1+1000                ; The value of r1 pluses 1000 (angel pluses 1)
N1070 M97 P1000                 ; cycle
N1080 M02
```

9.3 Process Monitoring and Execution

The common part program is executed according to the designed path one by one in advance, it can’t make the prompt response for the real time happened matter in the command executive midway.

In the system, there are ten inspector which are numbered according to 0# to 9# turn, called 0# inspector, 1# inspector… 9# inspector. Their work is called process monitor; in the same time of executing the common part program, they specially track with the matters which are real time happened in the part program execution process. But the user must describe the task of the inspector, and tell them to track what matter, how to deal with it after it happen. The inspector without task is in dormancy state.

Each inspector has a monitor register and a monitor management register separately, the corresponding turn number is as following:

Inspector number: 0#~9# number in turn

Monitor register number: r7000~r7009 corresponding the inspector number in turn

Monitor management register number: r7010~ r7019 corresponding the inspector number in turn

In the progress of machining, if there are progress monitors enabled, on the right side of the program status bar is displayed “M-n”. Thereinto, M indicates the process monitor, and n indicates the number of enabled process monitors. The operator can also view the states of process monitors being used on the macro variable window.

E.g. M-2 indicates there are two process monitors enabled.

9.3.1 Process monitor description (r7000)

Using the process monitor, at first must describe the process monitor according to the rule. The process monitor description includes a assignment statement and a if condition statement, neither of the two can be dispensed; the assignment statement indicates the monitor object, the if condition statement can make the judgment according to the information by monitor, and decide to execute some branch block or not.

【Description method of process monitor】

1) Assignment description:

What is called assignment description, is to designate the monitor object by a assignment statement; all assignment statements which aim at monitor register(r7000~r7009) are called monitor description statement.

For example: r7000= r1001 or r1002; 0# monitor r7000 object are interface input signal UI01, UI02
r7001=r4003(rotate speed); 1# monitor r7001 comes from spindle real time speed

2) Condition description

What is called condition description, is to designate how to make judgment according to the monitored information;

The condition description statement and common conditional statement have the unanimous basic form, and the program rule is basic same.

if (relation expression) then statement 1 else statement 2;

Among them: in the condition description statement, the left of if related expression is monitor register name;

In the condition description statement, the call can’t be used in then, else, only assignment or transfer.

For example: if (r7000=1) then P1500 ; if the input signal can meet the requirement, then turns p1500

if (r7001>6000) then r3=r3+1 ; meet the requirement, r3 adds 1

【Explanation】

1) The system regulation: all assignment statement of aiming at r7000~r7009, are the description to monitor 0#~9#; according to the program execution path, the latest description is effective.
2) The operator of assignment description statement only can be one of“+”, “-”, “or”, “and”; otherwise alarm.
3) the conditional judge statement is allowed to make the assignment description, such as if (r5004=3) then r7000= r1001 + r1002，it is the legal statement.
4) system rule: if the r7000～r7009 appears in the left conditional expression of if conditional statement, it is to say that’s the conditional description to 0#～9# monitor. The call can’t be used in then, else, only assignment or transfer.
5) The assignment description and if conditional description must appear in pair; if there is no assignment description, or evaluated the cannot monitor variable, then r7000=0; if there is no if conditional description, it’s allowed but with little signification and without monitor function.
6) In the if condition description, the system can’t execute the description statement immediately, but wait for the corresponding serial number monitor function opened, then starts the monitor.
7) If the assignment meets the requirement, it’s not the conditional transfer behind, but the common variable evaluated, such as if (r7000=100) then r3=r3+1， the monitor won’t close.

9.3.2 The start and close of process monitor

After making the process monitor rule description, evaluate the monitor management register (r7010~r7019),then can open or close the monitor. There are following working modes for opening the monitor.

Assignment	Process mode of matter
0	Close the opened monitor, let the inspector in the dormancy state; keep its task, can open again and go on the monitor;
1	Open the monitor; in the monitor process, make the judgment according to the matter's relation expression, if the condition comes into existence, the process mode is as following: 1) If the inspector execute the assignment on common variable or output variable, it won't impact the execution of common program command, go on the monitor; 2) If the inspector wants to execute the special assignment, then close the monitor, stop the current motion command immediately, wait for the execution ending of all executing MST command, execute the special assignment; 3) If the inspector want to execute transfer, then close the monitor, stop the current motion command immediately, wait for the execution ending of all executing MST command, execute the transfer;
2	Open the monitor; in the monitor process, make the judgment according to the matter's relation expression, if the condition comes into existence, the process mode is as following: 1) If the inspector execute the assignment on common variable or output variable, it won't impact the execution of common program command, go on the monitor; 2) If the inspector wants to execute the special assignment, then close the monitor, stop the current motion command immediately, wait for the execution ending of all executing MST command, execute the special assignment; 3) If the inspector want to execute transfer, then close the monitor, stop the current motion command immediately, wait for the execution ending of all executing MST command, execute the transfer;
Note: In execution, when meet the M20/M02, close all the monitor, clear the task description; Special assignment means to evaluate the program control register r5008, system special variable set 1 and set 2.	

【Example】

r7010= 0 ; if the system writes zero to r7010, then cancel the r7010 monitor;

r7016= 1 ; open r7016 monitor; if the system meets the condition, stop the current motion command immediately, execute the assignment or transfer;

r7012= 2 ; open r7012 monitor; if the system meets the condition, executes the valuation or transfer after executed current motion command;

【Explanation】

1) Once opened monitor, in the same time of executing the common part program, in fact there are two description statements are alternated ceaseless, executed circularly in the system inner; until they are closed.
2) The if statement opens or closes the process monitor are allowed; such as if (r1=0) then r7010=1.
3) It's allowed that one monitor opens another one, but won't closed itself; such as if (r7001=0) then r7010=1, 1# monitor when it meets the requirement opens 0# monitor, at this time 1# is still open.
4) In making program, before open the monitor, it must make the description to the monitor; if it opens a monitor(without task) which don't have description, the system will alarm prompting "E400: process monitoring variable undescribed".

5) If opened some monitor, change its monitor description in the instance of don't meet requirement and don't stop monitor, then the new monitor description will change the old description, and the monitor will still on the opening state, needn't restart. But it's very dangerous in this state, the monitor must be closed at first, then change its monitor description, then open it again.
6) After meets the monitor requirement, if the executed command in monitor condition is skip command(Pxxxx), close the monitor automatically; when the executed command is assignment or calculate command, don't close the monitor.
7) Monitoring management register cannot used for condition judge, otherwise, system alarm occurs; for example if (r7010 > 1) then (r002 = 2), system alarm "machining abnormal! E413: unknown process monitoring description".
8) If the monitor is opened, under the PAUSE/Block stop /Cycle stop state, the monitor is still effective; its assignment or operation command will be executed after meeting the requirement, the skip command can be executed by pressing "CYCLE START"key.
9) Once the monitor is opened, in the system inner, because its two description statements are alternated ceaseless, executed circularly, its execution speed is faster than the common program; for the calculation statement which executes assignment after meet the requirement, it may be executed for time after time, this variable result is uncertainly(suggest to don't use it like this). Pay attention in the common part program, this variable must be used carefully.
   For example, if (r7000=100) then r3=r3+1 ; // if meet the condition, r3 pluses 1, at this time pay much attention, the value of r3 is very uncertainly(the accumulation frequency is very high), if the call or transfer of subprogram in the program uses r3, it will induce the program execution uncertainly, suggest that the uncertainly variable like r3 can't be used for the real function of all command in this instance.
10) In the common program, read the monitor register, monitor management register, it's value is zero or uncertain; such as r5= r7000, then the value of r5 is uncertain.
11) If one monitor is open, it can check the signal change above 3ms width; when ten monitor are open, they can check the signal change above 30ms width.

9.3.3 Monitor program example

【Program example 1】

The following program introduce the explanation of process monitor.

In the batch machining, when the rough bar uneven length, it's hard to confirm the machining start point. Suppose a sensor is installed in the tool, then the system can use the sensor to confirm the machining start point.

In the following program, if UI05 corresponding pin is connected to the system detection signal; when the tool is far away the workpiece UI05="1"，when the tool is near the workpiece UI05="0"，when the tool is moving to the direction of near workpiece from far away, it is stopped at the position UI05="0", and confirm this point to be the machining start point.

```
%105
N0010 r7000=r1005            ;  0# monitor tests the state of input signal r1005, it forms the
                                 monitor description with nether judgment statement
N0020 if(r7000=0)  then  P1000   ; If the signal r1005 is monitored to be "Zero", then turn to
                                      P1000 program running
N0030 G00 Z300 X200          ;  At first orientate to the initial point
N0040 G00 X180               ;
N0050 r7010=1                ;  Opening 0# monitor by mode 1, when it meets the requirement,
                                 stops the motion immediately, and turn P1000
N0060 G00 W-100  F1000       ;  The tool is closing the workpiece from far away
N0070 r7010=0                ;  If the last command is finished, but nothing can be checked,
                                then close the 0# monitor
N0080 G00 Z300 X200          ;  Back to initial point
N0080 M02
N1000 G50 Z200 X180          ;  Set this point to be the machining start point, set the workpiece
                                coordinate system again
N1020 G01 Z90  F500          ;  Cut outer circle
N1030 G01 X0                 ;  Cut off
N1040 G51                    ;  Revert the workpiece coordinate system
N1050 G00 Z300 X200          ;  Back to initial point
N1060 M02                    ;
```

【Program Example 2】

The following program introduce the explanation of process monitor.

The system has exterior cycle start/pause function, the handlers stand far away the system and can use the exterior press-button to come true the start/pause function. But in the position which is far away the system, it's hard to come true "single block stop". In the following program, it will come true the function through the process monitor

In the program, if UI05 corresponding pin is connected to the system detection signal; when press the switch UI05="0", when release UI05="1". After opened the monitor, this press-button can make the cycle switch between single block and continuum execution working mode.

```
%106
N0030  r7000 =r1005           ; 0# monitor tests the state of input signal r1005
N0040  if(r7000 =0) then r5008=2   ; If the signal r1005 is monitored to be "zero", then
                                 pause
N0030  r7001 =r1005           ; 1# monitor tests the state of input signal r1005, r1006
N0040  if(r7001 =1) then r7010=2   ; If the press-button is released, then open the 0#
                                monitor again
N0070  r7011=2                ; Open the 1# monitor by mode 2
N0070  r7010=2                ; Open the 0# monitor by mode 2
N0010  G0 X100 Z200
N0020  G00 X50 Z190
N0050  G1 X50 Z160 F300
N0060  G2 W-80 R100
N0080  G1 U10 W-20
N0080  G1 W-20
N0080  G1 U10 W-20
N0090  G0 X100 Z200
N0160  M02
```

【Program Example 3】

The following program introduce the explanation of process monitor.

In the following program, if the UI05, UI06 pin are connected to detection signal, output signal UO05 pin, in the machining process, when UI05, UI06 are "0", the system is required to output "0" from UO05 pin, and output "1" in other instance.

```
%107
N0010 r7000=r1005 or r1006        ; 0# monitor tests the state of input signal r1005, r1006
N0020 if(r7000=0) then r2005=0    ; If two signals r1005, r1006 are "zero" at the
                                    same time, UO05 outputs "zero";
N0030 r7010=1                     ; Opening 0# monitor by mode 1, when it meets the requirement,
                                    UO05 outputs "zero";
N1000 G00 Z300 X200               ; Orientate to the initial point
N1010 G00 X180                    ;
N1020 G01 Z90   F500              ; Cut outer circle
N1030 G01 X0                      ; Cut off
N1050 G00 Z300 X200               ; Back to initial point
N1060 M97 P1000                   ;
N1070 M02                         ;
```

9.3.4 Pulse monitoring (r7100)

In this system, there are other four pulse monitor variable with number 0#～3# in turn. They specially engage the pulse count of input signal. Each pulse monitor variable has a monitoring register and a management register separately, the corresponding number in turn are as following:

Pulse monitoring variable number: 0#～3# number in turn

Pulse monitoring register number: r7100～r7103 corresponding the monitor variable number in turn

Pulse monitoring management register number: r7110～r7113 corresponding the monitor variable number in turn

What is called pulse monitor, it belongs to process monitor too, its description mode, open/close mode, all rules are absolutely same to process monitor.

In the machining process, when the pulse monitoring is started, the right of process status bar will display "P-n". it also can check the state of system current used pulse monitoring. Such as: P-1, expresses one pulse monitoring is started.

◆The explanation of pulse monitoring:

1) At first make the description to pulse monitoring variable; (all assignment statement for r7100 are description)

   Such as: r7100 = r1001; r7100 adds 1 for the pulse signal of interface UI01

2) Then make the description to pulse monitoring condition;

   Such as: if (r7100>50) then P1500 ; if the r7100 count value is greater than fifty, then turn P1500

3) And then start the monitor through the assignment of pulse monitoring manager

   Through the assignment of pulse monitoring management register(r7110～r7113) , can open or close the monitor.

Among them: when the assignment 0, 1, 2 are same to process monitor.

When the assignment is 5, the pulse monitor counter is cleared to 0.

When the assignment is 6 or 7, the operator should set the pulse monitor count mode .

Assignment	The process method of matter
0	Close the opened monitor, just the same to process monitor
1	Open the monitor; the process method is absolutely same to process monitor
2	Open the monitor; the process method is absolutely same to process monitor
5	When the assignment is 5, the pulse monitor counter is cleared to 0.
6	Set the counter mode: when the operation result is changed from zero to non zero, the inner counter will plus 1.
7	Set the counting mode: when the operation result is changed from zero to non zero, the inner counter will plus 1.

◆How to count about the pulse monitoring ;

1) When the pulse monitoring is opened, it can't execute the assignment description statement repeatedly, when the last operation result compared with this time, it matches the following skip, the inner counter will add 1.

   If set 6, the last operation result is 0, however this time operation result is non- zero, the inner counter will plus 1.

   If set 7, the last operation result is non-zero, however this time operation result is zero, the inner counter will plus 1.

2) In the initial that the pulse monitoring is opened, the counter is automatically cleared to zero.

3) When only one pulse monitoring is opened, it can check the above 3ms width signal change; when four pulse monitoring are opened, it can check the above 12ms width signal change.

9.3.5 Pulse monitoring program example

【Program example】

The following programs introduce the explanation of pulse monitoring.

In the following program, if UI05 corresponding pin is connected to the system detection signal; in the machining, when the times of UI05 changing from "0" to "1" is greater than ten, end the program.

```
%108
N0010 r7100 = r1005              ; Making the plus 1 count to r1005 pulse signal
N0020 if(r7100>10)  then  P2000; If the monitor pulse number is greater than 10, then
                                   turn to P2000 running
N0030 r1=0                       ;
N0040 r7110=6                    ; Set the count mode, when it is changed from zero to non-zero,
                                  the inner counter will plus 1.
N0050 r7110=2                    ; Choosing the monitor working mode 2 to open
N1000 G00 Z300 X200              ; Orientating to initial point
N1010 G00 X180                   ;
N1020 G01 Z90  F500              ; Cut outer circle
N1030 G01 X0                     ; Cut off
N1050 G00 Z300 X200              ; Back to the initial point
N1060 M97 P1000                  ;
N2000 M02                        ;
```

9.3.6 Variable transfer register (r7900)

Variable transfer register: r7900; (the system forbid to use this variable in the process monitor description statement)

【Explanation example】

r7900= 1 ;

Write any number to this register, it expresses all common variable in monitor backup area are copied to common variable storage, the following will explain this register function.

In an ordinary way, in order to avoid the collision, when some common variable is used in the monitor, this common variable must be avoided using in the common block. Because the system has a common variable storage, and a backup storage of monitor variable, the two section variable value change maybe aren't synchronous.

Example as common variable 3, explain the change of r3:

1) When r3 assignment statement is executed, r3 is modified in the common program, then the r3 in monitor will be modified immediately too;
2) When the r3 assignment statement is executed in the monitor, it only has modified the r3 in backup monitor; now the r3 in common program isn't modified.
3) When the variable transfer statement(i.e.r7900=1) has been executed, the system will copy all common variable in backup monitor to common variable storage;

【Program Example】

In the following program, if UI05 corresponding pin is connected to the system detection signal; in the machining, when the times of UI05 changing from "0" to "1" is greater than ten, after the cycle execution is finished, the program end.

```
%109
N0010 r7100 = r1005              ;  Making the plus 1 count to r1005 pulse signal
N0020 if(r7100>10) then  r1=1    ;  If the pulse number is greater than ten, r1 equals
                                    to 1, in fact it has modified the r1 in backup monitor
N0030 r1=0                       ;  Set the initial value
N0040 r7110=6                    ;  Set the count mode, change from zero to non-zero, the inner
                                    counter will plus one.
N0050 r7110=2                    ;  Choose the monitor working mode 2 to open
N1000 G00 Z300 X200              ;  Oriented the initial point
N1010 G00 X180                   ;
N1020 G01 Z90  F500              ;  Cut outer circle
N1030 G01 X0                     ;  Cut off
N1050 G00 Z300 X200              ;  Back to the initial point
N0060 r7900=1                    ;  Read the common variable value of monitor
N0020 if(r1=1) then  P2000       ;  If r1 equals to 1, then turn to P2000

N1060 M97 P1000                  ;
N2000 M02                        ;
```

9.4 Attached List

9.4.1 ASCII list

character	ASCII code	character	ASCII code	character	ASCII code	character	ASCII code	character	ASCII code	character	ASCII code
Space	32	0	48	@	64	P	80	`	96	p	112
!	33	1	49	A	65	Q	81	a	97	q	113
"	34	2	50	B	66	R	82	b	98	r	114
#	35	3	51	C	67	S	83	c	99	s	115
$	36	4	52	D	68	T	84	d	100	t	116
%	37	5	53	E	69	U	85	e	101	u	117
&	38	6	54	F	70	V	86	f	102	v	118
,	39	7	55	G	71	W	87	g	103	w	119
(	40	8	56	H	72	X	88	h	104	x	120
)	41	9	57	I	73	Y	89	i	105	y	121
*	42	:	58	J	74	Z	90	j	106	z	122
+	43	;	59	K	75	[	91	K	107	{	123
,	44	<	60	L	76	\	92	l	108	|	124
-	45	=	61	M	77	]	93	m	109	}	125
.	46	>	62	N	78	^	94	n	110	~	126
/	47	?	63	O	79	-	95	o	111		

9.4.2 Often used color and code value corresponding list

name	code	name	code	name	code	name	code	name	code	name	code
black	0	cyan	41	purple	85	red	168	yellow	245	grey	251
blue	6	Light blue	54	light green	105	pink	172	golden	248	hoar	253
green	35	green yellow	80	brown	126	orange	231	silvery white	250	white	255

Chapter 10 Customization Command Program

10.1 Customization Command

They system has a set of customization command except the offered standard M command. The machine manufacturer can set some commands to come true the control of additive equipment, however the operator can operate the additive equipment by input the command expediently.

The system has provided fifteen customization commands from M60 to M74, how many is need exactly is edited by the machine manufacturer. The customization command must be edited in %254 program, at first debug %245 program successfully in AUTO working mode, then harden the program in EDIT working mode; after the program is hardened successfully, the hardened customization command can be used in AUTO mode or other program(i.e. %000～%253) , otherwise the system will alarm that there is no customization command.

This chapter will express the written customization command method from example:

【Program example:】

It is supposed that the manufacturer install a loader in the machine. UO31 output pin controls the forward and back of the loader, when it is input “0”, the loader goes ahead, when it is output “1”, the loader will go back; checking the loader forward and back is in the place or not by UI05/UI06 inputting pin, when the system has checked the UI05 is “0” the loader is in the forward place, when the system has checked the UI06 is “0” the loader is in the back place; in the example M61 command is used for controlling the loader forward an check if it is in-position ; M62 command is used for controlling the loader backing, and check if it is in the back place.

```
%254
 N0010 M98 P1000                  ; No. %245 program starts execution, call the M61
                                    command at first
 N0020 G04 D3                     ;
 N0030 M98 P2000                  ; Cll M62 command
 N0040 G04 D3                     ;
 N0050 M02                        ;
 N1000 -M61                       ; The start sign of M61 command
 N1010 r2031=0                    ; Loader forward
 N1020 if (r1005=1)  then  P1000  ;If it detects that UI05 is “1”, then start the cycle
                                    check
 N1030 M99                        ; M61 command is end
 N2000 -M62                       ; The start sign of M62 command
 N2010 r2031=1                    ; Loader backing
 N2020 if (r1006=1)  then  P2000  ; If it detects that UI06 is “1”, then start the cycle
                                    checking
 N2030 M99                        ; M62 command is end
```

10.1.1 Customization command program format

In No. %254 program, the system customization command program format is : input a set program which starts from “M60” to “M99” in the program, this block is formed M60 command. The other block which start by “-M61 ～ -M74”and end by “M99” is formed M61 ～ M74 command.

【Format】

```
N1000 -M61                         ; The start sign of M61 command
N1010 r2031=0                      ; Loader forward
N1020 if (r1005=1)  then  P1000    ; If it detects that UI05 is "1", then start the cycle
                                     checking
N1030 M99                          ; M61 command is end
```

【Explanation】

1)The customization command is mainly formed by statement, when G code want to be added in it, the position parameter **P404_d2**=1 must be set, it also is to say M61 command allows the G motion code, otherwise the system alarms.

10.2 Customization Command Store (**P254**)

The customization command harden is in No. %254 program. So No. %254 program also is called the user-defined command storeroom: P254 mainly includes the M60~M74 command which is formed by statement and block, the system will make the special translate and edit in translating and edition.

10.2.1 Format and debugging of customization command storeroom

【Format】

P254 program format:

```
N0010   M98 P1000         ;   No.%254 program starts execution
N0020   M98 P2000         ;   Call M61 command
N0030   M98 P3000         ;   Call M62 command
N0040   M02               ;
N1000   -M60              ;   the start of M60
…
N1100   M99               ;   the end of M60
N2000   -M61              ;   the start of M61
…                         ;   the user customized M61 content
N2100   M99               ;   the end of M61
N3000   -M62              ;   the start of M62
…                         ;   the user customized M62 content
N3100   M99               ;   the end of M62
```

The debugging steps of customization command storeroom is as following:

1) Edit the user need customization command according to the above customization command storeroom program format

2) debug the program by single block mode in AUTO working mode

3) After debugged the program, harden the program in EDIT mode, press the key: hp5 5 ; the machine manufacturer confirm if it's allowed to modify the hardened program and harden again, it also is to set the position parameter **P404_d0**=1.

4)The system prompts that after the P254 translating and harden succeed, press "ESC" key.

【Explanation】

After the No.%254 translating and harden succeed, it also can input the customization command in P254 in JOG working mode and run, in order to check the correctness of P254.

10.2.2 Explanation of customized command storage

In the JOG working mode, input the customization command directly when it's need to execute the hardened customization command in P254. In editing program the hardened customization command in system P254 can be used , the operation is simple and convenient.

【Using customization command format 】

```
%001            ; execute the customization command beside the No.%254 program
N0010 M61       ; execute M61 command
N0020 G04 D3    ;
N0030 M62       ; execute M62 command
N0040 G04 D3    ;
…
…
N0050 M02       ;
```

【explanation】

1) The M60~M74 can be used in JOG working mode or other program directly only the No.% 254 program has hardened to FLASH, otherwise the system alarm; when the corresponding customization command isn't written in No. % 254 program, but it is used in JOG working mode or other program, the system alarm too.
2) The operation of how to harden the No.%254 program to FLASH, please refer the No.%254 program explanation, with the detail in OPERATION, 4.3 EDIT working mode in this explanation notebook.
3) After the No. %254 program is modified, it must be hardened to FLASH again, otherwise the called M60~M74 command in JOG working mode or other program aren't the latest customization command after modified.
4)In AUTO working mode, when the M60~M74 used variable are used in main machining process, must pay attention to the impaction of variable cross-change to the program
5) M60～M74 command must be used separately , such as if(r1>100) then M61 expression will alarm.

【Special attention】

1) When user-defined command is executed in AUTO mode, press CYCLE PAUSE, the system will not stop the blocks under user-defined command, rather it will continue the execution after a short pause.
2) When user-defined command is executed in AUTO mode, if SINGLE is valid, SINGLE function is valid for the user-defined command not to the blocks under the command.
3) When user-defined command is executed in MANUAL mode, press CYCLE PAUSE, the user-defined command execution will be paused.

10.2.3 Customized command machining example

【Program example】

The following is the program of coming true the change tool operation by written customization command. M61 changes the first too; M62 changes the second tool; M63 changes the third tool; M64 changes the fourth tool. Note: if tool changing is executed under following programs, M60 user-defined command should be set at first; see Section 3.4.3.6 in CONNECTION for details.

```
%254
N0000  M98 P50                              ; Call M61, change the T11 tool number
N0010  M98 P200                             ; Call M62, change the T22 tool number
N0020  M98 P350                             ; Call M63, change the T33 tool number
N0030  M98 P500                             ; Call M64, change the T44 tool number
N0040  M30                                  ; Program end
N0050  -M61                                 ; Start to call M61, start to change tool
N0060  T11                                  ; Target tool number
N0070  if(r1001 = 0) then(P190) else(P80)   ; Judge the current tool is consistent to target tool
                                              or not
N0080  r2011 = 1                            ; Close the tool post CCW rotation
N0090  r2012 = 0                            ; Tool post CW rotation
N0100  r4010 = r39                          ; Changing tool time is set to be 30 seconds
N0110  if(r4010 < 5) then(P650) else(P120); Judge the tool changing time is too long or not
N0120  if(r1001 = 0) then(P130) else(P110); Judge the tool position signal
N0130  r2012 = 1                            ; Close the tool post CW rotation
N0132  r4011 =50                            ; Set to delay 50ms
N0134  if(r4011<2) then (P140) else(P134)  ; Delay 50ms
N0140  r2011 = 0                            ; The tool post CCW rotation
N0150  r4011 = r40                          ; Set the tool post CCW rotation time
N0160  if(r4011 < 5) then(P170) else(P160)     ; Check the tool post CCW rotation time
N0170  r2011 = 1                            ; Close the tool post CCW rotation
N0172  r4010 = 100                          ; Tool post CCW rotation in-position delayed time
N0174  if(r4010 < 5) then(P180) else(P174)     ;Tool post CCW rotation in-position delayed
N0180  if(r1001 = 0) then(P190) else(P700)     ; Judge the in-position signal
N0190  M99                                  ; Tool change end
N0200  -M62                                 ; Start to call M62, start the tool change
N0210  T22                                  ; Target tool number
N0220  if(r1002 = 0) then(P340) else(P230); The current tool is consistent to target tool or not
N0230  r2011 = 1                            ; Close tool post CCW rotation
N0240  r2012 = 0                            ; Tool post CW rotation
N0250  r4010 = r39                          ; Set the tool change time 30 seconds
N0260  if(r4010 < 5) then(P650) else(P270); Judge the tool change time is too long or not
```

```
N0270   if(r1002 = 0) then(P280) else(P260); Judge the tool position signal
N0280   r2012 = 1                          ; Close the tool post CW rotation
N0282   r4011 =50                          ; Set to delay 50ms time
N0284   if(r4011<2) then (P290) else(P284) ; Delay 50ms
N0290   r2011 = 0                          ; Tool post CCW rotation
N0300   r4011 = r40                        ; Set the tool post CCW rotation time
N0310   if(r4011 < 5) then(P320) else(P310); Check the tool post CCW rotation time
N0320   r2011 = 0                          ; Close the tool post CCW rotation
N0322   r4010 = 100                        ; Tool post CCW rotation in-position delayed time
N0324   if(r4010 < 5) then(P330) else(P324); Tool post CCW in-position delayed time
N0330   if(r1002 = 0) then(P340) else(P700); Judge the in-position signal
N0340   M99                                ; Change tool end
N0350   -M63                               ; Start to call M63, start the tool changing
N0360   T33                                ; Target tool number
N0370   if(r1003 = 0) then(P490) else(P380); The current tool is consistent to target tool or not
N0380   r2011 = 1                          ; Close the tool post CCW rotation
N0390   r2012 = 0                          ; Tool post CW rotation
N0400   r4010 = r39                        ; Set the tool changing time to 30s
N0410   if(r4010 < 5) then(P650) else(P420) ; Judge the tool change time is too long or not
N0420   if(r1003 = 0) then(P430) else(P410) ;Judge the tool position signal
N0430   r2012 = 1                          ; Close the CW rotation
N0432   r4011 =50                          ; Set to delay 50ms time
N0434   if(r4011<2) then (P440) else(P434) ; Delay 50ms time
N0440   r2011 = 0                          ; Tool post CCW rotation
N0450   r4011 = r40                        ; Set the tool post CCW rotation time
N0460   if(r4011 < 5) then(P470) else(P460); Check the tool post CCW rotation time
N0470   r2011 = 1                          ; Close the tool post CCW rotation
N0472   r4010 = 100                        ;Tool post CCW in-position delayed time
N0474   if(r4010 < 5) then(P480) else(P474);Tool post CCW in-position delayed time
N0480   if(r1003 = 0) then(P490) else(P700); Judge the in-position signal
N0490   M99                                ; Tool change end
N0500   -M64                               ; Start to call M64 and execute the tool change
N0510   T44                                ; Target tool number
N0520   if(r1004 = 0) then(P650) else(P530)      ; The current tool is consistent with target tool
                                                       or not
N0530   r2011 = 1                          ; Close the tool post CCW rotation
```

```
N0540   r2012 = 0                             ; Tool post clockwise rotates
N0550   r4010 = r39                           ; Set the change tool time to 30s
N0560   if(r4010 < 5) then(P650) else(P570); Judge the change tool time is too long or not
N0570   if(r1004 = 0) then(P580) else(P560); Judge the tool position signal
N0580   r2012 = 1                             ; Close the tool post CW rotation
N0582   r4011 =50                             ; Set to delay 50ms
N0584   if(r4011<2) then (P590) else(P584)   ; Delay 50ms
N0590   r2011 = 0                             ; Tool post CCW rotation
N0600   r4011 = r40                           ; Set the tool post CCW rotation time
N0610   if(r4011 < 5) then(P620) else(P610); Check the tool post CCW rotation time
N0620   r2011 = 1                             ; Close tool post CCW rotation time
N0622   r4010 = 100                           ; Tool post CCW rotation in-position delayed time
N0624   if(r4010 < 5) then(P630) else(P624); Tool post(CCW) in-position delayed
N0630   if(r1004 = 0) then(P640) else(P700); Judge the in position signal
N0640   M99                                   ; Tool change end
N0650   r2012 = 1                             ; Close the tool post CW rotation
N0652   M05                                   ; Close spindle
N0660   00 SE335                              ; Check the tool position signal overtime
N0670   r5002 = 1                             ; Open display
N0680   r5002 = 1000                          ; Display alarm
N0690   r5008 = 1                             ; Motion pause
N0692   M00                                   ; Program pause
N0700   01 SE333                              ; Tool selection number alarm
N0710   r5002 = 1                             ; Open display
N0720   r5002 = 1001                          ; Display alarm
N0730   r5008 = 1                             ; Motion pause
N0740   M00                                   ; Program pause
```

10.3. Foot switch in M61 command

◆Foot switch in M61/ M62, M63/ M64, M65/ M66 commands:

When you need foot switch to control some reverse motion commands such as M10/M11, M79/M78, M61/M62 can realize it. For example, M61 is programmed as feeding-in, M62 as feeding-back, set the corresponding I/O of foot switch input pin in parameter P533, and connect them correctly. Then, M61/M62 can be executed alternately.

◆ Key control M61~M66:

When the system input interface is not enough, set parameters P533~P535 to 99; in AUTO or MANUAL mode, press numerical keys can control commands M61~M66:

When P533 is 99, key 1 corresponds to M61, key 2 to M62; when P534 is 99, key 3 to M63, key 4 to M64; when P535 is 99, key 5 to M65, key 6 to M66.

【Instruction】

1) In MANUAL/AUTO mode, key control function can only be used when the system is free or no program is executed. It cannot be used even in SINGLE stop mode and when window popped up.

2) When the system is power-on, M61/M63/M65 is alway executed when foot switch is used for the fisrt time.

3) In the process of M61/M63/M65 execution, is RESET key is pressed, the system will go to M62/M64/M66 when foot switch is press next time.

CONNECTION

Chapter 1 Interface

1.1 Rear Cover Interface Position Layout

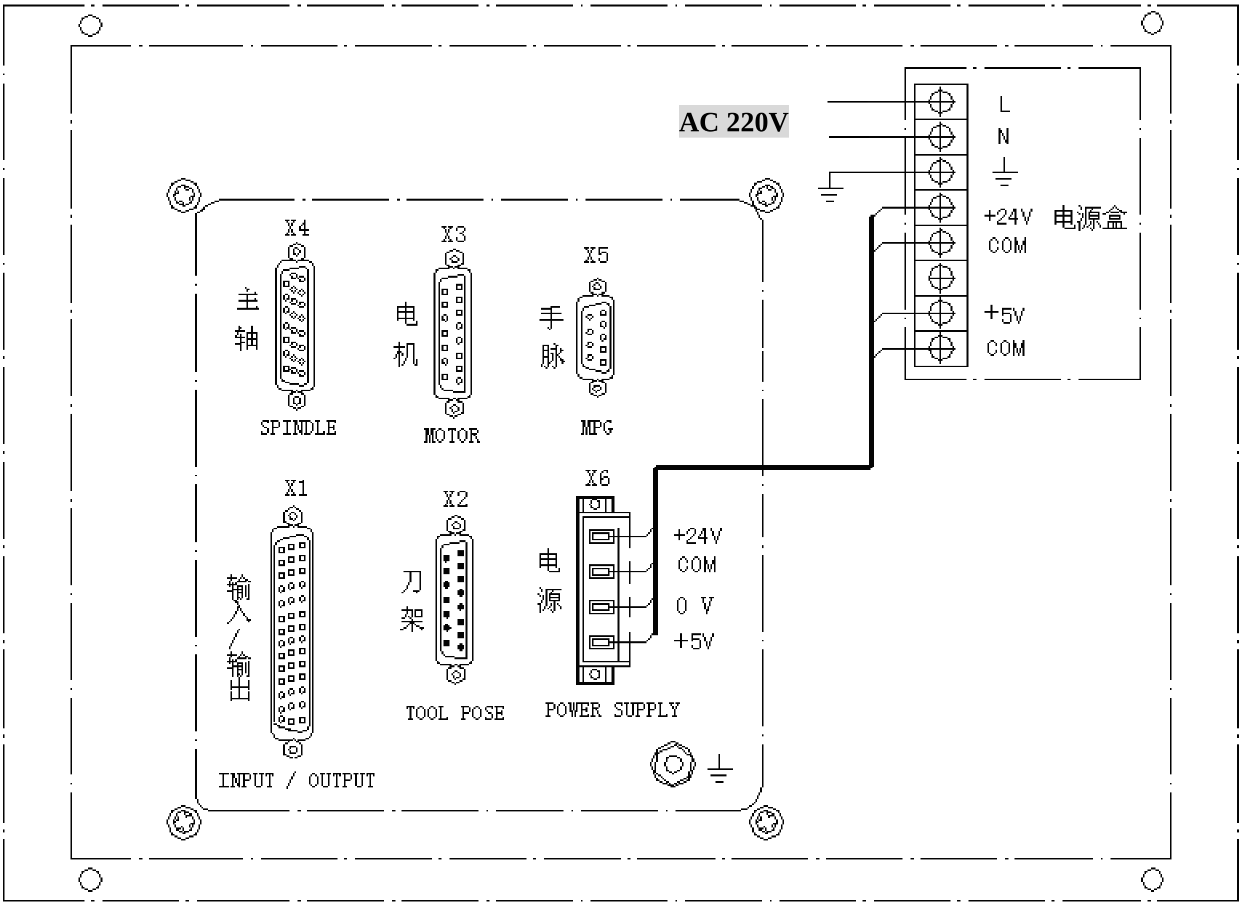


Fig. 1-1 rear cover interface layout

【Explanation】

- X1：input/output, 44-pin D-type female socket, CNC receives machine signal/CNC signal outputs to machine interface
- X2：tool pose, 15-pin D-type male socket, input/output interface
- X3：motor, 5-pin D-type female socket, interface of X/Z drive unit
- X4：spindle, 26-pin D-type female socket, spindle coder, spindle inverter and Y drive unit interface
- X5：MPG, 9-pin D-type female socket, connect with MPG
- X6：input power supply, green 4-pin female socket, the power supply box has been connected to the system X6 interface, the user only connects with 220V power supply
- Power supply box: adopt GSK-PB or GSK-PC2 (their connecting terminals are different); GSK-PB is adopted in Fig. 1-1. It supplies GND, +5V, +24V power.

1.2 Total Frame

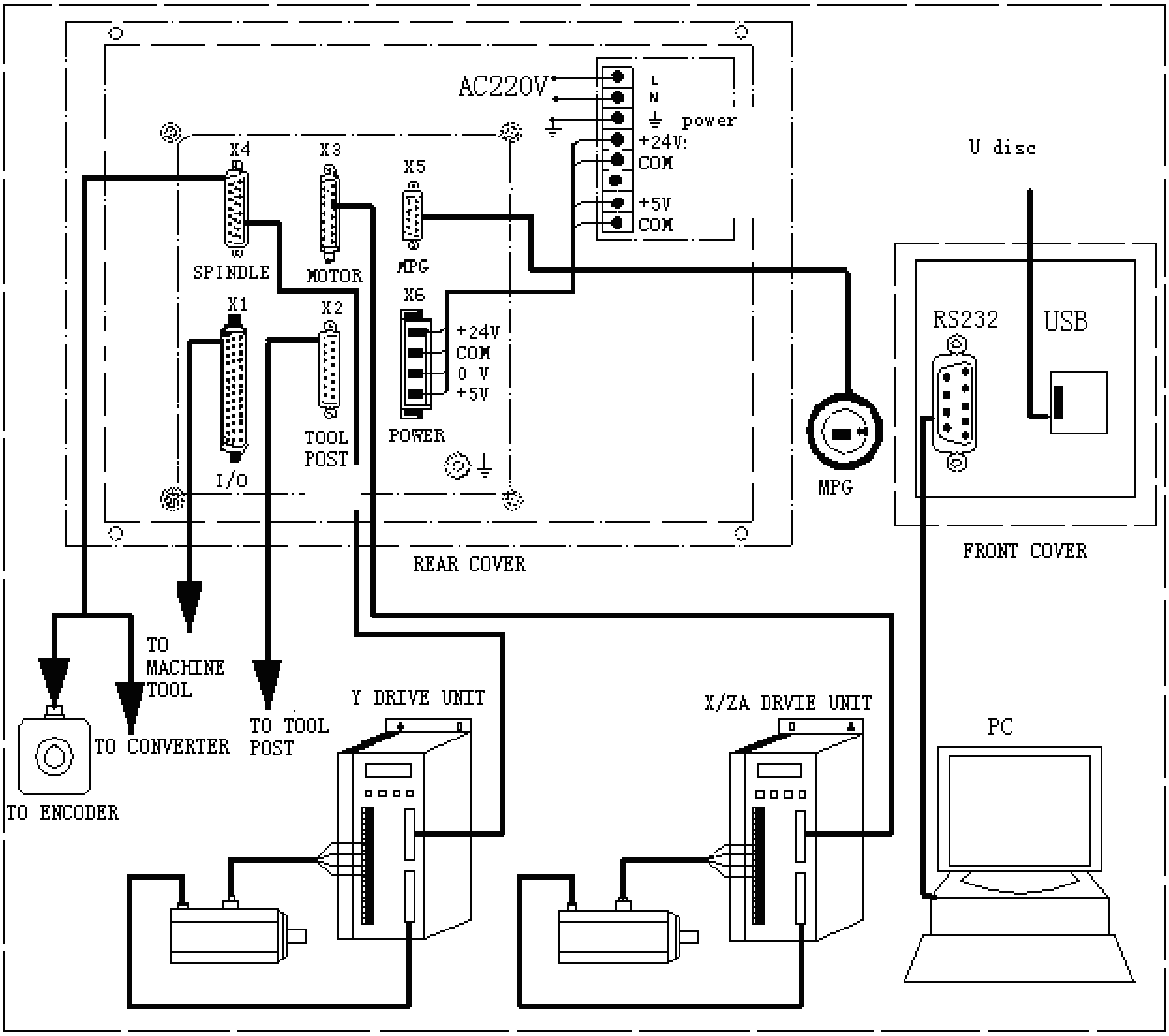
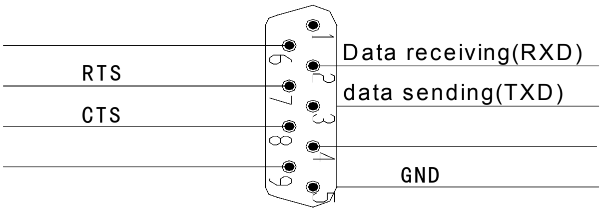


Fig. 1-2 total connection drawing

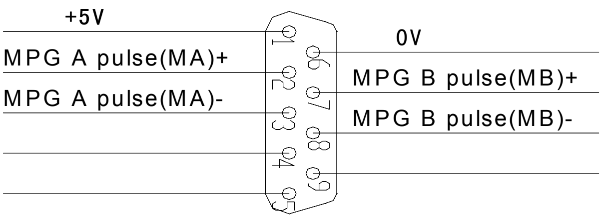
Chapter 2 Interface Graph

2.1.1 Interface layout 1

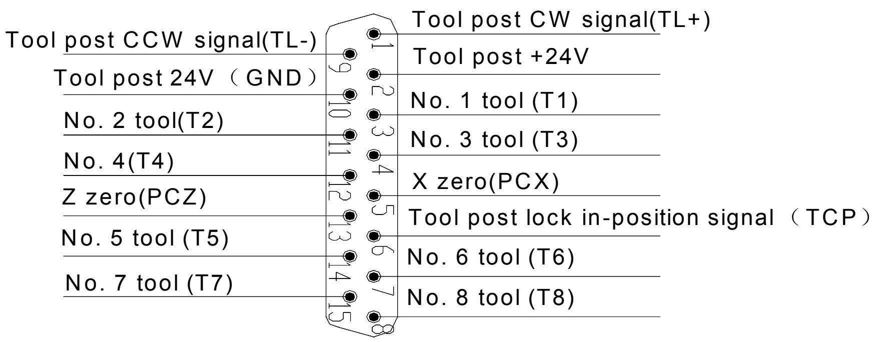
Front cover RS232 communication(male)



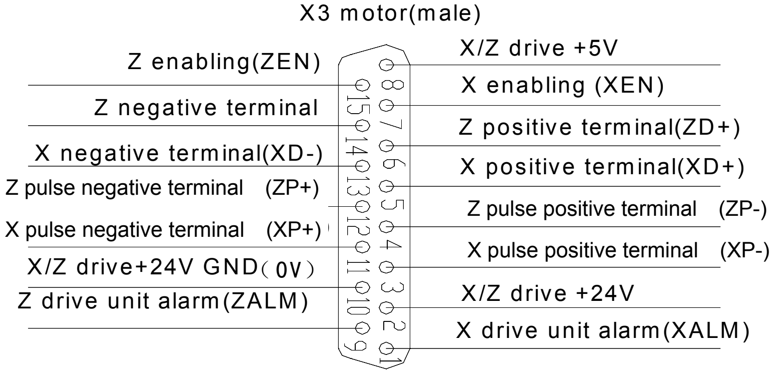
X5 MPG(female)



X2 tool post (male)

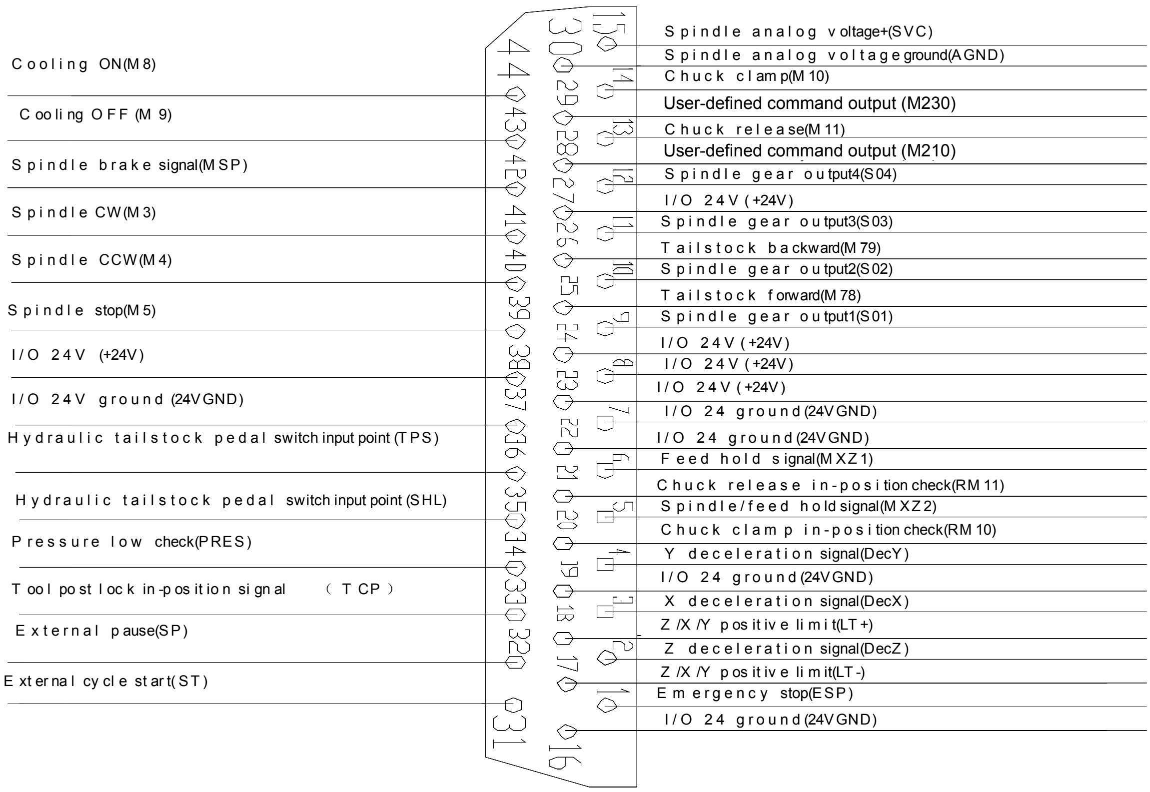


X3 motor(male)

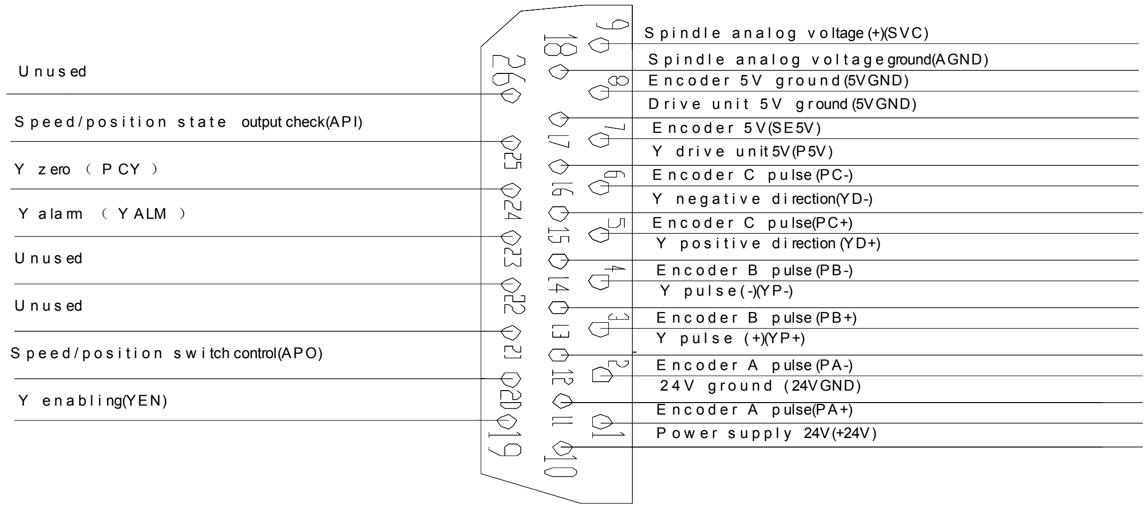


2.1.2 Interface layout 2

X1 input/output （female）



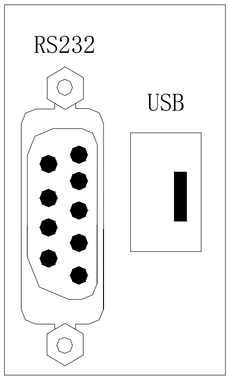
X4 spindle(female)



Chapter 3 CNC Device Connection

3.1 Front Cover Communication Interface

The CNC system can connect with the external PC(RS232 interface) or another CNC system by the serial to perform the data exchange or transmission; also perform the data exchange or transmission by USB interface and external U disk. The front cover communication position layout is as follows:



【Explanation】

1) Serial communication interface: RS232 communication, pin 9 D male to connect with PC RS232 interface.
2) USB interface: connect with U disk.

3.1.1 USB interface

USB interface is used to connect the CNC system and U disk. The system not only sends the data to the U disk, and also receives the data in the U disk by the USB interface. The U disk is directly inserted into the USB interface on the system panel, and the system automatically identifies and opens the content of the U disk when the U disk creates the file and file name in the root catalog according to the file catalog requirements of the system.

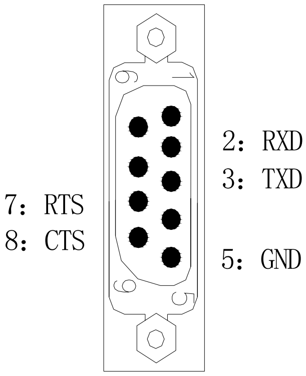
【Note】

1) The system USB interface must be covered without being used and without being exposed for long time, otherwise, which causes the surface metal being oxidated and reduces the interface sensitivity.
2) Do not keeping the U disk in the system USB interface for long time, otherwise, which causes the system interface to be aged, and damages the U disk.
3) After the U disk is used, the user must press ESC to close the U disk before pulling out it, at the moment, the USB icon displayed on the system window disappears and it can be pulled out from the system USB interface, otherwise, which damages the system hardware and the U disk.

3.1.2 Serial RS232 technical specifications

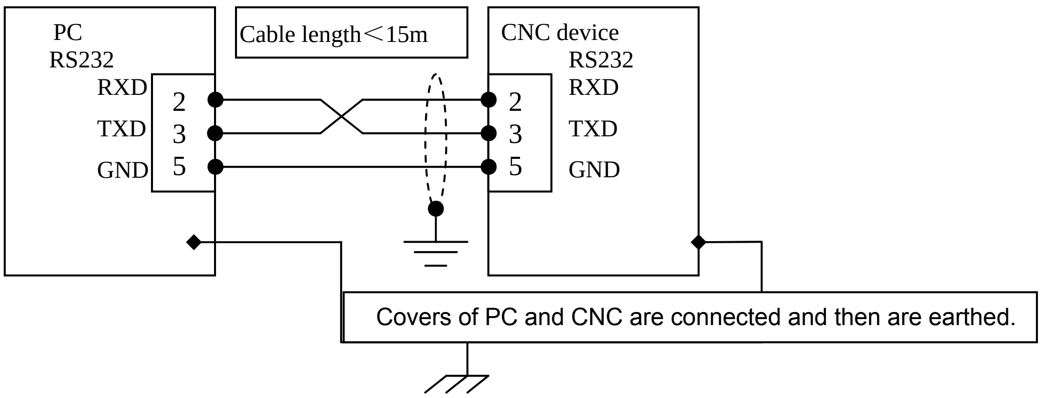
- Level: standard RS232 level;
- Communication baud: 9600 bps, 19200 bps, 38400bps are selected by the parameters.

3.1.3 Serial RS232 signal definition



Pin	Signal name	Signal explanation	Signal direction
2	RXD	Receiving data	PC → CNC
3	TXD	Sending data	CNC → PC
5	GND	Communication signal ground	
7	RTS	Unused	
8	CTS	unused	

3.1.4 Connecting with external PC by RS232

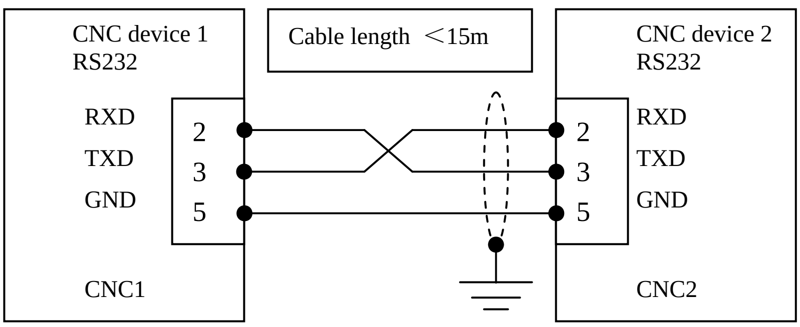


! When the system performs the data with the external PC, the user must use our developed communication software.

! The communication cable length cannot exceed 15m, otherwise, which causes the data be distortion.

! For protecting RS232 interface circuit from being damaged by the static electricity, the coats of the CNC and PC should be earthed.

3.1.5 Connecting with another CNC system by RS232 communication interface (communication connections between GSK928TEa)



! The communication cable length must be less than 15m, otherwise, which will cause the skipping data distortion.

3.2 **X1, X2** Interface

The CNC system X1, X2 interface have 23-channel digital input, 18-channel digital output, which use the photoelectric isolation.

3.2.1 X1, X2 interface signal definition

Special attention：

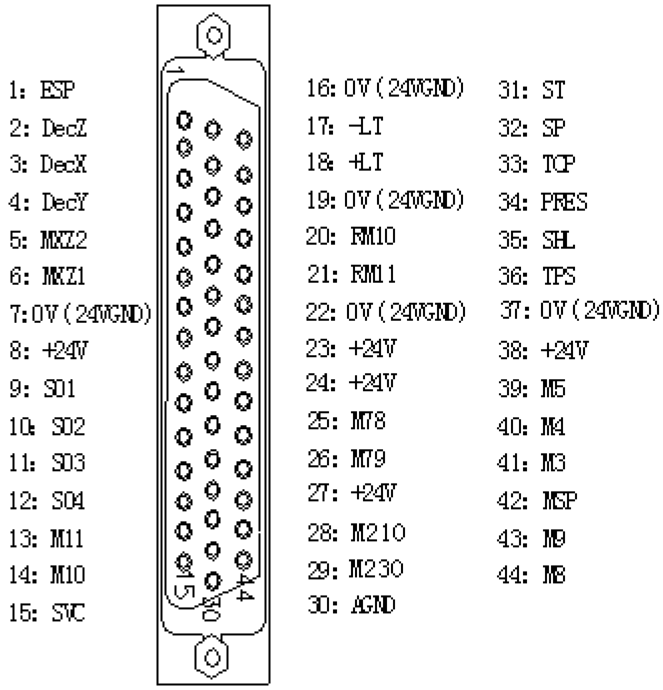
1) The 23-channel digital input signal and 18-channel digital output signal correspond to 23 input pins and 18 output pins. Each pin has their “pin number” and two “signal names”(exclusive signal name and common signal name”. Input general signal names are numbered UI01~UI32, output common signal names are numbered UO01~UO32; among them, UI17~UI25, UO19~UO32 are not led out (unused; displayed in grey in DIAGNOSIS mode). If a signal is not specified, it is displayed in white UI** or UO**, representing it can be used otherwise.
2) This system has already set control and detection pin for most of the devices. These pins are named “standard signal name”, for example, spindle, chuck, tailstock, tool post etc. Set parameters correctly before used these functions. In DIAGNOSIS mode, the standard signal names are displayed in yellow, representing it cannot be used otherwise.
3) During system parameter initialization, some command (such as M91, M21, G31) has been set pins i.e. been defined interface parameters P500 (M210, P501, (M230), P517 (M91I), P518 (M93I), P532 (G31I); they are displayed in green in DIAGNOSIS mode; machine tool builder can make connection according to these interface parameters, the system detect corresponding signals on pins.
4) Some other devices (see Section 4.4.9 in OPERATION), there is not pin set for their functions. They can be set to any pin in this way: fill the sequence number of unused “general signal name” in the “interface parameter” in PARAMETER mode. The newly added signals in “interface parameters” are displayed in green in DIAGNOSIS mode. For example: input signal UI05 is invalid for 4-position tool post. Set parameter P511 to 5, it turns to be the detection signal of protection door (SAGT). The system detects UI05 signal (pin 14 on X2 interface) during protection door detection.
5) Through statement programming, the value of input interface signal r1001~r1032 can be read; but not all output signal can be read; when parameter P412_d0=0, statement programming can only be performed on “UO” pins displayed on DIAGNOSIS screen; otherwise, system alarm will be raised; to read variable r1005 is to read UI05, in another words, to detect the level of pin 14 on X2 interface.
6) “Pin 15 on X1 interface” and “pin 9 on X4 interface” are “spindle analog voltage +” signals (SVC). They have the same functions.
7) “Pin 30 on X1 interface” and “pin 18 on X4 interface” are “spindle analog voltage ground” signals (AGND). They have the same functions.
8) “Pin 33 on X1 interface” and “pin 6 on X2 interface” are “spindle analog voltage ground” signals (TCP) . They have the same functions.

The definition of 23-channel digital input signal and 18-channel digital output signal are as follows:

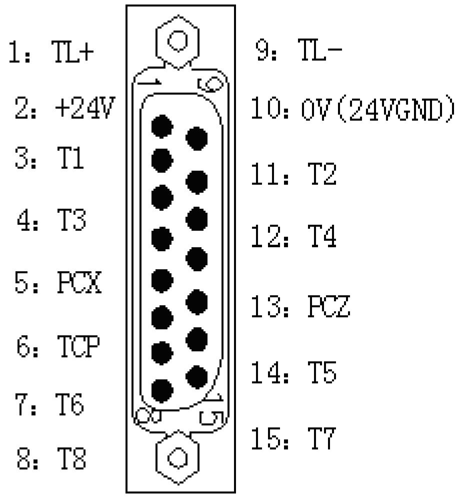
Interface	Pin	Standard Signal name	General signal name	Variable	Signal function
X1 interface	1	ESP			Emergency stop (emergency stop signal)
	2	DecZ	UI28	r1028	Z axis deceleration signal
	3	DecX	UI29	r1029	X axis deceleration signal
	4	DecY	UI30	r1030	Y axis deceleration signal
	5	MXZ2	UI15	r1015	Spindle//feed hold signal
	6	MXZ1	UI16	r1016	Feed hold signal
	7	0V (24VGND)			IO24V earthing
	8	+24V			24V
	9	S01	UO01	r2001	Spindle gear output 1
	10	S02	UO02	r2002	Spindle gear output 2
	11	S03	UO03	r2003	Spindle gear output 3
	12	S04	UO04	r2004	Spindle gear output 4
	13	M11	UO13	r2013	Chuck releasing
	14	M10	UO14	r2014	Chuck clamping
	15	SVC			Spindle analog voltage +
	16	0V (24VGND)			IO24V earthing
	17	LT-	UI31	r1031	ZXY negative limit
	18	LT+	UI32	r1032	ZXY positive limit
	19	0V (24VGND)			IO24V earthing
	20	RM10	UI14	r1014	Chuck clamping in-position check
	21	RM11	UI13	r1013	Chuck releasing in-position check
	22	0V (24VGND)			IO24V earthing
	23	+24V			24V
	24	+24V			24V
	25	M78	UO15	r2015	Tailstock going forward
	26	M79	UO16	r2016	Tailstock going backward
	27	+24V			24V
	28	M210	UO17	r2017	P500 set as user-defined command output
	29	M230	UO18	r2018	P501 set as user-defined command output
	30	AGND			Spindle analog voltage ground
	31	ST	UI26	r1026	External cycle start
	32	SP	UI27	r1027	External pause
	33	TCP	UI09	r1009	Tool post locked in-position signal
	34	PRES	UI10	r1010	Pressure LOW check
	35	SHL	UI11	r1011	Hydraulic chuck foot switch input
	36	TPS	UI12	r1012	Hydraulic tailstock foot switch input
	37	0V (24VGND)			IO24V earthing
	38	+24V			24V
	39	M5	UO05	r2005	Spindle stop
	40	M4	UO06	r2006	Spindle CCW
	41	M3	UO07	r2007	Spindle CW
	42	MSP	UO08	r2008	Spindle brake signal
	43	M9	UO09	r2009	Cooling OFF
	44	M8	UO10	r2010	Cooling ON

Table 3-2

Interface	Pin name	Standard signal name	General signal name	Variable name	Standard signal name function explanation
X2 interface	1	TL+	UO12	r2012	Tool post(CW) output signal
	2	+24V			Power supply 24V
	3	T1	UI01	r1001	Tool post position signal T1
	4	T3	UI03	r1003	Tool post position signal T3
	5	PCX			X axis zero point signal
	6	TCP	UI09	r1009	Tool post lock in-position signal
	7	T6	UI06	r1006	Tool post position signal T6
	8	T8	UI08	r1008	Tool post position signal T8
	9	TL-	UO11	r2011	Tool post CCW output signal
	10	0V			Power supply 24V ground
	11	T2	UI02	r1002	Tool post position signal T2
	12	T4	UI04	r1004	Tool post position signal T4
	13	PCZ			Z axis zero point signal
	14	T5	UI05	r1005	Tool post position signal T5
	15	T7	UI07	r1007	Tool post position signal T7



X1：input/output, 44-pin D-type female



X2: input/output, 15-pin D-type male

3.2.2 Connection method of input signal

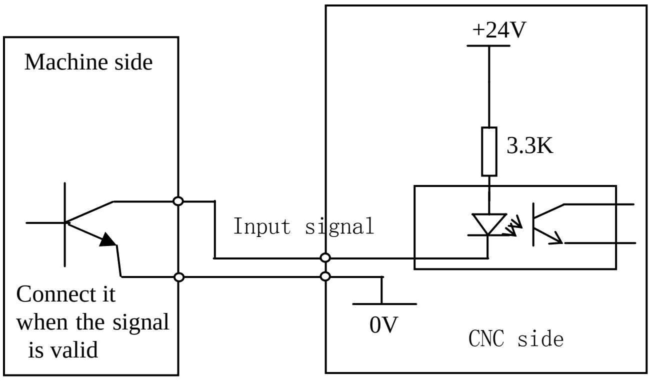
The input signal includes UI01～UI16 ,UI26～UI32 and zero signal (PCX, PCZ, PCY). CNC checks the machine states by the input signal; the signal direction: machine to CNC. The input signal is valid in LOW.

The external input of the input signal: one uses the machine contact switch input, by which the signal is from the machine side press key, the limit switch and relay contact; another uses the electronic proximity switch (transistor) input without the contact.

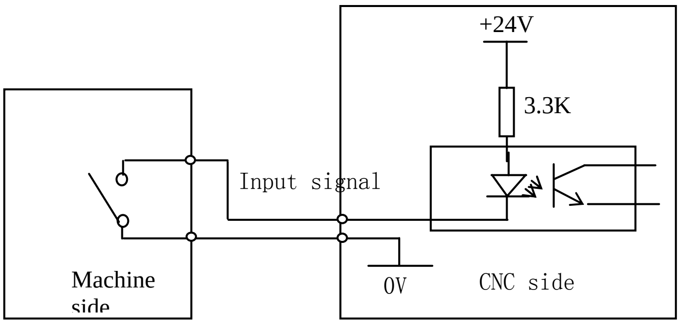
Note: zero signal (PCX, PCZ, PCY) can connect with one-turn signal of the servo motor (connecting with the servo motor) .

1) The input signal can use the normally-open contact input of the machine contact, and also use the electronic proximity switch input without the contact (proximity in the output LOW). The interface connection method is as follows:

NPN connection method without contact:



Machine contact connection method:



The contact of the input signal at the machine side should meet the conditions:

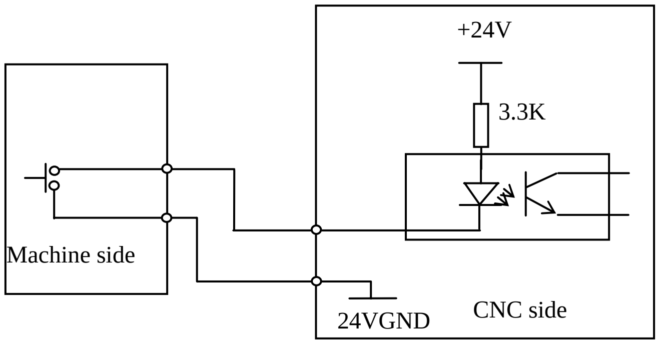
Contact capacity: more than DC28V, 16mA

leakage current among the contacts in open circuit: below 1mA.

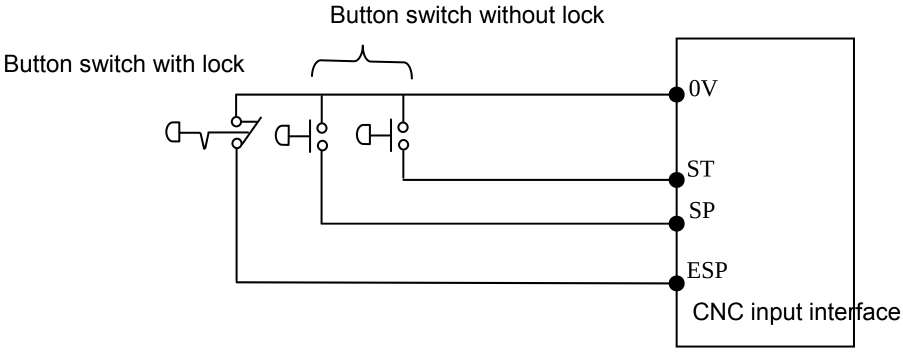
Voltage drop among contact in close-circuit: below 1V (current 8.5mA including the voltage drop).

2) The input signal UI26, UI27(SP, ST are standard signals) use the normally-open contact of the machine contact switch; ESP uses the normally-closed contact of the machine contact switch with self-lock.

Circuit diagram：



Connection example：



3) Standard signal name definition of input interface

SP：external pause operation key signal.

ST：external cycle start key signal.

ESP：emergency stop key signal(the signal must be connected) .

SHL(chuck foot switch) ：foot switch input signal of hydraulic chuck.

TPS(tailstock foot switch) ：foot switch input signal of hydraulic tailstock. PRES：pressure low check, the hydraulic system pressure low check input signal

DecX：X axis machine reference point return deceleration signal.

DecZ：Z axis machine reference point return deceleration signal.

DecY：Y axis machine reference point return deceleration signal.(Note: See DecX,DecZ, DecY Appendix 3: the external control connection layout)

PCX, PCZ, PCY：Zero signal of machine reference point return for of X, Z, Y axis

LT+,LT-：X,Z,Y positive/negative limit switch signals. Connect X, Z positive/negative limit signal to the signal.

Note: LT+, LT- connections are referred to OPERATION, 4.1 Safety Guard.

MXZ1：feed hold signal. When it is valid(i.e. switch contact ON), the feed is locked(i.e. X, Z stop).

MXZ2：spindle/feed hold signal. When it is valid(i.e. switch contact ON), the feed is locked(namely, X, Z axes stop). Note: MXZ1, MXZ2 control are referred to **OPERATION, Auto Working Mode**.

RM10：chuck clamping(outer chuck)/releasing(inner chuck) in-position detection.

RM11：chuck releasing(outer chuck)/clamping(inner chuck) in-position detection.

Note: the hydraulic chuck and tailstock controls are referred to OPERATION, JOG Working Mode.

T1～T8：tool post position signal, connecting with the tool post; selecting 4～16 tool selection tool post; when the tool selection is more than 4, it can input to the CNC system by T1～T.

TCP：tool post lock in-position signal connects with tool post.

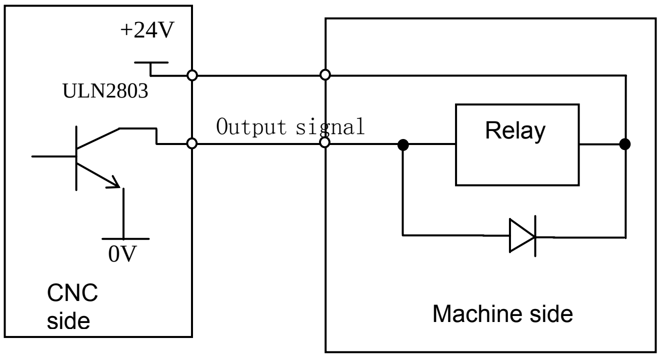
3.2.3 Connection method of output signal

The output signal (UO01～UO18) is used to control the relative operations of the machine, the signal direction: CNC to machine. The signal can drive the relay and the indicator at the machine side. When the output signal is connected with 0V, the output function is valid; when it is not connected with 0V, the output function is invalid. X1, X2 interfaces have 18-channel output interface, and the output signal connection method is as the following figure.

1) output signal connection

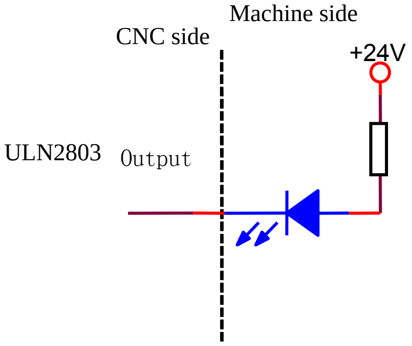
● drive sensitive load：

Use ULN 2803 output to drive the sensitive load, at the moment, connect with fly-wheel diode near to the coil to protect the output circuit and reduce the interference.



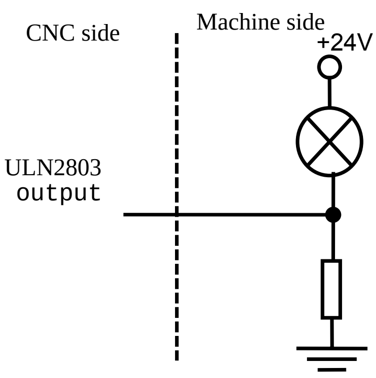
● drive LED:

Use LUN2803 output to drive LED with a serial resistor to limit the current (about 10Ma) through LED.



● Drive filament indicator

Use ULN2803 output to drive the filament indicator, connect externally one preheat resistor to reduce the current impact, and the preheat resistor value is referred to the condition that the indicator does not light.



2) OUTPUT STANDARD SIGNAL

- The output standard signal are driven by ULN2803 transistor, max. load instant current 200mA. When the signal is valid, the transistor is connected and public terminal is +24V.
- The machine side is connected with the relay and other inductive load, the spark suppressor which is near to 20cm must be used. The serial current-limiting resistance must be used when the machine side is connected with the capacitance load.
- The output standard signal M8, M9, M3, M4, M5, M10, M11, M78, M79 can be set to the level control mode or pulse control mode by the bit parameter, M4, MSP standard signal is set by the parameter to execute the output; the time sequence of the signal output is referred to **OPERATION, JOG Working Mode.**
- The output standard signal S01, S02, S03, S04, M41, M42, M43, M44 gear shifting execution process and time sequence of signal output are referred to **OPERATION, JOG Working Mode.**
- Output standard signal TL+, TL- output to control the tool post CW/CCW.
- U01, U02 are the standard undefined output.

3.2.4 Input/output signal technical specification

- Voltage +24V
- Max. load instant current of output signal is 200mA

【Note】

1) When the transistor of the electronic switch is connected, the output voltage should be within 1V; when the transistor is turned off, the output voltage should be more than 23V.
2) When the input function is valid, the input signal is connected with 24VGND; when it is invalid, the signal is not connect with 0V.
3) When the output function is valid, the signal is connected with 24VGND; when it is invalid, the signal is in high-impedance state.

! It is suggested that the input/output cable should use the shield cable, and the shield layer is connected with the plug metal cover and the machine to improve the anti-interference ability.

3.3 Machine Zero Return Function and Connection

Relative interface signal of machine zero return is as the following table X1, X2, X4 interfaces:

1) X1 interface：

Pin 2	DECZ	Z deceleration signal
Pin 3	DECX	X deceleration signal
Pin 4	DECY	Y deceleration signal

2) X2 interface：

Pin 5	PCX	X zero signal
Pin 13	PCZ	Z zero signal

3) X4 interface：

Pin 24	PCY	Y zero signal

Bit parameter **P406_d7,P406_d6,P406_d5,P406_d4,P406_d3,P406_d2** set the machine zero return mode.

Bit parameter setting 0 means there is no deceleration signal or zero signal; bit parameter setting 1 means there is the deceleration signal or zero signal.

There are four zero return methods, and their detailed parameter setting methods are referred to *Operation Parameter Working Mode*; the detailed zero return execution process is referred to *Operation JOG Working Mode*.

Connection example：

1) The followings are the two kinds of connection examples of deceleration signal: travel switch, NPN proximity switch; it is suggested that the user should use the travel switch; the concrete connection example is as follows:

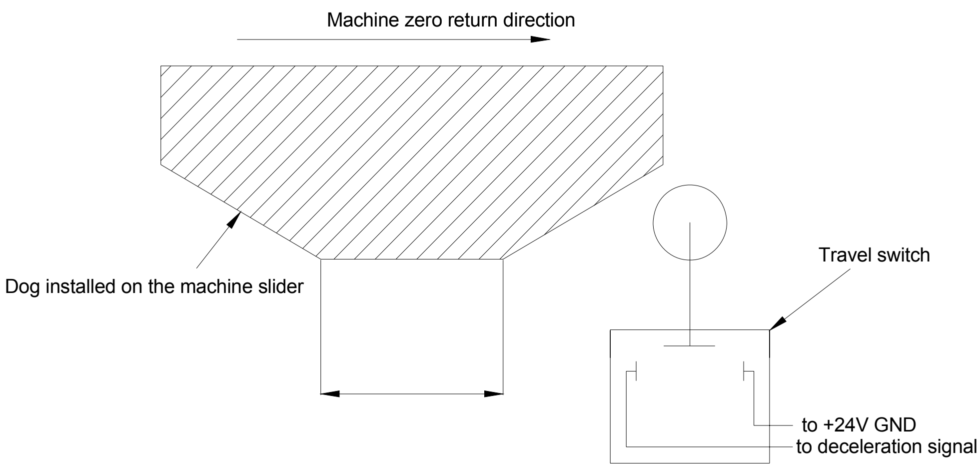


Fig. 3-1 deceleration signal to the travel switch

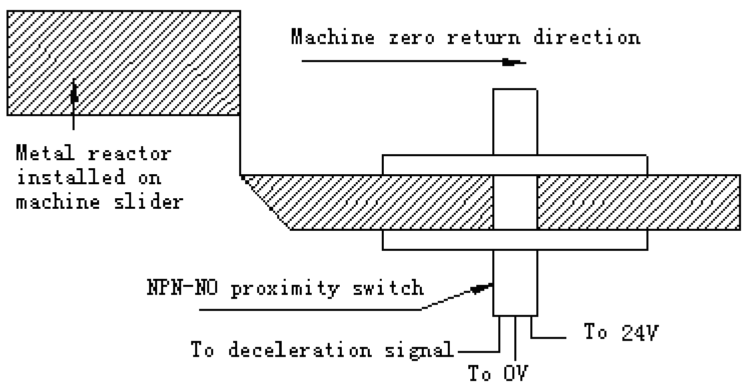


Fig. 3-2 deceleration signal to NPN proximity switch

2) When the bit parameter **P407_d7, P407_d6, P407_d5, P407_d4, P407_d3, P407_d2** is set to 0, the machine zero return is positive, the deceleration signal LOW is valid. The following is the connection example of the deceleration signal and zero signal; the one-turn signal of servo motor is taken as the zero signal when the system is connected with the servo motor.

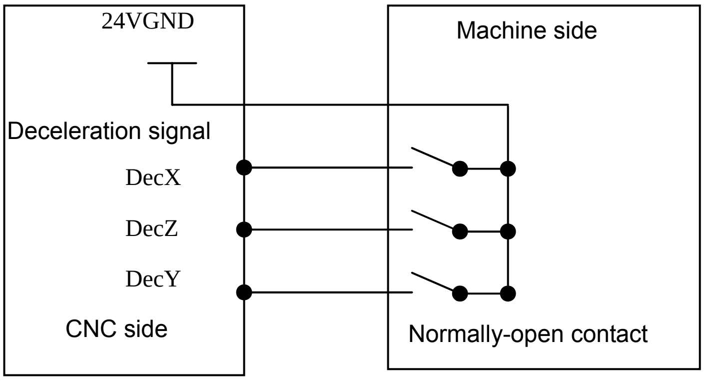


Fig. 3-3 deceleration signal connection

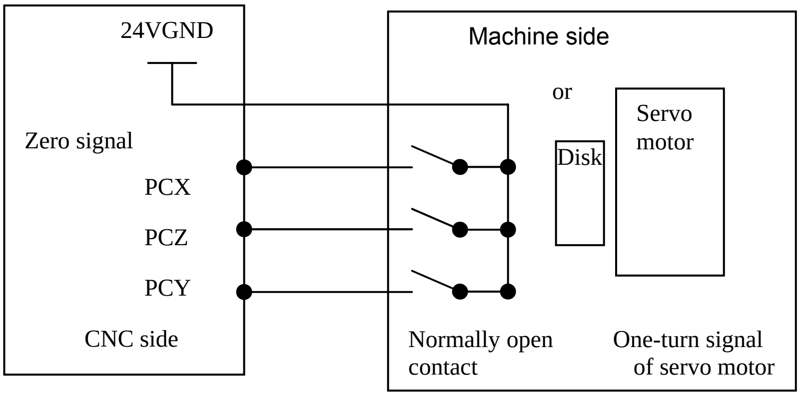


Fig. 3-4 zero signal connection

3.4 Tool Exchange Control Function and Connection

3.4.1 Tool exchange control signal definition

Relative interface signals of too change control:

X2 interface	General signal name	Standard signal name	Standard signal function	Remark
Pin 8	UI08	T08	Tool post position signal T8	General input interface UI08
Pin 15	UI07	T07	Tool post position signal T7	General input interface UI07
Pin 7	UI06	T06	Tool post position signal T6	General input interface UI06
Pin 14	UI05	T05	Tool post position signal T5	General input interface UI05
Pin 12	UI04	T04	Tool post position signal T4	General input interface UI04
Pin 4	UI03	T03	Tool post position signal T3	General input interface UI03
Pin 11	UI02	T02	Tool post position signal T2	General input interface UI02
Pin 3	UI01	T01	Tool post position signal T1	General input interface UI01
	O	TZD	Tool post worktable brake	Optional to SWD120,AK31,SBWD-80 tool post
	O	TFD	Tool post worktable pre-graduation	Optional to AK31,SBWD-80 tool post
Pin 1	UO12	TL+	Tool post (CW) output	As general output interface UO12
Pin 9	UO11	TL-	Tool post (CCW) output	As general output interface UO11
	I	TFDC	Pre-graduation proximity switch	Optional to AK31,SBWD-80 tool post
	I	TXT	Tool position strobe signal	Optional to AK31,SBWD-80 tool post
	I	TGR	Tool post worktable overheat check	Optional to AK31,SBWD-80 tool post
Pin 6	UI09	TCP	Tool post clamping in-position signal	General input interface UI09

Note: AK31, SBWD-80 tool post is referred to the user manuals of Yantai AK31 series tool post, Changzhou SBWD-80 series tool post .

3.4.2 Signal connection

The connection method of general input/output (UI01～UI09,UO11～UO12) interface is according to X1, X2 interface method connection.

3.4.3 Function description

The tool change mode is set by P318. The tool change mode and the control time sequence are as follows:

3.4.3.1 Tool change mode 0

P318=0: tool change mode 0，optional to the line-up tool post.

3.4.3.2 Tool change mode 1

P318=1: tool post type 1, tool change mode 1, is applied to the general 4-tool electromotive turn tool post, tool change (CW) and the clamped (CCW). (Example, P318=5, 6, 7, 8: the system executes the tool change in the tool change mode 1).

Execution steps as follows:

1）Calculate the new tool nose coordinate according to tool offset number, and display it;

2）If the current tool is the target tool, and detected tool position signal is correct, tool change is not performed; otherwise, the system goes to next step.

3) The system outputs the tool post (CW) signal TL+ checks the tool signal of the target tool, and close TL+ output after it checks the signal; when P325 (the time upper of tool change shifting) is in the set time and has not checked the tool signal, it closes the TL+output and alarms: “Check tool signal overtime”.

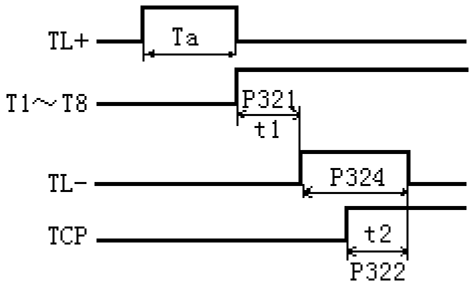
4) The system output tool post(CCW) signal TL- after the time set by the delay data parameter P321(t1);

5) The followings are executed based on whether P408_d6 has the tool post lock in-position signal TCP:

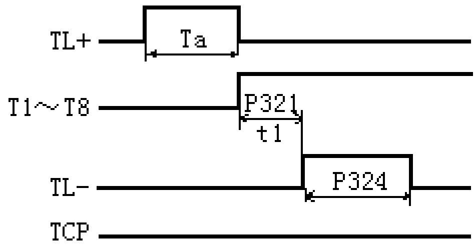
- Delay **P324** (tool post (CCW) locking time) setting time when the locking signal TCP(**P408_d6= 0)** is not checked; the next step is executed after the time ends.
- The system checks TCP in the time set by P324 when the system checks the locking signal TCP (**P408_d6=1);** the system closes TL- output and alarms “**Tool post locking overtime**” when it has not received TCP**;** the system delays the time set by **P322(t2)** to execute the next step.

6) Close the tool post(CCW) output signal (TL-), and the tool change ends.

7) Confirm the signal, i.e. check whether the current tool input signal is consistent with the current tool number; if it is, an alarm is raised.



check TCP locking signal



do not check TCP locking signal

3.4.3.3 Tool change mode 2

P318=2: tool post type 2, tool change mode 2, is applied to the general 4-tool electromotive turn tool post, tool change (CW) and the clamped (CCW).

The tool definition of tool change mode 2 is the same that of the tool change mode 1, and its tool change process is the same that of the tool change mode 1, it only reduces the last step, i.e. the system does not whether the current tool signal is consistent with the target tool in the tool change mode 2.

Execution steps as follows:

1）Calculate the new tool nose coordinate according to tool offset number, and display it;

2）If the current tool number is the same as the target tool number, the following tool change is not performed.

3) The system outputs the tool post (CW) signal TL+ checks the tool signal of the target tool, and close TL+ output after it checks the signal; when the system has not checked the tool signal in the time set by P325 (tool change shifting time upper),, it closes the TL+output and alarms: “**Check tool signal overtime**”.

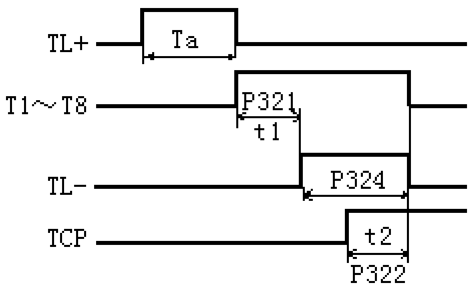
4) The system output tool post(CCW) signal TL- after the time set by the delay data parameter P321(t1).

5) The followings are executed based on whether **P408_d6** has the tool post lock in-position signal TCP:

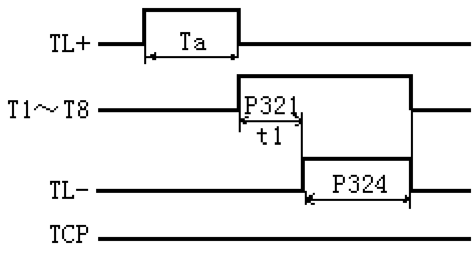
●Delay **P324** (tool post (CCW) locking time) setting time when the locking signal TCP(**P408_d6= 0)** is not checked; the next step is executed after the time ends.

●The system checks TCP in the time set by P324 when the system checks the locking signal TCP (**P408_d6=1);** the system closes TL- output and alarms “**Tool post locking overtime**” when it has not received TCP**;** the system delays the time set by **P322(t2)** to execute the next step.

6) Close the tool post(CCW) output signal (TL-), and the tool change ends.



check TCP locking signal



do not check TCP locking signal

3.4.3.4 Tool change mode 3

P318=3: tool post type 3, tool change mode 3, is applied to Hengyang CLT-63~CLT300 turning machine tool tower series in Taiwan, the system nearby executes the tool change CW/CCW.

In tool change mode 3, max. tool quantity (P319) and tool signal covering the circuit (P320) is set by the corresponding tool post type.

Used signal definition as follows:

Tool post signal	CNC signal	Signal explanation
SensorA	T1	Input tool signal 1
SensorB	T2	Input tool signal 2
SensorC	T3	Input tool signal 3
SensorD	T4	Input tool signal 4
SensorE	TXT (P529)	Input tool inductive signal (strobe signal)
SensorF	TCP	Tool post lock in-position signal
Sol A1	TZD (P507)	Output tool post releasing control signal(tool post worktable brake)
Sol A2	TFD (P508)	Output tool post locking control signal(tool post worktable graduation)
Sol B	TL+	Tool post CW output signal
Sol C	TL-	Tool post CCW output signal

Tool change signal explanation as follows：

1) Sensor A，B，C，D is only used to check the tool, is not the starting signal of any operations;

2) Sensor E：it senses once when tool position is changed, and it is the starting signal of the tool post locking;

3) Sensor F：release the locking confirmation signal. It is locked in HIGH, is released in LOW. Releasing means the tool post is released to start the tool post to rotate; locking means the oil pressure motor stops the rotation;

4) Sol A1，Sol A2：two-head electromagnetic valve. When Sol A 1 is turned on and Sol A2 is turned off, the tool post is locked;

5) Sol B，Sol C：two-head electromagnetic valve. It controls the oil pressure motor to rotate (CW/CCW), confirms the electromagnetic valve in the middle after it is locked, and the motor stops rotating.

Tool change sequence as follows:

1）Calculate the new tool nose coordinate according to tool offset number, and display it;

2) If the current tool is the target tool, and detected tool position signal is correct, tool change is not performed; otherwise, the system goes to next step.

3) Sol A1 is turned on, Sol A2 is turned off, and the tool post is released;

4) When Sensor F is valid, the tool post is released. The system alarm: "**Tool post released overtime**" when the system has not checked SensorF is valid in the time set by P325;

5) Control the tool post to rotate(CW/CCW) to execute nearby the tool change according to the current tool number and the target tool number to judge the tool change direction;

6) After the SensorE drop edge which has checkes the tool post rotating to the tool signal before the target tool number appears, the system executes the next step;

7) After the SensorE drop edge which has checks the tool post rotating to the tool signal before the target tool number appear, SolA1 is turned off, SolA2 is turned on, the tool post is locked (at the moment, Sol B still keeps ON, the motor normally rotates); when the system has not checked the tool signal before the target tool number or the tool signal of the target tool in the tool change time upper set by P325, the system alarms: "**Check tool signal overtime**";

8) The system checks the SensorF is valid, Sol B is turned off, the motor stops rotating, and the tool change is completed; the system alarms "**Tool post locked overtim**e" when the system has not checked SensorF is valid in the time set by **P324**.

【Example】

Example: the turret with 8-tool executes the tool change from No.1 to No.4 tool.

1) Sol A1 is turned on, Sol A2 is turned off, and the tool post is released;

2) The system wait the Sensor F is invalid, judges the nearby tool change direction, Sol B is turned on and motor rotates;

3) Check the tool signal(Note: SensorE creates the valid signal when it is in the No. 1, No. 2, No.3 tool, does not perform the locking operation in the 4th tool); when it checks No. 3 tool signal, it sets SensorE preparatory operation to make that the tool post is in No. 4 tool, SolA1 is turned off, SolA2 is turned on and the tool post is locked(at the moment, SolB still keeps ON and the motor normally rotates) once Sensor E is valid;

4) When the system has checked Sensor F is valid, SolB is turned off, the motor stops rotating and the tool changed is performed.

3.4.3.5 Tool change mode 4

P318=4: tool post type 4, tool change mode 4. It is applied to the tool post type which executes the nearby tool change (CW/CCW).

Used signal definitions as follows:

CNC signal	**Signal explanation**
T1~T8	Start inputting tool signal from T1 in 1~8
TCP	Input tool post locking signal
TFD (P508)	Output tool post locking control signal(tool post worktable pre-graduation)
TL+	Output tool post rotation (CW) control signal
TL-	Output tool post rotation (CCW) control signal

Execution steps as follows:

1）Calculate the new tool nose coordinate according to tool offset number, and display it;

2）If the current tool is the target tool, and detected tool position signal is correct, tool change is not performed; otherwise, the system goes to next step.

3) The system outputs the tool post rotation (CW/CCW) signal (TL+ or TL-) checks the tool signal of the target tool. and close TL+ output after it checks the signal; when the system has not checked the tool signal in the time set by P325 (tool change shifting time upper), it closes the TL+output and alarms: “Check tool signal overtime”.

4) After the system has checked the tool in-position signal, it outputs the tool post locking control signal (TFD) to ensure the tool post is in the locking control state and the tool rotation signal still keeps;

5) The following different executions are executed according to **P408_d6**:

- When the system does not check the tool post lock in-position signal TCP**(P408_d6=0) ,** it delays the time set by **P324;** the system executes the next step after the setting time ends.
- When the system checks the locking signal TCP (**P408_d6=1)**, checks TCP in the time set by P324; when the system has not received TCP, it closes the tool post rotation signal and alarms “tool post locking overtime”, when it has received TCP, it delays the time set by **P322**(t2), and executes the next step.

6) Close the tool post rotation signal (TL+ or TL-), close the tool post locking control signal (TFD);

7) Confirm the signal, i.e. the system checks whether the current tool input signal is consistent with the current tool number; if it is, the tool change is completed; it is not, an alarm is raised.

3.4.3.6 Tool change 9

P318=9: tool post type 9, tool change mode 9. use M60 to execute the tool change.

In tool change mode 9, the system automatically calls M60 to execute the tool change when T command is executed.

T command execution process as follows:

1) The system firstly modifies the tool number and the tool offset, and counts the target tool nose coordinates;

2) Modify macro variable r4005 (target tool number) and r4006(target tool offset number);

3) Call M60 to execute the tool change programs;

4) Wait M60 to be completed;

5) Complete the tool change.

【Program example】

The following is the program to compile the customized command to realize the tool change mode 9 operation; applied to the general electromotive turret tool post.

%254

M98 P1000 **;** 4 tools, setting tool signal(T4 T3 T2 T1) separately in r1004~r1001

```
M02
N1000 -M60
N1010 r1 = 14                    ; 1# tool signal (1110)
N1020 r2 = 13                    ; 2# tool signal (1101)
N1030 r3 = 11                    ; 3# tool signal (1011)
N1040 r4 = 7                     ; 4# tool signal (0111)
N1050 if(r4005 = 1) then r5 = r1 ; target tool number saved to r5
N1060 if(r4005 = 2) then r5 = r2
N1070 if(r4005 = 3) then r5 = r3
N1080 if(r4005 = 4) then r5 = r4 ; look for target tool number
N1090 r2012 = 0                  ; tool post (CW) searching for target tool position
N1100 r4010 = 10000              ; set max. time (CW) to be 10m
N1110 r6 = r1000                 ; read 32 input signal to r6
N1120 r7 = r6 and 15             ; read tool signal (r1004~r1001) to r7
N1130 if(r7 = r5) then P2000     ; searching for tool number
N1140 if(r4010 = 0)then P3000    ; alarm for CW overtime
N1150 M97 P1110                  ; continuously check tool signal
; tool post lock
N2000 r2012 = 1                  ; stop tool post rotating after having found tool signal
N2010 r4010 = 500                ; tool post (CCW) being locked after delaying 500ms N2020
if(r4010>0) then P2020           ; delaying wait
N2030 r4010 = 1000               ; set the CCW locking time
N2040 r2011 = 0                  ; CCW locking
N2050 if(r4010>0) then P2050     ; wait the CCW locking
N2060 r2011 = 1                  ; stop CCW
M99                              ; complete the tool change
; tool change failure
N3000 r2012 = 1                  ; stop tool post rotation after alarm
N3010 00S check tool selection signal overtime
N3020 r5002 = 110001             ; set the window width to be one line
N3020 r5002 = 130168             ; font color to be red
N3030 r5002 = 1
N3040 r5002 = 1000               ; display alarm message
N3050 M97 P3050                  ; tool change failure, wait to manually stop the machining
                                   program
N3060 M99
```

In the above, No. 254 program is written to the system FLASH, and the detailed operation is referred to Program 10.2 Customizing Commands. The detailed operation is referred to **PROGRAMMING Chapter 10.2 Customized Commands**; and after the user sets the parameter related to the tool change mode 9, the system executes the T to realize the required tool change function in the manual tool change or the machining program. See Section 10.2.3 in PROGRAMMING.

3.4.4 Tool signal check and parameter setting

The tool signal check is controlled by **P408_d7. P408_d7=0,** the tool signal check is the default mode, **P408_d7=1:** the tool signal check is table look-up mode. Note: line-up tool **(P318=0)** is not influenced by **P408_d7.**

3.4.4.1 Default mode **(P408_d7=0)**

In the default mode, P319 must be equal to P320, otherwise, the system prompts "**P319** is not equal to **P320**" in tool change.

Tool signal definition in the default mode as follows:

The tool signal circuit quantity defined by P320 separately corresponds the tool quantity defined by P319, each signal line corresponds to one tool number, and the valid level of the tool signal is LOW, other tool signals are invalid when some tool signal is valid.

Example: P319=4，P320=4: the tool signals are as follows:

	T04	T03	T02	T01
No.1	1	1	1	0
No.2	1	1	0	1
No.3	1	0	1	1
No.4	0	1	1	1

Note: 1 in the table stands for HIGH, 0 for LOW

Parameter setting is as follows:

Parameter	Parameter setting value	Remark
P318	1	Tool change mode 1
P319	4	4-tool tool post
P320	4	4 tool signals
P408_d7	0	Bit parameter is set to default mode

3.4.4.2 Table look-up mode **(P408_d7=1)**

In the table look-up mode, P319 is not equal to P320. The tool signal is defined by P541~P556.

Tool signal definition in table look-up is as follows:

P541~P556 correspond to tool signal code of No. 1~16 tool, the tool code is expressed with the decimal, and the code method is as follows: all used tool signals consist of binary codes($T_{P320...}$T1) from the high to the low, and then the binary code corresponding to each tool number is switched to the decimal to fill the position corresponding to P541~P556. The binary code of the tool signal can be seen in DIAGNOSIS mode.

Example: Hengyuan CLT-63~CLT300 turning machine turret serial 8-tool post uses the 4-tool signal, and the corresponding tool codes are as follows:

Tool Number	Tool code(T04...T01)	Decimal	Corresponding parameter
No. 1	0010	2	P541
No. 2	1000	8	P542
No. 3	0001	1	P543
No. 4	0100	4	P544
No. 5	0111	7	P545
No. 6	1101	13	P546
No. 7	1011	11	P547
No. 8	1110	14	P548

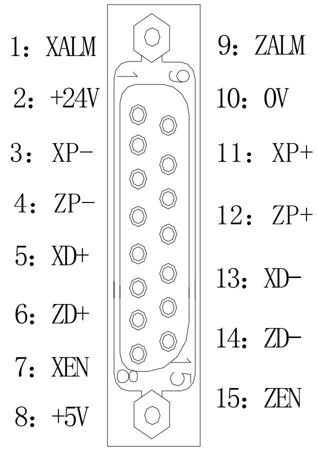
Parameter setting as follows:

Parameter	Parameter setting value	Remark
P318	3	Tool change mode 3
P319	8	8-tool post
P320	4	4 lines
P408_d7	1	Bit parameter is set to table look-up mode
P541 tool 1 check signal	2	Tool post position signal T1
P542 tool 2 check signal	8	Tool post position signal T2
P543 tool 3 check signal	1	Tool post position signal T3
P544 tool 4 check signal	4	Tool post position signal T4
P545 tool 5 check signal	7	Tool post position signal T5
P546 tool 6 check signal	13	Tool post position signal T6
P547 tool 7 check signal	11	Tool post position signal T7
P548 tool 8 check signal	14	Tool post position signal T8

3.5 X3 Motor Interface

The system can be matched with the drive units of the reaction stepper motor, the compound stepper motor and AC servo motor by the motor drive unit interface X3.

3.5.1 Signal definition



X3 motor (DB15 male)

Pin	Standard signal name	Standard signal name explanation	Signal direction
1	XALM	X drive unit alarm input terminal	Drive unit → CNC
2	+24V	X/Z drive power supply +24V	
3	XP-	X pulse positive terminal	CNC →Drive unit
4	ZP-	Z pulse positive terminal	CNC →Drive unit
5	XD+	X positive terminal	CNC →Drive unit
6	ZD+	Z positive terminal	CNC →Drive unit
7	XEN	X axis enabled	CNC →Drive unit
8	+5V	X/Z drive power supply +5V	
9	ZALM	Z drive unit alarm input terminal	Drive unit → CNC
10	0V	Power ground	
11	XP+	X pulse negative terminal	CNC →Drive unit
12	ZP+	Z pulse negative terminal	CNC →Drive unit
13	XD-	X negative terminal	CNC →Drive unit
14	ZD-	Z negative terminal	CNC →Drive unit
15	ZEN	Z axis enabled	CNC →Drive unit

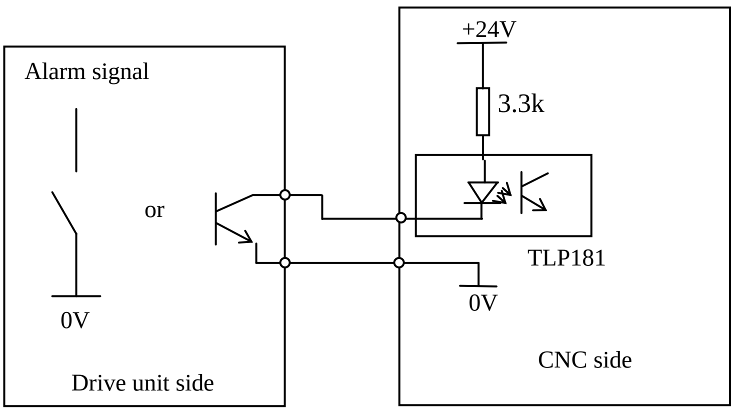
3.5.2 Technical specifications

- Max. pulse output frequency: 500kHZ
- Pulse width:：2μs

3.5.3 Equivalent circuit

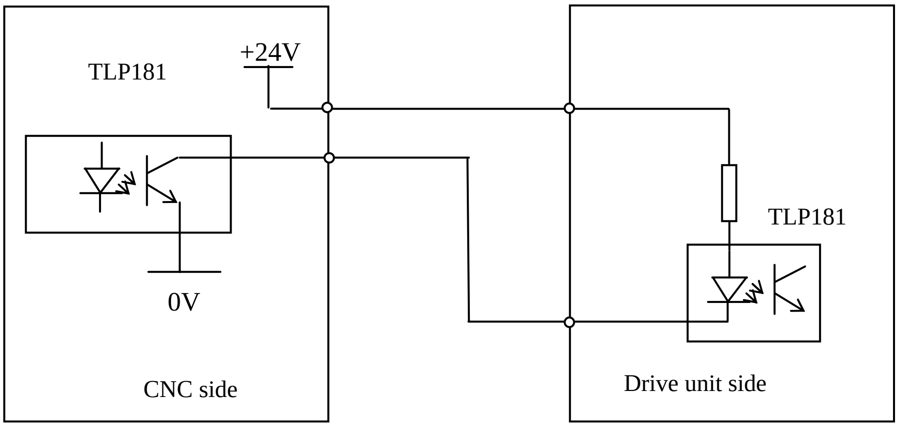
3.5.3.1 Drive unit alarm signal XALM, ZALM, YALM

P405_d4,P405_d3, P405_d2 set the drive unit alarm level is LOW or HIGH. The drive unit must use the following methods to provide the signals:



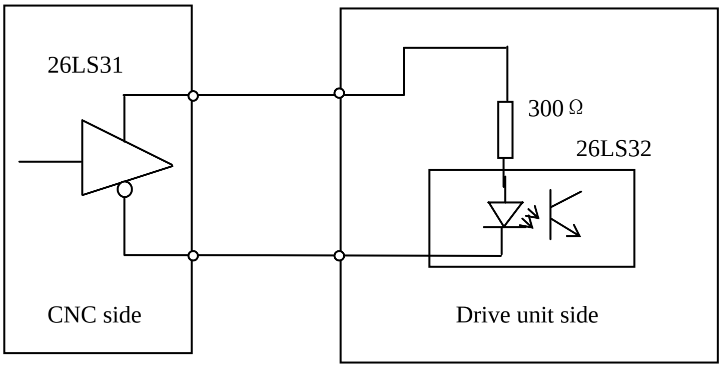
3.5.3.2 Enable signal Xen, Zen, Yen

When the CNC is working normally, the enable signal output is valid (the enable signal is connected with 0V). The circuit diagram is shown as follows:



3.5.3.3 Pulse signal and direction signal

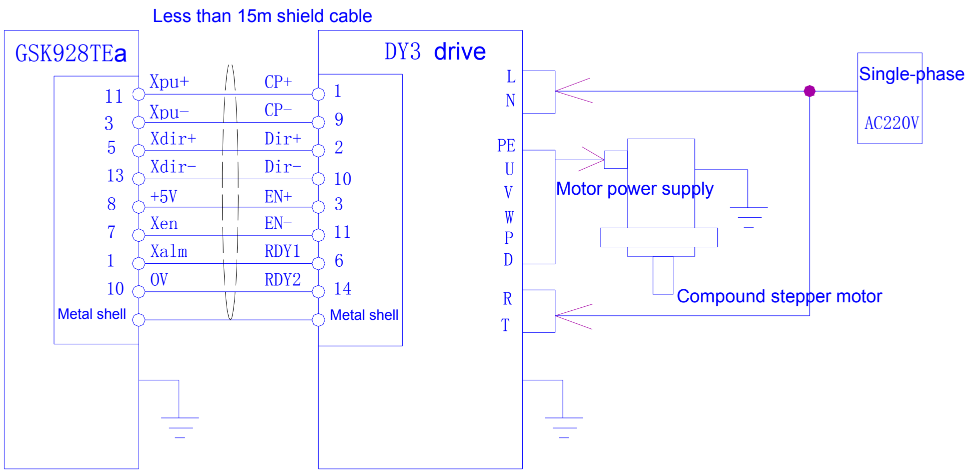
XP+,XP-,ZP+,ZP- are pulse signals, XD+,XD-,ZD+,ZD- are direction signals. The signals in the two groups are difference output, the external should use 26LS32 and the circuit method layout is as follows:



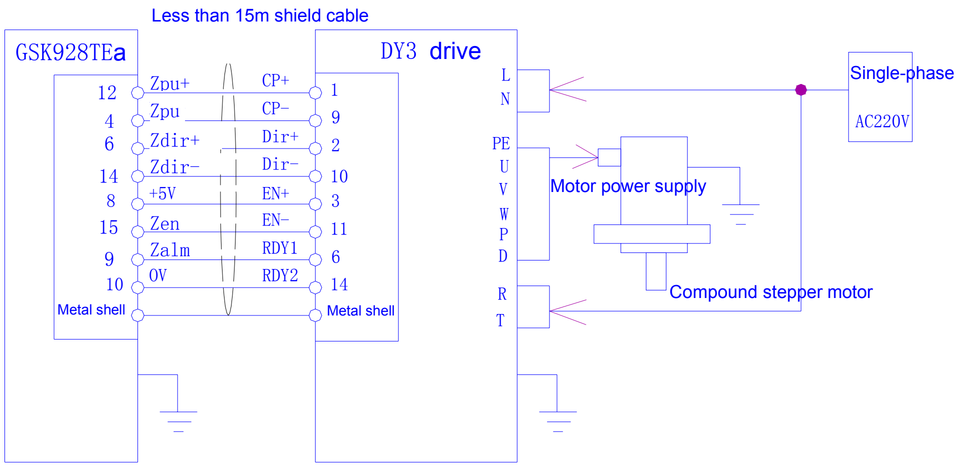
3.5.4 Connection between CNC system and drive unit of compound stepper motor

Connection layout between CNC and GSK DY3:

X connection layout：



Z connection layout：



Connection layout between CNC and **GSK DY3**:

GSK928TEa(X) | **DY3 drive unit** Signal interface：

11	Xpu +	X pulse +	1	CP +
3	Xpu-	X pulse -	9	CP-
5	Xdir+	X direction +	2	Dir+
13	Xdir-	X direction -	10	Dir-
8	+5V	+5V	3	Dv+
7	Xen	X enabling	11	Dv-
1	Xalm	X alarm	6	Alm
10	0V		14	COM
Metal shell			Metal shell	

GSK928TEa(Z) | **DY3 drive unit** Signal interface：

12	Zpu +	Z pulse +	1	CP +
4	Zpu-	Z pulse-	9	CP-
6	Zdir+	Z direction +	2	Dir+
14	Zdir-	Z direction -	10	Dir-
8	+5V	+5V	3	Dv+
15	Zen	Z enabling	11	Dv-
9	Zalm	Z alarm	6	Alm
10	0V		14	COM
Metal shell			Metal shell	

When other stepper drive unit is connected with the CNC system, the system can uses the corresponding control switching, and its detailed connection method is referred to the corresponding drive device user manual.

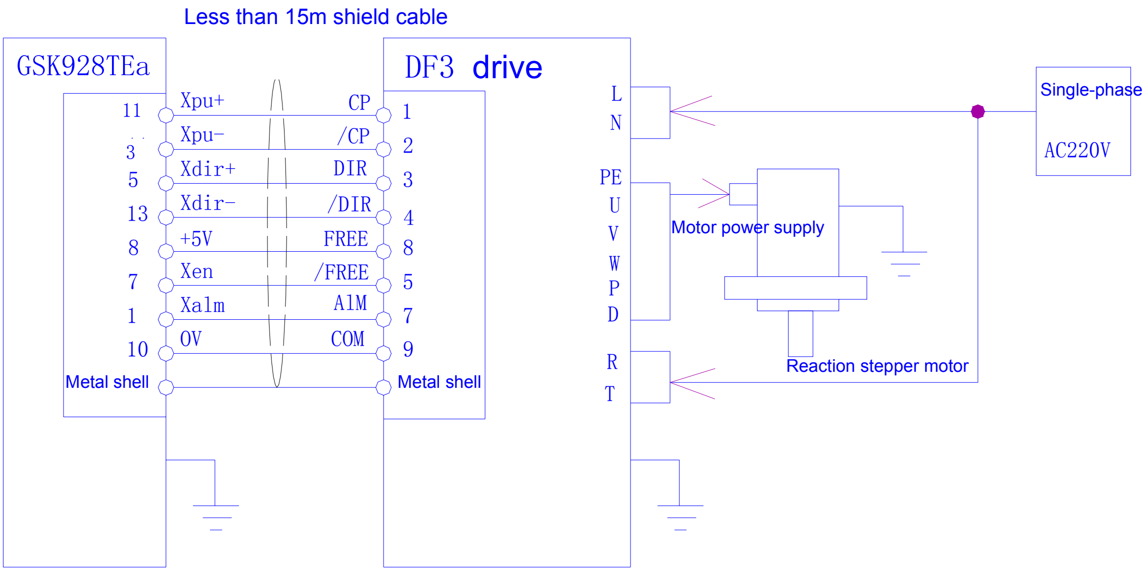
【Note】

- When the stepper motor is used, it is regulated according to the bit parameter **P405(d 7～d 0)** ,X-motion parameter(**P100～P116**) , and definitions of parameter are referred to **Operation**, **Parameter Working Mode.**
- The shield cable must be used to connect the step driver and CNC system, otherwise cause that the motor steps out owing to the external interference.
- CNC system, the stepper driver and the stepper motor must be reliably connected with the earthing to avoid the motor stepping out because of the external interference.

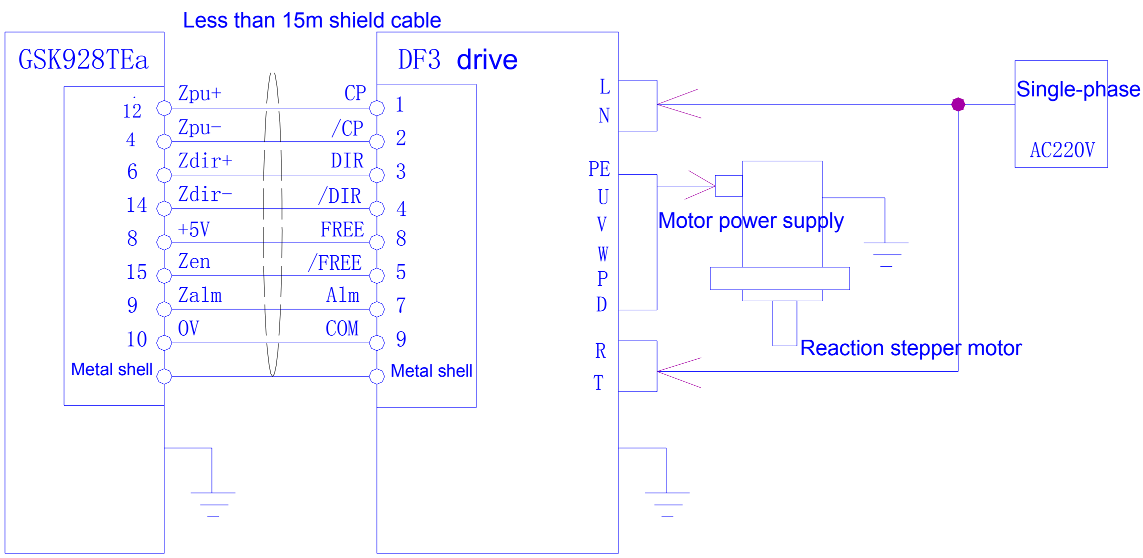
3.5.5 Connecting between CNC and drive unit of reaction stepper motor

Connection layout between CNC and **GSK DF3**:

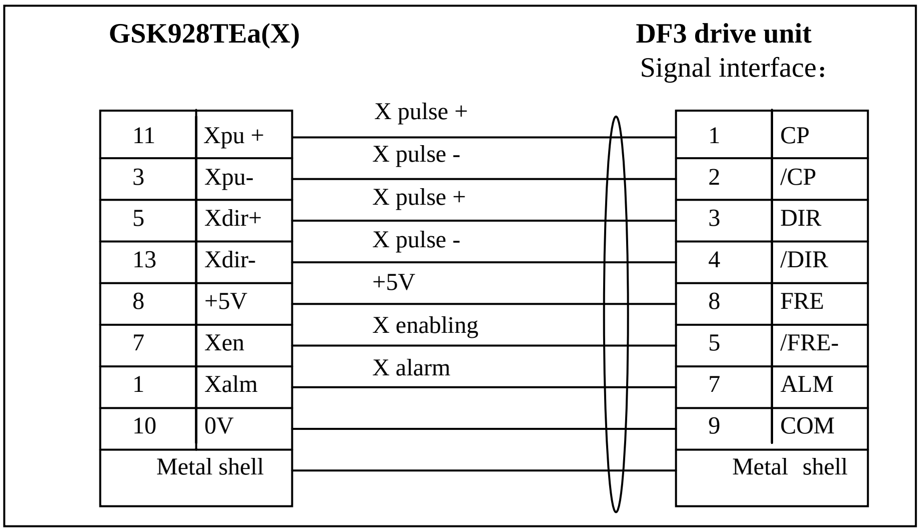
X connection layout：

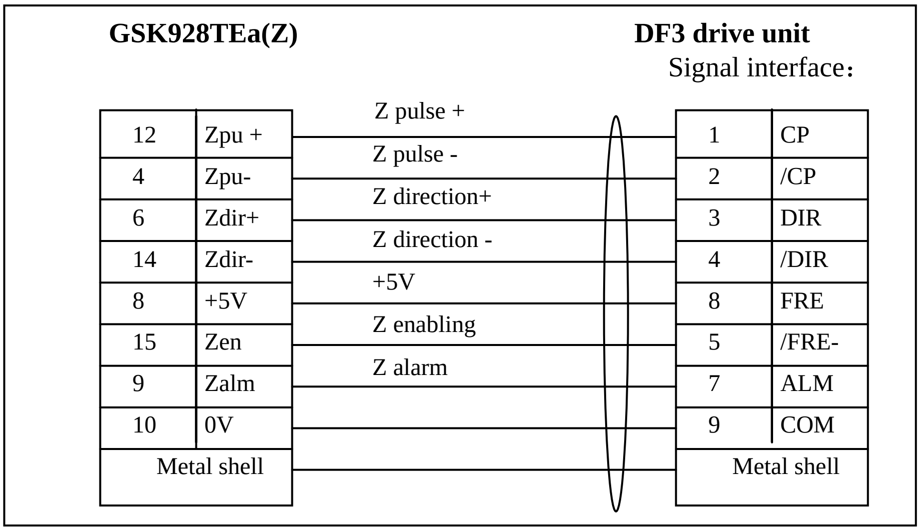


Z connection layout：



Connection layout between CNC and **GSK DF3**:





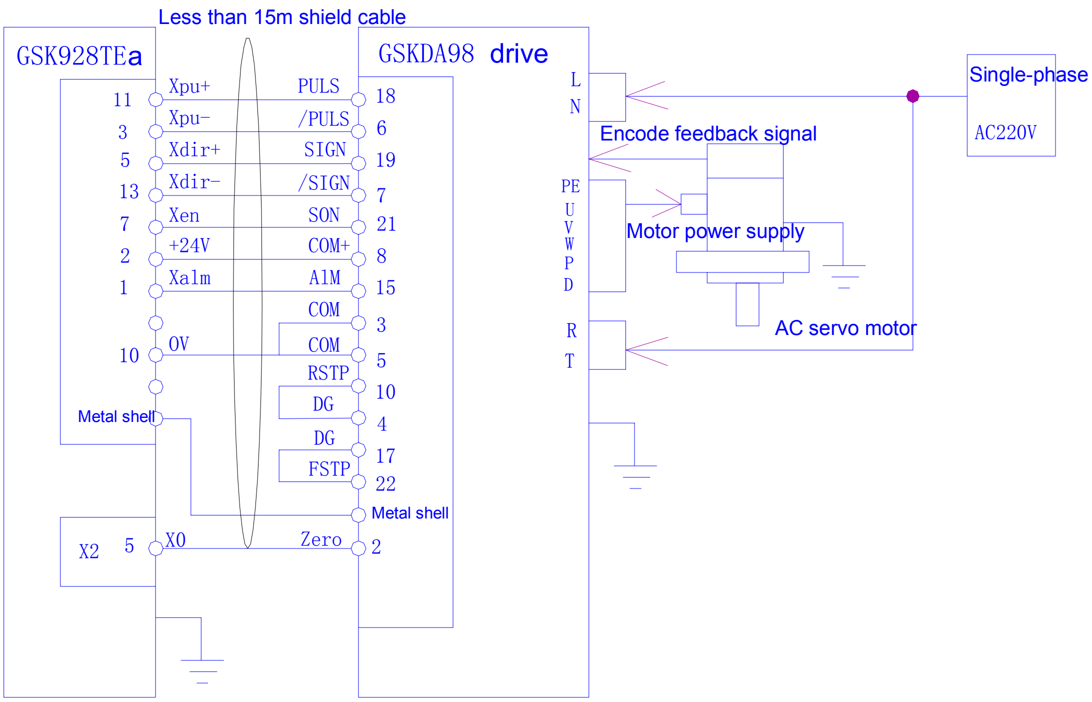
【Note】

- When the stepper motor is used, it is regulated according to the bit parameter **P405**(**d 7～d 0**) ,X-motion parameter(**P100**～**P116**) , and definitions of parameter are referred to **Operation**, **Parameter Working Mode.**
- The shield cable must be used to connect the step driver and CNC system, otherwise cause that the motor steps out owing to the external interference.
- CNC system, the stepper driver and the stepper motor must be reliably connected with the earthing to avoid the motor stepping out because of the external interference.

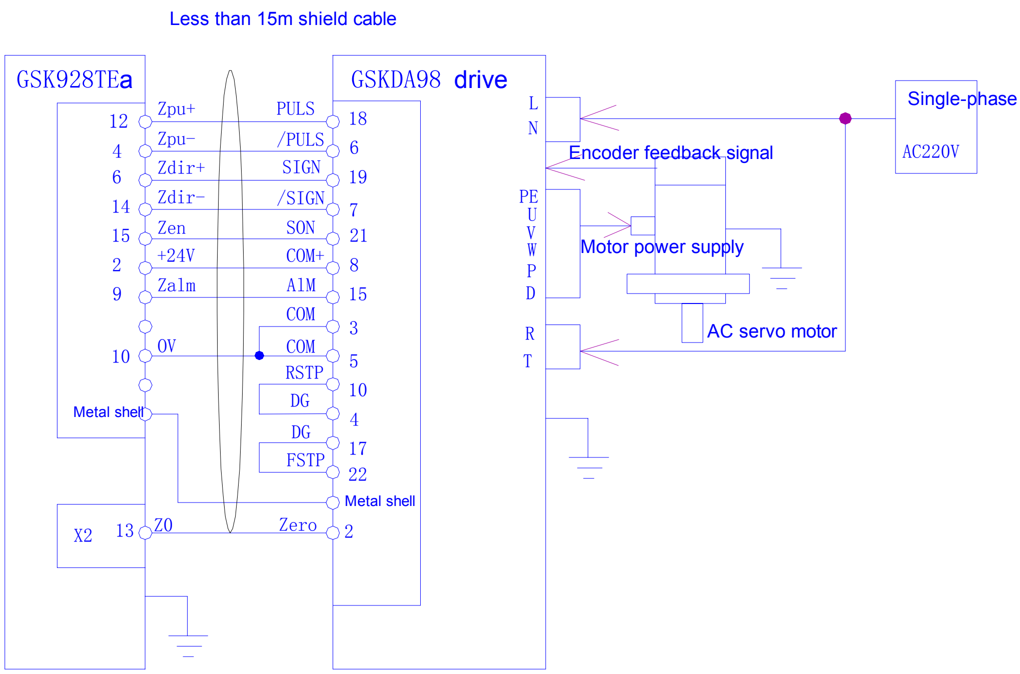
3.5.6 Connection layout between CNC and AC servo drive unit

Connection layout between CNC and **GSK DA98 AC** servo drive unit:

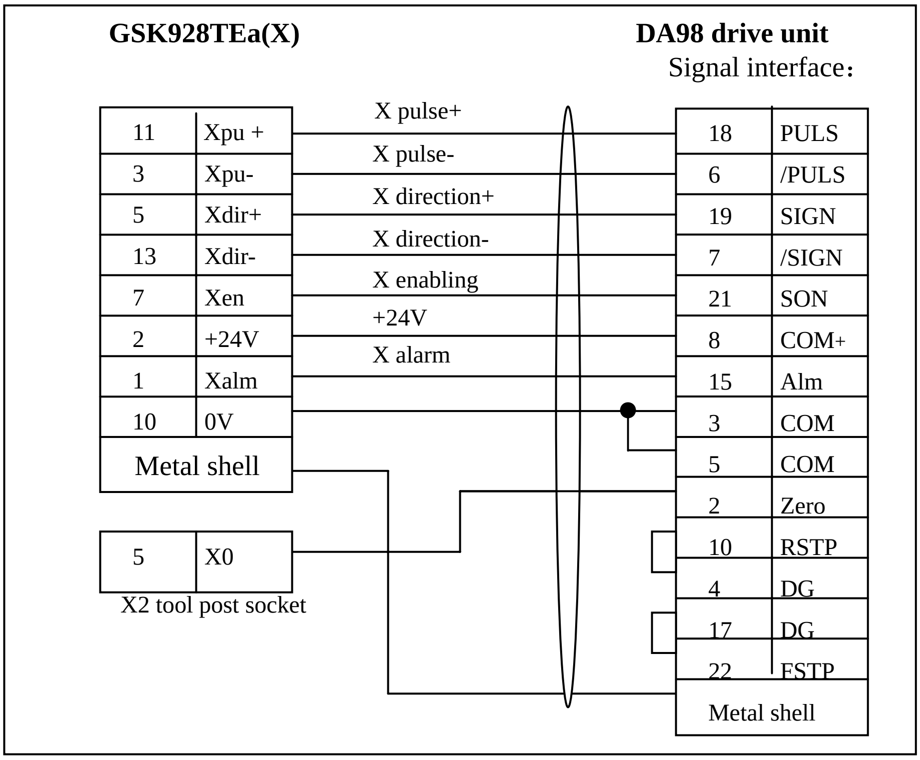
X connection layout:

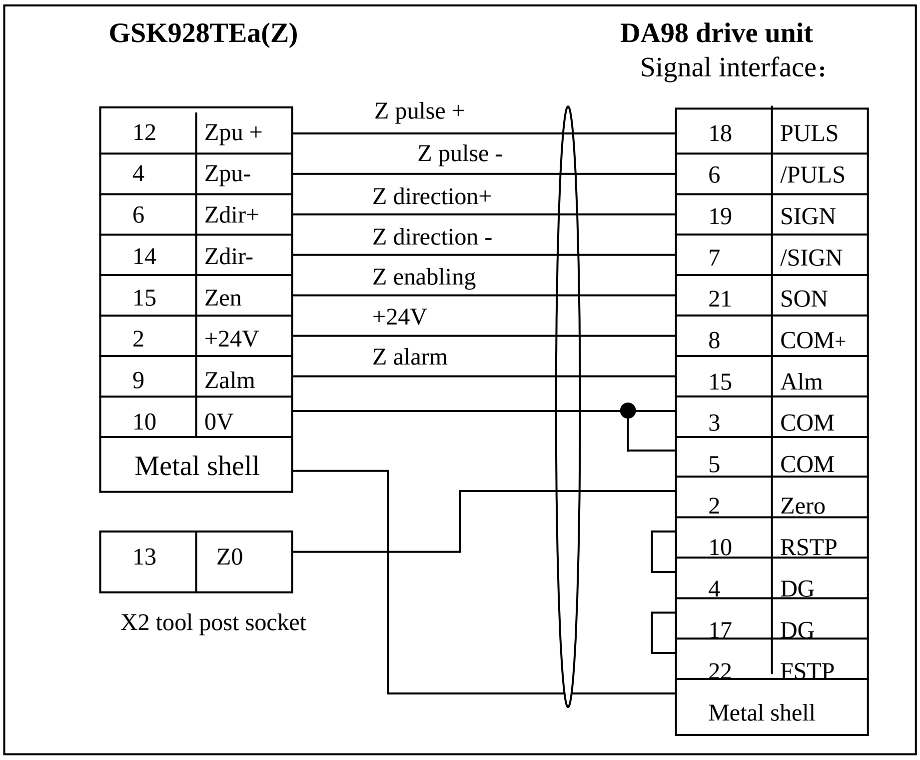


Z connection layout:



Connection layout between CNC and GSK DA98 AC servo drive unit





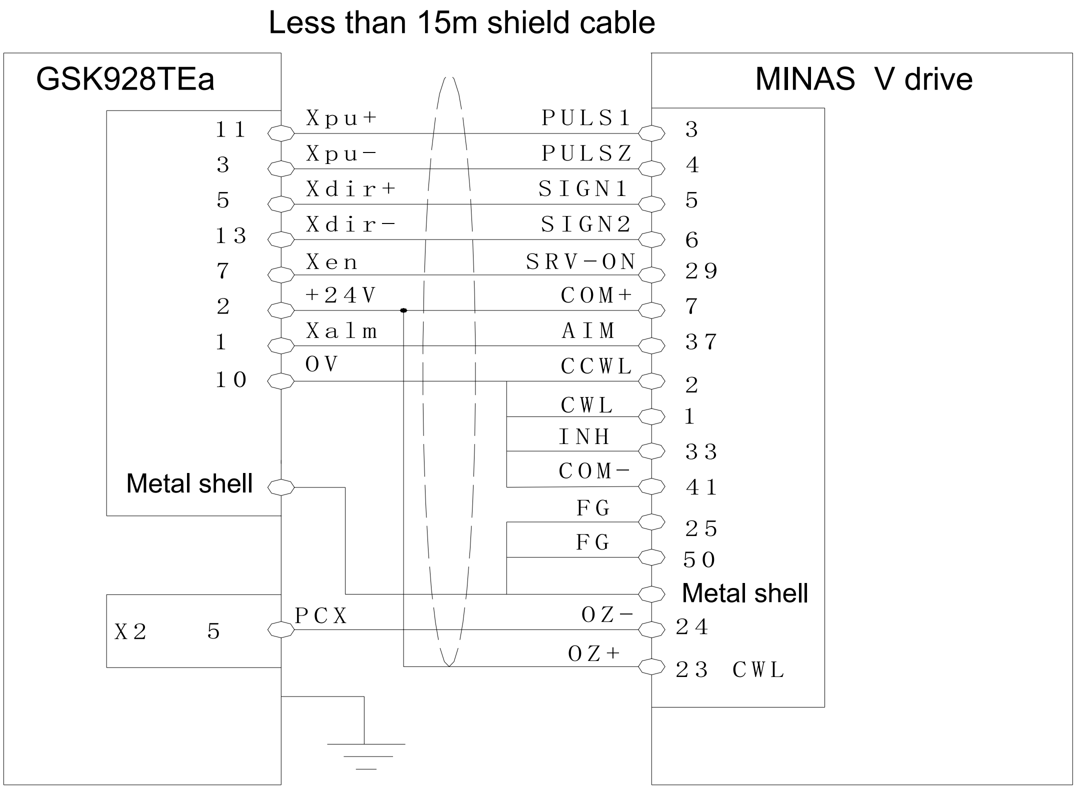
【Note】

- When the stepper motor is used, it is regulated according to the bit parameter **P405**(**d 7**～**d 0**) ,X-motion parameter(**P100**～**P116**) , and definitions of parameter are referred to **Operation**, **Parameter Working Mode.**
- The shield cable must be used to connect the step driver and CNC system, otherwise cause that the motor steps out owing to the external interference.
- CNC system, the stepper driver and the stepper motor must be reliably connected with the earthing to avoid the motor stepping out because of the external interference.

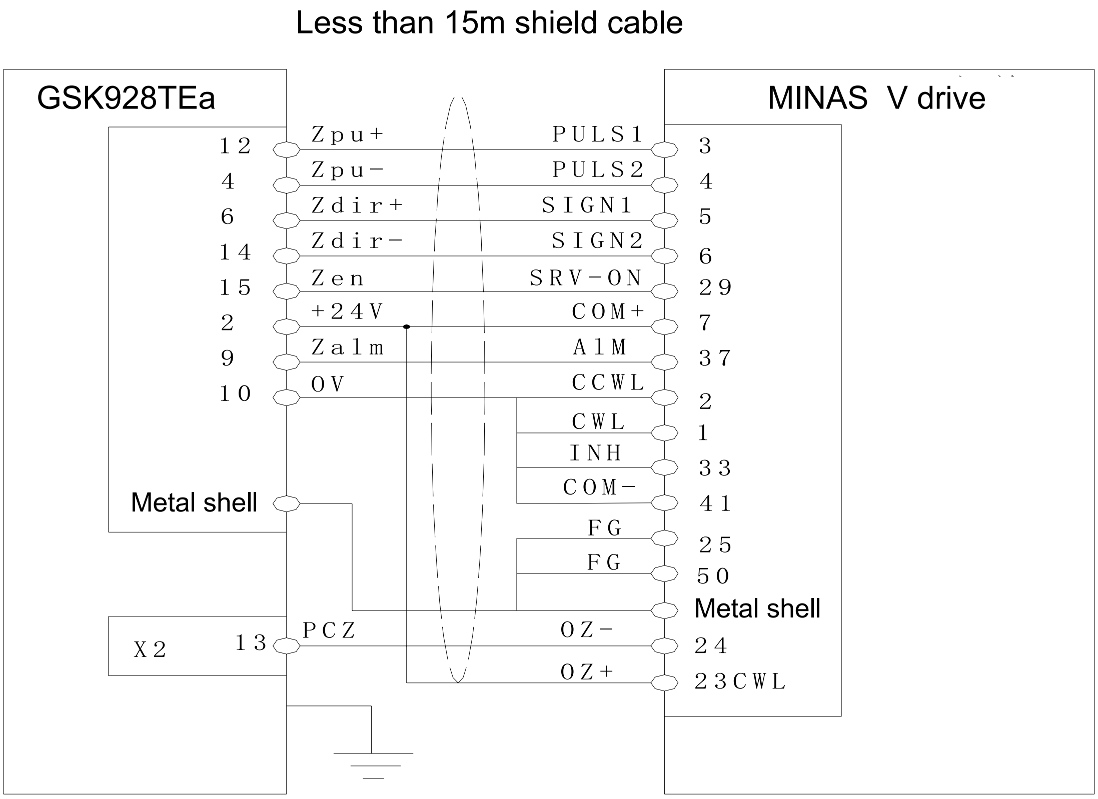
3.5.7 Connection layout between CNC and Panasonic drive unit

Connection layout between CNC and Panasonic MINAS V serial drive unit

X connection layout:

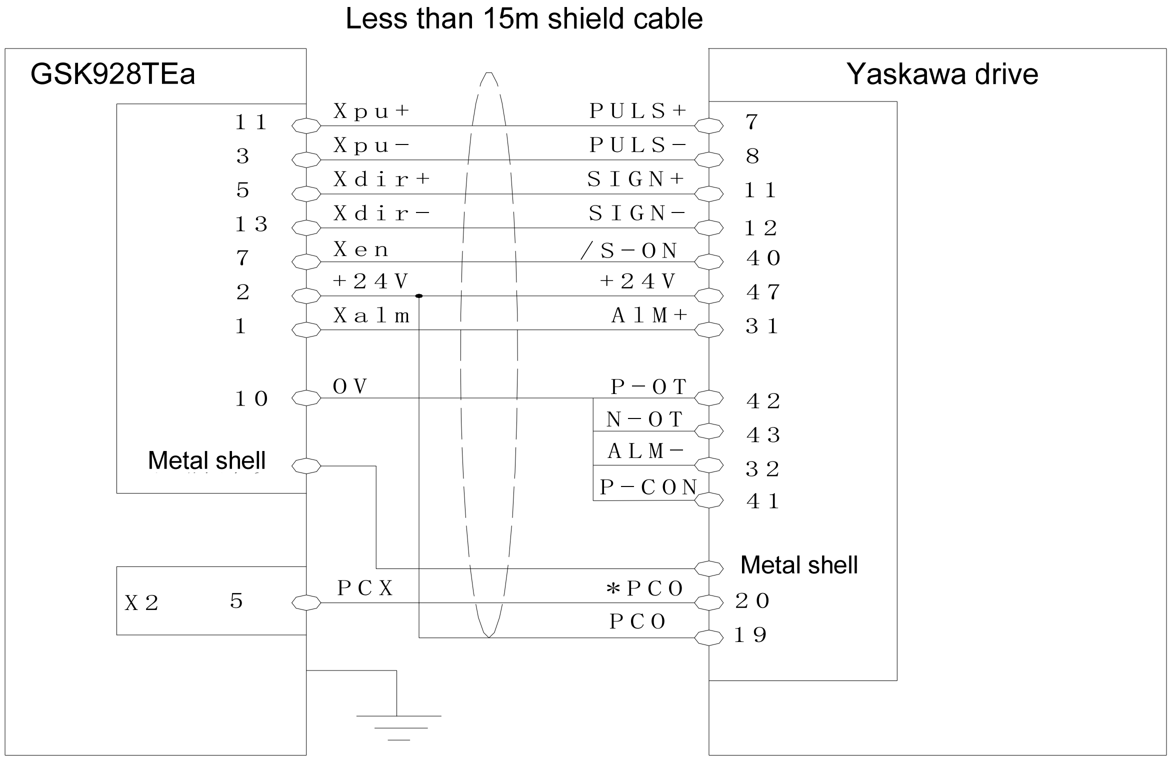


Z connection layout:

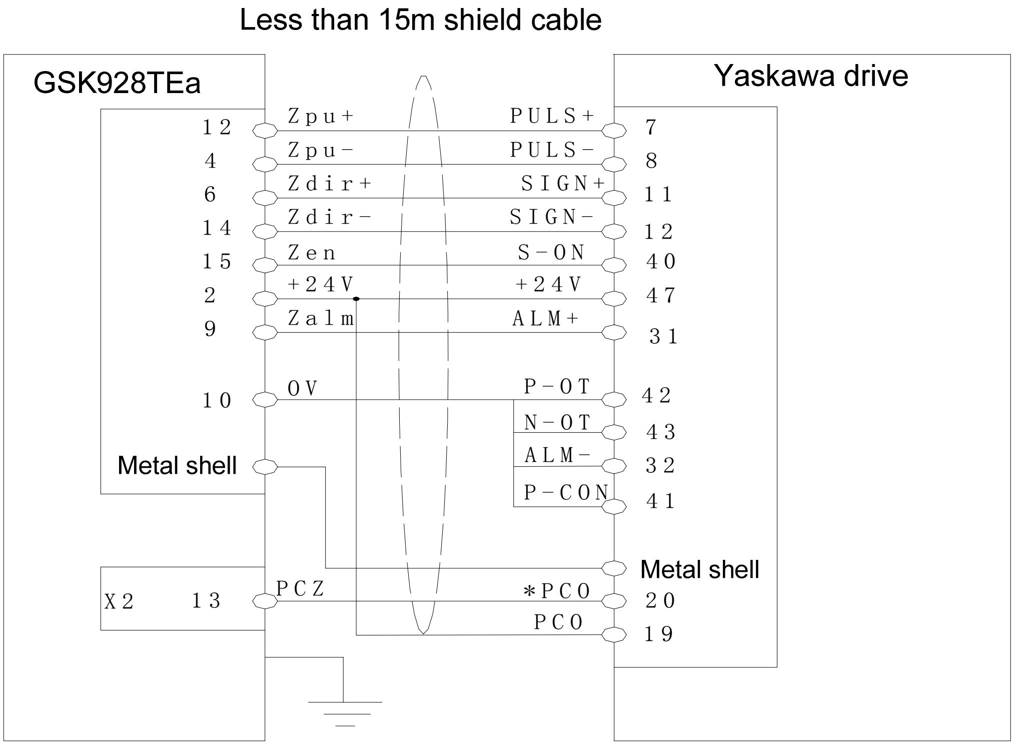


3.5.8 Connection layout between CNC system and Japanese Yaskawa drive unit

X connection layout：



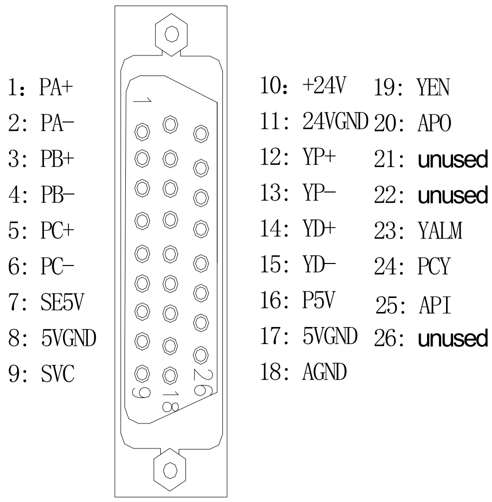
Z connection layout：



3.6 **X4 Spindle Interface**

The CNC system controls the connection between the voltage(SVC) output signal and the spindle converter by the spindle X4 converter, which realizes the stepless change-speed within limits.

3.6.1 Signal definitions



Pin name	**Standard signal**	**Pin function**
1	PA+	Encoder A pulse +
2	PA-	Encoder A pulse -
3	PB+	Encoder B pulse +
4	PB-	Encoder B pulse -
5	PC+	Encoder C pulse +
6	PC-	Encoder C pulse -
7	SE5V	Encoder 5V
8	0V (5VGND)	Encoder 5V earthing
9	SVC	Spindle analog voltage+
10	+24V	24V
11	0V (24VGND)	24V earthing
12	YP+	Y pulse +
13	YP-	Y pulse -
14	YD+	Y + direction
15	YD-	Y- direction
16	P5V	Y drive unit 5V
17	0V (5VGND)	Y drive unit 5V earthing
18	AGND	Spindle analog voltage ground
19	Yen	Y enabling
20	APO	Speed/position switch control
21	Unused	Unused
22	Unused	Unused
23	YALM	Y axis drive unit alarm
24	PCY	Y axis zero point
25	API	Speed/position state check
26	Unused	Unused

3.6.2 Converter technical specification

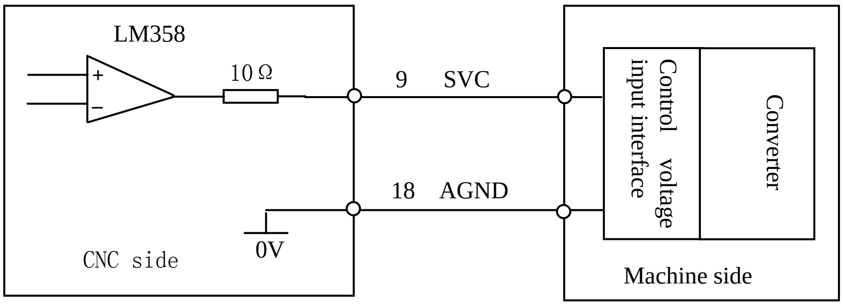
- System output analog voltage is 0 V～10 V.
- The connection cable between the system and the converter should use the shield cable, and the shield is connected with X4 socket metal shell.

3.6.3 Encoder technical specifications

- The system can connect externally the spindle encoder by the spindle interface X4, which is used to the thread machining, and tapping.
- Can use the encoder with many.
- Voltage +5V.

3.6.4 Connection layout of converter analog voltage

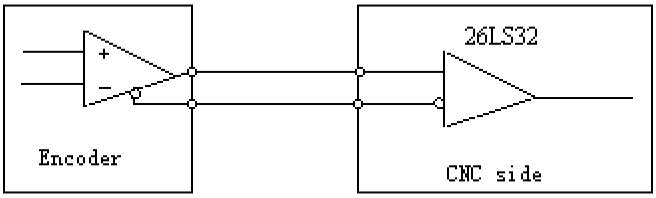
Analog spindle interface SVC can output 0～10V, and the circuit is as follow:



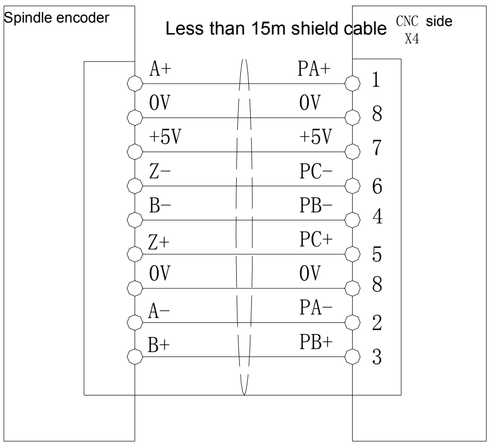
❗ The connection cable between the system and the converter should use the shield cable.

3.6.5 Encoder interface method

Signal explanation: PA+/PA-,PB+/PB-,PC+/PC- are the separate difference input signal of encoder A, B, C phase, which are received by 26LS32; PA+/PA-,PB+/PB-,PC+/PC- are quadrature square wave of the difference 90°, max. signal frequency ＜1MHz; the CNC uses the encoder lines is set by P209 in the range 100～5000.



3.6.6 Encode interface connection layout



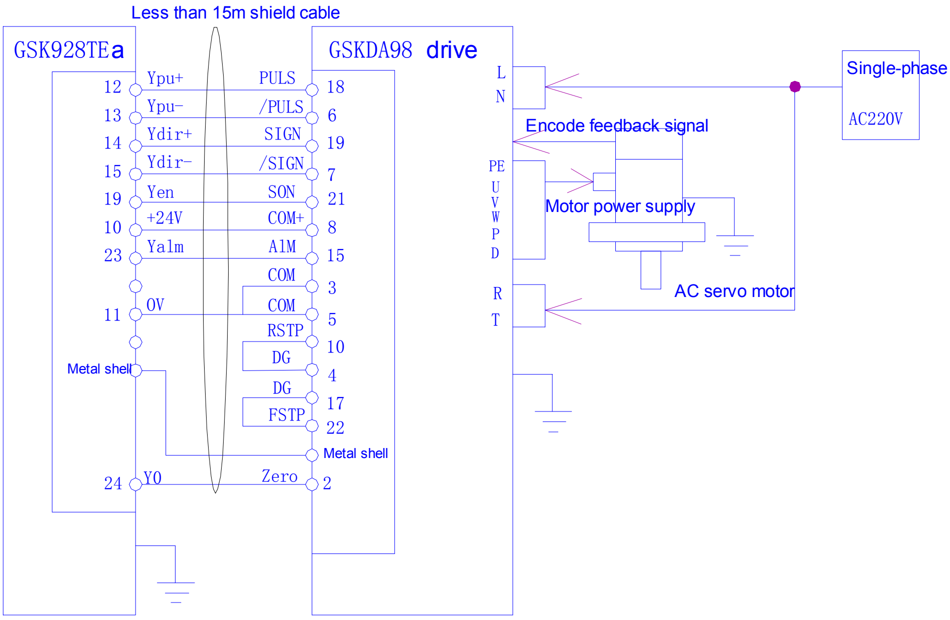
❗ The connection cable between the system and the spindle encoder must use the shield cable which must connect with the socket shell.

❗ The connection between the system and the spindle encoder must use the doublet cord.

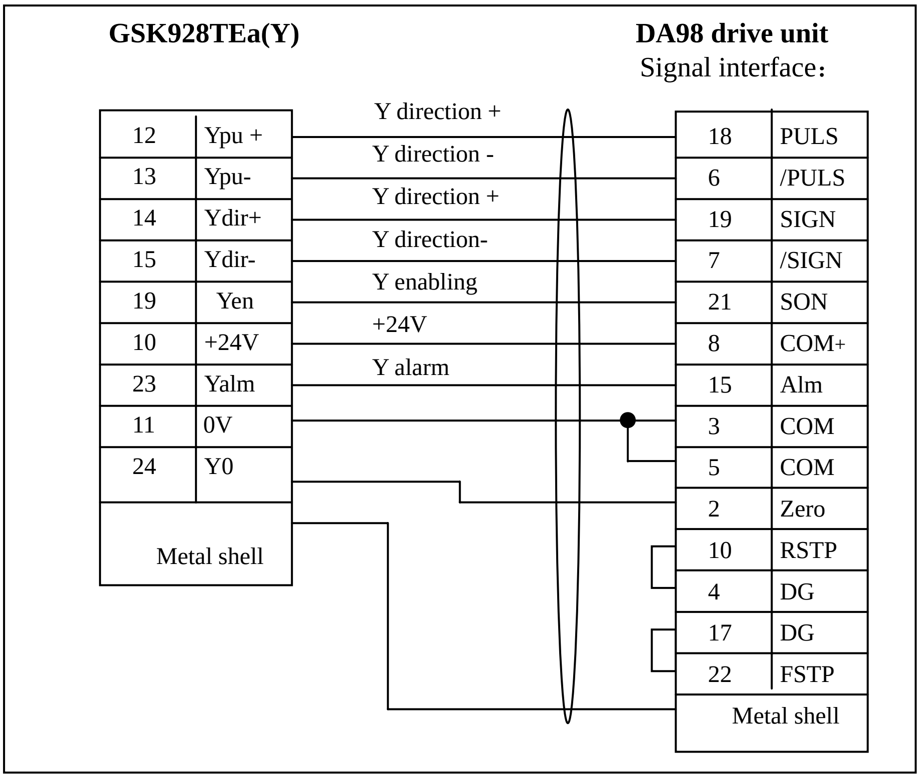
❗ When the spindle encoder output signal is not the difference output mode, PA-,PB-,PC- cannot be connected, at the moment, the anti-interference ability of the encoder output signal reduces. It is suggested that the system should use the spindle encoder with the difference output mode.

3.6.7 Connection between CNC system Y and AC servo drive unit

Connection layout between CNC system Y and GSK DA98 AC servo drive unit



Connection table between CNC system Y and GSK DA98 AC servo drive unit



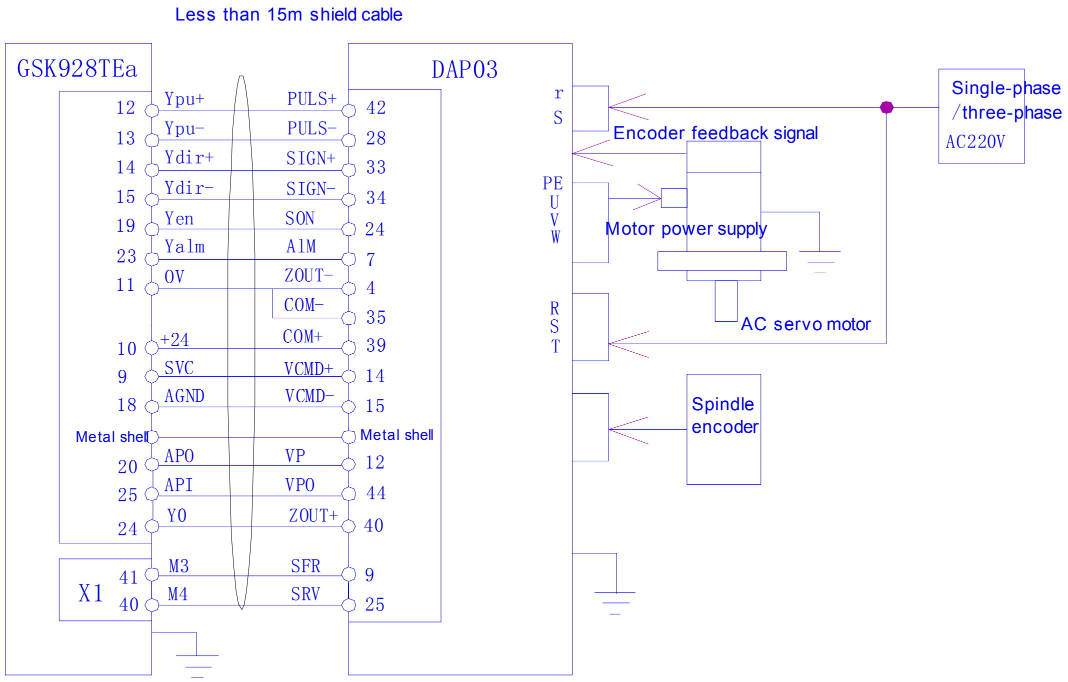
Note: When the spindle and Y are switched (P410__d4=1), Y is connected with the drive unit; the connection method between Y and other drive units is referred to that between Z/X and other drive units.

【Note】

❢ When the stepper motor is used, it is regulated according to the bit parameter **P405(d 7～d 0)** ,X-motion parameter(**P100～P116**) , and definitions of parameter are referred to **Operation**, **Parameter Working Mode.**

- ! The shield cable must be used to connect the step driver and CNC system, otherwise cause that the motor steps out owing to the external interference.
- ! CNC system, the stepper driver and the stepper motor must be reliably connected with the earthing to avoid the motor stepping out because of the external interference.

3.6.8 Connection between CNC system Y and DAP03 spindle drive unit



Connection table between CNC system and DAP03 spindle drive unit

GSK928TEa(Y) **DAP03 drive unit**

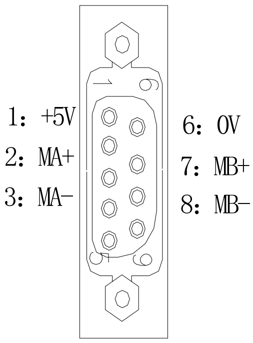
Signal interface:

GSK928TEa(Y) pin	Signal		DAP03 pin	Signal
12	Ypu +	Y pulse+	42	PULS
13	Ypu-	Y pulse-	28	/PULS
14	Ydir+	Y direction +	33	SIGN
15	Ydir-	Y direction-	34	/SIGN
19	Yen	Y enabling	24	SON
10	+24V	+24V	39	COM+
23	Yalm	Y alarm	7	Alm
			4	COM
11	0V		35	COM
9	SVC		14	VCMD+
18	AGND		15	VCMD-
20	APO		12	VP
25	API		44	VPO
41	M3		9	SFR
40	M4		25	SRV
24	Y0		19	ZOUT+
Metal shell			Metal shell	

3.7 X5 MPG Interface

The CNC system can be externally connected with MPG by the MPG interface X5. MPG can control the coordinate axis move. When the MPG connection line is less than 1m, it can use the single-terminal connection, when it is longer than 1.5m, it is advised to use the differential connection to improve the anti-interference ability. The input pins are not connected when the MPG has no MA-, MB-.

3.7.1 Signal definition

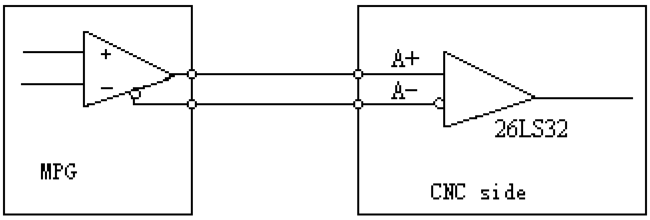


X5 MPG

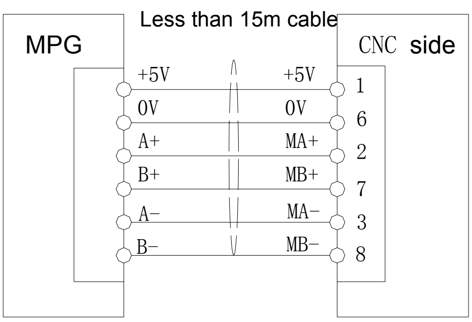
Pin	Standard signal name	Pin function
1	+5V	
2	MA+	MPG A pulse+
3	MA-	MPG A pulse -
4	Empty	
5	Empty	
6	0V	
7	MB+	MPG B pulse +
8	MB-	MPG B pulse -
9	Empty	

3.7.2 Interface method

When MA+,MA- and MB+,MB- are taken as the difference (26LS31) output, it is suggested that the system uses 26LS32 to receive the signals and the circuit method is as follows:



3.7.3 Connection layout



- ! When the axis moving is controlled by MPG, the moving direction of MPG cannot be changed quickly, otherwise the moving distance does not coincide with the MPG dial;
- ! It should adopt the shield cable between the system and MPG;
- ! When the MPG output signal is not in the difference output mode，MA- is not connected with MB-;

Chapter 4 User and Maintenance

4.1 Environmental Condition

System storage, transportation and working environmental condition as follows:

Item	Working climate condition	Storage, transportation climate condition
Environmental temperature	0℃～45℃	-40℃～55℃
Relative humidity	≤90%RH(no dewing)	≤95%(40℃)

4.2 Earthing

The correct earthing in the electricity device is important and its aims are as follows:

1) Protect the operator from being hurt because of the abnormal conditions;

2) Protect the electric devices from interference caused by the machine and electric devices nearby. (the interference may cause abnormality of the control device).

3) The machine and system must be grounded firmly, the neutral wiring in the charged barded wire net must not be the earthing line, otherwise, which causes the injury of persons or the device damaged.

4.3 Power Supply Requirements

The system can normally run in the following AC input power supply:

Voltage wave:AC220V (-15％～+10%)

Frequency wave: 50Hz ± 2%

The requirements for power supply of machine tool is described in machine tool installation manual.

4.4 Guard

The guard grade is not less than IP20.

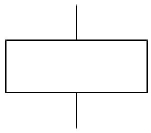
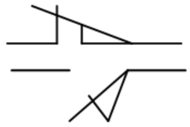
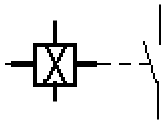
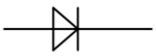
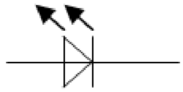
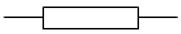
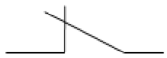
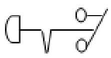
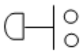
4.5 Use after Long-Time Unuse

After the CNC system is not used for long time, the user must firstly clean the dust, and dry up it, and then check the wiring, the earthing of the CNC system device, keeps it power-on in some time to ensure that the system runs without any failure.

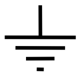
APPENDIX

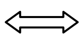
Appendix 1 CNC system electrical component symbol explanations

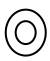
The following examples are some connection symbols of electrical components.

Name	Symbol	Graph	Name	Symbol	Graph
Relay	**K**		Travel switch	**S**	
Motor	**M**		Hall proximity switch	**B**	
Semiconductor diode	**D**		Indicator	**E**	
Capacitor	**C**		LED	**P**	
Resistor	**R**		Normally-open contact		
Push-button switch with lock	**S**		Normally-closed contact		
Push-button switch without lock	**S**				

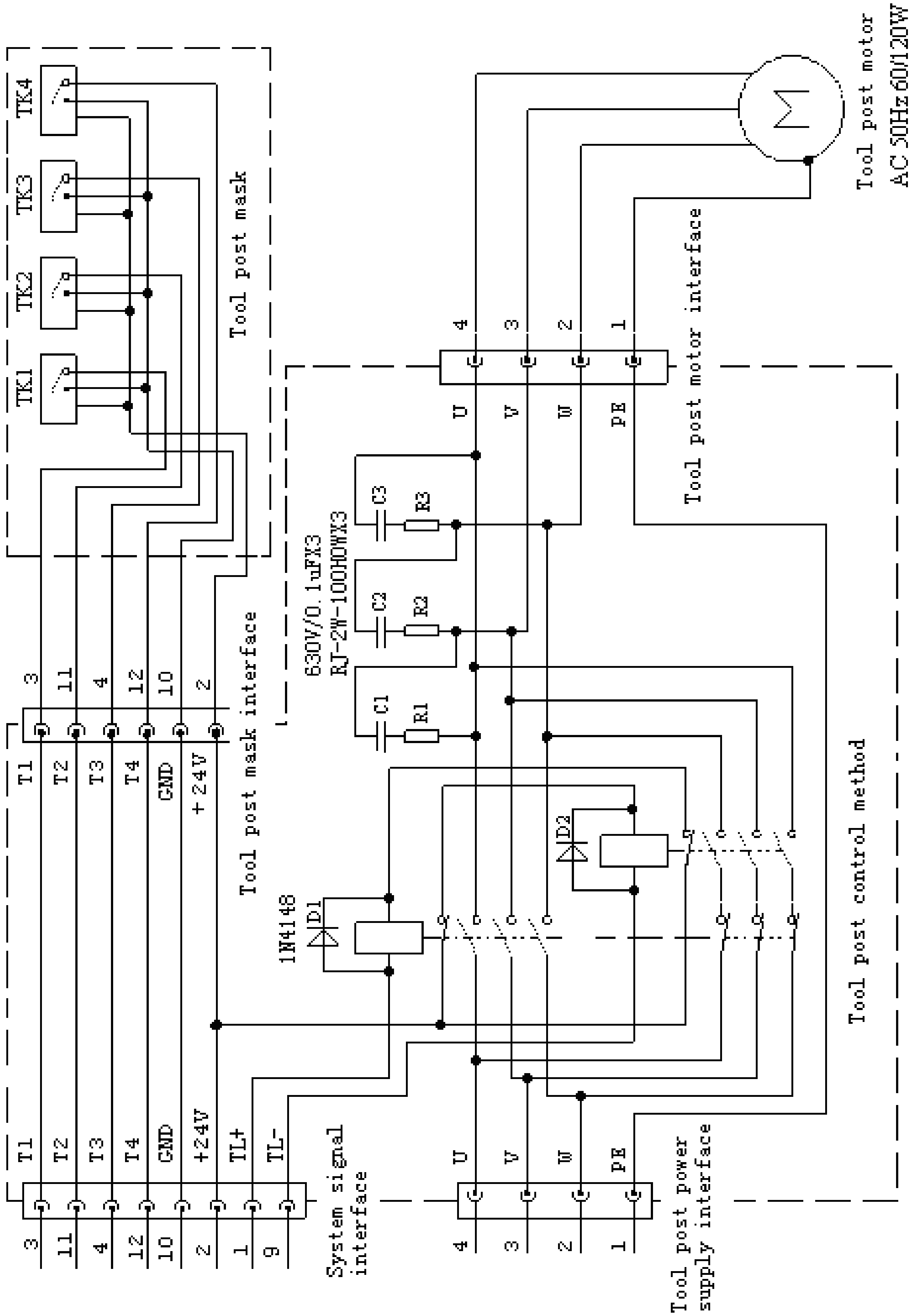
 Shield layer

 Protective earthing

 Exchange.

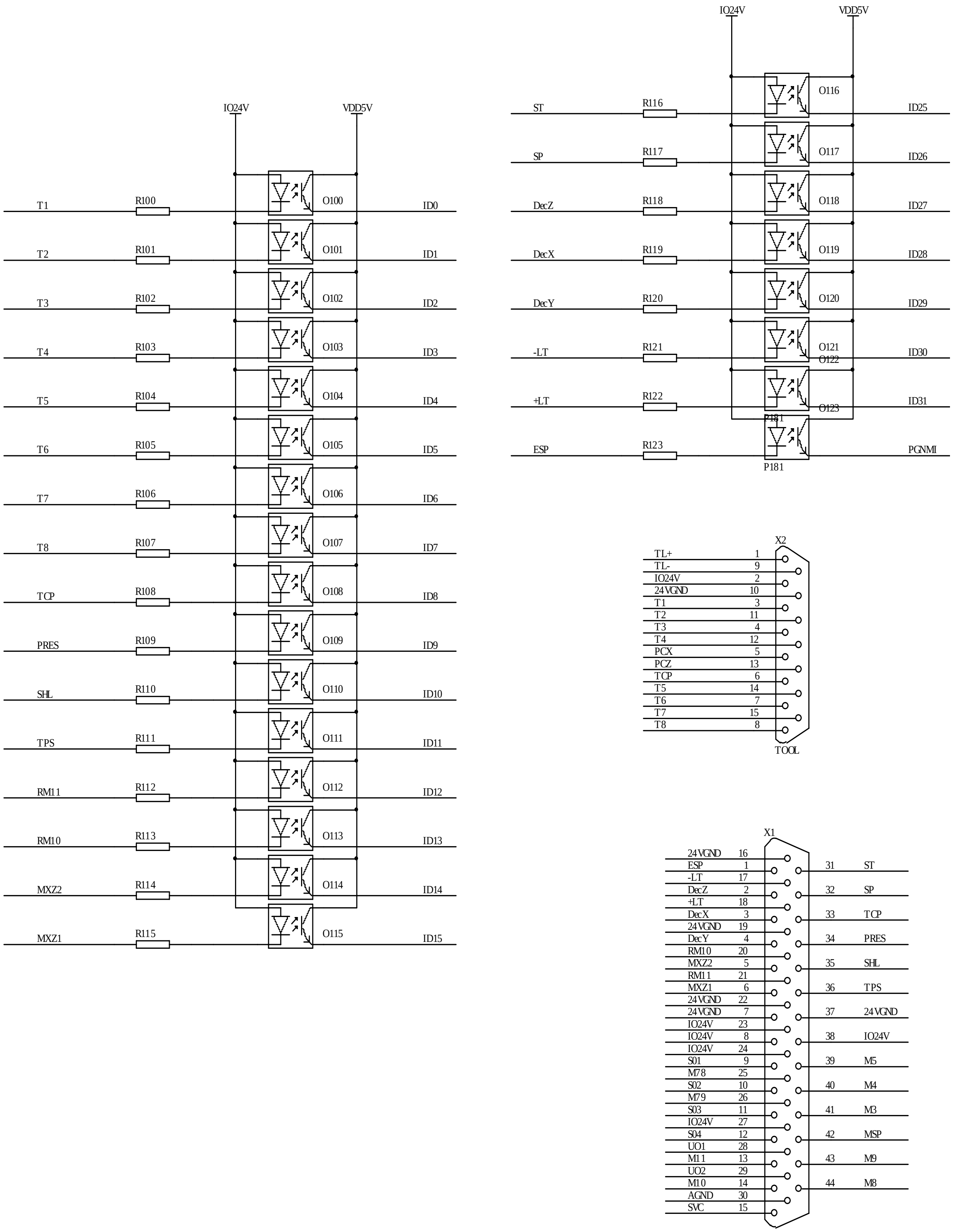
 Wiring terminal

Appendix 2 CNC system tool post controller circuit method layout

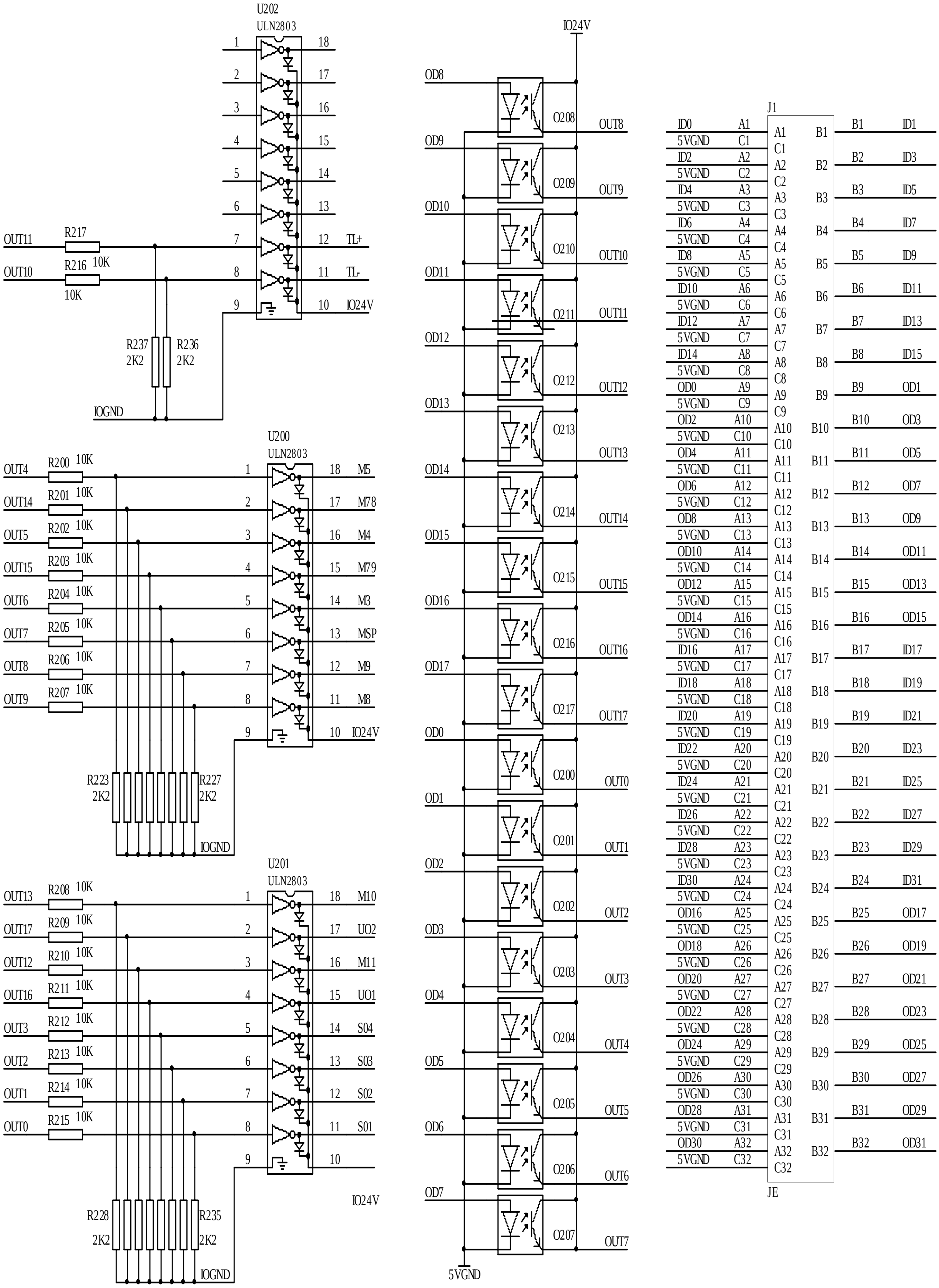


Appendix 3 Interface circuit method layout

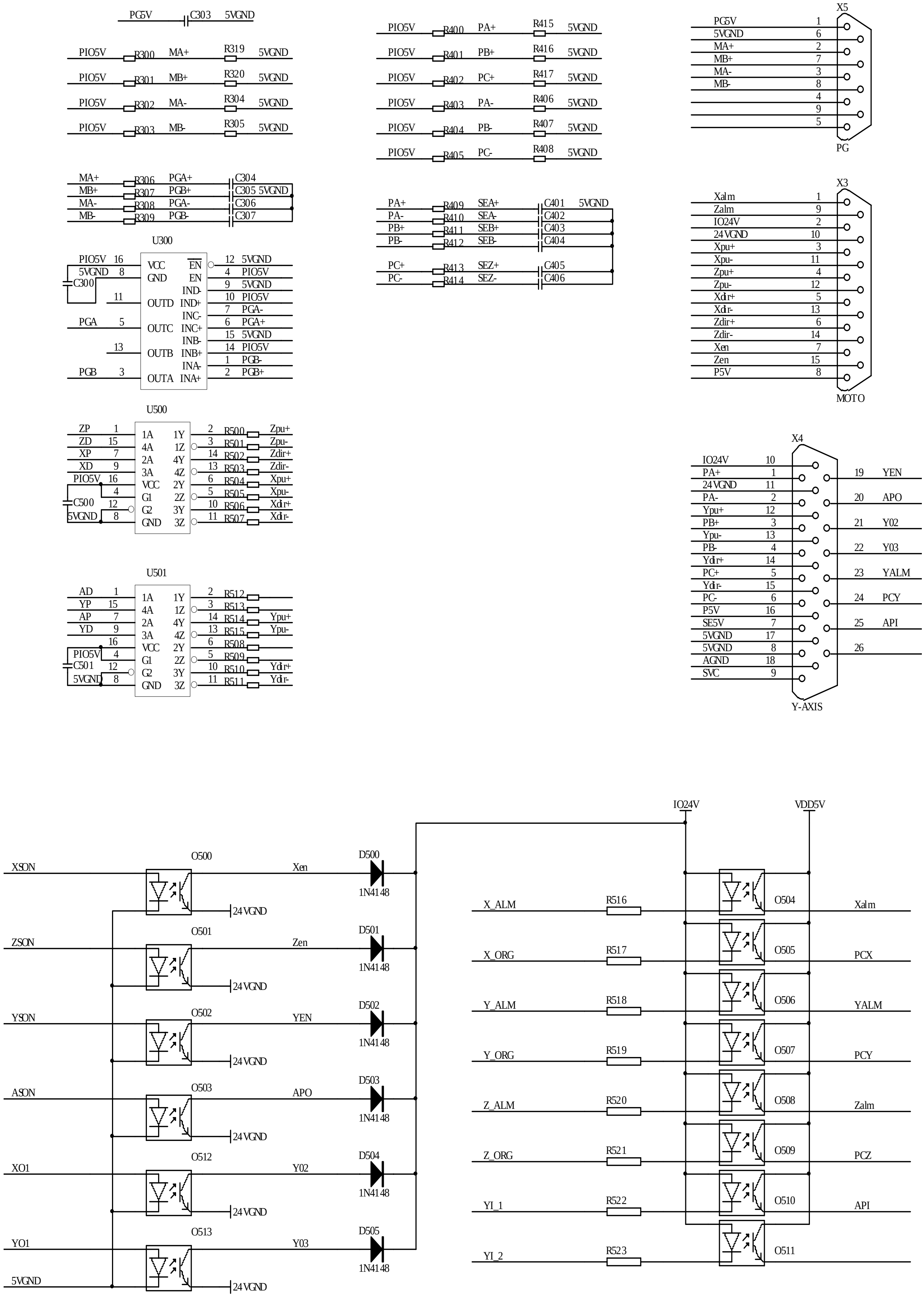
Interface circuit method layout 1 (input)



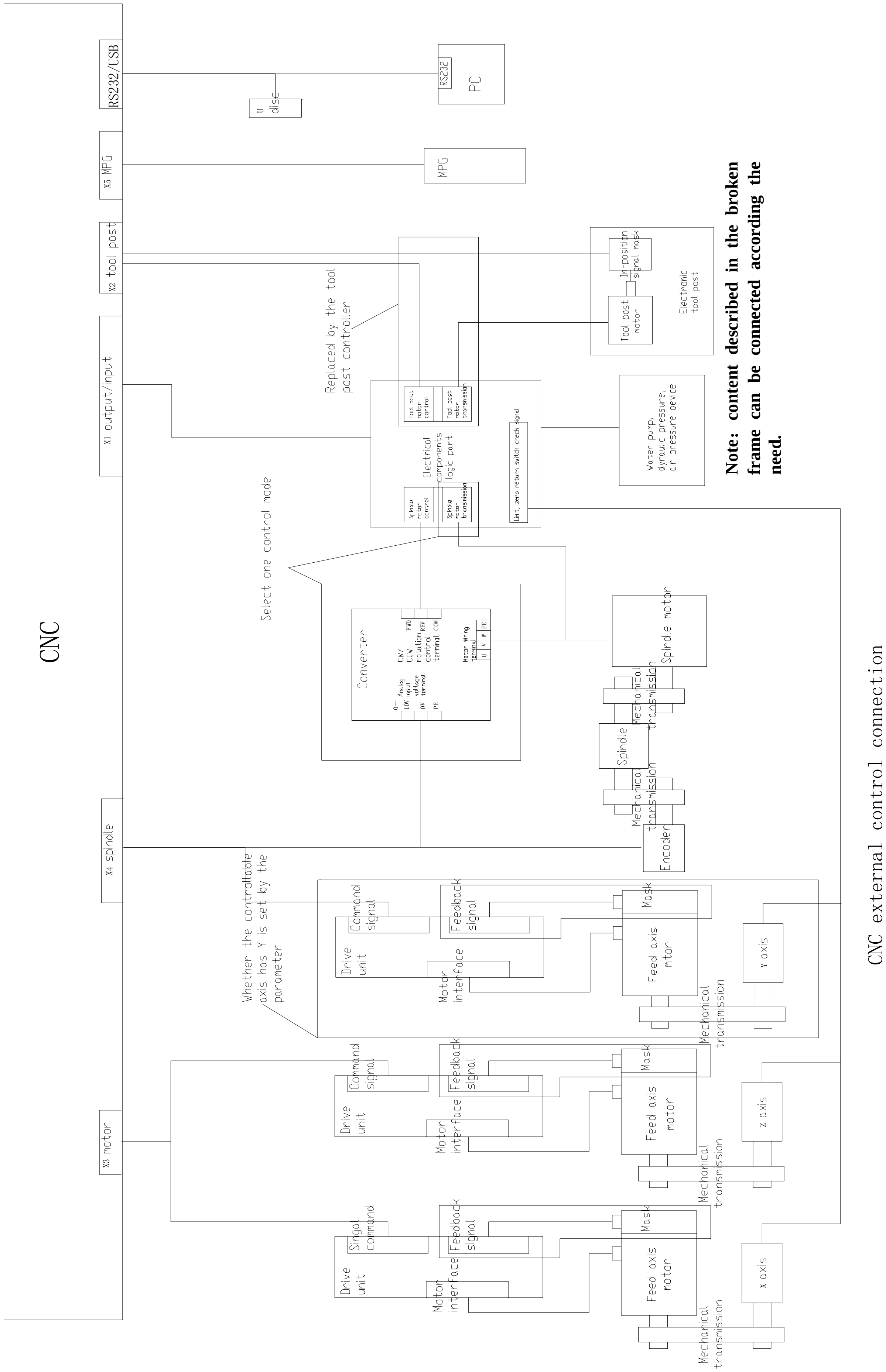
Interface circuit method layout 2 (output)



Interface circuit method layout 3



Appendix 4 External control connection layout



Appendix 5 CNC system appearance installation dimension