✦ This manual is used for PLC of GSK980TDHi series bus lathe CNC system and its installation and connection.

✦ 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

Your Excellency,

We are honored by your purchase of this GSK 980TDHi Turning CNC System made by GSK CNC Equipment Co., Ltd.

This manual is used for PLC of GSK980TDHi bus-based lathe CNC system (version V1.5) and its installation connection and describes how PLC of the system is programmed, installed and connected in details.

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

Warning

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

Note:

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!

STATEMENT!

- 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 deployment and technical performance of the machine tool are designed by the machine tool manufacturer, so function configuration and technical indexes are subject to the user manual from the machine tool manufacturer.
- It is strongly suggested that PLC should be modified by GSK staff. To avoid the accident, don't modify the system on-site.

This manual is subject to change without further notice.

Cautions

■ Delivery and storage

- Packing box over 6 layers in pile is unallowed.
- Never climb the packing box, stand on it or place heavy objects on it.
- Do not move or drag the products by the cables connected to it.
- Forbid collision or scratch to the panel and display screen.
- Avoid dampness, insolation and drenching.

■ Open-package inspection

- Confirm that the products are the required ones.
- Check whether the products are damaged in transit.
- Confirm that the parts in packing box are in accordance with the packing list.
- Contact us in time if any inconsistence, shortage or damage is found.

■ Connection

- Only qualified personnel can connect the system or check the connection.
- The system must be earthed, and the earth resistance must be less than 0.1Ω. The earth wire cannot be replaced by zero wire.
- The connection must be correct and firm to avoid any fault or unexpected consequence.
- Connect with surge diode in the specified direction to avoid damage to the system.
- Switch off power supply before plugging out or opening electric cabinet.

■ Troubleshooting

- Switch off power supply before troubleshooting or changing components.
- Check the fault when short circuit or overload occurs. Restart can only be done after troubleshooting.
- Frequent switching on/off of the power is forbidden, and the interval time should be at least 1 min.

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 responsible for being familiar with and mastering the safety operation procedures through training with the safety operation of the CNC system.

——Be responsible for the dangers caused by adding, changing or altering the original CNC systems and the accessories.

——Be responsible for the dangers caused by failing to observe the provisions in the manual for operation, adjustment, maintenance, installation and storage.

This manual is kept by the end user.

Thank you for supporting us in the use of GSK's products!

Part One Programming

It describes the specifications, address, basic code and functional code , etc. of the PLC of GSK980TDHi series bus-based lathe CNC system.

Part Two Operations

It describes the PLC related operations for GSK980TDHi series bus-based lathe CNC system.

Part Three Functions

It describes the major functions of GSK980THDi series bus-based lathe CNC system.

Part Four Installation and Connection

It describes the installation, connection and setting of GSK980TDHi series bus-based lathe CNC system.

Appendix

It describes how GSK980TDHi series bus-based lathe CNC system can be matched with servo turret.

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Chapter One Sequential Programming Flow

1.1 GSK980TDHi PLC specifications

GSK980TDHi PLC has the following specifications:

Table 1-1-1

Specifications	GSK980TDHi　PLC
Programming language	Ladder
Program series	2
First-level program execution cycle	8ms
Average processing time for basic code	5μs
Program capacity	8000 steps
Code	basic code＋functional code
Internal relay　　　　(R) PLC alarm detection　　(A) Holding storage area Timer　　　　　(T) Counter　　　　(C) Data sheet　　　(D) Holding relay　　(K) Counter prevalue data register　(DC) Timer prevalue data register　(DT) Subprogram　　　　(P) Label　　　　(L) NC side input signal　(F) Signal that outputs to NC side　(G)	0~990　(bytes) 0~63 (bytes) 0~127　(words) 0~127　(words) 0~255　(words) 0~63　(bytes) 0~127 (words) 0~127 (words) 0~99 0~99 0～255 (bytes) 0～255 (bytes)
I/O module　　(X) 　　　　(Y)	0~127　(bytes) 0~127　(bytes)

1.2 Sequential program

A sequential program refers to the program with logical control of the machine tool and related equipment.

After converting the program, the CPU can decode and process it and store the result in RAM. The CPU reads out each code line stored in the memory in high speed and execute the program through arithmetic operation.

The sequential program is composited beginning with a ladder diagram.

Part One Programming

1.3 Interface assignment (step 1)

After determining the controlled object and calculating the corresponding I/O signal points, then you can assign interfaces.

When assigning an interface, refer to the table of I/O interface signal in Part Four Installation and Connection of this manual.

1.4 Ladder diagram compilation (step 2)

GSK980TDHi's ladder diagram does not allow online modification and can only be edited with Lad Edit.exe on the computer so that control actions required by the machine tool will be represented by the ladder diagram. For functions like Timer and Counter that can not be represented by relay symbols, specified functional code symbols may be used.

The edited ladder diagram will need to be re-upgraded to the system.

1.5 Sequential program debugging (step 3)

You can debug the sequential program in the following ways:

1）Debugging with the emulator

Replace the machine tool with an emulator (with a light and a switch). Switch on and off indicates the status of the input signal of the machine tool while light on and off indicates the status of the output signal.

2）Debugging through actual operation

Debug on the actual machine tool. Take precautions before debugging to prevent unexpected cases.

Chapter Two Sequential Program

As the PLC's sequential control is achieved with Lad Edit.exe of the ladder diagram, its working principle is not the same as that of the general relay circuit.

Therefore, you should fully understand the principle of sequential control when designing the PLC's sequential program.

2.1 Sequential program execution process

In the general relay control circuit, all relays can operate simultaneously. In the example below, relays D and E can operate simultaneously when relay A operates (if contacts B and C are closed). In the PLC's sequence control, all relays operate in turn. When relay A operates, relay D first operates then relay E operates (see the figure below). That is, all relays operate in the order (editing order) in the ladder diagram.
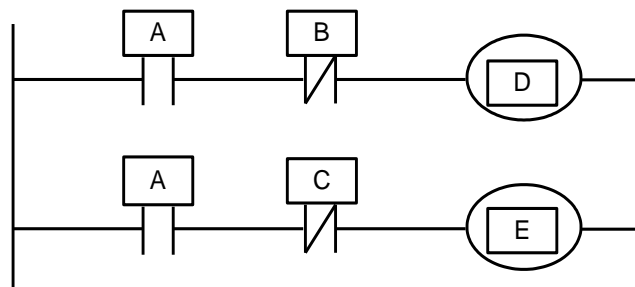
Figure 2.1(a) Circuit Example

Figure 2.1 (b) and (c) below shows the different operations between the relay circuit and the PLC program.

Figure 2.1(b)

Part One Programming
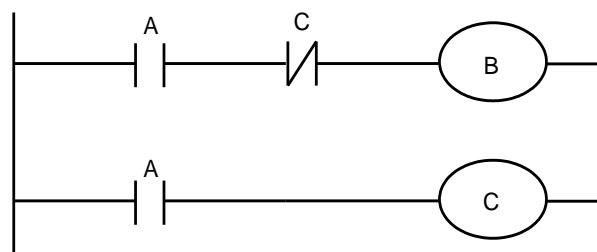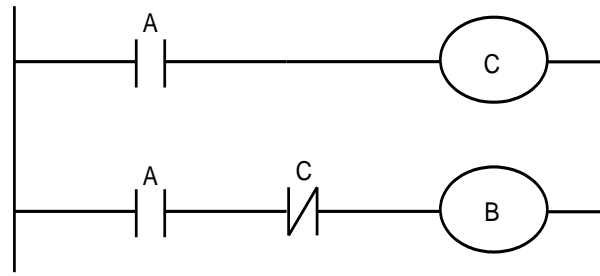
Figure 2.1(c)

(1) Relay circuit

Figure 2.1 (b) and (c) shows the same operations. When A is connected, B and C are connected. After C is connected, B is disconnected.

(2) PLC program

In Figure 2.1 (b), when A is connected, B and C are connected, the same as the relay circuit. After a cycle of the PLC program, B is disconnected. In Figure 2.1 (c), after A is connected, C is connected, but B is not connected.

2.2 Looping execution

The PLC is executed from the beginning of the ladder diagram until the end of the ladder diagram and after that, it is re-executed from the beginning of the ladder diagram. This is called looping execution.

The execution time from the beginning of the ladder diagram to the end is referred to as the loop processing cycle. The shorter the processing period is, the stronger the response capability of the signal is.

2.3 Execution priorities (level one, level two)

GSK980TDHi PLC program is divided into two parts: level one program and level two program. They are different in the execution cycle.

 Level one program is executed every 8ms. It can process some short-pulse signals that require fast response.

 Level two program is executed in every 8*n ms. N is the partition number of level two program.

When starting executing level two programs, the PLC will partition it into N portions. Only one portion is executed every 8ms.
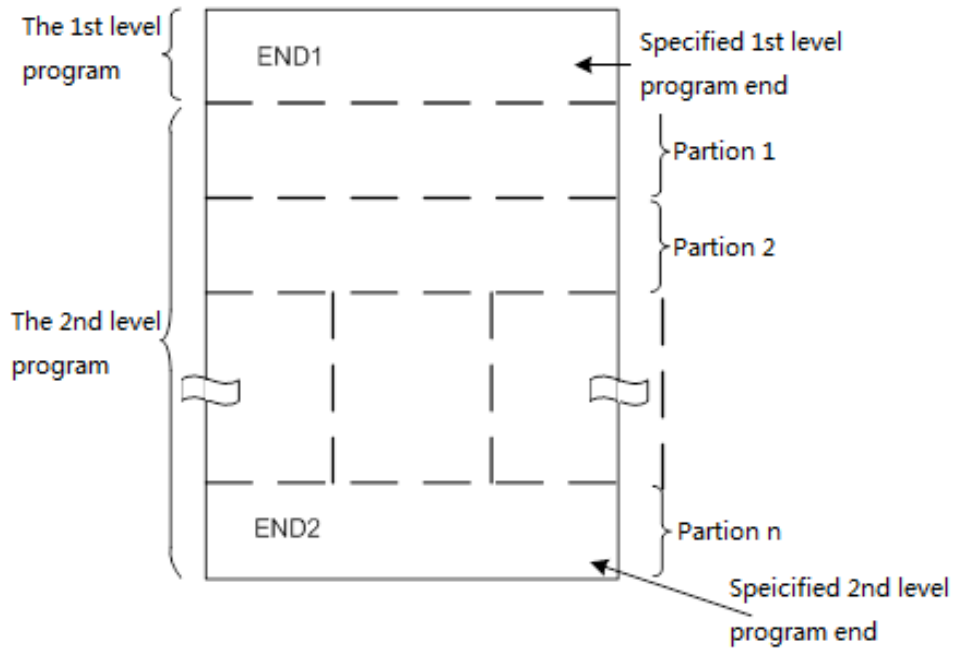
Figure 2-3-1

GSK980TDHi series PLC is executed alone in the PLC-AVR microcontroller. The first 1 ms of every 8 ms is the communication time for the CNC to read and write PLC data. The 5th ms is for the PLC to obtain the system control signal (F, X) and upload the external port I/O (X, Y) of the control results data (G, Y parameters). The PLC is executing ladder diagram operation at any time other than when the response exchange data is interrupted.
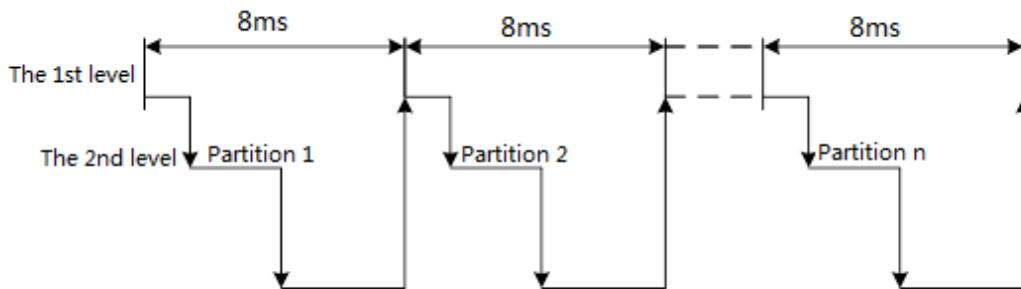
Figure 2-3-2

When level two program with a partition number of n is executed, the program will be executed again from the beginning. Thus, when the partition number is n, the execution time for one cycle is 8 * n ms. Level one program is executed every 8 ms and level two program executed every 8*n ms. If the number of steps in level one program is increased, then the number of steps in level two program will be reduced, the partition number will be increased and the processing time for the whole program will

be longer. Therefore, level one program should be compiled as short as possible.

2.4 Sequential program structure

In the traditional PLC, the ladder diagram's sequential compilation has the following advantages among ladder diagram languages that allow structured programming:

1. The program is easy to understand and compile.

2. It is more convenient to locate programming errors.

3. It is easier to locate the cause when an operation error occurs.

There are 3 major structured programming methods:

1)　Subprogram

The subprogram takes the ladder diagram as a processing unit.
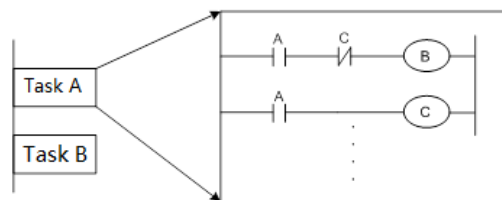
Figure 2-4-1

2)　Nesting

A subprogram can call other subprograms to complete a task.
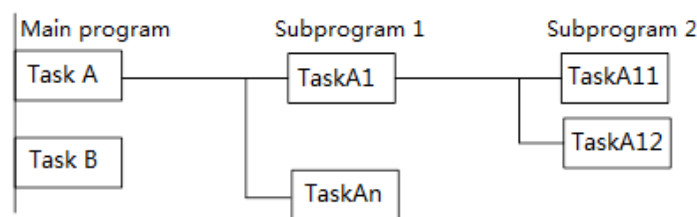
Figure 2-4-2

3)　Conditional branch

The main program is executed in loop and will check whether the conditions are met. If so, then the corresponding subprogram will be executed. If not, the corresponding subprogram will not be executed.

14
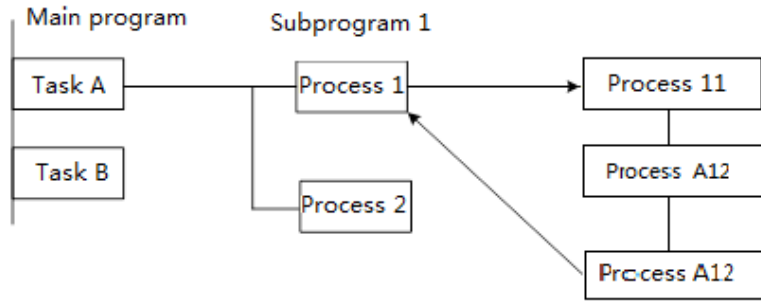
Figure 2-4-3

2.5 I/O signal processing

Input signal processing:
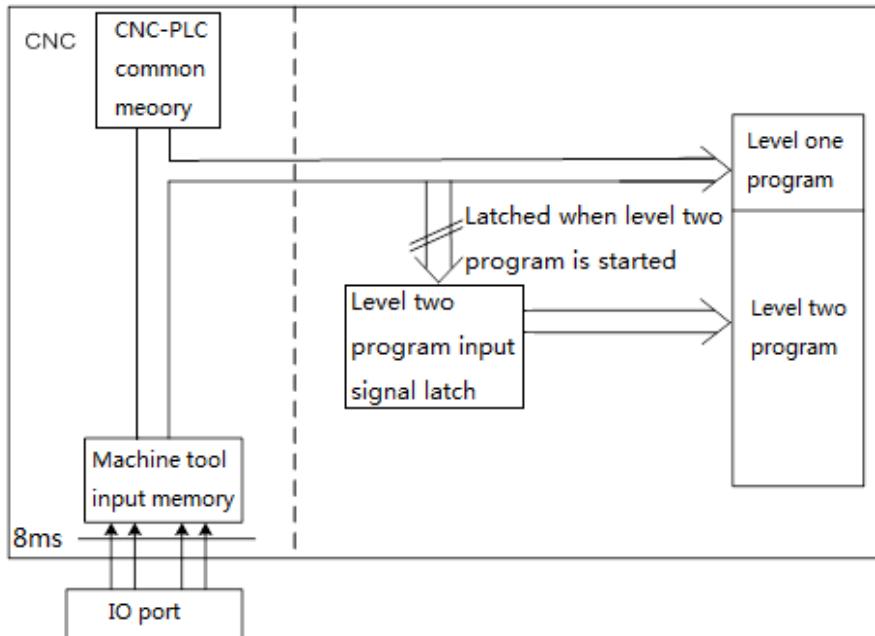
Figure 2-5-1

Output signal processing:
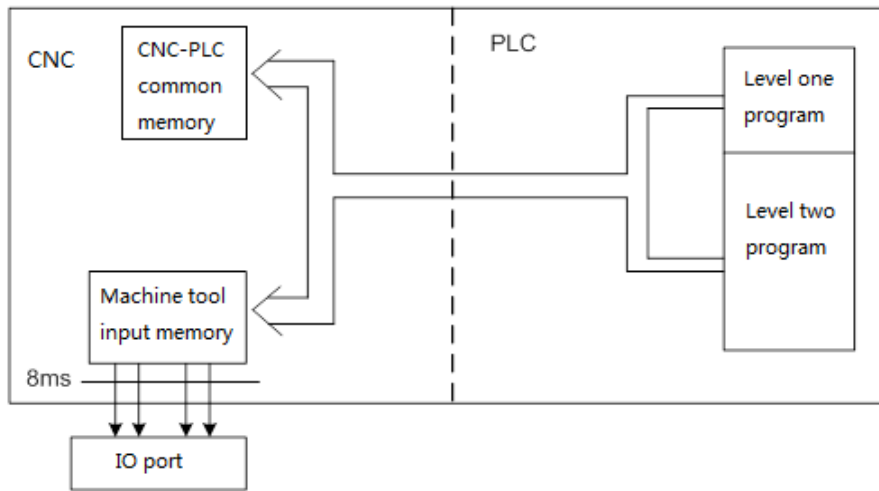
Figure 2-5-2

2.5.1 Input signal processing

(1) NC input memory

The input signal from the NC is stored in the NC input memory and is transferred to the PLC every 8 ms. Level one program directly references the status of these signals and executes the corresponding processing.

(2) Machine tool input memory

The machine tool input memory scans and stores the input signals from the machine tool every 8 ms. Level one program also directly references the status of these signals and executes the corresponding processing.

(3) Level two program input latch

Level two program input latch is also known as level two synchronous input signal memory, where the input signal stored is specifically used for level two program processing and has its status synchronized with the signal status of level two program. Only when the execution of level two program is started, will the signal in the NC input memory and the machine tool input memory be latched into level two program input latch. And the signal status in this latch remains unchanged throughout the execution of level two program.

2.5.2 Output signal processing

(1) NC output memory

The output signal is transferred from the PLC to the NC output memory every 8 ms.

(2) Machine tool output memory

The signal stored in the machine tool output memory is transferred to the machine tool every 8 ms.

Note: The signal status of the NC input memory, NC output memory, machine tool input memory and machine tool output memory can be displayed using its self-diagnostic function. The diagnostic number is the address number in the sequential program.

2.5.3 Difference of the signal status between level one program and level two program

For the same input signal, its status in level one program may be different from that in level two program as different input memories are used. That is, the input signal used by level two program is the latched input signal of level one program. So the signal in level two program is lagging behind the input signal in level one program. In the worst case, it can lag for an execution cycle of level two program.

Keep this in mind when compiling the ladder diagram.
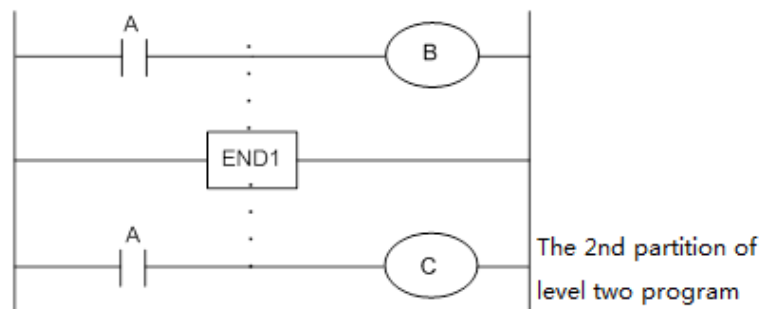
Figure 2-5-3-1

At the first 8 ms, if A＝1 and level one program is executed, then B＝1. And the execution of level two program is started, A＝1 is latched to level two program and partition one of level two program is executed.

At the second 8 ms, if A＝0 and level one program is executed, then B＝0. And partition two of level two program is executed. Still A＝1. So C = 1.

So, B and C have different statuses.

2.6 Interlocking

In the sequential control, from the security point of view, interlocking is very important.

Necessary interlocking must be taken in the sequential control program. Meanwhile, necessary hard interlocking should also be taken in the relay control circuit of high-voltage electric cabinet at the machine tool side. This is because, even if interlocking is taken logically in the sequential program (software), it will fail when the hardware in the sequential program fails.Therefore, interlocking taken in the high-voltage electric cabinet at the machine tool side can ensure safety of the operator and prevent damage to the machine tool.

Chapter Three PLC Address

Addresses are used to distinguish signals. Different addresses correspond to the I/O signal at the machine tool side, I/O signal at the CNC side, internal relay, counter, timer, holding relay and data sheet. Each address includes an address number and a bit number. Its numbering rule is as follows:

Address numbering rule:

The address number consists of an address type, an address number and a bit number.

$$\underline{X} \quad \underline{000} \quad . \quad \underline{6}$$

Type   Address Number   Bit Number

Address type: It includes X, Y, R, F, G, K, A, D, C, T

Address number: A decimal number that represents a byte.

Bit number: An octal number, 0 to 7 respectively represent the 0 to 7 bits represented by the preceding address number.

GSK980TDHi PLC has the following address types:

Table 3-1

Address	Description	Length
X	Machine tool→PLC (128 bytes)	INT8U
Y	PLC→machine tool (128 bytes)	INT8U
F	CNC→PLC (256 bytes)	INT8U
G	PLC→CNC (256 bytes)	INT8U
R	Intermediate relay (990 bytes)	INT8U
D	Data register (0～255)	INT16U
DC	Counter prevaluedata register	INT16U
C	Counter (0～127)	INT16U
A	PLC alarm detection	INT8U
T	Timer (0～127)	INT16U
DT	Timer prevalue data register	INT16U
K	Holding relay (64 bytes)	INT8U

The INT8U data type is an unsigned 8-bit character type and the INT16U data type is an unsigned 16-bit integer type.

3.1 Machine tool→PLC address (X)

GSK980TDHi PLC's X address is divided into two types:

1. X address assigned to on an IO input port of the system XS40.

2. X address assigned to the input key of the MDI panel of the system.

3.1.1 X addresses on the I/O input port

They are from X8 to X9, defined as INT8U for a total of 16 and distributed on an I/O input port of the system XS40. These X addresses, maybe defined with their own signal meanings by the user depending on the actual situation, are used to connect the machine tool and complie the corresponding ladder diagram. For the initial definition of the input address, see table 3-1-1, in section3.1, Chapter 4. Installation and Connection.

3.1.2 X addresses on the MDI panel

They are from X16.0 to X23.7, with a total of 8 bytes. These X addresses correspond to the key inputs on the MDI panel. The user cannot change the signal definition. The keys on the MDI panel are first responded by the CNC, which will send the X signal to the PLC.

They correspond to the keys as follows:

Table 3-1-2-1

Operation Panel Key Input	PLC Address	Operation Panel Key Input	PLC Address
Editing Mode	X16.1	Fast 100%	X19.1
Automatic Mode	X16.2	Shaft + 4th	X19.2
MDI Mode	X16.3	Manual Feed Shaft + X	X19.3
Zero Return Mode	X16.4	Manual Feed Shaft Y	X19.4
Driving Manual Pulse\Single Step Mode	X16.5	Counterclockwise Shaft C	X19.5.
Manual Mode	X16.6	Tool Change	X19.6
Program Zero Return	X16.7	Reduced Spindle Override	X19.7
Single Stage	X17.0	Manual Feed Shaft + Y	X20.0
Skipping Stage	X17.1	Manual Feed Shaft X	X20.1
Machine Tool Lock	X17.2	Shaft + 4th	X20.2
Auxiliary Lock	X17.3	Clockwise Shaft + C	X20.3
Dry Running	X17.4	Cooling	X20.4
Optional Stop	X17.5	Increased Spindle Override	X20.5
Fast F0	X17.6	Spindle Clockwise	X20.6

Part One Programming

Operation Panel Key Input	PLC Address	Operation Panel Key Input	PLC Address
Fast 25%	X17.7	Increased Feedrate Override	X20.7
Manual Pulse Trial Cut	X18.0	Spindle Stop	X21.0
USER1\Hydraulic Pressure	X18.1	Feedrate Override100%	X21.1
Manual Feed Shaft + Z	X18.2	Spindle Counterclockwise	X21.2
Fast Moving Switch	X18.3	Reduced Feedrate Override	X21.3
Manual Feed Shaft Z	X18.4	Loop Start	X21.4
C/S Shaft Switching	X18.5	Feed Hold	X21.5
Lubrication	X18.6	Chuck (980TDHi-V)	X21.6
Jogging	X18.7	Tailstock (980TDHi-V)	X21.7
Fast 50%	X19.0		

3.2 PLC → machine tool side address (Y)

Y addresses of GSK980TDHi series PLC are assigned on each indicator on the MDI panel of the system.

3.2.1 Y addresses on the MDI panel

They are from Y16 to Y23. with a total of 8 bytes. These Y addresses correspond to the indicator lights on the MDI panel. The user cannot change the signal definition. The PLC system feeds back to the keyboard module of the CNC system after operation, used for indicator light signal display.

Part One Programming

They correspond to the indicator lights as follows:

Table 3-2-1-1

Keyboard Indicator Light Output	PLC Address	Keyboard Indicator Light Output	PLC Address
Editing Key Indicator Light	Y16.1	Tool Change Indicator Light	Y19.6
Automatic Key Indicator Light	Y16.2	+Y Shaft Key Indicator Light	Y20.0
MDI Key Indicator Light	Y16.3	+X Shaft Key Indicator Light	Y20.1
Zero return Key Indicator Light	Y16.4	+4th Shaft Key Indicator Light	Y20.2
Driving Manual Pulse\Single Step Key Indicator Light	Y16.5	+C Shaft Key Indicator Light	Y20.3
Manual Key Indicator Light	Y16.6	Cooling Indicator Light	Y20.4
Zero return Indicator Light	Y16.7	Spindle Stop Indicator Light	Y21.0
Single Stage Indicator Light	Y17.0	Feedrate Override100%	Y21.1
Skipping Stage Indicator Light	Y17.1	Loop Start Indicator Light	Y21.4
Machine Tool Lock Indicator Light	Y17.2	Feed Hold Indicator Light	Y21.5
Auxiliary Lock Indicator Light	Y17.3	Chuck Indicator Light (980TDHi-V)	Y21.6
Dry Running Indicator Light	Y17.4	Tailstock Indicator Light (980TDHi-V)	Y21.7
Optional Stop Indicator Light	Y17.5	Nixie Tube Output Coding 0 (BCD)	Y22.0
Fast F0	Y17.6	Nixie Tube Output Coding 1 (BCD)	Y22.1
Fast 25%	Y17.7	Nixie Tube Output Coding 2 (BCD)	Y22.2
Manual Pulse Trial Test Indicator Light	Y18.0	Nixie Tube Output Coding 3 (BCD)	Y22.3
USER1\Hydraulic Pressure Indicator Light	Y18.1	Nixie Tube Output Coding 4 (BCD)	Y22.4
+Z Shaft Indicator Light	Y18.2	Nixie Tube Output Coding 5 (BCD)	Y22.5
Fast Moving Switch Indicator Light	Y18.3	Nixie Tube Output Coding 6 (BCD)	Y22.6

Keyboard Indicator Light Output	PLC Address	Keyboard Indicator Light Output	PLC Address
Increased Spindle Override Indicator Light	Y18.4	Nixie Tube Output Coding 7 (BCD)	Y22.7
C/S Switch Indicator Light	Y18.5	X Shaft Zero return Indicator Light	Y23.0
Lubrication Indicator Light	Y18.6	Y Shaft Zero return Indicator Light	Y23.1
Jogging Key Indicator Light	Y18.7	Z Shaft Zero return Indicator Light	Y23.2
Fast 50%	Y19.0	4th Shaft Zero return Indicator Light	Y23.3
Fast 100%	Y19.1	C Shaft Zero return Indicator Light	Y23.4
Reduced Spindle Override Indicator Light	Y19.2	Alarm Indicator Light	Y23.5
Counterclockwise Indicator Light	Y19.3	Readiness Indicator Light	Y23.6
Clockwise Indicator Light	Y19.4	Running Indicator Light	Y23.7
Reduced Feedrate Override	Y19.5		

Part One Programming

3.3 PLC→CNC address (G)

They are from G0 to G63, defined as INT8U for a total of 64 bytes.

Operation Panel Key Signals

Table 3-3-1

Operation Panel Key Signal	PLC address	Operation Panel Key Signal	PLC address
Mode Selection Signal	G43.0～G43.2	Chuck Status	G60.0/G60.1
Incremental Feed	G43.3	Loop Start	G7.2
Driving Manual Pulse Trial Switch Selection Signal	G43.4	Feed Hold	G8.5
Program Zero Return	G43.6	High-Speed Switch	G19.7
Manual Reference Point Return Selection Signal	G43.7	Manual Feed Shaft +1st	G100.0
Skipping Stage	G44.0	Manual Feed Shaft +2nd	G100.1
Single Stage	G46.1	Manual Feed Shaft +3rd	G100.2
Dry Running	G150.7	Manual Feed Shaft +4th	G100.3
Auxiliary Lock	G5.6	Manual Feed Shaft +C	G100.4
Machine Tool Lock	G44.1	Manual Feed Shaft -1st	G102.0
Spindle Counterclockwise (forward)	G26.2	Manual Feed Shaft -2nd	G102.1
Spindle Clockwise (reverse)	G26.3	Manual Feed Shaft -3rd	G102.2
Spindle Jogging Directional Shift	G29.5	Manual Feed Shaft -4th	G102.3
Cs Contour Control Switching Signal	G27.7	Manual Feed Shaft +C	G102.4

Note: Fast rate and manual pulse step size are defined by the binary composed of 2 G addresses: G14.0=0, G14.1=0 for Fast F0, G14.0=1, G14.1=0 for Fast 25%, G14.0=0, G14.1=1 for Fast 50%, G14.0=1, G14.1=1 for Fast 100%; G19.4=1, G19.5=0, G19.6=0 for manual pulse step size*1. G19.4=0, G19.5=1, G19.6=0 for manual pulse step size*10, G19.4=1, G19.5=1, G19.6=0 for manual pulse step size*100, G19.4=0, G19.5=0, G19.6=1 for manual pulse step of a specified parameter.

3.4 CNC→PLC address (F)

They are from F0 to F63. defined as INT8U for a total of 64 bytes.

See Part Three Functions for signals.

3.5 Internal relay address (R)

This address area is cleared when the system is powered up. R990, R991 are occupied by the system.

The address is defined as INT8U for a total of 990 bytes.
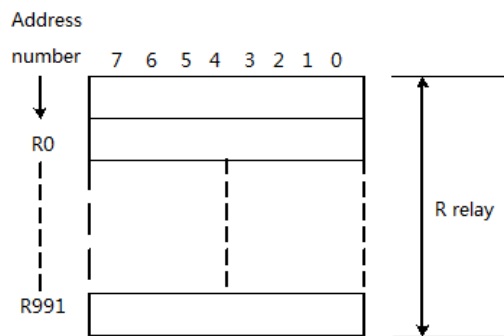
Figure 3-5-1

Area managed by the system program:

R990

When the PLC starts or restarts, the signal of the R990.0 address is set to 1 to initialize the user-set signal, and after the ladder diagram is executed for a cycle, the R990.0 is reset to 0.

R991 (system timer)

The following four signals can be used as the system timer:
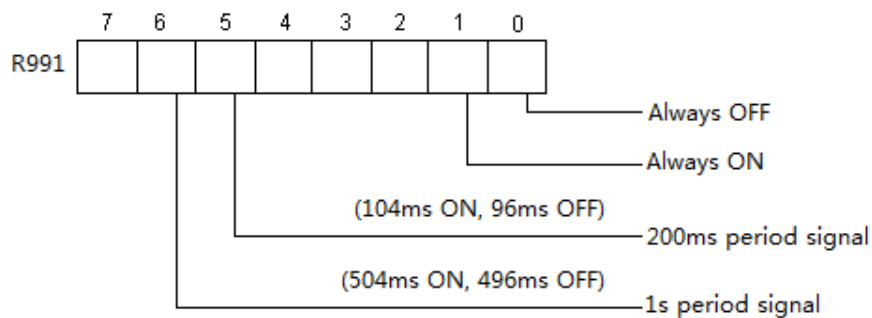
Figure 3-5-2

3.6 Holding relay address (K)

This address area is used as the holding relay and to set PLC parameters. It is a nonvolatile memory area, where even if the system is powered down, what is stored in the memory will not be lost. K000 ~ ~ K005 are occupied by the system to save the PLC system parameters so that the user can control the PLC in the CNC.

The address is defined as INT8U for a total of 64 bytes.
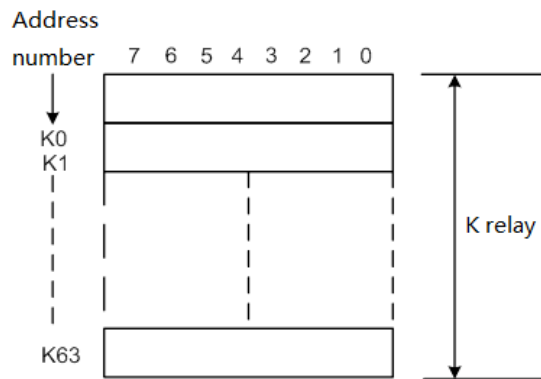
Figure 3-6-1

Note: When the PLC address K005.2=1, the PLC enters the debugging mode. All external alarm signals are canceled. The machine tool interlocking signal is canceled. The tool change code can not be executed. You must understand this parameter before modifying it, so as to avoid damage to the machine tool or a personal accident.

3.7 Information displaying request address (A)

This address area is cleared when the system is powered up.
The address is defined as INT8U for a total of 32 bytes.
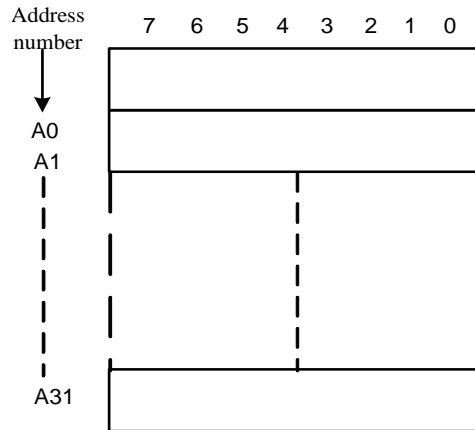
Figure 3-7-1

3.8 Counter address (C)

This address area is used to store the counter's current count value. After the system is powered down, the data is cleared.

The address is defined for a total of 128 addresses.

3.9 Counter prevalue address (DC)

This address area is used to store the counter prevalue. It is a nonvolatile memory area, where even if the system is powered down, what is stored in the memory will not be lost.

The address is defined for a total of 128 addresses. The DC value set can be read only.

3.10 Timer address (T)

This address area is used to store the current value of Timer. After the system is powered down, the data is initially preset. When it is set to 0, the current data is the preset value.

The address is defined for a total of 128 addresses.

3.11 Timer prevalue address (DT)

This address area is used to store the timer prevalue. It is a nonvolatile memory area, and even if the system is powered down, what is stored in the memory will not be lost.

The address is defined for a total of 128 addresses. The DT value set can be read only.

3.12 Data sheet address (D)

Even if the system is powered down, what is stored in the memory will not be lost.

The address is defined for a total of 256 addresses.

3.13 Marking address (L)

It is used to specify the jump target label in the JMPB code and the label in the LBL code.

Range: 0～99

3.14 Subprogram number (P)

It is used to specify the target subprogram no. called in the CALL code and the subprogram no. in the SPcode.

Range: 0～99

Chapter Four PLC Basic Code

The sequential program design begins with the ladder diagram compilation. The ladder diagram consists of relay contacts and functional code. The logical relationships represented in the ladder diagram constitute the sequential program. There are two ways to input the sequential program: one uses the mnemonic language (this system does not support the PLC command code of RD, AND, OR); the other uses the relay symbols. With relay symbols, you can use the ladder diagram format and program without having to understand the PLC code.

In fact, even if the sequential program is input with the relay symbols method, it will also be converted into the corresponding PLC code in the system.

The basic code is the most commonly used code to design the sequential program and will execute one calculation.

The basic instructions code for GSK980TDHi series is as follows:

Table 4-1

Code Name	Function
RD	To left shift the content of the register one bit and set the signal status of the specified address to ST0
RD.NOT	To left shift the content of the register one bit and set the signal status of the specified address to ST0 after taking not
WRT	To output the logical operation result to a specified address
WRT.NOT	To output the logical operation result to a specified address after taking not
AND	Logic and
AND.NOT	Logic and after the specified status is taken not
OR	Logic or
OR.NOT	Logic or after the specified status is taken not
OR. STK	To right shift the stack register one bit after ST0 and ST1 logic or
AND.STK	To right shift the stack register one bit after ST0 and ST1 logic and

Part One Programming

4.1 RD, RD.NOT, WRT, WRT.NOT

Mnemonic symbols and functions

Table 4-1-1

Mnemonic symbol	Function
RD	To left shift the content of the register one bit and set the signal status of the specified address to ST0
RD.NOT	To left shift the content of the register one bit and set the signal status of the specified address to ST0 after taking not
WRT	To output the logical operation result to a specified address
WRT.NOT	To output the logical operation result to a specified address after taking not

Code description

- WRT, WRT. NOT code is the coil drive code for the output relay and internal relay. It cannot be used for the input relay.
- The coordinate WRT commands can be used repeatedly to support multi-coil output.

Such as programming

RD   X002.1

WRT   Y003.7

RD.NOT F100.3

WRT   G120.0

Figure 4-1-1

4.2 AND, AND.NOT

Mnemonic symbols and functions

Table 4-2-1

Mnemonic symbol	Function
AND	Logic and
AND.NOT	Logic and after the specified status is taken no

Code description

● AND, AND.NOT code can be used to connect in series 1 contact. There is no limit to the number of series contacts and the code can be used multiple times.

Such as programming:


```
X002.1   F100.3   X008.6        Y003.7      RD        X002.1
  | |      |/|      | |           ( )        AND.NOT   F100.3
                                             AND       X008.6
                                             WRT       Y003.7
```
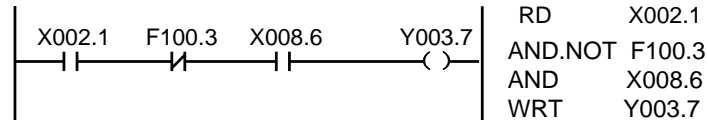
Figure 4-2-1

4.3 OR, OR.NOT

Mnemonic symbols and functions

Table 4-3-1

Mnemonic symbol	Function
OR	Logic or
OR.NOT	Logic or after the specified status is taken not

Code description

● OR, OR.NOT code can be used to connect in parallel with a contact.
● OR, OR.NOT refers to the connection in parallel with the above RD, RD.NOT code from the step of such code.

Such as programming


```
X002.1                          Y003.7      RD        X002.1
  | |                             ( )        OR.NOT    F100.3
                                             WRT       Y003.7
F100.3
  |/|
```
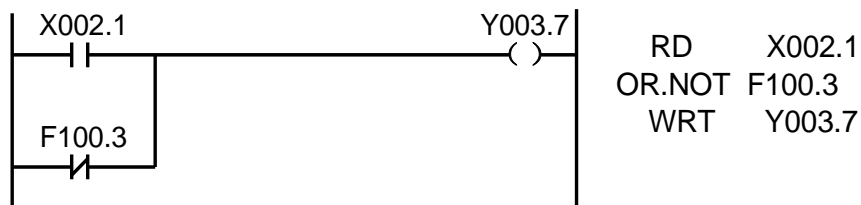
Figure 4-3-1

4.4 OR. STK

Mnemonic symbols and functions

Table 4-4-1

Mnemonic symbol	Function
OR. STK	To right shift the stack register one bit after ST0 and ST1 logic or

Code description

● OR.STK code is an independent code with no address.

Such as programming
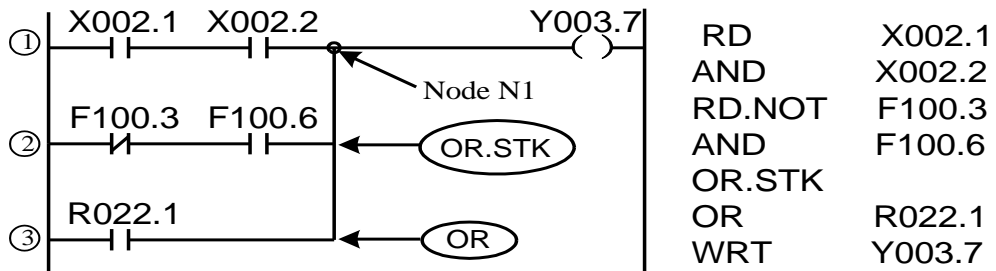
Figure 4-4-1

As shown in the figure, there are three branches ①, ②, ③ from the left bus to the node N1. Branches ① and ② are series circuit blocks and when there are parallel circuit blocks from the bus to nodes or between nodes, except the first branch, the following branches use the RD code. Branch ③ is not a series circuit block, so the OR code can be used.

OR.STK and AND.STK are code without any operating components that represent the or, and relationships between the circuit blocks.

4.5 AND.STK

Mnemonic symbols and functions

Table 4-5-1

Mnemonic symbol	Function
AND.STK	To right shift the stack register one bit after ST0 and ST1 logic and

Code description

- The AND.STK code is used when the branch loop (parallel circuit blocks) is connected in series with the preceding loop. The RD, RD．NOT code is used at the starting point of the branch and after the parallel circuit loop blocks are connected, the AND.STK code is used to connect in series the preceding loop.
- The AND.STK code is an independent code with no address.

Such as programming
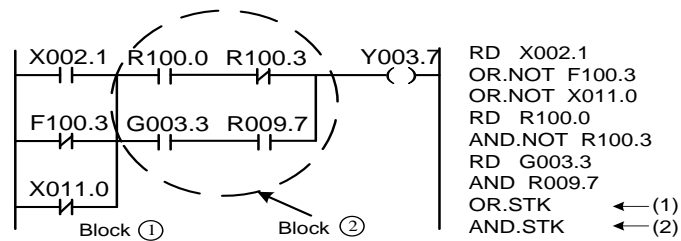
Figure 4-5-1

As shown in the ladder diagram and instruction list, ⑴ OR.STK represents the series circuit blocks in parallel in block ②, ⑵ AND.STK represents circuit block ① and circuit block ② in series.

Chapter Five PLC Functional Code

When it is difficult to compile some machine tool actions with the basic instructions code, the functional instructions code may be used to simplify programming.

Table 5-1 (980TDHi PLC Functional Instructions Code)

No.	Name	Function	No.	Name	Function
1	END1	To end level one sequential program	19	ROT	Binary rotation control
2	END2	To end level two sequential program	20	SFT	Register shift
3	CALL	To call a subprogram	21	DIFU	Rising edge detection
4	CALLU	To unconditionally call a subprogram	22	DIFD	Falling edge detection
5	SP	Subprogram	23	COMP	Binary number comparison
6	SPE	To end the subprogram	24	COIN	Consistency comparison
7	SET	Set	25	MOVN	Data transfer
8	RST	Reset	26	MOVB	1 byte transfer
9	JMPB	Label jump	27	MOVW	Two bytes transfer
10	LBL	Label	28	XMOV	Binary indexed data transfer
11	TMR	Timer	29	DSCH	Binary data search
12	TMRB	Fixed timer	30	ADD	Binary addition
13	TMRC	Timer	31	SUB	Binary subtraction
14	CTR	Binary counter	32	ANDF	Logic and
15	DEC	Binary decoding	33	ORF	Logic or
16	COD	Binary code conversion	34	NOT	Logic not
17	COM	Common line control	35	EOR	Exclusive or
18	COME	To end common line control			

Part One Programming

5.1 END1 (To end level one sequential program)

Function:

It must be given in the sequential program once at the end of level one program or the beginning of level two program when there is no level one program. Level one program can be complied up to 500 steps.

Format:

```
|——————————[        END1        ]——————————|
```
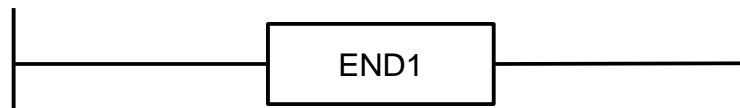
Figure 5-1-1

5.2 END2 (To end level two sequential program)

Function:

It must be given at the end of level two program.

Format:

```
|——————————[        END2        ]——————————|
```
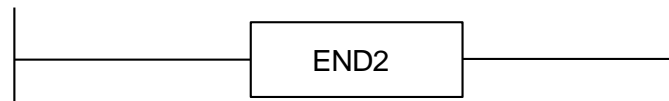
Figure 5-2-1

5.3 CALL (To call a subprogram)

Function:

It is used to call a specified subprogram.

It has the following characteristics and limitations:

A subprogram can call in nesting other subprograms up to 18 levels but the system will give an alarm where an endless loop is caused due to a closure call. The system allows a maximum call number of 100 to control the amount of executed data. No calling a subprogram is allowed in level one program. For any code or network that is written between END2 and SP, after SPE and before SP, it cannot be executed so the system to give an alarm.

Part One Programming

Format:
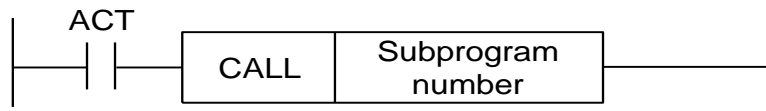
Figure 5-3-1

Control conditions:

ACT＝0, then it will execute the next code line after CALL.

ACT＝1, then it will call a subprogram with a subprogram number.

Parameter:

Subprogram number: The specified called subprogram number, ranging from 0 to 99.

5.4 CALLU (To unconditionally call a subprogram)

Function:

It is used to unconditionally call a subprogram.

It has the following characteristics and limitations:

A subprogram can call in nesting other subprograms up to 18 levels but the system will give an alarm where an endless loop is caused due to a closure call. The system allows a maximum call number of 100 to control the amount of executed data. No calling a subprogram is allowed in level one program. For any code or network that is written between END2 and SP, after SPE and before SP, it cannot be executed so the system to give an alarm.

Format:
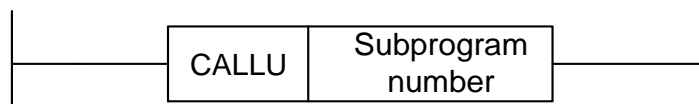
Figure 5-4-1

Parameter:

Subprogram number: The specified called subprogram number, ranging from 0 to 99.

5.5 SP (subprogram)

Function:

SP is used to generate a subprogram. The subprogram number is the name of a subprogram. The SP code is used together with the SPE code described below to specify the scope of a subprogram.

Notes:

1. The subprogram must be compiled after END2.

2. No subprogram should be provided inside with another subprogram.

Format:
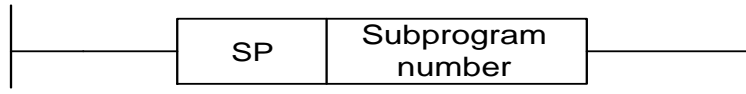
Figure 5-5-1

Parameter:

Subprogram number: The specified called subprogram number, ranging from 0 to 99.

5.6 SPE (To end the subprogram)

Function:

* SPE is used together with SP to specify the scope of a subprogram.

* When this functional code is executed, the control will return to the main program that calls this subprogram.

* The subprogram must be compiled after END2.

Graphic format:
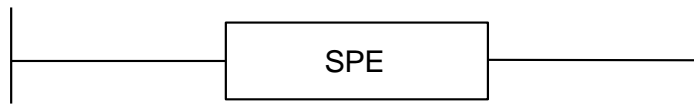
Figure 5-6-1

Such as:
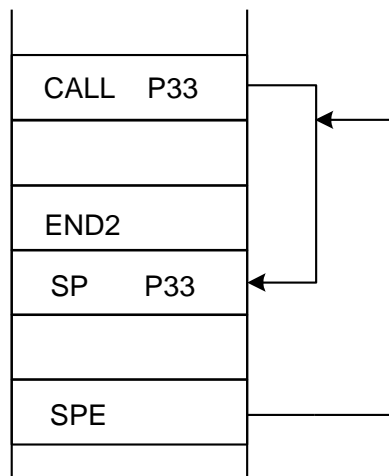
Figure 5-6-2

5.7 SET (set)

Function:

The specified address is set to 1.

Format:
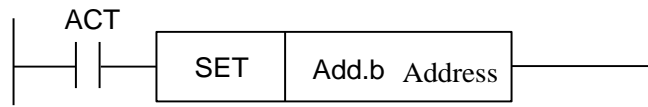
Figure 5-7-1

Control conditions:

ACT＝0, then the add.b status remains unchanged.

ACT＝1, then add.b is set to 1.

Parameter:

Add.b: The component address bits set may be the output coil, Add = Y, G, R, K, A.

5.8 RST (reset)

Function:

The specified address is set to 0.

Format:
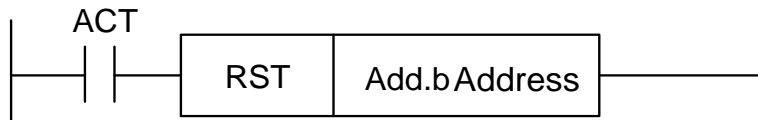
Figure 5-8-1

Control conditions:

ACT＝0, then the add.b status remains unchanged.

ACT＝1, then add.b is set to 0.

Parameter:

Add.b: The component address bits reset may be the output coil, Add= Y, G, R, K, A.

5.9 JMPB (Label jump)

Function:

JMPB will immediately transfer the control to the program set after the label in the ladder diagram program.

It has the following characteristics and limitations:

* Multiple jump codes may use the same label.

* Level one program and level two program cannot jump to each other.

* Subprograms cannot jump to each other.

* Rejump is allowed but the user should be sure not to cause an endless loop.

* The main program and subprograms cannot jump to each other.

Format:
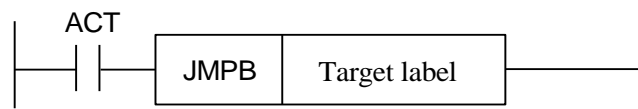
Figure 5-9-1

Control conditions:

ACT＝0, then it will not jump and will execute the next code line after JMPB.

ACT＝1, then it will jump to the specified label and execute the next code line after the label.

Parameter:

Lx: The target label of the specified jump, with a specified value ranging from 0 to 99.

5.10 LBL (label)

Function:

One label is specified in the ladder diagram, as the target of a specified jump JMPB.

It should be noted that one xxlabel can only be specified once with LBL or it will cause an alarm.

Format:
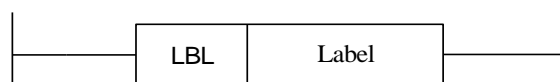
Figure 5-10-1

Parameter:

xx: The target label of the specified jump, with a specified value ranging from 0 to 99.

Such as:
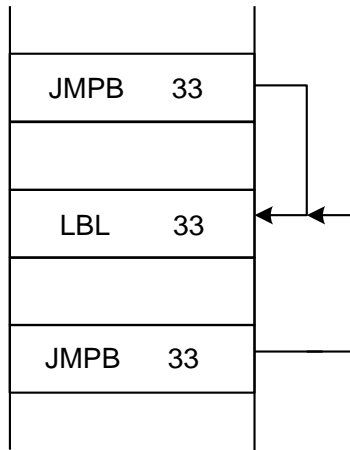
Figure 5-10-2

5.11 TMR (Timer)

Function:

On-state time delay timer.

Format:
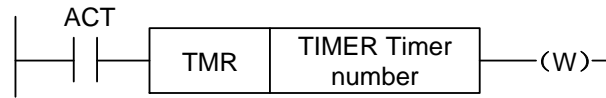
Figure 5-11-1

Control conditions:

ACT＝0, then it will stop the timer.

ACT＝1, then it will start the timer.

It works as follows:
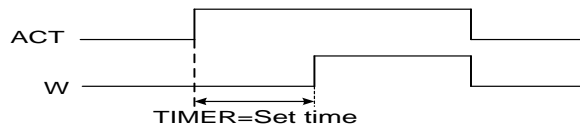
Figure 5-11-2

Parameter:

TIMER ： The timer number is represented by xxx in numbers (0～127).

Output:

W ： Output coil. When the preset value is reached, W＝1; when the preset value is not reached, W＝0.

Note: The timer is executed once every 8ms, set in ms, with an execution base of 8ms; it is regarded 8ms when less than 8ms. For example, if set to 54ms, 54=6*8+6. then it actually executes 56ms with 2ms additionally. The time of the timer is set at 【TMR】 in 【+ Ladder Diagram Parameters】 on the bottom of the ladder diagram interface. The system will automatically detect the range of the serial number of the timer and will give an alarm if there is a repeated number or a number is beyond the range.

5.12 TMRB (Fixed timer)

Function:

On-state time delay timer.

Format:
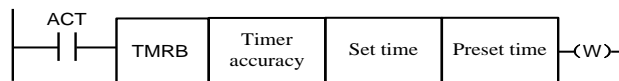
Figure 5-12-1

Control conditions:

ACT＝0, then it will stop the timer.

ACT＝1, then it will start the timer.

It works as follows:
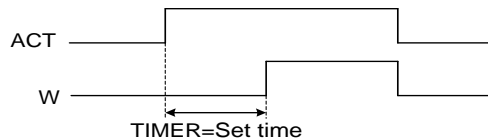
Figure 5-12-2

Parameter:

TIMER   :   The timer number is represented by xxx in numbers (0～127).

Table 5-12-1 (Timer Accuracy)

Timer accuracy	Set number	Set time range	Error range
8ms	0	8 ms to 524.280s	Scanning cycle from 0 to level one program
48ms	1	48 ms to 31.456 min	Scanning cycle from 0 to level one program
1s	2	1s to 546 min	Scanning cycle from 0 to level one program
10s	3	10 s to 182 h	Scanning cycle from 0 to level one program
1min	4	1 min to 65535 min	0 to 1s
1ms	5	1 ms to 65.4 s	Scanning cycle from 0 to level one program

Preset time:

The timing time for the fixed timer is set with a value ranging from 0 to 65535.

Output

W: Output coil. When the preset value is reached, W=1; when the preset value is not reached, W=0.

> **Note:** The system will automatically detect the range of the number of the timer and will give an alarm if there is a repeated number or a number is beyond the range. The preset time in this timer is firmed in the ROM so that you can only change the timer time by modifying the ladder diagram file.

5.13 TMRC (Timer)

Function

On-state time delay timer

Format
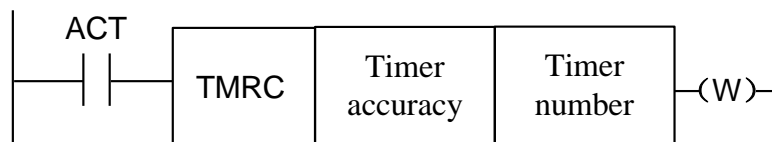
Figure 5-13-1

Control conditions

ACT＝0, then it will stop the timer.

ACT＝1, then it will start the timer.

It works as follows:
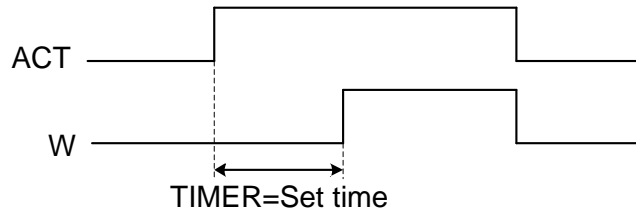
Figure 5-13-2

Parameter

TIMER : The timer number is represented by xxx in numbers (0～127)..

Table 5-12-1 (Timer accuracy)

Timer accuracy	Set number	Set time range	Error range
8ms	0	8ms to 524.280s	Scanning cycle from 0 to level one program
48ms	1	48ms to 31.456 min	Scanning cycle from 0 to level one program
1s	2	1 s to 546 min	Scanning cycle from 0 to level one program
10s	3	10 s to 182 h	Scanning cycle from 0 to level one program
1min	4	1 min to 65535 min	0 to 1 s
1ms	5	1ms to 65.4 s	Scanning cycle from 0 to level one program

Output:

W: Output coil. When the preset value is reached, W=1; when the preset value is not reached, W=0.

Note: The time of the timer is set at 【TMR】 in 【+ Ladder Diagram Parameters】 at the bottom of the ladder diagram interface. Timer TMRC and timer TMR share the same address so they cannot have the same number. The system will automatically detect the range of the number of the timer and will give an alarm if there is a repeated number or a number is beyond the range.

5.14 CTR (Binary counter)

Function

The data in this counter is binary and have the following functions depending on the applications.

1) Preset counter

If the count reaches the preset value to output signal, it will preset the count value.

2) Ring counter

If the counter reaches the preset value, it will input the count signal, reset to the initial value and count again.

3) Up/down counter

This is a reversible counter that can be used to add or subtract.

4) Selection of the initial value

The initial value can be 0 or 1.

Format:
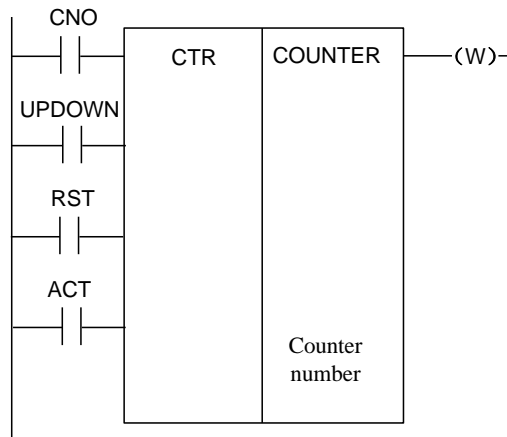
Figure 5-14-1

Control conditions:

To specified the initial value (CN0):

CN0=0, then the counter will start from 0.

CN0=1, then the counter will start from 1.

To specify an up or down counter (UPDOWN):

UPDOWN=1, then down counter.

UPDOWN=0, then up counter.

To reset (RST):

RST=0, then release reset.

RST=1, then reset W to 0 and the count value to its initial value. Set RST to 1 when reset is required.

To count signal (ACT):

ACT＝1, then count on the rising edge of ACT.

ACT＝0, then the counter does not operate and W does not change.

Parameter:

COUNTER: The specified counter number is represented by xxx in numbers ranging from 0 to 127.

Output:

W: Coil output, when the preset value is reached, then W=1.

Note 1: The system will automatically detect the range of the number of the counter and will give an alarm if there is a repeated number or a number is beyond the range.

Note 2: After the ladder diagram is re-upgraded, the current value of the counter will be cleared automatically.

In order to ensure the reliability of the counter count, please use the pulse signal to reset the counter.

5.15 DEC (Binary decoding)

Function:

DEC can decode binary code data. When one of the referred continuous eight-digit (one byte) or sixteen-digit (two bytes) numbers is the same as the code number, then the output number will be 1; when there is no such same number, then the output number will be 0.

This code is used for M or T function data decoding.

Format:
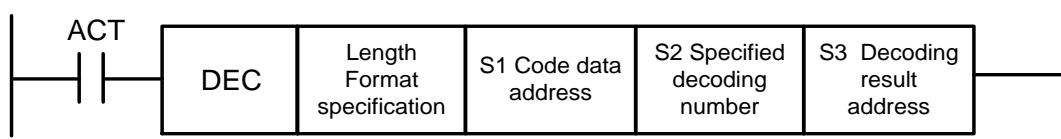
Figure 5-15-1

Control conditions:

ACT=0, then it will reset all output bits.

ACT＝1, then it will decode data and the processing result will be set at the output data address.

Parameters:

Length: The size of the code data is set at the first bit of the parameter.

0001: The code data is one-byte binary code data.

0002: The code data is two-byte binary code data.

S1   : Code data address. It gives an address to store the code data.

S2   : Specified decoding number. It gives the first digit of the continuous 8 (one byte) or 16 (two bytes) numbers to be decoded.

S3   : Decoding result address. It gives the address of an output decoding result. The storage area must have a one-bytes or two-byte area available to the output.

Such as:
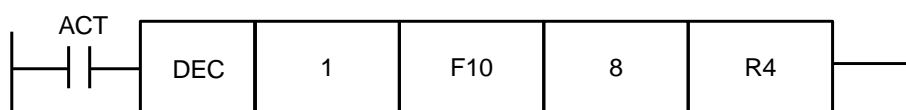
Figure 5-15-2

ACT＝1, F10＝8 then R4＝0000,0001;

ACT＝1, F10＝9 then R4＝0000,0010;

…………………………..

ACT＝1, F10＝15 then R4＝1000,0000;

5.16 COD (Binary code conversion)

Function:

When data is input, the COD code will automatically generate a table of a corresponding size below the function block for the user to input the conversion table data. This table has 10 cells every line (Where all the cells have a remainder when divided by 10, the number of lines will be the quotient number plus one. But the capacity data does not change and the address of the table number will not be displayed).

Format:
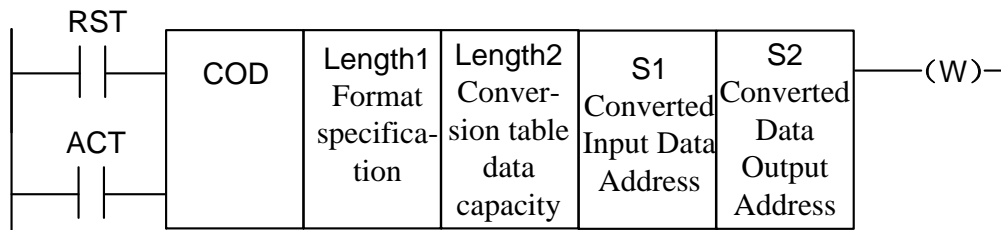
Figure 5-16-1

Table 5-16-1

S1	0	1	2	………	9
S2	XXX	YYY	AAA	………	………
S1	10	11	12	………	N-1
S2	………	………	………	………	UUU

Control conditions

Reset (RST):

RST=0 then no reset.

RST=1 then it will output the error and reset W.

Working code (ACT):

ACT＝0, then it will not execute COD.

ACT＝1 then it will execute COD to extract from the conversion table the converted data in line with the table number as which the value of the "Converted Input Data Address (S1)" is taken and output to the Converted Data Output Address (S2).
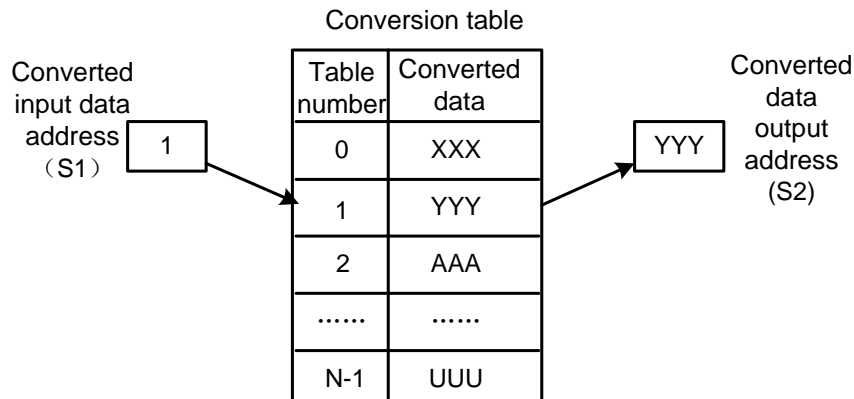
Figure 5-16-2

Parameters:

Length1: Specified number of bytes of binary data in the conversion table.

1: 1-byte binary.

2: 2-byte binary.

Length2: Capacity of the conversion table data. It should not exceed 100 for each conversion table. When specified as 1-byte format, then it is 100 bytes; when specified as 2-byte format, then it is 100 words. The total capacity of all COD code conversion tables should not be more than 512 bytes.

S1: The data in the conversion table can be extracted by a specified table number whose address is called the input address of the converted data. The address needs to provide a 1-byte memory.

S2: Output address of the converted data, which is the number of bytes of the specified memory in the format specification at the specified address.

Output:

If the COD code is executed with an exception, then W=1, indicating an error.

Note: The maximum capacity of the converted data sheet is 100 bytes (words). This table is located between the parameter's converted data output address and the error output (W).

5.17 COM (Common line control)

Function:

COM specifies control until the coil work within the range of COME. If COME is not specified, the system will give an alarm.

Format:
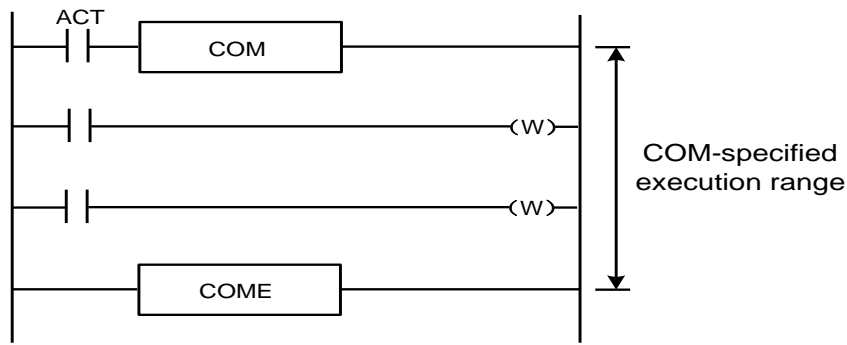
Figure 5-17-1

Control conditions:

ACT=0 then the coil within the specified range is unconditionally connected and disconnected (W=0).

ACT＝1, then it is the same as COM does not execute any operation.

Note 1: It is not allowed to specify any other COCode M within the range specified by a COCode M.

Note 2: When COM=0 for COM, the coil of WRT. NOT within the specified range is unconditionally set to 1(WRT. NOT=1).

Note 3: No functional codes such as JMPB, END1. END2. CALL, CALLU, LBL, SP, SPE, COM and COME can be used between COM and COME. Otherwise, the system will give an alarm.

5.18 COME (To end common line control)

Function:

This code specifies the control range of the common control line code (COM), which can not be used alone and must be used in conjunction with COM.

Format:
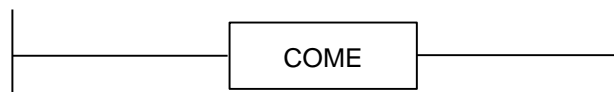
Figure 5-18-1

5.19 ROT (Binary rotation control)

Function:

This code is used to rotate control of the tool post, rotary table, etc and has the following functions:

1. To select the rotation direction of a short path.

2. To calculate the number of steps from the current position to the target position; or to

calculate the number of steps from the previous position of the current position to the previous position of the target position.

3. To calculate position number of the previous position of the target position or the number of steps to the previous position of the target position.

Format:

CN0	ROT	S1 Rotary table positioning address	S2 Current position address	S3 Target position address	S4 Calculation result output address	（W）
DIR						
POS						
INC						
ACT						
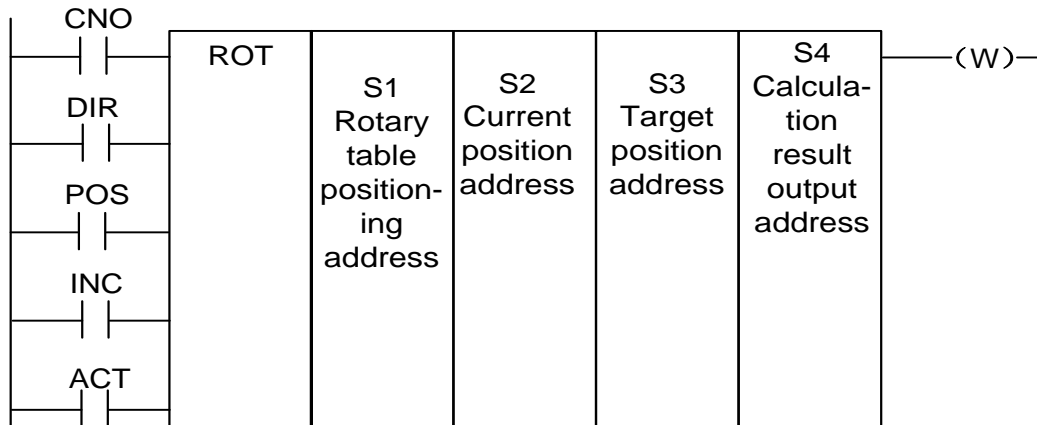
Figure 5-19-1

Control conditions:

To specify the initial number of a rotary table (CN0):

CN0=0, then the counter will start from 0.

CN0=1, then the counter will start from 1.

Whether to select the rotation direction (DIR) from a short path:

DIR=0 then not select and the rotation direction is only forward

DIR=1, then select and the rotation direction may be both forward and reverse.

To specify the operating conditions (POS):

POS=0 then count the target position.

POS=1 then count the previous position of the target position.

To specify the number of positions or steps (INC):

INC=0 then count the number of positions. If to calculate the previous position of the target position, specify INC=0 and POS=1,

INC=1 then count the number of steps. If to calculate the difference between the current position and the target position, specify INC=1 and POS=0.

To execute the code (ACT):

ACT=0 then not execute ROT and W will not be changed.

ACT＝1 then execute ROT and. Generally set ACT=0, but if the operating result is needed, then set ACT=1.

Parameters:

S1: To specify the position number of the rotary table.

S2: To specify the address where the current position is stored.

S3: To specify the address (or code value) where the target position is stored, like the address of the T code output by the stored CNC.

Part One Programming

S4: To calculate the result output address, the number of steps the rotary table to rotate, and the number of steps if to reach the target position or the previous position of the target position.

When you want to use the calculation result, always check whether ACT is 1.

Output:

W: Rotatory direction output. It will output to W from the rotatory direction of a short path: when W=0, then it is forward (FOR); when W=1, then it is reverse (REV). FOR and REV are defined as shown below, forward (FOR) is the direction that increases the position number of the rotary table while reverse (REV) is the direction that reduces the position number of the rotary table. The address of W can be freely selected. However, when the result of W is to be used, it is always necessary to detect the conditions for ACT=1.

For example, there is a rotary table as follows:
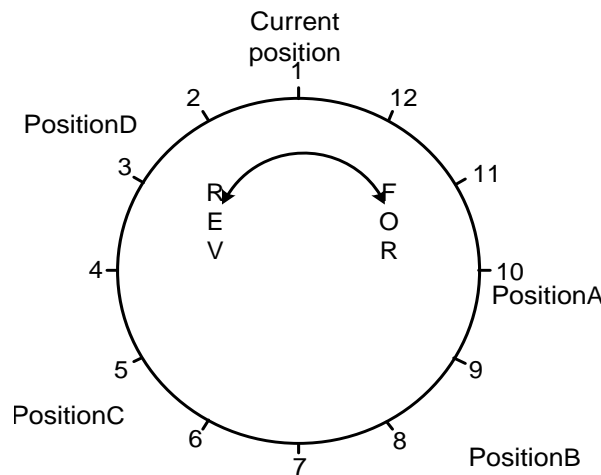
Figure 5-19-2
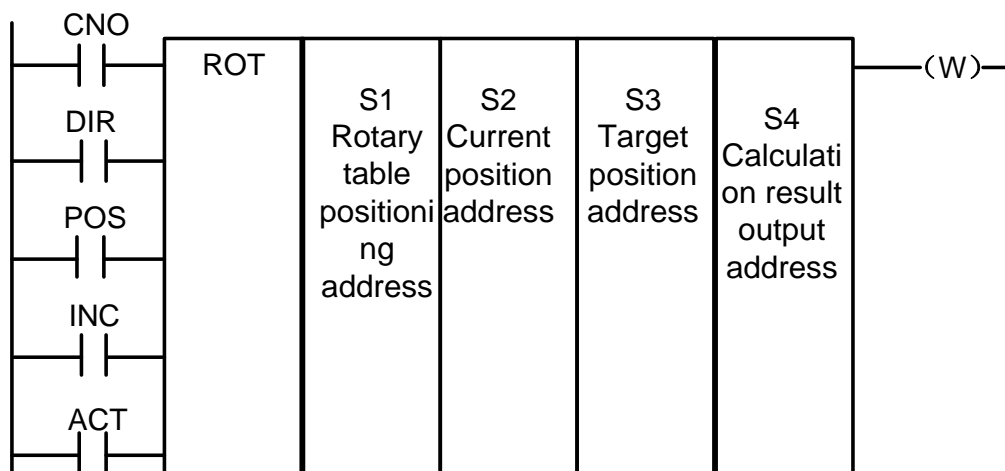
Figure 5-19-3

Perform a short path rotation and calculate the position number of the previous position of the target position.

When the current position number S2＝1, the indexed position number of the rotary table S1＝12, DIR=1, POS=1, INC=0.

Then:

When S3＝10, target position＝A, if ACT＝1, then S4＝11, W＝1

When S3＝8, target position＝B, if ACT＝1, then S4＝9, W＝1

When S3＝5, target position＝C, if ACT＝1, then S4＝4, W＝0

When S3＝3, target position＝D, if ACT＝1, then S4＝2, W＝0

5.20 SFT (Register shift)

Function:

This code can shift one-byte (8 bits) data by the number of bits specified by the code parameter each time. For the cyclic shift, "1" that overflows will be added from the opposite direction. If the highest bit is "1" that overflows, then "1" will be added at the lowest bit; vice versa.

Format:
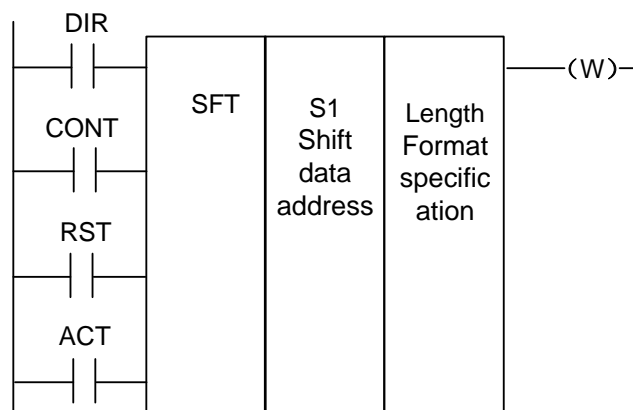
Figure 5-20-1

Control conditions:

To specify the shift direction (DIR)

DIR=0 then left shift

DIR=1 then right shift

To specify the status (CONT)

CONT=0 then no cyclic shift

CONT=1 then cyclic shift

To reset (RST)

To reset the shift output data (W=1) is (W=0)

RST=0 then W will not be reset

RST=1 then W will be reset (W=0)

Execution conditions (ACT)

ACT=0 then execute SFT.

ACT＝1, then execute a shift. If only to shift one bit, set ACT to 0 after code execution.

Parameters:

S1 　　: To set the shift data address, which consists of a one-byte storage area.

Length : A four-digit number, defined as follows:
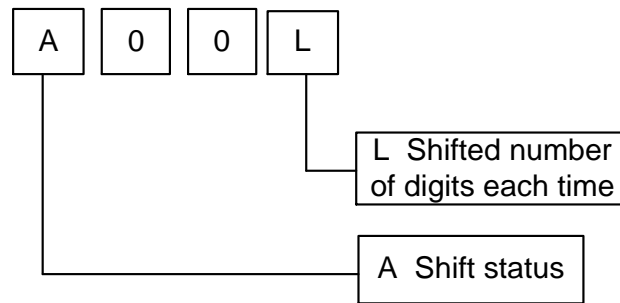
Figure 5-20-2

L : Ranging from 0 to 8.

A : Parameter, when A=0, if ACT=1, it will always shift, moving once every cycle.

　　　When A=1, ACT is regarded as pulse signal, if it changes from 0 to 1, it will move once.

Output:

W 　　:　　W=0, then after shift, there no "1" status will overflow.

　　　　　 W=1, then after shift, a "1" status will overflow.

5.21 DIFU (Rising edge detection)

Function:

This code will set the output signal to 1 during the scanning cycle of the rising edge of the input signal.

Format:
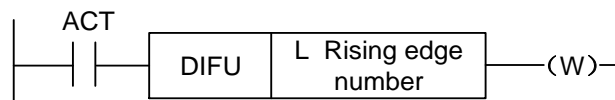
Figure 5-21-1

Control conditions:

Input signal: It will set the input signal to 1 at its rising edge (0→1).

Output signal: When this functional code is being executed, the output signal in a scanning cycle of the ladder diagram remains 1.

Parameter:

L: Rising edge number, ranging from 0 to 255. If the same number is used for another DIFU code or DIFD code in the ladder diagram, the system will give an alarm.

Operation
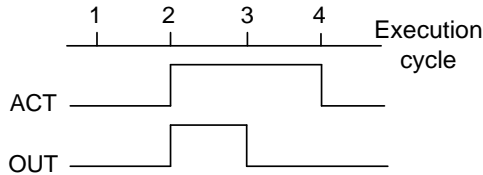
Figure 5-21-2

The system will automatically detect the scope of the number at the rising edge and will give an alarm if there is a repeated number or a number is beyond the range.

5.22 DIFD (Falling edge detection)

Function:

This code will output signal 1of a scanning cycle at the falling edge of the input signal.

Format:
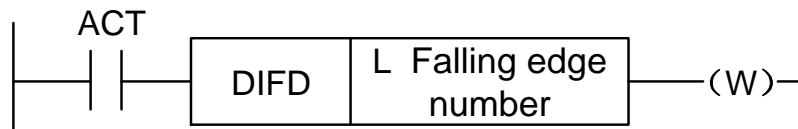
Figure 5-22-1

Control conditions:

Input signal: It will set the input signal to 1 at its falling edge (1→0).

Output signal: When this functional code is being executed, the output signal=1 remains in a scanning cycle of the ladder diagram.

Parameter:

L   :   Falling edge number, ranging from 0 to 255. If the same number is used for another DIFU code or DIFD code in the ladder diagram, the system will give an alarm.

Operation:
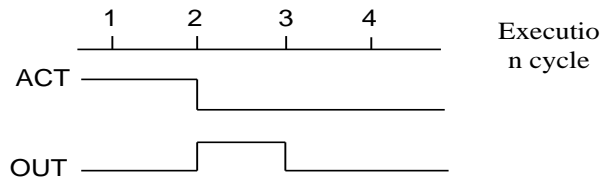
Figure 5-22-2

The system will automatically detect the scope of the number at the falling edge and will give an alarm if there is a repeated number or a number is beyond the range..

5.23 COMP (Binary number comparison)

Function:

To compare the size of the two binary numbers, you need to specify enough bytes in the memory to store the input data and compare the numbers.

Format:
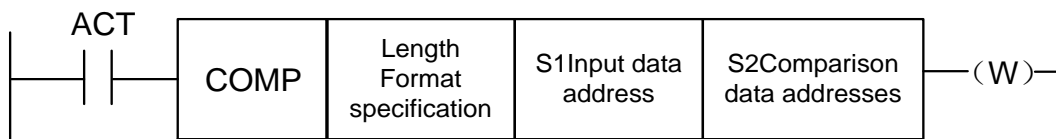
Figure 5-23-1

Control conditions:

ACT＝0, then it will not execute COMP and W remains unchanged.

ACT＝1, then it will execute COMP.

Parameters:

Length: Specified form (constant or address) and specified data length (1. 2 bytes) of the input data.
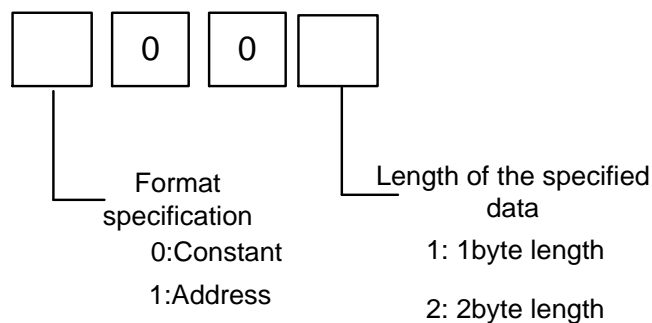
Figure 5-23-2

S1, S2: Reference source 1 and reference source 2 can constants or address numbers. Address numbers fall into R, X, Y, F, G, K, A, D, C types.

Output:

W=0, then input data＞reference source

W=1, then input data ≤ reference source

5.24 COIN (Consistency comparison)

Function:

This code checks whether the input value and the comparison value coincide.

Format:
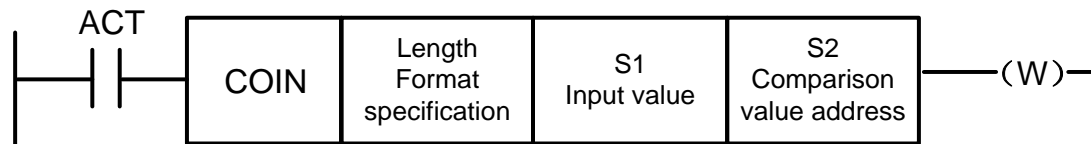
Figure 5-24-1

Control conditions:

ACT＝0, then it will not execute COIN. W remains.

ACT＝1, then it will execute COIN..

Parameters:

Length: Specified form (constant or address) and specified data length (1. 2 bytes) of the input data.

Format specification
0:Constant
1:Address

Length of the specified data
1: 1 byte length
2: 2 byte length
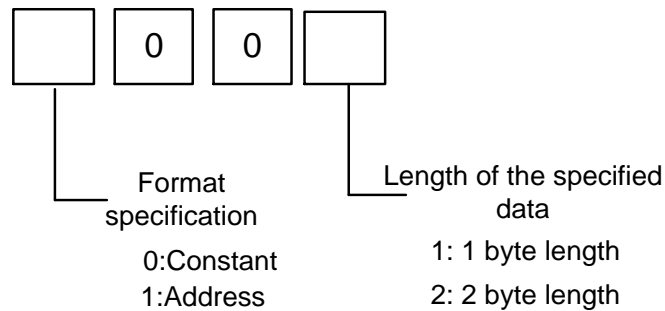
Figure 5-24-2

S1 : Input data can be specified in constant or addresses.

S2 : Storage address of the reference source.

Output

W : W=0, then input value≠comparison value.

W=1, then input value=comparison value.

5.25 MOVN (Data transfer)

Function:

To transfer to the target address data of the source address data or specified binary data.

Format:
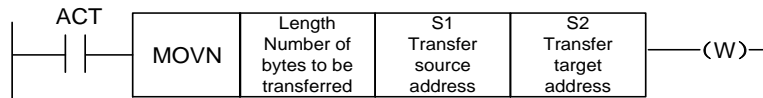
Figure 5-25-1

Control conditions:

ACT＝0, then no data will be transferred.

ACT＝1, then specified number of bytes will be transferred.

Parameters:

Length : Number of bytes or number of numbers to be transferred.

S1　　　: Source starting address or constant.

　　　　Select a transfer type depending on S1:

　　　　1.　When S1 is a constant, if S2 is a single-byte address, then copy S1 by its value of bytes to an address of length-numbered bytes starting from S2; if S2 is a word address, then copy S1 by its value of words to an address of length-numbered words starting from S2.

　　　　2.　When S1 is an address, transfer data by its address of bytes regardless of whether S1 coincide with S2 in terms of the address type.

S2　　　: Target starting address.

Such as:
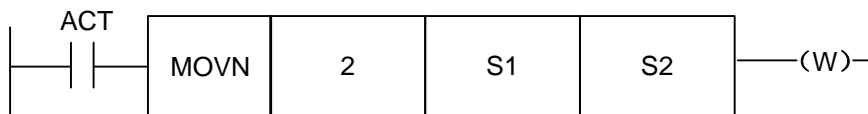
Figure 5-25-2

1. When S1=5 and S2=R60, then R60=00000101.

2. When S1=5 and S2=D60, then D60=5.

3. When S1 is address D50 and S2 is D60, then D60=D50.

W=1, then specified number of bytes will be transferred.

W=0, no data will be transferred.

The system will give an alarm if any data is detected beyond the range of the parameter types during transfer.

5.26 MOVB (1-byte transfer)

Function:

MOVB transfers1-byte data from a specified source address to a specified target address.

Format:
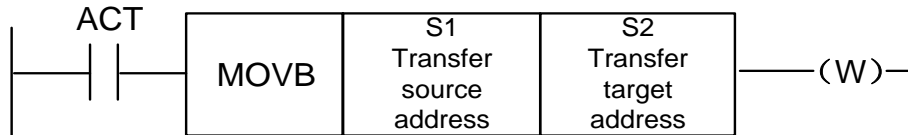
Figure 5-26-1

Control conditions:

ACT＝0, then no data will be transferred.

ACT＝1, then1-byte data will be transferred.

Parameters:

S1   : Source address or constant.

If S2 is a 1-byte address, then copy S1 by its value of bytes to S2; if S2 is a word address, then copy S1 by its value of words to S2.

S2   : Target address.

5.27 MOVW (2-byte transfer)

Function:

MOVW transfers 2-byte data from a specified source address to a specified target address.

Format:
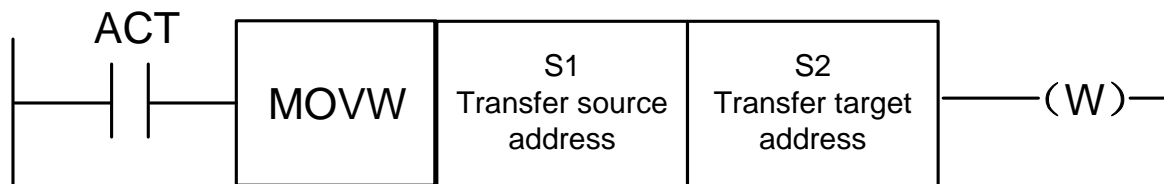
Figure 5-27-1

Control conditions:

ACT＝0, then no data will be transferred.

ACT＝1, then1-byte data will be transferred.

Parameters:

S1   : Source address or constant.

S2   : target address.

5.28 XMOV (Binary indexed data transfer)

Function:

This functional code is used to read or overwrite data in the Data sheet. The number of numbers in the data sheet (table capacity) can be specified by address. The PLC will operate the data sheet during its operation as set by the user.

Format:
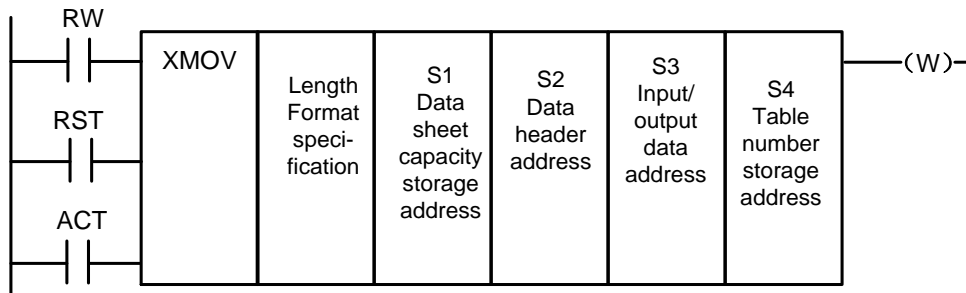
Figure 5-28-1

Control conditions:

To specify a read or write operation (RW)

RW=0, then read data from the data sheet.

RW=1, then write data to the data sheet.

To reset (RST)

RST=0, then release reset.

RST=1, then reset W=0.

To execute XMOV (ACT)

ACT＝0, then it will not execute XMOV and W remains unchanged.

ACT＝1, then it will execute XMOV.

Parameters:

Length: Length of format-specified data to be transferred.

1: 1-byte length.

2: 2-byte length.

S1: Address of the data sheet data capacity to be stored. It is used to store the data capacity of the data sheet. The number of bytes occupied should be in line with the Length-specified length. The active data range is determined by the Length-specified length.

1-byte length: from 1to 512.

2-byte length: from 1to 256. Namely 256×2＝512 bytes, which is the capacity of the PLC data sheet.

S2: Set header address of the data sheet. The storage area of the data sheet is equal to length of bytes × data number of the data sheet. The header address must be the value set in data sheet D.

S3: Input/output address. When the data are being read, the address is to be stored in the reading result. When the data are being rewritten, the address is set to store the data written. The number of bytes occupied should be as set by the Length format and its address is limited to register D.

S4 :   Address of the table numbers to be stored. It is used to store the table number where data is read or written. The number of bytes occupied should be as set in Length. If the table number set is greater than the number stored in S1, then it will output W= 1 with an error. Actual transport address = header address + table number. The table number ranges from 0 to S1-1. The transport address must not exceed the data sheet.

Output:

When the table number exceeds the value in S1, then W=1 and the data sheet cannot be read or written.

W=0 indicates no error.

W=1 indicates an error.

5.29 DSCH (Binary data retrieval)

Function:

This functional code is used to retrieve binary data in the data sheet. The number of numbers in the data sheet (table capacity) can be specified by address, so that the table capacity may still be changed even after a ROM is written in the program.

Format:
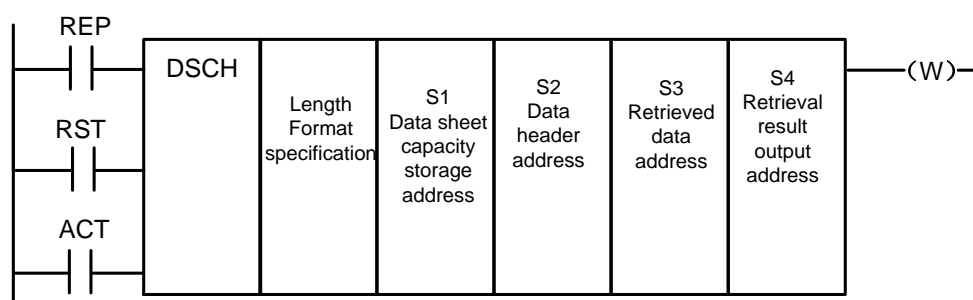
Figure 5-29-1

Control conditions:

To detect repetition (REP)

REP=0, then it will execute DSCH and start researching from the first address of the data sheet regardless of whether the target data is repeated or not. It will stop researching when the target data is detected for the first time and output the address. If no such data is found, then W=1,

REP=1, then it will execute DSCH. If no searched data is found or two or more is found,

then W=1,

To reset (RST)

RST=0, then release reset.

RST=1, then reset W=0.

To execute DSCH (ACT)

ACT＝0, then it will not execute DSCH and W remains unchanged.

ACT＝1, then it will execute DSCH. If the searched data is found, then output its table number; If no searched data is found or two or more is found, then W=1,

Parameter:

Length:　Length of format-specified data to be retrieved.

　　　　　　1: 1-byte length.

　　　　　　2: 2-byte length.

S1　　:　Address of the number of numbers in the data sheet to be stored. Its specified length of bytes assigns the area to store the required bytes. The number of numbers in the data sheet is n+1 (table header=0, table end=n).

S2　　:　Set header address of the data sheet.

S3　　:　Set input address of the searched data.

S4　　:　Address of the table numbers to be stored. It is used to store the table number where data is read or written. The number of bytes occupied should be as set in Length. If the table number set is greater than the number stored in S1, then it will output W= 1 with an error. Actual transport address = header address + table number. The table number ranges from 0 to S1-1. The transport address must not exceed the data sheet. Upon retrieval, if the retrieved data is found, and then output its table number. The table number will be output to the output address of the search result, whose required number of bytes should meet the specified format.

Output:

W=0 then the retrieved data is found.

W=1 then no retrieved data is found.

5.30 ADD (Binary addition)

Function:

This code is used for the addition of 1-byte, 2-byte binary data. Storage addresses with proper lengths of bytes are required for the augend and the result output.

Format:
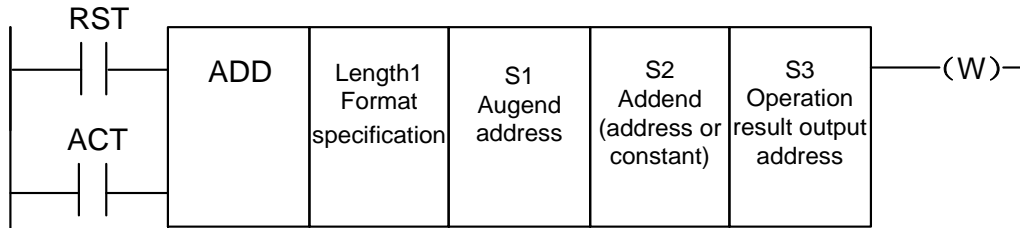
Figure 5-30-1

Control conditions:

To reset (RST):

RST=0 then release reset.

RST=1 then W=0.

To execute ADD (ACT):

ACT＝0, then it will not execute ADD and W remains unchanged.

ACT＝1, then it will execute ADD.

Parameters:

Length: Length of the specified data (1-byte or 2-byte) and the specified method for the addend (constant or address).
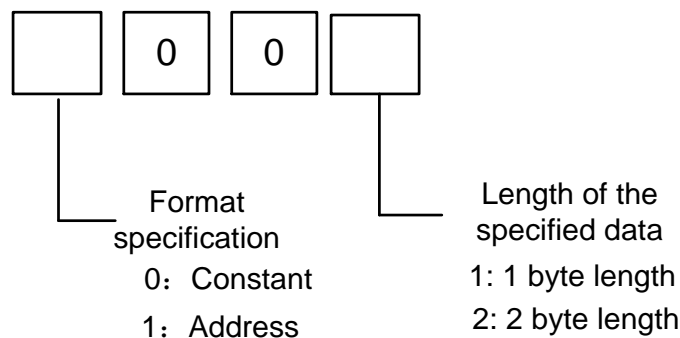
Figure 5-30-2

S1: Address of the specified augend to be stored.

S2: Specified method for the addend depends on Length.

S3: Specified address to output operation result.

Part One Programming

Output:

> W=0, then it is normal operation.
>
> W=1, then it is abnormal operation.
>
> When the result of the addition exceeds the specified data length, then W=1,

5.31 SUB (Binary subtraction)

Function:

> This code is used for the subtraction of 1-byte, 2-byte binary data. Storage addresses with proper lengths of bytes are required for the subtracted data and the result output.

Format:
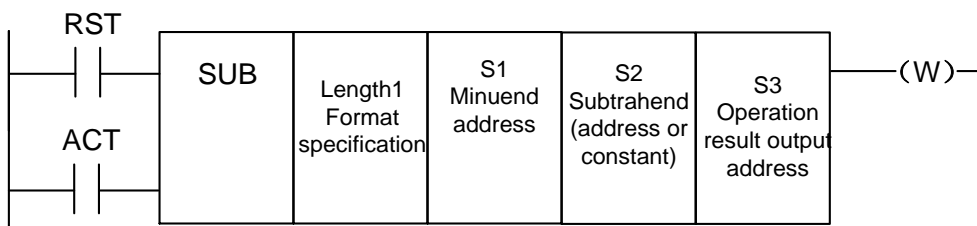
Figure 5-31-1

Control conditions:

> To reset (RST):
>
> > RST=0, then release reset.
> >
> > RST=1:   Reset W=0.
>
> To execute SUB (ACT):
>
> > ACT＝0, then it will not execute SUB and W remains unchanged.
> >
> > ACT＝1, then it will execute SUB.

Parameters:

> Length: Length of the specified data (1-byte or 2-byte) and the specified method for the subtrahend (constant or address) .
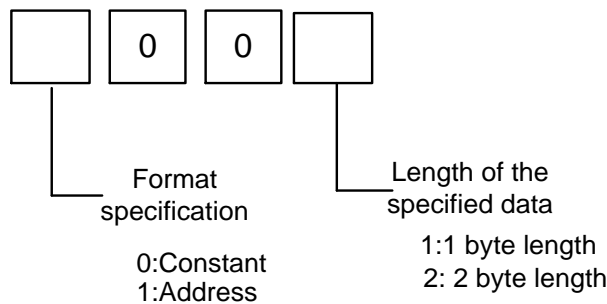
Figure 5-31-2

> S1:   Address of the specified minuend to be stored.
>
> S2:   Specified method for the subtrahend depends on Length.
>
> S3:   Specified address to output operation result.

Output:

W=0, then it is normal operation.

W=1, then it is abnormal operation.

When the result of the substation exceeds the specified data length, then W=1,

5.32 ANDF (AND)

Function:

This code makes what is in address A AND a constant (or what is in address B), and stores the result at address C.
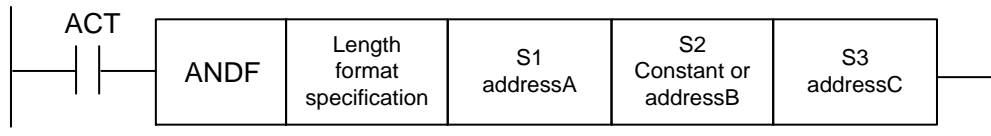
Format:

Figure 5-32-1

Control conditions:

ACT＝0, then it will not execute ANDF.

ACT＝1, then it will execute ANDF.

Parameter:

Length: Length of the specified data (1-byte or 2-byte) and input data format (constant or address) .
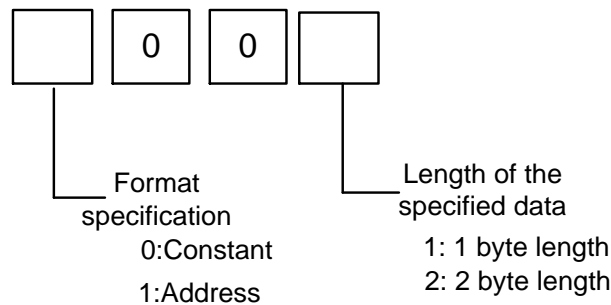
Figure 5-32-2

S1:　Specified input data to be made AND. It starts from this address and the data length is the same as the length specified by Length.

S2:　Input data to be made AND the input data. When the format is specified as the address specifications, it starts from this address and the data length is the same as the length specified by Length.

S3:　Address used to store the ANDF operation result. The storage starts from this address, and the data length is the same as the length specified by Length.

For example, when address A and address B have the following data:

Address A

1	1	1	0	0	0	1	1

Address B

0	1	0	1	0	1	0	1

The ANDF operation result is as follows:

Address C

0	1	0	0	0	0	0	1

5.33 ORF (OR)

Function:

This code makes what is in address A OR a constant (or what is in address B), and stores the result at address C.
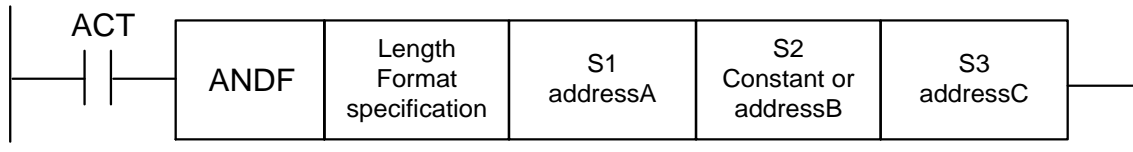
Format:

Figure 5-33-1

Control conditions:

ACT＝0, then it will not execute ORF.

ACT＝1, then it will execute ORF.

Parameters:

Format specification
0:Constant
1:Address

Length of the specified data
1:1 byte length
2:2 byte length
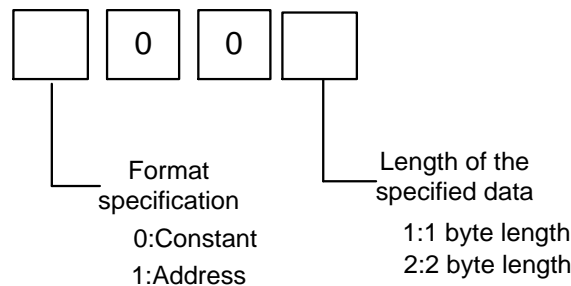
Figure 5-33-2

Length ： Length of the specified data (1-byte or 2-byte) and input data format (constant or address) .

S1 ： Specified input data to be made OR. It starts from this address and the data length

is the same as the length specified by Length.

      S2   :   Input data to be made OR the input data. When the format is specified as the address specifications, it starts from this address and the data length is the same as the length specified by Length.

      S3   :   Address used to store the ORF operation result. The storage starts from this address, and the data length is the same as the length specified by Length.

For example, when address A and address B have the following data:

Address A	1	1	1	0	0	0	1	1

Address B	0	1	0	1	0	1	0	1

The ORF operation result is as follows:

Address C	1	1	1	1	0	1	1	1

5.34 NOT (Not)

Function: This code is used to negate all bits in address A and store the result in address B.

Format:
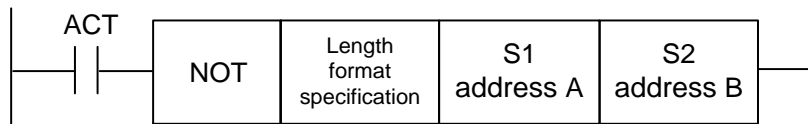
Figure 5-34-1

Control conditions:

    ACT＝0, then it will not execute NOT.

    ACT＝1, then it will execute NOT.

Parameters:

    Length: Length of the specified data (1-byte or 2-byte).

Length of the
specified data
1:1 byte length
2: 2 byte length
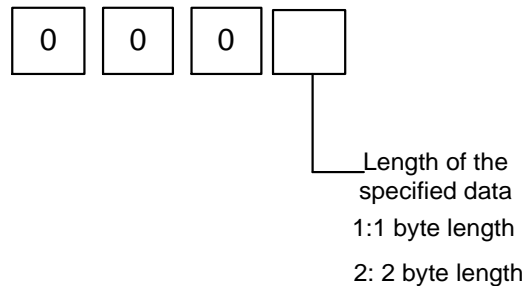
Figure 5-34-2

S1: Input data negated bit by bit. It starts from this address and the data length is the same as the length specified by Length.

S2: Address used to store the NOT operation result. The storage starts from this address, and the data length is the same as the length specified by Length.

For example,

When address A and address B have the following data:

Address A

1	1	1	0	0	0	1	1

The NOT operation result is as follows:

Address B

0	0	0	1	1	1	0	0

5.35 EOR (Exclusive or)

Function:

This code makes what is in address A exclusive or a constant (or what is in address B), and stores the result at address C.
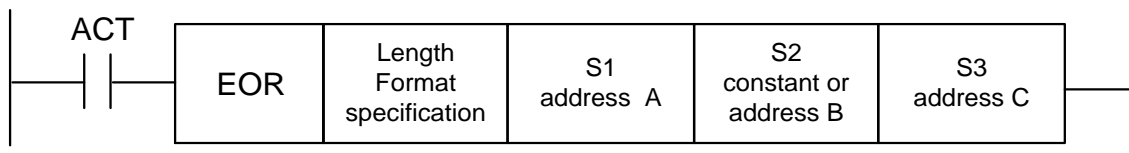
Format:

Figure 5-35-1

Control conditions:

ACT＝0 , then it will not execute EOR.

ACT＝1 , then it will execute EOR.

Parameter:

Length: Length of the specified data (1-byte or 2-byte) and input data format (constant or address).
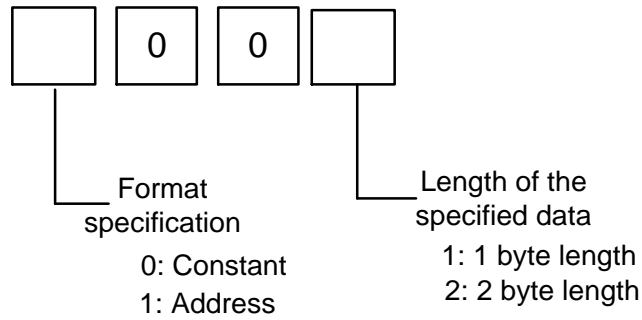
Figure 5-35-2

S1: Specified input data to be made exclusive or. It starts from this address and the data length is the same as the length specified by Length.

S2: Input data to be made exclusive or the input data. When the format is specified as the address specifications, it starts from this address and the data length is the same as the length specified by Length.

S3: Address used to store the EOR operation result. The storage starts from this address, and the data length is the same as the length specified by Length.

For example, when address A and address B have the following data:

Address A

1	1	1	0	0	0	1	1

Address B

0	1	0	1	0	1	0	1

The EOR operation result is as follows:

Address C

1	0	1	1	0	1	1	0

Part One Programming

Chapter Six Ladder Diagram Editing Limitations

1. The program must have END1 and END2 as the end of level one program and level two program and END1 must be used before END2.

2. It only supports parallel output and does not support multi-level output.

3. The result output addresses in all basic codes and output function codes must not be set with the following addresses:

   1) Preset counter address DC, preset timer address DT.

   2) K0~K5 address systems occupied that cannot be user-defined.

   3) R990, R991 address systems occupied that cannot be user-defined.

   4) Address X and address F on the IO input port.

4. The vertical lines are vacant. The nodes are not connected to the subsequent nodes. The horizontal conducting lines are connected in parallel with the node network. These three cases will generate nodes or network that cannot be executed. Therefore, the system gives an alarm.

5. Star network. That is, the vertical lines of different lines in the same row are not directly connected. There is a line without connecting vertical lines in the middle, in which case the system cannot process, so it will give an alarm.

6. No upper bulges are allowed within the network. That is, there will be a parallel network above some nodes of a row and any line above cannot connect to the parallel network. The system will give an alarm about this..

The following cases are considered syntax errors, so the system will give an alarm.
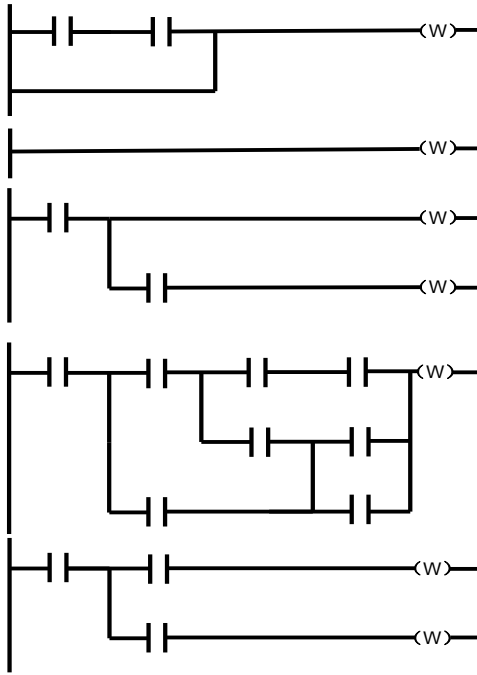
Figure 6-1

Part Two Operations

广州数控 **PLC of GSK980TDHi Series Bus-Based Lathe CNC System and Its Installation and Connection**

Chapter One PLC Interface Display

1.1 Automatic operation when GSK980TDHi PLC is powered up

After the system is powered up, the PLC will start running: the first cycle will use R990.0 to turn on its network lines for one cycle, then the value of R910.0 will be reset to 0. The user cannot output to it, so the value of holding relay will be the last output value before the PLC stops running.

> **Note:** In the following description, keys in <> are the panel keys; keys in 【】 are the soft keys at the bottom of the screen; 【】 is the interface corresponding to the current soft keys; ⊞ represents that there are submenus under the menu; all operations of the PLC are all under the MDI Mode while the other modes can only be used to view and search.

1.2 Ladder diagram interface display

1.2.1 Ladder diagram information interface

Press the <**Ladder Diagram**> key on the panel to enter the page and press the soft key 【**Ladder Diagram Information**】 to enter the **Ladder Diagram Information** interface, as shown in Figure **1-2-1-1.**

Or define parameter **N0: 26#6=1**, set in the PLC interface, re-press the key <**Ladder Diagram**> and switch the screen to enter the ladder diagram information interface. The interface gives the related information, such as the running file of the system ladder diagram and the modification date for the ladder diagram version.

Figure 1-2-1-1

(1) The interface gives the name of the current ladder diagram. The ladder diagram files can be

divided into three kinds: the only running ladder diagram, the other 15 ladder diagrams except the running ladder diagram of ladder diagrams 0 to 15, and the other reference ladder diagrams (to be numbered in two-digit numbers other than 0-15).

(2) When the system is initialized for power on, it is set by the parameter 53#0 to #3 in binary combination parameters. For 0, ladder diagram 0 is used; for 1 to 15, ladder diagram 1 to 15 is used. Determine to load ladder diagram file number as the running file (this may cause danger and it will only enter into force after power off and restart). If the format is not correct, the file will be deleted and re-created. The user will need to be careful when specifying the ladder diagram file number. All ladder diagrams must be named "ladderXX.grp" (XX represents numbers), or these files will not be recognized by the system. The file format is provided by the system and cannot be modified outside the system. Otherwise, it may be deleted or can not be recognized.

(3) Selection of the ladder diagram. Move the cursor or enter "LX"/"LXX" (X/XX are numbers) to specify the file name, press the "Input" key so that the system will detect whether "LX"/"LXX" si a known file number. If no such file is detected, then a ladder diagram will be created by the file name "ladder0X.grp" or "ladderXX.grp". The system will automatically generate two function blocks "END1" and "END2" when the file is created.

(4) The file header contains the basic information of the file, such as the number of lines and the number of steps, of which the number of steps will only be known to the updated when such ladder diagram is actually used. The user may delete the unopened ladder diagram files that are not running. The user needs to be especially careful because this is irreversible. When the user opens a non-running ladder diagram, the system will stop refreshing the network information of the ladder diagram so as to avoid misleading. When the cursor stays in the background to edit the file location, the user can press the "Modify" key to open the 【Ladder Diagram Information】 to modify the file background (including the ladder diagram version number, adapted machine tool, ladder diagram maintainer).

1.2.2 Ladder diagram interface

Press the soft key 【Ladder Diagram】 to enter the **Ladder Diagram** interface or define parameter **N0: 26#6=1**, set in the PLC interface, re-press the key <**Ladder Diagram**> and switch the screen to enter the ladder diagram information interface, as shown in Figure **1-2-2-1**.
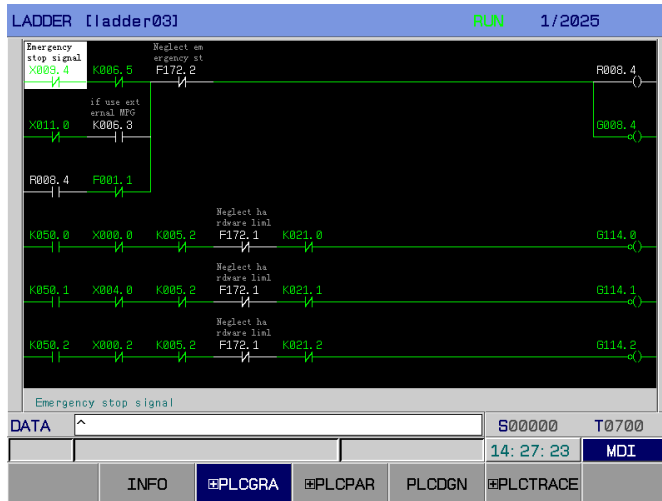
Figure 1-2-2-1

Ladder diagram interface contents and operations:

Ladder diagram [ladder03]: Name of the currently running ladder diagram.

1/1259: It indicates that the cursor-specified line is currently at the position of the ladder diagram.

RUN **:** Running status of the ladder diagram, including RUN, STOP, DEBUG

Graphics area: Ladder diagram program.

Input: It displays the input data. Press the arrow key ⬇ on the panel to query the input

data.

MEA : Comments for cursor positioning nodes.

Input mode: Current work mode.

You can locate by pressing page up/down keys and four arrow keys to view or modify the components.

1.2.3 Ladder diagram parameters interface

Press the soft key 【⊞**Ladder Diagram Parameters**】 at the bottom of the screen to enter the **Ladder Diagram Parameters** interface or define parameter N0: 26#6=1, set in the PLC interface, re-press the key <**Ladder Diagram**>, and switch the screen to enter the **Ladder Diagram Parameters** interface, as shown in Figure **1-2-3-1**.

Figure 1-2-3-1

Ladder diagram parameters interface contents and operations:

RUN:　　　　Running status of the ladder diagram.

ADDR:　　　Holding relay address.

Bit0~Bit7:　Bit number status of the holding relay address.

　　　1: It indicates that the address maintains the status after power off to that before power off;

　　　0: It indicates that the address is reset to the default status after power off.

Input: To display input data.

Input mode: Current work mode.　(**Note:　Ladder Diagram Parameters** related parameters can only be modified in the input mode.)

You can locate by pressing page up/down keys and four arrow keys to view or modify the components.

1.2.4 Signal diagnostic interface

Press the **soft key** 【Signal Diagnosis】 to enter the signal diagnostic interface, or define parameter N0: 26#6=1, set in the PLC interface, re-press the key <Ladder Diagram>, and switch the screen to enter the signal diagnostic interface, as shown in Figure**1-2-4-1**.

Figure 1-2-4-1

Signal Diagnosis interface contents and operations:

RUN: Running status of the ladder diagram.

ADDR: Diagnostic number address.

Bit0~Bit7: Bit number status of the diagnostic address. 1: It indicates that the signal is conducting; 0: It indicates that the signal is not conducting.

Input: To display input data.

Input mode: Current work mode.

You can locate by pressing page up/down keys and four arrow keys to view the corresponding diagnostic number.

The user can only search generally on this interface and after obtaining authority and setting K0.1 to 1, the PLC I/O port will enter the signal debugging mode where the user can can modify X, Y signals.

1.2.5 Signal tracking interface

The signal tracking interface has two sub-interfaces "Setting" and "Tracking". Press the soft key 【⊞**Signal Tracking**】 on the bottom of the screen to enter the signal tracking "Setting" interface, as shown in Figure**1-2-5-1**.
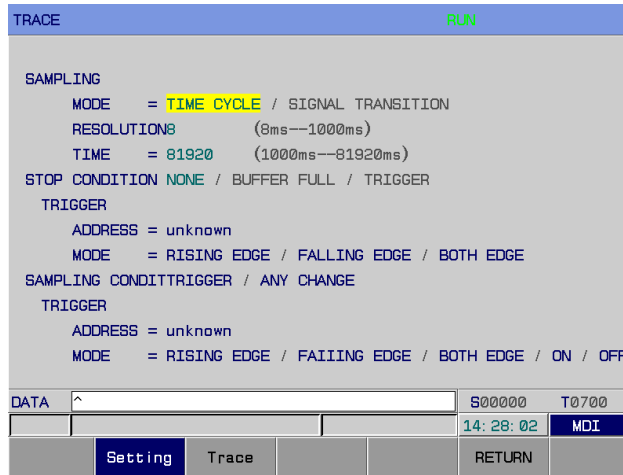
Figure 1-2-5-1

Signal Tracking "Setting "interface contents and operations

⑴ Mode:

    - - Periodic Cycle: Sampling in each time cycle

    - - Signal Change: Sampling when the signal changes.

⑵ Resolution:

The input resolution is the minimum resolution (8 ms) by default, ranging from 8 ms to 10 ms.

The input value takes multiples of 8 ms.

⑶ Time limit:

This parameter will be displayed when the sampling mode is set to "Periodic Cycle". Input the execution time to be tracked. The "Resolution" value or the number of a specified signal address determines the range of the "Periodic Cycle". It will be displayed on the right.

⑷ Frame limit:

This parameter will be displayed when the sampling mode is set to "Signal Change". Input the number of samples. It will be displayed on the right.

⑸ Stop Conditions:

    - - No: No stop tracking.

    - - Full Buffer: Stop tracking when the buffer is full

    - - Signal Trigger: Stop tracking by signal trigger

Trigger setting: This parameter is active when "Stop Conditions" is selected to "Signal Trigger".

    ①   Address : Input signal address as a stop trigger (you cannot use address R as a stop trigger)

    ②   Mode: It decides to use what trigger mode to stop tracking.

      Rising edge: It automatically stops tracking with the rising edge of the trigger signal.

Falling edge: It automatically stops tracking with the falling edge of the trigger signal.

Any change: It automatically stops tracking with the rising or falling edge of the trigger signal.

⑹ Sampling Conditions: When the sampling mode is set to "Signal Change", the parameters work. It is a condition for determining sampling.

- -Signal Trigger: When the signal specified by the trigger address set by the sampling conditions has a specified mode change, it will start sampling.

- -Any change: When the signal specified by the trigger address set by the sampling conditions has any change, it will start sampling.

Trigger setting: This parameter works when the sampling mode is set to "Signal Change" and the sampling conditions are set to "Signal trigger".

① Address: Input signal address as the trigger signal for sampling (you can not use address R as a sampling trigger)

② Mode: To input the trigger mode for a specified trigger signal.

Rising edge: It is the status of sampling a specified signal with the rising edge of the trigger signal.

Falling edge: It is the status of sampling a specified signal with the falling edge of the trigger signal.

Any change: It is the status of sampling a specified signal with the rising or falling edge of the trigger signal.

On: It is the status of sampling a specified signal when the trigger signal is on.

Off: It is the status of sampling a specified signal when the trigger signal is off.
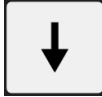
Press the soft key【Tracking】 to enter the Signal Tracking "Tracking" interface, as shown in Figure 1-2-5-2.

Figure 1-2-5-2

Signal Tracking "Tracking" interface contents and operations

⑴ Sampling mode : It displays the current sampling mode of the system.

⑵ Cycle: It displays the current sampling cycle of the system, that is, the resolution.

⑶ Time:

  - - Display format when it is tracking: The left is the current time, and the right is the maximum allowable time.

  - - Display format when it is stopped: The left is the time at the right end of the current screen, the middle is the time when tracking is stopped, and the right is the maximum allowable time.

⑷ Set address : Input the signal in [   ] with moving cursors [↑] and [↓] to track fifteen signals at the same time. You may input any address. For address R, you may input addresses before 256 in the first three positions and 2 addresses after 255 in position four and position five.

⑸ (S) Start : After correctly setting the tracking parameters, press the key [S] to start the signal tracking.

(T) Terminate: Press the key [T] stop the signal tracking.

Delete: Press the key [DELETE] to delete the address under the cursor and the screen resulting from tracking.

Extended screen: Press the key [INPUT] so that the system will use the entire interface to track the signal address where the cursor stays.

Chapter Two PLC Address and Parameter Settings

Addresses and parameters such as the counter, timer, data sheet and holding relay are used in the PLC. View and set them in their own corresponding interfaces. Re-Press the soft Key 【⊞Ladder Diagram Parameters】 in the **Ladder Diagram Parameters** interface to enter the PLC address, parameter settings interface, as shown in Figure 2-**1**, including the holding relay, timer, data sheet and counter.   (The user can only set after inputting the debugging password to obtain authority)

NO.	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
K000	0	0	0	0	0	0	0	0
K001	0	0	0	0	0	1	1	1
K002	0	0	0	0	0	0	1	0
K003	0	0	0	0	0	0	0	0
K004	0	0	0	0	0	0	0	0
K005	0	0	0	0	0	0	0	1
K006	0	0	0	0	0	1	0	0
K007	1	0	0	1	0	0	0	1
K008	1	0	0	1	0	0	0	0
K009	0	0	0	0	0	0	1	1
K010	0	0	0	0	0	0	0	0
K011	0	0	0	1	0	0	0	1

K PARAMETER   RUN
PLCPAR ******* ******* ******* ******* CLEANY SIGN   PARSW
DATA   S00000   T0700
                                              14: 28: 48   MDI
KPAR   TMR   DATA   CTR   RETURN

Figure 2-1

2.1 Holding relay

Press the soft key【KPAR】 in Figure 2-**1** to enter the holding relay view and setting interface, as shown in Figure 2-**1-1**.

NO.	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
K000	0	0	0	0	0	0	0	0
K001	0	0	0	0	0	1	1	1
K002	0	0	0	0	0	0	1	0
K003	0	0	0	0	0	0	0	0
K004	0	0	0	0	0	0	0	0
K005	0	0	0	0	0	0	0	1
K006	0	0	0	0	0	1	0	0
K007	1	0	0	1	0	0	0	1
K008	1	0	0	1	0	0	0	0
K009	0	0	0	0	0	0	1	1
K010	0	0	0	0	0	0	0	0
K011	0	0	0	1	0	0	0	1

K PARAMETER   RUN
PLCPAR ******* ******* ******* ******* CLEANY SIGN   PARSW
DATA   S00000   T0700
                                              14: 28: 48   MDI
KPAR   TMR   DATA   CTR   RETURN

Figure 2-1-1

Part Two Operations

Holding relay interface contents and operations:

RUN: Running status of the ladder diagram.

ADDR: Holding relay address.

Bit0~Bit7:   Bit number status of the holding relay address.

1: It represents that the address maintains the status after power off to that before power off;

0: It represents that the address is reset to the default status after power off.

Input   :   To display input data.

Input mode: Current work mode.

【Return】:   Return to the previous menu.

Upon modification, the system will display KPAR downloading successfully! When there is an error while saving, the system will display download failed! When the download conditions are not met, the system will display illegal download parameters!

You can locate by pressing page up/down keys and four arrow keys to view or modify the holding relay address.

2.2 Timer

Press the soft key【TMR】 in Figure 2-1 to enter the timer view and setting interface, as shown in Figure 2-2-1.

NO.	ADDR.	CURT.	SET.	REMARK
000	T000	15000	15000	MST function execute alarm time
001	T001	00000	00000	spindle CW delay finish time
002	T002	00000	00000	spindle CCW delay finish time
003	T003	00500	00500	spindle CW OFF, CCW delay ON time
004	T004	00500	00500	spindle CCW OFF, CW delay ON time
005	T005	00000	00000	S funtion finish delay time(no g-change)
006	T006	00500	00500	spindle jog ON time
007	T007	00500	00500	delay output brake after spindle stop
008	T008	01000	01000	spindle brake time
009	T009	08000	08000	spindle orientation check time
010	T010	00500	00500	spindle orientation delay finish time
011	T011	01500	01500	M29 execute finish time(no check time)

DATA   ^

S00000   T0700

14: 29: 07   MDI

| | KPAR | TMR | DATA | CTR | RETURN | |

Figure 2-2-1

Timer interface contents and operations:

RUN: Running status of the trapezoid.

NO. : Timer number, which cannot be modified.

ADDR. : Timer address, which cannot be modified.

CURT. : Current value of the timer, which cannot be modified.

SET. : Preset value of the timer, which can be modified when the password authority is is enabled.

Input: To display input data.

Input mode: Current work mode.

【Return】: Return to the previous menu.

Upon modification, the system will display TMR downloading successfully! When there is an error while saving, the system will display download failed! When the download conditions are not met, the system will display illegal download parameters!

You can locate by pressing page up/down keys and four arrow keys to view or modify the timer address.

2.3 Data sheet

Press the soft key 【DATA】in Figure 2-1 to enter the data sheet view and setting interface, as shown in Figure 2-3-1.

Figure 2-3-1

Data sheet interface contents and operations:

RUN　　　: Running status of the trapezoid.

NO.　　　: Data sheet number, which cannot be modified.

ADDR.　　: Data sheet address, which cannot be modified.

DATA　　 : Set value of the data input, which can be modified when the password authority is enabled.

Input　　 : To display input data.

Input mode　: Current work mode.

【Return】　: Return to the previous menu.

Upon modification, the system will display DATA downloading successfully! When there is an

error while saving, the system will display download failed! When the download conditions are not met, the system will display illegal download parameters!

You can locate by pressing page up/down keys and four arrow keys to view or modify the data sheet address.

2.4 Counter

Press the soft key【CTR】in Figure 2-1 to enter the counter view and setting interface, as shown in Figure 2-**4-1**.

NO.	ADDR.	CURT.	SET.	REMARK
000	C000	00000	00000	STANDBY
001	C001	00000	00000	STANDBY
002	C002	00000	00000	STANDBY
003	C003	00000	00000	STANDBY
004	C004	00000	00000	STANDBY
005	C005	00000	00000	STANDBY
006	C006	00000	00000	STANDBY
007	C007	00000	00000	STANDBY
008	C008	00000	00000	STANDBY
009	C009	00000	00000	STANDBY
010	C010	00000	00000	STANDBY
011	C011	00000	00000	STANDBY

Figure 2-4-1

Counter interface contents and operations:

RUN : Running status of the trapezoid.

NO. : Counter No., which cannot be modified.

ADDR . : Counter address, which cannot be modified.

CURT. : Current value of the counter, which cannot be modified.

SET. : Counter prevalue, which can be modified when the password authority is enabled.

Input : To display input data.

Input mode : Current work mode.

【Return】 : Return to the previous menu.

Upon modification, the system will display CTR downloading successfully! When there is an error while saving, the system will display download failed! When the download conditions are not met, the system will display illegal download parameters!

You can locate by pressing page up/down keys and four arrow keys to view or modify the counter address.

Chapter Three Ladder Diagram Editor Instructions

3.1 Overview

At present, GSK980TDHi system supports the associated GSK ladder diagram editor.

GSK ladder diagram editor, as the ladder diagram editor on the PC for GSK 980TDHi CNC system, mainly provides editing, conversion, troubleshooting and printing functions. This software can run on Windows 98, Windows Me, Windows 2000, Windows XP and Windows 2003.

3.2 Introduction to software

3.2.1 Software startup

GSK ladder diagram editor is green software that needs not to be installed. The software package contains two files Lad Edit.exe and Diag.mea and a folder LadFile, and Ladder03 in the LadFile folder is the system's standard ladder diagram. Double click Lad Edit.exe to run the software and open Ladder03 in the LadFile folder as follows:
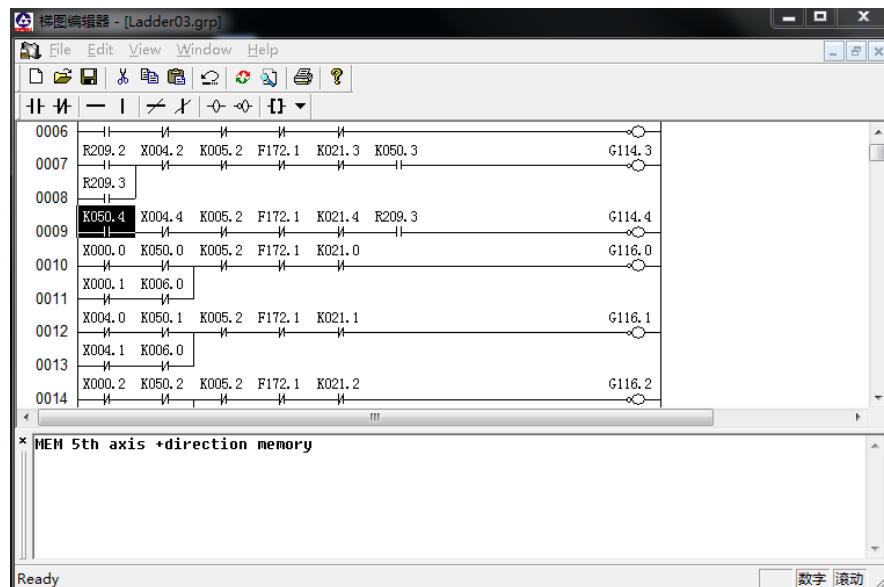
Figure 3-2-1-1

3.2.2 Functions

● **File Menu**

The File Menu includes functions such as Create, Open and Save Files, Generate Executable Ladder Diagram Files or Binary Files, Print, Print Preview and Print Settings, List of Recent Files.

Note: "Ladder Diagram Version Number", "Applicable Machine Tool" and "Last Modifier" in the dialog box "Edit Ladder Diagram Information" can only be input in English other than Chinese, or there will be an error after transfer.

● **Edit Menu**

The Edit Menu includes functions such as Cut, Copy, Paste, Search, Convert and Edit the ladder diagram.

● **View Menu**

It controls the display and hiding of the Toolbar, Status Bar, Output Window, and Instruction List Window.

● **Window Menu**

It controls the selection and layout of each window.

● **Help Menu**

Version information on this software

3.3 Software operations

3.3.1 Toolbar

The main view frame has two toolbars that are related to the ladder diagram editing.

3.3.1.1 Main Toolbar

Icon	Function
☐	Create File
📂	Open File
💾	Save File
✂	Cut to Clipboard
📋	Copy to Clipboard
📋	Paste from Clipboard
🔄	Convert
🔍	Find Component
🖨	Print
❓	About

3.3.1.2 Edit Toolbar
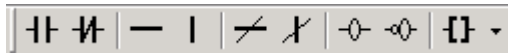
  Add a normally open contact

  Add a normally closed contact

  Add a horizontal conduction line

  Add a vertical conduction line (at the bottom right of the cursor)

  Delete a component or horizontal conduction line

  Delete the vertical conduction line at the bottom right

  Add the output coil

  Add the output coil to negate

  Functional code key. The functional code can be edited in the following two ways:

1. Click the small arrow to the right of the key to pop up the drop-down menu and select the functional code.
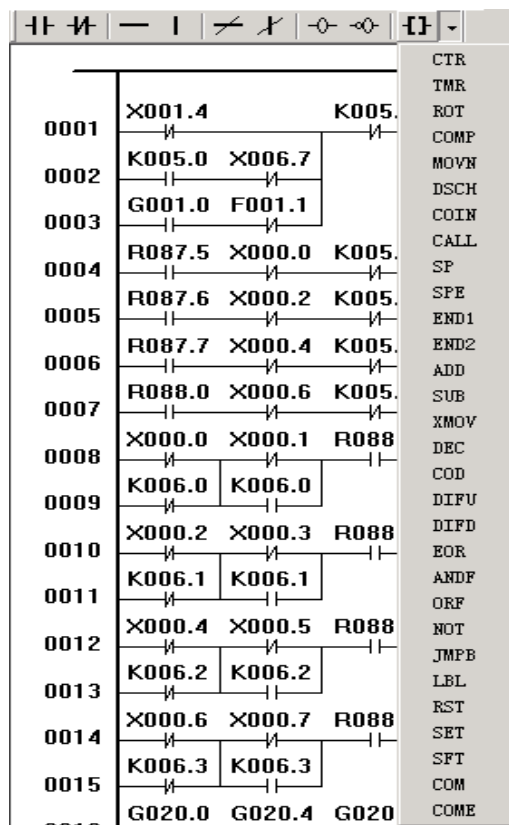
Figure 3-3-1-2-1

2. Or click the key icon, pop up the functional code selection dialog box for functional code settings.
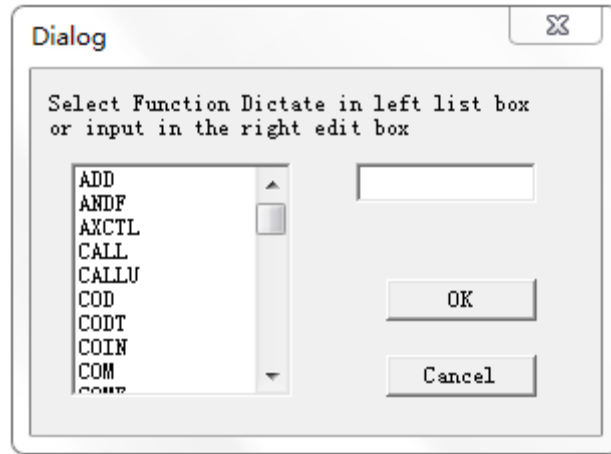
Figure 3-3-1-2-2

3.3.2 Graphics selection

In the ladder diagram edit view, with the black rectangular shadow indicating the cursor, left click the graphics edit area between the two bus lines and select the position where the graphics need to be edited, as shown below:
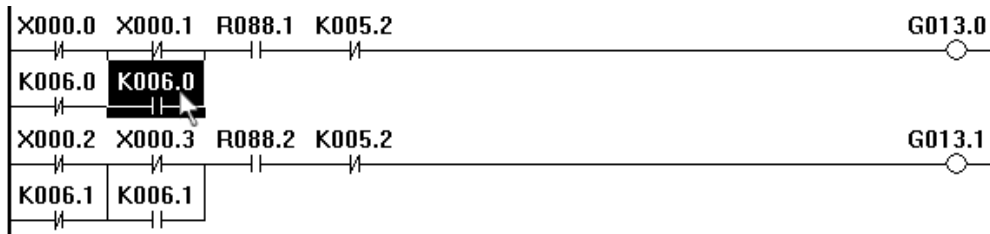
Figure 3-3-2-1

When selecting a block, left click the starting location and drag it to the end of the block. Before releasing the left key, the selected area is surrounded by a rectangle of dotted lines.
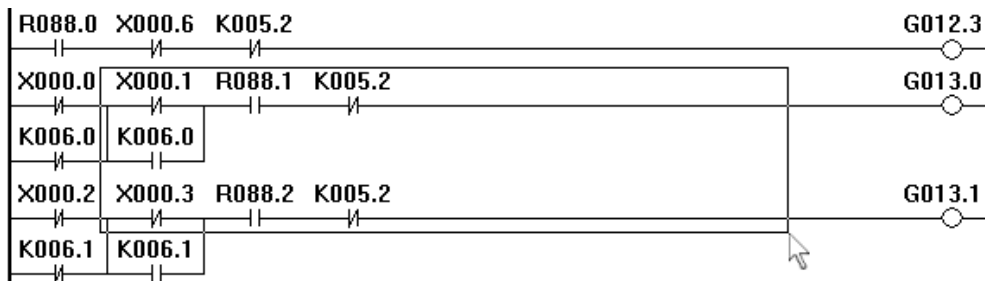
Figure 3-3-2-2

After releasing the ladder diagram block inversion, it represents that the ladder diagram within the range is selected and you can proceed to next step operation such as cut, delete and copy.
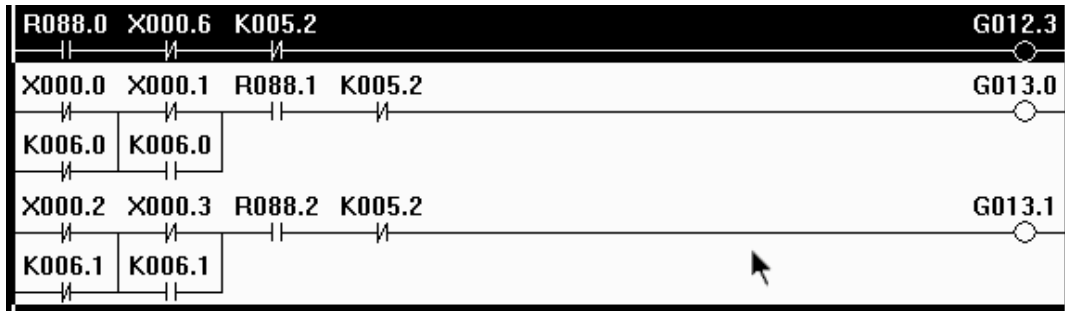
Figure 3-3-2-3

3.3.3 Graphic editing

3.3.3.1 Cut

After selecting the ladder diagram area to be edited, there are three ways to do this:

    1. Right click to pop up the environment menu and select Cut;

    2. Select Edit [Alt+E]---Cut [T] in the main menu;

    3. Direct Shortcut [Ctrl+X];

You can copy the content of the clipboard in the ladder diagram by pasting what is cut into the clipboard.

3.3.3.2 Copy

After selecting the ladder diagram area to be copied, there are three ways to do this:

    1. Right click to pop up the environment menu and select Copy;

    2. Select Edit [Alt+E]---Copy [C] in the main menu;

    3. Direct Shortcut [Ctrl+C];

You can copy the content of the clipboard in the ladder diagram by pasting what is cut into the clipboard after copying.

3.3.3.3 Paste

After selecting the position where to paste in the ladder diagram, there are three ways to do this:

    1. Right click to pop up the environment menu and select Paste;

    2. Select Edit [Alt+E]---Paste [P];

    3. Direct Shortcut [Ctrl+V].

3.3.3.4 Delete

After selecting the ladder diagram area to be deleted, there are three ways to do this:

    1. Right click to pop up the environment menu and select Basic Code----Delete Nodes;

    2. Click [Delete Nodes] on the Edit Bar;

    3. Direct Shortcut [Delete];

3.3.3.5 Insert Row

To move the cursor to the position where to insert a ladder diagram line, there are three ways to do this:

1. Right click to pop up the environment menu and select 插入;

2. Select Edit [Alt+E]---Insert Row[I];

3. Direct Shortcut [Insert];

3.3.3.6 Delete Row

To move the cursor to the position where to delete a ladder diagram line, there are three ways to do this:

1. Right click to pop up the environment menu and select Delete Row;

2. Select Edit [Alt+E]---Delete Row[D];

3. Direct Shortcut [Ctrl+Delete];

3.3.3.7 Convert

To convert the ladder diagram program in the current edit interface into the instruction list program, there are three ways to do this:

1. Select Edit [Alt+E]---Convert[V];

2. Click the [Convert] key 🔄 ;

3. Direct Shortcut [F7];

3.3.4 Ladder diagram annotations

3.3.4.1 Ladder diagram line annotations

Left double-click outside the right bus area of the ladder diagram and input annotations in the edit box that pops up.
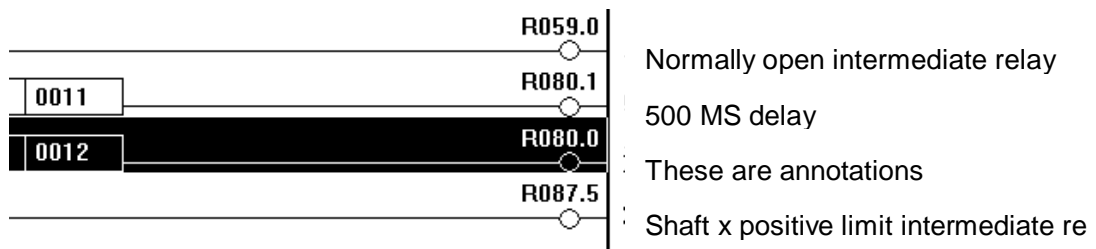
Figure 3-3-4-1-1

3.3.4.2 Ladder diagram component annotations

To move the cursor to the position where to modify a ladder diagram component, there are two ways to do this:

1. After selecting the component, right click it and select Modify Annotations [M] in the pop-up menu;
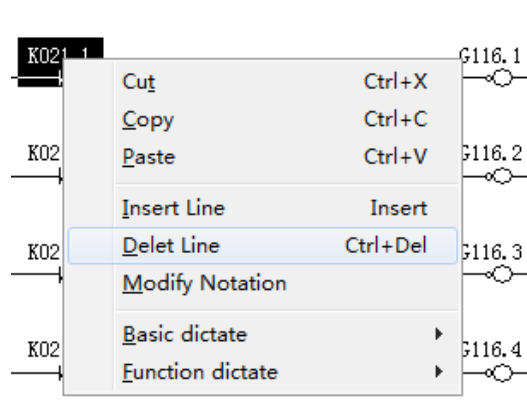
Figure 3-3-4-2-1

2. Select Edit [Alt+E]----Modify Annotations [M].
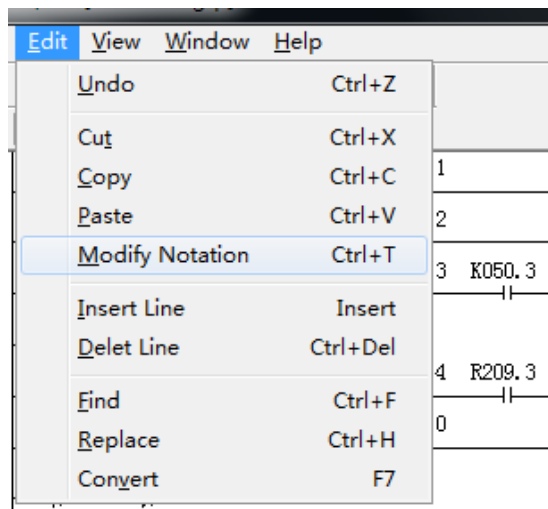
Figure 3-3-4-2-2

3. Direct Shortcut [Ctrl+T]

Input annotations in the pop-up dialog box and click OK to Save.
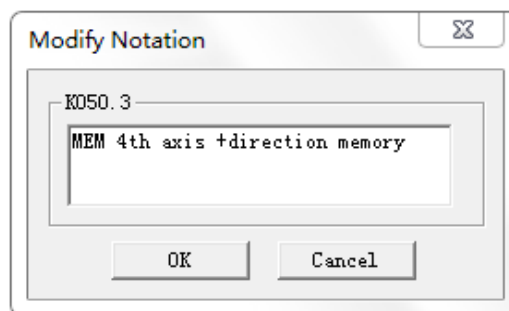
Figure 3-3-4-2-3

The saved annotations will appear in the output window at the bottom of the screen each time a component is selected, as shown below:
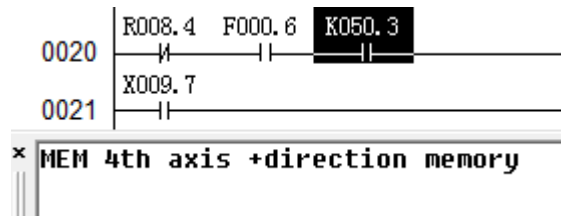
Figure 3-3-4-2-4

3.3.5 Export

After the ladder diagram file is edited and saved, it needs to be converted before it may generate executable files. It can be transferred to CNC through serial communication software or USB disks and executed by the PLC of the CNC system. See System Communications，Chapter Thirty-One, Part Three, 980TDHi Programming and Operation Manual for details.

How to generate a ladder diagram file

Select Main Menu File [Alt+F]---- Generate Ladder Diagram File [L], input name and path, save and generate a ladder diagram file with the extension ".grp" which can be used by GSK 980TDHi lathe.

The ladder diagram configuration file has its format as shown in Appendix II.

Part Three Functions

Chapter One Control Shaft

1.1 System control shaft number output signal

Overview   System control shaft number output

Signal   System control shaft number binary signal
AXIS1~AXIS4 (F171#0~F171#3)
For example, when the number of system shafts is 3, (F#171=0000 0011)

1.2 Output of the shaft movement status

Overview   The movement status of each shaft can be output to the PLC..

Signal   **Signal**
MV1～MV5 (F102#0～F102#4)

[Type]   Output signal

[Function]   These signals indicate that one control shaft is moving

MV1: Shaft 1 is moving

MV2: Shaft 2 is moving

MV3: Shaft 3 is moving

MV4: Shaft 4 is moving

MV5: Shaft 5 is moving

[Output Conditions]

In the following case, the signal becomes 1:

● The corresponding shaft has already begun moving

In the following case, the signal becomes 0:

● The corresponding shaft has already stopped moving

Shaft movement direction signal
MVD1~MVD5 (F106＃0~F106＃4)

[Type]   Output signal

[Function]   These signals indicate the moving direction of a control shaft.

MVD1: Shaft 1 moving direction signal

MVD2: Shaft 2 moving direction signal

MVD3: Shaft 3 moving direction signal

MVD4: Shaft 4 moving direction signal

MVD5: Shaft 5 moving direction signal

[Output Conditions] "0" indicates that the corresponding shaft is moving in the reverse direction, and "1" indicates that the corresponding shaft is moving in the forward direction.

Note:

During the stop, these signals remain their current statuses to indicate the shaft movement direction before stopping.

Signal address

	#7	**#6**	**#5**	**#4**	**#3**	**#2**	**#1**	**#0**
F102				MV5	MV4	MV3	MV2	MV1
F106				MVD5	MVD4	MVD3	MVD2	MVD1

1.3 Servo readiness signal

Signal　　Servo readiness signal
**　　　　SA (F000#6)**

[Type]　Output signal

[Function]　When the servo is ready, SA Signal becomes 1. For a shaft with braking, when this signal is output, then braking is released; when no such signal is output, then braking is enabled.

Signal address:

	#7	**#6**	**#5**	**#4**	**#3**	**#2**	**#1**	**#0**
F102		SA						

Chapter Two Readiness for Operation

2.1 Emergency stop

Overview   Press Emergency Stop on the operation panel of the machine tool and the machine tool will stop moving immediately.
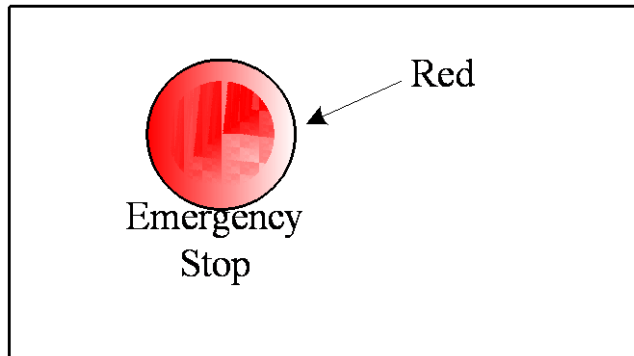
Figure 2-1

After pressed, the button will be locked. Its release is different depending on the machine tool manufacturer. It is usually to left rotate.

Signal   **Emergency stop signal**

*ESP   (G008.4)

[Type]   Input signal

[Function]   Input the Emergency Stop Signal to stop the machine tool immediately

[Action]   When the Emergency Stop Signal ESP becomes 0, the CNC will be reset and the machine tool will be in emergency stop.

Signal address

	#7	#6	#5	#4	#3	#2	#1	#0
G008				*ESP				

2.2 CNC overtravel signal

Overview   When the tool moves beyond the travel end set by the machine tool limit switch, the limit switch will operate and the tool will decelerate and stop, displaying an overtravel alarm.

Signal   **Overtravel signal**

+L1～+L5 (G114#0~G114#4)

−L1～−L5 (G116#0~G116#4)

[Type]   Input signal

[Function]   It indicates that the control shaft has reached its travel limit and all directions of each control shaft have such signal. +, - of the signal name indicates the direction, number corresponds to the control shaft.
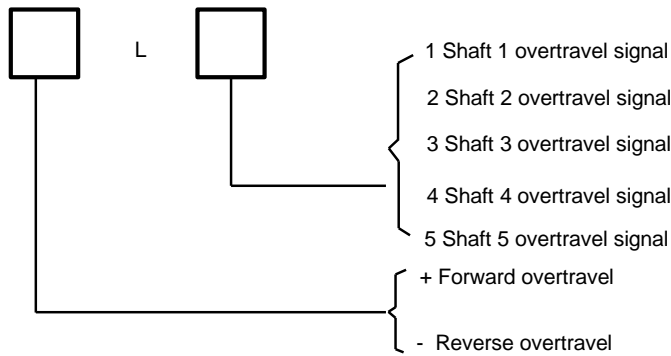
[Operation]   When Signal is "0", the control unit operates as follows:

* For automatic operation, even if only one shaft overtravel signal becomes 1, then the shaft used should slow to stop, resulting in an alarm and running interruption.

* For manual operation, only shafts with moving signal 1 will slow to stop and the stopped shafts will move to the opposite direction.

* Once the shaft overtravel signal becomes 1, its moving direction will be stored. Even if the signal becomes 0, the shaft cannot move in that direction until the alarm is cleared.

Signal address

	#7	#6	#5	#4	#3	#2	#1	#0
G114				+L5	+L4	+L3	+L2	+L1
G116				*-L5	*-L4	*-L3	*-L2	*-L1

2.3 Alarm signal

Overview   When an alarm occurs in the CNC, the alarm will be displayed on the screen and the alarm signal will be set to 1.

Signal   Alarm signal

      AL (F001＃0)

    [Type]   Output signal

    [Function]   The alarm signal indicates that the CNC is in alarm and has the following alarm display:

                a) P/S alarm

                b) Overtravel alarm

                c) Servo alarm

    [Output Conditions]   In the following case, the alarm signal is 1:

        ——The CNC is in alarm.

        In the following case, the alarm signal is 0:

        ——The CNC will clear the alarm when reset.

Signal address

	#7	#6	#5	#4	#3	#2	#1	#0
F001								AL

Part Three Functions

2.4 Operation mode selection

Signal   Mode selection signal

The mode selection signal may be used to select by setting the following as per the following table.

Mode Selection Signal

MD1,MD2,MD4 (G043#0～#2)

Manual Reference Point Return Selection Signal

ZRN (G043#7)

Incremental Feed Selection Signal

INC (G043#3)

Driving Manual Pulse Trial Switch Selection Signal

TEACH (G043#4)

Program Zero Return Selection Signal

PRGZ (G043#6)

Operation Mode Check Signal

Incremental Feed Selection Confirmation Signal
MINC (F003#0)
Driving Manual Pulse Feed Selection Confirmation Signal
MH (F003#1)
Manual Continuous Feed Selection Confirmation Signal
MJ (F003#2)
Manual Data Input Selection Confirmation Signal
MMDI (F003#3)
Memory Operation Selection Confirmation Signal
MMEM (F003#5)
Program Edit Selection Confirmation Signal
MEDT (F003#6)
Manual Pulse Trial Cut Selection Confirmation Signal
RHPG (F006#3)
Manual Reference Point Return Selection Confirmation Signal
MREF (F004#5)

Mode		Input signal							Output signal
		MD1	MD2	MD4	INC	TEACH	PRGZ	ZRN	
		G43.0	G43.1	G43.2	G43.3	G43.4	G43.6	G43.7	
Automatic operation	Manual Data Input (MDI)	0	0	0	-	-	-	-	MMDI
	Memory Operation (Automatic Mode)	1	0	0	-	0	-	-	MMEM
	Manual Pulse Trial Cut	1	0	0	-	1	-	-	RHPG
	Memory Editing (EDIT)	1	1	0	-	-	-	-	MEDT
Manual operation	Driving Manual Pulse	0	0	1	0	-	-	-	MH
	Incremental Feed (Single Step)	0	0	1	1	-	-	-	MINC
	Manual JOG Feed	1	0	1	-	-	-	0	MJ
	Manual Reference Point Return	1	0	1	-	-	0	1	MREF
	Program Zero Return	1	0	1	-	-	1	1	

Table 2-4-1 Relationship between Mode Selection Signal and Confirmation Signal

Note: ("-" is irrelevant to the signal status)

Signal address

	#7	#6	#5	#4	#3	#2	#1	#0
F003		MEDT	MMEM		MMDI	MJ	MH	MINC
F004			MREF					
F006					RHPG			

2.5 Status output signal

Cutting feed signal

CUT (F002＃6)

[Type]   Output signal

[Function]   This signal indicates that automatic cutting feed is in progress.

[Output Conditions]   In the following case, the signal is 1:

Automatic cutting feed (linear interpolation, circular interpolation, thread cutting, cutting in skip cutting).

Notes

1. The signal will not be output when the feed is paused.

2. The signal may be output during interlocking or when the feedrate override is 0.

Signal address

	#7	#6	#5	#4	#3	#2	#1	#0
F002		CUT						

Chapter Three Manual Operation

3.1 JOG feed/incremental feed

Overview

JOG feed   In the JOG mode, set the feed shaft and direction selection signal on the operation panel of the machine tool to 1, then the machine tool will move continuously along the selected shaft in the selected direction.

Incremental Feed   In the incremental feed mode, set the feed shaft and direction selection signal on the operation panel of the machine tool to 1, then the machine tool will move one stop along the selected shaft in the selected direction, with a minimum moving distance equal to the minimum input increment. Each step may be equal to 1, 10, 100, or 1000 times the minimum input increment (1000 times only for a single step increment, not for the driving manual pulse increment).

The only difference between the JOG feed and the incremental feed is the way to select the feed distance. In JOG Feed, when the feed shaft and direction selection signal for + J1, -J1, + J2, -J2, + J3, -J3, etc. is 1, the machine tool can have continuous feed. In incremental feed, the machine tool has manual pulse/single step feed. The JOG feed rate may be adjusted with the JOG feed rate override key.

With the fast feed selector switch, the machine tool can move at the fast feed rate regardless of the JOG feed rate override signal.

The single step distance can be selected through the incremental step MP1, MP2,MP3 G019＃4~G019＃6.

Signal   Feed shaft and direction selection

＋**J1~ ＋J5 (G100＃0~G100＃4)**

－**J1~ －J5 (G102＃0~G28＃4)**

[Type]   Input signal

[Function]   Select the desired feed shaft and direction under the JOG feed or incremental feed. ＋, － in the signal name indicates that the feed direction and number corresponds to the control shaft.

1 Shaft X feed
2 Shaft Y feed
3 Shaft Z feed
4 Shaft A feed

+ Forward feed
- Reverse feed
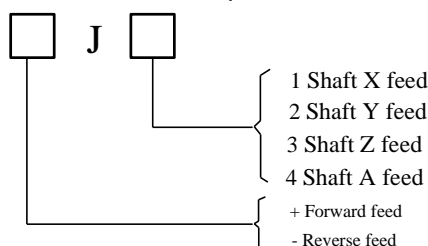
[Operation]   When the signal is 1, the control unit operates as follows:

* When the JOG feed or incremental feed is active, the control unit specifies the shaft movement in the specified direction.

In the JOG feed, when the signal is 1, the control unit will move the control shaft continuously.

* In the incremental feed, the control unit makes the specified shaft feed in the defined step, and then the control unit will stop moving. When the shaft has feed, even if the signal is 0, the control unit will not stop the feed. To move the shaft again, the signal needs to be set to 0 and then set to 1.

Manual fast feed selection signal

 RT (G019＃7)

[Type]　　Input signal

[Function]　　Select the fast feed rate of the JOG feed.

[Action]　　When the signal becomes 1, the control unit operates as follows:

● The control unit executes the JOG feed at the fast feed rate, and the rapid feedrate Override is active.

● During the JOG feed period, when the signal is switched from 1 to 0 or the other way round, the feedrate will be reduced to 0, and then increased to the defined value. During the acceleration/deceleration period, the feed shaft and direction selection signal can be maintained at 1.

Signal address

	#7	#6	#5	#4	#3	#2	#1	#0
G019	RT							
G100				+J5	+J4	+J3	+J2	+J1
G102				-J5	-J4	-J3	-J2	-J1

3.2 Manual pulse/single step feed

Overview　　In the manual pulse/single step feed, the machine tool can be moved slightly with the rotatory manual pulse generator or single-step operation. The machine toolshaft movement may be selected through manual pulse feed shaft selection signal or shaft movement signal.

Signal　　**Manual pulse/single step feed selection signal**

 (G19＃4~G19＃6)

[Type]　　Input signal

[Function]　　Manual pulse/ single step feed selection signal

The signal is binary coded with two G signals, indicating the distance traveled by each step.

Manual Pulse/Single Step Feed Selection Signal			Manual Pulse	Single Step
G19.4(MP1)	G19.5(MP2)	G19.6(MP4)	mm/inc	mm/inc
0	0	0	--	--
1	0	0	*1	*1
0	1	0	*10	*10
1	1	0	*100	*100
0	0	1	Parameter to be specified	*1000

Chapter Four Reference Position Return

4.1 Manual reference point return position

Overview   In the manual reference point return mode, the machine tool will move in the set direction and return back to the reference point by setting parameter N0: 7#0~#4. The selected shaft of the panel key only represents the selected shaft back to zero regardless of the shaft movement direction.

The following signals relate to the manual reference position return:

Table 4-1-1

	Manual reference position return
Reference position return deceleration signal	DECX, DECY, DECZ, DEC4, DEC5
Reference position return end signal	ZP1, ZP2, ZP3, ZP4, ZP5

Signal

Reference position return end signal

ZP1～ZP5(F094＃0~F094＃4)

[Type]   Output signal

[Function]   The signal indicates that the machine tool is at the reference position of the control shaft.

These signals correspond to shafts..

Table 4-1-2

ZP1	Shaft 1 Zero return point end signal
ZP2	Shaft 2 Zero return point end signal
ZP3	Shaft 3 Zero return point end signal
ZP4	Shaft 4 Zero return point end signal
ZP5	Shaft 5 Zero return point end signal

[Output Conditions] When the signal becomes 1:

- The manual reference position return has ended and the current position is set to the in-position area.
- The automatic reference position return (G28) ends and the current position is set to the in-position area.
- The reference position return detection ends and the current position is set in the in-position area.

When the signal becomes 0:

- When the machine tool is removed from the reference position.
- When there is an emergency stop signal.
- When a servo alarm occurs.

Zero return deceleration signal detection

*DEC1~*DEC5   (G0196#0~G0196#4)

[Type]   Input signal

[Function]   These signals will reduce the speed of the manual reference point return so as to be close to the reference point at a low rate.

Note: When there is manual reference point return with absolute code, it will automatically zero return of the machine tool.

Chapter Five Automatic Operation

5.1 Cycle start/feed hold

Overview

Automatic operation activation (Loop Start)   In the memory, in the automatic or MDI mode, when automatic start enables the signal ST and set it to 1 and then set it to 0, then the CNC will enter the automatic operation start status and start operating.

In the following cases, the signal ST will be ignored:

1. In other modes other than automatic and MDI.

2. When the feed hold signal (*SP) is 1.

3. When the emergency stop signal (*ESP) is 0.

4. When the reset & rewind signal RRW is "1"

5. The <RESET> key on the MDI keyboard is pressed.

6. The CNC is in alarm.

7. Automatic operation has been started.

8. When the program restart signal (SRN) is 1.

9. The CNC is searching for a sequence.

During automatic operation, the CNC will enter the feed hold status and stop operation in the following cases:

1. When the feed hold signal (*SP) is 0.

2. The single block code ends during its operation.

3. The MDI operation has ended.

4. An alarm will occur to the CNC.

5. When it is changed to another automatic operation mode or the editing mode, the single block code has ended.

During automatic operation, the CNC will be reset and stop operation in the following cases:

1. The emergency stop signal (*ESP) is set to 0.

2. The <RESET> key on the MDI keyboard is pressed.

Automatic operation interruption (feed hold)   During automatic operation, the CNC will enter the paused status and stop operation when the feed hold signal*SP is set to 0. Meanwhile, the loop start indicator light STL will be cleared to 0, and the feed hold indicator light SPL will be set to 1. Even if the SP signal is cleared to 0 again, the automatic operation will not be retarted. If to restart the automatic operation, you must first clear the SP signal to 0, set the SP signal to 1 and then again clear it to 0.

Signal Loop Start Signal

ST (G007＃2)

[Type] Input signal

[Function] It starts automatic operation.

[Operation] In the automatic operation, if ST in the MDI mode will detect the falling edge, then the CNC will enter the Loop Start status and start operation.

Feed Hold Signal

*SP (G008＃5)

[Type] Input signal

[Function] It interrupts automatic operation.

[Operation] During the automatic operation period, if the SP signal detects the falling edge, the CNC will enter the feed hold status and stop operation. When the SP signal is set to 0, Loop Start is not allowed.

Loop Start Indicator Light Signal

STL (F000＃5)

[Type] Output signal

[Function] It indicates that the PLC has entered automatic operation activation.

[Output Conditions] The signal may be set to 1 or 0, depending on the CNC status, as shown in Table 5-1.

Feed Hold Indicator Light Signal

SPL (F000＃4)

[Type] Output signal

[Function] It indicates that the PLC has entered feed hold.

[Output Conditions] The signal may be set to 1 or 0, depending on the CNC status, as shown in Table 5-1.

Automatic Operation Signal

OP (F000＃7)

[Type] Output signal

[Function] It indicates that the PLC automatic operation is in progress.

[Output Conditions] The signal may be set to 1 or 0, depending on the CNC status, as shown in Table 5-1.

Table 5-1

	Loop Start Indicator Light STL	**Feed Hold Indicator Light SPL**	**Automatic Operation Indicator Light OP**
Loop Start Status	1	0	1
Feed Hold Status	0	1	1
Automatic Operation Stop Status	0	0	0
Reset Status	0	0	0

Signal address

	#7	#6	#5	#4	#3	#2	#1	#0
G007						ST		
G008			*SP					
F000	OP		STL	SPL				

5.2 Reset

Overview   In the following cases, the CNC will be reset and enter the reset status.

1. The emergency stop signal (*ESP) is set to 0.
2. The <RESET> key on the MDI keyboard is pressed.

When the CNC is reset, the reset signal RST will be output to the PLC. After it is released and the reset signal RST set by parameter 203 outputs time, the reset signal RST will be set to 0.

RST＝T_{reset} (Reset processing time) ＋ set value of parameter 203
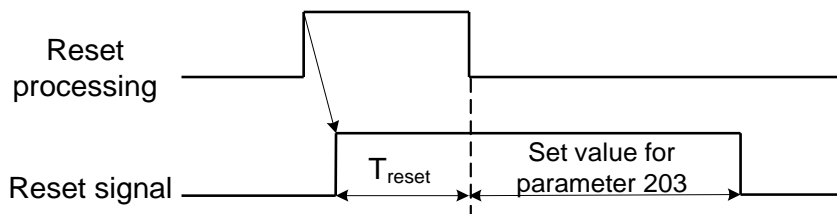
Figure 5-2

During the automatic operation, when the CNC is reset, the automatic operation will stop and the operating shaft will be decelerated and stopped.

When the CNC is reset during execution of M, S, and T functions, MF, SF, TF signals will

be set to 0 within 16 min.

RST (F001＃1)

[Type]   Output signal

[Function]   It notifies the PLC that the CNC has been reset. The signal is used for PLC reset processing.

[Output Conditions]   In the following cases, the signal will be set to 1:

1. The emergency stop signal (*ESP) is set to 0.

2. The <RESET> key on the MDI keyboard is pressed.

In the following case, the signal will be set to 0:

When the above cases are released and the CNC is reset, the output time of the reset signal set by parameter 203 has ended.

Signal address

	#7	#6	#5	#4	#3	#2	#1	#0
F001							RST	

5.3 Program testing

Overview   Before machining, run the automatic operation to detect if the generated program is correct. Detect by observing the change in position displayed without running the machine tool or by running the machine tool.

5.3.1 Machine Tool Latching

Overview   Change in monitoring position displayed without moving the machine tool.

When the all shafts machine tool latching signal MMLK is 1, in the manual or automatic operation, output pulse to the servomotor will be stopped, but still the code is assigned and the absolute and relative coordinates will be updated. Therefore, the operator can check whether the code compilation is correct by monitoring the change in position.

All Shafts Machine Tool Latching Detection Signal

MMLK (F004＃1)

[Type]   Output signal

[Function]   It notifies the PLC of the status of the all shafts machine tool latching signal.

[Output Conditions]   When the signal is set to 1, the all shafts machine tool latching signal will be set to 1.

When the signal is set to 0, the all shafts machine tool latching signal will be set to 0.

Signal address

	#7	#6	#5	#4	#3	#2	#1	#0
F004							MMLK	

5.3.2 Dry Running

Overview   Dry Running is only active for automatic and MDI operation. The machine tool moves at constant feedrate without executing the feedrate defined in the program. The feedrate is set by parameter P86.

This function is used to check the movement of the machine tool when the machine tool is not loaded.

Signal   **dry dunning signal**

DRN (G046＃7)

[Type]   Input signal

[Function]   Dry Running is active.

[Operation]   When this signal is set to 1, the machine tool moves at the feedrate set at dry running.

When this signal is set to 0, the machine tool is moved normally.

Notes:

During the machine tool movement, when the dry dunning signal is changed from 0 to 1, the machine tool will have its program-specified operating speed accelerated or decelerated to the dry running speed; when the dry dunning signal is changed from 1 to 0, the machine tool will have its operating speed decelerated or accelerated to the program-specified speed from the dry running speed.

Signal address

	#7	#6	#5	#4	#3	#2	#1	#0
G046	DRN							

5.3.3 Single block

Overview

During the automatic and MDI operation, when the single block signal (SBK) is set to 1, then the CNC will enter automatic operation stop status after executing the current block.

In the sequential automatic operation, after each block in the program is executed, the CNC will enter the automatic operation stop status and when the single block signal (SBK) is set to 0, the automatic operation will be re-executed.

Signal   **Single block signal**

SBK (G046＃1)

[Type]   Input signal

[Function]   Single block is active.

[Operation]   When this signal is set to 1, the single block operation will be executed.

When this Signal is set to 0, the normal operation will be executed.

Single block detection signal

MSBK (F004＃3)

[Type]   Output signal

113

[Function]   It notifies the PLC of the status of the single block signal.

[Operation]   In the following case, the signal will be 1:

——The single block signal SBK is 1.

In the following case, the signal will be 0:

——The single block signal SBK is 0.

Notes:

Operation in thread cutting

During the thread cutting period, when the SBK signal becomes 1, then after the first non-thread cutting block after the thread cutting code is executed, the operation will be stopped.

Signal address

	#7	#6	#5	#4	#3	#2	#1	#0
G046							SBK	
F004					MSBK			

5.4 Optional block skip

Overview   In the automatic or MDI operation, when a slash is specified at the beginning of the block and the optional block skip signal BDT is set to 1, the block will be ignored.

Signal   **Optional block skip signal**

BDT (G044#0)

[Type]   Input signal

[Function]   Select whether the block containing "/" is to be ignored.

[Operation]   In the automatic operation, when the BDT is 1, the block containing "/" will be ignored.

When the BDT is 0, the program will be executed normally.

Optional block skip detection signal

MBDT (F004#0)

[Type]   Output signal

[Function]   It notifies the PLC of the status of the optional block skip BDT

Signal address

	#7	#6	#5	#4	#3	#2	#1	#0
G044								**BDT**
F004								**MBDT**

Chapter 6 Feed Rate Control

6.1 Fast moving override

Overview   4-level override (F0, 25%, 50%, 100%) can be used for fast moving rate.

Feed rate   Whether it is the automatic or manual operation (including manual reference point return, program zero return), the actual moving rate is obtained by multiplying the value set by parameters P088 to 092 with the override value.

F0 speed is set by parameter P093.

Signal   Fast moving override coding signal (G14#0~G14#2)

[Type] Input signal

[Function] Fast moving rate override coding detection signal

[Operation] The coding signal corresponds to the following override

Fast moving override coding signal			Override	
RV4	RV2	RV1	ROV1=0	ROV2=1
0	0	0	0%	0%
0	0	1	25%	20%
0	1	0	50%	40%
0	1	1	100%	60%
1	0	0	——	80%
1	0	1	——	100%

6.2 Feed rate override

Overview   To select the override key to increase or decrease the programmed feed rate, this feature is used for program detection. For example, when the specified feed rate in the program is 100mm/min, if the override is set to 50%, then the machine tool will move at mm/min.

Signal   Feed rate override coding detection signal (G012#0~G012#4)

[Type] Input signal

[Function] The cutting feed speed rate signal has 5 binary coding signals corresponding to the override:

Therefore, the override can be selected every 10% from 0 to 200%.

[Operation] The coding signal corresponds to the following override

Cutting feed rate override coding signal					Override
FV16	FV8	FV4	FV2	FV1	
0	0	0	0	0	0%
0	0	0	0	1	10%
……	……	……	……	……	……
…….	……	……	……	……	……
1	0	0	1	1	190%
1	0	1	0	0	200%

6.3 Override cancellation

Overview The override cancellation signal will fix the feed rate override to 100%.

Signal Override cancellation signal

  OVC (G006#4)

  [Type]   Input signal

  [Function]   The feed rate override is fixed at 100%.

  [Operation]   When the signal is 1, the CNC operates as follows:

  ● Regardless of the feed rate override signal, the feed rate override is fixed at 100%.

  ● The fast moving override and spindle rate override are not affected.

Signal address

	#7	#6	#5	#4	#3	#2	#1	#0
G006				OVC				

Chapter Seven Auxiliary Functions

7.1 Auxiliary functions of code M

Overview　Auxiliary functions of code M　　When an 8-digit number is value by a command following address M, the Code M coding signal and the gating signal will be transferred to the PLC, which will use these signals to to enable or disable the functions.

Normally, only one code M is active in one block, but there can be three commands at maximum (to be set by parameter NO.33#7 M3B). In addition, the maximum number of parameter (No. 204) can be used to give an alarm if the command exceeds the maximum number of digits.

Basic processing process

The signal is used for the following functions:

Table 7-1-1

Function	Address	Output signal		Assignment completion signal	Answer and end signal
		Code M coding signal	Gating signal		
Auxiliary function of code M	M**	M00~M31 (F010#0~F013#7)	MF (F007#0)	DEN (F001#3)	FIN (G004#3)
Auxiliary function of No. 2M	M**	M200~M215 (F014#0~F015#7)	MF2 (F008#4)		
Auxiliary function of No. 3M	M**	M300~M315 (F016#0~F017#7)	MF3 (F008#5)		
Spindle function	S***	S00~S31 (F22#0～F25#7)	SF (F007#2)		
tool function	T****	T00～T31 (F26#0～F29#7)	TF (F007#3)		

Auxiliary function (Code M), spindle function (Code S) and tool function (Code T) have different addresses and signals used in the program, but the steps for signal switching are the same in all the functions, as follows:

（1） Suppose that Mxxx is commanded in the command program. A maximum number of bits can be specified for each function by xxx through parameter (No.204 ~ No.206). When the command exceeds the maximum number of bits, there will be an alarm given.

（2） When the output code signal M00 to M31 is after the TMF (generally 64 msec) set through parameter (No. 207), the gating pulse signal MF will become '1'. The code signal expresses the program command value xxx in binary. With auxiliary functions, it commands other functions (move instruction, pause, spindle function, etc.), and it also starts the output of the code signal and the execution of other functions.

（3） On the PLC side, read the code signal when the gating pulse signal becomes 1.

（4） If you want to execute accordingly after the commands such as move instruction and pause in the same block are completed, please wait until the assignment completion signal DEN become '1'.

（5） On the PLC side, when an action is executed accordingly, please set the completion signal FIN to '1'. However, the completion signal is used in common in the external functions such as auxiliary function, spindle function, tool function, etc. When these other functions operate at the same time, you will need to set the completion signal FIN to '1' under the condition that all functions have been completed.

（6） When the completion signal remains at '1' for longer than the time TFIN set through parameter (No.208), the CNC will set the gating pulse signal to '0', indicating the fact of having accepted the completion signal.

（7） On the PLC side, please set the completion signal to '0' when the gating pulse signal becomes '0'.

（8） When the completion signal is set to '0', the CNC will set all code signals to '0', and the sequence of auxiliary functions will be all completed.

（9） The CNC will not move to the next block until the other commands are completed for the same block.

The above cases, if to be shown by the time chart, are as follows.

Example 1: Separate instructions
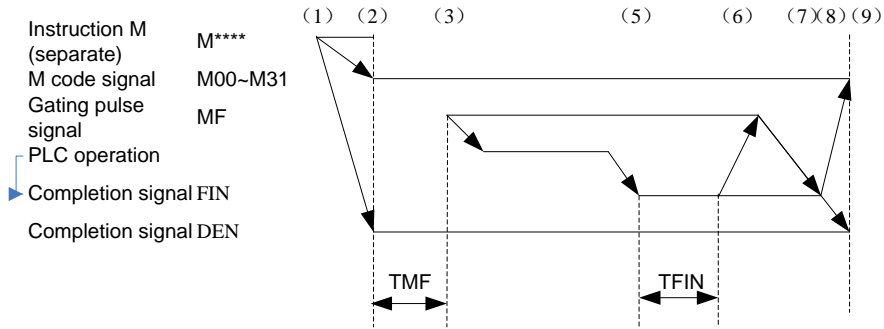
Figure 7-1-1

Example 2: Auxiliary functions and the move instruction at the same block

   a. Auxiliary functions are executed before the completion of the move instruction
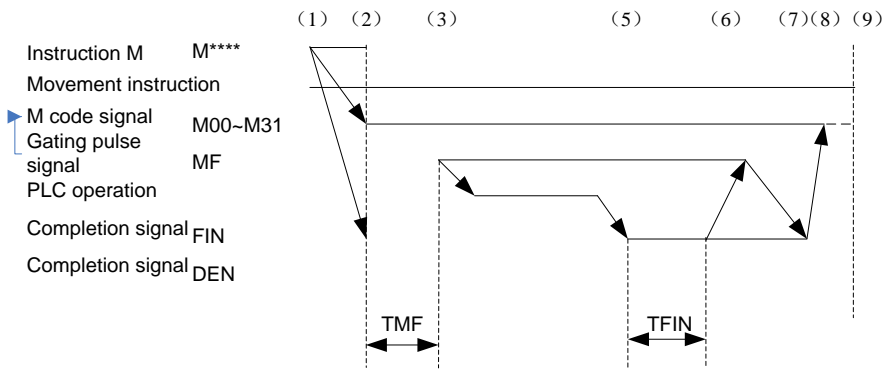
Figure 7-1-2

b. Auxiliary functions are executed after the completion of the move instruction
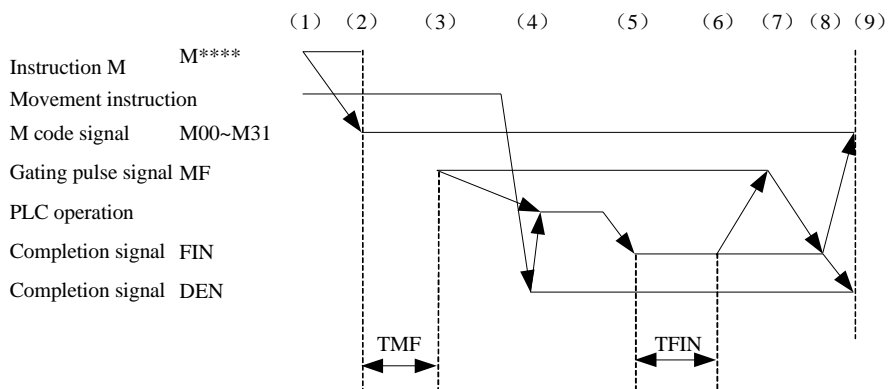
Figure 7-1-3

7.2 Auxiliary functions of code S

Overview When operating Code S, set parameter NO: 1#2 to the I/0 point or analog control.

Basic processing process for the spindle Code S I/0 point control:

Table 7-2-1

Function	Address	Output signal		Answer and end signal
		Address F signal	**Gating signal**	
Auxiliary functions of code S	S*	S* (F22)	SF (F007#2)	FIN(G004#3)

The following are about the auxiliary functions of code S:

(1) Suppose that SX is specified in the program:

X ranges from 1 to 8. If it goes beyond the range, the system will give an alarm. S1~S8 correspond to address F signal F22#0~#7 (To take S1 as an example, S1 corresponds to address F signal F22#0).

(2) If the codes other than M, S, T and the auxiliary functions are specified at the same time, then the auxiliary functions and the other codes will be executed at the same time.

(3) When S1 is executed, set address F signal F22#0 and gating signal F007#2 to 1 and meanwhile make sure that the PLC will set answer signal FIN(G004#3) to 0.

(4) When S1 is completed, set FIN (G004#3) to 1. If the auxiliary functions of codes M, S and T are operating at the same time, the end signal FIN (G004#3) can only be set to 1 after all the functions end.

(5) If codes M, S and T in the same block are executed at the same time, the CNC can only execute the next block after confirming the end signal FIN becomes 1.

Basic processing process for the spindle code S analog control

Table 7-2-2

Function	Address	Output signal		Answer and end signal
		Address F signal	**Gating signal**	
Auxiliary functions of code S	S****	S** (F22#0~ F25#7) (F34#0~#3)	SF (F007#2)	FIN(G004#0)

The following are about the auxiliary functions of code S:

  (1) Suppose that SXXXX is specified in the program: (The status of F34#0~#3 is determined by parameters P246 to 249. The PLC can have gear switching processing through this signal. Set parameter P246 to 1000 and execute S500).

  (2) If the codes other than M, S, T and the auxiliary functions are specified at the same time, then the auxiliary functions and the other codes will be executed at the same time.

  (3) When S500 is executed, set address F signal F34#0 and gating signal F007#2 to 1 and meanwhile make sure that the PLC will set answer signal FIN(G004#3) to 0.

  (4) When the S500 is completed, the PLC will set the end signal FIN (G004#3) to 1. If the auxiliary functions of codes M, S and T are operating at the same time, the end signal FIN (G004#3) can only be set to 1 after all the functions end.

  (5) If codes M, S and T in the same block are executed at the same time, the CNC can only execute the next block after confirming the end signal FIN becomes 1.

  (6) In the auxiliary lock status, execute Code S to change S mode of the the system.

7.3 Auxiliary functions of code T

Overview   Auxiliary functions of code T   Code T and Code M are used together, such as T0603M03;

When operating Code T, the data address (D241) and gating signal will be transferred to the PLC, which will use these signals to enable or disable the functions.

Basic processing process

The signal is used for the following functions:

Table 7-3-1

Function	Address	Output signal		Answer and end signal
		Data address	**gating signal**	
Auxiliary functions of code T	T**	(F026#0～F029#7)	TF (F007#3)	FIN(G004#3)

  (1) Suppose that TXX is specified in the program: (XX will be transferred to data address D241):

  (2) If the codes other than M, S, T and the auxiliary functions are specified at the same time, then the auxiliary functions and the other codes will be executed at the same time.

  (3) When TXX is executed, set gating signal F007#3 to 1 and meanwhile make sure that the PLC will set answer signal FIN(G004#3) to 0.

(4) When this operation is completed, the PLC will set the end signal FIN (G004#3) to 1. If the auxiliary functions of codes M, S and T are operating at the same time, the end signal FIN (G004#3) can only be set to 1 after all the functions end.

(5) If codes M, S and T in the same block are executed at the same time, the CNC can only execute the next block after confirming the end signal FIN becomes 1.

7.4 Auxiliary function gating signal

Auxiliary functions of code M gating signal

MF1 (F007＃0)

[Type]   Output signal

[Function]   These signals indicate the actually specified M function.

Auxiliary functions of code 2M gating signal

MF2 (F008＃4)

[Type]   Output signal

[Function]   These signals indicate the actually specified M function.

Auxiliary functions of code 3M gating signal

MF3 (F008＃5)

[Type]   Output signal

[Function]   These signals indicate the actually specified M function.

[Output Conditions] See "7.1 Auxiliary functions of code M" for the output conditions and the execution process.

Note： The following auxiliary functions will not be output even if instructions are given in the program:

* M98, M99

* Code M that calls a subprogram

* Code M that calls the user macro program

Auxiliary functions of code Sgating signal

S F (F007＃2)

[Type]   Output signal

[Function]   These signals indicate the actually specified spindle speed function.

[Output Conditions] See "7.2 Auxiliary functions of code S" for the output conditions and the execution process.

Auxiliary functions of code Tgating signal

TF (F007＃3)

[Type]   Output signal

[Function]   These signals indicate the actually specified tool function.

[Output Conditions] See "7.3 Auxiliary functions of code T" for the output conditions and the execution process.

Auxiliary function end signal

FIN (G004＃3)

[Type]　Input signal

[Function]　These signals indicate the end of the auxiliary functions of codes M, S, T.

[Operation]　When this signal bit changes from 1- 0-1, see 7.1, 7.2, 7.3 for the operation and processing process of the control unit.

Warning

All of the above functions share FIN (G004 # 3) as the end signal and this signal must be set to 1 after all functions end.

7.5 Auxiliary function latching

Overview　Don't execute the specified M, S, and T functions. That is, the code signal and the gating signal will not be output. The Function is used to detect the program.

Signal　**Auxiliary function latching signal**

AFL (G005＃6)

[Type]　Input signal

[Function]　This signal selects auxiliary function latching. This signal prevents the execution of the specified S and T, and part of the M functions.

[Operation]　When the signal is 1, the functions of the control unit are as follows:

　1. For the automatic operation and the MDI operation, the control unit does not execute the specified M, S and T functions, i.e. the code signal and the gating signal are not output.

　2. After the code signal is output, this signal will be set to 1 and execute normally until the output ends (until the manual FIN signal is reached and the gating signal is set to 0)

　3. Even if this signal is 1, the auxiliary functions M00, M01, M02 and M30 can also be executed. All the code signal, gating signal and decoding signal will be output normally.

　4. Even if this signal is 1, the auxiliary functions M98 and M99 will still be executed normally, but the result will be not output in the control unit.

Warning　Even if this signal is 1, the spindle analog voltage output will still be executed.

Auxiliary function latching detection signal

MAFL (F004＃4)

[Type]　Output signal

[Function]　This signal indicates the status of the auxiliary function latching signal AFL.

[Output Conditions] When this signal is 1, the auxiliary function latching signal AFL is 1.

　　When this signal is 0, the auxiliary function latching signal AFL is 0.

Signal address

	#7	#6	#5	#4	#3	#2	#1	#0
G005		AFL						
F004				MAFL				

Chapter Eight Spindle Speed

8.1 Spindle speed control mode

Overview   The spindle can be divided by its control into gear spindle and analog spindle.

1. In the gear spindle, the CNC controls the spindle speed by converting Code S into the switching signal and outputting to the spindle.

2. In the analog spindle, the CNC controls the spindle speed by converting Code S into the analog quantity and outputting to the spindle.

Set parameter NO: 1#2 into the I/0 point or analog control.

8.1.1 Gear spindle

Overview   A gear spindle means that Code S of the spindle is controlled by the I/O point.

Signal

Spindle speed gating signal

SF (F007＃2)

Gear spindle address signal

F034#0～F034#4

[Type]   Output signal

[Function]   These signals indicate the actually specified spindle speed function.

[Output Conditions] See Spindle Code S I/0 point control in 7.2 Auxiliary Functions of code

S for the output Conditions and the execution process.

Note：   Code S ranges from S0 to S7. If it goes beyond the range, the system will give an alarm. S0～S7 correspond to Address F signal F022#0～F025#7. The standard ladder diagram in the system only have S1, S2, S3 and S4 for reference and S5～S7 are not available. If necessary, the user will need to increase a ladder diagram accordingly.

8.1.2 Analog spindle

Overview   An analog spindle means that the spindle speed is controlled by the analog voltage output by the CNC. The CNC controls the spindle speed by converting Code S into the analog voltage and outputting to the spindle.

The actually output analog voltage is equal to control S value of the spindle multiplied by the spindle override.

Signal   **spindle override coding signal (G030#0~G030#7)**

[Type]Input signal

[Function] The spindle override coding signal spindle override coding detection signal have 3 binary coding signals corresponding to the override:

Therefore, the spindle override can be selected every 10% from 50% to 120%.

When executing the spindle speed control without using the spindle speed override, set the override to 100%.

Note: The spindle speed override function is not active during thread cutting.

Gear shift processing

Although code S represents the spindle speed, the actually controlled object is the spindle motor. Therefore, the CNC needs to determine the corresponding relationship between the spindle motor speed and the gear. As directly selected by Code S, the CNC selects the gear based on the speed range for each gear pre-defined and notify the PLC of the corresponding gears through the gear selection signal (GR4, GR3, GR2, GR1). At the same time, the CNC outputs the spindle motor speed corresponding to the selected gear. With S0~S99999 specified in the MDI operation, the CNC outputs the code corresponding to the spindle speed (GR1, GR2, GR3, GR4, output). You can set 2 or 4 speed gears (GR1, GR2, GR3, GR4) and output the gear selection signal with parameters No. 26 to No249. When there is a change of gear, it will also output the SF signal.

The gear shift signal has the following meanings::

<div align="center">Table 8-1-2-1</div>

Gear	Description
GR1	Gear 1 speed
GR2	Gear 2 speed
GR3	Gear 3 speed
GR4	Gear 4 speed

·When the code voltage is 10V, spindle speed A (parameter no.246) (min^{-1}).

·When the code voltage is 10V, spindle speed B (parameter no.247) (min^{-1}).

·When the code voltage is 10V, spindle speed C (parameter no.248) (min^{-1}).

·When the code voltage is 10V, spindle speed D (parameter no.249) (min^{-1}).

The relationship between Code S instruction and spindle motor speed code voltage (0 ~ 10V) and gear selection signal (GR1, GR2, GR3, GR4) is as shown above:

M-type gear shift
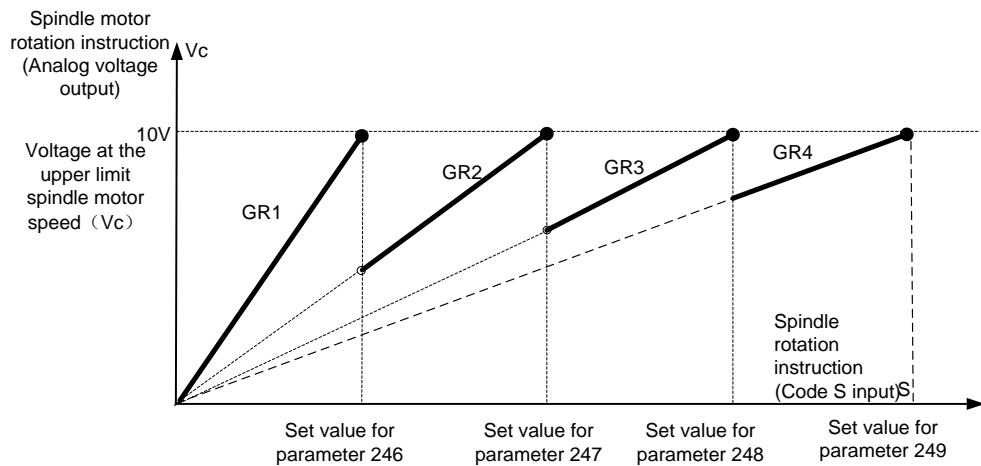
Figure 8-1-2-1

Signal: **Gear selection signal**

GR1, GR2, GR3, GR4 (F034#0～#3)

[Type] Output signal

[Function] These signals notifies the PLC of the the gear selected.

[Output Conditions] See the gear shift mode in the Overview for the explanation of these signals.

Gear selection signal (input)

GR1, GR2, GR3, GR4 (G028#0～#3)

[Type] Input signal

[Function] These signals notifies the PLC of the the gear currently selected.

[Output Conditions] See the gear shift mode in the Overview for the explanation of these signals.

Signal address

	#7	#6	#5	#4	#3	#2	#1	#0
G028					GR4	GR3	GR2	GR1
F007						SF		
F034					GR4	GR3	GR2	GR1

T-type gear shift

When parameter 38#5 is set to 1, the T-type gear shift selected.

The T-type gear shift occurs when a spindle gear is selected through the PLC G signal(G28.0～G28.3) and the corresponding maximum speed is determined through parameter (P246～P249). Based on the transmission ratio of the mechanical part, calculate and set the corresponding parameters. The gear is shifted through the PLC compilation and the gear is instructed through code IO or code M. When a gear is instructed and Code S is executed, then the spindle analog voltage can be calculated based on the maximum speed of the gear.

Table 8-1-2-2

Gear selection signal	G Signal	Gear number	Maximum spindle speed parameter
GR1	G28.0	1	Parameter P246
GR2	G28.1	2	Parameter P247
GR3	G28.2	3	Parameter P248
GR4	G28.3	4	Parameter P249

When signal G is connected by the PLC, the executed Code S will convert the analog voltage accordingly. For example, if P246 is set to 3000 and P247 to 6000, when G28.0 is connected, the system will output 5V analog voltage with S1500 executed; when G2.1 is connected, the system will output 2.5V with S1500 executed.
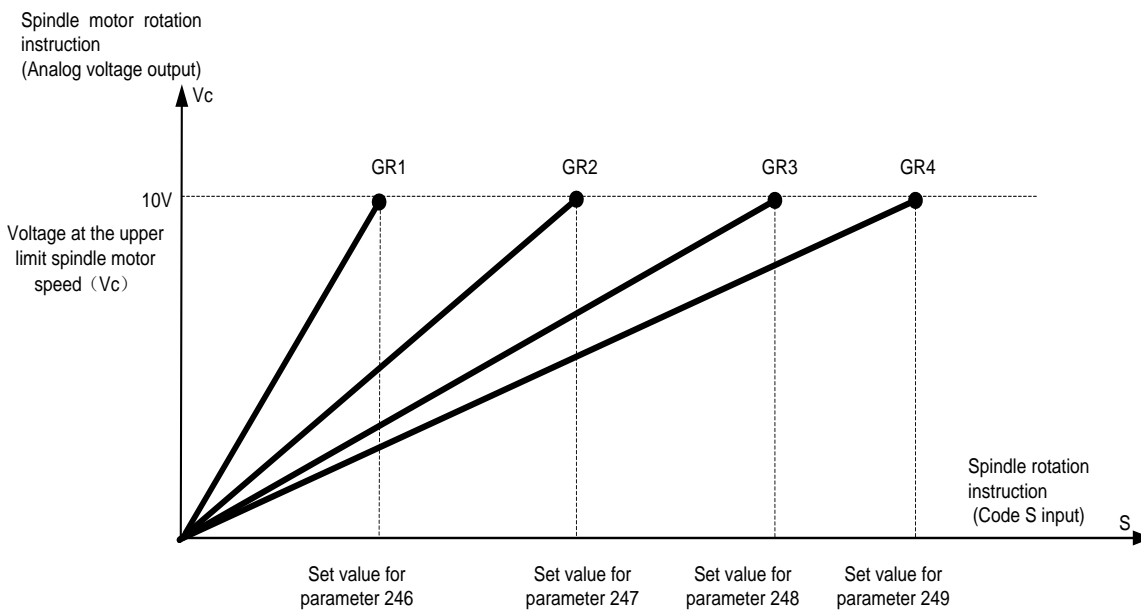
Figure 8-1-2-2

8.2 PMC shaft control

- **Overview**   Set parameters to separate the shaft from the CNC so that it will no longer receive CNC instructions. Then it will receive instruction data from the PLC and execute the specified functions. The PLC shaft will operate independently and will not link with the CNC shaft. The system can control two PLC shafts, generally used for the control of index tables and tool turrets. The control that can be achieved from the PLC shaft includes:

    1. Fast moving
    2. Reference point return
    3. Selection of a mechanical coordinate system

  Note: The PLC shaft control achieves a variety of control through the PLC instructions and the CNC will provide a set of I/O signals for the PLC shaft control.

- **Steps**

    (1)   Set the control shaft that provides the PLC shaft control in P540~P541;

(2)   To control a shaft directly, set the selection signal of the shaft to be controlled EAX1～EAX4 to 1 based on the set group number so that it will be separated from the CNC to become a PLC shaft. Set the minimum PLC shaft control shaft in Parameter P381.

(3)   Specify the PLC shaft to execute the operation. Specify the operation type with the shaft control instruction signal EC0g～EC6g, the shaft control feed rate with the shaft feed rate signal EIF0g～EIF15g, and the movement or other data with the shaft control data signal EID0g ~ EID31g. The end of the above signals and blocks stops the signal from specifying 1 blcok. These signals are together called the shaft control block data signals.

(4)   When the setting data of one block is completed, the current logic of the shaft control instruction signal EBUFg will be reversed. If the current EBUFg is 0, then it will be set to 1; if it is 1, then it will be set to 0. The logic of the shaft control instruction reading completion signal EBSYg and of signal EBUFg must be the same, or it cannot be reversed.

● **Control parameters**

System parameter

0	6	0		PMCA	PMCP				PMCS		

PMCS   =1:   PMC shaft selection is specified by signal G.

=0:   PMC shaft selection is not specified by signal G.

PMCP   =1:   PMC shaft zero return mode selection: one turn signal

=0:   PMC shaft zero return mode selection: no turn signal

PMCA   =1:   PMC shaft non-reference point return instruction mechanical coordinate system selection mode alarm

=0:   No PMC shaft non-reference point return instruction mechanical coordinate system selection mode alarm

Data parameter

0 5 4 0	System shaft number of the PMC shaft control (0:No 1~5: shaft 1 ～ shaft 5)

0 5 4 1	Minimum PMC shaft control data unit (0.0001～360.0)

8.2.1 Signal address

	#7	#6	#5	#4	#3	#2	#1	#0
F130	EBSY			EGEN		EIAL		EINP
F133	EBSY			EGEN		EIAL		EINP
F136	EBSY			EGEN		EIAL		EINP
F139	EBSY			EGEN		EIAL		EINP
F131							MABUF	
F134							MABUF	
F137							MABUF	
F140							MABUF	

8.2.2 Instruction

Table 8-2-2-1

Instr.	Operation	Data 1	Data 2	Description
00	Fast moving	Fast moving speed	Total movement	Same execution as CNC G00
05	Reference point return	------	------	Same execution as the CNC Manual Reference Point Return
32	Machine tool coordinate system selection	Fast moving speed	Mech. coordinates	Same execution as CNC G53

Note: "Instruction" means the shaft control instruction signal EC0g-EC6g.

"Data 1" means shaft control feed rate signal EIF0g-EIF15g.

"Data 2" means the shaft control data signal EID0g-EID31g.

Continuous feed instructions are instant instructions and the CNC side does not cache instructions.

8.2.3 Instruction operation time chart
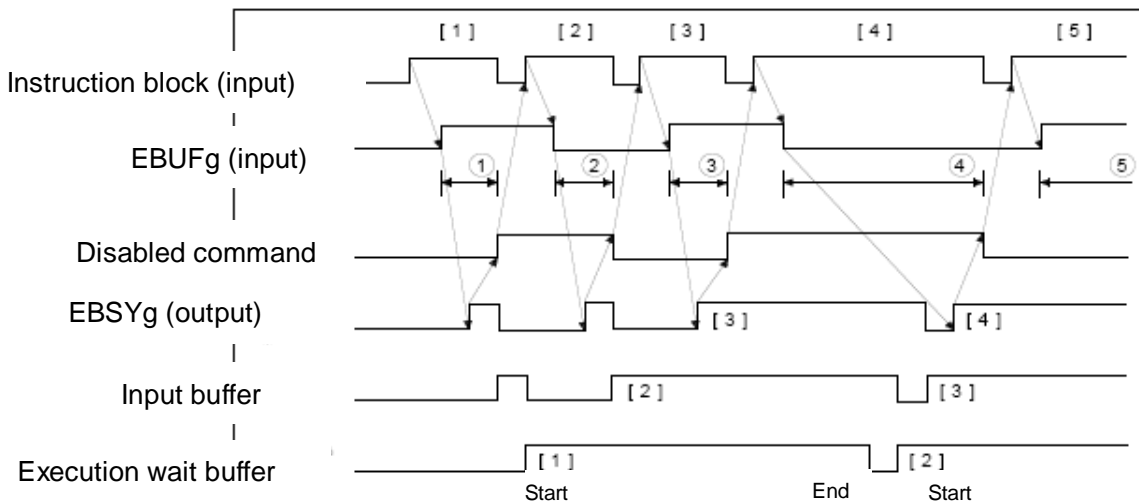
Figure 8-2-3-1

8.2.4 Signal description

g (blank, B) sign shaft 0 or 2PMC.

(1)   PMC shaft selection signal (PMC shaft control)

Signal symbol: EAXg1~ EAXg6 (G136.0~G136.4)

Signal type: PLC →NC

Signal function:

(2)   Shaft control instruction signal (PMC shaft control)

Signal symbol: EC0g～EC6g (G143.0～G143.6,   G155.0～G155.6, G167.0～G167.6
G179.0～ G179.6)

Signal type: PLC →NC

Signal function:

(3)   Control feed rate signal (PMC shaft control)

Signal symbol: EIF0g～EIF15g (G144.0～G145.7, G156.0～G157.7)

Signal type: PLC →NC

Signal function:

(4)   Shaft control data signal (PMC shaft control)

Signal symbol: EID0g～EID31g (G146.0～G149.7, G158.0～G161.7, G170.0～G173.7,
G182.0～G182.7)

Signal type: PLC →NC

Signal function: Specified movement of the binary data which cannot instruct the movement direction.

(5)   Instruction reading control signal (PMC shaft control)

Signal symbol: EBUFg (G142.7, G154.7, G166.7, G178.7)

Signal type: PLC →NC

Signal function: It instructs the CNC to read the instruction data of a block controlled by the PLC shaft.

(6) Shaft control reading completion signal (PMC shaft control)

Signal symbol: EBSYg (F130.7, F133.7, F136.7, F139.7)

Signal type: NC →PLC

Signal function: The CNC notifies that it has read the instruction data of a block controlled by the PLC shaft into the signal in the buffer.

(7) Reset signal

Signal symbol: ECLRg (G142.6 , G154.6. G166.6. G178.6)

Signal type: PLC →NC

Signal function: When the PLC shaft control instruction is reset and this signal is set to "1"

A. If the shaft is moving, it slows down and stops

B. If the shaft is executing suspension, it stops execution

C. When the auxiliary functions are operating, they stop executing and clear all instructions that have been buffered and the control instructions will be inactive when this signal is 1. When the continuous feed (EC0g ~ EC6g: 06h) instruction is specified, set the reset signal ECLRg to 1 and stop the instruction. At this time, the servo motor decelerates to stop, the signal EGENg in the Shaft movement will be set to 0, and the control shaft selection status signal EAXSL will also be set to 0. Please maintain the reset signal ECLRg at 1 before confirming the control shaft selection status signal EAXSL is set to 0. In addition, maintain the reset signal ECLRg at 1 before the signal EGENg in shaft movement is set to 0.

(8) Blcok stop signal

Signal symbol: ESBKg (G142.3. G142.3)

Signal type: PLC →NC block stop invalidation signal symbol: EMSBKg (G143.7, G167.7)

Signal type: PLC →NC

Signal function: It stops each instruction block or forbids such stop. On executing the instruction issued by the PLC, when setting the blcok stop signal ESBKg to 1 and the currently executed block ends, it will stop the shaft control. When setting the block stop signal ESBKg to 0, it will execute the buffered instruction. However, when the instruction block stop forbidding signal EMSBKg is 1, the block stop signal ESBKg will be inactive.

(9) In-position signal

Signal symbol: EINPg (F136.0, F139.0)

Signal type: NC→PLC

Signal function:

It indicates whether the PLC shaft is in position. This signal will be 1 when the shaft controlled by the PLC is in position. When the shaft movement is in the deceleration status, the in-position detection will be performed. The next instruction will not be executed until it is in position.

(10) Alarming signal (PMC shaft control)

Signal symbol: EIALg (F130.2, F133.2, F136.2, F139.2.)

Signal type: NC→PLC

Signal function: It indicates the alarm status associated with the PLC shaft control. This signal will be set to 1 when a servo alarm, overtravel alarm, alarm occurs to the shaft controlled by the PLC. The alarm will be released with the following operation, which will reset the signal ECLRg to 1 and this signal to 0. For the servo alarm, eliminate the cause and reset the CNC. For the overtravel alarm, move the shaft within the storage travel limit and reset the CNC. Such instruction may be fast moving (EC0g～EC6g).

(11)   Shaft moving signal (PMC shaft control)

Signal symbol: EGENg (F130.4, F133.4, F136.4, F139.4)

Signal type: NC→PLC

Signal function: It indicates the movement status of the shaft.

(12)   Zero return end signal

Signal symbol: Reference point return signal completion signal ZP1～ZP5 (F094.0～F094.4)

Signal type: NC→ PLC

Signal function: It is defined the same as the reference point return signal of the PLC shaft and the CNC control shaft. The number at the end indicates the number of the control shaft. This signal will be set to "1" when the reference point return is completed in position. When a servo alarm is given due to removal from the reference point or an emergency stop, this signal will be set to "0".

8.3 Cs contour control mode

Overview   A servo spindle can be positioned and interpolated between other servo shafts or interpolated in line between the spindle and the servo shaft.

The control of the spindle speed over a servo spindle is called the spindle rotation control (to rotate the spindle with the speed instructions); the control of the position over the spindle is called the spindle contour control (to rotate the spindle with the movement instructions). The control of the contour over such spindle is the Cs contour control function.

The spindle rotation control and the Cs contour control are switched depending on the output signal sent by the PLC. The manual and automatic operation of the Cs contour control shaft is the same as that of the usual servo shaft in the Cs contour control mode. (See Function Description 4.1 for the reference point return operation).

8.3.1 Cs contour control shaft settings

The Cs contour control function is active when parameter (No37#7 SCS) = "1". The spindle can be controlled by the Cs contour control. The shaft will be configured as a shaft in the CNC control shaft. The system will takes shaft 5 as the Cs contour shaft and set the CNC control shaft number to 5. It can not be changed.

Part Three Functions

8.3.2 Spindle rotation control/Cs contour control switching

1. Switch from the spindle rotation control mode to the Cs contour control mode: When the Cs Contour control signal CON (G033＃4) is "1", the spindle will become the Cs contour control shaft. When switching to the Cs contour control in the spindle rotation, the spindle will immediately stop and execute the switch.

2. Switch from the Cs contour control mode to the spindle rotation control mode: When the Cs contour control switch signal CON (G033＃4) is "0", the spindle will become the spindle rotation control mode. After confirming that the spindle movement instructions of both the relative automatic operation and the manual operation have been completed, the switch will be executed. When the switch is executed in the spindle movement, an alarm will be given.

8.3.3 Setting of the shaft for the interpolation with the Cs contour control shaft

The servo shaft for the interpolation with the Cs contour control shaft can choose 2 shafts at maost and only the linear interpolation is active.

8.3.4 Reference point return for the Cs contour control shaft

When parameter (No37#5 CsZR) = "0", the reference point return function of the Cs contour control shaft is inactive. After the switch from the spindle rotation control mode to the Cs contour control mode, the CNC will set the current point to zero. (When the GS series spindle servo unit is fitted, the switch of the servo unit from the position mode to the speed mode will need to be set to 0, the servo unit will be directed to the set position. See the GS Series Spindle Servo Unit Manual for the position setting.)

When parameter (No37#5 CsZR) = "1", the reference point return function of the Cs contour control shaft is active.

Operation steps:

    1. Manual operation mode

    After the servo spindle is switched to the Cs contour control mode, when the feed shaft direction selection signal (G100#4) is set to "1" in the reference point return mode, the spindle will start the reference point return operation. After the reference point is positioned, the reference point return signal completion signal ZP5 (F094#4) will be set to "1".

    2. Automatic operation mode

    （1）**Instruction G00**

After the servo spindle is switched to the Cs contour control mode, when instruction G00 is given without any execution of the reference point return operation, the servo spindle will operate the reference point return operation. When G00 is instructed, the servo spindle will return the reference point. After the reference point return ends, the reference point return signal completion signal ZP5 (F094#4) will be set to "1" and position to the instructed position. Instruction G00 with more than one reference point return operations executed will become normal positioning operations.

The difference between the reference point return based on G00 and G28 or the manual reference point return lies in that, the reference point is always positioned in the reference point

return operation based on manual and G28 while in the case of G00, any instruction position can be positioned.

（**2**） **Instruction G28**

When the servo spindle is switched to the Cs contour control mode to instruct G28, after the spindle motor stops, the spindle will be moved to the midpoint. Then, the reference point return operation will be executed and after the reference point is positioned, the reference point return signal completion signal ZP5 (F0946#4) will be set to "1". After the servo spindle is switched to the Cs contour control mode with more than one reference point return operations executed, positioning to the reference point will be executed and ZP5 will be set to "1".

3. **Reference point return interruption**

（1）In the manual operation mode, when the reset, emergency stop, or feed shaft direction selection signals are set to "0", the reference point return operation can be interrupted. The reference point return operation will be re-executed from the beginning.

（2）In the automatic operation mode, the reset, emergency stop, feed hold, etc. signals can be used to interrupt. In any case, the interrupted reference point return operation will be re-executed from the beginning.

8.3.5 Cs contour control shaft operation (automatic/manual)

After switched to the Cs contour control mode and the reference point return executed, it can be operating like a normal servo shaft, but will not operate as a Cs control shaft in the spindle rotation control mode. An alarm will be given in the automatic operation (PS0197).

In addition, with respect to the manual operation of the Cs contour control shaft, please process through the PLC trapezoidal timing so that it will not operate in the spindle rotation mode.

Signal:

CS contour control switching signal CON (G027＃7)

【Type】Input signal

【Function】It instructs the switch of the spindle between the spindle rotation control mode and the Cs contour control mode. It is active when parameter (No37#7) = "1".

Spindle Cs contour control switch completion signal FCSS1 (F042＃6) spindle 1

【Type】Output signal

【Function】 It notifies the spindle that it has switched to the CS contour control mode.

【Output Conditions】 In the following cases, it will be set to "1".

The spindle has not yet become the Cs contour control mode. When parameter (No37#7) = "1", it is active.

Part Three Functions

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Time chart
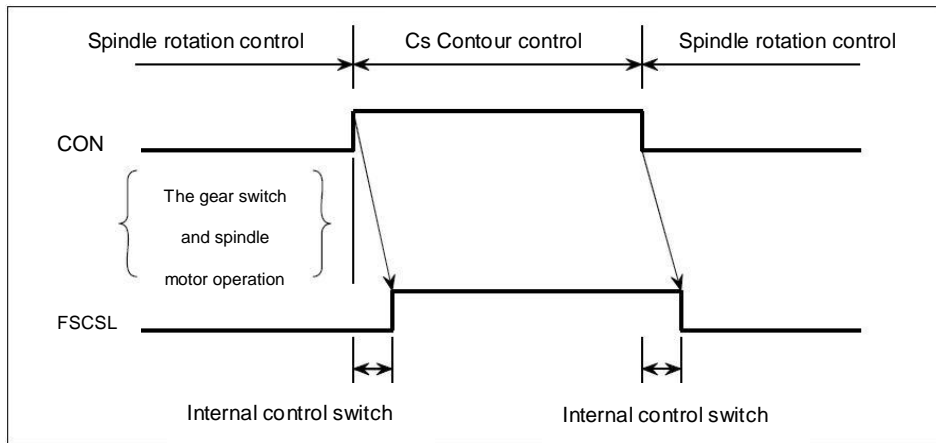
Figure 8-3-5-1

CS contour control related signals

Gear selection signal GR1O, GR2O, GR3O, GR40, (F034#0～F34#3)

【Type】Output signal

【Function】 It instructs the PMC about the gear switching series.

Gear selection signalGR1. GR2,GR3. GR4 (G028#0～G29#3)

【Type】Input signal

【Function】 These signals notify the CNC of the currently selected range of gears

Table 8-3-5-1

M-type gear shift (on the CNC side)				
Gear	Gear selection			
	GR40	GR30	GR20	GR10
1	0	0	0	1
2	0	0	1	0
3	0	1	0	0
4	1	0	0	0

T-type gear shift (on the PLC side)				
Gear	Gear selection			
	GR40	GR30	GR20	GR10
1	0	0	0	1
2	0	0	1	0
3	0	1	0	0
4	1	0	0	0

Cs contour control shaft reference point return signal completion signal ZP5 (F094#4)

[Type**]** Output signal

【Function】It indicates that the reference point return for the Cs contour control shaft has been completed.

ZP []

    []: 1…. Reference point return signal for shaft 1

      2…. Reference point return signal for shaft 2

      3…. Reference point return signal for shaft 3

【Output Conditions】In the Cs contour control mode, when the manual reference point return or the GZ-based automatic reference point return instruction is executed and the Cs contour control shaft is at the reference point, this signal will be set to 1.

Chapter Nine Programming Code

9.1 User macro

Overview   Although the subprogram is useful for repeating the same operation, the user macro function allows the use of variables, arithmetic operation, logical operation, and conditional branch, which is very easy for developing general programs. The machining program can use a simple code and call the user macro program like calling a subprogram.


```
O0001 Name of the main program
N10  G50  X100  Z100;
N20  G00  U50  F100;
N30  G01  U0.8;
N40  M61;
N50  G0  X100  Z100;
```

```
Subprogram (user-defined M61)
O9064;
N10  G65  P#1104 Q1;
G65  H82  P20  Q#1004  R1;
............
G65  H01  P#1001  Q0;
M99  P50;
```
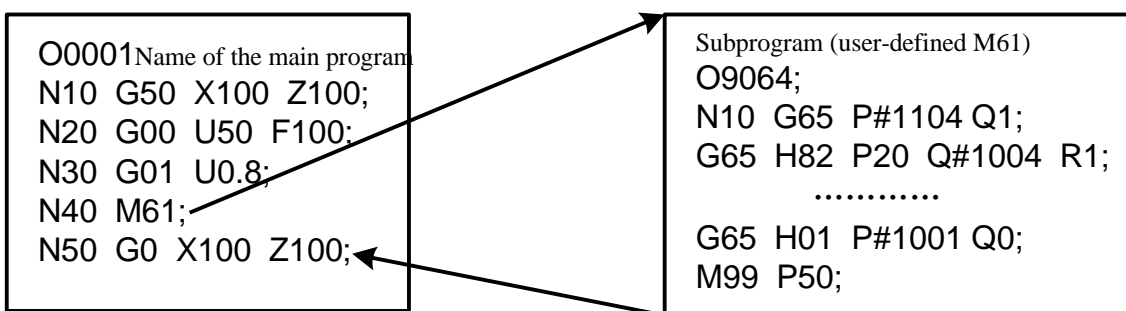
Figure 9-1-1

This means that a function that is programmed with a macro program can be a generic function. That is, a program can be written with data variables (variable data or unknown data). For example, user macro can be used for the group process.

Signal   **User macro input signal**

    UI000~UI015 (G054. G055)

    [Type]   Input signal

    [Function]   It does not provide any function to the control unit. These signals are read as a system variable by a macro program and used as the interface between the macro and the PLC.

The system variables corresponding to these signals are as follows:

Table 9-1-1

Signal	Address	Variable
UI000	G54#0	#1000
UI001	G54#1	#1001
UI002	G54#2	#1002
UI003	G54#3	#1003
UI004	G54#4	#1004
UI005	G54#5	#1005
UI006	G54#6	#1006
UI007	G54#7	#1007
UI008	G55#0	#1008
UI009	G55#1	#1009
UI010	G55#2	#1010
UI011	G55#3	#1011
Signal	**Address**	**Variable**
UI012	G55#4	#1012
UI013	G55#5	#1013
UI014	G55#6	#1014
UI015	G55#7	#1015
UI000~UI015	G54. G55	#1032

Note: # 1032, as 16-bit variables, has the following composition:

Signal address

	#7	#6	#5	#4	#3	#2	#1	#0
#1032	U1007	U1006	U1005	U1004	U1003	U1002	U1001	U1000
#1032	U1015	U1014	U1013	U1012	U1011	U1010	U1009	U1008

User macro input signal
UO000～UO015
(F054～F055)
[Type]   Output signal

[Function]   It does not provide any function to the control unit. These signals are read as a system variable by a macro program and used as the interface between the macro and the PLC.

The system variables corresponding to these signals are as follows:

Table 9-1-2

Signal	Address	Variable
UO000	F54#0	#1100
UO001	F54#1	#1101
UO002	F54#2	#1102
UO003	F54#3	#1103
UO004	F54#4	#1104
UO005	F54#5	#1105
UO006	F54#6	#1106
UO007	F54#7	#1107
UO008	F55#0	#1108
UO009	F55#1	#1109
UO010	F55#2	#1110
UO011	F55#3	#1111
UO012	F55#4	#1112
UO013	F55#5	#1113
UO014	F55#6	#1114
UO015	F55#7	#1115
UO000~UO015	F54,F55	#1132

Note: # 1032, as 16-bit variables, has the following composition:

	#7	#6	#5	#4	#3	#2	#1	#0
#1132	UO007	UO006	UO005	UO004	UO003	UO002	UO001	UO000

	#7	#6	#5	#4	#3	#2	#1	#0
#1132	U1015	U1014	U1013	U1012	U1011	U1010	U1009	UO008

Chapter Ten Display/Setting

10.1 Clock function

Overview   The date and time will be displayed in the soft key screen 【CNC Settings】: year, month, day, hour, minute and second.

(Note: The clock can only be set on this screen.)

10.2 Alarm history and operation history

Overview   The alarm interface can display the internal or external user alarm information that the system is currently experiencing.

The alarm history interface can display the system now and before the alarm information has occurred.

The operation history interface can display the history record of the operator to modify the system parameters.

10.3 Help function

Overview   The help function can display detailed information about the alarms and CNC operations that appear on the screen:

System information, system operation, code G, parameter table, macro instruction, PLC address.

The alarm table can display all the alarms of the system and their solutions.

The calculator function can help the operator calculate the data.

Part Three Functions

Chapter Eleven Measurement

Overview The shaft movement can be specified after code G31 just like G01, which can be interpolated linearly. If an external skip signal is input during the execution of this command, then the execution of the command will be interrupted and the execution of the next block will be executed.

When the end of the measurement is not programmed, but it ends with the signal instruction machining by the machine tool ends, the skip function will be used. For example, during the turning. The skip function can also be used to measure the size of workpieces.

The coordinate values when the skip signal is turned on can be used in the user macro program because they are stored in the system variables #5016～#5019 of the user macro program as follows:

#5016 End point of shaft X block

#5017 End point of shaft Y block

#5018 End point of shaft Z block

#5019 End point of shaft 4 block

Signal **Skip signal**

SKIP (G001#1)

[Type] Input signal

[Function] This signal ends the skip cutting. That is, in a block containing G31, the position where the skip signal is set to "1" will be stored in the user macro variable. At the same time, it ends the movement code of the block.

[Operation] When the skip signal is set to "1", the controlled device operates as follows:

● When the block includes skip code processing code G31, the control device reads and stores the current position of the code shaft when this signal is 1. The control device ends the movement of the shaft and then clears the remaining moving distance of the code shaft.

The skip signal is monitored of its status other than its rising edge. So, if the skip signal continues to be "1", when the next skip cutting is instructed, it will be deemed as having been immediately met its skip conditions.

Note: The skip signal should have a width of at least 10ms.

Signal address

	#7	#6	#5	#4	#3	#2	#1	#0
G001							SKIP	

Chapter Twelve Panel Latching Settings

Signal   **Program editing lock signal**

LEDT (G046#3)

[Type]   Input signal

[Function]   This signal locks the program editing function.

[Operation]   When the signal is set to 1, the program editing function is inactive and the program can not be edited.

When the signal is set to 0, the program editing function is active.

Signal address

	#7	#6	#5	#4	#3	#2	#1	#0
G016					LEDT			

Appendix 1 Address between the PLC and the CNC

1: CNC→PLC address: F000 ----- F205

Appendix 1

Signal	Symbol	Address
Rewinding signal	RWD	F000#0
Automatic operation stopping signal	SPL	F000#4
automatic operation starting signal	STL	F000#5
Servo readiness signal	SA	F000#6
Automatically operating signal	OP	F000#7
Alarming signal	AL	F001#0
Resetting signal	RST	F001#1
Assignment end signal	DEN	F001#3
Spindle enabling signal	ENB	F001#4
Tapping signal	TAP	F001#5
Ready signal	MA	F001#7
British Input signal	INCH	F002#0
Fast moving signal	RPDO	F002#1
Constant cycle speed signal	CSS	F002#2
Thread cutting signal	THRD	F002#3
Cutting feed signal	CUT	F002#6
Dry running confirmation signal	MDRN	F002#7
Incremental feed selection confirmation signal	MINC	F003#0
Manual driving control pulse feed selection confirmation signal	MH	F003#1
JOG feed selection confirmation signal	MJ	F003#2
Manual data input selection confirmation signal	MMDI	F003#3
Automatic operation selection confirmation signal	MMEM	F003#5
Memory edit selection confirmation signal	MEDT	F003#6
Optional block skip acknowledgment signal	MBDT1	F004#0
All shafts machine latching confirmation signal	MMLK	F004#1
Manual absolute confirmation signal	MABSM	F004#2
Single block confirmation signal	MSBK	F004#3
Auxiliary function latching confirmation	MAFL	F004#4

Signal	Symbol	Address
signal		
Manual Reference Point Return Selection confirmation signal	MREF	F004#5
MDI-based reset confirmation signal	MDIRST	F006#1
Driving manual pulse trial cut status signal	RHPG	F006#3
Ongoing syntax detection signal	SCHK	F006#4
System model selection	CNCS	F006#5
Driving manual pulse interruption starting signal	HSIL	F006#7
Auxiliary function gating pulse signal	MF	F007#0
spindle function gating pulse signal	SF	F007#2
tool function gating pulse signal	TF	F007#3
M2~M3 function gating pulse signal	MF2 , MF3	F008#4~#5
M decoding signal	DM99 ~DM98 DM30 , DM00~DM02	F009#2~#3 F009#4~#7
Auxiliary functional code signal	M00~M31	F010#0~F13#7
M2 functional code signal	M200~M215	F014#0~F15.#7
M3 functional code signal	M300~M315	F016#0~F017#7
spindle functional code signal	S00~S31	F022#0~F025#7
T functional code signal	T00~T31	F026#0~F029#7
Gear selection signal (output)	GR1O~GR4O	F034#0~F034#3
Spindle change detection alarm signal	SPAL	F035#0
S12-digit code signal	R01O~ R12O	F036#0~F037#3
Spindle clamping signal	SCLPA	F038#0
Spindle release Signal	SUCLPA	F038#1
Spindle enabling signal	ENB2	F038#2
Spindle positioning signal	MSPOSA	F039#0
Actual spindle speed Signal	AR00~AR15	F040#0~F41#7
Cs contour control switch completion signal	FCSS1~FCSS2	F042#0~#1
Output signal for the user macro program	UO000~UO131	F054#0~F059#7
Reading completion signal for external data input	EREND	F060#0
Retrieval completion signal for external data input	ESEND	F060#1
Retrieval cancellation signal for external data input	ESCAN	F060#2
Required number of parts reaching signal	PRTSF	F062#7
Polygon master shaft non-reaching signal	PSE1	F063#0

Signal	Symbol	Address
Polygon sync shaft non-reaching signal	PSE2	F063#1
Polygon spindle speed reaching signal	PSAR	F063#2
Inter-path spindle instruction confirmation signal	COSP1 ~COSP2	F063#3~#4
Waiting signal	WATO	F063#6
Polygon synchronizing signal	PSYN	F063#7
Tool change signal	TLCH	F064#0
New tool selection signal	TLNW	F064#1
One-by-one toll replacement signal	TLCHI	F064#2
Tool life warning signal	TLCHB	F064#3
Spindle rotation direction signal	RGSPP ,RGSPM	F065#0~#1
Spindle synchronous speed ratio control clamp signal	RSMAX	F065#2
Rollback completion signal	RTRCTF	F065#4
Tapping return completion signal	RTPT	F066#1
Processing start point signal	RTNMVS	F066#3
Position switch signal	PSW01~PSW15	F070#0~F071#7
Output signal for the Code P macro program	EUO00~EUO15	F084#0~F085#7
Shaft 1 release signal	UCLP1~UCLP5	F086#0~#4
Shaft 1 clamping signal	CLP1~CLP5	F088#0~#4
Reverse moving signal	MRVMD	F091#0
Steering prohibiting signal	MNCHG	F091#1
Reverse movement prohibition signal	MRVSP	F091#2
Checking signal	MMMOD	F091#3
Tool life count invalidation signal	LFCIF	F093#2
Shaft 1~Shaft 5 reference point return signal completion signal	ZP1~ZP5	F094#0~#4
Shaft 1~Shaft 5 reference point 2 return signal completion signal	ZP21~ZP25	F096#0~#4
Shaft 1~Shaft 5 reference point 3 return signal completion signal	ZP31~ZP35	F098#0~#4
Shaft 1~Shaft 5reference point 4 return signal completion signal	ZP41~ZP45	F100#0~#4
Shaft 1~Shaft 5 moving signal	MV1~MV5	F102#0~#4
Shaft 1~Shaft 5 in-position signal	INP1 ~INP5	F104#0~#4
Shaft 1~Shaft 5 movement direction signal	MVD1~MVD5	F106#0~#4
Shaft 1~Shaft 5 mirror confirmation signal	MMI1~MMI5	F108#0~#4
Shaft 1~Shaft 5 control shaft removing	MDTCH1~MDTCH5	F110#0~#4

Signal	Symbol	Address
signal		
Shaft 1~Shaft 5 assignment completion signal (PMC shaft control)	EADEN1~EADEN5	F112#0~#4
Shaft 1~Shaft 5torque limit reaching signal	TRQL1~TRQL5	F114#0~#4
Shaft 1~Shaft 5 workpiece origin return end signal	PRZP1~ PRZP5	F116#0~#4
Shaft 1~Shaft 5reference point establishment signal	ZRF1~ZRF5	F120#0~#4
Shaft 1~Shaft 5 forward overtravel alarming signal	+OT1 ~ +OT5	F124#0~#4
Shaft 1 reverse overtravel Alarming signal	-OT1 ~ -OT5	F126#0~#4
Override 0% signal (PMC shaft control)	EOV0	F129#5
Control shaft selection status signal (PMC shaft control)	*EAXSL	F129#7
In-position signal (PMC shaft control)	EINPA	F130#0, F133#0 F136#, F139#0
Cumulative zero detection signal (PMC shaft control)	ECKZA	F130#1, F133#1 F136#1, F139#1
Alarming signal (PMC shaft control)	EIALA	F130#2, F133#2 F136#2, F139#2
Auxiliary function executing signal (PMC shaft control)	EDENA	F130#3, F133#3 F136#3, F139#3
Shaft moving signal (PMC shaft control)	EGENA	F130#4, F133#4 F136#4, F139#4
Overtravel forward direction (PMC shaft control)	EOTPA	F130#5, F133#5 F136#5, F139#5
Overtravel reverse direction (PMC shaft control)	EOTNA	F130#6, F133#6 F136#6, F139#6
Shaft control instruction reading completion signal (PMC shaft control)	EBSYA	F130#7, F133#7 F136#7, F139#7
Auxiliary function gating pulse signal (PMC shaft control)	EMFA	F131#0, F134#0 F137#0, F140#0
Full buffer Signal (PMC shaft control)	EABUFA	F131#1, F134#1 F137#1, F140#1
Auxiliary function gating pulse signal 2 (PMC shaft control)	EMF2A	F131#2, F134#2 F137#2, F139#2
Auxiliary function gating pulse signal 3 (PMC shaft control)	EMF3A	F131#3, F134#3 F137#3, F139#3
Auxiliary functional code signal (PMC shaft control)	EM11A , EM12A EM14A, EM18A	F132#0~#7 F135#0~#7

Signal	Symbol	Address
	EM21A, EM22A	F138#0~#7
	EM24A, EM28A	F141#0~#7
	EM11B , EM12B	F151#0~#7
	EM14B, EM18B	
	EM21B, EM22B	
	EM24B, EM28B	
	EM11C , EM12C	
	EM14C, EM18C	
	EM21C, EM22C	
	EM24C, EM28C	
	EM11D, EM12D	
	EM14D, EM18D	
	EM21D, EM22D	
	EM24D, EM28D	
	EM31D, EM32D	
	EM34D, EM38D	
	EM41D, EM42D	
	EM44D, EM48D	
Multi-spindle address P signal	MSP00~MSP17	F160#0~F161#7
System control shaft number binary signal	AXIS1 ,AXIS2 AXIS4. AXIS8	F171#0~F171#3
Hard limit ignore	LALM	F172#1
Emergency stop ignore signal	EALM	F172#2
Shaft 1~Shaft 5 controlling signal (PMC shaft control)	EACNT1~EACNT5	F182#0~#4
S 12-digit code signal	R01O2~R12O2. R01O3 ~R12O3	F200#0~F201#3 F204#0~F205#3
Actual spindle speed signal	AR002~AR152	F202#0~F203#7

2: PLC→CNC address: G000 ----- G205

Appendix 2

Signal	Symbol	Address
Data signal for external data input	ED00~ED15	G000#0~G001#7
Address signal for external data input	EA0 ~EA6	G002#0~#6
Reading signal for external data input	ESTB	G002#7
Completion signal	FIN	G004#3
M2 function completion signal	MFIN2	G004#4
M3 function completion signal	MFIN3	G004#5
M function completion signal	MFIN	G005#0
S function completion signal	SFIN	G005#2
T function completion signal	TFIN	G005#3
Auxiliary function latching signal	AFL	G005#6
Override cancellation signal	OVC	G006#4
Skip signal	SKIPP	G006#6
Automatic operation start signal	ST	G007#2
All shaft interlocking signal	*IT	G008#0
Cutting block interlocking start signal	*CSL	G008#1
Block interlocking start signal	*BSL	G008#3
Emergency stop signal	*ESP	G008#4
Automatic operation stop signal	*SP	G008#5
Reset & rewinding signal	RRW	G008#6
External reset signal	ERS	G008#7
External part number retrieval signal	PN1, PN2 PN4, PN8	G009#0~#4
Manual feed rate override signal	*JV00~*JV15	G010#0~G011#7
Feed rate override signal	*FV0~*FV7	G012#0~#7
Fast moving override signal	ROV1,VOV2,ROV4	G014#0~#2
F1feed selection signal	F1D	G016#7
No 1 manual control driving manual pulse feed shaft selection signal	HS1A~HS1D	G018#0~#3
Manual control driving manual pulse feed movement selection signal (incremental feed signal)	MP1, MP2. MP4	G019#4~#6
Manual fast moving selection signal	RT	G019#7
Extended external part number retrieval number	EPN00 ~EPN13	G024#0~G025#5
Spindle forward	SFR1, SFR2, SFR3	G026#2. #4. #6
Spindle reverse	SRV1 ,SRV2,SRV3	G026#3. #5. #7
spindle selection signal	SWS1~SWS3	G027#0~#2
Each spindle stop signal	*SSTP1~*SSTP3	G027#3~#5
Cs contour control switching signal	CON, CONS1	G027#7,G033#4
Gear selection signal (input)	GR1~GR4	G028#0~#3,

Signal	Symbol	Address
	GR21~GR24	029#0~3
Speed reaching signal	SAR	G029#4
Spindle orientation signal	SOR	G029#5
Spindle stop signal	*SSTP	G029#6
Spindle speed override signal	SOV0~SOV7	G030#0~#7
Spindle 2 ~ spindle 4 speed override signal	SOV20~ SOV22	G031#0~#2
spindle motor speed instruction signal	R01I ~R12I R01I2~R12I2	G032#0~G033#3 G034#0~G035#3
Spindle motor instruction output polarity signal	SGN ,SGN2	G033#5,G035#5
Spindle motor instruction polarity selection signal	SSIN ,SSIN2	G033#6,G035#6
Spindle motor speed instruction selection signal	SIND SIND2	G033#7,G035#7
Tool compensation number selection signal	OFN0～OFN 5	G039#0~#5
Workpiece origin compensation measurement mode selection signal	WOQSM	G039#6
Tool compensation measurement mode selection signal	GOQSM	G039#7
Tool compensation number selection signal	OFN6 ~OFN9	G040#0~#3
Position record signal	PRC	G040#6
Workpiece coordinate system offset writing signal	WOSET	G040#7
Manual control driving manual pulse shaft selection interruption signal	HS1IA ~HS1ID	G041#0~#3
Mode selection signal	MD1~MD4	G043#0~#2
Incremental FeedMode Selection Signal	INC	G043#3
Driving manual pulsetrial cut mode selection signal	TEACH	G043#4
Program zero return mode selection signal	PRGZ	G043#6
Manual reference point return selection signal	ZRN	G043#7
Optional block skip signal	BDT1	G044#0
Machine tool latching signal	MLK	G044#1
Memory protection signal	KEYP	G046#0
Single block signal	SBK	G046#1
Memory protection signal	KEY1~KEY4	G046#3~#6
Dry dunning signal	DRN	G046#7
Tool group number selection signal	TL1 ,TL2,TL4,TL8 TL16,TL32,TL64, TL128	G047#0~#7
Tool life count invalidation signal	LFCIV	G048#2
Tool skip signal	TLSKP	G048#5

Signal	Symbol	Address
One-by-one toll replacement Reset signal	TLRSTI	G048#6
Tool change reset signal	TLRST	G048#7
Tool life count override signal	*TLV0 ~*TLV9	G049#0~G051#1
Input signal for the user macro program	UI000~UI15	G054#0~G055#7
External reading start signal	EXRD	G058#1
External reading/output stop signal	EXSTP	G058#2
External output start signal	EXWT	G058#3
Chuck status signal	CHUCK	G060#0
Tail frame barrier selection signal	*TSB	G060#7
Rigid tapping signal	RGTAP	G061#0
Rigid tapping spindle selection signal	RGTSP1	G061#4~#5
Tapping return start signal	RTNT	G062#6
Simple spindle synchronization control	ESRSYC	G064#6
Rollback Signal	RTRCT	G066#5
Shaft 1~Shaft 5 release completion signal	EULP1~EULP5	G086#0~#4
Shaft 1~Shaft 5 clamping completion signal	ECLP1~ECLP5	G088#0~#4
Shaft 1~Shaft 5 feed shaft forward direction selection signal	+J1~+J5	G100#0~#4
Shaft 1~Shaft 5 feed shaft reverse direction selection signal	-J1~-J5	G102#0~#4
Shaft 1~Shaft 5 mirror signal	MI1~MI5	G106#0~#4
Shaft 1 forward external decelerating signal	*+ED3~*+ED35	G107#0~#4
Shaft 1~Shaft 5 machine tool latching signal	MLK1~MLK5	G108#0~#4
Shaft 1~Shaft 5 forward travel limit external setting signal	+LM1~+L5	G110#0~#4
Shaft 1~Shaft 5 reverse travel limit external setting signal	-LM1~-LM5	G112#0~#4
Shaft 1~Shaft 5 forward overtravel signal	*+L1~*+L5	G114#0~#4
Shaft 1~Shaft 5 reverse overtravel signal	*-L1~ *-L5	G116#0~#4
Shaft 1~Shaft 5 servo off signal	SVF1~SVF5	G126#0~#4
Shaft 1~Shaft 5 shaft interlocking signal	*IT1~*IT5	G130#0~#4
Shaft 1~Shaft 5control shaft selection signal (PMC shaft control)	EAX1~ EAX5	G136#0~#4
Auxiliary function completion signal for group 1~ group 4 (PMC shaft control)	EFINA	G142#0,G154#0 G166#0,G178#0
Accumulated zero detection signal for group 1~ group 4 (PMC shaft control)	ELCKZA	G142#1,G154#1 G166#1,G178#1
Buffering prohibition signal for group 1~ group 4 (PMC shaft control)	EMBUFA	G142#2,G154#2 G166#2,G178#2
Blcok stop signal for group 1~ group 4 (PMC	ESBKA	G142#3,G154#3

Signal	Symbol	Address
shaft control)		G166#3,G178#3
Servo off signal for group 1~ group 4(PMC shaft control)	ESOFA	G142#4,G154#4 G166#4,G178#4
Shaft control temporary stop signal for group 1~ group 4 (PMC shaft control)	ESTPA	G142#5,G154#5 G166#5,G178#5
Reset signal for group 1~ group 4 (PMC shaft control)	ECLRA	G142#6,G154#6 G166#6,G178#6
Shaft control instruction reading signal for group 1~ group 4 (PMC shaft control)	EBUFA	G142#7,G154#7 G166#7,G178#7
Shaft control instruction signal for group 1 (PMC shaft control)	EC0A ~EC6A	G143#0~G143#6
Block stop prohibition signal for group 1~ group 4 (PMC shaft control)	EMSBKA	G143#7,G155#7 G167#7,G179
Shaft control feed rate signal for group 1 (PMC shaft control)	EIF00A ~EIF15A	G144#0~G145#7
Shaft control data signal for group 1 (PMC shaft control)	EID00A~EID31A	G146#0~G149#7
Fast moving override signal (PMC shaft control)	EROV1 ~EROV2	G150#0~#1
Override cancellation signal for group 1 (PMC Shaft control)	EOVC	G150#5
Manual fast moving selection signal (PMC shaft control)	ERT	G150#6
Dry dunning signal (PMC shaft control)	EDRN	G150#7
Feed rate override signal for group 1 (PMC shaft control)	*EFOV0~*EFOV7	G151#0~#7
Shaft control instruction signal for group 2 (PMC shaft control)	EC0B~ECB6	G155#0~#6
Shaft control feed rate signal for group 2 (PMC shaft control)	EIF00B~EIF15B	G156#0~G157#7
Shaft control data signal for group 2 (PMC shaft control)	EID00B~EID31B	G158#0~G161#7
Override cancellation signal for group 2 (PMC shaft control)	EOVCB	G162#5
Feed rate override signal for group 2 (PMC shaft control)	*EFOV0B~EFOV7B	G163#0~#7
Shaft control instruction signal for group 3 (PMC shaft control)	EC0C~EC6C	G167#0~#6
Shaft control feed rate signal for group 3 (PMC shaft control)	EIF00C ~EIF15C	G168#0~G169#7
Shaft control data signal for group 3 (PMC shaft control)	EID00C~EID31C	G170#0~G173#7
Override cancellation signal for group 3	EOVCC	G174#5

Signal	Symbol	Address
(PMC shaft control)		
Feed rate override signal for group 3 (PMC shaft control)	*EFOV0C~*EFOV7C	G175#0~#7
Shaft control instruction signal for group 4 (PMC shaft control)	EC0D~EC6D	G179#0~#6
Shaft control feed rate signal for group 4 (PMC shaft control)	EIF00D~EIF15D	G180#0~G181#7
shaft control data signal for group 4 (PMC shaft control)	EID00D~EID31D	G182#0~G185#7
Override cancellation signal for group 4 (PMC shaft control)	EOVCD	G186#5
Feed rate override signal for group 4 (PMC shaft control)	*EFOV0D~*EFOV7D	G187#0~#7
Deceleration signal for shaft 1~shaft 5 reference point return	*DEC1~ *DEC5	G196#0~#4
Manual control driving manual pulse feed generator selection signal	IOLBH1 ~IOLBH2	G199#0~#1

Part Four Installation and Connection

Chapter One System Structure and Installation

1.1 System composition

GSK980TDHi CNC system is mainly composed of the following parts, as shown in Figure 1-1.
  (1) GSK980TDHi CNC system
  (2) Additional operation panel (optional)
  (3) Digital AC servo drive unit
  (4) Servo motor
  (5) AC transformer
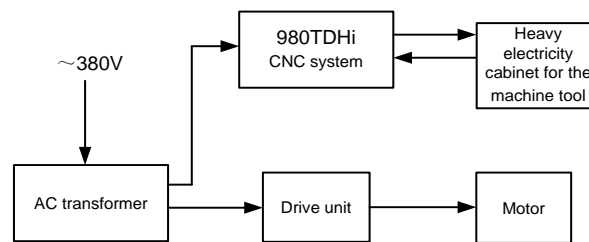
Figure 1-1

1.2 System installation and connection

First, check whether the CNC system, drive unit, motor, photoelectric encoder and other components to be installed are complete, sound and matching.

The CNC system must be securely installed and provided with some room around to ensure that the system heat can be distributed. It should be installed in a place where it is easy to operate and can avoid the processing iron and cooling solution.

The heavy current and the light current should be separated. The power supply for the CNC system and the drive unit should be provided by an isolating transformer, separated from the heavy current for the machine tool. All signal lines should be kept away from the AC contactor to minimize interference. The power supply must be strictly grounded.

Plug all plugs firmly, tighten the screws, and it is prohibited to pull the signal line connector when the system is powered on.

When installing the CNC system, make sure that the system panel will not be scratched by hard objects, sharp tools, etc. If to paint, remove the CNC system to avoid dirtying the system panel.

The CNC system should have no heavy current or strong magnetic interference sources and be away from flammable, explosive materials and other dangerous goods as far as possible.

Part Four Installation and Connection

1.3 CNC system shape and installation dimensions
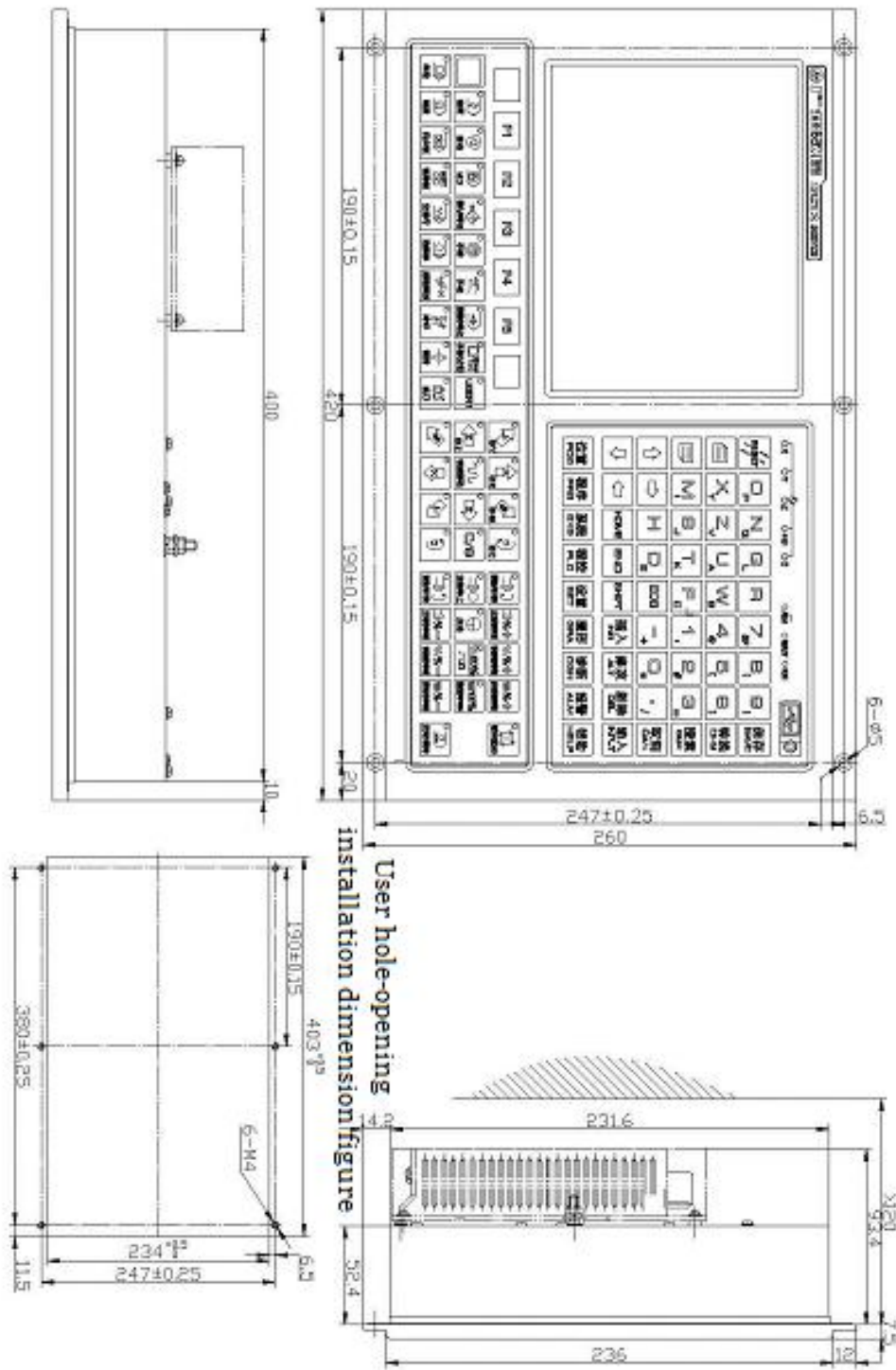
Figure 1-3-1 GSK980TDHi system installation dimensions

Figure 1-3-2 GSK980TDHi-V system installation dimensions

1.4 Additional panel drawings

980TDHi system can be provided with an additional panel by the customer. The following are the additional panels for GSK980TDHi and GSK980TDHi-V:

- **Additional panel AP01 (for 980TDHi, assembled below)**
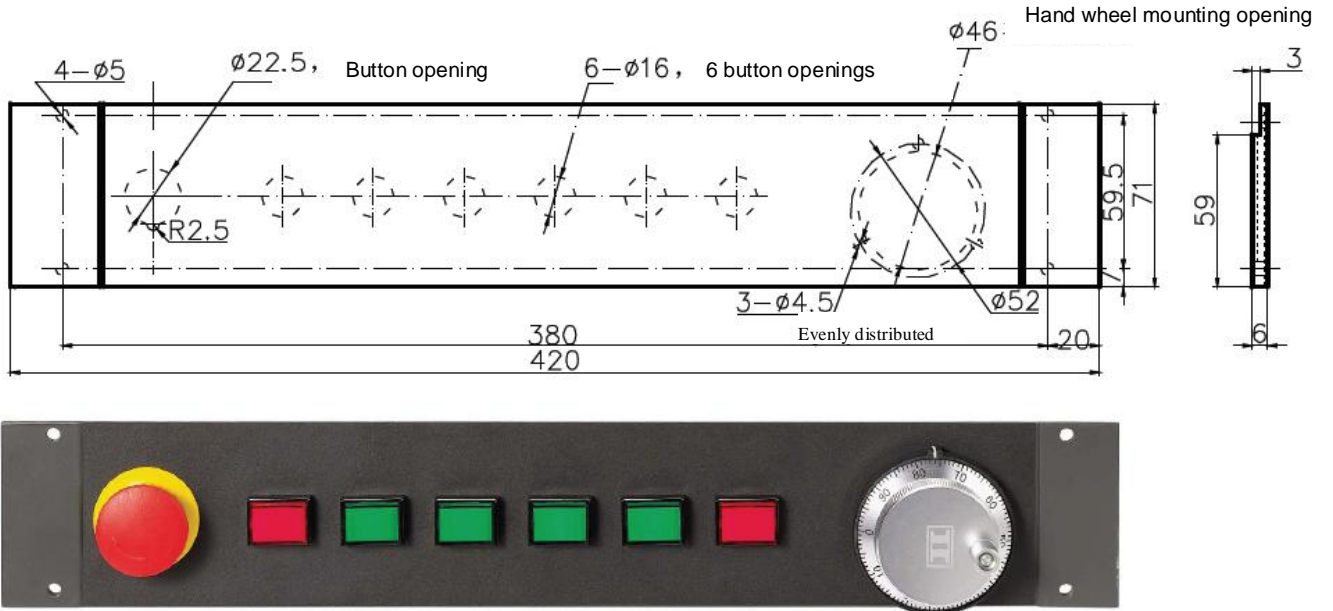
Figure 1-4-1 GSK 980TDHi additional panel AP01 installation dimensions

Part Four Installation and Connection

● **Additional panel AP02 (for 980TDHi, side assembled)**
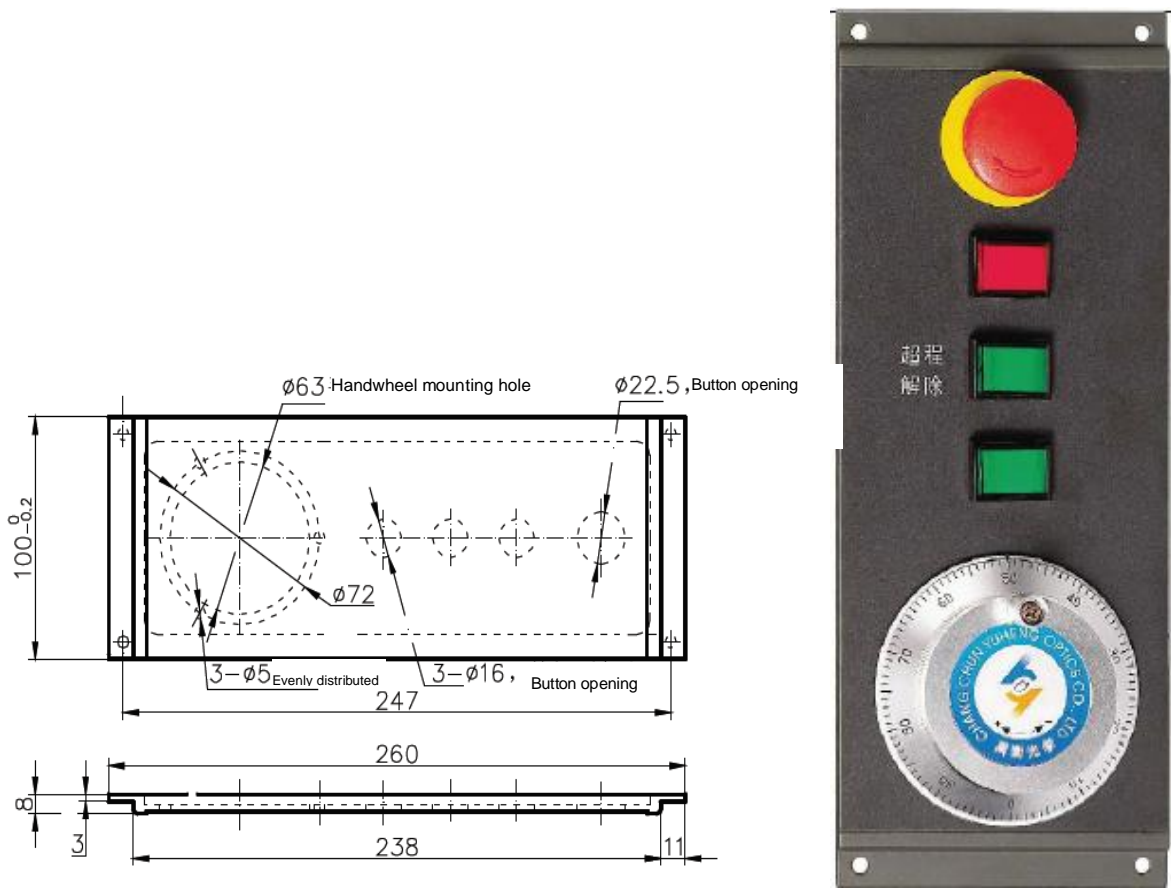
Figure 1-4-2 GSK 980TDHi additional panel AP02 and installation dimensions

● **Additional panel AP03 (for 980TDHi-V, assembled below)**
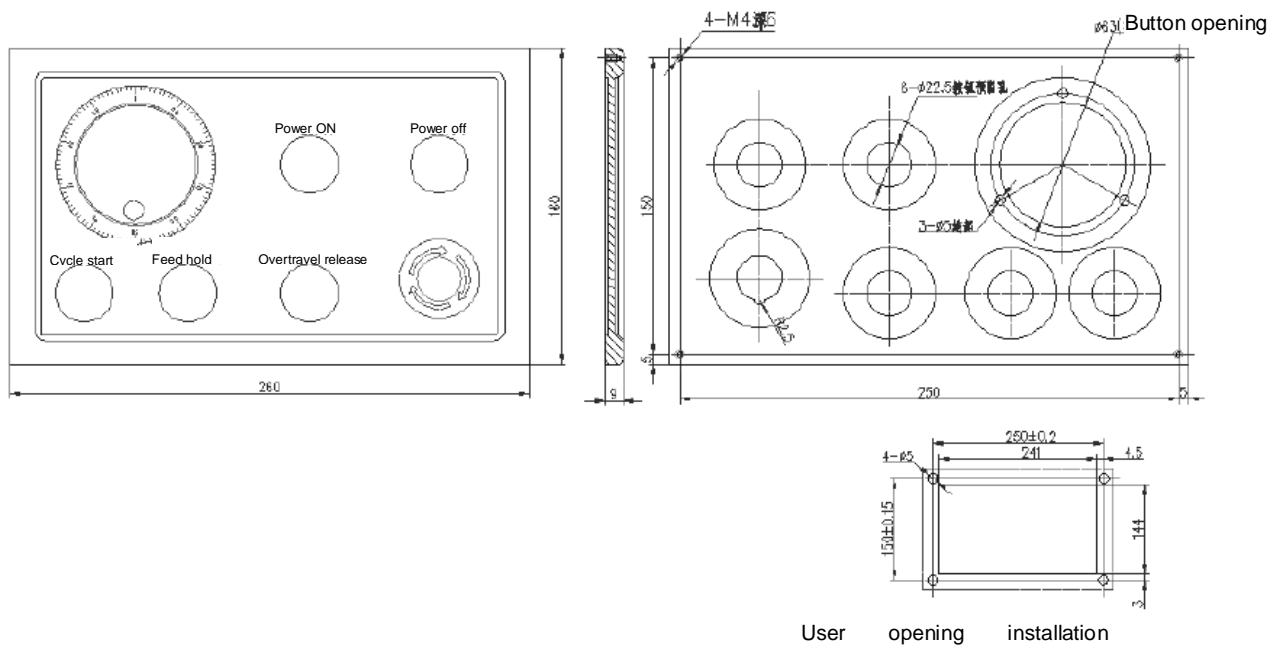
Figure 1-4-3 GSK 980TDHi additional panel AP03 and installation dimensions

Chapter Two Connection between Equipment

2.1 External connection block diagram for the system

2.1.1 Interface position layout
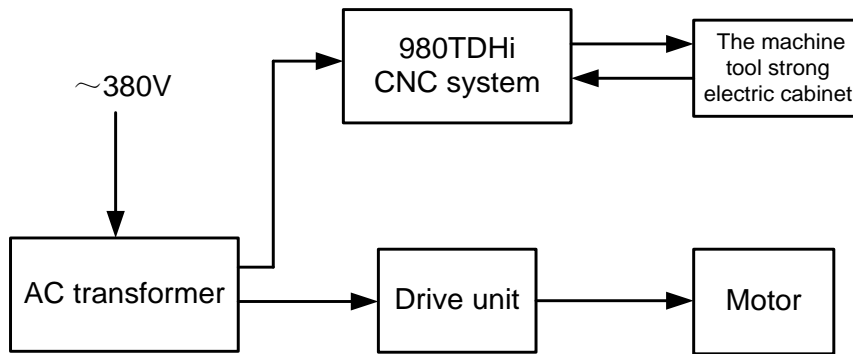
Figure 2-1-1-1 980TDHi interface diagram

2.1.2 Bus servo connection diagram
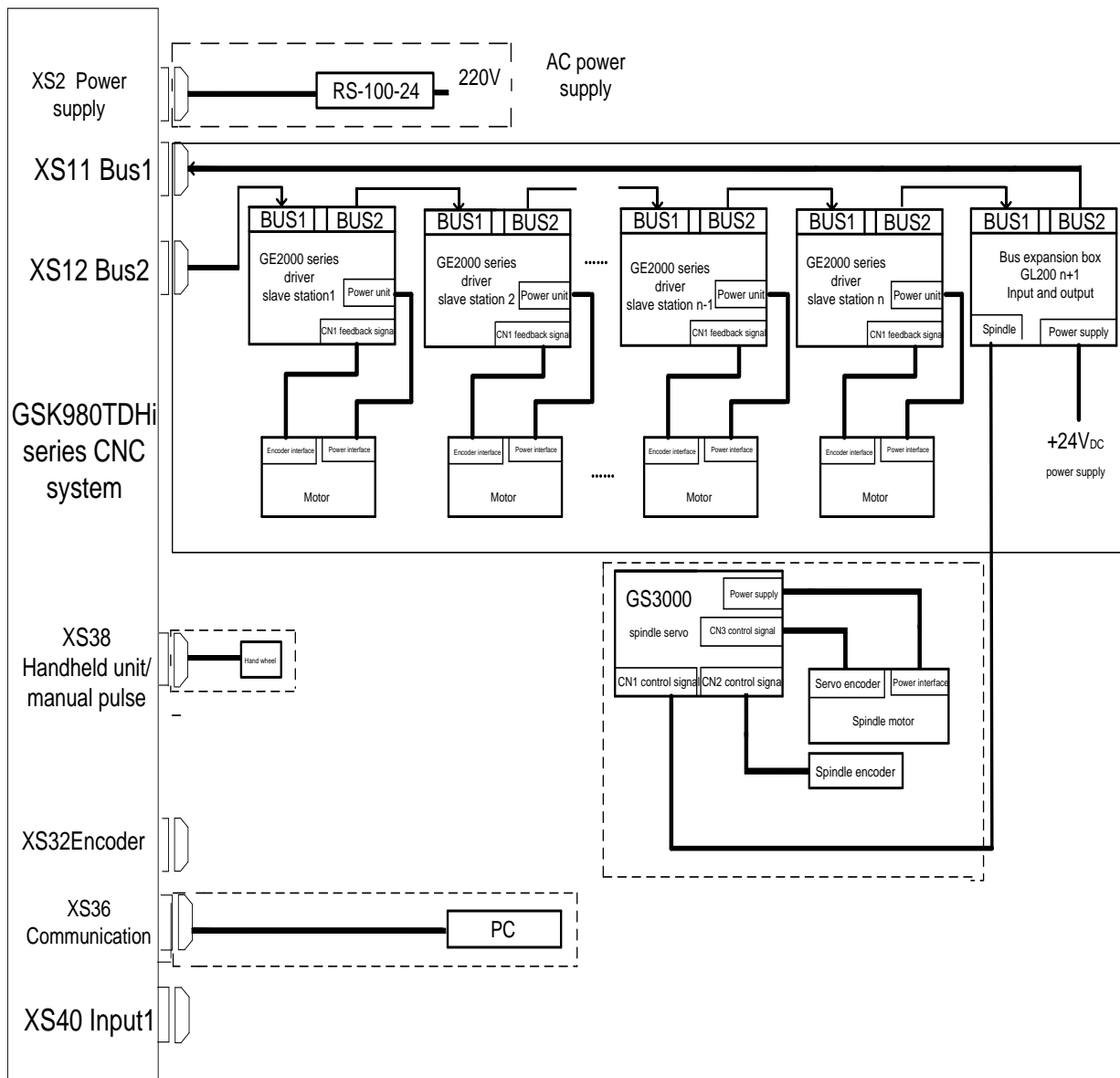
Figure 2-1-2-1

The system CNC bus interface 2 (i.e. XS12 interface of the CNC) which is connected to the servo BUS1 (GT17 interface) is the cluster station 1 (i.e. the first shaft) and which is connected from the BUS2 (GT17 interface) to the system bus interface 1 (XS11 interface of the CNC) is the last shaft.

2.2 Connection of the system to the drive unit

2.2.1 System interface diagram
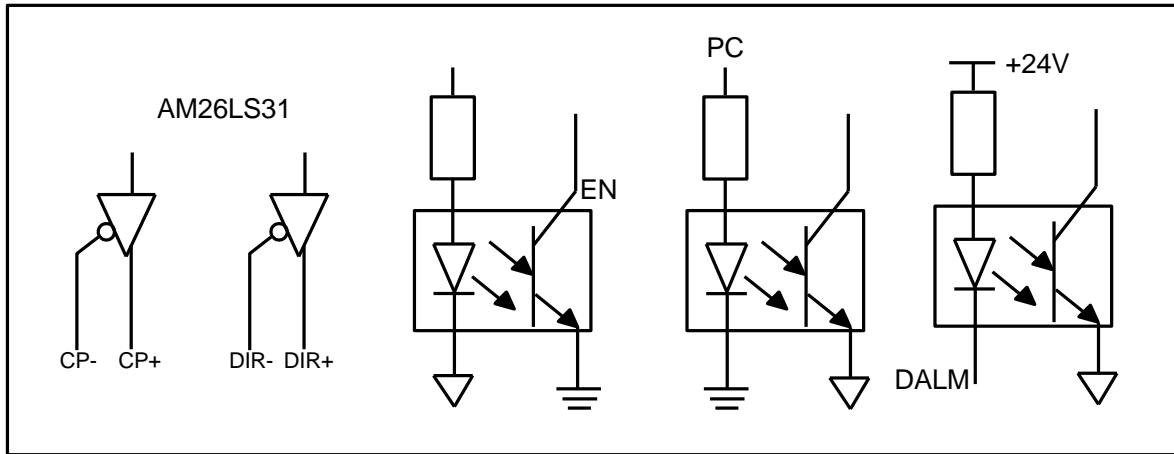
Figure 2-2-1-1

2.2.2 Signal description

1. Drive unit alarm signal ALM (input)

    This signal has the receiving mode on the system side as follows. Parameter 19 can be used to set whether a high level or a low level is active to the drive unit alarm. (The level is consistent with the drive unit setting).
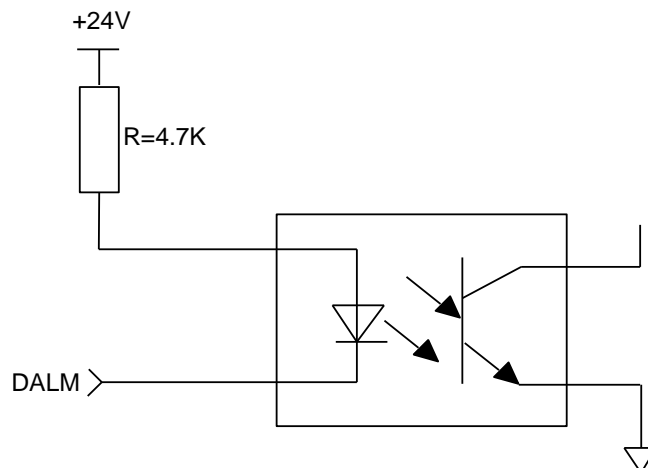
Figure 2-2-2-1

2. CNC system readiness signal EN (contact output)
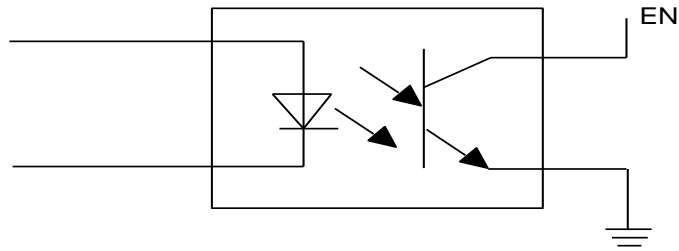
Figure 2-2-2-2

3. Signal PC for the reference point return

The system supports + 24V zero return and + 5V zero return. This signal has receiving circuits on the system side as shown below:

+24V Zero return   +5V Zero return
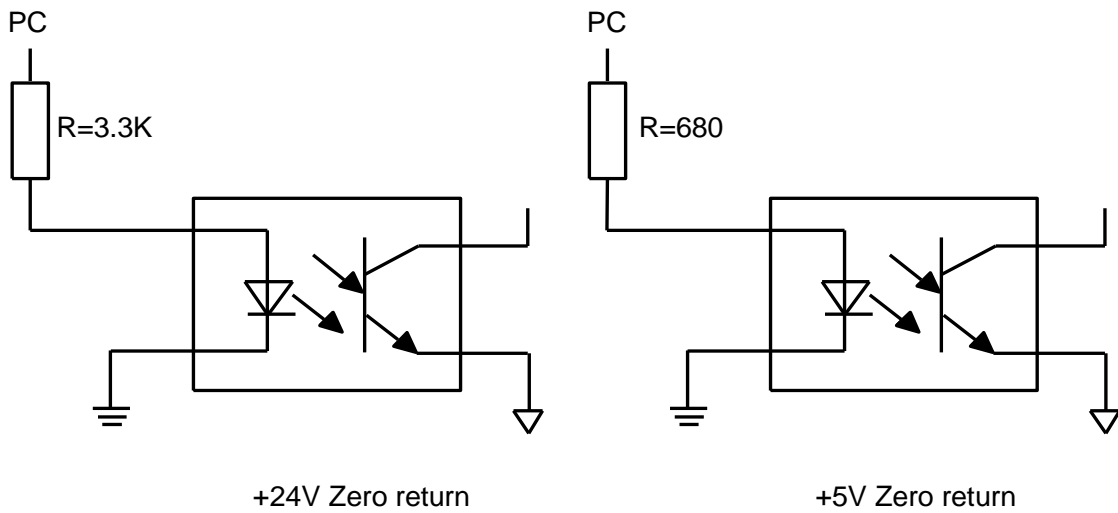
Figure 2-2-2-3

The waveform of signal PC to be provided by the user is as shown below:
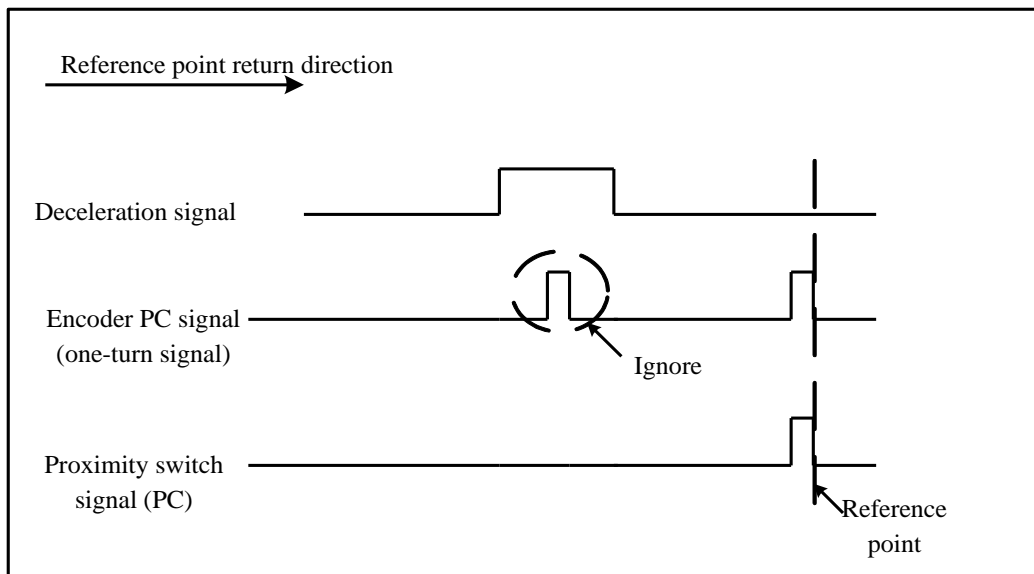
Figure 2-2-2-4

2.2.3 GSK-Link cable connection diagram
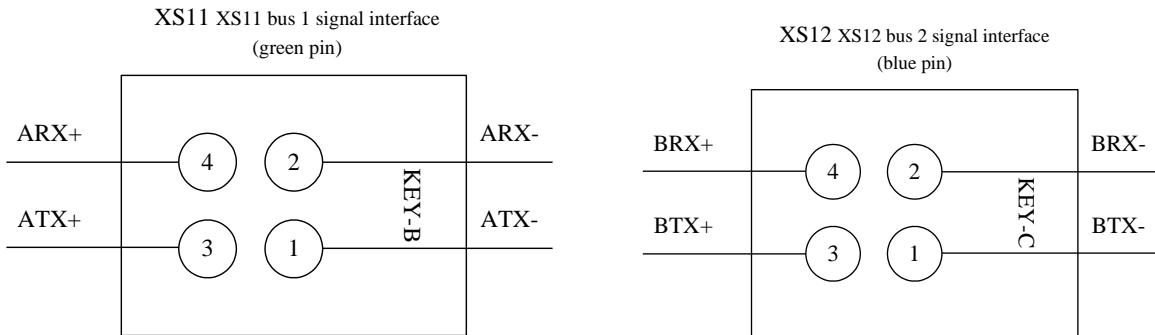
XS11 XS11 bus 1 signal interface
(green pin)

ARX+   4   2   ARX-

ATX+   3   1   ATX-

KEY-B

Interface signal description:

1) ATX: Bus differential data transmission;

2) ARX: Bus differential data reception;

3) GND: Signal ground

XS12 XS12 bus 2 signal interface
(blue pin)

BRX+   4   2   BRX-

BTX+   3   1   BTX-

KEY-C

Interface signal description:

1) ATX: Bus differential data transmission;

2) ARX: Bus differential data reception;

3) GND: Signal ground

3-1 CNC side bus interface definition diagram

GT17-4DS-HU (KEYB green) connecting GT17-8DS-HU						
GT17VS-4DS-HU (KEYB green) XS11			Connection	GT17VS-8DS-HU (pressure line) GE Series CN2		
Serial number	Signal name	Cable color		Serial number	Signal name	Cable color
2	PHY1_RX-	Green white		1	PHY1_RX-	Orange white
4	PHY1_RX+	Green		2	PHY1_RX+	Orange
1	PHY1_TX-	Orange white		3	PHY1_TX-	Green white
3	PHY1_TX+	Orange		4	PHY1_TX+	Green
PG	Shielding network			PG	Shielding network	
Note: 1. Industrial Ethernet cable model: IE-5CC4*2*AWG26/7-9VC (Weidmuller)						

Figure 2-2-3-2 Connection of the bus interface 1 on the CNC side and the drive unit

GT17-4DS-HU (KEYC blue) connecting GT17-8DS-HU						
GT17VS-4DS-HU (KEYC blue) XS12			Connection	GT17VS-8DS-HU (pressure line) GE Series CN1		
Serial number	Signal name	Cable color		Serial number	Signal name	Cable color
2	PHY1_RX-	Green white		1	PHY1_RX-	Orange white
4	PHY1_RX+	Green		2	PHY1_RX+	Orange
1	PHY1_TX-	Orange white		3	PHY1_TX-	Green white
3	PHY1_TX+	Orange		4	PHY1_TX+	Green
PG	Shielding network			PG	Shielding network	
Note: 1. Industrial Ethernet cable model: IE-5CC4*2*AWG26/7-9VC (Weidmuller)						

Figure 2-2-3-3 Connection of the bus interface 2 on the CNC side and the drive unit

GSK_LINK industrial Ethernet cable (GT17 interface)						
GT17VS-8DS-HU((pressure line) GESeries CN2			Connection	GT17VS-8DS-HU((pressure line) GESeries CN1		
Serial number	Signal name	Cable color		Serial number	Signal name	Cable color
1	RX- （BI_DA-）	Orange white		1	RX- （BI_DA-）	Green white
2	RX+ （BI_DA+）	Orange		2	RX+ （BI_DA+）	Green
3	TX- （BI_DB-）	Green white		3	TX- （BI_DB-）	Orange white
4	TX+ （BI_DB+）	Green		4	TX+ （BI_DB+）	Orange
5	Reserved （BI_DC-）	Blue white		5	Reserved （BI_DC-）	Brown white
6	Reserved （BI_DC+）	Blue		6	Reserved （BI_DC+）	Brown
7	Reserved （BI_DD-）	Brown white		7	Reserved （BI_DD-）	Blue white
8	Reserved （BI_DD+）	Brown		8	Reserved （BI_DD+）	Blue
Notes: 1. The 1000M network signal is defined in the bracket. 2. Industrial Ethernet cable model: IE-5CC4*2*AWG26/7-PVC (Weidmuller)						

Figure 2-2-3-4 Connection between the drive units

2.3 RS232 standard serial interface

GSK980TDHi CNC system can communicate with a general PC via RS232-C serial interface (GSK980TDHi communication software must be provided). The connection diagram is as follows. The cable connection diagram is as follows. The shielded cables are connected to the GND while the metal shells are not connected to the shielded cables:
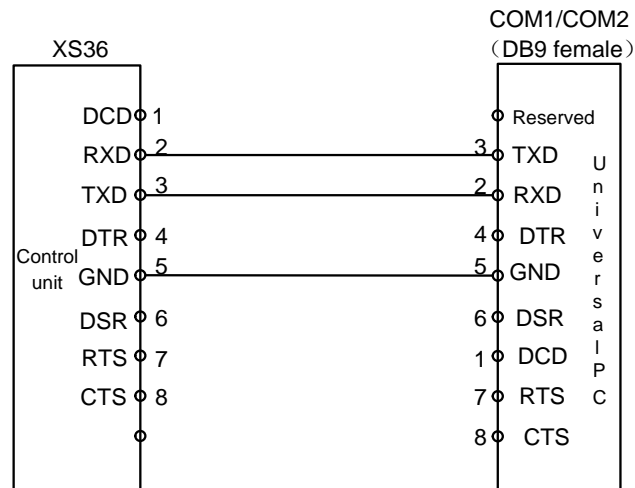
Signal	Description
RXD	Receive data
TXD	Send data

Figure 2-3-1

Note: The shield layer is welded to the plug metal body

2.4 Connection of the manual pulse and the handheld unit

2.4.1 Interface signal diagram

980TDHi system can be matched with differential and non-differential driving manual pulse or handheld units as shown below.

Handheld unit/manual pulse interface (pin)
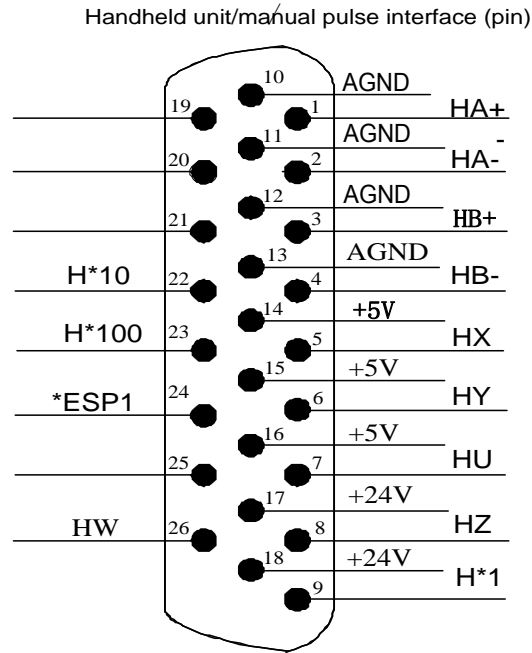
Figure 2-4-1-1

2.4.2 Interface signal description

HA +, HA +, HB +, HB-: matched with differential manual pulse (when matched with non-differential manual pulse, HA＋, HB＋ connected to +5V; HA－ connected to A of the driving manual pulse; HB－ connected to B of the driving manual pulse);

ESP1, ESP2: Handheld unit emergency stop signal;

HX, HY, HZ, H4. H5: Shaft selection signals for shafts X, Y, Z, 4, 5;

H*1. H*10, H*100: Override signals for the driving manual pulse equivalents;

VCOM: Common terminal of the handheld unit.

980TDHi is connected to the built-in manual pulse (non-differential manual pulse) as follows:

DB26Hole welding		Cold-pressed terminal
XS38		Built-in handwheel
Pin	Signal	Signal
14	+5V	VCC
3	HB+	
1	HA+	
10	0V	0V
4	HB−	B
2	HA−	A
	FG	

Figure 2-4-2-1

Part Four Installation and Connection
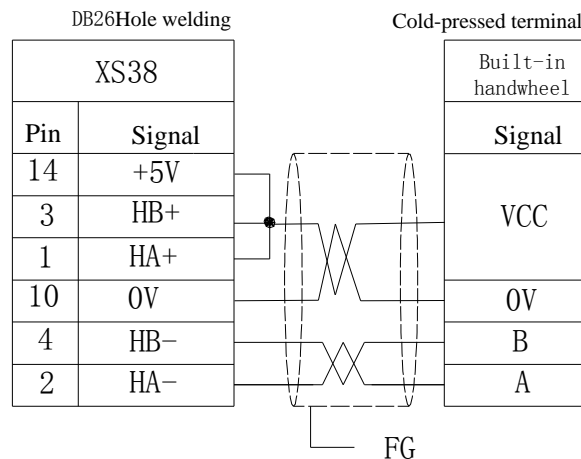
Diagram of the connection of GSK980TDHi and the differential (L) handheld unit

XS38 DB26（Hole welding）		Handheld unit Terminal block
5	HX	X
6	HY	Y
7	HU	U
8	HZ	Z
23	H*100	X100
22	H*10	X10
9	H*1	X1
12	0V	EN/COM
11	0V	ESP2
24	ESP1	ESP1
17	+24V	LED+
13	OV	LED-
1	HA+	A+
2	HA-	A-
3	HB+	B+
4	HB-	B-
14	+5V	+5V
10	0V	0V
Metal shell		Metal shell

FG
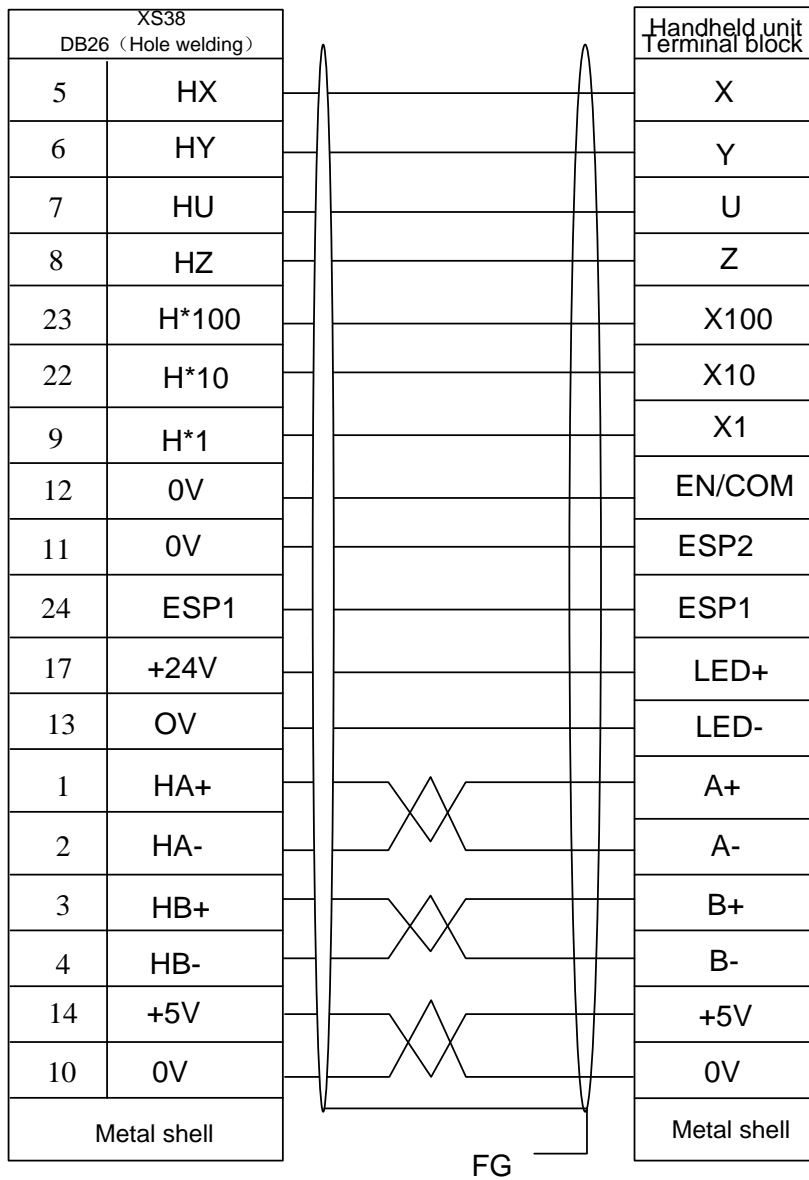
Figure 2-4-2-2

Diagram of the connection of GSK980TDHi and the voltage type (E) handheld unit

Terminal block

XS38 DB26（Hole welding）		Handheld unit
5	HX	X
6	HY	Y
7	HU	U
8	HZ	Z
23	H*100	X100
22	H*10	X10
9	H*1	X1
12	0V	EN/COM
11	0V	ESP2
24	ESP1	ESP1
17	+24V	LED+
13	OV	LED-
2	HA-	A
4	HB-	B
1	HA+	VCC
3	HB+	
14	+5V	
10	0V	0V
Metal shell		Metal shell

FG
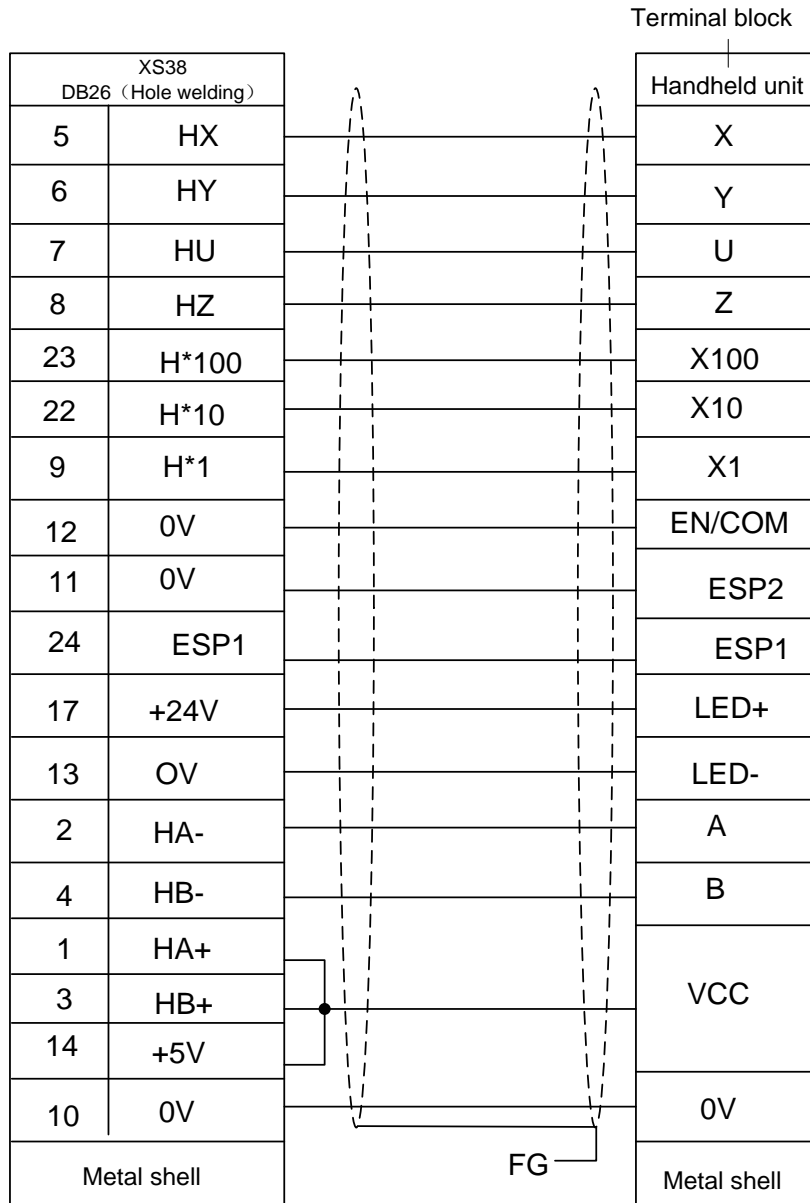
Figure 2-4-2-3

2.4.3 Handheld unit interface circuit

a) The handheld unit receives only 0V level input and no 24V input is allowed.

b) The shaft selection and override signal loop are as shown in Figure 3-2-2-1.
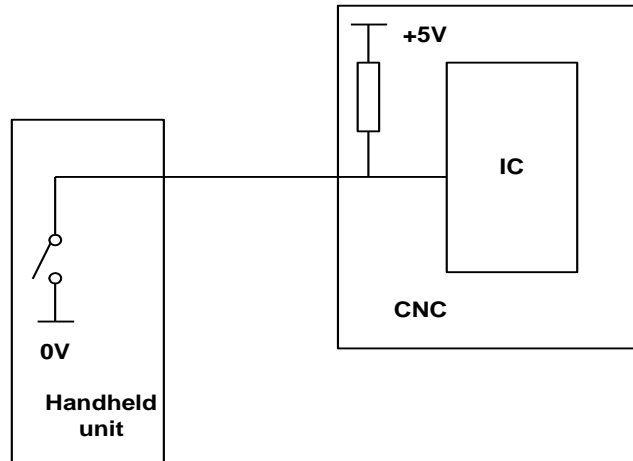
Figure 2-4-3-1

The pin definitions for the handheld unit interface are shown in the following table:

Address	Signal interface	Interface pin name	Definition	Contact selection
X10.0	XS38	26	External manual pulse shaft 5 selection	Normally open contact
X11.0	XS38	24	External emergency stop	Normally closed contact
X11.1	XS38	23	External manual pulse step*100	Normally open contact
X11.2	XS38	22	External manual pulse step*10	Normally open contact
X11.3	XS38	9	External manual pulse step*1	Normally open contact
X11.4	XS38	7	External manual pulse shaft 4 selection	Normally open contact
X11.5	XS38	8	External manual pulse shaft 3 selection	Normally open contact
X11.6	XS38	6	External manual pulse shaft 2 selection	Normally open contact
X11.7	XS38	5	External manual pulse shaft 1 selection	Normally open contact

2.5 System power interface

The input voltage of this system is +24 V. The power interface is as follows:

```
+24V ──────────────  1
+12V ──────────────  2
GND  ──────────────  3
+5V  ──────────────  4
GND  ──────────────  5
```

Figure 2-5-1

Part Four Installation and Connection
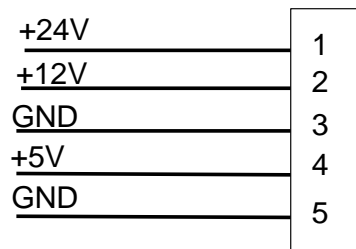
2.6 Spindle encoder connection

1024-line or 1200-line incremental position encoders can be used for the system. *PCS, PCS,

*PBS, PBS,   *PAS, PAS in the following figure respectively corresponds to $\overline{Z}$, Z, $\overline{B}$, B, $\overline{A}$, A.

XS32 Encoder signal interface (pin)
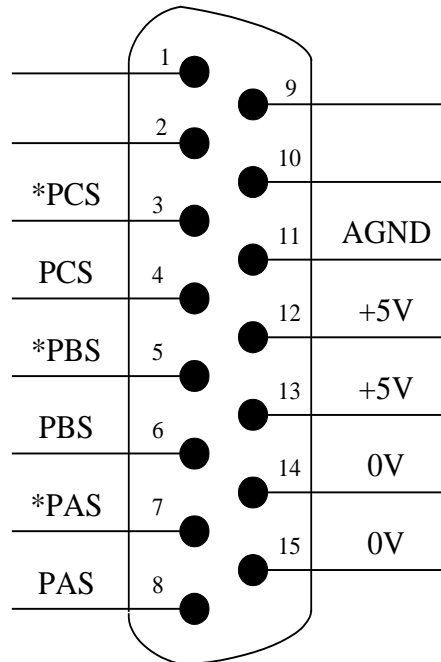
Figure 2-6-1

2.6.1 Interface signal description

1) Encoder A-phase pulse: PAS, *PAS
2) Encoder B-phase pulse: PBS, *PBS
3) Encoder Z-phase pulse: PCS, *PCS

2.6.2 Cable connection diagram
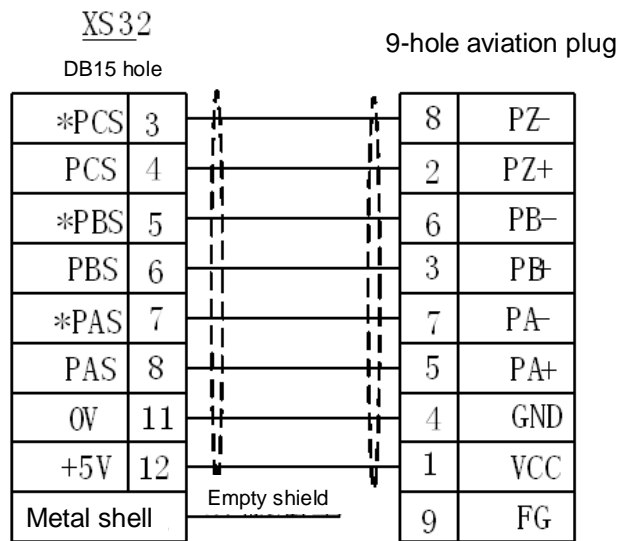
Note: To be welded with this method if the 1024 encoder is provided by us

Figure 2-6-2-1

2.7 Diagram of the outside wiring for GL200 bus modules

The GL200 bus box has three main function modules: power module used for the input of the power supply; spindle module used for the spindle input and output; I/O module used for the I/O input and output. (Figure 2-7-1)
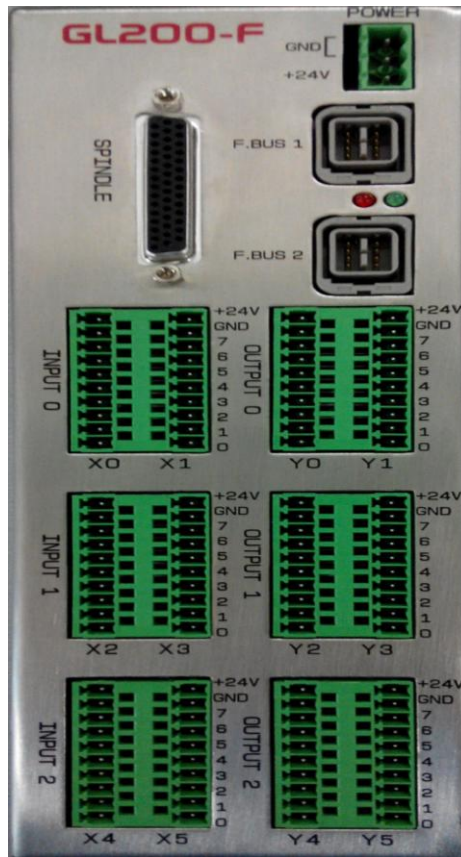
Figure 2-7-1 GL200 bus module
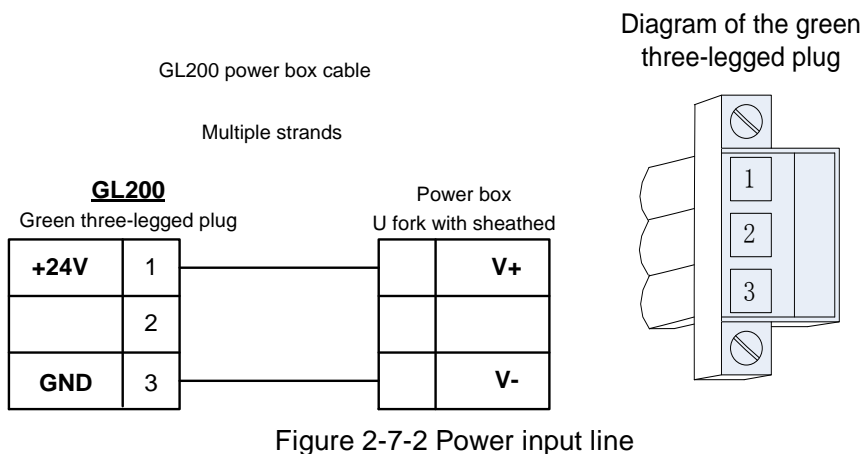
Figure 2-7-2 Power input line

INPUT 0	+24V	+24V	+24V
	GND	GND	GND
	X0. 7	X1. 7	7
	X0. 6	X1. 6	6
	X0. 5	X1. 5	5
	X0. 4	X1. 4	4
	X0. 3	X1. 3	3
	X0. 2	X1. 2	2
	X0. 1	X1. 1	1
	X0. 0	X1. 0	0
	X0	X1	

OUTPUT 0	+24V	+24V	+24V
	GND	GND	GND
	Y0. 7	Y1. 7	7
	Y0. 6	Y1. 6	6
	Y0. 5	Y1. 5	5
	Y0. 4	Y1. 4	4
	Y0. 3	Y1. 3	3
	Y0. 2	Y1. 2	2
	Y0. 1	Y1. 1	1
	Y0. 0	Y1. 0	0
	Y0	Y1	

INPUT 1	+24V	+24V	+24V
	GND	GND	GND
	X2. 7	X3. 7	7
	X2. 6	X3. 6	6
	X2. 5	X3. 5	5
	X2. 4	X3. 4	4
	X2. 3	X3. 3	3
	X2. 2	X3. 2	2
	X2. 1	X3. 1	1
	X2. 0	X3. 0	0
	X2	X3	

OUTPUT 1	+24V	+24V	+24V
	GND	GND	GND
	Y2. 7	Y3. 7	7
	Y2. 6	Y3. 6	6
	Y2. 5	Y3. 5	5
	Y2. 4	Y3. 4	4
	Y2. 3	Y3. 3	3
	Y2. 2	Y3. 2	2
	Y2. 1	Y3. 1	1
	Y2. 0	Y3. 0	0
	Y2	Y3	

INPUT 2	+24V	+24V	+24V
	GND	GND	GND
	X4. 7	X5. 7	7
	X4. 6	X5. 6	6
	X4. 5	X5. 5	5
	X4. 4	X5. 4	4
	X4. 3	X5. 3	3
	X4. 2	X5. 2	2
	X4. 1	X5. 1	1
	X4. 0	X5. 0	0
	X4	X5	

OUTPUT 2	+24V	+24V	+24V
	GND	GND	GND
	Y4. 7	Y5. 7	7
	Y4. 6	Y5. 6	6
	Y4. 5	Y5. 5	5
	Y4. 4	Y5. 4	4
	Y4. 3	5. 3	3
	Y4. 2	Y5. 2	2
	Y4. 1	Y5. 1	1
	Y4. 0	Y5. 0	0
	Y4	Y5	

Figure 2-7-3 GL200 bus I/O module definition diagram

2.7.1 Definition of the input address X

The input X address is defined as follows:

Table 2-7-1-1

Address	Definition	Contact selection
X0.0	Shaft 1 limit signal (for a biswitch, forward)	Normally closed contact
X0.1	Shaft 1 reverse limit signal (for a biswitch, active)	Normally closed contact
X0.2	Shaft 3 limit signal (for a biswitch, forward)	Normally closed contact
X0.3	Shaft 3 reverse limit signal (for a biswitch, active)	Normally closed contact
X0.4	Shaft 1 shaft zero return deceleration signal	Parameter K6.4 specified
X0.5	Shaft 3 shaft zero return deceleration signal	Parameter K6.4 specified
X0.6	Shaft 5 shaft zero return deceleration signal	Parameter K6.4 specified
X0.7	Protection door detection signal	Parameter K18.4 specified
X1.0	Chuck tightness control input	Normally open contact
X1.1	Chuck locking in position (outside)/Chuckrelease in position (inside)	Parameter K11.2 specified
X1.2	Chuck release in position (outside)/Chuck locking in position (inside)	Parameter K11.2 specified
X1.3	Tailstock control signal	Normally open contact
X1.4	Tailstock advance in position detection	Parameter K10.6 specified
X1.5	Tailstock back in position detection	Parameter K10.6 specified
X1.6	Low lubrication pressure detection	Parameter K9.6 specified
X1.7	Air source air pressure detection	Parameter K9.7 specified
X2.0	Spindle gear one in position	Normally open contact
X2.1	Spindle gear two in position	Normally open contact
X2.2	Spindle gear three in position	Normally open contact

Address	Definition	Contact selection
X2.3	Spindle gear four in position	Normally open contact
X2.4	External spindle Jogging	Normally open contact
X2.5	Not defined	---
X2.6	Tool post locking in-position signal (electric tool post/Delta servo/sensor F (Lio Shing tool post)/Yantai AK31)	Parameter K12.0 specified
X2.7	tool postreleaseIn-position signal (Delta servo)	Parameter K12.0 specified
X3.0	Tool location signal 1/sensor A (Lio Shing tool post)	Parameter to be specified
X3.1	Tool location signal 2/sensor B (Lio Shing tool post)	Parameter to be specified
X3.2	Tool location signal 3/sensor C (Lio Shing tool post)	Parameter to be specified
X3.3	Tool location signal 4/sensor D (Lio Shing tool post)	Parameter to be specified
X3.4	Tool location signal 5/sensor E (Lio Shing tool post)	Parameter to be specified
X3.5	Tool location signal 6/gating signal (Yantai AK31)	Parameter to be specified
X3.6	Tool location signal 7/ pre-indexing proximity switch (Yantai AK31)	Parameter to be specified
X3.7	Tool location signal 8/ tool post overheat detection (Yantai AK31)	Parameter to be specified
X4.0	Shaft 2 limit signal (for a biswitch, forward)	Normally closed contact
X4.1	Shaft 2 reverse limit signal (for a biswitch, active)	Normally closed contact
X4.2	Shaft 4 limit signal (for a biswitch, forward)	Normally closed contact
X4.3	Shaft 4 reverse limit signal (for a biswitch, active)	Normally closed contact
X4.4	Shaft 5 limit signal (for a biswitch, forward)	Normally closed contact
X4.5	Shaft 5 reverse limit signal (for a biswitch, active)	Normally closed contact
X4.6	Shaft 2 shaft zero return deceleration signal	Parameter K6.4 specified
X4.7	Shaft 4 shaft zero return deceleration signal	Parameter K6.4 specified
X5.0	M120 in-position detection signal	Parameter K20.0

Address	Definition	Contact selection
		specified
X5.1	M121 in-position detection signal	Parameter K20.1 specified
X5.2	M122 in-position detection signal	Parameter K20.2 specified
X5.3	M123 in-position detection signal	Parameter K20.3 specified
X5.4	M124 in-position detection signal	Parameter K20.4 specified
X5.5	M125 in-position detection signal	Parameter K20.5 specified
X5.6	M126 in-position detection signal	Parameter K20.6 specified
X5.7	M127 in-position detection signal	Parameter K20.7 specified

Note 1: Part of the input can be defined with a variety of functions, as shown with "/" above;

Note 2: The input function will be active with the input signal and +24V conducting, or the input will be not active.

2.7.2 Definition of the output address Y

Table 2-7-2-2

Address	Definition
Y0.0	Feed shaft brake
Y0.1	Cooling
Y0.2	Hydraulic pressure start
Y0.3	Lubrication output
Y0.4	Not defined
Y0.5	Green indicator light
Y0.6	Red alarm indicator light
Y0.7	Yellow indicator light
Y1.0	Spindle forward (If the double spindles are spindle 2, forward)
Y1.1	Spindle Stop (If the double spindles are spindle 2, stop)
Y1.2	Spindle reverse (If the double spindles are spindle 2, reverse)
Y1.3	Spindle brake (spindle 1)
Y1.4	Spindle gear one (frequency conversion /I0 point frequency control)
Y1.5	Spindle gear two (frequency conversion /I0 point frequency control)
Y1.6	Spindle gear three (frequency conversion /I0 point frequency control)
Y1.7	Spindle gear four (frequency conversion /I0 point frequency

Address	Definition
	control)
Y2.0	External chuck clamping output signal/Internal chuck release output
Y2.1	External chuck clamping output signal/ Internal chuck clamping output
Y2.2	Tailstock advance output
Y2.3	Tailstock back output
Y2.4	M26/M27output (Tailstock main body release/ locking)
Y2.5	M35/M36 output
Y2.6	M20 spindle locking output
Y2.7	Tool post servo enabling
Y3.0	Target tool number output TDO0
Y3.1	Target tool number output TDO1
Y3.2	Target tool number output TDO2
Y3.3	Target tool number output TDO3
Y3.4	Cutter locking output/tool post pre-indexing coil (Yantai AK31)
Y3.5	Cutter release output/tool post brake(Yantai AK31)
Y3.6	Tool post forward TL+/ MDO
Y3.7	Tool post reverse TL-/ MDI
Y4.0	M101/M102 output
Y4.1	M103/M104 output
Y4.2	M105/M106 output
Y4.3	M107/M108 output
Y4.4	M109/M110 output
Y4.5	M111/M112 output
Y4.6	M113/M114 output
Y4.7	M115/M116 output
Y5.0	Not defined
Y5.1	Not defined
Y5.2	Not defined
Y5.3	Not defined
Y5.4	Not defined
Y5.5	Not defined
Y5.6	Not defined
Y5.7	Not defined

Note 1: Part of the input can be defined with a variety of functions, as shown with "/" above;

Note 2: The output function will be active with the output signal and GND conducting, or the input will be not active.

Note 3: The input function will be active with the input signal and +24V conducting, or the input will be not active.

The input function will not be active with the input signal with" * "and +24 V conducting, or the input will be active;

Note 4: + 24V, COM and CNC supporting power box with the same name terminal are equivalent.

2.7.3 Input signal

1) DC input signal A

DC input signal A is the signal from the machine tool to the CNC, from the keys, limit switches, relay contacts (including DECX, DECZ, ESP, TCP, ST, SP, DITW, X16, etc.) on the machine tool side .

a) The contacts on the machine tool side should meet the following conditions:

Contact capacity: DC30V, 16mA or more

Leakage current between contacts in the open circuit: less than 1mA (voltage 26.4V)

Voltage drop between contacts in the closed circuit: less than 24V (current 8.5mA, including the voltage drop of cables)

b) The signal loop for this type of signal is as shown in Figure 3-2-1
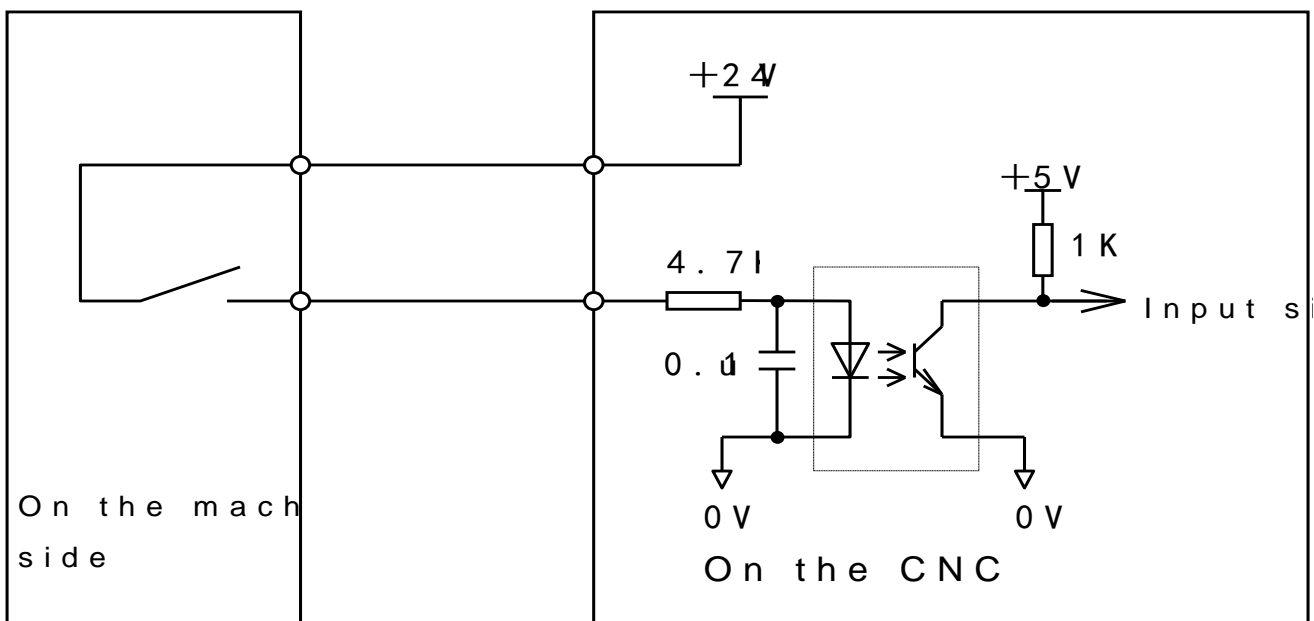
Figure 3-2-1

2) DC input signal B

DC input signal B is the signal from the machine tool to the CNC, used in high speed(T1~T8) .

a) The contacts on the machine tool side should meet the following conditions:

Contact capacity: DC30V, 16mA or more

Leakage current between contacts in the open circuit: less than 1mA (voltage 26.4V)

Voltage drop between contacts in the closed circuit: less than 24V (current 8.5mA,

including the voltage drop of cables)

    b)   The signal loop for this type of signal is as shown in Figure 3-2-2
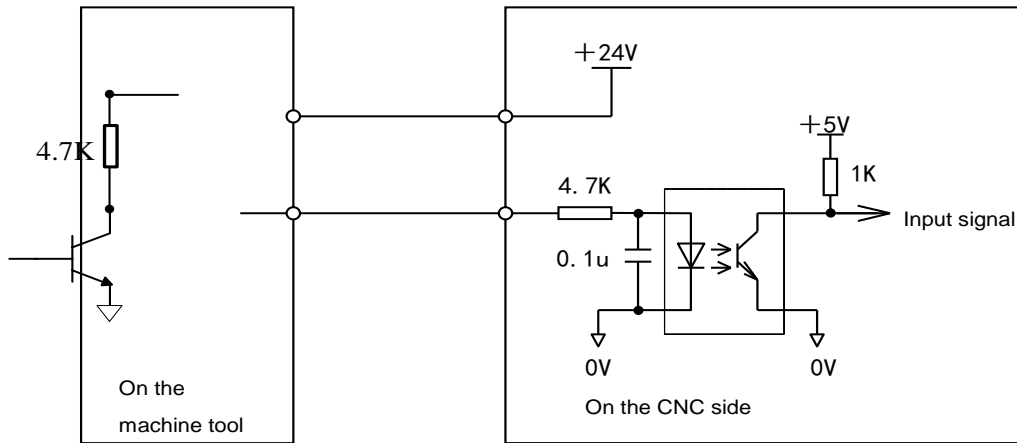
Figure 3-2-2

2.7.3.1 Signal description

   1)   Input signal

      a)   T01～T08 Tool location signal

        The active level is low. When one of the signals has a low level, it means that the tool post is in the tool number position. The connection diagram is shown below, and 8 pull-up resistors are external..

The tool post level in position signal can be set by PLC K parameter NO:13#0 (0 represents active high level and 1 active low level)
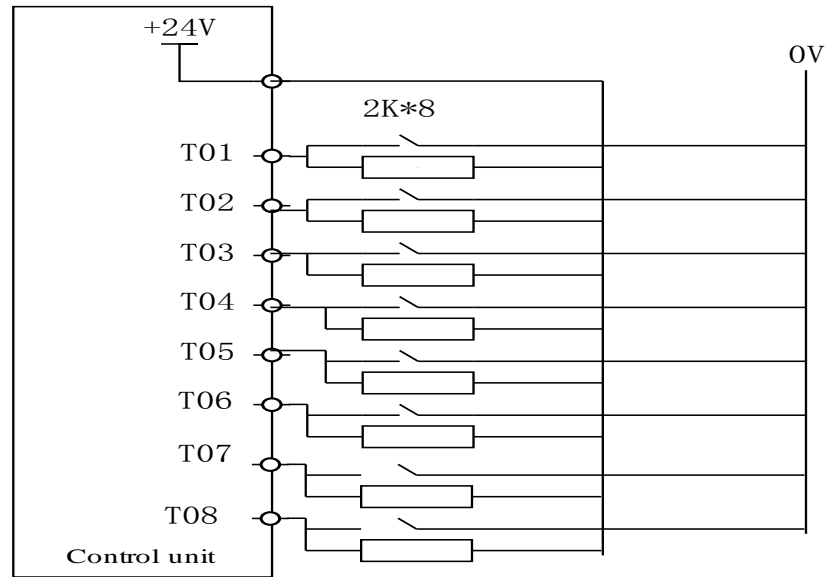
Figure 3-3-1

2.7.4 Output signal

1) Output signal

The DC output signal is used to drive the relay and indicator light on the machine tool side. Transistors are used for the drive circuit, including: **S1～S4. M3. M4. M5. M8, DOTWJ (M10) , DOTWS (M11) , DOQPJ (M12) , DOQPS (M13) , M32. TL-, TL+, SPZD**.

a) Transistors for output have the following specifications:

① Maximum output current with output ON, including the instantaneous current, below 200mA.

② Saturation voltage with output ON, maximum 1.6V at 200mA, typically 1V..

③ Withstand voltage with output OFF, including the instantaneous voltage, less than 24 +20%.

④ Leakage current with output OFF, below 100µA.

b) Output loop:
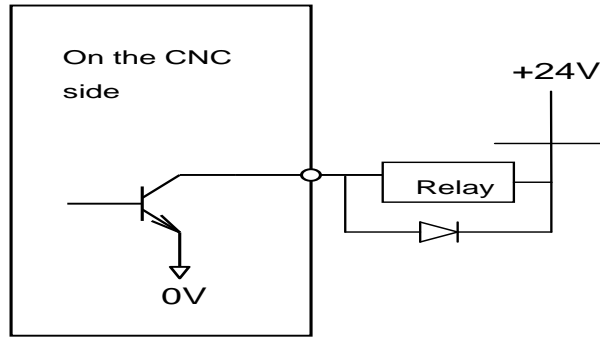
Figure 3-4-1

The output signal of the system is provided by the Darlington tubes, and the corresponding Darlington tubes are conducted when the output is active. The common end of signal is +24 V.

2.8 Spindle unit connection

2.8.1 Interface signal diagram

SPINDL(44-hole socket)
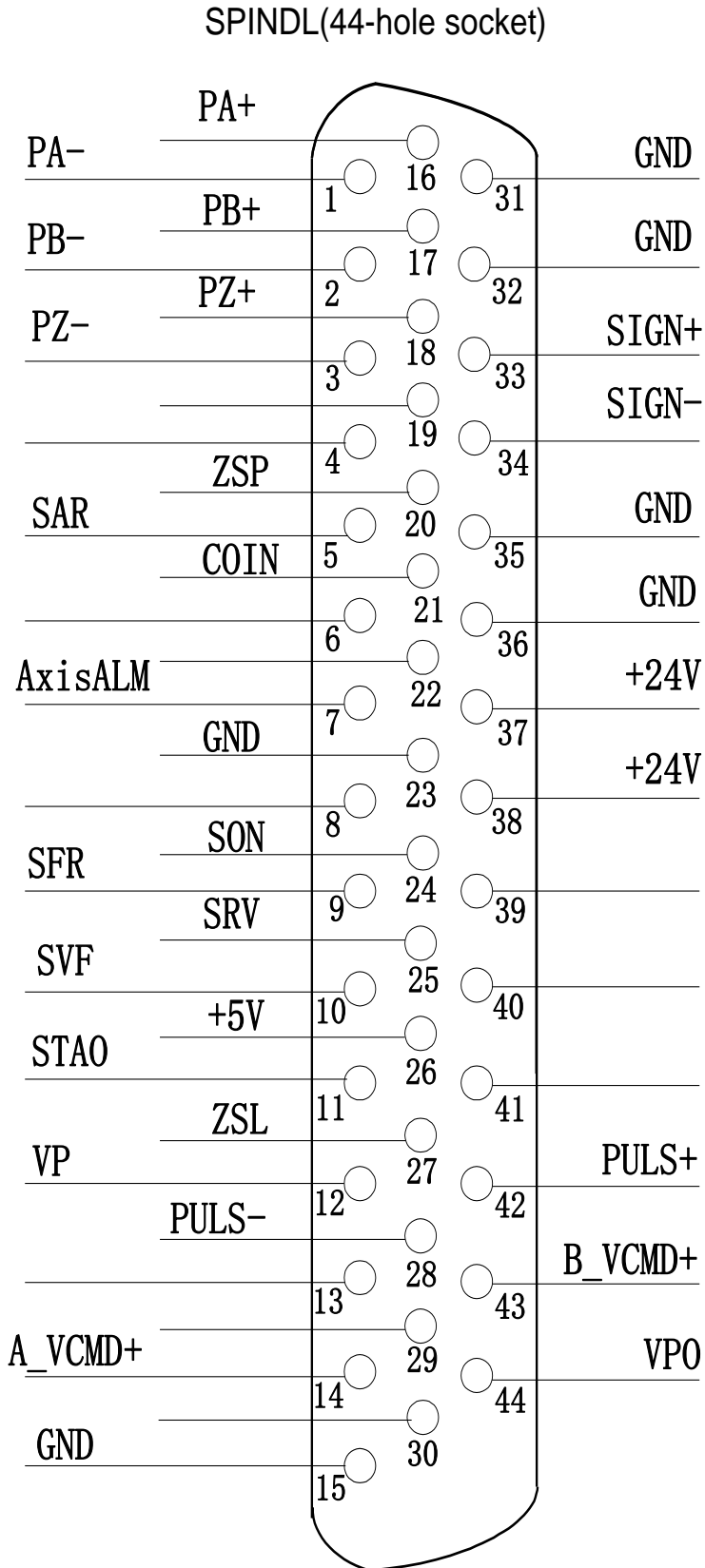
Figure 2-8-1-1 GL200-F spindle

2.8.2 Spindle interface definitions

Table 2-8-2-1

Label	Definition	Description
14	A_VCMD+	First way spindle analog voltage output
15	GND	0~10V or -10V~10V (determined by parameter K7.6)
43	B_VCMD+	First way spindle analog voltage output
36	GND	0~10V or -10V~10V (determined by parameters)
1. 2. 3	PA-, PB-, PZ-	Encoder feedback signal
16. 17, 18	PA+, PB+, PZ+	Encoder feedback signal
28	PULS-	Spindle pulse difference signal output
42	PULS+	
33	SIGN+	Spindle pulse direction difference signal
34	SIGN-	
26	+5V	Spindle encoder supply DC + 5V voltage output t
7	AxisALM	Spindle alarm input
10	SVF	Spindle servo excitation reduction Y6.7
27	ZSL	Zero speed clamp Y6.6
9	SFR	Spindle forward Y6.4
25	SRV	Spindle reverse Y6.5
24	SON	Spindle enabling Y6.0
11	STAO	Spindle orientation Y6.3
12	VP	Speed / position switch Y6.2
44	VPO	Speed / position switch completion X6.5
21	COIN	Spindle orientation completion signal X6.6
5	SAR	Spindle speed reached X6.2
20	ZSP	Spindle zero speed detection X6.3
37, 38, 39	+24V	+24V DC voltage output
23. 31. 32. 35	GND	Spindle ground

Note: The spindle input signal and 0V conducting are active.

2.8.3 Cable connection diagram

1. GSK980TDHi matching DAP03 control line interface connection:

DB 44   male welding   DB44 female welding

SPINDLE				DAP 03 Spindle	
Pin	Signal			Signal	Pin
15	GND			VCMD −	15
14	VCMD+			VCMD +	14
16	PA +			PA +	16
1	PA −			PA −	1
17	PB +			PB +	17
2	PB −			PB −	2
18	PZ +			PZ +	18
3	PZ −			PZ −	3
7	AxisALM			ALM	7
9	Spindle forward Y6.4			SFR	9
25	Spindle reverse Y6.5			SRV	25
37	+ 24 V			COM+	37
24	pindle enabling Y6.0			SON	24
11	Spindle orientation Y6.3			STA0	11
27	Zero speed clamp Y6.6			ZSL	27
12	Speed\position switch Y6.2			VP	12
42	PULS +			PULS+	42
28	PULS −			PULS −	28
33	SIGN +			SIGN+	33
34	SIGN −			SIGN −	34
5	Spindle speed reaching X6.2			SAR	5
20	Spindle zero speed detection X6.3			ZSP	20
21	Spindle orientation completion X6.6			COIN	21
44	Speed\position switch completion X6.5			VP0	44
35	GND −			COM −	35

FG

Figure 2-8-3-1

2. GSK980TDHi matching GS3000 control line interface connection:

DB44 male welding   DB44 female welding

SPINDLE			GS3000	
Signal	Pin		Signal	Pin
VCMD+	14		VCMD+	44
VCMD−	15		VCMD−	14
PA+	16		PAO+	19
PA−	1		PAO−	4
PB+	17		PBO+	18
PB−	2		PBO−	3
PZ+	18		PZO+	31
PZ−	3		PZO−	32
PULS+	42		PULS+	2
PULS−	28		PULS−	17
SIGN+	33		SIGN+	1
SIGN−	34		SIGN−	16
ALM	7		ALM+	9
COM+	37		COM+	39
Spindle forward Y6.4	9		SFR	20
Spindle reverse Y6.5	25		SRV	5
Spindle enabling Y6.0	24		SON	23
Spindle orientation Y6.3	11		OSTA	8
Speed\position switch Y6.2	12		PSTI	38
Spindle servo excitation reductionY6.7	10		BREF	21
Speed\position switch completion X6.5	44		PSTO+	10
Spindle orientation completion X6.5	21		COIN+	12
Spindle speed reaching X6.2	5		PSR	41
Spindle zero speed detection X6.3	20		ZSP	42
COM−	35		COM−	24
Metal shell			ALM−	25
			PSTO−	26
FG			COIN−	28
			Metal shell	

Connecting cable

Figure 2-8-3-2

Chapter Three Machine Tool Control I/O Interface

3.1 Interface signal diagram

XS40 input signal 1 interface (pin)

X8.6	1		14	AGND
X8.7	2		15	AGND
X8.0	3		16	AGND
X8.1	4		17	AGND
X8.2	5		18	AGND
X8.3	6		19	X9.4
X9.5	7		20	X9.6
X9.7	8		21	X9.0
X9.1	9		22	X9.2
X9.3	10		23	+24V
+24V	11		24	AGND
X8.5	12		25	AGND
X8.4	13			
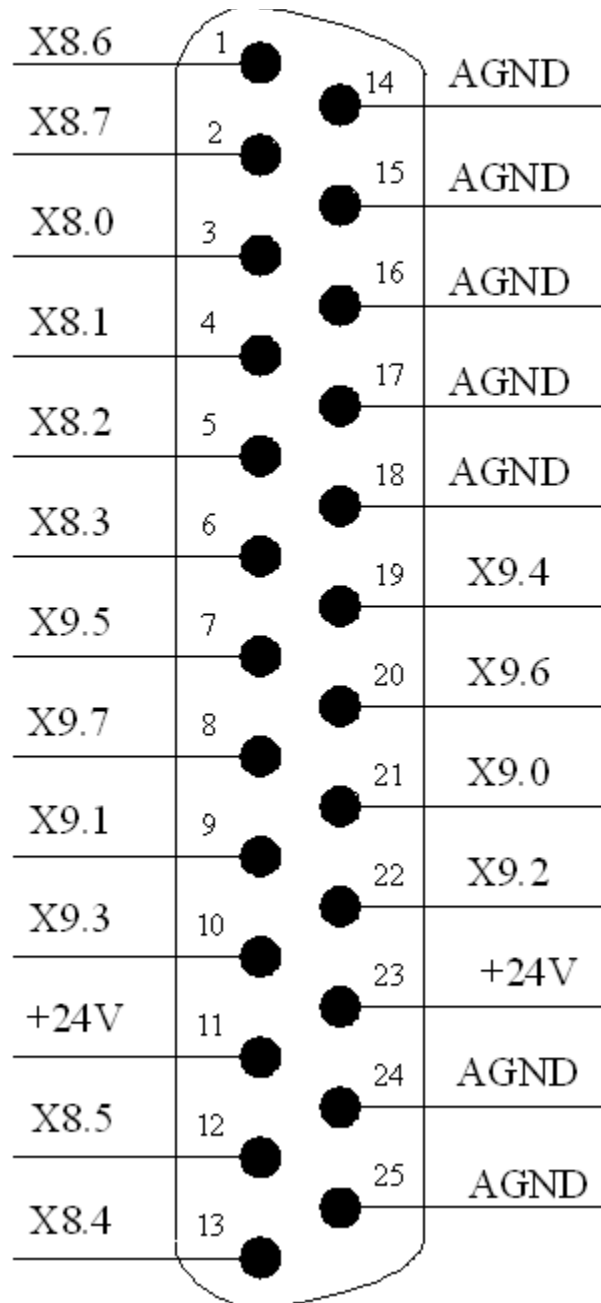
Figure 3-1-1

The pin definitions for in the input address X are as shown in the following table:

Part Four Installation and Connection

Table 3-1-1

Address	Signal interface	Interface pin name	Definition	Contact selection
X8.0	XS40	3	Program lock/External fastrate override ROV1	Normally open contact
X8.1	XS40	4	Feed allowing signal /External fastrate override ROV2	Normally open contact
X8.2	XS40	5	Spindle rotation allowing signal/External fastrate override ROV3	Normally open contact
X8.3	XS40	6	External feedrate override coding (Gray code)	---
X8.4	XS40	13	External feedrate override coding (Gray code)	--
X8.5	XS40	12	External feedrate override coding (Gray code)	--
X8.6	XS40	1	External feedrate override coding (Gray code)	--
X8.7	XS40	2	External feedrate override coding (Gray code)	--
X9.0	XS40	21	External spindle signal power coding (Gray code)	--
X9.1	XS40	9	External spindle signal power coding (Gray code)	--
X9.2	XS40	22	External spindle signal power coding (Gray code)	--
X9.3	XS40	10	External Chuck control signal	--
X9.4	XS40	19	emergency stop signal	Normally closed contact
X9.5	XS40	7	External Loop StartSignal	Normally open contact
X9.6	XS40	20	External Feed HoldSignal	Normally closed contact
X9.7	XS40	8	G31 high speed skip signal	--

Note: When the signal and +24V are conducted on the XS40 input interface, such input will be effective; when the input signal and +24V end, such will be ineffective.

Chapter Four Machine Tool Debugging

This chapter describes some methods and steps for the installation and debugging of GSK980TDHi system. Upon debugging with the following operation steps, you can carry out the corresponding machine tool operation.

4.1 Preparation for debugging

GSK980TDHi debugging may be carried out as follows:

● System connection: A correct connection is the basis for smooth system debugging

● PLC debugging: It makes the system security functions effective (such as emergency stop, hard limit, etc.) and the operation functions effective

● Drive unit parameters setting: To set the motor model, control mode and others

● System parameters setting: To set control parameters, speed parameters, etc.

● Data backup: Upon debugging of the system, data backup, such as parameters backup, compensation data backup, PLC and program backup, will be carried out

  Note the following before debugging and operating GSK980TDHi

● To ensure that all cables are connected correctly, check the polarity of the relays, solenoid valves and other devices.

● Check the connection phase of the heavy current motor cables

● Check the position control cable, code feedback cable, heavy current motor cable of the AC servo feed device

● Confirm the type of the analog voltage code received by the spindle unit

● Make sure that all ground wires are reliably connected

● Confirm the validity of the emergency stop button and the emergency stop loop, to ensure that after the emergency stop button is pressed or the emergency stop loop is disconnected, power supply of the drive unit, spindle drive unit and other moving parts can be shut down

● Make sure that the voltage of each part of the circuit is correct and that the polarity is connected correctly

● Make sure that each part of the power supply in the circuit has correct specifications

● Make sure that the specifications and incoming and outgoing directions of each part of the transformer in the circuit are correct

● Make sure that the incoming and outgoing power supply lines of of the devices such as circuit breakers in the circuit are oriented correctly

Part Four Installation and Connection

4.2 System energization

● Press the emergency stop button to ensure that all air switches in the system are disconnected

● Switch on the main power supply air switch of the electric cabinet

● Switch on the DC 24V control air switch or fuse and check whether the DC24V power supply is normal

● Check whether the other parts of the power supply is normal

● Power on the GSK980TDHi CNC device

4.3 Emergency stop and limit

The system has a software limit function. For the sake of safety, it is recommended that hardware limit measures be taken including installing a travel limit switch at the forward and reverse direction of each shaft.

009#4 (emergency stop signal) in the 【Signal X】 interface under the <Diagnostics> interface. After the emergency stop button is pressed, all air switches must be switched off.

In the manual or manual pulse mode, move slowly the coordinate axes to verify the validity of the shaft overtravel limit switch, correctness of the alarm display and effectiveness of the overtravel release button; in case of overtravel or when the emergency stop button is pressed, the system will give an alarm and the alarm may be cancelled if the overtravel release button is pressed to move in the opposite direction.

● Emergency stop signal

GSK980TDHi parameter diagnosis (input status on the system side)

Status address				X9.4				
Subscript				XS40.19				

Note: If the system displays 0251: emergency stop alarm, check X9.4.

In order to accurately report an alarm of a shaft (shaft 1 or shaft 2 or shaft 3) in a certain moving direction (forward or reverse) when overtravel occurs to the servo shaft and make sure that after an overtravel alarm, if such overtravel is released, the shaft will not move to the overtravel direction, GSK980TDHi system provides two connections for the travel limit switch to meet customer needs:

A. When there is only one travel limit switch:

(One means that one travel switch is shared for the forward and reverse limits of a shaft)

1. Connect by strictly following the table below

Table 4-3-1

Address	Signal interface	Interface pin name	Definition	Contact selection
X0.0	GL200 (X0)	0	Shaft 1 travel limit signal	Normally closed contact
X0.2	GL200 (X0)	2	Shaft 3 travel limit signal	Normally closed contact
X4.0	GL200 (X4)	0	Shaft 2 travel limit signal	Normally closed contact
X4.2	GL200 (X4)	2	Shaft 4 travel limit signal	Normally closed contact
X4.4	GL200 (X4)	4	Shaft 5 travel limit signal	Normally closed contact

2. Modify the following parameters:

Table 4-3-2

Address	Definition	Status 0	Status 1	Set value
K006.0	Whether there is only one travel limit switch used	2	1	1

B. When there is two travel limit switches: (IO needs to be expanded)

(Two means that one travel switch is used for the forward limit of a shaft and one travel switch for its reverse limit)

1. Connect by strictly following the table below:

Table 4-3-3

Address	Signal interface	Interface pin name	Definition	Contact selection
X0.0	GL200 (X0)	0	Shaft 1 forward travel limit signal	Normally closed contact
X0.1	GL200 (X0)	1	Shaft 1 reverse travel limit signal	Normally closed contact
X0.2	GL200 (X0)	2	Shaft 3 forward travel limit signal	Normally closed contact
X0.3	GL200 (X0)	4	Shaft 3 reverse travel limit signal	Normally closed contact
X4.0	GL200 (X4)	0	Shaft 2 forward travel limit signal	Normally closed contact
X4.1	GL200 (X4)	4	Shaft 2 reverse travel limit signal	Normally closed contact
X4.2	GL200 (X4)	2	Shaft 4 forward travel limit signal	Normally closed contact
X4.3	GL200 (X4)	3	Shaft 4 reverse travel limit signal	Normally closed contact
X4.4	GL200 (X4)	4	Shaft 5 forward travel limit signal	Normally closed contact
X4.5	GL200 (X4)	5	Shaft 5 reverse travel limit signal	Normally closed contact

2. Modify the following parameters

Table 4-3-4

Address	Definition	Status 0	Status 1	Set value
K006.0	Whether there is only one travel limit switch used	2	1	0

System parameter number

0	6	1			LALM						

LALM =1: Ignore the hard limit alarm.

=0: Don't ignore the hard limit alarm.

4.4 Gear ratio adjustment

Related parameters

No.	Bit	Param. name	Meaning	Default value
Parameter				
0000	Bit 1	INM	Minimum moving unit of a linear shaft (0: metric, 1: British)	0
0000	Bit 2	INI	Input unit (0: metric input, 1: British input)	0
0005	Bit 1	ISC	Minimum moving unit: 0:0.001,0.0001;1:0.0001,0.00001(mm&deg inch)	1
0039	Bit 2	DIA	Whether to use the diameter programming (0: radius, 1: diameter)	1

When the moving distance of the machine tool is not the same as the distance shown by the system coordinates, you may modify the system parameters P160~ P164 and P165~ P169 to adjust the electronic gear ratio to adapt to a different mechanical transmission ratio.

The system gear ratio is the same as the digital servo drive gear ratio. When the digital servo drive is provided with the electronic gear ratio function, it is recommended to set the electronic gear ratio of the system to 1: 1 and set the calculated electronic gear ratio to the digital servo drive.

In the position control mode, it is easy to match with various pulse sources by setting the parameters to achieve the user's ideal control resolution (ie, angle/pulse).

Gear ratio calculation formula

$$\text{Gear ratios} = \text{Minimum moving unit} * \frac{\text{Number of pulses per turn of the pulse encoder}}{\text{Lead}} * \frac{Z_M}{Z_D}$$

The minimum instruction unit from the CNC to the machine tool, also known as the minimum increment of the tool movement on the machine tool as well as the minimum moving unit.

Number of pulses for 1 turn of the pulse encoder $=$ Number of encoder lines (absolute encoder for the feed motor)

$= 4 \times$ Number of encoder lines (incremental encoder for the feed motor)

ZM: Number of teeth of the screw end gear

ZD: Number of teeth of the motor end gear

Absolute gear ratio calculation method:

【Example 1】 feed shaft gear ratio calculation:

The machine tool is provided with GSK980TDHi system, GE2000 feed drive and an absolute motor (A4)/(A4I). It is programmed with the ISC system, where shaft X is programmed in diameter with a lead of 6 mm and shaft Z is programmed in radius with a lead of 8 mm and shaft Z crews are directly connected (ZD: ZM=1: 1) and 17-bit absolute encoder (encoder line number: 217 (ie

131072)) is used to calculate the gear ratio corresponding to shaft X and shaft Z.

Shaft X calculation:

Minimum moving unit: 0.0001mm (ISC system, diameter programming)

$$\text{Gear ratios} \quad j = \frac{\text{Minimum moving unit}}{} \times \frac{\text{Number of pulses per turn of the puls}}{\text{Lead}} \times \frac{Z_M}{Z_D}$$

$$= 0.0001 \times \frac{131072}{6} \times \frac{1}{1} = \frac{8192}{3750}$$

Parameter NO.39.2 = 1 (diameter programming), gear ratio not multiplied by 1/2. The system will automatically handle the pulse halving output.

Shaft Z calculation:

Minimum moving unit: 0.0001mm (ISC system, radius programming)

$$\text{Gear ratios} \quad j = \frac{\text{Minimum moving unit}}{} \times \frac{\text{Number of pulses per turn of the puls}}{\text{Lead}} \times \frac{Z_M}{Z_D}$$

$$= 0.0001 \times \frac{131072}{8} \times \frac{1}{1} = \frac{8192}{5000}$$

【Example 2】Rotary shaft gear ratio calculation:

The motor is an incremental motor (1024 lines) and ISC system programming is used

$$\text{Gear ratios} \quad j = \frac{\text{Minimum moving unit}}{} \times \frac{\text{Number of pulses per turn of the puls}}{\text{Lead}} \times \frac{Z_M}{Z_D}$$

$$= 0.0001 \times \frac{1024 \times 4}{360} \times \frac{Z_M}{Z_D}$$

Incremental motor ratio calculation method:

【Example 1】If the screw has a lead of 8mm, the minimum output code unit of the system is 0.001mm and the number of encoder lines of the motor is 2500, then:

$$G = \frac{4C}{L/\zeta} \times \frac{Z_M}{Z_D} = \frac{4 \times 2500}{8/0.001} \times \frac{1}{1} = \frac{5}{4}$$

Data parameter NO. 160 (CMRX) =5.   NO.165 (CMDX) =4;

The system gear ratio is the same as the digital servo gear ratio. When the digital servo drive is provided with the electronic gear ratio function, it is recommended to set the electronic gear ratio of the system to 1: 1 and set the calculated electronic gear ratio to the digital servo drive.

【Example 2】Rotatory shaft gear ratio calculation formula

$$G = \frac{N \times C \times 4}{P} = \frac{1 \times 2500 \times 4}{360 \times 1000 \times \text{reduction ratio (active teeth/passive teeth)}}$$

Note: Number of motor photoelectric encoders C＝2500.

4.5 Backlash compensation

You may use a dial gage, dial indicator or laser detector. Backlash compensation requires accurate compensation to improve machining accuracy, so it is not recommended to use the driving manual pulse or single step mode to measure the screw backlash while the following method should be used to measure the backlash:

● Editing program::

O0001;

N10 G01 U1 F800 ;

N20 U1 ;

N30 U1 ;

N40 U-1 ;

N50 M30 ;

● The backlash error compensation value should be set to zero before measurement;

● Operate the program in a single stage, position twice to find the measurement benchmark A, record the current data, and then operate for 1 mm in the same direction, then operate for 1 mm in the opposite direction and read the current data.

Figure 4-5-1 measurement (Backlash method)
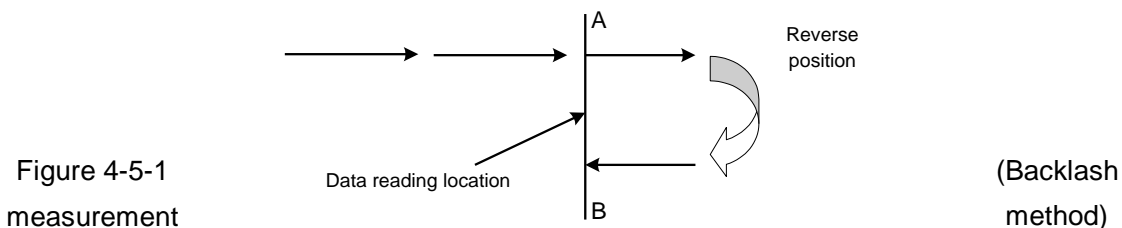
● Backlash error compensation value = | Data recorded at point A –Data recorded at point B| ; input the calculated data to the corresponding system parameter.

Data A: Data read from the dial gage at point A;

Data B: Data read from the dial gage at point B;

Pulse equivalent: 1 micron

Note 1: The backlash compensation for each shaft is set with parameter P190～P194.

Note 2: The backlash compensation mode and compensation step are set with parameter P195～P199.

Note 3: In order to ensure accuracy of the machine tool, backlash should be re-detected after it is used for 3 months.

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System parameter number

0	1	8		RVCS	RBK						RVIT

RVIT =1: When the backlash is greater than the gap tolerance value, the next block will be executed upon compensation.

=0: When the backlash is greater than the gap tolerance value, the next block will be executed before compensation is completed.

RBK =1: Backlash compensation for cutting/fast moving respectively.

=0: No backlash compensation for cutting/fast moving respectively.

RVCS =1: Backlash compensation mode: acceleration and deceleration.

=0: Backlash compensation mode: fixed frequency.

4.6 Drive unit related settings

If the machine tool moves in a direction different from that required by the displacement code, you may modify position parameter NO: 3#0~ NO: 3#4

System parameter number

0	0	3				DIR5	DIR4	DIR3	DIR2	DIR1

DIR1 =1: Shaft 1 feed direction is to be reversed.

=0: Shaft 1 feed direction is not to be reversed.

DIR2 =1: Shaft 2 feed direction is to be reversed.

=0: Shaft 2 feed direction is not to be reversed.

DIR3 =1: Shaft 3 feed direction is to be reversed.

=0: Shaft 3 feed direction is not to be reversed.

DIR4 =1: Shaft 4 feed direction is to be reversed.

=0: Shaft 4 feed direction is not to be reversed.

DIR5 =1: Shaft 5 feed direction is to be reversed.

=0: Shaft 5 feed direction is not to be reversed.

If the system displays shaft 1, shaft 2, shaft 3, shaft 4, shaft 5 or the spindle drive unit gives an alarm with power on, first check whether there is an alarm given by the drive unit and whether the drive unit wiring is correct. If there is no such alarm, then level set by the alarm parameter of the system does not match the alarm level of the drive unit, in which case you may modify parameter NO: 19#0 ~ NO: 19#5 and set it to effective alarm with high-level or low-level. When the drive unit is provided by us, set parameter NO: 19#0 ~ NO: 19#5 to 0. After the parameter is modified, press <Reset> to cancel the system alarm, and for the sake of safety, set the system parameter switch to "off".

If the drive unit used does not provide the drive alarm signal, do not connect this signal, and set

the status parameter NO: 19#0 ~ NO: 19#5 to 1. When the system displays a drive unit alarm, you should further determine the fault is on the system side or on the drive unit side.

System parameter number

0	1	9			ALS1	ALM5	ALM4	ALM3	ALM2	ALM1

ALM1   =1:   An alarm will be given when shaft 1 drive unit alarm signal is set to 1.

          =0:   An alarm will be given when shaft 1 drive unit alarm signal 1 is set to 0.

ALM2   =1:   An alarm will be given when shaft 2 drive unit alarm signal is set to 1.

          =0:   An alarm will be given when shaft 2 drive unit alarm signal 1 is set to 0.

ALM3   =1:   An alarm will be given when shaft 3 drive unit alarm signal is set to 1.

          =0:   An alarm will be given when shaft 1 drive unit alarm signal 1 is set to 0.

ALM4   =1:   An alarm will be given when shaft 4 drive unit alarm signal is set to 1.

          =0:   An alarm will be given when shaft 4 drive unit alarm signal 1 is set to 0.

ALM5   =1:   An alarm will be given when shaft 5 drive unit alarm signal is set to 1.

          =0:   An alarm will be given when shaft 5 drive unit alarm signal 1 is set to 0.

ALS1   =1:   An alarm will be given when spindle 1 drive unit alarm signal is set to 1.

          =0:   An alarm will be given when spindle 1 drive unit alarm signal is set to 0.

System parameter number

0	6	1	FALM	LALM	EALM	SALM	AALM			SSC

SSC   =1:   Constant speed control.

       =0:   No constant speed control.

AALM =1:   Ignore the external user alarm.

        =0:   Don't ignore the external user alarm.

SALM =1:   Ignore the spindle drive unit alarm.

        =0:   Don't ignore the spindle drive unit alarm.

EALM =1:   Ignore the emergency stop alarm.

        =0:   Don't ignore the emergency stop alarm.

LALM =1:   Ignore the hard limit alarm.

        =0:   Don't ignore the hard limit alarm.

FALM =1:   Ignore the feed shaft drive unit alarm.

        =0:   Don't ignore the feed shaft drive unit alarm.

4.7 Machine tool pitch compensation

● **Notes for setting the pitch error compensation**

1. The compensation set is related to the position relationship between the zero point and the compensation point, the direction of mechanical movement and the compensation interval.

2. The compensation at compensation point N (N=0, 1. 2. 3. ……255) is determined by the mechanical error of interval between N and N-1. The number of compensation points that can be set for each shaft is 256.

3. To take the mechanical zero as the compensation origin, set the compensation for each shaft as the parameter value.

4. Shaft that can be compensated: X, Z, 4.

5. Range of compensation: compensation value (-999 pulse equivalent ~ +999 pulse equivalent) × minimum compensation unit. (Metric: 0.001mm British: 0.0001 inch)

6. When the pitch error compensation pitch is set to zero, the system will not compensate. (The pitch error compensation is done around the midpoint of the compensation interval)

7. After pitch error compensation related parameters are set, it will only take effect after power off to restart and mechanical zero return.

8. Upon pitch compensation, the mechanical zero of the machine tool can not be modified freely. Becuase after the mechanical zero position is changed, the pitch compensation point and the actual compensation position of the machine tool will be mismatched, resulting in a decline in the accuracy of the machine tool. If the mechanical zero has to be reset for some reasons, then it is necessary to re-detect the pitch error compensation data.

9. To set the pitch error compensation data, you may have pitch error compensation, in the detection unit, for each shaft so as to improve the accuracy of the machine tool. For different machine tools, the pitch error is different, so you should set the pitch compensation data based on the characteristics of the machine tool after the machine tool is connected to the CNC system. When the pitch error compensation data is set, the end user must not change the data in principle because changing such data will reduce the accuracy of the machine tool.

● **Pitch error compensation setting related parameters**

1. Set whether the pitch compensation function is effective or not parameter NO:37#0 (0: No, 1: Yes)

2. Set the pitch error compensation pitch for shaft with parameter P226~230;

3. Set the pitch compensation number at the reference point for each shaft by parameter P216 ~ 220;

Set the pitch compensation number at the reference point for each shaft is as follows:

①　The pitch compensation number at each compensation point corresponds to the coordinates of the machine tool. That is, the greater the coordinate value of the machine tool at the compensation point, the larger the corresponding compensation number.

②　When a pitch error compensation is needed for the machine tool at a certain interval,

it is usually considered that the compensation number at the compensation point with the minimum value in the coordinate system of the machine tool is 0. The pitch compensation number at the reference point is determined based on the position relationship between the reference point and the compensation point.

③ Example: Suppose that the machine tool has a travel of 100 mm, a pitch error compensation pitch of 10 mm, and a compensation number of from 0 to 10. Then the pitch compensation number at the reference point is determined as follows:

A. The zero return direction of the machine tool is forward zero return. The minimum value in the coordinate system of the machine tool at this interval is -100, then the compensation number at this point is 0 and based on the position relationship between the reference point and the compensation point no.0, it can be known that the compensation number at the reference point is 10, as shown below (Figure 4-7-1) :

Forward zero return
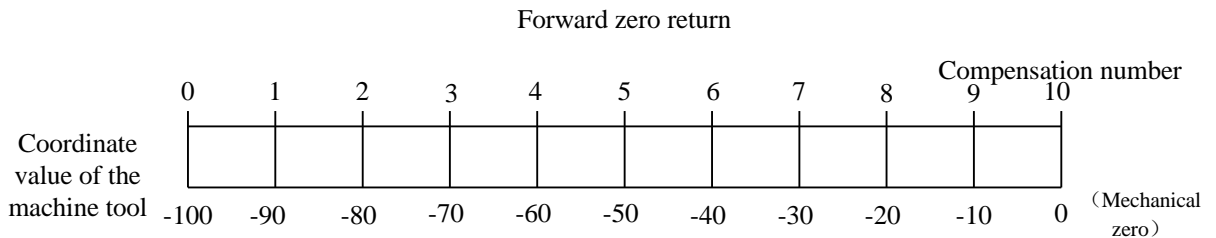
Figure 4-7-1

B. The zero return direction of the machine tool is reverse zero return.   The minimum value in the coordinate system of the machine tool at this interval is 0 and then it can be known that the compensation number at the reference point is 0, as shown below (Figure 4-7-2):

Reverse zero return
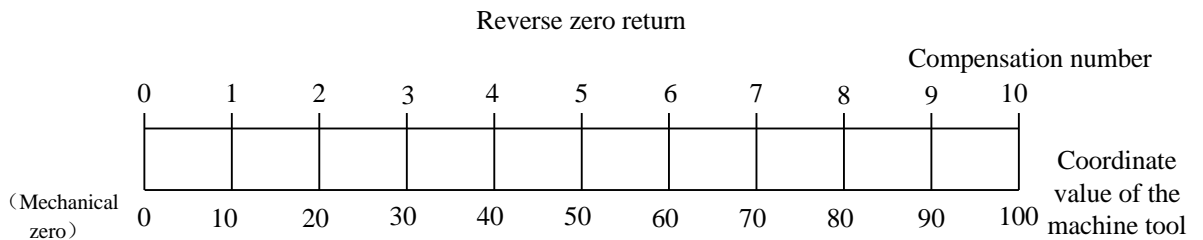
Figure 4-7-2

C. The reference point of the machine tool is in the middle of the machine tool position, which only occurs when an absolute encoder is generally used. The minimum value in the coordinate system of the machine tool at this interval is -50, then the compensation number at this point is 0 and based on the position relationship between the reference point and the

compensation point no.0, it can be known that the compensation number at the reference point is 5, as shown below (Figure 4-7-3):

Reference point in the middle of the travel
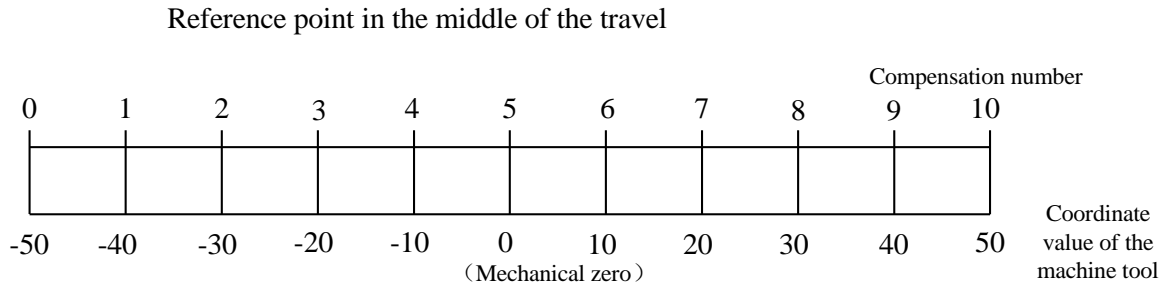
Figure
4-7-3

Note: The pitch error compensation related parameters should be set in strict accordance of the actual circumstance when the pitch error is detected. If wrongly set, the machine tool will have a reduced accuracy.

● **Corresponding relationship between the pitch error compensation and the compensation number at the reference point**

The corresponding relationship between the pitch error compensation and the compensation number is as shown in Figure 4-7-4:
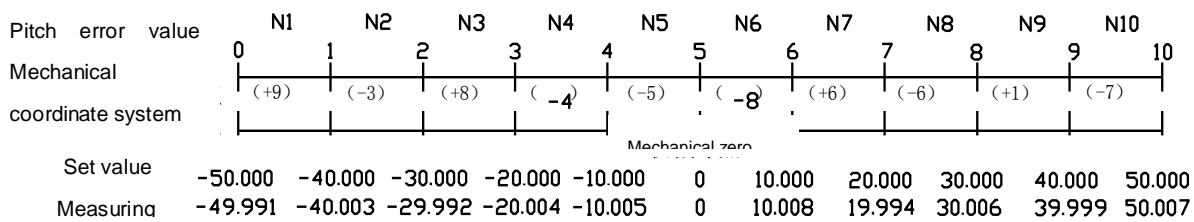
Figure 4-7-4

The corresponding relationship between the pitch error compensation and the compensation number is as shown in Table 4-7-1:

Table 4-7-1

Comp. no.	0	1	2	3	4	5	6	7	8	9	10
Comp.	0	+9	-3	+8	-4	-5	-8	+6	-6	+1	-7

The distance between the minimum value and the maximum value of the moving travel of the working platform of the machine tool is divided into N segments for error dection, with a fixed pitch error at each interval and free from the control by the moving direction of the working platform. As shown in Figure 4-7-4，the error value at the N1 interval should be input to the position of the compensation No. "1" corresponding to the system, so that the system can correctly call the pitch error compensation at the N1 interval. Similarly, the error value at the N1 interval should be input to the position of the compensation No. "6" corresponding to the system, so that the system can correctly call the pitch error compensation at the N6 interval. Thus, it can be seen that the pitch

error value at each interval corresponds to the end position of the forward direction at the interval.

● **Example of the pitch error compensation settings**

For the linear shaft pitch error compensation, to take shaft X as an example, other shafts are set the same.

A. For zero return in the forward direction, to detect the error compensation with the mechanical zero as the reference point.

Suppose that the error compensation spacing is 10mm, the travel of shaft X is 100mm, then the number of compensation points 11. The compensation number at the reference point is 10 and the relevant data parameters are set as show in Table 4-7-2:

Table 4-7-2

Parameter	Default value	Actual value
P216: Compensation number of shaft 1 at the reference point	0	10
P226: Pitch error compensation spacing of shaft 1	5	10

The actual measuring values are as shown in Figure 4-7-5:
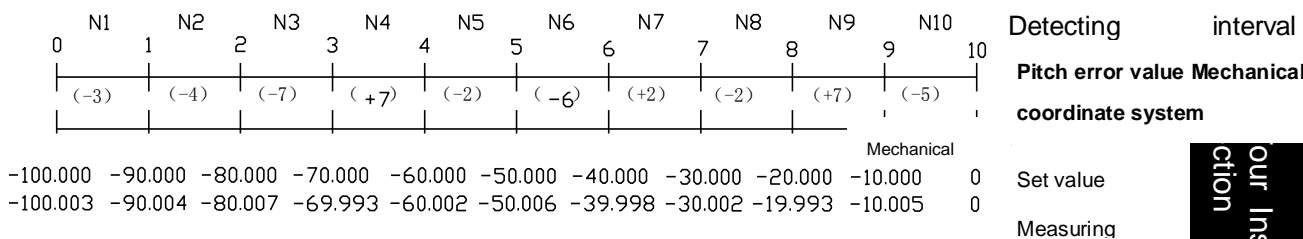
Figure 4-7-5

At the time, the pitch error compensation values of shaft X are set as shown in Table 4-7-3:

Table 4-7-3

Comp. no.	0	1	2	3	4	5	6	7	8	9	10
Comp.	0	-3	-4	-7	+7	-2	-6	+2	-2	+7	-5

B. For zero return in the reverse direction, to detect the error compensation with the mechanical zero as the reference point.

Suppose that the error compensation spacing is 10mm, the travel of shaft X is 100mm, then the relevant data parameters are set as show in Table 4-7-4:

Table 4-7-4

Parameter	Default value	Actual value
P216: Compensation number of shaft 1 at the reference point	0	0
P226: Pitch error compensation spacing of shaft 1	5	10

The actual measuring values are as shown in Figure 4-7-6:
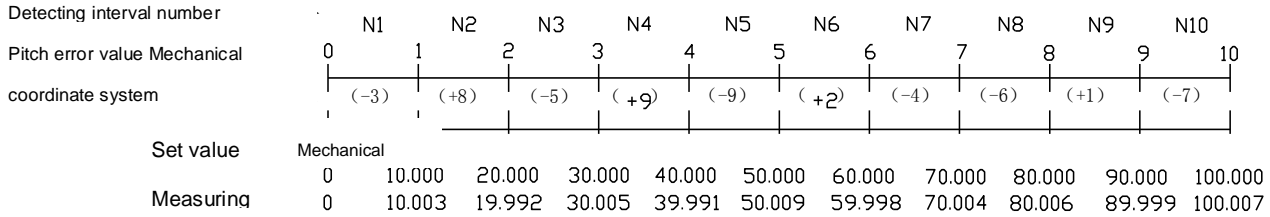
Detecting interval number   N1   N2   N3   N4   N5   N6   N7   N8   N9   N10

Pitch error value Mechanical

coordinate system

	0	1	2	3	4	5	6	7	8	9	10
		(−3)	(+8)	(−5)	(+9)	(−9)	(+2)	(−4)	(−6)	(+1)	(−7)

Set value   Mechanical

Set value	0	10.000	20.000	30.000	40.000	50.000	60.000	70.000	80.000	90.000	100.000
Measuring	0	10.003	19.992	30.005	39.991	50.009	59.998	70.004	80.006	89.999	100.007

Figure 4-7-6

At the time, the pitch error compensation values of shaft X are set as shown in Table 4-7-5:

Table 4-7-5

Comp. no.	0	1	2	3	4	5	6	7	8	9	10
Comp.	0	-3	+8	-5	+9	-9	+2	-4	-6	+1	-7

C. For zero return in the middle of the travel, to detect the error compensation with the mechanical zero as the reference point.

Suppose that the error compensation spacing is 10mm, the travel of shaft X is 100mm, the limiting value from the reverse direction to the forward direction is -50 ~+50, then the relevant data parameters are set as show in Table 4-7-6:

Table 4-7-6

Parameter	Default value	Actual value
P216: Compensation number of shaft 1 at the reference point	0	5
P226: Pitch error compensation spacing of shaft 1	5	10

The actual measuring values are as shown in Figure 4-7-7:
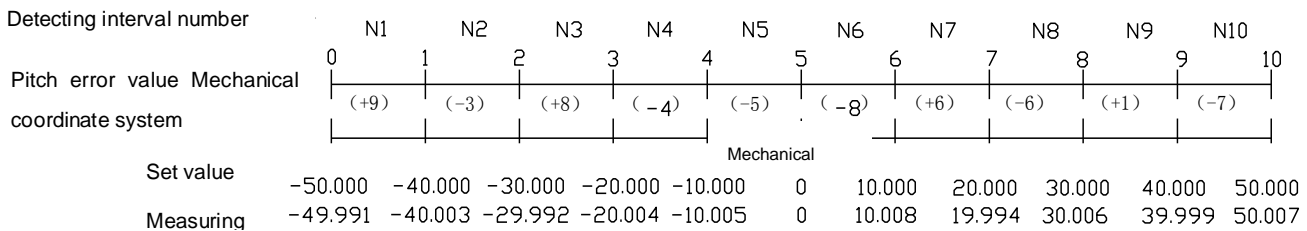
Detecting interval number   N1   N2   N3   N4   N5   N6   N7   N8   N9   N10

Pitch error value Mechanical

coordinate system

	0	1	2	3	4	5	6	7	8	9	10
	(+9)	(−3)	(+8)	(−4)	(−5)	(−8)	(+6)	(−6)	(+1)	(−7)	

Mechanical

Set value	−50.000	−40.000	−30.000	−20.000	−10.000	0	10.000	20.000	30.000	40.000	50.000
Measuring	−49.991	−40.003	−29.992	−20.004	−10.005	0	10.008	19.994	30.006	39.999	50.007

Figure 4-7-6

At the time, the pitch error compensation values of shaft X are set as shown in Table 4-7-7:

Table 4-7-7

Comp. no.	0	1	2	3	4	5	6	7	8	9	10
Comp.	0	+9	-3	+8	-4	-5	-8	+6	-6	+1	-7

4.8 Mechanical zero return (machine tool zero return)

What is the mechanical zero return (machine tool zero return)

The machine tool coordinate system is an inherent coordinate system of the machine tool. Its origin, called the mechanical zero (or machine tool zero), also known as the reference point in this manual, is the mechanical zero provided for by the machine tool manufacturer and usually installed at the forward maximum travel of shaft X, Z, 4 and 5. The mechanical zero is not known when the CNC device is powered on, so automatic or manual zero return is required.

There are two zero return modes: 1. After block; 2. Before block. To be set by parameter N0: 6#1.

There are two zero return modes: 1. with one-turn signal; 2. without one-return signal. To be set by parameter N0: 6#7.

For zero return, when there is no one-return signal, the zero return mode can be devided into two types A and B. To be set by parameter N0: 6#7.

4.8.1 Bus servo zero return settings

There are two zero return modes when the system is set for the bus servo: incremental zero return and absolute zero return. They are described as follows:

I. Incremental zero return

Set Incremental under 【Bus Configuration】 as the encoder type. A normal zero return mode may be applicable to the system, with or without one-return signal, which can be used to configure GE2000 series incremental version. In the zero mode, it is effective for all shafts.

When the servo motor with a coded disk is used (with the position parameter NO.6#6=1, type A/B block and logic before and after block set the same):

Operate the system to mechanical zero return to make the machine tool slide to the zero direction with a distance of L1, a speed parameter P100-104 and a deceleration time constant parameter P352 (used for all shafts). When the zero return switch detects the zero return deceleration signal G17.0-G17.4, the system will slow down to the speed set by parameter P342-P346 with a acceleration/deceleration time constant parameter P353 (used for all shafts). When the induction switch is away from the zero return block, the system will immediately slow down to the speed set by parameter P99, waiting for the encoder one-turn signal (nPC). When the nPC signal is received, the system will be stopped with this point (D) as the mechanical zero. So the zero return ends.

Notes:
1.   Adjust parameters P100-104 and P352 to ensure steady start and stop in section L1.
2.   Adjust parameters P100-104 and P353 to ensure that no vibration occurs to the system when it slows down from section L1 to section L2 (B) and slows down to the speed set by parameter P342-P346 in section L2.
3.   Adjust parameter P342-P346 to ensure that no vibration occurs to the system when it slows down from section L2 to section L3 (C).
4.   In order to ensure zero return accuracy, it is recommended that L3 is not less than 2MM.
5.   If the system is set to zero return before blcok, the system will slow down to 0 and then move in the reverse direction at the speed set by parameter P342-P346.
6.   If you need to use the grid offset function (limited to the offset in the moving direction in section L3), set parameter P180-183 to the offset distance required
(L4, unit MM) when the system is set to zero return, use point E as the mechanical zero.

Signal timing diagram when using a servo motor: Type A/B type zero return mode

Figure 4-8-1-1

Steps for mechanical zero return of the bus incremental servo are:

(1) Press the key [MACHINE ZERO] to enter the mechanical zero return mode, when "Mechanical Zero Return" will be displayed at the lower right corner of the LCD screen.

(2) Select shaft X , Z, 4 or 5 that needs mechanical zero return, with the return direction to be set by parameter N0:7#0～N0:7#4.

(3) The machine tool is moving in the mechanical zero direction. Before the deceleration point, it is moving fast (at a speed to be set by parameter P100～P104); when it touches the speed reducing switch, set the zero return speed for all shafts with parameter P342~P346 and when it is off the block, the machine tool will be moving to the mechanical zero (or reference point) at the FL speed (to be set by parameter P099). After mechanical zero return, the coordinate axis will stop moving, with the zero return indicator light on.

Example:

To take normal incremental zero return for shaft 1. First, shaft 1 hits the block with a high speed

F4000 (with parameter P100 set to 4000); after it touches the speed reducing switch, it will go through the blcok with F500 (with parameter **P342** set to 500); after it is away from the block, it will search the servo one-turn pulse signal Z at a low speed F40 (with parameter **P99** set to 40); after such signal is obtained, it will stop immediately, as shown in Figure 4-8-1-2.
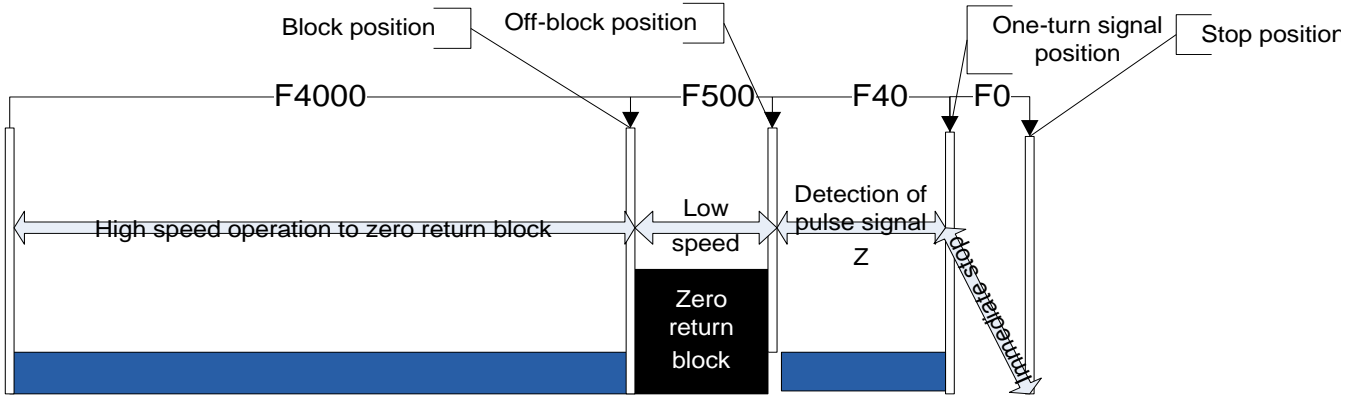
Figure 4-8-1-2
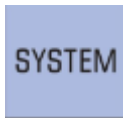
2. Steps for mechanical zero return with the program code

   After setting parameter NO: 6#3 to 0, use the program code G28 for zero return because the detection travel block is equivalent to manual mechanical zero return.

II. Absolute zero settings and zero return

   Setting method:
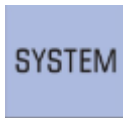
   Press the key [SYSTEM] to enter the system page, switch to display 【⊞Bus Configuration】 interface, as shown below in Figure 4-8-1-3 :
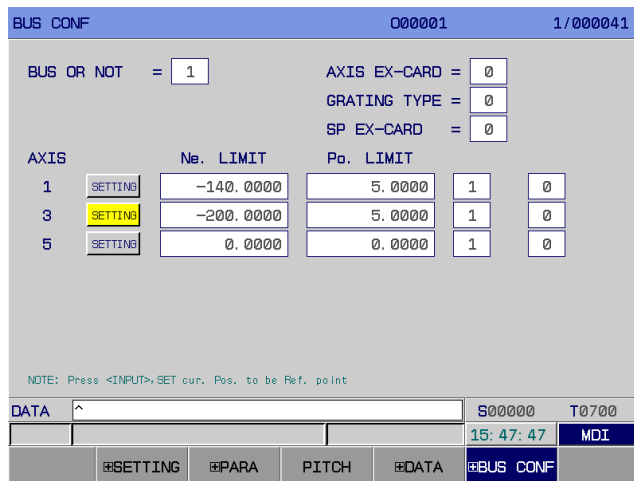
Figure 4-8-1-3

   a) First, set the gear ratio, feed shaft direction and zero return direction on the system side, power off and power on again.

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b) In the MDI Mode, set "Whetehr Bus or Not" to "1", Encoder Type " to 1 and move each shaft to set the zero position.

c) Move the cursor to SETTING , press twice the < Input> key, and when the zero return indicator light is on, record the current position of the absolute encoder for each shaft as the machine tool zero. Based on the actual maximum travel of the machine tool, set the reverse and forward boundaries to offset forward or backward a unit the absolute coordinates of the machine tool and finally set parameter No.61#6 to 1 to validate the positive and negative limits.

Range: -99999.9999~99999.9999.

d) Whether to configure gratings. Set whetehr to configure gratings for each shaft, 0: No, 1: Yes.

e) Press **INPUT** key to confirm.

Note 1: After zero settings for the machine tool, if you modify the zero return direction for each shaft, the moving direction for the feed shaft and the gear ratio for the servo and the system, it will cause a zero loss, in which case the machine tool zero must be re-set.

Note 2: After zero re-settings for the machine tool, it will affect other reference points, in which case reference points 2 and 3 must be reset.

Example:

Set zero for the absolute encoder based on the absolute position fed back by the motor, as shown in Figure 4-8-2-4.
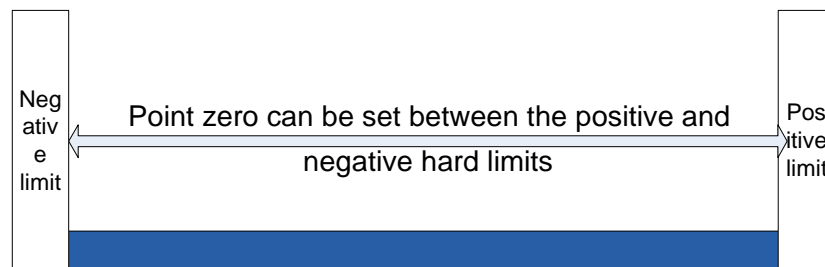
Figure 4-8-1-4 Zero Settings for the Absolute Encoder

Note 1: If your machine tool is not installed with a zero return speed reducing switch or provided with mechanical zero, don't operate mechanical zero return

Note 2: After mechanical zero return, the indicator light for the corresponding shaft will be on.

Note 3: When such shaft is not at mechanical zero, the zero return indicator light will be off.

Note 4: For the mechanical zero (or reference point) direction, see the operation instruction for the machine tool provided by the manufacturer.

Note 5: Do not modify the zero return direction, feed shaft direction and gear ratio size for each shaft.

● **Related signals**

DECX: Shaft X deceleration signal;

DECY: Shaft Y deceleration signal;

DECZ: Shaft Z deceleration signal;

DEC4: Shaft 4 deceleration signal

DEC5: Shaft 5 zero return Signal

Parameter diagnosis (input status on the machine tool side)

Status address		X0.6	X0.5	X0.4				
Subscript		GL200X0.6	GL200X0.5	GL200X0.4				

Status address	X4.7	X4.6						
Subscript	GL200X4.7	GL200X4.6						

System parameter number

0	0	6		MAOB	ZPLS		SJZ			ZMOD	

ZMOD　=1: Zero return mode selection: before block.

　　　　=0: Zero return mode selection: after block.

SJZ　=1: Memory at the reference point.

　　　=0: No memory at the reference point.

ZPLS　=1:　Zero return mode selection: with one-turn signal.

　　　　=0:　Zero return mode selection: without one-turn signal.

MAOB　=1:　Zero return mode selection without one-turn signal: Mode B.

　　　　=0:　Zero return mode selection without one-turn signal: Mode A.

System parameter number

0	0	7				ZMI5	ZMI4	ZMI3	ZMI2	ZMI1

ZMI1　=1:　Set shaft 1 reference point return direction: reverse.

　　　　=0:　Set shaft 1 reference point return direction: forward.

ZMI2　=1:　Set shaft 2 reference point return direction: reverse.

　　　　=0:　Set shaft 2 reference point return direction: forward.

ZMI3　=1:　Set shaft 3 reference point return direction: reverse.

　　　　=0:　Set shaft 3 reference point return direction: forward.

ZMI4　=1:　Set shaft 4 reference point return direction: reverse.

　　　　=0:　Set shaft 4 reference point return direction: forward.

ZMI5　=1:　Set shaft 5 reference point return direction: reverse.

　　　　=0:　Set shaft 5 reference point return direction: forward.

Parameter No.099

0	9	9		(FL) speed when the pulse signal Z is obtained (for all shafts)

Parameter No.100～No.104

1	0	0	Shaft 1 reference point return speed
1	0	1	Shaft 2 reference point return speed
1	0	2	Shaft 3 reference point return speed
1	0	3	Shaft 4 reference point return speed
1	0	4	Shaft 5 reference point return speed

Parameter No.342～No.346

3	4	2	Shaft 1 zero return low speed
3	4	3	Shaft 2 zero return low speed
3	4	4	Shaft 3 zero return low speed
3	4	5	Shaft 4 zero return low speed
3	4	6	Shaft 5 zero return low speed

Parameter No.352～No.353

3	5	2	Zero return high speed acceleration/deceleration time constant
3	5	3	Zero return low speed acceleration/deceleration time constant

Parameter No.354

3	5	4	Low speed at the machine tool zero after zero return

Parameter No.180～No.184

1	8	0	Shaft 1 grid offset or reference point offset
1	8	1	Shaft 2 grid offset or reference point offset
1	8	2	Shaft 3 grid offset or reference point offset
1	8	3	Shaft 4 grid offset or reference point offset
1	8	4	Shaft 5 grid offset or reference point offset

4.9 Spindle forward/reverse I/O signal control

- Related signals

  M03: Spindle forward

  M04: Spindle reverse

  M05: Spindle Stop

  SON: Spindle enabling

  SAR: Spindle speed reaching

  ZSP: Spindle zero speed detection

  COIN: Spindle orientation completion signal

Parameter diagnosis (output status on the system side)

Status address					Y1.2	Y1.1	Y1.0
Subscript					GL200 (Y1.2)	GL200 (Y1.1)	GL200(Y1.0)

Y1.0=spindle forward (double-spindle, spindle 2 forward) ; Y1.1=Spindle stop (spindle 2 stop) ;

Y1.2=spindle reverse (double-spindle, spindle 2 reversal).

Status address								Y6.0
Subscript								GL200(SPINDL44-hole).24

Y6.0=Spindle enabling.

Parameter diagnosis (input status on the machine tool side)

Status address					X6.2		
Subscript					GL200 (SPINDL 4 -hole).24		

X6.2=spindle speed reaching signal.

Status address		X6.6	X6.5		X6.3			
Subscript		GL200 (SPINDL 44-hole). 21	GL200 (SPINDL 44-hole). 24		GL200 (SPINDL4 4-hole).20			

X6.3=spindle zero speed detection signal; X6.5=speed /position switch completion; X6.6=Spindle orientation completion.

Parameter No.258

2	5	8	Upper spindle speed limit

Parameter No.286～No.288

2	8	6	Number of teeth of the side gear of the spindle (gear 1)
2	8	7	Number of teeth of the side gear of the spindle (gear 2)
2	8	8	Number of teeth of the side gear of the spindle (gear 3)

Parameter No.290～No.292

2	9	0	Number of teeth of the side gear of the position encoder (gear 1)
2	9	1	Number of teeth of the side gear of the position encoder (gear 2)
2	9	2	Number of teeth of the side gear of the position encoder (gear 3)

● Operation sequence

The spindle has the operation sequence as shown in Figure 4-9-1:
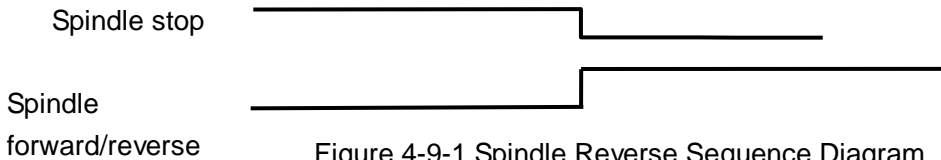
Figure 4-9-1 Spindle Reverse Sequence Diagram

- Control logic

  ① When the system starts, the spindle will stop and signal M05 will maintain output;

  ② Upon execution of code M3/M4, M3/M4 will be effective and stable and signal M05 will stop output;

4.10 Spindle gear shift control

- Related signals

  X2.0～X2.3: Spindle gear shift in-position signal

  When the spindle frequency control (0～10V analog voltage output) is selected, the system supports 4-gear spindle automatic shift control and 4-gear shift in-position detection.

- Signal diagnosis

Parameter diagnosis (input status on the machine tool side)

Status address					X2.4	X2.3	X2.1	X2.0
Subscript					GL200 (X2.3)	GL200 (X2.2)	GL200 (X2.1)	GL200 (X2.0)

X2.0=Spindle gear one in position; X2.1=Spindle gear two in position; X2.2=Spindle gear three in position; X2.3=Spindle gear four in position;

- Control parameters

Status parameter

0	0	1						SPT		

SPT =1: Spindle control type: I/O point control.

=0: Spindle control type: frequency conversion or others.

Parameter No.242

2	4	2	Spindle speed during spindle orientation or gear shift

Parameter No.246

2	4	6	Maximum speed of gear 1

Spindle speed with a frequency converter voltage of 10V at gear one

Parameter No.247

2	4	7	Maximum speed of gear 2

Spindle speed with a frequency converter voltage of 10V at gear two

Parameter No.248

2	4	8	Maximum speed of gear 3

Spindle speed with a frequency converter voltage of 10V at gear three

Parameter No.250

2	5	0	Minimum clamping speed of the spindle motor

Speed for parameter 251

Parameter No.251

2	5	1	Maximum clamping speed of the spindle motor

Motor speed with a frequency converter voltage of 10V

> **Note:** 1. When the machine tool has an automatic gear shift device, set K8.2 to 1; otherwise, set K8.2 to 0. When automatic gear shift does not work, it is the maximum speed of gear 1 by default, with 246≥247≥248
>
> 2. When there is no detection switch for spindle gears, set K8.4 to 1; otherwise, set K8.4 to 0.
>
> 3. When I/O point control is used for the spindle, set K4.0 to 1.

4.11 External loop start and feed hold

● Related signals

ST: The external loop start signal has the same function as the loop start key in the machine tool panel.

*SP: The external feed hold signal has the same function as the feed hold key in the machine tool panel.

● Signal diagnosis

Parameter diagnostics (input status on the system side)

Status address		X9.6	X9.5					
Subscript		XS40.20	XS40.7					

X9.5=External loop start X9.6=External feed hold

● Internal signal connection

* See Figure 4-11-1 below for the internal circuit for the SP/ST signal:
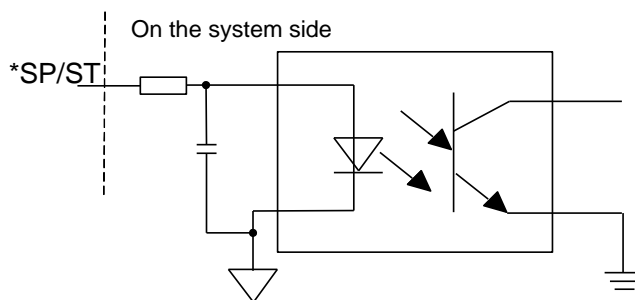
Figure 4-11-1

● External circuit

Part Four Installation and Connection

* See Figure 4-11-2 below for the external circuit for the SP/ST signal.
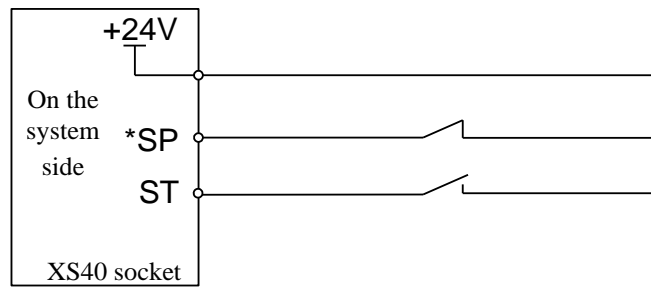
Figure 4-11-2

● Modify the following parameters

Address	Definition	Status 0	Status 1	Set value
K005.1	Whether the machine tool has external loop start	No	Yes	1
K005.3	Whether the machine tool has external feed hold	No	Yes	1

4.12 Cooling and lubrication control

● Related M codes
　　　M08: Coolant on.
　　　M09: Coolant off.
　　　M32: Lubrication on.
　　　M33: Lubrication off.

● Signal diagnosis

Parameter diagnosis (output status on the machine tool side)

Status address					Y03		Y0.1	
Subscript					GL200(Y0.3)		GL200(Y0.1)	

Y0.1=Cooling; Y0.3=Lubrication.

TimerTMR

Address T	Definition	Default value
T016	Lubrication interval (Unit: minute)	30
T017	Lubrication time (Unit: second)	15

Automatic Lubrication, after 30 minutes' lubrication, automatic conduction for lubrication of 15 seconds.

K018.2 lubrication start mode selection (0: Auto timing 1: Manual connection)

● The internal circuit is as shown in Figure 4-12-1:
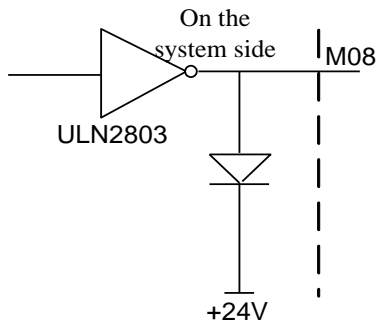
Figure 4-12-1 Internal Circuit for M08

4.13 Feed rate related settings

System parameter number

0	1	2		RDR	FDR		RFO			LRP	RPD

RPD =1: From power on to before the reference point, manual operation will be quickly effective.

     =0: From power on to before the reference point, manual operation will be quickly ineffective.

LRP =1: The positioning (G00) interpolation type is linear.

     =0: The positioning (G00) interpolation type is non-linear.

RFO =1: It will stop when the fast feed and feedrate override is Fo.

     =0: It will not stop when the fast feed and feedrate override is Fo.

FDR =1: Dry cutting will be effective during cutting feed.

     =0: Dry cutting will not be effectiv during cutting feed.

RDR =1: Dry running will be effective during fast positioning.

     =0: Dry running will not be effective during fast positioning.

0086	Dry running speed	2000

Range: 0～9999 (mm/min)

0087	Power Cutting feed rate when the power is on	100

Range: 0～9999 (mm/min)

0088	G0 fast positioning speed of shaft 1	4000

Range: 0～30000 (mm/min)

0089	G0 fast positioning speed of shaft 2	8000

Range: 0～30000(mm/min)

0090	G0 fast positioning speed of shaft 3	8000

Range: 0～30000 (mm/min)

0091	G0 fast positioning speed of shaft 4	8000

Range: 0～30000 (mm/min)

0092	G0 fast positioning speed of shaft 5	8000

Range: 0～30000(mm/min)

0093	Fo speed during fast operatioon override of each shaft (for all shafts)	30

Range: 0～1000 (mm/min)

0094	Maximum feed rate during fast positioning (for all shafts)	8000

Range: 300～30000 (mm/min)

0095	Minimum feed rate during fast positioning (for all shafts)	0

Range: 0～300 (mm/min)

0096	Maximum control rate during cutting feed (for all shafts)	8000

Range: 300～30000 (mm/min)

0097	Minimum control rate during cutting feed (for all shafts)	0

Range: 0～300 (mm/min)

0098	Feed rate during manual (JOG) continuous feed of each shaft	2000

Range: 0～30000 (mm/min)

0099	(FL) speed when pulse signal Z is obtained (for all shafts)	100

Range: 1～60 (mm/min)

0100	Shaft 1 reference point return speed	2000

Range: 0～9999 (mm/min)

0101	Shaft 2 reference point return speed	4000

Range: 0～9999 (mm/min)

Part Four Installation and Connection

0102	Shaft 3 reference point return speed	4000

Range: 0～9999 (mm/min)

0103	Shaft 4 reference point return speed	4000

Range: 0～9999 (mm/min)

0104	Shaft 5 reference point return speed	4000

Range: 0～9999 (mm/min)

0170	Shaft 1 manual fast positioning speed	4000

Range: 0～30000 (mm/min)

0171	Shaft 2 manual fast positioning speed	8000

Range: 0～30000 (mm/min)

0172	Shaft 3 manual fast positioning speed	8000

Range: 0～30000 (mm/min)

0173	Shaft 4 manual fast positioning speed	8000

Range: 0～30000 (mm/min)

0174	Shaft 5 manual fast positioning speed	8000

Range: 0～30000 (mm/min)

4.14 Chuck control

1. Address definitions

Y2							DOQPS	DOQPJ

Y2.0: External chuck clamping output/Internal chuck release output

Y2.1: External chuck release output/Internal chuck clamping output

X1						NQPF	WQPJ	DIQP

X1.0: Chuck release control signal (DIQP)

X1.1: External chuck locking in position/Internal chuck release in position (WQPJ)

X1.2: External chuck release in-position signal/Internal chuck locking in position (NQPJ)

2. Control parameters

K011			BIT5	BIT4	BIT3	BIT2	BIT1	BIT0

K11.0 = 1: With chuck;

= 0: Without chuck.

 Definition of K11.1:

K11.1 =1: External chuck, WQPJ is the external chuck clamping signal and NQPJ is the external chuck release signal;

=0: Internal chuck, NQPJ is the internal chuck clamping signal and WQPJis the external chuck release signal.

K11.2 =1: Chuck release with no detection switch;

=0: Chuck release with detection switch.

K11.3 = 1: Chuck release switch is normally off

=0: Chuck release switch is normally on

K11.4 = 1: Chuck status with power on and automatic output and before power off

=0: Chuck status with power on and automatic non-output

K11.5 = 1: Chuck release is not related to chuck operations

=0: Chuck rotation is prohibited during chuck release and chuck release is prohibited during spindle rotation

T021	Chuck clamping in position detection time ms
T022	Chuck release in position detection time ms

3. Control logic

Signals during external chuck	**Chuck clamping**	WQPJ (X1.1) : Chuck clamping in-position signal
		DOQPJ (Y2.0): Chuck clamping output signal
	Chuck release	NQPJ (X1.2) : Chuck release in-position signal
		DOQPS (Y2.1): Chuck release output signal
Signals during internal chuck	**Chuck clamping**	NQPJ (X1.2) : Chuck clamping in-position signal
		DOQPS (Y2.1): Chuck clamping output signal
	Chuck release	WQPJ (X1.1) : Chuck release in-position signal

		DOQPJ (Y2.0): Chuck release output signal

When the system starts, DOQPJ and DOQPS signals remain the last status before shutdown; DOQPJ and DOQPS signals have non-volatile memory.

When chuck control input (DIQP) is effective, the chuck clamping/chuck release signal will output alternately. That is, every time the chuck control input signal is effective, the output status will be changed once.

Upon reset and emergency stop, the output status of DOQPJ and DOQPS remains unchanged.

4. Sequence diagram
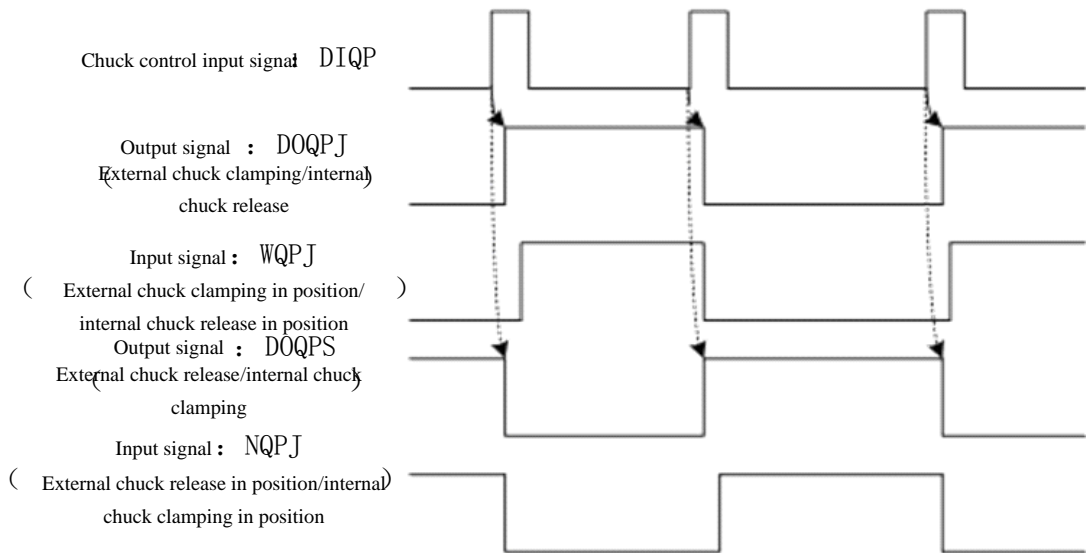
Figure 4-14-1

4.15 Tool change control

A standard ladder diagram currently supports two tool post control logics; an appropriate tool post can be selected by setting parameter K and combining Bit0 and Bit1.

K0001								BIT0

K1.0   Whether to use tool post functions (0 NO, 1 YES)

K1.0=0   Row tool is not used

K1.0=1   Tool post functions are used (to select the corresponding tool post with K2.0 and K2.1)

K0002							BIT1	BIT0

K2.0=0, K2.1=0: Standard electric tool post (adaptable to Chang Zhou tool post)

K2.0=1, K2.1=0: Servo tool post (adaptable to Delta tool post servo, see appendix I)

K2.0=0, K2.1=1: Hydraulic pressure-tool post

K2.0=1, K2.1=1: Yantai tool post

D0000	Total number of tool positions

Normal electric tool post: K2.0=0, K2.1=0, (adaptable to Chang Zhou tool post**)**

1) Control parameters

K0012					BIT3	BIT2		
K0013								BIT0

K12.2　1: Select tool change A mode for the standard tool post

　　　　0: Select tool change B mode for the standard tool post

K12.3　1: Check the tool position signal upon tool change;

　　　　0: Don't check the tool position signal upon tool change.

K13.0　1: The normal tool position signal of the electric tool post is normally on

　　　　0: The normal tool position signal of the electric tool post is normally on

T036	Total tool change time (0-65535ms)
T037	Tool post reverse locking time (0-65535ms)
TMRB09	Delay time of the tool post from forward stop to reverse output (0-65536ms)

2)　Signal address:

X0003	T8	T7	T6	T5	T4	T3	T2	T1
Y0003	TL-	TL+						

3) Tool change B mode (K1.0=1, K2.0=0, K2.1=0, K12.2=0)

① After tool change is executed, the system will output the tool post forward signalTL + and start detecting the tool position signal. After the tool position signal is detected, stop the TL + output. After the time set by the PLC parameter DT47 is delayed, it will output the tool post reverse signal TL-. After the time set by the PLC parameter DT37 is delayed, it will stop the tool post reverse signal TL-. If no target tool position signal is detected within the time set by DT36 and the the tool post reverse signal TL- is stopped, the system will give an alarm.

② If Bit3 of K0012 is set to 1 (to check the tool position signal upon tool change), confirm if the current tool position input signal is consistent with the current tool number upon the tool post reverse time; if not consistent, the system will give an alarm.

③ The Tool Change process ends.

4) Tool change B flow chart
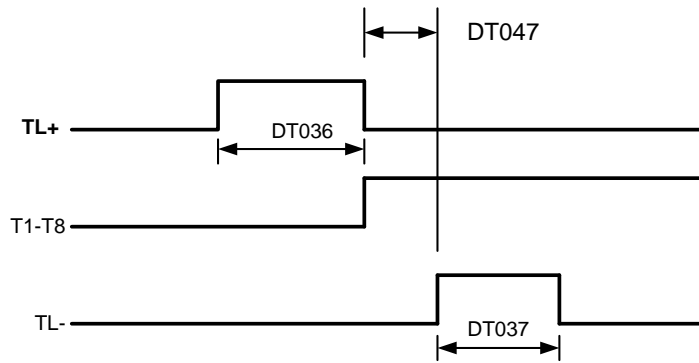
Figure 4-15-1Tool Change Sequence Diagram

4.16 Tailstock control

● Related signals
  DOTWJ: Tailstock advance output signal
  DOTWS: Tailstock back output signal
  DITW: Tailstock control input signal

● Signal diagnosis

Signal	DITW	DOTWJ	DOTWS
Diagnostic address	X1.3	Y2.2	Y2.3
Interface pin	GL200(X1.3)	GL200(Y2.2)	GL200(Y2.3)

● Control parameters

Status parameter

K10			BIT6	BIT5	BIT4	BIT3	BIT2	BIT1	BIT0

BIT0 =1: With automatic tailstock

=0: Without automatic tailstock

BIT1 =1: Spindle rotation allows tailstock to move forward and backward

=0: Spindle rotation allows tailstock to move forward and backward

BIT2 =1: Tailstock forward in-position detection switch

=0: Tailstock forward in-position non-detection switch

BIT3 =1: Tailstock forward output time delay disconnection with timer TMR25

=0: Tailstock forward output remains

BIT4 =1: Tailstock reverse output time delay disconnection with timer TMR26

=0: Tailstock reverse output remians

BIT5 =1: Tailstock reverse in position detection is effective

=0: Tailstock forward in position detection is effective

BIT6 =1: Tailstock detection in-position signal is normally off

=0: Tailstock detection in-position signal is normally on

● Operation sequence
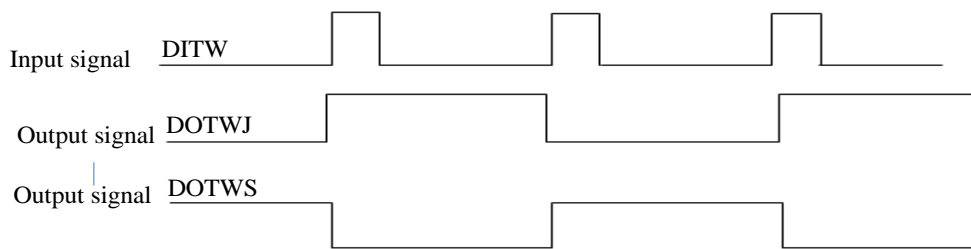
Figure 4-16-1Tailstock Control Sequence

When the system starts, both tailstock forward (DOTWJ) and tailstock backwards (DOTWS) will be ineffective. When tailstock control input (DITW) is effective for the 1st time, tailstock forward will be effective; When tailstock control input (DITW) is effective for the 2nd time, tailstock backwards will be effective. The tailstock forward/tailstock backwards signal will be interlocked and output alternately. That is, every time the tailstock control input signal is effective, the output status will change. Upon execution of code M10, DOTWJ (GL200Y3.2) will input 0V, resulting in tailstock forward; Upon execution of code M11, DOTWS (GL200Y3.3) will output 0V, resulting in tailstock backwards.

4.17 C/S shaft control

1. Address definitions

X018			BIT5					
Y018			BIT5					

X18.5: C/S key

Y18.5: C/S key indicator light

2. Control parameters

K07	BIT7							BIT0
NO037	SCS							

K7.0   =1: With spindle contour control

      =0: Without spindle contour control

K7.7   =1: In the spindle position mode

      =0: In the spindle speed mode

NO37.6   =1: Cs contour control for each spindle

      =0: No Cs contour control for each spindle

NO37.7   =1: With spindle contour control functions

      =0: Without spindle contour control functions

Address T	Definition	Default value
T011	Spindle position mode switch completion time (no detection switch)	1500ms
T013	Spindle speed mode switch completion time (no detection switch)	1500ms

T011: Spindle position mode switch completion time (no detection switch)

T013: Spindle speed mode switch completion time (no detection switch)

3. Function description

GSK980TDHi standard PLC program supports Cs contour control for spindle one.

This function will only be effective when the system parameters and the PLC parameters are set at the same time.

In the automatic mode, execute M14 to switch from the speed mode to the contour control mode; execute M15 to switch from the contour control mode to the speed mode.

In the manual mode, execute driving manual pulse and single-step operations, press the "C/S" key on the panel to switch the spindle control mode. When the spindle is in the contour control mode, the "C/S" key indicator light will be normally on; when it is switched to the contour control mode, the "C/S" key indicator light will flash; when it is in the speed control mode, the "C/S" key indicator light will be off.

When it is reset or not reset during switch, the system will return to the control mode before switching.

When the spindle is in the contour control mode, don't execute spindle operations such as forward, reverse and orientation.

4.18 Shaft 4 related settings

GSK 980TDHi series has 4-shaft, 4-linkage functions..

Set parameter P5 to 4. When the system is powered off and restarts, the shaft 4 function will be effective.

Related parameters:

System parameter number

0	0	9			RAB						

RAB =1: If each shaft rotates as the rotating shaft, it will rotate nearby

=0: If each shaft rotates as the rotating shaft, it will not rotate nearby

System parameter number

0	0	8					AXS4			

AXS4 =1: Set shaft 4 as the rotating shaft

=0: Set shaft 4 as the linear shaft

System parameter number

0	5	0		SIM					REL	

REL =1: The relative position of the index table displays within 360°.

=0: The relative position of the index table displays beyond 360°.

SIM =1: The index code and other control shaft codes trigger an alarm in the same section.

=0: The index code and other control shaft codes trigger no alarm in the same section.

Related parameters**:**

Table 4-16-1

No.	Default value	Range	Meaning
0005	3	3~5	Number of the CNC control shafts
0178	4	0～5	Name of the shaft 4 program (0~5: X,Y,Z,A,B,C)

4.19 Bus servo related settings

System parameter number

0	0	0			SVCD	SEQ	MSP			INI	INM	

INM	=1:	Minimum moving unit of the linear shaft (British)
	=0:	Minimum moving unit of the linear shaft (metric)
INI	=1:	Input unit (British)
	=0:	Input unit (metric)
MSP	=1:	Double-spindle control
	=0:	No double-spindle control
SEQ	=1:	Automatic insertion of sequence number
	=0:	No insertion of sequence number
SVCD	=1:	Bus servo card
	=0:	No bus servo card

System parameter number

0	0	1						SPT	SBUS	RASA

RASA	=1:	Absolute grating
	=0:	No absolute grating
SBUS	=1:	Spindle drive unit in the bus control mode
	=0:	Spindle drive unit in the non-bus control mode
SPT	=1:	Spindle control type (I/O point control)
	=0:	Spindle control type (frequency conversion or others)

System parameter number

0	0	5							ISC	

ISC	=1:	Minimum moving unit: metric0.0001 (mm&deg) , British 0.00001 (inch)
	=0	Minimum moving unit: metric0.001 (mm&deg) , British 0.0001 (inch)

System parameter number

0	2	0			USNO				ITL

ITL	=1:	All shafts are effectively interlocked
	=0:	All shafts are not effectively interlocked

Parameter number

0008	Ethernet bus slave MDT packet size	16

Range: 2. 4. 6. 8, 10, 12. 14. 16. 20

Note: This parameter must not be modified by non-developers..

0009	Maximum number of Ethernet bus retransmissions	10

Range: 0~30

Note: This parameter must not be modified by non-developers.

0380	Set the synchronizing shaft of shaft 4 0: Not with anShaft Y 1: Shaft X 2: Shaft Y 3: Shaft Z	0

Range: 0~3

0381	Maximum allowable error between synchronizing shafts	200

Range: 0~10000

0392	Moving distance when the servo is optimized	50

Range: 0~100

0393	Moving speed when the servo is optimized	2000

Range: 0~5000

0444	To be expanded	50

Range: 0~500

0445	Grating accuracy configured for Shaft 1	0.0010

Range: 0~10

0446	Grating accuracy configured for Shaft 2	0.0010

Range: 0~10

0447	Grating accuracy configured for Shaft 3	0.0010

Range: 0~10

0448	Grating accuracy configured for Shaft 4	0.0010

Range: 0~10

0449	Grating accuracy configured for Shaft 5	0.0010

Range: 0~10

Appendix

Appendix One Servo Tool Post

I. Software version information

1. Software design by the project team of GSK CNC Equipment Co., Ltd.
2. PLC software version: standard version
3. Remarks: (servo tool post, Delta drive)

II. System related signal parameters

1. Input signal

Input port	Pin no.	Signal name	Defined signal function	Remarks (Delta drive, different signals may have different drives)
GL200(X3)	0	X03.0/T1	Tool number position signal	Corresponding servo drive unit CN1 interface 6, 7 pin DO1 signal
	1	X03.1/T2	Tool number position signal	Corresponding servo drive unit CN1 interface 4, 5 pin DO2 signal
	2	X03.2/T3	Tool number position signal	Corresponding servo drive unit CN1 interface 2, 3 pin DO3 signal
	3	X03.3/T4	Tool number position signal	Corresponding servo drive unit CN1 interface 1, 26 pin DO4 signal
	4	X03.4/T5	Tool number position signal	Corresponding servo drive unit CN1 interface 27, 28 pin D05 signal
	+24V	+24V	DC24V	Corresponding servo drive unit CN1 interface 11 pin COM+
	AGND	AGND	DC0V	Corresponding servo drive unit CN1 interface 45, 47, 49 pin COM-
GL200(X2)	6	X2.6/TCP	Servo tool post locking induction signal	Input signal by the proximity switch S8 on the machine tool side. This point will be used when there is only one switch (K12.1=1) (refer to the operating instruction for the machine tool)
	5	X02.7	Servo tool post release detection signal	Tool post releasedetection input signal

2. Output signal

Output port	Pin no.	Signal name	Defined signal function	Remarks
GL200(Y2)	7	Y2.7	Servo start	Corresponding servo drive unit CN1 interface 32 pin DI6 signal
GL200(Y3)	0	Y3.0	NC signal output to drive unit DI1	Corresponding servo drive unit CN1 interface 9 pin tool number selection
	1	Y3.1	NC signal output to drive unit DI2	Corresponding servo drive unit CN1 interface 10 pin tool number selection
	2	Y3.2	NC signal output to drive unit DI3	Corresponding servo drive unit CN1 interface 34 pin tool number selection
	3	Y3.3	NC signal output to drive unit DI4	Corresponding servo drive unit CN1 interface 8 pin tool number selection
	4	Y3.4	Tool post locking signal	Tool post locking output signal
	5	Y3.5	Tool post release signal	Tool post release output signal
	6	Y3.6	Mode switch input MD0	Corresponding servo drive unit CN1 interface 31 pin DI7 signal
	7	Y3.7	Mode switch input MD1	Corresponding servo drive unit CN1 interface 30 pin DI8 signal

Appendix

3. Ladder diagram related parameters

Param eter no.	Set value	Parameter definitions	Remarks
K01.0	1	Whether to use tool post	
K2.0/1	K2.0=1 K2.1=0	Tool post selection	Select the servo tool post
K09.0	1	Whether to use the hydraulic pressure device	980TDHi requires to set K9.1 to 1 and directly start hydraulic pressure without opening this parameter
K12.0	0	Whether the tool post clamping/release signal switch is normally off	To be set based on the tool post switch status
K12.1	0	One input is used for tool post release locking detection	To be set based on the tool post switch status
T038	5000	Tool post locking delay detection	If no X2.6 in-position signal is received within this range after the locking signal is sent, the system will give alarm A5.2
T039	5000	Tool post releasedelay detection	If no X2.6/X3.5 in-position signal is received within this range after the release signal is sent, the system will give alarm A5.0
T040	10000	Servo preparation delay detection time	If no servo preparation readiness signal is detected within this range, the system will give alarm A5.0
T041	10000	Tool post zero return delay detection time	If no zero return is completed within this range, the system will give alarm A5.4
T042	10000	Tool selection control delay detection	If no tool change is completed within this range, the system will give alarm A5.6
T043	100	Tool post locking delay completion	After the servo receives the locking signal, the execution of the next step will be delayed
T044	100	Tool post release delay completion	After the servo receives the release signal, the execution of the next step will be delayed
T045	1000	Delay tool post servo alarm	If the servo alarm signal length exceeds this range, the system will give alarm A6.0
D000	4	Total number of bits of tool posts	To be set based on the tool post provided
D001	0000	Servo alarm code value	DO01-05 corresponding drive manual status binary to decimal code
D002	0001	Servo preparation readiness code value	DO01-05 corresponding drive manual status binary to decimal code
D003	0002	Servo zero returning code value	DO01-05 corresponding drive manual status binary to decimal code

D004	0005	Servo zero return completion code value	DO01-05 corresponding drive manual status binary to decimal code
D005	0004	Servo conversation code value	DO01-05 corresponding drive manual status binary to decimal code
D006	0004	Tool number showing subtrahend	DO01-05 corresponding drive manual status binary to decimal code

2. Related alarms

Alarm No.	Alarm content	Treatment
A5.0/1240	Tool post servo preparation not ready	Check if parameter PLC-TMR040 set is too small Check whether the servo drive is abnormal, whether line DO1-DO5 is open, and whether the input signal is normal. Check whether signals Y2.7, S8(X2.6) are normal and whether the turret hydraulic circuit is normal
A5.1/1241	Tool post servo preparation ready, please reset and execute tool post zero return	Execute zero return for the turret
A5.2/1242	Tool post locking detection error	Check if parameter PLC-TMR038 set is too small Check whether signals Y3.4, S8(X2.6) are normal and whether the turret hydraulic circuit is normal
A5.3/1243	Tool post release detection error	Check if parameter PLC-TMR039 set is too small Check whether signals Y3.5, S8(X2.7) are normal and whether the turret hydraulic circuit is normal
A5.4/1244	Tool post zero return completion signal detection error	Check if parameter PLC-TMR041 set is too small Check whether line DO1-DO5 is open and whether the input signal is normal. Check whether signals Y3.4, S8(X2.6) are normal and whether the turret hydraulic circuit is normal Check whether PLD-D4 is correctly set.
A5.5/1245	Tool post signal error, please re-execute zero return	Please re-execute zero return
A5.6/1246	Servo tool post tool seeking timeout	Check if parameter PLC-TMR042 set is too small Check whether the servo drive is abnormal, whether line DO1-DO5 is open, and whether the input signal is normal.
A6.0/1248	Tool post servo drive unit alarm, please restart	Check if the servo drive unit has an alarm. Restart the machine tool to see if there is still an alarm. Refer to the manual for the drive unit to troubleshoot

Appendix

III. Function description

1. After energized, the system will start the turret servo preparation process and when ready, it will pop up alarm No. A5.1/1241, suggesting that the servo turret has no zero return.

2. Reset to eliminate the alarm No. A5.1/1241.

3. Select "Mechanical Zero Return" and press "Clockwise Tool Selection" or "Counterclockwise Tool Selection" to execute zero return for the turret.

4. Execute code T in the "Automatic Mode" and "Input Mode" or press "Clockwise Tool Selection" or "Counterclockwise Tool Selection" in the "Manual Mode" or "Driving Manual Pulse Mode" to execute the tool change process.

5. Before tool change, the system will automatically check whether the turret has executed tool post zero return; if not, it will execute zero return for the turret and then tool change.

6. Before tool post zero return, check whether the turret servo preparation is ready and if not ready within the value set by parameter PLC-TMR040, the system will pop up timeout alarm No. A5.0/1240.

7. During the servo zero return and tool change process, if the logic sequence is abnormal, then the system will give alarm A5.4/1244 or A5.5/1245.

8. Before servo zero return and tool change, detect whether the oil pressure is activated.

IV. Flow chart and I/O input output control

1. Servo preparation ready

```
┌─────────────────┐
│  Turret servo   │◄──────────────────────┐
│   preparation   │                       │
└─────────────────┘                       │
         │                                │
         ▼                                │
┌─────────────────┐          ┌─────────────────────┐
│Oil pressure start Y0.2│     │   System alarm      │
│Servo enabling   Y2.7  │     │   A5.0/1240:        │
└─────────────────┘          │ Tool post servo not │
         │                   │       ready         │
         ▼                   └─────────────────────┘
┌─────────────────┐                       ▲
│ Cutter locking  │                       │
│ Y3.4:1, Y3.5:0  │                       │
└─────────────────┘                       │
         │                                │
         ▼                                │
┌─────────────────┐  Timeout (parameter TMR038)
│Locking in position│────────────────────┤
│    （X2.6）       │                     │
└─────────────────┘                       │
         │                                │
         ▼                                │
┌─────────────────┐                       │
│Torque reduction │                       │
│  MD0:1  MD1:1   │                       │
│    TL+, TL−     │                       │
└─────────────────┘                       │
         │                                │
         ▼                                │
┌─────────────────┐  Timeout (parameter TMR040)
│Servo preparation│────────────────────────┘
│  D01~D05非0     │
│   T01~T05       │
└─────────────────┘
         │
         ▼
┌─────────────────┐
│   Servo off     │
│     Y2.7        │
└─────────────────┘
         │
         ▼
┌─────────────────┐
│ System alarm    │
│ A5.1/1241:Servo │
│turret without zero return│
└─────────────────┘
         │
         ▼
   ╭─────────────╮
   │ Servo ready │
   ╰─────────────╯
```
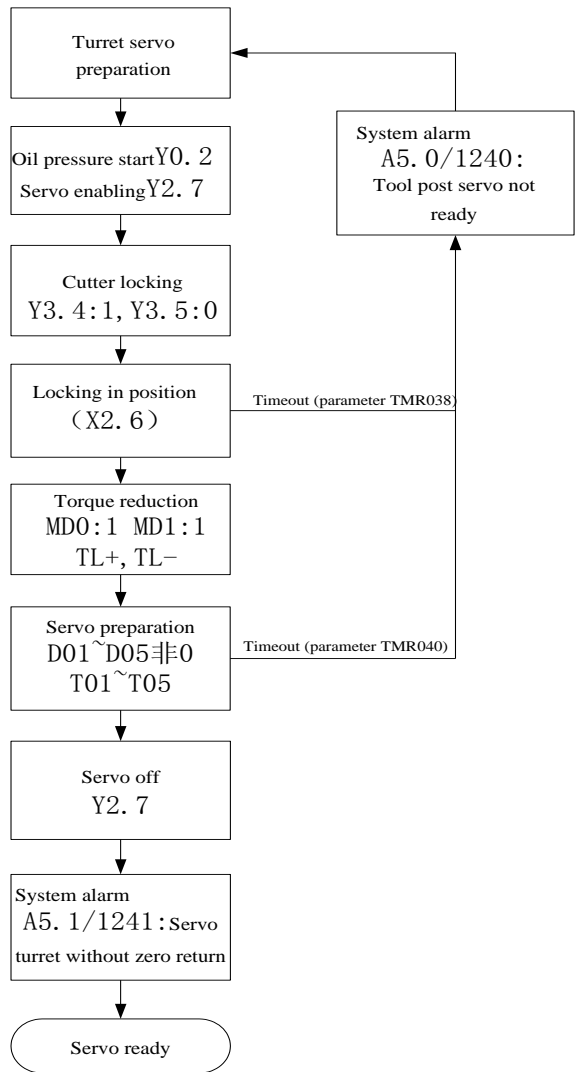
1.1 Output Y0.2 to 1.
1.2 Output Y2.7 to 1.
1.3 Output Y3.6 to 1 and Y3.7 to 0.
1.4 Detect X2.6 and input 1 (timeout alarm).
1.5 Output TL+ to 1 and TL- to 1.
1.6 Check T01, T02, T03, T04 and T05 and any of them other than 0 (timeout alarm).
1.7 Output Y2.7 to 0.

2. Turret origin return

Turret selection control	3.1 Output Y2.7 to 1 with tool post on.
	3.2 Output the tool selection position with DI bits
	3.3 Output Y3.4 to 0 with tool post locking, Y3.8 to 1 with tool post release
Servo on Servo on	3.4 Check S8 (X2.6) to 0 with locking input, X2.7 to 1 with release input (timeout alarm)
	3.5 Output tool selection trigger signal MDO (Y3.6) to 1 and MD1 (Y3.7) to 0
DI output Set the tool selection position	3.6 Check T01 ~ T05 corresponding to bits for tool selection number +4 (time-out alarm).
	3.7 Output Y3.4 to 1 with tool post locking, Y3.5 to 0 with tool post release.
	3.8 Check S8 (X2.6) to 1 with lock input and X2.7 to 0 with release input (time-out alarm).
Release output	3.9 Output MD0 (Y3.6) to 1, MD1 (Y3.7) to 1 with torque reduction
	3.10 Output Y2.7 to 0 with servo off

Check input
S8 off — Time out → System alarm
A5. 3/ 1243
Tool post release detection error

Tool selection trigger output
MD0=1 MD1=0

Check D0 input
D0: tool number +4 — Time out → System alarm
A5.6/1246
Servo tool post tool seeking timeout

Locking output

Check input
S8 on — Time out → System alarm
A5. 2/ 1242
Tool post locking detection error

Torque reduction output
MDO=1 MD1=I

System alarm
A5. 5/ 1245:
If the tool post signal has any error, re-execute zero return

Servo off
Servo off

Tool election end

3. Tool selection control

3.1 Output Y2.7 to 1 with tool post on.
3.2 Output the tool selection position with DI bits
3.3 Output Y3.4 to 0 with tool post locking, Y3.8 to 1 with tool post release
3.4 Check S8 (X2.6) to 0 with locking input, X2.7 to 1 with release input (timeout alarm)
3.5 Output tool selection trigger signal MDO (Y3.6) to 1 and MD1 (Y3.7) to 0
3.6 Check T01 ~ T05 corresponding to bits for tool selection number +4 (time-out alarm).
3.7 Output Y3.4 to 1 with tool post locking, Y3.5 to 0 with tool post release.
3.8 Check S8 (X2.6) to 1 with lock input and X2.7 to 0 with release input (time-out alarm).
3.9 Output MD0 (Y3.6) to 1, MD1 (Y3.7) to 1 with torque reduction
3.10 Output Y2.7 to 0 with servo off

Flowchart box		
Turret selection control		
Servo on / **Servo on**		
DI output / Set the tool selection position		
Release output		
Check input / S8 off	Time out →	System alarm / A5.3/1243 / Tool post release detection error
Tool selection trigger output / MD0=1 MD1=0		
Check D0 input / D0: tool number +4	Time out →	System alarm / A5.6/1246 / Servo tool post tool seeking timeout
Locking output		
Check input / S8 on	Time out →	System alarm / A5.2/1242 / Tool post locking detection error
Torque reduction output / MDO=1 MD1=I		System alarm / A5.5/1245: / , / If the tool post signal has any error, re-execute zero return
Servo off / Servo off		
Tool election end		

Appendix

Appendix II Taiwan Lio Shing Tool Post Wiring Table

GSK980TDHi matches the Taiwan Lio Shing tool post, with K1.0 modified to 1, K2.0 to 0 and K2.1 to 1.

GL200				
GL200 (X3)		+ 24V		+ 24V
	0	T1		Sensor A
	1	T2		Sensor B
	2	T3		Sensor C
	3	T4		Sensor D
	4	T5		Sensor E
GL200 (X2)	6	TCP		Sensor F
GL200 (Y3)	4	TLCOK		Cutter locking solenoid valve
	5	TOPEN		Cutter release solenoid valve
	6	TL +		Cutter forward solenoid valve
	7	TL -		Cutter reverse solenoid valve
		+ 24V		+ 24V
		AGND		0V

Appendix III Ladder Diagram Configuration File Format

Signals in the ladder diagram configuration file LadChixx.txt ("xx" corresponds to the operating ladder diagram file number set by the system) store the following information in a fixed order.

I. Code MM00---M99 signal F and meaning

Format: Mxx + space + Fyyyy + space + Chinese annotations + line break (enter)

Such as: "M00 F0317 program is suspended"

Where, "xx" is **00, 01. 02** ... until **99** in order from top to bottom, for a total of **100** numbers, which order cannot be changed.

"Space" is generally a space and can not be doped with other characters.

"Yyyy" represents that this Code M corresponds to the value of signal F. For example, "F0317 represents F31.7". You can set 0260 to 0337 (Signa F l26.0 to 33.7). If set to "-001", it represents no registration and that the system will not recognize this Code M.

"Chinese annotations" can have 32 characters at most, 16 Chinese characters or Chinese characters + characters of the same number. The same below.

"line break indicates the end of this line and the following characters will not be recognized.   The same below.

II. "%" in a single line indicates the end of information stored by Code M

III. Signal X X0.0---X6.7 code name and meaning

Format: Xxxxx＋space＋Chinese annotations＋line break (enter)

Such as: "X0000   Shaft 1limit signal (for a biswitch, forward) "

Where, "xxxx" represents the value of Signal X. For example, "0000 represents 0.0", "0067 represents 6.7", 0000 to 0067 in order from top to bottom (Signal X from 0.0 to 6.7), which order cannot be changed.

"Space" is generally 5 spaces and can not be doped with other characters. The same below.

IV. Signal Y Y0.0---Y5.7 code name and meaning

Format: Yxxxx＋space＋Chinese annotations＋line break (enter)

Such as :   "Y0000   Lubrication output"

Where, "xxxx" represents the value of Signal Y. For example, "0000 represents 0.0", "0057 represents 5.7", 0000 to 0057 in order from top to bottom (Signal Y from 0.0 to 5.7), which order cannot be changed.

V. Signal K K6.0---K63.7 code name and meaning

Format: Kxxxx＋space＋Chinese annotations＋line break (enter)

Such as: "K0060   Whether there is only one travel limit switch used"

Where, "xxxx" represents the value of Signal K. For example, "0060 represents 6.0",

"0637 represents 63.7", 0060 to 0637 in order from top to bottom (Signal K from 6.0 to 63.7), which order cannot be changed.

"Space" is generally 5 spaces and can not be doped with other characters.

VI. Signal A A0.0---A31.7 code name and meaning

Format: **Axxxx**＋space＋Chinese annotations＋line break (enter)

Such as: "**A0000**   Pneumatic pressure detection error"

Where, "**xxxx**" represents the value of Signal A. For example, "**0000** represents **0.0**", "**0317** represents **31.7**", **0000** to **0317** in order from top to bottom (Signal A **from 0.0** to **31.7**), which order cannot be changed.

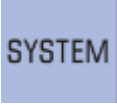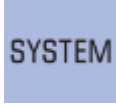"Space" is generally 5 spaces and can not be doped with other characters.

VII. End // End sign

Note: Each line of the above information must be written. Refer to LadChixx.txt, the Ladder Diagram Parameters configuration file in the system. In the corresponding English file LadEngxx.txt, Chinese annotations must be 32 English letters or characters, which is the only difference.

Appendix IV Common Debugging Methods

1.1 Zero return methods and common parameter settings

Press [SYSTEM] and press 【CNC Settings】 under the [SYSTEM] interface to enter the CNC Settings page:

a) Input in the parameter switch 1 for on or 0 for off.

b) Move the cursor to the Permission Settings area. Select the machine tool password and input the original password "111111". This password can be used to change the current password.

Note: The password is not necessarily a number, and it may include an "enter key".

c) Upon modification, if you input the wrong password again or, after power off and restart, input the original password to no effect, you need to re-input the modified password. The original password "111111" may only be effective when the system is initialized.

d) After steps a and b above, you may modify the values displayed in the six interfaces 【Bit Parameters】, 【Parameters】, 【Macro Variables】, 【Pitch Compensation】, 【Bus Configuration】 and 【Ladder Diagram Parameters】.

e) Absolute zero return: Set zero under Bus Configuration as shown below. First move the cursor "Settings" for shaft 1 and press twice the input key until the shaft X zero return indicator light on the system panel is on. Move to "Settings" for shaft 3 and press twice the input key until the shaft Z zero return indicator light on the system panel is on. Finally, input the positive and negative boundaries based on the actual position of the machine tool.

Note: The positive and negative borders are set based on the actual coordinates of the machine tool after you move each shaft and in order to prevent the programmer from inputting too large data and avoid risks of collision. The other shafts are also set as above.

Appendix

Figure 1-1-1

f) Incremental zero return: For details, refer to "I. Incremental zero retsurn" of "4.8.1 Bus servo zero return settings".

g) Upon modification, you can set the parameter switch to 0, to prevent the operator from modifying the system related parameters.

Common parameters:

● Feed shaft and alarm ignoring settings

System parameter number

0	0	0								**PBUS**

PBUS =1: Drive unit transmission mode: bus

=0: Drive unit transmission mode: pulse

Note: The drive unit transmission mode can also be set at "Whether Bus or Not" at the "Bus Configuration" softkey interface of the system.

System parameter number

0	0	3						**DIR3**		**DIR1**

DIR1 =1: Shaft 1 feed direction is to be reversed

=0: Shaft 1 feed direction is not to be reversed.

DIR3 =1: Shaft 3 feed direction is to be reversed

=0: Shaft 3 feed direction is not to be reversed.

If drive unit parameter PA15=1, set the shaft position pulse direction (matched with GE2000 drive unit)

System parameter number

0	0	5							ISC	

   ISC   =1:   Minimum moving unit 0.0001. 0.00001 (inch&deg)

            =0:   Minimum moving unit 0.001. 0.0001 (mm&deg)

  Note: If this parameter is 1 after the system is upgraded, then reduce the gear ratio to 1/10 of the original or modify it to 0.

System parameter number

0	0	6							ZRN

  ZRN   =1:   If the reference point is not established, the instruction other than G28 in automatic operation will give an alarm.

           =0:   If the reference point is not established, the instruction other than G28 in automatic operation will not give an alarm.

System parameter number

0	0	7					ZMI3		ZMI1

  ZMI1   =1:   Set shaft 1 reference point return direction: reverse

            =0:   Set shaft 1 reference point return direction: forward

  ZMI3   =1:   Set shaft 3 reference point return direction: reverse

            =0:   Set shaft 3 reference point return direction: forward

System parameter number

0	1	9			ALS1			ALM3		ALM1

  ALM1   =1:   An alarm will be given when shaft 1 drive unit alarm signal is set to 1

          =0:   An alarm will be given when shaft 1 drive unit alarm signal is set to 0

  ALM3   =1:   An alarm will be given when shaft 3 drive unit alarm signal is set to 1

          =0:   An alarm will be given when shaft 3 drive unit alarm signal is set to 0

  ALS1   =1:   An alarm will be given when spindle 1 drive unit alarm signal is set to 1

          =0:   An alarm will be given when spindle 1 drive unit alarm signal is set to 0

System parameter number

0	6	1		FALM	LALM	EALM	SALM	AALM			SSC

Appendix

SSC	=1:	Constant speed control
	=0:	No constant speed control
AALM	=1:	Ignore the external user alarm
	=0:	Don't ignore the external user alarm
SALM	=1:	Ignore the spindle drive unit alarm
	=0:	Don't ignore the spindle drive unit alarm
EALM	=1:	Ignore the emergency stop alarm
	=0:	Don't ignore the emergency stop alarm
LALM	=1:	Ignore the hard limit alarm
	=0:	Don't ignore the hard limit alarm
FALM	=1:	Ignore the feed shaft drive unit alarm
	=0:	Don't ignore the feed shaft drive unit alarm

系统 K 参数

0	1	6				**Bit4**	**Bit3**	**Bit2**	**Bit1**	**Bit0**

Bit0	=1:	Shaft X key direction is to be reversed
	=0:	Shaft X key direction is not to be reversed
Bit1	=1:	Shaft Y key direction is to be reversed
	=0:	Shaft Y key direction is not to be reversed
Bit2	=1:	Shaft Z key direction is to be reversed
	=0:	Shaft Z key direction is not to be reversed
Bit3	=1:	Shaft 4 key direction is to be reversed
	=0:	Shaft 4 key direction is not to be reversed
Bit4	=1:	Shaft C key direction is to be reversed
	=0:	Shaft C key direction is not to be reversed

- **Multi-shaft settings**

Parameter No.005

0	0	5	Number of CNC control shafts

Note: Set parameters 0005 to 5 and CNC control shaft to shaft 5 and the system wll prompt that you need to power off and restart the system.

- **Gear ratio settings**

Parameter No.160

1	6	0	Shaft 1 instruction multiplication factor (CMR)

Parameter No.161

1 6 1	Shaft 2 instruction multiplication factor (CMR)

Parameter No.162

1 6 2	Shaft 3 instruction multiplication factor (CMR)

Parameter No.163

1 6 3	Shaft 4 instruction multiplication factor (CMR)

Parameter No.164

1 6 4	Shaft 5 instruction multiplication factor (CMR)

Parameter No.165

1 6 5	Shaft 1 instruction division factor (CMD)

Parameter No.166

1 6 6	Shaft 2 instruction division factor (CMD)

Parameter No.167

1 6 7	Shaft 3 instruction division factor (CMD)

Parameter No.168

1 6 8	Shaft 4 instruction division factor (CMD)

Parameter No.169

1 6 9	Shaft 5 instruction division factor (CMD)

In addition to setting the above parameters, you can also set PA12, PA13 for each shaft in the 【+ Bus Setting】 servo interface for the system gear ratio (matched with GE2000 drive unit)

● **Tool post settings**

Open the parameter K interface to select the following tool post model

K1.0=0, row tool post
K1.0=1, K2.0=0, K2.1=0: standard electric square tool post
K1.0=1, K2.0=1, K2.1=0: Servo tool post (matched with Delta servo-tool post)
K1.0=1, K2.0=0, K2.1=1: (matched with Lio Shing Hydraulic Pressure-tool post)
K1.0=1, K2.0=1, K2.1=1: Yantai tool post

1.2 Chuck control

Press Ladder diagram to enter the 【Ladder Diagram Parameters】 soft key interface to select related K parameters
K11.0=1 (with chuck)
K11.1 (whether chuck is an inner card)
K11.2 (whether chuck release has no detection switch)

1.3 Tailstock control

Press Ladder diagram to enter the 【Ladder Diagram Parameters】 soft key interface to select related K parameters

K10.0=1 (With automatic tailstock)

1.4 Hydraulic pressure start

Press Ladder diagram to enter the 【Ladder Diagram Parameters】 soft key interface to select related K parameters

K9.0=1 (with hydraulic pressure device)

K9.1=1 (Control hydraulic pressure with USER1)

1.5 Cs shaft settings

Steps for Cs:

1. Parameter NO37, Bit7 = 1 (with Cs contour control)

2. Ladder diagram parameter K7.0 = 1 (with spindle contour control), K7.7 = 1 (in the spindle position mode)

3. In the manual mode, press the CS shaft system on the panel to change from the speed mode to the position mode or input M14 to enable the CS shaft. Also press the CS shaft on the panel or M15 in the manual mode to disable the CS shaft.

Notes: The above parameters should be set based on the machine tool or the actual conditions of the system. For more details, refer to Chapter Four Machine Tool Debugging, Part Four Installation and Connection in this manual.

Appendix