This user manual describes all items concerning the operation of this CNC system in detail. 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 considered impractical or unallowable.

Preface

Your Excellency,

We are honored by your purchase of this GSK 25i Milling Machining Center CNC System made by GSK CNC Equipment Co., Ltd.

This book is “PLC Programming and Connection” section of the User Manual Volume Ⅱ.

⚠ This system can only be operated by authorized and qualified personnel as improper operation may cause accidents. Please carefully read this manual before use!

Special caution:

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

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

Warning and Precaution

Please read this manual and a manual from machine tool builder carefully before installation, programming and operation, and strictly observe the requirements.

This manual includes the precautions for protecting user and machine tool. The precautions are classified into Warning and Caution according to their bearing on safety, and supplementary information is described as Note. Read these Warnings, Caution and Note carefully before operation.

Warning

User may be injured or equipment be damaged if operations instructions and procedures are not observed.

Caution

Equipment may be damaged if operation instructions or procedures are not observed.

Note

It is used to indicate the supplementary information other than Warning and Caution.

Announcement

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

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 a machine tool with this CNC system are determined by machine tool builder's design, so functions and technical indexes are subject to the user manual from machine tool builder.
- Refer to the user manual from machine tool builder for function and meaning of keys on control panel.

Precautions

■ Delivery and storage

- Packing box over 6 layers in pile is not allowed.
- Never climb the packing box, neither stand on it, nor 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, isolation and drenching.

■ Open-package inspection

- Confirm that the products are the required ones.
- Check that the products are not damaged in delivery.
- Confirm that the parts in packing box are in accordance with the order.
- 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

- Only competent personnel are supposed to inspect the System or machine.
- Switch off power supply before troubleshooting or changing components.
- Check for 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 trained with the safety operation of CNC system and familiar with the safety operation procedures.

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

——Be responsible for the failure to observe the provisions for operation, adjustment, maintenance, installation and storage in the manual.

All specifications and designs herein are subject to change without further notice.

This manual is reserved by end user.

We are full of heartfelt gratitude to you for supporting us in the use of GSK's products.

Contents

Part 1 Programming

1 Sequence Program Creating Process

1.1 GSK25i PLC specifications

Specification of GSK25i PLC are as follows(see Table 1-1):

Table 1-1

Specification	GSK25i PLC
Programming method language	Ladder, command table
Number of ladder level	2
1st level execution period	8ms
Mean processing time of basic command	0.5(μs/step)
Program capacity	12000 steps
Command	P：10 Functional command：44
Internal relay （R） Data table （D） Meter （C） Timer （T） PLC alarm detection （A） Keep relay （K） Label （L） Subprogram （P）	1100 bytes（R0 to R1099） 1860 bytes （D0 to D1859） 400 bytes （C0 to C399）100PCS 200 bytes （T0 to T199）100PCS 32 bytes(A0 to A31) 32 bytes(K0 to K31) 9999（L1～L9999） 512（P1～P512）
Machine →PLC(X) PLC→machine (Y) CNC→PLC(F) PLC→CNC(G)	128 bytes（X0 to X127） 128 bytes （Y0 to Y127） 256 bytes （F0 to F255） 256 bytes （G0 to G255）

1.2 What ’s a Sequence Program

A sequence program is a program for sequence control of machine tools and other systems.

The program is converted into a format to enable CPU execute encoding and arithmetic processing, and stored into RAM. CPU reads out every instruction stored in the memory at a high-speed and executes the program by arithmetic operation

The sequence program is written firstly from ladder.

1.3 Assignment of interface specifications（step 1）

After deciding the control object specification, calculate the number of input/output signal points, create the interface specification.

For input/output interface signals, see *Ⅱ **Connection.***

1.4 Establishment of ladder diagram（step 2）

Express the control operations decided by 25i ladder diagram. For the timer, meter, etc, which cannot be expressed with relay symbol, are expressed with the functional instructions.

The edited ladder should be converted into the corresponding PLC instruction i.e. instruction list to store.

1.5 Sequence program debugging（step 3）

The sequence program can be debugged in two ways:

1） Debug by simulator

Instead of the machine, connect a simulator (consisting of lamps and switches). Switch ON/OFF stands for the input signal state of machine, lamp ON/OFF for the output signal state.

2） Actual operation debugging

Debug sequence program through operating the machine. Do measures against the unexpected affairs before debugging.

2 Sequence Program

Since PLC sequence control handled by software and operates on principle difference from a general relay circuit, the sequence control method must be fully understood in order to design PLC sequence program.

2.1 Execution process of sequence program

In general relay control circuit, each relay operates at approximately the same time, in the figure below for example, when relay A operate, the relay D and E operate at approximately the same time(when contacts B and C are off)., In PLC sequence control, each relay of circuit operates sequentially. When relay A operates, relay D operates, then relay E. Thus each relay operates in sequence (Programmed sequence) which can be written as a ladder diagram, see Fig.2-1 (a).

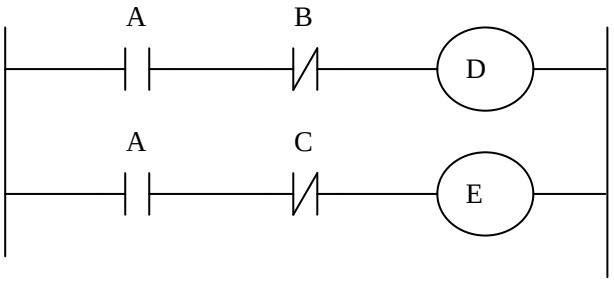


Fig. 2-1(a)

Fig.2.1(b) and (c) illustrate operations varying from the relay circuit to PLC programs.

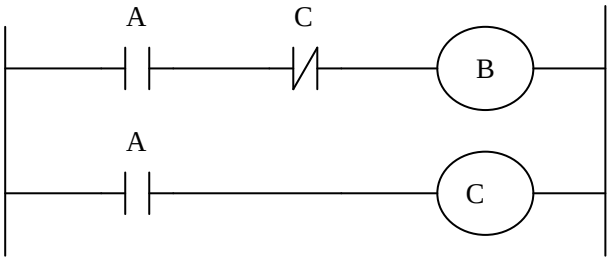


Fig. 2-1(b)

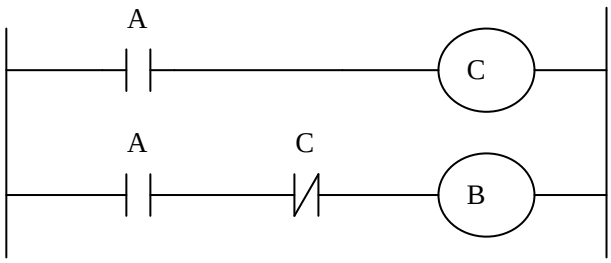


Fig.2-1(c)

(1) Relay circuit

In Fig. 2.1(b) and (c), the operations A and B are the same. Turning on A turns on B and C. Turning on C turns off B.

In Fig.2.1(b), as in the relay circuit, turning on A turns on B and C, and after one cycle of the PLC sequence, turns off B. But in Fig.2.1(c), turning on A turns on C, but B does not turn on

2.2 Repetitive cycle

The PLC executes the ladder diagram from the beginning to the end . When the ladder diagram ends, the program starts over from the beginning. This is called repetitive operation.

The execution time from the beginning to the end of the ladder diagram is called the sequence processing time. The shorter the process time is, the better the signal response becomes.

2.3 Priority of execution(1st level, and 2nd level)

GSK25i PLC consists of two parts: 1st level sequence part, 2nd level sequence part. They have different execution period.

The 1st level sequence part operates every 8 ms, which can deal with the short pulse signal with high-speed response). For example: Emergency stop, Jump, Overtravel etc. EDN1 command is edited when the first program is not used.

The 2nd level sequence part operates every 8*n ms. Here N is a dividing number for the 2nd level sequence part. The 2nd level sequence part is divided into n part, and every part is executed every 8ms.

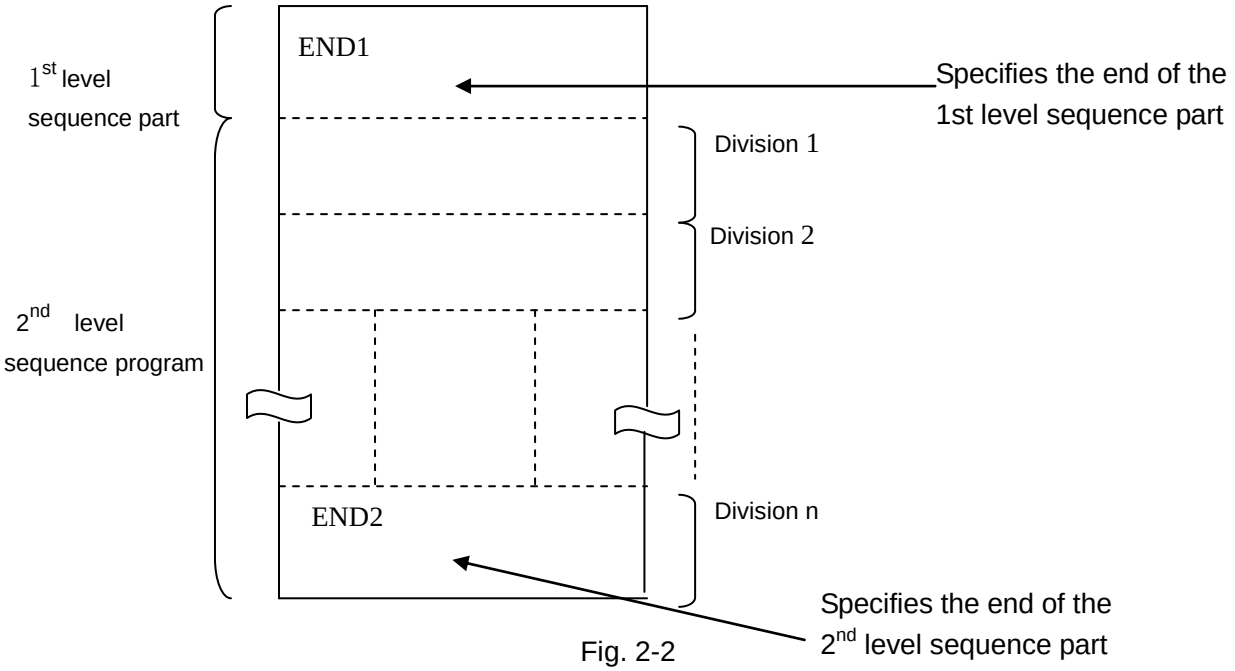


Fig. 2-2

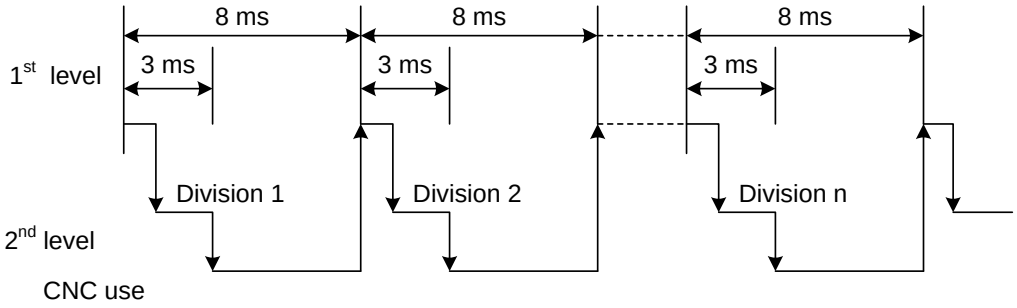


Fig. 2-3

After the last 2nd level sequence part (division n) is executed, the sequence program is executed again from the beginning. Thus, when the dividing number is n, the cycle of execution is 8*n ms. The 1st level sequence operates every 8ms, and the 2nd level sequence every 8*n ms. If the steps of the 1st level sequence is increased, the steps of the 2nd level sequence operating within 8ms becomes less, thereby increasing the dividing number and making the processing time longer. Therefore, it is desirable to program so as to reduce the 1st level sequence to a minimum.

2.4 Sequence program structure

With the conventional PLC, a ladder program is described sequentially. By employing a ladder language that allows structured programming, the following benefits are derived:

1. A program can be understood and developed easily
2. A program error can be found easily.
3. When an operation error occurs, the cause can be found easily.

Three major structured programming capabilities are supported:

1） Subprogram

A subprogram can consist of a ladder sequence as the processing unit.

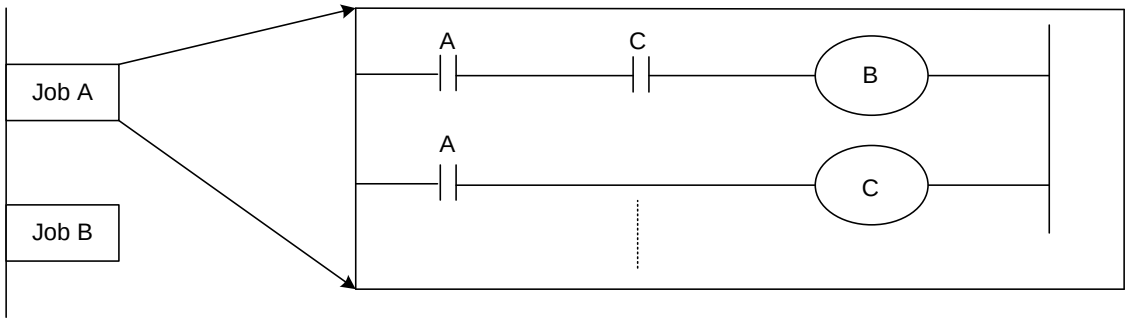


Fig. 2-4

2) Nesting

The Ladder subprograms can call the other ladder subprogram to execute the job.

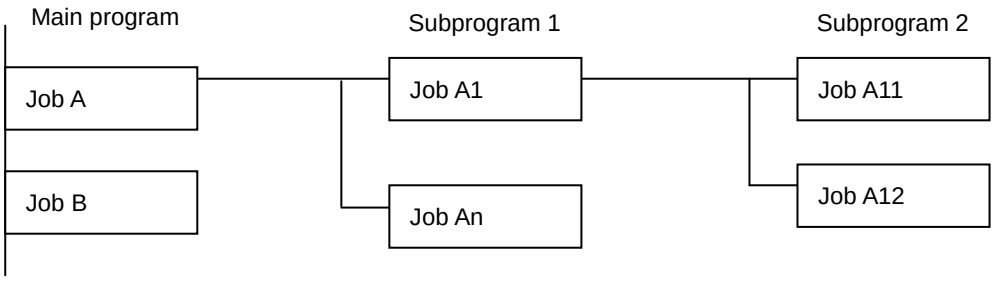


Fig. 2-5

3) Conditional branch

The main program loops and checks whether conditions are satisfied. If a condition is satisfied, the corresponding subprogram is executed. If the condition is not satisfied, the subprogram is jumped.

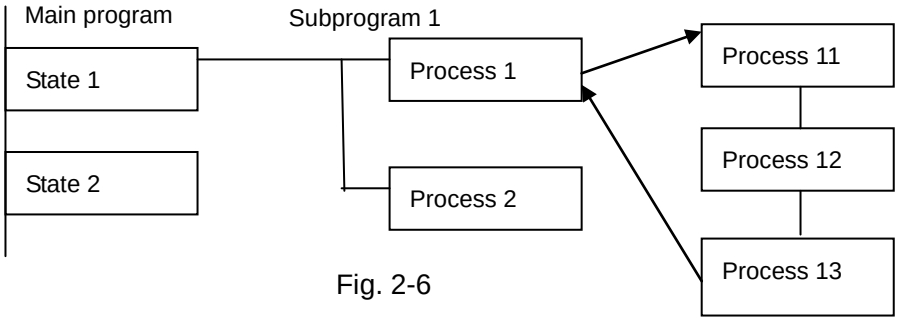


Fig. 2-6

2.5 Processing I/O (input/output) signals

Input signal processing:

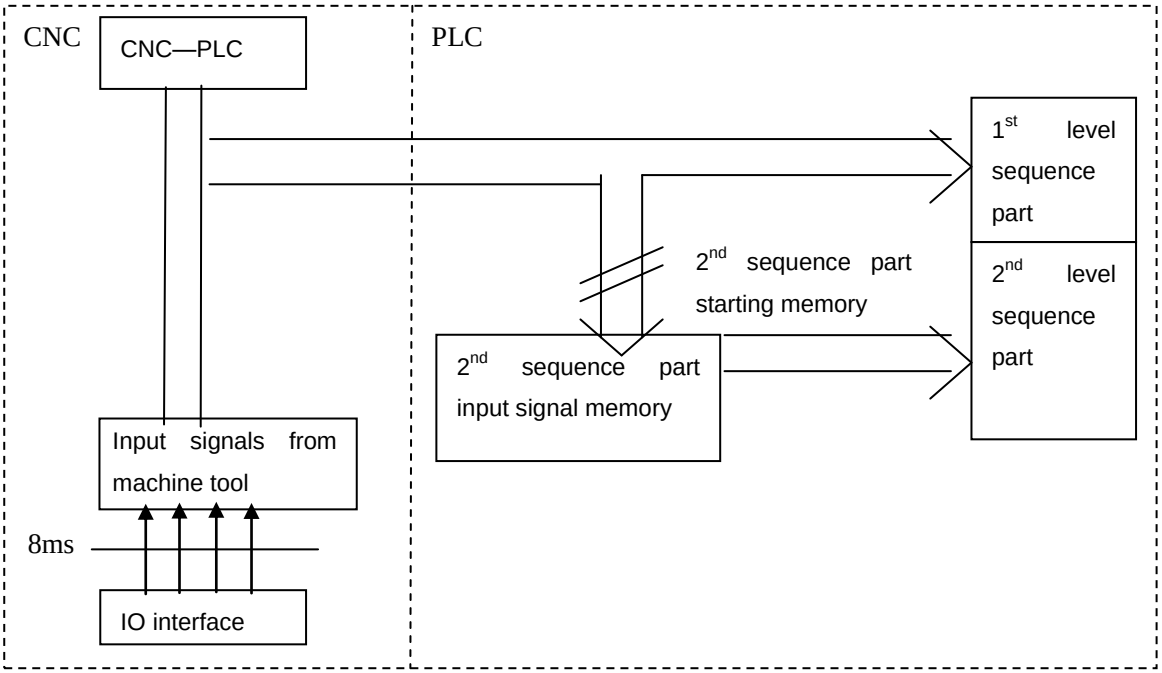


Fig. 2-7

Output signal processing:

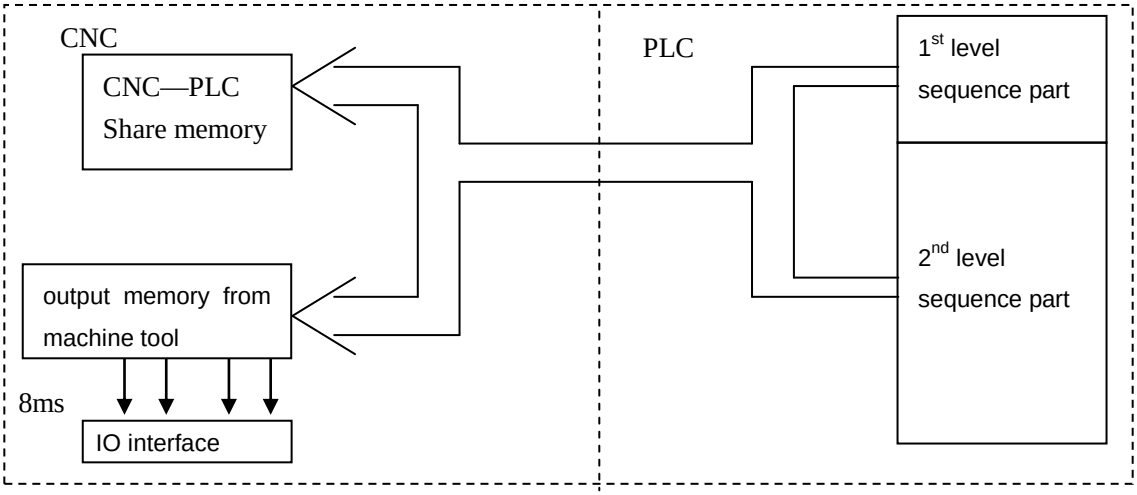


Fig. 2-8

2.5.1 Input signal processing

（1）Input memory of NC

The input signals from NC are loaded in memory of NC and are transferred to the PLC at intervals of 8ms. Since the 1st level sequence part directly refer to these signal and process operations.

（2）Input signal memory to machine tool

The input signal memory stores signals transferred from the machine tool at intervals of 8ms period. Since the 1st level sequence part directly refer to these signal and process operations.

（3）2nd level input signal memory

The 2nd level input signal memory is also called as 2nd level synchronous input signal memory. The stored signals are processed by the 2nd level sequence part. State of the signals set this memory synchronizes with that of 2nd level sequence part.

Input memory Signals from NC and machine tool are transferred to the 2nd level input signal memory only at the beginning of execution of the 2nd level sequence part. Therefore, the state of the 2nd level synchronous input signal memory does not change from the beginning to end of the execution of the 2nd level sequence part.

2.5.2 Output signal processing

（1）NC output memory

The output signals are transferred form the PLC to the NC output memory at intervals of 8ms.

（2）Output signals to machine tool

Output signal to the machine tool from PLC output signal memory to the machine tool at intervals of 8ms.

Note:

The state of the NC input memory, NC output memory, input signals from machine, input/output memory signals to machine can be checked by using the PC self-diagnosis function. The self-diagnosis number specified is the address number used by the sequence program.

2.5.3 Synchronous processing the short pulse signal

1st program can process the short pulse signal. When the short pulse signal change is less than 8ms, i.e. when the system executes the 1st program, the input signal state can change to cause the followings.

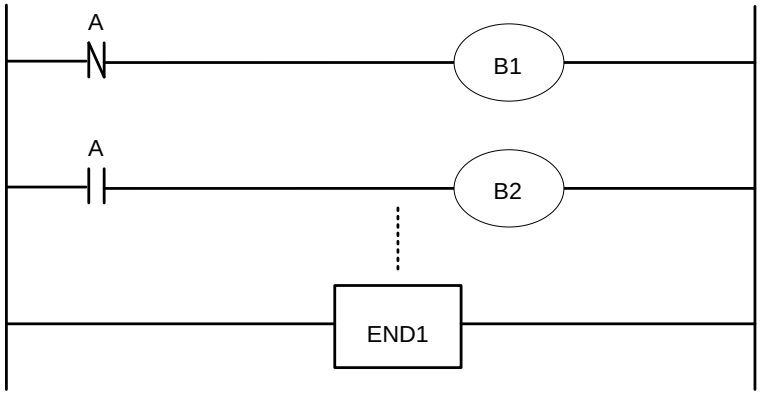


Fig. 2-9

When A＝0 and B1＝1，A becomes 1, at the moment, the system executes the next ladder statement to make B2＝1. so, B1 and B2 become 1.

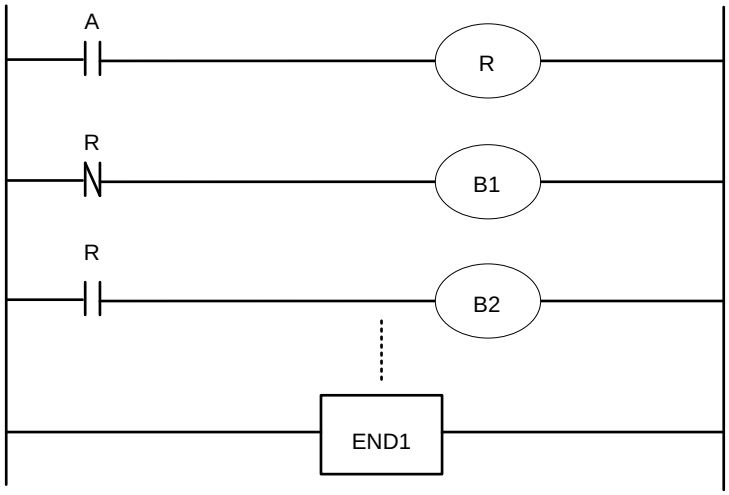


Fig. 2-10

When the medium relay R synchronously processes the signal A, B1, B2 are not 1 at the same time.

2.5.4 Difference state of signals between 1st level and 2nd level

The state of the same input signal may be different in the 1st level and 2nd level sequences as different input memory are used. That is, at 1st level, processing is performed using input signal memory and at 2nd level, processing is performed using the 2nd level synchronous input signal memory. Therefore, it is possible for a 2nd level sequence execution at the worst, compared with a 1st level input signal.

This must be kept in mind when writing the sequence program.

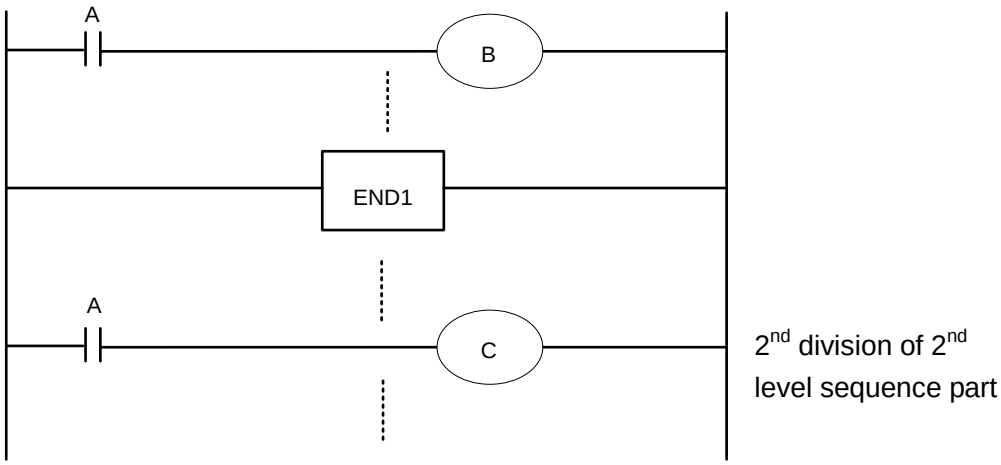


Fig. 2-11

When the processing is 1st 8ms, A=1, and B=1 after 1st sequence part is executed. At the same time, 2nd sequence part is started to execute A=1 is stored to the 2nd sequence part and the 1st division of 2nd sequence part is executed.

When the processing is 2nd 8ms, A=0, and B=0 after 1st sequence part is executed. And then 2nd division of 2nd sequence part is executed, at this time, A is still 1. So C=1.

So, B and C are different.

2.6 Interlocking

Interlocking is externally important in sequence control safety.

Interlocking with the sequence program is necessary. However, interlocking with the end of the electric circuit in the machine tool magnetic cabinet must not be forgotten. Even though logically interlocked with the sequence program (software), the interlock will not work when trouble occurs in the hardware used to execute the sequence program. Therefore, always provide an interlock inside the machine tool magnetic cabinet panel to ensure operator safety and to protect the machine from damage.

3 Address

An address shows a signal location. Addresses include input/output signals with respect to the machine, the input/output signals with respect to the CNC, the internal relays, the meters, the timer, the keep relays, and data table. Each address consists of an address number and a bit number. Its serial number regulations are as follows:

Address regulations:

The address comprises the address type, address number and the bit number in the format as shown below:

X 000. 6
Type Address number Bit number

Type: including X, Y, R, F, G K, A, D ,C, T

Address number: decimal serial number stands for one byte.

Bit number: octal serial number, 0～7 stands for 0～7 bit of byte of front address number

GSK25i PLC address type is as follows Fig.3-1：

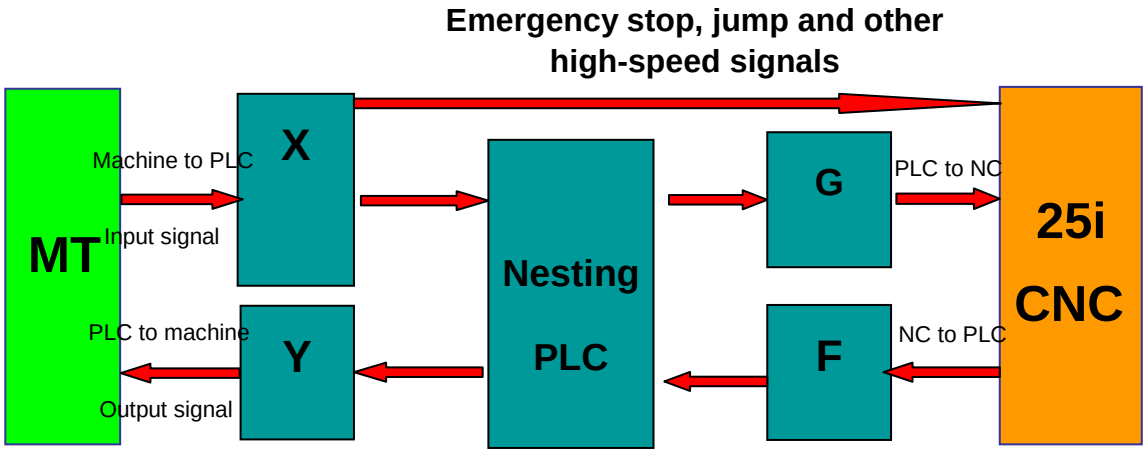


Fig. 3-1

Table 3-1

Address	Address explanation	Address range
X	machine→PLC(128 bytes)	X0～X127
Y	PLC→machine(128 bytes)	Y0～Y127
F	CNC→PLC(256 bytes)	F0～F255
G	PLC→CNC(256 bytes)	G0～G255
R	Internal relay(1100 bytes)	R0～R1099
D	Data register(1860 bytes)	D0～D1859
C	Counter (400 bytes)	C0～C 399
T	Timer (200 bytes)	T0～T199
A	Timer preset data register (32 bytes)	A0～A31
K	Keep relay（32 bytes）	K0～K31

3.1 Machine →PLC address（X）

X addresses of GSK25i PLC are divided into three:

1. X addresses are assigned to IO input interface.
2. X addresses are assigned to the input press keys on MDI panel.
3. X addresses are assigned to other external interfaces, such as the spindle, MPG control signal input.

3.1.1 Assignment of IO module X address

The addresses are from X9 to X119. Its type is INT8U, 111 types.

The signal specification of X addresses can be customized by customer according to the actual operation. X addresses are used to connect the machine tool with the ladder. For the initial definition of input address, see ***Chapter Four Connection.***

3.1.2 Assignment of MDI panel X address

The addresses are from X0 to X8, 9 bytes. They correspond to the press keys on MDI panel. The corresponding relationship between them and the press keys on the standard panel is as Fig. 3-2:

Table 3-2

INPUT KEY ON OPERATION PANEL	PLC ADDRESS	INPUT KEY ON OPERATION PANEL	PLC ADDRESS
Auto mode	X0.0	-Z	X3.5
Edit mode	X0.1	-4	X3.6
MDI mode	X0.2	-5	X3.7
Manual mode	X0.3	Spindle CCW	X4.0
MPG mode	X0.4	Spindle stop	X4.1
Zero mode	X0.5	Spindle CW	X4.2
DNC mode	X0.6	Spindle orientation	X4.3
USER1	X0.7	F0 / 0.001	X4.4
Single block	X1.0	25% / 0.01	X4.5
Jump	X1.1	50% / 0.1	X4.6
Machine lock	X1.2	100% / 1	X4.7
Auxiliary lock	X1.3		
+4	X1.4		
+Z	X1.5		
-Y	X1.6	Tool magazine in feed	X5.3
+5	X1.7	Tool retraction	X5.4
Dry run	X2.0	Tool change manipulator	X5.5
Overtravel release	X2.1	Tool magazine CCW	X5.6
Optional stop	X2.2	Tool magazine zero	X5.7
Program restart	X2.3	Clamp/release	X6.0
+X	X2.4	USR2	X6.1
Rapid	X2.5	USR3	X6.2
Step	X2.6	USR4	X6.3
-X	X2.7	Feed hold	X6.4
Cooling	X3.0	Cycle start	X6.5
Lubricating	X3.1	Tool magazine CCW	X6.6
Chip removal	X3.2	Feedrate override, up to 24-gear(no output light)	X7.0-X7.4
Working light	X3.3	Spindle override, up to 16-gear（no output light）	X8.0-X8.3
+Y	X3.4	Emergency stop	X8.4

3.1.3 MPG signal input X address

Table 3-3

MPG signal input	PLC address
HDC0_STP （MPG emergency stop signal）	X121.0
HDC0_MX100（MPG federate override）	X120.0
HDC0_MX10 （MPG federate override）	X120.1
HDC0_MX1 （MPG federate override）	X120.2
HDC0_5 （5th axis）	X120.3
HDC0_4 （4th axis）	X120.4
HDC0_Z （Z axis）	X120.5
HDC0_Y （Y axis）	X120.6
HDC0_X （X axis）	X120.7

3.2 PLC→machine side address（Y）

Y addresses of GSK25i PLC are divided into three:

1. Y addresses are assigned to IO input interface.
2. Y addresses are assigned to the indicators on MDI panel.
3. Y addresses are assigned to the indicators on MPG.

3.2.1 Y address of I/O output interface

The addresses are from Y8 to Y119. Its type is INT8U, 112 types.

The signal specification of Y addresses can be customized by customer according to the actual operation. Y addresses are used to connect the machine tool with the ladder. For the initial definition of input address, see *Chapter Four Connection*.

3.2.2 Assignment of IO module Y address

The addresses are from Y0 to Y7, 8 bytes. They correspond to the indicators on MDI panel.

Addresses and indicators are as the following Table.3-4:

Table 3-4

OUTPUT KEY ON OPERATION PANEL	PLC ADDRESS	OUTPUT KEY ON OPERATION PANEL	PLC ADDRESS
Auto key indicator	Y0.0	-Z key indicator	Y3.5
Edit key indicator	Y0.1	-4 key indicator	Y3.6
MDI key indicator	Y0.2	-5 key indicator	Y3.7
Manual key indicator	Y0.3	Spindle CCW key indicator	Y4.0
MPG key indicator	Y0.4	Spindle stop key indicator	Y4.1
Zero key indicator	Y0.5	Spindle CW key indicator	Y4.2
DNC key indicator	Y0.6	Spindle orientation key indicator	Y4.3
USER1 key indicator	Y0.7	F0／0.001 key indicator	Y4.4
Single block key indicator	Y1.0	25%／0.01 key indicator	Y4.5
Jump key indicator	Y1.1	50%／0.1 key indicator	Y4.6
Machine lock indicator	Y1.2	100%／1 key indicator	Y4.7
Auxiliary lock indicator	Y1.3	Tool magazine infeed key indicator	Y5.3
+4 key indicator	Y1.4	Tool retraction key indicator	Y5.4
+Z key indicator	Y1.5	Tool change key indicator	Y5.5
-Y key indicator	Y1.6	Tool magazine CCW key indicator	Y5.6
+5 key indicator	Y1.7	Tool magazine zero key indicator	Y5.7
Dry run key indicator	Y2.0	Clamp/release tool key indicator	Y6.0
Overtravel release key indicator	Y2.1	USR2 key indicator	Y6.1
Optional stop key indicator	Y2.2	USR3 key indicator	Y6.2
Program restart key indicator	Y2.3	USR4 key indicator	Y6.3
+X key indicator	Y2.4	Feed hold key indicator	Y6.4
Rapid key indicator	Y2.5	Cycle start key indicator	Y6.5
Step key indicator	Y2.6	Tool magazine CW key indicator	Y6.6
-X key indicator	Y2.7	X zero return indicator	Y7.0
Cooling key indicator	Y3.0	Y zero return indicator	Y7.1
Lubricating key indicator	Y3.1	Z zero return indicator	Y7.2
Chip removal key indicator	Y3.2	4^{th} zero return indicator	Y7.3
Working light key indicator	Y3.3	5^{th} zero return indicator	Y7.4
+Y key indicator	Y3.4	System alarms	Y7.6

3.2.3 MPG signal light output

MPG signal light output	Y120.0

3.3 PLC→CNC address（G）

Addresses are from G0 to G255. Type: INT8U,256 bytes. G addresses are the signals from PLC to NC, and these signals have been defined in designing the CNC system and cannot be modified. The concrete is referred to Appendix 1.

3.4 CNC→PLC address（F）

Addresses are from F0 to F255. Type: INT8U,256 bytes. F addresses are the signals from NC to PLC, and these signals have been defined in designing the CNC system and cannot be modified. The concrete is referred to Appendix 1.

3.5 Internal relay address（R）

The address area is cleared to zero when the power is turned on.
Type: INT8U, with 1100 bytes.

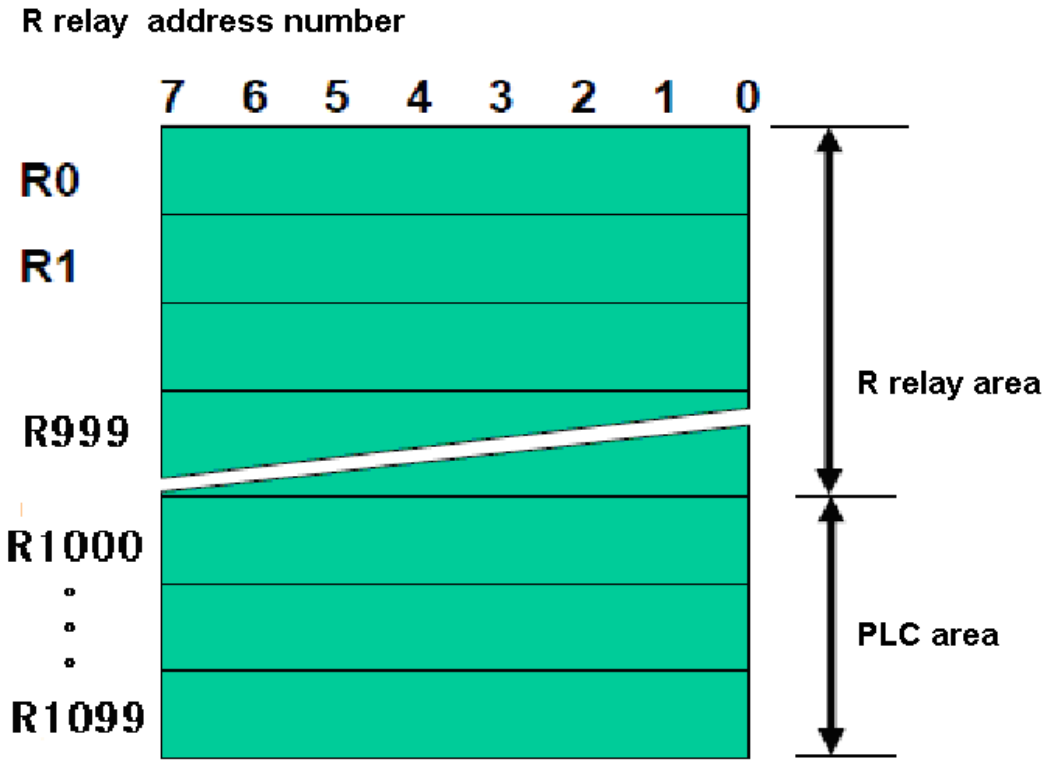


Fig. 3-2

Note: the addresses from R1000 are used by PLC. For example: ADDB, SUBB functional command operation result are output to the register:

	#7	#6	#5	#4	#3	#2	#1	#0
R1000		Overflow					Negative	Zero

Fig. 3-3

3.6 Address of keep relay（K）

The area is used for the keep relays and PLC parameters. Since this area is nonvolatile, the content of the memory do not disappear even when the power is turned off.

Type: INT8U, with 32 bytes

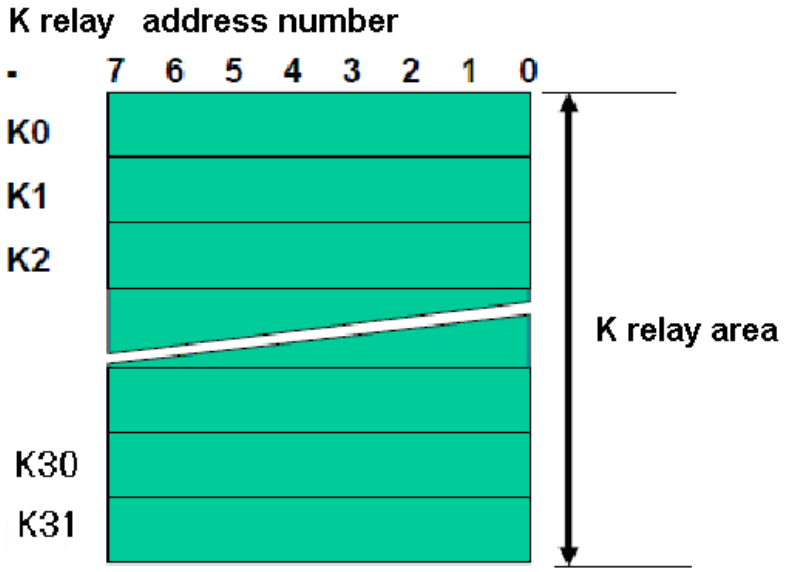


Fig. 3-4

3.7 Addresses(A) for message selection

The address area is cleared to zero when the power is turned on.

Type: INT8U, with 32 bytes.

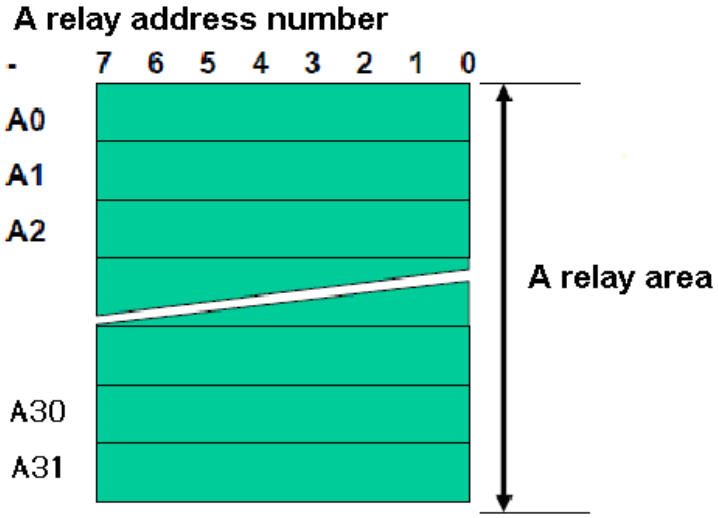


Fig. 3-5

3.8 Address of counter（C）

The area is used as storing current counting value in meter.

Type: 400 bytes.

C1～C100: count range: 0～65535, can set increase/reducing count, and the counting value does not disappear even when the power is turned off.

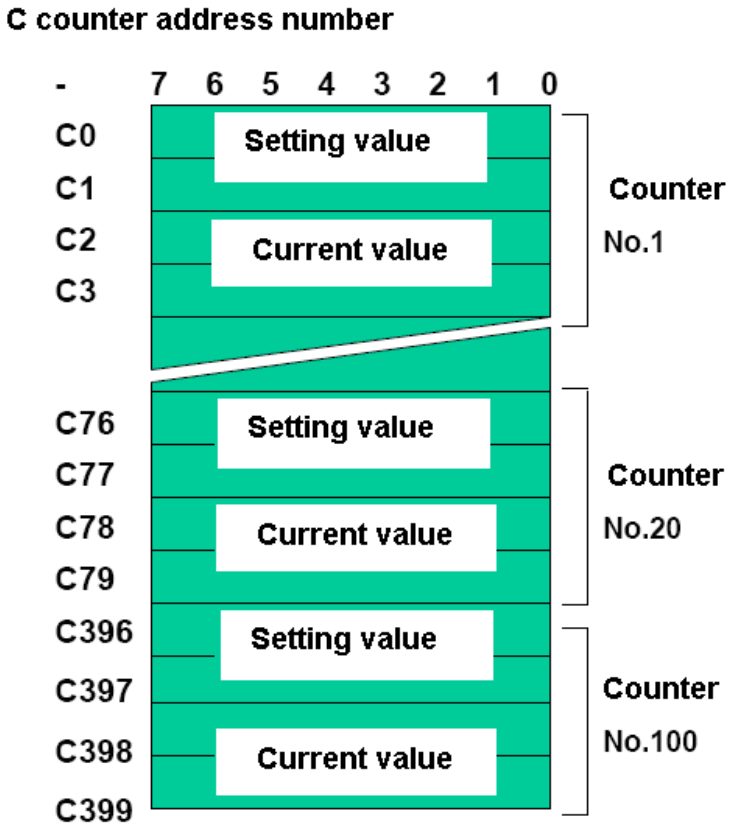


Fig. 3-6

3.9 Address of timer （T）

Type: 200 bytes.

T1～T100，The timing value does not disappear even when the system is turned off.

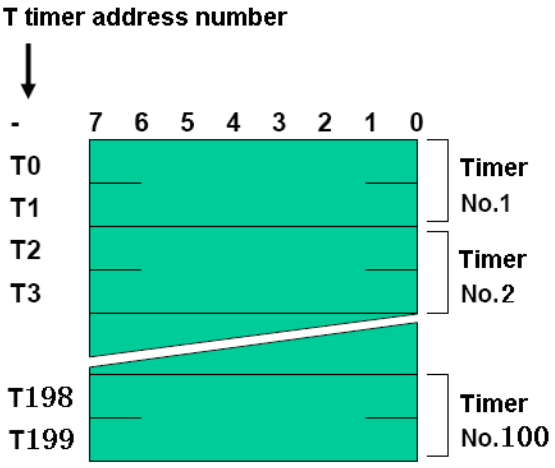


Fig. 3-7

3.10 Address（D）of data table

Each data register has 8-bit, two continuous data registers can store 16-bit data, four continuous data registers can store 32-bit data.

The content of the memory do not disappear even when the power is turned off.

Number of data table：D0～D1859，1860 bytes.

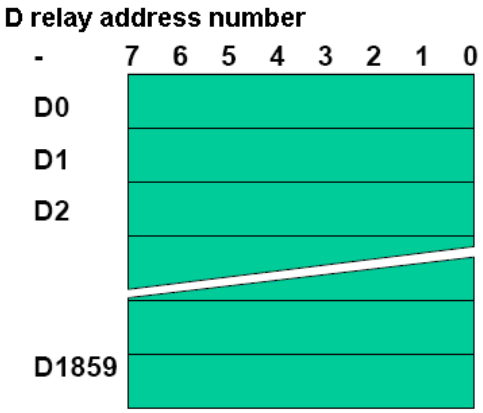


Fig. 3-8

3.11 Label address（L）

Label addresses are used to specify jump destination labels and LBL labels in JMPB instructions.

Range: L0～L9999

3.12 Subprogram numbers（P）

Subprogram numbers are used to specify destination subprogram labels and SP instruction subprogram labels in CALL and CALLU instruction.

Range: P0～P511.

4 PLC Basic Instruction

Designing a sequence program begins with writing a ladder diagram. The ladder diagram is written using relay contact symbols and functional instruction code. Logic written in the ladder diagram is entered as a sequence program in the Programmer. There are two sequence program entry methods. One is the entry method with the mnemonic language (PLC instructions such as LD, AND, OR). The other is the relay symbols of the ladder diagram. When the relay symbol method is used, the ladder diagram format can be used and programming can be performed without understanding the PLC instruction format.

Actually, however, the sequence program entered by the relay symbol method is also internally converted into the instruction corresponding to the PLC instruction.

The basic instructions are often used when the sequence program is designed, and the execute one-bit operation.

GSK25i basic instructions are as follows(see Table 4-1):

Table 4-1

Instruction	Function
LD	Shifts left the content by one bit in register and sets the state of a specified signal in ST0.
LDI	Shifts left the content by one bit in register and inverts the logic state of a specified signal and sets it in ST0.
OUT	Outputs the results of logic operation to a specified address.
OUTI	Inverts the results of logical operations and output it to a specified address.
AND	Induces a logical product.
ANI	Inverts the state of a specified signal and induces a logical product.
OR	Induces a logical sum.
ORI	Inverts the state of a specified signal and induces a logical sum.
ORB	Sets the logical sum of ST0 and ST1, and shifts the stack register right by one bit.
ANB	Sets the logical product of ST0 and ST1, and shifts the stack register right by one bit.

4.1 LD, LDI, OUT, OUTI command

Instructions and functions（Table 4-2）:

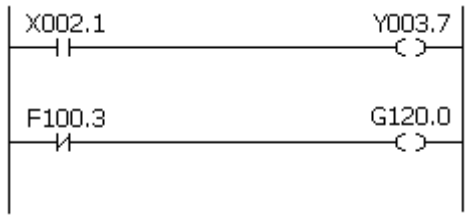
Table 4-2

Instruction	Function
LD	Shifts left the content by one bit in register and sets the state of a specified signal in ST0.
LDI	Shifts left the content by one bit in register and sets the logic state of a specified signal in ST0.
OUT	Outputs the results of logic operation to a specified address.
OUTI	Inverts the results of logical operations and output it to a specified address.

Instruction specifications:

- OUT, OUTI are the output relay, internal relay instructions. They cannot be used to input relay.
- The parallel OUTI instruction can be continuously used many times.

Programming




```
LD    X002.1
OUT   Y003.7
LDI   F100.3
OUT   G120.0
```

4.2 AND, ANI command

Instructions and functions（Table 4-3）:

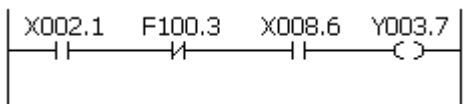
Table 4-3

Instruction	Function
AND	Induces a logical product.
ANI	Inverts the state of a specified signal and induces a logical product.

Instruction specifications:

- AND, ANI can connect with one contact in serial. The serial contact numbers are not limited and they can be used many times.

Programming




```
LD    X002.1
ANI   F100.3
AND   X008.6
OUT   Y003.7
```

4.3 OR, ORI command

Instructions and functions (Table 4-4)

Table 4-4

Instruction	Function
OR	Induces a logical sum.
ORI	Inverts the state of a specified signal and induces a logical sum.

Instruction specification:

- OR, ORI can connect with one contact in parallel.
- OR, ORI begins from their step, which can connect with the mentioned step in parallel.

Programming:


```
LD    X002.1
ORI   F100.3
OUT Y003.7
```

4.4 ORB command

Instruction and function(Table 4-5):

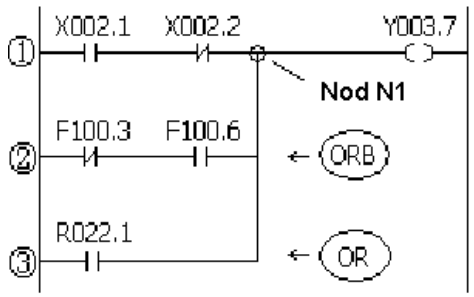
Table 4-5

Instruction	Function
ORB	Sets the logical sum of ST0 and ST1, and shifts the stack register right by one bit.

Instruction specification:

- ORB a sole instruction without other address.

Programming




```
LDI   F100.3
AND   F100.6
ORB
OR R022.1
OUT   Y003.7
LD    X002.1
ANI   X002.2
```

As the above figure, there are three branch circuit ①，②，③ from left bus to the node N1, among which ①，② is circuit block in series; when there is the serial circuit block in the parallel from the bus to node or between nodes, the following branch end uses ORB instruction except for the first branch.

The branch ③ is not serial circuit block to use OR instruction.

ORB and ANB are instructions without operation components, indicating the ORB, ANB relationship between circuit blocks.

4.5 ANB command

Instruction and function（Table 4-6）:

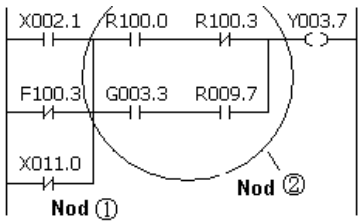
Table 4-6

Instruction	Function
ANB	Sets the logical product of ST0 and ST1, and shifts the stack register right by one bit.

Instruction specification

- When the branch loop (parallel loop block) is connected to the previous loop in series, use ANB instruction. The starting point of branch uses LD, LDI instruction, after the parallel loop block ends, ANB instruction is connected to previous loop in series.
- ANB a sole instruction without other address.

Programming




```
LD    X002.1
ORI   F100.3
ORI   X011.0
LD    R100.0
ANI   R100.3
LD    G003.3
AND   R009.7
ORB                ← (1)
ANB                ← (2)
OUT   Y003.7
```

As the above figure and instruction list, (1)ORB reports the series circuit block in block ②is connected parallel (2)ANB reports the block ① and ② are connected in series.

5 PLC Functional Instructions

Basic instructions such as controlling operations of machine tool are difficult to program, therefore, functional instructions are available to facilitate programming.

25i PLC functional instruction as follows(Table 5-1):

Table 5-1

No.	Instruction	Processing
0	END1	End of a 1st level ladder program
1	END2	End of a 2nd level ladder program
2	TMR	Timer processing
3	TMRB	Fixed timer processing
4	TMRC	Timer processing
5	DECB	Binary decoding
6	CTR	Counter processing
7	CTRC	Counter processing
8	ROTB	Binary rotation control
9	CODB	Binary code conversion
10	MOVE	Data transfer after logic AND
11	MOVOR	Data transfer after logic OR
12	MOVB	Transfer of 1 byte
13	MOVW	Transfer of 2 bytes
14	MOVN	Transfer of an arbitrary number of bytes
15	PARI	Parity check
16	DCNVB	Data conversion
17	COMPB	Binary comparison
18	COIN	Coincidence check
19	DSCHB	Binary data search
20	XMOVB	Binary indexed data transfer
21	ADDB	Binary addition
22	SUBB	Binary subtraction
23	MULB	Binary multiplication
24	DIVB	Binary division
25	NUMEB	Binary constant definition
26	DIFU	Edge Up detection

27	DIFD	Failing edge detection
28	SFT	Register shift
29	EOR	Exclusive OR
30	AND	Exclusive AND
31	OR	Exclusive OR
32	NOT	Logic NOT
33	COM	Common line control
34	COME	End of common line control
35	JMP	Jump
36	JMPE	End of a jump
37	CALL	Conditional subprogram call
38	CALLU	Unconditional subprogram call
39	JMPB	Label jump
40	JMPC	Label jump
41	LBL	Label
42	SP	Subprogram
43	SPE	End of a subprogram
44	WINDR	Reading data on the CNC window
45	WINDW	Writing data on the CNC window
46	AXLCTL	PLC axial control
47	PSGNL	Position signal output
48	PSGN2	Position signal output 2

5.1 END1（1st level sequence program end）

Function: It must be specified once in a sequence program, either at the end of the 1st level sequence, or at the beginning of the 2nd level sequence when there is no 1st level sequence. The 1st level is used to execute the actions required high respond speed such as emergency stop, jump etc..
Format:

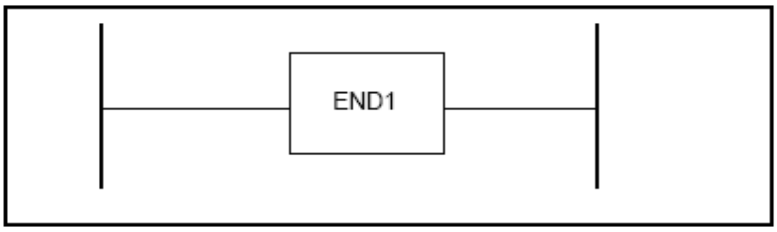


Fig. 5-1

Command table format：

Table 5-2

No.	Command	Operand	Remark
1	FUNC	0	End of 1st level program

5.2 END2（2nd level sequence program end）

Function:

Specify at the end of 2nd level sequence.

Format:

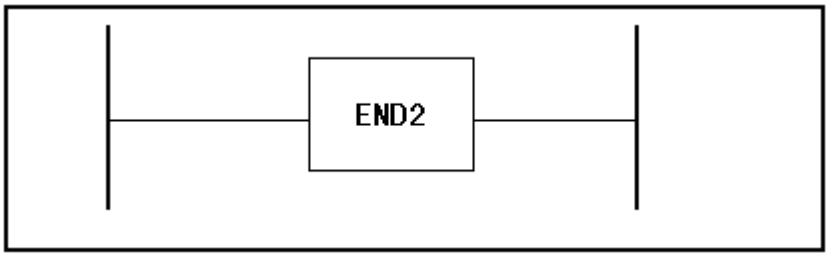


Fig. 5-2

Command table

Table 5-3

No.	Command	Operand	Remark
1	FUNC	1	End of 2nd level program

Note: Only the subprograms of SP head, SPE end are added to the ladder following END2, otherwise, the system prompts the wrong.

5.3 TMR（Timer）

Function:

This is an on-delay timer.

Format:

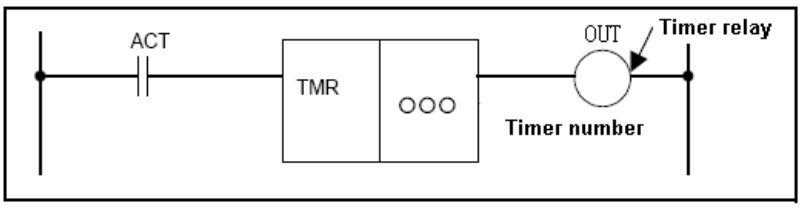


Fig. 5-3

Command table format:

Table 5-4

No.	Command	Operand	Remark
1	LD	○○○○. ○	Exclusive conditions
2	FUNC	2	Timer command TMR
3	PRM	○○○	Timer number
4	OUT	○○○○. ○	Timer relay

Control conditions： ACT＝0，turns off timer relay.

ACT＝1，start TIMER.

Concrete working conditions are as follows:

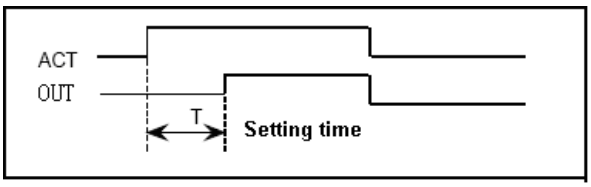


Fig. 5-4

Parameter：

Timer number：reports with ○○○, ○○○ are the number(1～100).

Output：

OUT ： timer relay.

OUT =1 ACT processing is done and reaches the preset time, the timer relay processing is done, OUT =1.

OUT =0 ACT processing is not done or has not reached the preset time, the timer relay is turned off, OUT =0.

Setting timer：

For timer TMR delay time setting value, 1st -20th timer take 48ms as the unit setting, and the maximum setting value is 3145680ms; when the value less than 48ms is omitted; 21st to 100th timer take 8ms as the unit setting and the maximum setting value is 524280ms, and the value less than 8ms is omitted.

For example: when the 1st timer value is 100ms, the set actual value is 96ms, 100=48×2+4 and the remainder 4 is omitted.

5.4 TMRB（fixed timer）

Function：

The timer is used as a fixed on-delay timer.

Format：

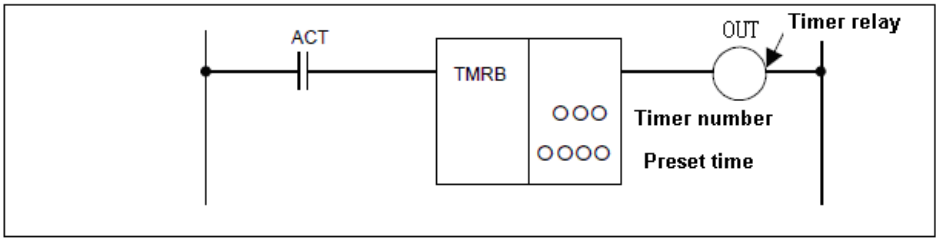


Fig. 5-5

Command table format：

Table 5-5

No.	Command	Operand	Remark
1	LD	○○○○. ○	Exclusive conditions
2	FUNC	3	Fixed timer TMRB
3	PRM	○○○	Timer number
4	PRM	○○○○	Timer time
5	OUT	○○○○. ○	Timer relay

Control condition：

ACT=0：turn off timer relay.

ACT=1：start timer.

Parameter:

Timer number set timer number of the fixed timer **(1~100).**

Timer time setting preset time（set delay time 8ms~999999ms）

The range of the preset time is 8ms nd the remainder is omitted. For example: the preset is 38ms, 38==8*4+6, and the remainder is discarded and the actual setting time is only 32ms.

Timer relay：

OUT ： timer relay.

OUT=1 ACT processing is done and reaches the preset time, the timer relay processing is done, OUT=1.

OUT=0 ACT processing is not done or has not reached the preset time, the timer relay is turned off, OUT=0.

Note: TMR timer number can set the timer parameter to be modified, and it is saved when power-off; the fixed timer number of TMRB is a timer parameter directly processed in the system internal, is not saved when power off, and cannot be modified by the user.

5.5 TMRC（timer）

Function：

TMRC is the on-delay timer using the address to set the fixed time. The processing data type is the binary data.

Format:

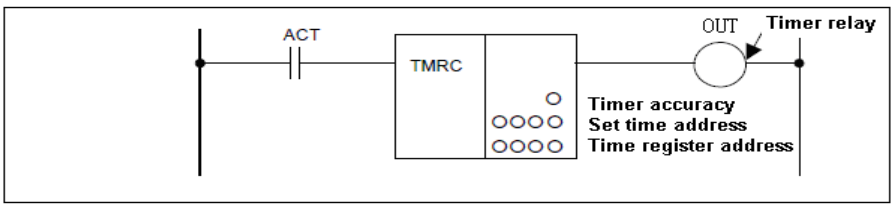


Fig. 5-6

Command table format：

Table 5-6

No.	Command	Operand	Remark
1	LD	○○○○. ○	Exclusive conditions
2	FUNC	4	TMRC command
3	PRM	○	Timer precision
4	PRM	○○○○	Timer time address
5	PRM	○○○○	Time register
6	OUT	○○○○. ○	Timer relay

Control condition：

ACT=0：turns off the timer relay.

ACT=1：starts the timer.

Parameter:

Timer precision: timer precision, parameter setting value, setting time and error are as follows:

Table 5-7

Timer accuracy	Setting value	Setting time	Timer accuracy error
8 ms	0	8 ms to 52428 ms	0 to ±8ms
48 ms	1	48 ms to 3145680 ms	0 to ±8ms
1s	2	1s to 65535 s	0 to ±8ms

Setting time address: the first address of the timer set time filed.

Timer register address: the first address of a specified continuous four-byte R is used as the system working area and is used in timer working.

Timer relay:

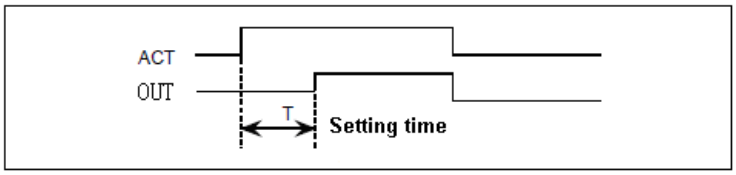


Fig. 5-7

OUT ： timer relay.

OUT =1 ACT processing is done and reaches the preset time, the timer relay processing is done,， OUT =1.

OUT =0 ACT processing is not done or has not reached the preset time, the timer relay is turned off, OUT =0.

5.6 DECB（binary decode）

Function：

DECB decodes the binary data with 1, 2, 4 bytes, the corresponding output data is 1 when one of the specified 8-digit continuous data is equal to the code data, and 0 when not.

The command is used to decode M or T function.

Format：

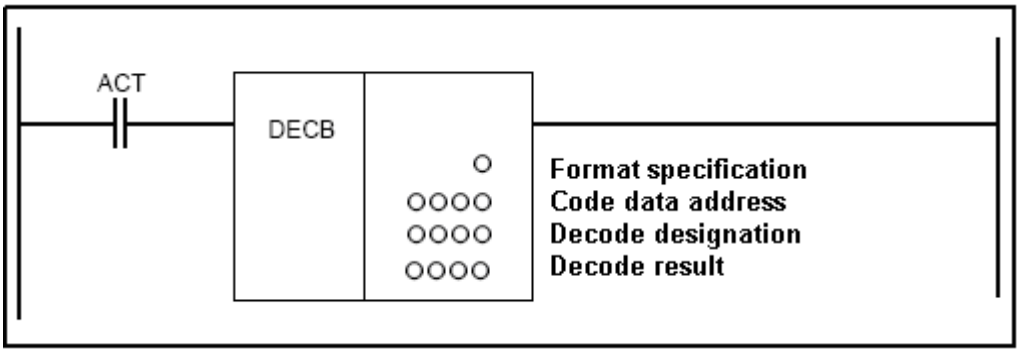


Fig. 5-8

Control condition：

ACT＝0：resets all the output data bits.

ACT＝1：decodes data. Results of processing is set in the output data address.

Command table format：

Table 5-8

No.	Command	Operand	Remark
1	LD	○○○○. ○	Control condition
2	FUNC	5	DECB command
3	PRM	○	Format specification
4	PRM	○○○○	Code data address
5	PRM	○○○○	Decode designation
6	PRM	○○○○	Decode output address

Parameters：

Format specification: Set the size of code data to the 1st digit of the parameter.

0001：code data is in binary format of 1-byte length.

0002：code data is in binary format of 2-byte length.

0004：code data is in binary format of 4-byte length.

Code data address: specify an address of a memory code data.

Decoding designating: designate the first number of the decoding continuous codes.

Decoding result address: designate an address of the output decoding result covering 1-byte. The decoding result of the designated number is output to

the 0-digit of the address, and the decoding result of the specified number +1 is output to 1-digit and the continuous 8 numbers are done like this.

Example：

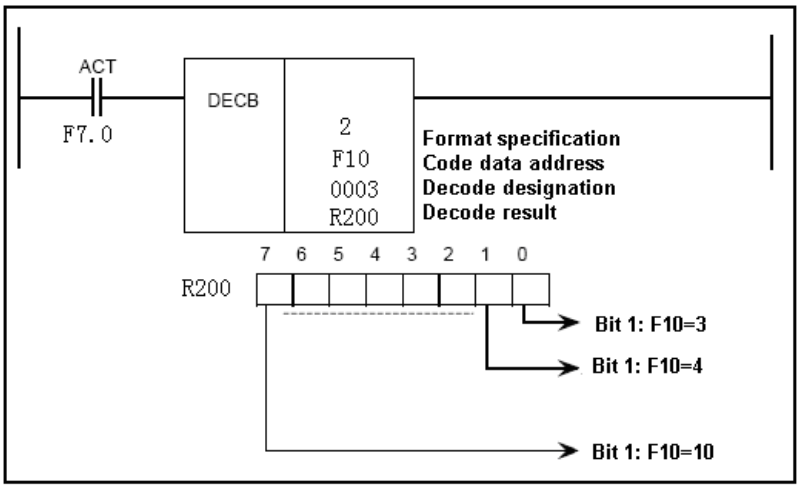


Fig. 5-9

After F7.0 is turned on, 2-byte data of F10～F11 are decoded. When the decoding data is in the range 3～10, the corresponding bit of R200 becomes 1.

5.7 CTR（counter）

Function：

The counter data type is the binary format and has the following functions to meet its application.

1) Preset counter

Output a signal when the preset count is reached.

2) Ring counter

Upon reaching the preset count, returns to the initial value by issuing another count signal.

3) Up/down counter

The count can be either up or down.

4) Selection of initial value

Select the initial value as either 0 or 1.

Format：

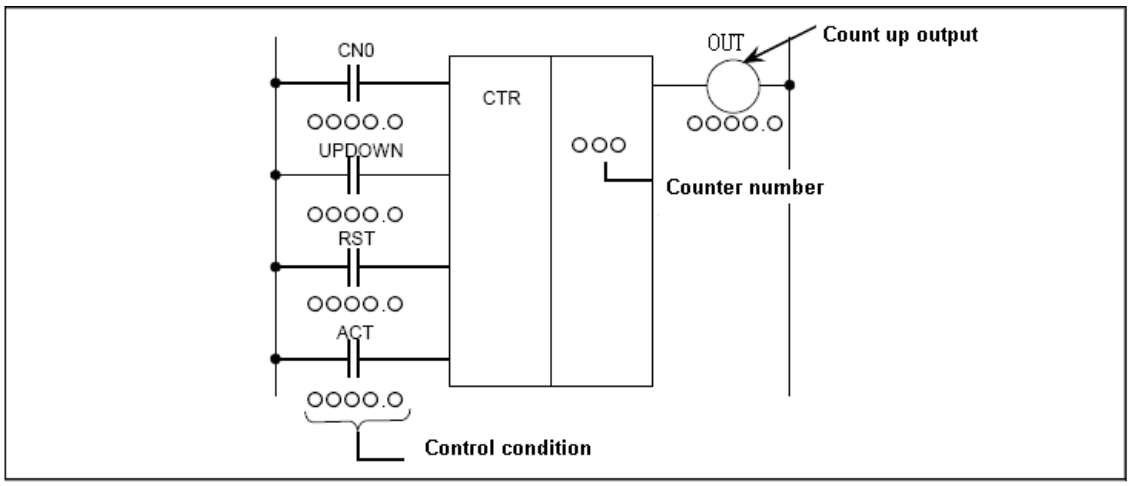


Fig. 5-10

Command table format：

Table 5-9

No.	Command	Operand	Remark
1	LD	○○○○. ○	CN0
2	LD	○○○○. ○	UPDOWN
3	LD	○○○○. ○	RST
4	LD	○○○○. ○	ACT
5	FUNC	6	CTR
6	PRM	○○○○	Counter number
7	OUT	○○○○. ○	Count up output

Control conditions：

CN0： Specify the initial value

CN0=0 begins the value of the counter with 0.

CN0=1 begins the value of the counter with 1.

UPDOWN： specify up or down counter:

UPDOWN=1 Up counter（the initial value is set by CN0）.

UPDOWN=0 Down counter(the counter begins with te preset value).

RST ： reset

RST=0 Releases reset.

RST=1 Enables reset. When OUT is reset to 0, the counter value is reset to the initial value(when the Up counter is done, it is 0 or 1 according to CN0 setting), when it is Down counter, it is the preset value of the counter).

ACT ： Counter signal

ACT=1：counter is made by catching the rise of ACT.

ACT＝0：counter does not operate. OUT does not change.

Parameter:

Counter number : specify the counter number and it is 1～100.

Output:

OUT : when the count is up to a preset value, the Up count reaches the maximum value or the minimum value, OUT = 1.

Note: When the counter is Up edge, the system executes the count. When the count number is repetitive, the operation is unexpected.

The current, preset value of the counter is set in 【Counter】 of 【PLC parameter】 in PLC window.

5.8 CTRC（counter）

Function:

The data in the counter is binary and the counter has the following functions.

1） Preset counter

Preset the count value and if the count reaches this preset value, outputs to show that.

2) Ring counter

This is the ring counter which is reset to the initial value when the count signal is input after the count reaches the preset value.

3) Up/down counter

This is the reversible counter to be used as both the up counter and down counter.

4） Selection of the initial value

Either 0 or 1 can be selected as the initial value.

Format:

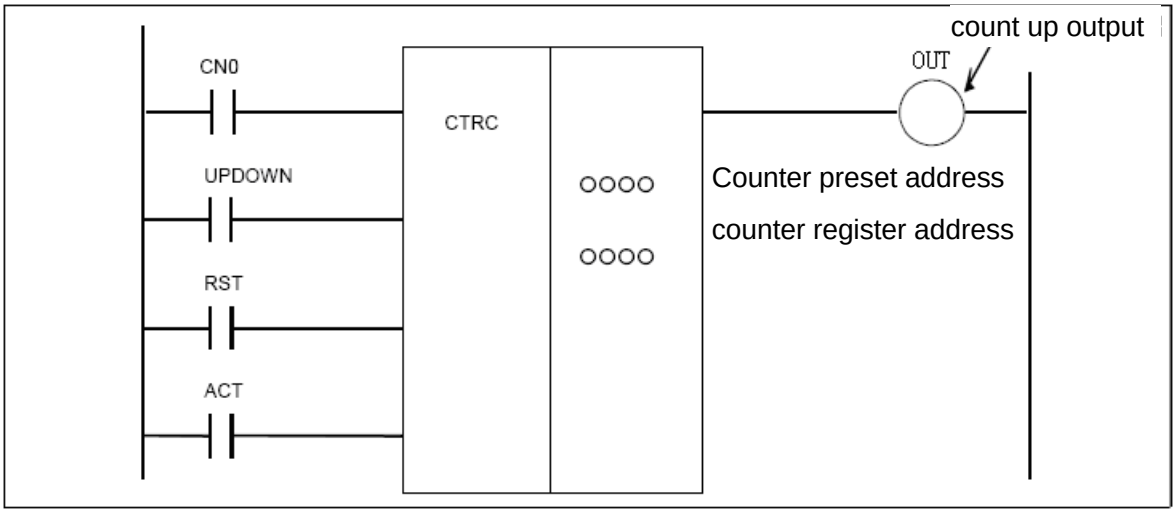


Fig. 5-11

Command table format：

Table 5-10

No.	Command	Operand	Remark
1	LD	○○○○. ○	CN0
2	LD	○○○○. ○	UPDOWN
3	LD	○○○○. ○	RST
4	LD	○○○○. ○	ACT
5	FUNC	7	CTRC command
6	PRM	○○○○	Counter preset address
7	PRM	○○○○	Counter register address
8	OUT	○○○○. ○	Count up output

Control conditions：

CN0 ： Specifying the initial value

CN0=0 the count value starts with 0.

CN0=1 the count value starts with 1.

UPDOWN ：Specifying up or down counter

UPDOWN=1 Up counter.

UPDOWN=0 Down counter.

RST ： reset

RST=0 release reset.

RST=1 enable reset. When OUT is set to 0 the count value is reset to the initial value.

ACT ： count signal

ACT=1：the counter operates at the rise of this signal.

ACT＝0：the counter does not operate, OUT does not change.

Parameter：

Counter preset value address: the first address of the counter preset value field with 2-byte is set. The continuous 2-byte memory space from the first address is required for this field and the field D is binary and its range is 0～32767.

Counter register address: The first address of the counter register field is set, the continuous 4-byte memory space from the first address is required for this field and the field D is normally used. The first two-byte is accumulated value and the second two –byte is the system working area.

Note: When field R is specified as the counter register address, the counter starts with count value "0" after powered on.

Output:

OUT ：When the count value reaches the preset value, the count reaches the maximum in the Up count or the minimum value in the Down count, OUT = 1.

5.9 ROTB（binary rotation control）

Function:

It is used to control the rotor, such as the tool post, rotary table, etc., and the data processed by ROTB is binary.

Control conditions:

CN0 ： specify the starting number of the rotor.

CNO=0 begins the number of the position of the rotor with 0.

CNO=1 begins the number of the position of the rotor with 1.

DIR ： select the rotation direction via the shorter path or not.

DIR=0 no direction is selected. The direction of rotation is only forward.

DIR=1 selected. The direction of rotation is forward or reverse via the shorter path.

POS ： specify the operating conditions.

POS=0 calculates the Designation position.

POS=1 calculates the position one position before the Designation position.

INC ： specify the position or the number of steps.

INC=0 calculates the number of the position. When the position one position before the Designation position is to be calculated, specify INC=0 and POS=1.

INC=1 calculates the number of steps. When the difference between the current position and the Designation position is to be calculated, specify INC=1 and POS=0.

ACT ： Execution command

ACT= 0：the ROT command is not executed and OUT does not change.

ACT＝1：ROT command is executed.

Format：

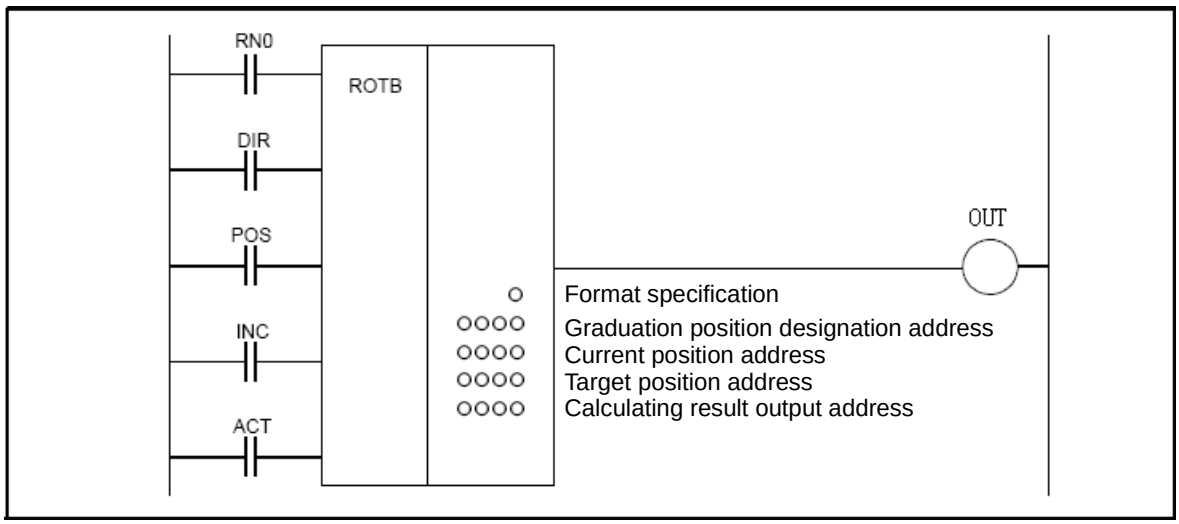


Fig. 5-12

Command table format：

Table 5-11

No.	Command	Operand	Remark
1	LD	○○○○. ○	RN0
2	LD	○○○○. ○	Selection of the shortest path DIR
3	LD	○○○○. ○	Operation condition POS
4	LD	○○○○. ○	Selection of calculation position or number of step INC
5	LD	○○○○. ○	ACT
6	FUNC	8	ROTB
7	PRM	○	Format specification
8	PRM	○○○○	Rotor indexed position address
9	PRM	○○○○	Current position address
10	PRM	○○○○	Target position address
11	PRM	○○○○	Calculating result output address
12	OUT	○○○○. ○	Rotation direction output

Parameter:

Format : specifies data length (1, 2, or 4 bytes).

1：1 byte

2：2 bytes

4：4 bytes

Rotor indexed address: specifies the address containing the number of rotary element positions to be indexed.

Current position address: specifies the address to store the current position.

Designation position address: specifies the address (or command value) to store the Designation position, such as the address of T code is output from CNC.

Calculation result output address: calculate the rotary steps of rotor and the step to reach the Designation position or the position before the Designation. When the calculated result is used, whether ACT is 1 or not is checked.

Output：

OUT ： the rotation direction output. The rotation direction via the short paths output to OUT. OUT =0: the direction is forward（FOR）; OUT =1: it is reverse（REV）, FOR and REV definitions are as Fig. 5-13，the direction to increase the rotor position number is forward(FOR); to decrease the position number is reverse(REV).

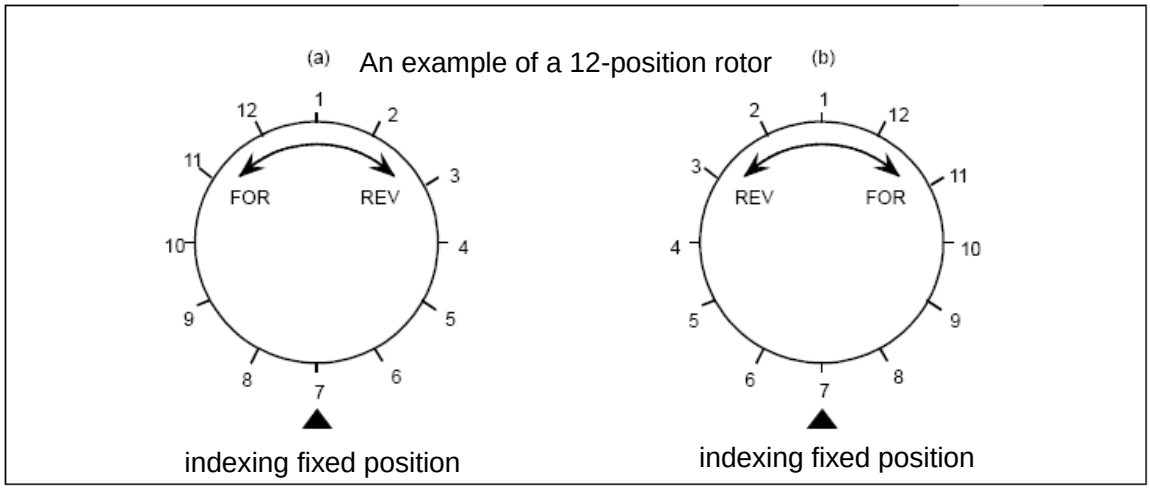


Fig. 5-13

5.10 CODB（binary code conversion）

Function：

The command converts the data in binary format to an optional binary format 1-byte, 2-byte or 4-byte, and the maximum quantity of conversion table is 256.

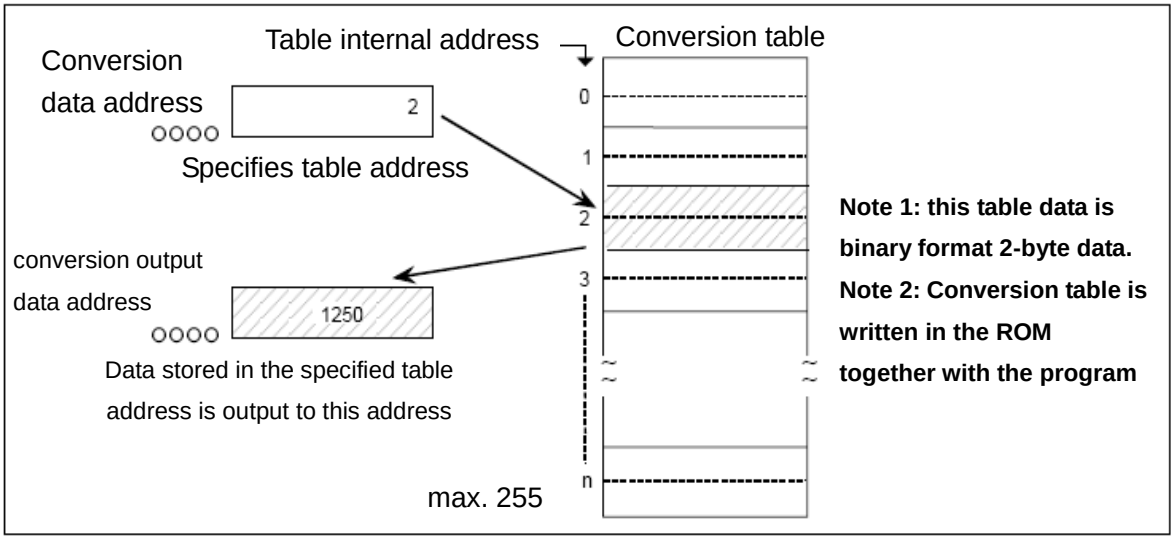


Fig. 5-14

Format:

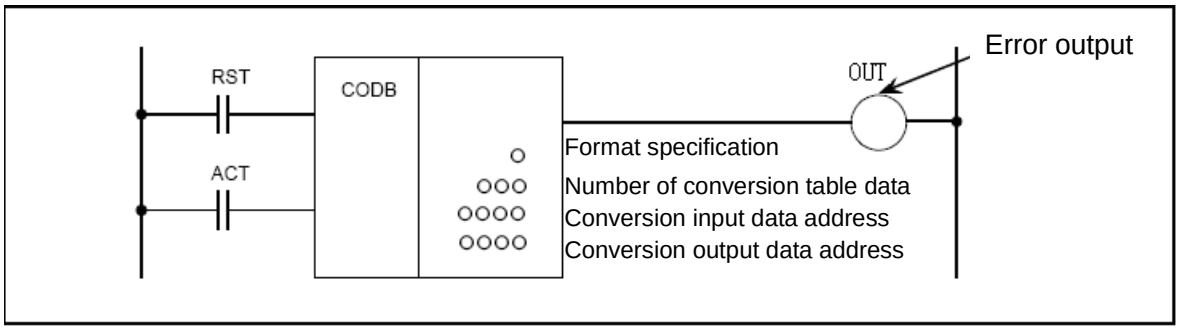


Fig. 5-15

Command table format:

Table 5-12

No.	Command	Operand	Remark
1	LD	○○○○. ○	RST
2	LD	○○○○. ○	ACT
3	FUNC	9	CODB
4	PRM	○	Format specification
5	PRM	○○○○	Number of data table
6	PRM	○○○○	Conversion input data address
7	PRM	○○○○	Conversion output data address
8	TABLE	○○○○	Table address 0 inverts data
9	:	:	
10	:	:	
n	OUT	○○○○. ○	Error output

Control conditions:

RST reset

RST=0 do not reset.

RST=1 reset error output OUT .

ACT activate command

ACT＝0 do not execute COD command.

ACT＝1 execute COD command.

Parameter:

Format specification: designates binary numerical size in the conversion table.

1：numerical data is binary 1-byte data.

2：numerical data is binary 2-byte data.

4: numerical data is binary 4-byte data.

Number of conversion table data ： designates size (1-256) of conversion table data can be made.

Conversion input data address: data in the conversion data table can be taken out by specifying the table number. The address specifying the table number is called conversion input data address, and 1-byte memory is required from

the specified address.

Conversion data output address: memory of the byte length specified in the format specification is necessary from the specified address.

Output：

When there are any abnormality when executing the CODB command, OUT=1 and error will be output.

5.11 MOVE（logical product transfer）

Function：

ANDs logical multiplication data and input data, and outputs the results to a specified address. Can also be used to remove unnecessary bits from an eight-bit signal in a specific address, etc..

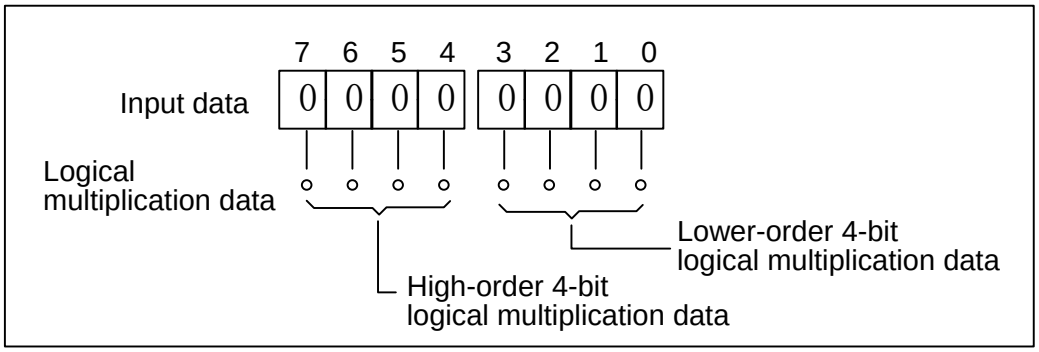


Fig. 5-16

Format:

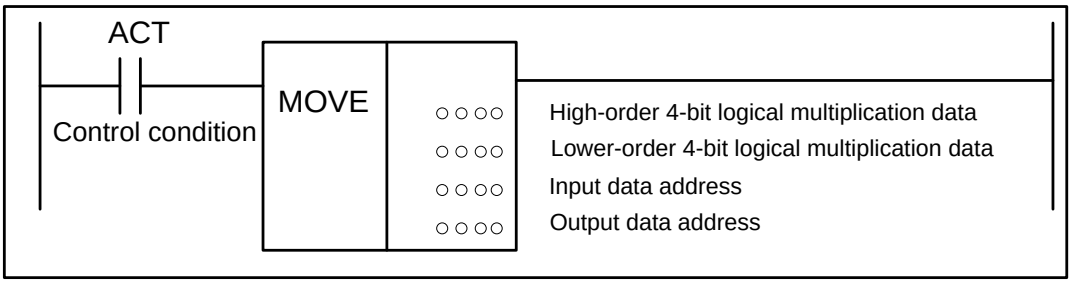


Fig. 5-17

Command table format：

Table 5-13

No.	Command	Operand	Remark
1	LD	○○○○．○	ACT
2	FUNC	10	MOVE
3	PRM	○○○○	high-order 4-bit logical multiplication data
4	PRM	○○○○	Low-order 4-bit logical multiplication data
5	PRM	○○○○	Input data address
6	PRM	○○○○	Output data address

Control conditions：

ACT＝0：MOVE command is not executed.

ACT＝1：MOVE command is executed.

Using example：

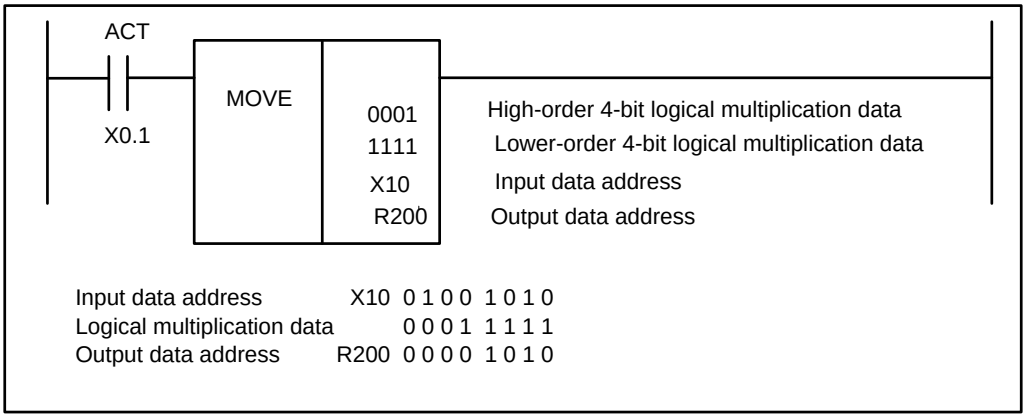


Fig. 5-18

5.12 MOVOR（data transfer after logical or）

Function：

This command Ors the input data and the logical or data and transfer the result to the destination.

Format:

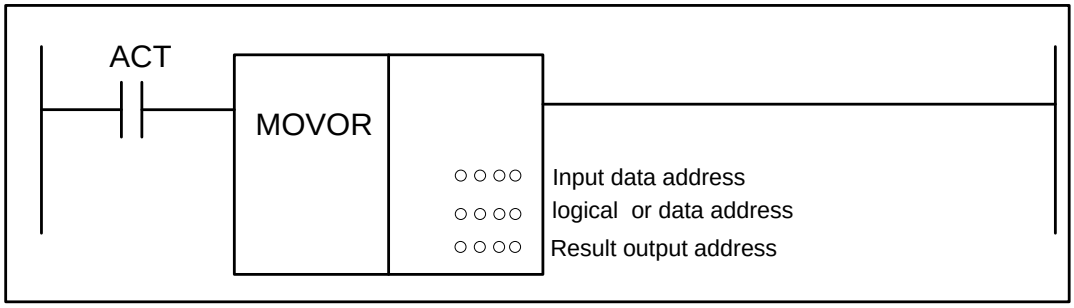


Fig. 5-19

Command table format：

Table 5-14

No.	Command	Operand	Remark
1	LD	○○○○. ○	ACT
2	FUNC	11	MOVOR
3	PRM	○○○○	Input data address
4	PRM	○○○○	Logical or data
5	PRM	○○○○	Output data

Control conditions：

ACT＝0：do not execute MOVOR command.

ACT＝1：execute MOVOR.

Parameter：

Input data address ： specifies the address for the input data.

Logical or data address : specifies the address of the logical or data with which to OR the transferred data.

Output address ：output the result in the logical sum data address.

5.13 MOVB （transfer of 1 byte）

Function：

The command transfer 1-byte data from a specified source address to a specified destination address.

Format：

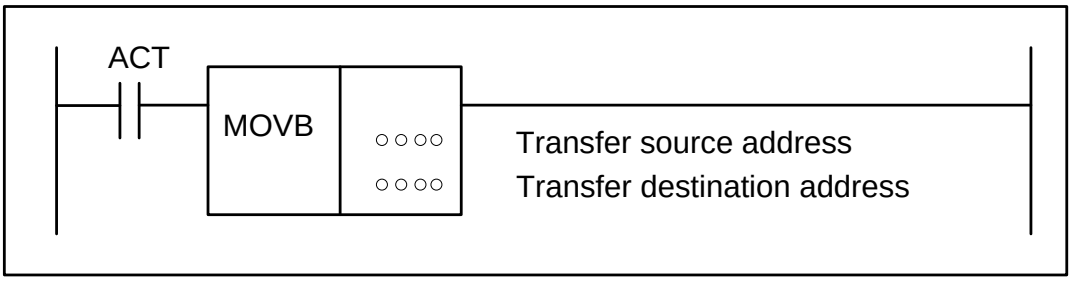


Fig. 5-20

Command table format：

Table 5-15

No.	Command	Operand	Remark
1	LD	○○○○．○	ACT
2	FUNC	12	MOVB
3	PRM	○○○○	Transfer source address
4	PRM	○○○○	Transfer destination address

Control conditions：

ACT Execution specification

ACT＝0 ： do not execute MOVB command and no data is transferred.

ACT＝1 ： execute MOVB command and one-byte data is transferred.

Parameter：

Data source address ： specifies source address.

Data destination address ： specifies destination address.

5.14 MOVW （transfer of 2 bytes）

Function：

The command transfers 2-bytes data from a specified source address to a specified destination address.

Format：

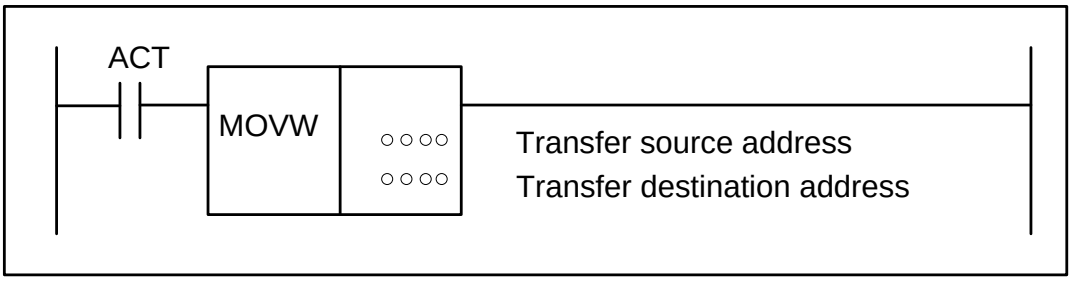


Fig. 5-21

Command table format：

Table 5-16

No.	Command	Operand	Remark
1	LD	○○○○．○	ACT
2	FUNC	13	MOVW
3	PRM	○○○○	Transfer source address
4	PRM	○○○○	Transfer destination address

Control conditions：

ACT Execution specification

ACT＝0 ： do not execute MOVW, no data is transferred.

ACT＝1 ： execute MOVW command and two-byte data is transferred.

Parameter：

Data source address： specifies source address.

Data destination address： specifies destination address.

5.15 MOVN（transfer of an arbitrary number of bytes）

Function：

The command transfers data consisting of an arbitrary number of bytes from a specified source address to a specified destination address.

Format：

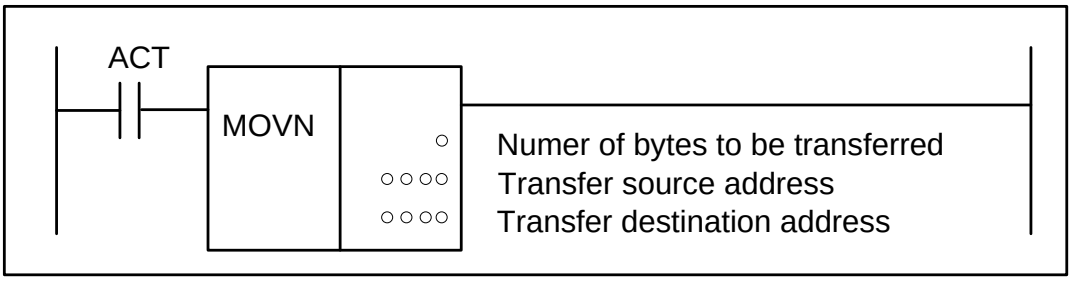


Fig. 5-22

Command table format：

Table 5-17

No.	Command	Operand	Remark
1	LD	○○○○. ○	ACT
2	FUNC	14	MOVN
3	PRM	○	Number of bytes to be transferred
4	PRM	○○○○	Transfer source address
5	PRM	○○○○	Transfer destination address

Control conditions：

ACT execution specification

ACT＝0 ： do not execute MOVN command, no data is transferred.

ACT＝1 ： execute MOVE command, and a specified number of bytes are transferred.

Parameter：

Number of bytes to be transferred ： specify the number（1～200）of bytes to be transferred.

Data source address: specifies the source address.

Data destination address: specifies the destination address.

5.16 PARI（parity check）

Function：

Checks the parity of code signals, and outputs an error if an abnormality is detected. Specifies either an even-or odd-parity check. Only one-byte (eight bits) of data can be checked.

Format：

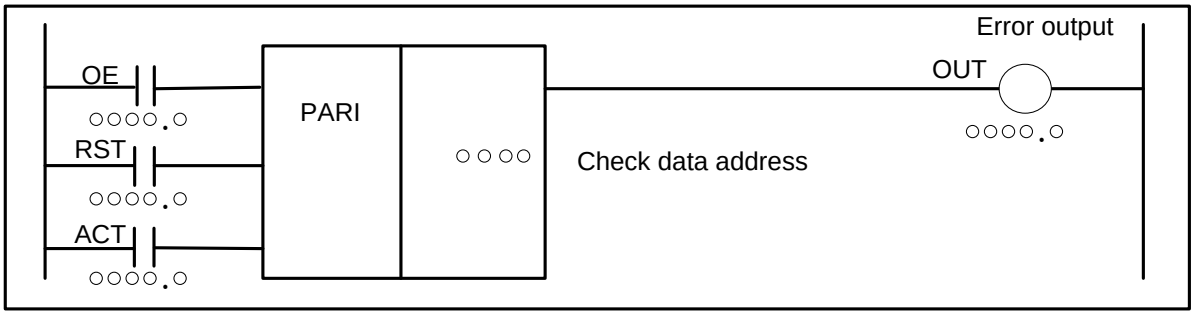


Fig. 5-23

Command table format：

Table 5-18

No.	Command	Operand	Remark
1	LD	○○○○. ○	O.E
2	LD	○○○○. ○	RST
3	LD	○○○○. ○	ACT
4	FUNC	15	PARI
5	PRM	○○○○	Check data address
6	OUT	○○○○. ○	Error output

Control conditions：

O.E specify even or odd.

O.E=0： even-parity check.

O.E=1： odd-parity check.

RST reset

RST=0：disables reset.

RST=1：sets error output coil OUT，that is, when OUT =1, RST=1. OUT =0.

ACT execution command

ACT=0： parity checks are not performed and the output does not change.

ACT=1： execute PARI command, performing a parity check.

Output：

If the result of executing the PARI command is abnormal, the check address data has 1-bit even in the odd check or 1-bit odd in the even check, OUT=1.

5. 17 DCNVB（extended data conversion）

Function：

This command converts 1, 2, and 4–byte binary code into BCD or vice versa.

Format：

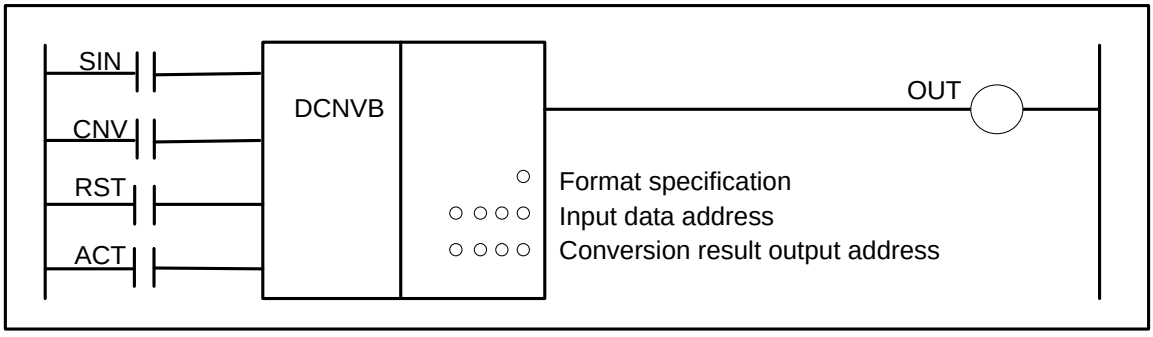


Fig. 5-24

Command table format：

Table 5-19

No.	Command	Operand	Remark
1	LD	○○○○. ○	SIN
2	LD	○○○○. ○	CNV
3	LD	○○○○. ○	RST
4	LD	○○○○. ○	ACT
5	FUNC	16	DCNVB
6	PRM	○	Format specification
7	PRM	○○○○	Input data address
8	PRM	○○○○	Conversion result output address
9	OUT	○○○○. ○	Error output

Control conditions ：

SIN sign of the data to be converted

This parameter is significant only when you are converting BCD data into binary coded data. It gives the sign of the BCD data. Though it is insignificant when you are converting binary into BCD data, you cannot omit it.

SIN=0： BCD code to be input is positive.

SIN=1：BCD code to be input is negative.

CNV type of conversion

CNV=0：convert binary data into BCD data.

CNV=1：convert BCD data into binary data.

RST reset

RST=0：release reset.

RST=1：reset error output coil OUT, that is, when OUT=1 and RST=1, OUT=0.

ACT execution command

ACT=0：data is not converted, and OUT does not change.

ACT=1：data is converted.

Parameter：

Format specification ： specify data length.

1：1 byte.

2：2 bytes.

4：4 bytes.

Input data address conversion: specify the address containing the input data address. The address of the specified table number is called as the input address of the conversion data. The address needs to provide a memory with one byte.

Address for the conversion result output: specify the output address of conversion data. Specify the number of byte of memory in the format starting from the specified address.

Error output（OUT）:

OUT =0：correct conversion.

OUT =1：abnormally.

The data to be converted is specified as BCD data but is found to be binary data, or the specified number of bytes(byte length) cannot contain the BCD data into which a binary data is converted, OUT=1.

Operation output register R1000

Set the register after the data conversion. When the binary data is converted into BCD data, and definition of each bit is as follows (table 5-25):

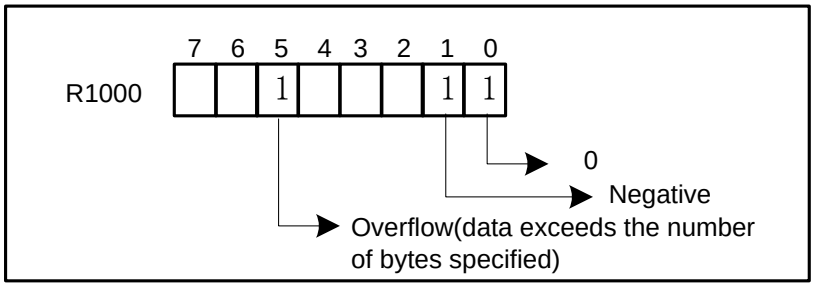


Fig. 5-25

5. 18 COMPB（binary compassion）

Function:

Compare the size of two binary data and comparison result is stored in the comparison result address. Specify enough byte in memory area when executing COMPB command to memory input and comparison values.

Format:

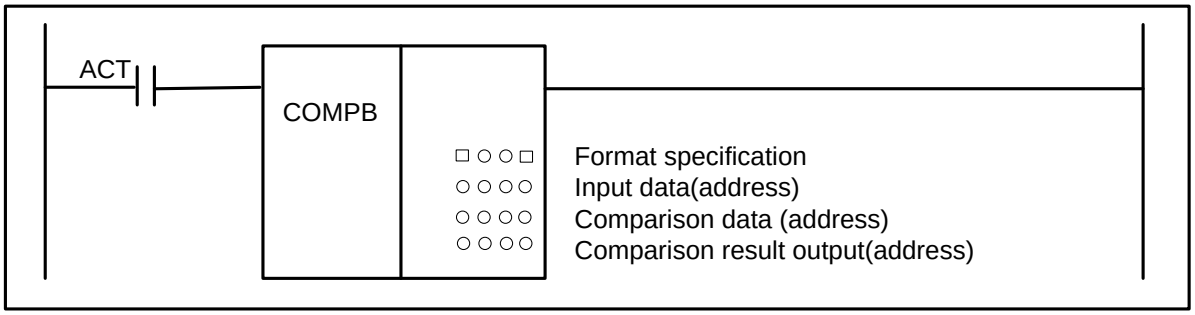


Fig. 5-26

Command table format：

Table 5-20

No.	Command	Operand	Remark
1	LD	○○○○. ○	ACT
2	FUNC	17	COMPB
3	PRM	□○○□	Format specification
4	PRM	○○○○	Input value
5	PRM	○○○○	Comparison data address
6	PRM	○○○○	Comparison result output

Control conditions：

ACT＝0：does not execute COMPB command.

ACT＝1：execute COMPB command.

Parameter：

Format destination: the specified format (constant or address) of input data and specified data length (1, 2 bytes).

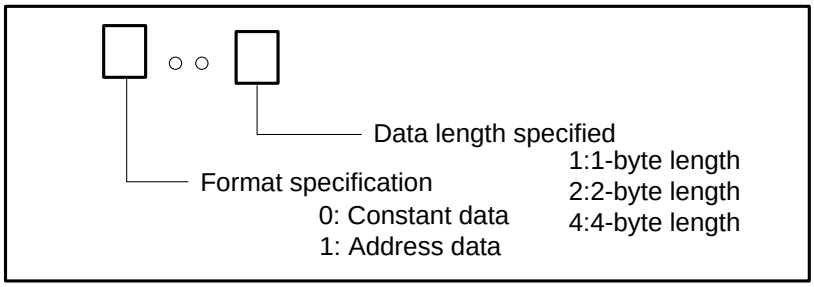


Fig. 5-27

Input data: specifies the comparison input data. The input data can be specified as either a constant or the address.

Comparison data: specifies the comparison data address.

Comparison result output: specifies the comparison result output covering one byte.

Comparison result output address:

Comparison result output address bit:	bit5	Bit2	Bit1	Bit0
Input data = data compared	0	0	0	1
Input data＞data compared	0	0	1	0
Input data ＜data compared	0	1	0	0
data overflow	1	0	0	0

5.19 COIN（coincidence check）

Function：

Checks whether the input value and comparison value coincide and the command is available with the binary data.

Format：

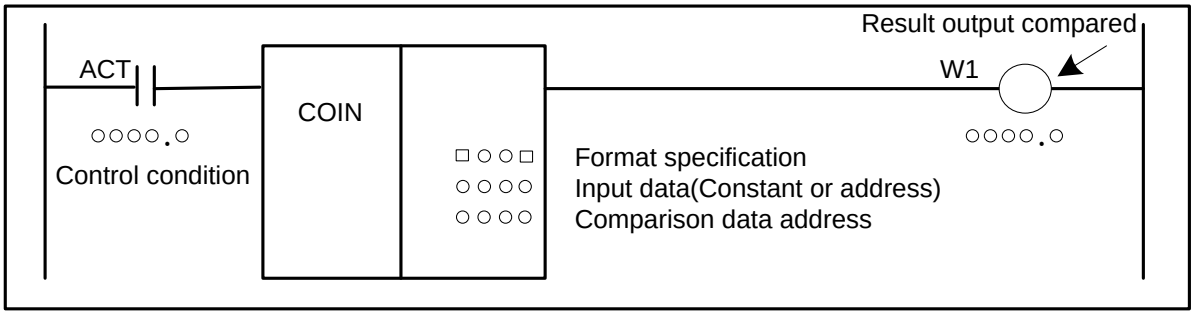


Fig. 5-29

Command table format:

Table 5-21

No.	Command	Operand	Remark
1	LD	○○○○. ○	ACT
2	FUNC	18	COIN
3	PRM	□○○□	Input value format
4	PRM	○○○○	Input value
5	PRM	○○○○	Comparison value address
6	OUT	○○○○. ○	Result output compared

Control conditions:

ACT execution command

ACT=0：the command is not executed and OUT does not change.

ACT=1：the command is executed and the result is output to OUT.

Parameter：

Input data format: specifies input data format (constant or address) and specifies data length (1 or 2 bytes)

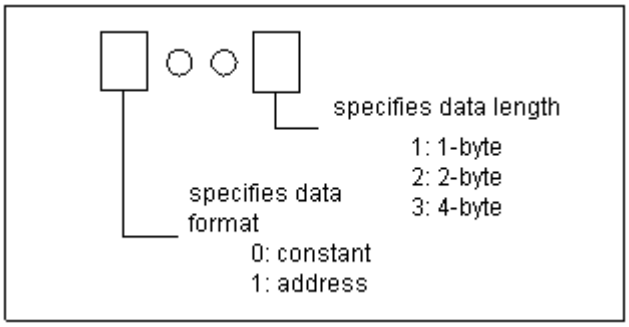


Fig. 5-30

Input data: the input data can be specified as either a constant or an address storing it.

Comparison data address: specifies the address storing the comparison data.

Output：

OUT ： OUT =0： input data ≠ comparison data.

OUT =1： input data = comparison data.

5.20 DSCHB（data search）

Function：

The command is used to searches the data in the data table. Searches the data table for a specified data, outputs an address storing it counting from the beginning of the data table. If the data cannot be found, OUT=1.

The command is available to the binary data, and the number of data (table capacity) in the data table.

Format：

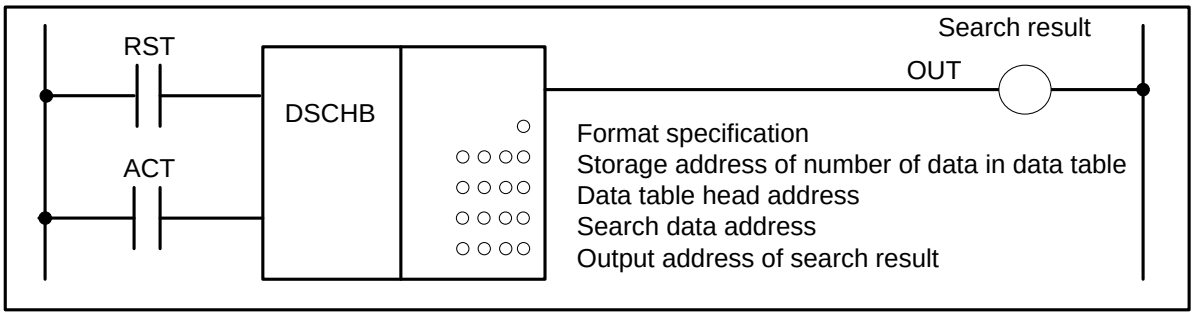


Fig. 5-31

Command table format：

Table 5-22

No.	Command	Operand	Remark
1	LD	○○○○. ○	RST
2	LD	○○○○. ○	ACT
3	FUNC	19	DSCHB
4	PRM	○	Format specification
5	PRM	○○○○	Number of data of the data table
6	PRM	○○○○	Data table head address
7	PRM	○○○○	Data table search address
8	PRM	○○○○	Search result output address
9	OUT	○○○○. ○	Error output

Control conditions：

RST reset

RST=0： release reset.

BYT=1： enable a reset, this is, sets OUT to 0.

ACT execution command

ACT=0：the command is not executed and OUT does not change.

ACT=1：the command is executed, and the table internal number storing the desired data is output, if the data cannot be found, OUT is set to1.

Parameter：

Format specification: specifies the length to search data.

1：1-byte length

2：2-byte length

4：4-byte length

Number of data of the data table: the size of the data table. The byte length specified by the address is assigned to the memory area requiring the byte. The number of data of data table is n+1 (the beginning of the data table is 0 and the end is n)

Data table head address: set the data head address. The head address must D address of D data table.

Search data address: set the address of the data to be searched.

Search result output address: if the data being searched for is found, the internal number of the table storing the data is output to this field. The search result output address field requires memory whose size is the number of bytes conforming to the size of the data specified by byte.

Output：

OUT =0: the data to be searched exists.

OUT =1，the data to be searched does not exist.

5.21 XMOVB（binary indexed modifier data transfer）

Function：

This functional command instructs reading and rewriting of data in the data. The number of data (table capacity) in the data table can be specified by specifying the address. The data processed is binary.

Format：

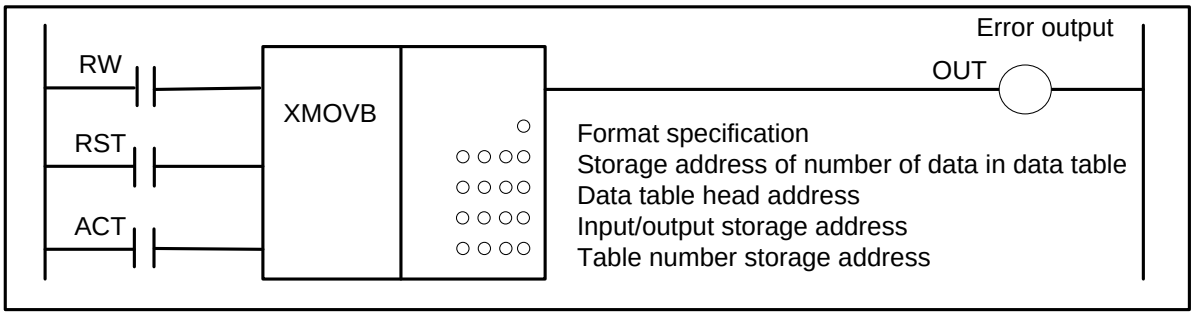


Fig. 5-32

Command table format ：

Table 5-23

No.	Command	Operand	Remark
1	LD	○○○○. ○	RW
2	LD	○○○○. ○	RST
3	LD	○○○○. ○	ACT
4	FUNC	20	XMOVB
3	PRM	○	Format specification
5	PRM	○○○○	Data capacity
6	PRM	○○○○	Data table head address
7	PRM	○○○○	Input/output data storage address
8	PRM	○○○○	Table number storage address
9	OUT	○○○○. ○	Error output

Control conditions：

RW read, write designation

RW=0： read data from data table.

RW=1： write data to data table.

RST reset

RST=0： release reset.

RST=1： reset, OUT =0.

ACT activation command

ACT＝0： do not execute XMOVB command，OUT does not change.

ACT＝1： execute XMOVB command.

Parameter：

Format specification: specifies data length.

1：1-byte length

2：2-byte length

4：4-byte length

Storage address of number of data table: it is used to store the number of data in the data

table, the number of byte is as follows with the specified length and the effective range of data is determined by the byte length specified by the format.

1-byte length：1 to 255.

2-byte length：1 to 65535（actually, set a value below the size of the D area）.

4-byte length：1 to 99999999（actually, set a value below the size of the D area）.

Data table head address: sets head address in the data table. The memory area of data table is: the byte length × the number of data table. The head address must be D address in D data table.

Input/output(I/O) data storage address: in case of the reading, set the address of the memory which stores a reading result. In case of the writing, set the address of the memory which stores a writing result.

Index storage address: set the address of the memory in which an index value is stored. The memory with the byte length set in format specification is necessary. When setting an index value above the value to set in storage address of number of data table, it causes error output OUT=1.

Output：

In the case where the index value set in the index storage address exceeds the value set in the storage address of number of data table, OUT=1, and the reading or writing of the data table is not executed.

OUT =0，No error.

OUT =1: Error found.

5.22 ADDB(addition)

Function：

The command is used to the binary addition operation with 1-, 2- or 4-byte length. The addend data and the output data of addition operation result are set with the storage address of the corresponding byte length

Format：

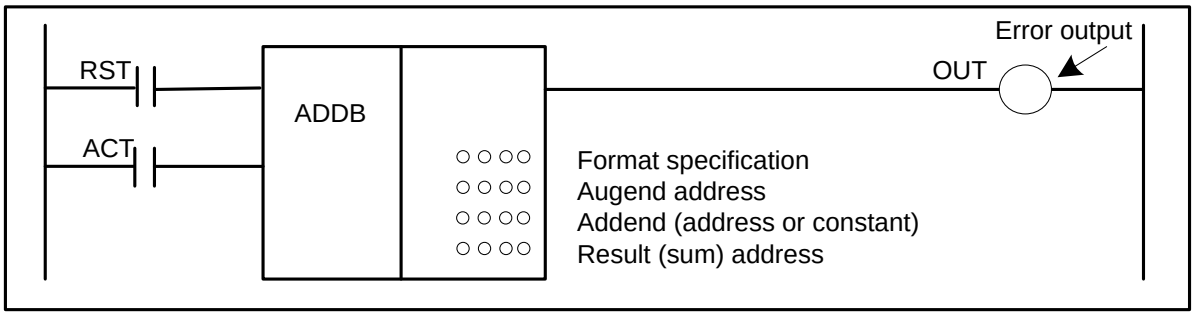


Fig. 5-33

Command table format ：

Table 5-24

No.	Command	Operand	Remark
1	LD	○○○○. ○	RST
2	LD	○○○○. ○	ACT
3	FUNC	21	ADDB
4	PRM	□○○□	Format specification
3	PRM	○○○○	Summand address
5	PRM	○○○○	addend address
6	PRM	○○○○	Sum output storage address
7	OUT	○○○○. ○	Error output

Control conditions：

RST reset

RST=0： release reset.

RST=1： reset OUT =1.

ACT execution command

ACT＝0 ： do not execute ADDB command.

ACT＝1 ： execute ADDB command.

Parameter：

Format designation: specifies the data length (1, 2, 4 bytes) and the specified method of addend (constant or address.

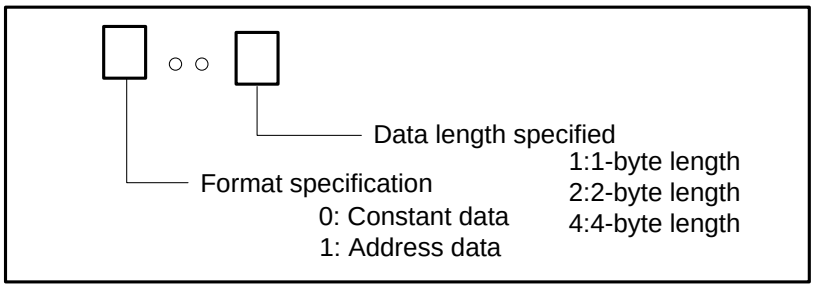


Fig. 5-34

Summand address : specifies the address.

Addend : the specified method of addend is determined by the format specification.

Sum output address: specifies the address to which the sum is to be output.

Output：

OUT =0： operation normability.

OUT =1： operation abnormality.

When the result of addition exceeds the specified data length, OUT=1.

Operation output register**(R1000)：**

Each bit of operation output register:

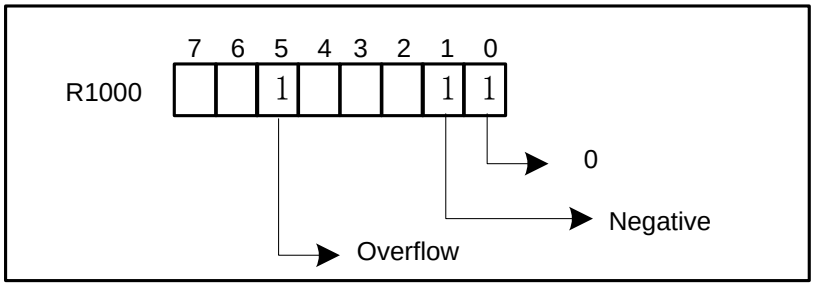


Fig. 5-35

5.23 SUBB（binary subtraction）

Function：

This command is used to the binary subtraction with 1-, 2-, 4-length. The minuend data, the subtraction operation output data need to set the storage address of corresponding byte length.

Format：

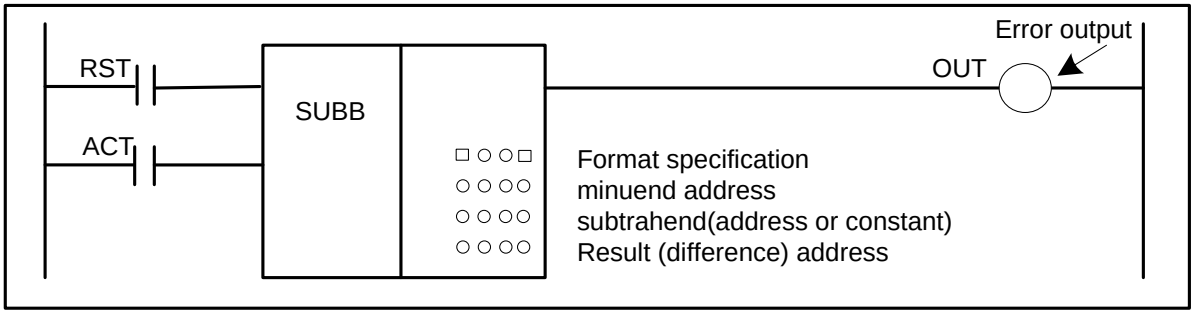


Fig. 5-36

Command table format ：

Table 5-25

No.	Command	Operand	Remark
1	LD	○○○○. ○	RST
2	LD	○○○○. ○	ACT
3	FUNC	22	SUBB
4	PRM	□○○□	Format specification
3	PRM	○○○○	Minuend address
5	PRM	○○○○	subtrahend
6	PRM	○○○○	Operation output storage address
7	OUT	○○○○. ○	Error output

Control conditions：

RST reset

RST=0： release reset.

RST=1： reset OUT =1.

ACT execution command

ACT＝0 ： do not execute SUBB command.

ACT＝1 ： execute SUBB command.

Parameter：

Format specification: specifies the data length (1-, 2-, 4-byte) and the specified method of the subtrahend (constant or address).

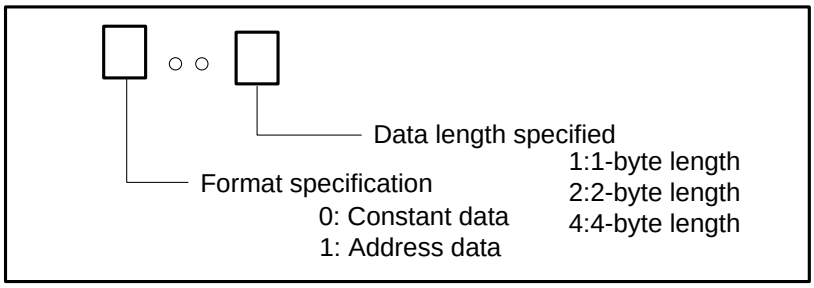


Fig. 5-37

Minuend address ： set the address storing the minuend.

Subtrahend ： the specified method of the subtrahend depends on the format specification.

Operation result output address: set the address to which the operation result is output.

Output：

OUT =0： operation normability.

OUT =1： operation abnormality.

When the operation result exceeds the specified data length, OUT=1.

Operation result register (R1000)：

Each bit of operation result register:

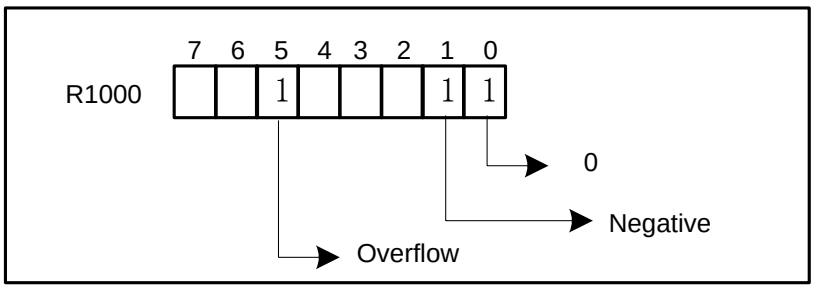


Fig. 5-37

5.24 MULB（binary multiplication）

Function：

This command multiplies 1-, 2-, 4-byte binary data. The operation result is output to the operation result output address. The multiplicand data and the multiplication operation result output data need to set the storage address of corresponding byte length.

Format:

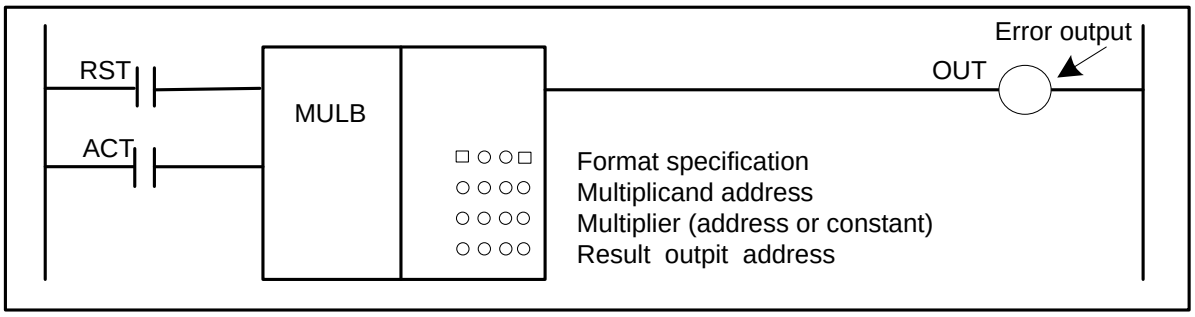


Fig. 5-39

Command table format ：

Table 5-26

No.	Command	Operand	Remark
1	LD	○○○○. ○	RST
2	LD	○○○○. ○	ACT
3	FUNC	23	MULB
4	PRM	□○○□	Format specification
3	PRM	○○○○	Multiplicand address
5	PRM	○○○○	Multiplier
6	PRM	○○○○	Operation result output storage address
7	OUT	○○○○. ○	Error output

Control conditions:

RST reset

RST=0: release reset .

RST=1: reset OUT =1.

ACT execution command

ACT＝0 ： do not execute MULB command.

ACT＝1 ： execute MULB command.

Parameter:

Format specification: specifies the data length (1-, 2-, 4-byte) and the specified method of the multiplication (constant or address).

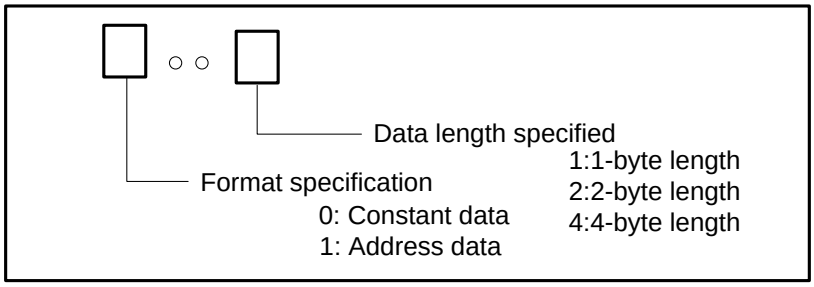


Fig. 5-40

Multiplicand address : address containing the multiplicand.

Multiplier data : the specified method of the multiplier is determined by the format

specification.

Operation result output address: specifies the address to contain the operation result.

Output：

OUT =0： operation normability.

OUT =1： operation abnormality.

When the result of multiplication exceeds the specified data length, OUT=1.

Operation result register(R1000)：

Each bit of operation result register:

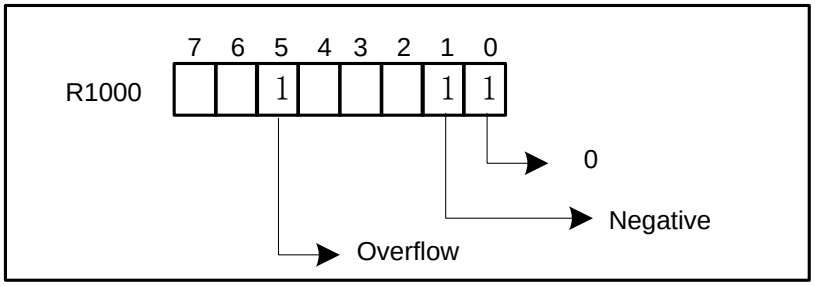


Fig. 5-41

5.25 DIVB（binary division）

Function：

This command divides 1-, 2-, 4-byte binary data. The operation result is output to the operation result output address. The divisor and the dividend and the operation result output data need to set the storage address of corresponding byte length.

Format：

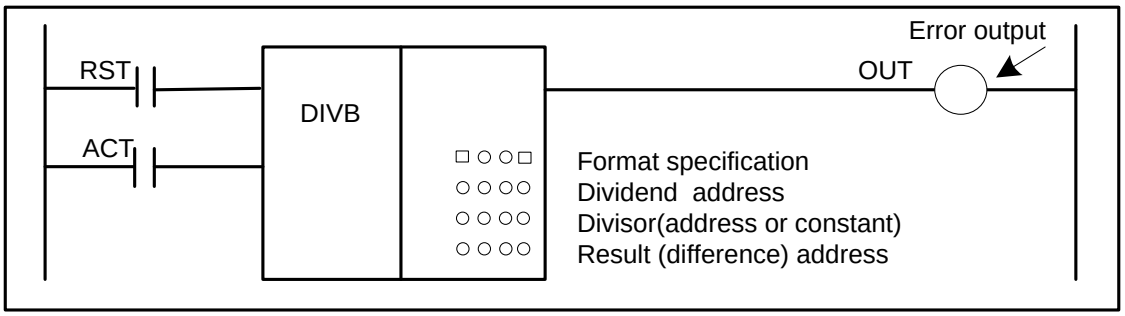


Fig. 5-42

Command table format ：

Table 5-27

No.	Command	Operand	Remark
1	LD	○○○○. ○	RST
2	LD	○○○○. ○	ACT
3	FUNC	24	DIVB
4	PRM	□○○□	Format specification
5	PRM	○○○○	Dividend address
6	PRM	○○○○	Divisor
7	PRM	○○○○	Operation result output storage address
8	OUT	○○○○. ○	Error output

Control conditions：

RST reset

RST=0： release reset .

RST=1： reset OUT =1.

ACT execution command

ACT＝0 ： do not execute DIVB command .

ACT＝1 ： execute DIVB command .

Parameter：

Format specification: specifies the data length (1-, 2-, 4-byte) and the specified method of the divisor data (constant or address).

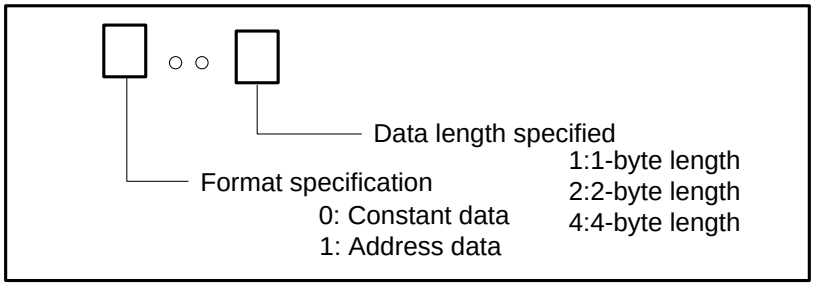


Fig. 5-43

Dividend address : sets the address storing the dividend.

Divisor : the specified method of the divisor is determined by the format specification.

Operation result output address: specifies the address to which operation result is output.

Output：

OUT =0： operation normality.

OUT =1： operation abnormality.

When the divisor is 0, OUT=1.

Operation result register(R1000)：

Each bit of operation result register:

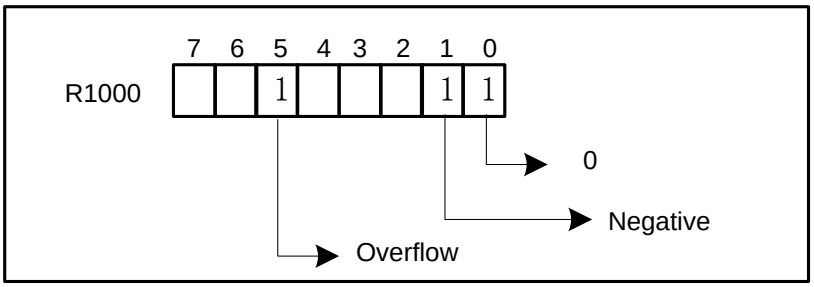


Fig. 5-44

Remainder output register:

The remainder is stored to R1002-R1005 according to the data length when there is the remainder.

5.26 NUMEB（definition of binary constant）

Function：

This command is used to the decimal constant data assign to the specified address. The output data is the binary data and is stored to the specified storage address. The data length can be 1-, 2- or 4- byte length according to the specified.

Format：

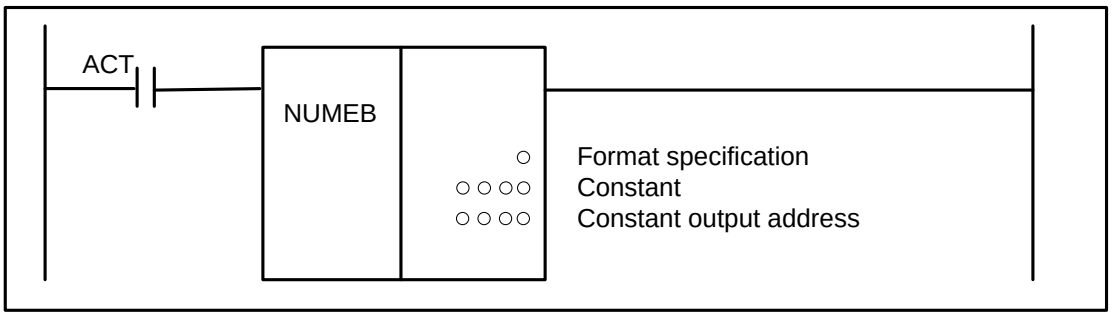


Fig. 5-45

Command table format ：

Table 5-28

No.	Command	Operand	Remark
1	LD	○○○○. ○	ACT
2	FUNC	25	NUMEB
3	PRM	○	Format specification
4	PRM	○○○○	Constant
5	PRM	○○○○	Constant output address

Control conditions：

ACT execute Command

ACT＝0 ： do not execute NUMEB command .

ACT＝1 ： execute NUMEB command .

Parameter ：

Format specification: specifies the data length.

1：1-byte length.

2：2-byte length.

4：4-byte length.

Constant : specifies the defined constant and its value is the decimal data.

Constant output address: specifies the address to output the operation result.

5.27 DIFU（Edge Up detection）

Function：

The command sets the output relay to 1 for one scanning period on a Edge Up of the output signal.

Format：

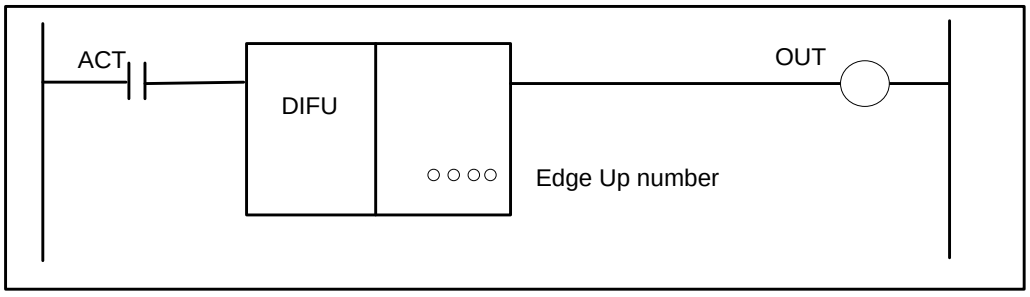


Fig. 5-46

Command table format ：

Table 5-29

No.	Command	Operand	Remark
1	LD	○○○○. ○	ACT
2	FUNC	26	DIFU
3	PRM	○○○○	Edge Up signal
4	OUT	○○○○. ○	Output

Control conditions：

ACT execute Command

ACT＝0 : do not execution command.

ACT＝1 : execution command, output signal sets one scanning period on the ACT Edge Up.

Parameter：

Edge Up number: specifies the Edge Up along the command serial number and its range is 1 to 256.

Warning:

If the same number is used for another DIFU command or a DIFD command in one ladder diagram, operation is not guaranteed.

Output（OUT）:

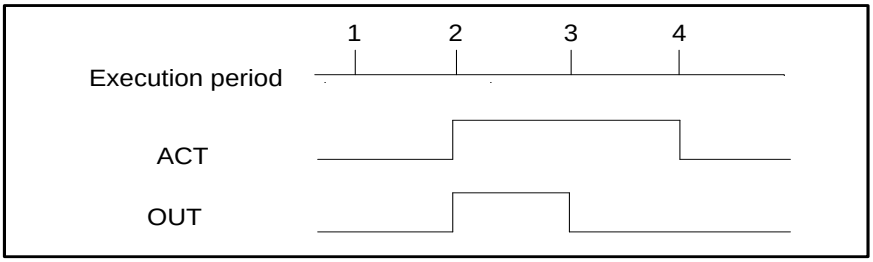


Fig. 5-47

5.28 DIFD（Edge Down detection）

Function:

The command sets the output relay to 1 for one scanning period on a Edge Down of the output signal.

Format:

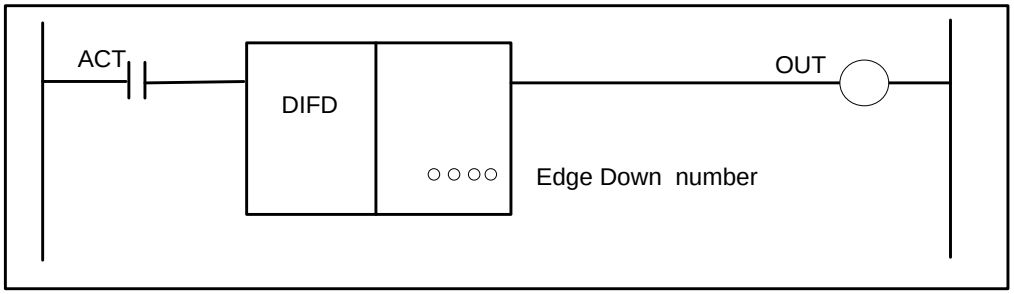


Fig. 5-48

Command table format ：

Table 5-30

No.	Command	Operand	Remark
1	LD	○○○○. ○	ACT
2	FUNC	27	DIFD
3	PRM	○○○○	Edge Down signal
4	OUT	○○○○. ○	output

Control conditions:

ACT execution command

ACT＝0 : do not execute command.

ACT＝1 : execution command, output signal sets one scanning period on the ACT Edge Down.

Parameter：

Edge Down number: specifies the Edge Down along the command serial number and its range is 1 to 256.

> Warning:
> If the same number is used for another DIFU command or a DIFD command in one ladder diagram, operation is not guaranteed.

Output（OUT）：

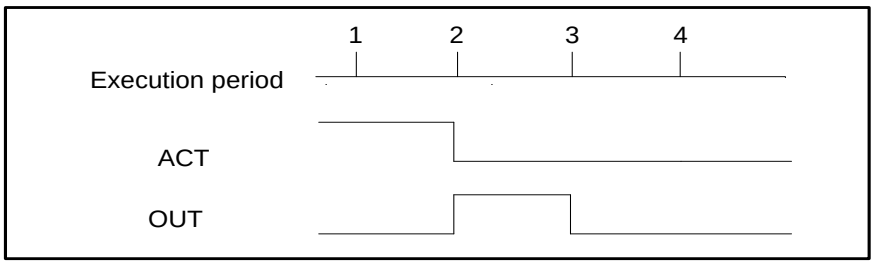


Fig. 5-49

5.29 SFT（shift register）

Function：

The command shifts 2-byte data by a bit to the left or right.

OUT=1 when data “1” is shifted from the left extremity (bit 15) in left shift or from the right extremity (bit 0) in right shift.

Format：

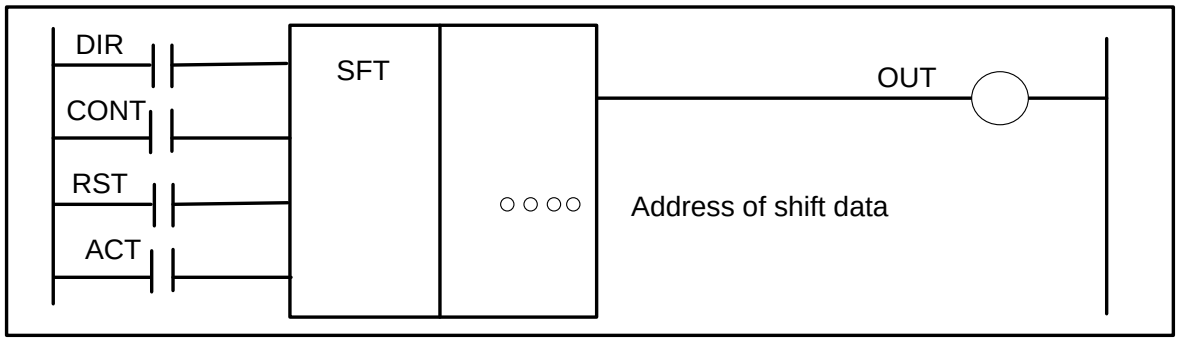


Fig. 5-50

Command table format：

Table 5-31

No.	Command	Operand	Remark
1	LD	○○○○. ○	DIR
2	LD	○○○○. ○	CONT
3	LD	○○○○. ○	RST
4	LD	○○○○. ○	ACT
5	FUNC	28	SFT
6	PRM	○○○○	Shift data
7	OUT	○○○○. ○	output

Control conditions：

DIR specifies shift direction

DIR=0 left shift

DIR=1 right shift

CONT specifies condition

CONT=0 the condition of a data bit is set to the original bit position of the on "0"bit.

CONT=1 the condition of a data bit is set to the original bit position of the on "1" bit..

RST reset

RST=0 OUT is not reset

RST=1 OUT reset （OUT =0）

ACT execution condition

ACT=0 do not execute SFT command

ACT=1 execute shift. When ACT=1, set ACT to 0.

Parameter：

Shift data address: designate addresses which require a continuous 2-byte memory for shift data.

Output：

OUT ： OUT =0 "1" is not shifted out after the shift operation.

OUT =1 "1" is shifted out after the shift operation.

5.30 EOR（EOR）

Function：

The EOR instruction exclusive-Ors the contents of address A with a constant (or the contents of address B), and stores the result at address C.

Format：

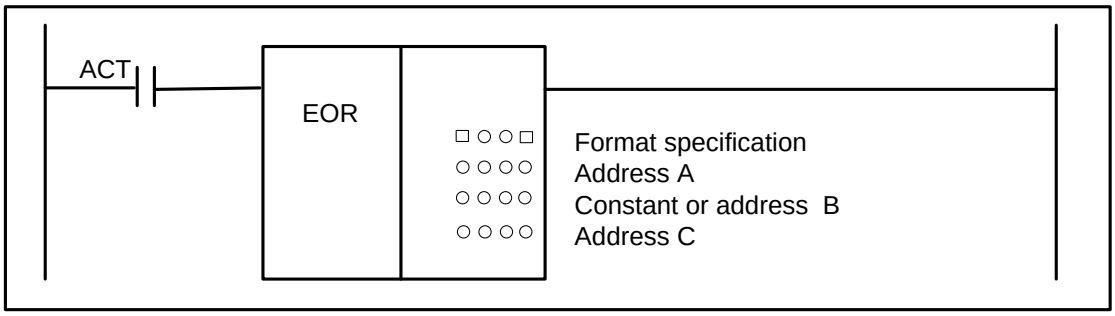


Fig. 5-51

Command table format ：

Table 5-32

No.	Command	Operand	Remark
1	LD	○○○○. ○	ACT
2	FUNC	29	EOR
3	PRM	□○○□	Format specification
4	PRM	○○○○	Address A
5	PRM	○○○○	Constant or address B
6	PRM	○○○○	Address C

Control conditions：

ACT execution condition

ACT＝0 ： do not execute EOR command .

ACT＝1 ： execute EOR command .

Parameter：

Format specification ： Specify a data length (1-, 2-, 4-byte) and an input data format(constant or address).

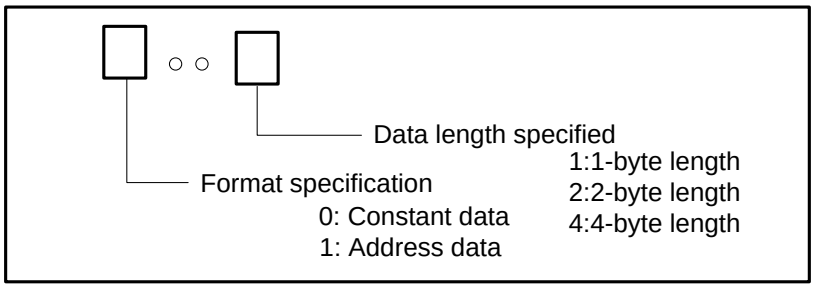


Fig. 5-52

Address A ： the head address of the input data to be exclusive-ORed.

Constant or address B ： Input data to be exclusive-ORed with A. the designation is determined by the format, that is, constant or address.

Address C ： Address used to store the result of an exclusive EOR operation. The result of an exclusive EOR operation is stored starting at this address, and has the data length specified in Length format specification.

Example：

When address A and B hold the following data:

Address A	1	1	1	0	0	0	1	1
Address B	0	1	0	1	0	1	0	1

The result of the exclusive EOR operation is as follows:

Address C	1	0	1	1	0	1	1	0

5.31 AND（logical and）

Function：

The command ANDs the contents of address A with a constant (or the contents of address B), and stores the result at address C.

Format：

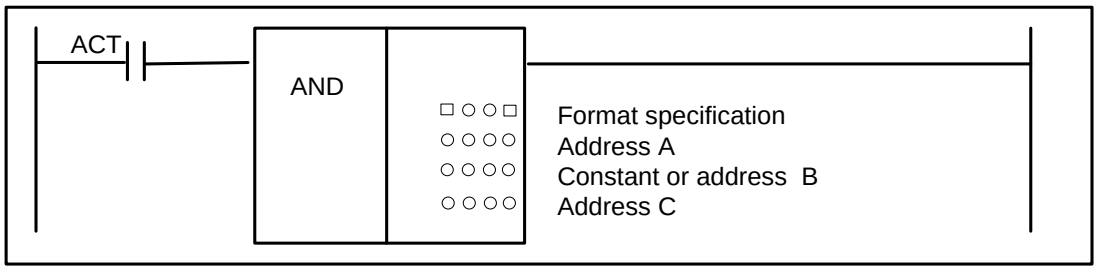


Fig. 5-53

Command table format ：

Table 5-33

No.	Command	Operand	Remark
1	LD	○○○○．○	ACT
2	FUNC	30	AND
3	PRM	□○○□	Format specification
4	PRM	○○○○	Address A
5	PRM	○○○○	Constant or address B
6	PRM	○○○○	Address C

Control conditions：

ACT execution conditions

ACT＝0 ： do not execute AND command.

ACT＝1 ： execute AND command .

Parameter：

Format specification ： Specify a data length (1-, 2-, 4-byte) and an input data format(constant or address).

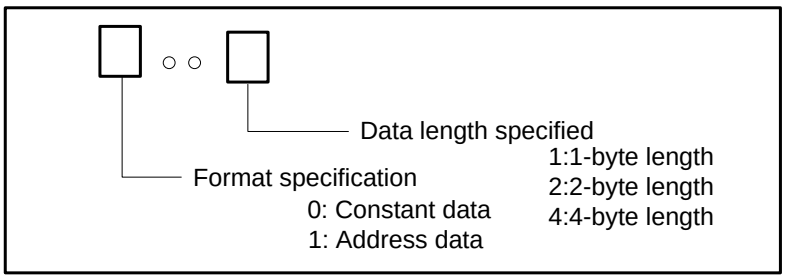


Fig. 5-54

Address A ： the head address of the input data to be exclusive-ANDed.

Constant or address B ： Input data to be exclusive-ANDed with A. the designation is determined by the format, that is, constant or address.

Address C ： Address used to store the result of an exclusive AND operation. The result of an exclusive AND operation is stored starting at this address, and has the data length specified in Length format specification.

Example:

When address A and address B hold the following data:

Address A	1	1	1	0	0	0	1	1
Address B	0	1	0	1	0	1	0	1

The result of the AND operation is as follows:

Address C	0	1	0	0	0	0	0	1

5.32 ORF（logical or）

Function：

The command Ors the contents of address A with a constant (or the contents of address B), and stores the result at address C.

Format：

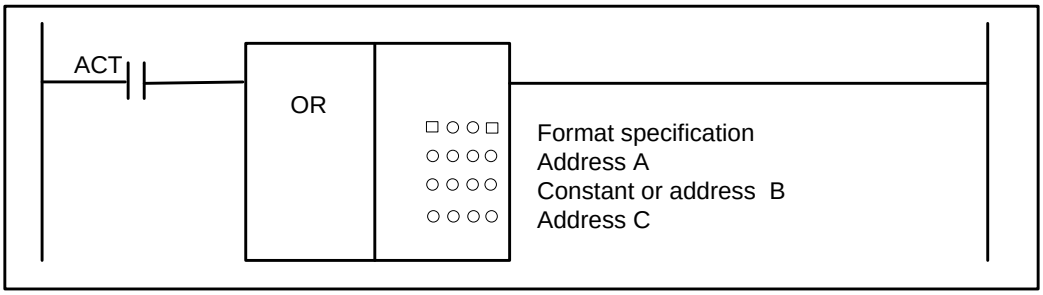


Fig. 5-55

Command table format ：

Table 5-34

No.	Command	Operand	Remark
1	LD	○○○○．○	ACT
2	FUNC	31	OR
3	PRM	□○○□	Format specification
4	PRM	○○○○	Address A
5	PRM	○○○○	Constant or address B
6	PRM	○○○○	Address C

Control conditions：

ACT execution condition

ACT＝0 ： do not execute ORF command .

ACT＝1 ： execute ORF command .

Parameter：

Format specification ： Specify a data length (1-, 2-, 4-byte) and an input data format(constant or address).

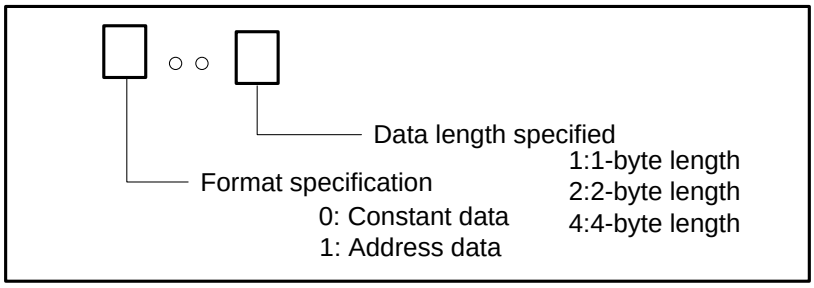


Fig. 5-56

Address A ： the head address of the input data to be ORed.

Constant or address B ： Input data to be ORed with A. the designation is determined by the format, that is, constant or address.

Address C ： Address used to store the result of an ORF operation. The result of an ORF operation is stored starting at this address, and has the data length specified in length format specification.

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 result of the OR operation is as follows:

Address C	1	1	1	1	0	1	1	1

5.33 NOT（logical not）

Function：

The command inverts each bit of the contents of address A, and stores the result at address B.

Format：

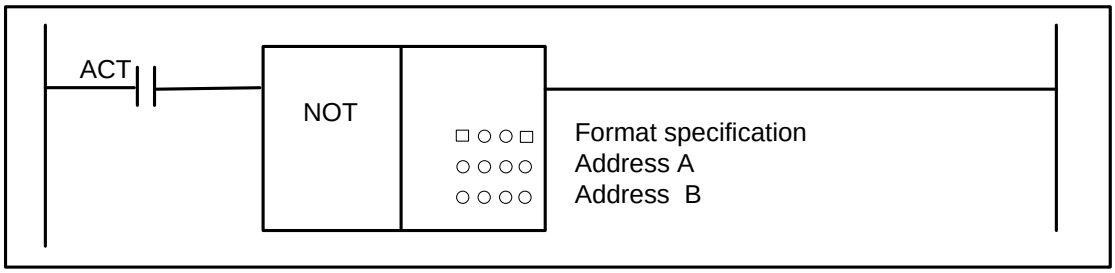


Fig. 5-57

Command table format ：

Table 5-35

No.	Command	Operand	Remark
1	LD	○○○○．○	ACT
2	FUNC	32	NOT
3	PRM	□○○□	Format specification
4	PRM	○○○○	Address A
5	PRM	○○○○	Address B

Control conditions：

ACT execution condition

ACT＝0，do not execute NOT command .

ACT＝1，execute NOT command .

Parameter：

Format specification: specifies a data length (1-, 2-, 4-byte).

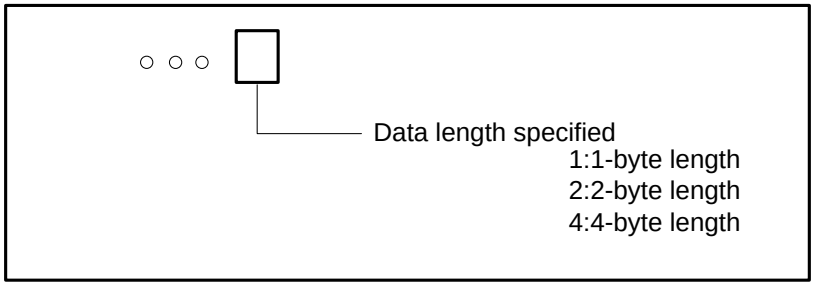


Fig. 5-58

Address A : specifies the head address of the input data to be inverted bit by bit.

Address B : specifies the address used to output the result of a NOT operation. The result of a NOT operation is stored starting at this address, and has the data length specified in format specification.

Example：

When address A and B have the following data:

Address A	1	1	1	0	0	0	1	1

The result of the NOT operation is as follows:

Address B	0	0	0	1	1	1	0	0

5.34 COM（common line control）

Function：

This command can be used to control the coil working from COM to COME (common line end command). The system specifies 0 for the number of coils and uses the common line control end command to use this function. The system alarms when the common line end command is not specified.

Format：

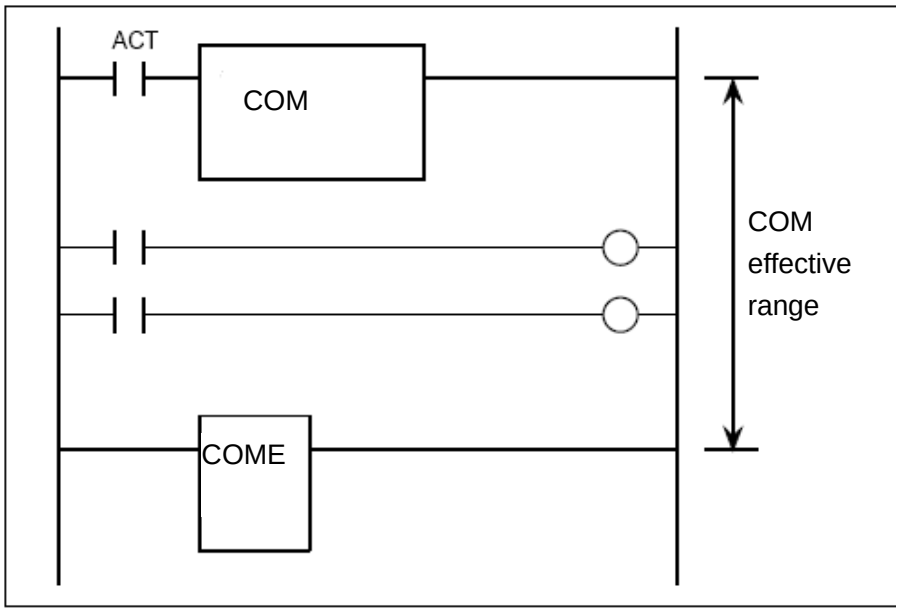


Fig. 5-59

Command table format ：

Table 5-36

No.	Command	Operand	Remark
1	LD	○○○○. ○	ACT
2	FUNC	33	COM

Control conditions：

ACT=0: the specified number of coils or the coils within the region specified are unconditionally turned off (set to 0).

ACT=1: not execute.

Parameter：

Specifies the number of coil: specifies to 0 and use COM specifying range.

Note:

1. In the range specified with a COM instruction, no additional COM instruction can be specified.
2. the coil for WRT.NOT in the range specified with a COM instruction is singly set to 1 (OUTN=1) ACT=0.

5.35 COME（common line control end）

Function：

The instruction can be used to specify the control range of the common control line instruction (COM). This instruction cannot be used alone. It must be used together with the COM instruction.

Format：

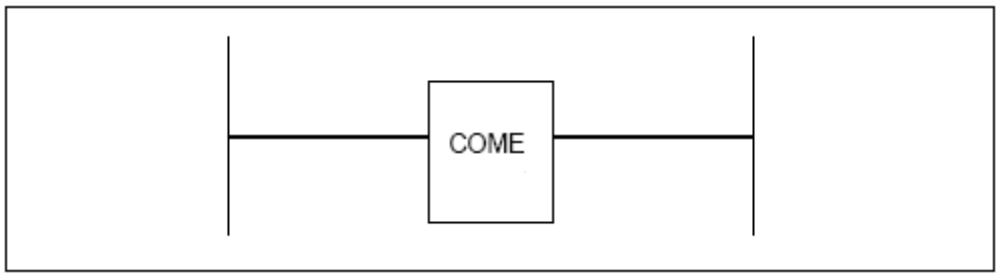


Fig. 5-60

Command table format ：

Table 5-37

No.	Command	Operand	Remark
1	FUNC	34	COME

5.36 JMP（jump）

Function：

The JMP transfers control to a ladder. When the JMP command is executed, the execution process jumps to the jump end command but does not execute the logic command (including functional command) between JMP and JMPE command. The specified coil number is 0. when the system uses JMPE command, it jumps the range. The system prompts the alarms when it does not command the jump end command.

Format：

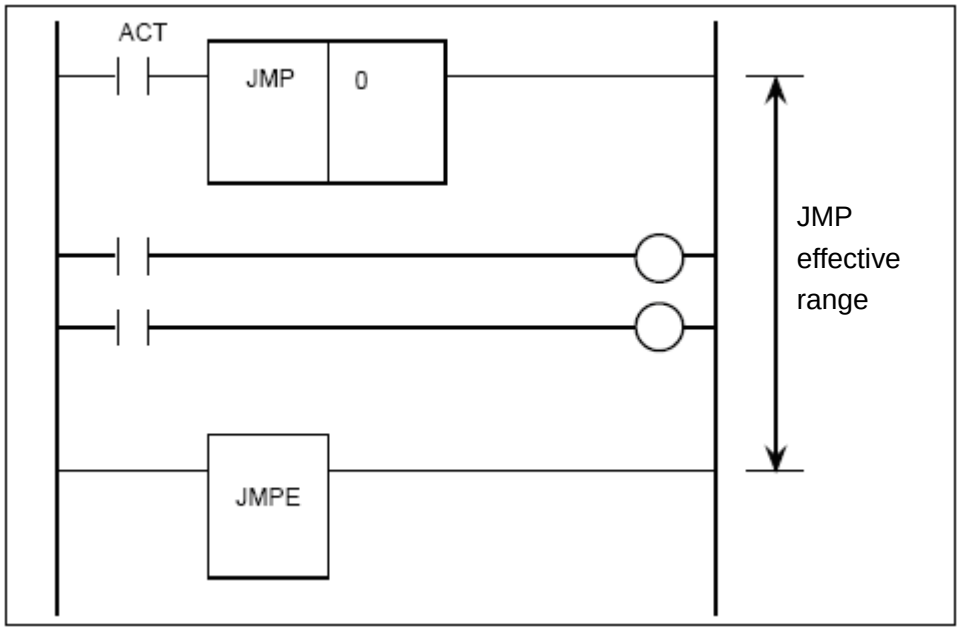


Fig. 5-61

Command table format ：

Table 5-38

No.	Command	Operand	Remark
1	LD	○○○○．○	ACT
2	FUNC	35	JMP
3	PRM	○	

Control conditions：

ACT=0：do not execute jump. The next command after the JMP command is executed.

ACT=1：jump the logical command (including functional command) in the specified range, and execute the program.

Parameter：

Specifies the number of coil: it is set to 0, use JMPE to specify the range.

Note：

JMP command operation.

ACT=1: the program jumps to the place where the jump end command (JMPE) is. The logical command (including functional command) in the specified range is not executed.

In compiling the program, do not create a program in which a combination of JMP and JMPE command is used to cause a jump to and from a sequence between the COM and COME command. The ladder sequence may not be able to operate normally after the jump.

5.37 JMPE（jump end）

Function：

Specifies the end of JMP(jump command) range. The command must be used together with JMP command.

Format：

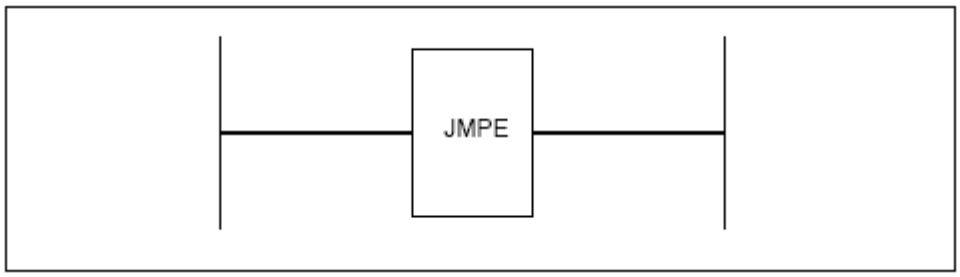


Fig. 5-62

Command table format ：

Table 5-39

No.	Command	Operand	Remark
1	FUNC	36	JMPE

5.38 CALL（conditional subprogram call）

Function：

A jump occurs to the subprogram when a condition is satisfied.

The command has the characteristics and limits as follows:

- ＊ Many call command can call the same one subprogram.
- ＊ The call command can be nested.
- ＊ The subprogram must follow END2 to be compiled.

Format：

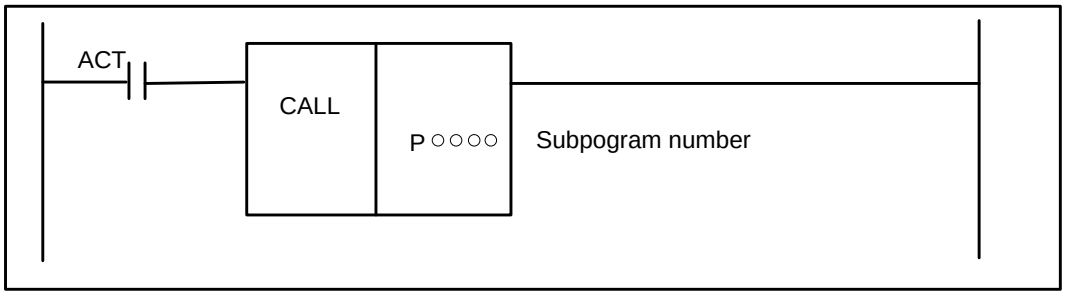


Fig. 5-63

Command table format ：

Table 5-40

No.	Command	Operand	Remark
1	LD	○○○○．○	ACT
2	FUNC	37	CALL
3	PRM	P○○○○	Subprogram number

Control conditions：

ACT execution conditions

ACT＝0: do not execute CALL command .

ACT＝1: execute CALL command，call the subprogram which number is specified.

Parameter：

Subprogram number ： specifies the called subprogram number. The subprogram number range is P1～P512.

5.39 CALLU（unconditional subprogram call）

Function：

The system unconditionally calls the specified subprogram when it executes the command CALLU.

Format：

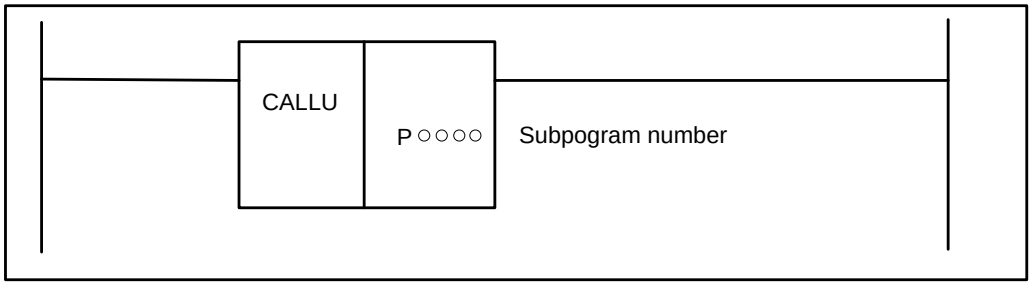


Fig. 5-64

Command table format ：

Table 5-41

No.	Command	Operand	Remark
1	FUNC	38	CALLU
2	PRM	P○○○○	Subprogram number

Parameter：

Subprogram number ： specifies the subprogram number of a subprogram to be called. The subprogram number must be specified in the P address form. A number from P1 to P512 can be specified.

5.40 JMPB（label jump 1）

Function：

The JMPB command transfers control to a ladder after the label set in a ladder program.

The JMPB has the following characteristics and limitations:

* More than one jump command can be coded for the same label.

* The jump command can transfer control freely before and after the command within the program unit (main program or subprogram) in which the command is coded.

* Jump commands can be nested.

* Jump END1 and END2 are forbidden.

Format：

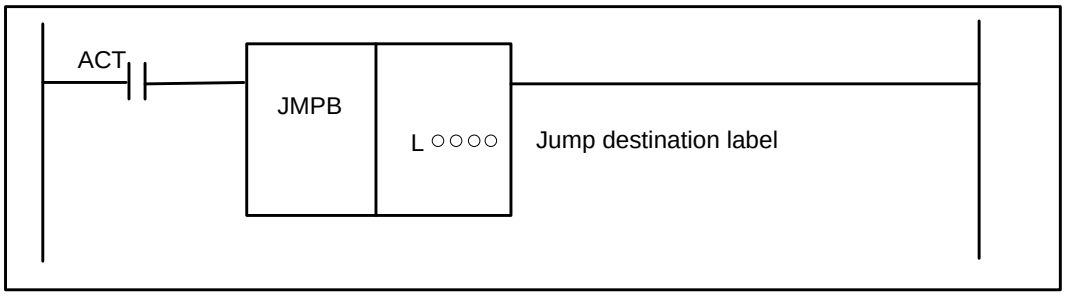


Fig. 5-65

Command table format ：

Table 5-42

No.	Command	Operand	Remark
1	LD	○○○○．○	ACT
2	FUNC	39	JMPB
3	PRM	L○○○○	Jump destination label number

Control conditions：

ACT execution conditions

ACT＝0，do not jump, execute the next command after JMPB command.

ACT＝1，jump to the next after the specified label, execute the next command after the label.

Parameter：

Jump destination label LX: specifies the label of the jump destination. The label number must be specified in the L address head. A value from L1 to L9999 can be specified.

5.41 JMPC（label jump 2）

Function：

The JMPC functional command returns control from a subprogram to the label code position of the main program. The specifications of the JMPC command are the same as those of the JMPB command, except that JMPC always returns control to the main program.

Format：

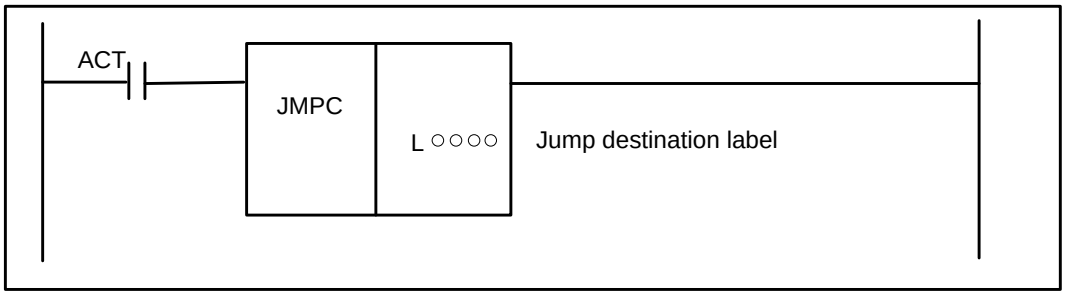


Fig. 5-66

Command table format ：

Table 5-43

No.	Command	Operand	Remark
1	LD	○○○○．○	ACT
2	FUNC	40	JMPC
3	PRM	L○○○○	Jump destination label

Control conditions：

ACT execution condition

ACT=0：the command after the JMPC command is executed.

ACT=1：control is transferred to the ladder after the specified label.

Parameter：

Jump destination label: specifies the label of the jump destination. The label number must be specified in the L address head. A number from L1 to L9999 can be specified.

Note: when the command is used to jump back to a previous command, care must be taken not to cause an infinite loop.

5.42 LBL（label）

Function：

The command specifies a label in ladder program for the jump destination of JMPB and JMPC.

Note: one Lx label only use LBL one time, otherwise, the system alarms.

Format：

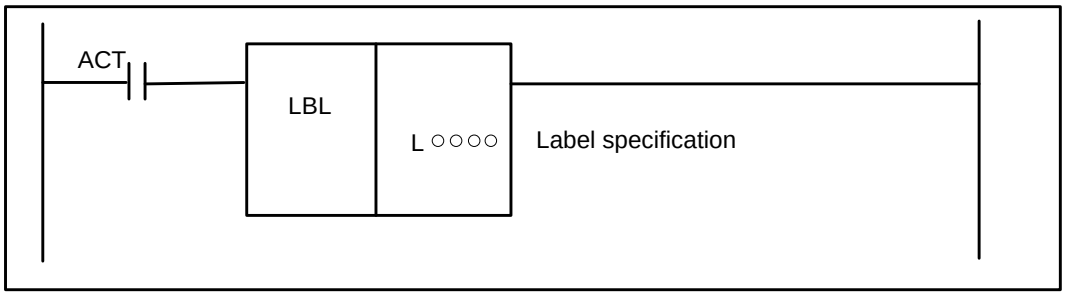


Fig. 5-67

Command table format ：

Table 5-44

No.	Command	Operand	Remark
1	LD	○○○○. ○	ACT
2	FUNC	41	LBL
3	PRM	L○○○○	Label specification

Parameter：

Label specification Lx: specifies the jump destination. The label number must be specified in L address head. A label number from L1 to L9999 can be specified.

5.43 SP（subprogram）

Function：

The SP command is used to create a subprogram for CALL and CALLU call, and SP is used with the mentioned later SPE to specify the subprogram range.

Notes：

1. the subprogram must follow END2 to be compiled.
2. can not set another subprogram in one subprogram.

Format：

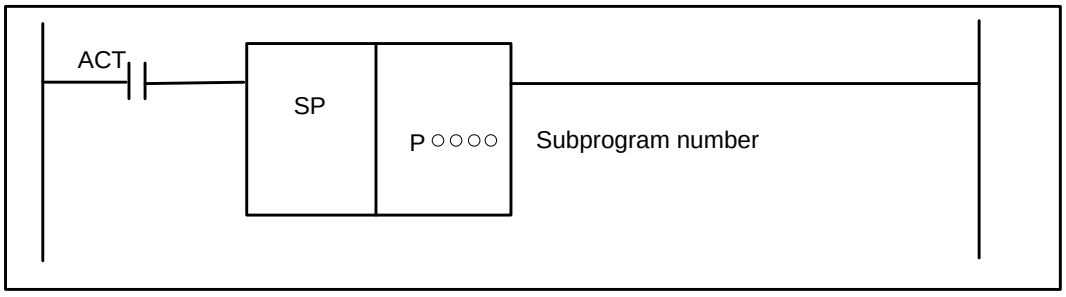


Fig. 5-68

Command table format ：

Table 5-45

No.	Command	Operand	Remark
1	LD	○○○○．○	ACT
2	FUNC	42	SP
3	PRM	P○○○○	Subprogram number

Parameter：

Subprogram number ： specifies the called subprogram label number in the P address form. The subprogram number range is P1～P512, and the specified subprogram number must be unique within the sequence program.

5.44 SPE（end of a subprogram）

Function：

* SPE is used with the S P command to specify the subprogram range.

* when the functional command is executed, control is returned to the main program that calls the subprogram.

* the subprogram must follow END2 to be compiled.

Format：

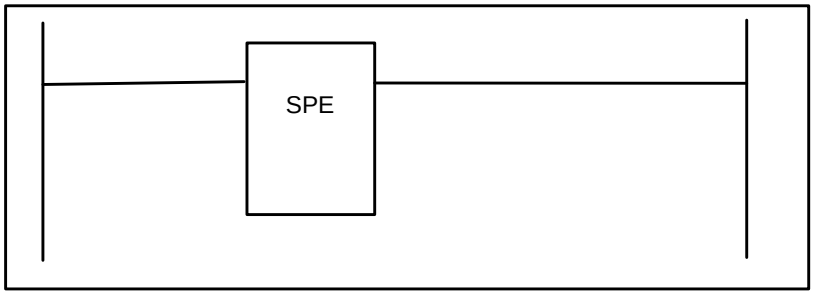


Fig. 5-69

Command table format ：

Table 5-46

No.	Command	Operand	Remark
1	FUNC	43	SPE

5.45 WINDR (Reading of CNC data)

Function:

Data exchange window between PLC and CNC is set for reading CNC data from PLC. “WINDR” is classified into two types；

1. Data reading is completed in a section of scan time (high-speed response function)

2. Data reading is completed in sections of scan time (low-speed response function)

Format：

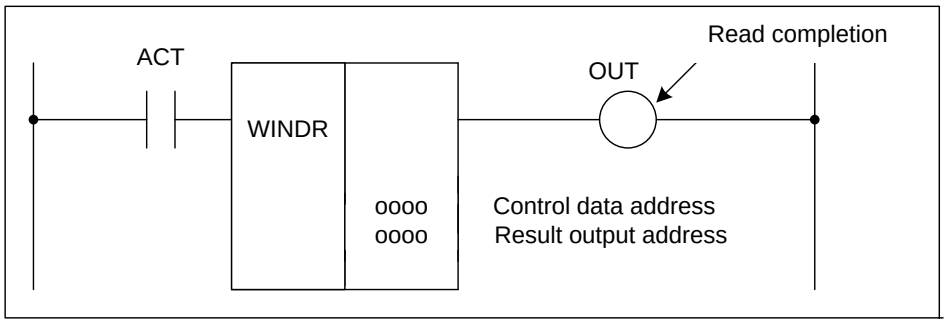


Fig. 5-70

Command table format ：

Table 5-47

No.	Command	Operand	Remark
1	LD	○○○○. ○	ACT
2	FUNC	44	WINDR
3	PRM	○○○○	Control data address
4	PRM	○○○○	Result output address
5	OUT	○○○○. ○	Reading completion

Control conditions：

ACT execution condition

ACT=0 ： do not execute WINDR function

ACT=1 ： execute WINDR command

Parameter:

Control data address

Data storage area is set by PLC byte address.

Control data:

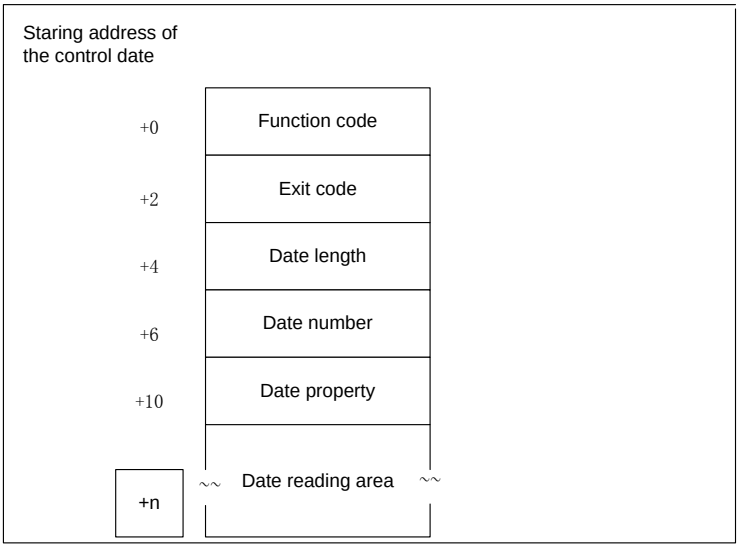


Fig. 5-71

Note: See table 5-48 for the function codes.

Output:

OUT = 0 : “WINDR” is not executed or “WINDR” is being executed.

OUT = 1 : Reading is finished. When low-speed response function is used, reset “ACT” is necessary after reading data.

Operation result register:

When error occurs in “WINDR” execution time, set the bit of operation result output register.

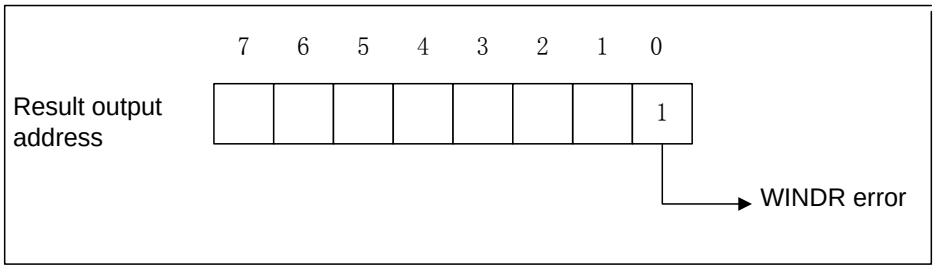


Fig. 5-72

5.46 WINDW (Writing of CNC data)

Function:

Data exchange window between PLC and CNC is set for writing CNC data from PLC. “WINDW” belongs to low-speed response function.

Format:

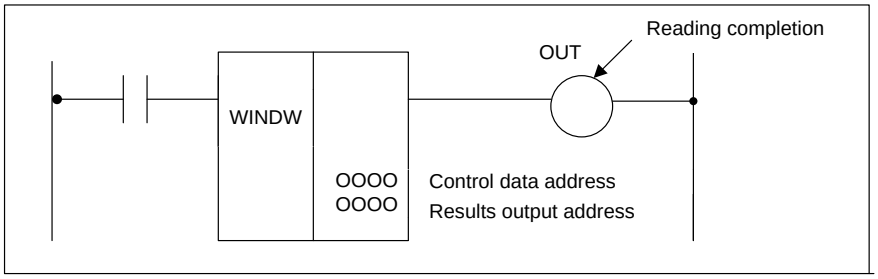


Fig. 5-73

Command table format:

Table 5-47

No.	Command	Operand	Remark
1	LD	○○○○. ○	ACT
2	FUNC	45	WINDW
3	PRM	○○○○	Control data address
4	PRM	○○○○	Result output address
5	OUT	○○○○. ○	Writing completion

Control conditions:

ACT execution condition

ACT=0：do not execute WINDW function

ACT=1：execute WINDW command. Reset “ACT” is necessary after writing data.

Parameter:

Control data address

Head address of the data storage area is specified by PLC byte.

Control data:

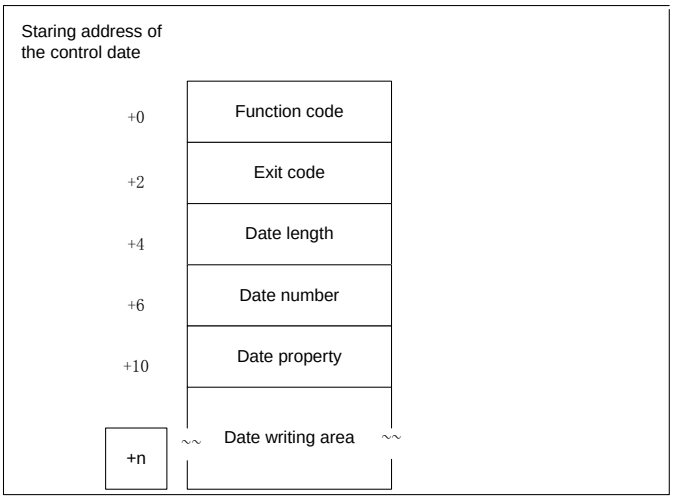


Fig. 5-74

Note: table 5-48 for function codes.

Output:

OUT = 0 : indicates “WINDW” is not executed or “WINDW” is being executed.

OUT = 1 ： writing completion. When low-speed response function is used, reset “ACT” is necessary after writing data.

Operation result register:

When error occurs in “WINDR” execution time, set the bit of operation result output register.

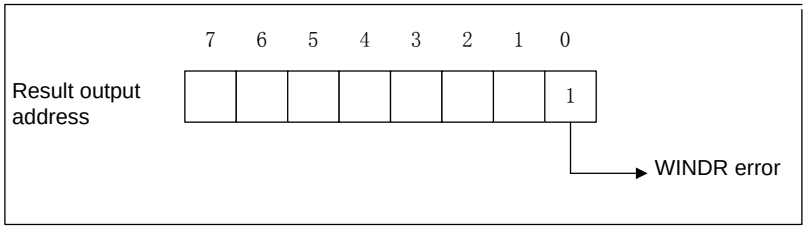


Fig. 5-75

Table 5-48 List of function code

Function	Function code	Response speed	Property
Reading CNC state information*	0	High speed	Read only
Reading tool offset	1	High speed	Read only
Writing tool offset	2	Low speed	Write only
Reading offset of workpiece zero point	3	High speed	Read only
Writing offset of workpiece zero point	4	Low speed	Write only
Reading parameter	5	Low speed	Read only
Writing parameter	6	Low speed	Write only
Reading set data	7	Low speed	Read only
Writing set data	8	Low speed	Write only
Reading user macro variable	9	Low speed	Read only
Writing user macro variable	10	Low speed	Write only
Reading data of screw pitch	11	Low speed	Read only
Writing data of screw pitch	12	Low speed	Write only

Reading current program number	13	High speed	Read only
Reading current sequence number	14	High speed	Read only
Reading actual speed of control axis	15	High speed	Read only
Reading absolute coordinate of control axis	16	High speed	Read only
Reading mechanical coordinate of control axis	17	High speed	Read only
Reading skipped space of control axis	18	High speed	Read only
Reading input motor load current	19	High speed	Read only
Writing motor torque limit data	20	Low speed	Write only
Reading actual spindle speed	21	High speed	Read only
Reading digital spindle load information	22	High speed	Read only
Reading relative coordinate of control axis	23	High speed	Read only
Reading distance-to-go	24	High speed	Read only
Reading modal data	25	Low speed	Read only
Reading diagnosis data	26	High speed	Read only
Reading time data	28	Low speed	Read only
Reading P code macro variable	29	Low speed	Read only
Writing P code macro variable	30	Low speed	Write only
Writing tool number low speed response	31	Low speed	Write only
Relative coordinate preset	32	Low speed	Write only

5.47 AXLCTL(PLC axis control)

Function：

The function is used for processing DI/DO signal of PLC control axis.

Format：

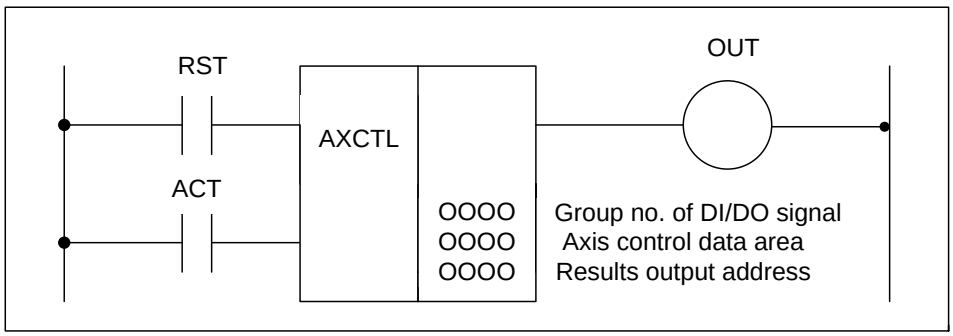


Fig. 5-76

Command table format：

Table 5-49

No.	Command	Operand	Remark
1	LD	○○○．○	RST
	LD	○○○．○	ACT
2	FUNC	46	PLC axis control function
3	PRM	○○○○	Group number of DI/DO signal
4	PRM	○○○○	Axis control data address
5	PRM	○○○○	Result output address
6	OUT	○○○.○	Execution complete

Control condition：

RST Reset command

RST=0 : Release reset

RST=1 : Set the reset signal to 1 to clear all codes, and the code being executed is stopped.

ACT Execution code

ACT=0 ： do not execute AXCTL function

ACT=1 ： execute AXCTL function

Parameter：

（a）Group number of DI/DO signal

1：Group A（G142 to G149，F130 to F132）

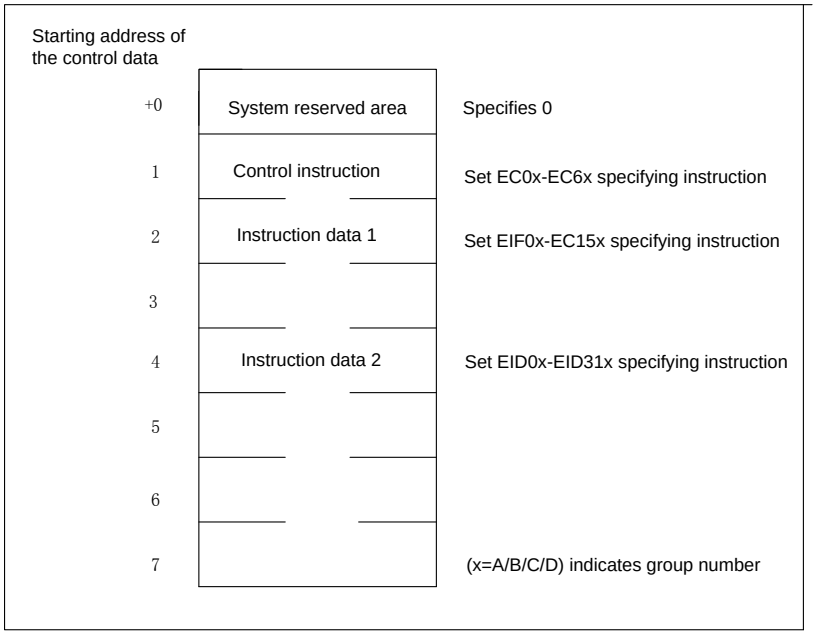
2：Group B（G154 to G161，F133 to F135）

3：Group C（G166 to G173，F136 to F138）

4：Group D（G178 to G185，F139 to F141）

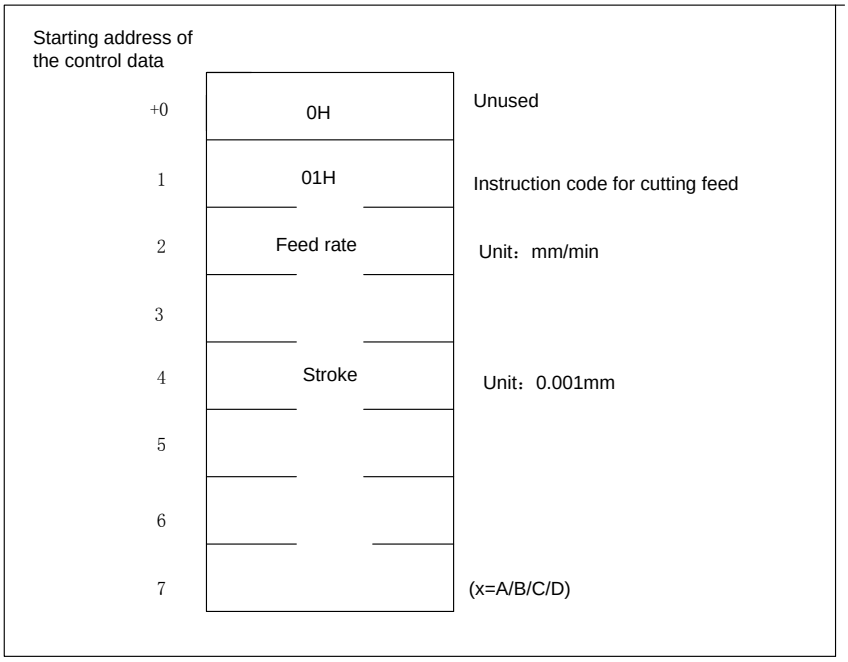
(b) Data address of axis control

Select the address contains PLC axis control data.



Example：

1) Cutting feed condition (feed per minute)



Note: relevant CNC parameter for axis move must be set.

Output：

OUT=0 : usually 0. OUT=1 indicates AXCTL command is completed.

Once the processing （OUT=1）is completed, ACT=0 must be set.

OUT=1 ： When PLC axis control command is stored in CNC or axis movement is performed, OUT=1.

Note: 1. No matter what the condition of ACT, OUT may become 1.

2. It has nothing to do with the condition of alarm signal.

Operation result register:

When error occurs in PLC control axis processing, set the corresponding bit of operation result output register.

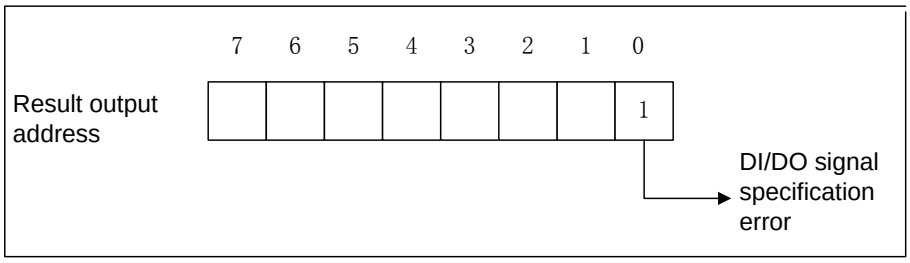


Fig. 5-72

Table 5-50 List of axis control signal

No.	Mark	Signal address	Significance	I/O
1	EAX1-EAX4	G136.0-3	Control axis selection signal	Input
2	EC0g-EC6g	G143.0-6, G155.0-6, G167.0-6, G179.0-6	Axis control command signal	Input
3	EIF0g-EIF15g	G144-G145, G156-G157 G168-G169, G180-G181	Axis control federate signal	Input
4	EID0g-EID31g	G146-G149, G158-G161 G170-G173, G182-G185	Axis control data signal	Input
5	EBUFg	G142.7, G154.7 G166.7, G178.7	Axis control command reading signal	Input
6	EBSYg	F130.7, F133.7, F136.7, F139.7	Reading completion signal of axis control command	Output
7	ECLRg	G142.6, G154.6 G166.6, G178.6	Reset	Input
8	ESTPg	G142.5, G154.5 G166.5, G178.5	Axis control pause signal	Input
9	ESBKg	G142.3, G154.3 G166.3, G178.3	Block stop signal	Input
10	EMSBKg	G143.7, G155.7 G167.7, G179.7	Block stop invalid signal	Input
11	EM11g-EM48g	F132; F135; F138; F141;	Miscellaneous function code signal	Output
12	EMFg	F131.0, F134.0, F137.0, F140.0	Miscellaneous function gating signal	Output
13	EMF2g	F131.2, F134.2, F137.2, F140.2	Miscellaneous function 2 gating signal	Output
14	EMF3g	F131.3, F134.3, F137.3, F140.3	Miscellaneous function 3 gating signal	Output
15	EFINg	G142.0, G154.0, G166.0, G178.0	Miscellaneous function completion signal	Input
16	ESOFg	G142.4, G154.4 G166.4, G178.4	Servo off signal	Input
17	EMBUFg	G142.2, G154.2 G166.2, G178.2	Buffer invalid signal	Input
18	*EAXSL	F129.7	Control axis state selection signal	Output
19	EINPg	F130.0, F133.0, F136.0, F139.0	In-position signal	Output
20	EIALg	F130.2, F133.2, F136.2, F139.2	Alarm signal	Output
21	EGENg	F130.4, F133.4, F136.4, F139.4	Axis movement signal	Output

22	EDENg	F130.3, F133.3, F136.3, F139.3	Miscellaneous function execution signal	Output
23	EOTNg	F130.6, F133.6, F136.6, F139.6	Negative over travel signal	Output
24	EOTPg	F130.5, F133.5, F136.5, F139.5	Positive over travel signal	Output
25	EFV0-EFV7	G151.0-G151.7	Feedrate override signal	Input
26	EOVC	G150.5	Override canceling signal	Input
27	EROV1, EROV2	G150.0, G150.1	Rapid traverse override signal	Input
28	EOV0	F129.5	Override 0% signal	Output
29	ESKIP	X13.6	Skip signal	Input
30	EADEN1-EADEN4	F112.0-3	Assignment completion signal	Output
31	EABUFg	F131.1, F134.1 F137.1, F140.1	B Buffer occupied signal B	Output
32	EACNT1-EACNT4	F182.0-3	Control signal	Output
33	*+ED1-*+ED6 *-ED1-*-ED6	G118.0-G118.4 G120.0-G120.4	External deceleration signal	Input

Table 5-51 Axis control function

Command	Action	Data 1	Data 2	Explanation
00h	Rapid traverse	Rapid traverse speed	Total movement	Operation is the same as in CNC G00
01h	Cutting feed rate per minute	Cutting feed rate	Total movement	Operation is the same as in CNC G94G01
02h	Cutting feed rate per rev	Feed rate per rev	Total movement	Operation is the same as in CNC G95G01
03h	Feed jump per minute	Cutting feed rate	Total movement	Operation is the same as in CNC G31G01
04h	Pause	—	Pause time	Operation is the same as in CNC G04
05h	Reference point return	—	—	Operation is the same as manual reference return
06h	Continuous feed	Continuous feed rate	Feed position	Operation is the same as CNC JOG feed
07h	1st reference point return	Rapid traverse speed	—	Operation is the same as CNC G28
08h	2nd reference point return	Rapid traverse speed	—	Operation is the same as CNC G30P2
09h	3rd reference return	Rapid traverse speed	—	Operation is the same as CNC G30P3

0Ah	4th reference return	Rapid traverse speed	—	Operation is the same as CNC G30P4
12h	1st miscellaneous function	—	Miscellaneous function code	Operation is the same as CNC miscellaneous function
14h	2nd miscellaneous function	—		Operation is the same as CNC miscellaneous function
15h	3rd miscellaneous function	—		Operation is the same as CNC miscellaneous function
20h	Machine coordinate selection	Rapid traverse speed	Mechanical coordinate	Operation is the same as CNC G53

Note:

Command indicates axis control commands EC0g-EC6g.

Data 1 indicates axis control federate signal EIF0g-EIF15g.

Data 2 indicates axis control data signal EID0g-EID31g.

Continuous feed command is immediate command, it is not stored in CNC.

5.48 PSGNL(Position signal output)

Function:

It is position signal output 1, which is used for specifying the area range in coordinate system of the current position.

Format:

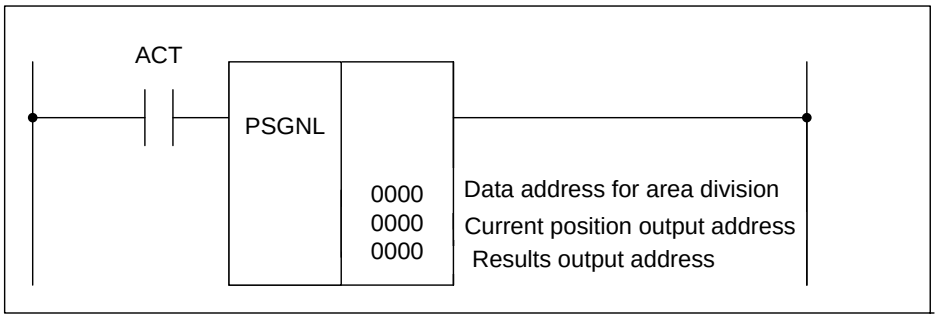


Fig. 5-73

Command table format:

Table 5-52

No.	Command	Operand	Remark
1	LD	○○○．○	ACT
2	FUNC	48	PSGNL
3	PRM	○○○○	Area division data address
4	PRM	○○○○	Current position outputting address
5	PRM	○○○○	Results outputting address

Control conditions：

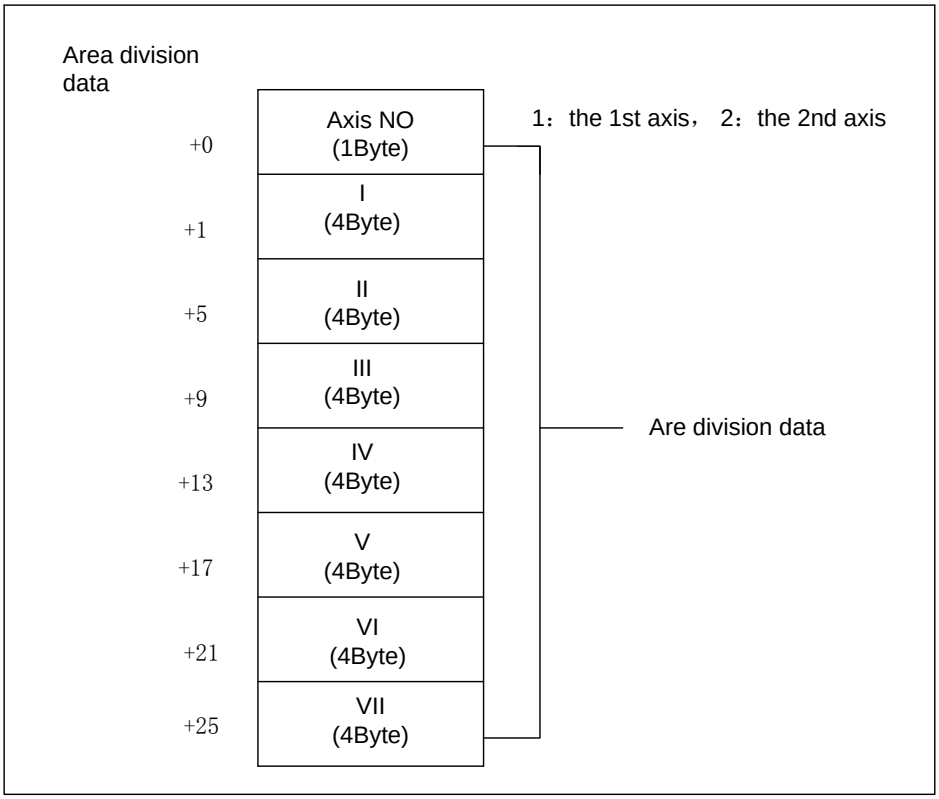
ACT=0 ： do not execute PSGNL function

ACT=1 ： execute PSGNL function

Parameter：

（1） Area division data address

Set head address of area division data. 29 bytes from the address are provide data for area division.



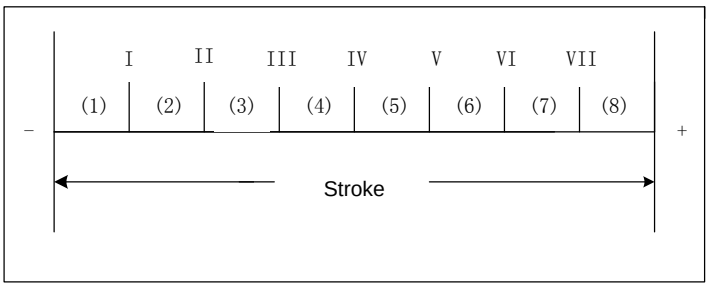
Axis No sets axis number (a binary one-byte data)

（Example）Axis No = 1 ： The 1st axis of the coordinate system.

Axis No = 2 ： The 2nd axis of the coordinate system.

Division data for areas （Ⅰ,Ⅱ,Ⅲ,…,Ⅶ）are 4-byte binary data.

(Area division example): total stroke is divided into 8 areas by 7 division points, see the figure below:



(2) Current area output address

The address is used for outputting area in coordinate system of the current position.

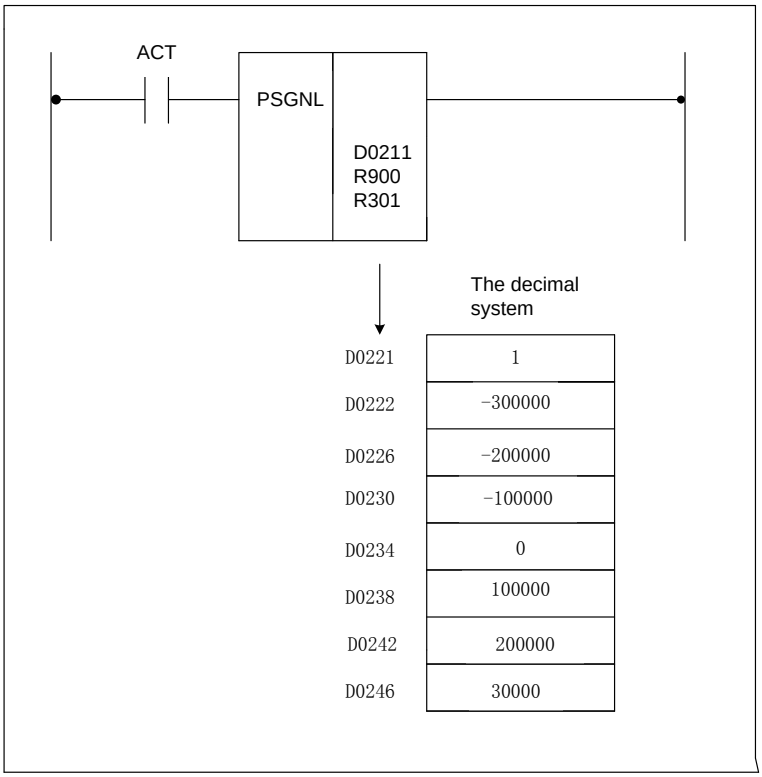
Current position	7	6	5	4	3	2	1	0
Output address	（1）	（2）	（3）	（4）	（5）	（6）	（7）	（8）

Corresponding position in coordinate system of the current position is set to 1.

(3) Operation result output register

When error occurs in PSGNL processing, the corresponding bit of the result output register is set to 1.

Position signal usage example:



For the above figure and area division data, if ACT=1, current position output（R1000）are as follows:

R1000.0=1: current position is bigger than 300.00mm in machine coordinate system.

R1000.1=1: current position is bigger than 200.00mm but smaller than 300.00mm in machine coordinate system.

R1000.2=1: current position is bigger than 100.00mm but smaller than 200.00mm in machine coordinate system.

R1000.3=1: current position is bigger than 0mm but smaller than 100.00mm in machine coordinate system.

R1000.4=1: current position is bigger than -100.00mm but smaller than 0mm in machine coordinate system.

R1000.5=1: current position is bigger than -200.00mm but smaller than -100.00mm in machine coordinate system.

R1000.6=1: current position is bigger than -300.00mm but smaller than -200.00mm in machine coordinate system.

R1000.7=1: current position is bigger than -300.00mm in machine coordinate system.

5.49 PSGN2 (Position signal output 2)

Function：

When the current position is in the specified area by the parameter, OUT=1.

Format

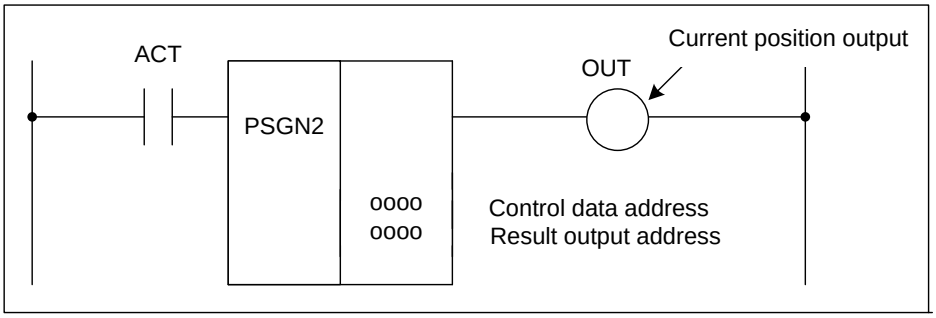


Fig. 5-70

Command table format：

Table 5-53

No.	Command	Operand	Remark
1	LD	○○○○. ○	ACT
2	FUNC	49	PSGN2
3	PRM	○○○○	Control data address
4	PRM	○○○○	Operation result output
5	OUT	○○○○. ○	Current position output address

Control conditions：

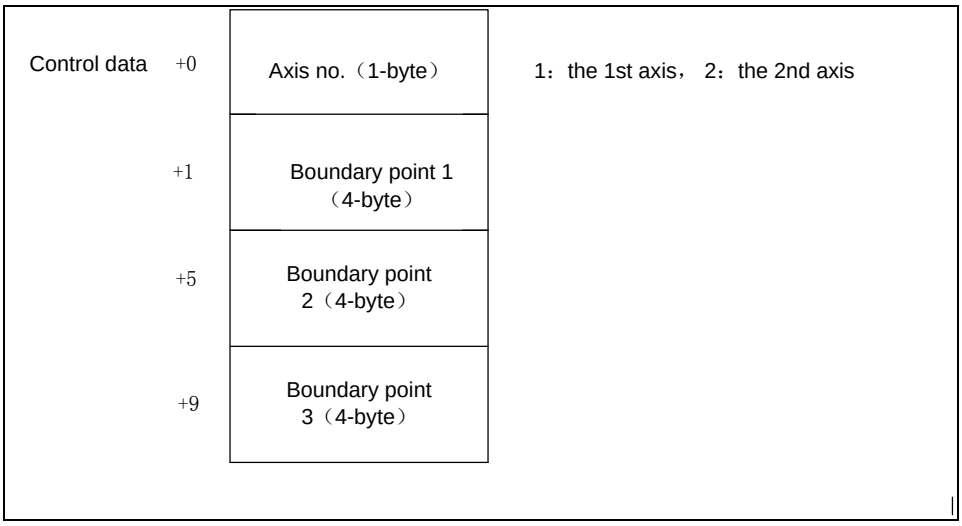
ACT=0 ： do not execute PSGN2 function

ACT=1 ： execute PSGN2 function

Parameter：

（1）Control data address

Set head address of control data

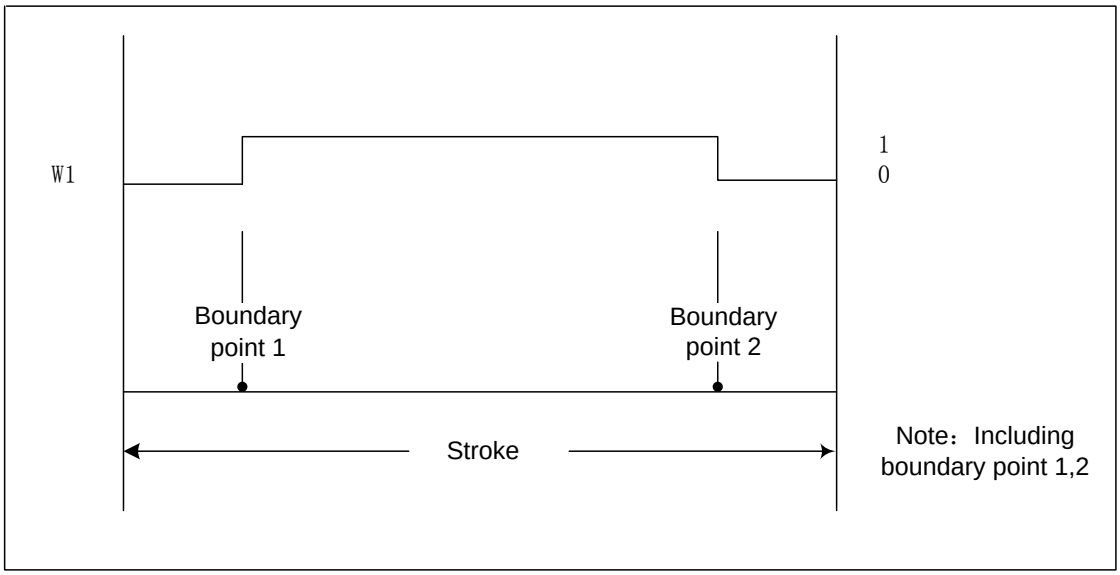


Axis number setting (binary one-byte number)

（Example）Axis number = 1 ： 1st axis coordinate

Axis number = 2 ： 2nd axis coordinate

Example of area division



（2）Operation result output address

When error occurs in PSGN2 processing, corresponding bit of operation result output register is set to 1.

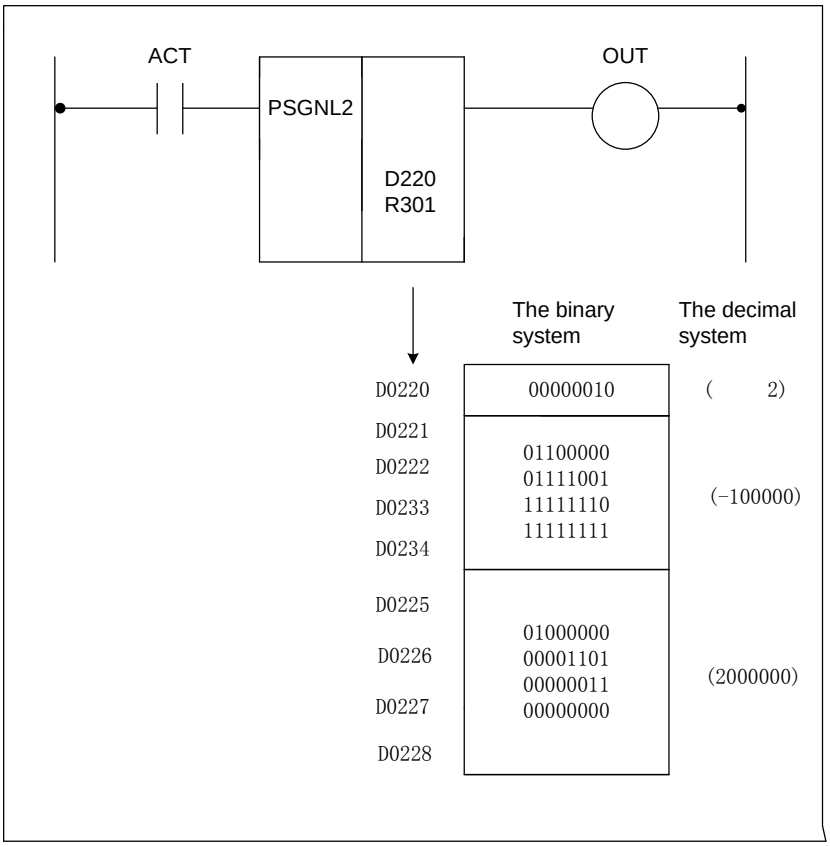
Output：

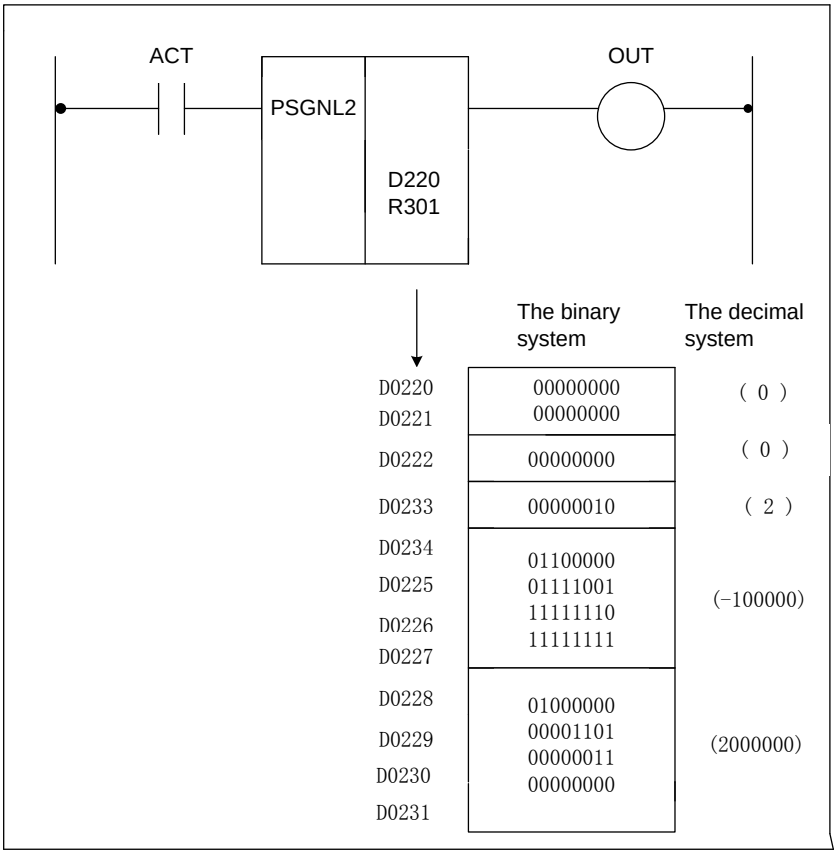
OUT=0: Current position is beyond the specified position in machine coordinate system

OUT=1：Current position is within the specified position in machine coordinate system

Usage example of position signal:

The example explains how to output position signal in machine coordinate of 2nd axis from the path 1. If the position is between -100.000mm to 200.000m, set control data address to D0220.





For the above ladder diagram and control data, if ACT=1, when -100.000<= 2nd axis position in machine coordinate <=200mm, OUT=1.

6 Ladder Writing Limit

Ladder writing limit constraints are as follows:

1. Sequence program must have END1 and END2 which are taken as the end marks of 1st level and 2nd level sequence part, and END1 must be before END2.
2. They only support the parallel output and do not support the multi-level output.
3. The result output address in all basic instructions and output function instruction are not set the following addresses:
   1) Counter preset address DC, timer preset address DT.
   2)) X address on IO input interface and CNC→PLC F address.

The followings are the phrasing error, and the system will alarm.

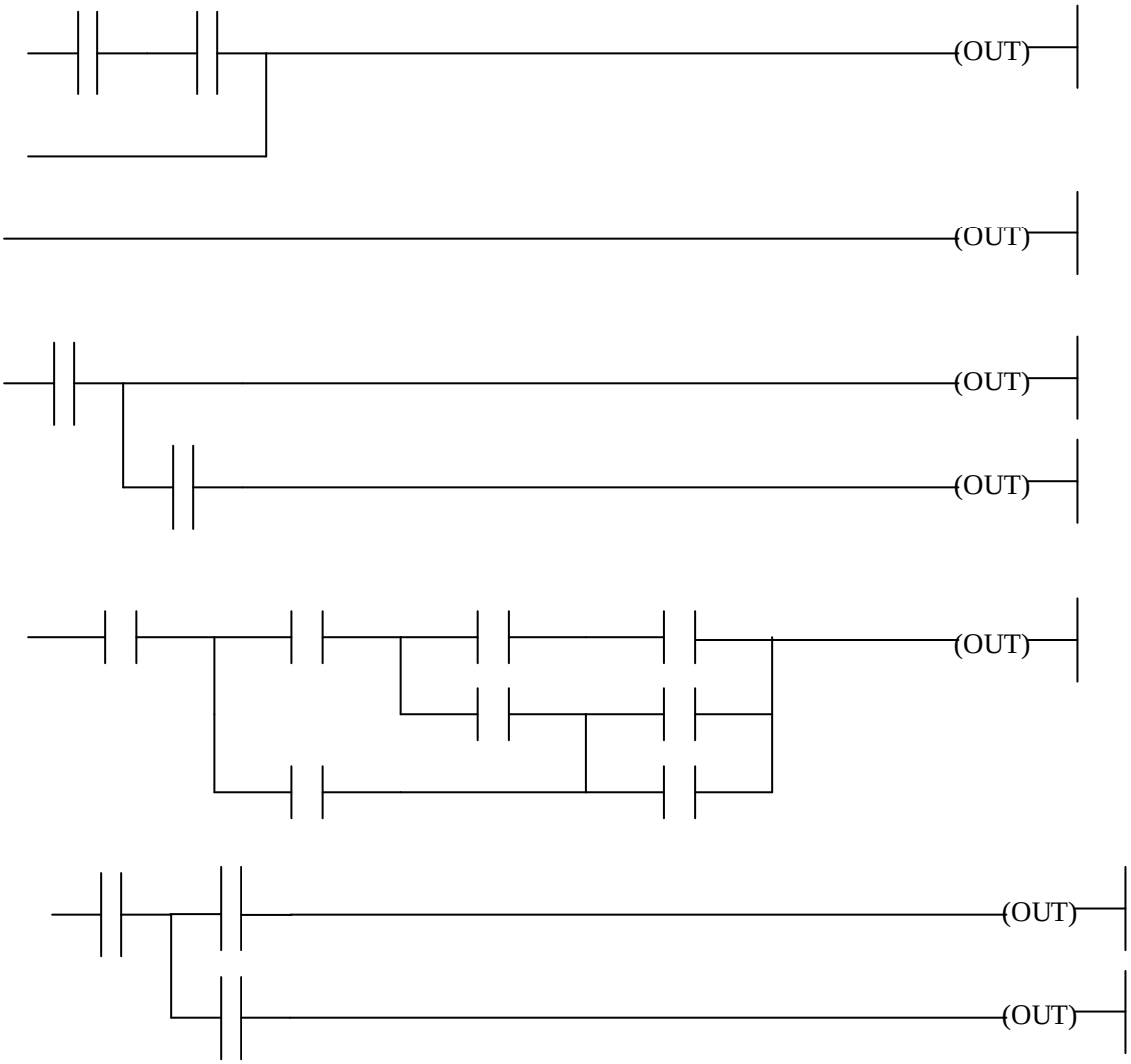


Fig. 6-1

Part 2 Function

1 Preparations for operation

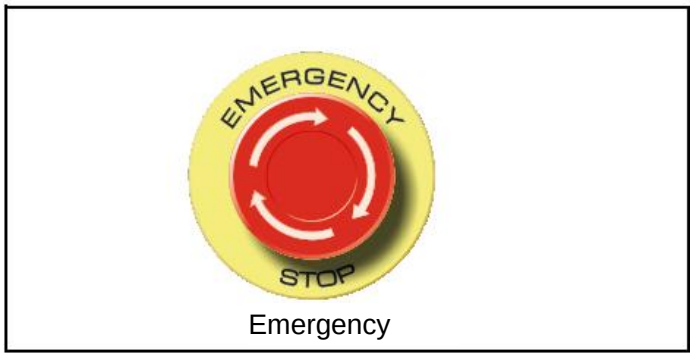
1.1 Emergency stop

Symbol ***ESP （ X008.4 G008.4 ）**

Type PLC→NC

Function The machine is stopped immediately by inputting emergency stop button.

When you press Emergency Stop button on the machine operation panel, emergency stop signal *ESP is changed into 0, the machine movement stops in a moment.



Emergency

Fig. 1-1

This button is locked when it is pressed. Although it varies with the machine tool builder, the button can usually be unlocked by twisting it right.

Signal

	#7	#6	#5	#4	#3	#2	#1	#0
X008				*ESP				
G008				*ESP				

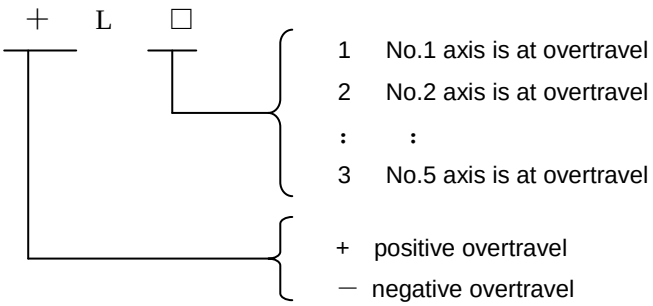
1.2 CNC overtravel signal

Signal **＋*L1～＋*L5(G114#0~G114#4, X9.6, X10.0,X10.2,X10.4,X10.6)**

－*L1～－*L5(G116#0~G116#4, X9.7, X10.1, X10.3, X10.5, X10.7)

Type **PLC→NC**

Function When the tool tries to move beyond the stroke end set by the machine tool limit switch, the tool decelerates and stops as a result of tripping the limit switch, and an OVERTRAVEL alarm is displayed. The signal indicates the control axis reaches the stroke limit, each direction of the control axis has this signal. ＋, － of the signal indicates the direction. The number corresponds to the control axis.



When it is “0”， the control unit operates as follows:

*In automatic operation, if even one axis overtravel signal becomes to “0”, all axes are decelerated to stop, an alarm is given and operation is halted.

*In manual operation, only the axis whose overtravel signal has turned to “0” is decelerated to a stop, and the axis can be moved in the opposite direction.

*Once the axis overtravel signal has turned to “0”, the axis direction is registered. Even if the signal returns to “1”, it is not possible to move that axis 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

	#7	#6	#5	#4	#3	#2	#1	#0
X009	−L1	+L1						
X010	−L5	+L5	−L4	+L4	−L3	+L3	−L2	+L2

1.3 Alarm signal

Symbol: AL（F001＃0）

Type: **NC→PLC**

Function: When an alarm is triggered in the CNC, the alarm signal is set to 1, and the alarm is displayed on the screen. The alarm indicates that CNC is in alarm state, and the following alarm occurs:

a) NC alarm
b) Overtravel alarm
c) Servo alarm

The alarm signal is set to 1 when::

——The CNC is placed in the alarm state.

The alarm signal is set to 0 when:

——The alarm has been released by resetting the CNC.

Signal address:

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

1.4 Interlock

All axes interlock signal

Symbol ***IT (G008#0)**

Type **PLC→NC**

Function These signals disable machine movement along axes. When any of these signals is activated during movement, tool movement along the affected axis is decelerated, then stopped. When the *IT is set to “0”, the axis movement is decelerated and stopped. In automatic operation, the system stops in automatic run state(the signal STL is “1”, the signal SPL is “0”).

Signal address

G008								*IT

Interlock signal for each axis

Symbol +MIT1~+MIT5 (G132#0~G132#4) -MIT1~-MIT5 (G134#0~G134#4)

Type PLC→NC

Function inhibit the specified axis to specify the axis movement.

Signal	Axis direction	Signal	Axis direction
+MIT1	1st axis positive	-MIT1	1st axis positive
+MIT2	2nd axis positive	-MIT2	2nd axis positive
+MIT3	3rd axis positive	-MIT3	3rd axis positive
+MIT4	4th axis positive	-MIT4	4th axis positive
+MIT5	5th axis positive	-MIT5	5th axis positive

when the axial interlock signal becomes “1”, the CNC applies interlock only in the corresponding axial direction. However, during automatic operation, all axes will stop.

Signal address

G132				+MIT5	+MIT4	+MIT3	+MIT2	+MIT1
G134				-MIT5	-MIT4	-MIT3	-MIT2	-MIT1

1.5 Operation mode selection

Operation mode selection

Symbol **MD1, MD2, MD3, INC (G43.0, G43.1, G43.2, G43.4)**

Type **NC→PLC**

Function System operation mode is selected according to the signal state

Input selection signal				Output signal	Operation mode
INC	**MD3**	**MD2**	**MD1**		
0	0	0	0	MMDI	MDI
0	0	0	1	MMEM	Auto
0	0	1	0	MEDT	Edit
0	0	1	1	MH	MPG
0	1	0	0	MJ	Manual
0	1	0	1	MZRO	Zero return
0	1	1	0	MRMT	DNC
1	1	0	0	MINC	Step

Signal address

	#7	#6	#5	#4	#3	#2	#1	#0
G043				INC		MD3	MD2	MD1

Operation mode confirmation signal

Symbol： MINC, MH, MJ, MMDI, MRMT, MMEM, MEDT, MZRO（F003#0~F003#7）

Type： NC→PLC

Function： Specifies the currently selected operation mode.

Signal address：

	#7	#6	#5	#4	#3	#2	#1	#0
F003	MZRO	MEDT	MMEM	MRMT	MMDI	MJ	MH	MINC

2 Coordinate axis control function

2.1 Axis Moving Signal

Symbol：MV1～MV5(F102.0～F102.4)

Type：NC→PLC

Function：The signal from CNC to PLC. It indicates the corresponding axis is moving.

MV1	The 1st axis is moving
MV 2	The 2nd axis is moving
MV 3	The 3rd axis is moving
MV 4	The 4th axis is moving
MV 5	The 5th axis is moving

Output is 1 when:

When the CNC is outputting position move command, the corresponding axis moving signal changes into 1. It remains 1 though the axis does not move and the operation is controlled by interlock, override signal.

In manual mode, the selection signal of the corresponding axis becomes 1.

Output is 0 when:

After sending the CNC position move command, axis stops and the corresponding axis move signal becomes 0. Servo driver delay is not considered here.

Signal address：

	#7	#6	#5	#4	#3	#2	#1	#0
F102				MV5	MV4	MV3	MV2	MV1

2.2 Axis move direction signal

Symbol： MVD1～MVD5(F106.0～F106.4)

Type： NC→PLC

Function： The signal from CNC to PLC. It indicates the move direction of the corresponding axis.

MVD1	1st axis is moving in negative direction
MVD2	2nd axis is moving in negative direction
MVD3	3rd axis is moving in negative direction
MVD4	4th axis is moving in negative direction
MVD5	5th axis is moving in negative direction

Output is 1 when:

The corresponding axis signal changes into 1 when the axis is moving in negative direction.

Output is 0 when:

The corresponding axis signal changes into 0 when the axis is moving in positive direction.

Note: The axis move direction signal remains the state before axis stop.

Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
F106				MVD5	MVD4	MVD3	MVD2	MVD1

2.3 Position Switch Signal

Symbol：PSW01～PSW32(F70～F73)

Type：NC→PLC

Function： The signal from CNC to PLC, 32-point in total. When the mechanical coordinate of the specified axis (by parameter N2500-N2531) is in the range specified by parameter, the corresponding signal becomes 1. It is software analog action.

Symbol	Address	Function
PSW01	F70.0	1st position switch signal
PSW02	F70.1	2nd position switch signal
:	:	:
:	:	:
PSW31	F73.6	31st position switch signal
PSW32	F73.7	32nd position switch signal

Signal address:

F070	PSW08	PSW07	PSW06	PSW05	PSW04	PSW03	PSW02	PSW01
	Position switch signal							
F071	PSW16	PSW15	PSW14	PSW13	PSW12	PSW11	PSW10	PSW09
	Position switch signal							
F072	PSW24	PSW23	PSW22	PSW21	PSW20	PSW19	PSW18	PSW17
	Position switch signal							
F073	PSW32	PSW31	PSW30	PSW29	PSW28	PSW27	PSW26	PSW25
	Position switch signal							

Relevant parameter:

	#7	#6	#5	#4	#3	#2	#1	#0
2401					SWI			

SWI: Position switch valid symbol

0：Position switch is invalid

1：Position switch is valid

2500	Servo axis no. to position switch 1
～	～
2531	Servo axis no. to position switch 16

Set servo axis number for each position switch. When the number is set to 0, the corresponding position switch is invalid. It corresponds to X axis when the number is 1, to Y axis when the number is 2, to Z axis when the number is 3, to the 4th axis when the number is 4, and so on.

2532	Max. value for action range of position switch 1
～	～
2563	Max. value for action range of position switch 32
2564	Min. value for action range of position switch 1
～	～
2595	Min. value for action range of position switch 32

Set action range of each position switch by mechanical coordinate value.

2.4 Synchronous Axis Control

Function Two motors are operated simultaneously by one axis command to propel the feed axis, which is usually called gantry axis function. The motors are primary, secondary moter separately.

Relevant parameter：

	#7	#6	#5	#4	#3	#2	#1	#0
4020							ADJ	SYN

SYN ： Feed axis synchronous valid symbol

0 ： Invalid

1 ： Valid

ADJ ： Synchronous reversion mode of feed axis

0 ： Invalid

1 ： Valid

4021	Main control axis number
4022	Allowed tolerance of the machine coordinate
4023	Synchronous error allowed by position offset
4024	Compensation allowed by synchronous

3 Manual operation

3.1 JOG feed/incremental feed

General

JOG feed In JOG mode, setting a feed axis and direction selection bit to 1 on the machine operator's panel moves the machine along the selected axis in the selected direction.

Incremental feed In incremental feed mode, setting a feed axis and direction selection bit to 1 on the machine operator's panel moves the machine one step along the selected axis in the selected direction. The minimum distance the machine moves, is the least input increment. The step can be 10, 100, or 1000 times the least input increment.

The only difference between JOG feed and incremental feed is the method of selecting the feed distance. In JOG feed, the machine continues to be fed while the following signals selecting the feed axis and direction are 1: ＋J1，－J1，＋J2，－J2，＋J3，－J3，etc. In incremental feed, the machine is fed by one step. Using JOG feedrate override dial can regulate JOG feedrate. The step distance can be selected by MPG feed movement distance G19＃4~G19＃5.

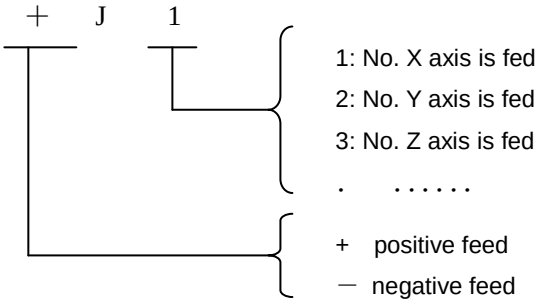
Signal Feed axis and direction selection signal

＋J1~＋J5（G100＃0~G100＃4）

－J1~－J5（G102＃0~G102＃4）

［Classification］ Input signal. **PLC→NC**

［Function］ In JOG feed or Incremental feed mode, select the required feed axis and direction. +/- in the signal name indicates the feed direction, the number corresponds to the controlled axis.



［Operation］ When the signal is set to 1, the control unit operate as follows:

* When JOG feed or incremental feed is allowed, the control unit moves the specified axis in the specified direction.

When the signal is set to 1 in JOG feed, the control unit continues to move that axis

Signal address

G100				+J5	+J4	+J3	+J2	+J1
G102				－J5	－J4	－J3	－J2	－J1

Manual rapid traverse selection signal

RT（G１９＃7）

［Classification］ **PLC→NC**

［Function］ Select the rapid traverse rate in JOG feed or incremental feed mode.

［Operation］ When the JOG feed signal becomes 1, the federate is increased, it is controlled by rapid traverse override.

Signal address

	＃7	＃6	＃5	＃4	＃3	＃2	＃1	＃0
G19	RT							

3.2 MPG / Step feed

Signal **HS1A、HS1B、HS1C（G018＃0~G018＃2）**

Classification PLC→NC

General In MPG feed mode, select the feed axis of MPG.

HS1C	HS1B	HS1A	Selected axis
0	0	1	X
0	1	0	Y
0	1	1	Z
1	0	0	4
1	0	1	5
1	1	0	6

Signal address:

	＃7	＃6	＃5	＃4	＃3	＃2	＃1	＃0
G018						HS1C	HS1B	HS1A

MPG/incremental feed selection signal

MP1, MP2（G019＃4~G19＃5）

［Classification］ **PLC→NC**

［Function］ The signal selects the movement distance of each pulse of MPG in MPG feed, and also selects the movement distance of each step in the incremental feed.

MP2(G19.5)	MP1(G19.4)	Override
0	0	×1
0	1	×10
1	0	×100
1	1	×1000

Signal address:

	＃7	＃6	＃5	＃4	＃3	＃2	＃1	＃0
G019			MP2	MP1				

4 Reference Point Return

4.1 Manual reference point return

General In manual reference point return mode, the machine tool move in the specified direction by setting the position parameter N1004#5 to execute the reference point return. The selected axis on the panel reports the axis to execute the machine zero return, which is not related to the move direction of axis.

When the system with absolute position detection unit is used, the specified position is kept. It unnecessary to create reference point after power on, the reference return will performed directed when reference return is executed.

Reference return deceleration signal

Signal ***DEC1~ *DEC5（X9＃0~X9＃4）**

Classification PLC→NC

Function Movement speed of manual reference return is reduced, and the reference point is searched at low speed. **X9＃0~X9＃4** is high-speed I/O signal, which is sent to CNC directly not through PLC. Parameter N2401#5 sets deceleration signal level of reference return.

Signal address:

	＃7	＃6	＃5	＃4	＃3	＃2	＃1	＃0
X009				*DEC5	*DEC4	*DEC3	*DEC2	*DEC1

Requirements for deceleration block of manual reference return:

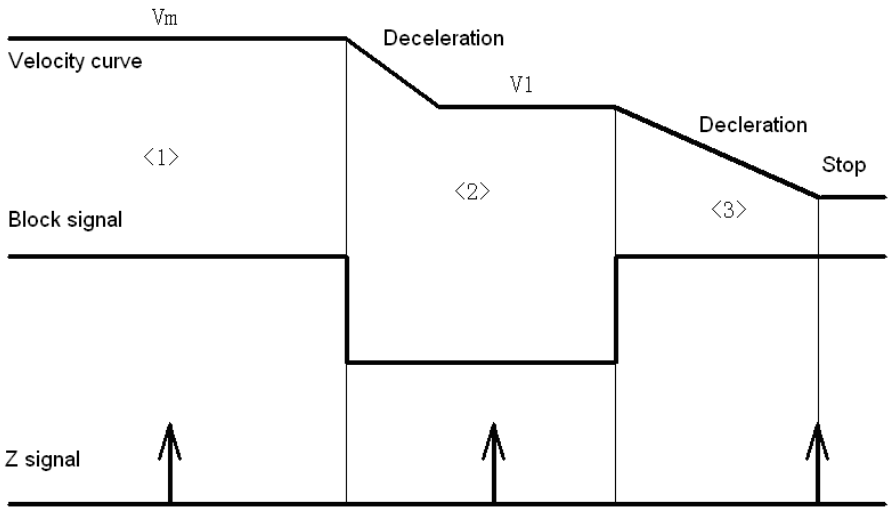


Fig. 4-1 The process of manual reference return

The min. length of deceleration block

L=（(Vm/60）*（Vm/60）-（V1/60）*（V1/60））/（2*a*1000）+D

Vm ： Reference return speed, which is set by parameter N1235

V1 ： FL speed of reference return, which is set by parameter N1234

a ： Deceleration/acceleration speed, which is set by parameter N1444

D ： Movement per rev of servo motor, which is set by parameter N1060

Reference point return completion signal

ZP1～ZP5(F94＃0~F94＃4)

［Classification］ **NC→PLC**

［Function］ These signals report that the machine tool is at the reference point on a controlled axis.

ZP1	1st axis reference point return completion signal
ZP2	2nd axis reference point return completion signal
ZP3	3rd axis reference point return completion signal
ZP4	4th axis reference point return completion signal
ZP5	5th axis reference point return completion signal

［Output conditions］When these signals becomes 1:

- Manual reference point return is completed and the current position is in the in-position area.
- The automatic reference point return(G28) is completed and the current position is in the in-position area.
- The reference point return check is completed and the current position is in the in-position area.

When the signal becomes 0:

- The machine tool moves from the reference point.

Signal address:

	＃7	＃6	＃5	＃4	＃3	＃2	＃1	＃0
F094				ZP5	ZP4	ZP3	ZP2	ZP1

Reference point establishment signal

ZRF1~ZRF4(F120＃0~F120＃4)

［Classification］ **NC→PLC**

［Function］ Notify the system that the reference point has been established.

ZRF1	1st reference point establishment signal
ZRF2	2nd reference point establishment signal
ZRF3	3rd reference point establishment signal
ZRF4	4th reference point establishment signal
ZRF5	5th reference point establishment signal

［Output condition］ The signal becomes 1 when :

- When the reference point is established after the manual reference point return.
- When the reference point is established using the absolute position detector at initial power-on.

The signal becomes 0 when :

- When the reference point is lost.

Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
F120				ZRF5	ZRF4	ZRF3	ZRF2	ZRF1

4.2 Reference Return (without Block)

General Reference return deceleration switch is not used to realize reference return. When the system parameter N1001#1 is set to 1, the function is valid.

Procedures:

1. In manual mode, move the axis to the adjacent place where reference point to be set.

2. Select reference return mode, and press axis moving key on the panel to choose the axis to return the reference point. The axis moves to reference point in the direction set by parameter N1004#5 at FL speed. Its direction has nothing to do with the one selected by key.

3. The system stops when one-turn signal is seized in the process of the CNC returns to the reference point. The position where the system stops is set to be the reference point. The reference return completion（ZPn）signal and reference position establishment（ZRFn）signal are set to 1.

4.3 The 2nd, 3rd, and 4th Reference Point Return

2nd, 3rd, and 4th reference point return completion signal

Signal： **2nd reference point return ZP21～ZP25(F96＃0~F96＃4)**

3rd reference point return ZP31～ZP35(F98＃0~F98＃4)

4th reference point return ZP41～ZP45(F100＃0~F100＃4)

Classification： NC→PLC

Function： In command G30, the numbers behind p are used to specify which point is returned to. Axis position specified by the same block is used to select reference return axis.

Set 2nd, 3rd, and 4th **reference point coordinate parameter as**：N1051, N1052, N1053.

ZP ◇ □

◇ 2： 2nd **reference point**

3： **3rd reference point**

4： **4th reference point**

□ 1： 1st axis

2： 2nd axis

……

……

The signal becomes 1 when :

- The 2nd, 3rd, and 4th **r**eference point return is completed by command G30 and the current position is in the in-position area.

The signal becomes 0 when :

- The machine tool moves from the reference point.

	＃7	＃6	＃5	＃4	＃3	＃2	＃1	＃0
F096				ZP25	ZP24	ZP23	ZP22	ZP21
F098				ZP35	ZP34	ZP33	ZP32	ZP31
F100				ZP45	ZP44	ZP43	ZP42	ZP41

5 Automatic operation

5.1 Cycle start/feed hold

General

* Start of automatic operation(cycle start)

When automatic operation start signal ST is set to 1 then 0 while the CNC is in memory mode, DNC operation mode or MDI mode, the CNC enters the automatic operation start state then starts operating.

The signal ST is ignored as follows:

1. When the CNC is in other modes except for MEM, RMT or MDI mode.
2. When the feed hold signal (SP) is set to 0.
3. The emergency stop signal (ESP) is set to 0.
4. When the reset signal（ERS）is set to 1.
5. When <RESET> on MDI panel is pressed.
6. When CNC is in the state of alarm.
7. When the automatic operation is started.

In automatic operation, the CNC enters the feed hold and stops run as follows:

1. When the feed hold signal (*SP) is set to 0.
2. The operation mode becomes manual, MPG, Zero return operation mode.

In automatic operation, the CNC enters the feed hold and stops run as follows:

1. The single block instruction is end when the single block is running.
2. MDI operation is completed.
3. CNC alarms.
4. The single block instruction is end after the mode is changed to others or Edit mode.

In automatic operation, the CNC enters the reset and stops running as follows:

1. When the emergency stop signal (ESP) is set to 1.
2. When the external reset signal (ERS) is set to 1.
3. When <RESET> on MDI panel is pressed.

* Halt of automatic operation

（Feed hold） When the feed hold signal SP is set to 0 in automatic operation, the CNC enters the halt state and stops operation. At the same time, cycle start lamp signal STL is set to 0 and feed hold lamp signal SPL is set to 1. Re-setting signal SP to 0 in itself will not restart automatic operation. To restart automatic operation, first set signal SP to 0, then set signal ST to 1 and to 0.

When signal * SP is set to 0 during the execution of a block containing only the M, S, T, or B function, signals STL is immediately set to 0, signal SPL is set to 1, and the CNC enters the feed hold state. If the FIN signal is subsequently sent from the PLC, the CNC executes processing up until the end of the block that has been halted. Upon the completion of that block, signal SPL is set to 0 (signal STL remains set to 0) and the CNC enters the automatic operation stops state.

1. During threading
   When signal SP is set to 0 during threading, the CNC enters the feed hold state after executing a threading block.
2. During tapping in a canned cycle
   When signal SP is set to 0 during tapping in a canned cycle (G84), signal SPL is immediately set to 1 but operation continues until the tool returns to the initial level or R point level after the completion of tapping.
3. When a macro command is being executed
   Operation stops after the currently executing macro command has been completed.

Signal Cycle start signal

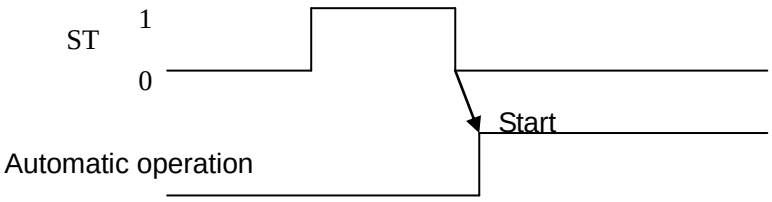
ST（G7＃2）

［Classification］ **PLC→NC**

［Function］ Start the automatic operation.

［Operation］ When signal ST is set to 1 then 0 in automatic operation(Auto), DNC and MDI mode, the CNC enters the cycle start state and starts operations.

In Auto，DNC and MDI mode



Feed hold signal

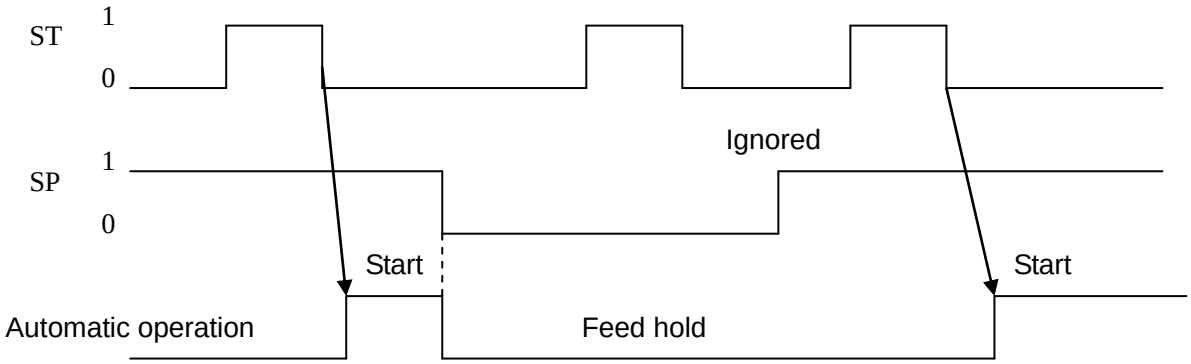
SP（G8#5）

［Classification］ **PLC→NC**

［Function］ Halt the automatic operation

［Operation］ In Auto mode, SP signal is set 1, CNC enters the feed hold and stops running. When SP signal is set to 0, the automatic operation does not start.

In Auto，DNC and MDI mode



Cycle start lamp signal

STL（F000#5）

［Type］ **NC→PLC**

［Function］ The signal reports PLC that the automatic operation is entered. The signal is set to 1 or 0, which is determined by CNC state as Table 5.1.

Feed hold lamp signal

STL（F000#4）

［Type］ **NC→PLC**

［Function］ The signal reports PLC that the feed hold is entered.

The signal is set to 1 or 0, which is determined by CNC state as Table 5.1.

Automatic operation signal

Feed hold lamp signal

OP（F000#7）

［Type］NC→PLC

Function The signal reports PLC that the automatic operation is performing

The signal is set to 1 or 0, which is determined by CNC state as Table 5.1.

Table 5.1

	Cycle start lamp STL	Feed hold lamp SPL	Automatic operation lamp OP
Cycle start	1	0	1
Feed hold	0	1	1
Automatic operation stopping	0	0	0
Reset	0	0	0

Signal address

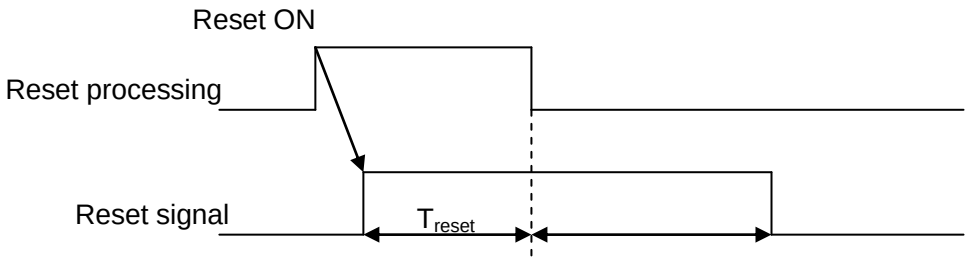
	#7	#6	#5	#4	#3	#2	#1	#0
G007						ST		
F000	OP		STL	SPL				

5.2 Reset

General CNC is reset and enters the reset state.

1. When the emergency signal (ESP) is set to 1.
2. When the external reset signal（ERS）is set to 1.
3. When <RESET> on MDI panel is pressed.

When the CNC is reset, the resetting signal RST is output to the PLC. The resetting signal RST is set to 0 when the resetting signal output time has elapsed after the above conditions have been released.



When the CNC is reset during automatic operation, automatic operation is stopped and is decelerated to stop. When the CNC is reset during the execution of the MF, SF or TF signal is set to 0 within 16ms.

Signal **External reset signal**

ERS（G8＃7）

［Classification］ **PLC→NC**

［Function］ reset the CNC.

［Operation］ turning the signal ERS to 1 resets the CNC and enters the reset state. While the CNC is reset, the resetting signal RST turns to 1.

Reset signal

RST（F001＃1）

［Classification］ **NC→PLC**

［Function］ Notifies the PLC that the CNC is being reset. This signal is used for reset processing on the PLC.

The signal is set to 1 when:

1. When the emergency stop signal (ESP) is set to 1.
2. When <RESET> on MDI panel is pressed.
3. <RESET> key on MDI is pressed.

The signal is set to 0 when:

When the reset signal output time set by a parameter is completed after the above are released and CNC is reset.

Signal address

	＃7	＃6	＃5	＃4	＃3	＃2	＃1	＃0
G008	ERS							
F001							RST	

5.3 Testing a program

General Before machining is started, the automatic running check can be executed. It checks whether the established program can operate the machine as desired. This check can be accomplished by running the machine or view the position display change without running the machine.

5.3.1 Machine tool lock

General The change of the position display can be monitored without moving the machine.

When all-axis machine lock signal MMLK is set to 1, output pulses to the servo motors are stopped in manual or automatic operation. The instructions are distributed, however, updating the absolute and relative coordinates. The operator can therefore check if the instructions are correct by monitoring the position display.

Signal **machine lock signal**

MLK G044＃1)

［Classification］ **PLC→NC**

［Function］ The signal reports PLC of the state of all-axis machine tool lock signal.

［Operation］ When this signal is set to 1, pulses are not output to the servo motors for all axes in manual or automatic operation.

All-axis machine lock check signal

MMLK（F004＃1）

［Classification］ **NC→PLC**

［Function］ Notifies the PLC of the state of the all-axis machine lock signal.

When the signal is set to 1, all-axis machine tool lock signal is set to 1.

When the signal is set to 0, all axes machine tool lock signals are set to 0.

Signal address

	＃7	＃6	＃5	＃4	＃3	＃2	＃1	＃0
F004							MMLK	
G044							MLK	

5.3.2 Dry run

General Dry run is valid only for automatic operation. The tool is moved at a constant feedrate regardless of the federate specified in the program. The feedrate is set by the data parameter P1210.

This function is used to check the movement of the tool without a workpiece.

Signal Dry run signal

DRN（G046＃7）

［Classification］ **PLC→NC**

［Function］ Enables dry run.

［Operation］When the signal is set to 1, the machine tool moves at the feedrate specified for dry run.

When the signal is 0, the machine tool normally moves.

Caution:

When the dry run signal is changed from 0 to 1 or 1 to 0 during the movement of the machine, the feedrate of the machine is first decelerated to 0 before being accelerated to the specified feedrate.

Dry run check signal
MDRN（F002＃7）
［Classification］ **NC→PLC**
［Function］ Notifies the PLC of the state of the dry run signal.
［Operation］ The signal is set to 1 in the following case:
——When the dry run signal DRN is set to 1.
The signal is set to 0 in the following case:
——When the dry run signal DRN is set to 0.

Signal address

	＃7	＃6	＃5	＃4	＃3	＃2	＃1	＃0
G046	DRN							
F002	MDRN							

5.3.3 Single block

General The single block operation is valid in automatic operation mode (Auto mode).
When the single block signal (SBK) is set to 1 during automatic operation, the CNC enters the automatic operation stop state after executing the current block. In subsequent automatic operation, the CNC enters the automatic operation stop state after executing each block in the program. When the single block signal (SBK) is set to 0, normal automatic operation is stored.

Signal **Single block signal SBK（G046＃1）**
［Classification］ **PLC→NC**
［Function］ Enables single block operation.
［Operation］Execute the single block when the signal is set to1.
Execute the normal operation when the signal is set to 0.

Single block check signal
MSBK（F004＃3）
［Classification］ **NC→PLC**
［Function］ The signal reports PLC of the state of single block signal.
［Operation］ The signal is set to 1 as follows:
——When the single block signal SBK is set to1.

The signal is set to 0 as follows:

——When the single block signal SBK is set to 0.

Caution:

1. Operations in thread cutting

When the SBK signal becomes 1 in thread cutting, the operation stops after the first non-thread cutting signal after thread cutting instruction.

2. Operation in canned cycle

When the SBK signal becomes 1 during canned cycle operation, the operation stops at each positioning, approach, drilling and retraction instead of the end of the block. The SPL signal becomes 1 while the STL signal becomes 0, showing that the end of the block has not been reached. When the execution of one block is completed, the STL and SPL signals become 0 and the operation is stopped.

Signal address

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

5.4 Optional block skip

General When a slash followed by a number is specified at the head of a block, and optional block skip signal BDT is set to 1 during automatic operation, the block is ignored**.**

Signal Skip optional block signal

BDT（G044#0）

［Classification］ **PLC→NC**

［Function］ Select whether a block with "/" is neglected.

［Operation］ During automatic operation, when BDT is 1, the block with "/" is neglected.

The program is normally executed when BDT is 0.

Optional block skip check signal

MBDT（F004#0）

［Classification］ **NC→PLC**

［Function］ The signal reports PLC of the state of skip optional block BDT.

Signal address

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

5.5 Program restart

General A program may be restarted at a block by specifying the sequence number of the block, after automatic operation is stopped because of a broken tool or for holidays. This function can also be used as a high-speed program check function.

There are two types of restart methods：

P type：restart after a tool is broken down.

Q type：restart after holiday.

Signal Program restart signal

SRN<G006#0>

[Classification**] PLC→NC**

[Function] Select the program restart

[Operation] When the program restart signal is set to 1 to search for the sequence number of the block to be restarted, the LCD screen changed to the program restart screen. When the program restart signal is set to 0, and automatic operation is activated, the machine moves back to the machining restart point at dry run speed along the axes one by one. When the machine moves to the restart point, machining restarts.

Signal during program restart

SRNMV<F002#4>

[Classification**] NC→PLC**

[Function**]** Report the program is started.

[Output conditions**]** The signal becomes 1 when:

—The program restart signal is set to 0 after the LCD screen changes to the program restart screen.

The signal is set to “0” when ：

—The program restart sequence ends(the tool has been moved to the restart point on all controlled axes）.

Signal address

	#7	#6	#5	#4	#3	#2	#1	#0
G006								SNR
F002				SRNM				

6 Feedrate Control

6.1 Rapid traverse rate

General A rapid traverse rate is set for each axis by the data parameter P1225, so no rapid traverse rate need be programmed.

The following overrides can be applied to a rapid traverse rate with the rapid traverse override signal:

F0，25％，50％， 100％.

F0 ： it is set by the data parameter P1231.

Signal **rapid traversing signal**

RPDO（F002#1）

［Type］ **NC→PLC**

［Function］ The signal indicates that a move command is executed at rapid traverse.

［Output condition］ “1” indicates that an axis starts moving after rapid traverse has been selected.

“0” indicates that an axis starts moving after a federate other than rapid traverse has been selected. This holds true for both automatic and manual operation modes.

Note：

1. The rapid traverse in automatic operation includes all rapid traverses in canned cycle positioning, automatic reference point return, etc., as well as the move command G00. The manual rapid traverse also includes the rapid traverse in reference position return.
2. Once rapid traverse has been selected, this signal remains “1”, including during a stop, until another federate has been selected and movement is started.

Signal address

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

6.2 Override

6.2.1 Rapid traverse override

General An override of four steps (F0，25％，50％，100％) can be applied to the rapid traverse rate. F0 is set by a parameter P1231.

1% step by step method can be used to select rapid traverse rate in the range of 0~100%.

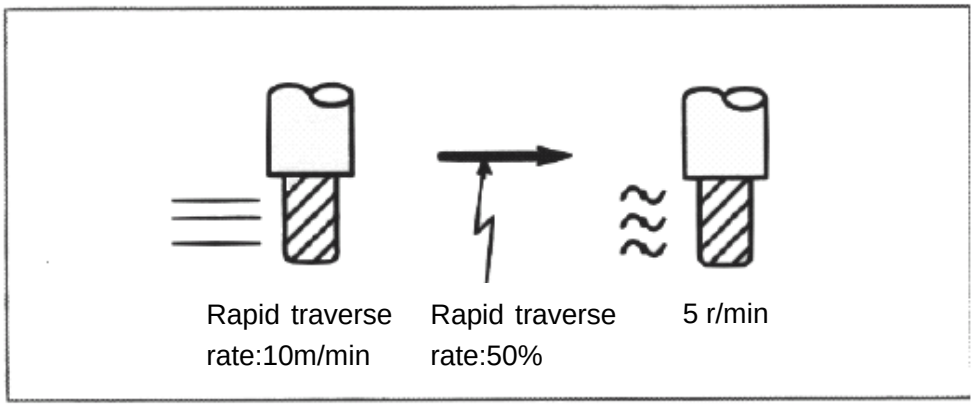


Fig. 6-1

Feedrate Actual feedrate is obtained by multiplying the rapid traverse rate preset by a parameter by the override value determined by this signal (including manual reference point return, program zero return).

F0 rate It is set by the data parameter P1231.

Signal rapid traverse rate override signal ROV1 ROV2<G14.0 G14.1>

ROV1 ROV2（G14.0 G14.1）

［Classification］ **PLC→NC**

［Function］ These signals override the rapid traverse rate.

Rapid traverse override signal		Override value
ROV2	**ROV1**	
0	0	F0
0	1	25%
1	0	50%
1	1	100%

Fig. 6-2

Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G014							ROV2	ROV1

1% step rapid traverse override selection signal HROV(G096.7)

Signal： **HROV(G096.7)**

Classification： **PLC→NC**

Function： Select rapid traverse override control signal.

When the signal is 0, ROV1 ROV2（G14.0 G14.1）is selected by rapid traverse override.

When the signal is 1, HROV0~HR0V6(G96.0~G96.6) is selected by rapid traverse override, 1% step rapid traverse override is valid.

Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G096	HROV							

1% step rapid traverse override signal HROV0~ HROV06(G096.0~G96.6)

Signal： **HROV0~ HROV06(G096.0~G96.6)**

Classification： **PLC→NC**

Function： Rapid override in 0~100% can be applied by 7-bit binary data (G096.0~G96.6) step by step (1%) .

When the binary data exceeds 100, the override is restricted in 100%.

Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G096		HROV6	HROV5	HROV4	HROV3	HROV2	HROV1	HROV0

6.2.2 Feedrate Override

Feedrate override

Signal： ***FV0~*FV7（G012）**

Classification： **PLC→NC**

Function： Manual and cutting federate override control

Feedrate override is a 8-bit binary code, which can be chosen by the min. 1% step in the range of 0%~254%. Actual feedrate is obtained by multiplying the commanded speed by the override value

G012(*FV0~*FV7)	Override	G012(*FV0~*FV7)	Override
0000 0000	0%	0110 0100	100%
0000 0001	1%	0110 0101	101%
0000 0010	2%	…. …..	…
0000 0011	3%	1111 1110	254%
…. …..	…	1111 1111	0%

Override control is invalid in the following conditions and it performed by 100%：

- G63 tapping mode
- Cutting feed of tapping canned cycle

Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G012	*FV7	*FV6	*FV5	*FV4	*FV3	*FV2	*FV1	*FV0

6.2.3 Safety Feedrate Selection

Safety federate selection signal

Signal： **FVL（G019#6）**

Classification： **PLC→NC**

Function： Restrict max. speed of rapid traverse and cutting feed

When the signal is 1, rapid traverse and cutting federate of CNC axes are restricted by parameter N1260.

Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G019		FVL						

7 M, S, T Auxiliary Function

7.1 Miscellaneous function

Basic procedure

The following signals are used for the following functions.

Table 7-1

Function	Program address	Output signal			Completion signal
		Code signal	Strobe signal	Distribution end signal	
Miscellaneous function	M	M**	MF	DEN	FIN
Spindle function	S	S00～S31	SF		
Tool function	T	T00~T31	TF		

Each function uses different program addresses and different signals, but they all input and output signals in the same way, as described below.(A sample procedure for the miscellaneous function is described below. The procedures for the spindle speed function and the tool function are obtained simply by substituting S, T in place of M.)

（1） Suppose that MXXX is specified during a program:
If XXX is not set，the CNC alarms.

（2） After the code signals M00~M31 is sent, the strobe signal MF is set to 1. The code signal is the binary representation of the programmed value XXX.
If a move, dwell, spindle speed, or other function is specified in the same block as the miscellaneous function, the execution of the other function is started when the code signal of the miscellaneous function is sent.

（3） When the strobe signal is set to 1, the PLC reads the code signal and performs the corresponding operation.

（4） To execute an operation after the completion of the move, dwell or other function specified in the block, wait until distribution end signal DEN is set to 1.

（5） Upon completion of the operation, the PLC sets completion signal FIN to 1. The completion signal is used by the miscellaneous function, spindle speed function, tool function described later, and other functions. If any of these functions are executed simultaneously, the completion signal must be set to 1 upon completion of all the functions.

（6） If the completion signal remains set to 1 for longer than period, the CNC sets the strobe signal to 0 and reports that the completion signal has been received.

（7） When the strobe signal is set to 0, set the completion signal to 0 in the PLC.

（8） When the completion signal is set to 0, the CNC sets all code signals to 0 and completes all sequences of the miscellaneous function.

（9） Once all other commands in the same block have been completed, the CNC executes the next block.

1. When the spindle speed is executed, the tool function is S code, T code signal is sent.
2. When the spindle speed, the tool function code signal is maintained until a new code for the corresponding function is specified.

The timing diagram is as follows:

One miscellaneous function specified in a block

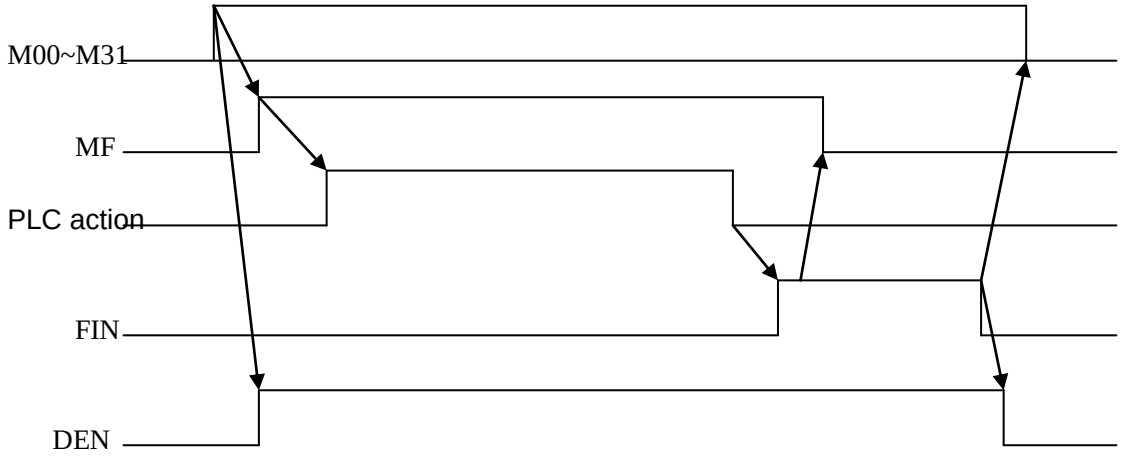


Fig. 7-1

Move command and miscellaneous function in the same block, execute a miscellaneous function with waiting for move command completion:

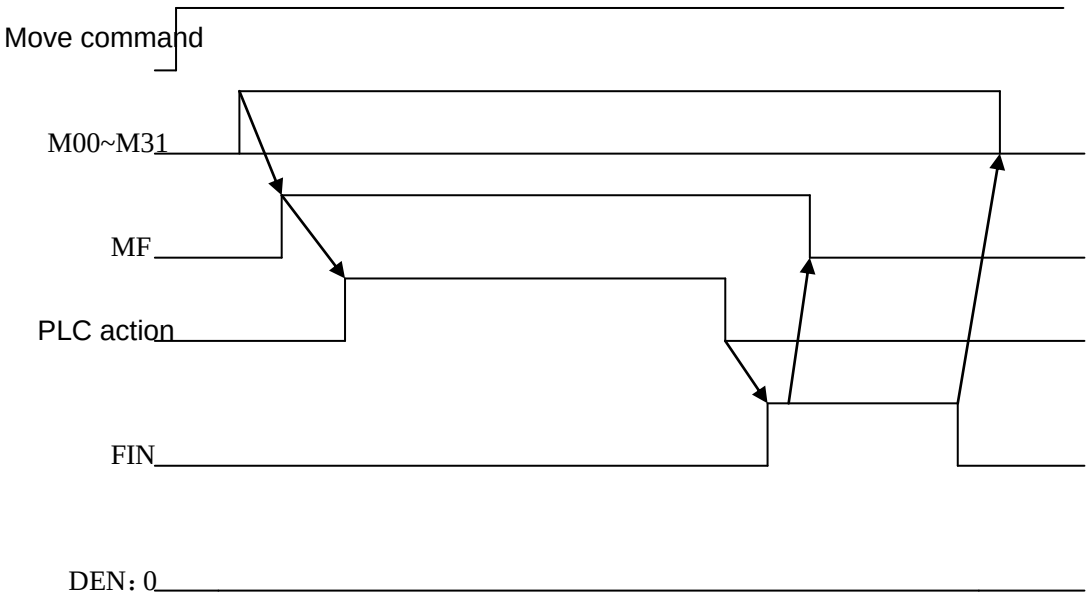


Fig. 7-2

Move command and miscellaneous function in the same block, execute a miscellaneous function with waiting for move command completion:

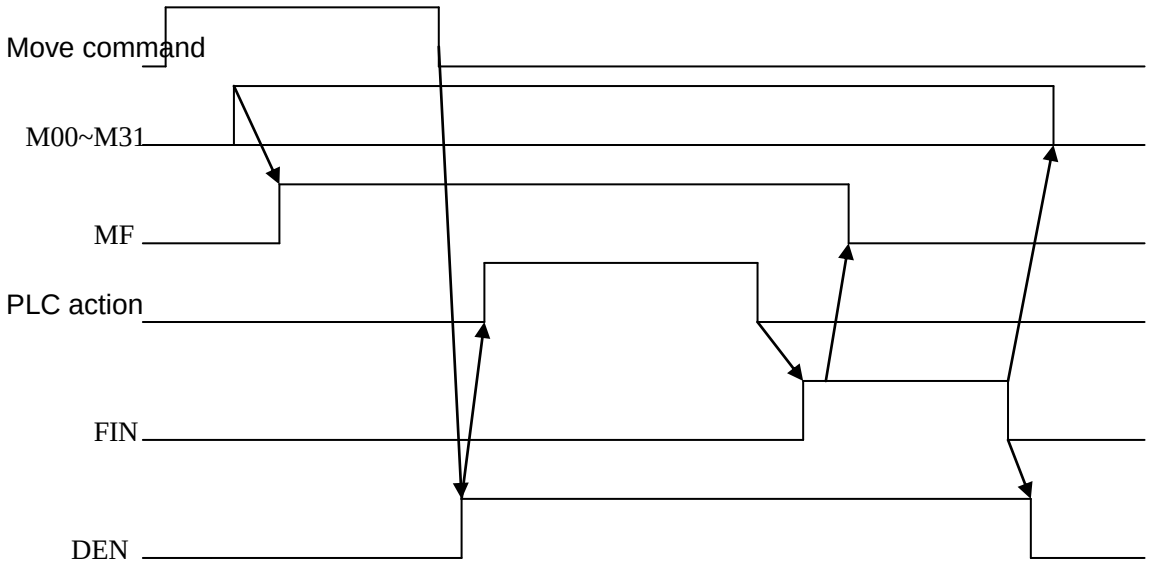


Fig. 7-3

Signal **Miscellaneous function code signals**

M00～M31（F010～F013）

Classification NC→PLC

Function NC sends miscellaneous function data signal

Miscellaneous function strobe signal

MF（F007＃0）

［Classification］ **NC→PLC**

［Function］ Strobe signal for M code when the code is performed by NC.

Note: 1. The following miscellaneous functions are only processed in the CNC; they are not output to the PLC when programmed:

- ＊ M98，M99，
- ＊ M code that calls a subprogram
- ＊ M code that calls a custom macro

2. The miscellaneous functions listed below is directly performed by CNC. Code signal can not be output. However, NC will send output signal to the PLC during execution.

Table 7-2

M Code	Output signal	Address
M00	DM00	F009＃7
M01	DM01	F009＃6
M02	DM02	F009＃5
M30	DM30	F009＃4

3. M00～M31 are output to M code in the binary BCD format.

For example: M5 corresponds to 00000000, 00000000, 00000000, 00000101

M decoding signal

Spindle speed code signals

S00～S31（F022～F025）

［Classification］ NC→PLC

［Function］ These signals report that the spindle speed sent to the PLC. S code is a binary number. For example: S20 corresponds to 00000000, 00000000, 00000000, 00010100.

Spindle speed strobe signal

SF（F007＃2）

［Classification］ **NC→PLC**

［Function］ These signals report that spindle speed function have been specified. For the output conditions and procedure, see the description of “Basic procedure”.

Tool function code signal

T00～T31（F026～F029）

［Classification］ NC→PLC

［Function］ Tool T command data sent to PLC. T command value is a binary number. For example: T12 corresponds to 00000000, 00000000, 00000000, 00001100.

Tool function strobe signal

TF（F007＃3）

［Classification］ **NC→PLC**

［Function］ These signals indicates the actually specified tool function. For the output conditions and procedure, see the description of “Basic procedure”.

Miscellaneous function end signal

FIN（G004＃3）

［Classification］ **PLC→NC**

［Function］ The response signal from PLC to the NC at the end of the miscellaneous function. After receiving the end signal, CNC executes the current block miscellaneous function. For the operation and procedure, see the description of “Basic procedure”.

Distribution end signal

DEN（F001＃3）

［Classification］ **NC→PLC**

［Function］When movement command in the block is performed, the signal turns to 1. When M, S, T command is in the same block with movement command, M, S, T command is executed after performing movement command.

Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G004					FIN			
F001					DEN			
F007					TF	SF		MF
F009	DM00	DM01	DM02	DM30				
F010	M07	M06	M05	M04	M03	M02	M01	M00
F011	M15	M14	M13	M12	M11	M10	M09	M08
F012	M23	M22	M21	M20	M19	M18	M17	M16
F013	M31	M30	M29	M28	M27	M26	M25	M24
F022	S07	S06	S05	S04	S03	S02	S01	S00
F023	S15	S14	S13	S12	S11	S10	S09	S08
F024	S23	S22	S21	S20	S19	S18	S17	S16
F025	S31	S30	S29	S28	S27	S26	S25	S24
F026	T07	T06	T05	T04	T03	T02	T01	T00
F027	T15	T14	T13	T12	T11	T10	T09	T08
F028	T23	T22	T21	T20	T19	T18	T17	T16
F029	T31	T30	T29	T28	T27	T26	T25	T24

7.2 Auxiliary function lock

General Inhibits execution of a specified M, S, and T function. That is, code signals and strobe signals are not issued. This function is used to check a program.

Signal Auxiliary function lock signal
AFL（G05＃6）
［Classification］ **PLC→NC**

［Function］ The signal selects the auxiliary function lock, i.e., the signal disables the execution of the specified M, S, T function.

When the signal becomes 1, the control unit functions are as follows:

1 . The control unit does not execute M, S, T functions specified for automatic operation, DNC operation, or MDI operation. That is, the control unit stops the output of code signals and strobe signals.

2. If this signal turns to “1” after code signal output, the output operation is executed in the ordinary manner until its completion (that is, until the FIN signal is received, and the strobe signal turns to “0”) .

3. Among the miscellaneous functions, M00,M01， M02 and M30 are executed even when this signal is “1” . All code signal, strobe signal and decoding signal are output in the ordinary manner.

4. Among the miscellaneous functions, even when this signal is “1”, those functions(M98 and M99) that are executed in the control unit without outputting their execution results are executed in the ordinary manner.

Auxiliary function lock check signal
MAFL（F004＃4）

［Classification］ **NC→PLC**

［Function］ The signal reports the state of auxiliary function lock signal AFL.

When the signal is 1, the auxiliary function lock signal AFL is1.

When the signal is 0, the auxiliary function lock signal AFL is 0.

Signal address

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

7.3 Multi-M Code in A Block

General Commonly a block only specifies one M code, while at most three M codes are specified in a block by using this function. The M codes are performed in the sequence of 1st, 2nd and 3rd code. Using this function, programming is simplified, execution time of processing program is shortened.

The function is valid when CNC parameter N1803#6 is set to 1. PLC support is necessary when multi-M code function is used.

Signal for the 2nd M code function

Signal：M100～M131（F014～F017）

Classification： NC→PLC

Function： 2nd M code function signal from NC

Signal for the 3rd M code function

Signal：M100～M131（F018～F021）

Classification： NC→PLC

Function： 3rd M code function signal from NC

Strobe signal for the 2nd M code function

Signal： MF（F007＃5）

Classification： NC→PLC

Function： M code strobe signal from NC when the 2nd code is being executed

Strobe signal for the 3rd M code function

Signal： MF（F007＃6）

Classification： NC→PLC

Function： M code strobe signal from NC when the 3rd code is being executed.

When program specifies Maa Mbb Mcc, as programming sequence, the system executes Maa as 1st code, Mbb as 2nd code and Mcc as 3rd code. Three M code has function code signal and strobe signal separately, which are sent to PLC simultaneously when the block is executed.

Execution sequence for 2nd, 3rd M function code and other miscellaneous function code are the same.

Signal address

	＃7	＃6	＃5	＃4	＃3	＃2	＃1	＃0
F014	M107	M106	M105	M104	M103	M102	M101	M100

Signal for the 2nd M code function

F015	M115	M114	M113	M112	M111	M110	M109	M108

Signal for the 2nd M code function

F016	M123	M122	M121	M120	M119	M118	M117	M116

Signal for the 2nd M code function

F017	M131	M130	M129	M128	M127	M126	M125	M124

Signal for the 2nd M code function

F018	M207	M206	M205	M204	M203	M202	M201	M200

Signal for the 3rd M code function

F019	M215	M214	M213	M212	M211	M210	M209	M208

Signal for the 3rd M code function

F020	M223	M222	M221	M220	M219	M218	M217	M216

Signal for the 3rd M code function

F021	M231	M230	M229	M228	M227	M226	M225	M224

8 Spindle Speed Function

8.1 Spindle speed control mode

8.1.1 Analog Spindle

General The analog spindle is defined that the spindle speed is controlled by CNC output analog voltage value. CNC changes S code to analog voltage to output to machine spindle to control the spindle speed. The range of analog voltage is ±10V. The actual output analog voltage is obtained multiplying spindle controlled S value by the spindle speed.

Spindle speed code signal
Signal **S00～S31（F022～F025）**
［Classification］ **NC→ PLC**
［Function］ These signals report the actually specified the spindle speed function.
For the output condition and the procedure, see “Basic procedure” .
Use S code output of analog spindle.
Note: S00～S31 is output to S code in the binary BCD format.
S4 corresponds to 00000000, 00000000, 00000000, 00000100.

Spindle stop signal
Signal ***SSTP（G029＃6）**
［Classification］ **PLC→NC**
［Function］ Control spindle enable signal
When the signal is 1, CNC outputs enable signal to the spindle.
When the signal is 0, CNC cut off the spindle enable signal.
When the analog spindle is being used, an offset voltage in the spindle motor speed amplifier may cause the spindle motor to rotate at low speed even if the command output to the spindle is zero. The ***SSTP** signal can be used to stop the motor in such a case.

Spindle speed override signal

Signal SOV0～SOV7（G030＃0～#5）
［Classification］ PLC→NC
［Function］ Spindle speed override is controlled by a 8-bit binary number

Spindle motor pole selection signal

Signal SGN（G033＃5）
［Classification］ PLC→NC
［Function］ CNC can output ±10V analog voltage. The pole of analog voltage to the spindle is selected by SGN signal.

CNC outputs negative voltage to the spindle when the signal is 1.
CNC outputs positive voltage to the spindle when the signal is 0.

Spindle enabling signal

Signal ENB<F001#4>

［Classification］ **NC→ PLC**

［Function］ Spindle enabling state confirmation

The ENB signal is logical 1 when a nonzero command output is sent to the spindle. If the command is logical 0, the ENB signal becomes logical 0.

Spindle alarm state signal

Signal SPALM（F045＃0）

［Classification］ **NC→ PLC**

［Function］ Note CNC that the spindle is in alarm state

Spindle zero speed signal

Signal SST（F045＃1）

［Classification］ **NC→ PLC**

［Function］ Note CNC that the spindle is stopped and the speed is 0.

Signal address

	＃7	＃6	＃5	＃4	＃3	＃2	＃1	＃0
G029		*SSTP						
	＃7	＃6	＃5	＃4	＃3	＃2	＃1	＃0
G030	SOV7	SOV6	SOV5	SOV4	SOV3	SOV2	SOV01	SOV0
	＃7	＃6	＃5	＃4	＃3	＃2	＃1	＃0
G033			SGN					
	＃7	＃6	＃5	＃4	＃3	＃2	＃1	＃0
F001				ENB				
	＃7	＃6	＃5	＃4	＃3	＃2	＃1	＃0
F022	S07	S06	S05	S04	S03	S02	S01	S00
	＃7	＃6	＃5	＃4	＃3	＃2	＃1	＃0
F023	S15	S14	S13	S12	S11	S10	S09	S08
	＃7	＃6	＃5	＃4	＃3	＃2	＃1	＃0
F024	S23	S22	S21	S20	S19	S18	S17	S16
	＃7	＃6	＃5	＃4	＃3	＃2	＃1	＃0
F025	S31	S30	S29	S28	S27	S26	S25	S24

8.1.2 Spindle Gear Control

General

Gear control is defined that the 2-gear or multi-gear control manner. There are two types of gear method: M type and T type, they can be selected by parameter N5001#6GTT. M type gear change controls 3-level gear. In M type, gear is changed automatically by signal GR1, GR2 and GR3 specified by S command and gear speed parameter. T type gear change controls 4-level gear. Gear shift should be completed before spindle rotation. CNC outputs speed value according to the setting of gear signal GR21, GR22 and gear speed parameter.

M type gear shift

Although S instructs the spindle speed, the actual is to control the spindle motor. So, CNC needs to confirm the corresponding relation between the spindle motor and gear. Like S instruction selection，CNC selects the gear according to the previously defined gear speed range by parameter to report PLC to select the corresponding the gear by using the gear change select signal (GR3, GR2, GR1). At the same time, CNC outputs the spindle motor speed according to the selected gear. CNC outputs the instruction corresponded to the spindle (GR1, GR2, GR3 output) speed by specifying S0～S99999 during MDI mode. 2 or 3 speed gear (GR1, GR2, GR3) is set simultaneously output to the gear select signal. When the S command is executed, CNC simultaneously output SF signal).

Significance of gear shift signal is as follows: （Table 8-1）

Table 8-1

Gear signal		No. 2 gear	No. 3 gear	Gear parameter
GR1	F34.0	Low	Low	N5120
GR2	F34.1	High	Medium	N5121
GR3	F34.2		High	N5122

Signal:

M type gear shift

Signal： GR1,GR2,GR3 (F034#0～#2)

Classification： NC→ PLC

Function： The signal notes selected gear level of PLC

Rotation speed selection for spindle gear shift

Signal： SOR (G029#5)

Classification： PLC →NC

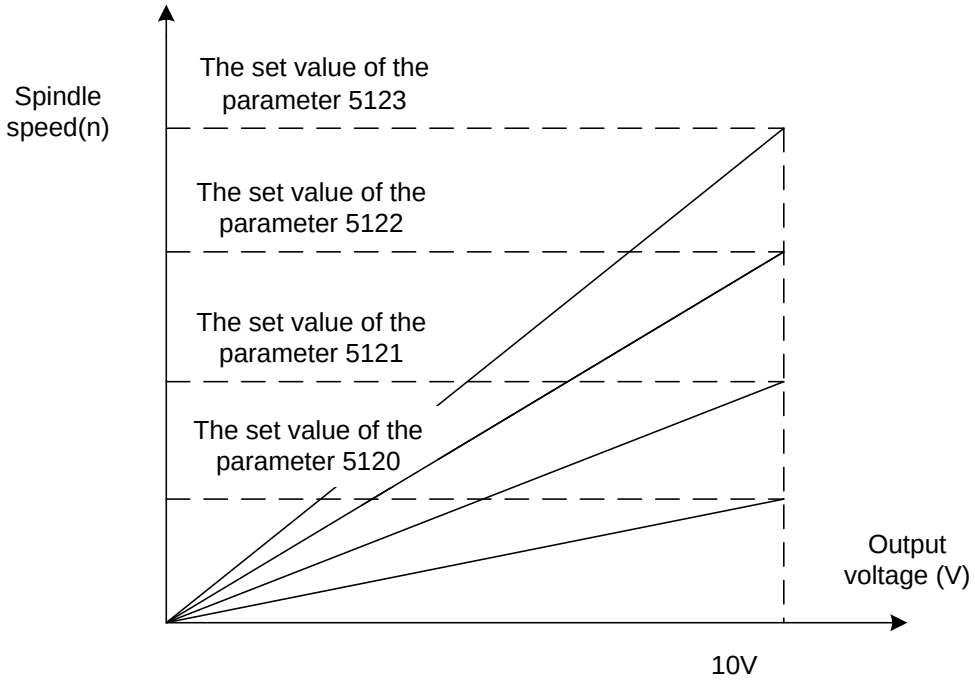
Function： When the signal is 1, speed set by parameter N5110 from CNC is sent to spindle motor for low-speed rotation control of the spindle gear shift.

Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
F034						GR3	GR2	GR1
	#7	#6	#5	#4	#3	#2	#1	#0
G029			SOR					

T type gear shift

T type gear shift is defined that CNC selects the actual gear by signal GR21 and GR22. Then the CNC outputs speed command based on the speed set by corresponding parameter.



T type gear selection signal for gear change

Signal： GR21,GR22 (G028#1～#2)

Classification： PLC →NC

Function： The signal reports the gear selected by NC spindle

Significance for gear change signal is as follows (table 8-2):

Table 8-2

Gear selection signal		Gear	Parameter
GR22	GR21		
0	0	1	5120
0	1	2	5121
1	0	3	5122
1	1	4	5123

8.2 Spindle Orientation

General It is used to make the spindle stop at a certain position, whish is also called spindle exact stop.

Spindle orientation signal

Signal： ORCM (G070#6)

Classification： PLC →NC

Function: The orientation signal from CNC to the spindle when the signal is 1.

Spindle orientation completion signal

Signal： ORAR（F045＃7）

Classification： NC→ PLC

Function: Notes CNC that the spindle is in orientation completion state.

Address:

	＃7	＃6	＃5	＃4	＃3	＃2	＃1	＃0
G070		ORCM						
	＃7	＃6	＃5	＃4	＃3	＃2	＃1	＃0
F045	ORAR							

8.3 Rigid tapping

General During a tapping cycle, synchronous control is applied to the tapping operation of a tapping axis and the operation of the spindle.
Namely, during rigid tapping (G74, G84), CNC needs to detect the rotation direction signal of spindle to confirm the cutting feed direction and machining process.

Signal **rigid tapping signal RGTAP（G61＃0）**

［Classification］ **PLC →NC**

［Function］ Reports to the servo to enter the rigid tapping mode.

After the system executes the rigid tapping command, the system sends the signal to the servo that the CNC has entered the rigid tapping command.

RGTAP 1：the current CNC is in the rigid tapping mode.

0：the current CNC is not in the rigid tapping

Signal address

	＃7	＃6	＃5	＃4	＃3	＃2	＃1	＃0
G061								RGTAP

Signal **spindle drive unit speed/position switch completion signal**

VPO 〈F076#3〉

〔Classification〕**NC→ PLC**

〔Function〕reports the PLC confirmation signal after the spindle drive unit completes entering the rigid tapping state.

when the system executes the rigid tapping command, PLC sends to the spindle drive unit to enter the rigid tapping state. After the spindle drive unit completes the rigid tapping switch to enter the rigid tapping state, the signal notifies the PLC that the spindle has completed the control switch to enter the rigid tapping state.

Signal address

	#7	#6	#5	#4	#3	#2	#1	#0
F076					VPO			

8.4 Detection for Spindle Speed Fluctuation

Function When the deviation value between the actual spindle speed and specified speed exceeds the range set by parameter, alarm 322 Spindle speed is abnormal occurs, and the system stops to protect workpiece, equipment and personnel safety.

Conditions for executing speed fluctuation detection:

NC parameter N5001#0(SVD) is set to 1.

Actual speed of the spindle is sent to NC.

Relevant parameter：

	#7	#6	#5	#4	#3	#2	#1	#0
5001								SVD

SVD ： Spindle speed fluctuation detection

0 ： Invalid

1 ： Valid

5010 Set the speed range (%) for starting speed fluctuation detection

When the deviation between spindle feedback speed and specified speed is in the percentage range set by the parameter, the spindle fluctuation detection is started. Once one of the condition set by parameter N5010 and N5013 is satisfied, the spindle fluctuation detection begins to perform.

5011 Allowed spindle speed fluctuation ratio (%) for spindle speed fluctuation detection

Allowed speed fluctuation percentage sent back by the spindle when spindle speed fluctuation detection is performing. System alarm occurs when exceeding the ranges set by parameter N5011 and N5012 simultaneously.

5012 Allowed spindle speed fluctuation value (rpm) for spindle speed fluctuation detection

Allowed spindle speed fluctuation value for spindle speed fluctuation detection. System alarm occurs when exceeding the ranges set by parameter N5011 and N5012 simultaneously.

5013 The time between spindle speed change to speed fluctuation detection (ms)

Interval between specifying spindle speed variation to the detection speed fluctuation. Once one of the condition set by parameter N5010 and N5013 is satisfied, the spindle fluctuation detection begins to perform.

8.5 Spindle Safety Speed Selection

Signal for spindle safety speed selection

Signal： **SVL（G033＃4）**

Classification： PLC→NC

Function： It is used to restrict the max. speed of spindle. When the signal is 1, the max. speed is restricted by parameter N5118.

Signal address:

	＃7	＃6	＃5	＃4	＃3	＃2	＃1	＃0
G033				SVL				

9 PLC Control Function

9.1 External Data Inputting

General External signal sends specified data from PLC to CNC, and the specified action is performed.

External data inputting function:

External data reading	Function address selection							Data signal	Function
ESTB	EA6	EA5	EA4	EA3	EA2	EA1	EA0	ED31~ED0	
1	0	0	0	0	0	0	0	Program number in binary system	External program search
1	0	0	1	Compensation specifying				Offset value in binary system	External tool compensation
1	0	1	0	Offset axis selection				Offset value in binary system	External workpiece coordinate offset
1	0	1	1	Offset axis selection				Offset value in binary system	External mechanical zero point offset

Relevant parameter：

External data reading

Signal： ESTB(G13.7)

Classification： PLC→NC

Function： Begins to read external data.

External data address

Signal： EA0~EA6(G13.0~G13.6)

Classification： PLC→NC

Function： Specifies the address of external data and realizes the function.

External inputting data

Signal： ED0~ED31(G0.0~G3.7)

Classification： PLC→NC

Function： Specifies the data in external data inputting.

External data reading completion

Signal： EREND(F60.0)
Classification： NC→PLC
Function： Reports that the external data inputting signal has been read by NC.

External data search has completed
Signal： ESEND(F60.1)
Classification： NC→PLC
Function： Reports that specification of external data inputting signal has been completed by NC.

External data reading is cancelled
Signal： ESCAN(F60.2)
Classification： NC→PLC
Function： Reset signal has been input and the parameter N1971#7 has set to 1 after inputting external data reading signal to NC and before performing search operation, the search operation is not performed and the signal is output.

Function descriptions:
External program selection:

External program selection is realized by external signal calling CNC stored program. It is used to select corresponding program by external switch signal when several programs are performed in one machine. The range of the program can be selected is from O1 to O9999. The program that named by non-numeric character can not be selected.

Set function selection address signals EA0～EA6 to 0 when executing external program selection function. Send the number of the program to be selected to the signal address ED0～ED31 by binary data, then set external data reading signal ESTB to 1. CNC can receive external program selection signal at any mode, but the function of external program selection only be performed in reset mode when CNC operates automatically.

Control sequence diagram is as follows:

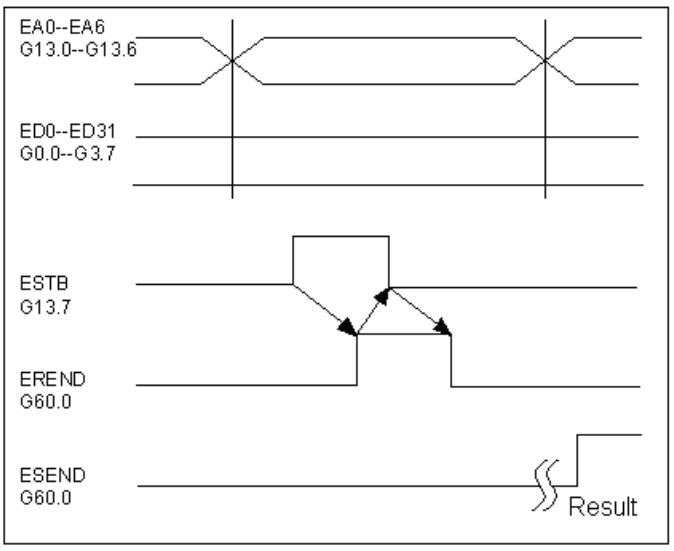


Fig. 9-2

Offset axis selection:

Axis	EA3	EA2	EA1	EA0
1st axis	0	0	0	0
2nd axis	0	0	0	1
3rd axis	0	0	1	0
4th axis	0	0	1	1
5th axis	0	1	0	0
6th axis	0	1	0	1

9.2 PLC Axis Control Function

General Parameter setting makes the axis separate from CNC, the axis no longer receive CNC command, but execute PLC specified function. PLC axis operates separately, it does not have linkage compensation relationship with CNC axis.

CNC performs the following control functions：

1. Rapid traverse
2. Cutting feed (feed per minute and feed per rev)
3. Jump (feed per minute)
4. Pause
5. Reference return
6. Manual continuous feed
7. Return reference point 1~4
8. 1~3 miscellaneous function
9. Mechanical coordinate selection

Signal：

- **Table for PLC axis control signal**

Table 9-1

No.	Symbol	Signal address	Significance	I/O
1	EAX1-EAX4	G136.0-3	Control axis selection signal	Input
2	EC0g-EC6g	G143.0-6, G155.0-6, G167.0-6, G179.0-6	Control axis command signal	Input
3	EIF0g-EIF15g	G144-G145, G156-G157 G168-G169, G180-G181	Axis control federate signal	Input
4	EID0g-EID31g	G146-G149, G158-G161 G170-G173, G182-G185	Axis control data signal	Input
5	EBUFg	G142.7, G154.7 G166.7, G178.7	Axis control command reading signal	Input
6	EBSYg	F130.7, F133.7, F136.7, F139.7	Reading completion signal	Output
7	ECLRg	G142.6, G154.6 G166.6, G178.6	Reset signal	Input

8	ESTPg	G142.5, G154.5 G166.5, G178.5	Axis control pause signal	Input
9	ESBKg	G142.3, G154.3 G166.3, G178.3	Block stop signal	Input
10	EMSBKg	G143.7, G155.7 G167.7, G179.7	Block stop invalid signal	Input
11	EM11g-EM48g	F132; F135; F138; F141;	Miscellaneous function code signal	Output
12	EMFg	F131.0, F134.0, F137.0, F140.0	Miscellaneous function strobe signal	Output
13	EMF2g	F131.2, F134.2, F137.2, F140.2	Miscellaneous function 2 strobe signal	Output
14	EMF3g	F131.3, F134.3, F137.3, F140.3	Miscellaneous function 3 strobe signal	Output
15	EFINg	G142.0, G154.0, G166.0, G178.0	Miscellaneous function completion signal	Input
16	ESOFg	G142.4, G154.4 G166.4, G178.4	Servo off signal	Input
17	EMBUFg	G142.2, G154.2 G166.2, G178.2	Buffer invalid signal	Input
18	*EAXSL	F129.7	Control axis selection state signal	Output
19	EINPg	F130.0, F133.0, F136.0, F139.0	In-position signal	Output
20	EIALg	F130.2, F133.2, F136.2, F139.2	Alarm signal	Output
21	EGENg	F130.4, F133.4, F136.4, F139.4	Axis movement signal	Output
22	EDENg	F130.3, F133.3, F136.3, F139.3	Miscellaneous execution signal	Output
23	EOTNg	F130.6, F133.6, F136.6, F139.6	Negative over travel signal	Output
24	EOTPg	F130.5, F133.5, F136.5, F139.5	Positive over travel signal	Output
25	EFV0-EFV7	G151.0-G151.7	Feedrate override signal	Input
26	EOVC	G150.5	Override cancel signal	Input
27	EROV1, EROV2	G150.0, G150.1	Rapid traverse signal	Input
28	EOV0	F129.5	Override 0％ signal	Output
29	ESKIP	X13.6	Skip signal	Input
30	EADEN1-EADEN4	F112.0-3	Distribution completion signal	Output
31	EABUFg	F131.1, F134.1, F137.1, F140.1	Buffer memory is occupied	Output
32	EACNT1-EACNT4	F182.0-3	In controlling	Output
33	*+ED1-*+ED6 *-ED1-*-ED6	G118.0-G118.4 G120.0-G120.4	External deceleration signal	Input

Illustration：

PLC command specifies control signal(table 9-1)to release each control function. CNC provides 4-group I/O signal group for PLC control. The groups are group A, group B, group C and group D. Each group has related I/O signal. The parameter N7010 decides which signal group controls the axis.

Small letter g in the I/O signal name stands for signal group. For example, g in axis control command reading signal EBUFg, actually it is not a signal in group EBUFg, g represents A,B,C,D, it is the signal of group A, group B, group C and group D. EBUFg is a expression way of signal EBUFA,EBUFB,EBUFC,EBUFD.

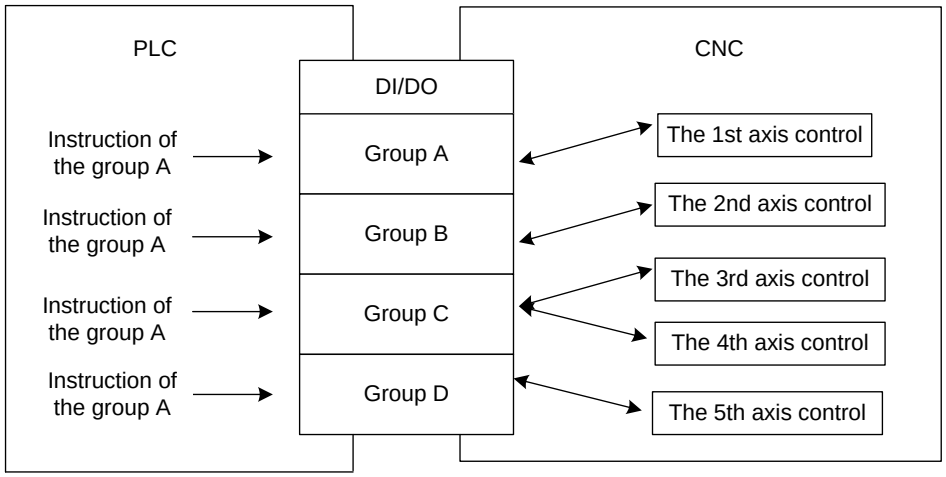


Fig.9.1 PLC axis control diagram

Signal allocation of each group

Group number	Input signal address	Output signal address
Group A	G142-G149,G150.5 G150.0,1,6,7	F130-F132,F142, F129.5,7
Group B	G154-G161,G162.5 G150.0,1,6,7	F133-F135,F145, F129.5,7
Group B	G166-G173,G174.5 G150.0,1,6,7	F136-F138,F148, F129.5,7
Group B	G178-G185,G186.5 G150.0,1,6,7	F139-F141,F151, F129.5,7

Operating procedure

（1） Set group DI/DO of PLC axis control in parameter N7010.When multiple axes are moving simultaneously in one group, make sure that federate, acceleration/deceleration time, axis property etc. parameters are set to the same one.

（2）When the axis is to be controlled by PLC directly, selection signal EAX1～EAX4 of the controlled axis should be set to 1, making it a PLC axis separate from CNC management.

（3）Specify PLC axis execution action.

Axis control command signal EC0g～EC6g controls the action type. Axis federate signal EIF0g～EIF15g controls axis control federate. Axis control

data signal EID0g～EID31g controls movement or other data.

The above mentioned signals and block stop prohibition signal specifies the command of one block. These signals are general named axis control block data signal.

Related signal for PLC axis controls one-block data

General name of signals	Signal name	Signal abbreviation	Data type
Axis control block data signal	Block stop prohibition signal	EMSBKg	Bit
	Axis control command signal	EC0g～EC6g	Byte
	Axis control federate signal	EIF0g～EIF15g	Character
	Axis control data signal	EID0g～EID31g	2-character

（4）When setting data action of a block is specified, the axis control command signal EBUFg logic is reversed. If EBUFg is 0 before, it set to be 1. If EBUFg is 1 before, it set to be 0.Logic of the axis control command reading completion signal EBSYg of CNC output signal should be the same as signal EBUFg logic, otherwise, the reversing operation can not be performed.

（5）When PLC executes several actions continuously, the commanded block is processed in CNC at first.

Therefore, though a command is being executed, the next block can be read to CNC side if the CNC is free. As the figure bellow: [2] and [3] are read to the CNC buffer during the command [1] is being executed, [4] is in the state of setting axis control block data.

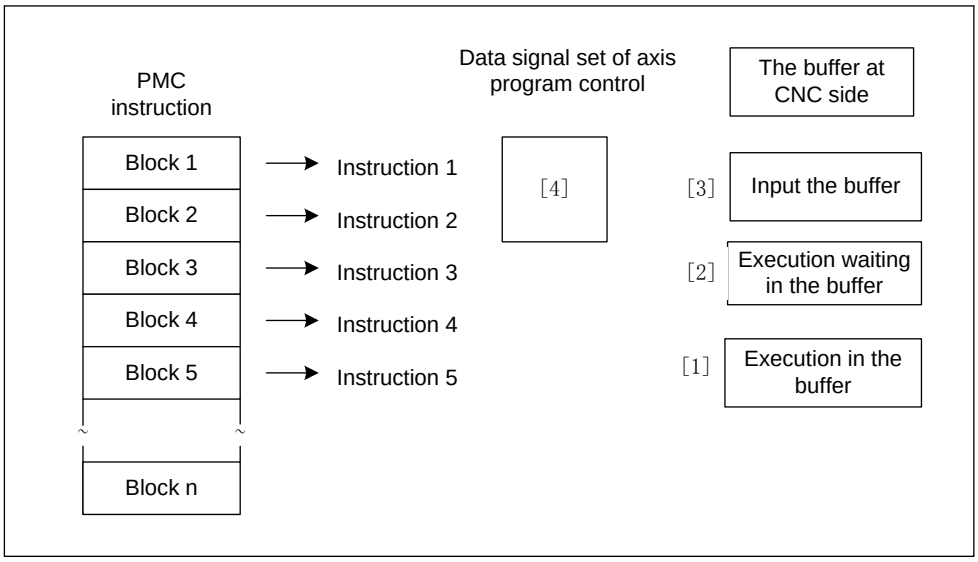


Fig. 9.2

After command [1] is completed,

Command [2]: executes waiting in the buffer → executing in the buffer

Command [3]: inputs waiting in the buffer → executes waiting in the buffer

Command [4]: Command the block → transmission input to the buffer. After

finishing the transmission from the command [4], specify the command [5] at the CNC side (axis control block data signal setting)

Command operating sequence diagram

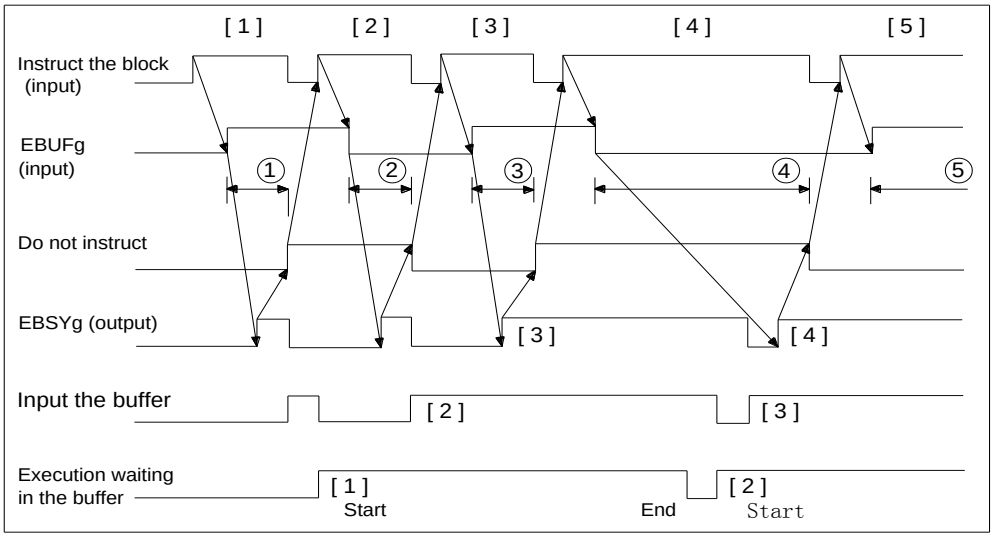


Fig. 9.3 PLC axis control command sequence diagram

The next block can not be specified in [1]，[2]，[3]，[4]，[5]. The buffer is occupied in block [4].

The state of buffer of CNC side can be judged by either-or of axis control command reading signal EBUFg of input signal sent by PLC side and axis control command reading completion EBSYg of output signal sent by CNC side.

State of buffer at PLC side

EBUFg	EBSYg	(XOR）Addition -without -carry	State of buffer at PLC side
0	0	0	The block reading of the last time is completed, the next one can be specified at PMC side.
1	1		
0	1	0	The block specified has not been read, the block is being read or the buffer is occupied, that is to say, it is waiting for buffer space. In this state, the next block can not be specified at PMC side. In addition, signal EBUFg reverse can not be performed. If reverse is performed at this state, the block has been commanded may become invalid.
1	0		

（6）Perform procedure [3] and [4]repeatedly.

If the last block command exchange is completed, other command is not necessary, set control axis signal EAX1～EAX5 to 0. Signal EAX1～EAX5 should be set to 0 after the block is being executed or the one waits for the buffer space or the one

input to the buffer is completed. If EAX1～EAX5 is set to 0 when the block is being executed or it waits for the buffer space or the block has input to the buffer. At the same time, the block executing stops, the one waits for the buffer space and the one input to the buffer become invalid.

The signal EAXSL decides whether a block in executing or waits for buffer space or input to the buffer. Moreover, CNC and PLC management exchange is unnecessary for the axis of control turret, brace and ATC, set the signal EAX1～EAX5 to 1 all the time. It unnecessary to set the signal EAX1～EAX5 to 0 though the command exchange is completed. After all specified command are performed, if there is not other block to be executed, the execution may stop automatically.

（7）When control axis selection signal EAX1～EAX5 changes from 1 to 0, it returns to CNC management state.

Function：

- **Axis control function**

Table 9-2

Command	Action	Data 1	Data 2	Explanation
00h	Rapid traverse	Rapid traverse speed	Total movement	Perform the same operation as CNC G00
01h	Cutting feed per minute	Cutting feedrate	Total movement	Perform the same operation as CNC G94G01
02h	Cutting feed per rev	Cutting feedrrate per rev	Total movement	Perform the same operation as CNC G95G01
03h	Feed skip per minute	Cutting feedrate	Total movement	Perform the same operation as CNC G31G01
04h	Pause	—	Pause time	Perform the same operation as CNC G04
05h	Reference return	—	—	Perform the same operation as CNC manual reference return
06h	Continuous feed	Continuous feed rate	Feed direction	Perform the same operation as CNC JOG feed
07h	1st reference return	Rapid move speed	—	Perform the same operation as CNC G28
08h	2nd reference return	Rapid traverse speed	—	Perform the same operation as CNC G30P2
09h	3rd reference return	Rapid move speed	—	Perform the same operation as CNC G30P3
0Ah	4th reference return	Rapid traverse speed	—	Perform the same operation as CNC G30P4

12h	Miscellaneous function 1	—	Miscellaneous function code	The function is the same as CNC miscellaneous function
14h	Miscellaneous function 2	—		The function is the same as CNC miscellaneous function
15h	Miscellaneous function 3	—		The function is the same as CNC miscellaneous function
20h	Machine coordinate selection	Rapid traverse speed	mechanical coordinate	The function is the same as CNC G53

Note：

Command indicates axis control command signal EC0g-EC6g.

Data1 indicates axis control federate signal EIF0g-EIF15g.

Data 2 indicates axis control data signal EID0g-EID31g.

Continuous feed command is commanded immediately, it is not stored at CNC side.

1. Rapid traverse

Rapid traverse speed: linear axis unit is 1mm/min, rotation axis unit is 1deg/min, range: 1-65535.
Total movement: it is incremental movement, in 0.1um.

2. Cutting federate per minute

Cutting federate: it is the same as rapid traverse.
Total movement: it is increment movement in 0.1um.

3. Cutting feed per rev

Cutting feed per rev: linear axis is 0.0001mm/rev, rotation axis is 0.0001deg/rev, range: 1-65535
Total movement: it is incremental movement in 0.1um.

4. Feed per minute

Cutting federate: it is the same as rapid traverse.
Total movement: it is total movement in 0.1um.

5. Pause

Pause time: the unit is ms, the range is 1－9999999.

6. Reference return

The operation is the same as CNC axis reference return.

7. Continuous feed

Continuous federate: besides the functions as rapid move, speed change is able. The speed changes once ebuf changes. The ebuf varies with ebuf. The max. value is 65535*override (when the override

is cancelled, the value is 100)

8. 1/2/3/4 reference return
Rapid traverse speed: it is the same as rapid traverse.
If the machine does not return to the reference point, alarm occurs.

9. 1/2/3 miscellaneous function
Miscellaneous code that specifies one-byte miscellaneous function.
Note that it has independent miscellaneous strobe and miscellaneous end signal from CNC.

10. Mechanical coordinate selection
Rapid traverse speed: it is the same as rapid traverse.
Mechanical coordinate value: the unit of the actual machine coordinate value is the same as rapid traverse.

Signal description:

(1) select axis control selection signal

Signal: EAX1～EAX5 (G0136.0～G0136.3)

Classification: PLC →NC

Function:

PLC axis control is valid when the signal is 1.

PLC axis control is invalid when the signal is 0. Note that when control axis selection signal *EAXSL is 0, the control selection shift can be performed based on the signal. If axis control shift is performed when *EAXSL is 1, alarm 311 occurs. Alarming signal EIALg is set to 1. On the contrary, alarm occurs when the signal is set to 1 during CNC is in execution.

In addition, if the signal is set to 1 after control axis selection signal is set to 0, alarm 311 occurs. Alarming signal EIALg will not be 1, though alarm occurs at the CNC side, command based on the PLC axis control can be performed.

(2) Axis control command signal

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

Classification: PLC →NC

Function:

See table 9-2 for the significance of each command.

(3) Axis federate signal

Signal: EIF0g～EIF15g（G144～145，G156～157，G168～169，G180～181）

Classification: PLC →NC

Function:

See table 9-2 for the significance of each command.

(4) Axis control data signal

Signal: EIF0g～EIF31g（G146～149，G158～161，G170～173，G182～185）

Classification: PLC →NC

Function:

It is one of the axis control block signal. Please refer to command list for its significance.

（5） Control command reading signal

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

Classification： PLC →NC

Function：

Command data for CNC reading one block from PLC axis control.

See 9.3 for the operation procedures of the signal.

（6） Axis control reading completion signal

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

Classification： NC →PLC

Function：

CNC notes PLC that one-block command data controlled by PLC axis has been read in buffer signal. See figure 9.3 for the signal operation procedure.

（7） Reset signal

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

Classification： PLC →NC

Function：

Reset PLC axis control command.

When the signal is set to 1

（1） Axis deceleration stops when the axis is moving

（2） Execution stops when it is in pause

（3） Execution stops when the miscellaneous function is being executed

At the same time, the commands in buffer are all cleared. The input control command is invalid when the signal is 1. When specifying continuous feed command （EC0g～EC6g ： 06h）, set reset signal ECLRg to 1, that is completion signal. Meanwhile, servo motor decelerates to stop. Axis moving signal EGENg is set to 0, and axis control selection state signal EAXSL is set to 0.

Confirm control axis selection state signal EAXSL is set to 0 first, set the reset signal ECLRg to 1.

In addition, set reset signal ECLRg to 1 before axis moving signal EGENg is set to 0.

（9） Block stop signal

Signal： ESBKg（G142.3,G154.3,G178.3）

Classification：PLC →NC

Block stop invalid signal

Signal：EMSBKg（G143.7,G155.7,G167.7,G179.7）

Classification：PLC →NC

Function：

To stop a block or prohibit a block to stop.

If the block stop signal ESBKg is set to 1 when the command sent by PLC

is in execution. After the execution is completed, axis control stops.

When the block stop signal ESBKg is set to 0, the command after buffering is performed. However, when stop prohibition signal EMSBKg is 1, block stop signal ESBKg is invalid. See figure 9.4 for command action sequence diagram.

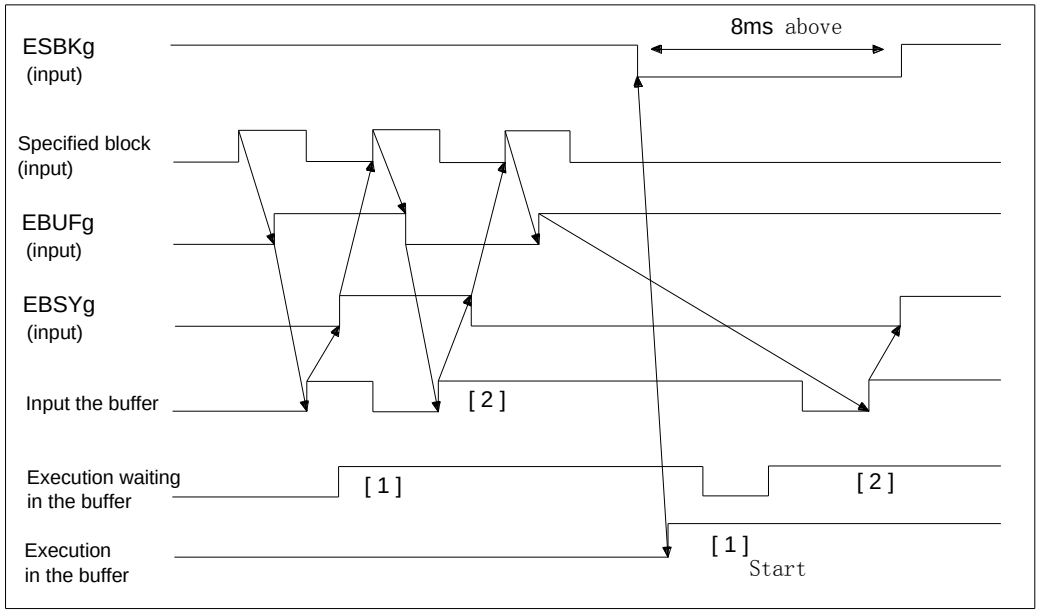


Fig. 9.4 Relevant signal sequence diagram to P block stop

（10） PLC miscellaneous function

Miscellaneous function code

Signal：EM11g～EM28g（F132,F135,F138,F141）

Classification：NC→PLC

Miscellaneous strobe signal

Signal：EMFg （F131.0, F134.0,F137.0,F140.0）

Classification：NC→PLC

Miscellaneous 2 strobe signal

Signal：EMF2g （F131.2,F134.2,F137.2, F140.2）

Classification：NC→PLC

Miscellaneous 3 strobe signal

Signal：EMF3g (F131.3,F134.3,F137.3, F140.3)

Classification：NC→PLC

Miscellaneous function completion signal

Signal：EFINg (G142.0,G154.0,G166.0,G178.0)

Classification：PLC→ NC

Function：

It reports whether the miscellaneous function has completed or not.

When the signal is setting to 1, the command sent by PLC is miscellaneous function （EC0g～EC6g ： 12h）. miscellaneous function 2 （EC0g～EC6g ：14h）. When miscellaneous 3 （EC0g～EC6g ： 15h）, miscellaneous function code is specified by one-byte

signal （EID0g～EID7g）.

CNC sends miscellaneous function code EID0g～EID7g, EID8g～EID15G to miscellaneous function code signal EM11g～EM28g, and waits for miscellaneous function completion signal EFINg. When returns to miscellaneous function completion signal EFINg, it enters to the next command block.

The time of miscellaneous function code and miscellaneous function strobe pulse signal sending, miscellaneous function completion signal receiving are the same to the CNC controlled miscellaneous function (M function).

（11） Servo off signal

Signal：ESOFg（G142.4,G154.4,G166.4,G178.4）

Classification：PLC→ NC

Function：

It controls servo enable signal.

Set the signal to 1 to change enable state of PLC controlled axis to servo off state.

Set the signal to 0 to connect the servo.

（12） Buffer prohibition signal

Signal：EMBUFg（G142.2,G154.2,G166.2,G178.2）

Classification：PLC→ NC

Function：

When set the signal to 1, the program read in buffer is continue to perform. Only when blocks in current buffering or in execution waiting buffer are all performed, and the buffer is empty, system will read in the command sent by PLC axis.

Reading command in

Outputting axis control reading completion signal EBSYg while CNC reads commands at buffer empty state to judge buffer prohibition state.

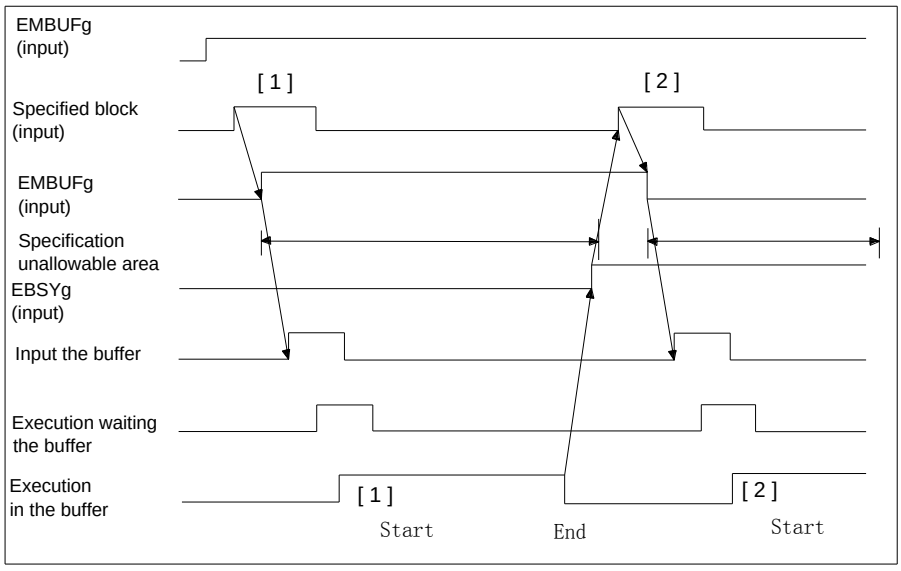


Fig. 9.5 Related signal sequence diagram to buffer

The following commands that are not related to buffer prohibition signal EMBUFg are always executed in buffer prohibition state.

（1） Skip feed per minute（EC0g～EC6g ： 03h）
（2） Reference return（EC0g～EC6g ： 05h）
（3） The 1st reference return（EC0g～EC6g ： 07h）
（4） The 2nd reference return（EC0g～EC6g ： 08h）
（5） The 3rd reference return（EC0g～EC6g ： 09h）
（6） The 4th reference return（EC0g～EC6g ： 0Ah）
（7） Mechanical coordinate selection（EC0g～EC6g ： 20h）

（13） Control axis selection state signal

Signal：*EAXSL（ F129.7）

Classification：NC→PLC

Function：

State signal indicate whether controlled by PLC axis.

When the signal is 0, control axis selection signal can be shifted between EAX1～EAX4.

The signal is 1 when:

PLC control axis is moving.

Reading block in buffer.

Servo off signal ESOFg is 1.

The signal is 1, control axis selection signal shift between EAX1～EAX is invalid. If shift is performed, system alarm occurs.

（14） In-position signal

Signal：EINPg（F130.0,F133.0,F136.0,F139.0）

Classification：NC→PLC

Function：

It reports whether PLC axis is in position.

The signal becomes 1 when the PLC controlled axis moves in position.

When the axis is in deceleration state, performs the in-position detection and does not reach in-position range, the next command will not perform.

（15） Alarm signal

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

Classification：NC→PLC

Function：

Indicates alarm state that is related to PLC axis control.

The signal becomes 1 when PLC controlled axis occurs servo alarm, overtravel alarm and alarm. Release the alarm by the following operation. When the reset signal ECLRg is set to 1, the signal becomes 0.

Servo alarm

Please confirm the reason for alarming and reset the CNC.

Overtravel alarm

Please move axis in the range of storage stroke limit and

reset the CNC. The commands that make axis moves to the range of storage stroke during alarming as shown in the following:

（1） Rapid traverse（EC0g～EC6g ： 00h）
（2） Cutting feed—feed per minute（EC0g～EC6g ： 01h）
（3） Cutting feed—feed per minute（EC0g～EC6g ： 02h）
（4） Continuous feed（EC0g～EC6g ： 06h）

（16） Axis is moving

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

Classification：NC→PLC

Function：

It indicates axis moving state.

The command sent by PLC becomes 1 in rapid move （EC0g～EC6g ：00h）, cutting feed （EC0g～EC6g ： 01h）etc. axis moving state. It keeps 0 when pause command （EC0g～EC6g ： 04h）is performed.

Note:
The signal that *the axis is moving* becomes 0 at the end of axis distribution. (deceleration becomes 0)

（17） Miscellaneous function is in execution

Signal：EDENg（F130.3,F133.3,F136.3,F139.3）

Classification：NC→PLC

Function：

It reports miscellaneous function is in execution.

When the commands sent by PLC is miscellaneous function （EC0g～EC6g ： 12h）, miscellaneous 2 （EC0g～EC6g ： 14h）, miscellaneous 3 （EC0g～EC6g ： 15h）, after sending miscellaneous function code EID0g～EID15g to miscellaneous function code signal EM11g～EM48g while before returning to miscellaneous function completion signal EFINg, the signal is 1.

See figure 9.6 for command operation timing sequence diagram.

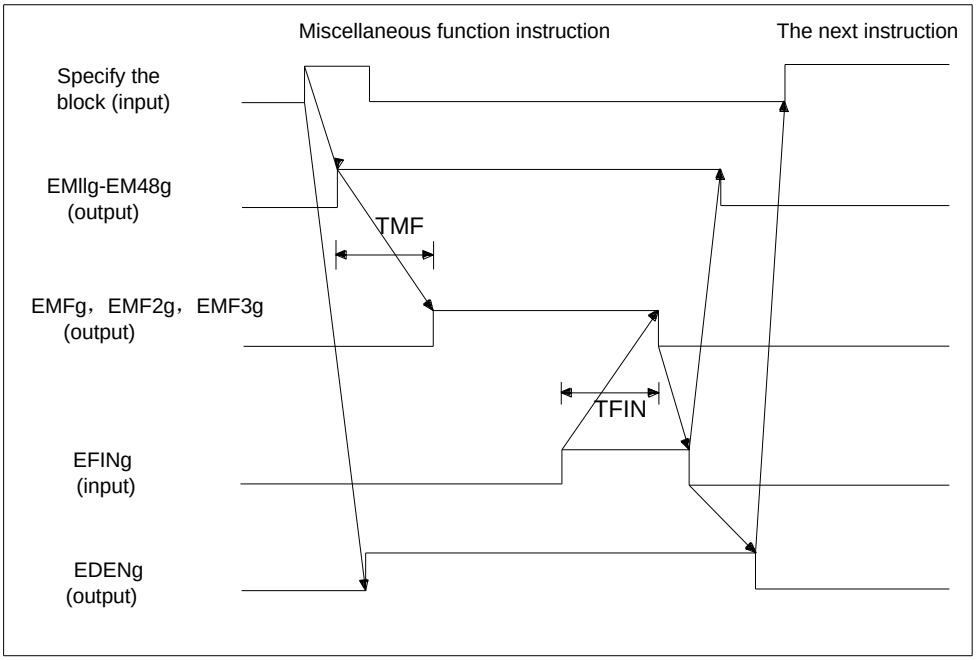


Fig.9.6 Related signal time diagram to miscellaneous function

（18） Overtravel signal

Signal：negative overtravel EOTNg(F130.6,F133.6,F136.6,F139.6）

Negative overtravel EOTNg(F130.5,F133.5,F136.5,F139.5)

Classification：NC→PLC

Function：

It reports overtravel state.

When overtravel alarm occurs,

If exceeds stroke limit at the negative side: negative direction signal EOTNg

If exceeds stroke limit at the positive side: alarm signal EIALg becomes 1 while the positive direction signal EOTPg changes to 1 as well. After releasing overtravel alarm, the signal becomes 0 when reset signal ECLRg is set to 1.

(19) Feedreate override signal

Signal：EFOV0～EFOV7（G151.0～G151.7）

Classification：PLC→NC

Function：

Cutting federate override application to federate commanded by PLC are the same as CNC federate override processing.

(20) Override canceling signal

Signal：EOVCg（G150.5 ）

Classification：PLC→NC

Function：

Disable PLC axis federate override.

When setting the signal to 1, cutting federate override is fixed at 100%, rapid traverse override is not affected.

(21) Rapid traverse override signal

Signal：EROV1, EROV2（G150.0～1）

Classification：PLC→NC

Function：

Application rapid traverse override to PLC are the same to CNC rapid traverse override signal processing.

F0 speed is set by parameter N1231.

(22) Override 0% signal

Signal：EOV0（F129.5）

Classification： NC →PLC

Function：

The signal reports whether the federate override is 0%, which becomes 1 when federate override is at 0%.

(23) Skip signal

Signal：ESKIP（X013.6）

Classification：I/O direct input signal

Function：

If the signal is set to 1 during skip cutting command is in execution, the current executing block stops and the next block is performed. The signal is a natural signal in PLC control.

(24) Distribution completion signal

Signal：EADEN1～EADEN5 (F112.0～.4）

Classification： NC →PLC

Function：

Reports that system is in distribution state based on PLC axis control.

By sending command from PMC, the signal becomes 0 when the axis is moving. The signal is 1 when the axis stops. However, the signal will not change to 1 if moving command is stopped by axis control pause signal ESTPg.

(25) Buffer is occupied

Signal：EABUFg (F131.1, F134.1, F137.1, F140.1)

Classification：NC→PLC

Report the buffer state of PLC axis control command.

If there is commanded block in the buffer when inputting group, the signal becomes 1. The signal becomes 0 if there is no command.

(26) Controlling signal

Signal：EACNT1～EACNT5<F182.0～F182.3>

Classification：NC→PLC

Function：

Indicates that PMC axis is in controlling.

When control axis selection signal *EAXSL is 1, axis position signal of the related axis in control becomes 1. While the servo off signal ESOFg is 1, the signal becomes 1 as well.

(27) External deceleration signal

Signal：Positive external deceleration +ED1～+ED5 (G118.0～G118.4)

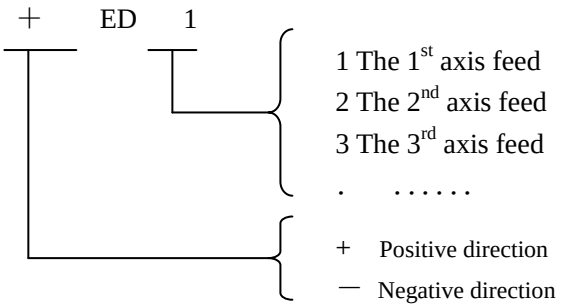
Negative external deceleration -ED1～-ED5 (G120.0～G120.4)

Classification：PLC→ NC

Function：

When the signal is 1, federate of the axis corresponding direction decelerates to the specified external deceleration speed. If the signal does not change to 1, the axis speed will not be effected.

＋ and － in the signal name indicate deed direction, the number corresponds to the control axis.



(28) Reference return signal

Signal： The 1st reference return completion signal ZP1～ZP5（F94.0～.4）
The 2nd reference return completion signal ZP21～ZP25（F96.0～.4）
The 3rd reference return completion signal ZP31～ZP35（F98.0～.4）
The 4th reference return completion signal ZP41～ZP45（F100.0～.4）

Classification：NC→ PLC

Function：

The signal significance of PLC axis and CNC control axis reference return.

The number at the end indicate control axis number. The signal becomes 1 after completing the reference return and in position. The signal changes to 0 when moving from reference point, emergency stop and servo alarm occurs.

Related parameter to PLC axis

7010 Axis DI/DO group selection in PLC axis control

The parameter sets DI/DO group number for axis control command in PLC axis control.

Set value	Significance
0	Not use PLC axis control
1	Use DI/DO signal of the group A
2	Use DI/DO signal of the group B
3	Use DI/DO signal of the group C
4	Use DI/DO signal of the group D

10 Programming command

10.1 Custom macro program

General Although subprograms are useful for repeating the same operation, the custom macro function also allows use of variables, arithmetic and logic operations, and conditional branches for easy development of general programs. A machining program can call a custom macro with a simple instruction, just like a subprogram.

This means that a functions of general use can be formed when programming a certain function as custom macro. That is, programs can be written using variables for data that might change or be unknown. This can be further applied to group technology.

Signal **User macro program input signal**
UI000~UI013（G054，G055, G056, G057）
UI100~UI113（G226，G227, G228, G229）
UI200~UI213（G230，G231, G232, G233）
UI300~UI313（G234，G235, G236, G237）

［Classification］ **PLC→NC**
［Function］ These signals which are taken as one of system variable is read by macro program, used for the interface signal between macro program and PLC.

The system variable corresponding to these signals are as follows:（Table 10-1）:

Table 10-1

Signals	Address	Q'ty	Variables
UI000	G54#0	1	#1000
UI001	G54#1	1	#1001
UI002	G54#2	1	#1002
UI003	G54#3	1	#1003
UI004	G54#4	1	#1004
UI005	G54#5	1	#1005
UI006	G54#6	1	#1006
UI007	G54#7	1	#1007
...	...		...
...	...	1	...
...	...	1	...
UI029	G57#5	1	#1029
UI030	G57#6	1	#1030

UI031	G57#7	1	#1031
UI000~UI031	G54~G57	32	#1032
UI100~UI131	G226~G229	32	#1033
UI200~UI231	G230~G233	32	#1034
UI300~UI331	G234~G237	32	#1035

Note: #1032 is variable with 32-bit as follows:

Signal address

	#7	#6	#5	#4	#3	#2	#1	#0
#1032	UI007	UI006	UI005	UI004	UI003	UI002	UI001	UI000
#1032	UI015	UI014	UI013	UI012	UI011	UI010	UI009	UI008
#1032	UI023	UI022	UI021	UI020	UI019	UI018	UI017	UI016
#1032	UI031	UI030	UI029	UI028	UI027	UI026	UI025	UI024

Custom macro program
output signal
UO000～UO031（F054～F057）
UO100～UO131（F226～F229）
UO200～UO231（F230～F233）
UO300～UO331（F234～F237）

［Type］ Output signal.
［Function］ T These signals which are taken as one of system variable are read/written by macro program, used for the interface signal between macro program and PLC.

The system variable corresponding to these signals are as follows (Table 10-2):

Table 10-2

Signals	Address	Q'ty	Variables
UO000	F54#0	1	#1100
UO001	F54#1	1	#1101
UO002	F54#2	1	#1102
UO003	F54#3	1	#1103
UO004	F54#4	1	#1104
UO005	F54#5	1	#1105
UO006	F54#6	1	#1106
UO007	F54#7	1	#1107
. . .	. . .		. . .
. . .	. . .	1	. . .
. . .	. . .	1	. . .
UO029	F57#5	1	#1129
UO030	F57#6	1	#1130
UO031	F57#7	1	#1131
UO000~UO031	F54~F57	32	#1132
UO100~UO131	F226~F229	32	#1133
UO200~UO231	F230~F233	32	#1134
UO300~UO331	F234~F237	32	#1135

Note: #1132 is variable with 32-bit variable as follows:

	#7	#6	#5	#4	#3	#2	#1	#0
#1132	UO007	UO006	UO005	UO004	UO003	UO002	UO001	UO000
#1132	UO015	UO014	UO013	UO012	UO011	UO010	UO009	UO008
#1132	UO023	UO022	UO021	UO020	UO019	UO018	UO017	UO016
#1132	UO031	UO030	UO029	UO028	UO027	UO026	UO025	UO024

Part 3 Connection

Notes

1. Machine electric box requirements

The machine electric boxes of the installation system and the drive unit use the fully closed dust-proof design to effectively protect the dust, the lubrication and the coolant from entering any internal components, and the temperature difference between the inner and the outer of the electric box cannot exceed 10℃. If can not meet the requirement, heat exchange system is needed. The max. temperature should not exceed 45℃.

2. System installation position

CNC system is the control core of the whole CNC machine, and it is prior to be placed in the position where there is the small temperature increasing and the less electromagnetic radiation interference. The spindle drive unit with strong power and the feed axis drive unit should be installed on the upper because their much heat. I/O should be placed in the below.

3. Protective ground

 Machine electric box should be grounded, the consecutive of the protective grounding should be meet with GB 5226.1-2008 requirements. It is necessary with the stable ground for the system stably running, each grounding wire of all components of the system cannot be series each other, and grounding bar (thickness ≥3mm copper) should be installed in the electric box, the grounding resistance of the ground connected with the grounding bar should be equal to or less than 0.1Ω, and the protective grounding terminal of each component should be separately connected with the grounding bar with the stubby yellow-green wiring.

4. Suppressing interference

Although the system uses the anti-interference in design to avoid the external interference influence, the following measures in the installation and connection should be executed to get the stable and reliable run.

a) use the insolated transformer to CNC power supply；

b) the installation of the CNC system should be far away from the ones bringing inference；

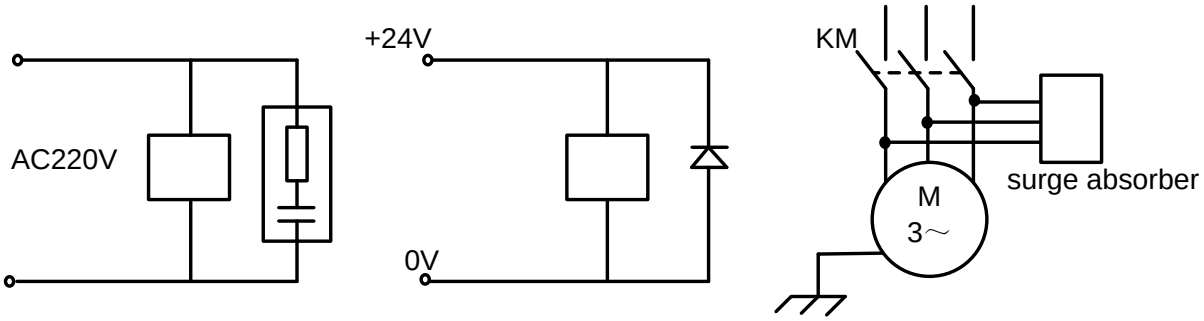
c) CNC signal should use the shield cable which should be far away from the power

electromagnetic interference, and which should be straight, otherwise, which causes the interference signals;

d) Parallel RC circuit in AC coil, and the RC circuit should approach the inductive load;

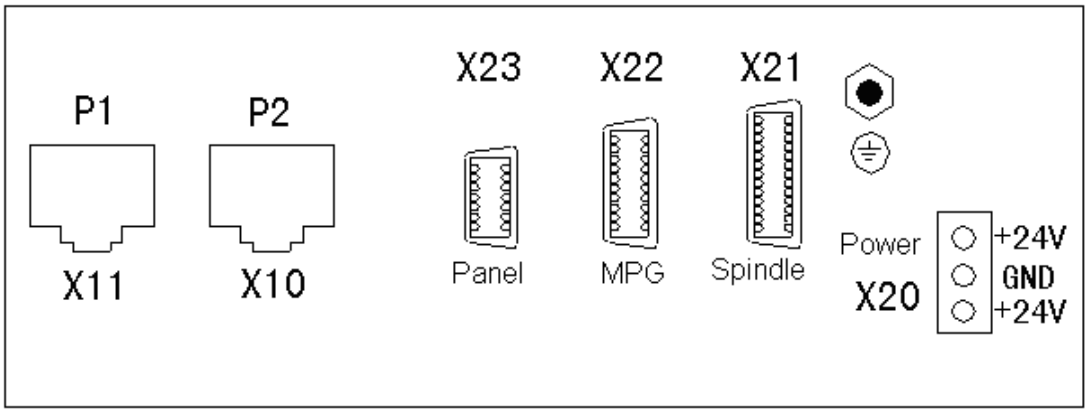
e) Inversely parallel freewheeling diode in the two terminals of DC coil;

f) Parallel surge absorber in AC motor winding terminal.



1 GSK25i System Box Interface

GSK 25i system box interface is as follows:



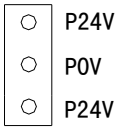
P1(x11): Ethernet interface one

pin explanation of another terminal of crystal plug	
pin No.	pin explanation
1	TX1+
2	TX1−
3	RX1+
4	NC
5	NC
6	RX1−
7	NC
8	NC

P2(x10): Ethernet interface two

pin explanation of another terminal of crystal plug	
pin No.	pin explanation
1	TX2+
2	TX2−
3	RX2+
4	NC
5	NC
6	RX2−
7	NC
8	NC

X20:Power



X23 :Operation panel interface

1	P24V	2	
3	P0V	4	
5		6	RXD−
7	RXD+	8	
9		10	
11	0V	12	
13	TXD+	14	TXD−

X22: MPG interface

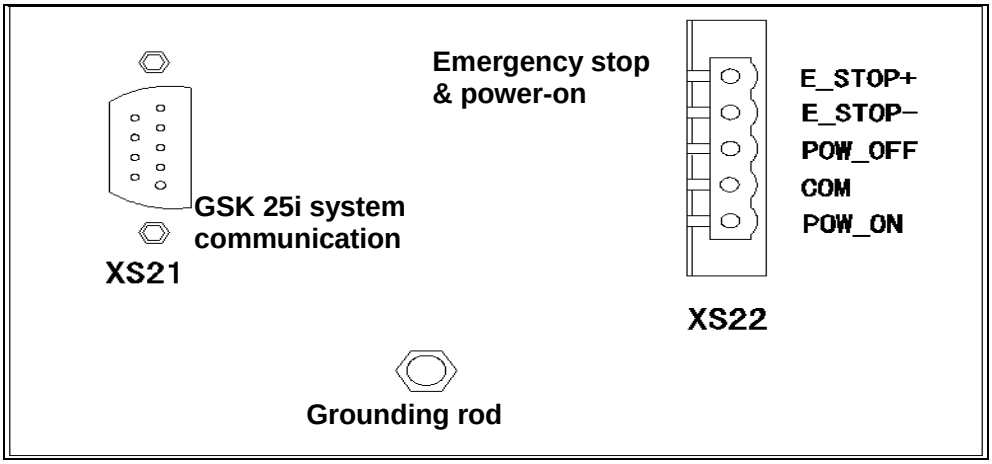
1	+5V	11	P_24V
2		12	
3	STP	13	
4	LED	14	PB−
5	HX	15	PB+
6	HY	16	PA+
7	HZ	17	PA−
8	H4	18	X100
9	H5	19	X1
10	P_0V	20	X10

X21:Spindle interface

1	SVC+	14	
2		15	
3	SVC−	16	PB+
4	CP+	17	PB−
5	CP−	18	PA+
6	DIR−	19	PA−
7	DIR+	20	
8	ALM	21	P_0V
9	COIN	22	VP
10	ZSP	23	EN
11	VPO	24	STA0
12	SAR	25	ZSL
13	P_24V	26	ARST

2 Operation panel interface

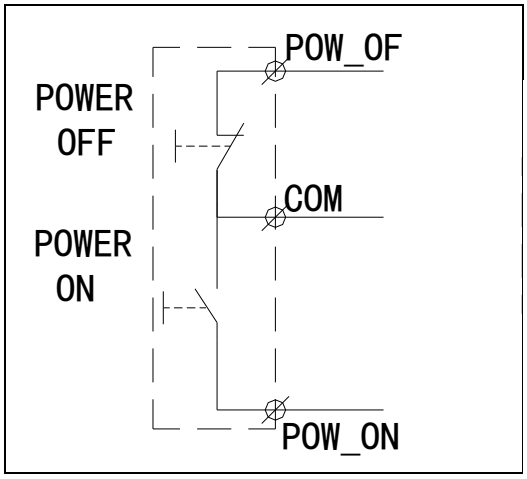
2.1 Sketch map of machine operation panel interface



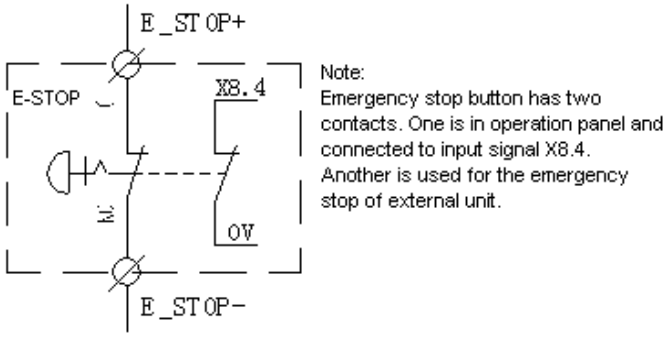
2.2 CNC system communication interface XS21

1	P24V	2	
3	P0V	4	
5		6	RXD-
7	RXD+	8	
9		10	
11	0V	12	
13	TXD+	14	TXD-

*TXD+, TXD-, RXD+, RXD- ：RS485 difference communication signal;
*0V：reference ground of difference signal；
*P24V，P0V：24V input
Emergency power on interface XS22



Power-on interface



Emergency stop interface

3 I/O Interface

Sketch map of I/O interface

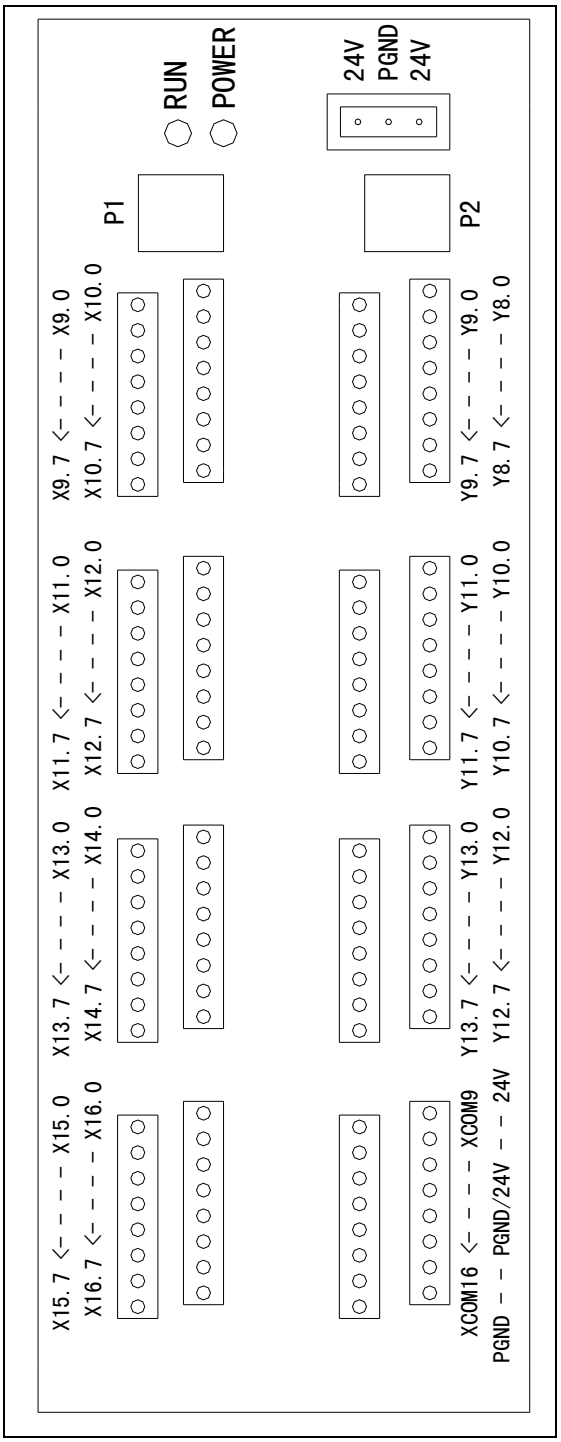


Fig. 3-1

①I/O power interface

XS34(3-male)

1	24v
2	0v
3	24v

Fig. 3-2

*0V：share with the corresponding ground of the machine.

②P1, P2 are the industrial Ethernet interface

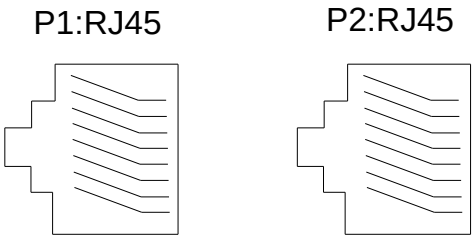


Fig. 3-3

Input signal interface

Input signal address on the I/O unit is X9~~X16, 8-byte, 64-point.

Output signal address on the I/O unit is Y8~~Y13, 6-byte, 48-point.

Note: COM9~COM16 are selection terminals of common end of the input signal. They determines whether the group of input signal is HIGH or LOW is valid：

（1）When COM is connected with 24V，the corresponding input point being connected with LOW (0V) is valid;

（2）When COM is connected with 0V，the corresponding input point being connected with HIGH (24V) is valid.

When using several I/O extended links, the address distribution is as follows according to Ethernet connection sequence:

Input signal address is X9~~X16 for the 1st I/O, output signal address is Y8~~Y13.

Input signal address is X17~~X24 for the 2nd I/O, output signal address is Y14~~Y19.

Input signal address is X25~~X32 for the 3rd I/O, output signal address is Y20~~Y25.

：

：

Input signal can be expanded up to X119, output signal can be expanded to Y119.

4 External Position Detection Unit

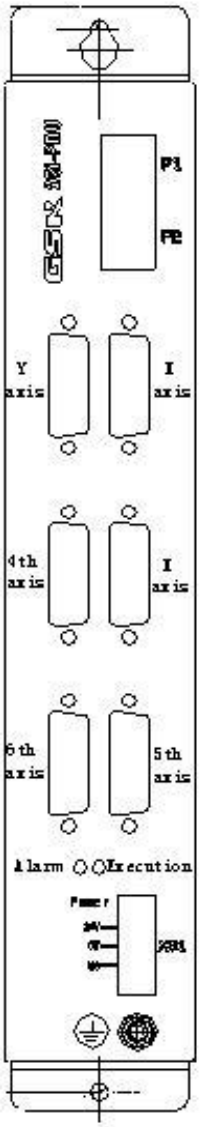


Fig. 4-1

RCN226。Note: Axis interface adopts HEIDEHAIN EnDat2.2 draft for connecting HEIDEHAIN EnDat2.2 absolute linear grating and angle encoder. Selectable linear grating is LC100 or LC400 aeries. For example: LC183,LC483.

Selectable encoder is RCN200, For example: RCN226.

Power interface for external position detection unit

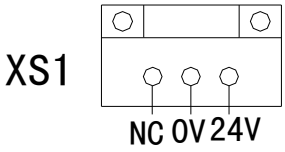


Fig. 4-2

Note: NC terminal is not used.

P1, P2 are the industrial Ethernet interface

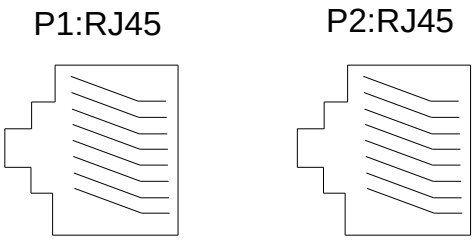


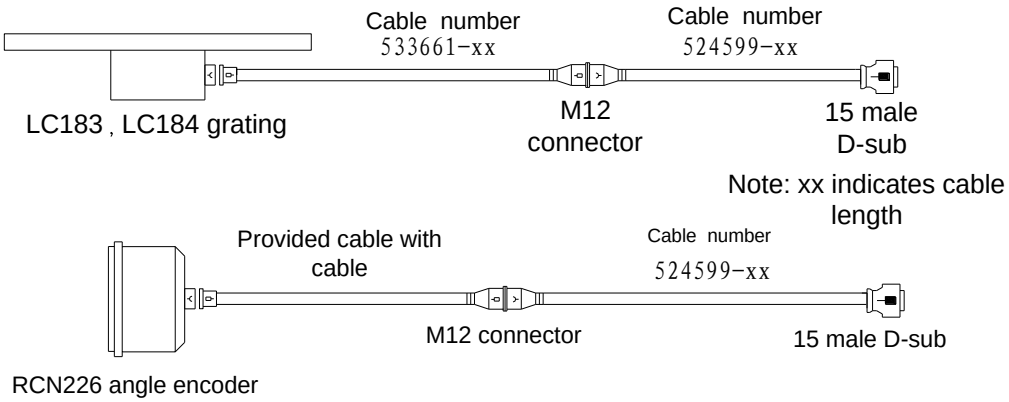
Fig. 4-3

Axis data interface

Axis data interface is a 15-core D-sub female-type plug, which is used to connect HEIDEHAIN EnDat absolute detection unit.

Selection for HEIDEHAIN auxiliary cable.

HEIDEHAIN grating and cable selection for GSK25i system



Note: Grating and the encoder are absolute type without incremental signal
Order sign: EnDat 2.2/22

Fig. 4-4

5 Interconnection Graph

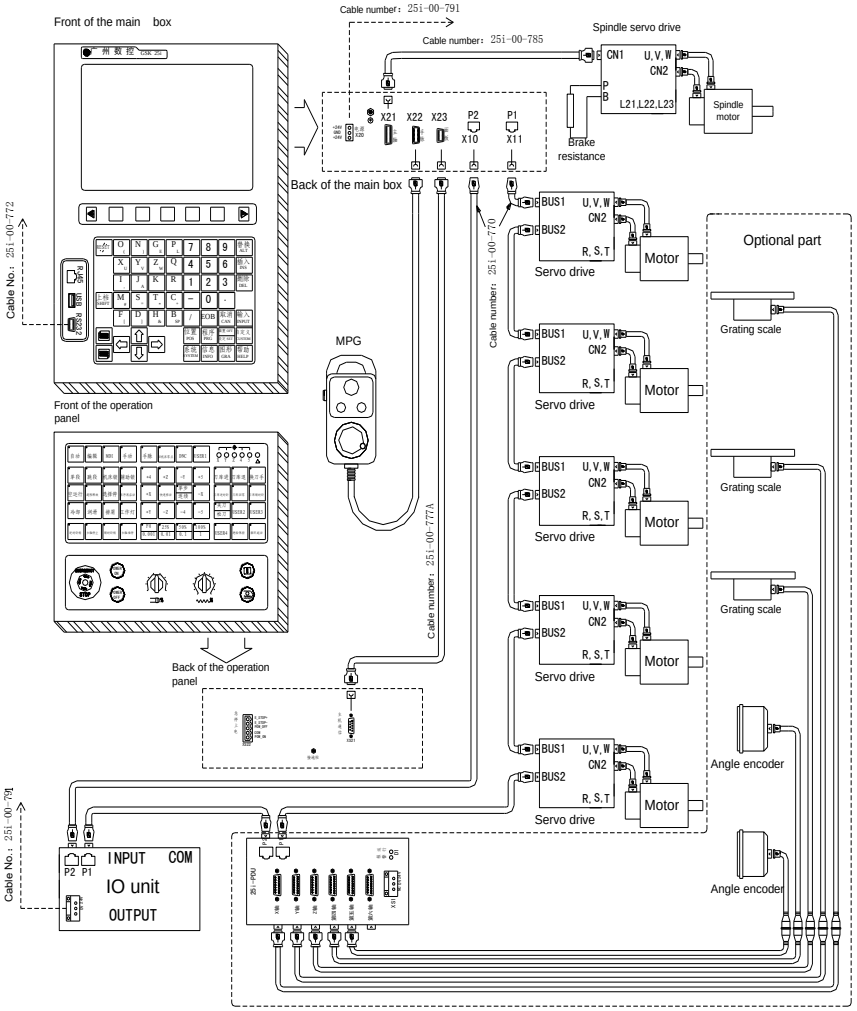


Fig. 5-1

6 PC serial communication wire

Communication connection between the system and PC RS232 is as Fig. 6-1.

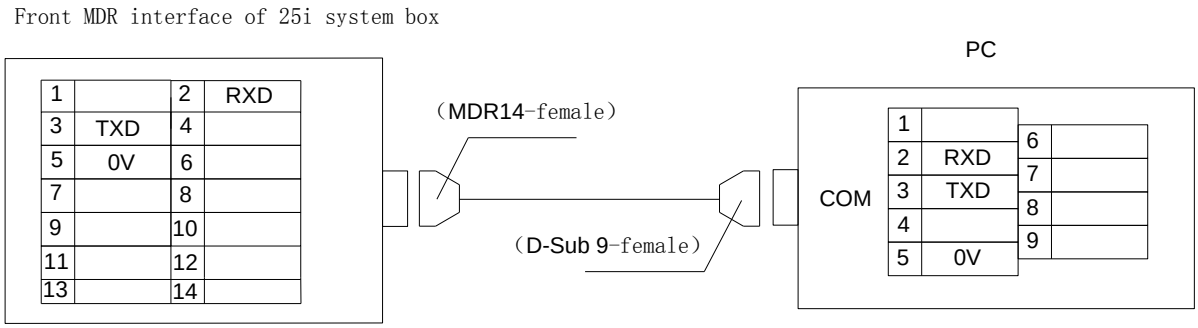


Fig. 6-1

PC communication cable connection is as Fig. 6-2.

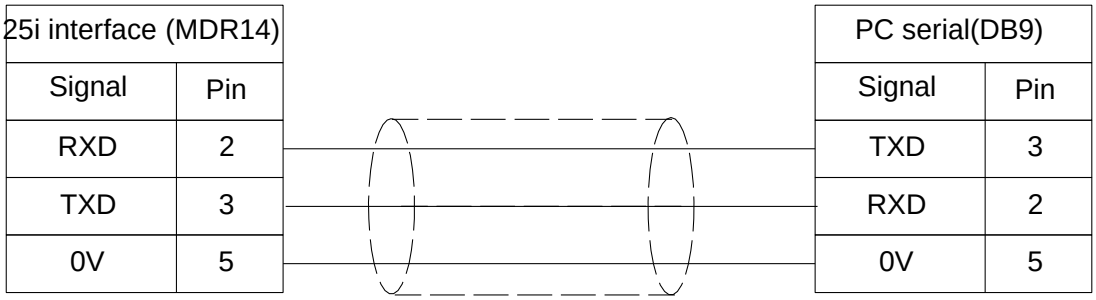


Fig. 6-2

7 MPG Wiring

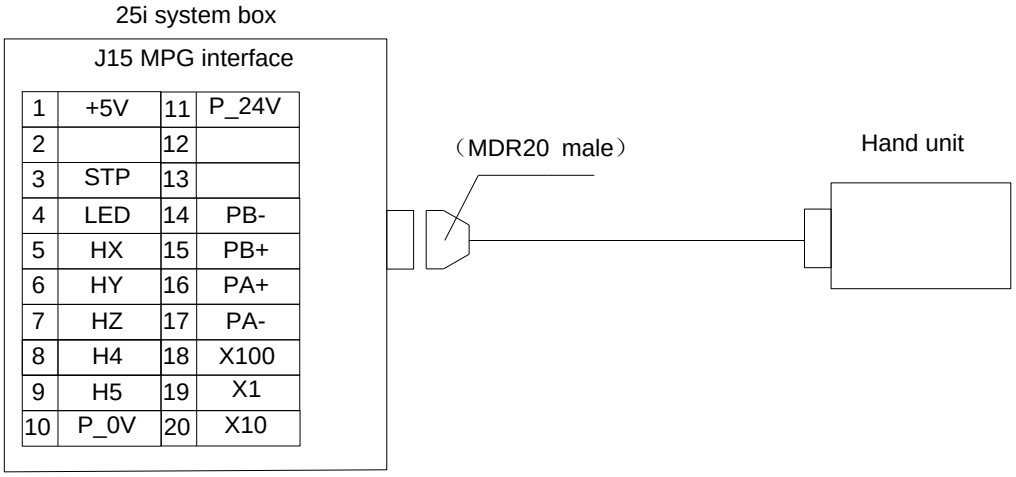


Fig. 7-1

External MPG signal connection is as Fig. 7-2.

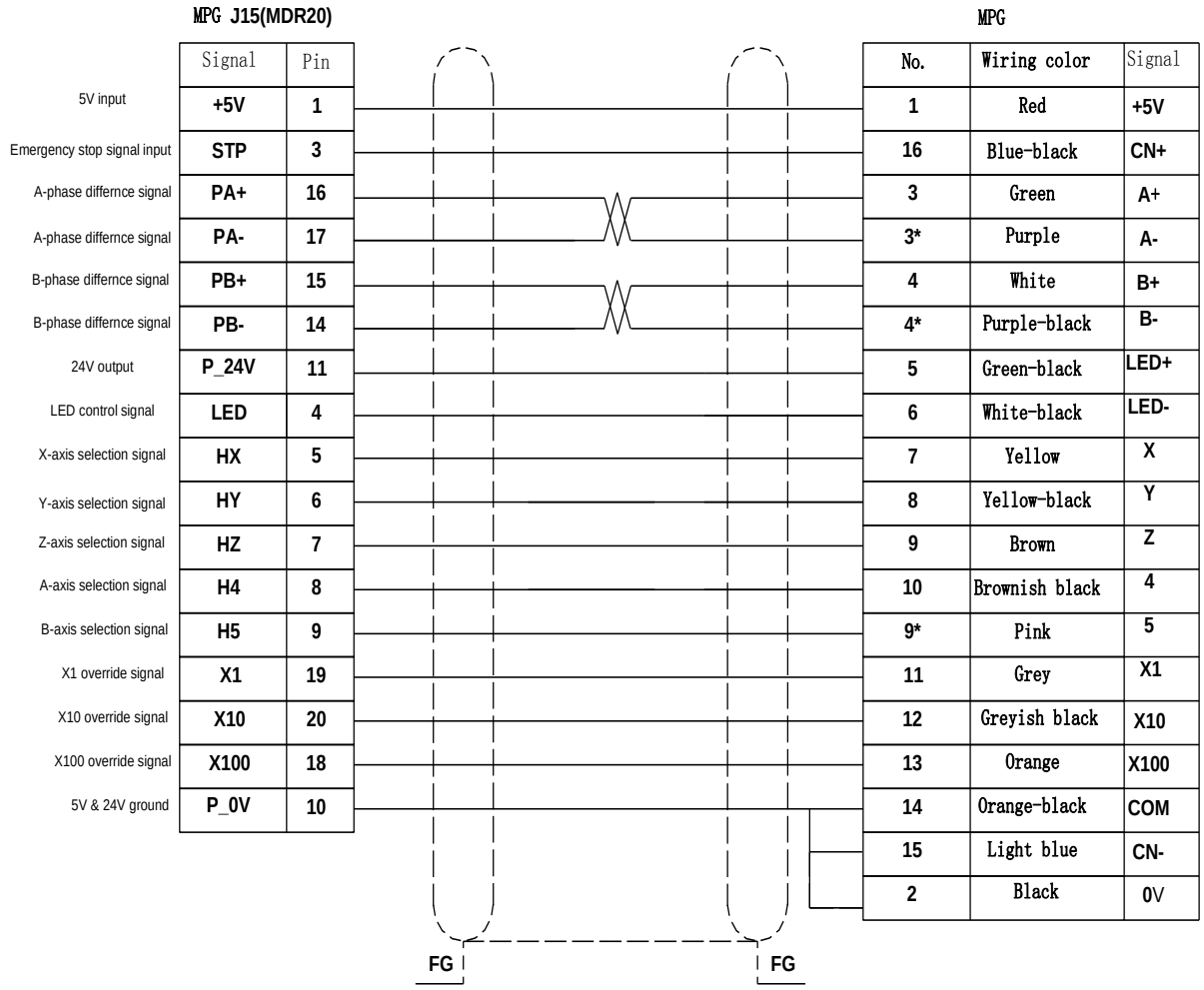
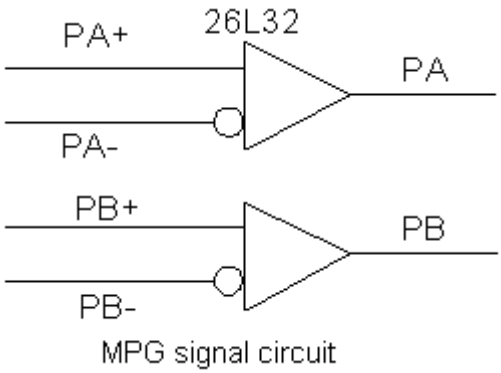


Fig. 7-2

Signal explanations:

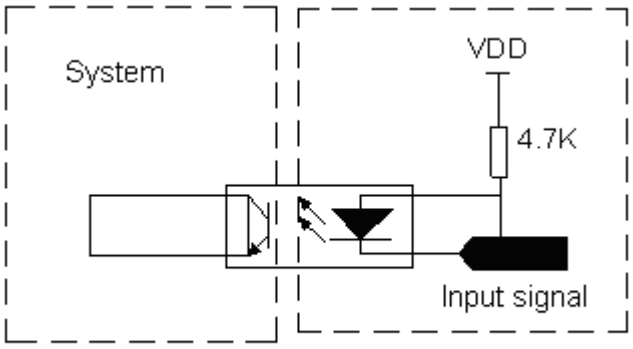
1. HA+, HA-, HB+, HB- are input signal of MPG A, B phase.



MPG signal circuit

Fig. 7-3

2. MPG input signal X1, X10, X100, HX, HY, HZ, H4, H5, STP. Its internal interface circuit are as follows:



Input interface circuit of MPG

Fig. 7-4

MPG signal point definition.

Table 7-1

Signal name	PLC address	Signal function	I / O
HX	X120.7	X axis selection signal input	I
HY	X120.6	Y axis selection signal input	I
HZ	X120.5	Z axis selection signal input	I
H4	X120.4	4 axis selection signal input	I
H5	X120.3	5 axis selection signal input	I
X1	X120.2	X1 override signal input	I
X10	X120.1	X10 override signal input	I
X100	X120.0	X100 override signal input	I
STP	X121.0	Emergency stop signal input	I
LED	Y120.0	LED lamp output	O

8 Operation Panel Signal Line

GSK25I CNC system communicates with the operation panel by RS485 serial interface as Fig. 8-1.

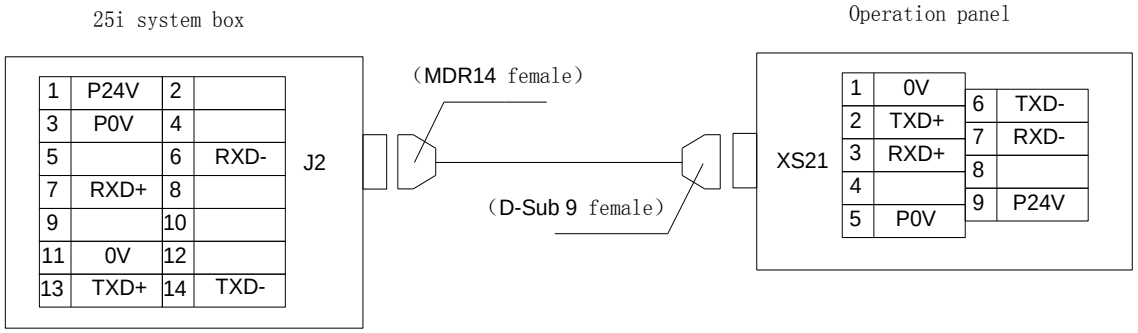


Fig. 8-1

Cable connection of operation panel is as Fig. 8-2.

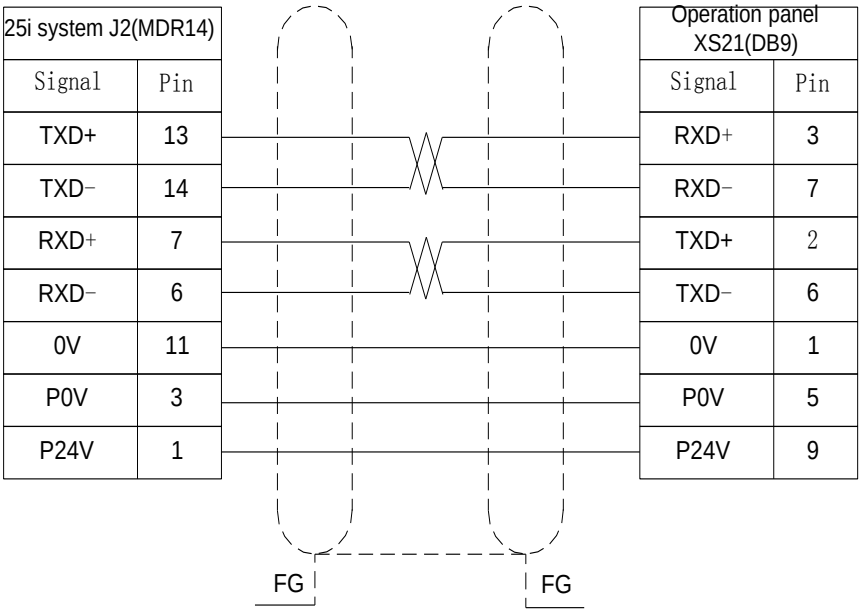


Fig. 8-2

9 Ethernet Communication Connection

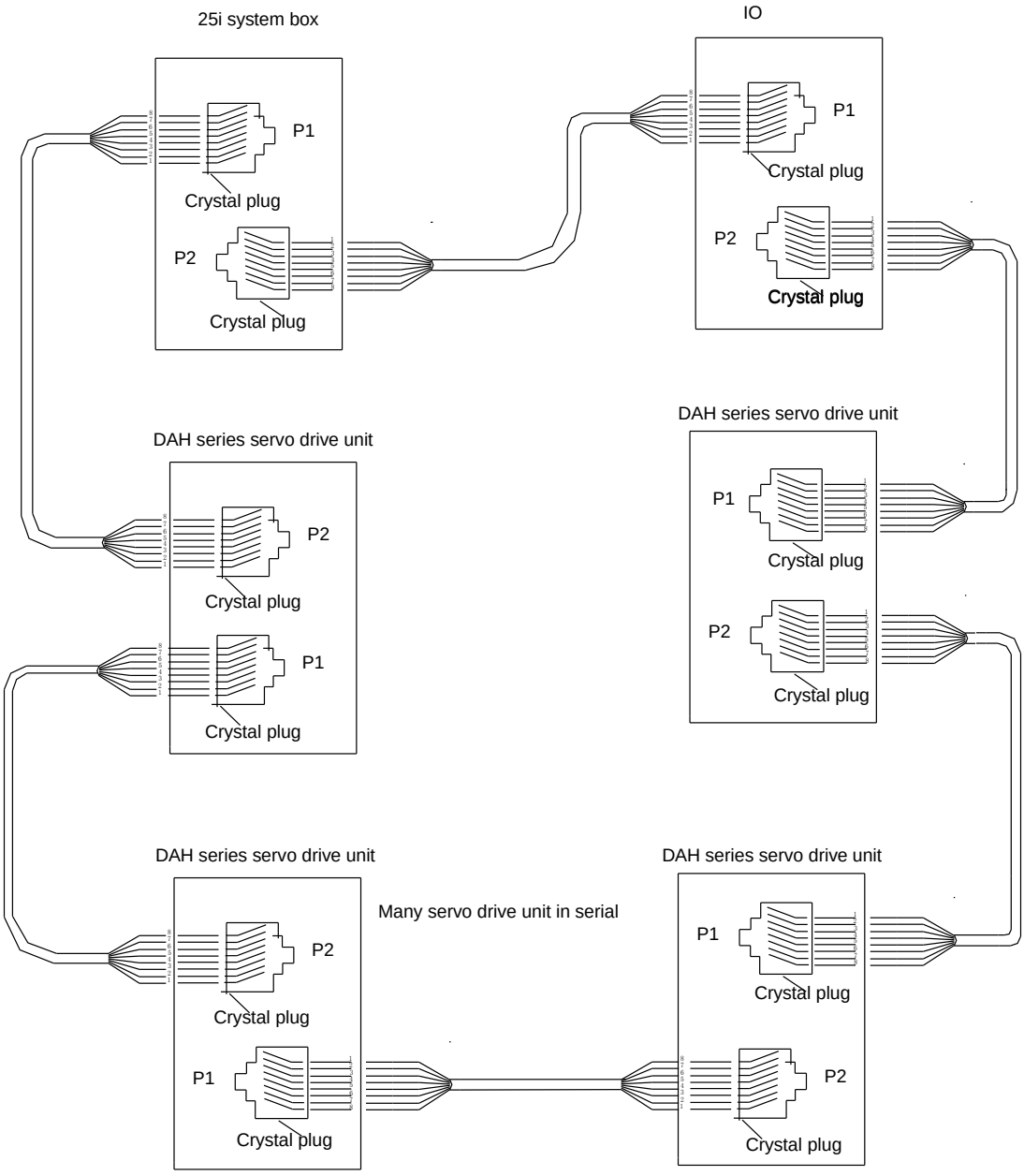


Fig. 9-1

Cable connection drawing of Ethernet

Connection drawing 1:

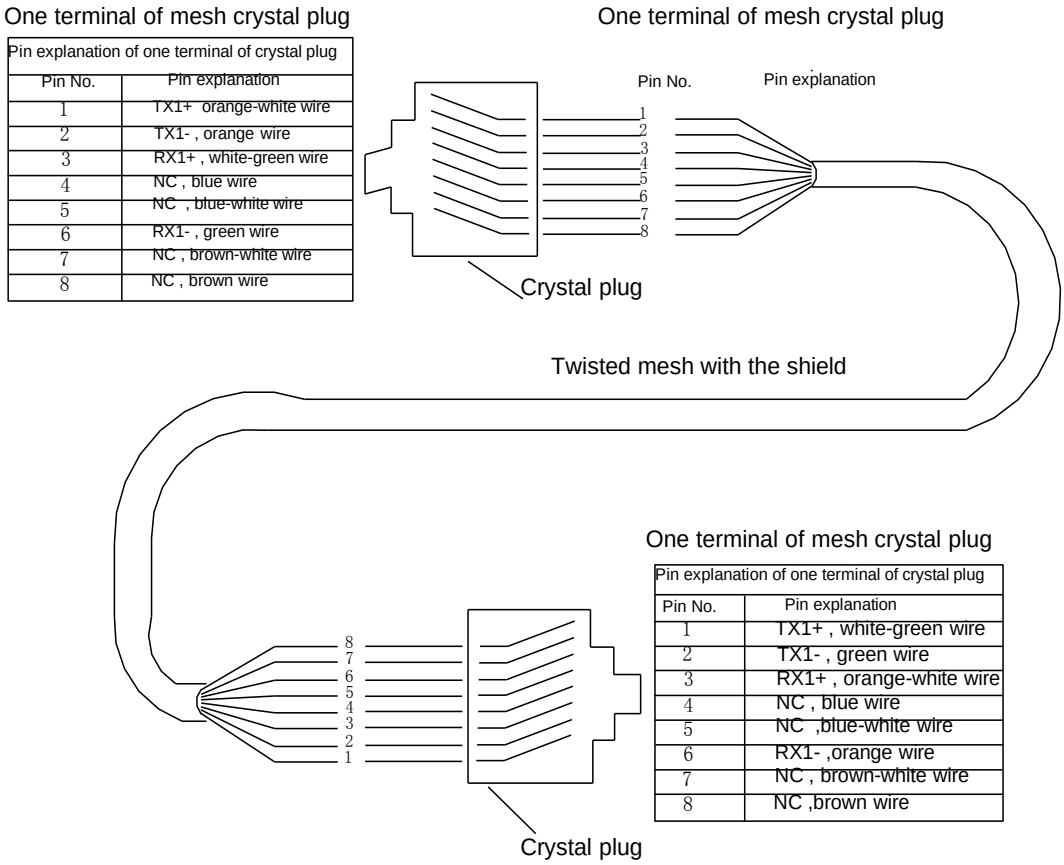
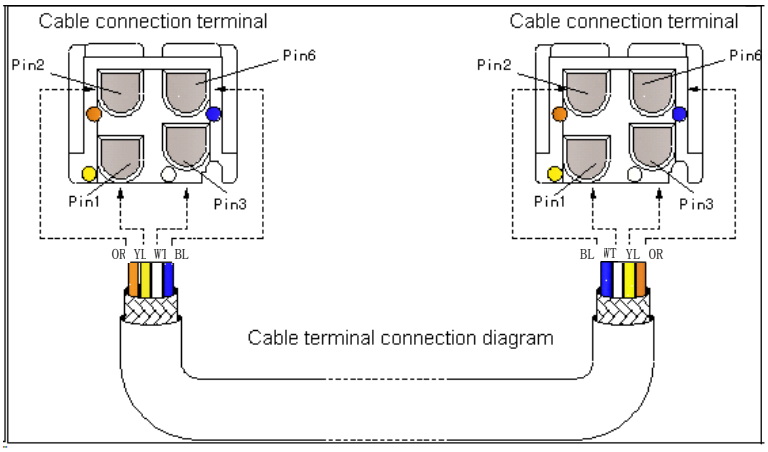


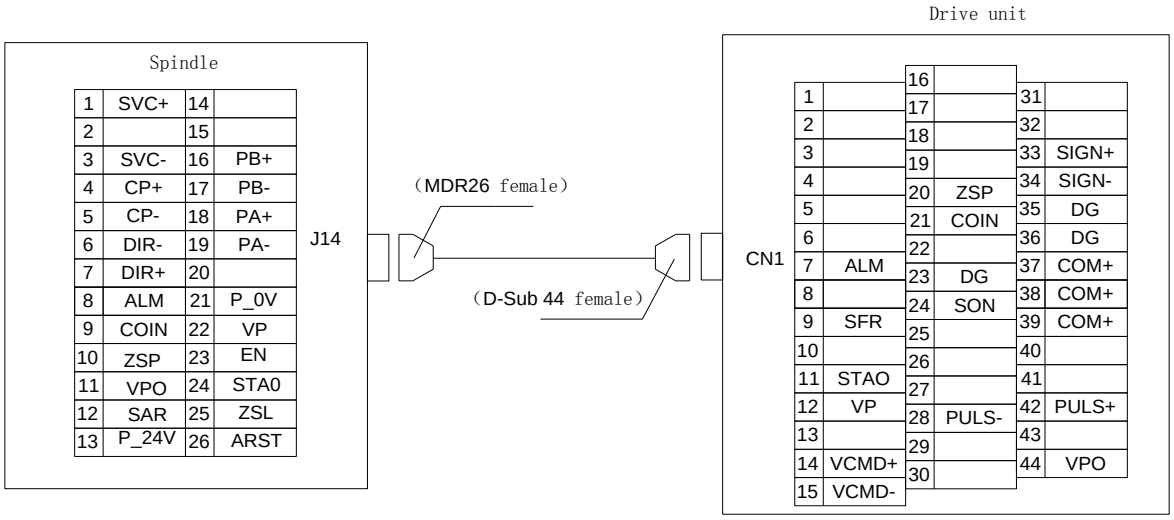
Fig. 9-2

Connection drawing 2:

Cable connection terminal



10 Connected with the Spindle Servo

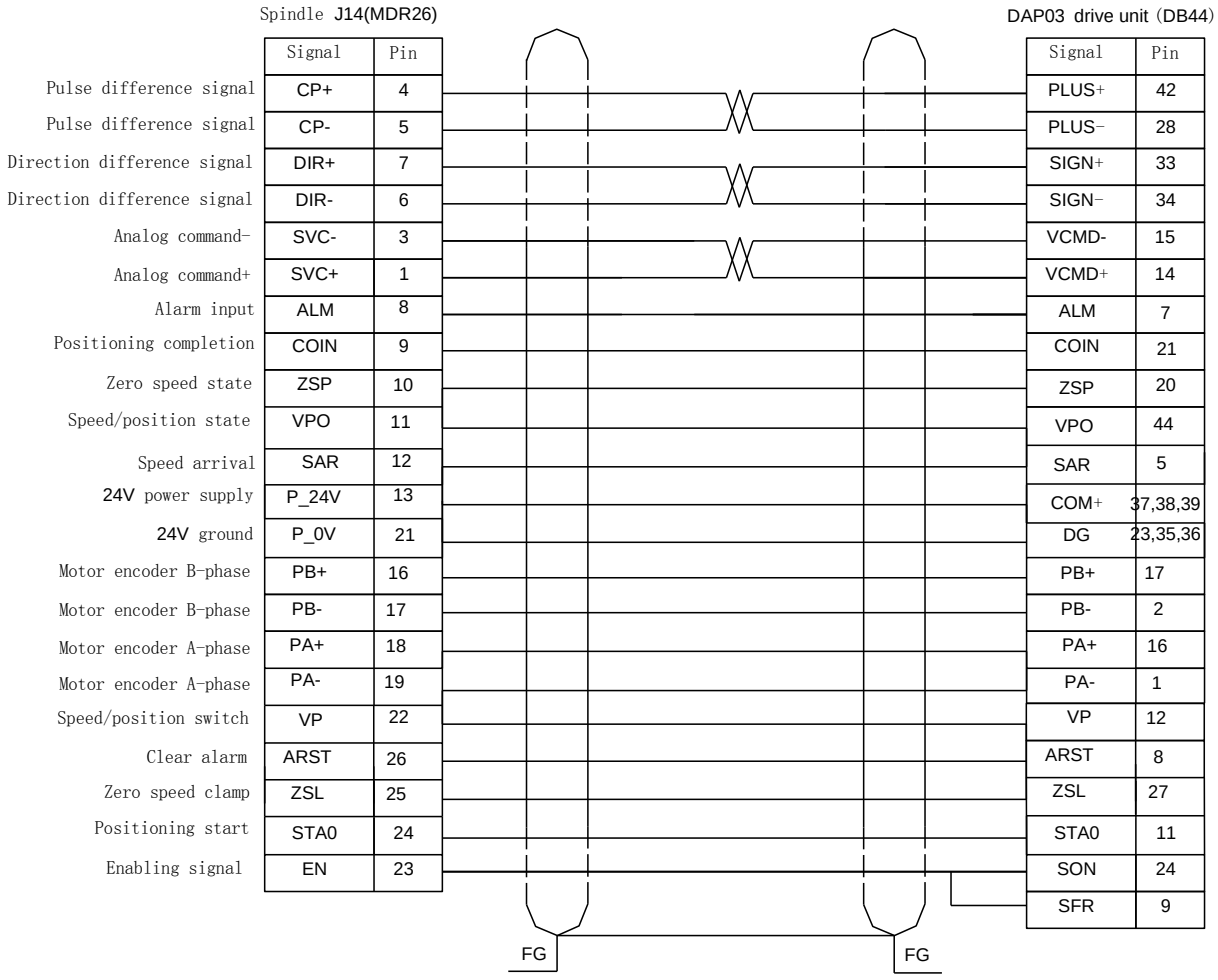


Spindle			
1	SVC+	14	
2		15	
3	SVC-	16	PB+
4	CP+	17	PB-
5	CP-	18	PA+
6	DIR-	19	PA-
7	DIR+	20	
8	ALM	21	P_0V
9	COIN	22	VP
10	ZSP	23	EN
11	VPO	24	STA0
12	SAR	25	ZSL
13	P_24V	26	ARST

CN1					
1		16		31	
2		17		32	
3		18		33	SIGN+
4		19		34	SIGN-
5		20	ZSP	35	DG
6		21	COIN	36	DG
7	ALM	22		37	COM+
8		23	DG	38	COM+
9	SFR	24	SON	39	COM+
10		25		40	
11	STAO	26		41	
12	VP	27		42	PULS+
13		28	PULS-	43	
14	VCMD+	29		44	VPO
15	VCMD-	30			

Fig. 10-1

Cable connection drawing of spindle.



	Spindle J14(MDR26)		DAP03 drive unit (DB44)	
	Signal	Pin	Signal	Pin
Pulse difference signal	CP+	4	PLUS+	42
Pulse difference signal	CP-	5	PLUS-	28
Direction difference signal	DIR+	7	SIGN+	33
Direction difference signal	DIR-	6	SIGN-	34
Analog command-	SVC-	3	VCMD-	15
Analog command+	SVC+	1	VCMD+	14
Alarm input	ALM	8	ALM	7
Positioning completion	COIN	9	COIN	21
Zero speed state	ZSP	10	ZSP	20
Speed/position state	VPO	11	VPO	44
Speed arrival	SAR	12	SAR	5
24V power supply	P_24V	13	COM+	37,38,39
24V ground	P_0V	21	DG	23,35,36
Motor encoder B-phase	PB+	16	PB+	17
Motor encoder B-phase	PB-	17	PB-	2
Motor encoder A-phase	PA+	18	PA+	16
Motor encoder A-phase	PA-	19	PA-	1
Speed/position switch	VP	22	VP	12
Clear alarm	ARST	26	ARST	8
Zero speed clamp	ZSL	25	ZSL	27
Positioning start	STA0	24	STA0	11
Enabling signal	EN	23	SON	24
			SFR	9

Fig. 10-2

Signal explanations：

1. Encoder signal input； PA+/PA- , PB+/PB- is differential input signal for A, B phase of the encoder. Its interface circuit is as follows:

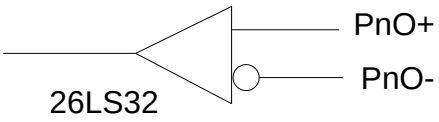


Fig. 10-3

2. Spindle IO input signal: ALM, COIN, ZSP, VPO, SAR, its interface circuit is as follows:

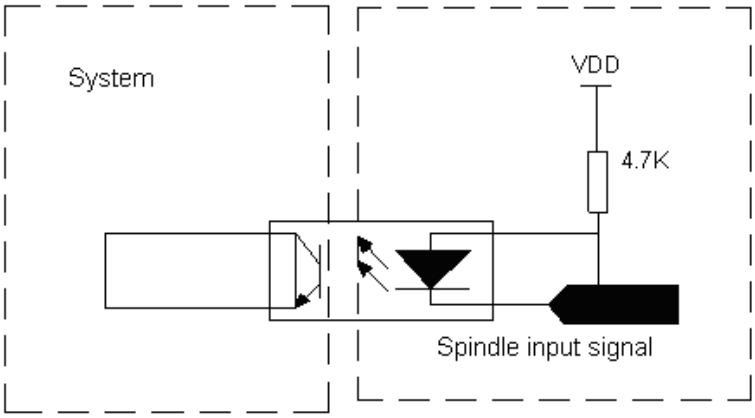


Fig. 10-4

3. Spindle IO input signal: ARST, ZSL, EN, STA0, VP. Its connection diagram is as follows:

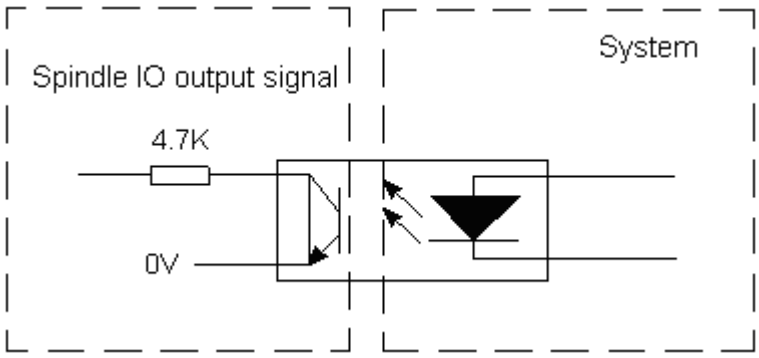


Fig. 10-5

4. Position, direction pulse output signal: CO+/CP-, DIR+/DIR-, which connection diagram is as follows:

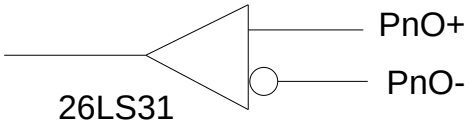
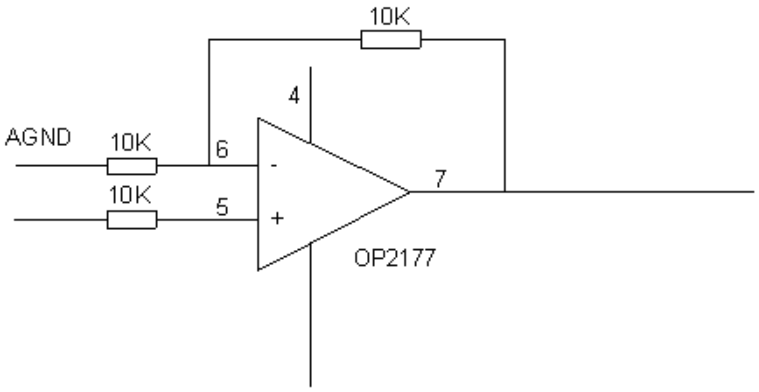


Fig. 10-6

5. Analog command signal: SVC-/SVC+, which connection diagram is as follows:



SVC signal diagram

Fig. 10-7

11 Connected with the Spindle Converter

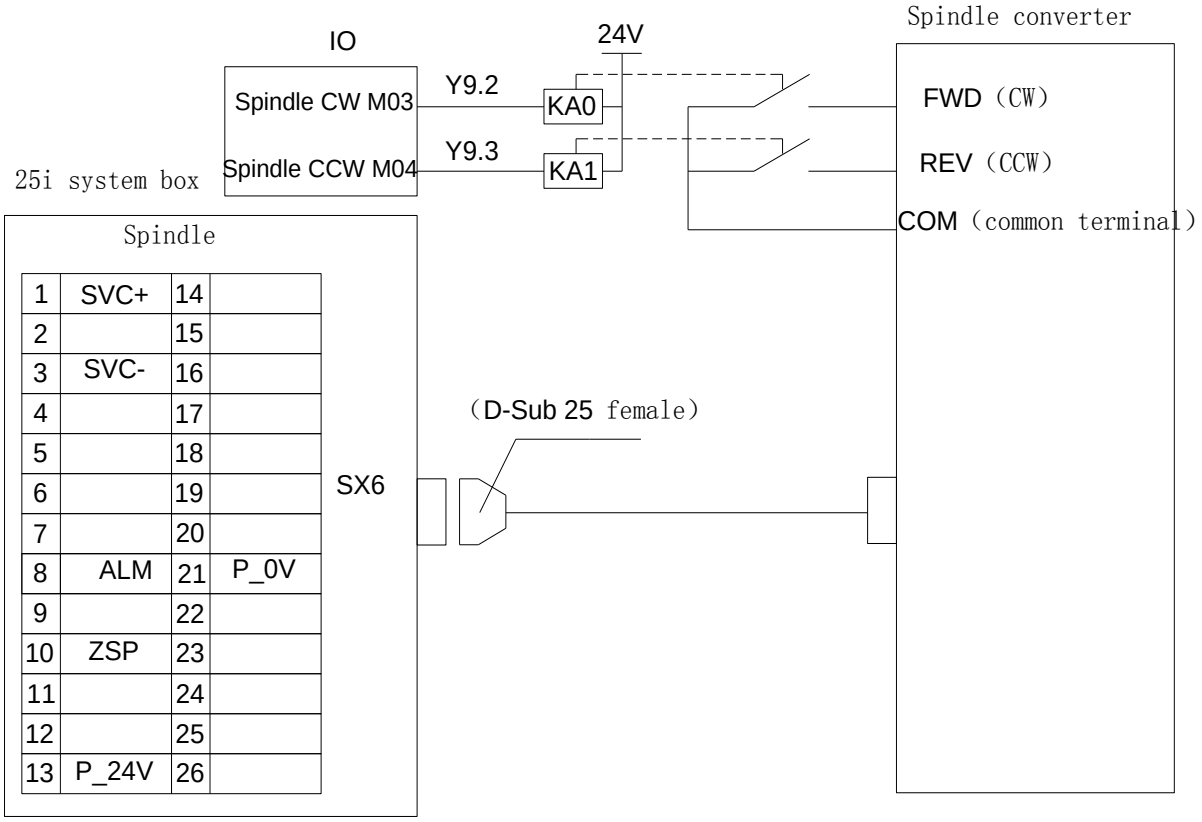


Fig. 11-1

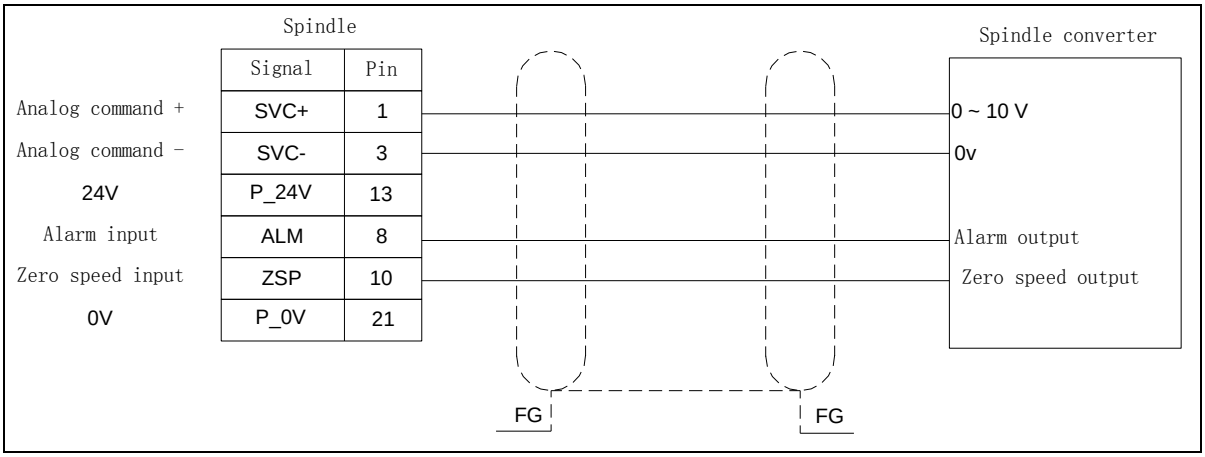


Fig. 11-2

12 Connection Method of Z Brake, System Power-on Control

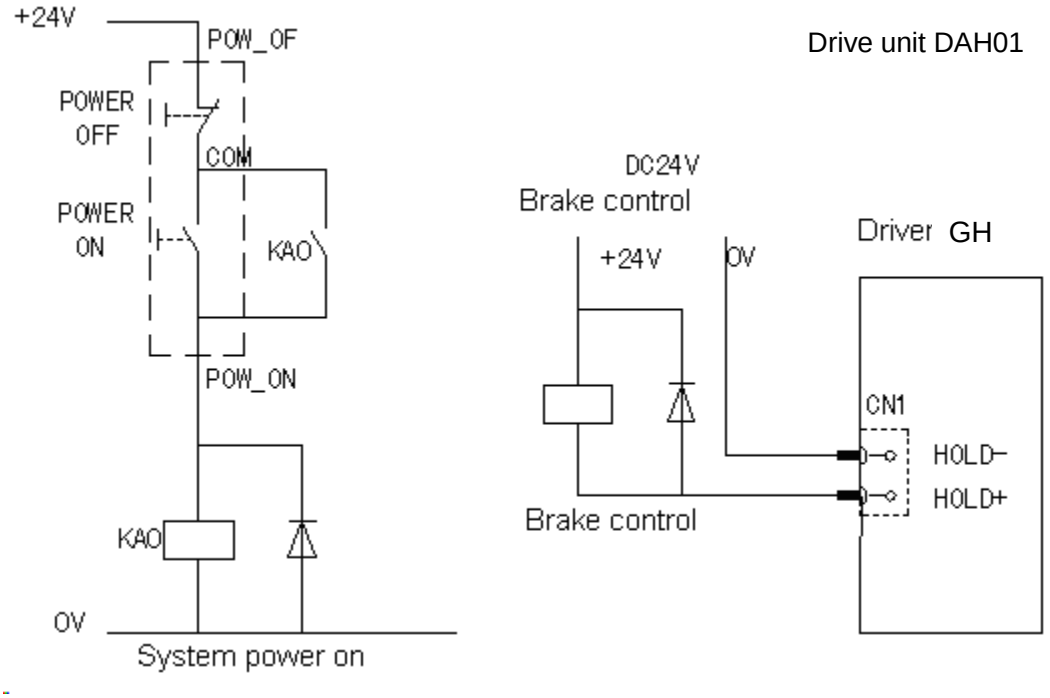


Fig. 12-1

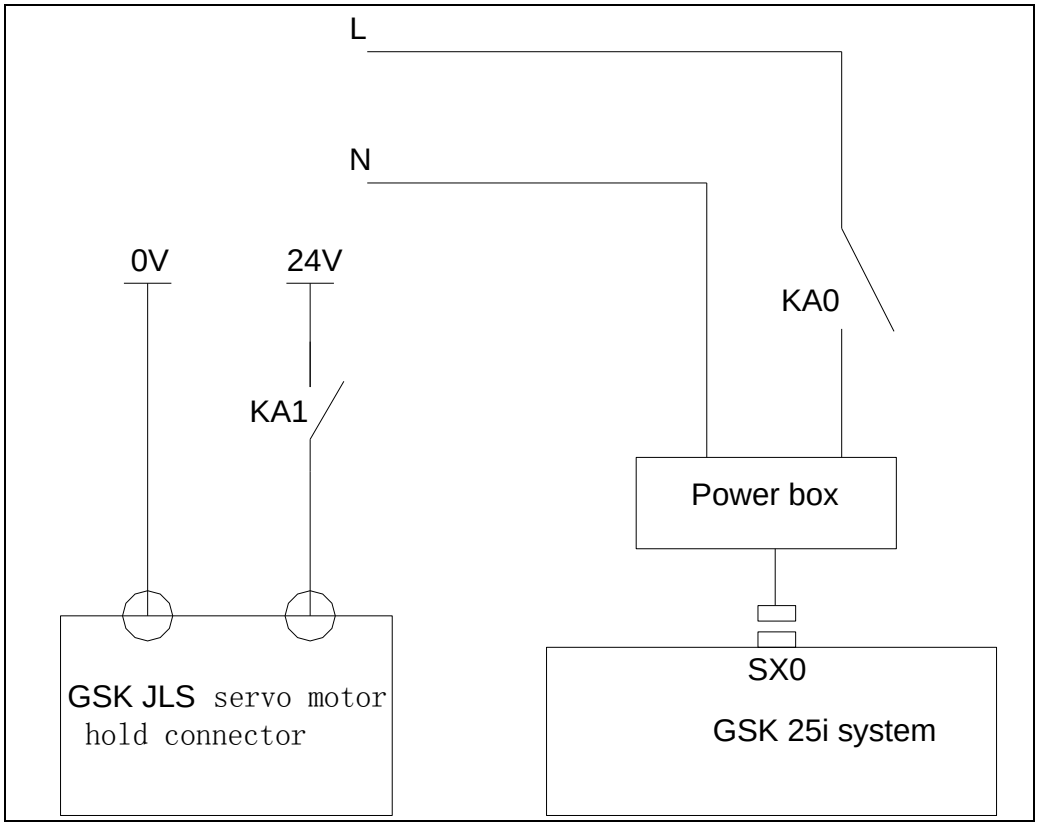


Fig. 12-2

13 I/O Input, Output Signal

13.1 Connection method of input signal

COM terminal of each group of address determines whether HIGH or LOW input is valid:

（1）When COM is connected with 24V, each input point connected with LOW（0V）is valid；

（2）When COM is connected with 0V, each input point connected with HIGH（24V）is valid.

connection method when LOW is valid **connection method when HIGH is valid**

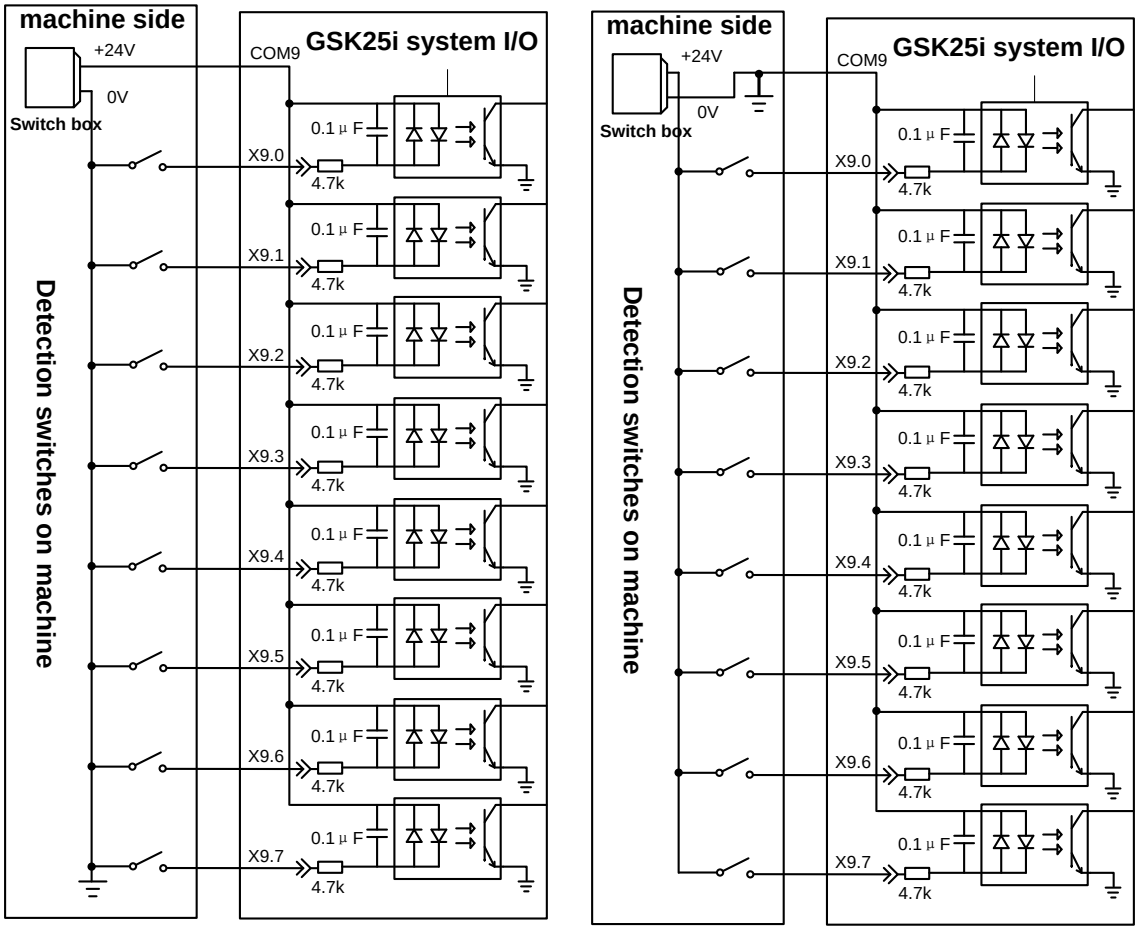


Fig. 13-1

***Note**：An input point has 8 groups including 64 points, the above figure takes the example of the group of X9.0—X9.7，and the connection methods of other groups are the same.

13.2 Connection method of output signal

An output signal has 48 points using the output ULN280-3，max. flowing current of each point is 200mA.

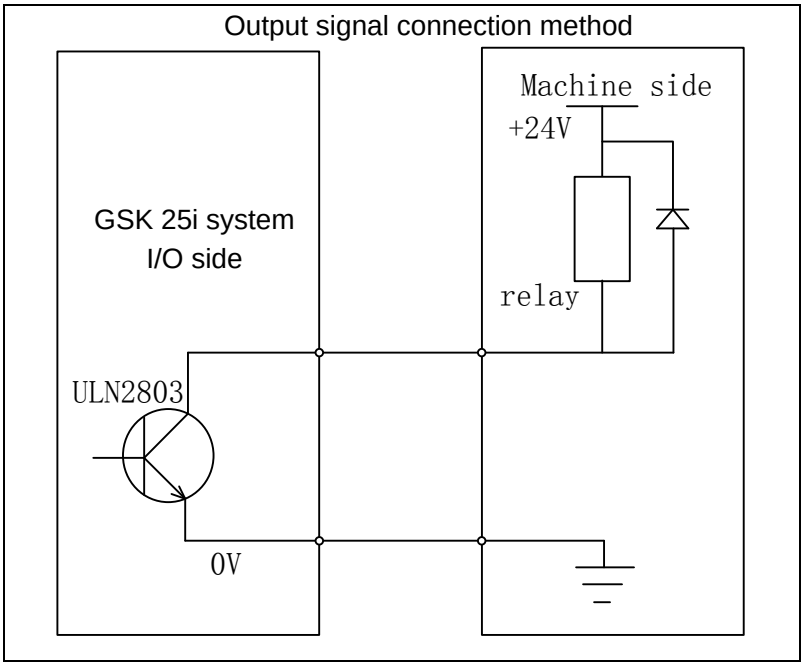


Fig. 13-2

13.3 Definition of input signal point

Table 13-1

Terminal No.	PLC address	Signal name	Signal function	I / O
X9.0	X9.0	*DECX（fixed）	X zero return deceleration input signal，normally-closed contact, power-off is valid	I
X9.1	X9.1	*DECY（fixed）	Y zero return deceleration input signal，normally- closed contact, power-off is valid	I
X9.2	X9.2	*DECZ（fixed）	Z zero return deceleration input signal，normally-closed contact, power-off is valid	I
X9.3	X9.3	*DEC4（fixed）	4th zero return deceleration input signal，normally- closed contact, power-off is valid	I
X9.4	X9.4	*DEC5（fixed）	5th zero return deceleration input signal，normally- closed contact, power-off is valid	I
X9.5	X9.5			
X9.6	X9.6	*+LX（fixed）	X positive limit(short circuit when not be used) normally- closed contact, power-off is valid	I
X9.7	X9.7	*-LX（fixed）	X negative limit(short circuit when not be used) normally- closed contact, power-off is valid	I
X10.0	X10.0	*+LY（fixed）	Y positive limit(short circuit when not be used) normally- closed contact, power-off is valid	I
X10.1	X10.1	*-LY（fixed）	Y negative limit(short circuit when not be used) normally- closed contact, power-off is valid	I
X10.2	X10.2	*+LZ（fixed）	Z positive limit(short circuit when not be used) normally- closed contact, power-off is valid	I
X10.3	X10.3	*-LZ（fixed）	Z negative limit(short circuit when not be used) normally- closed contact, power-off is valid	I
X10.4	X10.4	*+L4（fixed）	4th positive limit(short circuit when not be used) normally- closed contact, power-off is valid	I
X10.5	X10.5	*-L4（fixed）	4th negative limit(short circuit when not be used) normally- closed contact, power-off is valid	I
X10.6	X10.6	*+L5（fixed）	5th positive limit(short circuit when not be used) normally- closed contact, power-off is valid	I
X10.7	X10.7	*-L5（fixed）	5th negative limit(short circuit when not be used) normally- closed contact, power-off is valid	I
X11.0	X11.0	LUB.ALM	Lubricating pump alarm input	I
X11.1	X11.1	DOOR	Safe door input	I
X11.2	X11.2	HYPUP.ALM	Hydraulic pump overload input signal	I
X11.3	X11.3	AIRPRE.ALM	Air pressure check alarm input signal	I
X11.4	X11.4	CLNM.ALM	Cooling pump motor overload alarm input signal	I
X11.5	X11.5	CHIPM.ALM	Chip removal motor overload input signal	I
X11.6	X11.6	MGPLA.ALM	Cutter disk motor overload input signal	I
X11.7	X11.7	USER.ALM1	Custom alarm 1 input terminal	I

Terminal No.	PLC address	Signal name	Signal function		I/O
X12.0	X12.0	GR1.M	Spindle No. 1 gear(in-position check)		I
X12.1	X12.1	GR2.M	Spindle No. 2 gear(in-position check)		I
X12.2	X12.2				I
X12.3	X12.3	SPCL.ALM	Spindle oil cooler alarm input signal		I
X12.4	X12.4	LUBPRE.I	Lubrication pump pressure detection		I
X12.5	X12.5	TRLCK.I	Release tool (in-position check)		I
X12.6	X12.6	TCLCK.I	Clamp tool(in-position check)		I
X12.7	X12.7	CKST	Release/clamp tool button		I
X13.0	X13.0	4UCLPI	4th axis release in-position check		I
X13.1	X13.1	4CLPI	4th axis clamp in-position check		I
X13.2	X13.2				
X13.3	X13.3				
X13.4	X13.4	5UCLPI	5th axis release in-position check		I
X13.5	X13.5	5CLPI	5th axis clamp in-position check		I
X13.6	X13.6				
X13.7	X13.7				
X14.0	X14.0	T-BARE		Cutter disk in-position (disk-type)	I
X14.1	X14.1	TZER.I	Tool magazine zero return signal		
X14.2	X14.2	TCN.I	Tool counting signal		I
X14.3	X14.3	TFN.I	Tool magazine forward in-position	Cutter set is vertical	I
X14.4	X14.4	TBK.I	Tool magazine backward in-position	Cutter set is horizontal	I
X14.5	X14.5			ATC original point	
X14.6	X14.6			ATC tool holding	
X14.7	X14.7			ATC stops	

Note: X15.0—X15.7, X16.0—X16.7 together have 16 input signal interfaces to the user.

13.4 Definition of output signal point

Terminal No.	PLC address	Signal name	Signal function	I/O
Y8.0	Y8.0	CLN.O	Cooling （coolant）pump output	O
Y8.1	Y8.1	MGFR.O	Tool magazine forward/ cutter set is vertical（Output signal）	O
Y8.2	Y8.2	MGBK.O	Tool magazine backward/ cutter set is horizontal（Output signal）	O
Y8.3	Y8.3			O
Y8.4	Y8.4	TRL.M	Release too/air blowing（Output signal）	O
Y8.5	Y8.5	MGCW.O	Tool magazine CW（Output signal）	O
Y8.6	Y8.6	MGCCW.O	Tool magazine CCW（Output signal）	O
Y8.7	Y8.7	HYPR.O	Hydraulic oil pump output	O
Y9.0	Y9.0	LUB.O	Lubricating pump output	O
Y9.1	Y9.1	OR.T	Overtravel release	O
Y9.2	Y9.2	M03	Spindle CW（Output signal）	O
Y9.3	Y9.3	M04	Spindle CCW（Output signal）	O
Y9.4	Y9.4	RED.ALL	Red lamp alarm output	O
Y9.5	Y9.5	YEL.ALL	Yellow lamp output（normally wait）	O
Y9.6	Y9.6	GRE.ALL	Green lamp output（machine normally runs）	O
Y9.7	Y9.7			O
Y10.0	Y10.0	GR1.O	Spindle No.1 gear output	O
Y10.1	Y10.1	GR2.O	Spindle No.2 gear output	O
Y10.2	Y10.2	GR3.O	Spindle No.3 gear output	O
Y10.3	Y10.3			O
Y10.4	Y10.4			
Y10.5	Y10.5			
Y10.6	Y10.6			
Y10.7	Y10.7			
Y11.0	Y11.0	LAMP.L	Machine working lamp	O
Y11.1	Y11.1	CLN2.O	chip water valve output	O
Y11.2	Y11.2	CFN.O	Spindle blowing output	O
Y11.3	Y11.3	CLN-2.O	Workpiece blowing output	O
Y11.4	Y11.4	CHIP1.CW	Chip removal 1 CW output	O
Y11.5	Y11.5	CHIP1.CCW	Chip removal 1 CCW output	O
Y11.6	Y11.6	CHIP2.CW	Chip removal 2 output	O
Y11.7	Y11.7			O

Y12.0	Y12.0	4UCLPO	4th axis release output	O
Y12.1	Y12.1	4-CLPO	4th axis clamp output	O
Y12.2	Y12.2	5UCLPO	5th release output	O
Y12.3	Y12.3	5-CLPO	5th clamp output	O
Y12.4	Y12.4			
Y12.5	Y12.5			
Y12.6	Y12.6			
Y12.7	Y12.7			
Y13.0	Y13.0			
Y13.1	Y13.1			
Y13.2	Y13.2			
Y13.3	Y13.3			
Y13.4	Y13.4			
Y13.5	Y13.5			
Y13.6	Y13.6			
Y13.7	Y13.7			

Appendix 1 CNC and PLC interface signal table

F code		
Address	Signal name	Symbol
F000#4	Automatic run pause signal	SPL
F000#5	Automatic run start signal	STL
F000#6	Servo ready signal	SA
F000#7	Automatic run signal	OP
F001#0	Alarm signal	AL
F001#1	reset signal	RST
F001#3	Distribution end signal	DEN
F001#4	Spindle enabling signal	ENB
F001#7	Read end signal	MA
F002#1	Rapid feed signal	RPDO
F002#4	Program restart signal	SRNMV
F002#6	Cutting feed signal	CUT
F002#7	Dry run check signal	MDRN
F003#0	Incremental feed selection signal	MINC
F003#1	MPG feed selection signal	MH
F003#2	Manual continuous feed selection signal	MJ
F003#3	Select manual data input signal	MMDI
F003#4	Select DNC run signal	MRMT
F003#5	Select automatic run signal	MMEM
F003#6	Memory edit selection signal	MEDT
F003#7	Machine zero return detection signal	MZRO
F004#0	Jump optional block detection signal	MBDT
F004#1	All-axes machine lock signal	MMLK
F004#3	Single block signal	MSBK
F004#4	Auxiliary function lock signal	MAFL
F004#5	Manual reference point return signal	MREF
F007#0	Auxiliary function strobe signal	MF
F007#2	Spindle speed strobe signal	SF
F007#3	Tool function strobe signal	TF
F007#5	No.2 M function strobe signal	MF2
F007#6	No. 3M function strobe signal	MF3
F009#4	M decoding signal	DM30
F009#5		DM02
F009#6		DM01
F009#7		DM00
F010~F013	Auxiliary function signal	M00-M31
F014~F017	No. 2M function signal	M100~M131
F018~F021	No. 3M function signal	M200~M231

F022~F025	Spindle function signal	S00~S31
F026~F029	Tool function signal	T00~T31
F034#0~#2	Gear selection signal(output)	GR1O,GR2O,GR3O
F045#0	Spindle alarm signal	SPALM
F045#1	Spindle zero-speed signal	SST
F045#3	Speed arrival signal	SAR
F045#7	Orientation completion signal	ORAR
F054~F057	Output signal used to user macro program	UO000~UO031
F060#0	External data read completion	EREND
F060#1	External data search completion	ERSND
F060#2	External data read cancel	ESCAN
F061#0	B-axis release signal	BUCLP
F061#1	B axis clamp signal	BCLP
F062#7	Signal for reaching the required number of workpiece	PRTSF
F065#0	Spindle rotation direction signal	RGSPP
F70#0~F71#7	Position switch signal	PSW01-PSW16
F076#3	Speed/position switch completion	VPO
F094	Reference point return end signal	ZP1~ZP5
F096	2nd reference point return end signal	ZP21~ZP24
F098	3rd reference point return end signal	ZP31~ZP34
F100	4th 2nd reference point return end signal	ZP41~AP44
F102	Axis moving signal	MV1~MV5
F106	Axis movement direction signal	MVD1~MVD5
F120	Reference point creation signal	ZRF1~ZRF5
F124	Travel limit arrival signal	+OT0~+OT4
F126	Travel limit arrival signal	-OT0~-OT4
F226~F229	Output signal used to macro program	UO100~UO131
F230~F233		UO200~UO231
F234~F237		UO300~UO331
G codes	Address	Signal name
G000~G003	External data input data signal	ED0~ED31
G004#3	Completion signal	FIN
G004#4	No. 2M function end signal	MFIN2
G004#5	No. 3M f unction end signal	MFIN3
G005#0	Auxiliary function end signal	MFIN
G005#6	Auxiliary function lock signal	AFL
G006#0	Program restart signal	SRN
G006#4	Override cancel signal	OVC
G006#6	Skip signal	JUMPP
G007#1	Start lock signal	STLK
G007#2	Automatic run start signal	ST
G008#0	All-axes interlock signal	***IT**

G008#4	Emergency stop signal	***ESP**
G008#5	Feed pause signal	***SP**
G008#2	Optional stop signal(add)	SOP
G008#6	Reset & tap rewinding signal	RRW
G008#7	External reset signal	ERS
G010~G011	Manual feedrate override signal	JV0~JV15
G012	Feedrate override signal	FV0~FV7
G013#0 ~G013#6	External data input address signal	EA0~EA6
G013#7	External data read signal	ESTB
G014#0,#1	Rapid feedrate override signal	ROV1,ROV2
G018#0~#3	MPG feed axis selection signal	HS1A~HS1D
G019#4,#5	MPG feed movement selection signal(incremental feed signal)	MP1,MP2
G019#6	Safety speed selection for feed	FVL
G019#7	Manual rapid feed selection signal	RT
G028#1-#2	Gear selection signal(input)	GR1,GR2,
G029#4	Spindle speed arrival signal	SAR
G029#5	Spindle orientation signal	SOR
G29#6	Spindle stop signal	***SSTP**
G030	Spindle speed override signal	SOV0~SOV7
G033#5	Spindle motor command polar selection signal	SGN
G033#6	Spindle motor command polar selection signal	SSIN
G033#7	Spindle motor command selection signal	SIND
G043#0~#2	Mode selection signal	MD1,MD2,MD4
G043#4	Step run selection signal	INC
G044#0	Jump optional block signal	BDT
G044#1	All-axes machine lock signal	MLK
G046#1	Single block signal	SBK
G046#7	Dry run signal	DRN
G054~G057	Macro call input signal	UI000~UI031
G061#0	Rigid tapping signal	RGTAP
G070#4	Spindle CCW rotation	SRVA
G070#5	Spindle CW rotation	SFRA
G070#6	Spindle orientation output signal	ORCM
G096#0~#6	1% rapid feedrate override signal	HROV0~HROV6
G096#7	1% rapid feedrate override select signal	HROV
G100#0~#4	Feed axis and direction signal	+J1~+J5
G102#0~#4	Feed axis and direction signal	-J1~-J5
G108#0~#4	Each axis machine lock signal	MLK1~MLK5
G114#0~#4	Overtravel signal	*+L1~*+L5
G116#0~#4	Overtravel signal	*-L1~*-L5
G118#0~#4	External deceleration signal	*+ED1~*+ED5
G120#0~#4	External deceleration signal	*-ED1~*-ED5
G132#0~ G132#4	Positive interlock of each axis	+MIT1~+MIT5

G134#0~ G134#4	Negative interlock of each axis	-MIT1~-MIT5
G226~G229	Input signal used to macro program	UI100~UI131
G230~G233		UI200~UI231
G234~G237		UI300~UI331

Appendix 2 Signal Address List（Arranged by the address）

2.1 F signal address list（NC-PLC）

F000	OP	SA	STL	SPL				
	Operating	Servo ready	Cycle start	Feed hold				
F001	MA			ENB	DEN		RST	AL
	Preparation ready			Spindle enable	Distribution end		Reset	Alarm
F002	MDRN	CUT		SRNMV			RPDO	
	Dry run	Cutting feed		Program restart			Rapid traverse	
F003	MZRO	MEDIT	MMEM	MRMT	MMDI	MJ	MH	MINC
	Zero return	Edit mode	Auto mode	DNC mode	MDI	Manual	MPG	Incremental feed confirmation
F004				MAFL	MSBK		MMLK	MBDT
				M.S.T lock Confirmation	Step		Machine lock	Skip
F007		MF3	MF2		TF	SF		MF
		3M M function Strobe	2M M function strobe		Tool function strobe	Spindle function strobe		M function strobe
F009	DM00	DM01	DM02	DM30				
	M00 code Output	M01 code output	M02 code output	M30 code output				
F010	M07	M06	M05	M04	M03	M02	M01	M00
	Miscellaneous function code signal							
F011	M15	M14	M13	M12	M11	M10	M09	M08
	Miscellaneous function code signal							
F012	M23	M22	M21	M20	M19	M18	M17	M16
	Miscellaneous function code signal							
F013	M31	M30	M29	M28	M27	M26	M25	M24
	Miscellaneous function code signal							
F014	M107	M106	M105	M104	M103	M102	M101	M100
	2M Miscellaneous function code signal							

F015	M115	M114	M113	M112	M111	M110	M109	M108

2M Miscellaneous function code signal

F016	M123	M122	M121	M120	M119	M118	M117	M116

2M Miscellaneous function code signal

F017	M131	M130	M129	M128	M127	M126	M125	M124

2M Miscellaneous function code signal

F018	M207	M206	M205	M204	M203	M202	M201	M200

2M Miscellaneous function code signal

F019	M215	M214	M213	M212	M211	M210	M209	M208

3M Miscellaneous function code signal

F020	M223	M222	M221	M220	M219	M218	M217	M216

3M Miscellaneous function code signal

F021	M231	M230	M229	M228	M227	M226	M225	M224

3M Miscellaneous function code signal

F022	S07	S06	S05	S04	S03	S02	S01	S00

Spindle function code signal

F023	S15	S14	S13	S12	S11	S10	S09	S08

Spindle function code signal

F024	S23	S22	S21	S20	S19	S18	S17	S16

Spindle function code signal

F025	S31	S30	S29	S28	S27	S26	S25	S24

Spindle function code signal

F026	T07	T06	T05	T04	T03	T02	T01	T00

Tool function code signal

F027	T15	T14	T13	T12	T11	T10	T09	T08

Tool function code signal

F028	T23	T22	T21	T20	T19	T18	T17	T16

Tool function code signal

F029	T31	T30	T29	T28	T27	T26	T25	T24

Tool function code signal

F034						GR3O	GR2O	GR1O
F045	ORAR						SST	SPALM

Gear selection signal output

Spindle orientation completion signal

Spindle zero speed signal

Spindle alarm signal

F054	UO007	UO006	UO005	UO004	UO003	UO002	UO001	UO000

User macro program output signal

F055	UO015	UO014	UO013	UO012	UO011	UO010	UO009	UO008

User macro program output signal

F056	UO023	UO022	UO021	UO020	UO019	UO018	UO017	UO016

User macro program output signal

F057	UO031	UO030	UO029	UO028	UO027	UO026	UO025	UO024

User macro program output signal

F060						ESCAN	ESEND	EREND

External data reading cancelled

External data search completed

External data reading completed

F061					CLP5	UCLP5	CLP4	UCLP4

5 axis clamp

5axis unclamp

4 axis clamp

4axis unclamp

F062		PRSF3	PRSF2	PRSF1				OPTC

Part counting 1 arrived

Part counting 2 arrived

Part counting 3 arrived

Operation panel communication abnormal

F065							RGSPM	RGSPP

Spindle rotation direction signal

F066						RTAP		

Rigid tapping

F070	PSW08	PSW07	PSW06	PSW05	PSW04	PSW03	PSW02	PSW01

Position switch signal

F071	PSW16	PSW15	PSW14	PSW13	PSW12	PSW11	PSW10	PSW09

Position switch signal

F072	PSW24	PSW23	PSW22	PSW21	PSW20	PSW19	PSW18	PSW17

Position switch signal

F073	PSW32	PSW31	PSW30	PSW29	PSW28	PSW27	PSW26	PSW25

Position switch signal

F076					VPO			

Speed position shifting completion

F094				ZP5	ZP4	ZP3	ZP2	ZP1

5th axis returns | 4th axis returns | 3rd axis returns | 2nd axis returns | 1st axis returns

F096				ZP25	ZP24	ZP23	ZP22	ZP21

5th axis to **4th** axis to **3rd** axis to **2nd** axis to **1st** axis to reference point 2

F098				ZP35	ZP34	ZP33	ZP32	ZP31

5th axis to **4th** axis to **3rd** axis to **2nd** axis to **1st** axis to reference point 3

F100				ZP45	ZP44	ZP43	ZP42	ZP41

5th axis to **4th** axis to **3rd** axis to **2nd** axis to **1st** axis to reference point 4

F102				MV5	MV4	MV3	MV2	MV1

Axis 5 | Axis 4 | Axis 3 | Axis 2 | Axis 1 is moving

F106				MVD5	MVD4	MVD3	MVD2	MVD1

Axis 5 | Axis 4 | Axis 3 | Axis 2 | Axis 1 moving direction

F120				ZRF5	ZRF4	ZRF3	ZRF2	ZRF1

Axis 5 | Axis 4 | Axis 3 | Axis 2 | Axis 1 reference point creation

F124				+OT5	+OT4	+OT3	+OT2	+OT1

Axis 5 | Axis 4 | Axis 3 | Axis 2 | Axis 1 positive direction overtravel

F126				-OT5	-OT4	-OT3	-OT2	-OT1

Axis 5 | Axis 4 | Axis 3 | Axis 2 | Axis 1 negative direction overtravel

F155	USK7	USK6	USK5	USK4	USK3	USK2	USK1	USK0

User-defined interface software address

F156	USK15	USK14	USK13	USK12	USK11	USK10	USK9	USK8

User-defined interface software address

F157	USK23	USK22	USK21	USK20	USK19	USK18	USK17	USK16

User-defined interface software address

F158	USK31	USK30	USK29	USK28	USK27	USK26	USK25	USK24

User-defined interface software address

F159	USK39	USK38	USK37	USK36	USK35	USK34	USK33	USK32

User-defined interface software address

F226	UO107	UO106	UO105	UO104	UO103	UO102	UO101	UO100

User macro program output 2

F227	UO115	UO114	UO113	UO112	UO111	UO110	UO109	UO108

User macro program output 2

F228	UO123	UO122	UO121	UO120	UO119	UO118	UO117	UO116

User macro program output 2

F229	UO131	UO130	UO129	UO128	UO127	UO126	UO125	UO124

User macro program output 2

F230	UO207	UO206	UO205	UO204	UO203	UO202	UO201	UO200

User macro program output 3

F231	UO215	UO214	UO213	UO212	UO211	UO210	UO209	UO208

User macro program output 3

F232	UO223	UO222	UO221	UO220	UO219	UO218	UO217	UO216

User macro program output 3

F233	UO231	UO230	UO229	UO228	UO227	UO226	UO225	UO224

User macro program output 3

F234	UO307	UO306	UO305	UO304	UO303	UO302	UO301	UO300

User macro program output 4

F235	UO315	UO314	UO313	UO312	UO311	UO310	UO309	UO308

User macro program output 4

F236	UO323	UO322	UO321	UO320	UO319	UO318	UO317	UO316

User macro program output 4

F237	UO331	UO330	UO329	UO328	UO327	UO326	UO325	UO324

User macro program output 4

2.2 G Signal Address List（PLC -NC）

G000	ED7	ED6	ED5	ED4	ED3	ED2	ED1	ED0

Data signal of external data inputting

G001	ED15	ED14	ED13	ED12	ED11	ED10	ED09	ED8

Data signal of external data inputting

G002	ED23	ED22	ED21	ED20	ED19	ED18	ED17	ED16

Data signal of external data inputting

G003	ED31	ED30	ED29	ED28	ED27	ED26	ED25	ED24

Data signal of external data inputting

G004					FIN			

Completion signal

G005		AFL						

M.S.T lock

G006								SRN

Restart

G007		EXLM				ST		

Stored stroke
Limit 1 shifting

Cycle start

G008	ERS		*SP	*ESP		SOP		*IT

Eternal reset Feed hold Emergency stop Optimal stop All axis interlock

G010	*JV07	*JV06	*JV05	*JV04	*JV03	*JV02	*JV01	*JV00

Manual federate override

G011	*JV15	*JV14	*JV13	*JV12	*JV11	*JV10	*JV09	*JV08

Manual federate override

G012	*FV7	*FV6	*FV5	*FV4	*FV3	*FV2	*FV1	*FV0

Manual federate override

G013	ESTB	EA6	EA5	EA4	EA3	EA2	EA1	EA0

Eternal data reading signal — Address signal of external data inputting

G014		WPC3	WPC2	WPC1			ROV2	ROV1

3# part counting — 2# part counting — 1# part counting — Rapid federate override

G018						HS1C	HS1B	HS1A

MPG axis selection signal

G019	RT	FVL	MP2	MP1				

Manual rapid Selection signal — Feed safety speed selection — MPG override selection signal

G028						GR2	GR1	

Gear selection signal

G029		*SSTP	SOR	SAR				

Spindle stop — Spindle shifting — Speed arrival
Speed selection

G030	SOV7	SOV6	SOV5	SOV4	SOV3	SOV2	SOV1	SOV0

Spindle speed override signal

G033			SGN	SVL				

Spindle command Pole selection — Spindle safety speed selection

G043				INC		MD4	MD2	MD1

Step mode — Mode selection signal

G044							MLK	BDT

Machine lock — Skip signal

G046	DRN						SBK	

Dry run — Step

G054	UI007	UI006	UI005	UI004	UI003	UI002	UI001	UI000

User macro program inputting signal

G055	UI015	UI014	UI013	UI012	UI011	UI010	UI009	UI008

User macro program inputting signal

G056

UI023	UI022	UI021	UI020	UI019	UI018	UI017	UI016

User macro program inputting signal

G057

UI031	UI030	UI029	UI028	UI027	UI026	UI025	UI024

User macro program inputting signal

G061

							RGTAP

Rigid tapping

G070

	ORCM						

Spindle orientation output signal

G096

HROV	HROV6	HROV5	HROV4	HROV3	HROV2	HROV1	HROV0

1% rapid override selection

1% rapid federate override signal

G100

			+J5	+J4	+J3	+J2	+J1

The 5th axis The 4th The 3rd The 2nd The 1st
Positive selection

G102

			-J	-J	-J	-J	-J1

The 5th axis The 4th The 3rd The 2nd The 1st
negative selection

G114

			*+L5	*+L4	*+L3	*+L2	*+L1

The 5th axis The 4th The 3rd The 2nd The 1st
Positive overtravel

G116

			*-L5	*-L4	*-L3	*-L2	*-L1

The 5th axis The 4th The 3rd The 2nd The 1st
negative overtravel

G118

			*+ED5	*+ED4	*+ED3	*+ED2	*+ED1

The 5th axis The 4th The 3rd The 2nd The 1st
Positive external deceleration

G120

			*-ED5	*-ED4	*-ED3	*-ED2	*-ED1

The 5th axis The 4th The 3rd The 2nd The 1st
negative external deceleration

G132

			+MIT5	+MIT4	+MIT3	+MIT2	+MIT1

The 5th axis The 4th The 3rd The 2nd The 1st
Positive direction interlock

G134

			-MIT5	-MIT4	-MIT3	-MIT2	-MIT1

The 5th axis negative direction interlock | The 4th | The 3rd | The 2nd | The 1st

G226

UI107	UI106	UI105	UI104	UI103	UI102	UI101	UI100

User macro program input signal 2

G227

UI115	UI114	UI113	UI112	UI111	UI110	UI109	UI108

User macro program input signal 2

G228

UI123	UI122	UI121	UI120	UI119	UI118	UI117	UI116

User macro program input signal 2

G229

UI131	UI130	UI129	UI128	UI127	UI126	UI125	UI124

User macro program input signal 2

G230

UI207	UI206	UI205	UI204	UI203	UI202	UI201	UI200

User macro program input signal 3

G231

UI215	UI214	UI213	UI212	UI211	UI210	UI209	UI208

User macro program input signal 3

G232

UI223	UI222	UI221	UI220	UI219	UI218	UI217	UI216

User macro program input signal 3

G233

UI231	UI230	UI229	UI228	UI227	UI226	UI225	UI224

User macro program input signal 3

G234

UI307	UI306	UI305	UI304	UI303	UI302	UI301	UI300

User macro program input signal 4

G235

UI315	UI314	UI313	UI312	UI311	UI310	UI309	UI308

User macro program input signal 4

G236

UI323	UI322	UI321	UI320	UI319	UI318	UI317	UI316

User macro program input signal 4

G237

UI331	UI330	UI329	UI328	UI327	UI326	UI325	UI324

User macro program input signal 4

Appendix 3 Factory Standard PLC Function Debugging (MV1.35 turntable style tool machine)

This section is only used to system built-in standard PLC, which matches three to five axes NC boring and milling machine and turntable style tool machine center. Please refer to the manual provided by the machine tool manufacturer when the machine tool manufacturer does not have the ladder diagram.

3.1 Address Definition

3.1.1 Input X Address by Standard Machine Operation Panel Key

Attached list 3-1

X address input by operation panel	**PLC** address	**X address input by operation panel**	**PLC** address
Auto mode	X0.0	-Z	X3.5
Edit mode	X0.1	-4	X3.6
MDI mode	X0.2	-5	X3.7
Manual mode	X0.3	Spindle CCW	X4.0
MPG mode	X0.4	Spindle stop	X4.1
Zero return	X0.5	Spindle CW	X4.2
DNC mode	X0.6	Spindle exact stop	X4.3
USER1	X0.7	F0 / 0.001	X4.4
Step	X1.0	25% / 0.01	X4.5
Skip	X1.1	50% / 0.1	X4.6
Machine lock	X1.2	100% / 1	X4.7
M.S.T lock	X1.3		
+4	X1.4		
+Z	X1.5		
-Y	X1.6	Tool magazine forward	X5.3
+5	X1.7	Tool retraction	X5.4
Dry run	X2.0	Tool change	X5.5
Overtravel release	X2.1	Magazine CCW	X5.6
Optional stop	X2.2	Magazine zero point return	X5.7
Program restart	X2.3	Clamp / Release	X6.0
+X	X2.4	USR2	X6.1
Rapid traverse	X2.5	USR3	X6.2
Step	X2.6	USR4	X6.3

-X	X2.7	Feed hold	X6.4
Cooling	X3.0	Cycle start	X6.5
Lubrication	X3.1	Magazine CW	X6.6
Chip removal	X3.2	Feedrate override, indicating max. gear 24 （without output lamp）	X7.0-X7.4
Lamp	X3.3	Spindle override，indicating max. gear 16 （without output lamp）	X8.0-X8.3
+Y	X3.4	Emergency stop	X8.4

MPG Signal Input X Address

Attached list 3-2

MPG signal input	PLC Address
STP （MPG emergency stop signal）	X121.0
X100（MPG federate override）	X120.0
X10 （MPG federate override）	X120.1
X1 （MPG federate override）	X120.2
H5 （5 axis selection）	X120.3
H4 （4 axis selection）	X120.4
HZ （Z axis selection）	X120.5
HY （Y axis selection）	X120.6
HX （X axis selection）	X120.7

3.1.3 Standard Machine Operation Panel Output Y Address

Attached list 3-3

Operation panel output	**PLC address**	**Operation panel output**	**PLC address**
Auto key lamp	Y0.0	-Z key lamp	Y3.5
Edit key lamp	Y0.1	-4 key lamp	Y3.6
MDI key lamp	Y0.2	-5 key lamp	Y3.7
Manual key lamp	Y0.3	Spindle CCW key lamp	Y4.0
MPG key lamp	Y0.4	Spindle stop key lamp	Y4.1
Zero point return lamp	Y0.5	Spindle CW key lamp	Y4.2
DNC key lamp	Y0.6	Spindle exact stop key lamp	Y4.3
USER1key lamp	Y0.7	F0 / 0.001 key lamp	Y4.4

Step key lamp	Y1.0	25% / 0.01 key lamp	Y4.5
Skip key lamp	Y1.1	50% / 0.1 key lamp	Y4.6
Machine lock key lamp	Y1.2	100% / 1 key lamp	Y4.7
M.S.T lock key lamp	Y1.3	Magazine forward lamp	Y5.3
+4 key lamp	Y1.4	Magazine retraction lamp	Y5.4
+Z key lamp	Y1.5	Tool changing key lamp	Y5.5
-Y key lamp	Y1.6	Tool magazine CCW key lamp	Y5.6
+5 key lamp	Y1.7	Tool magazine zero point return lamp	Y5.7
Dry run key lamp	Y2.0	Tool clamp / tool release key lamp	Y6.0
Overtravel release key lamp	Y2.1	USR2 key lamp	Y6.1
Optional stop lamp	Y2.2	USR3 key lamp	Y6.2
Program restart lamp	Y2.3	USR4 key lamp	Y6.3
+X key lamp	Y2.4	Feed hold key lamp	Y6.4
Rapid key lamp	Y2.5	Cycle start kay lamp	Y6.5
Step key lamp	Y2.6	Tool magazine CW key lamp	Y6.6
-X key lamp	Y2.7	X axis reference point lamp	Y7.0
Cooling key lamp	Y3.0	Y axis reference point lamp	Y7.1
Lubrication key lamp	Y3.1	Z axis reference point lamp	Y7.2
Chip removal key lamp	Y3.2	4 axis reference point lamp	Y7.3
Working lamp	Y3.3	5 axis reference point lamp	Y7.4
+Y key lamp	Y3.4	System alarm	Y7.6

3.1.4 MPG Signal Output Y Address

MPG signal lamp output	Y120.0

3.1.5 I/O Unit Input X Address

Terminal No.	PLC address	Signal name	Signal function	I / O
X9.0	X9.0	*DECX（fixed）	X axis reference return deceleration signal , normally closed contact are valid when they are off.	I
X9.1	X9.1	*DECY （ fixed ）	Y axis reference return deceleration signal , normally closed contact are valid when they are off.	I
X9.2	X9.2	*DECZ （ fixed ）	Z axis reference return deceleration signal , normally closed contact are valid when they are off.	I
X9.3	X9.3	*DEC4 （ fixed ）	The 4th reference return deceleration signal , normally closed contact are valid when they are off.	I
X9.4	X9.4	*DEC5 （ fixed ）	The 5th reference return deceleration signal , normally closed contact are valid when they are off.	I
X9.5	X9.5			
X9.6	X9.6	*+LX	X axis positive limit, normally closed contact are valid when they are off.	I
X9.7	X9.7	*-LX	X axis negative limit, normally closed contact are valid when they are off.	I
X10.0	X10.0	*+LY	Y axis positive limit, normally closed contact are valid when they are off.	I
X10.1	X10.1	*-LY	Y axis negative limit, normally closed contact are valid when they are off.	I
X10.2	X10.2	*+LZ	Z axis positive limit, normally closed contact are valid when they are off.	I
X10.3	X10.3	*-LZ）	Z axis negative limit, normally closed contact are valid when they are off.	I
X10.4	X10.4	*+L4	The 4th axis positive limit, normally closed contact are valid when they are off.	I
X10.5	X10.5	*-L4	The 4th axis negative limit, normally closed contact are valid when they are off.	I
X10.6	X10.6	*+L5	The 5th axis positive limit, normally closed contact are valid when they are off.	I
X10.7	X10.7	*-L5	The 5th axis negative limit, normally closed contact are valid when they are off.	I
X11.0	X11.0	LUB.ALM	Lubrication pump alarm input signal	I
X11.1	X11.1	DOOR.ALM	Protection door alarm input signal	I
X11.2	X11.2	HYPUP.ALM	Hydraulic pump overload input signal	I
X11.3	X11.3	AIRPRE.ALM	Pressure detection alarm input signal	I
X11.4	X11.4	CLNM.ALM	Cooling pump motor overload alarm input signal	I
X11.5	X11.5	CHIPM.ALM	Chip removal motor overload input signal	I
X11.6	X11.6	MGPLA.ALM	Cutting disk motor overload input signal	I
X11.7	X11.7	ARM.ALM	Arm motor overload input signal	I

Terminal No.	PLC address	Signal name	Signal function		I / O
X12.0	X12.0	GR1.M	Spindle gear 1(in-position detection)		I
X12.1	X12.1	GR2.M	Spindle gear 2 (in-position detection)		I
X12.2	X12.2				I
X12.3	X12.3	SPCL.ALM	Spindle oil cooler alarm input signal		I
X12.4	X12.4	LUBPRE.I	Lubrication pump pressure detection		I
X12.5	X12.5	TRLCK.I	Tool release (in-position detection)		I
X12.6	X12.6	TCLCK.I	Tool clamp (in-position detection)		I
X12.7	X12.7	CKST	Release/clamp tool key		I
X13.0	X13.0	4UCLPI	The 4th axis releases in-position detection		I
X13.1	X13.1	4CLPI	The 4th axis clamps in-position detection		I
X13.2	X13.2				I
X13.3	X13.3				I
X13.4	X13.4	5UCLPI	The 5th axis releases in-position detection		I
X13.5	X13.5	5CLPI	The 5th axis clamps in-position detection		I
X13.6	X13.6				I
X13.7	X13.7				I
X14.0	X14.0	T-BARE		Cutting disk in-position (mechanical arm)	I
X14.1	X14.1	TZER.I	Tool magazine zero point return signal		I
X14.2	X14.2	TCN.I	Tool count signal		I
X14.3	X14.3	TFN.I	Magazine forwards in-position (turntable style)	Cutter set is vertical (mechanical arm)	I
X14.4	X14.4	TBK.I	Magazine retracts in-position (turntable style)	Cutter set is horizontal (mechanical arm)	I
X14.5	X14.5	ATCZERO.I		ATC reference point（mechanical arm）	I
X14.6	X14.6	ATCHOLD.I		ATC holds tool（mechanical arm）	I
X14.7	X14.7	ATCSTOP.I		ATC stop（mechanical arm）	I

Note: There are group X15.0—X15.7 and group X16.0—X16.7, two groups of input points 16 in total for users.

3.1.6 I/O Unit Output Y Address

Terminal No.	PLC address	Signal name	Signal function		I/O
Y8.0	Y8.0	CLN.O	Cooling (coolant) pump output		O
Y8.1	Y8.1	MGFR.O	Magazine forward (turntable style)	Cutter set is vertical (mechanical arm)	O
Y8.2	Y8.2	MGBK.O	Magazine retraction (turntable style)	Cutter set is vertical (mechanical arm)	O
Y8.3	Y8.3				O
Y8.4	Y8.4	TRL.M	Tool release (output signal)		O
Y8.5	Y8.5	MGCW.O	Magazine CW (output signal)		O
Y8.6	Y8.6	MGCCW.O	Magazine CCW (output signal)		O
Y8.7	Y8.7	ARM.O	Mechanical arm motor (output signal)		O
Y9.0	Y9.0	LUB.O	Lubricant pump output		O
Y9.1	Y9.1	OR.T	Overtravel release		O
Y9.2	Y9.2	M03	Spindle CW (output signal)		O
Y9.3	Y9.3	M04	Spindle CCW (output signal)		O
Y9.4	Y9.4	RED.L	Red light signal		O
Y9.5	Y9.5	YEL. L	Yellow light output		O
Y9.6	Y9.6	GRE. L	Green light output		O
Y9.7	Y9.7	HYPR.O	Hydraulic oil pump output		O
Y10.0	Y10.0	GR1.O	Spindle gear 1 output		O
Y10.1	Y10.1	GR2.O	Spindle gear 2 output		O
Y10.2	Y10.2				O
Y10.3	Y10.3				O
Y10.4	Y10.4				
Y10.5	Y10.5				
Y10.6	Y10.6				
Y10.7	Y10.7				
Y11.0	Y11.0	LAMP.L	Machine work lamp		O
Y11.1	Y11.1	CLEAN.O	Chip removal pump output		O
Y11.2	Y11.2				O
Y11.3	Y11.3	CLN-2.O	Workpiece air output		O
Y11.4	Y11.4	CHIP	Chip removal output		O
Y11.5	Y11.5				O
Y11.6	Y11.6				O
Y11.7	Y11.7				O

Y12.0	Y12.0	4UCLPO	The 4th axis release output	O
Y12.1	Y12.1	4-CLPO	The 4th axis clamp output	O
Y12.2	Y12.2	5UCLPO	The 5th axis release output	O
Y12.3	Y12.3	5-CLPO	The 5th axis clamp output	O
Y12.4	Y12.4			
Y12.5	Y12.5			
Y12.6	Y12.6			
Y12.7	Y12.7			
Y13.0	Y13.0			
Y13.1	Y13.1			
Y13.2	Y13.2			
Y13.3	Y13.3			
Y13.4	Y13.4			
Y13.5	Y13.5			
Y13.6	Y13.6			
Y13.7	Y13.7			

3.2 Parameter Setting

K parameter setting

Address	Function	Set value：0	Set value：1	Remarks
K0.6	Tool magazine function	Off	On	
K1.1	Lubricant pressure detection function	Off	On	
K1.2	Protection door alarm function	Off	On	
K2.0	External Mpg function	Off	On	
K2.2	Rapid transverse and federate override are controlled simultaneously	Off	On	
K2.5	Magazine forward / retract valve selection	Use two valves	Use a valve	Used by turntable style tool machine
K2.7	Spindle control analog voltage selection	±10V	0～10V	
K3.1	Mechanical arm jog mode selection	Continuous jog	Step jog	Used by arm magazine
K3.4	Z negative direction limit during tool changing	Off	On	Used by turntable style tool machine

K3.6	Tool magazine debugging state	Retraction	In feed	
K4.0	The 4th axis release/clamp device selection	No	Yes	
K4.1	The 5th axis release/clamp device selection	No	Yes	
K4.2	The 4th/5th axis release/clamp signal selection	With release /clamp signals	Only with clamp signal	
K4.4	The 4th axis automatic release function	Off	On	If it is on during moving operation, it clamps after moving.
K4.5	The 5th axis automatic release function	Off	On	
K4.6	The 4th axis automatic clamp function	Off	On	
K4.7	The 5th axis automatic clamp function	Off	On	
K7.1	Whether to detect spindle zero speed signal during tool releasing	Detect	Not detect	
K7.2	Spindle two-gear M type shift function	No	Yes	
K7.3	Whether to detect release/clamp tool signal	Detect	Not detect	
K7.5	Spindle is off or not when protection door alarm occurs	No	Yes	
K9.0	All axis hardware overtravel detection	Detect	Not detect	
K9.4	The 4th axis overtravel alarm detection	Detect	Not detect	
K9.5	The 5th axis overtravel alarm detection	Detect	Not detect	
K11.0	Lubrication alarm input signal	Connect to normally open contact	Connect to normally closed contact	
K11.1	Protection door alarm input signal	Connect to normally open contact	Connect to normally closed contact	
K11.2	Hydraulic alarm input signal	Connect to normally open contact	Connect to normally closed contact	
K11.3	Pressure alarm input signal	Connect to normally open contact	Connect to normally closed contact	
K11.4	Cooling pump alarm input signal	Connect to normally open contact	Connect to normally closed contact	
K11.5	Chip removal alarm input signal	Connect to normally open contact	Connect to normally closed contact	
K11.6	Magazine cutting disk alarm input signal	Connect to normally open contact	Connect to normally closed contact	

K11.7	Mechanical arm alarm input signal	Connect to normally open contact	Connect to normally closed contact	

C parameter setting

Counter No.	Current value	Preset value	Function
1	Lubricant pump oil supply time (second)	Lubricant pump stop interval time (minute)	
2	Magazine tool changing position cutter set number	Magazine cutter number	

Note: Before the version MV1.34, PLC uses T parameter to set lubricant time. T6+T7 is total stop time of the automatic lubricant pump, T8 is oil supply time which in ms.

3.3 M Code List

M code	Function	M code	Function
M00	Program stop	M19	Spindle orientation
M01	Selection stop	M29	Rigid tapping
M02	Program end	M30	Program end and return
M03	Spindle CCW	M37	Detecting probe blowing on
M04	Spindle CW	M38	Detecting probe blowing off
M05	Spindle stop	M39	Cancel rigid tapping
M06	Tool change	M54	Spindle tool release
M07	Workpiece blowing cooling	M55	Spindle tool clamp
M08	Cooling pump on	M60	Magazine tool selection （turntable magazine）
M09	Cooling, blowing off	M61	Tool changing condition detection
M10	The 4th axis clamp	M65	Magazine forwards/cutter set is vertical
M11	The 4th axis release	M66	Magazine retracts/ cutter set is horizontal
M20	The 5th axis clamp	M98	Subprogram call
M21	The 5th axis release	M99	Subprogram return or circulation

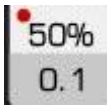
3.4 PLC Function

3.4.1 Basic Function

1) External MPG box function

After fixing external MPG according to the connection diagram, external MPG will be operated automatically. The MPG can be performed by setting parameter K2.0 to 1 or closed by setting parameter K2.0 to 0.

The working lamp turns on when the external MPG axis selection signal is on. Axis positive/negative direction lamp on the machine operation panel lights up means that the axis is controlled by the MPG. When override signal on the external MPG box is on, the corresponding movement volume is indicated on the machine operation panel.

MPG box override key	×1	×10	×100	×1
Operation panel indication				
Corresponding movement	0.001	0.01	0.1	1

Note: The emergency button is invalid when the external MPG function is not used.

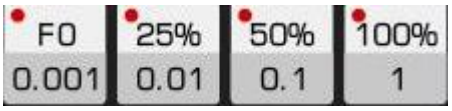
Control signal:

Address	Function	Remarks
X121.0	MPG emergency stop	
X120.0	X100（MPG federate override）	
X120.1	X10（MPG federate override）	
X120.2	X1（MPG federate override）	
X120.3	5 axis selection	
X120.4	4 axis selection	
X120.5	Z axis selection	
X120.6	Y axis selection	
X120.7	X axis selection	
Y120.7	MPG signal lamp output	
K2.0	External MPG function	0：off 1：on

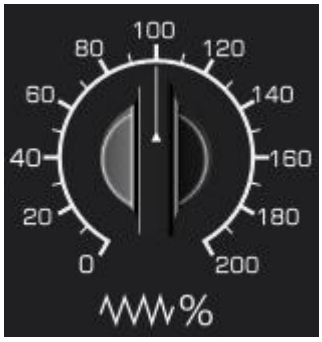
2) Rapid federate override selection

When the parameter K2.2 is set to 0, manual rapid traverse and G00 override are controlled by F0, 25%, 50%, 100% keys on the operation panel. Override initial value is 50%. When the parameter K2.2 is set to 1, manual rapid traverse and G00 override are controlled

by cutting feed switch on the panel. The switch also control cutting feed and rapid traverse override. The range of the rapid traverse override is 0%~100%, adjustment incremental is 10%. The override is handled as 100% when it exceeds 100%, and the cutting federate is handled as the actual selected value, K2.2=1.



K2.2=0



K2.2=1

3) Spindle control analog voltage pole selection

When K2.7=0, spindle control analog voltage output is ±10V.

When K2.7=1, spindle control analog voltage output is 0~10V.

4) The 4th, 5th turntable control signal

It is used for releasing/clamping signal control for different unit manufacturer.

When there is a releasing/clamping unit on the 4th, 5th turntable, set K4.0=1, K4.1=1.

When there is not a releasing/clamping unit on the 4th, 5th turntable, set K4.0=0、K4.1=0.

When there is a releasing/clamping detection unit on the 4th, 5th turntable:

Set K4.0=1, K4.1=1, K4.2=0 when there are releasing and clamping detection units.

Set K4.0=1, K4.1=1, K4.2=1 when there is only clamping detection switch.

M codes（M10、M11、M20、M21）controls the releasing/clamping of the 4th, 5th axis turntable. Or it can be realized by setting parameter, it releases before axis moving, and clamps after the moving.

K4.4=1 when the 4th axis releases automatically, K4.4=0 when the 4th axis does not release.

K4.5=1 when the 5th axis releases automatically, K4.5=0 when the 5th axis does not release.

K4.6=1 when the 4th clamps automatically, K4.6=0 when the 4th axis does not clamp.

K K4.7=1 when the 5th clamps automatically, K4.7=0 when the 5th axis does not clamp.

5) Spindle tool releasing/clamping control

Not to detect the spindle zero speed signal during spindle tool releasing, set K7.1 to 1; set K7.1 to 0 to detect it.

When the spindle does not have tool releasing/clamping switch signal, set K7.3=1; the spindle has the detection switch, set K7.3=0.

6) Hardware overtravel

When all axis hardware overtravel detection is shielded, K9.0=1; K9.0=0 when it is not shielded.

When the 4th axis hardware overtravel, K9.4=1; while the 5th axis hardware overtravel, K9.5=1.

When the 4th axis hardware overtravel is not shielded, K9.4=0, K9.5=0 when the 5th axis hardware overtravel is not shielded.

Note: In order to ensure the machine tool safety, please confirm that hardware overtrave of the machine tool is valid.

7) Three-color control

Control signal

Address	Function	Remarks
Y9.4	Red	The system is in alarm state
Y9.5	Yellow	The system is in operation state
Y9.6	Green	The system is automatically operating

8) Lubrication pump control

1. C1：Preset value set the lubrication pump stop time interval, unit: minute
C1：The current value set the lubrication pump automatic fule supply time, unit : second
C11：The current value display the executed lubrication pump stop interval time, unit: minute

When the current value and the preset value of the C1 are not 0. After C1 preset value is specified, the lubrication pump starts work. If set K1.1 to during lubrication pump operation, the pump stops after setting the current value of the C1. If K1.1 is set to 1, the pump stops one-second delay after the operation of X12.4 pressure switch. If the pressure is not reached after setting the C1 current value, alarm 2032 occurs. The pressure switch is on at the time lubrication pump start up, the alarm 2010 occurs.

2. If K1.1 is set to 1 when manually press down the lubrication key, the pump stops one-second delay after the operation of the X12.4 pressure switch。 When K1.1 is set to 0, and the current of C1 IS NOT 0, the pump stops after the operation of the pump current setting value. When the current value of the C1 is 0, the lubrication pump stops after releasing the lubrication pump.

3. The lubrication pump work time interval is accumulated, and the current accumulated value is saved after power off. It continue to count after reset. When the emergency stop, preset and the current value is set to 0, the accumulative timing stops.

4. The lubrication pump does not output when the emergency stop, reset and lubrication alarm occurs.

5. When the current value of the C11 is bigger than the preset value of C1, the system alarm 2043 occurs. PLC parameter setting error.

6. When the K11.1 is set to 0, the lubrication alarm signal X11.0 is 1 or K11.1 is set 1, lubrication alarm input signal X11.0 is 0, the system alarm 2000 occurs. The lubrication pump does not output when the alarm occurs.

Control signal:

Address	Function	Remark
X3.1	Lubrication key	
Y3.1	Lubrication lamp	
Y9.0	Lubrication pump output	
X11.0	Lubrication alarm input signal	
X12.4	Lubrication pressure detection signal	
K1.1	Whether to detect the lubrication pressure	0：Not detect 1：Detect
K11.0	Lubrication alarm signal selection	0：Normally-open 1：Normally-closed

9) Cooling pump control

1. The cooling pump does not output at the system power on.

2. In any operation mode, the cooling pump output state turns over once when press down the cooling key on the panel once.

3. Control cooling pump M code: M8 cooling pump on, N9 cooling pump off.

4. When cooling pump overload alarm and emergency stop, reset, the output is off.

5. In automatic operation, protection door alarm cooling pump is off when the cooling pump is outputting. The cooling pump is on once the protection door is closed. The cooling pump can be operated manually if there is no protection door alarm.

Control signal:

Address	Function	Remarks
X3.0	Cooling key	
Y3.0	Cooling key lamp	
Y8.0	Cooling pump control output	
X11.4	Cooling pump overload	
K11.4	Cooling alarm signal selection	0：Normally open 1：Normally closed

10) Hydraulic pump control

1. When the system power on and the emergency stop key is released, the hydraulic pump outputs to enter the work state.

2 When the emergency stop key is pressed or hydraulic pump alarms, hydraulic pump is off. It returns to the output state after releasing the alarm and emergency stop key.

Control signal:

Address	Function	Remarks
Y9.7	Cooling pump control output	
X11.2	Hydraulic pump overload	
K11.2	Hydraulic alarm signal selection	0：Normally-open 1：Normally-closed

11) Workpiece air cooling control

1.In any operation mode, when 

key on the panel is pressed workpiece air cooling output state turns over once.

2. Control cooling pump M code: M7 workpiece air cooling on, M9 workpiece air cooling off.

3. Output is off when emergency stop and reset is working.

Control signal:

Address	Function	Remarks
X6.1	Workpiece air cooling key	USER2 key
Y6.1	Workpiece air cooling lamp	USER2 key
Y11.3	Workpiece air cooling control output	

12) Protection door alarm control

1. The protection door function is valid when the parameter K1.2 is set to 1.

2. When the program is cycle started in auto or DNC mode, the system alarms if the protection is open.

3. Protection door alarm signal: 1001 the door is not closed, please close the protection door before starting the machine tool.

4. The program execution is stopped when the protection door alarm occurs. Close the door and press the cycle start key to perform the program.

5. Whether to close the spindle when PLC parameter K7.5 selection alarm occurs. If selected spindle off, the spindle continue to run after selecting the spindle off.

6. If open the protection door in the mode except auto or DNC mode, the alarm does not occur but the max. speed and the max. federate are limited.

The spindle speed limit NC parameter: N5118, maximum federate limit NC parameter: N1260.

Control signal:

Address	Function	Remarks
X11.1	Protection door alarm input signal	
K1.2	Protection door alarm function	0：on 1：off
K11.1	Protection door alarm signal inverts	0：normally-open 1：normally-closed

3.4.2 Turntable Type Magazine Debugging

1) Related parameter to the magazine

Set K0.6=1 when the machine with a magazine, set K0.6=0 if there is no magazine.

There only one forward valve controls tool forward and retraction, set K2.5=1. Set K2.5=0 if there are two valves.

If Z negative-direction position limitation function is on during tool changing, set K3.4=1, if it is off, set K3.4=0. When using Z negative limitation function, it is necessary to set position switch function in the system, the setting is as follows: 2401#3SWI=1, 2500=3, 2532=1, 2564= the position where 1mm after the Z axis 2nd reference point during tool changing. During tool changing, Z axis negative direction position switch controls Z axis negative moving range when the magazine does not in retraction position.

Set K3.6=1 when enter to the tool debugging state. Set K3.6=0 after retracting the debugging mode.

Counter C parameter setting:

Preset value in the counter C2 sets the magazine total tool number. The current value sets the cutting disk number of the current tool changing.

Note：The magazine action can be controlled by the key on the panel or moving the feed axis slowly when the magazine does not at retraction position. Because part interlock is released by the debugging, please operate it with caution.

2) Operation procedures for tooling changing of the turntable type magazine

1. After executing M6 Txx instruction, see if the program judgment instruction tool number meets the requirements, tool changes if meets the requirements.
2. Z axis returns to the 1st reference point.
3. X, Y axes return to the 1st reference point.
4. Z axis returns to the 2nd reference point and the spindle orientation is performed.
5. Magazine forwards and clamps the tool of the current spindle.
6. The cylinder hits the tool and tools on the spindle is released.
7. Z axis returns to the 1st reference point, and return the tools back to the magazine.
8. Turn the cutter to the new position at the cutting disk.
9. Z axis returns to the 2nd reference point. Clamp the tool after inputting the cutter to the spindle.
10. The magazine retracts and the tool changing is completed.

2) Tool changing program of turntable type magazine

```
O9001                          （Tool changing macro program）
N010IF[#1000EQ1]GOTO190        （Turn the tool to the end when it is in the spindle,
machine lock, miscellaneous lock）
N012M61                        (Tool changing condition detection)
N020G15G40G49G80G69G50         （Cancel the module）
N030G50.1X0Y0Z0                （Cancel the module）
N040#1=#4003                   （Save G90/G91module）
N060G28G91Z0                   （Z axis returns to the 1st reference point）
N070G28X0Y0                    （X, Y axes returns to the 1st reference point）
N080G30G91Z0M19                （Z axis returns to the 2nd reference point and orientation
is performed）
N090M65                        （Tool magazine forwards）
N100M54                        （Spindle releases the cutter）
N110G4X0.3                     （Delay 0.3S）
N120G28G91Z0                   （Z axis lifts and returns to the 1st reference point）
N130M60                        （Select new cutter）
N140G04X0.2                    （Delay 0.2S）
N150G30G91Z0                   （Z axis returns to the 2nd reference point）
N160M55                        （Spindle clamps the tool）
N170M66                        （Tool magazine retracts）
N180G#1M05                     （Return to the module and release the orientation）
N190M99                        （Tool changing ends）
%
```

Note: In the radius compensation, the compensation is cancelled automatically. Set the related tool D code again after tool changing.

3.5 PLC Alarm Signals

Address	Alarm No.	Alarm signal	Remarks
A0.0	2000	The lubrication pump is short of oil, pressure or the pump has fault	
A0.1	1001	The door is not closed, please close the protection door and start the machine again	
A0.2	1002	Hydraulic motor overload, check the motor load and the wire	
A0.3	2003	Air pressure low alarm, air pressure is low or pressure detection circuit faults	
A0.4	1004	Cooling pump motor overload, check the motor load and the circuit	
A0.5	1005	Chip removal motor overload, check the motor load and the wire	
A0.6	1006	Cutting disk overload, check the motor load and the wire	
A1.0	2010	Lubrication pressure switch state is wrong	
A1.1	1011	Releasing/ clamping signal X12.5, X12.6 is wrong	
A1.2	1012	Releasing or clamping tool instruction execution overtime	
A1.3	2013	Tool releasing is not allowed during the spindle rotation	
A1.4	1014	The cutting disk does not rotate after executing tool selection instruction or it is performed without counting signal	
A1.5	1015	Tool selection instruction overtime	
A1.6	1016	Tool magazine counting switch stop position is wrong	
A1.7	1017	The magazine forward or retraction instruction execution overtime	
A2.0	1020	Tool magazine forward or retraction signal X14.3, X14.4 is wrong	
A2.1	2021	The spindle is not allowed to rotate when the tool magazine does not at safety position	
A2.2	2022	The spindle is not allowed to rotate when the spindle releasing/clamping signal is abnormal	
A2.3	1023	The instruction tool number is not in the allowed range, that is, tool number is 0 or it exceeds the total tool number	
A2.4	1024	The spindle cooling system alarms, alarm signal address X12.3	
A2.5	1025	The operation communication is interrupted	
A2.6	2026	k3.6 debugging state is on, please operate with caution, and turn it off after completion	
A2.7	1027	When the magazine does not at retraction position, the	

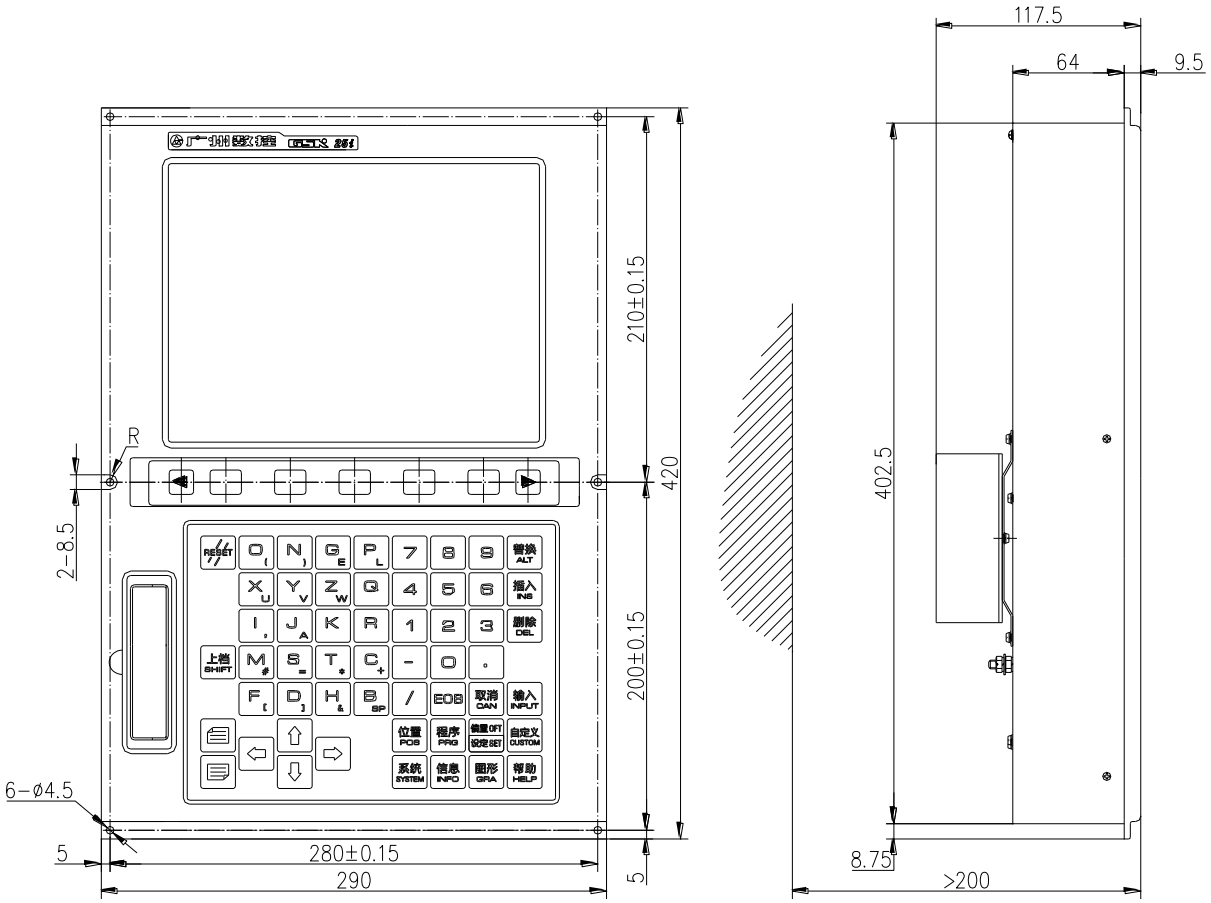
		spindle can not be moved if the tool is not released or stop exactly	
A3.0	1030	Specified the undefined M code	
A3.1	2031	The spindle can not be operated manually in rigid tapping state	
A3.2	2032	The lubrication pump does not reach the preset pressure in the specified working time.	
A3.3	1033	Instruction T is not specified when executing M06 tool changing instruction	
A3.4	1034	The 4th axis is not released	
A3.5	1035	The 5th axis is not released	
A3.6	1036	Z axis moves out of the limit range when the magazine does not at the retraction position	
A3.7	1037	The turntable is not clamped	
A4.0	1040	The spindle orientation overtime	
A4.1	1041	Spindle VP shifting action overtime	
A4.2	1042	Tool change can not be started when the magazine does not at retraction position	
A4.3	2043	PLC parameter setting is wrong	
A4.4	1044	Spindle gear shift overtime	
A4.5	2045	Spindle gear signal is wrong	

Note：

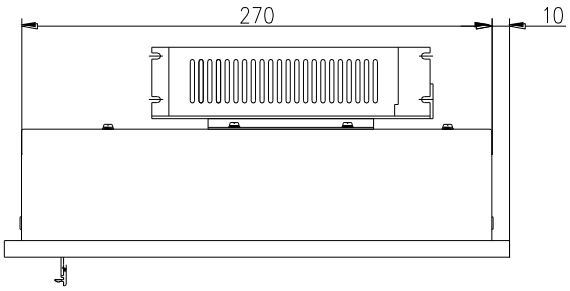
If PLC alarm in the range 1000~1999 occurs, the system displays the alarm state and the automatic operation stops. It is a prompt message if in the range 2000~2999, and the automatic operation state will not be affected.

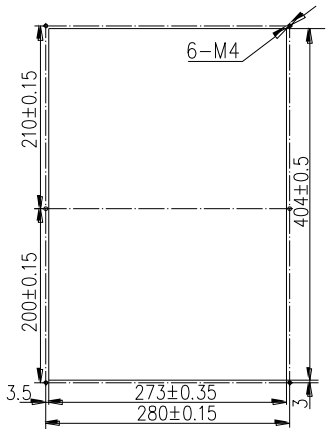
Appendix 4 Installation Dimension Drawing

4.1 GSK25i-M installation dimension (vertical 10.4 inch color screen)

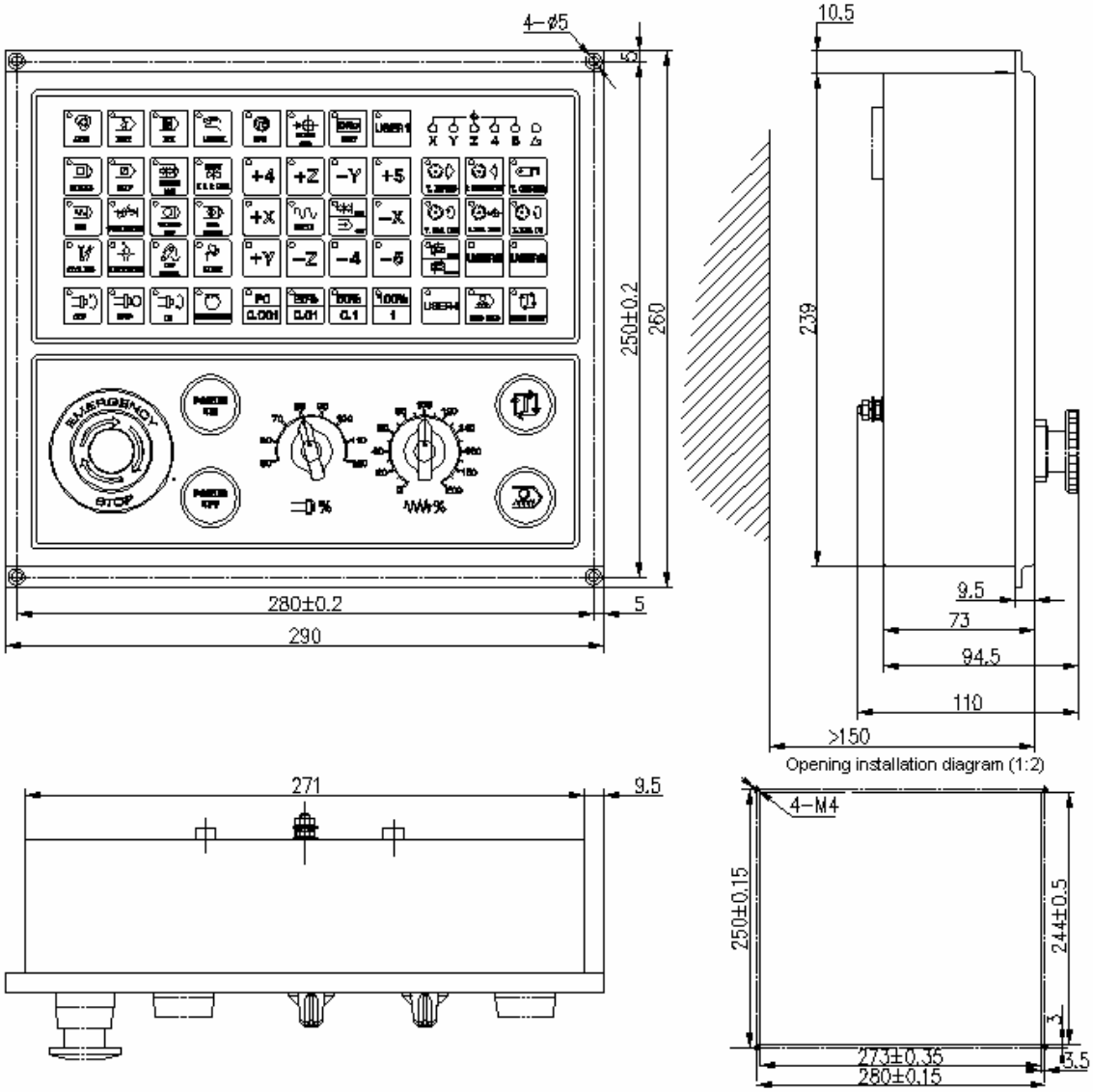


Opening installation diagram (1:2)

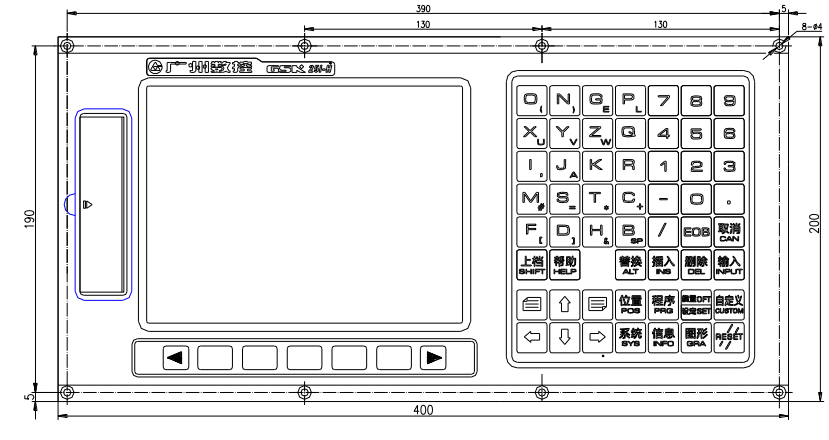


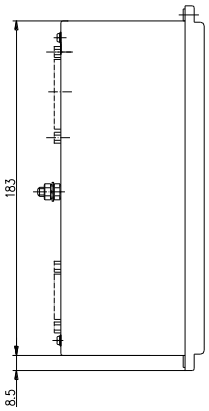


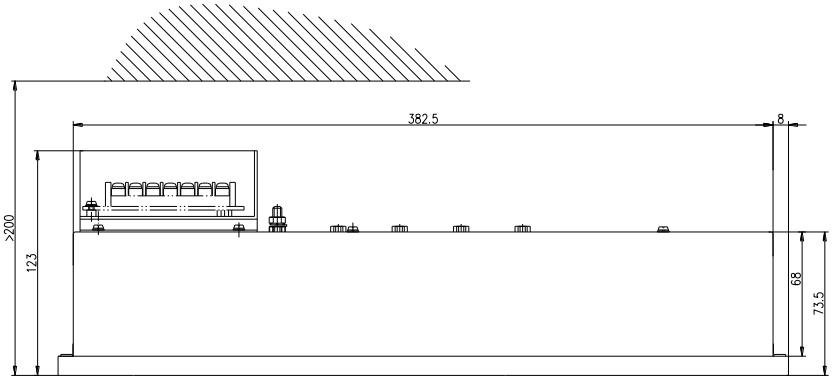
4.2 GSK25i-M operation panel installation dimension (vertical)



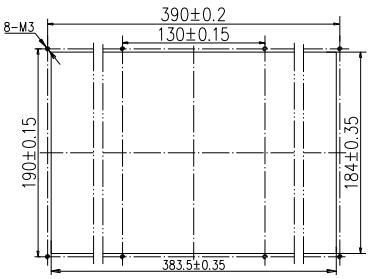
4.3 GSK25i-MH box installation dimension (horizontal 8.4 inch color screen)





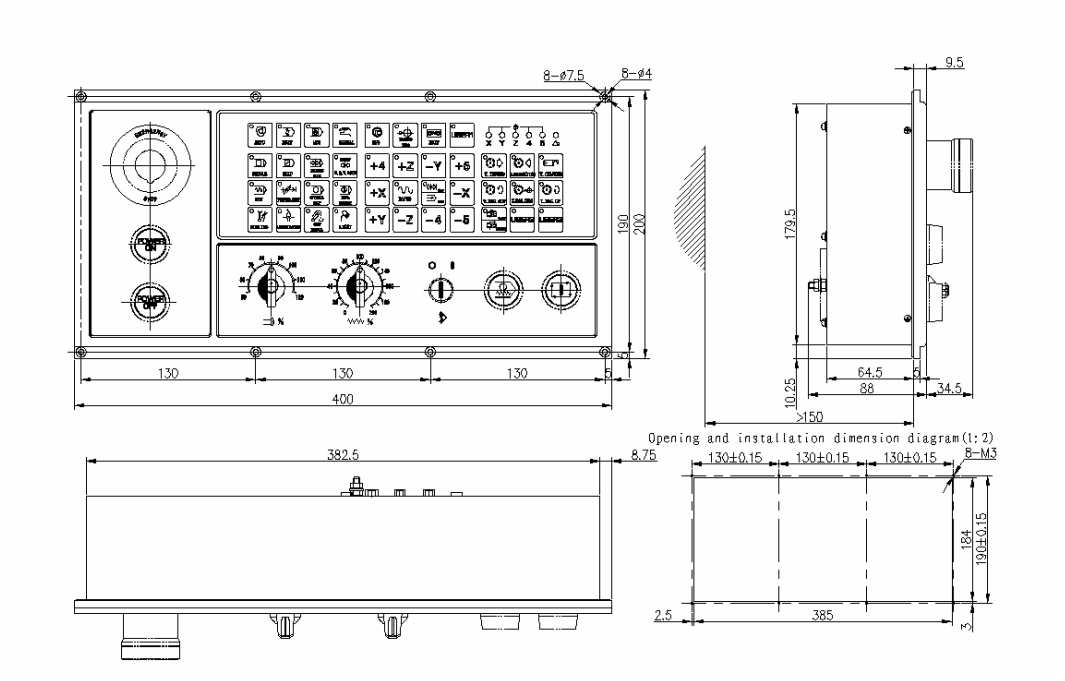


Opening installation diagram

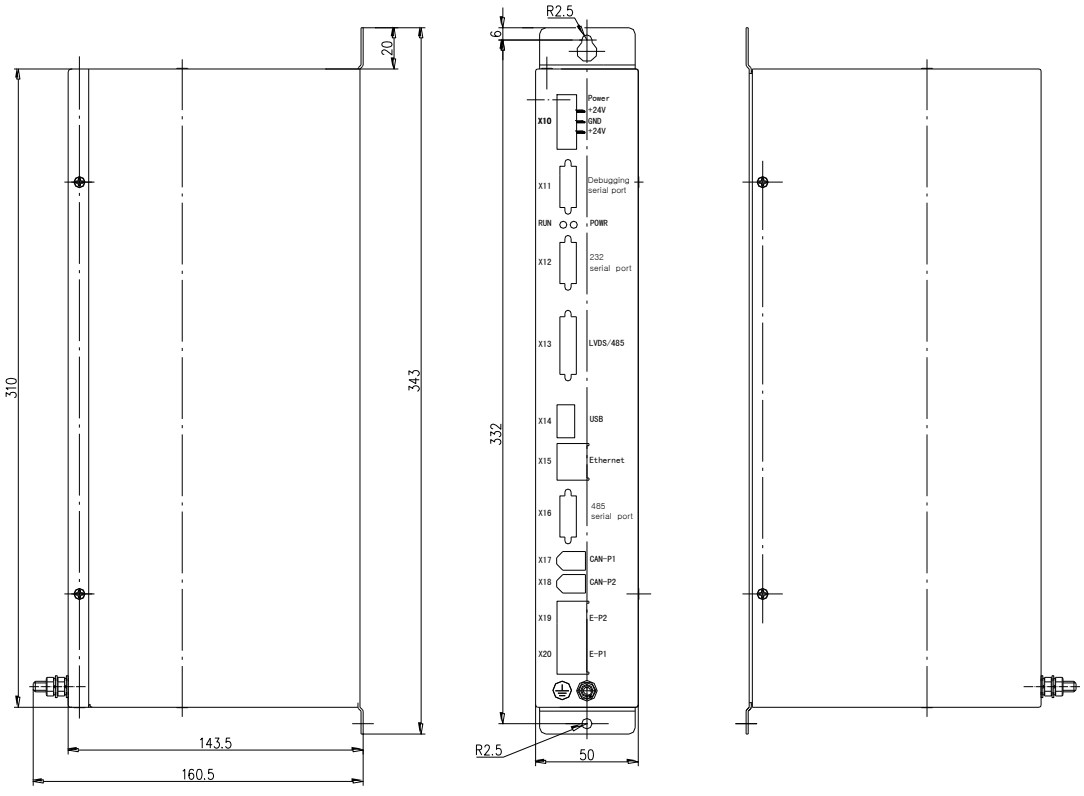


Part 4 Appendix

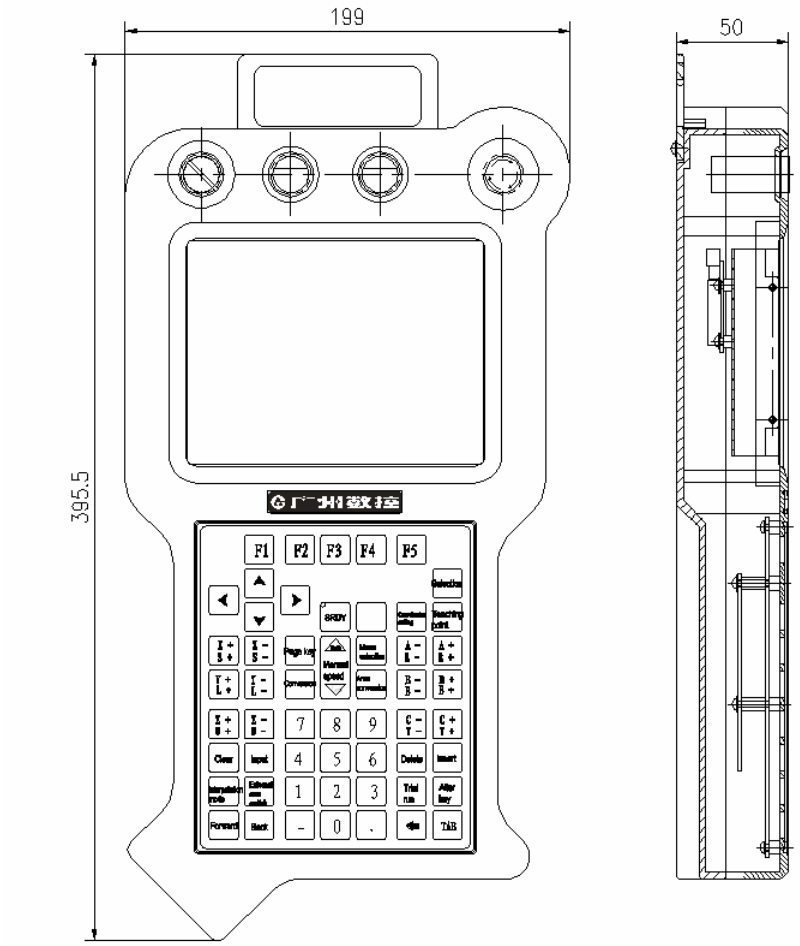
4.4 GSK25i-MH operation panel installation dimension (horizontal)



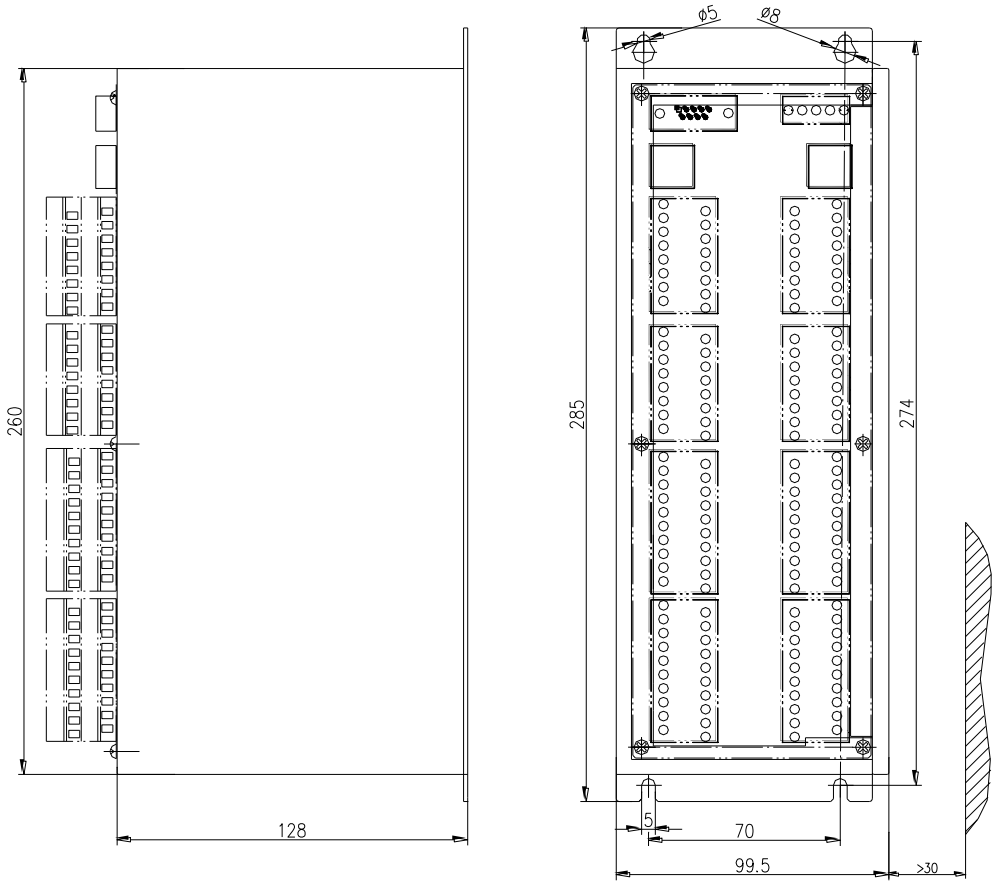
4.5 GSK25i-Ra box installation dimension



4.6 GSK25i-Ra teaching box dimension



4.7 I/O unit installation dimension



4.8 External position detection unit GSK25i-PDU installation dimension