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.

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

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

Please read this manual carefully before operation！

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 unallowed.
- 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, insolation 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.

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Ⅰ PLC PROGRAMMING

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 execute 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 ***Chapter 4.***

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 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(see Fig.2-1). Thus each relay operates in sequence which can be written as a ladder diagram. (Programmed sequence).

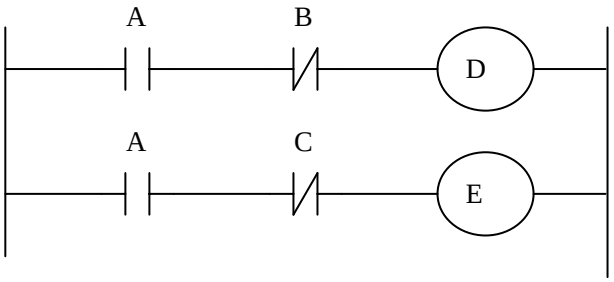


Fig. 2-1(a)

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

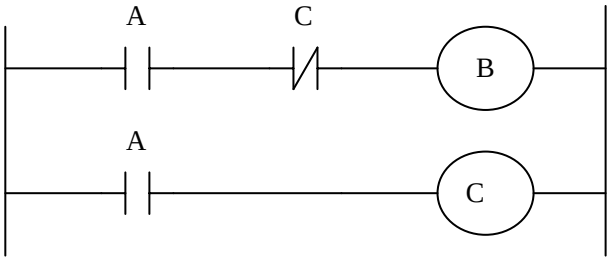


Fig. 2-1(b)

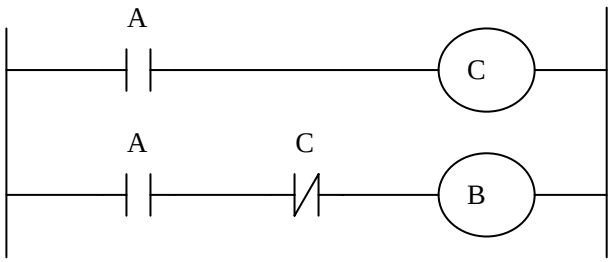


Fig.2-1(c)

(1) Relay circuit

In Fig. 2.1(b) and (c), the operations are the same. Turning on A turns on B and C. Turning on C turns off B.(2) PLC program

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 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).

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 V part, and every part is executed every 8ms.

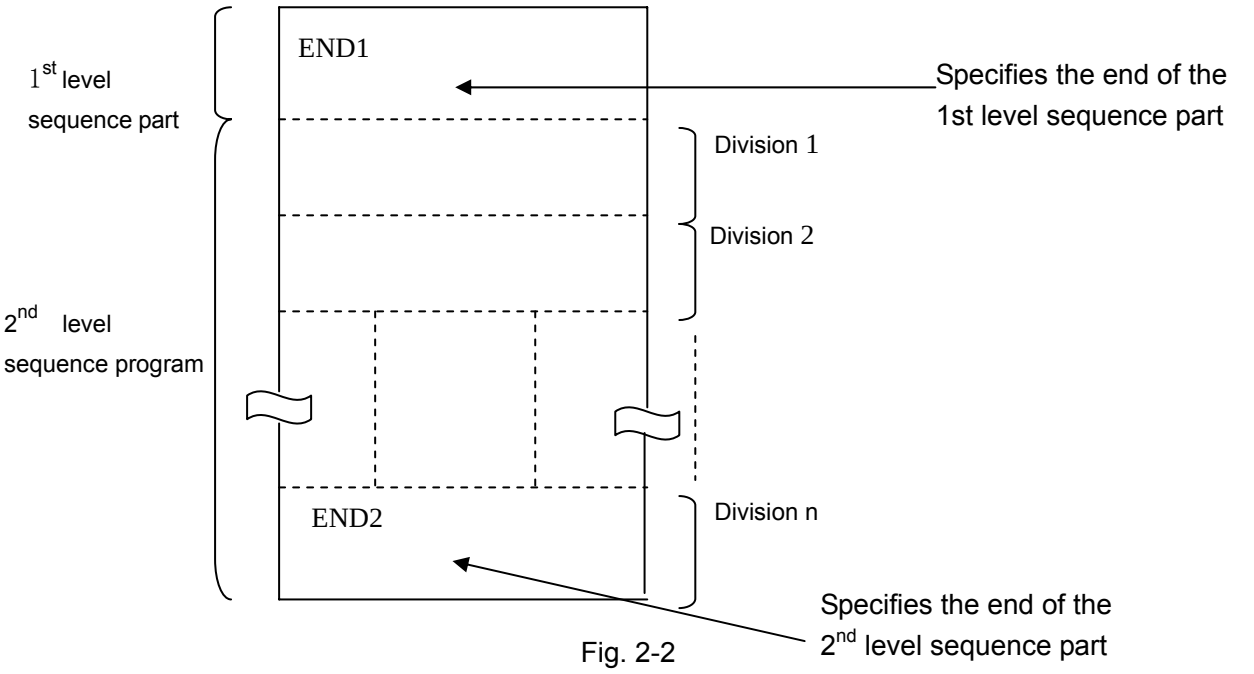


Fig. 2-2

GSK 25i PLC is solely executed in PLC-AVR single chip, and the first 1ms of each 8ms is the communication time of CNC reading or writing PLC data. The fifth 1ms is the time that the PLC receives the system control signal（F, X）and uploads the control result data（G, Y parameter）to the external I/O interface（X, Y）, except for the time responding the interruption to exchange the data, the PLC executes the ladder operation at the rest time.

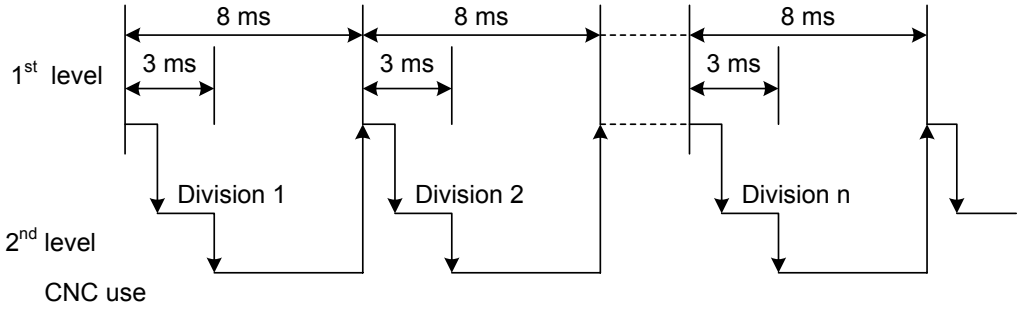


Fig. 2-3

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 4ms 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.

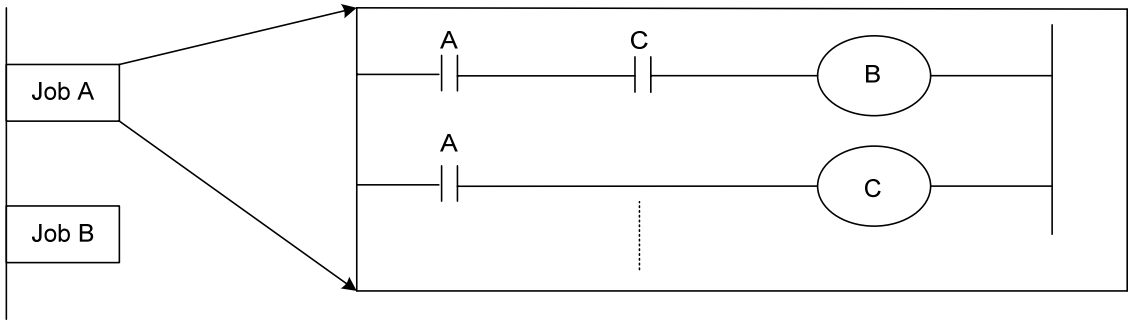


Fig. 2-4

2) Nesting

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

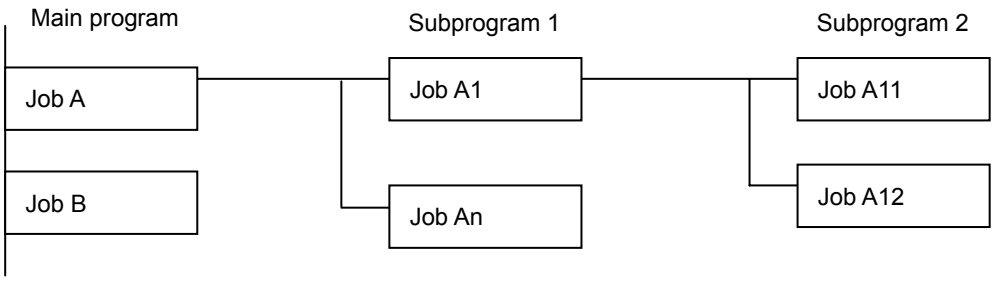


Fig. 2-5

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 jumpped.

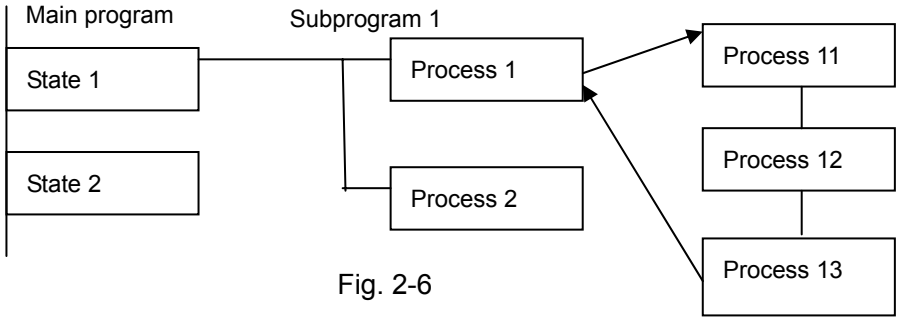


Fig. 2-6

2.5 Processing I/O (input/output) signals

Input signal processing:

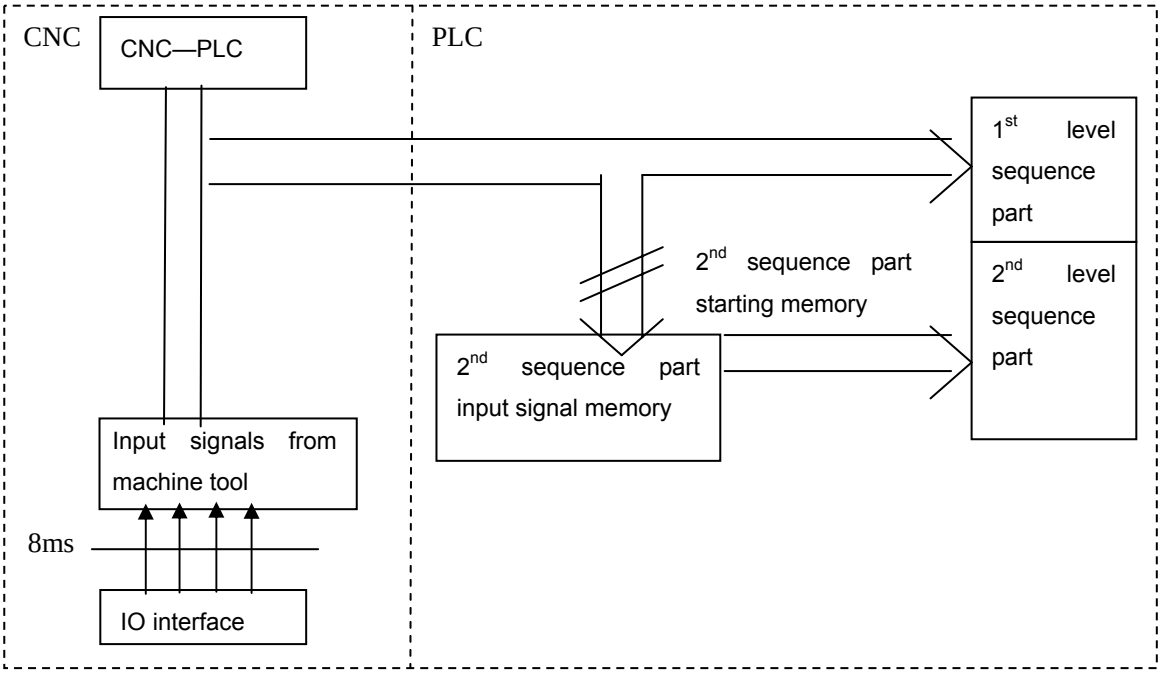


Fig. 2-7

Output signal processing:

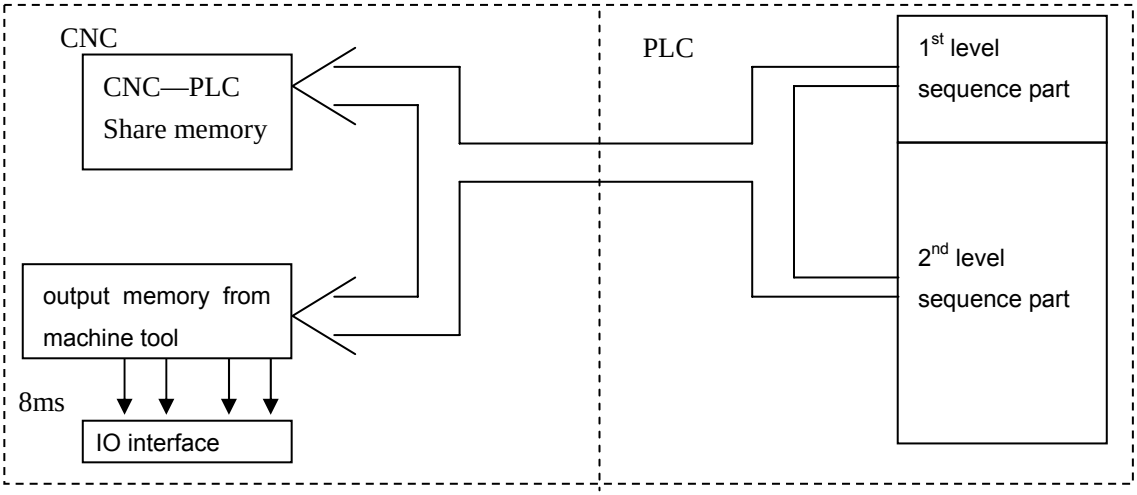


Fig. 2-8

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.

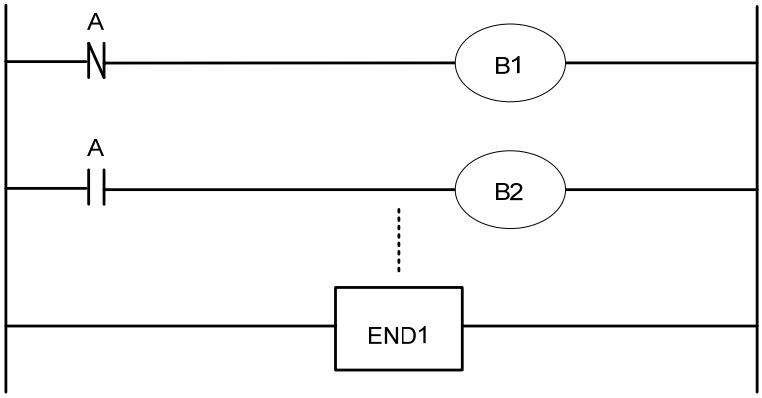


Fig. 2-9

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.

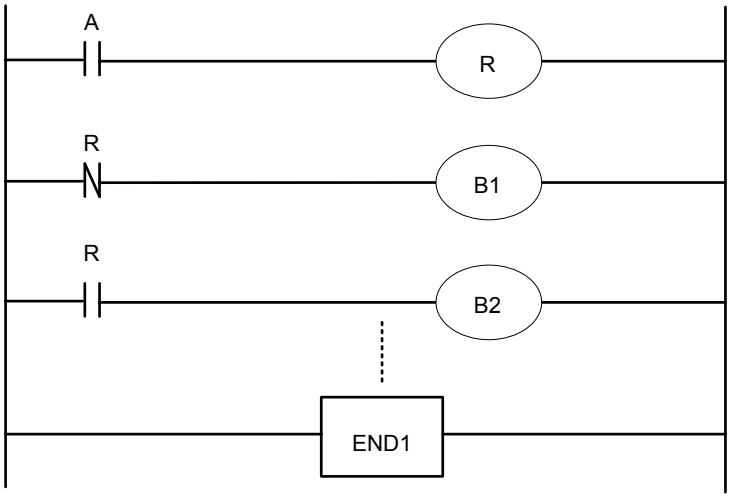


Fig. 2-10

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. 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.

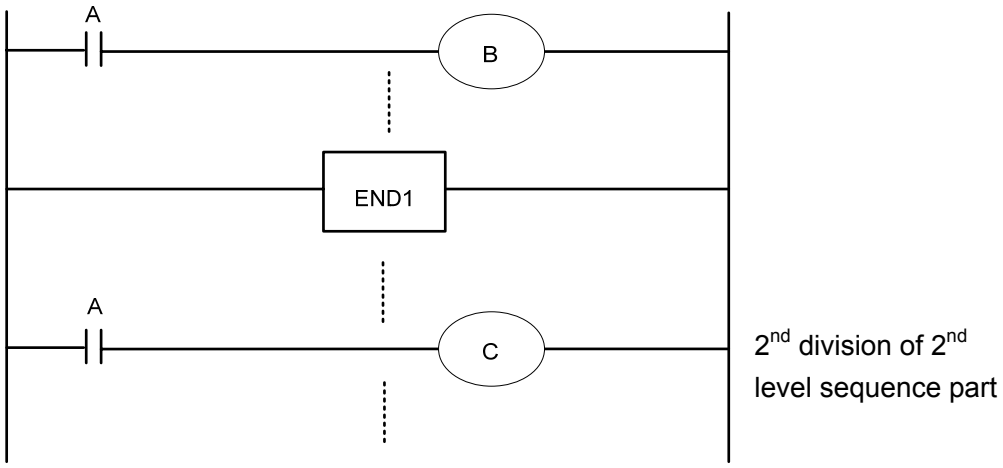


Fig. 2-11

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 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：

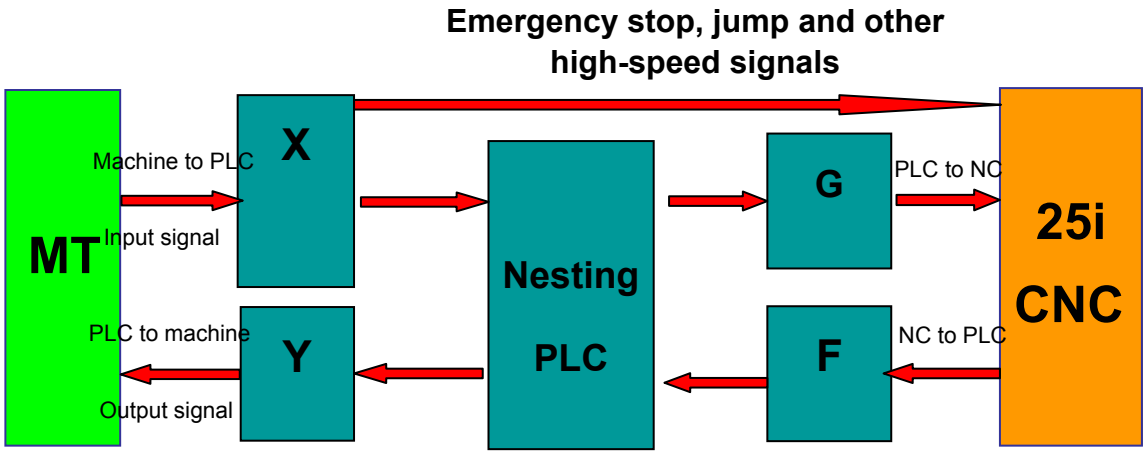


Fig. 3-1

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 two:

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 CW	X4.0
MPG mode	X0.4	Spindle stop	X4.1
Zero mode	X0.5	Spindle CCW	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 infeed	X5.3
+5	X1.7	Tool retraction	X5.4
Dry run	X2.0	Tool change manipulator	X5.5
Overtravel release	X2.1	Tool magazine CW	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, and their signal definitions cannot be changed by user.

Addresses and indicators are as follows 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 CW key indicator	Y4.0
MPG key indicator	Y0.4	Spindle stop key indicator	Y4.1
Zero key indicator	Y0.5	Spindle CCW key indicator	Y4.2
DNC key indicaor	Y0.6	Spindle orientation key indicator	Y4.3
USER1 key indicaor	Y0.7	F0／0.001 key indicator	Y4.4
Single block key indicaor	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 CW 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 CCW 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）

A ddresses 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.

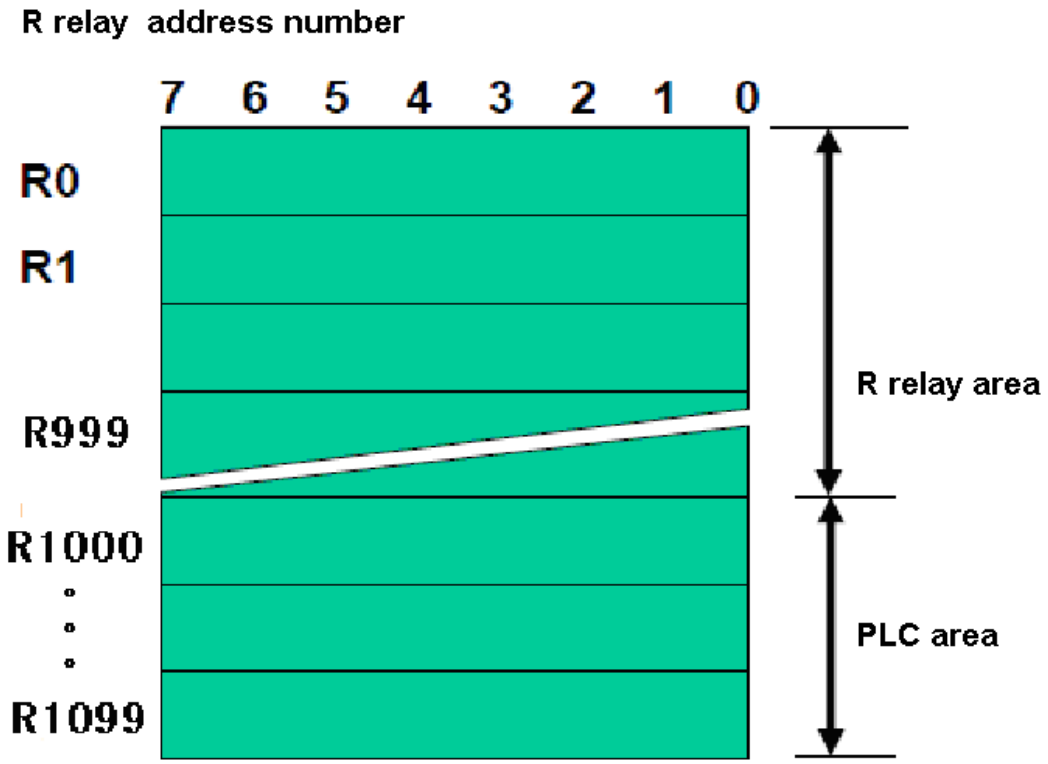


Fig. 3-2

Note: the addresses from R1000 are used by PLC. For example: ADDB, SUBB, COMB 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

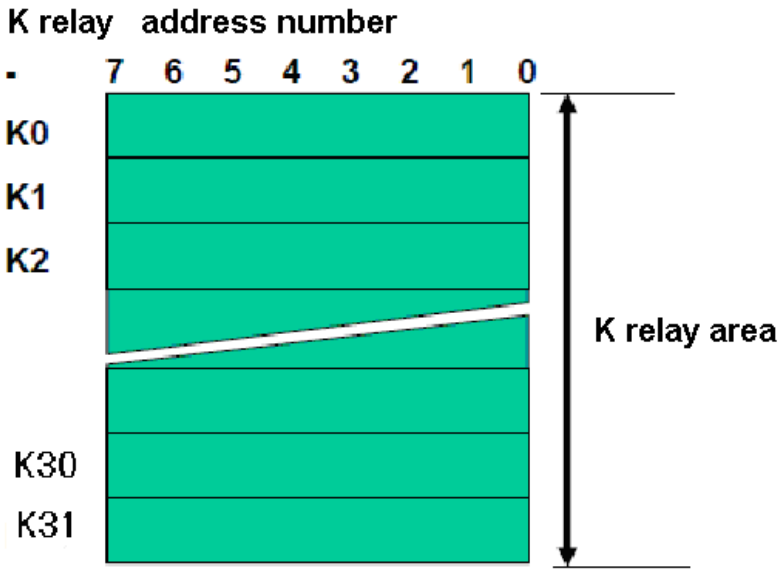


Fig. 3-4

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.

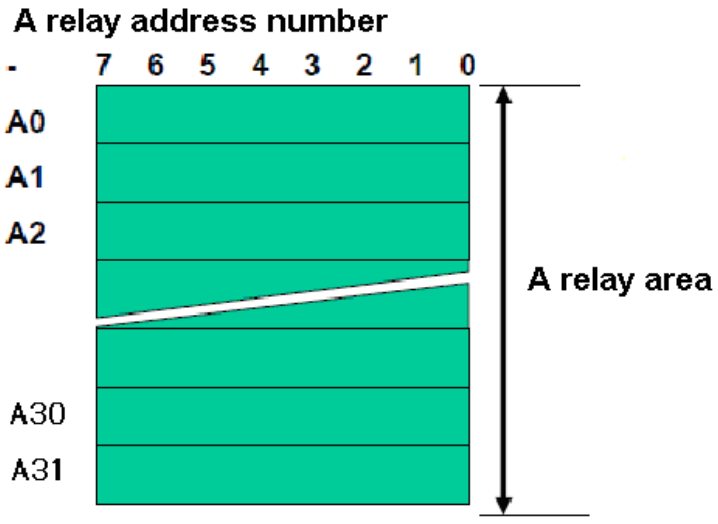


Fig. 3-5

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.

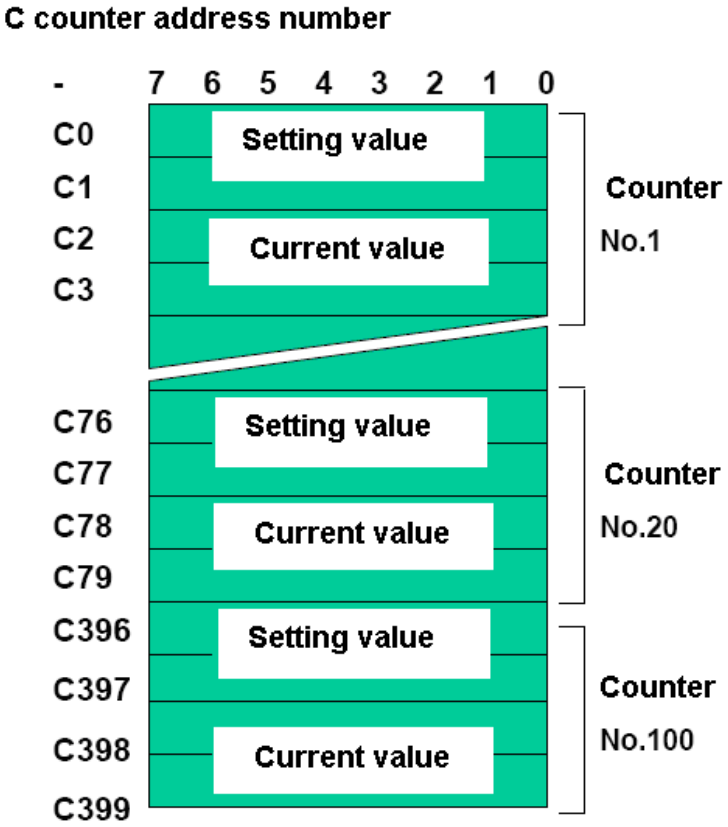


Fig. 3-6

3.9 Address of timer （T）

Type: 200 bytes.

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

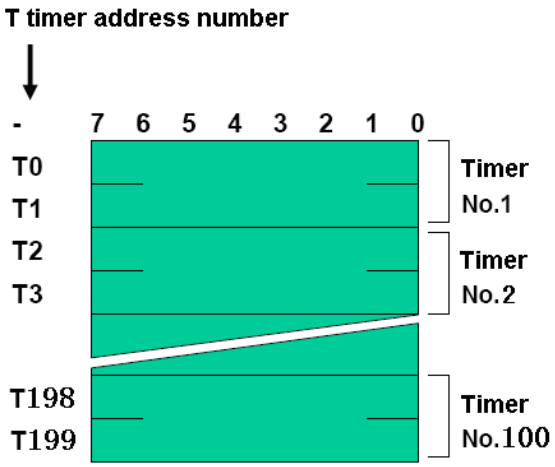


Fig. 3-7

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.

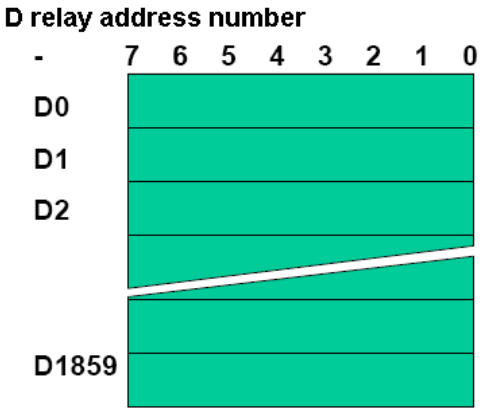


Fig. 3-8

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 jump destination subprogram labels and SP instruction subprogram labels in CALL 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 RD, 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 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.
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）:

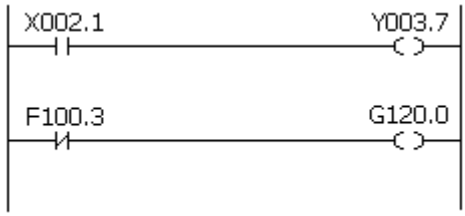
Table 4-2

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:

- WRT, WRT. NOT are the output relay, internal relay instructions. They cannot be used to input relay.
- The parallel WRT 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）:

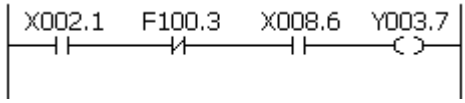
Table 4-3

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):

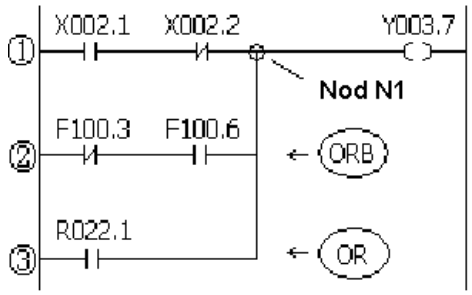
Table 4-5

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 LD 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 OR, AND relationship between circuit blocks.

4.5 ANB command

Instruction and function（Table 4-6）：

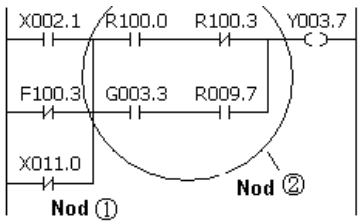
Table 4-6

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 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

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. It can write 500 steps.

Format:

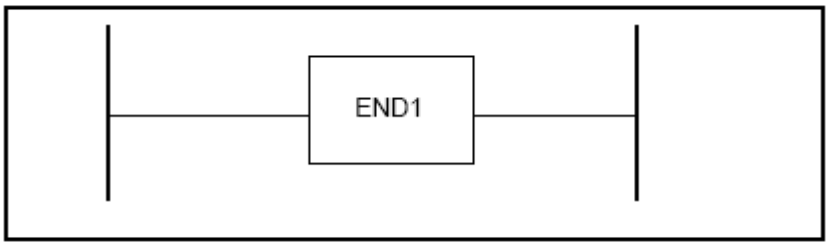


Fig. 5-1

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:

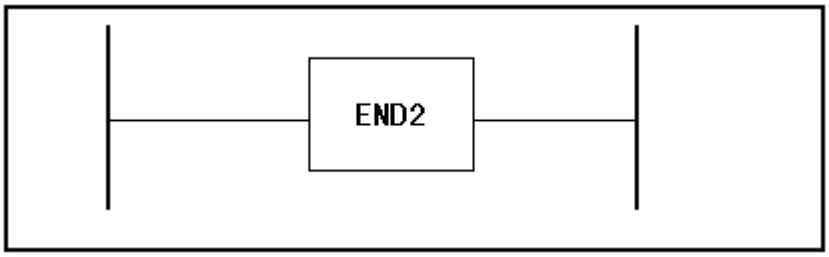


Fig. 5-2

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:

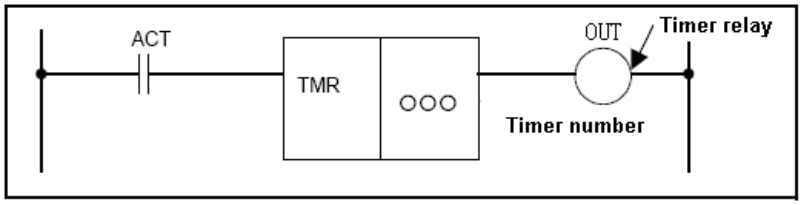


Fig. 5-3

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:

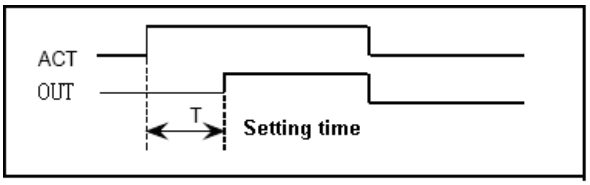


Fig. 5-4

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：

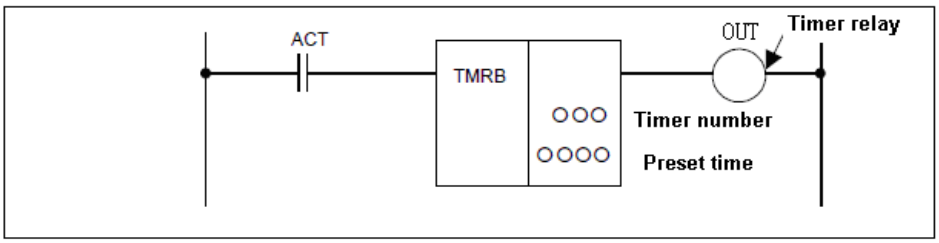


Fig. 5-5

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 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:

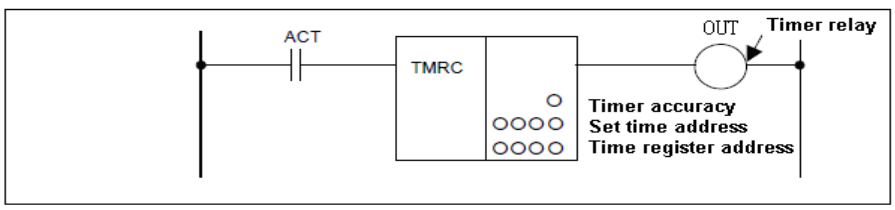


Fig. 5-6

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:

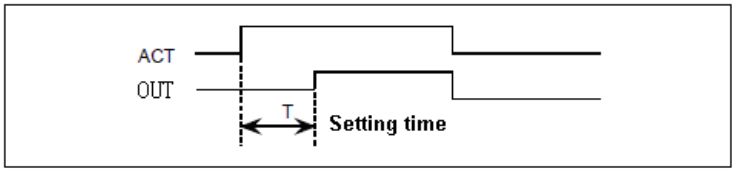


Fig. 5-7

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：

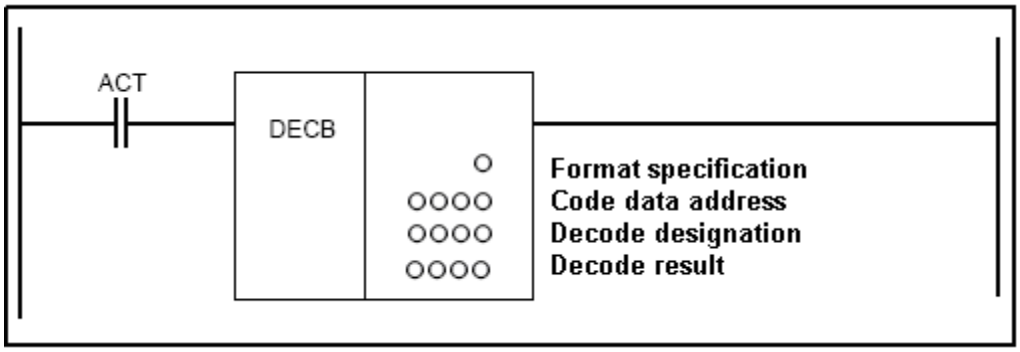


Fig. 5-8

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 8 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：

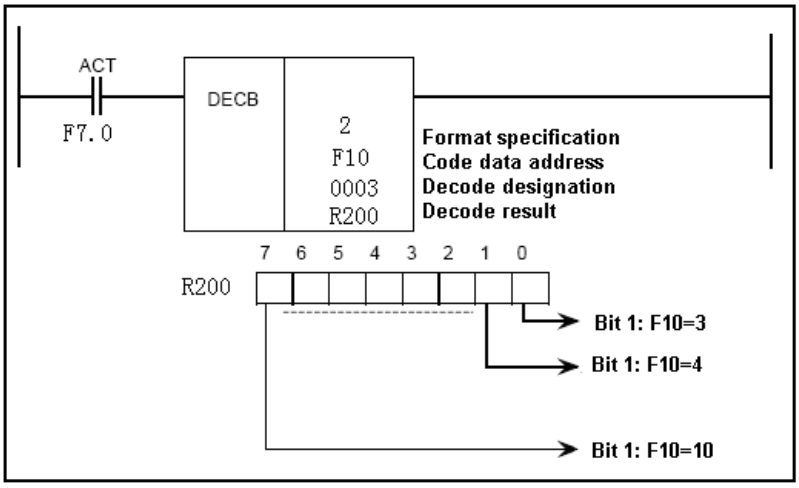


Fig. 5-9

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：

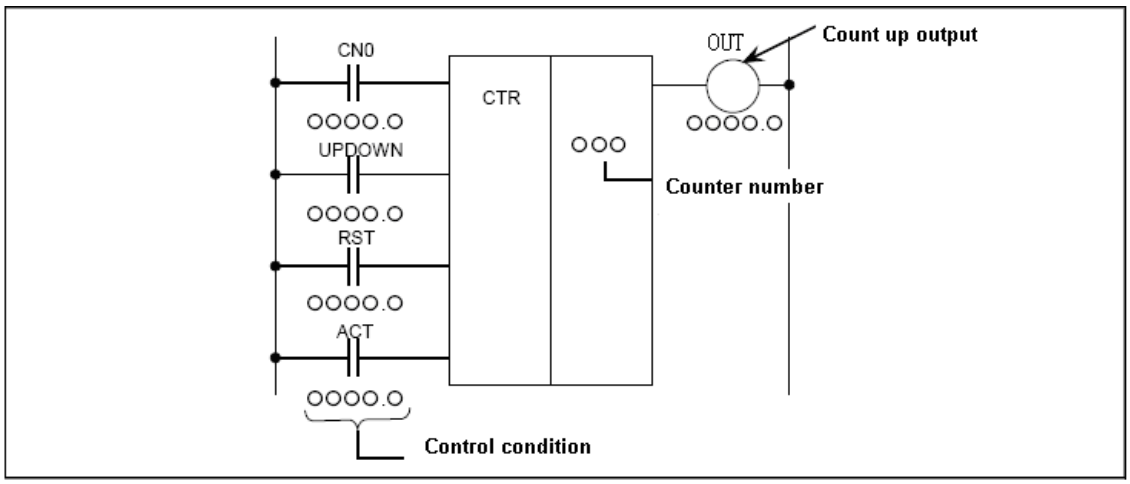


Fig. 5-10

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 accoridng to CN0 setting), when it is Down counter, it is the preset value of the counter).

ACT ： Counter signal

ACT=1：counter is madeby 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 minmum 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 counbter

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：

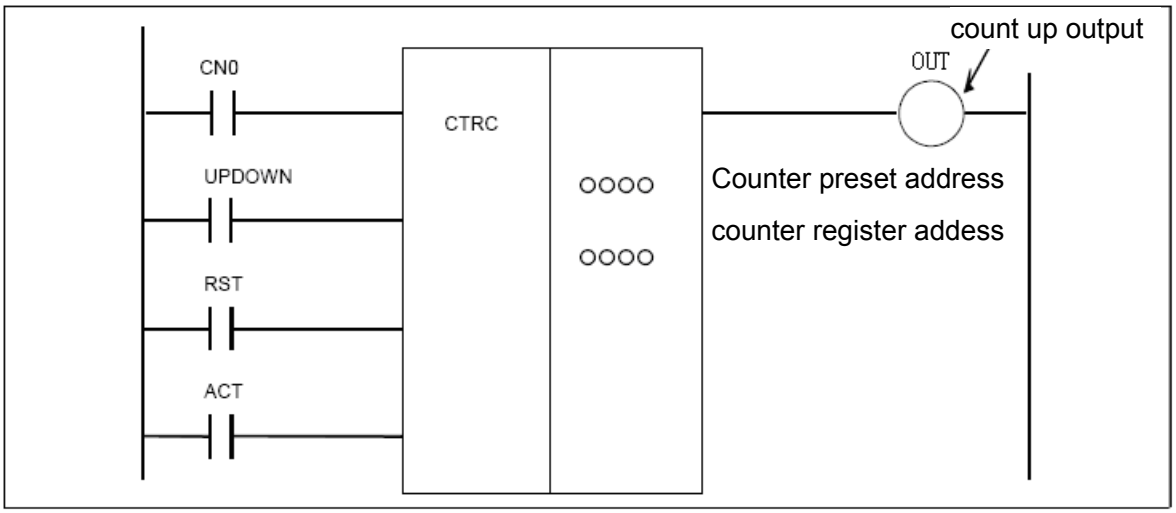


Fig. 5-11

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 ：Spcifying 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 directin 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：

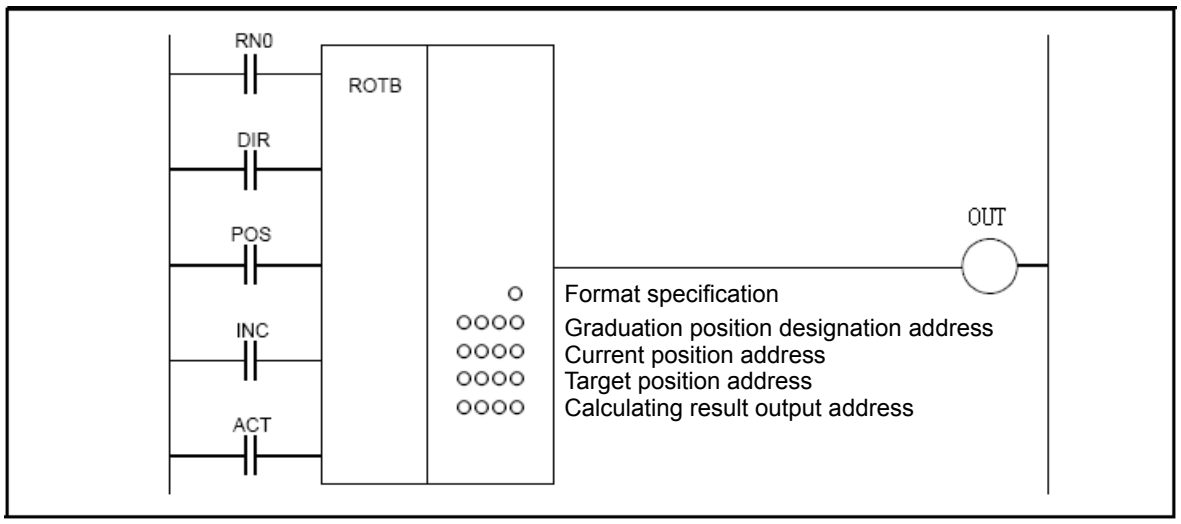


Fig. 5-12

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 rotarty 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 pathis 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).

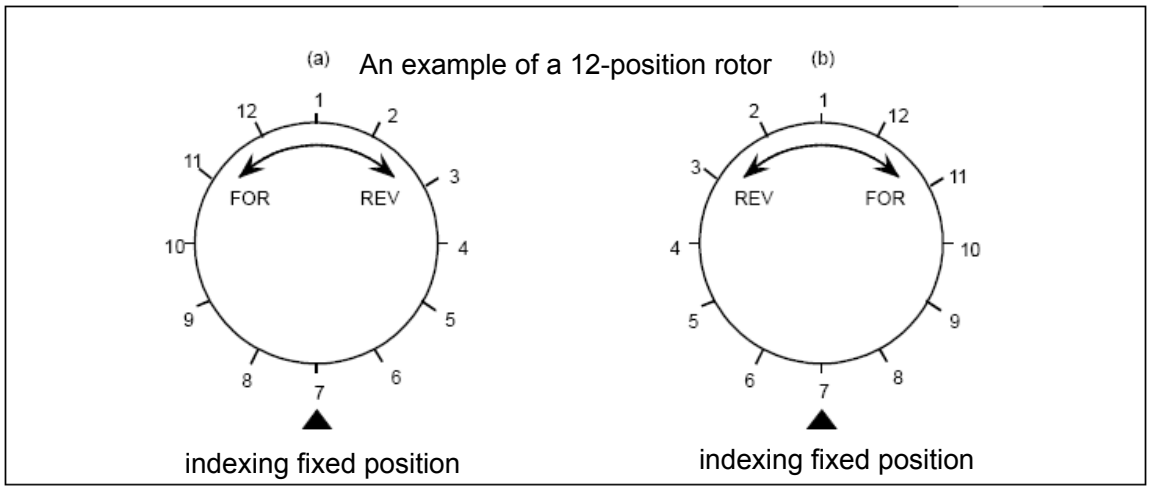


Fig. 5-13

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.

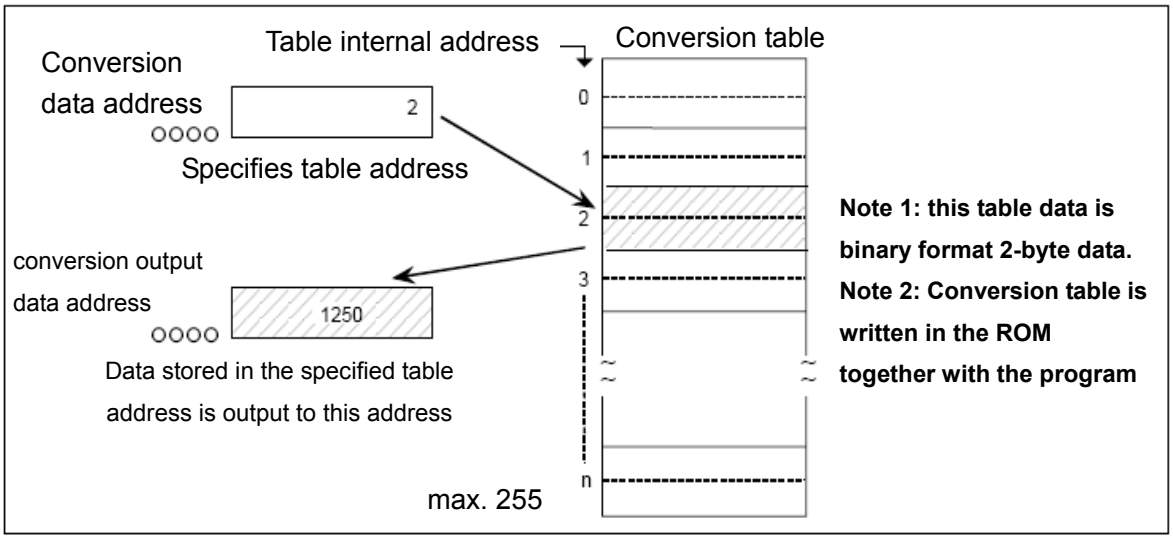


Fig. 5-14

Format：

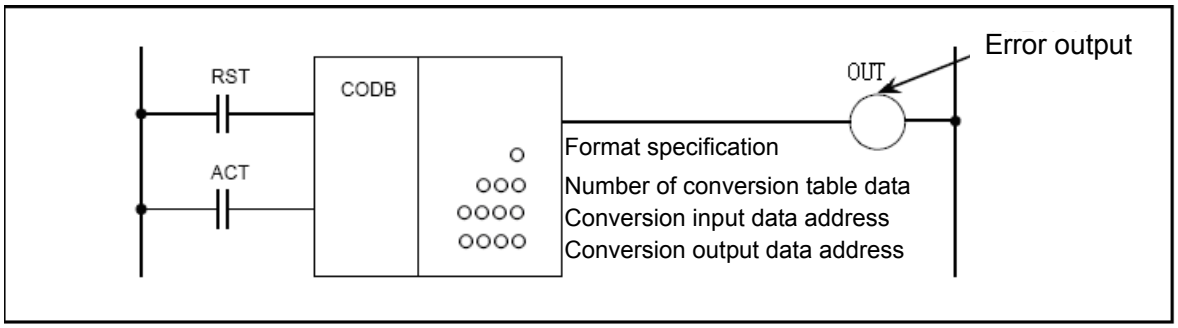


Fig. 5-15

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 numberical 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 specifc address, etc..

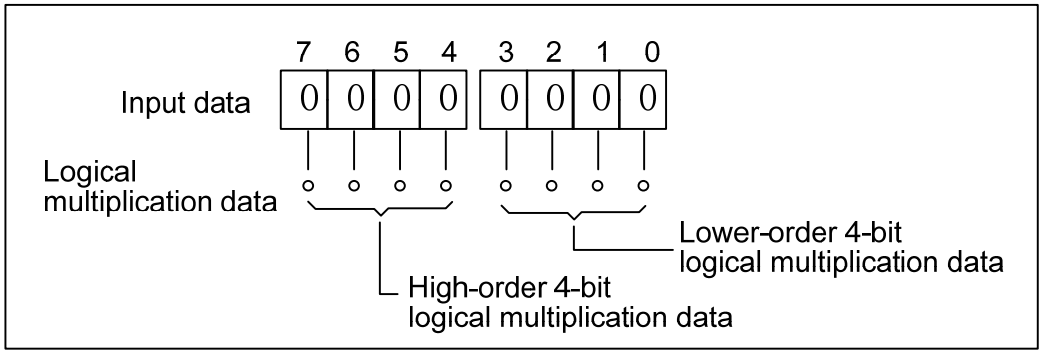


Fig. 5-16

Format:

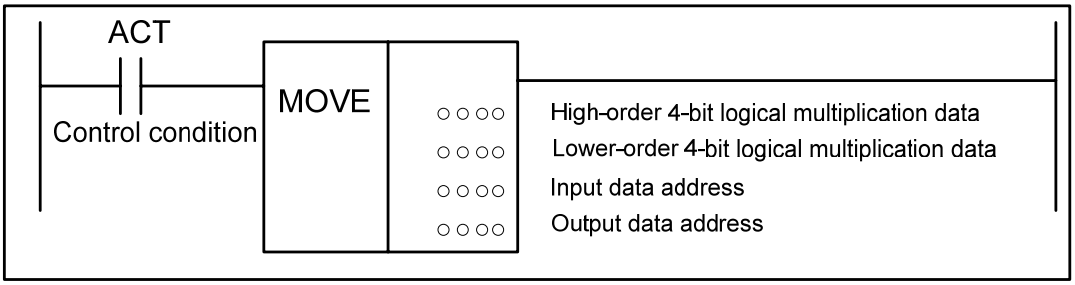


Fig. 5-17

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：

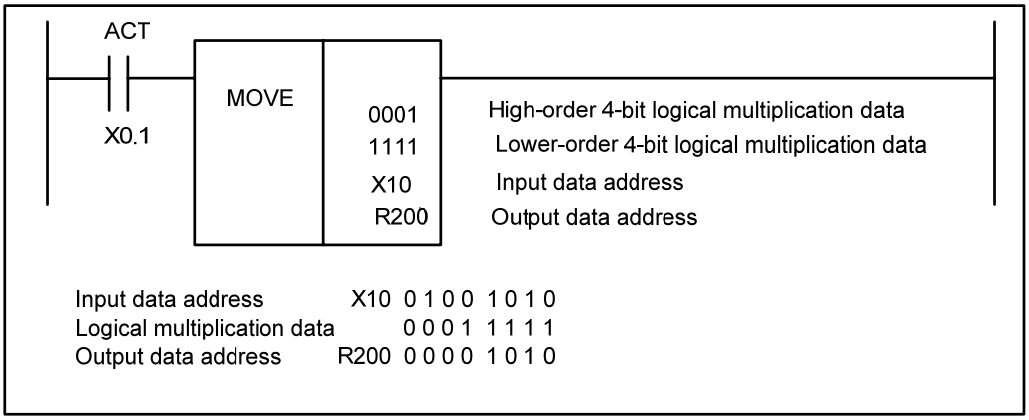


Fig. 5-18

5.12 MOVOR（data transfer after logical sum）

Function：

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

Format:

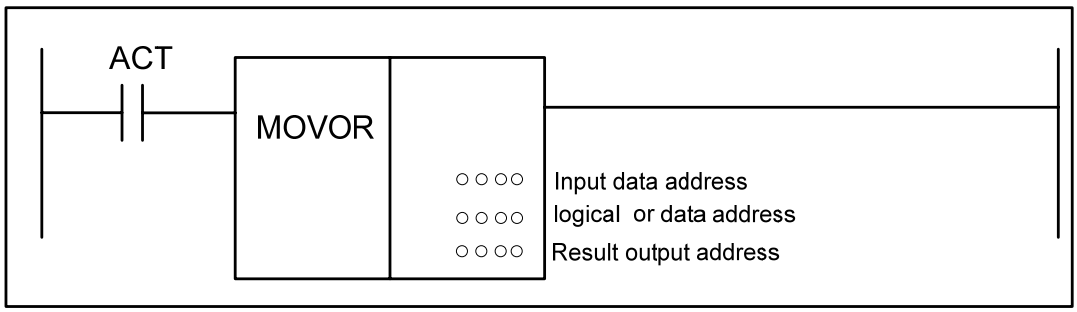


Fig. 5-19

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 sum 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 sum data address : specifies the address of the logical sum 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：

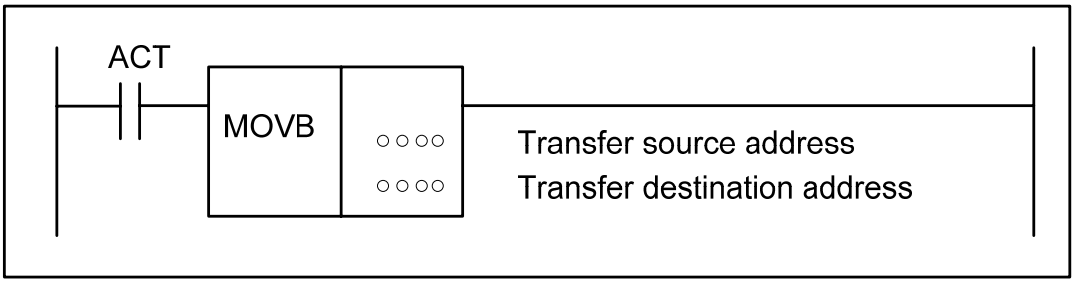


Fig. 5-20

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：

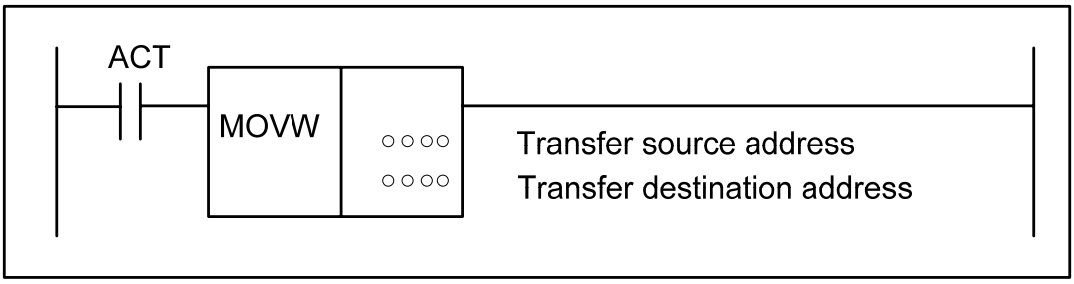


Fig. 5-21

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：

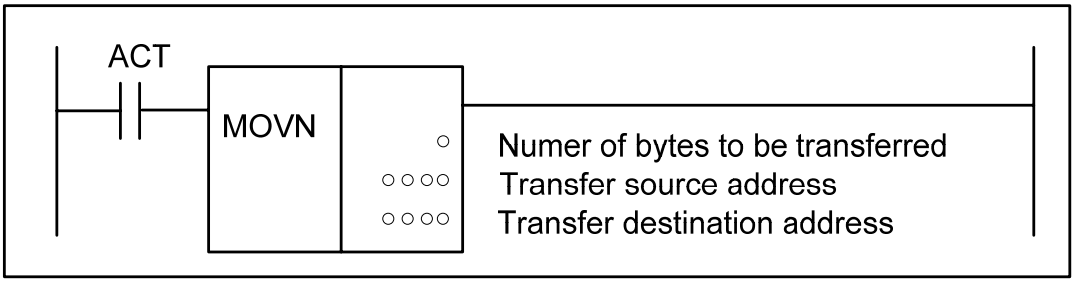


Fig. 5-22

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：

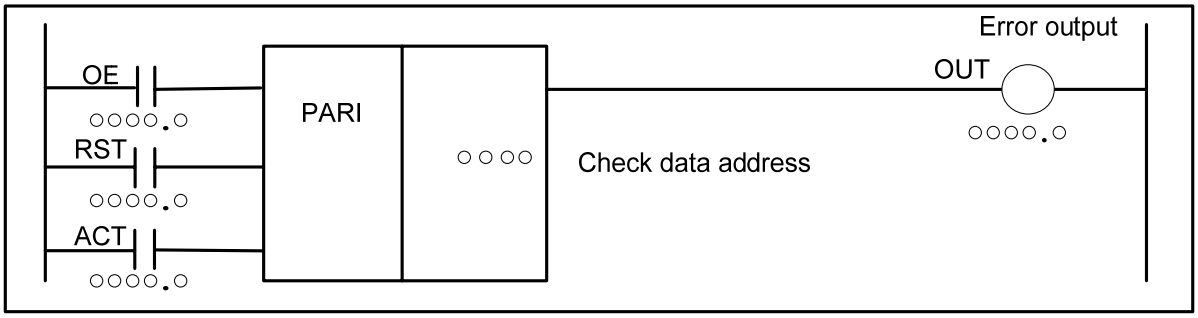


Fig. 5-23

Command table format：

Table 5-18

No.	Commnd	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 –byte binary code into BCD or vice versa.

Format：

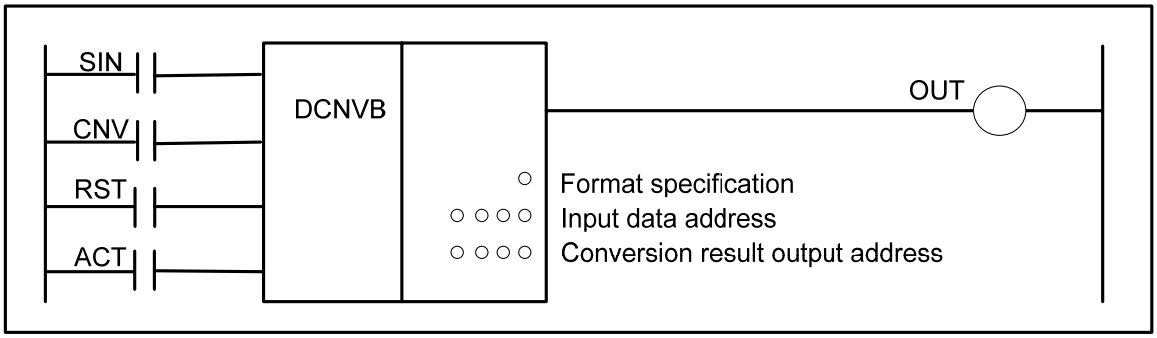


Fig. 5-24

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：abnorally.

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.

Operaton 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):

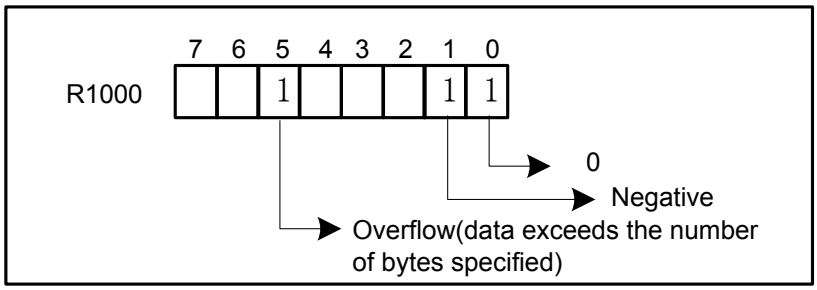


Fig. 5-25

5. 18 COMPB（binary compasion）

Function：

Compare the size fo 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：

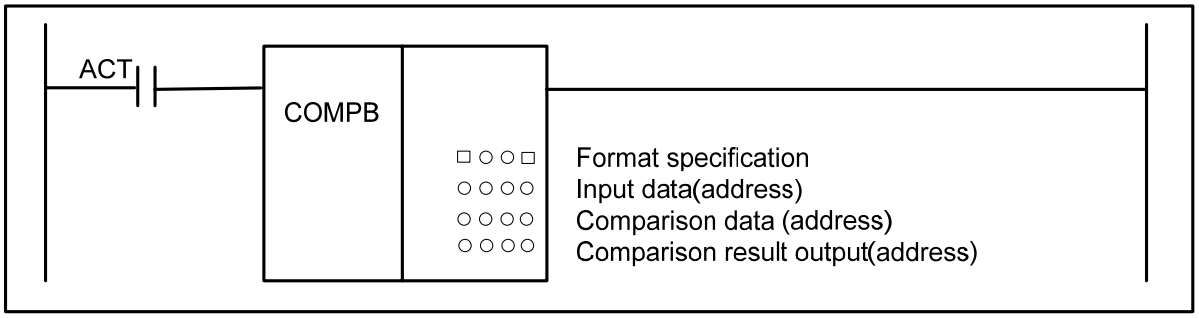


Fig. 5-26

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).

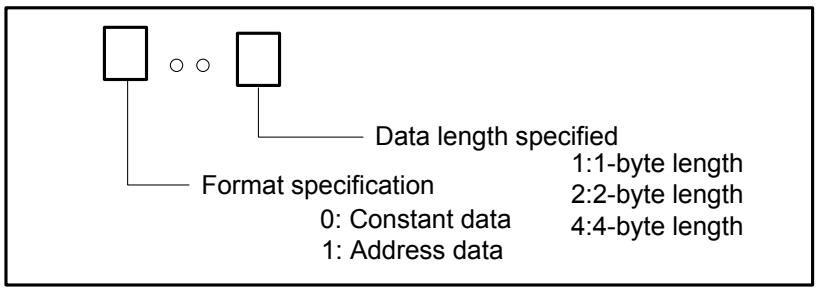


Fig. 5-27

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 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 conincide and the command is available with the binary data.

Format：

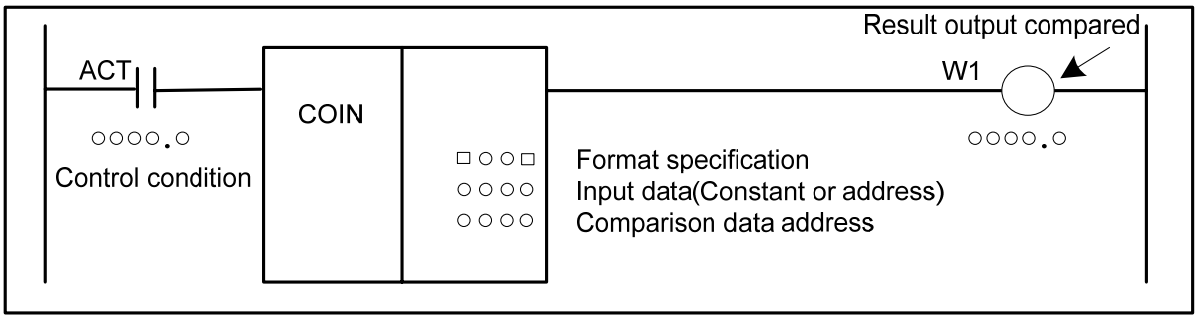


Fig. 5-29

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.

0：specifies input data as a constant.

1：specifies input data as an address.

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 countig from thebeginning 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：

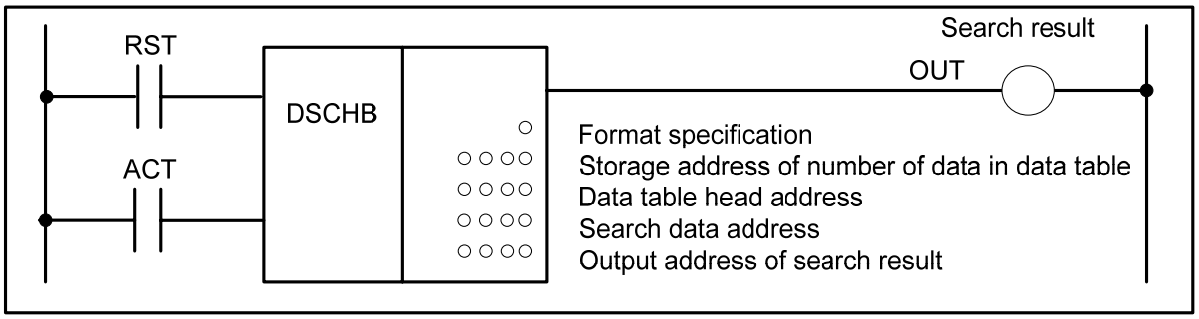


Fig. 5-30

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 PIT tp 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 tinternal 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 addresss is assigned to the 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 ata table can be specified by specifying the address.

Format：

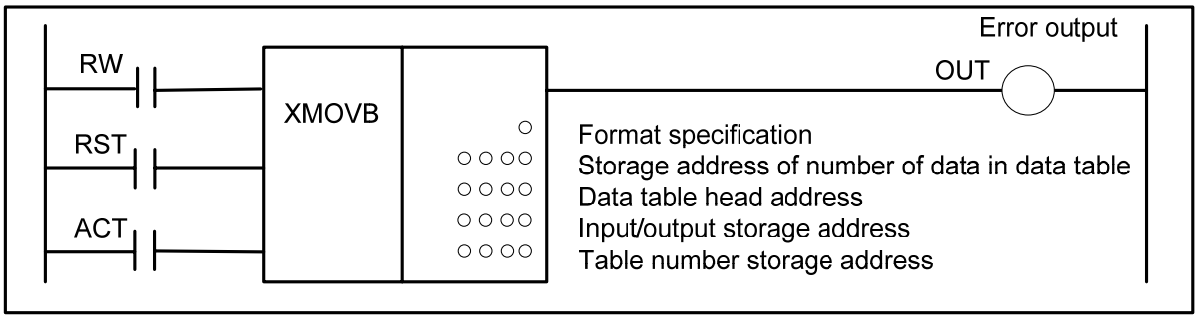


Fig. 5-31

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 capcity
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 settting 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 addion operation result are set with the storage address of the corresponding byte length

Format：

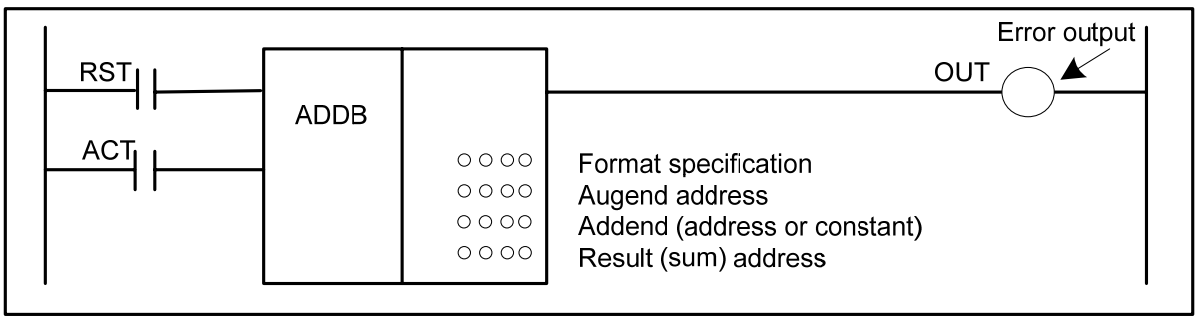


Fig. 5-32

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：

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

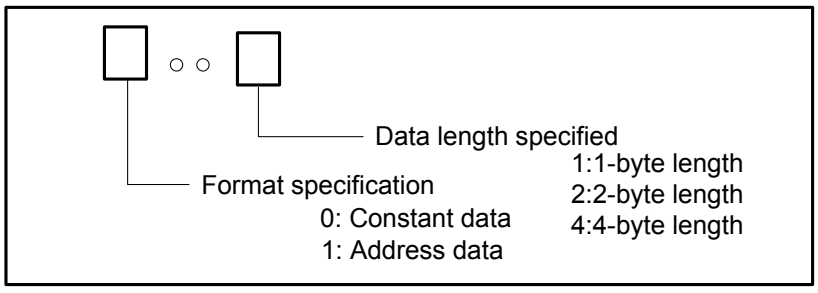


Fig. 5-33

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:

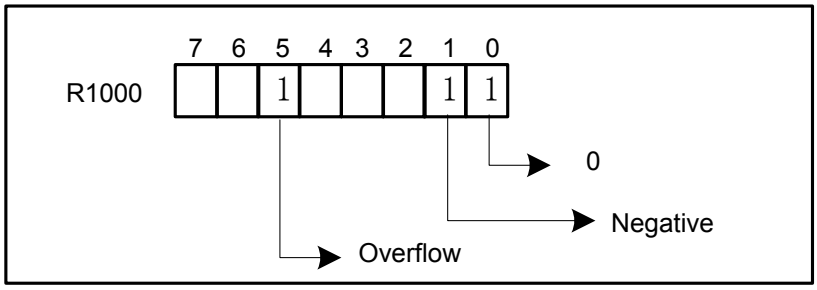


Fig. 5-34

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：

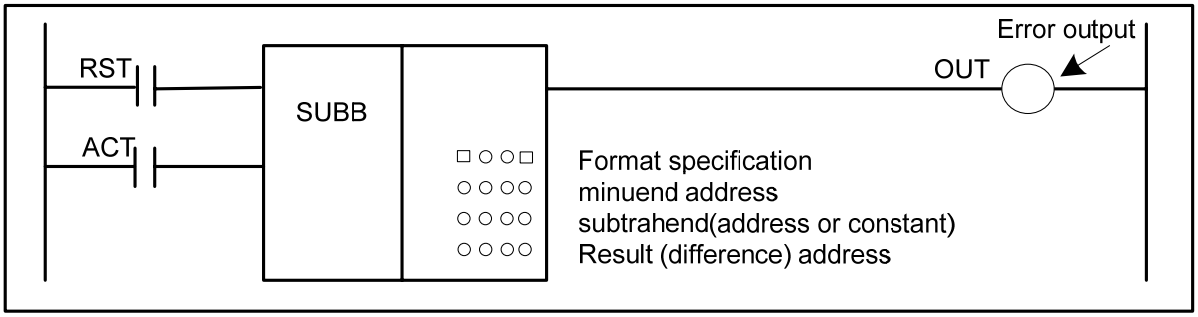


Fig. 5-35

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. 5-36

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:

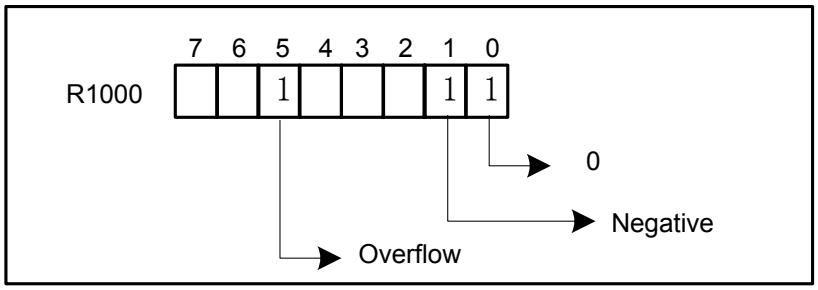


Fig. 5-37

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：

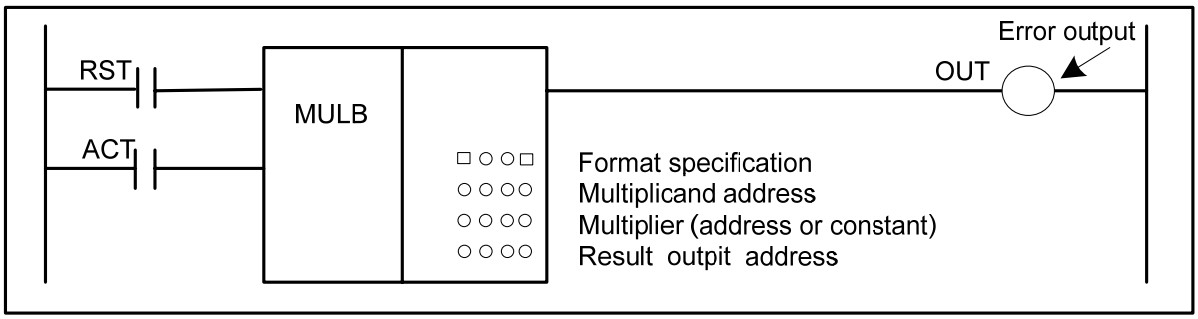


Fig. 5-38

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).

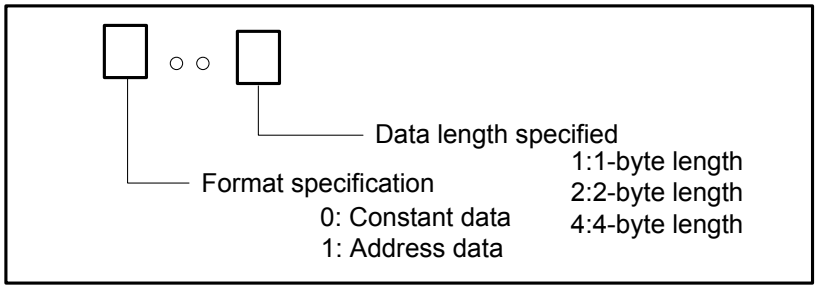


Fig. 5-39

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:

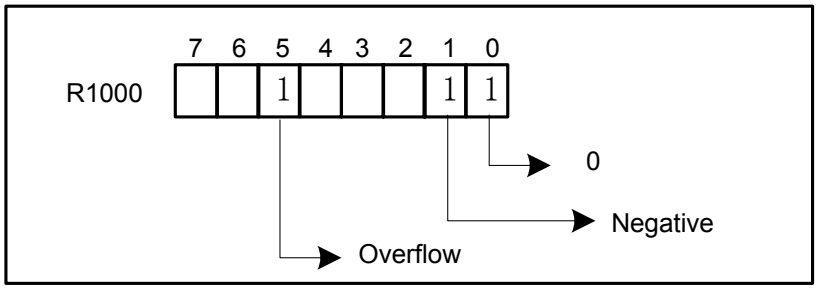


Fig. 5-40

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：

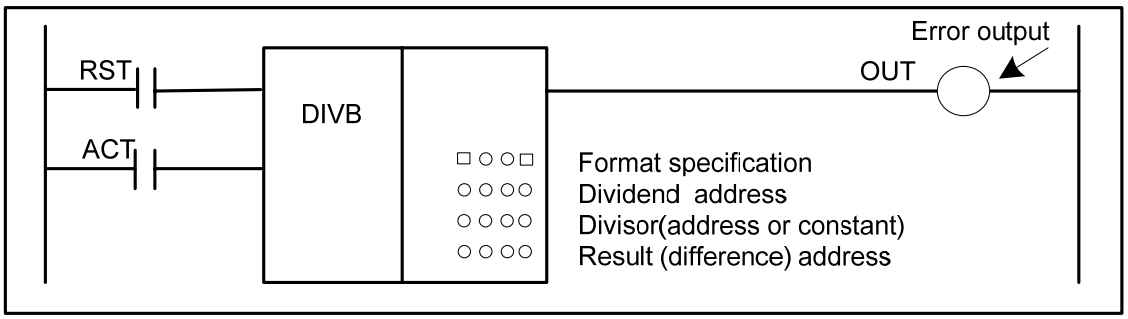


Fig. 5-41

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. 5-42

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:

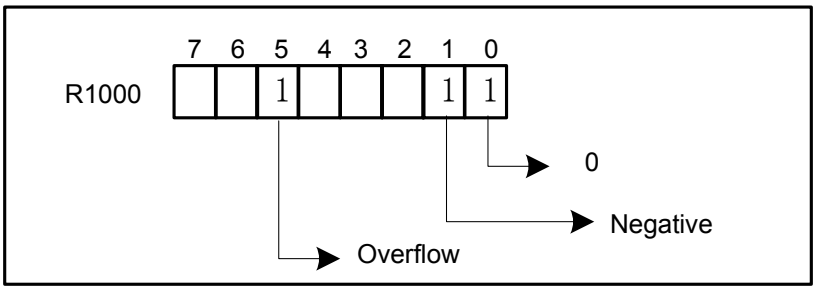


Fig. 5-43

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：

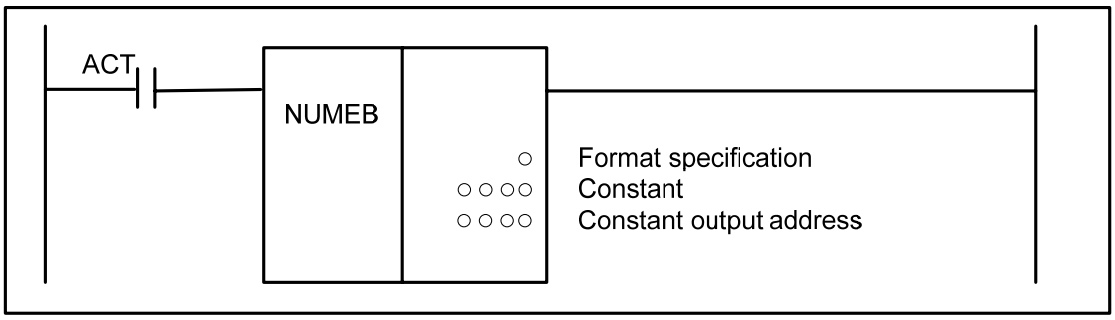


Fig. 5-44

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：

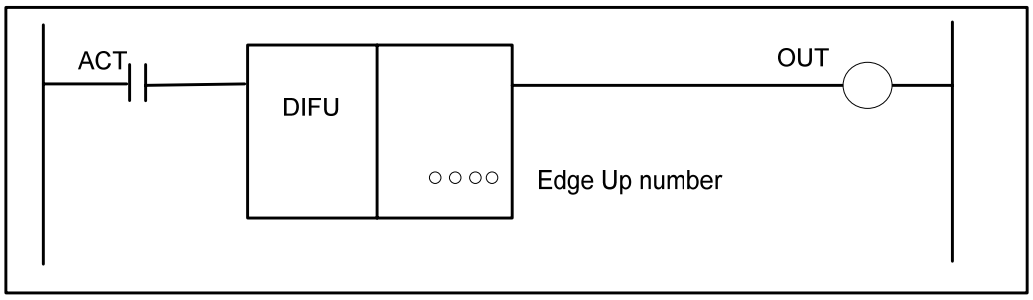


Fig. 5-45

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）:

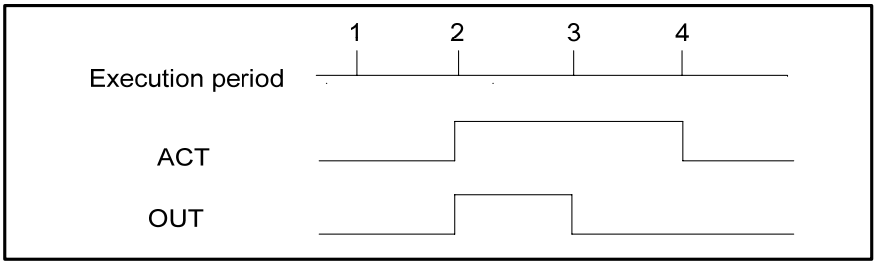


Fig. 5-46

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:

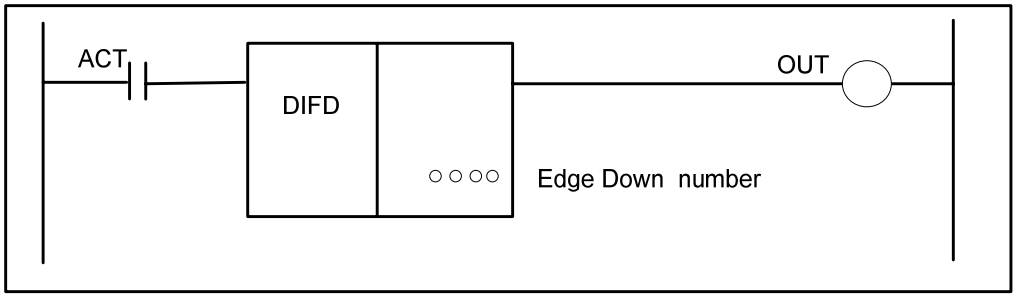


Fig. 5-47

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）：

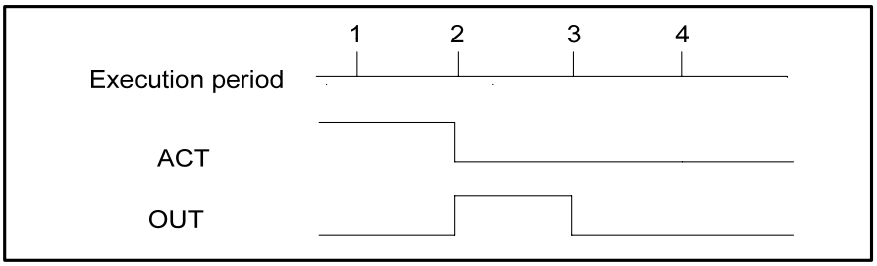


Fig. 5-48

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：

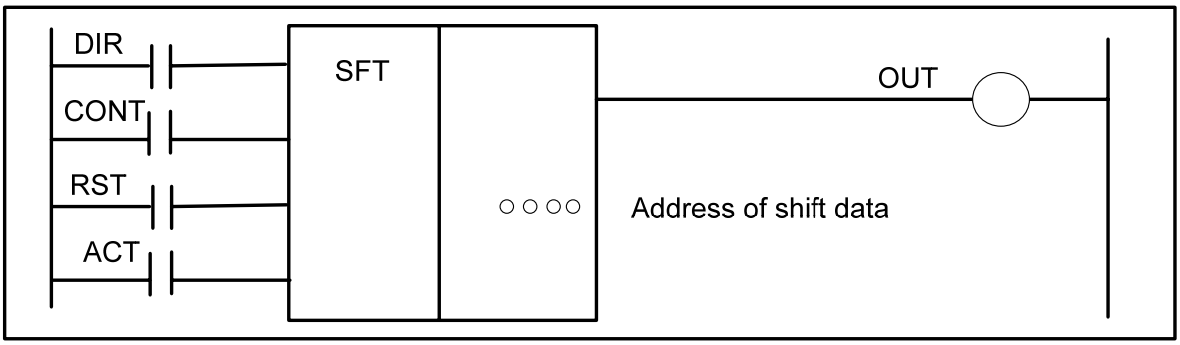


Fig. 5-49

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:

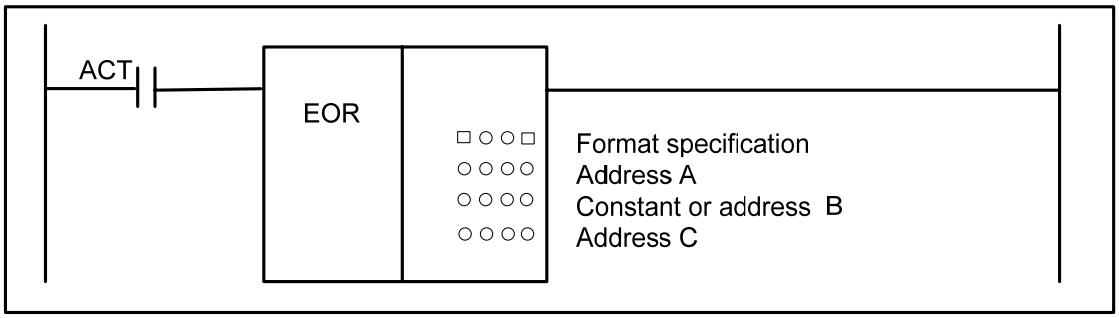


Fig. 5-50

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. 5-51

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：

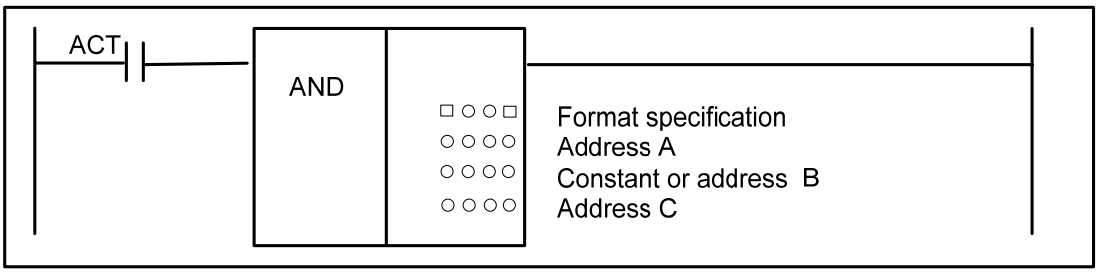


Fig. 5-52

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. 5-53

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 has 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 OR（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：

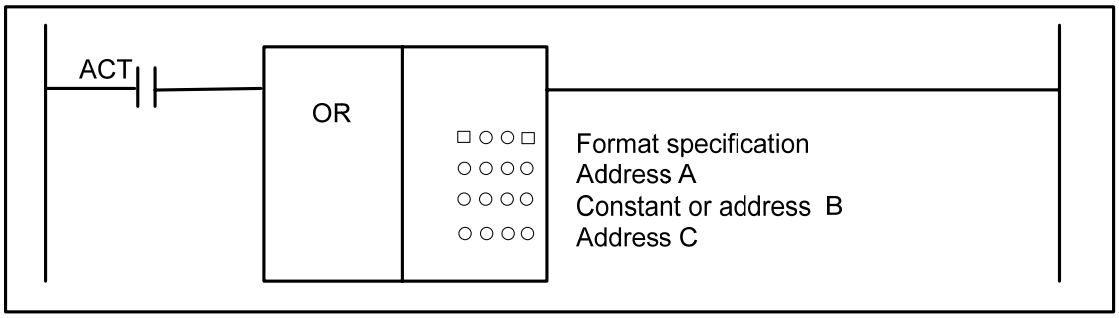


Fig. 5-54

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 OR command .

ACT＝1 ： execute OR command .

Parameter：

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

Fig. 5-55

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 OR operation. The result of an OR 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：

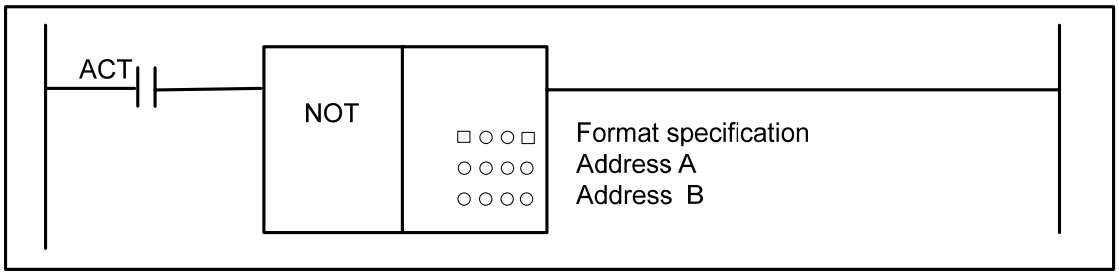


Fig. 5-56

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).

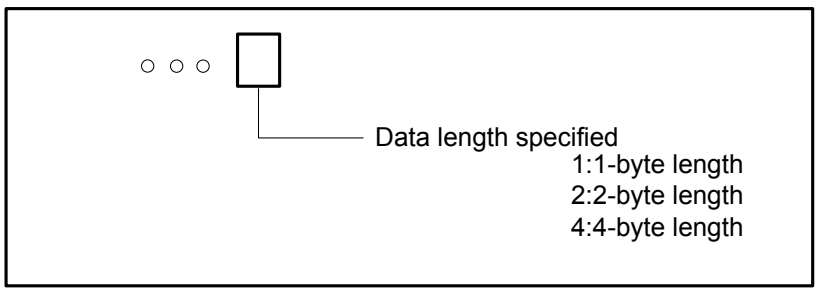


Fig. 5-57

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：

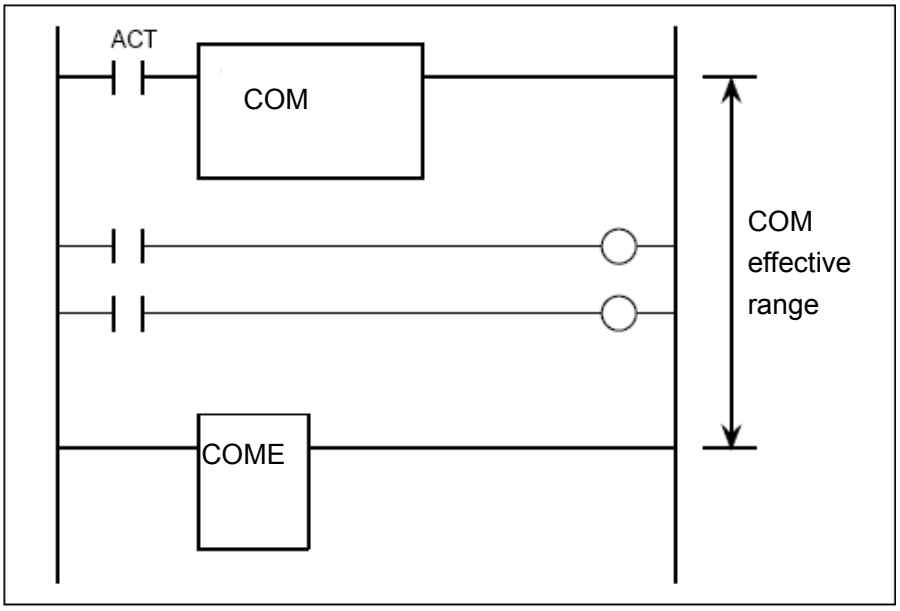


Fig. 5-58

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：

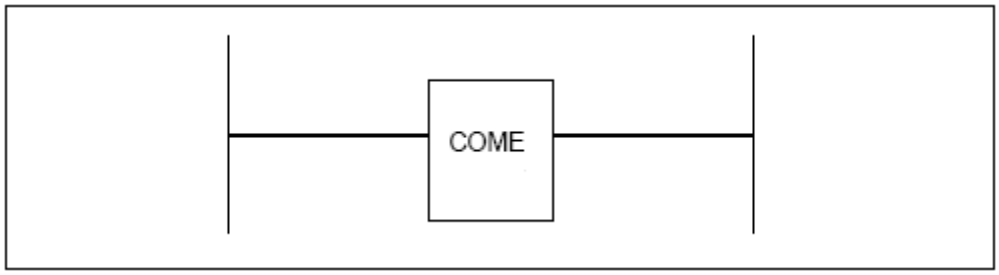


Fig. 5-59

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：

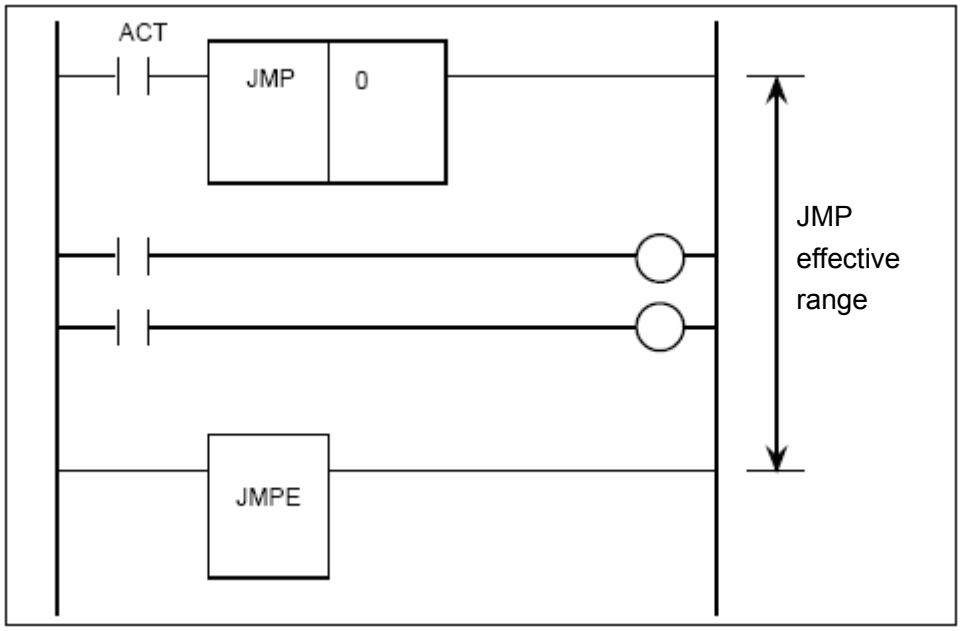


Fig. 5-60

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 compileing 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：

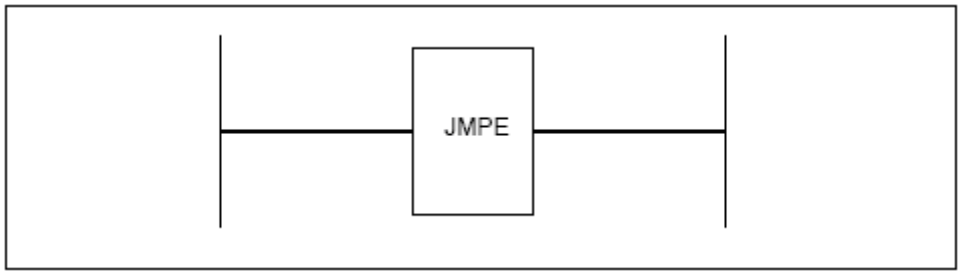


Fig. 5-61

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：

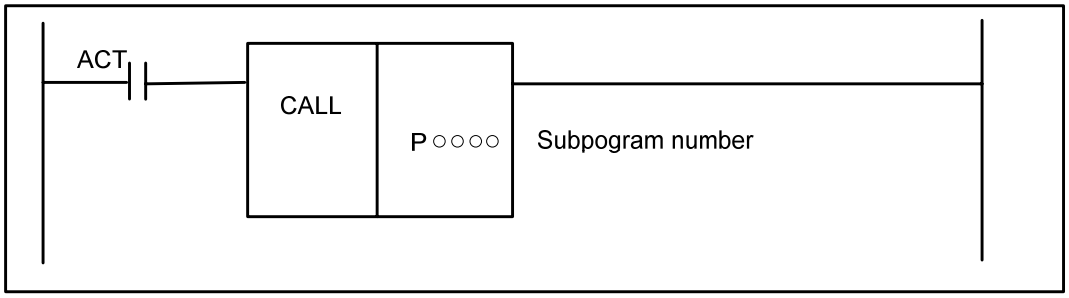


Fig. 5-62

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（uncoditional subprogram call）

Function：

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

Format：

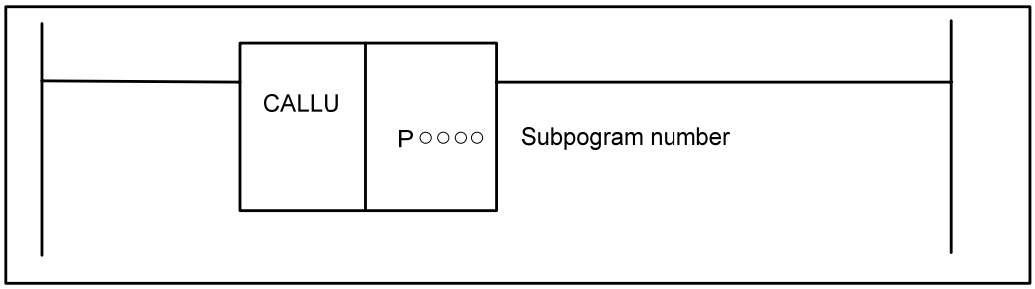


Fig. 5-63

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 pgoram.

The JMPB has the following additional functions:

* 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：

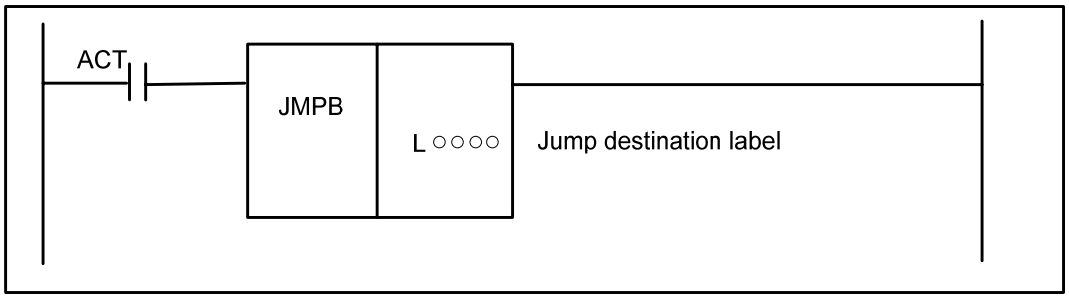


Fig. 5-64

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：

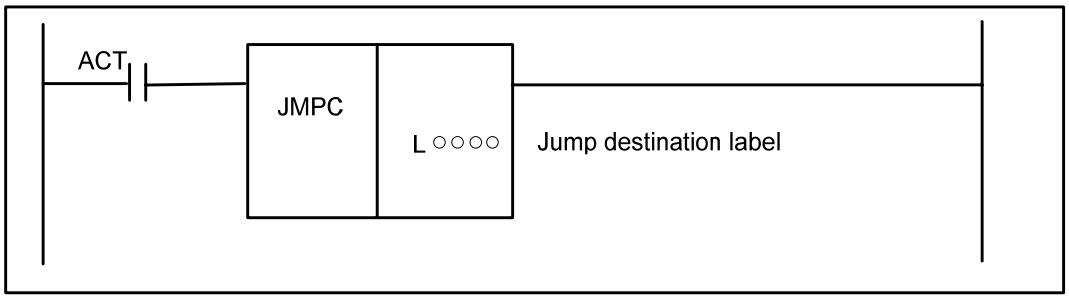


Fig. 5-65

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 bac 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：

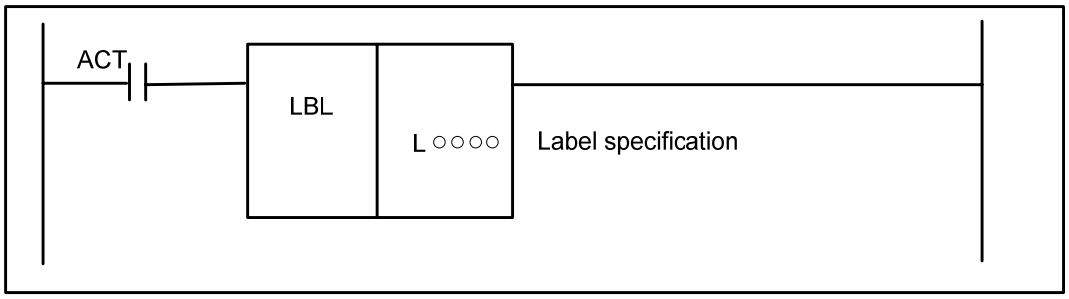


Fig. 5-66

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：

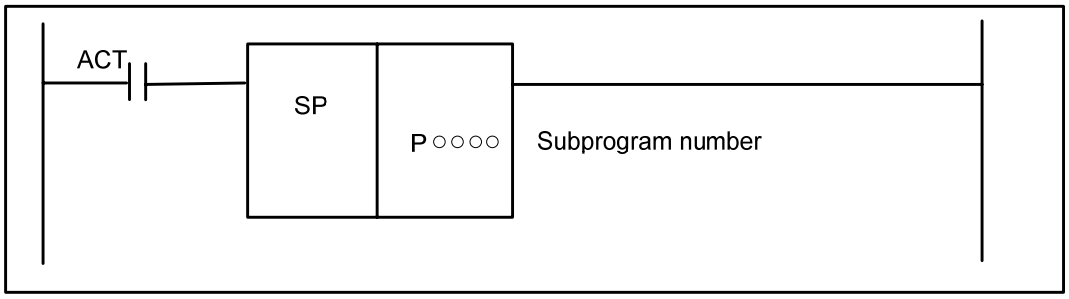


Fig. 5-67

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：

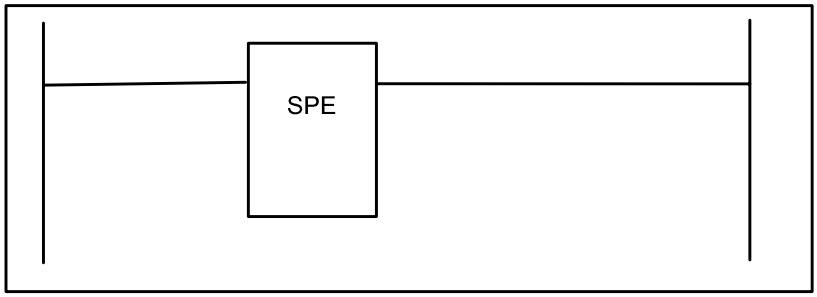


Fig. 5-68

Command table format ：

Table 5-46

No.	Command	Operand	Remark
1	FUNC	43	SPE

6 Ladder Writing Limit

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.

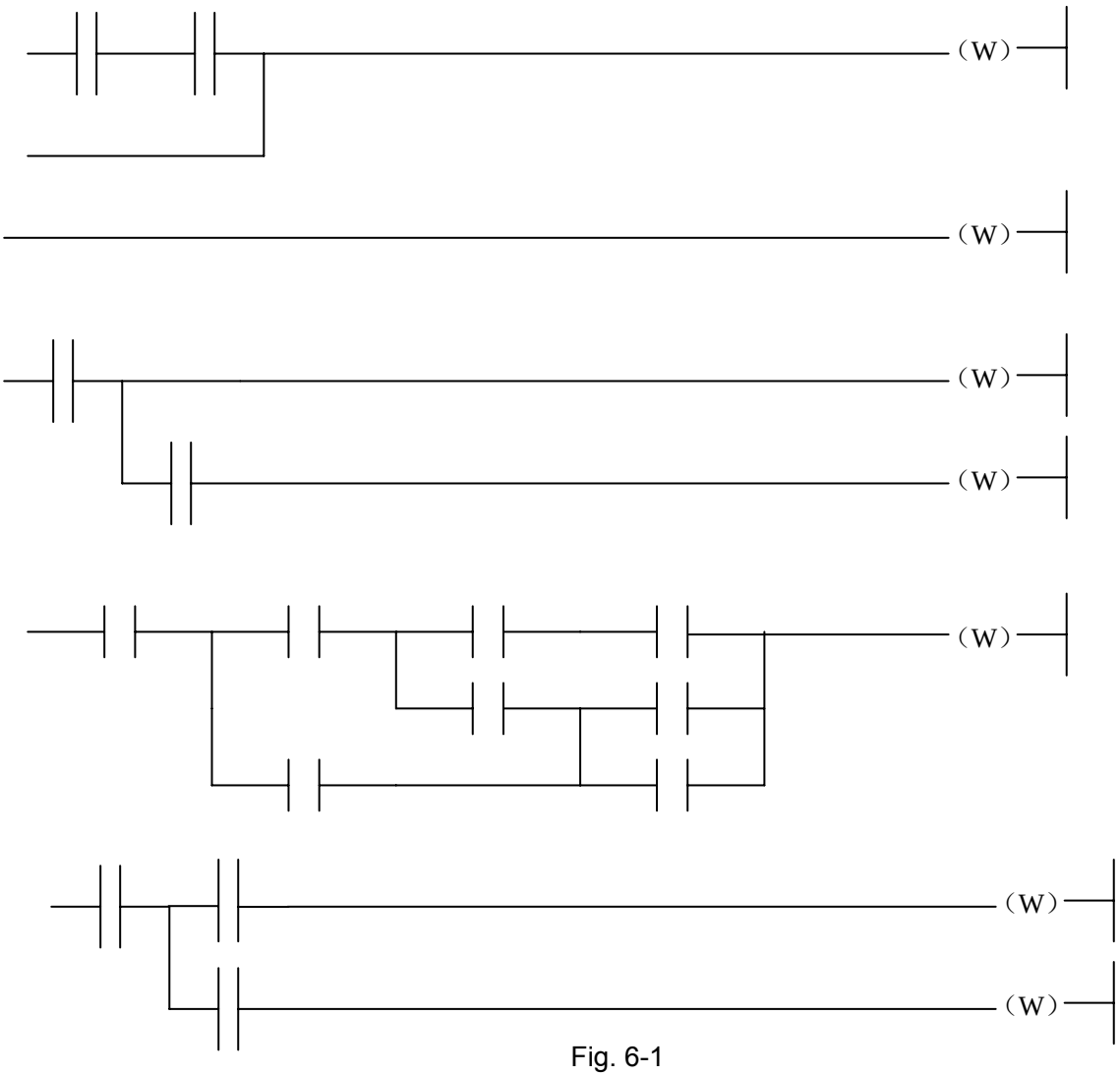


Fig. 6-1

Part 2 Function

1 Preparations for operatoin

1.1 Emergency stop

General When you press Emergency Stop button on the machine operation panel, the machine movement stops in a moment.

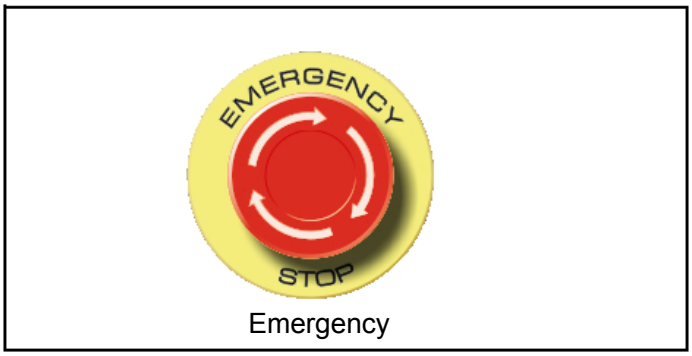


Fig. 1-1

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

Signal emergency stop signal

***ESP （ X008.4 G008.4 ）**

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

［Classification］ input signal.

［Function］ activating an emergency stop signal stops the machine instantly.

［Operation］ when the emergency stop signal *ESP becomes to “0”, the emergency stop is applied to the machine and the CNC is reset.

1.2 CNC overtral signal

General 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 is displayed. The signal can be output with an alarm.

Signal overtravel signal

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

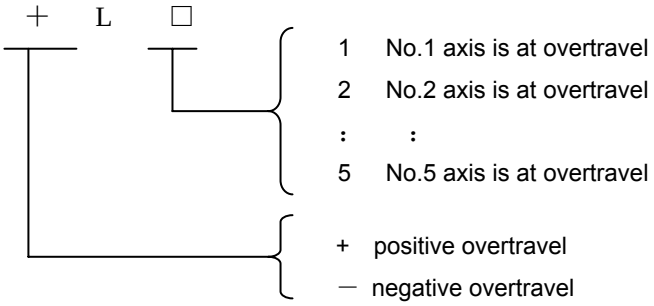
－*L1～－*L5(G116#0~G116#4, X9.7, X10.1, X10.3, X10.5, X10.7)

	#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

［Classification］ input signal.

［Function］ indicates that the control axis has reached its stroke limit. There are individual signals for each direction in every control axis. The +/-in the signal name indicates the direction and the number corresponds to the control axis.



［Operation］ 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.

1.3 Alarm signal

General When an alarm is triggered in the CNC, the alarm is displayed on the screen, and the alarm signal is set to 1.

Signal alarm signal

AL（F001＃0）

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

［Classification］ output signal.

［Function］ the alarm signal reports that the CNC is in an alarm state:

a) NC alarm

b) Overtravel alarm

c) Servo alarm

［Output condition］ 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.

1.4 Interlock

General 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.

All axes interlock signal

***IT (G008＃0)**

［Classification］ input signal.

［Function］ This signal is used to inhibit the machine from moving. When the *IT is “0”, the axis movement is decelerated and stopped. In automatic operation, the system stops in automatic run state(the cycle start signal STL is “1”, the signal SPL is “0”).

Signal address

G008								*IT

Interlock signal for each axis

+MIT1~+MIT5 (G132＃0~G132#4)

-MIT1~-MIT5 (G134#0~G134#4)

［Classification］ input signal.

［Function］ inhibit the specified axis to specify the axis movement.

［Operation］ when the axial interlock signal becomes “1”, the CNC applieds 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

Signal Mode selection signal

F003#0~F003#7

[Classification**]** Output signal.

[Function**]** The currently selected operation mode is output.

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

2 Manual operation

2.1 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.

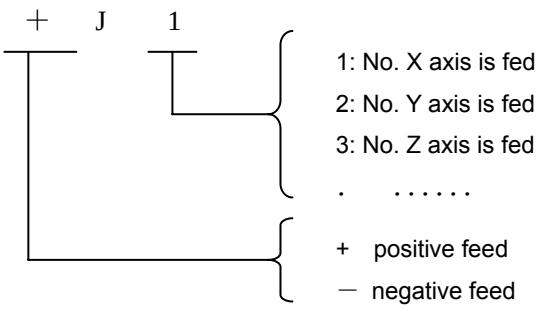
Signal Feed axis and direction selection signal

＋J1~＋J5（G100＃0~G100＃4）

－J1~－J5（G102＃0~G102＃4）

［Classification］ Input signal.

［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

* In incremental feed, the control unit feeds the requested axis by the step distance which is specified by the manual handle feed move distance selection signal, then the axis stops. Even if the signal is set to 0 while the axis is being fed, the control unit does not stop moving. To feed the axis again set the signal to 0, then to 1 again.

Manual rapid traverse selection signal

RT（G１９＃7）

［Classification］ input signal.

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

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

- The control unit executes the jog feed or incremental feed at a rapid traverse rate. The rapid traverse override is valid.
- When the signal is switched from 1 to 0 or vice versa in jog feed or incremental feed, the feedrate is decelerated until it reaches zero, then increased to the specified value. During acceleration and deceleration, the feed axis and direction selection signal can be kept 1.

Signal address

	＃7	＃6	＃5	＃4	＃3	＃2	＃1	＃0
G19	RT							
G100				+J5	+J4	+J3	+J2	+J1
G102				－J5	－J4	－J3	－J2	－J1

2.2 MPG / Step feed

General In MPG/Step feed mode, the machine moves by rotating the manual pulse generator(MPG) or Step. Select the axis along which the machine moves with the MPG feed axis selection signal/axis move signal.

Signal （**G018＃0~G018＃3**）

［Classification］ Input signal.

［Function］ Select MPG feed axis.

Signal MPG/incremental feed selection signal

（G019＃4~G19＃5）

［Classification］ Input signal.

［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.

3 Reference Point Return

3.1 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#6 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.

The following signals are related to the manual reference point return:

	Manual reference point return
Reference point return selection	MREF
Reference point return deceleration signal	*DEC1~*DEC5
Reference point return completion signal	ZP1~ZP5
Creating reference point signal	ZRF1~ZRF5

Signal Reference point return completion signals

MREF（F004＃5）

［Classification］ Output signal.

［Function］ This signal indicates that manual reference point return has been selected.

［Output condition］ The signal turns to “1” when:

* Manual reference point return has been selected.

The signal turns to “0” when:

* The selection of manual reference point return has terminated.

Reference point return completion signal

ZP1～ZP5(F94＃0~F94＃4)

［Classification］ Output signal.

［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.
- The emergency stop signal appears.
- The servo alarm appears.

Reference point return deceleration signal

***DEC1~ *DEC5（G122＃0～G122#4, X9＃0~X9＃4）**

［Type］ Input signal.

［Function］These signals decelerate the feedrate for manual reference point return to a low feedrate in order to approach the reference point at the low feedrate.

Reference point establishment signal

ZRF1~ZRF4(F120＃0~F120＃4)

［Classification］ Output signal.

［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
X009				*DEC5	*DEC4	*DEC3	*DEC2	*DEC1
F004			MREF					
F094				ZP5	ZP4	ZP3	ZP2	ZP1
F120				ZRF5	ZRF4	ZRF3	ZRF2	ZRF1
G122				*DEC5	*DEC4	*DEC3	*DEC2	*DEC1

4 Automatic operation

4.1 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 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 1 in automatic operation, the CNC enters the feed hold 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 bloc 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 setn 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 non-thread block after the threading blocks.

   When signal SP is set to 0 during threading with the G92 command (thread cycle), signal SPL is immediately set to 1 but operation continues up until the end of the retraction bloc following thread.

   When signal SP is set to 0 during threading with the G32 command, signal SPL is immediately set to 1 but operation continues until the end of a non-threading block following the threading blocks.

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 execued

   Operation stops after the currently executing macro command has been completed.

Signal Cycle start signal

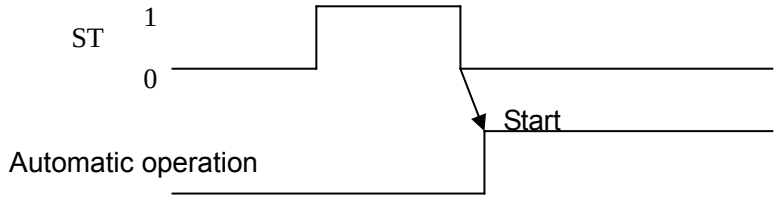
ST（G7＃2）

［Classification］ Input signal.

［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

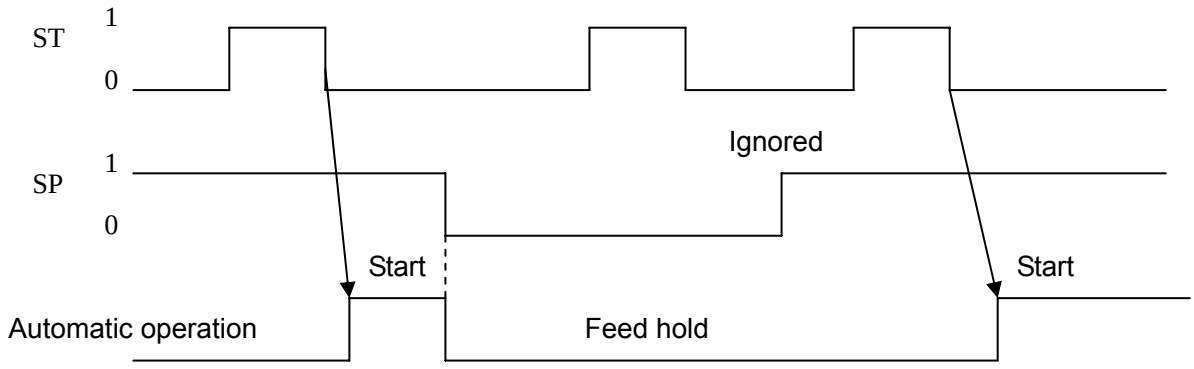
SP（G8＃5）

［Classification］ Input signal.

［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



Feed hold lamp signal

STL（F000＃5）

［Type］ Output signal.

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

［Output conditions］ The signal is set to 1 or 0, which is determined by CNC state as Table 4-1.

Feed hold lamp signal

SPL（F000＃4）

［Classification］ Output signal.

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

［Output conditions］ The signal is set to 1 or 0, which is determined by CNC state as Table 4-1

OP（F000＃7）

［Classification］ Output signal.

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

［Output conditions］ The signal is set to 1 or 0, which is determined by CNC state as Table 4-1.

Table 4-1

	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

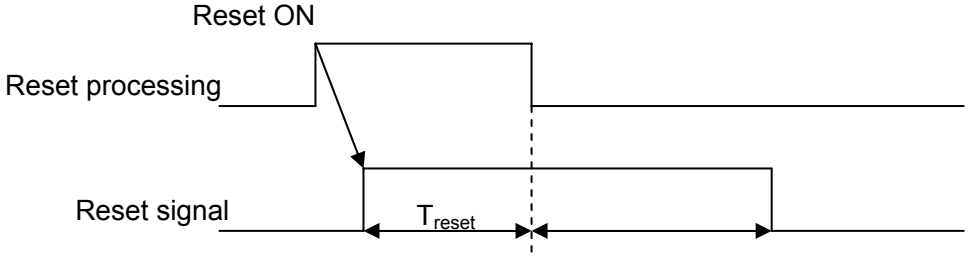
	＃7	＃6	＃5	＃4	＃3	＃2	＃1	＃0
G007						ST		
F000	OP		STL	SPL				

4.2 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］ Input signal.

［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］ Output signal.

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

［Output condition］ 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	

4.3 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.

4.3.1 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］ Input signal.

［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］ Output signal.

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

［Output condition］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	

4.3.2 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］ Input signal.

［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］ Output signal.

［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							

4.3.3 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］ Input signal.

［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］ Output signal.

［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			

4.4 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］ Input signal.

［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］ Output signal.

［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

4.5 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**]** Input signal

[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 CRT 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**]** Output signal

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

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

—The program restart signal is set to 0 after the CRT 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				

5 Feedrate Control

5.1 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］ Output signal.

［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 cannced 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 durig a stop, until another federate has been selected and movement is started.

Signal address

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

5.2 Override

5.2.1 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.

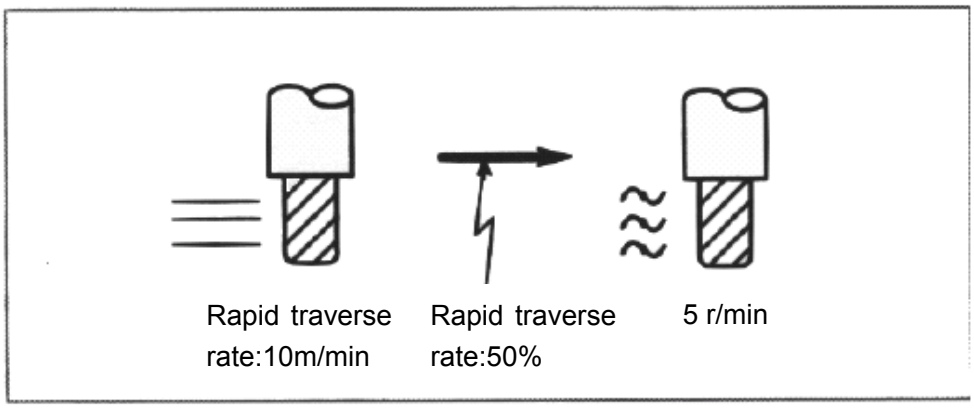


Fig. 5-1

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>

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

Fig. 5-2

［Classification］ Input signal.

［Function］ These signals override the rapid traverse rate.

5.2.2 Override cancel

General The override cancel signal fixes the feerate override to 100%.

Signal Override cancel signal

OVC（G006＃4）

［Classification］ Input signal.

［Function］ The feedrate override is fixed to 100％.

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

- The feedrate override is fixed to 100% irrespective of the feedrate override signal.
- Rapid traverse override and spindle speed override are not affected.

Signal address

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

6 Auxiliary Function

6.1 Miscellaneous function

General miscellaneous function (M code) When the maximum 3-digit number following the address M is specified, a code signal and a strobe signal are set to the machine. The machine uses these signal to turn on or off its functions.

Basic procedure

The following signals are used for the following functions.

Table 6-1

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 strob signal to 0 and reports that the completion signal has been received.

（7） When the strobe signal is set to0, 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

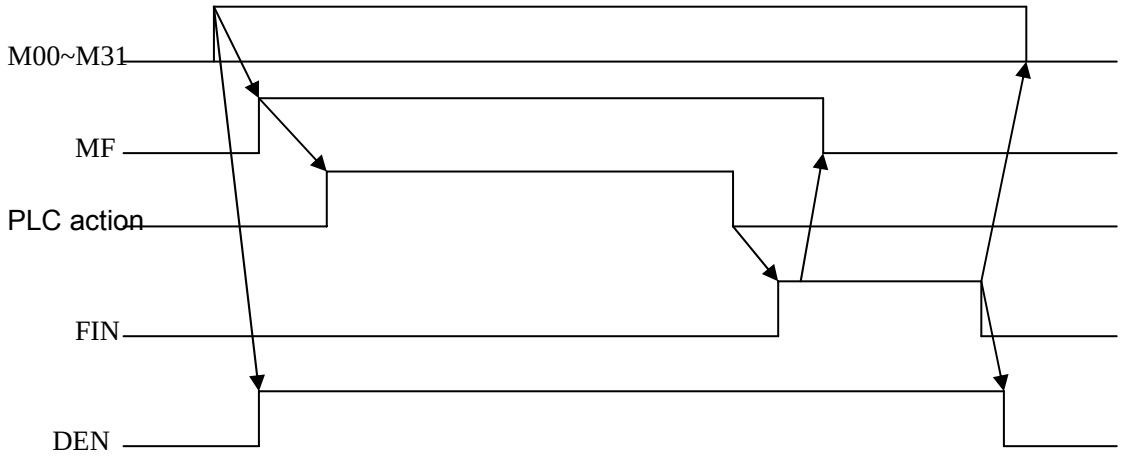


Fig. 6-1

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

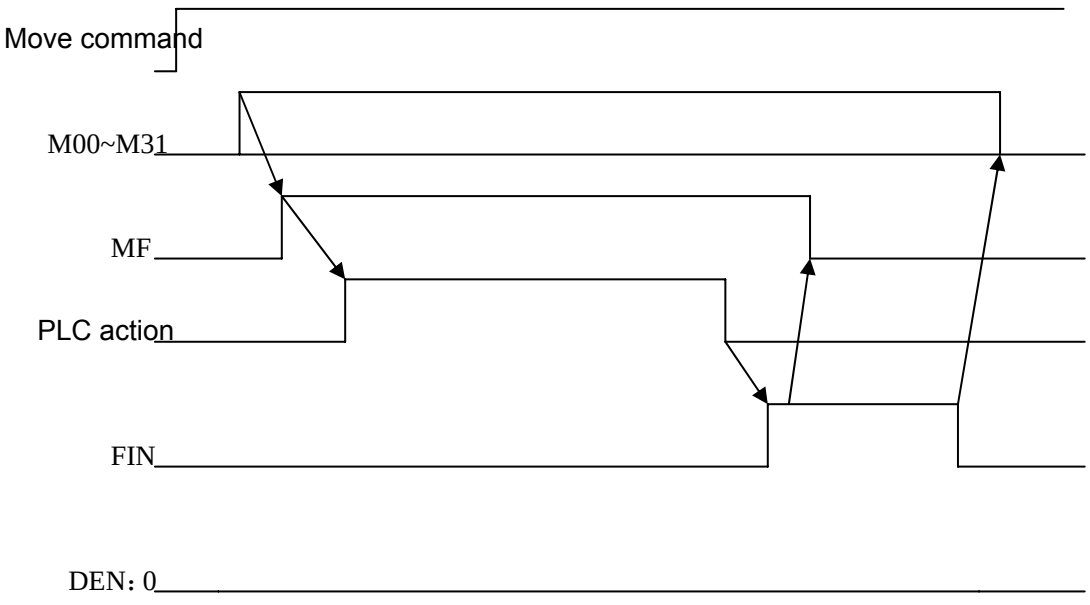


Fig. 6-2

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

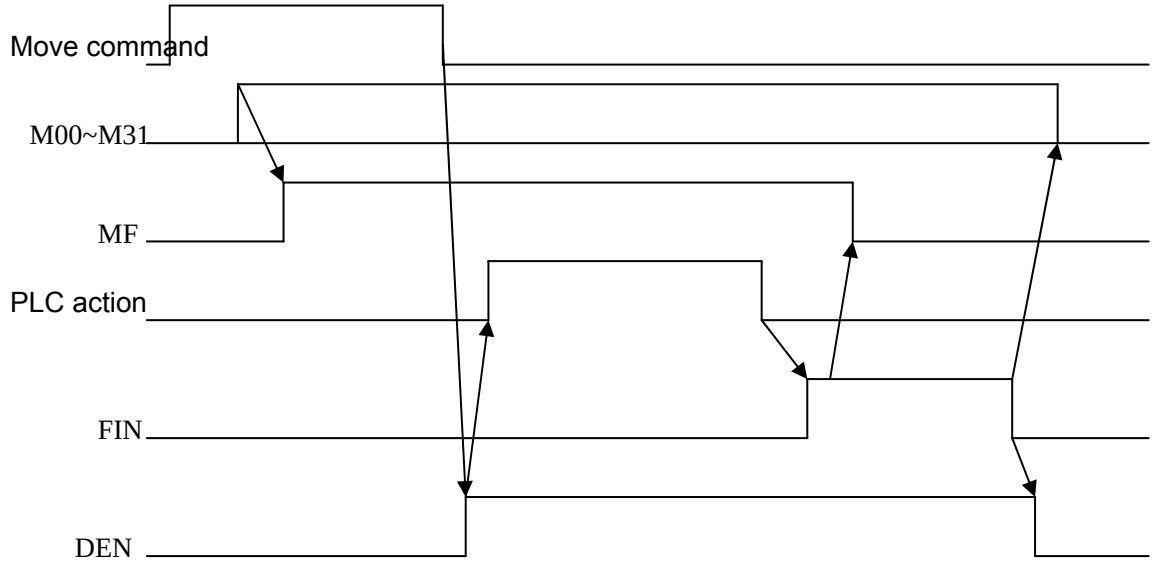


Fig. 6-3

Signal **Miscellaneous function code signals**

M00～M31（F010～F013）

Miscellaneous function strobe signal

MF（F007＃0）

［Classification］ Output signal.

［Function］ These signals report the specification of miscellaneous functions.

［Output condition］ For the output conditions and procedure, see the description of "Basic procedure" above.

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. Decode signals as well as the code signals and strobe signal are output for the miscellaneous functions listed below..

M00，M01，M02，M30

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

DM00（F009＃7）

DM01（F009＃6）

DM02（F009＃5）

DM30（F009＃4）

［Classification］ Output signal.

［Function］ These signals report particular miscellaneous function are specified. The miscellaneous functions in a command program correspond to output signals as indicated below.（Table 6-2）：

Table 6-2

Program command	Output signal
M00	DM00
M01	DM01
M02	DM02
M30	DM30

［Output condition］ A decode M signal goes “1” when :

- The corresponding miscellaneous function is specified, and any move commands and dwell commands specified in the same block are completed. These signals are not output when the end signal of the miscellaneous function is returned before completion of such move command and dwell commands.

A decode M signal goes “0” when :

- FIN signal goes “1”.
- Reset occurs.

Spindle speed code signals

S00～S31（F022～F025）

Spindle speed strobe signal

SF（F007＃2）

［Classification］ Output signal.

［Function］ These signals report that spindle speed function have been specified.

［Output condition］For the output conditions and procedure, see the description of “Basic procedure” above.

Use S code output of the analog spindle.

Note: S00～S31 in the binary BCD format is output to S code.

For example: S4 corresponds to 00000000, 00000000, 00000000, 00000100.

Tool function code signal

T00～T31（F026～F029）

Tool function strobe signal

TF（F007＃3）

［Classification］ Output signal.

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

［Output condition］For the output conditions and procedure, see the description of "Basic procedure" above.

Note： T00～T31 in the binary BCD format is output to T code.

For example: T3 corresponds to 00000000, 00000000, 00000000, 00000011.

Miscellaneous function end signal

FIN（G004＃3）

［Classification］ Input signal.

［Function］ These signals report that the end of the miscellaneous function, the spindle speed function, the tool function.

［Operation］ When the signal goes "1", for the operation and procedure, see the description of "Basic procedure".

Warning

Only one end signal is used for all functions above, the end signal must go "1" after all functions are completed.

Distribution end signal

DEN（F001＃3）

［Classification］ Output signal.

［Function］ These signals report that all commands (such as move commands and dwell) are completed except those miscellaneous functions, spindle speed function, tool functions and other commands (move command and pause command) are contained in the same block and have been set to the PLC FIN signal.

［Output condition］ The DEN signal turns to "1" when:

Waiting for the completion of miscellaneous functions, spindle speed function, tool functions and other commands in the same block are completed, and the current position is in the in-position.

The DEN signal turns to "0" when:

The execution of one block is completed.

Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G004					FIN			
F001					DEN			
F007					TF	SF		MF
F009	DM00	DM01	DM02	DM30				
F030	M07	M06	M05	M04	M03	M02	M01	M00
F031	M15	M14	M13	M12	M11	M10	M09	M08
F032	M23	M22	M21	M20	M19	M18	M17	M16
F033	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

6.2 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］ Input signal.

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

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

1 . The control unit does execute M, S, T functions specified for memory 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” .

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.

Warning Even when this signal is “1”, spindle analog output or spindle serial output is executed.

Auxiliary function lock check signal

MAFL（F004＃4）

［Classification］ Output signal.

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

［Output conditions］ 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 Spindle Speed Function

7.1 Spindle speed control mode

General **For 25i CNC System, the spindle is divided into gear spindle and analog spindle:**

1. In gear spindle mode, CNC changes S code to switch value to output to the spindle to control the spindle speed.
2. During analog spindle, changes S code to analog value to output to the spindle to control the spindle speed.

Spindle enabling signal

ENB<F001#4>

Another output related to spindle control is the spindle enable signal ENB.

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.

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(in this case, analog voltage) to the spindle is zero. The ENB signal can be used to stop the motor in such a case.

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

7.1.1 Gear spindle

General Gear spindle is defined that the actual spindle speed is controlled by the machine gear. So, the CNC outputs the switching inverted by S code to the machine gear to control the spindle speed.

Signal Spindle speed code signal

S00～S31（F022～F025）

Spindle speed strobe signal

SF（F007#2）

［Classification］ Output signal.

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

［Output condition］For the output condition and the procedure, see “Basic procedure” .

Use S code ouput of analog spindle.

Note: S00～S31 is output to S code in the binary BCD format.

S4 corresponds to 00000000, 00000000, 00000000, 00000100.

7.1.2 Analog spindle

General The analog spindle is defined that the spindle speed is controlled by the analog voltage value from CNC. So, CNC changes S code into the analog voltage value to output to the spindle of machine tool to control the spindle speed.

1. The actual output analog voltage value equals to the S value controlled by the spindle multiplying the spindle override.
2. CNC still reports the speed by S00~S31 signal but SF signal does not output.

Gear change processing：

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 gear select signal is changed, CNC simultaneously output SF signal).

Specification of gear change signal is as follows:（Table 7-1）：

Table 7-1

	No. 2 gear	No. 3 gear	Remark
GR1	Low	Low	Low: low gear
GR2	High	Medium	Medium: middle gear
GR3		High	High: high gear

Signal: Gear select signal

GR1,GR2,GR3

<F034#0～#2>

[Classification] Output signal.

[Function] These signals report PLC the selected gear.

[Output conditions] For the definition of these signals, see Gear change Mode.

Gear change select signal (input)

GR1,GR2<G028#1～#2>

[Classification] Input signal.

[Function] These signals report CNC the current selected gear.

[Output condition] For the definition of these signals, see Gear change Mode.

7.2 Spindle speed arrival signal

General The spindle speed arrival signal SAR is an input signal used as a condition for the CNC to start cutting feed. This signal is used generally when cutting feed should be started after the spindle reaches the specified speed. In this case, a sensor is used to check the spindle speed. The detected speed is sent to the CNC via the PLC. When the avoe operation is performed continuously using the PLC ladder, however, cutting feed may be started based on the SAR signal indicating the previous spindle start, if the spindle speed change command and the cutting feed command are issued at the same time.

Signal **Spindle speed arrival signal**

SAR（G029＃4）

［Classification］ Input signal.

［Function］ SAR signal controls the start of the cutting feed. When the signal is set to 0, the CNC starts the cutting feed.

［Operation］ Notifies that the CNC spindle has reached the specified spindle speed, so, the signal is set to 1 after the actual spinde speed reaches the specified value.

CNC checks SAR signal in the following states:

1. Before starting distribution of the first feed(move command) block after shifting from the rapid traverse mode to the cutting feed mode. This checking is performed after the time set by parameter No. 5113 has elapsed after the feed block is read.
2. Before starting distribution of the first feed command block after an S code is command. The wait time for checking is the same as in item 1.
3. When an S code and feed are programmed in the same block, the S code (or command output to the spindle) is output, and the SAR signal is checked after a fixed time elapses. If the SAR signal is set to “1”, feed begins.

Signal address

	＃7	＃6	＃5	＃4	＃3	＃2	＃1	＃0
G029				SAR				

7.3 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.

Procedure：

Spindle rotating→ Z tool infeed tapping→ transmit M05 to spindle→ wait for spindle to completely stop→ transmit CCW instruction→ starting point of Z tool retraction→ spindle stops rotating

So, to realize the rigid tapping, the corresponding ladder must be written to report the rotation direction of CNC external spindle.

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

［Classification］ Output signal.

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

［Output condition］ After the system executes the rigid tappind command, the system sends the signal to the servo that the CNC has entered the rigid tapping command. .

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

0：the current CNC is not during 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〕Output signal

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

〔Output condition〕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 Tool function

8.1 T command tool change

The custom specifies T command to execute the tool change in automatic run and MDI mode. After the CNC explains the T command, sends the tool number and the strobe signal specified by T command and waits PLC to complete the tool change.

9 Programming command

9.1 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 unkown. 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］ Input signal
［Function］ The signals do not provide any functions for the control unit. 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 9-1）:

Table 9-1

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］ The signals do not provide any functions for the control unit. 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 9-2):

Table 9-2

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

Ⅱ 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 tween the inner and the outer of the electric box cannot exceed 10℃.

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；

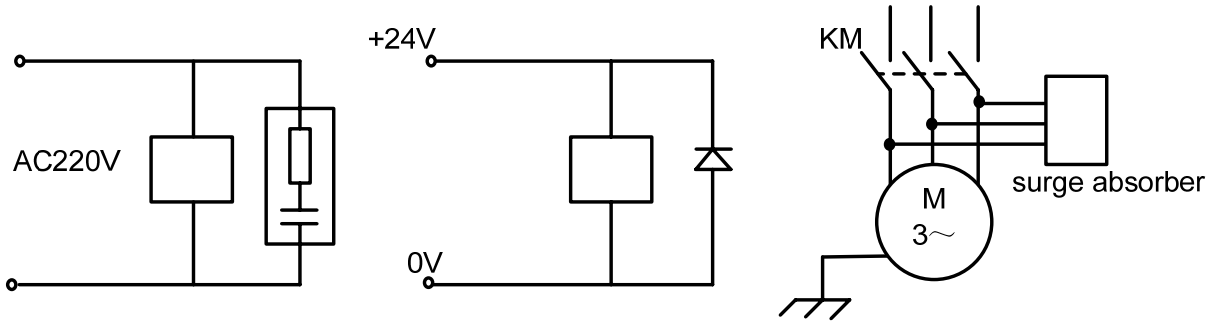
c) CNC signal should use the shield cable which should be far away from the power electromagnetic interferenece, and which should be straight, otherwise, which causes the

interference signals;

d) Parallel RC circuit in AC coil, and the RC circuit should approach the inductive load;

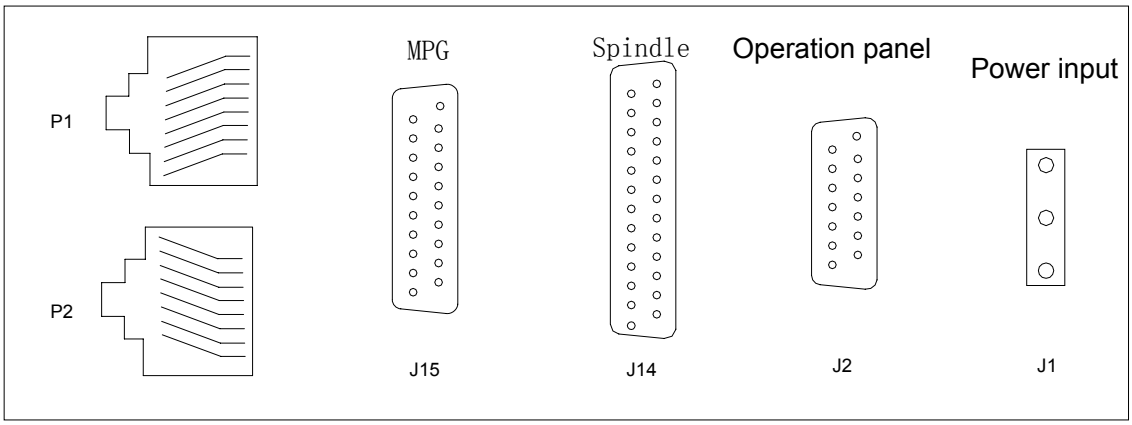
e) Inversely parallel freewheeling diode in the two terminals of DC coil;

f) Parallel surge absorber in AC motor winding terminal.



1 GSK25i System Box Interface

GSK 25i system box interface is as follows:



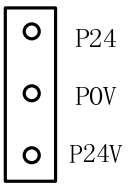
P1: Ethernet interface one	
pin explanation of one terminal of crystal plug	
pin No.	pin explanation
1	TX1+
2	TX1-
3	RX1+
4	NC
5	NC
6	RX1-
7	NC
8	NC

P2: 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

J2 :Operation panel interface			
1	P24V	2	
3	P0V	4	
5		6	RXD-
7	RXD+	8	
9		10	
11	0V	12	
13	TXD+	14	TXD-

J15: 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

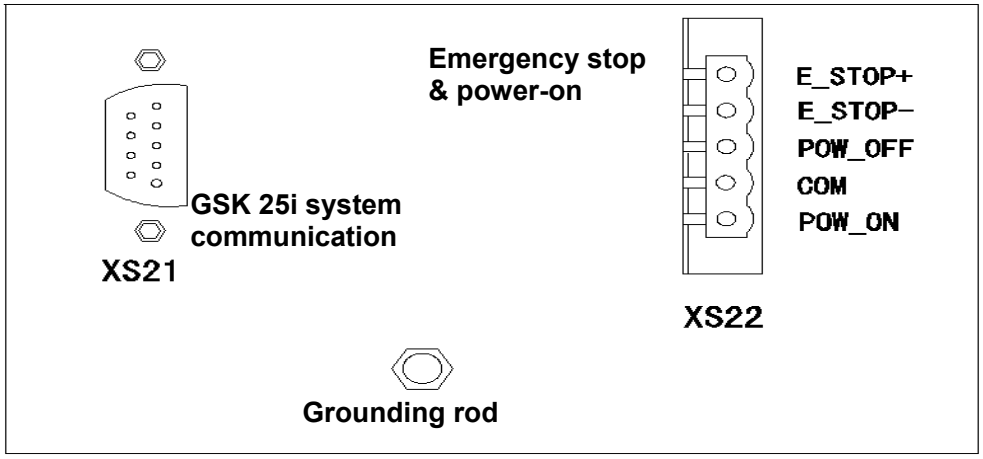
J1:Power interface



J14: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	STAO
12	SAR	25	ZSL
13	P_24V	26	ARST

2 Operation panel interface

2.1 Sketch map of machine operation panel interface



2.2 GSK 25i 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

2.3 Emergency stop power-on interface

XS22 (5-male)

Emergency stop
& power-on

1	E_STOP+
2	E_STOP-
3	POW_OFF
4	COM
5	POW_ON

3 I/O Interface

Sketch map of I/O interface

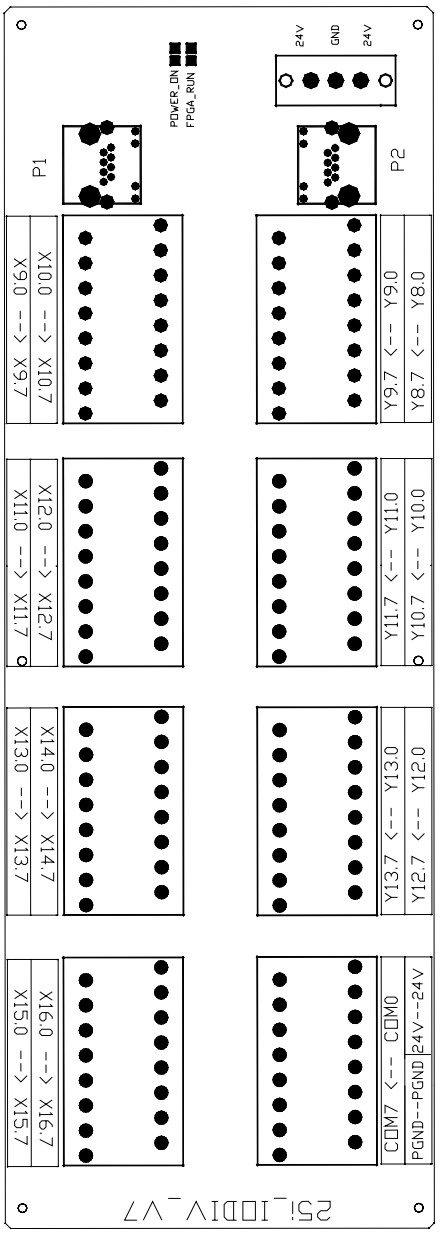


Fig. 3-1

①I/O power interface

XS34(3-male)

1	24v
2	0v
3	24v

Fig. 3-2

*0V：share with the corresponding groundi of the machine.

②P1, P2 are the industrial Ethernet interface

P1:RJ45 P2:RJ45

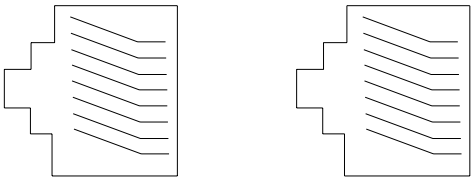


Fig. 3-3

③0V～24V terminal is the level selection one of the input signal COM, which determines whether the group of input signal is HIGH or LOW is valid：

（1）Marking COM0～COM7，orderly corresponds the common terminal of the input point X9～X16;

（2）When COM is connected with 24V，the corresponding input point being connected with LOW (0V) is valid;

（3）When COM is connected with 0V，the corresponding input point being connected with HIGH (24V) is valid.

Example:（1）COM0 is the common terminal of X9, i.e. input signal X9.0～X9.7are taken COM0 as the common terminal.

（2）When COM0 is connected with LOW（0V），the input point X9.0～X9.7being connected with HIGH（24V）is valid.

（3）When COM0 is connected with HIGH（24V） ，the input point X9.0～X9.7 being connected with LOW（0V）is valid

4 Interconnection Graph

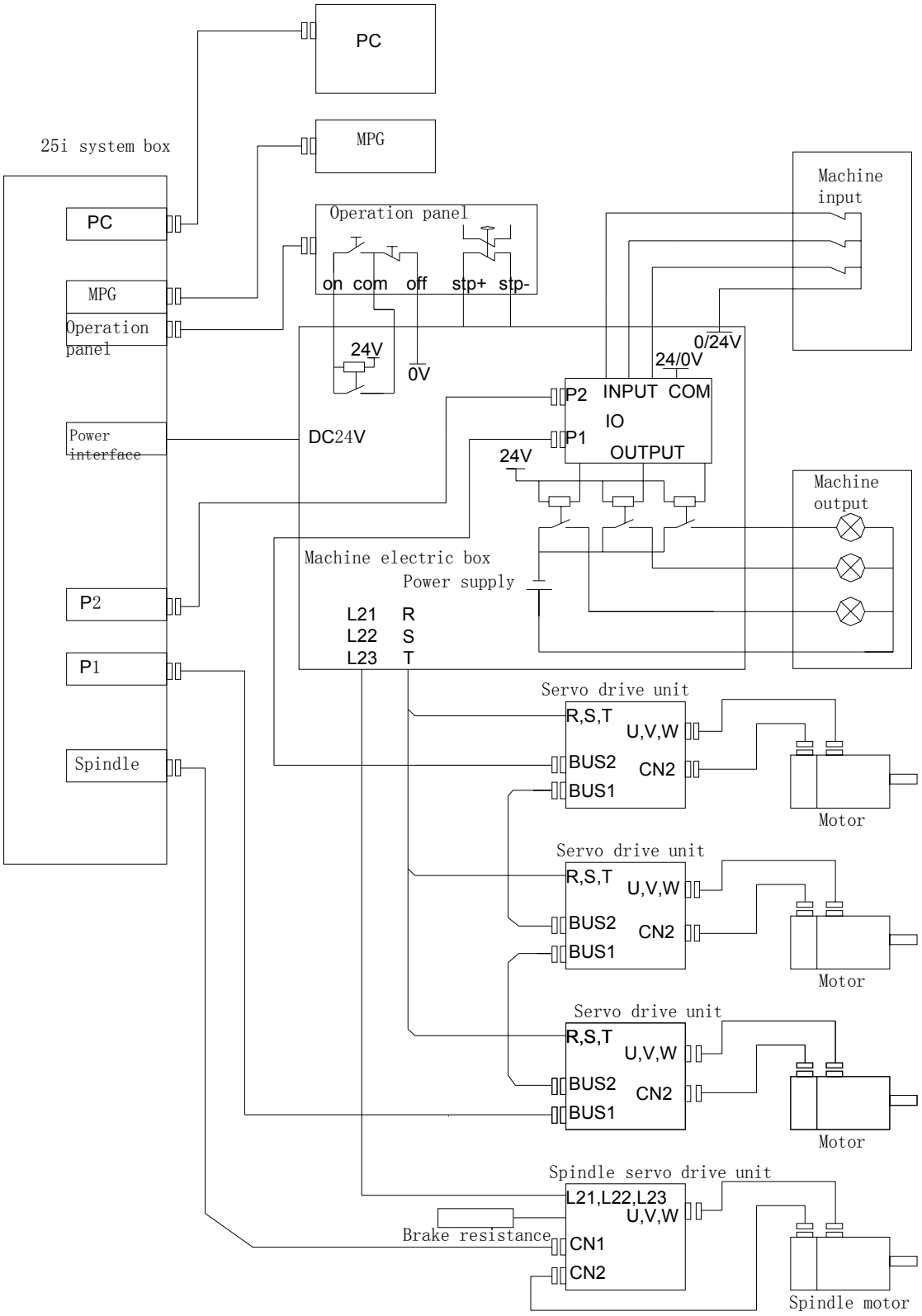


Fig. 4-1

5 PC serial communication wire

Communication connection between the system and PC RS232 is as Fig. 5-1.

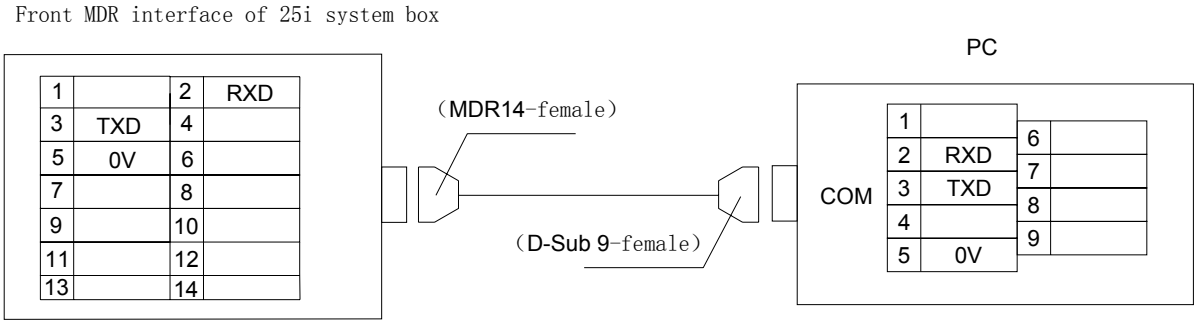


Fig. 5-1

PC communicatin cable connection is as Fig. 5-2.

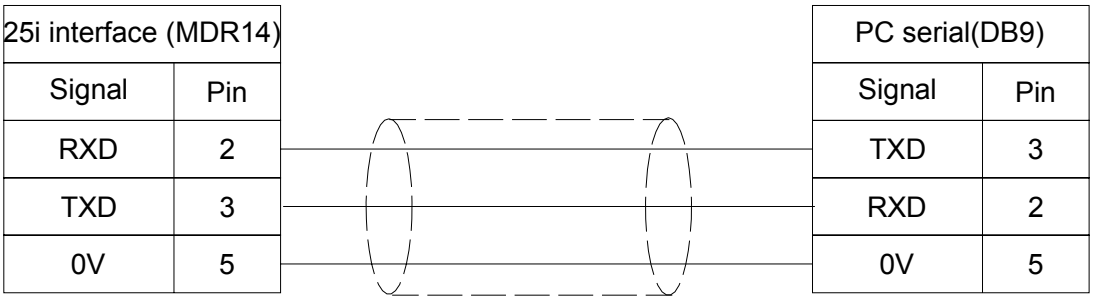


Fig. 5-2

6 MPG Wiring

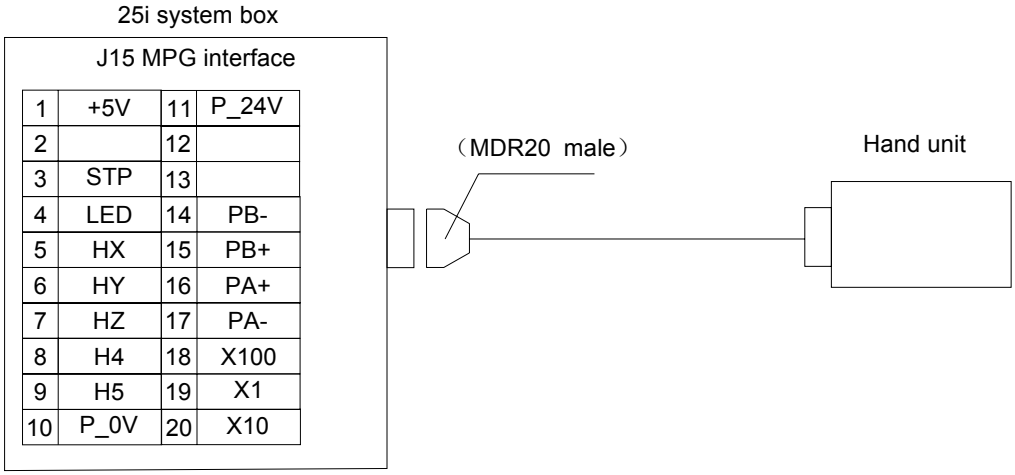


Fig. 6-1

External MPG signal connection is as Fig. 6-2.

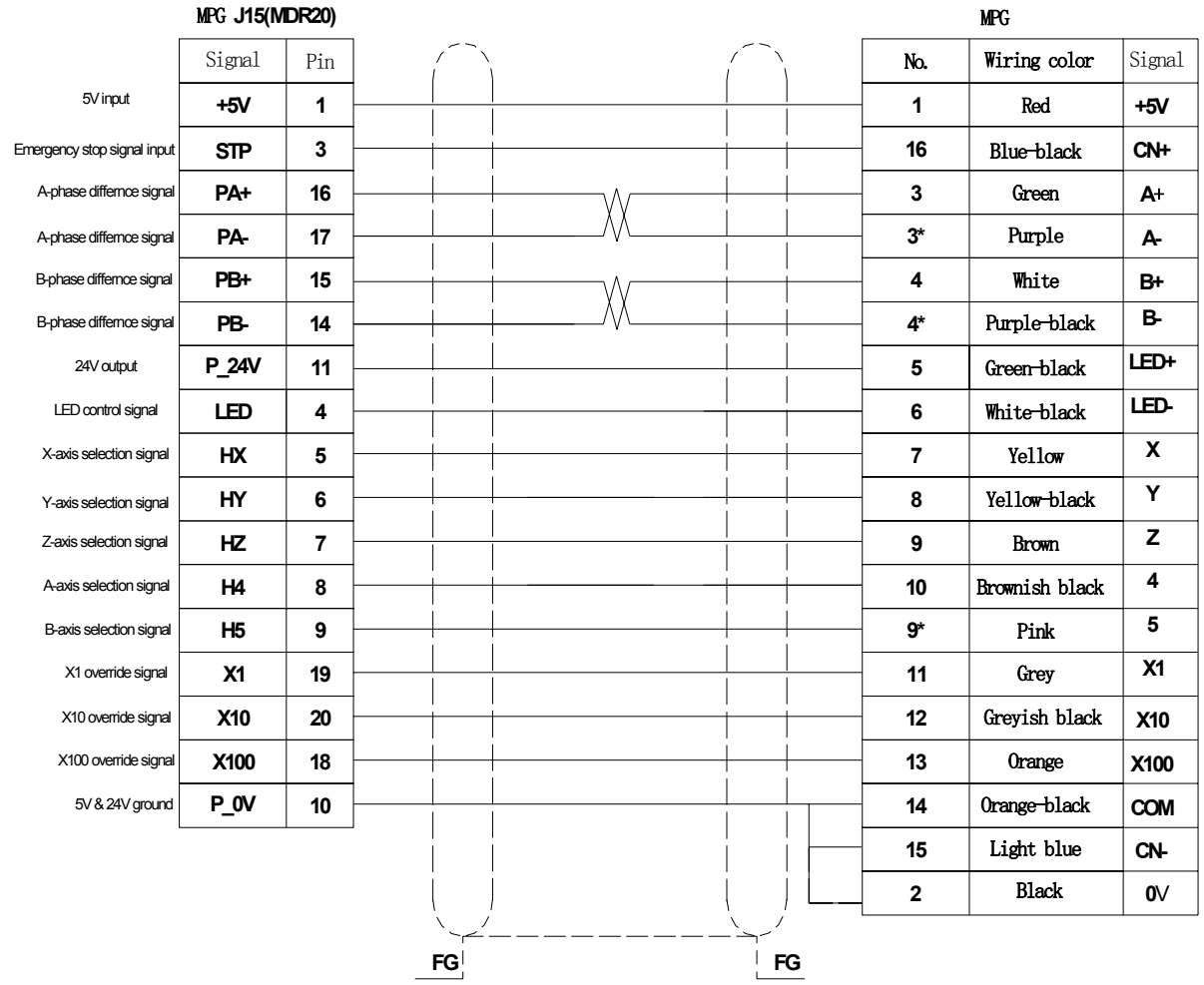


Fig. 6-2

MPG signal point definition.

Table 6-1

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

7 Operation Panel Signal Line

GSK25I CNC system communicates with the operation panel by RS485 serial interface as Fig. 7-1.

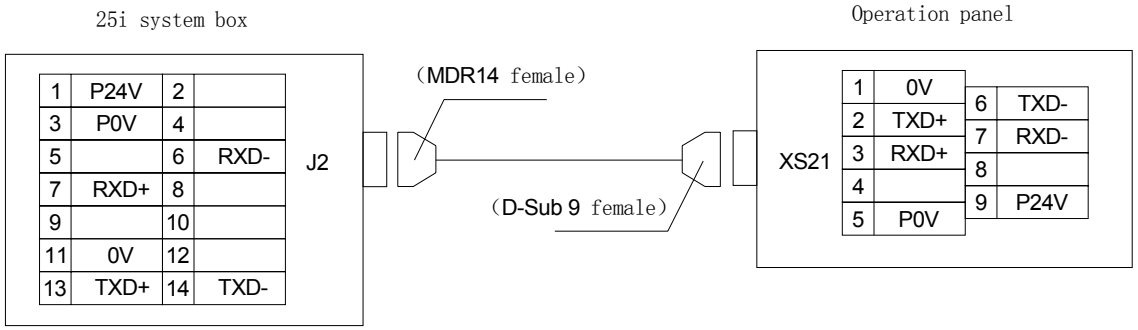


Fig. 7-1

Cable connection of operation panel is as Fig. 7-2.

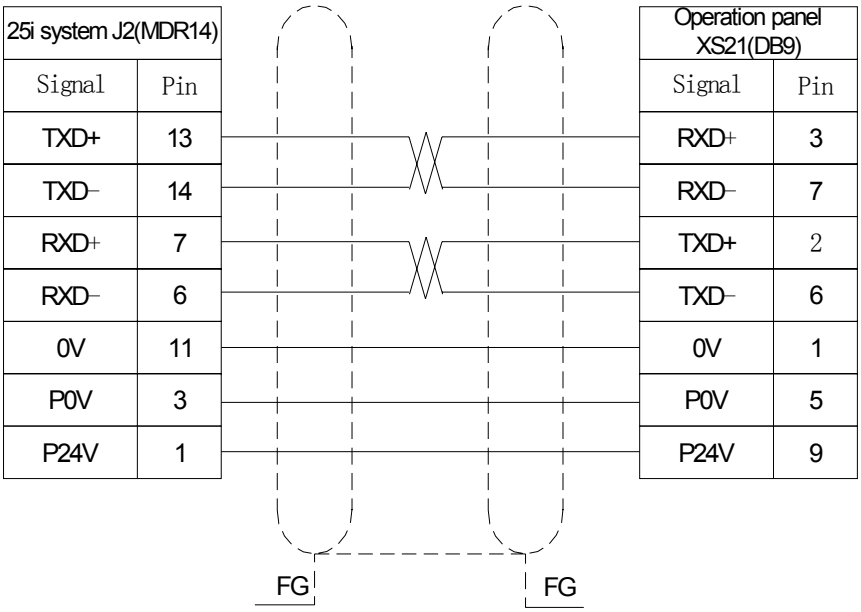


Fig. 7-2

8 Ethernet Communication Connection

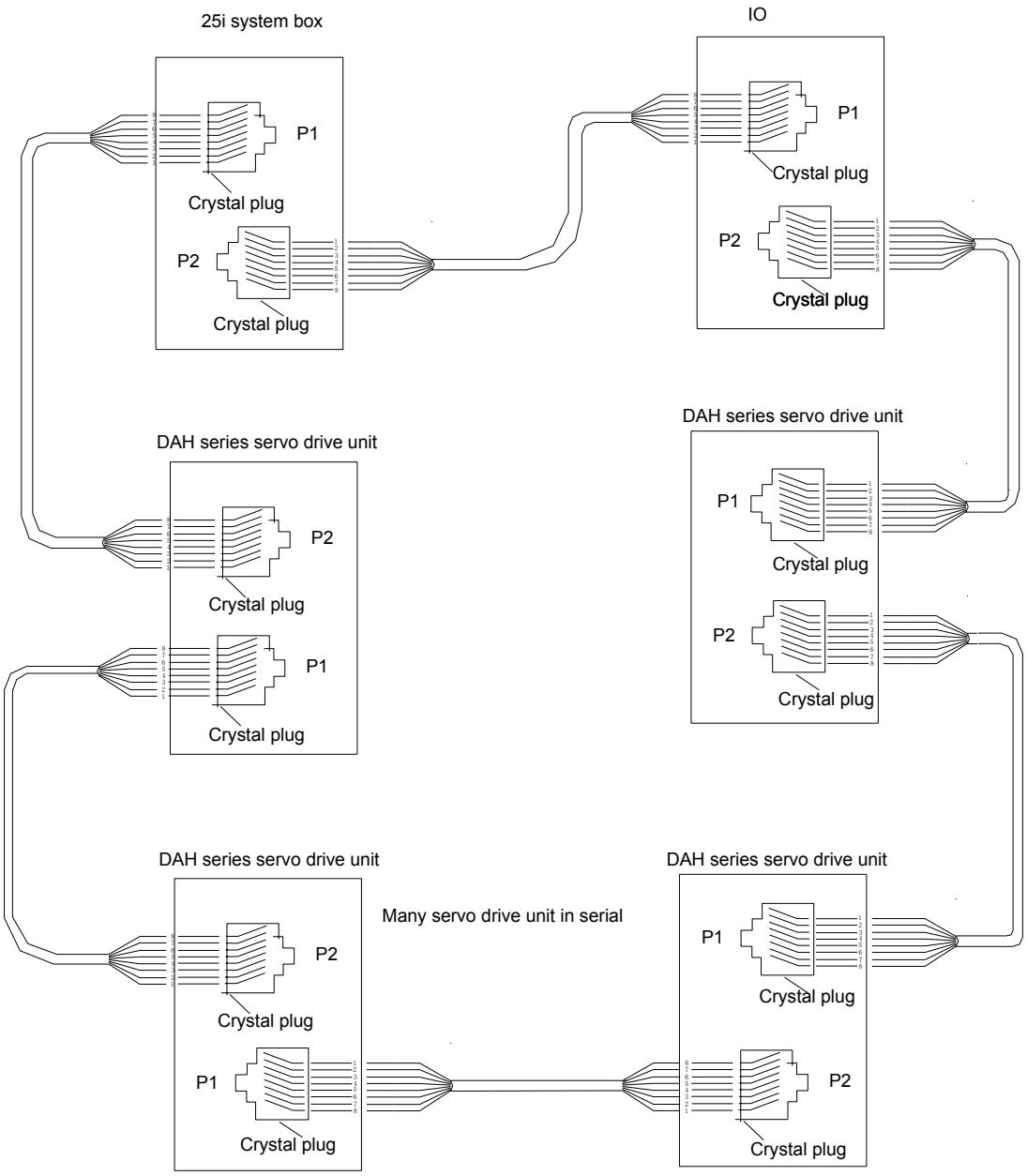
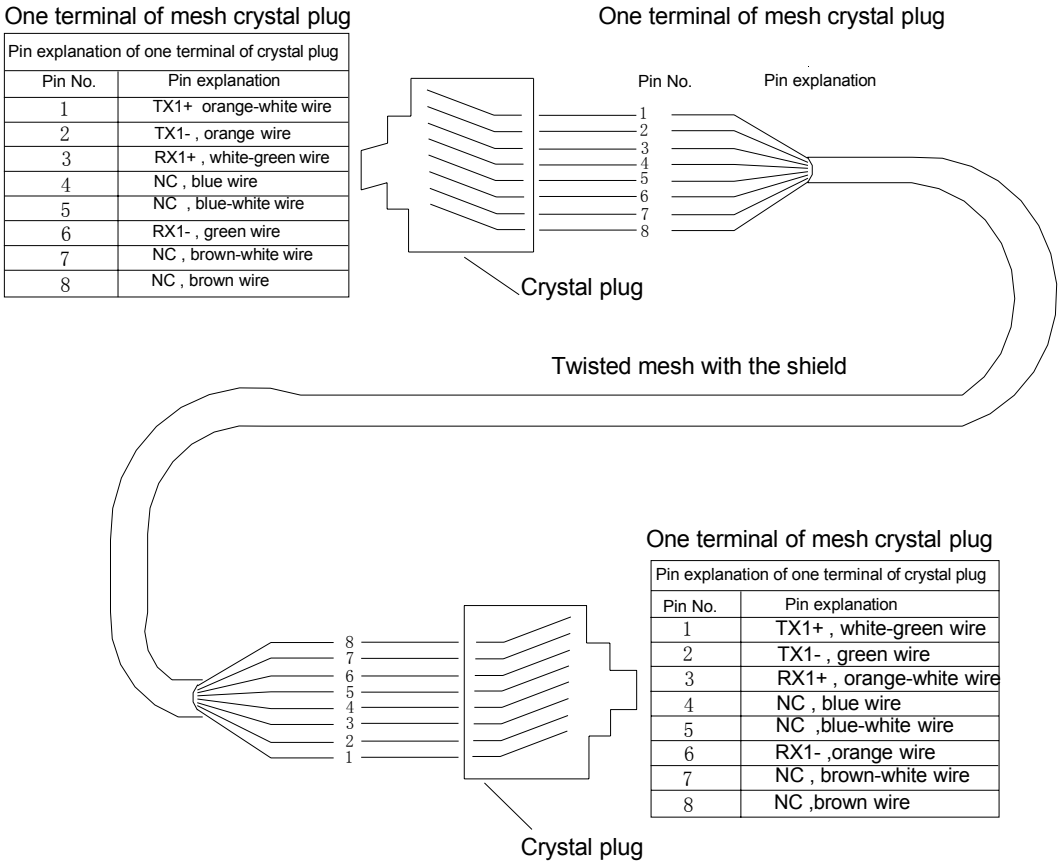


Fig. 8-1

Cable connection drawing of Ethernet

One terminal of mesh crystal plug

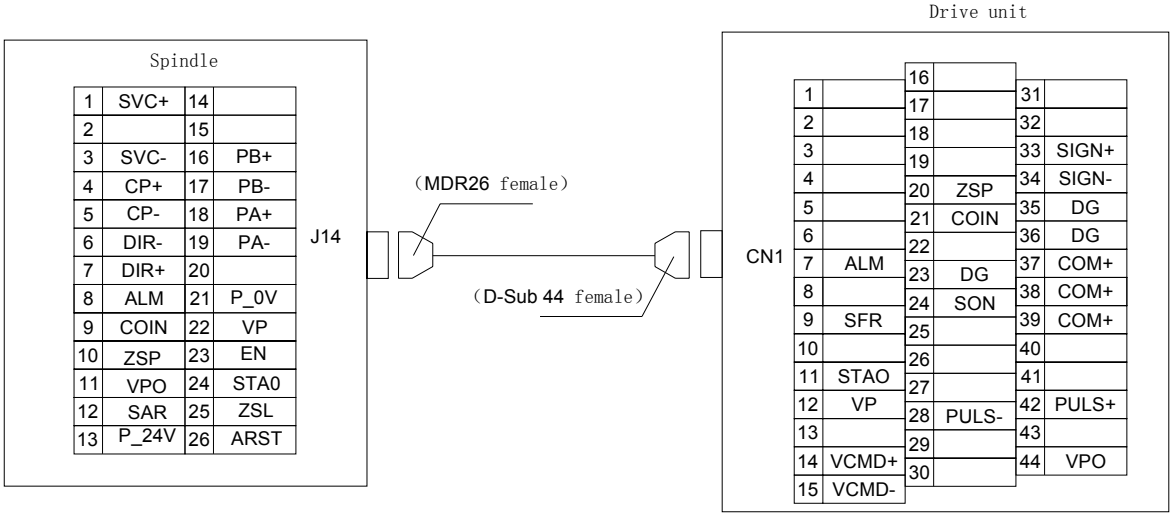
Pin explanation of one terminal of crystal plug	
Pin No.	Pin explanation
1	TX1+ orange-white wire
2	TX1- , orange wire
3	RX1+ , white-green wire
4	NC , blue wire
5	NC , blue-white wire
6	RX1- , green wire
7	NC , brown-white wire
8	NC , brown wire



Pin explanation of one terminal of crystal plug	
Pin No.	Pin explanation
1	TX1+ , white-green wire
2	TX1- , green wire
3	RX1+ , orange-white wire
4	NC , blue wire
5	NC ,blue-white wire
6	RX1- ,orange wire
7	NC , brown-white wire
8	NC ,brown wire

Fig. 8-2

9 Connected with the Spindle Servo

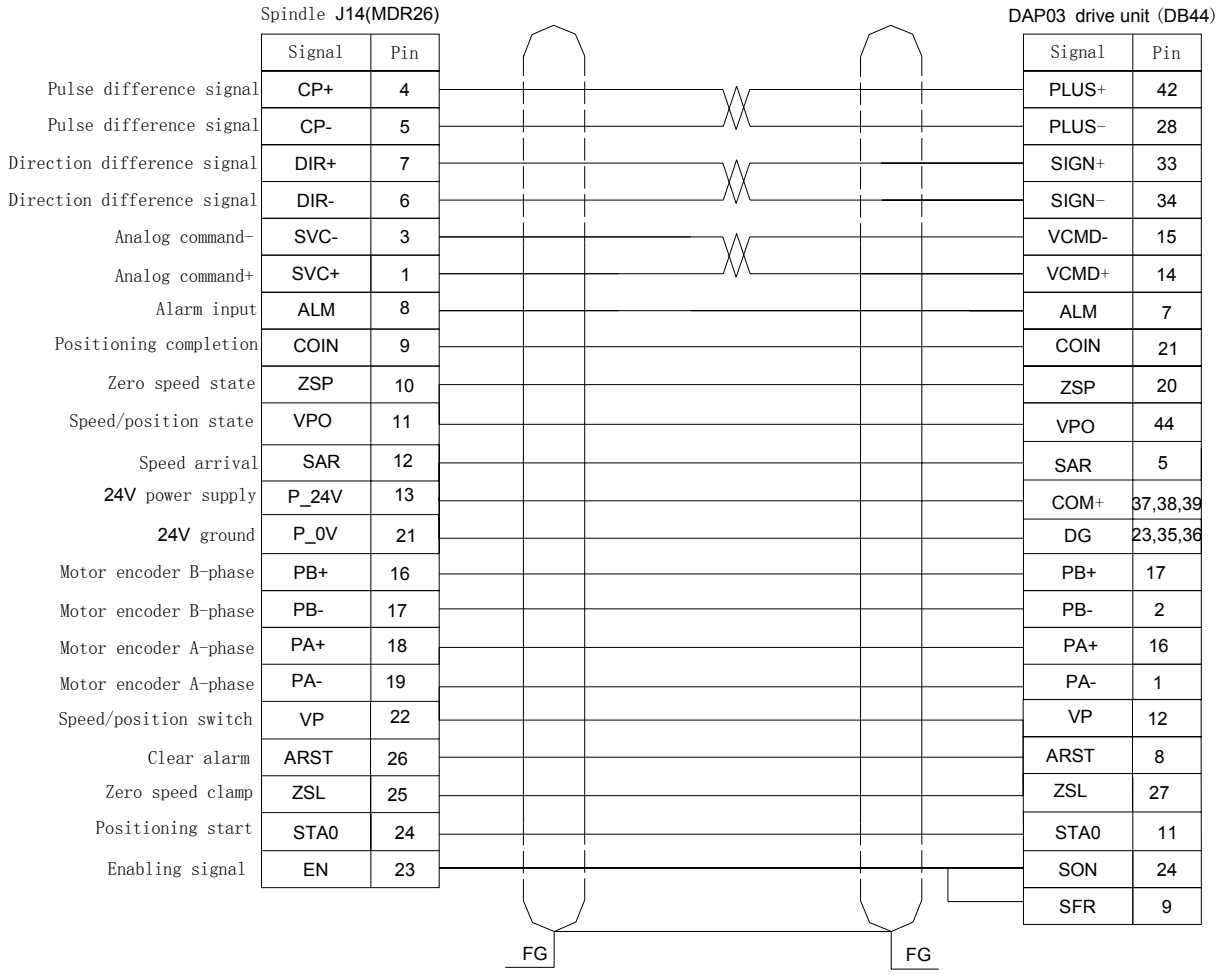


1	SVC+	14	
2		15	
3	SVC-	16	PB+
4	CP+	17	PB-
5	CP-	18	PA+
6	DIR-	19	PA-
7	DIR+	20	
8	ALM	21	P_0V
9	COIN	22	VP
10	ZSP	23	EN
11	VPO	24	STA0
12	SAR	25	ZSL
13	P_24V	26	ARST

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. 9-1

Cable connection drawing of spindle.



	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. 9-2

10 Connected with the Spindle Converter

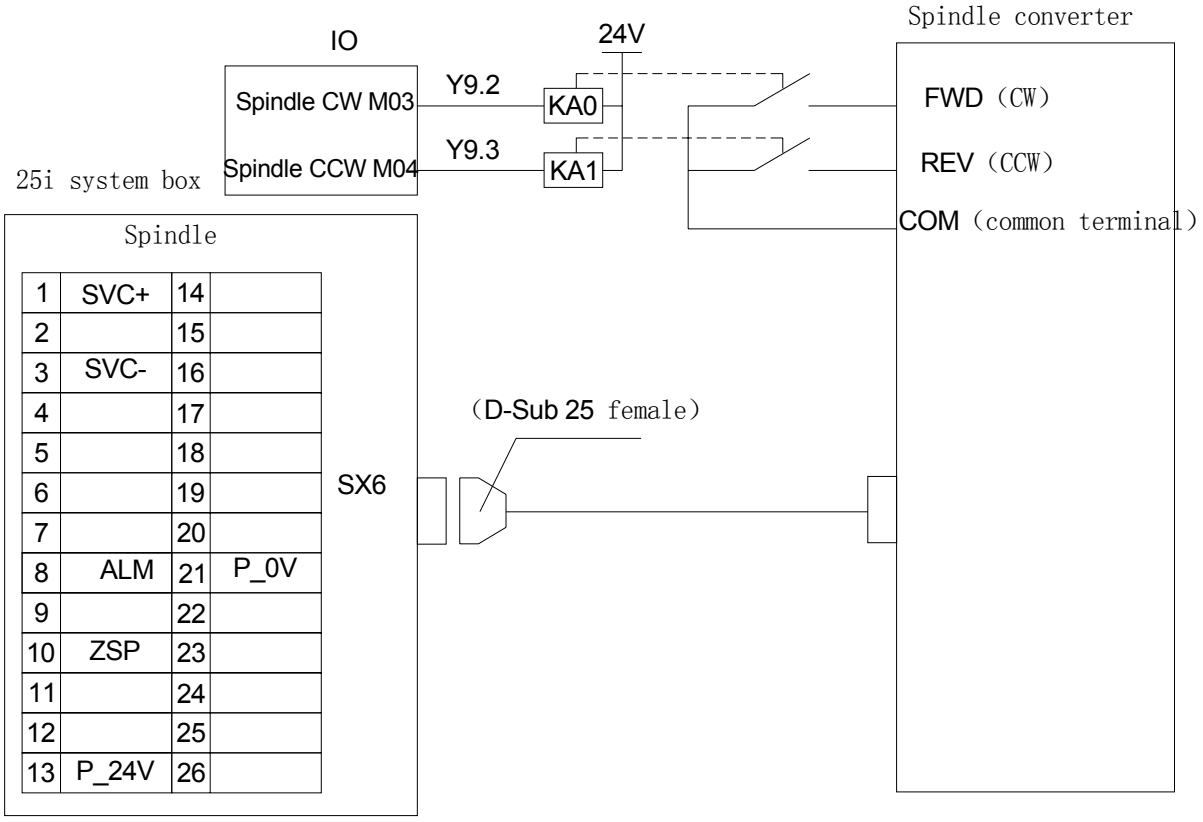


Fig. 10-1

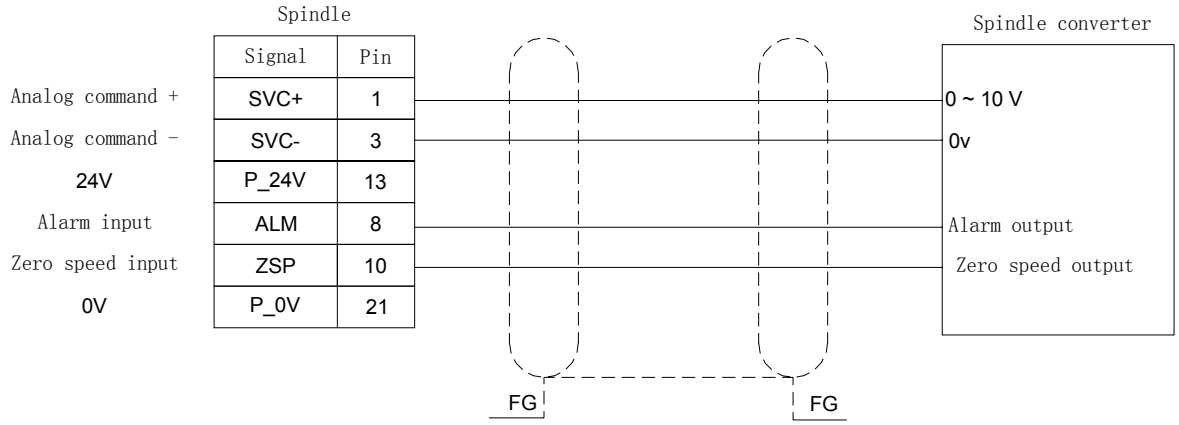


Fig. 10-2

11 Connection Method of Z Brake, System Power-on Control

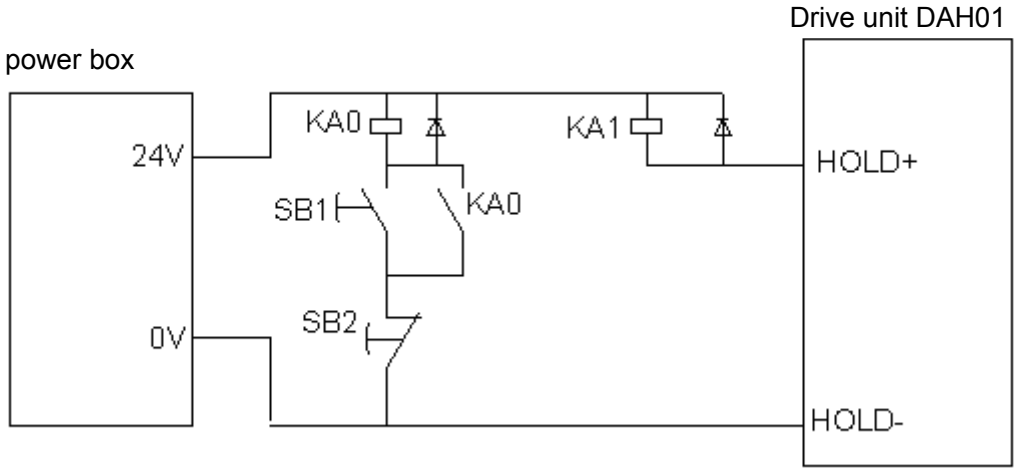


Fig. 11-1

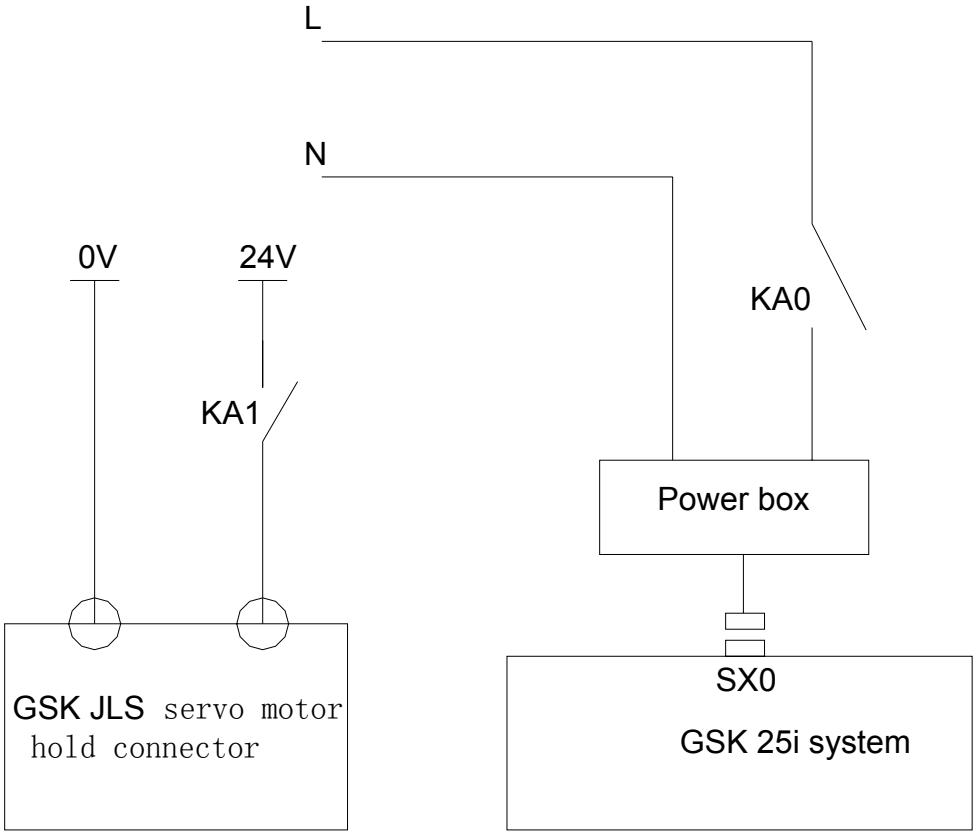


Fig. 11-2

12 I/O Input, Output Signal

12.1 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**

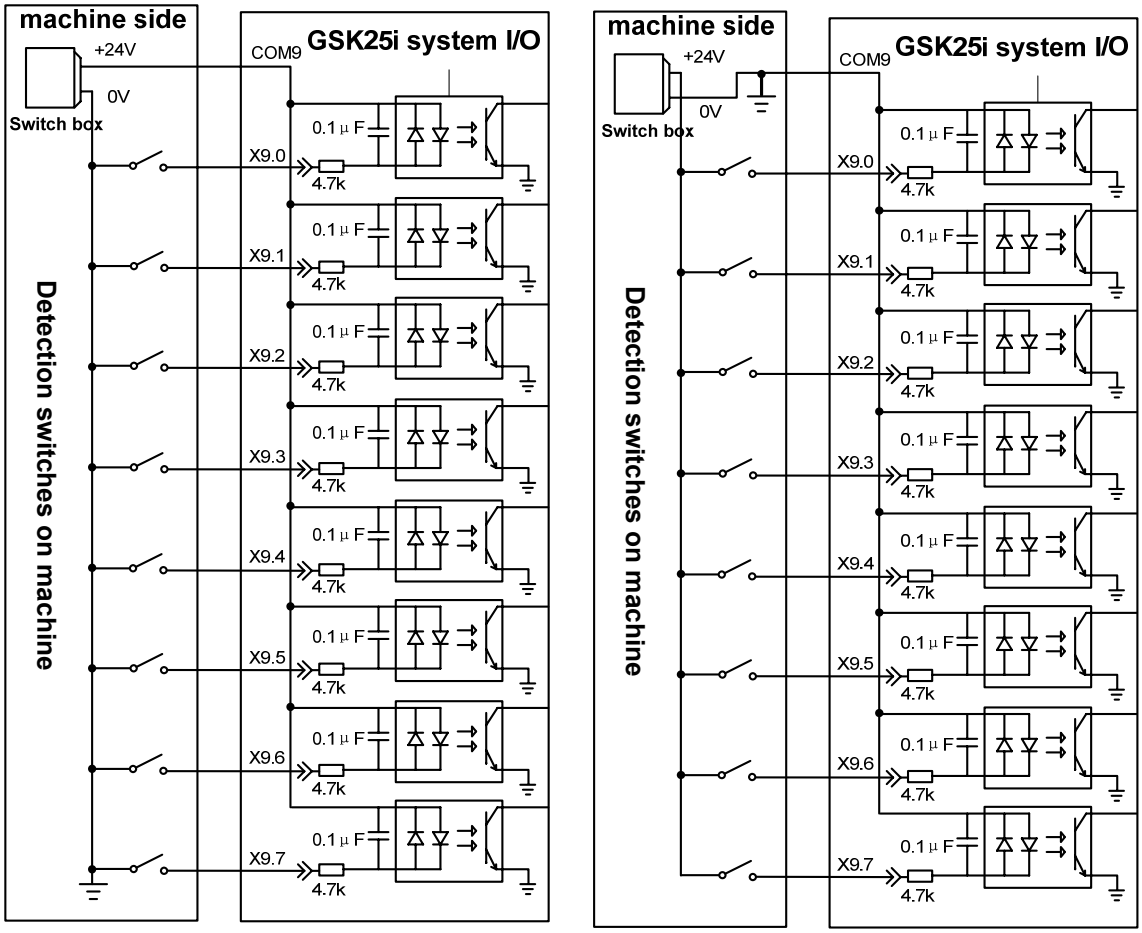


Fig. 12-1

***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.

12.2 Connection method of output signal

An output signal has 48 points using the output ULN280-3，max. flowing current of each point is 200mA.

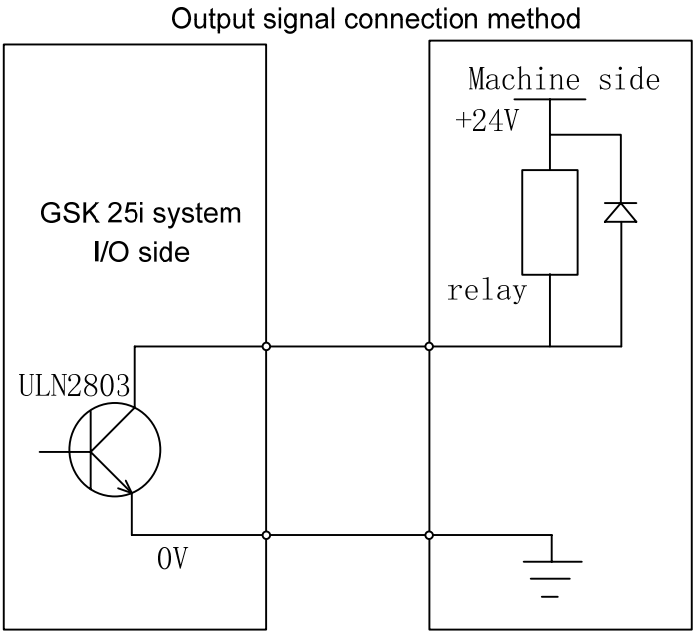


Fig. 12-2

12.3 Definition of input signal point

Table 12-1

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	Tool pot 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	GR3.M	Spindle No. 3 gear(in-position check)	I
X12.3	X12.3			I
X12.4	X12.4			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	4^{th} axis release in-position check	I
X13.1	X13.1	4CLPI	4^{th} axis clamp in-position check	I
X13.2	X13.2	4CLPI.JOG	4^{th} axis clamp button button input	I
X13.3	X13.3	4UCLPI.JOG	4^{th} axis release button input	I
X13.4	X13.4	5UCLPI	5^{th} axis release in-position check	I
X13.5	X13.5	5CLPI	5^{th} axis clamp in-position check	I
X13.6	X13.6	5CLPI.JOG	5^{th} axis clamp button button input	I
X13.7	X13.7	5UCLPI.JOG	5^{th} axis release button input	I
X14.0	X14.0	T-BARE	Current position empty tool check of tool magazine	I
X14.1	X14.1	TZER.I	Tool magazine zero return signal	
X14.2	X14.2	TCN.I	Tool count signal	I
X14.3	X14.3	TFN.I	Tool magazine forward in-position	I
X14.4	X14.4	TBK.I	Tool magazine backward in-position	I
X14.5	X14.5			
X14.6	X14.6			
X14.7	X14.7			

Note: **X15.0—X15.7, X16.0—X16.7 together have 16 input signal interfaces to the user.**

12.4 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（Output signal）	O
Y8.2	Y8.2	MGBK.O	Tool magazine backward（Output signal）	O
Y8.3	Y8.3			O
Y8.4	Y8.4	TRL.M	Release tool（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 Signal table(address order)

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#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
G043#5	DNC run selection signal	DNCI
G043#7	Manual reference point return selection signal	ZRN
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

2 Contour installation dimension drawing

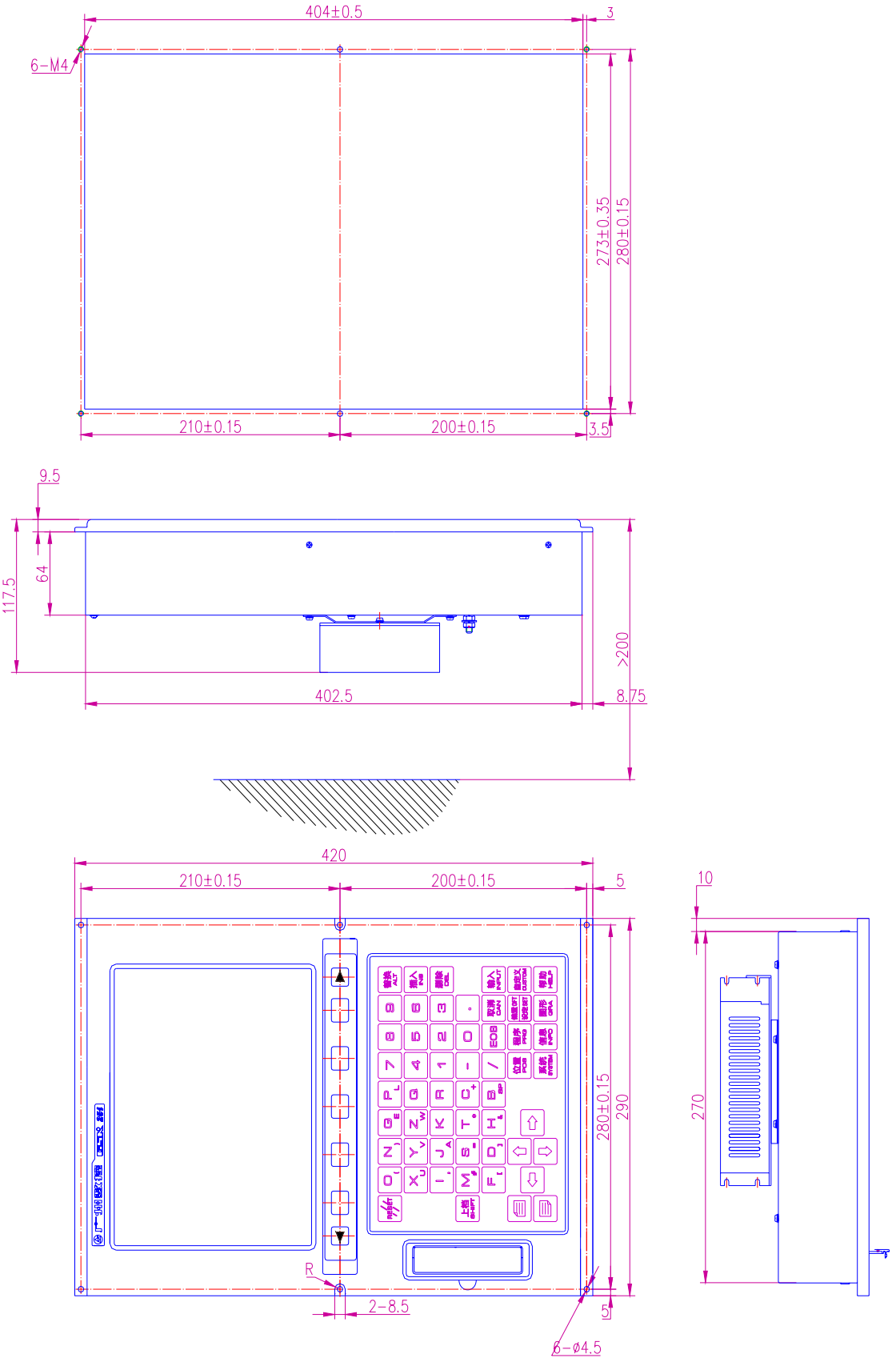


Fig. B-1 **GSK 25i system box installation dimension (unit：mm)**

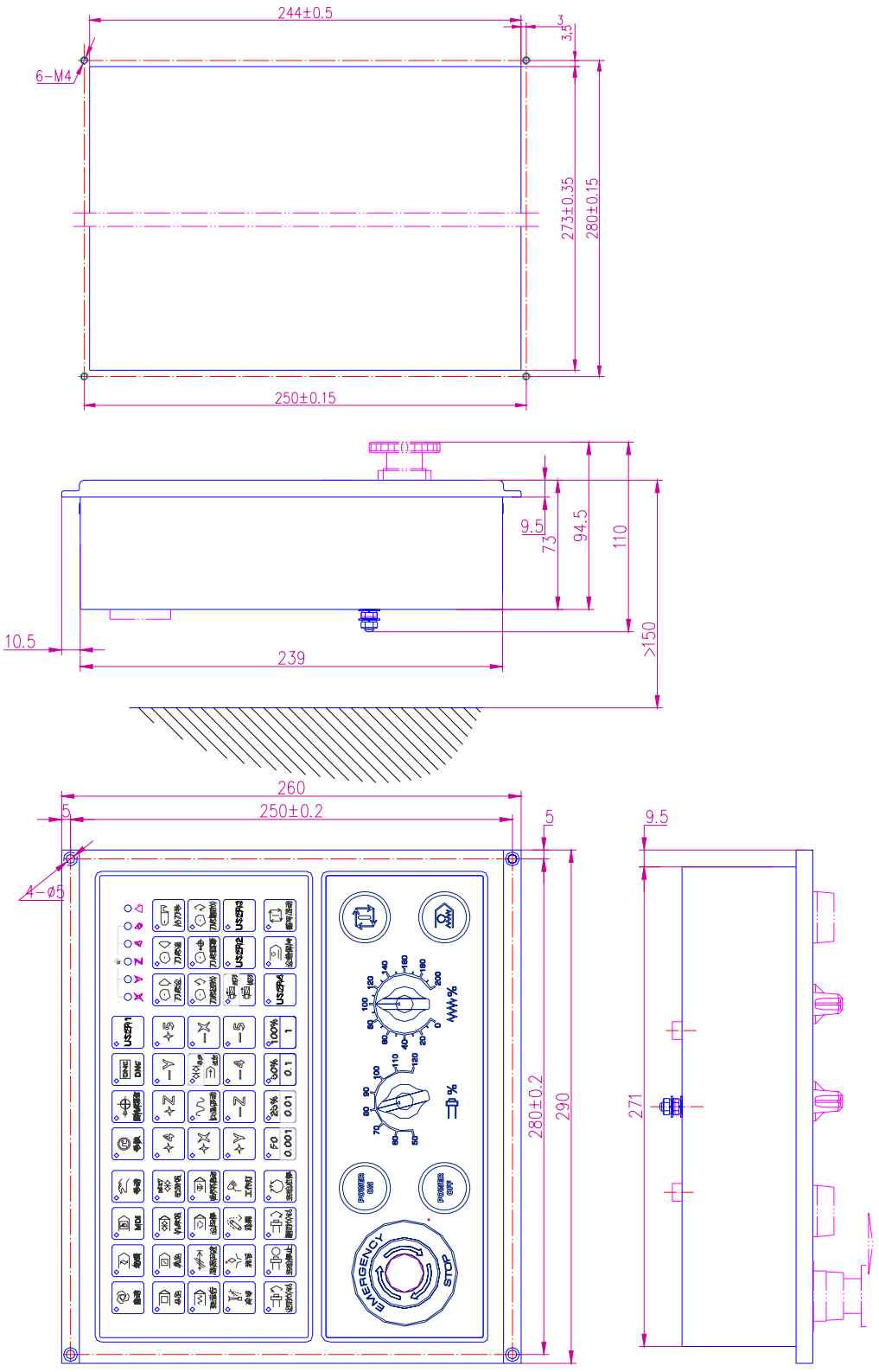


Fig. B-2 **Operation panel installation dimension(unit：mm)**

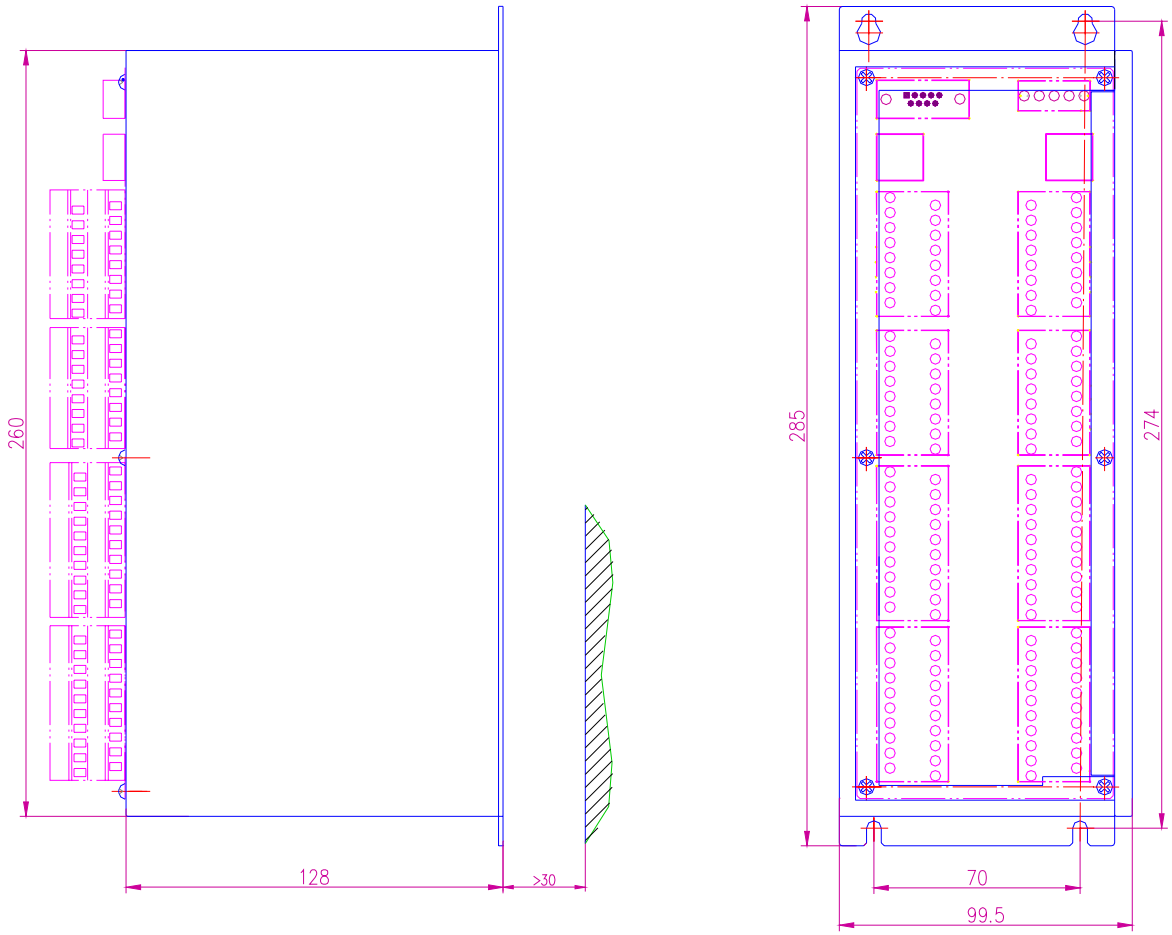


Fig. B-3 **I/O Unit installation dimension(unit：mm)**

Remark: These dimensions are subject to change without further notice. Please refer to the actual product and installation manual for details.