The user manual describes all items concerning the operation of this CNC system in detail as much as possible. However, it's impractical to give particular descriptions for all unnecessary and/or unavailable operations on the motor due to the limit of the manual, specific operations of the product and other causes. Therefore, the operations not specified in this manual may be considered impossible or unallowable.

Technological Spot Service

You can ask for spot service if you have the problems that can't be solved by telephone. We will send the engineers authorized to your place to resolve the technological problems for you.

Foreword

Dear user,

It's our pleasure for your patronage and purchase of this GSK GSK218M CNC system made by GSK CNC Equipment Co., Ltd.
The manual is "Connection and PLC Manual".

⚠ **Accident may occur by improper connection and operation! This system can only be operated by authorized and qualified personnel. Please carefully read this manual before usage!**

Special cautions:

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.

This manual is reserved by final user.

All specifications and designs herein are subject to change without further notice.
We are full of heartfelt gratitude to you for supporting us in the use of GSK's products.

Warning and precautions

Warning, notice and explanation

This manual contains the precautions to protect user and machine. The precautions are classified as warning and notice by safety, and supplementary information is regarded as explanation. Read the warnings, notes and explanations carefully before operation.

Warning

User may be hurt or equipment can be damaged if operations and steps are not observed.

Notice

Equipment may be damaged if operation instructions or steps are not observed by user.

Explanation

It is used for the supplementary information except for warning and notice.

Contents

Ⅰ Programming

1 Sequence Program Creating Process

1.1 GSK218M PLC specification

Specifications of GSK218M PLC are as follows:

Specification	GSK218M PLC
Programming method language	Ladder
Number of ladder level	2
1st level execution period	8ms
Mean processing time of basic instruction	5μs
Program capacity	4700 step
Instruction	Basic instruction +function instruction
Internal relay （R） PLC alarm detection （A） Keep memory ＊ Timer （T） ＊ Meter （C） ＊ Data table （D） ＊ Keep relay （K） ＊ Meter preset value data register （DC） ＊ Timer preset value data register （DT） Subprogram （P） Label （L）	0~511 byte 0~31 byte 0~127 byte 0~127 byte 0~255 byte 0~63 byte 0~127 byte 0~127 byte 0~99 0~99
I/O module（X） （Y）	0~63 byte 0~47 byte

1.2 What is 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 218M 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 the below figure). Thus each relay operates in sequence which can be written as a ladder diagram. (Programmed sequence).

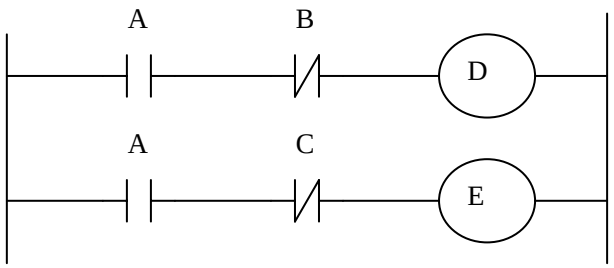


Fig. 2.1(a) circuit example

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

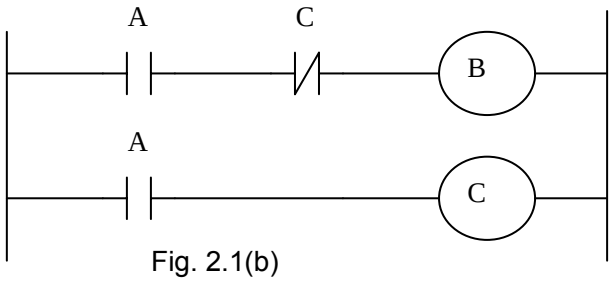


Fig. 2.1(b)

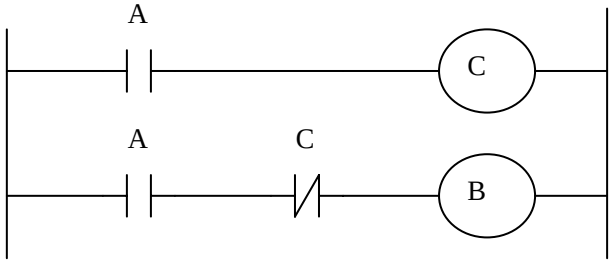


Fig. 2.1(c)

(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 B.

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)

GSK218M 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.

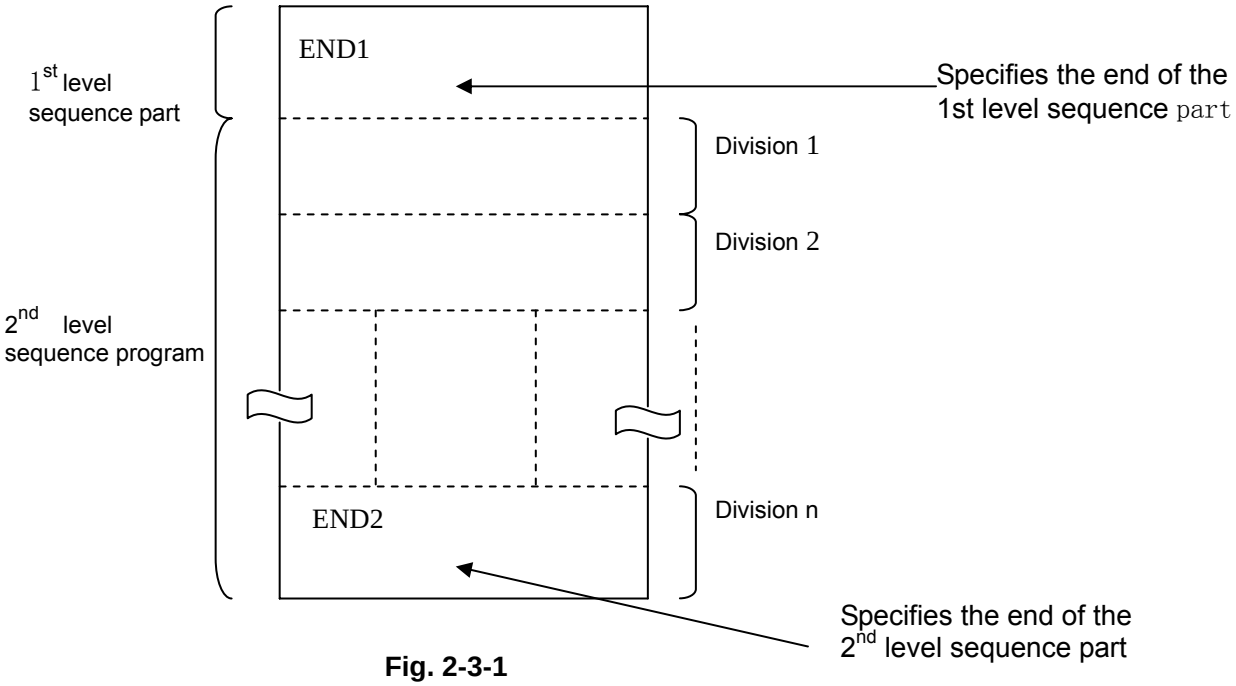


Fig. 2-3-1

218M 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.

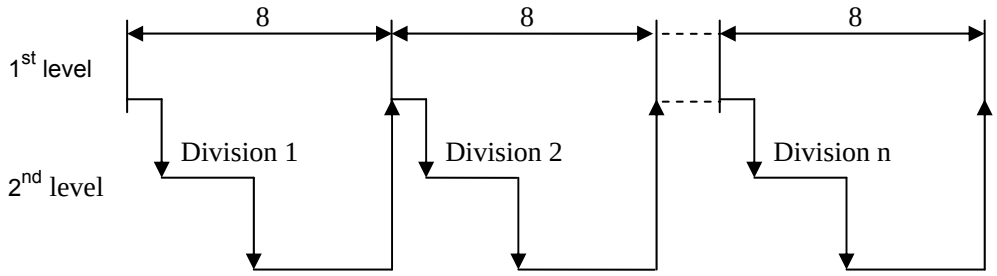


Fig.2-3-2

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.

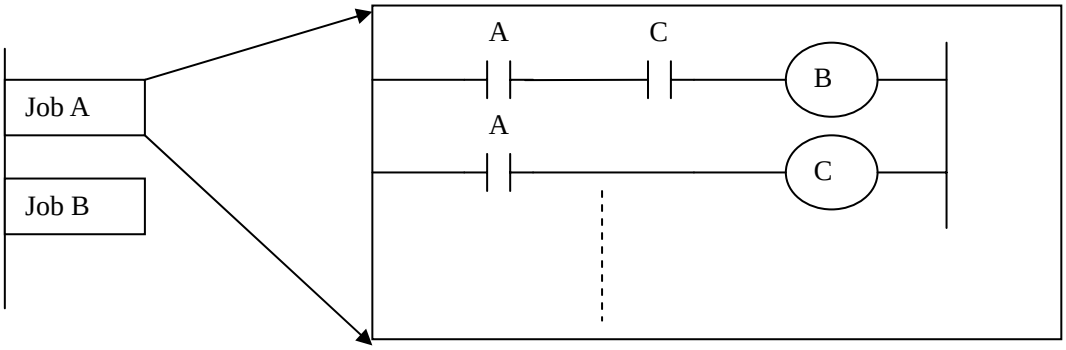


Fig.2-4-1

2) Nesting

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

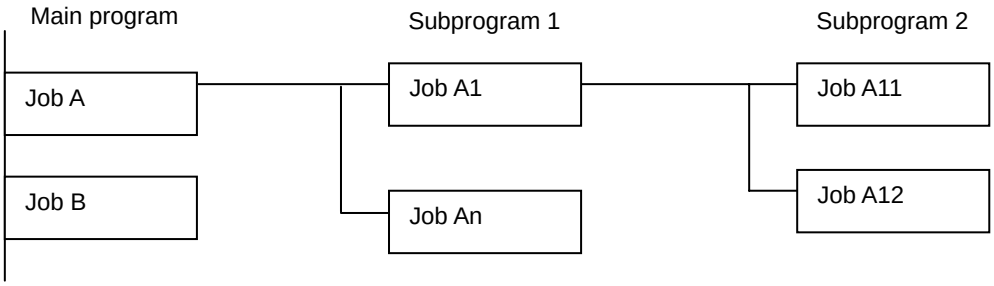


Fig.2-4-2

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 skipped.

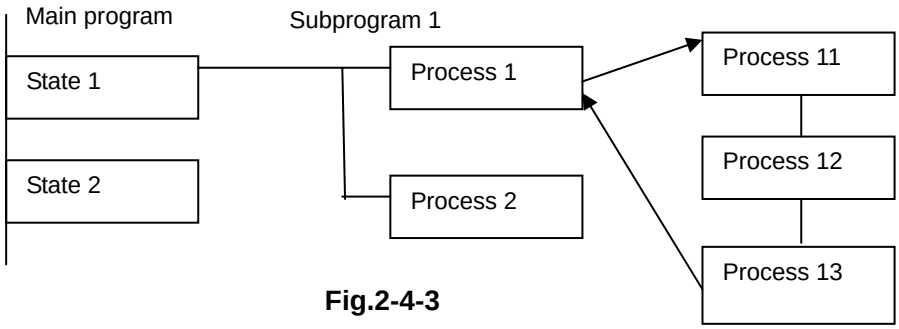


Fig.2-4-3

2.5 Processing I/O (input/output) signals

Input signal processing:

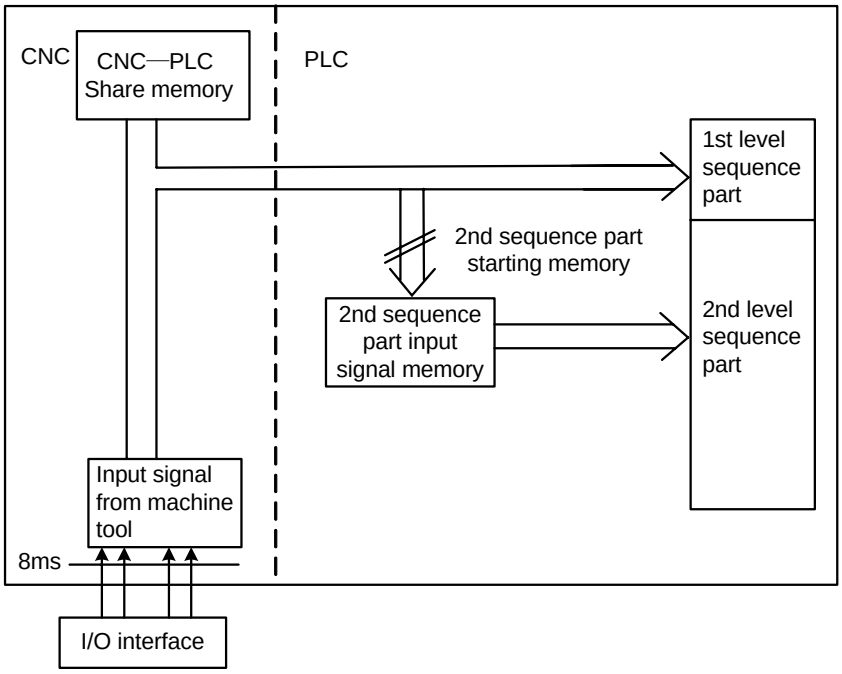


Fig.2-5-1

Output signal processing:

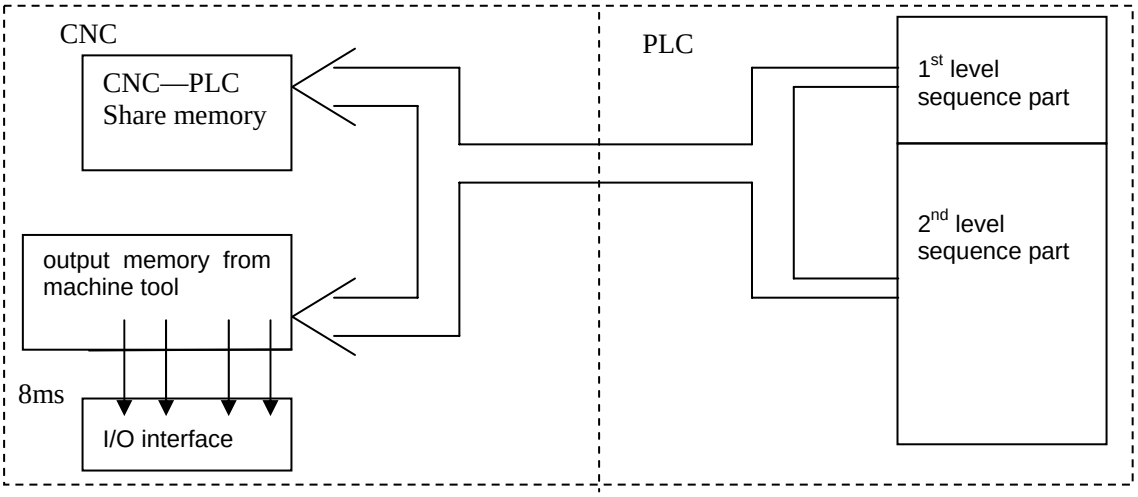


Fig.2-5-2

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 4ms. 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 2ms 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 from the PLC to the NC output memory at intervals of 4ms.

（2）Output signals to machine tool

Output signal to the machine tool from PLC output signal memory to the machine tool.

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 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.

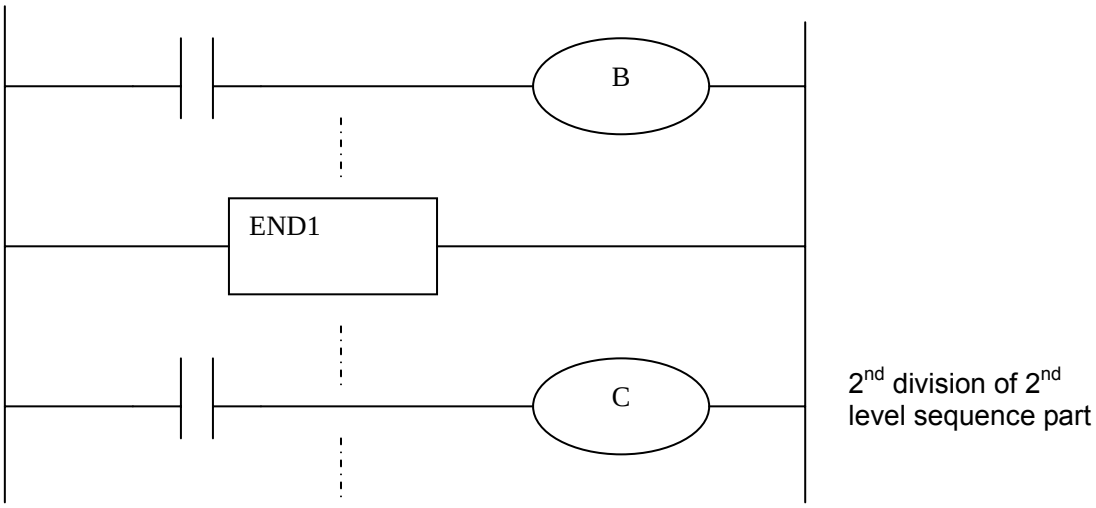


Fig.2-5-3-1

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.

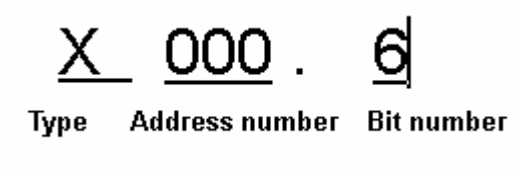
Interlocking with the sequence program is necessary. However, interlocking with the end of the electric circuit in the machine tool magnetic cabinet must not be forgotten. Even though logically interlocked with the sequence program (software), the interlock will not work when trouble occurs in the hardware 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:



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

218M PLC address type is as follows:

Table 3-1

Character	Signal description	Length
X	Machine tool→PLC(64 byte)	INT8U
Y	PLC→machine tool (64 byte)	INT8U
F	CNC→PLC(64 byte)	INT8U
G	PLC→CNC(64 byte)	INT8U
R	Internal relay(512 byte)	INT8U
D	Data register (0～255)	INT16U
DC	Counter preset data register	INT16U
C	Meter (0～127)	INT16U
A	PLC message request signal	INT8U
T	Timer (0～127)	INT16U
DT	Timer preset data register	INT16U
K	Keep relay（64 byte）	INT8U

INT8U data type is 8-bit character without signs, INT16U data type is 16-bit integer without signs.

3.1 Addresses from Machine tool to PLC（X）

X addresses of GSK218M PLC are divided into two:

1. X addresses are assigned to IO input interface of XS43, XS44 and XS45.
2. X addresses are assigned to the input press keys on MDI panel.

3.1.1 Assignment of IO module X address

The addresses are from X0 to X5. Its type is INT8U, 48 types. They are assigned to three IO input interface of XS 43, XS44 and XS45.

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 X20 to X30, 11bytes. They correspond to the press keys on MDI panel, and their signal definitions cannot be changed by user. The key signal of the MDI panel is responded by the CNC firstly, then X signal is sent to PLC. G is the operation result state signal: X（CNC）→G（from PLC to CNC）;

Addresses and press keys are as follows:

Table 3-1-2-1

Input key on operator panel	PLC address
Edit mode	X20.0
Auto mode	X20.1
MDI mode	X20.2
Machine zero return mode	X20.3
Single step mode	X20.4
Manual mode	X20.5
MPG mode	X20.6
DNC mode	X20.7
Skip	X21.0
Single block	X21.1
Dry run	X21.2
Miscellaneous(M, S, T) lock	X21.3
Machine lock	X21.4
Selection stop	X21.5
Program restart	X21.6
Spindle CW	X22.0
Spindle stop	X22.1
Spindle CCW	X22.2
Spindle negative override	X22.3
Spindle override cancel	X22.4
Spindle positive override	X22.5
Spindle jog	X22.6
Lubrication	X23.0
Cooling	X23.1
Chip removal	X23.2
Cycle start	X23.6
Feed hold	X23.7
Feedrate positive override	X24.0

Feedrate override cancel	X24.1
Feedrate negative override	X24.2
Rapid	X24.7
Rapid F0 / 0.001	X26.0
Rapid 25% / 0.01	X26.1
Rapid 50% / 0.1	X26.2
Rapid 100% / 1	X26.3
Manual feed axis +X	X27.0
Manual feed axis +Y	X27.1
Manual feed axis +Z	X27.2
Manual feed axis +4TH	X27.3
USER1	X27.4
Manual feed axis -X	X28.0
Manual feed axis -Y	X28.1
Manual feed axis -Z	X28.2
Manual feed axis -4TH	X28.3
USER2	X28.4
USER3	X28.7
Spindle orientation	X29.0
Tool magazine zero return	X29.1
Tool clamp/ release	X29.2
Tool magazine CW	X29.3
Tool magazine CCW	X29.4
tool infeed	X29.5
tool retraction	X29.6
Tool change manipulator	X29.7
Overtravel release	X30.0

3.2 Address (Y) from PLC to machine tool

Y addresses of GSK218M PLC are divided into two:

1. Y addresses are assigned to IO input interface of XS40, XS41 and XS42.
2. Y addresses are assigned to the indicators on MDI panel.

3.2.1 Assignment of IO module Y address

The addresses are from Y0 to Y5. Its type is INT8U, 48 types. They are assigned to three IO input interface of XS40, XS41 and XS42.

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 Y12 to Y19, 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 3-2-2-1

Output key on operator panel	PLC address
Edit key indicator	Y12.0
Auto key indicator	Y12.1
MDI key indicator	Y12.2
Machine zero return indicator	Y12.3
Single step key indicator	Y12.4
Manual key indicator	Y12.5
MPG key indicator	Y12.6
DNC key indicator	Y12.7
Spindle CW indicator	Y13.0
Spindle CCW indicator	Y13.1
Spindle override cancel indicator	Y13.2
X machine zero return indicator	Y13.3
Y machine zero return indicator	Y13.4
Z machine zero return indicator	Y13.5
4TH machine zero indicator	Y13.6
DEF(program restart) indicator	Y13.7
Skip indicator	Y14.0
Single block indicator	Y14.1
Dry run indicator	Y14.2
Miscellaneous(M, S, T) lock indicator	Y14.3
Machine tool lock indicator	Y14.4
Machine tool lamp indicator	Y14.5
Lubrication indicator	Y14.6
Cooling indicator	Y14.7
Chip removal indicator	Y15.0
Feedrate override cancel indicator	Y15.1
Rapid switch indicator	Y15.2
0.001/F0 indicator	Y15.3
0.01/25% indicator	Y15.4
0.1/50% indicator	Y15.5
1/100% indicator	Y15.6
Spindle orientation indicator	Y15.7
Tool magazine zero return indicator	Y16.0
Tool magazine CCW indicator	Y16.1
Tool magazine CW indicator	Y16.2

Tool magazine infeed indicator	Y16.3
Tool magazine retraction indicator	Y16.4
Tool magazine clamp indicator	Y16.5
Tool change manipulator indicator	Y16.6
USER3（tool change position）indicator	Y16.7
+X indicator	Y17.0
+Y indicator	Y17.1
+Z indicator	Y17.2
+4TH indicator	Y17.3
USER1 indicator (+TH5)	Y17.4
-X indicator	Y18.0
-Y indicator	Y18.1
-A indicator	Y18.2
-4TH indicator	Y18.3
USER2 key indicator (-TH)	Y18.4
Overtravel completion indicator	Y19.0
Feed hold indicator	Y19.1
Cycle start indicator	Y19.2
Tool magazine zero return indicator	Y19.3
Optional stop indicator	Y19.4

3.3 Address (G) from PLC to CNC

Addresses are from G0 to G63. Type: INT8U, 64 bytes.

For signals, see Volume Function.

Key signals on the operator panel

Table 3-3-1

Key signal on operator panel	PLC address
Edit mode	G20.0
Auto mode	G20.1
MDI mode	G20.2
Machine zero return mode	G20.3
Single step mode	G20.4
Manual mode	G20.5
MPG mode	G20.6
DNC mode	G20.7
Skip	G21.0
Single block	G21.1
Dry run	G21.2
Miscellaneous (M,S, T) lock	G21.3
Machine tool lock	G21.4

Selection stop	G21.5
Program restart	G21.6
Spindle CCW	G22.0
Spindle stop	G22.1
Spindle CW	G22.2
Spindle negative override	G22.3
Spindle override cancel	G22.4
Spindle positive override	G22.5
Spindle jog	G22.6
Lubrication	G23.0
Cooling	G23.1
Chip removal	G23.2
Cycle start	G23.6
Feed hold	G23.7
Feedrate positive override	G24.0
Feedrate override cancel	G24.1
Feedrate negative override	G24.2
Rapid switch	G24.7
Rapid F0	G25.0
Rapid 25%	G25.1
Rapid 50%	G25.2
Rapid 100%	G25.3
Incremental step 0.001	G26.0
Incremental step 0.01	G261
Incremental step 0.1	G26.2
Incremental step 1	G26.3
Manual feed axis +X	G27.0
Manual feed axis +Y	G27.1
Manual feed axis +Z	G27.2
Manual feed axis +4TH	G27.3
Manual feed axis -X	G28.0
Manual feed axis -Y	G28.1
Manual feed axis -Z	G28.2
Manual feed axis -4TH	G28.3
Spindle orientation	G29.0
Tool magazine zero return	G29.1
Tool clamp/release	G29.2
Tool magazine CCW	G29.3
Tool magazine CW	G29.4

Tool infeed	G29.5
Tool retraction	G29.6
Tool change manipulator	G29.7
Overtravel release	G30.0

The bit signals of G63 bytes are internally used by the system, G63.0, G63.1 and G63.2 are separately the system internal response signals for M, S, T code completion.

3.4 Address (F) from CNC to PLC

Addresses are from F0 to F63. Type: INT8U, 64 bytes.
For signals, see Volume Function.

3.5 Internal relay address（R）

The address area is cleared to zero when the power is turned on. R255.0~R255.7 are used by the system, cannot be defined by the user. the signal of R255 is set to 1 when the user starts the PLC or restarts it, it is used to initialize the user setting signals, the signal of R255 is reset to 0 after the ladder is finished for the first pass.

Type: INT8U, with 512 bytes.

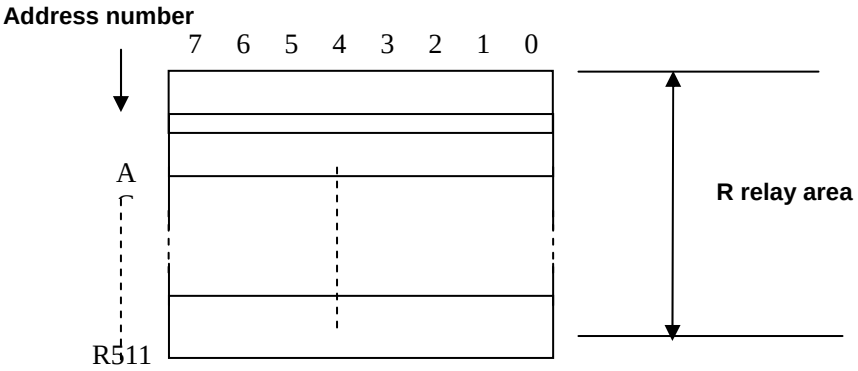


Fig. 3-5-1

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. K000~~K005 are used by the system, which is used for storing the PLC parameter. It is convenience for the user to control the PCL in the CNC.

Type: INT8U, with 64 bytes.

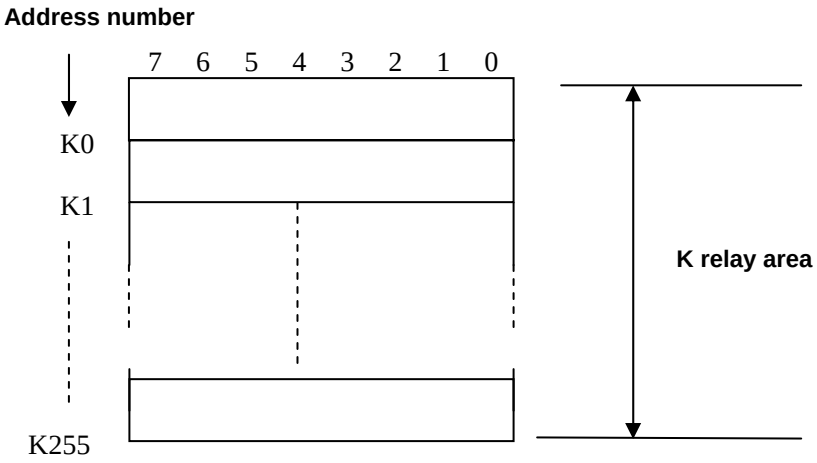


Fig. 3-6-1

Note: when PLC address K K005.2=1, PLC enters the debug mode, cancel all the external alarm signals and machine interlock signals, the tool change instruction can't be executed. The parameter can be modified under fully understanding it to avoid the machine damage or the person accidence.

3.7 Addresses(A) for message selection displayed on CRT

The address area is cleared to zero when the power is turned on.
Type: INT8U, with 32 bytes.

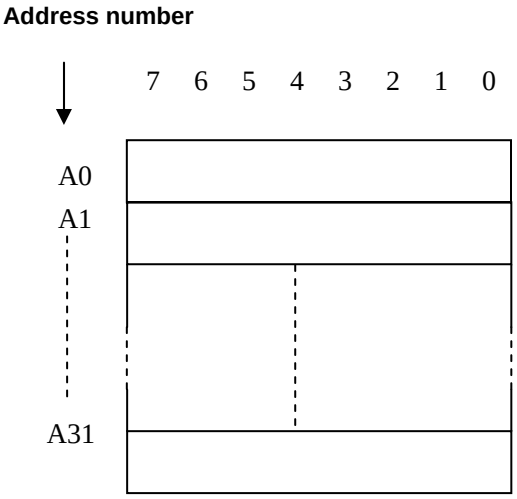


Fig. 3-7-1

3.8 Address of meter（C）

The area is used as storing current counting value in meter. The address area is cleared to zero when the power is turned on.
Type: 128 addresses.

3.9 Meter preset address(DC)

The address area is used to store the meter preset value. Since this area is nonvolatile, the content of the memory do not disappear even when the power is turned off.
Type: 128 addresses. The setting value of DC can not be written, but read.

3.10 Timer addresses（T）

The area is used as storing current counting value in timer. The initial data is the preset value when the system is turned off. When preset value is 0, the current data is preset value.
Type: 128 addresses.

3.11 Addresses of timer preset value（DT）

The address area is used as storing preset value. Since this area is nonvolatile, the content of the memory do not disappear even when the power is turned off.
Type: 128 addresses. The setting value of DT can not be written, but read.

3.12 Address of data table（D）

The content of the memory do not disappear even when the power is turned off.
Type: 256 addresses. D240～247 are for tool magazine. D240～247 are used by the system and cannot be defined by the user.

3.13 Label address（L）

Label addresses are used to specify jump destination labels and LBL labels in JMPB instructions.
Range: 0～99

3.14 Subprogram numbers（P）

Subprogram numbers are used to specify jump destination subprogram labels and SP instruction subprogram labels in CALL instruction.
Range: 0～99

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, but currently the system does not support it). 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.
GSK218M basic instructions are as follows:

Table 4-1

Instruction	Function
RD	Shifts left the content by one bit in register and sets the state of a specified signal in ST0.
RD.NOT	Shifts left the content by one bit in register and sets the logic state of a specified signal in ST0.
WRT	Outputs the results of logic operation to a specified address.
WRT.NOT	Inverts the results of logical operations and output it to a specified address.
AND	Induces a logical product.
AND.NOT	Inverts the state of a specified signal and induces a logical product.
OR	Induces a logical sum.
OR.NOT	Inverts the state of a specified signal and induces a logical sum.
OR._STK	Sets the logical sum of ST0 and ST1, and shifts the stack register right by one bit.
AND.STK	Sets the logical product of ST0 and ST1, and shifts the stack register right by one bit.

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

Instructions and functions

Table 4-1-1

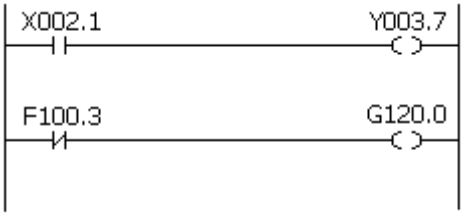
Instruction	Function
RD	Shifts left the content by one bit in register and sets the state of a specified signal in ST0.
RD.NOT	Shifts left the content by one bit in register and sets the logic state of a specified signal in ST0.

WRT	Outputs the results of logic operation to a specified address.
WRT.NOT	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




```
RD     X002.1
WRT    Y003.7
RD.NOT  F100.3
WRT    G120.0
```

Fig. 4-1-1

4.2 AND, AND.NOT instructions

Instructions and functions

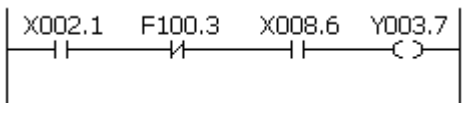
Table 4-2-1

Instruction	Function
AND	Induces a logical product.
AND.NOT	Inverts the state of a specified signal and induces a logical product.

Instruction specifications:

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

Programming




```
RD     X002.1
AND.NOT  F100.3
AND    X008.6
WRT    Y003.7
```

Fig. 4-2-1

4.3 OR, OR.NOT instructions

Instructions and functions

Table 4-3-1

Instruction	Function
OR	Induces a logical sum.
OR.NOT	Inverts the state of a specified signal and induces a logical sum.

Instruction specification:

- OR, OR_NOT can connect with one contact in parallel.
- OR, OR.NOT begins from their step, which can connect with the mentioned step in parallel.

Programming:


```
RD     X002.1
OR._NOT   F100.3
WRT    Y003.7
```

Fig. 4-3-1

4.4 OR. STK instruction

Instruction and function:

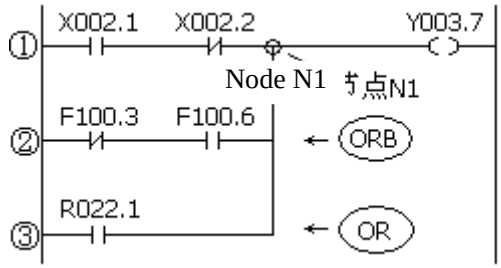
Table 4-4-1

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

Instruction specification:

- OR.STK a sole instruction without other address.

Programming




```
RD     X002.1
AND.NOT   X002.2
RD.NOT   F100.3
AND   F100.6
OR.STK
RD R022.1
WRT   Y003.7
```

Fig. 4-4-1

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 RD instruction except for the first

branch. The branch ③ is not serial circuit block to use OR instruction.
OR.STK and AND.STK are instructions without operation components, indicating the OR, AND relationship between circuit blocks.

4.5 AND.STK instruction

Instruction and function

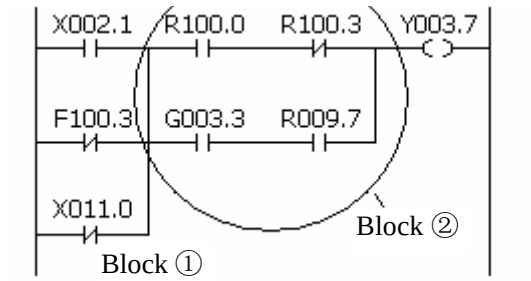
Table 4-5-1

Instruction	Function
AND.STK	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 AND.STK instruction. The starting point of branch uses RD, RD.NOT instruction, after the parallel loop block ends, AND,STK instruction is connected to previous loop in series.
- AND.STK a sole instruction without other address.

Programming




```
RD     X002.1
OR.NOT   F100.3
OR.NOT   X011.0
RD     R100.0
AND.NOT   R100.3
RD     G003.3
AND   R009.7
OR.STK                ← (1)
AND.STK               ← (2)
WRT   Y003.7
```

Fig. 4-5-1

As the above figure and instruction list, (1)OR and STK report the series circuit block in block ②is connected parallel (2)AND.STK 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.

218M functional instruction as follows:

Table 5-1

No.	Instruction	Processing
1	END1	End of a 1st level ladder program
2	END2	End of a 2nd level ladder program
3	CALL	Calling subprogram
4	SP	Subprogram
5	SPE	End of subprogram
6	SET	Set
7	RST	Reset
8	JMPB	Label jump
9	LBL	Label
10	TMR	Timer
11	CTR	Binary meter
12	DEC	Binary decoding
13	COD	Binary code conversion
14	COM	Common line control
15	COME	End of common line control
16	ROT	Binary rotation control
17	SFT	Register shift
18	DIFU	Rising edge check
19	DIFD	Failing edge check
20	COMP	Binary comparison
21	COIN	Coincidence check
22	MOVN	Transfer of an arbitrary number of bytes
23	XMOV	Indexed data transfer
24	DSCH	Binary data search
25	ADD	Binary addition
26	SUB	Binary subtraction
27	ANDF	Functional AND
28	ORF	Functional OR
29	NOT	Logical Negation
30	EOR	Exclusive OR

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:

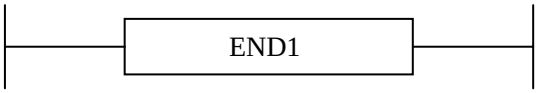


Fig. 5-1-1

5.2 END2（2nd level sequence program end）

Function
Specify at the end of 2nd level sequence.

Format:

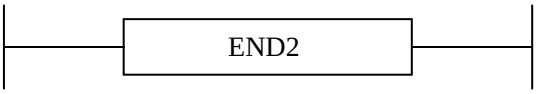


Fig. 5-2-1

5.3 CALL（call subprogram）

Function

Call a specified subprogram.

CALL has the following additional functions:
The subprogram may be nested up to 18 levels by other subprograms, but if a dead cycle is made by the closed loop calling, an alarm will be issued by system. Therefore to execute the data volume under the control, the allowable subprogram calling times are 100, and the subprogram calling in the 1st level is disabled. Alarm will be issued for the instructions or network between SP and END2, SPE and SP which can't be executed by system.

Format:

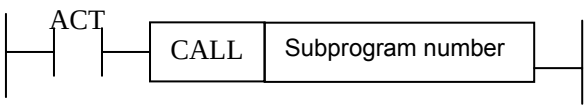


Fig. 5-3-1

Control condition:

ACT＝0，execute the next instruction behind CALL.

ACT＝1，call subprogram which number is specified.

Parameter:
Subprogram number: specifies the subprogram number of a subprogram to be coded following this instruction. Range: 0～99.

5.4 SP（Subprogram）

Function:

The SP functional instruction is used to create a subprogram. A subprogram number is specified as a subprogram name. SP is used with the SPE functional instruction to specify the subprogram range.

Note:

1. A subprogram must be written after END2.
2. Another subprogram cannot be nested into a subprogram.

Format:

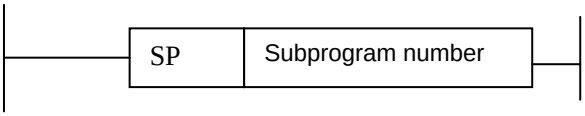


Fig. 5-4-1

Parameter:

Subprogram number: specifies the subprogram label of a subprogram to be coded following this instruction. Range: 0～99.

5.5 SPE（subprogram end）

Function:

* it is used to specify the range of subprogram when SPE is used with the S P.
* the control will return to the main program which called the subprogram when the instruction is executed.
* the subprogram is written after END2.

Format:

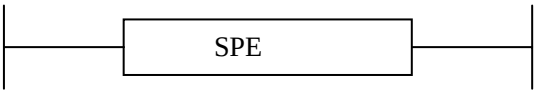


Fig. 5-5-1

Example：

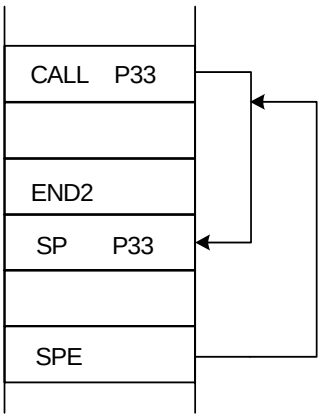


Fig. 5-5-2

5.6 SET（set）

Function:

Set to 1 for the specified address.

Format:

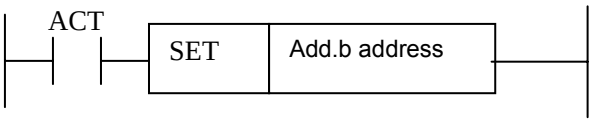


Fig. 5-6-1

Control condition:

ACT＝0，keep add.b invariably.

ACT＝1，set add.b to1.

Parameter:

Add.b：set element address bit can be the output coil, Add= Y，G，R，K，A.

5.7 RST（reset）

Function:

Set to 0 for the specified address.

Format:

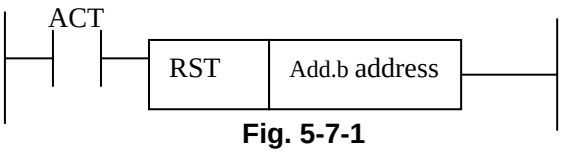


Fig. 5-7-1

Control condition:

ACT＝0，keep add.b invariably.

ACT＝1，set add.b to1.

Parameter:

Add.b：reset element address bit can be the output coil, Add= Y，G，R，K，A.

5.8 JMPB（label jump）

Function:

The JUMP functional instruction transfer control to a Ladder immediately after the lable set in a ladder program.

JMPB has the following additional functions:

* More than one jump instruction can be coded for the same label.
* Jumped END1 and END2 are forbidden.
* Jumped subprogram and subprogram are forbidden.
* Jump back is permitted, but the user should handle the infinite loop may be caused by it .

* Jumped main program and subprogram are forbidden.

Format:

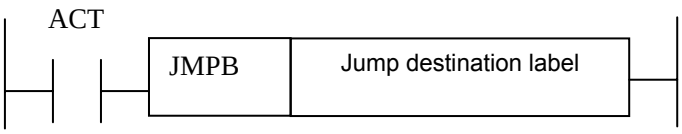


Fig. 5-8-1

Control conditions:

ACT＝0: The next instruction after the JMPB instruction is executed.

ACT＝1: jump to the specified label and executes the next instruction behind the label

Parameter:

Lx: specifies the label of the jump destination. A value from 0 to 99 can be specified.

5.9 LBL（Label）

Function:

The LBL functional instruction specifies a label in a ladder program. It specifies the jump destination for JMPB functional instruction.

Note: one Lx label is only specified one time with LBL. Otherwise, the system alarms.

Format:

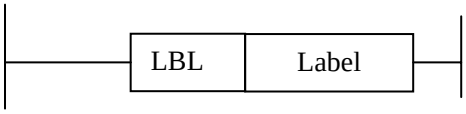


Fig. 5-9-1

Parameter:

Lx: specifies the label of the jump destination. Label number range: 0～99

Example:

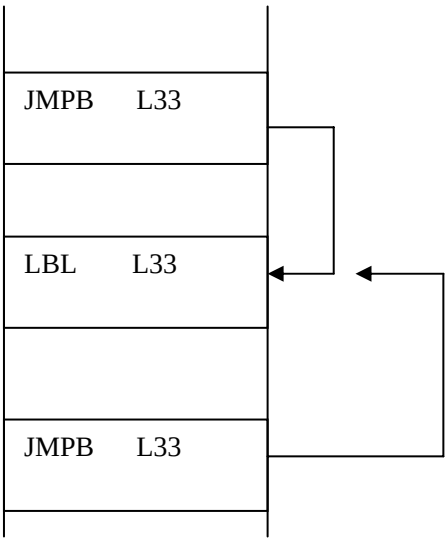


Fig. 5-9-2

5.10 TMR（timer）

Function:
This is an on-delay timer.

Format:

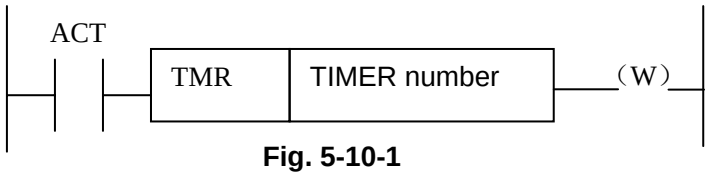


Fig. 5-10-1

Control condition:

ACT=0: turns off the timer relay.
ACT=1: initiates the timer. i.e. timing from 0.

Detailed functions:

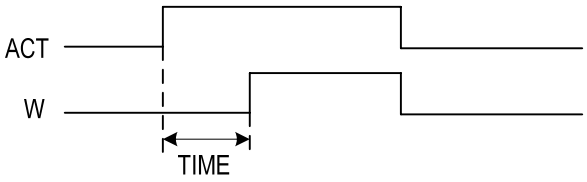


Fig. 5-10-2

Parameter:

TIMER ：timer serial number is named with xxx which are numbers (0～127).

Output:

W ： output coil. W=1 when the output reaches the preset value. W=0 when the output does not reach the preset value.

Note:

Timer is executed each 8ms, take ms as its setting unit, and 8ms is taken as the execution base. Those time less than 8ms are taken as 8ms. i.e. it is set for 54ms, 54=6*8+6, 2ms is needed to be added, so the actual execution time is 56ms.
The time of the timer is set under the 【TMR】of 【PLCPAR】in PRG interface.
The system will automatically detect the range of the sequence number of the timer, alarm will be issued for those duplicate or beyond range sequence numbers.

5.11 CTR（binary counter）

Function:
The data in the counter are binary and their functions are as follows:

1) Preset counter
   Preset the count. It outputs a signal when the preset count is reached.
2) Ring counter
   Upon reaching the preset count, returns to the initial value by issuing another counter signal.

3) Up/down counter
The count can be either up or down.
4) Selection of initial value
Its initial value is 0 or 1.

Format:

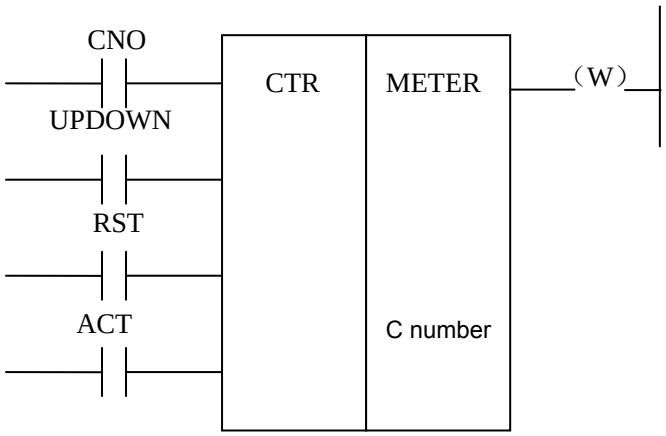


Fig. 5-11-1

Control condition:

Specifies the initial value(CN0):

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

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

Specify up or down counter (UPDOWN):

UPDOWN=1: Up counter

UPDOWN=0: Down counter

Reset (RST):

RST=0: release reset.

RST=1: enable reset. When W=0, the integrated value is reset to the initial value.
RST is set to 1 only when reset is required.

Count signal(ACT):

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

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

Parameter:

METER：specifies the counter serial number with xxx which are numbers (0～127).

Output:

W：coil output. W=1 when the counter reaches the preset value.

Note: The system will automatically detect the range of the sequence number of the counter, alarm will be issued for those duplicate or beyond range sequence numbers.

5.12 DEC（binary decode）

Function:

DEC can decode binary code data. Outputs 1 when the eight-digit BCD signal is equal to a specified number, and 0 when not.

It is mainly used to decode M or T function.

Format:

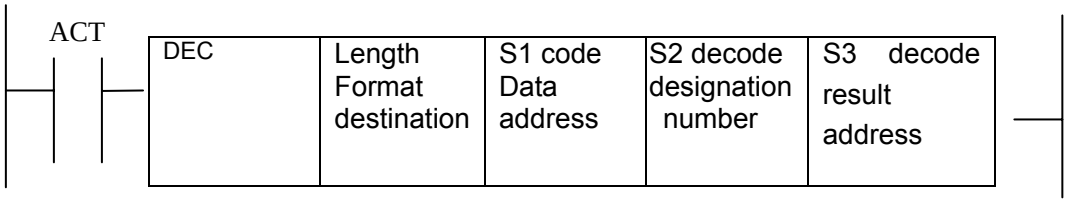


Fig. 5-12-1

Control condition:

ACT＝0 : resets all the output data bit.

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

Parameter:

length : 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.

S1 : code data address. Specifies an address at which code data is stored.

S2 : number specification decode designation. Specifies the first of the 8 continuous numbers to be decoded.

S3 : decode result address. Specifies an address where the decoded result shall be output. A one-byte area is necessary in the memory for the output.

Example:

DEC 1 F10 8 R4

When ACT＝1 and F10＝8， R4＝0000,0001；
When ACT＝1 and F10＝9， R4＝0000,0010；
……
When ACT＝1 and F10＝15， R4＝1000,0000；

5.13 COD（binary code conversion）

Function:

COD instruction automatically creates a table with corresponding size used for user inputting conversion table data when it inputs the data capacity. Each table has 10 lattices and if it is not divided by 10, count the lattices by its quotient adding 1, but its capacity data does not change.

Format:

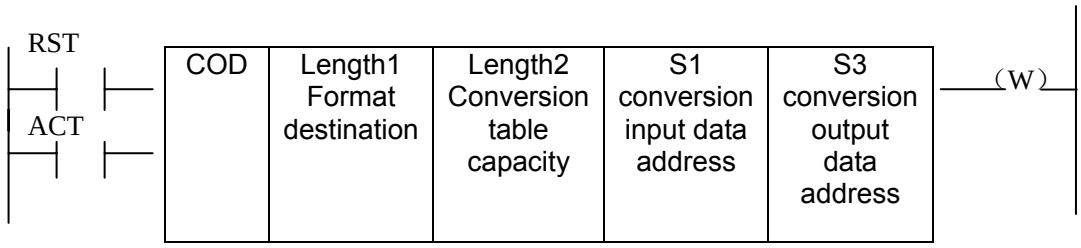


Fig. 5-13-1

Table 5-13-1

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

Control conditions:

Reset (RST):

RST=0: do not reset.

RST=1: reset error output W.

Activate instruction (ACT):

ACT＝0 : do not execute COD.

ACT＝1 : execute COD. Take value of “Conversion input data address(S1)” as the table number of conversion table, take out of 1 conversion data which corresponds to the table number from the conversion table, output the output address used for the conversion data (S2).

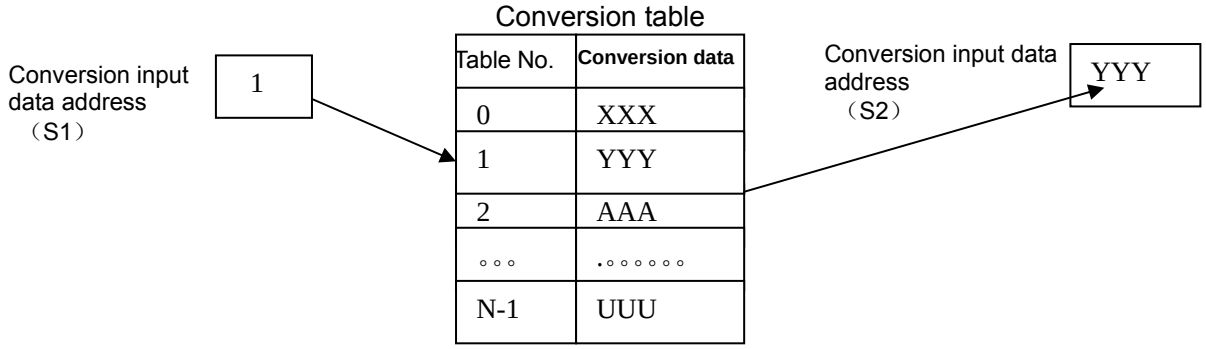


Fig. 5-13-2

Parameter:

Length1 ： designates binary numerical size in the conversion table.

1：Numerical data is binary 1-byte data.

2：Numerical data is binary 2-byte data.

length2 ： Capacity of conversion table data. 100 data can be made. 100 bytes when designating 1 byte format, and 100 words when 2 byte format. All number is at most 512 bytes in COD conversion table.

S1 ： 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.

S2 ： Conversion data output address. Memory of the byte length specified in the format designation is necessary from the specified address.

Output:

If there are any abnormality when executing the CODB instruction, W=1

Note: Size of the conversion data table is maximum 100. This conversion data table is programmed between the parameter conversion data output address of this instruction and the error output (W).

5.14 COM (common line control)

Function:

This function can be used for specifying the number of coil only on the PLC-SB/SC. If the common line end instruction is not specified, the system will alarm.

Format:

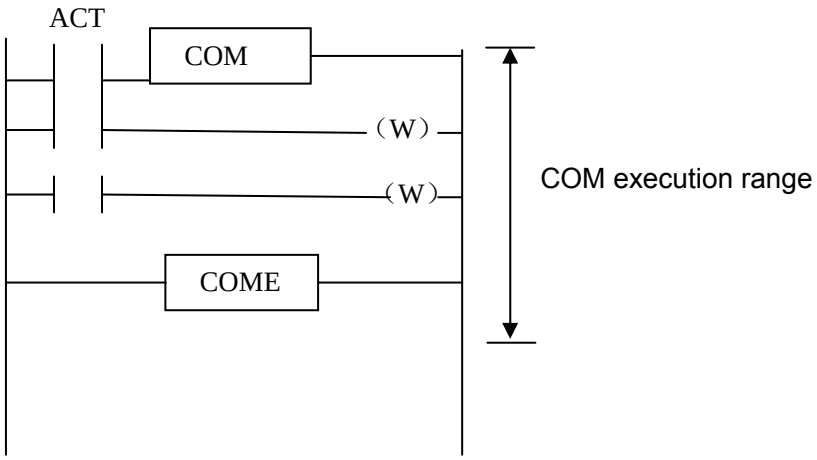


Fig. 5-14-1

Control condition:

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

ACT=1: No processing is performed.

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 when COM ACT=0.
3. do not use the function block between COM and COME, otherwise, the system will alarm.

5.15 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:

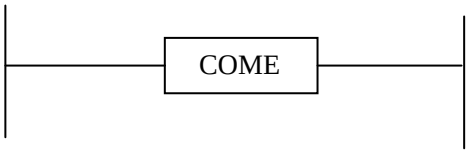


Fig. 5-15-1

5.16 ROT（Binary rotation control）

Function:

Controls rotors, such as the tool post, rotary table, etc., and it is used for the following functions.

1. Selection of the rotation direction via the shorter path.
2. Calculation of the number of steps between the current position and the goal position; calculation of the position on position before the goal to the number of steps up to one position before the goal.
3. To calculate the position number just before the target position or the steps to the position just before the target position.

Format:

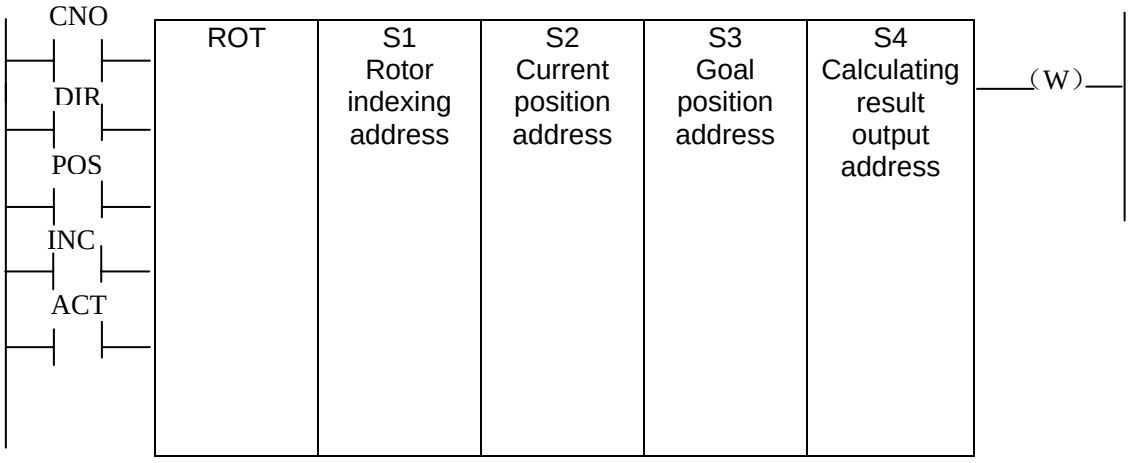


Fig. 5-16-1

Control conditions:

Specify the starting number of the rotor(CN0):

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.

Select the rotation direction via the shorter path or not: (DIR)：

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

DIR=1: selected. The direction of rotation is forward/backward.

Specify the operating conditions (POS):

POS=0: calculate the goal position.

POS=1: calculates the position one position before the goal position.

Specify the position or the number of steps(INC):

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

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

Execution instruction (ACT):

ACT= 0：the ROT instruction is not executed. W does not change.

ACT＝1：executed. Normally, set ACT=0. If the operation results are required, set ACT=1.

Parameter:

S1 ： specify the rotor indexing number.

S2 ： specify the address storing the current position.

S3 ： specify the address storing the goal position(or instruction value), for example the address storing the CNC output T code.

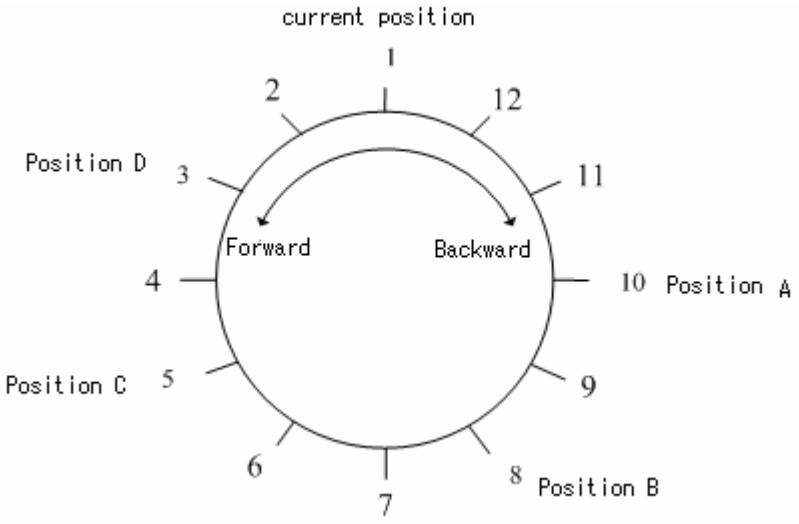
S4 ： calculate the number of steps for the rotor to rotate, the number of steps up to the position one position before, or the position before the goal. When the calculating result is to be used, always check that if ACT=1.

Output:

W: The direction of rotation for control of rotation via the shorter path is output to W. When W=0, the direction is forward (FOR) when 1, reverse (REV). The definition of FOR and REV is shown in the following figure. If the number given to the rotor is ascending, the rotation is FOR; if descending, REV. The address of W can be determined arbitrarily. When, however, the result of W is to be used, always check that ACT=1.

Example:

Rotor rotation direction:



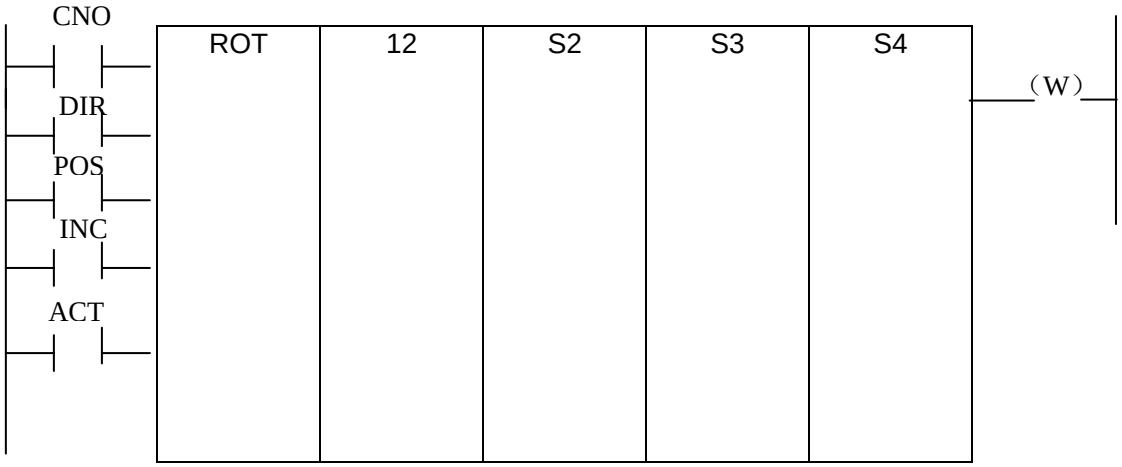


Fig. 5-16-2

Perform the short path rotation, and calculate the position number of previous one position of goal position.

Current position number S2=1, position number of rotation graduation S1＝12，CNO=1，DIR=1 POS=1，INC=0:

When S3=10 goal position is A, and ACT=1, S4＝11，W＝1.

When S3=8 goal position is B, and ACT=1, S4＝9，W＝1.

When S3=5 goal position is C, and ACT=1, S4＝4，W＝0.

When S3=3 goal position is D, and ACT=1, S4＝2，W＝0.

5.17 SFT（shift register）

Function:

This instruction can each time shift a byte data (8 bits) by a bits number set by a Parameter, For the circular shifting, each overflowing "1" will be added reversely, i.e. If the highest bit "1" is overflowed by the left shifting, so the lowest bit will be filled by "1", vice versa.

Format:

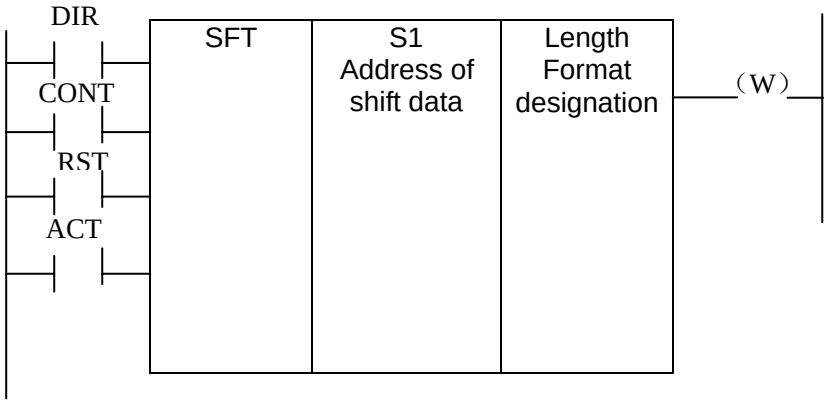


Fig. 5-17-1

Control conditions:

Shift direction specification (DIR)

DIR=0: Left shift

DIR=1: Right shift

Condition specification (CONT)

CONT=0: do not cycle shift

CONT=1: cycle shift

Reset（RST）

The shifted out data(W=1) is reset (W=0).

RST=0: W is not reset.

RST=1: W is reset (W=0).

Actuation signal (ACT)

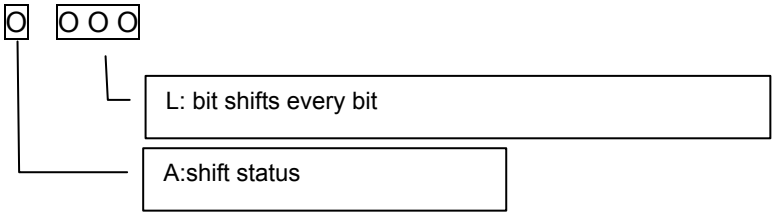
ACT=0: do not execute SFT instruction.

ACT=1:shifting processing is done when ACT=1. For shifting one bit only, execute an instruction when ACT=1, and then, set ACT to 0.

Parameters:

S1 ：sets shift data addresses. These designated addresses require a continuous 1-byte memory for shift data.

Length ： a 4-bit number, and its definition is as follows:



L ： range: 0~8.

A ： bit parameter. A=0: When ACT=1 is shifting, the shift period is one bit.

A=1: ACT is taken as pulse signal, it is 1 from 0, shift one bit.

Output:

W ： W=0: “1” was not shifted out because of the shift operation.

W=1: “1” was shifted out because of the shift operation.

5.18 DIFU（rising edge check）

Function:

The DIFU instruction sets the output signal to 1 for one scanning cycle on a rising edge of the input signal.

Format:

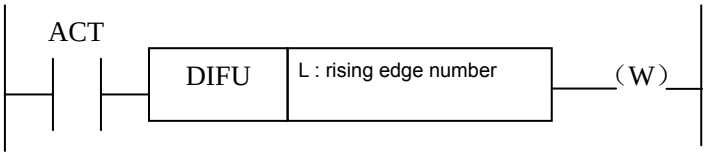


Fig. 5-18-1

Control condition:

Input signal: On a rising edge（0→1）of the input signal, the output signal is set to 1.

Output signal: The output signal level remains at 1 for one scanning cycle of the ladder level where this functional instruction is operating.

Parameter: Rising edge number

Parameter： L :rising edge number, range 0~255. Another DIFU instruction or DIFD instruction in the ladder uses the same number, the system will alarm.

Operation:

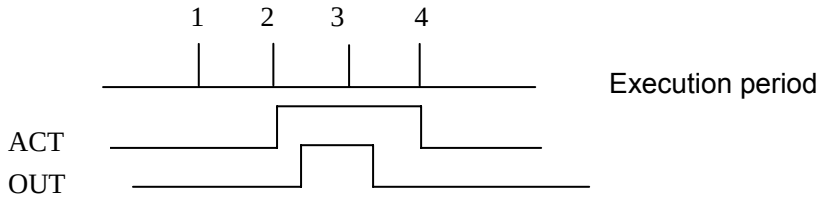


Fig. 5-18-2

The system will check the sequence number of the rising edge automatically, when the number exceeds the range or the number is duplicated, an alarm occurs.

5.19 DIFD（falling edge check）

Function:

The DIFD instruction set the output signal to 1 for one scanning period on a falling edge of the input signal.

Format:

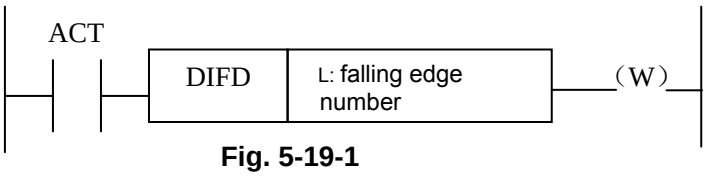


Fig. 5-19-1

Control conditions:

Input signal: on a falling edge（1→0）of the input signal, the output signal is set to 1.

Output signal: the output signal level remains at 1 for one scanning period of the ladder level where this functional instruction is operating.

Parameter:

L ： rising edge number, range 0~255. Another DIFU instruction or DIFD instruction in the ladder uses the same number, the system will alarm.

Operation：

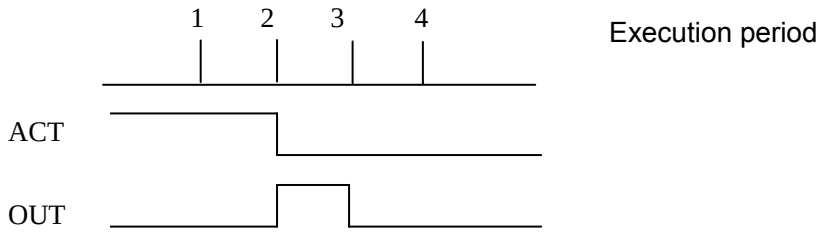


Fig. 5-19-2

The system will check the sequence number of the falling edge automatically, when the number exceeds the range or the number is duplicated, alarm occurs.

5.20 COMP（binary comparison）

Function:

Compares binary values. Specifies enough byte to store the input data and the comparison data in the memory.

Format:

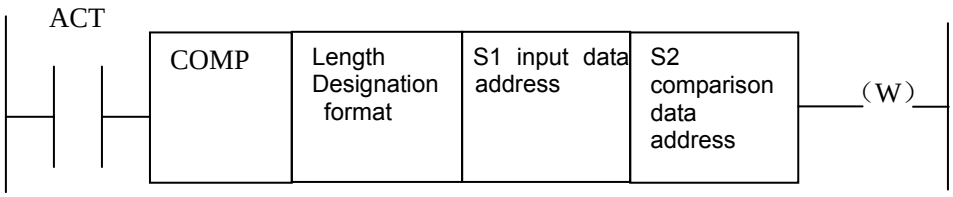


Fig. 5-20-1

Control conditions:

ACT＝0: The COMP instruction is not executed. W does not alter.

ACT＝1: The COMP instruction is executed.

Parameter:

Length：specification format(constant or address) and data length(1 or 2 bytes) for the input data.

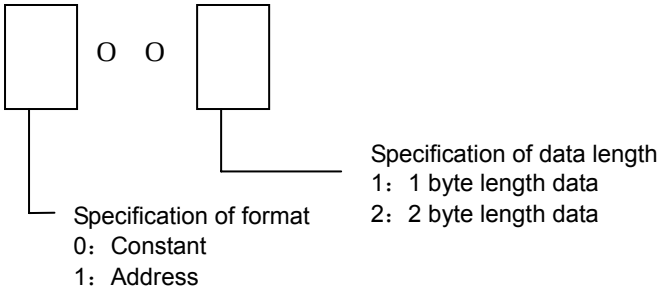


Fig. 5-20-2

S1, S2: content of comparison source 1 and comparison source 2. It can be constant and also be address number.

Address number: R, X, Y, F, G, K, A, D, T, C.

Output:

W=0： input data>comparison data

W=1： input data ≤comparison data

5.21 COIN（coincidence check）

Function:

Checks whether the input value and comparison value coincide.

Format:

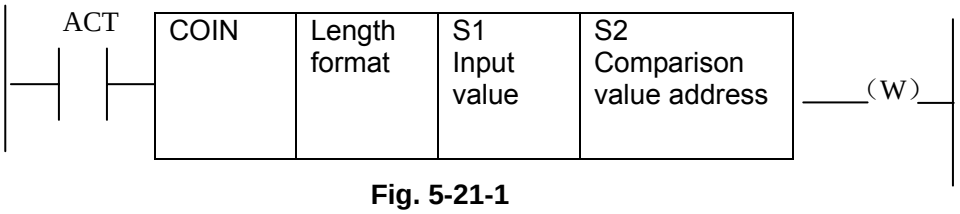


Fig. 5-21-1

Control conditions:

ACT＝0，the COIN instruction is not executed. W does not change.

ACT＝1，the COIN instruction is executed.

Parameter:

Length：specification format(constant or address) and data length(1 or 2 bytes) for the input data.

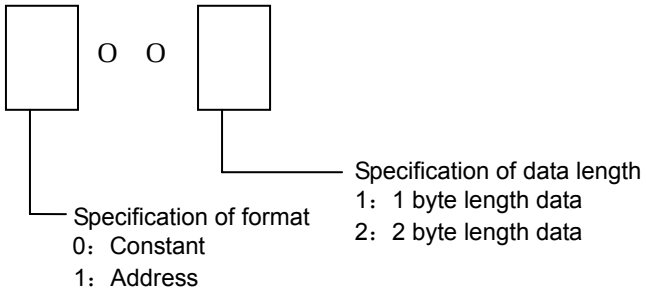


Fig. 5-21-2

S1 ： The input data can be specified as either a constant or an address storing it.

S2 ： address storing of comparison data

Output:

W ： W=0： input value ≠comparison value

W=1： input value=comparison value

5.22 MOVN（transfer of data）

Function:

The MOVN instruction transfers data from source address and a specified binary data to a specified destination address.

Format:

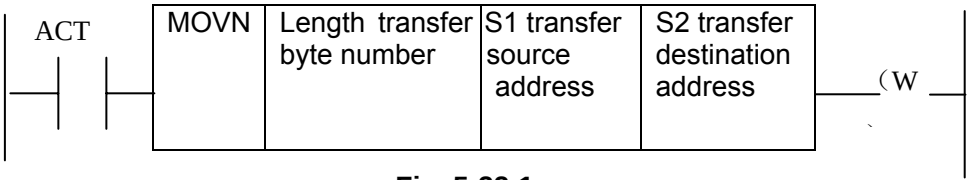


Fig. 5-22-1

Control condition:

ACT＝0: No data is transferred.

ACT＝1: The byte of specified number is transferred.

Parameter:

Length ： transferred byte number.

S1 ： stating byte of address or constant of source data.

Selecting transfer format according to S1:

1. S1 is constant: if S2 is single byte address, S1 in byte unit is copied to address corresponding to Length byte which takes S2 as the initial; if S2 is word unit, S2 in word unit is copied to the address corresponding to Length word which takes S2 as the initial

2. S1 is address: S1 and S2 transmit the data in byte in spit if S1 and S2 address classifications are matched.

S2 ： starting byte of destination address.

Example:

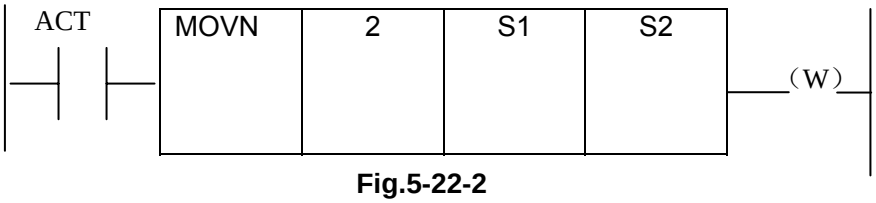


Fig.5-22-2

1.When S1 is the constant,5 and S2 is R60，R60=00000101,R61=00000101

2.When S1 is the constant ,5 and S2 is D60，D60=5, D61=5.

3.When S1 is the addressD,50 and S2 is D60，D60=50

W=1, the specified number byte is delivered.

W=0, no data be delivered.

If it detects that it exceeds the range of parameter type in transferring , the alarm will be issued

5.23 XMOV（Binary index data transfer）

Function:

This function instruction instructs reading and rewriting of data in the data table. The number of data (table capacity) in the data table can be specified by specifying the address, the PLC operates the data table according to the user setting.

Format:

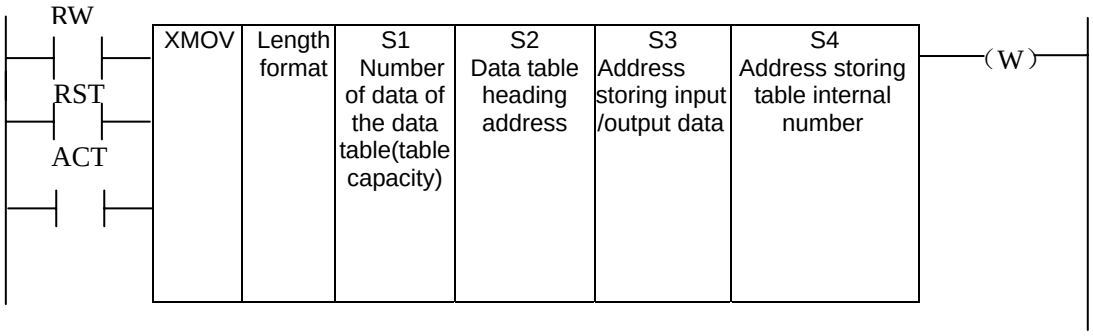


Fig. 5-23-1

Control condition:

Specify the reading or rewriting (RW)

RW=0： data is read from the data table.

RW=1： data is written in the data table.

Reset（RST）

RST=0： release reset.

RST=1： reset W=0.

Execution instruction (ACT):

ACT＝0 ： The XMOV instruction is not executed. W does not change.

ACT＝1 ： The XMOV instruction is executed.

Parameter:

Length ： Specify the data long.

1：1-byte long data.

2：2-byte long data.

S1 ： Storage address of number of data table elements. The address is used to store the data number of data table, its byte should correspond to the length specified in Length format specification, and the effective range of number of data table element is as follows with the byte length which set in Length1 format.

1 byte length：1 to 512.

2 byte length：1to 256, i.e. 256 x 2=512 byte, which is the capacity of the PLC data table.

S2 ： Sets head address in the data table. The memory of (byte length)X (number of data table elements). The head address must be the value set in the D data table.

S3 ： Input/output 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，its byte should correspond to the length specified in Length format specification.

S4 ： Index storage address. Set the address of the memory in which an index

value is stored. The memory with the byte length set in Length format specification is necessary. When setting an index value above the value to set in S1 storage address of number of data table elements, it causes an error output W=1. Actually, the number of data table elements does not exceed 255.

Output:

The index value set in Index storage address exceeds the value set in S1, W=1, the reading or writing of the data table isn't executed.

W=0，No error.

W=1，Error found.

5.24 DSCH （binary data search）

Function:

The DSCH instruction is used to search the binary data in data table. The number of data (table capacity) in the data table can be specified by specifying the address. Thus allowing change in table capacity even after writing the sequence program in the ROM.

Format:

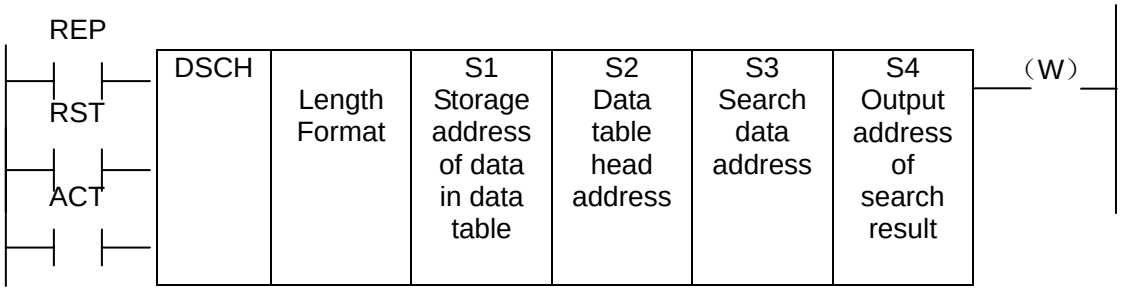


Fig. 5-24-1

Control conditions:

Check repetition（REP）

REP=0：Execute the DSCH instruction, search begins from the head address, and the repetition will be omitted, the search stops when the target data is found in the first time, and output its address. If the searched data is not found, W=1.

REP=1：Execute the DSCH instruction, if the searched data is not found or is two （or more than two）, W=1.

Reset（RST）

RST=0：Release reset.

RST=1：Reset. W=0.

Activation instruction (ACT):

ACT＝0 : Do not execute DSCH instruction, W does not change.

ACT＝1 : Execute DSCH instruction. If the search data is found, table number where the data is stored will be output. If the search data is not found, W becomes 1.

Parameter:

Length ： Specifies data length

1：1-byte long data.

2：2-byte long data.

S1 ： Storage address of number of data in data table. This address requires memory of number of byte according to the format designation. Number of data in the table is n+1(head number in the table is 0 and the last number is n).

S2 ： Data table head address.

S3 ： Search data input address.

S4 ： Search result output address. After searching, if search data is found, the table number where the data is stored will be output. the searched table number is output in this search result output address. This address requires memory of number of byte according to the format designation.

Output:

W=0，Search data found.

W=1，Search data not found.

5.25 ADD（addition）

Function:

This instruction performs binary addition between 1-, 2-byte data. In the operation result register, operation data is set besides the numerical data representing the operation results. The required number of bytes is necessary to store each augend, the added, and the operation output data.

Format:

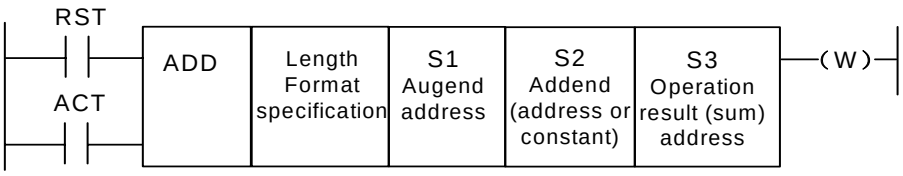


Fig. 5-25-1

Control conditions:

Reset (RST):

RST=0： Release reset.

RST=1： Reset. W=0.

Activation instruction (ACT)：

ACT＝0 ： Do not execute ADD. W does not changed.

ACT＝1 ： Execute ADD.

Parameter:

Length ： Specifies data length(1 or 2 bytes) and the format for the addend(constant or address).

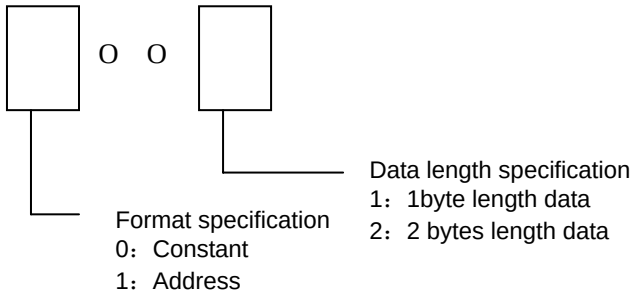


Fig. 5-25-2

S1 ： Address containing the augend

S2 ： Length specification determines the format of the addend.

S3 ： Specify the address to contain the result of output operation.

Output:

W=0： Operation correct.

W=1： Operation incorrect.

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

5.26 SUB（binary subtraction）

Function:

This instruction executes the subtraction operation in the binary format of 1 or 2 bytes. In the operation result register, operation data is set besides the numerical data representing the operation. A required number of bytes is necessary to store the subtrahend, and the result.

Format:

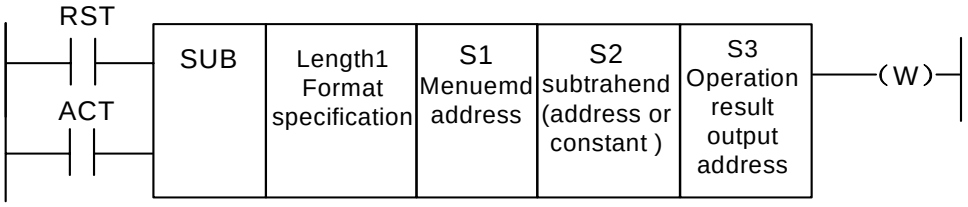


Fig. 5-26-1

Control conditions:

Reset (RST)：

RST=0： Release reset.

RST=1： Reset. W=0.

Activation instruction (ACT)：

ACT＝0 ： Do not execute SUB. W does not change.

ACT＝1 ： Execute SUB.

Parameter:

Length ： Specifies data length(1 or 2 bytes) and the format for the subtrahend(constant or address).

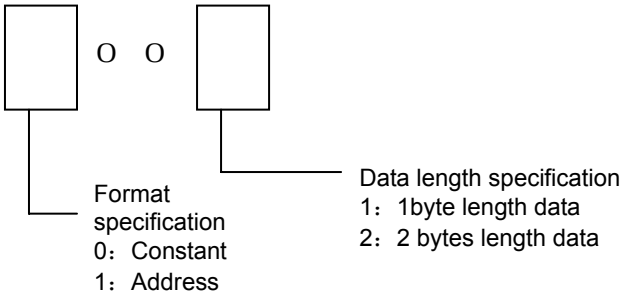


Fig. 5-26-2

S1 ： Address containing the minuend.

S2 ： Specification determines the Length.

S3 ： Specifies the address to contain the result of operation.

Output:

W=0： Operation correct.

W=1： Operation incorrect.

When W=1, the result of subtraction exceeds the specified data length.

5.27 ANDF（functional and）

Function:

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

Format:

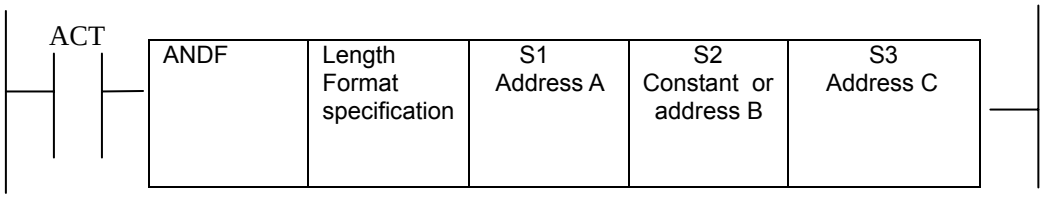


Fig. 5-27-1

Control conditions:

ACT＝0 ： The ANDF instruction is not executed.

ACT＝1 ： The ANDF instruction is executed.

Parameter:

Length ： Specify a data length (1 or 2 bytes), and an input data format (constant or address specification).

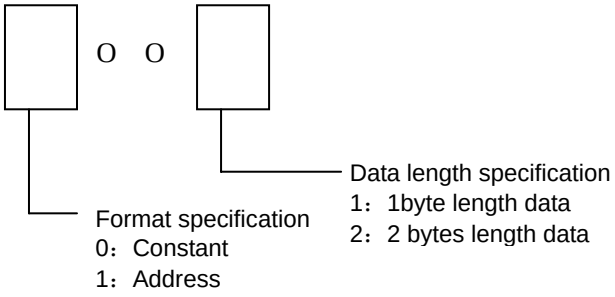


Fig. 5-27-2

S1 ：Input data to be ANDed. The data that is held starting at this address and has the data length specified in Length format specification is treated as input data.

S2 ：Input data to be ANDed with. When address specification is selected in format specification, the data that is held starting at this address and has the data length specified in Length format specification is treated as input data.

S3 ：Address used to store the result of an ANDF operation. The result of and ANDF operation is stored starting at this address, and has the data length specified in Length format specification.

Example:

When address A and address B hold the following data:

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

The result of the ANDF operation is as follows:

Address C	0	1	0	0	0	0	0	1

5.28 ORF（functional or）

Function:

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

Format:

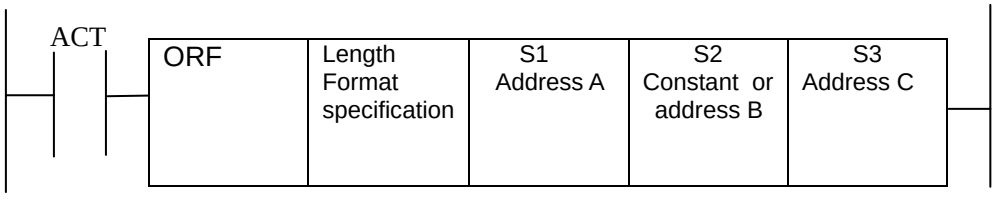


Fig. 5-28-1

Control conditions:

ACT＝0 ： The ORF instruction is not executed.

ACT＝1 ： The ORF instruction is executed.

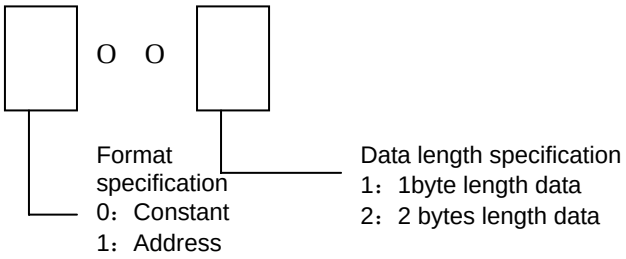


Fig. 5-28-2

Parameter:

Length: Specify a data length(1 or 2 bytes), and an input data format(constant or address specification).

S1 : Specify the input data t o ORed. The data that is held starting at this address and has the data length specified in Length format specification is treated as input data.

S2 : Input data to be ORed with. When address specification is selected in format specification, the data that is held starting at this address and has the data length specified in Length format specification is treated as input data.

S3 : Address used to store the result of an ORF operation. The result of an ORF operation is stored starting at this address, and has the data length specified in format specification.

Example:

When address A and address B hold the following data:

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

ORF operates results are as follows:

Address C	1	1	1	1	0	1	1	1

5.29 NOT（logical not）

Function:

The NOT instruction inverts each bit of the contents of address A, and stores the result at address B.

Format:

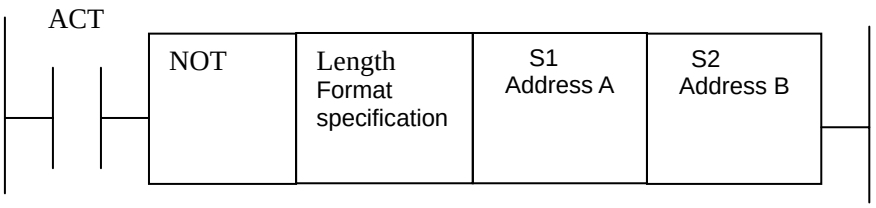


Fig. 5-29-1

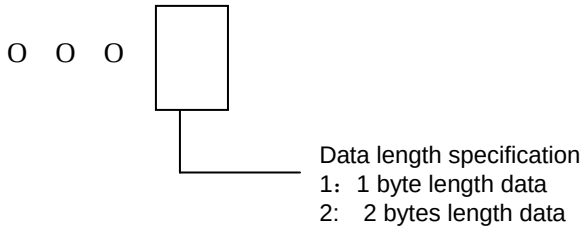
Control condition:

ACT＝0: The NOT instruction is not executed.

ACT＝1: The NOT instruction is executed.

Parameter:

Length ： Specifies a data length (1 or 2 bytes).



S1 ： Input data to be inverted bit by bit. The data that is held starting at this address and has the data length specified in Length format specification is treated as input data.

S2 ： 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 Length format specification.

Example:

When address A holds 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

5.30 EOR（exclusive or）

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:

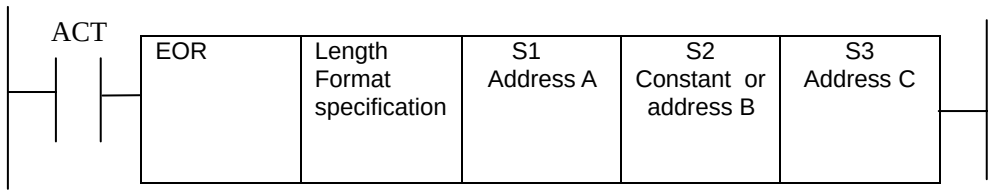


Fig. 5-30-1

Control conditions:

ACT＝0 ： The EOR instruction is not executed.

ACT＝1 ： The EOR instruction is executed.

Parameter:

Length ： Specify a data length (1 or 2 bytes) and an input data format(constant or address specification).

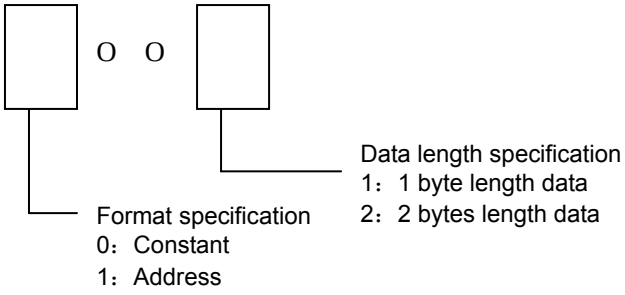


Fig. 5-30-2

S1 ： Input data to be exclusive-ORed. The data that is held starting at this address and has the data length specified in Length format specification is treated as input data.

S2 ： Input data to be exclusive-ORed with. When address specification is selected report that specification, the data that is held starting at this address and has the data length specified in Length format specification is treated as input data.

S3 ： 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

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) K0~K5 address are occupied by the system, and the user can't define them.
   3) G63, R255 address are occupied by the system. and the user can't define them.
   4) X address on IO input interface and CNC→PLC F address.
4. Such case like vertical line overhanging, node disconnected, horizontal through line paralleling to the node network will result in the nodes or network that can' t be executed, so alarm will be issued by the system.
5. Star network, in which there is no direct connection between the vertical lines of different lines in a column, and a line in the middle isn't jointed with a vertical line. So alarm will be issued because the case can't be processed by the system.
6. The upward convex is not allowed in the network. That is there is a parallel network above he nodes of a line, and no line can be connected to this network. So alarm will be issued

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

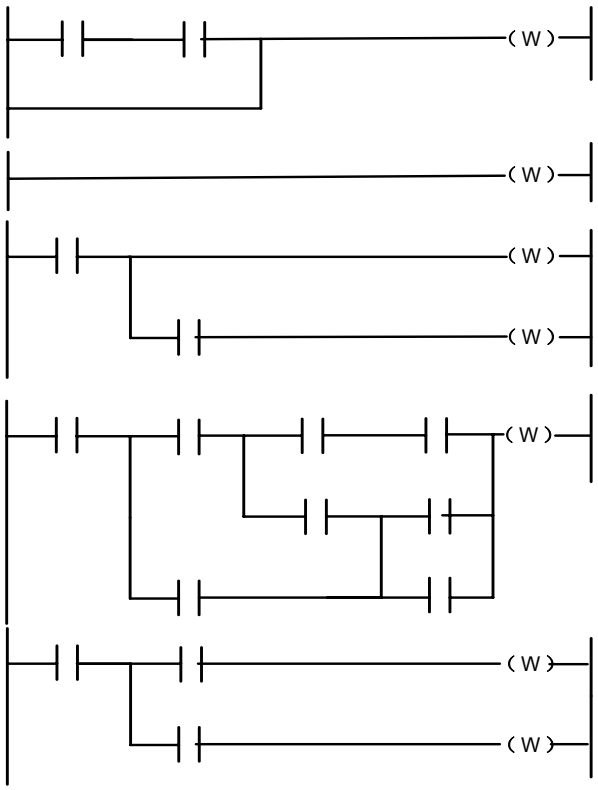


Fig.6

Ⅱ Function

1 Controlled Axis

1.1 Outputting of movement state of an axis

General The movement state of each axis can be output to the PLC.

Signal Axis moving signals

MV1～MV4 （F017#0～F017#3）

［Classification］ Output signal

［Function］These signals indicate that a controlled axis is moving.

MV1：X is moving.

MV2：Y is moving.

MV3：Z is moving.

MV4：A is moving.

［Output conditions］

The signals become 1 when:

- The corresponding axis has started moving.

The signals become 0 when:

- The corresponding axis has stopped moving.

Axis moving direction signals

MVD1~MVD4（F019＃0~F019＃3）

［Classification］ Output signal

［Function］These signals indicate the movement direction of controlled axis.

MV1：movement direction of X.

MV2：movement direction of Y.

MV3：movement direction of Z.

MV4：movement direction of A.

［Output conditions］

“0” indicates the corresponding axes are negatively moving,

“1” indicates the corresponding axes are positively moving.

Caution:

These signals maintain their condition during a stop, indicating the direction of the axes’ movement before stopping.

Signal address

	＃7	＃6	＃5	＃4	＃3	＃2	＃1	＃0
F017					MV4	MV3	MV2	MV1
F019					MVD4	MVD3	MVD2	MVD1

1.2 Servo ready signal

Signal **servo ready signal**
SA（F000#6）
［Classification］ Output signal
［Function］ After the servo is ready, SA signal becomes 1. For the axis with absorption brake, release the brake when outputting the signal，execute the brake when the system does not output the signal.

Signal address

	#7	#6	#5	#4	#3	#2	#1	#0
F000		SA						

2 Preparation for Operation

2.1 Emergency stop

General If you press Emergency Stop button on the machine operator's panel, the machine movement stops in a moment.

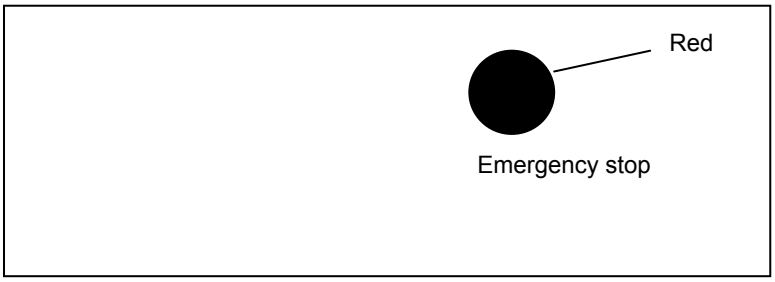


Fig. 2-1-1

The button is locked when it is pressed, although it varies with the machine to builder, the button can usually be unlocked by twisting it right.

Signal **Emergency stop signal**

***ESP （G001.0 ）**

［Classification］ Input signal

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

［Operation］ When the emergency stop *ESP becomes 1, the emergency stop is applied to the machine and the CNC is reset.

Signal address

G001								*ESP

2.2 CNC overtravel 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 Over TRAVEL is displayed. The signal can be output with an alarm.

Signal **Overtravel signal**

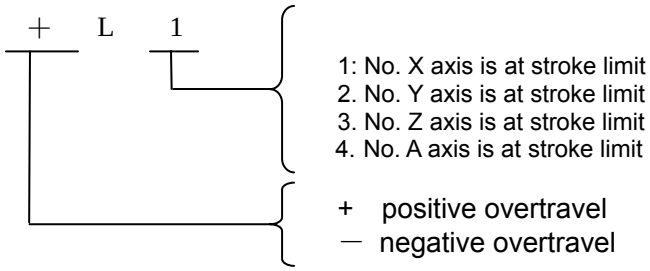
＋L1～＋L4(G12#0~G12#3)

－L1～－L4(G13#0~G13#3)

［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.



［Operations］ when the signal becomes “0”: the controlled unit operates as follows:

* Automatic operation: If even one axis overtravel signal becomes 0, all axes are decelerated to stop, an alarm is given and operation is halted.
* Manual operation: Only the axis whose overtravel signal has become 0 is decelerated to a stop, and the axis can be moved in the opposite direction.

*Once the axis overtravel signal has become 0, the axis direction is registered.

Even if the signal returns to 1, it is not possible to move that axis in that direction until the alarm is cleared.

Signal address

	#7	#6	#5	#4	#3	#2	#1	#0
G01					＋L4	＋L3	＋L2	＋L1
G01					－L4	－L3	－L2	－L1

2.3 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. If the voltage level of the memory backup battery falls to below a specified level while the CNC is turned off, the battery alarm signal is set to 1.

Signal **Alarm signal**

AL（F001＃0）

［Classification］ Output signal

［Function］ Alarm signal reports CNC is in an alarm state as follows:

a) P/S alarm
b) Overtravel alarm
c) Servo alarm

［Output conditions］These alarm signals are set to 1 when:

——The CNC is placed in the alarm state.

These alarm signals are set to 0 when:

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

Signal address

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

2.4 Mode selection

Signal **mode check signal**

F003#0~F003#7

[Classification] Output signal
[Function] Report the current selected operation mode

Signal address

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

2.5 Status output signal

Signal **Rapid traversing signal**

RPDO（F002＃1）

［Classification］ Output signal

Cutting feed signal

CUT（F002＃6）

［Classification］ Output signal

［Function］ These signals indicate that the cutting feed is being performed by automatic operation.

［Output conditions］ These signals are 1 when:

Cutting feed is being performed by automatic operation (cutting feed for linear interpolation, circular interpolation, helical interpolation, thread cutting, skip cutting, or cutting in canned cycle).

Note:

1. Do not output the signal in the state of feed hold.
2. Output the signal during the interlock or the feedrate override is set to 0.

Signal address

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

3 Manual Operation

3.1 MANUAL feed / incremental feed

General

MANUAL feed in MANUAL 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 MANUAL feed and incremental feed is the method of selecting the feed distance. In MANUAL 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 MANUAL feedrate override dial can regulate MANUAL feedrate. The step distance can be selected by MPG feed movement distance G026＃0~G026＃3.

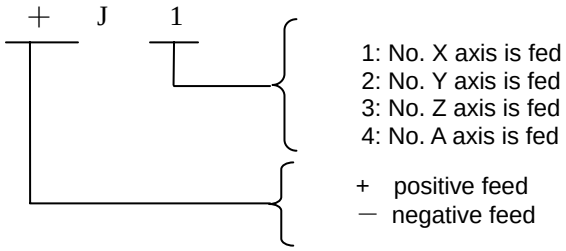
Signal **Feed axis and direction selection signal**

＋J1~＋J4（G27＃0~G27＃3）

－J1~－J4（G28＃0~G28＃3）

［Classification］ Input signal

［Function］ In MANUAL 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 MANUAL 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 MANUAL 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（G024＃7）

［Classification］ Input signal

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

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

- The control unit executes the MANUAL 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 MANUAL 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
G024	RT							
G027					+J4	+J3	+J2	+J1
G028					－J4	－J3	－J2	－J1

3.2 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 **MPG/Incremental select signal**

（G026＃0~G026＃3）

［Classification］ Input signal

[Function］ When the signal selects the MPG feed, MPG generates the movement distance of every pulse which also can select the movement distance per step of incremental feed .

4 Reference Point Return

4.1 Manual reference point return

General In manual reference point return mode, the machine tool move in the specified direction by setting the position parameter N0：7#3~#7 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 deceleration signal	DECX,DECY,DECZ,DECA
Reference point return completion signal	ZP1,P2, ,ZP3,ZP4

Reference point return completion signals

ZP1～ZP4(F016＃0~F016＃3)

［Classification］ Output signal

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

These signals correspond separately to all axes.

ZP1	X axis reference point return completion signal.
ZP2	Y axis reference point return completion signal.
ZP3	Z axis reference point return completion signal.
ZP4	A 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

DECX（X017＃0）DECY（X017＃1） DECZ（X017#2）DECA（X017#3）

［Classification］ 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.

4.2 Reference point return check signal

2nd reference point check permission signal

PREF20---PREF23 （G057#0----#3）

3rd reference point check permission signal

PREF30---PREF33 （G058#0----#3）

4th reference point check permission signal

PREF40---PREF43 （G059#0----#3）

［Type］ Input signal

［Function］When the signal is set to 1, the reference point return completion signals(F42, F43, F44) are enabled.

These signals correspond separately to all axes.

PREF*0	X axis reference point check permission signal
PREF*1	Y axis reference point check permission signal
PREF*2	Z axis reference point check permission signal
PREF*3	A axis reference point check permission signal

2nd reference point return completion signal

ZP21---ZP24 （F042#0---#3）

3rd reference point return completion signal

ZP31---ZP34 （F043#0---#3）

4th reference point return completion signal

ZP41---ZP44 （F044#0---#3）

［Type］ output signal

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

These signals correspond separately to all axes

ZP*1	X axis reference point return completion signal
ZP*2	Y axis reference point return completion signal
ZP*3	Z axis reference point return completion signal
ZP*4	A axis reference point return completion signal

［Output conditions］ the signal is enabled when it is the reference point check permission signals(G57, G58, G59) become 1.

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(G30) 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 reference point check permission signal (G57, G58,G59 become 0,

- The machine tool moves from the reference point.
- The emergency stop signal appears.
- The servo alarm appears.

4.3 Area check signal

Area check signal

AQ1—AQ3 (F045#0---#2)

［Type］ Output signal

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

These signals correspond separately to all axes.

AQ1	X axis area check signal
AQ2	Y axis area check signal
AQ3	Z axis area check signal

［Output conditions］

When the machine is in the stored travel check 1(the data parameter set **P66~P75** the limit, and outside the stored travel check 2 (the data parameter **P76~P8** or program command can set the limit of this side), the signal becomes 1, otherwise becomes 0.

Signal addresses

	#7	#6	#5	#4	#3	#2	#1	#0
F016					ZP4	ZP3	ZP2	ZP1
F042					ZP24	ZP23	ZP22	ZP21
F043					ZP234	ZP33	ZP32	ZP31
F044					ZP44	ZP43	ZP42	ZP41
F045						AQ3	AQ2	AQ1
G017					DECA	DECZ	DECY	DECX
G057					PREF23	PREF22	PREF21	PREF20
G058					PREF43	PREF32	PREF31	PREF30
G059					PREF43	PREF42	PREF41	PREF40

5 Automatic Operation

5.1 Cycle start/feed hold

General

Start of automatic Operation(cycle start)

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

The signal ST is ignored as follows:

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

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

1. When the feed hold signal (SP) is set to 1.

In automatic operation, the CNC enters the feed hold and stops running 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 <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.

Signal **Cycle start signal**

ST（G023＃6）

［Type］ 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

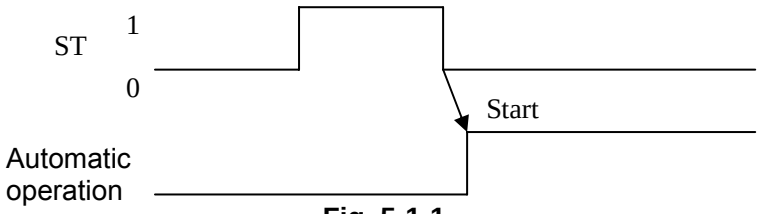


Fig. 5-1-1

Feed hold signal
SP（G023＃7）

［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.

Cycle start lamp signal
STL（F000＃5）

［Classification］ Output signal

［Function］ The signal reports PLC that the automatic operation start is entered.

［Output conditions］The signal is set to 1 or 0, which is determined by CNC state as Fig. 5-1-1.

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 Fig. 5-1-1.

Automatic operation signal
OP（F000＃7）

［Classification］ Output signal

［Function］ The signal reports PLC that the automatic operation is entered.

［Output conditions］ The signal is set to 1 or 0, which is determined by CNC state as Fig. 5-1-1.

Table 5-1-1

	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
G023	SP	ST						
F000	OP		STL	SPL				

5.2 Reset

General CNC is reset and enters the reset state：

1. When the emergency signal (ESP) is set to 1.
2. When <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, set by No. 203, has elapsed after the above conditions have been released.

RST＝T_{reset}（Reset processing time）＋parameter setting value by No. 203

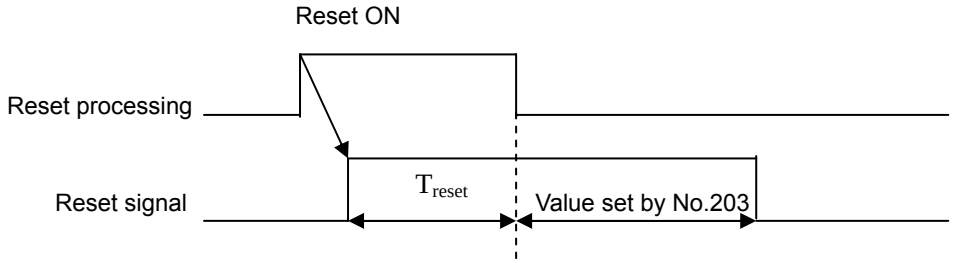


Fig. 5-2-1

When the CNC is reset in automatic operation, the automatic operation is stopped and movement axis is decelerated and stopped. When the CNC is reset during the execution of the M, S, T function, signal MF，SF or TF is set to 0 within 16ms.

RST（F001＃1）

［Classification］ Output signal

［Function］ The signal reports PLC that CNC is reset.

［Output conditions］ 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.

The signal is set to 0 when:

When the reset signal output time set by No. 203# is completed after the above are released and CNC is reset.

Signal address

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

5.3 Testing a program

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

5.3.1 Machine tool lock

General The change of the position display can be monitored without moving the machine.
When all-axis machine lock signal MMLK is set to 1, output pulses to the servo motors are stopped in manual or automatic operation. The instructions are distributed, however, updating the absolute and relative coordinates. The operator can therefore check if the instructions are correct by monitoring the position display.

all-axis machine lock signal

MMLK（F004＃1）

［Classification］ Output signal

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

5.3.2 Dry run

General Dry run is valid only for automatic operation. The machine moves at a constant feedrate regardless of the feedrate specified in the program. The feedrate is set by P86.
This function is used to check the movement of the machine without a workpiece.

Signal **Dry run signal**

DRN（G021＃2）

［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.

Signal address

	#7	#6	#5	#4	#3	#2	#1	#0
G021						DRN		

5.3.3 Single block

General The single block operation is valid in automatic operation mode (Auto mode).

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

Signal **Single block signal**

SBK（G021＃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
G021							SBK	
F004					MSBK			

5.4 Optional block skip

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

Signal Skip optional block signal
BDT（G021#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
G021								BDT
F004								MBDT

5.5 Program restart

General A program may be restarted at a block by specifying the sequence number of the block, after automatic operation is stopped because of a broken tool or for holidays.

Signal **Program restart signal**
SRN<G021#6>
[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:

— When G21#6 is 1 in automatic mode, the program restarting signal is set to 1.

The signal becomes 0 when :

—The program restart sequence ends(all controlled axes of machine tool moves to the restart point).

Signal address

	#7	#6	#5	#4	#3	#2	#1	#0
G021		SNR						
F002				SRNM				

6 Feedrate Control

6.1 Rapid traverse rate

General The 4 gears (F0，25％，50％， 100%) can be used for rapid traverse rate.

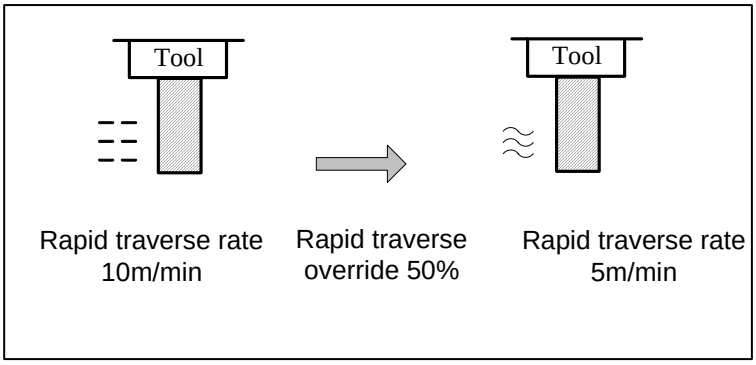


Fig. 6-1-1

Feedrate: Actual moving speed is obtained by multiplying the override value by the value set by the data parameter (P088-092) either in the auto mode or manual operation mode (including manual reference point return and program zero return).

F0 ：it is set by the data parameter P093.

Signal **rapid traverse override signal**

Rapid F0 （G025＃0）

Rapid F25% （G025＃1）

Rapid F50% （G025＃2）

Rapid F100%（G025＃3）

［Classification］ Input signal

［Function］ it is the rapid traverse override signal

6.2 Feedrate override

General A programmed feedrate can be reduced or increased by a percentage selected by the override dial. This feature is used to check a program. For example, when a feedrate of 100 mm/minute is specified during the program, setting the override to 50% to move the tool at 50 mm/min.

Signal Feedrate positive override signal （G24#0）

Feedrate negative override signal （G24#2）

［Classification］ Input signal

［Function］ Cutting feedrate override signal. 16 steps (0%~150%).

［Operation］ Actual feedrate is obtained by multiplying the specified speed by the override value selected by this signal.

6.3 Override cancel

General **The override cancel signal fixes the feedrate override to 100%.**

Signal **Override cancel signal**

OVC（G024＃1）

［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
G024							OVC	

7 Miscellaneous Function

7.1 Miscellaneous function （M code）

General miscellaneous function (M code) When the M code registered is executed, the register signal (F26～F33) and strobe signal are transmitted to PLC which use these signals to start or cut off its relative functions.

Basic procedure
The following signals are used for the following functions.

Table 7-1-1

Function	Program address	Output signal		Reply signal	Completion signal
		Register signal	Strobe signal		
Miscellaneous function(M code)	M**	M** （F26~F33）	MF (F007＃0）	MRESP (G63#0)	FIN(G00#0) MFIN(G00#1)

（1） Suppose that MXXX is specified during a program:
If XXX is not specified, CNC alarms. When the user registers the M code in the system, the F signal is specified to be the only one, i.e. the code signal for F26~F33.

（2） If a non-M, S, T, instructions such as move, dwell are specified with MST together, they are ran at the same time. When more than one code of the MST is specified in a same block, they will be executed by sequence.

（3） Set the register signal FYYY.Y and strobe signal F007#0 to 1 in executing MXX, and ensure the reply signal RESP (G63#0) is set to 0 by PLC.

（4） Upon completion of the operation, the PLC sets completion signal MFIN (G00#1) and FIN (G00#0) to 1. The completion signal is used by the miscellaneous function, spindle speed function, tool function. If any of these functions are executed simultaneously, the completion signal must be set to 1 upon completion of all the function.

（5） Ensure that the PLC sets the reply signal MRESP (G63#0) to 0 upon completion of MXX.

（6） The M, S, T instruction in a same block can be executed simultaneously, and CNC executes the next block when the completion signal FIN is confirmed to be 1

7.2 Miscellaneous function (S code)

General Miscellaneous function (S code) When the S code is to be executed, the I/O point or analog control is set by bit parameter No.1#2.

Basic procedure for spindle S code I/O point control:

Table 7-2-1

Function	Program address	Output signal		Reply signal	Completion signal
		Register signal	Strobe signal		
Miscellaneous function(M code)	M**	M** （F26~F33）	MF (F007＃0）	MRESP (G63#0)	FIN(G00#0) MFIN(G00#1)

These S code functions are explained as the following:

（1） Suppose that SX is specified in a program:
X range is 0~7, alarm is issued if it is beyond this range, and S0~S7 correspond to F address signals F22#0~#7 respectively. (For S1, it corresponds to the F address signal F22#1.)

（2） If a non-M, S, T instruction such as move, dwell is specified in the same block with the miscellaneous function, these instructions will be executed simultaneously.

（3） When S1 is executed, the F address signal F22#1 and the strobe signal should be set to 1, and the response signal SRESP(G63#1) should be set to 0 by PLC.

（4） As the operation is finished, the completion signals SFIN (G00#4) and FIN (G00#0) are set to 1 by PLC. If M, S, T functions are to be executed simultaneously, the completion signal FIN (G00#0) can't be set to1 till they are finished.

（5） When S1 is executed, the response signal SRESP(G63#1) should be set to 0 by PLC.

（6） M, S, T codes in a same block will be executed simultaneously, and only the completion signal FIN is set to 1 could next block be executed.

Basic procedure for spindle S code analog control

Table 7-2-2

Function	Program address	Output signal		Gear shift Finish signal	Response signal	Completion signal
		F address signal	Strobe signal			
S code function	S****	S**** (F34#0~#2)	TF (F007＃2)	GRAR (G02#4)	SRESP (G63#1)	FIN(G00#0) SFIN(G00#4)

These S code functions are explained as the following:

（1） Suppose that SXXX is specified in a program, F34#0~#2 is defined by data parameter P246~248, this signal can be used for gear exchange by PLC. (etc. S500 by 1000 set by data parameter P246.)

（2） If a non-M, S, T instruction such as move, dwell is specified in the same block with the miscellaneous function, these instructions will be executed simultaneously.

（3） When S500 is to be executed, the F address signal F34#0 and the strobe signal should be set to 1, and the response signal SRESP(G63#1) should be set to 0 by PLC.

（4） When the gear shift is over, the gear shift completion signal GRAR（G02#4）is set to 1 by PLC.
（5） As the S code is finished, the completion signals SFIN(G00#4) and FIN(G00#0) are set to 1 by PLC. If M, S, T functions are to be executed simultaneously, the completion signal FIN(G00#0) can't be set to1 till they are finished.
（6） When S500 is executed, the response signal SRESP(G63#1) should be set to 1 by PLC.
（7） M, S, T codes in a same block will be executed simultaneously, and only the completion signal FIN is set to 1 could next block be executed.

7.3 Miscellaneous function （T code）

General Miscellaneous function (T code) When the T code is to be executed, the code signal (D241) and the strobe signal are sent to PLC, by these signals PLC switch on or off its functions.

Basic processing
The signals are used for the following functions:

Table 7-3-1

Function	Program address	Output signal			Completion signal
		Code signal	Strobe signal	Response signal	
T code function	T**	T** （D241）	BF (F007＃3）	SRESP (G63#2)	FIN(G00#0) TFIN(G00#5)

（1） Suppose that TXX is specified in a program（XX is sent to code signal D241）:
（2） If a non-M, S, T instruction such as move, dwell is specified in the same block with the miscellaneous function, these instructions will be executed simultaneously. If multiple MST codes are specified in the same block, these codes will be executed by sequence.
（3） If TXX is to be executed, the strobe signal F007#3 is set to 1.
（4） As the operation is finished, the completion signals TFIN (G00#5) and FIN (G00#0) are set to 1 by PLC. If M, S, T codes are to be executed simultaneously, the completion signal FIN (G00#0) can't be set to1 till they are finished.
（5） M, S, T codes in a same block will be executed simultaneously, and only the completion signal FIN is set to 1 could next block be executed.

Signal **M code login signal**

M00～M99（F026～F033）
M code strobe signal
MFEFD（F007＃0）
［Type］ Output signal
［Function］ These signals report PLC the specification of miscellaneous function.
［Output conditions］ For relative output conditions and procedure, please see "7.1 Miscellaneous function （M code）".

Note: 1．The following miscellaneous functions are only processed in CNC: they are not output even programmed.
＊ M98，M99，M198

＊ M codes for calling subprograms

＊ M codes for call customer macro programs

2. The code signal and strobe signal as well as decoding signal can be output for the miscellaneous function listed below.

M00，M01，M02，M30

3. M code is given by binary code by M00～M39.

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

M decoding signal

DM00（F009＃7）
DM01（F009＃6）
DM02（F009＃5）
DM30（F009＃4）
［Type］ Output signal

These signals point out particular miscellaneous function actually specified. The correspondence list of program instruction miscellaneous functions to output signals is as following:

Table 7-3-2

Instruction	Output signal
M00	DM00
M01	DM01
M02	DM02
M30	DM30

［**Output conditions**］ M decoding signal is 1 while as:

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

M decoding signal is 0 while as:

- FIN signal becomes 1.
- Reset.

M code completion signal

MFIN<G000#1>
M code response signal
MRESP<G063#0>
［Type］ Input signal
［Function］ It means M code execution is completed.
［Action］ For the control unit operation and procedure, please see “7.1 Miscellaneous function （M code）”.

S code strobe signal

TF（F007＃2）
［Type］ Output signal
［Function］ These signals notify PLC the spindle speed function specified.
［Output conditions］ For relative output conditions and procedure, please see “7.2 Miscellaneous function （S code）”.

S code completion signal

SFIN<G000#4>
S code response signal
SRESP<G063#1>

［Type］ Input signal
［Function］ It means S code execution is completed.
［Action］ For the control unit operation and procedure, please see “7.2 Miscellaneous function （S code）”.

T code strobe signal

BF（F007＃3）
［Type］ Output signal
［Function］ These signals specifies the tool function.
［Output conditions］ For relative output conditions and procedure, please see “7.3 Miscellaneous function （T code）”.

T code completion signal

TFIN<G000#5>
［Type］ Input signal
［Function］It means T code execution is completed.
［Action］ For the control unit operation and procedure, please see “7.3 Miscellaneous function （T code）”.

Miscellaneous function **completion signal**
FIN（G000＃0）

［Type］ Input signal
［Function］ It specifies the completion of M, S, T codes.
［Action］ For the control unit operation and procedure, please see section 7.1, 7.2, 7.3 .

Warning

All the functions above share the same completion signal FIN（G000#0）, and this signal must be set to 1 after all the functions are completed.

Signal address

	＃7	＃6	＃5	＃4	＃3	＃2	＃1	＃0
G000			TFIN	SFIN			MFIN	FIN
G063							SRESP	MRESP
F007					BF	TF		MF
F009	DM00	DM01	DM02	DM30				

7.4 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（G021＃3）

［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 not execute M, S, and T functions. That is, the control unit stops the output of code signals and strobe signals.
2. If this signal becomes “1” after code signal output, the output operation is executed during the ordinary manner until its completion(that is, until the FDURING signal is received, and the strobe signal becomes to “0”.)
3. Among the miscellaneous function, M00,M01，M02 and M30 are executed even when this signal is “1”. All code signals, strobe signals, decode signals are output during the ordinary manner.
4. Even when this signal is “1”, M98 and M99 are executed during the control unit without outputting their execution results are executed during 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
G021					AFL			
F004				MAFL				

8 Spindle Speed Function

8.1 Spindle speed control mode

General **For 218M 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.

The control mode is I / O or analog is set by bit parameter NO：1#2.

8.1.1 Gear spindle

General **The gear spindle is defined that the spindle S code is controlled by I/O point.**

Signal **Spindle speed strobe signal**

TF（F007#2）

Gear spindle address signal

F22#0～F22#7

［Classification］ Output signal

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

［Output conditions］For the output conditions and procedure, see **"7.2** S code I/O control".

Note： S code range: S0～S7, the system alarms if it exceeds the range, S0～S7 separately corresponds to F address signal F22#0~#7.(For example, S1 corresponds to F22#1 of F address signal)

8.1.2 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.

Signal Spindle positive override signal （**G22#5**）

Spindle negative override signal （**G22#3**）

Spindle override cancel signal OVC（**G22#4**）

［Classification］ Input signal

［Function］The signal specifies the S override change controlled by spindle.

Note: The spindle override function is invalid as follows:
Tapping cycle
Thread cutting

Gear change process:

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 by No.246～248 to 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 8-1-2-1

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

- When the instruction voltage is 10V, the low gear spindle speed is A (parameter No.246) (min^{-1})
- When the instruction voltage is 10V. the high gear spindle speed is B (parameter No.247) (min^{-1}) (middle gear during 3rd gear)
- When the instruction voltage is 10V, the high gear spindle speed is Ac (parameter No.248) （3rd gear）S and spindle motor speed instruction the voltage （0～10V） and gear select signal, （GR1，GR2，GR3）is as the above figure

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,GR3<G002#0～#2>
[Classification] Input signal
[Function] These signals report CNC the current selected gear.
[Output conditions] For the definition of these signals, see Gear change Mode.

Gear change in-position signal
GEAR<G002#4>
[Classification] Input signal
[Function] These signals report CNC in-position of the current selected gear.
[Output conditions] For the definition of these signals, see Gear change Mode.

Signal address

	#7	#6	#5	#4	#3	#2	#1	#0
G002				GEAR		GR3	GR2	GR1
G022			SPOV	OVC	SMOV		P	
F007						TF		
F034						GR3	GR2	GR1

8.2 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**

RGTATP（G003＃1）
［Classification］ Output signal
［Function］ Report to PLC that CNC is during the rigid tapping mode.
［Output conditions］ RGTAP 1：the current CNC is during the rigid tapping mode.
0：the current CNC is not during the rigid tapping mode.

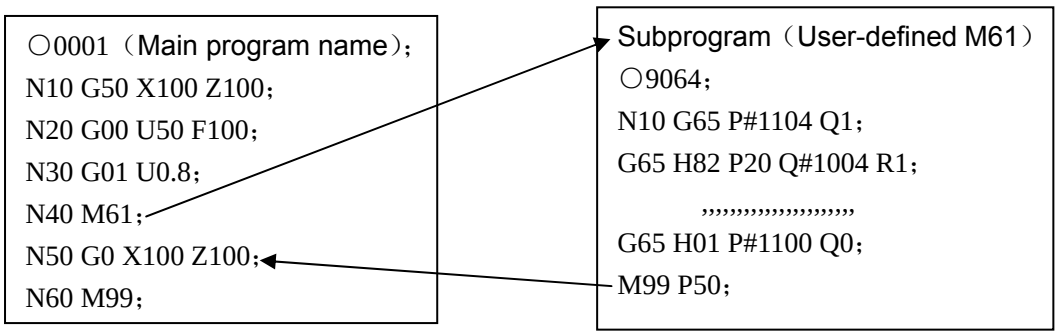
Signal address

	#7	#6	#5	#4	#3	#2	#1	#0
G003							RGTAP	

9 Programmng Instruciton

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 reports some function programmed by macro program can be taken as the general function.

i.e., the program can be written by the data variable(variable data or unknown data. For example, the custom program can be used for technology.

Signal **Custom macro program input signal**

UI000~UI015（G054，G055）

［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 9-1-1

Signal	Address	Variable
UI000	G54#0	#1000
UI001	G54#1	#1001
UI002	G54#2	#1002
UI003	G54#3	#1003
UI004	G54#4	#1004
UI005	G54#5	#1005
UI006	G54#6	#1006
UI007	G54#7	#1007
UI008	G55#0	#1008
UI009	G55#1	#1009
UI010	G55#2	#1010
UI011	G55#3	#1011
UI012	G55#4	#1012
UI013	G55#5	#1013

UI014	G55#6	#1014
UI015	G55#7	#1015
UI000~ UI015	G54, G55	#1032

Note: #1032 is variable with 16-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

Custom macro program output signal
UO000～UO015
（F054～F055）
UO100～UO131
（F056～F059）
［Classification］ 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 9-1-2

Signal	Address	Variable
UO000	F54#0	#1100
UO001	F54#1	#1101
UO002	F54#2	#1102
UO003	F54#3	#1103
UO004	F54#4	#1104
UO005	F54#5	#1105
UO006	F54#6	#1106
UO007	F54#7	#1107
UO008	F55#0	#1108
UO009	F55#1	#1109
UO010	F55#2	#1110
UO011	F55#3	#1111
UO012	F55#4	#1112
UO013	F55#5	#1113
UO014	F55#6	#1114
UO015	F55#7	#1115
UO000~ UO015	F54, F55	#1132
UO100~ UO115	F56~F59	#1133

Note:

1. ＃1132 is a variable with 16-bit.
2. ＃1133 is a variable with 32-bit.

Composition is 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
#1133	UO107	UO106	UO105	UO104	UO103	UO102	UO101	UO100
#1133	UO115	UO114	UO113	UO112	UO111	UO110	UO109	UO108
#1133	UO123	UO122	UO121	UO120	UO119	UO118	UO117	UO116
#1133	UO131	UO130	UO129	UO128	UO127	UO126	UO125	UO124

9.2 Canned cycle

General Canned cycles make it easier for the programmer to create programs. With a canned cycle, a frequently-used machining operation can be specified during a single block with a G function; without canned cycles, normally more than one block is required. During addition, the use of canned cycles can shorten the program to save memory.

One canned cycle consists of a sequence of six operations:

Operation 1: Positioning a hole

Operation 2: Rapid traverse up to R level

Operation 3: Hole machining

Operation 4: Operation at the bottom of a hole

Operation 5: Retraction to point R level

Operation 6: Rapid traverse up to the initial point

Operation sequence of canned cycle is as follows:

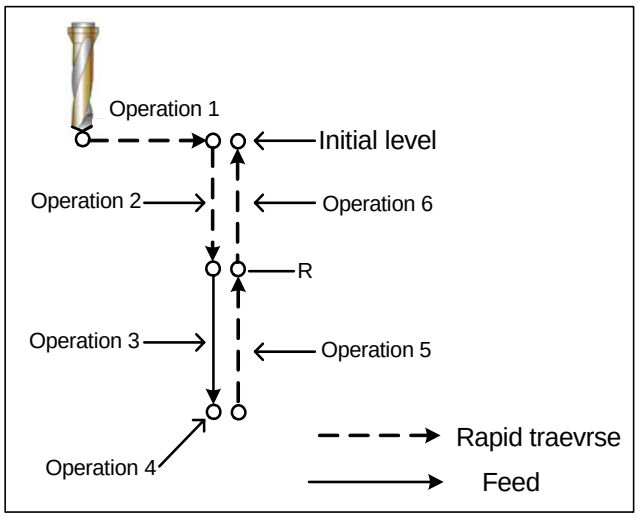


Fig. 9-2-1

The spindle control is required to output negative rotation spindle instruction in some canned cycle. The following canned cycles require spindle control:

Reverse tapping cycle G74） Fine boring cycle G76）
Tapping cycle G84 Boring cycle G86
Back boring cycle G87 Boring cycle G88

For spindle control, the following normal miscellaneous functions are used:
See the description of the miscellaneous functions.

M03：CW spindle rotation

M04：CCW spindle rotation

M05：Spindle stops

M19：Spindle orientation

When the rotation direction of the spindle is to be switched from one direction to the other (for example, when M04 is output during M03 operation), a parameter can be specified whether to send M05 at the time switching.

Tapping signal	During the tapping cycle, output the tapping signal. When the tapping cycle G code is valid, CNC also outputs the tapping signal.
Override	During the tapping, the cutting feedrate override is always set to 100%.
Feed hold	During the tapping, the traverse does not stop immediately when the feed hold is pressed down. But it stops when the tool returns to R level.
Dry run	TDR (parameter 12#5) defines if the dry run is valid during the tapping.

Signal **Tapping signal**

TAP＜F001＃5＞

[Classification**]** Output signal

[Function**]** The signal reports CNC is during tapping mode.

[Output conditions**]** The signal is 1:

－CNC is during the tapping cycle mode G74, G84.
－CNC is during the tapping cycle mode G63. the signal is set to 0:
－CNC is not tapping cycle and tapping mode.
－The reset or emergency stop signal is input.

Signal address:

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

10 Display/Set

10.1 Clock Function

General Time is displayed during the hour/minute/second format on set screen.
The custom macro system variable can be used to read the time.
Time report can be read and written.

10.2 Displaying operation history

General This function displays a history of the key stroke and signal operations, performed by the CNC operator, when a failure or CNC alarm occurs.

10.3 Help function

General The help function displays on the screen detailed report about alarms issued during the CNC and about CNC operations. The screen displays detailed information about the alarms and how to recover from them. The detailed information is displayed only for a limited number of P/S alarms. These alarms are often misunderstood and are rather difficult to understand.

11 Measurement

11.1 Skip function

General Linear interpolation can be commanded by specifying axial following the G31 instruction, like G01. If an external skip signal is input during the execution of this instruction, execution of the instruction is halted and the next block is executed. The skip function is used when the end of machining is not programmed but specified with a signal from the machine, for example, during grinding. It is used also for measuring the dimensions of a workpiece.

The coordinate values when the skip signal is turned on can be used during a custom macro because they are stored during the custom macro system variable #5061～#5068, as follows:

#5061 1st axis coordinate value
#5062 2nd axis coordinate value
#5063 3rd axis coordinate value
:

Signal **Skip signal**

SKIPP <G001#1>
[Classification] Input signal
[Function] This signal terminates skip cutting. That is, the position where a skip signal turns to “1” during a block containing G31 is stored during a custom macro variable, and the move instruction of the block is terminated at the same time.
[Operation] When a skip signal turns to “1”, the control unit works as described below.

- When a block contains a skip cutting instruction G31, the control unit reads and stores the current position of the specified axis at that time. The control unit stops the axis, then cancels the remaining distance that the block was supposed to be moved.
- The skip signal is monitored not for a rising edge, but for its state. So, if a skip signal continues to be “1”, a skip condition is assumed to be satisfied immediately when the next skip cutting is specified.

Note:

The skip signal width requires at least 10ms.

Signal address

	#7	#6	#5	#4	#3	#2	#1	#0
G001							SKIPP	

12 Panel locked setting

Signal Lock edit signal

LEDT（G016#6）

［Type］ Input signal

［Function］The signal locks the press key on the edit panel.

［Operation］When the signal is set to 1, all keys on the panel are locked and disenabled.

When the signal is set to 0, all keys on the panel are enabled.

Lock machine signal

LSYS（G016#7）

［Type］ Input signal

［Function］The signal locks the press key on the machine panel.

［Operation］When the signal is set to 1, all keys on the panel are locked and disenabled.

When the signal is set to 0, all keys on the panel are enabled.

Signal address

	#7	#6	#5	#4	#3	#2	#1	#0
G016	**LSYS**	**LEDT**						

Appendix

Signal list (During order of address)

Addresses between PLC and CNC

1. CNC→PLC address: F000 ----- F064

Table 1

Signal name	Symbol	Address
Feed hold alarm signal	SPL	F000#4
Cycle start alarm signal	STL	F000#5
Servo ready completion signal	SA	F000#6
Automatic operation signal	OP	F000#7
Alarm signal	AL	F001#0
Resetting signal	RST	F001#1
Tapping signal	TAP	F001#5
Tapping in process signal	D TAP	F001#6
Thread cutting signal	THRD	F002#3
Program restart signal	SRNMV	F002#4
Cutting feed signal	CUT	F002#6
Dry run check signal	MDRN	F002#7
Incremental feed select check signal	MINC	F003#0
MPG feed select check signal	MH	F003#1
MANUAL feed select check signal	MJ	F003#2
Manual data input select check signal	MMDI	F003#3
DNC operation selection confirm signal	MRMT	F003#4
Automatic operation select check signal	MMEM	F003#5
Memory edit select check signal	MEDT	F003#6
Machine zero return select check signal	MZRO	F003#7
Skip optional block check signal	MBDT	F004#0
All-axis machine lock check signal	MMLK	F004#1
Single block check signal	MSBK	F004#3
Auxiliary function lock signal	MAFL	F004#4
Manual reference point return check	MREF	F004#5
Feedrate override OFF check signal	CFORD	F005#0
Spindle override OFF check signal	CSORD	F005#1
M function strobe signal	MFEFD	F007#0
S function strobe signal	TF	F007#2
T function strobe signal	BF	F007#3
Decode M signal	DM30	F009#4
	DM02	F009#5
	DM01	F009#6
	DM00	F009#7
Axis moving direction signal	MV1 --- MV5	F017
Axis moving direction signal	MVD1--- MVD5	F019
Spindle I/O gear control signal	S00 --- S31	F22#0---#7
Miscellaneous function code signal	M**	F026 --- F033（see Ⅲ Operation 3.5）
Spindle analog control gear select	GR1,GR2,GR3	F034#0 --- #2

signals		
2nd reference point return completion signals		F042#0---#3
3rd reference point return completion signals		F043#0---#3
4th reference point return completion signals		F044#0---#3
Area check signals		F045#0---#2
Customer macro program output signal	U000 --- U015 U100 --- U131	F054,F055 F056 --- F059
Reference point establishment signal	ZRF1 ---- ZRF5	F060

2. PLC→CNC address：G000 ----- G064

Table 2

Signal name	Symbol	Address
Miscellaneous function completion signal	FIN	G000#0
M function completion signal	MFIN	G000#1
S function completion signal	SFIN	G000#4
T function completion signal	TFIN	G000#5
Emergency stop signal	ESP	G001#0
Skip signal	SKIPP	G001#1
Gear select signal (input)	GR1,GR2, GR3	G002#0 --- #2
Gear change completion signal	GEAR	G002#4
Rigid tapping signal	RGTAP	G003#1
Overtravel signal	*+L1 --- *+L5 *-L1 ---- *-L5	G012#0 ---- #4 G013#0 ---- #4
Edit lock signal	LEDT	G016#6
Operator panel lock signal	LSYS	G016#7
Zero return deceleration signal check		G017#0 ---- #4
Zero return completion signal check		G018#0 ---- #4
Edit mode		G20.0
Auto mode		G20.1
MDI mode		G20.2
Zero return mode		G20.3
Step mode		G20.4
Manual mode		G20.5
MPG mode		G20.6
DNC mode		G20.7
Skip		G21.0
Single block		G21.1
Dry run		G21.2
Auxiliary lock		G21.3
Machine lock		G21.4
Optional stop		G21.5
Program restart		G21.6
Spindle override(-)		G22.3
Spindle override OFF		G22.4
Spindle override (+)		G22.5
Spindle JOG		G22.6
Cycle start		G23.6
Feed hold		G23.7
Feedrate override (+)		G24.0
Feedrate override OFF		G24.1
Feedrate override (-)		G24.2
Rapid switch		G24.7
Rapid Fo		G25.0
Rapid 25%		G25.1
Rapid 50%		G25.2
Rapid 100%		G25.3
Incremental step length 0.001		G26.0
Incremental step length 0.01		G26.1
Incremental step length 0.1		G26.2
Incremental step length 1		G26.3

MPG step length 0.001		G26.4
MPG step length 0.01		G26.5
MPG step length 0.1		G26.6
Manual feed axis +X		G27.0
Manual feed axis +Y		G27.1
Manual feed axis +Z		G27.2
Manual feed axis +4TH		G27.3
Manual feed axis +Th5		G27.4
Manual feed axis -X		G28.0
Manual feed axis -Y		G28.1
Manual feed axis -Z		G28.2
Manual feed axis -4TH		G28.3
Manual feed axis -Th5		G28.4
Spindle orientation		G29.0
Overtravel release		G30.0
User macro program interruption signal	UINT	G031#1
User macro program input signal	UI000 --- UI015	G054,G055
2nd reference point check permission signal	PREF20----PREF23	G057#0 ----- #3
3rd reference point check permission signal	PREF30----PREF33	G058#0 ----- #3
4th reference point check permission signal	PREF40----PREF43	G059#0 ----- #3

Ⅲ Operation

1 PLC Window Display

1.1 Automatic operation when GSK218M PLC power on

PLC starts after power on: it will make use of R255 to conduct the net contain it during the first period, and then set R255 to “0” which can't be output, the value of the keep relay gets from the PLC last output before stop running

Note: The keys during < > are the panel; the ones in【 】are the soft keys; 【 】 is the window corresponding the current soft key; ◆ reports there is the sub-menu in the menu; all operations in PCL are executed during MDI mode and only view and search can be executed during other modes.

1.2 INFO window display

1.2.1 INFO window

1. Press <INFO> key on the panel to enter the default INFOR window as Fig. 1-2-1-1. If the 【**INFO**】soft key has not found on the below of the screen, the bit parameter No: N0：26#6=1 can be defined to set the key on the PLC window, and then <**INFO**> is pressed to enter INFO window. There is the version number of GSK218M, modification data, PLC I/O interface definition state and so on INFO interface.

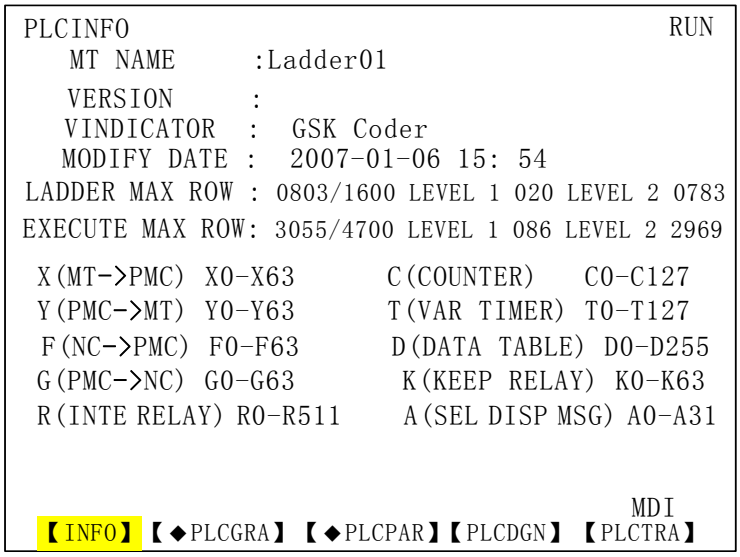


Fig. 1- 2- 1-1

4 soft keys on the below of the screw are 5 kinds of information display window of PLC.

2. Press PageUp/PageDown in INFO window to enter the next window of INFO as follows:

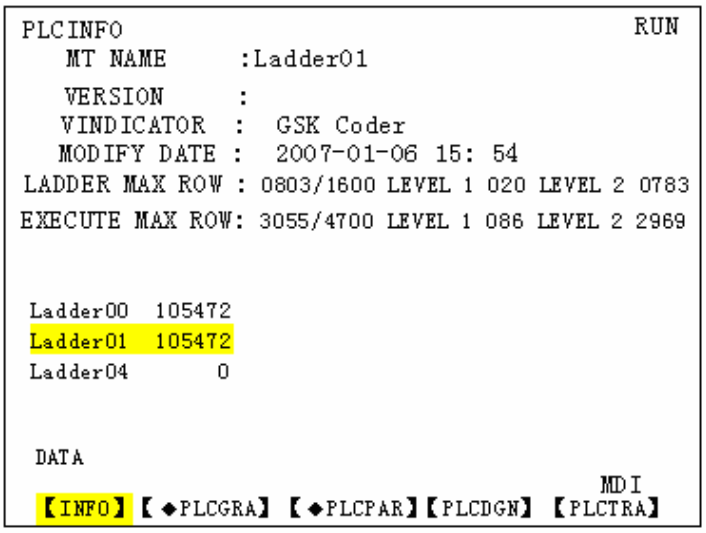


Fig. 1- 2- 1-2

1. The system appears the ladder name which is running in the window. The ladder is divided into three: the ladder is the only one that is running, other 15 ladders in No.0-15 ladder besides the one is running, up to 4 ladders which can be editable or referred.(they can be named with 2-digit serial number except for 0-15).
2. When the system is turned on, the bit parameter 53#0~#3 setting value is the binary combination parameter, when the setting value is 0, No.0 ladder is used; when it is1~15, No. 0~15 parameter is used. After the system determines to load some ladder which is running (the operation maybe appear the danger, it is enabled after the system restarts). If the format is incorrect, the ladder is deleted to recreated, and the user needs to specify the running ladder No. carefully. Names of all ladder files must be with “ladderXX.grp” (XX is the serial number) , otherwise, the system does not identify the files. The file format is determined by the system, and the user cannot modify the file outside of the system, otherwise, the file maybe be deleted or cannot be identified.
3. When the system uses No. 0 ladder, M6 cannot call macro program, when uses No. 1~15 ladder, M6 separately call O91001~O91015 macro program.
4. Selecting ladder. Move the cursor or input “LX”/“LXX”（X/XX is number）to specify the file name, the system checks whether “X”/“XX” is the known file number after “Enter” is pressed, if the system has not checked it, it creates an ladder with the name “ladder0X.grp” or “ladderXX.grp” . The system automatically creates “END1” and “END2” to ensure that the user continuously operates the ladder file (if the open file does not convert, the INSTRUCTION list will be always empty) when the file is created. The user can copy or clip the ladder (it does not exceed 100 rows, otherwise the system only copy or clip the front 100 rows) which is normally opened, For security, after the system opens one file to edit, the system will automatically save the current file and then open another file, the system will execute the grammar check before saving, and will abandon the save after it finds out the error.
5. The ladder format has been adjusted, and the file head includes the basic information of file, such as row number, step number. The step information is the new one when it is converted. The user can delete the ladder which is not opened and is not running, which

must be executed orderly. After the user opens the ladder which is not running, the system stops refreshing the ladder network information to avoid the mistake. The ladder which is running can be copied or saved to conveniently copy the content in the file to others, before the users edits the ladder which is running, it should be stopped. When the cursor stops in the background edit file the user can press “Ctrl＋CHG” to open Info to modify the edit file.

1.2.2 PLCGRA window

Press 【**PLCGRA**】to enter **PLCGRA** window or define the bit parameter N0：26#6=1 to press <**INFO**> key on the PLC window to enter **PLCGRA** window as Fig.1-2-2-1.

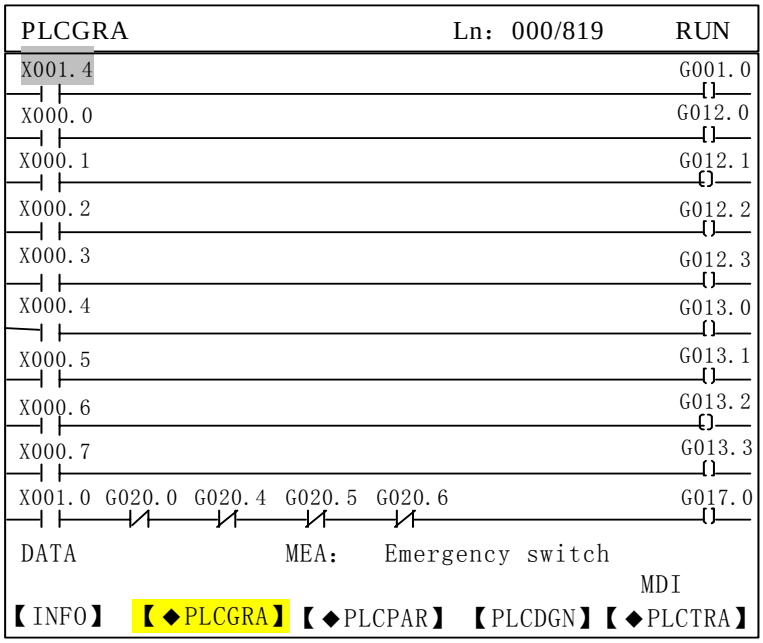


Fig. 1- 2- 2-1

Contents and operations on **PLCGRA** window:

PLCGRA[ladder01]： current ladder name。

001/810： current line position specified by the cursor during the ladder the cursor

RUN: operation state of ladder, including RUN/run, STOP/stop, DEBUG/debug

Diagram: ladder program

Data/serial number: displaying input data. The serial number appears by pressing <**SEARCH**> on the panel to search the data. The CNC returns to the data displaying window after press <CANCEL>.

MEA: Commentaries of element positioned by the cursor.

MDI mode: current operation mode (note: the ladder can be modified only in MDI mode).

Press the Page Up/Page Down, four Direction keys to search, view and modify the elements.

1.2.3 PLCPAR window

Press 【**PLCGRA**】to enter **PLCPAR** window or define the bit parameter N0：26#6=1 to press <**INFO**> key on the PLC window to enter **PLCPAR** window as Fig.1-2-3-1.

PLCPara RUN

ADDR	N.7	N.6	N.5	N.4	N.3	N.2	N.1	N.0
K000	0	0	0	0	0	0	0	0
K001	0	0	0	0	1	0	0	0
K002	0	0	0	0	0	0	0	0
K003	0	0	0	0	0	0	0	0
K004	0	0	0	0	0	0	0	0
K005	0	0	0	0	0	1	0	0
K006	0	0	0	0	0	0	1	1
K007	0	0	0	0	0	0	0	0
K008	0	0	0	0	0	0	0	0
K009	0	0	0	0	0	0	0	0
K010	0	0	0	0	0	0	0	0
K011	0	0	0	0	0	0	0	0

DATA

MDI

【INFO】【◆PLCGRA】【◆PLCPAR】【PLCDGN】【◆PLCTRA】

Fig. 1- 2- 3-1

Contents and operations on **PLCPAR** window:

RUN ： operation state of ladder

ADDR： keep relay address

N.0~N.7 ： bit status of keep relay address

1：the address maintains the state before power OFF.

0：the address resets to default state after power OFF

Data/serial number: displaying input data. The serial number appears by pressing <**SEARCH**> on the panel to search the data. The CNC returns to the data displaying window after press <CANCEL>.

MDI mode: current operation mode(note: the relative parameter of PLCPAR can be modified only in MDI mode).

Press the Page Up/Page Down, four Direction keys to search, view and modify the elements.

1.2.4 PLCDGN window

Press 【**PLCDGN**】to enter PLCDGN window or define the bit parameter N0：26#6=1 to press <**INFO**> key on the PLC window to enter PLCDGN window as Fig.1-2-4-1.

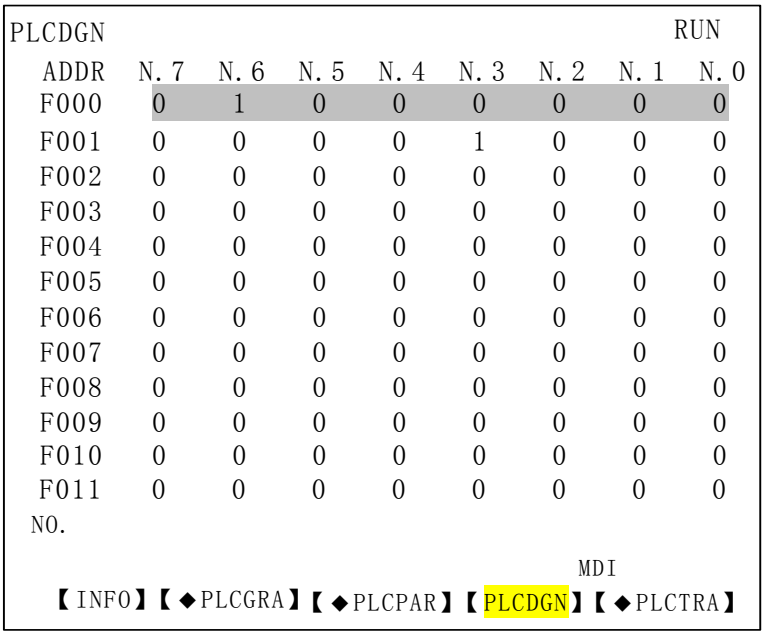


Fig. 1- 2- 4-1

Contents and operations on **PLCDGN** window:

RUN： operation state of ladder

ADDR： address of diagnosis number

N.0~N.7： bit number state of diagnosis address.

1：the signal is connected；

0：the signal is not connected.

Data/serial number: displaying input data. The serial number appears by pressing <**SEARCH**> on the panel to search the data. The CNC returns to the data displaying window after press <CANCEL>.

MDI mode: current operation mode.

Press the Page Up/Page Down, four Direction keys to search the corresponding diagnosis number.

Generally, only the searching can be operated in the window, the I/O interface of PLC enters the signal debug mode only when the user gets the authority to set K0.1 to 1.,and “data/serial number” change to data automatically, then the user can modify the X, Y signal.

1.2.5 PLCTRA window

Press 【**PLCTRA**】to enter PLCTRA window or define the bit parameter N0：26#6=1 to press <**INFO**> key on the PLC window to enter PLCTRA window as Fig.1-2-5-1:

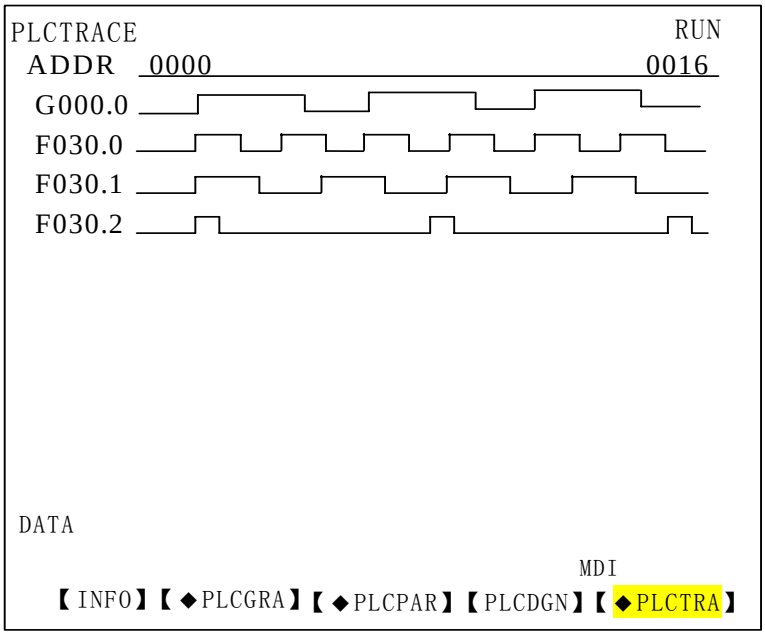


Fig. 1- 2- 5-1

Contents and operations on **PLCTRA** window:

ADDR： check address.

0000 ： variation for all check addresses in the position.

0016 ： variation for all check addresses in the position. Sum by subtracting the previous data is variation of check address on the screen.

Data: displaying input data. Input the required address. check the address, and cannot execute the input when the check is being executed.

MDI mode: current operation mode.

Press the Page Up/Page Down, four Direction keys to search the corresponding diagnosis number.

2 PLC Programming Operation

2.1 General

GSK218M CNC PLC operations are performed in the corresponding windows. Modifying the ladder operation must upon getting the authority above the system debug level.

There are two windows:

1. PLCGRA window include: basic instruction, function instruction and instruction list. Press 【**PLCGRA**】 to enter PLCGRA window as Fig. 1-2-2-1. Press 【**PLCGRA**】to enter PLCGRA window as Fig. 2-1-1.

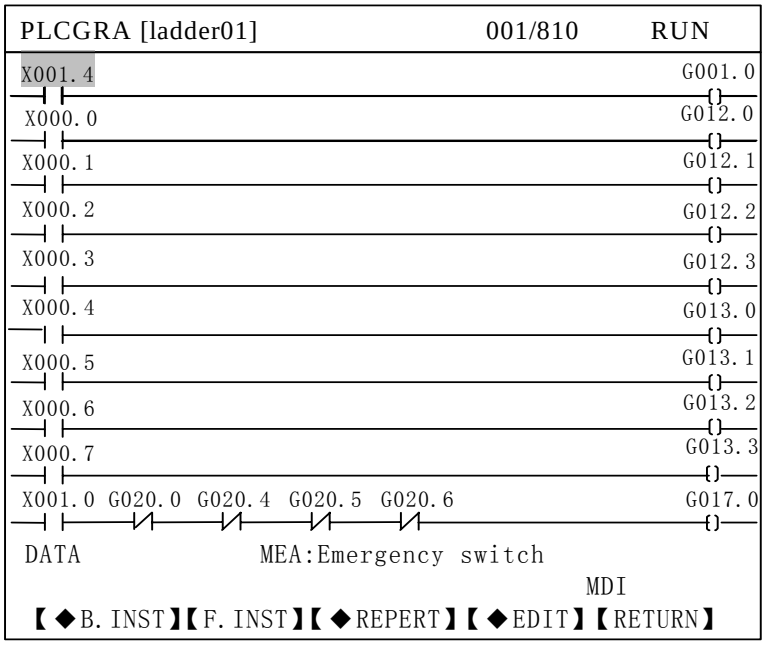


Fig. 2- 1- 1

2. **PLCPAR** window includes CTR, TMR, DATA, KPAR and MDEC.

Press 【**PLCPAR**】 to enter PLCRAR window as Fig. 1-2-3-1. Press 【**PLCPAR**】to enter PLCRAR window as Fig. 2-1-2. modifying the parameter, PLC running control, enter I/O debug mode must upon getting the authority above the system debug level. See ***chapter three***

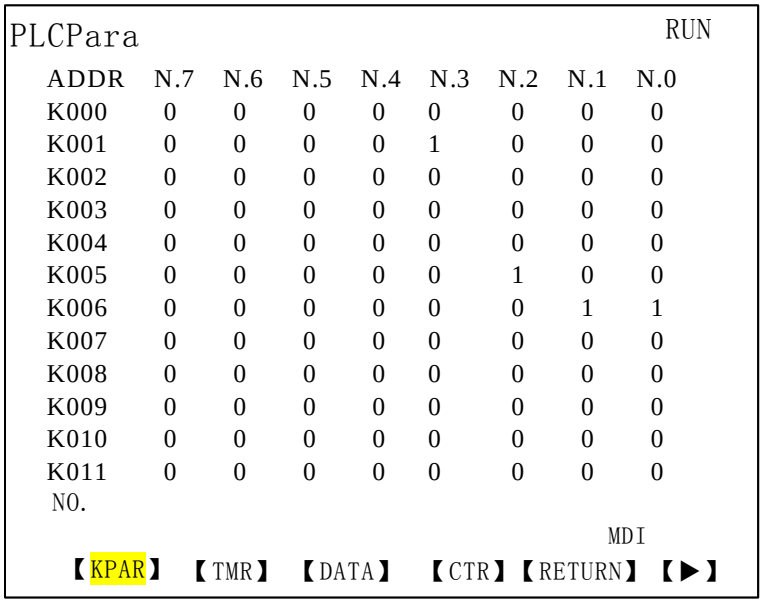


Fig. 2- 1- 2

2.2 Basic instruction(B. INST)

Press 【**B. INST**】in Fig. 2-1-2 to enter the basic instruction operation window as Fig.2-2-1.

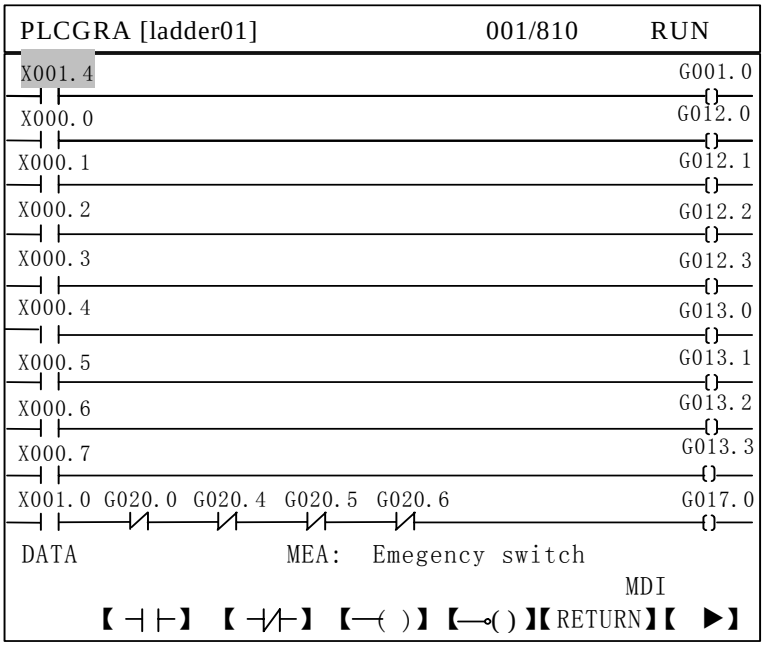


Fig. 2- 2- 1

Press 【▶】to display other basic instructions as Fig. 2-2-2.

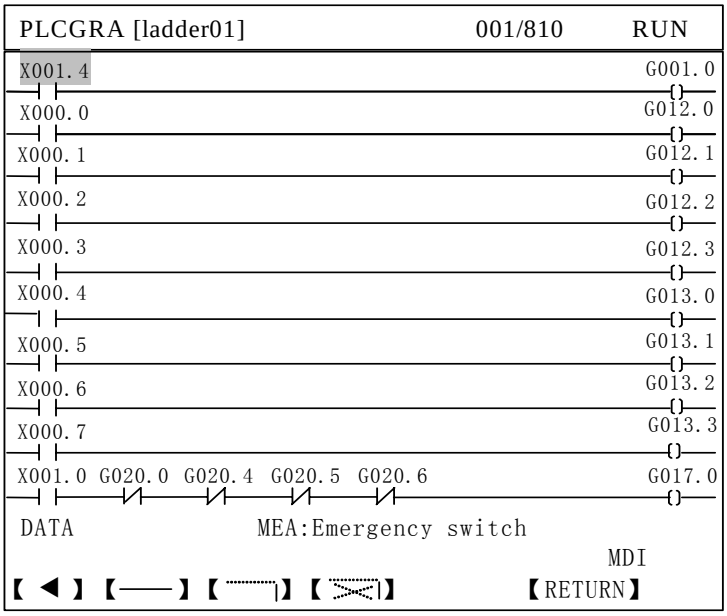


Fig. 2- 2- 2

The basic instructions are divided into 7 kinds of graphic display:

【 ⊣⊢ 】 ：normally open contact

【 ⊣/⊢ 】 ： normally closed contact

【—( ) 】 ：output coil

【—○( )】： output coil reversing

【——】： horizontal conductive line

【 】： vertical conductive line

【 】： deleting a vertical conductive line

Auxiliary soft key:

【 ► 】： Page Down

【 ◄ 】： Page Up

【 RETURN 】： return to the previous menu.

2.3 Operations of ladder

- Adding an element: position the cursor to the required position, press the corresponding menu to input the element name, press <**ENTER**> to confirm the addition after it is displayed behind the data. If the current position has element, the new element will replace the previous one.
- Inserting an element: position the cursor to the required, press <**INSERT**> to insert empty position, and then add the new element as the above method. The cursor can insert orderly. (Note: ensure the indicator above <**CTRL**> key is OFF when inserting element.)

- Deleting an element: press <**DELETE**> to delete the current element and the following one will orderly move forward(Note: ensure the indicator above <**CTRL**> key is OFF when deleting element.)
- Adding a vertical conductive line: press【 】to add one vertical conductive line under the lower-right of current cursor position.
- Deleting a vertical conductive line: press 【 】 to delete one vertical conductive line under the lower-right of current cursor position.
- Adding a horizontal conductive line: press 【——】to add one horizontal conductive line before the cursor position, if the current position has element, the horizontal conductive line replace the element.
- Inserting a line: position the cursor to the any line of target line, press <**CTRL**>, and then press <**INSERT**> after the indicator above <**CTRL**> is ON, insert the blank line at the place above of the specified line by cursor, and the sequent line will orderly move down one line.
- Deleting a line: position the cursor to the target line, press <**CTRL**>, and then press <**DELETE**> to delete the current line after the indicator above <**CTRL**> is ON, and the sequent line will orderly move up one line.
- Deleting a block: position the cursor to the initial position which will be deleted, Input the address number of target block's coil, and last press < **DELETE** >.
- Search: directly input the required element name, press 【 ↑ 】to search up and press 【 ↓ 】to search down after the data on screen is displayed,
- Save: press <**STORE**> to save the modified ladder.

Ladder programming example:

1. position the cursor to the initial position of programming, press 【 】and there is normally-open contact symbol at the cursor position, directly input the element name X1.4 and press <**ENTER**> and X001.4 appears at the current cursor position.
2. right move the cursor, press【 】, and there is there is normally-open contact symbol at the cursor position, directly input the element name X2.1 and press <**ENTER**> and X002.1 appears at the current cursor position.
3. position the cursor to the initial position of next line, press【 】there is there is normally-open contact symbol at the cursor position, directly input the element name X2.4 and press <**ENTER**> and X002.4 appears at the current cursor position.
4. right move the cursor, press 【——】, and draw a horizontal conductive line at the current cursor position.
5. up move the cursor, press 【 】, and draw a vertical conductive at the current cursor position.
6. press 【—( )】and the system automatic create the output coil, namely the necessary horizontal conductive line. Directly input the element name G1.0, press <**ENTER**> and G001.0 appears at the current cursor position.

The programmed ladder is as Fig. 2-3-1:

Fig. 2-3-1 Ladder example

Note: The green element in the ladder is turned on no matter that it is normally-open and normally-closed or outputs the coil, and the white indicates it is turned off (owing to the printing, the dark stands it is turned off, and the light stands it is turned on.)

2.4 Function instruction

Press 【**F. INST**】in Fig. 2-1-1 to enter the function instruction operation window as Fig. 2-4-1.

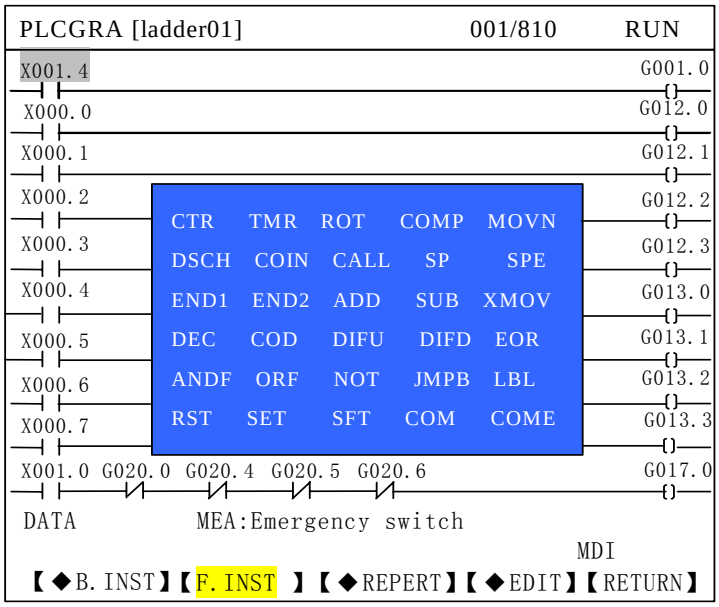


Fig. 2- 4- 1

There are 30 PLC function instructions in the function instruction list. For the format and use of function instruction, see Programming.

2.5 Instruction list

Press 【**REPERT**】in **PLCGRA** window as Fig.2-1-1 to enter the operation window of instruction classification as Fig. 2-5-1.

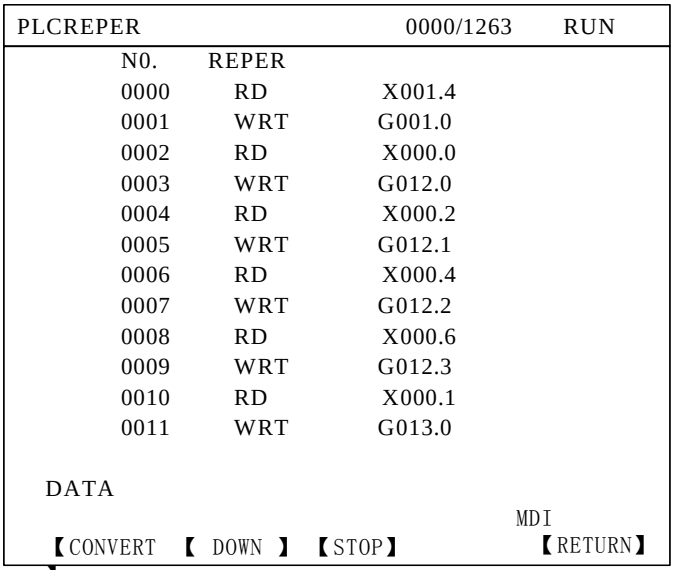


Fig. 2- 5- 1

Contents and operations of instruction list window:

0000/1263: the step number and total step number of current ladder run

RUN: operation state of ladder

Data/serial number: displaying input data. The serial number appears by pressing <**SEARCH**> on the panel to search the data. The CNC returns to the data displaying window after press <CANCEL>.

MDI mode: current operation mode.

【CHANGE】: ladder is changed into instruction list.

【DOWNLOAD】: the instruction list is downloaded to CNC to automatically operate the PLC ladder.

【STOP】: stop ladder running.

【Esc】: return to the up menu.

Press the Page Up/Page Down, four Direction keys to search and position, view the instruction list address.

2.6 Edit instruction

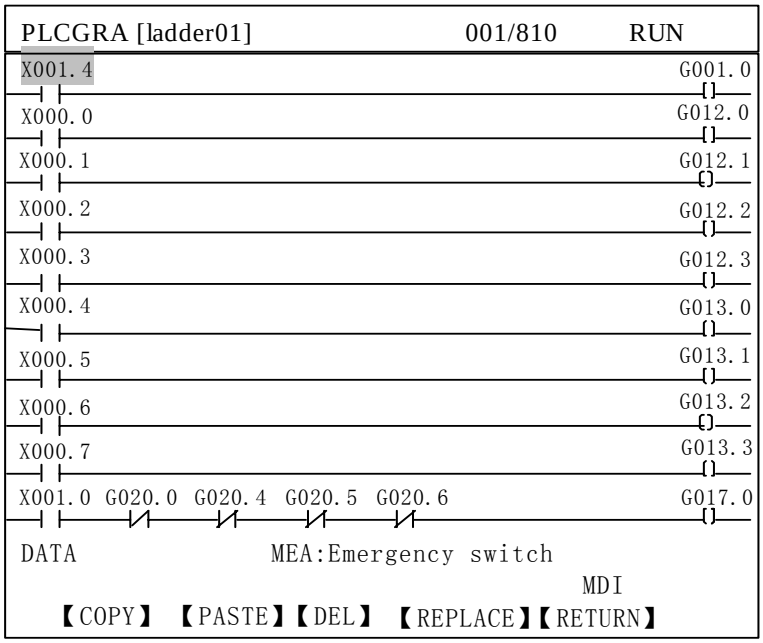


Fig. 2-6-1

Contents and operations on instruction list window:

001/810： displaying the current position of cursor and total line number of ladder

RUN: operation state of ladder

Data/serial number: displaying input data. The serial number appears by pressing <**SEARCH**> on the panel to search the data. The CNC returns to the data displaying window after press <CANCEL>.

MDI mode: current operation mode.

【COPY】 ： after inputting G12.1, press it and the ladder between the cursor and G12.1 can be copied.

【PASTE】 ： paste the copied ladder.

【DELETE】： after inputting G12.1, press it and the ladder between the cursor and G12.1 can be deleted.

【CHANGE】：input the signal address needed to change, and press the key, the system prompts if the address is changed or all addresses are changed.

Y：YES； N：NOT； A：ALL

Press the Page Up/Page Down, four Direction keys to search and position, view the instruction list address.

2.7 PLC operation step

PLC operation steps:

1. Press<Setting> key and input the machine manufacturer level password in 【PASSWORD】window.

2. press**<PLC>**key, then press【KPAR】in【PLCPAR】window to enter the viewing and setting window of keep relay, operate PLC by modifying the related bit of K000, K001. (such as setting K000.7 to 1 can modify the ladder after saving). see ***Appendix K INSTRUCTION List in chapter four Connection*** for the definition of related bit
3. In 【PLCGRA】 window, press 【INSTRUCTION】 to press【STOP】, the system stops the running ladder(if the modified ladder is not the current, the step can be omitted).
4. In 【PLCGRA】 window, complete PLC programming by executing 【B. INST】, 【FUNCTION INST】、【EDIT INST】 etc . Press **<SAVE>**key, the data field prompts " Ladder Saved!", it means the saving is successful. The corresponding PLC alarms during saving when PLC is mistaken, please check the PLC program.
5. In【PLCGRA】window, press <CHANGE> on the panel then the data field will prompt "CHANGING……", and prompts "CHANGE SUCCEEDED!" after the change finishes.
6. In**【PLCGRA】**window, click <INSTRUCTION LIST>, then click **【DOWNLOAD】** , and the data column prompts "DOWNLOADING……", and "DOWNLOAD SUCCEEDED!" after the download finishes. The ladder is changed into instruction list and downloaded to CNC, then automatically operates.

3 PLC Address, Parameter Setting

In PLC, the addresses and parameters of counter, timer, data list, keep relay are used, viewing and setting must be in the corresponding window. Press 【**PLCPAR**】in PLCPAR window to enter PLC address, parameter setting window as Fig. 3-1, including counter, timer, data list, keep relay and so on, used for viewing and setting the addresses, parameter and data list. (Only the debugging password is entered by user for authority, could the corresponding setting be done.)

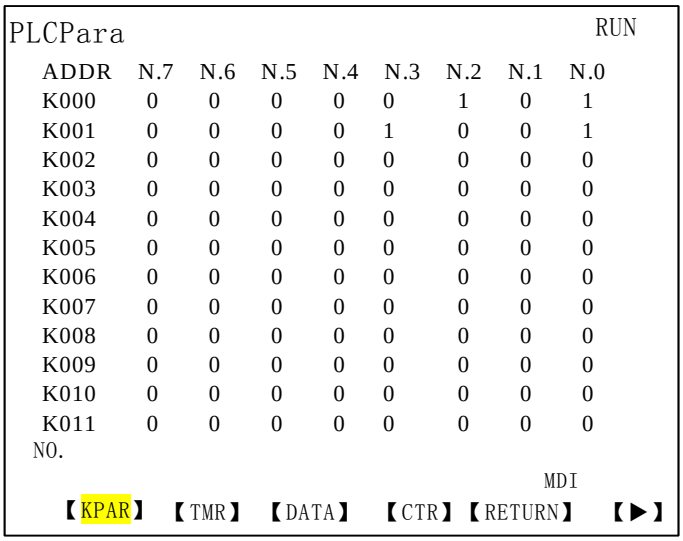


Fig. 3- 1

3.1 Keep relay

Press 【**CTR**】in Fig. 3-1 to enter the view and the setting window of keep relay as Fig. 3-1-1.

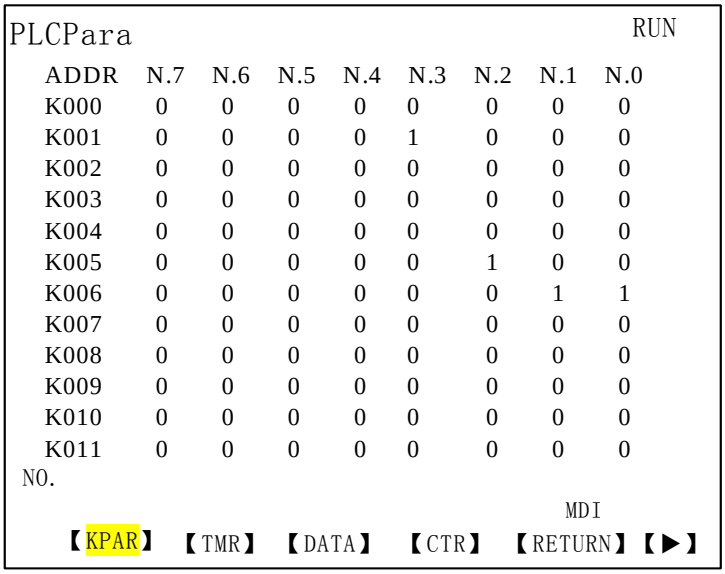


Fig. 3- 1- 1

Contents and operations on keep relay window: ：

RNU: operation state of ladder.

ADDR: keep relay address.

N.0~N.7: bit number state of keep relay address. 1: After the CNC is turned off, the address keeps the state which is before power-off. 0: after the CNC is turned off, the address resets to the default state.

Data/serial number: displaying input data. The serial number appears by pressing <SEARCH> on the panel to search the data and view the current value. The CNC returns to the data displaying window after press <CANCEL>. The current value will not be refreshed for convenience to modify the data for the user.

MDI mode: current operation mode.

【RETURN】: Return to the up menu.

【▶】 : Enter the next page.

Press <SAVE> to download the setting value to operate the CNC. When the save is completed, the system displays: KPAR Downloaded OK ! , when the save is not completed, the system displays: Download failed ! when the download doesn't have the condition, the system displays: Illegal Download Parameter.

(Note: press **【SAVE】**after modification to save the modification and operation the CNC.

K000~~K005 is taken up by the CNC. For its definition, see Function, Appendix A.1

Press the Page Up/Page Down, four Direction keys to search and position, view or modify the keep relay address.

3.2 Timer

Press 【TMR】in Fig. 3-1 to enter the view and the setting window of timer as Fig. 3-2-1.

PLCPara RUN

NO.	ADDRESS	CURRENT	SET
0000	T000	00000	00100
0001	T001	00000	00100
0002	T002	00000	00100
0003	T003	00000	00100
0004	T004	00000	00100
0005	T005	00000	00100
0006	T006	00000	00100
0007	T007	00000	00100
0008	T008	00000	00100
0009	T009	00000	00100
0010	T010	00000	00100
0011	T011	00000	00100

NO.

MDI

【KPAR】【TMR】【DATA】【CTR】【RETURN】【▶】

Fig. 3- 2- 1

Contents and operations on counter window:

RUN : operation state of ladder。

N0.: timer number, cannot be changed.

ADDRESS: timer address, cannot be changed.

CURRENT: timer current value, cannot be changed.

SET: the timer preset value can be changed after setting K000.0 (PLC parameter is permitted to modify) to 1 in MDI mode.

Data/serial number: displaying input data. The serial number appears by pressing <**SEARCH**> on the panel to search the data and view the current value. The CNC returns to the data displaying window after pressing <CANCEL>, the current value will not be refreshed for convenience to modify the data for the user.

MDI mode: current operation mode.

【Esc】: return to the up menu.

【▶】: enter the next page

Press <**SAVE**> to download the setting value to operate the CNC. When the save is completed, the system displays: TMR Downloaded OK ! , when the save is not completed, the system displays: Download failed ! when the download doesn't have the condition, the system displays: Illegal Download Parameter.

(Note: press 【**SAVE**】after modification to save the modification and operate the CNC.

Press the Page Up/Page Down, four Direction keys to search and position, view or modify the timer address.

3.3 Data list

Press 【DATA】 in Fig. 3-1 to enter the view and the setting window of data list as Fig. 3-3-1.

PLCPara RUN

N0.	ADDRESS	DATA	N0.	ADDRESS	DATA
000	D000	00000	012	D012	00000
001	D001	00000	013	D013	00000
002	D002	00000	014	D014	00000
003	D003	00000	015	D015	00000
004	D004	00000	016	D016	00000
005	D005	00000	017	D017	00000
006	D006	00000	018	D018	00000
007	D007	00000	019	D019	00000
008	D008	00000	020	D020	00000
009	D009	00000	021	D021	00000
010	D010	00000	022	D022	00000
011	D011	00000	023	D023	00000

NO.

MDI

【KPAR】 【TMR】 【DATA】 【CTR】 【RETURN】 【▶】

Fig. 3- 3- 1

Contents and operations on data list window:

RUN : operation state of ladder.
N0. : data list number, cannot be changed.
DATA : data list setting value, can be changed after setting K000.0 (PLC parameter is permitted to modify) to 1 in MDI mode.
Data/serial number: displaying input data. The serial number appears by pressing <SEARCH> on the panel to search the data and view the current value. The CNC returns to the data displaying window after pressing <CANCEL>. The current value will not be refreshed for convenience to modify the data for the user.
MDI mode : current operation mode.
【RETURN】 : return to the up menu.
【▶】 : enter the next page :

Press <**SAVE**> to download the setting value to operate the CNC. When the change is completed, the system displays: DATA Downloaded OK ! , when the change is not completed, the system displays: Download failed ! When the download doesn't have the condition, the system displays: Illegal Download Parameter.

(Note: press 【**SAVE**】after modification to save the modification and operate the CNC.)

Press the Page Up/Page Down, four Direction keys to search and position, view or modify the data list address.

3.4 Counter

Press 【**CTR**】in Fig. 3-1 to enter the view and the setting window of counter as Fig. 3-4-1.

PLCPara RUN

N0.	ADDRESS	CURRENT	SET
0000	C000	00000	00001
0001	C001	00000	00001
0002	C002	00000	00001
0003	C003	00000	00001
0004	C004	00000	00001
0005	C005	00000	00001
0006	C006	00000	00001
0007	C007	00000	00001
0008	C008	00000	00001
0009	C009	00000	00001
0010	C010	00000	00001
0011	C011	00000	00001

NO. MDI

【KPAR】 【TMR】 【DATA】 【CTR】 【RETURN】 【▶】

Fig. 3- 4- 1

Contents and operations on counter window :

RNU : operation state of ladder.
N0. : counter number, cannot be changed.
ADDRESS : counter address. cannot be changed.

CURRENT : counter current value, cannot be changed.

SET : the counter preset value can be changed after setting K000.0 (PLC parameter is permitted to modify) to 1 in MDI mode.

Data/serial number: displaying input data. The serial number appears by pressing <**SEARCH**> on the panel to search the data and view the current value. The CNC returns to the data displaying window after pressing <**CANCEL**>. The current value will not be refreshed for convenience to modify the data for the user.

MDI mode: current operation mode.

【RETURN】: return to the up menu.

【▶】 : enter the next page.

Press <**SAVE**> to download the setting value to operate the CNC. When the change is completed, the system displays: DATA Downloaded OK ! , when the change is not completed, the system displays: Download failed ! When the download doesn't have the condition, the system displays: Illegal Download Parameter.

(Note: press 【**SAVE**】after modification to save the modification and operate the CNC.)

Press the Page Up/Page Down, four Direction keys to search and position, view or modify the counter address.

3.5 F address corresponded to M function

press【▶】in Fig.3-1 to enter the next page, press【**MDEC**】to enter the search and setting window of F address corresponded to M function as Fig. 3-5-1:

MCodeDEC(M00-M97~F026-F033 RUN

MCODE	MEANING	ADDR
M00	Program Stop	F031.7
M01	Optional Stop	F*** *
M02	End of Program	F*** *
M03	Spindle forward	F030.0
M04	Spindle backward	F030.1
M05	Spindle stop	F030.2
M06	Auto change tool	F*** *
M07	STNANDBY	F***.*
M08	Coolant on	F031.0
M09	Coolant off	F031.1
M10	A axis Clamp	F031.2
M11	A axis Release	F031.3

MDI

【◀】【MDEC】 【RETURN】

Fig. 3-5- 1

Content and operation of F address corresponded to M function:

MCodeDEC：MDEC window.

MOO-M97： setting range of M function instruction.

F026-F033：setting range of F address.

RUN： run status of ladder.

MCODE： M function number.

MEANING： M function explanation.

ADDR： F address can be modified in MDI mode by inputting one which is higher than the terminal user password, and the modification is valid after the system restarts.

MDI mode： current operation mode.

【Esc】: return to the upper menu.

【◀】: enter the upper menu.

This window is used for registering and deleting the M instruction. F signal is set to the only one corresponding to M instruction. The M instruction without setting by F is invalid.
The corresponding F strobe signal is output and the ladder net is started in executing M Instruction. After modification, the system “Alarm”, prompting “Please Power OFF” and the setting is valid after the system restarts. In PLC program, there is M function setting, and after the address is modified, the corresponding ladder should be modified to avoid the unexpected operation of machine tool.

Search or modify F address corresponded to M by PageUp/PageDown and four direction keys on the operator panel.

Note:

1. M00, M03, M04, M05 are taken up by the system and cannot be changed.
2. When the system manages the ladder files and configuration files, their number must be the same. When the user modifies the data list, the system saves it to the configuration file which corresponds to the current running ladder file number, the user should edit again the signal significations in the configuration file to ensure that the system correctly displays the information modified by the user. Chinese comment name in the configuration file is “LadChixx”, and English one is “LadEngxx”.

4 PLC address check operation

Press 【PLCTRA】in 【PLCTRA】to execute PLC address check operation as Fig. 4-1.

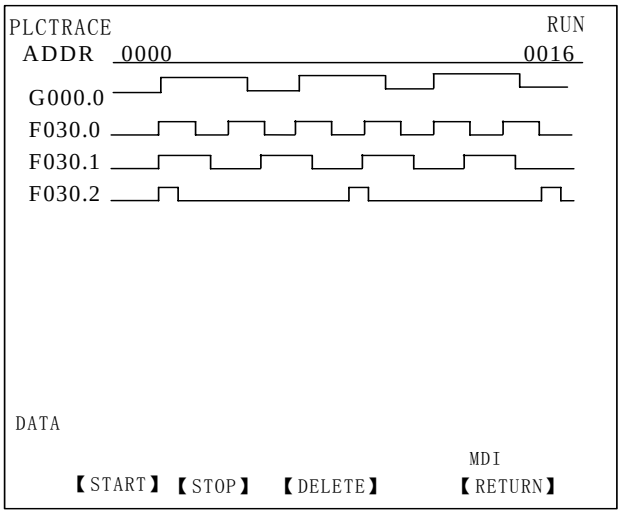


Fig. 4- 1

Content and operations of address check window:

RUN： ladder run state.

ADDR：address of check.

0000 ： bit number state of check address.

0016 ： bit number state of check address. Sum by subtracting the previous data is bit number state of check address on the screen. The system can record up to 1024, otherwise restarts recording.

Data: display input data. Input the check address, Check the address, and cannot execute the input when the check is being executed.

MDI mode: current operation mode.

【START】: the system checks the input address after it is pressed. The new address cannot be input and the user cannot view the history record when the check is being executed.

【STOP】: the system stops the check in the input address window after it is pressed. The system permits inputting the new address which is to be checked, and the user can view the history recorder of address with the direction key. The program is still running and so the address does although the window stops check.

【CLEAR】:clear the graph and return to the start position.

【ESC】: return to the previous menu.

Press the Page Up/Page Down, four Direction keys to search the corresponding check number.

This function is mainly used for checking the address and maintaining the system.

5 Ladder edit software use

5.1 Summary

Presently, GSK218M system supports the matched GSK ladder edit software.
GSK ladder edit software is the ladder editor in PC of GSK218M series milling machine, machining center CNC system, providing the edit, change, searching error and print functions of GSK218M series ladder. The software can run in Windows 97, Windows Me, Windows 2000, Windows XP and Windows 2003.

5.2 Software introduction

5.2.1 Starting software

GSK ladder edit software is a green one that is not installed. The software package contains Lad Edit.exe, Diag.mea, and LadFile in which Ladder01 file is the system's standard ladder. Double-click Lad Edit.exe to run the software, and open Ladder01 ladder in LadFile as follows:

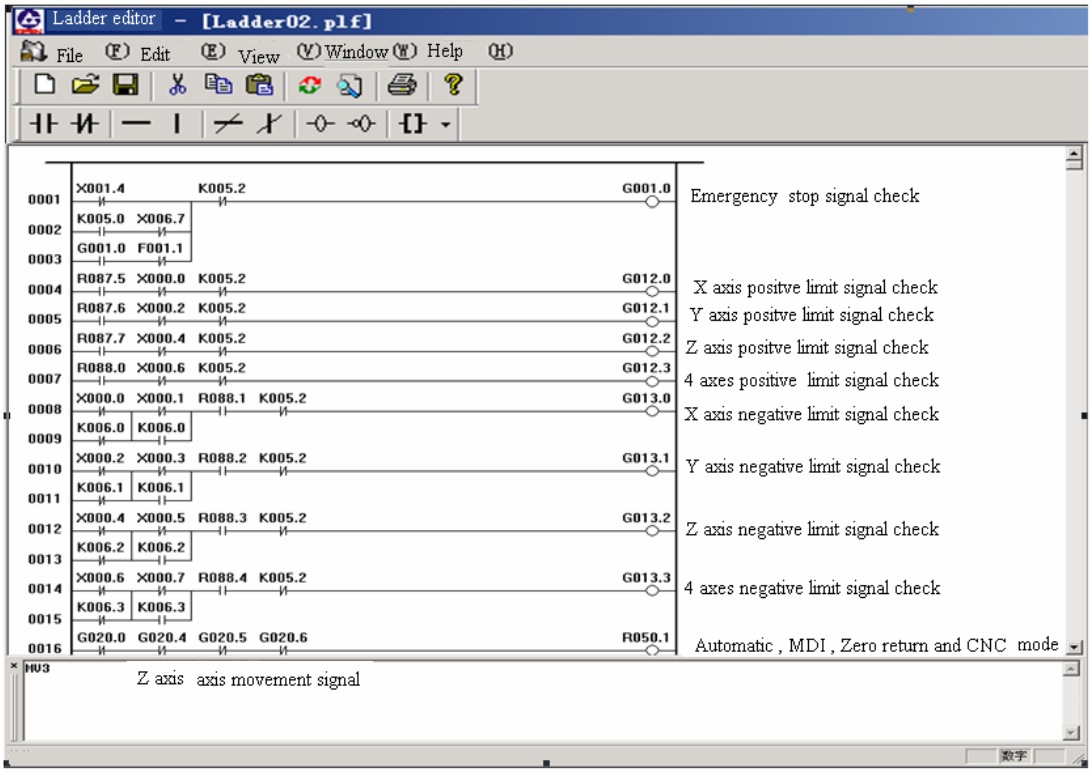


Fig. 5-2-1-1

5.2.2 Function introduction

- **File menu**

  The file menu contains New, Open and Save file, Create ladder or binary file, Print, Print Preview, Print Setup, Latest Open File List and other functions.

  Note: use English instead of Chinese in “Ladder Version Number”, “Applicable Machine”, “ Last Editor” in “Edit Ladder Message”, otherwise, the error occurs after the transmission is executed.

- **Edit menu**

  Edit menu includes Cut, Copy, Paste, Search, Change, Edit and other functions

- **View menu**

  Display or hide Tool Bar, Status Bar, Output Window and Instruction List Window.

- **Window menu**

  Select and distribute each window.

- **Help menu**

  Version information of the software.

5.3 Software operation

5.3.1 Tool bar

There are two tool bars which are related to ladder edit in the main view frame,

5.3.1.1 Main tool bar


creating a new ladder file


opening a ladder file


saving a ladder file


cutting the selected content to the clipboard


copying the selected content to the clipboard


pasting the content from the clipboard

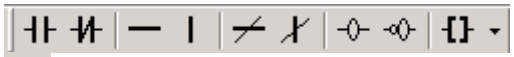

changing a ladder


searching a element


printing a ladder


about dialog box

5.3.1.2 Edit tool bar



 adding a normally open contact

 adding a normally closed contact

 adding a horizontal conduct

 adding a vertical conductive line(lower right of cursor)

 deleting some element or horizontal conductive line

 deleting a vertical conductive line at the lower right of element

 adding a output coil

 reversing an added output coil

 function command button, there are two methods to edit function instructions:

1. Click the cursor at the right of button and the system pops-up the menu to select the function instruction.

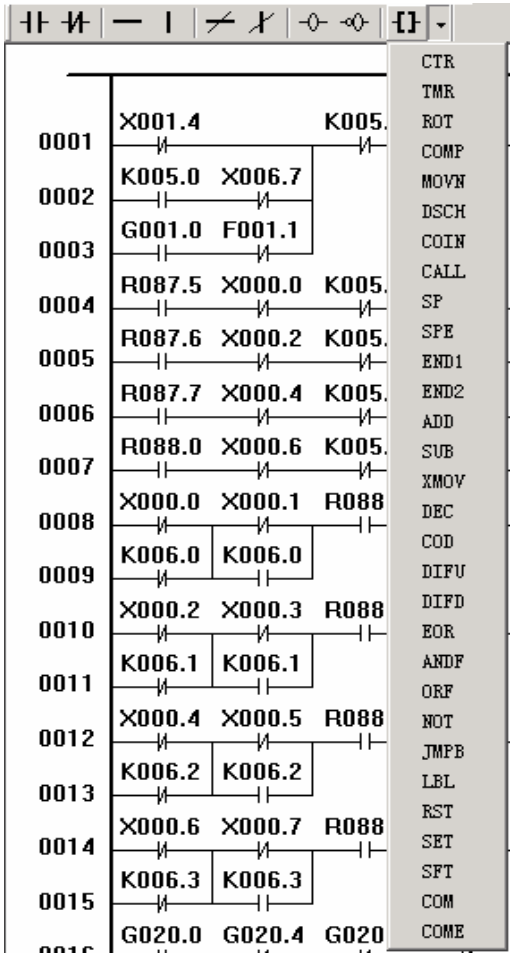


Fig. 5-3-1-2-1

2. Or, click the button, and the system pops-up the function instruction dialog box to execute the function instruction setting.

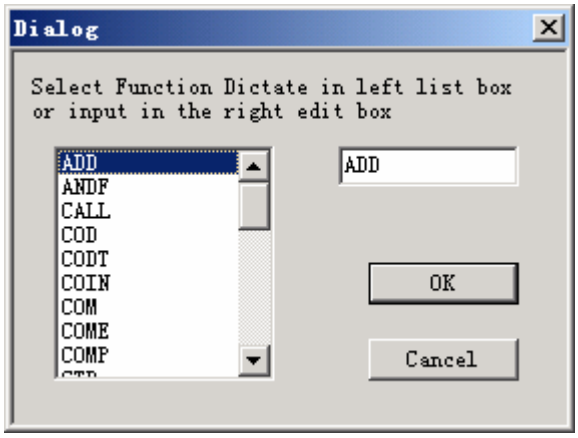


Fig. 5-3-1-2-2

5.3.2 Selecting a graph

In the edit view of ladder, the black rectangular shade is the cursor, and the user clicks the left mouse in the graphic edit area between the two bus bars to select the position of the required edit graph as follows:

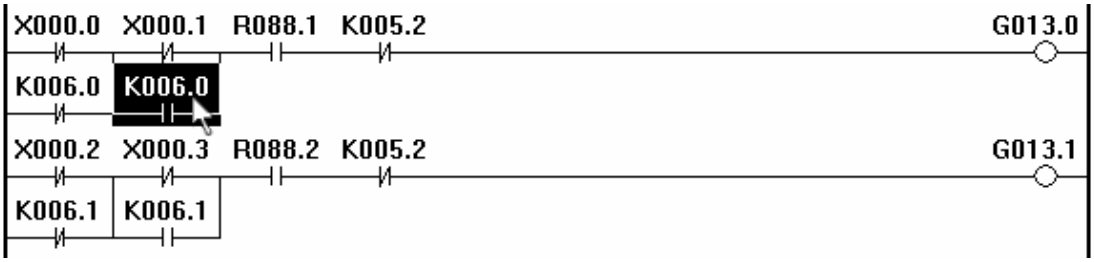


Fig. 5-3-2-1

When the block is selected, the user should press the left key of mouse in its initial position to drag the mouse to the end of the row, and the surroundings of the selected area is appeared by a rectangle with many dotted line before releasing the key.

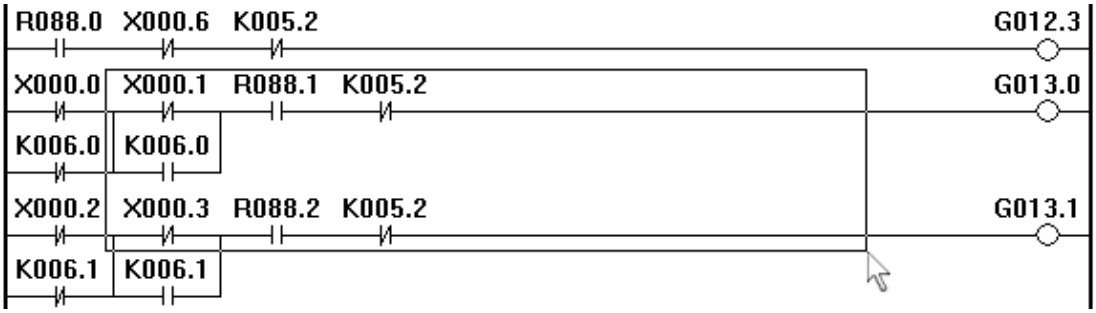


Fig. 5-3-2-2

After the mouse is released, the whole ladder becomes black, i.e., the ladder in the range is selected, and the user can execute the next operation, such as clip, delete, copy and so on.

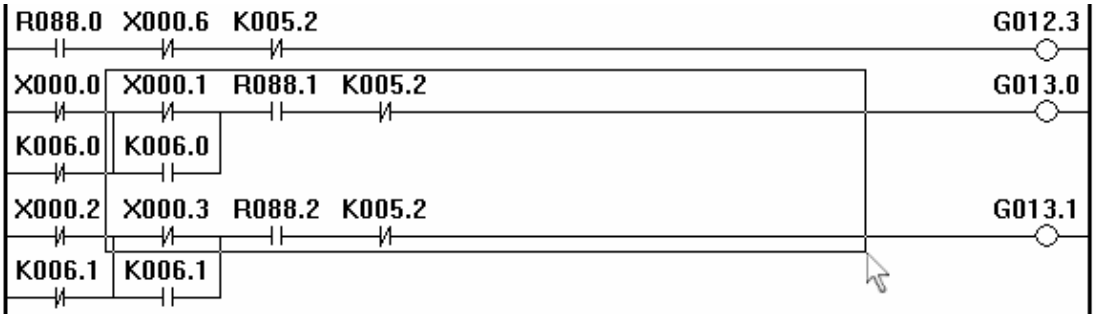


Fig. 5-3-2-3

5.3.3 Editing a graph

5.3.3.1 Cutting

The user selects the required position to execute the operation by one of three methods as follows:

1. Click the right key of the mouse and the system pops-up the environmental menu to select the cut operation;
2. Click [Alt + E]--- [T] in the main menu;
3. Directly press the shortcut key [Ctrl+X]；

After the cut content is placed to the clipboard, the user can execute the paste operation to copy it to the ladder.

5.3.3.2 Copying

The user selects the required position to execute the operation by one of three methods as follows:

1. Click the right key of the mouse and the system pops-up the environmental menu to select the copy operation;
2. Click [Alt + E]--- [C] in the main menu;
3. Directly press the shortcut key [Ctrl+ C];

After the copy operation is executed and the cut content is placed to the clipboard, the user can execute the paste operation to copy it to the ladder.

5.3.3.3 Paste

The user selects the required position to execute the operation by one of three methods as follows::

1. Click the right key of the mouse and the system pops-up the environmental menu to select the paste operation;
2. Click [Alt+E]--- [P] in the main menu;
3. Directly press the shortcut key [Ctrl+V];

5.3.3.4 Deleting

The user selects the required position to execute the operation by one of three methods as follows:

1. Click the right key of the mouse and the system pops-up the environmental menu to select [Alt+B]----delete the node;
2. Click the button- [Delete node] in the edit bar;
3. Directly press the shortcut key [Delete];

5.3.3.5 Inserting one row

The user moves the cursor the required position to execute the operation by one of three methods as follows:

1. Click the right key of the mouse and the system pops-up the environmental menu to select the insert operation;
2. Click [Alt+E]--- [I] in the main menu;
3. Directly press shortcut key [Insert]；

5.3.3.6 Deleting one row

The user selects the required position to execute the operation by one of three methods as follows:

1. Click the right key of the mouse and the system pops-up the environmental menu to select the deletion operation;
2. Click [Alt +E]--- [D] in the main menu;
3. Directly press shortcut key [Ctrl +Delete]；

5.3.3.7 Converting

The user changes the ladder program of current edit window into the instruction list program by one of three methods as follows:

1. Click [Alt +E]--- [V] in the main menu;
2. Click [Convert ladder] in the edit bar;
3. Directly press shortcut key;

5.3.4 Ladder comment

5.3.4.1 Row comment

Double-click the left key outside the right bus bar area of the ladder, and the edit box to edit the input comment.

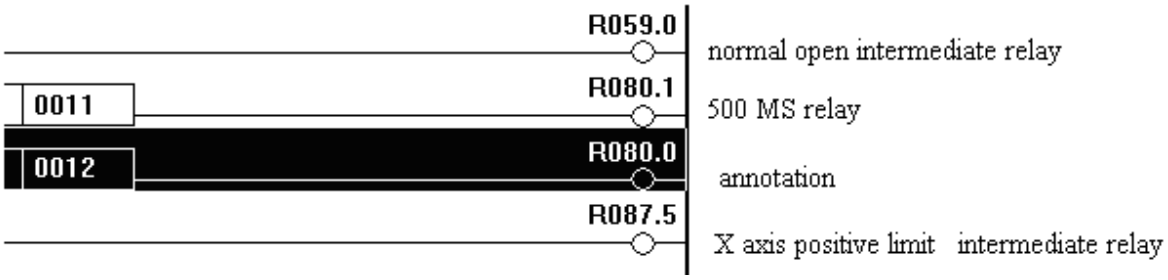


Fig. 5-3-4-1-1

5.3.4.2 Element comment

The user moves the cursor to the required position which element should be modified by one of two methods as follows:

1. Click the right key of mouse after the element is selected, and the system pops-up the environmental menu to select [Alt+M];

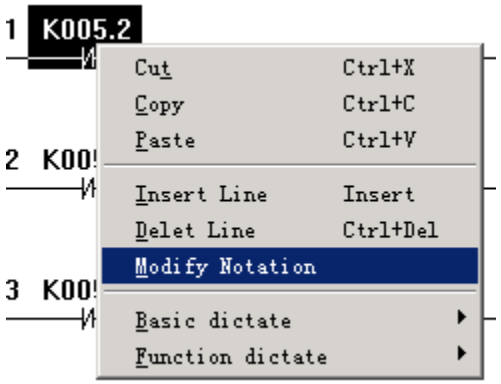


Fig. 5-3-4-2-1

2. Click [Alt+E]---- [M] in the main menu;

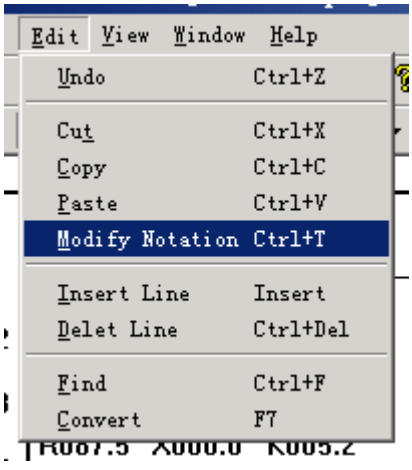


Fig.5-3-4-2-2

After the system pops-up the dialog box, the user inputs the comment and then click OK to save it.

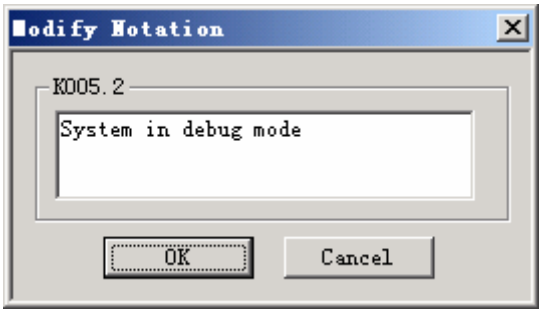


Fig. 5-3-4-2-3

The saved comment appears in the output window at the bottom of the screen when the element is selected every time as follows:

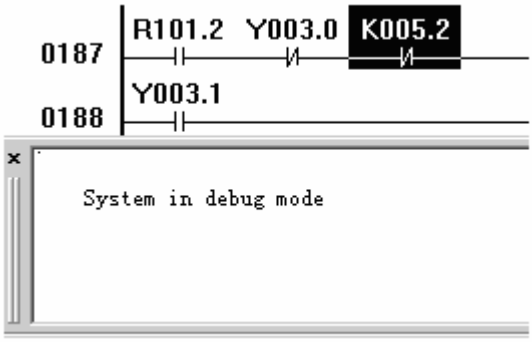


Fig. 5-3-4-2-4

5.3.5 Exporting

After the ladder is saved, the user should convert it to generate the executable file to send to CNC by the serial communication software. See ***System Communication*** in ***GSK218M Programming and Operation Manual***.

Generate a ladder file

Click [Alt +F]----[L] in the main menu, input the name and path to save them, and the system generates ladder file ".grp " which is applied to the milling machine and machining center of GSK218M series.

Ladder configuration format is showed as appendix two.

Ⅳ Connection

1 System Structure and Installation

1.1 System composition

GSK218M CNC system mainly consists of the following units as Fig. 1-1-1.

（1）GSK218M CNC system
（2）Additional operator panel(optional)
（3）Stepper driver(number AC servo driver)
（4）Stepper motor(servo motor)
（5）AC transformer

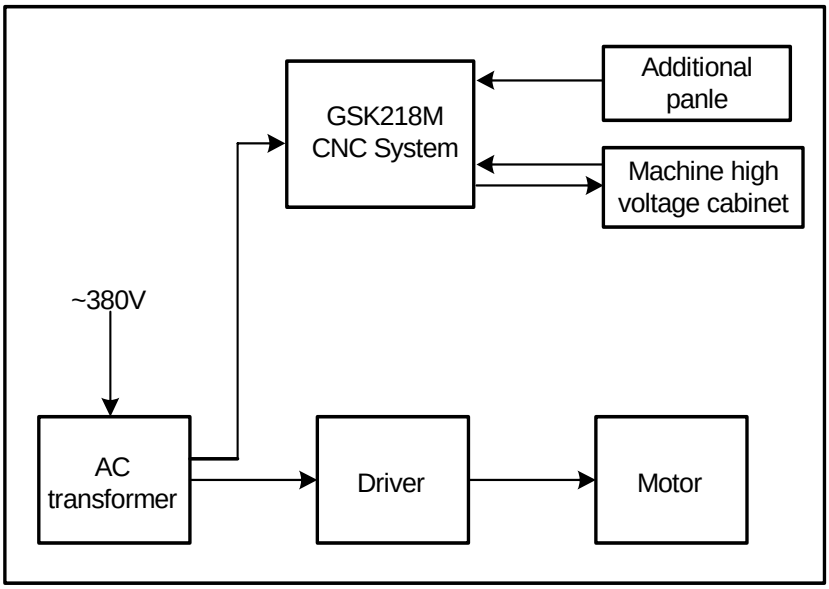


Fig. 1-1-1

1.2 System installation & connection

Firstly, check if the CNC system, driver, motor, and photoelectric encoder are ready, intact and matched.

The CNC system must be fixed stably, and there is some space around the system to ensure the air circulates, and the heat radiates. The installation position of CNC system must be convenient to the operation and avoid the position of processing chip and cooling.

The high/low voltage should be separated. The power supplies of CNC system and driver are provided by transformer, which are separated from the machine high voltage. All kind of signal line should be far from AC contactor to avoid the interference. The photoelectric encoder, limit signal and emergency stop signal should be directly connected to the CNC system. The power supply must be strictly grounded.

All kind of plug and bolt must be fixed stably, and forbid the signal connector is ON/OFF after the CNC system is turned on.

The system panel cannot be damaged by hard thing and sharp weapon when the CNC system is

installed; the CNC system should be carried down to avoid dirtying the system panel.
There is no the source of high voltage, magnetic field around the CNC system, and the system should be far from the inflammable, explosive substance and all sort of dangerous thing.

1.3 CNC system installation dimension

1. Front view

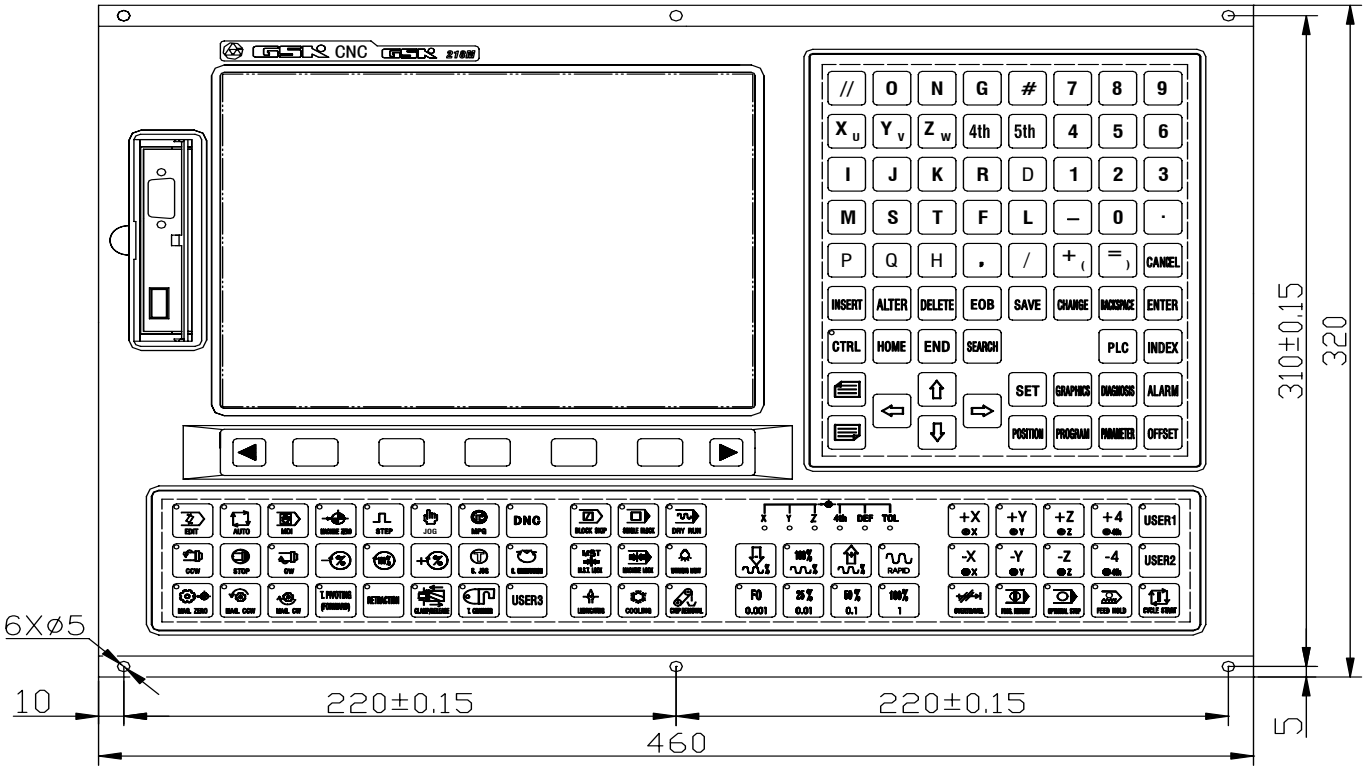


Fig. 1-3-1 front view

2. Side view

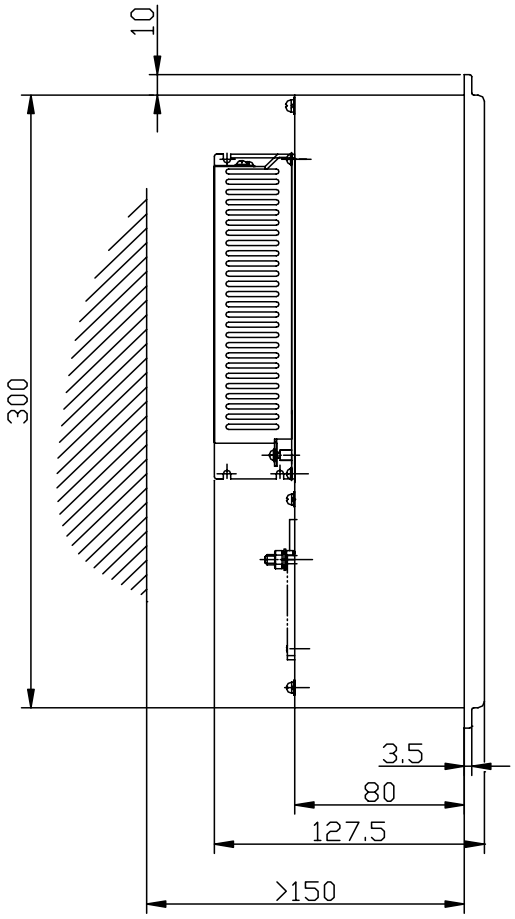


Fig. 1-3-2 side view

3. Overlook

Without PC2 power supply

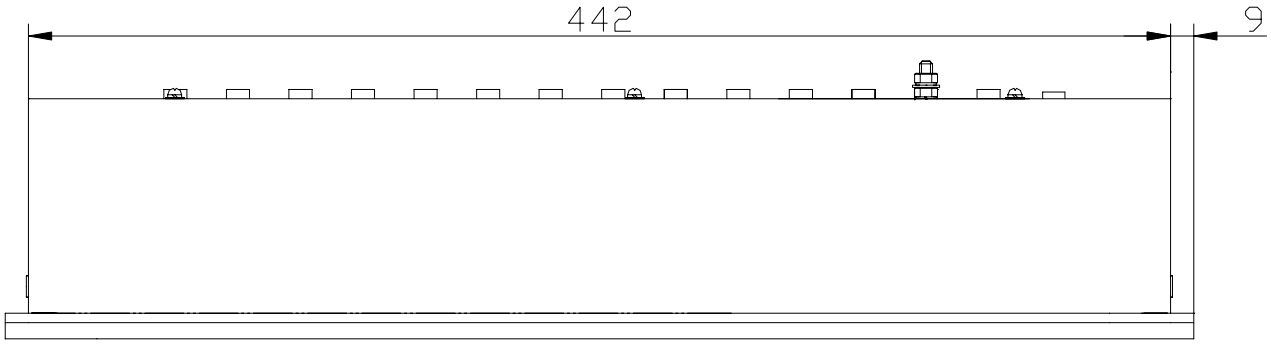


Fig. 1-3-3 over look

4. Back view

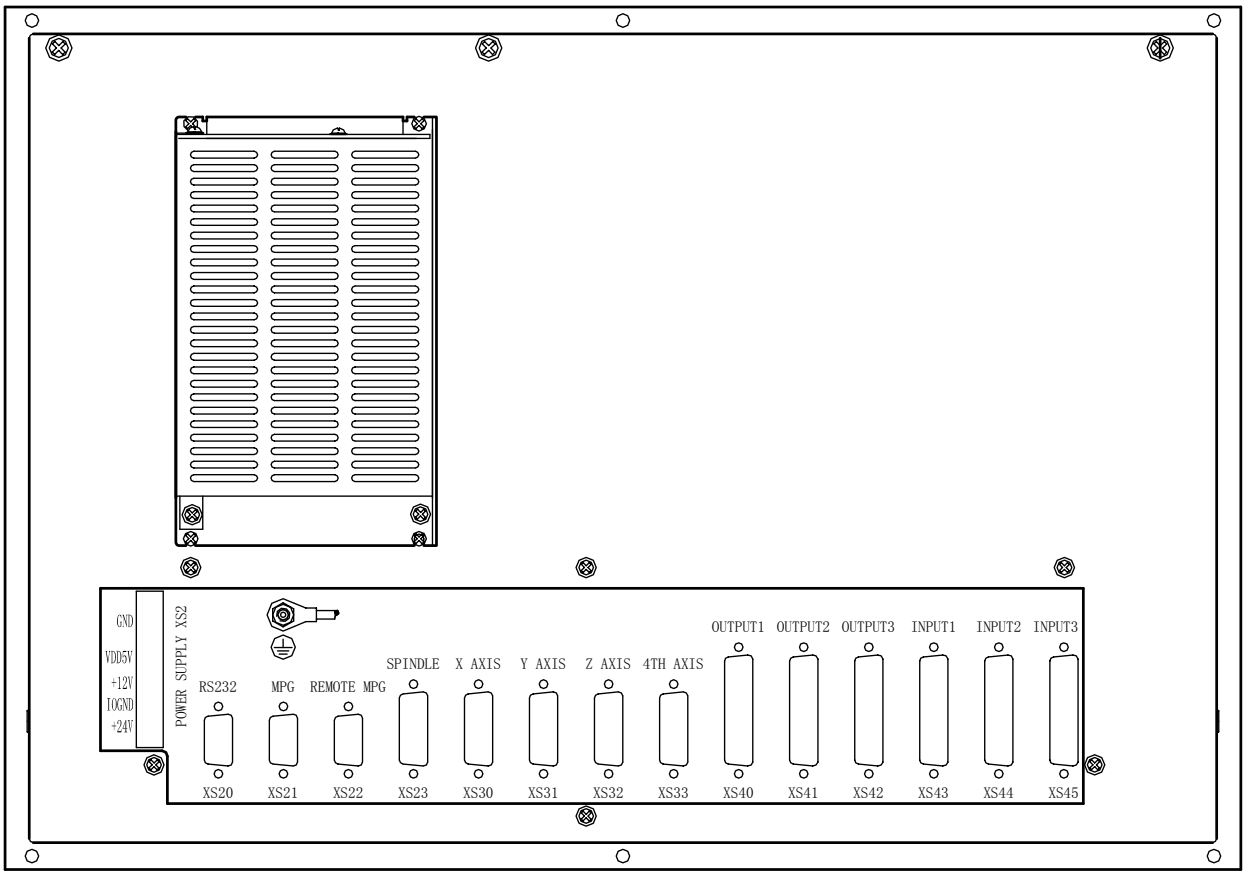


Fig. 1-3-4 back view

5. Additional panel

The user can select the additional panel for the system, and the functions of extension holes on the panel can be defined by the user, such as emergent stop, program lock, power on/off of the system, feed hold, cycle start, MPG and so on. The optional accessories of the system are as follows:

MPG: Changchun LGF-001-100；

Additional panel: aluminum alloy （460×130mm）can be assembled under of GSK218M operator panel;

Emergency stop button: LAY3-02ZS/1

No. self-locking button: KH-516-B11（green or red）;

Self-locking button: KH-516-B21（green or red）;

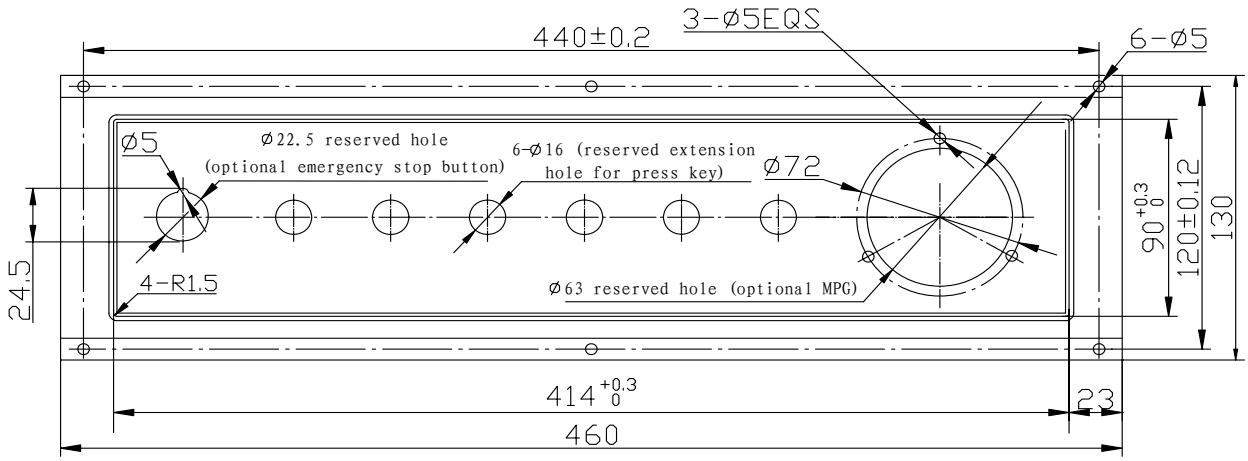


Fig. 1-3-5 additional panel

2 Device Connection

2.1 CNC external connection

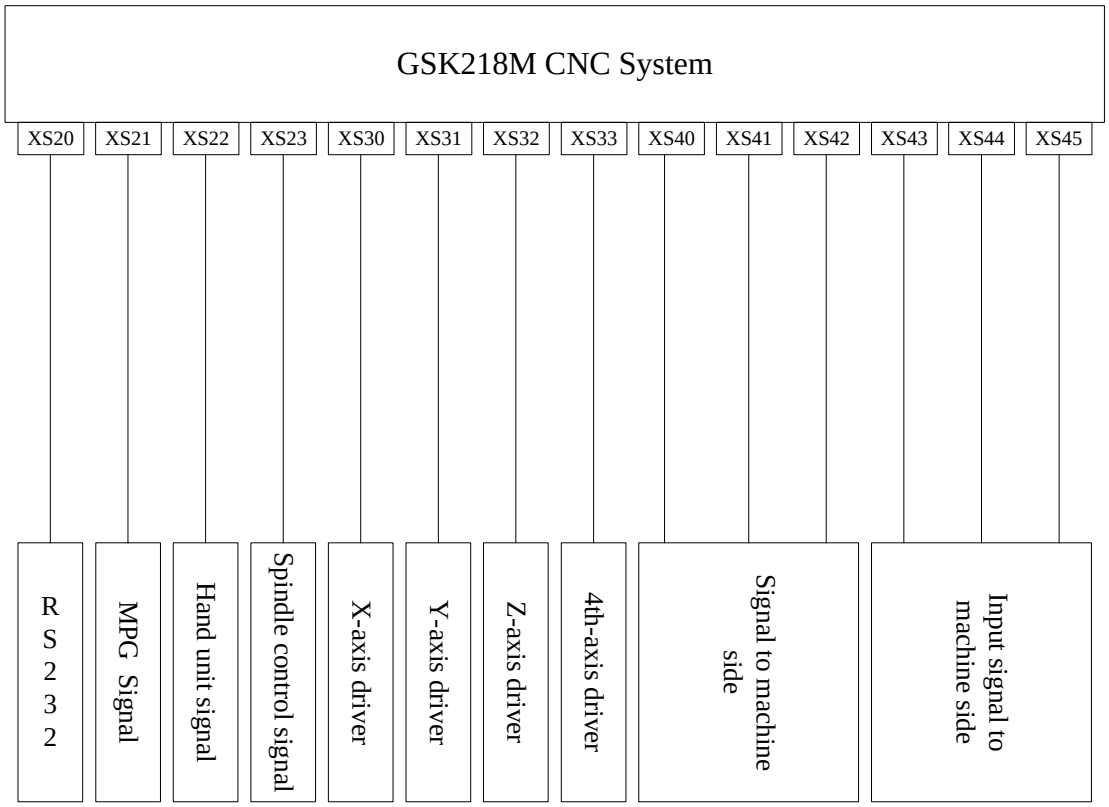


Fig. 2-1-1

2.2 Connection between system and driver

Interfaces to driver include XS30（X axis）, XS31（Y axis）, XS32（Z axis）, XS33（4TH axis）.

2.2.1 System interface

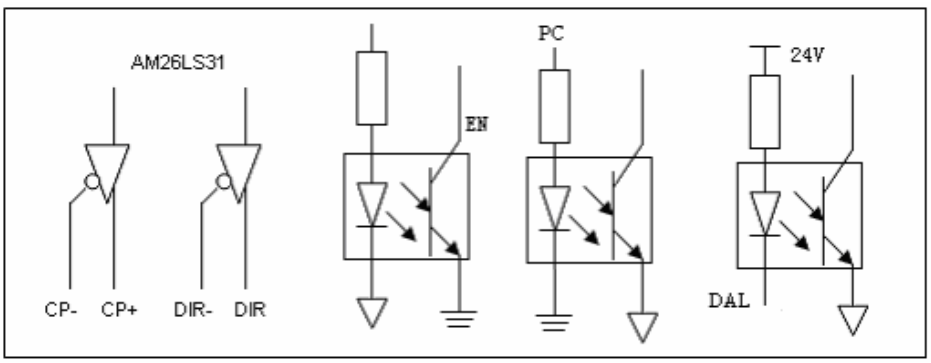


Fig. 2-2-1-1

2.2.2 Interface signal list

XS30：DB15 female（X axis）

1	XCP+	9	XCP-
2	XDIR+	10	XDIR-
3	XPC	11	0V
4	+24V	12	+5V
5	XDALM	13	+5V
6		14	0V
7	XEN	15	0V
8	0V		

XS31：DB15 female（Y axis）

1	YCP+	9	YCP-
2	YDIR+	10	YDIR-
3	YPC	11	0V
4	+24V	12	+5V
5	YDALM	13	+5V
6		14	0V
7	YEN	15	0V
8	0V		

XS32：DB15 female（Z axis）

1	ZCP+	9	ZCP-
2	ZDIR+	10	ZDIR-
3	ZPC	11	0V
4	+24V	12	+5V
5	ZDALM	13	+5V
6		14	0V
7	ZEN	15	0V
8	0V		

XS33：DB15 female（4TH aixs）

1	4CP+	9	4CP-
2	4DIR+	10	4DIR-
3	4PC	11	0V
4	+24V	12	+5V
5	4DALM	13	+5V
6		14	0V
7	4EN	15	0V
8	0V		

Fig. 2-2-2-1

2.2.3 Signal specification

1 Pulse motion instruction signal

XCP+，XCP-，YCP+，YCP-，ZCP+，ZCP-, 4CP+，4CP- are instruction pulse signals，XDIR+，XDIR-，YDIR+，YDIR-，ZDIR+，ZDIR-，4DIR+，4DIR- are motion direction signal, and they are differential signals.

Connection is as follows:

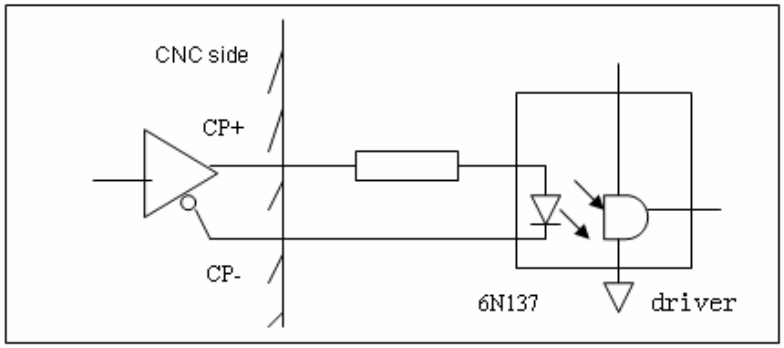


Fig. 2-2-3-1

2 Driver alarm signal ALM (input)
The receiving method of signal at the CNC side is as follows. The parameter 019bit0 set if the driver fault is the low level “0” or the high level.

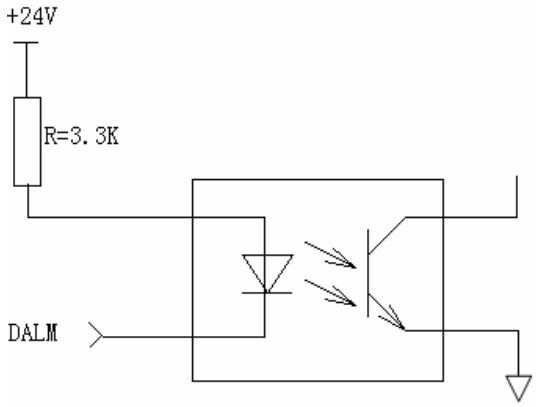


Fig. 2-2-3-2

3） CNC ready completion signal EN(contact output) CNC

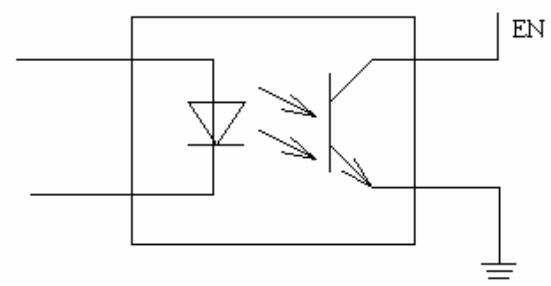


Fig. 2-2-3-3

4） Reference point return with signal PC
The receiving method of signal at the CNC side is as follows.

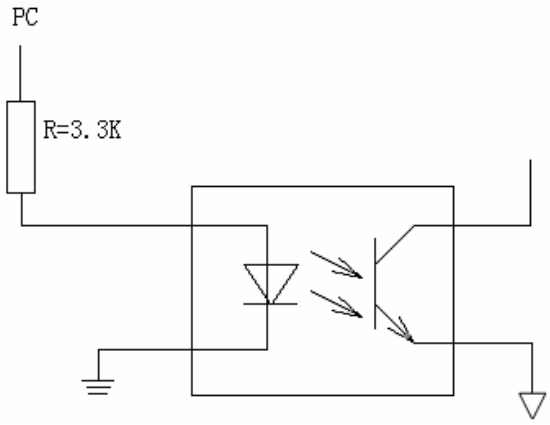


Fig. 2-2-3-4

Wave of PC signal provided by customer is as follows:

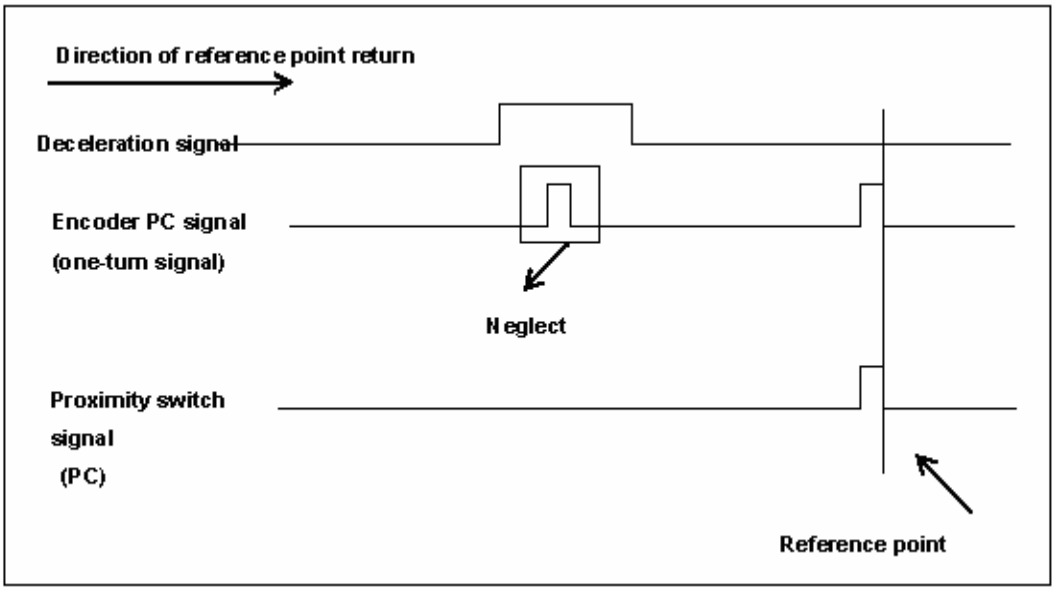


Fig. 2-2-3-5

2.2.4 Cable connection

1. Cable for 218M connecting with DY3 series driver

XS30, 31, 32, 33	
Signal	Pin
nCP+	1
nCP−	9
nDIR+	2
nDIR−	10
nEN	7
＋5V	12
nDALM	5
0V	11

DY3 series driver	
Signal	Pin
nCP+	1
nCP−	9
nDIR+	2
nDIR−	10
EN−	11
EN+	3
RDY1	6
RDY2	14

Fig. 2-2-4-1

2. Cable for 218M connecting with DA98 series servo driver

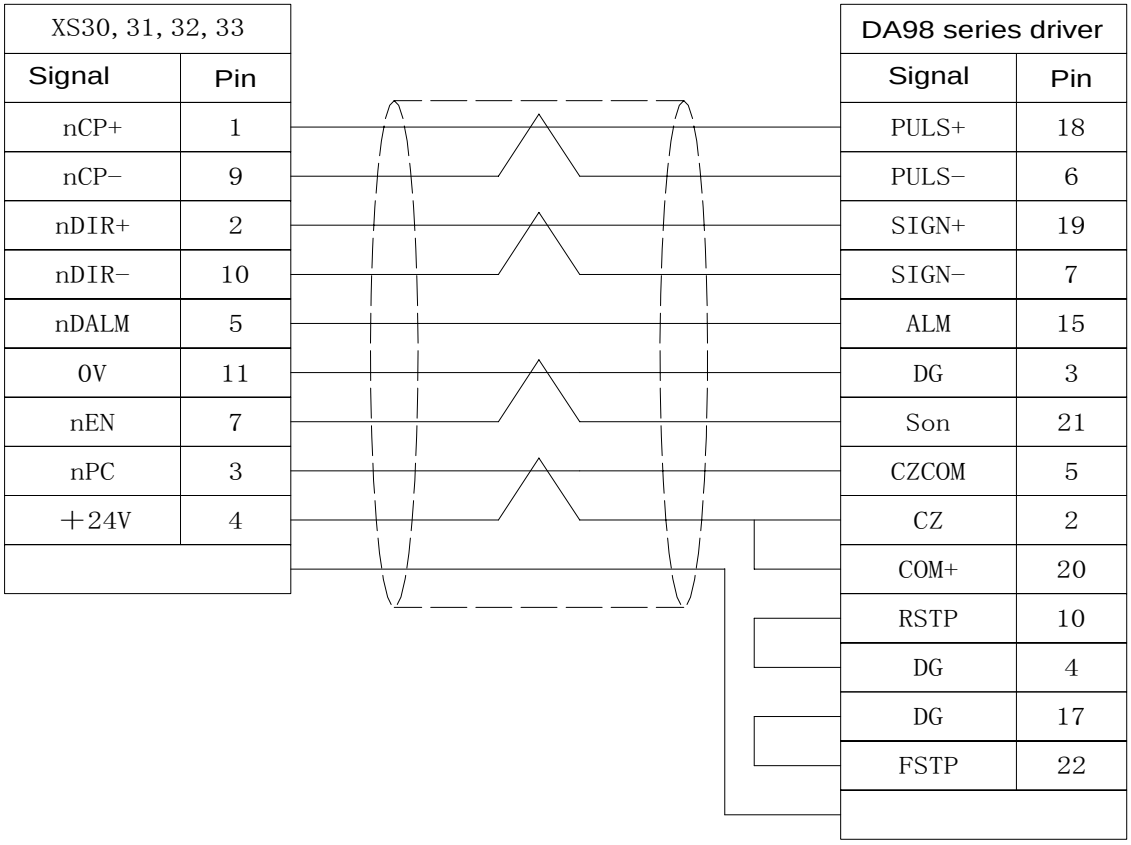


Fig. 2-2-4-2

3. Cable for 218M connecting with DA98 series servo driver

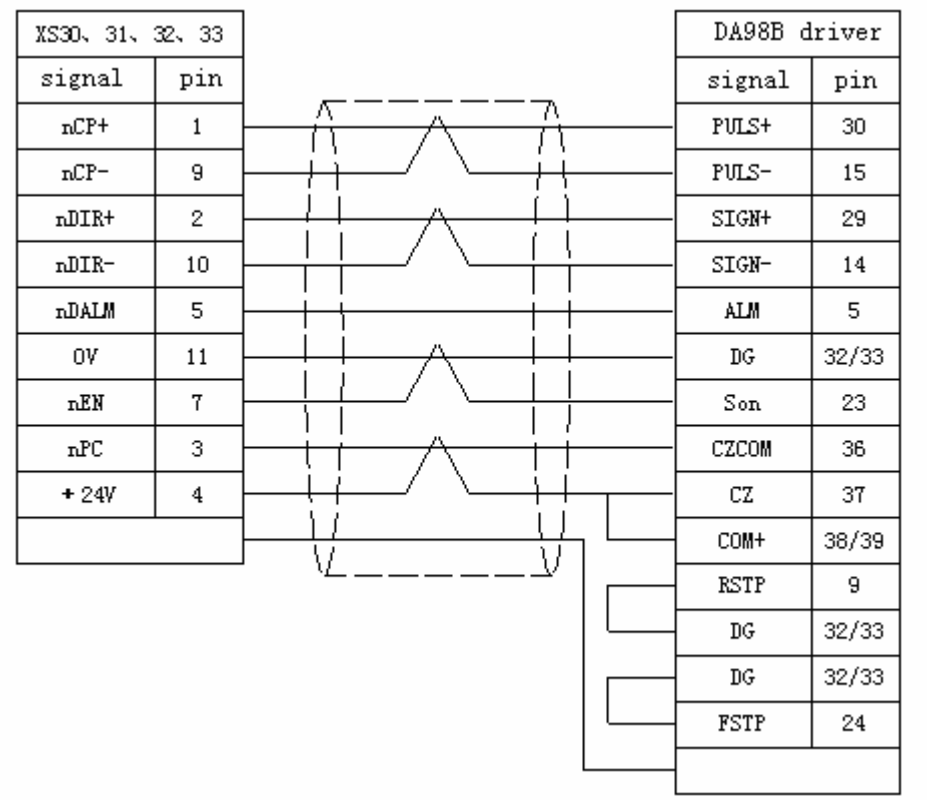


Fig. 2-2-4-3

2.3 RS232 standard serial interface

GSK218M CNC system can communicate with the general-purpose PC (must match with 218M communication software) by RS232-C. Its connection is as follows:
Connection of cable is as follows:

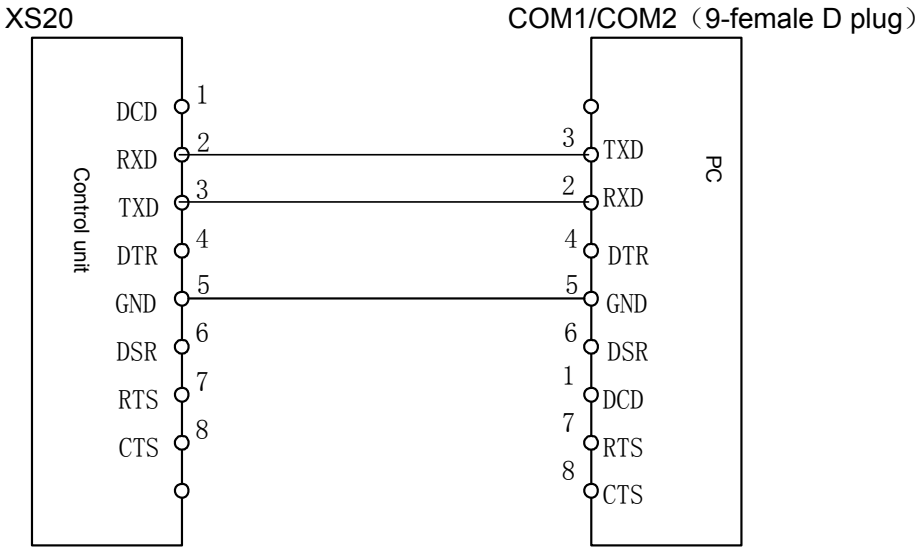


Fig. 2-3-1

2.4 MPG (handwheel), hand unit connection

2.4.1 Interface signal list

The 218M CNC system can be matched with MPG or hand unit. When it is matched with MPG, the MPG signal is connected to XS21 interface; with hand unit, the MPG signal of hand unit is connected to XS21 interface and other signals are connected to XS22.

X21: DB9 female

1	+5V	6	VCOM
2	HA＋	7	HA－
3	HB＋	8	HB－
4	ESP1	9	ESP2
5	0V		

X22: DB9 female

1	+5V	6	HX
2	HY	7	HZ
3	HU	8	H*1
4	H*10	9	H*100
5	0V		

Fig. 2-4-1-1

2.4.2 Interface signal

HA＋, HA－, HB＋, HB－：differential MPG or hand unit pulse signal (when match with nondifferentiable MPG or hand unit , HA+, HB+ connects with +5V; HA- connects with A of the MPG, HB- connects with B of the MPG)
ESP1, ESP2：hand unit emergency stop signal;
HX, HY, HZ, HU：are separately axis select signal of X, Y, Z, 4TH.
H*1, H*10, H*100：are separately the override of MPG pulse equivalent;
VCOM：hand unit common terminal.
Connection diagram between 218M and nondifferentiable MPG:

XS21		MPG
Signal	Pin	Signal
＋5V	1	＋5V
HA+	2	
HB＋	3	
0V	5	0V
HA－	7	HA
HB－	8	HB

Fig. 2-4-2-1

Connection diagram between 218M and PSG series MPG:

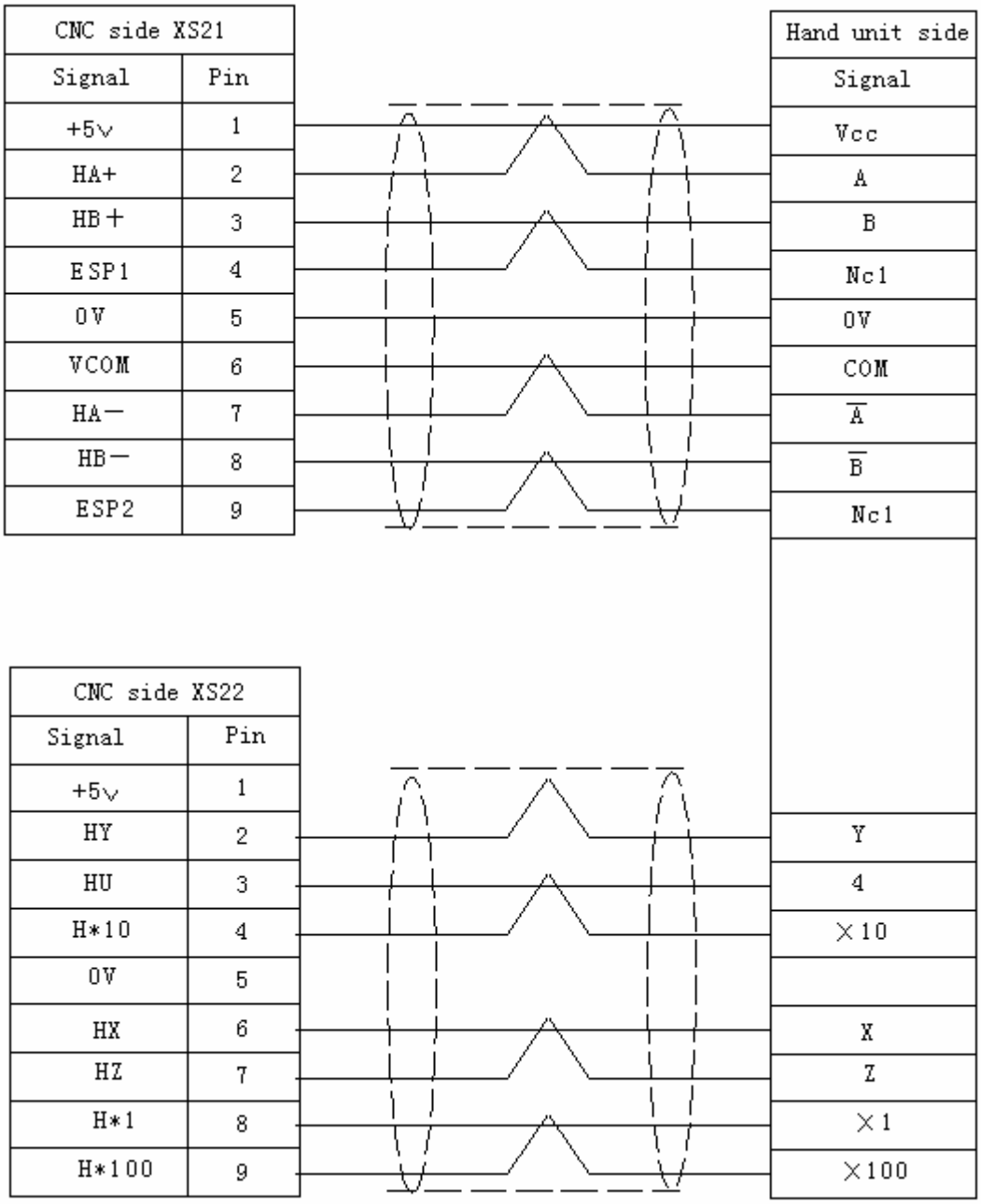


Fig. 2-4-2-2

2.5 Spindle unit connection

2.5.1 Interface signal list

The CNC interface is DB15 male and its pin definition is as follows:

XS23：DB15 male

1	SCOM	9	SVC
2		10	A+
3	A-	11	B+
4	B-	12	Z+
5	Z-	13	SDALM
6	+5V	14	
7		15	+24V
8	COM		

Fig. 2-5-1-1

2.5.2 Interface signal

（1）A＋, A－, B＋, B－, Z＋, Z－：pulse signal of spindle encode;
（2）SVC：spindle analog voltage signal;
（3）SCOM：spindle analog power signal ground;
（4）SDALM：spindle alarm input signal;

2.5.3 DAP01 interface connection

The GSK990MA matches DAP01 control line interface connection ：

control line graph of GSK218M maches with DAP01

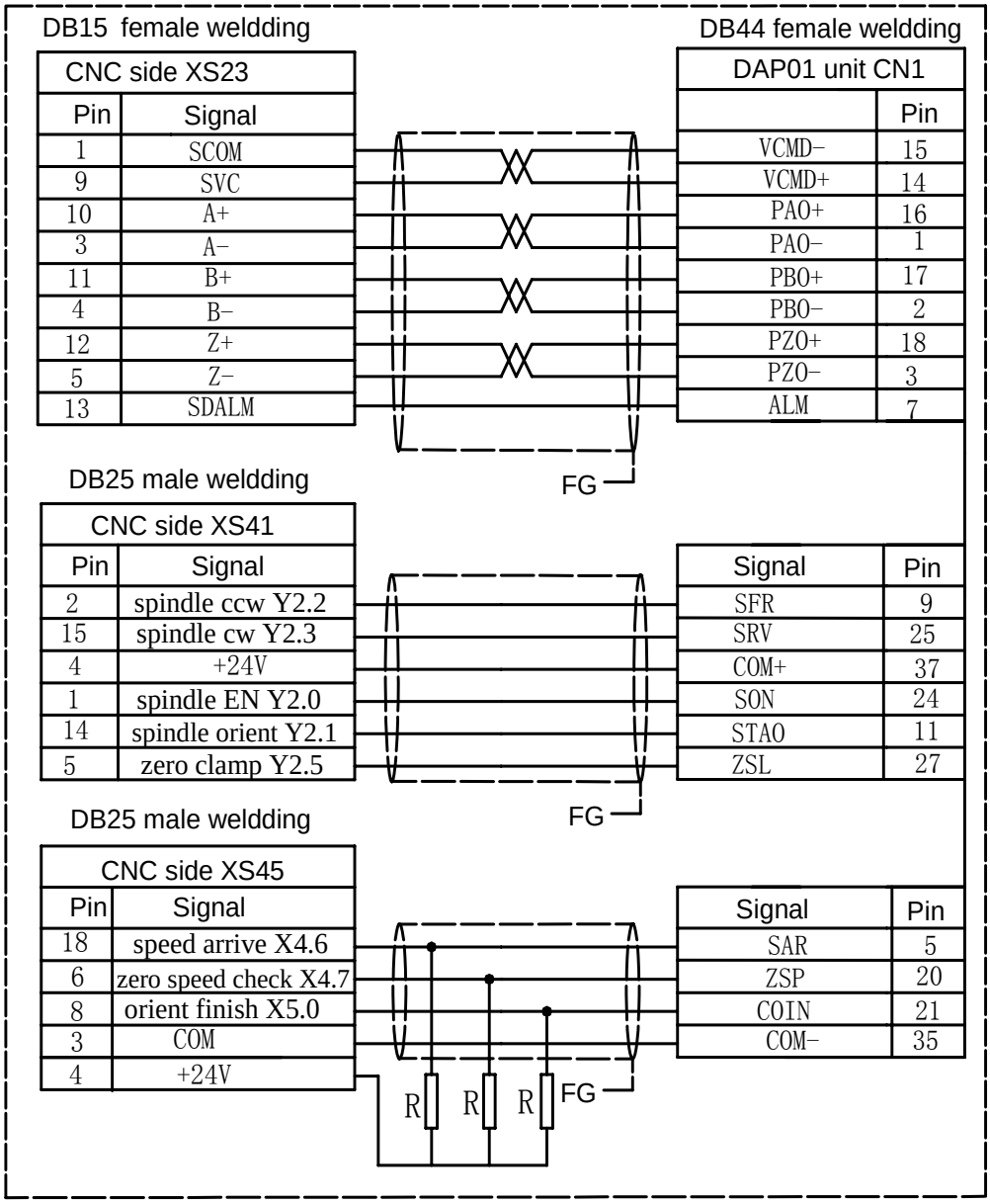


Fig. 2-5-3-1

Note ： resistance R is 2.2K ,0.5w .

2.6 Power supply interface

The input voltage of the CNC has two groups: +5V，+24V，among which +5V is for the CNC internal system, and +24V for external interface. The power supply interface is as follows:

9	GND2
8	GND2
7	
6	+5V
5	+5V
4	
3	GND1
2	
1	+24V

Fig. 2-6-1

3 Machine Control I/O Interface

3.1 Interface signal list

XS40：DB25 female

1	DO00	14	DO01
2	DO02	15	DO03
3	COM	16	+24V
4	+24V	17	DO04
5	DO05	18	DO06
6	DO07	19	COM
7	+24V	20	+24V
8	DO08	21	DO09
9	DO10	22	DO11
10	COM	23	+24V
11	+24V	24	DO12
12	DO13	25	DO14
13	DO15		

XS41：DB25 female

1	DO16	14	DO17
2	DO18	15	DO19
3	COM	16	+24V
4	+24V	17	DO20
5	DO21	18	DO22
6	DO23	19	COM
7	+24V	20	+24V
8	DO24	21	DO25
9	DO26	22	DO27
10	COM	23	+24V
11	+24V	24	DO28
12	DO29	25	DO30
13	DO31		

XS42：DB25 female

1	DO32	14	DO33
2	DO34	15	DO35
3	COM	16	+24V
4	+24V	17	DO36
5	DO37	18	DO38
6	DO39	19	COM
7	+24V	20	+24V
8	DO40	21	DO41
9	DO42	22	DO43
10	COM	23	+24V
11	+24V	24	DO44
12	DO45	25	DO46
13	DO47		

XS43：DB25 male

1	IN00	14	IN01
2	IN02	15	IN03
3	COM	16	COM
4	+24V	17	IN04
5	IN05	18	IN06
6	IN07	19	COM
7	COM	20	+24V
8	IN08	21	IN09
9	IN10	22	IN11
10	COM	23	COM
11	+24V	24	IN12
12	IN13	25	IN14
13	IN15		

XS44：DB25 male

1	IN16	14	IN17
2	IN18	15	IN19
3	COM	16	COM
4	+24V	17	IN20
5	IN21	18	IN22
6	IN23	19	COM
7	COM	20	+24V
8	IN24	21	IN25
9	IN26	22	IN27
10	COM	23	COM
11	+24V	24	IN28
12	IN29	25	IN30
13	IN31		

XS45：DB25 male

1	IN32	14	IN33
2	IN34	15	IN35
3	COM	16	COM
4	+24V	17	IN36
5	IN37	18	IN38
6	IN39	19	COM
7	COM	20	+24V
8	IN40	21	IN41
9	IN42	22	IN43
10	COM	23	COM
11	+24V	24	IN44
12	IN45	25	IN46
13	IN47		

Fig. 3-1-1

XS40, XS41, XS42 are output interfaces（DB25 female），XS43, XS44, XS45 are input interface.

3.2 Input interface

3.2.1 Input interface method

DC input signal A

DC input signal A is from the machine to the CNC, and they are from the press key at the machine side, limit switch and contact of relay.

a）Contacts at the machine side should meet the following:

Contact capacity: over DC30V, 16mA.

Leak current between contacts during open circuit: below 1mA(voltage 26.4).

Voltage-drop between contacts during closed-circuit: below 2V(current 8.5mA, including voltage-drop of cable).

b) Signal loop is as Fig 3-2-1-1:

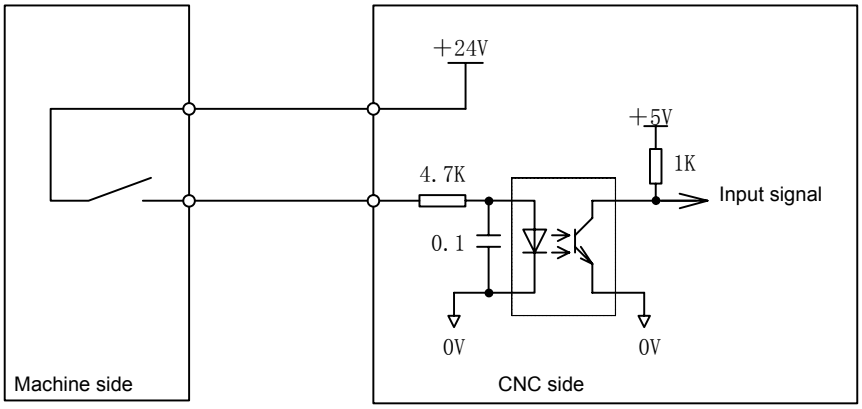


Fig. 3-2-1-1

3.2.2 Input signal interface definition

Pin definition of input interface is as follows:

XS43 input 1

Pin	Mark	Label
1	IN00	X0.0
14	IN01	X0.1
2	IN02	X0.2
15	IN03	X0.3
17	IN04	X0.4
5	IN05	X0.5
18	IN06	X0.6
6	IN07	X0.7
8	IN08	X1.0
21	IN09	X1.1
9	IN10	X1.2
22	IN11	X1.3
24	IN12	X1.4
12	IN13	X1.5
25	IN14	X1.6
13	IN15	X1.7

XS44 input 2

Pin	Mark	Label
1	IN16	X2.0
14	IN17	X2.1
2	IN18	X2.2
15	IN19	X2.3
17	IN20	X2.4
5	IN21	X2.5
18	IN22	X2.6
6	IN23	X2.7
8	IN24	X3.0
21	IN25	X3.1
9	IN26	X3.2
22	IN27	X3.3
24	IN28	X3.4
12	IN29	X3.5
25	IN30	X3.6
13	IN31	X3.7

XS45 input 3

Pin	Mark	Label
1	IN32	X4.0
14	IN33	X4.1
2	IN34	X4.2
15	IN35	X4.3
17	IN36	X4.4
5	IN37	X4.5
18	IN38	X4.6
6	IN39	X4.7
8	IN40	X5.0
21	IN41	X5.1
9	IN42	X5.2
22	IN43	X5.3
24	IN44	X5.4
12	IN45	X5.5
25	IN46	X5.6
13	IN47	X5.7

3.3 Output signal

3.3.1 Output interface method

a） Output transistor specification:

① When the output is ON, max. load current, including instantaneous current is below 200mA.

② When the output is ON and the current is 200mA, the saturation voltage is 1.6V and the typical value is 1V .

③ When the output is OFF, the withstand voltage including instantaneous voltage is below 24+20%.

④ When the output is OFF, the leak current is below 100μA.

b） Output loop：

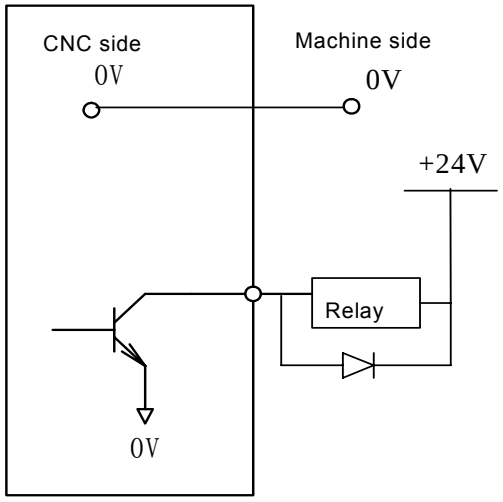


Fig. 3-3-1-1

The output signals of the CNC are provided by Darlington pipe and Darlington pipe is conducted when the output is enabled. Except for TL-, TL+, SPZD are pulse signals, other outputs are the level signal and their common terminal is 24V.

3.3.2 Output signal interface definition

XS40 output 1

Pin	Mark	Label
1	DO00	Y0.0
14	DO01	Y0.1
2	DO02	Y0.2
15	DO03	Y0.3
17	DO04	Y0.4
5	DO05	Y0.5
18	DO06	Y0.6
6	DO07	Y0.7
8	DO08	Y1.0
21	DO09	Y1.1
9	DO10	Y1.2
22	DO11	Y1.3
24	DO12	Y1.4
12	DO13	Y1.5
25	DO14	Y1.6
13	DO15	Y1.7

XS41 Output 2

Pin	Mark	Label
1	DO16	Y2.0
14	DO17	Y2.1
2	DO18	Y2.2
15	DO19	Y2.3
17	DO20	Y2.4
5	DO21	Y2.5
18	DO22	Y2.6
6	DO23	Y2.7
8	DO24	Y3.0
21	DO25	Y3.1
9	DO26	Y3.2
22	DO27	Y3.3
24	DO28	Y3.4
12	DO29	Y3.5
25	DO30	Y3.6
13	DO31	Y3.7

XS42 output 3

Pin	Mark	Label
1	DO32	Y4.0
14	DO33	Y4.1
2	DO34	Y4.2
15	DO35	Y4.3
17	DO36	Y4.4
5	DO37	Y4.5
18	DO38	Y4.6
6	DO39	Y4.7
8	DO40	Y5.0
21	DO41	Y5.1
9	DO42	Y5.2
22	DO43	Y5.3
24	DO44	Y5.4
12	DO45	Y5.5
25	DO46	Y5.6
13	DO47	Y5.7

4 Debugging Machine

The chapter introduces the trial operation methods and steps after GSK218M CNC system is turned on firstly, and the corresponding machine operation can be performed after the following steps are done.

4.1 Debug preparation

GSK218M debug is as follows:

- System connection: the correct connection is the basis to successfully debug the system.
- PLC debug：it makes the safety functions(emergency stop, hardware limit) and operation functions be effective.
- Parameter setting of driver: set the motor type and control mode.
- Parameter setting of system: set the control parameter, speed parameter and so on.
- Data backup: after the system is debugged, the data including the parameter, the compensation data and PLC program is backup.

Notes before debugging GSK218M：

- To ensure all cables are connected correctly, please check the polarity of diode of relay, electromagnetic valve.
- Check the connection phase sequence of cable with high voltage of motor.
- The position cable, encoder feedback cable and motor cable with high voltage of AC servo feed device correspond one by one.
- Ensure the analog voltage instruction type received by the spindle.
- Ensure all grounding are stably connected.
- Ensure the emergency stop button and emergency stop circuit are valid. When the emergency stop button or emergency stop circuit is turned off, the power supply of drive device, spindle drive device can be turned off.
- Ensure the voltage and the polarity are correct.
- Ensure the specifications of power supply are correct.
- Ensure the specifications and the inlet/outlet directions of transformer are correct.
- Ensure the inlet/outlet lines of power supply of breakers are correct.

4.2 System power on

- Press the emergency stop button to ensure all air switches during the CNC are turned off.
- The power air switch during the electric cabinet is turned on.
- The air switch or the fuse is connected with DC 24V, and ensure DC24V is normal.
- Ensure other power supplies are normal.
- GSK218M CNC device is turned on.

4.3 Emergency stop and limit

The CNC has the soft limit function, it should be also adopted with the hardware limit function to get the safe operation, and the travel limit switch during the positive/negative direction of axis is installed.

In 【MACHINE SIDE】 screen of <DIAGNOSIS> window, the user can monitor and view the state of the emergency stop isignal by viewing NO:1#4（*ESP）, it is required that all the air switches must be turned off after pressing emergency stop button.

During Manual or MPG (handwheel) mode, the CNC can verify the validity of each axis overtravel limit switch, the accuracy of alarm display, and the validity of overtravel release button by slow moving each coordinate axis; when the overtravel occurs or the emergency stop is pressed, the CNC alarms, which can be released by pressing the overtravel releasing to execute the reverse move.

- Emergency stop signal

*ESP：Emergency stop signal

Parameter diagnosis (CNC side input state)

state address								**X1.4**
Pin								**XS43.24**

In order to properly give an alarm of "an axis (X, Y or Z axis) is on a moving direction (positive or negative)" in case of servo axis overtravel, as well as to ensure the axis that has an overtravel alarm not move to the overtravel direction continuously with the overtravel releasing, this GSK218M CNC system provides two connection methods for the travel limit switch for the user:

A. when has two travel limit switch:

(i.e. an axis positive direction limit use -- travel switch, negative direction use -- travel)

1. Connecting by the following table :

Address	Signal Interface	Interface Pin	Definition	Contact Selection
X000.0	XS43	1	X axis positive travel limit signal	Normally-closed contact
X000.1	XS43	14	X axis negative travel limit signal	Normally-closed contact
X000.2	XS43	2	Y axis positive travel limit signal	Normally-closed contact
X000.3	XS43	15	Y axis negative travel limit signal	Normally-closed contact
X000.4	XS43	17	Z axis positive travel limit signal	Normally-closed contact
X000.5	XS43	5	Z axis negative travel limit signal	Normally-closed contact

2. Modify the following parameter:

Address	Definition	State 0	State 1	Setting Value
K006.0	X axis limit switch selection	2	1	0
K006.1	Y axis limit switch selection	2	1	0
K006.2	Z axis limit switch selection	2	1	0

B. When has one travel limit switch:

Address	Signal Interface	Interface Pin	Definition	Contact Selection
X000.0	XS43	1	X axis travel limit signal	Normally-closed contact
X000.2	XS43	2	Y axis travel limit signal	Normally-closed contact
X000.4	XS43	17	Z axis travel limit signal	Normally-closed contact

2. Modify the following parameter:

Address	Definition	State 0	State 1	Setting Value
K006.0	X axis limit switch selection	2 个	1 个	1
K006.1	Y axis limit switch selection	2 个	1 个	1
K006.2	Z axis limit switch selection	2 个	1 个	1

3. Cautions:

The alarm direction may be inconsistent with the actual one owing to using a stroke switch, (example: when X axis moves positively, alarm " 0510 hardware limit overtravel: -X" occurs, but the actual alarm is " 0510 hardware limit overtravel: +X."), which can be adjusted by the following parameters.

Address	Definition	State 0	State 1	Setting Value
K007.0	X axis limit alarm direction reverses			
K007..1	Y axis limit alarm direction reverses			
K007.2	Z axis limit alarm direction reverses			

State parameter No.011

0	1	1	BFA	LZR							

LZR =1: The travel check is executed during the period from power-on time to the completion of the manual reference point return.

=0: The travel check is not executed during the period from power-on time to the completion of the manual reference point return.

BFA =1: The CNC alarms after overtravel when it transmits the overtravel instruction.

=0: The CNC alarms before overtravel when it transmits the overtravel instruction.

System parameter number

0	3	1	G13								

G13 =1: The system is executed by G13 when it is turned on or clearing .

=0: The system is executed by G12 when it is turned on or clearing .

System parameter number

0	6	1		LALM							

LALM =1: Ignore the limit alarm.

=0: Do not ignore the limit alarm.

4.4 Gear ratio adjustment

When the machine move distance is not uniform with the displacement distance of coordinate display, NO.160~ NO.169 are modified to adjust the electronic gear ratio to meet to the different machine driving ratio.

Division/multiplying of positioning INSTRUCTION pulse (electronic handwheel/MPG).

In position control mode, it can match with all pulse source by setting parameters to get the required resolution(angle/pulse).

Computation formula: $P \times G = N \times C \times 4$

$$G = \frac{\text{Division numerator}}{\text{Division denominator}}$$

Division numerator: INSTRUCTION multiplying coefficient（system parameter NO.160, NO.161, NO.162, NO.163, NO.164）

Division denominator: INSTRUCTION division coefficient（system parameter NO.165, NO.166, NO.167, NO.168, NO.169）

P：pulse quantity of input INSTRUCTION;

G：electronic gear ratio;

N：motor rotation rev;

C：photoelectric encoder lines/rev，the system C＝2500.

【Example】When the input instruction pulse is 6000, the servo motor rotates 1 rev.

$$G = \frac{N \times C \times 4}{P} = \frac{1 \times 2500 \times 4}{6000} = \frac{5}{3}$$

Data parameter NO. 160（CMRX）=5， NO.165（CMDX）=3；

The ratio between the system gear and the parameter has the same function that of digital servo gear and parameter. When the system is employed with the digital servo with the electronic gear ratio function, the electronic gear ratio is set to 1:1, which is set to the digital servo.

When the CNC is adopted with the stepper driver, it should use the stepper division driver as possible, v and the proper machine driving ratio, and set the electronic gear ratio to 1:1 to avoid the large difference between the numerator and denominator.

4.5 Backlash compensation

Use the gauge, micrometer gauge or laser master gauge to measure the backlash, the backlash compensation must be precise, otherwise it cannot improve the precision of processing and it is suggested that the following methods should be adopted to measure the leading screw backlash instead of MPG(handwheel) or single step:

- Edit program:

```
O0001；
N10 G01 G91 X1 F800 ；
N20 X1 ；
N30 X1 ；
N40 X-1 ；
N50 M30 .
```

- The backlash error compensation value is set to zero before measuring.
- The program runs during Single block mode, and the CNC looks for the measure datum point A after positioning two times, the program runs 1mm and reversely runs 1mm to B point, and the CNC reads the current data.

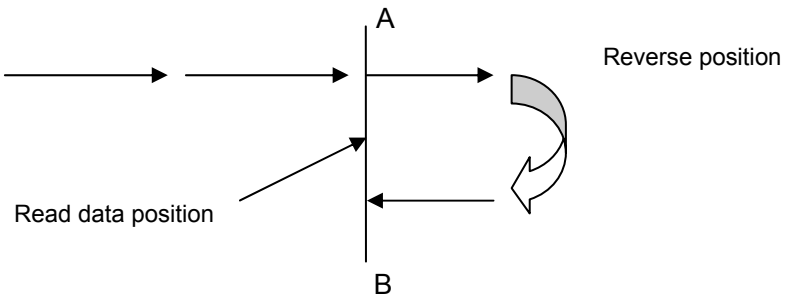


Fig. 4-5-1 backlash measure method

- Backlash error compensation value= |data recorded by A point –data recorded by B point|; input the operation result to the system parameter No.190.

  Data A: read the data of gauge at the A point;

  Data B: read the data of micrometer gauge at the B point;

  Pulse equivalent: 1 micron

Note: 1. The system parameter P190~P194 can set the backlash compensation for each axis.

2. The system parameter NO.195~NO.199 can set the backlash compensation mode and the compensation frequency.

3. To get the high precision, the backlash must be checked after the machine has been used for 3 months.

System parameter number

0	1	8					RBK				

RBK =1: cutting and rapid separately perform backlash compensation

=0: cutting and rapid do not separately perform backlash compensation

4.6 Parameter of driver

If the machine moving direction is inconsistent with the one required by the bit instruction, it can be adjusted by modifying the system parameter NO:3#1~ NO:3#5.

System parameter number

0	0	3			DIR5	DIR4	DIRZ	DIRY	DIRX	INM

DIRX =1: X axis feeds direction
=0: X axis feeds direction reverse
DIRY =1: Y axis feeds direction
=0: Y axis feeds direction reverse
DIRZ =1: Z axis feeds direction
=0: Z axis feeds direction reverse
DIR4 =1: 4TH axis feeds direction
=0: 4TH axis feeds direction reverse
DIR5 =1: 5TH axis feeds direction
=0: 5TH axis feeds direction reverse

Check the driver alarm or driver connection if an alarm of X, Y, Z axis, or spindle alarm is shown at system power on. If there is no such case, the cause may be that the level set by the system alarm parameter is not matched with the driver alarm level, which may be modified by bit parameter No. 19#0 ~ NO:19#5 for high or low level alarm active. When matching with our driver, the bits #0 ~ #5 of bit parameter NO:19 should be set to 0. After the parameter is modified, the alarm can be cancelled by pressing the “RESET" key. For security, please set the system parameter switch to "OFF".

If there is no drive alarm provided by the driver, please don't connect that signal, and set the bits #0 ~ #5 of bit parameter NO:19 to 1. If the driver alarm is shown by the system, make a judgement where the fault might be, at CNC side or at driver side.

System parameter number

0	1	9			ALMS	ALMS5	ALMS4	ALMSZ	ALMSY	ALMSX

ALMX =1: driver alarms, high level is valid.
=0: driver alarms, low level is valid
ALMY =1: driver alarms, high level is valid.
=0: driver alarms, low level is valid
ALMZ =1: driver alarms, high level is valid.
=0: driver alarms, low level is valid
ALM4 =1: driver alarms, high level is valid
=0: driver alarms, low level is valid
ALM5 =1: driver alarms, high level is valid
=0: driver alarms, low level is valid
ALMS =1: driver alarms, high level is valid
=0: driver alarms, low level is valid

System parameter number

0	6	1		FALM			SALM				

SALM =1: ignore the spindle driver alarm
=0: nonignore the spindle driver alarm
FALM =1: ignore the feed spindle driver alarm.
=0: nonignore the feed spindle driver alarm.

4.7 Machine pitch compensation

- Setting compensation value

1. The set compensation value is related to the position between the zero and compensation point machine move direction and compensation backlash and so on.
2. The compensation value of compensation point N(N=0,1,2,3,…127) is determined by the machine error between N, N-1.
3. The machine zero is taken as the compensation origin point, and the set compensation of every axis is taken as the parameter value.
4. Compensable axis: X, Y, Z, 4, 5 axis. Compensation points: 128 points for each axis.
5. Compensation value range: each compensation point（-7～+7）×compensation override. The input exceeding -7～+7 is disabled.
6. The setting method is the same that of input method of system parameter, see Operation.

- Notes for compensation value setting

1. Bit parameter NO：37#1determines whether the pitch compensation is executed, and NO：37#2 determines to select the unidirectional or bidirectional compensation.
2. System parameter 216～220：pitch error compensation number of reference point of each axis(setting of compensation zero).
3. System parameter 221～225：compensation points of pitch error compensation of each axis
4. System parameter 226～230：pitch error compensation backlash of each axis. Execute the compensation with the value when the positive compensation value is input; execute the compensation with the absolute value of the value when the negative compensation value is input
5. System parameter 231～235： pitch error compensation override of each axis. The CNC defaults 0.001.
6. The compensation is not executed when the input compensation backlash is zero.
7. After the pitch error parameter is set, the CNC is turned on again, and the pitch error parameter is enabled after the machine zero return is executed.

- The following is the unidirectional compensation parameters, taking X axis as example:

The error compensation takes the machine zero as reference point. The pitch error compensation is executed when the positive coordinate system of machine zero is moving.

Table 4-7-1

Parameter	Setting value
P216: compensation number of X axis reference point	127
P221: X-axis pitch error compensation points	128
P226: X-axis pitch error compensation backlash	10
P231: X-axis pitch error compensation override	0.001

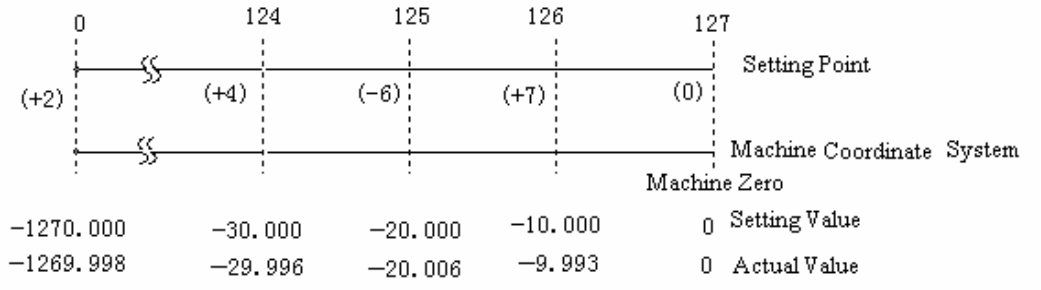


Fig. 4-7-1

The set compensation value in 【Pitch compensation X】.

Number	0	…	…	124	125	126	127
Compensation	+2	…	…	+4	−6	+7	0

The error compensation takes the machine zero as reference point. The pitch error compensation is executed when the negative coordinate system of machine zero is moving.

Table 4-7-2

Parameter	Setting value
P216: compensation number of X axis reference point	0
P221: X-axis pitch error compensation points	128
P226: X-axis pitch error compensation backlash	10
P231: X-axis pitch error compensation override	0.001

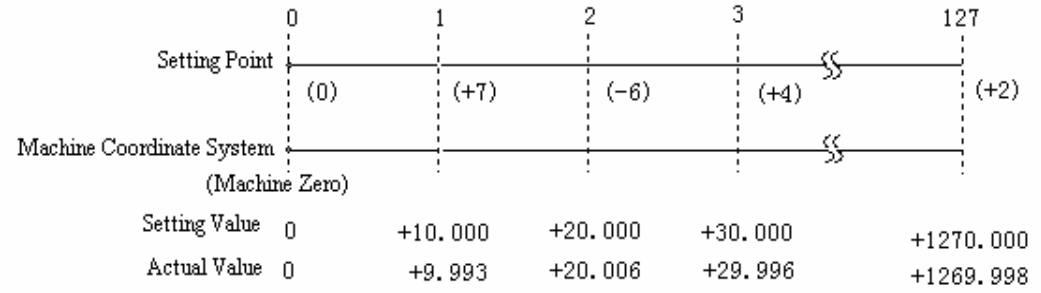


Fig. 4-7-2

The set compensation value in 【Pitch compensation X】.

Number	0	1	2	3	…	…	127
Compensation	0	+7	−6	+4	…	…	+2

The setting method of the Y and Z axis is the same as above

- Bidirectional compensation setting takes X axis as the example:
  The error compensation takes the machine zero as the reference point. The pitch error compensation can be executed when the positive/negative coordinate system of machine zero moves

Operation in the positive coordinate: the first compensation length is No. 0000 set compensation value during 【Compensation X】, the second is that of No. 0001 and the N is that of No. N-1.

Operation in the negative coordinate: the first compensation length is No. 1000 set compensation value during 【Compensation X】, the second is that of No. 1001 and the N is that of No. 1000+N-1.

Table 4-7-3

Parameter	Setting value
P216: compensation number of X-axis reference point	40
P221: X-axis pitch error compensation points	128
P226: X-axis pitch error compensation during interval	50
P231: X-axis pitch error compensation override	0.001mm

Output the compensation value at the compensation point of corresponding area. The example for the compensation is as follows:

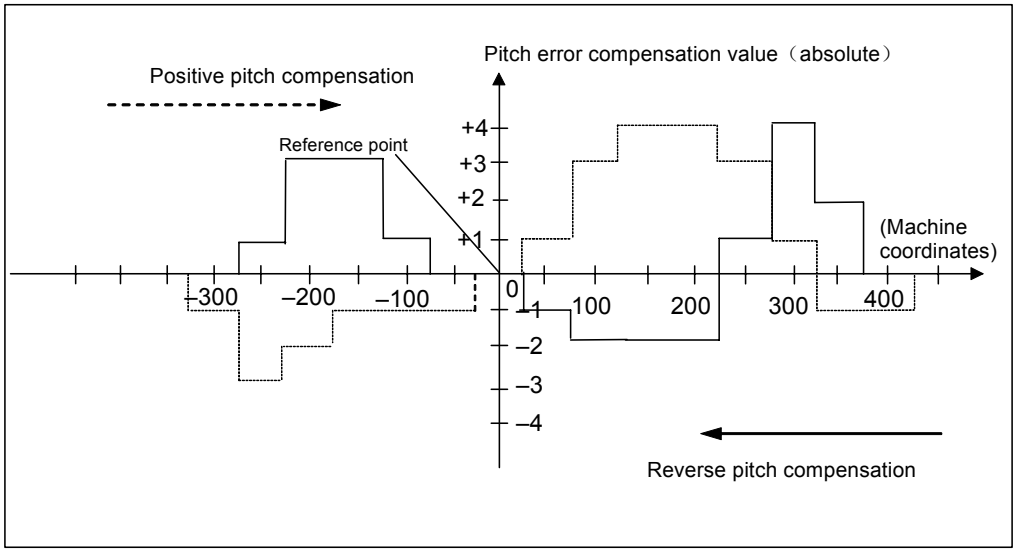


Fig. 4-7-3

Positive pitch compensation（imaginal line drawing）:

Number	34	35	36	37	38	39	40	41	42	43	44	45	46	47	49
Compensation value	+1	+2	-1	-1	0	0	-1	+1	+3	+1	0	-1	-2	-2	+1

Negative pitch compensation（continuous line drawing）:

Number	1034	1035	1036	1037	1038	1039	1040	1041	1042	1043	1044	1045	1046	1047
Compensation value	−1	−2	0	+2	+1	0	−1	−1	0	0	+3	+3	−2	−2

4.8 Machine zero return

1、 Conception of machine zero

The machine coordinate system is the inherent coordinate system by machine. Its origin is called mechanical zero (or machine zero), as is called reference point in this manual. It is usually fixed at the maximum stroke point of X axis, Y axis or Z axis. This origin that is a fixed point is set after the machine is designed, manufactured and adjusted. As the machine zero is not confirmed by the CNC system at power-on, the auto or manual machine zero return is usually performed.

The machine zero return has two types: one-revolution-signal, non-one-revolution-signal. It is set by bit parameter No.6#6. For the zero return of the non-one-revolution-signal by the motor, it is classified for the A, B two types. It is set by bit parameter No.6#7.

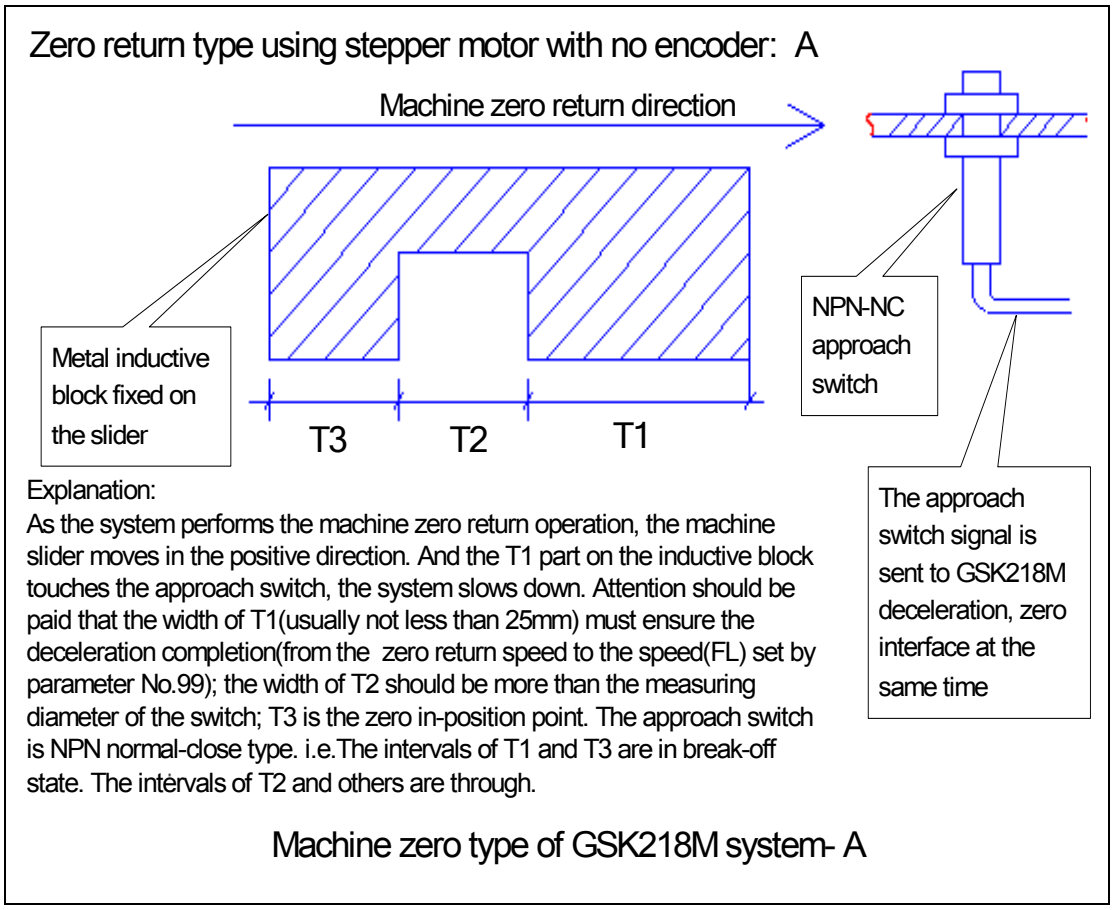


Fig. 4-8-1

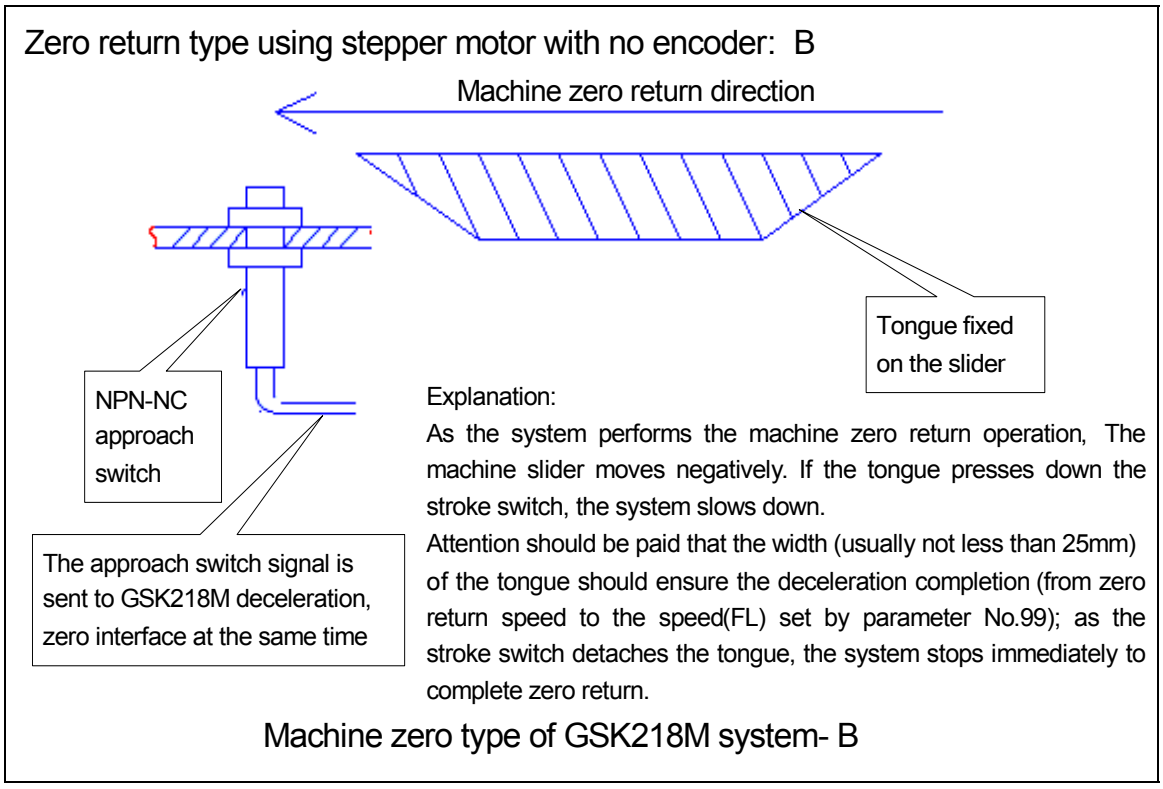


Fig. 4-8-2

2 . Steps for machine zero

(1) Press 

to enter Machine Zero mode, the characters “machine zero “will be displayed at the down-right of the LCD screen;

(2) Select the axis X, Y, or Z for machine zero and its direction is set by bit parameter **No. 7#3～N0.7#5**;

(3) The machine moves towards the machine zero. Before the deceleration point is reached the machine traverses rapidly(traverse speed set by number parameter No.100～No.102), then moves to the machine zero point(i.e. reference point) by a speed of FL(set by number parameter No.099) if the machine touches the deceleration switch. As the machine zero is reached, the corresponding axis moving stops and the Machine Zero indicator lights up.

3 . Machine zero steps by program

After the bit parameter No.4#3 is set for 0, the machine zero can be specified by G28 instruction. Because it detects the stroke tongue, this instruction is equivalent to manual machine zero.

Note:

1. If the machine zero is not fixed on your machine, don’t perform the machine zero operation.
2. The indicator of the corresponding axis lights up when the machine zero is finished.
3. The indicator is gone out on condition that the axis is moved out from the machine zero by the operator.

4、Refer to the machine builder’s manual for the direction of the machine zero (reference point).

- Signals

  DECX：X-axis deceleration signal;
  DECY：Y-axis deceleration signal;
  DECZ：Z-axis deceleration signal;
  DEC4：4th-axis deceleration signal;

Parameter diagnosis(machine side input state)

State address					X1.3	X1.2	X1.1	X1.0
Pin					XS43.22	XS43.09	XS43.21	XS43.08

State parameter No.001

0	0	1	SJZ							

SJZ =1: reference point memory: do.
=0: reference point memory: not.

System parameter number

0	0	6	MAOB	ZPLS						

ZPLS =1: Zero type selection: one-revolution signal
=0: Zero type selection: non-one-revolution signal
MAOB =1: Zero type selection for non-one-revolution signal: B
=0: Zero type selection for non-one-revolution signal: A

System parameter number

0	0	7	ZMI5	ZMI4	ZMI_Z	ZMI_Y	ZMI_X			

ZMI_X =1: Direction setting of X axis reference point return: negative
=0: Direction setting of X axis reference point return: positive
ZMI_Y =1: Direction setting of Y axis reference point return: negative
=0: Direction setting of Y axis reference point return: positive
ZMI_Z =1: Direction setting of Z axis reference point return: negative
=0: Direction setting of Z axis reference point return: positive
ZMI4 =1: Direction setting of 4th axis reference point return: negative
=0: Direction setting of 4th axis reference point return: positive
ZMI5 =1: Direction setting of 5th axis reference point return: negative
=0: Direction setting of 5th axis reference point return: positive

Data parameter NO.009

0	9	9	ZRNFL

ZRNFL: low rate of X, Y, Z-axis reference point return(all axes).

Data parameters **No.100～No.104**

1	0	0	X-axis reference point return speed
1	0	1	Y-axis reference point return speed
1	0	2	Z-axis reference point return speed
1	0	3	4TH-axis reference point return speed
1	0	4	5TH-axis reference point return speed

4.9 Input/output signal control of spindle CW/CCW

- Signals

  M03: spindle CCW

  M04: spindle CW

  M05: spindle stop

  ENB: spindle enable

  SAR: spindle speed arrival

  ZSPD: spindle zero speed check

  SION: Spindle orientation in-position

Parameter diagnosis(machine side output state)

state address					Y2.3	Y2.2		
Pin					XS41.15	XS41.02		

Y2.2=spindle CCW signal output；Y2.3= spindle CW signal output.

state address								Y2.0
Pin								XS41.01

Y2.0=spindle enable

Parameter diagnosis(machine side input state)

state address	X4.7	X4.6						
Pin	XS45.06	XS45.18						

X4.6=spindle speed arrival signal input；X4.7＝spindle zero speed check signal input.

state address								X5.0
Pin								XS45.8

X5.0=spindle orientation completion signal

Data parameter No.245

2	4	5	

Time for check spindle speed arrival signal

Data parameter No.257

2	5	7	

Spindle speed up limit during tapping cycle

Data parameter No.258

2	5	8	

Spindle speed up limit

- Operation time sequence

  Time sequence of spindle operation is as Fig. 4-9-1:

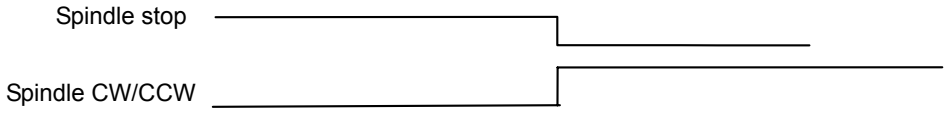


Fig. 4-9-1 Spindle CW time sequence

- Control logic
  1. The spindle stops and M05 outputs when CNC is turned on;
  2. After M3/M4 is executed, it is enabled and M05 stops output.

4.10 Spindle automatic gear change control

- Signals

  Y3.4～Y3.6：Spindle automatic gear shift output signal

  X4.1～X4.3：Spindle gear change completion signal

  When CNC selects the spindle frequency conversion control (0～10V analog voltage output), it can support 4-gear spindle automatic gear change control and 4-gear change completion check function.

- Signal diagnosis

  Parameter diagnosis(CNC side output state)

state address		Y3.6	Y3.5	Y3.4				
Pin		XS41.25	XS41.12	XS41.24				

  Y3.4=spindle gear 1 output；Y3.5=spindle gear 2 output；Y3.6=spindle gear 3 output.

  Parameter diagnosis(machine side input state)

state address						X4.3	X4.2	X4.1	
Pin						XS45.15	XS45.02	XS45.14	

  X4.1= spindle gear1 in-position； X4.2=spindle gear2 in-position； X4.3=spindle gear3 in-position.

- Control parameter

  State parameter

0	0	1						SPT		

  SPT =1: Spindle control: I/O point.
  =0: Spindle control: frequency conversion or other modes.

  Data parameter No.246

2	4	6	

  Corresponding to max. speed of gear 1.

  Data parameter No.247

2	4	7	

  Corresponding to max. speed of gear 2.

Data parameter No.248

2	4	8	

Corresponding to max. speed of gear 3.

- Control logic

  1. Up to 1 of S1～S3 is enabled;
  2. S1～S3 stops output after S0 is executed;
  3. When some S** is executed, the corresponding S** output is enabled and kept, and CNC automatically stops other S** output

4.11 External cycle start and feed hold

- Signals

ST：external automatic cycle start signal has the same function that of automatic cycle start key on the machine panel.

*SP：feed hold signal has the same function that of the feed hold key on the machine panel.

- Signal diagnosis

Parameter diagnosis(machine side output state)

State address		X1.6	X1.5					
Pin		XS43.25	XS43.12					

X1.5=External cycle start X1.6=External feed hold

- Internal circuit of signal

*SP/ST internal circuit is as Fig. **4-11-1：**

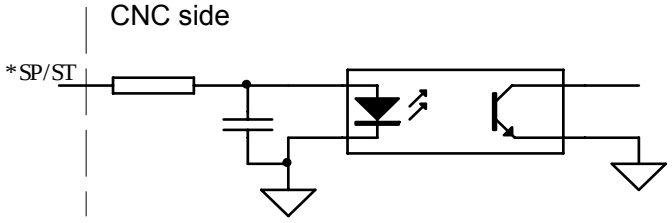


Fig.4--11-1

- External circuit

*SP, ST external circuit is as Fig. **4-11-2.**

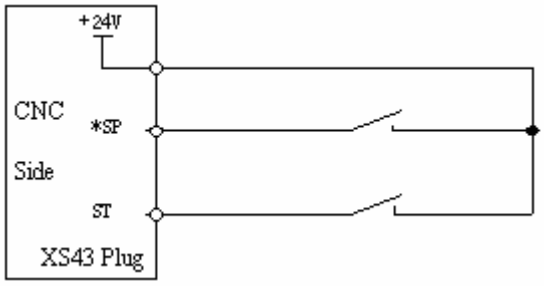


Fig. 4-11-2

System parameter number

0	5	9		OTOP							

OTOP =1: Use external start and stop
=0: No use external start and stop

4.12 External editing lock and external operator panel lock

- Signals

LEDT：External editing lock signal，if it is 1, the program edit can be done. And its function is the same with that of the system program switch.

LSYS：External operator panel lock signal, if it is 1, all the machine operator keys are locked.

Signal address

	#7	#6	#5	#4	#3	#2	#1	#0
G016	LSYS	LEDT						

System diagnosis（CNC side input state）

State address							X3.1	X3.0
Pin							XS44.21	XS44.8

X3.0= external editing lock X3.1= external operator panel lock

System parameter number

0	5	9			OTOP	LOPT					

LOPT =1: Use external operator panel lock.
=0: Not use external operator panel lock.
OTOP =1: Use external editing lock.
=0: Not use external editing lock.

4.13 Cooling, lubricant and chip removal control

- Signals
  M08：cooling ON
  M32：lubricant ON
  M35：Chip removal ON

- Signal diagnosis

Parameter diagnosis (machine side output state)

State address							Y0.1	
Pin							XS40.14	

Y0.1=cooling switch control

Parameter diagnosis(machine side output state)

State address						Y1.2	Y1.1	
Pin						XS40.9	XS40.21	

Y1.1=chip removal switch control；Y1.2=lubricant switch control.

- Internal circuit is as Fig. 3-13-1:

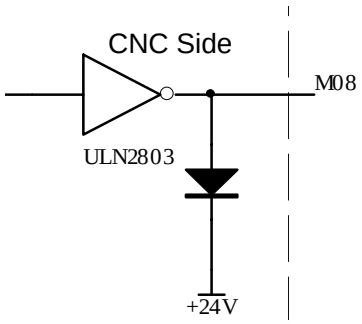


Fig.3-13-1 M08 internal circuit

4.14 Parameter of feedrate

System parameter number

0	1		FDR	RDR	TDR	RFO			LRP	RPD

RPD =1: Manual rapid traverse during the period from power-on time to the completion of the reference point return is enabled.
=0: Manual rapid traverse during the period from power-on time to the completion of the reference point return is disabled.

LRP =1: The positioning(G00) interpolation is performed with the linear.
=0: The positioning(G00) interpolation is performed with the non-linear.

RFO =1: The machine tool stops moving when the feedrate override is F0 during rapid traverse.

=0: The machine tool does not stop moving when the feedrate override is F0 during rapid traverse.

TDR =1: The dry run is enabled during the tapping.

=0: The dry run is disabled during the tapping.

RDR =1: The dry run is enabled.

=0: The dry run is disabled.

FDR =1: When the rapid position is being executed, the dry run is enabled.

=0: When the rapid position is being executed, the dry run is disenabled.

System parameter number

0	1	4								
										HFC

HFC =1: Clamp combined by straight line and arc for helical interpolation feedrate

=0: Clamp by straight line and arc separately for helical interpolation feedrate

0086	Dry run speed	5000

Setting range: 0～9999 (mm/min)

0087	The cutting feedrate during Auto mode when power-on.	300

Setting range: 0～9999 (mm/min)

0088	X-axis rapid operation speed	5000

Setting range: 0～9999 (mm/min)

0089	Y-axis rapid operation speed	5000

Setting range: 0～9999 (mm/min)

0090	Z-axis rapid operation speed	5000

Setting range: 0～9999 (mm/min)

0091	4TH-axis rapid operation speed	5000

Setting range:0～9999 (mm/min)

0092	5TH-axis rapid operation speed	5000

Settingrange: 0～9999 (mm/min)

0093	All-axis rapid operation override F0 speed (all axes)	30

Setting range: 0～9999 (mm/min)

0094	Max. feedrate(all axes)	8000

Setting range: 0～9999 (mm/min) max. controlled speed in non-prediction control mode

0095	Min. feedrate(all axes)	0

Set range:0～500 (mm/min) min. controlled speed in non-prediction control mode

0096	Max. control speed during predict control mode(all axes)	6000

Setting range: 0～9999 (mm/min)

0097	Min. control speed during predict control mode(all axes)	0

Setting range:：0～500 (mm/min)

0098	All-axis JOG continuous feedrate	2000

Setting range: 0～5000 (mm/min)

0099	Reference point return speed (all axes)	40

Setting range: 0～500

0100	X-axis reference point return speed	4000

Setting range:

0101	Y-axis reference point return speed	4000

Setting range: 0～9999

0102	Z-axis reference point return speed	4000

Setting range: 0～9999

0103	4TH-axis reference point return speed	4000

Setting range: 0～9999

0104	5TH-axis reference point return speed	4000

Setting range: 0～9999

4.15 Parameter of tapping

System parameter number

0	4	4		FHD	PCP	DOV			VGR	G84

G84 =1: Use M codes in rigid tapping
=0: Not use M codes in rigid tapping

VGR =1: Arbitrary gear ratio of the spindle and position encoder enabled in rigid tapping.
=0: Arbitrary gear ratio of the spindle and position encoder disabled in rigid tapping.

DOV =1: Override effective during rigid tapping retraction.
=0: Override ineffective during rigid tapping retraction.
PCP =1: To change rigid tapping for high-speed peck drilling cycle.
=0: Not change rigid tapping for high-speed peck drilling cycle.
FHD =1: Single block effective for feed dwell during rigid tapping.
=0: Single block ineffective for feed dwell during rigid tapping.

System parameter number

0	4	5					OV3	OVU	TDR		NIZ

NIZ =1: To perform the rigid tapping finishing.
=0: Not perform the rigid tapping finishing.
TDR =1: To use the same time constant during the rigid tapping advance and retraction.
=0: Not use the same time constant during the rigid tapping advance and retraction.
OVU =1: 10% retraction override for rigid tapping.
=0: 1% retraction override for rigid tapping.
OV3 =1: Spindle speed effective by program instruction.
=0: Spindle speed ineffective by program instruction.

System parameter number

0	4	6			ORI				SSOG	DGN

DGN =1: Difference of the spindle and the tapping axis errors
=0: Synch error in rigid tapping.
SSOG =1: For servo spindle control at the beginning of rigid tapping.
=0: For following spindle control at the beginning of rigid tapping.
ORI =1: To perform spindle dwell when rigid tapping starts.
=0: Not perform spindle dwell when rigid tapping starts.

K parameter number

0	0	7	PAP							

PAP =1: Use spindle position mode
=0: No use spindle position mode
It is set to 1 when using rigid tapping, and set to 0 when using flexibility tapping

Appendix 1

Guide for GSK218M matching with ladder

1. Notices of GSK218M matching with turret tool magazine

(1) Install wiring according to the ladder.
(2) Set PLC parameters correctly to ensure that the ladder matches with the machine tool when the ladder is used
(3) The machine tool has special control requirements. When the program is added to the ladder, the persons responsible for modification should be master the electric and PLC method, and the ladder.
(4) The ladder is only suitable for general CNC milling machine and the machining center with the turret tool magazine, otherwise, other machine tools may result in the unexpected accidence.
(5) The ladder is referred, and the ladder is different for the different machine tool.

2. Allocation and definition of PLC IO address, auxiliary relay and register

Table 1 Input signal interface definition

Address	Signal interface	Interface pin	Definition	Contact selection
X000.0	XS43	1	X axis positive travel limit signal	Normally closed contact
X000.1	XS43	14	X axis negative travel limit signal	Normally closed contact
X000.2	XS43	2	Y axis positive travel limit signal	Normally closed contact
X000.3	XS43	15	Y axis negative travel limit signal	Normally closed contact
X000.4	XS43	17	Z axis positive travel limit signal	Normally closed contact
X000.5	XS43	5	Z axis negative travel limit signal	Normally closed contact
X000.6	XS43	18	4TH axis positive travel limit signal	Normally closed contact
X000.7	XS43	6	4TH axis negative travel limit signal	Normally closed contact
X001.0	XS43	8	X axis zero return deceleration signal	Normally closed contact
X001.1	XS43	21	Y axis zero return deceleration signal	Normally closed contact
X001.2	XS43	9	Z axis zero return deceleration signal	Normally closed contact
X001.3	XS43	22	4TH axis zero return deceleration signal	Normally closed contact
X001.4	XS43	24	Emergency stop switch	Normally closed contact
X001.5	XS43	12	External cycle start	Normally open contact
X001.6	XS43	25	External feed hold	Normally open contact
X001.7	XS43	13	Lubrication pressure or oil level detection	Normally open contact
X002.0	XS44	1	Air supply pressure detection	Normally open contact
X002.1	XS44	14	Skip signal	Normally open contact
X002.2	XS44	2	Undefined	
X002.3	XS44	15	Undefined	
X002.4	XS44	17	External clamping/releasing tool control	Normally open contact
X002.5	XS44	5	Releasing tool check	Normally open contact
X002.6	XS44	18	Clamping tool check	Normally open contact

X002.7	XS44	6	Undefined	
X003.0	XS44	8	Edit lock	Normally open contact
X003.1	XS44	21	Operation lock	Normally open contact
X003.2	XS44	9	Undefined	
X003.3	XS44	22	Undefined	
X003.4	XS44	24	Undefined	
X003.5	XS44	12	Undefined	
X003.6	XS44	25	Undefined	
X003.7	XS44	13	Undefined	
X004.0	XS45	1	Undefined	
X004.1	XS45	14	Spindle gear-1 in-position	Normally open contact
X004.2	XS45	2	Spindle gear-2 in-position	Normally open contact
X004.3	XS45	15	Spindle gear-3 in-position	Normally open contact
X004.4	XS45	17	Spindle speed/position status output	Normally open contact
X004.5	XS45	5	Undefined	
X004.6	XS45	18	Spindle speed/position arrival	Determined by the parameter
X004.7	XS45	6	Spindle zero speed check	Normally closed contact
X005.0	XS45	8	Spindle orientation in-position	Determined by the parameter
X005.1	XS45	21	Tool magazine forward in-position	Determined by the parameter
X005.2	XS45	9	Tool magazine backward in-position	Determined by the parameter
X005.3	XS45	22	Tool magazine CCW/CW in-position	Determined by the parameter
X005.4	XS45	24	Tool magazine zero return in-position	Determined by the parameter
X005.5	XS45	12	Undefined	
X005.6	XS45	25	Undefined	
X005.7	XS45	13	Undefined	
X006.0	XS22	6	External MPG X axis selection	Normally open contact
X006.1	XS22	2	External MPG Y axis selection	Normally open contact
X006.2	XS22	7	External MPG Z axis selection	Normally open contact
X006.3	XS22	3	External MPG A axis selection	Normally open contact
X006.4	XS22	8	External MPG step 0.001	Normally open contact
X006.5	XS22	4	External MPG step 0.01	Normally open contact
X006.6	XS22	9	External MPG step 0.1	Normally open contact
X006.7	XS21	ESP（4，9）	External emergency stop	Normally closed contact

Note:

(1) Refer to ***Volume Four*** for PLC input (X) connection and precautions.

(2) Contact selection: normally open contact and normally closed contact. It is determined by the parameter, thereinto, it is determined by parameter means that this input point to normally open contact or normally closed contact is determined by the KAPA parameter in the PLC, see **KAPA parameter** for details.

(3) When the ladder is used, the user can add the new function for the undefined input part. （it is needed to modify the ladder diagram when using the undefined part, please do it cautiously）。

(4) Operator panel : USER1 key function: K11.1=0, chip washing pump on-off;

K11.1=1, Z axis manual 1st reference

position return .

USER2 key function: Z axis manual 2nd reference position return

USER2 key function: Spindle blowing switch (on-off)

Table 2 Output signal interface definition

Address	Signal interface	Interface pin	Definition
Y000.0	XS40	1	Z axis holding brake
Y000.1	XS40	14	Cooling
Y000.2	XS40	2	Tool releasing/clamping
Y000.3	XS40	15	Undefined
Y000.4	XS40	17	Spindle brake
Y000.5	XS40	5	Undefined
Y000.6	XS40	18	Red alarm light
Y000.7	XS40	6	Yellow alarm light
Y001.0	XS40	8	Green alarm light
Y001.1	XS40	21	Chip removal control
Y001.2	XS40	9	Lubrication control
Y001.3	XS40	22	Machine light control
Y001.4	XS40	24	Undefined
Y001.5	XS40	12	Spindle blowing
Y001.6	XS40	25	Undefined
Y001.7	XS40	13	Undefined
Y002.0	XS41	1	Spindle enabling
Y002.1	XS41	14	Spindle orientation
Y002.2	XS41	2	Spindle CCW
Y002.3	XS41	15	Spindle CW
Y002.4	XS41	17	Hand unit light
Y002.5	XS41	5	Undefined
Y002.6	XS41	18	Washing pump output
Y002.7	XS41	6	Spindle position/speed mode change
Y003.0	XS41	8	Tool magazine CCW
Y003.1	XS41	21	Tool magazine CW
Y003.2	XS41	9	Tool magazine forward
Y003.3	XS41	22	Tool magazine backward
Y003.4	XS41	24	Spindle gear 1st (frequency conversion\IO point control)
Y003.5	XS41	12	Spindle gear 2nd (frequency conversion\IO point control)
Y003.6	XS41	25	Spindle gear 3rd (frequency conversion\IO point control)
Y003.7	XS41	13	Spindle gear 4th (frequency conversion\IO point control)）
Y004.0	XS42	1	Undefined
Y004.1	XS42	14	Undefined
Y004.2	XS42	2	Undefined
Y004.3	XS42	15	Undefined
Y004.4	XS42	17	Undefined
Y004.5	XS42	5	Undefined
Y004.6	XS42	18	Undefined
Y004.7	XS42	6	Undefined
Y005.0	XS42	8	Undefined

Y005.1	XS42	21	Undefined
Y005.2	XS42	9	Undefined
Y005.3	XS42	22	Undefined
Y005.4	XS42	24	Undefined
Y005.5	XS42	12	Undefined
Y005.6	XS42	25	Undefined
Y005.7	XS42	13	Undefined

Note:

(1) Refer to ***Volume Four*** for PLC input (X) connection and precautions

(2) When the ladder is used, the user can add the new function for the undefined input part (it is needed to modify the ladder diagram when using the undefined part, please do it cautiously).

Table 3 KAPA address definition

Address	Definition	Status 0	Status1	Setting value by customer
K000.0	Permit PLC parameter to be modified	No permission	Permission	
K000.1	Permit PLC signal to be debugged	No permission	Permission	
K000.2	All Y signals are cleared after PLC enters the debugging mode.	Not clearing	Clearing	
K000.3	Undefined			
K000.4	Undefined			
K000.5	Undefined			
K000.6	Undefined			
K000.7	Permit the instruction table to be operated	No permission	Permission	
K001.0	Permit the tool magazine to be used	No permission	Permission	
K001.1	If the ladder downloads automatically when it is converted	No	Yes	
K001.2	Reversed			
K001.3	Reversed			
K001.4	Reversed			
K001.5	Reversed			
K001.6	Reversed			
K001.7	Reversed			
K002.0	If the 4TH axis is used	No	Yes	
K002.1	Reversed			
K002.2	Reversed			
K002.3	Reversed			
K002.4	Reversed			
K002.5	Reversed			
K002.6	Reversed			
K002.7	Reversed			
K003.0	Reversed			
K003.1	Reversed			

K003.2	Reversed			
K003.3	Reversed			
K003.4	Reversed			
K003.5	Reversed			
K003.6	Reversed			
K003.7	Reversed			
K004.0	If the spindle uses the gear control(I/O point)	No	Yes	
K004.1	If the manual reference point controls one axis	Many axes	1 axis	
K004.2	Reversed			
K004.3	Reversed			
K004.4	Reversed			
K004.5	Reversed			
K004.6	Reversed			
K004.7	Reversed			
K005.0	Whether the machine tool has external handwheel (MPG) or not	No	Yes	
K005.1	Whether the machine tool has external cycle Start function or not	No	Yes	
K005.2	If the system enters the debugging mode	No	Yes	
K005.3	Reversed			
K005.4	Reversed			
K005.5	Reversed			
K005.6	Reversed			
K005.7	Reversed			
K006.0	X axis limit switch selection	2 PCS	1 PCS	
K006.1	Y axis limit switch selection	2 PCS	1 PCS	
K006.2	Z axis limit switch selection	2 PCS	1 PCS	
K006.3	4TH axis limit switch selection	2 PCS	1 PCS	
K006.4	Reversed			
K006.5	Reversed			
K006.6	Reversed			
K006.7	Reversed			
K007.0	X axis limit alarm reverse			
K007.1	Y axis limit alarm reverse			
K007.2	Z axis limit alarm reverse			
K007.3	4TH axis limit alarm reverse			
K007.4	Reversed			
K007.5	Reversed			
K007.6	Reversed			
K007.7	If the spindle position mode is used	No	Yes	
K008.0	If the spindle positioning detection is normally open.	Normally closed	Normally open	

K008.1	The tool clamping/releasing control selection	External button	Button on panel	
K008.2	If the tool clamping/releasing device is not used.	No	Yes	
K008.3	if the automatic lubricating control is used	Yes	No	
K008.4	If the spindle has the gear change device	No	Yes	
K008.5	If spindle speed (speed mode)/position (position mode) check arrival is the normally closed	Normally closed	Normally open	
K008.6	Whether the check switch is closed or not (it is turned off in position mode) in the spindle speed mode	Closed	open	
K008.7	Whether the spindle position/speed mode conversion checks the signal or not	Yes	No	
K009.0	Whether the spindle position arrival signal checks the signal or not?	Yes	No	
K009.1	If the lubrication pressure or oil level is checked	No	Yes	
K009.2	If the air pressure is checked	No	Yes	
K009.3	If the spindle gear detection has a detecting switch			
K009.4	Reversed			
K009.5	Reversed			
K009.6	Reversed			
K009.7	Reversed			
K010.0	The tool magazine rotation in-position mode selection	No reaction	Reaction	
K010.1	If the tool magazine has the zero switch	No	Yes	
K010.2	The tool magazine zero return contact selection	Normal open	Normally closed	
K010.3	The tool magazine infeed tool contact selection	Normal open	Normally closed	
K010.4	The tool magazine tool retraction contact selection	Normal open	Normally closed	
K010.5	The tool counting switch contact selection	Normal open	Normally closed	
K010.6	If the tool origin point setting is enabled	Disabled	Enabled	
K010.7	If the tool magazine enters the regulation mode	No	Yes	
K011.0	If the manual tool clamping/releasing prompts the tool number which corresponds to the spindle	Yes	No	
K011.1	If the manual operation returns the tool change position	No	Yes	
K011.2	If the No.1244 alarm cleared by modifying the parameter	No	Yes	
K011.3	Clear the No.1244 alarm	Yes	No	
K011.4	Reversed			

K011.5	Reversed			
K011.6	Reversed			
K011.7	Reversed			
K015.0	Whether it is the operator panel B or not	No	Yes	

KAPA use notes:

1. When the system normally runs, K0000, K0001, K0002, K0003, K0004, K0005, K0006, K0007, K0052, K0107 must be 0, otherwise there may be the unexpected accidence.
2. The modified K0010 is valid when the system is started again, when K0010=0(i.e. the tool magazine is not used), the setting of the K0100, K010.1, K010.2, K010.3. K010.4, K010.5, K010.6, K010.7, K011.0, K011.1, K011.2 and K011.3 is disabled.
3. When K0010=1(i.e. the tool magazine is enabled), K0082 setting is disabled.
4. When K0082=0(i.e. the tool clamping/releasing device is no used), K0081 setting is disabled.
5. K006.0 setting:

   When two travel limit switches on X axis have been installed (the positive limit switch connects with X0.0, the negative limit switch connects with X 0.1) , K0060 set to 0 is enabled, and K007.0 setting is disabled.

   When one travel limit switch on X axis is installed (connecting with X0.0), k006.0 sets to 1 is enabled, If the X axis moves in the positive direction to the limit, the negative direction hard limit occurs.

   When the system alarms or X axis moves in the negative direction to the limit, the system alarms for the positive direction, when the K0070 is modified, the alarm reverses, namely, the error alarm is regulated.

   The settings ofK006.1 and K007.1 on Y axis, K006.2 and K007.2 on Z axis, K0063 and K0073 on the 4^{TH} axis are the same that of X axis.
6. K008.3=1: the lubricating ON/OFF time is controlled by the system, i.e. by regulating CTR101(lubricating OFF time: default: minute) and CTR102(lubricating ON time: default: second), when K008.3=0, the lubricating is not controlled by the system.
7. K0052=1, all alarm interlocks are released, and the system enters the debugging mode, which is used when the system is being tested, when the system run normally, the parameter is set to 0, otherwise, there may be the unexpected accidence.
8. Refer to ***the usage and maintain of tool magazine on chapter three*** for the parameter K0100, K0101, K0102, K0103, K0104, K0105, K0106, K0107, K0110, K0111
9. K004.0（When the spindle uses I/O control or not）=1: K008.4（whether the spindle has the gear change device or not?）setting is disabled, i.e. the spindle has no gear change device.
10. K015.0=0: the user should use the operator panel of GSK218M; k015.0=1: use that of GSK990MA.

Table 4 PLC external alarm definition

PLC alarm number	A address	Alarm content
1200	A000.0	Air pressure check abnormal
1201	A000.1	Lubricating check abnormal
1202	A000.2	Lubricating motor check abnormal
1203	A000.3	Cooling motor check abnormal
1204	A000.4	Chip removal motor check abnormal
1205	A000.5	Pressure oil pump check abnormal
1206	A000.6	Spindle cooling unit check abnormal
1207	A000.7	Machine tool light check abnormal
1208	A001.0	Machine tool control box check abnormal
1209	A001.1	Machine tool bed temperature check abnormal
1210	A001.2	Machine tool vibration check abnormal
1211	A001.3	Pressure oil temperature check abnormal
1212	A001.4	Oil pressure low
1213	A001.5	Machine not ready
1214	A001.6	Spindle gear can't rotate because of the abnormity
1215	A001.7	it is needed to execute T instruction before executing the M60
1216	A002.0	Do not rotate the spindle when the tool releases
1217	A002.1	The tool cannot release when the spindle rotates
1218	A002.2	reconfirm the tool number when the tool magazine stops abnormally
1219	A002.3	The spindle cannot rotate when the tool magazine is in the feed tool position
1220	A002.4	Spindle tool clamping check abnormal
1221	A002.5	Spindle tool releasing check abnormal
1222	A002.6	Spindle unit temperature check abnormal
1223	A002.7	Spindle speed check abnormal
1224	A003.0	Spindle motor enabling check abnormal
1225	A003.1	Spindle orientation in-position check abnormal
1226	A003.2	Spindle gear change abnormal
1227	A003.3	The tool magazine cannot rotate when it is not in the origin point
1228	A003.4	The tool magazine cannot execute the cycle start in the feed tool position
1229	A003.5	Set spindle tool number
1230	A003.6	The tool change cannot be executed when the spindle tool releases
1231	A003.7	The tool change cannot be executed when the tool magazine is in the retraction position
1232	A004.0	The tool magazine rotation in-position check abnormal
1233	A004.1	When the tool magazine rotates, the motor check is abnormal
1234	A004.2	The program stops run when the tool magazine is in the feed position
1235	A004.3	The tool magazine move in-position check abnormal
1236	A004.4	The tool magazine zero return check abnormal
1237	A004.5	It needs to execute the zero return when the tool magazine position lose
1238	A004.6	The feed in-position check abnormal
1239	A004.7	The retraction in-position check abnormal
1240	A005.0	The tool magazine executes the zero return because of the abnormal

1241	A005.1	The tool magazine feed check abnormal
1242	A005.2	The tool magazine retraction check abnormal
1243	A005.3	The tool magazine zero position setting is valid
1244	A005.4	Stop the abnormal tool change
1245	A005.5	There is no tool number or there is the repetitive tool number
1246	A005.6	The feed tool cannot be executed because it is not in tool change position
1247	A005.7	The tool magazine does not execute the infeed tool because the spindle does not perform the positioning
1248	A006.0	The tool magazine does not execute the retraction when the tool is released
1249	A006.1	The spindle with the tool does not execute the infeed tool
1250	A006.2	The spindle and the current tool number of tool magazine does not execute the infeed tool
1251	A006.3	Please cut off
1252	A006.4	The tool clamps and the Z axis cannot be moved
1253	A006.5	Debug the tool magazine carefully
1254	A006.6	The system does not execute the cycle start when the tool magazine is in the debugging mode
1255	A006.7	The clamped tool cannot return to the origin position
1256	A007.0	The clamped tool cannot return to the tool change position
1257	A007.1	The spindle cannot return to the tool exchange position
1258	A007.2	The tool magazine cannot return to the tool change position
1259	A007.3	The tool change cannot be executed because the T number abnormal
1260	A007.4	The cycle start cannot be executed when returning to the tool change position is executed manually
1261	A007.5	The retraction cannot be executed in the origin position
1262	A007.6	Exceed the safety position
1263	A0077	The cycle start cannot be executed in the debugging mode
1264	A0080	The spindle speed position mode conversion is abnormal
1265	A0081	The spindle position speed mode conversion is abnormal
1360	A020.0	Lubrication pressure low or oil level low

PLC alarm diagnosis:

Alarm information: 1200 the air pressure check is abnormal.
Fault cause: no
Troubleshooting: check the state of the X002.0

Alarm information: 1201 the lubricant check is abnormal.
Fault cause: defined by customer
Troubleshooting: no

Alarm information: 1202 the lubricating motor check is abnormal.
Fault cause: defined by customer
Troubleshooting: no

Alarm information: 1203 the cooling motor check is abnormal.
Fault cause: defined by customer
Troubleshooting: no

Alarm information: 1204 the chip removal motor check is abnormal.
Fault cause: defined by customer
Troubleshooting: no

Alarm information: 1205 the pressure oil pump motor check is abnormal.
Fault cause: defined by customer
Troubleshooting: no

Alarm information: 1206 the spindle cooling unit check is abnormal
Fault cause: defined by customer
Troubleshooting: no

Alarm information: 1207 the machine light check is abnormal.
Fault cause: defined by customer
Troubleshooting: no

Alarm information: 1208 the machine control box temperature check is abnormal.
Fault cause: defined by customer
Troubleshooting: no

Alarm information: 1209 the machine bed temperature check is abnormal.
Fault cause: defined by customer
Troubleshooting: no

Alarm information: 1210 the machine vibration frequency check is abnormal.
Fault cause: defined by customer
Troubleshooting: no

Alarm information: 1211 pressure oil temperature check is abnormal.
Fault cause: defined by customer
Troubleshooting: no

Alarm information: 1212 the oil pressure is low.
Fault cause: defined by customer
Troubleshooting: no

Alarm information: 1213 the machine is not ready.
Fault cause: defined by customer
Troubleshooting:

Alarm information: 1214 Spindle gear can’t rotate because of the abnormity
Fault cause: Spindle gear abnormity is detected when the spindle is rotated by the instruction.
Resolution: the gear 1 in-position detection switch (X0041) is not closed within the setting time of

T0021 when the spindle shifts for the gear 1（i.e. Y3.4=1）; adjust the T0021 setting time or check if X0041 is closed; the gear 1 in-position detection switch (X0042) isn't closed within the setting time of T0022 when the spindle shifts for the gear 2 (i.e. Y3.5=1), adjust the T0022 setting time or check if X0042 is closed; the gear 1 in-position detection switch (X0043) isn't closed within the setting time of T0023 when the spindle shifts for the gear 3 (i.e. Y3.6=1), adjust the T0023 setting time or check if X0043 is closed.

Alarm information: 1215 it is needed to execute the T instruction before executing the M60 instruction.
Fault cause:The valid T instruction isn't executed when executing the M60 instruction.
Troubleshooting: Execute the valid T instruction before executing the M60 instruction.

Alarm information: 1216 do not rotate the spindle when the tool releases.
Fault cause: execute the spindle rotating when the tool releases: in Manual mode, press the spindle CCW, CW, JOG, POSITIION, or execute M03,M04, M19 in AUTO mode, the spindle will rotate.
Troubleshooting: in Manual mode, press "CLAMP/RELEASE", and the tool is clamped (i.e. Y0.2=0) to check whether the tool clamp check switch (X2.6) is 1, when it is 1, the rotating spindle does not appear alarm.

Alarm information: 1217 the tool does not release when the spindle rotates.
Fault cause: the tool release instruction is executed when the spindle rotates.
Troubleshooting: when the spindle stops, the tool release instruction is executed to avoid the alarm.

Alarm information: 1218 reconfirm the tool number because the tool magazine abnormally stops.
Fault cause: M6 is executed when the tool magazine rotates, the alarm appears, or press "RESET", the alarm appears.
Troubleshooting: 1. the tool magazine executes the zero return.
2. set the spindle tool number and tool magazine number again.
(see ***chapter three*** for details)

Alarm information: 1219 the spindle cannot rotate when the tool magazine in the infeed position
Fault cause: the spindle rotation is executed when the tool magazine does not retract to the in-position.
Troubleshooting: execute the tool magazine returning to the retraction position (if the tool magazine has returned to the retraction position by X5.2.

Alarm information: 1220 the clamped tool corresponding to the spindle is abnormal.
Fault cause: when the tool is clamped(i.e.Y0.2=0), the tool magazine clamp check switch (X2.6) is not closed during the time set by T010.
Troubleshooting: 1. check whether the tool magazine clamp check switch is normal.
2. check whether Y0.2 outputs.
3. regulate again T010 setting time.

Alarm information: 1221 the released tool corresponding to the spindle is abnormal.
Fault cause: when the tool is clamped(i.e.Y0.2=1), the tool magazine clamp check switch

(X2.5) is not closed during the time set by T009.

Troubleshooting: 1. check whether the tool magazine release check switch is normal.
2. check whether Y0.2 outputs.
3. regulate again T009 time.

Alarm information: 1222 the spindle unit temperature check is abnormal
Fault cause: defined by customer
Troubleshooting: No

Alarm information: 1223 the spindle speed check is abnormal
Fault cause: Defined by customer
Troubleshooting: No

Alarm information: 1224 the spindle motor enabling check is abnormal.
Fault cause: Defined by customer
Troubleshooting: No

Alarm information: 1225 the spindle orientation in-position check is abnormal.
Fault cause: The spindle orientation check switch (X5.0) isn't closed within the setting time of T013 when the spindle is executing the positioning (i.e.Y2.1=1),
Troubleshooting: 1. The spindle driver or spindle encoder is normal.
2. Check whether Y2.1 outputs.
3. Regulate again T013 time.

Alarm information: 1226 the spindle gear is abnormal
Fault cause: the spindle gear abnormity is checked
Resolution: the gear 1 in-position detection switch (X0041) is not closed within the setting time of T0021 when the spindle shifts for the gear 1（i.e. Y3.4=1）; adjust the T0021 setting time or check if X0041 is closed; the gear 1 in-position detection switch (X0042) isn't closed within the setting time of T0022 when the spindle shifts for the gear 2 (i.e. Y3.5=1), adjust the T0022 setting time or check if X0042 is closed; the gear 1 in-position detection switch (X0043) isn't closed within the setting time of T0023 when the spindle shifts for the gear 3 (i.e. Y3.5=1), adjust the T0023 setting time or check if X0043 is closed.

Alarm information: 1227 the tool magazine which is not in the origin point cannot rotate.
Fault cause: The tool magazine is not in the retraction position and Z axis is not in the origin point, or press "MAG. CCW" or "MAG. CW", the alarm appears.
Troubleshooting: The tool magazine returns to the retraction position or Z axis returns to the origin point.

Alarm information: 1228 the tool magazine cannot execute the cycle start when it is in the infeed position
Fault cause: When the tool magazine is not in the retraction position, or press "CYCLE START" , the alarm appears.
Troubleshooting: The tool magazine returns to the retraction position

Alarm information: 1229 please set the spindle tool number
Fault cause: Press “CLAMP/RELEASE” when the tool number is 0, which causes the alarm appears.
Troubleshooting: the alarm only prompts the tool cannot be installed on the spindle but KAPA0110 is modified to shield the alarm when the tool number is 0

Alarm information: 1230 the tool change cannot be executed when the spindle tool is released.
Fault cause: M06 or M50 is executed when the tool is released (Y0.2=1),
Troubleshooting: ensure that the spindle is clamped(Y0.2=0).

Alarm information: 1231 the tool change cannot be executed when the tool magazine is not in the retraction position.
Fault cause: M06 or M50 is executed when the tool magazine is not in the retraction position.
Troubleshooting: ensure that the spindle is in the retraction position.

Alarm information: 1232 the tool magazine rotating in-position check is abnormal
Fault cause: Defined by customer
Troubleshooting: No

Alarm information: 1233 the tool magazine rotation motor check is abnormal
Fault cause: defined by customer
Troubleshooting: No

Alarm information: 1234 the program stops the run when the tool magazine is in the infeed position.
Fault cause: when the program is running, the tool is not in the retraction position, which causes the alarm.
Troubleshooting: Executed the program when the tool magazine is in the retraction position.

Alarm information: 1235 the tool magazine moving in-position check is abnormal
Fault cause: Defined by customer
Troubleshooting: No

Alarm information: 1236 the tool magazine zero return check is abnormal
Fault cause: defined by customer
Troubleshooting: No

Alarm information: 1237 the tool magazine needs to return to zero because its origin is lost.
Fault cause: When the tool magazine is performing the zero return, it is stopped abnormally to cause an alarm.
Troubleshooting: the tool magazine returns to the zero once again

Alarm information: 1238 the infeed in-position check is abnormal
Fault cause: Defined by customer
Troubleshooting: No

Alarm information: 1239 the retraction in-position check is abnormal.
Fault cause: Defined by customer
Troubleshooting: No

Alarm information: 1240 the tool magazine needs to return the zero again because it is abnormal.
Fault cause: 1. the tool magazine stops the rotation in the time set by T102, the system has checks that the tool magazine count switch9X5.3) abnormally creates the pulse signal.
2. when the tool magazine rotates, the system checks that the tool magazine count switch 0 or 1 exceeds the time set by T103.
Troubleshooting: 1. the tool magazine CCW or CW output part (Y3.0 Y3.1) is abnormal.
2. the tool magazine count switch is abnormal.
3. set T102 and T103 value again.
(See details for its operation in the 3rd Section The usage and maintenance for GSK 218M CNC system matching with the carousel-type tool magazine)

Alarm information: 1241 the tool magazine infeed check is abnormal
Fault cause: The tool magazine infeed check switch (X5.1) doesn't act within the setting time of T104 when the tool magazine executes the infeed action (i.e. Y3.2=1).
Troubleshooting: 1. Check if the tool magazine infeed check switch is normal.
2. Check if the Y3.2 outputs.
3. Adjust the T104 setting time again.

Alarm information: 1242 the tool magazine retraction check is abnormal
Fault cause: The magazine infeed detecting switch(X5.2) doesn't act within the setting time of T105 when the tool magazine performs the retraction action (i.e. Y3．3=1)
Troubleshooting: 1. Check if the tool magazine infeed check switch is normal.
2. Check if Y3.3 outputs.
3. Adjust the setting time of T105 again

Alarm information: 1243 the tool magazine zero setting is valid.
Fault cause: when the tool magazine has no zero return switch(i.e. K010.1=0), and K0106=1, the system alarms and prompts that the tool magazine zero setting is invalid.
Troubleshooting: set K0106 to 0.
(See details for its operation in the 3rd Section The usage and maintenance for GSK 218M CNC system matching with the carousel-type tool magazine)

Alarm information: 1244 stopping for abnormal tool change to ensure the magazine.
Fault cause: The tool change stops because of its abnormal run when the tool magazine is executing automatic tool change or it is checked not in the retraction position when starting the system, this alarm occurs, which only prompts that there may be the disorder of tool magazine and the spindle tool number, it is needed to reset the tool magazine and spindle tool number after clearing the alarm to ensure the tool magazine normal.
(See details for its operation in the 3rd Section The usage and maintenance for GSK 218M CNC system matching with the carousel-type tool magazine)

Troubleshooting: 1. when K001.2=1(i.e. clear the NO.1224 alarm by modifying the parameter), set the K011.3 (clear the message of the NO.1244 alarm) to 0, and then press RESET" to clear the alarm; when K011.2=0 (i.e. it is no need to modify the parameter to clear the NO.1244 alarm), press "RESET " to clear the alarm.
2. Readjust the tool magazine and confirm if the spindle tool number is congruous, including if the tool magazine has returned to the retraction position, if the spindle is clamped, if the current cutter head number is coincided with the current value of CTR100, if the spindle tool number is coincide with the value of D245, ensure there is no tool in the spindle.

Alarm information: 1245 there is no T tool number or repeated tool number in the tool list.
Fault cause: there is no tool number specified by T code or there is the repeated tool number specified by T code in the tool list (D001-D099).
Troubleshooting: modify the tool number value in the tool list.

Alarm information: 1246 the tool magazine cannot execute the tool change because it is not in the tool change position.
Fault cause: Z axis is not the tool change position, and the tool magazine infeed is executed.
Troubleshooting: execute G91G30Z0 to make Z axis return to the tool change position.

Alarm information: 1247 the tool magazine cannot execute the infeed because the spindle does not position.
Fault cause: the spindle does not position and the tool magazine infeed is executed.
Troubleshooting: position the spindle.

Alarm information: 1248 the tool magazine does not execute the retraction when the tool is released.
Fault cause: the retraction is executed when the spindle tool is released.
Troubleshooting: execute the retraction after the spindle tool is clamped.

Alarm information: 1249 the spindle with the tool cannot execute the infeed.
Fault cause: the infeed is executed when Z axis is in the origin and the spindle has the tool.(D245 is not 0)
Troubleshooting: dismount the tool on the spindle and set D245 to 0.

Alarm information: 1250 the infeed cannot be executed because the tool number on the spindle is not the same that of the current tool magazine.
Fault cause: Z axis is in the tool change position, and the infeed is executed when the tool number on the spindle is not the same that of the current tool magazine.
Troubleshooting: rotate the tool magazine to ensure that the tool number on the spindle is the same that of current tool magazine.

Alarm information: 1251 please turn off the power supply
Fault cause: the modified parameter is enabled after power-off.
Troubleshooting: restart the system.

Alarm information: 1252 Z axis cannot move because the tool is clamped.
Fault cause: when the tool is in the infeed position and the spindle tool is clamped, Z axis moves.
Troubleshooting: 1. the tool magazine is in the retraction position.
2. the spindle tool is released.

Alarm information: 1253 carefully operate the system because the tool magazine is in the debug mode.
Fault cause: When K0107 is set to 1, the system alarms, which prompts the tool magazine enters the debug mode, and which is not related to its other alarms and interlock signal, at this time, we should carefully operate the system, otherwise, there maybe damage the machinery.
Troubleshooting: press “RESET”.(Note: it doesn’t mean that the system is not in the tool magazine debug mode , it is need to set the K010.7 to 0 to exit the tool magazine debug mode)

Alarm information: 1254 the system cannot execute the cycle start
Fault cause: when K0107 is set to 1, the “CYCLE START” is pressed in AUTO or MDI or DNC mode, which causes the system alarms.
Troubleshooting: set K0107 to 0.

Alarm information: 1255 the tool cannot return to the origin point because it is clamped.
Fault cause: Z axis is executed to return to the origin point when the tool magazine is in the infeed position and the spindle tool is clamped.
Troubleshooting: 1. the tool magazine is in the retraction position.
2. the spindle tool is released.

Alarm information: 1256 the tool cannot return the tool change position because it is clamped.
Fault cause: Z axis is executed to return to the tool change position when the tool magazine is in the infeed position and the spindle tool is clamped.
Troubleshooting: 1. the tool magazine is in the retraction position.
2. the spindle tool is released.

Alarm information: 1257 the spindle cannot return the tool change position because the spindle does not position
Fault cause: Z axis is executed to return to the tool change position when the tool magazine is in the infeed position and the spindle is not positioned.
Troubleshooting: 1. The tool magazine is in the retraction position.
2. Position the spindle

Alarm information: 1258 the tool magazine cannot return to the tool change position because it is abnormal.
Fault cause: reserved
Troubleshooting: no

Alarm information: 1259 the tool change cannot be executed because the T tool number is

abnormal.
Fault cause: the error T instruction is executed before executing M06, (error T instruction means: there is no tool number specified by T code or there is the repeated tool number specified by T code in the tool list (D001-D099)).
Troubleshooting: Execute the M06 instruction after executing the correct T instruction.

Alarm information: 1260 the system cannot execute the cycle start because the manual tool change is executed.
Fault cause: when K0111 is set to 1(i.e. the manual tool change position return is valid), the 了 "CYCLE START" is pressed in AUTO or MDI or DNC mode, which causes the system alarms.
Troubleshooting: set K0111 to 0.

Alarm information: 1261 the tool cannot execute the retraction because it is not in the origin point.
Fault cause: the tool magazine retraction is executed when the tool magazine is in the infeed position and Z axis is not in the origin point.
Troubleshooting: the retraction is executed after Z axis returns to the origin point.

Alarm information: 1262 exceed the safety position.
Fault cause: Z axis exceeds the tool change position when the tool magazine is in the infeed position and Z axis moves.
Troubleshooting: move Z axis to the position between the tool change position and origin point.

Alarm information: 1263 the system cannot execute the cycle start when it is in the debug mode.
Fault cause: Defined by customer
Troubleshooting: No

Alarm information: 1264 the spindle position mode conversion is abnormal
Fault cause: when M29 is executed, the system has not received the spindle position mode completion signal in the time set by T24.
Troubleshooting: adjust T24 setting time or ensure the spindle position mode completion signal outputs

Alarm information: 1265 the spindle speed mode conversion is abnormal
Fault cause: when M28 is executed, the system has not received the spindle speed mode completion signal in the time set by T28.
Troubleshooting: adjust T28 setting time or ensure the spindle speed mode completion signal outputs

Alarm information: 1360 lubrication pressure low or oil level low
Fault cause:
Troubleshooting: check X001.7

Note: when the alarm is for "User definition" and there is no the alarm in the ladder, the user should modify the ladder to increase it.

Table 5 TMR parameter definition

Address	Statement	Initial value (ms)	Setting value by customer (ms)
T0001	Delay timer for spindle CCW completion	500	
T0002	Delay timer for spindle CW completion	500	
T0003	Delay timer for spindle gear change completion	500	
T0004	Delay timer for spindle positioning completion	0	
T0005	Delay timer for auxiliary function(M.S.T) completion	0	
T0006	Timer for spindle gear change check	500	
T0007	Delay timer for spindle tool release completion	0	
T0008	Delay timer for spindle tool clamp completion	0	
T0009	Time setting for spindle tool release check	8000	
T0010	Time setting for spindle tool clamp check	8000	
T0011	Pulse signal time 1 in 1 second	500	
T0012	Pulse signal time 2 in 1 second	500	
T0013	Time setting for spindle positioning check time	8000	
T0014	Time setting for spindle CCW check	500	
T0015	Time setting for spindle CW check	500	
T0016	Time unit setting for lubricating off	60000	
T0017	Time unit setting for lubricating on	1000	
T0018	Time setting for spindle positioning delay check	2000	
T0019	Delay timer for spindle JOG	2000	
T0020	Delay timer for program restart	10	
T0021	Delay timer for spindle gear 1	10000	
T0022	Delay timer for spindle gear 2	10000	
T0023	Delay timer for spindle gear 3	10000	
T0024	Check time of spindle speed position mode conversion	10000	
T0025	Completion time of M29 execution (enabled without check signal)	4000	
T0026	Positioning completion time in spindle position mode(enabled without check signal)	1500	
T0027	Completion time of M28 execution(enabled without check signal)	2000	
T0028	Check time of spindle position speed mode conversion	10000	
T0100	Delay time 1 for turret tool magazine manually rotating	2000	
T0101	Delay time 2 for turret tool magazine manually rotating	2000	
T0102	Delay check time setting for turret tool magazine stopping	2000	
T0103	Delay check time setting for turret tool magazine rotating	3000	
T0104	Delay check time setting for tool magazine infeed	10000	
T0105	Delay check time setting for turret tool	10000	

	magazine retraction		
T0106	Delay timer for turret tool magazine infeed completion	0	
T0107	Delay timer for turret tool magazine retraction completion	0	

Notes:

1. PLC pulse signal period is 1s, set T0011 and T0012 to 500.
2. T016 setting will change C101 unit. For example: C101 unit is 60000ms(i.e. 1m) when T0016 is set to 60000.
   T017 setting will change C102 unit. For example: C102 unit is 1000ms(i.e. 1s) when T0017 is set to 10000.

Table 6 DATA parameter definition

Definition	Statement	Setting value by customer
D000	Spindle tool number display	Cannot set
D001	No.1 tool number	
D002	No.2 tool number	
⋮	⋮	
D098	No.98 tool number	
D099	No.99 tool number	
D100	Tool magazine capacity	
D241	T code tool number	Cannot set
D243	Current cutter head number	Cannot set
D245	Spindle tool number	

Notes:

1. D100 setting value must be less than 100, and must be the same that of CTR100, otherwise, there may be the abnormal.
   For example: D100=16, the data table D001-D016 is valid.
   D100=24, the data table D001-D024 is valid.
2. D000 only displays the spindle tool number, the spindle tool number cannot be modified at the D000 but at the D245.
3. D241 value cannot be modified.
4. D240～D247 is used by the system and cannot be defined by the user.
5. See ***part three*** for the details.

Table 7 CTR parameter definition

Address	Statement	Initial value	Setting value by customer
C100	Tool magazine capacity setting	16	
C101	Automatic lubricating OFF time setting	30	
C102	Automatic lubricating ON time setting	30	

Notes:

1. CTR100 setting value must be less than 100 and must be the same that of D100, otherwise there may be the abnormal.

   For example: CTR100 =16, the total tool magazine number is 16.

   CTR100=24, the total tool magazine number is 24.

2. C101 unit is related to T0016.

   For example: T0016 is set to 60000, C101 unit is 1m, and C101 is set to 30, the lubricating OFF time is 30ms(minutes).

3. C102 unit is related to T0017

   For example: T0017 is set to 1000, C102 unit is 1s, and C102 is set to 10, the lubricating ON time is 10s.

Table 8 M code definition

M code	F signal	Function	Remark
M00	F031.7	Program pause	
M01	F030.4	Optional stop	
M02	F030.5	End of program	
M03	F030.0	Spindle CCW	
M04	F030.1	Spindle CW	
M05	F030.2	Spindle stop	
M06	F030.3	Automatic tool change	
M08	F031.0	Cooling ON	
M09	F031.1	Cooling OFF	
M10	F031.2	A axis clamp	Reversed
M11	F031.3	A axis release	Reversed
M16	F026.0	Spindle release instruction	Reversed
M17	F026.1	Spindle clamp instruction	Reversed
M18	F-00.1	Cancel the spindle exact stop	
M19	F026.2	Spindle exact stop instruction	
M21	F026.3	Search tool instruction when retraction	
M22	F026.4	Search tool instruction when startup the current tool	
M23	F026.5	Tool magazine forward	
M24	F026.6	Tool magazine backward	
M26	F0.27.5	Start chip removal hydrovalve	
M27	F0.27.6	Close chip removal hydrovalve	
M28	F032.3	Rigid tapping instruction cancel	
M29	F032.2	Rigid tapping instruction	
M30	F028.0	End of program	
M32	F031.4	Lubricating ON	
M33	F031.5	Lubricating OFF	
M35	F028.1	Start helical chip removal conveyor	
M36	F028.2	Close helical chip removal conveyor	
M40	F***.*.	X axis image	
M41	F***.*.	Y axis image	
M42	F***.*.	Z axis image	
M43	F***.*	Cancel image	
M44	F026.7	Start spindle blow	
M45	F027.0	Stop spindle blow	

M50	F027.1	Start automatic tool change	
M51	F027.2	End of automatic tool change	
M53	F027.3	Judge whether the tool is correct after the tool change is executed	Reversed
M55	F027.4	Judge whether the spindle has the tool	Reversed

Note:

1. "F***.*" and M instructions with “Reserved” in F signal table cannot be used.
2. M16, M17, M21, M22, M23 and M24 are valid when the tool change is being executed, and they cannot run separately.

3. Usage and maintenance of GSK 218M CNC System matching with turret tool magazine

Tool magazine preparation and use

1. Tool magazine installation and related PLC parameter setting

Operation aim: ensure the ladder fit to the allocation of tool magazine

A. requirements of the ladder matched with the turret tool magazine to the machine tool:

1. The machine tool has the spindle tool automatically clamping/releasing device which has the normally open in-position check switch.
2. The spindle has the positioning function and its positioning angle can be regulated.
3. The tool magazine capacity must be less than 100.
4. The tool magazine can execute CCW/CW.
5. The tool magazine has the count switch, forward in-position check switch, and retraction in-position check switch.
6. The tool magazine has zero return switch (optional).

B. Wire connection related to tool magazine

1）Input .

Address	Statement	Remark
X002.4	External clamp/release control	Selection
X002.5	Release check	Normally open contact
X002.6	Clamp check	Normally open contact
X005.0	Spindle orientation in-position	Normally-closed contact
X005.1	Tool magazine forward in-position	Normal open or normal close
X005.2	Tool magazine backward in-position	Normal open or normal close
X005.3	Tool magazine CCW/CW in-position	Normal open or normal close
X005.4	Tool magazine zero return in-position	Selection

2）. Output:

Address	Statement	Remark
Y000.2	Tool release/clamp	
Y002.0	Spindle enabling	

Y002.1	Spindle orientation	
Y003.0	Tool magazine CCW	
Y003.1	Tool magazine CW	
Y003.2	Tool magazine forward	
Y003.3	Tool magazine backward	

C. Tool magazine switch type and rotation in-position mode selection

Tool magazine no zero return switch set K010.1 to 0
Tool magazine zero return switch set K10.1 to 1
Tool magazine zero return switch is normal open set K010.2 to 0
Tool magazine zero return switch is normal close set K010.2 to 1
Tool magazine infeed switch is normal open set K010.3 to 0
Tool magazine infeed switch is normal close set K010.3 to 1
Tool magazine retraction switch is normal open set K010.4 to 0
Tool magazine retraction switch is normal close set K010.4 to 1
Tool magazine count switch is normal open set K010.5 to 0
Tool magazine count switch is close open set K010.5 to 1
Tool magazine rotation in-position A mode set K010.0 to 0
Tool magazine rotation in-position B mode set K010.0 to 1

Note:

1. K010.2 setting is disabled when K010.1 is set to 0.
2. The tool magazine rotation in-position A mode: when the tool magazine rotates the normal stop position, the tool magazine count switch has not responded the block(See Fig. A).
3. The tool magazine rotation in-position A mode: when the tool magazine rotates the normal stop position, the tool magazine count switch has responded the block (See Fig. B).

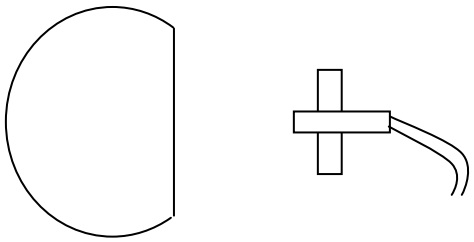


Fig. A

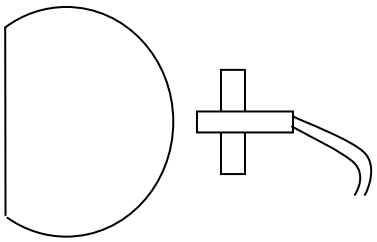


Fig. B

K010.1=0 K010.2=0 K010.3=0 K0104=0 K010.5=0 K010.0=0

For example: the tool magazine has no zero return switch, all check switches are normal open and the rotation in-position is A mode, the parameter setting is as follows:

K010.1=0 K010.2=0 K010.3=0 K010.4=0 K010.5=0 K010.0=0

D. tool magazine capacity setting

Input tool magazine capacity in DATA100 and CTR100

Notes:

1. The tool magazine capacity is defined that total tool magazine numbers in the tool magazine.
2. DATA100 and CTR100 setting values must be less than 100.

E. Tool number setting:

Data table D001-D099 separately correspond to the tool magazine number 1-99, and the setting values in the data table D001-D009 separately corresponds to the tool number in the tool magazine number 1-99. D245 is the spindle tool number.

Notes:

1. In D001-D099, there is no the same tool number(except for 0), otherwise the system alarms when the tool change is executed.
2. The tool number setting range meets the requirements set by the parameter 0206, otherwise the system alarm when the T instruction is executed.

For example: when the tool magazine capacity is 16:

When the tool magazine is set orderly to 1-16 in D1-D16, and T8M6 is executed, the tool change is executed after No. 8 tool magazine number will rotate to the tool change position.

When the tool magazine is set orderly to 10, 20, 30…160 in D1-D16, and T80M6 is executed, the tool change is executed after No. 8 tool magazine number will rotate to the tool change position

When D1 and D2 are set to 8, and T8M6 is executed, the system alarms.

F. Time parameter setting related to the tool magazine:

Address	Statement	Setting range	Initial value (ms)
T0004	Delay timer for spindle positioning	More than or equal to 0	0
T0007	Delay timer for spindle tool releasing completion	More than or equal to 0	0
T0008	Delay timer for spindle tool clamping completion	More than or equal to 0	0
T0009	Time setting for spindle tool r eleasing check	More than releasing tool time	8000
T0010	Time setting for spindle tool clamping check	More than clamping tool time	8000
T0013	Time setting for spindle positioning check	More than positioning time	8000
T0018	Time setting for spindle positioning delay check	Related to the positioning width	2000
T0100	Delay time 1 for turret tool magazine manually rotating	More than rotating one tool selection	2000
T0101	Delay time 2 for turret tool magazine manually rotating	More than rotating one tool selection	2000
T0102	Delay check time for turret tool magazine stopping	More than rotating one tool selection	2000
T0103	Delay check time for tool magazine rotating	More than rotating one tool selection	3000
T0104	Delay check time for turret tool magazine infeed	More than infeed time	10000

T0105	Delay check time for turret tool magazine retracting	More than retraction time	10000
T0106	Delay timer for turret tool magazine infeed completion	More than or equal to 0	0
T0107	Delay timer for turret tool magazine retraction completion	More than or equal to 0	0

Notes:

1. The above parameter(TMR) is related to the tool magazine type, the tool magazine speed and other performances. Please refer to the tool magazine performance to properly set the parameter.
2. when the above parameter (TMR) setting is not proper, the system alams to cause that the tool change is not executed normally.

The ladder match with the tool magazine after the above A-F steps are operated, but the tool magazine cannot normally run, the tool magazine executes the CCW, CW, infeed and retraction in Manual mode to check whether each operation of tool magazine is normal through the following No. 2 setting and operation(i.e. 2. Tool magazine manual and zero return operation).

1. Tool magazine manual and zero return operation

Operation aim: check whether the each operation of tool magazine is normal.

The detailed operation is as follows:

A. the tool magazine is enabled.

1. Because the tool magazine is turret, and the following bit parameter must be set. Bit parameter 53.0=1 bit parameter 53.1=0 bit parameter 53.2=0 bit parameter 53.3=0
2. KAPA parameter K001.0 of PLC is set to 1

B. Confirming the rotation direction of tool magazine

In Manual mode, press “MAG. CCW” and the tool magazine rotates according to the prescribed positive direction of machine tool, press “MAG. CW” and the tool magazine rotates according to the prescribed negative direction of machine tool, otherwise, the tool magazine count will be disorder to cause that the tool change is executed wrongly, which can be resolved by regulating the phase sequence of the motor.

C. Tool magazine zero return:

Tool magazine zero return operation is divided into zero return switch and no zero return switch.

1. The tool magazine has the zero return switch: press “MAG. ZERO” in “ZERO RETURN” mode, and the zero return is completed when the indicator is light(the light flashing indicates the tool magazine is executing the zero return.)
2. The tool magazine has no the zero return switch
   a. In Manual mode, press “CCW” or “CW” to make the No. tool magazine number rotate to the tool change position.
   b. set K010.6 to 1 in MDI mode.
   c. press “MAG. ZERO” in zero return mode until its indicator is light.
   d. set K010.6 to 0

2. Spindle positioning angle and tool change coordinate position regulation

A. the spindle positioning angle regulation refers to the explanation of spindle

driver.

B. Z axis has two positions including origin point and tool change position when the tool magazine executes the tool change.

The parameter 0047 must be set to 0 when the tool magazine returns to the origin point, otherwise, there maybe the accidence to damage the machine.

We can correctly execute the tool change through the above operations. Operating T and M instructions are as follows:

TxxM6; it has the same execution effect that of Txx;M6;

T0M6; the spindle tool retracts to the tool magazine.

Warning: the tool must not be installed on the spindle when the spindle tool number is 0, otherwise, there maybe the accidence when the tool change is executed to damage the machinery.

4. Macro program statement of GSK218M CNC System matching with turret tool magazine

Macro program statement of GSK218M CNC System matching with turret tool magazine

```
O91001;                          (program name)
G65 H81 P50 Q#1003 R1;           (M.S.T and machine are locked, execute N50, end of program )
G69 G50 G15 G80;                 (cancel the related modes)
M50;                             (start the tool change and check its conditions of tool change, if
                                  not, the system alarms.)
G65 H81 P40 Q#1001 R1;            (spindle tool number=T tool number: not execute the tool
                                  change but N40, end of program)
G65 H81 P20 Q#1000 R1;           (spindle tool number=0: the spindle has no tool, execute N20
                                  instead of the retraction tool instruction)
M19 G91 G30 Z0;                  (spindle positioning, return to the coordinate position of tool
                                  change)
M21;                             (retraction-> tool magazine rotating tool magazine forward
                                  spindle releasing )
N20 M19 G91 G28 Z0;              (return to machine's origin point)
G65 H81 P30 Q#1002 R1;           (T code tool number=0: not execute the tool search but N30)
M22;                             (tool search ->tool magazine rotating tool magazine forward
                                  spindle releasing tool)
G91 G30 Z0;                      (return to coordinate point of tool change)
N30 M17;                         (spindle clamping tool)
M24;                              (tool magazine retraction)
N40 M51;                         (end of tool change)
N50 M99;                         (end of program)
%
```

Appendix 2

Configuration file format of ladder

The signal in configuration file **LadChixx.txt** of ladder **("xx" corresponds with the running ladder file number set by system)** stores the following information by fixed sequence:

一、F signal and meaning for M00-M99 of M code

Format: MXX + space + Fyyyy + space + Chinese notes + EOB symbol(enter)
Example: "M00 F0317 program dwell"
Thereinto: "xx" from up to down is 00\01\02\.. till to 99, it totals 100. and its sequence cannot be altered.
"Space" generally includes one Space, which cannot be adulterated by any other characters.

"**yyyy**" means a value to F signal by M code, i.e. **F0317** represents **F31.7**". it may set from 0260 to 0337 (i.e. F signal from 26.0 to 33.7). if it is set to "**-001**" , it means no registration is allowed and it cannot be identified by system.
"Chinese remark" contains up to 32 characters, it may has 16 Chinese characters or equivalent Chinese characters + characters. The following is same as this.

"EOB symbol" means the end of the line and the characters following will not be identified. The following is same as this.

二、"%" that occupies a line exclusively means the end of M code information storage.

三、The codes and meaning of X signal X0.0-X6.7

Format: Xxxxx + space + Chinese remark + EOB symbol (enter)
Example: "**X0000** X axis positive stroke limit signal"
Thereinto: "**xxxx**" means the value of X signal, i.e. "**000**0 for **0.0**"，"**0067** for **6.7**". and it is from 0000 to 0067 from up to down(i.e. X signal from 0.0 to 6.7), its sequence can't be altered.
"Space" generally includes 5 spaces, which cannot be adulterated by any other characters. The following is same as this.

四、The codes and meaning of Y signal Y0.0---Y5.7

Format: Yxxxx + space + Chinese notes + EOB symbol(enter)
Example: "**Y0000** Z axis holding"
Thereinto: "**xxxx**" means the value of Y signal, i.e. "**000**0 for **0.0**"，"**0057** for **5.7**". and it is from 0000 to 0057 from up to down(i.e. Y signal from 0.0 to 5.7), its sequence can't be altered.

五、The codes and meaning of K signal Y6.0---Y63.7

Format: Kxxxx + space + Chinese remark + EOB symbol(enter)

Example: "**K0060** If X axis stroke switch is 1"

Thereinto : "**xxxx**" means the value of K signal, i.e. "**006**0 for **6.0**"，"**0637** for **63.7**". and it is from 0060 to 0637 from up to down(i.e. K signal from 6.0 to 63.7), its sequence can't be altered.

"Space" generally includes 5 spaces, which cannot be adulterated by any other characters.

六、The codes and meaning of A signal A0.0-A31.7

Format: Axxxx + space + Chinese notes + EOB symbol(enter)

Example: "**A0000** air pressure detection abnormal"

Thereinto: "**xxxx**" means the value of A signal, i.e. "**000**0 for **0.0**"，"**0317** for **31.7**". and it is from 0000 to 0317 from up to down(i.e. A signal from 0.0 to 31.7), its sequence can't be altered.

"Space" generally includes 5 spaces, which cannot be adulterated by any other characters.

七、end//end sign

Note: Every line of above information should be written in a set form, refer to system embedded file LadChixx.txt for details. The English files LadEng01.txt contains 32 English characters or words.