This Manual is the PLC manual of the CNC System developed and manufactured by GSK CNC Equipment Co., Ltd.

In this Manual, we will endeavor to describe various matters related to the operation of this series of CNC systems. It is not possible to describe in detail all the operations that need not be done and/or cannot be done in the system due to length constraints and specific product usage. Therefore, anything not specifically indicated in this Instruction Manual shall be deemed to be the operation that is "impossible" or "not permitted".

Preface

Dear Customers:

We are honored and grateful to you for choosing CNC System from GSK CNC Equipment Co., Ltd.

This manual is the PLC Manual part of the CNC System user manual. It introduces the PLC use instructions, signal descriptions, programming and GSKLadder software of the CNC System in detail.

Please read this manual carefully before installing and using the series products in order to ensure the product safety and the normal and valid operation.

Safety Warnings

Improper operation will lead to accidents, thus personnel with appropriate qualifications are required to operate the system.

Special Tip: **The power supply installed on (in) the chassis is specially provided for the CNC Systems manufactured by our company.**

Users are not allowed to use this power supply for other purposes. Otherwise, great danger will be caused!

Statement!

- **This manual describes as many different things as possible, but it is not possible to describe all the things that can or cannot be done due to many possibilities involved. Therefore, the content that is not specifically explained in this manual can be regarded as unusable.**

Warnings!

- **Before installing, connecting, programming and operating this product, you must read the product manual and the manual of the machine tool manufacturer in detail, and perform related operations in strict accordance with the requirements of this manual and manual. Otherwise it may cause damage to the product, machine tool, scrapped work piece or even personal injury.**

Note!

- **The product functions and technical indicators (such as accuracy, speed, etc.) described in this manual are only for this product. The actual function configuration and technical performance of CNC machine tool are determined by the design of the machine tool manufacturer, which are subject to the instruction manual of the machine tool manufacturer.**

The content of this manual is subject to change without notice!

Important Notice

■ Transport and Storage

- **Product packing boxes shall not be stacked more than six layers;**
- **Do not climb, stand or place heavy objects on product packing boxes;**
- **Do not use cables connected to the product to drag or carry the products**
- **Do not collide or scratch the panel and display screen;**
- **Product packing boxes shall be protected from dampness, exposure to the sun and rain.**

■ Unpacking Inspection

- **Please confirm whether it is the product you purchased after opening the package;**
- **Check whether the product is damaged in transit;**
- **Confirm whether the components are complete and damage according to the list;**
- **Please contact our company in time in case of product model inconsistency, missing accessories or transport damage.**

■ Wiring

- **Participants in wiring and inspection must be competent professionals;**
- **The product must be grounded reliably, with the grounding resistance no greater than 0.1 Ω. Neutral wire shall not be used instead of grounding wire;**
- **The wiring must be correct and firm so as not to cause product failure or unintended consequences;**
- **Surge absorbing diodes must be connected to the product in the specified direction, otherwise the product will be damaged;**
- **The product must be powered off before plugging or unplugging or opening the product chassis.**

■ Overhaul

- **Power supply must be cut off before repairing or replacing components;**
- **The failure must be checked in case of short circuit or overload, and it can be restarted after troubleshooting;**
- **The power to the product shall not be frequently turned on or off. The interval shall be at least 1 min if re-energization is required after power-off.**

Safety Responsibility

Manufacturer's Responsibility for Safety

-------The manufacturer shall be responsible for the hazard of the supplied CNC System and accompanying accessories that have been eliminated and/or controlled in design and structure.

-------The manufacturer shall be responsible for the safety of the supplied CNC System and accompanying accessories.

-------The manufacturer shall be responsible for the use information and advice provided for the user.

Users' Responsibilities for Safety

------Users shall be familiar with and master the safe operation through learning and training of safe operation of CNC System.

-------Users shall be responsible for the safety and hazards as a result of adding, changing or modifying the original CNC System and accessories by themselves.

-------Users shall be responsible for any hazard caused by failure to operate, adjust, maintain, install, store and transport the products in accordance with the Manual.

This manual shall be kept by final users.

Thank you very much for using the products of GSK CNC Equipment Co., Ltd. and for your friendly support of our company!

Contents

Chapter 1 PLC Instructions

1.1 PLC specifications

PLC system version	PLC-N5
Programming language	Ladder diagram
Programming software	GSKLadder
Program level	2
Execution cycle of level 1 program	8ms
Average processing time of basic command	<2μs
Maximum number of steps	5000 steps
Programming commands	Basic commands + Function commands:

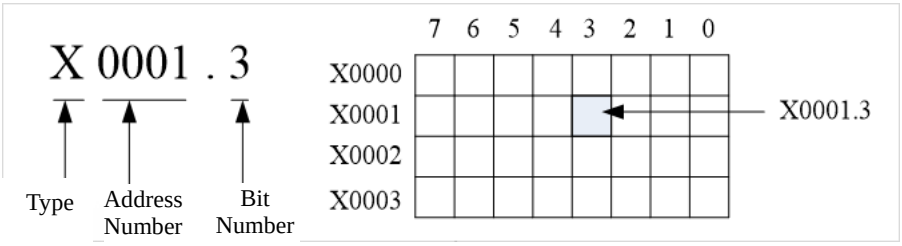
PLC Address	PLC Address Range	PLC Address Data Length	Note
Internal relay address (R)	R0～R999	1 byte	Read/Write
Information display request signal (A)	A0～A49	1 byte	Read/Write
Timer address (T)	T0～T199	4 bytes	Read only
Counter address (C)	C0～C199	4 bytes	Read only
Data sheet address (D)	D0～D999	4 bytes	Read/Write
Holding relay address (K)	K0～K39	1 byte	Read/Write
Counter preset value address (DC)	DC0～DC199	4 bytes	Read/Write
Timer preset value address (DT)	DT0～DT199	4 bytes	Read/Write
Subprogram address (P)	P0～P9999		Not accessible
Tag address (L)	L0～L9999		Not accessible
Address of Machine → PLC (X)	X0～X127	1 byte	Read only
Address of PLC → Machine (Y)	Y0～Y127	1 byte	Read/Write
Address of CNC→PLC (F)	F0～F511	1 byte	Read only
Address of PLC→CNC (G)	G0～G511	1 byte	Read/Write

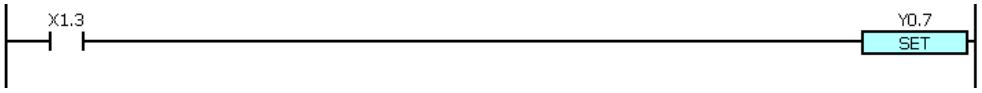
1.2 PLC address

The PLC's address read data is divided into two types: bit value and byte value. The byte value is divided into single-byte, double-byte and four-byte value. The following is a description of these types of values.

Value by bit, used to read the status of a bit in the PLC address space. For example, the input and output status of external I/O points, or the bit status in a certain process. The PLC bit address is composed of address type, address number and bit number.

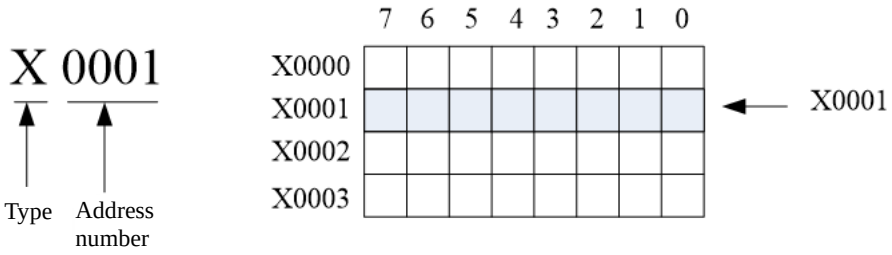
For example: X0001.3 means the status of the 3rd bit of the PLC external input X0001.





Value by byte, used to read the data stored in a single address or consecutive addresses in the PLC address space. For example, obtain the value of PLC data parameter D. The byte address of PLC is composed of address type and address number.

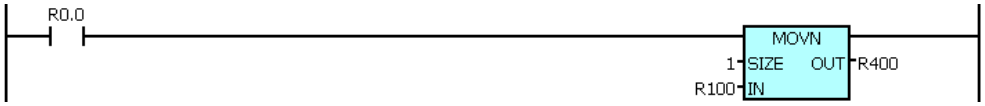
For example: X0001 means the address of PLC external input X0001 (data length is 8 bits).



There are three forms of PLC address value by byte. The following is an example to explain it.

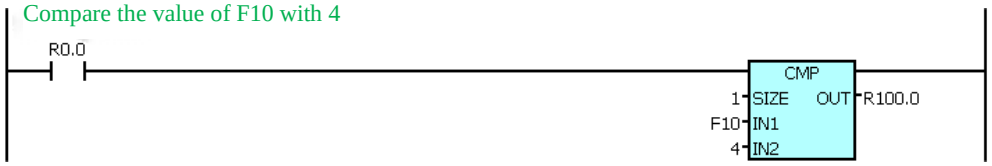
- Single-byte

  For example:



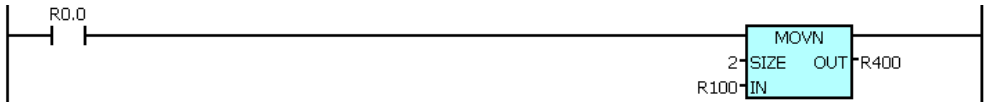
or

Compare the value of F10 with 4



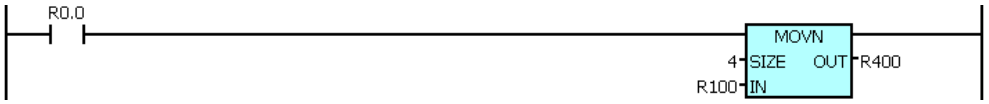
- Double byte

  For example:

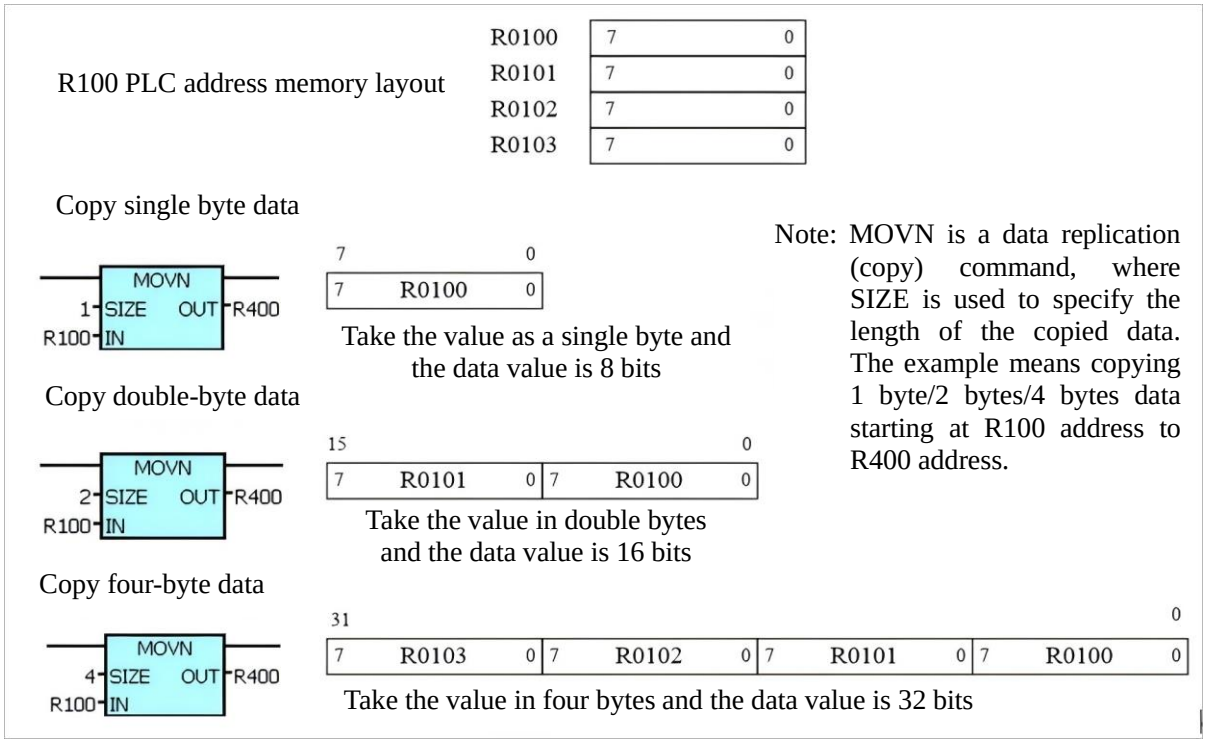


- Four-byte value

  For example:



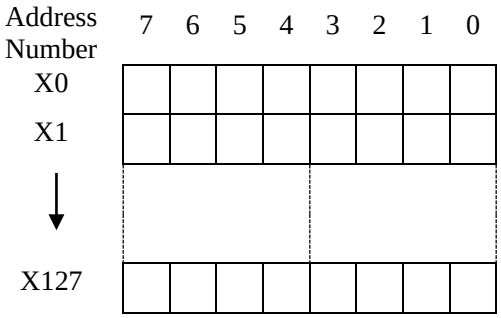
The data obtained under the three value methods are shown in the figure below.



Note: For a four-byte address (DT, DC, D, T, C), the data length in an address is 4 bytes. When being valued by byte, the length (SIZE) is generally specified as 4 in the PLC instruction. The output data value is 32 bits (binary representation); if the specified length is 1 or 2, then the truncated data will be fetched. For the specified length of 1 byte, take the low 8 bits of the 32-bit address; if the specified length is 2 bytes, take the low 16 bits of the 32-bit address.

1.2.1 X-address (Machine → PLC)

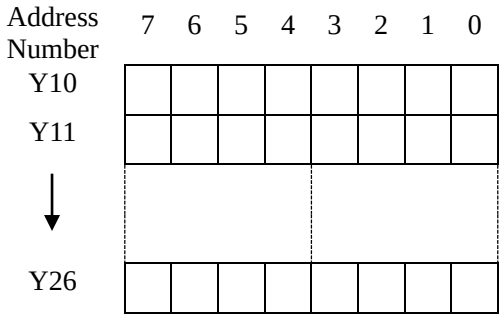
X addresses of system are divided into three types: The first type of address (X0.0～X0.7) is mainly allocated to the fast I/O port of CNC, Including fixed addresses (such as external emergency stop port X0.5) and definable addresses for the input of external machine tool signals; The second type of address (X10.0～X26.7) is assigned to the input keys of the machine tool panel; The third type of address (X30.0～X127.7) is allocated to the ordinary I/O port. The X address is a read-only address. The X address is a single-byte address, and the data length is 8 bits.



Note: In the X address space of the PLC, only the X address defined by the CNC can be read, otherwise it is meaningless.

1.2.2 Y-address (PLC→ Machine)

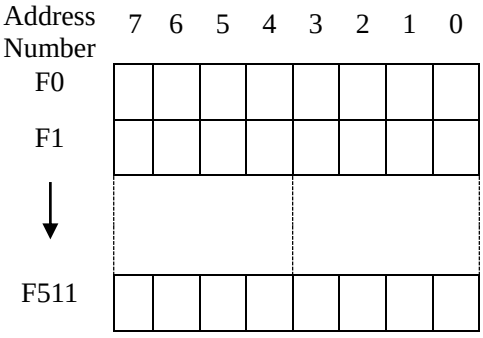
The Y addresses of CNC are divided into two types: the first type of address (Y30.0～Y127.7) is mainly allocated to the CNC I/O ports, which are all definable addresses; the second type of address (Y10.0～Y26.7)) is assigned to the machine tool panel. The Y address is a single-byte address, and the data length is 8 bits.



Note: In the Y address space of the PLC, only the Y address defined by the CNC can be read, otherwise it is meaningless.

1.2.3 F-address (CNC→PLC)

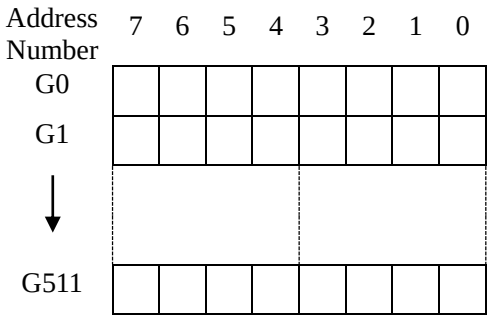
The F address is a read-only address and its address range is F0～F511. It is a single-byte address and the data length is 8 bits.



See the appendix of this manual for detailed function definition of F address.

1.2.4 G-address (PLC→CNC)

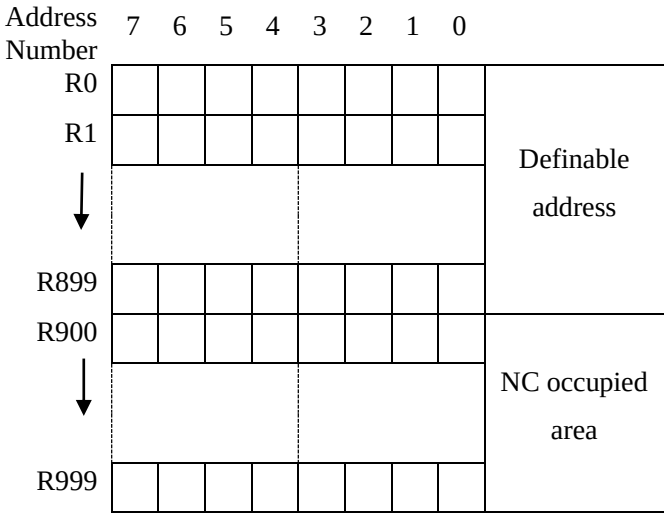
The G address range is from G0 to G511, which is a single-byte address, and the data length is 8 bits.



See the appendix of this manual for detailed function definition of G address.

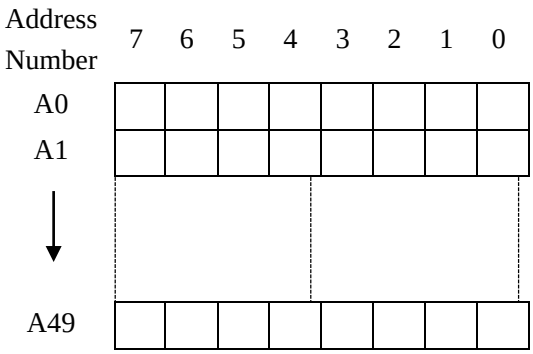
1.2.5 Internal relay address (R)

The address range is R0～R999, it is a single-byte address, and the data length is 8 bits. This address area is cleared when the CNC is powered on.



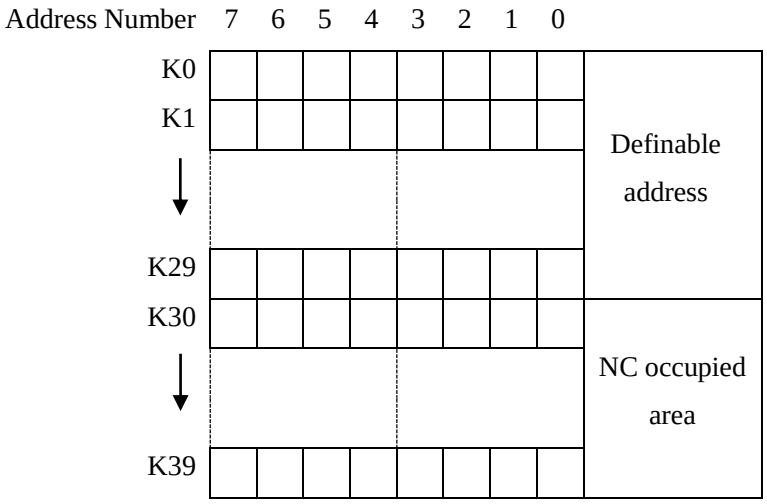
1.2.6 Information display request signal (A)

The address range is A0～A49, which is a single-byte address, and the data length is 8 bits. This address area is cleared when the CNC is powered on and used for PLC alarms.



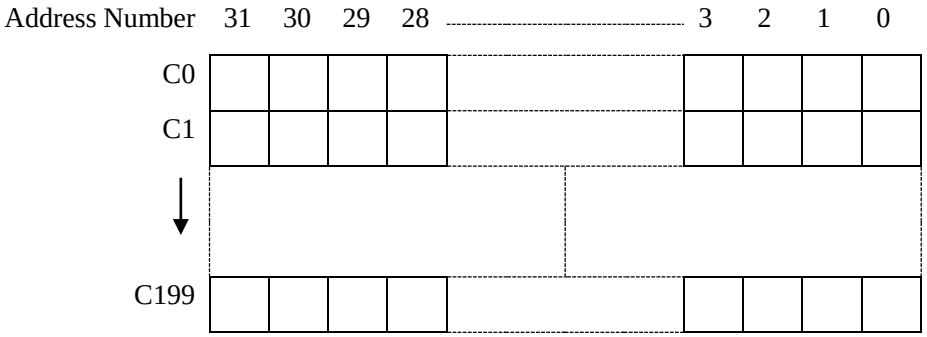
1.2.7 Holding relay address (K)

This address area is used for holding relays and setting PLC parameters. The data is saved when power off. The address range: K0～K39, which is a single-byte address, and the data length is 8 bits.



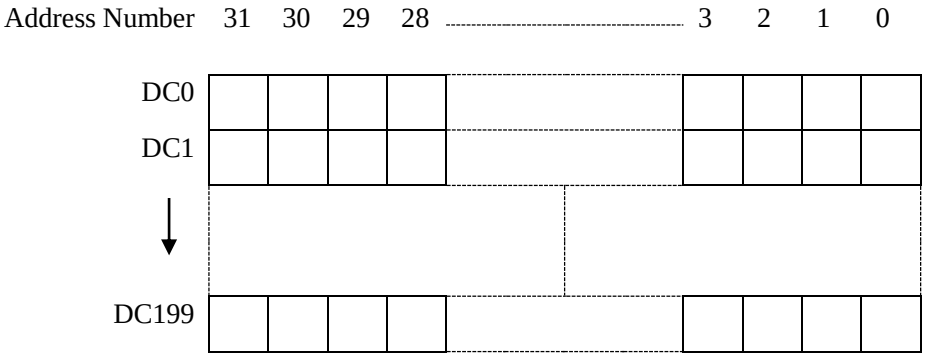
1.2.8 Counter address (C)

This address area is used to store the current count value of the counter. The data in this area is saved when power is off. The address range is C0～C199. Ranges: 0～2, 147, 483, 647.



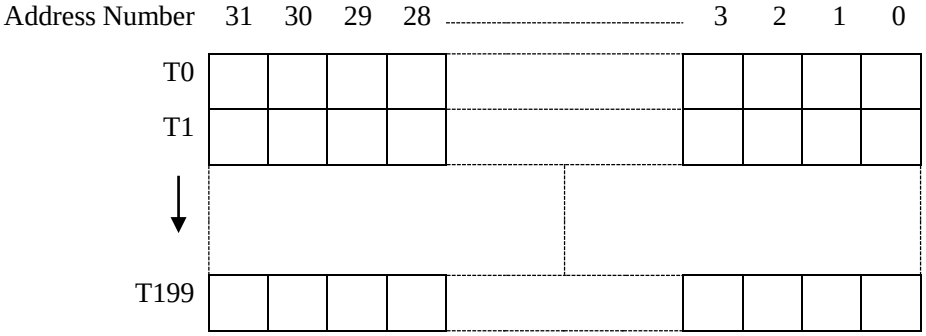
1.2.9 Counter preset value address (DC)

This address area is used to store the counter preset value, and the data is saved when power is off. The address range is DC0～DC199, the data length is 32 bits, and the value range is: -2, 147, 483, 648～2, 147, 483, 647.



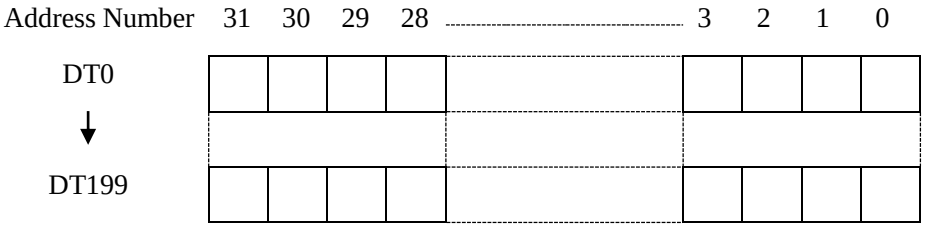
1.2.10 Timer address (T)

This address area is used to store current value of the timer, and the data is saved when power is off. Address range: T0～T199; Data length is 32 bits; Value range: 0～2, 147, 483, 647.



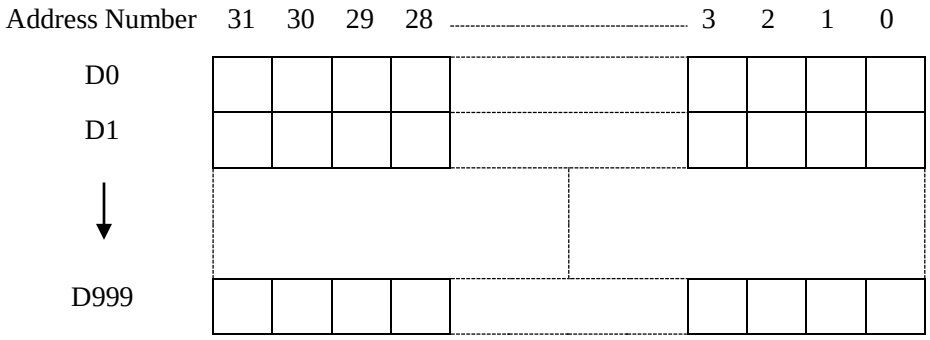
1.2.11 Timer preset value address (DT)

This address area is used to store the timer preset value, and the data is saved when power is off. Address range: DT0～DT199; data length is 32 bits; value range: 0～2, 147, 483, 647.



1.2.12 Data sheet address (D)

The address data of the data sheet is saved when power-off. Address range: D0～D999; data length is 32 bits; value range: -2, 147, 483, 648～2, 147, 483, 647.



1.2.13 Tag address (L)

Used to specify the jump target label in JMPB and the label of LBL.

It is forbidden to directly access the L address in the PLC. The L address can only be used in the PLC s function commands JMPL and LBL. L address range: L0～L9999.

1.2.14 Subprogram number (P)

Used to specify the target subprogram number called in CALL and the subprogram number of SP.

It is forbidden to directly access the P address in the PLC. The P address can only be used in the PLC function commands SP and CALL. P Address Range: P0～P9999.

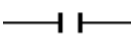
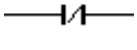
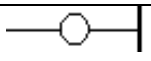
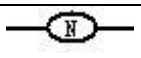
1.3 Basic commands of PLC

Basic commands are the most commonly used when designing the sequential program, which perform one-bit operation. The basic commands of this CNC are as follows.

Command Name	Function	Operable Elements
LD	Read normally open contact status	X, Y, F, G, R, K, A
LDI	Read normally closed contact status	X, Y, F, G, R, K, A
OUT	Drive output coil	Y, G, R, K, A
OUTN	Drive the output coil when the condition is not met	Y, G, R, K, A
AND	Normally open contacts in series	X, Y, F, G, R, K, A
ANI	Normally closed contacts in series	X, Y, F, G, R, K, A
OR	Normally open contacts in parallel	X, Y, F, G, R, K, A
ORI	Normally closed contact in parallel	X, Y, F, G, R, K, A
ORB	Parallel connection of series circuit	N/A.
ANB	Series connection of parallel circuit blocks	N/A.
MPS	Logical result into the stack	N/A.
MRD	Read the logic result at the top of the stack	N/A.
MPP	Pop up logical result stack top	N/A.

1.3.1 LD, LDI, OUT, OUTN

- Mnemonic symbol and function

Mnemonic Symbol	Function	Ladder Diagram Symbol
LD	Read normally open contact status	
LDI	Read normally closed contact status	
OUT	Drive output coil	
OUTN	Output not	

- Command description

A: LD and LDI commands are used to connect the contacts to the bus. Other usages are combined with the ANB command described later, and can also be used at the starting point of the branch.

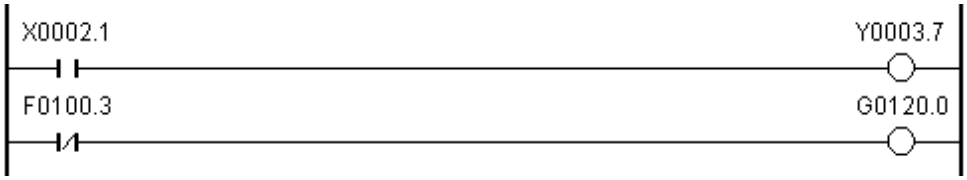
B: OUT command is the one to drive output relay and internal relay coil. Cannot be used for input

relays.

C: Parallel OUT commands can be used continuously for many times.

D: OUTN command inverts the driving condition, and other use methods are the same as OUT.

- Programming example



Program description

Take the state of X2.1, if it is 1, output Y3.7.

Take the status of F100.3, if it is 0, output G120.0.

1.3.2 AND, ANI

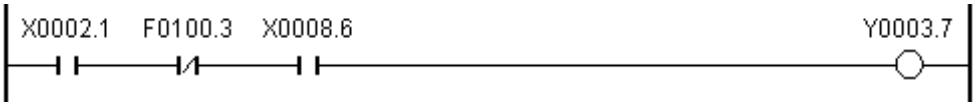
- Mnemonic symbol and function

Mnemonic Symbol	Function	Ladder Diagram Symbol
AND	Normally open contacts in series	
ANI	Normally closed contacts in series	

- Command description

1 contact can be connected in series with AND and ANI. There is no limit to the number of series contacts, and the commands can be used multiple times.

- Programming Example



Program description

Take the state of X2.1.

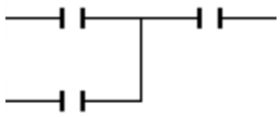
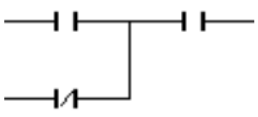
Take the state of F100.3 and the state of X2.1 in series.

Take the state of X8.6 in series with the first two.

If X2.1 and X8.6 are 1, and F100.3 is 0, Y3.7 is output.

1.3.3 OR, ORI

- Mnemonic symbol and function

Mnemonic Symbol	Function	Ladder Diagram Symbol
OR	Normally open Contacts in Parallel	
ORI	Normally closed contact in parallel	

- Command description

  A: 1 contact can be connected in parallel with OR and ORI command. If there are two or more contacts connected in series and this series circuit block is connected in parallel with other circuits, use the ORB command described later.

  B: OR, ORI refers to a parallel connection with above-mentioned LD and LDI command steps from this command step.

- Programming example

Program description:

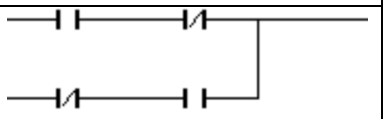
Take the state of X2.1.

Take the state of F100.3 in parallel with X2.1.

When X2.1 is 1 or F100.3 is 0, Y3.7 is output.

1.3.4 ORB

- Mnemonic symbol and function

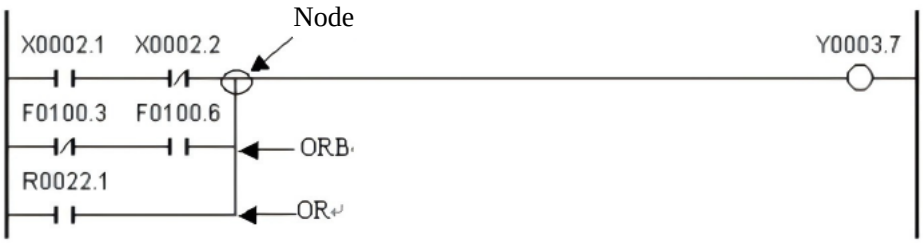
Mnemonic Symbol	Function	Ladder Diagram Symbol
ORB	Parallel connection of series circuit	

- Command description

  A: A circuit connected in series by two or more contacts is called a series circuit block. When connecting serial circuit blocks in parallel, use the LD and LDI command for the start of the branch, and use the ORB command for the end of the branch.

  B: ORB is an independent command without address.

- Programming example



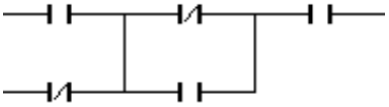
Program description

As shown in the figure, there are three branches from the left busbar to the node. The first and second branches are series circuit blocks. When there are parallel-connected series circuit blocks between the busbar and the node or between nodes, the ORB instruction shall be used at the end of all branches except the first one. The third branch is not a series circuit block, so the OR instruction is sufficient.

ORB and ANB are commands with no operating elements and mean OR-AND relationship between circuit blocks.

1.3.5 ANB

- Mnemonic symbol and function

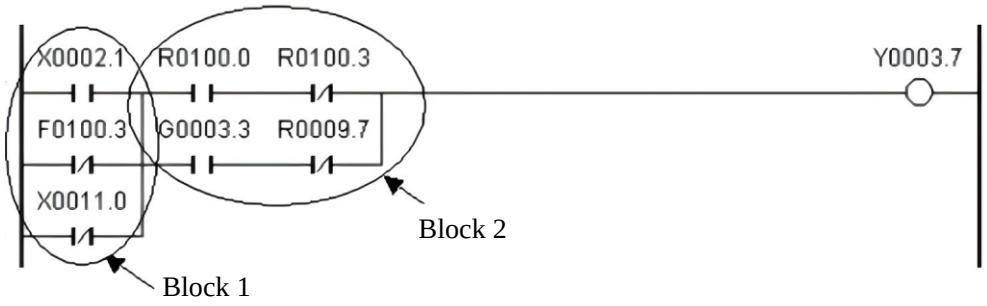
Mnemonic Symbol	Function	Ladder Diagram Symbol
ANB	Series of parallel circuits	

- Command description

A: ANB is used when the branch circuit (parallel circuit block) is connected in series with the preceding circuit. The starting point of the branch uses LD and LDI. After the parallel circuit block is finished, ANB is used to connect with the preceding circuit in series.

B: ANB is an independent command without address.

- Programming example



Program description

As shown in the above ladder diagram, ORB represents the parallel connection of the series circuit blocks in block while ANB represents the series connection of the circuit block 1 and the circuit block 2.

1.3.6 MPS, MRD, MPP

The PLC in the system supports multi-level output.

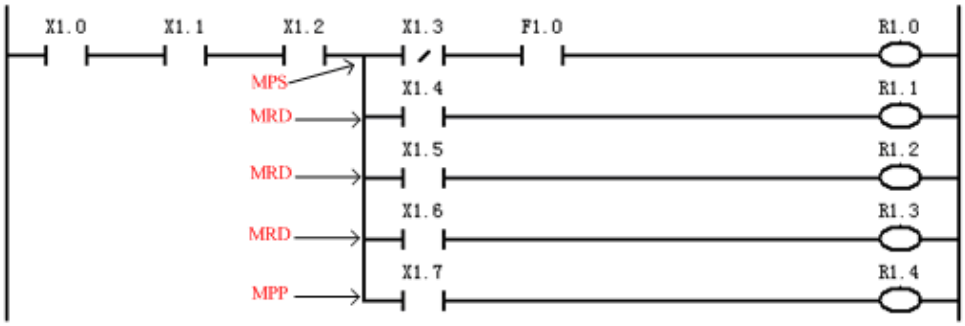
(1) MPS (into the stack instruction): The result of the operation into the first segment of the stack memory, while the previously sent data to move to the next section of the stack.

(2) MRD (read stack instruction): the first paragraph of the stack memory data (last into the stack of data) read and the data continues to be stored in the first paragraph of the stack, the data in the stack does not move.

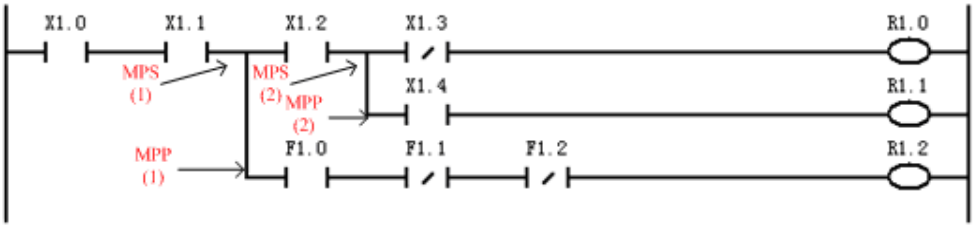
(3) MPP (out of the stack instruction): The stack memory of the first piece of data (the last stack of data) read and the data from the stack disappeared, while the other data in the stack in turn up.

The information after being pushed into the stack can be used indefinitely, and it is popped out using the MPP instruction last time.

The below figure is a 1-layer stack.



The below figure is a 2-layer stack.



Instructions for the use of stack instructions:

1) The stack instruction has no target element;

2) MPS and MPP must be paired to use.

1.4 Function instructions of PLC

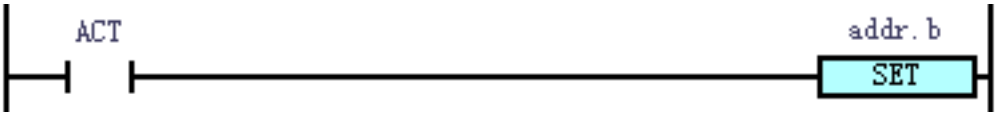
When it is difficult to complete certain functional requirements using basic commands, function instructions can be used to achieve it. The PLC has the following function commands.

1	SET	Set
2	RST	Reset
3	CMP	Compare set
4	CMPR	Real number comparison
5	TMRB	Timer
6	TMRC	Timer 2
7	CTRC	Binary counter
8	MOVN	Binary data replication
9	MOVR	Real number replication
10	DECB	Binary decoding
11	CODB	Binary code conversion
12	JMPB	Label jump
13	LBL	Label
14	CALL	Subprogram call
15	CALLU	Call subprogram unconditional

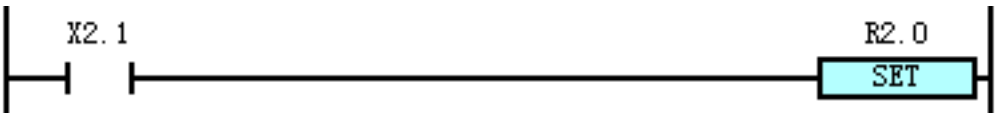
16	ROTB	Binary rotation control
17	PARI	Odd-even check
18	ADDB	Binary addition
19	ADDR	Real number addition
20	SUBB	Binary subtraction
21	SUBR	Real number subtraction
22	DIFU	Set on rising edge
23	DIFD	Set on falling edge
24	ALT	Alternate output
25	MOVE	Logical multiplication
26	WAND	Binary byte and
27	WOR	Binary data or
28	WXOR	Binary data xor
29	WINV	Binary data inversion
30	WSHL	Binary data shift left
31	WSHR	Binary data shift right
32	MULB	Binary multiplication
33	MULR	Real number multiplication
34	DIVB	Binary division
35	DIVR	Real number division
36	WINDR	Read CNC window function
37	AXCTL	PLC control axis
38	XMOV	Binary index data transmission
39	DSCHB	Data retrieval
40	PSGNL	Position signal output
41	PSGN2	Position signal output 2
42	ZCP	Area comparison command
43	SIN	Sine calculation
44	COS	Cosine calculation
45	TAN	Tangent calculation
46	SQRT	Square root calculation
47	DTR	Double integer to real
48	ROUND	Rounding real number to integer

1.4.1 SET (Set)

- Command function
  Set 1 to the specified address.
- Ladder diagram format



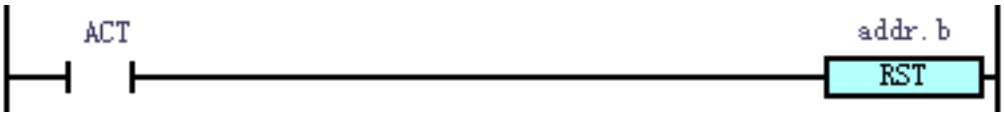
- Control conditions
  ACT=0: the state of addr.b remains unchanged.
  =1: addr.b is set to 1.
- Relevant parameters
  addr.b: set component address bit, which can be contact or output coil, addr= Y, G, R, K, A.
- Program example



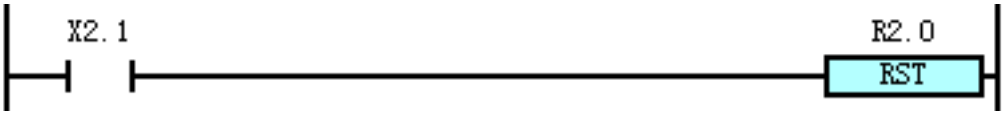
Note: when X2.1 is 1, R2.0 is set to 1, and when X2.1 is 0, the state of R2.0 remains unchanged.

1.4.2 RST (Reset)

- Command function
  Set 0 to the specified address.
- Ladder diagram format



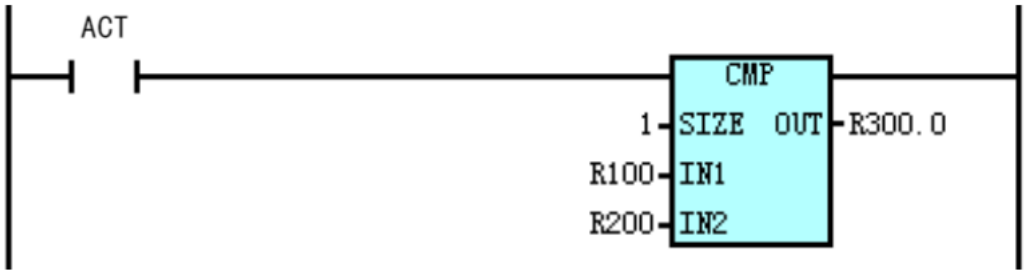
- Control conditions
  ACT=0: the state of addr.b remains unchanged.
  =1: addr.b is set to 0.
- Relevant parameters
  addr.b: reset component address bit, which can be contact, output coil, addr= Y, G, R, K, A.
- Program example:



Note: when X2.1 is 0, the state of R2.0 remains unchanged; when X2.1 is 1, R2.0 is set to 0.

1.4.3 CMP (Binary data comparison)

- Command function
  Compare the size of two binary data and output the comparison result.
- Ladder diagram format



- Control conditions

  Assuming that the address of OUT is represented by addr.b, then

  ACT=0: addr.b keeps the original value

  =1: compare the sizes of IN1 and IN2, and the output results are as follows.

	addr.(b+2）	addr.(b+1）	addr.(b+0）
IN1> IN2	0	0	1
IN1= IN2	0	1	0
IN1< IN2	1	0	0

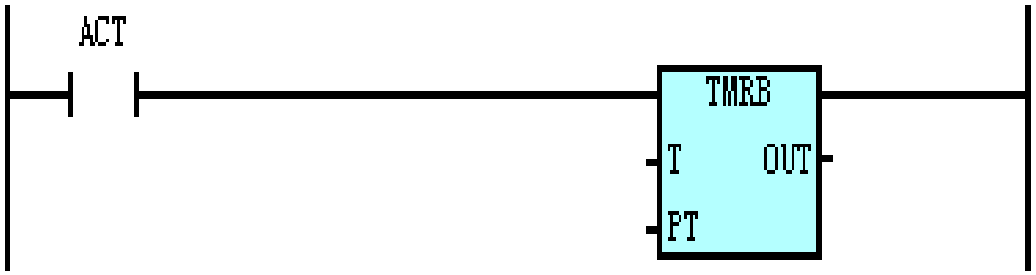
- Relevant parameters

  Size: specify the length of the comparison data. When set to 1, 2, 4, the corresponding data lengths are 1 byte, 2 bytes, and 4 bytes respectively.

  IN1, IN2: The content of comparison source data 1 and comparison source data 2, which can be a constant or an address number (cannot be an address bit, such as addr.b is illegal). The address numbers are R, X, Y, F, G, K, A, D, T, C, DC, DT, etc.

  OUT: to compare the output results. Can be R, Y, G, K, A, etc.

- Program example



Note: When X2.1 is 0, no comparison is made, and the status of R300.0, R300.1, and R300.2 remains unchanged;

When X2.1 is 1, the comparison is made, and the result is as follows.

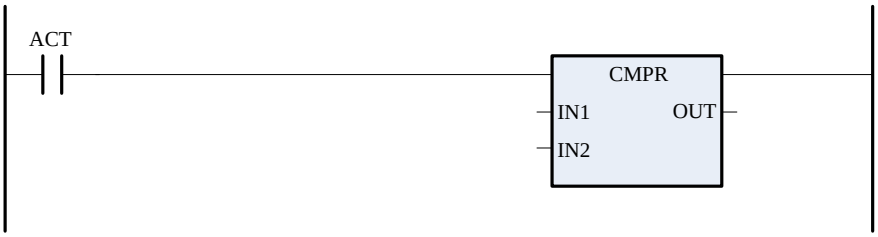
	R0300.2	R0300.1	R0300.0
R100>R200	0	0	1
R100=R200	0	1	0
R100<R200	1	0	0

1.4.4 CMPR (Real number comparison)

- Command function

  Compare the size of two real number and output the comparison result.

- Ladder diagram format



- Control conditions

  Compare the 32-bit real numbers in IN1 and IN2, and save the results to the bit addresses starting from OUT.

  Assuming that the address of OUT is represented by addr.b, then

  ACT=0: addr.b keeps the original value

  =1: compare the numbers of IN1 and IN2, and the output results are as follows.

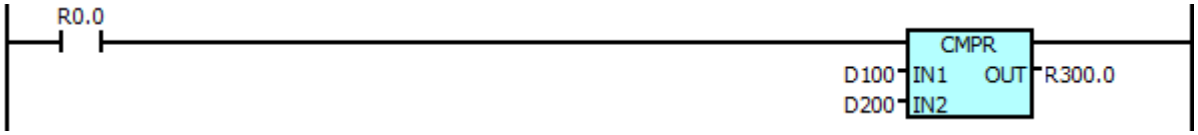
	addr.（b+2）	**addr.（b+1）**	**addr.（b+0）**
IN1> IN2	0	0	1
IN1= IN2	0	1	0
IN1< IN2	1	0	0

- Relevant parameters

  IN1, IN2: The content of comparison source data 1 and comparison source data 2, which can be data of D address or a constant.

  OUT: to compare the output results. Can be R, Y, K.

- Program example



Note: When R0.0 is 0, no comparison is made, and the status of D100, D200, and R300 remains unchanged;

When R0.0 is 1, the comparison is made, and the result is as follows.

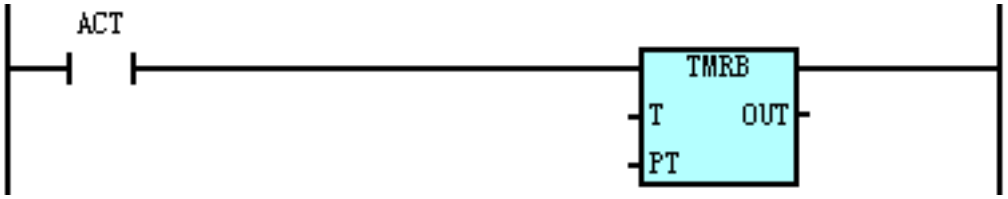
	R0300.2	**R0300.1**	**R0300.0**
D100>D200	0	0	1
D100=RD00	0	1	0
D100<D200	1	0	0

1.4.5 TMRB (Timer)

- Command function

  Delay break-over timer. The timing unit is milliseconds (ms).

- Ladder diagram format

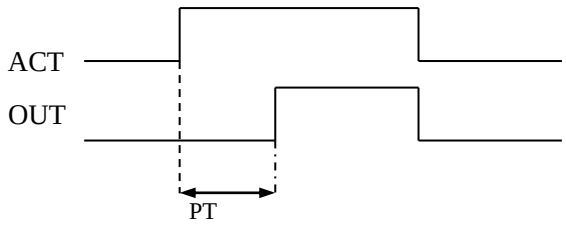


- Control conditions

  ACT=0: T and OUT are reset.

  =1: T starts timing from 0. When the preset time of PT is reached (the time unit of PT is millisecond), OUT=1.

  The logical relationship is as follows.



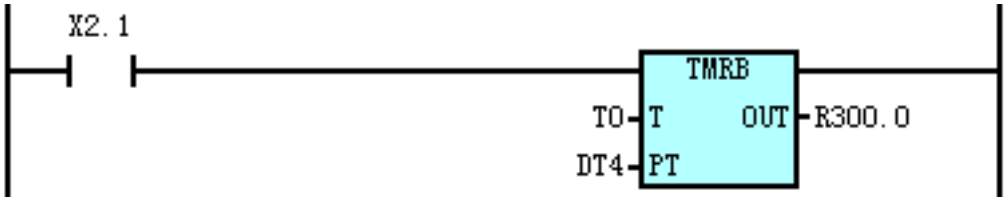
- Relevant parameters

  T: Timer number, the range is from T0 ~T199.

  PT: timing constant or data register starting with DT. DT setting range: 0～2,147,483,647 (ms)

  OUT: timer output address, which can be R, Y, G, K, A, etc.

- Program example



Note: assume that the current set value of DT4 is 100.

When X2.1 is 0, T0 and R300.0 are both 0;

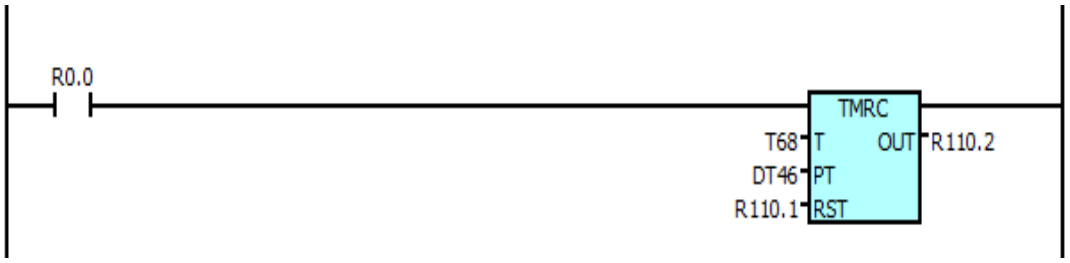
When X2.1 is 1, T0 starts timing, and R300.0 is set to 1 after reaching 100 milliseconds (the time set by DT4).

1.4.6 TMRC (Timer 2)

- Command function

  Delay break-over timer. Timing in milliseconds (ms).

- Ladder diagram format

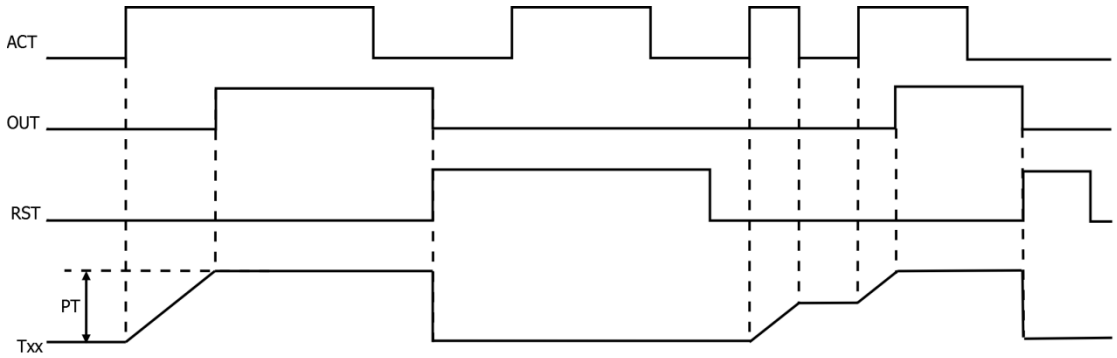


- Control conditions

  ACT=0: OUT keeps the state unchanged

  ACT=1: T starts timing from 0. When the PT preset time is reached (the unit of PT time is milliseconds), OUT=1.

  The sequence chart is as follows:



  When ACT=0, the time counted by PT will not be cleared. When ACT is equal to 1 again, PT continues the last time counting.

- Relevant parameters

  T: Timer number, the range is T0~T199.

  PT: Timing constant or data register starting with DT. DT setting range: 0~21, 4748, 3647 (ms).

  OUT: Timer output address, which can be R, Y, G, K, A, etc.

1.4.7 CTRC (Binary counter)

- Command function

  The data in this counter is binary and has the following functions depending on the application.

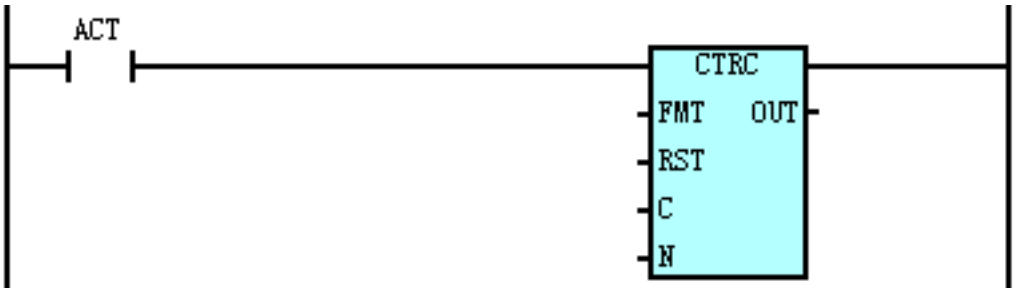
  A: Preset type counter: Preset the count value, and output the corresponding signal if the count reaches the preset value.

  B: Ring counter: When the counter reaches the preset value, the counting signal is input, it is reset to the initial value and performs recounting.

  C: Up and down counters: bit reversible counters, which can be used for both up and down.

  D: Choice of initial value: The initial value can be 0 or 1.

- Ladder diagram format



- Control conditions

  When ACT is a rising edge:

  Up Counting: C starts counting up from the set initial value. When there is the rising edge, C counts up once. When it reaches the preset count value (N), OUT =1. When C is less than N, OUT =0; if there is another rising edge, C recovers its initial value and starts counting, and OUT =0 at the same time.

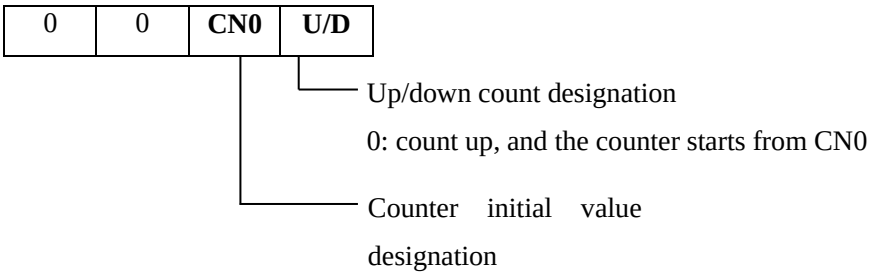
  Down Counting: C starts counting down from the set preset count value (N), and C will count down once there is the rising edge. When it reaches the set initial value, OUT =1. When C is greater than N, OUT =0; if there is another rising edge, C returns to the initial value and restarts counting, OUT =0.

  When ACT=0:

  C and OUT keep the original value.

- Relevant parameters

  FMT: Data format



  RST: When it is 1, C=CN0, OUT=0 regardless of the state of ACT. RST can be: X, Y, G, F, R, K and A, etc.

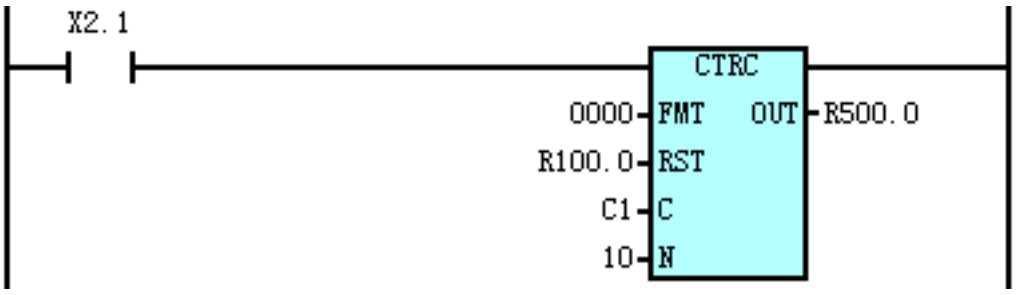
  C : Specify the counter number, represented by Cxxx, where xxx is a number (0～199)

  N : Counter preset value, which can be a constant or a data register starting with DC. If it is a constant, its value range is

  0～2,147,483,647

  OUT: When the count value is reached, the output position is 1. OUT can be R, Y, G, K and A, etc.

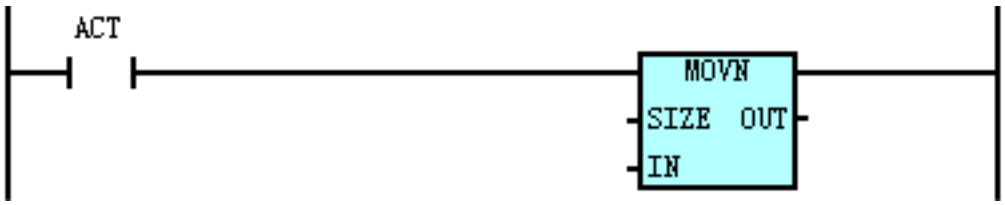
- Program example



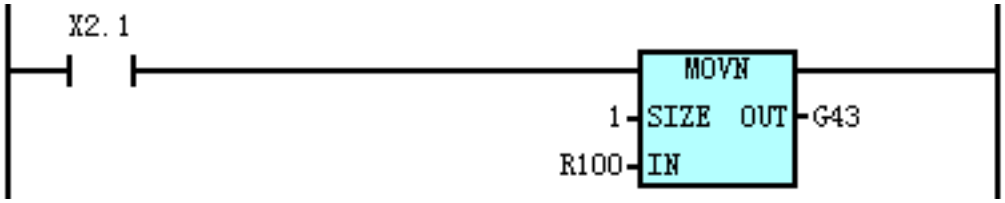
Note: When R100.0 is 1, C1=0, R500.0=0;
When R100.0 is 0, C1 counts up every time X2.1 has a rising edge. When it reaches 10, R500.0 is set to 1.
When X2.1 has a rising edge again, C1 returns to 0 and restarts counting, and R500.0 is reset to 0.

1.4.8 MOVN (Binary data transfer)

- Command function
  Transfer the data of the source address or the specified binary data to the destination address (data copy).
- Ladder diagram format



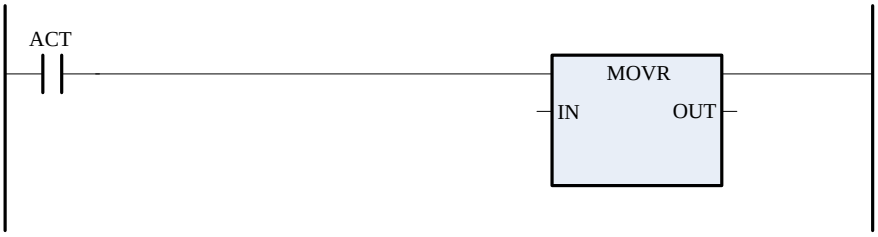
- Control conditions
  ACT=0: OUT keeps the original value.
  =1: Copy the value or constant in IN into OUT.
- Relevant parameters
  SIZE: the length of the copied data (1, 2, 4 bytes)
  IN: The starting byte or constant of the source data address which the address number is R, X, Y, F, G, K, A, D, T, C, DC, DT, etc.
  OUT: The starting byte of the target address which address number is R, Y, G, K, A, D, T, C, DC, DT, etc.
- Program example



Note: When X2.1 is 1, the value of R100 (1 byte) is transferred to G43.

1.4.9 MOVR (Real number transfer)

- Command function
  Transfer the real number data of the source address to the destination address (data copy).
- Ladder diagram format



- Control conditions

  ACT=0: OUT keeps the original value.

  =1: Copy the value or constant in IN into OUT.

- Relevant parameters

  IN: data of the source address， content in D address or a constant.

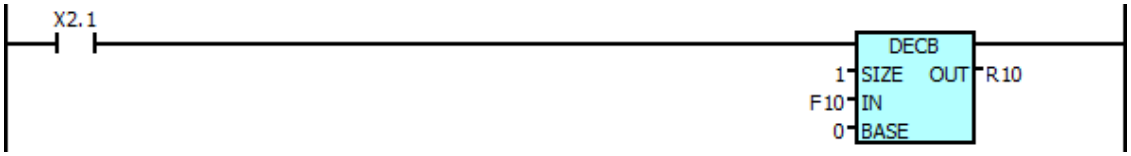
  OUT: D address of the copy target

1.4.10 DECB (Binary decoding)

- Command function

  DECB can decode binary code data. When one of the 8-bit continuous data is the same as the code data, the corresponding output data bit is 1; when there is no identical number, the output data is 0. This command is used for data decoding of M or T Function.

- Ladder diagram format



- Control conditions

  ACT = 0: All 8 data bits of OUT are reset.

  =1: Compare the content value of the decoding address (IN) with the 8 consecutive data starting with BASE. If the content value of IN is equal to any of the 8 data, and this equal data ranks in the 8^{th} data, the corresponding bit of the output address (OUT) will be set to 1.

- Relevant parameters

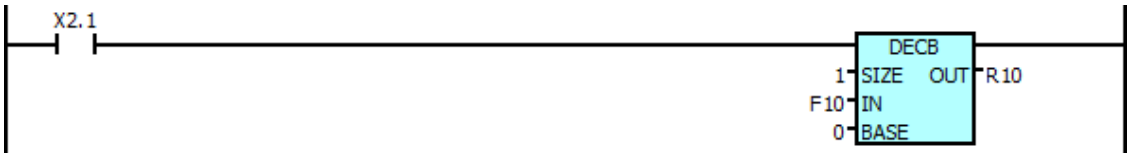
  SIZE: Specify the length of the IN1 address (1, 2, 4 bytes).

  IN: Decoding start address which address numbers are R, X, Y, F, G, K, A, D, T, C, DC, DT, etc.

  BASE: The base value of the comparison constant.

  OUT: Comparison result output which address numbers are R, Y, G, K, A, etc.

- Program example



When X2.1=1:

If F10=0 at this time, R10.0=1;

If F10=1 at this time, R10.1=1;

……

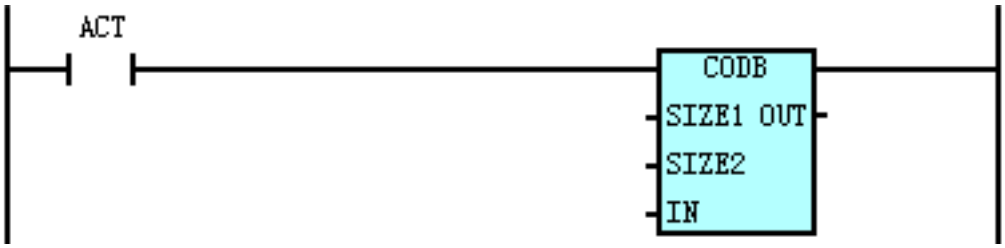
If F10=7 at this time, R10.7=1;

1.4.11 CODB (Binary code conversion)

- Command function

  This command is used to convert binary data.

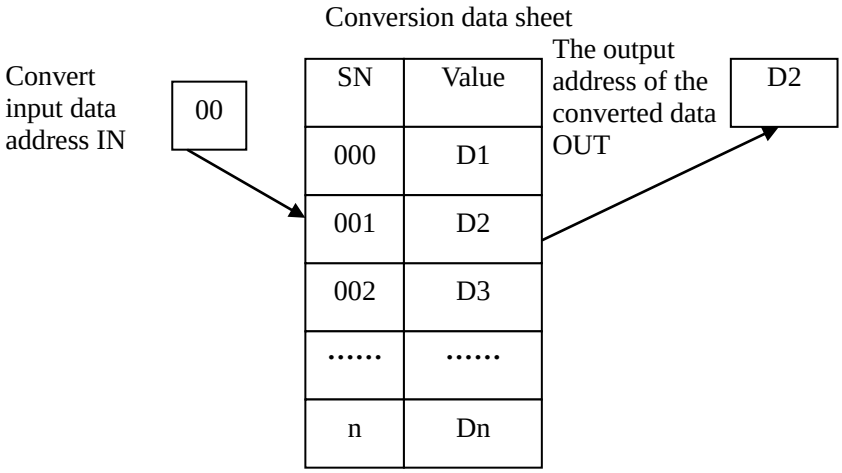
- Ladder diagram format



- Control conditions

  ACT = 0: The value in OUT remains unchanged.

  =1: Take the value of "conversion input data address (IN)" as the table number of the conversion table; take out the conversion data corresponding to the table number from the conversion table, and output it to the output address (OUT) of the conversion data.



- Relevant parameters

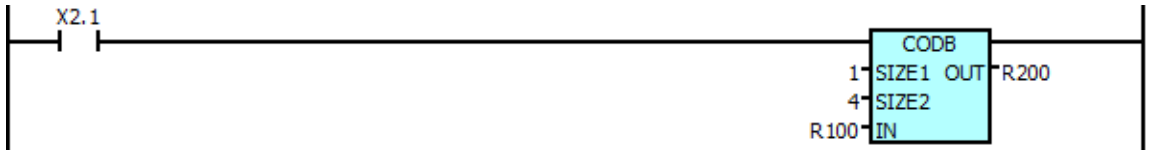
  SIZE1: The binary data length of the conversion data and the output address length of the conversion data in the conversion table, 1-1 bytes, 2-2 bytes, 4-4 bytes.

  SIZE2: The length of the conversion table, the length corresponds to the conversion data.

  IN : The input address of the conversion data, which only needs one byte of data. The addresses are R, X, Y, G, F, A, K, D, etc.

  OUT : The output address of the converted data, the address is R, X, Y, G, F, K, A, D, DT, DC, etc.

- Program example:



Example

When X2.1=1,

When X2.1=1, R100=0: R200=1

When X2.1=1, R100=1: R200=2

When X2.1=1, R100=2: R200=3

When X2.1=1, R100=3: R200=4

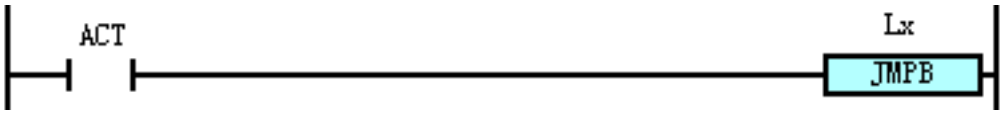
Conversion data

Serial Number	Value
000	1
001	2
002	3
003	4

1.4.12 JMPB (Label jump)

- Command function

  Immediately transfer the program to the program position set by the label for execution. It has several characteristics: multiple jump instructions can use the same label; it is forbidden to jump out of the subroutine; it can jump forward or jump down.
- Ladder diagram format

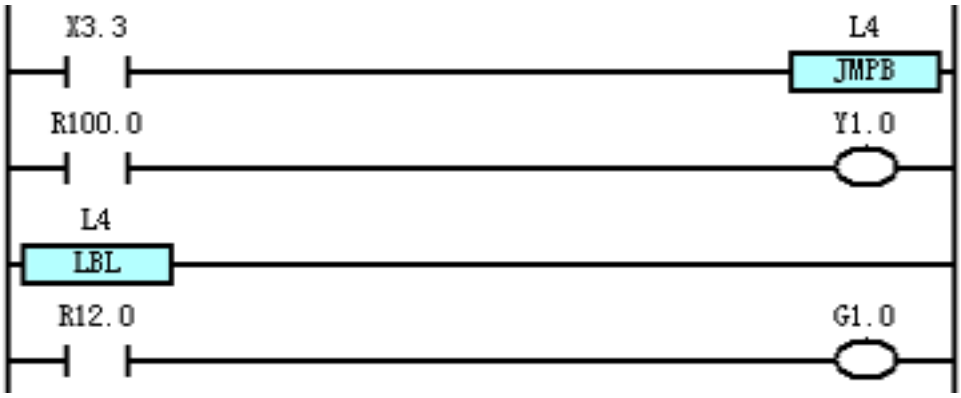


- Control conditions

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

  ACT = 1, jump to the specified label and execute the next command after the label.
- Relevant parameters

  Lx: Specify the destination label of the jump. The number of labels must be specified at the beginning of the L address, and a value from L1 to L9999 can be specified.
- Program example

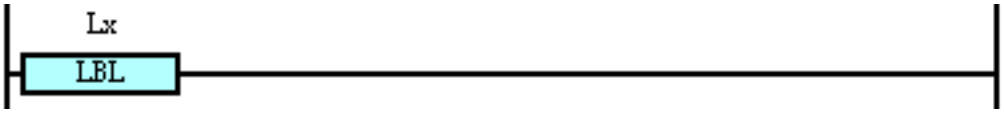


Note: When X3.3 is 1, the program skips R100.0 and executes sequentially from R12.0; if X3.3 is 0, it executes sequentially from R100.0.

1.4.13 LBL (Label)

- Command function

  Specify a label in the ladder diagram, that is, JMPB specifies the destination of the jump. One Lx label can only be specified with LBL once, otherwise it will alarm.
- Ladder diagram format

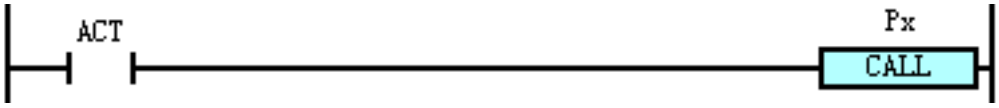


- Command parameter

  Lx: Specify the destination label of the jump. The number of labels must be specified at the beginning of the L address, and a value from L1 to L9999 can be specified.

1.4.14 CALL (Call subprogram)

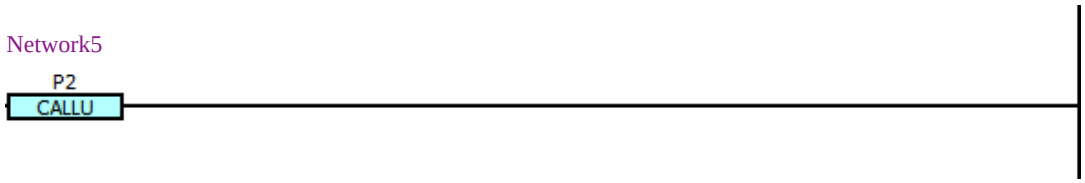
- Command function
  Calling a designated subprogram has the following characteristics: multiple call instructions can call the same subroutine; call instructions can be nested.
- Ladder diagram format



- Control conditions
  ACT =0: execute the next instruction after CALL.
  =1: Call the subprogram of the specified subprogram number.
- Relevant parameters
  Px: Specify the label of the called subprogram. The number of subprogram labels must be specified at the beginning of the P address, and a value from P1 to P9999 can be specified.

1.4.15 CALLU (Call subprogram unconditional)

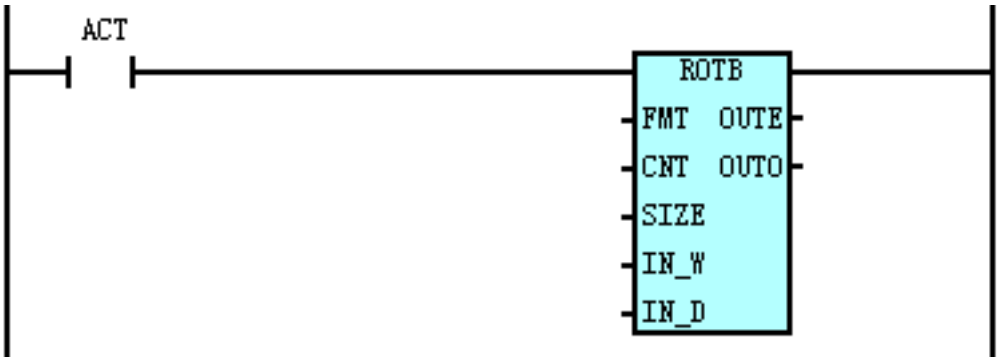
- Command function
  Calling a designated subprogram has the following characteristics: multiple call instructions can call the same subroutine; call instructions can be nested.
- Ladder diagram format



- Control conditions
  Unconditional call
- Relevant parameters
  Px: Specify the label of the called subprogram. The number of subprogram labels must be specified at the beginning of the P address, and a value from P1 to P9999 can be specified.

1.4.16 ROTB (Binary rotation control)

- Command function
  Used for rotation control, such as tool post, rotary table, etc. The command has the following functions: select the direction of rotation of the short path; calculate the number of steps from the current position to the target position, or calculate the number of steps from the previous position of the current position to the previous position of the target position; calculate the position of the previous target position number.
- Ladder diagram format



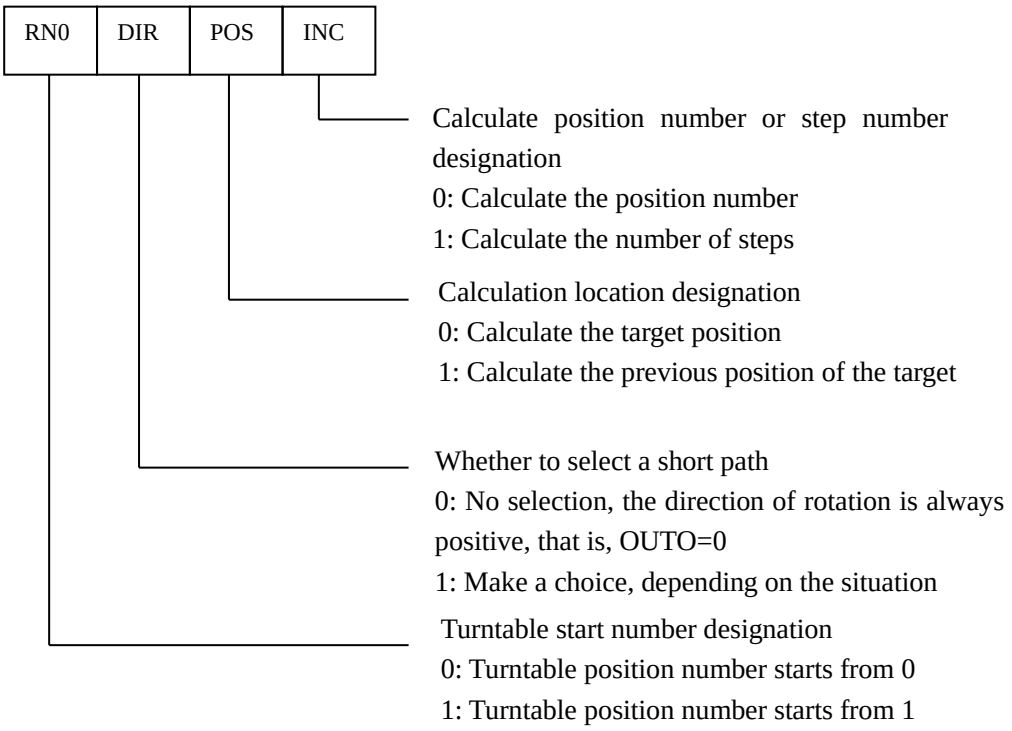
- Control conditions

  ACT =0: Do not execute the command, OUTE and OUTO keep the original value;

  =1: Execute the instruction, and output the result to OUTE and OUTO.

- Relevant parameters

  FMT: Data format:



  CNT: Number of indexing positions of the turntable.

  SIZE: Specify the address length of IN_W, IN_D and OUTE (1, 2, 4 bytes).

  IN_W: The current location address, which stores the current location number. The address numbers are R, X, Y, F, G, K, A, D, DC and DT, etc.

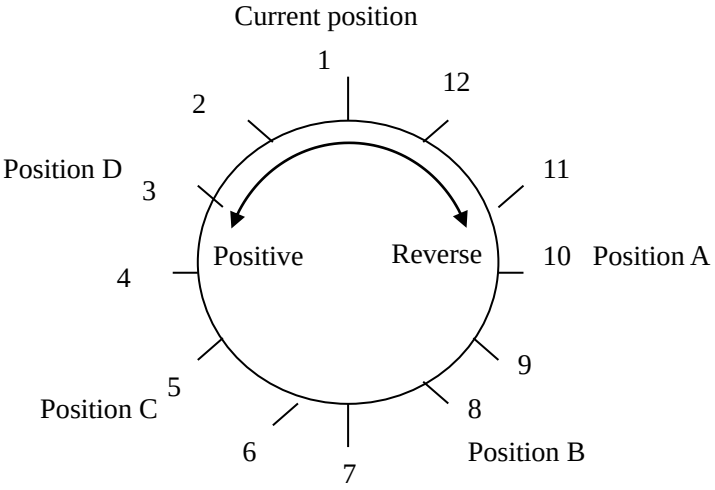
  IN_D: Target location address, storing the target location number. The address numbers are R, X, Y, F, G, K, A, D, DC and DT, etc.

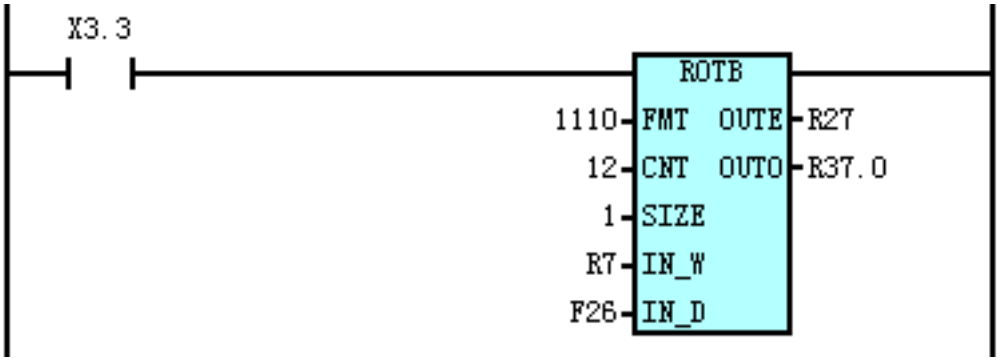
  OUTE: The output address of the calculation result. The address numbers are R, Y, G, K, A, D, DC and DT, etc.

  OUTO: Rotation direction output, the direction that the position number of the turntable increases is the forward direction (FOR); if it decreases, it is the reverse direction (REV). When OUTO=0, it is forward rotation; when OUTO=1, it is reverse rotation. The address numbers are R, Y, G, K and A, etc.

- Program example

For example: There is a turntable tool post as follows, and the current position is at the No. 1 tool position.





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

Current position number R7=1, turntable index position number CNT=12, then X3.3=1:

F26=10 When the target position is A, R27=11, R37.0=1.

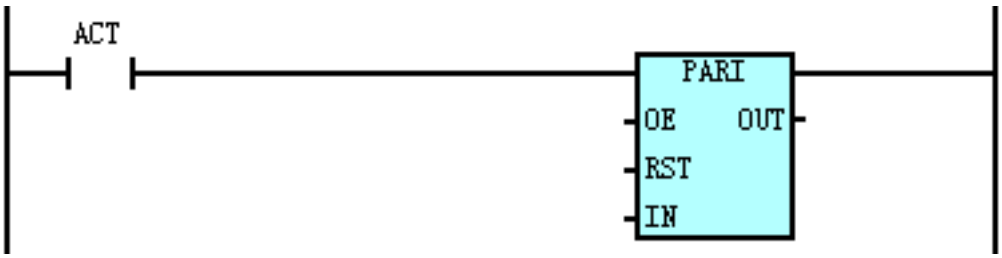
F26=8 When the target position is B, R27=9, R37.0=1.

F26=5 When the target position is C, R27=4, R37.0=0.

F26=3 When the target position is D, R27=2, R37.0=0.

1.4.17 PARI (Parity check)

- Command function
  Parity check is performed on the input data, and the input data is 1 byte (8 bits).
- Ladder diagram format



- Control conditions
  ACT=1: Perform parity check on the input data. If the input data does not match the designation of OE,

OUT is 1; otherwise, OUT is 0.

ACT=0: The command is not executed, and OUT does not keep the original value.

- Relevant parameters

OE =0: The number of '1' in the input data is even;

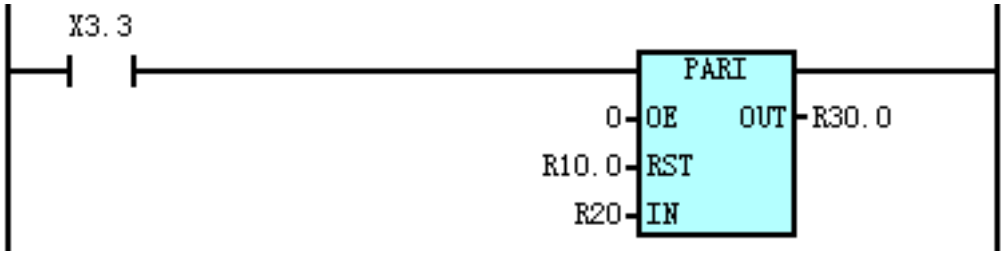
=1: The number of '1' in the input data is odd.

RST: When it is 1, OUT is reset to 0, and the addresses are X, Y, G, R, F, A, and K, etc.

IN : Input data address, the address can be X, Y, G, R, F, A, K and D.

OUT: The output address of the verification result, the address can be Y, G, R, A and K, etc.

- Program example



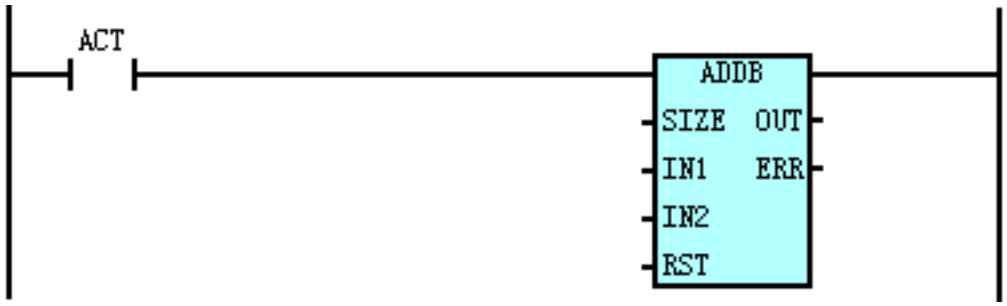
Note: When X3.3 is 1, execute the PARI instruction, OE=0000, and perform even parity. When R10.0 is 1, R30.0 is reset to 0 and no verification is performed. When R10.0 is 0, check is performed. When the value of R20 contains an even number of 1s, R30.0 is 0, and when the value of R20 contains an odd number of 1s, R30.0 is 1.

1.4.18 ADDB (Addition of binary data)

- Command function

Binary data addition

- Ladder diagram format



- Control conditions

ACT=1: Execute OUT=IN1+IN2. ERR is 1 if there is an operation error; otherwise, ERR is 0.

ACT=0: No command is executed, OUT and ERR remain unchanged.

- Relevant parameters

SIZE: 1-1 bytes long, 2-2 bytes long, 4-4 bytes long.

IN1: The addend, which can be a constant or an address. The address numbers are R, X, Y, F, G, A, K, D, T, C, DC and DT, etc.

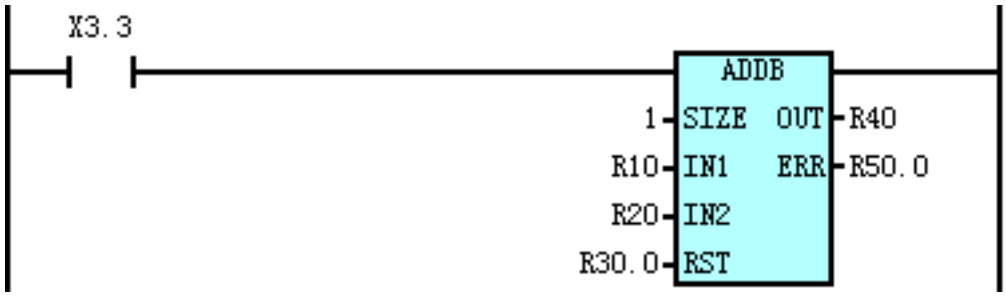
IN2: Addend, which can be a constant or an address. The address numbers are R, X, Y, F, G, A, K, D, T, C, DC and DT, etc.

RST: When it is 1, ERR is reset to zero, and OUT is unchanged. The address numbers are R, X, Y, F, G, A and K, etc.

OUT: Operation result output data address. Address can be Y, G, R, A, K, DC, DT, D, C and T, etc.

ERR: The output address of the operation result error, the address can be Y, G, R, A and K.

- Program example



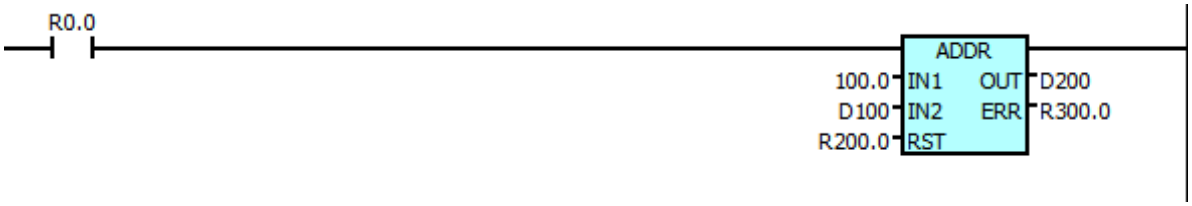
Note: When X3.3=1, the ADDB command is executed. R40=R10+R20, if there is an error in the operation, R50.0 will be 1, otherwise it will be 0. When R30.0 is 1, the state of R40 remains unchanged, and R50.0 is reset to 0.

1.4.19 ADDR (Addition of real number)

- Command function

Real number data addition and output the result

Ladder diagram format



- Control conditions

R0.0=1: Execute OUT=IN1+IN2. ERR is 1 if there is an operation error; otherwise, ERR is 0.

=0: No command is executed, OUT and ERR remain unchanged.

- Relevant parameters

IN1: The addend, which can be a constant or a D address.

IN2: Addend, which can be a constant or a D address.

RST: When it is 1, ERR is reset to zero, and OUT is unchanged. The address numbers are R, X, Y and K, etc.

OUT: Operation result output data D address.

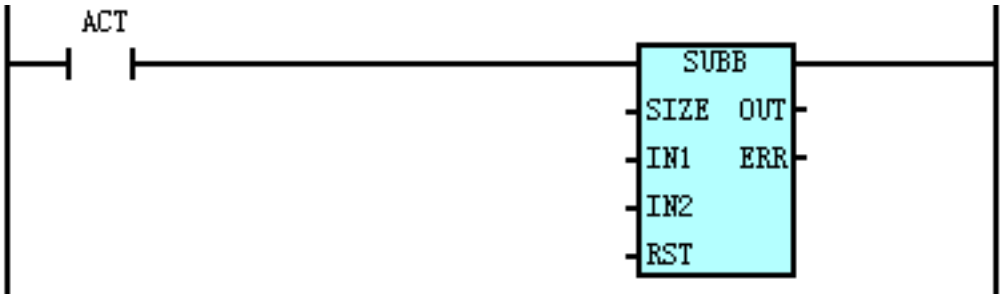
ERR: The output address of the operation result error, the address can be Y, R and K.

1.4.20 SUBB (Binary data subtraction)

- Command function

Binary data subtraction.

- Ladder diagram format



- Control conditions

  ACT=1: Execute OUT= IN1-IN2. ERR is 1 if there is an operation error; otherwise, ERR is 0.

  ACT=0: No command is executed, OUT and ERR remain unchanged.
- Relevant parameters

  SIZE: It can be 1, 2, 4, corresponding to 1 byte long, 2 byte long, and 4 byte long respectively.

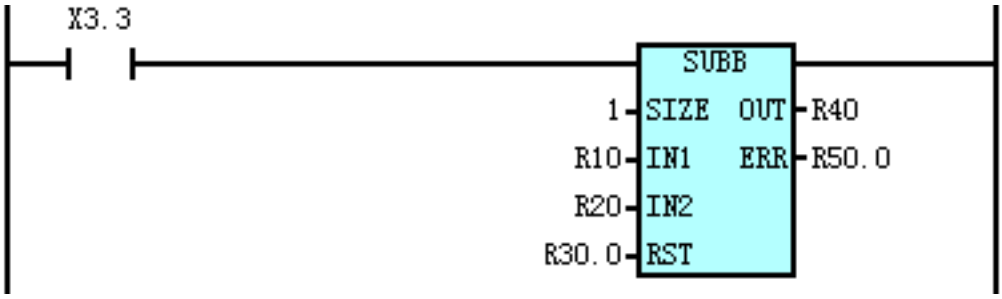
  IN1: The subtracted number, which can be a constant or an address. Address numbers R, X, Y, F, G, A, K, D, T, C, DC and DT, etc.

  IN2: Decrement, which can be a constant or an address. Address numbers R, X, Y, F, G, A, K, D, T, C, DC and DT, etc.

  RST: When it is1, ERR is reset. The address numbers are R, X, Y, F, G, A and K, etc.

  OUT: Operation result output data address. The addresses are Y, G, R, A, K, DC, DT, D, C, and T etc.

  ERR: Operation result error output address, the address is Y, G, R, A and K, etc.
- Program example

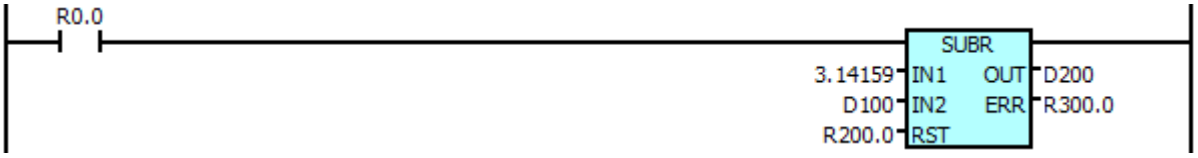


Note: When X3.3=1, execute the SUBB command, R40=R10-R20, if the operation is error, R50.0 is 1, otherwise R50.0 is 0; when R30.0 is 1, the state of R40 remains unchanged , R50.0 is reset to 0.

1.4.21 SUBR (Real number subtraction)

- Command function

  Real number data subtraction.
- Ladder diagram format



- Control conditions

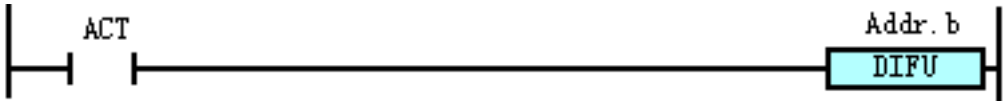
  R0.0 =1: Execute OUT=IN1-IN2. ERR is 1 if there is an operation error; otherwise, ERR is 0.

  =0: No command is executed, OUT and ERR remain unchanged.
- Relevant parameters

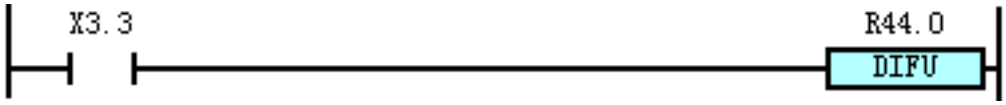
IN1: The subtracted number, which can be a constant or a D address.
IN2: Decrement, which can be a constant or a D address.
RST: When it is 1, ERR is reset. The address numbers are R, X, Y and K, etc.
OUT: Operation result output data D address.
ERR: The output address of the operation result error, the address can be Y, R and K.

1.4.22 DIFU (Set on rising edge)

- Command function
  The output signal is set to 1 during the scan period of the rising edge of the input signal.
- Ladder diagram format



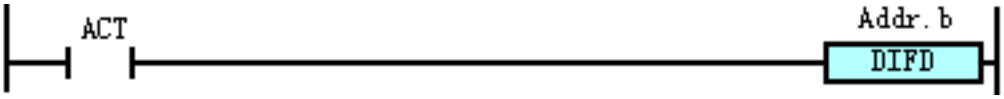
- Control conditions
  Input signal ACT: Set the output signal to 1 at the rising edge of ACT (0→1).
  Output signal Addr.b: When this function command is executed, Addr.b remains as1 in one scan cycle of the ladder diagram, and becomes 0 in the next scan cycle).
- Relevant parameters
  Addr.b: Operation result output address, the address can be Y, G, R, A and K, etc.
- Program example



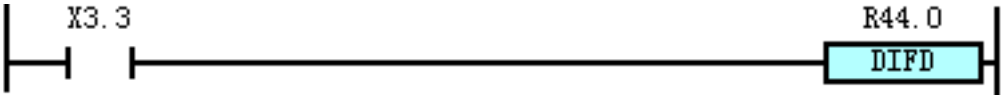
Note: When X3.3 comes on the rising edge, R44.0 outputs 1.

1.4.23 DIFD (Set on falling edge)

- Command function
  The output signal is set to 1 during the scan period of the falling edge of the input signal.
- Ladder diagram format



- Control conditions
  Input signal ACT: Set the output signal to 1 at the falling edge of ACT (1→0).
  Output signal Addr.b: When this function command is executed, Addr.b remains as 1 in one scan cycle of the ladder diagram, and becomes 0 in the next scan cycle)
- Relevant parameters
  Addr.b: Operation result output address, the address can be Y, G, R, A and K, etc.
- Program example



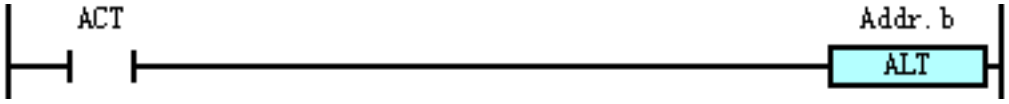
Note: When X3.3 comes on the falling edge, R44.0 outputs 1.

1.4.24 ALT (Alternate output)

- Command function

  Alternate output command, when the input signal changes every time (0→1), the output signal is reversed and output.

- Ladder diagram format



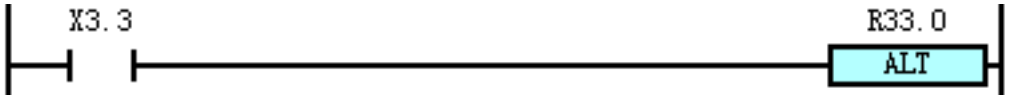
- Control conditions

  Each time the input signal ACT changes from 0→1, the output signal Addr.b is inverted and output.

- Relevant parameters

  Addr.b: Output signal, the address can be Y, G, R, A and K, etc.

- Program example



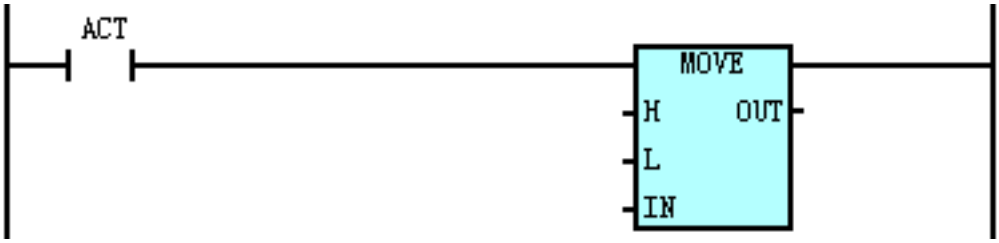
Note: The state of R33.0 flips once every time the rising edge of X3.3 comes.

1.4.25 MOVE (Logical multiplication)

- Command function

  Perform a logical and operation between the logical multiplier and the input data, and output the result to the specified address.

- Ladder diagram format



- Control conditions

  When ACT=1: Perform a logical and operation between the logical multiplier (H, L) and the input data (IN), and output the result to the specified address (OUT). Can be used to exclude unnecessary bits from an 8-bit signal in the specified address.

  When ACT=0: OUT keeps the original value.

- Relevant parameters

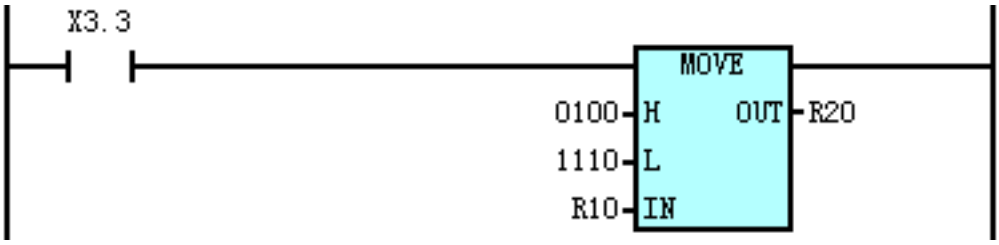
  H : High four-digit logical multiplier

  L : Low four-digit logical multiplier

  IN : Input the data address, the address number is R, A, K, X, Y, F, G and D, etc.

  OUT: Output data address, the address number is R, A, K, Y, G and D, etc.

- Program example

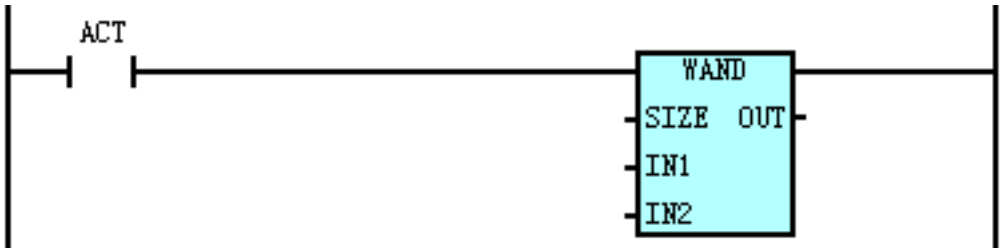


Note: When X3.3 is 1, R10 and 01001110 are ANDed, and the result is stored in R20.

1.4.26 WAND (Binary byte AND)

- Signal function

  WAND performs byte bitwise AND operation on two input data (1, 2, 4 bytes), and outputs the calculation result to the output address.
- Ladder diagram format



- Control conditions

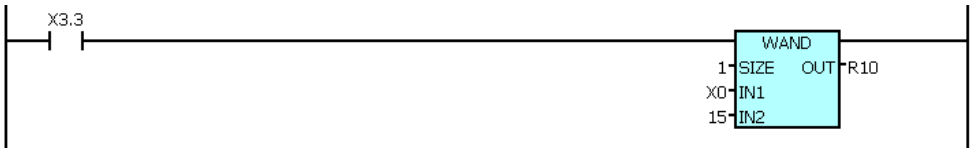
  ACT=0: The value of OUT remains unchanged.

  ACT=1: Operate the contents of IN1 and IN2 as AND, and output the result to the OUT address.
- Relevant parameters

  SIZE: Specify the length of IN1 and IN2 addresses (1, 2, 4 bytes) .

  IN1, IN2: The starting address or constant of the input data. The address numbers are R, X, Y, F, G, K, A, D, T, C, DC, DT.

  OUT: Result output address, operation address can be R, Y, G, K, A, D, T, C, DC, DT.
- Program example

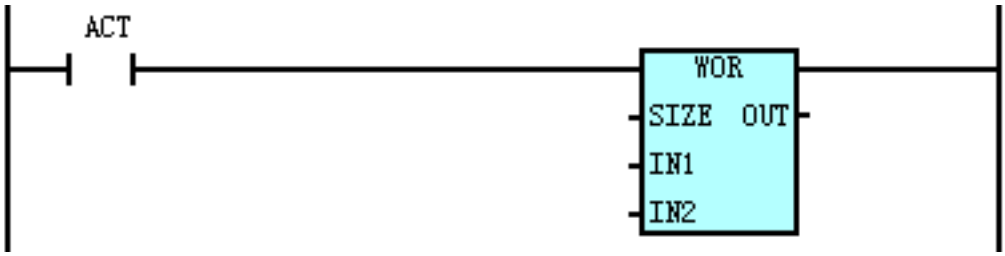


Note: When X3.3=1, the data in X0 (8 digits) and 15 (that is, 00001111 in binary) are ANDed, and the result is put into R10. For example, when X3.3=1 and X0 is 11000110, after the WAND command, the result in R10 is 00000110.

1.4.27 WOR (Binary byte OR)

- Command function

  WOR performs byte bitwise OR operation on two input data (1, 2, 4 bytes), and the calculation result is output to the output address.
- Ladder diagram format



- Control conditions

  ACT=0: The value of OUT remains unchanged.

  ACT=1: OR operation on the contents of IN1 and IN2, and output the result to the OUT address.
- Relevant parameters

  SIZE: Specify the length of IN1 and IN2 addresses (1, 2, 4 bytes) .

  IN1, IN2: The starting address or constant of the input data. The address can be R, X, Y, F, G, K, A, D, T, C, DC, DT.

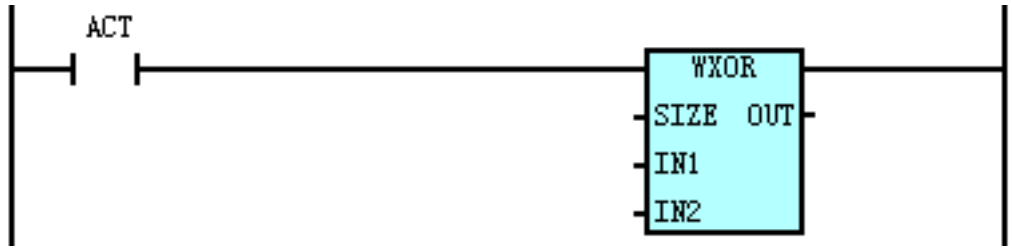
  OUT: Result output address, operation address can be R, Y, G, K, A, D, T, C, DC, DT.
- Program example

Note: When X3.3=1, the data in X0 (8 digits) and 15 (i.e. 00001111 in binary) are bitwise ORed, and the result is put into R10. For example, when X3.3=1 and X0 is 11000110, after the WOR command, the result in R10 is 11001111.

1.4.28 WXOR (Binary byte XOR)

- Command function

  WXOR performs byte wise XOR operation on two input data (1, 2, 4 bytes), and outputs the calculation result to the output address.
- Ladder diagram format



- Control conditions

  ACT=0: The value of OUT remains unchanged.

  ACT=1: XOR the contents of IN1 and IN2, and output the result to the OUT address.
- Relevant parameters

  SIZE: Specify the length of IN1 and IN2 addresses (1, 2, 4 bytes) .

  IN1, IN2: start byte or constant of data input address. The address can be R, X, Y, F, G, K, A, D, T, C, DC, DT.

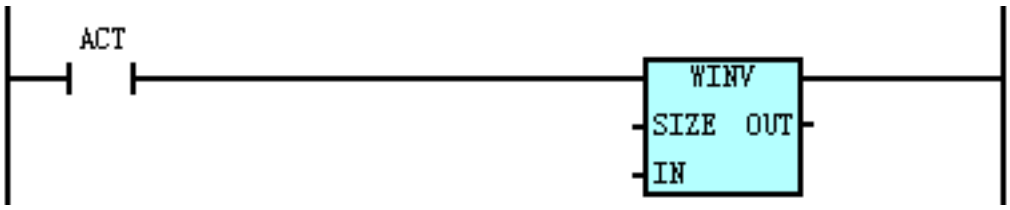
  OUT: The result output address, the address can be R, Y, G, K, A, D, T, C, DC, DT.
- Program example

Note: When X3.3=1, the data in X0 (8 digits) and 15 (i.e. 00001111 in binary) are XORed, and the result is put into R10. For example, when X3.3=1 and X0 is 11000110, after the WXOR command, the result in R10 is 11001001.

1.4.29 WINV (Inverted binary byte)

- Function

  Invert the data or constant of the input address and save it to the output address.
- Ladder diagram format



- Control conditions

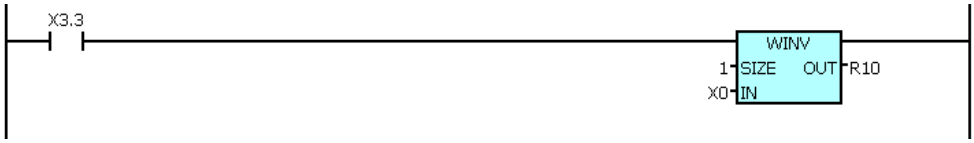
  ACT=0: OUT keeps the original value.

  ACT=1: Invert the value of IN and save it to the OUT address.
- Relevant parameters

  SIZE: The length of the data (1, 2, 4 bytes).

  IN: The starting byte or constant of the data input address. The input address can be R, X, Y, F, G, K, A, D, T, C, DC, DT.

  OUT: The start byte of the output address. The address can be R, Y, G, K, A, D, T, C, DC, DT.
- Program example

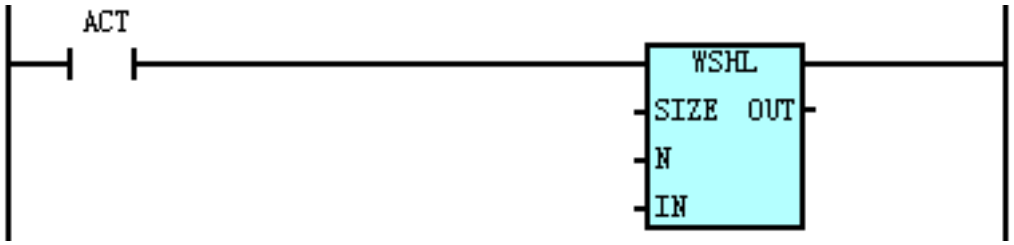


Note: When X3.3=1, the data in X0 (8 digits) is inverted, and the result is put into R10. For example, when X3.3=1 and X0 is 11000110, after the WINV instruction, the result in R10 is 00111001.

1.4.30 WSHL (Left shift of binary data)

- Command function

  WSHL shifts the two input data (1, 2, 4 bytes) to the left according to the specified number of bits, and outputs the result to the output address.
- Ladder diagram format



- Control conditions

  ACT=0: The value of OUT remains unchanged.

  ACT=1: Shift the value of IN to the left by N bits, and output the result to the OUT address.

- Relevant parameters

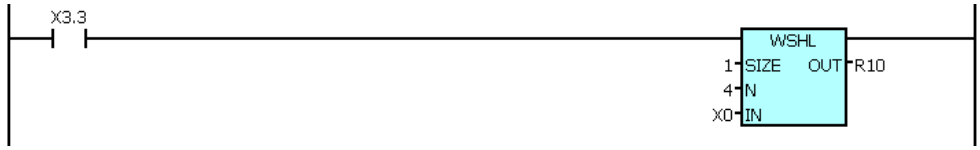
  SIZE: Specify the data length of IN (1, 2, 4 bytes).

  N : Shift number address or constant. Address can be R, X, Y, F, G, K, A, D, T, C, DC, DT.

  IN : Start byte or constant of data input address which can be R, X, Y, F, G, K, A, D, T, C, DC, DT.

  OUT: Result output address which can be R, Y, G, K, A, D, T, C, DC, DT.

- Program example



Note: When X3.3=1, the data in X0 (8 digits) is shifted to the left by 4 digits, and the result is put into R10. For example, when X3.3=1 and X0 is 11000110, after the WSHL command, the result in R10 is 01100000.

1.4.31 WSHR (Right shift of binary data)

- Command function

  WSHR shifts the two input data (1, 2, 4 bytes) to the right according to the specified number of bits, and outputs the result to the output address.

- Ladder diagram format

- Control conditions

  ACT=0: The value of OUT remains unchanged.

  ACT=1: Shift the value of IN to the right by N bits, and output the result to the OUT address.

- Relevant parameters

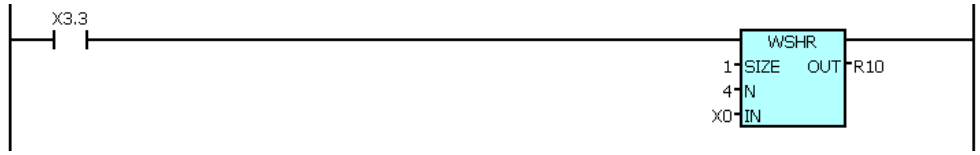
  SIZE: Specify the data length of IN (1, 2, 4 bytes).

  N : Shift number address or constant. The address can be R, X, Y, F, G, K, A, D, T, C, DC, DT.

  IN : Start byte or constant of data input address. The address can be R, X, Y, F, G, K, A, D, T, C, DC, DT.

  OUT: Result output address, the address can be R, Y, G, K, A, D, T, C, DC, DT.

- Program example



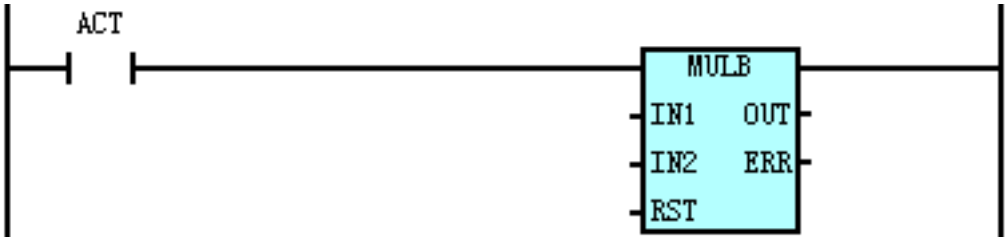
Note: When X3.3=1, the data in X0 (8 digits) is shifted right by 4 digits, and the result is put into R10. For example, when X3.3=1 and X0 is 11000110, after the WSHR command, the result in R10 is 00001100.

1.4.32 MULB (Multiplication of binary data)

- Command function

  MUL multiplies two input data (16-bit integer) to produce a 32-bit product and saves it to the output address (32-bit).

- Ladder diagram format



- Control conditions

  RST=0: Keep ERR and OUT unchanged.

  RST=1: Reset ERR and OUT.

  ACT=0: The value of OUT remains unchanged.

  ACT=1: Multiply the value of IN1 and IN2, and output the result to the OUT address.

- Relevant parameters

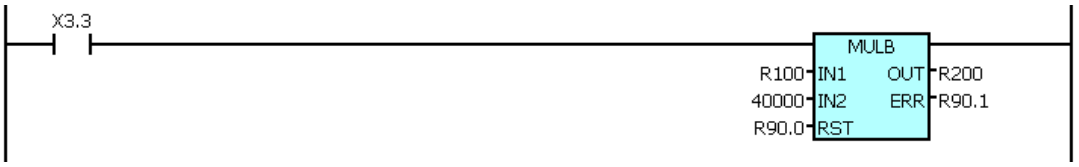
  IN1, IN2: Multiplier input address starting byte or constant, the address can be R, X, Y, F, G, K, A, D, T, C, DC, DT; if using R, X, Y, F, G, K, A, D single-byte (8-bit) address, the command will take 2 consecutive bytes as the multiplier; if using T, C, DC, DT double –bytes (32-bit) address, the command will take the lower 16 bits as the multiplier;

  OUT: Result output address, the address can be R, Y, G, K, A, D, T, C, DC, DT.

  RST: Command reset signal input address (bit address).

  ERR: Operation error output address (bit address), the address can be R, Y, G, K, A.

- Program example



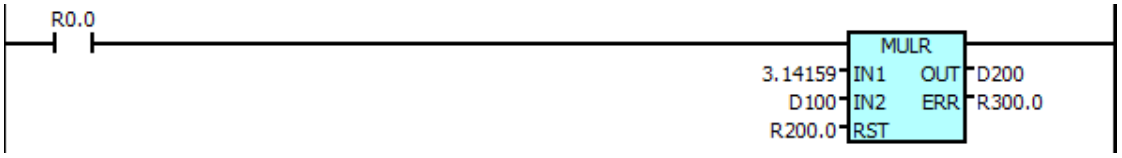
Note: When X3.3=1, the data composed of R100 and R101 (16 digits, R101 occupies the high 8 bits, R100 is the low 8 bits) is multiplied with the constant 40000, and the result is placed with R200 as the starting address the 4 bytes (R200, R201, R202, R203, where R200 occupies the lower 8 bits).

1.4.33 MULR (Multiplication of real number data)

- Command function

  MUL multiplies two input data (real number data) to produce a real number product and saves it to the output address.

- Ladder diagram format



- Control conditions

  RST=0: Keep ERR and OUT unchanged.

  RST=1: Reset ERR and OUT.

  ACT=0: The value of OUT remains unchanged.

  ACT=1: Multiply the value of IN1 and IN2, and output the result to the OUT address.

- Relevant parameters

  IN1, IN2: Multiplier input D address or constant.

  OUT: Result output D address.

  RST: Command reset signal input address, the address can be X, Y, R, K (bit address).

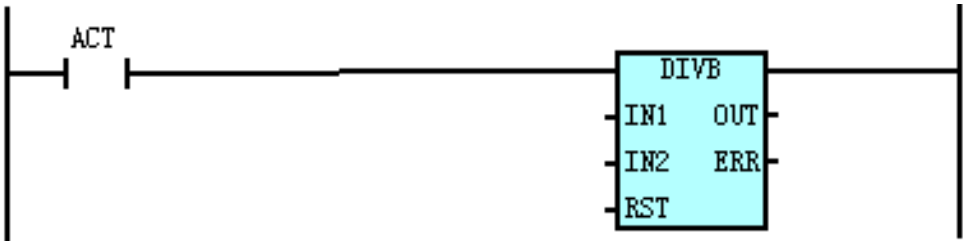
  ERR: Operation error output address (bit address), the address can be R, Y, K.

1.4.34 DIVB (Division operation of 16-bit binary data)

- Command function

  DIV divides two input data (16-bit integers) to produce a 32-bit result (including 16-bit remainder (high) and 16-bit quotient (low)) and saves it to the output address (32-bit).

- Ladder diagram format



- Command format

DIV	IN1	IN2	RST	OUT	ERR

- Control conditions

  RST=0: Keep ERR and OUT unchanged.

  RST=1: Reset ERR and OUT.

  ACT=0: The value of OUT remains unchanged.

  ACT=1: Divide IN1 by IN2, and output the result to the OUT address.

- Relevant parameters

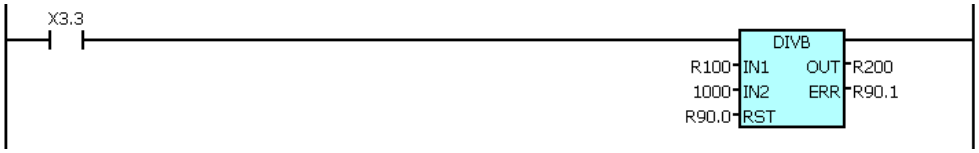
  IN1, IN2: Start byte or constant of data input address, address can be R, X, Y, F, G, K, A, D, T, C, DC, DT; if using R, X, Y, F, G, K, A, D single-byte (8-bit) address, the command will take 2 consecutive bytes as the divisor; if the T, C, DC, DT double bytes (32-bit) address is used, the command will take its low 16 bits as the divisor.

  OUT: Result output address, the address can be R, Y, G, K, A, D, T, C, DC, DT.

  RST: Command reset signal input address (bit address).

  ERR: Operation error output address (bit address), the address can be R, Y, G, K, A.

- Program example

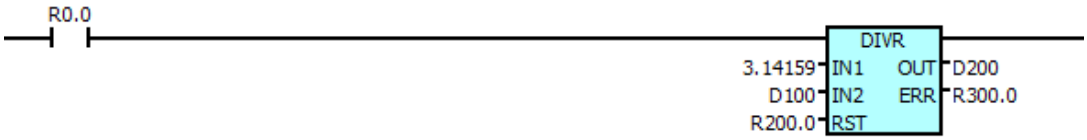


Note: When X3.3=1, the 16-bit integer composed of R100 and R101 (R101 occupies the high 8 bits, R100 is the low 8 bits) is used as the dividend, and the constant 1000 is the divisor for division).

Is put into the 2 bytes starting with R200 (R200, R201, where R200 occupies the lower 8 bits), and the remainder (16 bits) in the result is put into the 2 bytes starting with R202 (R202, R203, where R202 occupies the lower 8 bits).

1.4.35 DIVR (Division operation of real number data)

- Command function
  DIV divides two input data (real number data) to produce a real number product and saves it to the output address.
- Ladder diagram format



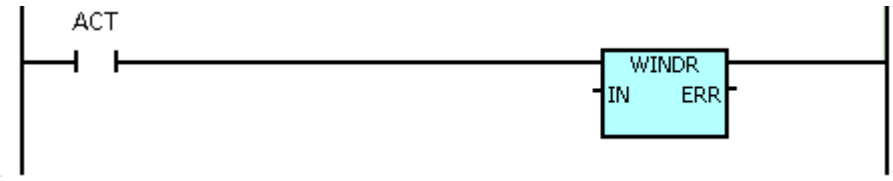
- Command format

DIV	IN1	IN2	RST	OUT	ERR

- Control conditions
  RST=0: Keep ERR and OUT unchanged.
  RST=1: Reset ERR and OUT.
  ACT=0: The value of OUT remains unchanged.
  ACT=1: Divide IN1 by IN2, and output the result to the OUT address.
- Relevant parameters
  IN1, IN2: input D address or constant.
  OUT: Result output D address.
  RST: Command reset signal input address, the address can be X, Y, R, K (bit address).
  ERR: Operation error output address (bit address), the address can be R, Y, K.

1.4.36 WINDR (Read CNC window data)

- Command function
  Create a window to transfer data between CNC and PLC, and read and write various data of CNC through the window function.
- Ladder diagram format



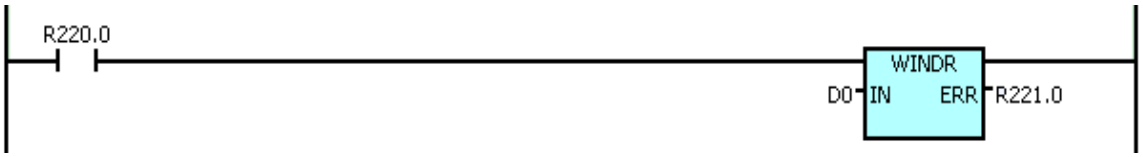
- Control conditions
  ACT=0: The command is not executed, and ERR is set to 0.
  ACT=1: The command is executed, the corresponding data is output and ERR is set to 1.
- Relevant parameters
  IN: The Initial address of the window, the address is D data.
  When the command is executed, the data in the data area is read (6+N data starting from the Initial address of the data area, N is specified by the data length), and the processed data is fed back to the

data area. There are six types of data in the data area: function code, end code, data length, data number, data attribute, channel number, and data content. The storage format is as follows.

Initial address 0	Function code	Constant output
Initial address 1	End code	
Initial address 2	Data length	
Initial address 3	Data number	Constant output
Initial address 4	Data attributes	Constant output
Initial address 5	Channel number	Constant output
Initial address 6	Data area	

ERR: Function completion output address, the address can be Y, G, R, K, A, D, C, T, DC, DT. It is 0 when the window command is not executed or is being executed, and it is set to 1 after the execution is complete.

- Program example



Note: When R220.0=1, read the data in the data area starting from D0000 (6+N data, N is determined by the data length D0002), and feed the processed data back to the data area. The data area is as follows.

D0000	**Function code**
D0001	**End code**
D0002	**Data length**
D0003	**Data number**
D0004	**Data attributes**
D0005	**Channel number**
D0006	**Data area**
…	(determined by the data length)

Precautions

(1) In the process, it is divided into high-speed window function and low-speed window function (determined by function). In the low-speed window function, the instruction may take more than two cycles to complete the scan. Therefore, ACT=1 must be maintained during the execution of the low-speed window instruction, and the control data does not change. After the processing is over (ERR is 1), the ACT must be reset once before the next low-speed window command execution can be performed.

In the high-speed window function, the command can be completed in the grade scan. After the processing is completed (ERR is 1), the next high-speed window instruction can be executed without resetting the ACT. Therefore, when ACT is always 1, data will be read and written continuously.

(2) The D address data length is 32 bits, and the value range is -2,147,483,647～2,147,483,647. The data in

the window function is based on the D address data length unit, which is 4 bytes. In the data arrangement, the address plus 1 means the data address is shifted by four bytes, each increase of 1 in the data length means the data length increases by 4 bytes.

(3) The length of the data area in the window function is not certain. Enough space must be reserved for the data area when writing PLC programs to prevent running errors.

(4) The channel number is only used in the dual-channel system. For the standard system, the reserved data does not need to be input. (When the number of channels in the dual-channel system is set to 1, no input is required)

(5) When ERR is 1, it means that the window function processing is completed, but it does not mean that the data processing is successful. Only from the output code can the state after the current execution be judged. The meaning of the end code is as follows.

End Code	Significance
0	Normal end
1	Invalid function code
2	Invalid data block length
3	Invalid data number
4	Invalid data attribute
5	Invalid channel number
6	Invalid data
7	Does not have the corresponding function
8	Write protection status

- Function code list

SN	Function	Function code	R/W
1	Read CNC system information	**0**	R
2	Read the current authority level of CNC	5	R
3	Read tool offset value	13	R
4	Write tool offset value [Low speed response]	14	W
5	Read Parameters	17	R
6	Write parameters [Low speed response]	18	W
7	Read macro variable	21	R
8	Write macro variable [Low speed response]	22	W
9	Read the absolute position of each axis (absolute coordinate value)	27	R
10	Read the mechanical position of each axis (machine coordinate value)	28	R
11	Read the load current value of the servo motor (A/D conversion data)	34	R
12	Encoder updates coordinate values in real time	77	R
13	Read the servo following error coordinate value	78	R
14	Read the load percentage of the feed axis motor	79	R
15	Read the load percentage of the spindle motor	80	R
16	Read the system cutting time	81	R
17	Read the positions of each auxiliary axis	82	R

SN	Function	Function code	R/W
18	Read the torque of the feed axis motor	83	R
19	Read the load torque of the spindle motor	84	R
20	Read clock data (date and time)	151	R
21	Read spindle motor load information	153	R

◆ Read CNC system information

Read CNC specific information. Including CNC name, system type, software version number, and number of control axes.

- Input data

Initial address +0	Function code 0
1	End code ——
2	Data length ——
3	Data number ——
4	Data attributes ——
5	Channel number ——
6	Data area ——

- Output data

Initial address +0	Function code 0	
1	End code 0	
2	Data length 5	
3	Data number ——	
4	Data attributes ——	
5	Channel number ——	
6	Data area CNC name	
7	Data area System type	
8	Data area System serial number	
9	Data area Software version	Expressed in decimal, for example, the value of V1.02 is 102
10	Data area Number of control axes	Same as the current axis number

◆ **Read current authority level of CNC**

Read CNC specific information. Including CNC name, system type, software version number, and number of control axes.

- Input data

Initial address	
+0	Function code 5
1	End code ——
2	Data length ——
3	Data number ——
4	Data attributes ——
5	Channel number ——
6	Data area ——

- Output data

Initial address		
+0	Function code 5	
1	End code 0	
2	Data length 1	
3	Data number ——	
4	Data attributes ——	
5	Channel number ——	
6	Data area System permission level	The permission level of the current system

◆ **Read tool offset value**

Read the tool offset value, wear value, radius compensation value, and imaginary tool nose number.

- Input data

Initial address	
+0	Function code 13
1	End code ——
2	Data length ——
3	Data number Tool offset number
4	Data attributes Bias type
5	Channel number ——
6	Data area ——

- Bias type

	X	**Z**	**Tool Nose R**	**Assumed Tool Nose**	**Y**
Offset	0	2	4	6	8
Wearing	1	3	5	7	9

- Output data

Initial address	
+0	Function code 13
1	End code End code description
2	Data length 1
3	Data number ——
4	Data attributes ——
5	Channel number ——
6	Data area Offset data

- Unit of offset data

Input unit	**IS-B**	**IS-C**
Metric	0.001 (mm)	0.0001 (mm)
Imperial	0.0001 (inch)	0.00001 (inch)

- End code description

End Code	**End Code Description**
0	Normal reading
3	The specified offset number is invalid (the offset number exceeds the valid range of 1～99).
4	The specified offset type is invalid (the offset type exceeds the valid range)

◆ **Write tool offset value (Low speed response)**

Write the tool offset value, wear value, radius compensation value, and imaginary tool nose number.

- Input data

Initial address		
	+0	Function code 14
	1	End code ——
	2	Data length 1
	3	Data number Tool offset number
	4	Data attributes Bias type
	5	Channel number ——
	6	Data area Offset data

- Bias type

	X	Z	Tool Nose R	Assumed Tool Nose	Y
Offset	0	2	4	6	8
Wearing	1	3	5	7	9

- Unit of offset data

Input unit	IS-B	IS-C
Metric	0.001 (mm)	0.0001 (mm)
Imperial	0.000 (inch)	0.00001 (inch)

- Output data

Initial address		
	+0	Function code 14
	1	End code End code description
	2	Data length 1
	3	Data number ——
	4	Data attributes ——
	5	Channel number ——
	6	Data area ——

- End code description

End Code	End Code Description
0	Normal reading
2	Invalid data length specification
3	The specified offset number is invalid (the offset number is out of the valid range 1～99)
4	The specified offset type is invalid (the offset type exceeds the valid range)
6	Invalid data

◆ **Read parameters**

Axis type parameters can be selected for one shaft output or all axis at the same time.

- Input data

Initial address		
	+0	Function code 17
	1	End code ——
	2	Data length ——
	3	Data number Parameter Number
	4	Data attributes Parameter axis selection
	5	Channel number ——
	6	Data area ——

- Parameter axis selection

  For non-axis type, non-spindle type, and non-channel type, the parameter must be set to 0.

  - For the axis type parameter setting range:

Axis	1 st	2nd	3rd	4th	5th	Nth	All axes
Code	1	2	3	4	5	6	-1

  - For the spindle axis type parameter setting range:

Spindle	1st Spindle	2nd Spindle	3rd Spindle	4th Spindle	Full Spindle
Code	1	2	3	4	-1

  The parameter axis selection must be strictly in accordance with the norm; otherwise it will be regarded as an invalid data attribute error (end code 4).

- Output data

Initial address		
	+0	Function code 17
	1	End code End code description
	2	Data length Data length description
	3	Data number ——
	4	Data attributes ——
	5	Channel number ——
	6	Data area Parameter data

- Data length description

1. When the parameter axis selection is not -1, that is, it is not the axis parameter of all-axis output, the data length is 1.

2. When the selected parameter is a channel type parameter and all channels are output, the data length is 2.

3. When the selected parameter is the spindle axis type parameter and the full axis is output, the data length is 3.

4. When the selected parameter is the feed axis type parameter and the full axis is output, the data length is #8130 and the number of valid axes is set.

- Parameter data

System parameters are divided into two types of word parameters and bit parameters:

1. For word parameters, read the parameter value directly, and each value occupies 4 bytes.
2. The bit parameter is read as an eight-bit binary number, and one of them cannot be read separately. Although the effective length of each bit parameter is one byte, for data alignment and uniform format, the bit parameter also occupies 4 bytes when output.
3. For a parameter that takes effect after power-on, if the parameter has been modified before being read, the value of the parameter before the modification is read instead of the value after the modification. That is, what is obtained is the current effective value.

- End code description

End Code	Code Description
0	Read normally.
3	The parameter number is out of the valid range.
4	The parameter axis is invalid.

◆ **Write parameters (Low-speed response)**

The axis parameters can be written in one axis or all axes at the same time. Some parameters will generate an alarm after modification.

- Input data

Initial address		
	+0	Function code 18
	1	End code ——
	2	Data length 1
	3	Data number Parameter number
	4	Data attributes Parameter axis selection
	5	Channel number ——
	6	Data area Parameter data

- Parameter axis selection

  For parameters that are not axis type, spindle type, and channel type, it must be set to 0.

  ■ For the axis type parameter setting range:

Axis Number	**1st**	**2nd**	**3rd**	**4th**	**5th**	**Nth**	**All Axes**
Code	**1**	**2**	**3**	**4**	**5**	**6**	**-1**

  ■ For the spindle axis type parameter setting range:

Spindle	**1st Spindle**	**2nd Spindle**	**3rd Apindle**	**4th spindle**	**Full Axis**
Code	**1**	**2**	**3**	**4**	**-1**

  The parameter axis selection must be strictly in accordance with the norm; otherwise, it will be regarded as an invalid data attribute error (end code 4).

- Parameter data

  System parameters are divided into two types of word parameters and bit parameters:

  1. For data parameters, write parameter values directly;

  2. For the status parameter, convert the input value to binary and modify the corresponding BIT bit.

- Output data

Initial address+0	Function code 18
1	End Code End code description
2	Data length ——
3	Data number ——
4	Data attributes ——
5	Channel number ——
6	Data area ——

- End code description

End Code	End Code Description
0	Read normally.
2	The data length specification is invalid.
3	The parameter number is out of the valid range.(1~254)
4	The parameter axis is invalid.
6	The parameter value is out of the valid range.

◆ **Read macro variable**

Read the macro variables in the system.

- Input data

Initial address +0	Function code 21
1	End Code ——
2	Data length ——
3	Data number Macro variable number
4	Data attributes Decimal places
5	Channel number ——
6	Data area ——

- Macro variable number
  Only public variables (#100~#199, #500~#999) and system variables (#1000~) can be selected for reading, and local variables (#1~#33) cannot be selected.
- Decimal places
  Set the decimal place of the macro variable, which cannot be greater than 7.
- Output data

Initial address+0	Function code 21
1	End Code End code description
2	Data length 2
3	Data number ——
4	Data attributes ——
5	Channel number ——
6	Data area Numerical part
7	Data area Decimal places

- Integer part
  Store the numerical part a of the macro variable.
- Index part
  Store the decimal place b of the macro variable, the actual value is: $a \times 10^{-b}$.
- End code description

End Code	End Code Description
0	Read normally.
3	The macro variable number is invalid (a local variable is selected, or a macro variable that does not exist).
4	Invalid decimal places.
6	The value of the macro variable exceeds the readable range or the macro variable is empty.

◆ **Write macro variables (Low-speed response)**

Input data to the macro variables of the system.

- Input data

Initial address	Function code
+0	22
1	End Code ——
2	Data length 2
3	Data number Macro variable number
4	Data attributes ——
5	Channel number ——
6	Data area Numerical part
7	Data area Decimal part

- Macro variable number
  Only public variables (#100~#199, #500~#999) and system variables (#1000~) can be selected for writing, and local variables (#1~#33) cannot be selected.
- Integer part
  Store the numerical part a (the numerical part can only be an integer).
- Index part
  Store the index part b, the actual value is: $a \times 10^{-b}$.
- Output data

Initial address	Function code
+0	22
1	End code End code description
2	Data length ——
3	Data number ——
4	Data attributes ——
5	Channel number ——
6	Data area ——

- End code description

End Code	End Code Description
0	Normal reading
2	The data length specification is invalid.
3	The macro variable number is invalid (a local variable is selected, or a macro variable that does not exist).
8	Data write protection or macro variable read only

◆ **Read the absolute coordinates of each axis (Absolute coordinate value)**

Read the absolute coordinates of each axis.

- Input data

Initial address	
+0	Function code 27
1	End code ——
2	Data length ——
3	Data number ——
4	Data attributes Axis selection
5	Channel number ——
6	Data area ——

- Axis selection

axis	1st	2nd	3rd	4th	5th	N th	All axes
Code	1	2	3	4	5	6	-1

- Output data

Initial address		
	+0	Function code 27
	1	End code End code description
	2	Data length Data length description
	3	Data number ——
	4	Data attributes ——
	5	Channel number ——
	6	Data area Absolute coordinate

- Data length description
  When the selected axis is any axis, the data length is 1.
  When the selected axis is all axes, the data length is #8130 and the number of valid axes is set.
- Absolute coordinates
  When all axes are selected for output, the coordinate data is output in the order of 1st, 2nd, 3rd, 4th, 5th, and invalid axes are also output.
- Absolute coordinate unit

Input unit	IS-B	IS-C
Metric	0.001 (mm)	0.0001 (mm)
Imperial	0.0001 (inch)	0.00001 (inch)

- End code description

End Code	End Code Description
0	Normal reading
4	Invalid axis selected

◆ **Read the mechanical position of each axis (Machine coordinate value)**

Read the machine coordinates of each axis.

- Input data

Initial address		
	+0	Function code 28
	1	End code ——
	2	Data length ——
	3	Data number ——
	4	Data attributes Axis selection
	5	Channel number ——
	6	Data area ——

- Axis selection

axis	1st	2nd	3rd	4th	5th	Nth	All axes
Code	1	2	3	4	5	6	-1

- Output data

Initial address		
	+0	Function code 28
	1	End Code End code description
	2	Data length Data length description
	3	Data number ——
	4	Data attributes ——
	5	Channel number ——
	6	Data area Machine coordinate

- Data length description

  1. When the selected axis is any axis, the data length is 1.

  2. When the selected axis is all axes, the data length is#8130 and the number of valid axes is set.

- Mechanical coordinates

  1. When all axes are selected for output, the coordinate data is output in the order of 1st, 2nd, 3rd, 4th, 5th, and invalid axes are also output.

  2. If the system only uses X, Y, C (5th) three axes. Full-axis output is also performed.

- Machine coordinate unit

Input unit	IS-B	IS-C
Metric	0.001 (mm)	0.0001 (mm)
Imperial	0.0001 (inch)	0.00001 (inch)

- End code description

End Code	End Code Description
0	Normal reading
4	Invalid axis selected

◆ **Read the current value of each feed axis**

Read the current value of each feed axis (unit: 0.1 A).

- Input data

Initial address+0	Function code 34
1	End code ——
2	Data length ——
3	Data number ——
4	Data attributes Axis selection
5	Channel number ——
6	Data area ——

- Axis selection

Feed Axis	**1 st**	**2nd**	**3rd**	**4th**	**5th**	**N th**	**All Axes**
Code	1	2	3	4	5	6	-1

- Output data

Initial address +0	Function code 34
1	End code End code description
2	Data length Data length description
3	Data number ——
4	Data attributes ——
5	Channel number ——
6	Data area Current value (0.1 A)

- Data length description

  1. When the selected axis is any axis, the data length is 1.

  2. When the selected axis is all axes, the data length is#8130 and the number of valid axes is set.

- Current value

The current value of the feed axis returned in the data area is the data magnified 10 times, that is, the unit is 0.1 A.

- End code description

End Code	End Code Description
0	Read normally.
4	The selected axis is invalid.

◆ **Read the encoder position of each axis**

Read the encoder coordinates of a certain axis or all axes.

- Input data

Initial address		
	+0	Function code 77
	1	End code ——
	2	Data length ——
	3	Data number ——
	4	Data attributes Axis selection
	5	Channel number ——
	6	Data area ——

- Axis selection

Feed Axis	1 st	2nd	3rd	4th	5th	N th	All Axes
Code	1	2	3	4	5	6	-1

- Output data

Initial address+0	
	Function code 77
1	End code End code description
2	Data length Data length description
3	Data number ——
4	Data attributes ——
5	Channel number ——
6	Data area Encoder coordinates

- Data length description

  1. When the selected axis is any axis, the data length is 1.

  2. When the selected axis is all axes, the data length is n (n is the maximum number of axes).

- Machine Coordinate

  When all axes are selected for output, the coordinate data is output in the order of 1st, 2nd, 3rd, 4th, 5th, and invalid axes are also output.

  For example, when the system only uses X, Y, and C (5th) three axes, it also performs full-axis output.

- Encoder coordinate unit

Input Unit	IS-B	IS-C
Metric	0.001(mm)	0.0001(mm)
Imperial	0.0001(inch)	0.00001(inch)

- End code description

End Code	End Code Description
0	Read normally.
4	The selected axis is invalid.

◆ **Read the servo following error of each axis**

Read the servo following error of each axis.

- Input data

Initial address		Function code
	+0	78
	1	End code ——
	2	Data length ——
	3	Data number ——
	4	Data attributes Axis selection
	5	Channel number ——
	6	Data area ——

- Axis selection

Feed Axis	1st	2nd	3rd	4th	5th	Nth	All Axes
Code	1	2	3	4	5	6	-1

- Output data

Initial address+0	Function code 78
1	End code End code description
2	Data length Data length description
3	Data number ——
4	Data attributes ——
5	Channel number ——
6	Data area Following error value

- Data length description

  1. When the selected axis is any axis, the data length is 1.

  2. When the selected axis is all axes, the data length is n (n is the maximum number of axes).

- Machine Coordinate

  When all axes are selected for output, the coordinate data is output in the order of 1st, 2nd, 3rd, 4th, 5th, and invalid axes are also output.

  For example, when the system only uses X, Y, and C (5th) three axes, it also performs full-axis output.

- Encoder coordinate unit

Input Unit	IS-B	IS-C
Metric	0.001(mm)	0.0001(mm)
Imperial	0.0001(inch)	0.00001(inch)

- End code description

End Code	End Code Description
0	Read normally.
4	The selected axis is invalid.

◆ **Read the load percentage of the feed axis motor**

Read the load percentage of the feed axis motor(Unit: 1%)

- Input data

Initial address		
	+0	Function code 79
	1	End code ——
	2	Data length ——
	3	Data number ——
	4	Data attributes Axis selection
	5	Channel number ——
	6	Data area ——

- Axis selection

Feed Axis	**1 st**	**2nd**	**3rd**	**4th**	**5th**	**N th**	**All Axes**
Code	1	2	3	4	5	N	-1

- Output data

Initial address		
	+0	Function code 79
	1	End code End code description
	2	Data length Data length description
	3	Data number ——
	4	Data attributes ——
	5	Channel number ——
	6	Data area Percentage value (1%)

- Data length description
  When the selected axis is any axis, the data length is 1.
  When the selected axis is all axes, the data length is n (n is the maximum number of axes).
- Percentage value
  The percentage value returned in the data area is the numerator of the load percentage scaled up, with the unit being 1%.
- End code description

End Code	End Code Description
0	Read normally.
4	The selected axis is invalid.

◆ **Read the load percentage of the spindle motor**

Read the load percentage of the spindle motor(Unit: 1%)

- Input data

Initial address		Function code
	+0	80
	1	End code ——
	2	Data length ——
	3	Data number ——
	4	Data attributes Axis selection
	5	Channel number ——
	6	Data area ——

- Axis selection

Feed Axis	1st	2nd	3rd	4th	All Axes
Code	1	2	3	4	-1

- Output data

Initial address		Function code
	+0	80
	1	End code End code description
	2	Data length Data length description
	3	Data number ——
	4	Data attributes ——
	5	Channel number ——
	6	Data area Percentage value (1%)

- Data length description

When the selected axis is any axis, the data length is 1.

When the selected axis is all axes, the data length is n (n is the maximum number of axes).

- Percentage value

  The percentage value returned in the data area is the numerator of the load percentage scaled up, with the unit being 1%.

- End code description

End Code	End Code Description
0	Read normally.
4	The selected axis is invalid.

◆ **Read the system cutting time**

Read the system cutting time

- Input data

Initial address		
	+0	Function code 81
	1	End code ——
	2	Data length ——
	3	Data number ——
	4	Data attributes Axis selection
	5	Channel number ——
	6	Data area ——

- Output data

Initial address		
	+0	Function code 81
	1	End code 0
	2	Data length 3
	3	Data number ——
	4	Data attributes ——
	5	Channel number ——
	6	Data area Hour
	7	Data area Minute
	8	Data area Second

◆ **Read the positions of each auxiliary axis**

Read the positions of each auxiliary axis.

- Input data

Initial address		
	+0	Function code 82
	1	End code ——
	2	Data length ——
	3	Data number ——
	4	Data attributes Axis selection
	5	Channel number ——
	6	Data area ——

- Axis selection

Feed Axis	**1 st**	**2nd**	**3rd**	**4th**	**All Axes**
Code	1	2	3	4	-1

- Output data

Initial address		
	+0	Function code 82
	1	End code End code description
	2	Data length Data length description
	3	Data number ——
	4	Data attributes ——
	5	Channel number ——
	6	Data area Absolute Coordinate

- Data length description

  1. When the selected axis is any axis, the data length is 1.

  2. When the selected axis is all axes, the data length is#8140 and the number of valid axes is set.

- Coordinate unit

Input Unit	**IS-B**	**IS-C**
Metric	0.001(mm)	0.0001(mm)
Imperial	0.0001(inch)	0.00001(inch)

- End code description

End Code	End Code Description
0	Read normally.
4	The selected axis is invalid.

◆ **Read the load torque of the feed axis motor**

Read the load torque of the feed axis motor(Unit: 0.01N・m)

- Input data

Initial address +0	Function code 83
1	End code ——
2	Data length ——
3	Data number ——
4	Data attributes Axis selection
5	Channel number ——
6	Data area ——

- Axis selection

Feed Axis	1 st	2nd	3rd	4th	5th	N th	All Axes
Code	1	2	3	4	5	6	-1

- Output data

Initial address+0	Function code 83
1	End code End code description
2	Data length Data length description
3	Data number ——
4	Data attributes ——
5	Channel number ——
6	Data area Torque Value (0.01N・m)

- Data length description

  When the selected axis is any axis, the data length is 1.

  When the selected axis is all axes, the data length is n (n is the maximum number of axes).

- Torque Value

The torque value returned in the data area is scaled up by 100 times, with the unit being 0.01 N·m.

- End code description

End Code	End Code Description
0	Read normally.
4	The selected axis is invalid.

◆ **Read the load torque of the spindle motor**

Read the load torque of the spindle motor(Unit: 0.01N • m)

- Input data

Initial address	+0	Function code 84
	1	End code ——
	2	Data length ——
	3	Data number ——
	4	Data attributes Axis selection
	5	Channel number ——
	6	Data area ——

- Axis selection

Feed Axis	**1 st**	**2nd**	**3rd**	**4th**	**All Axes**
Code	1	2	3	4	-1

- Output data

Initial address+0	Function code 84
1	End code End code description
2	Data length Data length description
3	Data number ——
4	Data attributes ——
5	Channel number ——
6	Data area Torque Value (0.01N • m)

- Data length description

  When the selected axis is any axis, the data length is 1.

  When the selected axis is all axes, the data length is n (n is the maximum number of axes).

- Torque Value

The torque value returned in the data area is scaled up by 100 times, with the unit being 0.01 N·m.

- End code description

End Code	End Code Description
0	Read normally.
4	The selected axis is invalid.

◆ **Read system time**

Read the system time.

- Input data

Initial address	
+0	Function code 151
1	End code ——
2	Data length ——
3	Data number ——
4	Data attributes ——
5	Channel number ——
6	Data area ——

- Output data

Initial address	
+0	Function code 151
1	End code 0
2	Data length 6
3	Data number ——
4	Data attributes ——
5	Channel number ——
6	Data area Years
7	Data area Month
8	Data area Day
9	Data area Hour
10	Data area Minute
11	Data area Second

◆ **Read the current value of each spindle**

Read the current value of each spindle (unit: 0.1 A).

- Input data

Initial address +0	Function code 153
1	End code ——
2	Data length ——
3	Data number ——
4	Data attributes Axis selection
5	Channel number ——
6	Data area ——

- Axis selection

Feed Axis	**1 st**	**2nd**	**3rd**	**4th**	**All Axes**
Code	1	2	3	4	-1

- Output data

Initial address+0	Function code 153
1	End code End code description
2	Data length Data length description
3	Data number ——
4	Data attributes ——
5	Channel number ——
6	Data area Current value (0.1 A)

- Data length description

  When the selected axis is any axis, the data length is 1.

  When the selected axis is all axes, the data length is n (n is the maximum number of axes).
- Current value

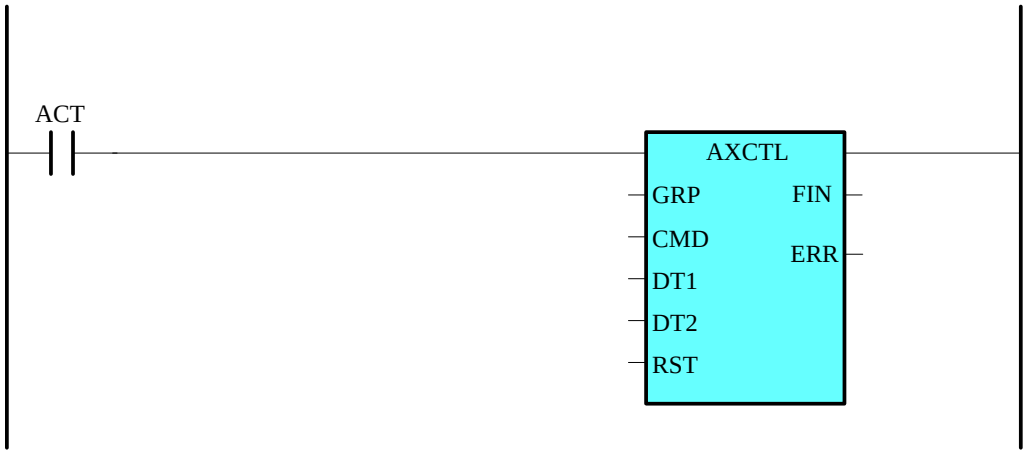
The spindle current value returned in the data area is the data magnified 10 times, that is, the unit is 0.1A.

- End code description

End Code	End Code Description
0	Normal reading
4	Invalid axis selected

1.4.37 AXCTL (PLC control axis)

- Command function
  Execute PLC axis control command
- Command format



ACT=0: Do not execute the AXCTL function.

ACT=1: Execute AXCTL command, ACT must remain at 1 until the execution of the axis control instruction ends. To avoid repeated execution, reset ACT immediately after execution (FIN=1).

- Parameter description

Parameter Name	Parameter Signification	Data Types
GRP	DI / DO group number (1-4) Corresponding to parameter #8010, if the setting value of an axis is the same as GRP, the axis is controlled.	Constant or X, Y, F, G, R, K, A, D, C, T, DC, DT (Byte address)
CMD	For control commands, see the list of PLC axis control commands for details.	Constant or X, Y, F, G, R, K, A, D, C, T, DC, DT (Byte address)
DT1	Command data 1, related to specific control commands.	Constant or X, Y, F, G, R, K, A, D, C, T, DC, DT (Byte address)
DT2	Command data 2 is related to specific control commands.	Constant or X, Y, F, G, R, K, A, D, C, T, DC, DT (Byte address)
RST	Reset input bit RST=1: The command is cleared and execution is aborted. It is recommended to set RST when CNC alarm or CNC reset	X, Y, F, G, R, K, A (Bit address)

Parameter Name	Parameter Signification	Data Types
FIN	End signal output bit FIN=0: not started or is being executed; FIN=1: When the axis control command is executed (including normal end and error).	Y, G, R, K, A (Bit address)
ERR	Command execution error output ERR=0:No error; ERR=1: Execution error.	Y, G, R, K, A (Bit address)

- Execution process and related signals

  In order to make the described process more concise, clear and easy to understand, the parameters and PLC signals involved in this section are only brief descriptions. Please check the parameter manual and PLC signal description document (see 4.11 in Chapter 4) in actual use to understand the specific details of the precautions.

- Parameter settings

  Which group of DI/DO controls the PLC axis is set by parameter No8010, please set this parameter according to the following instructions.

8010	DI/DO group selection for each axis in PLC axis control

[Data Type] Word

[Value range] 0～4

The DI/DO groups used by each PLC control axis are shown in the following table.

Value	Descriptions
0	The axis is not controlled by PLC
1	Use DI/DO signal of Group A
2	Use DI/DO signal of Group B
3	Use DI/DO signal of Group C
4	Use DI/DO signal of Group D

- Signal enable

  Before executing the AXCTL command the control axis selection signal (EX1～EX5) of the corresponding axis must be set to 1, and the signal address is G0136, as shown below.

	#7	#6	#5	#4	#3	#2	#1	#0
G0136				EAX5	EAX4	EAX3	EAX2	EAX1

[Type] Input signal

[Function] When the signal is set to '1', the corresponding axis becomes PLC control

When the signal is set to '0', the PLC control becomes invalid.

Note: After setting the control axis selection signals EAX1～EAX5 to '1', it will take at least 8ms before the PLC can send commands to the CNC.

- AXCTL execution process

  The AXCTL process described below is executed inside AXCTL. There is no need to write the process or read and write related signals in the ladder diagram. The description here is only for the user to

understand the related process and make it easier to debug and diagnose.

1. When ACT changes from 0 to 1, AXCTL starts to execute and the following actions will be executed
   a) CMD is filled into the axis control command register (EC0g to EC6g)
   b) DT1 is filled in the axis control feed rate register (EIF0g to EIF15g)
   c) DT2 is filled in the axis control data register (EID0g to EID15g)
   d) Reverse axis control read signal EBUFg.

Related information address

DI / DO Group	Command Register EC0g-EC6g	Speed Register EIF0g-EIF15g	Data Registration EID0g-EID15g	Axis Control Reading Signal EBUFg
1	G0141.0-G0141.6	G0142 and G0143	G0144 and G0145	G0140.7
2	G0151.0-G0151.6	G0152 and G0153	G0154 and G0155	G0150.7
3	G0161.0-G0161.6	G0162 and G0163	G0164 and G0165	G0160.7
4	G0171.0-G0171.6	G0172 and G0173	G0174 and G0175	G0170.7

2. When ACT keeps at 1, the PLC control command keeps executing. AXCTL checks the execution status of the command once every PLC cycle, and checks the following status:
   a) Set FIN to 1 when the query is completed, otherwise keep it to 0;
   b) If an execution error or alarm is found, set ERR to 1, otherwise it is 0;
   c) When RST=1 is found, the axis control reset signal EXLRg is set to 1, and FIN is also set to 1.
3. When ACT changes from 1 to 0, AXCTL is suspended. The processing in different states is as follows:
   a) Regardless of the execution result, FIN and ERR are set to 0;
   b) If the current axis control command is not completed, set the program stop signal ESBKg to 1.

- Related information address

DI / DO Group	Reset Signal ECLRg	Stop Signal ESBKg
1	G0140.6	G0140.3
2	G0150.6	G0150.3
3	G0160.6	G0160.3
4	G0170.6	G0170.3

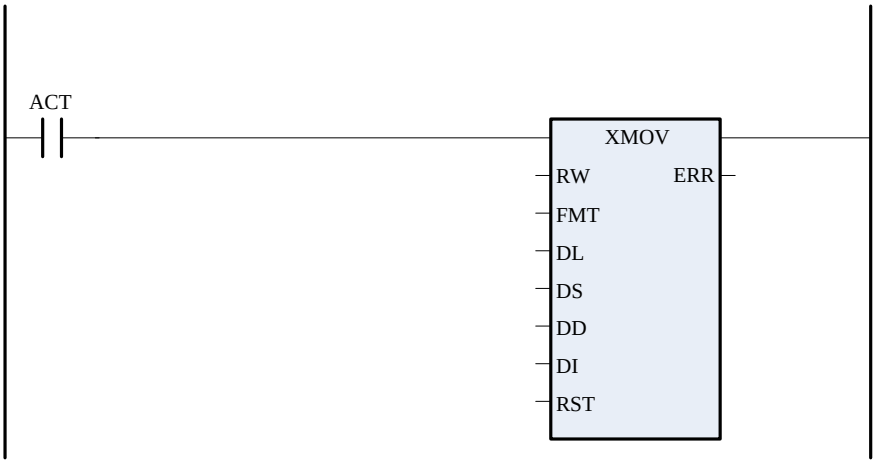
- Axis control command list

Operate	Script (CMD)	Command Data 1 (DT1)	Command data 2 (DT2)
Fast Moving	0x00	Feed rate When parameter #8002.0=0, there is no need to set this value. Speed is determined by system parameters	Total trip
Cutting infeed (Feed per minute)	0x01	Feed rate	Total trip
Cutting infeed (Feed per revolution)	0x02	Feed rate	N/A.
Pause	0x04	N/A.	Pause time

Operate	Script (CMD)	Command Data 1 (DT1)	Command data 2 (DT2)
Manual return to reference point	0x05	N/A.	N/A.
Continuous feed	0x06	Feed rate	Feed direction
Return to the first reference point	0x07	Feed rate When parameter #8002.0=0, there is no need to set this value. Speed is determined by system parameters	N/A.
Return to the 2nd reference point	0x08		
Return to the 3rd reference point	0x09		
Return to the 4th reference point	0x0A		
Speed command	0x10	Feed rate	N/A.
1st auxiliary function	0x12		
2nd auxiliary function	0x14		
3rd auxiliary function	0x15		
Selection of machine coordinate system (G53)	0x20	Feed rate When parameter #8002.0=0, there is no need to set this value. Speed is determined by system parameters	Machine coordinate position (Absolute value)

1.4.38 XMOV (Binary index data transfer)

- Command function
  Read or change the contents of the data table.
- Ladder diagram format

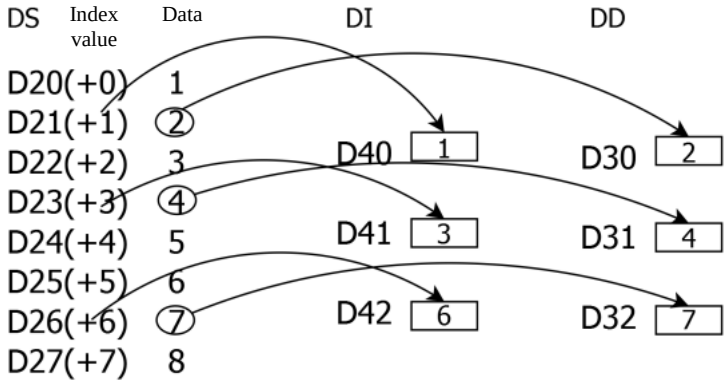


- Control conditions
  ACT=0: Do not execute command.
  ACT=1: Read or write data from the data table with the Initial address specified by DS to the data table with the Initial address specified by DD.
- Parameter description

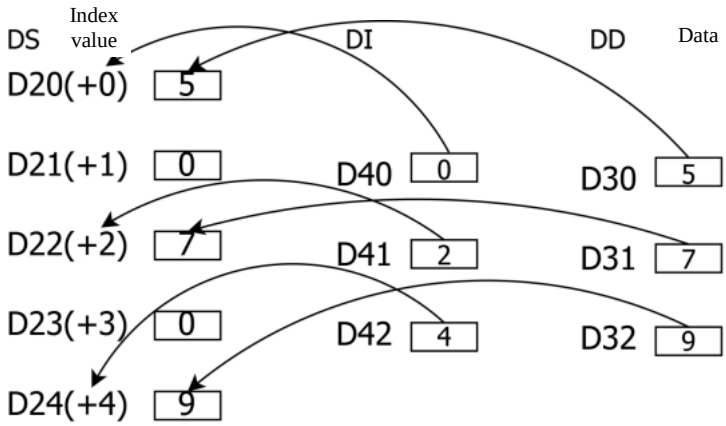
Parameter Name	Parameter Signification	Data Types
RW	Read/write designation. RW=0: Read data from the data table with the Initial address specified by DS to the data table with the Initial address specified by DD. RW=1: Write the data in the data table with the Initial address specified by DD to the data table with the Initial address specified by DS.	Constant
FMT	It is specified in the form of a command with a 4-bit constant. 0 n n x The byte length setting can only be selected among 1, 2, and 4 Index array length 00-01: Transmit 1 data 02-99: Continuously read or write data table nn times.	Specify format constant
DL	Specify the length of the data table with DS as the first address. According to the byte length setting specified in FMT, the corresponding settable values are as follows: 1 byte length: 1-255; 2 bytes length: 1– 16384; 4 bytes length: 1 – 16384.	Constant or X, Y, F, G, R, K, A, D, C, T, DC, DT (Byte address)
DS	The Initial address of the data table. Specify the Initial address of the data table to be read and written. The number of bytes of register space to be occupied is: (byte length specified in FMT) x (data table length specified by DL).	X, Y, F, G, R, K, A, D, C，T, DC, DT (Byte address)
DD	Input/output data storage address. When reading, it indicates the address of the register storing the reading result. When writing, it indicates the address of the register where the written value is stored.	Y, G, R, K, A, D, C, T, DC, DT (Byte address)
DI	Set the Initial address of the register storing the index value. The data occupies the byte length specified in the FMT.	Y, G, R, K, A, D, C, T, DC, DT (Byte address)
RST	Reset input bit	X, Y, F, G, R, K, A
ERR	Instruction execution error output. ERR=0: No error. ERR=1: Execution error.	Y, G, R, K, A (Bit address)

- Program example

Note: When R0001.1=1, assign the data in the D0020 to D0027 data table to the data table with D0030 as the Initial address according to the index value stored in the DI table. Which three data is determined by the index value stored in the D000I table. The schematic diagram of the process is shown in the figure below.



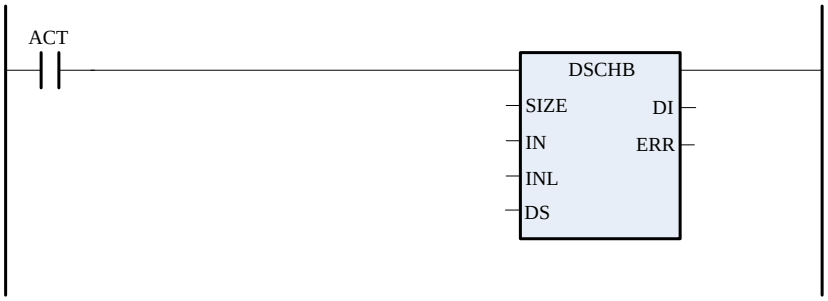
Note: The process of reading data from the DD data table to the DS table is shown in the figure below. The length of the DS data table is 5, and the index array length is 3 (FMT=0034).



1.4.39 DSCHB (Data retrieval)

- Command function

  Retrieve whether the specified data value exists in the data table. If there is, output the number from the beginning of the data table, if not, output the information that there is no data.
- Ladder diagram format



- Control conditions

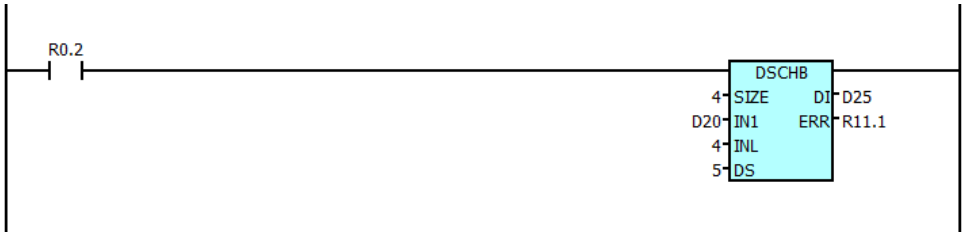
  ACT=0: Do not execute command.

  ACT=1: Search whether the data stored in DS exists from INL data starting from the Initial address of the data table stored in IN. If there is the searched data in the data table, the position in the data table is returned, otherwise, ERR is set to 1. The data table position starts counting at 0.

- Parameter description

Parameter Name	Parameter Signification	Data Types
SIZE	Data length specification (1, 2, 4)	Constant
IN1	Datasheet first address	X, Y, F, G, R, K, A, D, DC, DT (Byte address)
INL	Number of data in the data table	Constant or X, Y, F, G, R, K, A, D, DC, DT (Byte address)
DS	Retrieve data, which can be a constant or an address	Constant or X, Y, F, G, R, K, A, D, DC, DT (byte address)
DI	Retrieval result output address	Y, G, R, K, A, D, DC, DT (Byte address)
ERR	ERR=0: Data is retrieved; ERR=1: No data is retrieved.	Y, G, R, K, A (Bit address)

- Program example



Note: As shown in the above program, when R0.2=1, the number 5 will be searched from the data table from D20 to D23. If there is indeed number 5 in the data table, return the position of number 5 to DI (position counting starts from 0, assuming D20=5, then DI=0). If the number 5 is not found in the data table, set ERR, namely R11.1, to 1.

1.4.40 PSGNL (Position signal output)

- Command function

  This function outputs a signal to specify the range of areas where the current position is located in the

machine coordinate system. Each area is set by AREA. If the range set by AXIS or AREA is wrong, when ACT=1, ERR=1.

- Command format

- Control conditions

  When ACT=0, the command is not executed.

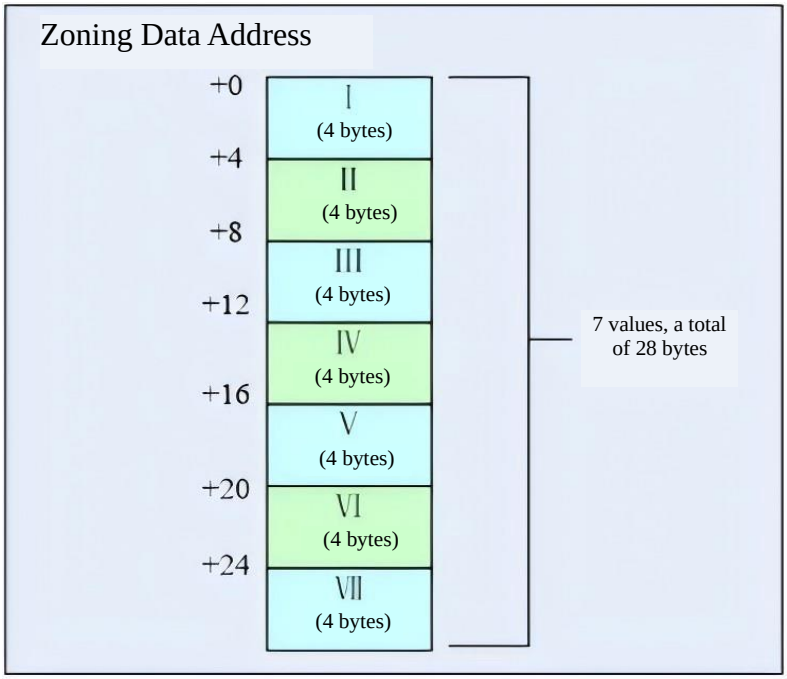
  When ACT=1, output the position area where the machine coordinate of the set axis is located.

- Parameter description

Parameter Name	Parameter Signification	Data Types
AXIS	Axis number data address	Constant or X, Y, F, G, R, K, A, D, C, T, DC, DT (Byte address)
AREA	Area division data address	X, Y, F, G, R, K, A, D, C, T, DC, DT (Byte address)
OUT	Current position area output address	X, Y, F, G, R, K, A, D, C, T, DC, DT (Byte address)
ERR	Error output bit	Y, G, R, K, A (Bit address)

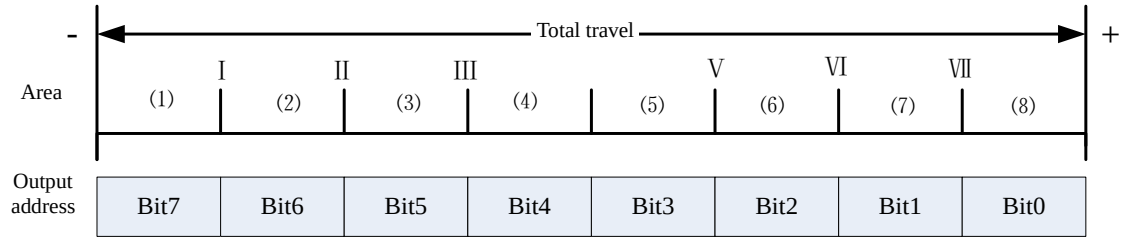
AXIS=1 is the first axis, and AXIS=2 is the second axis. If it is a dual-channel system, AXIS=21 is the first axis of the second channel, and AXIS=22 is the second axis of the second channel.

The address specified by AREA stores 7 area division data consecutively, as shown in the figure below.



7 division points can be divided into 8 areas. When the current axis is at the specified position, the corresponding output address bit is set to 1. The corresponding relationship between the output address

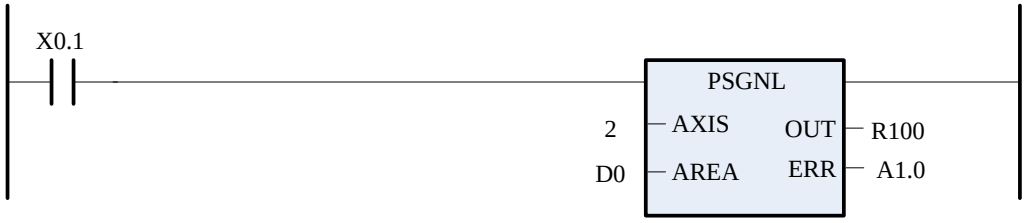
bit and the area is shown in the figure below. The coordinate value filled in the area division data table should be filled in after the corresponding coordinate value is multiplied by the corresponding magnification. If the coordinate value is 100.0000mm, it should be written as 1000000 when filling in the data.



- Coordinate magnification

Unit	IS-B	IS-C
Metric	1000	10000
Imperial	10000	100000

- Program example



Suppose the current coordinate position of the second axis is 150.0000mm, and the values of D0~D6 are as follows.

D0	D1	D2	D3	D4	D5	D6
0	1000000	2000000	3000000	4000000	5000000	6000000

When X0.1=1, check the current area of the second axis is (3), that is, between D0001 and D0002, so set R100.5 to 1, and clear other bits to 0.
When X0.1=0, the command does not act.

1.4.41 PSGN2 (Position signal output 2)

- Command function:
  Position signal output 2, when the current position of the specified axis is in the area between MIN (MIN is a non-negative number) and MAX in the machine tool coordinate system, the output bit OUT=1. If MIN>MAX or AXIS is set incorrectly, when ACT= 1, ERR=1.
- Command format:

- Control conditions
  When ACT=0, the command is not executed.
  When ACT=1, if the machine coordinate of the specified axis is between [MIN, MAX], then OUT=1, otherwise OUT=0.
- Parameter description

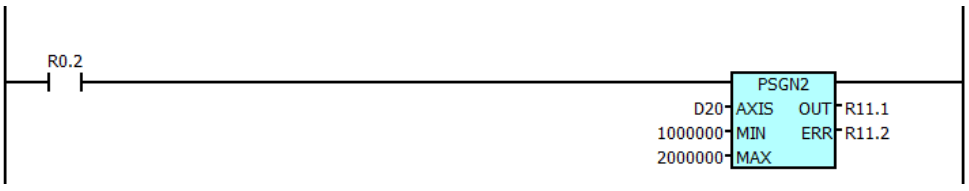
Parameter Name	Descriptions	Address Type
AXIS	Axis number data address	Constant or X, Y, F, G, R, K, A, D, C, T, DC, DT (Byte address)
MIN	Minimum position of the area	Constant or X, Y, F, G, R, K, A, D, C, T, DC, DT (Byte address)
MAX	Maximum position of the area	Constant or X, Y, F, G, R, K, A, D, C, T, DC, DT (Byte address)
OUT	Check result output address	Y, G, R, K, A (bit address)
ERR	Error output bit	Y, G, R, K, A (bit address)

AXIS=1 is the first axis, and AXIS=2 is the second axis. If it is a dual-channel system, AXIS=21 is the first axis of the second channel, and AXIS=22 is the second axis of the second channel. When filling in the position coordinates, it also needs to be multiplied by the corresponding magnification and then filled in. For example, if you want to know whether the current machine coordinate is between 0.0000mm and 100.0000mm, you should fill in 0 in MIN and 1000000 in MAX.

- Coordinate magnification

Unit	IS-B	IS-C
Metric	1000	10000
Imperial	10000	100000

- Program example



Assuming that the current coordinate position of the second axis is 150.0000mm and D0020=2, the

processing is as follows:

When R0.2=1, it is checked that the second axis is in the set area, and R11.1 is set to 1.

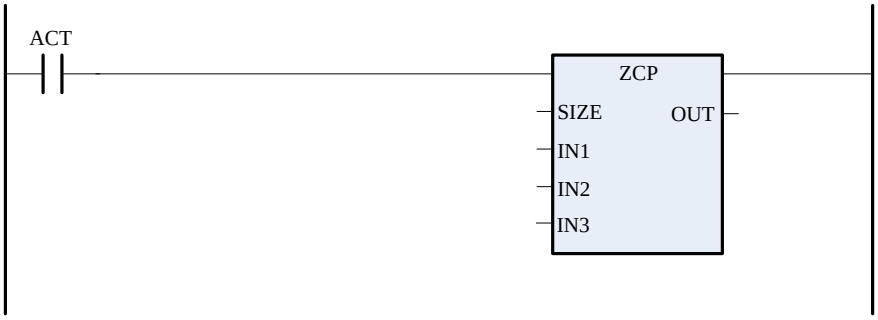
When R0.2=0, the command does not work.

1.4.42 ZCP (Area comparison command)

- Command function

  Compare a certain value or the value in a specified register with a certain area, and output the comparison result.

- Command format



- Control conditions

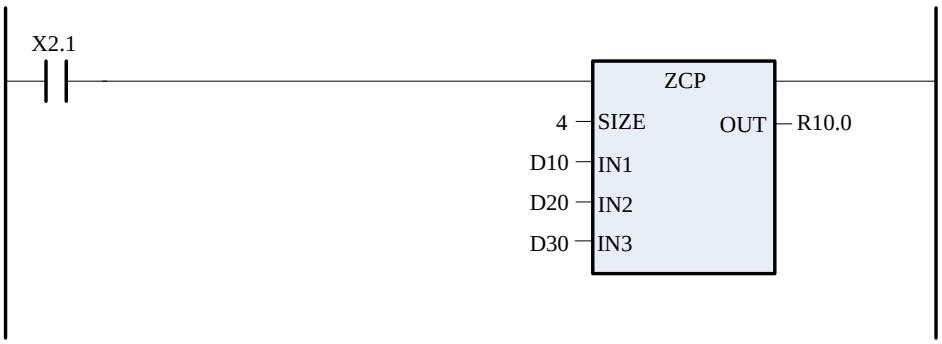
  When ACT=0, the command is not executed.

  When ACT=1, compare the source data with the two data areas

- Parameter description

Parameter Name	Descriptions	Address Type
SIZE	Data length specification (1, 2, 4)	Constant (Only 1, 2, 4)
IN1	Comparison data area 1	Constant or X, Y, F, G, R, K, A, D, C, T (Byte address)
IN2	Comparison data area 2	Constant or X, Y, F, G, R, K, A, D, C, T (Byte address)
IN3	Comparative data	Constant or X, Y, F, G, R, K, A, D, C, T (Byte address)
OUT	Comparison result output start bit	Y, G, R, K, A (Bit address)

- Program example:



When X2.1 is 0, no comparison is made, and the states of R10.0, R10.1, and R10.2 remain unchanged.
When X2.1 is 1, compare the results and the results are shown in the table below.

Size Relationship	R10.0	R10.1	R10.2
IN1>IN2>IN3	1	0	0
IN1>IN3>IN2	1	0	0
IN2>IN1>IN3	1	0	0
IN2>IN3>IN1	0	1	0
IN3>IN1>IN2	0	0	1
IN3>IN2>IN1	0	0	1
IN1=IN2=IN3	0	1	0

It can be seen from the results recorded in the above table:

As long as IN1>IN3, R10.0=1;

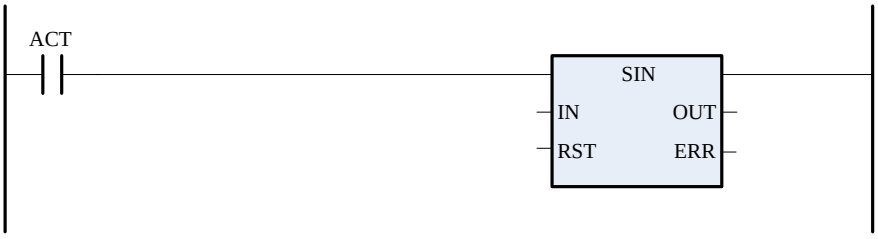
When IN3>IN2, R10.2=1;

When IN1<=IN3<=IN2, R10.1=1.

1.4.43 COS，SIN，TAN

SIN Sine calculation

- Command format



- Command function

  To perform a sine trigonometric operation on the angle value IN and place the result in OUT.

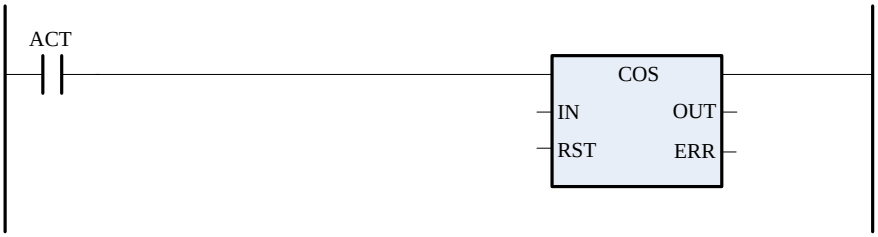
  The input angle is in degrees,if you want to convert it to radians, you can multiply the angle by 1.745329E-2 (which is approximately π/180).

- Parameter description

Parameter Name	Descriptions	Parameter Address
IN	Operation value	D or constant
OUT	Result output address	D
RST	Error reset input address	X,Y,R,K(Bit Address)
ERR	Error output	Y,R,K(Bit Address)

COS Cosine calculation

- Command format



- Command function

  To perform a cosine trigonometric operation on the angle value IN and place the result in OUT.

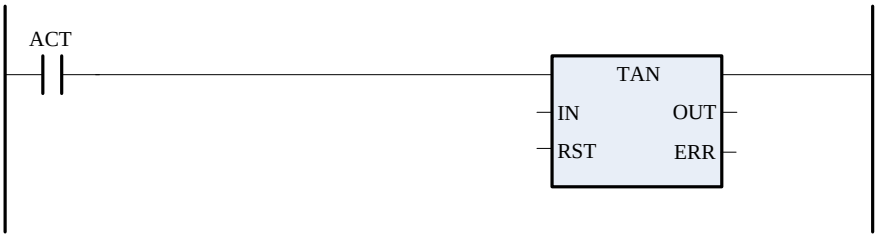
  The input angle is in degrees,if you want to convert it to radians, you can multiply the angle by 1.745329E-2 (which is approximately π/180).

- Parameter description

Parameter Name	Descriptions	Parameter Address
IN	Operation value	D or constant
OUT	Result output address	D
RST	Error reset input address	X,Y,R,K(Bit Address)
ERR	Error output	Y,R,K(Bit Address)

TAN Tangent calculation

- Command format



- Command function

  To perform a tangent trigonometric operation on the angle value IN and place the result in OUT.

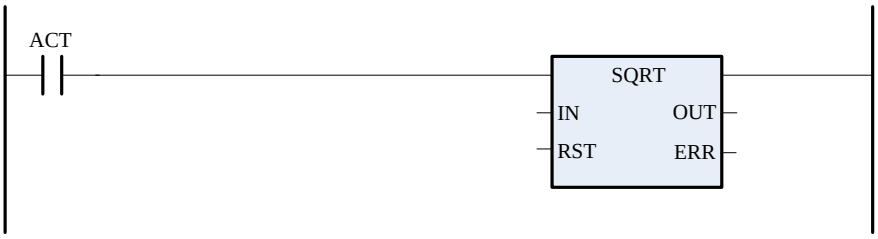
  The input angle is in degrees,if you want to convert it to radians, you can multiply the angle by 1.745329E-2 (which is approximately π/180).

- Parameter description

Parameter Name	Descriptions	Parameter Address
IN	Operation value	D or constant
OUT	Result output address	D
RST	Error reset input address	X,Y,R,K(Bit Address)
ERR	Error output	Y,R,K(Bit Address)

1.4.44 SQRT (Calculate square root)

- Command format

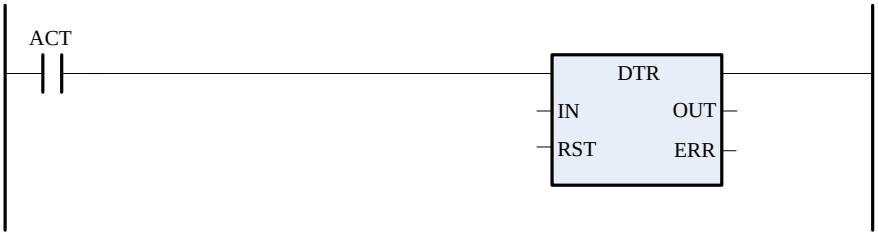


- Command function
  Calculate the square root of a 32-bit real number and generate a 32-bit real number result.
- Parameter description

Parameter Name	Descriptions	Parameter Address
IN	Operation value	D or constant
OUT	Result output address	D
RST	Error reset input address	X,Y,R,K(Bit Address)
ERR	Error output	Y,R,K(Bit Address)

1.4.45 DTR (Convert integer to real number)

- Command format

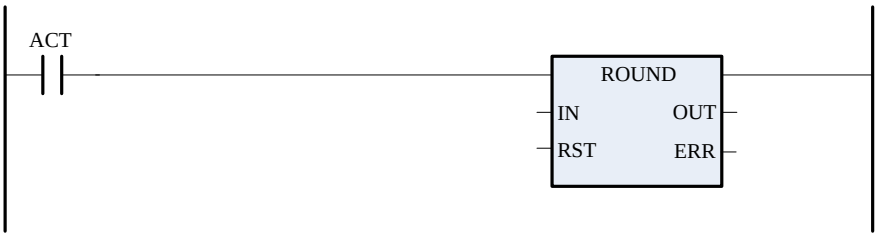


- Command function
  Convert the 32-bit integer in IN to a 32-bit real number and save the result in OUT.
- Parameter description

Parameter Name	Descriptions	Parameter Address
IN	Operation value	D or integer constant
OUT	Result output address	D
RST	Error reset input address	X,Y,R,K(Bit Address)
ERR	Error output	Y,R,K(Bit Address)

1.4.46 ROUND (Round a real number to an integer)

- Command format



- Command function
  Round the 32-bit real number in IN to a 32-bit integer and save the result in OUT.
- Parameter description

Parameter Name	Descriptions	Parameter Address
IN	Operation value	D or real number constant
OUT	Result output address	D
RST	Error reset input address	X,Y,R,K(Bit Address)
ERR	Error output	Y,R,K(Bit Address)

Chapter 2 Programming

2.1 Sequence program structure

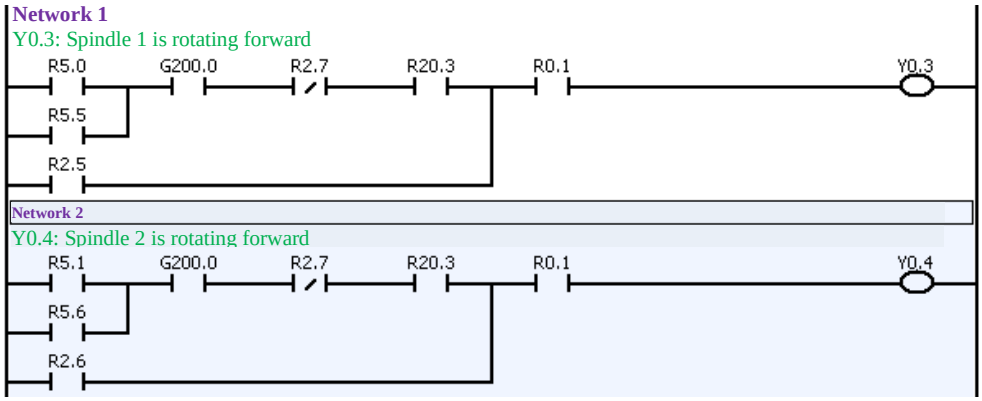
Sequential program refers to a program for logical control of machine tools and related equipment. The program is executed step by step in the order of the ladder diagram. In the traditional PLC, the ladder diagram language is used for preparation. The PLC of system integrates the ideas of traditional PLC and modern structured programming, and adopts the method of structured programming. Subprogram, subprogram nesting and conditional branching can be used in programming, which has obvious advantages over traditional PLCs.

2.2 The execution process of the program

The compiled program (ladder diagram program) is downloaded to the CNC through the serial port or U disk. After the CNC is powered on again, it reads the ladder diagram and converts it into a certain format that the CNC can recognize, and the CPU decodes it Sum operation processing, and then execution.

Since PLC sequence control is realized by software, it is different from the working principle of general relay circuits. Therefore, the principle of sequence control should be fully understood when designing PLC sequence programs.

In a general relay control circuit, each relay can operate at the same time in time. As shown in the figure below, when the conditions are met, Y0.3 and Y0.4 can be output at the same time; in PLC sequence control, each output acts in sequence. When R0.1 is closed and R2.5 and R2.6 are both closed, Y0.3 is output first, and then after a short delay, Y0.4 is output, that is, each output acts in sequence in the order (editing order) in the ladder diagram.



2.2.1 Cyclic execution of the program

The PLC executes from the beginning of the ladder diagram to the end of the ladder diagram. After the operation ends, it executes again from the beginning of the ladder diagram. This is called the cyclic execution of the sequence program.

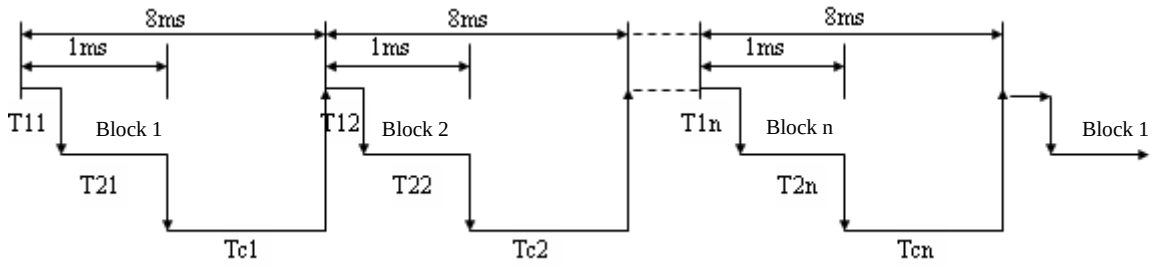
The execution time from the beginning to the end of the ladder diagram is known as the loop processing cycle for short. The shorter the processing cycle, the more responsive the signal is.

2.2.2 Priority of program execution

The PLC program in system is divided into two parts: the first-level program and the second-level program. The execution of the first-level program must be less than 600 steps. Their execution cycles are inconsistent. The first-level program is executed every 8 (ms) to process short pulse signals with fast response; the second-level program is executed every 8n (ms), and n is the number of divisions of the second-level program. When the second-level program is executed, the PLC will automatically divide the second-level program into n blocks according to the time required to execute the program, and execute only one block for each 8 (ms).

The division of the second-level program is to execute the first-level program. When the number of divisions is n, the execution process of the program is shown in the following figure; among them, T11, T12, and T1n are the time required to execute the first-level program every 8ms when the nth cycle is executed. T21, T22, and T2n are the time required to execute the first block, the second block, and the n-th block of the second-level program when one cycle is executed. Tc1, Tc2, and Tcn are the time occupied by the CNC every 8ms when the cycle is executed once.

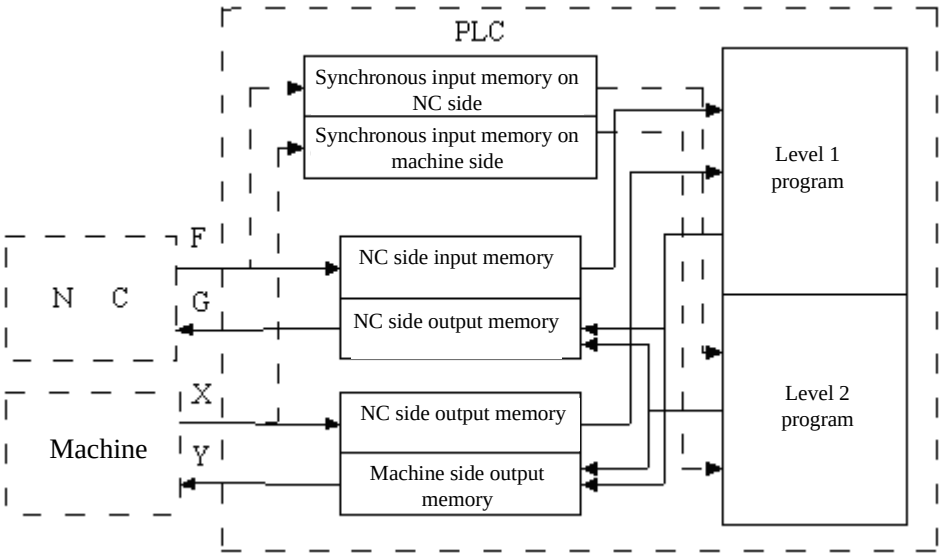
When the last part of the second-level program is executed, the program returns to the beginning to execute again. The first-level program is executed every 8ms, and the n-th block of the second-level program is executed every 8n (ms), a cycle of execution takes 8n (ms).



2.3 Processing of Input/Output signals

The processing of input and output signals is shown in the figure below. The X signal of the machine tool I/O terminal and the F signal of the NC are respectively input to the machine tool side input memory and the NC side input memory of the PLC, and are directly adopted by the first-level program; at the same time, they are input to the synchronous input memory on the machine tool side and the synchronous input memory on the NC side are adopted by the second-level program. The output signals of the first-level program and the second-level program are respectively output to the NC side output memory and the machine tool side output memory, and then respectively output to the NC and machine tool I/O terminals.

The signal state of NC input and output memory, machine tool side input and output memory is displayed on the diagnosis interface.



2.3.1 Input signal processing

A: The input signal used in the first level program

The NC side input memory scans and stores the F signals from the NC every 8ms. When the first-level program is executed, the state of these signals is directly quoted.

The input memory of the machine tool scans and stores the input signal X from the machine tool every 8ms. When the first-level program is executed, the state of these signals is directly quoted.

B: Input signal used in the second level program

The input signal in the second-level program of the PLC is the input signal in the first-level program that has been latched. The first-level program directly uses the F signal and the X signal, so the input signal in the second-level program is higher than that in the first-level program. The input signal lags behind, the longest can lag the execution cycle of the second level program.

C: The difference between the input signal state in the first-level program and the second-level program

In the process of PLC reading the input signal, even if it is the same input signal, the state in the first-level program and the second-level program may be different, because the first-level program reads the NC side input memory and the machine tool when the PLC is executing side input memory, while the second level program reads the NC side synchronous input memory and the machine tool side synchronous input memory. The input signal in the second level program is lagging behind the input signal in the first level program by up to 8ms (the execution cycle of the second level program), you need to pay attention to this when programming the program.

2.3.2 Output signal processing

A: Signal output to NC

The PLC transmits the output signal to the NC-side output memory every 8ms, and the NC-side output memory directly outputs the signal to the NC.

B: Signal output to the machine tool

The PLC directly transmits the output signal to the machine tool side output memory, and the machine tool side output memory outputs the signal to the machine tool every 2ms.

2.3.3 Short pulse signal processing

The first level program is only used to process short pulse signals, but when the change of the short pulse signal is less than 8ms, that is, when the first level program is executed, the input signal state may change, which may cause the program to be executed incorrectly.

The solution is to use the internal relay R to save the signal when the signal is read, and use the buffered R signal as the state of the short pulse signal in the next cycle of the PLC program scan. This can ensure that the logic state of the external signal of the PLC is consistent within a single scan cycle.

2.3.4 Signal interlock

In the sequence control, considering the safety, the necessary soft interlock must be adopted. Meanwhile, the necessary hard interlocking shall be adopted in the relay control circuit of the strong current cabinet on the machine side. This is because even if interlocking is logically taken in sequential program (software), the interlocking will fail when the hardware executing the sequential program fails. Therefore, interlocking adopted in the strong current cabinet on the machine side can ensure the safety of the operator and prevent the damage to the machine.

2.4 Programming

The programming of the program starts from editing the ladder diagram. The ladder diagram is composed of relay contacts, symbols, and function instruction codes. The logical relationship shown in the ladder diagram constitutes a sequence program. There are two methods for editing a sequence program, one input method is to use programming instructions, another method is to use relay symbols to edit the sequence program through the corresponding relay contacts, symbols, and function instruction symbols. When using the relay symbol method, you can use the ladder diagram format without understanding the mnemonic language.

In the actual program editing process, after understanding the functional requirements, you can use the ladder diagram programming method to program to achieve logic control. Ladder diagram programming is generally divided into the following steps to complete.

2.4.1 Distribution interface

After the control object is determined and the number of corresponding input/output signal points is calculated, the interfaces can be allocated. When assigning interfaces, please refer to the input/output interface signal table of system related manuals.

2.4.2 Ladder diagram

Through the ladder diagram editing software GSK Ladder, use the ladder diagram to show the control actions required by the machine tool. The edited ladder diagram is downloaded to the CNC through the serial port or U disk for the CNC to read and execute.

2.4.3 Debug ladder diagram

After downloading the compiled ladder diagram to CNC, the following methods can be used to debug the ladder diagram program:

A: Debug with emulator

Replace machine with emulator (consisting of lights and switches). The input signal state of the machine is indicated by switch on or off, and the output signal state is indicated by light on or off. Execute the

CNC function and observe whether the status of the various lights on the emulator is correct.

B: Use CNC to diagnose and debug

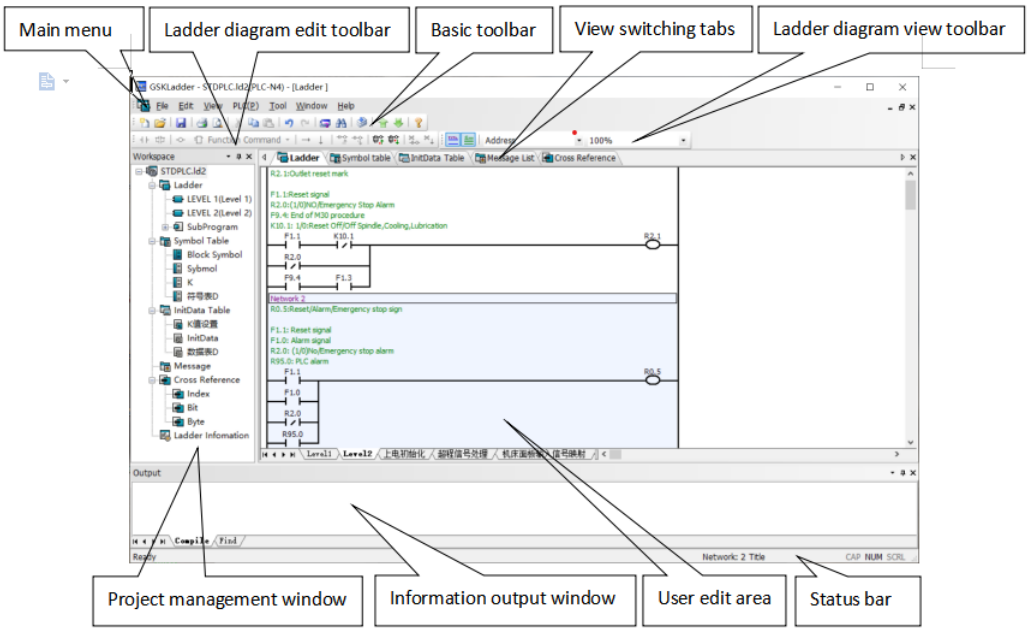
Perform different functions of CNC and observe whether the diagnostic status of each signal is consistent with the function requirements. Check each function in turn to check whether the ladder diagram is correct.

C: Debugging through actual operation

When debugging the program on actual machines, precautions shall be taken because unexpected situations may occur.

Chapter 3 GSK Ladder Software Introduction

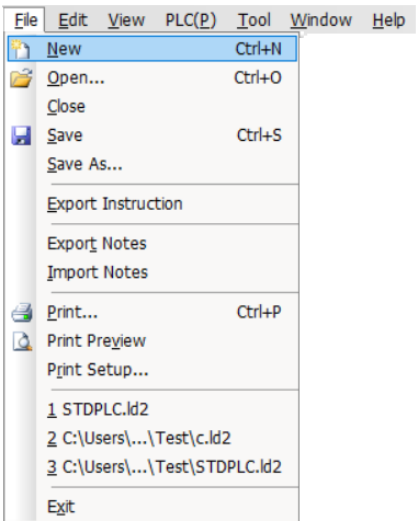
3.1 Interface introduction



•Main menu	All software operation commands.
•Basic toolbar	Common operation commands.
• Ladder diagram edit toolbar	Operation commands for ladder diagram editing.
• Ladder diagram view toolbar	It is used to set the display style of the ladder diagram.
•View switching tabs	To facilitate users to switch between different view frame windows.
•Project management window	Realize the management of various configurations in the project in this window.
• Information output window	Output ladder diagram compilation information and search content information, etc.
•User edit area	In this area, different types of views are displayed according to the user's selection, so that the user can perform various operations, such as ladder diagram programming, symbol and initialization data editing, etc.
•Status bar	Display tool tips, keyboard status and current cursor position, etc.

3.2 Main menu command

3.2.1 File menu



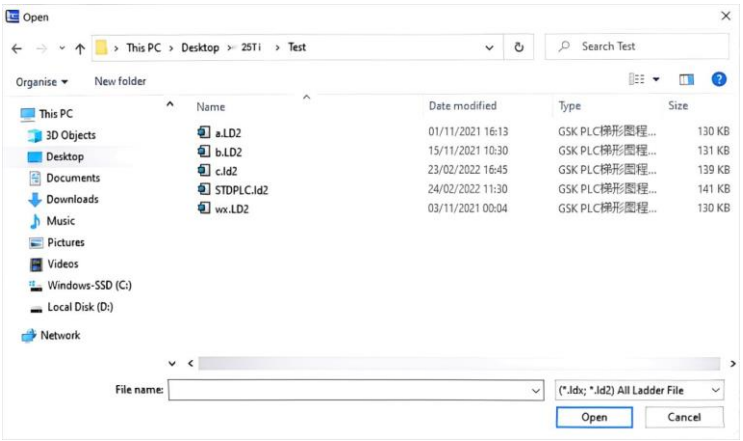
[New]

Create a new project. You can use the shortcut key [Ctrl+N] or click on the basic toolbar with the mouse  .

After executing the new command, a project named "GSKLad#" ('#' is a number) will be generated. The project is not stored in the hard disk before the user saves it, so the user needs to press "Save" to save it after the creation To the hard disk, a dialog box similar to that when executing the [Save As] command will pop up. After setting the name and path, click OK to save.

[Turn on]

Open a project stored on the hard disk. You can use the shortcut key [Ctrl+O] or click on the basic toolbar with the mouse  . After executing this command, a file open dialog box will pop up. After selecting the project file *.ld2, click the [Open] button to open the project.



[Shut down]

Close the currently open project. If the current project is not saved, the program will prompt the user whether to save the current project before exiting.

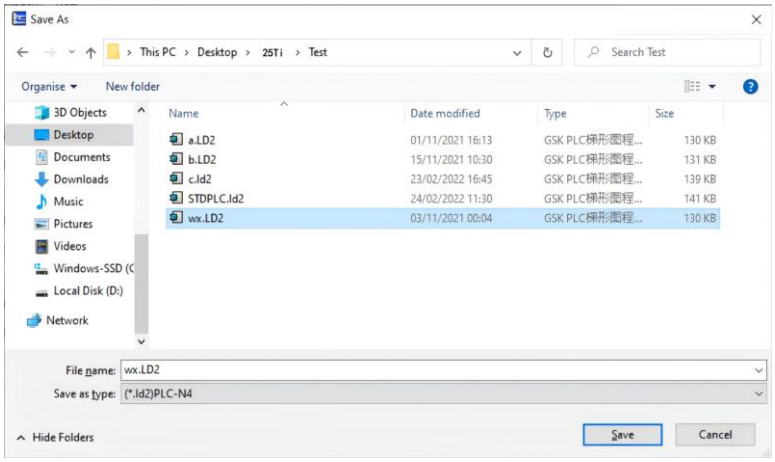
[Save]

Save the currently opened project. You can use the shortcut key [Ctrl+S] or click on the basic

toolbar.

[Save as]

Save the current project as another backup, and set the saved project to open. When this command is executed, a save file dialog box will pop up. After setting the name and path, click "Save" to save the file.



[Export Instruction List]

Export a text file of the instruction list composed of basic instructions, addresses, and function instructions for the current project.

[Export Comments]

Export the Chinese comments of the current project.

[Export Multilingual Comments]

Export the comments in other languages of the current project.

[Import Comments]

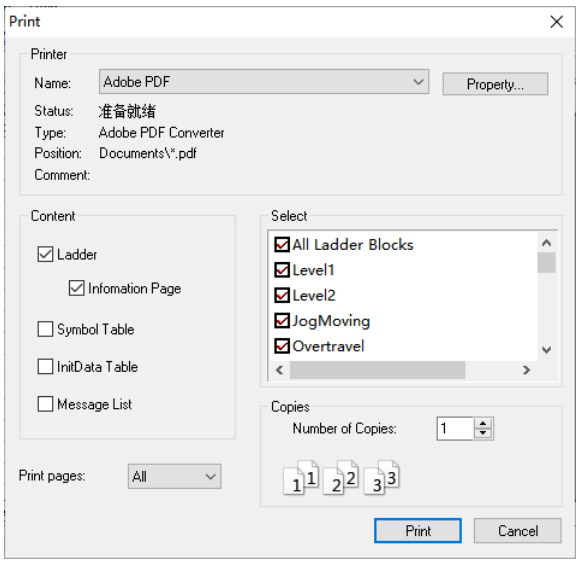
Import Chinese comments into the current project.

[Import Multilingual Comments]

Import comments in other languages into the current project.

[Print]

Print the current file. You can use the shortcut key [Ctrl+P] or click on the basic toolbar. Executing this command will pop up the print setting window. In addition to setting the printer, the user can also choose which content to print. If you select "Ladder Diagram" separately, you can also choose which program blocks to print in the list on the right.



[Printing preview]

Do not print, firstly preview the print effect on the screen. The previewed content is different in different views. For example, in the ladder diagram view, the preview is the ladder diagram, while in the symbol table view, only the symbols are previewed. If the preview is a ladder diagram, the previewed ladder diagram display style is the same as the style in the current view.

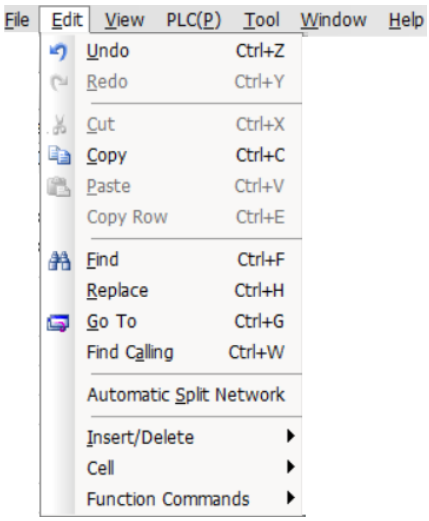
[Recently opened file list]

That is, the file name options are listed under the [Print Settings] menu. Can list 4 recently opened projects, directly click the file name to open the corresponding project.

[Drop out]

Exit the current application. If the current project is not saved, the program will prompt the user whether to save the current project before exiting.

3.2.2 Edit menu



It should be noted that the last three items of the "Edit" menu, "Insert/Delete", "Basic Component" and "Function Command" will only appear when the current ladder view is used.

[Undo]

Undo the most recent modification, up to twenty most recent modifications can be undone. You can use the shortcut key [Ctrl+Z] or click in the basic toolbar.

[Redo]

Redo the operation that has been undone recently. When the user makes a new modification after the undo, it cannot be redone. You can use the shortcut key [Ctrl+Y] or click in the basic toolbar.

[Cut]

Delete the selected content and copy it to the clipboard. You can use the shortcut key [Ctrl+X] or click in the basic toolbar.

[Copy]

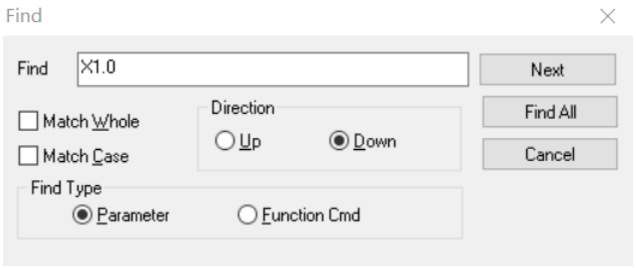
Copy the selected content to the clipboard. You can use the shortcut key [Ctrl+C] or click in the basic toolbar.

[Paste]

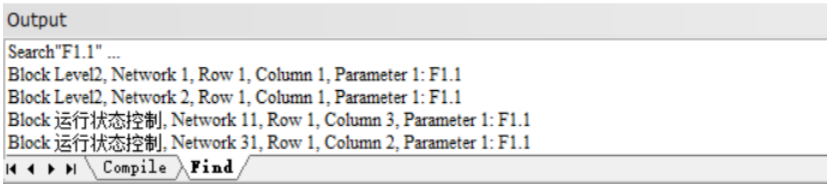
Paste the contents of the clipboard to the selected location. You can use the shortcut key [Ctrl+V] or click in the basic toolbar.

[Find]

Find the string and address in the current view. You can use the shortcut key [Ctrl+F] or click in the basic toolbar. There is a little difference between the pop-up window when executing this command in the ladder diagram view and other views. The pop-up window in the ladder diagram view can select the search type, while the search window popped up in other views does not have this option and can only use the default character search by string.



Enter the search content in the edit box, then set the search conditions, execute [Find Next], if found, the cursor will be positioned at the location found; if you execute [Find All], the search results will be displayed in the information output window, Double-click the text in the output window to jump to the corresponding search position. See the figure below.

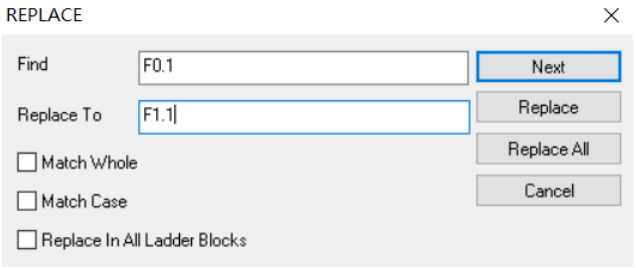


When searching in the ladder diagram view, the type of parameter (constant, address, or symbol) to be searched according to the input string, and then only this type of parameter will be searched. Search options such as "Exact match" and "Case sensitive" only work when searching for symbols or functional commands. If the input is an address, the "Case sensitive" option is invalid; if the input is a constant, then " Both "exact match" and "case sensitive" are invalid. When looking up an address, although the two types of addresses like "x0.1" and "X0000.1" are written differently, they represent the same address, so the search results are the same.

If you search in the table view, whatever you enter will be processed as a string.

[Replace]

Replace the content of the specified condition with the new content in the current view. Can use shortcut key [Ctrl+H]. Executing this command will pop up the replace dialog box as shown in the figure below.

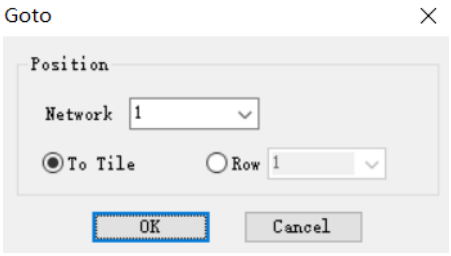


The search function in the replace dialog box is the same as the method introduced in [Find]. Only the search condition of the content symbol at the target location, and the content used for replacement is legal after being substituted into the target location, can it be replaced successfully. The replacement can be

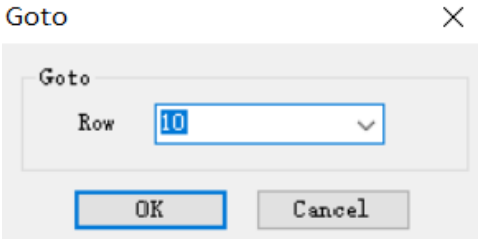
successful only if the content symbol lookup condition at the target location is valid and the content used for replacement is substituted into the target location For example, you cannot use addresses to replace constants, or bit addresses to replace byte addresses, and vice versa.

[Go to]

Jump to the location specified in the current view. You can use the shortcut key [Ctrl+G] or click in the basic toolbar. Executing this command will pop up the dialog box, and the dialog box popped up in the ladder diagram is different from the dialog box popped up in other views, as shown in the following two figures.



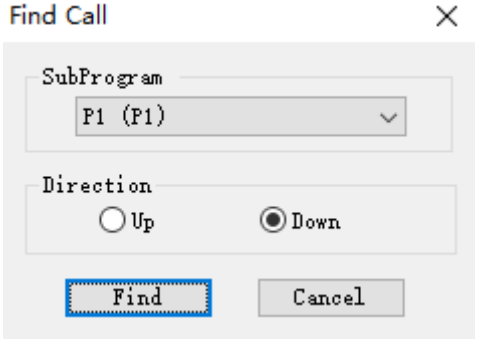
In the dialog box under the ladder diagram view, you can select (or enter) the network location and row location (as shown in the figure above). In addition to a certain line in the network, the line position can also be the network title, which is the network title by default. After selecting the jump location, press [OK] to scroll the cursor to the specified location.



In the dialog box under the table view, you can only choose which row of the table to jump to (as shown in the figure above). After selecting the row number, press [OK], and the table will scroll to the target position.

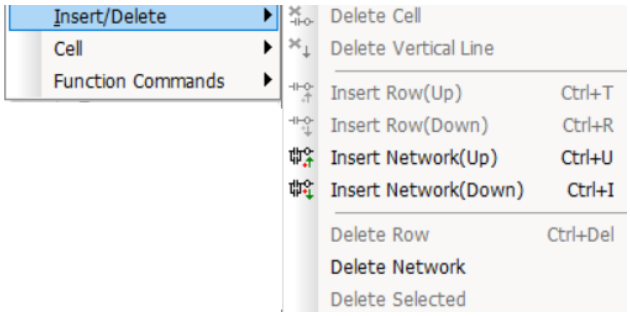
[Find Calls]

Click "Find Calls" to pop up the following dialog box, select "Up" or "Down", then click "Find" to check where the "Subroutine" is called.



[Insert/Delete]

Perform the insert and delete operations in the ladder diagram, and the pop-up menu is as shown in the figure below.



----[Delete element]

Delete the ladder diagram component at the cursor position. Use the shortcut key [Delete] or click in the ladder editing toolbar.

----[Remove vertical line]

Delete the vertical line to the left of the cursor position. You can click in the ladder diagram editing toolbar.

----[Insert row (top)]

Insert a line above the current cursor position. Can use shortcut key [Ctrl+T].

----[Insert row (below)]

Insert a line below the current cursor position. Use shortcut key [Ctrl+R].

----[Insert the network (on)]

Insert a network above the network at the current cursor position. Use shortcut key [Ctrl+U].

----[Insert the network (below)]

Insert a network below the network where the cursor position is currently located. Use shortcut key [Ctrl+I].

----[Delete row]

Delete the row at the current cursor position. If there is only one row in the current network, a blank row will be inserted automatically after deletion.

----[Delete area]

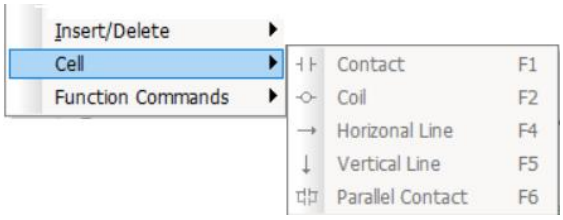
To delete the currently selected area, use the shortcut key [Delete]. If the current block is empty after deletion, a network will be automatically inserted.

----[Delete current network]

Delete the network where the current cursor position is located.

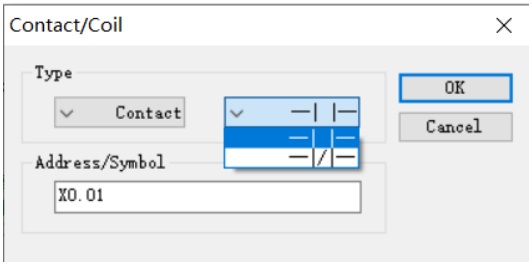
[Basic elements]

Add basic elements to the ladder diagram, and the pop-up menu is as shown in the figure below.



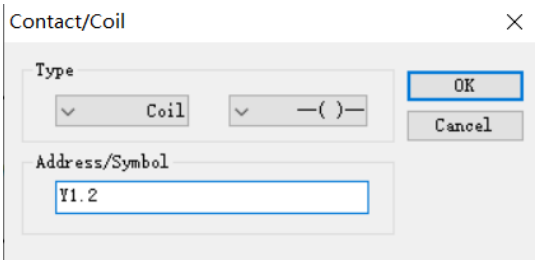
----[Contact]

Add a contact (normally open/normally closed) at the selected position. You can use the shortcut key [F1] or click in the ladder editing toolbar. Executing the operation command will pop up a dialog box in the center of the screen to set the contact type and address or symbol.



----[Coil]

Add an output coil at the selected position. You can use the shortcut key [F2] or click in the main ladder diagram editing toolbar. Executing the operation command will pop up a dialog box in the center of the screen to set the coil type and address or symbol.



----[Horizontal line]

Add a horizontal line at the selected position. You can use the shortcut key [F4] or click in the main ladder diagram editing toolbar.

----[Vertical line]

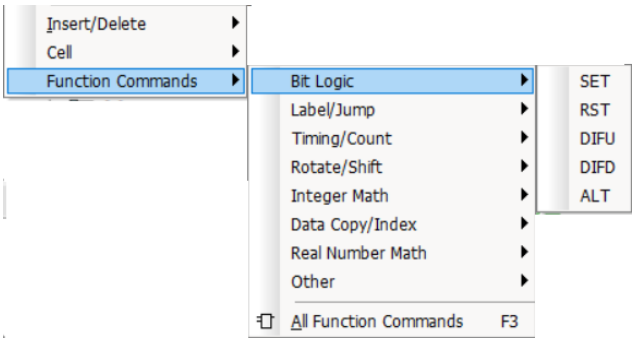
Add a drop-down vertical line to the left of the selected position. You can use the shortcut key [F5] or click in the ladder editing toolbar.

----[Parallel contact]

Add a contact at the selected position and pull vertical lines on its left and right ends to make it parallel to the components in the previous row. You can use the shortcut key [F6] or click in the ladder editing toolbar.

----[Function command]

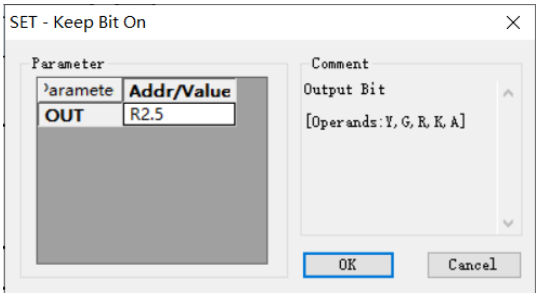
Add a function instruction in the ladder diagram, and the pop-up menu is as shown in the figure below.



----[Category sub-menu]

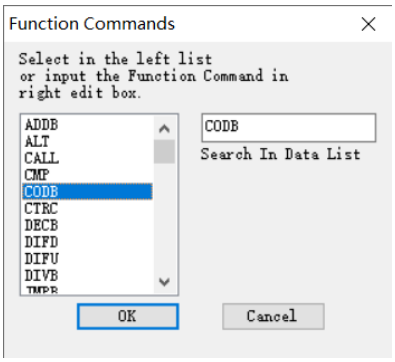
There are five sub-menus [bit output], [label/jump], [timing/counting], [rotation/shift], and [integer math operation]. Each sub-menu contains multiple function commands. When you select When a certain command is in, the editing window of the function command will pop up. After filling in it, press [OK] to finish editing, and the command will be added to the target position. Take the SET command as an example, select: [Edit]—[Function Command]—[Bit Output]—[SET], and the edit

window as shown in the figure below will pop up. The left side of the window is the parameter list. Enter the parameter value in the second column of the table. When the parameter value is set incorrectly, the parameter will be displayed in red; the right side of the window is the parameter comment. When a parameter is selected in the left list , The comment of the parameter will be displayed here.



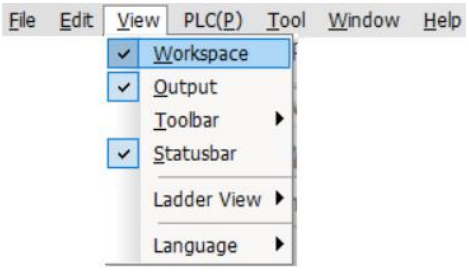
----[All function commands]

Add a function instruction at the selected position. You can click on the editing toolbar of the main ladder diagram. Executing this command will pop up the function command selection window as shown in the figure below.



You can select the function instruction in the list on the left side of the dialog box, or you can directly enter the name of the function instruction in the edit box. Double-click the option in the list box or press [OK] to pop up the editing window of the function command, and the effect is the same as executing the command in the category submenu.

3.2.3 View menu



The last item in this menu [Ladder Diagram] will only appear when the current view is a Ladder Diagram.

[Project manager]

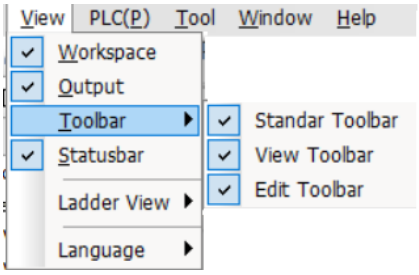
Display/not display the project manager window.

[Information output window]

Display/not display the information output window.

[Toolbar]

Display/ not display the toolbar. The pop-up menu is as follows.



----[Basic toolbar]

Display/not display the basic toolbar.

----[Ladder diagram view toolbar]

Display/not display the ladder view toolbar.

----[Ladder diagram edit toolbar]

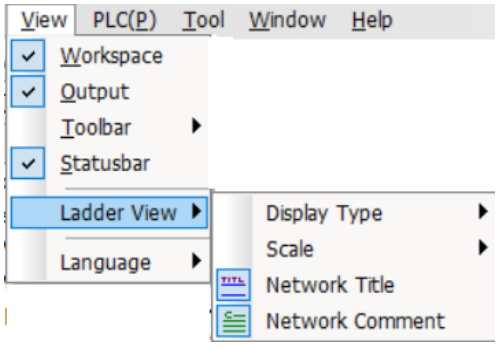
Display/not display the ladder diagram editing toolbar.

[Status bar]

Display/not display the status bar under the main window frame.

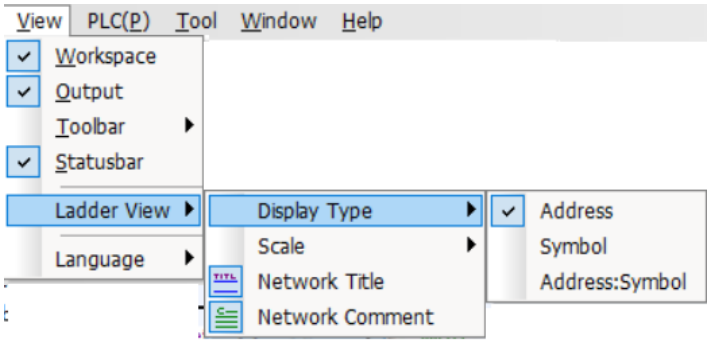
[Ladder diagram]

Some settings related to ladder diagram viewing. The pop-up menu is as shown in the figure below.



----[Display address type]

Set the display mode of the parameters in the ladder diagram, there are three modes: "address", "symbol" and "address: symbol". It can also be set through the combo box in the ladder view toolbar. When selecting an address, all parameters that can be displayed as addresses are displayed as addresses. If a parameter is a symbol and the symbol cannot find the corresponding address, the parameter will still be displayed as a symbol, otherwise it will be displayed in blue after being converted to an address; When selecting a symbol, all parameters belonging to the symbol type are displayed as symbols, and other parameters that cannot be displayed as symbols are displayed according to their parameter types, that is, address parameters are displayed as addresses, and constants are displayed as numbers.



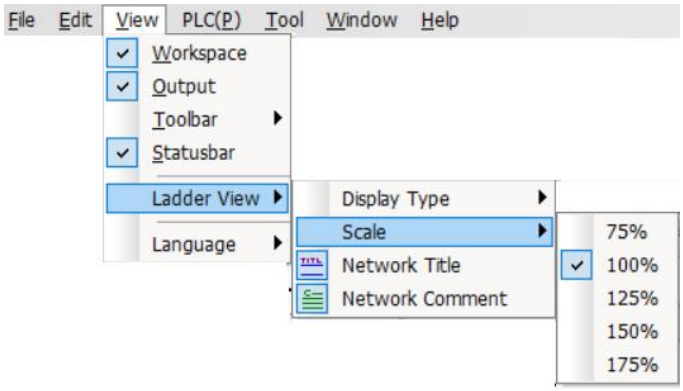
The address display mode is as shown in the figure below.

The symbol display is shown in the figure below.

Address: Symbol display mode is as shown in the figure below.

----[Scaling ratio]

Set the display scaling ratio of the ladder diagram, there are five scaling ratios: 75%, 100%, 125%, 150%, and 175%. It can also be set through the combo box in the ladder view toolbar.



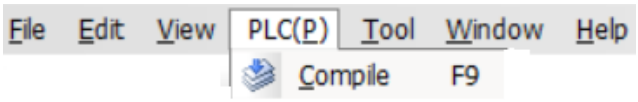
----[Network title]

Display/not display the network title. You can click on the ladder view toolbar.

----[Network notes]

Display/not display network comments. You can click on the ladder view toolbar.

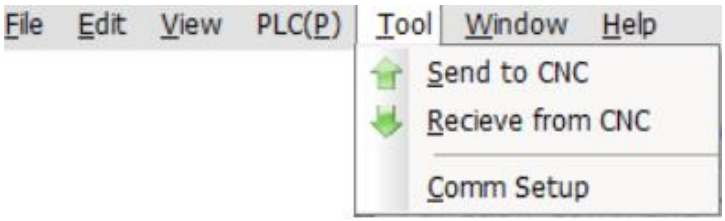
3.2.4 PLC menu



[Compile]

Compile the current ladder program. You can use the shortcut key F9 or press on the basic toolbar. The compiled information will be output in the information output window. Double-click the error or warning message in the output window to jump to the place where the error occurred.

3.2.5 Tools menu



[Send to CNC]

Send the files in the current project to CNC for storage.

[Read in from CNC]

Transfer the PLC file in the CNC to the PC.

[Communication settings]

Set the parameters of the serial port, including selecting the serial port number and communication baud rate.

3.3 Toolbar

3.3.1 Basic toolbar

 New project.

 Open an existing project.

 Save the current project.

 Print the ladder diagram.

 Printing preview.

 Cut the selected area.

Copy the selected area.

Paste in the selected area.

Undo the last step of the operation.

Re-execute the previously undone operation.

Jump to the location specified in the current view.

Find the specified text.

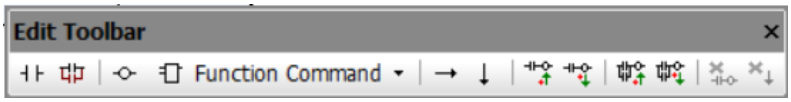
Ladder diagram compilation.

Send the current project to CNC.

Read in PLC file from CNC.

Display program information, version number and copyright.

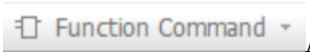
3.3.2 Ladder diagram editing toolbar



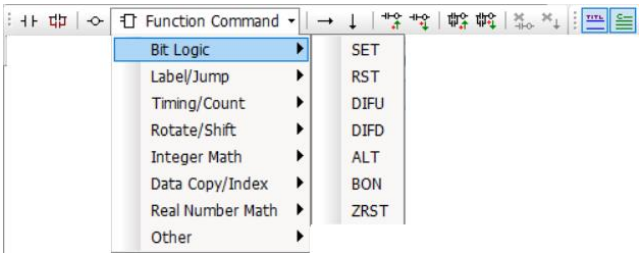
Add a contact at the cursor (shortcut key F1).

Add a parallel contact at the cursor.

Add an output coil at the cursor (shortcut key F2).



Add a function command at the cursor, click the small arrow on the right to pop up a drop-down menu, and then select a function command from the category menu; if you select all function commands, a function command selection window (shortcut key F3) will pop up, the effect is the same as  clicking the icon directly.



Add a horizontal connecting wire at the cursor (shortcut key F4).

Add a vertical connecting wire to the left of the cursor (shortcut key F5).

Delete the selected ladder diagram element (shortcut key Delete).

Delete the vertical connecting wire on the left side of the selected element.

Add a line above the line where the current cursor is located.

Add a line below the line where the current cursor is.

Add a network above the network where the cursor is currently located.

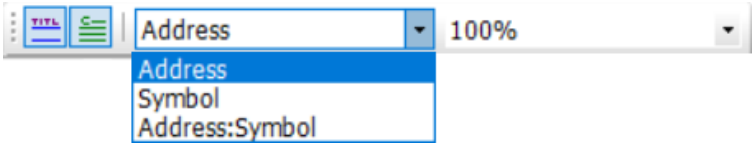
Add a network under the network where the cursor is currently located.

3.3.3 Ladder diagram view toolbar

Display/not display the network title.

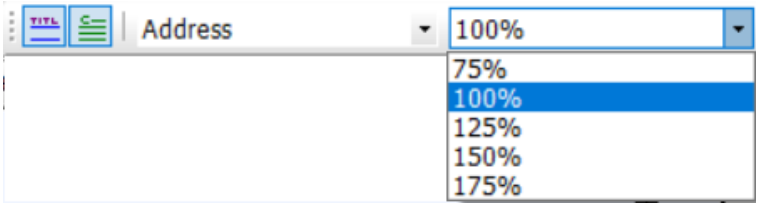
Display/not display network comments.

The display address type selection combo box is as shown in the figure below.



It is used to set the display mode of the parameters in the ladder diagram. There are three modes: "address", "symbol" and "address: symbol". When selecting an address, all parameters that can be displayed as addresses are displayed as addresses. If a parameter is a symbol and the symbol cannot find the corresponding address, the parameter will still be displayed as a symbol, otherwise it will be displayed in blue after being converted to an address; When selecting a symbol, all parameters belonging to the symbol type are displayed as symbols, and other parameters that cannot be displayed as symbols are displayed according to their parameter types, that is, address parameters are displayed as addresses, and constants are displayed as numbers.

The scaling ratio selection combo box is as shown in the figure below.



Set the display scaling ratio of the ladder diagram, there are five scaling ratios: 75%, 100%, 125%, 150%, and 175%.

3.4 Use of the software

The project manager is a tree structure, and its root node is the project name. There are nine first-level tree nodes under the root node [Ladder Diagram], [Symbol Table], [Data Setting Table], [Display Information Table], [Reference Index Table], [Diagnostic Information Table], [Permission Table], [M-Code Comment Table], [Ladder Diagram Version Information].

[Ladder diagram]

The following is composed of [first-level program], [second-level program] and [subroutine], and the number of nodes under [subroutine] is uncertain, and you can add and delete nodes by adding and deleting

subprograms.

[Symbol table]

The following is composed of [Program Block Symbol] and some user-defined symbol table nodes. Among them, the [Program Block Symbol] node is fixed, and the number of custom symbol table nodes is related to the number of symbol tables.

[Data setting table]

There are 5 fixed nodes below, namely K, D, D_FLOAT, DT, and DC. Double-click these nodes to enter their setting pages. On this page, you can set the initial values, value ranges, and multilingual comments of these addresses, as well as other related information.

[Display information table]

There is no branch tree node, and child nodes cannot be added to it, that is to say, there is only one in the display information table.

[Reference index table]

There are three child nodes: [Index], [Bit Use], [Byte Use]. These three nodes are fixed and cannot be deleted or edited, and no new child nodes can be added to the reference index table.

[Diagnostic Information Table]

There are no branch tree nodes, so sub-nodes cannot be added to them. PLC addresses and their related multilingual comments can be added to the Diagnostic Information Table. After importing into the system and running, the corresponding information will be displayed on the "Ladder Diagram -> PLC Diagnosis" page. For bit-type addresses (such as K addresses), the status (ON/OFF) will be displayed as a light along with related comments; for word-type addresses (such as D addresses), their data values and related comments will be displayed.

[Permission Table]

There are no branch tree nodes, so sub-nodes cannot be added to them. In the Permission Table, addresses such as K, DT, and DC can be configured. After configuration, when the program is running, addresses set in the Permission Table allow modification under Level 2 permission or lower; while addresses not set in the Permission Table do not allow modification under Level 2 permission or lower.

[M-Code Comment Table]

There are no branch tree nodes, so sub-nodes cannot be added to them. In this table, you can set M-codes and their corresponding comments. For M-codes with comments configured, when the part program is running, the corresponding M-code comment will be displayed at the top of the interface when the program executes the line where the M-code is located.

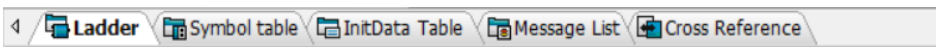
[Ladder diagram version information]

It is a fixed node with no sub-nodes. Double-click this node, and you can add information such as the designer and comments in the pop-up dialog box. In addition, you can set a "Ladder Diagram Password" for this ladder program. For a PLC program with a ladder diagram password set, when exporting or editing it on the CNC system, you must first enter the correct password to be allowed to perform further operations.

3.4.1 View opening and switching

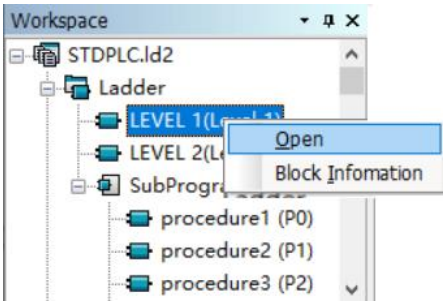
There are three ways to switch between views: double-click the tree node of the project manager, execute the [Open] menu of the tree node of the project manager, click the view frame switch label at the top of the user edit area and the sub-view switch label at the bottom.

The view frame switching tab is as shown in the figure below.



The sub-view switching tab is as shown in the figure below.

Switch the view by opening the menu as shown in the figure below.



3.4.2 Ladder diagram

After opening the project, the current view will be the first-level program (Level1) of the ladder program. You can switch between different program blocks or switch to other view frames according to the method introduced in the previous section. Please refer to the instructions in the previous two chapters for the operations of the menus and toolbars. The following only introduces the creation, renaming, deletion of subprograms, editing of program block information, and adding network comments.

3.4.2.1 Creation, renaming and deletion of subprograms

Create subprogram

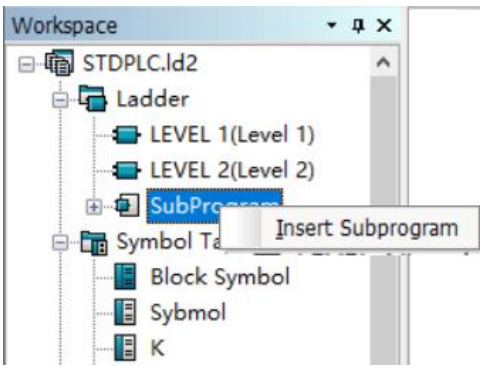
Right-click on the [Subprogram] node to pop up the [Insert Subprogram] menu, execute this command to generate a new subprogram, and add a node under the node and a subview in the ladder view frame.

Rename subprogram

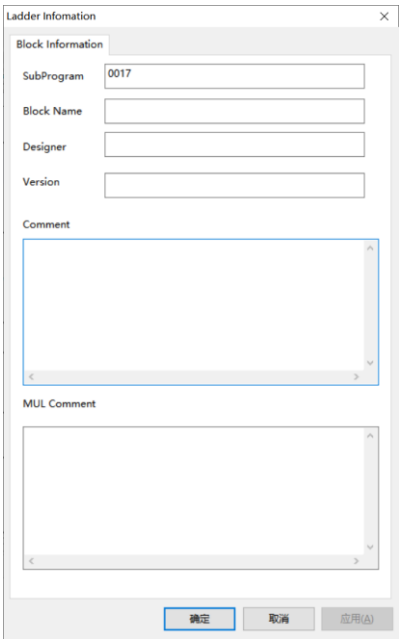
Expand the [Subprogram] node, right-click the pop-up menu on the sub-node and execute [Rename], or click the left-click on the sub-node that has been focused, then the string of the node becomes editable, modify the String, press [Enter] to end editing. Note that the name of the subprogram cannot be the same as other program blocks, including the first-level program and the second-level program.

Delete subprogram

Execute [Delete] menu pops up a dialog box asking whether to delete, press OK to delete the subprogram corresponding to the focused node.



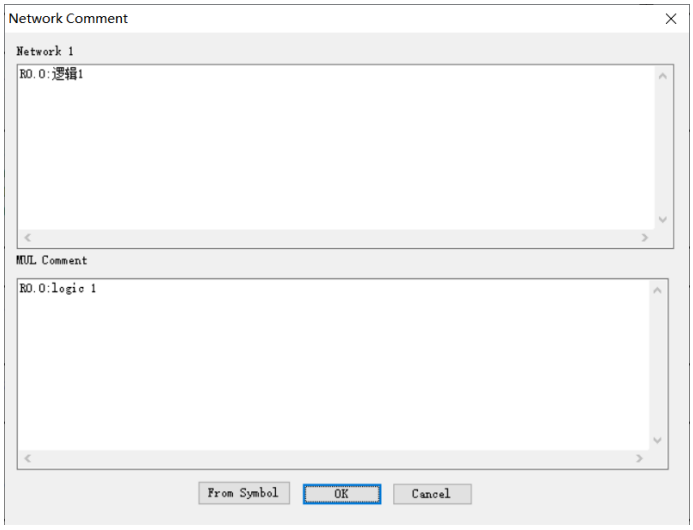
3.4.2.2 Modify block information



This dialog box will pop up when you execute the [Program Block Information] menu in the figure above. After editing, press [OK] to make the modification effective. If you don't want to modify it, press [Cancel] to exit.

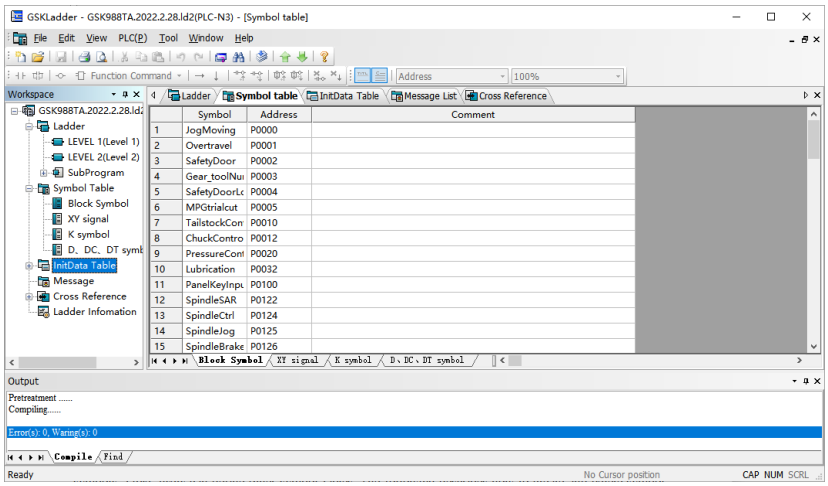
3.4.2.3 Add network notes

Double-click the network title in the ladder diagram view to pop up the following dialog box. Modify the network comment in the edit box. After editing, press [OK] to make the modification effective. If you don't want to modify it, press [Cancel] to exit.



3.4.3 Symbol table

Click the [Symbol Table] tab to switch to the symbol table view frame, and use the subview tab to switch between different symbol tables.



The main function of the symbol table is to realize the mapping between symbols and addresses. With this mapping relationship, users can use symbols to replace addresses when editing ladder diagrams. The symbol table can be added or deleted, but the “program block symbol" table is fixed and uneditable. It mainly provides users with the mapping relationship between the subprogram name and the subprogram address, so the subprogram name can also be used as a symbol (in Called in the CALL instruction). In addition to the "program block symbols" table, users can define other symbol tables. The following describes how to create and delete symbol tables.

3.4.3.1 Symbol table creation, renaming and deletion

Create symbol table

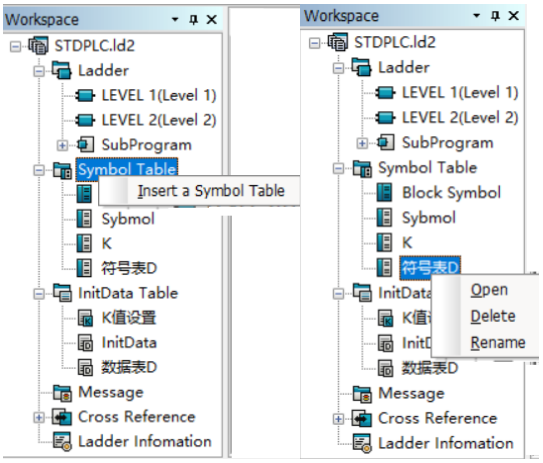
Right-click on the [Symbol Table] node to pop up the [Insert Symbol Table] menu, execute this command to generate a new symbol table, and add a node under the node and a subview in the symbol table view frame.

Rename symbol table

Expand the [Symbol Table] node, right-click the pop-up menu on the child node and execute [Rename], or click with the left button on the child node that has been focused, then the string of the node becomes editable, modify the string, press [Enter] to end editing. Note that the symbol table cannot have the same name as other symbol tables, including the "program block symbol" table.

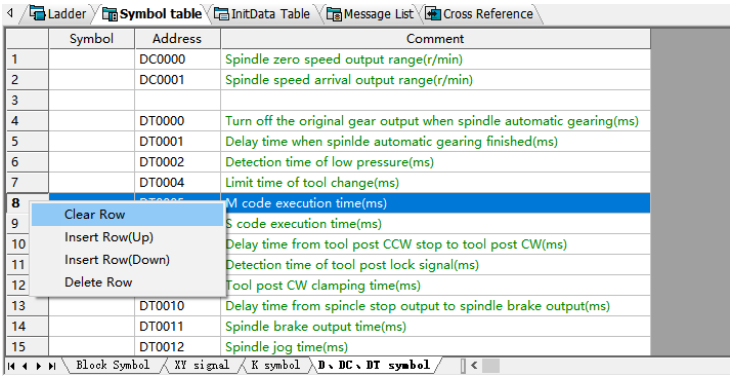
Delete symbol table

Executing the [Delete] menu pops up a dialog box asking whether to delete. After pressing OK, the symbol table corresponding to the focused node will be deleted.



3.4.3.2 Symbol table editing

Row editing: Right-click the row header of the symbol table, and the following row editing menu will pop up. Execute [Clear this line] to clear the content of the selected line, but do not delete this line; execute [Insert a line (up)] to insert a line above the current position; execute [Insert a line (down)] to insert a line above the current position Insert a row below the position; execute [Delete a row] to delete the selected row.



Symbol input

Symbols have format restrictions. The input characters must be letters, numbers, underscores and Chinese characters. The first character of the symbol cannot be a number, and the length cannot exceed 32 characters. The symbols are not allowed to be the same, if they are the same, it is invalid even if the format is correct. If there is the same symbol, it means that the symbol already exists.

Address input

The address has format restrictions. The byte address is: type (letter) + address number (number), and the bit address is: type (letter) + address number (number) + '.' + bit number (number). The allowed input types are: A, X, Y, R, K, F, C, T, D, DT, DC. The addresses are not allowed to be the same, and the same addresses are marked in green.

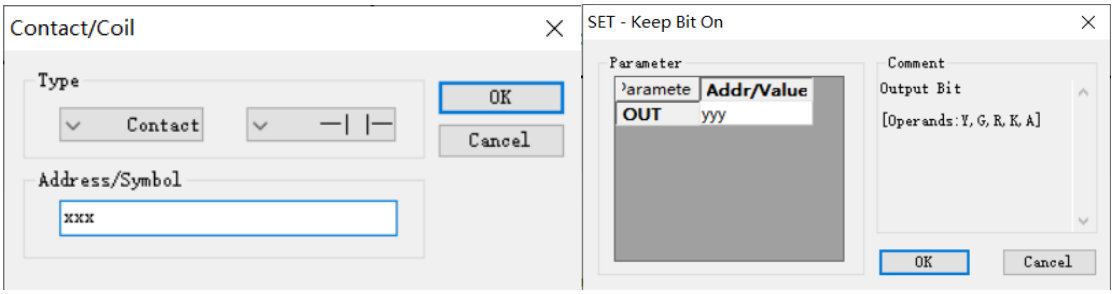
Comment input

The length of the comment is limited (127 bytes), but the content and format are not limited, and it is not necessary to enter it.

There is a special case, it is allowed to enter only the address and comment without entering the symbol, which is regarded as a kind of comment on the address at this time; but on the contrary, it is incorrect if only the symbol is entered without entering the address. At this time, the symbol is invalid.

3.4.3.3 Use of symbols

The use of symbols is very simple. When editing element, you can directly input the symbols as parameters. The symbol does not have to be defined before it can be used, and the undefined symbol can also be used first, and then the symbol is defined.

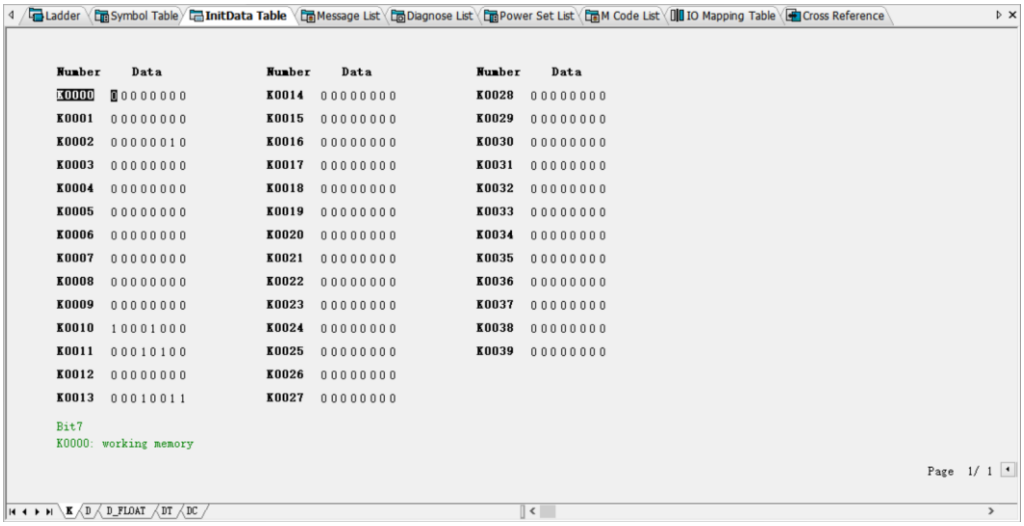


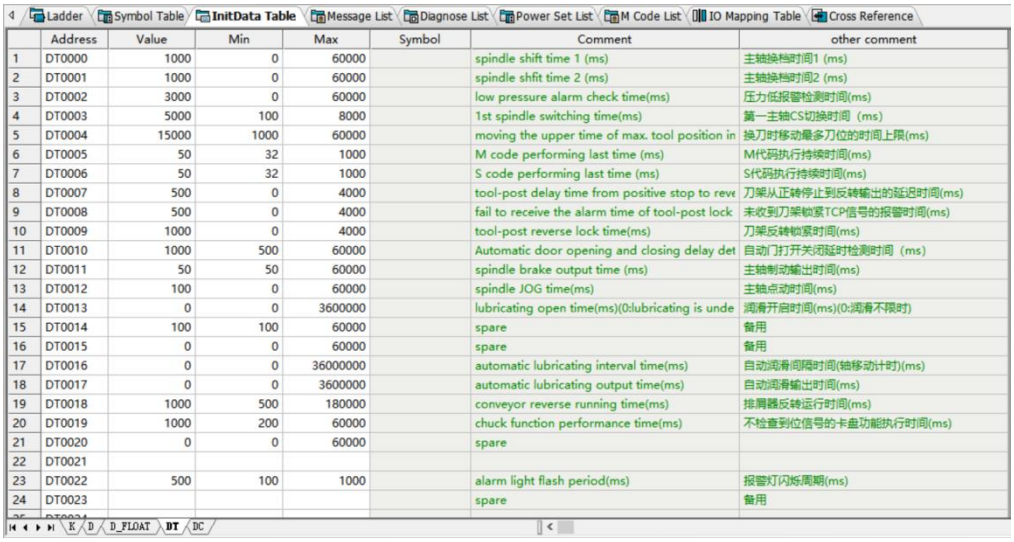
When the parameter of the entered symbol is displayed in the "address" view mode, the address mapped by

the symbol will be displayed in blue, and if the symbol is invalid or undefined, the symbol will be displayed in red. When the symbol is displayed in the "Symbol" view mode or "Address: Symbol" view mode, the symbol is displayed in black when the parameter is correct; the type of the address mapped by the symbol is not the type required by the parameter is displayed in orange; the symbol is incorrect or not It is displayed in red when it is defined.

3.4.4 Data setting table

Click the [Data Setting Table] tab to switch to the data setting table view frame. The data setting table view frame has two different editing interfaces: parameter page and table. The parameter page is used to set the value of K, and the form is used to input the initialization data of the D, DT and DC addresses. If it is the first time to switch to the data setting table view, the "K value setting" view is opened. The "K value setting" is a fixed view and cannot be removed. Except for "K value setting", other views all use the data setting table, and can be added and deleted freely.





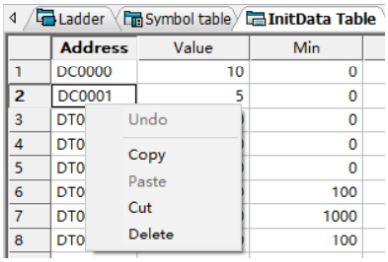
	Address	Value	Min	Max	Symbol	Comment	other comment
1	DT0000	1000	0	60000		spindle shift time 1 (ms)	主轴换档时间1 (ms)
2	DT0001	1000	0	60000		spindle shfit time 2 (ms)	主轴换档时间2 (ms)
3	DT0002	3000	0	60000		low pressure alarm check time(ms)	压力低报警检测时间(ms)
4	DT0003	5000	100	8000		1st spindle switching time(ms)	第一主轴CS切换时间 (ms)
5	DT0004	15000	1000	60000		moving the upper time of max. tool position in	换刀时移动最多刀位的时间上限(ms)
6	DT0005	50	32	1000		M code performing last time (ms)	M代码执行持续时间(ms)
7	DT0006	50	32	1000		S code performing last time (ms)	S代码执行持续时间(ms)
8	DT0007	500	0	4000		tool-post delay time from positive stop to reve	刀架从正转停止到反转输出的延迟时间(ms)
9	DT0008	500	0	4000		fail to receive the alarm time of tool-post lock	未收到刀架锁紧TCP信号的报警时间(ms)
10	DT0009	1000	0	4000		tool-post reverse lock time(ms)	刀架反转锁紧时间(ms)
11	DT0010	1000	500	60000		Automatic door opening and closing delay det	自动门打开关闭延时检测时间 (ms)
12	DT0011	50	50	60000		spindle brake output time (ms)	主轴制动输出时间(ms)
13	DT0012	100	0	60000		spindle JOG time(ms)	主轴点动时间(ms)
14	DT0013	0	0	3600000		lubricating open time(ms)(0:lubricating is unde	润滑开启时间(ms)(0:润滑不限时)
15	DT0014	100	100	60000		spare	备用
16	DT0015	0	0	60000		spare	备用
17	DT0016	0	0	36000000		automatic lubricating interval time(ms)	自动润滑间隔时间(轴移动计时)(ms)
18	DT0017	0	0	3600000		automatic lubricating output time(ms)	自动润滑输出时间(ms)
19	DT0018	1000	500	180000		conveyor reverse running time(ms)	排屑器反转运行时间(ms)
20	DT0019	1000	200	60000		chuck function performance time(ms)	不检查到位信号的卡盘功能执行时间(ms)
21	DT0020	0	0	60000		spare	
22	DT0021						
23	DT0022	500	100	1000		alarm light flash period(ms)	报警灯闪烁周期(ms)
24	DT0023					spare	备用

3.4.4.1 K Value setting

The parameter page for setting K value is composed of multiple parameter items sorted by column, and each parameter item is composed of serial number and data. Since the view area may not contain all the parameter items, the parameters may be displayed in multiple pages. The number of pages and the number of parameter items per page are determined by the size of the view area. Use the spin button at the bottom right corner of the parameter page or the shortcut keys [PageUp] and [PageDown] to turn pages. There are two lines of green comments below the parameter page, the first line is the bit comment, and the second line is the comment on the parameter item. These comments are not fixed in the software, but are added by the user. The user can add and edit these comments in the symbol table.

K value setting adopts bit editing mode. To modify a bit, double-click the bit to be modified directly with the mouse, or move the cursor to this bit and press [Enter].

3.4.4.2 Editing of data setting table (D、D_FLOAT、DT、DC)



Line edit

Right-click the row header of the data setting table, and the following row editing menu will pop up. Execute [Clear this line] to clear the content of the selected line, but do not delete this line; execute [Insert a line (top)] to insert a line above the current position; execute [Insert a line (down)] to insert a line at the current position Insert a row below; execute [Delete a row] to delete the selected row.

Address input

The address input is similar to the address input in the symbol table, but the data setting table only supports four types of addresses: D、D_FLOAT、DC、DT.

Numerical input

If the minimum and maximum values are not entered, you can enter an integer from -2,147,483,648 to 2,147,483,647; if the minimum and maximum values have been entered, the range of values entered is limited to the minimum to maximum, which is less than the minimum the minimum value is assigned, and the maximum value is assigned if it is greater than the maximum value.

Minimum input

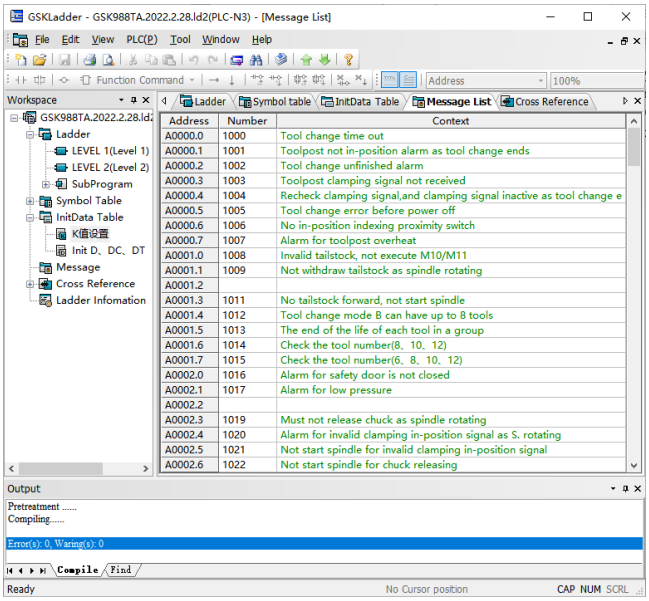
If the maximum value is not entered, you can enter an integer from -2,147,483,648 to 2,147,483,647; if the maximum value has been entered, the value range of the input is limited to the range of -2,147,483,648 to the maximum value. If it is less than -2,147,483,648, it will be assigned to -2,147,483,648, which is greater than the maximum value is assigned the maximum value. If the minimum value is modified so that the "value" is smaller than the minimum value, the minimum value is assigned to the "value".

Maximum input

If the minimum value is not entered, you can enter an integer from -2,147,483,648 to 2,147,483,647; if the minimum value has been entered, the input value range is limited to the minimum value to 2,147,483,647. If the value is greater than 2,147,483,647, it will be assigned 2,147,483,647, and if it is less than the minimum value, Give the minimum value. If after modifying the maximum value, the "number" is greater than the maximum value, then the maximum value is assigned to the "number".

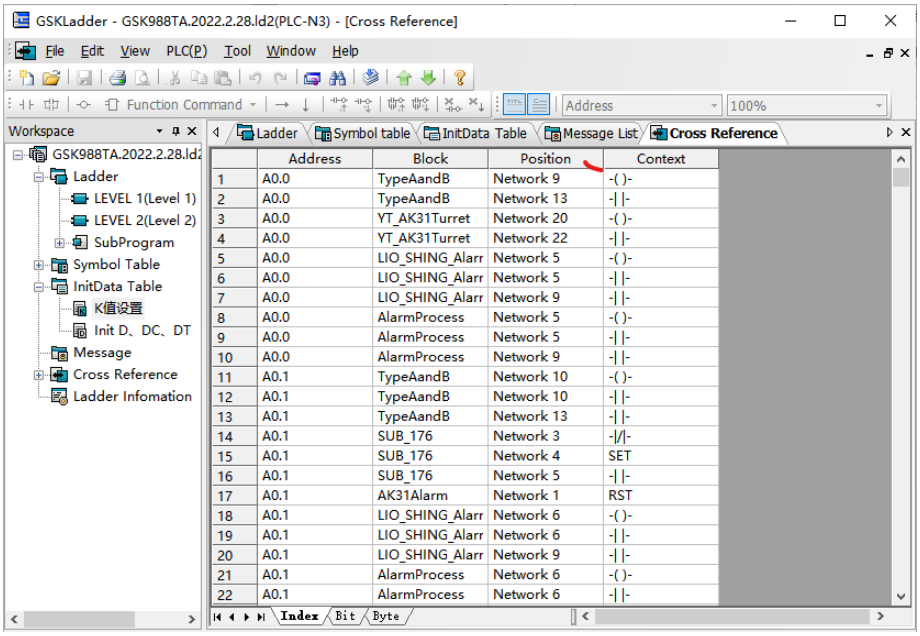
3.4.5 Display information table

Click the [Display Information Table] tab to switch to the display information table view. There is only one display information table, users cannot add or delete, and the display information table has only a fixed 200 rows, the address is from A0000.0 to A0049.7, users cannot add or delete rows. The alarm number ranges from 1000 to 9999 and cannot be the same. The alarm number and display content cannot be entered only one without the other, otherwise there will be a warning when compiling and preprocessing.



3.4.6 Reference index table

Click the [Reference Index Table] tab to switch to the reference index table view. The reference index table is used to count the use and allocation of addresses in the ladder diagram. It includes three tables: "index", "bit use" and "byte use". These three tables cannot be edited and are generally empty. The relevant information is generated only after compilation, and once the project is modified, the contents of these three tables will be cleared.



3.4.6.1 Index table

The index table is used to display the context of the referenced address, which is convenient for users to find the referenced location. The index table has five columns: row number, address, block, location, and context. If you double-click a cell in the "Address" or "Context" column, it will jump to the element location that refers to the address; if you double-click a cell in the "Block" column, it will jump to the program block that refers to the address; if you double-click the "Location" The cells in one column jump to the network location of the referenced address.

3.4.6.2 Bit usage table

The bit usage table is used to point out the reference situation of the bit address in the ladder diagram. The row header of the bit usage table indicates the byte portion of the bit address, and the following eight columns indicate the usage of each bit of the byte. If a column is marked with 'X', it means that the bit address corresponding to the column has been used. For example, the last column of the row "A0000._", that is, the column titled '0' is marked with 'X', which means The bit address A0000.0 has been used. It should be noted that this table does not list all the bit addresses. Only if at least one bit of a byte is quoted is listed. That is to say, if a certain bit address is not listed, it means that the address of this bit is not quoted.

位	7	6	5	4	3	2	1	0
A0000._	X	X	X	X	X	X	X	X
A0001._	X	X	X	X	X	X	X	X
A0002._	X	X	X	X	X	X	X	X
A0003._	X	X	X	X	X	X	X	X
A0004._	X	X	X	X	X	X	X	X
A0005._	X	X	X	X	X	X	X	X
A0006._	X	X	X	X	X	X	X	X
A0007._	X	X	X	X	X	X	X	X
A0008._	X	X	X	X	X	X	X	X
A0009._	X	X	X	X	X	X	X	X
A0010._	X	X	X	X	X	X	X	X
A0011._	X	X	X	X	X	X	X	X
A0012._	X	X	X	X	X	X	X	X

3.4.6.3 Byte usage table

The byte usage table is used to point out the reference situation of the byte address in the ladder diagram. In order to reduce the length of the table and facilitate searching, each row of the byte usage table lists ten byte addresses. The row heading points out the part of the address number excluding the single digits, and the other ten columns indicate the single digits of the address number. For example, the column heading "9" in the row of "C000_" indicates the address C0009. If a cell is marked with 'X', it means that the address corresponding to the cell has been used. It should be noted that not all addresses will be listed. If an address is not listed, it means that the address is not used.

字节	0	1	2	3	4	5	6	7	8	9
C000_										X
C001_	X	X								
C002_	X									
D000_	X	X	X	X	X	X		X	X	
T000_	X	X	X	X	X	X	X	X	X	X
T001_	X	X	X	X	X	X	X	X	X	X
T002_	X	X	X	X	X	X	X	X	X	X
T003_	X	X	X		X	X	X	X	X	X
T004_	X	X				X	X	X	X	X
T005_		X	X	X	X	X	X	X	X	X
T006_	X	X					X		X	X

3.4.7 Ladder diagram version information

Double-click the tree node "Ladder Diagram Version Information" in the project management or use the right-click menu "Open" to pop up the program version information editing dialog box as shown in the figure below. Fill in the author, version and remarks in the three edit boxes of "Ladder Diagram Design", "Ladder Diagram Version" and "Remarks". There is no format limitation but there is a limit on the number of words. "Ladder Diagram Design" is not more than 63 characters, "Ladder Diagram Version" no more than 19 characters, and "Remarks" no more than 511 characters. "Ladder diagram check" refers to the 32-bit CRC checksum of the entire ladder diagram file. The checksum can only be seen when the project has not been modified or saved and modified.

Chapter 4 PLC Signal Description

4.1 Control axis

4.1.1 Axis movement status

The NC can transmit the current axis movement status to the PLC, and the PLC will act according to the axis movement status.

4.1.1.1 Signal for moving axis

MV1～MV8 (F102.0～F102.7)

- Signal type: NC->PLC
- Signal function: MV1, MV2, MV3, MV4, MV5, MV6, MV7, MV8correspond to the movement signals of axis 1, 2, 3, 4, 5, 6, 7 and 8 respectively. When the axis moves, the corresponding axis movement signal is set to 1, and when the axis is in a stopped state, it corresponds to the axis movement signal is 0. After the PLC receives the axis movement signal from the NC, it will act according to the state of the signal.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
F102	MV8	MV7	MV6	MV5	MV4	MV3	MV2	MV1

4.1.1.2 The moving direction signal of the axis

MVD1～MVD5 (F106.0～F106.7)

- Signal type: NC->PLC
- Signal function: MVD1, MVD2, MVD3, MVD4, MVD5, MVD6, MVD7, MVD8 correspond to the movement direction signals of axis 1, 2, 3, 4, 5, 6, 7 and 8 respectively. When an axis moves in the negative direction, the movement direction signal of the corresponding axis is 1; When an axis moves in the positive direction, the corresponding axis movement direction signal is 0; when the axis stops, the movement direction signal of the corresponding axis is set to 1 or 0 according to the movement state before stopping, and the PLC will proceed to the next step after receiving the axis movement direction signal action.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
F106	MVD8	MVD7	MVD6	MVD5	MVD4	MVD3	MVD2	MVD1

4.1.2 Servo ready signal

SA (F0.6)

- Signal type: NC->PLC
- Signal function: When NC receives an alarm signal from the servo system and generates an alarm, it sets the SA signal to 0 to notify the PLC that the servo is not ready and the axis cannot be moved; when the alarm is canceled, SA is set to 1, and the axis can be moved.

- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
F0		SA						

4.2 Operation preparation

4.2.1 Emergency stop

Emergency Stop Signal ESP(G8.4):

Signal type: PLC->NC

- Signal function: When G8.4 is 0 level, NC detects this signal and generates an emergency stop alarm.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G8				ESP				

4.2.2 CNC ready signal

MA(F1.7):

- Signal type: NC->PLC
- Signal function: CNC ready signal indicates that the CNC is ready.
- Output condition: After the CNC is ready to be powered on, this signal is set to 1, and it is usually set to 1 in a few seconds after power on. If a CNC alarm occurs or an emergency stop operation is executed, this signal becomes 0.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
F1	MA							

4.2.3 Alarm signals

AL (F1.0):

- Signal type: NC->PLC
- Signal function: When the CNC alarms, the alarm will be displayed on the screen, AL is set to 1, and the PLC will control according to the state of the alarm signal after receiving this signal. There are three types of alarm display: servo alarm, P/S alarm, and overtravel alarm. When the CNC is reset, the alarm is cleared and AL is 0.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
F1								AL

4.2.4 Mode selection

The mode selection signals include MD1, MD2, MD4, DNC1, and ZRN. There are six working modes available: edit mode, automatic mode, input mode, manual mode, MPG mode/single-step mode, mechanical zero

return and program zero return. The CNC informs the PLC system of the current working mode by outputting the working mode detection signal.

4.2.4.1 Mode selection signal

MD1, MD2, MD4 (G43.0～G43.2) DNC1 (G43.5) ZRN (G43.7):

- Signal type: PLC->NC
- Signal function: the coding of the working mode is shown in the table below.

Serial Number	Code Signal / Operation Mode	ZRN	DNC1	MD4	MD2	MD1
1	Edit mode (EDIT)	0	0	0	1	1
2	Automatic mode (MEM)	0	0	0	0	1
3	Entry method (MDI)	0	0	0	0	0
4	Hand pulse mode/single step mode (HANDLE/INC)	0	0	1	0	0
5	Manual mode (JOG)	0	0	1	0	1
6	DNC mode(DNC)	0	1	0	0	1
9	Mechanical return to zero (REF)	1	0	1	0	1

After the PLC receives the input signal of the working mode, it assigns a value to the coded signal, and then transmits it to the NC, and the NC determines the working mode of the CNC according to the coded signal.

- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G43	ZRN		DNCI			MD4	MD2	MD1

4.2.4.2 Operation mode detection signal

MINC (F3.0), MH (F3.1), MJ (F3.2), MMDI (F3.3), MRMT (F3.4), MMEM (F3.5), MEDT (F3.6), MREF (F4.5)

- Signal type: NC->PLC
- Signal function: When the CNC is in a certain working mode, the corresponding F signal is set to 1, and then the F signal is transmitted to the PLC, and the PLC performs the next control according to the working mode detection signal.

Single step detection signal	MINC
Hand pulse method detection signal	MH
Manual detection signal	MJ
Input mode detection signal	MMDI
DNC detection signal	MRMT
Automatic detection signal	MMEM
Edit mode detection signal	MEDT
Detection signal of mechanical zero return mode	MREF

- Signal function:

	#7	#6	#5	#4	#3	#2	#1	#0
F3		MEDT	MMEM	MRMT	MMDI	MJ	MH	MINC
F4			MREF					

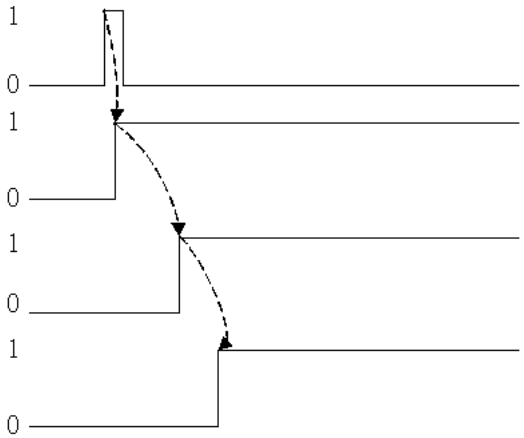
4.2.4.3 Working mode signal timing

Working mode key input (X20.0, X20.1, X20.2, X20.3, X20.4, X20.5, X21.3)

Working mode selection signal G43

Working mode heart signal (F3.0, F3.1, F3.2, F3.3, F3.5, F3.6, F4.5, F4.6)

Working mode indicator (Y5.3, Y5.2, Y5.5, Y5.6, Y5.7, Y5.4, Y6.2)



4.2.5 Status output

Rapid feed signal

RPDO (F2.1):

- Signal type: NC->PLC
- Signal function: When CNC is in manual rapid traverse mode, it executes axis movement operation, and RPDO is set to 1.
- Precautions: When the axis is in rapid feed, RPDO is 1. After the feed is stopped, the RPDO status remains unchanged and remains at 1. Select the non-rapid traverse mode, and the RPDO signal is reset to 0 after moving the axis.
- Signal address:

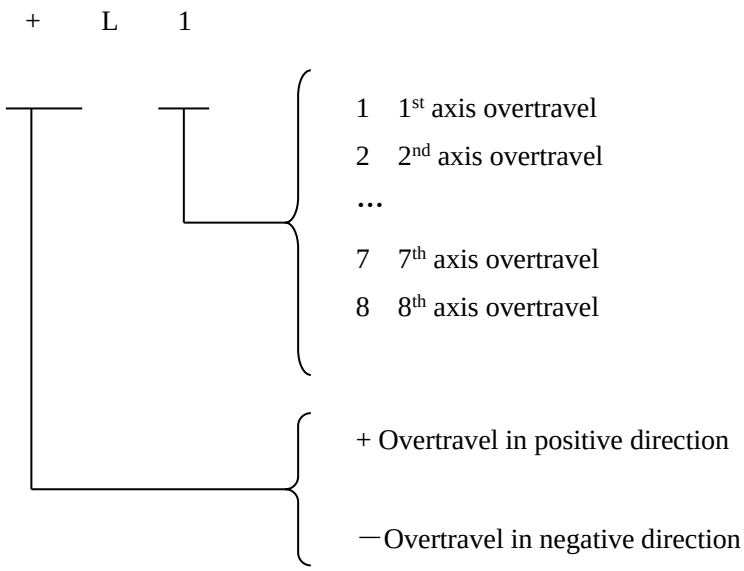
	#7	#6	#5	#4	#3	#2	#1	#0
F2							PRDO	

4.2.6 Overtravel detection

4.2.6.1 Overtravel signal

+L1 ~ +L8 (G114#0~G114#7) , -L1 ~ -L8 (G116#0~G116#7)

- Signal type: PLC->NC
- Signal function: This signal indicates that the control shaft has reached the limit of travel, and each control shaft has this signal in each direction. The signal + and - indicates the direction, and the number corresponds to the control shaft.



[Action] When the above signal is '0', the control unit's actions are as follows:

* During automatic operation, even if only one shaft over-travel signal becomes 0, the axis used stops after deceleration, with alarm generated and operation interrupted.
* In manual operation, only the axis whose shift signal is 0 stops after deceleration, and the stopped axis can shift in the opposite direction.
* Once the axis over-travel signal becomes 0, its shift direction is stored. Even if the signal becomes 1, the axis cannot shift along this direction until the alarm is cleared.

- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G114	+L8	+L7	+L6	+L5	+L4	+L3	+L2	+L1
G116	-L8	-L7	-L6	-L5	-L4	-L3	-L2	-L1

Signal in overtravel alarm

+OT1～+OT5 (F124.0～F124.7), -OT1～-OT4 (F126.0～F126.7)

- Signal type: NC->PLC
- Signal function: This signal informs whether the tool is about to enter the prohibited area specified by the parameter.

  This signal becomes effective when the parameter OTS (No1301.6) is set to '1'.

  This is the signal for each direction of each control axis. The +/- in the signal name indicates the direction, and the number at the end indicates the number of the control axis.

  OT□

  □: 1. Decelerate the 1st axis

  2. Decelerate the 2nd axis

  …..

  When the parameter OTS (No1301.6) is '1', the signal becomes '1' when the following overtravel alarm occurs

  Storage stroke detection 1

  Storage stroke detection 2

Storage stroke detection 3

Store the axis and its direction once it becomes '1'. The axis cannot be moved further in the same direction. It can only be moved in the direction opposite to the stored axis direction. By moving it in the opposite direction, the signal becomes '0'.

- Signal address

	#7	#6	#5	#4	#3	#2	#1	#0
F124	+ OT8	+ OT7	+ OT6	+ OT5	+ OT4	+ OT3	+ OT2	+OT1
F126	- OT8	- OT7	- OT6	- OT5	- OT4	- OT3	- OT2	- OT1

4.2.6.2 Storage stroke detection 1

Storage stroke detection selection signal

EXLM (G7.6)

- Signal type: PLC->NC
- Signal function: When this signal is 1, use parameters No.1326 and No.1327 to detect stroke detection 1; when this signal is 0, use parameters No.1320 and No.1321 to detect stroke detection 1.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G7		EXLM						

4.2.6.3 Storage stroke detection 2, 3

Stroke detection 3 release signal

RLSOT3 (G7.4)

- Signal type: PLC->NC
- Signal function: Choose whether to perform storage stroke detection 3. When the signal is 1, the storage stroke detection 3 is not performed; when the signal is 0, and the parameters No.1300.5 and No.1310.1 are 1, the storage stroke detection 3 is performed.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G7				RLSOT3				

4.2.7 Full-axis inter-lock

These signals prohibit the axis movement of the machine tool, and the axis movement action decelerates and then stops.

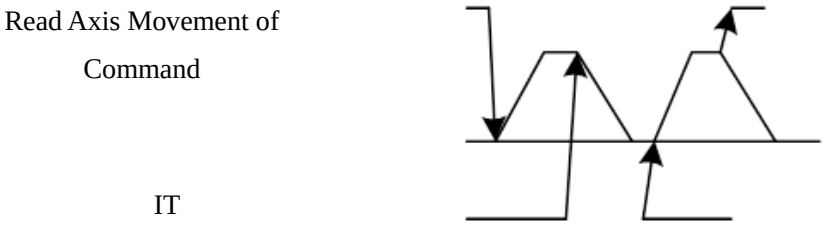
All axis interlock signal IT (G8.0)

- Signal type: PLC->CNC
- Signal function: This signal is used to prohibit the movement of the mechanical axis, and it is valid regardless of the mode.

  When the signal IT is set to '0', the axis movement will stop after deceleration regardless of the mode. However, during automatic operation, it will stop while maintaining automatic operation.

  In automatic operation, when there is no axis movement command and only the block of MSTB command continues to move, the MSTB function is executed one after another before the block where the axis movement command is located. In the axis

movement command and MSTB function, only the MSTB function is sent, and it stops in the state of automatic operation. After the signal IT is set to '1', the operation is restarted.



- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G8								IT

Cutting block start interlock signal CSL (G8.1)

- Signal type: PLC->CNC
- Signal function: During automatic operation, it is forbidden to execute blocks of movement instructions other than rapid movement.

  When it is set to '0', the execution of the block of movement commands other than rapid positioning during automatic operation will not start. Program block that the execution has already begun will be executed completely without being affected. The system is not in the stopped state, and the instruction in the next block is in the standby state as a valid instruction, so the execution restarts immediately when the signal becomes '1'.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G8							CSL	

Block start interlock signal BSL (G8.3)

- Signal type: PLC->CNC
- Signal function: Prohibit the start of the next block during automatic operation.

  When it is set to '0', the execution of the next block in automatic operation will not start, and the block that has already been executed will be executed to the end without any influence. At this time, the system is not in a stopped state, and the instruction of the next block is in the standby state as a valid instruction, and the execution restarts immediately when the signal becomes '1'.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G8					BSL			

Interlock signals for each axis IT1～IT8 (G130.0～G130.7)

- Signal type: PLC->CNC
- Signal function: This signal prohibits each axis from independently commanding the feed of the axes.

  There is a signal in each control axis, and the number at the end of the signal name indicates the number of the control axis.

IT□

□: 1..... Corresponding to the 1st axis application interlock
2..... Corresponding to the 2nd axis application interlock
3..... Corresponding to the 3rd axis application interlock

① During manual operation

The axis to which the interlock has been applied is prohibited from moving, while the other axes can be moved. When the interlock is applied during axis movement, the tool will stop after deceleration, and restart when the interlock is released.

② During automatic operation

When the interlock is applied to the commanded moving axis, the feed of all axes is prohibited. During automatic operation, when interlocking is applied to the moving axes, all axes decelerate to a stop, and then restart when the interlock is released.

This function is also effective in dry running.

- Signal address

	#7	#6	#5	#4	#3	#2	#1	#0
G130	IT8	IT7	IT6	IT5	IT4	IT3	IT2	IT1

4.3 Manual operation

4.3.1 Manual feed/Incremental feed

Manual feed: In manual mode, set the feed axis and direction selection signal on the machine operation panel to 1, and the machine tool will move continuously along the selected axis in the selected direction.

Incremental feed: In single-step mode, set the feed axis and direction selection signal on the machine operation panel to 1, and the machine tool will move one step along the selected axis in the selected direction. The minimum distance of the machine tool movement is the minimum input increment. There are four magnification values of 0.001, 0.010, 0.100 or 1.000 for each step.

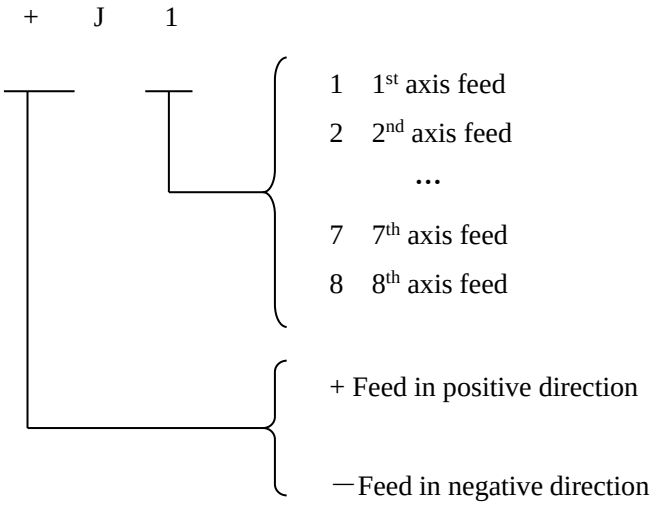
The sole difference between manual feed and incremental feed is the form selecting feed distance. Under the mode of "manual feed", when the selection signal for feed axis and direction of + J1, － J1, + J2, － J2, + J3 and J3 is set as 1, the machine can realize continuous feed. Under the mode of "incremental feed", the machine is under single step feed.

Through the manual rapid feed selection switch, the machine tool can move at the rapid feed speed. The single step distance of incremental feed can be selected through MP1 and MP2.

4.3.1.1 Selection of feed axis and direction signal

＋J1～＋J8 (G100.0～G100.7), －J1～－J8 (G102.0～G102.7)

- Signal type: PLC ->NC
- Signal function: Select the desired feed axis and direction under manual feed or incremental feed, and execute axis movement operation, then the corresponding axis and direction selection signal is set to 1, and the PLC can proceed to the next step after receiving this signal control. "+" and "-" indicate the feed direction, and the number corresponds to the control axis.



- Note: A: In manual feed, CNC makes the corresponding axis move continuously; in incremental feed, CNC makes the corresponding axis feed in steps defined by signals MP1 and MP2.
  B: When the axis moves, the corresponding axis and direction selection signal is 1, and when the movement stops, the signal is reset.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G100	+J8	+J7	+J6	+J5	+J4	+J3	+J2	+J1
G102	-J8	-J7	-J6	-J5	-J4	-J3	-J2	-J1

4.3.1.2 Manual feed rate signal

JV00～JV15 (G10, G11):

- Signal type: PLC->NC
- Signal function: select manual movement speed. The corresponding relationship between these signals and manual feed speed is shown in the table below. When the PLC receives the external override input signal, it assigns values to G10 and G11, and then transmits them to the NC, and the CNC displays the corresponding movement rate.

G11	G10	Feed rate override (%)
0000 0000	0000 0000	0
0000 0000	0000 0001	10
0000 0000	0000 0010	20
0000 0000	0000 0011	30
0000 0000	0000 0100	40
0000 0000	0000 0101	50
0000 0000	0000 0110	60
0000 0000	0000 0111	70
0000 0000	0000 1000	80
0000 0000	0000 1001	90
0000 0000	0000 1010	100
0000 0000	0000 1011	110

G11	G10	Feed rate override (%)
0000 0000	0000 1100	120
0000 0000	0000 1101	130
0000 0000	0000 1110	140
0000 0000	0000 1111	150

- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G10	JV7	JV6	JV5	JV4	JV3	JV2	JV1	JV0
G11	JV15	JV14	JV13	JV12	JV11	JV10	JV9	JV8

4.3.1.3 Selection signal for manual rapid feed

RT (G19.7)

- Signal type: PLC ->NC
- Signal function: Select manual rapid feed rate. After the PLC receives the manual rapid traverse input signal, it sets RT to 1, and then transmits it to the NC.
  During manual rapid traverse, when RT is switched from 1 to 0, or from 0 to 1, the feed rate is reduced to 0 and then increased to the specified value. During acceleration and deceleration, the state of the feed axis and direction selection signal remains unchanged.
- Signal address:

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

4.3.2 MPG feed

In the MPG feed mode, the MPG can be rotated to make the machine tool move in a small amount, and the moving axis can be selected by the MPG feed axis selection signal.

4.3.2.1 MPG feed axis selection signal

HS1A～HS1D (G18.0～G18.3), HS2A～HS2D (G18.4～G18.7)

- Signal type: PLC ->NC
- Signal function: MPG feed axis selection signal. After the PLC receives the MPG feed axis input signal, it assigns values to HSnA～HSnD, and the NC selects the corresponding axis feed according to the status of the HSnA～HSnD signal. The corresponding relationship between these signals and MPG feed axis is shown in the table below.

HSnD	HSnC	HSnB	HSnA	Feed Axis
0	0	0	0	Axisless feed
0	0	0	1	1-axis feed
0	0	1	0	2-axis feed
0	0	1	1	3-axis feed
0	1	0	0	4-axis feed
0	1	0	1	5-axis feed

- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G18	HS2D	HS2C	HS2B	HS2A	HS1D	HS1C	HS1B	HS1A

4.3.2.2 MPG rate signal

MP1 (G19.4), MP2 (G19.5):

- Signal type: PLC->NC
- Signal function: This signal is used during the MPG feed period to select the magnification of the MPG feed amount corresponding to each pulse generated by the MPG pulse generator. After the PLC receives the input signal of the MPG gear button (×1, ×10, ×100, ×1000) on the machine tool panel, it assigns values to MP1 and MP2, and then transmits them to NC to select the corresponding MPG feed rate. The correspondence between MP1 and MP2 and MPG magnification is shown in the table below.

MP2	MP1	MPG Magnification	Total Movement
0	0	1	Minimum input unit ×1
0	1	10	Minimum input unit ×10
1	0	Set by system parameter NO.7113	Minimum input unit × NO.7113 parameter value
1	1	Set by system parameter NO.7114	Minimum input unit × NO.7114 parameter value

Note: In addition to the MPG override, the system parameter NO.7103#2 HNT is also used to set the incremental feed/MPG feed movement amount to magnify 10 times.
(HNT is set to 1 when the amount of movement is magnified by 10 times). The amount of movement in the above table is calculated when HNT is set to 0 (the amount of movement is not magnified by 10 times).

When parameter No.7100.5 is set to 1, the second MPG uses the following signals:

The second MPG rate signal

MP21(G87.0), MP22(G87.1)

- Signal type: PLC->NC
- Signal function: This signal is used during the MPG feed period to select the magnification of the MPG feed amount corresponding to each pulse generated by the MPG pulse generator. After the PLC receives the input signal of the MPG gear button (×1, ×10, ×100, ×1000) on the machine tool panel, it assigns values to MP21 and MP22, and then transmits them to NC to select the corresponding MPG feed rate. The correspondence between MP21, MP22 and MPG magnification is shown in the table below.

MP22	MP21	MPG Magnification	Total Movement
0	0	1	Minimum input unit ×1
0	1	10	Minimum input unit ×10
1	0	Set by system parameter No.7113	Minimum input unit × No.7113 parameter value
1	1	Set by system parameter No.7114	Minimum input unit × No.7114 parameter value

- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G19			MP2	MP1				
G87							MP22	MP21

4.3.3 Manual hand pulse back function

You can use the hand-controlled MPG in automatic operation to make the program move forward or backward. By actually operating the machine, program errors can be easily detected.

Check mode signal MMOD (G67.2)

- Signal type: PLC->CNC
- Signal function: switch ON/OFF of the hand-controlled MPG return mode.

  When this signal is in the state of '1', when the automatic operation starts in the automatic mode, it becomes the manual MPG retreat mode. When MDI is running, it will not become a manual return mode.

  In addition, when this signal is set to '1' during automatic operation in automatic mode, the manual MPG retreat mode starts from the block to be executed next time.

  When this signal is set to '0' in automatic operation, the hand-controlled MPG retreat mode becomes OFF from a block to be executed.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G67						MMOD		

Hand control hand pulse check signal MCHK (G67.3)

- Signal type: PLC->CNC
- Signal function: Switch the valid/invalid of the MPG in the manual MPG return mode.

  When this signal is set to '1' in the manual MPG return mode, the program will be executed at the corresponding manual MPG rotation speed. In addition, when rotating the MPG in the opposite direction, the program will be executed in the opposite direction.

  When this signal is '0', the program will be executed in the forward movement direction at the speed commanded by the program as in normal automatic operation. When this signal is changed from '1' to '0' in the middle of the block, the same action will be taken.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G67					MCHK			

Signal MMMOD in check mode (F91.3)

- Signal type: CNC->PLC
- Signal function: Notify the fact that it is in the retreat mode of manual MPG.

  This signal becomes '1' when entering the manual MPG fallback mode, and when the manual MPG fallback mode is OFF, this signal becomes '0'.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
F91					MMMOD			

Signal MRVMD in reverse movement (F91.0)

- Signal type: CNC->PLC
- Signal function: Notify the fact that the program is moving in the reverse direction.

This signal becomes '1' when it enters the reverse movement state in the manual MPG retreat mode. It becomes '0' during forward movement and during forward movement again.

- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
F91								MRVMD

Reverse movement prohibition signal MRVSP (F91.2)

- Signal type: CNC->PLC
- Signal function: Notify that it is in a reverse movement prohibited state.

  In the manual MPG retreat mode, it becomes '1' when it enters a state where it cannot move in the reverse direction from a certain block. When the program can be moved in the reverse direction, it becomes '0'.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
F91						MRVSP		

4.3.4 Manual hand pulse interruption function

In automatic operation mode (automatic operation, MDI mode) and edit mode, by rotating the hand pulse generator, the movement generated by it can be superimposed on the movement of automatic movement.

Manual MPG interrupt axis selection signal

HS1IA~HS1ID(G41.0~G41.3), HS2IA~HS2ID(G41.4~G41.7)

- Signal type: PLC->CNC
- Signal function: Select the interrupt axis in manual MPG interruption. Each hand pulse generator (maximum 2 sets) has one set, each group is a code signal composed of 4 signals A, B, C, and D. The number in the signal name indicates which signal is relative to the hand pulse generator.

HSnID	HSnIC	HSnIB	HSnIA	Interrupt axis
0	0	0	0	No axis interruption
0	0	0	1	1 axis interrupt
0	0	1	0	2 axis interrupt
0	0	1	1	3 axis interrupt
0	1	0	0	4 axis interrupt
0	1	0	1	5 axis interrupt

- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G41	HS2ID	HS2IC	HS2IB	HS2IA	HS1ID	HS1IC	HS1IB	HS1IA

4.4 Mechanical return to zero

4.4.1 Mechanical return to zero

In the mechanical zero return mode, by setting the feed axis and direction selection signal to 1, the machine tool moves in the set direction and returns to the mechanical zero point. After returning to the machine zero point, CNC will establish the workpiece coordinate system with the values set by data parameters No.1240～No.1243.

4.4.1.1 Mechanical zero return end signal

ZP1～ZP8(F94.0～F94.7) , ZP21～ZP28(F96.0～F96.7)

ZP31～ZP38(F98.0～F98.7) , ZP41～ZP48(F100.0～F100.7)

- Signal type: NC->PLC
- Signal function: When the mechanical zero return of a certain axis is completed, NC will set the corresponding F signal to 1, and then transmit it to PLC, and PLC will perform logic control according to the signal state. ZPn1, ZPn2, ZPn3, ZPn4, ZPn5, ZPn6, ZPn7, ZPn8 correspond to the mechanical zero return end signal of the first, second, third, fourth, and fifth, sixth, seventh, eighth axis respectively.
- Precautions: When the mechanical zero return (including the use of G28 command to zero) has ended, and the current position is in the setting area, the mechanical zero return end signal becomes 1.
  When the machine tool moves out of the mechanical zero point, when an emergency stop alarm occurs, or when the driver alarms, the mechanical zero return end signal becomes 0.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
F94	ZP8	ZP7	ZP6	ZP5	ZP4	ZP3	ZP2	ZP1
F96	ZP28	ZP27	ZP26	ZP25	ZP24	ZP23	ZP22	ZP21
F98	ZP38	ZP37	ZP36	ZP35	ZP34	ZP33	ZP32	ZP31
F100	ZP48	ZP47	ZP46	ZP45	ZP44	ZP43	ZP42	ZP41

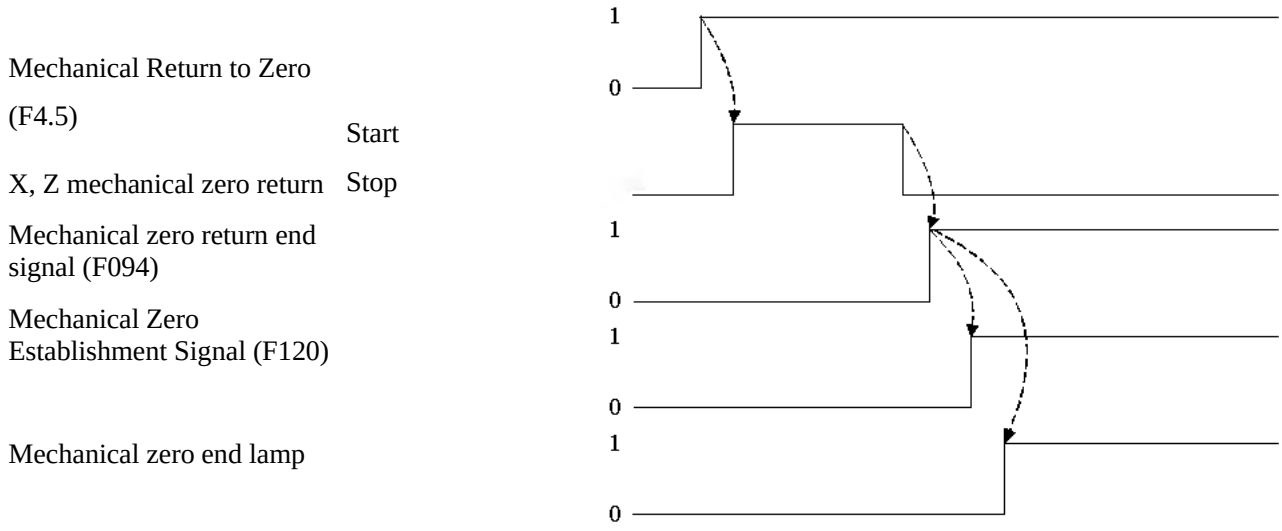
4.4.1.2 Mechanical zero establishment signal

ZRF1～ZRF5(F120.0～F120.7)

- Signal type: NC->PLC
- Signal function: CNC mechanical zero return is over. After the mechanical zero point is established, the corresponding mechanical zero point establishment signal is set to 1, and then transmitted to the PLC. The PLC performs logic control according to the state of the mechanical zero point establishment signal. ZRF1, ZRF2, ZRF3, ZRF4, ZRF5, ZRF6, ZRF7, ZRF8 correspond to the mechanical zero point establishment signals of the 1, 2, 3, 4, 5, 6, 7 and 8 axes respectively.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
F120	ZRF8	ZRF7	ZRF6	ZRF5	ZRF4	ZRF3	ZRF2	ZRF1

4.4.1.3 Mechanical zero return signal timing



4.4.1.4 Signal of deceleration for homing

Deceleration signal for reference point return DEC1～DEC5 (G196.0～G196.7)

- Signal type: PLC->NC
- Signal function: The feed decelerates when returning to the reference point manually, approaching the reference point at a slower speed. Each axis is independent of each other, and the number at the end indicates the number of the control axis.

DEC□

□: 1..... 1st axis reference point return deceleration signal
2..... 2nd axis reference point return deceleration signal
3..... 3rd axis reference point return deceleration signal
…..

For the action of the control device based on the deceleration signal, please refer to the basic steps of manual reference point return operation.

If you want to use this signal as a deceleration signal, the parameter GDC (No3006) must be set to '1'.

- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G196	DEC8	DEC7	DEC6	DEC5	DEC4	DEC3	DEC2	DEC1

4.5 Automatic operation

4.5.1 Cycle start/Feed pause

Cycle start (start automatic operation):

In the automatic mode or the input mode, when the automatic operation start signal ST is valid, the program starts to run.

1. The signal ST is ignored under the following cases:
   A: In addition to the automatic mode or the input mode.
   B. When the signal for feed suspension (SP) is 0.

C. When the signal for emergency shutdown (ESP) is 0.
D. When the external reset signal (ERS) is 1.
E: Press down Reset on the panel.
F: CNC is in alarm state.
G: Automatic operation has been started.
H: When program restart signal (SRN) is 1.
I: CNC is searching for a sequence number.

2. During automatic operation, CNC feed pauses under the following conditions:
A: When the signal for feed suspension (SP) is 0.
B: When switching to manual mode, MPG mode, single-step mode, mechanical zero return, and program zero return.
C: The SBK command are ended during SBK operation.
D: The operation has ended in the input mode.
E: CNC alarm.
F: After switching to the editing mode, the single block command has ended.

3. During automatic operation, the CNC enters the reset state and the operation stops under the following conditions:
A: The signal for emergency stop (ESP) is set as 0.
B: When the external reset signal (ERS) is 1.
C: Press the "reset button" on the panel.

Feed pause (automatic operation interruption):

When the feed pause signal SP is 0 during automatic operation, the CNC enters the pause state and stops running. At the same time, the cycle start light signal STL is set to 0. The feed pause signal SPL is set to 1. Setting the SP signal to 1 will not restart the automatic operation. When the SP signal is set to 1, and then the ST signal is valid, the automatic operation can be restarted.

During execution of the program blocks only comprising M/S/T function commands, if the SP signal is set as 0, the STL signal will turn into 0 immediately. The SPL signal is 1 and CNC enters the state of "feed suspension". When the FIN signal is delivered from PLC, CNC will keep processing the FIN signal. After the program block is finished, set the SPL signal as 0 (hold the STL signal as 0) and CNC will enter the state of "automatic operation suspension".

4.5.1.1 Signal for cyclic start

ST (G7.2):

- Signal type: PLC -> NC, the falling edge is valid.
- Signal function: In the automatic mode or the input mode, when the PLC receives the start pulse input signal, it will set G7.2 to 1, and then to 0, and transmit it to the NC to start the automatic operation.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G7						ST		

4.5.1.2 Feed pause signal

SP (G8.5)

- Signal type: PLC -> NC, valid when it is 0.
- Signal function: After the PLC receives the pause signal, it sets G8.5 to 0, and then transmits it to the NC to stop automatic operation. When the SP signal is set as 0, automatic operation

cannot be activated.

- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G8			SP					

4.5.1.3 Signal for cyclic start

STL (F0.5)

- Signal type: NC->PLC
- Signal function: When the CNC is running automatically, the STL is set to 1, and then transmitted to the PLC, and the PLC performs logic control according to the state of the STL.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
F0			STL					

4.5.1.4 Feed pause signal

SPL (F0.4)

- Signal type: NC->PLC
- Signal function: When the CNC is in the pause state, the SPL is set to 1, and then transmitted to the PLC, and the PLC performs logic control according to the state of the SPL.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
F0				SPL				

4.5.1.5 Signal for automatic operation

OP (F0.7)

- Signal type: NC->PLC
- Signal function: When the CNC is running automatically, the OP is set to 1, and then transmitted to the PLC, and the PLC performs logic control according to the OP status.

	Cycle Start Light Signal STL	Feed Pause Light Signal SPL	Signal For Automatic Operation
State of cyclic start	1	0	1
State of feed suspension	0	1	1
State of automatic operation suspension	0	0	0
Reset state	0	0	0

- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
F0	OP							

4.5.2 Reset/External part number search

Under the following conditions, CNC enters the reset state:

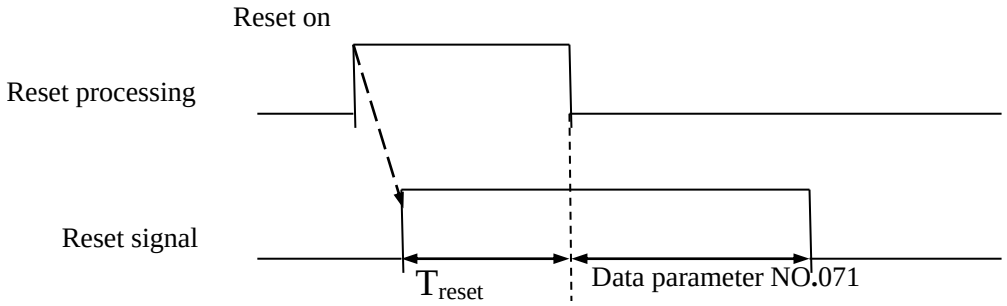
A:The signal for emergency stop (ESP) is set as 0.

B:When the external reset signal (ERS) is 1.

C: Press the "reset button" on the panel.

After the above conditions are removed, the reset signal RST becomes 0 after the time set by data parameter No.071.

RST time = T_{reset} (reset processing time) + the set value of data parameter No.071



During automatic operation, when CNC is reset, automatic operation will be stopped and the movement of the machine along the control axis will be decelerated and stopped. CNC is reset during execution of the M/S/T functions and the signal of MF/SF/TF is set as 0 within 16ms.

4.5.2.1 External reset signal

ERS (G8.7)

- Signal type: PLC->NC
- Signal function: When the PLC receives the external reset input signal, it sets G8.7, and then transmits it to the NC to reset the CNC. When the CNC is reset, the RST signal becomes 1.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G8	ERS							

4.5.2.2 Reset signal

RST (F1.1)

- Signal type: NC->PLC
- Signal function: When the CNC is in the reset state, set RST to 1, and then transmit it to the PLC, and the PLC will perform logic control according to the state of the RST.
- Precautions: RST is set to 1 in the following situations:

  A: The external emergency stop input signal (ESP) is set to 0.

  B:When the external reset signal (ERS) is 1.

  C: Press the "reset button" on the panel.

  When the above three states are released and the time set by data parameter NO.071 has ended, RST is set to 0.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
F1							RST	

4.5.2.3 External part number search

PN1, PN2, PN4, PN8, PN16 (G9.0～G9.4)

- Signal type: NC->PLC
- Signal function: This signal specifies the workpiece number executed in the memory operation mode. They are 5 code signals, corresponding to the part number, as shown in the following table (binary code).

Workpiece number search signal					Workpiece number
PN16	PN8	PN4	PN2	PN1	
0	0	0	0	0	00
0	0	0	0	1	01
0	0	0	1	0	02
Omission					
1	1	1	1	0	30
1	1	1	1	1	31

Among these signals, the workpiece number 00 is used for the special designation of "do not search". Therefore, the range of 01 to 31 can be specified as the workpiece number.

- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G9				PN16	PN8	PN4	PN2	PN1

4.5.2.4 Extended external part number search signal

EPN0～EPN13 (G24.0～G25.5)

- Signal type: PLC->CNC
- Signal function: This signal specifies the workpiece number executed in the memory operation mode. Correspond to the workpiece number in the manner shown in the table below.

External Workpiece Search Signal														Workpiece number
EPN13	EPN12	EPN11	EPN10	EPN9	EPN8	EPN7	EPN6	EPN5	EPN4	EPN3	EPN2	EPN1	EPN0	
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0000
0	0	0	0	0	0	0	0	0	0	0	0	0	1	0001
0	0	0	0	0	0	0	0	0	0	0	0	1	0	0002
Omission														
1	0	0	1	1	1	0	0	0	0	1	1	1	0	9998
1	0	0	1	1	1	0	0	0	0	1	1	1	1	9999

Among these signals, the workpiece number 0000 is used for the special designation of "do not search". Therefore, the range of 0001 to 9999 can be specified as the workpiece number. When using the parameter EPN (No. 3006.1) to select the signal, these signals are used instead of the external workpiece number search signals PN1 to PN16.

The operation after the search is executed is the same as when the external part number search signal is used.

- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G024	EPN7	EPN6	EPN5	EPN4	EPN3	EPN2	EPN1	EPN0
G025			EPN13	EPN12	EPN11	EPN10	EPN9	EPN8

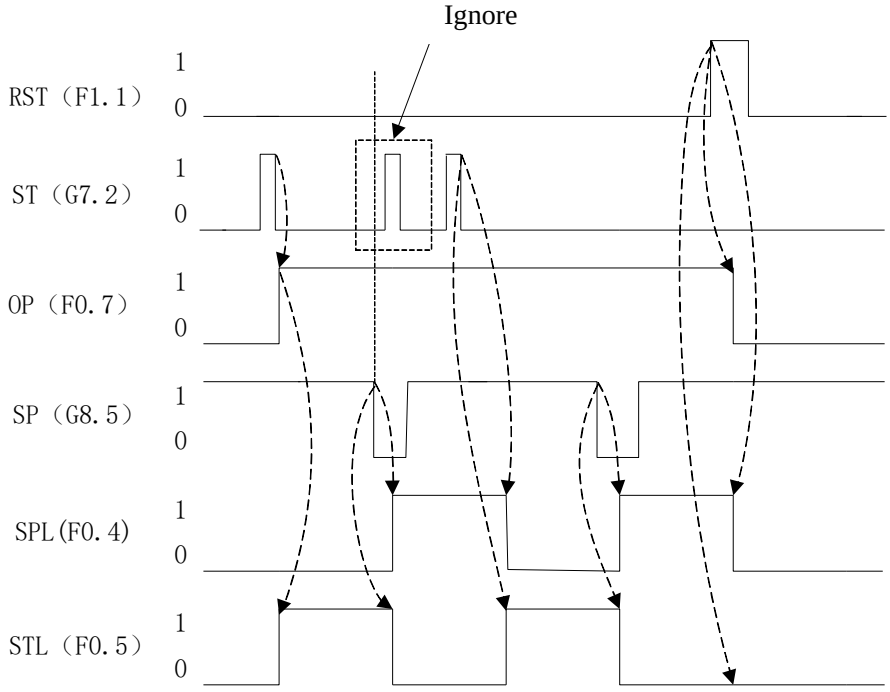
4.5.2.5 External part number search start signal

EPNS (G25.7)

- Signal type: PLC->CNC
- Signal function: This signal is a signal that only executes the search function of workpiece number search and does not execute automatic operation. The search function is executed when the signal changes from '1' to '0'.
  When the parameter EPS (No3006.2) is set to '1', this signal is valid, and the search function based on ST is invalid.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G025	EPNS							

4.5.2.6 Start running sequence



4.5.2.7 MDI-based reset confirmation signal

MDIRST (F6.1)

- Signal type: NC->PLC
- Signal function: This signal informs the PLC that the "RESET" key in MDI mode has been pressed.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
F6							MDIRST	

4.5.3 Locking of the machine

When checking the program before processing, you can turn on the machine lock function, set the machine lock signal MLK of all axes or the machine lock signal MLK1～MLK4 of each axis to 1, and stop outputting pulses to the servo motor during manual or automatic operation. However, the CNC still distributes commands, and the absolute and relative coordinates are also updated. The correctness of the programmed program can be checked by monitoring the change of the coordinate position.

4.5.3.1 Signal for locking of the machine of all axes

MLK (G44.1)

- Signal type: PLC->NC
- Signal function: PLC will set MLK to 1 after receiving all axis machine lock signals, and then send it to NC, CNC controls all axes to be in machine lock state.
- Precautions: When MLK is 1, in manual or automatic operation, CNC does not output pulses to the axis servo motor, and the machine tool table does not move.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G44							MLK	

4.5.3.2 Signal for detection on locking of the machine of all axes

MMLK (F4.1)

- Signal type: NC->PLC
- Signal function: When all axes are in the locked state, CNC will set all the axis locked detection signals to 1, and then send it to the PLC.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
F4							MMLK	

4.5.4 Dry run

Dry run is effective in automatic operation mode. At this time, the machine tool moves at a constant feed rate without executing the feed rate defined in the program. This function is used to check the movement of the machine tool without a workpiece, and the running speed depends on the manual feed rate override signal (JV0～JV15).

Selection Signal For Manual Rapid Feed(RT)	Dry Running Speed
1	Manual rapid feed rate
0	Multiplying power of manual feed rate

4.5.4.1 Signal for dry run

DRN (G46.7):

- Signal type: PLC->NC
- Signal function: When the PLC receives the dry run input signal, it sets DRN to 1. Then it is passed to the NC to make the CNC enter the dry running state.
- Note: A: When DRN is 1, the machine tool moves at the feed rate set by dry run; when it is 0, the machine tool moves normally.
  B: When the DRN changes from 0 to 1 or 1 to 0 during the movement of the machine tool, the running speed of the machine tool decelerates to 0 first, and then accelerates to the specified feed rate.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G46	DRN							

4.5.4.2 Dry run detection signal

MDRN (F2.7):

- Signal type: NC->PLC
- Signal function: When CNC is in dry running state, MDRN is set to 1, and then transmitted to PLC.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
F2	MDRN							

4.5.5 Single block

Single block operation is only valid for automatic operation. During automatic operation, when the single block signal (SBK) is set to 1, after executing the current block, the CNC enters the feed pause state. When the single block signal (SBK) is set to 0, the program runs again.

4.5.5.1 Signal for Single Block

SBK(G46.1):

- Signal type: PLC->NC
- Signal function: When the PLC receives the single block operation input signal, it sets SBK to 1, and then transmits it to the NC to make the CNC enter the single block operation state.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G46							SBK	

4.5.5.2 Signal for detection on single block

MSBK (F4.3):

- Signal type: NC->PLC
- Signal function: When CNC is in single block running state, MSBK is set to 1, and then transmitted to PLC.
- Precautions: A: During thread cutting: When the SBK signal becomes 1 during thread cutting, the operation stops after the first non-thread cutting block after the thread cutting

command is executed.

B: When the SBK signal is set as 1 during operation at a fixed cycle, stop operating when each positioning is close to the borehole and the tool is retracted rather than the end of the block.

- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
F4					MSBK			

4.5.6 Skip optional block

During automatic operation, once one slash is specified at the beginning of the block. When the signal for block delete BDT is set as 1, such block is ignored.

4.5.6.1 Signal for skipping optional block

BDT1 (G44.0):

- Signal type: PLC->NC
- Signal function: When the PLC receives the input signal for skipping optional blocks, it sets BDT1 to 1, and then transmits it to NC, so that CNC enters the skipping optional block execution state. In the program, the block that has "/" at its front will not be executed
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G44								BDT1

4.5.6.2 Skip optional block detection signal

MBDT1 (F4.0):

- Signal type: NC->PLC
- Signal function: When CNC is in the execution state of skipping optional blocks, MBDT1 is set to 1, and then transmitted to PLC, PLC can perform logic control according to the status of MBDT1.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
F4								MBDT1

4.5.7 Manual abso lute value

When the machine tool moves in manual operation (JOG feed and MPG feed), select whether the movement amount is added to the current position of the workpiece coordinate system, and output a detection signal to indicate whether the manual absolute value in the CNC is on or off.

4.5.7.1 Manual absolute value signal

ABSM (G6.2)

- Signal type: PLC->NC
- Signal function: Set the manual absolute value signal to on or off. When the signal is set to 1, the manual absolute value function is invalid; when the signal is set to 0, the manual

absolute value function is valid.

- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G6						ABSM		

4.5.7.2 Manual absolute value detection signal

MABSM (F4.2)

- Signal type: NC->PLC
- Signal function: Inform the PLC of the state of the manual absolute value signal. When the ABSM (G6.2) signal is 0, the signal is 1, and the manual absolute value function is valid; when the ABSM (G6.2) signal is 1, the signal is 0, and the manual absolute value function is invalid.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
F4						MABSM		

4.5.8 Program restart

When the tool is damaged in automatic operation, or when you want to restart the processing that was interrupted before the rest after a few days of rest, you can restart from the program segment by specifying the sequence number of the program segment you want to restart, or the number of program segments. That is reprocessed from the beginning of this block.

Program restart signal SRN (G6.0)

- Signal type: PLC->NC
- Signal function: Set the program restart signal to '1', and when searching for the sequence number of the program segment that you want to restart, the screen changes to the program restart screen. In this state, set the program restart signal to '0'. When starting automatic operation, the tool moves to the position where the machining is restarted at the dry running speed one by one in the order set by the parameter (No7310), and then restart processing.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G6								SRN

Signal SRNMV during program restart (F2.4)

- Signal type: NC->PLC
- Signal function: This signal informs the state of being in the process of restarting the program.

  Becomes '1' in the following situations:

  After the screen is changed to the program restart screen, when the program restart signal is set to '0'.

  The following situations become '0':

  At the end of the program restart.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
F2				SRNMV				

4.6 Feed shaft speed control

4.6.1 Signal for fast-moving

The rapid traverse speed of each axis can be controlled by data parameter No. 1420, without programming. But you can control the speed of rapid movement by adjusting the rapid movement magnification.

RPDO (F2.1):

- Signal type: NC->PLC
- Signal function: When the CNC executes a movement command at a rapid movement speed, it sets RPDO to 1, and then transmits it to the PLC.
- Note: A: RPDO of 1 indicates that an axis starts to move after rapid traverse is selected; 0 indicates that an axis starts to move after non-rapid traverse speed is selected.
  B: Automatic fast-moving includes all the fast-movings, such as positioning at a fixed cycle and automatic return to the reference position in addition to G00 movement command. Manual fast-moving also includes fast-moving of homing.
  C: Once fast-moving is selected, the signal is kept as 1 (even during the stop period), until other feed rates are selected and movement is started.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
F2							RPDO	

4.6.2 Fast moving rate signal

The rapid traverse override can be divided into four levels: F0, 25%, 50%, and 100%, among which the speed defined by FO is set by the data parameter NO.1421.

In automatic mode or manual mode (including mechanical zero return and program zero return), the actual moving speed is obtained by multiplying the value set by data parameter No.1420 and the override value.

Fast moving rate signal

ROV1, ROV2 (G14.0, G14.1)

- Signal type: PLC->NC
- Signal function: When the PLC receives the rapid traverse rate input signal, it assigns values to ROV1 and ROV2, and then transmits them to the NC to determine the rapid traverse speed. The magnification values corresponding to ROV1 and ROV2 are as follows.

ROV2	ROV1	Rate
0	0	100%
1	0	50%
0	1	25%
1	1	FO

- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G14							ROV2	ROV1

4.6.3 Feed rate multiplier

The feed speed can be adjusted by the feed speed override signal, which can be used for program detection. For example, when the feed rate specified in the program is 100mm/min, if the feed rate override is adjusted to 50%, the machine tool will move at a speed of 50mm/min.

Spindle speed rate signal

FV0～FV7 (G12.0～G12.7):

- Signal type: PLC->NC
- Signal function: After the PLC receives the feed rate multiplier input signal, it assigns values to FV0～FV7, and then transmits them to NC to determine the feed rate. The magnification values corresponding to the binary codes of FV0～FV7 are as follows.

FV7～FV0 (G012.7～G012.0)	Cutting Feed Rate
0000 0000	0%
0000 0001	10%
0000 0010	20%
0000 0011	30%
0000 0100	40%
0000 0101	50%
0000 0110	60%
0000 0111	70%
0000 1000	80%
0000 1001	90%
0000 1010	100%
0000 1011	110%
0000 1100	120%
0000 1101	130v
0000 1110	140%
0000 1111	150%

- Precautions: In automatic operation, the speed specified by the cutting feed is multiplied by the override value of the feed rate override signal to obtain the actual feed rate.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G12	FV7	FV6	FV5	FV4	FV3	FV2	FV1	FV0

4.6.4 Rate cancel signal

OVC(G6.4):

- Signal type: PLC->NC
- Signal function: After the PLC receives the override cancel input signal, it sets OVC to 1 and transmits it to the NC so that the feed rate override is fixed at 100%.
- Note: When OVC is 1, CNC operations are as follows:
  A: Regardless of the feed rate override signal, the feed rate override is fixed at 100%;
  B: The rapid traverse override and spindle speed override are not affected.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G6				OVC				

4.7 MST function

When the maximum 8 digits behind the address M, S, T are specified, the corresponding code signal and strobe signal are sent to the PLC, and the PLC performs related logic control according to the state of these signals. The relevant signals are as follows.

Function	Program Address	NC to PLC			End Signal
		Code Signal	Strobing Signal	End of Distribution Signal	
Auxiliary functions	M	Mbit00～Mbit31	MF	DEN	FIN
Spindle speed function	S	Sbit0～Sbit31	SF		
Tool function	T	Tbit00～Tbit31	TF		

The processing process is as follows: (change the M code to S, T code, that is, the processing process of the spindle speed function and the tool function)

A: Assuming that M XXX is specified in the program, if CNC is not set, an alarm will be generated.

B: After the code signal Mbit00～Mbit31 are designated, the strobe signal MF is set to 1, and the code signal uses the binary form to express the program command value XXX. If being moved and suspended, the spindle speed or other functions and auxiliary functions are commanded simultaneously. When the code signal for the auxiliary function is delivered, start performing other functions.

C: When the strobing signal is set as 1, PLC will read the code signal and perform corresponding operation.

D: After moving pause or other functions in a block, when performing another operation, it is necessary to wait for the distribution end signal DEN to change to 1.

E: After the operation is finished, PLC will set the completion signal FIN as 1. Such signal is used for auxiliary functions, spindle speed and the tool functions. If these functions operate simultaneously, such signal can only be set as 1 upon completion of all functions.

F: When the completion signal FIN is 1, CNC can only set the strobing signal as 0 after certain time periods and notify that such signal is received.

G: When the strobing signal is 0, set the completion signal FIN as 0 in PLC.

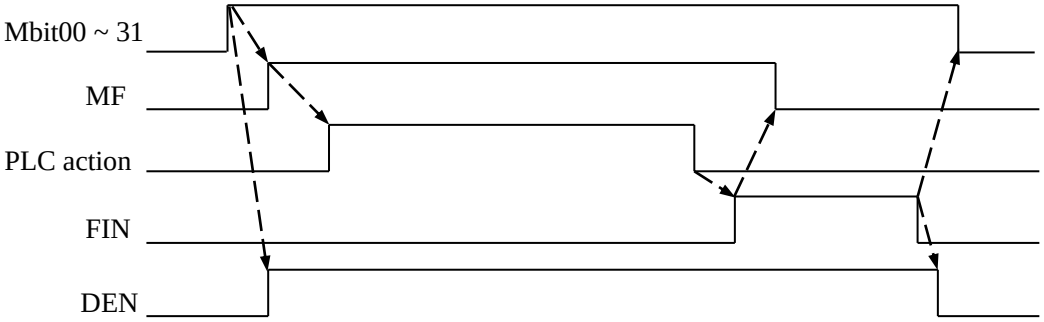
H: When the completion signal FIN is 0, CNC will set all the code signals as 0, and all sequential operations

of the auxiliary function will be ended.

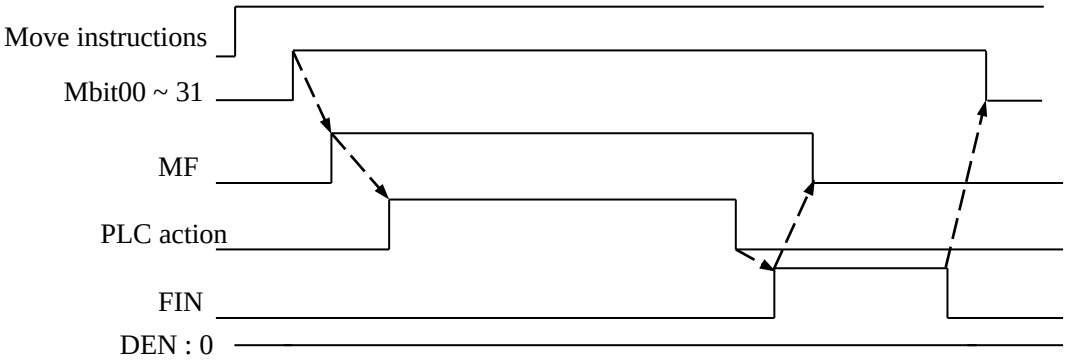
I: When other commands of the same program block are completed, CNC will perform the next block.

The control sequence is as follows:

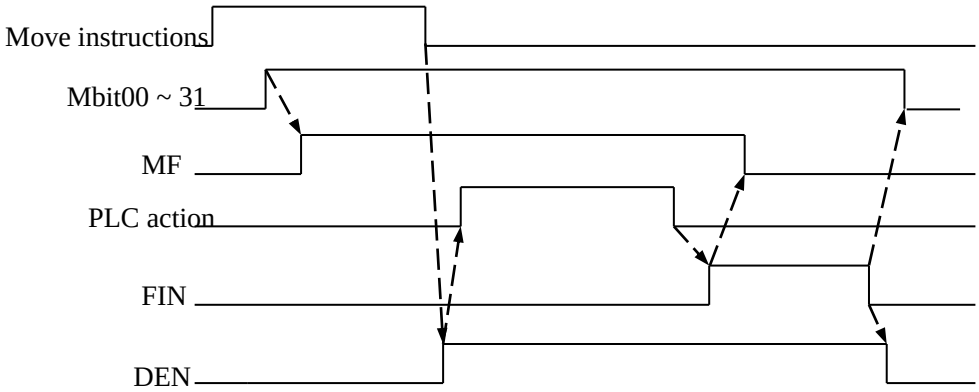
There is one auxiliary function in the program block



If the commands for movement and the auxiliary function are within the same program block, the auxiliary function is performed before completion of the commands for movement.



If the commands for movement and the auxiliary function are within the same program block, the auxiliary function is performed after such commands are finished:



4.7.1 Auxiliary function (M function)

4.7.1.1 Auxiliary function code signal and strobe signal

Auxiliary function code signal: Mbit00～Mbit31 (F10～F13)

Auxiliary function strobe signal: MF (F7.0)

- Signal type: NC->PLC

- Signal function: After the program executes the M code, the corresponding F code signal is set to 1 and MF is also 1, and then transmitted to the PLC for logic control. For output conditions and execution process, please refer to the above description of the execution process.The corresponding relationship between the M command and the code signal encoding is as follows.

F13～F10	M command
F13,F12,F11,00000000	M00
F13,F12,F11,00000001	M01
F13,F12,F11,00000010	M02
F13, F12, F11, 00000011	M03
F13, F12, F11, 00000100	M04
F13, F12, F11, 00000101	M05
F13, F12, F11, 00000110	M06
F13, F12, F11, 00000111	M07
F13, F12, F11, 00001000	M08
…	…

- Note: 1: The following auxiliary function commands cannot be output even if they are commanded in the CNC program:

  A: M98, M99, M198；

  B: The M code calling the subprogram;

  C: The M code calling the user macroprogram.

  2: The auxiliary functions listed below can be output in addition to code signals and strobe signals, as well as decoding signals: M00, M01, M02, M30.

  3. Note: M00~M31 give the M code in binary code form. For instance, M5 corresponds to 00000000, 00000000, 00000000, 00000101.

- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
F10	**Mbit7**	**Mbit6**	**Mbit5**	**Mbit4**	**Mbit3**	**Mbit2**	**Mbit1**	**Mbit0**
F11	**Mbit15**	**Mbit14**	**Mbit13**	**Mbit12**	**Mbit11**	**Mbit10**	**Mbit9**	**Mbit8**
F12	**Mbit23**	**Mbit22**	**Mbit21**	**Mbit20**	**Mbit19**	**Mbit18**	**Mbit17**	**Mbit16**
F13	**Mbit31**	**Mbit30**	**Mbit29**	**Mbit28**	**Mbit27**	**Mbit26**	**Mbit25**	**Mbit24**
F7								**MF**

4.7.1.2 M decoding signal

- **DM00 (F9.7)**
- **DM01 (F9.6)**
- **DM02 (F9.5)**
- **DM30 (F9.4)**
- Signal type: NC->PLC, valid when it is 1.
- Signal function: When CNC executes M00, M01, M02, M30, M99 instructions, the corresponding decoding signals DM00, DM01, DM02, DM30, DM99 are set to 1.

Program Command	Output Signal
M00	DM00
M01	DM01
M02	DM02
M30	DM30
M99	DM99

- Note: Under the following conditions, the M decoding signal is 1:
  The corresponding auxiliary function is designated, and other movement instructions and pause instructions are completed in the same block (if the NC has received the FIN signal before the end of the movement instruction and the pause instruction, the M decoding signal will not be output).
  Under the following conditions, the M decoding signal is 0:
  FIN signal is 1 or when reset.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
F9	**DM00**	**DM01**	**DM02**	**DM30**	**DM99**			

4.7.1.3 Multiple M commands in one block

CNC allows up to 3 M codes in a block to be output to the machine tool at the same time. This means that compared with the traditional method of one M code per block, a shorter processing cycle time can be achieved.

2nd, 3rd M function code signals: M2bit00～M2 bit 15 (F14～F15), M3 bit 00～M3 bit 15 (F16～F17)

2nd and 3rd M function strobe signals: MF2 (F8.4), MF3 (F8.5)

- Signal type: NC->PLC
- Signal function: After the program executes the 2nd and 3rd M codes, the corresponding F code signal is set to 1, and MF2 and MF3 are also 1, and then transmitted to the PLC for logic control. The corresponding relationship between the M command and the code signal encoding is as follows.

F15～F14	2M Instructions
F15, 00000000	M00
F15, 00000001	M01
F15, 00000010	M02
F15, 00000011	M03
F15, 00000100	M04
F15, 00000101	M05
F15, 00000110	M06
F15, 00000111	M07
F15, 00001000	M08
.	.
.	.
.	.

F17～F16	3M Instructions
F17, 00000000	M00
F17, 00000001	M01
F17, 00000010	M02
F17, 00000011	M03
F17, 00000100	M04
F17, 00000101	M05
F17, 00000110	M06
F17, 00000111	M07
F17, 00001000	M08
. . .	. . .

- Precautions: 1. Due to mechanical operation restrictions, certain M codes cannot be specified at the same time. For detailed information on the mechanical operation limits of multiple M codes specified in one block at the same time, see the manual of each machine tool manufacturer.
  2. M00, M01, M02 or M30 are commanded together with other M codes, other M codes will be ignored and not executed; M00, M01, M02 or M30 are commanded together, the first command M code is valid, and the remaining M codes are ignored and not executed.

For example:

One M command in one block

```
M03;
M10;
M12;
G01 X100 Z100;
……
```

There can be multiple M commands in one block

```
M03 M10 M12;
G01 X100 Z100;
……
```

- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
F14	**M2bit7**	**M2bit6**	**M2bit5**	**M2bit4**	**M2bit3**	**M2bit2**	**M2bit1**	**M2bit0**
F15	**M2bit15**	**M2bit14**	**M2bit13**	**M2bit12**	**M2bit11**	**M2bit10**	**M2bit9**	**M2bit8**
F16	**M3bit7**	**M3bit6**	**M3bit5**	**M3bit4**	**M3bit3**	**M3bit2**	**M3bit1**	**M3bit0**
F17	**M3bit15**	**M3bit14**	**M3bit13**	**M3bit12**	**M3bit11**	**M3bit10**	**M3bit9**	**M3bit8**
F8			**MF3**	**MF2**				

The second auxiliary function signal B00～B31 (F30～F33)

The second auxiliary function strobe signal BF (F7.7)

- Signal type: NC->PLC

- Signal function: This signal indicates that the second auxiliary function has been commanded.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
F7	BF							
F30	B07	B06	B05	B04	B03	B02	B01	B00
F31	B15	B14	B13	B12	B11	B10	B09	B08
F32	B23	B22	B21	B20	B19	B18	B17	B16
F33	B31	B30	B29	B28	B27	B26	B25	B24

4.7.2 Spindle speed function (S function)

Spindle speed code signal S bit00～S bit31 (F22～F25), spindle speed strobe signal SF (F7.2)

- Signal type: NC->PLC
- Signal function: When the S command is executed, the NC will set the corresponding S code signal to 1, and the SF is also 1, and then pass it to the PLC for logic control. For the output conditions and execution process, please refer to the previous related instructions. The corresponding relationship between the S command and the binary code of the code signal is shown in the following table.

F25～F22	S command
F25, F24, F23, 00000000	S00
F25, F24, F23, 00000001	S01
F25, F24, F23, 00000010	S02
F25, F24, F23, 00000011	S03
F25, F24, F23, 00000100	S04
. . . .	. . . .

- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
F22	Sbit07	Sbit06	Sbit05	Sbit04	Sbit03	Sbit02	Sbit01	Sbit00
F23	Sbit15	Sbit14	Sbit13	Sbit12	Sbit11	Sbit10	Sbit09	Sbit08
F24	Sbit23	Sbit22	Sbit21	Sbit20	Sbit19	Sbit18	Sbit17	Sbit16
F25	Sbit31	Sbit30	Sbit29	Sbit28	Sbit27	Sbit26	Sbit25	Sbit24
F7						SF		

4.7.3 Tool function (T function)

Blade functional code signal

Tbit00～Tbit31 (F26～F29), tool function strobe signal TF (F7.3)

- Signal type: NC->PLC

- Signal function: When NC commands a T command, the corresponding T code signal is set to 1, and TF is also set to 1, and then transmitted to the PLC for logic control. Regarding the output conditions and execution process, please refer to the previous related descriptions. The T command corresponds to the binary code of the T code signal.
  The relationship is as follows:

F29～F26	T Command
F29, F28, F27, 00000000	T00
F29, F28, F27, 00000001	T01
F29, F28, F27, 00000010	T02
F29, F28, F27, 00000011	T03
F29, F28, F27, 00000100	T04
. . . .	. . . .

- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
F26	Tbit07	Tbit06	Tbit05	Tbit04	Tbit03	Tbit02	Tbit01	Tbit00
F27	Tbit15	Tbit14	Tbit13	Tbit12	Tbit11	Tbit10	Tbit09	Tbit08
F28	Tbit23	Tbit22	Tbit21	Tbit20	Tbit19	Tbit18	Tbit17	Tbit16
F29	Tbit31	Tbit30	Tbit29	Tbit28	Tbit27	Tbit26	Tbit25	Tbit24
F7					TF			

4.7.4 End of MST function

4.7.4.1 End signal

FIN (G4.3)

- Signal type: PLC->NC
- Signal function: When the auxiliary function, spindle speed function, and tool function are executed, PLC sets FIN to 1, and then transmits it to NC.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G4					FIN			

MFIN (G5.0)

- Signal type: PLC->NC
- Signal function: When the auxiliary function is executed, PLC will set MFIN to 1, and then send it to NC.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G5								MFIN

SFIN (G5.2)

- Signal type: PLC->NC
- Signal function: After the spindle speed function is executed, PLC sets SFIN to 1, and then transmits it to NC.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G5						SFIN		

TFIN (G5.3)

- Signal type: PLC->NC
- Signal function: After the tool function is executed, PLC sets TFIN to 1, and then transmits it to NC.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G5						TFIN		

MFIN2 (G4.4),MFIN3 (G4.5)

- Signal type: PLC->NC
- Signal function: When the M2 and M3 functions are executed, the PLC will set the end signal to 1, and then send it to the NC.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G4			MFIN3	MFIN2				

The second auxiliary function end signal BFIN (G5.7)

- Signal type: PLC->NC
- Signal function: indicate that the 2nd auxiliary function of the high-speed M/S/T/B interface is completed.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G5	BFIN							

DEN (F1.3)

- Signal type: NC->PLC
- Signal function: When the auxiliary function, spindle speed function, tool function and other commands (such as movement command and pause command) are in the same segment, after the execution of other commands is finished, NC sets DEN to 1, and waits for the FIN signal sent by PLC. After the execution of the block, DEN becomes 0.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
F1					DEN			

4.7.5 Signal for locking of the auxiliary function

4.7.5.1 Locking auxiliary function

AFL (G5.6)

- Signal type: PLC->NC
- Signal function: When the PLC receives the auxiliary function lock input signal, it sets AFL to 1, and then transmits it to the NC to prohibit the execution of the M, S, and T functions.
- Note: When the AFL signal is 1, CNC will do the following:
  1. For operation in automatic operation and input mode, CNC does not execute the specified M, S and T functions, that is, code signals and strobe signals are not output.
  2. If AFL is set to 1 after the code signal is output, it will be executed in the normal way until the end of execution (until the FIN signal is received and the strobe signal is set to 0).
  3. When AFL is 1, M00, M01, M02 and M30 instructions are executable, and the corresponding code signals, strobe signals, and decode signals are output in the normal way.
  4. When AFL is 1, the auxiliary functions M98 and M99 are still executed in the normal way, but the execution result is not output.
  5. When AFL is 1, the spindle analog can still be output.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G5		AFL						

4.7.5.2 Signal for detection on locking of auxiliary functions

MAFL (F4.4):

- Signal type: NC->PLC
- Signal function: When the CNC is in the auxiliary function lock state, MAFL is set to 1, and then transmitted to the PLC.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
F4				MAFL				

4.8 Spindle speed function

4.8.1 Spindle speed control

The S command is input by the machining program and specifies the analog spindle speed controlled by the CNC. For constant linear speed cutting (G96 mode), CNC converts the specified surface linear speed into spindle speed.

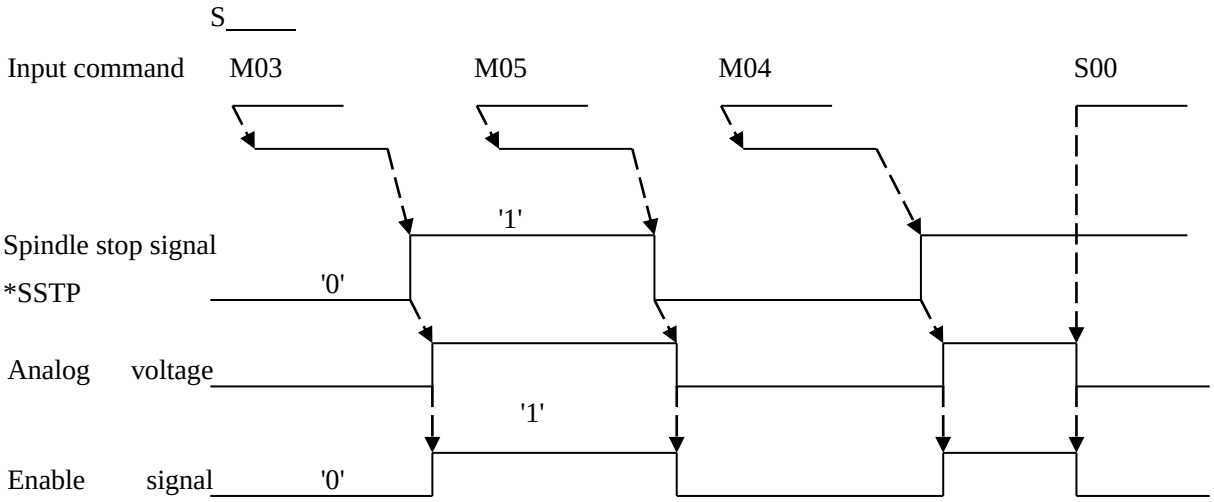
Spindle stop signal

SSTP (G29.6):

- Signal type: PLC->NC
- Signal function: Stop the output of the spindle speed command. This signal sets the S command in NC to 0. The relevant sequence is shown in the figure below.
- Note: When the spindle stop signal *SSTP is 0, the output voltage becomes 0V. When this signal becomes 1, the analog voltage output command value. When this signal is not used, set this signal to 1 so that CNC executes spindle speed control.

- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G29		SSTP						



Spindle speed rate signal

SOV00～SOV07(G30)

- Signal type: PLC->NC
- Signal function: After the PLC receives the spindle speed override input signal, it assigns the corresponding value to SOV00～SOV07, and then transmits it to the NC to set different spindle speed overrides. The relationship between the codes of SOV00～SOV07 and the magnification value is as follows.

SOV7～SOV0(G30.7～G30.0)	Spindle override
0000 0101	50%
0000 0110	60%
0000 0111	70%
0000 1000	80%
0000 1001	90%
0000 1010	100%
0000 1011	110%
0000 1100	120%

- Note: Spindle override function is invalid in tapping cycle and thread cutting.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G30	SOV07	SOV06	SOV05	SOV04	SOV03	SOV02	SOV01	SOV00

Spindle allow signal

ENB (F1.4)

- Signal type: NC->PLC
- Signal function: indicates whether there is a spindle command.
- Note: When a non-zero command is output to the spindle, ENB is 1; if the command is 0, the ENB signal becomes logic 0. In the analog spindle, even if the command output to the spindle is 0 (ie,

the analog voltage is 0V), due to the drift voltage of the inverter, the spindle motor will rotate at a low speed. In this case, the ENB signal can be used to stop the motor.

- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
F1				ENB				

Gear selection signal

GR1, GR2 (G28.1, G28.2)

- Signal type: PLC->CNC
- Signal function: This signal informs the CNC of the currently selected gear, and the specific actions are described above.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G28						GR2	GR1	

Constant surface cutting speed control

CSS (F2.2)

- Signal type: PLC->CNC
- Signal function: When the signal is 1, it means that the constant surface cutting speed control mode (G96) is being executed, and it is 0 that it is not being executed.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
F2						CSS		

Spindle speed-reached state signal

SAR (G29.4)

- Signal type: PLC->CNC
- Signal function: This signal informs CNC that the spindle has reached the speed of the specified spindle.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G29				SAR				

Spindle motor speed selection command signal

SIND (G38.7)

- Signal type: PLC->CNC
- Signal function: This signal is used to select the speed command of the spindle motor.

  SIND 1: Control the spindle motor according to the speed command issued by the PLC.

  0: Control the spindle motor according to the speed command issued by CNC. That is, the spindle speed specified by the S command.

- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G38	SIND							

S12-bit code signal of the 1st spindle

R01O~R12O (F36.0~F37.3)

- Signal type: CNC->PLC
- Signal function: This signal converts the spindle speed command calculated by CNC into 0~0xFFF code information.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
F36	R08O	R07O	R06O	R05O	R04O	R03O	R02O	R01O
F37					R12O	R11O	R10O	R090

PLC input the first spindle motor speed command signal

R01I~R12I (G32.0~G33.3)

- Signal type: PLC->CNC
- Signal function: This signal represents the speed command issued by the PLC for inputting the spindle motor speed.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G32	R08I	R07I	R06I	R05I	R04I	R03I	R02I	R01I
G33					R12I	R11I	R10I	R09I

1st spindle actual spindle speed signal

AR00~AR15 (F40~F41)

- Signal type: CNC->PLC
- Signal function: The actual rotation speed of the spindle indexed by the feedback pulse issued by the position encoder installed on the spindle is output from the CNC to the PLC.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
F40	AR07	AR06	AR05	AR04	AR03	AR02	AR01	AR00
F41	AR15	AR14	AR13	AR12	AR11	AR10	AR09	AR08

Spindle change detection alarm signal SPAL (F35.0)

- Signal type: NC->PLC
- Signal function: This signal informs that the actual spindle speed has deviated from the allowable speed relative to the command speed.

  Becomes '1' in the following situations:

  When the actual spindle speed deviates from the allowable speed relative to the command speed.

  Becomes '0' in the following situations:

  The alarm of spindle speed change has not been detected.

  In the '1' state, a reset was applied to the control device to cancel the alarm.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
F35								SPAL

4.8.2 Multi-spindle control

Spindle selection signal

SWS1 (G27.0)

SWS2 (G27.1)

SWS3 (G27.2)

SWS4 (G250.1)

- Signal type: PLC->NC
- Signal function: The multi-spindle working mode controls whether the S command of the NC is output to the spindle.

  SWS1 1: output speed command to the 1st spindle

  0: Do not output speed command to the 1st spindle

  SWS2 1: output speed command to the 2nd spindle

  0: Do not output the speed command to the 2nd spindle

  SWS3 1: Output speed command to the **3rd** spindle

  0: Do not output the speed command to the **3rd** spindle

  SWS4 1: Output speed command to the 4th spindle

  0: Do not output the speed command to the 4th spindle
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G27						**SWS3**	**SWS2**	**SWS1**
G250							**SWS4**	

Rigid tapping spindle selection signal

RGTSP1 (G61.4)

RGTSP2 (G61.5)

RGTSP3 (G61.6)

RGTSP4 (G250.2)

- Signal type: PLC->NC
- Signal function: In the multi-spindle control mode, the spindle selection signal. The parameter NO.5200.7 determines whether to use this signal or SWS1\SWS2\SWS3\SWS4.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G61		**RGTSP3**	**RGTSP2**	**RGTSP1**				
G250						**RGTSP4**		

Spindle stop signal

SSTP1 (G27.3)

SSTP2 (G27.4)

SSTP3 (G27.5)

SSTP4 (G250.7)

- Signal type: PLC->NC
- Signal function: Only valid for multiple spindles, each axis can be stopped by this signal.

  SSTP1 1: Do not output 0 rpm to the 1st spindle

  0: output 0 rpm to the 1st spindle

  SSTP2 1: Do not output 0 rpm to the 2nd spindle

0: output 0 rpm to the 2nd spindle

SSTP3 1: Do not output 0 rpm to the **3rd** spindle

0: Output 0 rpm to the **3rd** spindle

SSTP4 1: Do not output 0 rpm to the 4th spindle

0: Output 0 rpm to the 4th spindle

- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G27			**SSTP3**	**SSTP2**	**SSTP1**			
G250	**SSTP4**							

Gear selection signal

GR1_1 ~ GR1_2 (G28.1～G28.2)

- Signal type: PLC->NC
- Signal function: gear grade selection of the first spindle

The maximum speed of the first spindle gear is set by data parameters No.3741～No.3744. The relationship between the signal and the gear is as follows.

GR1_2	GR1_1	Gear	No. 1 Spindle Maximum Speed Parameter Number
0	0	1	Data parameter No.3741
0	1	2	Data parameter No.3742
1	0	3	Data parameter No.3743
1	1	4	Data parameter No.3744

- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G28						**GR1_2**	**GR1_1**	

GR2_1 ~ GR2_2 (G29.0～G29.1)

- Signal type: PLC->NC
- Signal function: When installing multiple spindles, it is used to select the gear grade of the second spindle (4th gear).

The maximum speed of the second spindle gear is set by data parameters No.3741～No.3744. The relationship between the signal and the gear is as follows:

GR2_2	GR2_1	Gear	The Parameter Number of The Maximum Speed of The Second Spindle
0	0	1	Data parameter No.3741
0	1	2	Data parameter No.3742
1	0	3	Data parameter No.3743
1	1	4	Data parameter No.3744

- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G29							GR2_2	GR2_1

GR3_1 ~ GR3_2 (G29.2～G29.3)

- Signal type: PLC->NC
- Signal function: When installing multiple spindles, it is used to select the gear grade of the 3rd spindle (4th gear).

  The maximum speed of the 3rd spindle gear is set by data parameters No.3741～No.3744. The relationship between the signal and the gear is as follows.

GR3_2	GR3_1	Gear	3rd spindle maximum speed parameter number
0	0	1	Data parameter No.3741
0	1	2	Data parameter No.3742
1	0	3	Data parameter No.3743
1	1	4	Data parameter No.3744

- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G29					GR3_2	GR3_1		

GR4_1 ~ GR4_2 (G250.4～G250.5)

- Signal type: PLC->NC
- Signal function: When installing multiple spindles, it is used to select the gear grade of the 4th spindle (4th gear).

  The maximum speed of the 4th spindle gear is set by data parameters No.3741～No.3744. The relationship between the signal and the gear is as follows.

GR4_2	GR4_1	Gear	4th Spindle Maximum Speed Parameter Number
0	0	1	Data parameter No.3741
0	1	2	Data parameter No.3742
1	0	3	Data parameter No.3743
1	1	4	Data parameter No.3744

- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G250			GR4_2	GR4_1				

Second spindle enable signal

ENB2 (F38.2)

- Signal type: NC->PLC
- Signal function: Inform the PLC whether or not to output a command signal to the second spindle in

multi-spindle control. This signal is used as a condition to stop the analog spindle.

ENB2 1: Allow the second spindle speed control

0: No 2nd spindle speed control allowed

- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
F38						**ENB2**		

2nd spindle motor speed selection command signal

SIND2 (G38.6)

- Signal type: PLC->CNC
- Signal function: This signal is used to select the speed command of the second spindle motor.

SIND2 1: Control the second spindle motor according to the speed command issued by the PLC.

0: Control the second spindle motor according to the speed command issued by CNC. That is, the spindle speed specified by the S command.

- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G38		**SIND2**						

S12-bit code signal of the 2nd spindle

- **R01O2~R12O2(F200.0~F201.3)**
- Signal type: CNC->PLC
- Signal function: This signal converts the spindle speed command calculated by CNC into 0~0xFFF code information.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
F200	**R08O2**	**R07O2**	**R06O2**	**R05O2**	**R04O2**	**R03O2**	**R02O2**	**R01O2**
F201					**R12O2**	**R11O2**	**R10O2**	**R09O2**

PLC input the second spindle motor speed command signal

R01I2~R12I2 (G34.0~G35.3)

- Signal type: PLC->CNC
- Signal function: This signal represents the speed command issued by the PLC for inputting the second spindle motor speed.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G34	**R08I2**	**R07I2**	**R06I2**	**R05I2**	**R04I2**	**R03I2**	**R02I2**	**R01I2**
G35					**R12I2**	**R11I2**	**R10I2**	**R09I2**

2nd spindle actual spindle speed signal

AR002~AR152 (F202~F203)

- Signal type: CNC->PLC
- Signal function: The actual rotation speed of the spindle indexed by the feedback pulse issued by the position encoder installed on the spindle is output from the CNC to the PLC.

- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
F202	AR072	AR062	AR052	AR042	AR032	AR022	AR012	AR002
F203	AR152	AR142	AR132	AR122	AR112	AR102	AR092	AR082

3rd spindle motor speed selection command signal

SIND3 (G38.5)

- Signal type: PLC->CNC
- Signal function: This signal is used to select the speed command of the 3rd spindle motor.

  SIND3 1: Control the 3rd spindle motor according to the speed command issued by PLC.

  0: Control the 3rd spindle motor according to the speed command issued by CNC. That is, the spindle speed specified by the S command.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G38			SIND3					

3rd spindle command code signal

- **R01O3~R12O3(F204.0~F205.3)**
- Signal type: CNC->PLC
- Signal function: This signal converts the spindle speed command calculated by CNC into 0~0xFFF code information.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
F204	R08O3	R07O3	R06O3	R05O3	R04O3	R03O3	R02O3	R01O3
F205					R12O3	R11O3	R10O3	R09O3

3rd spindle actual spindle speed signal

AR002~AR152 (F206~F207)

- Signal type: CNC->PLC
- Signal function: The actual rotation speed of the spindle indexed by the feedback pulse issued by the position encoder installed on the spindle is output from the CNC to the PLC.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
F206	AR073	AR063	AR053	AR043	AR033	AR023	AR013	AR003
F207	AR153	AR143	AR133	AR123	AR113	AR103	AR093	AR083

PLC input the 3rd spindle motor speed command signal

R01I3~R12I3 (G36.0~G37.3)

- Signal type: PLC->CNC
- Signal function: This signal represents the speed command issued by the PLC for inputting the speed of the third spindle motor.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G36	R08I3	R07I3	R06I3	R05I3	R04I3	R03I3	R02I3	R01I3
G37					R12I3	R11I3	R10I3	R09I3

3rd spindle enable signal

ENB3 (F38.3)

- Signal type: NC->PLC
- Signal function: Inform the PLC whether to output a command signal to the third spindle in the multi-spindle control. This signal is used as a condition to stop the analog spindle.
  ENB3 1: Allow the **3rd** spindle speed control
  0: No **3rd** spindle speed control allowed
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
F38					ENB3			

Position encoder selection signal PC2SLC (G28.7), PC3SLC (G26.0)

- Signal type: PLC->NC
- Signal function: selection signal of position encoder

Position Encoder Selection Signal	PC2SLC	PC3SLC
1st position encoder	0	0
2nd position encoder	1	0
3rd position encoder	0	1

Position encoder selection signal

PC4SLC (G250.0)

- Signal type: PLC->NC
- Signal function: selection signal of position encoder.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G250								PC4SLC

4th spindle enable signal

ENB4 (F250.0)

- Signal type: NC->PLC
- Signal function: Inform the PLC whether to output a command signal to the 4th spindle in the multi-spindle control. This signal is used as a condition to stop the analog spindle.
  ENB4 1: Allow the 4th spindle speed control
  0: No 4th spindle speed control allowed
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
F250								ENB4

4th spindle motor speed selection command signal

SIND4 (G250.6)

- Signal type: PLC->CNC
- Signal function: This signal is used to select the speed command of the 4th spindle motor.

  SIND4 1: Control the 4th spindle motor according to the speed command issued by the PLC.

  0: Control the 4th spindle motor according to the speed command issued by CNC. That is, the spindle speed specified by the S command.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G250		SIND4						

S12-bit code signal of the 4th spindle

R01O4~R16O4 (F208~F209)

- Signal type: CNC->PLC
- Signal function: This signal converts the spindle speed command calculated by CNC into 0~0xFFFF code information.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
F208	R08O4	R07O4	R06O4	R05O4	R04O4	R03O4	R02O4	R01O4
F209	R16O4	R15O4	R14O4	R13O4	R12O4	R11O4	R10O4	R09O4

PLC input the 4th spindle motor speed command signal

R01I4~R16I4 (G252~G253)

- Signal type: PLC->CNC
- Signal function: This signal represents the speed command issued by the PLC for inputting the 4th spindle motor speed.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G252	R08I4	R07I4	R06I4	R05I4	R04I4	R03I4	R02I4	R01I4
G253	R16I4	R15I4	R14I4	R13I4	R12I4	R11I4	R10I4	R09I4

4th spindle actual spindle speed signal

AR004~AR154 (F212~F213)

- Signal type: CNC->PLC
- Signal function: The actual rotation speed of the spindle indexed by the feedback pulse issued by the position encoder installed on the spindle is output from the CNC to the PLC.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
F212	AR074	AR064	AR054	AR044	AR034	AR024	AR014	AR004
F213	AR154	AR144	AR134	AR124	AR114	AR104	AR094	AR084

Rotation direction of each spindle in multi-spindle control

The first spindle reverse signal GSRV (G70.4)

The first spindle forward signal GSFR (G70.5)
The second spindle reverse signal GSRV (G74.4)
The second spindle forward signal GSFR (G74.5)
The third spindle reversal signal GSRV (G78.4)
The third spindle reversal signal GSFR (G78.5)

- Signal type: CNC->PLC
- Signal function: inform the NC side of the current running direction of each spindle
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G70			GSFR	GSRV				
G74			GSFR	GSRV				
G78			GSFR	GSRV				

4.8.3 Spindle position/Speed switch

Spindle contour control switching signal
CON (G27.7)

- Signal type: PLC->NC
- Signal function: This signal specifies Cs contour control function. Make the servo spindle switch between spindle speed control mode and Cs contour control mode. When this signal is "1", the spindle will switch from speed control mode to Cs contour control mode. When this signal becomes "0", the Cs contour control mode will be switched back to the speed control mode.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G27	CON							

Spindle contour control switching end signal
FSCSL (F44.1)

- Signal type: NC->PLC
- Signal function: When the signal is '0', it indicates that the controlled axis is in the spindle speed control mode. When this signal is '1', it indicates that the controlled axis is in Cs contour control mode.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
F44							FSCSL	

Rigid tapping signal RGTAP (G61.0)

- Signal type: PLC->NC
- Signal function: Through the instruction of M29 (preparation auxiliary function for rigid tapping mode), the PLC side is set to rigid tapping mode.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G61								RGTAP

Spindle contour control switching signal in multi-spindle control

The first spindle contour control switching signal CONS1 (G254.0)

The second spindle contour control switching signal CONS2 (G254.1)

The third spindle contour control switching signal CONS3 (G254.2)

The fourth spindle contour control switching signal CONS4 (G254.3)

- Signal type: PLC->NC
- Signal function: spindle contour control switching signal used in multi-spindle control
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G254					CONS4	CONS3	CONS2	CONS1

Rigid tapping spindle selection signal RGROD (G61.2)

- Signal type: PLC->CNC
- Signal function: Before executing rigid tapping, notify the CNC spindle rotation direction.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G61						RGROD		

Spindle rotation direction signal RGSPM, RGSPP (F65.1, F65.0)

- Signal type: NC->PLC
- Signal function: In the execution of rigid tapping, inform the PLC whether the spindle is rotating forward or backward.

  RGSPP '1': Forward turning
  '0': Non-forward turning
  RGSPM '1': Reversing
  '0': Non-reversal

  When the spindle moves during rigid tapping, a signal is output. Therefore, even in the action of positioning to the hole position in the rigid tapping method, and the pause at the hole bottom or R point, no signal is output.

  Of course, no signal is output during feed hold and single block stop.

  However, when the machine stops due to interlock, the machine is locked, or the Z-axis is ignored, it will not be regarded as a stop and a signal will be output.

  The spindle rotation direction signal is only valid in the rigid tapping mode, and no signal is output in the normal spindle control.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
F65							RGSPM	RGSPP

Signal in rigid tapping RTAP (F76.3)

- Signal type: NC->PLC
- Signal function: a signal to inform the PLC that it is in the rigid tapping mode.

  RTAP '1': In rigid tapping mode

'0': In non-rigid tapping mode

- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
F76					RTAP			

Ordinary tapping signal PTAP (F76.2)

- Signal type: NC->PLC
- Signal function: a signal that informs the PLC that it is in the normal tapping mode.

PTAP '1': Normal tapping method

'0': In the non-ordinary tapping method

- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
F76						PTAP		

Each spindle Cs contour control switching completion signal FCSS1 (F254.0)

FCSS2 (F254.1)

FCSS3 (F254.2)

- Signal type: NC->PLC
- Signal function: Notify that the spindle has been switched to the Cs contour control mode.

Becomes '1' in the following cases:

When the belonging spindle becomes the Cs contour control mode.

Becomes '0' in the following cases:

When the spindle to which it belongs has not yet become the Cs contour control mode.

- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
F254						FCSS3	FCSS2	FCSS1

Each spindle Cs corresponds to the feed axis signal (F270~F273)

The first spindle (F270)

The second spindle (F271)

The third spindle (F272)

Fourth spindle (F273)

- Signal type: NC->PLC
- Signal function: inform the PLC of the feed axis corresponding to each spindle
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
F270			J6	J5	J4	J3	J2	J1
F271			J6	J5	J4	J3	J2	J1
F272			J6	J5	J4	J3	J2	J1
F273			J6	J5	J4	J3	J2	J1

4.9 Tool function

When the T code or HDT signal is specified, the NC compares the required tool number with the current tool number NOWT00～NOWT07. If the tool numbers are consistent, no tool change will be performed; if they are inconsistent, the code signal and selection communication of the required tool number will be generated. No., the machine tool selects the tool according to the generated signal.

This CNC can change the tool by T command in automatic and input mode, and can also change the tool sequentially by HDT signal in manual mode.

T command tool change

The user can specify the T command to change the tool in the automatic mode and the input mode. After the NC interprets the T command, it sends the tool position number and strobe signal specified by the T command, and then waits for the PLC tool change to be completed.

Current tool number signal

NOWT00～NOWT07 (G201)

- Signal type: PLC -> NC
- Signal function: After the PLC detects the current tool position signal, it sets NOWT00～NOWT07 (G201) to the corresponding value, and then sends it to NC to inform NC of the current tool number. These signals represent the tool number in binary code.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G201	NOWT07	NOWT06	NOWT05	NOWT04	NOWT03	NOWT02	NOWT01	NOWT00

4.9.1 Tool life management

The tool group is classified into several groups, and the life of the tool (the number of times of use or the time of use) is determined in advance in each group. In addition, the life of the tools belonging to each group is counted every time they are used, and when the life is approaching the end, new tools that are arranged in a certain order in advance in the same group are automatically selected. As a result, it is possible to continue machining while managing the life of the tool. The data for managing tool life is composed of tool group number, tool life value, tool number, tool compensation amount designation code, and these data are registered in the CNC.

Tool change signal TLCH (F64.0)

- Signal type: CNC->PLC
- Signal function: This signal informs the fact that the life of the last tool in the group has reached its end.

  Becomes '1' in the following situations:

  Whenever the life of a tool has come to an end, the next tool in the group is selected in turn, when the life of the last tool in one of the groups has come to an end.

  Becomes '0' in the following situations:

  There is no time for a group that has reached the end of its life.

  In the state of '1', through the tool change reset signal TLRST sent from the PLC side or MDI operation, and all groups whose life has reached the end are notified that the CNC tool change has been completed, and this signal becomes '0'.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
F64								TLCH

Tool change reset signal TLRST (G48.7)

- Signal type: PLC->CNC
- Signal function: All execution data marked with the life technology, * and @ of the group are cleared.
  After replacing all the tools in the group whose life has reached the end displayed on the screen with new tools, specify the group number through the tool group number selection signal, input this signal, and set the parameter GRS (No6800.4) to '1', it is not necessary to input the tool group number selection signal, and execute the clear operation with respect to all registered groups.
  In addition, operations from MDI can also be cleared.
  When the signal changes from "0" to "1", the control device operates as follows.
  If the tools of all groups specified by the tool group number selection signal have reached their life, this information will be cleared. In other words, when the group number is commanded by the program command, the tool is selected again from the first tool. If there is only one tool that has not reached the end of its life in the group specified by the tool group number selection signal, there will be no action.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G48	TLRST							

Tool change signal TLCHI one by one (F64.2)

- Signal type: CNC->PLC
- Signal function: When the tool life count is specified by time, it notifies that the life of the tool currently in use has reached the end. Insert the tool change program through this signal, and the program can be restarted after the tool is changed.
  Becomes '1' in the following situations:
  When the life of the tool currently in use has reached the end.
  Becomes '0' in the following situations:
  When performing tool-by-tool replacement reset operation.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
F64						TLCHI		

Tool replacement reset signal TLRSTI (G48.6)

- Signal type: PLC->CNC
- Signal function: Set the tool change signal TLCHI one by one to '0'.
  When the signal becomes '1', the control device performs the following actions:
  Set the tool change signal one by one to '0'.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G48		TLRSTI						

Tool skip signal TLSKP (G48.5)

- Signal type: PLC->CNC
- Signal function: the tool whose life has not yet reached the end can be skipped, and the next tool can be selected forcibly. One of the following two methods can be selected through the parameter SIG (No6800.3).
  ① The way to specify the group number with the tool group number selection signal.

(SIG = '1')

Through the tool group number selection signal, specify the group number to which the tool belongs and set the tool skip signal to '1'. Through this operation, the next tool is selected in the group where the following T code commands skip.

② The method of specifying the group number without using the tool group number selection signal. (SIG = '0')

If the group number is not specified, the tool skip signal TLSKP is set to '1', and it is deemed that the group to which the selected tool belongs has been specified.

Through this operation, the next tool is selected in the group specified to be skipped by the next T code command. However, when the tool skip signal TLSKP is set to '1' relative to the last tool, the tool change signal TLCH becomes '1'.

When the signal changes from '0' to '1', the control device operates as follows.

Among the tools that have not reached the life in the group that should be skipped, the tool number with the smallest numerical value arranged in the tool life management table is marked. When the group is commanded again by the T code command, the tool is skipped and the next tool is selected.

However, when the tool skip signal TLSKP is set to "1" relative to the last tool, the tool change signal TLCH becomes '1'.

- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G48			TLSKP					

New tool selection signal TLNW (F64.1)

- Signal classification: CNC->PLC
- Signal function: This signal informs the PLC that a new tool in the group has been selected. When a new tool is selected, it is expected to be used when the tool length compensation amount of the tool is automatically measured.

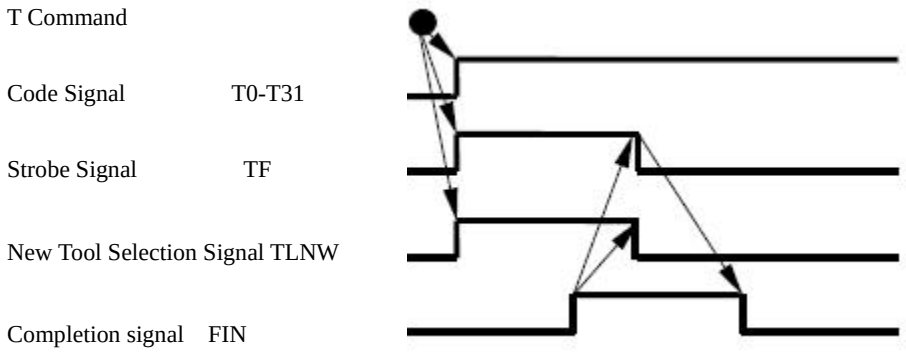
It becomes '1' in the following cases.

When the tool group number is commanded by the T code command, the next new tool is selected because the previously used tool in the group has reached the end of its life.

After sending the code signal of the new tool, this signal becomes '1' at the same time as the tool function strobe signal TF is sent.

The following situations become '0'

When this signal is in the state of '1', the completion signal FIN of the strobe signal TF becomes '1'.



- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
F64							TLNW	

Tool group number selection signal TL01～TL08 (G47.0～G47.7)

- Signal type: PLC->CNC
- Signal function: Specify the tool group number. Before inputting the tool change reset signal TLRST or the tool skip signal TLSKP, use this signal to specify which group to execute the tool change reset or tool skip.

  Binary data is used to represent the tool group number, and the actual tool group number is accumulated by binary data.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G47	TL08	TL07	TL06	TL05	TL04	TL03	TL02	TL01

Tool life counting magnification signal TLV0～TLV7 (G49)

- Signal type: PLC->CNC
- Signal function: When the life counting type is specified by time, by setting the parameter LFV (No.6800.2) to '1', the magnification can be applied to the life counting.

  The counting time of tool life management is multiplied by the actual cutting time based on the time-based life count and the override value selected by the signal For example, if the override value is 0.1 times and the world cutting time is set to 1000s, the counting time of the tool life is 100s.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G49	TLV7	TLV6	TLV5	TLV4	TLV3	TLV2	TLV1	TLV0

Tool life forecast signal TLCHB (F64.3)

- Signal type: CNC->PLC
- Signal function: By setting the redesign value before selecting a new tool, using life counting, when the remaining life of the group is the same as or below the set redesign value, the tool life forecast signal is output in advance Make a preview.

  Redesign the values and use the parameters (No6844, No6845).

  Becomes '1' in the following situations:

  When the parameter RMT (No6802.7) =0, the remaining amount of life (life value-life count value) ≤ redesign value;

  When the parameter RMT (No6802.7) =1, the remaining amount of life (life value-life count value) = redesign value.

  The following situations become '0':

  When the parameter RMT (No6802.7) =0, the remaining amount of life (life value-life count value)> redesign value;

  When the parameter RMT (No6802.7) =1, the remaining amount of life (life value-life count value) ≠ the redesign value.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
F64					TLCHB			

Tool life counting invalid signal LFCIV (G48.2)

- Signal type: PLC->CNC
- Signal function: Invalidate the life count of the selected tool.
  When the signal becomes "1", the control device performs the following actions.
  For the selected tool, the life count is not performed.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G48						LFCIV		

Tool life counting invalid signal LFCIF (F93.2)

- Signal type: CNC->PLC
- Signal function: This signal informs that the life count of the selected tool is invalid.
  Becomes '1' in the following situations:
  When the tool life count invalid signal LFCIV is set to '1' and the life count is invalid.
  Becomes '0' in the following situations:
  When the tool life count invalid signal LFCIV is set to '0' and the life count is valid.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
F93						LFCIF		

4.10 Other functions:

4.10.1 Metric/Imperial conversion

Inch input signal INCH (F2.0)

- Signal type: NC->PLC
- Signal function: If the signal is 1, it means that it is the inch input mode (G20), and 0 means that it is the metric input mode (G21).
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
F2								INCH

4.10.2 Thread cutting

Thread cutting signal THRD (F2.3)

- Signal type: NC->PLC
- Signal function: This signal indicates that thread cutting is in progress.
  The signal is 1 in the following situations:

1) In thread cutting mode;
2) Thread cutting is in progress.
The signal is 1 in the following situations:
It is not a thread cutting method, and it does not perform thread cutting.

- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
F4					THRD			

4.10.3 Parts count

Target parts count arrival signal PRTSF (F62.7)

- Signal type: NC->PLC
- Signal function: When the number of processed parts reaches the number of required parts set by parameter #6713, the PRTSF signal is output to the PLC; when #6713 is set to 0, the PRTSF signal is not output.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
F62	PRTSF							

4.10.4 Tool compensation amount measurement value direct input function B

Tool compensation amount writing mode selection signal GOQSM (G39.7)

- Signal type: PLC->NC
- Signal function: select the writing method of tool compensation amount
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G39	GOQSM							

Tool compensation number selection signal OFN0～OFN5 (G39.0～G39.5)

- Signal type: PLC->NC
- Signal function: select tool compensation number
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G39			OFN5	OFN4	OFN3	OFN2	OFN1	OFN0

Workpiece coordinate system offset writing mode selection signal WOQSM (G39.6)

- Signal type: PLC->CNC
- Signal function: Select the writing method of the workpiece coordinate system offset.
  When the signal is set to "1" when the manual operation mode is selected, it becomes the writing mode of the workpiece coordinate system offset. The screen automatically switches to the workpiece offset screen, and the status icon at the bottom of the screen is displayed, and the workpiece coordinate system offset writing mode has been entered. However, it will be ignored when the tool compensation amount writing

method is selected.

- Signal address

	#7	#6	#5	#4	#3	#2	#1	#0
G39		WOQSM						

Workpiece coordinate system offset write signal WOSET (G40.7)

- Signal type: PLC->CNC
- Signal function: Automatically calculate and set the workpiece coordinate system offset when the signal becomes '1' in the state of writing mode, the system automatically calculates and sets the Z axis workpiece coordinate system offset.
- Signal address

	#7	#6	#5	#4	#3	#2	#1	#0
G40	WOSET							

Tool compensation amount write signal MIT1P ～ MIT2P (G132.0 ～ G132.1) MIT1N ～ MIT2N(G134.0～G134.1)

- Signal type: PLC->NC
- Signal function: Prohibit axial feed corresponding to manual operation. When the tool compensation amount writing mode selection signal GOQSM is '1', the tool shape compensation amount of the corresponding axis is automatically calculated and set in the tool compensation amount memory while the axial feed corresponding to the prohibition of manual operation is automatically calculated in.

  When the signal becomes "1", the control device performs the following actions.

  Apply interlock to the axial feed corresponding to manual operation

  When the parameter TSI (No5004.3)=0, the X axis is the first axis, and the Z axis is the second axis:

  MIT1P: Apply interlock to the manual feed in the + direction of the X axis;

  MIT1N: Apply interlock to the manual feed of the -direction of the X axis;

  MIT2P: Apply interlock to the manual feed in the + direction of the Z axis;

  MIT2N: Apply interlock to the manual feed in the -direction of the Z axis.

  When the parameter TSI (No5004.3)=1:

  MIT1P: Apply interlock to the corresponding direction through automatic discrimination;

  MIT1N: not used;

  MIT2P: not used;

  MIT2N: Not used.

  When the tool compensation amount writing mode selection signal GOQSM is '1', the tool shape compensation amount of the tool compensation number pointed to by the cursor at this time is automatically calculated and set in the tool compensation amount memory.

- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G132							MIT2P	MIT1P
G134							MIT2N	MIT1N

Tool compensation axis selection signal MITXP～MITZP (G133.0～G133.1) MITXN～MITZN (G135.0～G135.1)

- Signal type: PLC->NC
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G133							MITZP	MITXP
G135							MITZN	MITXN

4.10.5 Tool compensation amount measurement value direct input function

Position recording signal PRC (G40.6)

- Signal type: PLC->NC
- Signal function: The signal used when the tool compensation measurement value is directly input. When the signal becomes '1', the rising edge of this signal is captured and the current position of all axes at that moment is stored.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G40		PRC						

4.10.6 Interrupt type user macro program

When a program is being executed, input an interrupt signal (UINT) from the mechanical side to call another program.

This function is called interrupt type user macro program function.

Interrupt signal UINT for user macro program (G53.3)

- Signal type: PLC->CNC
- Signal function: Calls and executes the program in memory. During this time, the automatically running program is temporarily interrupted. It must be in automatic startup mode.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G53					UINT			

4.10.7 Polygon processing

Polygonal machining refers to the process of machining a workpiece into a polygonal shape by rotating the workpiece and the tool at a certain ratio.

By changing the rotation ratio of the workpiece and the tool and the number of installed blades of the tool, the workpiece can be machined into a quadrilateral or a hexagon. the polygonal machining in this system adopts two methods: one is that the spindle adopts the speed control mode, and the tool rotation axis is completed by the cnc control axis (servo feed axis); the other is that the spindle adopts the position control mode, and the tool rotation axis is completed by the cnc control axis (servo feed axis). parameter No.7603.4 controls which control mode the cnc adopts.

Polygon synchronization signal PSYN (F63.7)

- Signal type: NC->PLC
- Signal function: This signal informs the PLC that it is currently in the state of polygon processing.
  By commanding the polygon processing mode, this signal becomes '1', and maintains '1' in the polygon processing mode. By canceling the polygon processing mode, this signal becomes '0'. This signal remains '0' when outside the polygon processing mode.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
F63	PSYN							

4.10.8 Inclined axis control

Quadrature axis tilt axis control invalid signal NOZAGC (G63.5)

- Signal type: PLC->NC
- Signal function: Set the tilt axis control of the orthogonal axis to be invalid.
- When it becomes '1', the movement command of the inclined axis can be converted to the inclined coordinate, but the orthogonal axis is not affected by the inclined axis command.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G63			NOZAGC					

4.10.9 Synchronous control of feed axis

Feed axis synchronization control selection signal SYNC1～SYNC8 (G190.0～G190.7)

- Signal type: PLC->NC
- Signal function: In automatic operation or MDI mode operation, synchronous control of the feed axis is performed.
  It is the signal in each control axis, and the number at the end of the signal name indicates the number of the control axis.
  1: The first axis is the axis controlled by the feed axis synchronously (slave control axis)
  2: The second axis is the axis controlled by the feed axis synchronously (slave control axis)
  …
  …
  When the signal becomes '1', in the case of automatic or MDI mode operation, the movement command of the main control axis is given to the two axes of the main control axis and the feed axis synchronously controlled axis. Which axis to synchronize with depends on the parameter setting.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G190	SYNC8	SYNC7	SYNC6	SYNC5	SYNC4	SYNC3	SYNC2	SYNC1

Feed axis synchronization control manual feed selection signal SYNCJ1～SYNCJ8 (G191.0～G191.7)

- Signal type: PLC->NC
- Signal function: In the case of manual, MPG and incremental feed, and manual reference point return, the feed axis is controlled synchronously.
  It is the signal in each control axis, and the number at the end of the signal name indicates the number of the control axis.
  1: The first axis is the axis controlled by the feed axis synchronously (slave control axis)
  2: The second axis is the axis controlled by the feed axis synchronously (slave control axis)
  …
  …
  When the signal becomes "1", in the case of manual, MPG or reference point return, the movement command of the main control axis is given to the two axes of the main control axis and the feed axis synchronously controlled axis. Which axis to synchronize with depends on the parameter setting.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G191	SYNCJ8	SYNCJ7	SYNCJ6	SYNCJ5	SYNCJ4	SYNCJ3	SYNCJ2	SYNCJ1

Output signal SYNMT1～SYNMT8 (F190.0～F190.7) in the consistent state of machine coordinates

- Signal type: NC->PLC
- Signal function: This is to notify the master axis and the slave axis to the outside regardless of the synchronous operation ON/OFF status and the servo status when the group of the main control axis and the slave control axis for the synchronous control of the feed axis is set. The signal of the same mechanical coordinate value.
  When this signal becomes '1', the machine coordinate values match.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
F190	SYNMT 8	SYNMT 7	SYNMT 6	SYNMT 5	SYNMT 4	SYNMT 3	SYNMT 2	SYNMT1

Signals SYNO1～SYNO8 (F191.0～F191.7) in the synchronization control of the feed axis

- Signal type: NC->PLC
- Signal function: This signal informs the fact that it is in the synchronous control of the feed axis.
  When the signal becomes '1', the corresponding axis is in the feed axis synchronization control.
  When the signal becomes '0', the corresponding axis is not in the feed axis synchronization control.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
F191	SYNO8	SYNO7	SYNO6	SYNO5	SYNO4	SYNO3	SYNO2	SYNO1

4.10.10 Torque control

Shaft torque control selection signal TOR1～TOR8 (G210.0～G210.7)

- Signal type: PLC->NC
- Signal function: When running in automatic mode, the axis performs torque control.

  It is the signal in each control axis, and the number at the end of the signal name indicates the number of the control axis.

  1: Torque control on the 1st axis

  2: Torque control on the 2nd axis

  …

  …

  When the signal becomes '1', the axis can be torque controlled in automatic mode operation.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G210	TOR8	TOR7	TOR6	TOR5	TOR4	TOR3	TOR2	TOR1

Shaft torque control reach signal TRQ1～TRQ8 (F114.0～F114.7)

- Signal type: NC->PLC
- Signal function: When running in automatic mode, the axis performs torque control to reach the output signal.

  It is the signal in each control axis, and the number at the end of the signal name indicates the number of the control axis.

  1: Torque control reached signal for the 1st axis

  2: Torque control reached signal for the 2nd axis

  …

  …

  When the signal becomes '1', in the case of automatic mode operation, the shaft torque control reach signal is output, indicating the end of torque control.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
F114	TRQ8	TRQ7	TRQ6	TRQ5	TRQ4	TRQ3	TRQ2	TRQ1

Signal TOR1～TOR8 (F210.0～F210.7) in shaft torque control

- Signal type: NC->PLC
- Signal function: When running in automatic mode, the shaft torque control switch completes the output signal.

  It is the signal in each control axis, and the number at the end of the signal name indicates the number of the control axis.

  1: The first axis performs torque control switching completion signal

  2: The second axis performs torque control switching completion signal

  …

  …

  When the signal becomes '1', the shaft torque control is in progress.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
F210	TOR8	TOR7	TOR6	TOR5	TOR4	TOR3	TOR2	TOR1

4.10.11 High-efficiency tool change signal

Tool change permission signal TEB (F1.6)

- Signal type: NC->PLC
- Signal function: When the signal becomes '1', it means that the tool change action is currently allowed.
  When G00, G01 feed motion and tool change command are executed in the same segment, the tool change permission signal is set to '1' when the tool post is in the safe area. If the tool change safety position is not set, the signal will be set after the movement ends. '1'.
  After the execution of the program segment ends, the signal is cleared to '0'.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
F1		TEB						

4.10.12 Site switch signal

Position switch output signal PSWx (F70, F71)

- Signal type: NC->PLC
- Signal function: When the moving distance of each axis exceeds the distance range set by the position switch of the axis, the output signal of the position switch corresponding to the axis is 0, otherwise it is 1.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
F70	PSW08	PSW07	PSW06	PSW05	PSW04	PSW03	PSW02	PSW01
F71	PSW18	PSW17	PSW16	PSW15	PSW14	PSW13	PSW12	PSW11

4.10.13 Indexing function of indexing table

Index axis clamp signal CLP1~ CLP8 (F262.0~F262.7)

- Signal type: output signal, CNC→PLC
- Signal function: This signal outputs the clamp signal of the indexing axis to the PLC.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
F262	CLP8	CLP7	CLP6	CLP5	CLP4	CLP3	CLP2	CLP1

Index axis clamping completion signal ECLP1~ ECLP8 (G262.0~G262.7)

- Signal type: input signal, PLC→CNC
- Signal function: This signal informs CNC that the indexing axis clamping is completed.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G262	ECLP8	ECLP7	ECLP6	ECLP5	ECLP4	ECLP3	ECLP2	ECLP1

Index axis release signal UCLP1~ UCLP8 (F263.0~F263.7)

- Signal type: output signal, CNC→PLC
- Signal function: This signal outputs the release signal of the indexing axis to the PLC.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
F263	UCLP8	UCLP7	UCLP6	UCLP5	UCLP4	UCLP3	UCLP2	UCLP1

Indexing shaft release completion signal EUCLP1~ EUCLP8 (G263.0~G263.7)

- Signal type: input signal, PLC→CNC
- Signal function: This signal informs the CNC that the indexing axis has been released.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G263	EUCLP8	EUCLP7	EUCLP6	EUCLP5	EUCLP4	EUCLP3	EUCLP2	EUCLP1

Servo off signal SVF1~SVF8<G126.0~G126.7>

- Signal type: input signal, PLC→CNC
- Signal function: This signal selects whether to place each axis in the servo off state.

  It is the signal in each control axis, and the number at the end of the signal name indicates the number of the control axis.

  SVF□

  □ : 1..... Set the 1st axis to servo off

  2 ..... put the 2nd axis in servo off

  3 ..... put the 3rd axis in servo off

  : :

  : :

  [Action] When set to '1', the servo will be turned off (the current will not flow to the servo motor).

  Although this operation can no longer perform position control, the current position will not be lost due to position detection.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G126	SVF8	SVF7	SVF6	SVF5	SVF4	SVF3	SVF2	SVF1

4.10.14 Parallel program

4.10.14.1 Parallel program automatic operation signal

Parallel program execution signal PSE1~PSE4 (G280.0~G280.3)

- Signal type: PLC->NC, valid at 1
- Signal function: Parallel program execution signal, the executed program is set by parameters. The number at the end of the signal name indicates the corresponding program.

  PSEx 1: Select the corresponding program to execute.

  0: Stop the selected program.

- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G280					PSE4	PSE3	PSE2	PSE1

Parallel program pause signal RSPE1~RSPE4 (G281.0~G281.3)

- Signal type: PLC->NC, valid at 1
- Signal function: Parallel program execution signal, the executed program is set by parameters. The number at the end of the signal name indicates the corresponding program. The PLC sets the pause signal RSPE1~RSPE4 to 1, and then transmits it to the NC to stop the automatic operation. When the parallel program pause signal is set to 1, it must be ensured that the parallel program execution signal PSE1~PSE4 remains at 1.

  PSPx 1: Select the corresponding program to pause.

  0: Stop the selected program.

- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G281					RSPE4	RSPE3	RSPE2	RSPE1

Parallel program position establishment signal RTPS1~RTPS8 (G283.0~G283.7)

- Signal type: PLC->NC
- Signal function: This signal indicates that the coordinate needs to be established. When the position mode needs to be restored after using the G35 command and the coordinate is established, the signal should be set to 1. The number at the end of the signal name indicates the corresponding control axis.

  RTPSx 1: Indicates that coordinates need to be established.

  0: Indicates that no coordinates need to be established.

- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G283	RTPS8	RTPS7	RTPS6	RTPS5	RTPS4	RTPS3	RTPS2	RTPS1

Signal RPE1~RPE4 during execution of parallel program (F280.0~F280.3)

- Signal type: NC->PLC
- Signal function: This signal indicates the status of the system in parallel program execution. The number at the end of the signal name indicates the corresponding execution program.

  RPEx 1: Indicates that the system is in a parallel program.

  0: Indicates that the system is not in a parallel program.

- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
F280					RPE4	RPE3	RPE2	RPE1

Alarm signal RPEE1~RPEE4 (F281.0~F281.3) during parallel program execution

- Signal type: NC->PLC
- Signal function: This signal indicates that the system generates an alarm during parallel program execution. The number at the end of the signal name indicates the corresponding execution program.

  RPEEx 1: Indicates that the system generates an alarm during parallel program execution.

0: Indicates that the system does not generate an alarm during parallel program execution.

- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
F281					RPEE4	RPEE3	RPEE2	RPEE1

Parallel program rigid tapping signals RRTAP1~RRTAP4 (F283.0~G283.3)

- Signal type: NC->PLC, valid when it is 1
- Signal function: Parallel program is the signal in rigid tapping. The number at the end of the signal name indicates the corresponding program. When the NC is in rigid tapping, set the rigid tapping signals **RRTAP1~RRTAP4** to 1.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
F283					RRTAP4	RRTAP3	RRTAP2	RRTAP1

The first parallel program alarm code signal: RPEN1~RPEN8 (F284)
The second parallel program alarm code signal: RPEN1~RPEN8 (F285)
The third parallel program alarm code signal: RPEN1~RPEN8 (F286)
The fourth parallel program alarm code signal: RPEN1~RPEN8 (F287)

- Signal type: NC->PLC
- Signal function: This signal represents the alarm code generated by the system during parallel program execution. Each channel corresponds to a set of values.
  RPENx 1: Indicates that the system alarm value is 1 during parallel program execution.
  0: Indicates that the system alarm value is 0 during parallel program execution.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
F284	RPEN8	RPEN7	RPEN6	RPEN5	RPEE4	RPEE3	RPEE2	RPEE1
F285	RPEN8	RPEN7	RPEN6	RPEN5	RPEE4	RPEE3	RPEE2	RPEE1
F286	RPEN8	RPEN7	RPEN6	RPEN5	RPEE4	RPEE3	RPEE2	RPEE1
F287	RPEN8	RPEN7	RPEN6	RPEN5	RPEE4	RPEE3	RPEE2	RPEE1

4.10.14.2 Parallel program MS function signal

Parallel program auxiliary function strobe signal RMF1~ RMF4 (F282.0~F282.3)

- Signal type: NC->PLC
- Signal function: This signal indicates that the auxiliary function is gated in the parallel program. The number at the end of the signal name indicates the corresponding execution program.
  RMFx 1: Represents auxiliary function strobe.
  0: Indicates that the auxiliary function is not strobed.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
F282					RMF4	RMF3	RMF2	RMF1

The first parallel program auxiliary M signal: RM11~RM116 (F290~F291)
The second parallel program auxiliary M signal: RM21~RM216 (F292~F293)
The third parallel program auxiliary M signal: RM31~RM316 (F294~F295)

The fourth parallel program auxiliary M signal: RM41~RM416 (F296~F297)

- Signal type: NC->PLC
- Signal function: This signal outputs the auxiliary function code signal selected and executed by the system in the program.
  RMx 1: The auxiliary function code is 1.
  0: The auxiliary function code is 0.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
F290	RM18	RM17	RM16	RM15	RM14	RM13	RM12	RM11
F291	RM116	RM115	RM114	RM113	RM112	RM111	RM110	RM19
F292	RM28	RM27	RM26	RM25	RM24	RM23	RM22	RM21
F293	RM216	RM215	RM214	RM213	RM212	RM211	RM210	RM29
F294	RM38	RM37	RM36	RM35	RM34	RM33	RM32	RM31
F295	RM316	RM315	RM314	RM313	RM312	RM311	RM310	RM39
F296	RM48	RM47	RM46	RM45	RM44	RM43	RM42	RM41
F297	RM416	RM415	RM414	RM413	RM412	RM411	RM410	RM49

Program selection to execute M auxiliary function completion signal RMFIN1~RMFIN4 (G282.0~G282.3)

- Signal type: PLC->NC
- Signal function: This signal indicates that the auxiliary function is completed in the parallel program. The number at the end of the signal name indicates the corresponding execution program.
  RMFINx 1: Indicates that the auxiliary function is completed.
  0: Indicates that the auxiliary function is not completed.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G282					RMFIN4	RMFIN3	RMFIN2	RMFIN1

Parallel program S auxiliary function strobe signal RSF1~ RSF4 (F289.0~F289.3)

- Signal type: NC->PLC, valid when it is 1
- Signal function: This signal indicates that the S auxiliary function is gated in the parallel program. The number at the end of the signal name indicates the corresponding execution program.
  RSFx 1: Represents the S auxiliary function strobe.
  0: Indicates that the S auxiliary function is not strobed.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
F289					RSF4	RSF3	RSF2	RSF1

Program selection to execute S auxiliary function completion signal RSFIN1~ RSFIN4 (G289.0~G289.3)

- Signal type: PLC->NC, valid at 1
- Signal function: This signal indicates that the S auxiliary function is completed in the parallel program. The number at the end of the signal name indicates the corresponding execution program.
  RSFINx 1: Indicates that the S auxiliary function is completed.
  0: Indicates that the S auxiliary function has not been completed.

- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G289					RSFIN4	RSFIN3	RSFIN2	RSFIN1

Parallel program rigid tapping signal RRTAP1~ RRTAP4 (G290.0~G290.3)

- Signal type: PLC->NC, valid at 1
- Signal function: Parallel program rigid tapping signal. The number at the end of the signal name indicates the corresponding program. PLC sets the rigid tapping signal **RRTAP1~RRTAP4** to 1, and then transmits it to NC.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G290					RRTAP4	RRTAP3	RRTAP2	RRTAP1

Parallel program rigid tapping spindle rotation selection signal RROD1~RROD4 (G291.0~G291.3)

- Signal type: PLC->NC, valid at 1
- Signal function: Parallel program rigid tapping spindle rotation selection signal. The number at the end of the signal name indicates the corresponding program. PLC sets the rigid tapping spindle rotation selection signal **RROD1~RROD4** to 1, and then transmits it to NC.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G291					RROD4	RROD3	RROD2	RROD1

The first parallel program rigid tapping and drilling spindle selection signal RRTSP11~ RRTSP14 (G292.0~G292.3)

- Signal type: PLC->NC, valid at 1
- Signal function: The first parallel program rigid tapping and drilling spindle selection signal. The number at the end of the signal name indicates the corresponding program. PLC sets the spindle selection signal **RRTSP11~RRTSP14** to 1, and then transmits it to the NC.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G292					RRTSP14	RRTSP13	RRTSP12	RRTSP11

The second parallel program rigid tapping and drilling spindle selection signal RRTSP21~ RRTSP24 (G293.0~G293.3)

- Signal type: PLC->NC, valid at 1
- Signal function: The second parallel program rigid tapping and drilling spindle selection signal. The number at the end of the signal name indicates the corresponding program. The PLC sets the spindle selection signals **RRTSP21~ RRTSP24** to 1, and then transmits them to the NC.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G293					RRTSP24	RRTSP23	RRTSP22	RRTSP21

The third parallel program rigid tapping and drilling spindle selection signal RRTSP31~ RRTSP34 (G294.0~G294.3)

- Signal type: PLC->NC, valid at 1
- Signal function: The third parallel program rigid tapping and drilling spindle selection signal. The

number at the end of the signal name indicates the corresponding program. PLC sets the spindle selection signals **RRTSP31~RRTSP34** to 1, and then transmits them to NC.

- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G294					RRTSP34	RRTSP33	RRTSP32	RRTSP31

The fourth parallel program rigid tapping and drilling spindle selection signal RRTSP41~ RRTSP44 (G295.0~G295.3)

- Signal type: PLC->NC, valid at 1
- Signal function: The 4th parallel program rigid tapping and drilling spindle selection signal. The number at the end of the signal name indicates the corresponding program. The PLC sets the spindle selection signals **RRTSP41~RRTSP44** to 1, and then transmits them to the NC.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G295					RRTSP44	RRTSP43	RRTSP42	RRTSP41

4.11 PLC axis control function

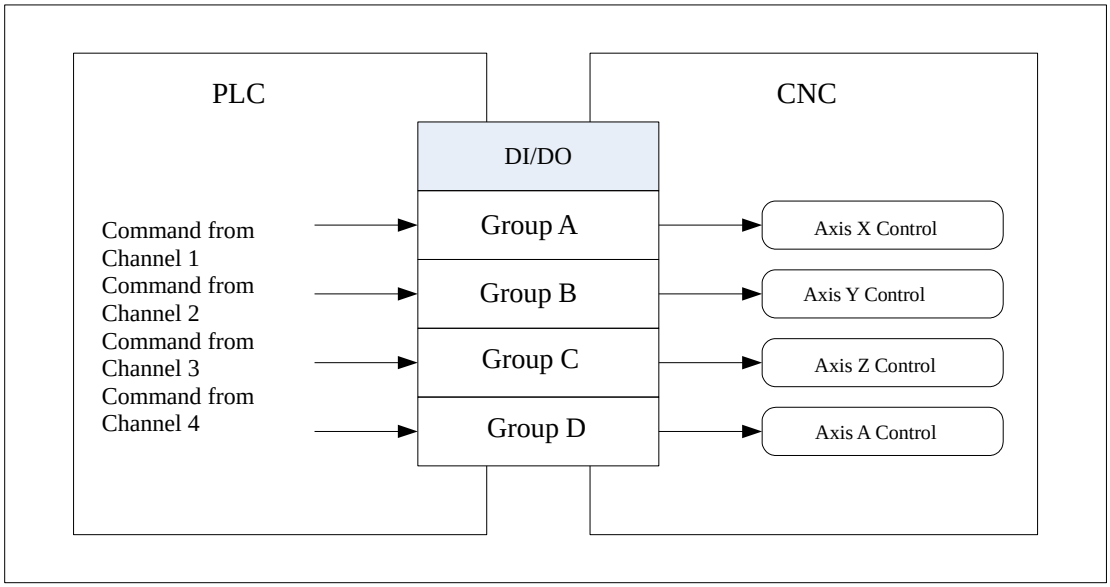
4.11.1 Functional overview

The PLC can directly control a given axis independently of the CNC. In other words, it is possible to move the tool along the axis not controlled by the CNC, and to input commands from the PLC, for example, command movement distance and feed speed. Using PLC to control the coordinate axis, it can control the tool post, exchange table, index table and other peripheral devices.

The maximum number of controllable axes of system is 8, and the number of CNC and PLC control axes of the system is determined by the parameters No1010 and No8130. A specific axis control signal (EAX) is used to determine whether an axis is controlled by CNC or PLC. PLC can directly control the following operations:

(1) The distance of the fast moving instruction;
(2) Cutting feed (feed per minute), the distance of the movement command;
(3) Cutting feed (feed per revolution), the distance of the movement command;
(4) Pause;
(5) Continuous feed;
(6) Manual reference point return;
(7) Return to 1st reference point;
(8) Return to 2nd reference point;
(9) Return to the 3rd reference point;
(10) Return to the 4th reference point;
(11) Feed shaft speed control;
(12) Auxiliary function, second auxiliary function, third auxiliary function;
(13) Selection of machine coordinate system.

PLC provides 4 control channels, using input and output signals to control these operations. By issuing instructions to 4 channels, the PLC can control 5 independent axes at the same time. Use parameter No8010 to determine which channel controls which axis. Commands can be sent to 2 or more axes through one channel, thus allowing PLC to use one channel to control multiple axes. The control diagram is shown below.



In the following description, the input/output signals from the 4 channels are group A (channel 1), group B (channel 2), group C (channel 3), and group D (channel 4). The names of input/output signals used for PLC axis control always contain a lowercase "g", which means that they correspond to these 4 groups of signals.

4.11.2 Basic steps

The basic steps of PLC axis control are as follows:

(1) In parameter No. 8010, specify which DI/DO signal group (A, B, C or D) controls which axis in PLC control.

When using a group to control 2 or more axes at the same time, check the parameter settings related to the feed speed (rapid traverse speed, acceleration/deceleration time constant, diameter/radius, linear axis/rotary axis, etc.). The controlled axes are the same.

(2) To make the PLC direct axis control effective, set the selected signal (EAX1 to EAX5) of the controlled axis to 1.

(3) Decide the type of operation

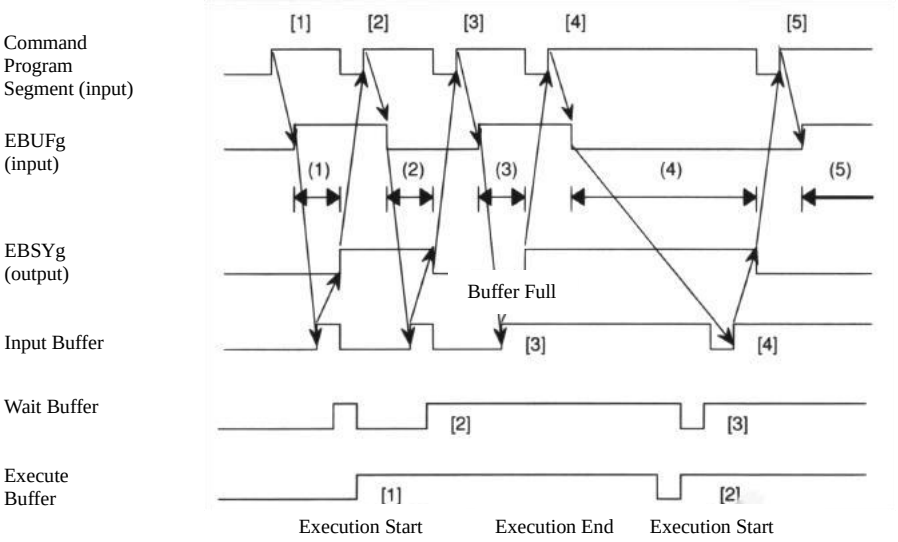
The axis control command signal (EC0g to EC6g) instructs the operation type. The axis control feed rate signal (EIF0g to EIF15g) commands the feed rate. Axis control data signals (EID0g to EID31g) command movement distance and other data.

These signals, together with the block stop prohibition signal EMSBKg, determine a complete operation, which is equivalent to executing a block during the automatic operation of CNC control. These signals are collectively referred to as axis control program block data signals.

The control signal table in one program segment of PLC axis control is as follows.

Collectively	Signal Name	Symbol	Data Types
Axis control program block data signal	Program block stop suppression signal	EMSBKg	Bit
	Shaft control command signal	EC0g~EC6g	byte
	Shaft control feed rate signal	EIF0g~EIF15g	word
	Shaft control data signal	EID0g~EID31g	Double word

(4) When the data for managing a complete operation (1 block) is confirmed, the reverse axis control command reads the logic state of the signal EBUFg (that is, from '0' to '1' or vice versa). For this reason, the axis control command read completion signal EBSYg must have the same logic state as EBUFg.
CNC can store the axis control function of PLC in its buffer, so it can execute multiple PLC control operations in sequence. If the buffer is already empty, the CNC is allowed to accept new block instructions from the PLC during the execution of another block.
There are three buffers of CNC, which are input buffer, waiting buffer and execution buffer. The sequence diagram of command operation is shown below.



The exclusive OR of the axis control command reading signal EBUFg input from the PLC and the axis control command reading completion signal EBSYg output from the CNC can determine the state of the CNC buffer.

EBUFg	EBSYg	Exclusive OR (XOR)	CNC buffer status
0	0	0	The previous block has been read into the CNC buffer, and the PLC can send out the next block.
1	1		
0	1	1	The previous block has not been read, it is reading or waiting for the CNC buffer to become available, the next block is not issued, and the logic state of EBUFg is not reversed. Reversing the state of EBUFg will invalidate the block that has been issued.
1	0		

(5) Repeat steps (3) and (4) until all blocks are sent.
When the last block has been issued, set the control axis selection signals EAX1 to EAX5 to '0'. However, before setting these signals to '0', check the input in the CNC memory, the waiting and execution buffer blocks have all been executed. When a program segment is being executed, setting this signal to '0' or there are still instruction segments in these buffers will cause a P/S alarm. This alarm stops the execution of the current block and invalidates the blocks stored in the input and waiting buffers.
To ensure that no program segment is being executed, or there is no reserved program segment in the

input and waiting buffers, check that the control axis selection status signal *EAXSL should be set to '0'. For those axes that have been controlled by the PLC, such as those that control the tool post, exchange table, and ATC, make sure that the EAX1 to EAX5 signals are always set to '1'. After issuing commands from PLC to CNC, it is not necessary to set these signals to '0'. When all command blocks have been executed (there are no remaining blocks to be executed), CNC automatically stops execution.

(6) When the control axis selection signals EAX1 to EAX5 go from '1' to '0', control returns to the CNC.

4.11.3 Signal details

4.11.3.1 Control shaft selection signal

EAX1～EAX8 (G136.0～G136.7)

- Signal type: PLC->NC
- Signal function: When the signal is set to '1', the corresponding axis becomes PLC control.

  When the signal is set to '0', the PLC control becomes invalid. Changing the setting of the control axis selection signal is only possible when the control axis selection status signal *EAXSL is set to '0'. When *EAXSL is set to '1', the axis selection signal is changed, causing P/S alarm (No139). The alarm signal EIALg is set to '1'.

  When the 5th bit (NCC) of parameter No8001 is set to ‘0’, at the same time, the control axis selection signal is set to '1', and the signal *EAXSL is set to '0', the command issued from the CNC is executed. When this parameter is set to '1', performing the above operation will cause a P/S alarm (No139). Note that this command is invalid when the tool is moving along the axis in manual continuous feed mode.

  While the CNC is currently executing a command, if the control axis selection signal is set to '1', a P/S alarm (No139) will be generated. In manual continuous feed mode, set this signal to '1' to stop the execution of the command. When the control axis selection signal is set to '1' and a P/S alarm (No139) is generated, at the same time, when *EAXSL is set to '0', the state of the alarm signal EIALg does not change to '1'. In this case, even if the CNC is in an alarm state, the axis can still be controlled by the PLC.
- Note: After setting the control axis selection signals EAX1 to EAX8 to ‘1’, it will take at least 8ms before the PLC can send commands to the CNC.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G136	EAX8	EAX7	EAX6	EAX5	EAX4	EAX3	EAX2	EAX1

4.11.3.2 Shaft control command signal

EC0g～EC6g (G141.0~G141.6), (G151.0~G151.6), (G161.0~G161.6), (G171.0~G171.6)

- Signal type: PLC->NC
- Signal function: Instruct the following operations through each channel.

Shaft control command signal (Hexadecimal code)	Operate
00h	Rapid movement (linear acceleration and deceleration)
	Execute the same operation as CNC G00
01h	Cutting feed per minute (exponential acceleration and deceleration after interpolation)
	Execute the same operation as CNC G98G01

Shaft control command signal (Hexadecimal code)	Operate
02h	Cutting feed per revolution (exponential acceleration and deceleration after interpolation)
	Execute the same operation as CNC G99G01
04h	Pause
	Execute the same operation as CNC G04
05h	Reference Point Return
	According to the reference point return direction set by the fifth digit (ZMIx) of parameter No1006, move the tool in rapid traverse mode, and then perform the same operation as the manual reference point return usually executed by CNC.
06h	Continuous feed (exponential acceleration and deceleration)
	Move the tool in the specified direction in JOG feed mode. Execute the same operation as CNC JOG feed
07h	Return to 1st reference point
	Perform the same operation as when positioning the tool to the reference point via the intermediate point specified by CNC G28.
08h	Return to 2nd reference point
	Perform the same operation as when CNC G30P2 specifies the reference point via the intermediate point.
09h	Return to the **3rd** reference point
	Perform the same operation as when CNC G30P3 specifies the reference point via the intermediate point.
0Ah	Return to the 4th reference point
	Perform the same operation as when CNC G30P4 specifies the reference point via the intermediate point.
10h	Speed command (linear acceleration and deceleration)
	Execute continuous feed at the specified speed.
12h	Other support
	Perform the same function as the auxiliary function (M function) used by CNC.
14h	2nd auxiliary function
	Perform the same function as the auxiliary function (M function) used by CNC.
15h	**3rd** auxiliary function
	Perform the same function as the auxiliary function (M function) used by CNC.
20h	Selection of machine coordinate system
	Perform the same operation as the G53 function used by CNC.

Fast moving speed

When using rapid traverse commands (EC0g to EC6g: 00h), the feed speed can be the same as the CNC used (No. 1420) or specified by PLC axis feed speed signals EIF0g to EIF15g. This can be set with the 0th bit (RPD) of parameter No8002.

Reference position return without stop

The reference position return command (EC0g to EC6g: 05h) realizes the following operations: the first digit (DLZ) of parameter No1002 sets all controlled axes to return to the reference point without a stop; the first digit (DLZx) of parameter No1005 is set An axis returns to the reference point without a stop.

After one of the above settings, when each axis has not returned to the reference point after switching on, when the return to reference point command (EC0g to EC6g: 05h) is issued, the tool will be moved along the 5th bit of parameter No1006 (ZMIx) Move in the return direction of the set reference point, and return to the reference position without deceleration signal (position the tool to the nearest grid point from the current position).

After the reference position has been established, issuing the reference position return command (EC0g to EC6g: 05h) can execute the reference position return at high speed, regardless of the reference position return direction set by the 5th bit (ZMIx) of parameter No1006.

Return to the first reference position without stop

When the first reference position return command (EC0g to EC6g: 07h) is used, if the first digit (DLZ) of parameter No1002 commands the reference position return without a stop for all axes or the first digit (DLZx) command of parameter No1005 When the reference position return of an impractical stop for an axis is valid, and the tool has not returned to the reference position since the power is turned on, when the first reference position return command (EC0g to EC6g: 07h) is issued, a P/S alarm will be caused (No090).

1st to 4th reference position return

When using the 1st to 4th reference position return commands (EC0g to EC6g: 07h to 0Ah), the feed rate can be specified using the 0th bit (RPD) of parameter No8002, and the rapid traverse command (EC0g to EC6g: 00h)), the method is the same.

Note: that in the case of the first reference position return, if the tool has not returned to the reference position manually after the power is turned on, the feed rate specified by parameter No1424 will be used.

Speed command

When using the speed command (EC0g to EC6g: 10h), the controlled axis designated by the 0th bit (ROTx) of parameter No1006 is the rotary axis.

When the continuous feed command (EC0g to EC6g: 06h) is being used for position control, the speed command (EC0g to EC6g: 10h) performs speed control on the servo motor. In this way, the speed is allowed to change dynamically during the continuous feed. This makes this command suitable for driving rotating tools with a servo motor.

Using parameter No. 8028, the linear acceleration and deceleration time constant can be set for each axis.

Note that when the speed command is executing JOG feed, the coordinate value does not change. This will cause the tool position to be lost. Therefore, after the continuous feed has been completed, before executing the motion command, always return the tool to the reference position.

Selection of machine coordinate system

The machine coordinate system selection command (EC0g to EC6g: 20h) executes absolute positioning, and moves the tool to the specified position in the machine coordinate system at a rapid traverse speed. This instruction is used to move the tool to a specific position on the machine tool. For example: tool exchange position.

For the rotation axis, a short path rotation can be commanded. When using this command, the tool offset and tool nose radius compensation should be canceled.

Before using this command, the machine coordinate system must be set. After turning on the power, use manual or G28 to return the tool to the reference position. When using the absolute position detector, there is no need to return the tool to the reference position because the tool position will be stored in the memory.

The following table shows the correspondence between axis control commands and their data.

Instruction block		
Operate	**Shaft control suspension signal EC0g EC6g**	**Instruction data**
Fast moving	00h	Total travel distance EID0g to EID31g Fast moving speed EIF0g to EIF15g When the 0th bit (RPD) of parameter No8002 is set to '1', the rapid traverse speed is valid.
Feed per minute	01h	Total travel distance EID0g to EID31g Feed rate EIF0g to EIF15g
Feed per rotation	02h	Total travel distance EID0g to EID31g Feed per revolution EIF0g to EIF15g
Pause	04h	Pause time EID0g to EID31g
Reference position return	05h	N/A.
JOG feed	06h	Feed direction EID31g JOG feed rate EIF0g to EIF15g
Return to 1st reference point	07h	Fast moving speed EIF0g to EIF15g When the 0th bit (RPD) of parameter No8002 is set to '1', the rapid traverse speed is valid.
Return to 2nd reference point	08h	
Return to the **3rd** reference point	09h	
Return to the 4th reference point	0Ah	
Speed command	10h	Continuous feed rate EIF0g to EIF15g
Other support	12h	Auxiliary function codes EID0g to EID15g
2nd auxiliary function	14h	
3rd auxiliary function	15h	
Set machine tool coordinate system	20h	Machine coordinate system setting (absolute value) EID0g to EID31g Fast moving speed EIF0g to EIF15g When the 0th bit (RPD) of parameter No8002 is set to '1', the rapid traverse speed is valid.

- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G141		**EC6A**	**EC5A**	**EC4A**	**EC3A**	**EC2A**	**EC1A**	**EC0A**
G151		**EC6B**	**EC5B**	**EC4B**	**EC3B**	**EC2B**	**EC1B**	**EC0B**
G161		**EC6C**	**EC5C**	**EC4C**	**EC3C**	**EC2C**	**EC1C**	**EC0C**
G171		**EC6D**	**EC5D**	**EC4D**	**EC3D**	**EC2D**	**EC1D**	**EC0D**

4.11.3.3 Shaft control feed speed signal

- EIF0g～EIF15g (G142,G143), (G152,G153), (G162,G163), (G172,G173)
- Signal type: PLC->NC,
- Signal function: Command the feed rate value of the PLC axis.

Fast moving (EC0g to EC6g:00h)

No.1 reference point returned (EC0g to EC6g: 07h)

No.2 reference point returned (EC0g to EC6g: 08h)
No.3 reference point returned (EC0g to EC6g: 09h)
No.4 reference point returned (EC0g to EC6g: 0Ah)

For these commands, when the 0th bit (RPD) of parameter No8002 is set to '1', this signal commands the rapid traverse speed in binary form. However, for the first reference position return, after the power is turned on, if manual reference position return has not been performed, use the rapid traverse speed set by parameter No. 1424.

The data unit is as follows.

		Data Unit		Unit
		IS-B	IS-C	
Linear axis	Metric machine	1		mm/min
	Imperial machine	0.1		inch/min
Rotary axis		1		deg/min

The valid data range is shown in the table below.

		Data Unit		Unit
		IS-B	IS-C	
Linear axis	Metric machine	30~15000	30~12000	mm/min
	Imperial machine	30~6000	30~4800	inch/min
Rotary axis		30~15000	30~12000	deg/min

Cutting feed per minute (EC0g to EC6g: 01h)

For this command, the signal is a binary command along the feed rate of one axis.

The data increment unit depends on the setting of the 6th (FR1) and 7th (FR2) of parameter No8002, the list is as follows.

Parameter		Metric input (mm/rev)	English input (inch/rev)	Rotation axis (deg/rev)
FR2	FR1			
1	1	0.0001	0.000001	0.0001
0	0			
0	1	0.001	0.00001	0.001
1	0	0.01	0.0001	0.01

The valid data range is shown in the table below.

		Data Unit		Unit
		IS-B	IS-C	
Linear axis	Metric machine	0.0001~500.0000		mm/rev
	Imperial machine	0.000001~9.999999		inch/rev
Rotary axis		0.0001~500.0000		deg/rev

Continuous feed (EC0g EC6g: 06h)

Set the feed rate as the cutting feed per minute (EC0g to EC6g: 01h). During continuous feed, the feed speed can be changed.

Use signals EIF0g to EIF15g to command the feed rate. During continuous feed, after the reverse axis

control command reads the signal EBUFg, the tool moves at the new feed speed.

Since the JOG feed command is not buffered, it is usually not necessary to check the axis control command reading completion signal EBUFg.

For this command, the signal specifies the speed of the servo motor in binary.

A positive value command rotates in the positive direction. Negative value commands reverse rotation.

When the new servo motor speed is commanded, the logic of the axis control command read signal EBUFg is reversed, and the servo motor is accelerated or decelerated until the new speed value is reached.

- Note: When it is set to '0', CNC continues to execute buffering without moving the tool. In this case, the buffer is released with the input reset signal ECLRg. The cutting speed clamp is invalid.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G142	EIF7A	EIF6A	EIF5A	EIF4A	EIF3A	EIF2A	EIF1A	EIF0A
G143	EIF15A	EIF14A	EIF13A	EIF12A	EIF11A	EIF10A	EIF9A	EIF8A

	#7	#6	#5	#4	#3	#2	#1	#0
G152	EIF7B	EIF6B	EIF5B	EIF4B	EIF3B	EIF2B	EIF1B	EIF0B
G153	EIF15B	EIF14B	EIF13B	EIF12B	EIF11B	EIF10B	EIF9B	EIF8B

	#7	#6	#5	#4	#3	#2	#1	#0
G162	EIF7C	EIF6C	EIF5C	EIF4C	EIF3C	EIF2C	EIF1C	EIF0C
G163	EIF15C	EIF14C	EIF13C	EIF12C	EIF11C	EIF10C	EIF9C	EIF8C

	#7	#6	#5	#4	#3	#2	#1	#0
G172	EIF7D	EIF6D	EIF5D	EIF4D	EIF3D	EIF2D	EIF1D	EIF0D
G173	EIF15D	EIF14D	EIF13D	EIF12D	EIF11D	EIF10D	EIF9D	EIF8D

4.11.3.4 Shaft control data signal

EID0g～EID31g

(G144, G145, G146, G147), (G154, G155, G156, G157)

(G164, G165, G166, G167), (G174, G175, G176, G177)

- Signal type: PLC->NC
- Signal function: command data for PLC axis control.

The data unit is as follows.

		Data Unit		Unit
		IS-B	IS-C	
Linear axis	Metric input	0.001	0.0001	mm
	Imperial input	0.0001	0.00001	inch
Rotary axis		0.001	0.00001	deg

Fast moving (EC0g to EC6g:00h)

Cutting feed per minute (EC0g to EC6g: 01h)

Cutting feed per revolution (EC0g to EC6g: 02h)

For these instructions, use signals EID0g to EID31g according to the input increment for the axis to specify the moving distance in binary increments.

The valid data range is shown in the table below.

		Data Unit		Unit
		IS-B	IS-C	
Linear axis	Metric input	±99999.999	±9999.9999	mm
	Imperial input	±9999.9999	±999.99999	inch
Rotary axis		±99999.999	±9999.9999	deg

When using the third digit (DIAx) of parameter No1006 to set diameter programming, the first digit (CDI) of parameter No8005 is used to set whether to use radius or diameter in the command.

Pause (EC0g to EC6g: 04h)

For this command, the signal is used in binary to command the pause time.

Data Range	Unit
1~99999999	ms

Continuous feed (EC0g EC6g: 06h)

For this command, the signal EID31g is used to command the direction of continuous feed, as follows:

0: Positive direction

1: Negative direction

The signals EID0g to EID30g are undefined.

Auxiliary function (EC0g to EC6g: 12h)

The second auxiliary function (EC0g to EC6g: 14h)

The third auxiliary function (EC0g to EC6g: 15h)

For this instruction, the signal is sent to the auxiliary function code of the CNC from the PLC as a binary instruction. The auxiliary function code is set according to the 6th bit (AUX) of parameter No8001, and can use 1 or 2 bytes of signals EID0g to EID15g.

Mechanical coordinate system selection (EC0g EC6g:20h).

For this command, the absolute coordinate system is commanded in binary according to the incremental system used by the axis.

- Note: When using the IS-C incremental system, according to the setting of the first digit (DWE) of parameter No8002, the minimum input increment of the pause time is 0.1ms.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G144	EID7A	EID6A	EID5A	EID4A	EID3A	EID2A	EID1A	EID0A
G145	EID15A	EID14A	EID13A	EID12A	EID11A	EID10A	EID9A	EID8A
G146	EID23A	EID22A	EID21A	EID20A	EID19A	EID18A	EID17A	EID16A
G147	EID31A	EID30A	EID29A	EID28A	EID27A	EID26A	EID25A	EID24A

	#7	#6	#5	#4	#3	#2	#1	#0
G154	EID7B	EID6B	EID5B	EID4B	EID3B	EID2B	EID1B	EID0B
G155	EID15B	EID14B	EID13B	EID12B	EID11B	EID10B	EID9B	EID8B

G156	EID23B	EID22B	EID21B	EID20B	EID19B	EID18B	EID17B	EID16B
G157	EID31B	EID30B	EID29B	EID28B	EID27B	EID26B	EID25B	EID24B

	#7	#6	#5	#4	#3	#2	#1	#0
G164	EID7C	EID6C	EID5C	EID4C	EID3C	EID2C	EID1C	EID0C
G165	EID15C	EID14C	EID13C	EID12C	EID11C	EID10C	EID9C	EID8C
G166	EID23C	EID22C	EID21C	EID20C	EID19C	EID18C	EID17C	EID16C
G167	EID31C	EID30C	EID29C	EID28C	EID27C	EID26C	EID25C	EID24C

	#7	#6	#5	#4	#3	#2	#1	#0
G174	EID7D	EID6D	EID5D	EID4D	EID3D	EID2D	EID1D	EID0D
G175	EID15D	EID14D	EID13D	EID12D	EID11D	EID10D	EID9D	EID8D
G176	EID23D	EID22D	EID21D	EID20D	EID19D	EID18D	EID17D	EID16D
G177	EID31D	EID30D	EID29D	EID28D	EID27D	EID26D	EID25D	EID24D

4.11.3.5 Shaft control command read signal

EBUFg (G140.7), (G150.7), (G160.7), (G170.7)

- Signal type: PLC->NC
- Signal function: Command CNC to read the command data block used for PLC axis control. The signal changes from '0' to '1' or from '1' to '0', see "Basic Steps" for detailed operation.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G140	EBUFA							
G150	EBUFB							
G160	EBUFC							
G170	EBUFD							

4.11.3.6 Shaft control command read completion signal

EBSYg (F140.7), (F150.7), (F160.7), (F170.7)

- Signal type: NC->PLC
- Signal function: Inform the system that CNC has read a program segment of command data for PLC axis control and has been stored in the output into the buffer. For details of output conditions and steps, see "Basic steps".
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
F140	EBSYA							
F150	EBSYB							
F160	EBSYC							
F170	EBSYD							

4.11.3.7 Reset signal

ECLRg (G140.6), (G150.6), (G160.6), (G170.6)

- Signal type: PLC->NC
- Signal function: reset the corresponding PLC control axis.

  When this signal is '1', perform the following operations:

  (1) When the tool is moving along the axis: decelerate and stop the tool.

  (2) When the tool is paused: stop operation.

  (3) When the auxiliary function is executing: stop the operation.

  At the same time, all buffered instructions are cleared. When this signal is set to '1', any control commands are ignored.

  The continuous feed command (EC0g to EC06g: 06h) can be executed by setting the reset signal ECLRg to '1'. When these commands are ended, the servo motor decelerates and stops, the axis motion signal EGENg is set to '0', and the control axis selection status signal *EAXSL becomes '0'. Do not set the reset signal ECLRg to '0' until the control axis selection status signal *EAXSL becomes '0'.

  Speed commands (EC0g to EC6g: 10h) can also be ended by setting the reset signal to '1'. When this command is ended, the servo motor decelerates and stops, and the axis moving signal EGENg is set to '0'. Before issuing the next command, make sure that the axis moving signal EGENg has been '0'. Do not set the reset signal ECLRg to '0' until the axis moving signal EGENg is '0'.

- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G140		ECLRA						
G150		ECLRB						
G160		ECLRC						
G170		ECLRD						

4.11.3.8 Shaft control suspension signal

ESTPg (G140.5), (G150.5), (G160.5), (G170.5)

- Signal type: PLC->NC
- Signal function: When this signal is set to '1', perform the following operations:

  (1) When the tool is moving along the axis, decelerate and stop the tool.

  (2) When the tool is paused: stop operation.

  (3) When the auxiliary function is being executed: When the auxiliary function completion signal EFINg is input, the operation is stopped.

  Set this signal to '0', and the stopped operation can be restarted.

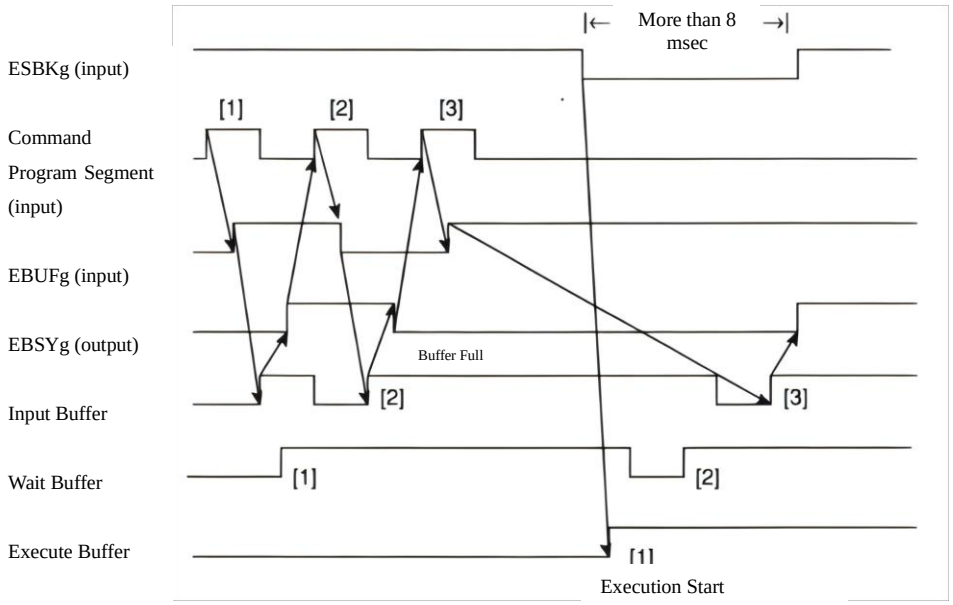
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G140			ESTPA					
G150			ESTPB					
G160			ESTPC					
G170			ESTPD					

4.11.3.9 Program block stop signal

ESBKg (G140.3), (G150.3), (G160.3), (G170.3)

- Signal type: PLC->NC
- Signal function: During the execution of the instruction issued by the PLC, when the block stop signal ESBKg is set to '1', it is executing. After the line block is completed, the axis control stops. When this signal is set to '0', the cached instruction is executed.
  The sequence diagram of instruction operation is shown below.



- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G140					ESBKA			
G150					ESBKB			
G160					ESBKC			
G170					ESBKD			

4.11.3.10 Program block invalid stop signal

EMSBKg (G141.7), (G151.7), (G161.7), (G171.7)

- Signal type: PLC->NC
- Signal function: When the block stop invalid signal EMSBKg is set to '1' in the block, the block stop signal ESBKg invalid.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G141	EMSBKA							
G151	EMSBKB							
G161	EMSBKC							
G171	EMSBKD							

4.11.3.11 Auxiliary function code signal

EM11g～EM48g (F142, F143), (F152, F153), (F162, F163), (F172, F173)

- Signal type: NC->PLC
- Signal function: When auxiliary function command (EC0g to EC6g: 12h), the second auxiliary function command (EC0g to EC6g: 14h) or when the third auxiliary function command (EC0g to EC6g: 15h) is issued by the PLC, the auxiliary function code is issued in 1 byte (using signals EID0g to EID7g) or 2 bytes (using signals EID0g to EID15g), depending on the parameters Setting of the 6th digit (AUX) of No8001.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
F142	EM28A	EM24A	EM22A	EM21A	EM18A	EM14A	EM12A	EM11A
F143	EM48A	EM44A	EM42A	EM41A	EM38A	EM34A	EM32A	EM31A

	#7	#6	#5	#4	#3	#2	#1	#0
F152	EM28B	EM24B	EM22B	EM21B	EM18B	EM14B	EM12B	EM11B
F153	EM48B	EM44B	EM42B	EM41B	EM38B	EM34B	EM32B	EM31B

	#7	#6	#5	#4	#3	#2	#1	#0
F162	EM28C	EM24C	EM22C	EM21C	EM18C	EM14C	EM12C	EM11C
F163	EM48C	EM44C	EM42C	EM41C	EM38C	EM34C	EM32C	EM31C

	#7	#6	#5	#4	#3	#2	#1	#0
F172	EM28D	EM24D	EM22D	EM21D	EM18D	EM14D	EM12D	EM11D
F173	EM48D	EM44D	EM42D	EM41D	EM38D	EM34D	EM32D	EM31D

4.11.3.12 Auxiliary function strobing signal

EMFg (F141.0), (F151.0), (F161.0), (F171.0)

- Signal type: NC->PLC
- Signal function: in the auxiliary function command (EC0g to EC6g: 12h), when the auxiliary function code command is sent, the signal is set to '1'.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
F141								EMFA
F151								EMFB
F161								EMFC
F171								EMFD

4.11.3.13 Auxiliary function 2 strobing signal

EMF2g (F141.2), (F151.2), (F161.2), (F171.2)

- Signal type: NC->PLC

- Signal function: In the second auxiliary function command (EC0g to EC6g: 14h), after the auxiliary function code command is sent, set this signal to '1'.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
F141						EMF2A		
F151						EMF2B		
F161						EMF2C		
F171						EMF2D		

4.11.3.14 Auxiliary function 3 strobing signal

EMF3g (F141.3), (F151.3), (F161.3), (F171.3)

- Signal type: NC->PLC
- Signal function: in the third auxiliary function command (EC0g to EC6g: 15h), after the auxiliary function code command is sent, set this signal to '1'.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
F141					EMF3A			
F151					EMF3B			
F161					EMF3C			
F171					EMF3D			

4.11.3.15 Auxiliary function completion signal

EFINg (G140.0), (G150.0), (G160.0), (G170.0)

- Signal type: PLC->NC
- Signal function: CNC sends auxiliary function codes to auxiliary function code signals EM11g to EM28g and EM31g to EM48g and wait for the auxiliary function completion signal EFINg. When the auxiliary function complete signal EFINg returns, the CNC starts to execute the next block.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G140								EFINA
G150								EFINB
G160								EFINC
G170								EFIND

4.11.3.16 Cache invalid signal

EMBUFg (G140.2), (G150.2), (G160.2), (G170.2)

- Signal type: PLC->NC
- Signal function: When this signal is '1' and it is executing, waiting, or the input buffer contains a block, it will not read PLC instructions. If this signal is '1', when any of these buffers contains a block, the block is executed, but only when all the buffers are empty, the sequence

command is read.

In order to judge the cache invalid state, only when all the buffers are empty and the command is read, the CNC outputs the axis control command reading completion signal EBSYg.

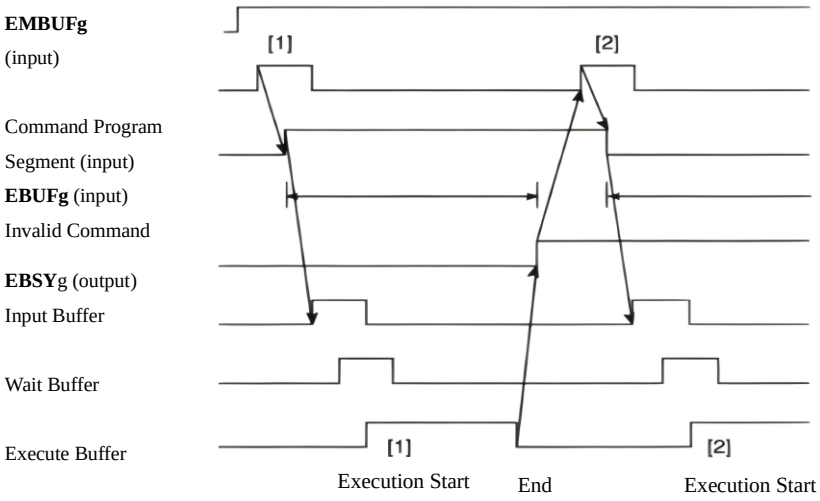
Regardless of the status of the buffer invalid signal EMBUFg for the following commands, the buffer is invalid:

(1) Reference point returned (EC0g to EC6g: 05h).
(2) No.1 reference point returned (EC0g to EC6g: 07h).
(3) No.2 reference point returned (EC0g to EC6g: 08h).
(4) No.3 reference point returned (EC0g to EC6g: 09h).
(5) No.4 reference point returned (EC0g to EC6g: 0Ah).
(6) Mechanical coordinate system selection (EC0g to EC6g:20h).

The following command ends with the reset signal ECLRg. Executed when the cache operation is invalid. That is, the subsequent blocks are not executed but canceled.

(1) Continuous feed (EC0g to EC6g: 06h).
(2) Continuous instruction (EC0g to EC6g: 10h).

The sequence diagram of instruction operation is shown below.



- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G140						EMBUFA		
G150						EMBUFB		
G160						EMBUFC		
G170						EMBUFD		

4.11.3.17 Control axis selection state signal

***EAXSL (F129.7)**

- Signal type: NC->PLC
- Signal function: When the signal is set to '0', the control axis selection signals EAX1 to EAX5 can be changed.

  This signal is '1' in the following situations:

  (1) When the tool is moving along the PLC control axis;
  (2) When a program segment is being read into the buffer;

When this signal is '1', the control axis selection signals EAX1 to EAX5 cannot be changed. Any attempt to change these signals will cause P/S alarm No139 to be output.

- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
F129	*EAXSL							

4.11.3.18 In-place signal

EINPg (F140.0), (F150.0), (F160.0), (F170.0)

- Signal type: NC->PLC
- Signal function: When the corresponding PLC control axis is in the in-position state, this signal is set to '1'.

  When the tool decelerates, the in-position check is performed, and the next command is not executed until the tool enters the in-position area. However, using the 6th bit (NCI) of parameter No8004 can skip the in-position check to reduce the cycle time.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
F140								EINPA
F150								EINPB
F160								EINPC
F170								EINPD

4.11.3.19 Tracking error zero check signal

ECKZg (F140.1), (F150.1), (F160.1), (F170.1)

- Signal type: NC->PLC
- Signal function: When the PLC control axis is performing tracking error zero check or in-position check, this signal is '1'.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
F140							ECKZA	
F150							ECKZB	
F160							ECKZC	
F170							ECKZD	

4.11.3.20 Alarm signals

EIALg (F140.2), (F150.2), (F160.2), (F170.2)

- Signal type: NC->PLC
- Signal function: When the PLC control axis has a servo alarm, over-travel alarm or P/S alarm No. 130 and No. 139, this signal is '1'. After the alarm is released, when the reset signal ECLRg is '1', this signal is '0'. As described below.

  Servo alarm

  Please eliminate the cause of the alarm and reset the CNC.

Over-travel alarm

The tool moves to the area within the storage stroke limit, and then the CNC is reset.

During the overtravel alarm, the following commands can be used to move the tool into the area within the storage travel limit:

(1) Fast moving (EC0g EC6g:00h)
(2) Cutting feed per minute (EC0g to EC6g: 01h);
(3) Cutting feed per revolution (EC0g to EC6g: 02h);
(4) Continuous feed (EC0g EC6g: 06h)

P/S alarm

Reset the CNC.

In the above situation, the reset signal ECLRg cannot reset the CNC, use the reset button set on the panel.

- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
F140						**EIALA**		
F150						**EIALB**		
F160						**EIALC**		
F170						**EIALD**		

4.11.3.21 Signal for moving axis

EGENg (F140.4), (F150.4), (F160.4), (F170.4)

- Signal type: NC->PLC
- Signal function: When the tool is in accordance with instructions, for example, rapid traverse (EC0g to EC6g: 00h) and cutting feed (EC0g to EC6g: 01h). When moving along the PLC control axis, this signal is '1'.
- Note: When the axis allocation is completed, this signal is set to '0'. During deceleration, this signal is set to '0'.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
F140				**EGENA**				
F150				**EGENB**				
F160				**EGENC**				
F170				**EGEND**				

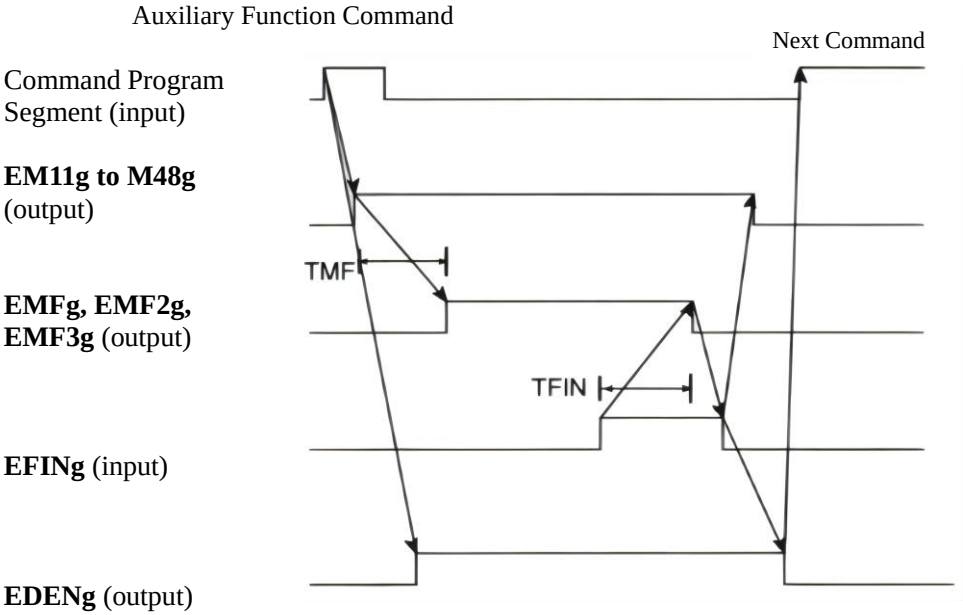
4.11.3.22 Auxiliary function execution signal

EDENg(F140.3), (F150.3), (F160.3), (F170.3)

- Signal type: NC->PLC
- Signal function: When auxiliary functions are instructed by PLC (EC0g to EC6g: 12h), auxiliary function codes EID0g to EID15g.

  It is sent to auxiliary function code signals EM11g to EM48g until the auxiliary function completion signal EFINg returns, this signal is '1'.

  The sequence diagram of instruction operation is shown below



- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
F140					**EDENA**			
F150					**EDENB**			
F160					**EDENC**			
F170					**EDEND**			

4.11.3.23 Negative over-travel signal

EOTNg (F140.6), (F150.6), (F160.6), (F170.6)

- Signal type: NC->PLC
- Signal function: When the negative travel limit is exceeded, the signal EOTNg is '1'. At the same time, the alarm signal EIALg is '1'.
  When the overtravel alarm is released and the reset signal ECLRg is '1', these signals are '0'.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
F140		**EOTNA**						
F150		**EOTNB**						
F160		**EOTNC**						
F170		**EOTND**						

4.11.3.24 Forward over-travel signal

EOTPg (F140.5), (F150.5), (F160.5), (F170.5)

- Signal type: NC->PLC
- Signal function: When the forward travel limit is exceeded, the signal EOTPg is '1'. At the same time,

the alarm signal EIALg is '1'.

When the overtravel alarm is released and the reset signal ECLRg is '1', these signals are '0'.

- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
F140			EOTPA					
F150			EOTPB					
F160			EOTPC					
F170			EOTPD					

4.11.3.25 Feed rate signal

***FV0E～*FV7E (G138)**

- Signal type: PLC->NC
- Signal function: Like the CNC feed rate override signal *FV0 to *FV7, these signals are used to select the cutting feed rate magnification. Use the second bit (OVE) of parameter No.8001 to set the override of the PLC control axis regardless of the CNC.

  The magnification calculation method is the same as that of CNC. When all signals are set to '0', the magnification is regarded as 0%, and the same is true when all signals are set to '1'.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G138	*FV7E	*FV6E	*FV5E	*FV4E	*FV3E	*FV2E	*FV1E	*FV0E

4.11.3.26 Rate cancel signal

OVCE(G137.5)

- Signal type: PLC->NC
- Signal function: When the second digit (OVE) of parameter No8001 is '1', the PLC feed rate override has nothing to do with the CNC. Set this when the signal reaches '1', the cutting feed rate override is fixed at 100%. This signal does not affect the rapid movement magnification.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G137			OVCE					

4.11.3.27 Fast moving rate signal

ROV1E,ROV2E(G137.0,G137.1)

- Signal type: PLC->NC
- Signal function: these signals are used to multiply the rapid traverse speed. Set the second bit (OVE) of parameter No8001 to enable the PLC. The rapid traverse magnification has nothing to do with CNC.

Fast moving rate signal		Rate
ROV2E	ROV1E	
0	0	100%
0	1	50%
1	0	25%
1	1	F0

Note: F0 is the speed set by parameter No.1421.

- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G137							ROV2E	ROV1E

4.11.3.28 Signal for dry run

DRNE (G137.7)

- Signal type: PLC->NC
- Signal function: Set the second bit (OVE) of parameter No8001. This signal is used to execute dry run and has nothing to do with CNC.
  When the dry run signal DRNE is set to '1', the specified rapid traverse speed and cutting feed rate are ignored, and the tool moves at the dry run speed (set in parameter No1410) multiplied by the specified magnification. The third bit (RDE) of parameter No8001 is used to set whether dry run is valid or invalid for rapid traverse.

Selection Signal for Manual Rapid Feed	Instructions from PLC	
	Fast Moving	Cutting Infeed
1	Fast moving speed	Cutting feed rate
0	Dry running feed speed×FV or rapid traverse speed	Dry running feed rate×FV

- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G137	DRNE							

4.11.3.29 Selection signal for manual rapid feed

RTE (G137.6)

- Signal type: PLC->NC
- Signal function: During dry running, when the manual rapid traverse selection signal RTE is set to '1', the tool moves at rapid traverse speed, and the cutting feed moves at the maximum cutting feed speed. When the signal is set to '0', the tool moves at a dry running speed. When the dry run signal DRNE is '0', the specified rapid traverse speed or cutting speed is restored.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G137		RTE						

4.11.3.30 Rate 0% signal

EOV0 (F129.5)

- Signal type: NC->PLC
- Signal function: When the feed rate override is 0%, this signal is '1'.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
F129			EOV0					

4.11.3.31 Assign completion signal

EADEN1～EADEN8 (F112.0～F112.7)

- Signal type: NC->PLC
- Signal function: When the tool is moving with PLC commands, these signals are set to '0'. Except during the execution of the motion instruction, the axis motion is suspended by the axis control pause signal ESPg. In other cases, when the tool does not move, these signals are set to '1'.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
F112	EADEN8	EADEN7	EADEN6	EADEN5	EADEN4	EADEN3	EADEN2	EADEN1

4.11.3.32 Buffer area full signal

EABUFg (F141.1), (F151.1), (F161.1), (F171.1)

- Signal type: NC->PLC
- Signal function: When the input buffer contains a command block, this signal is '1'.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
F141							EABUFA	
F151							EABUFB	
F161							EABUFC	
F171							EABUFD	

4.11.3.33 Control medium signal

EACNT1～EACNT8 (F182.0～F182.7)

- Signal type: NC->PLC
- Signal function: When the control axis selection status signal *EAXSL is set to '1', the signal EACNTn of the corresponding controlled axis is set to '1'.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
F182	EACNT8	EACNT7	EACNT6	EACNT5	EACNT4	EACNT3	EACNT2	EACNT1

4.11.3.34 Torque control signal

Signal ETRQM1～ETRQM8 in torque control mode (F183.0～F183.7)

- Signal type: NC->PLC
- Signal function: Indicates the axis in the torque control mode.
  When the signal becomes '1', in the torque control command based on PLC axis control, which axis is in the torque control mode.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
F183	ETRQM8	ETRQM7	ETRQM6	ETRQM5	ETRQM4	ETRQM3	ETRQM2	ETRQM1

4.12 Additional axis function

4.12.1 Additional axis page signal

Additional axis page selection signal MPSS-APSS (G318.0~G318.1)

- Signal type: PLC->NC
- Signal function: When G318.1 is 1, the additional axis page in the main additional coordinate page of the position set is valid, and the CNC sets the output signal APE (F302.0) of the additional axis page to 1; when G318.0 is At 1, the main page of the main coordinate page of the position set is active, and the CNC sets the output signal APE (F302.0) of the additional axis page to 0; when both G318.0 and G318.1 are 1, the position set The main page and the additional axis page of the main attached coordinate page are valid at the same time.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G318							APSS	MPSS

Additional axis page output signal APE (F302.0)

- Signal type: NC->PLC
- Signal function: When the CNC system interface is on the additional axis coordinate page and the MDI additional axis program page, this signal is set to 1.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
F302								APE

4.12.2 Additional axis teaching programming

Additional axis teaching programming input signal ATPL (G314.0)

- Signal type: PLC->NC
- Signal function: In the teaching programming mode, when the signal output is 1, the current absolute coordinate values of all additional axes in the CNC system are input into the program.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G314								ATPL

Additional axis teaching programming each axis input signal ATPL1~ATPL4 (G315.0~G315.3)

- Signal type: PLC->NC
- Signal function: In manual teaching/MPG teaching mode, when the corresponding bit output of the signal is 1, input the current absolute coordinate value of the corresponding additional axis into the program.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G315					ATPL4	ATPL3	ATPL2	ATPL1

4.12.3 Synchronous operation of additional axes

The additional axis synchronously waits for the M code to ignore the signal ANOWT (G311.6)

- Signal type: PLC->NC
- Signal function: When the signal output is 1, when the additional axis program and the main program are executed together, even if the additional axis execution program and the main program specify the synchronous waiting M code, the additional axis program and the main program will not wait for each other.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G311		ANOWT						

The additional axis synchronously waits for the M code execution signal AWATO (F302.6)

- Signal type: NC->PLC
- Signal function: When the additional axis program and the main program are executed together, when any one of the additional axis execution program and the main program is executed to the line of synchronous waiting for the M code, the signal output is '1'.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
F302		AWATO						

4.12.4 Additional axis mechanical return

In the mechanical zero return mode, by setting the feed additional axis and direction selection signal to 1, the machine tool moves in the set direction and returns to the mechanical zero point. After returning to the machine zero point, CNC will establish the workpiece coordinate system with the values set by data parameters No.1240～No.1243.

4.12.4.1 Additional axis mechanical zero return end signal

Additional axis mechanical zero return complete signal AZP1~AZP4 (F301.0~F301.3)

- Signal type: NC->PLC
- Signal function: When the mechanical zero return of an additional axis is completed, NC sets the corresponding F signal to 1, and then transmits it to the PLC, and the PLC performs logic control according to the signal state. AZPn1, AZPn2, AZPn3, AZPn4 correspond to the mechanical zero return end signal of the 1st, 2nd, 3rd, and 4th additional axis respectively.
- Precaution:

1. When the mechanical zero return (including the use of G28 command to zero) has ended, and the current position is in the setting area, the mechanical zero return end signal becomes 1.
2. When the machine tool moves out of the mechanical zero point, when an emergency stop alarm occurs, or when the driver alarms, the mechanical zero return end signal becomes 0.

- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
F301					AZP4	AZP3	AZP2	AZP1

4.12.4.2 Additional axis mechanical zero point establishment signal

Additional axis mechanical zero point establishment signal AZRF1~AZRF4 (F300.0~F300.3)

- Signal type: NC->PLC
- Signal function: CNC mechanical zero return is over. After the mechanical zero point is established, the corresponding mechanical zero point establishment signal is set to 1, and then transmitted to the PLC. The PLC performs logic control according to the state of the mechanical zero point establishment signal. AZRF1, AZRF2, AZRF3, and AZRF4 correspond to the mechanical zero establishment signals of the additional axes 1, 2, 3, and 4 respectively.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
F300					AZRF4	AZRF3	AZRF2	AZRF1

4.12.5 Additional axis stroke detection

Additional axis 2nd soft limit detection switching signal ASLS (G317.0)

- Signal type: PLC -> NC
- Signal function: When CNC parameter #8402.0 is '1', the signal is valid. When this signal is set to '1', it means that the forbidden area of storage stroke detection 2 is inside the boundary; when it is set to '0', it means that the forbidden area of storage stroke detection 2 is outside the boundary.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G317								ASLS

4.12.6 Additional axis overtravel alarm signal

Additional axis storage stroke detection positive alarm signal
AOTP1~ AOTP4 (F306.0~F306.3)

- Signal type: NC->PLC
- Signal function: notify the PLC that a positive overtravel occurred in the storage stroke detection 1 or 2.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
F306					AOTP4	AOTP3	AOTP2	AOTP1

Additional axis storage stroke detection negative alarm signal
AOTN1~ AOTN4 (F307.0~F307.3)

- Signal type: NC->PLC
- Signal function: inform the PLC that a negative overtravel occurred in the storage stroke detection 1 or 2.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
F307					AOTN4	AOTN3	AOTN2	AOTN1

4.12.7 Additional axis position switch signal

Additional axis position switch output signal APSW (F303)

- Signal type: NC->PLC
- Signal function: When the moving distance of each axis of the additional axis exceeds the distance range set by the position switch of the axis, the output signal of the position switch corresponding to this axis is 0, otherwise it is 1.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
F303	APSW8	APSW7	APSW6	APSW5	APSW4	APSW3	APSW2	APSW1

4.12.8 The additional axis program runs automatically

◆ **Cycle start (start automatic operation)**

In the automatic mode or the input mode, when the automatic operation start signal ST is valid, the program starts to run.

1.The signal ST is ignored under the following cases:

A: In addition to the automatic method or the input method;

B: When the feed pause signal (ASP) is '0';

C: When the emergency stop signal (ESP) is '0';

D: When the external reset signal (ERS) is 1.

E: Press down Reset on the panel;

F: CNC is in alarm state.

G: Autorun has started

H: Program restart signal (SRN) is 1;

I: CNC is searching for a sequence number.

2. During automatic operation, CNC feeding pauses in case of the following:

A: When the feed pause signal (ASP) is '0';

B: When switching to manual mode, MPG mode, single-step mode, mechanical zero return, and program zero return;

C: The SBK command are ended during SBK operation.

D: The operation has ended in the input mode;

E: CNC alarm;

F: After switching to the editing mode, the single block command has ended.

3. During automatic operation, the CNC enters the reset state and the operation stops under the following conditions:

A: The emergency stop signal (ESP) is set to '0';

B: When the external reset signal (ERS) is 1.

C: Press the "reset button" on the panel;

◆ **Feed pause (automatic operation interruption)**

When the feed pause signal ASP is '0' during automatic operation, the CNC enters the pause state and stops running. At the same time, the cycle start light signal ASTL is set to '0'. The feed pause signal ASPL is set to '1', and the ASP signal is set to '1' again, and the automatic operation will not be restarted. When the ASP signal is set to '1' and then the AST signal is enabled, the automatic operation can be restarted.

During execution of the program blocks only comprising M/S/T function commands, if the SP signal is set as 0, the STL signal will turn into 0 immediately. The SPL signal is 1 and CNC enters the state of “feed suspension”. When the FIN signal is delivered from PLC, CNC will keep processing the FIN signal. After the program block is finished, set the SPL signal as 0 (hold the STL signal as 0) and CNC will enter the state of “automatic operation suspension”.

Additional axis cycle start signal

AST(G312.2):

- Signal type: PLC -> NC, the falling edge is valid.
- Signal function: In the automatic mode or the input mode, when the PLC receives the start pulse input signal, it will first set G312.2 to '1' and then set it to '0', and transmit it to the NC to start automatic operation.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G312						AST		

Additional axis feed pause signal

ASP (**G312.5**)

- Signal type: PLC -> NC, valid when it is '0'.
- Signal function: After the PLC receives the pause signal, it sets G312.5 to '0', and then transmits it to the NC to stop automatic operation. When the SP signal is set as 0, automatic operation cannot be activated.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G312			ASP					

Additional axis cycle start signal

ASTL (F323.5)

- Signal type: NC->PLC
- Signal function: When CNC is running automatically, ASTL is set to '1', and then transmitted to PLC, and PLC performs logic control according to the status of ASTL.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
F323			ASTL					

Additional axis feed pause signal

ASPL (F323.4)

- Signal type: NC->PLC
- Signal function: When the CNC is in the pause state, set ASPL to '1', and then transmit it to the PLC, and the PLC will perform logic control according to the ASPL state.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
F323				ASPL				

Additional axis auto run signal

AOP (F323.7)

- Signal type: NC->PLC
- Signal function: When CNC is running automatically, set AOP to '1', and then pass it to PLC, PLC will perform logic control according to the status of AOP.

	Cycle Start Light Signal ASTL	Feed Pause Light Signal ASPL	Automatic Operation Signal AOP
State of cyclic start	1	0	1
State of feed suspension	0	1	1
State of automatic operation suspension	0	0	0
Reset state	0	0	0

- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
F323	AOP							

4.12.9 Additional axis single block

Single block operation is only valid for automatic operation. During automatic operation, when the single block signal (ASBK) is set to '1', after executing the current additional axis block, the CNC enters the feed pause state. When the single block signal (ASBK) is set to '0', the program runs again.

4.12.9.1 Additional axis single block signal

ASBK (G311.1)

- Signal type: PLC->NC
- Signal function: When the PLC receives the single block operation input signal, it sets ASBK to '1' and then transmits it to the NC to make the CNC enter the single block operation state.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G311							ASBK	

4.12.9.2 Signal for detection on single block

AMSBK (F322.3)

- Signal type: NC->PLC
- Signal type: When CNC is in single block running state, AMSBK is set to '1' and then transmitted to PLC.
- Signal type:

	#7	#6	#5	#4	#3	#2	#1	#0
F322					AMSBK			

4.12.10 Manual operation of additional axis

JOG feed: Under the mode of JOG feed, set the selection signal for feed axis and direction on the machine operation panel as 1, so the machine is under continuous movement along the axis selected in the direction selected.

Incremental feed: In single step mode, set the additional axis and direction selection signal on the machine operation panel to '1', then the machine tool will move one step along the selected additional axis in the selected direction, and the minimum distance of the machine tool movement will be the smallest Enter the increment, each step has four magnification values of 0.001, 0.010, 0.100 or 1.000.

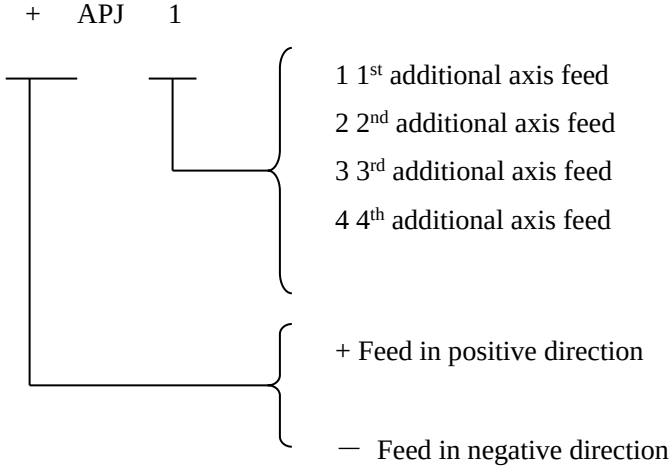
The sole difference between manual feed and incremental feed is the form selecting feed distance. In manual feed, when the additional axis and direction selection signal such as +AJ1, -AJ1, +AJ2, -AJ2, +AJ3, -AJ3 is '1', the machine tool can feed continuously. Under the mode of “incremental feed”, the machine is under single step feed.

Through the manual rapid feed selection switch, the machine tool can move at the rapid feed speed. The single step distance of incremental feed can be selected through MP1 and MP2.

Additional axis feed axis and direction selection signal

APJ1～APJ4(G300.0~G300.3), ANJ1～ANJ4(G302.0~G302.3)

- Signal type: PLC ->NC
- Signal function: Select the required additional axis and direction under manual feed or incremental feed, and execute the additional axis movement operation, then the corresponding additional axis and direction selection signal will be set to '1', and the PLC will be able to select the signal after receiving this signal. Proceed to the next step of control. "+" and "-" indicate the feed direction, and the number corresponds



- Notes: A: In manual feed, CNC makes the corresponding additional axis move continuously; in

incremental feed, CNC makes the corresponding additional axis feed in steps defined by signals MP1 and MP2.

B: When the axis moves, the corresponding axis and direction selection signal is '1', when the movement stops, the signal is reset.

- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G300					+APJ4	+APJ3	+APJ2	+APJ1
G302					-ANJ4	-ANJ3	-ANJ2	-ANJ1

Additional axis manual feed rate signal

AJV00～AJV14 (G305.0~G305.3):

- Signal type: PLC->NC
- Signal function: Select manual movement speed. The corresponding relationship between these signals and manual feed speed is shown in the table below. When the PLC receives the external override input signal, it assigns a value to G305, and then transmits it to NC, and the CNC displays the corresponding movement speed.

G305	Feed Rate Override (%)
0000 0000	0
0000 0001	10
0000 0010	20
0000 0011	30
0000 0100	40
0000 0101	50
0000 0110	60
0000 0111	70
0000 1000	80
0000 1001	90
0000 1010	100
0000 1011	110
0000 1100	120
0000 1101	130
0000 1110	140
0000 1111	150

- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G305					AJV3	AJV2	AJV1	AJV0

4.12.11 Additional axis MPG feed

In the MPG feed mode, the MPG can be rotated to make the machine tool move in a small amount, and the additional axis can be selected by the MPG feed additional axis selection signal.

4.12.11.1 MPG feed additional axis selection signal

The first hand-controlled MPG additional axis selection signal: AHS1A～AHS1D (G308.0~G308.3)

The second hand control MPG additional axis selection signal: AHS2A～AHS2D (G308.4~G308.7)

- Signal type: PLC ->NC
- Signal function: MPG feed axis selection signal. After the PLC receives the MPG feed axis input signal, it assigns values to AHSnA～AHSnD, and the NC selects the corresponding axis feed according to the state of the AHSnA～AHSnD signal. The corresponding relationship between these signals and MPG feed axis is shown in the table below.

AHSnD	AHSnC	AHSnB	AHSnA	Feed Additional Axis
0	0	0	0	Axisless feed
0	0	0	1	1-axis feed
0	0	1	0	2-axis feed
0	0	1	1	3-axis feed
0	1	0	0	4-axis feed
0	1	0	1	5-axis feed

- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G308	AHS2D	AHS2C	AHS2B	AHS2A	AHS1D	AHS1C	AHS1B	AHS1A

4.12.11.2 Additional axis MPG rate signal

AMP1 (G309.4), AMP2 (G309.5):

- Signal type: PLC->NC
- Signal function: This signal is used during the MPG feed period to select the magnification of the MPG feed amount corresponding to each pulse generated by the MPG pulse generator. After the PLC receives the input signal of the MPG gear button (×1, ×10, ×100, ×1000) on the machine tool panel, it assigns values to AMP1 and AMP2, and then transmits them to the NC to select the corresponding MPG feed rate. The corresponding relationship between AMP1, AMP2 and MPG magnification is shown in the table below.

AMP2	AMP1	MPG Magnification	Total Movement
0	0	1	Minimum input unit ×1
0	1	10	Minimum input unit ×10
1	0	Set by system parameter NO.7113	Minimum input unit × NO.7113 parameter value
1	1	Set by system parameter NO.7114	Minimum input unit × NO.7114 parameter value

Note: In addition to the MPG magnification, the system parameter NO.7103#2 HNT is also used to set whether the incremental feed/MPG movement is enlarged by 10 times (when HNT is set to 1, the moving amount is enlarged by 10 times)). The amount of movement in the above table is calculated when HNT is set to 0 (the amount of movement is not magnified by

10 times).

- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G309			AMP2	AMP1				

4.12.12 Additional axis feed speed control

The rapid traverse rate of the additional axis can be divided into four levels: F0, 25%, 50%, and 100%. The speed defined by FO is set by the data parameter No. 8451.

In automatic mode or manual mode (including mechanical zero return and program zero return), the actual moving speed is obtained by multiplying the value set by data parameter No. 8450 and the override value.

Fast moving rate signal

AROV1, AROV2 (G307.0, G307.1)

- Signal type: PLC->NC
- Signal function: When the PLC receives the rapid traverse rate input signal, it assigns values to AROV1 and AROV2, and then transmits them to the NC to determine the rapid traverse speed. The magnification values corresponding to AROV1 and AROV2 are as follows.

AROV2	AROV1	Rate
0	0	100%
1	0	50%
0	1	25%
1	1	FO

- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G307							AROV2	AROV1

4.12.13 Additional axis feed speed rate

The feed speed can be adjusted by the feed speed override signal, which can be used for program detection. For example, when the feed rate specified in the program is 100mm/min, if the feed rate override is adjusted to 50%, the machine tool will move at a speed of 50mm/min.

Spindle speed rate signal

AFV0～AFV73 (G304.0~G304.3):

- Signal type: PLC->NC
- Signal function: After the PLC receives the feed rate multiplier input signal, it assigns values to AFV0～AFV3, and then transmits them to the NC to determine the feed rate. The magnification values corresponding to the binary codes AFV0～AFV3 are as follows.

G304	Cutting Feed Rate
0000 0000	0%
0000 0001	10%
0000 0010	20%

G304	Cutting Feed Rate
0000 0011	30%
0000 0100	40%
0000 0101	50%
0000 0110	60%
0000 0111	70%
0000 1000	80%
0000 1001	90%
0000 1010	100%
0000 1011	110%
0000 1100	120%
0000 1101	130%
0000 1110	140%
0000 1111	150%

- Precautions: In automatic operation, the speed specified by the cutting feed is multiplied by the override value of the feed rate override signal to obtain the actual feed rate.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G304					AFV3	AFV2	AFV1	AFV0

4.12.14 Additional axis auxiliary M function

When the maximum 8 digits behind the address M are specified, the corresponding code signal and strobe signal are sent to the PLC, and the PLC performs related logic control according to the state of these signals. The relevant signals are as follows.

Function	Program Address	NC To PLC			End Signal
		Code Signal	Strobing Signal	End Of Distribution Signal	
Other support	M	Mbit00～Mbit31	AMF	ADEN	AMFIN

■ **The processing process of the additional axis M command is as follows:**

A: Assuming that M XXX is specified in the program, if CNC is not set, an alarm will be generated.

B: After the code signal AMbit00～AMbit15 are designated, the strobe signal AMF is set to '1', and the code signal uses the binary form to express the program command value XXX. If being moved and suspended, the spindle speed or other functions and auxiliary functions are commanded simultaneously. When the code signal for the auxiliary function is delivered, start performing other functions.

C: When the strobing signal is set as 1, PLC will read the code signal and perform corresponding operation.

D: After moving pause or other functions in a block, when performing another operation, it is necessary to wait for the allocation end signal ADEN to change to '1'.

E: At the end of the operation, the PLC sets the end signal AMFIN to '1'. Such signal is used for

auxiliary functions, spindle speed and the tool functions. If these functions operate simultaneously, such signal FIN can only be set as 1 upon completion of all functions.

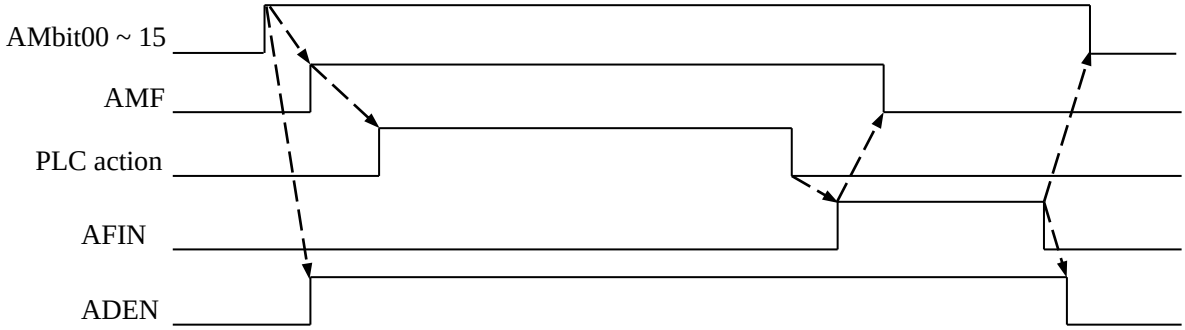
F: When the completion signal AFIN is 1, CNC can only set the strobing signal as 0 after certain time periods and notify that such signal is received.

G: When the strobe signal is '0', set the AFIN signal to '0' in the PLC.

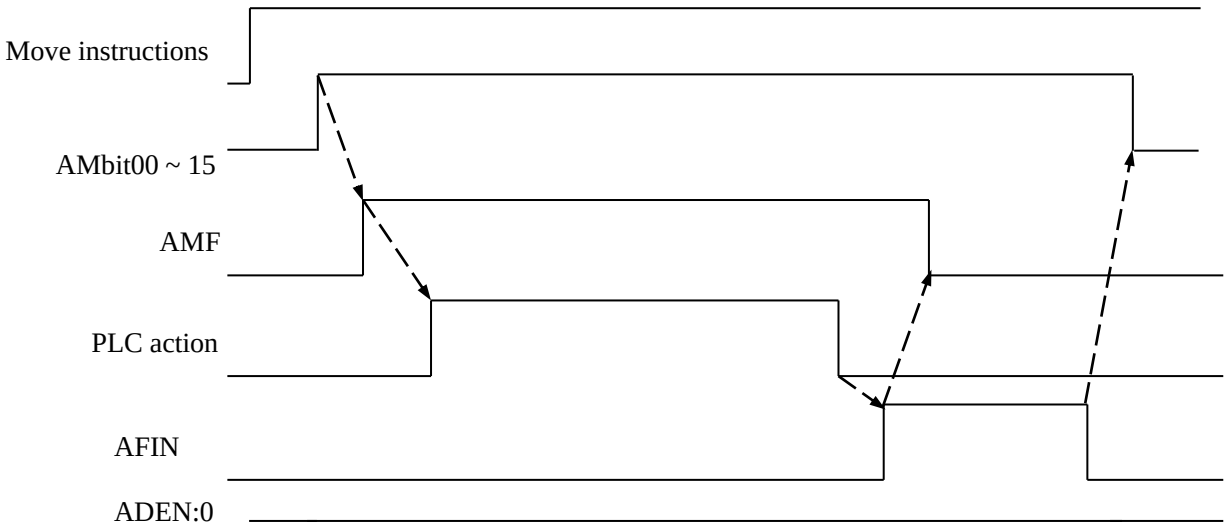
H: When the completion signal is 0, CNC will set all the code signals as 0, and all sequential operations of the auxiliary function will be ended.

I: When other commands of the same program block are completed, CNC will perform the next block.

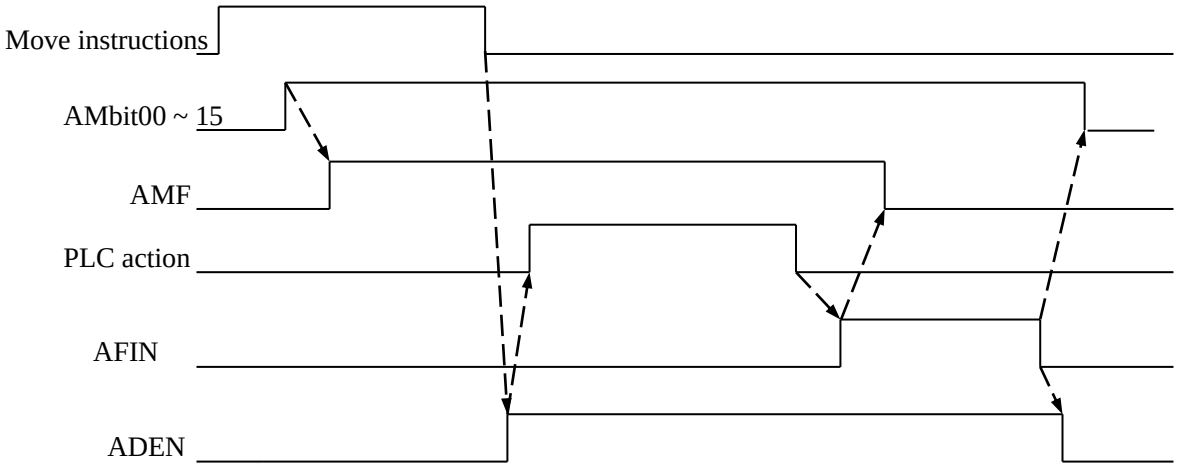
- **The control sequence is as follows:**
  - **There is one auxiliary function in the program block**



  - **If the commands for movement and the auxiliary function are within the same program block, the auxiliary function is performed before completion of the commands for movement.**



  - **If the commands for movement and the auxiliary function are within the same program block, the auxiliary function is performed after such commands are finished:**



4.12.15 Additional axis auxiliary function code signal and strobe signal

Additional axis auxiliary function code signal: AMbit00～Ambit15 (F310～F311)
Additional auxiliary function strobe signal: AMF (F320.0)

- Signal type: NC->PLC
- Signal function: After the program executes the M code, the corresponding F code signal is set to '1' and AMF is also '1', and then transmitted to the PLC for logic control. Please refer to "Basic Processing Process of Auxiliary Functions" Please refer to "Basic Execution Process. The corresponding relationship between the M command and the code signal encoding is as follows.

F311～F310	M Command
F311, 00000000	M00
F311, 00000001	M01
F311, 00000010	M02
F311, 00000011	M03
F311, 00000100	M04
F311, 00000101	M05
F311, 00000110	M06
F311, 00000111	M07
F311, 00001000	M08
…	…

- Precaution:
  Note: M00~ M31 give the M code in binary code form. For example, M5 corresponds to 00000000 and 00000101, as shown in the table above.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
F310	AMbit7	AMbit6	AMbit5	AMbit4	AMbit3	AMbit2	AMbit1	AMbit0
F311	AMbit15	AMbit14	AMbit13	AMbit12	AMbit11	AMbit10	AMbit9	AMbit8
F320								AMF

4.12.16 Multiple M commands in additional axis block

CNC allows up to 3 M codes in a block to be output to the machine tool at the same time. This means that compared with the traditional method of one M code per block, a shorter processing cycle time can be achieved.

Additional axis 2M function code signal: AM2bit00～AM2 bit 15 (F314 ~ F315)

Additional axis 3M function code signal: AM3bit00～AM3 bit 15 (F316 ~ F317)

Additional axis 2M function strobe signal: AMF2 (F320.4)

Additional axis 3M function strobe signal: AMF3 (F320.5)

- Signal type: NC->PLC
- Signal function: After the program executes the 2nd and 3rd M codes, the corresponding F code signal is set to '1', and AMF2 and AMF3 are also '1', and then transmitted to the PLC for logic control. The corresponding relationship between the M command and the code signal encoding is as follows.

F315～F314	Additional 2M Instructions
F315, 00000000	M00
F315, 00000001	M01
F315, 00000010	M02
F315, 00000011	M03
F315, 00000100	M04
F315, 00000101	M05
F315, 00000110	M06
F315, 00000111	M07
F315, 00001000	M08
.....	.....

F317～F316	Additional axis 3M Command
F317, 00000000	M00
F317, 00000001	M01
F317, 00000010	M02
F317, 00000011	M03
F317, 00000100	M04
F317, 00000101	M05
F317, 00000110	M06
F317, 00000111	M07
F317, 00001000	M08
.....	.....

- Precautions: 1. Due to mechanical operation restrictions, certain M codes cannot be specified at the same time. For detailed information on the mechanical operation limits of multiple M codes specified in one block at the same time, see the manual of each machine tool manufacturer.

2. M00, M01, M02 or M30 are commanded together with other M codes, other M codes will be ignored and not executed; M00, M01, M02 or M30 are commanded together, the first command M code is valid, and the remaining M codes are ignored and not executed.

For example:

One M command in one block

M03;
M10;
M12;
G01 X100 Z100;
……

There can be multiple M commands in one block

M03 M10 M12;
G01 X100 Z100;
……

- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
F314	AM2bit7	AM2bit6	AM2bit5	AM2bit4	AM2bit3	AM2bit2	AM2bit1	AM2bit0
F315	AM2bit15	AM2bit14	AM2bit13	AM2bit12	AM2bit11	AM2bit10	AM2bit8	AM2bit8
F316	AM3bit7	AM3bit6	AM3bit5	AM3bit4	AM3bit3	AM3bit2	AM3bit1	AM3bit0
F317	AM3bit15	AM3bit14	AM3bit13	AM3bit12	AM3bit11	AM3bit10	AM3bit8	AM3bit8
F320			AMF3	AMF2				

4.12.17 Additional axis end signal

Additional axis end signal AFIN (G310.0)

- Signal type: PLC->NC
- Signal function: When the auxiliary function ends, PLC will set AFIN to '1' and then send it to NC.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G310								AFIN

Additional axis auxiliary function end signal AMFIN (G310.1)

- Signal type: PLC->NC
- Signal function: When the auxiliary function is executed, the PLC will set AMFIN to '1' and then send it to the NC.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G310							AMFIN	

Additional axis 2M function end signal AMFIN2 (G310.4)
Additional axis 3M function end signal AMFIN3 (G310.5)

- Signal type: PLC->NC

- Signal function: When the M2 and M3 functions are executed, the PLC will set the end signal to '1' and then send it to the NC.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G310			AMFIN3	AMFIN2				

Additional axis allocation end signal ADEN (F321.3)

- Signal type: NC->PLC
- Signal function: When the auxiliary function is in the same segment with other instructions (such as movement instructions and pause instructions), after the execution of other instructions is completed, the NC sets ADEN to '1' and waits for the AFIN signal sent by the PLC. After the execution of the block, ADEN becomes ‘0’.
- Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
F321					ADEN			

Appendix

1 List of G signals

Address	Signal Name	Symbol	Chapter Section
G2.0~G2.5	Axis teaching input signal	TIA1~TIA6	
G3.0	Tool enable signal	TE	
G3.7	Teaching input signal for all axes	TIA	
G4.3	Signal for completion of the auxiliary function	FIN	4.7.4.1
G4.4	2M function end signal	MFIN2	4.7.4.1
G4.5	3M function end signal	MFIN3	4.7.4.1
G5.0	Signal for completion of the auxiliary function	MFIN	4.7.4.1
G5.2	Signal for completion of the spindle function	SFIN	4.7.4.1
G5.3	Signal for completion of the tool function	TFIN	4.7.4.1
G5.6	Signal for locking of the auxiliary function	AFL	4.7.5.1
G5.7	Signal for completion of the second auxiliary function	BFIN	4.7.4.1
G6.0	Signal for re-start of the program	SRN	4.5.8
G6.2	Manual absolute value signal	ABSM	4.5.7.1
G6.4	Rate cancel signal	OVC	4.6.4
G7.2	Signal for cyclic start	ST	4.5.1.1
G7.4	Stroke detection 3 release signal	RLSOT3	4.2.6.3
G7.6	Store travel limit selection signal	EXLM	4.2.6.2
G8.0	Full-axis interlock signal	IT	4.2.7
G8.1	Cutting program block starts interlock signal	CSL	4.2.7
G8.3	Program block starts interlock signal	BSL	4.2.7
G8.4	Emergency stop signal	ESP	4.2.1
G8.5	Feed pause signal	SP	4.5.1.2
G8.7	External reset signal	ERS	4.5.2.1
G9.0	External part number search signal	PN1, PN2, PN4, PN8, PN16	4.5.2.4
G9.1			
G9.2			
G9.3			
G9.4			
G10.0~G11.7	Manual feed rate signal	JV0～JV15	4.3.1.2
G12	Feed rate signal	FV0～FV7	4.6.3
G14.0~G14.1	Fast moving rate signal	ROV1, ROV2	4.6.2
G18.0~G18.3	MPG 1 feed axis selection signal	HS1A～HS1D	4.3.2.1
G18.4~G18.7	MPG 2 feed axis selection signal	HS2A～HS2D	4.3.2.1
G19.4~G19.5	MPG/single step rate signal	MP1, MP2	4.3.2.2

Address	Signal Name	Symbol	Chapter Section
G19.7	Selection signal for manual rapid feed	RT	4.3.1.3
G24.0~G25.5	Extended external part number search signal	EPN~EPN13	4.5.2.4
G25.7	External part number search start signal	EPNS	4.5.2.5
G26.0	3rd Position encoder selection signal	PC3SLC	4.8.2
G27.0	1st Spindle selection signal	SWS1	4.8.2
G27.1	2nd Spindle selection signal	SWS2	4.8.2
G27.2	3rd Spindle selection signal	SWS3	4.8.2
G27.3	1st Spindle stop signal	SSTP1	4.8.2
G27.4	2nd Spindle stop signal	SSTP2	4.8.2
G27.5	3rd Spindle stop signal	SSTP3	4.8.2
G27.7	Spindle contour control switching signal	CON	4.8.3
G28.1~G28.2	Gear selection signal	GR1,GR2	4.8.1
G28.7	2nd position encoder selection	PC2SLC	4.8.2
G29.0	2nd main shaft gear selection	GR2_1	4.8.2
G29.1	2nd main shaft gear selection	GR2_2	4.8.2
G29.2	3rd spindle gear selection	GR3_1	4.8.2
G29.3	3rd spindle gear selection	GR3_2	4.8.2
G29.4	Spindle speed-reached state signal	SAR	4.8.1
G29.6	Spindle stop signal	SSTP	4.8.1
G30.0~G30.7	Spindle speed rate signal	SOV00～SOV07	4.8.1
G32.0～G33.3	PLC input the first spindle motor speed command signal	R01I～R12I	4.8.1
G34.0～G35.3	PLC input the second spindle motor speed command signal	R01I2～R12I2	4.8.2
G36.0～G37.3	PLC input the third spindle motor speed command signal	R01I3～R12I3	4.8.2
G38.5	3rd spindle motor speed selection command signal	SIND3	4.8.2
G38.6	2nd spindle motor speed selection command signal	SIND2	4.8.2
G38.7	Spindle motor speed selection command signal	SIND	4.8.1
G39.0～G39.5 G40.0～G40.3	Tool compensation number selection signal	OFN0~OFN5 OFN20~OFN23	4.10.4
G39.6	Workpiece coordinate system offset writing mode selection signal	WOQSM	4.10.4
G39.7	Tool compensation amount writing mode selection signal	GOQSM	4.10.4
G40.5	Parameter writing method selection signal	POQSM	
G40.6	Location recording signal	PRC	4.10.5
G40.7	Workpiece coordinate system offset write signal	WOSET	4.10.4
G41.0～G41.7	Manual MPG interrupt axis selection signal	HS1IA~HS1ID, HS2IA~HS2ID	4.3.4
G43.0～G43.2, G43.5, G43.7	Mode selection signal	MD1, MD2, MD4, DNC1, ZRN	4.2.4.1
G44.0	Signal for skip the optional program segment	BDT1	4.5.6.1
G44.1	Signal for detection on locking of the machine of all axes	MlK	4.5.3.1

Address	Signal Name	Symbol	Chapter Section
G46.1	Signal for single block	SBK	4.5.5.1
G46.7	Signal for dry run	DRN	4.5.4.1
G47.0~G47.7	Tool group number selection signal	TL	4.9.1
G48.2	Counting invalid signal in tool life management	LFCIV	4.9.1
G48.5	Tool skip signal in tool life management	TLSKP	4.9.1
G48.6	Tool change reset signal one by one in tool life management	TLRSTI	4.9.1
G48.7	Tool change reset signal in tool life management	TLRST	4.9.1
G49.0~G49.7	Counting rate signal in tool life management	TLV	4.9.1
G61.0	Rigid tapping signal	RGTAP	4.8.3
G61.2	Rigid tapping spindle rotation direction selection signal	RGROD	4.8.3
G61.4	Rigid tapping first spindle selection signal	RGTSP1	4.8.2
G61.5	Rigid tapping second spindle selection signal	RGTSP2	4.8.2
G61.6	Rigid tapping third spindle selection signal	RGTSP3	4.8.2
G63.5	Quadrature axis tilt axis control invalid signal	NOZACC	4.10.8
G67.2	Manual hand pulse check mode signal	MMOD	4.3.3
G67.3	Manual hand pulse check signal	MCHK	4.3.3
G67.4	MPG selection signal during MPG trial cutting	MCHO	
G70.0	The first bus spindle alarm clear signal	GSCA	
G70.1	The first bus spindle zero-speed clamp signal	GSZL	
G70.2	The first bus spindle orientation start signal	GSOC	
G70.3	The first bus spindle rigid tapping start signal	GSTS	
G70.4	The first bus spindle reversal signal	GSRV	4.8.2
G70.5	The first bus spindle forward signal	GSFR	4.8.2
G70.6	The first bus spindle mechanical lock signal	GSML	
G70.7	The first bus spindle high and low speed switching signal	GSSC	
G74.0	The second bus spindle alarm clear signal	GSCA	
G74.1	The second bus spindle zero-speed clamp signal	GSZL	
G74.2	The second bus spindle orientation start signal	GSOC	
G74.3	The second bus spindle rigid tapping start signal	GSTS	
G74.4	The second bus spindle reversal signal	GSRV	4.8.2
G74.5	The second bus spindle forward signal	GSFR	4.8.2
G74.6	The second bus spindle mechanical lock signal	GSML	
G74.7	The second bus spindle high and low speed switching signal	GSSC	
G78.0	The third bus spindle alarm clear signal	GSCA	
G78.1	The third bus spindle zero-speed clamp signal	GSZL	
G78.2	The third bus spindle orientation start signal	GSOC	
G78.3	The third bus spindle rigid tapping start signal	GSTS	

Address	Signal Name	Symbol	Chapter Section
G78.4	The third bus spindle reversal signal	GSRV	4.8.2
G78.5	The third bus spindle forward signal	GSFR	4.8.2
G78.6	The third bus spindle mechanical lock signal	GSML	
G78.7	The third bus spindle high and low speed switching signal	GSSC	
G82.0~G82.3	Bus spindle enable signal	GSENB	
G83.0	The fourth bus spindle alarm clear signal	GSCA	
G83.1	The fourth bus spindle zero-speed clamp signal	GSZL	
G83.2	The fourth bus spindle orientation start signal	GSOC	
G83.3	The fourth bus spindle rigid tapping start signal	GSTS	
G83.4	The fourth bus spindle reversal signal	GSRV	
G83.5	Fourth bus spindle forward signal	GSFR	
G83.6	The fourth bus spindle mechanical lock signal	GSML	
G83.7	The fourth bus spindle high and low speed switching signal	GSSC	
G87.0	Selection signal for MPG/incremental feed amount	MP21	4.3.2.2
G87.1		MP22	4.3.2.2
G100.0~G100.7	Selection of feed axis and direction	+J1～+J8	4.3.1.1
G102.0~G102.7		-J1～-J8	4.3.1.1
G114.0~G114.7	Overtravel signal	+L1～+L8	4.2.6.1
G116.0~G116.7		-L1～-L8	4.2.6.1
G125.0~G125.7	Axis reference point establishment signal	PSAC1~PSAC8	
G126.0~G126.7	Servo shut-off signal	SVF1~SVF8	4.10.13
G127.0~G127.7	Axis servo enable coordinate signal	SVAD1~SVAD8	
G128.0~G128.7	Axis servo enable cancel coordinate signal	SVAF1~SVAF8	
G129.0~G129.7	Axis servo enable cancel coordinate signal	SVMI1~SVMI8	
G130.0～G130.7	Full-axis interlock signal	IT1~IT8	4.2.7
G132.0	Tool compensation amount write signal X+	MIT1P	4.10.4
G132.1	Tool compensation amount write signal Z+	MIT2P	4.10.4
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G140.5	Axis control pause signal of the first group of PLC	ESTPA	4.11.3.8
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G150.7	Control command reading signal of the second group of PLC	EBUFB	4.11.3.5
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G160.2	PLC cache invalid signal	EMBUFC	4.11.3.16
G160.3	Block end signal of the third group of PLC	ESBKC	4.11.3.9
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G170.3	Block end signal of the fourth group of PLC	ESBKD	4.11.3.9
G170.5	Axis control pause signal of the fourth group of PLC	ESTPD	4.11.3.8
G170.6	Reset signal of the fourth group of PLC	ECLRD	4.11.3.7
G170.7	Control command reading signal of the fourth group of PLC	EBUFD	4.11.3.5
G171.0～G171.6	Axis control signal of the fourth group of PLC	EC0D～EC6D	4.11.3.2
G171.7	Invalid stop signal of PLC fourth group program segment	EMSBKD	4.11.3.10
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G262.0~G262.7	Index axis clamp completion signal	ECLP1~ECLP8	4.10.13
G263.0~G263.7	Indexing shaft release complete signal	EUCLP1~EUCLP8	4.10.13
G264.0~G264.7	Indexing table control valid signal	ECDT1~ECDT8	
G265.0~G265.7	Indexing table control servo enable signal	ESES1~ESES8	
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G271.0~G271.1	Tool breakage detection spindle selection signal	TDCS1~TDCS2	
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G281.0~G281.3	Parallel program pause signal	PSPE1~PSPE4	4.10.14
G282.0~G282.3	Program selection execution M auxiliary function completion signal	RMFIN1~ RMFIN4	4.10.14
G283.0~G283.7	Parallel program position establishment signal	RTPS1~ RTPS8	4.10.14
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G285.0~G258.3	End signal for parallel programs 1~4	PSST1~PSST4	
G286.0~G286.3	M code wait ignore signal for parallel programs 1~4	IPWT1~IPWT4	
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G288.0~G288.3	Tool function completion signal for parallel programs 1~4	RTFIN1~RTFIN4	
G289.0~G289.3	Program selection to execute S auxiliary function completion signal	RSFIN1~RSFIN4	4.10.14
G290.0~G290.3	Parallel program rigid tapping signal	RRTAP1~ RRTAP4	4.10.14
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G293.0~G293.3	The second parallel program rigid tapping and drilling spindle selection signal	RRTSP21~ RRTSP24	4.10.14
G294.0~G294.3	The third parallel program rigid tapping and drilling spindle selection signal	RRTSP31~ RRTSP34	4.10.14
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G302.0~G302.3	Additional axis negative feed axis and direction selection signal	ANJ1～ANJ4	4.12.10.1
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G305.0~G305.3	Additional axis manual feed rate signal	AJV0～AJV3	4.12.10.1
G307.0~G307.1	Additional axis fast moving rate signal	AROV1, AROV2	4.12.12.1
G308.0~G308.3	First hand control MPG additional axis selection signal:	AHS1A～AHS1D	4.12.11.1
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G309.7	Auxiliary axis manual rapid feed selection signal	ART	
G310.0	Additional axis end signal	AFIN	4.12.17
G310.1	Signal for completion of the auxiliary function	AMFIN	4.12.17
G310.4	Additional axis 2M function end signal	AMFIN2	4.12.17
G310.5	Additional axis 3M function end signal	AMFIN3	4.12.17
G311.1	Additional axis single block signal	ASBK	4.12.9.1
G311.6	The additional axis synchronously waits for the M code ignore signal	ANOWT	4.12.3
G312.2	Additional Axis Cycle Start Signal	AST	4.12.8
G312.5	Additional Axis Feed Pause Signal	ASP	4.12.8
G314.0	Additional axis teaching programming input signal	ATPL	4.12.2
G315.0~G315.3	Additional axis teaching programming each axis input signal	ATPL1~ATPL4	4.12.2
G317.0	Additional axis 2nd soft limit detection switching signal	ASLS	4.12.5
G318.0~G318.1	Spindle/Additional axis page selection signal	MPSS-APSS	4.12.1
G320.0~G320.3	Auxiliary axis torque control switching signal	ATOR1~ATOR4	
G321.0~G321.3	Auxiliary axis torque control limit detection signal	ATLSC1~ATLSC4	
G322.0~G322.3	Auxiliary axis torque control clear signal	ATCD1~ATCD4	
G324.0~G324.3	Auxiliary axis positive direction lock signal	AITXP1~AITXP4	
G325.0~G325.3	Auxiliary axis negative direction lock signal	AITXN1~AITXN4	
G329.0~G329.1	Auxiliary axis clear stack full signal	APILE1~APILE2	
G353.0~G353.3	Spindle Cs contour control switching signal (switches position only, C-axis not supported)	OPCS1~OPCS4	
G354.0~G354.3	Direction of spindle Cs contour control in position mode (for spindle speed control)	OPCSD1~OPCSD4	

2 List of F signals

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F0.5	Signal for cyclic start	STL	4.5.1.3
F0.6	Servo ready signal	SA	4.1.2
F0.7	Signal for automatic operation	OP	4.5.1.5
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F1.1	Reset signal	RST	4.5.2.2
F1.3	End of distribution signal	DEN	4.7.4.1
F1.4	Spindle allow signal	ENB	4.8.1
F1.6	Tool change permission signal	TEB	4.10.11
F1.7	CNC ready signal	MA	4.2.2
F2.0	Input signal (English system)	INCH	4.10.1

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F2.2	Constant line speed cutting signal	CSS	4.8.1
F2.3	Thread cutting	THRD	4.10.2
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F2.6	Cutting feed signal	CUT	
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F3.0	Single step detection signal	MINC	4.2.4.2
F3.1	Hand pulse method detection signal	MH	4.2.4.2
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F3.3	Input mode detection signal	MMDI	4.2.4.2
F3.4	DNC detection signal	MRMT	4.2.4.2
F3.5	Automatic detection signal	MMEM	4.2.4.2
F3.6	Edit mode detection signal	MEDT	4.2.4.2
F3.7	Teaching programming detection signal	MMTE	
F4.0	Signal for detection on block delete	MBDT1	4.5.6.2
F4.1	Signal for detection on locking of the machine of all axes	MMLK	4.5.3.2
F4.2	Manual absolute value detection signal	MABSM	4.5.7.2
F4.3	Signal for detection on single block	MSBK	4.5.5.2
F4.4	Signal for detection on locking of auxiliary functions	MAFL	4.7.5.2
F4.5	Machine tool zero return mode detection signal	MREF	4.2.4.2
F4.6	Selected stop detection signal	MSTK	
F6.0	Stored stroke detection alarm signal	OTA	
F6.1	MDI-based reset confirmation signal	MDIRST	4.5.2.8
F7.0	Auxiliary function strobing signal	MF	4.7.1.1
F7.2	Strobing signal for spindle speed	SF	4.7.2
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F7.7	Strobing signal of the 2nd auxiliary function	BF	4.7.1.3
F8.4	No.2 M auxiliary functional code signal	MF2	4.7.1.3
F8.5	No.3 M auxiliary functional code signal	MF3	4.7.1.3
F9.3	M decoding signal	DM99	4.7.1.2
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F9.5		DM02	4.7.1.2
F9.6		DM01	4.7.1.2
F9.7		DM00	4.7.1.2
F10～F13	Auxiliary function code signal	Mbit00～Mbit31	4.7.1.1
F14～F15	No.2 M auxiliary functional code signal	M2bit00～M2 bit 15	4.7.1.3
F16～F17	No.3 M auxiliary functional code signal	M3 bit 00～M3 bit 15	4.7.1.3
F22～F25	Code signal for spindle speed	S bit00～S bit31	4.7.2

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F26～F29	Blade functional code signal	Tbit00～Tbit31	4.7.3
F30～F33	No.2 M auxiliary functional code signal	B00~B31	4.7.1.3
F35.0	Spindle speed fluctuation alarm signal	SPAL	4.8.1
F35.1	Spindle speed reach output signal	SPAR	
F36.0～F37.3	S12-bit code signal of the 1st spindle	R01O～R12O	4.8.1
F38.2	Second spindle enable signal	ENB2	4.8.2
F38.3	**3rd** spindle enable signal	ENB3	4.8.2
F40～F41	1st spindle actual speed signal	AR00～AR15	4.8.1
F44.1	Spindle contour control switching end signal	FSCSL	4.8.3
F45.0	The first bus spindle alarm signal	GSA	
F45.1	The first bus spindle zero speed output signal	GSZ	
F45.2	The first bus spindle orientation complete signal	GSPF	
F45.3	The first bus spindle torque arrival signal	GSTA	
F45.4	The first bus spindle speed reached signal	GSSA	
F45.5	The first bus spindle position arrival signal	GSPA	
F45.6	The first bus spindle rigid tapping signal	GSTAP	
F49.0	The second bus spindle alarm signal	GSA	
F49.1	The second bus spindle zero speed output signal	GSZ	
F49.2	The second bus spindle orientation complete signal	GSPF	
F49.3	The second bus spindle torque arrival signal	GSTA	
F49.4	The second bus spindle speed reached signal	GSSA	
F49.5	The second bus spindle position arrival signal	GSPA	
F49.6	The signal of the second bus spindle rigid tapping	GSTAP	
F53.0	The third bus spindle alarm signal	GSA	
F53.1	The third bus spindle zero speed output signal	GSZ	
F53.2	The third bus spindle orientation complete signal	GSPF	
F53.3	The third bus spindle torque arrival signal	GSTA	
F53.4	The third bus spindle speed reached signal	GSSA	
F53.5	The third bus spindle position arrival signal	GSPA	
F53.6	The third bus main line spindle rigid tapping signal	GSTAP	
F62.7	Target parts count arrival signal	PRTSF	4.10.3
F63.6	Polygon machining phase synchronization output signal	PSYNC	
F63.7	Polygon synchronization signal	PSYN	4.10.7
F64.0	Tool change signal in tool life management	TLCH	4.9.1
F64.1	New tool selection signal in tool life management	TLNW	4.9.1
F64.2	Tool change signal one by one in tool life management	TLCHI	4.9.1
F64.3	Tool life forecast signal in tool life management	TLCHB	4.9.1

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F64.7	Simple tool life management alarm signal	STLAL	
F65.0	In rigid tapping, the spindle forward rotation signal	RGSPP	4.8.3
F65.1	In rigid tapping, the spindle reversal signal	RGSPM	4.8.3
F65.6	Electronic gear box machining in-process output signal	SYNMOD	
F65.7	Electronic gear box phase synchronization output signal	ESYNC	
F70.0~F71.7	Site switch signal	PSW01~PSW18	4.10.12
F73.0~F73.2、F73.4	Soft panel mode selection	MD1O、MD2O、MD4O、ZRNO	
F75.2	Soft panel block skip	BDTO	
F75.3	Soft panel single block	SBKO	
F75.4	Soft panel machine lock	MLKO	
F75.5	Soft panel dry run	DRNO	
F75.7	Soft panel feed hold	SPO	
F76.0~F76.1	Soft panel handwheel override selection	MP1O、MP2O	
F76.2	Normal tapping progress signal	PTAP	4.8.3
F76.3	Rigid tapping signal	RTAP	4.8.3
F76.4~F76.5	Soft panel rapid traverse override	ROV1O、ROV2O	
F77.0~F77.3	Soft panel handwheel feed axis selection	HS1xO	
F78.0~F78.7	Soft panel feed rate override	FV0O~FV7O	
F79.0`F79.7	Soft panel JOG feed rate override	JV0O~JV7O	
F80.0~F80.4 F81.0~F81.4	Soft panel JOG feed axis selection	+J1O~+J5O -J1O~-J5O	
F83.0	The fourth bus spindle alarm signal	GSA	
F83.1	The fourth bus spindle zero speed output signal	GSZ	
F83.2	The fourth bus spindle orientation complete signal	GSPF	
F83.3	The fourth bus spindle torque arrival signal	GSTA	
F83.4	The fourth bus spindle speed reached signal	GSSA	
F83.5	The fourth bus spindle position arrival signal	GSPA	
F83.6	The fourth bus main axis rigid tapping signal	GSTAP	
F91.0	MPG try to cut the signal in reverse movement	MRVMD	4.3.3
F91.2	MPG back to prohibit reverse movement signal	MRVSP	4.3.3
F91.3	Manual hand pulse check mode confirmation signal	MMMOD	4.3.3
F93.2	Counting invalid signal in tool life management	LFCIF	4.9.1
F94.0～ F94.7	Machine tool zero return end signal	ZP1～ZP8	4.4.1.1
F96.0～ F96.7	The second reference point machine tool zero return end signal	ZP21～ZP28	4.4.1.1
F98.0～ F98.7	The third reference point machine tool zero return end signal	ZP31～ZP38	4.4.1.1
F100.0～ F100.7	The 4th reference point machine tool zero return end signal	ZP41～ZP48	4.4.1.1

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F102.0～ F102.7	Signal for moving axis	MV1～MV8	4.1.1.1
F106.0～ F106.7	Shaft movement signal	MVD1～MVD8	4.1.1.2
F112.0～ F112.7	PLC allocation complete signal	EADEN1～EADEN8	4.11.3.31
F114.0～ F114.7	Shaft torque control arrival signal	TRQ1～TRQ8	4.10.10
F120.0～ F120.7	Mechanical zero establishment signal	ZRF1～ZRF8	4.4.1.2
F124.0～F124.7	Storage stroke detection forward alarm signal	+OT1～+OT8	4.2.6.1
F126.0～F126.7	Storage stroke detection negative alarm signal	-OT1～-OT8	4.2.6.1
F128.0～F128.7	Manual measurement input completion signal for each axis	OFMF1~OFMF8	
F129.5	PLC axis override 0% signal	EOV0	4.11.3.30
F129.7	Signal of selecting PLC axis control	EAXSL	4.11.3.17
F130~F131	1st spindle current output signal		
F132~F133	2nd spindle current output signal		
F134~F135	3rd spindle current output signal		
F136~F137	4th spindle current output signal		
F140.0	PLC axis in-position signal	EINPA	4.11.3.18
F140.1	PLC axis tracking error zero check signal	ECKZA	4.11.3.19
F140.2	PLC axis alarm signal	EIALA	4.11.3.20
F140.3	PLC auxiliary function execution signal	EDENA	4.11.3.22
F140.4	PLC axis motion signal	EGENA	4.11.3.21
F140.5	PLC axis positive overtravel signal	EOTPA	4.11.3.24
F140.6	PLC axis negative overtravel signal	EOTNA	4.11.3.23
F140.7	PLC 1st group axis control command reading completion signal	EBSYA	4.11.3.6
F141.0	PLC auxiliary function strobe signal	EMFA	4.11.3.12
F141.1	PLC buffer full signal	EABUFA	4.11.3.32
F141.2	PLC auxiliary function 2 strobe signal	EMF2A	4.11.3.13
F141.3	PLC auxiliary function 3 strobe signal	EMF3A	4.11.3.14
F142~F143	PLC auxiliary function code signal	EM11A～EM48A	4.11.3.11
F150.0	PLC axis in-position signal	EINPB	4.11.3.18
F150.1	PLC axis tracking error zero check signal	ECKZB	4.11.3.19
F150.2	PLC axis alarm signal	EIALB	4.11.3.20
F150.3	PLC auxiliary function execution signal	EDENB	4.11.3.22
F150.4	PLC axis motion signal	EGENB	4.11.3.21
F150.5	PLC axis positive overtravel signal	EOTPB	4.11.3.24
F150.6	PLC axis negative overtravel signal	EOTNB	4.11.3.23
F150.7	PLC 2nd group axis control command reading completion signal	EBSYB	4.11.3.6
F151.0	PLC auxiliary function strobe signal	EMFB	4.11.3.12
F151.1	PLC buffer full signal	EABUFB	4.11.3.32
F151.2	PLC auxiliary function 2 strobe signal	EMF2B	4.11.3.13

Address	Signal Name	Symbol	Chapter Section
F151.3	PLC auxiliary function 3 strobe signal	EMF3B	4.11.3.14
F152~F153	PLC auxiliary function code signal	EM11B～EM48B	4.11.3.11
F160.0	PLC axis in-position signal	EINPC	4.11.3.18
F160.1	PLC axis tracking error zero check signal	ECKZC	4.11.3.19
F160.2	PLC axis alarm signal	EIALC	4.11.3.20
F160.3	PLC auxiliary function execution signal	EDENC	4.11.3.22
F160.4	PLC axis motion signal	EGENC	4.11.3.21
F160.5	PLC axis positive overtravel signal	EOTPC	4.11.3.24
F160.6	PLC axis negative overtravel signal	EOTNC	4.11.3.23
F160.7	PLC **3rd** group axis control command reading completion signal	EBSYC	4.11.3.6
F161.0	PLC auxiliary function strobe signal	EMFC	4.11.3.12
F161.1	PLC buffer full signal	EABUFC	4.11.3.32
F161.2	PLC auxiliary function 2 strobe signal	EMF2C	4.11.3.13
F161.3	PLC auxiliary function 3 strobe signal	EMF3C	4.11.3.14
F162~F163	PLC auxiliary function code signal	EM11C～EM48C	4.11.3.11
F170.0	PLC axis in-position signal	EINPD	4.11.3.18
F170.1	PLC axis tracking error zero check signal	ECKZD	4.11.3.19
F170.2	PLC axis alarm signal	EIALD	4.11.3.20
F170.3	PLC auxiliary function execution signal	EDEND	4.11.3.22
F170.4	PLC axis motion signal	EGEND	4.11.3.21
F170.5	PLC axis positive overtravel signal	EOTPD	4.11.3.24
F170.6	PLC axis negative overtravel signal	EOTND	4.11.3.23
F170.7	PLC 4th group axis control command reading completion signal	EBSYD	4.11.3.6
F171.0	PLC auxiliary function strobe signal	EMFD	4.11.3.12
F171.1	PLC buffer full signal	EABUFD	4.11.3.32
F171.2	PLC auxiliary function 2 strobe signal	EMF2D	4.11.3.13
F171.3	PLC auxiliary function 3 strobe signal	EMF3D	4.11.3.14
F172~F173	PLC auxiliary function code signal	EM11D～EM48D	4.11.3.11
F182.0~F182.7	PLC axis control signal	EACNT1~EACNT8	4.11.3.33
F183.0～F183.7	PLC axis torque control mode Signal in	ETRQM1～ETRQM8	4.11.3.34
F188.0~F188.7	Multi-spindle address P signal		
F190.0～F190.7	The output signal of the consistent state of the mechanical coordinates in the synchronous control	SYNMT1～SYNMT8	4.10.9
F191.0～F191.7	Signal of selecting feeding axis synchronous control	SYNO1～SYNO8	4.10.9
F193.0~F193.7	Axis servo enable signal	SVF1~SVF8	
F194.0~F194.3	Spindle servo enable signal	SSVF1~SSVF	
F197.0	Signal in flexible synchronous control mode	MFSY	
F200.0～F201.3	S12-bit code signal of the 2nd spindle	R01O2～R12O2	4.8.2
F202～F203	2nd spindle actual spindle speed signal	AR002～AR152	4.8.2

Address	Signal Name	Symbol	Chapter Section
F204.0～F205.7	3rd spindle command code signal	R01O3～R12O3	4.8.2
F206～F207	3rd spindle actual spindle speed signal	AR003～AR153	4.8.2
F208～F209	4th spindle speed command signal	R01O4～R16O4	4.8.2
F210.0～F210.7	Set the torque control mode of each axis	TOR1～TOR8	4.10.10
F212～F213	4th spindle actual spindle speed signal	AR004～AR154	4.8.2
F214.0～F217.7	Corresponding to system macro variables #1100～#1131		
F220.0~F227.7	Gateway communication data		
F230.0~F237.7	2nd gateway communication data		
F240.0~F247.7	Analog input data		
F250.0	4th spindle enable signal	ENB4	4.8.2
F251.0~F251.3	Spindle speed fluctuation detection signal	SSF1~SSF4	
F254.0	Cs contour control switching end signal for each spindle	FCSS1	4.8.3
F254.1	Cs contour control switching end signal for each spindle	FCSS2	4.8.3
F254.2	Cs contour control switching end signal for each spindle	FCSS3	4.8.3
F254.3	Cs contour control switching end signal for each spindle	FCSS4	
F255.0~F255.3	Signal in spindle SV rotation control mode	SVREV1~SVREV4	
F256.0~F256.3	Spindle phase deviation detection signal	FSPPC1~FSPPC4	
F257.0~F257.3	Signal in spindle synchronous control mode	FSPPH1~FSPPH4	
F258.0~F258.3	Spindle phase deviation calculation completion signal	FSPRV1~FSPRV4	
F259.0~F259.3	Spindle phase deviation input completion signal	FSPRE1~FSPRE4	
F260.0~F260.7	Axis encoder PC detection signal	ENCE1~ENCE8	
F261.0~F261.7	Axis detection PLC motion signal	PLCM1~PLCM8	
F262.0~F262.7	Indexing axis clamping signal	CLP1~CLP8	4.10.13
F263.0~F263.7	Indexing axis unclamping signal	UCLP1~UCLP8	4.10.13
F265.0~F265.7	Axis servo current overload signal	SCAS1~SCAS8	
F266.0~F266.3	Spindle servo current overload signal	SEOS1~SEOS4	
F267.0	Tool breakage detection overload alarm output signal	TCSA	
F267.1	Tool breakage detection no-load alarm output signal	TCSN	
F267.2	Tool breakage detection condition output signal	TCSC	
F270~F273	Each spindle Cs corresponds to the feed axis signal		4.8.3
F276~F279	Each parallel program tool function code signal		
F280.0~F280.3	Parallel program execution signal	RPE1~RPE4	4.10.14.1
F281.0~F281.3	Alarm signal during parallel program execution	RPEE1~RPEE4	4.10.14.1
F282.0~F282.3	Parallel program auxiliary function strobe signal	RMF1~RMF4	4.10.14.2
F283.0~F283.3	Parallel program rigid tapping signal	RRTAP1~ RRTAP4	4.10.14.1
F284	Alarm code signal of the first parallel program	RPEN1~RPEN8	4.10.14.1

Address	Signal Name	Symbol	Chapter Section
F285	The second parallel program alarm code signal	RPEN1~RPEN8	4.10.14.1
F286	The third parallel program alarm code signal	RPEN1~RPEN8	4.10.14.1
F287	The fourth parallel program alarm code signal	RPEN1~RPEN8	4.10.14.1
F288.0~F288.3	Each parallel program tool function strobe signal	RTF1~RTF4	
F289.0~F289.3	Parallel program S auxiliary function strobe signal	RSF1~ RSF4	4.10.14.2
F290~F291	The first parallel program auxiliary M signal	RM11~RM116	4.10.14.2
F292~F293	The second parallel program auxiliary M signal	RM21~RM216	4.10.14.2
F294~F295	The third parallel program auxiliary M signal	RM31~RM316	4.10.14.2
F296~F297	The fourth parallel program auxiliary M signal	RM41~RM416	4.10.14.2
F300.0~F300.3	Additional axis mechanical zero point establishment signal	AZRF1~AZRF4	4.12.4.2
F301.0~F301.3	Additional axis mechanical zero return complete signal	AZP1~AZP4	4.12.4.1
F302.0	Additional axis page output signal	APE	4.12.1
F302.6	The additional axis synchronously waits for the M code execution signal	AWATO	4.12.3
F303	Additional axis position switch output signal	APSW1~APSW8	4.12.7
F304.0~F304.1	Additional axis stack 1 and 2 completion output signal	APFO1、APFO2	
F306.0~F306.3	Additional axis storage stroke detection positive alarm signal	AOTP1~ AOTP4	4.12.6
F307.0~F307.3	Additional axis storage stroke detection negative alarm signal	AOTN1~ AOTN4	4.12.6
F310~F311	Auxiliary functional code signal of PLC axis	AMbit00～AMbit15	4.12.15
F314 ~ F315	Additional axis 2M function code signal	AM2bit00～AM2 bit 15	4.12.16
F316 ~ F317	Additional axis 3M function code signal	AM3bit00～AM3 bit 15	4.12.16
F320.0	Additional auxiliary function strobe signal	AMF	4.12.16
F320.4	Additional axis 2M function strobe signal	AMF2	4.12.16
F320.5	Additional axis 3M function strobe signal	AMF3	4.12.16
F321.3	Additional axis allocation end signal	ADEN	4.12.17
F322.3	Additional axis single block detection signal	AMSBK	4.12.9.2
F323.0	Additional axis alarm signal	AAL	
F323.4	Additional axis feed Pause signal	ASPL	4.12.8
F323.5	Additional axis cycle start signal	ASTL	4.12.8
F323.7	Additional axis auto run signal	AOP	4.12.8
F324.0~F324.3	Signal in the additional axis torque control operation mode	ATOR1~ATOR4	
F325.0~F325.3	Additional axis torque control arrival signal	ATRQ1~ATRQ4	
F330.0~F330.3	Additional axis movement signal	AMV1~AMV4	
F331.0~F331.3	Additional axis movement direction signal	AMVD1~AMVD4	
F340~F347	Analog input data		
F351.0~F351.7	Axis torque speed value output signal	TRSO1~TRSO8	
F360~F363	1st spindle encoder output signal		