In this instruction manual, we will endeavor to describe various matters related to the operation of the GSK25iMc/GSK25iTc Series Bus-type Milling/Turning CNC System. 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 GSK25iMc/GSK25iTc Series Bus-type Milling/Turning CNC System.

This manual is the PLC Manual for GSK25iMc/GSK25iTc Series Bus-type Milling/Turning CNC System. This manual describes in detail the PLC programming and functions of the GSK25iMc/GSK25iTc Series Bus-type Milling/Turning CNC System.

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

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

Please read this instruction manual carefully before operation!

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!

Safety Warnings

Before installing, connecting, programming and operating the product, you must read the instruction manual of this product and the operating manual provided by the machine manufacturer in detail, and carry out the relevant operations in strict accordance with the requirements of the instruction manual and the operating manual of machine.

This manual contains safety precautions to protect the user and prevent damage to the machine. These precautions are divided into warnings and cautions according to the nature of the safety. Supplementary information is described as notes. Please read the warnings, cautions and notes carefully before operating the machine.

Warnings

Failure to follow the specified operating methods or steps may result in injury to the user or damage to the equipment.

Caution

Failure to follow the specified operating methods or steps may result in damage to the equipment.

Notes

Notes are used to indicate supplementary information in addition to warnings and cautions.

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. Consequently, contents not specifically described in this manual are considered unusable.

Caution

- 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 the 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.
- Please refer to the operating manual provided by the machine manufacturer for the function and meaning of keys on the machine panel.

Precautions

■ 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 damaged 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**

■ Servicing

- **Participants in repair must be competent professionals**
- **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 Safety Responsibilities

——**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 this manual.**

All specifications and designs are subject to change without prior notice.

This manual shall be kept by final users.

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

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PART I PROGRAMMING

PART II FUNCTIONS

APPENDIX

Part I Programming

Part I Programming

Chapter I Sequential Programming Process

1.1 GSK25iMc/GSK25iTc PLC specification

GSK25iMc/GSK25iTc PLC specifications are presented in Table 1-1.

Table 1-1

Specifications	GSK25iMc/GSK25iTc PLC
Programming language	Ladder diagram and command list
Program level	2
Execution cycle of Level 1 program	8ms
Average processing time of basic command	0.5(μs/step)
Program capacity	12,000 steps
Command	Basic command: 10 Function command: 49
Intermediate relay (R) Data register (D) Counter (C) Timer (T) Information display request signal (A) Holding relay (K) Jump label (L) Subprogram label (P)	1100 bytes (R0 to R1099) 1860 bytes (D0 to D1859) 400 bytes (C0 to C399) 100 200 bytes (T0 to T199) 100 32 bytes (A0 to A31) 32 bytes (K0 to K31) 9999 (L1～L9999) 512 (P1～P512)
Machine→PLC (X) PLC→Machine (Y) CNC→PLC(F) PLC→CNC(G)	128 bytes (X0 to X127) 128 bytes (Y0 to Y127) 256 bytes (F0 to F255) 256 bytes (G0 to G255)

1.2 Concept of sequential program

The so-called sequential program refers to the logical control program of machines and related equipment.

After converting the program to a certain format, the CPU can decode and calculate it, and store the result in RAM. The CPU reads each command stored in the memory at a high speed and executes the program through arithmetic operation.

Programming of sequential program begins with the preparation of ladder diagram.

1.3 Allocate interfaces (Step 1)

After the control object is determined and the number of corresponding input/output signal points is calculated, the interfaces can be allocated.

When allocating interfaces, please refer to "Table 3-1 Address Distribution Table" in Chapter III of this volume.

1.4 Prepare ladder diagram (Step 2)

The control actions required by the machine are represented by the ladder diagram through the online editing of GSK 25iMc/GSK25iTc ladder diagram. Functions such as timer, counter, etc. that cannot be represented by relay symbols are represented by specified function commands.

The edited ladder diagram shall be converted into corresponding PLC command and saved.

1.5 Debug sequential program (Step 3)

Debugging of sequential program can be done in the following ways:

1) Debugging with simulator

Replace machine with simulator (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.

2) Debugging through actual operation

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

Chapter II Sequential Program

Because PLC sequential control is realized by online ladder diagram editing, it is not exactly the same as the general circuit working principle of relay. Therefore, the principle of sequential control shall be fully understood when designing PLC sequential program.

2.1 Execution process of sequential program

In the general relay control circuit, each relay can be operated simultaneously in time. Relay D and E can be operated simultaneously when Relay A is done, as illustrated in the figure below. In PLC sequential control, each relay can be operated in turn. When Relay A is operated, Relay D can be operated, followed by Relay E. That is, each relay is operated in the order shown in the ladder diagram (editing order), as shown in Figure 2-1 (a).

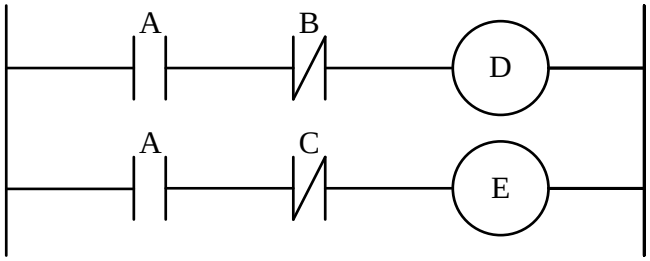


Figure 2-1 (a)

Figures 2-1 (b) and 2-1 (c) illustrate the difference between relay circuit and PLC program operation.

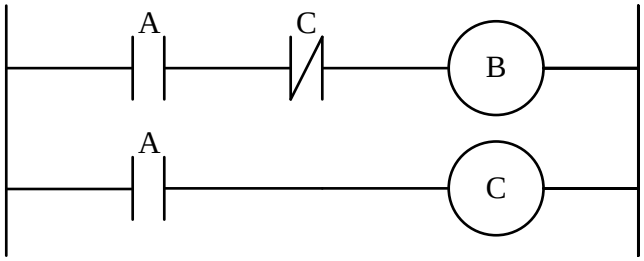


Figure 2-1 (b)

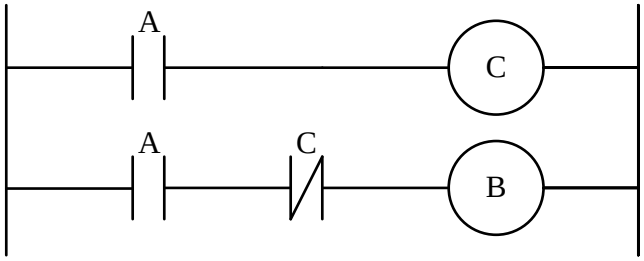


Figure 2-1 (c)

1) Relay circuit

A and B are operated as the same in Figure 2-1 (b) and Figure 2-1 (c). After A is on, B and C are on. After C is on, B is off.

2) GSK25iMc/GSK25iTc system PLC program

In Figure 2-1 (b), B and C are on after A is on, which is same as the relay circuit. B is off after a cycle of the PLC program. In Figure 2-1 (c), after A is on, C is on but B is not.

2.2 Loop execution

The PLC is executed from the beginning of the ladder diagram to its end. After the ladder diagram is finished, execution is restarted from the beginning of the ladder diagram. This is called loop execution.

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 is, the more responsive the signal will be.

2.3 Priority of execution (Level 1, Level 2)

GSK25iMc/GSK25iTc PLC program is divided into two parts: Level 1 program and Level 2 program. They do not coincide in the execution cycle.

Level 1 program is executed every 8ms. Short pulse signals requiring fast response can be processed. Such as: emergency stop, jump, over-travel, etc. END1 command can only be programmed when Level 1 program is not used, and this cannot be omitted.

Level 2 program is executed every 8×n ms. n is the number of splits in Level 2 program. At the beginning of Level 2 program, the PLC divides Level 2 program into n parts. Only one part is executed every 8ms.

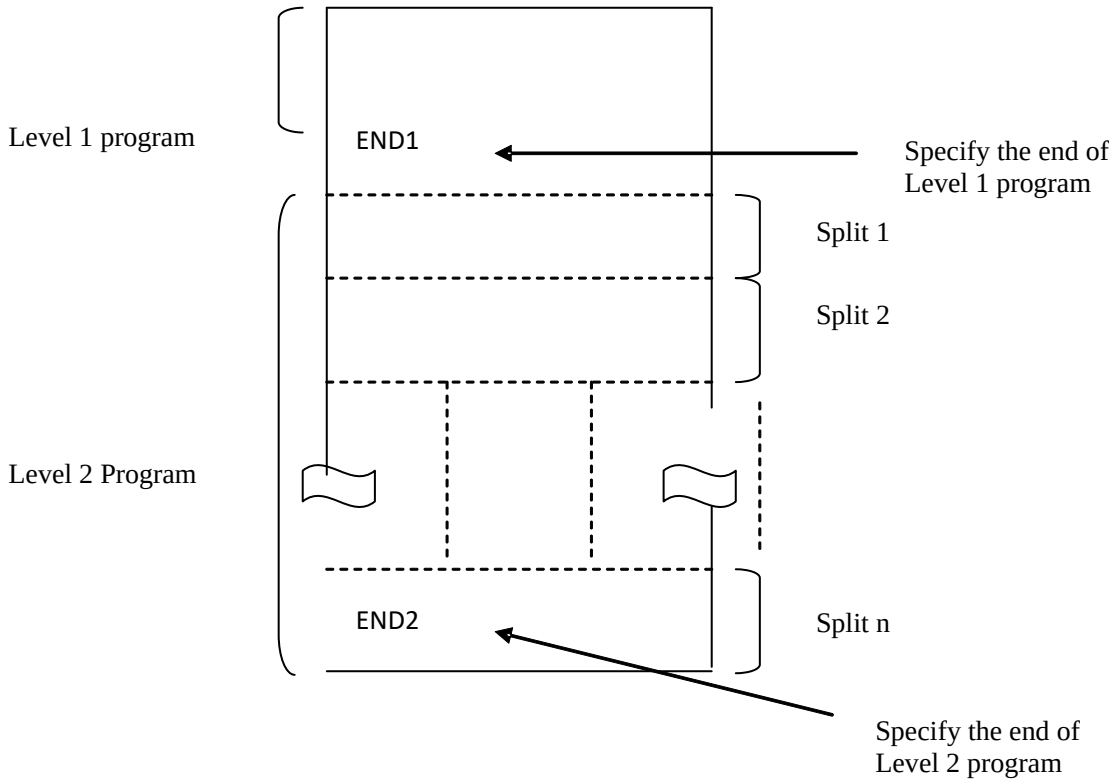


Figure 2-2

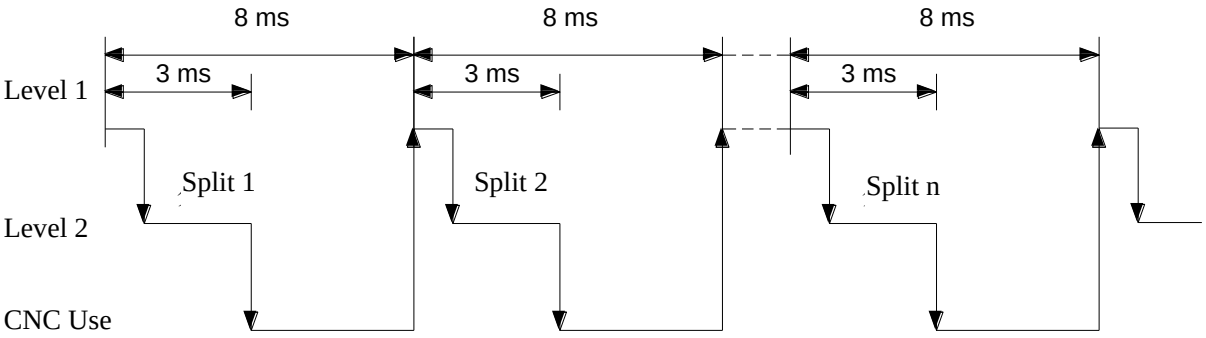


Figure 2-3

When Level 2 program with the last number of splits n is executed, the program is executed from the beginning. Thus, when the number of splits is n, the execution time of a cycle is 8×n ms. Level 1 program is executed every 8ms, while Level 2 program is executed every 8×n ms. If the steps of Level 1 program increase, the steps of Level 2 program will decrease correspondingly within 8ms, thus the number of splits will increase and the processing time of the whole program will become longer. Therefore, the commands of Level 1 program shall be as short as possible.

2.4 Structure of sequential program

In the traditional PLC, the ladder diagram language is used for preparation. A ladder diagram language that allows structured programming has the following advantages:

1. The program is easy to be understood and prepared.
2. Programming errors can be more easily found.
3. When a run error occurs, it is easy to identify the cause.

There are three main structured programming methods:

1) Subprogram

The subprogram uses ladder diagram as processing unit.

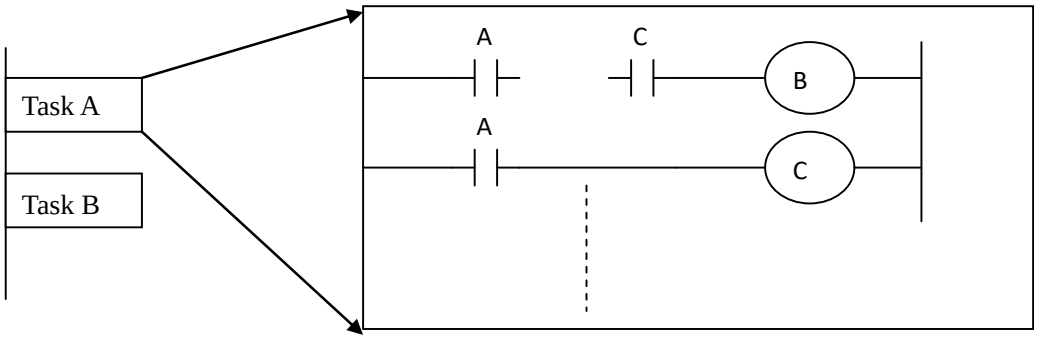


Figure 2-4

2) Nest

Subprogram can call other subprogram to complete the task.

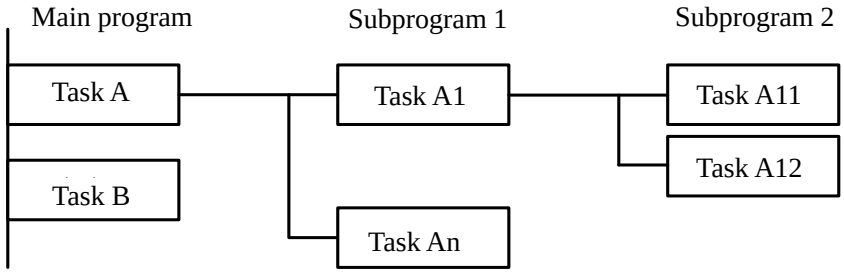


Figure 2-5

3) Conditional branch

The main program is executed in loops and detects whether conditions are met. If the conditions are met, appropriate subprogram will be executed. If the conditions are not met, corresponding subprogram will not execute.

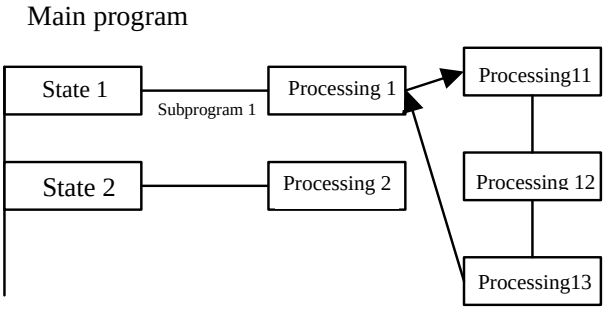


Figure 2-6

2.5 Processing of input/output signals

Input signal processing is shown in Figure 2-7.

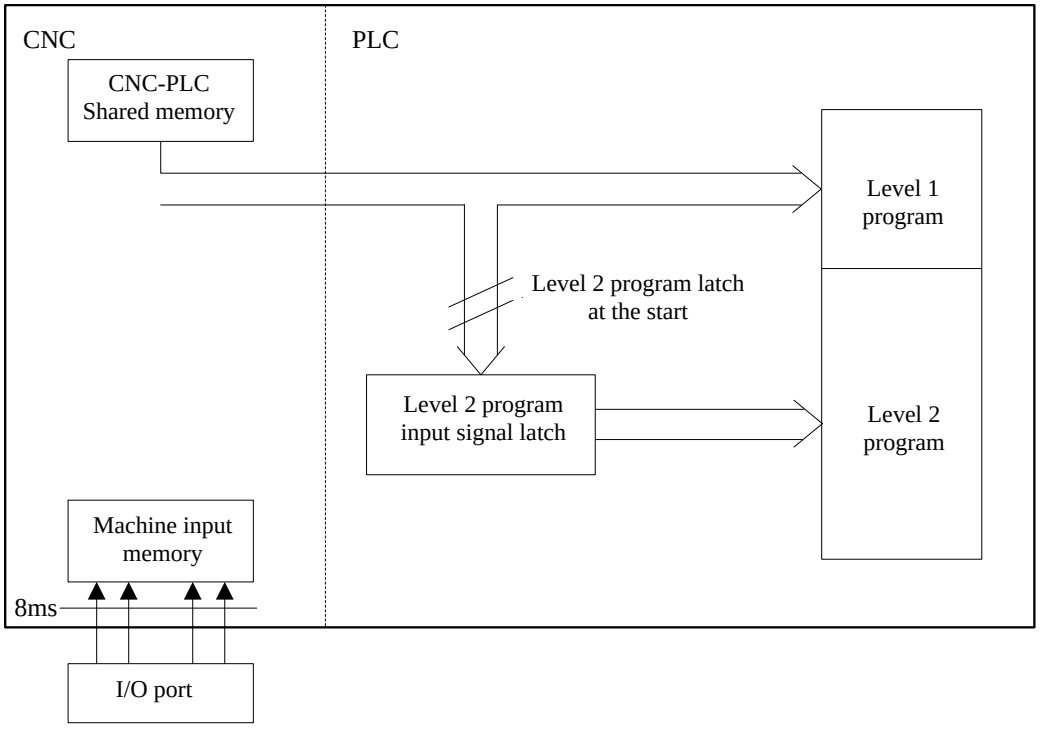


Figure 2-7

Output signal processing is shown in Figure 2-8.

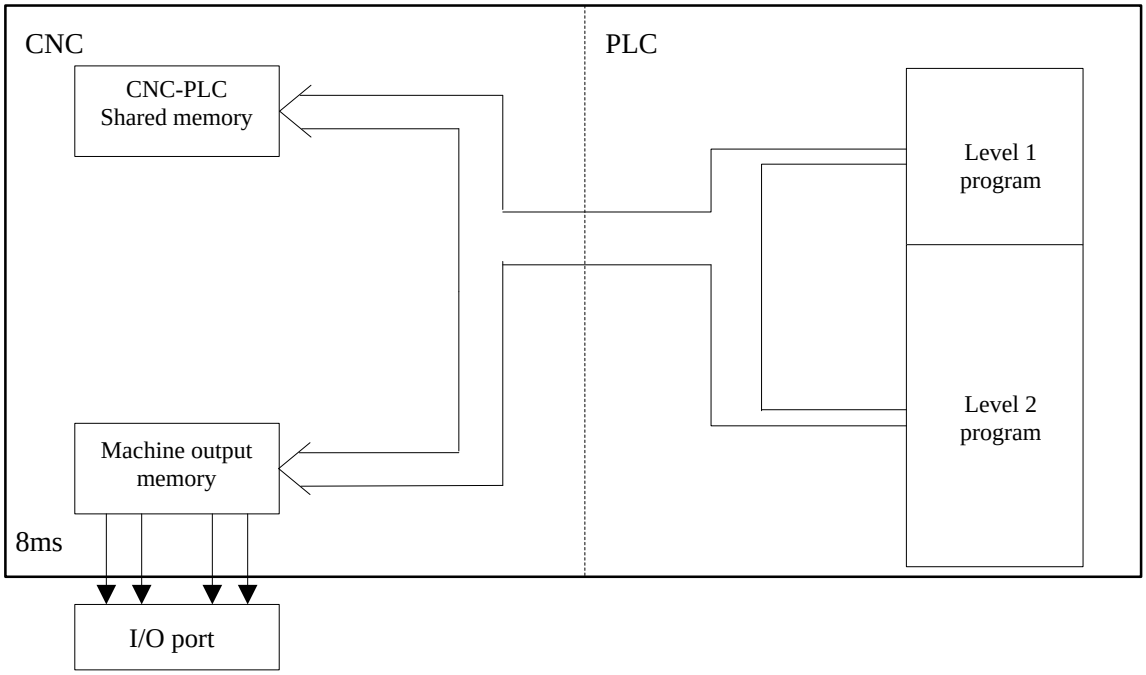


Figure 2-8

2.5.1 Input signal processing

(1) CNC input memory

The input signals from the CNC are stored in the CNC input memory and transferred to the PLC every 8ms. Level 1 program refers directly to the states of these signals and executes the corresponding processing.

(2) Machine input memory

The machine input memory scans and stores input signals from the machine every 8ms. Level 1 program also refers directly to the states of these signals and executes the corresponding processing.

(3) Level 2 program input latch

Level 2 program input signal latch is also known as Level 2 program synchronous input signal memory. The input signals stored therein are specially processed by Level 2 program. The signal state in this memory is synchronized with that of Level 2.

The signals in the CNC input memory and the machine input memory can be latched into the Level 2 program input latch only when execution of Level 2 program begins. And the signal state in this latch remains unchanged throughout the execution of Level 2 program.

2.5.2 Processing of output signal

(1) CNC output memory

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

(2) Machine output memory

The signals stored in the machine output memory are transferred to the machine every 8ms.

Note: The signal state of the CNC input memory, CNC output memory, machine input memory and machine output memory can be displayed by the self-diagnosis function. The diagnostic number is the address number in the sequential program.

2.5.3 Synchronous processing of short pulse signals

Level 1 program can be used to process short pulse signals. However, when the short pulse signal changes less than 8ms, that is, when the input signal state is likely to change during the execution of Level 1 program, the following problems arise.

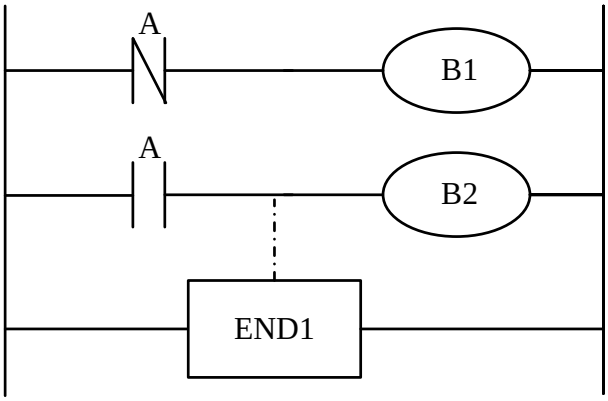


Figure 2-9

If A=0 at the beginning, A becomes 1 immediately after B1=1, then the execution of next ladder diagram leads to B2=1. This is where B1 and B2 are both 1 at the same time.

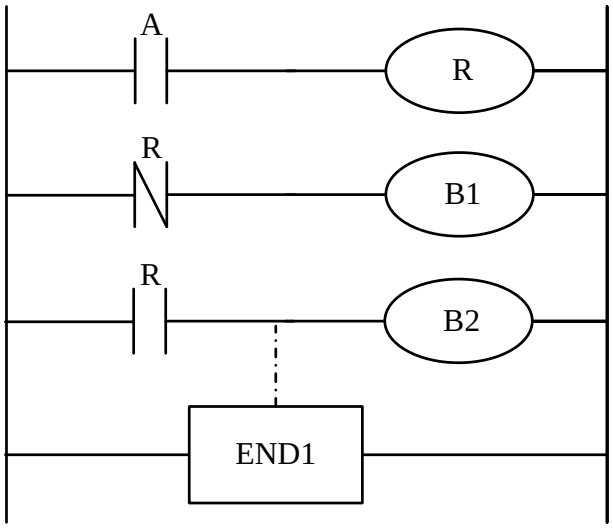


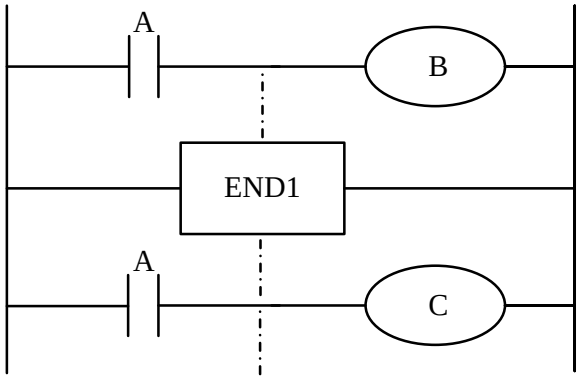
Figure 2-10

If Signal A is synchronized using Intermediate Relay R, B1 and B2 being 1 at the same time will not occur again.

2.5.4 Difference between signal states in Level 1 and Level 2 programs

The same input signal may also have different states in Level 1 program and Level 2 program. This is because different input memories are used in Level 1 program and Level 2 program. That is, the input signal used by Level 2 program is a latched input signal of Level 1 program. Thus, the signals in Level 2 program lag behind the input signals in Level 1 program. In the worst case, an execution cycle of Level 2 program can be delayed.

This shall be borne in mind when preparing the ladder diagram.



2nd split belonging to the Level 2 program

Figure 2-11

At the first 8ms, A=1 and Level 1 program is executed, B=1. And execution of Level 2 program starts to latch A=1 to Level 2 program, and the 1st split of Level 2 program is executed.

At the second 8ms, A becomes 0, Level 1 program is executed and B=0. The 2nd split of Level 2 program is then executed, but State A is still the same as State 1 at the time of the last latch. Thus C=1.

As such, the states of B and C are different.

2.6 Interlock

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

Necessary interlocking must be taken in the sequential control program. 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.

Chapter III Address

The address is used to distinguish signals. Different addresses correspond to input/output signals on the machine side, input/output signals on CNC side, internal relay, counter, timer, holding relay and datasheet. Each address consists of address number and bit number. The numbering rules are as below:

Address numbering rules:

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

X 0 0 0. 6

Type Address number Bit number

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

Address number: Decimal numbering, representing one byte.

Bit number: Octal numbering, 0~7 represents 0~7 bits of bytes represented by the preceding address number.

The address type in the GSK25iMc/GSK25iTc PLC is shown in Figure 3-1.

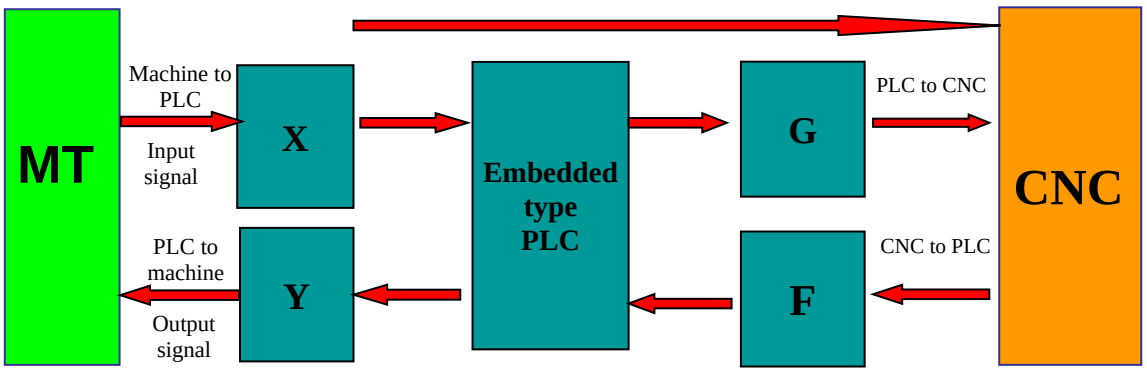


Figure 3-1

Table 3-1

Address	Address Description	Address Range
X	Machine→PLC (128 bytes)	X0～X127
Y	PLC→Machine (128 bytes)	Y0～Y127
F	CNC→PLC (256 bytes)	F0～F255
G	PLC→CNC (256 bytes)	G0～G255
R	Intermediate relay (1,100 bytes)	R0～R1099
D	Data register (1,860 bytes)	D0～D1859
C	Counter (400 bytes)	C0～C 399
T	Timer (200 bytes)	T0～T199
A	Information display request signal (32 bytes)	A0～A31
K	Holding relay (32 bytes)	K0～K31

3.1 Address of Machine→PLC (X)

GSK25iMc/GSK25iTc X address of the PLC falls into three categories:

1. X address is assigned to the input port of the system I/O unit.

2. X address is assigned to the input key of machine operation panel of the system.

3. X address is assigned to the interfaces provided externally in the system, such as: spindle and MPG control signal input.

3.1.1 X address on the input port of the I/O unit

Address ranges from X9 to X119. Definition type: INT8U, totaling 111 bytes.

Signals for X address of these I/O ports can be defined by the user according to the actual situation to connect the machine and prepare the corresponding ladder diagram. For details about the definition of the input address, please refer to Part I of the *Installation and Commissioning Manual of GSK25iMc/GSK25iTc Series Bus-type Milling/Turning CNC System*.

3.1.2 X address on the machine operation panel

Address ranges from X0 to X8, totaling 9 bytes. These X addresses correspond to key inputs on the machine operation panel one to one.

Their correspondence to standard panel keys is shown in Table 3-2.

Table 3-2

Operation Panel Key Input	PLC Address	Operation Panel Key Input	PLC Address
Auto mode	X0.0	-Z	X3.5
Editing mode	X0.1	-4	X3.6
Enter mode	X0.2	-5	X3.7
Manual mode	X0.3	Turn counter-clockwise	X4.0
MPG mode	X0.4	Spindle stop	X4.1
Zeroing mode	X0.5	Turn clockwise	X4.2
DNC mode	X0.6	Spindle orientation	X4.3
MPG trial cutting	X0.7	F0 / 0.001	X4.4
Single block	X1.0	25% / 0.01	X4.5
Skip	X1.1	50% / 0.1	X4.6
Machine lock	X1.2	100% / 1	X4.7
Auxiliary lock	X1.3	Chip removal forward	X5.0
+4	X1.4	Chip removal reverse	X5.1
+Z	X1.5	Chip removal stop	X5.2
-Y	X1.6	Tool magazine forward	X5.3
+5	X1.7	Tool magazine back	X5.4
Dry run	X2.0	Tool changer	X5.5
Over-travel release	X2.1	Tool magazine counter-clockwise	X5.6
Optional stop	X2.2	Tool magazine return to zero	X5.7

Operation Panel Key Input	PLC Address	Operation Panel Key Input	PLC Address
Program restart	X2.3	Worktable loose/tight	X6.0
+X	X2.4	USR2	X6.1
Fast	X2.5	USR3	X6.2
Single-step	X2.6	USR1	X6.7
-X	X2.7	Feed hold	X6.4
Cooling	X3.0	Cycle start	X6.5
Lubricating	X3.1	Tool magazine clockwise	X6.6
Safety door	X3.2	Feed override, presenting 24th gear at maximum (no output light)	X7.0-X7.4
Work light	X3.3	Spindle override, presenting 16th gear at maximum (no output light)	X8.0-X8.3
+Y	X3.4	Emergency stop	X8.4

3.1.3 MPG signal input X address

Table 3-3

MPG Signal Input	PLC Address
HDC0_STP (MPG Emergency Stop Signal)	X121.0
HDC0_MX100 (MPG feed override)	X120.0
HDC0_MX10 (MPG feed override)	X120.1
HDC0_MX1 (MPG: feed override)	X120.2
HDC0_5 (Axis 5)	X120.3
HDC0_4 (Axis 4)	X120.4
HDC0_Z (Axis Z)	X120.5
HDC0_Y (Axis Y)	X120.6
HDC0_X (Axis X)	X120.7

3.2 Address of PLC→machine side (Y)

GSK25iMc/GSK25iTc Y address of the PLC falls into three categories:

1. X address is assigned to the output port of the system I/O unit.
2. Y address is assigned to each indicator on the machine operation panel of the system.
3. Y address is assigned to the indicator on the MPG of system.

3.2.1 Y address on the output port of the I/O unit

Address ranges from Y8 to Y119. Definition type: INT8U, totaling 112 bytes.

Signals for Y address of these I/O ports can be defined by the user according to the actual situation to connect the machine and prepare the corresponding ladder diagram. For details about the definition of the output address, please refer to Part I of the *Installation and Commissioning Manual of GSK25iMc/GSK25iTc Bus-type*

Milling/Turning CNC System.

3.2.2 Y address on the machine operation panel

Address ranges from Y0 to Y7, totaling 8 bytes. These Y addresses correspond to the indicators on the machine operation panel one to one, and their correspondence to each indicator is shown in Table 3-4.

Table 3-4

Operation Panel Output	PLC Address	Operation Panel Output	PLC Address
Automatic key indicator	Y0.0	-5 key indicator	Y3.7
Edit key indicator	Y0.1	Spindle counter-clockwise key indicator	Y4.0
Enter key indicator	Y0.2	Spindle stop key indicator	Y4.1
Manual key indicator	Y0.3	Spindle clockwise key indicator	Y4.2
MPG key indicator	Y0.4	Spindle orientation key indicator	Y4.3
Back-to-zero key indicator	Y0.5	F0/0.001 key indicator	Y4.4
DNC key indicator	Y0.6	25%/0.01 key indicator	Y4.5
USER1 key indicator	Y0.7	50%/0.1 key indicator	Y4.6
Single block key indicator	Y1.0	100%/1 key indicator	Y4.7
Skip key indicator	Y1.1	Chip removal forward	Y5.0
Machine lock key indicator	Y1.2	Chip removal reverse	Y5.1
Auxiliary lock key indicator	Y1.3	Chip removal stop	Y5.2
+4 key indicator	Y1.4	Tool magazine forward key indicator	Y5.3
+Z key indicator	Y1.5	Tool magazine back key indicator	Y5.4
-Y key indicator	Y1.6	Tool changer key indicator	Y5.5
+5 key indicator	Y1.7	Tool magazine counter-clockwise key indicator	Y5.6
Dry run key indicator	Y2.0	Tool magazine back-to-zero key indicator	Y5.7
Over-travel release key indicator	Y2.1	Tool releasing/clamping key indicator	Y6.0
Optional stop key indicator	Y2.2	USR2 key indicator	Y6.1
Program restart key indicator	Y2.3	USR3 key indicator	Y6.2
+X key indicator	Y2.4	USR1 key indicator	Y6.7
Quick key indicator	Y2.5	Feed hold key indicator	Y6.4
Single step key indicator	Y2.6	Cyclic start key indicator	Y6.5
-X key indicator	Y2.7	Tool magazine clockwise key indicator	Y6.6
Cooling key indicator	Y3.0	X-axis reference point indicator	Y7.0

Lubricating key indicator	Y3.1	Y-axis reference point indicator	Y7.1
Safety door	Y3.2	Z-axis reference point indicator	Y7.2
Work light key indicator	Y3.3	Axis 4 reference point indicator	Y7.3
+Y key indicator	Y3.4	5-axis reference point indicator light	Y7.4
-Z key indicator	Y3.5	System alarming	Y7.6
-4 key indicator	Y3.6		

3.2.3 MPG signal light output

MPG signal light output	Y120.0

3.3 Address of PLC→CNC (G)

Address ranges from G0 to G255. Definition type: INT8U, totaling 256 bytes. G address is a signal from PLC to CNC. These signals have been defined in the CNC system design and cannot be modified. See Appendix I for details.

3.4 Address of CNC→PLC (F)

Address ranges from F0 to F255. Definition type: INT8U, totaling 256 bytes. F address is a signal from CNC to PLC. These signals have been defined in the CNC system design and cannot be modified. See Appendix I for details.

3.5 Intermediate relay address (R)

This address area is cleared when the system is powered on.
Definition type: INT8U, totaling 1,100 bytes.

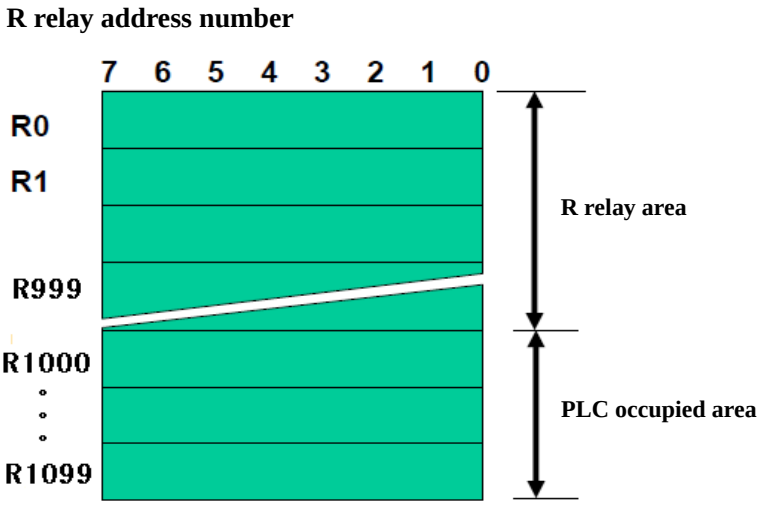


Figure 3-2

Notes: PLC occupied area starts with R1000. Such as: ADDB, SUBB function command operation result output register:

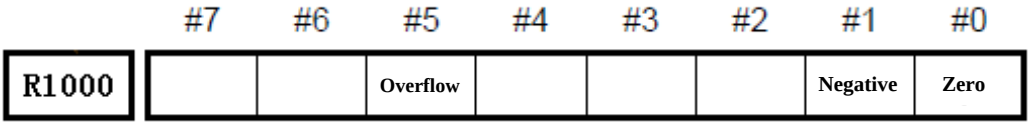


Figure 3-3

3.6 Holding relay address (K)

This address area is used as a holding relay and to set PLC parameters. This area is a nonvolatile storage area. The contents of the memory will not be lost even if the system is powered down.

Definition type: INT8U, totaling 32 bytes.

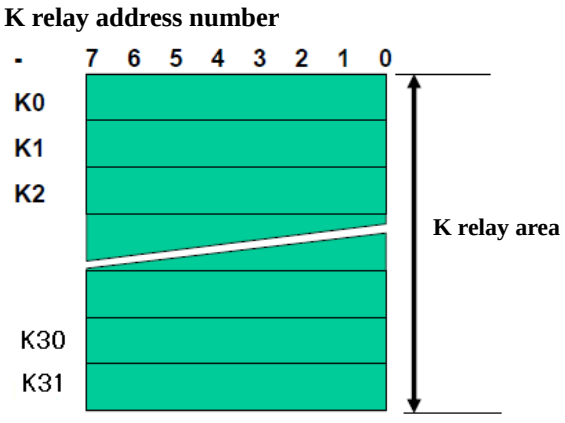


Figure 3-4

3.7 Message selection display address (A)

This address area is cleared when the system is powered on.

Definition type: INT8U, totaling 32 bytes.

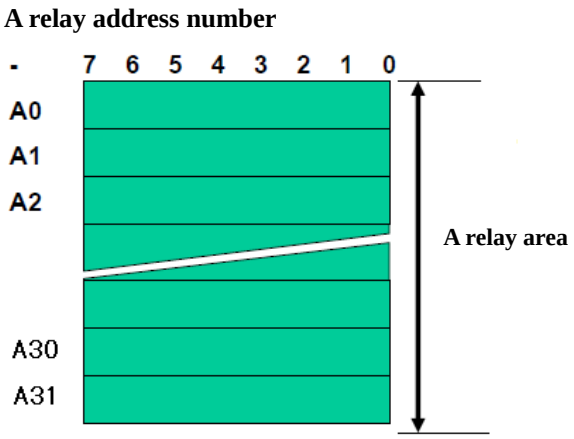


Figure 3-5

3.8 Counter address (C)

This address area is used to store the current value of the counter.

Definition type: Totaling 400 bytes.

C1~C100: The counting range is 0~65,535, and increase/decrease counting can be set, with counting value protection in power-down mode.

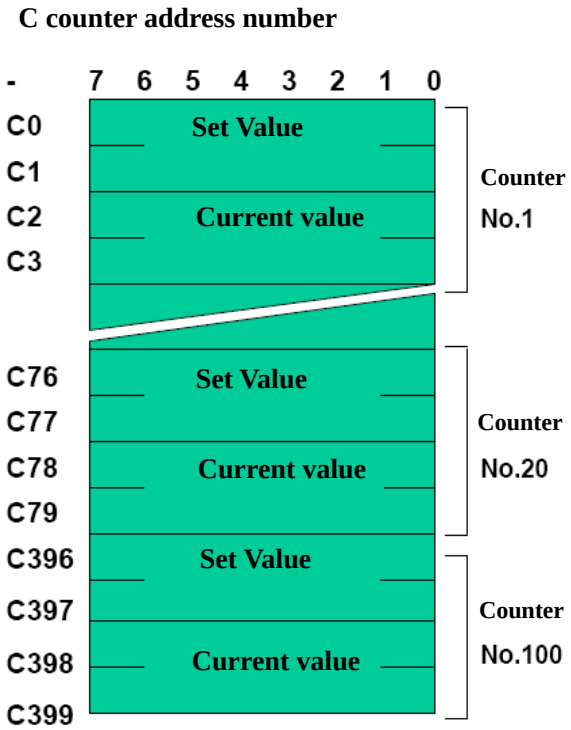


Figure 3-6

3.9 Timer address (T)

Definition type: Totaling 200 bytes.

T1~T100, timing value is stored in power-down mode.

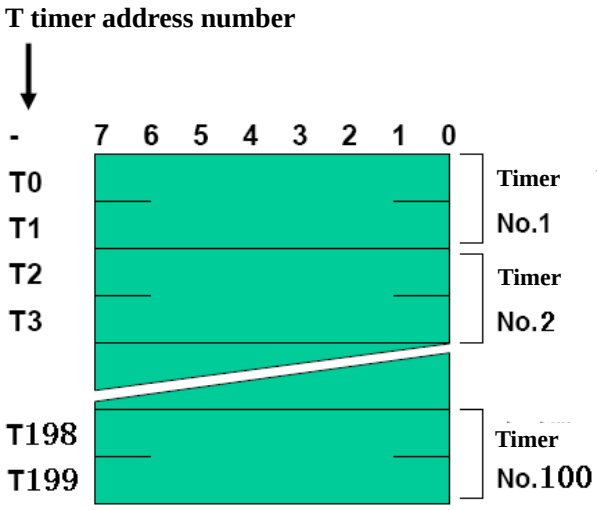


Figure 3-7

3.10 Data sheet address (D)

Each data register is 8-bit. Two consecutive data registers can store 16-bit data, while four consecutive data registers can store 32-bit data.

Even if the system is powered down, the contents of the memory will not be lost.

Number of data sheets: D0~D1,859, totaling 1,860 bytes.

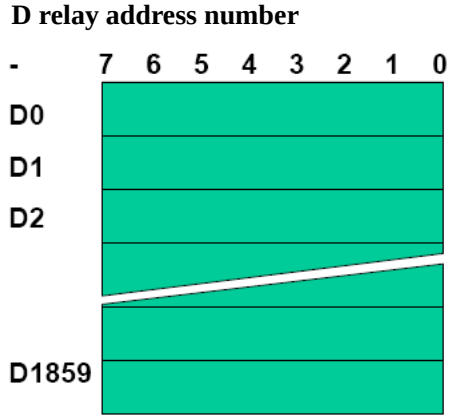


Figure 3-8

3.11 Tag address (L)

It is used to specify the jump target label in JMPB and JMPC commands and the label of LBL command.

Range: L0~L9999.

3.12 Subprogram number (P)

It is used to specify the target subprogram number called in CALL and CALLU commands and the subprogram number of SP command.

Range: P0~P511.

Chapter IV Basic Commands of PLC

The design of sequential program begins with the ladder diagram preparation. The ladder diagram consists of relay contact and function command. The logical relationship represented in the ladder diagram constitute a sequential program. There are two ways to input sequential program: one is to use mnemonic languages (PLC command code of LD, AND and OR); the other is to use a ladder diagram format for editing without understanding the PLC command format.

In fact, even if the sequential program is input by the ladder diagram method, it is converted into the corresponding PLC command in the system.

Basic commands are the most commonly used when designing the sequential program. They perform one-bit operation.

The basic function command codes for GSK25iMc/GSK25iTc are presented in Table 4-1.

Table 4-1

Command Name	Function
LD	Shift the contents of the register by 1 bit to the left and set the signal state of the specified address to ST0
LDI	Shift the contents of the register by 1 bit to the left and set the signal state of the specified address to non-ST0
OUT	Output the result of the logical operation to the specified address
OUTI	Output the result of the logical operation to the specified address after it has been negated
AND	Logic AND
ANI	Logic AND after the specified state has been negated
OR	Logic OR
ORI	Logic OR after the specified state has been negated
ORB	After the logic OR of ST0 and ST1, the stack register is shifted by one bit to the right
ANB	After the logic AND of ST0 and ST1, the stack register is shifted by one bit to the right
SET	The Signal Logic OR Back in ST0 and the specified address returns the result to the specified address
RST	The ST0 state is inverted, and the Signal Logic AND Back in the specified address returns the result to the specified address

4.1 LD, LDI, OUT, OUTI commands

Mnemonic symbols and functions are presented in Table 4-2.

Table 4-2

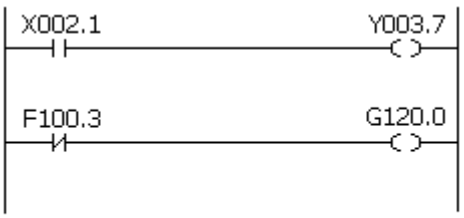
Mnemonic Symbol	Function
LD	Shift the contents of the register by 1 bit to the left and set the signal state of the specified address to ST0

LDI	Shift the contents of the register by 1 bit to the left and set the signal state of the specified address to non-ST0
OUT	Output the result of the logical operation to the specified address
OUTI	Output the result of the logical operation to the specified address after it has been negated

Command description

- OUT and OUTI commands are used to drive coils for output and internal relays. They cannot be used for input relay.
- Parallel OUTI command can be used multiple times consecutively.

Such as programming




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

4.2 AND and ANI commands

Mnemonic symbols and functions are presented in Table 4-3.

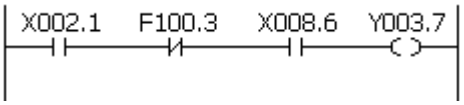
Table 4-3

Mnemonic Symbol	Function
AND	Logic AND
ANI	Logic AND after the specified state has been negated

Command description

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

Such as programming




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

4.3 OR and ORI commands

Mnemonic symbols and functions are presented in Table 4-4.

Table 4-4

Mnemonic Symbol	Function
OR	Logic OR

ORI	Logic OR after the specified state has been negated

Command description

- 1 contact can be connected in parallel with OR and ORI commands.
- OR and ORI refer to a parallel connection with above-mentioned LD and LDI command steps from this command step.

Such as programming


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

4.4 ORB command

Mnemonic symbols and functions are presented in Table 4-5.

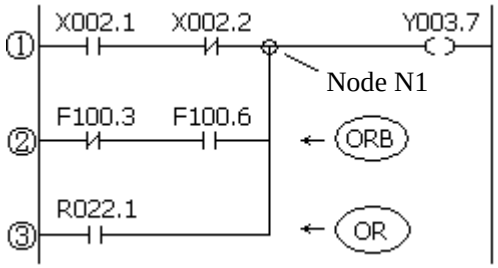
Table 4-5

Mnemonic Symbol	Function
ORB	After the logic OR of ST0 and ST1, the stack register is shifted by one bit to the right.

Command description

- ORB command is an independent command without address.

Such as programming




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

As shown in the figure, there are three branches including ①, ②, ③ from the left bus bar to the node N1, in which ① and ② are series circuit blocks. When there are series circuit blocks in parallel from the bus bar to the node or between nodes, the use of ORB command ends in the subsequent branches, except for the 1st branch. ③ is not a series circuit block, thus OR command is sufficient.

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

4.5 ANB command

Mnemonic symbols and functions are presented in Table 4-6.

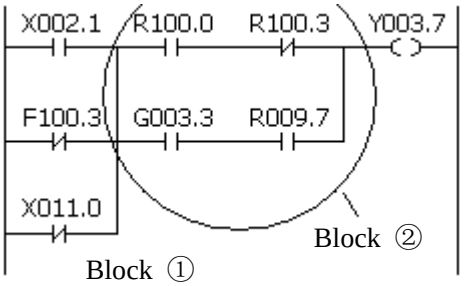
Table 4-6

Mnemonic Symbol	Function
ANB	After the logic AND of ST0 and ST1, the stack register is shifted by one bit to the right

Command description

- ANB command 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 commands. After the parallel circuit block is finished, ANB command is used to connect with the preceding circuit in series.
- ANB command is an independent command without address.

Such as programming




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

As shown in the ladder diagram and command list above:
(1) ORB means that the series circuit blocks in circuit block ② are connected in parallel;
(2) ANB represents the series connection of the circuit block ① and the circuit block ②.

4.6 SET and RST commands

Mnemonic symbols and functions are presented in Table 4-7.

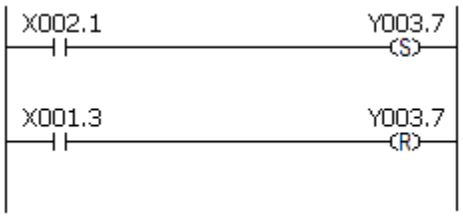
Table 4-7

Mnemonic Symbol	Function
SET	The Signal Logic OR Back in ST0 and the specified address returns the result to the specified address
RST	The ST0 state is inverted, and the Signal Logic AND Back in the specified address returns the result to the specified address

Command description

- SET command will output address setting 1 after the breakover condition is connected. Even if the breakover condition is disconnected after connection, it remains connection.
- RST command resets the output address to 0 after the breakover condition is turned on, and the address cannot be set when the reset condition is turned on.
- SET and RST commands can be used multiple times for the same output address, but the command executed finally is valid.

Such as programming




```
LD    X002.1
SET   Y003.7
LD    X001.3
RST   Y003.7
```

Chapter V Function Commands of PLC

Function command code can be used to simplify programming when it is difficult to program some actions of the machine with basic command code.

The PLC function command codes of GSK25iMc/GSK25iTc are shown in Table 5-1.

Table 5-1

S/N	Function Command	Function
0	END1	End of Level 1 sequential program
1	END2	End of Level 2sequential program
2	TMR	Timer
3	TMRB	Fixed timer
4	TMRC	Timer
5	DECB	Binary decoding
6	CTR	Counter
7	CTRC	Counter
8	ROTB	Binary rotation control
9	CODB	Binary code conversion
10	MOVE	Logic Multiply data transfer
11	MOVOR	Post logic OR data transfer
12	MOVB	One-byte data transfer
13	MOVW	Two-byte data transfer
14	MOVN	Arbitrary byte data transfer
15	PARI	Odd-even check
16	DCNVB	Extended data exchange
17	COMPB	Binary value comparison
18	COIN	Unanimous judgment
19	DSCHB	Binary data retrieval
20	XMOVB	Binary index data transfer
21	ADDB	Binary addition
22	SUBB	Binary subtraction
23	MULB	Binary multiplication
24	DIVB	Binary division
25	NUMEB	Define binary constants
26	DIFU	Rising edge detection

S/N	Function Command	Function
27	DIFD	Falling edge detection
28	SFT	Register shifting
29	EOR	Exclusive OR
30	AND	Logic AND
31	OR	Logic OR
32	NOT	Logic NOT
33	COM	Common line control
34	COME	End of common line control
35	JMP	Jump
36	JMPE	End of jump
37	CALL	Call subprogram
38	CALLU	Unconditionally call subprogram
39	JMPB	Label jump
40	JMPC	Label jump
41	LBL	Label
42	SP	Subprogram
43	SPE	End of subprogram
44	WINDR	Read CNC window data
45	WINDW	Write CNC window data
46	AXLCTL	PLC axis control
48	PSGNL	Position signal output
49	PSGN2	Position signal output 2

5.1 END1 (End of Level 1 sequential program)

Function:

It must be given once in a sequential program, either at the end of Level 1 program or at the beginning of Level 2 program when there is no Level 1 program. Level 1 program is mainly used to deal with emergency stop, jump and other actions requiring high-speed response.

Ladder diagram format:

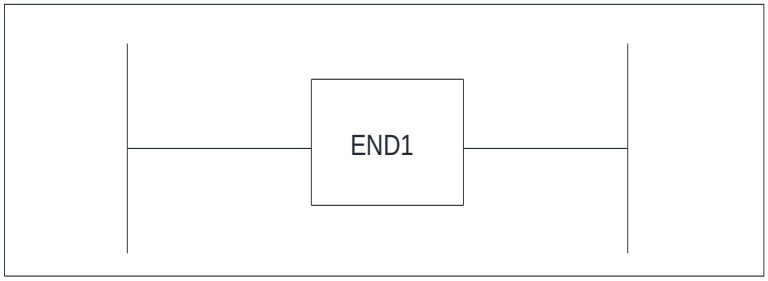


Figure 5-1

Command table format:

Table 5-2

S/N	Command	Operand	Notes
1	FUNC	0	End of Level 1 program

5.2 END2 (End of Level 2 sequential program)

Function:

Given at the end of Level 2 program.

Ladder diagram format:

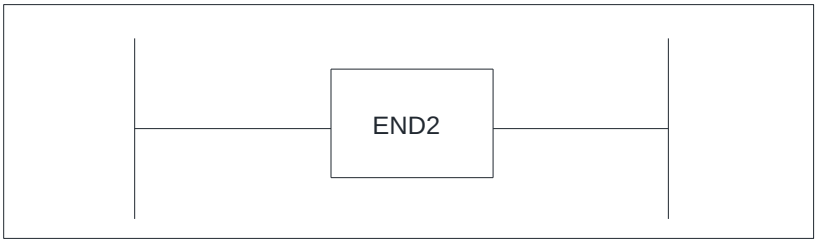


Figure 5-2

Command table:

Table 5-3

S/N	Command	Operand	Notes
1	FUNC	1	End of Level 2 program

Note: The ladder diagram after END2 can only be added to the subprograms beginning with SP and ending with SPE, otherwise an error will occur.

5.3 TMR (Timer)

Function:

Delay breakover timer.

Ladder diagram format:

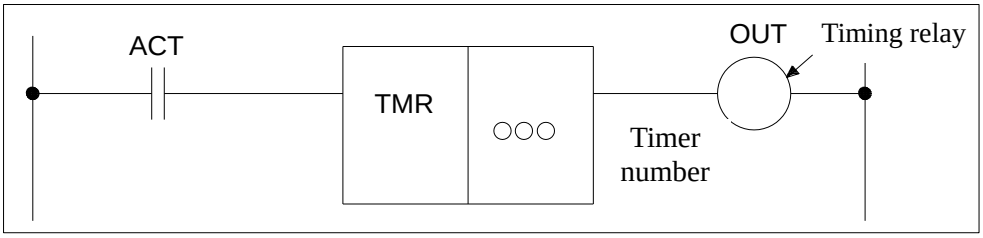


Figure 5-3

Command table format:

Table 5-4

S/N	Command	Operand	Notes
1	LD	○○○○. ○	Execution conditions
2	FUNC	2	Timer command TMR
3	PRM	○○○	Timer number
4	OUT	○○○○. ○	Timing relay

Control conditions:

ACT=0, turn off timing relay.

ACT=1, start TIMER and start timing.

The details are as follows:

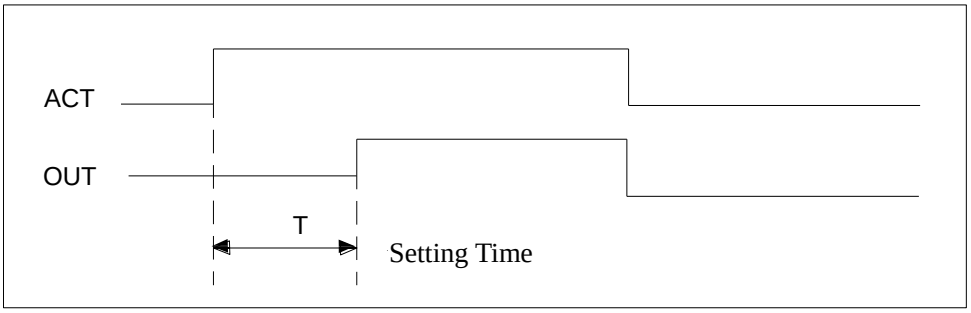


Figure 5-4

Parameters:

Timer number: It is represented in ○○○ and ○○○ is a number (1~100).

Output:

OUT Timing relay

OUT=1 ACT is broken over and reaches preset time, and timing relay is broken over, OUT=1.

OUT=0 ACT is not broken over or does not reach preset time, and timing relay is disconnected, OUT=0.

Setting timer:

The delay time set value for Timer TMR is 3,145,680ms in 48ms at maximum for Timer 1 to Timer 20, with the set value less than 48ms ignored. 524,280ms is set in 8ms at maximum for Timer 21 to Timer 100, with the set value less than 8ms ignored.

For example: To set the value of Timer 1 to 100ms, the actual value is 96ms after setting. Since 100=48×2+4, the remainder 4 is ignored.

5.4 TMRB (Fixed Timer)

Function:

This timer is used as a time-fixed delay breakover timer.

Ladder diagram format:

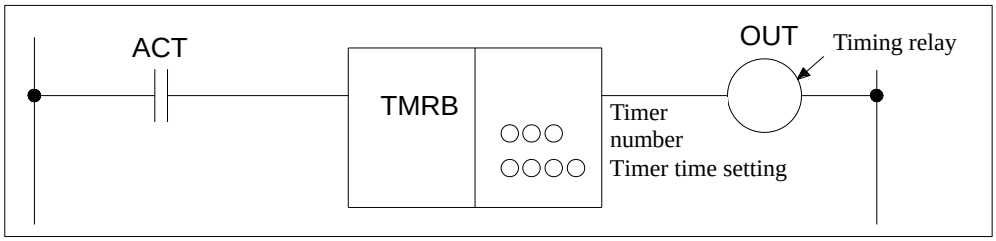


Figure 5-5

Command table format:

Table 5-5

S/N	Command	Operand	Notes
1	LD	○○○○.○	Execution conditions
2	FUNC	3	Fixed timer TMRB
3	PRM	○○○	Timer number
4	PRM	○○○○	Timing time
5	OUT	○○○○.○	Timing relay

Control conditions:

ACT=0: Turn off timing relay.

ACT=1: Start timer.

Parameters:

Timer number: Set the timing number of fixed timer (1~200).

Timing time setting: Preset time (delay time can be set from 8ms to 999999ms).

The preset time is in 8ms, with the remainder ignored. For example: If 38ms is set, 38=8*4+6, the remainder 6 is discarded, and the actual setting time is only 32ms.

Timing relay:

OUT Timing relay

OUT=1 ACT is broken over and reaches preset time, and timing relay is broken over, OUT=1.

OUT=0 ACT is not broken over or does not reach preset time, and timing relay is disconnected, OUT=0.

Note: The timer number of TMR corresponds to the timer parameter that modification can be set, and can be saved in power-off; the fixed timer number of TMRB is the timer parameter directly processed inside the system, and cannot be saved in power off or set for modification by users.

5.5 TMRC (Timer)

Function:

TMRC is a delay breakover timer that sets the timing time with address. The data type processed is binary data.

Ladder diagram format:

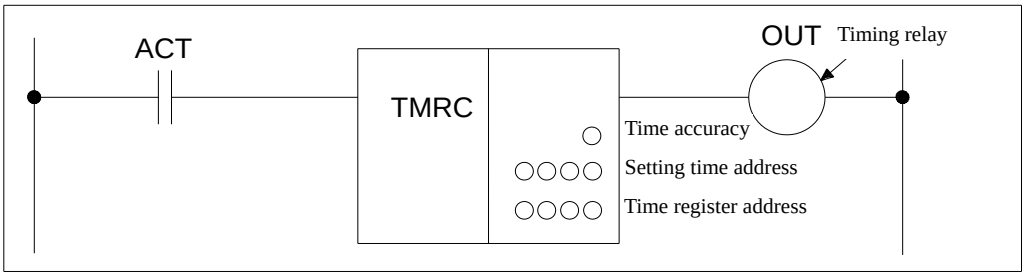


Figure 5-6

Command table format:

Table 5-6

S/N	Command	Operand	Notes
1	LD	○○○○.○	Execution conditions
2	FUNC	4	TMRC command
3	PRM	○	Timer Accuracy
4	PRM	○○○○	Timing time address
5	PRM	○○○○	Time register
6	OUT	○○○○.○	Timing relay

Control conditions:

ACT=0: Turn off timing relay.

ACT=1: Start timer.

Parameters:

Timer accuracy: Timer accuracy, parameter set value, and setting time range and errors are as follows:

Table 5-7

Timer Accuracy	Set Value	Setting Time	Timing Accuracy Error
8msec	0	8ms to 524,280ms	0 to ±8ms
48msec	1	48ms to 3,145,680ms	0 to ±8ms
1s	2	1s to 65,535s	0 to ±8ms

Set time address: Specify the first address of the time setting address.

Time register address: Specify the first address of R address for 4 consecutive bytes as the system operation area, for use by the timer in operation.

Timing relay:

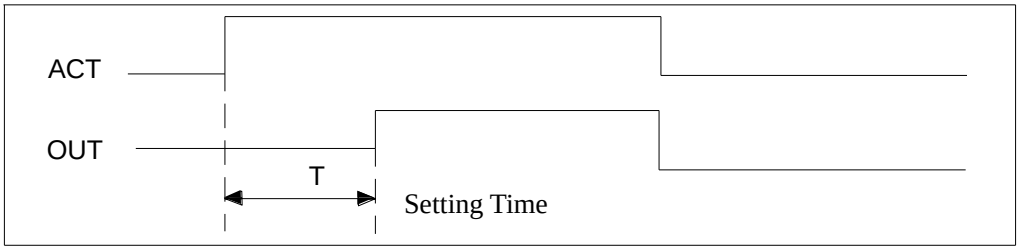


Figure 5-7

OUT Timing relay

OUT=1 ACT is broken over and reaches preset time, and timing relay is broken over, OUT=1.

OUT=0 ACT is not broken over or does not reach preset time, and timing relay is disconnected, OUT=0.

5.6 DECB (Binary decoding)

Function:

DECB can decode 1-byte, 2-byte and 4-byte binary code data. One of signified eight-bit consecutive data matches the code data, the corresponding output data bit is 1. In case of inconsistency, the output data is 0.

This command is used for data decoding of M or T Function.

Ladder diagram format:

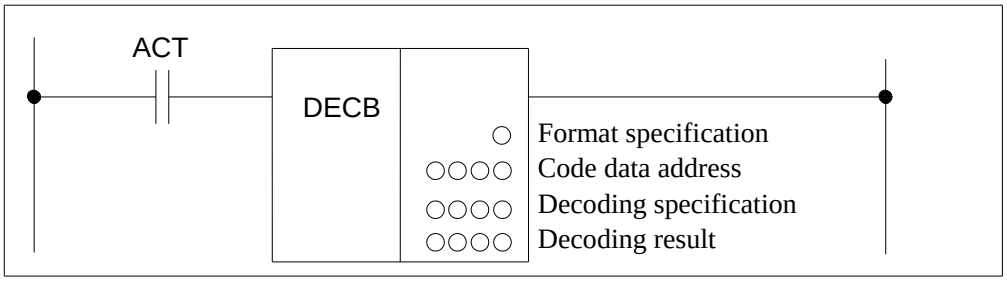


Figure 5-8

Control conditions:

ACT=0: Reset all output bits.

ACT=1: Decode the data and output the processing result to the decoded result data address.

Command table format:

Table 5-8

S/N	Command	Operand	Notes
1	LD	○○○○.○	Control conditions
2	FUNC	5	DECB
3	PRM	○	Format specification
4	PRM	○○○○	Code data address
5	PRM	○○○○	Decoding specification
6	PRM	○○○○	Decoding output address

Parameters:

Format specification: Set the size of the code data in the 1st bit data of the parameter.

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

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

0004: The code data is four-byte binary code data

Code data address: Giving the address of a storage code data.

Decoding specification: Specify the 1st code of the consecutive code to be decoded.

Decoding result address: Giving an address that accounts for the output decoding result of the specified byte. The decoding result of the decoding specified number is output to the corresponding bit of this address. The decoding result of the specified number +1 is output to 1 bit, and the rest can be done in the same manner for consecutive bits.

For example:

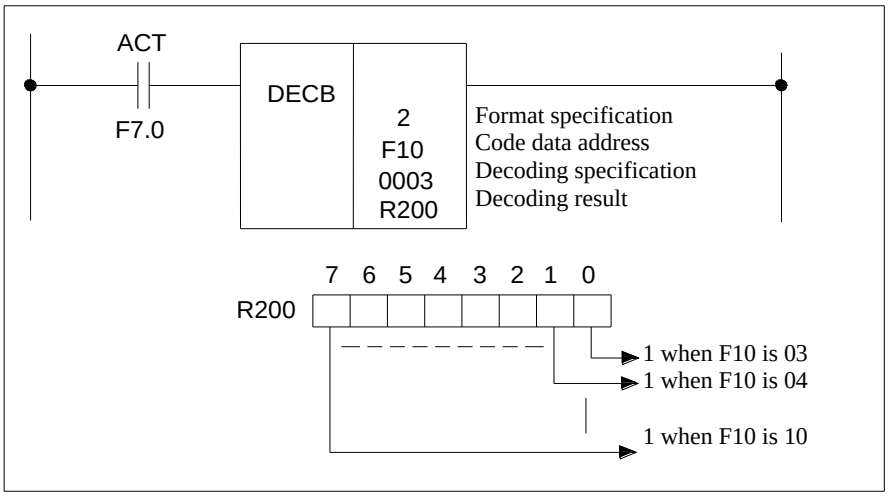


Figure 5-9

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

5.7 CTR (Counter)

Function:

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

1) Preset counter
   The counting value is preset, and the signal is output if the counting reaches the preset value.
2) Ring counter
   When the counter reaches the preset value, the counting signal is input, it is reset to the initial value and performs recounting.
3) Up/Down counter
   A reversible counter can be used for Up or Down.
4) Selection of initial value
   The initial value can be 0 or 1.

Ladder diagram format:

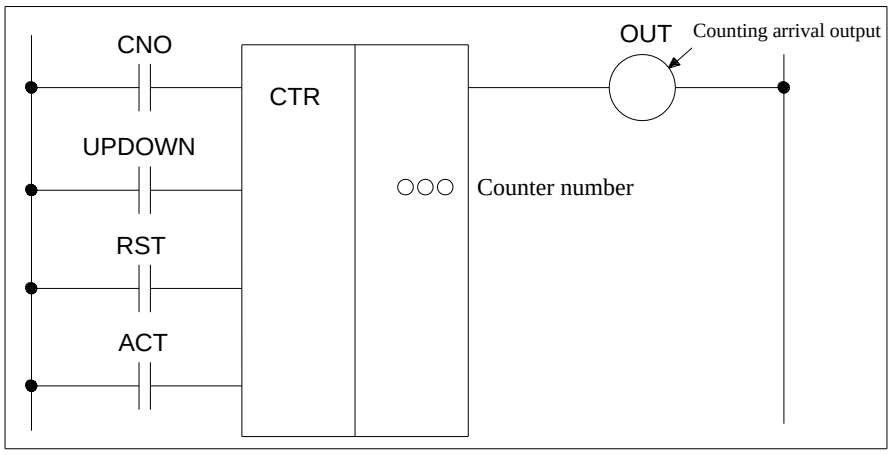


Figure 5-10

Command table format:

Table 5-9

S/N	Command	Operand	Notes
1	LD	○○○○.○	Specify initial value CN0
2	LD	○○○○.○	Specify the Up/Down Counter UPDOWN
3	LD	○○○○.○	Reset RST
4	LD	○○○○.○	Control conditions ACT
5	FUNC	6	Counting command CTR
6	PRM	○○○○	Counter number
7	OUT	○○○○.○	Counting arrival output

Control conditions:

CN0 Specify the initial value

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

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

UPDOWN Specify Up or Down Counter

UPDOWN=0 Up Counter (setting with initial value as CN0).

UPDOWN=1 Down Counter (initial value is counter preset).

RST Reset

RST=0 Dereset.

RST=1 Reset. OUT is reset to 0, and the counting value is reset to the initial value (it becomes 0 or 1 in Up Counting based on CN0 setting and becomes counter preset in Down Counting).

ACT counting signal

When ACT=1: Counting on ACT rising edge.

When ACT=0: Counter does not act, and OUT does not change.

Parameters:

Counter number: Specify the counter number, and the value is number (1~100).

Output:

OUT: When counting reaches output, maximum in Up Counting or minimum in Down Counting, OUT=1.

Note: The counter performs counting on the rising edge. If the counter number is repeated, its operation will be unpredictable.

Currently, the preset value of the counter is set in the [Counter] of [PLC Parameters] under the PLC interface.

5.8 CTRC (Counter)

Function:

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

1) Preset counter

The counting value is preset, and the signal is output if the counting reaches the preset value.

2) Ring counter

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

3) Up/Down counter

This is a reversible counter that can be used for Up or Down.

4） Selection of initial value

The initial value can be 0 or 1.

Format:

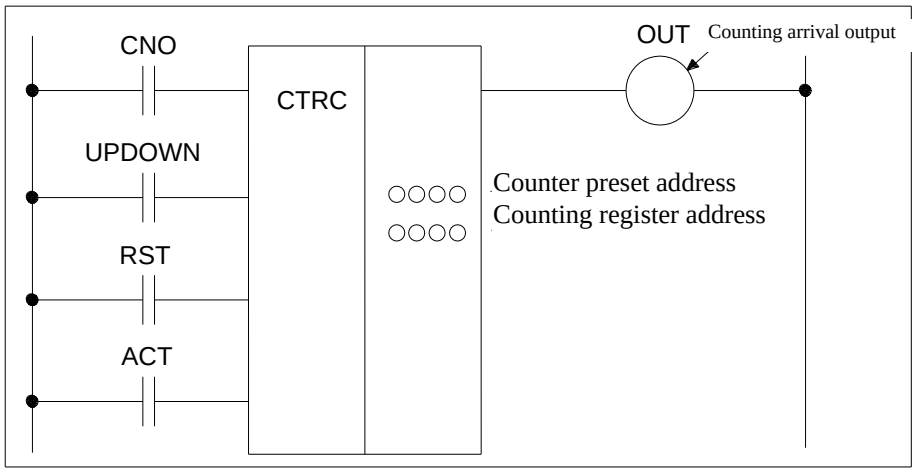


Figure 5-11

Command table format:

Table 5-10

S/N	Command	Operand	Notes
1	LD	○○○○.○	Specify initial value CN0
2	LD	○○○○.○	Specify the Up/Down Counter UPDOWN
3	LD	○○○○.○	Reset RST
4	LD	○○○○.○	Control conditions ACT
5	FUNC	7	Counting command CTRC
6	PRM	○○○○	Counter preset address
7	PRM	○○○○	Counter register address
8	OUT	○○○○.○	Counting arrival output

Control conditions:

CN0 Specify the initial value

CN0=0 The counter begins with 0.

CN0=1 The counter begins with 1.

UPDOWN Specify Up or Down Counter

UPDOWN=0 Up Counter.

UPDOWN=1 Down Counter.

RST Reset

RST=0 Dereset.

RST=1 Reset. OUT is reset to 0, and the counting value is reset to the initial value.

ACT counting signal

When ACT=1: Counting on ACT rising edge.

When ACT=0: Counter does not act, and OUT does not change.

Parameters:

Counter preset address: Set the 1st address of 2-byte counter preset value.

This area requires a memory space with 2 consecutive bytes that begins with the 1st address, typically using the D Address of data sheet, which is binary in value and ranges from 0 to 32,767.

Counter register address: The start address of the counting memory with 4 consecutive bytes is set, typically using the D Address of data sheet. The first two bytes are the cumulative values, and the latter two bytes are the system work areas.

> Caution
>
> When the R Address is used as the counter register address, the counter performs counting from 0 after power-on, and the counting value will not be saved after power-off.

Output:

OUT: When counting reaches output, maximum in Up Counting or minimum in Down Counting, OUT=1.

5.9 ROTB (Binary rotation control)

Function:

For rotary control, such as tool holder, rotary worktable, etc., the data processed by ROTB command is binary.

Control conditions:

CN0 Specify the initial position number of the revolving object.

CNO=0 The initial position begins with 0.

CNO=1 The initial position begins with 1.

DIR Whether the rotation direction is selected by the short path.

DIR=0 Not selected, the rotation direction is only forward.

DIR=1 Selected, the rotation direction is positive or negative according to the shortest path.

POS Specify operation conditions.

POS=0 Count the target location.

POS=1 Count the previous position of the target.

INC Specify the number of positions or steps.

INC=0 Count the number of positions. To calculate the previous position of the target one, command INC=0 and POS=1.

INC=1 Count the number of steps. To calculate the difference between the current position and the target position, the command INC=1 and POS=0.

ACT Execute command

When ACT= 0: No ROT command is executed, and OUT remains unchanged.

When ACT=1: ROT command is executed.

Ladder diagram format:

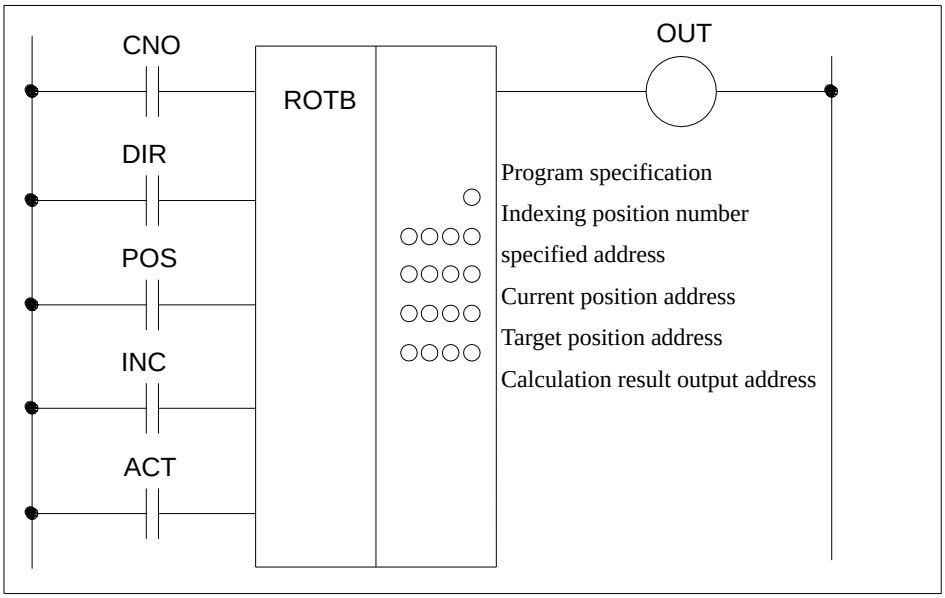


Figure 5-12

Command table format:

Table 5-11

S/N	Command	Operand	Notes
1	LD	○○○○.○	Specify start number CN0
2	LD	○○○○.○	Shortest path selection DIR
3	LD	○○○○.○	Specify operation condition POS
4	LD	○○○○.○	Calculate position or steps selection INC
5	LD	○○○○.○	Control conditions ACT
6	FUNC	8	Rotation control ROTB
7	PRM	○	Format specification
8	PRM	○○○○	Revolving object index address
9	PRM	○○○○	Current position address
10	PRM	○○○○	Target position address
11	PRM	○○○○	Calculation result output address
12	OUT	○○○○.○	Rotation direction output

Parameters:

Format specification: Specify the data length (1 byte, 2 bytes or 4 bytes).

1: 1 byte

2: 2 bytes

4: 4 bytes

Revolving object index address: Specify the target address of the revolving object index.

Current position address: Giving the address where the current position is stored.

Target position address: Specify the address (or command value) where the target position is stored. Such as the address of T code output from CNC.

Output address of calculation result: the output address of calculation result, calculating the number of steps to be rotated by the rotary table, and the number of steps to reach the target position or the previous position. Whether ACT is 1 shall be detected always when the calculation result is used.

Output:

OUT: Rotation direction output. The direction of the shortest path rotation is output to OUT. When OUT=0, the direction is Forward (FOR); when OUT=1, it is Reverse (REV). FOR and REV are defined in Figure 5-13, and the direction in which the position number of the rotary table is increased is Forward (FOR); otherwise, it is Reverse (REV).

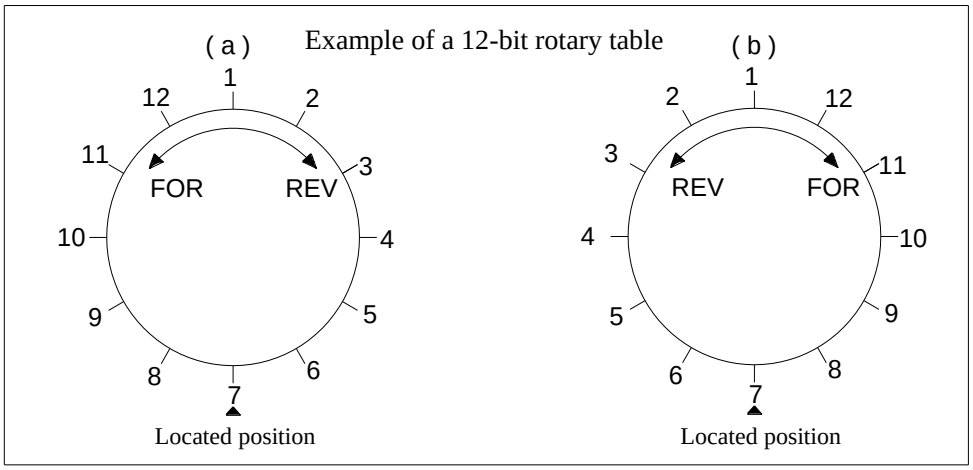


Figure 5-13

5.10 CODB (Binary code conversion)

Function:

It is used to convert binary data to 1-byte, 2-byte, or 4-byte binary data with 256 conversion tables at maximum.

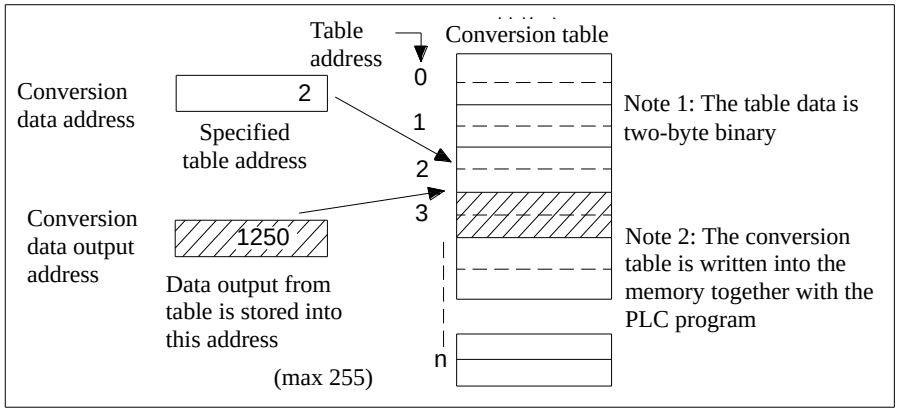


Figure 5-14

Ladder diagram format:

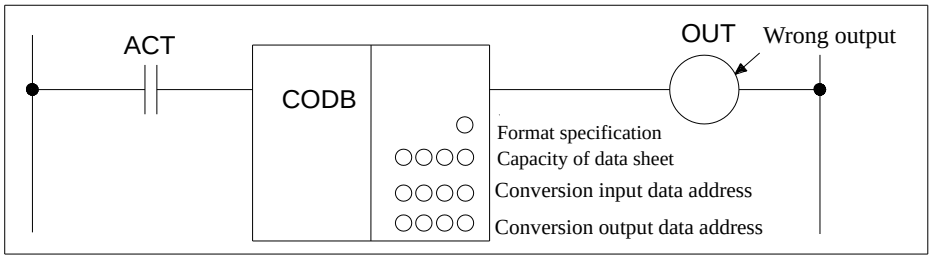


Figure 5-15

Command table format:

Table 5-12

S/N	Command	Operand	Notes
1	LD	○○○○.○	RST
2	LD	○○○○.○	ACT
3	FUNC	9	CODB
4	PRM	○	Format specification
5	PRM	○○○○	Capacity of data sheet
6	PRM	○○○○	Conversion data input address
7	PRM	○○○○	Conversion output data address
8	TABLE	○○○○	Table address 0 conversion data
9	:	:	
10	:	:	
n	OUT	○○○○.○	Wrong output

Control conditions:

RST Reset

RST=0: Not reset.

RST=1: Reset the wrong output OUT.

ACT Work command

ACT=0: Do not execute CODB command.

ACT=1: Execute CODB command.

Parameters:

Format specification: Specify the number of bytes of binary data converted from data in the conversion table.

1: 1 byte binary.

2: 2 bytes binary.

4: 4 bytes binary.

Capacity of data sheet: capacity of conversion table data (1-256).

Conversion data input address: The data in the conversion table can be taken out through specified table number whose address is called the input address of the conversion data. This address needs to provide one-byte memory.

Conversion data output address: The output address of the conversion data. The number of bytes of memory specified in the format specification begins with the specified address.

Output:

If an abnormality occurs while CODB command is executed, OUT=1, presenting an error.

5.11 MOVE (Logic multiply data transfer)

Function:

The logic multiplier is multiplied logically by the input data (AND), and the result is output to the specified address, and can be used to specify an octet signal in the address to exclude needless bits.

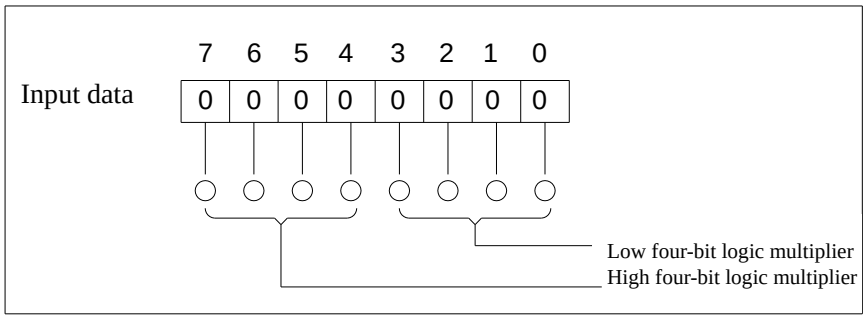


Figure 5-16

Ladder diagram format:

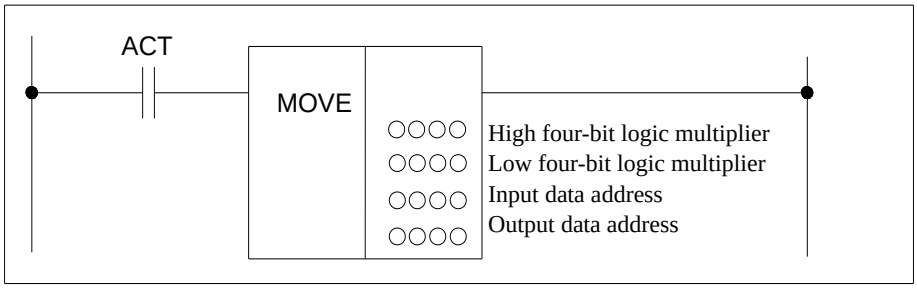


Figure 5-17

Command table format:

Table 5-13

S/N	Command	Operand	Notes
1	LD	○○○○.○	ACT
2	FUNC	10	MOVE
3	PRM	○○○○	High four-bit logic multiplier
4	PRM	○○○○	4^{th} bit logic multiplier
5	PRM	○○○○	Input data address
6	PRM	○○○○	Output data address

Control conditions:

ACT=0: Do not execute MOVE command.

ACT=1: Execute MOVE command.

Use example:

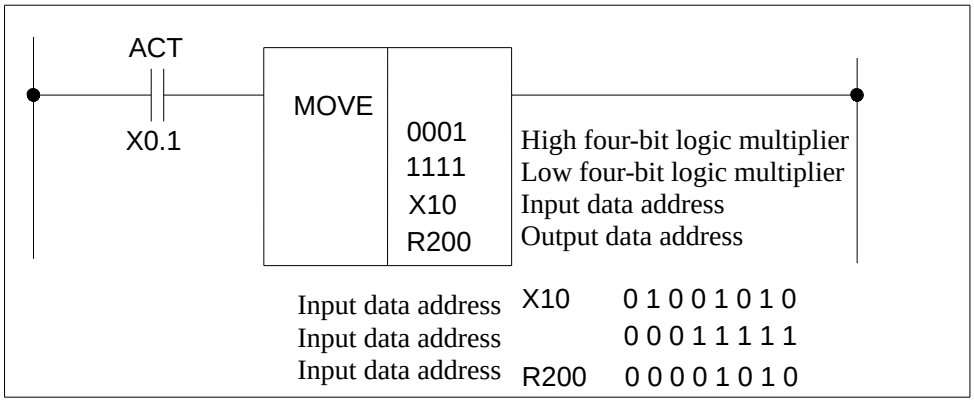


Figure 5-18

5.12 MOVOR (Logic or data transfer)

Function:

A logic or operation is performed on data of one byte specified by the input data address and data specified by the logic or data address, with the result of the operation written to the result output address.

Format:

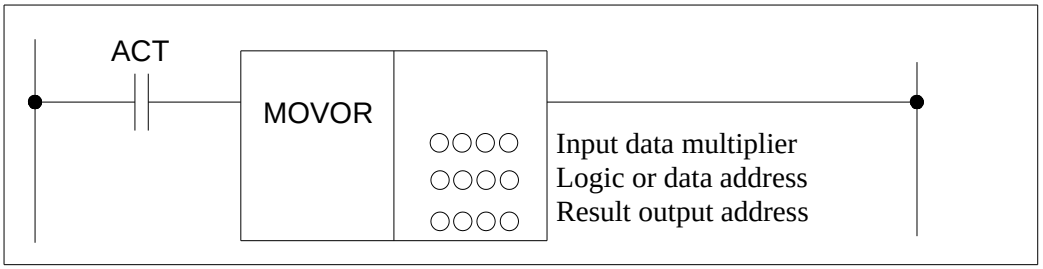


Figure 5-19

Command table format:

Table 5-14

S/N	Command	Operand	Notes
1	LD	○○○○.○	ACT
2	FUNC	11	MOVOR
3	PRM	○○○○	Input data address
4	PRM	○○○○	Logic or data address
5	PRM	○○○○	Output data address

Control conditions:

ACT=0: Do not execute MOVOR command.

ACT=1: Execute MOVOR command.

Parameters:

Input data address: Specify the address of input data.

Logic or data address: Specify the data address for logic or operation of the input data.

Result output address: The output address of the operation result.

5.13 MOVB (One-byte transfer)

Function:

This command transfers one-byte data from the outgoing address to the incoming address.

Ladder diagram format:

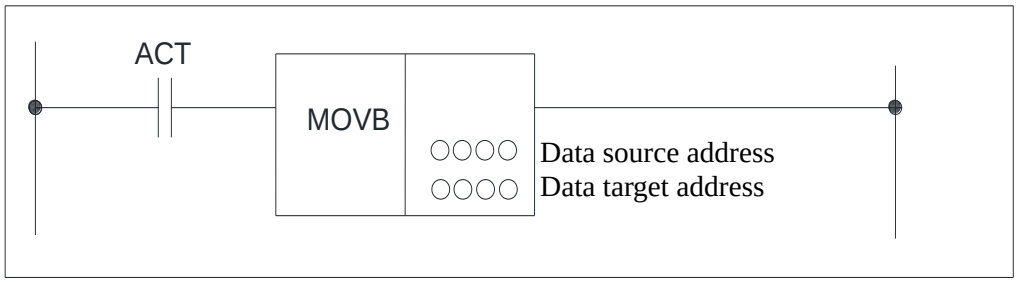


Figure 5-20

Command table format:

Table 5-15

S/N	Command	Operand	Notes
1	LD	○○○○.○	ACT
2	FUNC	12	MOVB
3	PRM	○○○○	Data source address
4	PRM	○○○○	Data target address

Control conditions:

ACT Execute command

ACT=0: Do not execute MOVB command, and do not transfer data.
ACT=1: Execute MOVB command, and transfer data.

Parameters:

Data source address: Specify the address of the outgoing data.
Data target address: Specify the address of the incoming data.

5.14 MOVW (Two-byte transfer)

Function:

This command transfers two-byte data from the outgoing address to the incoming address.

Ladder diagram format:

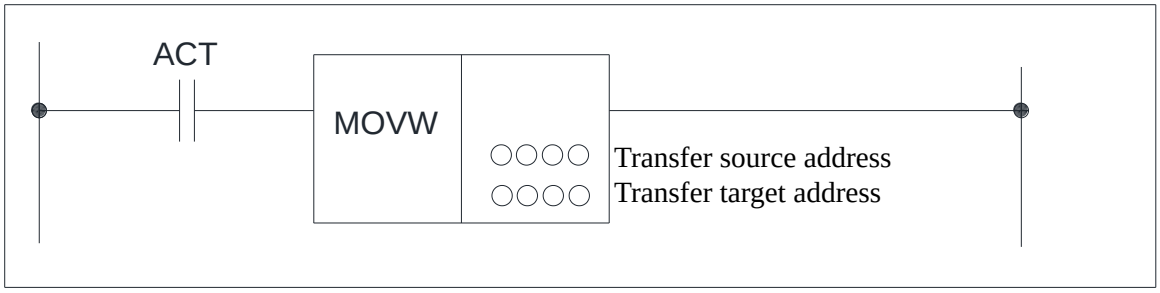


Figure 5-21

Command table format:

Table 5-16

S/N	Command	Operand	Notes
1	LD	○○○○.○	ACT
2	FUNC	13	MOVW
3	PRM	○○○○	Transfer source address
4	PRM	○○○○	Transfer target address

Control conditions:

ACT Execute command

ACT=0: Do not execute MOVW command, and do not transfer data.

ACT=1: Execute MOVW command, and transfer data.

Parameters:

Transfer source address: Specify the address of the outgoing data.

Transfer target address: Specify the address of the incoming data.

5.15 MOVN (Arbitrary byte data transfer)

Function:

This command transfers arbitrary byte data from the outgoing address to the incoming address.

Ladder diagram format:

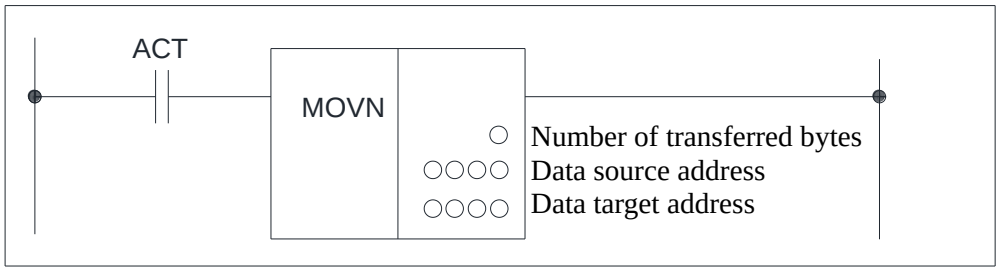


Figure 5-22

Command table format:

Table 5-17

S/N	Command	Operand	Notes
1	LD	○○○○.○	ACT
2	FUNC	14	MOVN
3	PRM	○	Number of transferred bytes
4	PRM	○○○○	Data source address
5	PRM	○○○○	Data target address

Control conditions:

ACT Execute command

ACT=0: Do not execute MOVN command, and do not transfer data.

ACT=1: Execute MOVN command, and transfer data.

Parameters:

Number of bytes transferred: Specify the number of bytes to transfer data (1~200).

Data source address: Specify the address of the outgoing data.

Data target address: Specify the address of the incoming data.

5.16 PARI (Odd-even check)

Function:

The odd-even parity checks are conducted on data or code signals, and an error will be output to the Relay position 1 when an abnormality is detected. It can specify whether to perform an odd parity or even parity check. It checks 1 byte (8 bits) data.

Ladder diagram format:

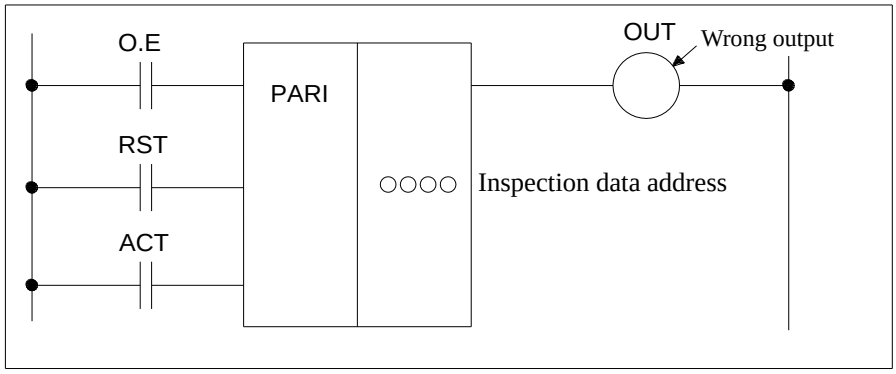


Figure 5-23

Command table format:

Table 5-18

S/N	Command	Operand	Notes
1	LD	○○○○.○	O.E
2	LD	○○○○.○	RST
3	LD	○○○○.○	ACT
4	FUNC	15	PARI
5	PRM	○○○○	Check data address
6	OUT	○○○○.○	Wrong output

Control conditions:

O.E Selection of odd-even check

O.E=0: Even check.

O.E=1: Odd check.

RST Reset

RST=0: Dereset.

RST=1: Reset wrong output coil OUT, that is, set RST=1 when OUT=1, then OUT=0.

ACT Execute command

ACT=0: Do not execute odd-even check, and do not change output.

ACT=1: Execute PARI command for odd-even check.

Output:

OUT=1 if the result is abnormal after the odd-even check (PARI) command is executed, that is, there is even number of Check Address Data Bit 1 in odd check or there is odd number of Check Address Data Bit 1 in even check.

5. 17 DCNVB (Extended data conversion)

Function:

1-byte, 2-byte or 4-byte binary code is converted to BCD code or BCD code is converted to binary code.

Ladder diagram format:

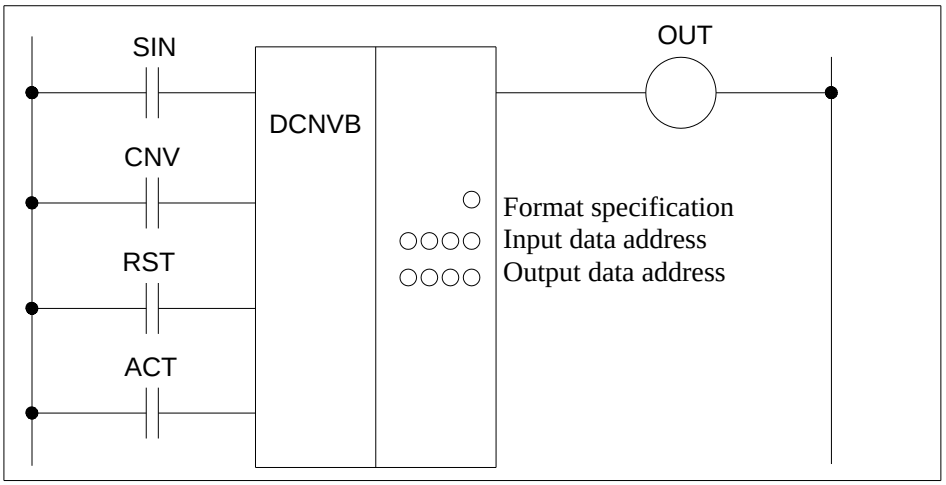


Figure 5-24

Command table format:

Table 5-19

S/N	Command	Operand	Notes
1	LD	○○○○.○	SIN
2	LD	○○○○.○	CNV
3	LD	○○○○.○	RST
4	LD	○○○○.○	ACT
5	FUNC	16	DCNVB
6	PRM	○	Format specification
7	PRM	○○○○	Input data address
8	PRM	○○○○	Conversion result data address
9	OUT	○○○○.○	Wrong output

Control conditions:

SIN Symbol for converted data

The symbol is used to represent the input of BCD code data, and SIN is meaningful only when BCD is converted to binary. When binary is converted to BCD, SIN is meaningless but cannot be omitted.

SIN=0: The input BCD code data is positive.

SIN=1: The input BCD code data is negative.

CNV Command data conversion type

CNV=0: Binary code is converted to BCD code.

CNV=1: BCD code is converted to binary code.

RST Reset

RST=0: Dereset.

RST=1: Reset wrong output coil OUT, that is, set RST=1 when OUT=1, then OUT=0.

ACT Execute command

ACT=0: Data is not converted, and OUT remains unchanged.

ACT=1: Data is converted.

Parameters:

Format specification: Specify the number of bytes of data.

1: 1 byte long.

2: 2 bytes long.

4: 4 bytes long.

Conversion data input address: The data in the conversion table can be taken out through specified table number whose address is called the input address of the conversion data. This address needs to provide one-byte memory.

Conversion data output address: The output address of the conversion data. The number of bytes of memory specified in the format specification begins with the specified address.

Wrong output (OUT**)**:

OUT=0: Normal.

OUT=1: Conversion error.

OUT=1 when the converted data shall be BCD data but is actually binary data, or when the binary data is converted to BCD data in excess of a pre-specified data size (byte length).

Operation result register R1000:

This register is set at the end of a data conversion, and when binary data is converted to BCD data, the bits have the meaning given in Figure 5-25.

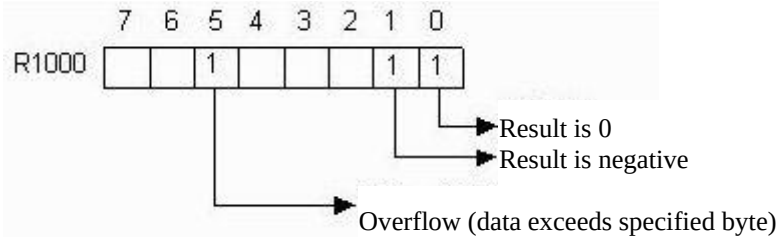


Figure 5-25

5. 18 COMPB (Binary number comparison)

Function:

The size of two binary data is compared, with the comparison result stored in the address of the comparison operation result. Executing COMPB command requires specification of enough bytes in the storage area to store the input data and the comparison data.

Ladder diagram format:

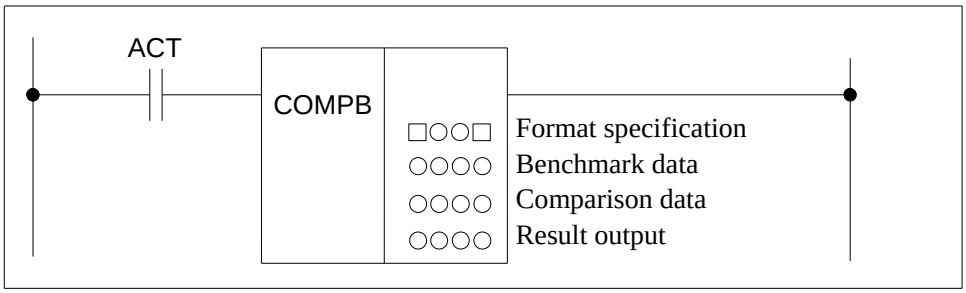


Figure 5-26

Command table format:

Table 5-20

S/N	Command	Operand	Notes
1	LD	○○○○.○	ACT
2	FUNC	17	COMPB
3	PRM	□○○□	Format specification
4	PRM	○○○○	Benchmark data
5	PRM	○○○○	Comparison data
6	PRM	○○○○	Result output address

Control conditions:

ACT=0: Do not execute COMPB command.

ACT=1: Execute COMPB command.

Parameters:

Format specification: Specified the form (constant or address) and data length (1-byte, 2-byte) of the benchmark data.

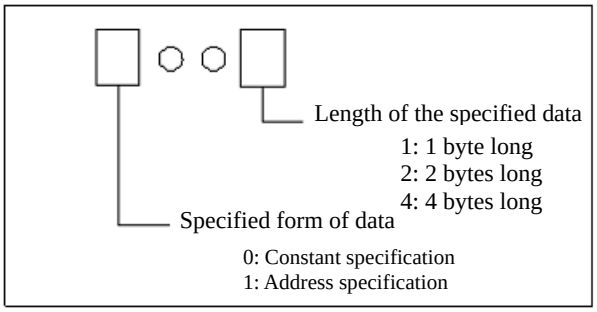


Figure 5-27

Benchmark data: Specify the benchmark data for comparison, and it can be a constant or an address depending on the format specification.

Comparison data: Specify the address of the comparison data.

Comparison result: Specify the output address of the comparison result, occupying one byte.

Comparison of operation result output address:

Comparison of result output address bit	Bit5	Bit2	Bit1	Bit0
Benchmark Data=Comparison Data	0	0	0	1
Benchmark Data>Comparison Data	0	0	1	0
Benchmark Data<Comparison Data	0	1	0	0
Data overflow	1	0	0	0

Figure 5-28

5.19 COIN (Consistency judgment)

Function:

The command determines whether the comparison data value is consistent with the benchmark data value and is applicable to binary data.

Ladder diagram format:

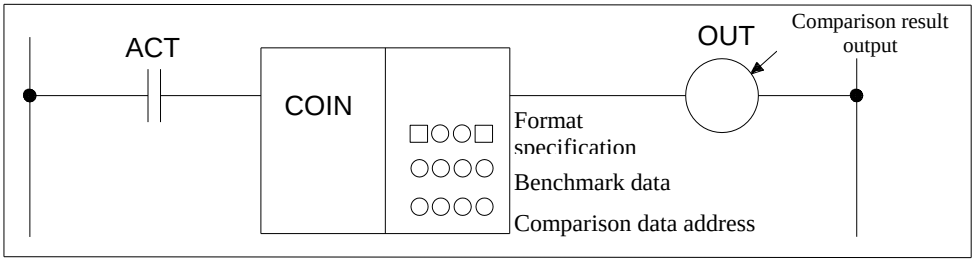


Figure 5-29

Command table format:

Table 5-21

S/N	Command	Operand	Notes
1	LD	○○○○.○	ACT
2	FUNC	18	COIN
3	PRM	□○○□	Format specification
4	PRM	○○○○	Benchmark data
5	PRM	○○○○	Comparison data
6	OUT	○○○○.○	Result output

Control conditions:

ACT Execute command

ACT=0: Do not execute, and OUT remains unchanged.

ACT=1: Execute the judgment command, and output the result to OUT command.

Parameters:

Benchmark data specification: Specified form (constant or address) and data length (1-byte, 2-byte) of the benchmark data.

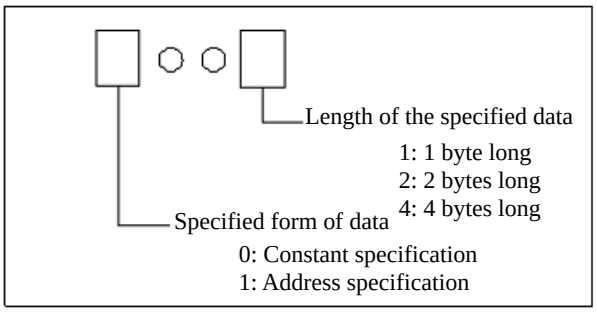


Figure 5-30

Benchmark data: Specify the benchmark data for comparison, and it can be a constant or an address depending on the format specification.

Comparison data: Specify the address of the comparison data.

Output:

OUT: OUT=0: Input value≠Comparison value.

OUT=1: Input value=Comparison value.

5.20 DSCHB (Binary data retrieval)

Function:

This function command is used to retrieve data from a data sheet. Execute the data specified by DSCHB command for retrieval in the data sheet and output the data sheet in-table number where the data is located in. If the specified data is not retrieved, OUT=1.

This command is applicable to binary data, and the number of data in the data sheet (sheet capacity) is specified by address.

Ladder diagram format:

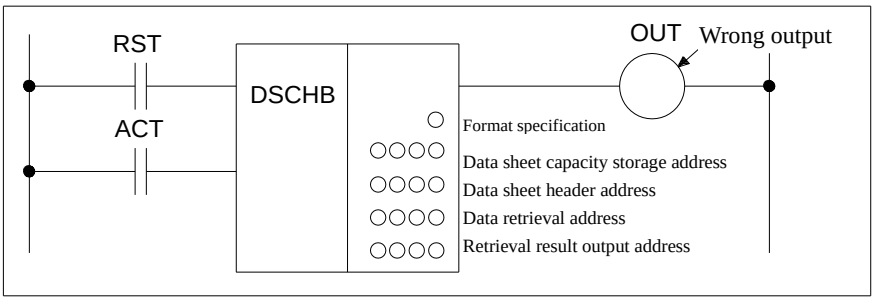


Figure 5-31

Command table format:

Table 5-22

S/N	Command	Operand	Notes
1	LD	○○○○.○	RST
2	LD	○○○○.○	ACT
3	FUNC	19	DSCHB
4	PRM	○	Format specification
5	PRM	○○○○	Data sheet capacity storage address
6	PRM	○○○○	Data sheet header address
7	PRM	○○○○	Data sheet retrieval address

8	PRM	○○○○	Retrieval result output address
9	OUT	○○○○.○	Wrong output

Control conditions:

RST Reset

RST=0: Dereset.

BYT=1: Reset, and retrieval result OUT is set to 0.

ACT Execute command

ACT=0: Do not execute retrieval command, and OUT remains unchanged.

ACT=1: Execute the retrieval command to store the in-table number of the data sheet where the retrieved data is located to the retrieval result output address. If the specified data is not found, OUT is set to 1.

Parameters:

Format specification: Specify the length of the retrieval data.

1: 1 byte long.

2: 2 bytes long.

4: 4 bytes long

Data sheet capacity address: Storage address of the number of data sheet data. The byte length specified by this address assigns the storage area of required bytes. The number of data sheet data is n+1 (0 in the header and n in the footer).

Data sheet header address: Set the data sheet header address. Header address must be D Address in the D Data Sheet.

Retrieval data address: Set the retrieval data input address.

Retrieval result output address: If the retrieved data is found, its in-table number will be output, and the in-table number is output to the retrieval result output address. The number of storage bytes required for this address shall conform to the specified format.

Output:

OUT=0, retrieved data is found.

OUT=1, retrieved data is not found.

5.21 XMOVB (Binary index data transfer)

Function:

This function command is used to read or overwrite data in the data sheet. The number of data (sheet capacity) in the data sheet is specified by address, and the data processed is in binary form.

Ladder diagram format:

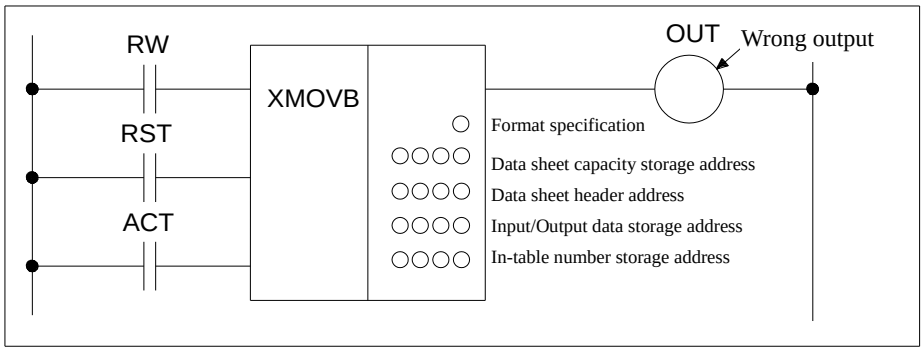


Figure 5-32

Command table format:

Table 5-23

S/N	Command	Operand	Notes
1	LD	○○○○.○	RW
2	LD	○○○○.○	RST
3	LD	○○○○.○	ACT
4	FUNC	20	XMOVB
3	PRM	○	Format specification
5	PRM	○○○○	Data capacity
6	PRM	○○○○	Data sheet header address
7	PRM	○○○○	Input or Output data storage address
8	PRM	○○○○	In-data sheet number storage address
9	OUT	○○○○.○	Wrong output

Control conditions:

RW Specify reading or writing operation

RW=0: Read data from the data sheet.

RW=1: Write data to the data sheet.

RST Reset

RST=0: Dereset.

RST=1: Reset, OUT=0.

ACT Execute command

ACT=0: Do not execute XMOVB command, and OUT remains unchanged.

ACT=1: Execute XMOVB command.

Parameters:

Format specification: Specify the length of the transferred data.

1: 1 byte long.

2: 2 bytes long.

4: 4 bytes long.

Data sheet number storage address: It is used to store the number of data in the data sheet. The number of bytes occupied shall conform to the length specified in the format. The valid range of the data is determined by the byte length specified in the format.

1 byte long: 1 to 255.

2 bytes long: 1 to 65,535 (actually set to a value less than the D-section size).

4 bytes long: 1 to 99,999,999 (actually set to a value less than the D-section size).

Data sheet header address: Set the data sheet header address. The storage area of the data sheet is the byte length × the number of data sheets. Header address must be D Address in the D Data Sheet.

Input/Output data storage address: When reading data, the address for storing the reading result is set. At the time of writing data, the address for storing the written data is set.

In-table number storage address: It's used to store in-table number with data read or written. The number of bytes occupied shall conform to the specification in the format setting. If the set in-table number is greater than the data stored in the format setting, the wrong output OUT=1.

Output:

When the in-table number exceeds the value in the format setting, OUT=1, and the reading or writing operation of the data sheet will not be executed.

OUT=0, indicating no errors.

OUT=1, indicating an error.

5.22 ADDB (Binary addition)

Function:

Command is used for 1-byte, 2-byte and 4-byte binary addition operation. Augend data and addition operation result output data need to set the storage address in corresponding byte length.

Ladder diagram format:

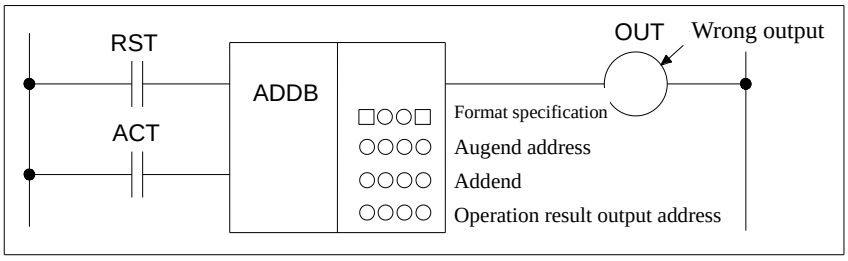


Figure 5-33

Command table format:

Table 5-24

S/N	Command	Operand	Notes
1	LD	○○○○.○	RST
2	LD	○○○○.○	ACT
3	FUNC	21	ADDB
4	PRM	□○○□	Format specification
3	PRM	○○○○	Augend address
5	PRM	○○○○	Addend
6	PRM	○○○○	Operation result output storage address
7	OUT	○○○○.○	Wrong output

Control conditions:

RST Reset

RST=0: Dereset.

RST=1: Reset OUT = 0.

ACT Execute command

ACT=0: Do not execute ADDB command.

ACT=1: Execute ADDB command.

Parameters:

Format specification: The method for specifying the data length (1-byte, 2-byte and 4-byte) and the addend (constant or address).

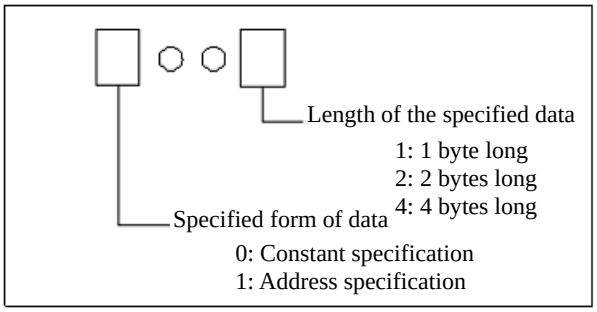


Figure 5-34

Augend address: Specify the address to store the augend.

Addend: The method for specifying an addend depends on the format specification.

Operation result output address: Specify the address to output operation result.

Output:

OUT=0: Operation is normal.

OUT=1: Operation is abnormal.

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

Operation result register (R1000):

Bit information of operation result register:

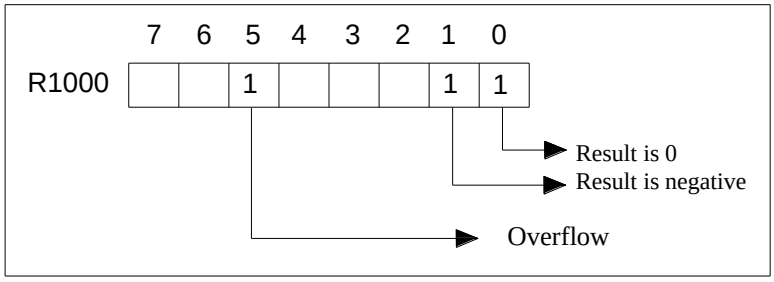


Figure 5-35

5.23 SUBB (Binary subtraction)

Function:

Command is used for 1-byte, 2-byte and 4-byte binary subtraction operation. Minuend data and subtraction operation result output data need to set the storage address in corresponding byte length.

Ladder diagram format:

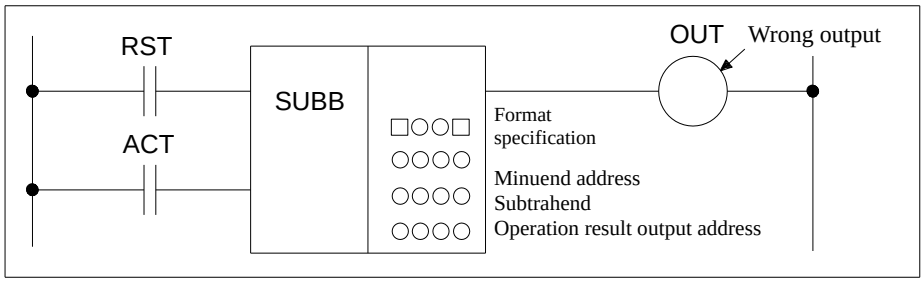


Figure 5-36

Command table format:

Table 5-25

S/N	Command	Operand	Notes
1	LD	○○○○.○	RST
2	LD	○○○○.○	ACT
3	FUNC	22	SUBB
4	PRM	□○○□	Format specification
3	PRM	○○○○	Minuend address
5	PRM	○○○○	Subtrahend
6	PRM	○○○○	Operation result output storage address
7	OUT	○○○○.○	Wrong output

Control conditions:

RST Reset

RST=0: Dereset.

RST=1: Reset OUT=0.

ACT Execute command

ACT=0: Do not execute SUBB command.

ACT=1: Execute SUBB command.

Parameters:

Format specification: The method for specifying the data length (1-byte, 2-byte and 4-byte) and the subtrahend (constant or address).

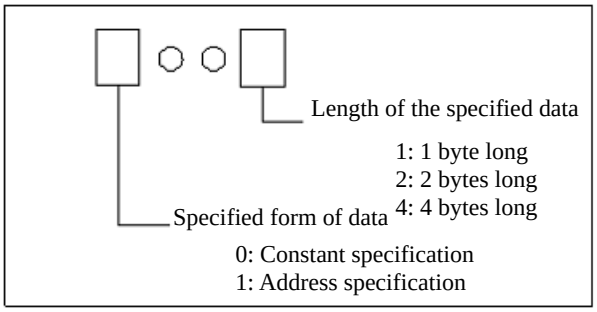


Figure 5-37

Minuend address: Specify the address to store the minuend.

Subtrahend: The method for specifying a subtrahend depends on the format specification.

Operation result output address: Specify the address to output operation result.

Output:

OUT=0: Operation is normal.

OUT=1: Operation is abnormal.

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

Operation result register (R1000):

Bit information of operation result register:

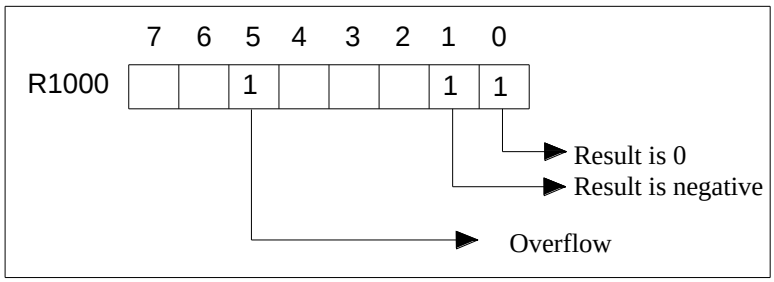


Figure 5-38

5.24 MULB (Binary multiplication)

Function:

This command is used for multiplication operation of 1-byte, 2-byte and 4-byte binary data. The operation result output is at the operation result output address. Multiplicand data and multiplication operation result output data need to set the storage address in corresponding byte length.

Ladder diagram format:

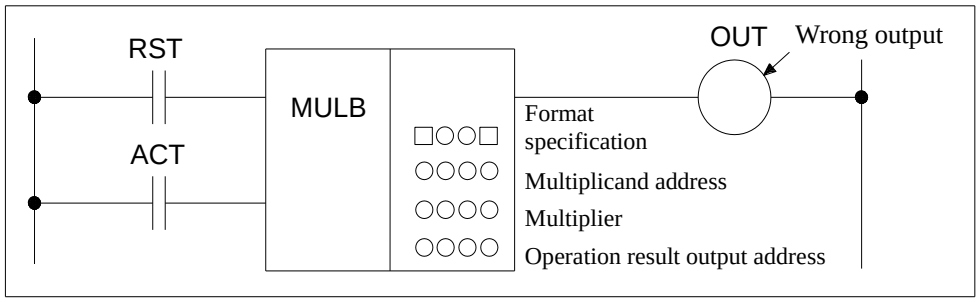


Figure 5-39

Command table format:

Table 5-26

S/N	Command	Operand	Notes
1	LD	○○○○.○	RST
2	LD	○○○○.○	ACT
3	FUNC	23	MULB
4	PRM	□○○□	Format specification
3	PRM	○○○○	Multiplicand address
5	PRM	○○○○	Multiplier
6	PRM	○○○○	Operation result output storage address
7	OUT	○○○○.○	Wrong output

Control conditions:

RST Reset

RST=0: Dereset.

RST=1: Reset OUT = 1.

ACT Execute command

ACT=0: Do not execute MULB command.

ACT=1: Execute MULB command.

Parameters:

Format specification: The method for specifying the data length (1-byte, 2-byte and 4-byte) and the multiplier (constant or address).

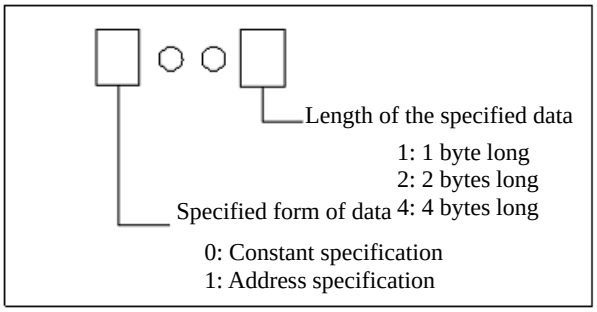


Figure 5-40

Multiplicand address: Specify the address to store the multiplicand.

Multiplier: The method for specifying a multiplier depends on the format specification.

Operation result output address: Specify the address to output operation result.

Output:

OUT=0: Operation is normal.

OUT=1: Operation is abnormal.

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

Operation result register (R1000):

Bit information of operation result register:

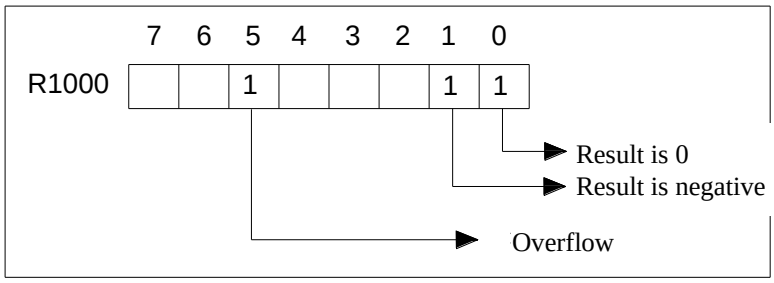


Figure 5-41

5.25 DIVB (Binary division)

Function:

This command is used for division operation of 1-byte, 2-byte and 4-byte binary data. The operation result output is at the operation result output address. Divisor, dividend data and operation result output data need to set the storage address in corresponding byte length.

Ladder diagram format:

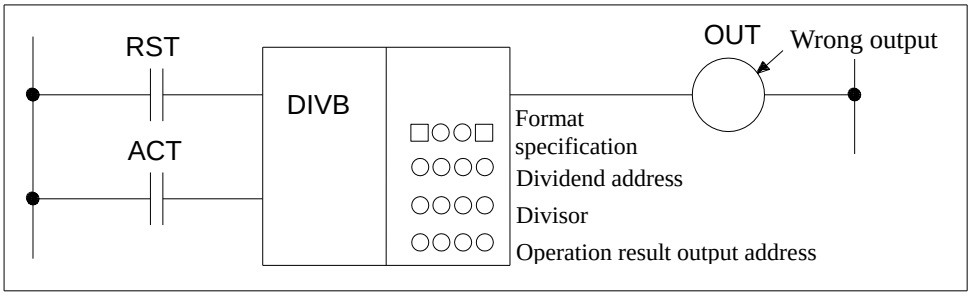


Figure 5-42

Command table format:

Table 5-27

S/N	Command	Operand	Notes
1	LD	○○○○.○	RST
2	LD	○○○○.○	ACT
3	FUNC	24	DIVB
4	PRM	□○○□	Format specification
5	PRM	○○○○	Dividend address
6	PRM	○○○○	Divisor
7	PRM	○○○○	Operation result output storage address
8	OUT	○○○○.○	Wrong output

Control conditions:

RST Reset

RST=0: Dereset.

RST=1: Reset OUT = 1.

ACT Execute command

ACT=0: Do not execute DIVB command.

ACT=1: Execute DIVB command.

Parameters:

Format specification: The method for specifying the data length (1-byte, 2-byte and 4-byte) and the divisor data (constant or address).

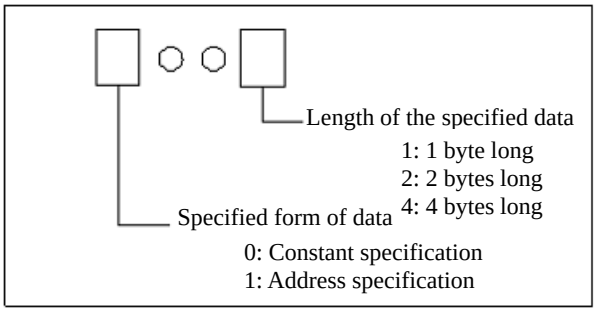


Figure 5-43

Dividend address: Specify the address to store the dividend.

Divisor: The method for specifying a divisor depends on the format specification.

Operation result output address: Specify the address to output operation result.

Output:

OUT=0: Operation is normal.

OUT=1: Operation is abnormal.

When the divisor is 0, OUT=1.

Operation result register (R1000):

Bit information of operation result register:

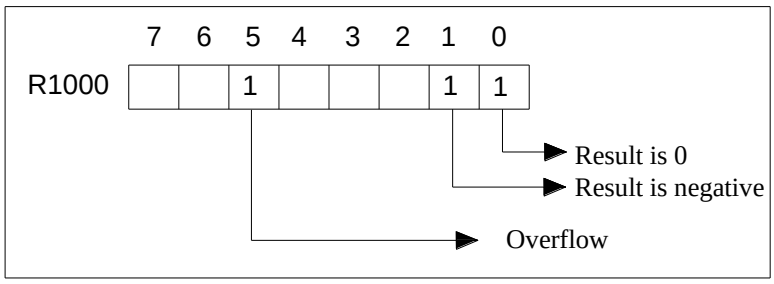


Figure 5-44

Remainder output register:

When there is a remainder, it is stored in R1002 to R1005 according to the data length.

5.26 NUMEB (Defining binary constant)

Function:

This command is used to assign decimal constant data to a specified address. Output data is binary and stored at the specified storage address. The data length can be 1 byte, 2 bytes or 4 bytes, depending on the specification.

Ladder diagram format:

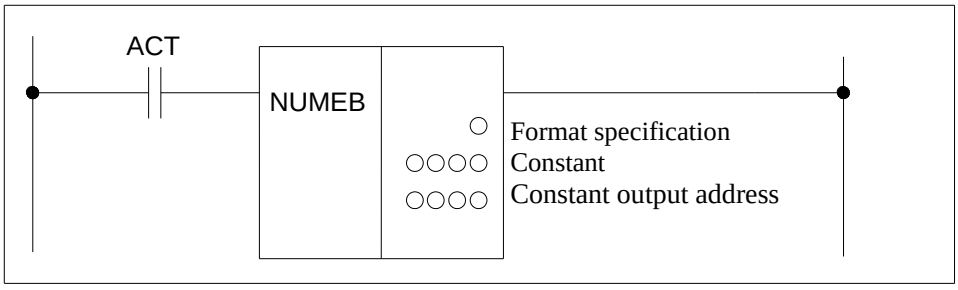


Figure 5-45

Command table format:

Table 5-28

S/N	Command	Operand	Notes
1	LD	○○○○.○	ACT
2	FUNC	25	NUMEB
3	PRM	○	Format specification
4	PRM	○○○○	Constant
5	PRM	○○○○	Constant output address

Control conditions:

ACT Execute command

ACT=0: Do not execute NUMEB command.

ACT=1: Execute NUMEB command.

Parameters:

Format specification: Specify the length of processing data.

1: 1 byte long.

2: 2 bytes long.

4: 4 bytes long.

Constant: Specify the value of the defined constant which is decimal data.

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

5.27 DIFU (Rising edge pulse detection)

Function:

This command breaks over the output relay for one scanning cycle on the rising edge connected by the input signal.

Ladder diagram format:

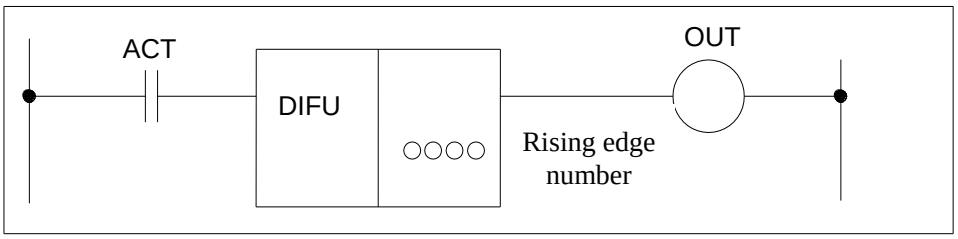


Figure 5-46

Command table format:

Table 5-29

S/N	Command	Operand	Notes
1	LD	○○○○.○	ACT
2	FUNC	26	DIFU
3	PRM	○○○○	Rising edge number
4	OUT	○○○○.○	Output

Control conditions:

ACT Execute command

ACT=0: Do not execute command.

ACT=1: Execute the command, and the output signal breaks over for one scanning cycle on the rising edge broken over by ACT.

Parameters:

Rising edge number: Specify the rising edge command number ranging from 1 to 200.

Output (OUT):

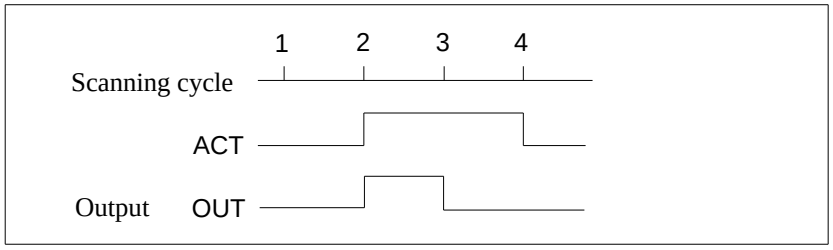


Figure 5-47

5.28 DIFD (Falling edge pulse detection)

Function:

This command breaks over the output relay for one scanning cycle on the falling edge connected by the input signal.

Ladder diagram format:

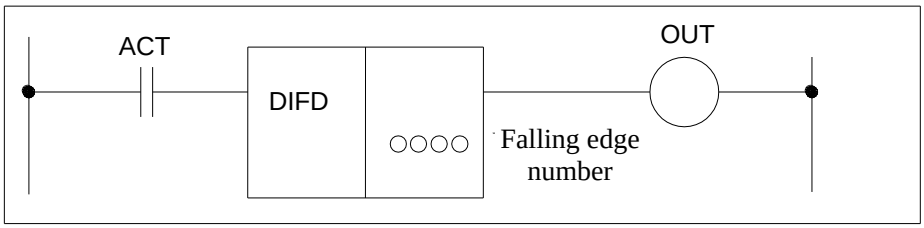


Figure 5-48

Command table format:

Table 5-30

S/N	Command	Operand	Notes
1	LD	○○○○.○	ACT
2	FUNC	27	DIFD
3	PRM	○○○○	Falling edge number
4	OUT	○○○○.○	Output

Control conditions:

ACT Execute command

ACT=0: Do not execute command.

ACT=1: Execute the command, and the output signal breaks over for one scanning cycle on the falling edge broken over by ACT.

Parameters:

Falling edge number: Specify the rising edge command number ranging from 1 to 200.

Output (OUT):

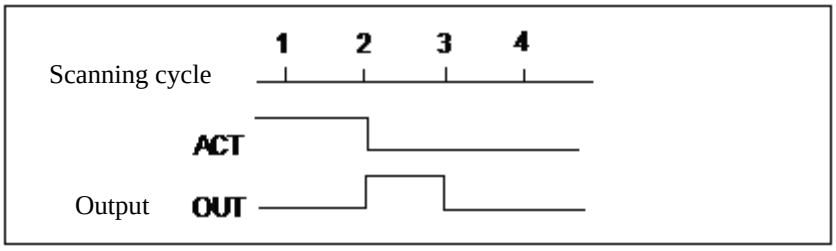


Figure 5-49

5.29 SFT (Register data shift)

Function:

This command can shift 2-byte data by 1 bit to the left or right.

OUT=1 when Data '1' shifts left at the leftmost (15 bits) or right at the rightmost (0 bit).

Ladder diagram format:

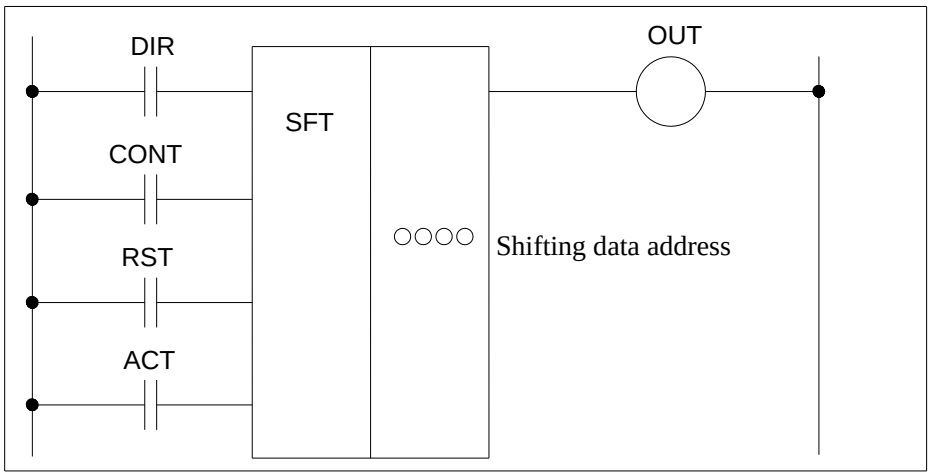


Figure 5-50

Command table format:

Table 5-31

S/N	Command	Operand	Notes
1	LD	○○○○.○	DIR
2	LD	○○○○.○	CONT
3	LD	○○○○.○	RST
4	LD	○○○○.○	ACT
5	FUNC	28	SFT
6	PRM	○○○○	Shifting data
7	OUT	○○○○.○	Output

Control conditions:

DIR Specify the shifting direction

DIR=0 Shift left

DIR=1 Shift right

CONT State specification

CONT=0 The original data bit is shifted to 0 after the state of the data bit is shifted in the specified direction.

CONT=1 The bit state whose original data bit is "1" is retained after the state of the data bit is shifted in the specified direction.

RST Reset

RST=0 OUT does not reset.

RST=1 OUT resets (OUT=0).

ACT Execution conditions

ACT=0 Do not execute SFT command.

ACT=1 Execute a shift and set ACT to 0 if only 1 bit is shifted after one scanning cycle is connected by the command.

Parameters:

Address of shifting data: Specify the first address of a storage area of two consecutive bytes.

Output:

OUT: OUT=0 No "1" state is shifted out after the shift operation.

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

5.30 EOR (Exclusive OR)

Function:

This command conducts Exclusive OR between the contents of Address A and constants (or contents of Address B), and stores the results at Address C.

Ladder diagram format:

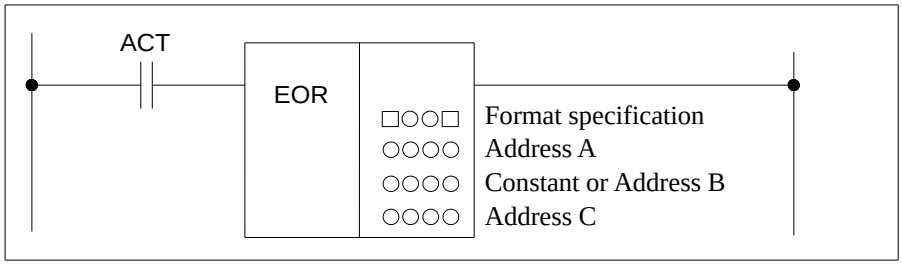


Figure 5-51

Command table format:

Table 5-32

S/N	Command	Operand	Notes
1	LD	○○○○.○	ACT
2	FUNC	29	EOR
3	PRM	□○○□	Format specification
4	PRM	○○○○	Address A
5	PRM	○○○○	Constant or Address B
6	PRM	○○○○	Address C

Control conditions:

ACT Execution conditions

ACT=0: Do not execute EOR command.

ACT=1: Execute EOR command.

Parameters:

Format specification: The method for specifying the data length (1-byte, 2-byte and 4-byte) and the data (constant or address).

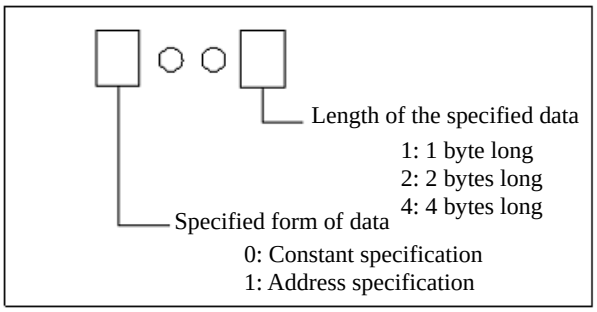


Figure 5-52

Address A: Specify the first address of the input data after Exclusive OR operation.

Constant or Address B: Specify the data that has undergone EOR operation with the input data of Address A, with the specifying method depending on the format specification, and it can be either constant or address.

Address C: Specify the address of the output operation result. The result of EOR operation begins to be stored at this address, with the data length occupied consistent with that specified by the format.

For example:

When there is the following data in Address A and Address B:

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

The results of EOR operation are as follows:

Address C	1	0	1	1	0	1	1	0

5.31 ANDF (Logic AND)

Function:

This command conducts AND operation between the contents of Address A and constants (or contents of Address B), and stores the results at Address C.

Ladder diagram format:

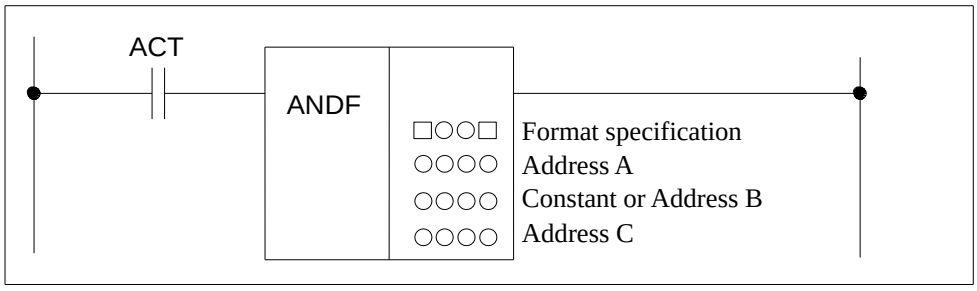


Figure 5-53

Command table format:

Table 5-33

S/N	Command	Operand	Notes

1	LD	○○○○.○	ACT
2	FUNC	30	ANDF
3	PRM	□○○□	Format specification
4	PRM	○○○○	Address A
5	PRM	○○○○	Constant or Address B
6	PRM	○○○○	Address C

Control conditions:

ACT Execution conditions

ACT=0: Do not execute ANDF command.

ACT=1: Execute ANDF command.

Parameters:

Format specification: The method for specifying the data length (1-byte, 2-byte and 4-byte) and the data (constant or address).

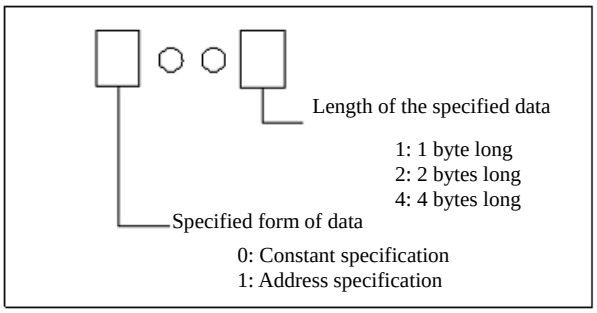


Figure 5-54

Address A: Specify the first address of the input data to be multiplied.

Constant or Address B: Specify data that is multiplied by the input data of Address A, with the specifying method depending on the format specification, and it can be either constant or address.

Address C: Specify the address of the output operation result. The result of ANDF operation begins to be stored at this address, with the data length occupied consistent with that specified by the format.

For example:

When there is the following data in Address A and Address B:

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

The results of ANDF operation are as follows:

Address C	0	1	0	0	0	0	0	1

5.32 ORF (Logic OR)

Function:

This command conducts OR operation between the contents of Address A and constants (or contents of Address B), and stores the results at Address C.

Ladder diagram format:

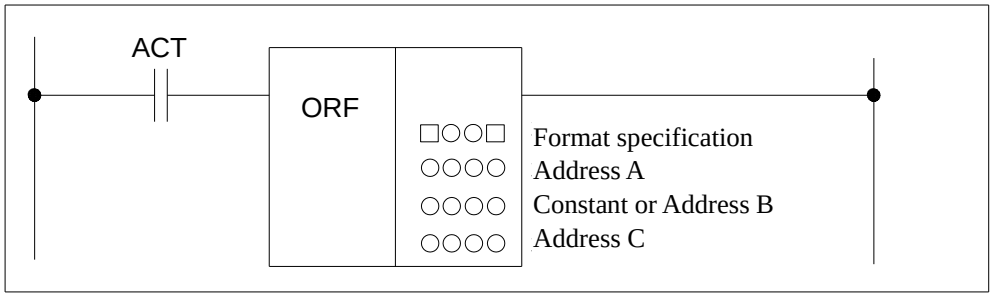


Figure 5-55

Command table format:

Table 5-34

S/N	Command	Operand	Notes
1	LD	○○○○.○	ACT
2	FUNC	31	ORF
3	PRM	□○○□	Format specification
4	PRM	○○○○	Address A
5	PRM	○○○○	Constant or Address B
6	PRM	○○○○	Address C

Control conditions:

ACT Execution conditions

ACT=0: Do not execute ORF command.

ACT=1: Execute ORF command.

Parameters:

Format specification: The method for specifying the data length (1-byte, 2-byte and 4-byte) and the data (constant or address).

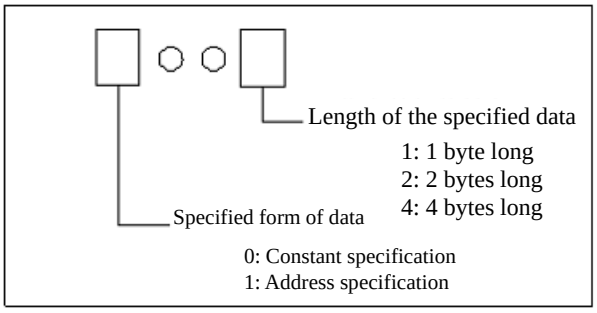


Figure 5-56

Address A: Specify the first address of the input data after ORF operation.

Constant or Address B: Specify data that has undergone ORF operation with the input data of Address A, with the specifying method depending on the format specification, and it can be either constant or address.

Address C: Specify the address of the output operation result. The result of ORF operation begins to be stored at this address, with the data length occupied consistent with that specified by the format.

For example:

When there is the following data in Address A and Address B:

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

The results of ORF operation are as follows:

Address C	1	1	1	1	0	1	1	1

5.33 NOT (Logic NOT)

Function:

This command inverts the contents of Address A at each bit and stores the result at Address B.

Ladder diagram format:

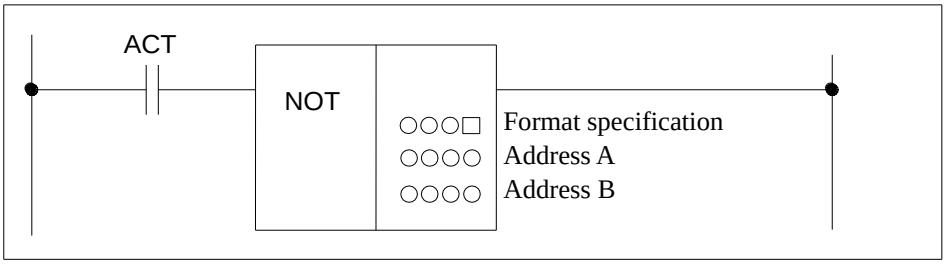


Figure 5-57

Command table format:

Table 5-35

S/N	Command	Operand	Notes
1	LD	○○○○.○	ACT
2	FUNC	32	NOT
3	PRM	□○○□	Format specification
4	PRM	○○○○	Address A
5	PRM	○○○○	Address B

Control conditions:

ACT Execution conditions

ACT=0, do not execute NOT command.

ACT=1, execute NOT command.

Parameters:

Format specification: Specify the data length as 1 byte, 2 bytes or 4 bytes.

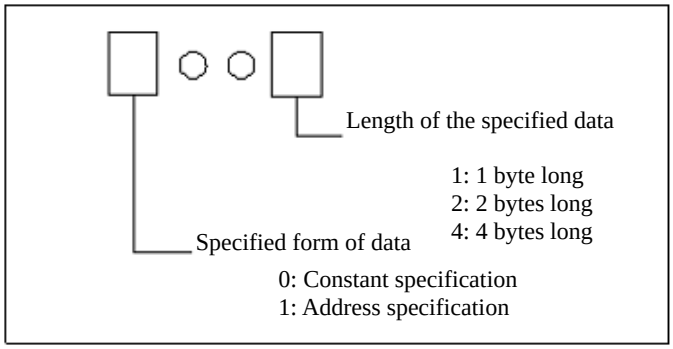


Figure 5-58

Address A: Specify the first address of the input data to be inverted.

Address B: Specify the address of the output operation result. The result of NOT operation begins to be stored at this address, with the data length occupied consistent with that specified by the format.

For example:

When there is the following data in Address A and Address B:

Address A	1	1	1	0	0	0	1	1

The results of NOT operation are as follows:

Address B	0	0	0	1	1	1	0	0

5.34 COM (Common line control)

Function:

COM command controls coil operation from COM to COME (Common End Command). The number of coils specified in this system shall be forced to set to 0. The control range of COM command shall be specified by the Common Line End Command. If the Common Line End Command is not specified, the system will give an alarm.

Ladder diagram format:

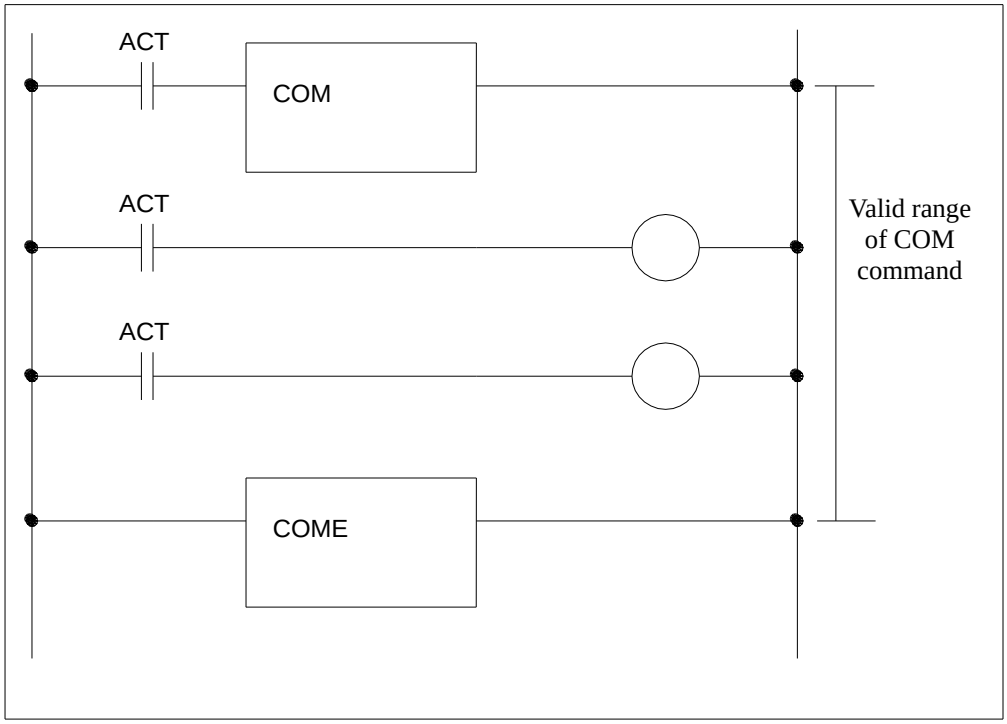


Figure 5-59

Command table format:

Table 5-36

S/N	Command	Operand	Notes
1	LD	○○○○.○	ACT
2	FUNC	33	COM

Control conditions:

ACT=0 The coil within the specified range is unconditionally disconnected (set to 0).

ACT=1 It is the same as if the COM command does not execute an operation.

Note 1: The specification of another COM command is not allowed within the scope specified by one COM command.

Note 2: When ACT=0 for COM, the coil of OUTN in the specified range is unconditionally set to 1 (OUTN=1).

5.35 COME (Common line control end)

Function:

Specify the scope of COM (Common Line Control command). This command must be used with COM command and cannot be used alone.

Ladder diagram format:

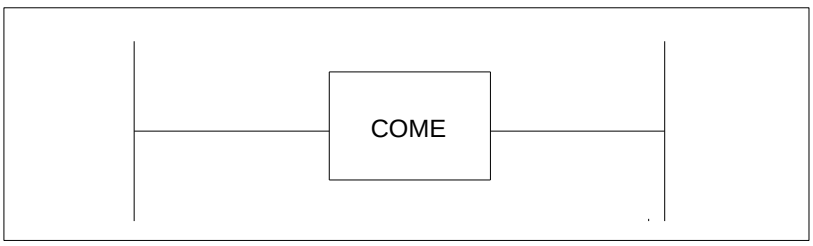


Figure 5-60

Command table format:

Table 5-37

S/N	Command	Operand	Notes
1	FUNC	34	COME

5.36 JMP (Jump)

Function:

JMP command causes the shift of ladder diagram program execution. When JMP command is executed, execution skips to the Jump End command without executing logical command (including function command) between JMP and JMPE commands. Set the number of specified coils to 0, and use the range to be skipped by JMPE command. When Jump End command is not specified, an alarm message will be displayed.

Ladder diagram format:

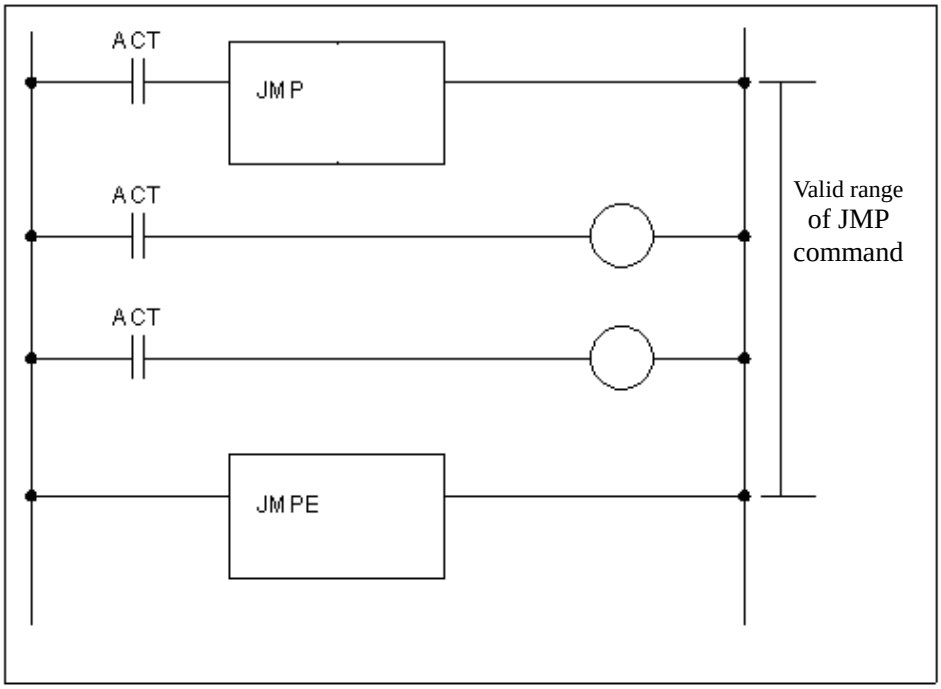


Figure 5-61

Command table format:

Table 5-38

S/N	Command	Operand	Notes
1	LD	○○○○.○	ACT
2	FUNC	35	JMP
3	PRM	○	

Control conditions:

ACT=0: Do not execute JMP command. The program proceeds from the next step of JMP command.

ACT=1: Skip logical command (including function command) in the specified range and continue program execution.

Note:

Operation of JMP command.

When ACT=1, the program jumps to Jump End command (JMPE). Logical command (including function command) within the specified scope is not executed. Caution shall be exercised in programming that jumps resulting from the use of JMP and JMPE commands shall not jump to or from the program between COM and COME commands, otherwise the ladder diagram may not be executed correctly after the jump.

5.36 JMPE (End of jump)

Function:

Specify the jump range end of JMP (Jump command). This command must be used with JMP command and cannot be used alone.

Ladder diagram format:

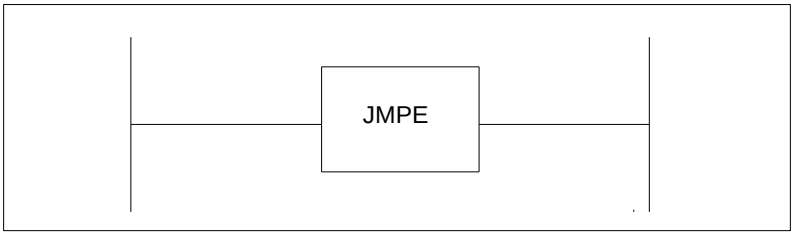


Figure 5-62

Command table format:

Table 5-39

S/N	Command	Operand	Notes
1	FUNC	36	JMPE

5.38 CALL (Conditionally call subprogram)

Function:

Call the specified subprogram when the control condition is met.

This command has the following characteristics and limitations:

* Multiple calling commands can call the same subprogram.
* Call commands can be nested.
* Subprogram must be programmed after END2.

Ladder diagram format:

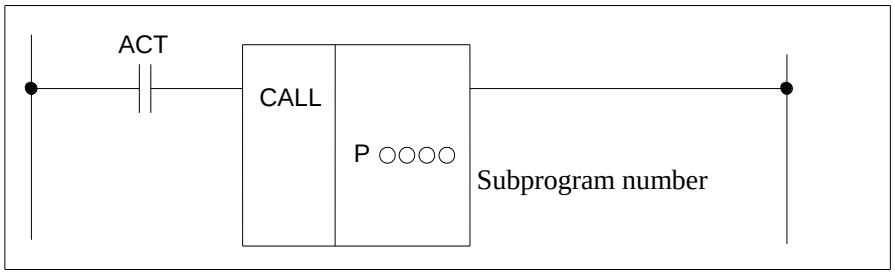


Figure 5-63

Command table format:

Table 5-40

S/N	Command	Operand	Notes
1	LD	○○○○.○	ACT
2	FUNC	37	CALL
3	PRM	P○○○○	Subprogram number

Control conditions:

ACT Execution conditions

ACT=0, do not execute CALL command.

ACT = 1, execute CALL command to call the subprogram with the specified subprogram number.

Parameters:

Subprogram number: Specify the called subprogram number ranging from P1 to P512.

5.39 CALLU (Unconditionally call subprogram)

Function:

The specified subprogram is called unconditionally when the system executes CALLU command.

Ladder diagram format:

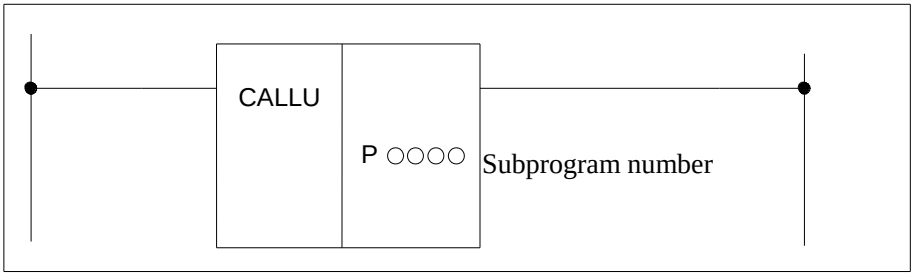


Figure 5-64

Command table format:

Table 5-41

S/N	Command	Operand	Notes
1	FUNC	38	CALLU
2	PRM	P○○○○	Subprogram number

Parameters:

Subprogram number: Specify the subprogram number to be called. The subprogram number must be specified in the form of P Address to specify the number from P1 to P512.

5.40 JMPB (Label Jump 1)

Function:

Executing JMPB can transfer the sequence control program to a program that is set after the label in the ladder diagram program.

It has the following characteristics and limitations:

* Multiple jump commands can use the same label.
* Jump command allows control to jump freely before and after the command within a program unit

(main program or subprogram).

* Jump can be nested.
* Skipping END1 and END2 is prohibited.

Ladder diagram format:

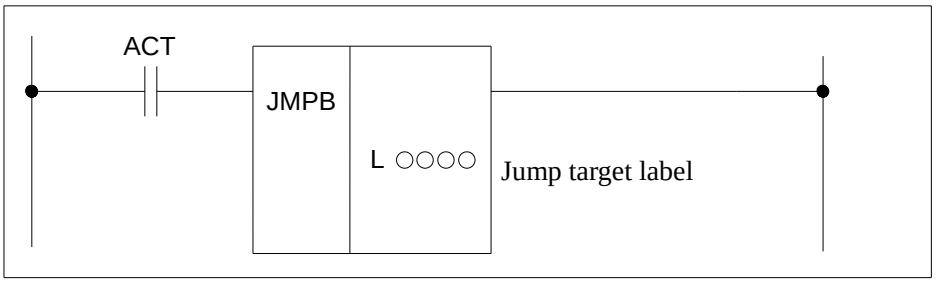


Figure 5-65

Command table format:

Table 5-42

S/N	Command	Operand	Notes
1	LD	○○○○.○	ACT
2	FUNC	39	JMPB
3	PRM	L○○○○	Jump target label

Control conditions:

ACT Execution conditions

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

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

Parameters:

Jump target label Lx: Specify the target label of the jump. The number of labels must be specified starting with L Address and can be any value specified from L1 to L9999.

5.41 JMPC (Label Jump 2)

Function:

The function command JMPC jumps the sequence control program from the subprogram to the target label code position in the main program. The specification of the function command JMPC is the same as that of the function command JMPB. Only JMPC returns control to the main program.

Ladder diagram format:

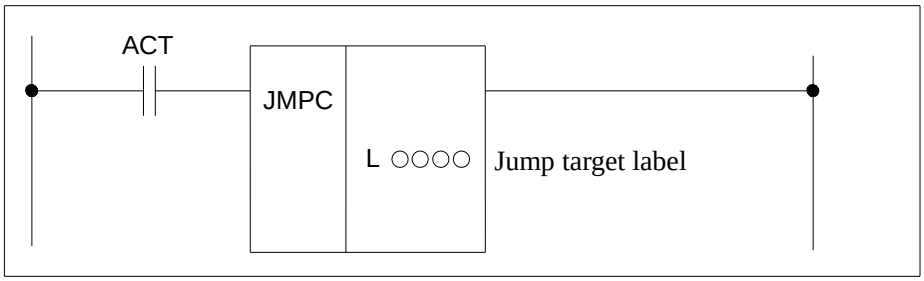


Figure 5-66

Command table format:

Table 5-43

S/N	Command	Operand	Notes
1	LD	○○○○.○	ACT
2	FUNC	40	JMPC
3	PRM	L○○○○	Jump target label

Control conditions:

ACT Execution conditions

ACT=0: Execute the command after JMPC command.

ACT=1: Jump the sequence control program to the ladder diagram after the specified label.

Parameters:

Jump target label: Specify the label of jump target. Label value must be specified in the form of L Address. A value from L1 to L9999 can be specified.

Note: When this command is used to skip back to the previous command, caution shall be exercised not to create a dead loop.

5.4.2 LBL (Label)

Function:

Specify a label in the ladder diagram as the destination for JMPB and JMPC jumps.

Caution: One Lx label can only be specified once with LBL, and alarm will be given for multiple times.

Ladder diagram format:

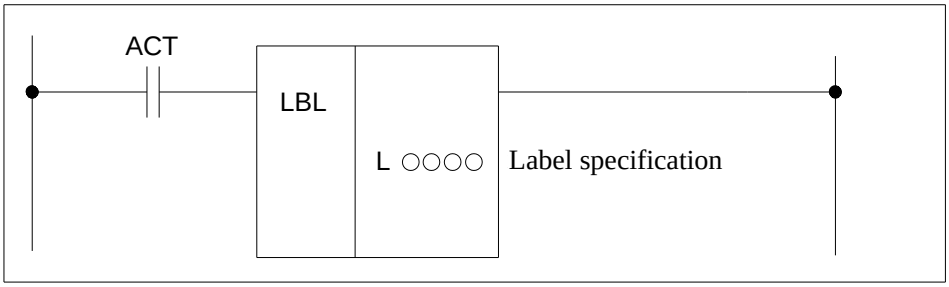


Figure 5-67

Command table format:

Table 5-44

S/N	Command	Operand	Notes
1	LD	○○○○.○	ACT
2	FUNC	41	LBL
3	PRM	L○○○○	Label specification

Parameters:

Label specification Lx: Specify the target label of the jump. The number of labels must be specified starting with L Address and can be any value specified from L1 to L9999.

5.43 SP (Subprogram)

Function:

SP command is used to create a subprogram to be used by CALL and CALLU, and SP command is used in conjunction with SPE command described later to specify the scope of the subprogram.

Caution:

1. The subprogram must be programmed after END2.
2. Another subprogram must not be set up within one subprogram.

Ladder diagram format:

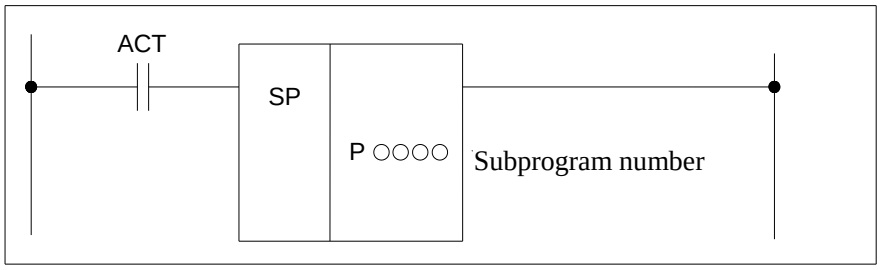


Figure 5-68

Command table format:

Table 5-45

S/N	Command	Operand	Notes
1	LD	○○○○.○	ACT
2	FUNC	42	SP
3	PRM	P○○○○	Subprogram number

Parameters:

Subprogram number: Specify the subprogram label called in the form of P Address. The subprogram number ranges from P1 to P512, and the subprogram number within the same program cannot be reused.

5.44 SPE (Subprogram end)

Function:

- ✲ SPE is used in conjunction with SP to specify the scope of the subprogram.
- ✲ When this function command is executed, the control will be returned to the main program that calls this subprogram.
- ✲ Subprogram must be programmed after END2.

Ladder diagram format:

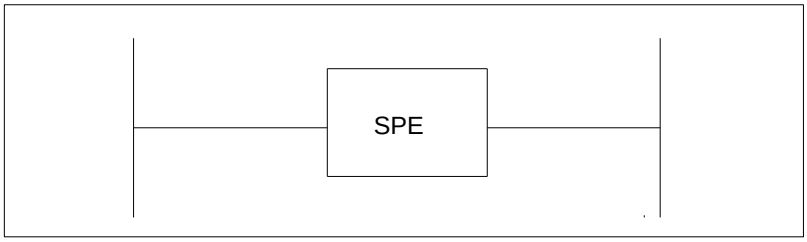


Figure 5-69

Command table format:

Table 5-46

S/N	Command	Operand	Notes
1	FUNC	43	SPE

5.45 WINDR (Read CNC window data)

Function:

A window for interactive data between PLC and CNC is used by PLC to read CNC data. "WINDR" falls into two categories:

1. Read data within a period of scanning time (HS response function);
2. Read data within several scanning periods (LS response function).

Ladder diagram format:

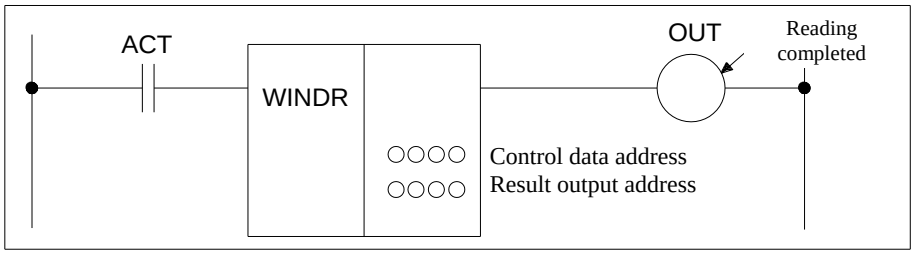


Figure 5-70

Command table format:

Table 5-47

S/N	Command	Operand	Notes
1	LD	○○○○.○	ACT
2	FUNC	44	WINDR
3	PRM	○○○○	Control data address
4	PRM	○○○○	Result output address
5	OUT	○○○○.○	Reading completed

Control conditions:

ACT Execution conditions

ACT=0: Do not execute the WINDR function.

ACT=1: Execute WINDR command.

Parameters:

Control data address

PLC Byte Address is used to specify the area to store the control data.

Control Data:

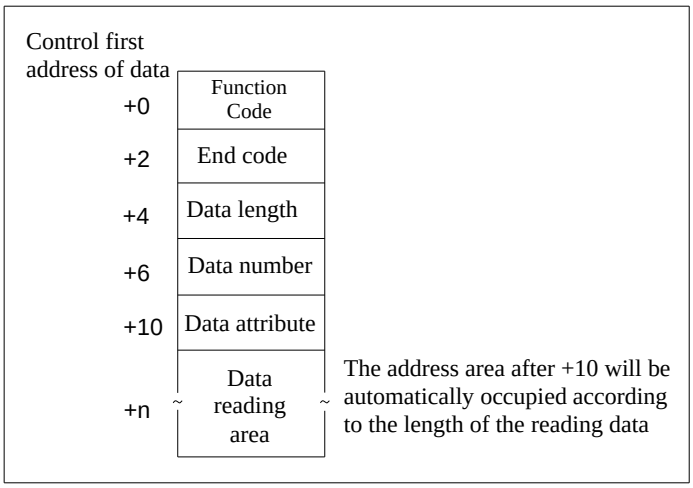


Figure 5-71

Note: See Table 5-48 for function codes.

Output:

OUT=0: Indicate that "WINDR" is not executed or "WINDR" is now being executed.

OUT=1: Indicate the end of data reading. If the LS response function is used, the "ACT" must be reset once the data has been read.

Operation result register:

An error occurs during the execution of "WINDR", and the bits in the operation result output register shall be set.

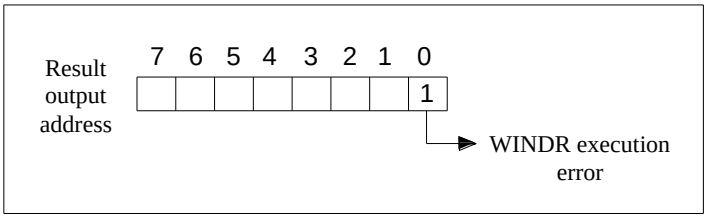


Figure 5-72

5.46 WINDW (Write CNC window data)

Function:

A window for interactive data between PLC and CNC is used by PLC to write data to CNC. "WINDW" belongs to the LS response function.

Ladder diagram format:

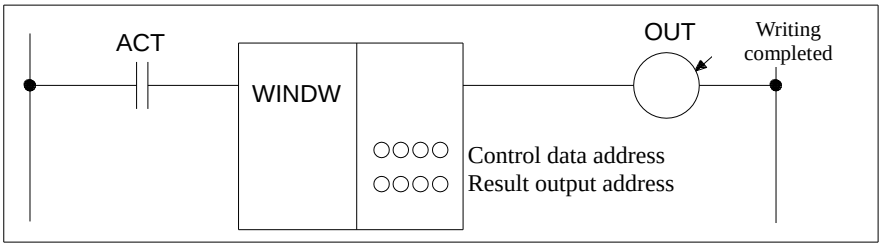


Figure 5-73

Command table format:

Table 5-48

S/N	Command	Operand	Notes
1	LD	○○○○.○	ACT
2	FUNC	45	WINDW
3	PRM	○○○○	Control data address
4	PRM	○○○○	Result output address
5	OUT	○○○○.○	Writing completed

Control conditions:

ACT Execution conditions

ACT=0: Do not execute the WINDW function.

ACT=1: Execute WINDW command. After the data is written, "ACT" must be reset.

Parameters:

Control data address

PLC Byte Address is used to specify the first address of the area to store the control data.

Control Data:

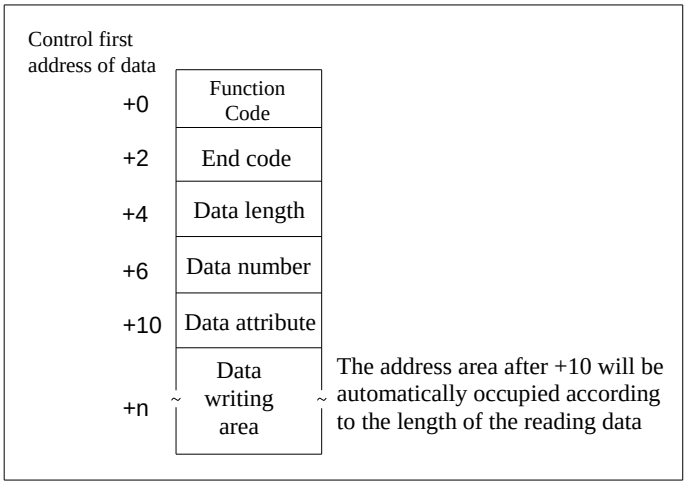


Figure 5-74

Note: See Table 5-48 for function codes.

Output:

OUT=0: Indicate that "WINDW" is not executed or "WINDW" is now being executed.

OUT=1: Data writing ends. If the LS response function is used, "ACT=0" must be reset once the data writing is completed.

Operation result register:

An error occurs during the execution of "WINDW", and the bits in the operation result output register shall be set.

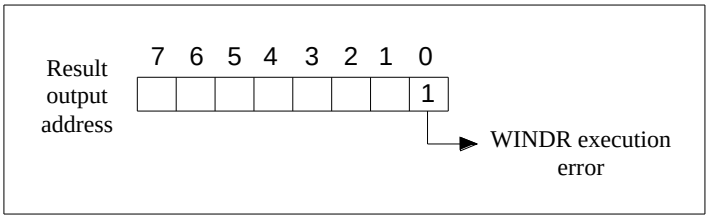


Figure 5-75

Table 5-49 List of Window Function Codes

Function	Function Code	Response Speed	Attributes
Read CNC state information*	0	High speed	Read only (not open)
Read tool offset	1	Low speed	Read only
Write tool offset	2	Low speed	Write only
Read workpiece origin offset	3	Low speed	Read only
Write workpiece origin offset	4	Low speed	Write only
Read parameters	5	Low speed	Read only
Writing parameters	6	Low speed	Write only
Read setting data	7	Low speed	Read only (not open)
Write setting data	8	Low speed	Write only (not open)
Read user macro variables	9	Low speed	Read only
Write user macro variables	10	Low speed	Write only
Read pitch compensation data	11	Low speed	Read only
Write pitch compensation data	12	Low speed	Write only
Read current program number	13	High speed	Read only
Read current sequence number	14	High speed	Read only
Read actual speed of control axis	15	High speed	Read only
Read absolute coordinates of control axis	16	High speed	Read only (not open)
Read mechanical coordinates of control axis	17	High speed	Read only
Read skipping position of control axis	18	High speed	Read only
Read load current value of feed motor	19	High speed	Read only
Write motor torque limit data	20	Low speed	Write only
Read actual spindle speed	21	High speed	Read only (not open)
Read digital spindle load information	22	High speed	Read only (not open)
Read relative coordinates of control axis	23	High speed	Read only (not open)
Read remaining movement	24	High speed	Read only (not open)
Read modal data	25	Low speed	Read only (not open)
Read diagnostic data	26	High speed	Read only (not open)
Read time data	28	Low speed	Read only (not open)

Function	Function Code	Response Speed	Attributes
Read P code macro variable values	29	Low speed	Read only (not open)
Write P code macro variable values	30	Low speed	Write only (not open)
Write tool number LS response	31	Low speed	Write only
Preset relative coordinates	32	Low speed	Write only (not open)

5.47 AXLCTL (PLC axis control)

Function:

This function command is used to process DI/DO Signal of PLC control axis.

Ladder diagram format:

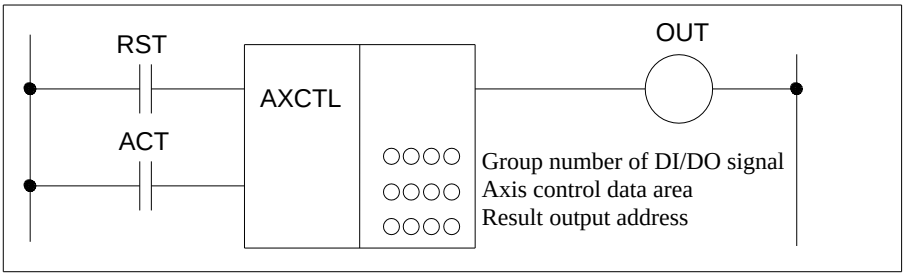


Figure 5-76

Command table format:

Table 5-50

S/N	Command	Operand	Notes
1	LD	○○○.○	RST
	LD	○○○.○	ACT
2	FUNC	46	PLC axis control function
3	PRM	○○○○	Group number of DI/DO signal
4	PRM	○○○○	Axis control data address
5	PRM	○○○○	Result output address
6	OUT	○○○.○	Execution completed

Control conditions:

RST Reset command

RST=0: Dereset.

RST=1: Set the reset signal to 1. All lookup commands are cleared, and the executing commands stop.

ACT Execute command

ACT=0: Do not execute the AXCTL function.

ACT=1: Execute the AXCTL function.

Parameters:

(a) Group number of DI/DO signal

1: Group A (G142 to G149, F130 to F132)

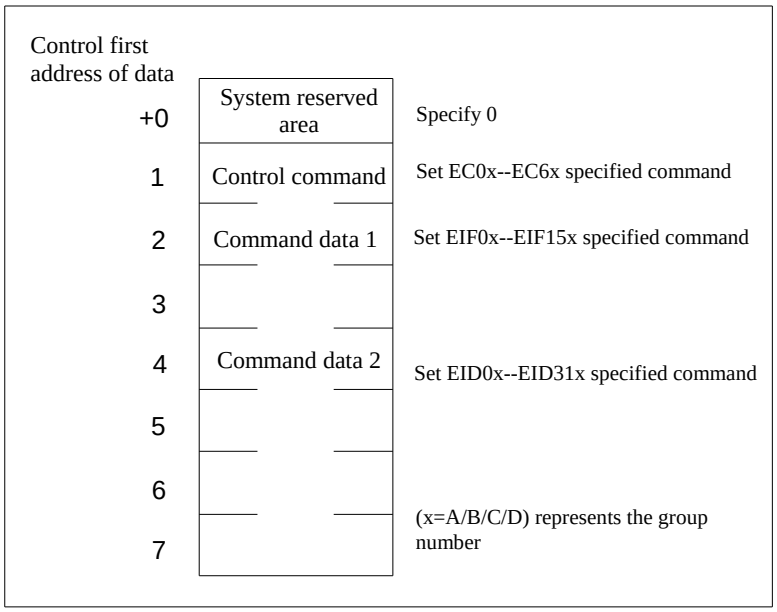
2: Group B (G154 to G161, F133 to F135)

3: Group C (G166 to G173, F136 to F138)

4: Group D (G178 to G185, F139 to F141)

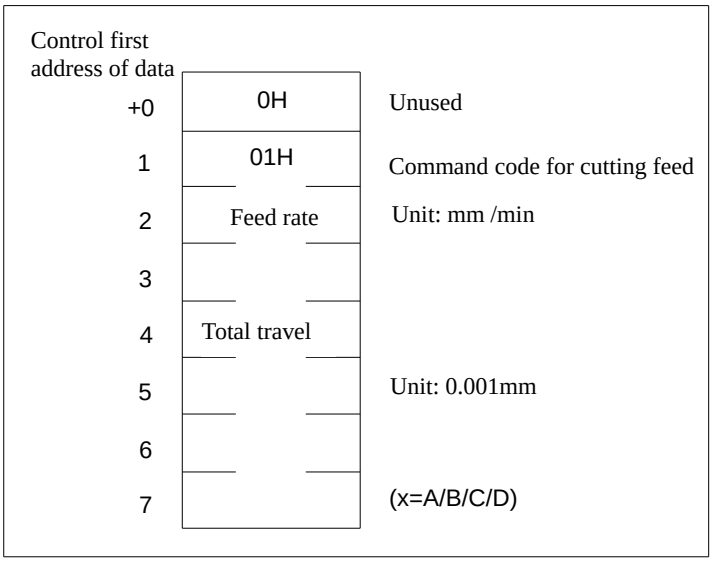
(b) Axis control data address

Select the address that contains the PLC axis control data position.



For example:

(example 1)Cutting feed (feed per minute)



Note: CNC parameters related to shaft movement must be set.

Output:

OUT=0: Usually 0. OUT=1 indicates that AXCTL command has been completed.
Specify ACT=0 immediately after processing (OUT=1).

OUT=1: When PLC axis control command is stored in CNC, or when the shaft shift has been completed, it will become 1.

Note 1: OUT can become 1 regardless of the state of ACT.
Note 2: It has no connection with the state of alarm signal.

Operation result register:

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

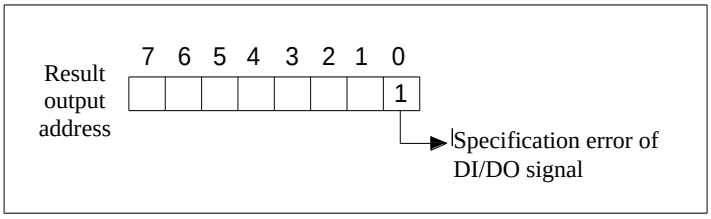


Figure 5-77

Table 5-51 Axis Control Signal Table

S/N	Symbol	Signal Address	Meaning	Input and Output
1	EAX1-EAX8	G136.0-7	Control axis selection signal	Input
2	EC0g-EC6g	G143.0-6, G155.0-6, G167.0-6, G179.0-6 G188.0-6, G197.0-6, G206.0-6, G215.0-6	Shaft control command signal	Input
3	EIF0g-EIF15g	G144-G145, G156-G157 G168-G169, G180-G181 G189-G190, G198-G199, G207-G208, G216-G217	Axis control feed speed signal	Input
4	EID0g-EID31g	G146-G149, G158-G161 G170-G173, G182-G185 G191-G194, G200-G203, G209-G212, G218-G221	Shaft control data signal	Input
5	EBUFg	G142.7, G154.7 G166.7, G178.7 G187.7, G196.7, G205.7, G214.7	Shaft control command read signal	Input
6	EBSYg	F130.7, F133.7, F136.7, F139.7 F142.7, F145.7, F148.7, F151.7	Shaft control command read completion signal	Output
7	ECLRg	G142.6, G154.6 G166.6, G178.6 G187.6, G196.6, G205.6, G214.6	Reset signal	Input
8	ESTPg	G142.5, G154.5 G166.5, G178.5 G187.5, G196.5, G205.5, G214.5	Shaft control dwell signal	Input

S/N	Symbol	Signal Address	Meaning	Input and Output
9	ESBKg	G142.3, G154.3 G166.3, G178.3 G187.3, G196.3, G205.3, G214.3	Program block stop signal	Input
10	EMSBKg	G143.7, G155.7 G167.7, G179.7 G188.7, G197.7, G206.7, G215.7	Program block invalid stop signal	Input
11	EM11g-EM48g	F132; F135; F138; F141; F144, F147, F150, F153	Auxiliary function code signal	Output
12	EMFg	F131.0, F134.0, F137.0, F140.0 F143.0, F146.0, F149.0, F152.0	Auxiliary function strobing signal	Output
13	EMF2g	F131.2, F134.2, F137.2, F140.2 F143.2, F146.2, F149.2, F152.2	Auxiliary function 2 strobing signal	Output
14	EMF3g	F131.3, F134.3, F137.3, F140.3 F143.3, F146.3, F149.3, F152.3	Auxiliary function 3 strobing signal	Output
15	EFINg	G142.0, G154.0, G166.0, G178.0 G187.0, G196.0, G205.0, G214.0	Auxiliary function completion signal	Input
16	ESOFg	G142.4, G154.4 G166.4, G178.4 G187.4, G196.4, G205.4, G214.4	Servo shut-off signal	Input
17	EMCUFg	G142.2, G154.2 G166.2, G178.2 G187.2, G196.2, G205.2, G214.2	Cache invalid signal	Input
18	*EAXSL	F129.7	Control axis selection status signal	Output
19	EINPg	F130.0, F133.0, F136.0, F139.0 F142.0, F145.0, F148.0, F151.0	In-position signal	Output
20	EIALg	F130.2, F133.2, F136.2, F139.2 F142.2, F145.2, F148.2, F151.2	Alarm signal	Output

S/N	Symbol	Signal Address	Meaning	Input and Output
21	EGENg	F130.4, F133.4, F136.4, F139.4 F142.4, F145.4, F148.4, F151.4	Shaft movement signal	Output
22	EDENg	F130.3, F133.3, F136.3, F139.3 F142.3, F145.3, F148.3, F151.3	Auxiliary function execution signal	Output
23	EOTNg	F130.6, F133.6, F136.6, F139.6 F142.6, F145.6, F148.6, F151.6	Negative over-travel signal	Output
24	EOTPg	F130.5, F133.5, F136.5, F139.5 F142.5, F145.5, F148.5, F151.5	Forward over-travel signal	Output
25	EFV0-EFV7	G151.0-G151.7	Feed speed override signal	Input
26	EOVC	G150.5	Override cancellation signal	Input
27	EROV1, EROV2	G150.0, G150.1 00 1% 01 25% 10 50% 11 100%	Rapid Traverse Override Signal	Input
28	EOV0	F129.5	Override 0% signal	Output
29	ESKIP	X13.6	Skip signal	Input
30	EADEN1-EADEN8	F112.0-7	Assign completion signal	Output
31	EABUFg	F131.1, F134.1, F137.1, F140.1 F143.1, F146.1, F149.1, F152.1	Buffer area full signal	Output
32	EACNT1-EACNT8	F182.0-7	Controlling signal	Output
33	*+ED1-*+ED8 *-ED1-*-ED8	G118.0-G118.7 G120.0-G120.7	External deceleration signal	Input
34	PLMVD1- PLMVD8	G137.0-G137.7	Axis direction control	Input

Table 5-51 Axis Control Function

Command	Action	Data 1	Data 2	Description
00	Fast moving	Fast moving speed	Total movement	Execute the same operation as CNC G00
01	Cutting feed per minute	Cutting feed speed	Total movement	Execute the same operation as CNC G94G01

02	Cutting feed per revolution	Feed speed per revolution	Total movement	Execute the same operation as CNC G95G01
03	Feed jump per minute	Cutting feed speed	Total movement	Execute the same operation as CNC G31G01
04	Dwell	—	Dwell time	Execute the same operation as CNC G04
05	Reference point return	—	—	Execute the same operation as CNC manual reference point return
06	Continuous feed	Continuous feed speed	Feed direction	Execute the same operation as CNC JOG feed
07	Return to the 1st reference point	Fast moving speed	—	Execute the same operation as CNC G28
08	Return to the 2nd reference point	Fast moving speed	—	Execute the same operation as CNC G30P2
09	Return to the 3rd reference point	Fast moving speed	—	Execute the same operation as CNC G30P3
10	Return to the 4th reference point	Fast moving speed	—	Execute the same operation as CNC G30P4
16	Speed command	Speed command speed	—	Execute continuous feed based on the speed command
18	1st auxiliary function	—	Auxiliary function code	Execute the same function as CNC auxiliary function
20	2nd auxiliary function	—		Execute the same function as CNC auxiliary function
21	3rd auxiliary function	—		Execute the same function as CNC auxiliary function
32	Selection of machine coordinate system	Fast moving speed	Mechanical coordinates	Execute the same function as CNC G53

Note:

"Command" represents axis control command signal EC0g-EC6g.

"Data 1" represents axis control feed speed signal EIF0g-EIF15g.

"Data 2" represents axis control data signal EID0g-EID31g.

The continuous feed command is an immediate command, and the CNC terminal does not cache the command.

5.48 PSGNL (Position signal output)

Function:

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

Ladder diagram format:

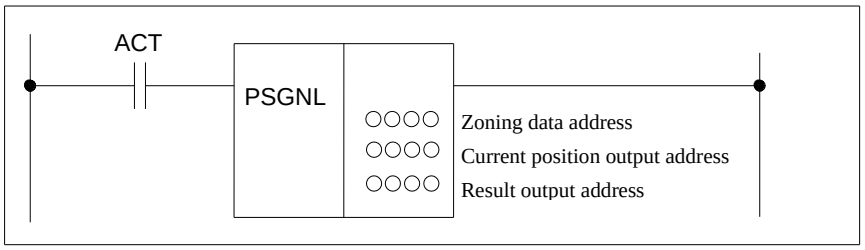


Figure 5-78

Command table format:

Table 5-53

S/N	Command	Operand	Notes
1	LD	○○○.○	ACT
2	FUNC	48	PSGNL
3	PRM	○○○○	Zoning data address
4	PRM	○○○○	Current position area output address
5	PRM	○○○○	Result output address

Control conditions:

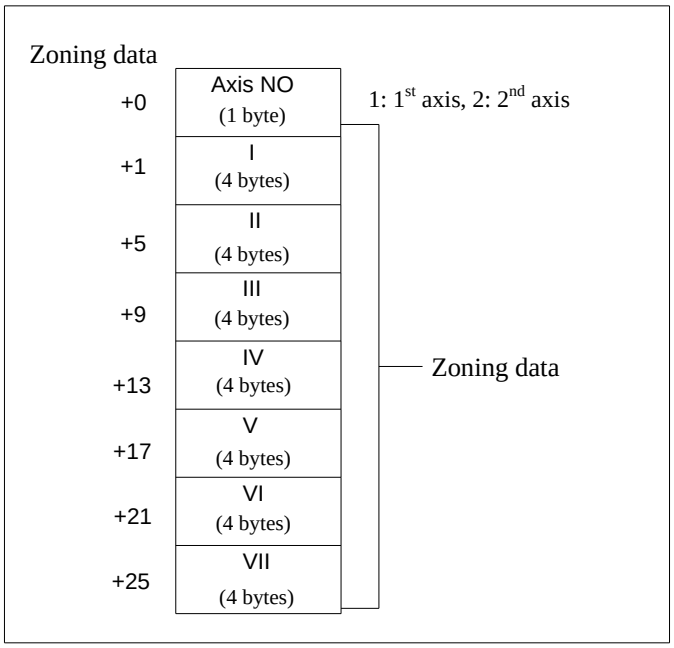
ACT=0: Do not execute PSGNL function.

ACT=1: Execute the PSGNL function.

Parameters:

(1) Zoning data address

The first address of zoning data is set, whereby 29 consecutive bytes of the address are supplied to the zoning data.



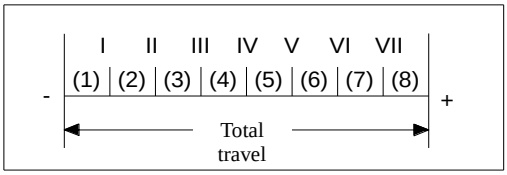
Axis No sets the axis number (one-byte data in binary format).

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

Axis No=2: the 2nd axis of the machine coordinate system

Each zoning data (I, II, III,..., VII) is the 4-byte binary data.

(Example of zoning): Divide the total travel into 8 zones through 7 zoning points, as shown in the following figure:



(2) Current position area output address

This address is used to output the area where the current position is located in the machine coordinate system.

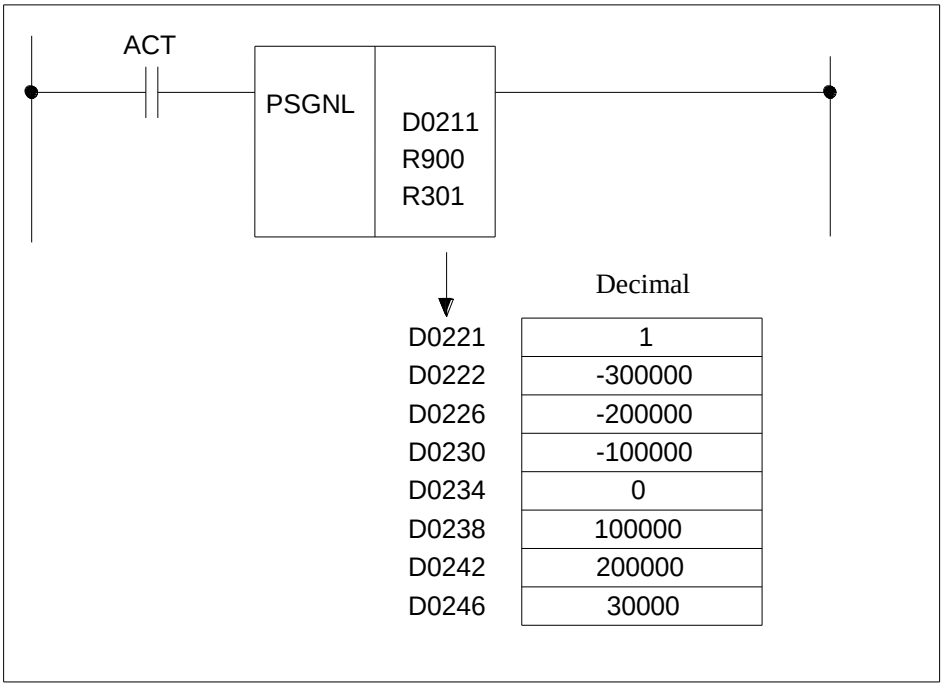
Current position	7	6	5	4	3	2	1	0
Area output address	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)

The corresponding bit of the current position in the area where the machine coordinate system is located in is set to 1.

(3) Operation result output register:

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

Example of position signal usage:



For the above ladder diagram and zoning data, if ACT=1, the current position area (R1000) output is as follows:

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

R1000.1=1: The current position is greater than 200.00mm but less than 300.00mm in the machine coordinate system.

R1000.2=1: The current position is greater than 100.00mm but less than 200.00mm in the machine coordinate system.

R1000.3=1: The current position is greater than 0mm but less than 100.00mm in the machine coordinate

system.

R1000.4=1: The current position is greater than -100.00mm but less than 0mm in the machine coordinate system.

R1000.5=1: The current position is greater than -200.00mm but less than -100.00mm in the machine coordinate system.

R1000.6=1: The current position is greater than -300.00mm but less than -200.00mm in the machine coordinate system.

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

5.49 PSGN2 (Position signal output 2)

Function:

OUT=1 when the current position is in the area specified by the parameter in the machine coordinate system.

Ladder diagram format:

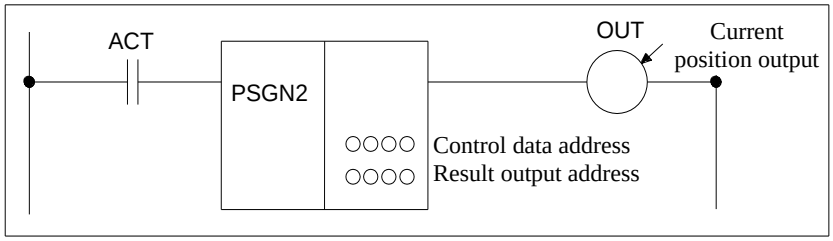


Figure 5-79

Command table format:

24

Table 5-54

S/N	Command	Operand	Notes
1	LD	○○○○.○	ACT
2	FUNC	49	PSGN2
3	PRM	○○○○	Control data address
4	PRM	○○○○	Operation result output
5	OUT	○○○○.○	Current position area output address

Control conditions:

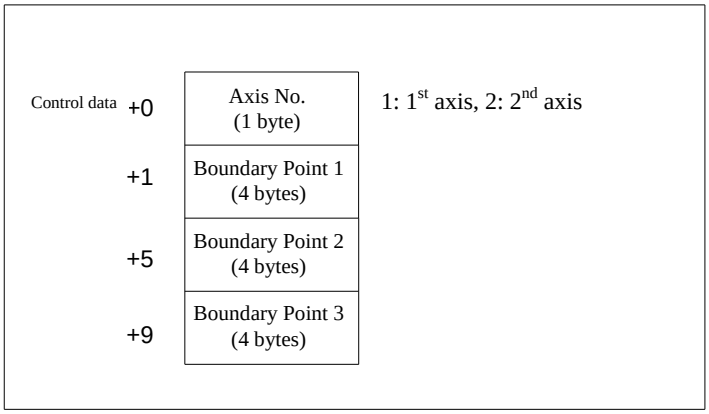
ACT=0: Do not execute the PSGN2 function.

ACT=1: Execute the PSGN2 function.

Parameters:

(1) Control data address

Set the first address of the control data.

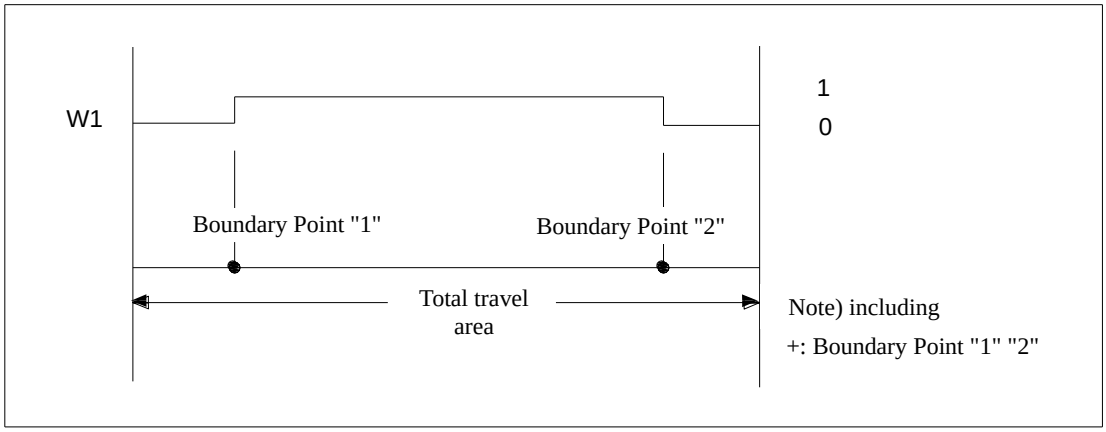


Axis number setting (1 byte in binary format)

(Example) Axis number=1: the machine coordinate of the 1st axis

Axis number=2: the machine coordinate of the 2nd axis

Example of zoning



(2) Operation result output address

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

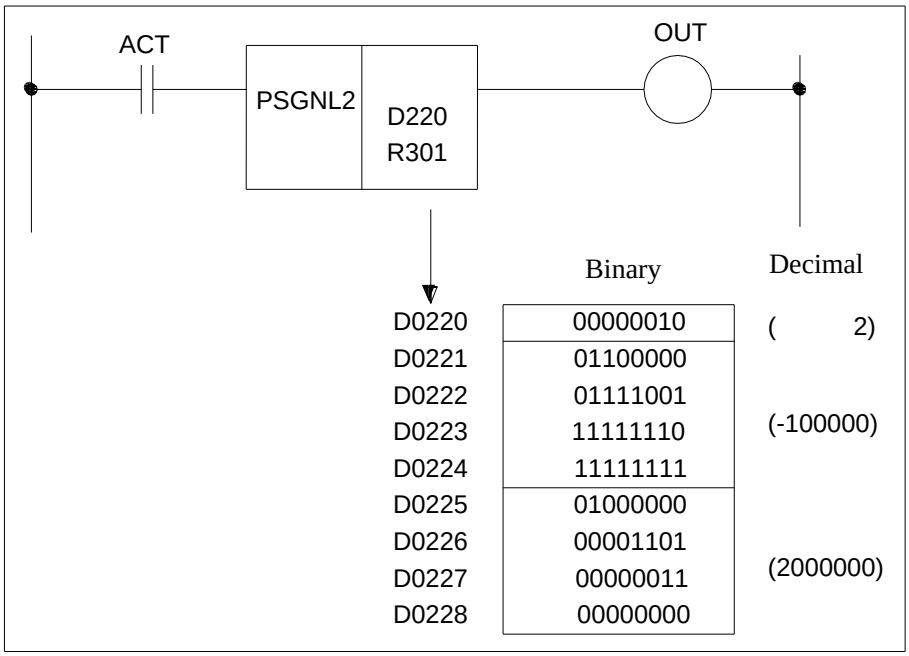
Output:

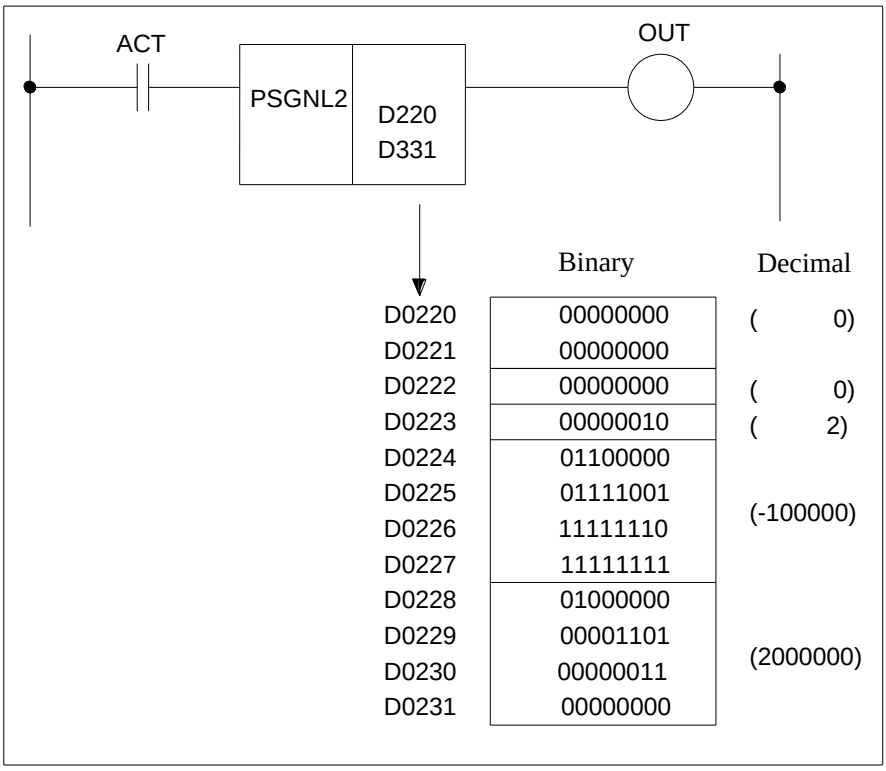
OUT=0: The current position is outside the area specified by the parameter in the machine coordinate system.

OUT=1: The current position is in the area specified by the parameter in the machine coordinate system.

Example of position signal usage:

This example shows how to output the current position signal of the 2nd axis of path 1 in the machine coordinate system. If the position is between -100.000mm and 200.000m, the control data address is set to D0220.





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

Chapter VI Editing Restrictions of Ladder Diagram

The editing restrictions of ladder diagram are shown as follows:

1. Programs must have END1 and END2 commands as end flag for Level 1 and Level 2 programs, and END1 must be before END2.
2. Only parallel output is supported instead of multi-level output.
3. For result output address in all basic commands and output function commands, the following address must not be set:
   1) Counter preset address and timer preset address.
   2) X Address on I/O input port and F Address of CNC→PLC.

The following conditions are considered as syntax errors, and the system will give alarm.

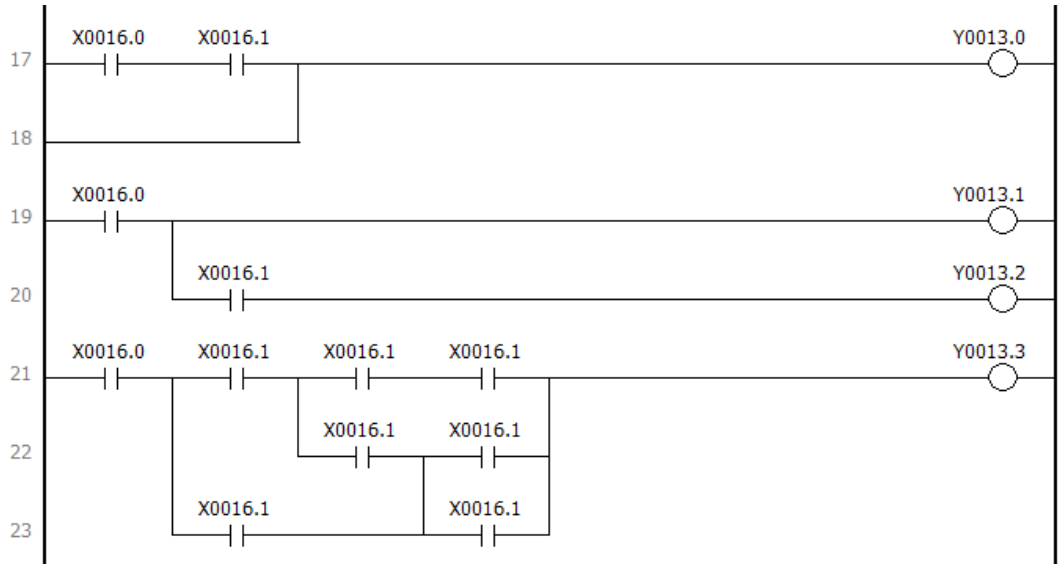


Figure 6-1

Part II Functions

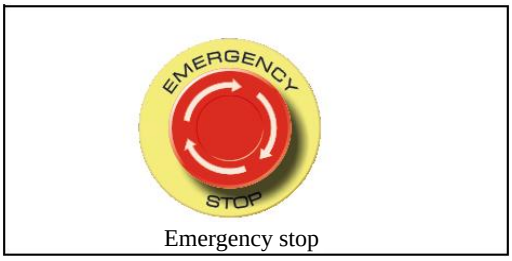
Chapter I Operation Preparation

1.1 Emergency stop

Signal symbol: *ESP (X008.4 G008.4)
Signal type: PLC→NC

Signal function: Enter an emergency stop signal to stop the machine immediately.

Press the emergency stop button on the machine operation panel. When the emergency stop signal *ESP becomes 0, the machine stops moving immediately, and CNC is reset to make the machine in emergency stop state.



Emergency stop

Figure 1-1

The button is locked after being pressed, and the method of release varies from machine manufacturer, it is usually rotated right for release.

Signal address:

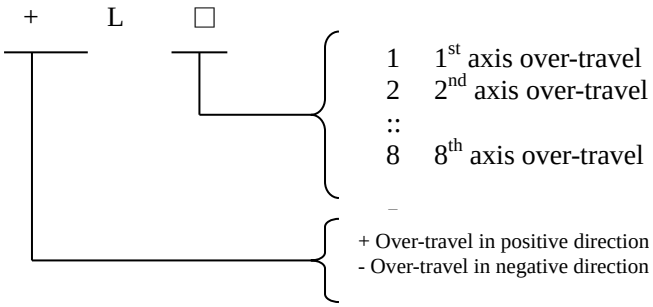
	#7	#6	#5	#4	#3	#2	#1	#0
X008			*ESP					
G008			*ESP					

1.2 CNC over-travel signal

Signal symbols: +*L1~+*L8 (G114#0~G114#7)
-*L1~-*L8 (G116#0~G116#7)

Signal type: PLC→NC

Signal function: When the tool shifts beyond the end of travel set by the limit switch of the machine, the limit switch runs, the tool slows down and stops, and the system displays an over-travel alarm. This signal indicates that the control axis has reached the limit of travel, and each control axis has this signal in each direction. The + and - of the signal name indicate the direction, and the number corresponds to the control axis.



When the over-travel signal is "0", the control unit runs as follows:

- ✧ During automatic operation, even if only one axis 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	-L5	-L4	-L3	-L2	-L2	-L1

1.3 Alarm signal

Signal symbol: ALM (F001#0)

Signal type: NC→PLC

Signal function: When an alarm occurs in CNC, the alarm signal is set to 1, with the alarm displayed on the screen. The alarm signal indicates that CNC is in alarm state, with the following alarm displays:

a) NC alarm
b) Over-travel alarm
c) Servo alarm

The alarm signal of following situations is 1:

--CNC is in alarm state.

The alarm signal of following situations is 0:

--Clear alarm through CNC reset.

Signal address:

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

1.4 Interlock

Full-axis interlock signal

Signal symbol: *IT (G008#0)

Signal type: PLC→NC

Signal function: This signal prevents the machine from shifting. When this signal is input during shift, the tool shift stops after deceleration. Specified axis shift is prohibited. The axis shift operation stops after deceleration when the signal *IT is set to '0'. However, in the case of autorun, it stops while maintaining the state of autorun (signal STL is '1', while signal SPL is '0').

Signal address:

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

Each axis is interlocked in different directions

Signal symbols: +MIT1~+MIT8 (G132#0~G132#7) -MIT1~-MIT8 (G134#0~ G134#7)

Signal type: PLC→NC

Signal function: The movement in the specified axis direction is prohibited.

Signal	Control Axis Direction	Signal	Control Axis Direction
+MIT1	1st axis positive direction	-MIT1	1st axis positive direction
+MIT2	2nd axis positive direction	-MIT2	2nd axis positive direction
+MIT3	3rd axis positive direction	-MIT3	3rd axis positive direction
…	…	…	…
+MIT8	8th axis positive direction	-MIT8	8th axis positive direction

When the interlock signal in the specified axis direction is set to "1", the CNC applies interlock only to the commanded axis direction. However, in the case of linkage in autorun, all axes are stopped.

Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G132	+MIT8	+MIT7	+MIT6	+MIT5	+MIT4	+MIT3	+MIT2	+MIT1
G134	-MIT8	-MIT7	-MIT6	-MIT5	-MIT4	-MIT3	-MIT2	-MIT1

Starting lock signal

Signal symbol: STLK (G007#1)

Signal type: PLC→NC

Signal function: This signal prevents any axis shift of the machine during autorun (automatic, DNC or MDI mode).

When the TLK signal is 1, the axis shift stops after deceleration.

In autorun, the program block containing only M, S, T, B, and the 2nd auxiliary function command may be executed consecutively before meeting the movement command block containing an axis.

Operation stops when a program block containing axis shift command is encountered, and the system is placed in autorun mode (STL=1, SPL=0). When the STLK signal becomes "0", the operation is restarted (Figures (a), (b)).

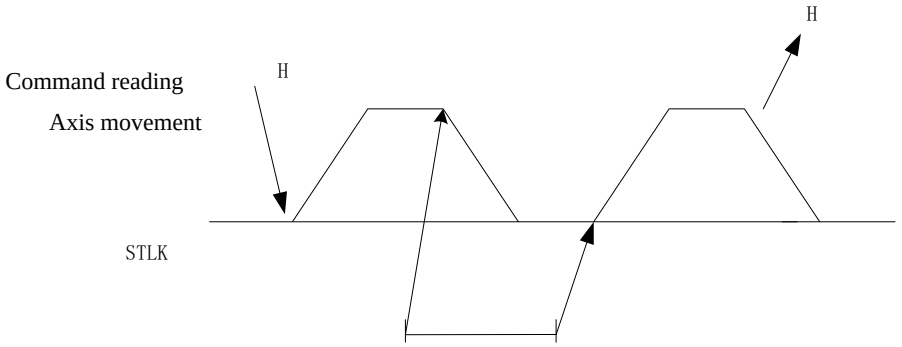


Figure (a) Program block containing the axis movement command only

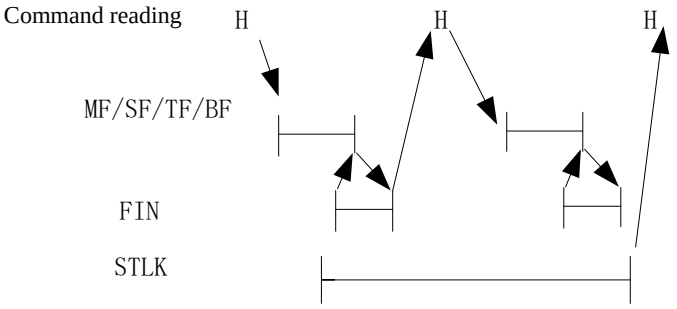


Figure (b) Program block containing auxiliary function only

Program block starts interlock signal

Signal symbol: *BSL (G008#3)

Signal type: PLC→NC

Signal function: This signal is used to control whether the next program block is allowed to start during autorun, as indicated by parameter 2402.0.

When this signal becomes 0, the next program block cannot be started in autorun mode.

This signal does not interrupt the autorun mode. The next program block is a valid command block. Once the signal is set to 1, the operation will resume.

Note: This signal only conducts interlock control of the initial program block of the loop when running an internally formed loop action program block such as a fixed cycle. For the halfway program block, execution will continue even if the signal becomes '0'.

Cutting program block starts interlock signal

Signal symbol: *CSL (G008#1)

Signal type: PLC→NC

Signal function: This signal is used to control the start of program block of shift command beyond ban positioning during autorun.

In autorun, the signal is set to '0', and execution of program block of shift command beyond positioning is not initiated.

Program block that the execution has already begun will be executed completely without being affected.

This signal does not interrupt the autorun mode, and the next program block is a valid command block. Once the signal is set to 1, the operation will resume.

Relevant parameters:

	#7	#6	#5	#4	#3	#2	#1	#0
2402								RLK

RLK: PLC starts the interlock function G007.1

0: Invalid

1: Valid

1.5 Operation mode selection

Operation mode selection

Signal symbols: MD1, MD2, MD3, INC (G43.0, G43.1, G43.2, G43.4)

Signal type: NC→PLC

Signal function: Select system operation mode based on the signal state.

Input Selection Signal				Output Signal	Operation Mode
INC	MD3	MD2	MD1		
0	0	0	0	MMDI	MDI mode
0	0	0	1	MMEM	Auto mode
0	0	1	0	MEDT	Editing mode
0	0	1	1	MH	MPG mode
0	1	0	0	MJ	Manual mode
0	1	0	1	MZRO	Zeroing mode
0	1	1	0	MRMT	DNC mode
1	1	0	0	MINC	Single-step method

Signal address:

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

Operation mode confirmation signal

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

Signal type: NC→PLC

Signal function: Indicate the currently selected operation mode.

Signal address:

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

1.6 Abnormal load detection

Overview

In the case of mechanical collision and poor tool head and damage, servo motor and spindle motor will bear more load torque than the usual feed and cutting. The abnormal load detection function detects the load torque borne by the motor. When the load torque is greater than the torque set in the parameters, servo motor and spindle motor shall be stopped as soon as possible in order to minimize the damage to the machinery.

The abnormal load detection function described in this function is divided into the following.

1. Load torque function

   The torque (current) of the motor is read by CNC at all times, and the data can be read by the diagnostic interface.

2. Abnormal load detection and alarm function

   It stops the motor and CNC outputs an alarm when the load torque is greater than the value set in the parameters.

   By using the bit parameter ABDW of the abnormal load detection function and the abnormal load detection ignoring signal IUDD1~IUDD8<G0125>, the abnormal load detection of the corresponding servo axis can be set to be invalid.

Caution:

Servo shut-off is used in the abnormal load detection function, under which, the excitation of the motor is cut, and the dynamic brake does not operate. Therefore, servo motor becomes completely free without braking force. Therefore, in the case of the gravity axis, if the mechanical brake and its drive circuit, sequence are abnormal, it is possible to fall quickly and freely. When applying abnormal load detection on the gravity axis, the abnormal load detection and alarm function shall be used.

PLC processing:

- Please enter the servo shut-off signal in the state of position tracking signal *FLWU <G007.5>='0'.
- When abnormal servo load alarm is detected, servo shut-off signals shall be entered to all axes.
- When abnormal loads are detected on the PMC axis, all axes enter an interlock state.
- When abnormal loads are detected in the digital spindle, and the servo axis needs to be stopped, the ladder diagram shall be used.

Related signals:

Abnormal load detection signal of servo axis

Signal symbol: ABTQSV (F090#0)

Signal type: NC→PLC

Signal function: Notify the PLC when an abnormal load is detected in the servo axis.

The servo axis becomes "1" when an abnormal load is detected.

Abnormal load detection signal of the 1st spindle

Signal symbol: ABTSP1 (F090#1)

Signal type: NC→PLC

Signal function: Notify the PLC when an abnormal load is detected in the 1st spindle.

The 1st spindle becomes "1" when an abnormal load is detected.

Abnormal load detection signal of the 2nd spindle

Signal symbol: ABTSP2 (F090#2)

Signal type: NC→PLC

Signal function: Notify the PLC when an abnormal load is detected in the 2nd spindle.

The 1st and 2nd spindles become "1" when an abnormal load is detected.

Abnormal load detection signal

Signal symbols: ABDT1~ABDT8 (Fn184.0~Fn184.7)

Signal type: NC→PLC

Signal function: Notify the PLC when the axis with abnormal load is detected.

When an abnormal load is detected on the feed axis, the corresponding bit becomes "1", and the abnormal load detection signal of servo axis ABTQSV (F090.0) also becomes "1".

Abnormal load detection ignoring signal

Signal symbols: IUDD1~IUDD8 (Gn125.0~Gn125.7)

Signal type: PLC→NC

Signal function: Abnormal load detection function will not be performed on the specified axis.

When the signal of the specified axis is 1, abnormal load detection will not be performed on the axis.

Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
F090						ABTSP2	ABTSP1	ABTQSV
F184	ABDT8	ABDT7	ABDT6	ABDT5	ABDT4	ABDT3	ABDT2	ABDT1
G125	IUDD8	IUDD7	IUDD6	IUDD5	IUDD4	IUDD3	IUDD2	IUDD1

Relevant parameters:

	#7	#6	#5	#4	#3	#2	#1	#0
7201								ABDW

ABDW: Abnormal load detection function of feed axis

0: Invalid

1: Valid

	#7	#6	#5	#4	#3	#2	#1	#0
7202								SPMT

SPMT: Abnormal load detection function of spindle

0: Invalid

1: Valid

7211	Abnormal servo load detection limit

[Data type] Integer axis type

[Data unit] percentage (%)

[Data range] 0-200

Set percentage of rated current (%)

7212	Abnormal servo load detection limit at acceleration and deceleration

[Data type] Integer axis type

[Data unit] percentage (%)

[Data range] 0-200

Set percentage of rated current (%)

7221	Abnormal spindle servo load detection limit

[Data type] Integer axis type

[Data unit] percentage (%)

[Data range] 0-200
Set percentage of rated current (%)

7222	Abnormal spindle servo load detection limit at acceleration and deceleration

[Data type] Integer axis type
[Data unit] percentage (%)
[Data range] 0-200
Set percentage of rated current (%)

1.7 Chuck tailstock barrier (turning)

Overview

Chuck tailstock barrier function is the function used to detect the interference between chuck and tailstock and tool nose to prevent damage to the machine. Depending on the shape of the chuck and the tailstock, a tool entering prohibited area can be set in advance by using a dedicated setting screen. This function stops the tool from shifting and displays an alarm message if the tool nose enters the prohibited area during processing. The tool can be removed from the prohibited area in the opposite direction of the feed.

Caution:

1. The chunk tailstock barrier is only valid for the lathe, the parameter **(No. 3000.0)** shall be set to "**1**"

2. When the chuck tailstock barrier is used, the parameter **(No. 1070.4)** shall be set to "**1**". After setting this parameter, the power supply needs to be temporarily shut off.

3. Storage travel detection **2, 3** cannot be used when the chunk tailstock barrier (parameter **(No. 1070.4)="1"**) is valid.

Note: The parameter interface is located in the 

key. Permission can be obtained through the login interface at the 

key. Parameters can be obtained through the [Search] key in the parameter interface, and parameter values are modified through the 

key.

Detailed description:

1. Press the 

key, and the **chuck tailstock** setting interface will pop up as shown in Figure 1-2.

To operate the functions of the chuck tailstock, press the 

key **first** to enter the display page, and then press the 

key to enter the login interface, where it can return to **the chuck tailstock interface** after obtaining the **login permission**.

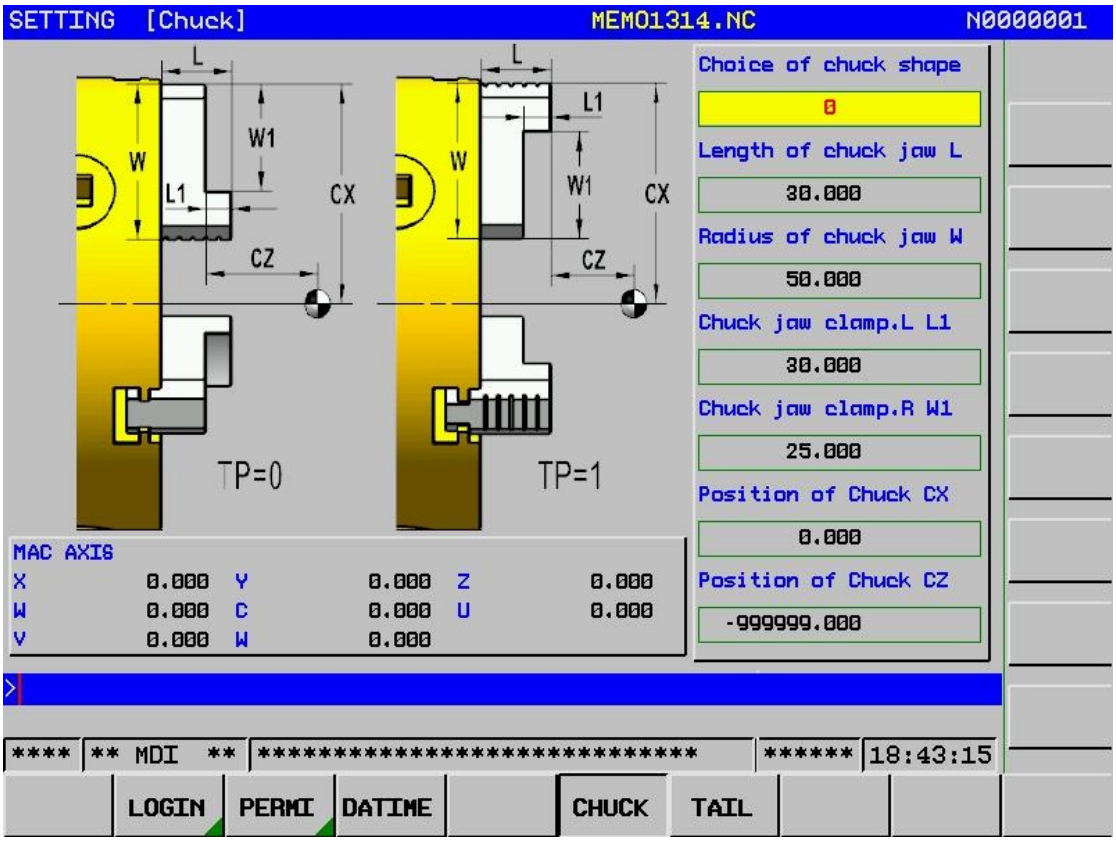


Figure 1-2 Interface of Chuck Tailstock

2. Setting of prohibited area of the chuck

The interface of chuck as shown in Figure 1-3 will pop up if pressing down the CHUCK key on the interface of chuck tailstock. See Figure 1-4 for the detailed introduction to the chuck.

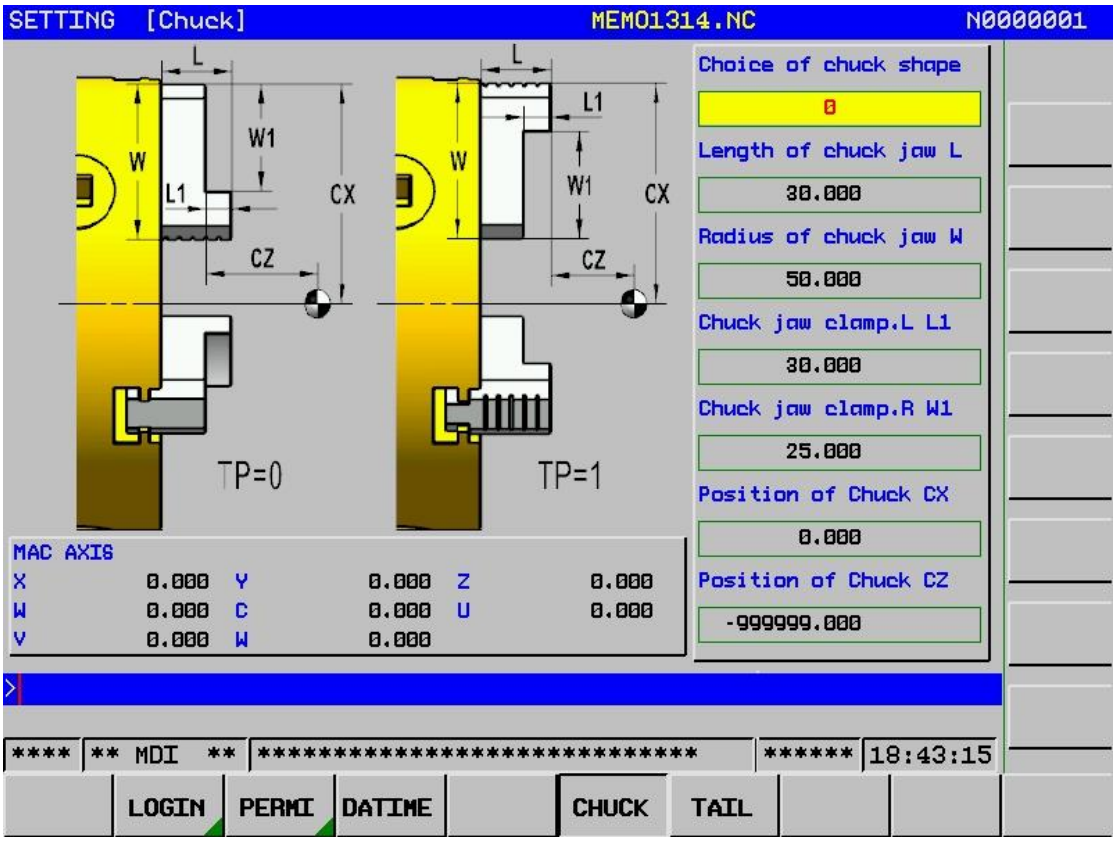


Figure 1-3 Interface of Chuck

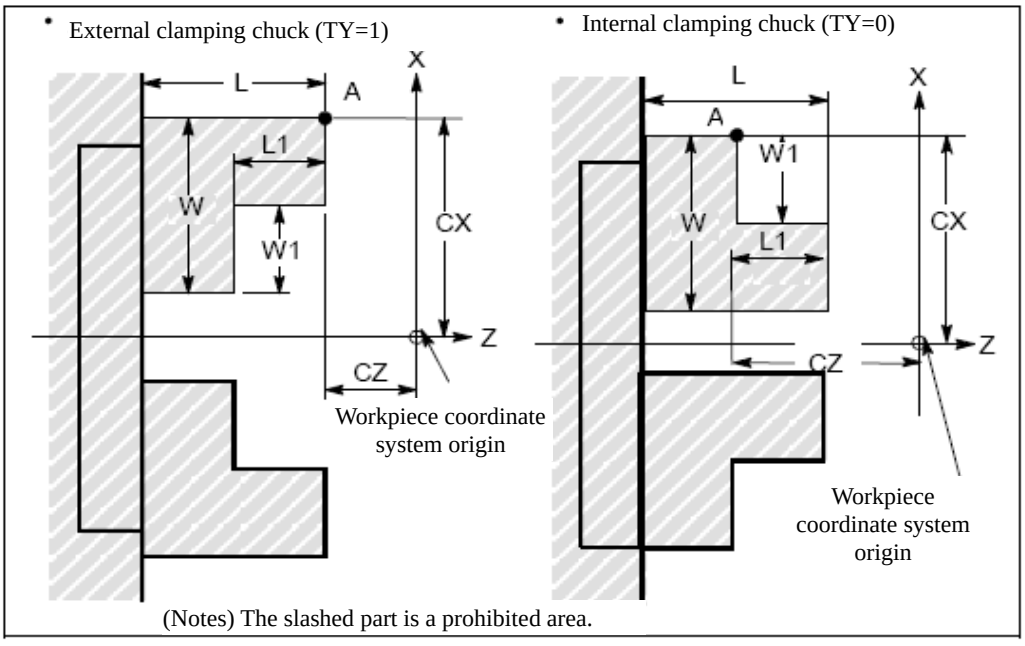


Figure 1-4 Detailed Introduction to the Chuck

Mark	Notes	Parameters
TY	Chuck shape selection (TP=**0**: internal clamping/**TP=1**: external clamping)	**No.1101**
L	Length of the chuck jaw	**No.1102**
W	Size of the chuck jaw (radius input)	**No.1103**
L1	Clamping length of the chuck jaw	**No.1104**
W1	Height difference for clamping of the chuck jaw (radius input)	**No.1105**
CX	Position of the chuck (**X**-axis)	**No.1106**
CZ	Position of the chuck (**Z**-axis)	**No.1107**

TY: Select the chuck shape. The internal clamping chuck is selected if 0 is specified, while the external clamping is selected if 1 is specified. **It is assumed that the chuck is symmetrical around Z-axis.**

L, L1: Define the length of the chuck jaw.

W, W1: Define the width of the chuck jaw.

CX, CZ: Set the position (A point) of the chuck through the coordinate value of the workpiece coordinate system. It is not the coordinate value in the machine coordinate system.

3. Setting of the prohibited area of the tailstock

The interface of tailstock as shown in Figure 1-5 will pop up if pressing down the TAIL key on the interface of chuck tailstock. See Figure 1-6 for the detailed introduction to the tailstock.

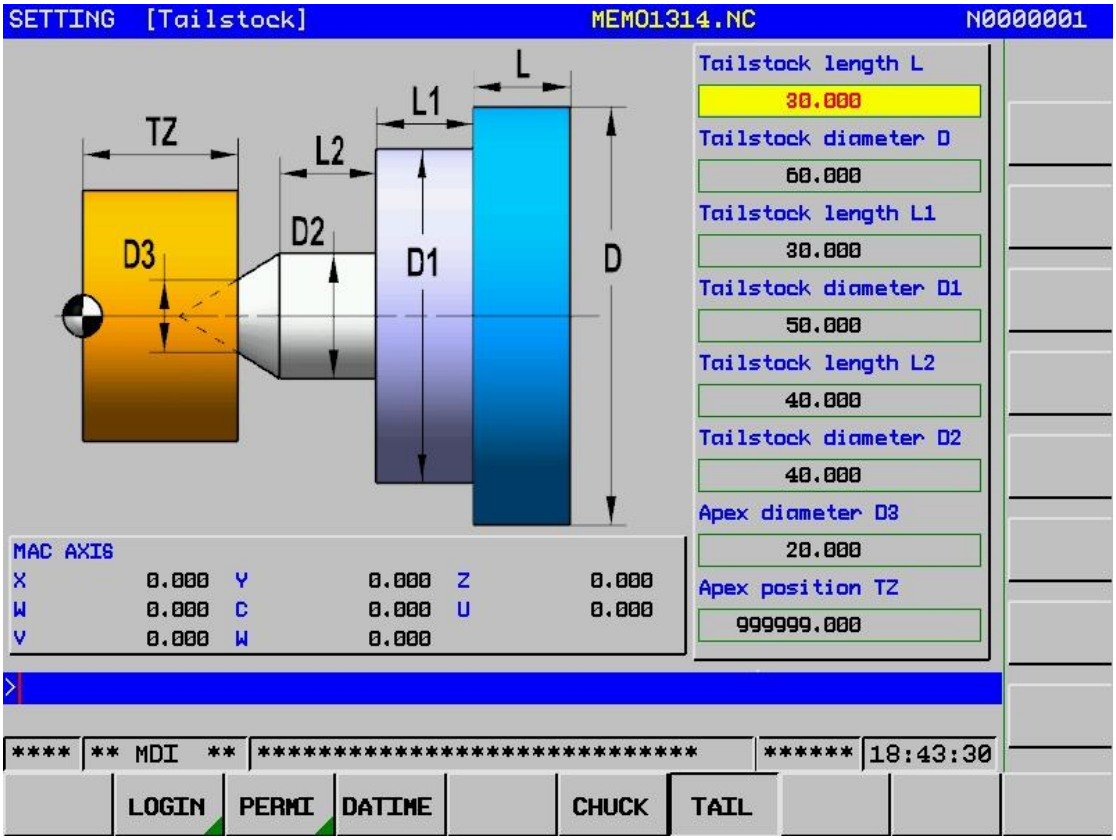


Figure 1-5 Interface of Tailstock

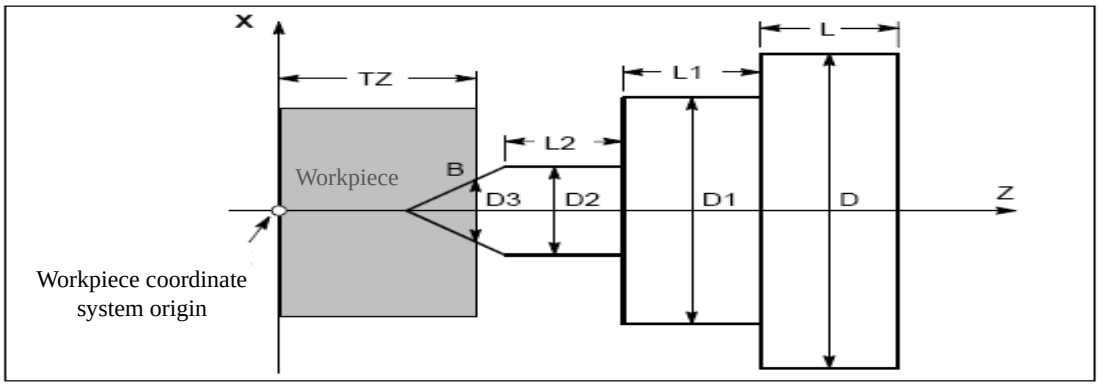


Figure 1-6 Detailed Introduction to the Tailstock

Mark	Notes	Parameters
L	Length of the tailstock	**No.1111**
D	Diameter of the tailstock (diameter input)	**No.1112**
L1	Length of the tailstock (**1**)	**No.1113**
L1	Length of the tailstock (**1**)	**No.1113**
D1	Diameter of the tailstock (**1**) (diameter input)	**No.1114**
L2	Length of the tailstock (**2**)	**No.1115**
D2	Diameter of the tailstock (**2**) (diameter input)	**No.1116**
D3	Bore diameter of the tailstock (**3**) (diameter input)	**No.1117**

TZ: Set the position (B point) of the tailstock through the coordinate value of the workpiece coordinate system. It is not the coordinate value in the machine coordinate system. It is assumed that the tailstock is symmetrical around the Z-axis.

L, L1, L2, D: Define the length of the tailstock.

D1, D2, D3: Define the diameter of the tailstock.

4. Signal

Selection signal for tailstock barrier *TSB<Gn060.7>

[Category] Input the signal

[Function] Select "Valid" or "Invalid" for the tailstock barrier.

[Action] If "1" is selected, the control device will act in the following means.

The tailstock will be set as "Invalid" in case G22 (Detection on Stored Travel is ON) is specified.

G Code	*TSB	Tailstock Barrier	Chuck Barrier (Reference)
G22	'0'	Yes	Yes
	'1'	No	Yes
G23	'0'	No	No
	'1'	No	No

The tailstock barrier will be Invalid in case G23 (Detection on Stored Travel is OFF) is specified no matter *TSB is set as "0" or "1".

The tailstock barrier can be set as "Invalid" if setting such signal as "1" in case G22

(Detection on Stored Travel is ON) is specified.

Get close to the tailstock in some cases by virtue of the M function, and set the tailstock barrier as "Valid" or "Invalid" through such signal while leaving the workpiece in some cases.

5. Restrictions

1) Correct setting for entering the prohibited area

The prohibited area may be invalid if the setting for entering the prohibited area is incorrect. Incorrect settings refer to the following situations.

- In setting of **the Chuck Shape**, **L<L1 or W<W1**.
- In setting of **the Tailstock Shape**, **D2<D3**.
- **The positions of the chuck and the tailstock are overlapped**.

2) Tool retracting if entering the prohibited area

If the tool enters the prohibited area and an alarm is sent out from the system, retract the tool manually after the switch is switched to manual mode. Afterwards, reset the system to cancel such alarm.

At this time, in manual mode, **tool can be moved in the opposite direction to that when entering prohibited area. Thus, the tool can no longer move along the direction (the direction further entering the prohibited area) identical to that entering the prohibited area.**

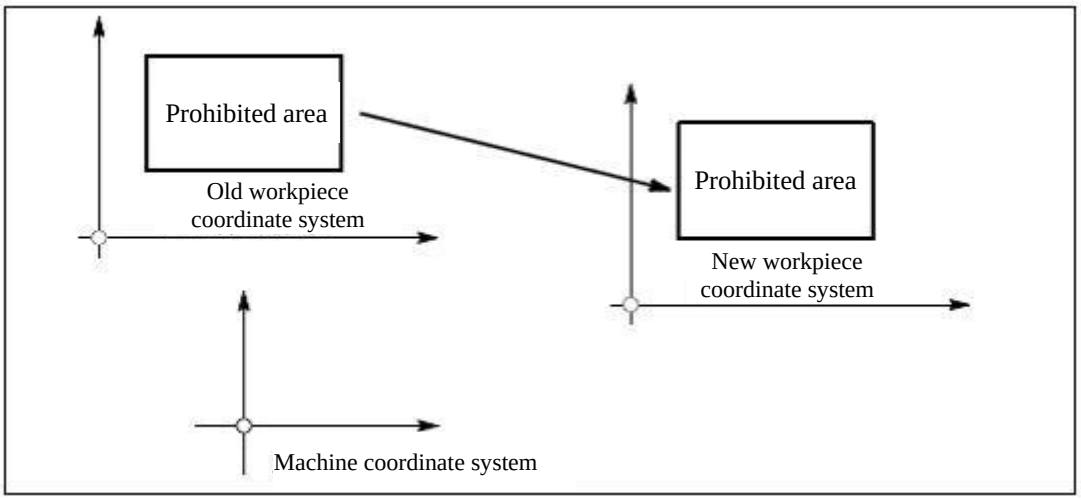
If **the prohibited area of the chuck tailstock is valid and the tool is positioned in such prohibited area, an alarm will be sent out once the tool is moved.**

If such alarm is sent out when the tool is moved and it is impossible to retract the tool from the prohibited area, change the setting of the prohibited area where the tool is located at, to make such tool beyond such area. Afterwards, reset the system to cancel such alarm, and retract the tool. Finally, recover the original setting.

3) Coordinate system

Since the prohibited area is defined through the workpiece coordinate system, the followings shall be noticed:

① While executing the commands or operations which may move the workpiece coordinate system, the prohibited area will also move for the same value.



The workpiece coordinate system may be displaced through the following commands and operations.

Command: G54~G59, G52, G50 (G92 in G code system B or C)

Operation: interruption of the manual-control MPG, change of the offset of the reference point of the workpiece, change of the offset (tool shape compensation) of the tool position, operation by virtue of the locked machine, manual operation when the absolute signal of the machine is OFF

② When the tool enters the prohibited area while in autorun and the tool is to be exited from the prohibited area by manual operation, please set manual absolute signal *ABSM<Gn006.2> to "0" (manual absolute signal is ON). If it is set to "1", even if the tool is moved in the manual operation mode, its movement amount will not be reflected in the workpiece coordinate value, and the tool cannot be withdrawn from the prohibited area.

6. Alarm and messages

Alarm Number	Alarm Messages
PS0270	Wrong parameters setting for the shape parameter of the chuck
PS0271	Wrong parameters setting for the shape parameter of the tailstock
PS0272	Overlapped position of the chuck and the nose

7. Input signal (imperial-system)

INCH <F002#0>

[Category] Output signal

[Function] Execute the signal processing of G20/G21 commands during autorun (memory or MDI operation)

[Action] If G20 command is executed, the INCH signal is 1; if G21 command is executed, the INCH signal is 0.

Chapter II Coordinate Axis Control Function

2.1 Signal for axis moving

Signal symbols: MV1~MV8 (F102.0~F102.7)

Signal type: NC→PLC

Signal function: CNC outputs signals to PLC, indicating that corresponding axis is moving.

MV1	Signal indicating that the 1st axis is moving
MV 2	Signal indicating that the 2nd axis is moving
MV 3	Signal indicating that the 3rd axis is moving
…	…
MV 5	Signal indicating that the 5th axis is moving

Conditions when the output is 1:

The signal indicating the moving of corresponding axis is changed as 1 when the command for movement is sent out from CNC. In this case, such figure is still kept as 1 even though no movement actually occurs under the control of interlocking and override signals.

Such figure is also 1 when the selection signal of corresponding axis is ON under manual control.

Conditions when the output is 0:

After the commands for movement from CNC are sent out, the signal for moving of corresponding axis is changed as 0 when such movement is suspended. The error arising from lagging of the servo drive is not considered for such signal.

Signal address:

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

2.2 Signal for movement direction of the axis

Signal symbols: MVD1~MVD8 (F106.0~F106.7)

Signal type: NC→PLC

Signal function: The signal output from CNC to PLC, indicating moving direction of corresponding axis.

MVD1	Signal indicating negative moving of the 1st axis
MVD2	Signal indicating negative moving of the 2nd axis
MVD3	Signal indicating negative moving of the 3rd axis
…	…
MVD5	Signal indicating the negative movement of the 5th axis

Conditions when the output is 1:

The signal of corresponding axis is changed as 1 when such axis starts negative moving.

Conditions when the output is 0:

The signal of corresponding axis is changed as 0 when such axis starts positive moving.

Note: The signal for moving direction of the axis shall be maintained to that before such axis stops moving.

Signal address

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

2.3 Enabling break signal of the axis

Signal symbols: SVF1~SVF8 (G126.0~G126.7)

Signal type: PLC→NC

Signal function: This signal controls the servo enabling state of each axis.

SVF1	Enabling break signal of the 1st axis
SVF2	Enabling break signal of 2nd axis
SVF3	Enabling break signal of the 3rd axis
…	…
SVF8	Enabling break signal of the 8th axis

When the signal is 1:

the corresponding axis will be the enabling break, and the servo motor is under a free state.

When the signal is 0:

the enabling of corresponding axis will be ON, and the servo motor is under an enabling state.

Caution: The motor is under a free state when the enabling of the axis breaks; the enabling signal can only be OFF after the axis is stopped. Great attention shall be paid to sharp falling of the axis under the effect of gravity with the enabling break signal.

Signal address

	#7	#6	#5	#4	#3	#2	#1	#0
G126	SVF8	SVF 7	SVF 6	SVF 5	SVF 4	SVF 3	SVF 2	SVF 1

2.4 Signal for position trailing

Signal symbol: *FLWU (G007.5)

Signal type: PLC→NC

Signal function: Such signal decides on whether position trailing is required when the servo enabling of each axis is OFF. Such function can prevent the position coordinates of machinery from offset after the servo enabling is OFF.

When the signal is 1:

Position trailing is not required during enabling break.

When the signal is 0:

Position trailing is required during enabling break.

Signal address

	#7	#6	#5	#4	#3	#2	#1	#0
G007			*FLWU					

2.5 Signal for position switch

Signal symbols: PSW01~PSW32 (F70~F73)

Signal type: NC→PLC

Signal function: the signal (32 points in total) output from CNC to PLC. When the mechanical coordinates of the axis specified by parameters (N2500-N2531) are within the scope set by such parameters, corresponding signal will turn as 1, which is an action simulated by the software for travel switch.

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

Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
F070	PSW08	PSW07	PSW06	PSW05	PSW04	PSW03	PSW02	PSW01
F071	PSW16	PSW15	PSW14	PSW13	PSW12	PSW11	PSW10	PSW09
F072	PSW24	PSW23	PSW22	PSW21	PSW20	PSW19	PSW18	PSW17
F073	PSW32	PSW31	PSW30	PSW29	PSW28	PSW27	PSW26	PSW25

Relevant parameters:

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

SWI: valid signs of position switch

0: function of position switch invalid

1: function of position switch valid

2500	Corresponding servo axis number of the position switch 1
~	
2531	Corresponding servo axis number of the position switch 16

Set corresponding servo axis number of each position switch. If such number is set as 0, the corresponding position switch is invalid, and set as 1 for Axis X, 2 for Axis Y, 3 for Axis Z, 4 for the

4th axis, and so on.

2532	Maximum action range of the position switch 1
~	
2563	Maximum action range of the position switch 32
2564	Minimum action range of the position switch 1
~	
2595	Minimum action range of the position switch 32

Set the action range of each position switch with mechanical coordinate values.

2.6 Synchronized axis control by PLC

Overview

Using the command of one axis to control the synchronous operation of two motors to drive a feed axis is often called gantry axis function. Two motors work under the master/slave mode respectively.

The synchronized axis can work under two operation methods. Firstly, make the axis operate under synchronous operation through parameters. Secondly, control the axis to switch from general state to synchronous operation state through signals.

Switching through signal

When the parameter 4020#0 SYN is set as 0, switch synchronous operation and general operation through the SYNC signal (1: synchronous operation; 0: general operation).

Through parameter setting:

When the parameter 4020#0 SYN is set as 1, synchronous operation remains and is unrelated to signal.

Feed axis synchronization selection signal

Signal symbols: SYNC1~SYNC8 (G138.0~G138.7)

Signal type: PLC→NC

Signal function: Select the slave axis for synchronous control under the mode of "Automatic/ MDI/ DNC".

Under the mode of Auto/MDI/DNC", the axis with a signal of 1 becomes (become the slave axis of whichever axis depends on the set value of the parameter 4021) the slave axis for synchronous control of the feed axis is cancelled when the signal is 0.

SYNC1	1st axis serves as the slave axis for synchronous control over the feed axis
SYNC2	2nd axis serves as the slave axis for synchronous control over the feed axis
SYNC3	3rd axis serves as the slave axis for synchronous control over the feed axis
…	…
SYNC8	8th axis serves as the slave axis for synchronous control over the feed axis

Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G138	SYNC8	SYNC7	SYNC6	SYNC5	SYNC4	SYNC3	SYNC2	SYNC1

Selection signal for manual synchronous control of the feed axis

Signal symbols: SYNCJ1~SYNCJ8 (G140.0~ G140.7)

Signal type: PLC→NC

Signal function: Select the slave axis for synchronous control during operation under the mode of "Manual, MPG and Returning to the Reference Point".

Under the mode of "Manual, MPG and Returning to the Reference Point", the axis with a signal of 1 becomes (become the slave axis of whichever axis depends on the set value of the parameter 4021) the slave axis for synchronous control of the feed axis. Synchronization is cancelled when the signal is 0

.

SYNCJ1	1st axis serves as the slave axis for synchronous control over the feed axis
SYNCJ2	2nd axis serves as the slave axis for synchronous control over the feed axis
SYNCJ3	3rd axis serves as the slave axis for synchronous control over the feed axis
…	…
SYNCJ8	8th axis serves as the slave axis for synchronous control over the feed axis

Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G140	SYNCJ8	SYNCJ7	SYNCJ6	SYNCJ5	SYNCJ4	SYNCJ3	SYNCJ2	SYNCJ1

Relevant parameters:

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

SYN: effective signs for synchronization of the feed axis

0: Invalid

1: Valid

ADJ: modification form for synchronization of the feed axis

0: Invalid

1: Valid

4021	Number of the main control axis
4022	Allowable synchronization error of the coordinates of the machine
4023	Allowable synchronization error of position deviation

4024	Allowable compensation of synchronous adjustment
4025	Allowable error of synchronous torque
4026	Zero amplitude of synchronous error compensation
4027	Gains of synchronous error compensation

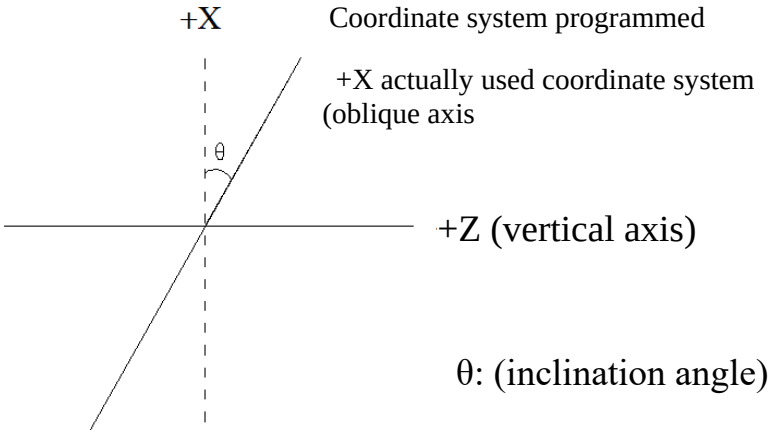
2.7 Oblique axis control

Overview

Such function is used to control the movement distance of each axis when two intersecting axes are not vertical (90°) and the inclination angle is converted into orthometric 90°. Assume that the oblique axis is perpendicular to the longitudinal axis during programming, but the actual movement distance shall be controlled as per the inclination angle.

Function description:

Schematic Diagram for Function of the Oblique Axis:



When the oblique axis is X-axis and the longitudinal axis is Z-axis, the movement distance of each axis shall be calculated as per the following formula.

The calculation formula for movement distance along the X-axis is as follows:

$$Xp=Xa*SIN\theta$$

The movement distance along the Z-axis shall be modified as per the inclination angle of the X-axis and be calculated as per the following formula:

$$Za=Zp–Xp\ tan\theta$$

The component of feed speed along the X-axis shall be calculated as per the following formula:

$$Fp=Fa*SIN\theta$$

Where:

Xa, Za, Fa: actual distance and speed

Xp, Zp, Fp: distance and speed of programming

● How to use

The oblique axis and the longitudinal axis in oblique axis control must be specified in the parameters

7110 and 7111 in advance.

Whether the function of oblique axis control is valid depends on the parameter SAXE (No.7100#0). When such function takes effect, the movement distance along each axis is controlled as per the inclination angle (No.7112).

● Display of absolute and relative position

The absolute position and the relative position shall be displayed as per the Cartesian coordinate system programmed.

● Display of the position of machine

The position of the machine can be displayed as per the machine coordinate system and the actual movement is affected by the inclination angle. During metric/imperial-system conversion, the position displayed comprises the results of oblique axis control after metric/imperial-system conversion.

Note: When the inclination angle is set close to 0 °or ±90 °, errors may occur. A proper scope of angle is ±20 °-±90 °.

Relevant parameters:

	#7	#6	#5	#4	#3	#2	#1	#0
7100							SAXJ	SAXE

SAXE: function of tilting axis control

0: Invalid

1: Valid

SAXJ: manual functions of tilting axis control

0: Invalid

1: Valid

7110	Number of the oblique axis

[Data type] Integer type

[Data range] 1~3

[Form of effectiveness] Reset

7111	Number of the orthogonal axis

[Data type] Integer type

[Data range] 1~3

[Form of effectiveness] Reset

7112	Angle of the oblique axis

[Data type] Real number type

[Data range] -180~180; input is prohibited for -105~-75 and 75~105. Anticlockwise centering the linear axis is positive.

[Form of effectiveness] Reset

2.8 Output of current speed scale

Overview

Start such function through the G171 P_ commands of the processing program. Calculate as per the current rate and proportionality coefficient and output the results to the address F240~241 of PLC.

Function description:

Formula: F240~F241 (binary)=current rate×P

G171 state signal: F88.0=1 Valid

F88.0=0 Invalid

P: proportionality coefficient in G170

G171 format used:

G171 P_ (P proportionality coefficient) Open the output of the current rate scale

.....

.....

G170 Close the output of the current rate scale

Remarks: 1. G171 reset is cancelled;

2. In case of no movement at the tool nose below RTCP, the output of the rate scale function F240 is 0.

Current rate signal

Signal symbols: F001~F016 (F240.0~F240.7)

Signal type: NC→PLC

Deliver the current feed speed F from NC to PLC through G171 of the G code as per certain proportion, and display through F240-F241.

Signal address:

F240	F008	F007	F006	F005	F004	F003	F002	F001
F071	F016	F015	F014	F013	F012	F011	F010	F009

Chapter III Manual Operation

3.1 JOG feed/incremental feed

Overview

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.

Under the mode of "single step feed", set the selection signal for feed axis and direction on the machine operation panel as 1, so the machine is moved for one step along the axis selected in the selected direction. The minimum distance for movement of the machine is the minimum input increment. Each step has the minimum input incremental value of 10/100/1000 times.

The sole difference between JOG feed and single step feed is the form selecting feed distance. Under the mode of "JOG 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. The feed speed of JOG can be adjusted by the JOG feed speed override switch. Through the fast feed selector switch, the machine moves at a fast feed speed regardless of the JOG feed speed override signal.

The single step incremental distance is selected through the signal **G19#4~G19#5 for** movement distance of MPG feed.

Selection of feed axis and direction

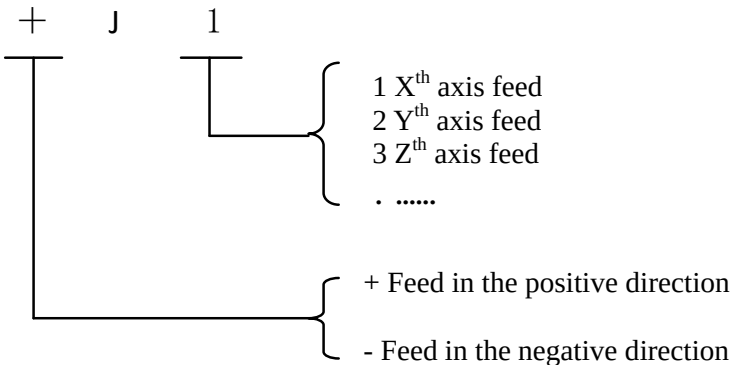
Signal symbols: +J1~+J8 (G100#0~G100#7)

-J1~-J8 (G102#0~G102#7)

Signal symbol: PLC→NC

Signal function: Select the feed axis and direction required under the mode of "JOG feed" or "incremental feed".

The "+/-" in the signal name indicates the feed direction, and the number corresponds to the control axis.



When the signal is 1, the action of the control unit is as follows:

When the JOG feed or single step feed is effective, the control unit will make the specified axis move in the specified direction.

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

Selection signal for manual rapid feed

Signal symbol: RT (G19#7)

Signal type: PLC→NC

Signal function: Select "JOG" to change feed as "rapid feed speed".

During JOG feed, the signal is changed as 1, the feed speed turns to fast feed, and is controlled by rapid override.

Signal address:

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

3.2 MPG feed

Signal symbols: HS1A, HS1B, HS1C, HS1D (G018#0~G018#3)

Signal type: PLC→NC

Signal function: Under the mode of "MPG feed", select the axis of MPG feed.

HS1D	HS1C	HS1B	HS1A	Select Axis
0	0	0	1	X
0	0	1	0	Y
0	0	1	1	Z
0	1	0	0	4
0	1	0	1	5
0	1	1	0	6
0	1	1	1	7
1	0	0	0	8

Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G018					HS1D	HS1C	HS1B	HS1A

Selection signal for the 2nd MPG axis

Signal symbols: HS2A, HS2B, HS2C, HS2D (G018#4~G018#7)

Signal type: PLC→NC

Signal function: Under the mode of "MPG feed", select the axis of MPG feed.

HS2D	HS2C	HS2B	HS2A	Select Axis
0	0	0	1	X
0	0	1	0	Y
0	0	1	1	Z

0	**1**	**0**	**0**	**4**
0	**1**	**0**	**1**	**5**
0	**1**	**1**	**0**	**6**
0	**1**	**1**	**1**	**7**
1	**0**	**0**	**0**	**8**

Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G018	HS2D	HS2C	HS2B	HS2A	HS1D	HS1C	HS1B	HS1A

Selection signal for MPG/incremental feed amount

Signal symbols: MP1, MP2 (G019#4~G19#5)

Signal type: PLC→NC

Signal function: During selection of the MPG feed of such signal, the movement distance of each pulse is generated from the MPG. And that of each step of incremental feed can also be selected.

Signal symbol: MPSELT (G019#3)

Signal type: PLC→NC

Signal function: When the signal is 1, the MPG override signal is controlled to be reduced by 10 times.

MP2 (G19.5)	MP1 (G19.4)	Override (G19.3=0)	Override (G19.3=1)
0	**0**	**×1**	**×0.1**
0	**1**	**×10**	**×1**
1	**0**	**×100**	**×10**
1	**1**	**×1000**	**×100**

Signal address:

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

Selection signal of the 2nd MPG/incremental feed

Signal symbols: MP1A, MP2B (G087#4~G87#5)

Signal type: PLC→NC

Signal function: During selection of the MPG feed of such signal, the movement distance of each pulse is generated from the MPG. And that of each step of incremental feed can also be selected.

MP2A (G87.5)	MP1B (G87.4)	Override
0	**0**	**×1**
0	**1**	**×10**
1	**0**	**×100**
1	**1**	**×1000**

Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G087			MP2A	MP1B				

Instructions of the 2nd MPG

The analog interface X21 of the spindle is adopted currently, and the below is the interconnected table.

Spindle Interface X21 (MDR26)	MPG Interface J15 (MDR20)	Line Color of the Handheld Box	Definition Description
20	1	**Red**	+5V
18	16	**Green**	PA+
19	17	**Purple**	PA-
16	15	**White**	PB+
17	14	**Purple and black**	PB-
13	11	**Green and black**	+24V
23	4	**White and black**	LED
8	5	**Yellow**	Selection of the X-axis
9	6	**Yellow and black**	Selection of the Y-axis
10	7	**Brown**	Selection of the Z-axis
11	8	**Brown and black**	4-axis selection
12	3	**Blue and black**	STP (emergency stop)
21	10	**Orange and black/light blue/black**	0V

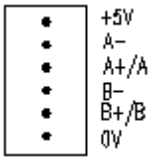
3.3 Functions of the 2nd MPG

Only GSK25iMc/GSK25iTc system's independent key operation panel is supported. The MPG signal is connected to CN303 or CN332 in the operation panel, and the MPG pulse receiving signal provides two input signals, which can be selected through PLC address Y121.7. When the system selection is completed, it will automatically give the X121.7 status.

Interface Selection	Control Signal	Completion Signal	Remark
CN303	Y121.7=0	X121.7=0	Using the pulse interface in CN3303
CN332	Y121.7=1	X121.7=1	Using the pulse interface in CN332

1. CN303 MPG Interface

Can receive TTL signal or differential signal MPG.

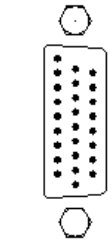


CN303 Interface		
Pin No.	**Address**	**Function Description**
1		+5V
2		A-
3		A+/A
4		B-
5		B+/B

	6		0V

2. **CN332** Interface of the Handheld Box

Connect to the 2nd hand MPG; HA+, HA-, HB+, HB- signals correspond to X124.0 to X127.7. The signal between X124.0 and X127.7 will change when the MPG is turned.



CN332 Interface								
Pin No.	**PLC Address**	**Function Description**	**Pin No.**	**PLC Address**	**Function Description**	**Pin No.**	**PLC Address**	**Function Description**
1	X124	HA+	10	——	GND	19	——	——
2	—	HA-	11	——	GND	20	X123.4	MPGX2.1
3	X127	HB+	12	——	GND	21	——	——
4	Four bytes	HB-	13	——	GND	22	X123.5	MPGX1.5
5	X123.0	MPGX1.0	14	——	+5V	23	X123.6	MPGX1.6
6	X123.1	MPGX1.1	15	——	+5V	24	X123.7	MPGX1.7
7	——	——	16	——	+5V	25	X121.2	MPGX1.3
8	X123.2	MPGX1.2	17	——	+24V	26	X121.3	MPGX2.0
9	X123.3	MPGX1.4	18	——	+24V			

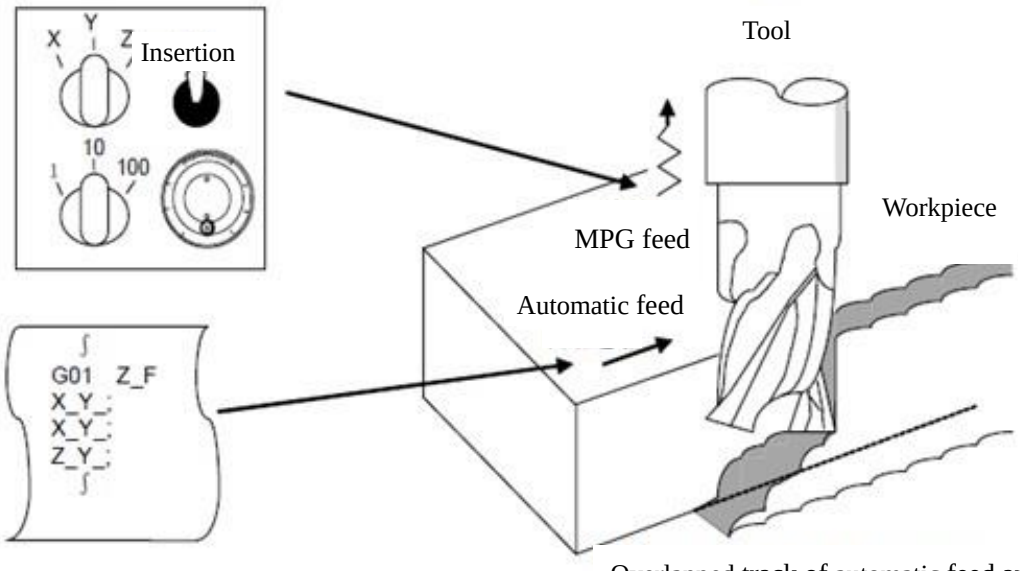
3.4 Insertion of the MPG

Overview:

Under the mode of autorun (MDI, DNC and automatic), insert the MPG by rotating for overlapping onto the movement under autorun. Select the axis for interrupting the MPG through the selection signal of the axis for interrupting the MPG. The feed override for inserting the MPG is identical to that of ordinary MPG (MP1, MP2<G019.4, 5>). This function is commonly used for adjusting while machining if the machining allowance is uncertain during programming. The insertion value of MPG will not change the workpiece coordinate system.

When the MPG interruption is valid, the insertion of the MPG can be viewed on the position interface. The coordinate of the machine tool will vary with the insertion of MPG, while (Absolute Coordinate), (Relative Coordinate) and (Surplus Distance) will remain unchanged.

The insertion of MPG of each axis corresponds to the #5301-#5308 macro-variable



Overlapped track of automatic feed and MPG feed

Caution:

1) When the machine is locked, the MPG interruption is invalid.
2) The speed and override of the MPG interruption cannot be changed.
3) Interruption of the MPG is invalid in the mode of MPG.
4) When the MPG interruption is valid, the mirror function is invalid.

Signal of handheld insertive axis

Signal symbols: HS1IA, HS1IAB, HS1IAC, HS1IAD (G041#0~G041#3)

Signal type: PLC→NC

Signal function: Under the "MPG insertion" mode, select the feed axis of MPG insertion.

HS1ID	HS1IC	HS1IB	HS1IA	Select Axis
0	0	0	1	X
0	0	1	0	Y
0	0	1	1	Z
0	1	0	0	4
0	1	0	1	5
0	1	1	0	6
0	1	1	1	7
1	0	0	0	8

2nd MPG insertion axis selection signal

Signal symbols: HS2IA, HS2IAB, HS2IAC, HS2IAD (G041#4~G041#7)

Signal type: PLC→NC

Signal function: Under the "MPG insertion" mode, select the 2nd feed axis of MPG insertion.

HS2ID	HS2IC	HS2IB	HS2IA	Select Axis
0	0	0	1	X
0	0	1	0	Y
0	0	1	1	Z
0	1	0	0	4
0	1	0	1	5
0	1	1	0	6
0	1	1	1	7
1	0	0	0	8

Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G041	HS2ID	HS2IC	HS2IB	HS2IA	HS1ID	HS1IC	HS1IB	HS1IA

Selection signal for tool axis insertion direction of 5-axis MPG

Signal symbol: HSFTA (G023#4)

Signal type: PLC→NC

Signal function: Under the "MPG insertion" mode, when the spindle is under swing, select whether the MPG insertion tool will move in the direction of tool axis after swing of the spindle during axial movement.

0: do not consider the swing angle of the spindle.

1: move as per the angle after swing.

Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G023				HSFTA				

3.5 Simulation of the MPG

Overview:

Start the simulation function of the MPG through control over G67#2 by PLC, and then control the feed speed and forward and backward movement direction of the program through the MPG

Function description:

1. Start the simulation function of the MPG through G67.2, and it is required to hold the signal;
2. Start the G67.2 signal during cycle start under the mode of autorun, and enter the simulation function of the MPG after the tail is stopped. After entering the simulation of the MPG, the signal F91.3=1 will be sent out;
3. Control the feed of the program with the MPG after the cycle start under the simulation function of the MPG;
4. Cancel the G67.2 signal under the simulation of the MPG, and then enter the automatic mode and the "no-operation" state. autorun can be resumed after the cycle start and the signal is F91.3=0;
5. Forward and backward movements can be controlled through G100.0 (+X forward)/G102.0 (-X backward) if without the MPG.

Relevant parameters:

	#7	#6	#5	#4	#3	#2	#1	#0
1400	HRE							

1550	Time constant for acceleration/deceleration of two-way simulation of the MPG (ms)
1500	Step override for two-way simulation of the MPG

Note 1: The step override for simulation of the MPG is 1551 and one fixed override can be multiplied based on the length of MPG pulse.

Note 2: The constant for acceleration/deceleration simulated by the MPG is 1550 milliseconds (interpolation period of 2 milliseconds during tests; #1550=60). Vibration may occur when the parameters are too small. The track will deviate from the programmed route when the parameters are too large.

Signal symbol: HDWS (G067#2)

Signal type: PLC→NC

Signal function: Control the feed speed and forward/backward direction of the program through the MPG.

Close the function when it is set as 0;

Start the function when it is set as 1.

Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G067						HRE		

3.6 MPG feed under the manual mode

Overview:

Use the function of the MPG control feed axis under the manual mode.

The following states can be selected through the parameter JHD (No.1400#0).

	Set JHD as 0		Set JHD as 1	
	Manual mode	**MPG mode**	**Manual mode**	**MPG mode**
JOG feed	Enabled	Disenabled	Enabled	Disenabled
MPG feed	Disenabled	Enabled	Enabled	Enabled

Function description:

1. The same axis cannot be controlled simultaneously by manual mode and the MPG, and the control mode operated first is valid.
2. Besides, different axes can be controlled simultaneously by manual mode and the MPG. The resultant rate is displayed in the feed speed.
3. Modify PLC, to make the signal of the MPG under the manual mode valid.

Relevant parameters:

	#7	#6	#5	#4	#3	#2	#1	#0
1400								JHD

JHD: MPG feed under the manual mode

0: Invalid

1: Valid

3.7 Manual feed per revolution

Function description:

Feed per revolution shall be made under the manual mode, and the feed speed is set in the parameter **(No.1232)**. The unit of feed per minute is in mm/min, while that of feed per revolution is in 0.0001 mm/rev.

Under the mode of manual feed per revolution, alarm PS243 (spindle speed: 0) will be given when the spindle is stopped.

Manual fast-moving mode will be performed on minute basis.

Relevant parameters:

	#7	#6	#5	#4	#3	#2	#1	#0
1400							JRV	

JRV: manual feed mode

0: feed per minute

1: feed per revolution

3.8 Manual demonstration programming

Overview

After the demonstration programming is activated, once the operating axis is moved under the MPG or manual mode, capture the current position of the absolute coordinate system of the axis into the program, so that the program of the position point of the axis can be prepared while moving.

As a programming command other than the axis name, the demonstration programming can also be input directly with an editing keyboard under the mode of editing.

Signal concerning demonstration function

Signal symbol: TECHN (G043#6)

Signal type: PLC→NC

Signal function: The signal for activating demonstration functions.

Under the manual or MPG mode, the demonstration function is activated when the signal is 1.

"Demonstration Programming under Progress" will be displayed at the lower right corner on the interface of the program once such function is activated.

There are two input methods for the axis coordinate of the demonstration program:

1. Input the axis coordinate selected into the program by pressing down the insertion key after the axis name is input;
2. Input the axis coordinate selected into the program by pressing down the insertion key directly.

Signal address:

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

3.9 Manual linkage movement function

Overview

Under the manual mode, CNC will move as per the proportional relation for displacement set by the NC parameters according to the axis (8 at most) selected by PLC, to realize multi-axis linkage movement function under the manual mode.

For instance, if the X/Y/Z-axis is the axis for manual linkage movement selected by PLC, the proportional relation for displacement among three axes is X=20mm/deg, Y=35mm (deg) and Z=50mm (deg). When the X-axis is moved for 20mm (deg) manually, corresponding Y-axis and Z-axis will be under linkage movement for 35mm (deg) and 50mm (deg) respectively. On the contrary, when the Z-axis is moved for 50mm (deg) manually, corresponding X-axis and Y-axis will be under linkage movement for 20mm (deg) and 35mm (deg) respectively.

Signal for manual linkage movement

Signal symbol: JLF (G062#4)

Signal type: PLC→NC

Signal function: Activate the signal for manual linkage movement.

When the signal is 1:

Manual linkage movement function is valid. Under the manual mode, CNC will select the signal G206.0~G206.7 as per the axis for manual linkage movement selected by PLC and will realize linkage movement of the axis selected in PLC as per the proportional relation for displacement of each axis set by the parameter #1448 of NC, to realize multi-axis associated interpolation under the

manual mode.

When manual linkage movement function of the axis is valid, CNC still moves or stops, under the automatic mode, as per the original logic rules given by the NC/PLC axis, without linkage movement of each axis.

When the signal is 0:

When the manual multi-axis linkage movement function is invalid, each axis will not be under linkage movement under the manual or automatic mode. It still moves or stops according to the logic rules of the original NC axis or PLC axis command of the CNC.

Selection signal for the axis under manual linkage movement

Signal symbols: G121#0~G121#7

Signal type: PLC→NC

Signal function: the selection signal for manual linkage movement of the 1st axis to 8th axis. When corresponding G signal is set as 1, corresponding axis will be selected as the axis for manual linkage movement.

Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G062				JLF				
G121	COLT8	COLT7	COLT6	COLT5	COLT4	COLT3	COLT2	COLT1
	8th axis	7th axis	6th axis	5th axis	4th axis	3rd axis	2nd axis	1st axis
	Manual linkage	Manual linkage	Manual linkage	Manual linkage	Manual linkage	Manual linkage	Manual linkage	Manual linkage

Relevant parameters:

1448	Proportion of manual linkage movement

[Data type] Integer type

[Data range] -999999~-999999

[Form of effectiveness] Reset

The data set are the set values for incremental displacement proportion among axes under manual linkage movement, and the data set specify the movement direction of each axis with "+ -". For the data with identical signs, the movement direction is identical. On the contrary, for the data with different signs, the movement direction is opposite.

For example:

#1448X 25
#1448Y 31
#1448Z 421
#1448A -22
#1448B 53
#1448U 12
#1448V 225
#1448W -122

Taking the parameters set above for instance, when the X-axis is under forward incremental movement for 25mm (deg) manually, the associated Y-axis will be under forward incremental movement for 31mm (deg)… If the associated A-axis is under reverse incremental movement for 22mm (deg), the associated W-axis will be under reverse incremental movement for 122mm (deg) etc.

3.10 MPG signal quadruple selection

Function description:

The received MPG signal is quadrupled.

Signal symbol: HD4T (G084#1)

Signal type: PLC→NC

Signal function: Control the feed speed and forward/backward direction of the program through the MPG.

Close the function when it is set as 0;

Start the function when it is set as 1.

Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G067							HD4T	

Chapter IV Return to the Position of the Reference Point

4.1 Manual reference point return

Overview

Under the manual reference point return mode, select the axis returning to the reference point and the machine will move along the direction set by N1004#5. The axis will move at a lower speed when it presses onto the speed-reducing switch for reference point return and will stop once the "1st revolution" signal of the coder is researched after being disconnected from such switch. The current position is the reference point. The axis selected by the keys on the panel only indicates the axis selected for returning to the reference point and is unrelated to the movement direction of the axis.

For the system using absolute position detector, the position will be memorized once the reference point is set. It is not necessary to conduct manual reference point return to establish the reference point after each power-on, and the machine will return to the reference point at reference point return speed when conducting manual reference point return.

Signal of deceleration for reference point return

Signal symbols: *DEC1~*DEC8 (X9#0~X9#7)

Signal type: Machine side→NC

Signal function: Reduce the movement speed of manual reference point return and search for the reference point with LS.

As the signal of HS I/O, **X9#0~X9#4** will be transmitted to CNC directly without PLC.

The level of the deceleration signal of reference point return can be set through the parameter N2401#5.

Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
X009	*DEC8	*DEC7	*DEC6	*DEC5	*DEC4	*DEC3	*DEC2	*DEC1

The requirements of speed reducing blocks for manual reference point return are:

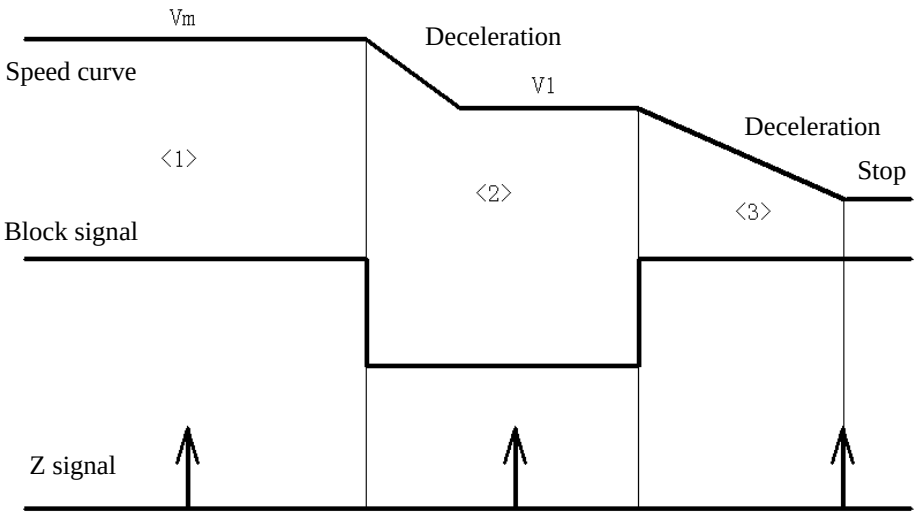


Figure 4-1 Process of Manual Reference Point Return

Minimum length of the speed reducing blocks L=((Vm/60)*(Vm/60)-(V1/60)*(V1/60))/(2*a*1000)+D

Vm: reference point return speed of each axis; it is set by the parameter N1235

V1: reference point return FL speed of each axis; it is set by the parameter N1234

a: the deceleration/acceleration speed of each axis; it is set by the parameter N1444

D: the movement amount of the "1st revolution" of the servo motor; it is set by the parameter N1060

Signal for completion of returning to the reference position

Signal symbols: ZP1~ZP8 (F94#0~F94#7)

Signal type: NC→PLC

Signal function: Notify that the machine is at the reference position of the control axis.

ZP1	Signal for completion of the 1st axis reference point return
ZP2	Signal for completion of the 2nd axis reference point return
ZP3	Signal for completion of the 3rd axis reference point return
…	…
ZP5	Signal for end of the 5th axis reference point return

Conditions of the signal changing as 1:

- Manual return to the reference position is completed and the current position is in the in-place area.
- Automatic return to the reference position (G28) is completed and the current position is in the in-place area.
- Detection on returning to the reference position is completed and the current position is in the in-place area.

Conditions of the signal changing as 0:

- When the machine is removed from the reference position.

Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
F094	ZP8	ZP7	ZP6	ZP5	ZP4	ZP3	ZP2	ZP1

Signal for establishing the reference position

Signal symbols: ZRF1~ZRF4 (F120#0~F120#4)

Signal type: NC→PLC

Signal function: The reference position is established for the system.

ZRF1	Signal for establishing the reference position of the 1st axis
ZRF2	Signal for establishing the reference position of the 2nd axis
ZRF3	Signal for establishing the reference position of the 3rd axis
…	…
ZRF5	Signal for establishing the reference position of the 5th axis

Conditions of the signal changing as 1:

- The reference position is established after manual return to the reference position.
- The reference position is established during initialization of power-on of the absolute position detector.

Conditions of the signal changing as 0:

- The reference position is lost.

Signal address

	#7	#6	#5	#4	#3	#2	#1	#0
F120	ZRF8	ZRF7	ZRF6	ZRF5	ZRF4	ZRF3	ZRF2	ZRF1

4.2 Return to the reference point without blocks

Overview

Manual reference point return without using reference point return speed reducing switch can be realized when the system parameter N1001#1 is set as "1".

Operation steps of returning to the reference point without blocks:

1. Move the axis to the position where the reference point is to be set under the manual mode;
2. Select the reference point return mode and press down the operation key for axis movement on the machine operation panel; select the axis for returning to the reference point and the axis will move towards the reference point at FL reference point return speed as per the direction set by the parameter N1004#5; the direction is independent of that selected by the key.
3. CNC will stop moving immediately once the "1st revolution" signal of the coder is captured in the reference point return direction and the stop position will be set as the reference point, and the end of reference point return signal (ZPn) and the reference position establishment (ZRFn) signal will be set as "1".

4.3 Return to the 2nd/3rd/4th reference point

Signal for completion of return to the 2nd/3rd/4th reference point

Signal symbols: Return to the 2nd reference point ZP21~ZP28 (F96#0~F96#7)

Return to the 3rd reference point ZP31~ZP38 (F98#0~F98#7)

Return to the 4th reference point ZP41~ZP48 (F100#0~F100#7)

Signal type: NC→PLC

Signal function: Select the reference point to be returned to with the figures behind P when using G30 for reference point return; use the axis position specified in the same program block to select the axis to be homed.

Set the parameters of the coordinates of the 2nd/3rd/4th reference point as N1051, N1052 and N1053.

ZP ◇□

◇ 2: 2nd reference point
3: 3rd reference point
4: 4th reference point

□ 1: 1st axis
2: 2nd axis

……
……

Conditions of the signal changing as 1:

- Returning to the 2nd/3rd/4th reference point is completed for G30 and the current position is in the in-place area.

Conditions of the signal changing as 0:

- After being removed from the reference point.

Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
F096	ZP28	ZP27	ZP26	ZP25	ZP24	ZP23	ZP22	ZP21
F098	ZP38	ZP37	ZP36	ZP35	ZP34	ZP33	ZP32	ZP31
F100	ZP48	ZP47	ZP46	ZP45	ZP44	ZP43	ZP42	ZP41

Chapter V Autorun

5.1 Cycle start /feed hold

* Start autorun

In the memory, DNC or MDI mode, if the signal for autorun ST sets (cycle start) as 1, and then as 0, CNC will enter the state of autorun and start running.

The signal ST is ignored under the following cases:

1. The methods other than MEM/RMT/MDI.
2. When the signal for feed hold (*SP) is 0.
3. When the signal for emergency stop (*ESP) is 0.
4. When the external reset signal (ERS) is 1.
5. Press down the <RESET> key on MDI.
6. CNC is under alarm state.
7. Autorun is launched.

During autorun, CNC will enter the state of "feed hold" under the followings and the program will stop operating:

1. When the signal for feed hold (*SP) is 0.
2. Shift to the manual, MPG and Back-to-zero" operation modes.

During autorun, CNC will enter the state of "autorun suspension" under the following conditions and the program will stop operating:

1. The SBK command are ended during SBK operation.
2. MDI operation is ended.
3. An alarm occurs in the CNC.
4. The commands of the program block under operation are ended after shifting to other modes of autorun or editing.

During autorun, CNC will enter the state of reset and be suspended under the followings:

1. The signal for emergency stop (ESP) is set as 0.
2. When the external reset signal (ERS) is 1.
3. Press down the <RESET> key on MDI.

* Interruption of autorun

(Feed hold) During autorun, when the signal for feed hold *SP is 0, CNC will enter the state of "autorun suspension" and the follow-up actions shall be stopped. Set the cycle start STL as 0 and the signal for feed hold SPL as 1. autorun will not be re-started even though the SP signal is set as 1. To re-start autorun, the SP signal must be set as 1 first and then set the ST signal as 1 and then 0.

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 hold". 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 "autorun suspension".

1. During thread cutting

   During thread cutting, when the SP signal is set as 0, CNC will enter the state of "feed hold" after the program block of thread cutting is performed.

2. During tapping at a fixed cycle

During tapping at a fixed cycle (G84), when the SP signal is 0, the SPL signal will become 1 immediately. However, keep operating until the tool is returned to the initial point or R point after tapping.

3. During execution of the macro commands

Operation will be ended after the current macro commands are performed.

Signal for cycle start

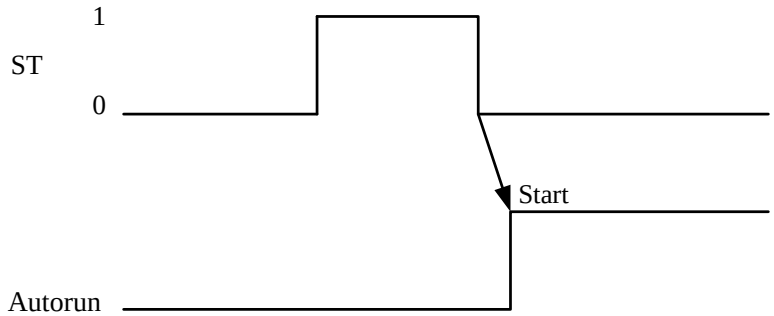
Signal symbol: ST (G7#2)

Signal type: PLC→NC

Signal function: The signal activating autorun.

Under the mode of "Automatic/DNC/MDI", when the ST signal is set as 1 and then 0, CNC will enter the state of "cycle start" and start operating.

Under the manual, DNC, MDI mode



Signal for feed hold

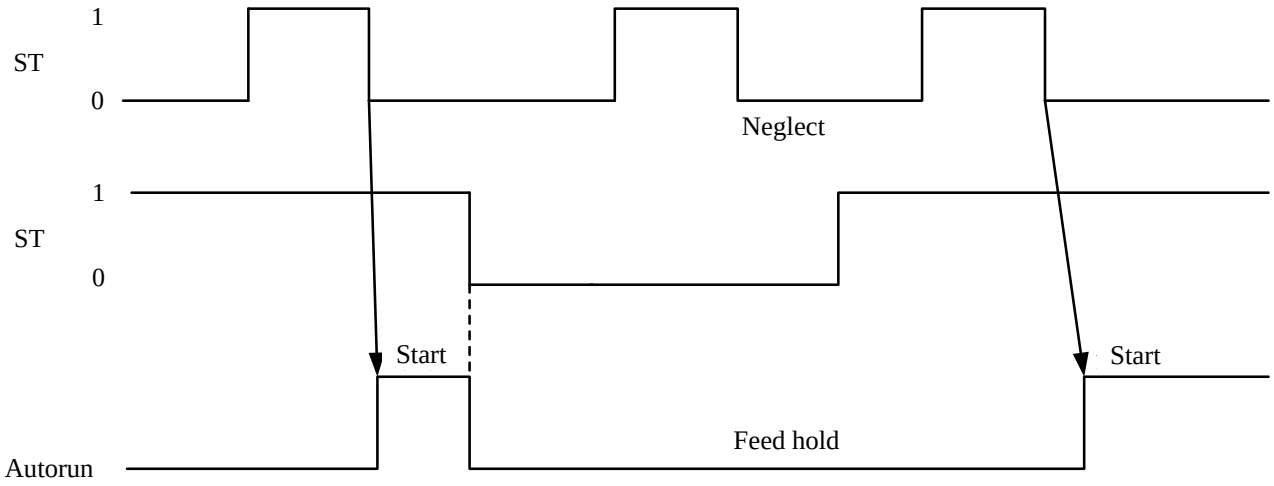
Signal symbol: SP (G8#5)

Signal type: PLC→NC

Signal function: Interrupt autorun.

During automatic operation, set the SP signal as 0, CNC will enter the state of "feed hold" and the program will stop running. When the SP signal is set as 0, autorun cannot be activated.

Under the manual, DNC, MDI mode



Signal for cycle start state

Signal symbol: STL (F000#5)

Signal type: NC→PLC

Signal function: Notify that PLC is under the state of autorun.

Whether such signal is set as 1 or 0 depends on the state of CNC, as shown in Table 5-1.

Signal for feed hold state

Signal symbol: SPL (F000#4)

Signal type: NC→PLC

Signal function: Notify that PLC is under the state of "feed hold" and operation of the program will be interrupted.

Whether such signal is set as 1 or 0 depends on the state of CNC, as shown in Table 5-1.

Signal for autorun

Signal symbol: OP (F000#7)

Signal type: NC→PLC

Signal function: Notify that PLC is under autorun.

Whether such signal is set as 1 or 0 depends on the state of CNC, as shown in Table 5-1.

Table 5-1

	Cycle Start STL	**Feed Hold SPL**	**Autorun OP**
State of cycle start	1	0	1
State of feed hold	0	1	1
State of autorun suspension	0	0	1
Reset state	0	0	0

Signal address:

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

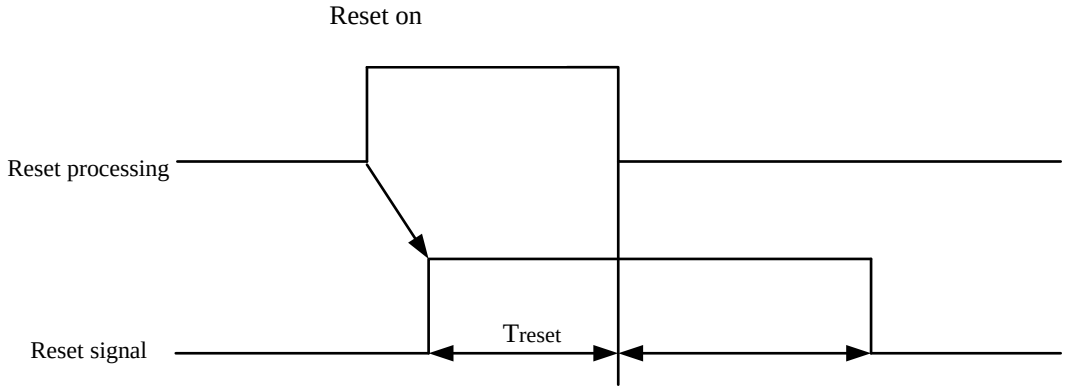
5.2 Reset

Overview

Under the following cases, CNC is reset and enters the state of "reset".

1. When the signal for emergency stop (*ESP) is set as 0.
2. When the external reset signal (ERS) is 1.
3. Press down the <RESET> key on MDI.

When CNC is reset, output the reset signal RST to PLC. After the conditions above are canceled, the reset signal RST is 0 after the output time of the reset signal of T_{reset}.



During autorun, when CNC is reset, autorun 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.

External reset signal

Signal symbol: ERS (G8#7)

Signal type: PLC→NC

Signal function: Reset CNC.

If the reset signal ERS is 1, reset CNC, entering the reset state. When CNC is reset, the reset signal RST is changed as 1.

Reset signal

Signal symbol: RST (F001#1)

Signal type: NC→PLC

Signal function: The signal delivered to PLC when CNC is reset; such signal is used for reset processing on PLC.

The signal is set as 1 under the following cases:

1. The signal for emergency stop (ESP) is set as 0.
2. When the external reset signal (ERS) is 1.
3. Press down the <RESET> key on MDI.

The signal is set as 0 under the following cases:

The output time of the reset signal set by the parameter is expired after the situations above are canceled and CNC is reset.

Signal address:

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

5.3 Program testing

Overview

Detection on autorun shall be performed first before processing, to detect whether the program generated

is correct. Such detection shall be made through the change at the observation position or through the machine under actual operation without operating the machine.

5.3.1 Machine locking

Overview

The change in the monitoring position of the unmovable machine.

When the locking signal MLK of the machine of all axes is 1, during manual or autorun, stop outputting pulse to the servo motor. However, the commands are still distributed and the absolute and relative coordinates are updated, so the operator may check whether the commands prepared are correct through the change at the monitoring position.

Signal for locking the machine

Signal symbol: MLK (G044#1)

Signal type: PLC→NC

Signal function: Put all the control axis under the state of locked machine.

When such signal is set as 1, during manual or autorun, pulse will not be output to the servo system of the axis. Eve n though the axis is not moved, the coordinates displayed will be updated.

Signal for detection on locking of the machine of all axes

Signal symbol: MMLK (F004#1)

Signal type: NC→PLC

Signal function: Notify the state of the signal for locking of the machine of all axes of PLC.

When the locking signal MLK of the machine is set as 1, such signal is set as 1.

When the locking signal MLK of the machine is set as 0, such signal is set as 0.

Signal address:

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

5.3.2 Dry run

Overview

Dry run is only effective for autorun. The machine moves at the feed speed set by the parameter P1210 of NC rather than that defined in the program.

Such function is used to check movement of the machine even without workpieces for the machine.

Dry running signal

Signal symbol: DRN (G046#7)

Signal type: PLC→NC

Signal function: Dry run is valid.

When such signal is set as 1, the machine will move at the feed speed set for dry run.

When such signal is set as 0, the machine will move normally.

Caution:

When the signal for dry run is changed from 0 to 1 or from 1 to 0 during movement of the machine, the machine shall be decelerated to 0 first before accelerating to the specified feed speed.

Dry run confirmation signal

Signal symbol: MDRN (F002#7)

Signal type: NC→PLC

Signal function: Notify the state of the signal for dry run of PLC.

Such signal is 1 when DRN is 1;

Such signal is 0 when DRN is 0.

Signal address:

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

5.3.3 Single block (SBK)

Overview

The SBK operation is only valid for autorun.

When the signal for SBK is set as 1 during autorun, after the current block is performed, CNC will enter the state of "autorun suspension". In sequential autorun, after each block of the program is performed, CNC will enter the state of "autorun suspension". When the signal for SBK is set as 0, re-perform autorun.

Signal for SBK

Signal symbol: SBK (G046#1)

Signal type: PLC→NC

Signal function: The SBK is valid.

Perform SBK when such signal is set as 1.

Perform normal operation when such signal is set as 0.

Signal for detection on SBK

Signal symbol: MSBK (F004#3)

Signal type: NC→PLC

Signal function: Notify the state of the signal for SBK of PLC.

Such signal is 1 when the SBK signal is 1.

Such signal is 0 when the SBK signal is 0.

Caution:

1) Operation of thread cutting

When the SBK signal is turned as 1 during thread cutting, the operation is stopped after the 1st program block for non-thread cutting of the commands for thread cutting is performed.

2) Operation at a fixed cycle

During fixed cycle, when SBK signal is set to 1, the operation is stopped each time when the positioning approaches the drilling and tool retracting, instead of at the end of program block. When the STL signal is set as 0, the SPL signal is changed as 1, indicating that the machine is not at the end of program block. After one block is performed, the STL and SPL signal is changed to 0 and the operation is stopped.

Signal address:

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

5.4 Block delete

Overview

During autorun, 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.

Signal for program block delete

Signal symbol: BDT (G044#0)

Signal type: PLC→NC

Signal function: Select whether the block comprising "/" is ignored.

During autorun, when BDT is 1, the program block comprising "/" is ignored; when BDT is 0, the program shall be performed normally.

Signal for detection on block delete

Signal symbol: MCDT (F004#0)

Signal type: NC→PLC

Signal function: Notify the state of BDT of PLC.

Signal address:

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

5.5 Program restart

Overview

In case of stop due to damage or idle of the tool, the program may re-start operating from the program block of specified sequence number. Such function can also be used for rapid inspection on the program.

There are two modes for re-start:

P: Re-start since the tool is damaged.

Q: Re-start since the tool is idle.

Signal for re-start of the program

Signal symbol: SRN (G006#0)

Signal type: PLC→NC

Signal function: Select re-start of the program.

When the re-start signal of the program is set as "1" to search for the sequence number of the re-starting

program block, the picture of LCD is switched to the re-start picture of the program. When the re-start signal of the program is set as "0" and autorun is valid, the machine will move towards the re-start point of processing at an idle speed as per the axis sequence set successively. After the machine is moved to the re-start point, processing is re-started.

Signal for re-starting of the program

Signal symbol: SRNMV (F002#4)

Signal type: NC→PLC

Signal function: Indicate that the program is now under the state of re-starting.

When such signal is changed as "1":

After the picture of LCD is switched to the re-start picture of the program, the signal for re-start of the program is set as 0.

When such signal is changed as "0":

The re-start sequence of the program is finished (all control axis of the machine are moved to the re-start point).

Signal address

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

5.6 Ignore machining timing

Overview

In autorun, it controls whether the "processing time" is counted during running and processing.

Signal for program block delete

Signal symbol: WTIME (G0255#6)

Signal type: PLC→NC

Signal function: During running and processing, when WTIME is 1, "processing time" does not count; when WTIME is 0, "processing time" counts.

	#7	#6	#5	#4	#3	#2	#1	#0
G255		WTIME						

5.7 Macro interruption

Overview

The interrupt program is a macro program call. This means that the level of local variable changes before and after the interrupt. Interrupts are not included in the nesting level of macro program calls. When a subprogram call or user macro program call is executed within an interrupt program, the call is included in the nesting level of the subprogram call or macro program call. Even if the user macro program interrupt is a macro program type interrupt, the independent variable cannot be passed from the current program.

User macro program interrupt signal

Signal symbol: UINT (G053#3)

Signal type: PLC→NC

Signal function: When the edge trigger mode is selected, the interrupt signal (UINT) is only valid on its rising edge. Therefore, the interrupt program is executed only momentarily (when program has only macro statements). When the state trigger method is not applicable or the user macro-program is executed only once in the whole program (at this time, the interrupt signal remains on), the edge trigger method can be used.

	#7	#6	#5	#4	#3	#2	#1	#0
G53					UNIT			

5.8 Program running lock

Overview

The operation start and operation prohibition of program are controlled by PLC signal.

Starting lock signal

Signal symbol: STLK (G007#1)

Signal type: PLC→NC

Signal function: The signal prohibits any axis movement of machine during autorun (memory or MDI operation).

When the STLK signal is 1, the axis movement stops after deceleration.

In autorun, the program block containing only M, S, T, B, and 2nd auxiliary function command may be executed consecutively until an axis movement command program block is encountered. When an axis movement command program block is encountered, the movement stops, and the system is placed in autorun mode (STL=1, SPL=0). When the STLK signal becomes "0", the operation is restarted.

Program block starts the interlock signal

Signal symbol: *BSL (G008#3)

Signal type: PLC→NC

Signal function: This signal prevents the next program block from starting during autorun. If parameter 2402.0 RLK is set to 0, this function is invalid; if it is set to 1, this function is valid.

When this signal becomes 0, the next program block cannot be started in autorun mode.

This signal does not interrupt the autorun mode. The next program block is a valid command block. Once the signal is set to 1, the operation will resume immediately.

Cutting program block starts the interlock signal

Signal symbol: *CSL (G008#1)

Signal type: PLC→NC

Signal function: This signal makes the movement command block unable to start instead of the positioning block during autorun. When parameter 2402.0 RLK] is set to 0, this function is invalid; when it is set to 1, this function is valid.

In autorun, the signal is 0, and it encounters the stop of movement command block containing axis, instead of deceleration stop of positioning block. Once the signal is set to 1, the operation will resume immediately.

	#7	#6	#5	#4	#3	#2	#1	#0
G007							STLK	

	#7	#6	#5	#4	#3	#2	#1	#0
G008					*BSL		*CSL	

Chapter VI Feed Speed Control

6.1 Fast moving speed

Overview

The fast-moving speed of each axis is set through the parameter N1225, so there is no need to program the fast-moving speed.

The override can be applied to the rapid traverse override signal through the rapid traverse signal.

F0, 25%, 50%, 100%.

F0: It is set by the parameter N1231.

Signal for fast-moving

Signal symbol: RPDO (F002#1)

Signal type: NC→PLC

Signal function: This signal indicates that the movement commands are performed at a fast-moving speed.

1 indicates that an axis starts moving after fast-moving is selected.

0 indicates that an axis starts moving after non-fast-moving is selected. Both automatic and manual modes are allowed.

Note 1: In autorun, 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 reference point return.

Note 2: Once fast-moving is selected, the signal is kept as 1 (even during the stop period), until other feed speeds are selected and movement is started.

Signal address

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

6.2 Override

6.2.1 Rapid traverse override

Overview

There are four overrides (F0, 25%, 50%, 100%) to be used for fast-moving. Where:

F0 is set through the data parameter N1231.

It is also possible to adjust the fast-moving override in the range of 0~100% using the 1% step override.

In automatic or manual operation (including manual reference point return and returning to program zero point), the actual movement speed is obtained by multiplying the value set by the data parameter by the override value, and F0 speed is set by the data parameter N1231.

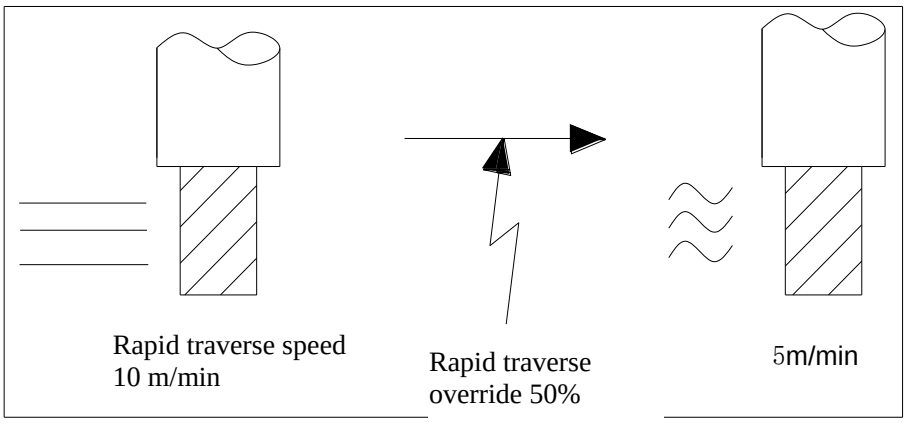


Figure 6-1

Signal for rapid traverse override ROV1, ROV2<G14.0, G14.1>

Signal symbols: ROV1, ROV2 (G14.0, G14.1)

Signal type: PLC→NC

Signal function: The signals for fast-moving override.

Rapid Traverse Override Signal		Override Value
ROV2	ROV1	
0	0	F0
0	1	25%
1	0	50%
1	1	100%

Signal address:

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

Selection signal for 1%-step rapid traverse override HROV (G096.7)

Signal symbol: HROV (G096.7)

Signal type: PLC→NC

Signal function: Select control signal of rapid traverse override.

When this signal is 0, the ROV1~ROV2 (G14.0 G14.1) signals are selected as rapid traverse override.

When this signal is 1, the HROV0~HR0V6 (G96.0~G96.6) signals are selected as rapid override of 1%-step feed.

Signal address:

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

Override signals for 1%-step rapid traverse HROV0~HROV06 (G096.0~G96.6)

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

Signal type: PLC→NC

Signal function: The fast override can be used through 7-bit binary data of G096.0~G96.6 in the range of 0~100% in 1% step increments. When the binary data value exceeds 100, the override

value is limited to 100%.

Signal address:

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

6.2.2 Feed speed override

Feed speed override signal

Signal symbols: *FV0~*FV7 (G012)

Signal type: PLC→NC

Signal function: It is used for controlling over the manual and cutting feed speed override.

The 8-bit binary code signal is used to represent the feed speed override, and the override can be controlled at a minimum of 1% in steps between 0% and 254%. The actual running speed is the value obtained by multiplying the commanded speed by the override.

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

The override control is invalid under the following circumstances and is always executed at 100%.

- Under the tapping mode of G63
- During tapping of the cutting feed at a fixed cycle

Signal address:

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

6.2.3 Selection of safe feed speed

Selection signal for safety limited speed

Signal symbol: FVL (G019#6)

Signal type: PLC→NC

Signal function: The most HS degree limiting fast-moving and cutting feed.

When the signal is 1, the rapid traverse and cutting feed traverse speed of each axis of CNC are limited by the parameter N1260.

Signal address

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

Chapter VII Auxiliary Functions

7.1 Auxiliary functions

Basic processing process:

The signals below are used for the following functions:

Table 7-1

Function	Program Address	Output Signal			End Signal
		Code Signal	Strobing Signal	End of Distribution Signal	
Auxiliary function	M	M**	MF	DEN	FIN
Spindle function	S	S00～S31	SF		
Tool function	T	T00~T31	TF		
2nd auxiliary function	B	B00~B31	BF		

The functions of M, S, T and B use different programming addresses and different signals, but all use the same method to input and output signals. Taking the auxiliary function M as an example, the following explanation is given:

(1) It is assumed that MXXX is specified in the program:
For XXX, if there is no setting in the CNC, an alarm will occur.

(2) After the code signals M00~M31 are sent, the strobing signal MF is set as 1. The code signal is a program command value XXX expressed by the binary.
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.

(3) When the strobing signal is set as 1, PLC will read the code signal and perform corresponding operation.

(4) If movement specified in one program block is required, perform the auxiliary function after suspension or completion of other functions. The auxiliary function can be performed after the signal for completion of waiting for distribution DEN is set as 1 through PLC control.

(5) After the operation is finished, PLC will set the end 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.

(6) When the end signal is 1, CNC can only set the strobing signal as 0 after certain time periods, and notify that such signal is received.

(7) When the strobing signal is 0, set the end signal as 0 in PLC.

(8) When the end signal is 0, CNC will set all the code signals as 0, and all sequential operations of the auxiliary function will be ended.

(9) When other commands of the same program block are completed, CNC will perform the next block.

① The code signal for S/T will be delivered while performing the spindle speed and the tool functions.

② The spindle speed is performed and the tool function code signal is always maintained, until new codes of corresponding function are specified.

The timing diagram is as follows:

There is one auxiliary function in the program block:

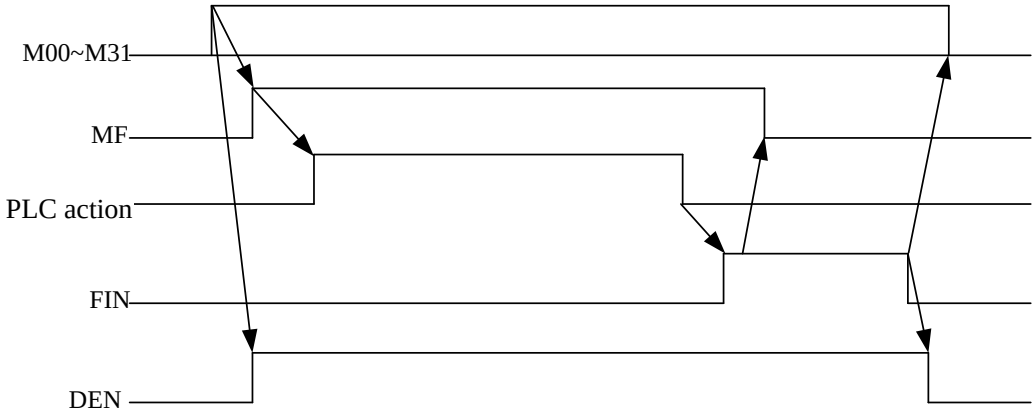


Figure 7-1

If the movement command and the auxiliary function are within the same program block, the auxiliary function is performed before completion of movement command.

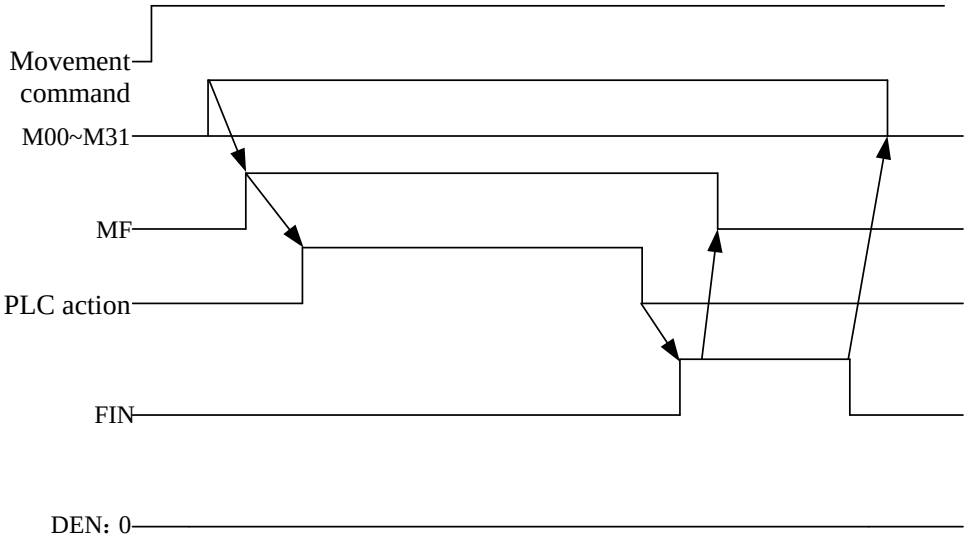


Figure 7-2

If the movement command and the auxiliary function are within the same program block, the auxiliary function is performed after such commands are finished:

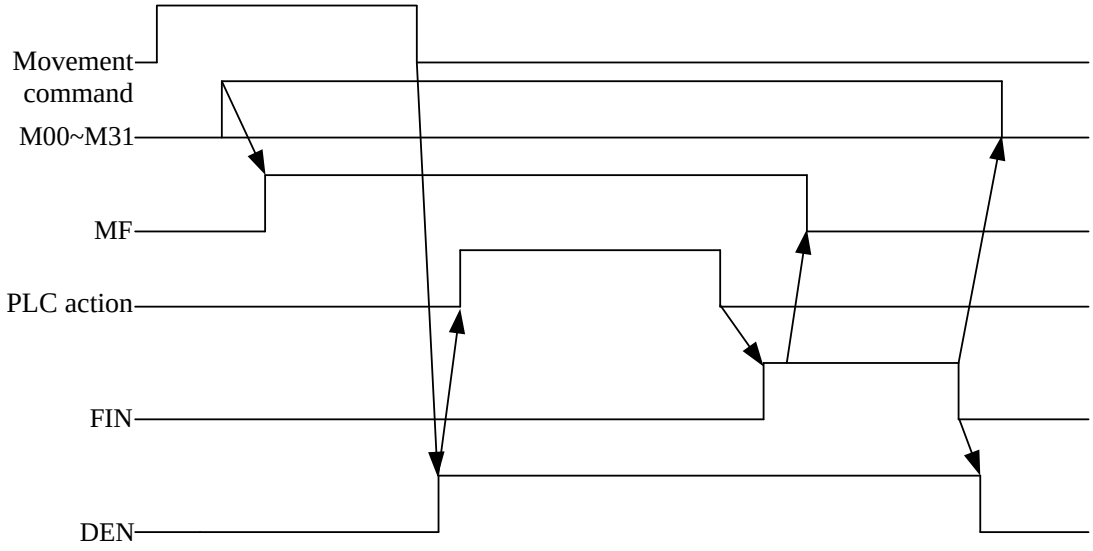


Figure 7-3

Auxiliary function code signal

Signal symbols: M00~M31 (F010~F013)

Signal type: NC→PLC

Signal function: The data signal for the auxiliary function delivered from NC.

Auxiliary function strobing signal

Signal symbol: MF (F007#0)

Signal type: NC→PLC

Signal function: The strobing signal of the M code delivered when the M code is performed by NC.

Note 1: The following auxiliary functions are handled with through CNC and the signal for the auxiliary functions not output to PLC is specified in the program:

* M98, M99;
* The M code calling the subprogram;
* The M code calling the user macro program.

Note 2: The following auxiliary functions listed are handled with through CNC directly, but the code signal and the strobing signal cannot be output, but NC will output signal to PLC during performing of such signal.

Table 7-2

Commands of M Code	Output Signal Name	Output Signal Address
M00	DM00	F009#7
M01	DM01	F009#6
M02	DM02	F009#5
M30	DM30	F009#4

Note 3: The codes M00~M31 of the auxiliary function are output in the form of a binary code.
For instance, M5 corresponds to 00000000, 00000000, 00000000, and 00000101.

Code signal for spindle speed

Signal symbols: S00~S31 (F022~F025)

Signal type: NC→PLC

Signal function: The data concerning spindle speed delivered to PLC and the binary indicates the S command value.

For instance, such figure is 00000000, 00000000, 00000000, and 00010100 of the

command S20.

Strobing signal for spindle speed

Signal symbol: SF (F007#2)

Signal type: NC→PLC

Signal function: The strobing signal of the S code, indicating that the spindle speed function is now under progress.

About output conditions and execution process. Please refer to the "Basic Processing Process of Auxiliary Functions" for the description.

Tool function code signal

Signal symbols: T00~T31 (F026~F029)

Signal type: NC→PLC

Signal function: The data concerning the command value of the tool T delivered to PLC; the T command value is expressed by the binary.

For instance, such figure is 00000000, 00000000, 00000000, and 00001100 of the command T12.

Strobing signal for the tool function

Signal symbol: TF (F007#3)

Signal type: NC→PLC

Signal function: The T code strobing signal. It indicates that the T function is being executed.

About output conditions and execution process. Please refer to "Basic Execution Process" for description.

End signal for auxiliary function

Signal symbol: FIN (G004#3)

Signal type: PLC→NC

Signal function: The response signal returned from PLC to NC after execution of the M/S/T function and the auxiliary function of the current program block is performed after the completion signal is received by CNC.

Please refer to "Basic Processing Process of Auxiliary Functions" for the operation and processing process of the control unit.

End of Distribution Signal

Signal symbol: DEN (F001#3)

Signal type: NC→PLC

Signal function: This signal is set to 1 when the execution of the movement command in the program block ends. It is generally used when the M, S, T commands and the movement command are in the same program block. The M, S, T commands are executed after the execution of the movement command in the program block ends.

Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G004					FIN			
F001					DEN			
F007					TF	SF		MF

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

7.2 2nd auxiliary function

Overview:

The control flow for M/S/T of the 2nd auxiliary function and the auxiliary functions is the same, and only different strobing signals and code signals are used. By specifying a B×××× (maximum 8 digits) command, an auxiliary code signal and a strobing signal are input to the machine, which are processed by PLC and used to control the indexing of the rotation axis of the machine.

Only one B code can be specified in one program block. The 2nd auxiliary function can be commanded with the address (A/C/U/V/W) other than B by setting the parameter (#1822).

2nd auxiliary function code signals

Signal symbols: B00~B31 (F030~F033)

Signal type: NC→PLC

Signal function: The data concerning the code value of the 2nd auxiliary function delivered to PLC and its command value is expressed with binary.

For instance, such figure is 00000000, 00000000, 00000000, and 00010100 of the command B20.

2nd auxiliary function strobing signal

Signal symbol: BF (F007#4)

Signal type: NC→PLC

Signal function: The strobing signal for the code of the 2nd auxiliary function, indicating that the auxiliary function is now under progress.

Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
F007				BF				
F030	B07	B06	B05	B04	B03	B02	B01	B00
F031	B15	B14B	B13	B12	B11	B10	B09	B08
F032	B23	B22	B21	B20	B19	B18	B17	B16
F033	B31	B30	B29	B28	B27	B26	B25	B24

7.3 Locking of the auxiliary function

Overview

The M/S/T function of the program command cannot be performed. In other words, the code signal and the strobing signal cannot be output. Such function is generally used for checking the program.

Signal for locking of the auxiliary function

Signal symbol: AFL (G05#6)

Signal type: PLC→NC

Signal function: This signal selects locking of the auxiliary function. The specified M/S/T function cannot be performed.

When the signal is 1, the functions of the control unit are described as follows:

1. For the mode of "Autorun/DNC/MDI", the control unit will not perform the specified M/S/T function. In other words, the code signal and the strobing signal will not be output.
2. If such signal is set as 1 after the code signal is output, output as per the normal methods until output is finished. (Set the strobing signal as 0 until the manual FIN signal).
3. The auxiliary functions M00, M01, M02 and M30 can also be performed even though such signal is 1. All code signals, strobing signals and decoded signals are output as per normal methods.
4. The auxiliary functions M98 and M99 are performed as per normal methods even though such signal is 1, but the execution results will not be output in the control unit.

Signal for detection on locking of auxiliary functions

Signal symbol: MAFL (F004#4)

Signal type: NC→PLC

Signal function: This signal indicates the state of the signal for locking of auxiliary functions AFL.

When such signal is 1, the signal for locking of auxiliary functions AFL is 1.

When such signal is 0, the signal for locking of auxiliary functions AFL is 0.

Signal address

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

7.4 Co-block of the multi-M code

Overview

Usually, only one M code is allowed to be commanded in one program block, and in this function, up to three codes can be commanded in one program block

The 1st/2nd/3rd M codes are decoded respectively as per the sequential order within the system. With this function, programming can be simplified, and the execution time of processing duration can be narrowed with such function.

Such function is valid when the parameter N1803#6 of CNC is set as "1", and the support from PLC is also required for the multi-M code co-block function.

Signal for the function of the 2nd M code

Signal symbols: M100~M131 (F014~F017)

Signal type: NC→PLC

Signal function: The data signal for the function of the 2nd M code delivered from NC.

Signal for the function of the 3rd M code

Signal symbols: M200~M231 (F018~F021)

Signal type: NC→PLC

Signal function: The data signal for the function of the 3rd M code delivered from NC.

Strobing signal for the function of the 2nd M code

Signal symbol: MF (F007#5)

Signal type: NC→PLC

Signal function: The strobing signal for the M code delivered when the 2nd M code is performed by NC.

Strobing signal for the function of the 3rd M code

Signal symbol: MF (F007#6)

Signal type: NC→PLC

Signal function: The strobing signal for the M code delivered when the 3rd M code is performed by NC.

For the Maa Mcb Mcc commands in one program block, the system will process Maa as the 1st M code, Mcb as the 2nd M code and Mcc as the 3rd M code as per the programming sequence. The three M codes above have different function code signals and strobing signals and will be delivered to PLC simultaneously while performing such program block.

The time sequence for performing the 2nd/3rd M code and other codes for auxiliary functions is identical.

Signal address:

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

2nd M auxiliary function code signal

F015	M115	M114	M113	M112	M111	M110	M109	M108

2nd M auxiliary function code signal

F016	M123	M122	M121	M120	M119	M118	M117	M116

2nd M auxiliary function code signal

F017	M131	M130	M129	M128	M127	M126	M125	M124

2nd M auxiliary function code signal

F018	M207	M206	M205	M204	M203	M202	M201	M200

3rd M auxiliary function code signal

F019	M215	M214	M213	M212	M211	M210	M209	M208

3rd M auxiliary function code signal

F020	M223	M222	M221	M220	M219	M218	M217	M216

3rd M auxiliary function code signal

F021	M231	M230	M229	M228	M227	M226	M225	M224

3rd M auxiliary function code signal

7.5 HS MSTB

Overview:

The time required for machining can be shortened by accelerating the time required to perform the M/S/T/B function.

The setting of MHI (No.2402#7) parameter can be selected to set the exchange mode of strobing pulse signal and completion signal, i.e. normal mode or HS mode.

Basic steps:

① For instance, if the following program is given.
Mxx;
Myy;

② In case of M commands on the CNC side, the code signals M00~M31 shall be delivered first. Besides, recover the logic level of the strobing pulse signal MF to the previous state, i.e. turning into "1" if the previous value is "0" and vice versa.

③ Once the strobing pulse signal is recovered on the CNC side, when the logic level of the signal for completion of auxiliary functions MFIN on the PMC side is the same as that of the strobing pulse signal, the actions on the PMC side can be deemed as completed.

In general, the action is completed after the rise (from '0' to '1') of the completion signal FIN of M/S/T/B

is captured first and then the fall (from '1' to '0') of such signal. The difference of the method is that the action can be deemed as completed only after one change of the signal is captured.

In general, there is only one completion signal (FIN) for the M/S/T/B function, and independent completion signals are provided for the M/S/T/B function in the method respectively. Their respective signal names are MFIN/SFIN/TFIN/BFIN.

Switching of the signals above is shown on the time chart below. The time chart of general mode is also shown for comparison.

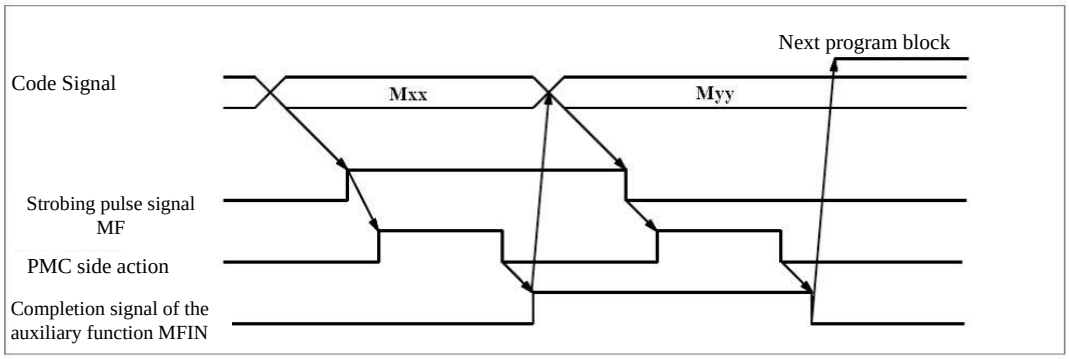


Figure 7-4 (a) Time Chart of HS Mode

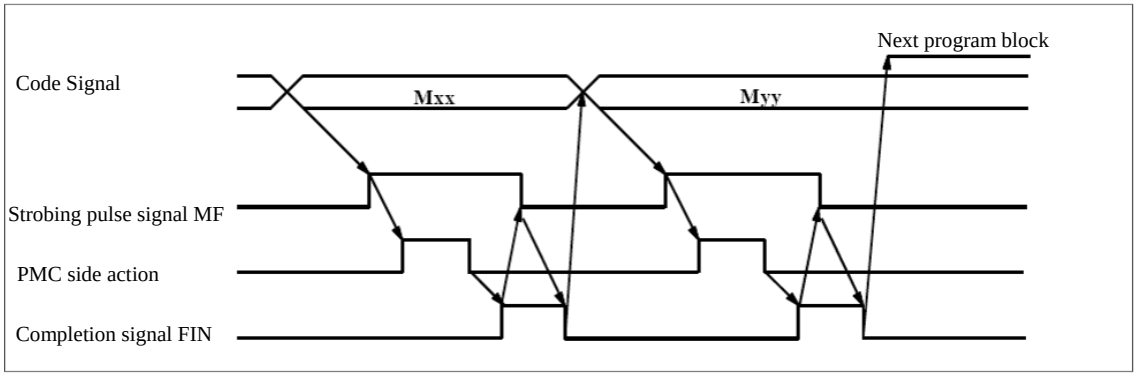


Figure 7-4 (b) Time Chart of General Mode

The HS interface can also be used for multi-M code commands in one program block. In this case, completion signals for three M codes are independently provided, and the respective signal names from the 1st to the 3rd are MFIN, MFIN2, and MFIN3. The switching steps of the signal of respective M codes are identical to those of HS interfaces for single M code command in one program block.

Related signals:

Auxiliary function completion signal

Signal symbol: MFIN (G005#0)

Signal type: PLC→NC

Signal function: This signal indicates that auxiliary functions of the HS M/S/T/B interface are completed.

Please refer to "Basic Steps" for the actions and steps of the control unit when the signal becomes '1' and '0'.

Signal for completion of the spindle function

Signal symbol: SFIN (G005#2)

Signal type: PLC→NC

Signal function: This signal indicates that the spindle function of the HS M/S/T/B interface is completed.

Please refer to "Basic Steps" for the actions and steps of the control unit when the signal becomes '1' and '0'.

Signal for completion of the tool function

Signal symbol: TFIN (G005#3)

Signal type: PLC→NC

Signal function: This signal indicates that the tool function of the HS M/S/T/B interface is completed.

Please refer to "Basic Steps" for the actions and steps of the control unit when the signal becomes '1' and '0'.

2nd auxiliary function completion signal

Signal symbol: SFIN2 (G005#7)

Signal type: PLC→NC

Signal function: This signal indicates that the 2nd auxiliary function of the HS M/S/T/B interface is completed.

Please refer to "Basic Steps" for the actions and steps of the control unit when the signal becomes '1' and '0'.

Signal for completion of the 2nd/3rd M function

Signal symbols: MFIN2 (G004#4), MFIN3 (G004#5)

Signal type: PLC→NC

Signal function: This signal indicates that the 2nd/3rd auxiliary function when the HS interface is used for M codes in one program block is completed.

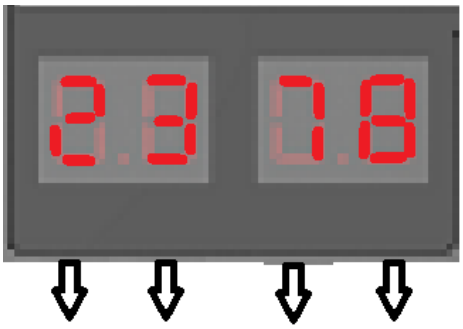
Please refer to "Basic Steps" for the actions and steps of the control unit when the signal becomes '1' and '0'.

Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G004			MFIN3	MFIN2	FIN			
G005	SFIN2				TFIN	SFIN		MFIN

7.6 Digital tube display function of operation panel

The digital tube display is only supported by the GSK25iMc 8.4-inch and 10.4-inch independent key operation panel, which is composed of four-digit digital tubes, and each digital tube is controlled by a four-digit binary display, as shown in the figure below.



1st digit 2nd digit 3rd digit 4th digit

The digital tube of the system operation panel corresponds to the PLC address:

The 1st digit of the digital tube corresponds to:

Y122.7	Y122.6	Y122.5	Y122.4
0	0	1	0

As shown in the figure above, the binary 0010 is converted to decimal system as 2, and the 1st digit of the digital tube is 2

The 2nd digit of the digital tube corresponds to:

Y122.3	Y122.2	Y122.1	Y122.0
0	0	1	1

As shown in the figure above, the binary 0011 is converted to decimal system as 3, and the 2nd digit of the digital tube is 3

The 3rd digit of the digital tube corresponds to:

Y123.7	Y123.6	Y123.5	Y123.4
0	1	1	1

As shown in the figure above, the binary 0111 is converted to decimal system as 7, and the 3rd digit of the digital tube is 7

The 4th digit of the digital tube corresponds to:

Y123.4	Y123.3	Y123.2	Y123.1
1	0	0	0

As shown in the figure above, the binary 1000 is converted to decimal system as 8, and the 4th digit of the digital tube is 8

If set according to the above PLC parameters, the final digital tube display:

2	3	7	8

Chapter VIII Function of the Spindle

8.1 Spindle control function

Overview

The system can control digital signal spindle drive and analog signal spindle drive, as well as control output of the two digital spindles through the industrial Ethernet bus and control one analog spindle through the analog signal interface; the single channel system can control two spindles at maximum; in the case that both are digital spindles, the former spindle connected from the system Ethernet interface P1 is the 1st spindle, and the latter spindle is the 2nd spindle. For the two spindles of the digital/analog hybrid, the digital spindle is the 1st spindle and the analog spindle is the 2nd spindle.

The relationship between the spindle control interface and the spindle configuration is:

Table 8-1

○=usable ×=unusable

Digital Spindle Output	Analog Spindle Output	1st Spindle	2nd Spindle
○	○	1st digital spindle It can use PC	Analog spindle It can use PC
○	×	1st digital spindle It can use PC	2nd digital spindle It can use PC
×	○	Analog spindle It can use PC	—
Note: PC=position encoder.			

The relationship between spindle and its function

Table 8-2

○=usable ×=unusable

Function	Digital Spindle		Analog Spindle	
	1st digital spindle	2nd digital spindle	As the 1st spindle (Without digital spindle)	As 2nd spindle (With digital spindle)
Thread cutting/feed per revolution (Synchronous feed)	○	○ (*1)	○	○ (*1)
Constant surface cutting speed control	○	○ (*1)	○	○ (*1)
Spindle speed fluctuation detection	○	○ (*1)	○	○ (*1)
Actual spindle speed output	○	○	○	○
Spindle positioning	○	○ (*1)	○	○ (*1)
Cs contour control	○	○ (*1)	○	○ (*1)
Multi-spindle control	○	○	×	○
Rigid tapping	○	○ (*1)	○	○ (*1)
Spindle phase synchronization control	○ Master control	○ Dependent control	×	×
Function of spindle	○	○	○	○

control unit Such as: spindle orientation, spindle switching, etc.				
Polygon cutting (for T series only)	○	○ (*1)	○	×

Notes:

1. (*1) Multi-spindle function is required; this function cannot be used for both the 1st spindle and the 2nd spindle.
2. Signals and parameters of the spindle speed control are common to both the spindle digital spindle output and the spindle analog output.

Different points directly controlled by relevant spindle control units:

Table 8-3

Item	Digital Spindle	Analog Spindle
Parameters of spindle control unit	Specified as CNC parameter (after 5300), it is transferred to the spindle control unit for use	Directly specified by the spindle control unit
Control signal of the spindle control unit	Connected to PMC via the CNC G0070~G0073 and F0045~F0048: address of the 1st spindle G0074~G0077 and F0049~F0052: address of the 2nd spindle	Connected to PLC via an external node
Spindle speed command interface	Digital data within the range of 0 the maximum spindle motor speed	0~±10V analog voltage (excluding adjustment section of the offset voltage)
Position encoder interface	Through the spindle control unit, connect to the CNC	Connected directly to the CNC

8.2 Spindle speed control function

By executing the S ×××× command, the CNC can output corresponding code signal and strobing signal to control the spindle speed. The NC parameter N5000#4SPS determines whether the spindle is digital or analog. The digital spindle uses the same signal as the analog spindle.

8.2.1 Analog spindle

Overview

The analog spindle refers to the analog voltage value at which the spindle speed is controlled by the CNC output. The CNC controls the spindle speed by changing the S code to an analog voltage output and transferring to the machine tool spindle. The analog voltage range is ±10V, and the spindle analog voltage = actual spindle speed/10V corresponding maximum spindle speed×10.

8.2.2 Digital spindle

Overview

The digital spindle refers to the drive connection between the CNC and the spindle through the

industrial Ethernet bus and the spindle command is controlled by the digital signal transmitted by the CNC through the Ethernet bus.

Related signals:

Code signal for spindle speed

Signal symbols: S00~S31 (F022~F025)

Signal type: NC→PLC

Signal function: These signals indicate the actual specified spindle speed function.

Using the output of the value specified by the S code of the analog spindle.

Note: S00~S31 give the S code in binary code form.

Such as S4, corresponding to 00000000, 00000000, 00000000, 00000100.

Spindle stop signal

Signal symbol: *SSTP (G029#6)

Signal type: PLC→NC

Signal function: Control spindle enabling signal

When the signal is set to 1, the CNC outputs an enabling signal to the spindle;

When the signal is set to 0, the CNC cuts off the enabling signal to the spindle.

When using the analog spindle, even if the speed command output to the spindle is 0, the spindle motor will rotate with LS due to the drift voltage of the spindle speed amplifier. In such case, ***SSTP** signal control can be used to completely stop the motor.

Signal of spindle speed override

Signal symbols: SOV0~SOV7 (G030#0~#5)

Signal type: PLC→NC

Signal function: Control the spindle speed override with an 8-bit binary value

Spindle motor command polarity selection signal

Signal symbol: SGN (G033#5)

Signal type: PLC→NC

Signal function: The CNC can output ±10V analog voltage, and the SGN signal selects the analog voltage polarity output to the spindle

When the signal is set to 1, the CNC outputs a negative voltage to the spindle;

When this signal is set to 0, the CNC outputs a positive voltage to the spindle.

Spindle enabling state signal

Signal symbol: ENB (F001#4)

Signal type: NC→PLC

Signal function: Spindle enabling state confirmation

When the enabling signal is output to the spindle, the ENB signal is logic 1; if the command is 0, then ENB

Signal becomes logic 0.

Spindle alarm state signal

Signal symbol: SPALM (F045#0)

Signal type: NC→PLC

Signal function: Inform the CNC that the spindle is in the alarm state

Spindle speed arrival state signal

Signal symbol: SAR (F045#3)

Signal type: NC→PLC

Signal function: Inform the CNC that the spindle is in the speed arrival state

Spindle speed arrival state signal

Signal symbols: INSAR for the 1st spindle (G29#3); INSAR2 for the 2nd spindle (G29#4)

Signal type: PLC→NC

Signal function: Notify the CNC that the spindle is in speed arrival state.

Spindle zero-speed state signal

Signal symbol: SST (F045#1)

Signal type: NC→PLC

Signal function: Inform the CNC that the spindle is in the stop state and the speed is 0

Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G029		*SSTP		INSAR2	INSAR			
F030	SOV7	SOV6	SOV5	SOV4	SOV3	SOV2	SOV1	SOV0
G033			SGN					
F001				ENB				
F022	S07	S06	S05	S04	S03	S02	S01	S00
F023	S15	S14	S13	S12	S11	S10	S09	S08
F024	S23	S22	S21	S20	S19	S18	S17	S16
F025	S31	S30	S29	S28	S27	S26	S25	S24
F045					SAR		SST	SPALM

8.3 Spindle gear control

Overview

Gear control refers to a control mode when the spindle has two or more levels and the system has two gear shift modes: M-type gear shift and T-type gear shift; M-type gear shift can process three-level gear through selection of parameter N5001#6GTT and send GR1, GR2, GR3 signals to automatically control the gear shift based on S command and gear speed parameter settings; T-type gear shift can process four-level gear and complete the gear shift before rotating the spindle; the CNC will output the speed value based on gear signals GR21, GR22 and gear speed parameter settings.

8.3.1 M-type gear shift processing

Although the S command is the spindle speed, the actual control object is the spindle motor speed. Therefore, the CNC needs to determine corresponding relation between the spindle motor speed and the gear. When

executing S command, the CNC selects the gear shift according to speed range of each gear defined in parameters in advance, and notifies the PLC to select corresponding gears by using gear selection signals (GR3, GR2, GR1); when the gear of the commanded speed is inconsistent with the current gear, the spindle gear should be shifted through PLC processing under the LS swing. At the same time, the CNC outputs the spindle motor speed according to the selected gear. By specifying S0～S99999 in MDI operation, the CNC outputs a command corresponding to the spindle (GR1, GR2, GR3 output) speed. 2 or 3 speed gears (GR1, GR2, GR3) can be set by parameters, and the gear selection signal is simultaneously output. When executing S command, the SF signal is also output.

The meaning of the gear shift signal is shown in Table 8-4.

Table 8-4

Gear Signal	GR1	GR2	GR3	GR4	
PLC Address	F34.0	F34.1	F34.2	F34.3	
Gear	Low	Medium-low	Medium-high	High	
Gear Parameter	5130: low to medium-low level shifting point speed of the spindle 5131: medium-low to medium-high level shifting point speed of the spindle 5132: medium-high to high level shifting point speed of the spindle				

Related signals:

M-type gear shift selection signal

Signal symbols: GR1, GR2, GR3, GR4 (F034#0~#3)

Signal type: NC→PLC

Signal function: These signals inform the PLC of the selected gear.

Spindle gear shift rotational speed selection signal

Signal symbol: SOR (G029#5)

Signal type: PLC→NC

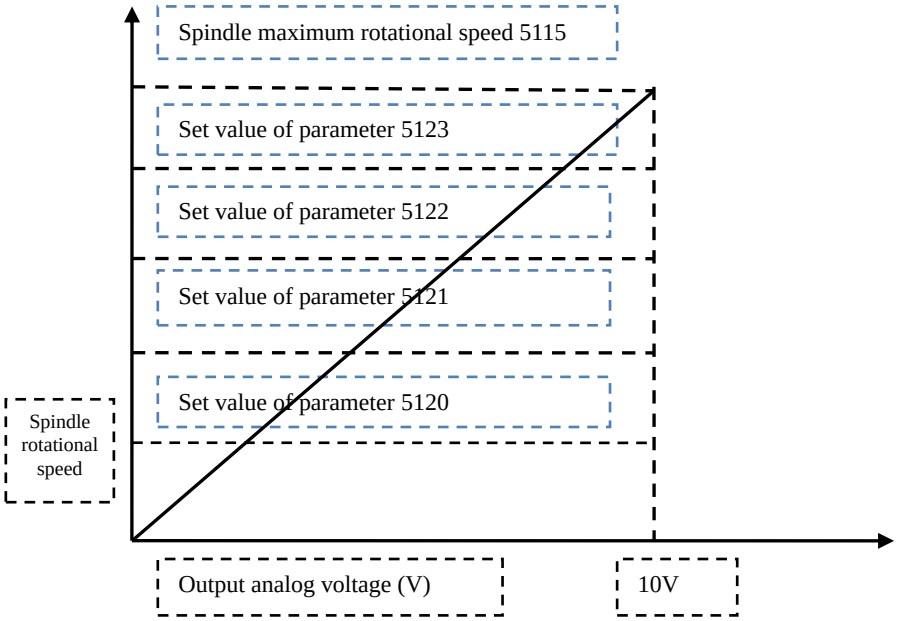
Signal function: When the is 1, the CNC outputs the speed set by parameter N5110 to the spindle motor for spindle gear shifting and spindle LS rotation control.

Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
F034					GR4	GR3	GR2	GR1
G029			SOR					

8.3.2 T-type gear shift processing

T-type gear shift determines the currently used gear based on gear selection signal GR21 and GR22, and then outputs corresponding speed command based on speed set by corresponding gear parameter.



T-type gear shift selection signal

Signal symbols: GR21, GR22 (G028#1~#2)

Signal type: PLC→NC

Signal function: These signals inform the NC spindle of the selected gear.

The meaning of the gear shift signal is shown in Table 8-5.

Table 8-5

Gear Selection Signal		Gear	Gear Parameter
GR22	GR21		
0	0	1	5120
0	1	2	5121
1	0	3	5122
1	1	4	5123

8.4 Spindle orientation

Overview

It is used to stop the spindle at a specific position, also called the spindle orientation. When equipped with the GR series spindle servo, it can support the eight-point orientation function.

Related signals

Spindle orientation signal

Signal symbols: ORCM (G070#6); ORCM2 (G074#6)

Signal type: PLC→NC

Signal function: When the signal is 1, the CNC outputs a directional signal to the spindle.

Spindle orientation position selection signal

Signal symbols: The 1st spindle STAO1, STAO2, STAO3 (G20.0, G20.1, G20.2);

The 2nd spindle 2STAO1, 2STAO2, 2STAO3 (G21.0, G21.1, G21.2);

Signal type: PLC→NC

Signal function:

Orientation Position Selection Signal				Orientation Position	Orientation Parameter
1SP	G20.2	G20.1	G20.0		
2SP	G21.2	G21.1	G21.0		
	0	0	0	1	5403,5404
	0	0	1	2	5405,5406
	0	1	0	3	5407,5408
	0	1	1	4	5409,5410
	1	0	0	5	5468,5469
	1	0	1	6	5470,5471
	1	1	0	7	5472,5473
	1	1	1	8	5474,5475

Spindle orientation completion signal

Signal symbols: ORAR (F045#7); ORAR2 (F049#7)

Signal type: NC→PLC

Signal function: Inform the CNC that the spindle is in the orientation completed state

Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G020						STAO3	STAO2	STAO1
G021						2STAO3	2STAO2	2STAO1
G074		ORCM2						
G074		ORCM2						
F045	ORAR							
F049	ORAR2							

8.5 Rigid tapping

Overview

During executing the rigid tapping fixed cycle (G84/G94 of the M series; G84/G88 of the T series), the tapping shaft feed and the spindle rotation are synchronously controlled, and the elastic tapping chuck may not be used for tapping.

When executing rigid tapping, it is necessary to add the auxiliary function code M29 during the command tapping cycle (G74, G84), and the CNC and spindle drive unit will be shifted to the position control state by executing the M29 command for synchronous control.

The M29 command shall be executed before the spindle rigid tapping to validate the rigid tapping signal

RGTAP; the PLC performs the spindle orientation at the same time, after which the signal RTAP is valid in the positional rigid tapping and the system can carry out the rigid tapping control;

The simulated spindle servo executes M29 to validate the rigid tapping signal RGTAP under conditions that the speed and position control is in switchable mode, and the PLC simultaneously performs the speed position switching, after which the signal RTAP in the rigid tapping is valid and the system can carry out the tapping control.

In the rigid tapping mode, the feed speed of the tapping shaft is specified by F. The spindle speed is S×360 (degree/min), and neither can use override. Rigid tapping uses linear acceleration/deceleration.

Dry run in G84 and G74 is valid. When dry run is applied to G84 (G74) tapping shaft, the spindle speed should match the dry run speed during tapping.

The machine tool locking is valid in G84 (G74). When G84 (G74) is locked by the machine, neither the tapping shaft nor the spindle can move.

Reset operation during the rigid tapping can reset the tapping mode where the spindle motor is reset to normal operation mode, but G84 (G74) will not be reset. G84 (G74) does not require feed hold and single block work.

G84 (G74) can only run in MEM and MDI mode. Rigid tapping cannot be used in manual feed mode.

During rigid tapping, the backlash compensation spindle selection signal can be executed during forward and reverse rotation of the spindle.

Precautions of rigid tapping:

1. When the spindle orientation function is used, the PMC logic command shall be executed to orient the spindle to the desired position, and the CNC shall not directly participate in the control.
2. When the spindle positioning function is used, the rigid tapping and the spindle positioning shall be used at the same time, the rigid tapping mode shall not be specified in the spindle positioning state, and the positioning mode shall not be specified in the rigid tapping state (the two cannot be simultaneously executed by the same spindle).
3. When the Cs contour control function is used, the rigid tapping and the Cs contour control shall be used at the same time, the rigid tapping mode shall not be specified in the Cs contour control state, and the Cs contour control shall not be specified in the rigid tapping state (the two cannot be simultaneously executed by the same spindle).

Rigid tapping rollback function

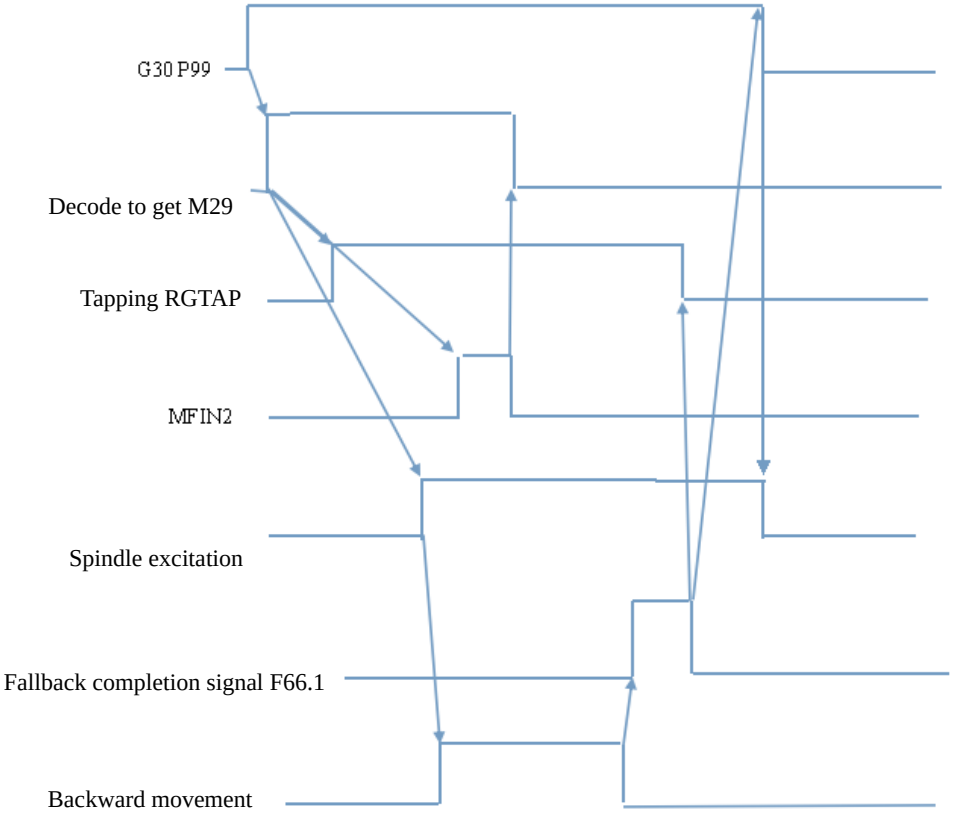
When rigid tapping is stopped by an emergency stop or reset, the tap may cut into the workpiece, and this function can automatically save and use related information on the most recent tapping, and realize automatic rollback to R point by PLC signal or command.

Two command methods for rigid tapping rollback function:

1. Programming command rollback

   Command format: G30 P99

   The command is executed by G30 P99 in the following timing sequence:



2. PLC signal command rollback

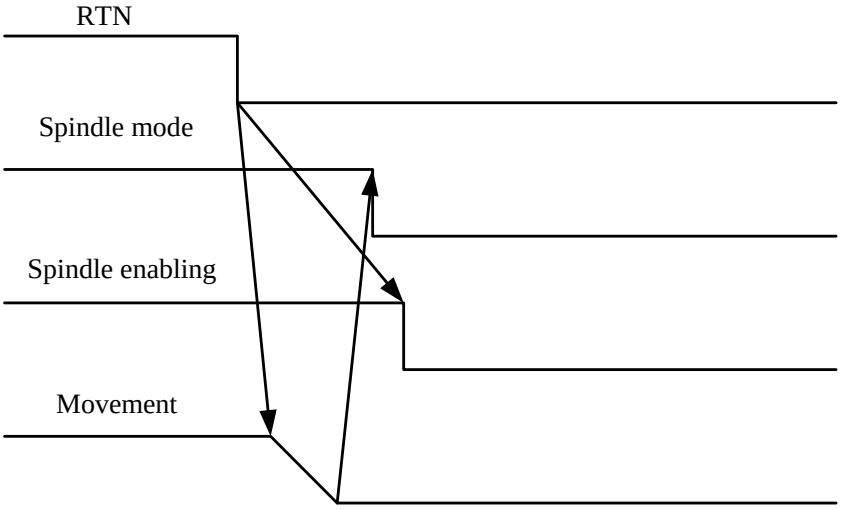
Signal function description:

When the rigid tapping rollback start signal G62.6 is set to 1, the tapping rollback start is effective.

The tapping rollback completion signal F66.1 is 0 after the tapping rollback is completed.

The tapping rollback signal F82.2 is 1 during the tapping rollback process.

3. Rigid tapping rollback termination: When the RTNT is broken over, the spindle shall enable; after the RTNT is disconnected, the spindle enabling shall be delayed, which is realized by the PLC in the following timing diagram:



Related signals:

Rigid tapping signal

Signal symbols: The 1st spindle RGTAP (G61#0); RGTAP2 the 2nd spindle (G61#1)

Signal type: PLC→NC

Signal function: Notify the servo to get into the rigid tapping mode after the rigid tapping function start command M9 is executed.

After executing the rigid tapping command, the system will send a command to the servo to get into the rigid tapping state.

RGTAP 1: Get into the rigid tapping mode

0: Exit from the rigid tapping mode

Note: Before the V366-210305 version (excluding this version), the 1st and the 2nd spindles share the 1st spindle signal control. Then separate the two signal controls.

Spindle drive speed/position switching completion signal

Signal symbols: The 1st spindle VPO (F076#3); the 2nd spindle VPO 2 (F076#4)

Signal type: NC→PLC

Signal function: The confirmation signal given to PLC when getting into rigid tapping state after the spindle drive is completed

When the system executes the rigid tapping command, the PLC sends command to the spindle drive to get into the rigid tapping state, and after the spindle drive completes the rigid tapping switch and gets into the rigid tapping state, such signal will be used to notify the PLC that the spindle has completed the control switch and gotten into the rigid tapping state.

Note: Before the V366-210305 version (excluding this version), the 1st and the 2nd spindles share the 1st spindle signal control. Then separate the two signal controls.

Spindle rigid tapping signal

Signal symbol: RTAP (F066#2)

Signal type: NC→PLC

Signal function: The signal indicates that the system has gotten into the rigid tapping state.

Spindle rotation direction signal

Signal symbols: RTGSPP, RGSPM (F065#0, F065#1)

Signal type: NC→PLC

Signal function: indicate whether the spindle is rotating forward or reverse during rigid tapping, and there is no output during non-rigid tapping.

It is rotating forward when RTGSPP is 1, and reverse when RTGSPM is 1.

Spindle rigid tapping rollback

Signal symbol: RTNT (G62#6)

Signal type: PLC→NC

Signal function: When the rigid tapping is interrupted during execution, the PLC can start the rigid tapping retract function after setting **G62#6** to 1, after which the system will automatically rollback to the plane position R of the previous G84 command with the same spindle speed when the tapping was interrupted.

RTNT1: Spindle tapping rollback started.

0: Spindle tapping rollback not started.

Spindle rigid tapping rollback completed

Signal symbol: RTPT (F66#1)

Signal type: NC→PLC

Signal function: This signal is sent out by the system after the rigid tapping rollback is started and the rollback is completed.

RTPT1: Spindle tapping rollback completed;

0: Spindle tapping rollback not completed.

Rigid tapping rollbacking signal

Signal symbol: RVSL (F082#2)

Signal type: NC→PLC

Signal function: It indicates that the system has gotten into the rigid tapping rollbacking state

Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G061								RGTAP
G062		RTNT						
F066						RTAP	RTPT	
F076					VPO			
F082						RVSL		

Relevant parameters:

2105	Setting of rigid tapping synchronous error width

Set width of rigid tapping synchronous error.

2106	In-place width of tapping shaft in rigid tapping

Set in-place width of tapping shaft in rigid tapping.

2107	In-place width of spindle in rigid tapping

Set in-place width of spindle in rigid tapping.

2112	Return amount of deep-hole rigid tapping cycle

Set return amount of deep-hole rigid tapping cycle.

2113	Default time when P is not specified during rigid tapping

Set default time when P is not specified during rigid tapping.

2120	Limit value of position deviation in the movement of tapping shaft in rigid tapping

Set limit value of position deviation in the movement of tapping shaft in rigid tapping.

2121	Limit value of position deviation in the movement of spindle during rigid tapping

Set limit value of position deviation in the movement of spindle during rigid tapping.

2122 Limit value of position deviation in the stop of tapping shaft in rigid tapping

Set limit value of position deviation in the stop of tapping shaft in rigid tapping.

2123 Limit value of position deviation in the stop of spindle during rigid tapping

Set limit value of position deviation in the stop of spindle during rigid tapping.

2140 Maximum rotational speed of the 1st gear of spindle during rigid tapping

Set maximum rotational speed of the 1st gear of spindle during rigid tapping.

2141 Maximum rotational speed of the 2nd gear of spindle during rigid tapping

Set maximum rotational speed of the 2nd gear of spindle during rigid tapping.

2142 Maximum rotational speed of the 3rd gear of spindle during rigid tapping

Set maximum rotational speed of the 3rd gear of spindle during rigid tapping.

2144 Maximum rotational speed of the 4th gear of spindle during rigid tapping

Set maximum rotational speed of the 4th gear of spindle during rigid tapping.

2210 Backlash amount of the 1st gear of spindle during rigid tapping

Set backlash amount of the 1st gear of spindle during rigid tapping.

2211 Backlash amount of the 2nd gear of spindle during rigid tapping

Set backlash amount of the 2nd gear of spindle during rigid tapping.

2212 Backlash amount of the 3rd gear of spindle during rigid tapping

Set backlash amount of the 3rd gear of spindle during rigid tapping.

2213 Backlash amount of the 4th gear of spindle during rigid tapping

Set backlash amount of the 4th gear of spindle during rigid tapping.

2170 Loop gain of the 1st gear of spindle during rigid tapping and spindle controlling tapping shaft position

Set loop gain of the 1st gear of spindle during rigid tapping and spindle controlling tapping shaft position.

2171 Loop gain of the 2nd gear of spindle during rigid tapping and spindle controlling tapping shaft position

Set loop gain of the 2nd gear of spindle during rigid tapping and spindle controlling tapping shaft position.

2172 Loop gain of the 3rd gear of spindle during rigid tapping and spindle controlling tapping shaft position

Set loop gain of the 3rd gear of spindle during rigid tapping and spindle controlling tapping shaft

position.

2173	Loop gain of the 4th gear of spindle during rigid tapping and spindle controlling tapping shaft position

Set loop gain of the 4th gear of spindle during rigid tapping and spindle controlling tapping shaft position.

2180	Loop gain multiplier of the 1st gear of spindle during rigid tapping

Set loop gain multiplier of the 1st gear of spindle during rigid tapping.

2181	Loop gain multiplier of the 2nd gear of spindle during rigid tapping

Set loop gain multiplier of the 2nd gear of spindle during rigid tapping.

2182	Loop gain multiplier of the 3rd gear of spindle during rigid tapping

Set loop gain multiplier of the 3rd gear of spindle during rigid tapping.

2183	Loop gain multiplier of the 4th gear of spindle during rigid tapping

Set loop gain multiplier of the 4th gear of spindle during rigid tapping.

8.6 Spindle speed fluctuation detection

Function

When deviation between spindle's actual speed and command speed exceeds the parameter setting range, the system will generate a "spindle speed abnormal" alarm and stop the program from running automatically, to protect workpiece, equipment and personal safety.

Conditions for performing speed fluctuation detection:

The NC parameter N5001#0 (SVD) is valid when it is set to 1 or G26.

The spindle has actual speed feedback to the NC.

G code command:

G26 Spindle speed fluctuation detection function is valid.

G25 Spindle speed fluctuation detection function is invalid.

Related signals:

Position encoder selection signal

Signal symbol: PC2SLC (G28#7)

Signal type: PLC→NC

Signal function: Select the encoder input signal for speed fluctuation detection during multi-spindle control.

The signal is 0: Select the 1st spindle feedback as input signal;

The signal is 1: Select the 2nd spindle feedback as input signal.

Spindle speed fluctuation alarm signal

Signal symbol: SPAL (F35#0)

Signal type: NC→PLC

Signal function: It indicates that the spindle speed fluctuation value exceeds the allowable range.

The signal is 0: The spindle speed fluctuation value does not exceed the allowable range;

The signal is 1: The spindle speed fluctuation value exceeds the allowable range.

Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G028	PC2SL							
F035								SPAL

Relevant parameters:

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

SVD: Spindle speed fluctuation detection

0: Invalid

1: Valid

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

The spindle speed fluctuation detection will be started when deviation between spindle's feedback speed value and command value getting into the percentage range set by this parameter, and the spindle speed fluctuation detection will be executed when the system satisfies one of the conditions set by the two parameters N5010 and N5013.

5011 Allowable spindle speed fluctuation rate (%) of the spindle speed fluctuation detection

An alarm will generate when the system exceeds both allowable spindle feedback speed fluctuation rates (%) set by the two parameters N5011 and N5012 when executing the spindle speed fluctuation detection.

5012 Allowable spindle speed fluctuation value (rpm) of the spindle speed fluctuation detection

The spindle is allowed to feed back the value of speed fluctuation when the spindle speed fluctuation detection is executed. The system will give an alarm if it exceeds simultaneously the ranges set by the two parameters N5011 and N5012.

5013 Time between change of the spindle speed command and start of the speed fluctuation detection (ms)

The system will start execution of the spindle speed fluctuation detection when the system exceeds both times between change of the spindle speed command and start of the speed fluctuation detection (ms) set by the two parameters N5010 and N5013 when executing the spindle speed fluctuation detection.

8.7 Spindle safe speed selection

Spindle safe speed selection signal

Signal symbol: SVL (G033#4)

Signal type: PLC→NC

Signal function: It is used to limit the maximum rotational speed of spindle,

When the signal is 1, the maximum rotational speed of spindle is limited by parameter N5118.

Signal address:

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

8.8 Constant surface speed control

Overview

During cutting process, rotation speed of the spindle is automatically adjusted according to change in the diameter direction to realize constant relative speed between the tool nose and the workpiece cutting surface.

G code determines whether to choose to execute the constant surface cutting speed control:

G96: Execute constant surface cutting speed control; S in G96 mode is m/min or feet/min.

G97: Do not execute constant surface cutting speed control; S in G97 mode is r/min.

Constant surface speed control signal

Signal symbol: CSS (F002#2)

Signal type: NC→PLC

Signal function: It indicates the constant surface speed control state; when the signal is 1, the constant surface speed control is valid.

Signal address:

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

8.9 Multi-spindle control

Overview

In addition to the usual (the 1st) spindle, the 2nd spindle can also be controlled. For any one of the spindle command S codes, the PMC signal determines which spindle is selected.

The S code is sent as a speed command to the spindle selected by the spindle selection signal <SWS1~SWS2><G027#0－#1>, and each spindle rotates at its specified speed. If the spindle selection signal corresponding to a spindle is not turned on, it continues to rotate at the previous speed. This allows spindle to rotate at different speed at the same time.

In multi-spindle control, the 1st or 2nd spindle is selected by the spindle selection signal control, and the spindle override signal and the spindle speed strobing signal are only for the selected spindle. Spindle positioning or CS contour control is independent of the spindle selection signal.

Spindle selection signal

Signal symbols: SWS1, SWS2 (G027#0, G027#1)

Signal type: PLC→NC

Signal function: Select the spindle controlled by command in the multi-spindle control, and specify a spindle selection signal each time.

Each spindle enabling control signal

Signal symbols: *SSTP1, *SSTP2 (G027#3, G027#4)

Signal type: PLC→NC

Signal function: It is only valid for multi-spindle control, and can stop each spindle separately.

*SSTP1 1: Output enabling to the 1st spindle.
0: Do not output enabling to the 1st spindle.
*SSTP2 1: Output enabling to the 1st spindle.
0: Do not output enabling to the 1st spindle.

1st spindle and 2nd spindle alarm state signal

Signal symbols: SPALM, SPALM B (F045#0, F049#0)

Signal type: NC→PLC

Signal function: Inform the CNC that the spindle is in the alarm state

1st spindle and 2nd spindle zero-speed output signal

Signal symbols: ZSL, ZSL2 (F045#1, F049#1)

Signal type: NC→PLC

Signal function: Inform the CNC that the spindle is at zero speed.

1st spindle and 2nd spindle speed arrival signal

Signal symbols: SAR, SAR2 (F045#3, F049#3)

Signal type: NC→PLC

Signal function: Notify the CNC that the spindle is in speed arrival state.

1st spindle and 2nd spindle orientation signal

Signal symbols: ORCM, ORCM 2 (G070#6, G074#6)

Signal type: PLC→NC

Signal function: When the signal is 1, the CNC outputs a directional signal to the spindle.

1st spindle and 2nd spindle orientation completion signal

Signal symbols: ORAR, ORAR2 (F045#7, F049#7)

Signal type: NC→PLC

Signal function: Notify the CNC that the spindle is in orientation completion state.

1st spindle and 2nd spindle motor command polarity selection signal

Signal symbols: SGN, SGN2 (G033#5, G035#5)

Signal type: PLC→NC

Signal function: CNC can output ±10V analog voltage, the SGN signal selects the polarity of the analog voltage output to spindle. When the signal is set to 1, the CNC output negative voltage to spindle; when the signal is set to 0, the CNC output positive voltage to spindle.

1st spindle and 2nd spindle actual spindle speed output signal

Signal symbols: AR00~AR15, AR002~AR152 (F040~F041, F202~F203)

Signal type: NC→PLC

Signal function: Output actual speed of the spindle encoder from the CNC to the PLC, with its speed value showed in binary.

Relevant parameters:

5005	System spindle number selection

Set number of system-controlled spindles.

Signal address:

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

G027				*SSTP2	*SSTP1		SWS2	SWS1
G033			SGN					
G035			SGN2					
G070		ORCM						
G074		ORCM2						
F045	ORAR				SARA		ZSL	SP1ALM
F049	ORAR2				SARA2		ZSL2	SP2ALM

8.10 Spindle positioning

Overview

This function positions the spindle via the spindle motor and position encoder. Usually, the spindle is mechanically clamped after completion of the positioning. In turning process, the workpiece is driven by the spindle and the spindle motor rotates at the specified speed. The spindle speed value is input from the spindle controller to the spindle amplifier.

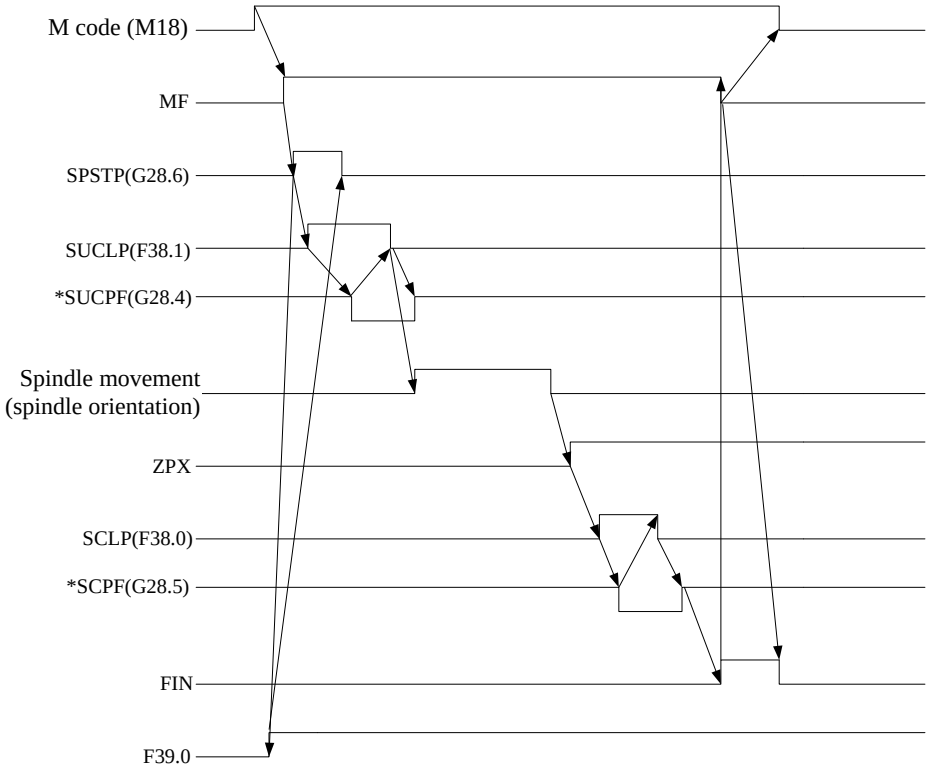
When the spindle positioning function is valid, the spindle rotates to a specified angle and the workpiece is also positioned at that angle.

Switch to spindle positioning mode

1. It is assumed that the M18 code has been commanded by the command program.
2. The auxiliary function code signal is transmitted, and the PMC auxiliary function strobing pulse signal MF becomes '1'. This transmission step is the same as the usual auxiliary function.
3. When the strobing pulse signal MF becomes '1', the code signal will be read at the PMC side, after which the spindle will stop and the spindle stop confirmation signal SPSTP <G028#6> will be set to '1'.
4. When the strobing pulse signal MF is set to '1', the CNC will immediately judge whether the spindle stop confirmation signal SPSTP is '1'. When the SPSTP signal is '1', the CNC will switch the spindle control mode from spindle rotation mode to spindle positioning mode, set the signal MSPOS <F39.0> in the spindle positioning mode to '1', and set SPSTP at the PMC side to 0.
5. The CNC sets the spindle release signal SUCLP<F038#1> to '1' and enables the spindle.
6. When the spindle release signal SUCLP becomes '1', the PMC side will process the spindle release signal and set the spindle release completion signal *SUCPF<G028#4> to '0', and the CNC will set the spindle release signal SUCLP to '0', after which please set the spindle release completion signal *SUCPF to '1' at the PMC side.
7. When the spindle release completion signal *SUCPF becomes '0', the CNC will perform spindle orientation internally, after which the home completion signal ZPx and related initial state of the set shaft shall be switched to position mode.
8. The CNC will set the spindle clamping signal SCLP<F038#0> to '1'.

9. When the spindle clamping signal SCLP becomes "1", the PMC side will clamp the spindle as needed, or mechanically clamp with an injection pin or the like. After the clamping is completed, the spindle clamping completion signal *SCPF<G028#5> will be set to '0'; at the same time, the CNC will disconnect the spindle enabling.
10. When the spindle clamping completion signal *SCPF becomes '0', the CNC will notify that the *SCPF has been received after setting the spindle clamping signal SCLP to '0'.
11. When the spindle clamping signal SCLP becomes '0', please set the spindle clamping completion signal *SCPF to '1' at the PMC side.
12. Finally, the completion signal FIN of the strobing pulse signal MF with respect to auxiliary function at the PMC side shall be set to '1'. Thus, the CNC shall set the MF signal to '0', and the FIN signal to '0' at the PMC side.

Timing diagram



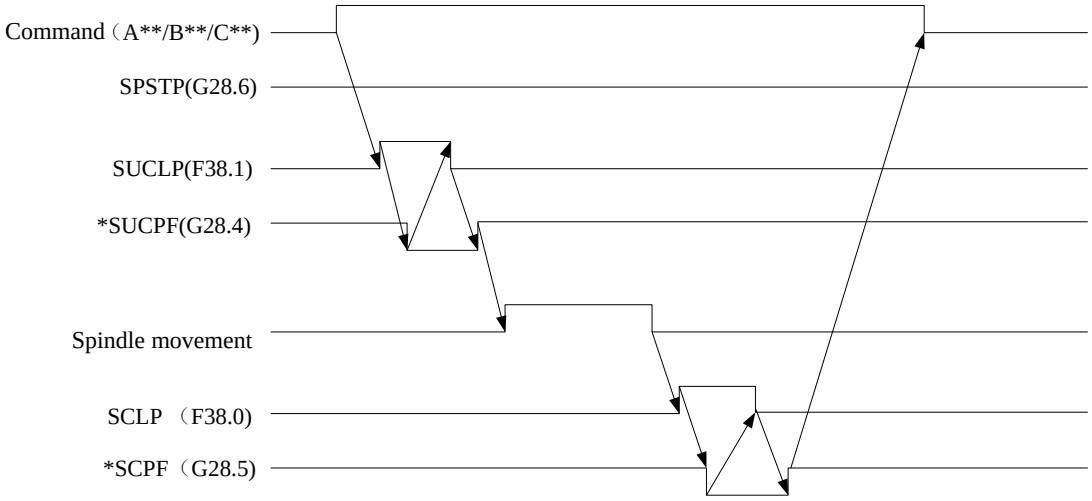
Spindle positioning

1. It is assumed that the spindle positioning motion command has been commanded by the command program.
2. The CNC sets the spindle release signal SUCLP to '1'.
3. When the spindle release signal SUCLP becomes "1", the PMC side will cancel the clamping of spindle, after which the spindle release completion signal *SUCPF will be set to '0'.
4. When the spindle release completion signal *SUCPF becomes '0', the CNC will set the spindle release signal SUCLP to '0' and notify that the *SUCPF signal has been received.
5. When the spindle release signal SUCLPs becomes '0', please set the spindle release completion signal *SUCPF to '1' at the PMC side. After setting the SUCLP signal to '0', the CNC will rotate the spindle and execute the commanded movement till it is completed, and then stop the spindle movement.
6. The CNC sets the spindle clamping signal SCLP to '1'.
7. When the spindle clamping signal SCLP becomes '1', please hold the spindle or mechanically clamp the spindle with an injection pin or the like as needed at the PMC side. After the clamping is completed,

please set the spindle clamping completion signal *SCPF to '0'.

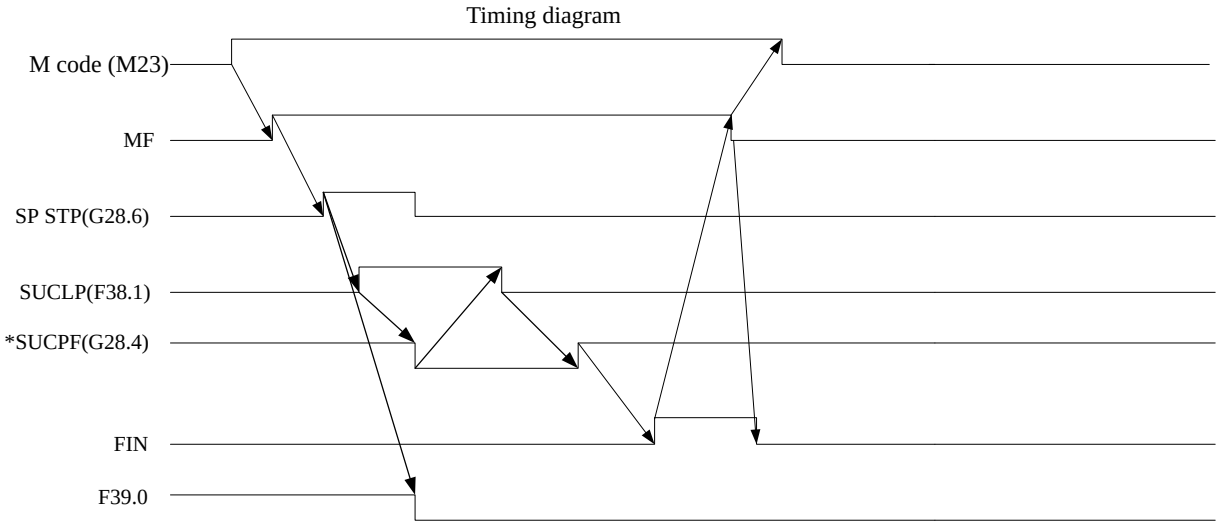
8. When the spindle clamping completion signal *SCPFs becomes '0', the CNC will notify that the *SCPFs has been received after setting the spindle clamping signal SCLP to '0'.
9. When the spindle clamping signal SCLPs becomes '0', please set the spindle clamping completion signal *SCPF to '1' at the PMC side.

Timing diagram



Spindle positioning cancel

1. It is assumed that the M23 code has been commanded by the command program.
2. The auxiliary function code signal is transmitted, and the auxiliary function strobing pulse signal MF becomes '1'. This transmission step is the same as the usual auxiliary function.
3. When the strobing pulse signal MF becomes '1' and related processing is completed at the PMC side, the spindle will stop and the spindle stop confirmation signal SPSTP will be set to '1'.
4. When the strobing pulse signal MF is set to '1', the CNC will immediately judge whether the spindle stop confirmation signal SPSTP is '1'. When the SPSTP signal becomes '1', please set the spindle release signal SUCLP to '1'.
5. When the spindle release signal SUCLP becomes '1', the PMC side will cancel the clamping of spindle, after which the spindle release completion signal *SUCPF will be set to '0'.
6. When the spindle release completion signal *SUCPF becomes '0', the CNC will set the spindle release signal SUCLP to '0' and notify that the *SUCPF signal has been received. When the CNC sets the SUCLP signal to '0', the spindle control mode will be switched from spindle positioning mode to spindle rotation mode, and the spindle positioning mode signal MSPOS will be set to '0'.
7. When the spindle release signal SUCLP becomes '0', please set the spindle release completion signal *SUCPF to '1' at the PMC side.
8. Finally, the completion signal FIN of the strobing pulse signal MF with respect to auxiliary function at the PMC side shall be set to '1'. Thus, the CNC shall set the MF signal to '0', and the FIN signal to '0' at the PMC side.



The diagnosis shows:

355:1: orientation completed, getting into positioning spindle mode;

2: orientation completed, under control of CS shaft, 0 means getting into position control.

356: control variables interacting with the system, 0 no orientation, 1 orientation undergoing, 2 orientation completed, 3 starting to get into positioning spindle control.

357: valid in positioning mode;

1: Spindle release signal F38.1 is valid;

2: Spindle release completion signal is valid <low level is valid G28.4>;

3: Spindle clamping signal is valid <F38.0>;

4: Spindle clamping end signal is valid <low level is valid G28.5>.

Spindle positioning signal

Signal symbol: SPSTP (G028#6)

Signal type: PLC→NC

Signal function: When the signal is 1, the CNC will position the spindle.

SPSTP 1: Start spindle positioning.

0: Do not start spindle positioning.

2nd spindle positioning signal

Signal symbol: SPSTP2 (G026#6)

Signal type: PLC→NC

Signal function: When the signal is 1, the CNC will position the 2nd spindle.

SPSTP2 1: Start the 2nd spindle positioning.

0: Do not start the 2nd spindle positioning.

Spindle positioning switching end signal

Signal symbol: MSPOS (F039#0)

Signal type: NC→PLC

Signal function: This signal indicates that it is already in spindle positioning control mode.

F039#0 1: Be in spindle positioning control mode.

0: Be not in spindle positioning control mode.

2nd spindle positioning switching end signal

Signal symbol: MSPOS2 (F039#1)

Signal type: NC→PLC

Signal function: This signal indicates that it is already in spindle positioning control mode.

F039#1 1: 2nd spindle is in positioning control mode.

0: 2nd spindle is not in positioning control mode.

Spindle release signal

Signal symbol: SUCLP (F038#1)

Signal type: NC→PLC

Signal function: This signal indicates the release of spindle mechanical clamping device during spindle positioning operation. When the signal is output, the spindle will be released mechanically (release the brake or pull out the pin).

SUCLP 1: Release spindle mechanical clamping device.

0: Do not release spindle mechanical clamping device.

2nd spindle release signal

Signal symbol: SUCLP2 (F038#5)

Signal type: NC→PLC

Signal function: This signal indicates the release of spindle mechanical clamping device during the 2nd spindle positioning operation. When the signal is output, the 2nd spindle will be released mechanically (release the brake or pull out the pin).

SUCLP2 1: Release the 2nd spindle mechanical clamping device.

0: Do not release the 2nd spindle mechanical clamping device.

Spindle release end signal

Signal symbol: *SUCPF (G028#4)

Signal type: PLC→NC

Signal function: This signal indicates the release of spindle mechanical clamping device during spindle positioning operation. When the signal is output, the spindle will be released mechanically (release the brake or pull out the pin).

SUCLP 1: Release spindle mechanical clamping device.

0: Do not release spindle mechanical clamping device.

2nd spindle release end signal

Signal symbol: *SUCPF2 (G026#4)

Signal type: NC→PLC

Signal function: This signal indicates the release of spindle mechanical clamping device during the 2nd spindle positioning operation. When the signal is output, the 2nd spindle will be released mechanically (release the brake or pull out the pin).

*SUCPF2 1: Release the 2nd spindle mechanical clamping device.

0: Do not release the 2nd spindle mechanical clamping device.

Spindle clamping signal

Signal symbol: SCLP (F038#0)

Signal type: NC→PLC

Signal function: This signal indicates the clamping of spindle during spindle positioning operation. When the signal becomes 1, the spindle will be clamped mechanically (clamp the brake or insert the pin).

SCLP 1: Start spindle mechanical clamping device.

0: Do not start spindle mechanical clamping device.

2nd spindle clamping signal

Signal symbol: SCLP2 (F038#4)

Signal type: NC→PLC

Signal function: This signal indicates the clamping of spindle during 2nd spindle positioning operation. When the signal becomes 1, the spindle will be clamped mechanically (clamp the brake or insert the pin).

SCLP21: Start 2nd spindle mechanical clamping device.

0: Do not start 2nd spindle mechanical clamping device.

Spindle clamping end signal

Signal symbol: *SCPF (G028#5)

Signal type: PLC→NC

Signal function: This signal indicates the end of spindle clamping operation corresponding to the spindle clamping signal SCLP.

*SCPF 1: Clamping of spindle mechanical clamping device completed.

0: Clamping of spindle mechanical clamping device not completed.

2nd spindle clamping end signal

Signal symbol: *SCPF2 (G026#5)

Signal type: PLC→NC

Signal function: This signal indicates the end of spindle clamping operation corresponding to the 2nd spindle clamping signal SCLP.

*SCPF2 1: Clamping of the 2nd spindle mechanical clamping device completed.

0: Clamping of 2nd spindle mechanical clamping device not completed.

Relevant parameters:

1022	Rotation axis is changed to -1/-2

Rotation axis is set to -1/-2

	#7	#6	#5	#4	#3	#2	#1	#0
5002								AXC

Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G026		SPSTP2	*SCPF2	*SUCPF2				
G028		SPSTP	*SCPF	*SUCPF				
F038				*SUCPF2			SUCL	SCLP
F039				*SUCPF			MSPOS2	MSPOS

8.11 CS contour control

Overview

CS contour control function can switch the spindle to rotating feed shaft, control position through position detection device mounted on the spindle, and perform interpolation function with other servo axes.

Spindle speed control function controls speed of the digital spindle, spindle speed control rotates the spindle through speed command, Cs contour control function controls position of the spindle ("spindle contour control"), but the spindle contour control uses the position movement command to rotate the spindle.

Switching between spindle speed control and spindle contour control is controlled by signals of the PLC. In Cs contour control mode, the Cs contour control axis can be operated manually or automatically, just like a normal servo axis.

- Setting of Cs contour control axis

  Shaft used for Cs contour control must be set to CNC control axis; the selected servo axis is set to -1/-2 in parameter No. 255, which respectively means that the $1^{st}/2^{nd}$ spindle realizes Cs contour control, and the contour control axis is set to rotation axis by ROTn of parameter No.1023.

- **Cs** contour control axis operation

  The PLC validates the spindle contour control switching signal and generates a spindle orientation command; after the spindle orientation is completed, the system will validate the contour control switching end signal and get into position control mode, where the spindle becomes Cs contour control axis, same as normal NC shaft.

  In spindle speed control mode, the Cs contour control axis cannot be operated. Otherwise, an alarm will occur during autorun.

  In spindle speed mode, manual operation of Cs contour control axis is prohibited with a PMC ladder diagram.

Manual home operation does not respond.

Related signals:

Spindle contour control switching signal, 2^{nd} spindle contour control switching signal

Signal symbols: CON (G027.7), CON2 (G027.6)

Signal type: PLC→NC

Signal function: This signal specifies Cs contour control function. When this signal is "1", the spindle will switch from speed control mode to Cs contour control mode. If the spindle is moving when switching, the spindle shall be immediately stopped. When this signal becomes "0", the Cs contour control mode will be switched back to the speed control mode

Spindle contour control switching end signal, 2^{nd}spindle contour control switching end signal

Signal symbols: FSCSL (F044.1), FSCSL 2 (F044.0)

Signal type: NC→PLC

Signal function: This signal indicates that the control axis is already in Cs contour control mode.

When this signal is "0", it indicates that the spindle is in speed control mode;

When this signal is "1", it indicates that the spindle is in Cs contour control mode.

Cs contour control axis reference position return end signal

Signal symbol: ZPx (F0094)

Signal type: NC→PLC

Signal function: This signal indicates that the Cs contour control axis reference position return operation ends normally.

Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G027	CON	CON2						
F044							FSCSL	FSCSL2
F094	ZP8	ZP7	ZP6	ZP5	ZP4	ZP3	ZP2	ZP1

Relevant parameters:

	#7	#6	#5	#4	#3	#2	#1	#0
5002							SCS	

SCS: Cs axis function
0: Invalid
1: Valid

5200	Cs spindle controlled the 1st gear position loop gain
5201	Cs spindle controlled the 2nd gear position loop gain
5202	Cs spindle controlled the 3rd gear position loop gain
5203	Cs spindle controlled the 4th gear position loop gain
52n0	Servo axis interpolated with Cs spindle control (group n)
52n1	1st gear position loop gain of servo axis interpolated with Cs spindle control
52n2	2nd gear position loop gain of servo axis interpolated with Cs spindle control
52n3	3rd gear position loop gain of servo axis interpolated with Cs spindle control
52n4	4th gear position loop gain of servo axis interpolated with Cs spindle control

8.12 Spindle synchronous control

Overview

This function controls synchronous rotation of two digital spindles. This function also controls phase rotation of spindle, so that irregular workpieces or bars can be clamped by the two spindles.

In synchronous control, spindle that receives and is controlled by the S command is called drive spindle. Spindle that is not controlled by the S command but rotates synchronously with the drive spindle is called slave spindle. The 1st spindle is drive spindle.

- Rotational speed synchronization

  When the spindle synchronous control signal is set to '1', it gets into spindle synchronous control mode. In command spindle synchronous control, when the spindle is accelerated or decelerated to the commanded rotational speed, it gets into synchronous control state.

  When the two spindles reach a rotational speed equivalent to that specified by the spindle synchronous speed command and the rotational speed difference between the two spindles is less

than the parameter setting value (No. 5260), the spindle synchronous speed control completion signal is output.

- Phase matching

  In spindle synchronous control mode (after the spindle synchronous speed control completion signal is output), the spindle phase synchronization will be executed when the spindle phase synchronous control signal is set to '1'. In spindle phase synchronous operation (before the spindle phase synchronous control completion signal becomes '1'), the two shafts are not maintained in synchronous state.

  When error between the two spindles is within the number of allowable pulses determined in the NC side parameter (No. 5261), the spindle phase synchronous completion signal will be output. After the spindle phase synchronization is completed, the spindle phase synchronization operation will be performed again when commanding the spindle phase synchronization. The spindle phase synchronization shall not be commanded when the two spindles are grabbing workpieces.

- Limits

  When it is in Cs contour control mode, rigid tapping, spindle simple synchronization (M series), and state of the spindle is outside spindle rotation mode, the spindle synchronous control mode cannot be performed. Switching to spindle synchronous control mode shall be performed when the drive shaft and slave shaft are in spindle rotation mode.

  For shafts in spindle synchronous control mode, commands such as Cs contour control, rigid tapping and spindle simple synchronization (M series) cannot be performed.

  The maximum spindle speed during synchronization is determined by the maximum HS of the drive spindle (5116).

Related signals:

Spindle synchronous control signal

Signal symbol: SPSYC (G038.2)

Signal type: PLC→NC

Signal function: Command the 1st and 2nd spindles to switch to spindle synchronous control mode.

Spindle synchronous speed control completion signal

Signal symbol: FSPSY (F044.2)

Signal type: NC→PLC

Signal function: This signal indicates that the spindle synchronization control (rotational speed synchronization) of the 1st/2nd spindle has been completed.

In spindle synchronous control mode, when the 2 spindles reach a rotational speed equivalent to that specified by the spindle synchronous speed command and the rotational speed difference between the 2 spindles is less than the parameter setting value, the signal will be output.

Spindle phase synchronous control signal

Signal symbol: SPPHS (G38.3)

Signal type: PLC→NC

Signal function: Command spindle phase synchronous control mode (phase matching) of the 1st/2nd spindle.

When this signal changes from '0' to '1', the spindle phase synchronous control of the 1st/2nd spindle will be performed.

This signal will be valid when the spindle synchronous control signal SPSYC is '1'.

Please command this signal after the spindle synchronous speed control end signal FPSSY becomes '1'. After capturing the rising edge of this signal, the system performs the spindle phase synchronous control action. Therefore, as long as this signal is set to '0', the phase after matching is no longer deviated.

However, when the signal is reset from '0' to '1', the system performs a phase matching action.

Spindle phase synchronization control completion signal

Signal symbol: SPPH (F044.3)

Signal type: NC→PLC

Signal function: This signal indicates the fact that the spindle phase synchronization control (phase matching) of the $1^{st}/2^{nd}$ spindle has been completed.

In spindle synchronization control mode, when the 2 spindles reach a rotational speed equivalent to that specified by the spindle synchronization speed command, the control signal is synchronized by the spindle phase, and when the phase matching is completed (the error pulse difference between the 2 spindles is below the parameter's set value), this signal is output.

Spindle phase error monitoring signal

Signal symbol: SYCAL (F044.4)

Signal type: NC→PLC

Signal function: In spindle synchronization control mode for the $1^{st}/2^{nd}$ spindle, the signal indicates the fact that the pulse difference between 2 spindles is greater than the parameter's set value. In spindle synchronization control mode, after completion of spindle synchronization control, the pulse difference between 2 spindles is greater than the parameter's set value (No.5262).

Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G038					SPPHS	SPSYC		
F044				SYCAL	SPPH	FSPSY		

8.13 Spindle output control by the PLC

Overview

Through the PLC, the functions of commanding the spindle's speed and direction are achieved.

Related signals:

1^{st} and 2^{nd} PLC spindles control signal

Signal symbols: SSND (G033.7), SSND2 (G035.7)

Signal type: PLC→NC

Signal function: 1^{st} and 2^{nd} spindles enter the PLC spindle output control mode.

When the signal is 1, the speed command and direction of the spindle are controlled by the PLC;

when the signal is 0, the speed command and direction of the spindle are controlled by the NC.

1^{st} and 2^{nd} PLC spindles polarity selection signal

Signal symbols: SGN (G033.5), SGN2 (G035.5)

Signal type: PLC→NC

Signal function: 1^{st} and 2^{nd} spindles enter the PLC spindle output control mode.

The SGN signal selects the analog voltage polarity that is output to the spindle.

When the signal is set to 1, the CNC outputs a negative voltage to the spindle;

When this signal is set to 0, the CNC outputs a positive voltage to the spindle.

1^{st} and 2^{nd} PLC spindles speed value signal

Signal symbols: R01I~R12I (G032.0~G033.3), R01I2~R12I2 (G034.0~G035.3)

Signal type: PLC→NC

Signal function: 1st and 2nd spindles PLC speed command value.

Spindle motor's actual rotational speed=maximum speed (NC parameter 5115)×(G32.0-G33.3)÷4096

Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G032	R08I	R07I	R06I	R05I	R04I	R03I	R02I	R01I

1st spindle speed value signal

G033	SSND		SGN		R12I	R11I	R10I	R09I

1st PLC spindle 1 command 1st spindle speed value signal axis control strobe polarity selection

G034	R08I2	R07I2	R06I2	R05I2	R04I2	R03I2	R02I2	R01I2

2nd spindle speed value signal

G035	SSND2		SGN2		R12I2	R11I2	R10I2	R09I2

2nd PLC spindle 2 command 1st spindle speed value signal axis control strobe polarity selection

8.14 PLC spindle actual load reading function

Overview

Through the PLC signal G16#0, notify the system to transfer the actual load of the spindle to one byte of PLC address F68, and display it in percentage units

Signal symbol: SP LOAD (G016#0)

Signal type: PLC→CNC

Signal function: It is used to read the actual load of the PLC spindle

When the signal is 1, the actual load of spindle is read.

Signal symbol: SPLOAD1-8 (F68)

Signal type: CNC→PLC

Signal function: It is used to display the actual load percentage of the PLC spindle

Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G016								SPLOAD

F68	SPLOAD8	SPLOAD7	SPLOAD6	SPLOAD5	SPLOAD4	SPLOAD3	SPLOAD2	SPLOAD1

8.15 Spindle control based on servo feed axis

Overview

Through the PLC signal, the system is notified to switch the feed axis to spindle control. The spindle number corresponding to the servo feed axis is set by parameter 4035. 1-4 correspond to the 1st to the 4th spindle, respectively.

Signal symbol: SVREV1 (G127#0~G127#3)

Signal type: PLC→NC

Signal function: It is used to switch the servo feed axis to spindle control.

When the signal is 1, the servo feed axis is switched to spindle control;

When the signal is 0, the servo feed axis control function will be restored.

Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G127					G127.3	G127.2	G127.1	G127.0

Chapter IX PLC Control Function

9.1 External data input

Overview

The external signal transmits specified data to the CNC via PLC commands and performs the function for specified action.

External data input function:

Reading External Data	Function Address Selection							Data Signal	Function
ESTC	EA6	EA5	EA4	EA3	EA2	EA1	EA0	ED31~ED0	
1	0	0	0	0	0	0	0	Program number indicated in binary	External program searching
1	0	0	1	Compensation specification				Offset amount indicated in binary	External tool compensation
1	0	1	0	Axis offset selection				Offset amount indicated in binary	External workpiece coordinate system's offset
1	0	1	1	Axis offset selection				Offset amount indicated in binary	External mechanical origin offset
1	1	1	0	EA0=0				Workpiece quantity indicated in binary	Workpiece quantity presetting
1	1	1		EA0=1				Workpiece quantity indicated in binary	Workpiece quantity replacement

Related signals:

External data input reading

Signal symbol: ESTC (G13.7)

Signal type: PLC→CNC

Signal function: Start external data reading.

Selection of program loading mode

Signal symbol: PRO-SL (G85.0)

Signal type: PLC→CNC

Signal function: Control whether the selected program is loaded in MDI mode or in automatic mode.

When it is 0, it is loaded in automatic mode;

When it is 1, it is loaded in MDI mode.

External data input address

Signal symbols: EA0~EA6 (G13.0~G13.6)

Signal type: PLC→CNC

Signal function: Specify addresses for external data input and functions to be implemented.

Data for external data input

Signal symbols: ED0~ED31 (G0.0~G3.7)

Signal type: PLC→CNC

Signal function: Specify data required for external data input.

External data input reading completed

Signal symbol: EREND (F60.0)

Signal type: NC→PLC

Signal function: Indicate the NC has read the external data input signal.

External data retrieving completed

Signal symbol: ESEND (F60.1)

Signal type: NC→PLC

Signal function: Indicate that the NC has completed the function specified by the external data input signal.

External data reading cancelled

Signal symbol: ESCAN (F60.2)

Signal type: NC→PLC

Signal function: After the external data reading signal is input to the NC and before retrieving is performed, if a reset signal is input and the parameter N1971#7 is set to '1', the retrieving won't be performed and this signal will be output.

Function details:

External program selection:

External program selection is a function to call programs stored in the CNC via external signals. It is often used to select a corresponding program through external switch signals when multiple programs is run on one machine. The program number that can be selected ranges between O1-O9999, and programs coded with non-numeric characters cannot be selected.

To perform external program selection function, firstly set function selection address signals EA0~EA6 to '0', send by binary data the number of the program to be selected to data signal address ED0~ED31; and then set the external data reading signal ESTC to '1', the CNC system will receive the external program selection data signal while it is in any mode, but the external program selection function is executed only when the CNC is in autorun mode and is in reset mode.

It can be selected by PLC signal G85.0 whether the program is loaded in MDI mode or in automatic mode. Before execution, the operation mode must be switched correctly to ensure normal calling and running.

The control action timing diagram is shown as follows:

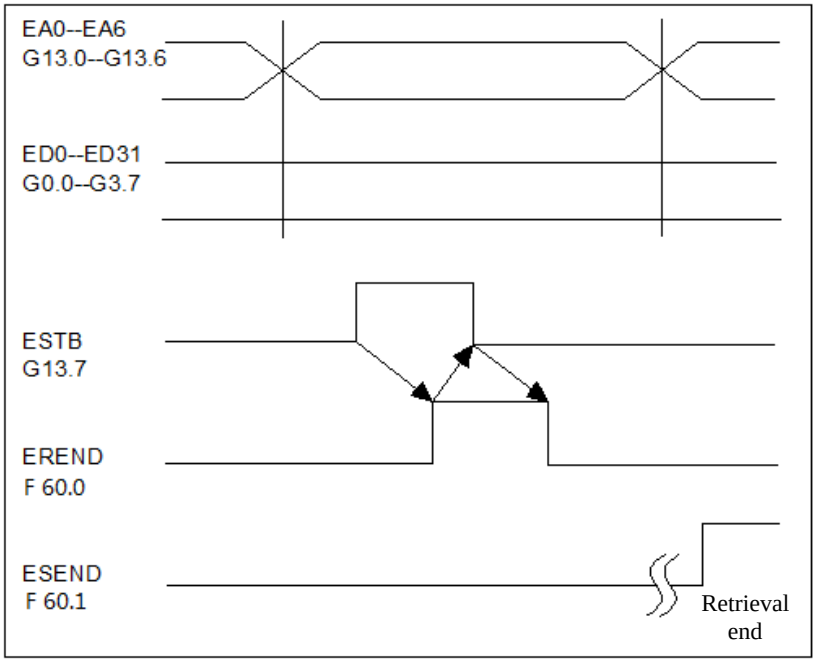


Figure 9-1

Axis offset selection:

Axis Name	EA3	EA2	EA1	EA0
1st axis	0	0	0	0
2nd axis	0	0	0	1
3rd axis	0	0	1	0
4th axis	0	0	1	1
5th axis	0	1	0	0
6th axis	0	1	0	1
7th axis	0	1	1	1
8th axis	1	0	0	0

9.2 PLC axis control function

Overview

Through parameter settings, axes are detached from CNC, so that they no longer receive commands from CNC. Operation commands are sent to the axes through PLC to execute the required action. PLC axis runs independently without linkage interpolation relationship with the CNC axis.

The system can control up to 8 PLC axes, and are generally used for the control of equipment such as indexing worktable and turret.

Control functions that can be implemented via the PLC axes:

1. Fast moving
2. Cutting feed (feed per minute and feed per revolution)
3. Jump (feed per minute)
4. Dwell
5. Reference point return
6. Manually continuous feed
7. Return to the 1st~4th reference points

8. 1st~3rd auxiliary functions
9. Selection of machine coordinate system

Signal:

- **PLC axis control signal table**

Table 9-1

S/N	Symbol	Signal Address	Meaning	Input and Output
1	EAX1-EAX4	G136.0-7	Control axis selection signal	Input
2	EC0g-EC6g	G143.0-6, G155.0-6, G167.0-6, G179.0-6, G188.0-6, G197.0-6, G206.0-6, G215.0-6	Shaft control command signal	Input
3	EIF0g-EIF15g	G144-G145, G156-G157, G168-G169, G180-G181, G189-G190, G198-G199, G207-G208, G216-G217	Axis control feed speed signal	Input
4	EID0g-EID31g	G146-G149, G158-G161, G170-G173, G182-G185, G191-G194, G200-G203, G209-G212, G218-G221	Shaft control data signal	Input
5	EBUFg	G142.7, G154.7, G166.7, G178.7, G187.7, G196.7, G205.7, G214.7	Shaft control command read signal	Input
6	EBSYg	F130.7, F133.7, F136.7, F139.7, F142.7, F145.7, F148.7, F151.7	Shaft control command read completion signal	Output
7	ECLRg	G142.6, G154.6, G166.6, G178.6, G187.6, G196.6, G205.6, G214.6	Reset signal	Input
8	ESTPg	G142.5, G154.5, G166.5, G178.5, G187.5, G196.5, G205.5, G214.5	Shaft control dwell signal	Input
9	ESBKg	G142.3, G154.3, G166.3, G178.3, G187.3, G196.3, G205.3, G214.3	Program block stop signal	Input
10	EMSBKg	G143.7, G155.7, G167.7, G179.7, G188.7, G197.7, G206.7, G215.7	Program block invalid stop signal	Input
11	EM11g-EM48g	F132, F135, F138, F141, F144, F147, F150, F153	Auxiliary function code signal	Output
12	EMFg	F131.0, F134.0, F137.0, F140.0, F143.0, F146.0, F149.0, F152.0	Auxiliary function strobing signal	Output
13	EMF2g	F131.2, F134.2, F137.2, F140.2, F143.2, F146.2,	Auxiliary function 2 strobing signal	Output

S/N	Symbol	Signal Address	Meaning	Input and Output
		F149.2, F152.2		
14	EMF3g	F131.3, F134.3, F137.3, F140.3, F143.3, F146.3, F149.3, F152.3	Auxiliary function 3 strobing signal	Output
15	EFINg	G142.0, G154.0, G166.0, G178.0, G187.0, G196.0, G205.0, G214.0	Auxiliary function completion signal	Input
16	ESOFg	G142.4, G154.4, G166.4, G178.4, G187.4, G196.4, G205.4, G214.4	Servo shut-off signal	Input
17	EMCUFg	G142.2, G154.2, G166.2, G178.2, G187.2, G196.2, G205.2, G214.2	Cache invalid signal	Input
18	*EAXSL	F129.7	Control axis selection status signal	Output
19	EINPg	F130.0, F133.0, F136.0, F139.0, F142.0, F145.0, F148.0, F151.0	In-position signal	Output
20	EIALg	F130.2, F133.2, F136.2, F139.2, F142.2, F145.2, F148.2, F151.2	Alarm signal	Output
21	EGENg	F130.4, F133.4, F136.4, F139.4, F142.4, F145.4, F148.4, F151.4	Shaft movement signal	Output
22	EDENg	F130.3, F133.3, F136.3, F139.3, F142.3, F145.3, F148.3, F151.3	Auxiliary function execution signal	Output
23	EOTNg	F130.6, F133.6, F136.6, F139.6, F142.6, F145.6, F148.6, F151.6	Negative over-travel signal	Output
24	EOTPg	F130.5, F133.5, F136.5, F139.5, F142.5, F145.5, F148.5, F151.5	Forward over-travel signal	Output
25	EFV0-EFV7	G151.0-G151.7	Spindle speed override signal	Input
26	EOVC	G150.5,G150.7	Override cancellation signal	Input
27	EROV1, EROV2	G150.0, G150.1	Rapid Traverse Override Signal	Input
28	EOV0	F129.5	Override 0% signal	Output
29	ESKIP	X13.6	Skip signal	Input
30	EADEN1-EADEN4	F112.0-7	Assign completion signal	Output

S/N	Symbol	Signal Address	Meaning	Input and Output
31	EABUFg	F131.1, F134.1, F137.1, F140.1, F143.1, F146.1, F149.1, F152.1	Buffer area full signal	Output
32	EACNT1-EACNT4	F182.0-7	Controlling signal	Output
33	*+ED1-*+ED6 *-ED1-*-ED6	G118.0-G118.7 G120.0-G120.7	External deceleration signal	Input

Description:

PLC axis control realizes various control functions through PLC command control signals (Table 9-1), and the CNC provides 8 groups of input/output signals, namely group A, group B, group C, group D, group E, group F, group G, and group H. Each group has a corresponding input/output signal. Which group controls the axis is decided by the setting of parameter N7010.

The lowercase letter "g" in the name of the input/output signal associated with the PLC axis control indicates the group of the signals. For example, the "g" in the axis control command reading signal EBUFg (for which no signal actually exists), stands for A, B, C, D, E, F, G, H, which are equivalent to signals of group A, group B, group C, group D, group E, group F, group G, and group H respectively. EBUFg is the expression of signals EBUFA, EBUFB, EBUFC and EBUFD.

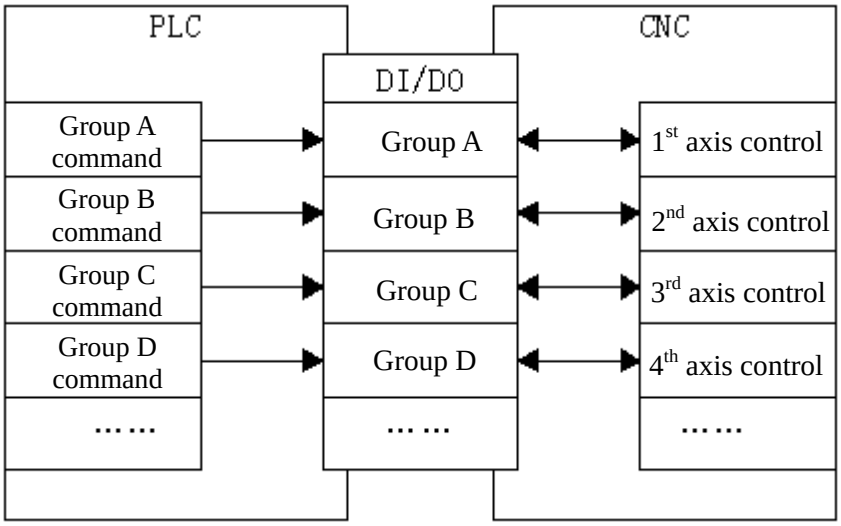


Figure 9-2 Schematic Diagram of the PLC Axis Control

Configuration of Each Group

Group No.	Input Signal Address	Output Signal Address
Group A	G142-G149,G150.5 G150.0,1,6,7	F130-F132,F142, F129.5,7
Group B	G154～G161,G162.5 G150.0,1,6,7	F133-F135,F145, F129.5,7
Group C	G166-G173,G174.5 G150.0,1,6,7	F136-F138,F148, F129.5,7
Group D	G178-G185,G186.5 G150.0,1,6,7	F139-F141,F151, F129.5,7
……	……	……

Operation steps:

(1) Set DI/DO group of the PLC axis control in parameter N7010. While synchronizing the axis motion of multiple axes in 1 group, make sure to set parameters related to feed speed, acceleration/deceleration time, and axis properties to the same values.

(2) To directly control the axis by the PLC, it is necessary to set, according to the set group number, selection signals EAX1~EAX4 to '1' for the axis to be controlled so that the axis disengages from the management of the CNC to become a PLC axis.

(3) Specify the action for the PLC axis to execute.

Specify the type of action using axis control command signals EC0g～EC6g, specify the feed speed controlled by the axis using axis feed speed signals EIF0g～EIF15g, and specify the amount of movement or other data using axis control data signals EID0g～EID31g.

The stop prohibition signal for above signals and program block specifies the command for 1 program block. These signals are collectively referred to as axis control program block data signals.

The PLC axis controls the data related signals of 1 program block quantity.

Signals' Collective Description	Signal Name	Signal Abbreviation	Data Type
Axis control program block data signal	Program block stop prohibition signal	EMSBKg	Bit type
	Shaft control command signal	EC0g~EC6g	Byte type
	Axis control feed speed signal	EIF0g~EIF15g	Character type
	Shaft control data signal	EID0g~EID31g	2 digit mode

(4) On completion of specification of set data action for 1 program block, flip the current logic of axis control command signal EBUFg: If EBUFg is '0' previously, set it to '1'; if it is '1', set it to '0'. After reading the axis control command of the CNC output signal, the logic of signal EBSYg and signal EBUFg must be the same, otherwise the flipping cannot be achieved.

(5) When the PLC performs multiple actions consecutively, the command program block will be buffered on the CNC side.

Therefore, even if 1 command is in executing, so long as the buffer on the CNC side is free, the next command program block is read to the CNC side. As shown in the figure below: While in execution of command [1], [2] and [3] are read into the buffer of the CNC, and [4] is already in the control program block data status with completed axis setting.

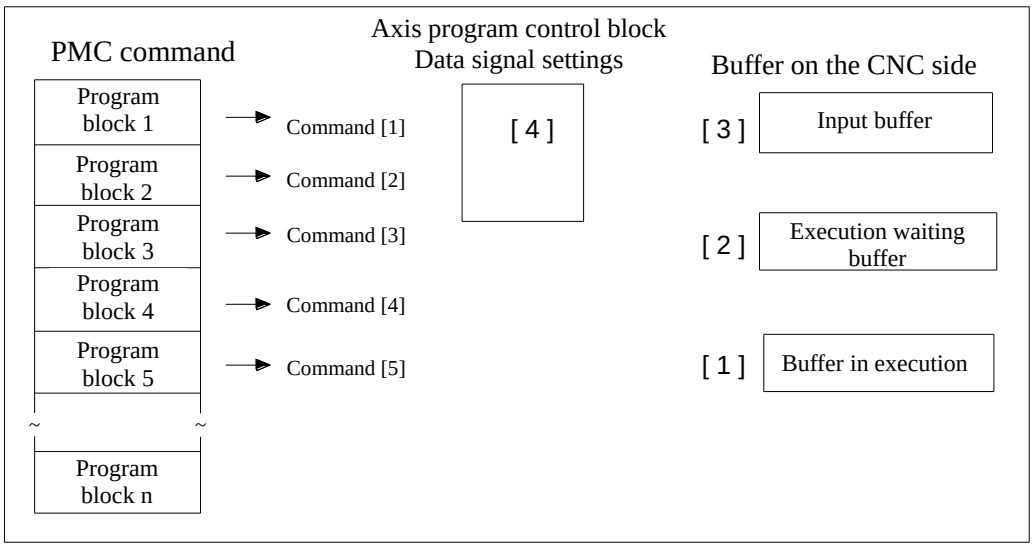


Figure 9-3

At the end of executing command [1],

Command [2]: Execution waiting buffer→executing buffer

Command [3]: Input waiting buffer→execution waiting buffer

Command [4]: Command program block→The transmission to the input buffer, on finishing the transmission to the input buffer of the command [4], issues the CNC side command (setting of axis control program block data signals) command [5].

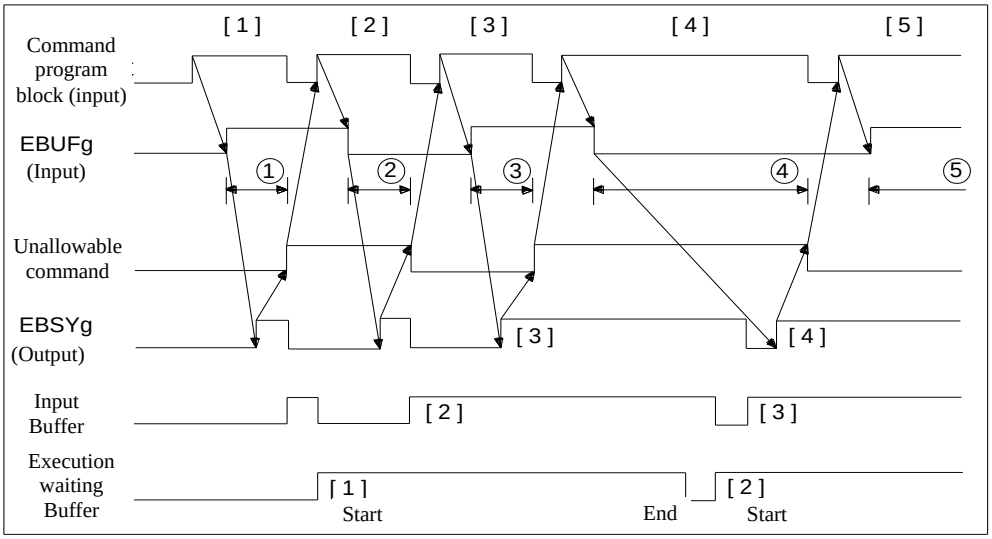


Figure 9-4 Timing Diagram of PLC Axis Control Commands

In interval of [1], [2], [3], [4] or [5], the next program block cannot be specified. In addition, in interval of [4], the buffer is full.

By reading the axis control command as the input signal from the PLC side, reading signal EBUFg and the axis control command as the output signal from the CNC side, and reading XOR of completed EBSYg, the status of the buffer on the CNC side can be judged.

Buffer status on the PLC side

EBUFg	EBSYg	Bitwise Addition (XOR)	Status of Buffer on the CNC Side
0	0	0	The last command program reading has been completed, and the next program block command can be executed from the PMC side.
1	1		
0	1	0	The last command program block reading has not been completed, it is in the course of reading each buffer, or the buffer is in "full" status, i.e., the waiting buffer is emptied. While in this status, the next program block command can't be executed from the PMC side. In addition, signal EBUFg must not be reversed. If reverse is performed in this status, the program block that has already been completed will be invalidated.
1	0		

(6) Repeat steps of [3] and [4] one by one.

At the end of the exchange of the last program block command, if the command is not required afterwards, set control axis selection signals EAX1~EAX5 to '0'. However, signals EAX1 to EAX5 must be set to '0' when the program block being executed currently and the program blocks input in the execution waiting buffer and the input buffer are finished. If there is any currently executed program block, or if any program block is input to in the execution waiting buffer and the input buffer, an alarm will be issued when signals EAX1~EAX5 are set to '0', and the execution of the currently executed program block will be interrupted, the program blocks in the execution waiting buffer and the input buffer will be invalidated. If there is no currently executed program block and there are not any program block in the execution waiting buffer and the input buffer, judge with control axis selection status signal EAXSL at '0'. In addition, for axes of those such as control turrets, pallets, ATC which are related to the management of shifting between the CNC and the PLC and axes always controlled under the management of the PLC, always set signals EAX1～EAX5 to '1'; even if the command exchange has been completed, it is not necessary to set signals EAX1～EAX5 to '0' according to conditions given above. After all the commanded program blocks have been executed and if there are no more program blocks to be executed, the execution will stop automatically.

(7) When the control axis selection signals EAX1~EAX5 change from 1 to 0, they are returned under the management of the CNC.

Function:

- **Shaft control function**

Table 9-2

Command	Action	Data 1	Data 2	Notes
00	Fast moving	Fast moving speed	Total movement	Execute the same operation as CNC G00
01	Cutting feed per minute	Cutting feed speed	Total movement	Execute the same operation as CNC G94G01
02	Cutting feed per revolution	Feed speed per revolution	Total movement	Execute the same operation as CNC G95G01
03	Feed jump per minute	Cutting feed speed	Total movement	Execute the same operation as CNC G31G01
04	Dwell	—	Dwell time	Execute the same operation as CNC G04
05	Reference point return	—	—	Execute the same operation as CNC manual reference point return

Command	Action	Data 1	Data 2	Notes
06	Continuous feed	Continuous feed speed	Feed direction	Execute the same operation as CNC JOG feed
07	Return to the 1st reference point	Fast moving speed	—	Execute the same operation as CNC G28
08	Return to the 2nd reference point	Fast moving speed	—	Execute the same operation as CNC G30P2
09	Return to the 3rd reference point	Fast moving speed	—	Execute the same operation as CNC G30P3
10	Return to the 4th reference point	Fast moving speed	—	Execute the same operation as CNC G30P4
16	Speed command run	Command speed	—	Execute continuous operation based on the speed command
18	1st auxiliary function	—	Auxiliary function code	Execute the same function as CNC auxiliary function
20	2nd auxiliary function	—		Execute the same function as CNC auxiliary function
21	3rd auxiliary function	—		Execute the same function as CNC auxiliary function
32	Selection of machine coordinate system	Fast moving speed	Mechanical coordinates	Execute the same function as CNC G53

Note: "Command" refers to axis control command signals EC0g-EC6g.

"Data 1" represents axis control feed speed signal EIF0g-EIF15g.

"Data 2" represents axis control data signal EID0g-EID31g.

The continuous feed command is an immediate command, and the CNC terminal does not cache the command.

1. Fast moving

Fast moving speed: In 1 mm/min for linear axis, in 1 deg/min for rotation axis, with a range of 1-65535.

Total movement: Incremental movement with 0.1um as the unit.

2. Cutting feed per minute

Cutting feed speed: Same as fast-moving.

Total movement: Incremental movement with 0.1um as the unit.

3. Cutting feed per revolution

Feed speed per revolution: 0.0001 mm/rev for linear axis, 0.0001 deg/rev for rotation axis, with a range of 1-65535.

Total movement: Incremental movement with 0.1um as the unit.

4. Skip - feed per minute

Cutting feed speed: Same as fast-moving.

Total movement: Incremental movement with 0.1um as the unit.

5. Dwell

Dwell time: In ms, with a range of 1-9999999.

6. Reference point return

Same as that for the CNC reference point return.

7. Continuous feed

Continuous feed speed: It is same as that of fast-moving, but the speed can be changed. Whenever

ebuf changes, the speed will change, and ebsy follows the changing of ebuf; maximum value: 65535* override (when override is canceled, the override value is 100).

Feed direction: '0', positive; '1', negative.

Only when eclr is valid, it decelerates and stops, and then eaxsl is set to '0'.

8. Return of the $1^{st}/2^{nd}/3^{rd}/4^{th}$ reference points

Fast moving speed: Same as that for fast-moving.

If the machine tool has not returned to zero, an alarm will be given off.

9. $1^{st}/2^{nd}/3^{rd}$ auxiliary functions

Auxiliary function code: Specify 1-byte auxiliary function.

Caution: It features auxiliary function strobing and auxiliary function end signals which are independent of the CNC.

10. Selection of machine coordinate system

Fast moving speed: Same as that for fast-moving.

Mechanical coordinate value: Actual machine's coordinate value, the unit are the same as that for fast-moving.

11. Speed command run

Command speed value: Execute command speed of -32768-32767 (rev/min); whenever ebuf changes, the speed will change; when reset signal ECLR is valid, the command can be ended, and before EGEN is set to 0, ECLR remains in state of 1.

Signal details:

(1) Selection of axis control selection signal

Signal symbols: EAX1~EAX5 (G0136.0~G0136.3)

Signal type: PLC→NC

Signal function:

When this signal is '1', the PLC axis control is valid.

When this signal is '0', the PLC axis control is invalid. Caution: During the period when control axis selection status signal *EAXSL is '0', axis control selection can be switched based on this signal. When control axis is switched while the control selection status signal *EAXSL is '1', an alarm (311) will be issued and signal EIALg will be set to '1' in alarm state. Conversely, an alarm will be issued if this signal is set to '1' while the CNC side is in executing.

In addition, if this signal is set to '1' when control axis selection status signal EIALg is '0' and alarm (311) is issued, signal EIALg will not become '1'. Thus, the CNC side can perform the command based on the PLC axis control.

(2) Shaft control command signal

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

Signal type: PLC→NC

Signal function:

Please refer to Table 9-2 for meanings of the relevant commands.

(3) Control feed speed signal

Signal symbols: EIF0g~EIF15g (G144~145, G156~157, G168~169, G180~181)

Signal type: PLC→NC

Signal function:

Please refer to Table 9-2 for meanings of the relevant commands.

(4) Axis control data signal

Signal symbols: EIF0g~EIF31g (G146~149, G158~161, G170~173, G182~185)

Signal type: PLC→NC

Signal function:

One of the axis control program block data signals. Please refer to the summary of commands for meanings of the commands.

(5) Control command reading signal

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

Signal type: PLC→NC

Signal function:

Command the CNC to read the command data of 1 program block quantity controlled by the PLC.

Please refer to Figure 9-4 for action and steps of this signal.

(6) Axis control reading completion signal

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

Signal type: NC→PLC

Signal function:

The CNC informs the PLC that the command data of 1 program block quantity controlled by the PLC axis has been read into the signal in the buffer.

Please refer to Figure 9-4 for action and steps of this signal.

(7) Reset signal

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

Signal type: PLC→NC

Signal function:

Reset the PLC axis **control command**

When this signal is set to '1'

(1) If the axis is moving: the axis will decelerate and stop

(2) If the execution is dwelled: execution will stop

(3) If the auxiliary function is being executed: execution will stop

At the same time, all the buffered commands are cleared, and the control command input while this signal is '1' is invalid.

When the continuous feed (EC0g to EC6g: 06h) command is given, set reset signal ECLRg to '1', and the command is ended. At this time, the servo motor decelerates and stops, signal EGENg while the axis is moving is set to '0', and the control axis selection status signal EAXSL is also set to '0'.

Please keep reset signal ECLRg in status of '1' before it is confirmed that control axis selection status signal EAXSL is set to '0'.

Additionally, please keep reset signal ECLRg in status of '1' before signal EGENg is set to '0' while the axis is moving.

(8) Program block stop signal

Signal symbol: ESBKg (G142.3, G154.3, G178.3)

Signal type: PLC→NC

(9) Program block invalid stop signal

Signal symbol: EMSBKg (G143.7, G155.7, G167.7, G179.7)

Signal type: PLC→NC

Signal function:

Stop each program block's execution, or prohibit stopping of each block.

While the command from the PLC is being executed if program block stop signal ESBKg is set to '1', the axis control will stop when the currently executed program block is finished.

If program block stop signal ESBKg is set to '0', the buffered command will be executed.

However, if the command program block stop prohibition signal EMSBKg is '1', program block stop signal ESBKg will be invalid.

The timing diagram of the command actions is shown in the timing diagram of related program block stop signals (Figure 9-5).

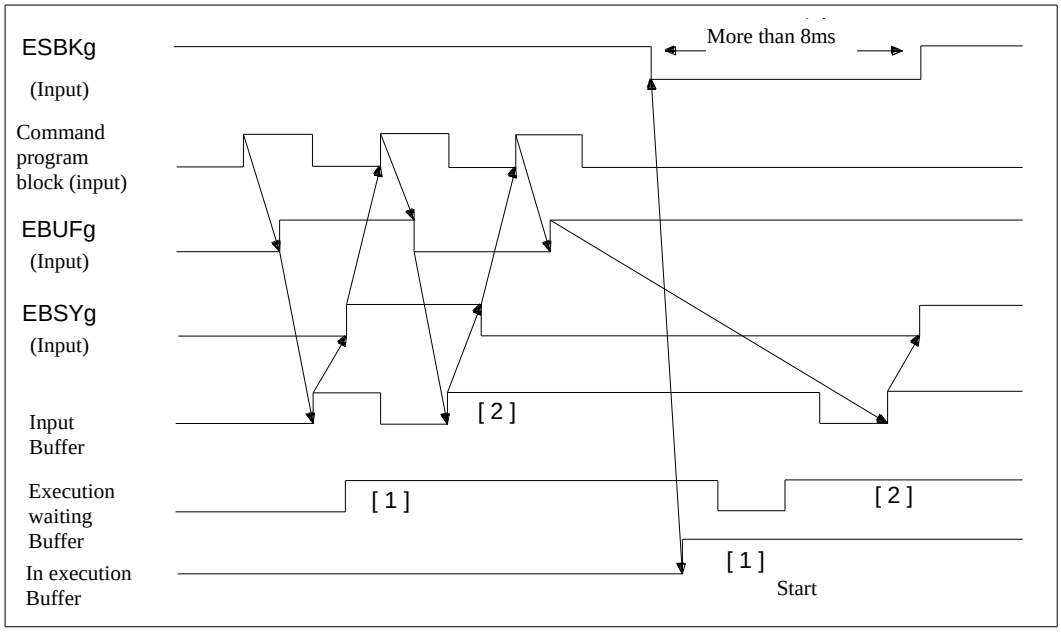


Figure 9-5 Timing Diagram of Related P Program Block Stop Signals

(10) PLC axis auxiliary functions

Auxiliary function code signal

Signal symbols: EM11g~EM28g (F132, F135, F138, F141)

Signal type: NC→PLC

Auxiliary function strobing signal

Signal symbol: EMFg (F131.0, F134.0, F137.0, F140.0)

Signal type: NC→PLC

Auxiliary function 2 strobing signal

Signal symbol: EMF2g (F131.2, F134.2, F137.2, F140.2)

Signal type: NC→PLC

Auxiliary function 3 strobing signal

Signal symbol: EMF3g (F131.3, F134.3, F137.3, F140.3)

Signal type: NC→PLC

Auxiliary function completion signal

Signal symbol: EFINg (G142.0, G154.0, G166.0, G178.0)

Signal type: PLC→NC

Signal function:

Indicate if the auxiliary function has been completed.

Set this signal to 1, when the command issued by the PLC is auxiliary function (EC0g~EC6g: 12h), auxiliary function 2 (EC0g~EC6g: 14h),

or auxiliary function 3 (EC0g~EC6g: 15h), the auxiliary function code is represented by 1 byte (signals EID0g~EID7g).

The CNC transmits auxiliary function codes EID0g~EID7g, EID8g~EID15G to auxiliary

function code signals EM11g~EM28g, and waits for auxiliary function completion signal EFINg. After auxiliary function completion signal EFINg is returned, the next command program block is entered.

The transmission of the auxiliary function code signal and the auxiliary strobing pulse signal, the receiving timing of the auxiliary function completion signal are the same as for the auxiliary functions (M functions) controlled by the CNC.

(11) Servo shut-off signal

Signal symbol: ESOFg (G142.4, G154.4, G166.4, G178.4)

Signal type: PLC→NC

Signal function:

It is used to control servo enabling.

Set this signal to '1', cut off enabled state of the axis controlled by the PLC, and the servo is turned off. Set it to '0', and the servo is turned on.

(12) Buffer disabled signal

Signal symbol: EMCUFg (G142.2, G154.2, G166.2, G178.2)

Signal type: PLC→NC

Signal function:

It is used to control program to execute buffering.

When this signal is set to '1', the program that has been read into the buffer will continue to be executed; and if there are program blocks which are being buffered or unfinished program blocks in the execution waiting buffer and the buffer is not empty. The system will no longer read the command sent by the PLC axis.

When the command is read through CNC while the buffer is empty, output axis control command reading completion signal EBSYg can judge the buffer disabled state.

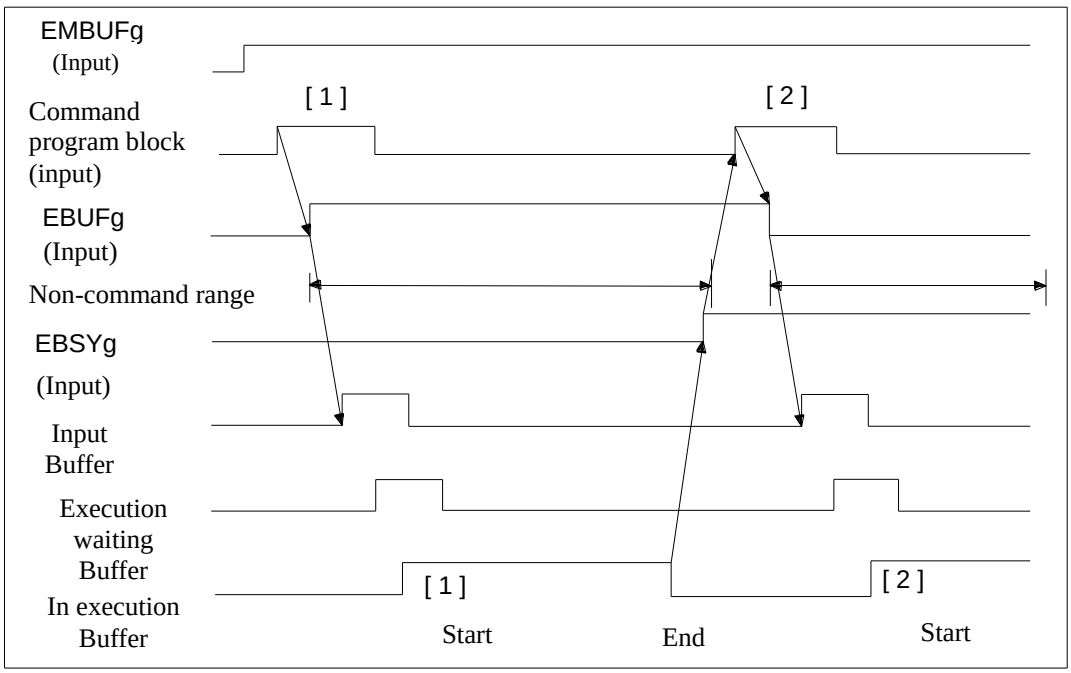


Figure 9-6 Timing Diagram of Buffer Related Signals

Following commands are always executed in buffer disabled mode regardless of buffer disabled signal EMCUFg:

(1) Skip-feed per minute (EC0g~EC6g: 03h)

(2) Return to reference point (EC0g~EC6g: 05h)
(3) Return to the 1st reference point (EC0g~EC6g: 07h)
(4) Return to the 2nd reference point (EC0g~EC6g: 08h)
(5) Return to the 3rd reference point (EC0g~EC6g: 09h)
(6) Return to the 4th reference point (EC0g~EC6g: 0Ah)
(7) Machine coordinate system selection (EC0g~EC6g: 20h)

(13) Control axis selection status signal

Signal symbol: *EAXSL (F129.7)

Signal type: NC→PLC

Signal function:

Indicate if the status signal is under the PLC axis control.

If this signal is '0', control axis selection signals EAX1～EAX4 can be switched.

This signal is set to 1 in following cases:

The PLC control axis is moving.

Program block is being read into the buffer.

When the servo switch-off signal ESOFg is 1:

When it is set to '1', switching of control axis selection signals EAX1～EAX4 is disabled, and if control axis selection signals EAX1～EAX4 are switched while it is '1', the system will give off an alarm.

(14) In-position signal

Signal symbol: EINPg (F130.0, F133.0, F136.0, F139.0)

Signal type: NC→PLC

Signal function:

Indicate if the PLC axis is in the right place.

This signal becomes 1 when the axis controlled by the PLC is in the right place.

When the axis motion is in decelerating status, the position will be examined to see if it is right into right, and the next command will not be executed until the right place width is reached.

(15) Alarm signal

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

Signal type: NC→PLC

Signal function:

Indicate alarm status associated with PLC axis control.

This signal becomes '1' when a servo alarm, over-travel alarm, or other alarm for the axis controlled by the PLC occurs. Cancel the alarm through following operation. When reset signal ECLRg is set to '1', this signal is '0'.

Servo alarm

Please eliminate the cause of the alarm and reset the CNC.

Over-travel alarm

Please make the axis move within the stored travel limit and reset the CNC. Commands which make the axis move within the stored travel limit in over-travel alarm are as follows:

(1) Fast moving (EC0g～EC6g: 00h)
(2) Cutting feed-feed per minute (EC0g～EC6g: 01h)
(3) Cutting feed-feed per minute (EC0g～EC6g: 02h)
(4) Continuous feed (EC0g～EC6g: 06h)

(16) Axis moving signal

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

Signal type: NC→PLC

Signal function:

It indicates the motion status of the axis.

The command issued by the PLC becomes '1' when the fast-moving (EC0g~EC6g: 00h) and cutting feed (EC0g~EC6g: 01h) axis are moving. For dwell (EC0g～EC6g: 04h) command, it keeps in '0' status.

Notes

The signal in the moving axis becomes '0' at the moment when the distribution of axis ends. (It becomes '0' during deceleration).

(17) Auxiliary function execution signals

Signal symbol: EDENg (F130.3, F133.3, F136.3, F139.3)

Signal type: NC→PLC

Signal function:

Indicate execution status of auxiliary functions.

When the command issued by the PLC is auxiliary function (EC0g~EC6g: 12h), auxiliary functions 2 (EC0g~EC6g: 14h), or auxiliary functions 3 (EC0g~EC6g: 15h), after auxiliary function codes EID0g~EID15g are transmitted to auxiliary function code signals EM11g~EM48g, and when auxiliary function completion signal EFINg has not been returned, this present signal becomes '1'.

A time diagram of the command action is shown in the time diagram of signals related to auxiliary functions as shown in Figure 9-7.

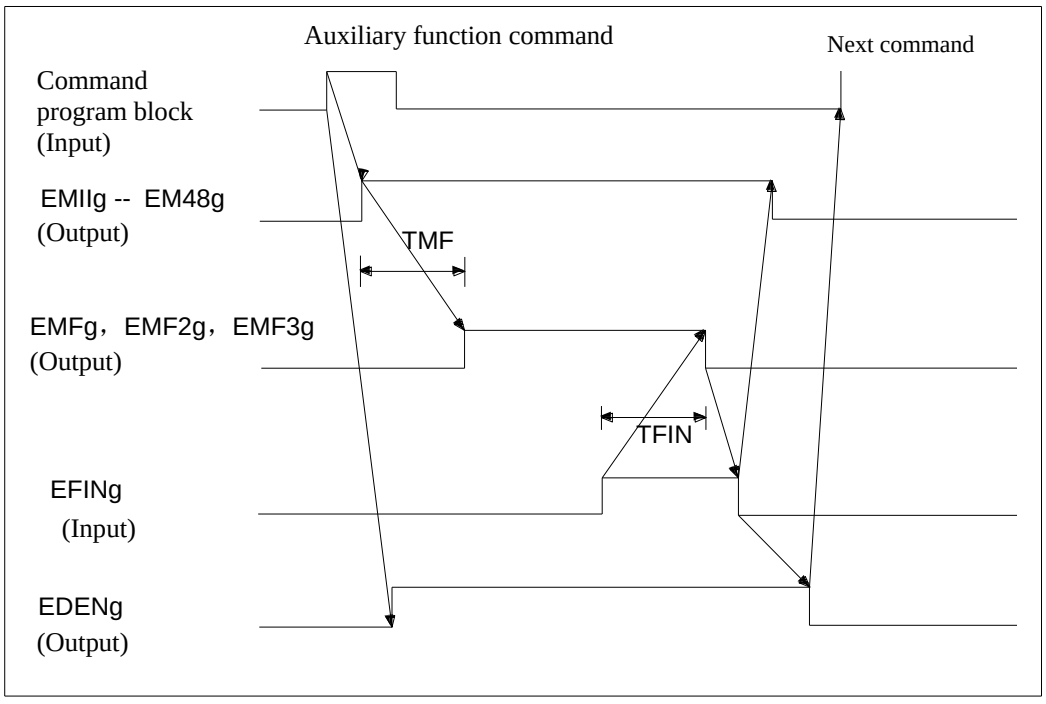


Figure 9-7 Time Diagram of Signals Related to Auxiliary Functions

(18) Over-travel signal

Signal symbols: Negative direction over-travel EOTNg (F130.6, F133.6, F136.6, F139.6)

Negative direction over-travel EOTNg (F130.5, F133.5, F136.5, F139.5)

Signal type: NC→PLC

Signal function:

Indicate over-travel status.

When an over-travel alarm is detected,

Exceeding - side travel limit: negative direction signal EOTNg

Exceeding + side travel limit: when the forward direction signal EOTPg becomes '1', the alarm signal EIALg will also become '1'. To cancel the over-travel alarm, set the reset signal ECLRg to '1' and this signal to '0'.

In addition, please refer to "Signal EIALg in Alarm" for cancellation of over-travel alarm.

(19) Feed speed override signal

Signal symbols: EFOV0~EFOV7 (G151.0~G151.7)

Signal type: PLC→NC

Signal function:

The cutting override is applied to the feed speed commanded by PLC axis, which is the same as the feed speed override signal processing of CNC.

(20) Override cancellation signal

Signal symbol: EOVCg (G150.5)

Signal type: PLC→NC

Signal function:

Invalidate the PLC axis feed override.

When this signal is set to '1' and the cutting feed override is fixed at 100%, the rapid traverse override will not be affected.

Signal symbol: EROV (G150.7)

Signal type: PLC→NC

Signal function:

When it is 0, use G150.0, G150.1 override.

When it is 1, use G151.0~7, that is, 0-255% override control.

(21) Rapid traverse override signal

Signal symbols: EROV1, EROV2 (G150.0~1)

Signal type: PLC→NC

Signal function:

The rapid traverse override should be applied for the PLC axis, and the treatment is the same as that for the rapid traverse override signal of the CNC.

F0 speed is set by the parameter (N1231).

(22) Override 0% signal

Signal symbol: EOV0 (F129.5)

Signal type: NC→PLC

Signal function:

It indicates whether the feed speed override is 0%, and the signal becomes '1' when the feed override is 0%.

(23) Skip signal

Signal symbol: ESKIP (X013.6)

Signal type: I/O direct input signal

Signal function:

When this signal is set to '1' during execution of the skip cutting command and the program block being executed currently stops, the next program block will be executed. This signal is inherent in the PLC axis control.

(24) Assign completion signal

Signal symbols: EADEN1~EADEN5 (F112.0~.4)

Signal type: NC→PLC

Signal function:

Indicate the assignment status based on the PLC axis control.

The signal in the moving axis becomes '0' through a command issued by the PMC. When the axis is in stop status, the signal will become '1'; and when the movement command being executed stops due to axis control dwell signal ESTPg, the signal will not become '1'.

(25) Buffer full signal

Signal symbol: EABUFg (F131.1, F134.1, F137.1, F140.1)

Signal type: NC→PLC

Signal function:

Indicate the buffering status of the PLC axis control command.

If there is any command program block in the input buffer of group, the signal will become '1'. If there is not any buffered command, the signal will become '0'.

(26) Controlling signal

Signal symbols: EACNT1~EACNT5<F182.0~F182.3>

Signal type: NC→PLC

Signal function:

Indicate being under the control of the PMC axis.

When the control axis selection status signal *EAXSL is '1', the position signal of the axis corresponding to the axis in control becomes '1'. When the servo switch-off signal ESOFg is '1', the signal also becomes '1'.

(27) External deceleration signal

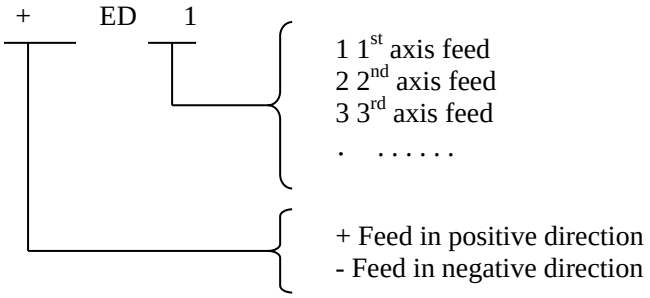
Signal symbols: External deceleration in the positive direction +ED1~+ED5 (G118.0~G118.4)
External deceleration in the negative direction-ED1~-ED5 (G120.0~G120.4)

Signal type: PLC→NC

Signal function:

When the signal is '1', the feed speed in the direction corresponding to the axis decelerates to the set external deceleration speed, and the speed of the axis of which the signal is not changed to '1' is not affected.

The "+/-" in the signal name indicates the feed direction, and the number corresponds to the control axis.



(28) Signal for return to reference points

Signal symbols: Signals indicating the completion of returning to the **1st** reference point **ZP1~ZP5 (F94.0~.4)**

Signals indicating the completion of returning to the **2nd** reference point **ZP21～ZP25 (F96.0～.4)**

Signals indicating the completion of returning to the 3rd reference point ZP31～ZP35 **(F98.0～.4)**

Signals indicating the completion of returning to the **4th** reference point **ZP41～ZP45 (F100.0～.4)**

Signal type: NC→PLC

Signal function:

The reference point return signals of PLC axis and CNC control axis are same in definition. The number at the end indicates the number of the control axis. The signal becomes '1' when the reference point completes the return and is in place. The signal becomes '0' when it is removed from the reference point and stopped in an emergency and a servo alarm occurs.

Related parameters of the PLC axis:

7010 DI/DO group selection for each axis in PLC axis control

This parameter is set to the DI/DO group number used for the control axis command for each axis in PLC axis control.

Set Value	Meaning
0	Fail to use PLC axis control
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
5	Use DI/DO signal of Group E
6	Use DI/DO signal of Group F
7	Use DI/DO signal of Group G
8	Use DI/DO signal of Group H

7122 Upper limit of PLC axis movement speed

This parameter sets the upper limit feed speed (mm/min) of the PLC-controlled servo axis in position control mode, and the maximum rotational speed (r/min) in speed control mode.

7130 **Acceleration when the PLC axis is stopped**

7131 **Acceleration when the PLC axis is started**

Function usage setting details:

(1) Fast movement control

Function: Execute the same operation as CNC G00

Control Data Address	Notes	Remark
+0	Function Code First address	No setting needed
+1	Function Code 0	Code function: fast movement
+2	Fast speed (set value in unit of: mm/min)	Set the fast speed of the servo axis

+4	Amount of servo axis movement (set value in unit of: 0.0001mm)	Set the incremental distance of the movement performed by the servo axis

(2) Cutting feed per minute

Function: Execute the same operation as CNC G00

Control Data Address	Notes	Remark
+0	Function Code First address	No setting needed
+1	Function Code 1	Code function: cutting feed
+2	Feed speed (unit: r/min)	Two bytes of data, set the feed speed of the servo axis
+4	Amount of servo axis movement (unit: 0.0001mm)	Four bytes of data, set the incremental distance of the movement performed by the servo axis

(3) Cutting feed per revolution

Function: Execute the same operation as CNC G95

Control Data Address	Notes	Remark
+0	Function Code First address	No setting needed
+1	Function Code 2	Code function: feed per revolution
+2	Feed speed (unit: mm/min)	Two bytes of data, set the feed speed of the servo axis
+4	Amount of servo axis movement (unit: 0.0001mm)	Four bytes of data, set the incremental distance of the movement performed by the servo axis

(4) Feed skip per minute

Function: Execute the same operation as CNC G31

Control Data Address	Notes	Remark
+0	Function Code First address	No setting needed
+1	Function Code 3	Code function: Skip running
+2	Feed speed (unit: mm/min)	Two bytes of data, set the feed speed of the servo axis
+4	Amount of servo axis movement (unit: 0.0001mm)	The data amount of four bytes, set the incremental distance of the movement performed by the servo axis. When the jump signal is received, the operation is completed.

(5) Dwell

Function: Execute the same operation as CNC G04

Control Data Address	Notes	Remark
+0	Function Code First address (D40)	No setting needed
+1	Function Code 4	Code selection: dwell
+2	—	No setting needed
+4	Dwell time (unit: 0.001S)	Data amount of four bytes, set the dwell time

(6) Return to the reference points

Function: Execute the same operation as CNC manual reference point return

Control Data Address	Notes	Remark
+0	Function Code First address	No setting needed
+1	Function Code 5	Code selection: return to reference points
+2	—	No setting needed
+4	—	No setting needed

(7) Return to the 1st reference point

Function: Execute the same operation as CNC G28

Control Data Address	Notes	Remark
+0	Function Code First address	No setting needed
+1	Function Code 7	Code function: return to the 1st reference point
+2	Reference point return speed (unit: mm/min)	Two bytes of data, set the reference point return speed of the servo axis
+4	—	No setting needed

(8) Return to the 2nd reference point

Function: Execute the same operation as CNC G30P2

Control Data Address	Notes	Remark
+0	Function Code First address	No setting needed
+1	Function Code D8	Code function: return to the 2nd reference point
+2	Reference point return speed (unit: mm/min)	Two bytes of data, set the reference point return speed of the servo axis

+4	—	No setting needed

(9) Return to the 3rd reference point

Function: Execute the same operation as CNC G30P3

Control Data Address	Notes	Remark
+0	Function Code First address	No setting needed
+1	Function Code 9	Code function: return to the 3rd reference point
+2	Reference point return speed (unit: mm/min)	Two bytes of data, set the reference point return speed of the servo axis
+4	—	No setting needed

(10) Return to the 4th reference point

Function: Execute the same operation as CNC G30P3

Control Data Address	Notes	Remark
+0	Function Code First address	No setting needed
+1	Function Code 10	Code function: return to the 4th reference point
+2	Reference point return speed (unit: mm/min)	Two bytes of data, set the reference point return speed of the servo axis
+4	—	No setting needed

(11) Manually continuous feed movement

Function: Execute the same operation as CNC manual continuous feed

Control Data Address	**Notes**	**Remark**
+0	Function Code First address	No setting needed
+1	Function Code 6	Code selection: continuous feed
+2	Feed speed (unit: mm/min)	Two bytes of data, set the manual continuous feed speed of the servo axis
+4	—	No setting needed

(12) Speed control based on NC axis

Function: Execute the same action as CNC M3Sxxxx

Control Data Address	**Notes**	**Remark**
+0	Function Code First address	No setting needed
+1	Function Code	Code function: speed command

	16	control
+2	Rotational speed command (unit: r/min)	Two bytes of data, set the rotational speed of the servo axis, usually the rotation axis, the system converts the speed according to the gear ratio to ensure that the servo axis rotates 360 degrees for one revolution
+4	—	No setting needed

Relevant Parameters Setting:

No.7122 PLC axis movement upper limit speed (mm/min for position control; r/min for speed control)

No.7130 Acceleration when PLC axis stops

No.7131 Acceleration when PLC axis starts

(13) 1st auxiliary function

Function: Execute the same action as the 1st auxiliary function of CNC

,

Control Data Address	Notes	Remark
+0	Function Code First address	No setting needed
+1	Function Code 18	1st auxiliary function
+2	—	No setting needed
+4	110	The executable range of auxiliary function code is 0~255

Instructions for use:

- The auxiliary function code is executed by the AXCTL function, and the output is controlled by the decoding command DECB after it is output.
- The strobing, decoded data address and auxiliary function completion signal of DECB are controlled by the address of the selected PLC axis group number.

(14) 2nd auxiliary function

Function: Execute the same action as the 2nd auxiliary function of CNC

Control Data Address	Notes	Remark
+0	Function Code First address	No setting needed
+1	Function Code 20	2nd auxiliary function
+2	—	No setting needed
+4	110	The executable range of auxiliary function code is 0~255

Instructions for use:

- The auxiliary function code is executed by the AXCTL function, and the output is controlled by the decoding command DECB after it is output.
- The strobing, decoded data address and auxiliary function completion signal of DECB are controlled by the address of the selected PLC axis group number.

(15) 3rd auxiliary function

Function: Execute the same action as the 3rd auxiliary function of CNC

Control Data Address	Notes	Remark
+0	Function Code First address	No setting needed
+1	Function Code 21	Code function: 3rd auxiliary function
+2	—	No setting needed
+4	Auxiliary function code	The executable range of auxiliary function code is 0~255

Instructions for use:

- The auxiliary function code is executed by the AXCTL function, and the output is controlled by the decoding command DECB after it is output.
- The strobing, decoded data address and auxiliary function completion signal of DECB are controlled by the address of the selected PLC axis group number.

(16) Selection of machine coordinate system

Function: Execute the same action as that of the CNC G53 function

Control Data Address	Notes	Remark
+0	Function Code First address (D40)	No setting needed
+1	Function Code D41=32	Code function: return to machine tool coordinate (hexadecimal)
+2	Feed speed (unit: mm/min)	Two bytes of data, set the manual continuous feed speed of the servo axis F0-F65535
+4	Servo axis machine tool position (set value in unit of: 0.0001mm)	Set the machine tool position of the servo axis movement

9.3 Window function

Overview

The window function is a function command through which CNC data can be read and written.

(1) During processing, there are HS window function and LS window function.

(2) Data is read and written through the CNC and PLC control when the LS responds.

(3) Thus, the ACT=1 of the window command must remain consistent till the transfer end signal W1 becomes 1 (interlock).

(4) Interlocking is not necessary in the HS response process because the data is read in directly

Caution:

The control of the serial command of the LS response excludes the window

command of other LS responses.

Thus, when data is continuously read and written, the ACT of the function command should be removed once after the end signal (W1) becomes 1.

It does not work when ACT=1 for other LS responses, such as W1=1 and ACT=1 for the LS response window function.

The window function of the HS response is not as unique as the LS response.

Thus, it is not necessary to make ACT=0 when data is read and written continuously.

The number of scans that have been processed is shown in the table below.

In the same scan cycle, it is forbidden to execute two or more window command the same time.

Type	The number of scans till the end of processing
Low speed	More than two scans (depending on the state of CNC)
High speed	One scan

WINDR (Read CNC window data)

Function:

A window for interactive data between PLC and CNC is used by PLC to read CNC data. "WINDR" falls into two categories:

1. Read data within a period of scanning time (HS response function);
2. Read data within several scanning periods (LS response function).

Ladder diagram format:

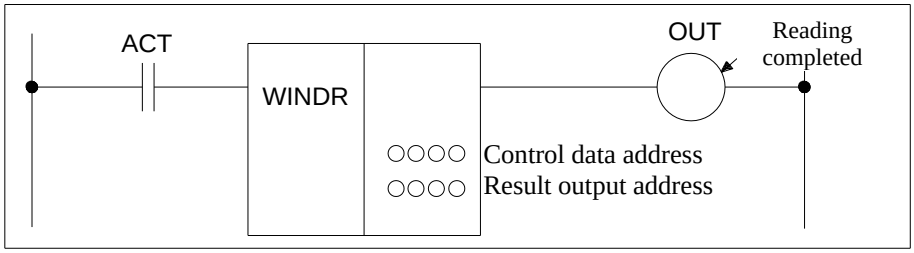


Figure 9-8

Command table format:

Table 9-3

S/N	Command	Operand	Notes
1	LD	○○○○.○	ACT
2	FUNC	44	WINDR
3	PRM	○○○○	Control data address
4	PRM	○○○○	Result output address
5	OUT	○○○○.○	Reading completed

Control conditions:

ACT Execution conditions

ACT=0: Do not execute the WINDR function.

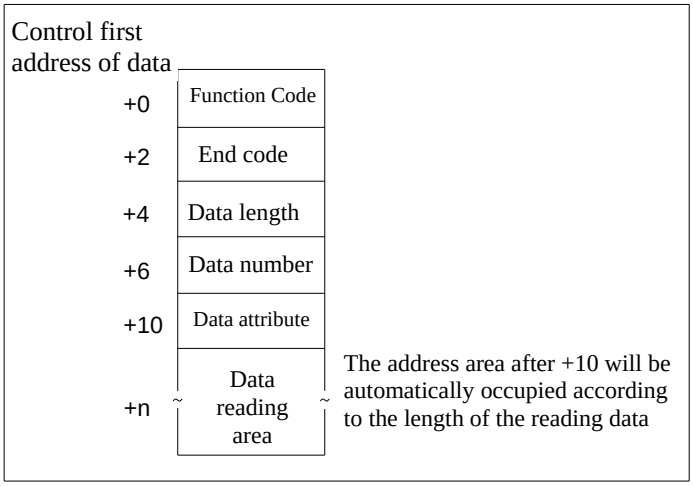
ACT=1: Execute WINDR command.

Parameters:

Control data address

PLC Byte Address is used to specify the area to store the control data.

Control Data:



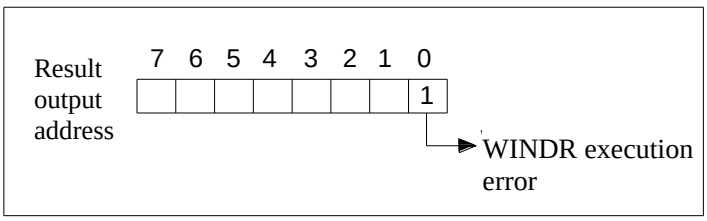
Output:

OUT=0: Indicate that "WINDR" is not executed or "WINDR" is now being executed.

OUT=1: Indicate the end of data reading. If the LS response function is used, the "ACT" must be reset once the data has been read.

Operation result register:

An error occurs during the execution of "WINDR", and the bits in the operation result output register shall be set.

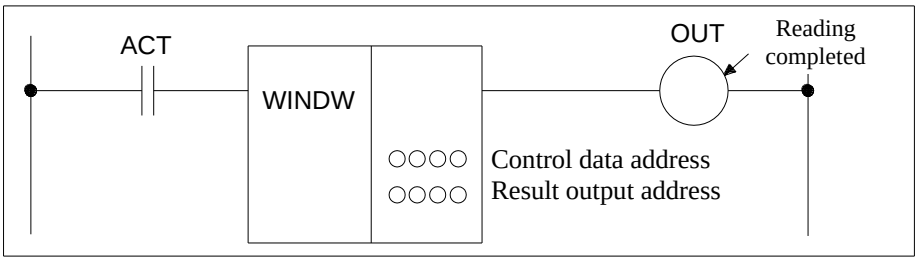


WINDW (Write CNC window data)

Function:

A window for interactive data between PLC and CNC is used by PLC to write data to CNC. "WINDW" belongs to the LS response function.

Ladder diagram format:



Command table format:

Table 9-4

S/N	Command	Operand	Notes
1	LD	○○○○.○	ACT
2	FUNC	45	WINDW
3	PRM	○○○○	Control data address
4	PRM	○○○○	Result output address
5	OUT	○○○○.○	Writing completed

Control conditions:

ACT Execution conditions

ACT=0: Do not execute the WINDW function.

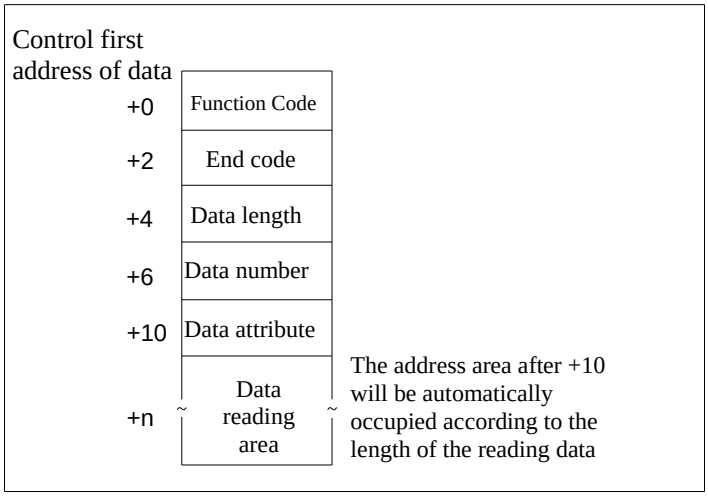
ACT=1: Execute WINDW command. After the data is written, "ACT" (ACT=0) must be reset.

Parameters:

Control data address

PLC Byte Address is used to specify the first address of the area to store the control data.

Control Data:



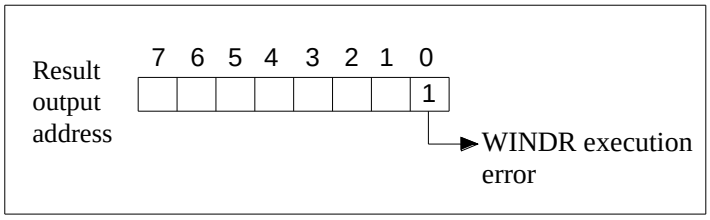
Output:

OUT=0: Indicate that "WINDW" is not executed or "WINDW" is now being executed.

OUT=1: Data writing ends. If the LS response function is used, "ACT" (ACT=0) must be reset once the data is written.

Operation result register:

An error occurs during the execution of "WINDW", and the bits in the operation result output register shall be set.



Window Function List

Function	Function	Response	Attributes

	Code	Speed	
Read CNC state information*	0	High speed	Read only (not open)
Read tool offset	1	Low speed	Read only
Write tool offset	2	Low speed	Write only
Read workpiece origin offset	3	Low speed	Read only
Write workpiece origin offset	4	Low speed	Write only
Read parameters	5	Low speed	Read only
Writing parameters	6	Low speed	Write only
Read setting data	7	Low speed	Read only (not open)
Write setting data	8	Low speed	Write only (not open)
Read user macro variables	9	Low speed	Read only
Write user macro variables	10	Low speed	Write only
Read pitch compensation data	11	Low speed	Read only
Write pitch compensation data	12	Low speed	Write only
Read current program number	13	High speed	Read only
Read current sequence number	14	High speed	Read only
Read actual speed of control axis	15	High speed	Read only
Read absolute coordinates of control axis	16	High speed	Read only (not open)
Read mechanical coordinates of control axis	17	High speed	Read only
Read skipping position of control axis	18	High speed	Read only
Read load current value of feed motor	19	High speed	Read only
Write motor torque limit data	20	Low speed	Write only (achieved or not?)
Read actual spindle speed	21	High speed	Read only (not open)
Read digital spindle load information	22	High speed	Read only (not open)
Read relative coordinates of control axis	23	High speed	Read only (not open)
Read remaining movement	24	High speed	Read only (not open)
Read modal data	25	Low speed	Read only (not open)
Read diagnostic data	26	High speed	Read only (not open)
Read time data	28	Low speed	Read only (not open)
Read P code macro variable values	29	Low speed	Read only (not open)
Write P code macro variable values	30	Low speed	Write only (not open)
Write tool number LS response	31	Low speed	Write only
Preset relative coordinates	32	Low speed	Write only (not open)

Format and contents of the control data:

(1) When interpreting the window function, the "_" symbol in the data structure indicates that the item is not set or the output data of the item is meaningless.

(2) Unless otherwise indicated, all data are binary data.

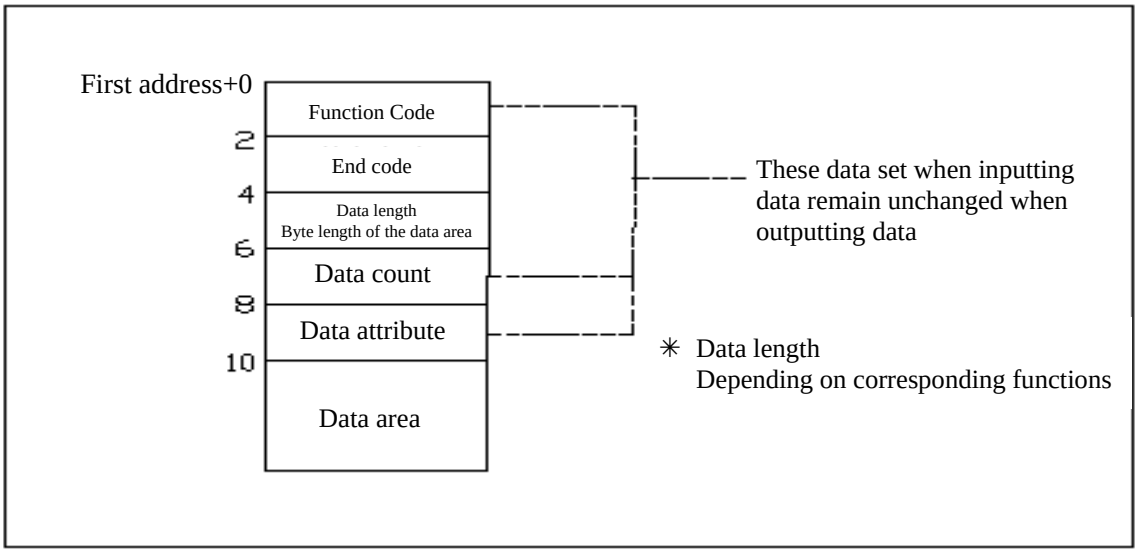
(3) All data lengths are specified in bytes.

(4) Only when the window function ends normally, the data output will be valid.

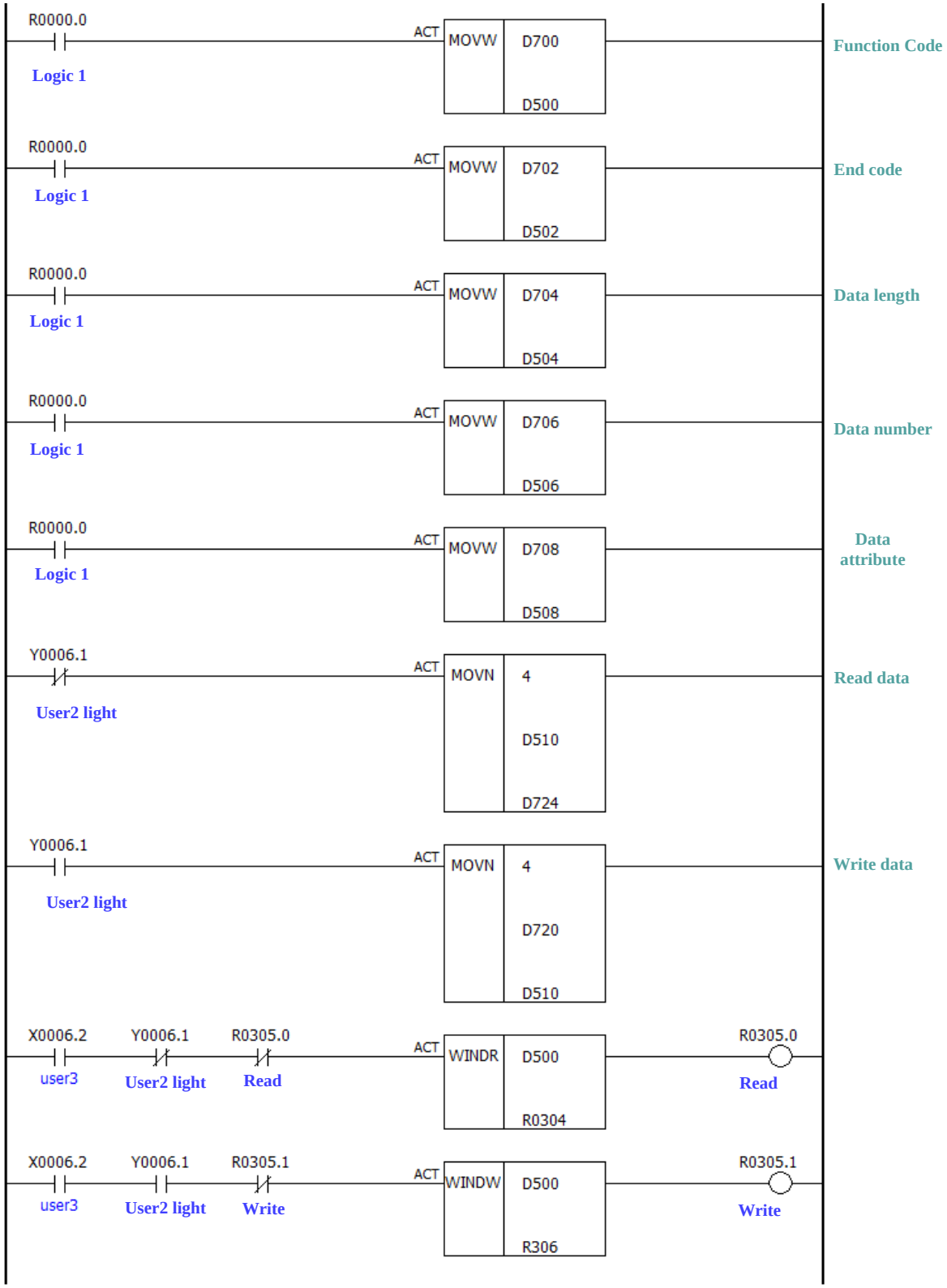
(5) There is one of the following end codes in the output data item, but not every function has an end code.

End code	Meaning
0	Normal end
1	Error (invalid function code)
2	Error (invalid data length)
3	Error (invalid data count)
4	Error (invalid data attribute)
5	Error (invalid data)
6	Error (not provided with corresponding functions)
7	Error (write-protect state)

The structure of inputting and outputting the control data is as follows:



PLC program example



9.3.1 Read tool offset

Function:

It is used by PLC to read tool offset data from CNC, including offset H, wear H, offset D and wear D.

Control Data Address	Notes	Remark
+0	Function Code 1	Read tool offset
+2	End code —	No setting needed
+4	Data length L (Number of address bytes where the read data is saved)	L=1: 1 byte L=2: 2 bytes L=4: 4 bytes
+6	Data number M (Offset number)	M=0: offset number 001 M=1: offset number 002 M=2: offset number 003 .....
+8	Data attribute N (Offset type)	N=0: offset H N=1: wear H N=2: offset D N=3: wear D
+10	Data reading area —	No setting needed (The read value is the offset value ×10000)

9.3.2 Write tool offset

Function:

It is used by PLC to write tool offset data to CNC, including offset H, wear H, offset D, wear D.

Control Data Address	Notes	Remark
+0	Function Code 2	Write tool offset
+2	End code —	No setting needed
+4	Data length L (number of data address bytes written)	L=1: 1 byte L=2: 2 bytes L=4: 4 bytes
+6	Data number M (Offset number)	M=0: offset number 001 M=1: offset number 002 M=2: offset number 003 .....
+8	Data attribute N (Offset type)	N=0: offset H N=1: wear H N=2: offset D N=3: wear D
+10	Data writing area —	The offset value to be written is the set value ÷10000 (For example, if the set value is 123456, the written offset value is

		12.3456)

9.3.3 Read workpiece origin offset

Function:

It is used by PLC to read workpiece coordinate system offset data from CNC, including EXT., G54~G59, G54.1 P1~G54.1 P48 coordinate system.

Control Data Address	Notes	Remark
+0	Function Code 3	Read workpiece coordinate system offset
+2	End code —	No setting needed
+4	Data length L (Number of address bytes where the read data is saved)	L=1: 1 byte L=2: 2 bytes L=4: 4 bytes
+6	Data number M (Offset number)	M=0:EXT. M=1:G54 ..... M=7:G54.1 P1 .....
+8	Data attribute N (Axis No.)	N=0:X N=1:Y N=2:Z .....
+10	Data reading area —	No setting needed (The read value is the set value×10000)

9.3.4 Write workpiece origin offset

Function:

It is used by PLC to write workpiece coordinate system offset data to CNC, including EXT., G54~G59, G54.1 P1~G54.1 P48 coordinate system.

Control Data Address	Notes	Remark
+0	Function Code 4	Write tool offset
+2	End code —	No setting needed
+4	Data length L (number of data address bytes written)	L=1: 1 byte L=2: 2 bytes L=4: 4 bytes
+6	Data number M (Offset number)	M=0:EXT. M=1:G54 ..... M=7:G54.1 P1 .....
+8	Data attribute N	N=0:X N=1:Y

	(Axis No.)	N=2:Z .....
+10	Data writing area —	The offset value to be written is the set value÷10000 (For example, if the set value is 123456, the written offset value is 12.3456)

9.3.5 Read parameters

Function:

It is used by PLC to read parameter data from CNC.

Control Data Address	Notes	Remark
+0	Function Code 5	Read parameters
+2	End code —	No setting needed
+4	Data length L (Number of address bytes where the read data is saved)	L=1: 1 byte L=2: 2 bytes L=4: 4 bytes
+6	Data number M (Parameter number)	Parameter number
+8	Data attribute N (Axis No.)	N=0:X N=1:Y N=2:Z ..... (Non-axis type parameters need to be set to 0)
+10	Data reading area —	No setting needed (The read value is the parameter value×10000)

9.3.6 Write parameters

Function:

It is used by PLC to write parameter data to CNC.

Control Data Address	Notes	Remark
+0	Function Code 6	Writing parameters
+2	End code —	No setting needed
+4	Data length L (Number of address bytes where the read data is saved)	L=1: 1 byte L=2: 2 bytes L=4: 4 bytes
+6	Data number M (Parameter number)	Parameter number

+8	Data attribute N (Axis No.)	N=0:X N=1:Y N=2:Z ..... (Non-axis type parameters need to be set to 0)
+10	Data writing area —	The written value is the set value÷10000 (For example, if the set value is 123456, the written offset value is 12.3456)

9.3.7 Read user macro variables

Function:

It is used by PLC to read user macro variable data from CNC.

Control Data Address	Notes	Remark
+0	Function Code 9	Read user macro variables
+2	End code —	No setting needed
+4	Data length L (Number of address bytes where the read data is saved)	L=1: 1 byte L=2: 2 bytes L=4: 4 bytes
+6	Data number M (Macro-variable number)	Macro-variable number
+8	Data attribute —	No setting needed
+10	Data reading area —	No setting needed (The read value is the set value×10000)

9.3.8 Write user macro variables

Function:

It is used by PLC to write user macro variable data to CNC.

Control Data Address	Notes	Remark
+0	Function Code 10	Write user macro variables
+2	End code —	No setting needed
+4	Data length L (number of data address bytes written)	L=1: 1 byte L=2: 2 bytes L=4: 4 bytes
+6	Data number M (Macro-variable number)	Macro-variable number (Only the value of the macro variable number from 100 to 999 can be written)

+8	Data attribute —	No setting needed
+10	Data writing area —	The offset value to be written is the set value÷10000 (For example, if the set value is 123456, the written offset value is 12.3456)

9.3.9 Read pitch compensation data

Function:

It is used by PLC to read pitch compensation data from CNC, including forward and reverse.

Control Data Address	Notes	Remark
+0	Function Code 11	Read pitch compensation data
+2	End code —	No setting needed
+4	Data length L (Number of address bytes where the read data is saved)	L=1: 1 byte L=2: 2 bytes L=4: 4 bytes
+6	Data number M (Pitch compensation number)	Pitch compensation number
+8	Data attribute N (Forward, reserve)	N=0: forward N=1: reverse
+10	Data reading area —	No setting needed (The read value is the set value×10000)

9.3.10 Write pitch compensation data

Function:

It is used by PLC to write pitch compensation data to CNC, including forward and reverse.

Control Data Address	Notes	Remark
+0	Function Code 12	Write pitch compensation data
+2	End code —	No setting needed
+4	Data length L (number of data address bytes written)	L=1: 1 byte L=2: 2 bytes L=4: 4 bytes
+6	Data number M (Pitch compensation number)	Pitch compensation number
+8	Data attribute N (Forward, reserve)	N=0: forward N=1: reverse

+10	Data writing area —	The offset value to be written is the set value÷10000 (For example, if the set value is 50000, the written offset value is 5. The setting value to be written must be an integer multiple of 10000)

9.3.11 Read the current program number

Function:

It is used by PLC to read the current program number from CNC (not open yet).

Control Data Address	Notes	Remark
+0	Function Code 13	Read current program number
+2	End code —	No setting needed
+4	Data length L (Number of address bytes where the read data is saved)	L=1: 1 byte L=2: 2 bytes L=4: 4 bytes
+6	Data number —	No setting needed
+8	Data attribute —	No setting needed
+10	Data reading area —	No setting needed (The read value is the set value×10000)

9.3.12 Read the current sequence number

Function:

It is used by PLC to read the current sequence number from CNC.

Control Data Address	Notes	Remark
+0	Function Code 14	Read current sequence number
+2	End code —	No setting needed
+4	Data length L (Number of address bytes where the read data is saved)	L=1: 1 byte L=2: 2 bytes L=4: 4 bytes
+6	Data number —	No setting needed
+8	Data attribute —	No setting needed
+10	Data reading area —	No setting needed (The read value is the set value×10000)

9.3.13 Read actual speed of control axis

Function:

It is used by PLC to read the actual speed of the control axis from CNC (not open yet).

Control Data Address	Notes	Remark
+0	Function Code 15	Read actual speed of control axis
+2	End code —	No setting needed
+4	Data length L (Number of address bytes where the read data is saved)	L=1: 1 byte L=2: 2 bytes L=4: 4 bytes
+6	Data number —	No setting needed
+8	Data attribute N (Axis No.)	N=0:X N=1:Y N=2:Z .....
+10	Data reading area —	No setting needed (The read value is the set value×10000)

9.3.14 Read mechanical coordinates of control axis

Function:

It is used by PLC to read the mechanical coordinate data of the control axis from CNC.

Control Data Address	Notes	Remark
+0	Function Code 17	Read mechanical coordinates of control axis
+2	End code —	No setting needed
+4	Data length L (Number of address bytes where the read data is saved)	L=1: 1 byte L=2: 2 bytes L=4: 4 bytes
+6	Data number —	No setting needed
+8	Data attribute N (Axis No.)	N=1:X N=2:Y N=3:Z .....
+10	Data reading area —	No setting needed (The read value is the set value×1000)

9.3.15 Read skipping position of control axis

Function:

It is used by PLC to read control axis skipping position data from CNC (not open yet).

Control Data Address	Notes	Remark
+0	Function Code 18	Read skipping position of control axis
+2	End code —	No setting needed
+4	Data length L (Number of address bytes where the read data is saved)	L=1: 1 byte L=2: 2 bytes L=4: 4 bytes
+6	Data number —	No setting needed
+8	Data attribute N (Axis No.)	N=0:X N=1:Y N=2:Z .....
+10	Data reading area —	No setting needed (The read value is the set value×10000)

9.3.16 Read load current value of feed motor

Function:

It is used by PLC to read the load current value data of feed motor from CNC (not open yet).

Control Data Address	Notes	Remark
+0	Function Code 19	Read load current value of feed motor
+2	End code —	No setting needed
+4	Data length L (Number of address bytes where the read data is saved)	L=1: 1 byte L=2: 2 bytes L=4: 4 bytes
+6	Data number —	No setting needed
+8	Data attribute N (Axis No.)	N=0:X N=1:Y N=2:Z .....
+10	Data reading area —	No setting needed (The read value is the set value×10000)

9.3.17 Write motor torque limit data

Function:

It is used by PLC to write motor torque limit data to CNC (not open yet).

Control Data Address	Notes	Remark
+0	Function Code 20	Write motor torque limit data
+2	End code —	No setting needed
+4	Data length L (number of data address bytes written)	L=1: 1 byte L=2: 2 bytes L=4: 4 bytes
+6	Data number —	
+8	Data attribute N (Axis No.)	N=0:X N=1:Y N=2:Z .....
+10	Data writing area —	The offset value to be written is the set value÷10000 (For example, if the set value is 123456, the written offset value is 12.3456)

9.3.18 Write tool number

Function:

It is used by PLC to write tool number data to CNC, including NX.T (pre-selected tool number) and HD.T (current tool number).

Control Data Address	Notes	Remark
+0	Function Code 31	Write pitch compensation data
+2	End code —	No setting needed
+4	Data length L (number of data address bytes written)	L=1: 1 byte L=2: 2 bytes L=4: 4 bytes
+6	Data number M (Type)	M=0:HD.T M=1:NX.T
+8	Data attribute —	No setting needed
+10	Data writing area —	The offset value to be written is the set value÷10000 (For example, if the set value is 50000, the written offset value is 5. The setting value to be written must be an integer multiple of 10000)

9.4 Function of data acquisition and servo guide

Overview The function of data acquisition and servo guide is an important module of the software, which is based on the CNC interpolation cycle (see parameter No. 811) as the sampling period. The command data and PID command data sent by the CNC system to the servo motor and the servo feedback data and raster feedback data fed back by the servo motor are collected and drawn into a waveform including speed, displacement, current, rigid tapping synchronism, and some images produced on the PC, such as roundness analysis images, trajectories, and so on. In the acquisition process, the parameter guide function can be used to view and modify the corresponding servo parameters to achieve the best working state of the servo motor.

Related signals

Signal symbol: DATA (G4#0)

Signal type: PLC→NC

Signal function: Inform CNC for data collection

1: Perform data collection

0: Close data collection

Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G004								DATA

9.5 Torque control function

Overview

Torque control is to achieve the purpose of control by controlling the torque and rotational speed of the motor. The torque value of the torque control axis is set by system parameter No. 4031, and the allowable motor rotational speed under torque control is set by parameter No. 4033. When the torque is closer to the set value, the motor decelerates, and after reaching set value, the motor decelerates to zero. When the difference between the actual motor torque and command torque exceeds the set value of parameter No. 4032, an alarm will occur.

Related signals

Torque control switching signal

Signal symbols: 1^{st}-8^{th} axisTRQUE1-8 (G250#0~7)

Signal type: PLC→NC

Signal function: When the signal is 1, it informs the CNC to switch to torque control according to the selected control axis.

In torque control mode, torque direction selection signal

Signal symbols: 1^{st}-8^{th} axis TRDIR1-8 (G246#0~7)

Signal type: PLC→NC

Signal function: Control the direction of torque change by changing the 0 or 1 state of the corresponding axis.

Motor rotational speed override control signal in torque control mode

Signal symbol: TSRATE (G247#0~7)

Signal type: PLC→NC

Signal function: Under the given torque control by PLC, the motor rotational speed output override

0~255%.

In torque control mode, torque override control signal

Signal symbol: TRATE (G248#0~7)

Signal type: PLC→NC

Signal function: Under the given torque control by PLC, the output torque override 0~255%.

Torque arrival signal

Signal symbols: 1st-8th axis TRQL (F114#0~7)

Signal type: NC→PLC

Signal function: When the motor torque reaches set value, CNC sets the signal corresponding to the torque control axis to 1.

Position ready signal

Signal symbols: 1st-8th axis POSCH (F208#0~7)

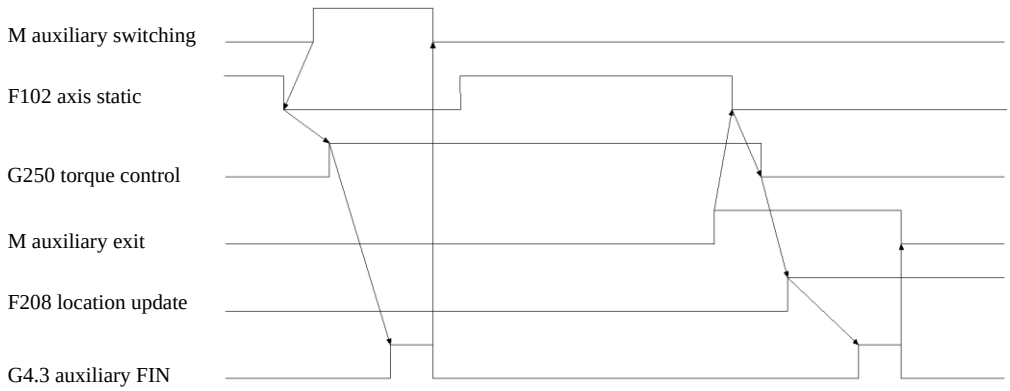
Signal type: NC→PLC

Signal function: When the axis control mode is switched to the position mode, the CNC will update the position, and the connection must be completed after the update is completed.

Caution: When switching between speed and torque control modes, the following conditions must be met when switching to speed control

1. **The switched axis speed is zero;**
2. **During autorun, it needs to be switched through the M command. After the switching is completed, the M command (set by parameters 3170~3179) that waits for decoding and interpolation synchronization must be executed before the subsequent program can be executed;**
3. **If there are more than three axes, the switch must be run in G05P0 mode.**

Control sequence:



Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G250	**TRQUE8**	**TRQUE7**	**TRQUE6**	**TRQUE5**	**TORQUE4**	**TRQUE3**	**TRQUE2**	**TRQUE1**
G246	**TRDIR 8**	**TRDIR 7**	**TRDIR 6**	**TRDIR 5**	**TRDIR 4**	**TRDIR 3**	**TRDIR 2**	**TRDIR1**
G247	**TSRATE 8**	**TSRATE 7**	**TSRATE 6**	**TSRATE 5**	**TSRATE 4**	**TSRATE 3**	**TSRATE 2**	**TSRATE1**

G248	**TRRATE 8**	**TRRATE 7**	**TRRATE 6**	**TRRATE 5**	**TRRATE 4**	**TSRATE 3**	**TRRATE 2**	**TRRATE1**
F114	**TRQL 8**	**TRQL 7**	**TRQL 6**	**TRQL 5**	**TRQL 4**	**TRQL 3**	**TRQL 2**	**TRQL1**
F208	**POSCH 8**	**POSCH 7**	**POSCH 6**	**POSCH 5**	**POSCH 4**	**TSRATE 3**	**POSCH 2**	**POSCH1**

Chapter X Programming Commands

10.1 User macro program

Overview

Unlike subprograms, the user macro program function allows the use of variables, arithmetic operation, logical operation, and conditional branches, which is very easy to develop a general program. The machine program can call a user macro program with a simple command as calling a subprogram.

This indicates that if a function is programmed with a macro program, a general function will be used. That is, a program can be written with data variables (variable data or unknown data).

User macro program input signal

Signal symbol:UI000~UI013（G054,G055, G056, G057）

UI100~UI113（G226,G227, G228, G229）

UI200~UI213（G230,G231, G232, G233）

UI300~UI313（G234,G235, G236, G237）

Signal type: PLC→NC

Signal function: It is used for macro program variable to read PLC interface signal.

The system variables corresponding to these signals are shown in Table 10-1.

Table 10-1

Signal	Address	Number of Digits	Variable
UI000	G54#0	1	#1000
UI001	G54#1	1	#1001
UI002	G54#2	1	#1002
UI003	G54#3	1	#1003
UI004	G54#4	1	#1004
UI005	G54#5	1	#1005
UI006	G54#6	1	#1006
UI007	G54#7	1	#1007
. . .	. . .		. . .
. . .	. . .	1	. . .
. . .	. . .	1	. . .
UI029	G57#5	1	#1029
UI030	G57#6	1	#1030
UI031	G57#7	1	#1031
UI000~UI031	G54~G57	32	#1032
UI100~UI131	G226~G229	32	#1033
UI200~UI231	G230~G233	32	#1034
UI300~UI331	G234~G237	32	#1035

Note: #1032 is a 32-bit variable composed as follows:

Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
#1032	UI007	UI006	UI005	UI004	UI003	UI002	UI001	UI000
#1032	UI015	UI014	UI013	UI012	UI011	UI010	UI009	UI008
#1032	UI015	UI014	UI013	UI012	UI011	UI010	UI009	UI008
#1032	UI023	UI022	UI021	UI020	UI019	UI018	UI017	UI016
#1032	UI031	UI030	UI029	UI028	UI027	UI026	UI025	UI024

User macro program output signal

Signal symbol:UO000～UO031（F054～F057）

UO100～UO131（F226～F229）

UO200～UO231（F230～F233）

UO300～UO331（F234～F237）

Signal type: NC→PLC

Signal function: It is used for user macro program system variables to read and write PLC interface signals.

The system variables corresponding to these signals are shown in Table 10-2.

Table 10-2

Signal	Address	Number of Digits	Variable
UO000	F54#0	1	#1100
UO001	F54#1	1	#1101
UO002	F54#2	1	#1102
UO003	F54#3	1	#1103
UO004	F54#4	1	#1104
UO005	F54#5	1	#1105
UO006	F54#6	1	#1106
UO007	F54#7	1	#1107
. . .	. . .		. . .
. . .	. . .	1	. . .
. . .	. . .	1	. . .
UO029	F57#5	1	#1129
UO030	F57#6	1	#1130
UO031	F57#7	1	#1131
UO000~UO031	F54~F57	32	#1132
UO100~UO131	F226~F229	32	#1133
UO200~UO231	F230~F233	32	#1134
UO300~UO331	F234~F237	32	#1135

Note: #1132 is a 32-bit variable

It is composed as follows:

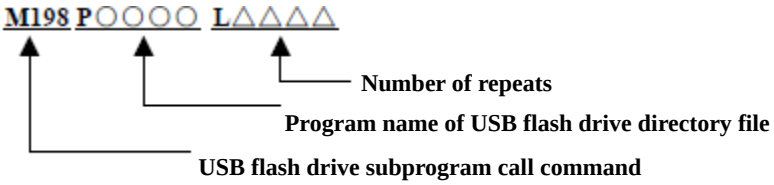
	#7	#6	#5	#4	#3	#2	#1	#0
#1132	UO007	UO006	UO005	UO004	UO003	UO002	UO001	UO000
#1132	UO015	UO014	UO013	UO012	UO011	UO010	UO009	UO008
#1132	UO015	UO014	UO013	UO012	UO011	UO010	UO009	UO008
#1132	UO023	UO022	UO021	UO020	UO019	UO018	UO017	UO016
#1132	UO031	UO030	UO029	UO028	UO027	UO026	UO025	UO024

10.2 Call external equipment subprogram

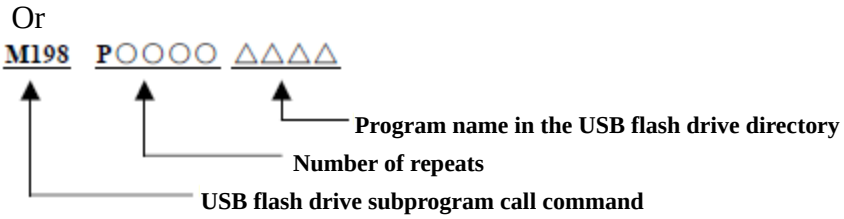
Overview

The call function of external equipment subprogram is used to call and execute the subprogram file stored in the USB flash drive in the automatic or DNC mode. When CNC executes the command, the subprogram under the USB flash drive directory will be called. The format of its subprogram name is "O****.NC"

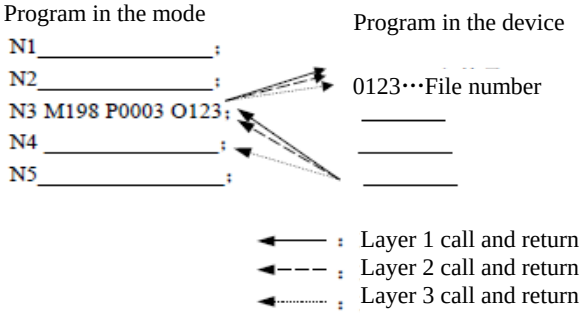
Command format:



Or



Program flow chart:



10.3 Indexing of the indexing table

Overview

The indexing of the indexing worktable in the machining center is achieved by specifying the indexing position (angle) for the indexing axis (a rotation axis, A, B or C). The indexing worktable is automatically released or clamped before and after indexing.

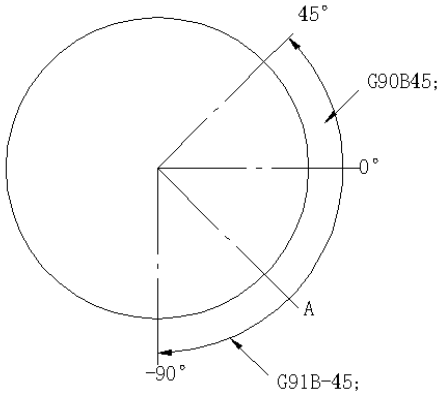
The minimum indexing angle input in the indexing worktable is the value set by parameter No.1931. Only integer multiples of the set value can be specified as the indexing angle. If other values other than integer multiples are specified, the P/S alarm (No. 135) unit will appear.

The absolute/incremental value command can be specified through G90/G91.

Example: The following command path for point A in the figure below, as the position at that time, is shown as below.

Absolute value command: G90 B45; indexing at the 45 °position.

Incremental value command: G91 B-45; negative rotation of 45 °indexing.



Regardless of the status of G code of Group 01 (G00, G01, G02, G03), the feed speed of the B axis is generally fast. When the B axis is specified in the G00, G01, G02, G03 mode, G00, G01, G02, G03 are still valid in the program block about other axes, and are not re-specified.

For example: G01 X10 F5; the X-axis moves at the cutting feed speed.

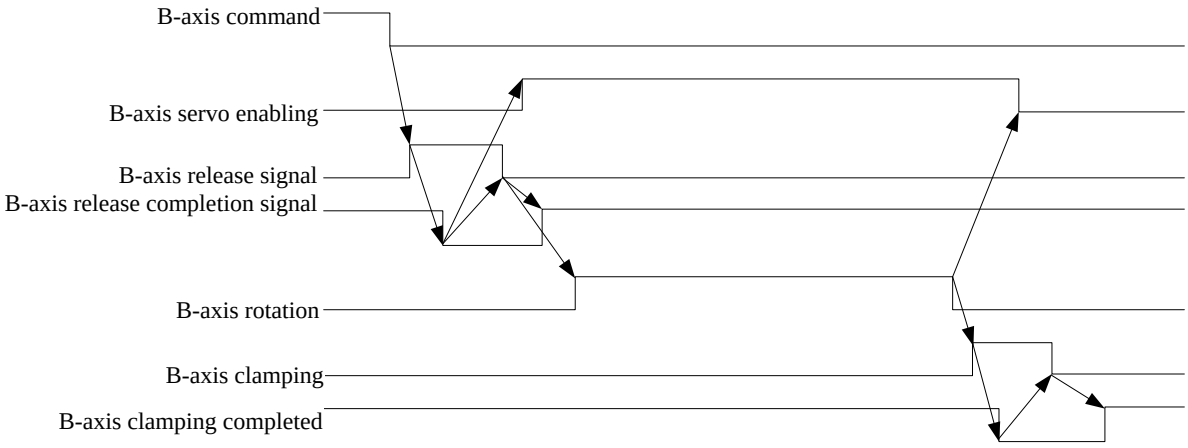
B45; The B-axis moves at a fast speed.

X29; The X-axis moves at the cutting feed speed

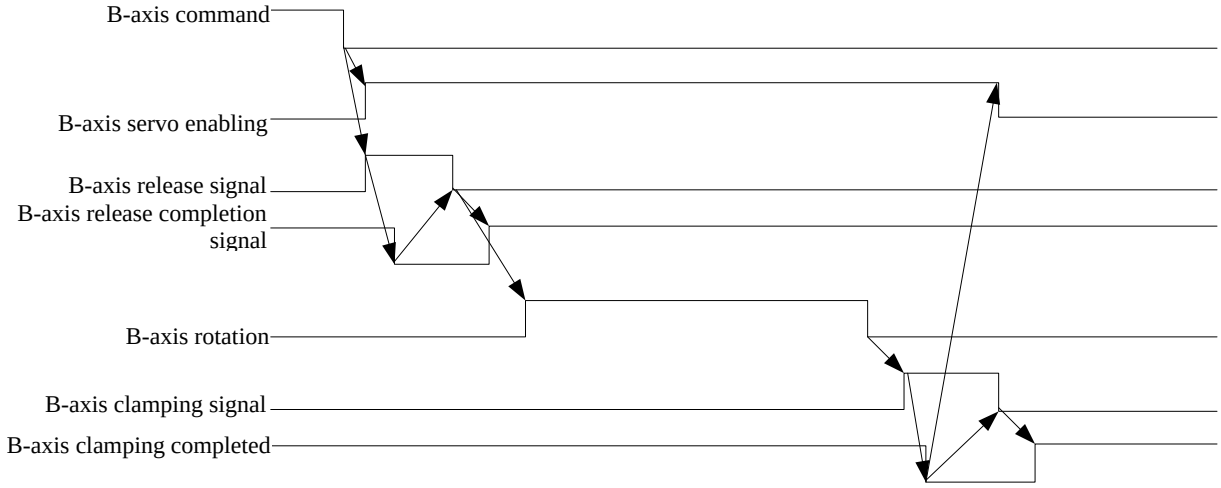
(G01 is still valid)

The indexing worktable is automatically released and clamped before and after the B-axis movement begins. Through parameter No.1030#6IDX, it is determined that the indexing order of the indexing rotary table is type A/B. Regardless of the indexing order, A/B is always checked in place at point A.

Indexing order A:



Indexing sequence B:



Note 1.The clamping signal or the release signal will be cleared when the clamping signal is reset at the waiting state after the clamping or releasing. The NC device completes the waiting state and enters the reset state.

Note 2.These conditions remain unchanged under clamping or releasing conditions even after resetting. That is: the order of release or clamping cannot be performed automatically by resetting. But the clamping and release signals are removed.

Note 3.In the diagnostic status, the status of clamping or releasing is displayed.

Note 4.The B-axis must be specified separately. When the X-, Y-, Z-axis or the 5th axis is commanded simultaneously with the B-axis, the PS gives an alarm. (No.136)

Note 5.The idle speed is invalid for the indexing rotary table.

Note 6.The parameter No.1030#1REL determines that whether the relative coordinate display of indexing function of indexing rotary table is 360 °rounded, and the rounded result coordinate value is displayed between 0 °and 359 °.

Note 7.When the parameter No.1030#7ABS=1, whether the absolute coordinate of the indexing function of the indexing rotary table is 360 °rounded will be displayed, and the rounded result coordinate value is displayed between 0 °and 359 °.

(i) When ABS=0, if the absolute coordinate value is not rounded to 360 °, it is started from the 0 °position. If G90 B720 is specified; then B axis is rotated by 720 °(2 rotations), and the position display and absolute coordinate value are 720 °.

(ii) When ABS=1, it is displayed that the absolute coordinate value is rounded to 360 °. However, the rounded absolute coordinate value is done after the incremental movement. When the parameter 1023.2ROSn=0, if G90 B720 is specified from the 0 °position; B axis is rotated by 720 °(2 rotations), and the absolute coordinate value is 0 °. When the parameter 1023.2ROSn=1, if the G90 B720 is specified from the 0 °position; if B axis does not move, the principle of proximity is adopted for positioning.

Note 8.When the automatic reference point is specified, (G28) the mechanical coordinate is used to calculate the movement amount. The movement between the intermediate point and the reference point is less than 360 °(one rotation).

Note 9.When the parameter No.1931=1, the minimum unit of the indexing rotary table is determined according to the minimum angle of the indexing rotary table. Unit: degree.

Note 10.When the parameter No.1932=4, 5, the 4th axis and 5th axis are defined as the indexing rotary table. When the parameter is 4, it corresponds to the 4th axis and when the parameter is 5, it corresponds to the 5th axis.

Note 11.When the parameter No.1030#7ITI=1, the indexing function of the indexing rotary table is valid, and G126 control corresponding to the servo shutdown signal is invalid.

Note 12.When the parameter No.1932=66, the name of indexing rotary table is defined.

Command address	A	B	C	U	V	W
Set value	65	66	67	85	86	87

10.4 External command output (macro printing)

Overview

In addition to specifying standard user macro program command, the macros are available, as shown in the below. (We call these commands as external output command)

- POPEN
- DPRNT
- PCLOS

These commands output the values and characters of the variables through the reader/puncher interface/USB flash drive.

Explanation:

These commands are assigned in the following order:

Open command: POPEN

The connection process with the USB flash drive is performed before the order of the data output command is specified.

Data output command: DPRNT

The data to be output is specified.

Close command: PCLOS

When the data output is complete, the connection to the external input/output equipment is released.

- Open command: POPEN

  The POPEN command establishes a connection to an external input/output equipment, and the open command must precede the order in which the data is output. Output DC2 control code from CNC.

- Data outputs the command DPRNT

  The DPRNT command outputs the value of each character and variable according to the code set in the setting data (ISO). The middle is separated by "*".

Example:

#2=128.47398

#5=91.2

#20=123.456

POPEN[12] (12 is the output document name)

DPRNT [X#2*Y#5*T#30]

PCLOS

M30

- Close command PCLOS

  The PCLOS commands are disconnected from external I/O devices and are specified when all data output commands are terminated.

1. It is not necessary to specified the open command (POPEN), data output command (DPRNT) and close command (PCLOS) continuously. Once an open command is specified at the beginning of the program, it is not necessary to specify an open command until a subsequent close command is specified.
2. Make sure that open command and close command are used in pairs. That is, specify the close command at the end of the program. Moreover, do not specify a close command separately when an open command is not specified.
3. When the data output command is outputting the data, if the reset operation is performed, the output will stop immediately and the subsequent data will be erased. Thus, when the data output command is outputting data at the end of the data output, if the reset operation is performed, the output will stop immediately and the subsequent data will be erased. In this case, when the reset operation is performed with M30 or the like at the end of the data output, the close command should be specified at the end of the program so that the reset operation is performed without completing the processing before all the data is output, and the close command should be assigned at the end of the program so that M30 is not processed until all data is output.

10.5 G code system: A, B, C (turning)

Overview

The turning system has three G code systems: A, B and C.

NC parameter 3000.6#=0 3000.7#=0, A series of G code is valid;

3000.6#=1, B series of G code is valid;

3000.7#=1, C series of G code is valid.

List of G-function of G code

G Code			Function
A	B	C	
G00▲	G00▲	G00▲	Positioning (quick)
G01	G01	G01	Linear interpolation (cutting feed)
G02	G02	G02	Clockwise circular interpolation
G03	G03	G03	Counterclockwise circular interpolation
G04	G04	G04	Dwell
G10	G10	G10	Programmable data input
G11	G11	G11	Programmable data input mode cancelled
G18▲	G18▲	G18▲	ZX plane selection
G20	G20	G20	Inch input
G21	G21	G21	Millimeter input
G22▲	G22▲	G22▲	Check stored travel is on
G23	G23	G23	Check stored travel is off

G Code			Function
A	B	C	
G27	G27	G27	Reference point return check
G28	G28	G28	Reference point return position
G30	G30	G30	Return to the 2nd, 3rd and 4th reference points
G31	G31	G31	Jump function
G32	G33	G33	Thread cutting
G34	G34	G34	Thread cutting with variable screw pitch
G40▲	G40▲	G40▲	Tool nose radius compensation cancelled
G41	G41	G41	Tool nose radius compensation on the left side
G42	G42	G42	Tool nose radius compensation on the right side
G50	G92	G92	Set coordinate system or maximum spindle speed
G50.3	G92.1	G92.1	Preset workpiece coordinate system
G52	G52	G52	Set local coordinate system
G53	G53	G53	Set machine coordinate system
G54▲	G54▲	G54▲	Select workpiece coordinate system 1
G55	G55	G55	Select workpiece coordinate system 2
G56	G56	G56	Select workpiece coordinate system 3
G57	G57	G57	Select workpiece coordinate system 4
G58	G58	G58	Select workpiece coordinate system 5
G59	G59	G59	Select workpiece coordinate system 6
G65	G65	G65	Macro program call
G66	G66	G66	Macro program modal call
G67▲	G67▲	G67▲	Macro program modal call cancelled
G70	G70	G72	Finish machining cycle
G71	G71	G73	Axial rough turning cycle
G72	G72	G74	Radial rough turning cycle
G73	G73	G75	Copying turning cycle
G74	G74	G76	Radial cutting cycle
G75	G75	G77	End face cutting cycle
G76	G76	G78	Multiple thread cycle
G80	G80	G80	Fixed cycle cancelled
G83	G83	G83	Drilling fixed cycle
G84	G84	G84	Tapping fixed cycle
G90	G77	G20	Single cycle for outer/inner diameter turning
G92	G78	G21	Single cycle for thread cutting
G94	G79	G24	Single cycle for end face turning
G96	G96	G96	Constant surface cutting speed control
G97▲	G97▲	G97▲	Constant surface cutting speed control cancelled

G Code			Function
A	B	C	
G98▲	G94▲	G94▲	Feed per minute
G99	G95	G95	Feed per rotation
—	G90▲	G90▲	Absolute value programming
—	G91	G91	Incremental value programming
—	G98	G98	Return to the initial plane
—	G99	G99	Return to R plane

10.6 Turning and milling system switching

Overview

The turning and milling functions of the system are switched by M code programming commands or setting parameters so as to adapt to the separate turning and milling functions in the composite machining.

Setting parameter switching:

	#7	#6	#5	#4	#3	#2	#1	#0
3000								GMT

GMT: system when power is turned on

0: machining center

1: lathe

M code switching:

The M code of running parameter setting can realize the switch between turning and milling system.

3144	Switch to the M code for the machining center	0

[Data type] Integer type

[Data range] 100~999

[Form of effectiveness] Reset

3145	Switch to the M code for the lathe	0

[Data type] Integer type

[Data range] 100~999

[Form of effectiveness] Reset

10.7 Grinding fixed cycle

Overview

If used for grinder control, it can be set to 1 by setting the NC parameter 3101#4MACT to switch the

fixed cycle for the turning system to the fixed cycle for inner and outer grinding, or to switch the fixed cycle for the milling system to the fixed cycle for surface grinding.

Turning system 3101#4MACT=1 Switch to inner and outer grinding cycles	Milling system 3101#4MACT=1 Switch to surface grinding cycles
Lateral grinding cycle (G71)	Plunge-cut grinding cycle (G75)
Horizontal direct grinding cycle with fixed size (G72)	Plunge-cut direct grinding cycle with constant size (G77)
Swing grinding cycle (G73)	Continuous feed surface grinding cycle (G78)
Swing direct grinding cycle with fixed size (G74)	Intermittent feed surface grinding cycle (G79)

Relevant parameters:

	#7	#6	#5	#4	#3	#2	#1	#0
3101				MACT				

MACT: Select the function of G71-G74

0: Turning fixed cycle

1: grinding cycle

10.8 Output function of external signal

Overview

This function outputs an external operation signal after the positioning of the program block is completed, and controls the machine tool to perform the specified action.

Command format:

G81 IP_; External signal output function starts (IP_ is the axis movement command);

G code of G80 or 01 group; End

Description:

After the positioning of each program block in program is completed, an external operation function signal can be output to allow the machine to perform the specified action.

After each positioning of the IP_ movement command is completed, the CNC sends an external operation signal to the machine tool. An external operation signal is output for each positioning operation until it is cancelled by the G80 or 01 group code.

Basic steps:

1. Once the positioning of the movement command is completed, the CNC sets the external operation signal F8.0 to 1.
2. When the F8.0 signal is 1, the PLC performs drilling or other operations. Once the operation is completed, the PLC sets the end signal FIN (G4.3) to 1.
3. The CNC receives the end signal from the PLC, sets the external operation signal F8.0 to 0, and the PLC resets the FIN signal to 0.
4. The CNC starts executing the next program block.

Related signals

External operation signal

Signal symbol: EF (F008#0)

Signal type: NC→PLC

Signal function: An external operation signal that is output after the positioning operation of the

external signal output command G81 is completed.

The positioning motion of G81 ends with "1".

When the completion signal FIN of the auxiliary function is "1", the signal is "1".

Relevant parameters:

	#7	#6	#5	#4	#3	#2	#1	#0
2000					EXC			

EXC: G81 meaning

0: Adopting fixed cycle command

1: Command external action

	#7	#6	#5	#4	#3	#2	#1	#0
2402			EOPF					

EOPF: HS external operation to finish processing

0: Invalid

1: Valid

2413	Allocating to measurement arrival or external HS signal address

When parameter 2402#5EOPF is set as 1, the auxiliary function completion signal FIN of the auxiliary function is not adopted to feedback the completion status of external operations. Its completion signal is reflected by the 5th digit of X address defined by parameter 2413.

10.9 Feed speed proportional output function (G170, G171)

Overview

This function can multiply the actual feed speed of the machine with proportionality coefficient of the command before outputting to PLC. This is usually adopted to control external motion by feed speed, so that external motion changes along with the feed speed in proportions, e.g. feed speed can be used to control rotational speed of the spindle, coolant flow, etc.

Detailed description:

Command format:

G171 P_; command to activate the proportional output of feed speed, (P: multiple);

G170; cancel.

P: multiple

Description:

Proportional output of feed speed can cope with PLC address F240~F241;

F240~F241 (binary) = actual feed speed of current machine ×P;

When G171 function is activated, proportional feed output signal F88.0=1; F88.0=0 when turned off;

G171 modal will be erased during reset.

Related signals

Proportional output status signal of feed speed

Signal symbol: SPF (F088#0)

Signal type: NC→PLC

Signal function: Status signal for activating the proportional output of feed speed.

When G171 function is activated, proportional feed output status signal F88.0=1; F88.0=0 when turned off.

Output signal of feed speed proportional output function

Signal symbols: SPS0~SPS31 (F240~F241)

Signal type: NC→PLC

Signal function: Output value of feed speed proportional output function.

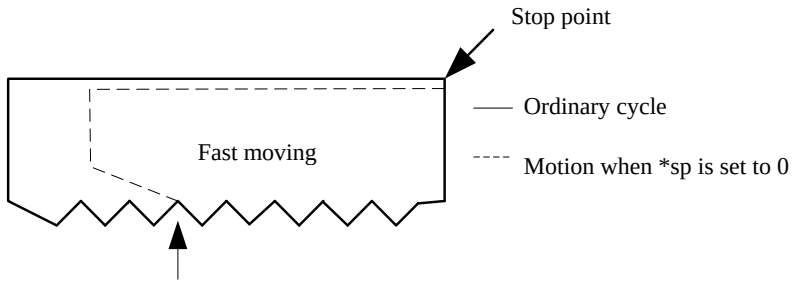
F240~F241 (binary) = actual feed speed of current machine ×P (P: multiple)

Chapter XI Interpolation Function

11.1 Thread cutting retreating function (turning function)

Overview

For thread cutting during thread cutting cycle (G92 and G76), the tool will immediately retreat if feed hold (when *SP signal G008#5 is 0) is activated; the tool retreats in linear chamfering and returns to the initial point of current cycle in the order of X axis and Z axis.



Motion when signal *SP is set to 0 at this point

Relevant parameters:

	#7	#6	#5	#4	#3	#2	#1	#0
3001	RTV							

RTV: Override during retreating of thread cutting tool:

0: Override is valid

1: Override is invalid

3130	Chamfering amount of thread cutting cycle G76 and G92

[Data type] Bit type

[Data unit] 0.1 screw pitch

[Valid data range] 0~127

Set the chamfering amount for thread cutting G76 and G92.

11.2 Normal direction control function (G40.1, G41.1, G42.1 or G150, G151, G152)

Overview

During processing, when tool of the rotation axis (C axis) moves on XY plane, the normal direction control function can control the tool and ensure that C axis is always vertical to the tool path (Figure 11-1 (a)).

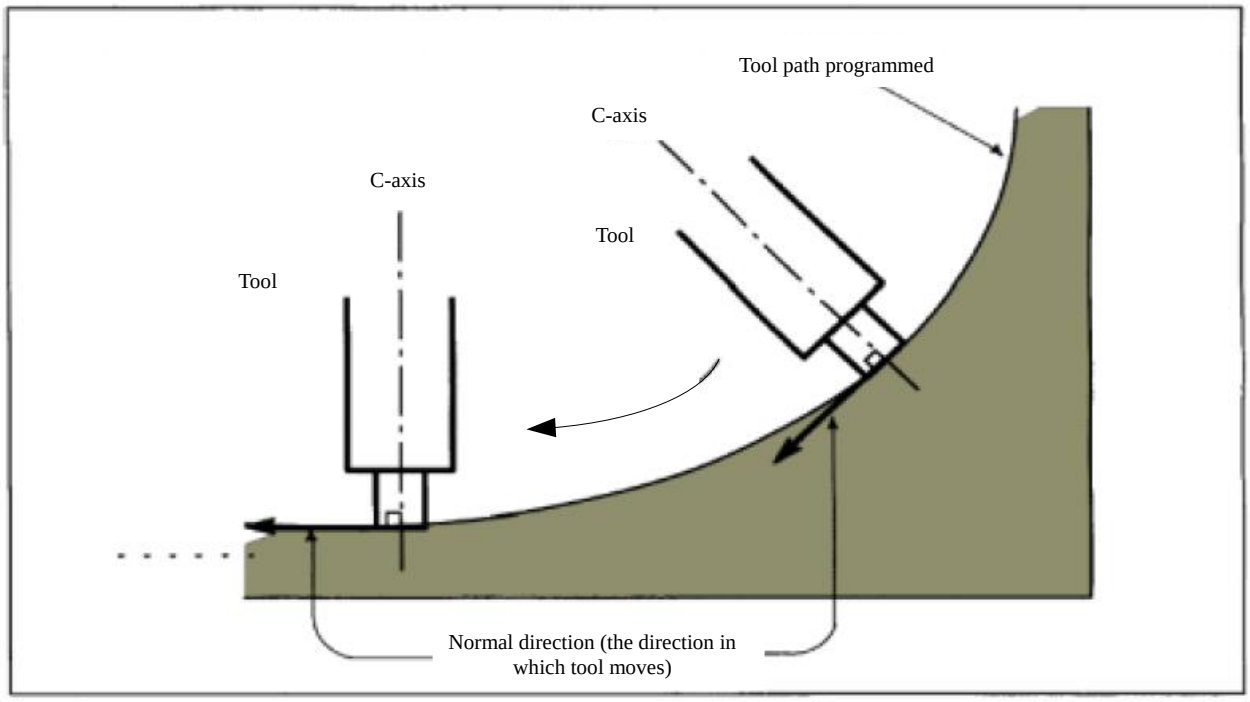


Figure 11-1 (a) Tool Moving in Normal Direction

Command format:

G Code	Function	Notes
G41.1 or G151	Normal direction Control left side	If along the forward direction, the workpiece is on the right side of tool path in the forward direction, specifying the normal direction control function at the left (G41.1 or G151). After G41.1 (or G151) or G42.1 (or G152) is specified, the normal direction control function is valid (normal direction control mode). When G40.1 (or G150) is specified, the normal Direction control mode is cancelled
G42.1 or G152	Normal direction Control right side	
G40.1 or G150	Cancel normal direction Direction control	

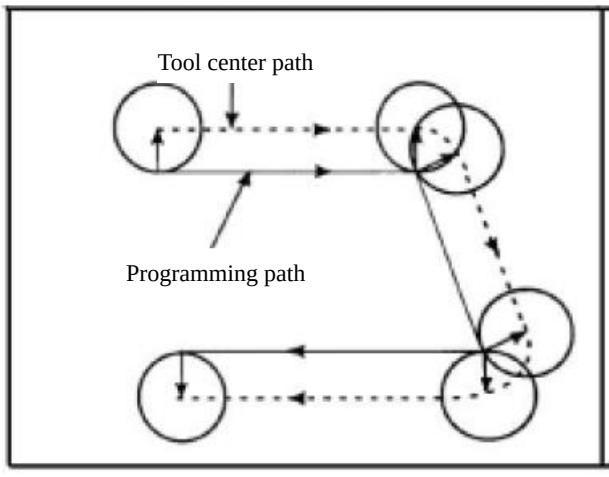


Figure 11-1 (b) Normal direction control left (G41.1)

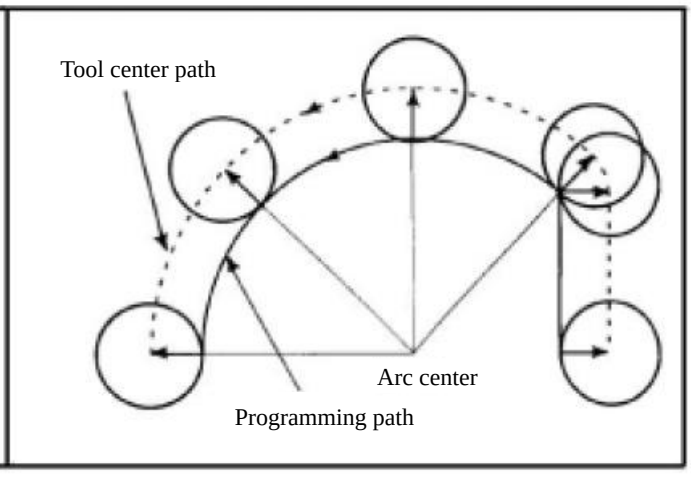


Figure 11-1 (c) Normal direction control right (G42.1)

Description:

Axial direction and angle of the rotation axis

Setting of normal direction control uses the parameter (No.7120) of rotation axis; #7120=65 indicates that A axis controls normal direction of the tool, while #7120=66 and 67 respectively correspond to B axis and C axis.

The direction of the rotation axis is controlled by the plane selection command; G17 corresponds to the axial direction taking Z-axis as the rotation axis; G18 takes Y-axis as the axial direction and G19 takes X-axis as the axial direction.

Setting of tool axis direction at 0 ° can use the parameter (No.7130). In general, the positive direction of the coordinate axis is the direction of tool axis at 0 °. For example, when the rotation axis is at 0 ° under G17, the tool axis direction is the positive direction of X axis; the positive direction of Y axis is at 90 °, the negative direction of X axis is at 180 ° and the negative direction of Y axis is at 270 °. In this case, X=1, Y=0 and Z=0 in #7130. The tool axis can also be set in an arbitrary direction, and X, Y and Z in the parameter (No.7130) may not be set as unit vectors.

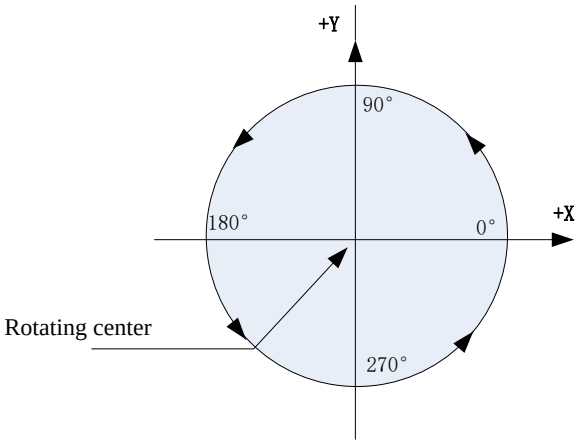


Figure 11-1 (d) Angle of C Axis

Normal direction control of C-axis

When switching from cancel mode to normal direction control mode, C axis is vertical to tool path at the beginning of G41.1 or G42.1 program block.

At the switch point of program block in normal direction control mode, tool-motion command is automatically inserted. Therefore, C axis is vertical to tool path at the beginning of each program block. The tool directs first to make C axis vertical to the tool path specified by the movement command; then it moves along X and Y axis.

During the radius compensation mode of the tool, it directs first to make C axis vertical to the tool path established after compensation.

In single block operation, the tool does not stop between the rotation command and movement command along X and Y axis. SBK always stops after the tool has moved along X and Y axis.

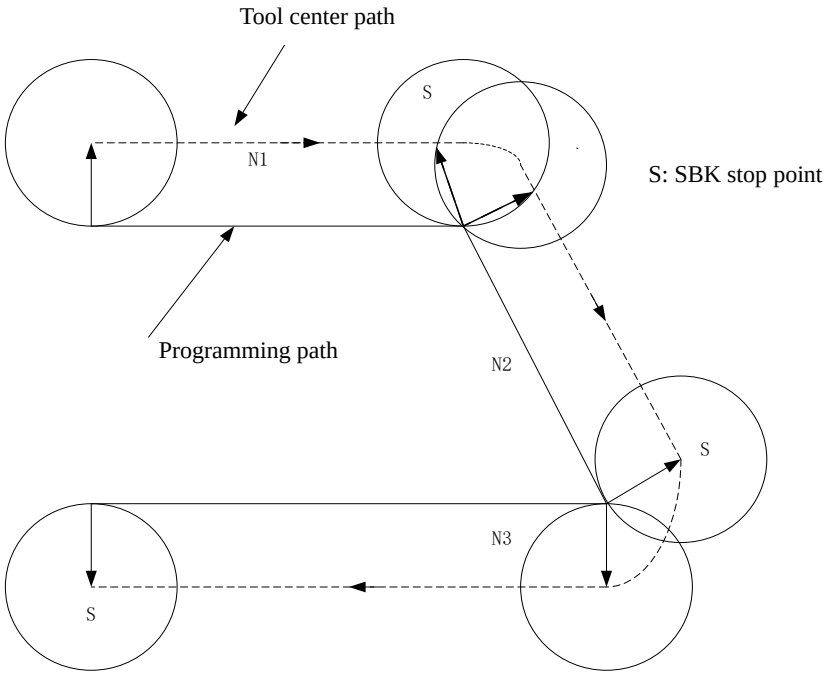


Figure 11-1 (e) In normal direction control mode, SBK stop point

The C-axis rotates before circular interpolation begins, making C-axis vertical to the arc at the start point of the arc.

Control the tool to make sure that the C-axis is always vertical to the tool path of circular interpolation during circular interpolation.

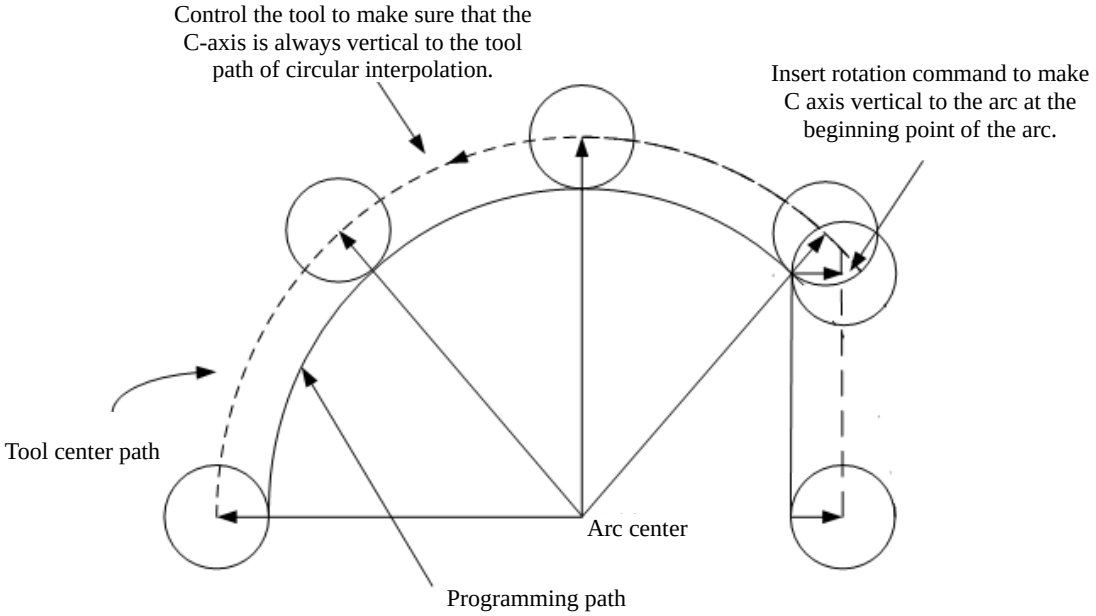


Figure 11-1 (f) Normal direction control of circular interpolation

Note: During normal direction control, rotation angle of C axis is less than 180°. That is, no matter what direction it rotates, it always moves by a shorter path.

C-axis feed speed

Tool motion is inserted to the beginning of each program block, and its feed speed is controlled by F value. If the machine is at dry run mode, it moves at the speed of dry run. In G00 mode, the tool moves along X and Y axis at fast-moving speed. During the circular interpolation, the feed speed of C axis is determined by the following formula:

$$F \times \frac{\text{movement amount of } C \text{ axis}}{\text{arc length (}mm\text{ or }inch\text{)}} \quad \text{(deg/min)}$$

F: Feed speed specified by corresponding arc program block (mm/min or inch/min)

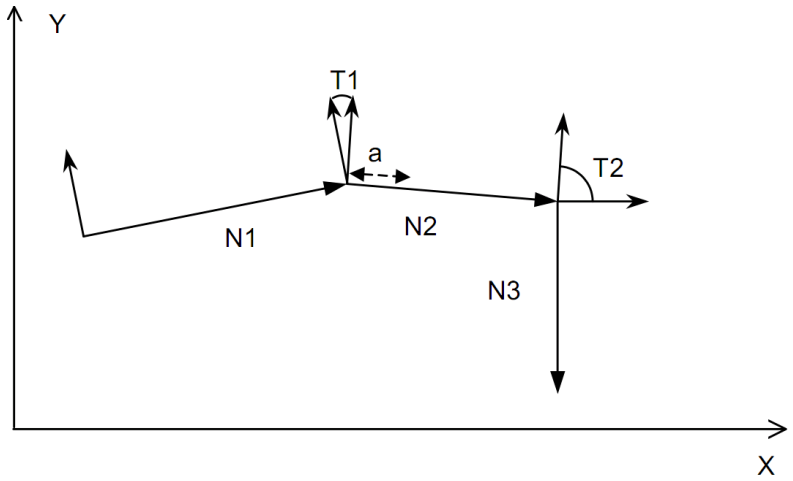
Movement amount of C axis: Angular difference between the beginning and end of program block.

Note: If the feed speed of C axis exceeds the maximum turning speed of C axis specified by parameter No. 1224, the speed of each axis will be clamped, to make the feed speed of C axis lower than the allowable maximum value.

Linkage movement length

In order to improve the processing speed and reduce speed fluctuation, the parameter (No. 7121) normal linkage movement length can be configured.

As shown in the figure, instead of rotating to the position before executing the N2 block, the C-axis finishes this action at the end of a linkage movement length a.



When length of the program block (arc length) is less than twice of the linkage movement length, the C-axis finishes the angle adjustment at the end of the whole section.

Notes

1. During normal direction control, no command can be specified to C axis. Any command specified at this time shall be ignored.
2. Before processing, (G92) or other coordinate systems are required to relate C axis coordinates of the workpiece with actual C axis position on the machine.
3. This requires the CNC screw cutting function. But screw cutting cannot be commanded during normal control mode.
4. Normal direction control cannot be executed by G53 movement command.
5. C axis must be a rotation axis.
6. Normal vector of the tool at 0^{o}. When #7130=1,0,0 and B=0, set the tool at this position with tool nose.

Chapter XII Measuring Commands

12.1 Jump function

Overview

G31 command can realize the same linear interpolation as that of G01 command. During command execution, if an external jump signal is entered, it will immediately stop feeding, cancel the remaining unfinished travel and execute command of the next program block.

The jump function is often adopted to measure the workpiece or at the end of grinding.

Command format: G31 X_Y_Z_F_P_

Coordinate value of the workpiece when the jump signal connects is stored in system variables #5061～#5065 of user macro program.

#5061……Coordinates of the 1st axis

#5062……Coordinates of the 2nd axis

#5063……Coordinates of the 3rd axis

#5064……Coordinates of the 4th axis

#5065……Coordinates of the 5th axis

Jump input signal

Signal symbol: SKIP (parameter setting)

Signal type: PLC→NC

Signal function: During the execution of G31 program block, it will immediately stop feeding, cancel the remaining unfinished travel and execute command of the next program block when this signal changes from "0" to "1".

Relevant parameters:

2412	Address assigned to jump signal

[Data type] Integer type

[Data range] 0～127

[Form of effectiveness] Immediately

Set the input address of G31 jump signal, for example: X12.0 address is adopted as the input address of jump signal when "12" is set; in versions before V3.4.4-B11.1, the whole byte will be taken after setting, and any digit inside this byte can act as the jump signal, so it cannot connect to other input signals except the jump signal.

Caution: Any figure less than 10 in the setting is invalid.

12.1 Multi-step jump function

Overview

In the program block of G31 P1~G31 P4 command, input multi-step jump signal (4 points) can activate the multi-step jump function and jump over the residual movement amount. Also, the jump signal from fixed-size measurement equipment can help to jump over the program under execution.

For example, input of the jump signal at the end of roughing, semi-fine processing, elaborate processing

or sparkless grinding during plunge grinding can help to automatically finish the motion from semi-fine process to sparkless grinding.

Speed of G31 command is the same as that of cutting feed and is specified by F value; if it is not specified, current modal value of F command shall be adopted.

Relevant parameters:

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

SKL: Jump signal rotation

0: Valid when it is 0

1: Valid when it is 1

2412	Address assigned to jump signal

Set the byte value n of I/O address of the jump signal and this parameter becomes invalid when it is less than 10.

For example: when it is set as 12, P1 corresponds to X12.0, P2 corresponds to X12.1, P3 corresponds to X12.2 and P4 corresponds to X12.3.

Command	Corresponding Signal
G31 or G31 P1	Xn.0
G31 P2	Xn.1
G31 P3	Xn.2
G31 P4	Xn.3
G31 P5	Xn.4
G31 P6	Xn.5
G31 P7	Xn.6
G31 P8	Xn.7

12.3 Torque limit jump function

Overview

G31P99 or G31P98 command can carry out linear interpolation just like G01 command. When actual torque of the servo motor in the specified action reaches the set limits (rated torque of the servo motor multiplies by value of the set override) or in case of input of the jump signal, it will immediately stop feeding, cancel the remaining unfinished travel and execute command of the next program block.

Signal

Torque limit jump override signal

Signal symbols: TROV0~TROV 7 (G097)

Signal type: PLC→NC

Signal function: The override control signal of torque limit value during torque limit jump.

Torque limit arrival signal

Signal symbols: TRQL1~TRQL8 (F114)

Signal type: NC→PLC

Signal function: The state signal for torque limit arrival of the feed axis.

TRQL1~ TRQL8 respectively correspond to the 1st axis to 8th axis.

When the signal is 1, it reaches the torque limit, but when the signal is 0, it does not reach the torque limit.

It jumps when the torque reaches the value of the NC parameter 4275*G97/100.

Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G097	TROV7	TROV6	TROV5	TROV4	TROV3	TROV2	TROV1	TROV0
F114	TRQL8	TRQL7	TRQL6	TRQL5	TRQL4	TRQL3	TRQL2	TRQL1

Chapter XIII Credit Management Function

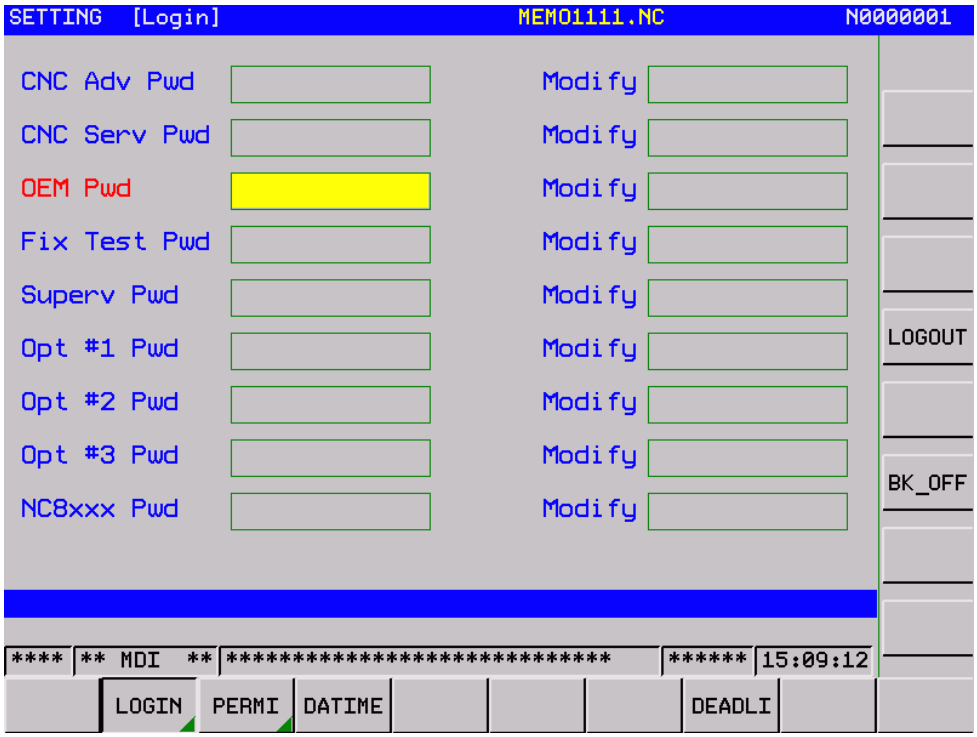
13.1 Credit management function

Overview

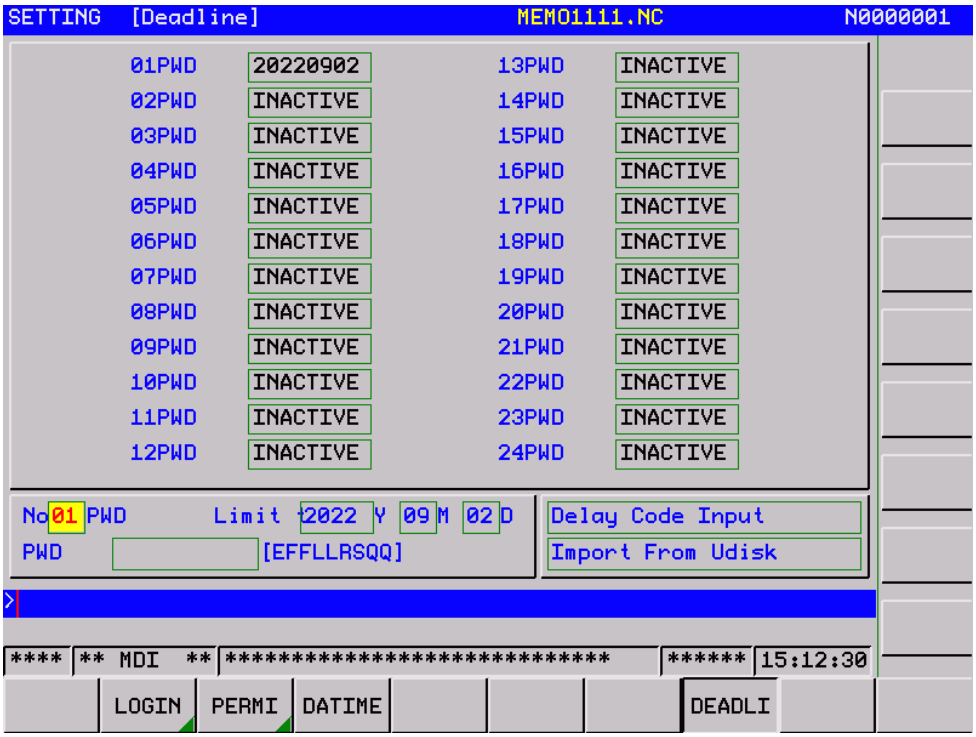
It also has a 24-stage time limit function. The time limit setting can control the operation time of CNC system and is usually adopted for payment by installment or limited service time on trials.

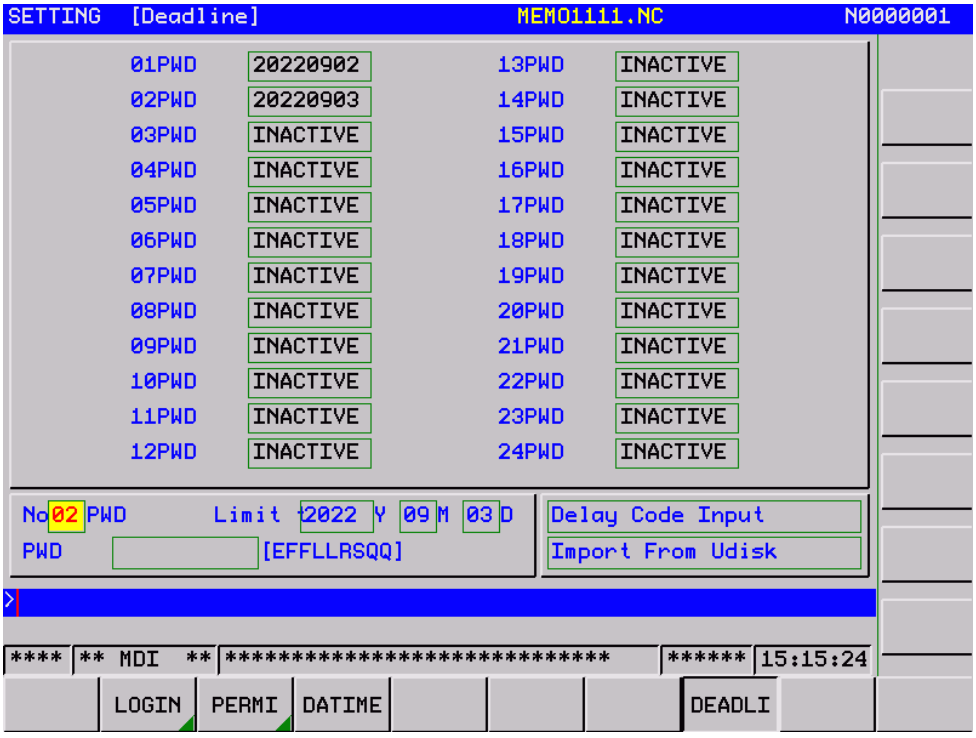
How to Use:

1. The "Payment password for installment" interface can only be displayed after logging in with the machine factory password. Once activated, this installment interface will no longer hide until all time limits are removed.

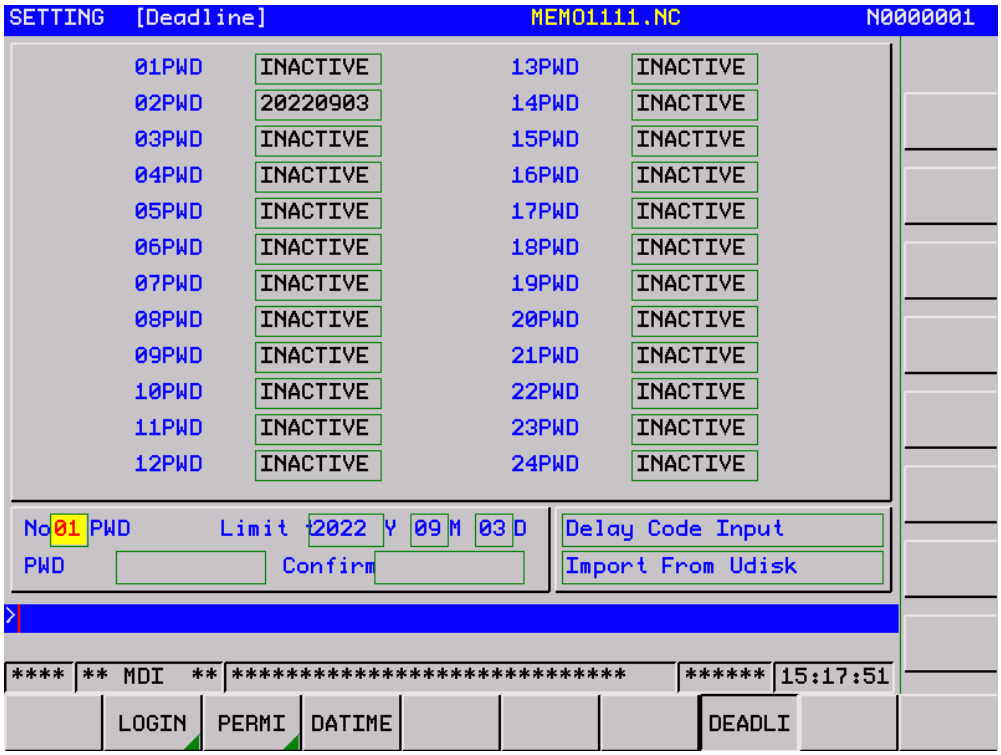


2. Input the number of installments, time limit and password and press enter to activate. Please set the system clock correctly before setting the time limit. The time limit set cannot be earlier than the current time and the system clock cannot be modified after activating the installment limit. Also, please remember your password and use different passwords for multiple limits.





3. On the last day of time limit, the system will prompt "PS0196 installment is due, please contact the manufacturer". Press "RESET" button can temporarily remove the limit within five days since the due date; but the system will be completely locked after 5 days, when payment password is required to remove the lock. How to remove the limit: Enter "Payment password" option from the "Login" page; enter the limit number to be removed, then input the payment password and press enter to remove; it will display "not activated" after the operation.



13.2 Payment delay function

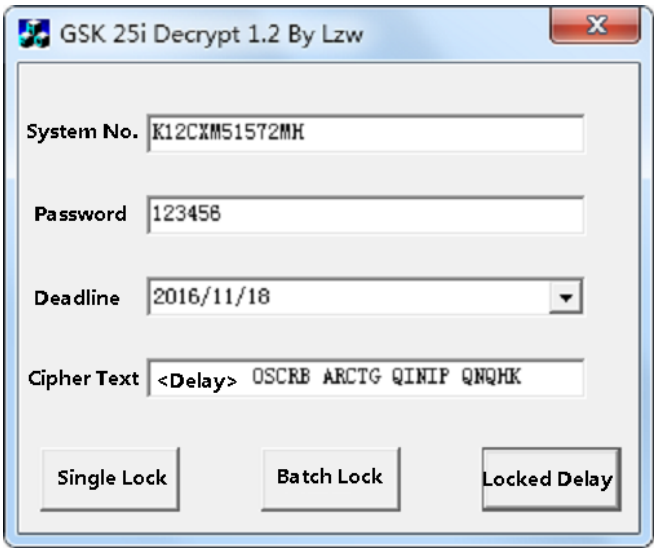
Overview

In order to modify the limiting time after setting the installment time limit of CNC system, it is possible to either remove the time limit and reset, or use the payment delay function to generate a string of codes to set a new time limit while removing the current one.

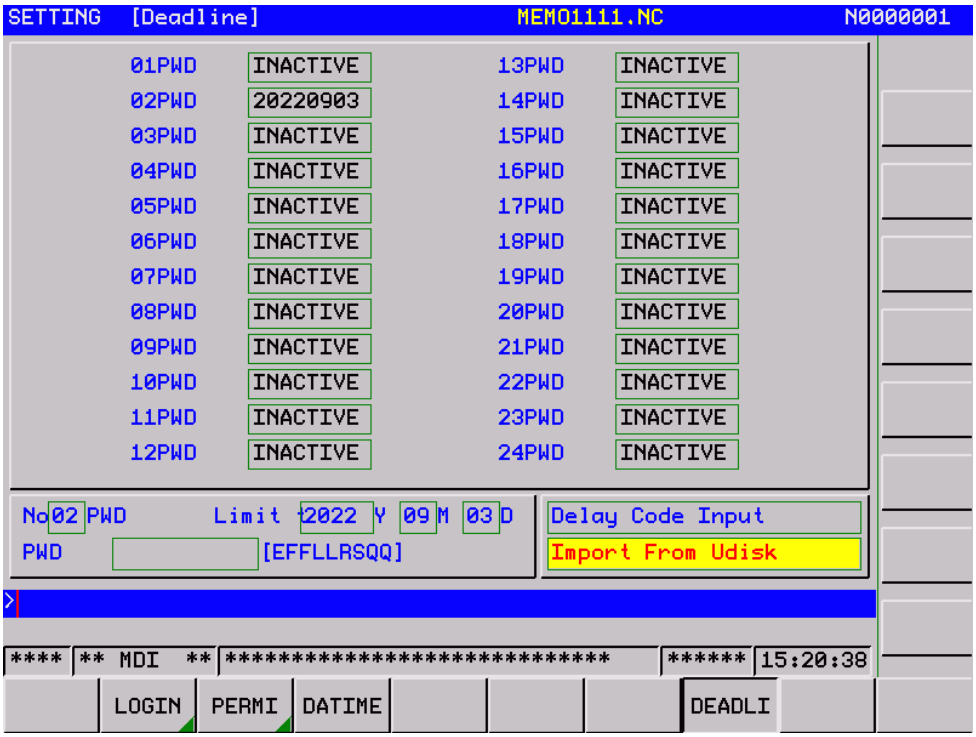
Caution: NC software began to support this function since the GSKV3.5.8-2 version.

Detailed description:

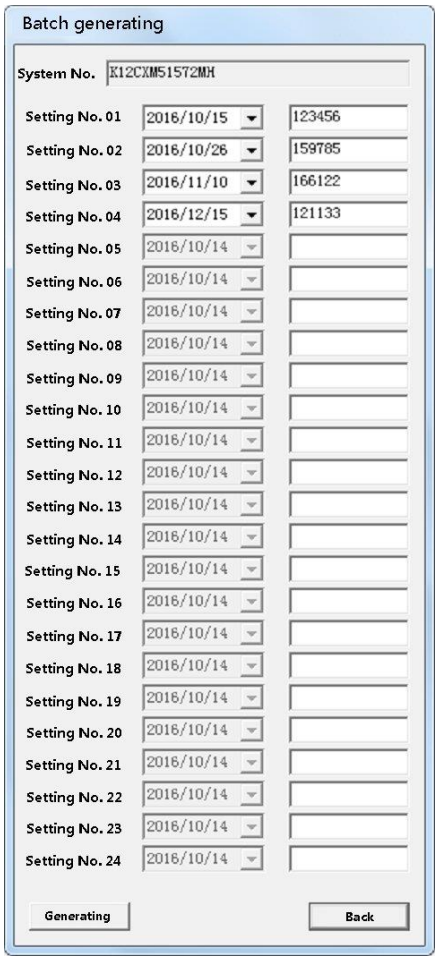
After running the **GSK25i Payment Password** delay setting software, input the system number, unlock password and lock date one by one and click "Single Lock", and the software will generate a string of ciphertext composed of 20 uppercase English characters.



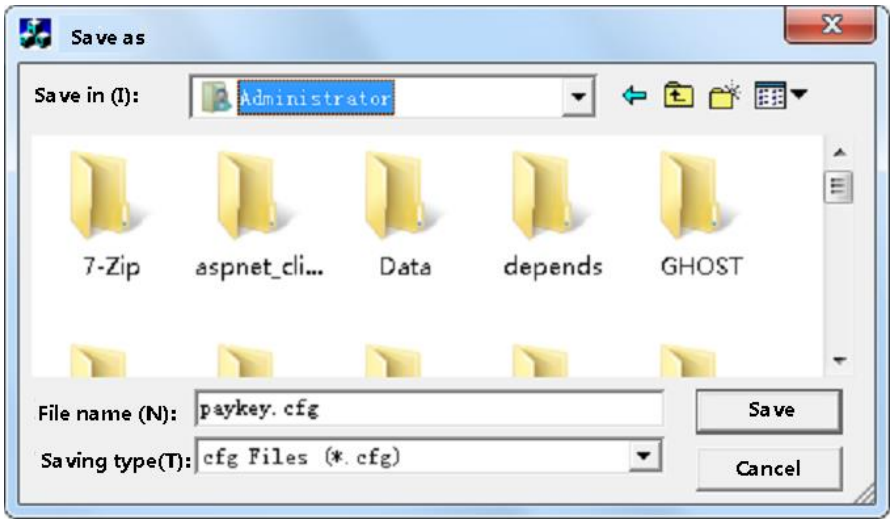
Input the ciphertext to the yellow cursor position of the system as the following figure shows to activate the time limit setting once.



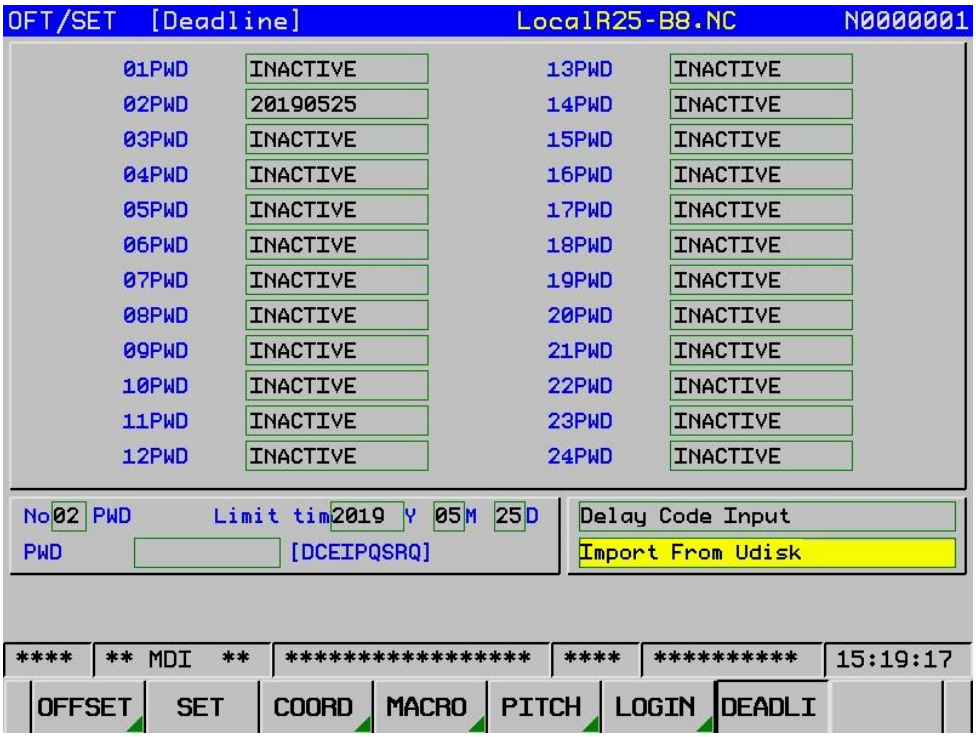
Click "Mass Production", input the system number, then set password and time.



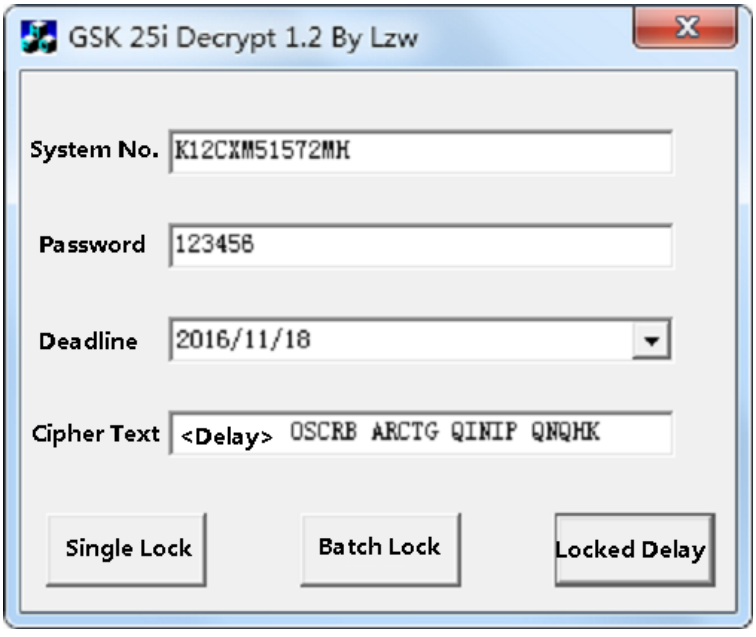
Click "Generate File" to generate paykey file.



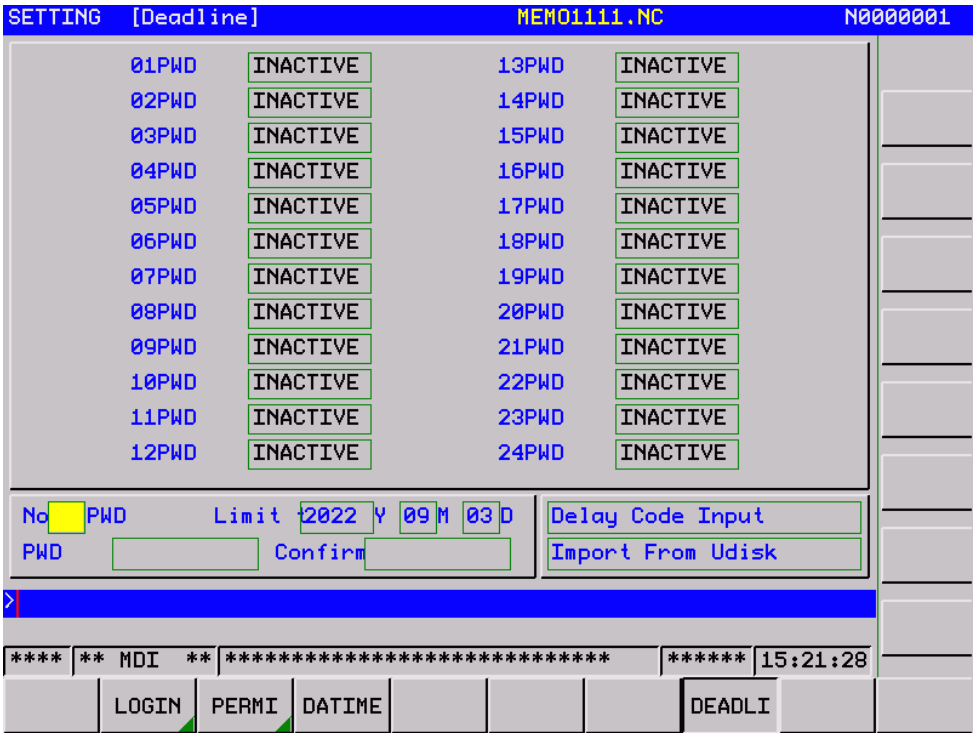
Save paykey file to the root directory of USB flash drive and enter time limit setting interface; then select "USB flash drive Root Directory Import" window, press the enter key, and wait for the finish message.



Input system number, unlock password and lock date one by one and make sure the unlock password of delay operation is consistent with the original lock password. Then click "Locked Delay" and the software will generate a ciphertext consisted of 20 uppercase English characters;



Input the ciphertext into the "Verification Code Input" window on time limit setting interface to activate the time limit setting once.


SETTING [Deadline] MEMO1111.NC N0000001
01PWD INACTIVE
02PWD INACTIVE
03PWD INACTIVE
04PWD INACTIVE
05PWD INACTIVE
06PWD INACTIVE
07PWD INACTIVE
08PWD INACTIVE
09PWD INACTIVE
10PWD INACTIVE
11PWD INACTIVE
12PWD INACTIVE
13PWD INACTIVE
14PWD INACTIVE
15PWD INACTIVE
16PWD INACTIVE
17PWD INACTIVE
18PWD INACTIVE
19PWD INACTIVE
20PWD INACTIVE
21PWD INACTIVE
22PWD INACTIVE
23PWD INACTIVE
24PWD INACTIVE
No PWD
Limit 2022 Y 09 M 03 D
PWD
Confirm
Delay Code Input
Import From Udisk
**** ** MDI ** ****** 15:21:28
LOGIN
PERMI
DATIME
DEADLI

Appendix

Appendix

Appendix I Checklist of Signal Addresses (by address)

1.1 Checklist of F signal address (CNC-PLC)

F000	OP	SA	STL	SPL				
	Autorun	Servo ready	Cycle start	Feed hold				
F001	MA			ENB	DEN		RST	ALM
	Ready			Spindle enabling	Distribution end		Reset signal	Alarm signal
F002	MDRN	CUT		SRNMV		CSS	RPDO	
	Dry running Signal	Cutting feeding signal		Program restart		Constant speed	Rapid feeding	
F003	MZRO	MEDIT	MMEM	MRMT	MMDI	MJ	MH	MINC
	Back to zero mode confirmation signal	Edit mode confirmation signal	Automatic mode confirmation signal	DNC mode confirmation signal	MDI mode confirmation signal	Manual mode confirmation signal	MPG mode confirmation signal	Incremental feed confirmation signal
F004				MAFL	MSBK		MMLK	MBDT
				Auxiliary function locking confirmation	Single block confirmation		Machine lock confirmation	Skipping confirmation
F007		MF3	MF2		TF	SF		MF
		3M auxiliary function strobing	2M auxiliary function strobing		Tool function strobing	Spindle function strobing		Auxiliary function strobing
F008								EF
								External signal end
F009	DM00	DM01	DM02	DM30				
	M00 decoding output	M01 decoding output	M02 decoding output	M30 decoding output				

F010

M07	M06	M05	M04	M03	M02	M01	M00

Auxiliary function code signal

F011

M15	M14	M13	M12	M11	M10	M09	M08

Auxiliary function code signal

F012

M23	M22	M21	M20	M19	M18	M17	M16

Auxiliary function code signal

F013

M31	M30	M29	M28	M27	M26	M25	M24

Auxiliary function code signal

F014

M107	M106	M105	M104	M103	M102	M101	M100

2nd M auxiliary function code signal

F015

M115	M114	M113	M112	M111	M110	M109	M108

2nd M auxiliary function code signal

F016

M123	M122	M121	M120	M119	M118	M117	M116

2nd M auxiliary function code signal

F017

M131	M130	M129	M128	M127	M126	M125	M124

2nd M auxiliary function code signal

F018

M207	M206	M205	M204	M203	M202	M201	M200

3rd M auxiliary function code signal

F019

M215	M214	M213	M212	M211	M210	M209	M208

3rd M auxiliary function code signal

F020

M223	M222	M221	M220	M219	M218	M217	M216

3rd M auxiliary function code signal

F021

M231	M230	M229	M228	M227	M226	M225	M224

3rd M auxiliary function code signal

F022

S07	S06	S05	S04	S03	S02	S01	S00

Spindle functional code signal

F023	S15	S14	S13	S12	S11	S10	S09	S08

Spindle functional code signal

F024	S23	S22	S21	S20	S19	S18	S17	S16

Spindle functional code signal

F025	S31	S30	S29	S28	S27	S26	S25	S24

Spindle functional code signal

F026	T07	T06	T05	T04	T03	T02	T01	T00

Tool function code signal

F027	T15	T14	T13	T12	T11	T10	T09	T08

Tool function code signal

F028	T23	T22	T21	T20	T19	T18	T17	T16

Tool function code signal

F029	T31	T30	T29	T28	T27	T26	T25	T24

Tool function code signal

F030	B07	B06	B05	B04	B03	B02	B01	B00

2nd auxiliary function B

F031	B15	B14	B13	B12	B11	B10	B09	B08

2nd auxiliary function B

F032	B23	B22	B21	B20	B19	B18	B17	B16

2nd auxiliary function B

F033	B31	B30	B29	B28	B27	B26	B25	B24

2nd auxiliary function B

F034					GR4O	GR3O	GR2O	GR1O

Gear selection signal output

F038

			*SUCLP2			SUCLP	SCLP
			2nd spindle releasing output			1st spindle releasing output	1st spindle clamping output

F039

			*SCLP			MSPOS2	MSPOS
			2nd spindle clamping output			2nd spindle positioning	1st spindle positioning

F040

AR07	AR06	AR05	AR04	AR03	AR02	AR01	AR00

Actual spindle speed signal output

F041

AR15	AR14	AR13	AR12	AR11	AR10	AR09	AR08

Actual spindle speed signal output

F044

			SYCAL	FDPPH	FSPSY	FSCSL	FSPSY2
			Spindle phase error detection	Spindle phase synchronization completed	Spindle synchronization completion signal	1st spindle CS controlling	2nd spindle CS controlling

F045

ORAR				SAR		ZSL	ALM
1st spindle orientation completed				1st spindle speed arrival		1st spindle zero speed signal	1st spindle alarm signal

F049

ORAR2				SAR2		ZSL2	ALM2
2nd spindle orientation completed				2nd spindle speed arrival		2nd spindle zero speed signal	2nd spindle alarm signal

F054

UO007	UO006	UO005	UO004	UO003	UO002	UO001	UO000

User macro program output signal

F055

UO015	UO014	UO013	UO012	UO011	UO010	UO009	UO008

User macro program output signal

F056

UO023	UO022	UO021	UO020	UO019	UO018	UO017	UO016

User macro program output signal

F057

UO031	UO030	UO029	UO028	UO017	UO016	UO015	UO014

User macro program output signal

F060

					ESCAN	ESEND	EREND
					External data reading cancelled	External data retrieving completed	External data reading completed

F061

				CLP5	UCLP5	CLP4	UCLP4
				5-axis clamping	5-axis release	4-axis clamping	4-axis release

F062

	PRSF3	PRSF2	PRSF1				OPTC
	Part counting 3 arrival	Part counting 2 arrival	Part counting 1 arrival				Abnormal communication of operation panel

F065

						RGSPM	RGSPP
						Spindle rotation	Direction signal

F066

					RTAP	RTPT	
					Rigid tapping	Tapping rollback completed	

F070

PSW08	PSW07	PSW06	PSW05	PSW04	PSW03	PSW02	PSW01

Position switch signal

F068

SPLOAD8	SPLOAD7	SPLOAD6	SPLOAD5	SPLOAD4	SPLOAD3	SPLOAD2	SPLOAD1

Spindle override percentage

F071

PSW16	PSW15	PSW14	PSW13	PSW12	PSW11	PSW10	PSW09

Position switch signal

F072

PSW24	PSW23	PSW22	PSW21	PSW20	PSW19	PSW18	PSW17

Position switch signal

F073

PSW32	PSW31	PSW30	PSW29	PSW28	PSW27	PSW26	PSW25

Position switch signal

F076

			VPO2	VPO			
			2 speed position switching completed	Speed position switching completed			

F094

ZP8	ZP7	ZP6	ZP5	ZP4	ZP3	ZP2	ZP1
8th axis return to reference point	7th axis return to reference point	6th axis return to reference point	5th axis return to reference point	4th axis return to reference point	3rd axis return to reference point	2nd axis return to reference point	1st axis return to reference point

F095

ZP8	ZP7	ZP6	ZP5	ZP4	ZP3	ZP2	ZP1
Group 8 PLC axis reference point 1	Group 7 PLC axis reference point 1	Group 6 PLC axis reference point 1	Group 5 PLC axis reference point 1	Group 4 PLC axis reference point 1	Group 3 PLC axis reference point 1	Group 2 PLC axis reference point 1	Group 1 PLC axis reference point 1

F096

ZP28	ZP27	ZP26	ZP25	ZP24	ZP23	ZP22	ZP21
8th axis return to reference point 2	7th axis return to reference point 2	6th axis return to reference point 2	5th axis return to reference point 2	4th axis return to reference point 2	3rd axis return to reference point 2	2nd axis return to reference point 2	1st axis return to reference point 2

F097

ZP8	ZP7	ZP6	ZP5	ZP4	ZP3	ZP2	ZP1
Group 8 PLC axis reference point 2	Group 7 PLC axis reference point 2	Group 6 PLC axis reference point 2	Group 5 PLC axis reference point 2	Group 4 PLC axis reference point 2	Group 3 PLC axis reference point 2	Group 2 PLC axis reference point 2	Group 1 PLC axis reference point 2

F098

ZP38	ZP37	ZP36	ZP35	ZP34	ZP33	ZP32	ZP31
8th axis return to reference point 3	7th axis return to reference point 3	6th axis return to reference point 3	5th axis return to reference point 3	4th axis return to reference point 3	3rd axis return to reference point 3	2nd axis return to reference point 3	1st axis return to reference point 3

F099

ZP8	ZP7	ZP6	ZP5	ZP4	ZP3	ZP2	ZP1
Group 8 PLC axis reference point 3	Group 7 PLC axis reference point 3	Group 6 PLC axis reference point 3	Group 5 PLC axis reference point 3	Group 4 PLC axis reference point 3	Group 3 PLC axis reference point 3	Group 2 PLC axis reference point 3	Group 1 PLC axis reference point 3

F100

ZP48	ZP47	ZP46	ZP45	ZP44	ZP43	ZP42	ZP41
8th axis return to reference point 4	7th axis return to reference point 4	6th axis return to reference point 4	5th axis return to reference point 4	4th axis return to reference point 4	3rd axis return to reference point 4	2nd axis return to reference point 4	1st axis return to reference point 4

F101

ZP8	ZP7	ZP6	ZP5	ZP4	ZP3	ZP2	ZP1
Group 8 PLC axis reference point 4	Group 7 PLC axis reference point 4	Group 6 PLC axis reference point 4	Group 5 PLC axis reference point 4	Group 4 PLC axis reference point 4	Group 3 PLC axis reference point 4	Group 2 PLC axis reference point 4	Group 1 PLC axis reference point 4

F102

MV8	MV7	MV6	MV5	MV4	MV3	MV2	MV1
8th axis moving	7th axis moving	6th axis moving	5th axis moving	4th axis moving	3rd axis moving	2nd axis moving	1st axis moving

F106

MVD8	MVD7	MVD6	MVD5	MVD4	MVD3	MVD2	MVD1
8th axis moving direction	7th axis moving direction	6th axis moving direction	5th axis moving direction	4th axis moving direction	3rd axis moving direction	2nd axis moving direction	1st axis moving direction

F112

EADE8	EADE7	EADE6	EADE5	EADE4	EADE3	EADE2	EADE1

Distribution of PLC axis completed

F114

TRQL8	TRQL7	TRQL6	TRQL5	TRQL4	TRQL3	TRQL2	TRQL1

Torque limit arrival

F120

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

F124

+OT8	+OT7	+OT6	+OT5	+OT4	+OT3	+OT2	+OT1
8th axis over-travel in positive direction	7th axis over-travel in positive direction	6th axis over-travel in positive direction	5th axis over-travel in positive direction	4th axis over-travel in positive direction	3rd axis over-travel in positive direction	2nd axis over-travel in positive direction	1st axis over-travel in positive direction

F126

-OT8	-OT7	-OT6	-OT5	-OT4	-OT3	-OT2	-OT1
8th axis over-travel in negative direction	7th axis over-travel in negative direction	6th axis over-travel in negative direction	5th axis over-travel in negative direction	4th axis over-travel in negative direction	3rd axis over-travel in negative direction	2nd axis over-travel in negative direction	1st axis over-travel in negative direction

F129

EAXSL		EOV0					
Control axis selection status		Override is 0					

F130

EBSYA	EOTNA	EOTPA	EGENA	EDENA	EIALA	ECKZA	EINPA
Axis command reading completed	PLC axis over-travel in negative direction	PLC axis over-travel in positive direction	PLC axis moving	Auxiliary function executing	PLC axis alarming	Acceleration/ deceleration delay is 0	PLC axis in-place

F131

				EMF3A	EMF2A	EABUF	EMFA
				3rd auxiliary function strobing	2nd auxiliary function	Buffer full strobing	Auxiliary function strobing

F132

EM28A	EM24A	EM22A	EM21A	EM18A	EM14A	EM12A	EM11A

Auxiliary function code signal of PLC axis

F133

EBSYB	EOTNB	EOTPB	EGENB	EDENB	EIALB	ECKZB	EINPB
Axis command reading completed	PLC axis over-travel in negative direction	PLC axis over-travel in positive direction	PLC axis moving	Auxiliary function executing	PLC axis alarming	Acceleration/ deceleration delay is 0	PLC axis in-place

F134

				EMF3B	EMF2B	EABUF	EMFB
				3rd auxiliary function strobing	2nd auxiliary function strobing	Buffer full	Auxiliary function strobing

F135

EM28B	EM24B	EM22B	EM21B	EM18B	EM14B	EM12B	EM11B

Auxiliary function code signal of PLC axis

F136

EBSYC	EOTNC	EOTPC	EGENC	EDENC	EIALC	ECKZC	EINPC
Axis command reading completed	PLC axis over-travel in negative direction	PLC axis over-travel in positive direction	PLC axis moving	Auxiliary function executing	PLC axis alarming	Acceleration/ deceleration delay is 0	PLC axis in-place

F137

				EMF3C	EMF2C	EABUF	EMFC
				3rd auxiliary function strobing	2nd auxiliary function strobing	Buffer full	Auxiliary function strobing

F138

EM28C	EM24C	EM22C	EM21C	EM18C	EM14C	EM12C	EM11C

Auxiliary function code signal of PLC axis

F139

EBSYD	EOTND	EOTPD	EGEND	EDEND	EIALD	ECKZD	EINPD
Axis command reading completed	PLC axis over-travel in negative direction	PLC axis over-travel in positive direction	PLC axis moving	Auxiliary function executing	PLC axis alarming	Acceleration/ deceleration delay is 0	PLC axis in-place

F140

				EMF3D	EMF2D	EABUF	EMFD
				3rd auxiliary function strobing	2nd auxiliary function strobing	Buffer full	Auxiliary function strobing

F141

EM28D	EM24D	EM22D	EM21D	EM18D	EM14D	EM12D	EM11D

Auxiliary function code signal of PLC axis

F142

EBSYA	EOTNA	EOTPA	EGENA	EDENA	EIALA	ECKZA	EINPA
Axis command reading completed	PLC axis over-travel in negative direction	PLC axis over-travel in positive direction	PLC axis moving	Auxiliary function executing	PLC axis alarming	Acceleration/ deceleration delay is 0	PLC axis in-place

F143

				EMF3A	EMF2A	EABUF	EMFA
				3rd auxiliary function strobing	2nd auxiliary function strobing	Buffer full	Auxiliary function strobing

F144

EM28A	EM24A	EM22A	EM21A	EM18A	EM14A	EM12A	EM11A

Auxiliary function code signal of PLC axis

F145

EBSYA	EOTNA	EOTPA	EGENA	EDENA	EIALA	ECKZA	EINPA
Axis command reading completed	PLC axis over-travel in negative direction	PLC axis over-travel in positive direction	PLC axis moving	Auxiliary function executing	PLC axis alarming	Acceleration/ deceleration delay is 0	PLC axis in-place

F146

				EMF3A	EMF2A	EABUF	EMFA
				3rd auxiliary function strobing	2nd auxiliary function strobing	Buffer full	Auxiliary function strobing

F147

EM28A	EM24A	EM22A	EM21A	EM18A	EM14A	EM12A	EM11A

Auxiliary function code signal of PLC axis

F148

EBSYA	EOTNA	EOTPA	EGENA	EDENA	EIALA	ECKZA	EINPA
Axis command reading completed	PLC axis over-travel in negative direction	PLC axis over-travel in positive direction	PLC axis moving	Auxiliary function executing	PLC axis alarming	Acceleration/ deceleration delay is 0	PLC axis in-place

F149

				EMF3A	EMF2A	EABUF	EMFA
				3rd auxiliary function strobing	2nd auxiliary function strobing	Buffer full	Auxiliary function strobing

F150

EM28A	EM24A	EM22A	EM21A	EM18A	EM14A	EM12A	EM11A

Auxiliary function code signal of PLC axis

F151

EBSYA	EOTNA	EOTPA	EGENA	EDENA	EIALA	ECKZA	EINPA
Axis command reading completed	PLC axis over-travel in negative direction	PLC axis over-travel in positive direction	PLC axis moving	Auxiliary function executing	PLC axis alarming	Acceleration/ deceleration delay is 0	PLC axis in-place

F152

				EMF3A	EMF2A	EABUF	EMFA
				3rd auxiliary function strobing	2nd auxiliary function strobing	Buffer full	Auxiliary function strobing

F153

EM28A	EM24A	EM22A	EM21A	EM18A	EM14A	EM12A	EM11A

Auxiliary function code signal of PLC axis

F155

USK7	USK6	USK5	USK4	USK3	USK2	USK1	USK0

Customized interface soft key address

F156

USK15	USK14	USK13	USK12	USK11	USK10	USK9	USK8

Customized interface soft key address

F157

USK23	USK22	USK21	USK20	USK19	USK18	USK17	USK16

Customized interface soft key address

F158	USK31	USK30	USK29	USK28	USK27	USK26	USK25	USK24

Customized interface soft key address

F159	USK39	USK38	USK37	USK36	USK35	USK34	USK33	USK32

Customized interface soft key address

F182	EACN8	EACN7	EACN6	EACN5	EACN4	EACN3	EACN2	EACN1

PLC axis controlling

F200	R08O2	R07O2	R06O2	R05O2	R04O2	R03O2	R02O2	R01O2

S12-bit code signal

F201					R12O2	R11O2	R10O2	R09O2

S12-bit code signal

F202	AR072	AR062	AR052	AR042	AR032	AR022	AR012	AR002

Actual spindle speed output signal

F203	AR152	AR142	AR132	AR122	AR112	AR102	AR092	AR082

Actual spindle speed output signal

F208	POSCH8	POSCH7	POSCH6	POSCH5	POSCH4	POSCH3	POSCH2	POSCH1

Position update completion output signal

F210	WIFI8	WIFI7	WIFI6	WIFI5	WIFI4	WIFI3	WIFI2	WIFI1

WIFI signal output

F226	UO107	UO106	UO105	UO104	UO103	UO102	UO101	UO100

User macro program output 2

F227	UO115	UO114	UO113	UO112	UO111	UO110	UO109	UO108

User macro program output 2

F228	UO123	UO122	UO121	UO120	UO119	UO118	UO117	UO116

User macro program output 2

F229	UO131	UO130	UO129	UO128	UO127	UO126	UO125	UO124

User macro program output 2

F230	UO207	UO206	UO205	UO204	UO203	UO202	UO201	UO200

User macro program output 3

F231	UO215	UO214	UO213	UO212	UO211	UO210	UO209	UO208

User macro program output 3

F232	UO223	UO222	UO221	UO220	UO219	UO218	UO217	UO216

User macro program output 3

F233	UO231	UO230	UO229	UO228	UO227	UO226	UO225	UO224

User macro program output 3

F234	UO307	UO306	UO305	UO304	UO303	UO302	UO301	UO300

User macro program output 4

F235	UO315	UO314	UO313	UO312	UO311	UO310	UO309	UO308

User macro program output 4

F236	UO323	UO322	UO321	UO320	UO319	UO318	UO317	UO316

User macro program output 4

F237	UO331	UO330	UO329	UO328	UO327	UO326	UO325	UO324

User macro program output 4

F240	F008	F007	F006	F005	F004	F003	F002	F001

Current feed speed output

F241	F016	F015	F014	F013	F012	F011	F010	F009

Current feed speed output

1.2 Checklist of G signal address (PLC-CNC)

G000	ED7	ED6	ED5	ED4	ED3	ED2	ED1	ED0

External data input data signal

G001	ED15	ED14	ED13	ED12	ED11	ED10	ED9	ED8

External data input data signal

G002	ED23	ED22	ED21	ED20	ED19	ED18	ED17	ED16

External data input data signal

G003

ED31	ED30	ED29	ED28	ED27	ED26	ED25	ED24

External data input data signal

G004

		MFIN3	MFIN2B	FIN			DATA
		3rd M completion signal	2nd M completion signal	Auxiliary function completion signal			Data collection

G005

SFIN	AFL		BF	TFIN	SFIN		MFIN
2nd auxiliary function completed	Auxiliary function lock function		2nd auxiliary function strobing	2nd auxiliary T function completed	2nd auxiliary S function completed		High-speed MSTC function completed

G006

							SRN
							Restart

G007

RLSOT	EXLM	FLWU			ST	STLK	
Travel limit 1 over-travel release	Storage travel limit 1 switch	Position tracking			Cycle start	Start locking	

G008

ERS	RRW	*SP	*ESP	*BSL	SOP	*CSL	*IT
External recovery	Recover & return	Feed hold	Emergency stop	Program block starts interlock	Optional stop	Chip cutting segment starts interlock	Full-axis interlock

G010

*JV07	*JV06	*JV05	*JV04	*JV03	*JV02	*JV01	*JV00

Manual feed speed override

G011

*JV15	*JV14	*JV13	*JV12	*JV11	*JV10	*JV09	*JV08

Manual feed speed override

G012

*FV7	*FV6	*FV5	*FV4	*FV3	*FV2	*FV1	*FV0

Feed speed override signal

G013

ESTB	EA6	EA5	EA4	EA3	EA2	EA1	EA0
External data reading signal	External data input address signal						

G014

	WPC3	WPC2	WPC1			ROV2	ROV1
	3#workpiece count	2#workpiece count	1#workpiece count			Fast feed override	

G016

							SPLOAD
							Spindle load

G018

HS1D	HS1C	HS1B	HS1A	HS1D	HS1C	HS1B	HS1A
2nd MPG axis selection signal			MPG axis selection signal				

G019

RT	FVL	MP2	MP1	MPSELT			
Manual rapid selection signal	Selection of safe feed speed	MPG override	MPG override	Unit selection of MPG override			

G023

TILTJOG			HSFTA				
The inclined face is effective if manually operated			Tool axis direction of MPG insertion				

G026

		*SCPFA2	*SUCPFA2			PC2SLC	PC1SLC
		2nd spindle clamping completed	2nd spindle release completed			2nd spindle selection high speed	1st spindle selection high speed

G027

CON	CON2		*SSTP2	*SSTP1		SWS2	SWS1
Cs axis switching of the 1st spindle	Cs axis switching of the 2nd spindle		2nd spindle stop	1st spindle stop		Multi-spindle selection	

G028

PCSLC	ORCM	*SCPFA	*SUCPFA		GR2	GR1	

Appendix

	Spindle feedback speed	Spindle positioning selection signal	Spindle clamping completion signal	Spindle release completion signal	Gear selection signal			
G029		*SSTP	SOR	INSAR2	INSAR1		2GR2	2GR1
		Spindle stop	Spindle gear shift rotational speed selection	2-speed arrival signal	Speed arrival signal		Gear selection of the 2nd spindle	
G030	SOV7	SOV6	SOV5	SOV4	SOV3	SOV2	SOV1	SOV0
	Signal of spindle speed override							
G032	R08I2	R07I2	R06I2	R05I2	R04I2	R03I2	R02I2	R01I2
	1st spindle speed value signal							
G033	SSND		SGN	SVL	R12I	R11I	R10I	R09I
	1st PLC spindle control strobing		Spindle command polarity selection	Spindle safe speed selection	1st spindle speed value signal			
G034	R08I2	R07I2	R06I2	R05I2	R04I2	R03I2	R02I2	R01I2
	2nd spindle speed value signal							
G035	SSND2		SGN2		R12I2	R11I2	R10I2	R09I2
	PLC spindle 2 control strobing		Spindle 2 command polarity selection		2nd spindle speed value signal			
G038	*BECLP	*BEUCP			SPPHS	SPSYC		
	B axis clamping completion signal	B-axis release completion signal			Spindle phase synchronous control	Spindle synchronous control signal		
G041	HS2ID	HS2IC	HS2IB	HS2IA	HS1ID	HS1IC	HS1IB	HS1IA
	2nd MPG insertion axis selection signal							
G043				INC		MD4	MD2	MD1

				Single-step method			Signal of selecting operating method	
G044	G55REO	G54REO	REO1	REO4			MLK	BDT
	Return to G55 coordinate system point	Return to G54 coordinate system point	Return to the 1st reference point	Return to the 4th reference point			Machine lock Signal	Skip signal
G046	DRN						SBK	
	Dry running						Single block	
G054	UI007	UI006	UI005	UI004	UI003	UI002	UI001	UI000
	User macro program input signal							
G053					UNIT			
					Macro interruption			
G055	UI015	UI014	UI013	UI012	UI011	UI010	UI009	UI008
	User macro program input signal							
G056	UI023	UI022	UI021	UI020	UI019	UI018	UI017	UI016
	User macro program input signal							
G057	UI031	UI030	UI029	UI028	UI027	UI026	UI025	UI024
	User macro program input signal							
G061							RGTAP2	RGTAP
							Rigid tapping of the 1st spindle	Rigid tapping of the 2nd spindle
G062		RTNT		COLA				
		Rigid tapping rollback signal		Multi-axis manual interactive function				
G063			NOZAGC					

			Tilting axis Invalid signal					
G067						HRE		
						Simulation of the MPG		
G070		ORCM						
		1st spindle orientation output						
G074		ORCMB						
		2nd spindle orientation signal						
G085								PRO-CH
								Program call Operation mode selection
G096	HROV	HROV6	HROV5	HROV4	HROV3	HROV2	HROV1	HROV0
	1% fast override selection	1% fast feed override signal						
G097	TROV7	TROV6	TROV5	TROV4	TROV3	TROV2	TROV1	TROV0
	Signal of torque limit override							

G100	+J8	+J7	+J6	+J5	+J4	+J3	+J2	+J1
	8th axis positive-direction selection	7th axis positive-direction selection	6th axis positive-direction selection	5th axis positive-direction selection	4th axis positive-direction selection	3rd axis positive-direction selection	2nd axis positive-direction selection	1st axis positive-direction selection
G102	-J8	-J7	-J6	-J5	-J4	-J3	-J2	-J1
	8th axis negative-direction selection	7th axis negative-direction selection	6th axis negative-direction selection	5th axis negative-direction selection	4th axis negative-direction selection	3rd axis negative-direction selection	2nd axis negative-direction selection	1st axis negative-direction selection

G114

*+L8	*+L7	*+L6	*+L5	*+L4	*+L3	*+L2	*+L1
8th axis over-travel in positive direction	7th axis over-travel in positive direction	6th axis over-travel in positive direction	5th axis over-travel in positive direction	4th axis over-travel in positive direction	3rd axis over-travel in positive direction	2nd axis over-travel in positive direction	1st axis over-travel in positive direction

G118

*+ED8	*+ED7	*+ED6	*+ED5	*+ED4	*+ED3	*+ED2	*+ED1
8th axis positive external deceleration	7th axis positive external deceleration	6th axis positive external deceleration	5th axis positive external deceleration	4th axis positive external deceleration	3rd axis positive external deceleration	2nd axis positive external deceleration	1st axis positive external deceleration

G120

*-ED8	*-ED7	*-ED6	*-ED5	*-ED4	*-ED3	*-ED2	*-ED1
8th axis negative external deceleration	7th axis negative external deceleration	6th axis negative external deceleration	5th axis negative external deceleration	4th axis negative external deceleration	3rd axis negative external deceleration	2nd axis negative external deceleration	1st axis negative external deceleration

G121

COLT8	COLT7	COLT6	COLT5	COLT4	COLT3	COLT2	COLT1
8th axis manual association	7th axis manual association	6th axis manual association	5th axis manual association	4th axis manual association	3rd axis manual association	2nd axis manual association	1st axis manual association

G126

SVF8	SVF7	SVF6	SVF5	SVF4	SVF3	SVF2	SVF1
8th axis enabling break	7th axis enabling break	6th axis enabling break	5th axis enabling break	4th axis enabling break	3rd axis enabling break	2nd axis enabling break	1st axis enabling break

G132

+MIT8	+MIT7	+MIT6	+MIT5	+MIT4	+MIT3	+MIT2	+MIT1
8th axis positive-direction interlock	7th axis positive-direction interlock	6th axis positive-direction interlock	5th axis positive-direction interlock	4th axis positive-direction interlock	3rd axis positive-direction interlock	2nd axis positive-direction interlock	1st axis positive-direction interlock

G134

-MIT8	-MIT7	-MIT6	-MIT5	-MIT4	-MIT3	-MIT2	-MIT1
8th axis negative-direction interlock	7th axis negative-direction interlock	6th axis negative-direction interlock	5th axis negative-direction interlock	4th axis negative-direction interlock	3rd axis negative-direction interlock	2nd axis negative-direction interlock	1st axis negative-direction interlock

G136

EAX8	EAX7	EAX6	EAX5	EAX4	EAX3	EAX2	EAX1

PLC control axis selection signal

G137

PMVD8	PMVD7	PMVD6	PMVD5	PMVD4	PMVD3	PMVD2	PMVD1

PLC control axis selection signal

G138

			SYNC5	SYNC4	SYNC3	SYNC2	SYNC1

Feed axis synchronous control selection signal

G140

			SYNCJ5	SYNCJ4	SYNCJ3	SYNCJ2	SYNCJ1

Manual feed axis selection signal for feed axis synchronous control

G142

EBUFA	ECLRA	ESTPA	ESOFA	ESBKA	EMBUF	ELCKZ	EFINA
PLC axis command reading	PLC axis reset signal	PLC axis dwell signal	PLC axis enabling break	PLC axis program stop	PLC axis buffer disabled	Axis acceleration/ deceleration delay detection	Auxiliary function completion signal

G143

EMSBK	EC6A	EC5A	EC4A	EC3A	EC2A	EC1A	EC0A
Program block stop prohibition signal	PLC axis control command signal						

G144

EIF7A	EIF6A	EIF5A	EIF4A	EIF3A	EIF2A	EIF1A	EIF0A

PLC axis control feed speed signal

G145

EIF15A	EIF14A	EIF13A	EIF12A	EIF11A	EIF10A	EIF9A	EIF8A

PLC axis control feed speed signal

G146

EID7A	EID6A	EID5A	EID4A	EID3A	EID2A	EID1A	EID0A

PLC axis control data signal

G147

EID15A	EID14A	EID13A	EID12A	EID11A	EID10A	EID9A	EID8A

PLC axis control data signal

G148

EID23A	EID22A	EID21A	EID20A	EID19A	EID18A	EID17A	EID16A

PLC axis control data signal

G149

EID31A	EID30A	EID29A	EID28A	EID27A	EID26A	EID25A	EID24A

PLC axis control data signal

G150

EROV		EOVC				EROV2	EROV1
Fast override selection		PLC axis override canceled				PLC axis rapid traverse override	

G151

EFOV8	EFOV7	EFOV6	EFOV5	EFOV4	EFOV3	EFOV2	EFOV1

PLC axis feed override

G154

EBUFB	ECLRB	ESTPB	ESOFB	ESBKB	EMBUF	ELCKZ	EFINB
PLC axis command reading	PLC axis reset signal	PLC axis dwell signal	PLC axis enabling break	PLC axis program stop	PLC axis buffer disabled	Axis acceleration/ deceleration delay detection	Auxiliary function completion signal

G155

EMSBKB	EC6B	EC5B	EC4B	EC3B	EC2B	EC1B	EC0B
Program block stop prohibition signal	PLC axis control command signal						

G156

EIF7B	EIF6B	EIF5B	EIF4B	EIF3B	EIF2B	EIF1B	EIF0B

PLC axis control feed speed signal

G157

EIF15B	EIF14B	EIF13B	EIF12B	EIF11B	EIF10B	EIF9B	EIF8B

PLC axis control feed speed signal

G158

EID7B	EID6B	EID5B	EID4B	EID3B	EID2B	EID1B	EID0B

PLC axis control data signal

G159

EID15B	EID14B	EID13B	EID12B	EID11B	EID10B	EID9B	EID8B

PLC axis control data signal

G160

EID23B	EID22B	EID21B	EID20B	EID19B	EID18B	EID17B	EID16B

PLC axis control data signal

G161

EID31B	EID30B	EID29B	EID28B	EID27B	EID26B	EID25B	EID24B

PLC axis control data signal

G162

		EOVCB					
		PLC axis override canceled					

G163

EFOV8	EFOV7	EFOV6	EFOV5	EFOV4	EFOV3	EFOV2	EFOV1

PLC axis feed override

G166

EBUFC	ECLRC	ESTPC	ESOFC	ESBKC	EMBUF	ELCKZ	EFINC
PLC axis command reading	PLC axis reset signal	PLC axis dwell signal	PLC axis enabling break	PLC axis program stop	PLC axis buffer disabled	Axis acceleration/ deceleration	Auxiliary function completion

						delay detection		signal

G167

EMSBKC	EC6C	EC5C	EC4C	EC3C	EC2C	EC1C	EC0C
Program block stop prohibition signal	PLC axis control command signal						

G168

EIF7C	EIF6C	EIF5C	EIF4C	EIF3C	EIF2C	EIF1C	EIF0C
PLC axis control feed speed signal							

G169

EIF15C	EIF14C	EIF13C	EIF12C	EIF11C	EIF10C	EIF9C	EIF8C
PLC axis control feed speed signal							

G170

EID7C	EID6C	EID5C	EID4C	EID3C	EID2C	EID1C	EID0C
PLC axis control data signal							

G171

EID15C	EID14C	EID13C	EID12C	EID11C	EID10C	EID9C	EID8C
PLC axis control data signal							

G172

EID23C	EID22C	EID21C	EID20C	EID19C	EID18C	EID17C	EID16C
PLC axis control data signal							

G173

EID31C	EID30C	EID29C	EID28C	EID27C	EID26C	EID25C	EID24C
PLC axis control data signal							

G173

		EOVCC					
		PLC axis override canceled					

G176

EFOV8	EFOV7	EFOV6	EFOV5	EFOV4	EFOV3	EFOV2	EFOV1
PLC axis feed override							

G178

EBUFD	ECLRD	ESTPD	ESOFD	ESBKD	EMBUF	ELCKZ	EFIND
PLC axis command reading	PLC axis reset signal	PLC axis dwell signal	PLC axis enabling break	PLC axis program stop	PLC axis buffer disabled	Axis acceleration/ deceleration delay detection	Auxiliary function completion signal

G179

EMSBKD	EC6D	EC5D	EC4D	EC3D	EC2D	EC1D	EC0D

	Program block stop prohibition signal	PLC axis control command signal						
G180	EIF7D	EIF6D	EIF5D	EIF4D	EIF3D	EIF2D	EIF1D	EIF0D
	PLC axis control feed speed signal							
G181	EIF15D	EIF14D	EIF13D	EIF12D	EIF11D	EIF10D	EIF9D	EIF8D
	PLC axis control feed speed signal							
G182	EID7D	EID6D	EID5D	EID4D	EID3D	EID2D	EID1D	EID0D
	PLC axis control data signal							
G183	EID15D	EID14D	EID13D	EID12D	EID11D	EID10D	EID9D	EID8D
	PLC axis control data signal							
G184	EID23D	EID22D	EID21D	EID20D	EID19D	EID18D	EID17D	EID16D
	PLC axis control data signal							
G185	EID31D	EID30D	EID29D	EID28D	EID27D	EID26D	EID25D	EID24D
	PLC axis control data signal							
G186			EOVCD					
			PLC axis override canceled					

G187	EBUFE	ECLRE	ESTPE	ESOFE	ESBKE	EMBUF	ELCKZ	EFINE
	PLC axis command reading	PLC axis reset signal	PLC axis dwell signal	PLC axis enabling break	PLC axis program stop	PLC axis buffer disabled	Axis acceleration/ deceleration delay detection	Auxiliary function completion signal
G188	EMSBKE	EC6E	EC5E	EC4E	EC3E	EC2E	EC1E	EC0E
	Program block stop prohibition signal	PLC axis control command signal						
G189	EIF7E	EIF6E	EIF5E	EIF4E	EIF3E	EIF2E	EIF1E	EIF0E
	PLC axis control feed speed signal							

G190

EIF15E	EIF14E	EIF13E	EIF12E	EIF11E	EIF10E	EIF9E	EIF8E

PLC axis control feed speed signal

G191

EID7E	EID6E	EID5E	EID4E	EID3E	EID2E	EID1E	EID0E

PLC axis control data signal

G192

EID15E	EID14E	EID13E	EID12E	EID11E	EID10E	EID9E	EID8E

PLC axis control data signal

G193

EID23E	EID22E	EID21E	EID20E	EID19E	EID18E	EID17E	EID16E

PLC axis control data signal

G194

EID31E	EID30E	EID29E	EID28E	EID27E	EID26E	EID25E	EID24E

PLC axis control data signal

G197

EBUFF	ECLRF	ESTPF	ESOFF	ESBKF	EMBUF	ELCKZ	EFINF
PLC axis command reading	PLC axis reset signal	PLC axis dwell signal	PLC axis enabling break	PLC axis program stop	PLC axis buffer disabled	Axis acceleration/ deceleration delay detection	Auxiliary function completion signal

G198

EMSBKF	EC6F	EC5F	EC4F	EC3F	EC2F	EC1F	EC0F
Program block stop prohibition signal	PLC axis control command signal						

G199

EIF7F	EIF6F	EIF5F	EIF4F	EIF3F	EIF2F	EIF1F	EIF0F

PLC axis control feed speed signal

G200

EIF15F	EIF14F	EIF13F	EIF12F	EIF11F	EIF10F	EIF9F	EIF8F

PLC axis control feed speed signal

G201

EID7F	EID6F	EID5F	EID4F	EIFD3F	EID2F	EID1F	EID0F

PLC axis control data signal

G202

EID15F	EID14F	EID13F	EID12F	EID11F	EID10F	EID9F	EID8F

PLC axis control data signal

G203

EID23F	EID22F	EID21F	EID20F	EID19F	EID18F	EID17F	EID16F

PLC axis control data signal

G204

EID31F	EID30F	EID29F	EID28F	EID27F	EID26F	EID25F	EID24EF

PLC axis control data signal

G205

EBUFG	ECLRG	ESTPG	ESOFG	ESBKG	EMBUF	ELCKZ	EFING
PLC axis command reading	PLC axis reset signal	PLC axis dwell signal	PLC axis enabling break	PLC axis program stop	PLC axis buffer disabled	Axis acceleration/ deceleration delay detection	Auxiliary function completion signal

G206

EMSBKG	EC6G	EC5G	EC4G	EC3G	EC2G	EC1G	EC0G
Program block stop prohibition signal	PLC axis control command signal						

G207

EIF7G	EIF6G	EIF5G	EIF4G	EIF3G	EIF2G	EIF1G	EIF0G

PLC axis control feed speed signal

G208

EIF15G	EIF14G	EIF13G	EIF12G	EIF11G	EIF10G	EIF9G	EIF8G

PLC axis control feed speed signal

G209

EID7G	EID6G	EID5G	EID4G	EID3G	EID2G	EID1G	EID0G

PLC axis control data signal

G210

EID15G	EID14G	EID13G	EID12G	EID11G	EID10G	EID9G	EID8G

PLC axis control data signal

G211

EID23G	EID22G	EID21G	EID20G	EID19G	EID18G	EID17G	EID16G

PLC axis control data signal

G212

EID31G	EID30G	EID29G	EID28G	EID27G	EID26G	EID25G	EID24G

PLC axis control data signal

G214

EBUFH	ECLRH	ESTPH	ESOFH	ESBKH	EMBUF	ELCKZ	EFINH
PLC axis command reading	PLC axis reset signal	PLC axis dwell signal	PLC axis enabling break	PLC axis program stop	PLC axis buffer disabled	Axis acceleration/ deceleration delay detection	Auxiliary function completion signal

G215

EMSBKH	EC6H	EC5H	EC4H	EC3H	EC2H	EC1H	EC0H

	Program block stop prohibition signal	PLC axis control command signal						
G216	EIF7H	EIF6H	EIF5H	EIF4H	EIF3H	EIF2H	EIF1H	EIF0H

PLC axis control feed speed signal

G217	EIF15H	EIF14H	EIF13H	EIF12H	EIF11H	EIF10H	EIF9H	EIF8H

PLC axis control feed speed signal

G218	EID7H	EID6H	EID5H	EID4H	EID3H	EID2H	EID1H	EID0H

P PLC axis control data signal

G219	EID15H	EID14H	EID13H	EID12H	EID11H	EID10H	EID9H	EID8H

PLC axis control data signal

G220	EID23H	EID22H	EID21H	EID20H	EID19H	EID18H	EID17H	EID16H

PLC axis control data signal

G221	EID31H	EID30H	EID29H	EID28H	EID27H	EID26H	EID25H	EID24H

PLC axis control data signal

G226	UI107	UI106	UI105	UI104	UI103	UI102	UI101	UI100

User macro program input signal 2

G227	UI115	UI114	UI113	UI112	UI111	UI110	UI109	UI108

User macro program input signal 2

G228	UI123	UI122	UI121	UI120	UI119	UI118	UI117	UI116

User macro program input signal 2

G229	UI131	UI130	UI129	UI128	UI127	UI126	UI125	UI124

User macro program input signal 2

G230	UI207	UI206	UI205	UI204	UI203	UI202	UI201	UI200

User macro program input signal 3

G231	UI215	UI214	UI213	UI212	UI211	UI210	UI209	UI208

User macro program input signal 3

G232	UI223	UI222	UI221	UI220	UI219	UI218	UI217	UI216

User macro program input signal 3

G233	UI231	UI230	UI229	UI228	UI227	UI226	UI225	UI224

User macro program input signal 3

G234	UI307	UI306	UI305	UI304	UI303	UI302	UI301	UI300

User macro program input signal 4

G235	UI315	UI314	UI313	UI312	UI311	UI310	UI309	UI308

User macro program input signal 4

G236	UI323	UI322	UI321	UI320	UI319	UI318	UI317	UI316

User macro program input signal 4

G237	UI331	UI330	UI329	UI328	UI327	UI326	UI325	UI324

User macro program input signal 4

G246	TRDIR 8	TRDIR 7	TRDIR 6	TRDIR 5	TRDIR 4	TRDIR 3	TRDIR 2	TRDIR1

Direction selection signal under the torque control mode

G247	TSRATE 8	TSRATE 7	TSRATE 6	TSRATE 5	TSRATE 4	TSRATE 3	TSRATE 2	TSRATE1

Motor rotational speed override signal under the torque control mode

G248	TRRATE 8	TRRATE7	TRRATE 6	TRRATE 5	TRRATE4	TSRATE 3	TRRATE 2	TRRATE1

Torque override signal under the torque control mode

G250	TRQUE8	TRQUE7	TRQUE6	TRQUE5	TORQUE4	TRQUE3	TRQUE2	TRQUE1

Torque control mode switching signal

G255		WTIME						

Processing timing stopped