User's Manual

LS Programmable Logic Controller

Advanced Position Module (Pulse Output Type)

GLOFA
MASTER-K

G4F – PP1O~3O
G4F – PP1D~3D
G6F – PP1O~3O
G6F – PP1D~3D

LS Industrial Systems

Before Using the Product…

Before using the product, please read this user's manual thoroughly for the effective use of the product.

◈ The Safety Precautions ◈

- The safety precautions should be complied by the user to use the product safely and correctly to prevent the occurrence of any accident or danger.
- Notices is divided by 'Warning' and 'Caution' and each meaning is as follows ;

Warning
: in case of violating the instructions, it may cause the significant injury or death.

Caution
: in case of violating the instructions, it may cause the slight injury or product damage.

- The meaning of symbols used in the product and user's manual is as follows:

means "to take care as the danger may occur ".

means "to take care as the electric shock may occur ".

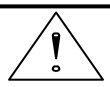
- After using the user's manual, you should keep it in the place where the users can see it easily whenever they need.

∘ Notices in Design

Caution

- I/O Signal/Communication Cables shall be designed apart at least 100mm from high tension wire or power cable to avoid the influence caused by the noise and the change of magnetic field.
  It may cause the malfunction by the noise.
- Please take cares not to apply the lamp directly to the product in the place where lots of lamp are installed. The inflow of metal particle is not permitted as it may cause the malfunction of the product.
- In case of installation environment with metal particles, it may cause the malfunction and it is required not to flow into the metal particles when installing.

∘ Notices in Installation



Caution

- PLC should be used in the environment condition described in the general standard.
- If used out of general standard, it may cause the electric shock, fire, malfunction, damage of product or furious flames etc.
- Make sure that the module is fixed correctly.
- If the module is not installed correctly, it may cause the malfunction, failure or falling.

∘ Notices in Wiring

Caution

- The grounding of FG terminal should be used with the 3rd class grounding for PLC.
  If not grounding, it may cause the malfunction.
- The wiring in PLC should be connected after confirming the rating voltage of the product and terminal layout.
- If connected to the different power from the rating or a wrong wiring, it may cause the fire or failure.
- In wiring, tighten the terminal screw with standard torque.
  If the terminal screw is loosened, it may cause the short circuit or malfunction.
- Cares should be taken not to put the wire remnants or foreign materials inside the module.

∘ Notices in Startup and Maintenance

Warning

- Do not touch the terminal in the state that the power is applied. It may cause the malfunction or electric shock.
- When cleaning or tightening the terminal screw, the power should be OFF.

Caution

- Do not remove PCB from the module case or remodel the module. It may cause the failure, malfunction, damage of the product or fire. The installation and removal of the module should be done after Power OFF.
- The change of battery should be done in the state of power ON.
  In case of changing in the power OFF, it may cause the loss of program.

∘ Notices in Disposal

Caution

- When the product is disposed, this should be treated as industry waste.

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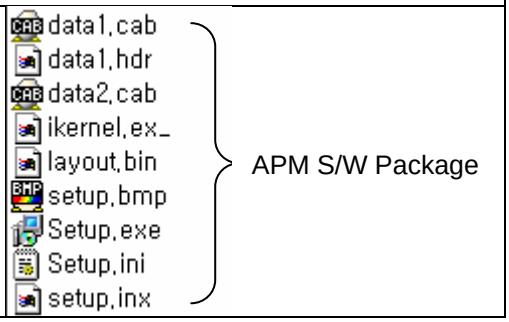
Chapter 1 Overview

This user's manual describes the standard of positioning module, installation method, the method to use each positioning function, programming and the wiring with external machine as below.

No. of Control Axis	Product Name		Related S/W Package
	Open Collector	Line Drive	
1 Axis	G4F-PP1O G6F-PP1O	G4F-PP1D G6F-PP1D	
2 Axis	G4F-PP2O G6F-PP2O	G4F-PP2D G6F-PP2D	
3 Axis	G4F-PP3O G6F-PP3O	G4F-PP3D G6F-PP3D	

G4F-PP1O,G4F-PP2O,G4F-PP3O,G4F-PP1D,G4F-PP2D,G4F-PP3D,G6F-PP1O,G6F-PP2O,G6F-PP3O, G6F-PP1D,G6F-PP2D,G6F-PP3D modules are described APM(advanced position module).

1.1 Characteristics

The features of positioning module is as follows :

1) The positioning module is available for GLOFA GM Series and MASTER-K Series.

2) Various positioning control function

It has various functions needed for positioning system such as positioning control at the random position, equal speed operation etc.

(1) The operation data including positioning address and operation method, operation pattern is available to set max. 400 at each axis.

With this operation data, the positioning at each axis is carried out.

(2/3 axis interpolation control and 2/3 axis simultaneous setting is available.)

(2) In case of positioning at each axis, the straight line control (3 axis simultaneous setting available) is available.

This control enables the single position control by one operation data and the continuous position control by plural operation data.

(3) In case of positioning more than 2 axis, speed control, interpolation control and circular arcs interpolation control of 2 axis are available.

(4) According to the control method designated by each operation data and parameter, there are position control, speed control, speed/position switching control, position/speed switching control.

(5) Abundant origin return control function.

(A) The method of origin return is shown as below and available to select one from 5 methods.

▶The origin detection after approximate origin OFF

▶The origin detection after deceleration in case of approximate origin ON

▶The origin detection by the origin and high-low limit

▶The origin detection by approximate origin

▶High speed origin detection

(B) Available to execute the positioning control (floating origin setting) from random position to the origin of machine.

(6) The Acceleration/Deceleration method contains trapezoid and S-type to select.

3) High speeding of setting process

Due to the realization of high speeding of positioning operation setting process, the setting process time reduced by 4ms~ 5ms.

Therefore, the delay time will not occur between axis in case of simultaneous setting (using several axis or during interpolation operation).

4) High speeding of pulse output and making a long-distance connection with driver

In case of using Line Drive type (G4F-PP1D, G4F-PP2D, G4F-PP3D, G6F-PP1D, G6F-PP2D, G6F-PP3D), it is available to realize the high speeding and making a long-distance connection.

5) Simplicity of maintenance

Various data such as positioning data, parameter etc. is saved in flash memory within positioning module.

6) The number of positioning module using in one base is not limited.

(but available to use within the range that satisfies the capacity of power module)

7) Self-diagnosis, monitoring, test by strong positioning software package is available.

(1) Diagnosis for I/O signal line

(2) Monitoring

(3) Tracking

(4) Simulation

(5) Detailed information and solution for each error is provided.

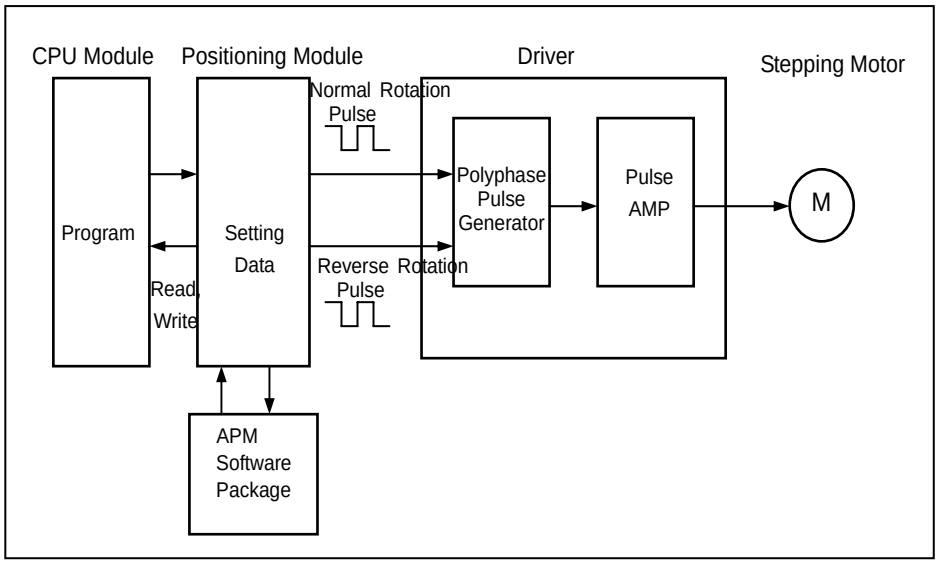
(6) Printer function in various ways is provided.

(7) Operation data editing of each axis is available in Excel program.

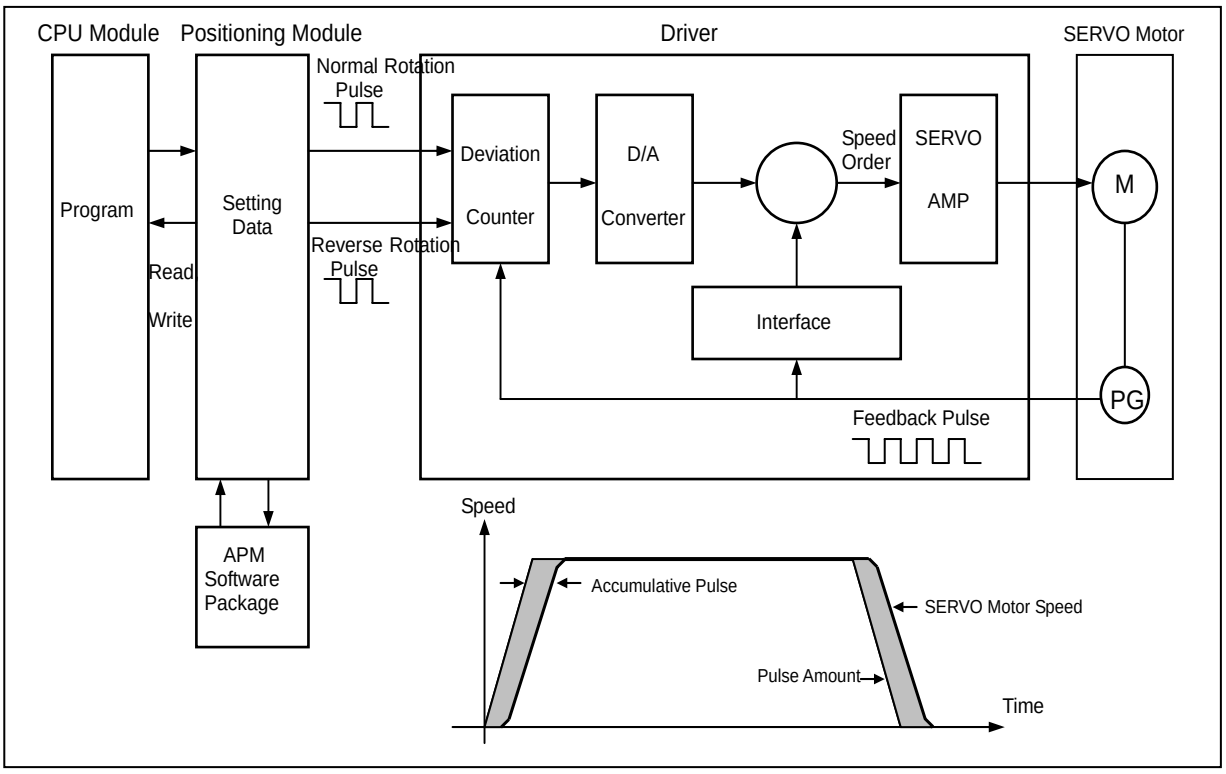
1.2 Purpose of Positioning Control

The purpose of positioning module is to transfer the moving objects (unprocessed items, tools etc.) by setting speed from the current position and stop them on the setting position correctly. And it also control the position of high precision by positioning pulse string signal as it is connected to various servo running devices or stepping motor control running devices.

In application, it can be used widely with engineering machine, semiconductor assembly machine, grinder, small machine center, lifter etc.



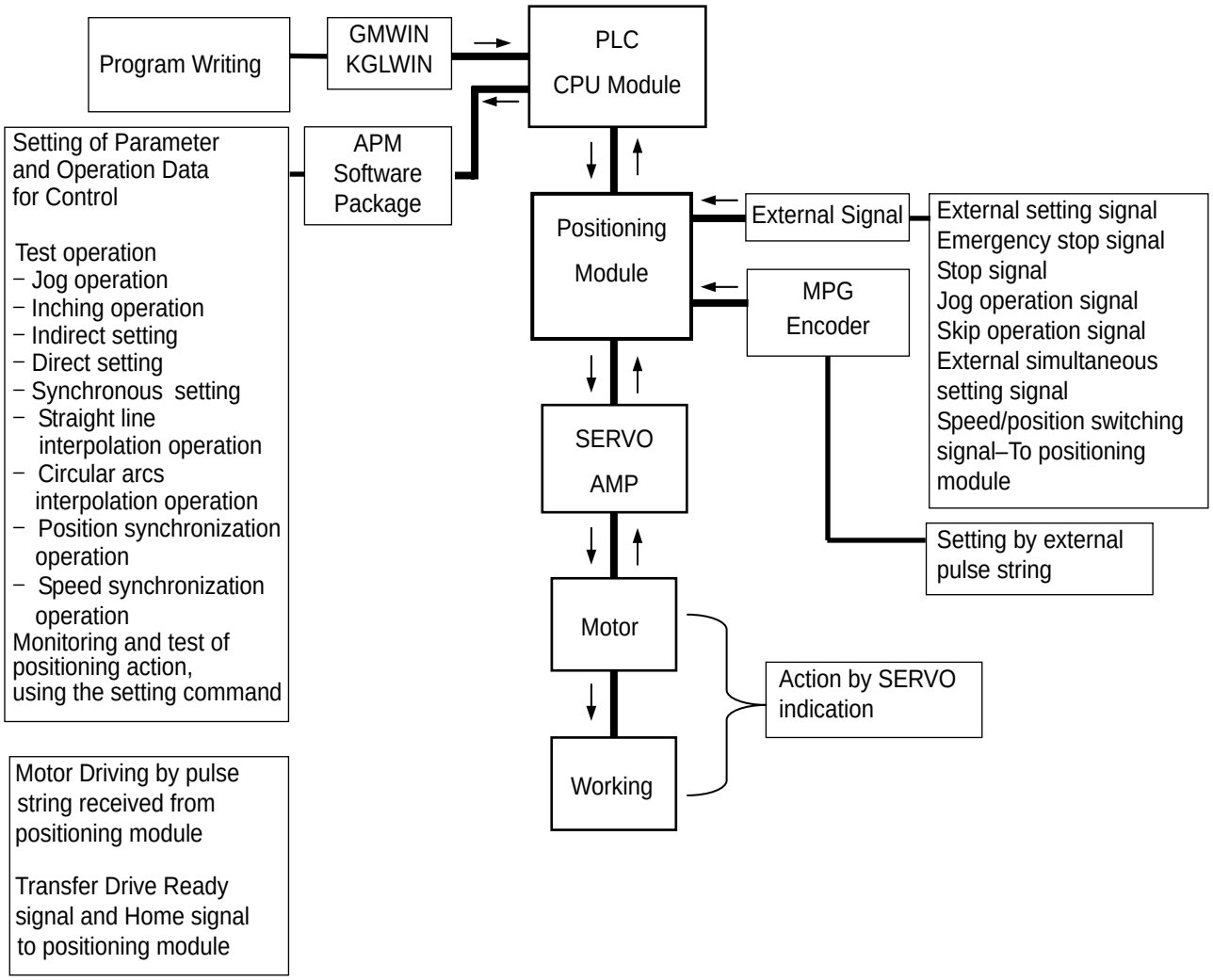
[Fig. 1-1] Overview of Position Control for Stepping Motor



[Fig. 1-2] Overview of Position Control for SERVO Motor

1.3 Signal Flow of Positioning Module

The flow of PLC system using the positioning module is as follows :



Point

1) When using GM4 CPUA,B module, ROM version should be more than V2.6 and GMWIN V3.6.
2) When using K300S CPUA module, ROM version should be more than V3.1 and KGL-WIN V3.3.
3) When using GM6 CPUA,B,C module, ROM version should be more than V2.0 and GMWIN V3.63
4) When using K200S CPUA,B,C module, ROM version should be more than V2.3 and KGL-WIN V3.3.

CHAPTER 2 Specification

2.1 General Specification

The General Specification for **GLOFA GM** series and **MASTER-K** series is shown on [Table 2-1].

<table>
<tr><th>No.</th><th>Items</th><th colspan="6">Specification</th><th>Reference</th></tr>
<tr><td>1</td><td>Use Temperature</td><td colspan="6">0 ~ 55 °C</td><td></td></tr>
<tr><td>2</td><td>Storage Temp.</td><td colspan="6">–25 ~ +70 °C</td><td></td></tr>
<tr><td>3</td><td>Use humidity</td><td colspan="6">5 ~ 95%RH, no dew</td><td></td></tr>
<tr><td>4</td><td>Storage humidity</td><td colspan="6">5 ~ 95%RH, no dew</td><td></td></tr>
<tr><td rowspan="9">5</td><td rowspan="9">Vibration-resistant</td><td colspan="4">In case of Intermittent vibration</td><td>-</td><td></td></tr>
<tr><td colspan="2">Frequency</td><td>Acceleration</td><td>Amplitude</td><td>Times</td><td rowspan="8">IEC61131-2</td></tr>
<tr><td colspan="2">10 ≤ f < 57Hz</td><td>–</td><td>0.075mm</td><td rowspan="6">X, Y, Z
10 times
each direction</td></tr>
<tr><td colspan="2">57 ≤ f ≤ 150Hz</td><td>9.8m/s^2{1G}</td><td>–</td></tr>
<tr><td colspan="4">In case of Continuous vibration</td></tr>
<tr><td colspan="2">Frequency</td><td>Acceleration</td><td>Amplitude</td></tr>
<tr><td colspan="2">10 ≤ f < 57Hz</td><td>–</td><td>0.035mm</td></tr>
<tr><td colspan="2">57 ≤ f ≤ 150Hz</td><td>4.9m/s^2{0.5G}</td><td>–</td></tr>
<tr><td>6</td><td>Impact-proof</td><td colspan="6">• Max. impact acceleration : 147 m/s^2{15G}
• Application time : 11ms
• pulse wave type : semi-sine wave pulse (3 times each direction X,Y,Z)</td><td>IEC61131-2</td></tr>
<tr><td rowspan="5">7</td><td rowspan="5">Noise-resistant</td><td>Square wave impulse noise</td><td colspan="4">± 1,500 V</td><td>LSIS standard</td></tr>
<tr><td>Electrostatic discharge</td><td colspan="4">Voltage : 4kV (Touch discharge)</td><td>IEC61131-2
IEC1000-4-2</td></tr>
<tr><td>Radiant electromagnetic field noise</td><td colspan="4">27 ~ 500 MHz, 10 V/m</td><td>IEC1131-2,
IEC1000-4-3</td></tr>
<tr><td rowspan="2">Fast transient / Bust noise</td><td>Classi-fication</td><td>Power module</td><td>Digital I/O (more than 24V)</td><td>Digital I/O (less than 24V)
Analog I/O
Communication interface</td><td rowspan="2">IEC1131-2
IEC1000-4-4</td></tr>
<tr><td>Voltage</td><td>2kV</td><td>1kV</td><td>0.25kV</td></tr>
<tr><td>8</td><td>Surrounding environment</td><td colspan="6">No corrosive gas, no dust</td><td></td></tr>
<tr><td>9</td><td>Use altitude</td><td colspan="6">Less than 2,000m</td><td></td></tr>
<tr><td>10</td><td>Pollution</td><td colspan="6">Less than 2</td><td></td></tr>
<tr><td>11</td><td>Cooling method</td><td colspan="6">Natural air-conditioning</td><td></td></tr>
</table>

Table 2.1 General Specification

Point

1) **IEC(International Electrotechnical Commission)**
: International civil community that promotes international cooperation for standardization of electric/electro technology, publishes international standard and operates suitability assessment system related to the above.

2) **Pollution Degree**
: An index to indicate the pollution degree of used environment that determines the insulation performance of the device. For example, pollution degree 2 means the state to occur the pollution of non-electric conductivity generally, but the state to occur temporary electric conduction according to the formation of dew.

2.2 Performance Specification

The Performance Specification for positioning module is shown on [Table 2-2].

<table>
<tr><th colspan="2">Items \ Model</th><th>G4F-PP1O,G4F-PP1D
G6F-PP1O,G6F-PP1D</th><th>G4F-PP2O,G4F-PP2D
G6F-PP2O,G6F-PP2D</th><th>G4F-PP3O,G4F-PP3D
G6F-PP3O,G6F-PP3D</th></tr>
<tr><td colspan="2">No. of control axis</td><td>1 axis</td><td>2 axis</td><td>3 axis</td></tr>
<tr><td colspan="2">Interpolation function</td><td>N/A</td><td>2 axis linear interpolation
2 axis circular arcs interpolation</td><td>2/3 axis linear interpolation
2 axis circular arcs interpolation</td></tr>
<tr><td colspan="2">Control method</td><td colspan="3">Position control, Speed control, Speed/Position control, Position/Speed control</td></tr>
<tr><td colspan="2">Control unit</td><td colspan="3">Pulse, ㎜, inch, degree</td></tr>
<tr><td colspan="2">Positioning data</td><td colspan="3">Each axis has 400 data range.(Operation step number 1 ~ 400)
Available to set with software package or program</td></tr>
<tr><td colspan="2">Software package</td><td colspan="3">Available (connected with RS-232C Port of CPU module)</td></tr>
<tr><td colspan="2">Back-up</td><td colspan="3">Save the parameter, operation data in Flash ROM (No Battery)</td></tr>
<tr><td rowspan="5">POSITIONING</td><td>Positioning method</td><td colspan="3">Absolute method/Relative method</td></tr>
<tr><td>Position address range</td><td colspan="3"><table><tr><th></th><th>Absolute method</th><th>Relative method</th><th>Speed/Position, Position/Speed Switching control</th></tr><tr><td>㎜</td><td>-214748364.8~ 214748364.7(㎛)</td><td>-214748364.8~ 214748364.7(㎛)</td><td>-214748364.8~ 214748364.7(㎛)</td></tr><tr><td>Inch</td><td>-21474.83648 ~ 21474.83647</td><td>-21474.83648 ~ 21474.83647</td><td>-21474.83648 ~ 21474.83647</td></tr><tr><td>degree</td><td>-21474.83648 ~ 21474.83647</td><td>-21474.83648 ~ 21474.83647</td><td>-21474.83648 ~ 21474.83647</td></tr><tr><td>pulse</td><td>-2147483648 ~ 2147483647</td><td>-2147483648 ~ 2147483647</td><td>-2147483648 ~ 2147483647</td></tr></table></td></tr>
<tr><td>Speed range</td><td colspan="3"><table><tr><th></th><th>Open collecor</th><th>Line driver</th></tr><tr><td>㎜</td><td colspan="2">0.01 ~ 20000000.00(㎜/min)</td></tr><tr><td>Inch</td><td colspan="2">0.001 ~ 2000000.000(Inch/min)</td></tr><tr><td>degree</td><td colspan="2">0.001 ~ 2000000.000(degree/min)</td></tr><tr><td>pulse</td><td>1 ~ 200,000(pulse/sec)</td><td>1 ~ 1,000,000(pulse/sec)</td></tr></table></td></tr>
<tr><td>Acceleration/decel-eration process</td><td colspan="3">Trapezoid type, S-type</td></tr>
<tr><td>Acceleration/decel-eration time</td><td colspan="3">1 ~ 65535 ㎳
Selection available from 4 types of acceleration/deceleration pattern</td></tr>
<tr><td colspan="2">Max. output pulse</td><td colspan="3">G4F-PP1O, G4F-PP2O, G4F-PP3O, G6F-PP1O, G6F-PP2O, G6F-PP3O : 200kpps
G4F-PP1D, G4F-PP2D, G4F-PP3D, G6F-PP1D, G6F-PP2D, G6F-PP3D : 1 Mpps</td></tr>
<tr><td colspan="2">Max. connection distance</td><td colspan="3">G4F-PP1O, G4F-PP2O, G4F-PP3O, G6F-PP1O, G6F-PP2O, G6F-PP3O : 2m
G4F-PP1D, G4F-PP2D, G4F-PP3D, G6F-PP1D, G6F-PP2D, G6F-PP3D : 10m</td></tr>
<tr><td colspan="2">Error indication</td><td colspan="3">Indicated by 17 segment indicator and LED(only G6F-PP□O, G6F-PP□D is indicated by LED)</td></tr>
<tr><td colspan="2">Max. Encoder input</td><td colspan="3">200kpps</td></tr>
<tr><td colspan="2">I/O indication</td><td colspan="3">Indicated by 17 segment indicator and LED(G4F-PP□O, G4F-PP□D)</td></tr>
<tr><td colspan="2">Connection connector</td><td colspan="3">40 Pin connector</td></tr>
<tr><td colspan="2">Size of use cable</td><td colspan="3">AWG #24</td></tr>
<tr><td colspan="2">I/O share point</td><td colspan="3">32 points</td></tr>
<tr><td colspan="2">Consumable current(㎃)</td><td>G4F-PP1O : 730
G4F-PP1D : 700
G6F-PP1O : 480
G6F-PP1D : 630</td><td>G4F-PP2O : 760
G4F-PP2D : 720
G6F-PP2O : 490
G6F-PP2D : 750</td><td>G4F-PP3O : 770
G4F-PP3D : 740
G6F-PP3O : 500
G6F-PP3D : 840</td></tr>
<tr><td colspan="2">Weight(g)</td><td>G4F-PP1□ : 310
G6F-PP1□ : 125</td><td>G4F-PP2□ : 325
G6F-PP2□ : 145</td><td>G4F-PP3□ : 330
G6F-PP3□ : 151</td></tr>
</table>

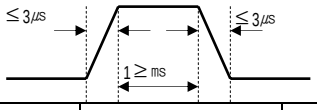
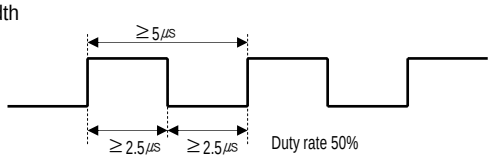
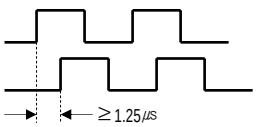
Table 2.2 Performance Specification

※ **G4F-PP□O, G6F-PP□O :** Pulse output is Open Collector type and □ shows the number of axis.
G4F-PP□D, G6F-PP□D : Pulse output is Line Driver type and □ shows the number of axis.

2.3 External Interface I/O Specification

Here describes the I/O interface with external equipment.

2.3.1 Input Specification

Signal name	Rated input voltage/curret	Use voltage range	On voltage/current	Off voltage/current	Input resistance	Response time
Approximate origin	DC 24V/4.7㎃	DC 20.4～26.4V	≥DC 16V/3.1㎃	≤DC 4V/1.0㎃	Approx. 5.1㏀	≤0.1㎳
External high-limit	DC 24V/4.7㎃	DC 20.4～26.4V	≥DC 16V/3.1㎃	≤DC 4V/1.0㎃	Approx. 5.1㏀	≤0.1㎳
External low-limit	DC 24V/4.7㎃	DC 20.4～26.4V	≥DC 16V/3.1㎃	≤DC 4V/1.0㎃	Approx. 5.1㏀	≤0.1㎳
Emergency stop	DC 24V/4.7㎃	DC 20.4～26.4V	≥DC 16V/3.1㎃	≤DC 4V/1.0㎃	Approx. 5.1㏀	≤0.5㎳
External stop	DC 24V/4.7㎃	DC 20.4～26.4V	≥DC 16V/3.1㎃	≤DC 4V/1.0㎃	Approx. 5.1㏀	≤0.1㎳
External command	DC 24V/4.7㎃	DC 20.4～26.4V	≥DC 16V/3.1㎃	≤DC 4V/1.0㎃	Approx. 5.1㏀	≤0.1㎳
Jog reverse operation	DC 24V/4.7㎃	DC 20.4～26.4V	≥DC 16V/3.1㎃	≤DC 4V/1.0㎃	Approx. 5.1㏀	≤0.1㎳
Drive Ready	DC 24V/4.7㎃	DC 20.4～26.4V	≥DC 16V/3.1㎃	≤DC 4V/1.0㎃	Approx. 5.1㏀	≤0.1㎳
External simultaneous start	DC 24V/4.7㎃	DC 20.4～26.4V	≥DC 16V/3.1㎃	≤DC 4V/1.0㎃	Approx. 5.1㏀	≤0.5㎳
Origin	DC 24V/8.9㎃	DC 20.4～26.4V	≥DC 16V/6.0㎃	≤DC 4V/1.6㎃	Approx. 2.7㏀	On: ≤0.4㎳
	DC 5V/8.9㎃	DC 4.25～5.5 V	≥DC 2.5V/6.0㎃	≤DC 1V/1.9㎃	Approx. 570Ω	On: ≤0.4㎳
						
Manual pulse generator / Encoder input	DC 5V/7.0㎃	DC 4.25～5.5 V	≥DC 2.5V/3.0㎃	≤DC 1V/1.0㎃	Approx. 940Ω	≤0.6㎳
	Encoder input : based on RS-422A Line Driver Level (Am26LS31)					
	1) Pulse width  2) Phase difference  If A phase input pulse precedes B phase input pulse, the position address value increases. If B phase input pulse precedes A phase input pulse, the position address value decreases.					
Speed/Position switching signal	DC 24V/4.7㎃	DC 20.4～26.4V	≥DC 16V/3.1㎃	≤DC 4V/1.0㎃	Approx.5.1㏀	≤O.1㎳

2.3.2 Output Specification

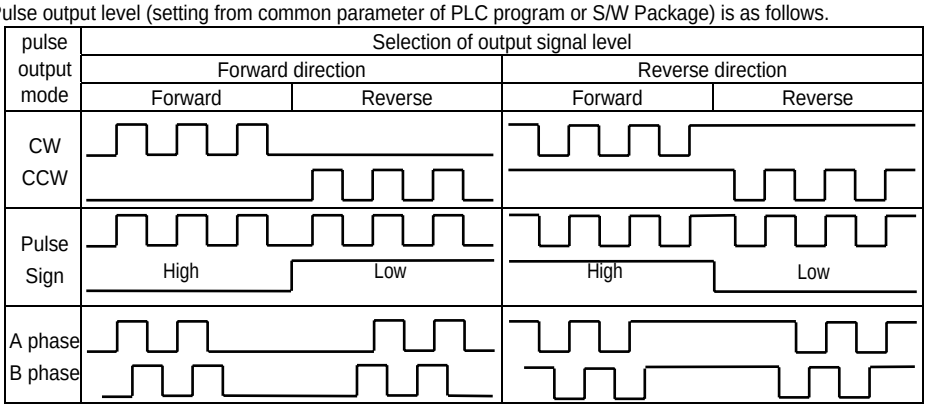
1) Pulse Output Specification

Signal Name	Rated load voltage	Use load voltage range	Max. load current / Inrush current	Max. voltage falling (ON)	Leakage current (OFF)	Response Time
Pulse Output (CW/Pulse/A phase) Pulse Sign (CCW/Sign/B phase)	DC 5~24V	DC 4.75~26.4V	50㎃(1 point) / ≤200㎃ 10㎳	≤DC 0.5V	≤0.1㎃	-

▷Differential Line Drive based on Am26C31(only Line Drive pulse output type)

▷CW/CCW type, Pulse/Sign type, A phase/B phase type can be selected from pulse output mode of basic parameter for program and S/W Package.

▷The relation of Pulse output mode (setting from basic parameter of PLC program or S/W Package), Pulse output direction (setting from expansion parameter of PLC program or S/W Package) and Pulse output level (setting from common parameter of PLC program or S/W Package) is as follows.



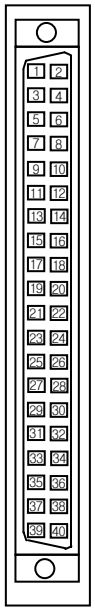
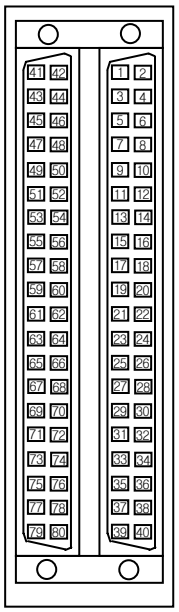
2) Transistor Output Specification_Sink type(Zone output)

Items		Specification
Isolation method		Photo Coupler Isolation
Rated load voltage		DC 24V
Voltage range of use load		DC 20.4 ~ 26.4V
Max. load current		100 ㎃
Leakage current when OFF		Less than 0.1 mA
Max. Inrush current		Less than 0.4 A / 10 ms
Max. voltage falling when ON		DC 1.0 V
Response time	Off → On	Less than 2 ms
	On → Off	Less than 2 ms
Common method		3points / 1 COM
Action indication		LED indication

※ Not available for G6F-PP□O, G6F-PP□D.

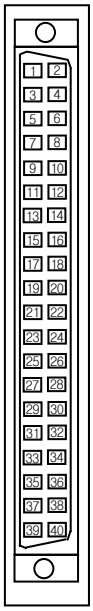
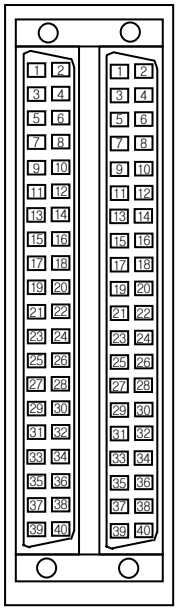
2.3.3 I/O Interface with External Equipment

1) Pin layout of connector(G4F-PP□O, G4F-PP□D)

Pin layout	Classification	Pin no. X axis	Pin no. Y axis	Pin no. Z axis	Signal Name		Signal direction positioning -external	Action condition
 1 axis	FUNCTION per AXIS	21	41	61	FP+	Pulse output (differential +)	→	
		22	42	62	FP-	Pulse output (differential -)	→	
		23	43	63	RP+	Pulse sign (differential +)	→	
		24	44	64	RP-	Pulse sign (differential -)	→	
		25	45	65	OV+※1	High limit	←	
		26	46	66	OV-※1	Low limit	←	
		27	47	67	STOP	External stop signal	←	
		28	48	68	DOG	Approximate origin	←	
		29	49	69	VTP	Speed/Position switching signal	←	
		30	50	70	ECMD	External command signal: Start	←	
						External command signal: Skip	←	
						External command signal: JOG+(Forward)	←	
		31	51	71	JOG-	JOG reverse opration	←	
		32	52	72	COM	Common (OV+,OV-STOP,DOG,VTP,ECMD,JOG-)	⇔	
		33	53	73	DRVIN※1	Drive Unit Ready signal	←	
		34	54	74	DRVIN COM	Drive Unit Ready signal Common	⇔	
 2/3 axis		35	55	75	HOME +24V	Zero signal (+24V)	←	
		36	56	76	NC	No use		
		37	57	77	HOME +5V	Zero signal (+5V)	←	
		38	58	78	HOME COM	Zero signal(+24V, +5V) Common	⇔	
		39	59	79	NC	No use		
		40	60	80	NC	No use		
	COMMON FUNCTION	1			MPG A+	Manual pulse generator/Encoder A+ input	←	
		2			MPG A-	Manual pulse generator/Encoder A- input	←	
		3			MPG B+	Manual pulse generator/Encoder B+ input	←	
		4			MPG B-	Manual pulse generator/Encoder B- input	←	
		5			MPG Z+	Encoder Z+ input	←	
		6			MPG Z-	Encoder Z- input	←	
		7			CON	External simultaneous start	←	
		8			EMG※1	Emergency stop	←	
		9			NC	No use		
		10			COM	(CON, EMG)Common	⇔	
		11			Out 1	Transistor output of Zone 1	→	
		12			Out 2	Transistor output of Zone 2	→	
		13			Out 3	Transistor output of Zone 3	→	
		14			COM	ZONE Common	⇔	
		15,16,17, 18,19,20			NC	No use		

※1 : High/low limit, drive Unit Ready signal, emergency stop signal should be connected to DC24V.

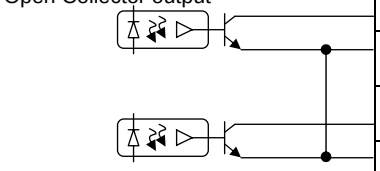
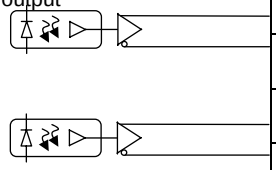
2) Pin layout of connector(G6F-PP□O, G6F-PP□D)

Pin layout	Classification	Pin no. X axis	Pin no. Y axis	Pin no. Z axis	Signal Name			Signal direction positioning -external	Action condition
 1 axis	FUNCTION per AXIS	21A	1B	21B	FP+	Pulse output (differential +)		→	
		22A	2B	22B	FP-	Pulse output (differential -)		→	
		23A	3B	23B	RP+	Pulse sign (differential +)		→	
		24A	4B	24B	RP-	Pulse sign (differential -)		→	
		25A	5B	25B	OV+※1	High limit		←	
		26A	6B	26B	OV-※1	Low limit		←	
		27A	7B	27B	STOP	External stop signal		←	
		28A	8B	28B	DOG	Approximate origin		←	
		29A	9B	29B	VTP	Speed/Position switching signal		←	
		30A	10B	30B	ECMD	External command signal	Start	←	
							Skip	←	
							JOG+(Forward)	←	
		31A	11B	31B	JOG-	JOG reverse operation		←	
		32A	12B	32B	COM	Common (OV+,OV-STOP,DOG,VTP,ECMD,JOG-)		↔	
		33A	13B	33B	DRVIN※1	Drive Unit Ready signal		←	
		34A	14B	34B	DRVIN COM	Drive Unit Ready signal Common		↔	
A B  2/3 axis		35A	15B	35B	HOME +24V	Zero signal (+24V)		←	
		36A	16B	36B	HOME COM	Zero signal(+24V, +5V) Common			
		37A	17B	37B	HOME +5V	Zero signal (+5V)		←	
		38A	18B	38B	P COM	External 5V, 24V GND (no use in case of Line drive output)		↔	
		39A	19B	39B	5V	External 5V Power Input (no use in case of Line drive output)		←	
		40A	20B	40B	24V	External 24V Power Input (no use in case of Line drive output)		←	
	COMMON FUNCTION	1A			MPG A+	Manual pulse generator/Encoder A+ input		←	
		2A			MPG A-	Manual pulse generator/Encoder A- input		←	
		3A			MPG B+	Manual pulse generator/Encoder B+ input		←	
		4A			MPG B-	Manual pulse generator/Encoder B- input		←	
		5A			NC	No use			
		6A			NC	No use			
		7A			CON	External simultaneous start (no use in case of 1 axis APM)		←	
		8A			EMG※1	Emergency stop		←	
		9A			NC	No use			
		10A			COM	(CON, EMG)Common		↔	
		11A, 12A, 13A, 14A, 15A, 16A, 17A, 18A, 19A, 20A			NC	No use			

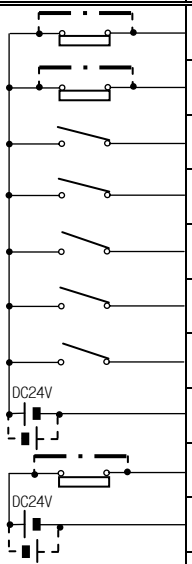
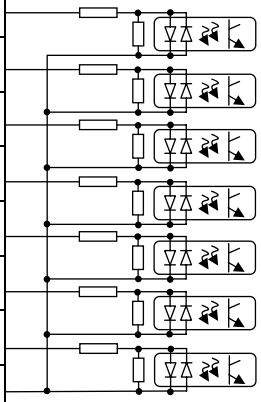
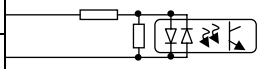
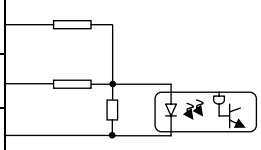
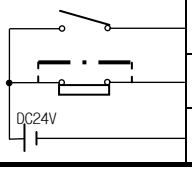
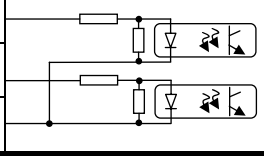
※1 : High/low limit, drive Unit Ready signal, emergency stop signal should be connected to DC24V.

3) Internal circuit of connector(G4F-PP□O, G4F-PP□D)

(1) Pulse output

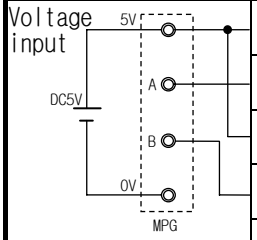
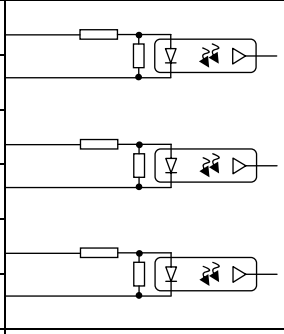
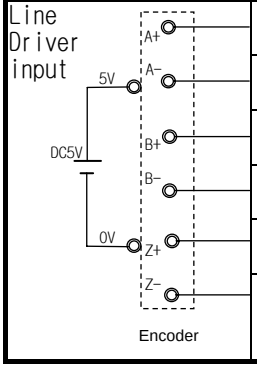
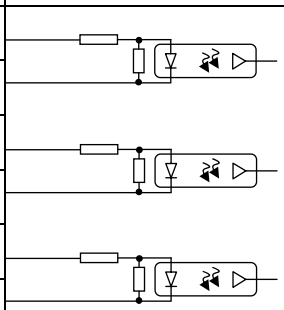
Internal circuit	Pin no. X	Pin no. Y	Pin no. Z	Signal	
Open Collector output 	21	41	61	FP+	Pulse F(CW/Pulse/A phase)
	22	42	62	FP-	Pulse COM(CW/Pulse/A phase)
	23	43	63	RP+	Pulse F(CCW/Sign/B phase)
	24	44	64	RP-	Pulse COM(CCW/Sign/B phase)
Line Drive output 	21	41	61	FP+	Pulse F+(CW/Pulse/A phase)
	22	42	62	FP-	Pulse F-(CW/Pulse/A phase)
	23	43	63	RP+	Pulse R+(CW/Pulse/A phase)
	24	44	64	RP-	Pulse R-(CW/Pulse/A phase)

(2) Input signal

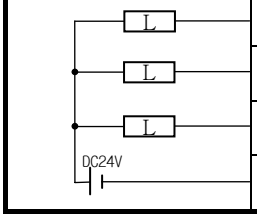
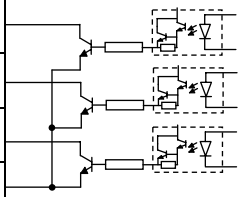
Classification	Pin no. X	Pin no. Y	Pin no. Z	Internal circuit	Signal	
	25	45	65		OV+※1	High limit(B contact)
	26	46	66		OV-※1	Low limit(B contact)
	27	47	67		STOP	External stop signal
	28	48	68		DOG	Approximate origin
	29	49	69		VTP	Speed/Position switching signal
	30	50	70		ECMD	External command signal
	31	51	71		JOG-	Reverse jog operation
	32	52	72		COM	Common (OV+,OV-,STOP,DOG,VTP,ECMD,JOG-)
	33	53	73		DRVIN※1	drive Unit Ready signal
	34	54	74		DRVIN COM	drive Unit Ready signal Common
	35	55	75		HOME +24V	Zero signal (+24V)
Wiring path without using the signal	37	57	77		HOME +5V	Zero signal (+5V)
	38	58	78		HOME COM	HOME(+24V, +5V) Common
	7				CON	External simultaneous start
	8				EMG※1	Emergency stop(B contact)
	10				COM	(CON, EMG)Common

※1 : High/Low limit, drive Unit Ready signal, emergency stop signal should be connected to DC24V.

(3) Manual pulse generator input/Encoder input

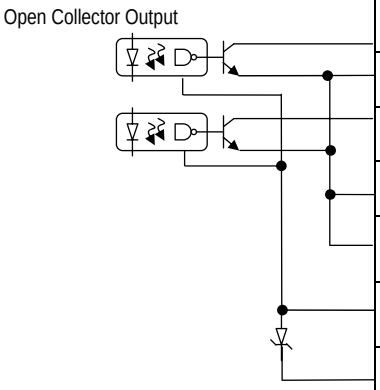
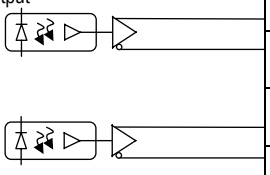
Classification	Pin no.	Internal circuit	Signal	
	1		MPG A+	Manual pulse generator A+ input
	2		MPG A-	Manual pulse generator A- input
	3		MPG B+	Manual pulse generator B+ input
	4		MPG B-	Manual pulse generator B- input
	5		MPG Z+	Encoder Z+ input
	6		MPG Z-	Encoder Z- input
	1		MPG A+	Encoder A+ input
	2		MPG A-	Encoder A- input
	3		MPG B+	Encoder B+ input
	4		MPG B-	Encoder B- input
	5		MPG Z+	Encoder Z+ input
	6		MPG Z-	Encoder Z- input

(4) Transistor Output

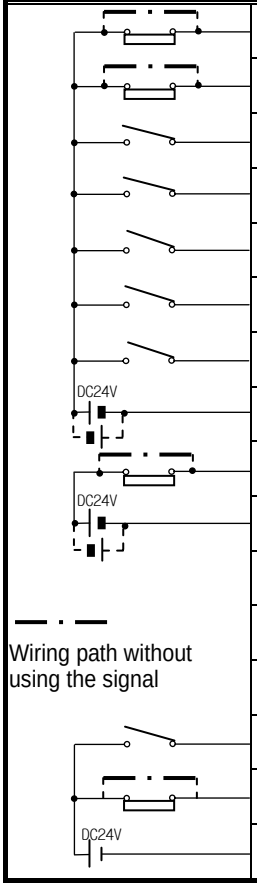
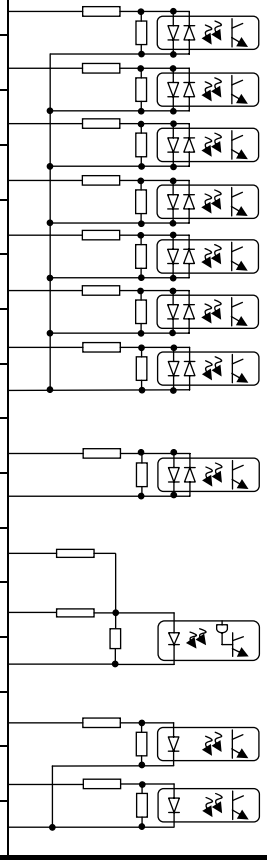
Classification	Pin no.	Internal circuit	Signal	
	11		Out1	Transistor output of Zone 0
	12		Out2	Transistor output of Zone 1
	13		Out3	Transistor output of Zone 2
	14		COM	Out1, Out2, Out3 Common

4) Internal circuit of connector(G6F-PP□O, G6F-PP□D)

(1) Pulse output

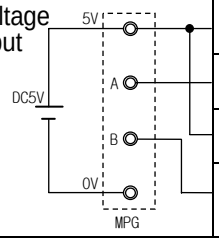
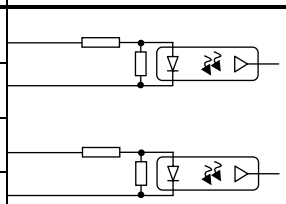
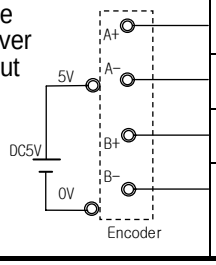
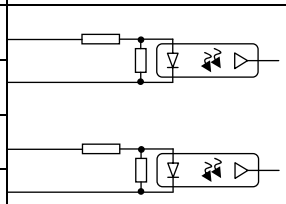
Internal circuit	Pin no.			Signal	
	X	Y	Z		
Open Collector Output 	21A	1B	21B	FP+	Pulse F(CW/Pulse/A phase)
	22A	2B	22B	FP-	Pulse COM(CW/Pulse/A phase)
	23A	3B	23B	RP+	Pulse F(CCW/Sign/B phase)
	24A	4B	24B	RP-	Pulse COM(CCW/Sign/B phase)
	38A	18B	38B	P COM	External 5V, 24V GND (G6F-PP□D is not used)
	39A	19B	39B	5V	External 5V Power Input (G6F-PP□D is not used)
	40A	20B	40B	24V	External 24V Power Input (G6F-PP□D is not used)
Line Drive Output 	21A	1B	21B	FP+	Pulse F+(CW/Pulse/A phase)
	22A	2B	22B	FP-	Pulse F-(CW/Pulse/A phase)
	23A	3B	23B	RP+	Pulse R+(CW/Pulse/A phase)
	24A	4B	24B	RP-	Pulse R-(CW/Pulse/A phase)

(2) Input signal

Classification	Pin no.			Internal circuit	Signal	
	X	Y	Z			
	25A	5B	25B		OV+※1	High limit(B contact)
	26A	6B	26B		OV-※1	Low limit(B contact)
	27A	7B	27B		STOP	External stop signal
	28A	8B	28B		DOG	Approximate origin
	29A	9B	29B		VTP	Speed/Position switching signal
	30A	10B	30B		ECMD	External command signal
	31A	11B	31B		JOG-	Reverse jog operation
	32A	12B	32B		COM	Common (OV+,OV-,STOP,DOG,VTP,ECMD,JOG-)
	33A	13B	33B		DRVIN※1	drive Unit Ready signal
	34A	14B	34B		DRVIN COM	drive Unit Ready signal Common
	35A	15B	35B		HOME +24V	Zero signal (+24V)
	37A	17B	37B		HOME +5V	Zero signal (+5V)
	36A	16B	36B		HOME COM	HOME(+24V, +5V) Common
	7A				CON	External simultaneous start
	8A				EMG※1	Emergency stop(B contact)
	10A				COM	(CON, EMG)Common

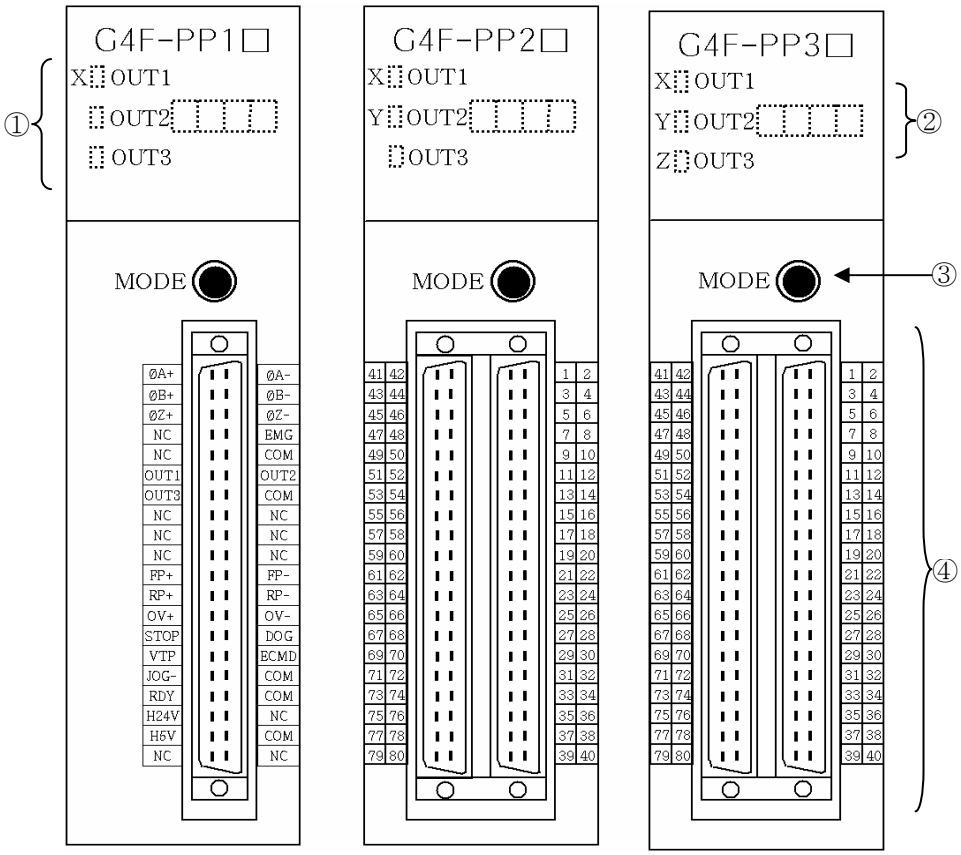
※1 : High/Low limit, drive Unit Ready signal, emergency stop signal should be connected to DC24V.

(3) Manual pulse generator input/Encoder input

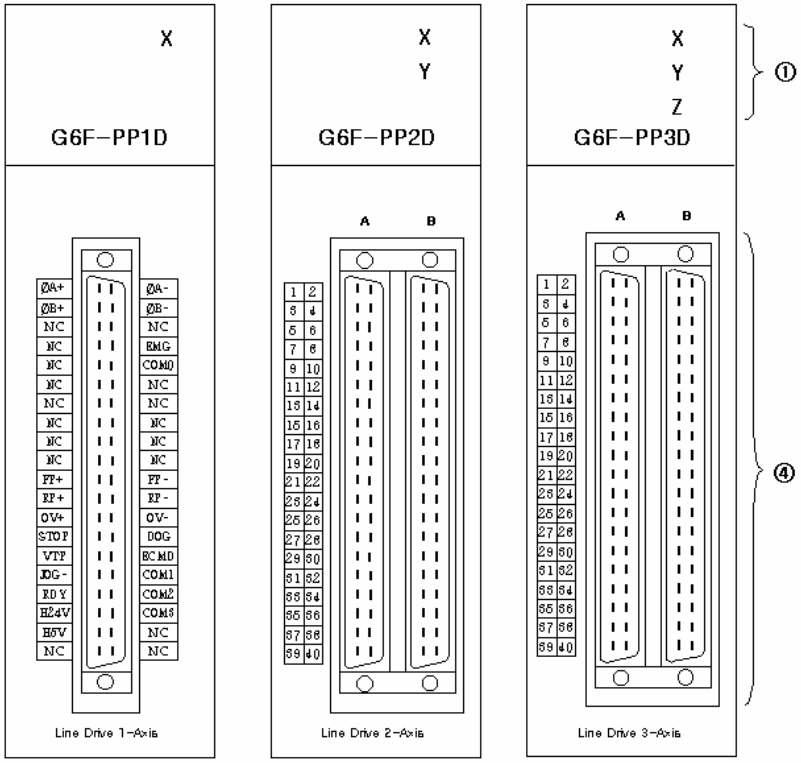
Classification	Pin no.	Internal circuit	Signal	
Voltage input 	1A		MPG A+	Manual pulse generator A+ input
	2A		MPG A-	Manual pulse generator A- input
	3A		MPG B+	Manual pulse generator B+ input
	4A		MPG B-	Manual pulse generator B- input
Line Driver input 	1A		MPG A+	Encoder A+ input
	2A		MPG A-	Encoder A- input
	3A		MPG B+	Encoder B+ input
	4A		MPG B-	Encoder B- input

2.4 The Name and Function of each Section

1) G4F-PP□O, G4F-PP□D

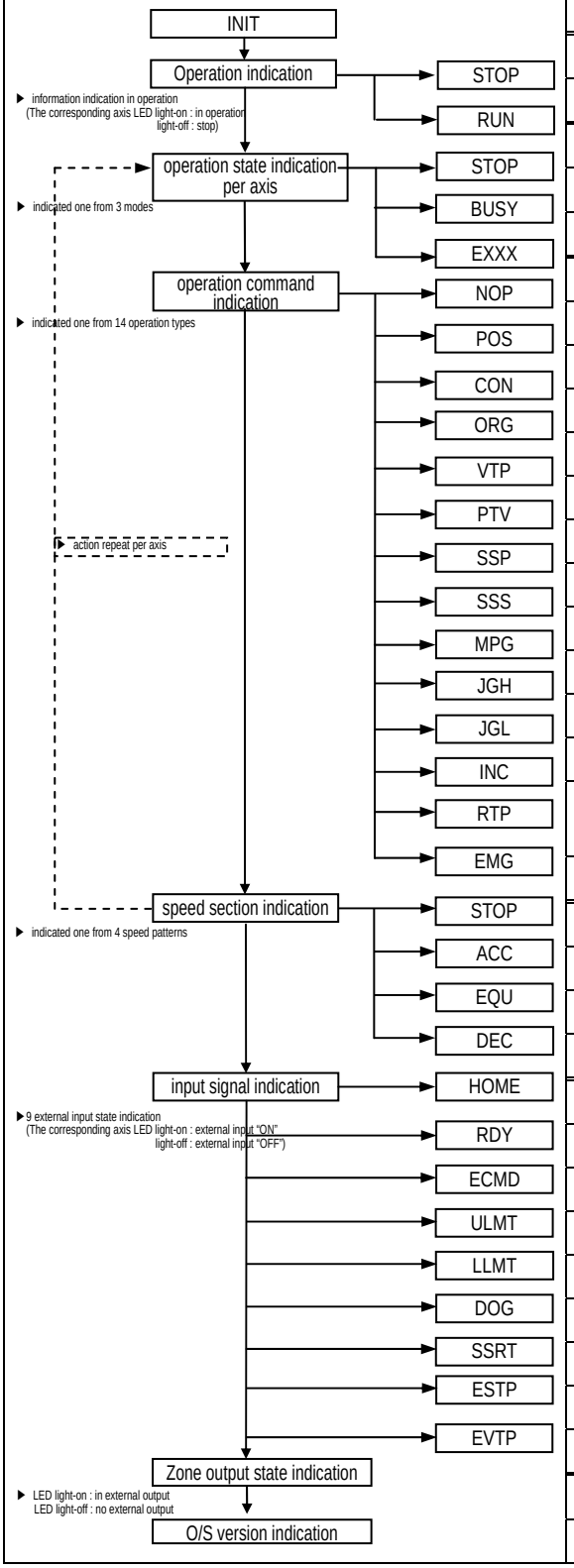


2) G6F-PP□O, G6F-PP□D



No.	Name	Description
①	Operation indication LED	1. Operation indication ▶Light-On: In operation of the corresponding axis ▶Light-Off: When the corresponding axis stops 2. Error indication ▶Light-On : In normal operation ▶Blink: Error of the corresponding axis
②	Operation information indicator	▶STOP : Operation stop ▶RUN :Nnormal operation ▶EXXX : Indication of error no. XXX (At this time, operation indication LED of the axis where the error occurred begins to blink.)
③	Mode switch	Selected the information of operation information indicator ▶The information of operation information indicator will be changed at each press.
④	External wiring connector	Connector to connect with drive machine, machine field input, manual pulse generator etc.

3) Relation of Operation information indicator and Mode switch



Mode switch	Operation information indicator	Description
	INIT	Self diagnosis indication when power ON
	STOP	Waiting state for operation
	RUN	In operation
	STOP	Waiting state for operation
	BUSY	In operation
	EXXX	Error no. indication
	NOP	Operation stop
	POS	1 axis position control operation
	CON	Simultaneous start operation
	ORG	Origin return operation
	VTP	Speed/Position conversion operation
	PTV	Position/Speed conversion operation
	SSP	Position synchronous start
	SSS	Speed synchronous start
	MPG	Manual pulse operation
	JGH	Jog high speed operation
	JGL	Jog low speed operation
	INC	Inching operation
	RTP	Return to the position before manual operation
	EMG	Emergency stop
	STOP	Operation stop
	ACC	Accelerating operation
	EQU	Equal speed operation
	DEC	Decelerating operation
	HOME	Home signal input
	RDY	Driver Ready signal input
	ECMD	External command signal input
	ULMT	Upper Limit signal input
	LLMT	Lower Limit signal input
	DOG	Dog signal input
	SSRT	External simultaneous start signal input
	ESTP	External stop signal input
	EVTP	External VTP signal input
	ZONE	ZONE output
	VX.X	Version information

Chapter 3 Function

3.1 Positioning Control

Positioning Control includes position control, interpolation control, speed control, speed/position conversion control, position/speed conversion control.

3.1.1 Position Control

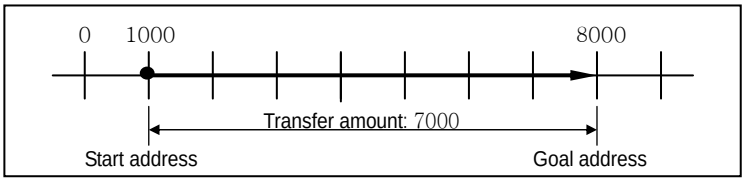
Positioning control from start address (present stop position) to goal address (transfer amount) for the assigned axis.

1) Control by Absolute method (Absolute coordinate)

(1) Positioning control from start address to goal address (the address assigned by positioning data).
(2) Positioning control is carried out based on the address assigned (origin address) by homing.
(3) Transfer direction shall be determined by start address and goal address.
▶Start address < Goal address : normal direction positioning
▶Start address > Goal address : reverse direction positioning

[Example]

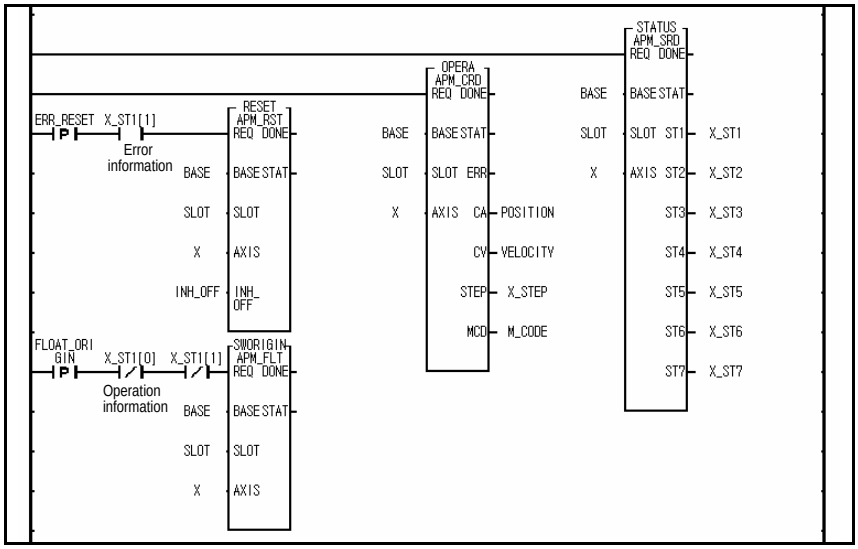
▷When Start address : 1000, ▷Goal address : 8000, this will be normal direction and transfer amount shall be 7000 (7000=8000-1000).



▷Software Package setting

Items of position data	Step No.	Coordinate	Control method	Operation pattern	Operation method	Goal position [pulse]	Circular interpolation aux. Point [pulse]	M code	Acce./ dece. No.	Operation speed [pls/s]	Dwell time [ms]	Circular interpolation direction
Setting	1	Absolute	Position control	End	Single	8000	0	0	1	100	0	CW

▷Program



Program 3.1 Basic(Floating point setting)

Point

▶**A control by Absolute method (Absolute coordinate)** shall start only in the state that the origin is determined.
▶If starting without determining the origin, error 234 will occur.

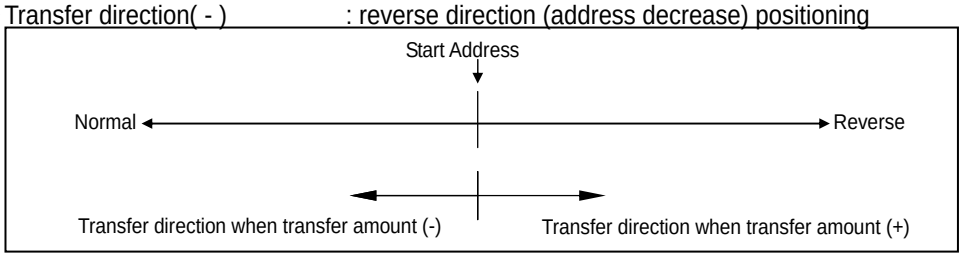
2) Control by Incremental method (Relative coordinate)

(1) Positioning control as much as the goal transfer amount from start address.

(2) Transfer direction shall be determined by the sign of transfer amount.

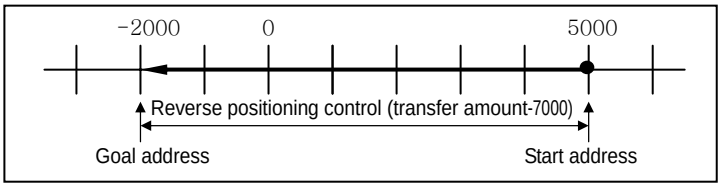
▷Transfer direction (+) or no sign : normal direction (address increase) positioning

▷Transfer direction(-) : reverse direction (address decrease) positioning



[Example]

▷When Start address : 5000, ▷Goal address : -7000, this will be reverse direction and positioning will be at the point of –2000.



▷ Software Package Setting

Items of position data	Step No.	Coordinate	Control method	Operation pattern	Operation method	Goal position [pulse]	Circular interpolation aux. Point [pulse]	M code	Acce./ dece. No.	Operation speed [pls/s]	Dwell time [㎳]	Circular interpolation direction
Setting	1	Incremental	Position control	End	Single	-7000	0	0	1	100	0	CW

▷Program

Same as Program 3.1.

3.1.2 Interpolation Control

1) 2 axis linear interpolation control

This carries out Linear interpolation control at the start address (present stop position) using the 2 assigned axis.

The available axis combinations for interpolation control are 3 types : X and Y, X and Z , and Y and Z.

(1) Control by Absolute method (Absolute coordinate)

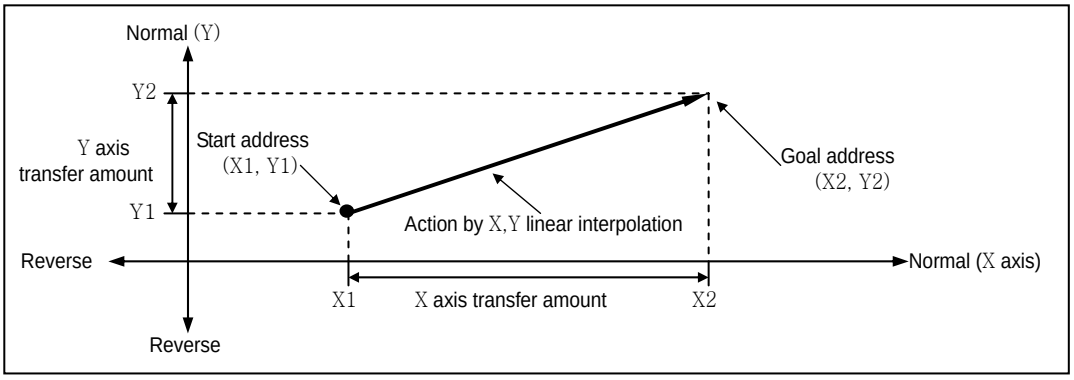
A) This carries out the linear interpolation by 2 axis from Start address to Goal address (the address assigned by positioning data).

B) Positioning control is carried out based on the address assigned by homing.

C) Transfer direction shall be determined by Start address and Goal address of each axis.

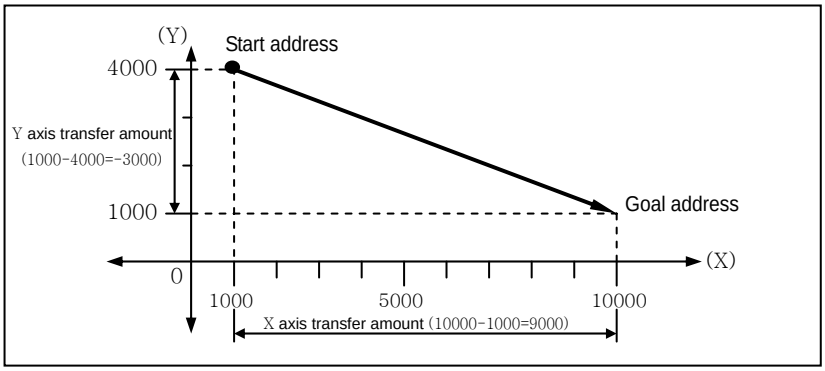
▶Start address < Goal address : normal direction positioning

▶Start address > Goal address : reverse direction positioning



[Example]

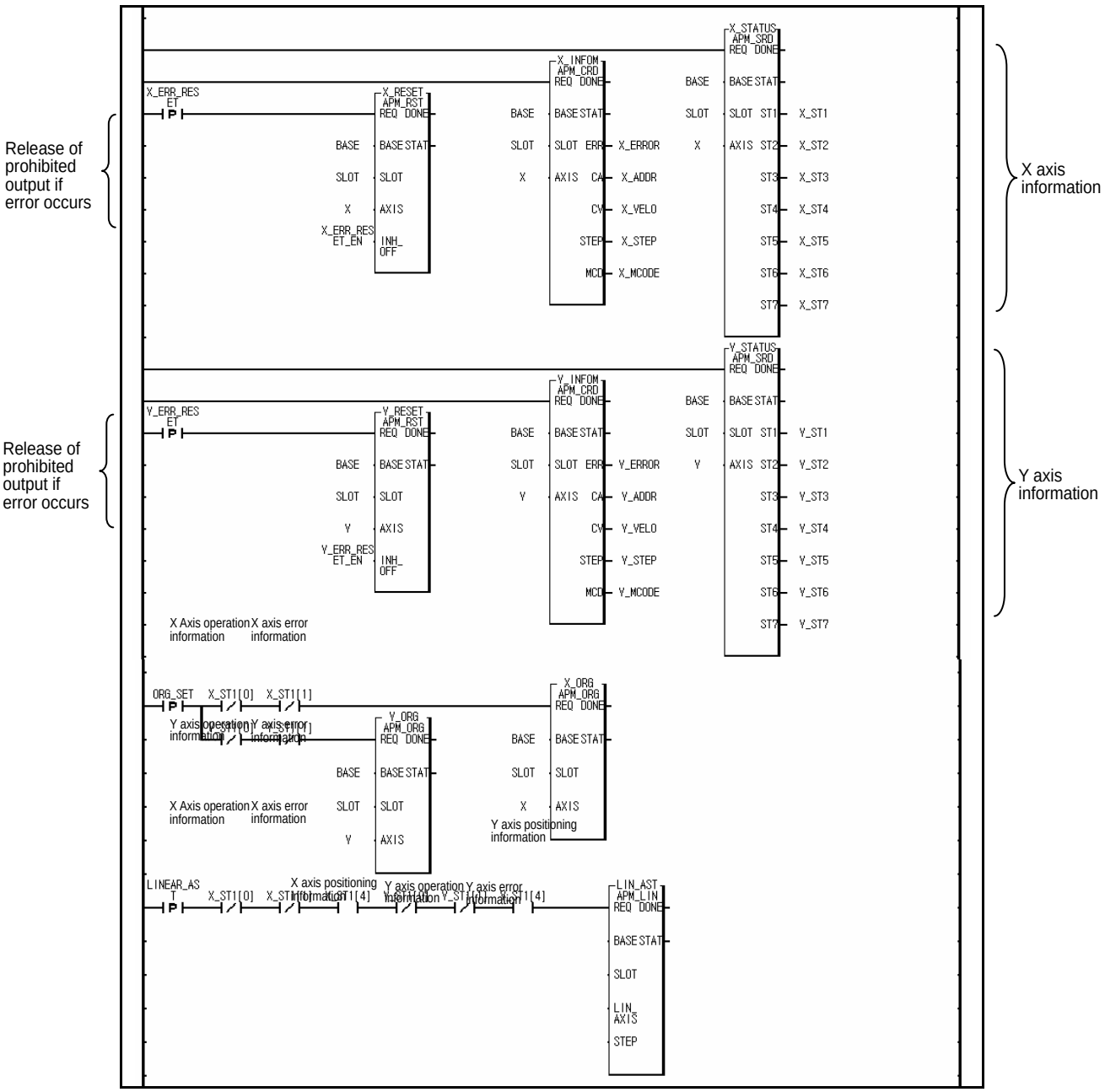
▷When Start address (1000, 4000), ▷Goal address (10000, 1000), the action is as follows.



▷ Software Package Setting

Items of position data	Step No.	Coordinate	Control method	Operation pattern	Operation method	Goal position [pulse]	Circular interpolation aux. Point [pulse]	M code	Acce./ dece. No.	Operation speed [pls/s]	Dwell time [ms]	Circular interpolation direction
X Setting	1	Absolute	Position control	End	Single	10000	0	0	1	100	0	CW
Y Setting	1	Absolute	Position control	End	Single	1000	0	0	1	100	0	CW

▷Program



Program 3.2 Basic (Linear interpolation)

Point

As at the linear interpolation start, 2 or 3 axis act synchronously, cares should be taken in using.

1) The available operation pattern is End, Go-on and operation method is Single, Repeat.
If set as Continuous, it shall be processed as End.

2) The available auxiliary operation is as follows.
Speed override, Stop, Emergency stop, Skip, Zone output permitted,

3) The command that is not used at the linear interpolation operation is as follows.
Position/Speed switching control, Position override, Continuous operation, Position/Speed override.

4) The auxiliary data related to the operation that acts based on the main axis during linear interpolation operation is as follows.
Operation method, operation pattern, Speed limit, Dwell time,

5) The main and subordinate axis shall be determined by the positioning address amount of operation step.
(1) main axis : the axis whose positioning address amount of the corresponding operation step number is bigger among X, Y, Z axis.
(2) subordinate axis : the axis whose positioning address amount of the corresponding operation step number is smaller among X, Y, Z axis. ; At this time, the speed, acceleration/deceleration time, bias speed of the subordinate axis shall be recalculated.

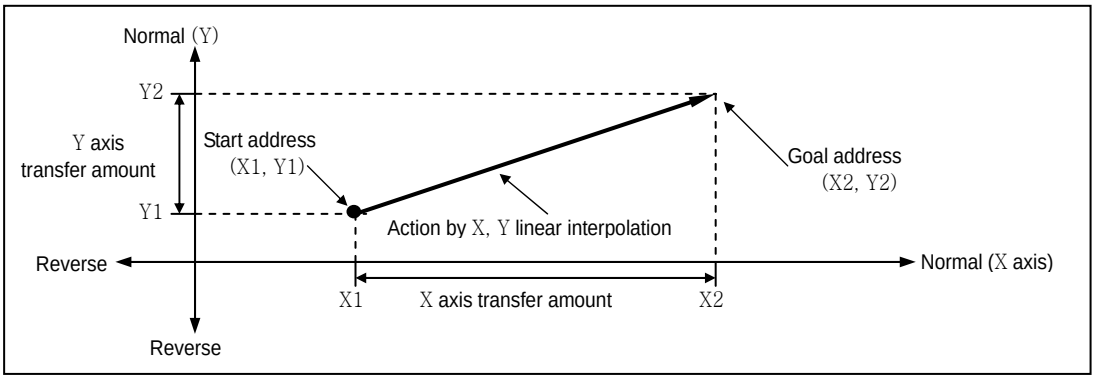
6) The items that acts based on the setting value of each axis are as follows.
; Backlash compensation amount, Software high limit, Software low limit, Position pass time, Zone setting area among the items of parameter

(2) Control by Incremental method (Relative coordinate)

A) Positioning control from start address to the position including goal transfer direction and transfer amount of each axis.

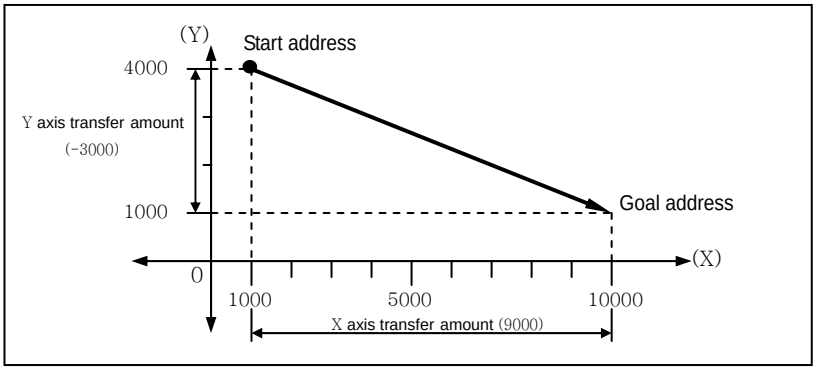
B) Transfer direction shall be determined by the sign of transfer amount of each axis.

- Transfer amount (+) or no sign : normal direction (address increase) positioning
- Transfer amount (-) : reverse direction (address decrease) positioning



[Example]

▷When Start address (1000, 4000), ▷Goal address (9000, -3000), the action is as follows.



▷Software Package Setting

Items of position data	Step no.	Coordinate	Control method	Operation pattern	Operation method	Goal position [pulse]	Circular interpolation aux. Point [pulse]	M code	Acce./ dece. No.	Operation speed [pls/s]	Dwell time [ms]	Circular interpolation direction
X Setting	1	Incremental	Position control	End	Single	9000	0	0	1	100	0	CW
Y Setting	1	Incremental	Position control	End	Single	-3000	0	0	1	100	0	CW

▷Program

Same as Program 3.2.

2) 3 axis Linear Interpolation Control

This carries out the linear interpolation control from Start address (present stop position) using 3 assigned axis.

(1) Control by Absolute method (Absolute coordinate)

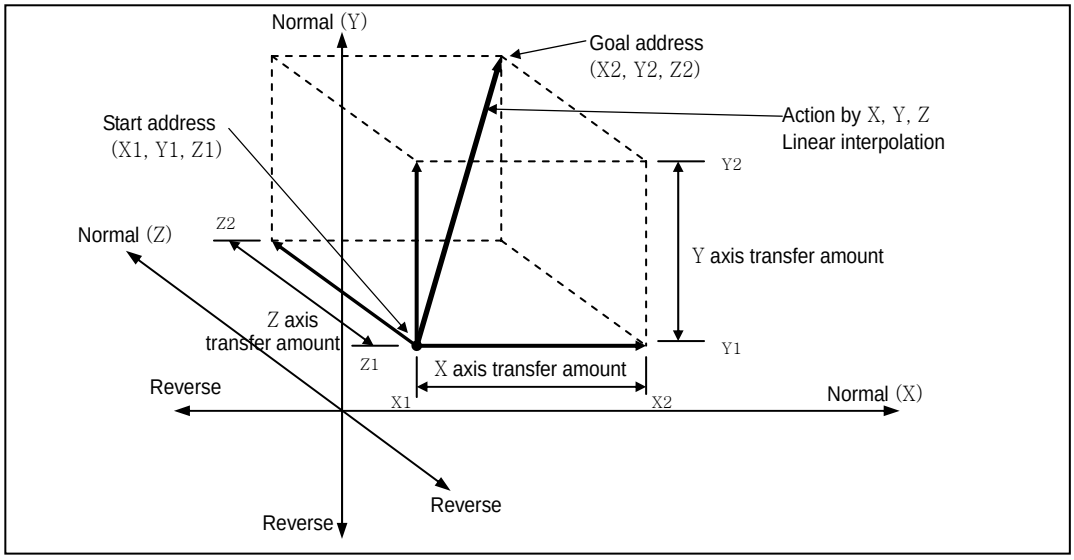
A) This carries out the linear interpolation by 3 axis from Start address to Goal address (the address assigned by positioning data).

B) Positioning control is carried out based on the address assigned by homing.

C) Transfer direction shall be determined by Start address and Goal address of each axis.

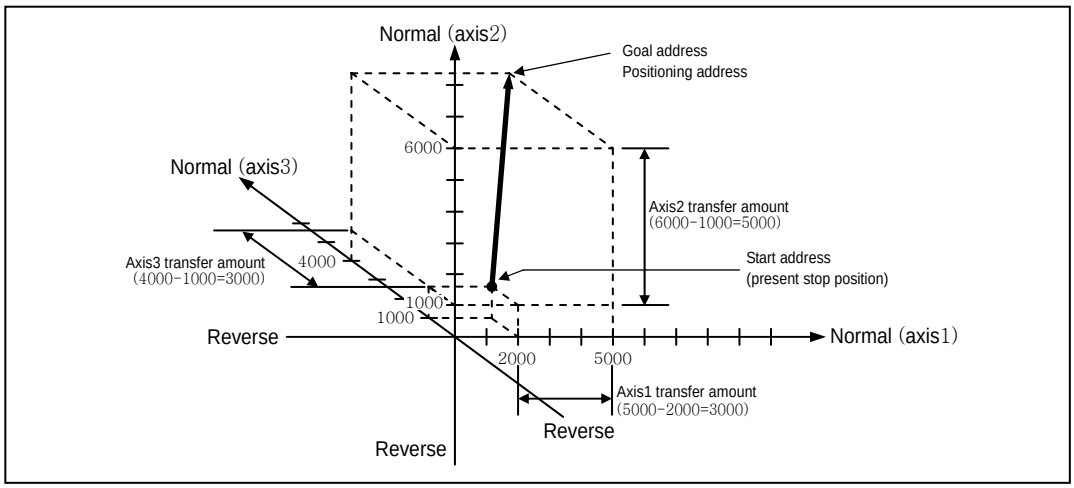
▶Start address < Goal address : normal direction positioning

▶Start address > Goal address : reverse direction positioning



[Example]

▷When Start address (2000, 1000, 1000), ▷Goal address (5000, 5000, 4000), the action is as follows.



▷Software Package Setting

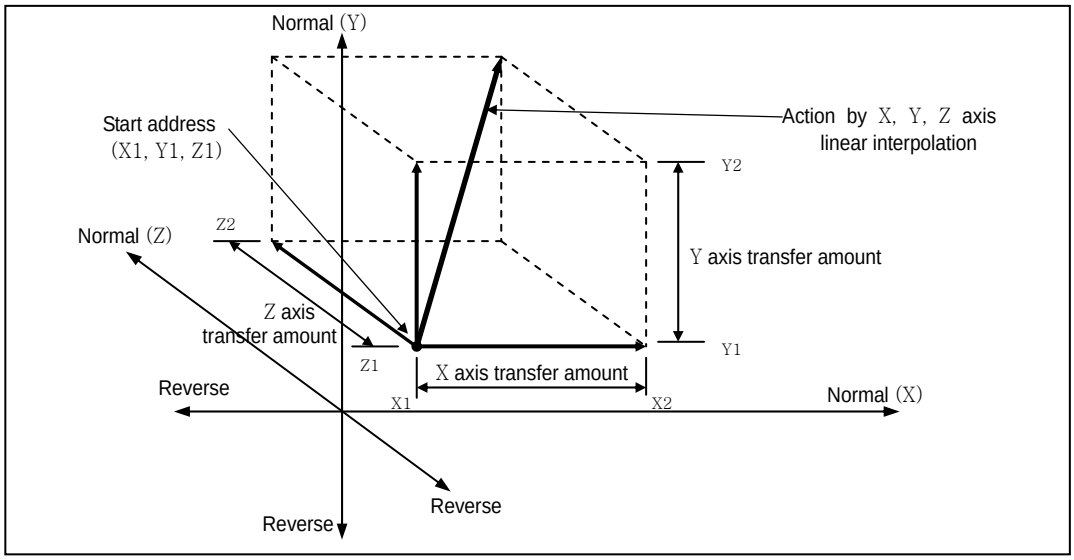
Items of position data	Step no.	Coordinate	Control method	Operation pattern	Operation method	Goal position [pulse]	Circular interpolation aux. Point [pulse]	M code	Acce./ dece. No.	Operation speed [pls/s]	Dwell time [ms]	Circular interpolation direction
X Setting	1	Absolute	Position control	End	Single	5000	0	0	1	100	0	CW
Y Setting	1	Absolute	Position control	End	Single	6000	0	0	1	100	0	CW
Z Setting	1	Absolute	Position control	End	Single	4000	0	0	1	100	0	CW

(2) Control by Incremental method (Relative coordinate)

A) Positioning control from start address to the position including goal transfer direction and transfer amount of each axis.

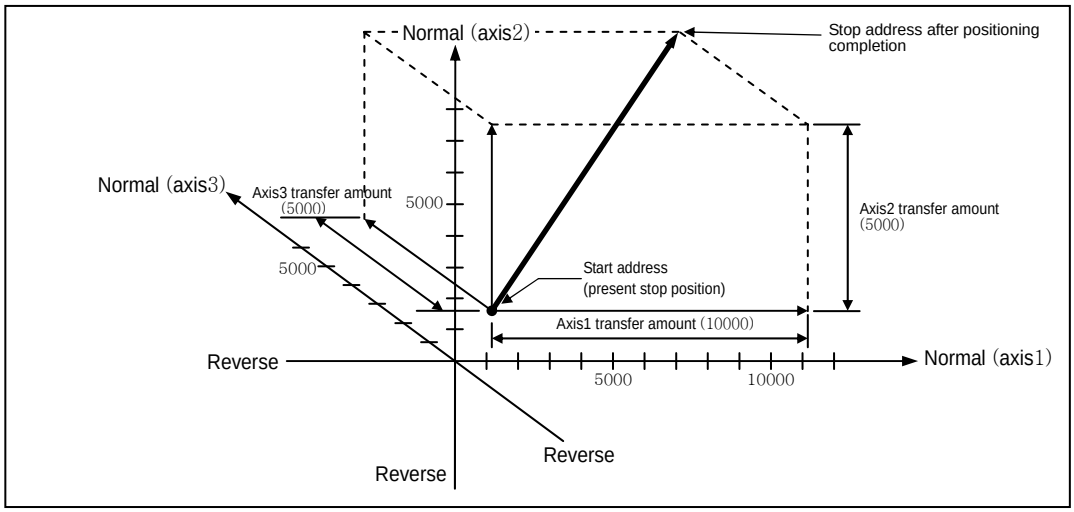
B) Transfer direction shall be determined by the sign of transfer amount of each axis.

- Transfer amount (+) or no sign : normal direction (address increase) positioning
- Transfer amount (-) : reverse direction (address decrease) positioning



[Example]

▷When X transfer amount : 10000, Y transfer amount : 5000, Z transfer amount : 5000, the action is as follows.



▷Software Package Setting

Items of position data	Step no.	Coordinate	Control method	Operation pattern	Operation method	Goal position [pulse]	Circular interpolation aux. Point [pulse]	M code	Acce./ dece. No.	Operation speed [pls/s]	Dwell time [ms]	Circular interpolation direction
X Setting	1	Absolute	Position control	End	Single	10000	0	0	1	100	0	CW
Y Setting	1	Absolute	Position control	End	Single	5000	0	0	1	100	0	CW
Z Setting	1	Absolute	Position control	End	Single	5000	0	0	1	100	0	CW

The Program is same as Program 3.2.

3) 2 axis Circular interpolation control

▶2 axis circular interpolation control begins the interpolation operation to the traveling direction of each axis using 2 motors and there are 2 kinds of methods : Middle point method that passes the assigned position and Center Point method that acts as an circle using the assigned position as a center position.

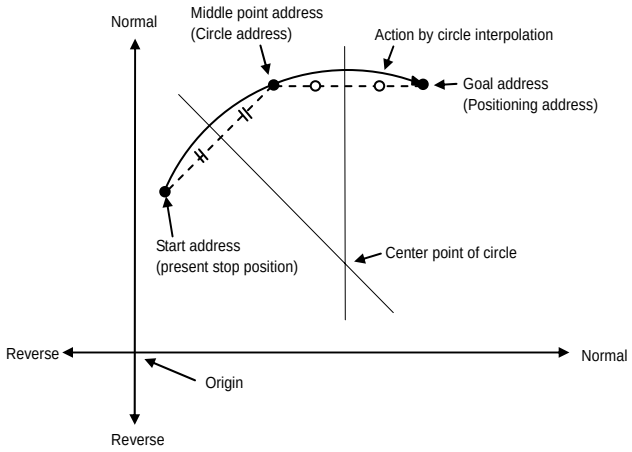
▶The available axis combination for circular interpolation control are 3 types : X and Y, X and Z, Y and Z.

(1) Circular interpolation control by Middle point assigned method

1) Control by Absolute method (Absolute coordinate)

(A) This carries out Circular interpolation from Start address to Goal address through the assigned Middle point address.

(B) The circle is made around the crossing point created by vertical bisection of Start address and Middle point address or Middle point address and Goal address.



(C) Circular interpolation control can not be used with control unit “Degree”.

(D) Transfer direction shall be determined by APM module

[Example]

▷When X transfer amount : 13000, Y transfer amount : 9000, the action is as follows in case that X auxiliary point :10000, Y auxiliary point :7500, rotation direction :CW, main axis :X, subordinate axis :Y.

▷Software Package Setting

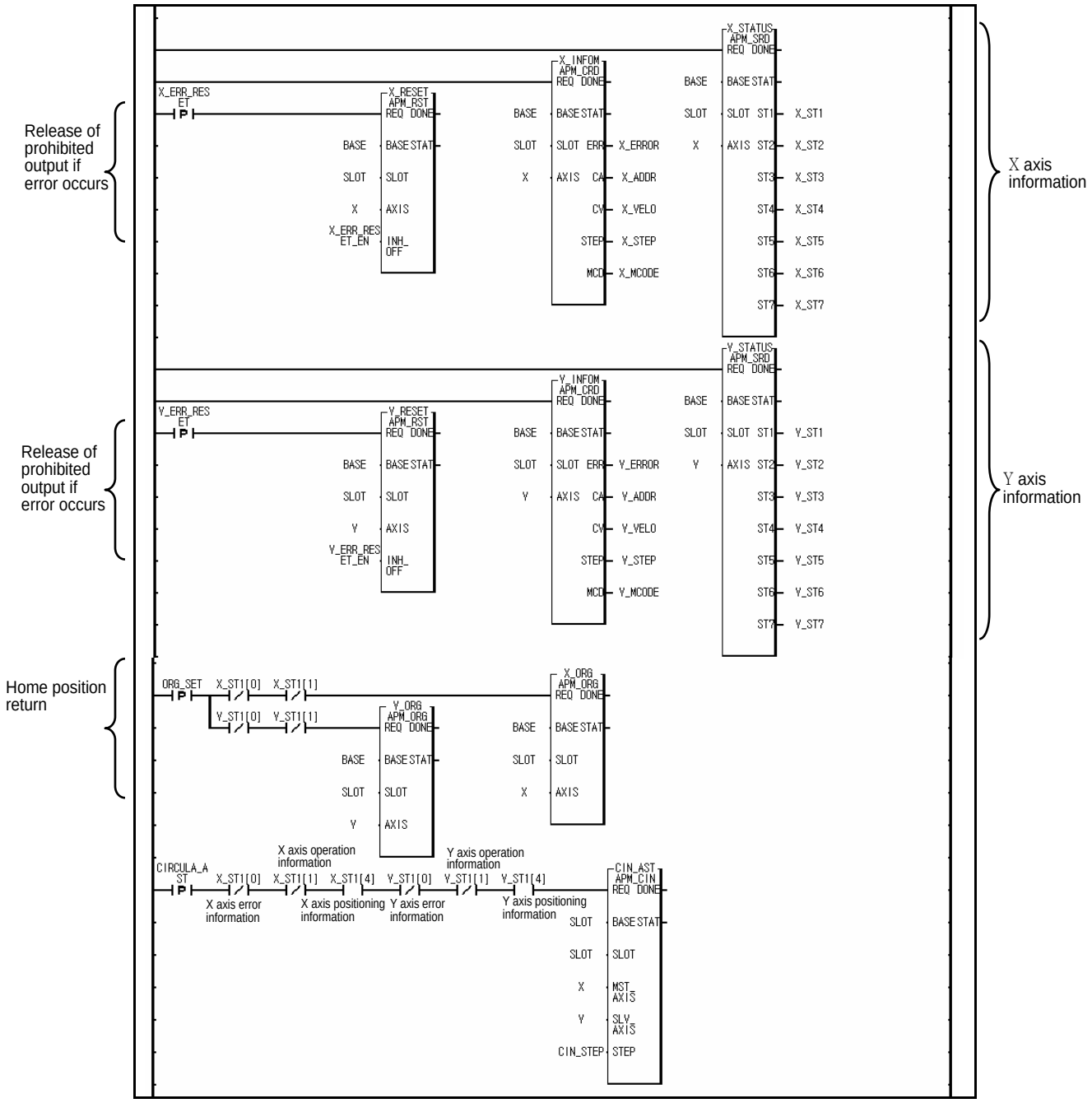
<Operation Data>

Items of position data	Step no.	Coordinate	Control method	Operation pattern	Operation method	Goal position [pulse]	Circular interpolation aux. Point [pulse]	M code	Acce./ dece. No.	Operation speed [pls/s]	Dwell time [ms]	Circular interpolation direction
X Setting	1	Absolute	Position control	End	Single	13000	10000	0	1	1000	0	CW
Y Setting	1	Absolute	Position control	End	Single	9000	7500	0	1	1000	0	CW

<Command window>

Circular interpolation operation	Step	1	Execution
	Subordinate axis	Y	

▷Program



Program 3.3 Basic (Circular interpolation)

Point

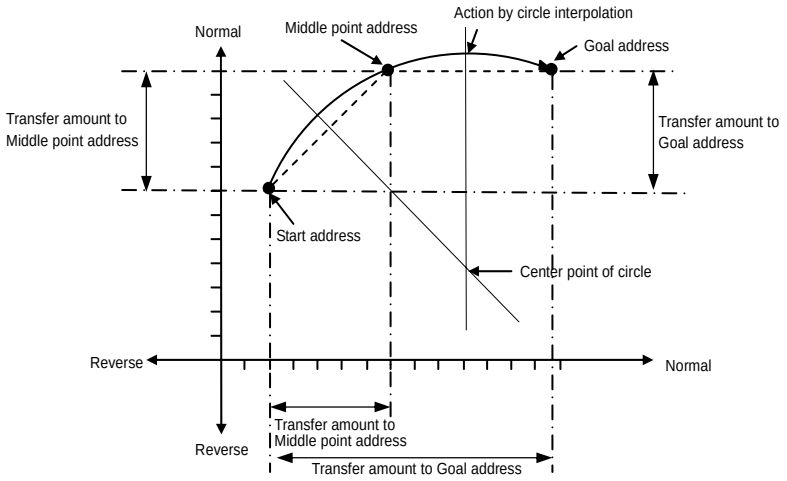
As at Circular interpolationstart 2 axis act synchronously, cares should be taken.

1) The available operation pattern is End, Go-on and the operation method is Single, Repeat.
   If set as Continuous, it shall be processed “Go-on”.
2) The available auxiliary operation is as follows.
   Speed override,Stop, Emergency stop, Zone output permitted,
3) The command that is not used at the linear interpolation operation is as follows.
   Position/Speed switching control, Position override, Continuous operation, Position/Speed override
4) **The auxiliary data related to the operation that acts based on the main axis during linear interpolation operation is as follows.**
   Operation method, operation pattern, Speed limit, Dwell time,
5) **The items that acts based on the setting value of each axis are as follows.**
   ; Backlash compensation amount, Software high limit, Software low limit, Position pass time, Zone setting area among the items of parameter

2) Control by Incremental method (Relative coordinate)

(A) This carries out the circular interpolation from Start address to Goal address through the assigned middle point address.

(B) The circle is made around the crossing point created by dividing the Middle point address calculated by transfer amount from Start address to Middle point address and Goal address calculated by transfer amount from Middle point address to Goal address into two vertically.



(C) Circular interpolation control can not be used with control unit “Degree”.

(D) Transfer direction shall be determined by APM module

[Example]

▷When X transfer amount : 13000, Y transfer amount : 9000, the action is as follows in case that X aux. Point :10000, Y aux. point: 7500, rotation direction: CW, main axis: X, subordinate axis: Y.

▷Software Package Setting

<Operation Data>

Items of position data	Step no.	Coordinate	Control method	Operation pattern	Operation method	Goal position [pulse]	Circular interpolation aux. Point [pulse]	M code	Acce./ dece. No.	Operation speed [pls/s]	Dwell time [ms]	Circular interpolation direction
X Setting	1	Relative	Position control	End	Single	13000	10000	0	1	1000	0	CW
Y Setting	1	Relative	Position control	End	Single	9000	7500	0	1	1000	0	CW

<Command Window>

The Program is same as Program 3.3.

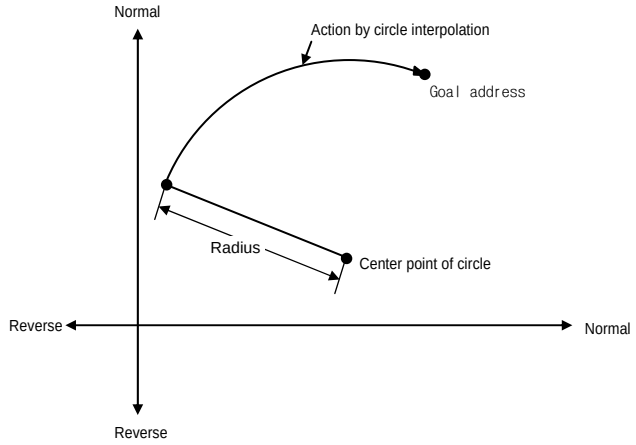
Circular interpolation operation	Step	1	Execution
	Subordinate axis	Y	

(2) Circular interpolation control by Center point assigned method

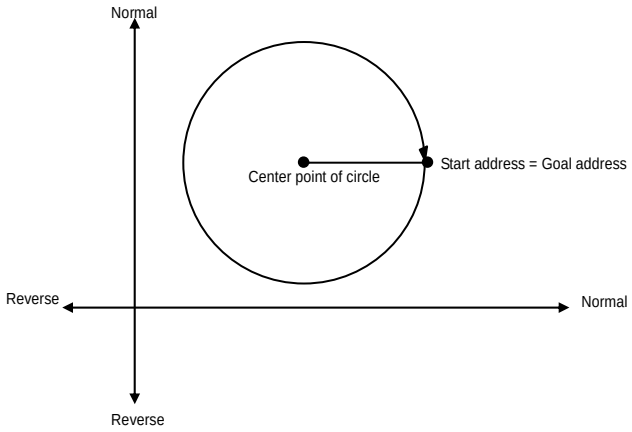
This is the Circular interpolation control to assign the Goal address of circular interpolation and the center point of circle.

1) Control by Absolute method (Absolute coordinate)

(A) This carries out the circular interpolation to Goal address by the circle whose radius is the distance from Start address to the assigned Middle point address.



(B) If Goal address equals to the Start address, the positioning for the circle whose radius is from Start address to the center point of circle shall be done.



(C) Circular interpolation control can be not used with control unit “Degree”.

(D) Transfer direction shall be determined by S/W package or Program.

[Example]

▷When X current position : 0, X goal position : 0, Y current position : 0, Y goal position : 0, the action is as follows in case that X aux. Point : 1000, Y aux. Point : 1000, rotation direction : CW, main axis : X, subordinate axis : Y.

▷Software Package Setting

<Operation Data>

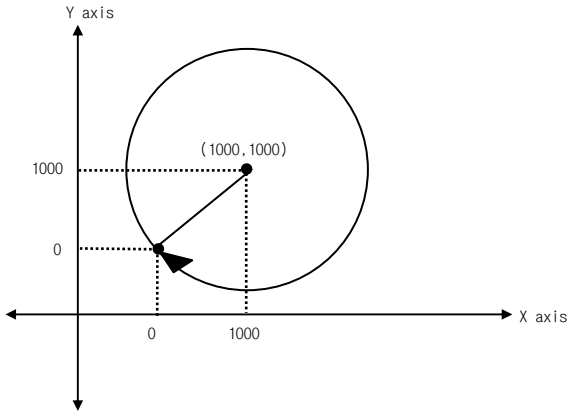
Items of position data	Step no.	Coordinate	Control method	Operation pattern	Operation method	Goal position [pulse]	Circular interpolation aux. Point [pulse]	M code	Acce./ dece. No.	Operation speed [pls/s]	Dwell time [ms]	Circular interpolation direction
X Setting	1	Absolute	Position control	End	Single	0	1000	0	1	100	0	CW
Y Setting	1	Absolute	Position control	End	Single	0	1000	0	1	100	0	CW

<Command Window>

Circular interpolation operation	Step	1	Execution
	Subordinate axis	Y	

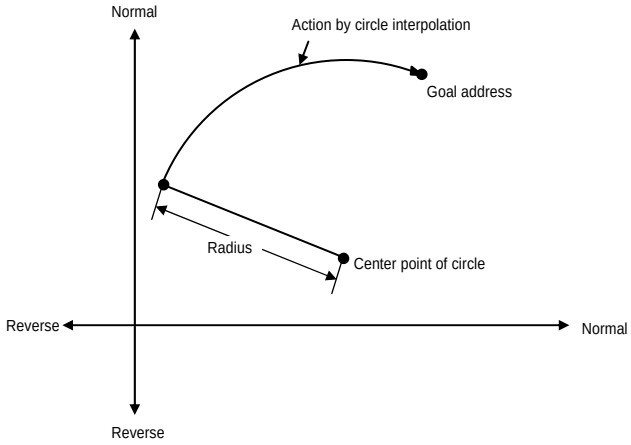
The Program is same as Program 3.3.

<Operation Pattern>

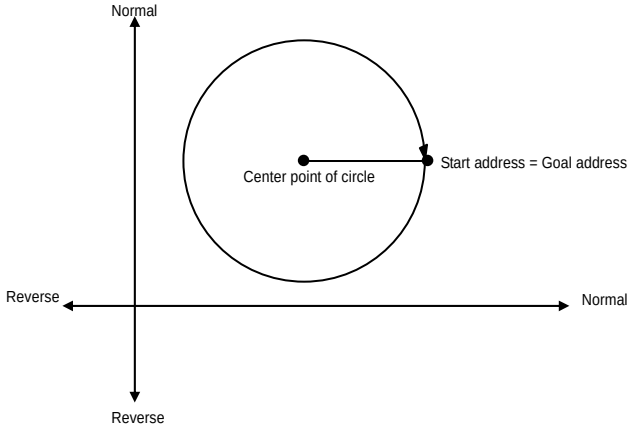


2) Control by Incremental method (Relative coordinate)

(A) This carries out the Circular interpolation to Goal address by the circle whose radius is the distance from Start address to the assigned Middle point address.



(B) If transfer amount is “0”, the positioning of the circle whose radius is from Start address to the Middle point address of the circle shall be done.



(C) The circular interpolation control cannot be used with control unit “Degree”.

(D) Transfer direction shall be determined by S/W package and Program.

[Example]

▷When X transfer amount : 13000, Y transfer amount : 9000, the action is as follows in case that X aux. Point :10000, Y aux. point: 7500, rotation direction :CW, main axis :X, subordinate : Y.

▷Software Package Setting

<Operation Data>

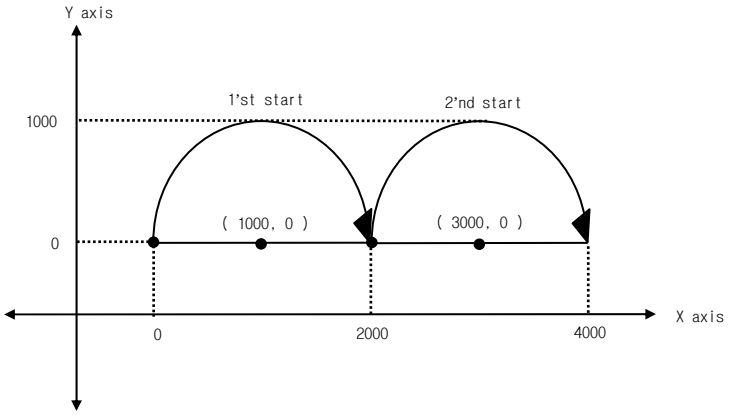
Items of position data	Step no.	Coordinate	Control method	Operation pattern	Operation method	Goal position [pulse]	Circular interpolation aux. Point [pulse]	M code	Acce./ dece. No.	Operation speed [pls/s]	Dwell time [ms]	Circular interpolation direction
X Setting	1	Relative	Position control	End	Single	13000	10000	0	1	100	0	CW
Y Setting	1	Relative	Position control	End	Single	9000	7500	0	1	100	0	CW

<Command Window>

Circular interpolation operation	Step	1	Execution
	Subordinate axis	Y	

The Program is same as Program 3.3.

<Operation Pattern>



3.1.3 Speed Control (Equal Speed Operation)

▶This controls the speed by the setting speed until deceleration stop command is entered after execution by positioning start.
(If the operation stops by deceleration stop command, it becomes “origin unsettled state”.)

▶Speed control contains 2 types of start : Normal direction start and Reverse direction start.
▷Normal direction : when position address is positive number (+) (“0” included)
▷Reverse direction : when position address is negative number (-)

▶In case of using speed control, the following items of positioning data does not effect.

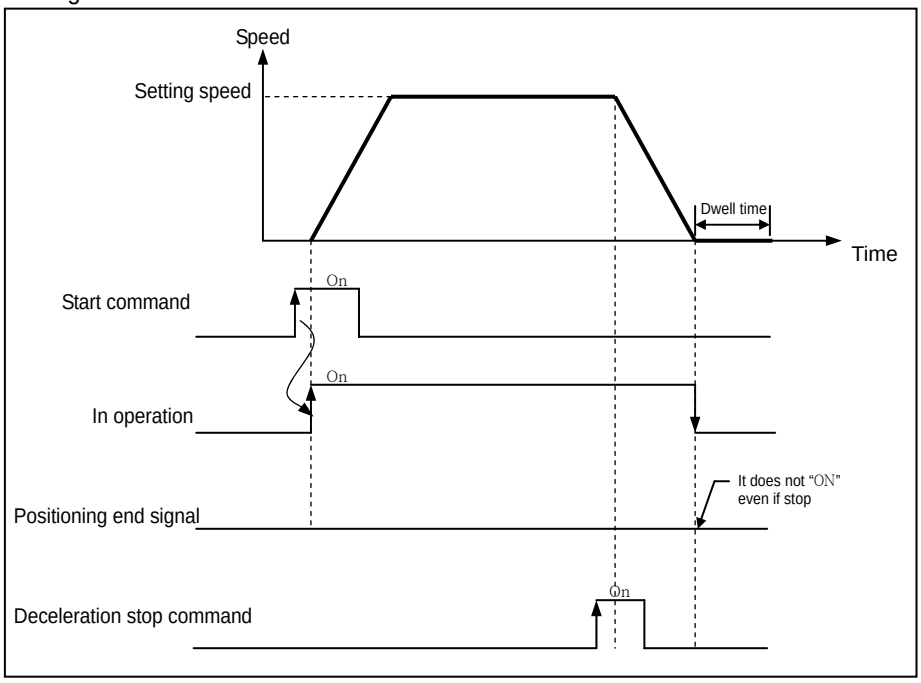
Items of Position Data	Step no.	Coordinate	Control method	Operation pattern	Operation method	Goal position [pulse]	Circular interpolation aux. Point [pulse]	M code	Acce/ dece. No.	Operation speed [pls/s]	Dwell time [ms]	Circular interpolation direction
Items that does not effect		↑		↑	↑						↑	

▶In case of using M code, please use only “With” mode.
(If using “After” mode, M code “ON” signal does not output.)

▶In case of changing the operation step no., it is required to use “Start step no assignment”.

▶When using the current position during operation, it is required to set **“Position during Equal speed operation” from “Extended parameter” of S/W Package** as **“Indication”.**
(The current position can be displayed only in the state that the origin is determined.)

▶Action Timing

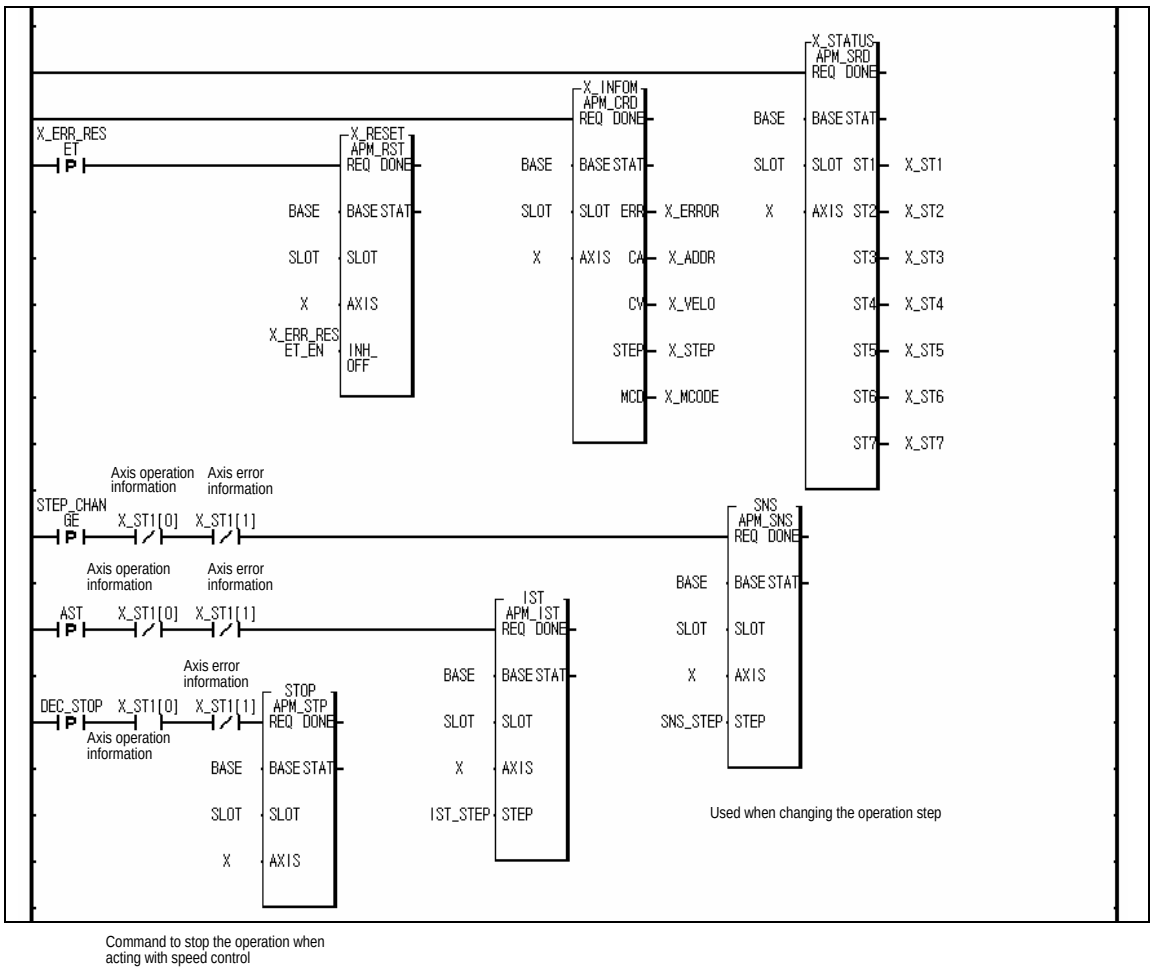


[Example]

▷Software Package Setting

Direction Setting	Step no.	Coordinate	Control method	Operation pattern	Operation method	Goal position [pulse]	Circular interpolation aux. Point [pulse]	M code	Acc./ dece. No.	Operation speed [pls/s]	Dwell time [ms]	Circular interpolation direction
Normal	1	Absolute	Speed control	Go-on	Single	100	0	**1**	1	1000	0	CW
Reverse	2	Absolute	Speed control	End	Repeat	-100	0	**2**	1	2000	0	CW

▷Program



Program 3.4 Speed Control

3.1.4 Speed/Position Conversion Control

▶The setting axis by positioning start carries out the speed control and is converted from speed control to position control when speed/position conversion signal is entered to the positioning module inside or outside, and then carries out the positioning as much as goal transfer amount.

▶Speed/Position Conversion control can be operated to the normal direction and reverse direction.

Direction Setting	Step no.	Coordinate	Control method	Operation pattern	Operation method	Goal position [pulse]	Circular interpolation aux. Point [pulse]	M code	Acc./ dec.No.	Operation speed [pls/s]	Dwell time [ms]	Circle interpolation direction
Normal	1	Relative	Speed	Go-on	Single	1000	0	**1**	1	1000	100	CW
Reverse	2	Relative	Speed	End	Repeat	-1000	0	**2**	1	2000	100	CW

The item that does not effect

▷Direction of Speed/Position conversion control (normal/reverse) shall be determined by the sign of position address.

(In this case, all is processed by Absolute method regardless of Absolute/Relative method.)

*1 (normal direction) : when position address is positive (+)

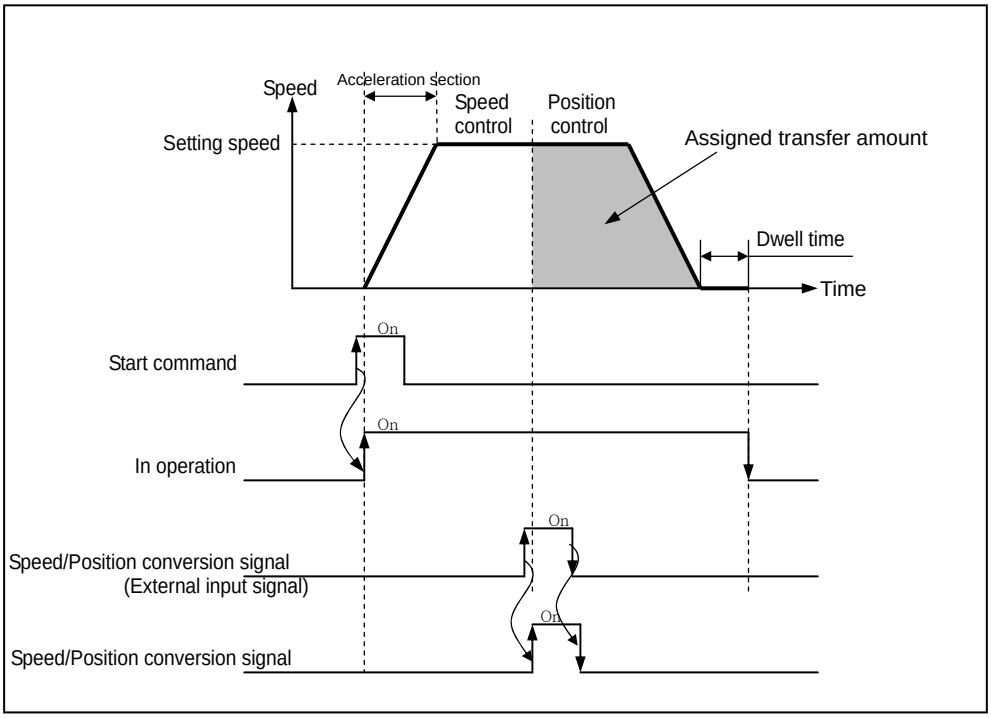
*2 (reverse direction) : when position address is negative (-)

▶0…According to the selection of position indication (“indication”/”no indication”) from “**Position Indication during Equal speed operation” of Extended parameter,** the current position shall be indicated differently.

Position indication “indication” : The origin is determined at speed control and the current position is indicated and it operates from “0” to Goal position during position control conversion

Position indication “no indication” : The origin is not determined at speed control and the current position is s indicated as “0” and it operates from “0” to Goal position during position control conversion.

▶Action Timing



▷Program

Program is same as Program 3.4.

3.1.5 Position/Speed Conversion Control

▶The setting axis by positioning start carries out the position control and is converted from position control to speed control when position/speed conversion signal is entered to the positioning module inside, and then it stops by deceleration stop or SKIP operation or continues next operation.

▶Position/Speed Conversion control can be operated to the normal direction and reverse direction.

Direction Setting	Step no.	Coordinate	Control method	Operation pattern	Operation method	Goal position [pulse]	Circular interpolation aux. Point [pulse]	M code	Acc./ Dec. No.	Operation speed [pls/s]	Dwell time [ms]	Circle interpolation direction
Normal	1	Absolute	Speed	Go-on	Single	10000	0	**1**	1	500	100	CW
Reverse	2	Absolute	Speed	End	Repeat	-10000	0	**2**	1	600	200	CW

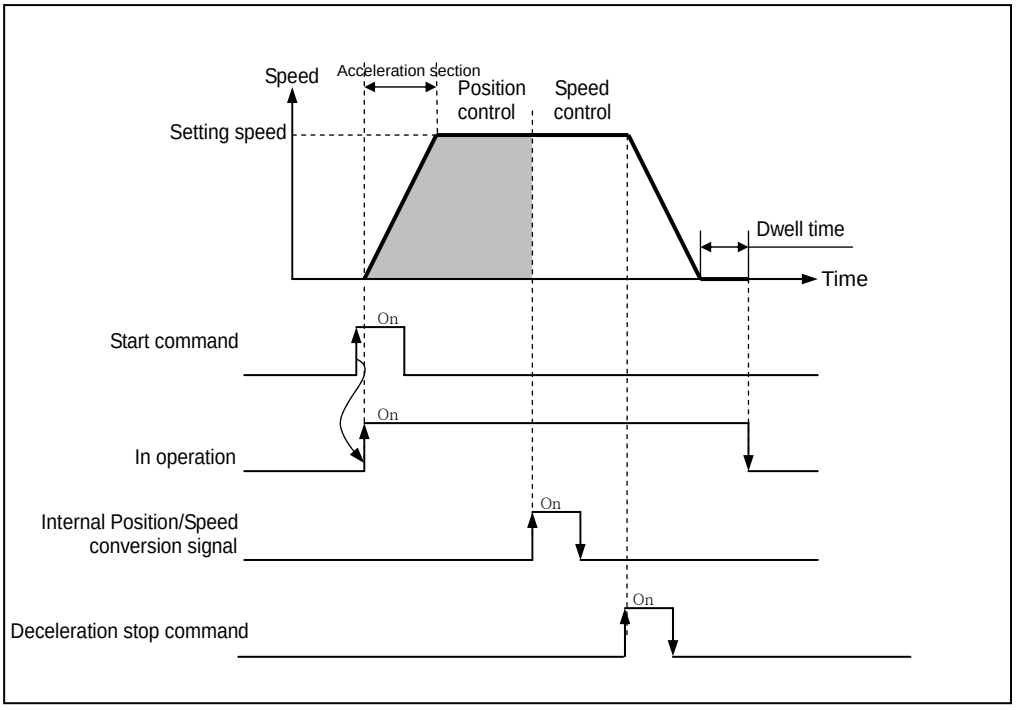
The item that does not effect

▷The direction of Position/Speed conversion control (normal/reverse) shall be determined by the sign of position address.

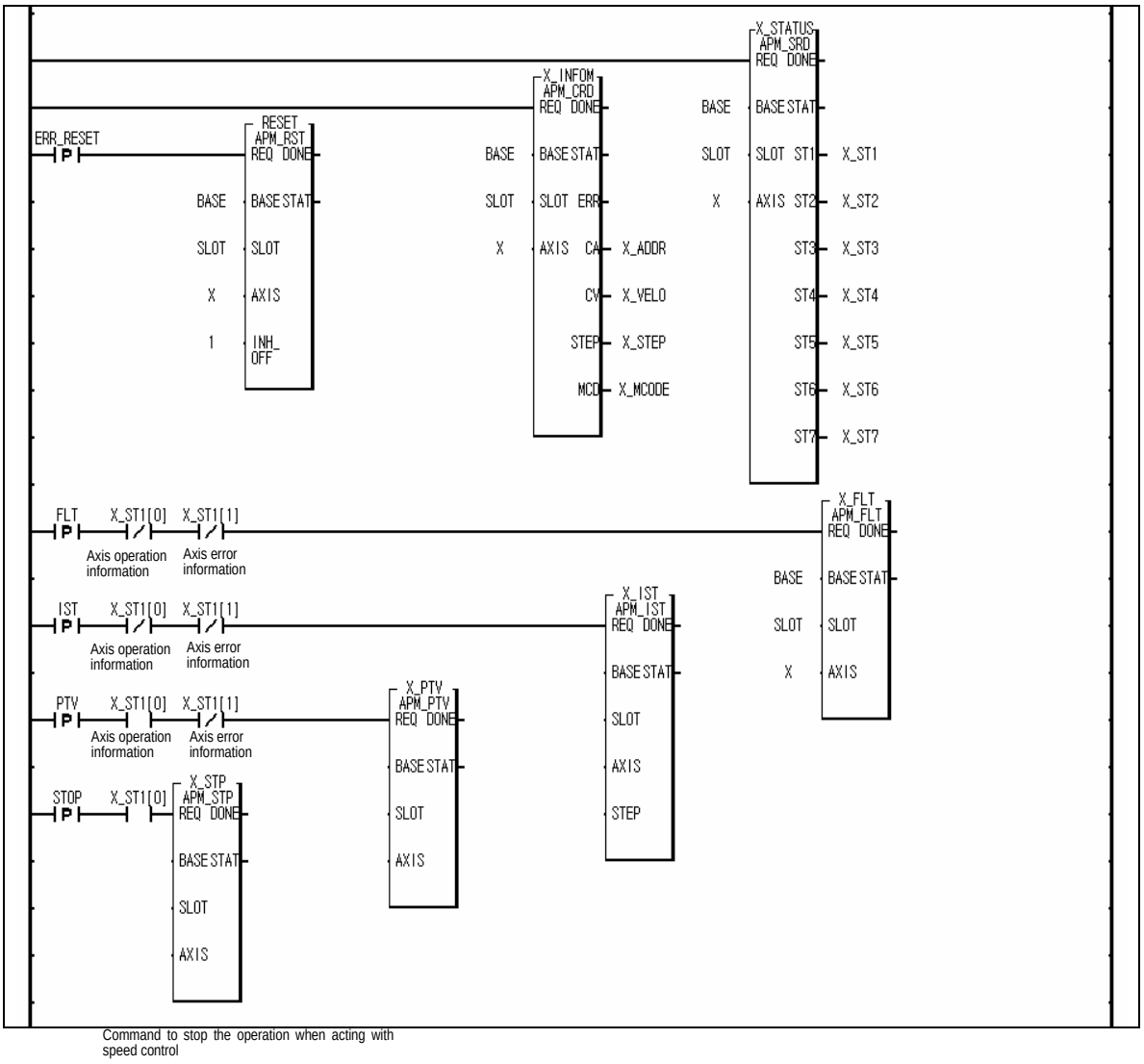
*1 (normal direction) : when position address is positive(+)

*2 (reverse direction) : when position address is negative(-)

▶Action Timing



▷Program



Program 3.5 Position/Speed Conversion Control

3.2 Operation Mode

▶Operation mode describes various configuration for how to operate the positioning data using several operation step no and how to determine the speed of position data.

▶Operation mode types are as follows.

Control method	Operation pattern	Operation method	Others
Position control	End	Single	
	End	Repeat	
	Go-on	Single	
	Go-on	Repeat	
	Continuous	Single	■Linear/Circular interpolation function is not used.
	Continuous	Repeat	■Linear/Circular interpolation function is not used.
Speed control	End	Single	■Linear/Circular interpolation function is not used.
	Go-on Continuous	Single Repeat	■not available

▶Operation mode shall be set from PLC Program or Operation data of Software Package.

▶Operation data can be set by max. 400 from operation step no. 1 ~ 400 at each axis.

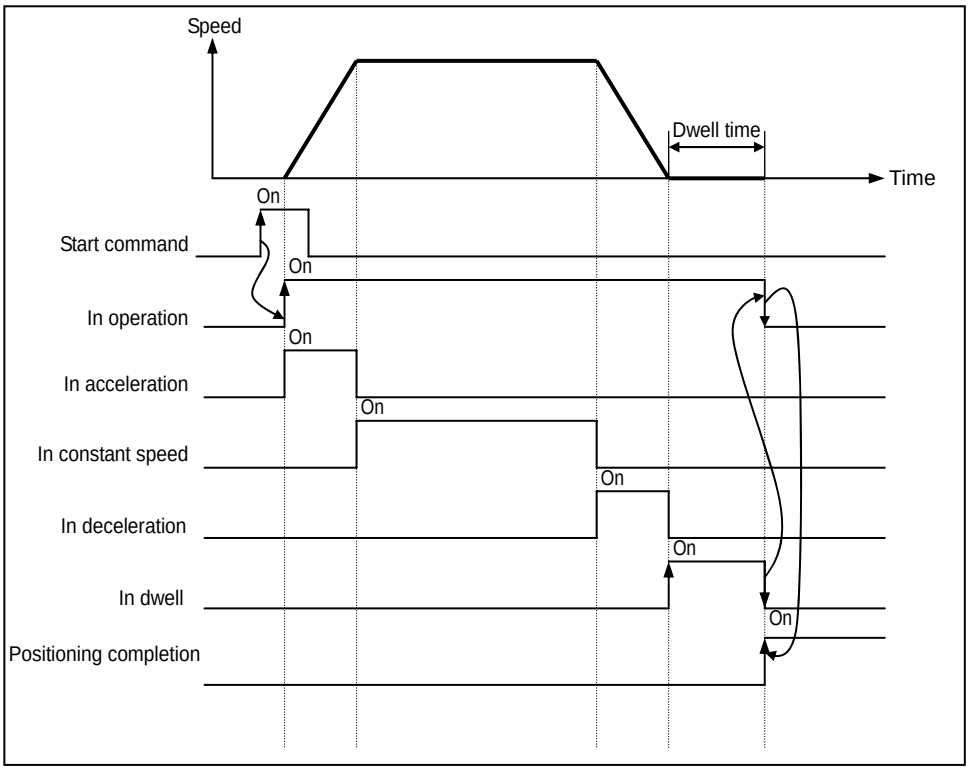
Type of Operation data	Step no.	Coordinate	Control method	Operation pattern	Operation method	Goal position [pulse]	Circular interpolation aux. Point [pulse]	M code	Acc./ dec. No.	Operation speed [pls/s]	Dwell time [ms]	Circle interpolation direction
Setting range/Type	1 ~ 400	Absolute relative	Position speed	End go-on conti.	Single repeat	- 2147483648 ~ 2147483647	-2147483648 ~ 2147483647	0 ~ 65535	1 ~ 4	0 ~ 1000000	0 ~ 50000	CW,CCW

▶With one time start command, positioning operation method by one operation step positioning data and positioning operation method by several operation step in order shall be determined by operation mode of each positioning data set by the operator.

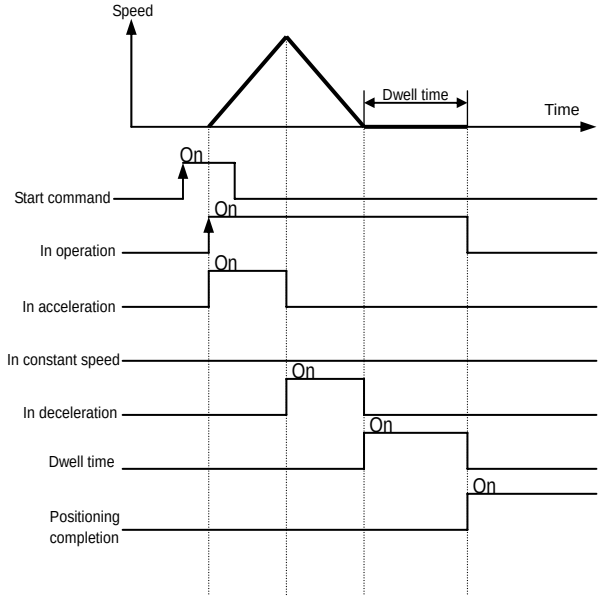
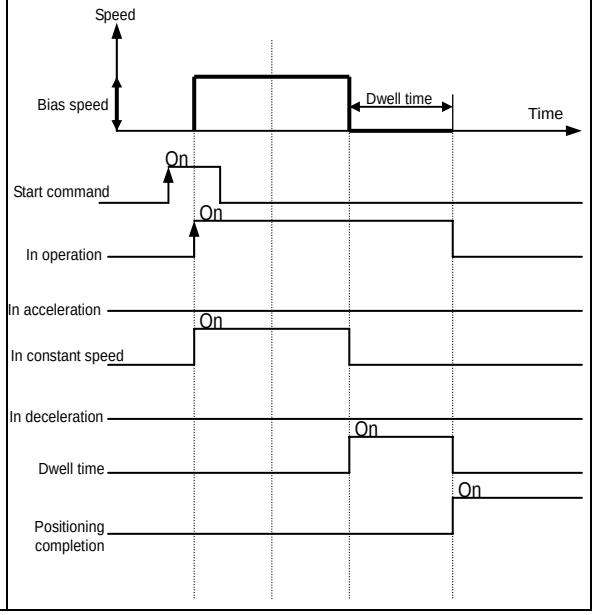
3.2.1 End Operation (Single)

1) With one time start command, the positioning to the goal position is executed and the positioning shall be completed at the same time as the dwell time proceeds.
2) The positioning completion of this operation mode can be used as operation mode of last positioning data of Go-on operation mode and Continuous operation mode.
3) Operation direction shall be determined by position address.
4) Operation action is trapezoid type operation that has acceleration, constant, deceleration section according to the setting speed and position data but the operation pattern according to the setting value is as follows.

a) Normal operation pattern

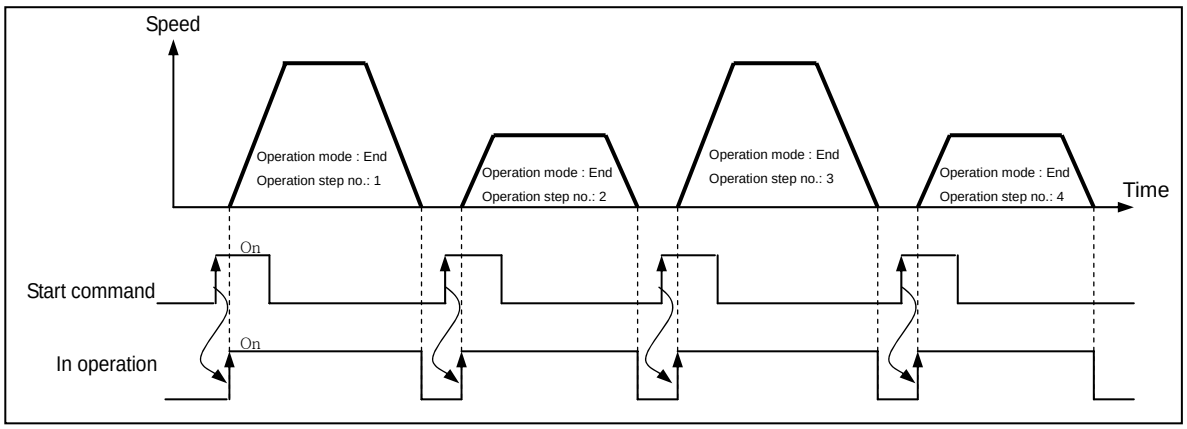


b) Abnormal operation pattern

When operation speed is set as “higher” than position transfer amount	When operation speed is set as same as bias speed
	

[Example]

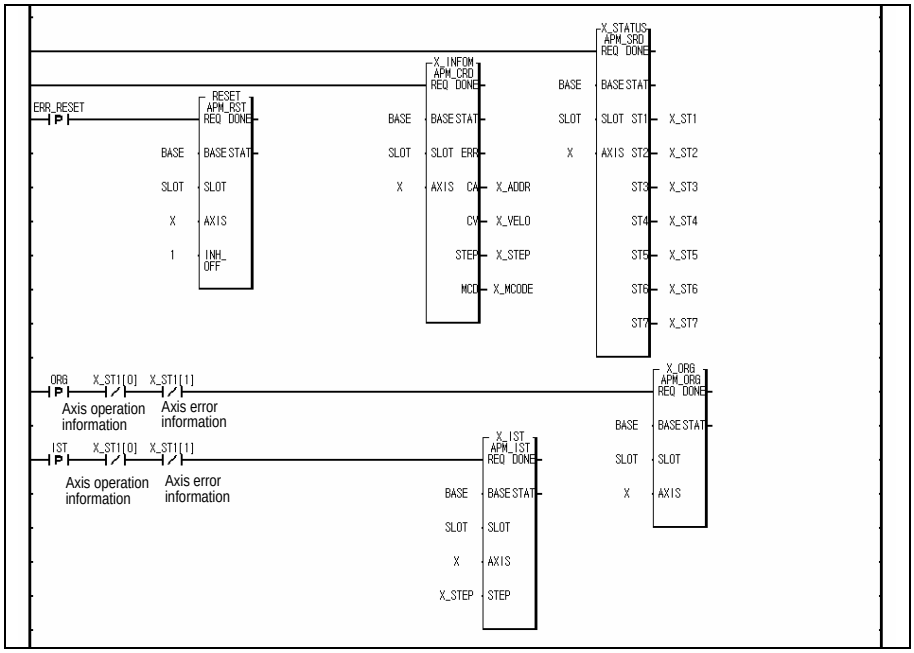
▷ Operation pattern



▷Software Package Setting

Step No.	Coordinate	Control method	Operation pattern	Operation method	Goal position [pulse]	Circular interpolation aux. point [pulse]	M code	Acc./ dec. No.	Operation speed [pls/s]	Dwell time [ms]	Circle interpolation direction
1	Absolute	Position	End	Single	10000	0	0	1	1000	0	CW
2	Absolute	Position	End	Single	20000	0	0	1	500	0	CW
3	Absolute	Position	End	Single	30000	0	0	1	1000	0	CW
4	Absolute	Position	End	Single	40000	0	0	1	500	0	CW

▷Program



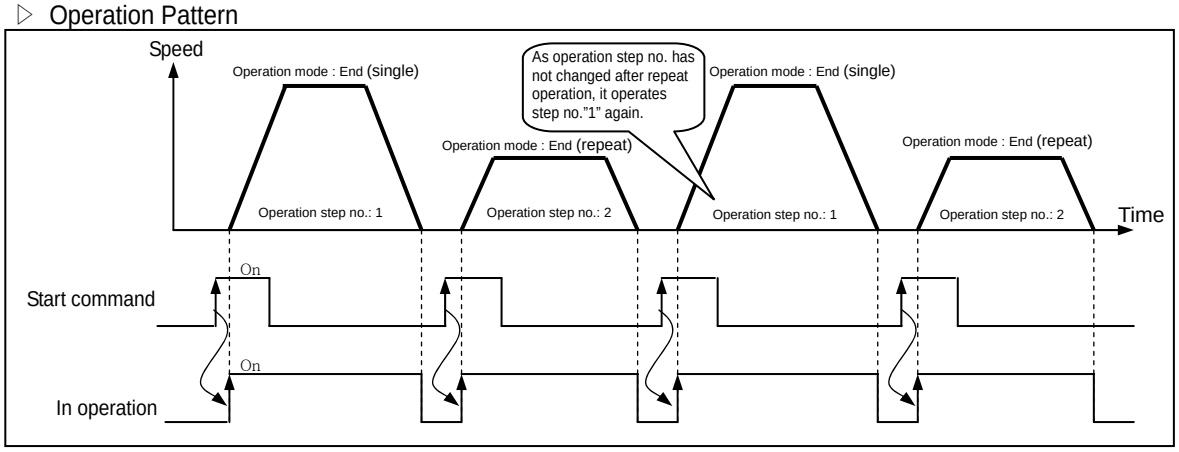
Program 3.6 End Operation (Homing)

3.2.2 End Operation (Repeat)

1) With one time start command, the positioning to the goal position is executed and the positioning shall be completed at the same time as the dwell time proceeds.
2) The operation type of Repeat operation mode is same as that of Single operation but the different thing is to determine next operation by operation step no. assigned by repeat step no. change command after positioning completion of Repeat operation mode.
3) Therefore, if Repeat step no. change command was not executed, the step no."1" shall be assigned after positioning completion of Repeat operation mode and operated at next Start command. Thus, this operation can be used for the structure that several operation steps are repeated.
4) In case that operation step is set as the value except "0" (1~400) when Indirect Start, the positioning operation shall be done with the setting step no. regardless of the current operation step no. But, if the step no. is set as "0", the positioning operation shall be done with the current step no. changed by Repeat operation mode.
5) Operation direction shall be determined by position address.
6) Repeat operation step no. change command is available to execute during operation.

[Example 1] When operating only by Start Command [In the case of step no = "0"]

▷ Operation Pattern



▷ Software Package Setting

No. of program start command	Step no.	Coordinate	Control method	Operation pattern	Operation method	Goal position [pulse]	Circular interpolation aux. point [pulse]	M code	Acc./ dec. No.	Operation speed [pls/s]	Dwell time [㎳]	Circle interpolation direction
1, 3	1	Absolute	Position	End	Single	10000	0	0	1	1000	0	CW
2, 4	2	Absolute	Position	End	Repeat	20000	0	0	1	500	0	CW
	3	Absolute	Position	End	Single	30000	0	0	1	2000	0	CW
	4	Absolute	Position	End	Repeat	40000	0	0	1	3000	0	CW

Operation step 3, 4 does not start.

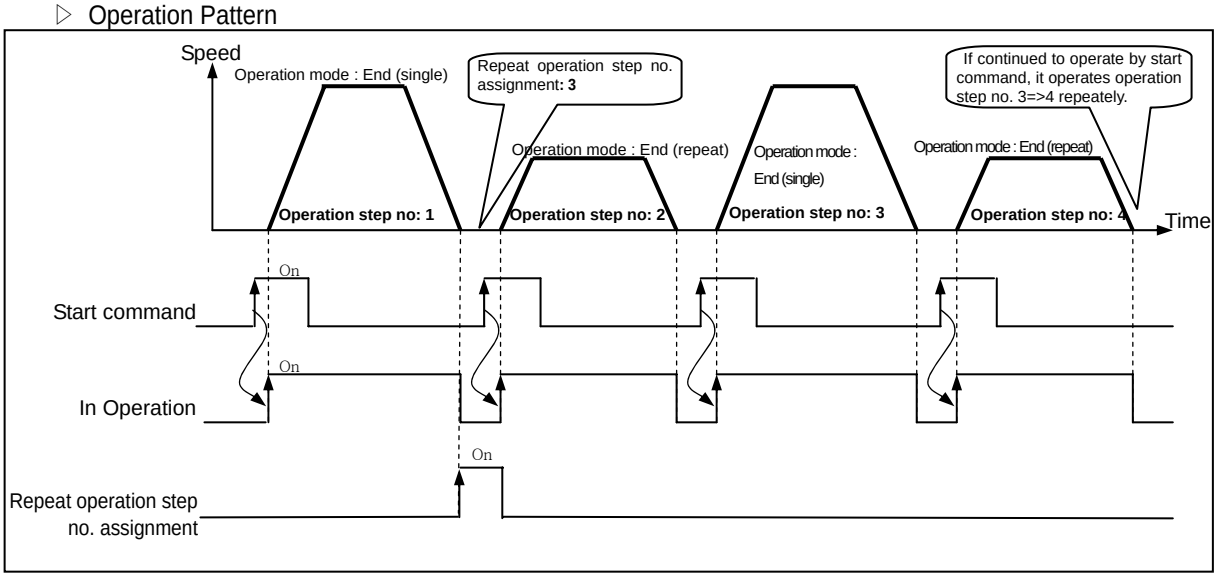
▷Program

Program is same as Program 3.6.

[Example 2] When operating Start command and Repeat operation step no. assignment

[In the case of step no = “0”]

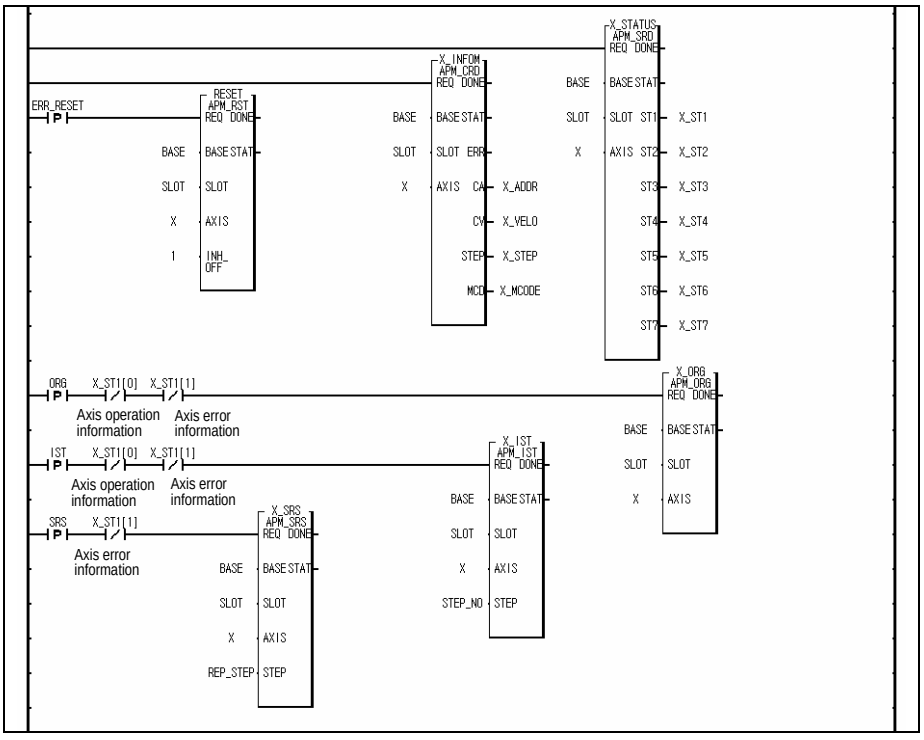
▷ Operation Pattern



▷ Software Package Setting

No. of program start command	Step no.	Coordinate	Control method	Operation pattern	Operation method	Goal position [pulse]	Circular interpolation aux. Point [pulse]	M code	Acc./dec no.	Operation speed [pls/s]	Dwell time [ms]	Circle interpolation direction
1, 3	1	Absolute	Position	End	Single	10000	0	0	1	1000	0	CW
2, 4	2	Absolute	Position	End	Repeat	20000	0	0	1	500	0	CW
The change of the number by Repeat operation step no. assignment [APM_SRS: rising edge ↑]												
	3	Absolute	Position	End	Single	30000	0	0	1	2000	0	CW
	4	Absolute	Position	End	Repet	40000	0	0	1	3000	0	CW

▷Program



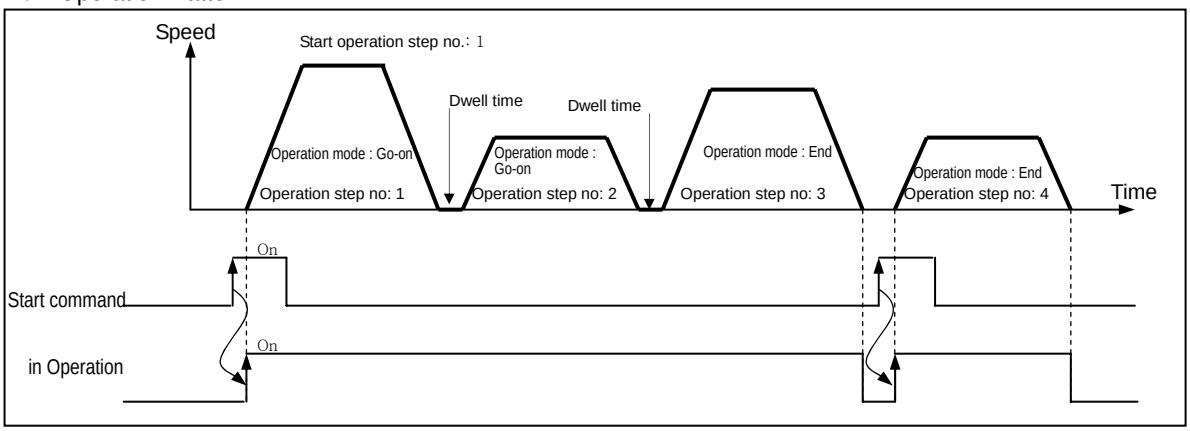
Program 3.7 End Operation(Repeat operation step no. change)

3.2.3 Go-on Operation

1) With one time Start command, the positioning to the goal position of operation step is executed and the positioning shall be completed at the same time as dwell time proceeds and without additional start command, the positioning of operation step for (current operation step no. +1) shall be done.
2) Go-on operation mode is available to execute several operation step in order.
3) Operation direction shall be determined by position address.

[Example]

▷ Operation Pattern



▷Software Package Setting

No. of program start command	Step no.	Coordinate	Control method	Operation pattern	Operation method	Goal position [pulse]	Circular interpolation aux. Point [pulse]	M code	Acc./ dec no.	Operation speed [pls/s]	Dwell time [ms]	Circle interpolation direction
1	1	Absolute	Position	Go-on	Single	10000	0	0	1	1000	0	CW
	2	Absolute	Position	Go-on	Single	20000	0	0	1	500	0	CW
	3	Absolute	Position	End	Single	30000	0	0	1	800	0	CW
2	4	Absolute	Position	End	Single	40000	0	0	1	500	0	CW

▷Program

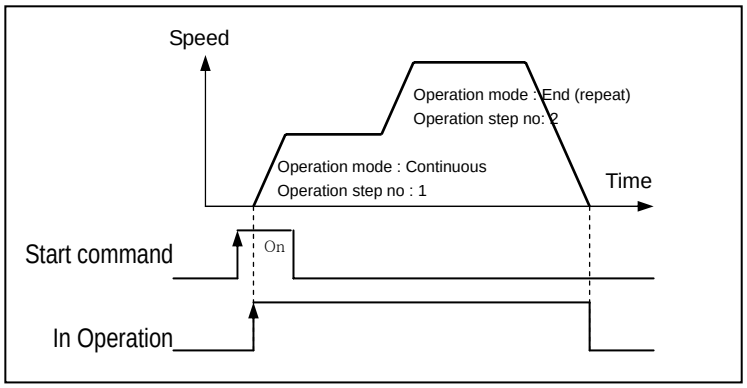
Program is same as Program 3.6.

3.2.4 Continuous Operation

1) With one time Start command, the positioning for operation step set by continuous operation mode is executed to the goal position without stop and the positioning shall be completed at the same time as dwell time proceeds.
2) If you want to operate with the position and speed of next step before the operation step that is active currently reaches the goal position, the operation by Next Move continuous operation command is available.
3) With Next Move continuous operation command, the operation in the acceleration, constant speed, deceleration section of Continuous operation is available.
4) Operation direction shall be determined by position address.

[Example]

▷ Operation Pattern



▷Software Package Setting

No. of program start command	Step no.	Coordinate	Control method	Operation pattern	Operation method	Goal position [pulse]	Circular interpolation aux. Point [pulse]	M code	Acc./ dec no.	Operation speed [pls/s]	Dwell time [ms]	Circle interpolation direction
1	1	Absolute	Position	Continuous	Single	10000	0	0	1	1000	0	CW
2	2	Absolute	Position	End	Repeat	20000	0	0	1	500	0	CW

▷Program

Program is same as Program 3.6.

3.3 Positioning Start

▶When the operation stops during position control action by stop cause, the positioning is carried out at the stopped position address value by starting again.

▶There are 8 kinds of start : 1) General start command, 2) Synchronous start command, 3) Synchronous start command, 4) Linear interpolation start command, 5) Circular interpolation start command, 6) Homing start command, 7) Jog start command, 8) Inching start command.

▶When you carries out the Start, the signal in operation should be “OFF”.

3.3.1 General Start

1) Program Start

(1) The general start command to start the positioning operation data at Program is applied to GM4/GM6 and K200S/K300S differently.

(2) GM4,GM6 have Indirect start (APM_IST) and Direct start (APM_DST) and MASTER-K200S,K300S have Indirect start (Command code :4), Direct start (Command code :3) and the start method by P contact No.(P(n+1)0, P(n+1)5, P(n+1)A).

2) **Start by External Input Signal**

(1) External command

A) If setting the external start of extended parameter as “permitted” and the command selection as “Start”, the positioning operation data starts according to the current operation step no. whenever the external input signal is “On”.

B) If setting the external start of extended parameter as “permitted” and the command selection as “Jog”, the Jog high speed operation (normal rotation) is carried out while the external input is “On”.

(2) External auxiliary command

If setting the external start of extended parameter as “permitted” and the command selection as ”Jog” , the Jog high speed operation (reverse rotation) is carried out while the external auxiliary command input is “On”.

3.3.2 Simultaneous Start

1) It carries out the synchronous start operation for 2 axis, 3 axis positioning operation data by internal synchronous start command according to the axis information and the setting step.
In this case, the external synchronous start of extended parameter should be set as “prohibited”.

2) If stop command is entered during synchronous start operation, reduce the speed and stop the corresponding axis and if the internal synchronous start command is entered again, the positioning operation is carried out according to Relative coordinate or Absolute coordinate in case that the synchronous start setting step no. is the current operation step no.

3) It carries out the synchronous start operation for 2 axis, 3 axis positioning operation data by external input signal according to the axis information and the setting step.

4) Set the external synchronous start of the corresponding axis for the synchronous start of extended parameter as “permitted” and execute the internal synchronous start command first. Then it shall be “the state in operation” and if the external synchronous start input signal is “ON”, it starts synchronously for the positioning operation.

3.3.3 Synchronous Start

1) Synchronous start by Position(SSP)

(1) Synchronous Start by Position command is carried out only in case that the main axis is in the origin determination state.

(2) Synchronous Start command starts by the synchronization of the subordinate axis according to the current position of the main axis.

(3) SSP carries out the SSP command at the subordinate axis.
Thus, if setting the command axis and the main axis equally, Error 347 will occur.

(4) If SSP command is executed, it becomes the state in operation and the actual operation is carried out at the subordinate axis where the current position of the main axis is the setting position of the position synchronous start.

(5) The setting step no. of position synchronous start should be set as the start step no. of the main axis.

(6) In case of cancellation after executing the SSP command at the subordinate axis, if you execute the stop command, the SSP command shall be released.

2) **Synchronous start by Speed(SSS)**

(1) Synchronous Start by Speed (SSS) command starts to operate by the speed synchronization of the subordinate axis when the main axis starts according to the Synchronous Start by speed rate.

(2) Even if the subordinate axis is set as position control mode, the operation of main axis repeats at the same time with the start and the stop. The rotation direction of the subordinate axis is the same as the rotation direction of the main axis.

(3) If SSS command is executed at the subordinate axis, it becomes the state in operation and maintains the state in SSS operation until the SSS command is released by stop command.

(4) When setting the Synchronous start by speed rate, the main axis rate ≥the subordinate axis rate. If not, error 356 will occur.

$$\text{Synchronous start by speed rate} = \frac{\text{Subordinate axis rate}}{\text{Main axis rate}}$$

(5) If the speed synchronization command is executed in the state that M code is “ON”, Error 353 will occur. Thus, release the M code before using.

(6) The setting of main axis is available for X, Y, Z axis, Encoder.

(7) For speed synchronization by encoder input, please refer to Article 3.7.2 Encoder Operation pulse input..

3.3.4 Linear Interpolation Start (APM_LIN : Rising edge ↑)

1) 2 axis Linear Interpolation Control

(1) This function exists only for 2 axis or 3 axis positioning module (G4/6F-PP2O,G4/6F-PP2D,G4/6F-PP3O, G4/6F-PP3D) and means the command to operate the 2 axis transfer path to be linear.

(2) As 2 axis act synchronously at the linear interpolation start, cares should be taken in using.

(3) When 2 axis linear interpolation start command, it is divided into the main axis and the subordinate axis by the positioning transfer amount of 2 axis (X-Y, Y-Z, X-Z).

; The speed data of the subordinate axis is processed as the following operation formula.

$$\text{Subordinate axis speed} = \frac{\text{Main axis speed} \times \text{Main axis distance}}{\text{Main axis distance}}$$

▷Terminology Definition

Main axis : the axis that has a large positioning transfer amount of the corresponding operation step no. from 2 axis (X-Y, Y-Z, X-Z).

Subordinate axis : the axis that has a small positioning transfer amount of the corresponding operation step no. from 2 axis (X-Y, Y-Z, X-Z).

; In this case, the speed, acceleration/deceleration time, bias speed of the subordinate axis shall be re-calculated.

(4) The available operation mode is limited as End operation, Go-on operation.

(5) The operation speed of the subordinate axis during 2 axis linear interpolation operation is not indicated.

2) 3 axis Linear Interpolation Control

(1) This function exists only for 3 axis positioning module (G4/6F-PP3O,G4/6F-PP3D) and means the command to operate the 3 axis transfer path to be linear.

(2) As 3 axis (X-Y-Z) act synchronously at the 3 axis linear interpolation start, cares should be taken in using.

(3) The available operation mode is limited as End operation, Go-on operation.

(4) The fast operation speed during the 3 axis linear interpolation operation is not indicated.

(5) For 3 axis linear interpolation operation, if the axis information is set as “X,Y,Z”and the command axis selected from 3 axis executes the linear interpolation command, 3 axis will carry out the linear interpolation operation synchronously. In this case, the 3 axis operation step no. that carries out the interpolation operation shall be the same step no. for interpolation opeation.

(6) The division of the main axis and the subordinate axis is the same as the case of 2 axis linear interpolation operation.

3.3.5 Circular interpolation Start

- This function exists only for 2 or 3 axis positioning module (G4/6F-PP2O,G4/6F-PP2D,G4/6F-PP3O,G4/6F-PP3D) and means the command to operate the 2 axis transfer path to be circular.
- As 2 axis (X-Y, Y-Z, X-Z) act synchronously at the 2 axis circular interpolation start, cares should be taken in using.
- The circular interpolation operation has the method by center point and the method by Middle point and it is required to set the circular interpolation method in advance from Common parameter. (S/W Package, PLC program)

Parameter items	Parameter content	Setting content
Common parameter	Circular interpolation method	0: middle point, 1: center point

1) Circular Interpolation by Center point

(1) For the circular interpolation operation by the center point, cares should be taken in setting the auxiliary data (center point).

(2) The case that operates by using the setting value of aux. Data as actual radius is shown as below.

(This is the case that one from aux. point of 2-axis is set as “0”.)

▷When X axis transfer amount : 0.0um, Y axis transfer amount : 0.0um, the action of the case that X axis center point : -10000.um, Y center point : 0.0um, rotation direction :CW, main axis :X, subordinate axis :Y axis is as follows.

▷Software Package Setting

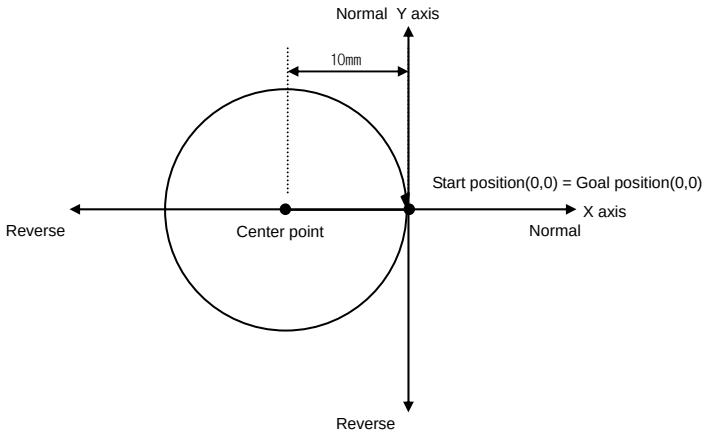
<Operation Data>

Items of Position data	Step no.	Coordinate	Control method	Operation pattern	Operation method	Goal position [um]	Circular interpolation aux. Point [um]	M code	Acc./ Dec no.	Operation speed [mm/m]	Dwell time [ms]	Circular interpolation direction
X Setting	1	Relative	Position	End	Single	0.0	-10000.0	0	1	100.00	0	CW
Y Setting	1	Relative	Position	End	Single	0.0	0.0	0	1	100.00	0	CW

<Command Window>

Circular interpolation operation	Step	1	Execution
	Subordinate axis	Y axis	

<Action Pattern>



(3) The case that does not operate by using the setting value of aux. Data as actual radius is shown as below.

▷When X axis start position & goal position : 0.0um, Y axis start position & goal position : 0.0um, the action of the case that X axis aux. Point : -10000.0um, Y aux. Point :10000.0um, rotation direction :CW, main axis :X, subordinate axis :Y is as follow.

▷Software Package Setting

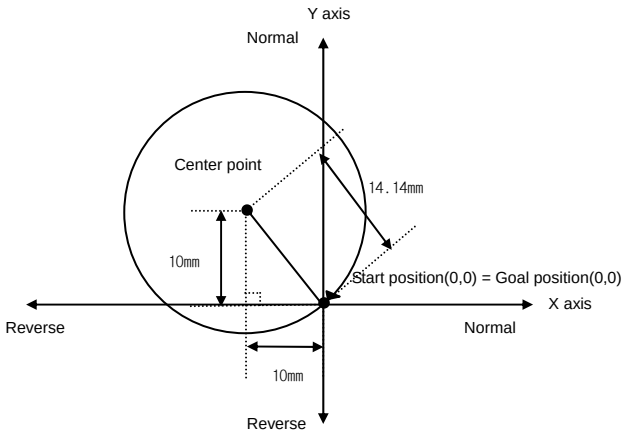
<Operation Data>

Items of Position data	Step no.	Coordinate	Control method	Operation pattern	Operation method	Goal position [um]	Circular interpolation aux. Point [um]	M code	Acc./ Dec no.	Operation speed [mm/m]	Dwell time [ms]	Circular interpolation direction
X Setting	1	Relative	Position	End	Single	0.0	-10000.0	0	1	100.00	0	CW
Y Setting	1	Relative	Position	End	Single	0.0	10000.0	0	1	100.00	0	CW

<Command Window>

Circular interpolation operation	Step	1	Execution
	Subordinate axis	Y axis	

<Action Pattern>



▷The radius of circular interpolation for the above action pattern shall be 14.14mm when applying the operation formula (1.414 x 10mm) and with this radius, it carries out the circular interpolation operation. (Actual diameter shall be 28.28mm.)

▷The formula that finds the circular interpolation radius by center point is as follows according to Pythagorean theorem.

$$\text{Circular interpolation radius} = \sqrt{(\text{Aux.1})^2 + (\text{Aux.2})^2}$$

2) **Circular Interpolation by Middle point**

(1) As in the case of circular interpolation operation by middle point, the setting value of aux. point 1 and aux. point 2 carries out the circular interpolation operation by the middle point of X axis and Y axis respectively, cares should be taken in using.

(2) For further information, please refer to Article 3.1.2 Interpolation Control.

(3) This carries out the circular interpolation from Start address to Goal address via the assigned middle point address.

(4) The circle is made around the crossing point created by vertical bisection of Start address and Middle point address or Middle point address and Goal address.

The circular interpolation control can not be used with control unit “Degree”.

(6) Transfer direction shall be determined automatically by APM module.

(7) If the of 2 axis middle point is set wrong, the circular interpolation radius deviates from the area available to operate and Error 286 will occur.

3.4 Positioning Stop

Here describes the causes to stop the axis during positioning.

3.4.1 Stop Command and Stop Causes

The stop command and stop causes are as follow and is divided into Stop per axis and Synchronous stop of all axis.

1) In case of Stop command and Stop causes per axis, only the axis that has the stop command “ON” or the stop causes will stop.
   But in case that there is Stop command and Stop cause on one axis during linear interpolation/circular interpolation control, both axis of interpolation control will stop.
2) In case of Synchronous stop command and Stop causes of all axis, both axis will stop at the point that there is the Stop command ”ON” or stop cause.

Stop cause		Positioning *1	Homing *2	Jog operation	Manual pulse generator (encoder) operation	Stop axis	Axis action state after stop command *3	M code ”On” Signal state
By parameter setting *4	Exceeds Soft high limit	Prompt stop	No detection	Prompt stop		Per axis	Error state (error 501) Output prohibited	No change
	Exceeds Soft low limit	Prompt stop	No detection	Prompt stop		Per axis	Error state (error 502) Output prohibited	No change
By sequence program *5	Deceleration stop command	Deceleration stop	Deceleration stop	Error 322 (operation continue)	Error 323 (operation continue)	Per axis	In deceleration	No change
	Emergency stop command	Prompt stop				All axis	Error state (error 481) Output prohibited	“OFF”
By external signal	External high limit “On”	Prompt stop		No detection	Prompt stop	Per axis	Error state(error492) *6 Output prohibited	No change
	External low limit “On”	Prompt stop		No detection	Prompt stop	Per axis	Error state(error493) *6 Output prohibited	No change
	Emergency stop “On”	Prompt stop				All axis	Error state (error491) Output prohibited	“OFF”
By software package	Dece. Stop command	Deceleration stop	Deceleration stop	Error 322 (operation continue)	Error 323 (operation continue)	Per axis	In stop	No change

Point

*1 : Positioning is the position control, speed control, position/speed conversion control, speed/position conversion control by the positioning data.

*2 : The external input signal (approximate origin and origin signal) does not effect the positioning control in the state of homing completion.
According to homing method, rotation direction will change or it stops promptly when external high/low limit “ON”.

*3 : If the axis action state after stop is “output prohibited”, execute the output prohibition release command to release the output prohibition and reset the error no.

*4 : Soft high/low limit by parameter can not be used in the speed control operation mode.

*5 : Sequence program means Function block or MASTER-K program method.

*6 : Error 495 may occur according to rotation direction.

3.4.2 Stop Processing and Priority

1) Stop Processing

Deceleration stop command has different content of processing according to acceleration section, constant speed section and deceleration section of operation pattern.

(1) Deceleration/Constant speed section

▶In case of deceleration stop by deceleration stop command, as the positioning operation is not completed by the setting goal position ,

① positioning completion signal will not occur,

② After mode of M code mode does not have M code signal “ON”.

If indirect start command (step no. = current step no.) occurs in the stop state afterward,

Absolute method operation operates the residual position of the current operation step that is not outputted, and Relative method operation operates as much as the goal address.

(2) Deceleration section

▶Even if deceleration stop command is executed in the deceleration section, the positioning completion signal, M code signal will occur same as normal stop.

▶If deceleration stop command is executed in the deceleration section of Go-on operation mode and Continuous operation mode, the deceleration stop command is not processed and it carries out the positioning operation by the setting Go-on operation pattern and Continuous operation pattern of operation data.

2) Emergency Stop, External Input High/Low Limit Processing

▶If Emergency stop command or external input high/low limit is entered during positioning control, the positioning control will stop and it becomes “output prohibited” state and then error will occur.

3) Priority of Stop Processing

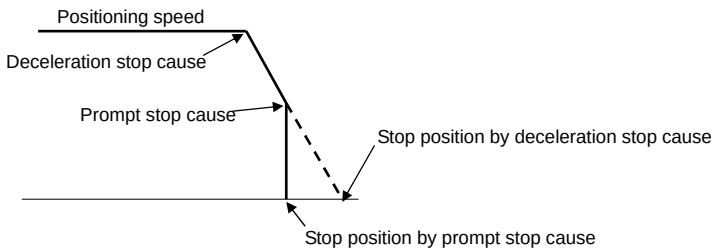
The priority of Stop Processing of positioning module is as follows.

Deceleration stop < Prompt stop

▶If encounters the prompt stop cause in the deceleration section in positioning, the prompt stop processing will be done at that point. But if the prompt stop time is longer than deceleration time, it continues the deceleration stop processing even if the prompt stop cause occurs during deceleration stop processing.

Point

▶If the prompt stop cause occurs during deceleration stop, the processing is as follows.



▶Prompt stop causes : ① Internal/external emergency stop, ② External input high/low limit, ③ Soft high/low limit

3.4.3 Interpolation Stop

1) If encounters stop command during interpolation operation (2 axis/3 axis linear interpolation, 2 axis circular interpolation), it carries out the deceleration stop.
2) If indirect start command is executed in the current step when reset after deceleration stop, it continues the operation to the goal position of positioning operation data. In this case, the operation is carried out differently according to Absolute coordinate and Relative coordinate.
3) The stop command during interpolation operation is available for internal deceleration stop and external deceleration stop.
4) The deceleration stop command should be executed in the main axis that is in interpolation operation.

3.4.4 Emergency Stop

1) If encounters the emergency stop while executing the start related command (indirect start, direct start, synchronous start, synchronous start, linear interpolation start, circular interpolation start, homing start, jog start, inching start), it carries out the prompt stop.
2) Emergency stop has 2 kinds of method : Internal emergency stop and External emergency stop.
3) In case of internal emergency stop, error 481 will occur and in case of external emergency stop, error 491 will occur.
4) As in case of emergency stop, it becomes output prohibited state and origin unsettled state, it is required to execute positioning (homing, floating origin, current position preset) in case of operating by Absolute coordinate or in the positioning state in order to carry out the positioning operation.
5) In case of 2 axis, 3 axis module, as 2 axis or 3 axis carries out Emergency stop synchronously in case of emergency stop, it is required to use Emergency stop signal of SERVO driver when using the individual emergency stop in the SERVO driver.

3.5 Reset after Positioning Stop

1) Reset after Deceleration Stop Command

(1) When encounters the deceleration stop command in Acceleration/Constant speed section,

▶First, deceleration stop and then carry out the positioning operation by operation step set at the indirect start.

▶In case of using With mode of M code mode, M code “ON” signal should be “OFF” to reset.

(2) When encounters the Stop command in deceleration section,

▶If reset after deceleration stop, the next operation step of the current operation step no. will act..

But in case of Go-on operation, Continuous operation, the operation will continue by operation pattern without treating the deceleration stop command in the deceleration section.

▶In case of using With mode or After mode from M code mode, M code “ON” signal should be “OFF” to reset.

2) After internal emergency stop, external emergency stop, external input high/low limit, Soft high/low limit,

▶if encounters internal emergency stop, external emergency stop, external input high/low limit and soft high/low limit, the positioning module shall be ① output prohibited state, ② origin unsettled state.

▶Thus if ① release the output prohibition ② settle the origin again (homing start, floating point setting), and

▶carry out the start, it carries out the reset from the setting operation step no.

3.6 Homing

▶Homing is carried out to confirm the origin of the machine when applying the power.

▶in case of homing, it is required to set homing parameter per axis.

▶For further information for homing parameter, please refer to Article 4.1, 4.6 and 4.7.

▶If the origin position is determined by homing, the origin detection signal is not recognized during positioning operation.

3.6.1 Homing method

▶Method by approximate origin (approach DOG)

Homing processing method by approximate origin (approach DOG) has 5 kinds of method as follows.

(1) Origin detection after approximate origin “OFF”

(2) Origin detection after deceleration when approximate origin “ON”

(3) Origin detection by approximate origin

▶Method by Non-approximate origin

(1) Origin detection by origin or high/low limit

(2) High speed origin detection

▶The items that effects to the homing from Software Package parameter are as follows.

(1) Homing method

(2) Homing direction

(3) Origin compensation amount

(4) Homing speed (high speed, low speed)

(5) Origin address

(6) Homing dwell time

(7) Homing reset waiting time

(8) Homing acceleration/deceleration time

- For further information, please refer to Article 4.7.

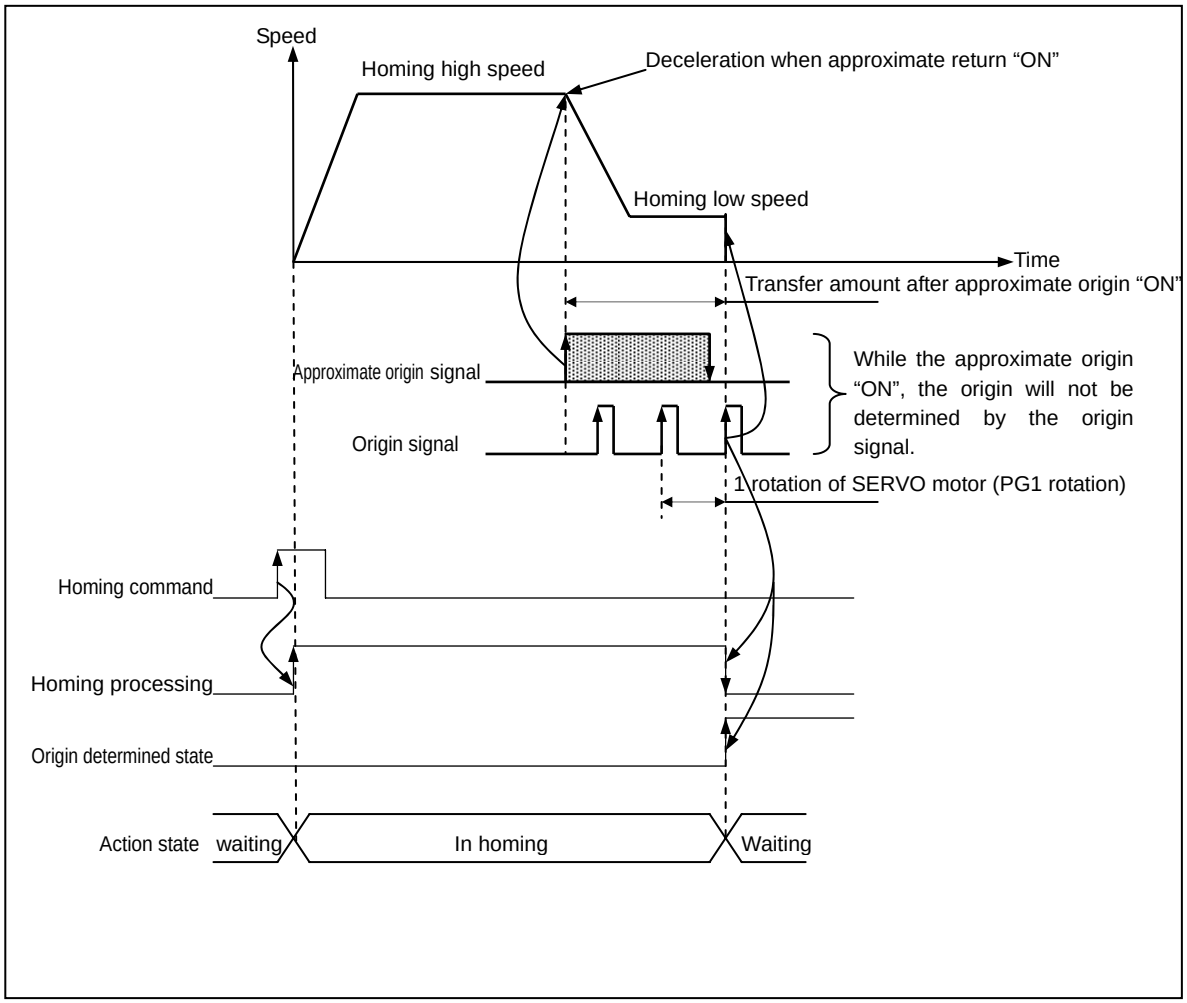
3.6.2 Origin Detection after Approximate origin OFF

This is the method using the approximate origin and origin signal and the action by homing command is as follows.

(1) It accelerates to the setting homing direction and acts by homing high speed.

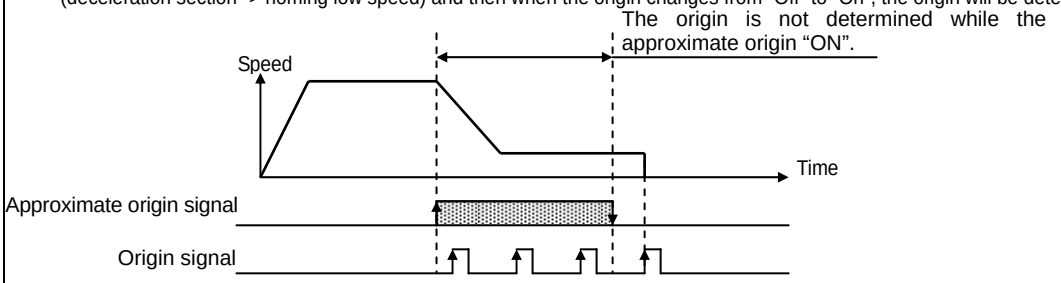
(2) In this case, if approximate origin as external input is entered, it decelerates and acts by homing low speed.

(3) If origin signal as external signal is entered after the approximate origin signal has changed from ”On” to “Off”, it stops.

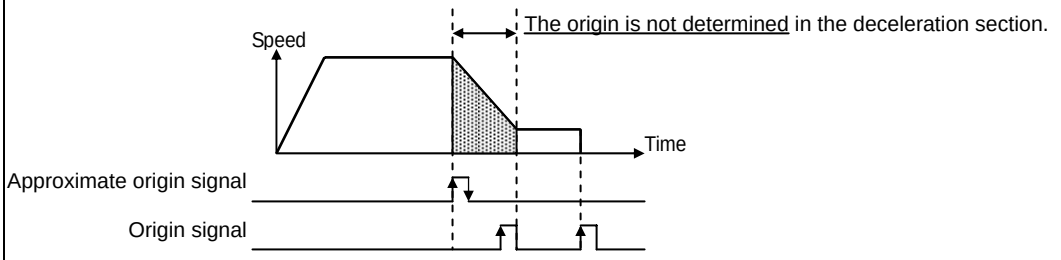


Point

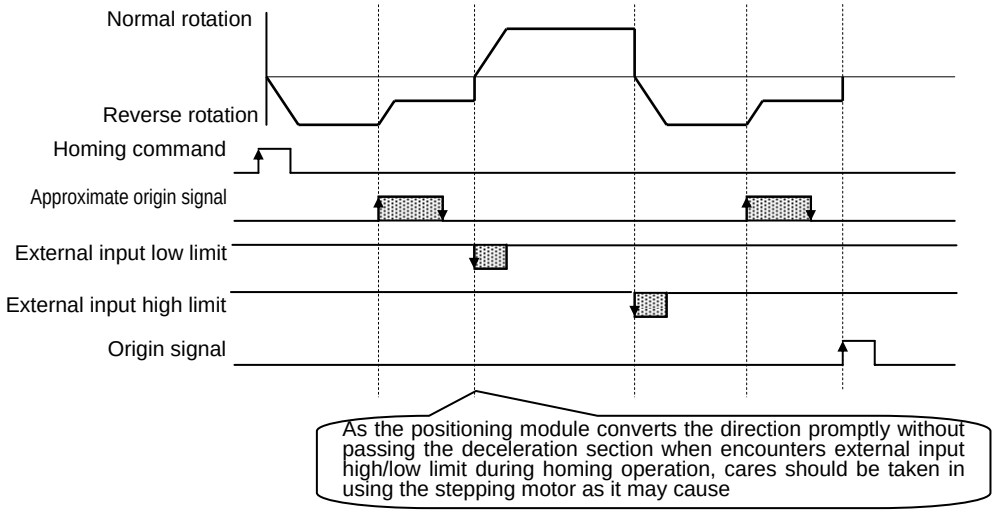
While approximate origin signal maintains “On”, the origin will not be determined by origin signal.
That is, when approximate origin signal changes from “Off” to “On”(acceleration section -> homing high speed) , from “On” to “Off” (deceleration section -> homing low speed) and then when the origin changes from “Off” to “On”, the origin will be determined.



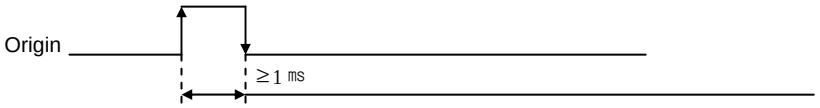
While the homing speed acts to the deceleration section by homing high speed after the approximate origin signal is changed from “Off” to “On”, from “On” to “Off”, the origin will not be determined even if encounters the origin input.



3. If the approximate origin signal is changed from “Off” to “On”, from “On” to “Off” and encounters external high/low limit while waiting the origin input, the action is as follow.



If “On” time of the origin is short, the positioning module can not recognize it.



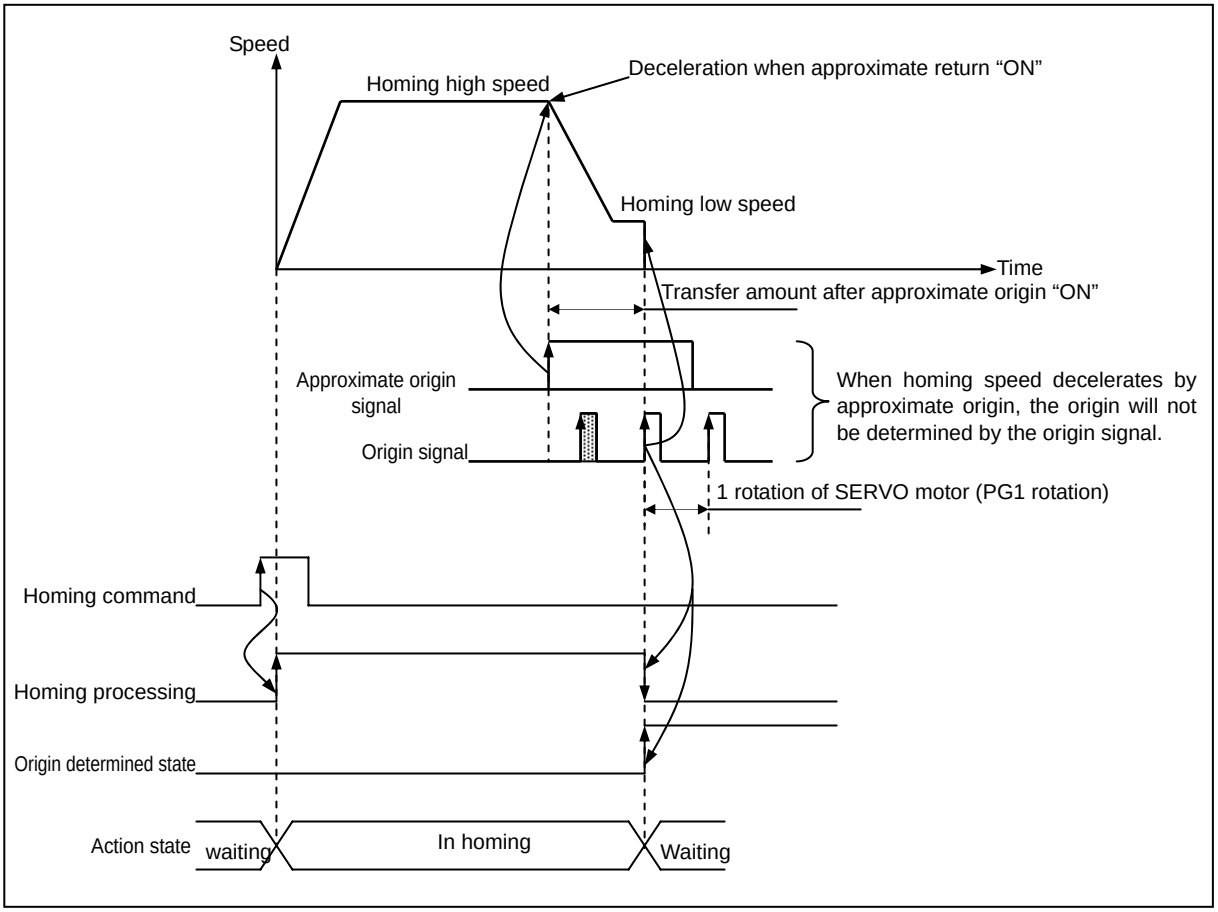
3.6.3 Origin Detection after Deceleration when Approximate origin ON

This is the method using the approximate origin and origin signal and the action by homing command is as follows.

(1) It accelerates to the setting homing direction and acts by homing high speed.

(2) In this case, if approximate origin as external input is entered, it decelerates and acts by homing low speed.

(3)If encounters the origin signal as external input signal when the approximate origin is “ON” while the homing low speed is active, the origin shall be determined and it stops.



Point

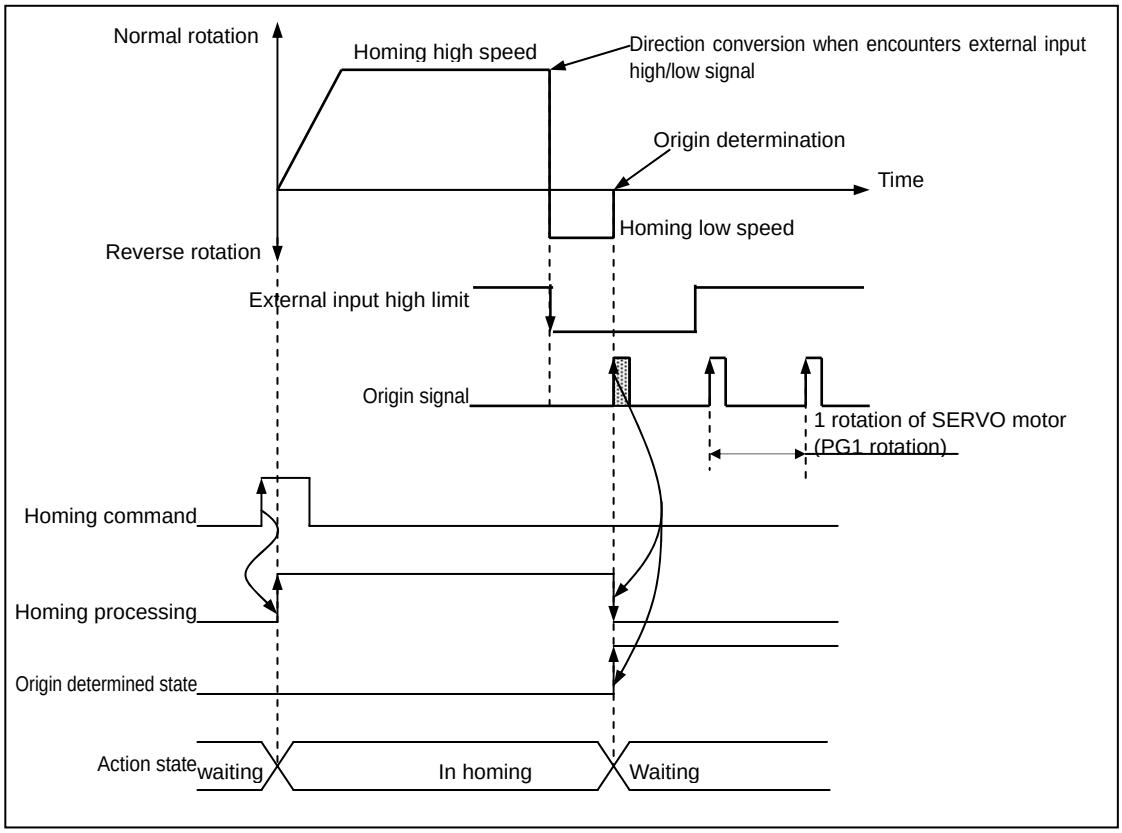
1) Once the approximate origin signal is “On”, when the homing speed acts from high speed to low speed via deceleration section, if the origin signal is entered in the state that the approximate origin signal is “ON”, the origin will be determined promptly.
That is, when the homing speed decelerates, the origin will not be determined by the origin signal.

2) When encounters the external input high/low limit signal before origin after the approximate origin signal has changed from “Off” to “On”, the action will be the same as the method of Article 3.6.2.

3) If “On” time of origin signal is short, the positioning module cannot recognize it.

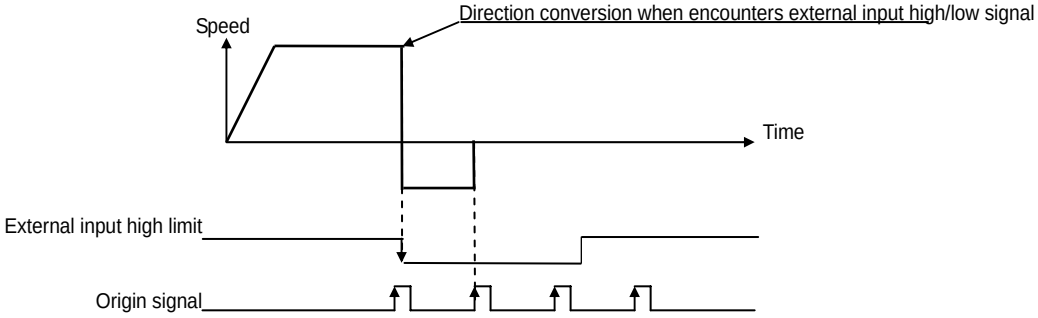
3.6.4 Origin Detection by Origin and High/Low Limit

This is used in case that it is close between external input high/low signal and the approximate origin signal.



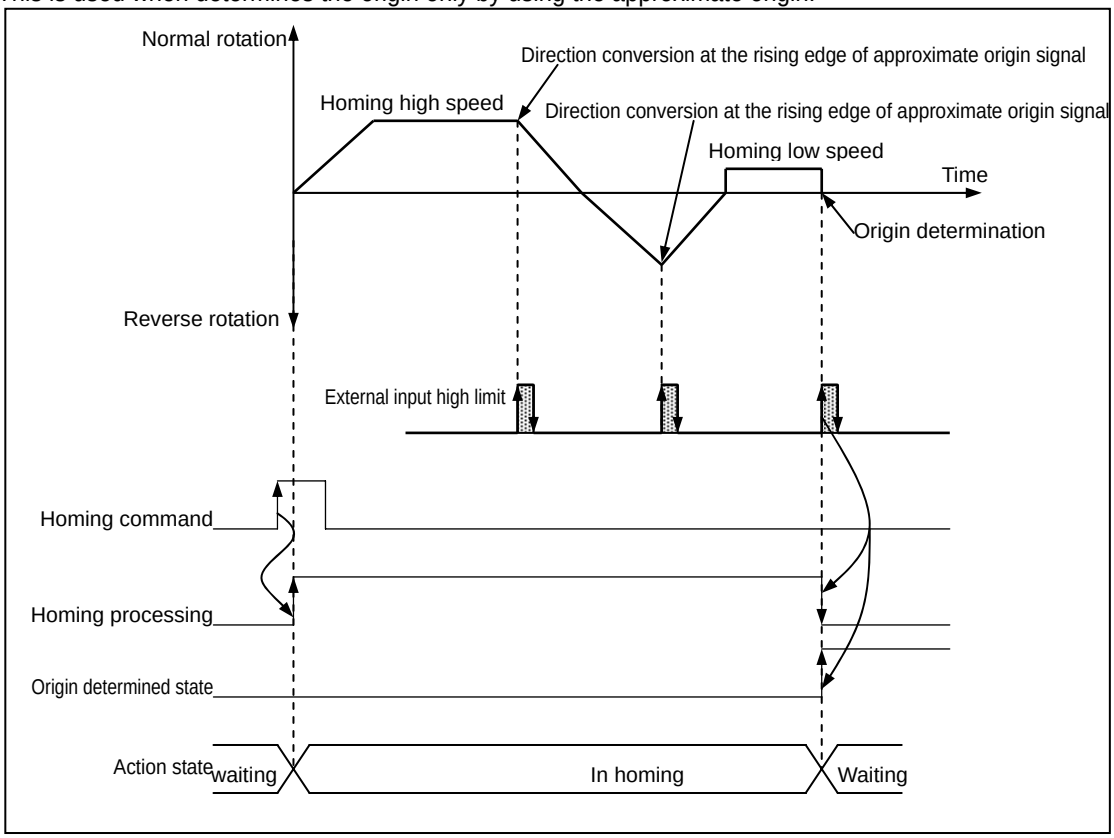
Point

1. In case that origin signal is “ON” before entering the external input high/low limit signal, it carries out the homing low speed operation when the external input high/low limit signal is entered and when origin signal is “ON”, the origin will be determined.



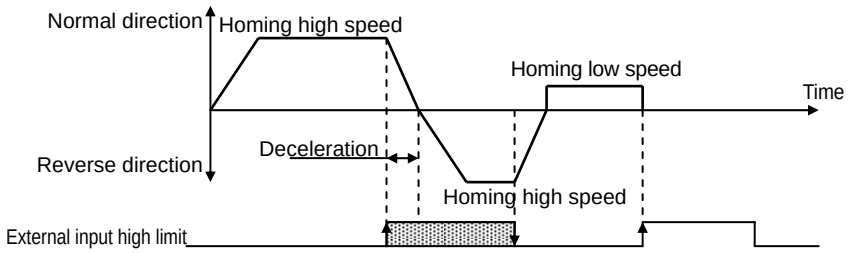
3.6.5 Origin Detection by Approximate Origin

This is used when determines the origin only by using the approximate origin.



Point

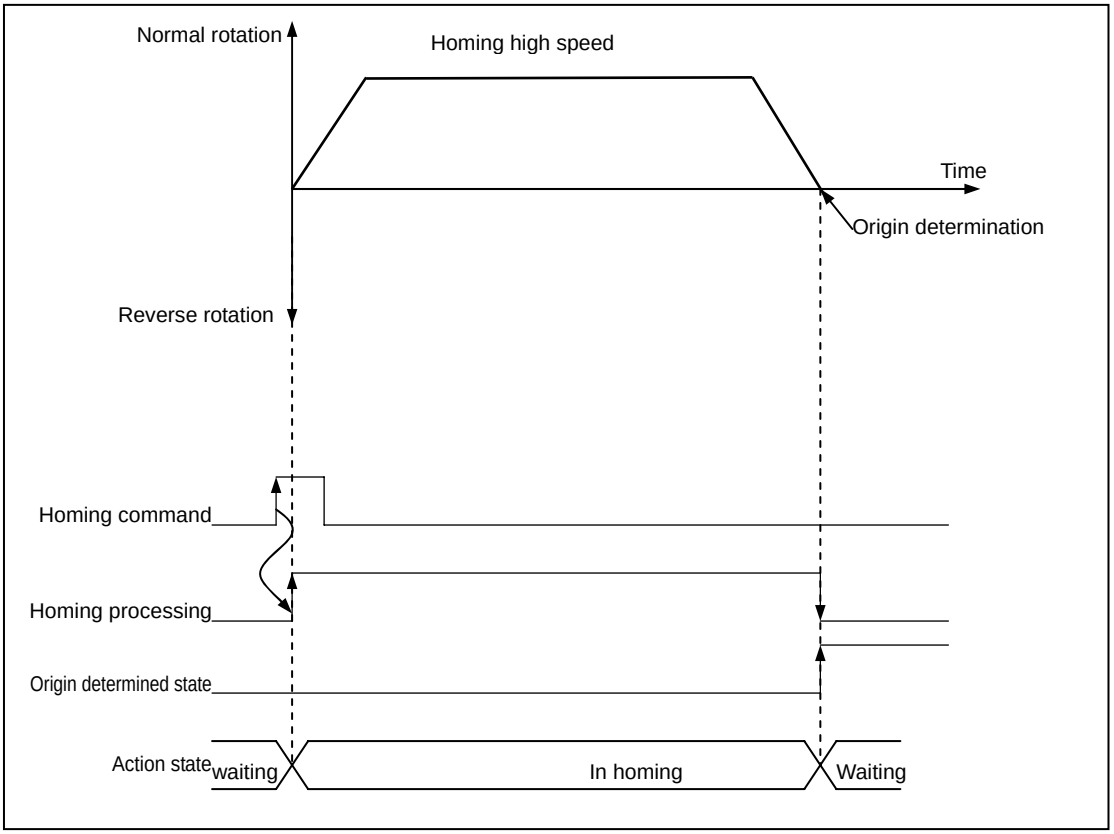
1. If “ON” time of approximate origin is longer than deceleration time, the action is as follows.



3.6.6 High Speed Homing

1) High speed origin detection is one of the homing methods that returns to the origin determination position without detection of external signal (approximate origin, origin signal, High/Low limit) when returning to the mechanical origin position after completion of the mechanical homing.

2) The operation pattern of High speed homing is as below.



3.7 Manual Operation

Manual operations includes Jog operation, Manual pulse generator operation, inching operation, previous position movement of manual operation etc.

3.7.1 JOG Operation (Level input)

1) JOG operation

▶carries out the positioning control by Jog command.

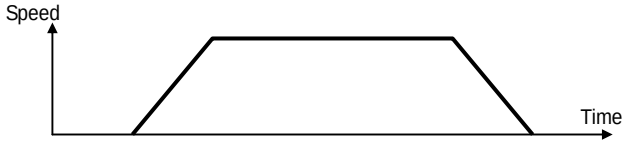
▶carries out the monitoring when the positioning acts by Jog command and the position address is changed.

▶This is used when acting without origin determination.

2) Acceleration/Deceleration Processing and Jog speed

(1) The acceleration/deceleration processing is controlled based on the setting time of Jog acceleration/ deceleration time from Software Package parameter setting.

▶Jog high speed/low speed operation : operation pattern with acceleration/deceleration



(2) If Jog speed is set out of the setting range, error will occur and the operation does not work.

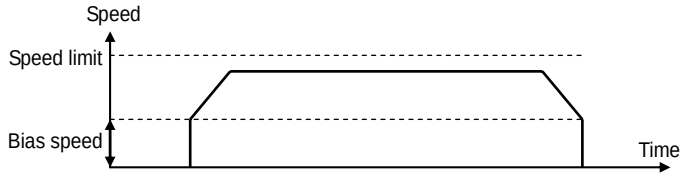
Setting range	Jog high speed operation	1～200,000 (open collector type) 1～1,000,000 (line driver type)	(Setting range :1pps)
	Jog low speed operation	1～Jog high speed	

Point

The notices when setting Jog speed is as follows.

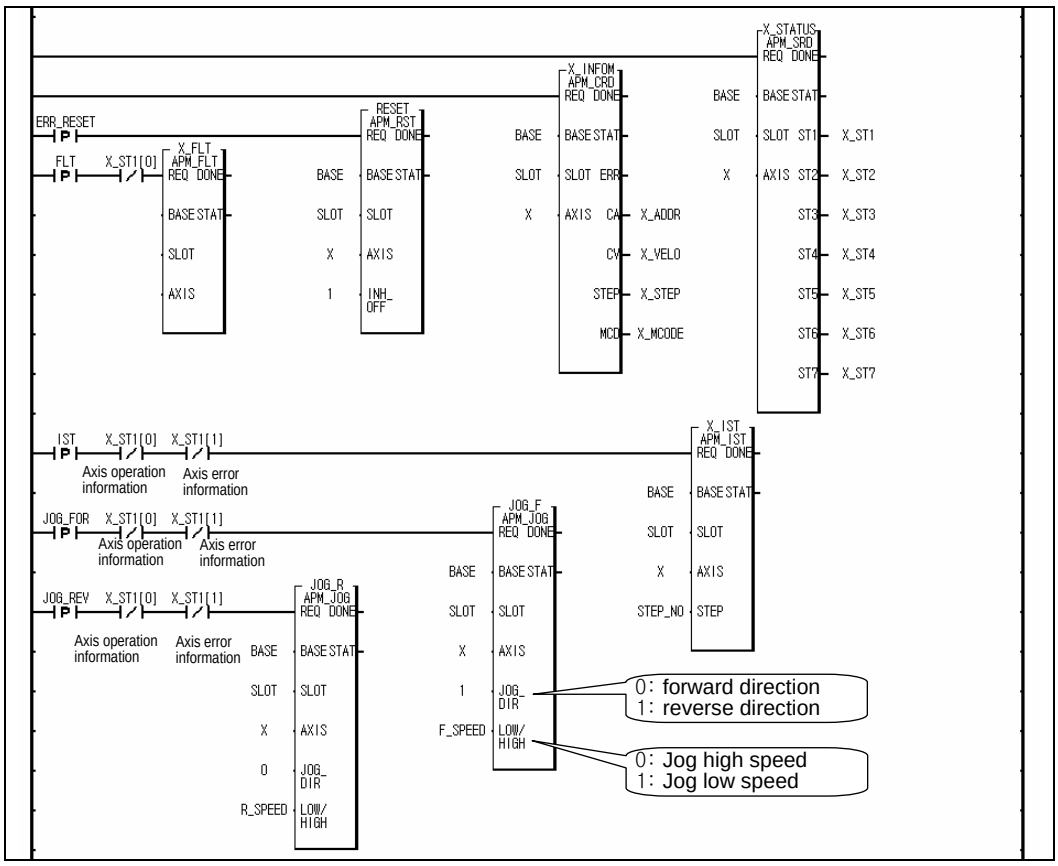
1) Jog high speed setting

Bias speed ≤ Jog high speed ≤ Speed limit



2) Jog low speed acts regardless of Bias sped and Speed limit.

▷Program



Program 3.8 Jog Operation

3.7.2 Manual Pulse Generator (or Encoder) Operation

1) Manual Pulse Generator Operation :

▶carries out the positioning control by the pulse entering from manual pulse generator.

▶this is used when carry out the precise positioning by manual.

2) Manual Pulse Generator Operation

(1) If executes Manual pulse generator operation permitted command, it becomes the state of manual pulse operation permitted.
From this time, this acts as the positioning control by the pulse entering from manual pulse generator.

(2) After releasing it by manual pulse generator operation prohibited command, it carries out the positioning operation by next start (start command, homing command, interpolation operation, jog operation, inching operation, synchronous start, synchronous start).

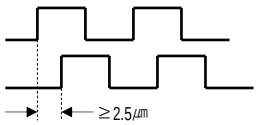
(3) It acts regardless of origin determined state or origin unsettled state.

(4) The pulse entered from manual pulse generator increases or decreases from the current position.

(5) Transfer direction shall be determined by the difference of phase.

▷normal direction positioning : when A phase input pulse proceeds B phase input pulse.

▷reverse direction positioning : when B phase input pulse proceeds A phase input pulse.



When A phase input pulse proceeds B phase input pulse, the position address increases.

When B phase input pulse proceeds A phase input pulse, the position address decreases.

(6) Encoder input mode of common parameter should be set as one of Phase A/B(2 phase1 multiplication /2 multiplication /4 multiplication).

3) Encoder operation

(1) Select one input mode from Encoder input mode of common parameter that corresponds to Encoder output signal of SERVO driver for the encoder operation.

(2) Encoder input speed available for Encoder operation is max. 200kpps.

(3) Count value by encoder input shall be indicated as Encoder value.

(4) It is available to set the Count range of actual encoder value by Encoder Auto Reload value of common parameter.
Ex) Auto Reload value : 100,000 Indication range of encoder value : 0 ~ 100,000

(5) Encoder input mode has 7 kinds of input mode.
(CW/CCW(1phase 1multiplication), CW/CCW(1phase 2 multiplication), PLS/DIR(1phase 1 multiplication), PLS/DIR(1phase 2 multiplication), PHASE A/B(2phase 1 multiplication), PHASE A/B(2phase 2 multiplication), PHASE A/B(2phase 4 multiplication))

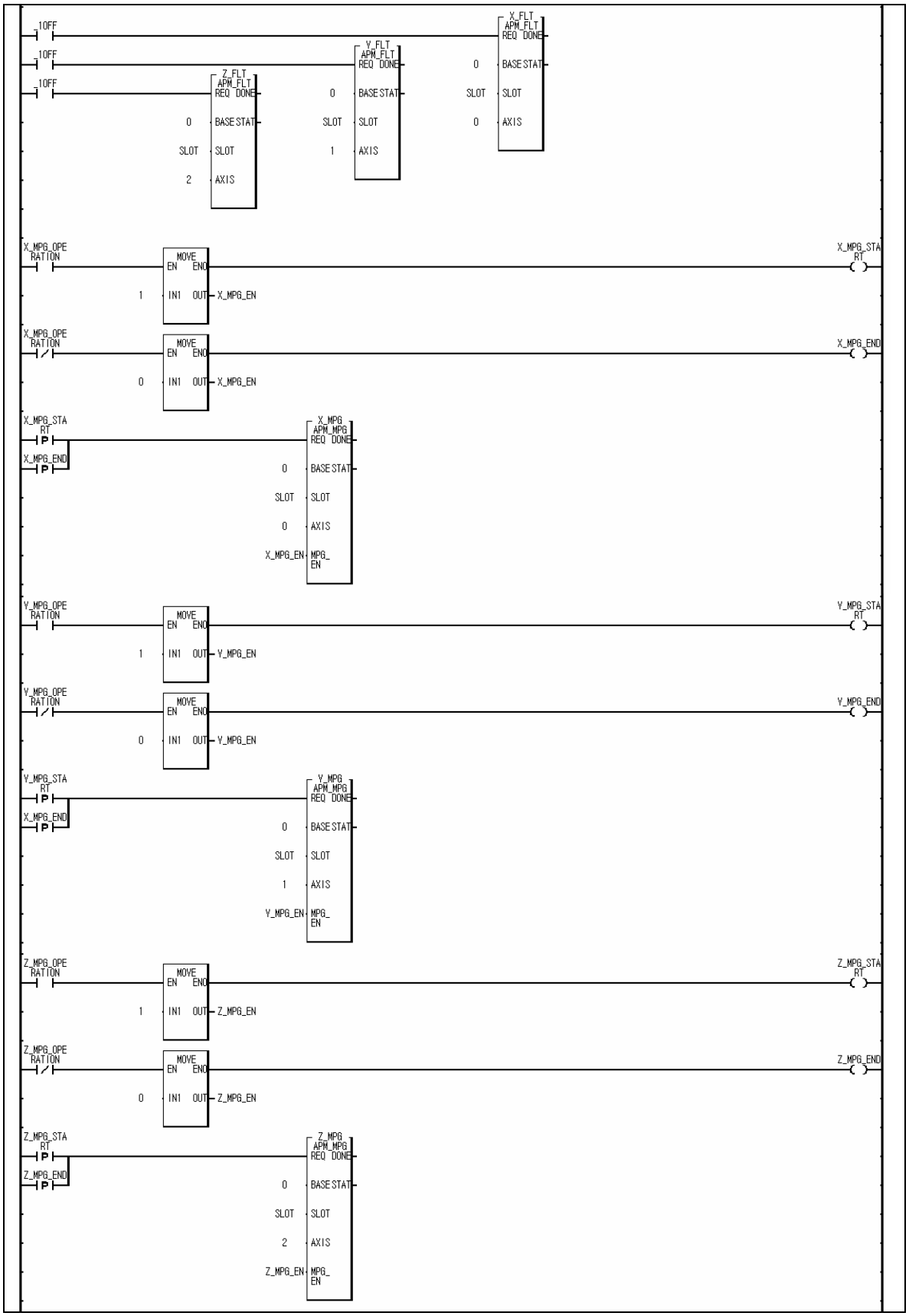
(6) The possibility of encoder operation shall be determined according to the setting of encoder input mode and the combination of pulse output type for encoder operation.

Input pulse type	Output pulse type	Possibility
Phase A/B 1 multiplication Phase A/B 2 multiplication Phase A/B 4 multiplication	CW/CCW	○
	PHASE A/B	×
	PLS/DIR	○
PLS/DIR 1 multiplication PLS/DIR 2 multiplication	CW/CCW	○
	PHASE A/B	×
	PLS/DIR	○
CW/CCW 1 multiplication CW/CCW 2 multiplication	CW/CCW	○
	PHASE A/B	×
	PLS/DIR	×

▷ If output pulse type is set wrong during operation by encoder input, error 424 will occur.

▷Program(used to CNC machine by 3 axis MPG operation)

The origin complete is not needed in the APM O/S V2.2 upper.

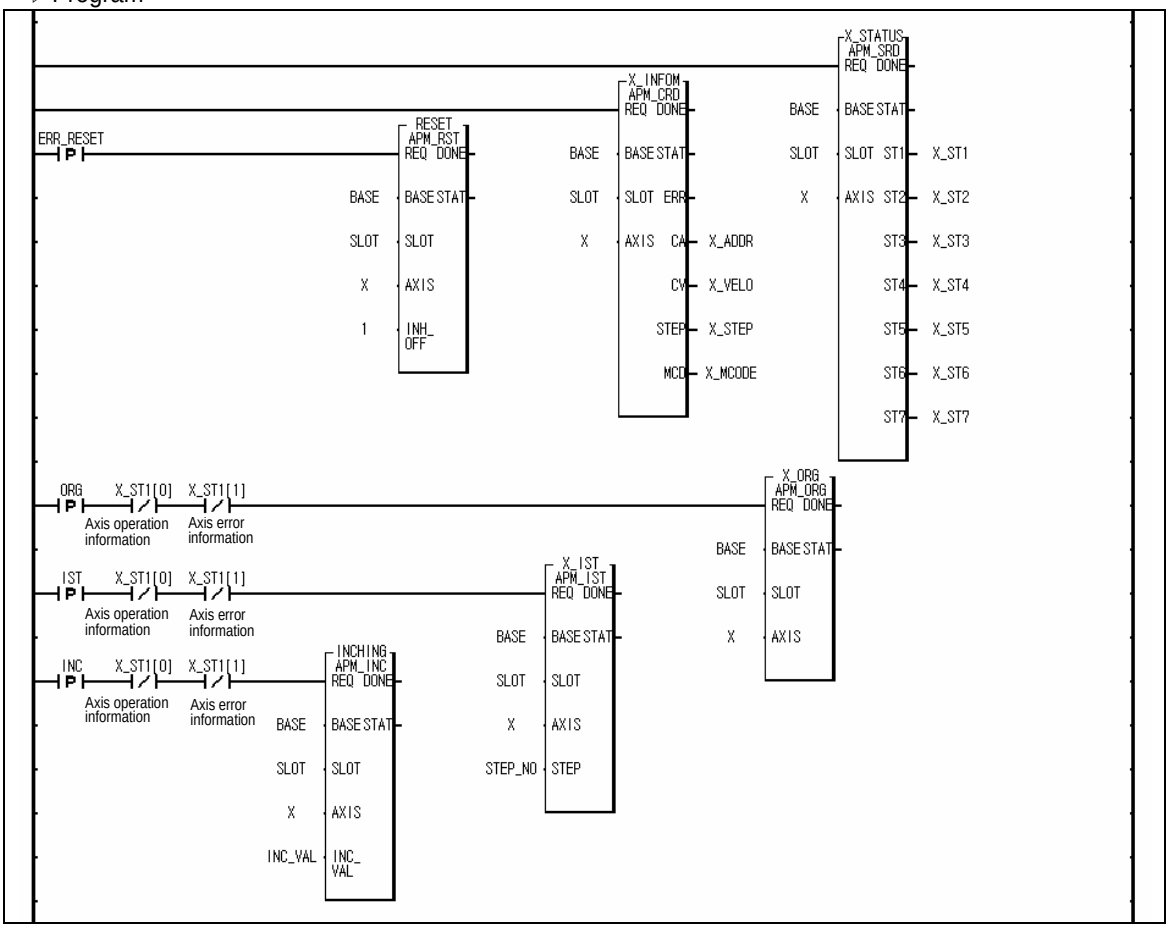


Program 3.9 Manual Pulse Generator

3.7.3 Inching Operation

- ▶This is a kind of manual operation and outputs as much as the pulse amount by the speed set in the inching speed from origin/manual parameter.
- ▶While the operation by Jog command is difficult in moving to the correct position as the operation starts and stops according to the command, the inching command enables to set the desired transfer amount easily and reach the goal point.
- ▶Thus, it is available to reach the correct goal position by moving fast near the working position by Jog command and operating the detail movement by inching command.
- ▶The setting range is –2147483648 ~2147483647 Pulse.

▷Program



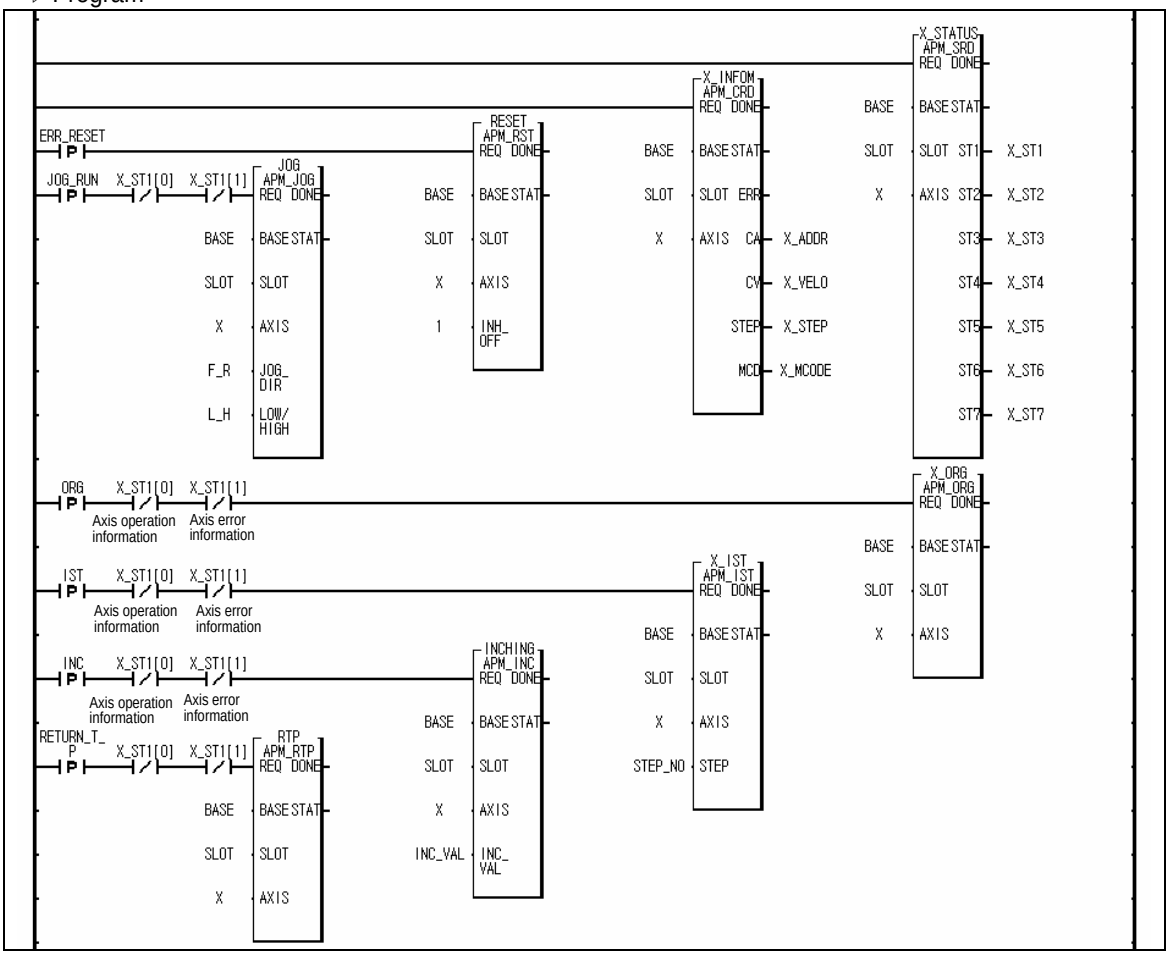
Program 3.10 Inching Operation

3.7.4 Return to the Position before Manual operation

▶This function is used to return to the position address that the positioning is completed before manual operation when the position is changed by manual operation (Jog operation, inching operation, manual pulse generator operation).

▶The transfer speed is operated by the setting speed of homing low speed from manual/origin parameter.

▷Program



Program 3.11 Return to the position before Manual operation

Point

▶ If the current position address in operation is “A” and the position address changed by manual operation (jog operation and inching operation) is “B”, it returns to the previous position “A” before manual operation by return to the previous position before manual operation command

3.8 Speed Change during Positioning Operation

3.8.1 Speed Override Command

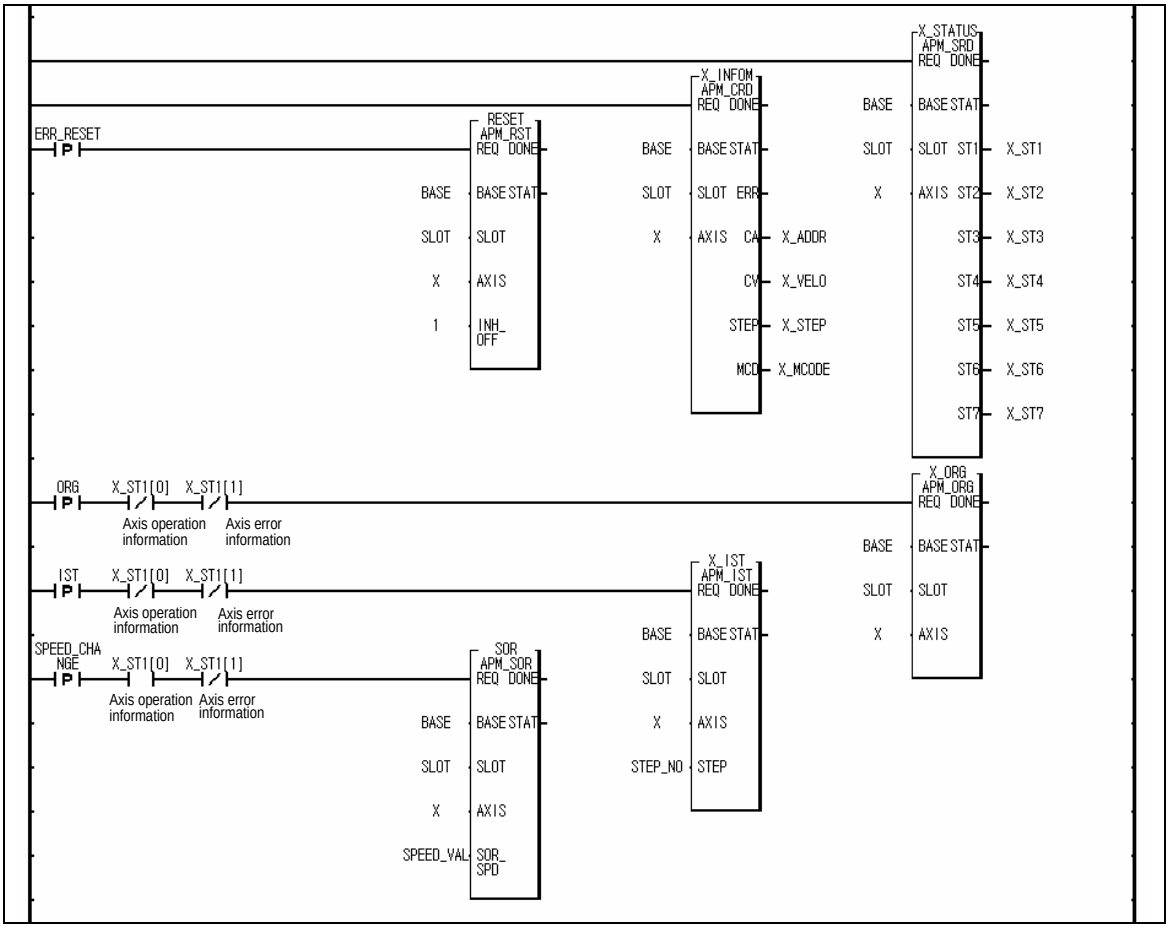
▶Speed override command is used only in the acceleration/constant speed section from operation pattern and the available operation mode is End operation, Go-on operation, Continuous operation.

▶The setting range is as follows

Open collector type : 1 ~ 200,000pps (Setting range : 1pps).

Line driver type : 1 ~ 1,000,000pps (Setting range : 1pps).

▷Program



Program 3.12 Speed Change

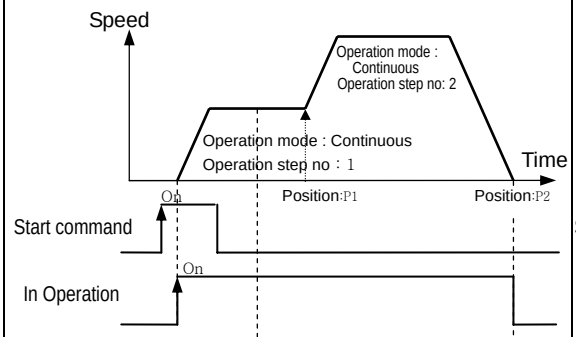
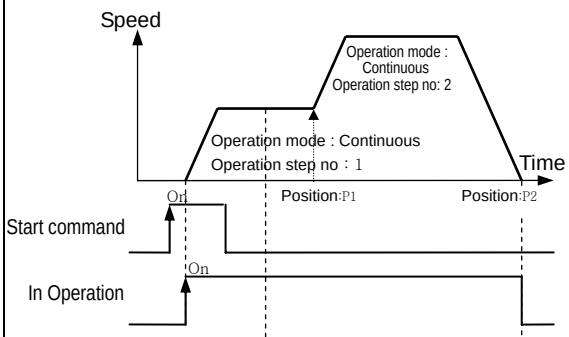
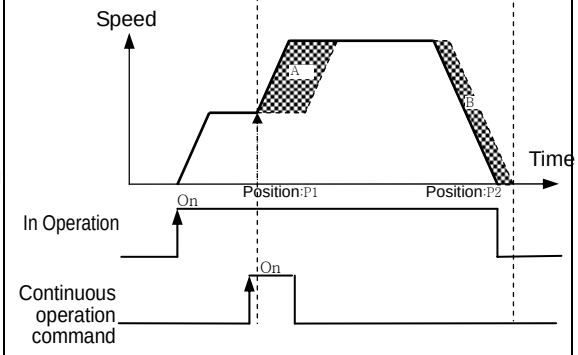
Point

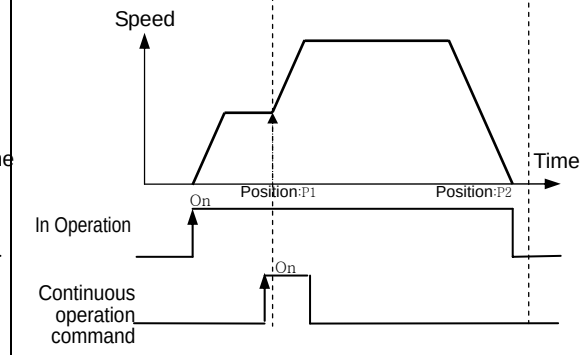
▶If the difference between the current speed using in operation and the speed changed newly by speed override is too big, abnormal motor operation will occur. Thus, cares should be taken in using.

▶If speed override command is executed in deceleration section during operation, Error 377 will occur and it continues to operate.

3.8.2 Operation Step No. Change by Continuous Operation

- ▶This is used in the operation mode (End, Go-on, Continuous operation) and in the operation pattern (Acceleration, Constant speed, Deceleration section).
- ▶If Continuous operation command is used during operation, the current operation step no. moves to the next operation step no.
- ▶According to the position data setting (Absolute coordinate/Relative coordinate), there is a difference of action in the Continuous operation command.

<table>
<tr><th></th><th>▶When using in the Absolute coordinate</th><th>▶When using in the Relative coordinate</th></tr>
<tr><td>If not using Continuous operation command,</td><td> 
</td><td> 
</td></tr>
<tr><td>When using Continuous operation command,</td><td> 

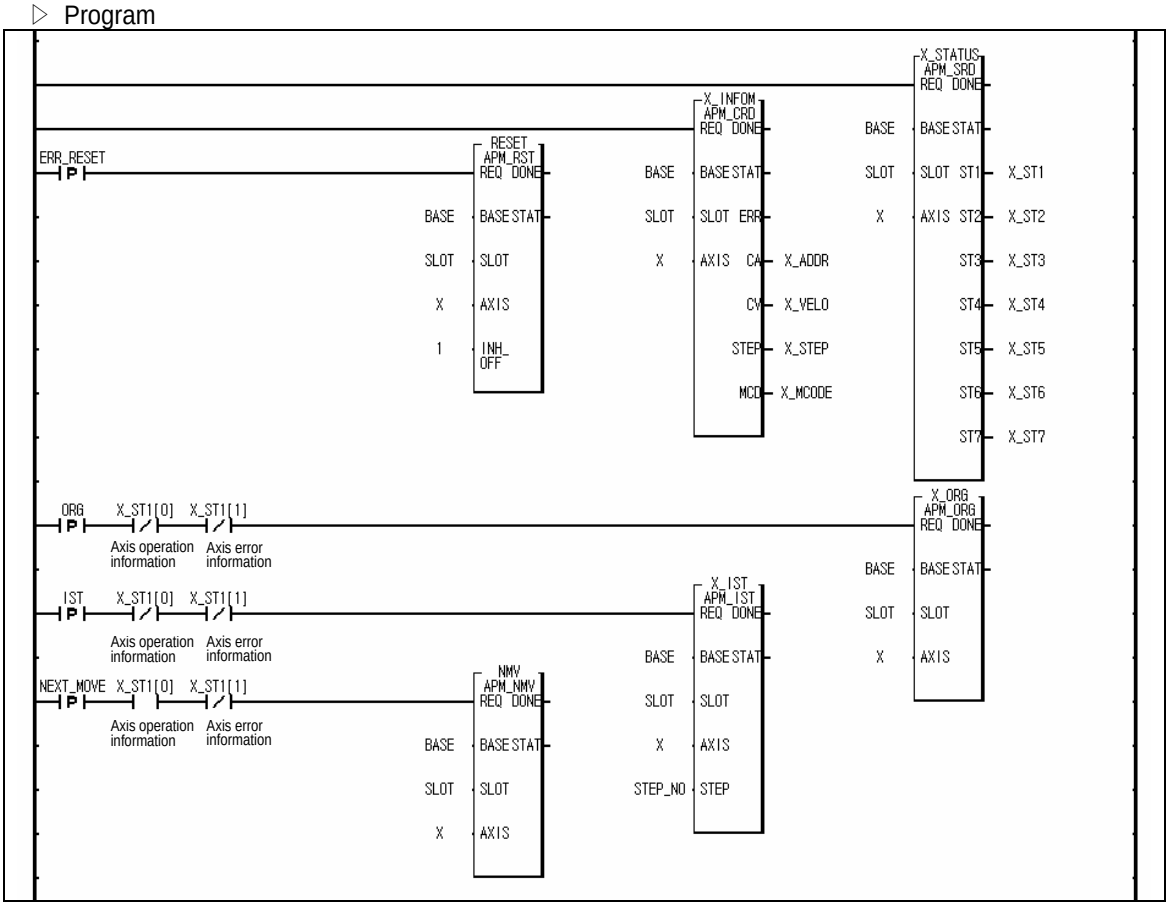
▷ The area of “A section” and “B section” is same.
▷ The current position set by Continuous operation command is P2.</td><td> 

▷ The setting goal position is P1 + P2 but the current position set by Continuous operation command is P1' + P2.</td></tr>
</table>

Point

- ▶If the positioning in Continuous operation mode is too small, it stops to operate by Continuous operation command and carries out the next step operation. Thus, cares should be taken in using.
- ▶In case of operating to the same direction by Continuous operation command (Next Move) from End, Go-on, Continuous operation mode, it continues to operate without stopping but in case of changing the rotation direction (normal=> reverse, reverse=>normal), the Continuous operation command is not be carried out. Thus, cares should be taken in using.

▷ Program



Program 3.13 Operation Step No. Change by Continuous Operation

3.8.3 Positioning Speed Override Command

1) This is the command to operate by the changed operation speed if it reaches the setting position during positioning operation.
2) This command is used only in Acceleration and Constant speed section from operation pattern and the available operation mode is End, Go-on, Continuous operation.
3) As this command is not carried out in Deceleration section, cares should be taken in using.
4) The position setting range is –2147483648 ~ 2147483647 Pulse.
5) The operation speed setting range is as follows

Open collector type : 1 ~ 200,000pps (setting unit : 1pps).

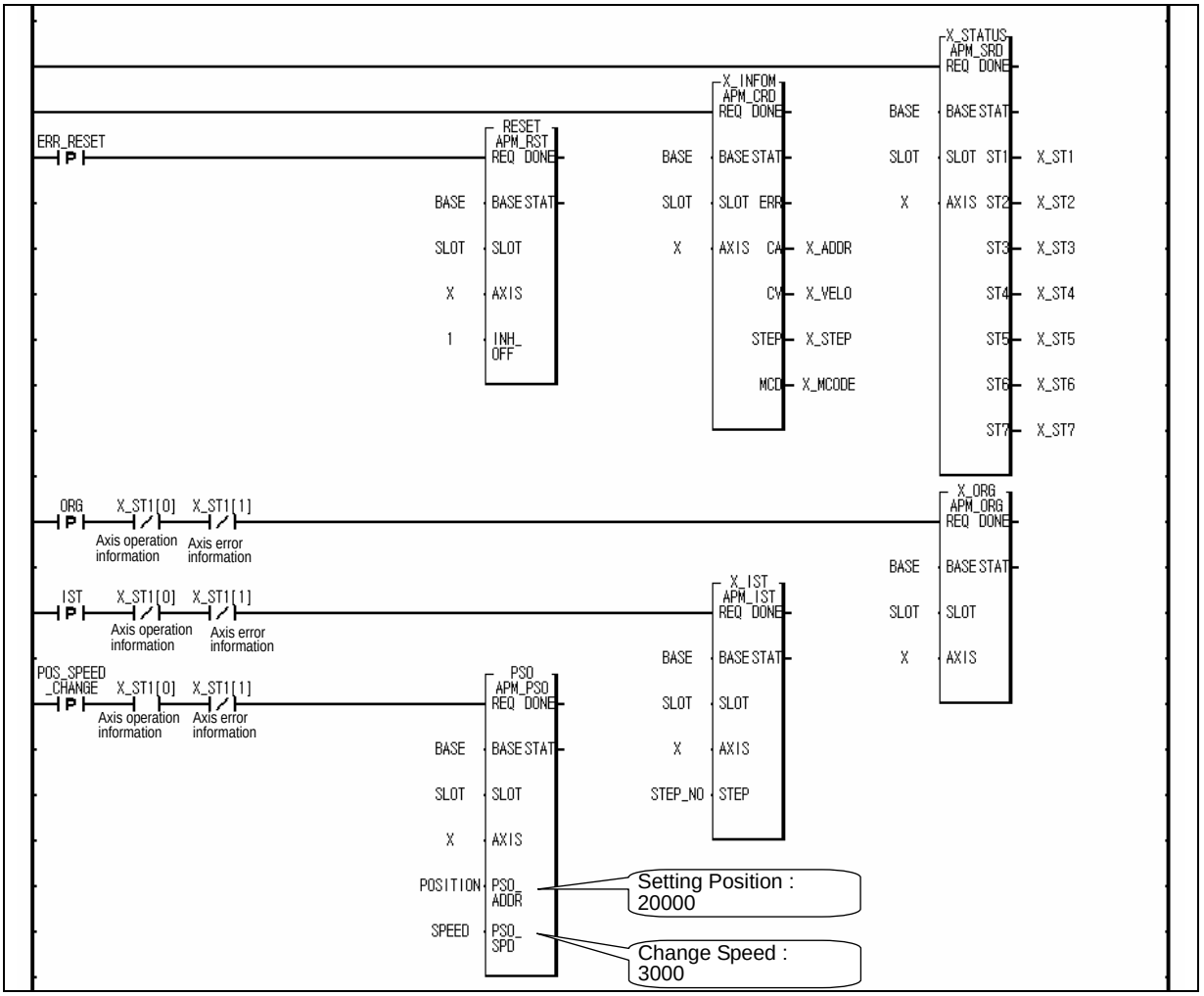
Line driver type : 1 ~ 1,000,000pps (setting unit : 1pps).

[Example]

▷Positioning Software Package Setting

Step no.	Coordinate	Control method	Operation pattern	Operation method	Goal position [pulse]	Circular interpolation aux. Point [pulse]	M code	Acc./ Dec. no.	Operation speed [pls/s]	Dwell time [ms]	Circular interpolation direction
1	Absolute	Position	End	Single	100000	0	0	1	1000	0	CW

▷Program



Program 3.14 Positioning Speed Override Command

3.9 Position Change during Positioning Operation

3.9.1 Position Change by Position Override

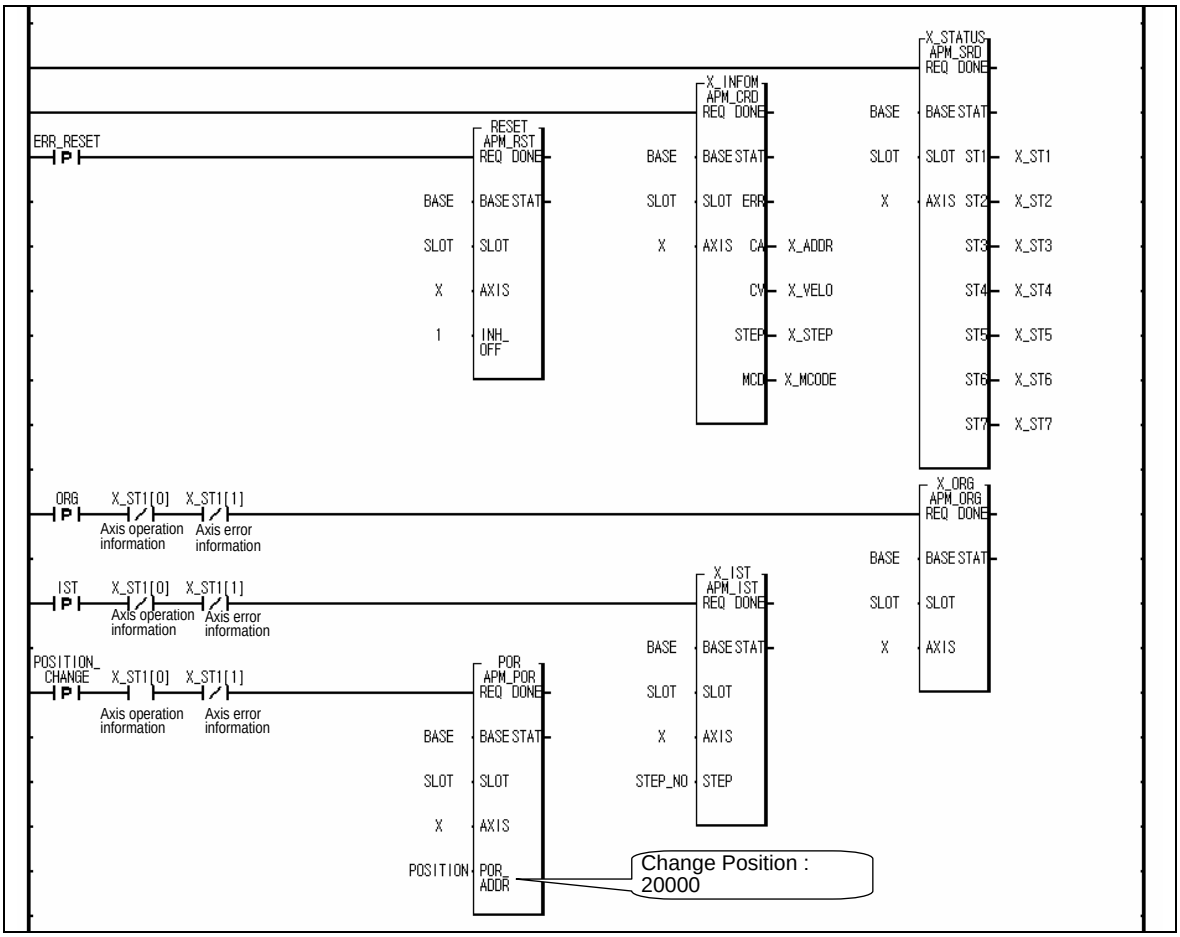
1) This is used to change the goal position during positioning operation by positioning data.
2) As the operation is different according to Position Override command during operation, cares should be taken in using.
   That is, if passing the desired position to change during operation, it carries out deceleration stop and continues the positioning operation by next operation pattern while if not passing yet, it carries out the positioning operation by the changed position.
3) Position override command is used in the operation pattern (Acceleration, Constant speed, Deceleration section) and the available operation mode is End operation, Go-on operation, Continuous operation.
4) Position setting range is –2147483648 ~ 2147483647 Pulse.

[Example]

▷Positioning Software Package Setting

Step no.	Coordinate	Control method	Operation pattern	Operation method	Goal position [pulse]	Circular interpolation aux. Point [pulse]	M code	Acc./ Dec. no.	Operation speed [pls/s]	Dwell time [ms]	Circular interpolation direction
1	Absolute	Position	End	Single	100000	0	0	1	1000	0	CW

▷Program



Program 3.15 Position Change by Position Override command

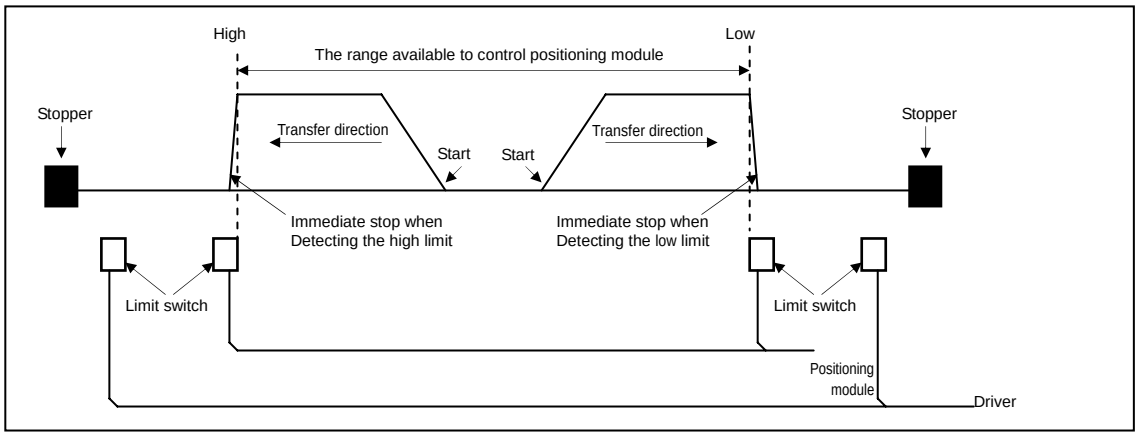
3.10 Stroke high/low Limit

Positioning module includes External input stroke limit (external input high limit signal, external input low limit signal) and Software stroke limit (Software upper/lower limit).

3.10.1 External Input Stroke High/Low Limit

▶External input stroke limit includes External input high limit signal and External input low limit signal as external input connector of positioning module.

▶This is used to stop the positioning module promptly before reaching Stroke limit/Stroke End of the Driver by installing the stroke limit of positioning module inside Stroke limit/Stroke end of the Driver.
In this case, if it deviates the high limit, Error 492 will occur and if it deviates the low limit, Error 493 will occur.



▶ If positioning module stops out of the range available to control, the positioning operation does not work.
If it stops by external input stroke limit detection, move within the range of positioning module available to control by manual operation (Jog operation, inching operation, manual pulse generator operation).

▶ As external input stroke high/low limit error is detected by the edge of positioning module, it is available to release the output prohibit out of stroke range and carry out manual operation.

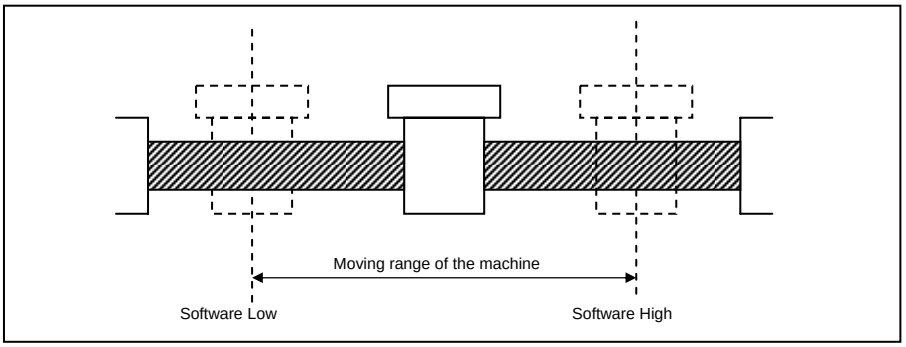
Point

▶In case of using either high limit or low limit of the sensor connected to external input stroke high/low limit, both high and low limit signal are not detected. Thus, the signal not used should be connected to N.C(Normal Close)

3.10.2 Software Stroke Upper/Lower Limit

▶Software stroke upper/lower limit is the function that does not carry out the positioning when operating out of the setting range of stroke upper/lower limit by software package parameter.

▶The range check of stroke upper limit and stroke lower limit shall be done when it starts to operate and during operation, respectively.



▶In case of operating out of the setting range, this function does not carry out the positioning for that command.

Point

▶Software upper/lower limit detection is not carried out in the origin unsettled status.

▶In case of occurring output prohbit by upper/lower limit error, convert it to the origin unsettled status and move to the stroke area by manual operation (Jog operation) and then carry out the homing again.

▶ If setting S/W upper/lower limit as “0”, it enables to carry out the positioning operation ultimately without detecting the internal input stroke upper/lower limit. Thus, please refer to this when Fixed-feed control.
But, in case of normal rotation operation, if it reaches the current position max. 2147483647, the current position is changed with –2147483648 and continues the normal rotation while in case of reverse rotation operation, if it reaches the current position min. –2147483648, the current position is changed with 2147483647 and continues the reverse rotation.

[Example]

▷Positioning Software Package Setting in case of Fixed-Feed control

<Operation Data Setting>

Step no.	Coordinate	Control method	Operation pattern	Operation method	Goal position [pulse]	Circular interpolation aux. Point [pulse]	M code	Acc./ Dec. no.	Operation speed [pls/s]	Dwell time [㎳]	Circular interpolation direction
1	Relative	Position	End	Repeat	1000	0	0	1	100	0	CW

<Parameter Setting>

Extended parameter	S/W upper limit	0 pls
	S/W lower limit	0 pls

3.11 Random Position Address Value Setting to the Origin and The Change of the current Position

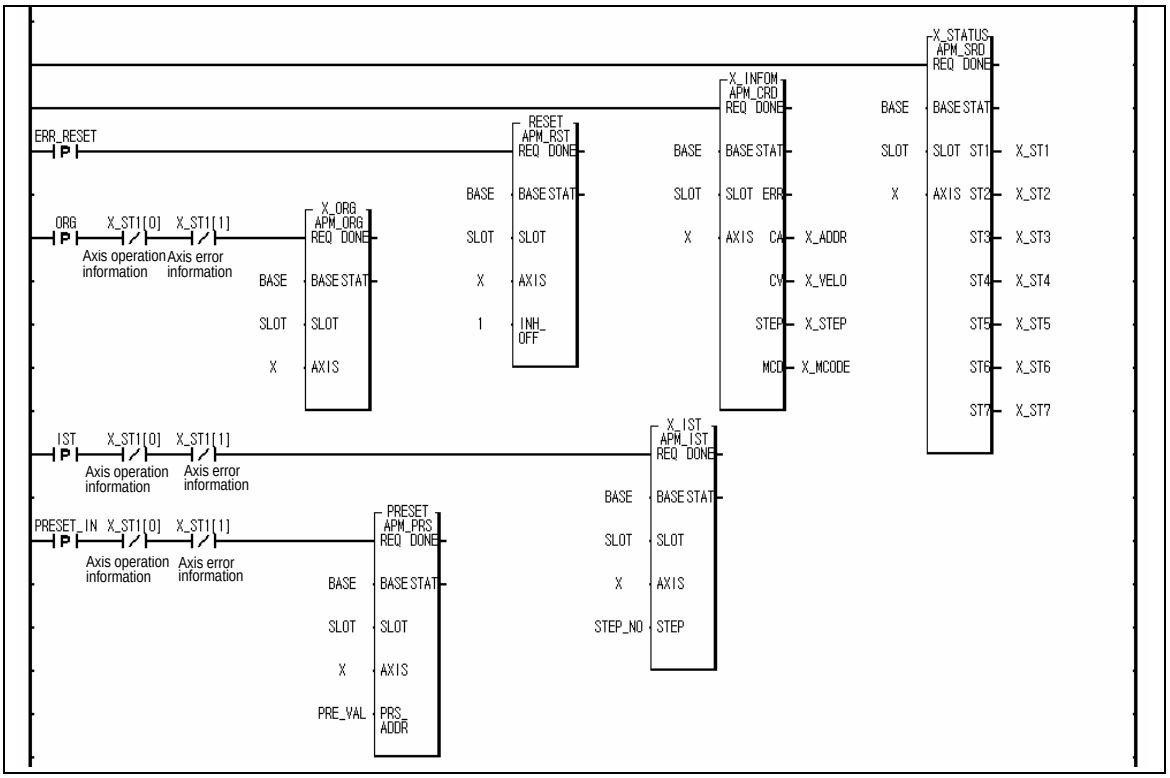
3.11.1 Random Position Address Setting to the Origin

- ▶Available to set the random position address by using the homing address item of Software package parameter.
- ▶Available to confirm the random position address of the setting axis by the current operation status code information read function block after completing the floating point setting or the homing.
- ▶And also available to confirm it by the current position after completing the floating point setting from software package monitor or the homing.

3.11.2 The Change of the current Position

- ▶The change of the current position is to change the current address with random address.
- ▶If the change of current position command is executed in the origin unsettled status, it is changed with the origin settled status.
- ▶If the current position is changed by the change of the current position command, the mechanical origin executed by the homing command is changed. Thus, it is required to execute the homing again.

▷Program



Program 3.16 The change of current Position

3.12 Floating Point Setting

▶This is used to force to set the current position as the origin without carrying out the homing action of the machine.

▶The position set in this case is the setting value from the homing address.

Point

▶As the floating point setting forces to set the current position as the origin by the homing address, the following cares should be taken in the program that has the floating point setting as the origin.

1. If error occurs, remove the error cause and reset the error and then release the output prohibit,
2. Set the floating point again, and
3. Change the desired operation step no. by the operation step no. setting before starting.

3.13 Teaching

▶This is to change the goal position of positioning data step no. set in the positioning address by manual operation (Jog operation, manual pulse generator operation).

▶ Teaching function (position teaching, speed teaching) is available for the axis in positioning operation.

But, this is limited only for RAM teaching function and teaching is available only for the step no. that is not in operation at the present.

▶In case of changing the goal position ad operation speed frequently, this function is used very conveniently.

Position teaching is to change the goal position and Speed teaching is to change the operation speed.

▶Teaching function includes Single teaching and Plural teaching that has RAM teaching and ROM teaching respectively.

3.13.1 RAM Teaching and ROM Teaching

1)RAM Teaching

When the positioning module acts in Power-ON, it is available to use it by changing the speed and position address but if the power is OFF, you may lose the speed and position address.

2)ROM Teaching

When the positioning module acts in Power-ON, it is available to use it by changing the speed and position address and even if the power is OFF, the used speed and position address shall be preserved permanently.

Point

▶ROM teaching is limited in the number of use and cares should be taken in using. (allowable number: 100,000)

▶The method to increase the number of use (when acting the teaching operation as one step) are as follows.

1) Set the 400 operation step by software package as repeat operation,
2) Count the teaching number from PLC program and if it reaches 99,000 comparing with less than 100000 (99,000), carry out the operation step no. change (APM_SNS) to the next operation step, and then
3) Max. teaching number shall be 99,000X400=39,600,000 available to use.

3.13.2 Single Teaching

▶This is used to change the goal position or operation speed set in one step from positioning operation step.

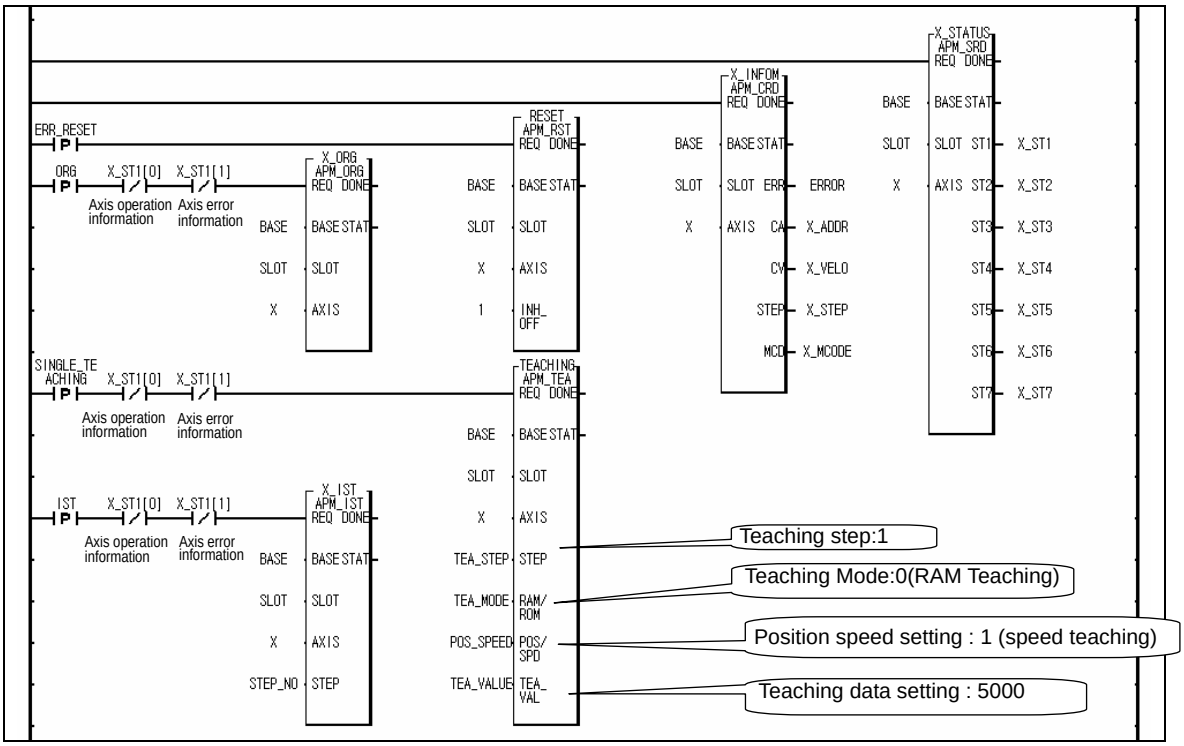
▶In case of RAM Teaching Mode, single teaching in operation is possible

[Example]

▷ Positioning Software Package Setting

Step no.	Coordinate	Control method	Operation pattern	Operation method	Goal position [pulse]	Circular interpolation aux. Point [pulse]	M code	Acc./ Dec. no.	Operation speed [pls/s]	Dwell time [ms]	Circular interpolation direction
1	Absolute	Position	End	Repeat	100000	0	0	1	100	0	CW

▷Program



Program 3.17 Single Teaching

3.13.3 Plural Teaching

▶This is used to change the goal position or operation speed set in the several step from positioning operation step. (Max. 16)

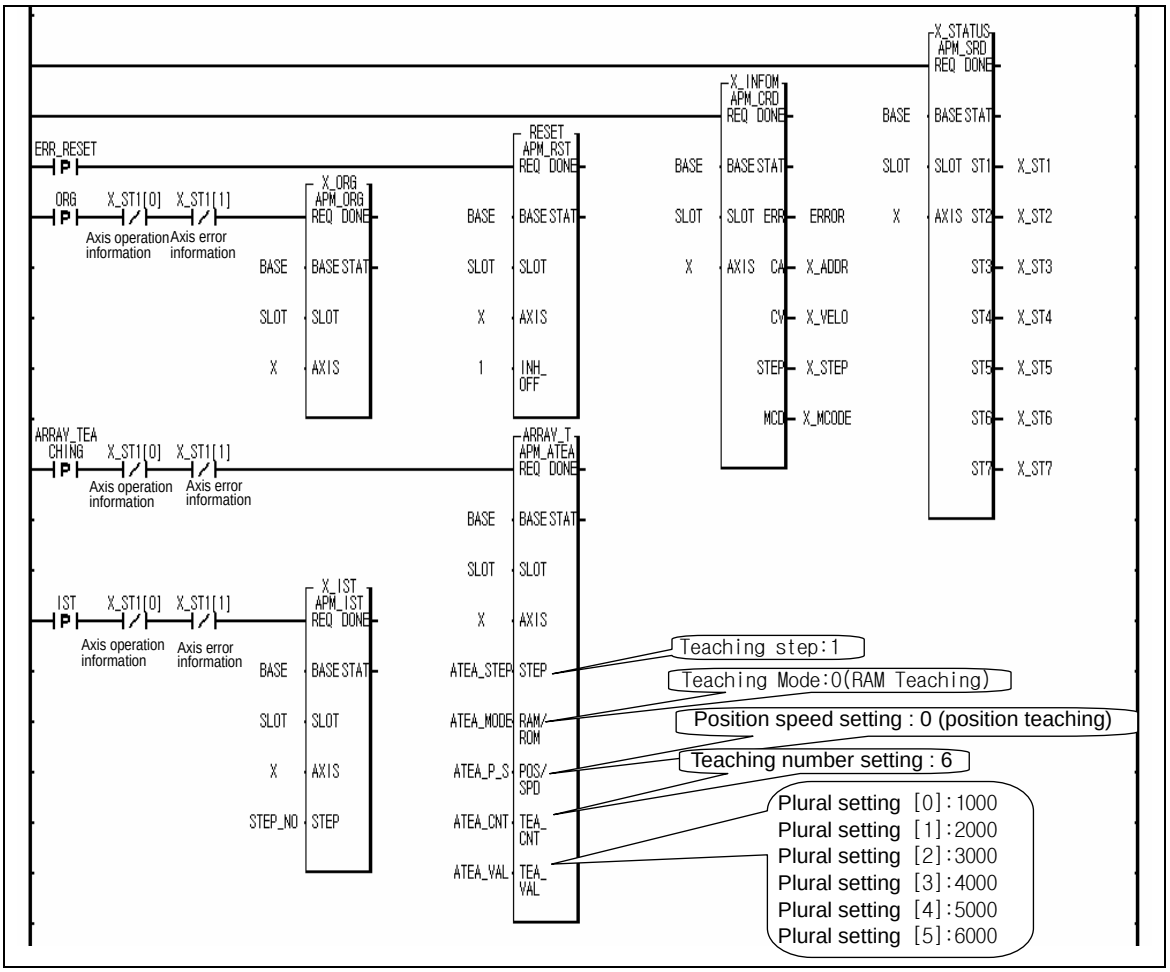
▶In case of RAM Teaching Mode, plural teaching in operation is possible

[Example]

▷Operation data setting

Step no.	Coordinate	Control method	Operation pattern	Operation method	Goal position [pulse]	Circular interpolation aux. Point [pulse]	M code	Acc./ Dec. no.	Operation speed [pls/s]	Dwell time [ms]	Circular interpolation direction
1	Absolute	Position	End	Single	10000	0	0	1	100	0	CW
2	Absolute	Position	End	Single	20000	0	0	1	150	0	CW
3	Absolute	Position	End	Single	30000	0	0	1	200	0	CW
4	Absolute	Position	End	Single	40000	0	0	1	250	0	CW
5	Absolute	Position	End	Single	50000	0	0	1	250	0	CW
6	Absolute	Position	End	Single	60000	0	0	1	300	0	CW

▷Program



Program 3.18 Plural Teaching

3.14 Start Step No. Change

▶ This is used to change the operation step no. to start only when it is in Stop status.

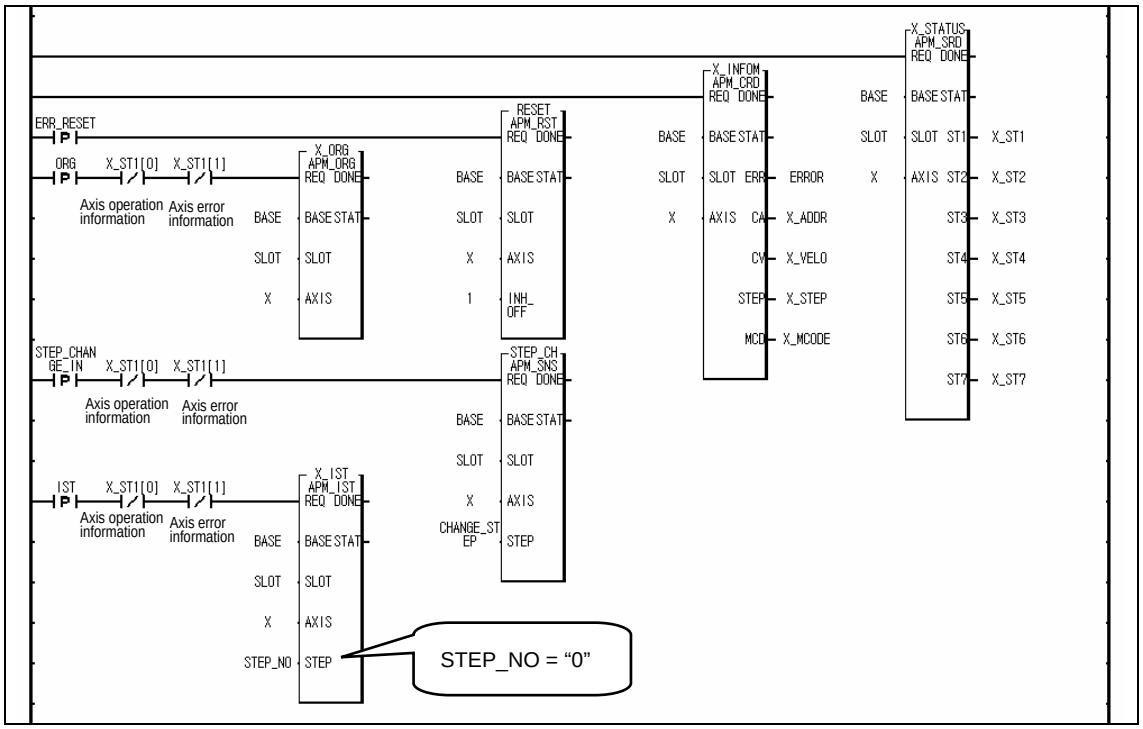
[Example]

▷ Software Package Setting

No. of Program start command	Step no.	Coordinate	Control method	Operation pattern	Operation method	Goal position [pulse]	Circular interpolation aux. Point [pulse]	M code	Acc./ Dec. no.	Operation speed [pls/s]	Dwell time [ms]	Circular interpolation direction
1	1	Relative	Position	End	Single	1000	0	**0**	1	100	0	CW
2	2	Relative	Position	End	Single	2000	0	**0**	1	150	0	CW
Step no. change by Operation step no. setting [APM_SNS: Rising edge ↑] : "10"												
3	10	Relative	Position	Go-on	Single	1000	0	**0**	1	100	0	CW
	11	Relative	Position	Go-on	Single	2000	0	**0**	1	150	0	CW
	12	Relative	Position	Go-on	Single	3000	0	**0**	1	200	0	CW
	13	Relative	Position	End	Single	4000	0	**0**	1	250	0	CW
Step no. change by Operation step no. setting [APM_SNS: Rising edge ↑] : "20"												
4	20	Relative	Position	End	Single	5000	0	**0**	1	300	0	CW

If setting the step no. as "0" by indirect start command, it carries out the positioning operation by the current operation step no. But, if the current operation step no. is 3 and operation speed is 0, E151 will occur.

▷ Program



Program 3.19 Start Step No. Change

3.15 SKIP Operation

▶This is used in case that the operation mode is End, Go-on, Continuous and the operation pattern is in Acceleration, Constant speed, Deceleration section.

▶If SKIP operation command is executed during operation, it moves from the current operation step no. to next operation step no. and carries out the operation.

▶SKIP operation command stops the operation and carries out the operation of next step after executing the command other than Continuous operation command (Next Move).

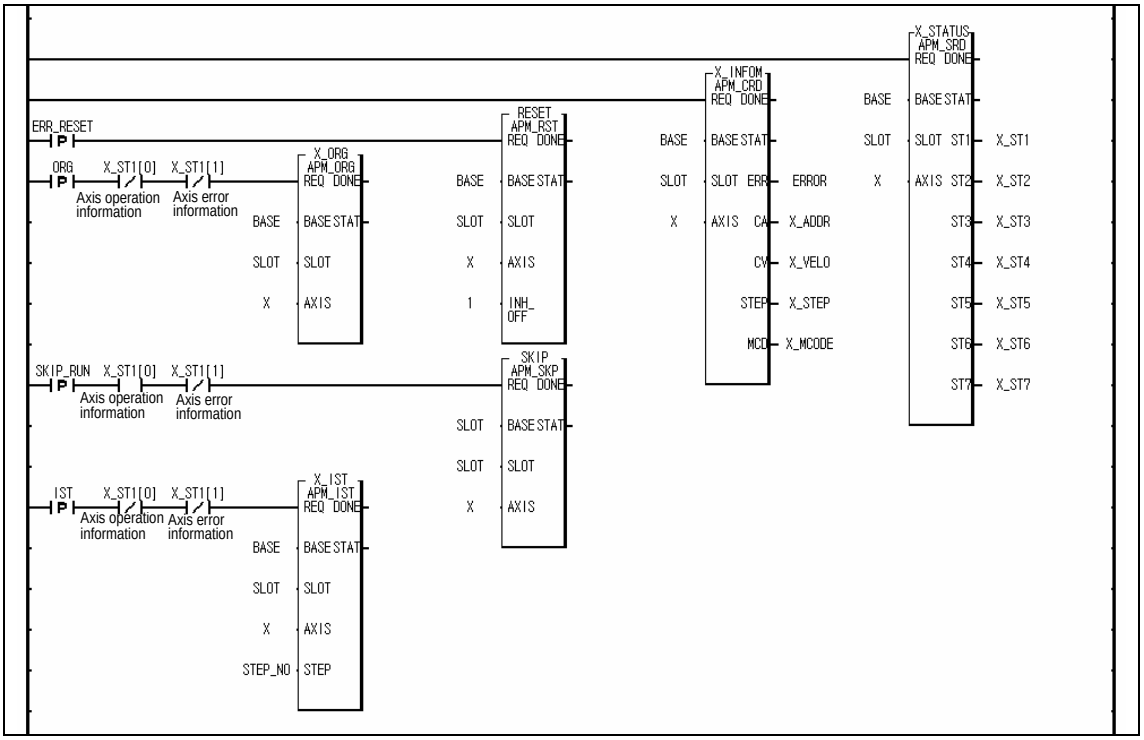
▶If SKIP operation command is executed in the status that the operation data of next step is not yet set, Error 151 will occur.

[Example]

▷Software Package Setting

No. of Program start command	Step no.	Coordinate	Control method	Operation pattern	Operation method	Goal position [pulse]	Circular interpolation aux. Point [pulse]	M code	Acc./ Dec no.	Operation speed [pls/s]	Dwell time [ms]	Circular interpolation direction
1	1	Absolute	Position	Go-on	Single	1000	0	**0**	1	1000	0	CW
	2	Absolute	Position	Go-on	Single	2000	0	**0**	1	1500	0	CW
	3	Absolute	Position	Go-on	Single	3000	0	**0**	1	2000	0	CW
	4	Absolute	Position	End	Single	4000	0	**0**	1	2500	0	CW

▷Program



Program 3.20 SKIP Operation

3.16 Repeat Operation Step no. Change

▶In case of repeat operation mode setting (End, Go-on, Continuous operation), the current operation step no. will be changed automatically to operate the step no.1 when repeat operation mode setting step completes the positioning operation but if start step no. change command is executed in repeat operation, the step no. will be changed with the assigned step no. not the step no.1 .

▶The start step no. change command in repeat operation can be executed during positioning operation.

▶This function is needed for the positioning operation by external start or the positioning operation by K200S/K300S P contact start (P(n+1)0, P(n+1)5, P(n+1)A) in repeat operation.

▶This function may not be used in case of the positioning operation by indirect start by setting the step no. directly.

▶For Program, please refer to Article 3.7 Single Operation (repeat operation step no. change).

3.17 M Code

▶ This is used to confirm the current operation step no. and carry out the auxiliary work (Clamp, Drill rotation, Tool change etc.) by reading M code from the current operation status code read function block output variable “MCD” of the program.

▶ M code should be set in the M code item of operation data.(Setting range : 1 ~ 65535)
If M code is set as “0”, M code signal will not occur.

▶ M code mode is set from the item of the extended parameter. (0 : NONE, 1 : WITH, 2:AFTER)

▶ If M code occurs, M code no.(1 ~ 65535) and M code signal (On) will occur simultaneously.

▶ In case of Go-on operation mode, if M code no. and M code signal occur, it is required to release it by M code release command to carry out Go-on operation to the next step without start command.

▶ In case of Continuous operation mode, M code no. and M code signal occurs but it carries out the Continuous operation without giving any effect to the Continuous operation of next step.

▶ M code release command can be used even during operation.

▶ For further information, please refer to Article 5.2.6 M code output..

[Example]

▷Software Package Setting

<Operation Data Setting>

No. of Program start command	Step no.	Coordinate	Control method	Operation pattern	Operation method	Goal position [pulse]	Circular interpolation aux. Point [pulse]	M code	Acc./ Dec no.	Operation speed [pls/s]	Dwell time [㎳]	Circular interpolation direction
1	1	Absolute	Position	Go-on	Single	10000	0	**10**	1번	1000	0	CW
	2	Absolute	Position	End	Single	20000	0	**20**	1번	2500	0	CW

<Parameter Setting>

Extended parameter	M code output	2 : AFTER

3.18 Parameter Change from Program

▶ This is used to change the Software package setting parameter by using each parameter change command.

▶ The parameter change is available only when the operation stops.

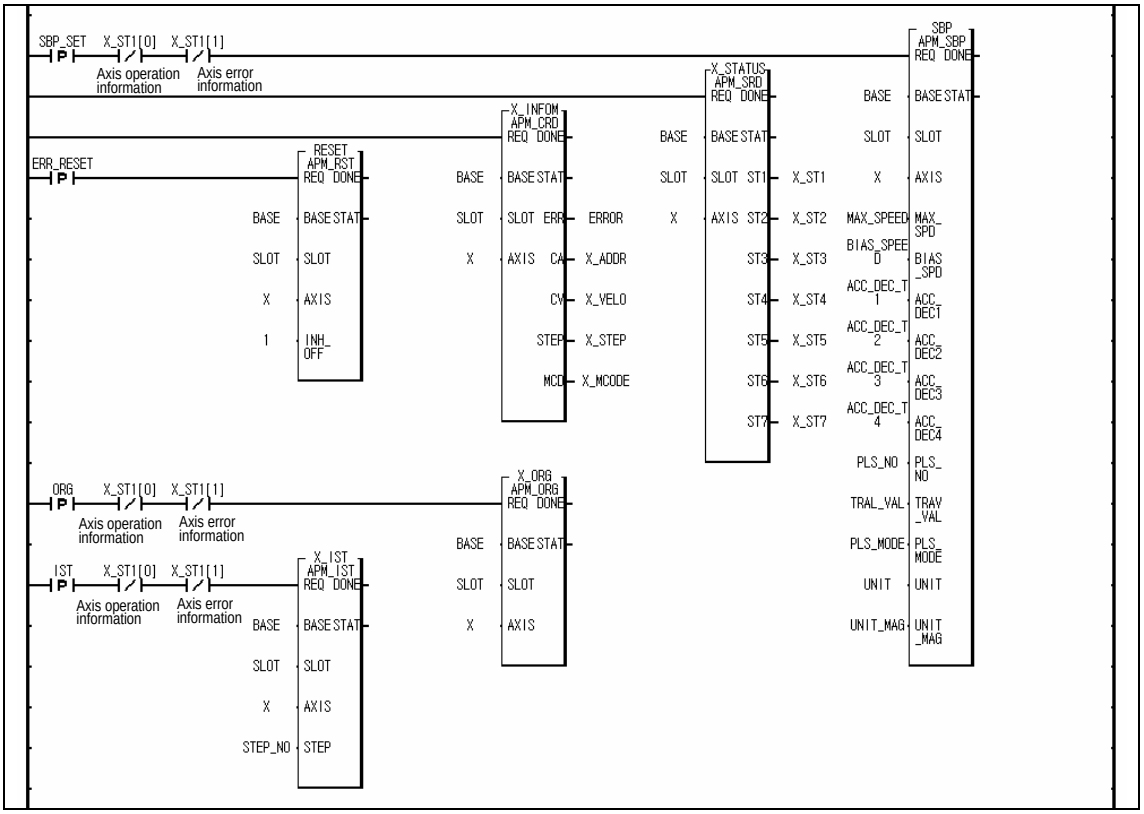
3.18.1 Basic Parameter Setting

▶ The items available to change is as follows.

Basic Parameter	Setting range
Speed Limit	mm : 1 ~ 2,000,000,000[X10^{-2}mm/m], Inch : 1 ~ 2,000,000,000[X10^{-3}Inch/m], degree : 1 ~ 2,000,000,000[X10^{-3} degree/m], pulse : 1 ~ 1,000,000[pulse/s]
Bias Speed	
Acc./Dec.Time No.1(ms)	0 ~ 65,535
Acc./Dec.Time No.2(ms)	
Acc./Dec.Time No.3(ms)	
Acc./Dec.Time No.4(ms)	
Pulse no. per Rotation	1 ~ 65,535
Travel distance per rotation	
Pulse output mode	0:CW/CCW, 1:PULSE/DIR, 2:PHASE
Unit	0:Pulse, 1:mm, 2:Inch, 3:Degree
Unit magnification	0: x 1, 1: x 10, 2: x 100, 3: x 1000

[Example]

▷ Program



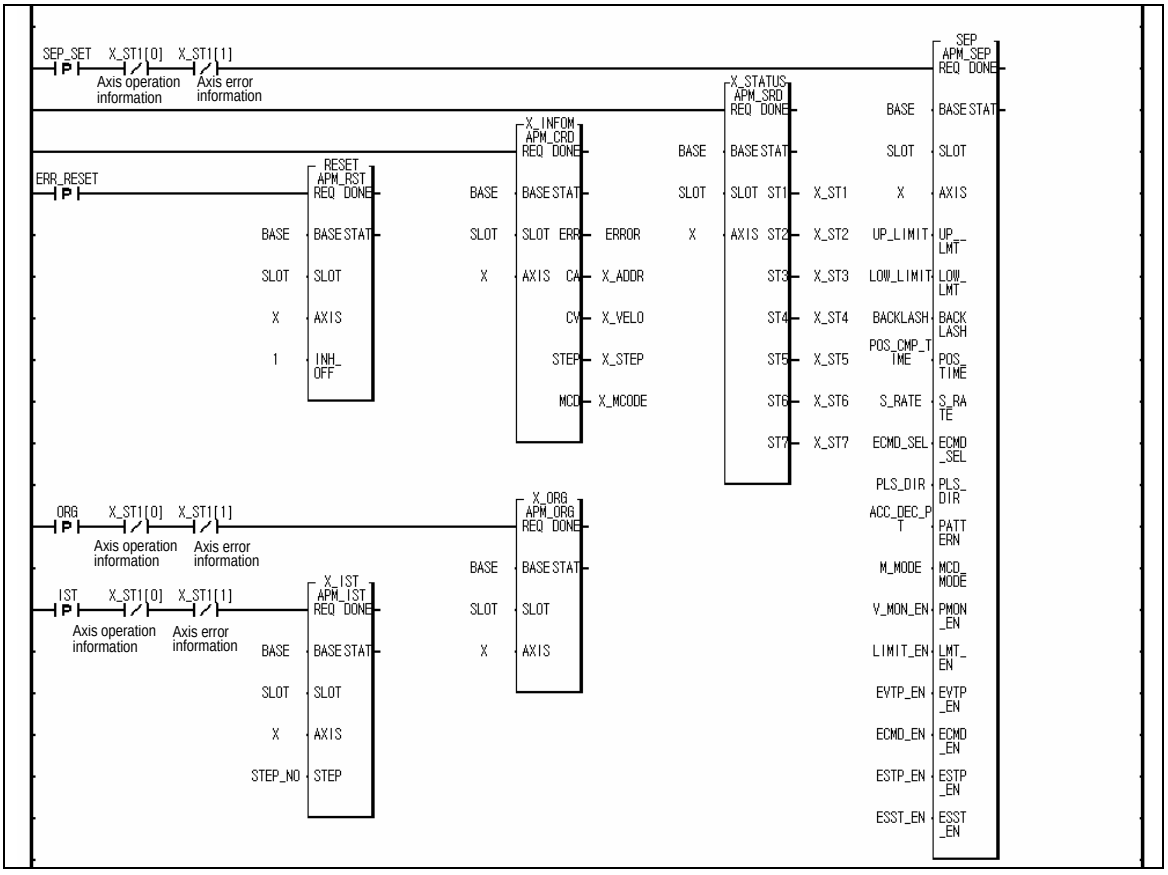
Program 3.22 Basic Parameter Setting

3.18.2 Extended parameter Setting

▶ The items available to change is as follows.

Extended parameter	Setting Range
Soft high limit (upper)	mm : -2,147,483,648 ~ 2,147,483,647 [X10^{-3}mm], Inch : -2,147,483,648 ~ 2,147,483,647 [X10^{-5}Inch], degree : -2,147,483,648 ~ 2,147,483,647 [X10^{-5}degree], pulse : -2,147,483,648 ~ 2,147,483,647 [pulse]
Soft low limit (lower)	
Backlash compensation amount	0 ~ 65,535
Positioning completion signal output time (ms)	
S-Curve rate(%)	1 ~ 100
External command signal selection	0: START, 1: JOG operation, 2:SKIP
Pulse output direction	0:CW, 1:CCW
Acceleration/Deceleration pattern	0: Trapezoid operation, 1:S-Curve operation
M Code mode	0:NONE, 1:WITH, 2:AFTER
Position indication during equal speed operation	0: no indication, 1: indication
Soft high/low limit detection during equal speed operation	0: no detection, 1: detection
External speed/position control switching permitted/prohibited	0: prohibited, 1: permitted
External command permitted/prohibited	
External stop permitted/prohibited	
External synchronous start permitted/ Prohibited	

[Example]



Program 3.23 Extended parameter Setting

3.18.3 Homing parameter Setting

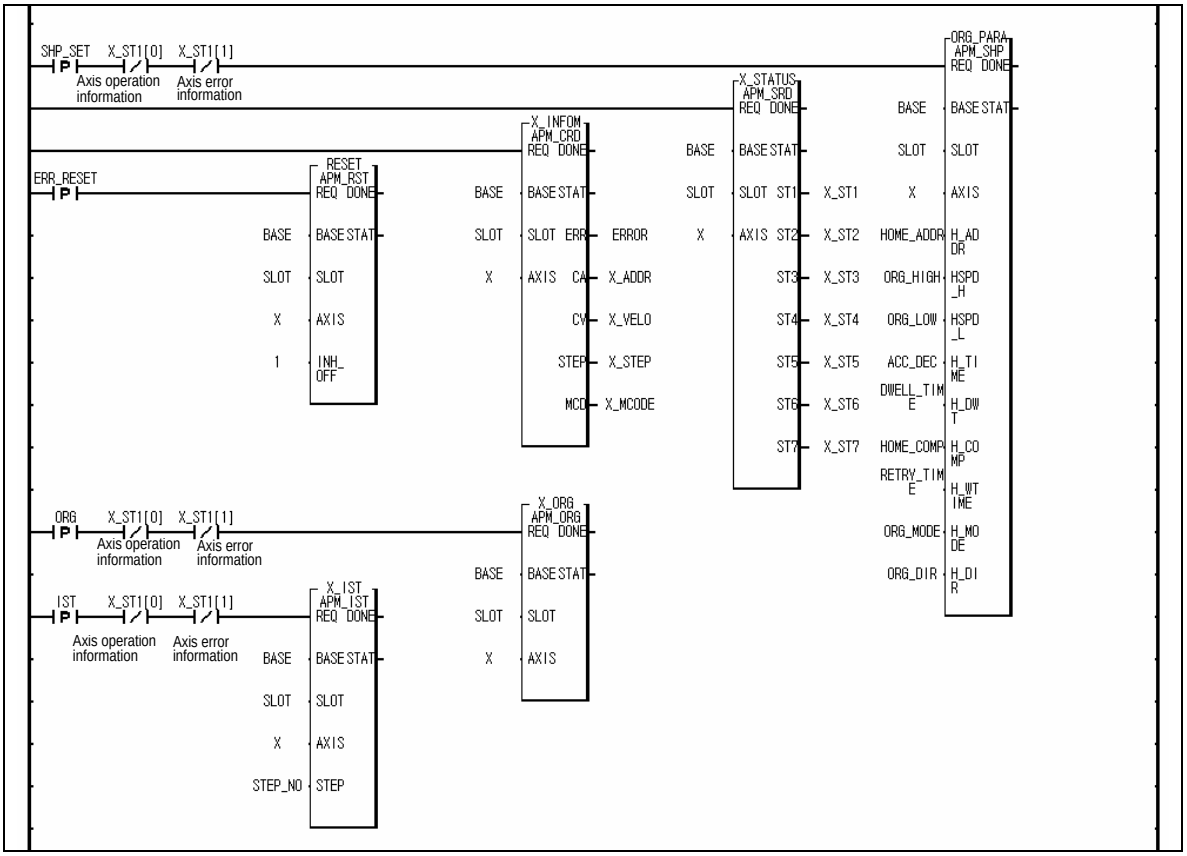
▶ The items available to change is as follow.

Homing parameter	Setting Range
Origin address	mm : -2,147,483,648 ~ 2,147,483,647 [X10^{-3}mm], Inch : -2,147,483,648 ~ 2,147,483,647 [X10^{-5}Inch], degree : -2,147,483,648 ~ 2,147,483,647 [X10^{-5}degree], pulse : -2,147,483,648 ~ 2,147,483,647 [pulse]
Homing high speed	mm : 1 ~ 2,000,000,000[X10^{-2}mm/m], Inch : 1 ~ 2,000,000,000[X10^{-3}Inch/m], degree : 1 ~ 2,000,000,000[X10^{-3} degree/m], pulse : 1 ~ 1,000,000[pulse/s]
Homing low speed	
Homing acceleration/ Deceleration time	0 ~ 65,535
Homing dwell time	
Origin compensation Amount	mm : -2,147,483,648 ~ 2,147,483,647 [X10^{-3}mm], Inch : -2,147,483,648 ~ 2,147,483,647 [X10^{-5}Inch], degree : -2,147,483,648 ~ 2,147,483,647 [X10^{-5}degree], pulse : -2,147,483,648 ~ 2,147,483,647 [pulse]
Homing reset waiting Time	0 ~ 65,535
Homing mode	0:DOG/origin(OFF),1:DOG/origin(ON), 2:high/low limit/origin, 3: approximate origin, 4: high speed origin
Homing direction	0: normal, 1: reverse

[Example]

▷ Program

Program (Status information, operation information, error reset) is same as Program 3.22.



Program 3.24 Homing parameter Setting

3.18.4 Manual Operation Parameter Setting

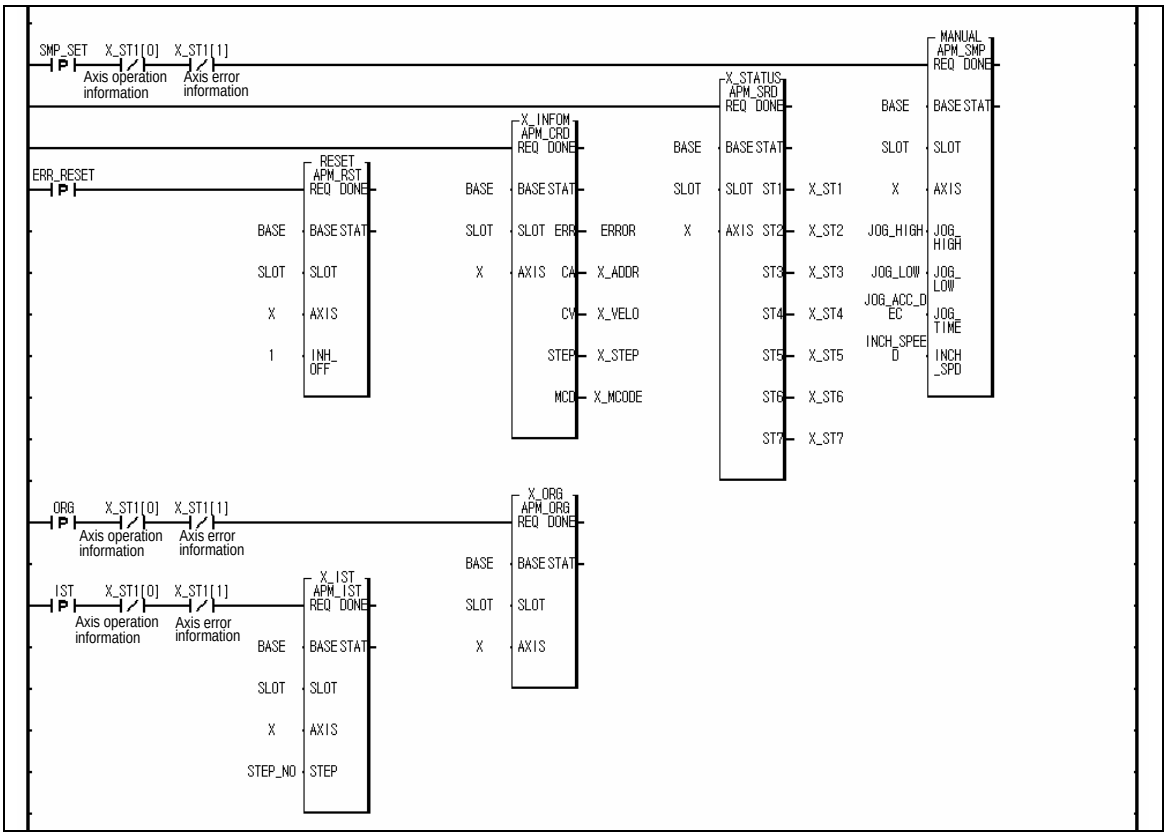
▶ The items available to change is as follows.

Manual Operation Parameter	Setting Range
JOG high speed	mm : 1 ~ 2,000,000,000[X10^{-2}mm/m], Inch : 1 ~ 2,000,000,000[X10^{-3}Inch/m], degree : 1 ~ 2,000,000,000[X10^{-3} degree/m], pulse : 1 ~ 1,000,000[pulse/s]
JOG low speed	
JOG acc./dec. time(ms)	0 ~ 65,535
Inching speed (pps)	mm : 1 ~ 65535[X10^{-2}mm/min], Inch : 1 ~ 65535[X10^{-3}Inch/min], degree : 1 ~ 65535[X10^{-3} degree/min], pulse : 1 ~ 65535[pulse/sec]

[Example]

▷ Program

Status information, operation information, error reset is same as Program 3.22.



Program 3.25 Manual Operation Parameter Setting

3.18.5 Common Parameter Setting

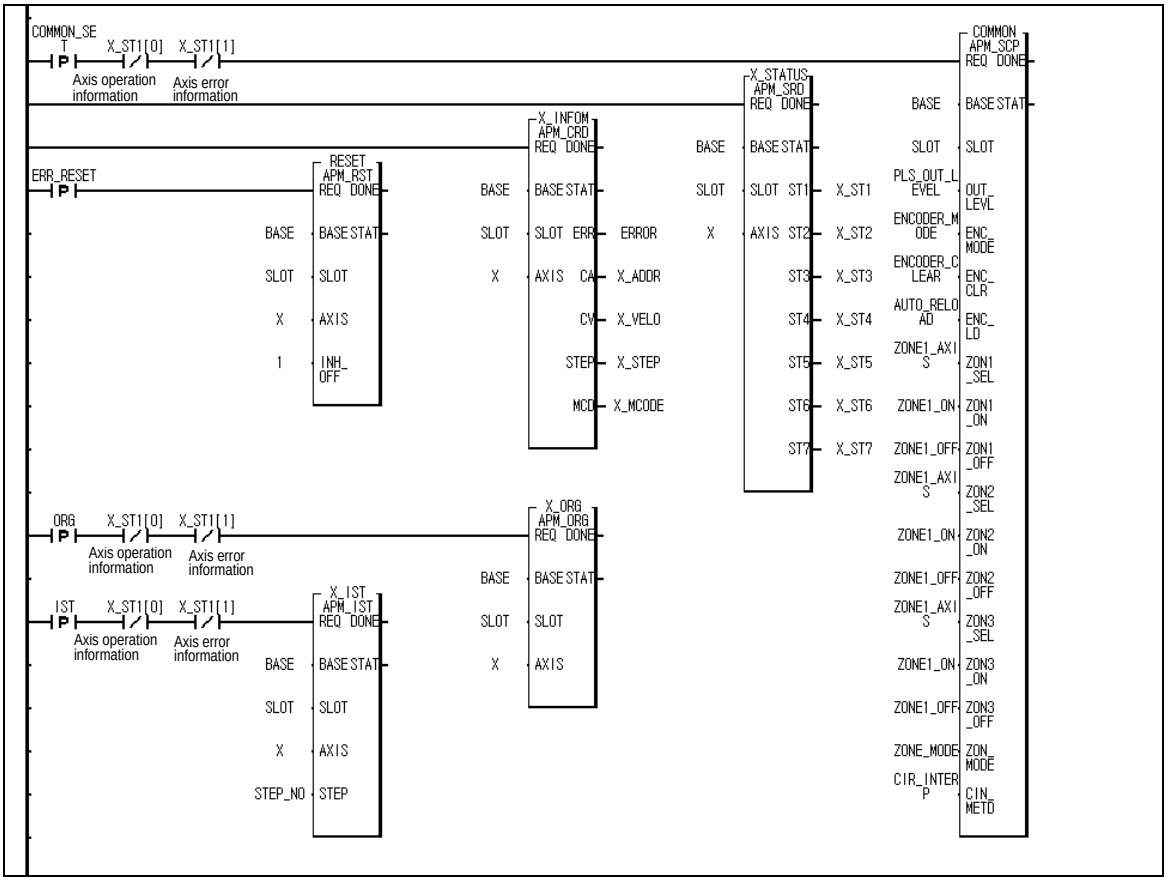
▶ The items available to change is as follows.

Common Parameter	Setting Range
Pulse output level	0:Low Active, 1:High Active
Encoder pulse input mode	0:CW/CCW(1), 1:CW/CCW(2), 2:PULSE/DIR(1), 3:PULSE/DIR(2), 4:PHASE A/B(1), 5:PHASE A/B(2), 6:PHASE A/B(4)
Encoder Clear mode by Z phase input*1	0: prohibited, 1: allowed
Encoder Auto Reload value	0 ~ 4,294,967,295
Zone1 setting axis assigned	0:X, 1:Y, 2:Z, 3:ENCODER
Zone1 output "ON" position	mm : -2,147,483,648 ~ 2,147,483,647 [$X10^{-3}$mm], Inch : -2,147,483,648 ~ 2,147,483,647 [$X10^{-5}$Inch], degree : -2,147,483,648 ~ 2,147,483,647 [$X10^{-5}$degree], pulse : -2,147,483,648 ~ 2,147,483,647 [pulse]
Zone1 output "OFF" position	
Zone2 setting axis setting	0:X, 1:Y, 2:Z, 3:ENCODER
Zone2 output "ON" position	mm : -2,147,483,648 ~ 2,147,483,647 [$X10^{-3}$mm], Inch : -2,147,483,648 ~ 2,147,483,647 [$X10^{-5}$Inch], degree : -2,147,483,648 ~ 2,147,483,647 [$X10^{-5}$degree], pulse : -2,147,483,648 ~ 2,147,483,647 [pulse]
Zone2 output "OFF" position	
Zone3 setting axis setting	0:X, 1:Y, 2:Z, 3:ENCODER
Zone3 output "ON" position	mm : -2,147,483,648 ~ 2,147,483,647 [$X10^{-3}$mm], Inch : -2,147,483,648 ~ 2,147,483,647 [$X10^{-5}$Inch], degree : -2,147,483,648 ~ 2,147,483,647 [$X10^{-5}$degree], pulse : -2,147,483,648 ~ 2,147,483,647 [pulse]
Zone3 output "OFF" position	
Zone output mode	0: individual output, 1: overall output (ZONE1)
Circular interpolation method	0: Middle point, 1: Center point

*1 : G6F-PP1O~3O, G6F-PP1D~3D shall not clear the encoder value in case of external Z phase input.

[Example]

▷ Program (Status information, operation information, error reset is same as Program 3.22.)



Program 3.26 Common Parameter Setting

3.19 Operation Data Setting

▶ The items available to change is as follows.

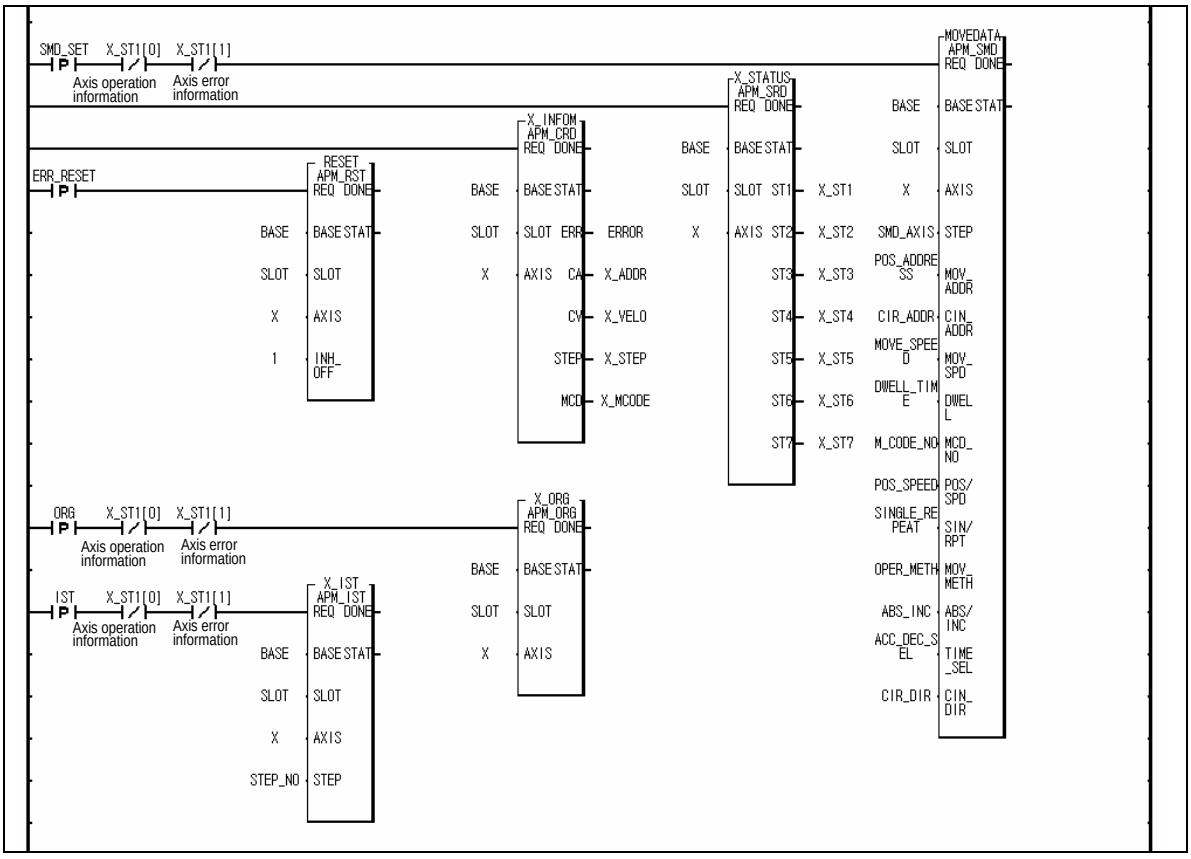
Operation Data	Setting Range
Goal position	mm : -2,147,483,648 ~ 2,147,483,647 [X10^{-3}mm], Inch : -2,147,483,648 ~ 2,147,483,647 [X10^{-5}Inch], degree : -2,147,483,648 ~ 2,147,483,647 [X10^{-5}degree], pulse : -2,147,483,648 ~ 2,147,483,647 [pulse]
Operation speed	mm : 1 ~ 2,000,000,000[X10^{-2}mm/m], Inch : 1 ~ 2,000,000,000[X10^{-3}Inch/m], degree : 1 ~ 2,000,000,000[X10^{-3} degree/m], pulse : 1 ~ 1,000,000[pulse/s]
Dwell time(ms)	0 ~ 50,000
M code no.	1 ~ 65,535
Control method	0: position control, 1: speed control
Operation method	0: Single, 1: Repeat
Operation pattern	0: End, 1: Go-on, 2: Continuous
Coordinate	0: Absolute, 2: Relative
Acc./dec. No.	0 ~ 3

▶ Operation data change is available from 1 ~ 400 step at X, Y, Z axis respectively.

[Example]

▷ Program

Status information, operation information, error resets is same as Program 3.22.



Program 3.27 Operation Data Setting

3.20 Encoder Preset

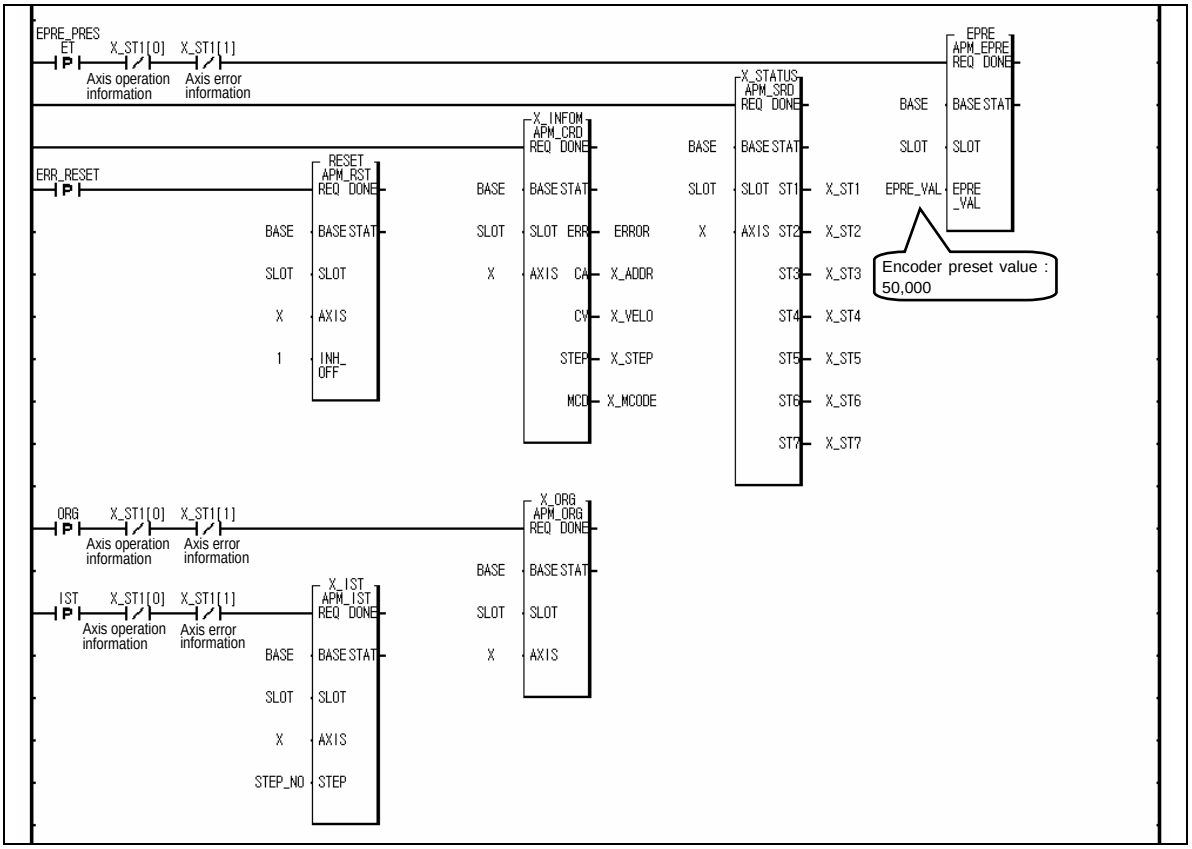
▶ This function is to change the content of encoder with encoder preset setting value.

▶ Encoder preset command should be executed in the status that external encoder pulse input is not applied.

▶ Encoder preset setting range : 0 ~ 4,294,967,295

[Example]

▷ Program



Program 3.28 Encoder Preset

3.21 Error and Output Prohibition

▶ Error includes Light failure error and Heavy failure error.

▶ If light failure error occurs, the positioning operation will continue and only error will occur.

▶ In case of heavy failure error, if the error is not cleared, it is not available to carry out the positioning operation. And if the heavy failure error occurs during operation, the operation will stop.

▶ If external high/low limit, external emergency stop, soft high/low limit, internal emergency stop during the positioning operation are detected during the positioning operation, it stops promptly and becomes the pulse output prohibition status. Thus it is required to release the pulse output prohibition by Error reset command . In case of occurring in the origin determination status, it is required to execute the origin determination by the origin return, floating origin, current position preset.

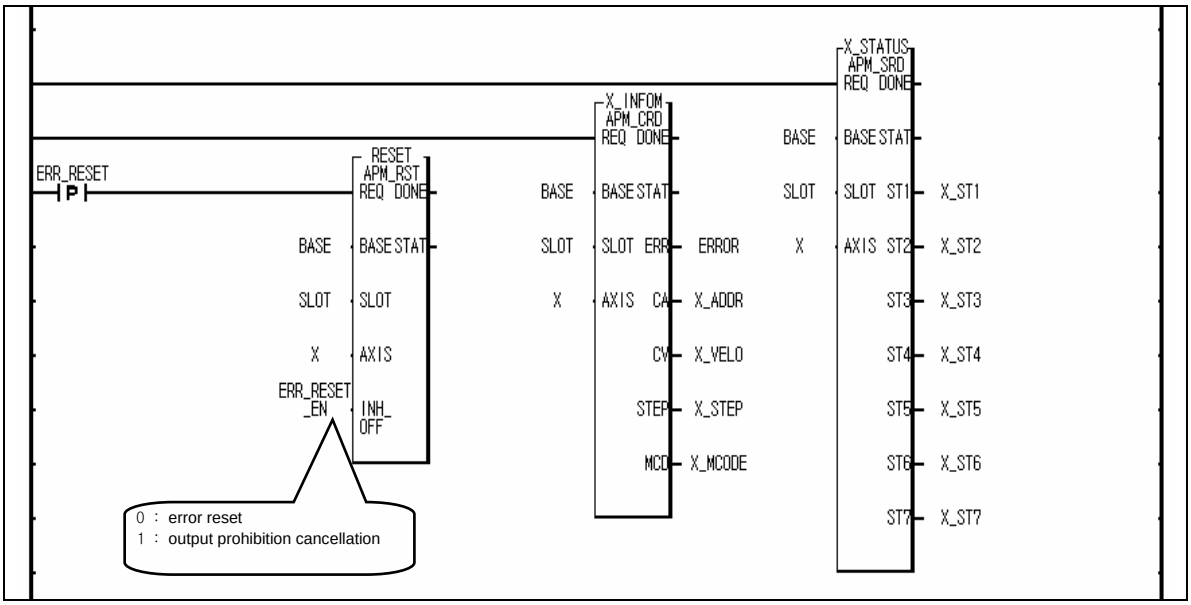
▶ Error reset command includes the case to reset the error only and the case to release the pulse output prohibited status.

▶ For further information, please refer to Article 7.11 Error code of function block .

▶ For further information of the error contents, it is available to confirm it from Software Help function and during the operation by Software Package it is available to confirm the content of error per axis.

[Example]

▷ Program



Program 3.29 Error and Output Prohibition

3.22 ZONE Output

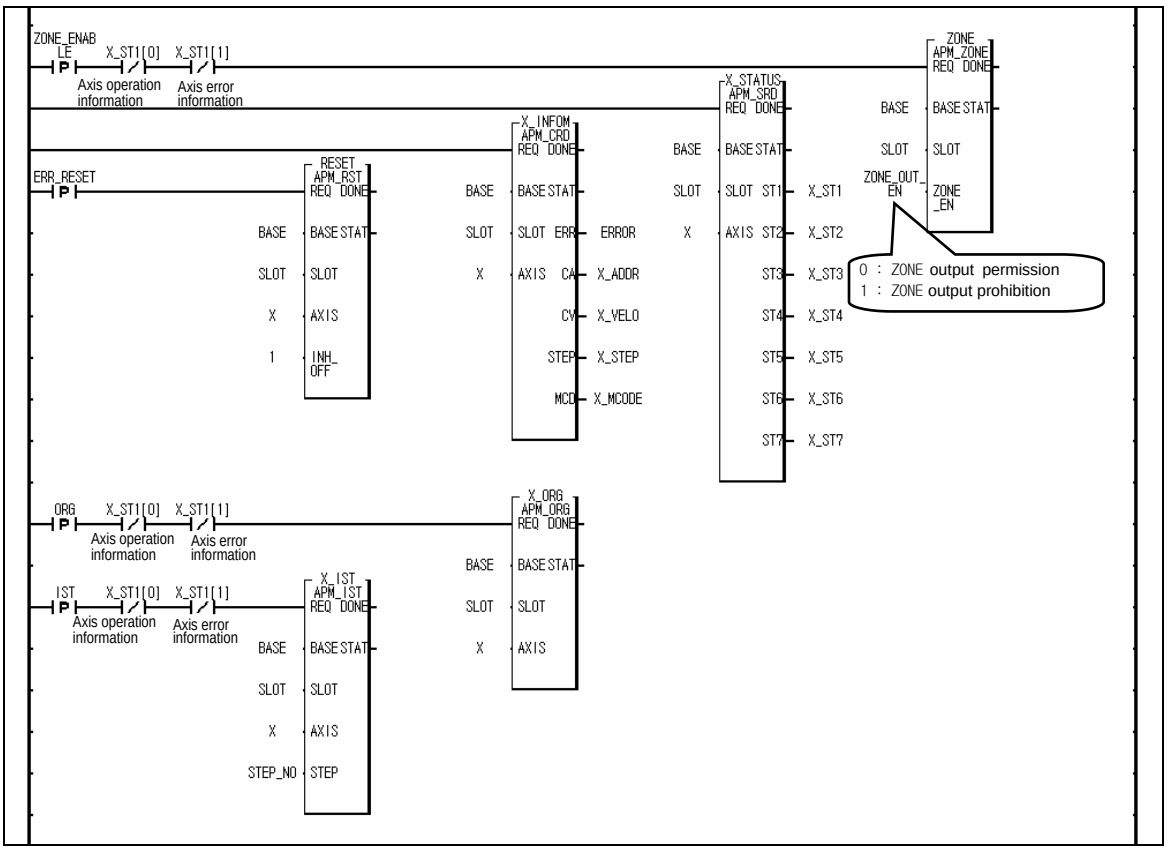
▶According to ZONE output mode (0: individual output, 1: batch output (ZONE1)), ZONE1/2/3axis setting, ZONE1/2/3 ON starting point, ZONE1/2/3 ON ending point setting, it is outputted by the signal of ZONE1, ZONE2, ZONE3.

▶According ZONE output command, it carries out the external output for ZONE1, ZONE2, ZONE3 “ON” signal or prohibits the external output.

▶For further information, please refer to Article 5.5.6 Zone Output.

[Example]

▷Program



Program 3.30 ZONE Output

3.23 Point Operation

▶ Point operation is the positioning operation available to operate by operation data of the step no. set by one time start command and is called also “Block operation”. It is available to set max. 20 point.

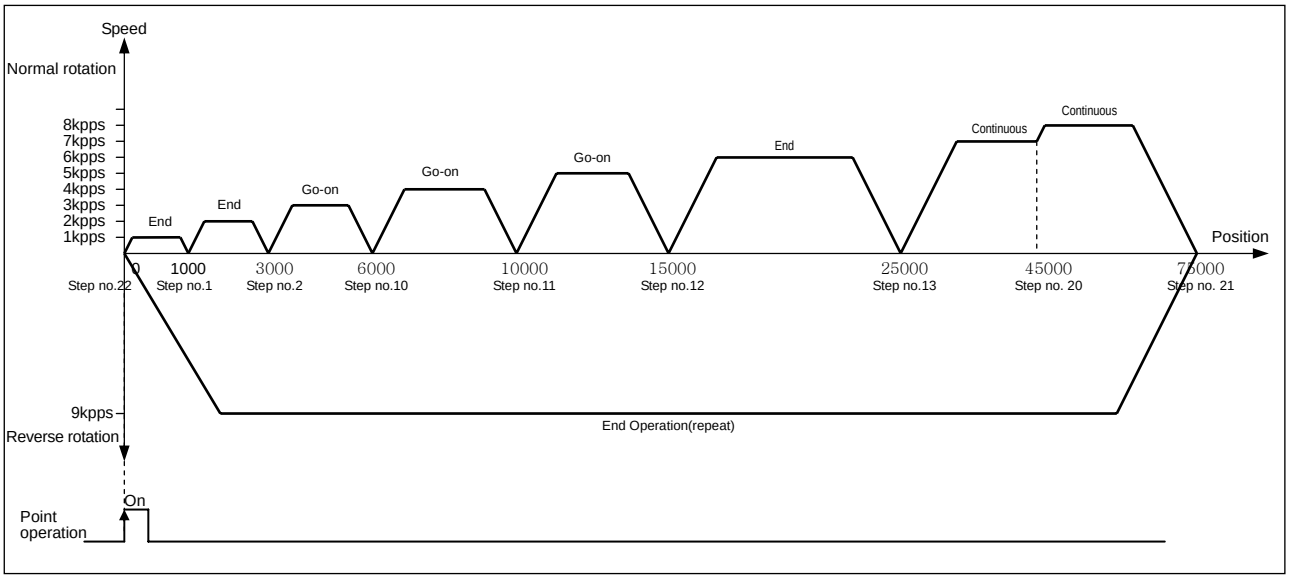
▶ It carries out the point operation as much as the assigned point number from step setting (Point 1) regardless of End, Go-on, Continuous operation mode. In this case, the step no. to be set should be set as the step no. that starts at the very first in case of Go-on or Continuous operation mode.

[Example]

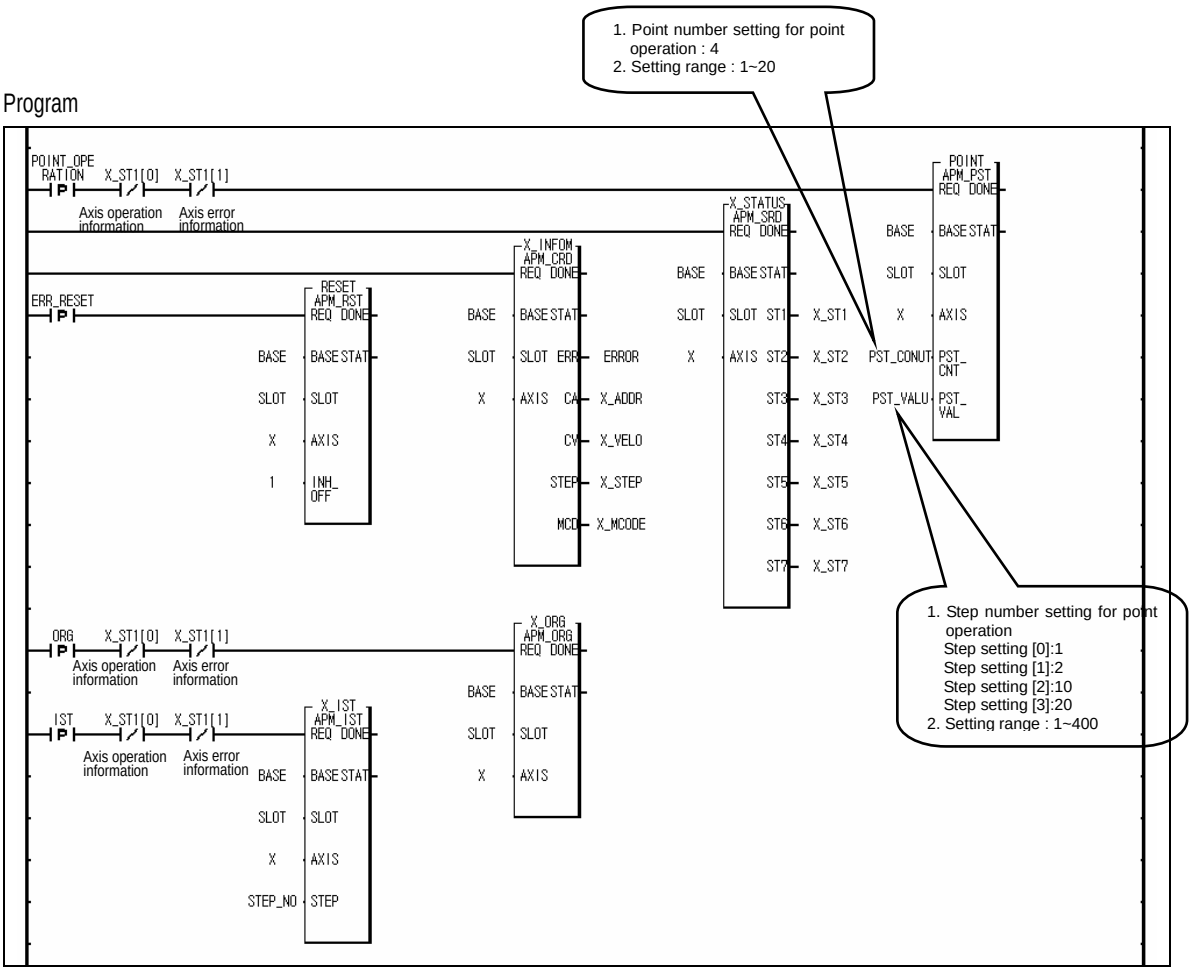
▷ Software Package Setting

Items of Position data	Step no.	Coordinate	Control method	Operation pattern	Operation method	Goal position [pulse]	Circular interpolation aux. Point [pulse]	M code	Acc./ Dec no.	Operation speed [pls/s]	Dwell time [ms]	Circular interpolation direction
X Setting	1	Absolute	Position	End	Single	1000	0	**0**	1	1000	20	CW
	2	Absolute	Position	End	Single	3000	0	**0**	1	2000	20	CW
	10	Absolute	Position	Go-on	Single	6000	0	**0**	1	3000	20	CW
	11	Absolute	Position	Go-on	Single	10000	0	**0**	1	4000	20	CW
	12	Absolute	Position	Go-on	Single	15000	0	**0**	1	5000	20	CW
	13	Absolute	Position	End	Single	25000	0	**0**	1	6000	20	CW
	20	Absolute	Position	Continuous	Single	45000	0	**0**	2	7000	0	CW
	21	Absolute	Position	Continuous	Single	75000	0	**0**	2	8000	0	CW
	22	Absolute	Position	End	Repeat	0	0	**0**	2	9000	0	CW

▷ Operation Pattern



▷Program



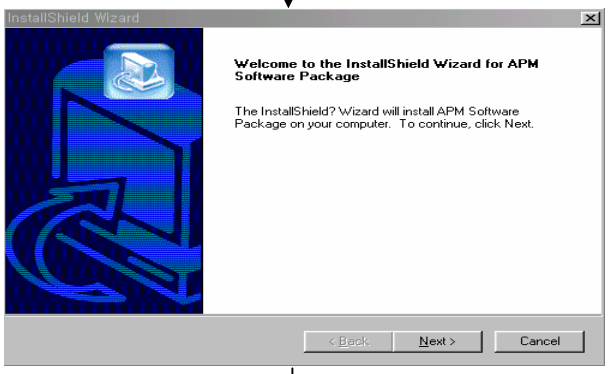
Program 3.31 Point operation

Chapter 4 Software Package

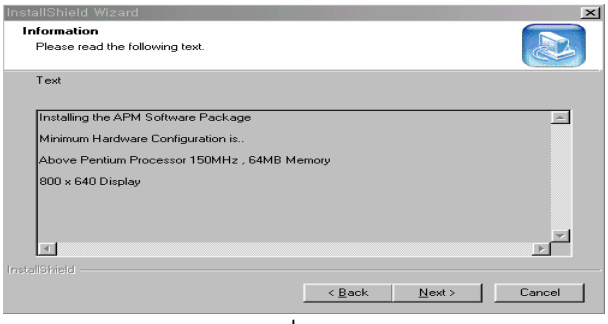
4.1 APM Software Package Installation and Removal

4.1.1 APM Software Package Installation Procedure

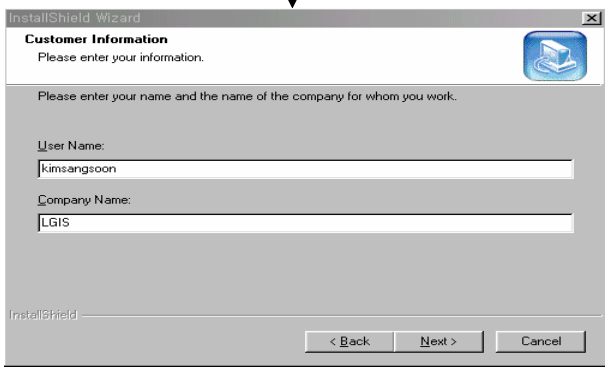
(1) Insert CD or diskette and open the Windows Search and then double click **[setup.exe].**



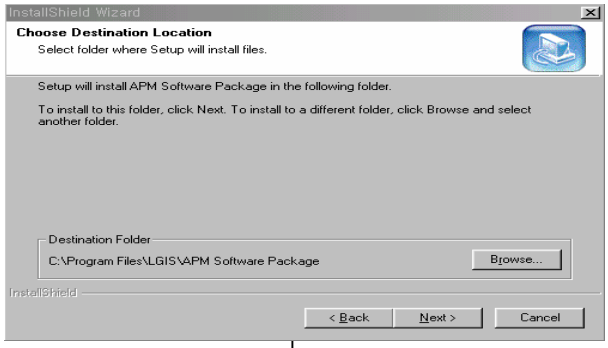
(2) If you double click **[setup.exe]**, the following screen will display as shown on the left side and if you press **[Next]** Button, the setup processing continues to the next step.



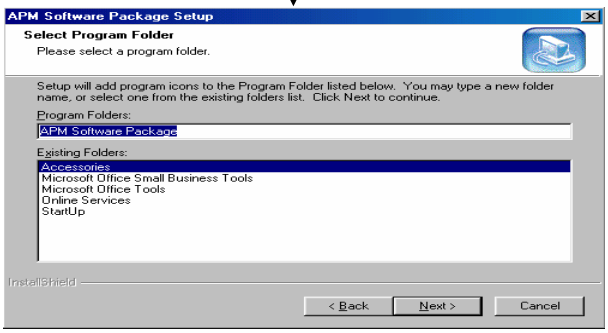
(3) Dialogue box including the setup information will display and if you press **[Next]** Button, it continues to the next step.



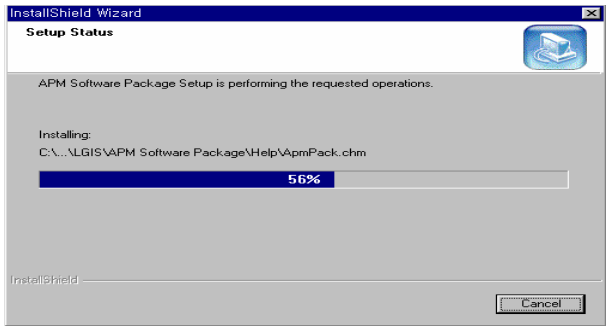
(4) After entering the user name and company name or school name, if you press **[Next]** Button, it continues to the next step.

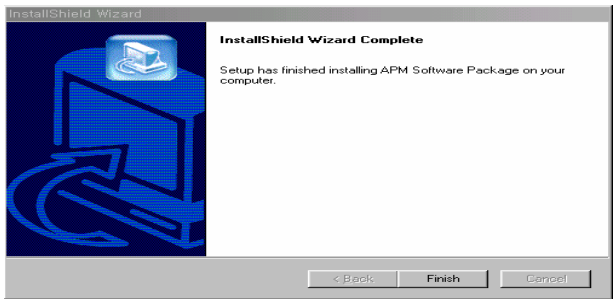


(5) After selecting the folder to install APM software package, if you press **[Next]** Button, it continues. If you press **[Backward]** Button, you can modify the information entered in the previous step.



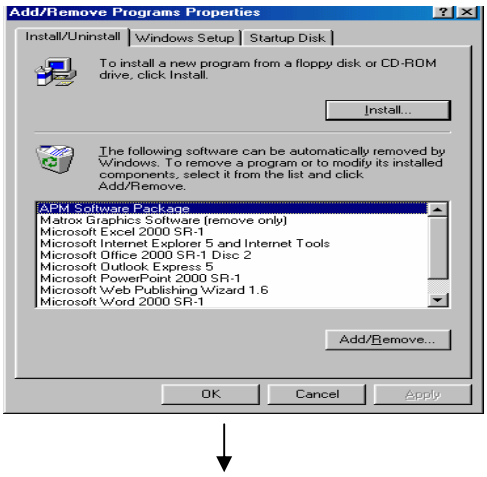
(6) Set the name of folder to install in the Windows and if you press **[Next]** Button, the setup processing begins.



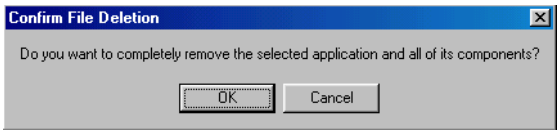


(7) As the setup is ended, press **[End]** Button. If the message to reboot the Windows is shown, you should **reboot** the computer for the normal action of APM software package.

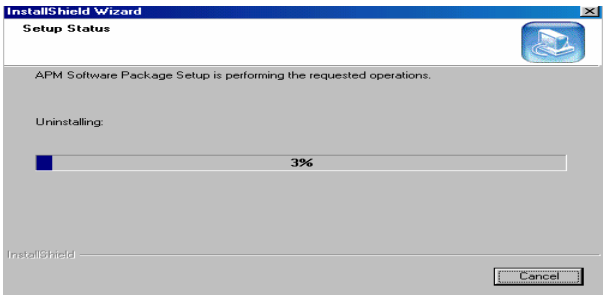
4.1.2 APM Software Package Removal Procedure

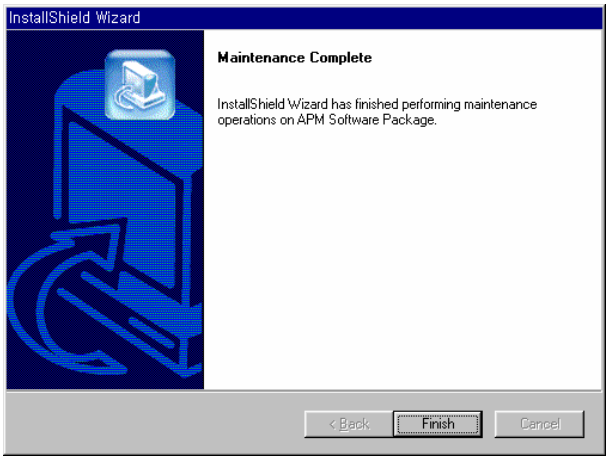


(1) If you press **[Change/Remove]** Button from APM software package item of Control Panels, the removal processing begins.



(2) If you press **[OK]** Button, APM software package removal begins.





(3) If you press **[End]** Button, APM software package removal is ended.

4.2 APM Software Package Basic Structure and Function List

4.2.1 APM Software Package Basic Display

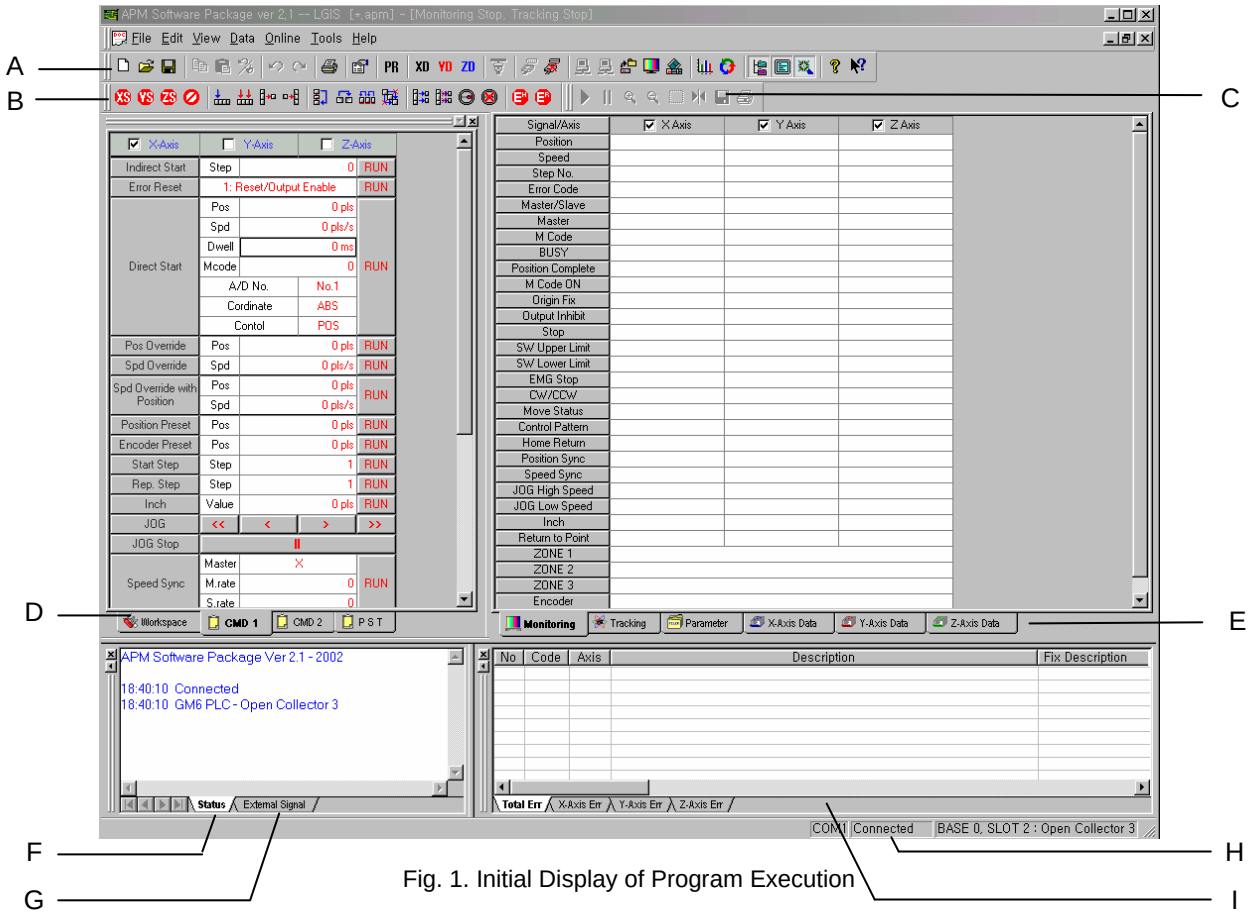


Fig. 1. Initial Display of Program Execution

Items	Description
A : Basic Tools	Includes tool collection such as file open/save, edit, print, operation data/operation parameter, online/offline model setting communication connection, monitoring and simulation function etc.
B : Command Tools gathering	Includes tool gathering of frequently used command items.
C : Tracking Tools gathering	With Tracking tools, the user can realize the Zoom-in/out function and various function when carrying out Tracking.
D : Working screen and Command window	Through "working screen", the user can move the working space to the desired display easily and carry out the commands through “command window”.
E : Working space	As it is divided into monitoring, Tracking, operation parameter, operation data(X,Y,Z) etc, the user can carry out several works at the same time.
F : Status display window	Indicates the working status information of APM software package.
G : External I/O signal window	Available to confirm the external I/O signal of each axis during monitoring.
H : Status line	Indicates the information of APM module characteristics and position, the information of telecommunication environment/status and max./min. operation parameter etc.
I : error history window	A Display available to confirm the specification of errors occurred while executing the commands by every 10 of each axis.

Table 1. Function description of APM software package initial display

▶ APM software package has “Show/Hide” function for all parts such as error history window, external I/O signal window, working space etc. This function is shown on **[View]** menu and the function description is shown on the following table.

Items	Action description	Short-cut key
Main tool gathering	Shows and Hides **Basic tool gathering.** * refer to Fig. 1	SHIFT+U
Command tool gathering	Shows and Hides **Command tool gathering**.	SHIFT+K
Tracking tool gathering	Shows and Hides **Tracking tool gathering.**	SHIFT+L
Status line	Shows and Hides **Status line.**	SHIFT+ S
Working space	Shows and Hides **Working space and Command window.**	SHIFT+W
External I/O signal / Status display	Shows and Hides **External I/O signal window and Status display.**	SHIFT+V
Error information	Shows and Hides **Error history display.**	SHIFT+E

Table 2. Show/Hide function of APM software package display

4.2.2 APM Software Package Function List

▶ Main Features

(1) Improved Editing function

- Includes block copy/paste function and Undo/Redo function and enables the user to write the desired operation profile as it is interlocked with Excel.

(2) Stereoscopic structure to verify the data easily and fast

- Available to verify the external I/O signal and the error history easily and fast during monitoring. Especially, as the error history display shows the detailed error contents and actions for the errors shown on the monitoring display at one time, it helps to solve the problem.

(3) Tracking function

- Provides the user to verify the operation processing visually by indicating the operation pattern in Graphic.

(4) Simulation function

- Provides the user with operation profile simulation and circular interpolation simulation function to prevent the malfunction by verifying the operation profile directly using the graph before actual operation after writing the operation data.

(5) Improved Printing function

- Available to set left/right margin and heading/bottom for the convenient data printing.

(6) Enforced Error history function

- Available to verify the error description and actions and save the error history as a file through error history display.

4.3 Working screen

4.3.1 Make working screen

▶ Method

(1) Select **[new file]** from file menu or select the corresponding icon from basic tool gathering.

(2) Select **[open file]** from file menu or select the corresponding icon from basic tool gathering.

(3) Select **[set online model]** or **[set offline model]** from model setting item or select the corresponding icon from basic tool gathering.

Items	Tool gathering	Short-cut key
New file		CTRL + N
Open file		CTRL + O
Set online model		SHIFT + N
Set offline model		SHIFT + B

Table 3. “Make working screen” related tool gathering

▶ Function description

- APM module axis number fixing when making Working screen

- When making Working screen after selecting **[new file]**, the working screen is composed with the assumption that it is basically **APM 1 axis module** and thus the user can not edit other axis except X axis in the monitoring display, operation parameter, operation data display.

  But if the user makes new working screen by using **[new file]** item after setting the APM module axis number by [set online model] or [set offline model] already, the user can make the working screen using the previously setting APM module axis number information.

4.3.2 Save Working screen

▶ Method

(1) Select **[Save]** or **[Save as other file name]** from file menu.

(2) Write the file name and save it, it is saved as **file name.apm**.

Items	Tool gathering	Short-cut key
Save working screen		CTRL + S

Table 4. “Save working screen” related tool gathering

▶ Function Description

- Save 3axis data regardless of APM module axis number

- When APM software package saves the working screen, it saves all 3 axis data even if APM model is 1 axis or 2 axis. (Ex : in case of 1 axis, Y,Z axis data is saved as Default.)
- After setting APM model as 3 axis to form the working screen and saving the corresponding file, if you reset APM software package and open the corresponding file, only 1 axis data shall be displayed. In this case, if you set 3 axis in [set offline model] item and open the file again, you can see all 3 axis data.

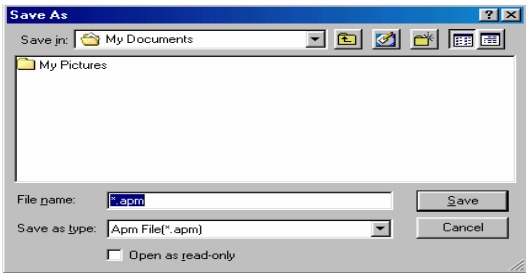


Fig. 2. The screen displayed when saving the working screen

4.3.3 The Structure of Working Screen

▶ Function Description

- Composed of 1 working screen

- Once the working screen is made, it is not available to make other working screen by using **[new file]**. In order to make new working screen instead of the existing working screen, you should save the existing working screen as a file and close it and then make new working screen.

- Proceeding status indication

- During monitoring or Tracking, as the upper part of the working screen changes to show the message such as **in Monitoring, Tracking stop** or **Monitoring stop, in Tracking**, it is available to recognize the current status when moving to other screen.

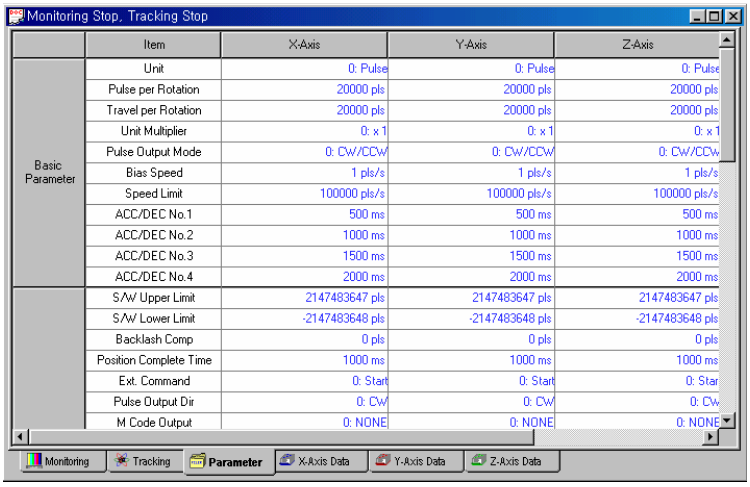


Fig. 3. Working screen

4.4 Offline and Online Model Setting

4.4.1 Offline model setting

▶ Method

(1) Select **[set offline model]** from model setting items or click the corresponding icon from basic tool gathering.

(2) After setting APM module type and APM module axis number, press **[Verify]** Button.

Items	Tool gathering	Short-cut key
Set offline model		SHIFT + B

Table 5. “set offline model” related tool gathering

▶Function Description

- Automatic setting of Data range according to APM Module type

- The purpose of offline model setting is for the user to write operation parameter or operation data without connecting to PLC. As **[Open collector]** type and **[Line driver]** type has different range of **speed limit**, cares should be taken in setting the model.

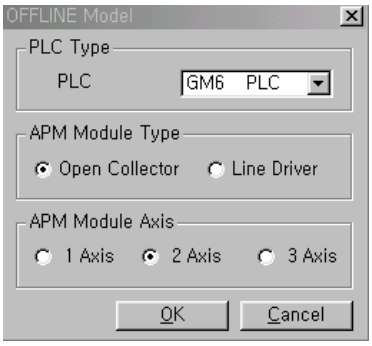


Fig. 4. Offline model setting dialogue box

- Maintains the existing data after setting offline model

- When you set new offline model in the state that the working screen is open, the existing operation parameter or operation data shall be maintained as it were. But in case that APM module axis number is changed, it may not be available to see the existing operation parameter or operation data.

4.4.2 Online model setting

▶ Method

(1) Select **[set Online model]** from model setting items or click the corresponding icon from basic tool gathering or click **[the previous online model setting]** icon.

(2) If you select the desired APM module and press **[Verify]** Button, new working screen shall be made.

Items	Tool gathering	Short-cut key
Set Online model		SHIFT + N
Set the previous online model		None

Table 6. Online model setting tool gathering

▶ Function Description

- In case that several APM modules are set in PLC.

- In this case, APM software package can recognize max. 4 bases (32 slot). GM PLC can recognize max. 8 APM modules for one base and Master-K PLC can recognize 32 APM modules for one base. The following figure shows the online model setting dialogue box when several APM modules are inserted.

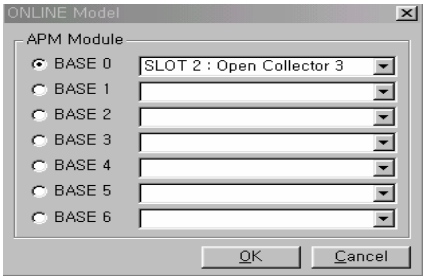


Fig. 5. Online model setting dialogue box in case of several APM modules.

- The previous online model setting function

This function enables to form the working screen by connecting PLC and software package directly using the previous online model setting information instead of using online model setting function when you need to set online model again after closing the communication port. But if you carry out the previous online model setting function without set the online model more than one time after executing APM software package program, the error message will be displayed as follows. Thus you should set the online model before carrying out this function.

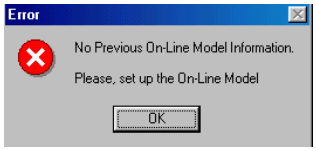


Fig. 6. The previous online model setting function error indication

- In case that communication error occurs

- If communication does not work because of PLC power OFF or communication cable problem when carrying out “positioning module read”, APM software package tries to communicate with PLC automatically and if the communication continues to fail, the error message will be displayed as follows.

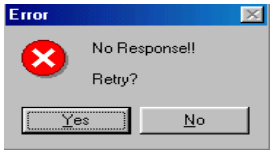


Fig. 7. Communication error message in case of Online model setting

4.5 Operation Parameter and Operation Data Setting

4.5.1 Operation Parameter Setting

▶ Method

(1) Select **[Operation parameter]** item from data menu or click the corresponding icon from basic tool gathering.

Items	Tool gathering	Short-cut key
Operation parameter		SHIFT + P

Table 7. Operation parameter related tool gathering

▶ Function Description

- Configuration

・ Operation parameter is divided into 4 types as follows.

Basic Parameter, Extended Parameter, Origin/Manual Parameter, Common Parameter

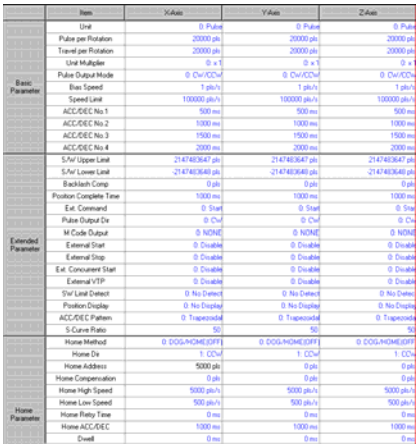


Fig. 8. Operation parameter screen

・ For the range and the meaning of each parameter item, please refer to APM manual.

- Automatic range and data error check function

・ With **[Automatic range and data error check function]** for each item, it is available to modify the error directly through detailed error message when the user entered the data wrong. If such data error occurs, it will be restored as the previous value automatically.

- Maintains operation parameter data when making new working screen

・ Even if the user makes the working screen again through offline/online model setting while editing operation parameter item, operation parameter information does not disappear and is maintained as it were. Thus this is very useful in case of using operation data in several APM modules.

- Unit conversion function and Parameter max./min. indication function

- If changing the **Unit** of each axis, the items related to speed and position shall be changed automatically in the unit and range indication. As Max./Min. of parameter item per unit is shown on **[Status line]** if selecting the corresponding items, it enables to reduce the data input error.

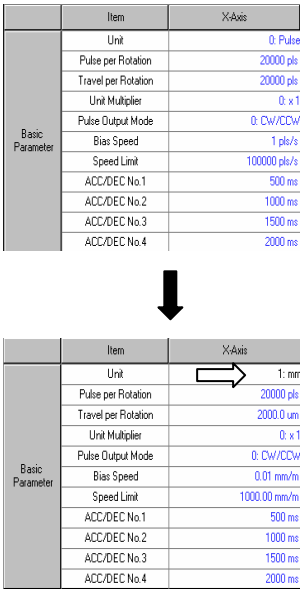


Fig.9. Unit conversion function (pulse → mm)

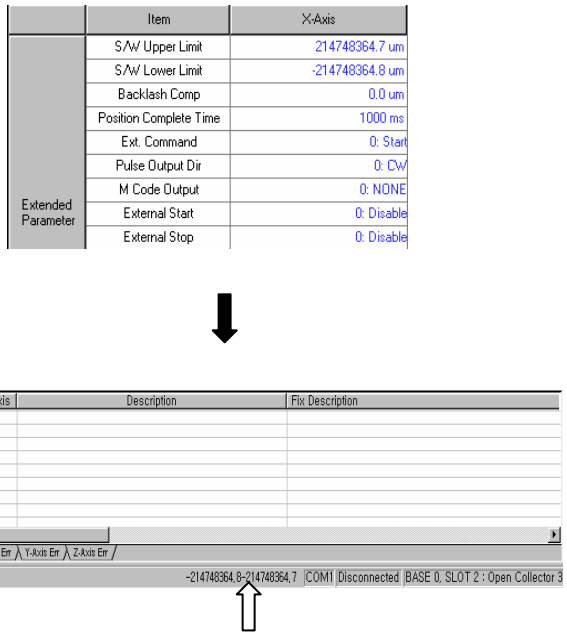


Fig.10. Parameter max./min. indication function

- Editing function

- For operation parameter screen, **[Copy/Paste]** function for block and each item is not applied.

4.5.2 Operation Data Setting

▶ Method

(1) Select [X/Y/Z axis operation data] from data menu or click the corresponding icon from basic tool gathering.

Items	Tool gathering	Short-cut key
X axis operation data	XD	SHIFT + X
Y axis operation data	YD	SHIFT + Y
Z axis operation data	ZD	SHIFT + Z
Copy		CTRL + C
Paste		CTRL + V
Return		CTRL + Z
Revive		CTRL + R
Initial value setting		None

Table 8. Operation parameter and Operation data setting tool gathering

▶ Function Description

- Configuration

- APM software package shows 50 operation step items for each axis as initial value. The user can change the step number of each axis through the environment setting function.

Step	Cordi	Control	Pattern	Method	Address [pulse]	Sub Address [pulse]	M Code	A/D No.	Speed [pls/s]	Dwell [ms]	Cir.Int Dir
1	ABS	POS	END	SIN	0	0	0	No.1	0	0	CW
2	ABS	POS	END	SIN	0	0	0	No.1	0	0	CW
3	ABS	POS	END	SIN	0	0	0	No.1	0	0	CW
4	ABS	POS	END	SIN	0	0	0	No.1	0	0	CW
5	ABS	POS	END	SIN	0	0	0	No.1	0	0	CW
6	ABS	POS	END	SIN	0	0	0	No.1	0	0	CW
7	ABS	POS	END	SIN	0	0	0	No.1	0	0	CW
8	ABS	POS	END	SIN	0	0	0	No.1	0	0	CW
9	ABS	POS	END	SIN	0	0	0	No.1	0	0	CW
10	ABS	POS	END	SIN	0	0	0	No.1	0	0	CW
11	ABS	POS	END	SIN	0	0	0	No.1	0	0	CW
12	ABS	POS	END	SIN	0	0	0	No.1	0	0	CW
13	ABS	POS	END	SIN	0	0	0	No.1	0	0	CW
14	ABS	POS	END	SIN	0	0	0	No.1	0	0	CW
15	ABS	POS	END	SIN	0	0	0	No.1	0	0	CW
16	ABS	POS	END	SIN	0	0	0	No.1	0	0	CW
17	ABS	POS	END	SIN	0	0	0	No.1	0	0	CW
18	ABS	POS	END	SIN	0	0	0	No.1	0	0	CW
19	ABS	POS	END	SIN	0	0	0	No.1	0	0	CW
20	ABS	POS	END	SIN	0	0	0	No.1	0	0	CW

Fig. 11. Operation data screen

- Automatic range and data error check function

- With **[Automatic range and data error check function]** for each item, it is available to modify the error directly through detailed error message when the user entered the data wrong. If such data error occurs, it will be restored as the previous value automatically.

- Maintains operation data when making new working screen

- Even if the user makes the working screen again through offline/online model setting while editing operation data item, operation data information does not disappear and is maintained as it were. Thus this is very useful in case of using operation data in several APM modules.

- Editing function

- Operation data screen supports **[Copy/Paste]** function for block and each item and carries out **[Copy/Paste/Return/Revive]** function by using the right side of mouse. And it is available to change the data of each item as initial value by using **[set initial value]** command.

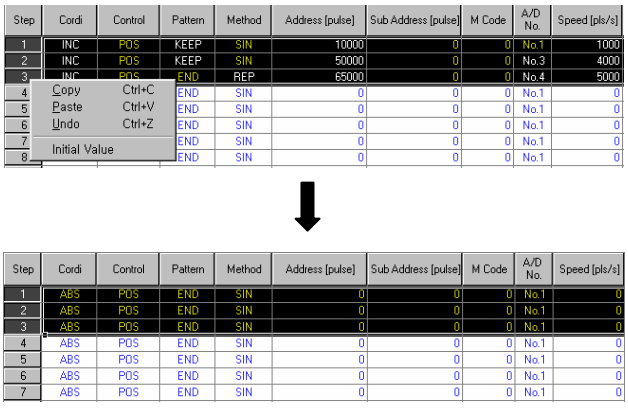


Fig. 12. Initial value setting command execution

- Operation data item indication function

- When the data is entered in the operation data item, if it is different from initial value, it shall be changed in **Black color** automatically that enables to distinguish the edited data. (Refer to environment setting function)

- Operation step change function

- Basically the step no. of X,Y,Z axis operation data screen is limited as 50 steps. If setting the range in **[environment setting]** function to increase the operation step number of each axis, the working screen shall be reformed.

- AUTO-FILL function

- This auto-fill function used in Excel enables the user to write the data in order easily. This function is available to work only in one longitudinal line and not available in case of more than two longitudinal line.

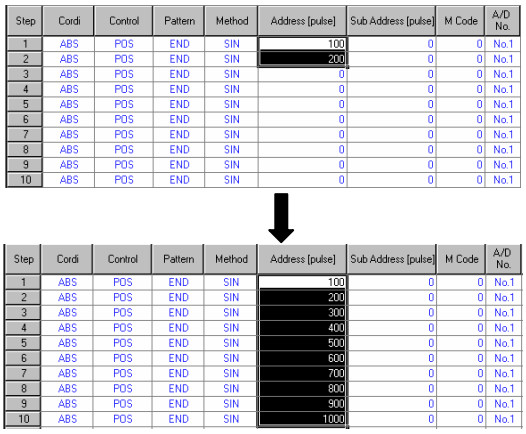


Fig. 13. Auto-Fill function

▶ Notices

- [Copy/Paste] function in different unit

- If you set X axis unit as “mm”, “inch”, “degree” (Y, Z axis “pulse) in operation parameter screen and move to X axis operation data screen to enter “0.01” for the goal position item and “0.1” for operation speed item and carry out block copy and then block paste to Y axis operation data screen, the Y axis goal position item and operation speed item shall be indicated as “0” instead of 0.01 and 0.1. This means that other units except “pulse” unit are allowed to indicate decimal point for goal position and operation speed item while “pulse” unit is not allowed.

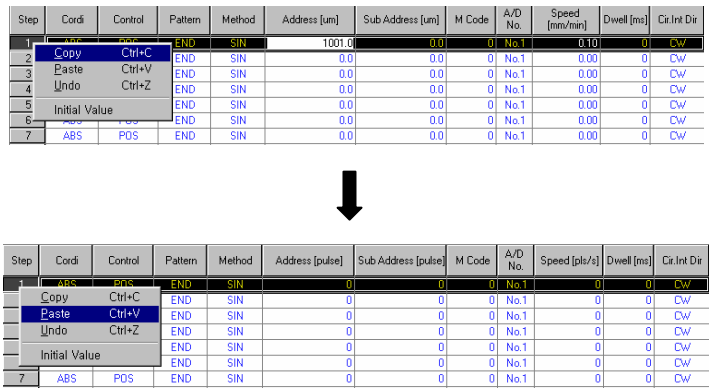


Fig. 14. [Copy/Paste] function error in different units

- [Copy/Paste] function in different block

- If you set the block for partial operation data item and carry out [copy/paste] function to other block without setting the block for overall operation data item and carrying out [copy/paste] function, the error message shall be displayed as follows.

Step	Cordi	Control	Pattern	Method	Address [pulse]	Sub Address [pulse]	M Code	A/D No.	Speed [pls/s]
1	ABS	POS	END	SIN	10010	0	0	No.1	10
2	ABS	POS	END	SIN	0	0	0	No.1	0
3	ABS	POS	END	SIN			0	No.1	0
4	ABS	POS	END	SIN			0	No.1	0
5	ABS	POS	END	SIN			0	No.1	0
6	ABS	POS	END	SIN			0	No.1	0
7	ABS	POS	END	SIN			0	No.1	0
8	ABS	POS	END	SIN	0	0	0	No.1	0

Copy Ctrl+C
Paste Ctrl+V
Undo Ctrl+Z
Initial Value

Step	Cordi	Control	Pattern	Method	Address [pulse]	Sub Address [pulse]	M Code	A/D No.	Speed [pls/s]	Dwell [ms]	Cir.Int Dir
1	ABS			SIN	0	0	0	No.1	0	0	CW
2	ABS			SIN	0	0	0	No.1	0	0	CW
3	ABS			SIN	0	0	0	No.1	0	0	CW
4	ABS			SIN	0	0	0	No.1	0	0	CW
5	ABS			SIN	0	0	0	No.1	0	0	CW
6	ABS	POS	END	SIN	0	0	0	No.1	0	0	CW
7	ABS	POS	END	SIN	0	0	0	No.1	0	0	CW

Copy Ctrl+C
Paste Ctrl+V
Undo Ctrl+Z
Initial Value

Fig. 15. [Copy/Paste] function error in different block

4.6 Command

4.6.1 Command

▶ Method

(1) Execute **[set Online model]**.

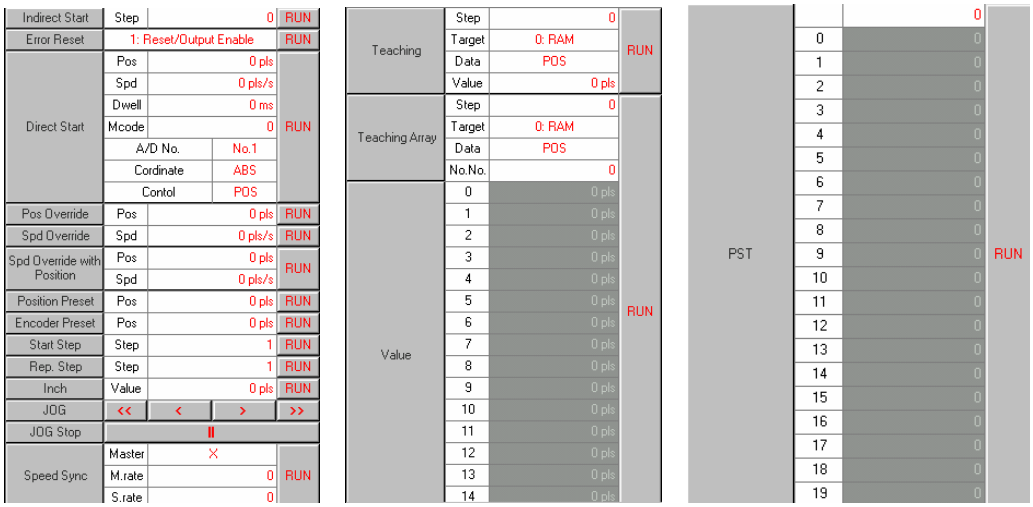
(2) After executing Monitoring or Tracking and setting the command axis, if you click the command item button or click the command item button right after setting the command axis, monitoring is automatically carried out and the corresponding command item is executed.

▶ Function Description

- Configuration

- As the command axis setting part does not change even if the command screen is changed or scrolled up and down, it is available to verify the command axis information easily. The command screen is composed of **CMD 1**, the basic command screen, **CMD 2**, the command screen related to teaching and teaching array, and **PST**, Point command screen and if the command axis is set in any from 3 screens, it shall be applied to all command screen simultaneously.

Fig. 16. Command axis setting part



CMD1 CMD2 PST

Fig. 17. Command screen configuration

- Unit conversion function

- The command item related to **Position** and **Speed** carries out the unit conversion function based on the corresponding axis unit set by operation parameter.

- Automatic range and data error check function

- The command screen contains **Automatic range and data error check function** for each item.
- If data input error occurs during monitoring, monitoring will stop for a while and the error message is displayed and then monitoring works starts again.

- Command item data

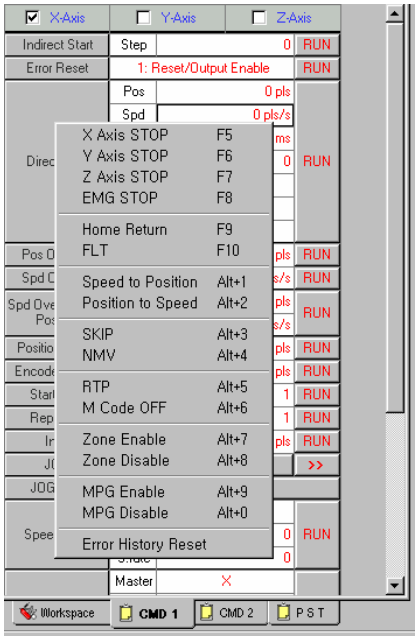
- The data to enter in the command item is not saved as a file other than operation data and maintains the input value only when the program is running and it shall be set as an initial value whenever the program begins.
- The command required to enter the **[Axis information]** from command items such as **Synchronous start, Circular interpolation etc**, display the item indication differently according to APM module axis number. For example, in case of 2 axis APM module, the axis information required to set on the linear interpolation shows only X,Y axis information except Z axis.

- Editing function

- The command screen is not available to carry out Editing function such as **Copy/Paste** function for each item.

- Short-cut command item and Tool gathering

- The command items not necessary to enter the data such as **Floating point setting, Stop, Emergency stop** can be carried out simply by using **[Command tool bar]** and **[Short-cut key]** and if you press the right side of mouse, the menu will be displayed in order to carry out the function same as the function shown on the command tool bar and carry out the command easily.



Command contents	Command icon	Contract key
X axis Stop		F5
Y axis Stop		F6
Z axis Stop		F7
Emergency Stop		F8
Origin return		F9
Floating origin setting		F10
Speed/Position switching		Alt + 1
Position/Speed switching		Alt + 2
SKIP operation		Alt + 3
Continuous operation		Alt + 4
Auto operation point return		Alt + 5
M Code OFF		Alt + 6
ZONE output permitted		Alt + 7
ZONE output prohibited		Alt + 8
MPG permitted		Alt + 9
MPG prohibited		Alt + 0
Error history reset		-

Fig. 18. Command execution using the Right side mouse and command tool gathering

- Command item according to APM Module

- The Command item has the item available for all APM module and the item available for more than 2 axis APM module (**Synchronous start, circular interpolation, position synchronous start, speed synchronous start operation etc**). Thus, in case of 1 axis APM module, the user can not carry out the command item which is carried out on 2 axis APM module.

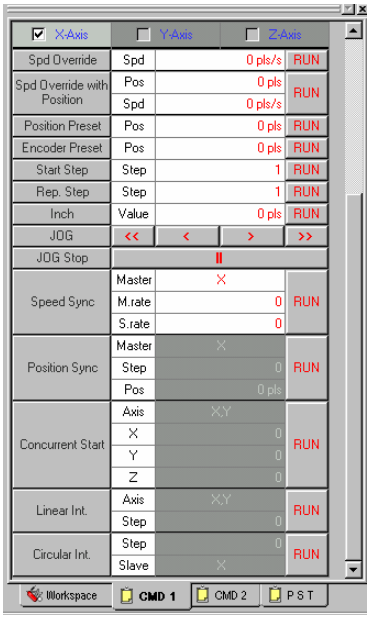


Fig. 19. The command items prohibited when selecting 1 axis APM module

▶ Notices

- Communication error

- When APM module does not carry out the command normally after the command execution (APM module and communication does not work to connect or the data can not be entered), APM software package shows the following error message and returns to the initial status.

Fig. 20. Error message

- Command axis setting error

- In case of command axis setting, if it does not fit with Monitoring axis or Tracking axis (for example, monitoring axis is set as Y axis and the command axis is set as X axis), the error message will be displayed as follows.

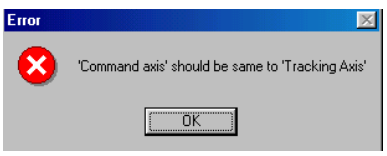


Fig. 21. Error message

4.7 Monitoring Execution

4.7.1 Monitoring

▶ Method

(1) Execute **[set online model]**.

(2) After selecting the axis for monitoring from monitoring screen, select **[operation status monitoring]** from monitoring item or click the corresponding icon from basic tool gathering.

(3) If you press monitoring button once, monitoring is executed and if you press the button one more, it stops.

Items	Tool gathering	Short-cut key
Monitoring		SHIFT + M

Table 9. Monitoring tool gathering

▶ Function Description

- Execution environment

- While executing monitoring, **[data read/write]** and **[Tracking]** function shall be inactive and not available to carry out the function.
- **The contents of [external I/O signal]** and **[error history]** is indicated only during monitoring and when monitoring stops, the related data is not indicated.
- In case of 1 axis/2axis APM module, Y axis or Z axis shall be treated in **Gray** in monitoring screen and data is not indicated.

- Monitoring axis change

- While executing monitoring, the user can not change the axis for monitoring. In order to change the axis for monitoring, it is required to stop monitoring and reset.

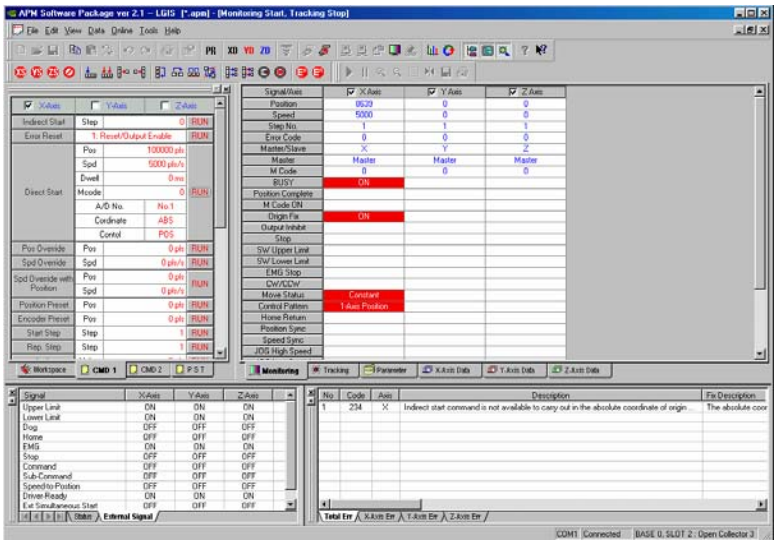


Fig. 22. 3 axis APM module monitoring screen

- Monitoring period change

- It is available to change the monitoring period by using **[environment setting] function** and set within the range 40 ~ 80 ms. [File => Option => Comm option]

▶ Notices

- Communication error

- If the communication does not work for the constant time (about 5~6 seconds) because of communication problem or PLC power OFF during monitoring, the error message will be displayed and APM software package return to the initial status. That is, as it returns to the previous step before setting online/offline model, the user should set APM online model after checking communication cable status or PLC power status. In this case, operation parameter and operation data set before maintains the previous setting value without changing it as it were.

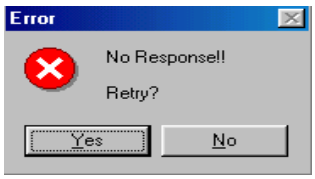


Fig. 23. Error message

4.8 Tracking Execution

4.8.1 Tracking

▶ Method

(1) Execute **[set online model].**

(2) After selecting the axis for tracking from Tracking screen, select **[Profile Tracking]** from monitoring menu or click the corresponding icon from basic tool gathering.

(3) If you press Tracking icon once, Tracking is executed and if you press the button one more time, it stops.

Items	Tool gathering	Short-cut key
Tracking		SHIFT + T
Start		None
Pause		None
Enlarge		None
Reduce		None
Area enlargement		None
Data indication		None
Save		None
Print		None

Table 10. Tracking tool gathering

▶ Function Description

- Execution environment

- On the Tracking screen, X axis means **Time** and Y axis means **Speed.**
- During Tracking, **[external I/O signal function]** is not indicated.
- On the Tracking screen, current position, current speed, current step, unit information are indicated basically.

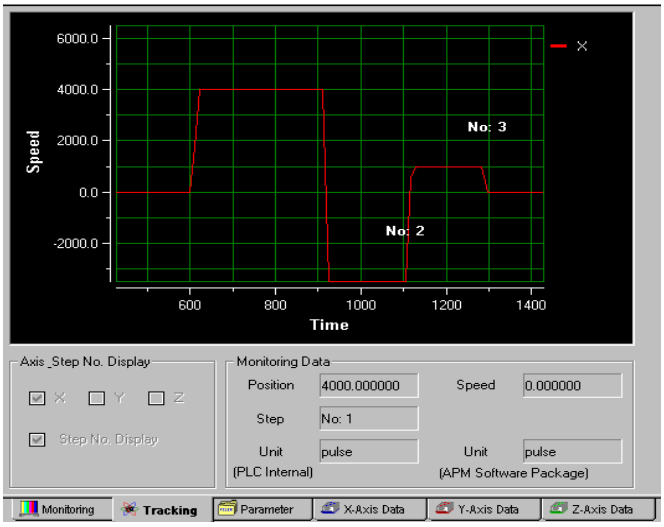


Fig. 24. Tracking screen

- Tracking tool gathering, while the working screen moves, becomes active and can carry out the corresponding function.
- Tracking is available only for 1 axis basically.
- The error occurred during Tracking shall be indicated on the Tracking screen and Error history screen at the same time.

- Tracking related tool gathering

Items	Tool gathering	Function
Start		When Tracking screen pauses or the coordinate of the screen is changed by Enlarge/Reduce function, if you press this button, the coordinate shall be restored as same as set at first and Tracking starts again.
Pause		Used for the **Pause** of Tracking screen.
Enlarge		If you press **[enlarge]** Button during tracking, the screen stops for a while automatically and appears enlarged. If you want to start Tracking again, press **[Start]** Button.
Reduce		If you press **[reduce]** Button during tracking, the screen stops for a while automatically and appears reduced. If you want to start Tracking again, press **[Start]** Button.
Area enlargement		This is used when you want to make the desired part enlarged during Tracking. To use this function correctly, if you stop for a while by using [pause] button and drag the desired area to enlarge by the mouse, only the selected area appears in enlarged. If you want to start Tracking again, press **[Start]** Button.
Data indication		This function is used when you want to see **X,Y data value** of the desired area during Tracking. To use this function correctly, if you stop the desired area by using [pause] button and move the cursor to the desired position, (X,Y) data shall be indicated automatically. If you want to start Tracking, press **[Start]** Button.
Save		This is used when you want to save the Tracking screen by **[save as picture file]** and available only when Tracking screen is in Pause. The picture file type available to support are 3 such as *.bmp, *.emf, *.jpg.
Print		This is used when you want to **print** Tracking screen and available to use only when Tracking screen is in Pause.

Table 11. Tracking tool gathering function description

- Step no. indication function

- **Step no. indication function** is to indicate the operation step no. on the Tracking screen when indirect start. The user can verify the operation information such as current operation speed, current position data and operation step information together with Tracking screen.

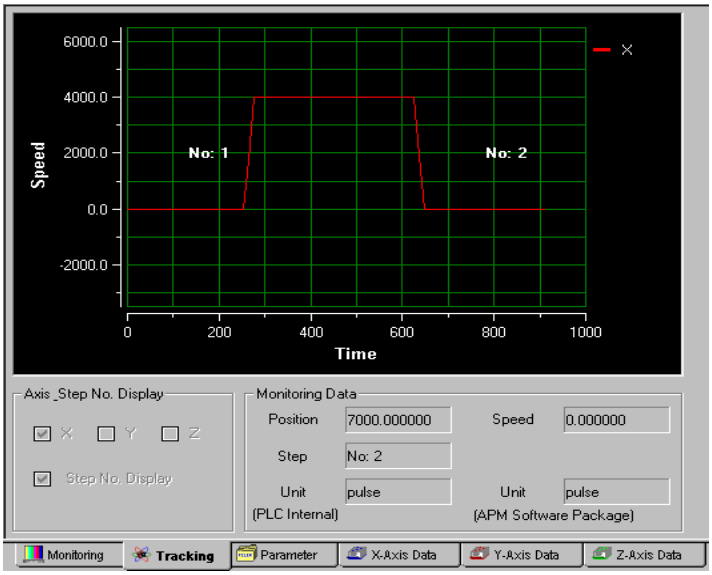


Fig. 25. Tracking – Step no. indication function

- Tracking axis unit

- In the bottom of Tracking screen, the axis unit set by APM software package and the corresponding axis unit saved in PLC internal memory are indicated and if two units are different, max. value of Y axis coordinate (speed) shall be set on the Tracking screen based on the unit saved in PLC internal memory.

▶ Notices

- Tracking related tool gathering may not act according to the O/S of APM software package installed computer. It may occur sometimes in Windows 2000, Windows Me, Windows XP and in this case the solution is to increase **Tracking period** by using **[environment setting function].**

  Reference: Window 95/98/Me/2000 : Tracking period 40ms

  Window XP : Tracking period 60ms

- As X axis (time) value of Tracking screen is quite different from actual operation time, cares should be taken in using.

4.9 Data Read/Write Function

4.9.1 Data Read/Write

▶ Method

- As Data Read/Write function is not available during monitoring or tracking, it is required to carry out the function after stop it when the corresponding is active.
- Click **[data read/write]** item from communication menu or click the corresponding icon from basic tool gathering to select the desired data and then press **[Read]** or **[Write]** Button.

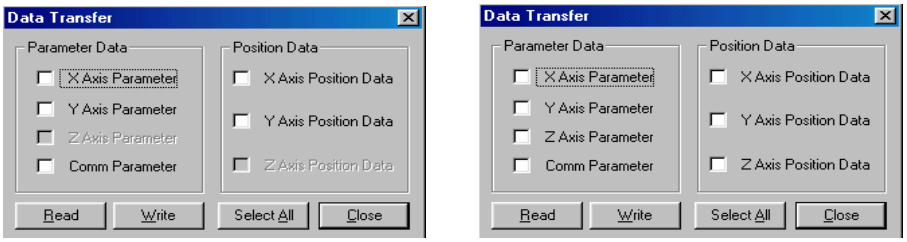
Items	Tool gathering	Short-cut key
Data Read/Write		SHIFT + R

Table 13. Data Read/Write related tool gathering

▶ Function Description

- Configuration

- The items shown on Data read/write dialogue box are different according to the APM module axis number.



APM 2 - axis APM 3 - aixs

Fig. 26. Data Read/Write dialogue box by APM module axis number

- After carrying out **[Data read]**, it is formed newly on the working screen but after carrying out **[Data write]**, the working screen is maintained as it were. As [data read/write] function can not be cancelled during working, cares should be taken in using.
- During data read/write working, the proceeding status is indicated in the status line in the bottom of APM software package.

Fig. 27. Data read/write proceeding status indication

▶ Notices

- If you want to carry out [data write] while APM is in operation (when 'Busy' signal indicates 'ON'), the error message shall be displayed as follows. But [data read/write] function is available while the PLC CPU is in the **RUN.**

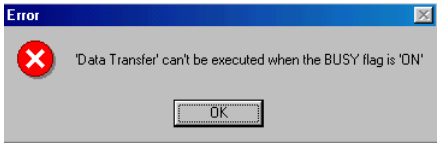


Fig. 28. Error message

4.10 Simulation Function

4.10.1 Profile Simulation

▶ Method

(1) Enter the data into the axis operation data item for simulation.

(2) Click **[Profile simulation]** from simulation menu or click the corresponding icon from basic tool gathering.

(3) After setting simulation axis and step no. from simulation dialogue box, press **[execute simulation]** Button.

Items	Tool gathering	Short-cut key
Profile simulation		SHIFT + F
Circular interpolation simulation		SHIFT + I
Restore		None
Enlarge		None
Reduce		None
Area enlargement		None
Data indication		None

Table 14. Simulation related tool gathering

▶ Function Description

- Execution environment

- If you click profile or circular interpolation simulation icon, tool gathering with 5 buttons except dialogue box shall be displayed. This tool gathering helps the user know the related result in detail by enlarging/reducing the simulation screen. The function for the corresponding tool gathering is shown same as **Table 11. Tracking tool gathering function description**.
- Profile simulation is available only for 1 axis simulation. That is, it is not available to carry out simulation for the 2 axis interpolation operation.

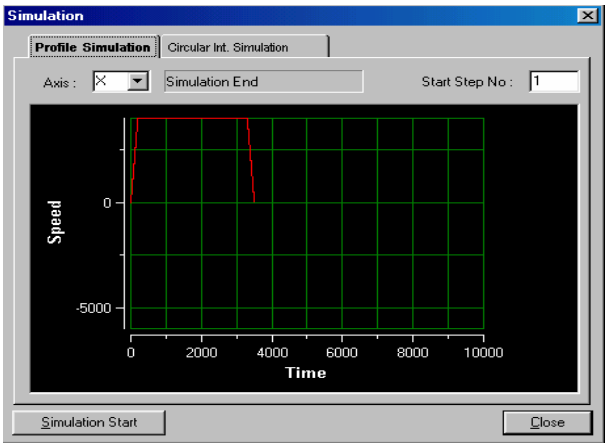


Fig. 29. Profile simulation screen

- Run-Time Refresh function

- Profile simulation has **Run-Time Refresh function** and if operation data is changed, the changed result shall be reflected right away and indicated on the simulation dialogue box.

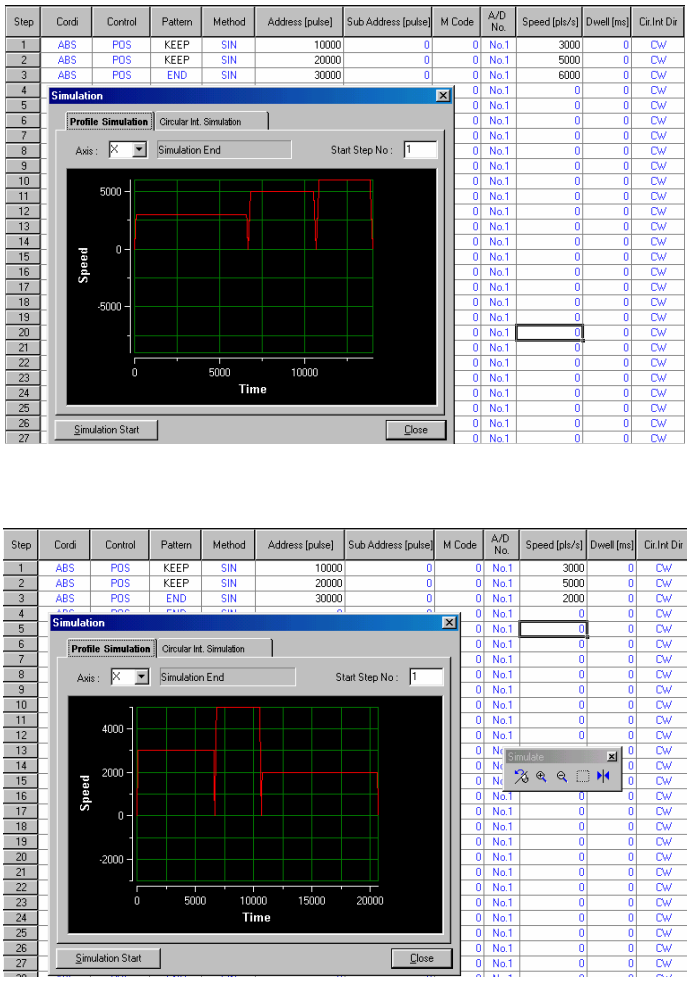


Fig. 30. Profile simulation Run-Time Refresh function

4.10.2 Circular Interpolation Simulation

▶ Method

(1) Click **[Circular interpolation simulation]** from simulation menu or click the corresponding icon from basic tool gathering.

(2) After entering circular interpolation method/direction information, starting point, Ending point and middle point data from circular interpolation dialogue box, press [execute simulation] button.

▶ Function Description

- Execute environment

- Circular interpolation simulation is available to carry out simulation by using the Middle point method, Center point method and circular interpolation direction setting (CW/CCW).
- If you press [Help] Button, the help dialogue box shall be displayed.

- Middle point method

- The following shows the result of simulation by Middle point method of circular interpolation.

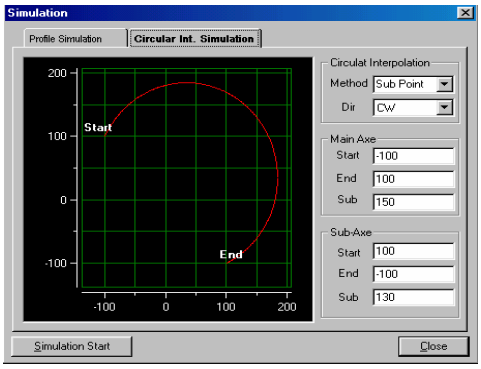


Fig. 31. Circular interpolation simulation by Middle point method

A) Middle point method is the method for simulation by calculating the middle point matching with the starting point and ending point with the coordinate of starting point, the coordinate of ending point and the coordinate of middle point. In this case, as the direction shall be determined according to the position of middle point, the user can not change it by random.

B) It is not available to match the starting point and the ending point, the ending point and middle point with the starting point and the ending point.

C) The point ca not be arranged in a straight line.

- Center point method

- The following shows the result of simulation by Center point method of circular interpolation.

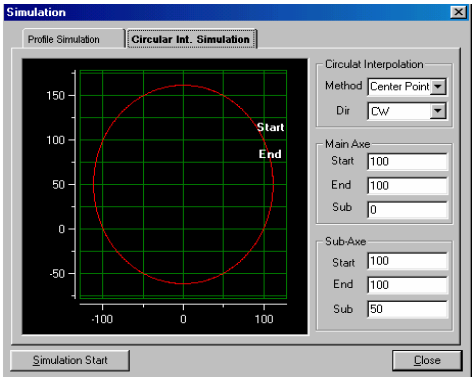


Fig. 32. Circular interpolation simulation by Center point method

D) Center point method is the method for simulation by calculating the center point again with the coordinate of the starting point, the coordinate of ending point and the coordinate of center point. In this case, the user can determine the direction.

E) Center point method is available to match the starting point with the ending point. In this case, it becomes the circle.

4.11 Status Screen, External I/O signal and Error history function

4.11.1 Status Screen

▶ Function Description

- Configuration

- Status Screen indicates the working status information that APM software package carries out.
- To hide/cover the status screen, press **[SHIFT+V]** short-cut key or click **[external I/O signal]** from view menu.

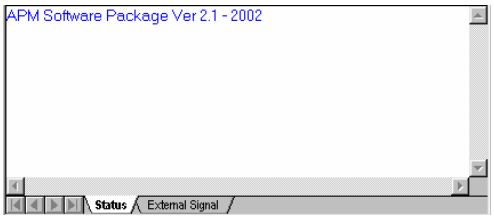


Fig. 33. Status screen

4.11.2 External I/O signal function

▶ Function Description

- Configuration

- External I/O signal window indicates the data only during monitoring. If monitoring stops, the data indicated on the external I/O signal window all disappeared and the screen is converted to the status screen.
- The item that appears in external I/O signal window is indicated based on the monitoring axis. That is, when monitoring axis is “X axis”, the external I/O signal window indicates only X axis external signal.
- To hide/cover external I/O signal screen, press **[SHIFT+V]** short-cut key or click **[external I/O signal]** from view menu.

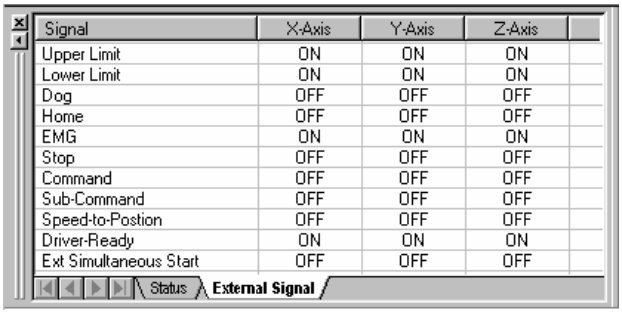


Fig. 34. External I/O signal window

4.11.3 Error History function

▶ Function Description

- Configuration

- Error history window is composed of **[overall error screen]** and **[each axis error screen]**.
- Error history data is indicated only during monitoring. If monitoring stops, the data indicated on the error history window all disappeared.
- The item indicated on the error history window is indicated based on the monitoring axis. That is, when monitoring axis is “X axis”, error history window indicates only X axis external signal.
- To hide/cover error history signal window, press **[SHIFT+E]** short-cut key or click **[error history information]** from view menu.

- Error indication method

- **[Overall error screen]** indicates all the latest occurred errors of each axis and **[X/Y/Z axis error screen]** indicates 10 errors occurred on each axis in order and shows the error description and solutions together in order to carry out the restore works promptly.
- If the redundant error repeats, **[each axis error screen]** indicates only one error and when you start monitoring again after completing monitoring, the redundant error all shall be indicated.
- If **[error history reset command]** is executed, the corresponding axis related error shall be removed from [overall error screen] or [axis error screen].

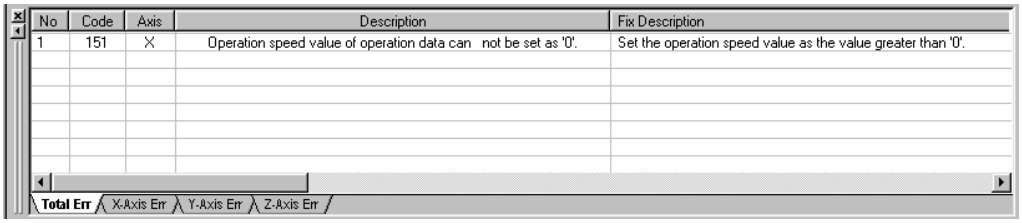


Fig. 35. Error history window

4.12 Print function

4.12.1 Print

▶ Method

(1) If you click **[Print]** from file menu when the working screen is open or click the corresponding icon from basis tool gathering, the working screen moves to monitoring screen and print dialogue box shall be displayed.

(2) After selecting the desired item, if you press **[Print]** Button, print dialogue box shall e displayed and it start to print. If you press **[Preview]** Button, you can verify the print screen before printing.

Items	Tool gathering	Short-cut key
Print		CTRL + P

Table 15. Print related tool gathering

▶ Function Description

- Execution environment

- Print dialogue box indicates **APM module specification** and **PLC information** obtained from **[online model setting function].**

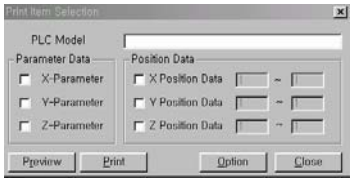


Fig. 36. Print dialogue box

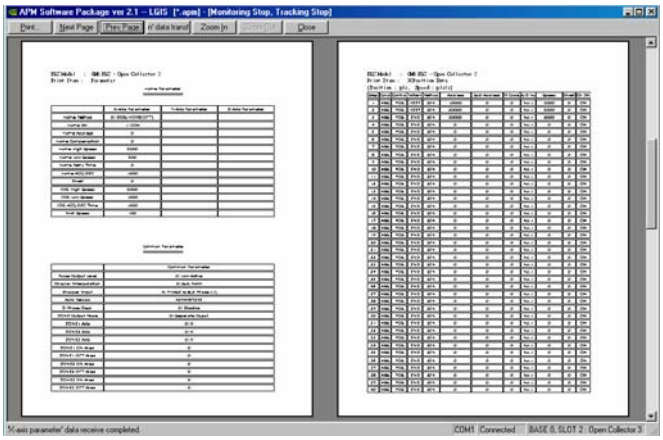


Fig. 37. Preview screen and Printer setting dialogue box

- Printer option function

- Through print option dialogue box, it is available to set the left/right margin and the head/bottom of print screen.

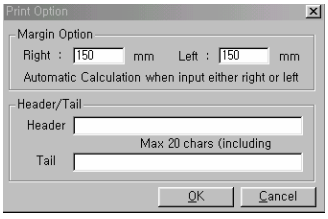


Fig. 38. Print option dialogue box

4.13 Environment Setting Function

4.13.1 Environment Setting Function

▶ Method

(1) Click **[environment setting]** from file menu or click the corresponding icon from basic tool gathering.

▶ Function Description

- Operation data option

- **[Operation data indication extension option]** is the option to change the step number of X/Y/Z axis operation data.
- **[Operation data item indication function]** is the option to change the color in order to distinguish it from other items easily when the data entered in X/Y/Z axis operation data by the user is different from the initial value.

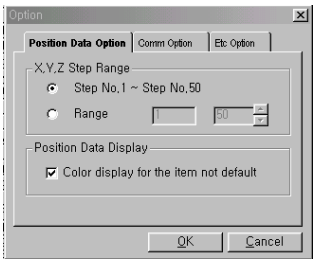


Fig. 39. Environment setting screen – Operation data option

- Communication option

- **[Monitoring period and Tracking period setting option]** is the option that the user can change the corresponding period according to the system.

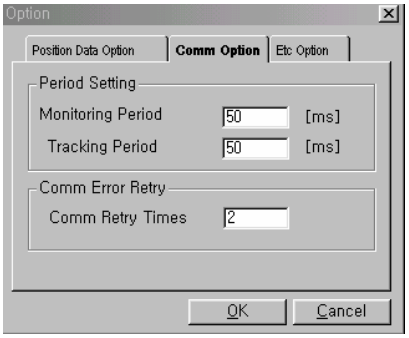


Fig. 40. Environment setting screen – Communication option

- **[Communication error restore option]** is the option to set how many times to try to restore the communication when the communication error occurs while APM software package and PLC carry out the communication works.

- Other option

- **[Error history file create option]** is the option to select whether or not to save the error occurred while working with APM by using APM software package as a separate file.

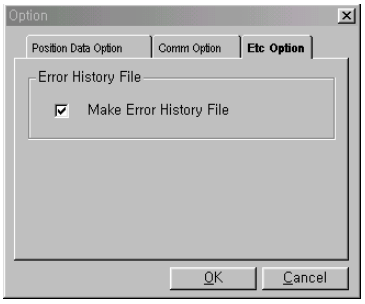


Fig. 41. Environment setting screen – Other option

4.14 Other Function

4.14.1 System Check Function

- APM software package exchanges the data with PLC periodically and monitors the status while data read/write, monitoring, tracking is not carried out. But in case that there is no response from PLC for 5~6 seconds, the error message will be shown as follows and it returns to the initial status.

Fig. 42. Communication error message

4.14.2 Error history file create function

- APM software package creates **ErrorHistory.txt** file when the program runs or if the file exists already, it opens the corresponding file and records the errors occurred during working.

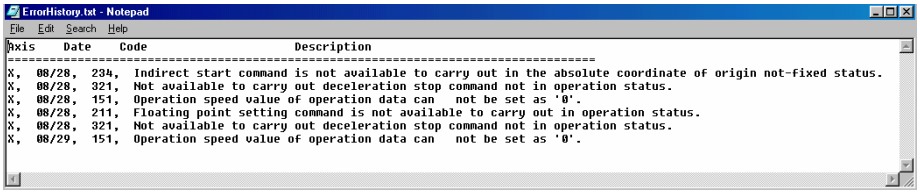


Fig. 43. Error history file

CHAPTER 5 Positioning Parameter & Operation Data

▶This chapter describes parameter to be set by software package.

▶Parameter configuration of software package is as follows and this parameter items should be set at each axis. (But common parameter shall be applied to all axis equally.)

	Item	X-Axis	Y-Axis	Z-Axis
Basic Parameter (To Article 5.1)	Unit	0: Pulse	0: Pulse	0: Pulse
	Pulse per Rotation	20000 pls	20000 pls	20000 pls
	Travel per Rotation	20000 pls	20000 pls	20000 pls
	Unit Multiplier	0: x 1	0: x 1	0: x 1
	Pulse Output Mode	0: CW/CCW	0: CW/CCW	0: CW/CCW
	Bias Speed	1 pls/s	1 pls/s	1 pls/s
	Speed Limit	100000 pls/s	100000 pls/s	100000 pls/s
	ACC/DEC No.1	500 ms	500 ms	500 ms
	ACC/DEC No.2	1000 ms	1000 ms	1000 ms
	ACC/DEC No.3	1500 ms	1500 ms	1500 ms
	ACC/DEC No.4	2000 ms	2000 ms	2000 ms
Extended Parameter (To Article 5.2)	S/W Upper Limit	2147483647 pls	2147483647 pls	2147483647 pls
	S/W Lower Limit	-2147483648 pls	-2147483648 pls	-2147483648 pls
	Backlash Comp	0 pls	0 pls	0 pls
	Position Complete Tim	1000 ms	1000 ms	1000 ms
	Ext. Command	0: Start	0: Start	0: Start
	Pulse Output Dir	0: CW	0: CW	0: CW
	M Code Output	0: NONE	0: NONE	0: NONE
	External Start	0: Disable	0: Disable	0: Disable
	External Stop	0: Disable	0: Disable	0: Disable
	Ext. Concurrent Start	0: Disable	0: Disable	0: Disable
	External VTP	0: Disable	0: Disable	0: Disable
	SW Limit Detect	0: No Detect	0: No Detect	0: No Detect
	Position Display	0: No Display	0: No Display	0: No Display
	ACC/DEC Pattern	0: Trapezoidal	0: Trapezoidal	0: Trapezoidal
	S-Curve Ratio	50	50	50
Home Parameter (To Article 5.3)	Home Method	0: DOG/HOME(OFF)	0: DOG/HOME(OFF)	0: DOG/HOME(OFF
	Home Dir	1: CCW	1: CCW	1: CCW
	Home Address	0 pls	0 pls	0 pls
	Home Compensation	0 pls	0 pls	0 pls
	Home High Speed	5000 pls/s	5000 pls/s	5000 pls/s
	Home Low Speed	500 pls/s	500 pls/s	500 pls/s
	Home Retry Time	0 ms	0 ms	0 ms
	Home ACC/DEC	0 ms	0 ms	0 ms
	Dwell	0 ms	0 ms	0 ms
	JOG High Speed	5000 pls/s	5000 pls/s	5000 pls/s
	JOG Low Speed	1000 pls/s	1000 pls/s	1000 pls/s
	JOG ACC/DEC Time	1000 ms	1000 ms	1000 ms
	Inch Speed	100 pls/s	100 pls/s	100 pls/s
Common Parameter (To Article 5.4)	Pulse Output Level	0: Low Active		
	Circular Interpolation	0: Sub Point		
	Encoder Input	4: PHASE A/B(2-Phase x1)		
	Auto Reload	4294967295		
	Z-Phase Clear	0: Disable		
	ZONE Output Mode	0: Seperate Ouput		
	ZONE1 Axis	0: X		
	ZONE2 Axis	0: X		
	ZONE3 Axis	0: X		
	ZONE1 ON Area	0 pls		
	ZONE1 OFF Area	0 pls		
	ZONE2 ON Area	0 pls		
	ZONE2 OFF Area	0 pls		
	ZONE3 ON Area	0 pls		
	ZONE3 OFF Area	0 pls		

[Parameter Configuration]

5.1 Basic Parameter

Here describes the basic parameter.

	Item	X-Axis	Y-Axis	Z-Axis
Basic Parameter	Unit	0: Pulse	0: Pulse	0: Pulse
	Pulse per Rotation	20000 pls	20000 pls	20000 pls
	Travel per Rotation	20000 pls	20000 pls	20000 pls
	Unit Multiplier	0: x 1	0: x 1	0: x 1
	Pulse Output Mode	0: CW/CCW	0: CW/CCW	0: CW/CCW
	Bias Speed	1 pls/s	1 pls/s	1 pls/s
	Speed Limit	100000 pls/s	100000 pls/s	100000 pls/s
	ACC/DEC No.1	500 ms	500 ms	500 ms
	ACC/DEC No.2	1000 ms	1000 ms	1000 ms
	ACC/DEC No.3	1500 ms	1500 ms	1500 ms
	ACC/DEC No.4	2000 ms	2000 ms	2000 ms

[Configuration of Basic Parameter]

<table>
<tr><th colspan="2">Items</th><th>Setting Range</th><th>Initial value</th></tr>
<tr><td colspan="2">Unit</td><td>0 : pulse, 1 : mm, 2 : Inch, 3 : degree</td><td>0</td></tr>
<tr><td colspan="2">Pulse per rotation</td><td>1 ~ 65,535[unit:pulse]</td><td>20,000</td></tr>
<tr><td colspan="2">Transfer distance per rotation</td><td>-㎜ : 1 ~ 65535[X10^{-1} ㎛]
-Inch : 1 ~ 65535[X10^{-5}inch]
-degree : 1 ~ 65535[X10^{-5}degree]
-pulse : 1 ~ 65535[pulse]</td><td>20,000</td></tr>
<tr><td colspan="2">Unit allocation</td><td>0:X1 times, 1:X10 times, 2:X100 times, 3:X1000 times</td><td>0</td></tr>
<tr><td colspan="2">Pulse output mode</td><td>0 : cw/ccw, 1 : pulse/dir, 2 : A phase/B phase mode</td><td>0</td></tr>
<tr><td colspan="2">Bias Speed</td><td><table><tr><th></th><th>Open Collector</th><th>Line Driver</th><th>Unit</th></tr><tr><td>mm</td><td colspan="2">1 ~ 2,000,000,000</td><td>X10^{-2} ㎜/min</td></tr><tr><td>inch</td><td colspan="2">1 ~ 2,000,000,000</td><td>X10^{-3}inch/min</td></tr><tr><td>degree</td><td colspan="2">1 ~ 2,000,000,000</td><td>X10^{-3} degree/min</td></tr><tr><td>pulse</td><td>1 ~ 200,000</td><td>1 ~ 1,000,000</td><td>Pulse/sec</td></tr></table></td><td>1</td></tr>
<tr><td colspan="2">Speed limit</td><td><table><tr><th></th><th>Open Collector</th><th>Line Driver</th><th>Unit</th></tr><tr><td>mm</td><td colspan="2">1 ~ 2,000,000,000</td><td>X10^{-2} ㎜/min</td></tr><tr><td>inch</td><td colspan="2">1 ~ 2,000,000,000</td><td>X10^{-3}inch/min</td></tr><tr><td>degree</td><td colspan="2">1 ~ 2,000,000,000</td><td>X10^{-3} degree/min</td></tr><tr><td>pulse</td><td>1 ~ 200,000</td><td>1 ~ 1,000,000</td><td>Pulse/sec</td></tr></table></td><td>100,000</td></tr>
<tr><td rowspan="4">Acceleration /Deceleration Time</td><td>No.1</td><td rowspan="4">0 ~ 65,535[unit:ms]</td><td>500</td></tr>
<tr><td>No.2</td><td>1000</td></tr>
<tr><td>No.3</td><td>1500</td></tr>
<tr><td>No.4</td><td>2000</td></tr>
</table>

[Basic Parameter Setting Range]

5.1.1 Unit

▶It sets the command unit for positioning control and according to control object, the command unit (mm, inch, pulse) is set and used from 1 axis to 3 axis at each axis separately.

▶In case of changing the unit setting, as the value of other parameter and operation data does not change, the value of parameter or operation data should be set within the setting range of the unit to be changed.

Ex) mm,inch,pulse : X-Y Table, Conveyor

degree : a body of rotation (360degree/rotation)

5.1.2 Pulse per Rotation (Ap)

▶Only in case of using the unit (mm, inch, pulse) as a positioning command unit, you can set and use the pulse necessary for 1 rotation of motor.

▶ In case of using SERVO, you can set the resolution per rotation of SERVO Encoder.

Transport amount per pulse = Transport amount per rotation (Al) / Pulse per rotation (Ap)

5.1.3 Transfer distance per rotation (Al) and Unit allocation (Am)

▶Only in case of using the unit (mm, inch, degree) as a positioning command unit, you can set and use transfer distance per 1 rotation of motor and unit allocation.

▶How is transferred by 1 rotation of motor is determined by the structure of machine.

If the lead of ball screw (mm/rev) is PB and the rate of deceleration is 1/n,

Transport amount per rotation(AL) = PB × 1/n .

▶But the value available to set with transfer distance per 1 rotation (Al) of this parameter is max. 6553.5 ㎛ (approx.6.5 ㎜).

▶ If AL exceeds this value, AL will be set as follows :

Transport amount per rotation(AL) = PB × 1/n

= (Al) × (Am)

Note) As (Am) is 1,10,100,1000, if the value of "PB × 1/n" exceeds 6553.5 ㎛, it is required to adjust the unit allocation so that the transfer distance per rotation (Al) does not exceed 6553.5 ㎛.

Ex1) In case that (AL) = PB × 1/n = 6000.0 ㎛(= 6 ㎜),

(AL) = (Al) × (Am) = 6000 × 1

Ex2) In case that (AL) = PB × 1/n = 60000.0 ㎛(= 60 ㎜),

(AL) = (Al) × (Am) = 6000 × 10

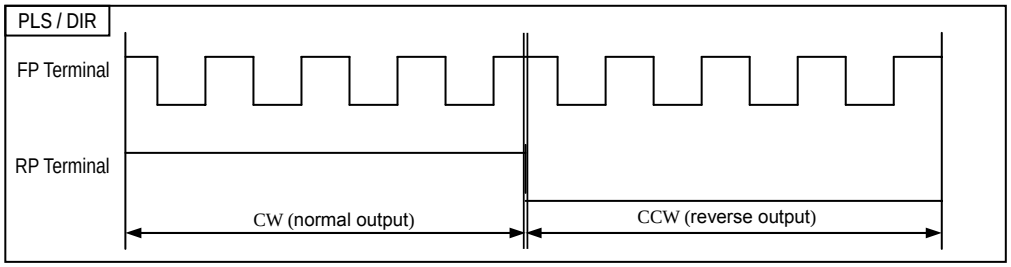
= 600 × 100

5.1.4 Pulse Output Mode

▶As input method to be used for SERVO Driver or Stepping Driver is different, it is required to select pulse output mode of positioning module according to the input method.

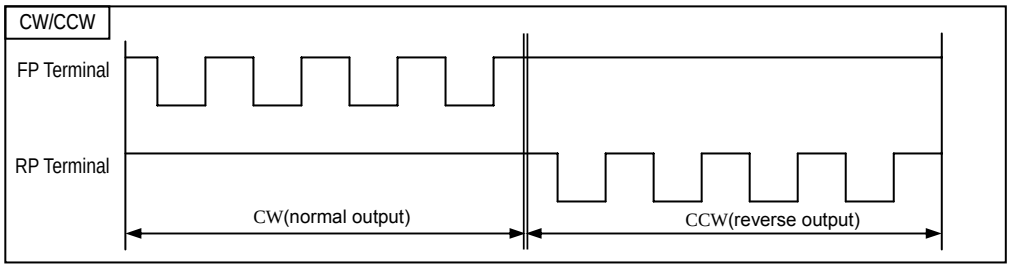
1) PLS/DIR mode

▶PLS/DIR mode shows the case that normal pulse and reverse pulse are outputted from one terminal and the normal/reverse discrimination signal is outputted from different terminal. The following shows the case that pulse output level is low active.



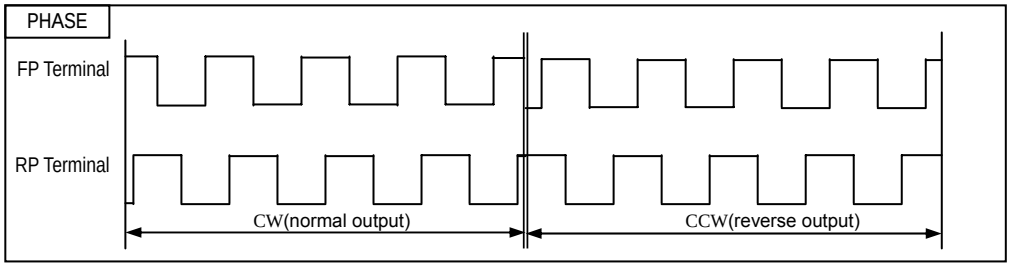
2) CW/CCW mode

▶CW/CCW mode shows the case that normal pulse and reverse pulse comes from different terminal. The following shows that pulse output level is Low Active.



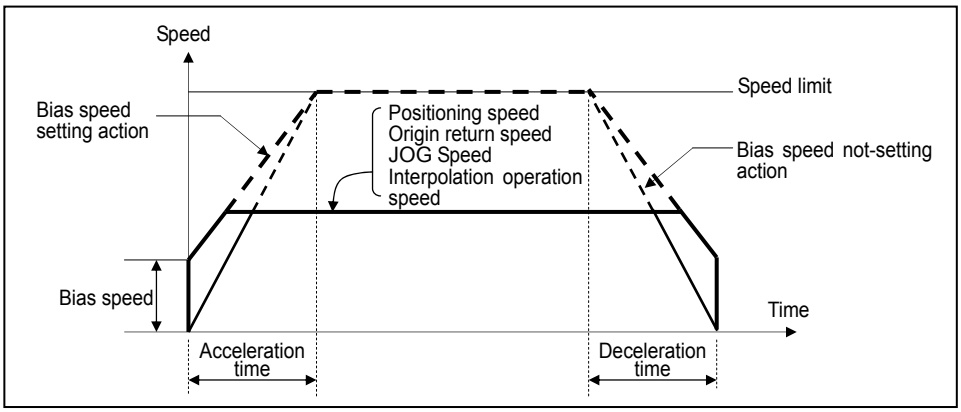
3) PHASE mode

▶PHASE mode shows the case that normal pulse and reverse pulse will be outputted with 90degree phase difference. The following shows the case that pulse output level is Low Active.



5.1.5 Bias Speed

- As the stepping motor has unstable torque near speed=0, the start speed shall be set in the beginning of operation in command to smooth the rotation of motor and reduce the positioning time. The speed to be set at this time is called “Bias Speed”.
- The setting range is 1 ~ 200,000(unit: 1pps) for open collector, 1 ~ 1,000,000 for line driver at each axis.
- Bias speed shall be used for the main axis of ① positioning operation by setting command,
  ② origin return operation,
  ③ JOG operation,
  ④ interpolation operation.



Point

If Bias speed is set as high, total operation time shall be reduced but if the setting value is too high, it may cause the occurrence of impact sound in the start/end time and forces the excessive effect to the machine. Cares shall be taken in using.

- The bias speed should be set within the range as follows :
  (If origin return speed is set less than bias speed, it occurs error 133, if positioning operation speed is set less than bias speed, error 153, and if Jog operation speed (high speed) is set less than bias speed, error 121, respectively.)
  1) Bias speed ≤ Positioning speed data
  2) Bias speed ≤ Origin return low speed ≤ Origin return high speed
  3) Bias speed ≤ JOG high speed (Jog low speed operation is not related to bias speed.)

5.1.6 Speed Limit

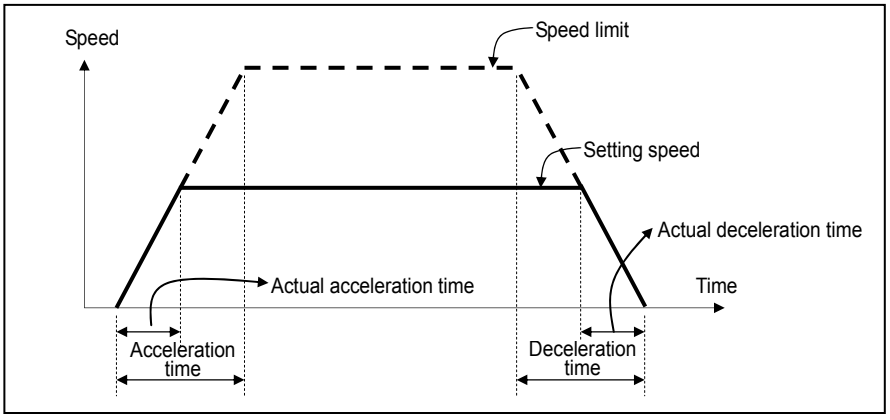
- ▶ max. Speed available to set for positioning operation.
- ▶ The setting range is 1~200,000 for G4F-PP1/2/3O, G6F-PP1/2/3O and 1～1,000,000 for G4F-PP1/2/3D, G6F-PP1/23/D (unit : 1pps).
- ▶ The operation speed of positioning operation, origin return speed and Jog operation speed is influenced by speed limit and if they are set as higher value than speed limit, error will occur.
  - ① If origin return speed is greater than speed limit : Error 133
  - ② If positioning operation speed is greater than speed limit : Error 152
  - ③ If Jog operation speed is greater than speed limit : Error 121

5.1.7 Acceleration/Deceleration Time

- ▶ This is applied at the starting/ending point of positioning operation and also applied to continuous operation command, SKIP command, speed override, positioning speed override among positioning operation.
- ▶ Acceleration/Deceleration time is set by axis unit at PLC program and Software Package).
- ▶ The setting range is 0 ～ 65,535 (unit: 1ms) at each axis.

1) Acceleration time : the time required to reach from speed “0”(stop state) to the speed limit which is set by parameter.
   - ▷ In case of using BIAS, it is the time required to reach from the setting bias speed to the speed limit which is set by parameter.

2) Deceleration time : the time required to reach from the speed limit set by parameter to the speed “0”(stop state).
   - ▷ In case of using BIAS, it is the time required to reach from the speed limit set by parameter to the setting bias speed.



- ▶ Definition of Terminology

  Speed limit : max. Speed available to set for positioning operation at the parameter of software package.

  Setting speed : speed value of operation data that position data operates actually.

  Actual acceleration time : the time required to reach from speed “0”(stop state) to the speed value which is set by operation data.

  Actual deceleration time : the time required to reach from the speed value set by operation data to speed “0”(stop state).

5.2 Expansion Parameter

Here describes Expansion Parameter.

	Item	X-Axis	Y-Axis	Z-Axis
Extended Parameter	S/W Upper Limit	2147483647 pls	2147483647 pls	2147483647 pls
	S/W Lower Limit	-2147483648 pls	-2147483648 pls	-2147483648 pls
	Backlash Comp	0 pls	0 pls	0 pls
	Position Complete Tim	1000 ms	1000 ms	1000 ms
	Ext. Command	0: Start	0: Start	0: Start
	Pulse Output Dir	0: CW	0: CW	0: CW
	M Code Output	0: NONE	0: NONE	0: NONE
	External Start	0: Disable	0: Disable	0: Disable
	External Stop	0: Disable	0: Disable	0: Disable
	Ext. Concurrent Start	0: Disable	0: Disable	0: Disable
	External VTP	0: Disable	0: Disable	0: Disable
	SW Limit Detect	0: No Detect	0: No Detect	0: No Detect
	Position Display	0: No Display	0: No Display	0: No Display
	ACC/DEC Pattern	0: Trapezoidal	0: Trapezoidal	0: Trapezoidal
	S-Curve Ratio	50	50	50

[Configuration of Expansion Parameter]

Items	Setting Range	Initial value
Software high limit	-㎜ : -2147483648 ~ 2147483647 [X10^{-4}㎜] -Inch : -2147483648 ~ 2147483647 [X10^{-5}Inch] -degree : -2147483648 ~ 2147483647 [X10^{-5}degree] -pulse : -2147483648 ~ 2147483647 [pulse]	2147483648
Software low limit	-㎜ : -2147483648 ~ 2147483647 [X10^{-4}㎜] -Inch : -2147483648 ~ 2147483647 [X10^{-5}Inch] -degree : -2147483648 ~ 2147483647 [X10^{-5}degree] -pulse : -2147483648 ~ 2147483647 [pulse]	-2147483648
Backlash compensation amount	-㎜ : 0 ~ 65535[X10^{-1}㎛] -Inch : 0 ~ 65535[X10^{-5}inch] -degree : 0 ~ 65535[X10^{-5}degree] -pulse : 0 ~ 65535[pulse]	0
Output time of positioning end signal	0 ~ 65,535[unit:ms]	1,000
S-Curve rate	1 ~ 100[unit:%]	50
External command function selection	0 : Set, 1 : Jog operation, 2 : Skip	0
Pulse output direction	0 : normal, 1 : reverse	0
Acceleration/Deceleration pattern	0 : trapezoid type, 1 : S-type	0
M Code mode	0 : None, 1 : With, 2 : After	0
Position indication during equal speed operation	0 : prohibited, 1 : permitted	0
Detection of soft high/low limit during equal speed operation	0 : prohibited, 1 : permitted	0
External speed/position control switching permitted/prohibited	0 : prohibited, 1 : permitted	0
External command permitted/prohibited	0 : prohibited, 1 : permitted	0
External stop permitted/prohibited	0 : prohibited, 1 : permitted	0
External simultaneous start permitted/prohibited	0 : prohibited, 1 : permitted	0

[Setting Range of Expansion Parameter]

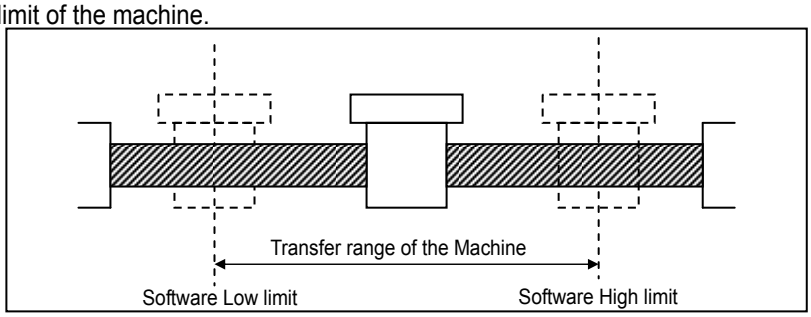
5.2.1 S/W High/Low limit

; it is also called "Stroke High/Low limit".

▶ The range of machine available to move is "stroke limit" and the high/low stroke limit is set as Software high limit and Software low limit. If operated out of the setting range, the function of positioning will not be carried out.

This means that if the operation is executed out of the setting range, this function will not carry out the positioning against practical command.

Therefore, this is used to avoid the breakaway of high/low limit by wrong setting of positioning address value and the malfunction caused by user program error and it is required to install limit switch for emergency stop near stroke limit of the machine.



▶ The range check of software high/low limit shall be done when the operation starts or during the operation.

▶ If the error is detected by the setting of software high/low limit (Software high limit error : 501, Software low limit error : 502), the pulse output of positioning module shall be prohibited.

Therefore, when the error is detected and you want to operate again, it is required to release the output prohibition before using.

▶ The setting range shall be done at each axis and has

Software high limit address value range : -2,147,483,648 ~ 2,147,483,647

Software low limit address value range : -2,147,483,648 ~ 2,147,483,647(unit: Pulse).

5.2.2 Backlash Compensation Amount

▶ The tolerance that the machine does not work by the wear when the rotation direction changes in case that a gear, screw etc is combined to run at the motor axle, is called as 'Backlash".

Therefore, when you change the rotation direction, it is required to add the backlash compensation amount to the positioning amount for output.

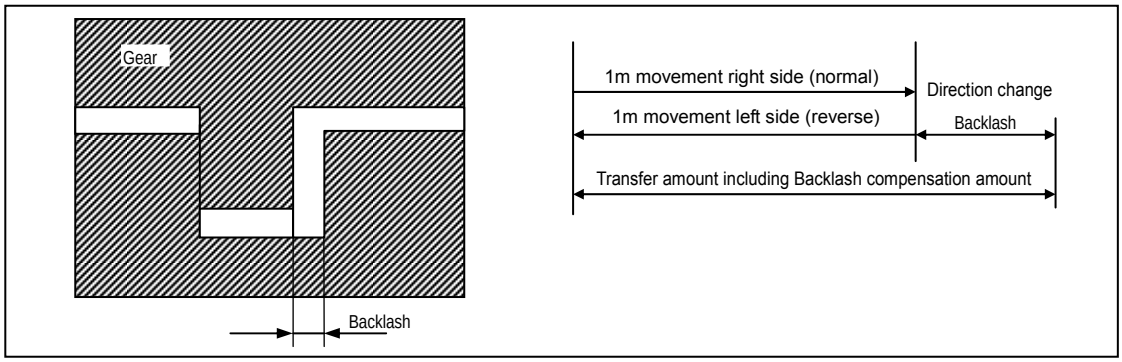
▶ In case of G4/6F-PP1/2/3O and G4/6F-PP1/2/3D, it is used for positioning operation, inching operation and job operation.

▶ The setting range is 0 ~ 65,535(unit: Pulse) at each axis.

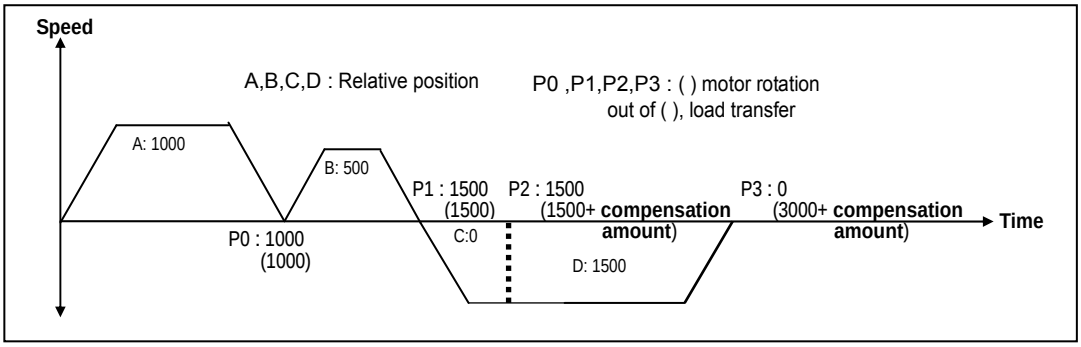
Point

After setting or changing the backlash compensation amount, the origin return should be carried out.

▶ If the position moved 1m to the right and again 1m to the left, it is not possible to reach the original position by backlash. At this time, it is required to add backlash compensation amount.



▶ In case of **G4/6F-PP1/2/3O,G4/6F-PP1/2/3D, the backlash compensation amount is outputted first and the address value of positioning operation, inching operation and jog operation will move to the goal point.**



5.2.3 Position End Output Time

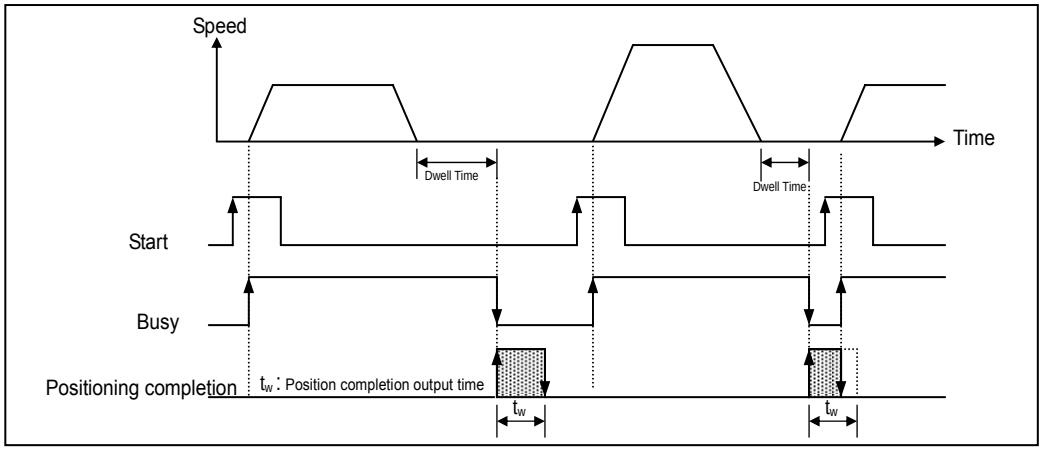
▶Position end output time shall be OFF after sustaining "ON" for the setting time after Positioning is completed during single operation, repeat operation, go-on operation, continuous operation, linear interpolation operation, circular arcs interpolation operation, speed/position switching operation (position indication during equal speed operation), inching operation and positioning end signal becomes "ON".

At this time, if all setting command is executed while positioning end signal is ON, it shall be OFF.

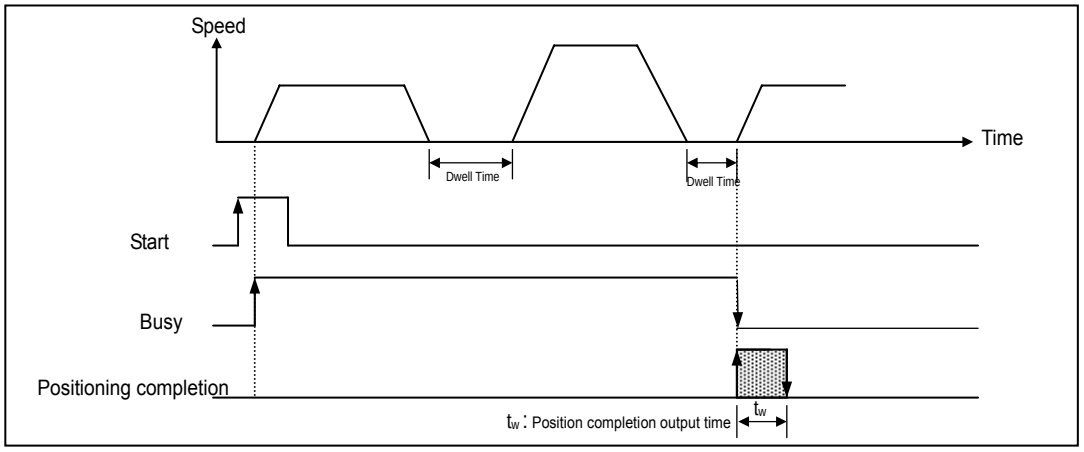
And only in case that go-on operation mode and continuous operation mode is ended completely, the positioning end signal shall be outputted.

▶The setting range is 0 ~ 65,535 (unit: ms).

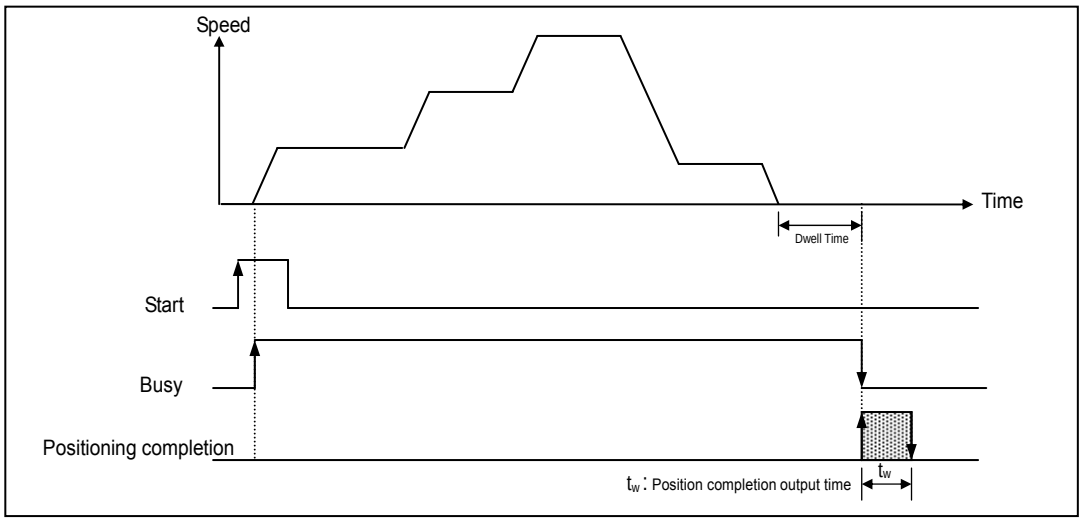
▶The action of single operation mode is as follows :



▶The action of Go-on operation mode is as follows :



▶ The action of Continuous operation mode is as follows :



5.2.4 Selection of External Command

▶It is available to select one among set, jog operation, skip for external command signal input.

▶In case of using the external command signal, the external command should be set as “permitted”.

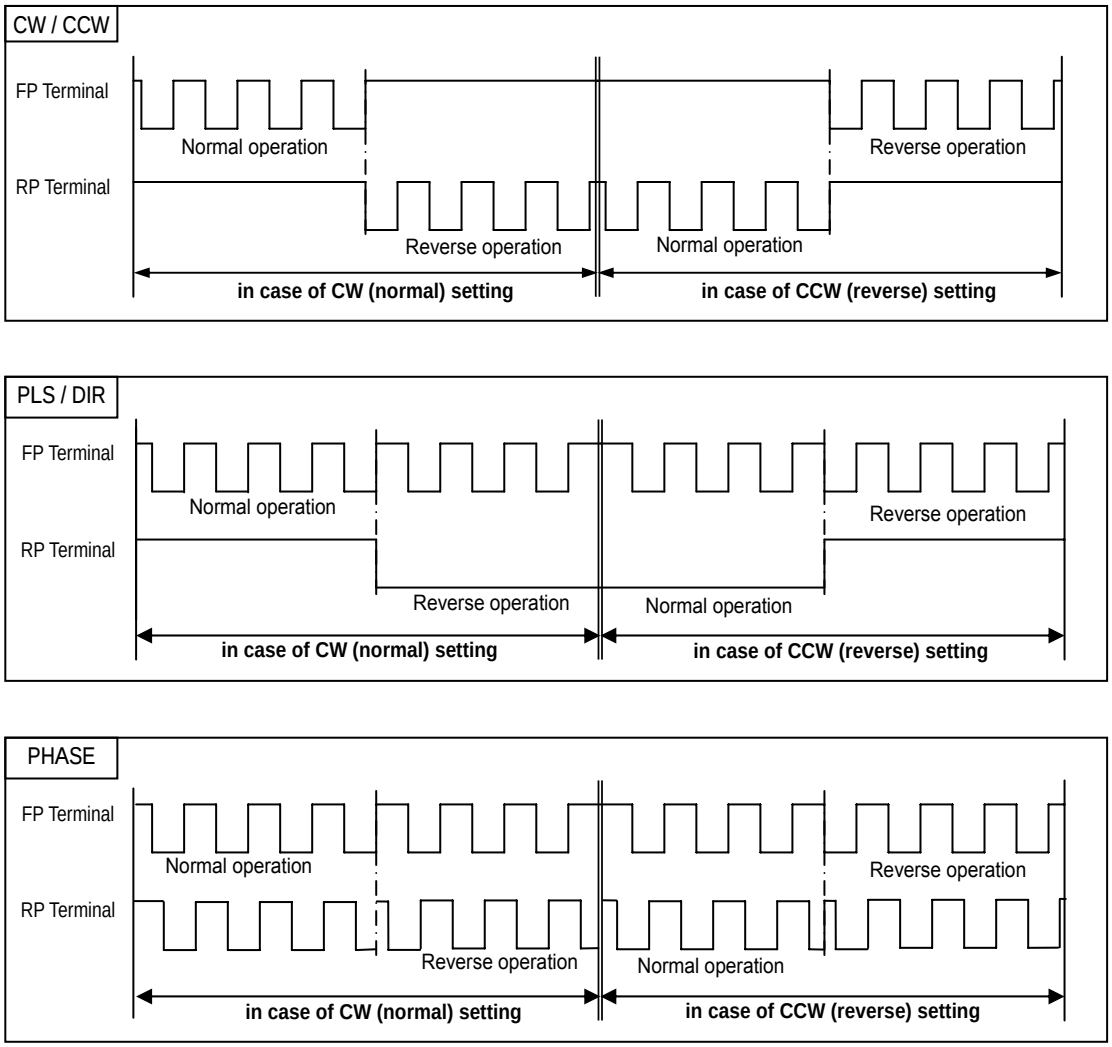
▶In case of using jog operation as external command selection, the external command signal shall be acted as jog high speed normal rotation and the external auxiliary command signal is acted as jog high speed reverse rotation.

5.2.5 Pulse Output Direction

The below shows the pulse output direction in case of Low Active.

▶normal rotation : the rotation direction shall be set to the direction to increase the current value of position address.

▶reverse rotation : the rotation direction shall be set to the direction to decrease the current value of position address.



5.2.6 M Code Output

- ▶ M code mode set by parameter shall be applied to all position data of the corresponding axis in a bundle.
- ▶ Available to set M code number differently at each operation step number of positioning data.
- ▶ M code number setting range : 1 ~ 65,535
- ▶ Available to use M code for the identification of operation step number in operation and the execution of auxiliary works (Clamp, Drill rotation, tool change etc) after reading it from output variable “MCD” of current operation state code read function blockof the program.
- ▶ M code signal occurring during operation shall be reset by M code “Off” command.

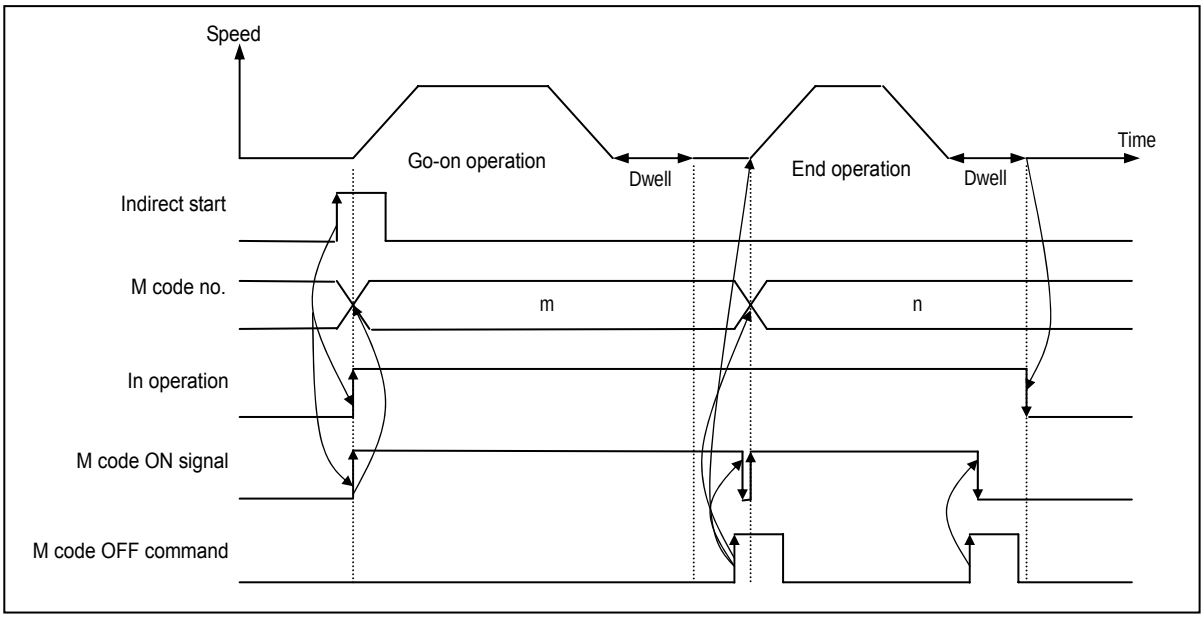
Point

▶ If M code signal is “ON” even if the positioning is completed, G4/6F-PP1/2/3O, G4/6F-PP1/2/3D treats Error (error no: 233) without acting the next operation step number. Therefore, in command to act the positioning of the next operation step number, M code signal should be “OFF” by M code “Off” command.

- ▶ M code mode has 2 kinds of mode according to the output timing of M code signal : With mode and After mode.

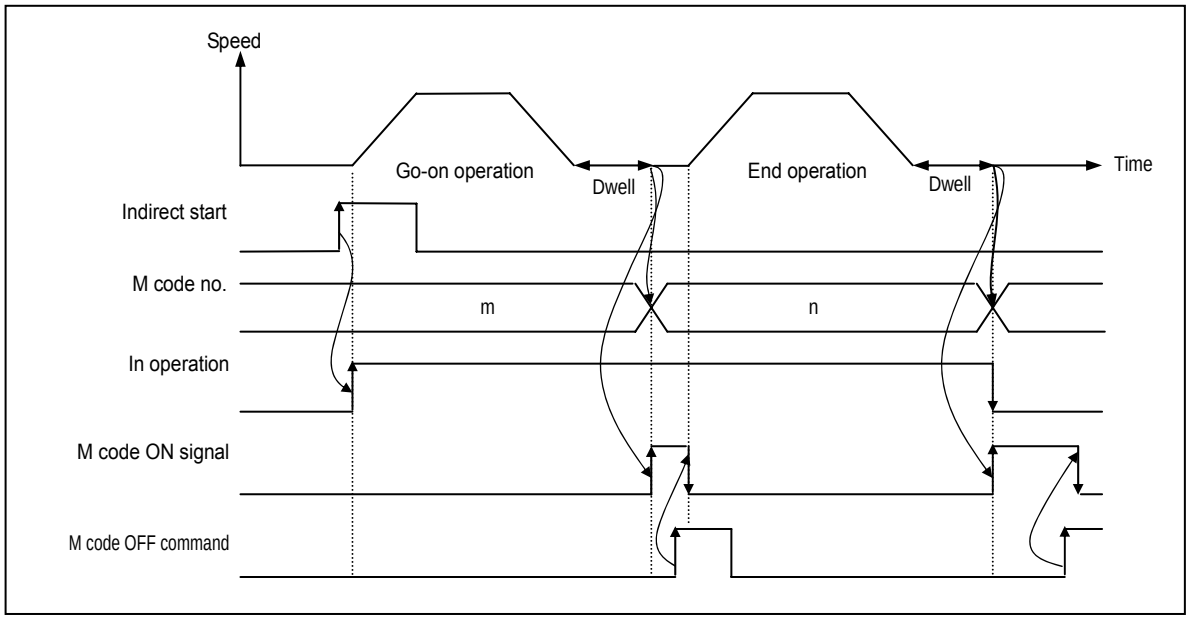
1) With mode

This is the mode that outputs M code number which is set by position data with start command of positioning action [indirect start, direct start, Circular interpolation, Simultaneous start, linear interpolation to the output variable “MCD” of current operation state code read function block and at the same time outputs M code ON signal.



2) After mode

This is the mode that outputs M code number to be set by position data after completing the positioning by start command (indirect start, direct start, circular interpolation, simultaneous start, linear interpolation to the output variable “MCD” of current operation state code read function block and at the same time outputs M code ON signal.



5.2.7 External Command

- In case of selecting one from external command (start, jog operation, skip), the setting of “external command permitted/prohibited” should be set as “permitted”.
- In case that it is set as ”prohibited”, the start of the external command selection, jog operation (high speed normal rotation), SKIP operation and jog operation by external auxiliary command (high speed reverse rotation) are not possible.

5.2.8 External Stop

- In case of using external deceleration stop function during positioning operation separate from internal deceleration stop, the external stop should be set as “permitted”.

5.2.9 External Simultaneous Start

- In case of starting 2axis~3axis simultaneously by the external simultaneous start, it should be set as “permitted”.
- External simultaneous start executes the axis information and operation step number first by internal start command and then makes the external simultaneous start input “ON”.
- If external simultaneous start is set as “permitted”, it starts only by external simultaneous start input despite of the execution of internal simultaneous start command.

5.2.10 External Speed/Position Switching

- External speed/position switching should be set as “permitted” in command to switch the position control by external signal during equal speed operation by speed control.

5.2.11 Equal Speed Operation S/W High/Low Limit

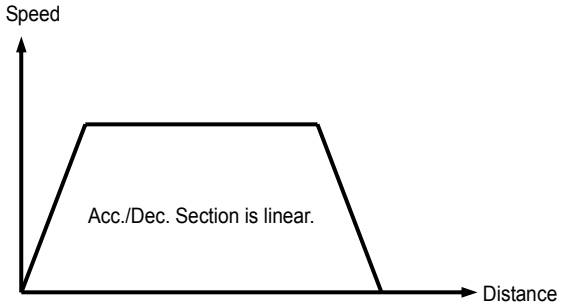
- This is used to stop the pulse output during equal speed operation by speed control because of detection of S/W high/low limit.
- In this case, the origin determination is completed and the position indication during equal speed operation should be set as “indication” for the detection of S/W high/low limit.

5.2.12 Position during Equal Speed Operation

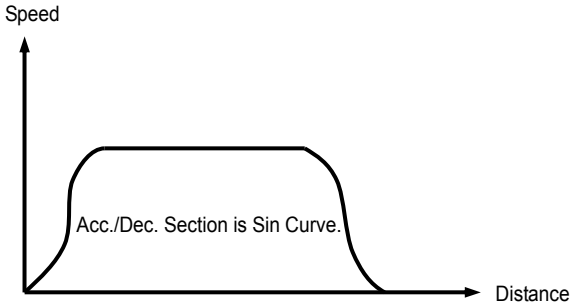
- If you want to know the current position during equal speed operation by speed control, the position indication during equal speed operation should be set as “indication”.
- But the current position shall be indicated only in the state that the origin determination is completed.

5.2.13 Acceleration/Deceleration Pattern

- There are 2 kinds of Acceleration/Deceleration operation pattern : Trapezoid operation and S-Curve operation.
- In case of positioning operation, it is available to select operation pattern (either trapezoid operation or S-Curve operation) at the section of acceleration and de deceleration.
- As it is not possible to use S-Curve operation pattern in case of continuous operation mode and speed override, care should be taken in setting.
- In case of using S-Curve acceleration/deceleration, it is available to protect the motor from the load effect at the point that the motor starts to move the moving object and stops it.



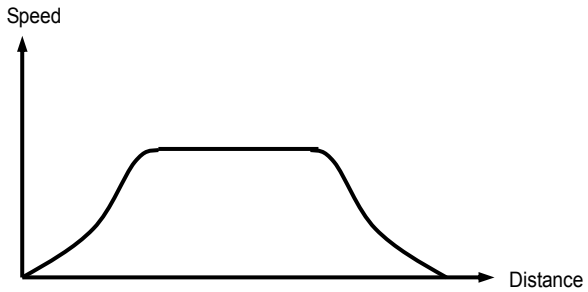
<Trapezoid Acceleration/Deceleration>



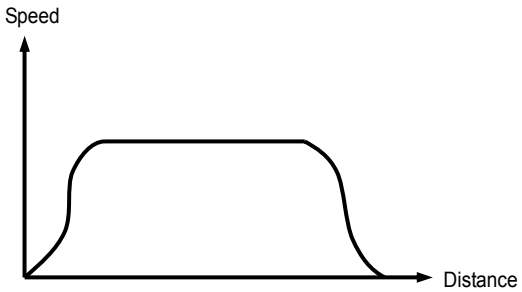
<S-Curve Acceleration/Deceleration>

5.2.14 S-Curve Rate

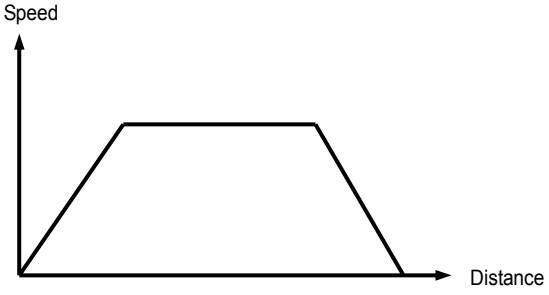
- In case of selecting S-Curve operation as an acceleration/deceleration pattern, S-Curve rate (1~100%) should be set.
- According to S-Curve rate, S-Curve operation pattern shall be formed.
- If S-Curve rate is 100%, it becomes the same as trapezoid operation and if the 50% rate is set, it becomes the acceleration/deceleration curve which is the closest to the Sin Curve.
- The figure as below shows the example of S-Curve rate setting.



S-curve rate : 50%



S-curve rate : 1%



S-curve rate : 100%

5.3 Origin/Manual Parameter

Here describes Origin/Manual Parameter.

	Item	X-Axis	Y-Axis	Z-Axis
Home Parameter	Home Method	0: DOG/HOME(OFF)	0: DOG/HOME(OFF)	0: DOG/HOME(OFF)
	Home Dir	1: CCW	1: CCW	1: CCW
	Home Address	0 pls	0 pls	0 pls
	Home Compensation	0 pls	0 pls	0 pls
	Home High Speed	5000 pls/s	5000 pls/s	5000 pls/s
	Home Low Speed	500 pls/s	500 pls/s	500 pls/s
	Home Retry Time	0 ms	0 ms	0 ms
	Home ACC/DEC	0 ms	0 ms	0 ms
	Dwell	0 ms	0 ms	0 ms
	JOG High Speed	5000 pls/s	5000 pls/s	5000 pls/s
	JOG Low Speed	1000 pls/s	1000 pls/s	1000 pls/s
	JOG ACC/DEC Time	1000 ms	1000 ms	1000 ms
	Inch Speed	100 pls/s	100 pls/s	100 pls/s

[Configuration of Origin/Manual parameter]

<table>
<tr><th>Items</th><th>Setting Range</th><th>Initial value</th></tr>
<tr><td>Origin address</td><td>-㎜ : -2147483648 ~ 2147483647 [X10^{-4}㎜]
-Inch : -2147483648 ~ 2147483647 [X10^{-5}Inch]
-degree : -2147483648 ~ 2147483647 [X10^{-5}degree]
-pulse : -2147483648 ~ 2147483647 [pulse]</td><td>0</td></tr>
<tr><td>Origin return high speed</td><td><table><tr><th></th><th>Open Collector</th><th>Line Driver</th><th>Unit</th></tr><tr><td>mm</td><td>0 ~ 200000</td><td>0 ~ 1000000</td><td>X10^{-2}㎜/min</td></tr><tr><td>Inch</td><td>0 ~ 200000</td><td>0 ~ 1000000</td><td>X10^{-3}inch/min</td></tr><tr><td>Degree</td><td>0 ~ 200000</td><td>0 ~ 1000000</td><td>X10^{-3} degree/min</td></tr><tr><td>pulse</td><td>0 ~ 200000</td><td>0 ~ 1000000</td><td>Pulse/sec</td></tr></table></td><td>5,000</td></tr>
<tr><td>Origin return low speed</td><td><table><tr><th></th><th>Open Collector</th><th>Line Driver</th><th>Unit</th></tr><tr><td>mm</td><td>0 ~ 200000</td><td>0 ~ 1000000</td><td>X10^{-2}㎜/min</td></tr><tr><td>Inch</td><td>0 ~ 200000</td><td>0 ~ 1000000</td><td>X10^{-3}inch/min</td></tr><tr><td>Degree</td><td>0 ~ 200000</td><td>0 ~ 1000000</td><td>X10^{-3} degree/min</td></tr><tr><td>pulse</td><td>0 ~ 200000</td><td>0 ~ 1000000</td><td>Pulse/sec</td></tr></table></td><td>500</td></tr>
<tr><td>Origin return acceleration/deceleration time※Note 1</td><td>0 ~ 65,535[unit:ms]</td><td>0</td></tr>
<tr><td>Origin return dwell time</td><td>0 ~ 50,000[unit:ms]</td><td>0</td></tr>
<tr><td>Origin compensation amount</td><td>-㎜ : -2147483648 ~ 2147483647 [X10^{-4}㎜]
-Inch : -2147483648 ~ 2147483647 [X10^{-5}Inch]
-degree : -2147483648 ~ 2147483647 [X10^{-5}degree]
-pulse : -2147483648 ~ 2147483647 [pulse]</td><td>0</td></tr>
<tr><td>Origin return reset waiting time</td><td>0 ~ 65,535[unit:ms]</td><td>0</td></tr>
<tr><td>Origin return mode</td><td><table><tr><th>Range</th><th>Detail contents</th></tr><tr><td>0</td><td>Origin detection by Approximate origin and the origin [Origin detection after approximate origin OFF]</td></tr><tr><td>1</td><td>Origin detection by Approximate origin and the origin [Origin detection after deceleration when approximate origin ON]</td></tr><tr><td>2</td><td>Origin detection by high/low limit and the origin</td></tr><tr><td>3</td><td>Origin detection by approximate origin</td></tr><tr><td>4</td><td>High speed origin detection</td></tr></table></td><td>0</td></tr>
<tr><td>Origin return direction</td><td>0:normal, 1:reverse</td><td>1</td></tr>
</table>

※ Note1] In case of setting the origin return acceleration/deceleration time as "0", it needs to follow the acceleration/deceleration setting value of basic parameter.

[Setting range of Origin/Manual Parameter]

Items	Setting Range				Initial value
Jog high speed		Open Collector	Line Driver	Unit	5,000
	mm	1 ~ 2000000000		X10^{-2} ㎜/min	
	inch	1 ~ 2000000000		X10^{-3}inch/min	
	degree	1 ~ 2000000000		X10^{-3} degree/min	
	pulse	1 ~ 200000	1 ~ 1000000	Pulse/sec	
Jog low speed		Open Collector	Line Driver	Unit	1000
	mm	1 ~ 2000000000		X10^{-2} ㎜/min	
	inch	1 ~ 2000000000		X10^{-3}inch/min	
	degree	1 ~ 2000000000		X10^{-3} degree/min	
	pulse	1 ~ 200000	1 ~ 1000000	Pulse/sec	
Jog acceleration/deceleration time ※ Note 2	0 ~ 65,535[unit:ms]				1000
Inching speed ※ Note 2		Open Collector	Line Driver	Unit	100
	mm	1 ~ 2000000000		X10^{-2} ㎜/min	
	inch	1 ~ 2000000000		X10^{-3}inch/min	
	degree	1 ~ 2000000000		X10^{-3} degree/min	
	pulse	1 ~ 200000	1 ~ 1000000	Pulse/sec	

※ Note 2] In case of setting the Jog acceleration/deceleration time as "0", it needs to follow the acceleration/deceleration setting value of basic parameter.

[Setting Range of Origin/Manual Parameter]

5.3.1 Origin Return Method

▶ There are 5 kinds of Origin return method.

Origin return treatment method	G4/6F-PP1/2/3O, G4/6F-PP1/2/3D
Origin detection after Approximate origin OFF	Available
Origin detection after deceleration when Approximate origin ON	Available
Origin detection by the origin and High/low limit	Available
Origin detection by Approximate origin	Available
High speed origin return	Available

▶ For further information of origin return treatment method, please refer to origin return items..

5.3.2 Origin Return Direction

▶Origin return direction is divided into CW(normal rotation) and CCW(reverse rotation) based on the origin return direction of 5.3.

Pulse output direction of 5.2	Origin return direction	Pulse output action of positioning module
CW(normal)	**CW(normal)**	Origin return to the normal direction
	CCW(reverse)	Origin return to the opposite (reverse direction) of normal direction
CCW(reverse)	**CW(normal)**	Origin return to the reverse direction
	CCW(reverse)	Origin return to the opposite (normal direction) of reverse direction

5.3.3 Origin Address

▶When origin return is completed by origin return command, the value set by origin return address shall be used to change the present address value.

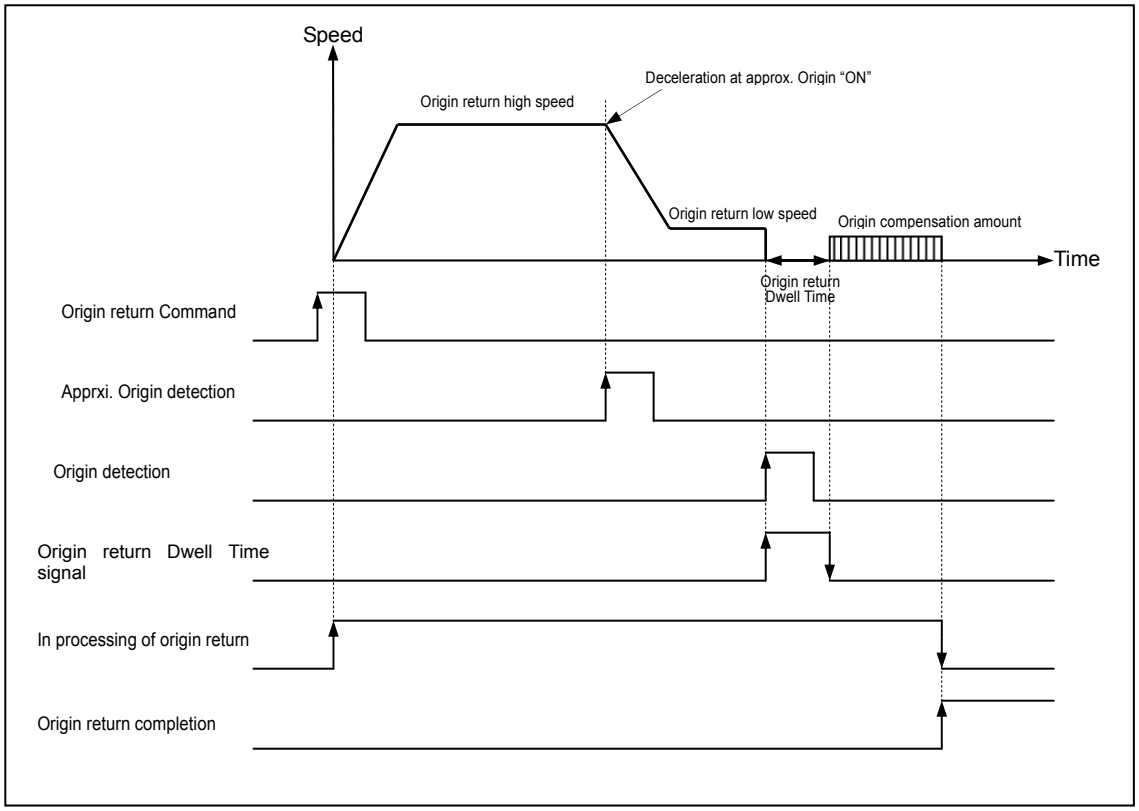
▶Setting range of origin return address : -2,147,483,648 ~ 2,147,483,647(unit: Pulse)

5.3.4 Origin Compensation Amount

▶If the machine origin is deviated slightly – the difference between the setting value and the actual transfer amount caused by the mechanical tolerance - at the origin detection (Z phase input), this is used to compensate the tolerance.

▶Therefore, if origin compensation amount is already set, when you carry out the origin return command, move as much as the data set as origin compensation amount (+,-) after detecting the origin, and then complete the origin return action

▶Origin compensation amount setting range : -2,147,483,648 ~ 2,147,483,647 (unit: Pulse)



5.3.5 Origin return-High speed

▶The speed when returning to the origin by origin return command : high speed and low speed

▶When setting the origin return speed, it should be "speed limit ≥ origin return-high speed ≥ origin return-low speed" .

▶The speed that acts to the constant speed section via acceleration section by origin return command.

▶Origin return-high speed setting range : G4/6F-PP1/2/3O → 1 ~ 200,000(unit: 1pps)
G4/6F-PP1/2/3D → 1 ~ 1,000,000(unit: 1pps)

5.3.6 Origin return-Low speed

▶The speed that acts to the constant speed section from high speed section via deceleration section by origin return command.

▶Origin return-low speed setting range : G4/6F-PP1/2/3O → 1 ~ 200,000(unit: 1pps)
G4/6F-PP1/2/3D → 1 ~ 1,000,000(unit: 1pps)

Point

▶When setting the origin return speed, it is recommended to set the origin return-low speed as low speed as possible.

▶If setting the low speed as "too fast", it may cause the incorrect origin signal detection.

5.3.7 Waiting Time for Reset

▶This is the time to be set when using the origin return method such as **origin detection after approximate origin OFF, origin detection after deceleration when approximate origin ON, origin return by approximate origin,** and also the waiting time for origin return to be used in case of meeting the high/low limit signal without detecting the approximate origin during the origin return.

▶As the pulse output is not possible during the time set as a waiting time for reset, the motor does not move actually.

5.3.8 Acceleration/Deceleration Time

▶When returning to the origin by origin return command, the origin return shall be carried out as origin return-high speed and low speed by the acceleration/deceleration time setting.

5.3.9 Dwell Time

▶This is the time needed to maintain the precise stop accuracy of SERVO motor when using the SERVO motor for positioning.

Practically, Dwell time is the time needed to remove the residual pulse of deviation counter after completion of positioning and especially Dwell time when returning to the origin is called as “origin return dwell time”.

▶Setting range of Origin return dwell time : 0 ~ 65,535(unit: 1㎳)

5.3.10 JOG High Speed

▶Jog speed is related to Jog operation (a kind of manual operation) and has 2 types of operation : Jog low speed operation and Jog high speed operation.

▶For further information, please refer to 3.6.1 JOG Operation.

▶JOG high speed operation has operation pattern as acceleration, constant speed, deceleration section. Therefore, acceleration section and deceleration section is controlled by JOG acceleration/deceleration time.

▶Jog high speed setting range : G4/6F-PP1/2/3O → 1 ~ 200,000(unit: 1pps)
G4/6F-PP1/2/3D → 1 ~ 1,000,000(unit: 1pps)

(notices when setting the high speed : Bias speed ≤ Jog high speed ≤ Speed limit)

5.3.11 JOG Low Speed

▶JOG low speed operation has operation pattern as acceleration, constant speed, deceleration section.

▶Jog low speed setting range : G4/6F-PP1/2/3O → 1 ~ Jog high speed
G4/6F-PP1/2/3D → 1 ~ Jog high speed

5.3.12 JOG Acceleration/Deceleration Time

▶This means JOG acceleration/deceleration time when Jog high speed and low speed operation.

▶JOG acceleration/deceleration time setting range : 0 ~ 65,535(unit: 1ms)

5.3.13 Inching Speed

▶The speed necessary for inching operation is set here.

▶Inching speed setting range : 1 ~ 65,535(unit: 1pps)

5.4 Common Parameter

Here describes Common parameter.

	Item	X-Axis	Y-Axis	Z-Axis
Common Parameter	Pulse Output Level	0: Low Active		
	Circular Interpolation	0: Sub Point		
	Encoder Input	4: PHASE A/B(2-Phase x1)		
	Auto Reload	4294967295		
	Z-Phase Clear	0: Disable		
	ZONE Output Mode	0: Seperate Ouput		
	ZONE1 Axis	0: X		
	ZONE2 Axis	0: X		
	ZONE3 Axis	0: X		
	ZONE1 ON Area	0 pls		
	ZONE1 OFF Area	0 pls		
	ZONE2 ON Area	0 pls		
	ZONE2 OFF Area	0 pls		
	ZONE3 ON Area	0 pls		
	ZONE3 OFF Area	0 pls		

[Configuration of Common Parameter]

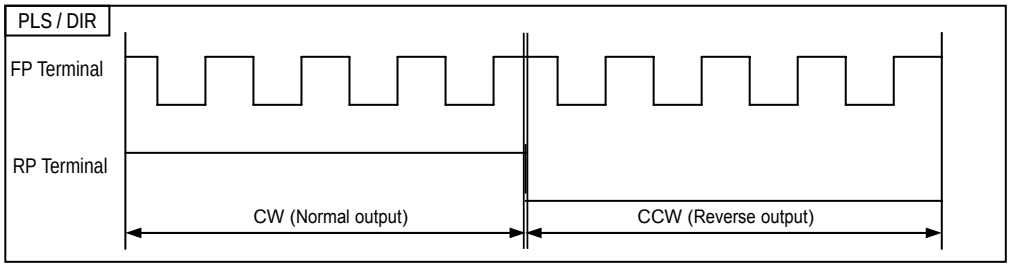
Items	Setting Range	Initial value
Pulse output level	0 : Low Active, 1 : High Active	0
Encoder pulse input mode	0 : CW/CCW, 1phase 1multiplication 1 : CW/CCW, 1phase 2 multiplication 2 : Pulse/Dir, 1phase 1 multiplication 3 : Pulse/Dir, 1phase 2 multiplication 4 : Phase A/B, 2phase 1 multiplication 5 : Phase A/B, 2phase 2 multiplication 6 : Phase A/B, 2phase 4 multiplication	4
Counter Clear mode by Z phase input	0 : Not Clear, 1 : Clear	0
Encoder Auto Reload value	0 ~ 4,294,967,295	4294967295
Zone1 setting axis designation	0 : X, 1 : Y, 2 : Z, 3 : Encoder	0
Zone1 output ON position	-㎜ : -2147483648 ~ 2147483647 [X10^{-4} ㎜] -Inch : -2147483648 ~ 2147483647 [X10^{-5}Inch] -degree : -2147483648 ~ 2147483647 [X10^{-5}degree] -pulse : -2147483648 ~ 2147483647 [pulse/sec]	0
Zone1 output OFF position		0
Zone2 setting axis designation	0 : X, 1 : Y, 2 : Z, 3 : Encoder	0
Zone2 output ON position	-㎜ : -2147483648 ~ 2147483647 [X10^{-4} ㎜] -Inch : -2147483648 ~ 2147483647 [X10^{-5}Inch] -degree : -2147483648 ~ 2147483647 [X10^{-5}degree] -pulse : -2147483648 ~ 2147483647 [pulse]	0
Zone2 output OFF position		0
Zone3 setting axis designation	0 : X, 1 : Y, 2 : Z, 3 : Encoder	0
Zone3 output ON position	-㎜ : -2147483648 ~ 2147483647 [X10^{-4} ㎜] -Inch : -2147483648 ~ 2147483647 [X10^{-5}Inch] -degree : -2147483648 ~ 2147483647 [X10^{-5}degree] -pulse : -2147483648 ~ 2147483647 [pulse]	0
Zone3 output OFF position		0
Zone output mode	0 :individual output, 1: lump-sum output [Zone1]	0
Circular arcs interpolation method	0: middle point, 1: center point	0

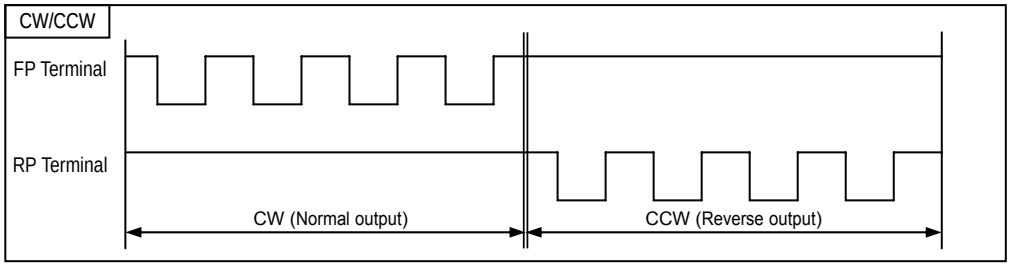
[Setting Range of Common Parameter]

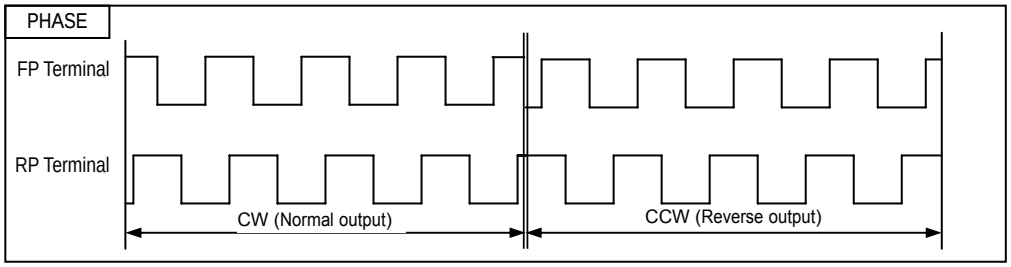
5.4.1 Pulse Output Level

▶For the pulse output level setting, select one from Low Active output and High Active output.

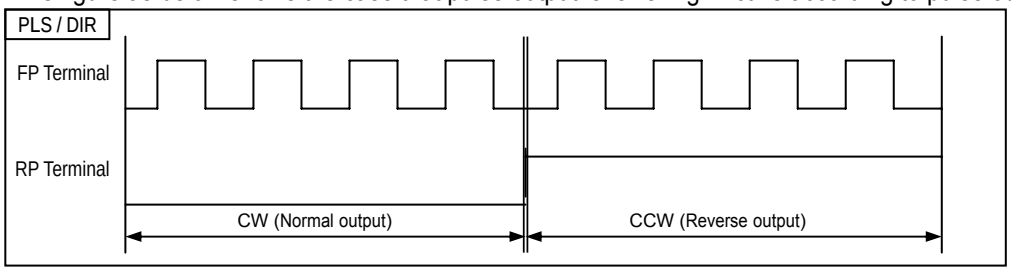
▶The figure as below shows the case that pulse output level is Low Active according to pulse output mode.

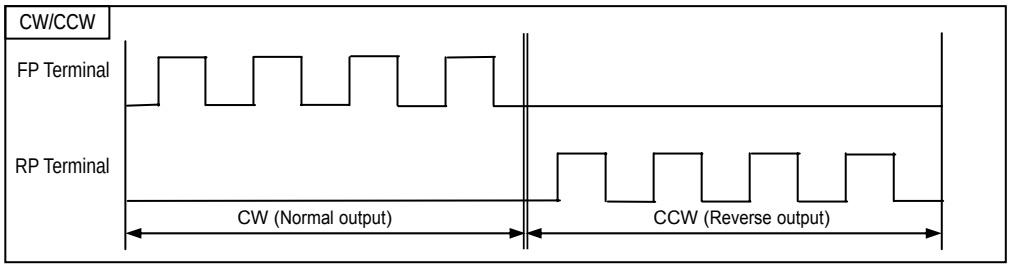


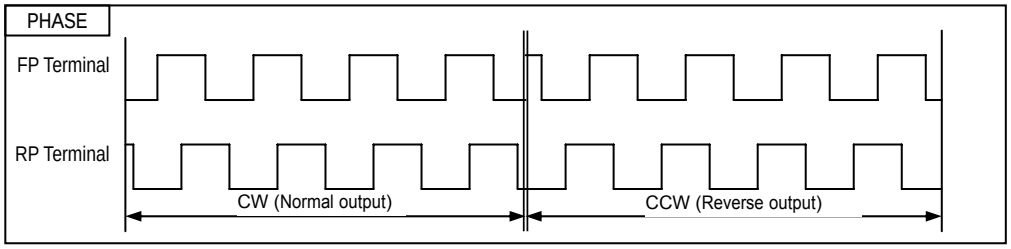




▶The figure as below shows the case that pulse output level is High Active according to pulse output mode.







5.4.2 Circular Arcs Interpolation method

▶Either Middle point method or Center point method is selected and set as Circular arcs interpolation operation method.

▶For further information, please refer to the content of circular arcs interpolation operation of User's manual.

5.4.3 Encoder Input Signal

▶In case of using the Encoder input signal of manual pulse generator or SERVO driver, select the signal that matches with the output type of generator or encoder.

▶In order to set the encoder input signal, select one from CW/CCW(1phase 1 multiplication), CW/CCW(1phase 2multiplication), PLS/DIR(1phase 1multiplication), PLS/DIR(1phase 2multiplication), PHASE(2phase 1 multiplication), PHASE(2phase 2multiplication) and PHASE(2phase 4multiplication).

5.4.4 Auto Reload

▶When counting the input pulse entered from Encoder signal of manual pulse generator or SERVO driver and indicating it as Encoder value, it is required to set the count range of Encoder value by Auto Reload value.

▶Setting range of Auto Reload value : 0 ~ 4,294,967,295

Ex) in case of setting Auto Reload value = 499, the indication range of Encoder value is 0 ~ 499.)

5.4.5 Z phase Clear

▶In case of using Z phase input from Encoder signal of SERVO driver, if you want to clear the Encoder value by Z phase signal, please set it as "permitted".

▶G6F-PP1/2/3O, G6F-PP1/2/3D is not allowed to set "ENABLE" as there is no external Z phase input.

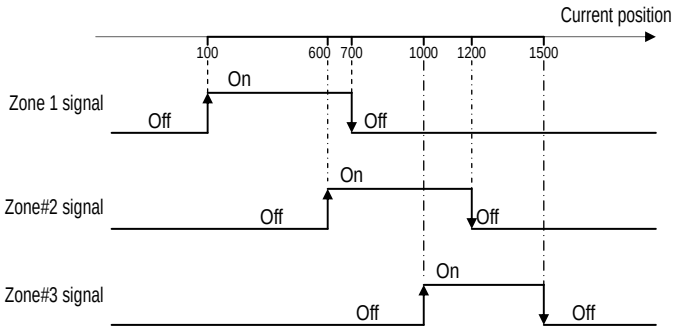
5.4.6 Zone Output

▶It is available to set within the position address range that the positioning module can move, and there are 3 types.

▶Zone setting range : -2,147,483,648 ~ 2,147,483,647(unit: 1Pulse)

▶Zone setting is as follow.

ZONE1 ON Area	100 p/s
ZONE1 OFF Area	700 p/s
ZONE2 ON Area	600 p/s
ZONE2 OFF Area	1200 p/s
ZONE3 ON Area	1000 p/s
ZONE3 OFF Area	1500 p/s



Point

The setting of “ON starting point” should be less than the setting of “ON ending point”.

▶For Zone output mode, select one from individual output and batch output (Zone 1).

▶In case of Individual output mode, the signal of Zone 1, Zone 2 and Zone3 becomes “ON” according the setting of Zone 1/2/3 axis.

▶In case of batch output (Zone 1), batch output for Zone 1 and at the same time individual output for Zone2 and Zone3 shall be done in the setting section between ON starting point and ending point of Zone 1, Zone 2 and Zone3.

▶For the setting of Zone 1 / 2 / 3 axis, it is available to select one from X, Y, Z axis and Encoder.

▶Even if the signal of Zone 1, Zone 2, Zone3 becomes “ON”, the internal Zone signal and external Zone output is not available without permission command of Zone output..

5.5 Operation Data

Here describes Operation Data

Step	Coordi	Control	Pattern	Method	Address [pulse]	Sub Address [pulse]	M Code	Acc/Dec No.	Speed [pls/s]	Dwell	Cir.Int Dir
1	ABS	POS	END	SIN	0	0	0	No.1	0	0	CW
2	ABS	POS	END	SIN	0	0	0	No.1	0	0	CW
3	ABS	POS	END	SIN	0	0	0	No.1	0	0	CW
4	ABS	POS	END	SIN	0	0	0	No.1	0	0	CW
5	ABS	POS	END	SIN	0	0	0	No.1	0	0	CW
6	ABS	POS	END	SIN	0	0	0	No.1	0	0	CW
7	ABS	POS	END	SIN	0	0	0	No.1	0	0	CW
8	ABS	POS	END	SIN	0	0	0	No.1	0	0	CW
9	ABS	POS	END	SIN	0	0	0	No.1	0	0	CW
10	ABS	POS	END	SIN	0	0	0	No.1	0	0	CW

[Configuration of Operation Data]

<table>
<tr><th>Items</th><th>Setting Range</th><th>Initial value</th></tr>
<tr><td>Goal position</td><td>-㎜ : -2147483648 ~ 2147483647 [X10^{-3}㎜]
-Inch : -2147483648 ~ 2147483647 [X10^{-5}Inch]
-degree : -2147483648 ~ 2147483647 [X10^{-5}degree]
-pulse : -2147483648 ~ 2147483647 [pulse]</td><td>0</td></tr>
<tr><td>Circular arcs interpolation aux. Position</td><td>-㎜ : -2147483648 ~ 2147483647 [X10^{-3}㎜]
-Inch : -2147483648 ~ 2147483647 [X10^{-5}Inch]
-pulse : -2147483648 ~ 2147483647 [pulse]</td><td>0</td></tr>
<tr><td>Operation speed</td><td><table><tr><th></th><th>Open Collector</th><th>Line Driver</th><th>Unit</th></tr><tr><td>mm</td><td colspan="2">1 ~ 2,000,000,000</td><td>X10^{-2}㎜/min</td></tr><tr><td>inch</td><td colspan="2">1 ~ 2,000,000,000</td><td>X10^{-3}inch/min</td></tr><tr><td>degree</td><td colspan="2">1 ~ 2,000,000,000</td><td>X10^{-3} degree/min</td></tr><tr><td>pulse</td><td>1 ~ 200000</td><td>1 ~ 1000000</td><td>Pulse/sec</td></tr></table></td><td>0</td></tr>
<tr><td>Dwell time</td><td>0 ~ 50,000[unit:㎳]</td><td>0</td></tr>
<tr><td>M Code no.</td><td>0 ~ 65,535</td><td>0</td></tr>
<tr><td>Operation method</td><td>single, repeat</td><td>Single</td></tr>
<tr><td>Operation mode</td><td>Position control, Speed control</td><td>Position</td></tr>
<tr><td>End/Go-on/Continuous</td><td>End, Go-on, Continuous</td><td>End</td></tr>
<tr><td>Absolute/Relative</td><td>Absolute, Relative</td><td>Absolute</td></tr>
<tr><td>Circular arcs interpolation direction</td><td>CW, CCW</td><td>CW</td></tr>
<tr><td>Selection of acceleration/deceleration time</td><td>1: acceleration/deceleration time No1
2: acceleration/deceleration time No2
3: acceleration/deceleration time No3
4: acceleration/deceleration time No4</td><td>1</td></tr>
</table>

[Setting range of Operation data]

5.5.1 Step No.

▶The setting range of positioning data as serial no. is 0 ~ 400.

▶The first Starting step of operation data is no.1 step.

Point

If the step no. is set as "0" for indirect start, simultaneous start, linear interpolation operation, circle interpolation operation, position synchronization, it is operated according to the operation data set as the current operation step no..

5.5.2 Coordinate

▶The coordinate of position data includes Absolute coordinate and Relative coordinate

1) **Absolute Coordinate (Control by Absolute method)**

A) This carries out the positioning control from the current position to the goal position (the goal position assigned by positioning data).

B) Positioning control is carried out based on the assigned position of origin return (origin address).

C) Transfer direction shall be determined by the current position and goal position.

▶Start position < Goal position : normal direction positioning

▶Start position > Goal position : reverse direction positioning

[Example]

▷When origin return address : 1000 , ▷Goal position : 8000, normal direction transfer amount is 7000(8000-1000).

▷Software Package Setting

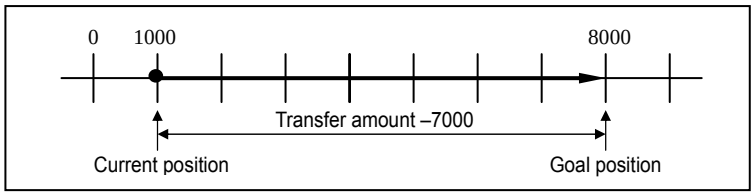
Parameter setting

Home Method	0: DOG/HOME(OFF)
Home Dir	1: CCW
Home Address	1000 pls
Home Compensation	0 pls
Home High Speed	5000 pls/s
Home Low Speed	500 pls/s
Home Retry Time	0 ms
Home ACC/DEC	1000 ms
Dwell	0 ms

Position data setting

Step	Cordi	Control	Pattern	Method	Address [pulse]	Sub Address [pulse]	M Code	A/D No.	Speed [pls/s]	Dwell [ms]	Cir.Int Dir
1	ABS	POS	END	SIN	8000	0	0	No.1	100	0	CW

▷Positioning Result (transfer amount –7000



Point

Control by Absolute method (Absolute coordinate) can start only in the state that the origin is determined.
If starting in the state that the origin is not determined, Error 234 will occur. The available operation mode is single, repeat, go-on and continuous operation.

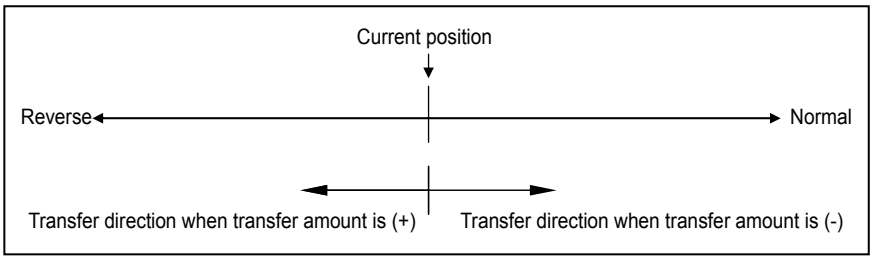
2) Relative Coordinate (Control by Incremental method)

A) This carries out the positioning control as much as goal transfer amount from the current position.

B) Transfer direction shall be determined by the sign of transfer amount.

▶When transfer direction is (+) or no sign : normal direction positioning (position increase direction)

▶When transfer direction is (-) : reverse direction positioning (position decrease direction)



[Example]

▷When origin return address : 5000 , ▷Goal position : -7000, the positioning shall be done at –2000 position.

▷Software Package Setting

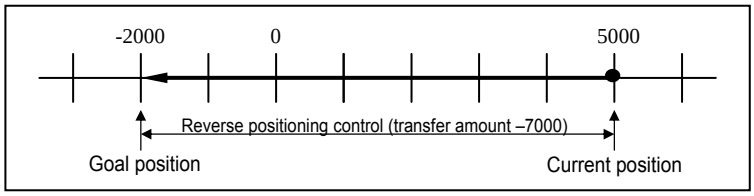
Parameter setting

Home Method	0: DOG/HOME(OFF)
Home Dir	1: CCW
Home Address	5000 pls
Home Compensation	0 pls
Home High Speed	5000 pls/s
Home Low Speed	500 pls/s
Home Retry Time	0 ms
Home ACC/DEC	1000 ms
Dwell	0 ms

Position data setting

Step	Cordi	Control	Pattern	Method	Address [pulse]	Sub Address [pulse]	M Code	A/D No.	Speed [pls/s]	Dwell [ms]	Cir.Int Dir
1	INC	POS	END	SIN	-7000	0	0	No.1	100	0	CW

▷Positioning Result



5.5.3 Control Method (Position/Speed)

▶Select the control method : Position control method, Speed control method.

▶For further information, please refer to 3.1.1 Position control and 3.1.3 Speed control of “Function”.

5.5.4 Operation Pattern (End/Go-on/Continuous)

▶Select one operation pattern from End, Go-on, Continuous operation.

▶For further information, please refer to 3.2 Operation Pattern of “Function”.

5.5.5 Operation Method (Single/Repeat)

▶Select operation method : Single operation or Repeat operation.

▶For further information, please refer to 3.2 Operation Method of “Function”.

5.5.6 Goal Position

▶This is the area to set the transfer amount of position data as “position value”.

▶The setting range is –2,147,483,648 ~ 2,147,483,647(setting unit: Pulse).

▶The change of goal position value is available at Program by using position teaching

5.5.7 M Code

▶M code is applied to the whole axis in a bundle by M code mode set by positioning parameter and is given to each operation step no. as a Number within the setting range to use at Program.

▶The setting range is 1 ~ 65,535.

Point

▶How to use M code at Program
1) M code no. is available to read by the current operation state code information read
2) M code action is available to confirm “ON/OFF” by the current operation state Bit information read

▶For further information, please refer to M code output of 5.2.6.

5.5.8 Acceleration/Deceleration No.

▶The dual accelertion/deceleration time setting is available by setting the acceleration/deceleration time 1/2/3/4 of basic parameter as acceleration/deceleration no. 1/2/3/4 respectively.

5.5.9 Operation Speed

▶Operation speed is set within the range that does not exceed Speed limit of basic parameter.

▶Setting range of operation speed (unit :pulse) : 1 ~ 200,000pps(G4/6F-PP1/2/3O), 1 ~ 1,000,000pps(G4/6F-PP1/2/3D)

5.5.10 Dwell Time

▶This is the waiting time before carrying out the next positioning operation after completing one positioning operation.

▶Setting range is 0 ~ 50,000 (setting unit: X1 ㎳).

▶Especially, in case of using SERVO motor, this is the data to set the waiting time by the stable stop state as positioning module is in the stop state but actual SERVO motor does not reach to the goal position or in transition state.

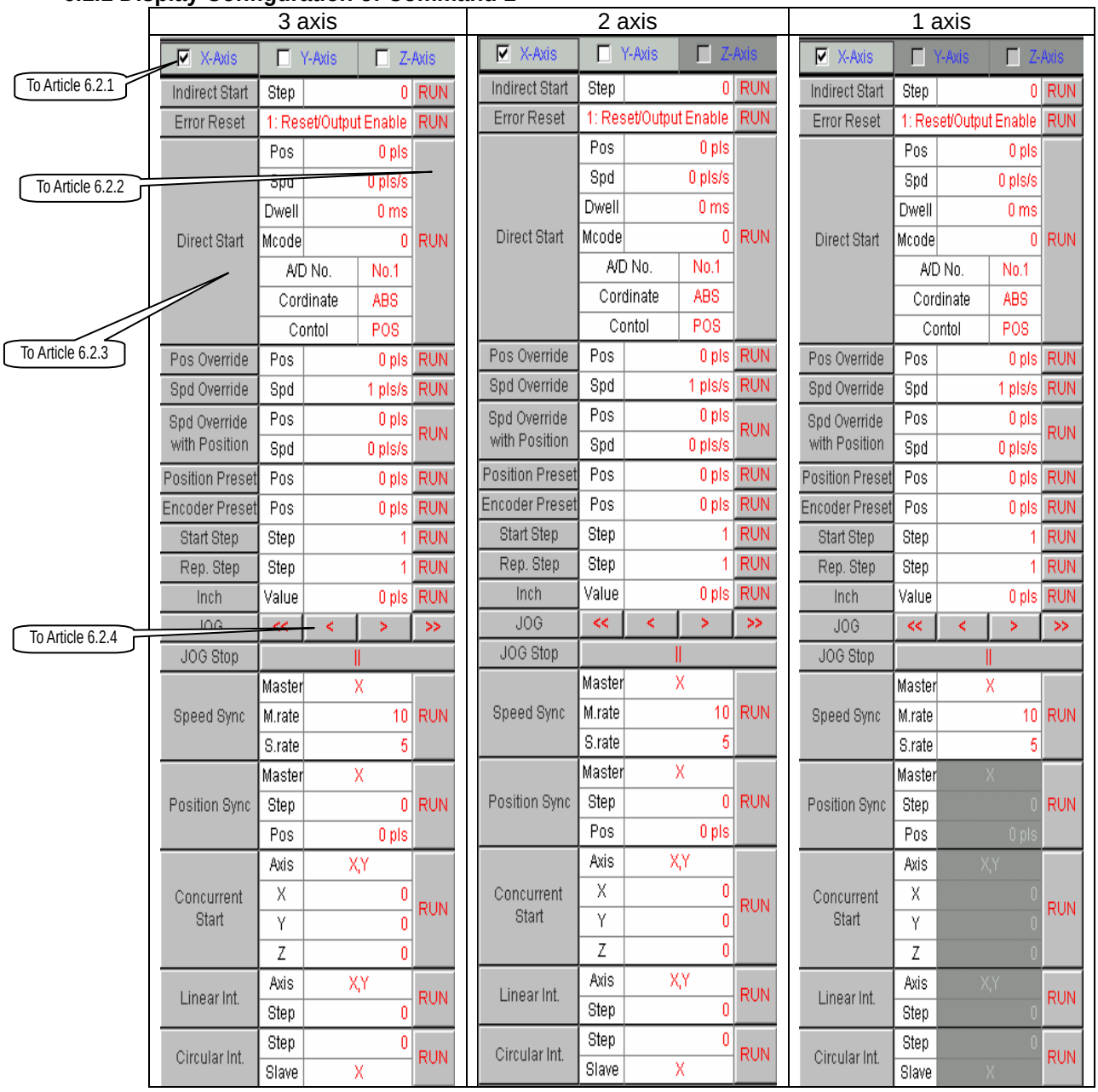
▶While dwell time is active, the corresponding axis of positioning module maintains “ON” of the “in operation state” and if dwell time proceeds, “in operation state” becomes “OFF” and the positioning end signal becomes “ON”.

Chapter 6 Software Package Startup

▶This chapter describes the Startup of Software Package.

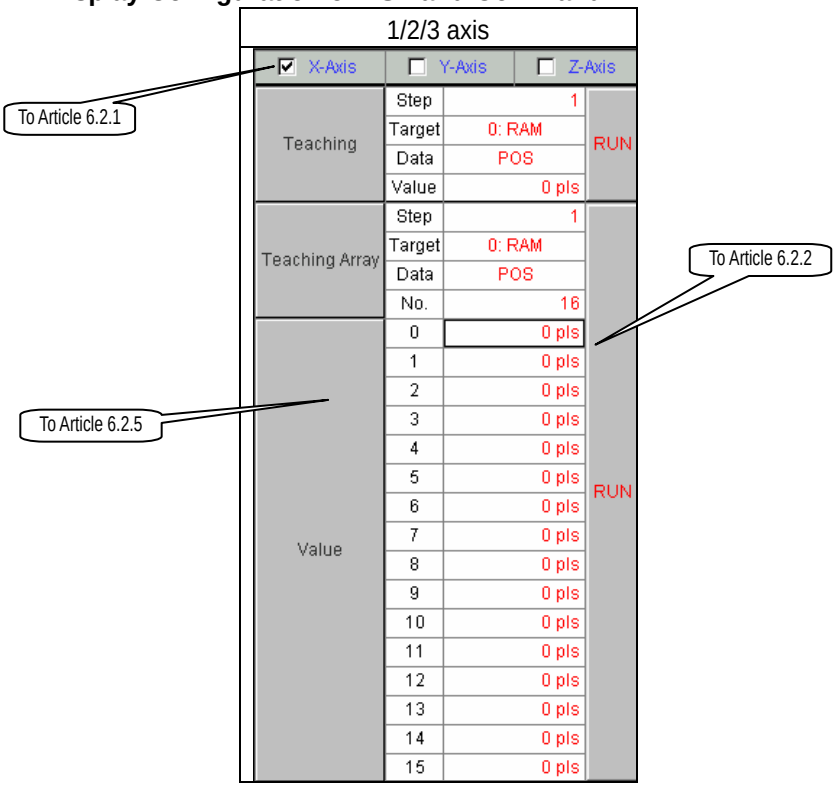
6.1 Startup Display Configuration

6.1.1 Display Configuration of Command 1



[Configuration of Command 1]

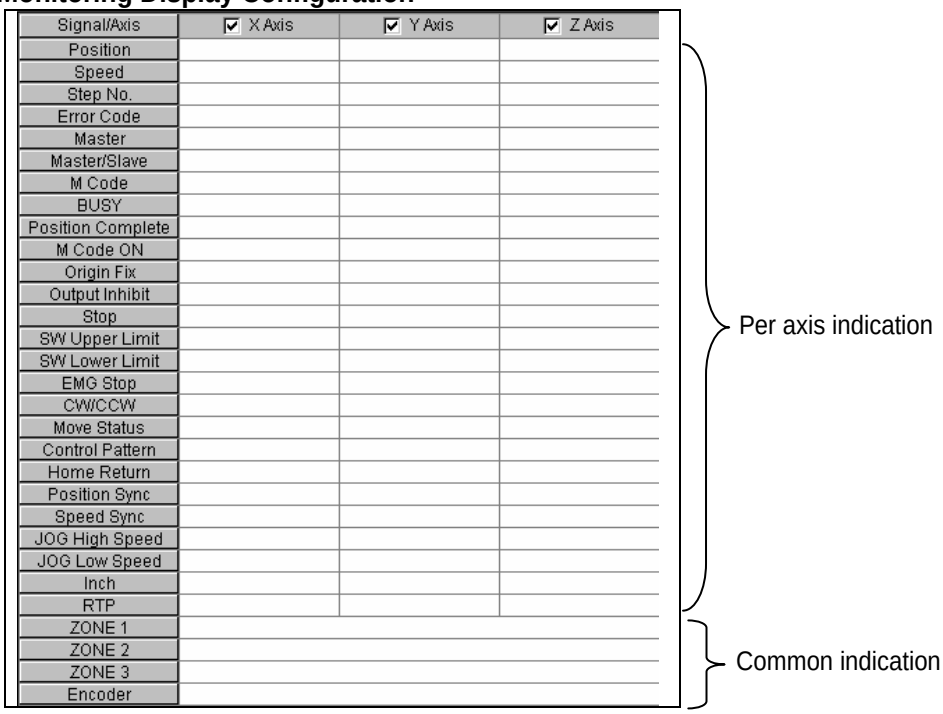
6.1.2 Display Configuration of PST and Command 2



[Configuration of Command 2]

▶For Display configuration of PST, please refer to Article 6.2.6.

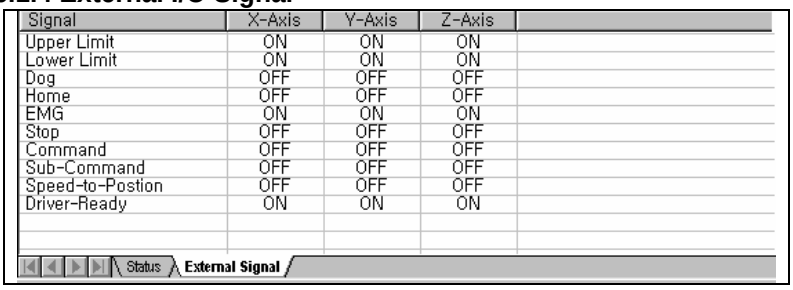
6.1.3 Monitoring Display Configuration



▶The contents of “indication per axis” indicates the action state of axis set from the current position to automatic operation point return when monitoring axis is set.

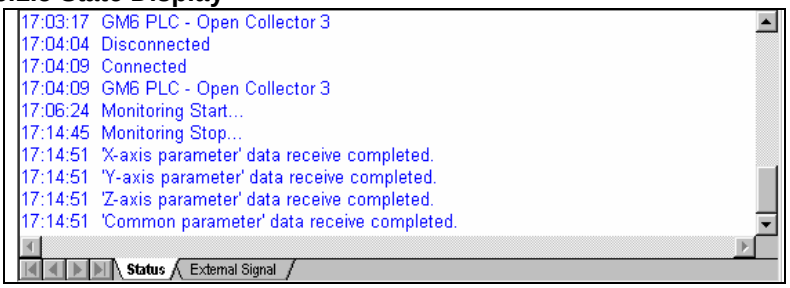
▶The contents of “common indication” is the part to be monitored when you click “monitoring button” regardless of the setting of axis.

6.1.4 External I/O Signal



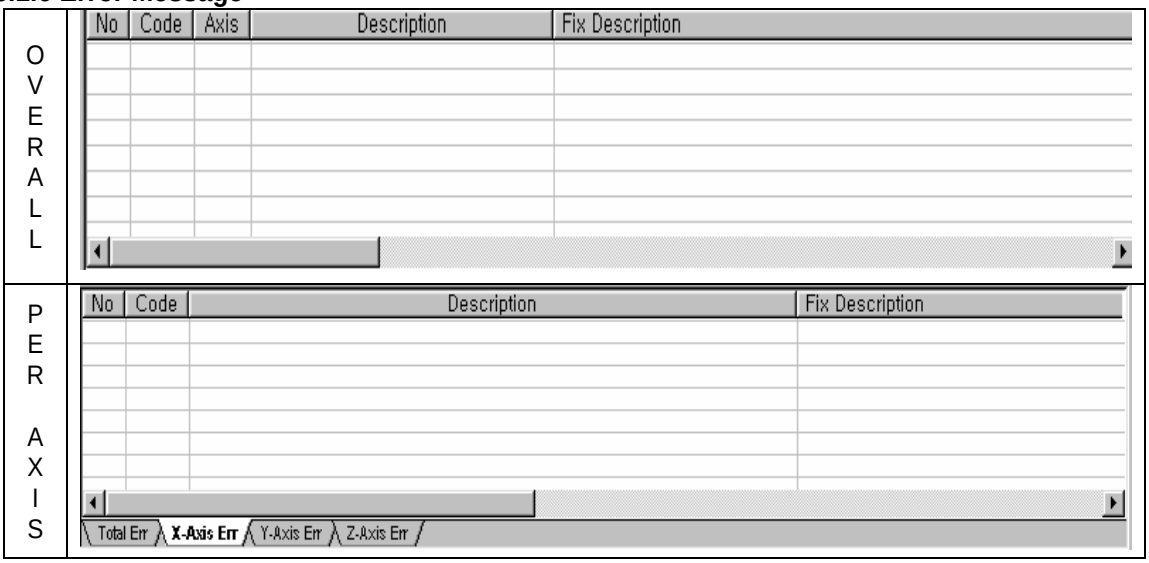
▶Here indicates the state of External I/O signal by “ON” or “OFF” per axis respectively.

6.1.5 State Display



▶Here describes the information of Software Package working state.

6.1.6 Error Message



- ▶ The contents of Overall Indication indicates Error code no. that occurs during operation, Error information, Occurrence time and Actions in order.
- ▶ The contents of Indication per Axis indicates Error code, Error information and Actions per X, Y, Z axis in order.
- ▶ If checking “Error History File create” from Environment setting/Other option, the error history will be saved in a file.(ErrorHistory.txt file)

6.2 Startup Mode

▶This is the area to carry out the startup of the positioning module by Software Package.

6.2.1 Selection of Command Axis

▶This selects the desired axis for the command of positioning module.

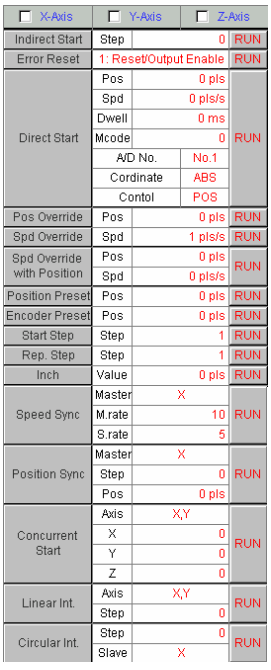
▶The selection of axis is "① X axis ② Y axis ③ Z axis and available to select according to the module.

▶If not selected the axis, the command will not be executed.

6.2.2 Execution

▶If pressing the execute button of all command, the command for the selected axis from Article 6.2.1 will be executed.

6.2.3 Startup by Software Package

Software Package	Command	Setting Range	Related function block
	Indirect start	Step : 1 ~ 400	APM_IST
	Error reset	-	APM_RST
	Direct start	Position : -2,147,483,648 ~ 2,147,483,647pls Speed : 1 ~ 1,000,000pps(G4F-PP1/2/3D) 1 ~ 200,000pps(G4F-PP1/2/3O) Dwell : 0 ~ 50,000ms M code : 0 ~ 65,535	APM_DST
	Position Override	Position : -2,147,483,648 ~ 2,147,483,647pls	APM_POR
	Speed Override	Speed : 1 ~ 200,000pps(G4F-PP1/2/3O) 1 ~ 1,000,000pps(G4F-PP1/2/3D)	APM_SOR
	Positioning speed Override	Position : -2,147,483,648 ~ 2,147,483,647pls Speed : 1 ~ 200,000pps(G4F-PP1/2/3O) 1 ~ 1,000,000pps(G4F-PP1/2/3D)	APM_PSO
	Current position preset	Position : -2,147,483,648 ~ 2,147,483,647pls	APM_PRS
	Encoder preset	Position : -2,147,483,648 ~ 2,147,483,647pls	APM_EPRE
	Start step change	Step : 1 ~ 400	APM_SNS
	Repeat step change	Step : 1 ~ 400	APM_SRS
	Inching operation	Inching amount : -2,147,483,648 ~ 2,147,483,647pls	APM_INC
	Simultaneous start (Step no.)	X, Y, Z axis : 1 ~ 400	APM_SST
	Linear interpolation operation	Step : 1 ~ 400	APM_LIN
	Circular arcs interpolation operation	Step : 1 ~ 400 Aux.1, Aux.2 : -2,147,483,648 ~ 2,147,483,647pls	APM_CIN
	Position synchro- nous operation	Step : 1 ~ 400 Position : -2,147,483,648 ~ 2,147,483,647pls	APM_SSP
	Speed synchronous operation	Main axis rate: 0 ~ 65,535 Subordinate : 0 ~ 65,535	APM_SSS

▷Click the right side execute button of the command contents and the command corresponding to the Icon will be executed.

▷The content of setting range is based on the case that the setting unit is Pulse.
(In case that the setting unit range is mm, inch, degree, please refer to Art.5.1 speed limit of basic parameter and Art.5.1. S/W high-low limit setting range of expansion parameter.)

Point

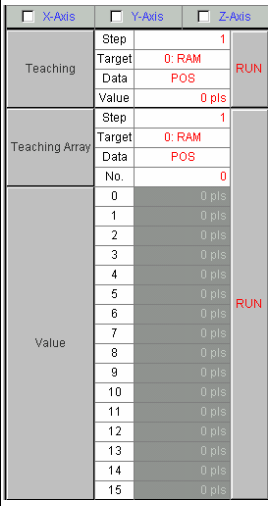
▷The setting range of Encoder preset is -2,147,483,648 ~ 2,147,483,647pls but the value indicated by actual encoder value shall be indicated by the unsigned value.
▷Thus, if setting Encoder preset value as –1, the value to be indicated actually as Encoder is maximum 4,294,967,295.
▷In case of encoder preset by the value exceeding 2,147,483,647 , it should be set as negative number (-).

6.2.4 JOG Operation by Software Package

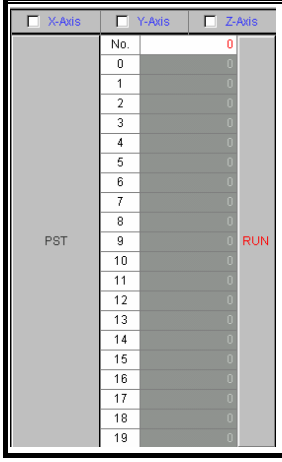
Software Package	Icon	Command	Related function block
	<<	Reverse high speed JOG operation	APM_JOG
	<	Reverse low speed JOG operation	
	>	Normal low speed JOG operation	
	>>	Normal high speed JOG operation	
	||	JOG operation stop	

▷If you click JOG operation icon using by mouse, the corresponding command to the icon will be executed, and when you click “JOG stop”, it stops.

6.2.5 Teaching Operation by Software Package

Software Package	Command	Setting Range	Related function block
	Teaching single	1.Step : 1 ~ 400 2.Target : 0(RAM),1(ROM) 3. < Data : POS> Value : -2,147,483,648 ~ 2,147,483,647pls <Data : SPD> mm : 1 ~ 2,000,000,000[X10^{-2}mm/min], Inch : 1 ~ 2,000,000,000[X10^{-3}Inch/min], degree : 1 ~ 2,000,000,000[X10^{-3} degree/min], pulse : 1 ~ 1,000,000[pulse/sec]	APM_TEA
	Teaching Array	1.Step : 1 ~ 400 2.Target : 0(RAM),1(ROM) 3.DATA : POS,SPD 4.Number : 1 ~ 16	APM_ATEA
	Teaching Array value	< Data : POS> Value : -2,147,483,648 ~ 2,147,483,647pls <Data : SPD> mm : 1 ~ 2,000,000,000[X10^{-2}mm/min], Inch : 1 ~ 2,000,000,000[X10^{-3}Inch/min], degree : 1 ~ 2,000,000,000[X10^{-3} degree/min], pulse : 1 ~ 1,000,000[pulse/sec]	

6.2.6 Point Operation by Software Package

<table>
<tr><th>Software Package</th><th>Command</th><th>Setting Range</th><th>Related function block</th></tr>
<tr><td rowspan="2"> 
</td><td rowspan="2">PST</td><td>Number : 1 ~ 20</td><td rowspan="2">APM_PST</td></tr>
<tr><td>Point setting (0 ~ 19) : 1 ~ 400
(Operation step no. setting)</td></tr>
</table>

▷Point operation carries out the positioning operation by max. 20 operation step no. set by one time execution.

▷In case of setting step no. when operation mode is Go-on or Continuous, it is required to set the highest step no. to operate.

▷If setting the Point number in case of PST execution, the lower items (0~19) as much as the setting number shall be activated.

▷For further information of Point operation, please refer to Art.3.23 Point Operation.

6.3 Command Icon

▶The command that is executed independently without command condition can be treated easily with Contract icon.

▶If pressing the right side of mouse in the area of Command 1 and Command 2, the command menu will display to execute easily as below.

Command icon	Command contents	Action description	Contract key
	X axis Stop	Deceleration/Stop during X axis operation.	F5
	Y axis Stop	Deceleration/Stop during Y axis operation.	F6
	Z axis Stop	Deceleration/Stop during Z axis operation.	F7
	Emergency Stop	Internal Emergency Stop command during operation.	F8
	Origin return	Origin return command by 5 origin return method setting.	F9
	Floating origin setting	Software origin setting	F10
	Speed/Position switching	Converts the speed control to position control during speed control operation.	Alt + 1
	Position/Speed switching	Converts the position control to speed control during position control operation.	Alt + 2
	SKIP operation	Stop the current step in operation and operate the next step.	Alt + 3
	Continuous operation	The operation continues without stop section from the current step in operation to next step.	Alt + 4
	Auto operation point return	In case of manual operation (JOG/Inching operation) after positioning completion, it returns to the position of positioning completion.	Alt + 5
	M Code OFF	Release command if M Code occurs.	Alt + 6
	ZONE output permitted	The command to permit external ZONE output if the current position in operation is in ZONE 1 / 2 / 3 section.	Alt + 7
	ZONE output prohibited	The command to prohibit external ZONE output if the current position in operation is in ZONE 1 / 2 / 3 section.	Alt + 8
	MPG permitted	The command to permit the operation by manual pulser or SERVO encoder input signal.	Alt + 9
	MPG prohibited	The command to prohibit the operation by manual pulser or SERVO encoder input signal.	Alt + 0
	Error history reset	Make clear the error content that occurred by the current time during operation.	-

▷For Profile TRACE and Profile/Circle interpolation simulation etc., please refer to the corresponding content of Chapter 4 Software Package.

6.4 Examples of Software Package Startup

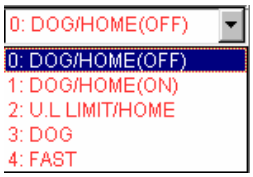
▶ Here describes the examples of Software Package Startup.

6.4.1 Origin Return(DOG/HOME(OFF))

▶Origin return is carried out to avoid the mechanical positioning in case of using Absolute coordinate.

1) Select the origin return methods, direction from Origin/Manual parameter.

Selection of Origin return method



2) Set the origin address, origin compensation amount, origin return high speed/low speed, waiting time for reset, acceleration/deceleration time, Dwell time. (if setting acceleration/deceleration time as “0”, the origin return acceleration/deceleration operation is carried out by the time set by acceleration/deceleration time of Basic parameter.)

Origin return parameter setting

Home Method	0: DOG/HOME(OFF)
Home Dir	1: CCW
Home Address	0 pls
Home Compensation	0 pls
Home High Speed	5000 pls/s
Home Low Speed	500 pls/s
Home Retry Time	0 ms
Home ACC/DEC	0 ms
Dwell	0 ms

3) Click [Data Read/Write] → select [X axis operation parameter] → Click [Write] → Click [Close] after completion of transmission → Click [Operation state monitoring].

4) If click [origin return] command button, the origin return starts to the reverse setting direction of origin return (CCW) and origin return high speed.

5) If DOG(Approximate origin) signal is ON, it decelerates with the origin return low speed.

6) If origin signal (HOME) is ON after DOG(Approximate origin) signal is OFF, it becomes the completion state of origin determination and the origin return shall be completed.

6.4.2 Indirect Start

1) X axis I/O Signal

Signal	X-Axis	Y-Axis	Z-Axis
Upper Limit	ON	ON	ON
Lower Limit	ON	ON	ON
Dog	OFF	OFF	OFF
Home	OFF	OFF	ON
EMG	ON	ON	ON
Stop	OFF	OFF	OFF
Command	OFF	OFF	OFF
Sub-Command	OFF	OFF	OFF
Speed-to-Postion	OFF	OFF	OFF
Driver-Ready	ON	ON	ON

Status | External Signal

▷In case of X axis operation, Driver Ready signal should be “ON” at the X axis external I/O signal.

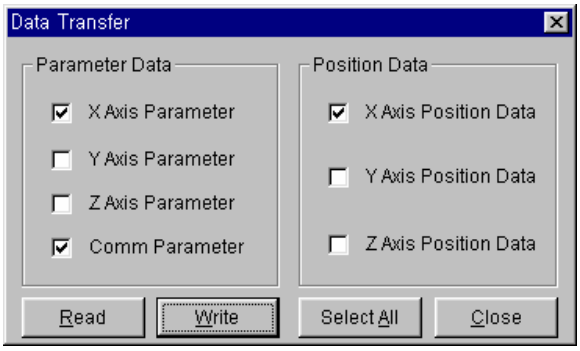
2) X axis Operation data setting

Step	Coordi	Control	Pattern	Method	Address [pulse]	Sub Address [pulse]	M Code	Acc/Dec No.	Speed [pls/s]	Dwell	Cir.Int Dir
1	ABS	POS	KEEP	SIN	1000	0	0	No.1	100	0	CW
2	ABS	POS	KEEP	SIN	2000	0	0	No.1	200	0	CW
3	ABS	POS	KEEP	SIN	3000	0	0	No.1	300	0	CW
4	ABS	POS	KEEP	SIN	4000	0	0	No.1	400	0	CW
5	ABS	POS	KEEP	SIN	5000	0	0	No.1	500	0	CW
6	ABS	POS	END	SIN	0	0	0	No.1	600	0	CW
7	ABS	POS	END	SIN	0	0	0	No.1	0	0	CW
8	ABS	POS	END	SIN	0	0	0	No.1	0	0	CW
9	ABS	POS	END	SIN	0	0	0	No.1	0	0	CW
10	ABS	POS	END	SIN	0	0	0	No.1	0	0	CW
11	ABS	POS	END	SIN	0	0	0	No.1	0	0	CW
12	ABS	POS	END	SIN	0	0	0	No.1	0	0	CW
13	ABS	POS	END	SIN	0	0	0	No.1	0	0	CW
14	ABS	POS	END	SIN	0	0	0	No.1	0	0	CW
15	ABS	POS	END	SIN	0	0	0	No.1	0	0	CW
16	ABS	POS	END	SIN	0	0	0	No.1	0	0	CW
17	ABS	POS	END	SIN	0	0	0	No.1	0	0	CW
18	ABS	POS	END	SIN	0	0	0	No.1	0	0	CW
19	ABS	POS	END	SIN	0	0	0	No.1	0	0	CW
20	ABS	POS	END	SIN	0	0	0	No.1	0	0	CW

▷The setting of X axis parameter should be pulse output mode suitable for SERVO and Stepping driver in advance. (Select one from CW/CCW, PLS/DIR, PHASE)

▷The setting of operation data can be done by using the MS Office Excel program to copy the edited contents and paste it.

3) X axis operation data write



▷ It carries out to write the setting X axis operation parameter, common parameter and operation data in the positioning module.

4) X axis indirect start execution

▷ It carries out the origin determination by the origin return command or floating origin setting as the coordinate of operation data is Absolute coordinate. In this case, X axis shall be “Monitoring state”.

▷ Click the execute button after setting the axis as “X” and the step no. as “0” in the Command 1 display. (In case that the step no. is set as “0”, the operation starts from the step no. which is in the state of monitoring.)

5) Disaplay that X axis indirect start is running

Signal/Axis	X Axis	Y Axis	Z Axis
Position	1094	0	0
Speed	100	0	0
Step No.	1	1	1
Error Code	0	0	0
Master	X	Y	Z
Master/Slave	Master	Master	Master
M Code	0	0	0
BUSY	ON		
Position Complete			
M Code ON			
Origin Fix	ON		
Output Inhibit			
Stop			
SW Upper Limit			
SW Lower Limit			
EMG Stop			
CW/CCW			
Move Status	Constant		
Control Pattern	1-Axis Position		
Home Return			
Position Sync			
Speed Sync			
JOG High Speed			
JOG Low Speed			
Inch			
RTP			
ZONE 1			
ZONE 2			
ZONE 3			
Encoder	0		

▷ If indirect start runs, it starts to operate from no.1 step to no.5 step with Go-on operation pattern and then ends to operate when the step no. becomes 6.

6.4.3 External Simultaneous Start

▶This is the operation that starts simultaneously by operation data of the corresponding step of each axis set by 2 axis (X-Y, Y-Z, X-Z) or 3 axis (X-Y-Z).

▶When external simultaneous start, first carry out the internal simultaneous start command and then make the external simultaneous start signal “ON”.

1) Set [external simultaneous start] of expansion parameter as “Permitted”.
2) Set the desired operation data of each axis to start simultaneously per step.
3) Click [Data Read/Write] → Select [Operation parameter] and [Operation data] → Click [Write] → Click [Close] after completion of transmission → Click [Operation state monitoring].
4) Complete the origin determination for the corresponding axis of simultaneous start.
5) Move to the item “Simultaneous start (step no.)” of Command 1 → Select [Axis information] → Set [step no. of the corresponding axis] → Click [Execute] → Make [external simultaneous start signal] “ON”.
6) If external simultaneous start signal is “ON”, it starts simultaneously to the setting step of the corresponding axis and executes to operate.

Display that internal simultaneous start command is executed

Signal/Axis	☑ X Axis	☑ Y Axis	☑ Z Axis
Position	0	0	0
Speed	0	0	0
Step No.	1	2	2
Error Code	0	0	0
Master	X	Y	Z
Master/Slave	Master	Master	Master
M Code	0	0	0
BUSY	ON	ON	ON
Position Complete			
M Code ON			
Origin Fix	ON	ON	ON
Output Inhibit			
Stop			
SW Upper Limit			
SW Lower Limit			
EMG Stop			
CW/CCW			
Move Status			
Control Pattern	1-Axis Position	1-Axis Position	1-Axis Position
Home Return			
Position Sync			
Speed Sync			
JOG High Speed			
JOG Low Speed			
Inch			
RTP			
ZONE 1			
ZONE 2			
ZONE 3			
Encoder	0		

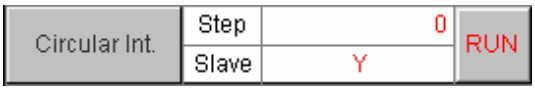
▷This is the case that the Axis information : X,Y,Z axis and the step no. is set as X: 1, Y: 2, Z: 2 from the items of simultaneous start.

6.4.4 Circular Arcs Interpolation

▶The circular arcs interpolation operation is carried out by Middle point method and Center point method for 2 axis (X-Y, Y-Z, X-Z).

1) First, select the circular arcs interpolation method from Common parameter.(0: Middle point, 1: Center point)
2) Set the goal position and speed by operation data of the corresponding axis. (In this case, the operation speed of the subordinate axis should be set as “0” as it has no meaning)
3) In case of Center point method of X, Y circular arcs interpolation, the circular interpolation aux. Point of X axis operation data indicates the center point of X axis and the circular interpolation aux. Point of Y axis indicates the center point of Y axis. The direction of circular arcs interpolation shall be set based on the main axis.
4) Click [Data Read/Write] → Select [Operation parameter] and [Operation data] → Click [Write] → Click [Close] after completion of transmission → Click [Operation state monitoring].
5) Complete the origin determination for the corresponding axis of circular arcs interpolation. (X axis, Y axis)
6) Set the step and subordinate axis from circular arcs interpolation items of Command 1.

Circular interpolation data setting display



7) Click [execute] button after completion of setting from circular interpolation items and the circular arcs interpolation operation starts.

Display in Circular interpolation operation

Signal/Axis	X Axis	Y Axis	Z Axis
Position	4189	4941	0
Speed	1000	0	0
Step No.	1	1	2
Error Code	0	0	0
Master	X	X	Z
Master/Slave	Master	Slave	Master
M Code	0	0	0
BUSY	ON	ON	
Position Complete			
M Code ON			
Origin Fix	ON	ON	
Output Inhibit			
Stop			
SW Upper Limit			
SW Lower Limit			
EMG Stop			
CW/CCW			
Move Status	Constant	Constant	
Control Pattern	2-Axes Circular Int.	2-Axes Circular Int.	
Home Return			
Position Sync			
Speed Sync			
JOG High Speed			
JOG Low Speed			
Inch			
RTP			
ZONE 1			
ZONE 2			
ZONE 3			
Encoder	0		

▷This is the case set by the center point method that the current position of (X-axis, Y-axis) is (0, 0), the goal position is (10000, 0), the circular interpolation center point is (5000,0), the speed of main axis (X) is 1000pps.

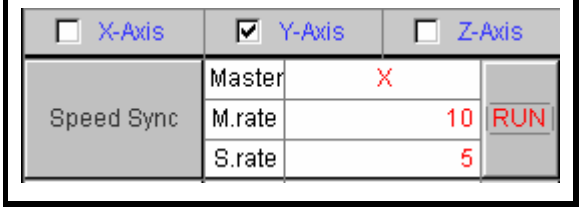
6.4.5 Speed Synchronization

▶This carries out the speed synchronization operation by the setting rate of the subordinate axis even if the speed of the main axis is changed according to operation speed rate of the main axis and the subordinate axis.

▶Thus, the setting operation speed and goal position of the subordinate axis that has the speed synchronization, has no meaning.

1) First, set the operation data of the main axis. (Available to set the position control and speed control.)
2) Click [Data Read/Write] → Select [Operation parameter] and [Operation data] → Click [Write] → Click [Close] after completion of transmission → Click [Operation state monitoring].
3) In case that the main axis is set as “position control”, complete the origin determination.
4) Set the corresponding axis of speed synchronization in the Display of Command 1.
5) Set the main axis, the main axis rate, the subordinate axis rate, respectively from the speed synchronization items of Command 1.

Speed synchronization data setting display



6) Click [execute] button from speed synchronization items of Command 1.

Display that speed synchronization is executed

Signal/Axis	X Axis	Y Axis	Z Axis
Position	0	0	
Speed	0	0	
Step No.	1	1	
Error Code	0	0	
Master	X	X	
Master/Slave	Master	Slave	
M Code	0	0	
BUSY		ON	
Position Complete			
M Code ON			
Origin Fix	ON	ON	
Output Inhibit			
Stop			
SW Upper Limit			
SW Lower Limit			
EMG Stop			
CW/CCW			
Move Status			
Control Pattern			
Home Return			
Position Sync			
Speed Sync		ON	
JOG High Speed			
JOG Low Speed			
Inch			
RTP			
ZONE 1			
ZONE 2			
ZONE 3			
Encoder	0		

7) In case of setting the axis as “the main axis” and indirect start in the display of Command 1, the speed synchronized axis by the setting rate of the main axis and the subordinate axis according to the speed of the main axis carries out the operation.
8) After completion of the operation of the main axis, the speed synchronized axis shall be released by the “deceleration stop” command.

6.4.6 Teaching (Array)

▶The function of Teaching is to set the goal position and operation speed set by operation data again through touch screen such as PMU in the positioning module and carry out the positioning operation by the changed goal position and operation speed in case of re-operation by the Start command.

▶Max. no of teaching (Array) is limited by 16.

▶When teaching (Array), set the goal position of the setting step no. and operation speed from Teaching array "0" in order and the data set as much as the number of teaching is executed in a bundle based on the setting step no.

1) First, set the axis for teaching array from teaching array display of Command 2.
2) Set the starting step no, teaching pattern (0:RAM, 1:ROM), teaching method (0: position, 1: speed) and the number of teaching array.
3) Set the desired data for teaching from teaching Array value "0" to the number of teaching.

Teaching Array data setting display

☑ X-Axis	☐ Y-Axis	☐ Z-Axis	
Teaching Array	Step	1	RUN
	Target	0: RAM	
	Data	POS	
	No.	4	
Value	0	1000 pls	
	1	2000 pls	
	2	3000 pls	
	3	4000 pls	
	4	0 pls	
	5	0 pls	
	6	0 pls	
	7	0 pls	
	8	0 pls	
	9	0 pls	
	10	0 pls	
	11	0 pls	
	12	0 pls	
	13	0 pls	
	14	0 pls	
	15	0 pls	

4) Click [execute] button.
5) If the step no. is set as "1" from indirect start item of Command 1 and the indirect start is executed, the operation is carried out to the setting goal position from step 1~step 4.
(In case of Absolute coordinate, the operation data such as operation speed from step 1~step4 should be set in advance.)
6) Click [Read/Write] button to read the operation data of teaching array and check if the goal position of operation data and operation speed is set as the value of teaching.

6.4.7 Point Operation

▶Here describes the startup example of Point operation.

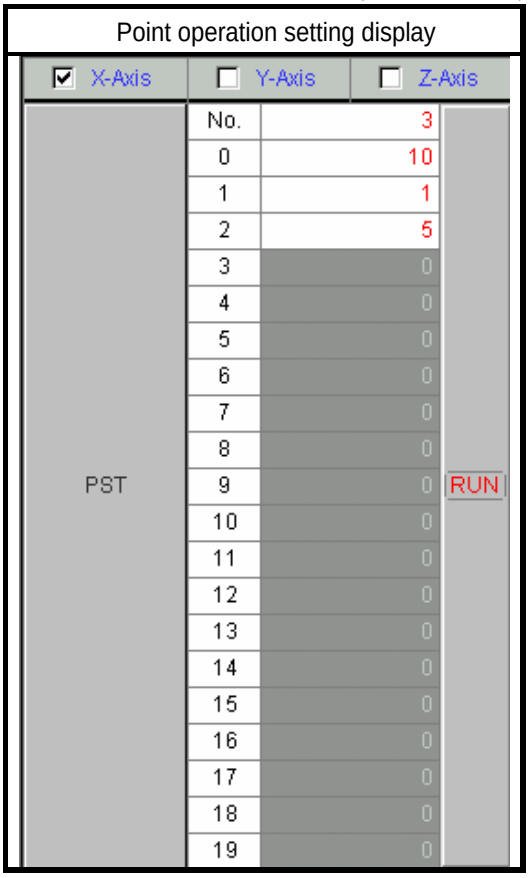
1) First, set the desired operation data to operate as follows.

Operation data setting display

Step	Coordi	Control	Pattern	Method	Address [pulse]	Sub Address [pulse]	M Code	Acc/Dec No.	Speed [pls/s]	Dwell	Cir.Int Dir
1	ABS	POS	END	SIN	10000	0	0	No.1	1000	0	CW
2	ABS	POS	END	SIN	0	0	0	No.1	0	0	CW
3	ABS	POS	END	SIN	0	0	0	No.1	0	0	CW
4	ABS	POS	END	SIN	0	0	0	No.1	0	0	CW
5	ABS	POS	CONT	SIN	100000	0	0	No.1	10000	0	CW
6	ABS	POS	END	SIN	0	0	0	No.1	10000	0	CW
7	ABS	POS	END	SIN	0	0	0	No.1	0	0	CW
8	ABS	POS	END	SIN	0	0	0	No.1	0	0	CW
9	ABS	POS	END	SIN	0	0	0	No.1	0	0	CW
10	ABS	POS	KEEP	SIN	100000	0	0	No.1	10000	0	CW
11	ABS	POS	END	SIN	1000	0	0	No.1	5000	0	CW
12	ABS	POS	END	SIN	0	0	0	No.1	0	0	CW

2) After selecting PST command window, set it as follows.
If the number of Point is set, the items of 0,1,2 shall be active.

Point operation setting display



3) Click [execute] button to carry out Point operation by the operation step order as 10->11->1->5->6.
Operation pattern is changed from Go-on(Step no.10)->End(Step no.1)->Continuous (Step no.5).

Chapter 7 Function Block

Here describes Function Block of positioning module for GMWIN.

The types of function block are as follows.

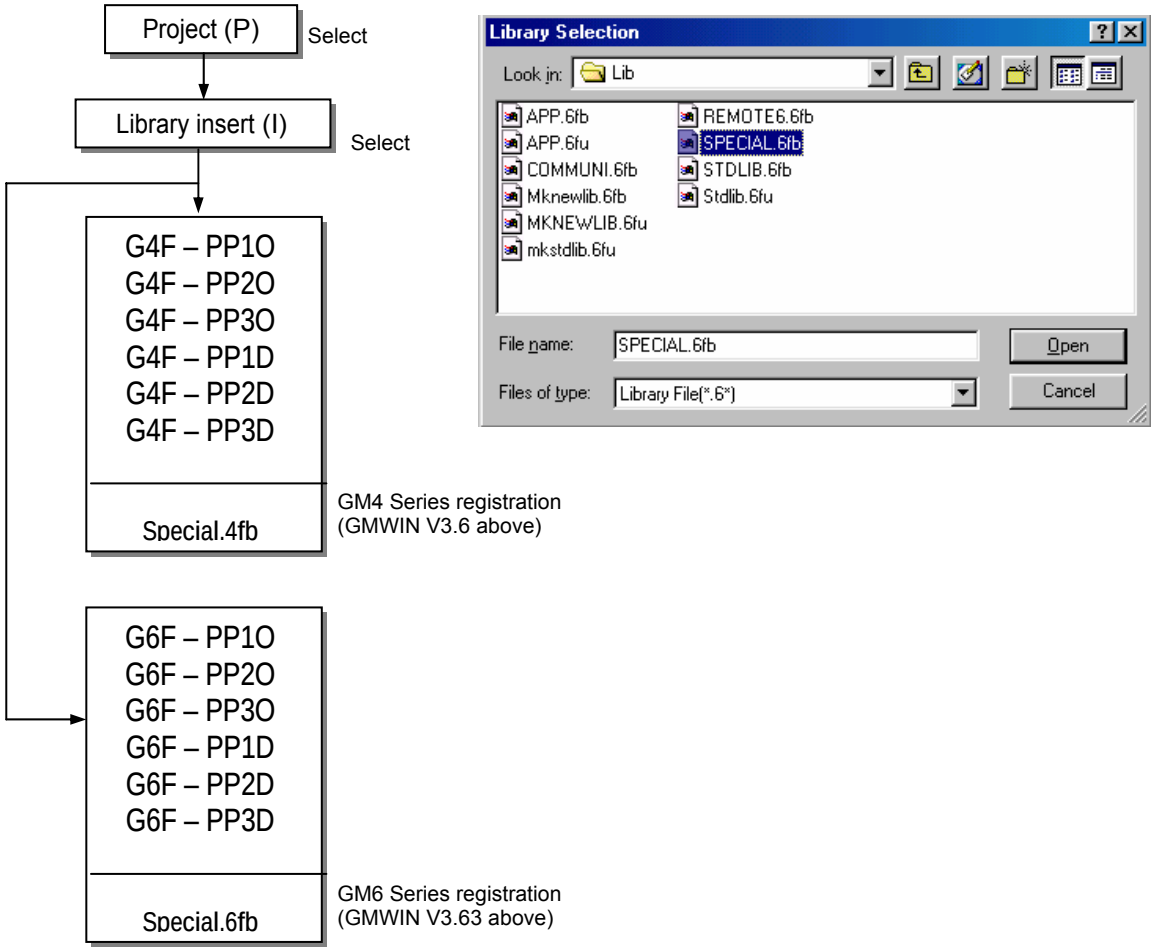
No.	Classification	Function block name	Description	Detailed description	Action condition	Running time
1	Module information	CRD	Code Status Read	Operation status code information read	Level	Within 1 ㎲
2		SRD	Status Read	Operation status bit information read	Level	Within 1 ㎲
3	Parameter setting	SBP	Set Basic Parameter	Basic parameter setting	Edge	Within 1100ms
4		SEP	Set Extended Parameter	Extended parameter setting	Edge	Within 1100ms
5		SCP	Set Common Parameter	Common parameter setting	Edge	Within 1100ms
6		SHP	Set Homing Parameter	Homing parameter setting	Edge	Within 1100ms
7		SMP	Set Manual Operation Parameter	Manual operation parameter setting	Edge	Within 1100ms
8	Operation data	SMD	Set Move Data	Operation data setting	Edge	Within 1100ms
9	Automatic operation	ORG	Return to Origin	Origin return start	Edge	Within 5ms
10		DST	Direct Start	Direct start	Edge	Within 5ms
11		IST	Indirect Start	Indirect start	Edge	Within 5ms
12		LIN	Linear Interpolation Start	Linear interpolation start	Edge	Within 6ms
13		CIN	Circular Interpolation Start	Circular interpolation start	Edge	Within 9ms
14		SST	Simultaneous Start	Simultaneous start	Edge	Within 5ms
15		PST	Point Start	PTP start	Edge	Within 5ms
16	Manual operation	JOG	Jog Start	Jog start	Level	Within 6ms
17		INC	Inching Start	Inching start	Edge	Within 5ms
18		MPG	Manual Pulse Generator	Manual pulse generator operation (or encoder)	Edge	Within 6ms
19		RTP	Return to Position	Automatic operation position return start	Edge	Within 5ms
20	Auxiliary operation	SSP	Synchronous Start by Position	Position synchronous start	Edge	Within 5ms
21		SSS	Synchronous Start by Speed	Speed synchronous start	Edge	Within 5ms
22		POR	Position Override	Position override	Edge	Within 5ms
23		SOR	Speed Override	Speed override	Edge	Within 5ms
24		PSO	Position Speed Override	Position speed override	Edge	Within 5ms
25		PTV	Position to Velocity	position/speed control	Edge	Within 5ms
26		VTP	Velocity to Position	Speed/position control	Edge	Within 5ms
27		SKP	Skip	Skip operatin	Edge	Within 9ms
28		NMV	Next Move	Next move	Edge	Within 5ms
29		SNS	Set Next Step Number	Start step no. setting	Edge	Within 5ms
30		SRS	Set Repeat Step Number	Start step no. setting in repeat operation	Edge	Within 5ms
31		STP	Stop	Stop	Edge	Within 5ms
32	Teaching	TEA	Position/Speed Teaching (single)	Position/speed teaching (ROM, RAM) (Single)	Edge	ROM: within 1100ms RAM: within 6ms
33		ATEA	Position/Speed Teaching (Array)	Position/speed teaching (ROM, RAM) (Array)	Edge	ROM: Within 1100ms RAM: Within 6ms
34	Error	EMG	Emergency	Emergency stop	Edge	Edge
35		RST	Error Reset / Inhibit Release	Error reset /output inhibit release	Edge	Within 5ms
36	Others	ZONE	Zone Output Enable	Zone output permitted	Edge	Within 5ms
37		MOF	M Code Off	M code Off	Edge	Within 6ms
38		PRS	Preset	Current position preset	Edge	Within 5ms
39		FLT	Floating Point Set	Floating point setting	Edge	Within 9ms
40		EPRE	Encoder Preset	Encoder preset	Edge	Within 5ms
41		ENCRD	Encoder Read	Encoder read	Level	Within 1 ㎲
42		MDRD	Move Data Read	Operation Data Read	Level	Within 1 ㎲

7.1 Positioning Module function block registration at GMWIN

7.1.1 Function block registration procedure

When GMWIN runs, function block is registered according to the following procedure.

Function block registration is available only in the state that project is open.



7.1.2 Common Items of Function Block

1)The function and use method of I/O variable name as below is applied commonly to all function block of Article 7.2.

Classification	Variable name	Data type	Description
Input	REQ	BOOL	Required area for function block execution • If the contion connected to this area during program running is formed and "0→1" (riging edge) or level input detection, function block runs.
	BASE	USINT	Base position no. ●This is the area to set the no. of base equiped with positioning module. ● Setting range : 0 ~ 3
	SLOT	USINT	Position no. of slot ●This is the area to set the no. of slot equiped with positioning module. ● Setting range : 0 ~ 7
	AXIS	USINT	Area to set the use axis ●X axis : 0 ●Y axis : 1 ●Z axis : 2 ● If out of setting range, "error 6" occurs.
Output	DONE	BOOL	Indication area of function block completion status ● If function block completed without error, the output is "1" and it is maintained by the next execution, If error occurs, the output is "0".
	STAT	USINT	Indication area of error status ● This is the area to output the error no. if error occurs during function block execution.

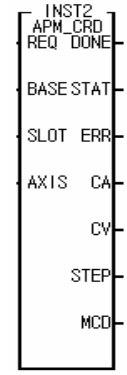
2) This is applied commonly to all function blocks to be described in Article 7.2 and the setting range of position and speed is shown as below and the position and speed to be described in Article 7.2 ~ 7.10 is based on pulse unit.

Classification	Setting unit	Setting Range
Position	pulse	-2,147,483,648 ~ 2,147,483,647 [puse]
	mm	-2,147,483,648 ~ 2,147,483,647 [X10^{-4} ㎜]
	inch	-2,147,483,648 ~ 2,147,483,647 [X10^{-5}Inch]
	degree	-2,147,483,648 ~ 2,147,483,647 [X10^{-5}degree]
Speed	pls/s	Open Collector output : 1 ~ 200,000 [pls/s] Line Drive output : 1 ~ 1,000,000 [pls/s]
	㎜/min	1 ~ 2,000,000,000[X10^{-2} ㎜/min]
	inch/min	1 ~ 2,000,000,000[X10^{-3}Inch/min]
	degree/min	1 ~ 2,000,000,000[X10^{-3} degree/min]

7.2 Module Information Read Function Block

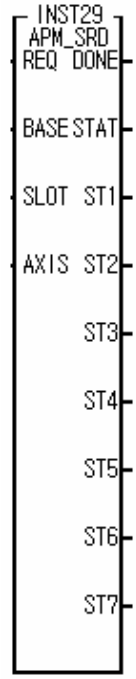
7.2.1 Current Operation Status Code Information Read (Status Code Read APM_CRD)

This carries out the monitoring by reading the current position address, operation speed, operation data no., M code of the setting axis and it can be used as a condition for user's program.

Function Block type	Variable	Data type	Description
	ERR	UINT	Indicates the error information during operation
	CA	DINT	Indicates the current position Address
	CV	UINT	Indicates the current operation speed
	STEP	UINT	Indicates the current operation data no.
	MCD	USINT	Indicates the current M code

7.2.2 Current Operation Status Bit Information Read (Status Bit Read APM_SRD)

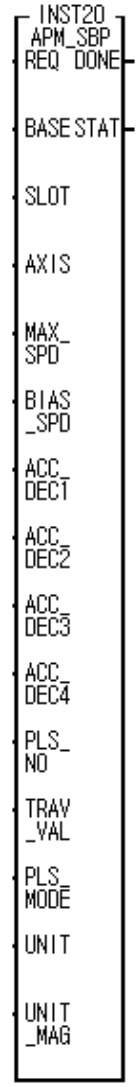
The contents of output variable ST1 ~ ST7 of current operation status Bit read function block is the important information to apply for the Program.
G6F-PP10~30, G6FPP1D~3D does not have Zone 1,2,3 output signal of ST7[3], ST7[4], ST7[5].

Function block type	Variable	Data type	Description			
			Bit no	**Execution**	Bit no	**Execution**
	ST1	BOOL [ARRAY]	[0]	In operation (0: Stop, 1:BUSY)	[4]	Origin setting status (0: No, 1:Yes)
			[1]	Error status	[5]	Pulse output prohibited status (0: Enable, 1: prohibited)
			[2]	Positioning completion	[6]	Stop status
			[3]	M Code On signal (0:Off, 1:On)	[7]	No use
	ST2	BOOL [ARRAY]	[0]	High limit detection	[4]	Acceleration
			[1]	Low limit detection	[5]	Constant speed
			[2]	Emergency stop status	[6]	Deceleration
			[3]	normal/reverse direction (0: normal, 1:reverse)	[7]	Dwell
	ST3	BOOL [ARRAY]	[0]	1axis position control operation	[4]	2 axis circular interpolation
			[1]	1 axis speed control operation	[5]	Origin return operation
			[2]	2 axis linear interplation I	[6]	Position synchronous operation
			[3]	3 axis linear interpolation	[7]	Speed synchronous operation
	ST4	BOOL [ARRAY]	[0]	Jog low speed operation	[4]	Manual operation point return
			[1]	Jog high speed operation	[5]	Zone 1
			[2]	Inching operation	[6]	Zone 2
			[3]	MPG operation	[7]	Zone 3
	ST5	BOOL [ARRAY]	[0]	Axis status (0: subordinate, 1: main)	[4]	Main axis information (Encoder)
			[1]	Main axis information (X)	[5]	No use
			[2]	Main axis information (Y)	[6]	No use
			[3]	Main axis information (Z)	[7]	No use
	ST6	BOOL [ARRAY]	[0]	Emergency stop input signal	[4]	High limit input signal
			[1]	Stop input signal	[5]	Low limit input signal
			[2]	Command input signal	[6]	Origin input signal
			[3]	Jog high speed reverse signal	[7]	Approximate origin input signal
	ST7	BOOL [ARRAY]	[0]	speed/position control switching input	[4]	Zone2 output signal
			[1]	Driver ready input signal	[5]	Zone3 output signal
			[2]	External synchronous start input	[6]	No use
			[3]	Zone1 output signal	[7]	No use

7.3 Parameter Setting Function Block

7.3.1 Basic Parameter Setting (Set Basic Parameter APM_SBP)

This is used to change the basic parameter during operation without using S/W Package.



Function block type	Variable	Data type	Description
	MAX_SPD	UDINT	Speed limit ●Setting range : Open Collector output 0 ~ 200,000 [unit:pls/s] Line Driver output 0 ~ 1,000,000 [unit:pls/s] ●If out of setting range, “Error 11” occurs.
	BIAS_SPD	UDINT	Bias speed ●Setting range : Open Collector output 0 ~ speed limit settinng value [unit:pls/s] Line Driver output 0 ~ speed limit setting value [unit:pls/s] ●If out of setting range, “Error 11” occurs.
	ACC_DEC1	UINT	Acceleration/Deceleration Time No1 ●Setting range : 0 ~ 65,535 [unit:㎳]
	ACC_DEC2	UINT	Acceleration/Deceleration Time No2 ●Setting range : 0 ~ 65,535 [unit:㎳]
	ACC_DEC3	UINT	Acceleration/Deceleration Time No3 ●Setting range : 0 ~ 65,535 [unit:㎳]
	ACC_DEC4	UINT	Acceleration/Deceleration Time No4 ●Setting range : 0 ~ 65,535 [unit:㎳]
	PLS_NO	UINT	No. of pulse per rotation ●Setting range : 1 ~ 65,535
	TRAV_VAL	UINT	Travel distance per rotation ●Setting range :
	PLS_MODE	USINT	Pulse output mode ●Setting range : 1 ~ 2 [0 : CW/CCW, 1 : Pulse/Dir , 2 : Phase] ●If out of setting range, “Error 11” occur.
	UNIT	USINT	Control unit ●Setting range : 0 ~ 3 [0: Pulse, 1: ㎜, 2: Inch, 3: Degree] ●If out of setting range, “Error 11 ” occurs.
	UNIT_MAG	USINT	Unit magnification ●Setting range : 0 ~ 3 [0 : X 1times, 1 : X 10times, 2 : X 100times, 3 : X 1000times] ●If out of setting range, “Error 11” occurs.

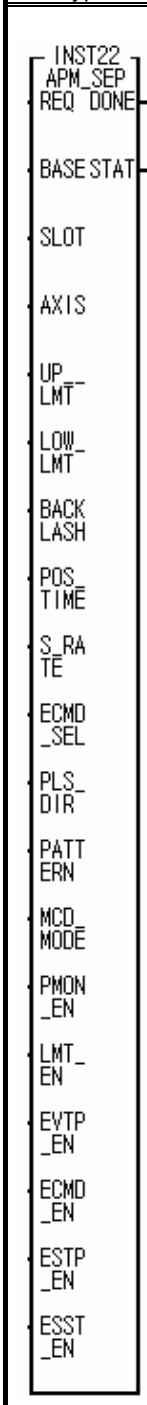
Control unit	Setting range	Actual input value	Setting range
Pulse	1 ~ 65,535	1 ~ 65,535	pls
㎜		0.1 ~ 6,553.5	* 1/10 ㎛
Inch		0.00001 ~ 0.65535	* 1/10000 inch
Phase		0.00001 ~ 0.65535	* 1/10000 degree

Point

1) If the setting range is set as “0” when entering acceleration/deceleration time, it disregards the speed set by bias and starts by the setting speed without acceleration/deceleration section.

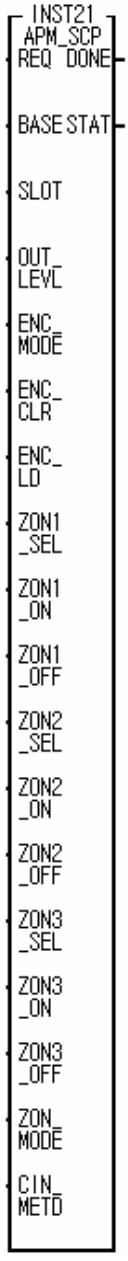
7.3.2 Extended Parameter Setting (Set Extended Parameter APM_SEP)

This is used to change the extended parameter during operation without using S/W Package.

Function block type	Variable	Data type	Description
	UP_LMT	DINT	Soft upper limit ●Setting range : -2,147,483,648 ~ +2,147,483,647
	LOW_LMT	DINT	Soft lower limit ●Setting range : -2,147,483,648 ~ +2,147,483,647
	BACK LASH	UINT	Backlash compensation amount ●Setting range : 0 ~ 65,535
	POS_TIME	UINT	Positioning completion signal output time ●Setting range : 0 ~ 65,535 [unit:㎳]
	S_RATE	USINT	S-Curve rate ●Setting range : 1 ~ 100 [unit:%] ●if out of setting range, “Error 11” occurs.
	ECMD_SEL	USINT	External command signal selection ●Setting range : 0 ~ 2 [0: start, 1: JOG operation, 2: Skip operation] ●if out of setting range, “Error 11 ” occurs.
	PLS_DIR	BOOL	Pulse output direction ●Setting range : 0 ~ 1 [0 : CW, 1: CCW]
	PATTERN	BOOL	Acceleration/Deceleration pattern ●Setting range : 0 ~ 1 [0 : trapezoid, 1: S-Curve]
	MCD_MODE	USINT	M Code mode ●Setting range : 0 ~ 2 [0 : None, 1 : With , 2 : After] ●if out of setting range, “Error 11” occurs.
	PMON_EN	BOOL	Position indication during equal speed operation ●Setting range : 0 ~ 1 [0: prohibited, 1: permitted]
	LMT_EN	BOOL	Soft upper/lower limit detection during equal speed operation ●Setting range : 0 ~ 1 [0: prohibited, 1: permitted]
	EVTP_FN	BOOL	External speed/position switching permitted/prohibited ●Setting range : 0 ~ 1 [0: prohibited, 1: permitted]
	ECMP_EN	BOOL	External command permitted/prohibited ●Setting range : 0 ~ 1 [0: prohibited, 1: permitted]
	ESTP_EN	BOOL	External stop permitted/prohibited ●Setting range : 0 ~ 1 [0: prohibited, 1: permitted]
	ESST_EN	BOOL	External synchronous start permitted/prohibited ●Setting range : 0 ~ 1 [0: prohibited, 1: permitted]

7.3.3 Common Parameter Setting (Set Common Parameter APM_SCP)

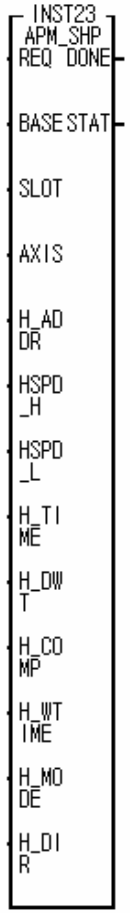
This is used to change common parameter during operation without using S/W Package.



Function block type	Variable	Data type	Description
	OUT_LEVL	BOOL	Pulse output level ●Setting range : 0 ~ 1 [0 : Low Active, 1 : High Active]
	ENC_MODE	USINT	Encoder pulse input mode ●Setting range : 0 ~ 6 Setting value / Description: 0 CW/CCW, 1상1체배; 1 CW/CCW, 1상2체배; 2 Pulse/Dir, 1상1체배; 3 Pulse/Dir, 1상2체배; 4 Phase A/B, 2상1체배; 5 Phase A/B, 2상2체배; 6 Phase A/B, 2상4체배 ●If out of setting range, “Error 11 ” occurs.
	ENC_CLR	BOOL	Counter Clear mode by Z phase input ●Setting range : 0 ~ 1 [0 : Not Clear, 1 : Clear]
	ENC_LD	DINT	Encoder Auto Reload ●Setting range : -2,147,483,648 ~ +2,147,483,647
	ZON1_SEL	USINT	Zone1 setting axis ●Setting range : 0 ~ 3 [0: X, 1: Y, 2: Z, 3: Encoder] ●If out of setting range, “Error 11” occurs.
	ZON1_ON	DINT	Zone1 output ON position ●Setting range : -2,147,483,648~ +2,147,483,647
	ZON1_OFF	DINT	Zone1 output OFF position ●Setting range : -2,147,483,648 ~ +2,147,483,647
	ZON2_SEL	USINT	Zone2 setting axis ●Setting range : 0 ~ 3 [0: X, 1: Y, 2: Z, 3: Encoder] ●If out of setting range, “Error 11” occurs.
	ZON2_ON	DINT	Zone2 output ON position ●Setting range : -2,147,483,648 ~ +2,147,483,647
	ZON2_OFF	DINT	Zone2 output OFF position ●Setting range : -2,147,483,648 ~ +2,147,483,647
	ZON3_SEL	USINT	Zone3 setting axis ●Setting range : 0 ~ 3 [0: X, 1: Y, 2: Z, 3: Encoder] ●If out of setting range, “Error 11” occurs.
	ZON3_ON	DINT	Zone3 output ON position ●Setting range : -2,147,483,648 ~ +2,147,483,647
	ZON3_OFF	DINT	Zone3 output OFF position ●Setting range : -2,147,483,648 ~ +2,147,483,647
	ZON_MODE	BOOL	Zone output mode ●Setting range : 0 ~ 1 [0: individual output, 1: batch output] ※ If selected batch output, it follows the setting condition of Zone 1.
	CIN_METD	BOOL	Circular interpolation method setting ●Setting range : 0 ~ 1 [0: middle point, 1: center point]

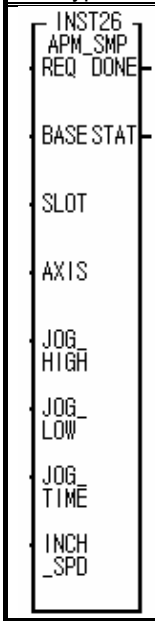
7.3.4 Homing Parameter Setting (Set Homing Parameter APM_SHP)

This is used to change Homing parameter during operation without using S/W Package.

Function block type	Variable	Data Type	Description
	H_ADDR	DINT	Origin address ●Setting range : -2,147,483,648 ~ +2,147,483,647
	HSPD_H	UDINT	Homing high speed ●Setting range : 1 ~ less than speed limit setting value [unit:pls/s] ●if out of setting range, “Error 11” occurs.
	HSPD_L	UDINT	Homing low speed ●Setting range : 1 ~ less than speed limit setting value [unit:pls/s] ●if out of setting range, “Error 11” occurs.
	H_TIME	UINT	Homing Acceleration/Deceleratin time ●Setting range : 1 ~ 65,535 [unit:㎳]
	H_DWT	UINT	Homing Dwell time ●Setting range : 0 ~ 50,000[unit:㎳] ●if out of setting range, “Error 11” occurs.
	H_COMP	DINT	Homing compensation amount ●Setting range : -2,147,483,648 ~ +2,147,483,647
	H_WTIME	UINT	Homing reset waiting time ●Setting range : 1 ~ 65,535 [unit:㎳]
	H_MODE	USINT	Homing mode • Setting range : 0 ~ 4 Setting value / Description 0 – Origin detection after approximate origin OFF 1 – Origin detection after deceleration when approximate orign ON 2 – Origin detection by high/low limit and the origin 3 – Origin detection by approximate origin 4 – High speed origin detection ●If out of setting range, “Error 11” occurs.
	H_DIR	BOOL	Homing direction ●Setting range : 0 ~ 1 [0: normal, 1: reverse]

7.3.5 Manual Operation Parameter Setting (**S**et **M**anual Opertion **P**arameter **APM_SMP)**

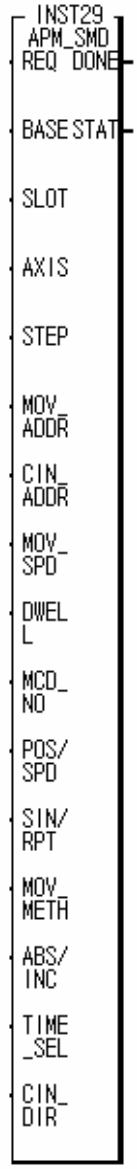
This is used to change manual operation parameter without using S/W Package.

Function block type	Variable	Data type	Description
	JOG_HIGH	UDINT	JOG high speed ●Setting range : 1 ~ less than speed limit [unit:pls/s] ●If out of setting range, “Error 11” occurs.
	JOG_LOW	UDINT	JOG low speed ●Setting range : 1 ~ less than JOG high speed[unit:pps] ●If out of setting range, “Error 11” occurs.
	JOG_TIME	UINT	JOG acceleration/deceleration time ●Setting range : 1 ~ 65,535 [unit:㎳]
	INCH_SPD	UINT	Inching speed ●Setting range : 1 ~ 65,535 [unit:pls/s]

7.4 Move Data Setting Function Block

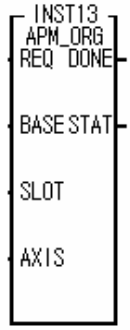
7.4.1 Move Data Setting (Set Move Data APM_SMD)

This is used to change Move data without using S/W Package.

Function block type	Variable	Data type	Description
	STEP	UINT	Operation step no. ●Setting range : 1 ~ 400 ●If out of setting range, “Error 11” occurs.
	MOV_ADDR	DINT	Goal position address ●Setting range : -2,147,483,648 ~ +2,147,483,647
	CIN_ADDR	DINT	Aux. Address of circular interpolation ●Setting range : -2,147,483,648 ~ +2,147,483,647
	MOV_SPD	UDINT	Operation speed ●Setting range : Open Collector module : 1 ~ 200,000 [unit:pls/s] Line Driver module : 1 ~ 1,0000,000 [unit:pls/s] ●If out of setting range, “Error 11” occurs.
	DWELL	UINT	Swell ime ●Setting range : 0 ~ 50,000 [unit:㎳] ●If out of setting range, “Error 11” occurs.
	MCD_NO	UINT	M Code no. ●Setting range : 0 ~ 65,535
	POS/SPD	BOOL	Position/Speed control setting ●Setting range : 0 ~ 1 [0: position control, 1: speed control]
	SIN/RPT	BOOL	Single/Repeat operation setting ●Setting range : 0 ~ 1 [0: single, 1: repeat]
	MOV_METH	USINT	End/Go-on/Continuous setting ●Setting range : 0 ~ 2 [0: End, 1: Go-on, 2 : Continuous] ●If out of setting range, “Error 11”
	ABS/INC	BOOL	Absolute/Relative setting ●Setting range : 0 ~ 1 [0 : Absolute, 1 : Relative]
	TIME_SEL	USINT	Acceleration/Deceleration time no. setting ●Setting range : 0 ~ 3 [0: Acc./Dece. Time 1, 1: Acc./Dec. Time No. 2, 2: Acc./Dece. time No 3, 3: Acc./Dece. Time No 4] ●If out of setting range, “Error 11”.
	CIN_DIR	BOOL	Circulation interpolation direction setting ●Setting range : 0 ~ 1 [0: CW, 1: CCW]

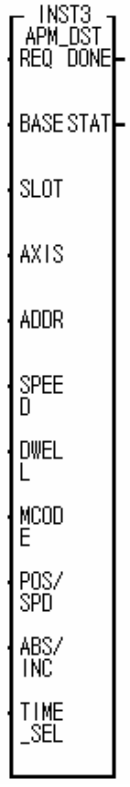
7.5 Automatic Operation Function Block

7.5.1 Origin Return Start (Return To Origin APM_ORG)

Function block type	Description
	Operation command to find the origin of machine by origin return processing method such as direction, compensation amount, high speed and low speed, address and dwell time set from Homing parameter of each axis and if Homing bit information ST1[4] is “ON”, the homing operation of machine will end.

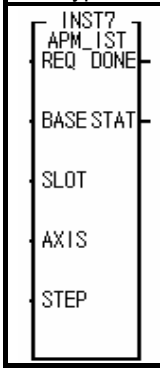
7.5.2 Direct Start (Direct Start APM_DST)

This is used to operate directly by setting the goal position address, operation speed, dwell time, M code no, control method, coordinate setting and acceleration/deceleration time no. without operation data.

Function block type	Variable	Data type	Description
	ADDR	DINT	Goal position address ●Setting range : -2,147,483,648 ~ +2,147,483,647
	SPEED	UDINT	Operation speed setting ●Setting range : Open Collector module : 1 ~ 200,000 [unit:pls/s] Line Driver module : 1 ~ 1,0000,000 [unit:pls/s] ●if out of setting range, “Error 11” occurs.
	DWELL	DINT	Dwell time setting ●Setting range : 0 ~ 50,000 [unit:㎳] ●If out of setting range, “Error 11” occurs.
	MCODE	UINT	M Code no. setting ●Setting range : 0 ~ 65,535
	POS/SPD	BOOL	Position/speed control setting ●Setting range : 0 ~ 1 [0: position control, 1: speed control]
	ABS/INC	BOOL	Absolute/Relative setting ●Setting range : 0 ~ 1 [0: absolute, 1: relative]
	TIME_SEL	USINT	Acceleration/Deceleration No. setting ●Setting range : 0 ~ 3 [0: acc./dec. Time No 1, 1: acc./dec. time No 2, 2: acc./dec. Time No 3, 3: acc./dec. Time No 4] ●If out of setting range, “Error 11” occurs.

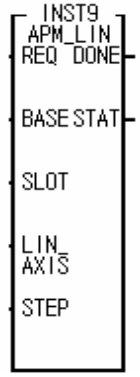
7.5.3 Indirect Start (Indirect Start APM_IST)

This is used to operate by setting the operation step no. by operation data.

Function block type	Variable	Data type	Description
	STEP	UINT	Operation step no. ●Setting range : 1 ~ 400 ●If out of setting range, “Error 11” occurs.

7.5.4 Linear Interpolation Start (Linear Interpolation Start APM_LIN)

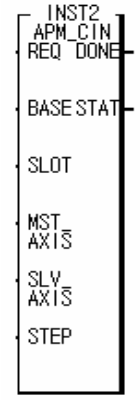
This is the command to carry out the linear interpolation operation at 2 axis or 3 axis positioning module.

Function block type	Variable	Data Type	Description
	LIN_ AXIS	USINT	Interpolation operation axis setting ●Setting range : 1 ~ 7(except 1,2,4) ●If out of setting range, “Error 6” occurs.
	STEP	UINT	Interpolation operation step no. ●Setting range : 1 ~ 400 ●If out of setting range, “Error 11” occurs.

Axis information			Setting value	Operation axis
Z(Bit2)	Y(Bit1)	X(Bit0)		
Off	On	On	3	X/Y
On	Off	On	5	X/Z
On	On	Off	6	Y/Z
On	On	On	7	X/Y/Z

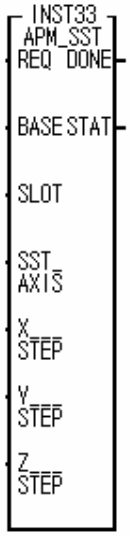
7.5.5 Circular Interpolation Start (Cicular Interpolation Start APM_CIN)

This is the command to carry out circular interpolation operation at 2 axis or 3 axis positioning module.

Function block type	Variable	Data type	Description
	MST_ AXIS	USINT	Main axis setting ●Setting range : 0 ~ 2 [0: X, 1:Y, 2:Z] ●If out of setting range, “Error 6” occurs.
	SLV_ AXIS	USINT	Subordinate axis setting ●Setting range : 0 ~ 2 [0: X, 1:Y, 2:Z] ●If out of setting range, “Error 6” occurs.
	STEP	UINT	Operation step no. setting ●Setting range : 1 ~ 400 ●If out of setting range, “Error 11” occurs.

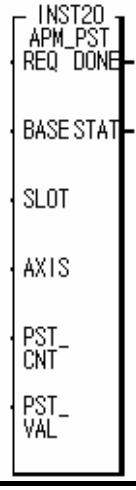
7.5.6 Simultaneous Start (Simultaneous Start APM_SST)

This is the command to start 2 axis or 3 axis operation simultaneously.

<table>
<tr><th>Function block type</th><th>Variable</th><th>Data type</th><th>Description</th></tr>
<tr><td rowspan="4"> 
</td><td>SST_AXIS</td><td>USINT</td><td>Simultaneous start axis setting
●Setting range : 1 ~ 7(except 1,2,4)
●if out of setting range, “Error 6” occurs.
<table>
<tr><th colspan="3">Axis information</th><th rowspan="2">Setting value</th><th rowspan="2">Operation axis</th></tr>
<tr><th>Z(Bit2)</th><th>Y(Bit1)</th><th>X(Bit0)</th></tr>
<tr><td>Off</td><td>On</td><td>On</td><td>3</td><td>X/Y</td></tr>
<tr><td>On</td><td>Off</td><td>On</td><td>5</td><td>X/Z</td></tr>
<tr><td>On</td><td>On</td><td>Off</td><td>6</td><td>Y/Z</td></tr>
<tr><td>On</td><td>On</td><td>On</td><td>7</td><td>X/Y/Z</td></tr>
</table></td></tr>
<tr><td>X_STEP</td><td>UINT</td><td>X axis simultaneous start operation step no. setting
●Setting range : 1 ~ 400
●If out of setting range, “Error 11” occurs.</td></tr>
<tr><td>Y_STEP</td><td>UINT</td><td>Y axis simultaneous start operation step no. setting
●Setting range : 1 ~ 400
●If out of setting range, “Error 11” occurs.</td></tr>
<tr><td>Y_STEP</td><td>UINT</td><td>Z axis simultaneous start operation step no. setting
●Setting range : 1 ~ 400
●If out of setting range, “Error 11” occurs.</td></tr>
</table>

7.5.7 PTP Start (Point Start APM_PST)

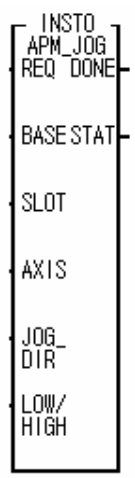
In case of PTP(Point to Point) operation, this command carries out the operation continuously without stop by setting max. 20 operation steps.

Function block type	Variable	Data type	Description
	PST_CNT	USINT	Operation step no. setting when PTP operation ●Setting range : 0 ~ 19 ●If out of setting range, “Error 6” occurs.
	PST_VAL	UINT [ARRAY] [0]~[19]	Operation step no. setting when PTP operation ●Setting range : 1 ~ 400 ●If out of setting range, “Error 6” occurs.

7.6 Manual Operation Function Block

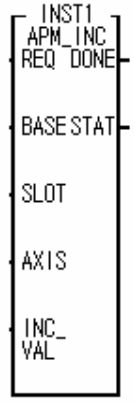
7.6.1 JOG operation (Jog Start APM_JOG)

This function is manual operation for test and is used to confirm the position address for the action of system , wiring checking and teaching and the speed is divided into high speed and low speed. If connection condtion of input variable REQ is “ON”, the pulse is outputted by the setting value and when “OFF”, it stops.

Function block type	Variable	Data type	Description
	JOG_ DIR	BOOL	Rotation direction setting when JOG operation •Setting range : 0 ~ 1 [0: normal, 1: reverse]
	LOW/ HIGH	BOOL	JOG speed setting when JOG operation •Setting range : 0 ~ 1 [0: Jog low speed operation, 1: Jog high speed operation]

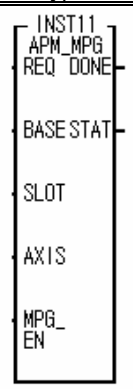
7.6.2 Inching Operation (Inching Start APM_INC)

This is a kind of manual operation which is used when processing the detailed movement as quantitive operation.

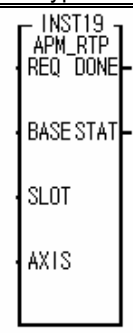
Function block type	Variable	Data type	Description
	INC_ VAL	DINT	The desired position amount setting to move by inching operation •Setting range : -2147483648 ~ 2147483647 ▶Inching speed is set by origin/manual parameter of extended parameter of S/W Package.

7.6.3 Manual Pulse Generator Operation (Manual Pulse Generator APM_MPG)

In case of operating by using the manual pulse generator installed outside, this command is used to make the positioning module ready to operate.

Function block type	Variable	Data type	Description
	MPG_EN	BOOL	MPG[manual pulse generator] operation permitted/prohibited setting •Setting range : 0 ~ 1 [0: prohibited, 1: permitted]

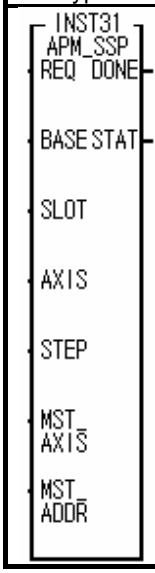
7.6.4 Return to the previous position before Manual Operation (Return To Position APM_RTP)

Function block type	Description
	When the position is changed by manual operation after positioning, this is used to return it to the previous position before manual operation. ▶In this case, manual operation includes inching operation, jog operation, manual pulse generator operation.

7.7 Auxiliary Operation Function Block

7.7.1 Synchronous Start by Position (**S**ynchronous **S**tart by **P**osition **APM_SSP)**

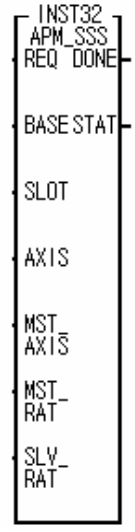
If the axis in operation is the subordinate axis and reaches the goal position set by the main axis, the operation step set here will act.

Function block type	Variable	Data type	Description
	STEP	UINT	Operation step no. setting for synchronous start by the operating axis •Setting range : 1 ~ 400
	MST_AXIS	USINT	Main axis setting •Setting range : 0 ~ 2 [0: X, 1:Y, 2:Z] •If out of setting range, “Error 6” occurs.
	MST_ADDR	DINT	Goal position setting of main axis •Setting range : -2147483648 ~ 2147483647

7.7.2 Synchronous Start by Speed **(S**ynchronous **S**tart by **S**peed **APM_SSS)**

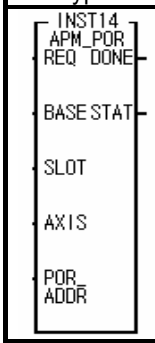
This is used to control the operation speed between 2 axis by the setting rate.

(speed rate of slave axis / Speed rate of master axis has to be set less than “1”)

Function block type	Variable	Data type	Description
	AXIS	USINT	Subordinate axis setting •Setting range : 0 ~ 2 [0: X, 1:Y, 2:Z] •If out of setting range, “Error 6” occurs
	MSP_AXIS	USINT	Main axis setting •Setting range : 0 ~ 2 [0: X, 1:Y, 2:Z] •If out of setting range, “Error 6” occurs.
	MST_RAT	UINT	Main axis Speed rate setting •Setting range : 0 ~ 65535
	SLV_RAT	UINT	Subordinate axis speed rate setting •Setting range : 0 ~ 65535

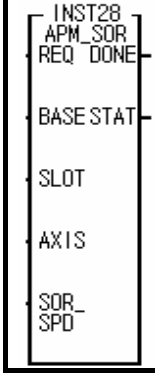
7.7.3 Position Override (Position Override APM_POR)

This is used to change the goal position from operation data of the step no. in operation of each axis.

Function block type	Variable	Data type	Description
	POR_ ADDR	DINT	New goal position setting •Setting range : -2147483648 ~ 2147483647

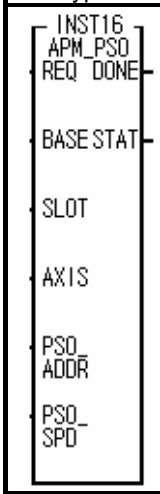
7.7.4 Speed Override (Speed Override APM_SOR)

This is used to change the operation speed from operation data of step no. in operation of each axis.

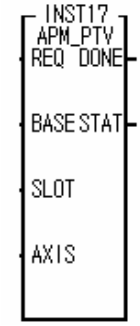
Function block type	Variable	Data type	Description
	SOR_ SPD	UDINT	New operation speed setting •Setting range : Open Collector output 0 ~ 200,000 [unit:pls/s] Line Driver output 0 ~ 1,000,000 [unit:pls/s] •If out of setting range, “Error 11” occurs.

7.7.5 Position/Speed Override (Position Speed Override APM_PSO)

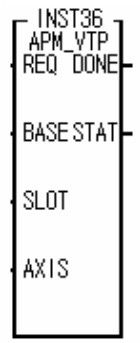
This is used to change the goal position and speed from operation data of step no. in operation of each axis simultaneously.

Function block type	Variable	Data type	Description
	PSO_ADDR	DINT	New goal position setting •Setting range : -2147483648 ~ 2147483647
	PSO_SPD	UDINT	New operation speed setting •Setting range : Open Collector output 0 ~ 200,000 [unit:pls/s] Line Driver output 0 ~ 1,000,000 [unit:pls/s] •If out of setting range, “Erro 11” occurs.

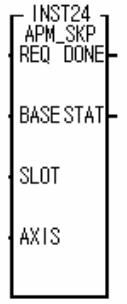
7.7.6 Position/Velocity Switching Control (Position To Velocity APM_PTV)

Function block type	Description
	While the axis set as positioning action carries out the position control by the setting transfer amount, it carries out the switching operation from position control to speed control by the position/velocity switching signal. If this command is executed, the origin becomes the unsettled state at the very executed time and carries out the speed control mode action by the setting speed from operation data.

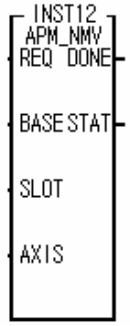
7.7.7 Velocity/Position Switching Control (Velocity To Position APM_VTP)

Function block type	Description
	While the axis set by the positioning action carries out the speed control, it is switched from speed control to position control by the velocity/position switching signal and carries out the positioning as much as by the setting transfer amount. If this command is executed, the origin will be determined at the very executed time and complete the positioning after moving to the setting goal position.

7.7.8 SKIP Operation (Skip APM_SKP)

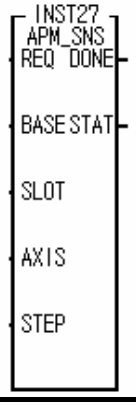
Function block type	Description
	This is used to carry out the operation by moving to next step without operating the operation step. Whenever it executes, it operates the next operation step by skipping and stopping the operation of the current operation step.

7.7.9 Continuous Operation (Next Move APM_NMV)

Function block type	Description
	This is used to carry out the operation by moving to next step without operating the operation step. Whenever it executes, it operates the next operation step by skipping and non-stopping the operation of the current operation step.

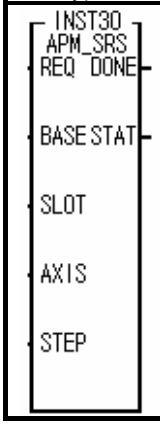
7.7.10 Start Step Number Setting (Set Next Step Number APM_SNS)

This is used to change the operation step of the setting axis. Indirect start carries out the operation by increasing the operation step one by one after completion of start and changes it with specific operation step. (In case of the step no = "0")

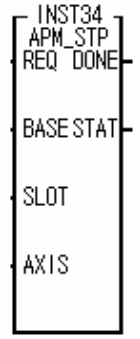
Function block type	Variable	Data type	Description
	STEP	UINT	Operation step no. setting for operation •Setting range : 1 ~ 400 •If out of setting range, "Error 11" occurs.

7.7.11 Start Step No. Setting when Repeat operation (Set Repeat Step Number APM_SRS)

The setting axis returns always to no.1 operation step when encounters the repeat operation while operating by operation data. But this is used to start the operation from the specific operation step by setting the start step no. when repeat operation.

Function block type	variable	Data type	Description
	STEP	UINT	Operation step no. setting for repeat operation •Setting range : 1 ~ 400 •If out of setting range, “Error 11” occurs.

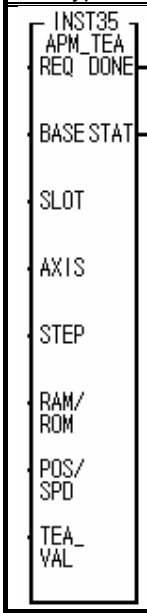
7.7.12 Stop (Stop APM_STP)

Function block type	Description
	This is used to stop the positioning module in operation. If encounters the stop command during the operation by operation data, it carries out the deceleration stop and then starts to operate again by Start command. The availalble operation are 1) indirect start, 2) direct start, 3) inching, 4) interpolation operation.

7.8 Teaching Function Block

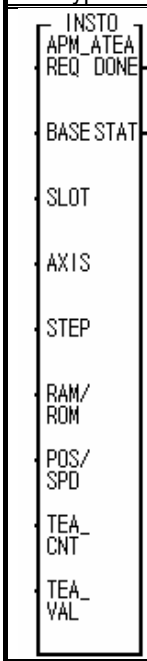
7.8.1 Position/Speed Teaching Function Block_Single (Teaching APM_TEA)

Speed teaching is used when the user wants to use the random speed for the specific operation data no. while Position teaching is used when the use wants to set the random address to the specific operation step no.

Function block type	Variable	Data type	Description
	STEP	UINT	Operation step no. setting for teaching •Setting range : 1 ~ 400 •If out of setting range, “Error 11” occurs.
	RAM/ ROM	BOOL	Selection of RAM teaching and ROM teaching •Setting range : 0 ~ 1 [0 : RAM teaching, 1 : ROM teaching]
	POS/ SPD	BOOL	Selection of Position teaching and Speed teaching •Setting range : 0 ~ 1 [0 : Position teaching, 1 : Speed teaching]
	TEA_ VAL	DINT	Teaching value setting •Position teaching range : -2147483648 ~ 2147483647 •Setting range : Open Collector output 1 ~ 200,000 [unit:pls/s] Line Driver output 1 ~ 1,000,000 [unit:pls/s] •If out of setting range, “Error 11” occurs.

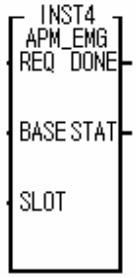
7.8.2 Position/Speed Teaching Function Block _Plural (Array Teaching APM_ATEA)

This is used to change the goal position and speed by max. 16 at one time by plural teaching function block.

Function block type	Variable	Data type	Description
	STEP	UINT	Operation step no. setting for array teaching •Seting range : 1 ~ 400 •If out of setting range, “Error 11” occurs.
	RAM/ ROM	BOOL	Selection of RAM teaching and ROM teaching •Setting range : 0 ~ 1 [0 : RAM teaching, 1 : ROM teaching]
	POS/ SPD	BOOL	Selection of Position teaching and Speed teaching •Setting range : 0 ~ 1 [0 : Position teaching, 1 : Speed teaching]
	TEA/ CNT	USINT	Teaching number setting •Setting range : 1 ~ 16 •Max. Teaching no. is 16. •If out of setting range, “Error 11” occurs.
	TEA_ VAL	DINT [Array] [0]~[15]	Teaching value setting •Position teaching range : -2147483648 ~ 2147483647 •Speed teaching setting range : Open Collector output 0 ~ 200,000 [unit:pls/s] Line Driver output 0 ~ 1,000,000 [unit:pls/s] •If out of setting range, “Error 11” occurs. •Teaching value is valid as much as the constant number set by TEA/CNT.

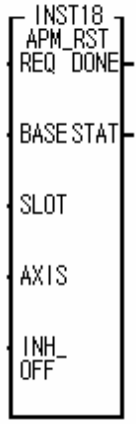
7.9 Error Function Block

7.9.1 Emergency Stop (Emergency APM_EMG)

Function block type	Description
	This is used to stop the operation in case of emergent status. All axis where this command is executed becomes stop status. As this is in converted to the status of output prohibited and origin unsettled, it is required to release the output prohibited and determine the origin again before reset.

7.9.2 Error Reset/Output Prohibit Release (Error Reset/Inhibit Release APM_RST)

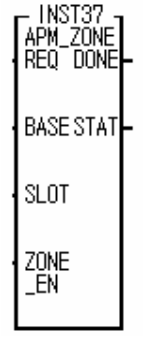
This is used to release the status that the pulse output is prohibited by external emergency stop, high/low limit detection or reset the error when the setting range of parameter is excessive or the error occurs during operation.

Function block type	Variable	Data type	Description
	INH_OFF	BOOL	Error reset or output prohibit release •Setting range : 0 ~ 1 [0 : error reset, 1 : error reset/output permit]

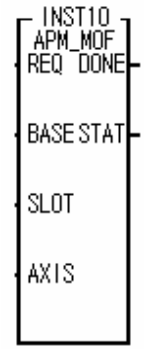
7.10 Other Function Block

7.10.1 Zone Output Permit (Zone Output Enable APM_ZONE)

This is the command to permit the output to internal / external Zone output by using the position data of the axis in operation and the position data value set by Zone1, Zone2, Zone3 for the zone set by common parameter of S/W Package.(but the GM6 APM module has the internal Zone output)

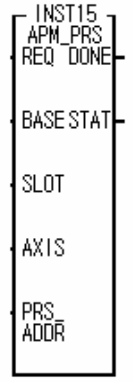
Function block type	Variable	Data type	Description
	ZONE _EN	BOOL	The internal Zone output/external Zonr output(Tr) permitt/prohibit setting •Setting range : 0 ~ 1 [0 : output prohibit, 1 : output permit] •The output status can be confirmed through Out1 ~ Out3.

7.10.2 M Code Off (M Code Off APM_MOF)

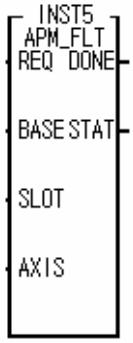
Function block type	Description
	In case that M code is set as With or After mode from parameter of each axis, this is used to make M code signal “OFF” when it is “ON”.

7.10.3 Preset (Preset APM_PRS)

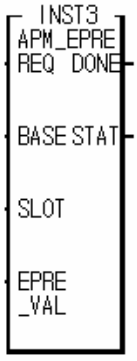
This is the command to change the current position with random position and if it is executed, the origin will be determined again.

Function block type	Variable	Data type	Description
	PRS_ ADDR	DINT	• Preset Setting range : -2147483648 ~ 2147483647

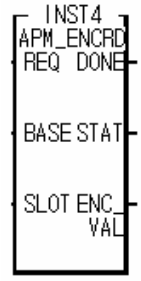
7.10.4 Floating Origin (Floating Point Set APM_FLT)

Function block type	Description
	This is the command to force to set the current position as the origin without carrying out the origin return action of machine and the setting address of origin return addres shall be the current position.

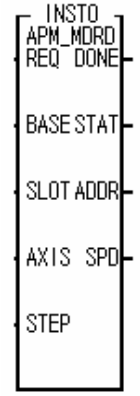
7.10.5 Encoder Preset (Encoder Preset APM_EPRE)

Function block type	Variable	Data type	Description
	EPRE _VAL	UDINT	• Encoder preset setting range : 0 ~ 4,294,967,295

7.10.6 Encoder Read (Encoder Read APM_ENCRD)

Function block type	Variable	Data Type	Description
	ENC_VAL	UDINT	• Encoder Read : 0 ~ 4,294,967,295

7.10.7 Operation Data Read (Move Data Read APM_MDRD)

Function block type	Variable	Data Type	Description
	STEP	UINT	Operation step no. setting for operation data read • setting range : 1 ~ 400 • If out of setting range, “Error 11” occurs.
	ADDR	DINT	• Teaching Positon Read : -2,147,483,648 ~ 2,147,483,647
	SPD	UDINT	• Teaching Speed Read : Open Collector : 1 ~ 200,000 [unit:pls/s] Line Drive : 1 ~ 1,0000,000 [unit:pls/s]

7.11 Function Block Error Code

Here describes the error types that are shown on output variable STAT and its solutions.

Error code	Error description	Output type		Module action	Solution
		Open	Line		
0	Normal action	O		Normal	
1	Position no. of Base exceeds the setting range.	O		Stop	Adjust the base position within the setting range
2	H/W error of the corresponding base	O		Stop	Ask the A/S for the base
3	Position no. of slot exceeds the setting range.	O		Stop	Adjust the slot position within the setting range.
4	The corresponding slot not installed	O		Stop	Install Positioning module to the corresponding slot.
5	The module name of the corresponding slot is different.	O		Stop	Install positioning module to the corresponding slot.
6	The setting axis no. exceeds the setting range.	O		Stop	Set the axis no. of positioning module correctly.
8	Common RAM error	O		H/W error occur	A/S asking
9	Function block command impossible as the module is in operation/stop	O		Error occur	Set the command condition correctly.
10	New command function block is executed before completing the previous command.	O		Error occur	Program change to execute new command after completing the previous command
11	The setting aux. Input value exceeds the setting range.	O		Stop	Adjust within the setting range.
13	During function block execution, the stop related command or emrgency stop is entered.	O		Error occur	1. Error initialization 2. Output prohibit Release

Here describes the error types and its solution that are shown on output variable ERR of APM_CRD function block. The more than Error code 101 is used to the GM4/GM6 and MASTER-K200S/300S.

Error code	Error description	Output type		Module action	Solution
		Open	Line		
101	Exceeds the range without acc./dec. Time of basic parameter	O		Stop	Asjust acc./dec.time within the setting range 0~ 65535.
101	Max. Speed of basic parameter exceeds the range.	O		Stop	Max.speed of basic parameter is more than 1 and less than 200000 for OpenCollector and more than 1 and less than 1000000 for Line Driver based on pulse unit.
102	Bias speed of basic parameter exceeds the range.	O		Stop	Bias speed of basic parameter should be smaller than max. Speed of basic parameter.
103	Pulse output mode of basic parameter exceeds the range.	O		Stop	Pulse output mode of basic parameter is 0:CW/CCW 1:Pulse/Dir 2:Phase A/B. Select one from these three modes.
111	Soft upper/lower limit of extended parameter exceeds the range.	O		Stop	S/W upper limit of extended parameter should be greater than or equal to S/W lower limit of extended parameter.
112	M code mode of extended parameter exceeds the range	O		Stop	M code output of extended parameter is 0:None 1:With 2:After. Select one from these three modes.
113	S-curve rate of extended parameter exceeds the range.	O		Stop	Modify the S-curve rate of extended parameter to be more than 1 and less than 100.
114	External command selection of extended parameter exceeds the range.	O		Stop	External command selection of extended parameter is 0:start 1:JOG command 2:SKIP. Select one from these three.
121	Jog high speed of manual operation parameter exceeds the range.	O		Stop	Set Jog high speed of manual operation parameter within the range greater or equal to bias speed of basic parameter and within the range smaller or equal to max. Speed of basic parameter.
122	Jog low speed of manual operation parameter exceeds the range.	O		Stop	Set Jog low speed of manual operation parameter within the range more than 1 and less than Jog high speed of manual operation parameter.
123	Inching speed of manual operation parameter exceeds the range.	O		Stop	Set the inching speed of manual operation parameter within the range greater than or equal to bias speed of manual operation parameter and within the rage smaller or equal to max. Speed of basic parameter.
131	Homing mode of homing parameter exceeds the range.	O		Stop	Homing method of homing parameter is 0:Dog/origin(Off) 1:Dog/origin(On) 2:high/low limit/origin 3:approximate origin 4: high speed origin. Select one from these.
132	Homing address of homing parameter exceeds the range.	O		Stop	Set the homing address of homing parameter as the value greater than S/W lower limit of extended parameter and smaller than S/W upper limit of extended parameter.
133	Homing high speed of homing parameter exceeds the range.	O		Stop	Set the homing high speed of homing parameter within the Range greater than or equal to bias speed of basic parameter and within the range smaller than or equal to max. Speed of basic parameter.
134	Homing low speed of homing parameter exceeds the range.	O		Stop	Set the homing low speed of homing parameter within the range greater than or equal to bias speed of basic parameter and within the range smaller or equal to homing high speed of homing parameter.
135	Homing dwell time of homing parameter exceeds the range.	O		Stop	Set the Dwell time of homing parameter as less than 50000.
141	Encoder Type of common parameter exceeds the range.	O		Stop	Set the encoder input signal of common parameter between 0 ~ 6..
142	Zone1 axis setting value of common parameter exceeds the range.	O		Stop	Zone1 axis setting of common parameter is 0:X 1:Y 2:Z 3: Encoder. Select one from these.
143	Zone2 axis setting value of common parameter exceeds the range.	O		Stop	Zone2 axis setting of common parameter is 0:X 1:Y 2:Z 3: Encoder. Select one from these.
144	Zone3 axis setting value of common parameter exceeds the range.	O		Stop	Zone3 axis setting of common parameter is 0:X 1:Y 2:Z 3: Encoder. Select one from these.
145	Pulse output level setting of common parameter exceeds the range.	O		Stop	Pulse output level of common parameter is 0:Low Active 1:High Active. Select one from these.
146	Zone output mode setting of common parameter exceeds the range.	O		Stop	Zone output mode of common parameter is 0: individual output 1:batch output (Zone1). Select one from these.
147	Circular interpolation method of common parameter exceeds the range.	O		Stop	Circular interpolation method of common parameter is 0: middle point 1: center point. Select one from these.
151	Operation speed of operation data can not be set as “0”.	O		Stop	Set the operation speed as the value greater than “0”.
152	Operation speed of operation data exceeds max. Speed.	O		Stop	Set the operation speed as the value smaller than or equal to max. Speed of basic parameter.
153	Operation speed of operation data is set as less than bias speed.	O		Stop	Set the operation speed as the value greater than or equa to bias speed of basic parameter.
154	Dwell time of operation data exceeds the range.	O		Stop	Set the Dwell time to operate as less than 50000.

Error code	Error description	Output type		Module action	Solution
		Open	Line		
155	End/Go-on/Continuous operation of operation data exceed the range.	O		Stop	Set operation pattern of operation data by selecting one from 0:End 1:Go-on 2: Continuous.
201	Homing command can not be used in operation status.	O		Move	Check if the command axis is in operation or not when giving the homing command.
202	Homing command can not be used in output prohibit satus.	O		Stop	Checkif the command axis is in output prohibit status or not when giving the homing command. Output prohibit is released by RST command as output prohibit release option.
203	Homing command can not be used in SERVO Ready OFF	O		Stop	Check if Driver ready signal of command axis is “OFF” when giving the homing command.
211	Floating origin command can not be used in opertion satus.	O		Move	Check if the command axis is in operation when giving the floating point setting command..
212	Floating origin command can not be used in SERVO Ready OFF.	O		Stop	Check if Driver ready signal of command axis is OFF when giving the floating point setting command.
221	Direct start command can not be used in operation status.	O		Move	Check if the command axis is in operation when giving direct start command.
222	Direct start command can not be used in output prohibit status.	O		Stop	Check if the command axis is in output prohibit status when giving direct start command. Output prohibit is released by RST command as output prohibit release option.
223	Direct start command can not be used in M Code ON.	O		Stop	Checkif M code signal of command axis is ON when giving direct start command. M code shall be OFF by MOF command.
224	Direct start command can not be used in the absolute coordinate of origin unsettled status.	O		Stop	Not available to carry out Absolute coordinate operation in origin unsettled status. Check the coordinate of operation data to operate and the current origin determination status. After setting the origin by homing command or floating point setting command, it is available to carry out the Absolute coordinate operation.
225	Direct start command can not be used in SERVO Ready OFF.	O		Stop	Check if Driver ready signal of command axis is OFF when giving direct start command.
231	Indirect start command can not be used in operation status.	O		Move	Check if the command axis is in operation status when giving indirect start command.
232	Indirect start command can not be used in output prohibit status.	O		Stop	Check if the command axis is in output prohibit status when giving indirect start command. Output prohibit shall be released by RST command as output prohibit release option.
233	Indirect start command can not be used in M Code ON.	O		Stop	Check if M code signal of command axis is ON when giving indirect start command. M code shall be OFF by MOF command.
234	Indirect start command can not be used in the absolute coordinate of origin unsettled status.	O		Stop	Not available to carry out Absolute coordinate operation in origin unsettled status. Check the step coordinate to operate and the current origin determination status. After setting the origin by homing command or floating point setting command, it is available to carry out the Absolute coordinate operation
235	Indirect start command can not be used in SERVO Ready OFF.	O		Stop	Check if Driver ready signal of command axis is OFF when giving indirect start command.
236	Continuous operation of indirect start can not be used with speed control.	O		Stop	Check if the control method is set as speed control during Continuous operationof position control from operation data and there is the step set by Continuous operation as operation pattern.
237	The step no. of Point control is not permitted to exceed 20.	O		Stop	Set the step no. to carry out Point control less than 20.
238	Continuous operation of indirect start can not be carried out for S-Curve Acceleration/Deceleration pattern.	0		Stop	Check if the acceleration/deceleration pattern of extended parameter of command axis is S-Curve.
241	Linear interpolation start can not be used in case that the main axis of linear interpolation is in operation.	O		Move	Check if the main axis is in operation status when giving linear interpolation command.
242	Linear interpolation start can not be used in case that the subordinate axis 1 of linear interpolation is in operation.	O		Move	Check if the subordinate axis 1 is in operation status when giving linear interpolation command.
243	Linear interpolation start can not be used in case that the subordinate axis 2 of linear interpolation is in operation.	O		Move	Check if the subordinate axis 2 is in operation status when giving linear interpolation command.
244	Linear interpolation start can not be used in case that the main axis of linear interpolation is in output prohibit status.	O		Stop	Check if the main axis is in output prohibit status when giving linear interpolation command. Output prohibit shall be released by RST command as output prohibit release option.

Error code	Error description	Output type		Module action	solutions
		Open	Line		
245	Not available to carry out the linear interpolation start when Linear interpolatin subordinate axis 1 is in output prohibit status.	O		Stop	Check if subordinate axis 1 is in output prohibit status when giving linear interpolation command. Output prohibit shall be released by RST command as output prohibit release option.
246	Not available to carry out the linear interpolation start when Linear interpolation subordinate axis 2 is in output prohibit status.	O		Stop	Check if subordinate axis 2 is in output prohibit status when giving linear interpolation command. Output prohibit shall be released by RST command as output prohibit release option.
247	Not available to carry the linear interpolation start when M code signal of linear interpolation main axis is “ON”.	O		Stop	Check if M code signal of main axis is “ON” when giving linear interpolation command. M code shall OFF by MOF command.
248	Not available to carry the linear interpolation start when M code signal of linear interpolation subordinate axis 2 is “ON”.	O		Stop	Check if M code signal of subordinate axis 1 is “ON” when giving linear interpolation command. M code shall OFF by MOF command.
249	Not available to carry the linear interpolation start when M code signal of linear interpolation subordinate axis 3 is “ON”.	O		Stop	Check if M code signal of subordinate axis 2 is “ON” when giving linear interpolation command. M code shall OFF by MOF command.
250	Not available to carry out the absolute coordinate positioning operation when linear interpolatin main axis is in origin unsettled status.	O		Stop	Not available to carry out Absolute coordinate operation in origin unsettled status. Check the step coordinate to operate and the current origin determination status. After setting the origin by homing command or floating point setting command, it is available to carry out the Absolute coordinate operation.
251	Not available to carry out the absolute coordinate positioning operation when linear interpolatin subordinate axis 1 is in origin unsettled status.	O		Stop	Not available to carry out Absolute coordinate operation in origin unsettled status. Check the step coordinate to operate and the current origin determination status. After setting the origin by homing command or floating point setting command, it is available to carry out the Absolute coordinate operation
252	Not available to carry out the absolute coordinate positioning operation when linear interpolatin subordinate axis 2 is in origin unsettled status.	O		Stop	Not available to carry out Absolute coordinate operation in origin unsettled status. Check the step coordinate to operate and the current origin determination status. After setting the origin by homing command or floating point setting command, it is available to carry out the Absolute coordinate operation.
253	In case that the main axis and subordinate axis of linear interpolation is set wrong (the subordinate axis is not set or only one axis is set or the axis is not set).	O		Stop	Check if there is the case that subordinate axis is not set or only one axis is set or the axis or the axis is not set when giving linear interpolation command.
254	Not available to carry out the operation as SERVO ready is OFF at the linear interpolation main axis.	O		Stop	Check if Driver ready signal of main axis is OFF when giving linear interpolation command.
255	Not available to carry out the operation as SERVO ready is OFF at the linear interpolation subordinate axis 1.	O		Stop	Check if Driver ready signal of subordinate axis 1 is OFF when giving linear interpolation command.
256	Not available to carry out the operation as SERVO ready is OFF at the linear interpolation subordinate axis 2.	O		Stop	Check if Driver ready signal of subordinate axis 2 is OFF when giving linear interpolation command.
257	Not available to carry out the linear interpolation in case that there is no goal position of the main axis.	O		Stop	Check if the goal position of operation data of linear interpolation step to carry out the linear interpolation is same as the current position in case of absolute coordinate and it is set as “0” in case of relative orrdinate.
258	Not available to carry out the linear interpolation when the main axis is speed control.	O		Stop	Check if the control method of main axis operation data step to carry out the linear interpolation operation is set as speed control.
259	Not available to carry out the linear interpolation when the subordinate axis 1 is speed control.	O		Stop	Check if the control method of subordinate axis 1 operation data step to carry out the linear interpolation operation is set as speed control.
260	Not available to carry out the linear interpolation when the subordinate axis 2 is speed control.	O		Stop	Check if the control method of subordinate axis 2 operation data step to carry out the linear interpolation operation is set as speed control.
271	Not available to carry out the circular interpolation start when the circular interpolation main axis is in operation.	O		Move	Check if the main axis is operation status when giving circular interpolation command.
272	Not available to carry out the circular interpolation start when circular interpolation subordinate axis is in operatiob.	O		Move	Check if the subordinate axis is operation status when giving circular interpolation command.
273	Not available to carry out the circular interpolation start when circular interpolation main asix is in output prohibit status.	O		Stop	Check if the main axis is in output prohibit status when giving circular interpolation command. Output prohibit shall be released by RST command as output prohibit release option..

Error code	Error description	Output type		Module action	Solutions
		Open	Line		
274	Not available to carry out circular interpolation start when circular interpolation subordinate axis is in output prohibit status.	O		Stop	Check if the subordinate axis is in output prohibit status when giving the circular interpolation command. Output prohibit shall be released by RST command as output prohibit release option.
275	Not available to carry out circular interpolation start when M code signal of circular interpolation main axis is ON.	O		Stop	Check if M code signal of main axis is ON when giving the circular interpolation command. M code shall be OFF by MOF command.
276	Not available to carry out circular interpolation start when M code signal of circular interpolation subordinate axis is ON.	O		Stop	Check if M code signal of subordinate axis is ON when giving the circular interpolation command. M code shall be OFF by MOF command..
277	Not available to carry out absolute coordinate positioning operation when circular interpolation main axis is in origin unsettled status.	O		Stop	Not available to carry out Absolute coordinate operation in origin unsettled status. Check the step coordinate to operate and the current origin determination status. After setting the origin by homing command or floating point setting command, it is available to carry out the Absolute coordinate operation..
278	Not available to carry out absolute coordinate positioning operation when circular interpolation subordinate axis is in origin unsettled status.	O		Stop	Not available to carry out Absolute coordinate operation in origin unsettled status. Check the step coordinate to operate and the current origin determination status. After setting the origin by homing command or floating point setting command, it is available to carry out the Absolute coordinate operation.
279	Not available to carry out the operation as the main axis and subordinate axis is set as equally during circular interpolation.	O		Stop	Check the setting of main axis and subordinate axis of circular interpolation command.
280	Not available to carry out the operation as SERVO ready is OFF at the circular interpolation main axis.	O		Stop	Check if Driver ready signal of main axis is OFF when giving circular interpolation command.
281	Not available to carry out the operation as SERVO ready is OFF at the circular interpolation subordinate axis.	O		Stop	Check if Driver ready signal of subordinate axis is OFF when giving circular interpolation command.
282/ 283	Not available to carry out Degree operation in the circular interpolation.	O		Stop	Check if the unit of basic parameter of circular interpolation command main axis is set as Degree.
284	Not available to carry out the operatin if start point = center point (middle point) or center point(middle point) = End point in the circular interpolation.	O		Stop	Check if center point or middle point is set as the same position of starting point or ending point in the circular interpolation.
285	The start point is not equal with end point in the middle point method of the circular interpolation.	O		Stop	Check if the circular interpolation method of common parameter is set by middle point and the starting point is same as the ending point.
286	Radius setting error in the circular interpolation.	O		Stop	The radius of circle available to carry out the circular interpolation operation is upto 2e31 pulse. Check if it is available to carry out the circular interpolation by the radius greater than that size.
287	Not available to carry out the operation as the linear profile comes from circular interpolation.	O		Stop	Check if the circular interpolation method of common parameter is set by middle point and the middle point is set by linear array with starting point and ending point.
288	The radius of circular interpolation should be greater than Backlash.	O		Stop	The radius of circle to carry out the circular interpolation operation should be greater than Backlash compensation amount set in the extended parameter of main axis and subordinate axis. Check the setting value.
291	Not available to carry out the synchronous start command in the operation status.	O		Move	Check if the axis that error occurred is included in the synchronous start command and there is the axis in operation when giving the synchronous start comand.
292	Not available to carry out the synchronous start command in the output prohibit status.	O		Stop	Check if the axis that error occurred is included in the synchronous start command and it is in output prohibit status when giving the synchronous start command. Output prohibit shall be released by RST command as output prohibit release option.
293	Not available to carry out the synchronous start command in M code ON status.	O		Stop	Check if the axis that error occurred is included in the synchronous start command and M Code signal is ON when giving the synchronous start command. M code shall be OFF by MOFcommand.
294	Not available to carry out the synchronous start command in case that there is no goal position.	O		Stop	Check if the axis that error occurred is included in the synchronous start command and the goal position of operation data step to operate is the same as the current position in case of Absolute coordinate and it is set as “0” in case of Relative coordinate.
295	Not available to carry out the synchronous start command in SERVO ready when SERVO ready is OFF.	O		Stop	Check if the axis that error occurred is included in the synchronous start command and Driver ready signal is OFF when giving the synchronous start command.

Error code	Error description	Output type		Module action	Solutions
		Open	Line		
296	The axis setting of synchronous start command is wrong.	O		Stop	Check if the axis setting of synchronous start command is set by one axis. The axis setting address means no.0 bit: X, no.1 bit: Y, no.2bit: Z and each bit is set as “1”.
301	Not available to carry out speed/position control switching command not in operation status.	O		Stop	Check if the axis is in stop status when giving speed/position control switching command.
302	Not available to carry out speed/position control switching command not in the speed control status.	O		Stop	Check if the axis is in speed control status when giving speed/position control switching command.
303	Not available to carry out speed/position control switching command in the subordinate axis of synchronous operation.	O		Stop	Check if the axis is in operation status to the subordinate axis of synchronous operation when giving speed/position control switching command.
304	Not available to carry out speed/position control switching command in case that there is no goal position.	O		Stop	Check if the operation has the position amount when giving speed/position control switching command.
311	Not available to carry out speed/position control switching command not in the operation status.	O		Stop	Check if the axis is in stop status when giving speed/position control switching command
312	Not available to carry out speed/position control switching command in the subordinate axis of synchronous operation.	O		Stop	Check if the axis is in operation status to the subordinate axis of synchronous operation when giving speed/position control switching command.
313	Not available to carry out speed/position control switching command in the circular interpolation operation.	O		Stop	Check if the axis is in circular interpolation operation when giving speed/position control switching command.
314	Not available to carry out speed/position control switching command in the linear interpolation operation.	O		Move	Check if the axis is in linear interpolation operation when giving speed/position control switching command.
321	Not available to carry out deceleration stop command not in the operation status.	O		Stop	Not available to carry out deceleration stop command not In the operation status.
322	Not available to carry out deceleration stop command in Jog operation status.	O		Move	Not available to carry out deceleration stop command in Jog operation status.
323	Not available to carry out deceleration stop command in the axis of manual pulse generator operation.	O		Move	Check if the axis is in manual pulse generator operation when giving deceleration stop command.
331	Not available to carry out Skip command not in the operation status.	O		Stop	Check if the axis is in stop status when giving Skip command.
332	Not available to carry out Skip command in the axis of linear interpolation operation.	O		Move	Check if the axis is in operation to the linear interpolation subordinate axis when giving Skip command.
333	Not available to carry out Skip command in the subordinate axis of synchronous operation.	O		Move	Check if the axis is in operation to the synchronous operation subordinate axis when giving Skip command.
334	Not available to carry out Skip command in the axis of manual pulse generator operation.	O		Move	Check if the axis is in manual pulse generator operation status when giving Skip command Skip.
335	Not available to carry out Skip command in the Jog operation status.	O		Move	Check if the axis is in jog operation status when giving Skip command.
336	Not available to carry out Skip command in the direct start operation status.	O		Move	Check if the axis is in direct start operation status when giving Skip command.
337	Not available to carry out Skip command in the inching operation status.	O		Move	Check if the axis is in inching operation status when giving Skip command.
338	Not available to carry out Skip command in the subordinate axis of circular interpolation operation.	O		Move	Check if the axis is in operation to the circular interpolation subordinate axis when giving Skip command.
341	Not available to carry position synchronous start command in the operation status.	O		Move	Check if the axis is in operation status when giving position synchronous start command.
342	Not available to carry position synchronous start command in the output prohibit status.	O		Stop	Check if the axis is in output prohibit status when giving position synchronous start command. Output prohibit shall be released by RST command as output prohibit release option.
343	Not available to carry position synchronous start command in the M code “ON” status.	O		Stop	Check if the M code signal of the axis is ON when giving position synchronous start command. M code shall be OFF by MOF command.
344	Not available to carry position synchronous start command in the absolute coordinate of origin unsettled status.	O		Stop	Not available to carry out Absolute coordinate operation in origin unsettled status. Check the step coordinate to operate and the current origin determination status. After setting the origin by homing command or floating point setting command, it is available to carry out the Absolute coordinate operation.
345	Not available to carry position synchronous start command in the SERVO ready OFF status.	O		Stop	Check if Driver ready signal of the axis is OFF when giving the synchronous start command.
346	Not available to carry out position synchronous start command in the origin unsettled status of main axis.	O		Stop	Checi if the main axis is in the origin unsettled status when giving position synchronous start command.
347	Error in setting the main axis and subordinate axis of position synchronous start command.	O		Stop	Check if the main axis of position synchronous start command is set as same as the command axis. The main axis is set by the setting address 0 (X),1(Y),2(Z).

Error code	Error description	Output type		Module action	solutions
		Open	Line		
348	Not available to carry out position synchronous start command in the speed control of the main axis with no position indication.	O		Stop	Check if the main axis is set as “no indication” from position indication during equal speed operation of extended parameter when giving position synchronous start command and carried out speed control operation.
351	Not available to carry out speed synchronous start command in operation status.	O		Move	Check if the axis is in the operation status(busy) when giving speed synchronous start command.
352	Not available to carry out speed synchronous start command in output prohibit status.	O		Stop	Check if the axis is in the output prohibit status when giving speed synchronous start command. Output prohibit shall be released by RST command as output prohibit release option.
353	Not available to carry out speed synchronous start command in M Code ON status.	O		Stop	Check if M code of he axis is ON when giving speed synchronous start command. M code shall be OFF by MOF command.
354	Not available to carry out speed synchronous start command in SERVO ready OFF.	O		Stop	Check if Driver ready signal of the axis is OFF when giving speed synchronous start command.
355	Error in setting the main axis/subordinate axis of speed synchronous start command.	O		Stop	Check if the main axis of speed synchronous start command is set as same as the command axis. The main axis is set by the setting address 0(X),1(Y),2(Z).
356	Error in setting the main axis/subordinate axis rate of speed synchronous start command.	O		Stop	The main axis rate of speed synchronous start command should be greater than or equal to the subordinate axis rate. check the main axis ratio/subordinate axis ratio setting.
357	Not available to carry out speed synchronous start command in the specific pulse mode.	O		Stop	The speed synchronous start command may not be carried out according to the pulse output mode set by basic parameter of the main axis and the combination of pulse output mode set by basic parameter of the subordinate axis.
361	Not available to carry out position override command not in the operation status (busy).	O		Stop	Check if the axis is in stop status when giving the position override command.
362	Not available to carry out position override command in dwell status.	O		Stop	Check if the axis is in dwell status when giving the position override command.
363	Not available to carry out position override command not in the positioning operation status.	O		Move	Check if the axis is in position control operation status when giving the position override command.
364	Not available to carry out position override command in the axis of linear interpolation operation.	O		Move	Check if the axis is in linear interpolation operation status when giving the position override command.
365	Not available to carry out position override command in the axis of circular interpolation operation.	O		Move	Check if the axis is in circular interpolation operation status when giving the position override command.
366	Not available to carry out position override command in the subordinate axis of synchronous start opeation.	O		Move	Check if the axis is in operation status to the subordinate axis of synchronous start operation when giving the position override command.
367	Not available to carry out position override command in the axis of manual pulse generator operation.	O		Move	Check if the axis is in manual pulse generator operation when giving the position override command.
371	Not available to carry out speed override command not in the operation status (Busy).	O		Stop	Check if the axis is in stop status when giving the speed override command.
372	Speed override exceeds the range.	O		Stop	The speed of speed override command should be smaller than or equal to max. Speed set by basic parameter. Check the speed value.
373	Not available to carry out speed override command in the subordinate axis of linear interpolation operation.	O		Move	Check if the axis is in operation to the linear interpolation subordinate axis when giving the speed override command.
374	Not available to carry out speed override command in the axis of circular interpolation operation.	O		Move	Check if the axis is in operation to the circular interpolation subordinate axis when giving the speed override command.
375	Not available to carry out speed override command in the subordinate axis of synchronous start operation.	O		Move	Check if the axis is in operation to the synchronous start operation subordinate axis when giving the speed override command.
376	Not available to carry out speed override command in the axis of manual pulse generator operation.	O		Move	Check if the axis is in manual pulse generator operation when giving the speed override command.
377	Not available to carry out speed override command in the deceleration section.	O		Move	Check if the axis is in the deceleration stop status when giving speed override command.
378	Not available to carry out speed override command in the acceleration/deceleration pattern.	O		Move	Check if acceleration/deceleration pattern of extended parameter of command axis is S-Curve.
381	Not available to carry out random position speed override command not in the operation status(busy).	O		Stop	Check if the axis is in stop status when giving the random position speed override command.
382	Not available to carry out random position speed override command not in the positioning operation.	O		Stop	Check if the axis is in speed control operation when giving the random position speed override command.
383	The speed override value of random position exceeds the range of speed override command.	O		Stop	The speed of random position speed override commandshould be smaller than or equal to max. speed set by basic parameter. Check the speed.
384	Not available to carry out random position speed override command in the subordinate axis of linear interpolation operation.	O		Move	Check if the axis is in operation to the subordinate axis of linear interpolation when giving the random position speed override command.

Error code	Error description	Output type		Module action	solutions
		Open	Line		
385	Not available to carry out random position speed override command in the axis of circular interpolation operation.	O		Move	Check if the axis is in circular interpolation operation when giving the random position speed override command.
386	Not available to carry out random position speed override command in the subordinate axis of synchronous start operation.	O		Move	Check if the axis is in operation to the subordinate axis of synchronous start operation when giving the random position speed override command.
387	Not available to carry out random position speed override command in the axis of manual pulse generator operation.	O		Move	Check if the axis is in manual pulse generator operation when giving the random position speed override command.
388	Not available to carry out random position speed override command in the SERVO ready OFF.	O		Stop	Check if Driver ready signal of the axis is OFF when giving the random position speed override command.
389	Not available to carry out random position speed override command in the S-curve acceleration/deceleration pattern	O		Stop	Check if acceleration/deceleration pattern of extended parameter of command axis is S-Curve.
390	Not available to carry out Continuous operation command in the S-curve acceleration/deceleration pattern.	O		Stop	Check if acceleration/deceleration pattern of extended parameter of command axis is S-Curve.
391	Not available to carry out Continuous operation command not in the operation status.	O		Stop	Check if the axis is in stop status when giving Continuous operation command.
392	Not available to carry out Continuous operation command not in the dwell status.	O		Stop	Check if the axis is in dwell when giving Continuous operation command.
393	Not available to carry out Continuous operation command not in the positioning operation status.	O		Stop	Check if the axis is in speed control operation when giving continuous operation command.
394	Speed data of Continuous operation command exceeds the allowable range.	O		Stop	The speed of next step should be smaller than or equal to max. speed set by basic parameter or more than 0 when giving Continuous operation command. Check the speed.
395	Not available to carry out Continuous operation command in the subordinate axis of linear interpolation operation.	O		Stop	Check if the axis is in operation to the subordinate axis of linear interpolation when giving Continuous operation command.
396	Not available to carry out Continuous operation command in the axis of circular interpolation operation.	O		Stop	Check if the axis is in circular interpolation operation when giving Continuous operation command.
397	Not available to carry out Continuous operation command in the subordinate axis of synchronous start operation.	O		Move	Check if the axis is in operation to the subordinate axis of synchronous start operation when giving Continuous operation command.
398	Not available to carry out Continuous operation command in the axis of manual pulse generator operation.	O		Move	Check if the axis is in manual pulse generator operation when giving Continuous operation command.
399	Not available to carry out Continuous operation command in the last step of operation data.	O		Move	Check if the axis is in operation of 400th step when giving continuous operation command.
400	Not available to carry out Continuous operation command in the direct start operation.	O		Move	Check if the axis is in operation by direct start command when giving Continuous operation command
401	Not available to carry out Inching command in the operation status.	O		Move	Check if the axis is in operation when giving inching command.
402	Not available to carry out Inching command in the output prohibit status.	O		Stop	Check if the axis is in output prohibit status when giving inching command. Output prohibit shall be released by RST command as output prohibit release option.
403	Not available to carry out Indirect start command in the SERVO ready OFF status.	O		Stop	Check if Driver ready signal of the axis is OFF when giving inching command.
411	Not available to carry out Jog command in the operation status.	O		Move	Check if the axis is in operation when giving Jog start command.
412	Not available to carry out Jog command in the output prohibit status.	O		Stop	Check if the axis is in output prohibit status when giving Jog start command. Output prohibit shall be released by RST command as output prohibit release option.
413	Not available to carry out Jog start command when SERVOready OFF.	O		Stop	Check if Driver ready signal of the axis is OFF when giving Jog start command.
421	Not available to carry out manual pulse generator operationin operation status.	O		Move	Check if the axis is in operation when giving manual pulse generator operation command.
422	Not available to carry out manual pulse generator operation in output prohibit status.	O		Stop	Check if the axis is in output prohibit status when giving manual pulse generator operation command. Output prohibit shall be released by RST command as output prohibit release option.
423	Not available to carry out manual pulse generator operation when SERVO rady OFF.	O		Stop	Check if Driver signal of the axis is OFF when giving manual pulse generator operation command.
424	Not available to carry out manual pulse generator operation in the setting pulse mode.	O		Move	Manual pulse generator operation command may not be carried out according to encoder input signal set by common parameter and the combination of pulse output mode set by basic parameter of command axis.
431	Not available to carry out automatic operation point return command in operation status.	O		Move	Check if the axis is in operation when giving automatic operation point return command.
432	Not available to carry out automatic operation point return command in output prohibit status.	O		Stop	Check if the axis is in output prohibit status when giving automatic operation point return command. Output prohibit shall be released by RST command as output prohibit release option.
433	Not available to carry out indirect start command when SERVO ready OFF.	O		Stop	Check if Driver ready signal of the axis is OFF when giving automatic operation point return command

Error code	Error description	Output type		Module action	Solutions
		Open	Line		
441	Not available to carry out start step no. change/repeat operation start step no. setting command in operation status.	O		Move	Check if the axis is in operation when giving start step no. change command.
442	The step of start ste no. change/repeat operation start step no. setting command exceeds the setting range.	O		Stop	Check if the setting step no. of start step no. change command or repeat operation start step no. setting command is in the range greater than or equalto 1 and smaller than or equal to 400.
451	Not available to carry out the current position preset command in operation status.	O		Move	Check if the axis is in operation when giving the current position preset command.
452	The aux. Position data is not allowed to exceed Soft upper/lower limit when giving the current position preset command.	O		Stop	Check if the position of the current position preset command is in the range of Soft upper/lower limit set by extended parameter.
461	Not available to carry out position teaching command in operation status.	O		Move	Check if the axis is in operation when giving position teaching command.
462	Not available to carry out teaching array command for the data over 16.	O		-	Check if the data no. of teaching array command is setin the range greater than or equal to 1 and smaller than or equal to 16.
463	Not available to carry out speed teaching command in operation status.	O		Move	Check if the axis is in operation when giving speed teaching command.
464	The speed of speed teaching command exceeds the setting range.	O		Stop	Check if the speed data of speed teaching command is set as greater than 1000000.
465	Error in setting step no. to carry out teaching command.	O		Stop	Check if the step to carry out teaching command is greater than or equal to 1 and smaller than or equal to 400.
471	Not available to carry out parameter teaching command in operation status.	O		Stop	Check if the axis is in operation when giving parameter teaching command.
472	Not available to carry out operation data teaching command in operation status.	O		Move	Check if the axis is in operation when giving operation data teaching command.
481	Internal emergency stop error	O		Stop	Clear the error by removing emergency stop cause and carrying out RST command. Output prohbit shall be released by RST command as output prohbit release option.
491	External emergency stop error	O		Stop	Clear the error by removing emergency stop cause and carrying out RST command. Output prohbit shall be released by RST command as output prohbit release option.
492	H/w upper limit error	O		Stop	Get rid of the external upper limit signal range by Jog command and then carry out RST command and clear the error. Output prohibit shall be released by RST command as output prohibit release option.
493	H/W lower limit error	O		Stop	Get rid of the external lower limit signal range by Jog command and then carry out RST command and clear the error. Output prohibit shall be released by RST command as output prohibit release option.
494	SERVO driver operation is not available.	O		Stop	Check if Driver ready signal is entered correctly. You can check it by external I/O signal window in the monitoring of Software Package and also by reading no.1 bit of SRD function block ST7 or no.9 bit of external I/O signal address.
495	The position of Upper/lower limit detection Sensor has been changed.	O		Stop	Install the upper limit detection sensor in the direction that the current position increases and the lower limit detection sensor in the direction that the current position decreases.
501	S/W upper limit error	O		Stop	Get rid of S/W upper limit signal range by Jog command and then carry out RST command and clear the error. Output prohibit shall be released by RST command as output prohibit release option.
502	S/W lower limit error	O		Stop	Get rid of S/W lower limit signal range by Jog command and then carry out RST command and clear the error. Output prohibit shall be released by RST command as output prohibit release option.
511	Command code no. is not the reserved no. (only for MASTER-K)	O		Stop	Command code is reserved from 1 ~ 38.
512	Aux. Data step no. exceeds the allowable range.	O		Stop	The step greater than 400 was set to the command. Please re-set the step no. within the range from 1 ~ 400.

*1: Error code 495 is deleted in more than O/S V2.1.

Chapter 8 MK Internal Memory and I/O Signal

8.1 Internal Memory

- ▶ Here describes internal memory for MASTER-K200S/300S.
- ▶ Internal memory saves positioning module and data for sending/receiving between PLC CPU.
- ▶ Parameter and operation data setting of internal memory should be set in the assigned address of internal memory. (PUT, PUTP command)
- ▶ In case of parameter and operation data setting, the basic unit is speed : 1pps, time : 1 ㎳.

8.1.1 Basic Parameter

1) **Contents of Basic Parameter**

Address			Basic Parameter	Setting range
X	Y	Z		
0	4400	8800	Speed limit (lower)	㎜ : 1 ~ 2,000,000,000[X10^{-2}㎜/m], Inch : 1 ~ 2,000,000,000[X10^{-3}Inch/m], degree : 1 ~ 2,000,000,000[X10^{-3} degree/m], pulse : 1 ~ 1,000,000[pulse/s]
1	4401	8801	Speed limit (upper)	
2	4402	8802	Bias speed (lower)	
3	4403	8803	Bias speed (upper)	
4	4404	8804	Acceleration/Deceleration time No.1(㎳)	0 ~ 65,535
5	4405	8805	Acceleration/Deceleration time No.2(㎳)	
6	4406	8806	Acceleration/Deceleration time No.3(㎳)	
7	4407	8807	Acceleration/Deceleration time No.4(㎳)	
8	4408	8808	Pulse number per Rotation	1 ~ 65,535
9	4409	8809	Travel distance per Rotation	
10	4410	8810	Pulse output mode (bit 0 ~ 1)	0:CW/CCW, 1:PULSE/DIR, 2:PHASE
			Unit (bit 2 ~ 3)	0:Pulse, 1:mm, 2:Inch, 3:Degree
			Unit magnification (bit 4 ~ 5)	0: x 1, 1: x 10, 2: x 100, 3: x 1000

2) Basic Parameter Setting

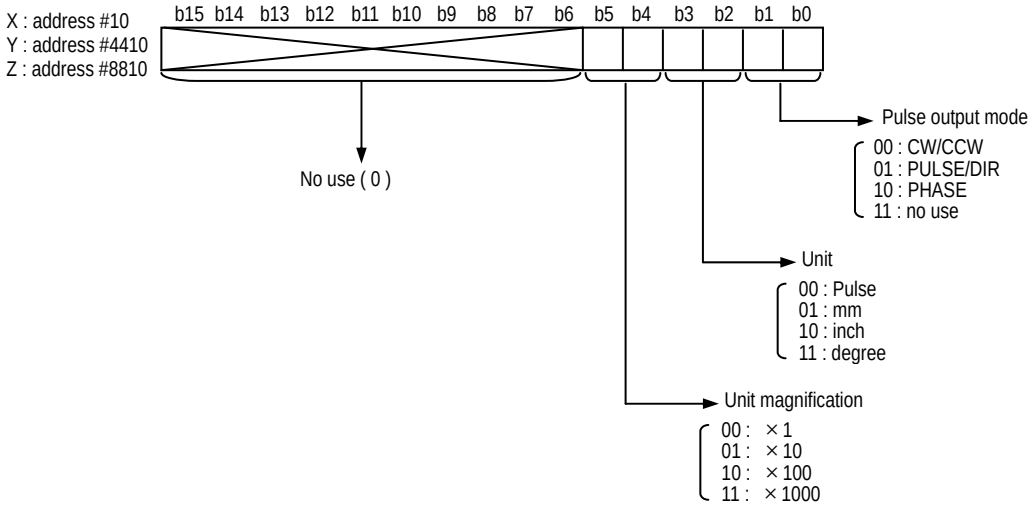
(1) The setting range of speed limit and bias speed is 1 ~ 200,000 (G4/6F-PP1/2/3O), 1 ~ 1,000,000(G4/6F-PP1/2/3D). (in case of using pulse unit)

(2) Travel distance per Rotation

This is used only for mm, inch, degree unit and the actual setting range is 1 ~ 65,535.

Setting range	mm	Inch	degree
Travel distance in setting	0.1 ~ 65,535 um	0.00001 ~ 0.65535 inch	0.00001 ~ 0.65535 degree

(3) Control words of Basic Parameter



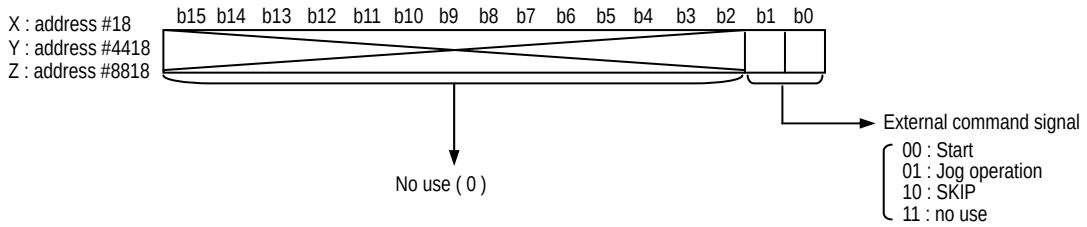
8.1.2 Extended Parameter

1) **Contents of Extended Parameter**

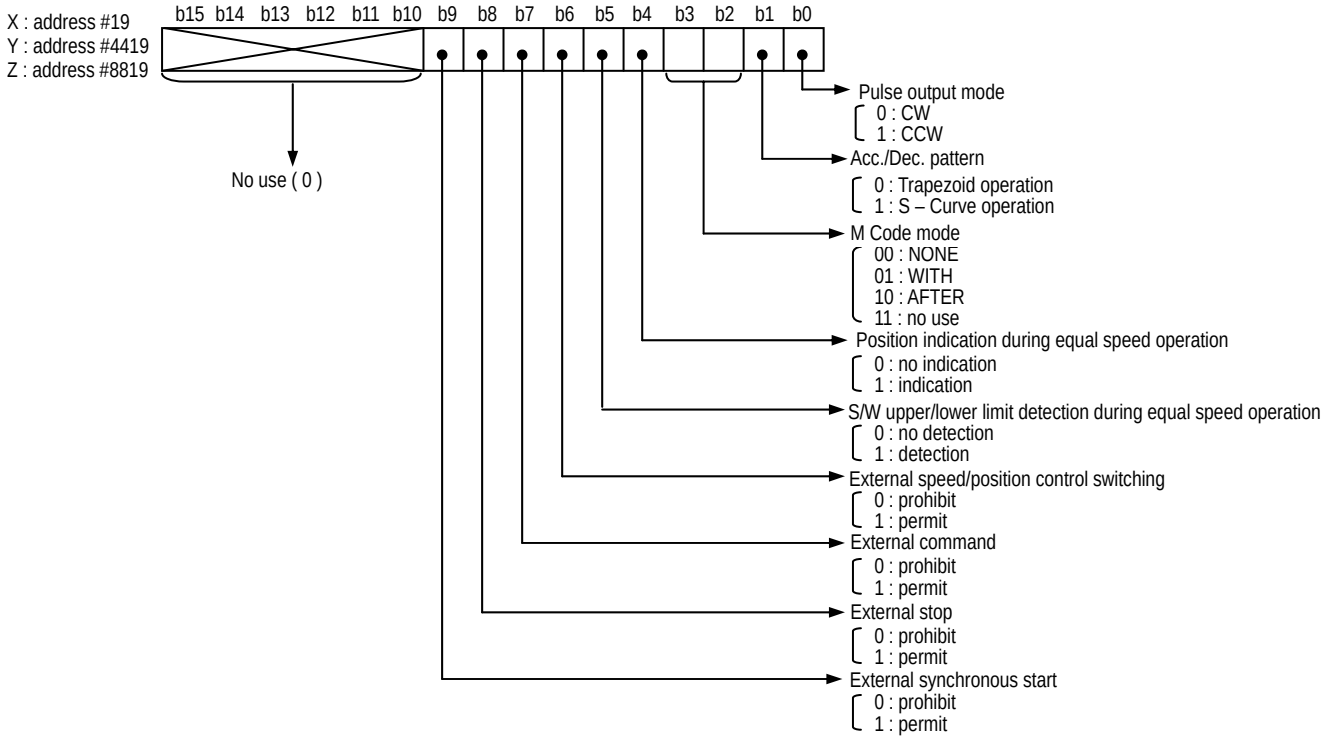
Address			Extended Parameter	Setting range
X	Y	Z		
11	4411	8811	S/W upper limit (lower)	mm : -2147483648 ~ 2147483647 [X10^{-4}mm], Inch : -2147483648 ~ 2147483647 [X10^{-5}Inch], degree : -2147483648 ~ 2147483647 [X10^{-5}degree], pulse : -2147483648 ~ 2147483647 [pulse]
12	4412	8812	S/W upper limit (upper)	
13	4413	8813	S/W lower limit (lower)	
14	4414	8814	S/W lower limit (upper)	
15	4415	8815	Backlash compensation amount	0 ~ 65,535
16	4416	8816	Positioning end signal output time (ms)	
17	4417	8817	S-Curve rate(%)	1 ~ 100
18	4418	8818	External command signal selection	0:Start, 1:Jog operation, 2:SKIP
19	4419	8819	Pulse output direction (bit 0)	0:CW, 1:CCW
			Acceleration/Deceleration pattern (bit 1)	0:Trapezoid operation, 1:S-Curve operation
			M Code mode (bit 2 ~ 3)	0:NONE, 1:WITH, 2:AFTER
			Position indication during equal speed operation (bit 4)	0:no indication, 1:indication
			S/W upper/lower limit during equal speed operation detection (bit 5)	0:no detection, 1:detection
			External speed/position control switching permit/ Prohibit (bit 6)	0:prohibit, 1:permit
			External command permit/prohibit (bit 7)	
			External stop permit/prohibit (bit 8)	
			External synchronous start permit/prohibit (bit 9)	

2) **Extended Parameter Setting**

(1) External Command Signal Selection



(2) Control Words of Extended Parameter



8.1.3 Manual Operation Parameter

1) Contents of Manual Operation Parameter

Address			Manual Operation Parameter	Setting range
X	Y	Z		
20	4420	8820	Jog high speed (lower)	mm : 1 ~ 2,000,000,000[X10^{-2}mm/m], Inch : 1 ~ 2,000,000,000[X10^{-3}Inch/m], degree : 1 ~ 2,000,000,000[X10^{-3} degree/m], pulse : 1 ~ 1,000,000[pulse/s]
21	4421	8821	Jog high speed (upper)	
22	4422	8822	Jog low speed (lower)	
23	4423	8823	Jog low speed (upper)	
24	4424	8824	Jog acceleration/deceleration time (ms)	0 ~ 65,535
25	4425	8825	Inching speed (pps)	mm : 1 ~ 65535[X10^{-2}mm/min], Inch : 1 ~ 65535[X10^{-3}Inch/min], Degree : 1 ~ 65535[X10^{-3} degree/min], Pulse : 1 ~ 65535[pulse/sec]

2) Manual Operation Parameter Setting

(1) Speed setting range of Jog high/low speed (in case of using pulse unit) : 1 ~ 200,000(G4/6F-PP1/2/3O), 1 ~ 1,000,000(G4/6F-PP1/2/3D)

(2) If Jog acceleration/deceleration time is set as “0”, it carries out Jog acceleration/deceleration operation by the acceleration/deceleration time No.1 set in the basic parameter.

8.1.4 Homing Parameter

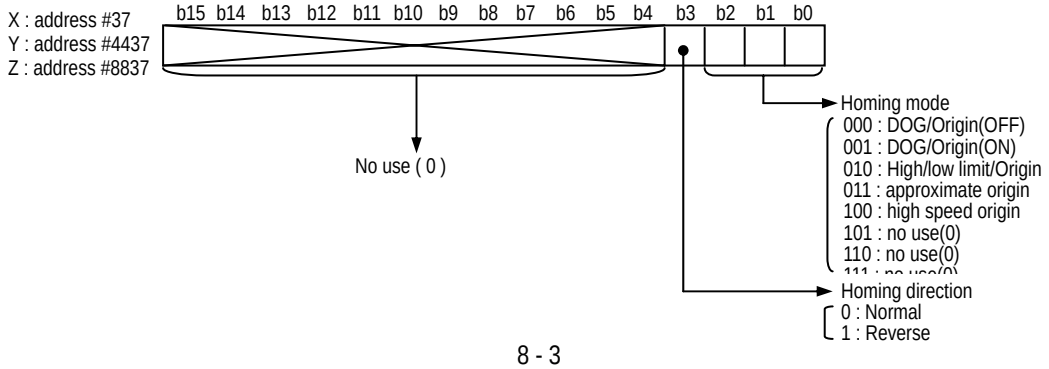
1) Contents of Homing Parameter

Address			Detailed description	Setting range
X	Y	Z		
26	4426	8826	Origin address (lower)	mm : -2147483648 ~ 2147483647 [X10^{-4}mm], Inch : -2147483648 ~ 2147483647 [X10^{-5}Inch], degree : -2147483648 ~ 2147483647 [X10^{-5}degree], pulse : -2147483648 ~ 2147483647 [pulse]
27	4427	8827	Origin address (upper)	
28	4428	8828	Homing high speed (Low)	mm : 1 ~ 2,000,000,000[X10^{-2}mm/m], Inch : 1 ~ 2,000,000,000[X10^{-3}Inch/m], degree : 1 ~ 2,000,000,000[X10^{-3} degree/m], pulse : 1 ~ 1,000,000[pulse/s]
29	4429	8829	Homing high speed (High)	
30	4430	8830	Homing low speed (Low)	
31	4431	8831	Homing low speed (High)	
32	4432	8832	Homing acceleration/deceleration time	0 ~ 65,535[ms]
33	4433	8833	Homing dwell time	
34	4434	8834	Origin compensation amount (Low)	mm : -2147483648 ~ 2147483647 [X10^{-4}mm], Inch : -2147483648 ~ 2147483647 [X10^{-5}Inch], degree : -2147483648 ~ 2147483647 [X10^{-5}degree], pulse : -2147483648 ~ 2147483647 [pulse]
35	4435	8835	Origin compensation amount (High)	
36	4436	8836	Homing reset waiting time	0 ~ 65,535[ms]
37	4437	8837	Homing mode (bit 0 ~ 2)	0:DOG/Origin(OFF),1:DOG/Origin(ON),2: high/low limit/Origin, 3:approximate origin, 4:high speed origin
			Homing direction (bit 3)	0:normal direction, 1:reverse direction

2) Homing Parameter Setting

(1) If homing acceleration/deceleration time is set as “0”, it carries out the homing acceleration/deceleration operation by the acceleration/deceleration time No.1 set in Basic Parameter.

(2) Control words of Homing parameter



8.1.5 Common Parameter

1) Contents of Common Parameter

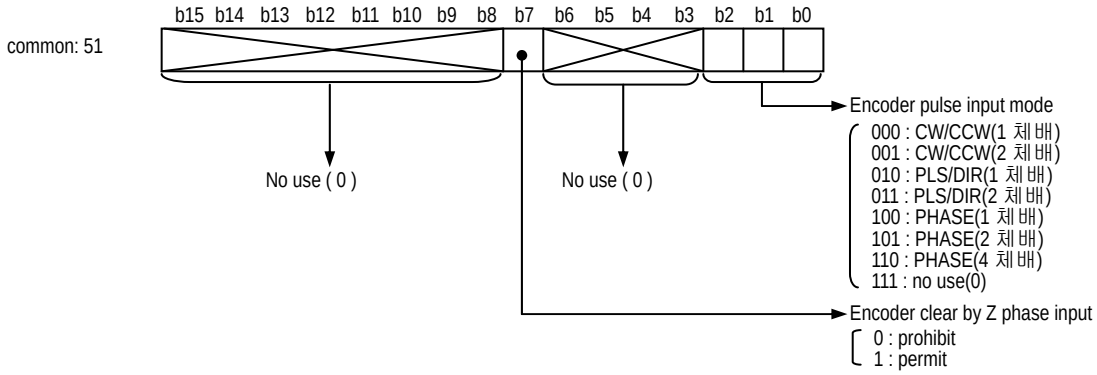
Address (common)	Common Parameter	Setting range
50	Pulse output level	0:Low Actve, 1:High Active
51	Encoder pulse input mode (bit 0/1/2)	0:CW/CCW(1), 1:CW/CCW(2), 2:PULSE/DIR(1), 3:PULSE/DIR(2), 4:PHASE A/B(1), 5:PHASE A/B(2), 6:PHASE A/B(4)
	Encoder clear mode by Z phase input (bit 7) *1	0:Prohibit, 1:Permit
52	Encoder Auto Reload (lower)	0 ~ 4294967295
53	Encoder Auto Reload (upper)	
54	Zone1 setting axis assignment	0:X, 1:Y, 2:Z, 3:ENCODER
55	Zone1 output ON position (lower)	mm : -2147483648 ~ 2147483647 [X10^{-4}mm], Inch : -2147483648 ~ 2147483647 [X10^{-5}Inch], degree : -2147483648 ~ 2147483647 [X10^{-5}degree], pulse : -2147483648 ~ 2147483647 [pulse]
56	Zone1 output ON position (upper)	
57	Zone1 output OFF position (lower)	
58	Zone1 output OFF position (upper)	
59	Zone2 setting axis assignment	0:X, 1:Y, 2:Z, 3:ENCODER
60	Zone2 output ON position (lower)	mm : -2147483648 ~ 2147483647 [X10^{-4}mm], Inch : -2147483648 ~ 2147483647 [X10^{-5}Inch], degree : -2147483648 ~ 2147483647 [X10^{-5}degree], pulse : -2147483648 ~ 2147483647 [pulse]
61	Zone2 output ON position (upper)	
62	Zone2 output OFF position (lower)	
63	Zone2 output OFF position (upper)	
64	Zone3 setting axis assignment	0:X, 1:Y, 2:Z, 3:ENCODER
65	Zone3 output ON position (lower)	mm : -2147483648 ~ 2147483647 [X10^{-4}mm], Inch : -2147483648 ~ 2147483647 [X10^{-5}Inch], degree : -2147483648 ~ 2147483647 [X10^{-5}degree], pulse : -2147483648 ~ 2147483647 [pulse]
66	Zone3 output ON position (upper)	
67	Zone3 output OFF position (lower)	
68	Zone3 output OFF position (upper)	
69	Zone output mode	0:Individual output, 1:batch output (ZONE1)
70	Circular interpolation method	0:Middle point, 1:Center point

*1: G6F-PP□O, G6F-PP□D shall not clear the encoder value by Z phase input.

2) Common Parameter Setting

(1) The contents of common parameter is the parameter used commonly for X, Y, Z axis.

(2) Control words of Encoder



8.1.6 Operation Data

1) Contents of Operation Data

Step no.	Address X	Address Y	Address Z	Operation Data	Setting range
1	100	4500	8900	Goal position (lower)	mm : -2147483648 ~ 2147483647 [X10^{-4}mm], Inch : -2147483648 ~ 2147483647 [X10^{-5}Inch], degree : -2147483648 ~ 2147483647 [X10^{-5}degree], pulse : -2147483648 ~ 2147483647 [pulse]
	101	4501	8901	Goal position (upper)	
	102	4502	8902	Circular interpolation aux. Position (lower)	
	103	4503	8903	Circular interpolation aux. Position (upper)	
	104	4504	8904	Operation speed (lower)	mm : 1 ~ 2,000,000,000[X10^{-2}mm/m], Inch : 1 ~ 2,000,000,000[X10^{-3}Inch/m], degree : 1 ~ 2,000,000,000[X10^{-3} degree/m], pulse : 1 ~ 1,000,000[pulse/s]
	105	4505	8905	Operation speed (upper)	
	106	4506	8906	Dwell time	0 ~ 50,000[ms]
	107	4507	9807	M code no.	0 ~ 65,535
	108	4508	8908	Control method (bit 0)	0:Position control, 1:speed control
				Operation method (bit 1)	0:single, 1:repeat
				Operation pattern (bit 3/2)	0:End, 1:Go-on, 2:Continuous
				Coordinate (bit 4)	0:Absolute, 1:Relative
				Acceleration/deceleration no. (bit 6/5)	0 ~ 3
				Circular interpolation direction (bit 7)	0:CW, 1:CCW
∫					
400	3691	8091	12491	Goal position (lower)	mm : -2147483648 ~ 2147483647 [X10^{-4}mm], Inch : -2147483648 ~ 2147483647 [X10^{-5}Inch], degree : -2147483648 ~ 2147483647 [X10^{-5}degree], pulse : -2147483648 ~ 2147483647 [pulse]
	3692	8092	12492	Goal position (upper)	
	3693	8093	12493	Circular interpolation aux. Position (lower) *1	
	3694	8094	12494	Circular interpolation aux. Position (upper) *1	
	3695	8095	12495	Operation speed (lower)	mm : 1 ~ 2,000,000,000[X10^{-2}mm/m], Inch : 1 ~ 2,000,000,000[X10^{-3}Inch/m], degree : 1 ~ 2,000,000,000[X10^{-3} degree/m], pulse : 1 ~ 1,000,000[pulse/s]
	3696	8096	12496	Operation speed (upper)	
	3697	8097	12497	Dwell time	0 ~ 50,000[ms]
	3698	8098	12498	M code no.	0 ~ 65,535
	3699	8099	12499	Control method (bit 0)	0:position control,1:speed control
				Control method (bit 1)	0:single, 1:repeat
				Operation pattern (bit 3/2)	0:End, 1:Go-on, 2:Continous
				Coordinate (bit 4)	0:Absolute, 1:Relative
				Acceleration/deceleration no. (bit 6/5)	0 ~ 3
				Circular interpolation direction (bit 7)	0:CW, 1:CCW

*1: As circular interpolation operation is not possible in degree unit, it is not available to set circular interpolation aux. position.

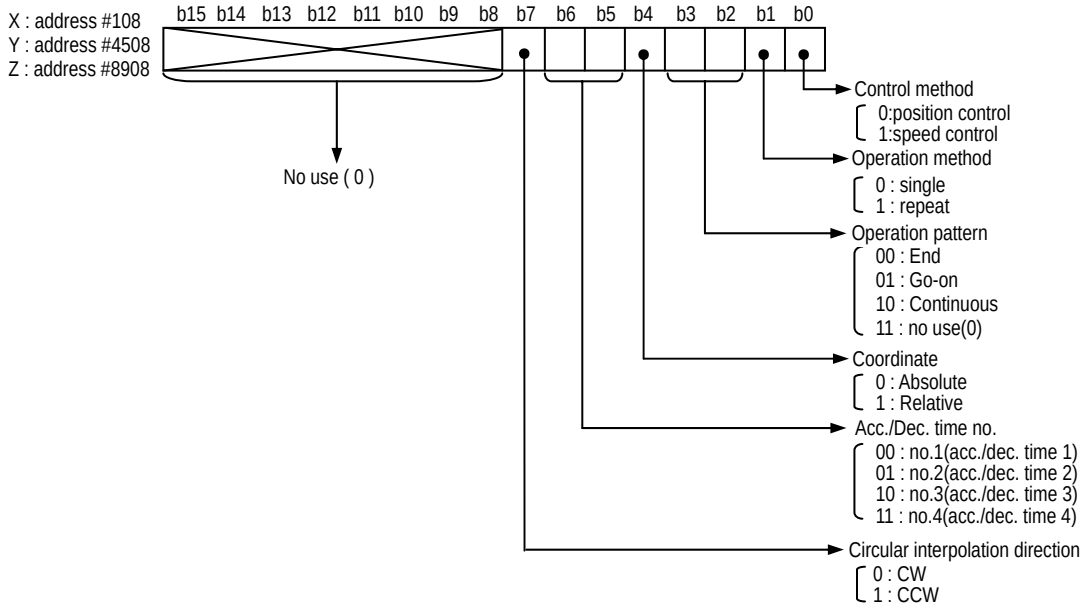
2) Operation Data Setting

(1) Operation data can set the operation data 1~400 steps per axis.

(2) For Internal memory address of operation data 1~400 steps, please refer to Appendix 2.

(3) The setting of operation data 1~400 steps is all same.

(4) Control words of Operation data (no.1 step)



8.1.7 Command Information

1) Contents of Command Information

Address			Command information	Setting range
X	Y	Z		
4200	8600	13000	Point operation setting 1	1 ~ 400
4201	8601	13001	Point operation setting 2	
4202	8602	13002	Point operation setting 3	
4203	8603	13003	Point operation setting 4	
4204	8604	13004	Point operation setting 5	
4205	8605	13005	Point operation setting 6	
4206	8606	13006	Point operation setting 7	
4207	8607	13007	Point operation setting 8	
4208	8608	13008	Point operation setting 9	
4209	8609	13009	Point operation setting 10	
4210	8610	13010	Point operation setting 11	
4211	8611	13011	Point operation setting 12	
4212	8612	13012	Point operation setting 13	
4213	8613	13013	Point operation setting 14	
4214	8614	13014	Point operation setting 15	
4215	8615	13015	Point operation setting 16	
4216	8616	13016	Point operation setting 17	
4217	8617	13017	Point operation setting 18	
4218	8618	13018	Point operation setting 19	
4219	8619	13019	Point operation setting 20	
4220	8620	13020	Point operation number	1 ~ 20
4300	8700	13100	Command code	1 ~ 38
4301	8701	13101	Step no.	1 ~ 400
4302	8702	13102	Position address (lower)	mm : -2147483648 ~ 2147483647 [X10^{-4}mm], Inch : -2147483648 ~ 2147483647 [X10^{-5}Inch], degree : -2147483648 ~ 2147483647 [X10^{-5}degree], pulse : -2147483648 ~ 2147483647 [pulse]
4303	8703	13103	Position address (upper)	
4304	8704	13104	Operation speed (lower)	mm : 1 ~ 2,000,000,000[X10^{-2}mm/m], Inch : 1 ~ 2,000,000,000[X10^{-3}Inch/m], degree : 1 ~ 2,000,000,000[X10^{-3} degree/m], pulse : 1 ~ 1,000,000[pulse/s]
4305	8705	13105	Operation speed (upper)	
4306	8706	13106	Dwell time	0 ~ 50,000[ms]
4307	8707	13107	M code	0 ~ 65,535
4308	8708	13108	Control method (bit 0)	0: position control, 1:speed control
			Operation method (bit 1)	0: single, 1: repeat
			Operation pattern (bit 3/2)	0: End, 1: Go-on, 2: Continuous
			Coordinate (bit 4)	0: Absolute, 1: Relative
			Acceleration/deceleration no. (bit 6/5)	0 ~ 3
4309	8709	13109	Axis information in case of using plural axis : X(bit 0), Y(bit 1), Z(bit2)	3:X-Y,5:Z-X,6:Z-Y,7:X-Y-Z
4310	8710	13110	Main axis setting	0:X, 1:Y, 2:Z, 3:Encoder
4311	8711	13111	Main axis speed synchronous start rate	1 ~ 65,535
4312	8712	13112	Subordinate axis speed synchronous start rate	
4313	8713	13113	X axis step no.	1 ~ 400
4314	8714	13114	Y axis step no.	
4315	8715	13115	Z axis step no.	
4316	8716	13116	No use area	-
4317	8717	13117	Reset control word (bit 0)	0: Pulse output prohibit, 1: Pulse output permit
4318	8718	13118	Teaching method (RAM teaching/ROM teaching)	0:RAM teaching, 1:ROM teaching
4319	8719	13119	Teaching method (position teaching/speed teaching)	0: position teaching, 1: speed teaching

Address			Command information	Setting range
X	Y	Z		
4320	8720	13120	Teaching single/array (data 1)(upper)	1.Position teaching setting range mm : -2147483648 ~ 2147483647 [X10^{-4}mm], Inch : -2147483648 ~ 2147483647 [X10^{-5}Inch], degree : -2147483648 ~ 2147483647 [X10^{-5}degree], pulse : -2147483648 ~ 2147483647 [pulse] 2.Speed teaching setting range mm : 1 ~ 2,000,000,000[X10^{-2}mm/m], Inch : 1 ~ 2,000,000,000[X10^{-3}Inch/m], degree : 1 ~ 2,000,000,000[X10^{-3} degree/m], pulse : 1 ~ 1,000,000[pulse/s]
4321	8721	13121	Teaching single/array (data 1)(upper)	
4322	8722	13122	Teaching array (data 2)(lower)	
4323	8723	13123	Teaching array (data 2)(upper)	
4324	8724	13124	Teaching array (data 3)(lower)	
4325	8725	13125	Teaching array (data 3)(upper)	
4326	8726	13126	Teaching array (data 4)(lower)	
4327	8727	13127	Teaching array (data 4)(upper)	
4328	8728	13128	Teaching array (data 5)(lower)	
4329	8729	13129	Teaching array (data 5)(upper)	
4330	8730	13130	Teaching array (data 6)(lower)	
4331	8731	13131	Teaching array (data 6)(upper)	
4332	8732	13132	Teaching array (data 7)(lower)	
4333	8733	13133	Teaching array (data 7)(upper)	
4334	8734	13134	Teaching array (data 8)(lower)	
4335	8735	13135	Teaching array (data 8)(upper)	
4336	8736	13136	Teaching array (data 9)(lower)	
4337	8737	13137	Teaching array (data 9)(upper)	
4338	8738	13138	Teaching array (data 10)(lower)	
4339	8739	13139	Teaching array (data 10)(upper)	
4340	8740	13140	Teaching array (data 11)(lower)	
4341	8741	13141	Teaching array (data 11)(upper)	
4342	8742	13142	Teaching array (data 12)(lower)	
4343	8743	13143	Teaching array (data 12)(upper)	
4344	8744	13144	Teaching array (data 13)(lower)	
4345	8745	13145	Teaching array (data 13)(upper)	
4346	8746	13146	Teaching array (data 14)(lower)	
4347	8747	13147	Teaching array (data 14)(upper)	
4348	8748	13148	Teaching array (data 15)(lower)	
4349	8749	13149	Teaching array (data 15)(upper)	
4350	8750	13150	Teaching array (data 16)(lower)	
4351	8751	13151	Teaching array (data 16)(upper)	
4352	8752	13152	The number of Teaching	1 ~ 16

2) Command Information Setting

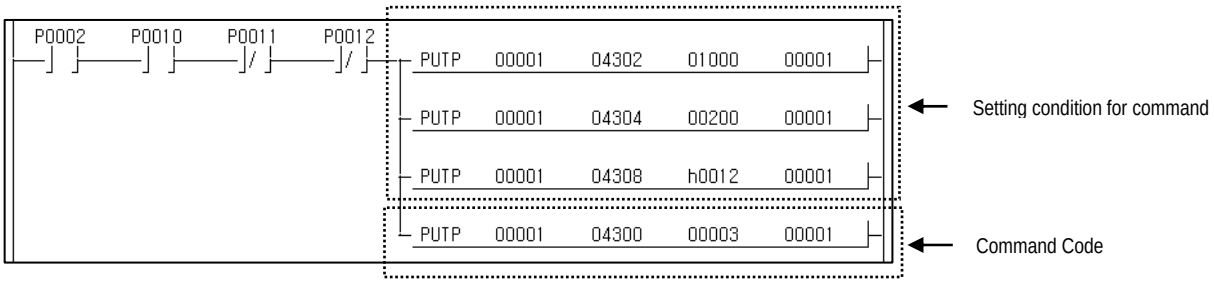
(1) Command code

A) Set in X : 4300, Y : 8700, Z : 13100, respectively.

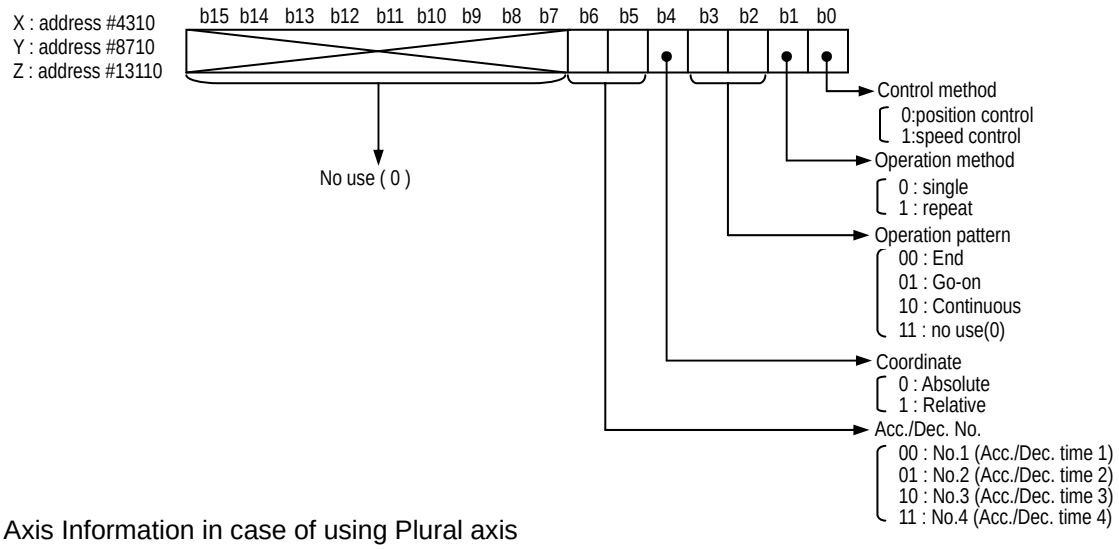
B) For command code setting, refer to Chapter 9 Command.

C) Command code in PLC program should be set after command condition for the action by command.

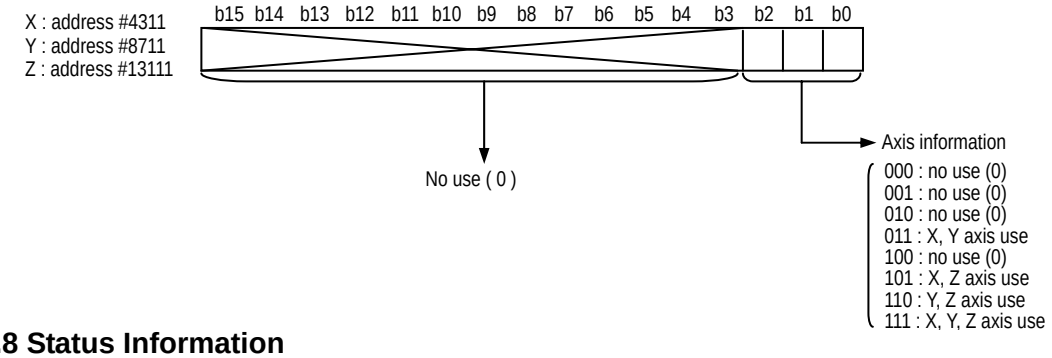
Example)



(2) Control Word of Command Information



(3) Axis Information in case of using Plural axis



8.1.8 Status Information

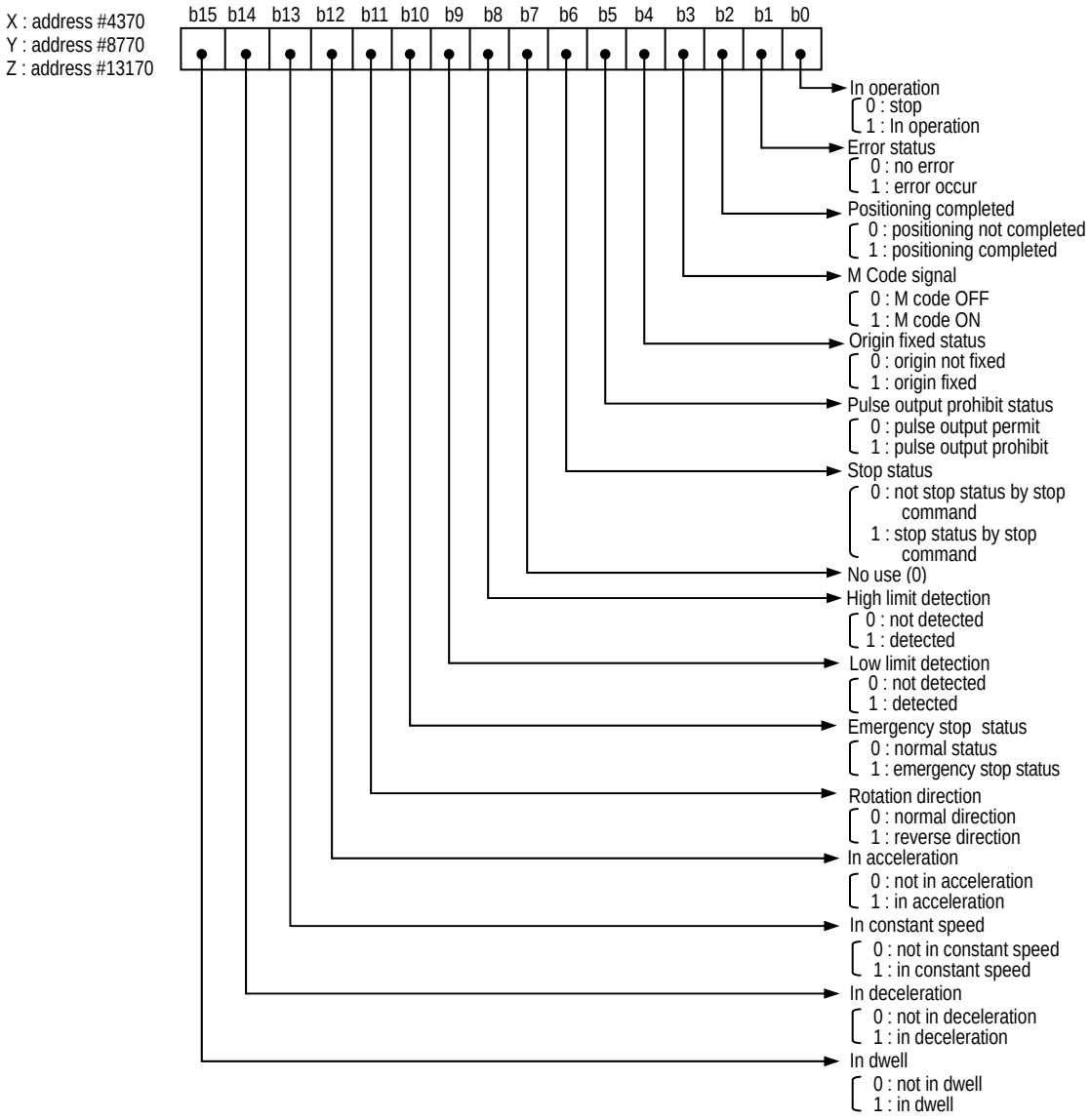
1) Contents of Status Information

Address			Status Information
X	Y	Z	
4370	8770	13170	Operation status bit information (lower)
4371	8771	13171	Operation status bit information (upper)
4372	8772	13172	Axis information
4373	8773	13173	External I/O signal status
4374	8774	13174	Current position (lower)
4375	8775	13175	Current position (upper)
4376	8776	13176	Current speed (lower)
4377	8777	13177	Current speed (upper)
4378	8778	13178	Step no.
4379	8779	13179	M code no.
4380	8780	13180	Current error information
4381	8781	13181	Error information 1
4382	8782	13182	Error information 2
4383	8783	13183	Error information 3
4384	8784	13184	Error information 4
4385	8785	13185	Error information 5
4386	8786	13186	Error information 6
4387	8787	13187	Error information 7
4388	8788	13188	Error information 8
4389	8789	13189	Error information 9
4390	8790	13190	Error information 10
4391			Encoder (lower)
4392			Encoder (upper)

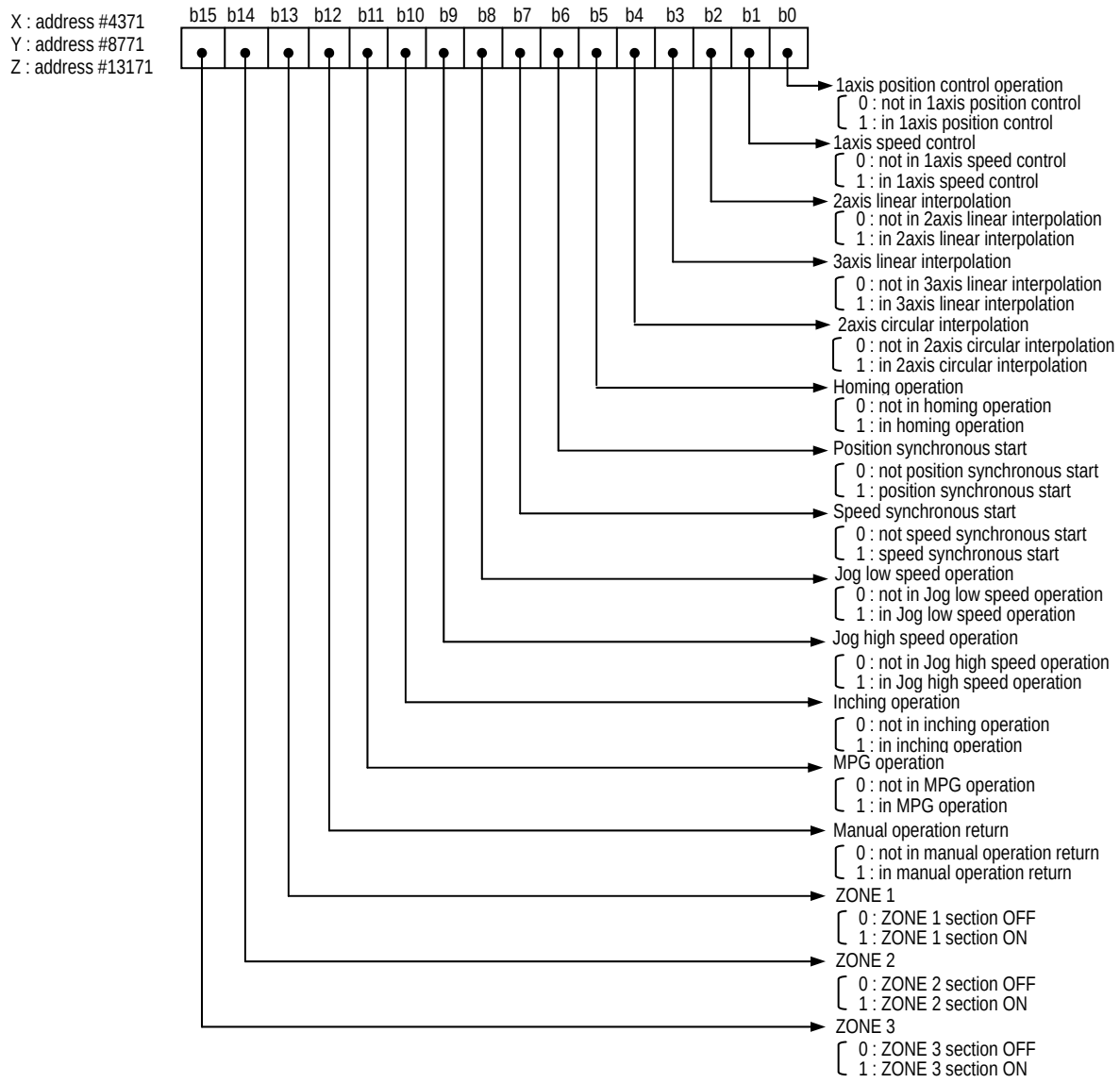
▷ Status information area of internal memory is only for Reading. Thus, the status information area of internal memory is available to use only by GET, GETP command better. (This is the area not allowed to use PUT, PUTP command.)

2) Use of Status Information

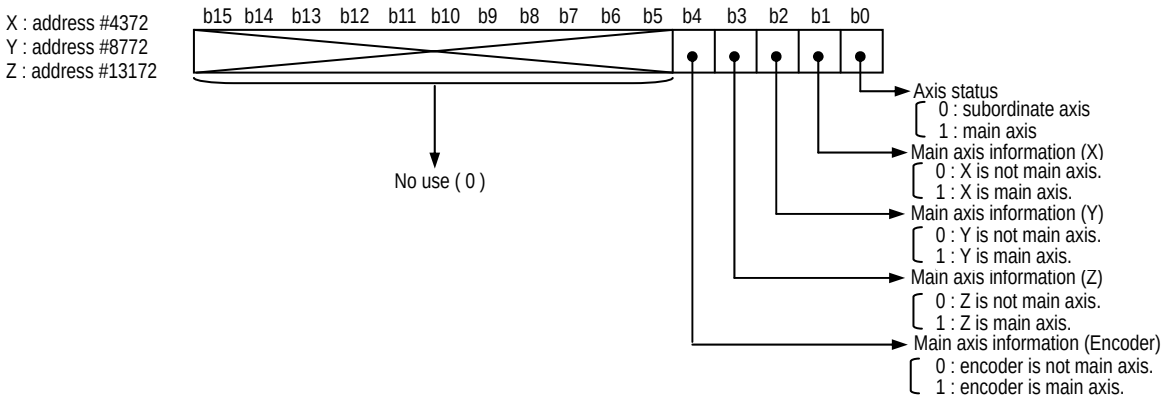
(1) Operation Status Bit Information (Lower)



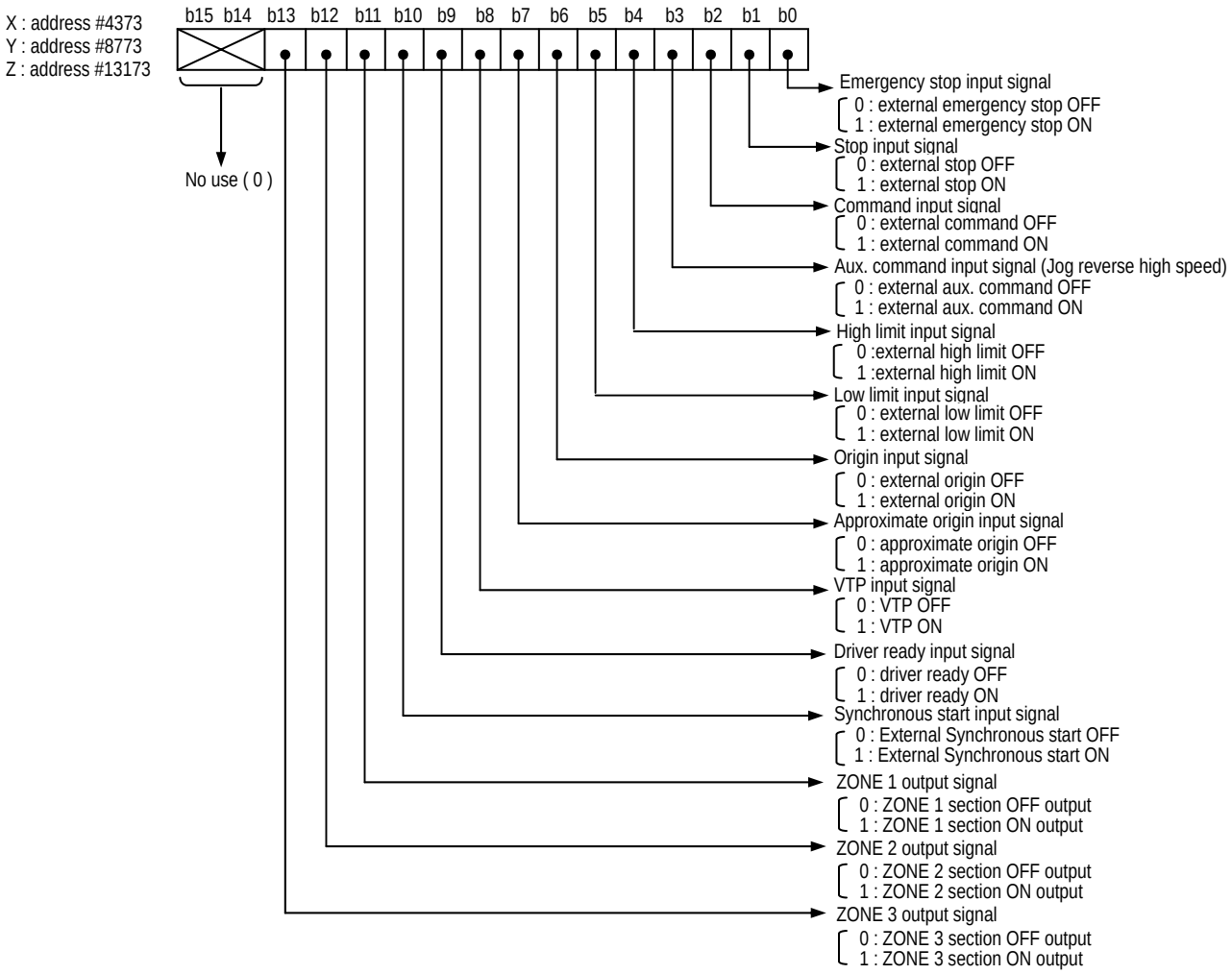
(2) Operation Status Bit Information (upper)



(3) Axis Information



(4) External I/O Signal Status



8.2 I/O Signal

- In case of using Positioning Module (G4/6F-PP1/2/3O,G4/6F-PP1/2/3D) for MASTER-K200S/300S, Input signal and Output signal for data exchange with PLC CPU is used.
- Here describes the contents and function of I/O signal.

8.2.1 Contents of I/O Signal

1) I/O signal of G4/6F-PP1/2/3O,G4/6F-PP1/2/3D contains total 32 points (Input :16 point, Output :16 point).
2) The following shows the case that I/O word no. of positioning module = n and n is subject to the setup position of positioning module.
3) The area of actual I/O signal is used differently for each positioning module.
   (G4/6F-PP1O/G4/6F-PP1D uses the corresponding I/O signal of X axis and G4/6F-PP2O/G4/6F-PP2D uses the corresponding I/O signal of X axis, Y axis, and G4/6F-PP3O/G4/6F-PP3D uses the corresponding I/O signal of X, Y, Z axis respectively.)
4) Position module operation ready signal (P0(n)F) becomes “ON” only when G4/6F-PP1/2/3O,G4/6F-PP1/2/3D is in H/W normal status and it always keeps “ON” regardless of PLC operation mode.

Axis	Signal direction: PLC CPU←Positioning module		Signal direction: PLC CPU→positioning module	
	Input	Description	Output	Description
X	P0(n)0	X axis command receiving	P0(n+1)0	X axis start
	P0(n)1	X axis in operation	P0(n+1)1	X axis normal direction Jog
	P0(n)2	X axis error status	P0(n+1)2	X axis reverse direction Jog
	P0(n)3	X axis positioning completed	P0(n+1)3	X axis Jog high/low speed
	P0(n)4	X axis M code ON	P0(n+1)4	X axis MPG operation (or Encoder)
Y	P0(n)5	Y axis command receiving	P0(n+1)5	Y axis start
	P0(n)6	Y axis in operation	P0(n+1)6	Y axis normal direction Jog
	P0(n)7	Y axis error status	P0(n+1)7	Y axis reverse direction Jog
	P0(n)8	Y axis positioning completed	P0(n+1)8	Y axis Jog high/low speed
	P0(n)9	Y axis M code ON	P0(n+1)9	Y axis MPG operation (or Encoder)
Z	P0(n)A	Z axis command receiving	P0(n+1)A	Z axis start
	P0(n)B	Z axis in operation	P0(n+1)B	Z axis normal direction Jog
	P0(n)C	Z axis error status	P0(n+1)C	Z axis reverse direction Jog
	P0(n)D	Z axis positioning completed	P0(n+1)D	Z axis Jog high/low speed
	P0(n)E	Z axis M code ON	P0(n+1)E	Zaxis MPG operation(or Encoder)
Common	P0(n)F	Positioning module ready	P0(n+1)F	No use

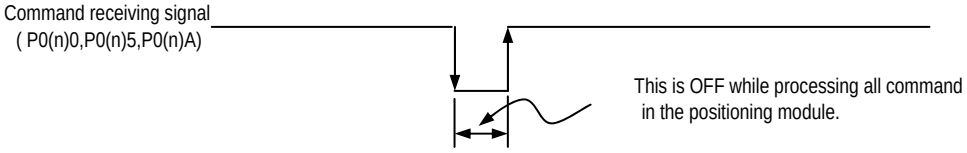
8.2.2 Use of I/O Signal

1) Command Receiving signal (P0(n)0,P0(n)5,P0(n)A)

(1) Processing of Command Receiving Signal

A) Command receiving signal is ON when positioning module is normal and it becomes OFF while carrying out the command by command code.

B) If the command by the command code is entered in positioning module, the command receiving signal changes ON -> OFF and after completion of the command, it return to OFF -> ON status.

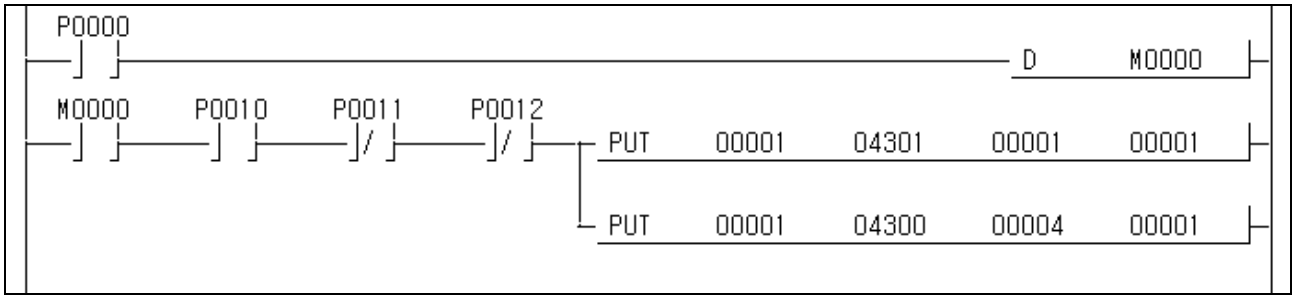


(2) Use of Command Receiving Signal

A) Command receiving signal should be used in Normal Open (A contact) input condition on PLC program when carrying out the command by using all command code.

B) Example of Indirect Start Command Program

(Step no.:1, Indirect Start command code:4)



Device	Description
P0000	X axis indirect start external input
P0010	X axis command receiving signal
P0011	X axis signal in operation
P0012	X axis error status

▷ But, in this case, I/O word no. of positioning module is “P0010 ~ P002F”.

Point

▶ In case of the command by P contact signal such as P contact start, Jog operation (normal direction), Jog operation (reverse direction), MPG operation (Encoder), it is not allowed to use the command receiving signal but allowed only in case of operation by the command code.

2) Start (P0(n+1)0,P0(n+1)5,P0(n+1)A)

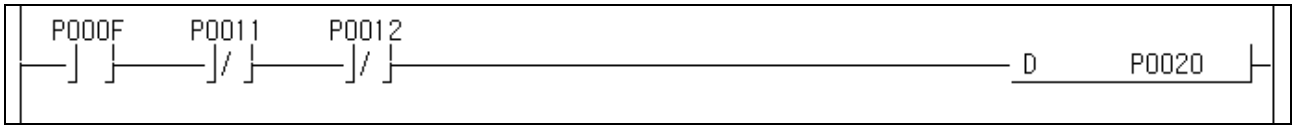
(1) Start signal carries out the positioning operation according to the current operation step no. of positioning module without setting the step no. other than indirect start or direct start by command code.

(2) In case of changing the current operation step no. during operation, it is required to use the command code 20 start step no. change command.

(3) Example of Start Program (P contact start)

A) Use Push button switch as Start external input switch.

B) In case of using the Toggle switch as Start external input switch, the signal in operation shall be OFF after positioning completion and it restarts automatically. Thus, cares should be taken in using.



Device	Description
P000F	X axis Start external input
P0011	X axis signal in operation
P0012	X axis error status
P0020	X axis start

▷ But, in this case, the I/O word no. of positioning module is “P0010 ~ P002F”.

Point

▶ In case of Start by P contact signal, indirect start, direct start, linear interpolation operation, circular interpolation operation, position synchronous start, synchronous start operation, the positioning parameter and operation data should be set in advance.

For the setting method, please refer to Chapter 5. Positioning Parameter and Operation Data.

3) Jog Operation

; (P0(n+1)1,P0(n+1)2,P0(n+1)3), (P0(n+1)6,P0(n+1)7,P0(n+1)8),
(P0(n+1)B,P0(n+1)C,P0(n+1)D)

P0(n+1)1	X axis normal direction Jog
P0(n+1)2	X axis reverse direction Jog
P0(n+1)3	X axis Jog high/low speed
P0(n+1)6	Y axis normal direction Jog
P0(n+1)7	Y axis reverse direction Jog
P0(n+1)8	Y axis Jog high/low speed
P0(n+1)B	Z axis normal direction Jog
P0(n+1)C	Z axis reverse direction Jog
P0(n+1)D	Z axis Jog high/low speed

(1) In case of setting Jog high/low speed for P0(n+1)3, P0(n+1)8, P0(n+1)D, it should be set as Jog high speed when ON and Jog low speed when OFF.

(2) The actual Jog operation shall be divided into Normal/Reverse direction Jog according to the ON/OFF signal of P0(n+1)1,P0(n+1)2, P0(n+1)6,P0(n+1)7, P0(n+1)B,P0(n+1)C.

(3) Jog operation carries out the operation by the level of ON/OFF signal and thus it carries out Jog operation when ON while it stops Jog operation when OFF.

(4) Example of Jog Operation Program

Device	Description
P0000	X axis high speed reverse direction Jog external input
P0001	X axis low speed normal direction Jog external input
P0012	X axis error status
P0021	X axis normal direction Jog
P0022	X axis reverse direction Jog
P0023	X axis low speed (OFF)/high speed (ON)

▷But, in this case, the I/O word no. of positioning module is “P0010 ~ P002F”.

Point

▶If you carries out Jog operation by adding the signal (P0(n+1)1, P0(n+1)6, P0(n+1)B) as Normal Close(B contact) input while operating in the Jog operation input condition, it occurs the malfunction. Thus it is not allowed to use it.

4) MPG Operation (or Encoder)

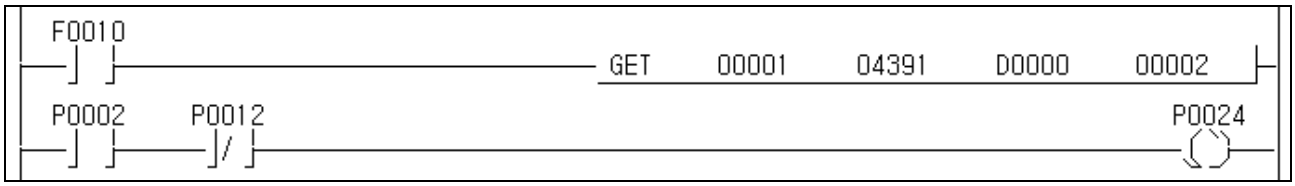
; (P0(n+1)4,P0(n+1)9,P0(n+1)E)

(1) MPG operation (Encoder) signal is Level Input. Thus, when it is ON, the encoder of internal memory address 4391,4391 shall be pulse output for X, Y, Z axis and when OFF, the pulse output will stop.

(2) The operation per axis by MPG operation (Encoder) is available to carry out MPG operation (Encoder) by X, Y, Z axis at the same time.

(3) MPG operation (Encoder) is available to use the Manual Pulse Generator (MPG) and the Encoder signal of SERVO driver as external input. For further information of Encoder pulse input mode, please refer to Chapter 5. Positioning Parameter and Operation Data.

(4) Example of MPG operation (Encoder) Program



Device	Description
P0002	X axis MPG operation (Encoder) permitted external input
P0012	X axis error status
P0024	X axis MPG operation (Encoder) signal

▷ But, in this case, the I/O word no. of positioning module is “P0010 ~ P002F”.

(5) Save the Encoder in Device

A) In case of using the encoder of internal memory, save it in Device area by GET command.

B) As the encoder occupies 2 word area, cares should be taken in using.

Internal memory address	Internal memory contents
4391	Encoder (low)
4392	Encoder (high)

→ D0000
→ D0001

5) M code ON signal (P0(n)4,P0(n)9,P0(n)E)

(1) This signal occurs during positioning operation or after positioning completion according to M code setting mode (With, After) and M code no. setting of operation data.

(2) For further information, please refer to Chapter 5. Positioning Parameter and Operation Data.

6) Positioning Completion Signal (P0(n)3,P0(n)8,P0(n)D)

(1) This signal occurs after positioning completion according to positioning completion output setting time of extended parameter and if start related command is received when positioning completion signal is ON, it becomes OFF automatically.

(2) For further information, please refer to Chapter 5. Positioning Parameter and Operation Data.

Chapter 9 MK Command

This chapter describes the method to use each command code of X, Y, Z axis to the address # 4300,8700,13100 of internal memory command code for MASTER-K200S/300S.

9.1 Contents of Command Code

▶The contents of command code set in the address 4300,8700,13100 of internal memory command code are as follows.

Command code	Command	Command condition
1	Homing start	-
2	Floating point setting	-
3	Direct start	Position/speed/dwell time/M code/control word
4	Indirect start	Step no.
5	Linear interpolation start	Step no./axis information
6	Circular interpolation start	Step no./aux point 1/aux point 2/ direction/axis information
7	Synchronous start	Axis information/X axis step no./Y axis step no./Z axis step no.
8	Speed/Position switching	-
9	Position/Speed switching	-
10	Stop	-
11	SKIP operation	-
12	Synchronous start by Position	Step no./main axis position/main axis setting
13	Synchronous start by Speed	Main axis setting/main axis rate/subordinate axis rate
14	Position override	Position
15	Speed override	Speed
16	Positioning speed override	Position/speed
17	Continuous operation	-
18	Inching start	Inching amount
19	Automatic operation point return start	-
20	Start step number change	Step no.
21	Repeat step number change	Step no.
22	M code release	-
23	Current position preset	Position
24	Zone output permit	-
25	Zone output prohibit	-
26	Encoder preset	Position
27	Single teaching	Step no./RAM(or ROM)/position(or speed)/teaching data
28	Plural teaching	Step no./RAM(or ROM)/position(or speed)/teaching number/teaching data
29	Basic parameter setting	Basic parameter
30	Extended parameter setting	Extended parameter
31	Homing parameter setting	Homing parameter
32	Manual operation parameter setting	Manual operation parameter
33	Common parameter setting	Common parameter
34	Operation data setting	Operation data
35	Emergency stop	-
36	Error reset, output prohibit release	Pulse output prohibit/permit
37	Error history reset	-
38	Point operation	No. of Point, Point data

9.2 Use of Command Code

▶Here describes the command of command code 1 ~ 38.

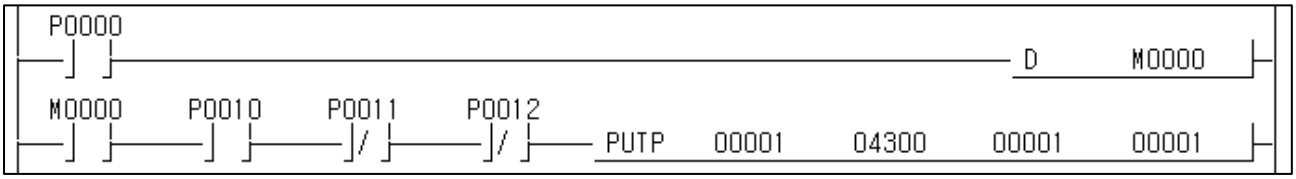
▶The setting of command code is based on X axis and describes the program method.
(But, in this case, the I/O word no. of positioning module is “P0010 ~ P002F”.)

▶For Program method, there are the method to use Push button switch for command input and the method to use Toggle switch for command input.(Ex) 9.2.1 Homing start)

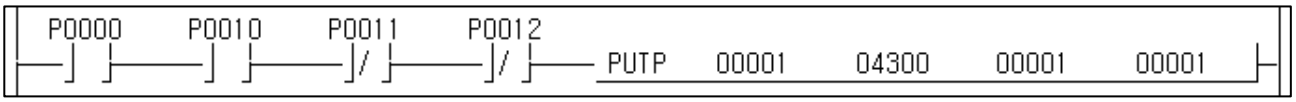
▶As Article 9.2.2 ~ 9.2.36 is programmed by the method using a Push button switch, if you use the Toggle switch, you are required to modify it by the program method of Art.9.2.1 Homing Start.

9.2.1 Homing Start (Command code:1)

1) Program (the method using a Toggle switch)



2) Program (the method using a Push button switch)



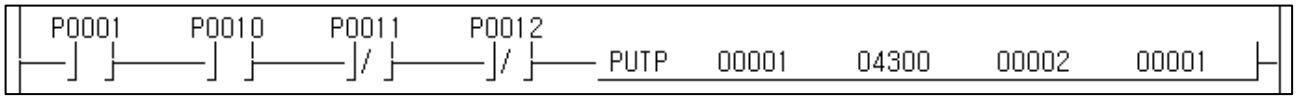
3) Description

Device	Description
P0000	X axis homing input
P0010	X axis command receiving
P0011	X axis signal in operation (BUSY)
P0012	X axis error status
M0000	X axis homing aux. Contact (ON during 1 Scan)

▷ The homing operation by 1) and 2) program is the same.

9.2.2 Floating Point Setting (Command code:2)

1) Program

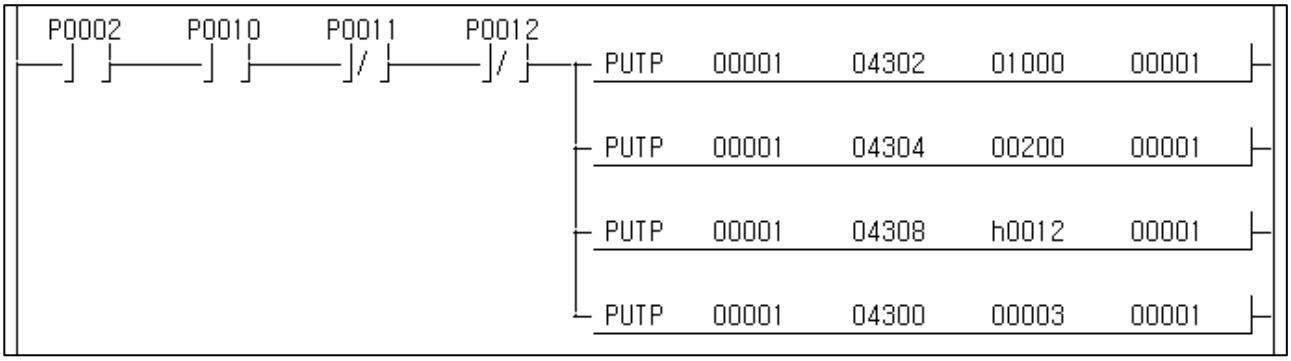


2) Description

Device	Description
P0001	X axis homing input
P0010	X axis command receiving
P0011	X axis signal in operation (BUSY)
P0012	X axis error status

9.2.3 Direct Start (Command code:3)

1) Program



2) Description

Device	Description
P0002	X axis direct start input
P0010	X axis command receiving
P0011	X axis signal in operation (BUSY)
P0012	X axis error status

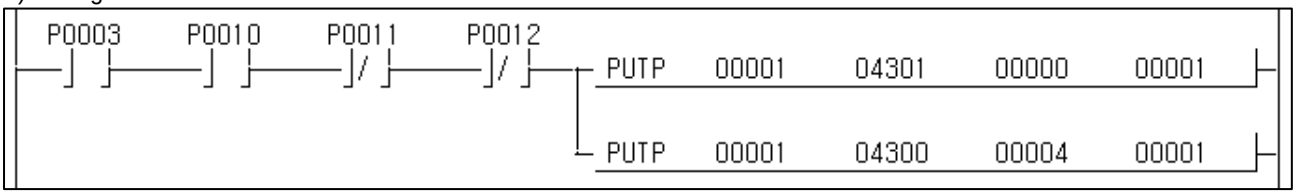
Address of internal memory	Contents of internal memory	Setting value
4302	Position address (low)	1000
4304	Operation speed (low)	200
4308	Control word of command information	h0012
4300	Command code	3

▷ If the control word of command information is h0012, it shall be set as position control, repeat, end, absolute, acceleration/deceleration time 1.

▷ For further information, please refer to Chapter 8 Internal memory and I/O signal.

9.2.4 Indirect Start (Command code:4)

1) Program



2) Description

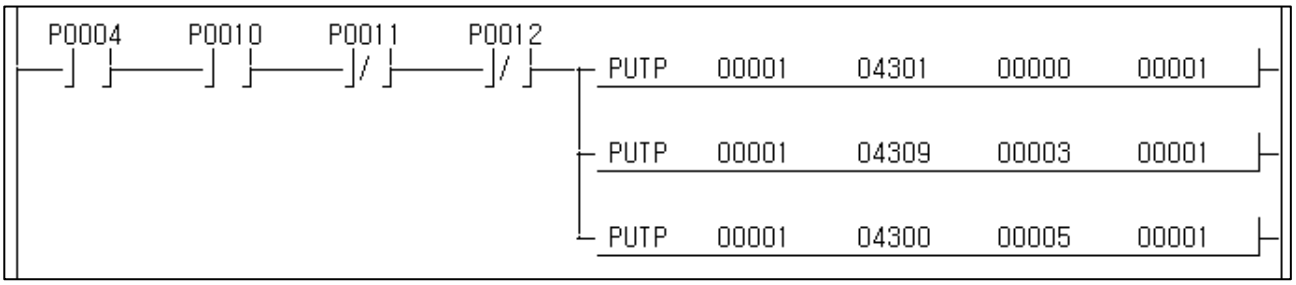
Device	Description
P0003	X axis indirect start input
P0010	X axis command receiving
P0011	X axis signal in operation (BUSY)
P0012	X axis error status

▷ Internal memory 4301 is X axis step no. setting.

▷ If in indirect start, the step no. is set as “0”, it carries out the operation by current operation step no.

9.2.5 Linear Interpolation Start (Command code:5)

1) Program



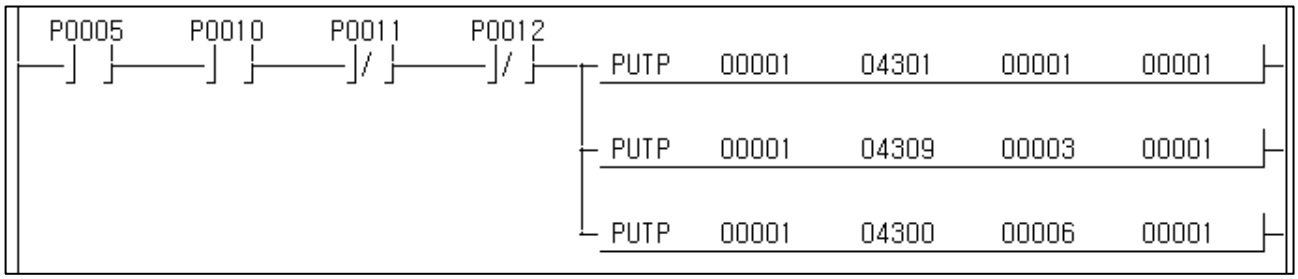
2) Description

Device	Description
P0004	2 axis linear interpolation start input
P0010	X axis command receiving
P0011	X axis signal in operation (BUSY)
P0012	X axis error status

Address of internal memory	Contents of internal memory	Setting value
4309	Axis information when using plural axis	3(X,Y)
4301	Step no.	1
4300	Command code	5

9.2.6 Circular Interpolation Start (Command code :6)

1) Program



2) Description

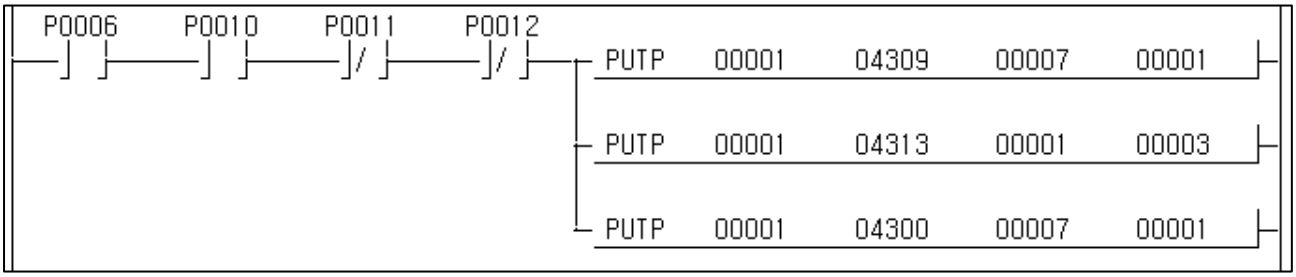
Device	Description
P0005	2 axis circular interpolation start input
P0010	X axis command receiving
P0011	X axis signal in operation (BUSY)
P0012	X axis error status

Address of internal memory	Contents of internal memory	Setting value
4301	Step no.	1
4309	Axis information when using plural axis	3(X,Y)
4300	Command code	6

▷In case of circular interpolation by center point method, X,Y axis circular interpolation aux. Point and rotation direction should be set in advance.

9.2.7 Simultaneous Start (Command code:7)

1) Program



2) Description

Device	Description
P0006	3 axis simultaneous start input
P0010	X axis command receiving
P0011	X axis signal in operation (BUSY)
P0012	X axis error status

Address of internal memory	Contents of internal memory	Setting value
4309	Axis information when using plural axis	7(X,Y,Z)
4313	X axis step no.	1
4314	Y axis step no.	1
4315	Z axis step no.	1
4300	Command code	7

▷ For further information for ‘axis information when using plural axis’, please refer to Chapter 8 Internal memory & I/O signal.

9.2.8 Speed/Position Switching (Command code:8)

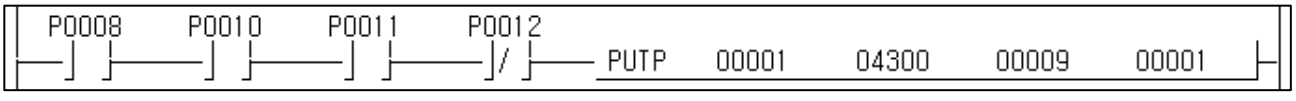
1) Program

2) Description

Device	Description
P0007	X axis speed/position switching input
P0010	X axis command receiving
P0011	X axis signal in operation
P0012	X axis error status

9.2.9 Position/Speed switching (Command code:9)

1) Program

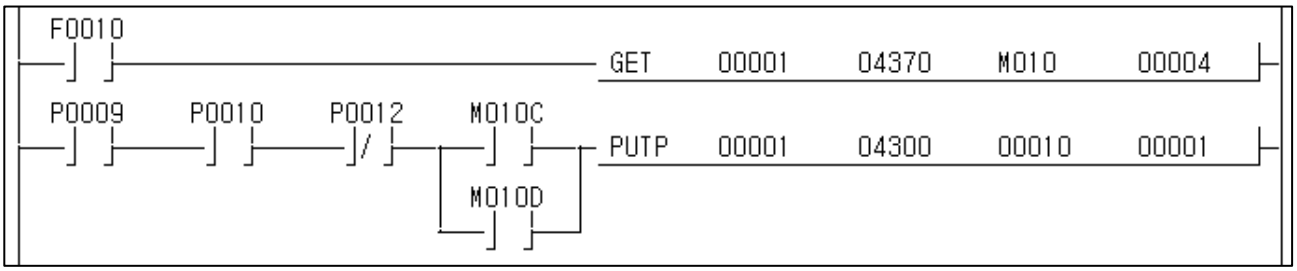


2) Description

Device	Description
P0008	X axis position/speed switching input
P0010	X axis command receiving
P0011	X axis signal in operation
P0012	X axis error status

9.2.10 Stop (Command code:10)

1) Program



2) Description

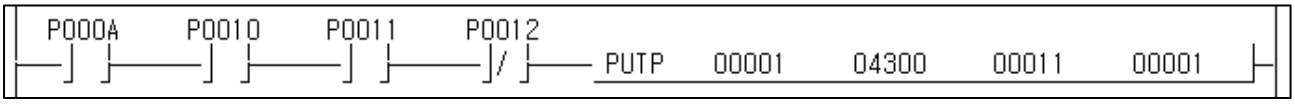
Device	Description
P0009	X axis stop input
P0010	X axis command receiving
M010D	X axis signal in constant speed
M010C	X axis signal in acceleration
P0012	X axis error status

▷ Deceleration stop command does not carry out the command during in deceleration but available only in acceleration or in constant speed.

▷ Internal memory address #4370 contains X axis operation status bit information (low) and for further information, please refer to Chapter 8 Internal Memory and I/O signal.

9.2.11 Skip Operation (Command code:11)

1) Program

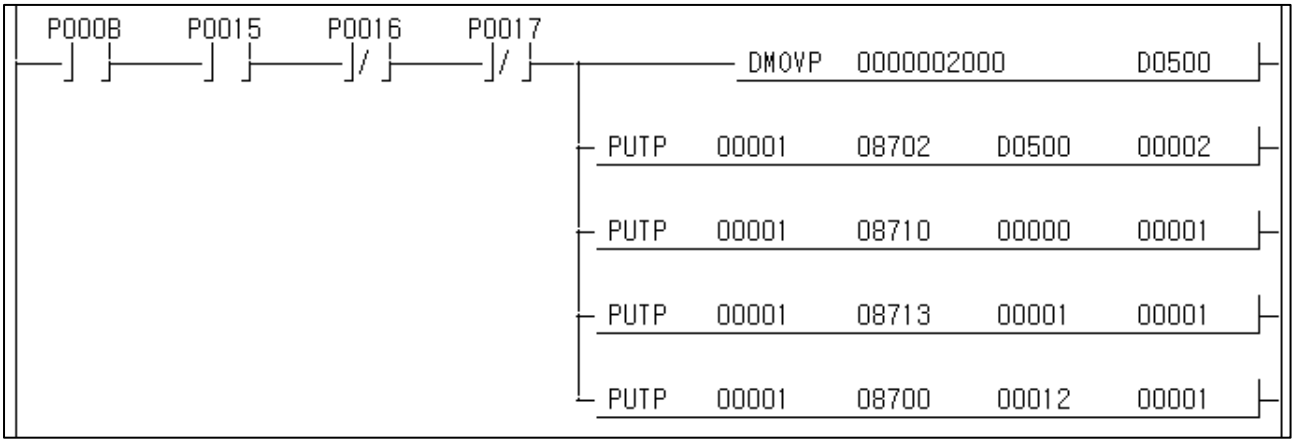


2) Description

Device	Description
P000A	X axis skip operation
P0010	X axis command receiving
P0011	X axis signal in operation
P0012	X axis error status

9.2.12 Synchronous Start by Position (Command code:12)

1) Program



2) Description

Device	Description
P000B	Y axis synchronous start by position input
P0015	Y axis command receiving
P0016	Y axis signal in operation
P0017	Y axis error signal
D0500~D0501	Position address (synchronous start by position)

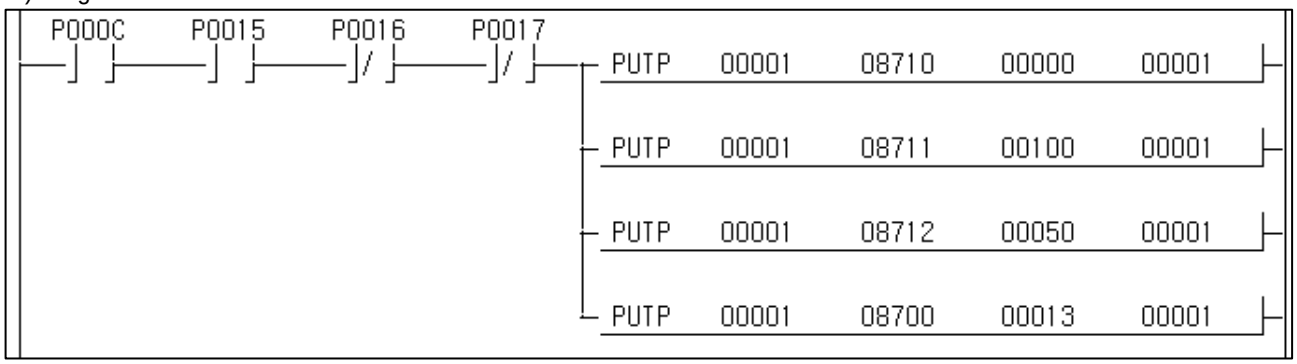
Address of internal memory	Contents of internal memory	Setting value
8713	X axis step no.	1
8702~8703	Position address (synchronous start by position)	2000
8710	Main axis setting	0(X axis)
8700	Command code	12

▷ If the command of synchronous start by position is executed, it becomes in operation status and does not have Y axis pulse output.

▷ If No. 1 step of X axis as main axis starts and the current position is 2000, No.1 step of Y axis starts and has the pulse output.

9.2.13 Synchronous Start by Speed (Command code:13)

1) Program



2) Description

Device	Description
P000C	Y axis synchronous start by speed input
P0015	Y axis command receiving
P0016	Y axis signal in operation
P0017	Y axis error status

Address of internal memory	Contents of internal memory	Setting value
8710	Main axis setting	0(X axis)
8711	Main axis speed synchronous start rate	100
8712	Subordinate axis speed synchronous start rate	50
8700	Command code	13

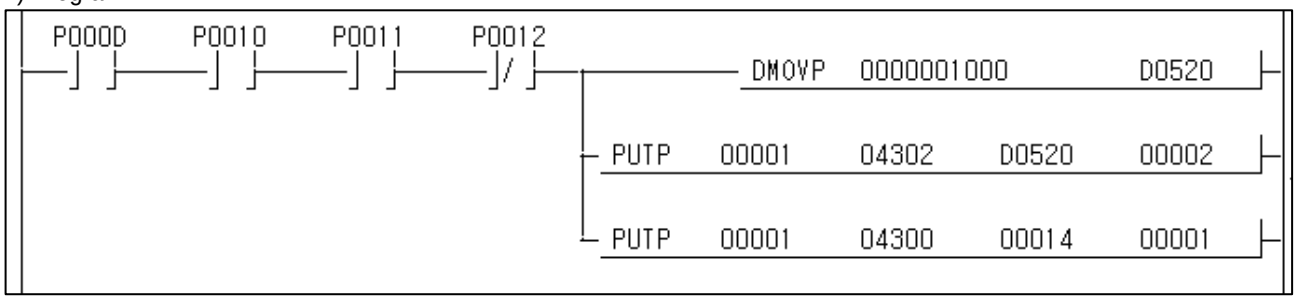
▷ If the command of synchronous start by speed is executed, it becomes in operation status and does not have Y axis pulse output.

▷ If X axis as main axis starts and operation speed is 100pps, Y axis operation speed is 50pps according to 100:50 speed synchronous start rate.

▷ If X axis operation speed as main axis is changed with 1000pps, Y axis operation speed is changed with 500pps according to 100:50 speed synchronous start rate.

9.2.14 Position Override (Command code:14)

1) Program



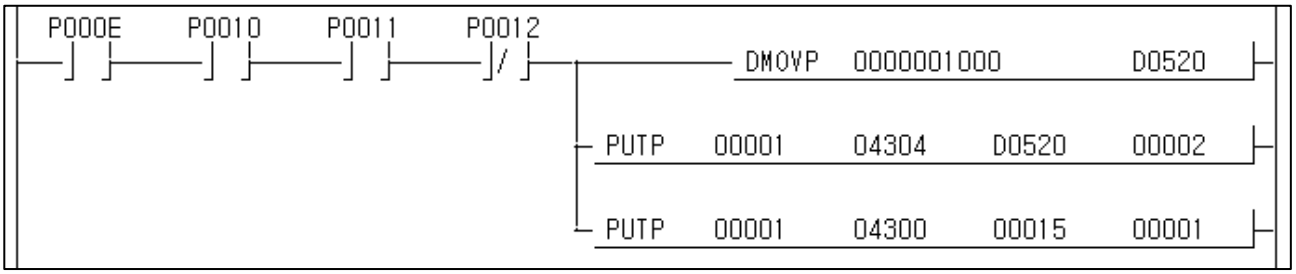
2) Description

Device	Description
P000D	X axis position override input
P0010	X axis command receiving
P0011	X axis signal in operation
P0012	X axis error status

▷ In case that X axis in operation goal position is 500, if position override is executed before reaching the goal position, the goal position is changed with 1000 and carries out the positioning operation.

9.2.15 Speed Override (Command code:15)

1) Program



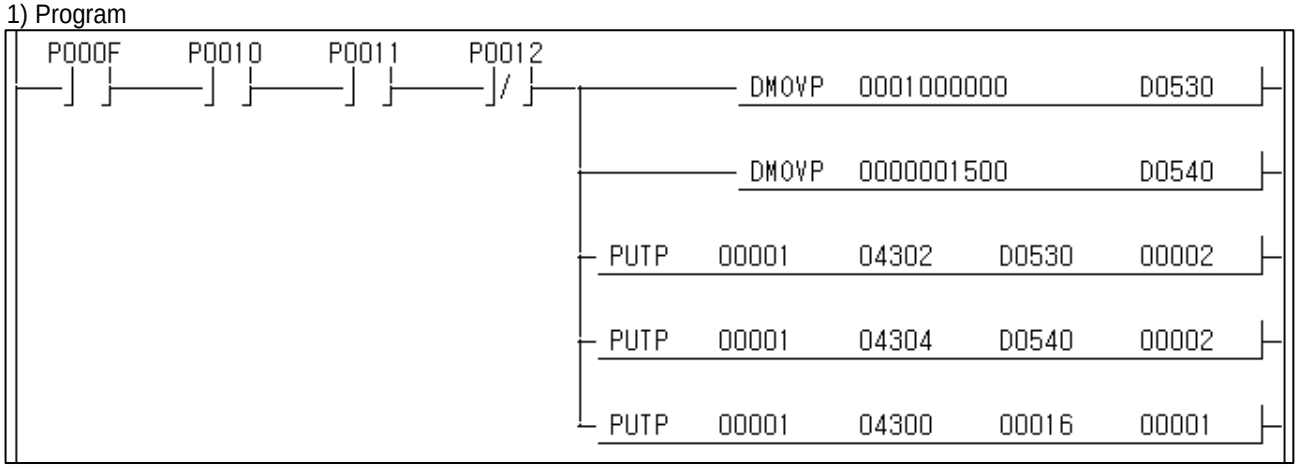
2) Description

Device	Description
P000E	X axis speed override input
P0010	X axis command receiving
P0011	X axis signal in operation
P0012	X axis error status
D0520	Operation speed

▷ In case that X axis current operation speed is 500pps and the command of speed override is executed during operation, the operation speed is changed with 1000pps set in internal memory address #4304.

9.2.16 Positioning Speed Override (Command code:16)

1) Program



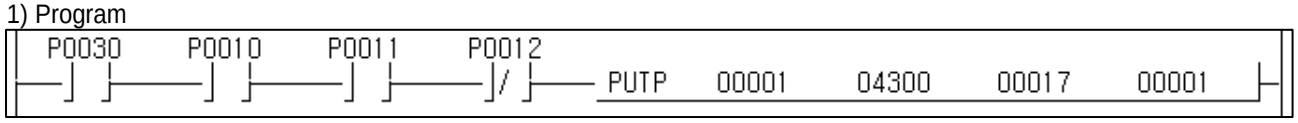
2) Description

Device	Description
P000F	X axis positioning speed override input
P0010	X axis command receiving
P0011	X axis signal in operation
P0012	X axis error status
D0530	Position address (100000)
D0540	Operation speed (1500)

▷ In case that X axis current operation speed is 500pps and the goal position is 200000, if the command of positioning override is executed and the current position is 100000, the operation speed is changed with 1500pps.

9.2.17 Continuous Operation (Command code:17)

1) Program



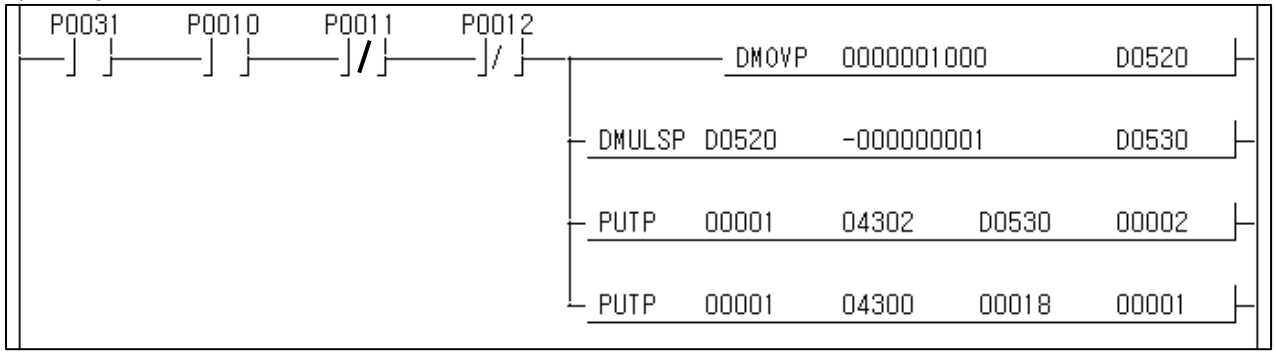
2) Description

Device	Description
P0030	X axis continuous operation input
P0010	X axis command receiving
P0011	X axis signal in operation
P0012	X axis error status

▷ In case that X axis is operated by continuous operation mode, if continuous operation (Next Move) command is executed, it moves to next step and carries out the operation.

9.2.18 Inching Start (Command code:18)

1) Program



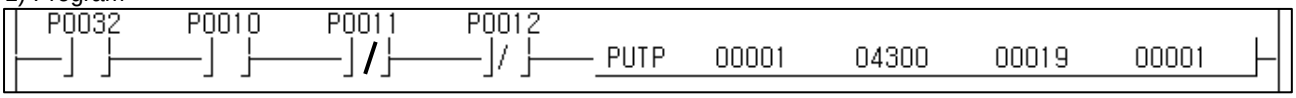
2) Description

Device	Description
P0031	X axis inching start input
P0010	X axis command receiving
P0011	X axis signal in operation
P0012	X axis error status
D0530	Inching amount (-1000)

▷ If P0031 is ON, it carries out the reverse operation by inching operation speed set in origin/manual parameter.(1000Pulse)

9.2.19 Automatic Operation Point Return Start (Command code:19)

1) Program

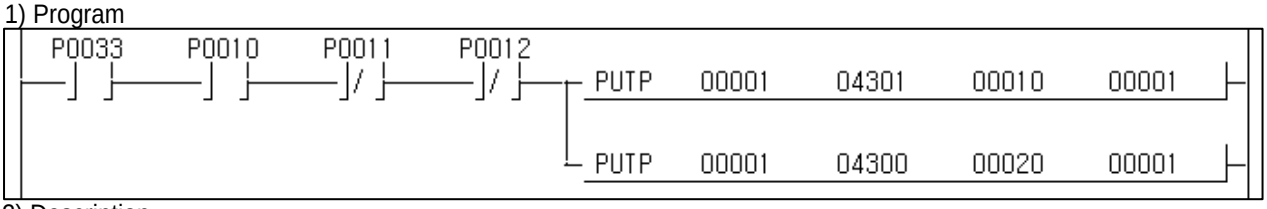


2) Description

Device	Description
P0032	X axis inching start input
P0010	X axis command receiving
P0011	X axis signal in operation
P0012	X axis error status

9.2.20 Start Step No. Change (Command code:20)

1) Program



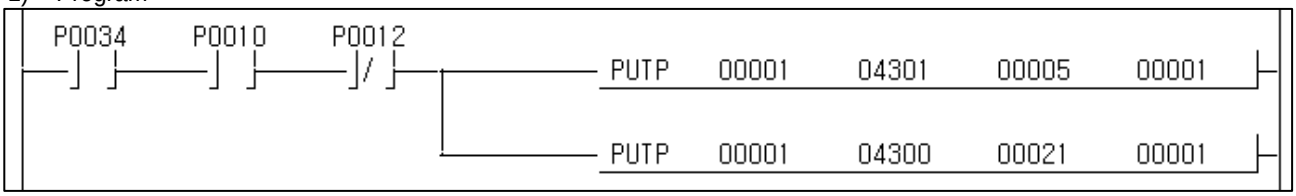
2) Description

Device	Description
P0033	X axis start step no. change input
P0010	X axis command receiving
P0011	X axis signal in operation
P0012	X axis error status

▷ If P0033 is ON, X axis current operation step no. is changed with 10.

9.2.21 Repeat Step No. Change (Command code:21)

1) Program



2) Description

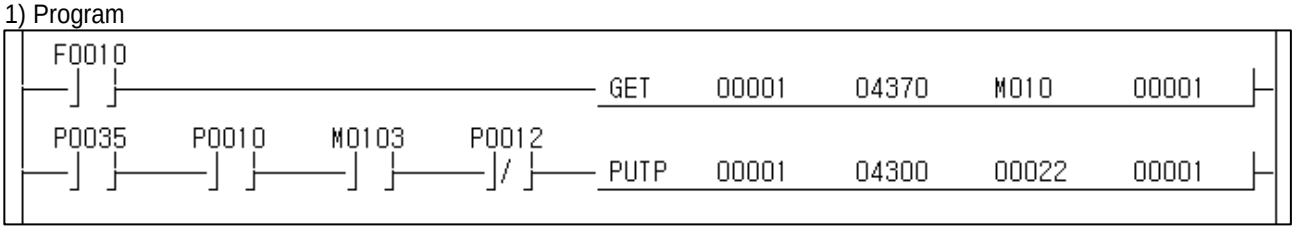
Device	Description
P0034	X axis start step no. change input
P0010	X axis command receiving
P0012	X axis error status

▷ If P0034 is ON, X axis repeat operation step no. is changed with 5.

▷ Repeat step no. change is available to change even during positioning operation.

9.2.22 M Code Release (Command code:22)

1) Program



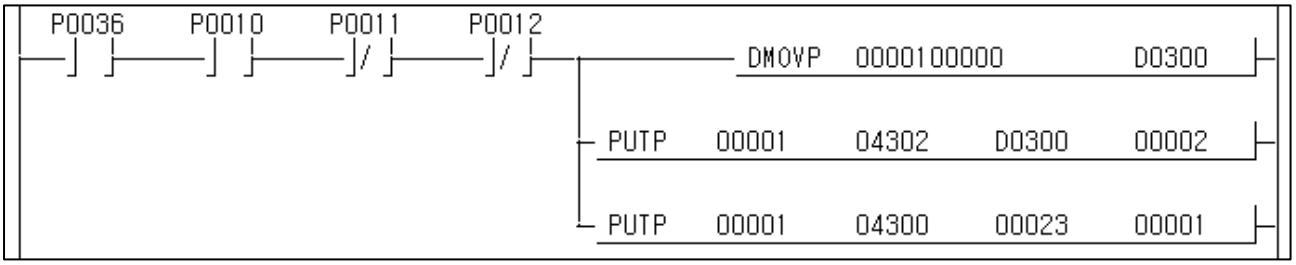
2) Description

Device	Description
P0035	X axis M code release input
P0010	X axis command receiving
M0103	X axis M code ON signal
P0012	X axis error status

▷ If P0035 is ON when M code occurs, M code ON signal and M code no. are released at the same time.

9.2.23 Current Position Preset (Command code:23)

1) Program



2) Description

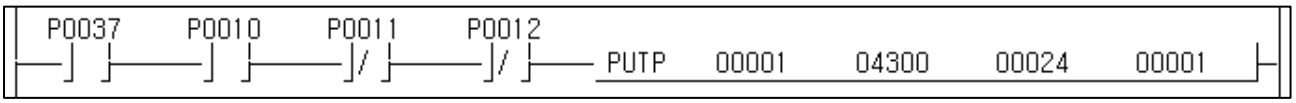
Device	Description
P0036	X axis current position preset input
P0010	X axis command receiving
P0011	X axis signal in operation
P0012	X axis error status

▷ If P0036 is ON, X axis current position is changed with 100000.

▷ If the command of current position preset is executed in the origin not fixed status, it becomes the origin fixed status and the current position is changed with the setting value.

9.2.24 Zone Output Permit (Command code:24)

1) Program



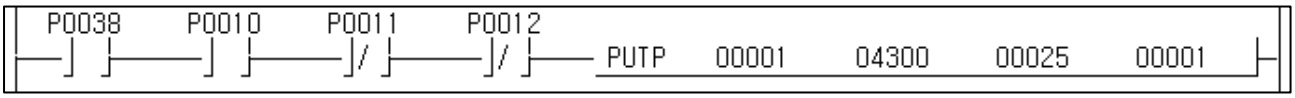
2) Description

Device	Description
P0037	X axis Zone output permit input
P0010	X axis command receiving
P0011	X axis signal in operation
P0012	X axis error status

▷ It permits the internal/external output of Zone 1/2/3 ON signal by Zone section setting.
(This function is not possible for the K200S APM module)

9.2.25 Zone Output Prohibit (Command code:25)

1) Program



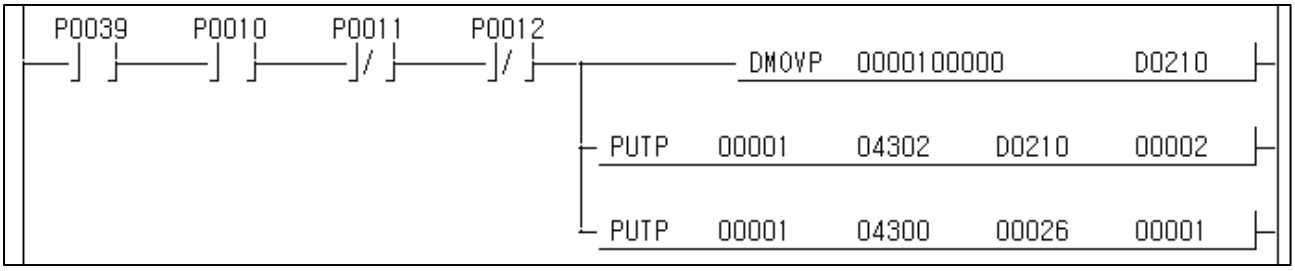
2) Description

Device	Description
P0038	X axis Zone output prohibit input
P0010	X axis command receiving
P0011	X axis signal in operation
P0012	X axis error status

▷ It prohibits the internal/external output of Zone1/2/3 ON signal by Zone section setting.
(This function is not possible for the K200S APM module)

9.2.26 Encoder Preset (Command code:26)

1) Program



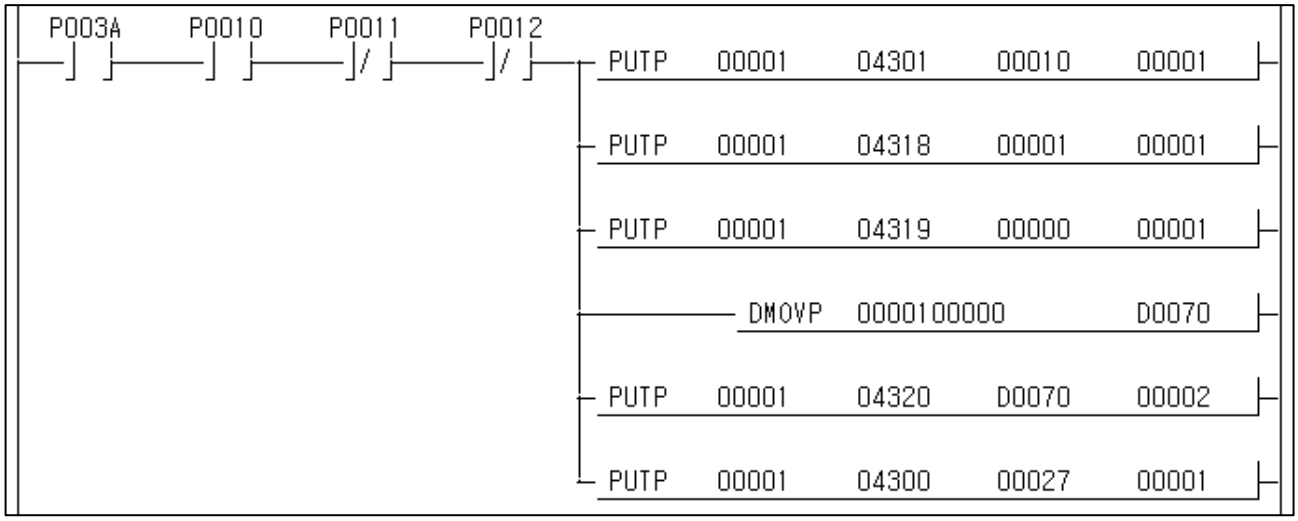
2) Description

Device	Description
P0039	X axis encoder preset input
P0010	X axis command receiving
P0011	X axis signal in operation
P0012	X axis error status

▷ If P0039 is ON, the encoder of internal memory address #4391,4392 is changed with the setting value 100000.

9.2.27 Single Teaching (Command code:27)

1) Program



2) Description

Device	Description
P003A	X axis single teaching input
P0010	X axis command receiving
P0011	X axis signal in operation
P0012	X axis error status
D0070~D0071	Teaching data (100000)

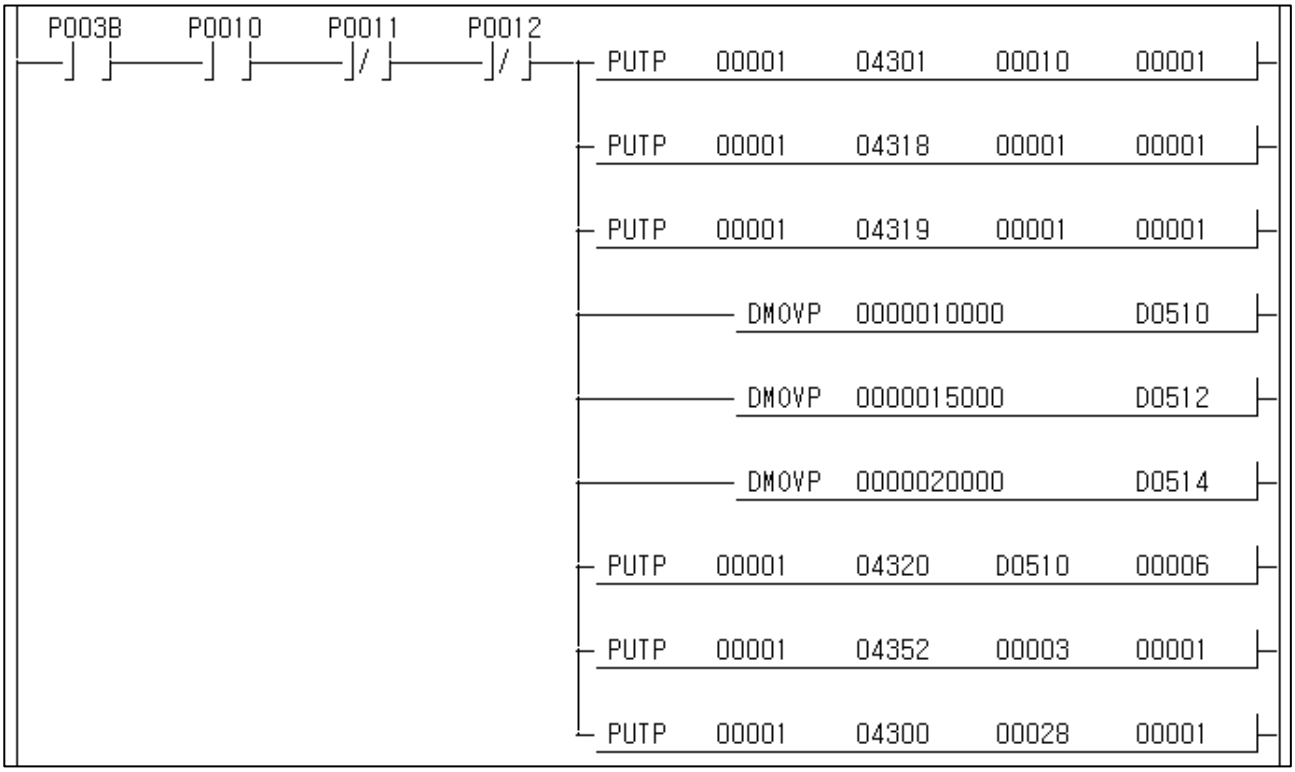
Address of internal memory	Contents of internal memory	Setting value
4301	Step no.	10
4318	RAM teaching/ROM teaching	1
4319	Position teaching/Speed teaching	0
4320~4321	Teaching data	100000
4300	Command code	27

▷ If P003A is ON, No.1 step goal position carries out the position teaching with 100000. (ROM teaching mode)

▷ In case of negative Teaching, use of [DMULS D70 -1 D72],[PUTP 1 4320 D72 2] sequence program.

9.2.28 Array Teaching (Command code:28)

1) Program



2) Description

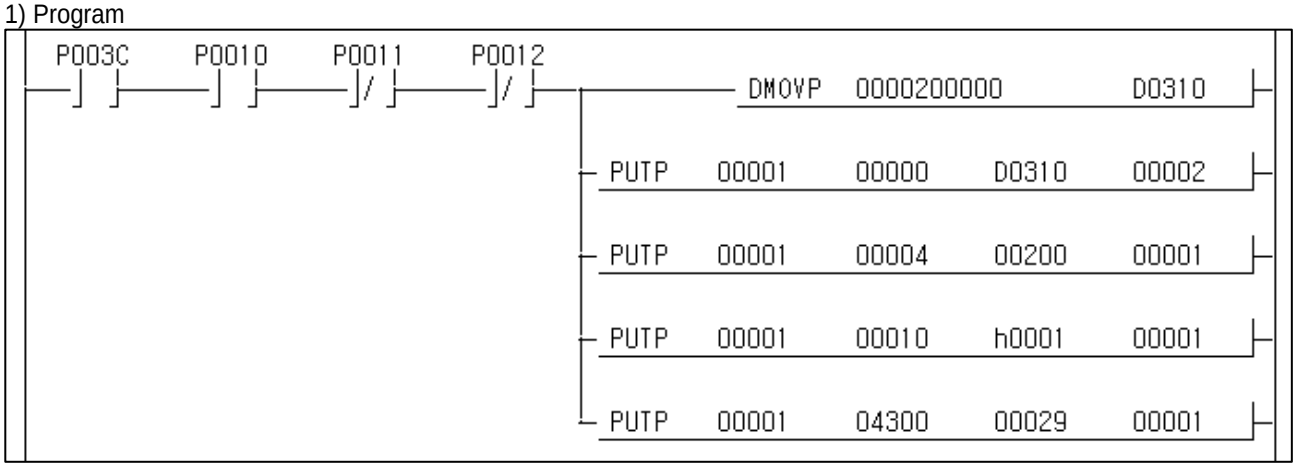
Device	Description	Device	Description
P003B	X axis array teaching input	D0510	Teaching data 1(10000)
P0010	X axis command receiving	D0512	Teaching data 2(15000)
P0011	X axis signal in operation	D0514	Teaching data 3(20000)
P0012	X axis error status		

Address of internal memory	Contents of internal memory	Setting value
4301	Step no.	1
4318	RAM teaching/ROM teaching	1
4319	Position teaching/Speed teaching	1
4320~4321	Array teaching data 1	10000
4322~4323	Array teaching data 2	10000
4324~4325	Array teaching data 3	10000
4352	No. of Teaching	6
4300	Command code	28

▷ If P003B is ON, the array teaching data set as D0510 ~ D0525 from No.1 step operation speed carries out the array speed teaching, respectively. (ROM teaching mode)

9.2.29 Basic Parameter Setting (Command code:29)

1) Program



2) Description

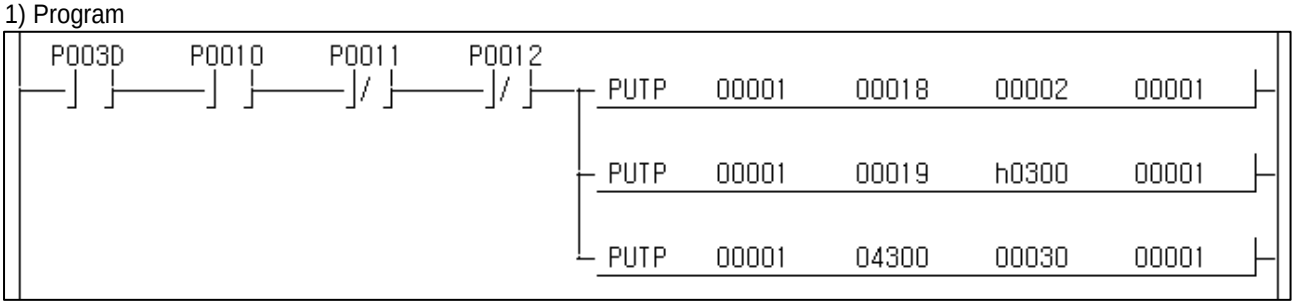
Device	Description
P003C	X axis basic parameter setting input
P0010	X axis command receiving
P0011	X axis signal in operation
P0012	X axis error status
D0310	X axis speed limit (200000)

Address of internal memory	Contents of internal memory (X axis)	Setting value
0000	Speed limit	200000
0004	Acceleration/deceleration 1	200
0010	Basic parameter control word	1(PLS/DIR, Pulse, ×1)
4300	Command code	29

▷ If P003C is ON, it is changed with X axis basic parameter setting.

9.2.30 Extended Parameter Setting (Command code:30)

1) Program



2) Description

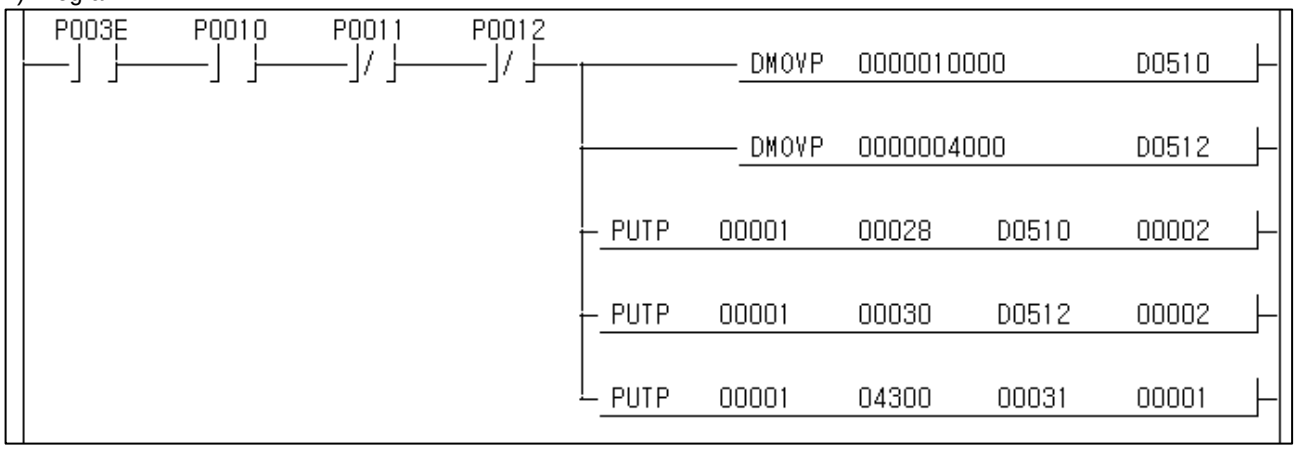
Device	Description
P003D	X axis extended parameter setting input
P0010	X axis command receiving
P0011	X axis signal in operation
P0012	X axis error status

Address of internal memory	Contents of internal memory (X axis)	Setting value
0018	External command signal selection	2(Skip operation)
0019	Extended parameter control word	h0300(external stop permit, external simultaneous start permit)

▷ If P003D is ON, it is changed with X axis extended parameter setting.

9.2.31 Homing Parameter Setting (Command code:31)

1) Program



2) Description

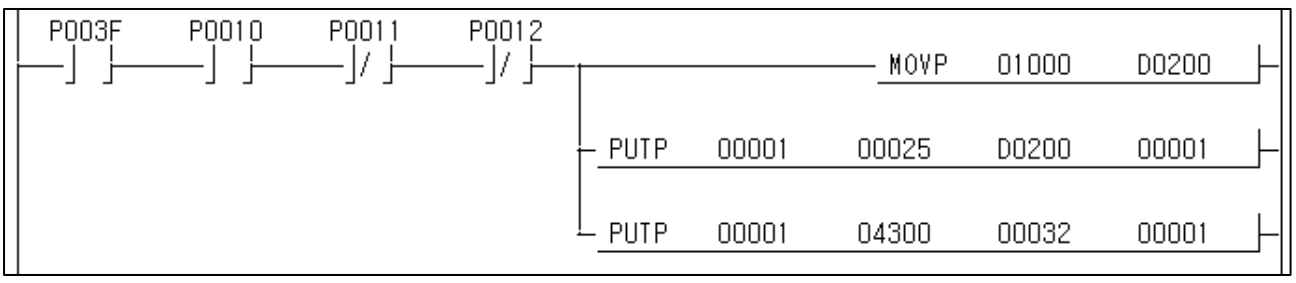
Device	Description
P003E	X axis homing parameter setting input
P0010	X axis command receiving
P0011	X axis signal in operation
P0012	X axis error status

Address of internal memory	Contents of internal memory (X axis)	Setting value
28	Homing high speed	10000(= D0510)
30	Homing low speed	4000(= D0512)

▷ If P003E is ON, it is changed with X axis homing parameter setting.

9.2.32 Manual Operation Parameter Setting (Command code:32)

1) Program



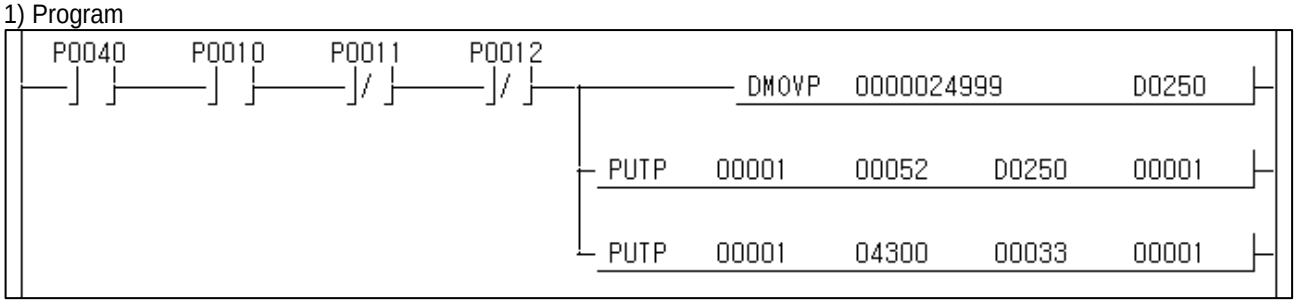
2) Description

Device	Description
P003F	X axis manual operation parameter setting input
P0010	X axis command receiving
P0011	X axis signal in operation
P0012	X axis error status

▷ If P003F is ON, X axis manual operation parameter inching speed of internal memory address #25 is changed with 1000pps.

9.2.33 Common Parameter Setting (Command code:33)

1) Program



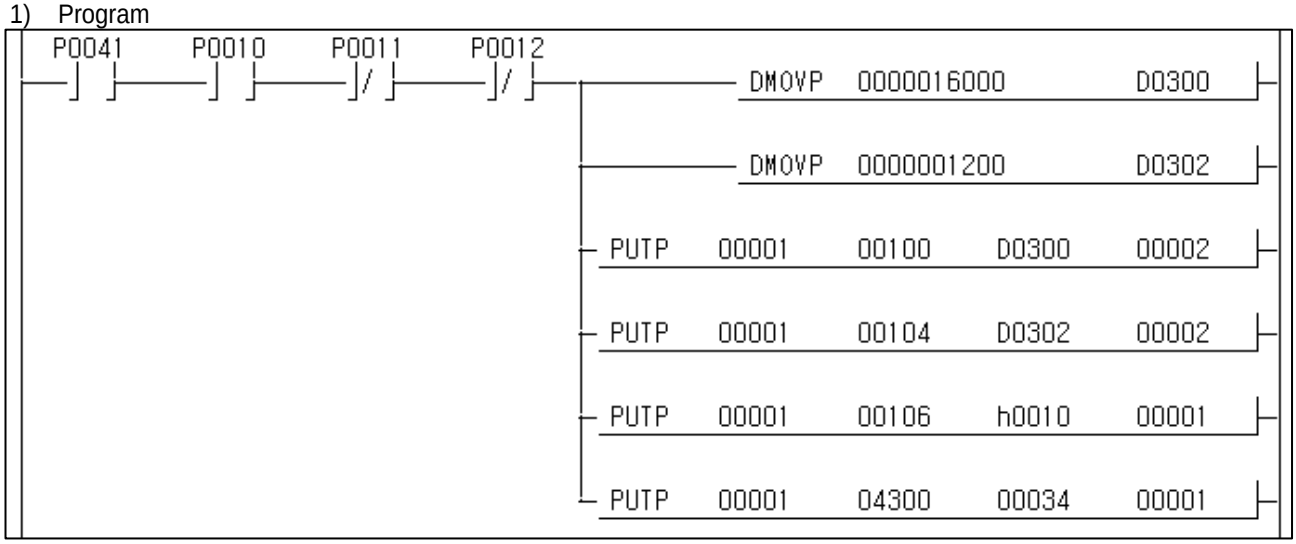
2) Description

Device	Description
P0040	X axis common parameter setting input
P0010	X axis command receiving
P0011	X axis signal in operation
P0012	X axis error status

▷ If P0040 is ON, X axis common parameter Auto Reload of internal memory address #52 is changed with 24999.

9.2.34 Operation Data Setting (Command code:34)

1) Program



2) Description

Device	Description
P0041	X axis operation data setting input
P0010	X axis command receiving
P0011	X axis signal in operation
P0012	X axis error status

Address of internal memory	Contents of internal memory (X axis)	Setting value
100~101	Goal position (Step no.1)	16000
104~105	Operation speed (Step no.1)	1200
108	Operation data control word (step no.1)	h0010 (Relative/Position/Single/End/ acceleration/deceleration time 1)

▷ If P0041 is ON, X axis step no.1 operation data is changed as the setting value.

9.2.35 Emergency Stop (Command code:35)

1) Program

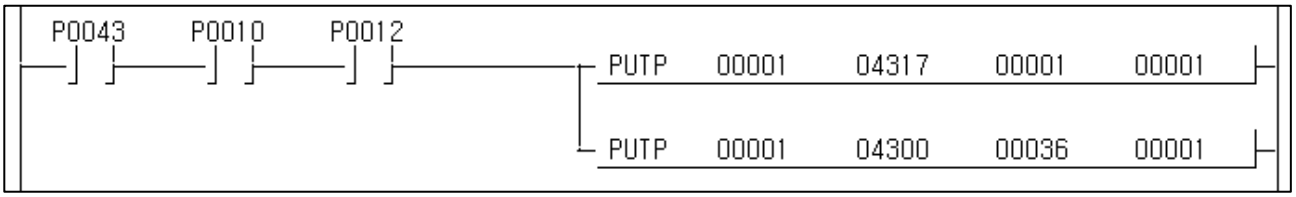
2) Description

Device	Description
P0042	X axis internal emergency stop input
P0010	X axis command receiving

▷ If P0042 is ON, X axis stops emergently and becomes pulse output prohibit status.

9.2.36 Error Reset, Output Prohibit Release (Command code:36)

1) Program



2) Description

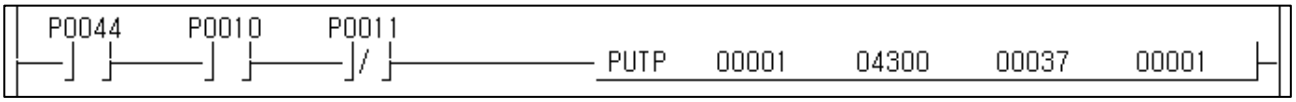
Device	Description
P0043	X axis error reset input
P0010	X axis command receiving
P0012	X axis error status

▷ If P0043 is ON, the error occurred on X axis will be reset and the pulse output prohibit status will be released.

▷ If the value of address #4317 is “0” according to internal memory address #4317, the error status only is released and if the value of #4317 is “1”, pulse output prohibit status will be released at the same time.

9.2.37 Error History Reset (Command code:37)

1) Program



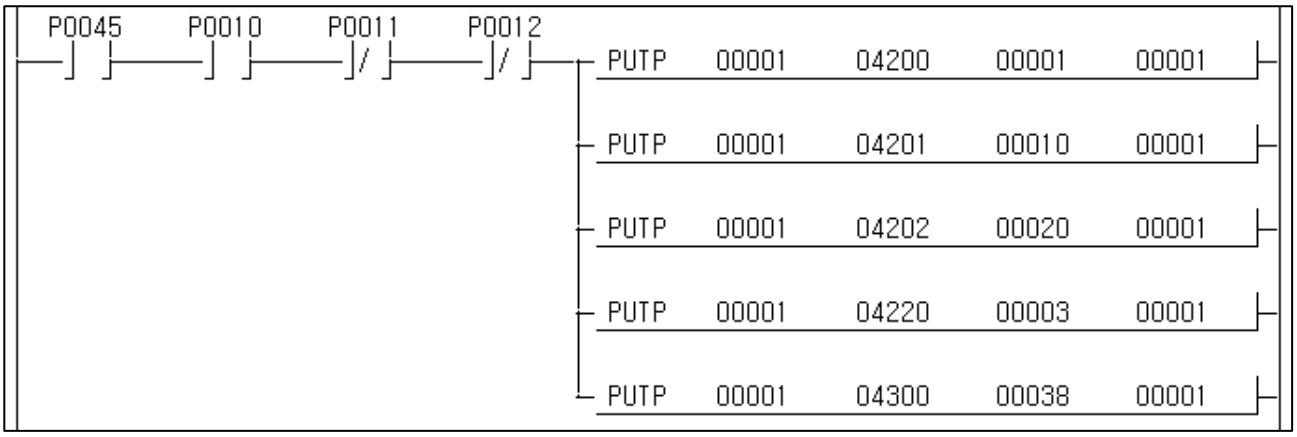
2) Description

Device	Description
P0044	X axis error history reset input
P0010	X axis command receiving
P0011	X axis signal in operation

▷ If P0044 is ON, the error history of internal memory address #4381 ~ 4390 occurred on X axis till now will be reset.

9.2.38 Point Operation (Command code:38)

1) Program



2) Description

Device	Description
P0045	X axis Point operation input
P0010	X axis command receiving
P0011	X axis signal in operation
P0012	X axis error status

▷ If P0045 is ON, it carries out Point operation for X axis step no.1, step no.10, step no.20 in order by one time start.

Chapter 10 GM Program

10.1 Before using Program

- As the information for the action of positioning module can be read in detail by **output variable of Operation status code information read [APM_CRD]** and Current operation status Bit information read **[APM_SRD],** these two function block should be applied for all program.
- Especially, 7 types output variable of Current operation status Bit information read [APM_SRD] should be used as protection circuit to prevent errors when using each function as these output variables provide operation information of positioning module.

Function block	Output variable		Description	
APM_CRD	ERR		Error : indicates Current error code	
	CA		Current Address : indicates Current position address	
	CV		Current Velocity : indicates Current operation speed	
	STEP		Current Step Number : indicates Current operation data no.	
	MCD		Current M Code Number : indicates Current M Code no.	
APM_SRD	ST1	[0]	In operation (0:Stop, 1:BUSY)	The area to indicate the information for the signal generated from Program or Software package.
		[1]	Error status	
		[2]	Positioning completion	
		[3]	M Code ON signal (0:Off, 1:On)	
		[4]	Origin fixing status (0:not fixed, 1:fixed)	
		[5]	Pulse output prohibit status (0:enable,1:prohibit)	
		[6]	Stop status	
		[7]	No used	
	ST2	[0]	High limit detection	
		[1]	Low limit detection	
		[2]	Emergency stop status	
		[3]	Direction (0:normal, 1:reverse)	
		[4]	In acceleration	
		[5]	In constant speed	
		[6]	In deceleration	
		[7]	In Dwell	
	ST3	[0]	1 axis position control operation	
		[1]	1 axis speed control	
		[2]	2 axis linear interpolation	
		[3]	3 axis linear interpolation	
		[4]	2 axis circular interpolation	
		[5]	Homing operation	
		[6]	Position synchronous start operation	
		[7]	Speed synchronous start operation	
	ST4	[0]	Jog low speed operation	
		[1]	Jog high speed operation	
		[2]	Inching operation	
		[3]	MPG operation	
		[4]	Manual operation point return	
		[5]	Zone 1	
		[6]	Zone 2	
		[7]	Zone 3	
	ST5	[0]	Axis status (0:subordinate axis, 1: main axis)	
		[1]	Main axis information (X axis)	
		[2]	Main axis information (Y axis)	
		[3]	Main axis information (Z axis)	
		[4]	Main axis information (Encoder)	
		[5]	No use	
		[6]	No use	
		[7]	No use	
	ST6	[0]	Emergency stop input signal	The area to indicate the information for the I/O signal of positioning module from external machine.
		[1]	Stop input signal	
		[2]	Command input signal	
		[3]	JOG high speed reverse operation signal	
		[4]	High limit input signal	
		[5]	Low limit input signal	
		[6]	Origin input signal	
		[7]	Approximate origin input signal	
	ST7	[0]	Speed/position control switching input signal	
		[1]	Driver ready input signal	
		[2]	External synchronous start input signal	
		[3]	Zone1 output signal	
		[4]	Zone2 output signal	
		[5]	Zone3 output signal	
		[6]	No use	
		[7]	No use	

10.2 Basic Program

For basic program, please refer to Chapter 3.

No.	Program Name	Page
1	Basic (Floating point setting)	3-1
2	Basic (Linear interpolation start Floating point setting)	3-4
3	Basic (Circular interpolation start Floating point setting)	3-9
4	Speed control	3-16
5	Position/Speed conversion control	3-19
6	End operation (Homing)	3-22
7	End operation (Repeat operation step no. change)	3-24
8	Jog operation	3-44
9	Manual pulse generator	3-45
10	Inching operation	3-47
11	Return to the position before manual operation	3-48
12	Speed change	3-49
13	Operation step no. change by Continuous operation (APM_NMV)	3-51
14	Positioning speed override command	3-52
15	Position change by position override	3-53
16	Current position change	3-56
17	Single teaching	3-58
18	Plural teaching	3-59
19	Start step no. change	3-60
20	Skip operation	3-61
21	M code operation	3-63
22	Basic parameter setting	3-64
23	Extended parameter setting	3-65
24	Homing parameter setting	3-66
25	Manual operation parameter setting	3-67
26	Common parameter setting	3-68
27	Operation data setting	3-69
28	Encoder reset	3-70
29	Error output and output prohibit	3-71
30	ZONE output	3-72

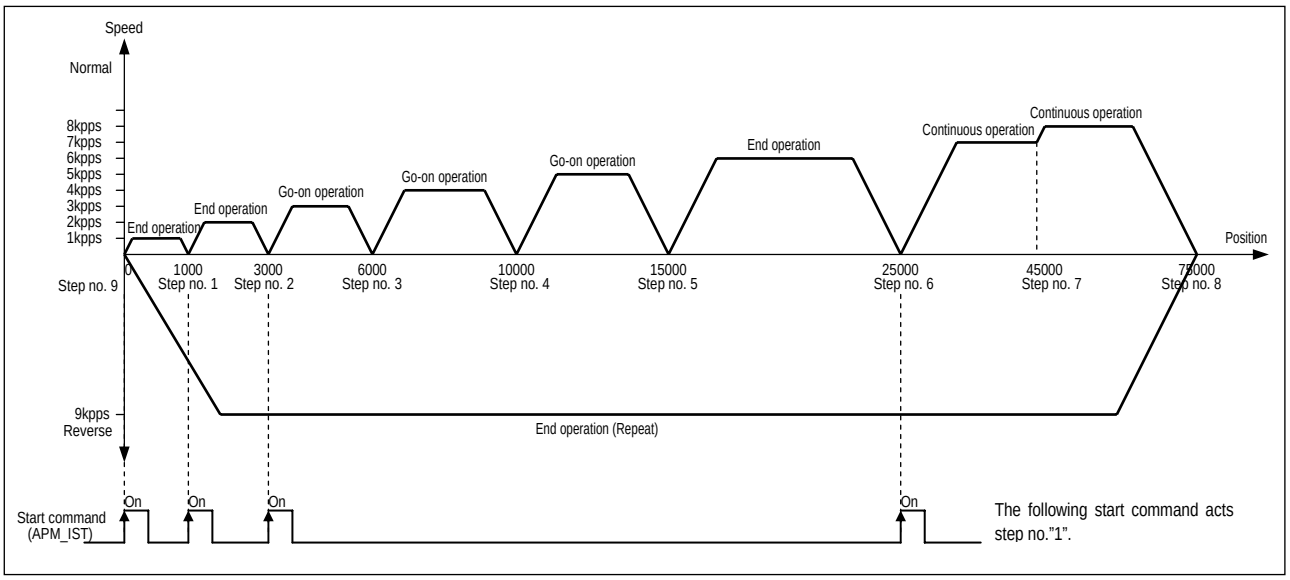
10.3 Application Program

10.3.1 End operation, Go-on operation, Continuous operation positioning

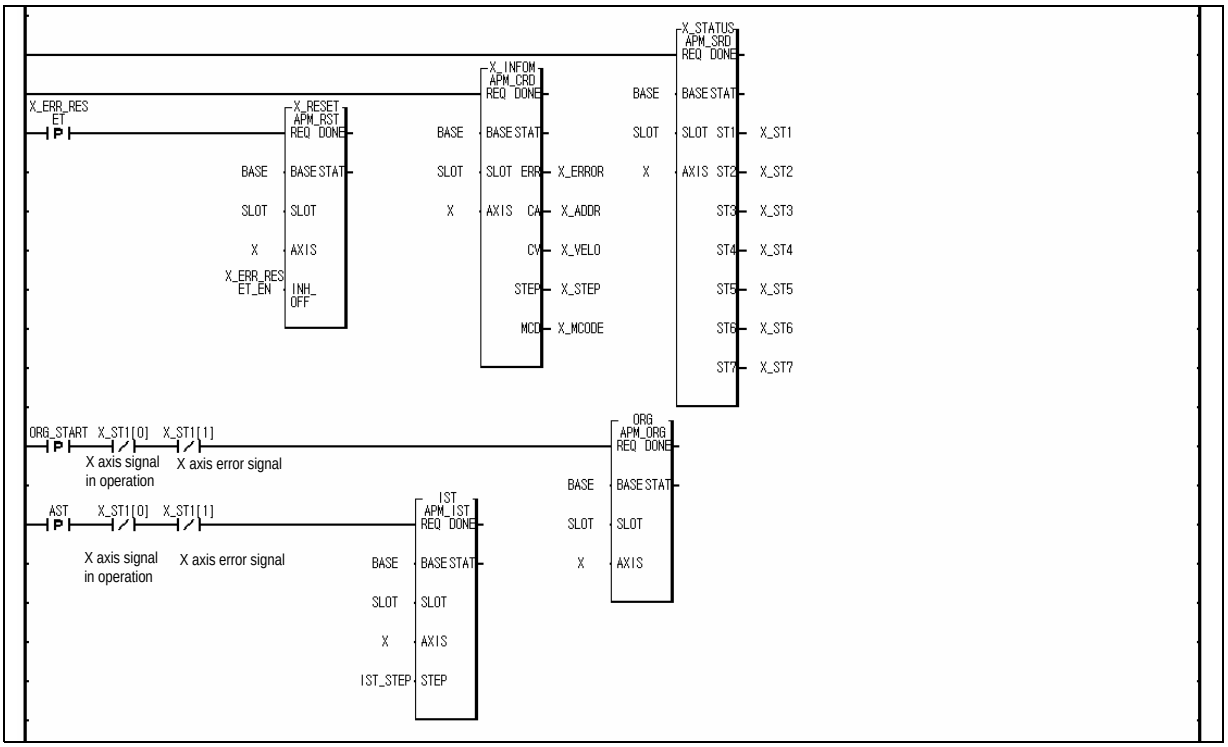
1) Soft t package setting

Items of Position data	Step No.	Coordinate	Control method	Operation pattern	Operation method	Goal position [pulse]	Circular interpolation aux. Point [pulse]	M code	Acc./ Dec. No.	Operation speed [pls/s]	Dwell time [ms]	Circular interpolation direction
X setting	1	Relative	Position	End	Single	1000	0	**0**	1	1000	20	CW
	2	Relative	Position	End	Single	2000	0	**0**	1	2000	20	CW
	3	Relative	Position	Go-on	Single	3000	0	**0**	1	3000	20	CW
	4	Relative	Position	Go-on	Single	4000	0	**0**	1	4000	20	CW
	5	Relative	Position	Go-on	Single	5000	0	**0**	1	5000	20	CW
	6	Relative	Position	End	Single	10000	0	**0**	1	6000	20	CW
	7	Relative	Position	Conti.	Single	20000	0	**0**	1	7000	20	CW
	8	Relative	Position	Conti.	Single	30000	0	**0**	1	8000	20	CW
	9	Relative	Position	End	Repeat	0	0	**0**	1	9000	20	CW

2) Operation pattern



3) Program example



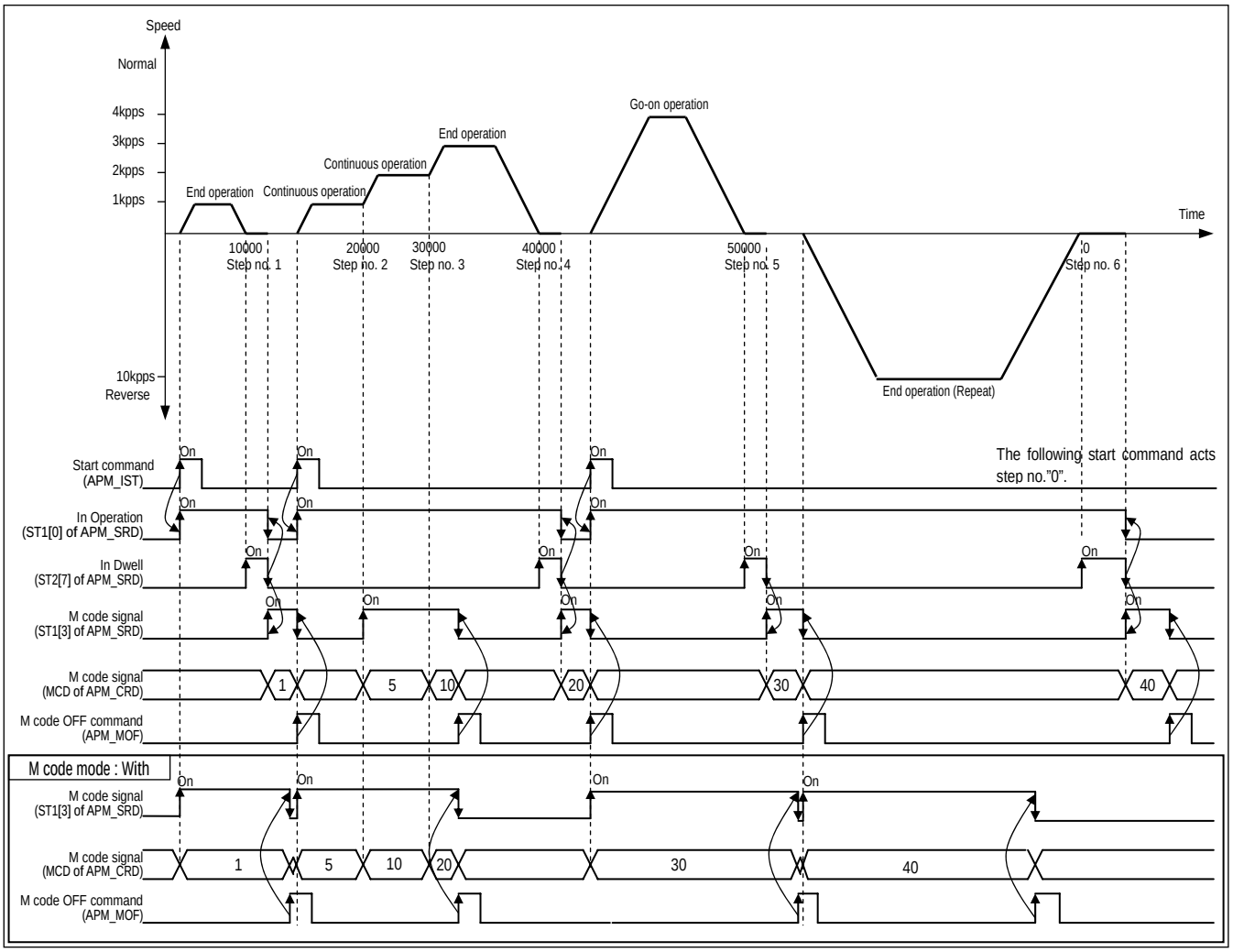
10.3.2 Positioning by M code

1) Software Package Setting

Items of Position data	Step No.	Coordinate	Control method	Operation pattern	Operation method	Goal position [pulse]	Circular interpolation aux. Point [pulse]	M code	Acc./ Dec. No.	Operation speed [pls/s]	Dwell time [ms]	Circular interpolation direction
X setting	1	Absolute	Position	End	Single	10000	0	**1**	1	1000	100	CW
	2	Absolute	Position	Conti.	Single	20000	0	**5**	1	1000	100	CW
	3	Absolute	Position	Conti.	Single	30000	0	**10**	1	2000	100	CW
	4	Absolute	Position	End	Single	40000	0	**20**	1	3000	100	CW
	5	Absolute	Position	Go-on	Single	50000	0	**30**	1	4000	100	CW
	6	Absolute	Position	End	Repeat	0	0	**40**	1	5000	100	CW

Extended parameter	M code output	2:AFTER

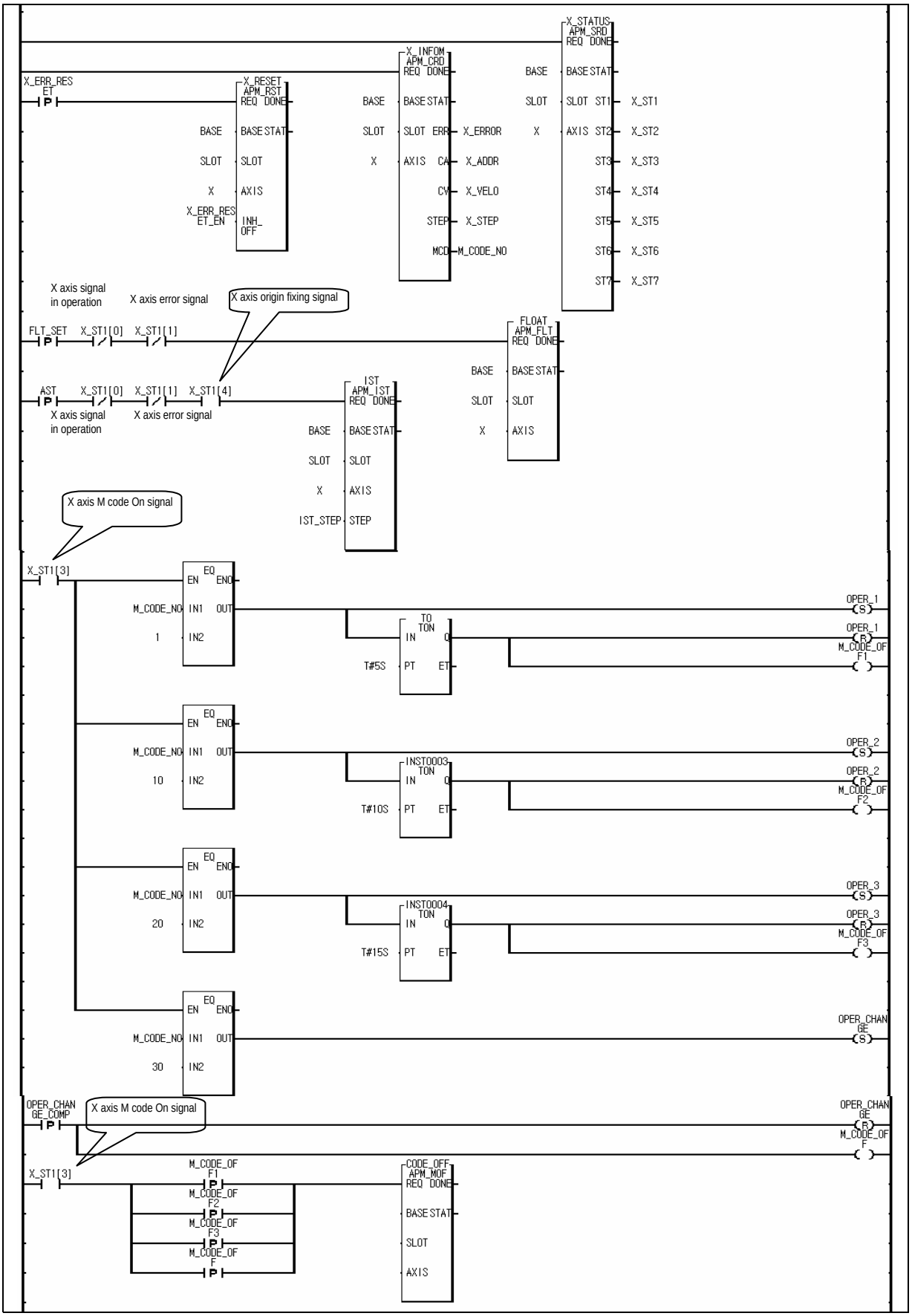
2) Operation pattern



Point

- ▶In case of Continuous operation mode, M code signal is changed with the corresponding M code signal without Stop whenever operation step no. is changed, and the operation continues.
- ▶In case of Go-on operation mode, if M code signal is ON, it is required to change the ON signal with OFF signal by M code OFF command in order to operate next operation step no.

3) Program example



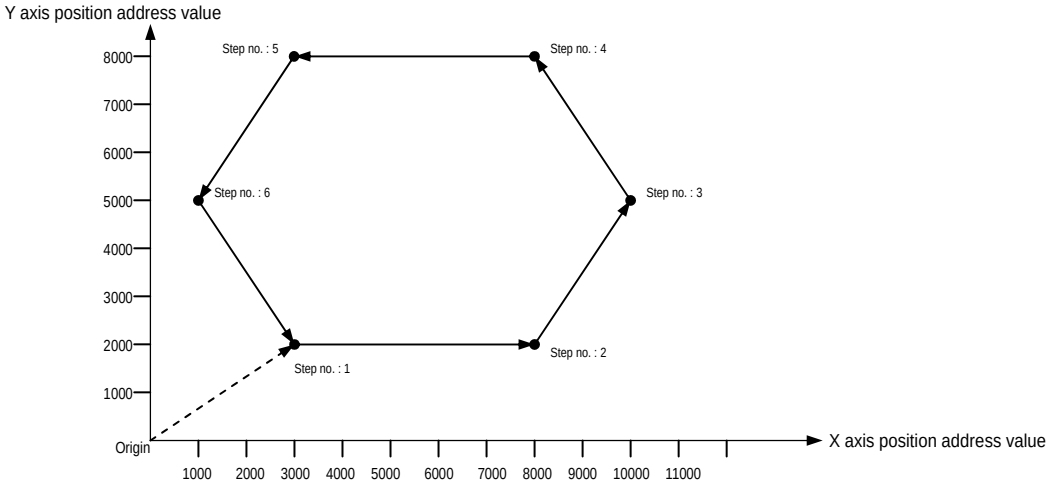
10.3.3 2 axis Linear Interpolation Operation

1) Software package setting

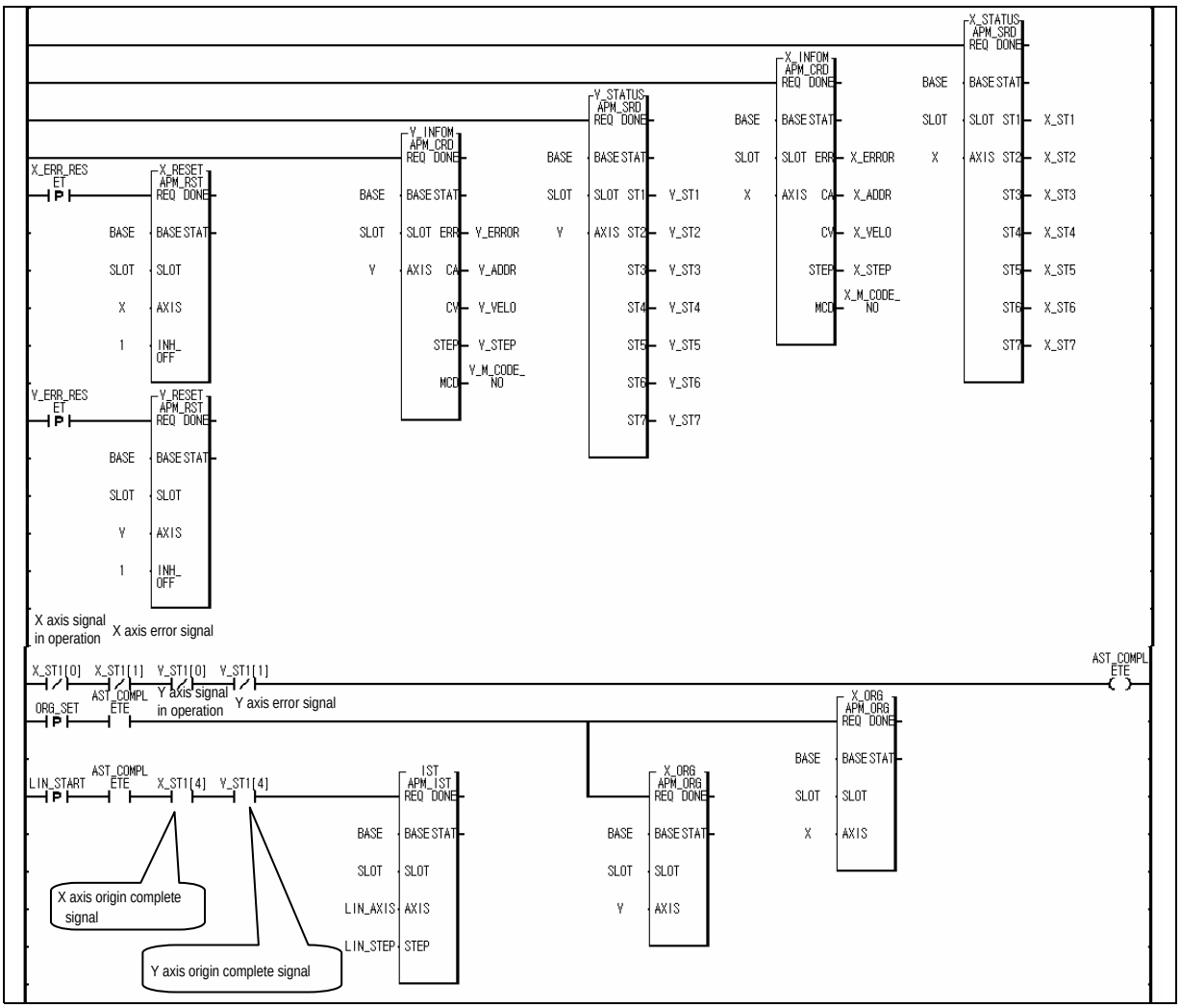
Items of Position data	Step No.	Coordinate	Control method	Operation pattern	Operation method	Goal position [pulse]	Circular interpolation aux. Point [pulse]	M code	Acc./ Dec. No.	Operation speed [pls/s]	Dwell time [ms]	Circular interpolation direction
X setting	1	Absolute	Position	End	Single	3000	0	**0**	1	1000	100	CW
	2	Absolute	Position	Go-on	Single	8000	0	**0**	1	1000	100	CW
	3	Absolute	Position	Go-on	Single	10000	0	**0**	1	1000	100	CW
	4	Absolute	Position	Go-on	Single	8000	0	**0**	1	1000	100	CW
	5	Absolute	Position	Go-on	Single	3000	0	**0**	1	1000	100	CW
	6	Absolute	Position	Go-on	Repeat	1000	0	**0**	1	1000	100	CW

Items of Position data	Step No.	Coordinate	Control method	Operation pattern	Operation method	Goal position [pulse]	Circular interpolation aux. Point [pulse]	M code	Acc./ Dec. No.	Operation speed [pls/s]	Dwell time [ms]	Circular interpolation direction
Y setting	1	Absolute	Position	End	Single	2000	0	**0**	1	1000	100	CW
	2	Absolute	Position	Go-on	Single	2000	0	**0**	1	1000	100	CW
	3	Absolute	Position	Go-on	Single	5000	0	**0**	1	1000	100	CW
	4	Absolute	Position	Go-on	Single	8000	0	**0**	1	1000	100	CW
	5	Absolute	Position	Go-on	Single	8000	0	**0**	1	1000	100	CW
	6	Absolute	Position	Go-on	Repeat	5000	0	**0**	1	1000	100	CW

2) Operation pattern



3) Program example



10.3.4 Position Teaching by MMI

1) Software package setting

Items of Position data	Step No.	Coordinate	Control method	Operation pattern	Operation method	Goal position [pulse]	Circular interpolation aux. Point [pulse]	M code	Acc./ Dec. No.	Operation speed [pls/s]	Dwell time [ms]	Circular interpolation direction
X setting	1	Absolute	Position	End	Single	10000	0	**0**	1	500	20	CW
	2	Absolute	Position	End	Repeat	0	0	**0**	1	500	20	CW

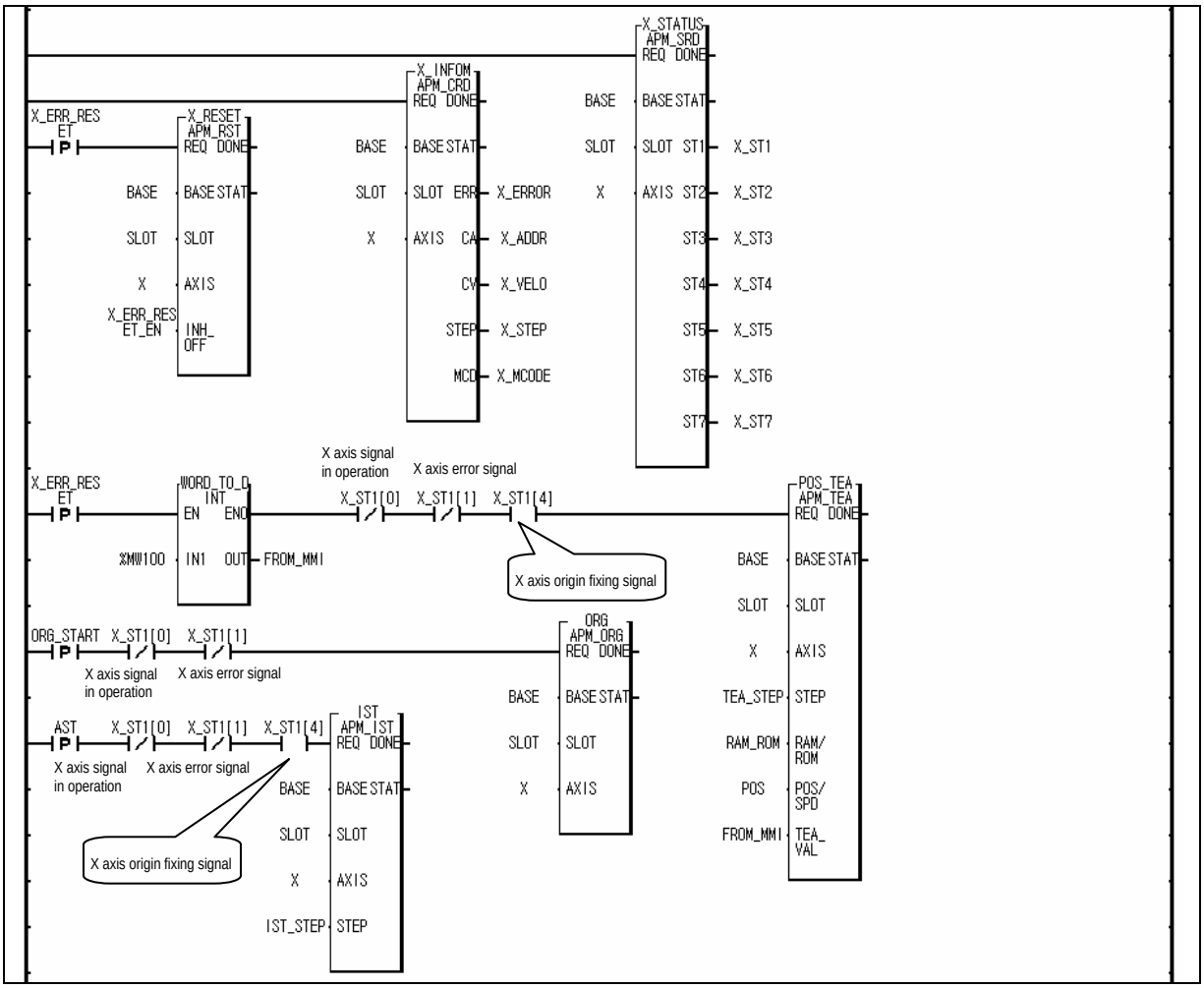
2) Using I/O variables

(1) Transmits the position address value to CPU module by %MW100 of MMI : %MW100

(2) Changes the position address value : %M0 (position change by MMI)

(3) Starts indirect start : %M1 (start command of MMI)

3) Program example

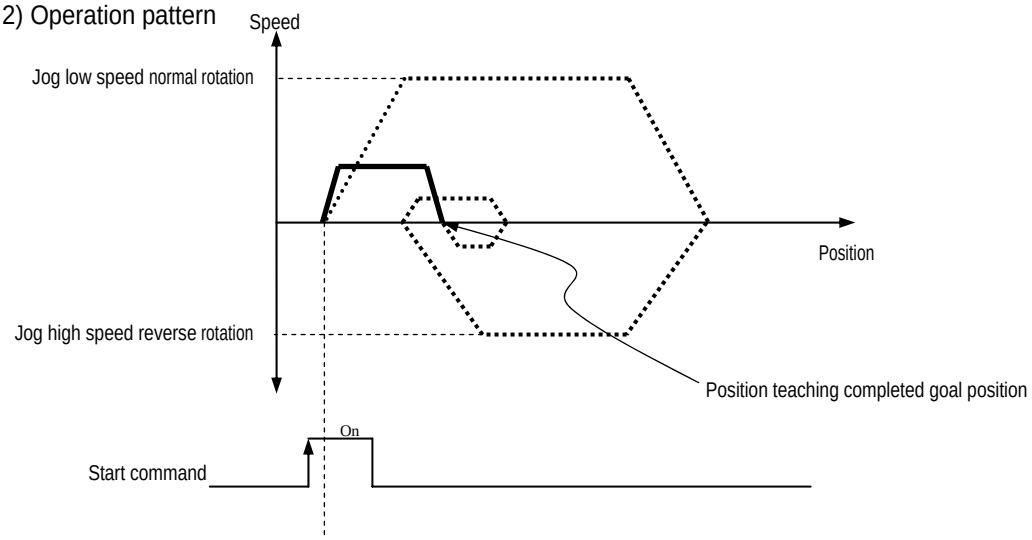


10.3.5 Position Teaching by Jog Operation and Inching Operation

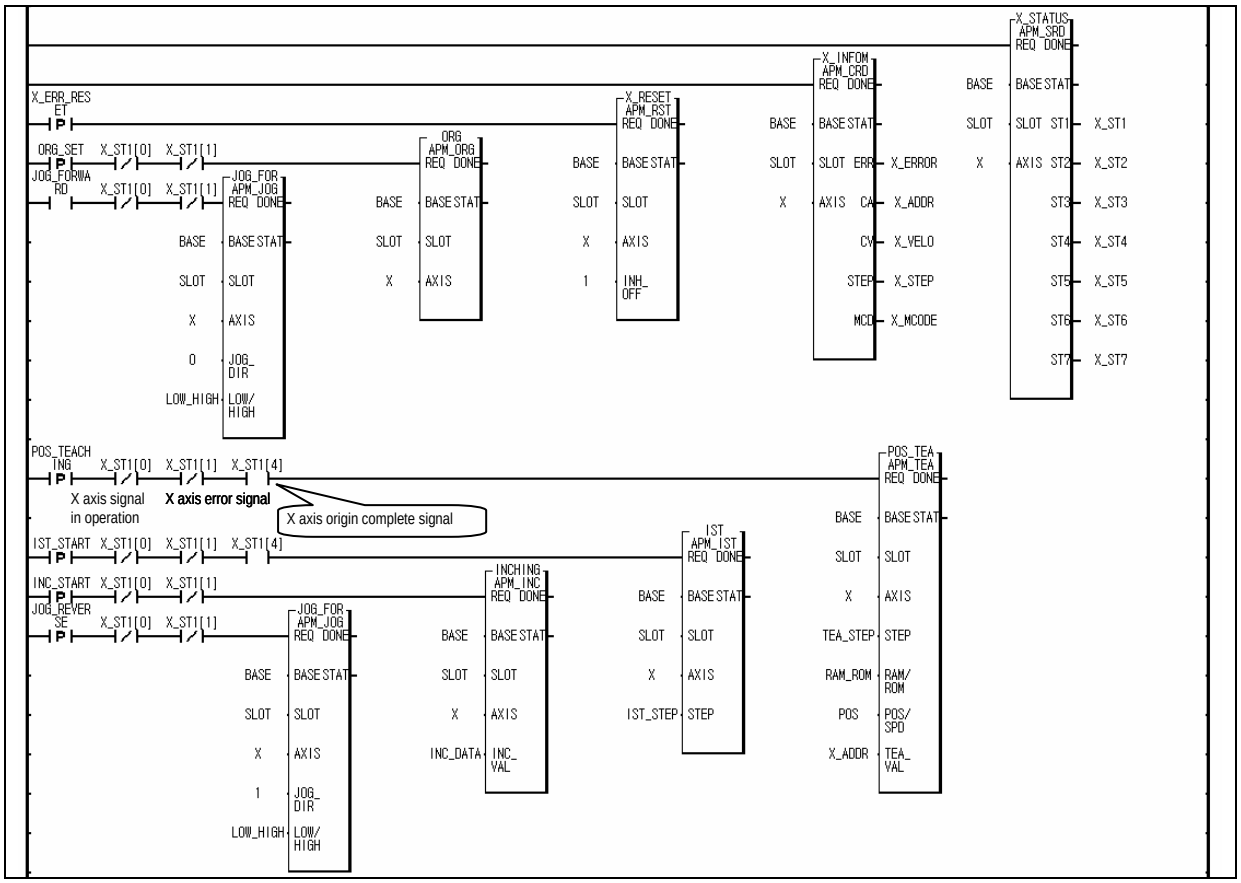
1) Software package setting

Items of Position data	Step No.	Coordinate	Control method	Operation pattern	Operation method	Goal position [pulse]	Circular interpolation aux. Point [pulse]	M code	Acc./ Dec. No.	Operation speed [pls/s]	Dwell time [ms]	Circular interpolation direction
X setting	1	Absolute	Position	End	Single	0	0	**0**	1	1000	100	CW
	2	Absolute	Position	End	Single	0	0	**0**	1	0	0	CW

2) Operation pattern



3) Program example

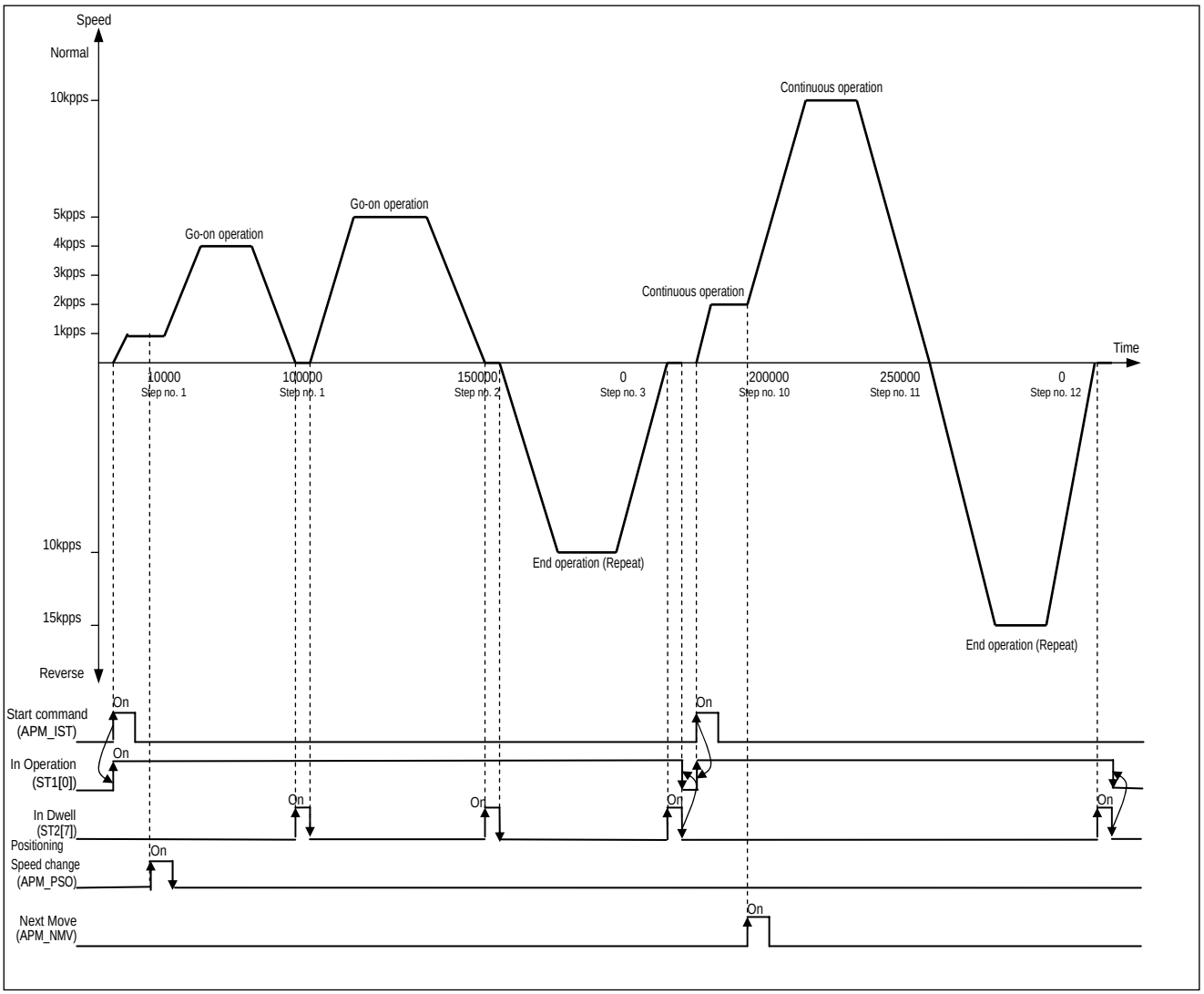


10.3.6 Positioning Speed Change, Next Move

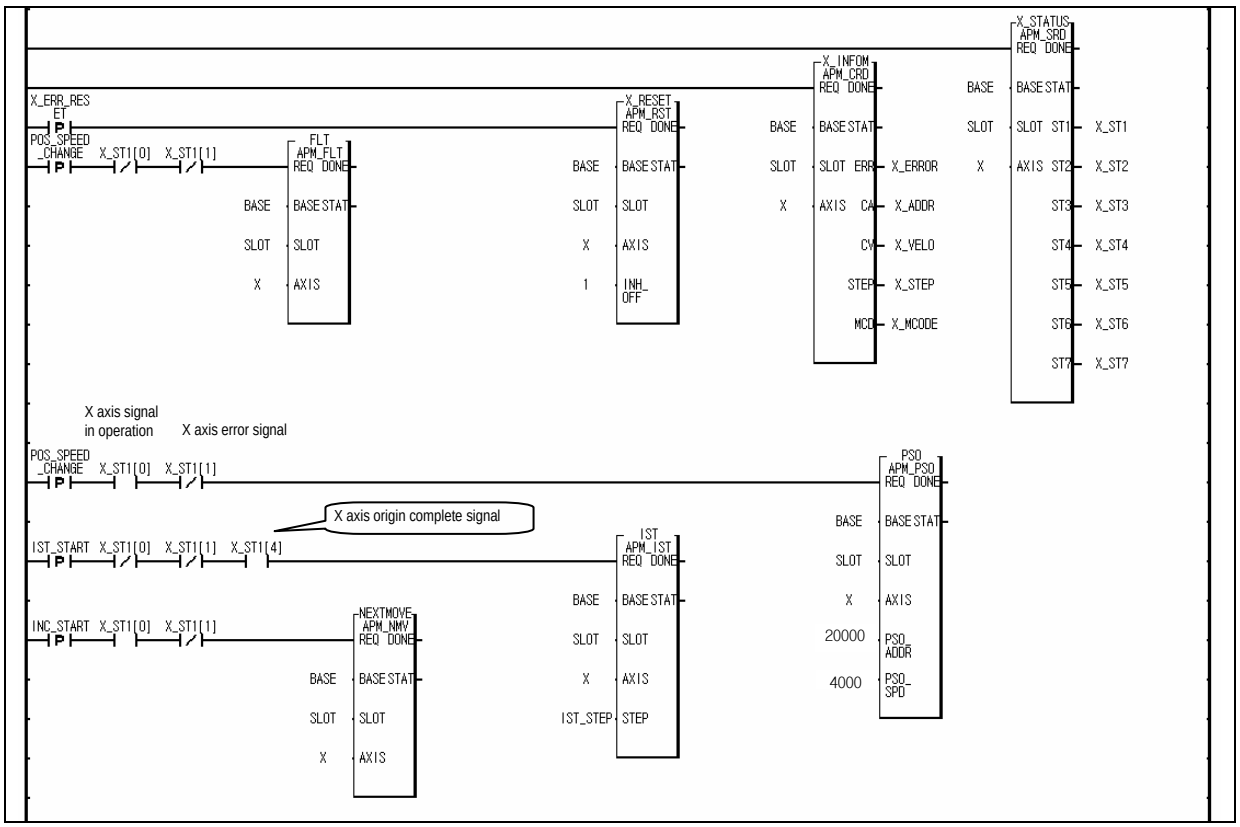
1) Software package setting

Items of Position data	Step No.	Coordinate	Control method	Operation pattern	Operation method	Goal position [pulse]	Circular interpolation aux. Point [pulse]	M code	Acc./ Dec. No.	Operation speed [pls/s]	Dwell time [ms]	Circular interpolation direction
X setting	1	Absolute	Position	Go-on	Single	100000	0	**0**	1	1000	100	CW
	2	Absolute	Position	Go-on	Single	150000	0	**0**	1	5000	100	CW
	3	Absolute	Position	End	Repeat	0	0	**0**	1	10000	100	CW
	10	Absolute	Position	Conti.	Single	200000	0	**0**	1	2000	100	CW
	11	Absolute	Position	Conti.	Single	250000	0	**0**	1	10000	100	CW
	12	Absolute	Position	End	Repeat	0	0	**0**	1	15000	100	CW

2) Operation pattern



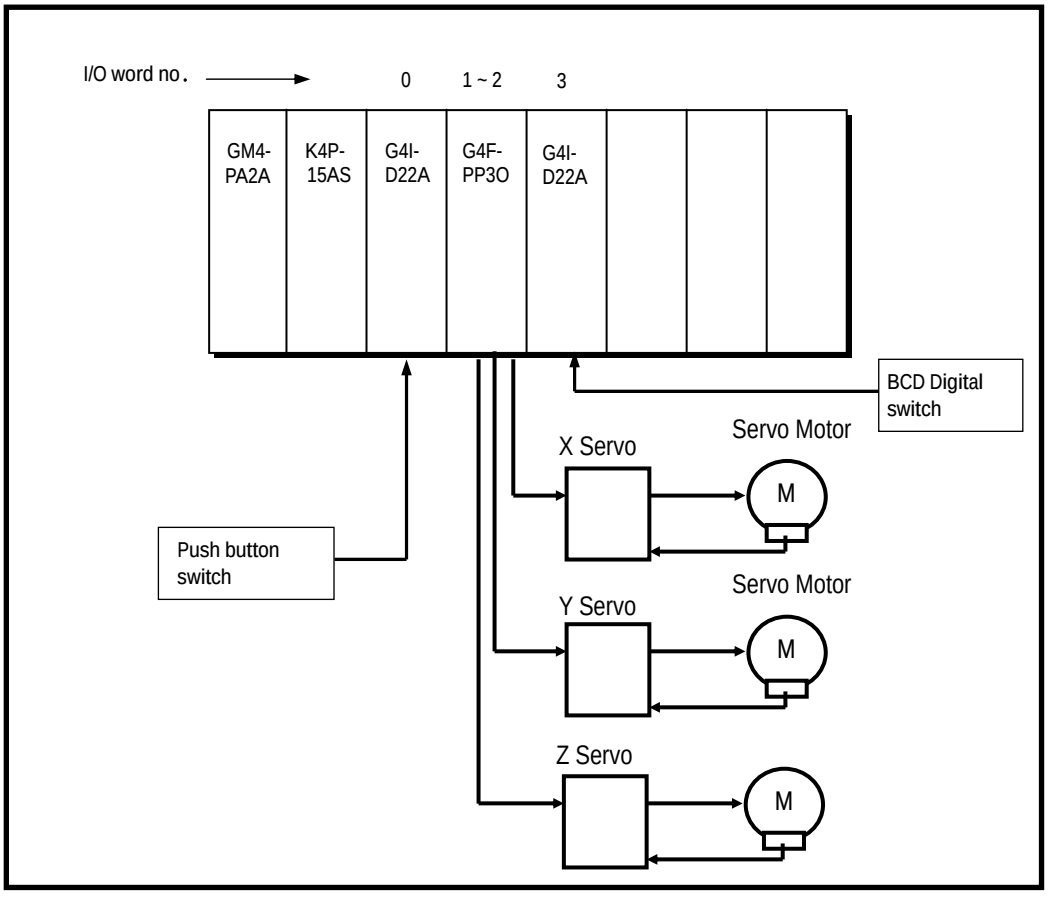
3) Program example



Chapter 11 MK Program

11.1 Before using the Program

- This chapter describes the application program examples that operate Positioning module (G4F-PP1/2/3O, G4F-PP1/2/3D) of MASTER-K300S by PLC program.
- Unless otherwise described, the examples are composed of PLC system as below.
- Fig. 11.1 show the case that positioning module (G4F-PP1/2/3O, G4F-PP1/2/3D) of MASTER-K300S is installed in Slot 1.
- In case of installing positioning module in other Slot, it is required to change I/O word no. to write Sequence program.
- In case of reading the status information when MASTER-K200S/300S carries out internal memory data read/write by positining module, GET, GETP command are used and in case of writing the command and data, PUT, PUTP command are used.
- For the method to use PUT, PUTP, GET, GETP command, please refer to MK programing manual.
- For external input switch, Push button switch was used. In case of using Toggle switch, cares should be taken in using.
-



[Fig. 11.1] System Configuration of Basic Example Program

11.2 Basic Program

11.2.1 Basic (Floating point setting)

1) Description

(1) Used device

Device	Description
P0000	X axis error reset, output prohibit release switch
P0001	X axis floating point switch
P000F	X axis start switch
P0010	X axis command receive signal
P0011	X axis signal in operation
P0012	X axis error status signal
P0020	X axis start
M000 ~ M003	X axis status informatin read (operation status bit information/axis information/ external I/O signal status)
D0000 ~ D0006	X axis operation information read (current position/speed/step no./M code/error information)

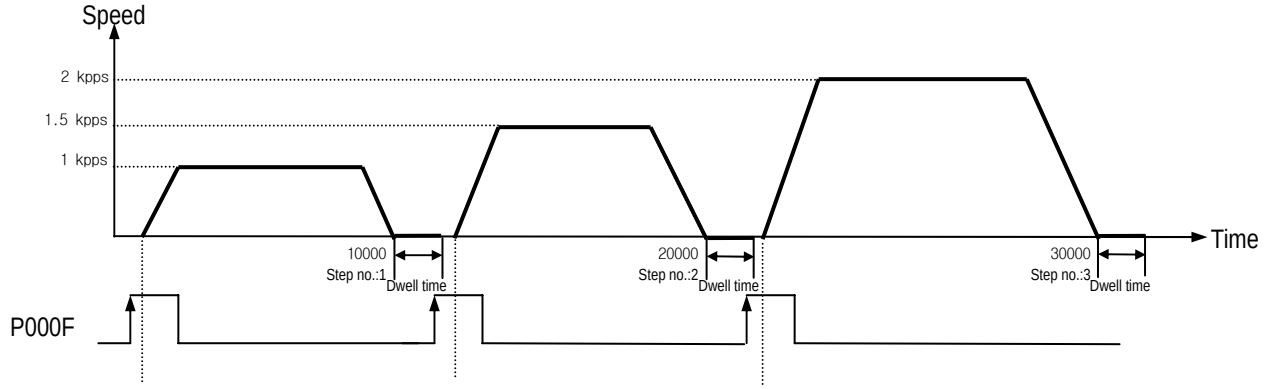
(2) Operation Order

P000F(Start) switch ON => P000F(Start) switch ON 3 times

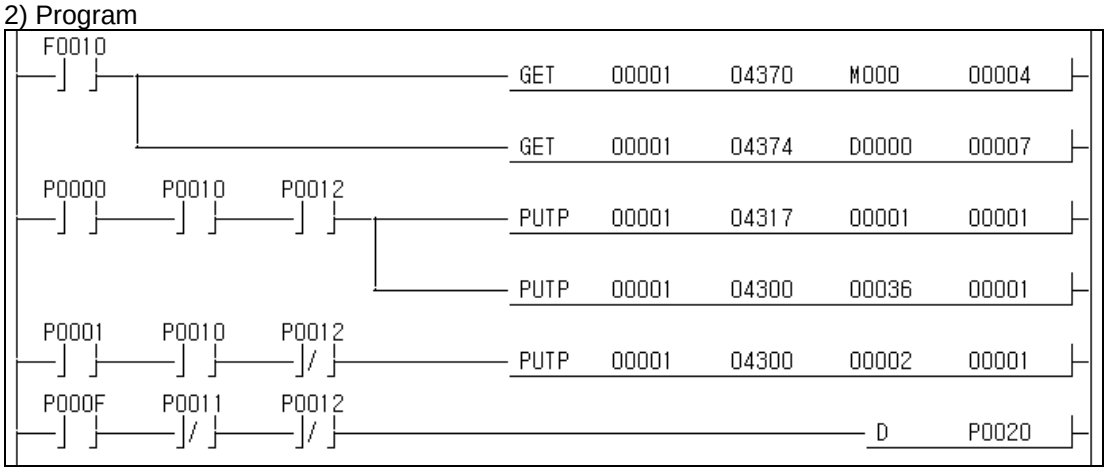
(3) Operation Data Setting

Items of Position data	Step no.	Coordinate	Control method	Operation pattern	Operation method	Goal position [pulse]	Circular interpolation aux. point [pulse]	M code	Acc./Dec. no.	Operation speed [pls/s]	Dwell time [ms]	Circular interpolation direction
X setting	1	Absolute	Position	End	Single	10000	0	0	1	1000	100	CW
	2	Absolute	Position	End	Single	20000	0	0	1	1500	100	CW
	3	Absolute	Position	End	Single	30000	0	0	1	2000	100	CW

(4) Operation Pattern



2) Program



11.2.2 Basic (Linear interpolation start_Floating point setting)

1) Description

(1) Used device

Device	Description
P0000	X,Y axis error reset, output prohibit release switch
P0001	X,Y axis floating point switch
P000F	X,Y axis linear interpolation start switch
P0010	X axis command receive signal
P0011	X axis signal in operation
P0012	X axis error status signal
P0015	Y axis command receive signal
P0016	Y axis signal in operation
P0017	Y axis error status signal
M000 ~ M003	X axis status information read (operation status bit information/ axis information / external I/O signal status)
D0000 ~ D0006	X axis operation information read (current position/speed/step no./M code/error information)
M010 ~ M013	Y axis status information read (operation status bit information/ axis information/ external I/O signal status)
D0010 ~ D0016	Y axis operation information read (current position/speed/step no./M code/error information)

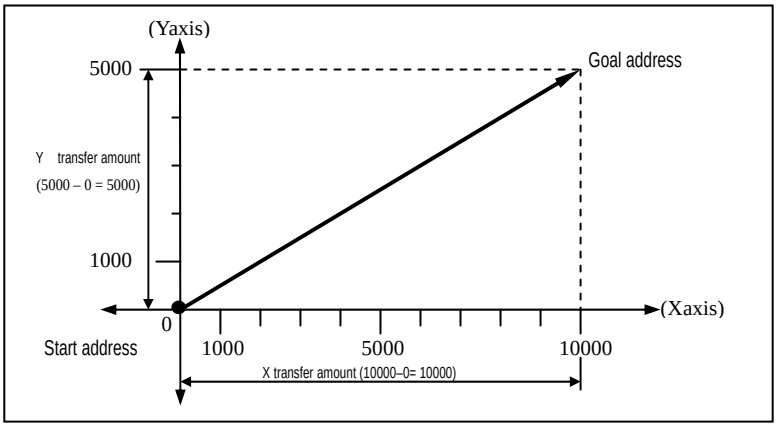
(2) Operation Order

P0001(floating point) switch ON => P000F(linear interpolation start) switch ON

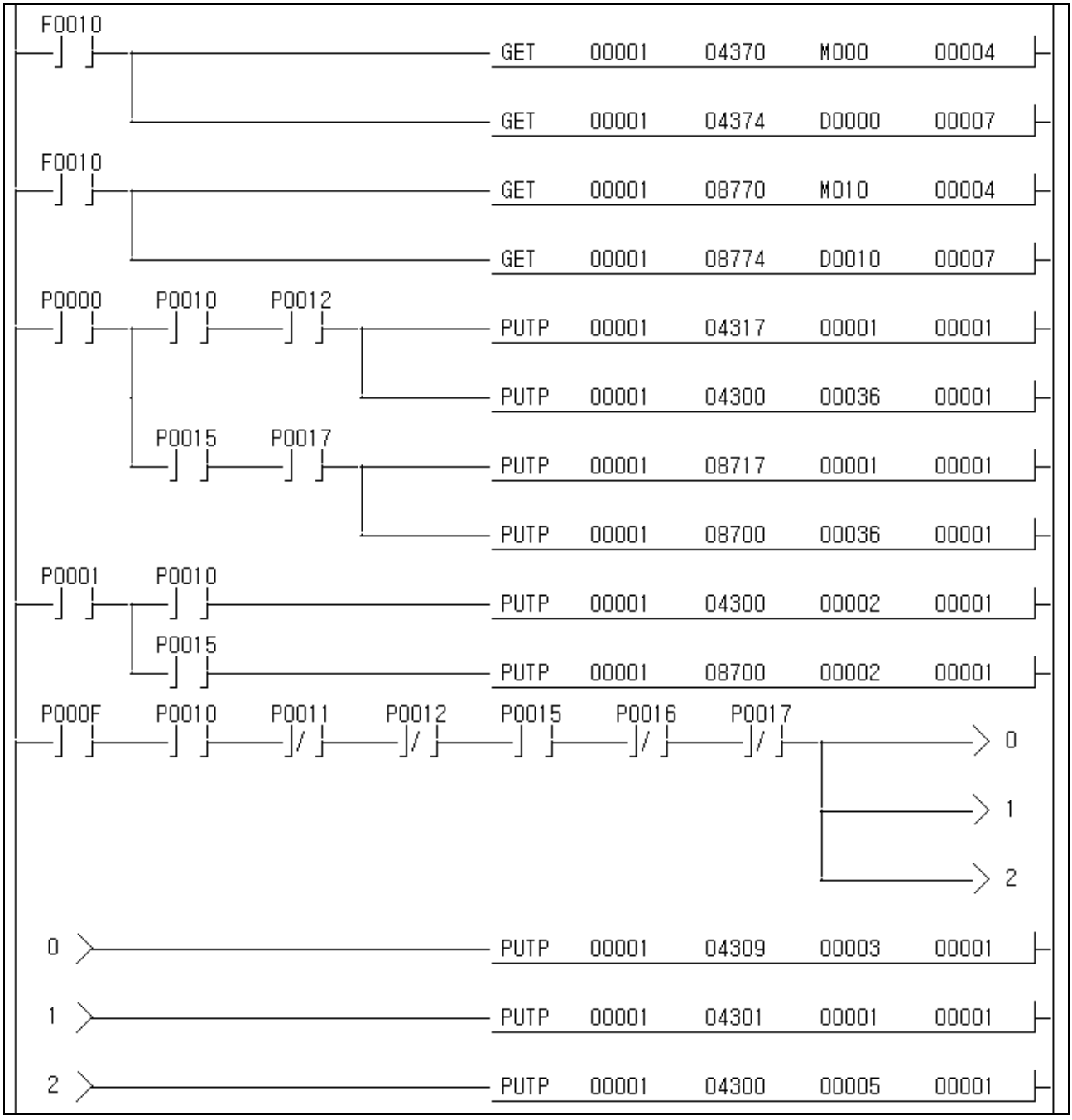
(3) Operation Data Setting

Items of Position data	Step no.	Coordinate	Control method	Operation pattern	Operation method	Goal position [pulse]	Circular interpolation aux. point [pulse]	M code	Acc./Dec. no.	Operation speed [pls/s]	Dwell time [ms]	Circular interpolation direction
X setting	1	Absolute	Position	End	Single	10000	0	0	1	1000	100	CW
Y setting	1	Absolute	Position	End	Single	5000	0	0	1	0	100	CW

(4) Operation Pattern



2) Program


F0010
GET 00001 04370 M000 00004
GET 00001 04374 D0000 00007
F0010
GET 00001 08770 M010 00004
GET 00001 08774 D0010 00007
P0000 P0010 P0012
PUTP 00001 04317 00001 00001
PUTP 00001 04300 00036 00001
P0015 P0017
PUTP 00001 08717 00001 00001
PUTP 00001 08700 00036 00001
P0001 P0010
PUTP 00001 04300 00002 00001
P0015
PUTP 00001 08700 00002 00001
P000F P0010 P0011 P0012 P0015 P0016 P0017
0
1
2
0
PUTP 00001 04309 00003 00001
1
PUTP 00001 04301 00001 00001
2
PUTP 00001 04300 00005 00001

11.2.3 Basic (Circular interpolation start_Floating point setting)

1) Description

(1) Used device

Device	Description
P0000	X,Y axis error reset, output prohibit release switch
P0001	X,Y axis floating point switch
P000F	X,Y axis circular interpolation start switch
P0010	X axis command receive signal
P0011	X axis signal in operation
P0012	X axis error status signal
P0015	Y axis command receive signal
P0016	Y axis signal in operation
P0017	Y axis error status signal
M000 ~ M003	X axis status information read (operation status bit information/ axis information/ external I/O signal status)
D0000 ~ D0006	X axis operation information read (current position/speed/step no./M code/error information)
M010 ~ M013	Y axis status information read (operation status bit information/ axis information/ external I/O signal status)
D0010 ~ D0016	Y axis operation information read (current position/speed/step no./M code/error information)

(2) Operation Order

P0001(floating point) switch ON => P000F(circular interpolation start) switch ON

▷ This is the case that circular interpolation operation by center point method is set in commpon parameter.

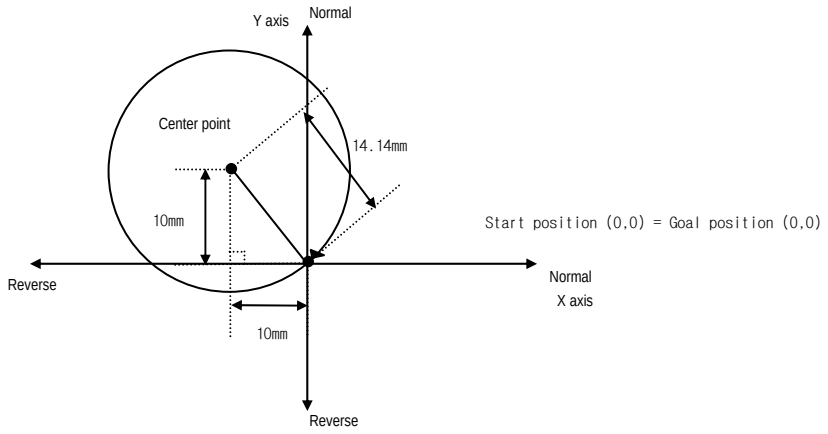
(3) Operation Data Setting

Items of Position data	Step no.	Coordinate	Control method	Operation pattern	Operation method	Goal position [um]	Circular interpolation aux. point [um]	M code	Acc./Dec. no.	Operation speed [mm/m]	Dwell time [ms]	Circular interpolation direction
X setting	1	Relative	Position	End	Single	0.0	-10000.0	0	1	100.00	100	CW
Y setting	1	Relative	Position	End	Single	0.0	10000.0	0	1	100.00	100	CW

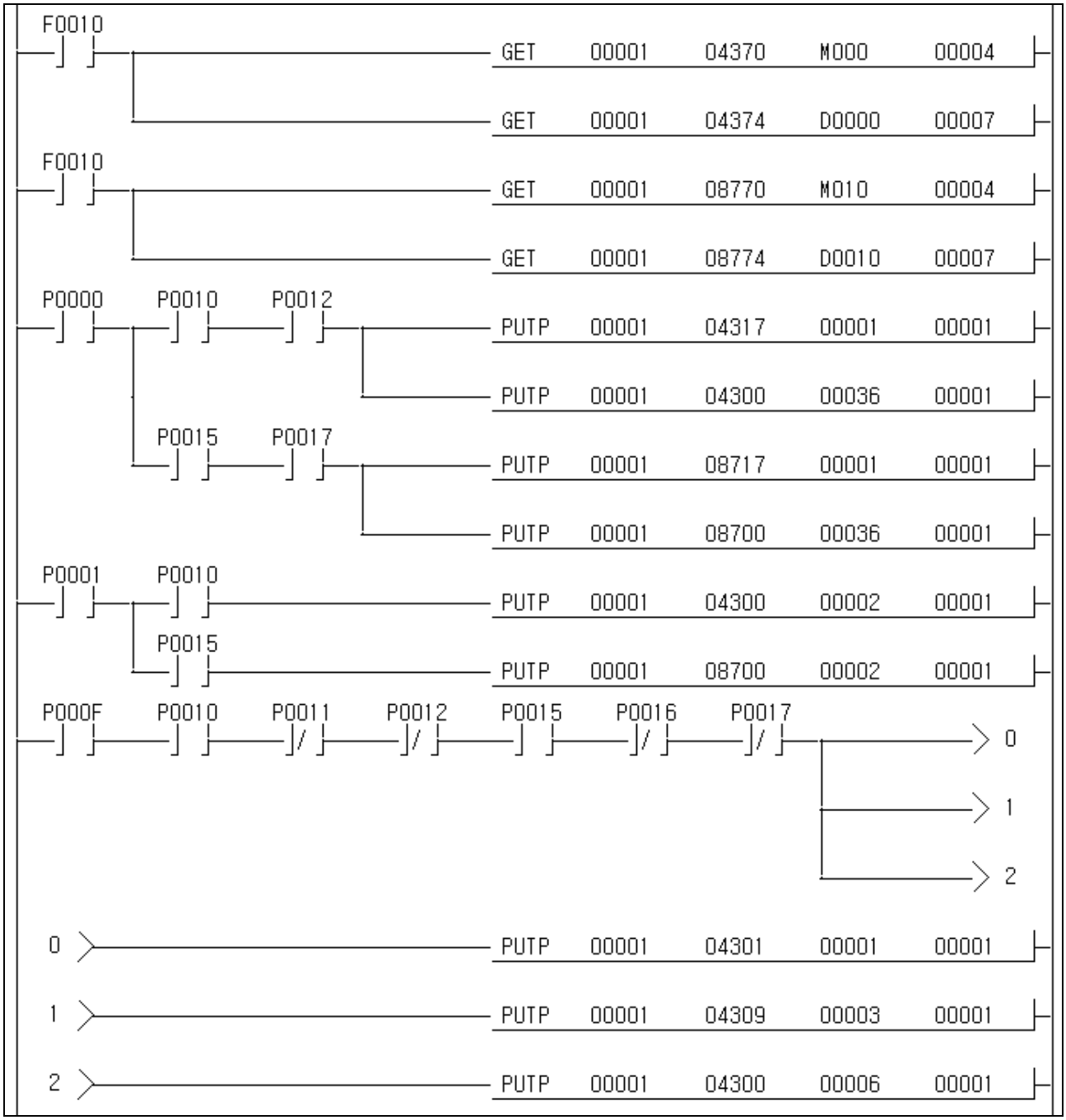
(4) Circular Interpolation Command Condition

Address of internal memory	Contents of internal memory	Setting value
4301	Step no.	1
4309	Axis information	3(X,Y)
4300	Command information	6

(5) Operation Pattern



2) Program


F0010
GET 00001 04370 M000 00004
GET 00001 04374 D0000 00007
F0010
GET 00001 08770 M010 00004
GET 00001 08774 D0010 00007
P0000 P0010 P0012
PUTP 00001 04317 00001 00001
PUTP 00001 04300 00036 00001
P0015 P0017
PUTP 00001 08717 00001 00001
PUTP 00001 08700 00036 00001
P0001 P0010
PUTP 00001 04300 00002 00001
P0015
PUTP 00001 08700 00002 00001
P000F P0010 P0011 P0012 P0015 P0016 P0017
0
1
2
0
PUTP 00001 04301 00001 00001
1
PUTP 00001 04309 00003 00001
2
PUTP 00001 04300 00006 00001

11.2.4 Deceleration Stop (Homing)

1) Description

(1) Used device

Device	Description
P0000	X axis error reset, output prohibit release switch
P0001	X axis homing switch
P0002	X axis deceleration stop switch
P000F	X axis start switch
P0010	X axis command receive signal
P0011	X axis signal in operation
P0012	X axis error status signal
M000C	X axis signal in acceleration
MOOOD	X axis signal in constant speed
M000 ~ M003	X axis status information read (operation status bit information/ axis information/ external I/O signal status)
D0000 ~ D0006	X axis operation information read (current position/speed/step no./M code/error information)

(2) Operation Order

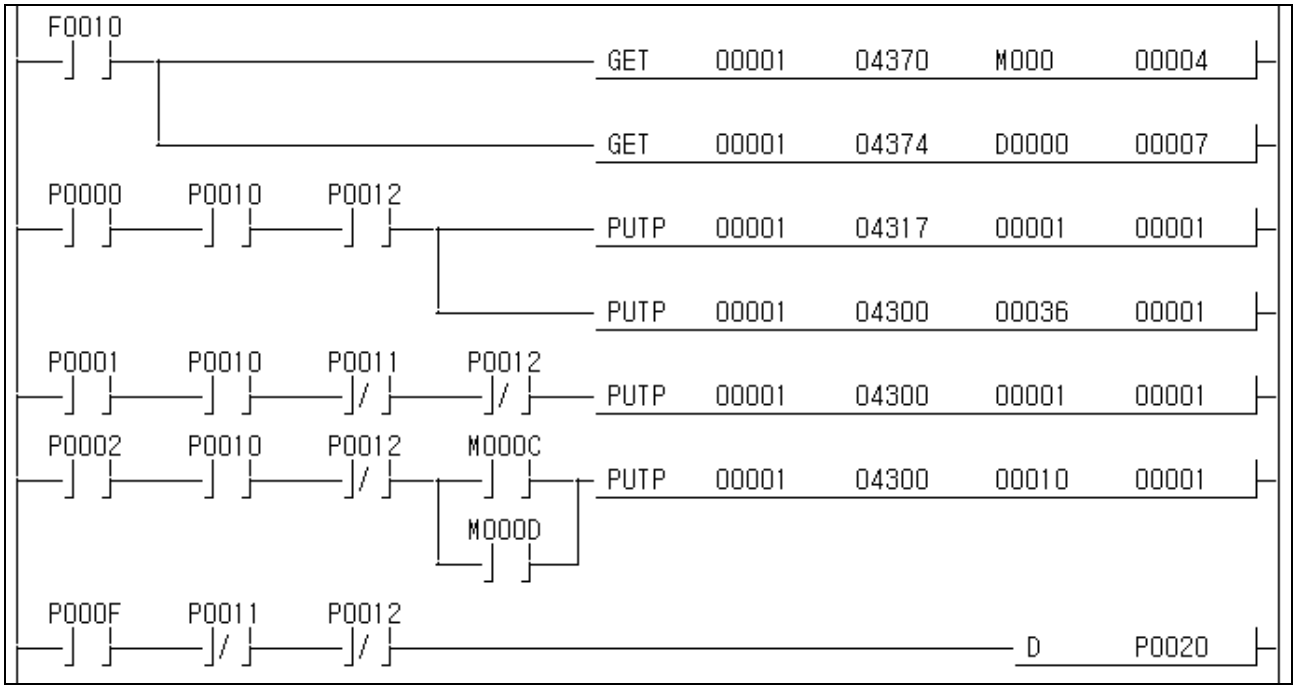
P0001(Homing) switch ON => P000F(Start) switch ON => P0002(deceleration stop) switch ON => P000F(Start) switch ON

▷ It carries out the homing by homing method set in homing/manual parameter. (0 : DOG/Origin (OFF))

(3) Operation Data Setting

Items of Position data	Step no.	Coordinate	Control method	Operation pattern	Operation method	Goal position [pulse]	Circular interpolation aux. point [pulse]	M code	Acc./Dec. no.	Operation speed [pls/s]	Dwell time [ms]	Circular interpolation direction
X setting	1	Absolute	position	End	Single	150000	0	0	1	1000	100	CW

2) Program



11.2.5 Single Operation (Operation step no. setting)

1) Description

(1) Used device

Device	Description
P0000	X axis error reset, output prohibit release switch
P0001	X axis homing switch
P0002	X axis step no. change switch
P000F	X axis start switch
P0010	X axis command receive signal
P0011	X axis signal in operation
P0012	X axis error status signal
P003	BCD Digital switch input
M000 ~ M003	X axis status information read (operation status bit information/ axis information/ external I/O signal status)
D0000 ~ D0006	X axis operation information read (current position/speed/step no./M code/error information)

(2) Operation Order

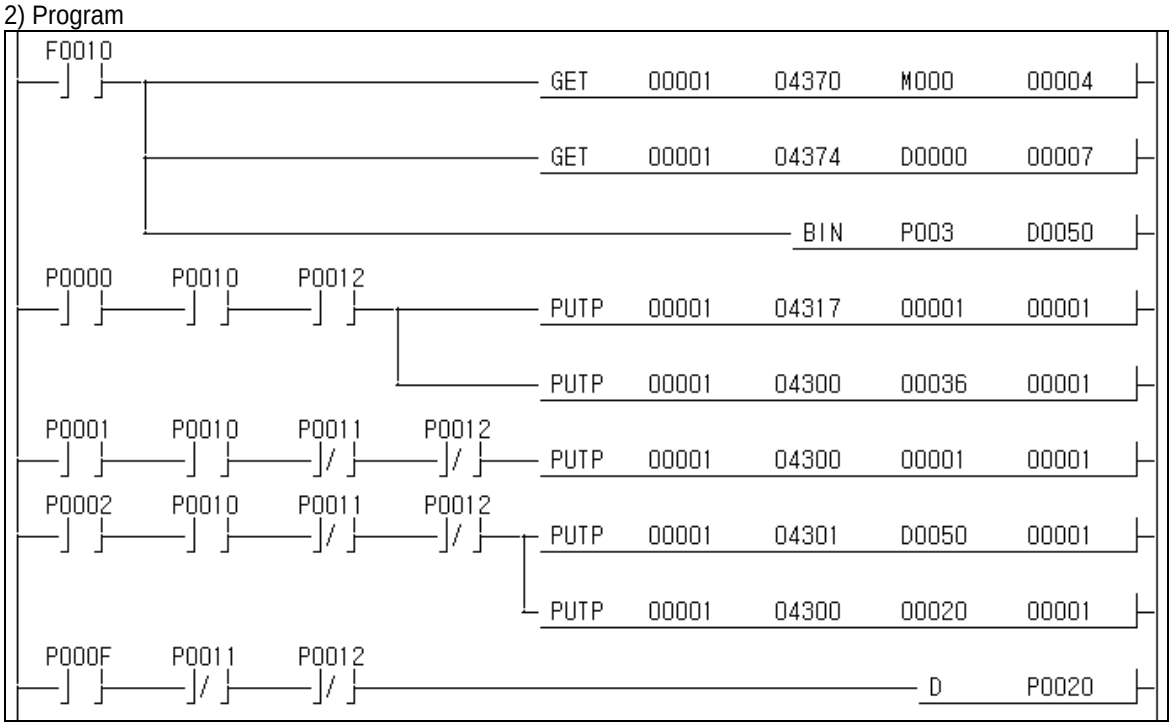
P0001(Homing) switch ON => P000F(Start) switch ON => P0002(Start step no. change) switch ON => P000F(Start) switch ON

▷ After Setting BCD external digital input as 10, switch ON P0002.

(3) Operation Data Setting

Items of Position data	Step no.	Coordinate	Control method	Operation pattern	Operation method	Goal position [pulse]	Circular interpolation aux. point [pulse]	M code	Acc./Dec.no.	Operation speed [pls/s]	Dwell time [ms]	Circular interpolation direction
X setting	1	Absolute	Position	End	Single	10000	0	0	1	1000	100	CW
	2	Absolute	Position	End	Single	20000	0	0	1	1500	100	CW
	3	Absolute	Position	End	Single	30000	0	0	1	2000	100	CW
	10	Absolute	Position	End	Single	50000	0	0	1	1000	100	CW
	11	Absolute	Position	End	Single	60000	0	0	1	1500	100	CW
	12	Absolute	Position	End	Single	70000	0	0	1	2000	100	CW

2) Program



11.2.6 Single Operation (by External input signal)

1) Description
(1) Used device

Device	Description
P0000	X axis error reset, output prohibit release switch
P0001	X axis homing switch
P0010	X axis command receive signal
P0011	X axis signal in operation
P0012	X axis error status signal
M000 ~ M003	X axis status information read (operation status bit information/ axis information/ external I/O signal status)
D0000 ~ D0006	X axis operation information read (current position/speed/step no./M code/error information)

(2) Operation Order

P0001(Homing) switch ON => external start switch ON

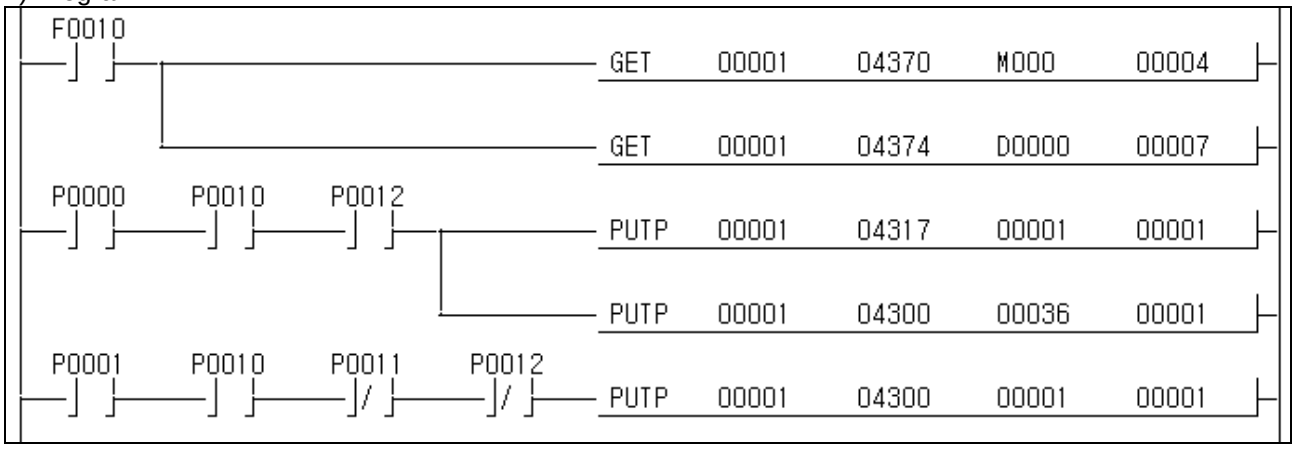
(3) Operation Data Setting

Items of Position data	Step no.	Coordinate	Control method	Operation pattern	Operation method	Goal position [pulse]	Circular interpolation aux. point [pulse]	M code	Acc./Dec. no.	Operation speed [pls/s]	Dwell time [ms]	Circular interpolation direction
	1	Absolute	Position	End	Single	10000	0	0	1	1000	100	CW
X setting	2	Absolute	Position	End	Single	20000	0	0	1	1500	100	CW
	3	Absolute	Position	End	Single	30000	0	0	1	2000	100	CW

(4) Parameter Setting

Extended parameter	External command selection	0: Start
	Pulse output direction	0:CW
	M code output	0:NONE
	External command	1: Permit

2) Program



11.2.7 Equal Speed Operation (Operation step no. setting)

1) Description

(1) Used device

Device	Description
P0000	X axis error reset, output prohibit release switch
P0001	X axis homing switch
P0002	X axis step no. change
P0003	X axis deceleration stop
P000F	X axis start switch
P0010	X axis command receive signal
P0011	X axis signal in operation
P0012	X axis error status signal
P003	BCD Digital switch input
M000 ~ M003	X axis status information read (operation status bit information/ axis information/ external I/O signal status)
D0000 ~ D0006	X axis operation information read (current position/speed/step no./M code/error information)

(2) Operation Order

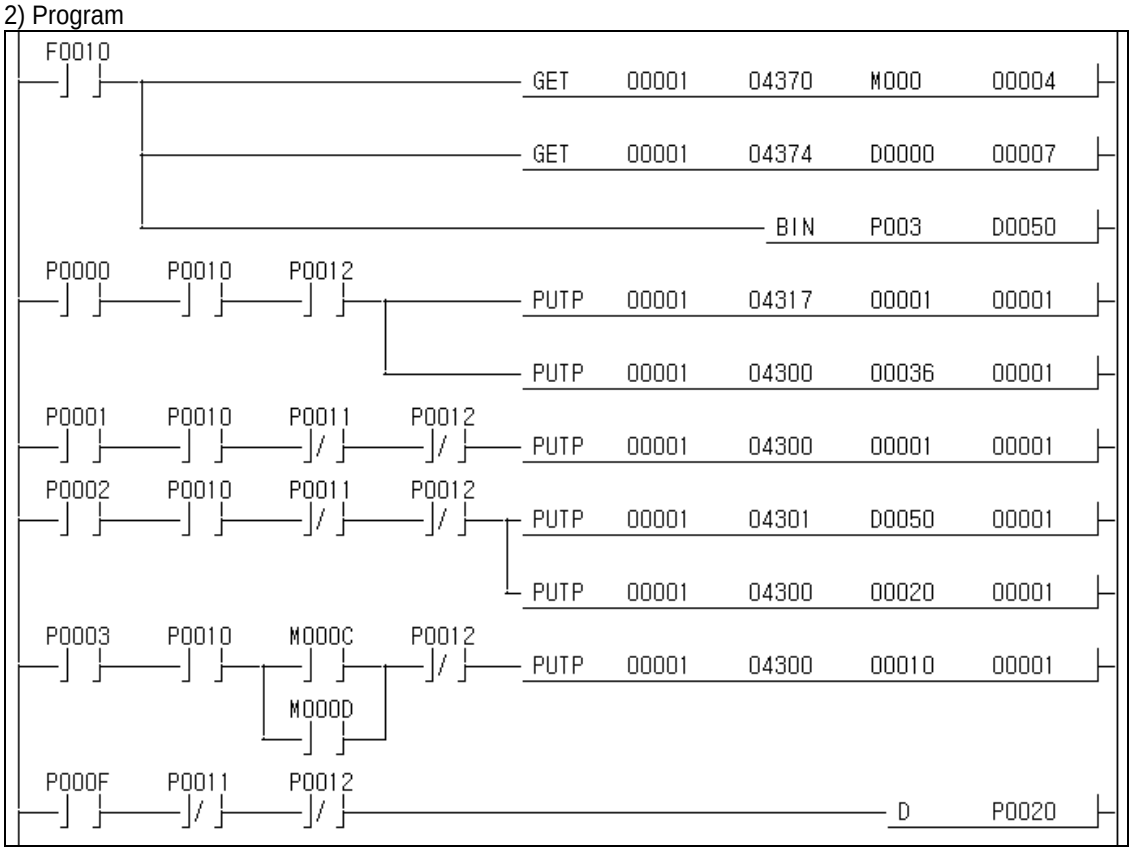
P0001(Homing) switch ON => P000F(Start) switch ON => P0003(Deceleration stop) switch ON => P0002(start stp no. change) switch ON => P000F(Start) switch ON => P0003(deceleration stop) switch ON

▷ After setting BCD external input as 10, switch ON P0002.

(3) Operation Data Setting

Items of Position data	Step no.	Coordinate	Control method	Operation pattern	Operation method	Goal position [pulse]	Circular interpolation aux. point [pulse]	M code	Acc./Dec. no.	Operation speed [pls/s]	Dwell time [ms]	Circular interpolation direction
X setting	1	Absolute	Speed	End	Single	0	0	0	1	1000	100	CW
	10	Absoute	Speed	End	Single	0	0	0	1 번	1000	100	CW

2) Program



11.2.8 Simultaneous Start

1) Description

(1) Used device

Device	Description
P0000	X, Y axis error reset, output prohibit release switch
P0001	X, Y axis homing switch
P000E	X, Y axis simultaneous start switch
P0010	X axis command receive signal
P0011	X axis signal in operation
P0012	X axis error status signal
P0015	Y axis command receive signal
P0016	Y axis signal in operation
P0017	Y axis error status signal
M000 ~ M003	X axis status information read (operation status bit information/ axis information/ external I/O signal status)
D0000 ~ D0006	X axis operation information read (current position/speed/step no./M code/error information)
M010 ~ M013	Y axis status information read (operation status bit information/ axis information/ external I/O signal status)
D0100 ~ D0106	Y axis operation information read (current position/speed/step no./M code/error information)

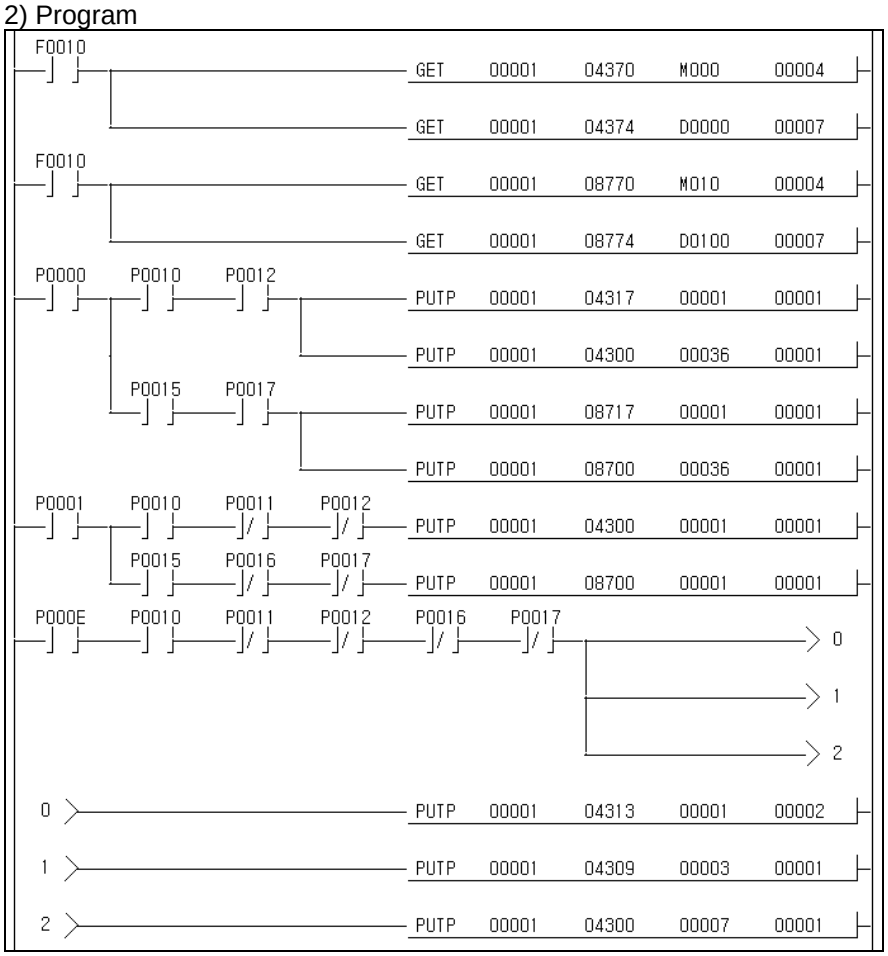
(2) Operation Order

P0001(Homing) switch ON => P000E(simultaneous start) switch ON 3times

(3) Operation Data Setting

Items of Position data	Step no.	Coordinate	Control method	Operation pattern	Operation method	Goal position [pulse]	Circular interpolation aux. point [pulse]	M code	Acc./Dec. no.	Operation speed [pls/s]	Dwell time [ms]	Circular interpolation direction
X setting	1	Absolute	Position	End	Single	10000	0	0	1	1000	100	CW
Y setting	1	Absolute	Position	End	Single	20000	0	0	1	2000	100	CW

2) Program



11.2.9 Synchronous Start by Position

1) Description

(1) Used device

Device	Description
P0000	X, Y axis error reset, output prohibit release switch
P0001	X, Y axis homing switch
P000E	X axis synchronous start by position switch
P000F	Y axis indirect start switch
P0010	X axis command receive signal
P0011	X axis signal in operation
P0012	X axis error status signal
P0015	Y axis command receive signal
P0016	Y axis signal in operation
P0017	Y axis error status signal
M000 ~ M003	X axis status information read (operation status bit information/ axis information/ external I/O signal status)
D0000 ~ D0006	X axis operation information read (current position/speed/step no./M code/error information)
M010 ~ M013	Y axis status information read (operation status bit information/ axis information/ external I/O signal status)
D0100 ~ D0106	Y axis operation information read (current position/speed/step no./M code/error information)

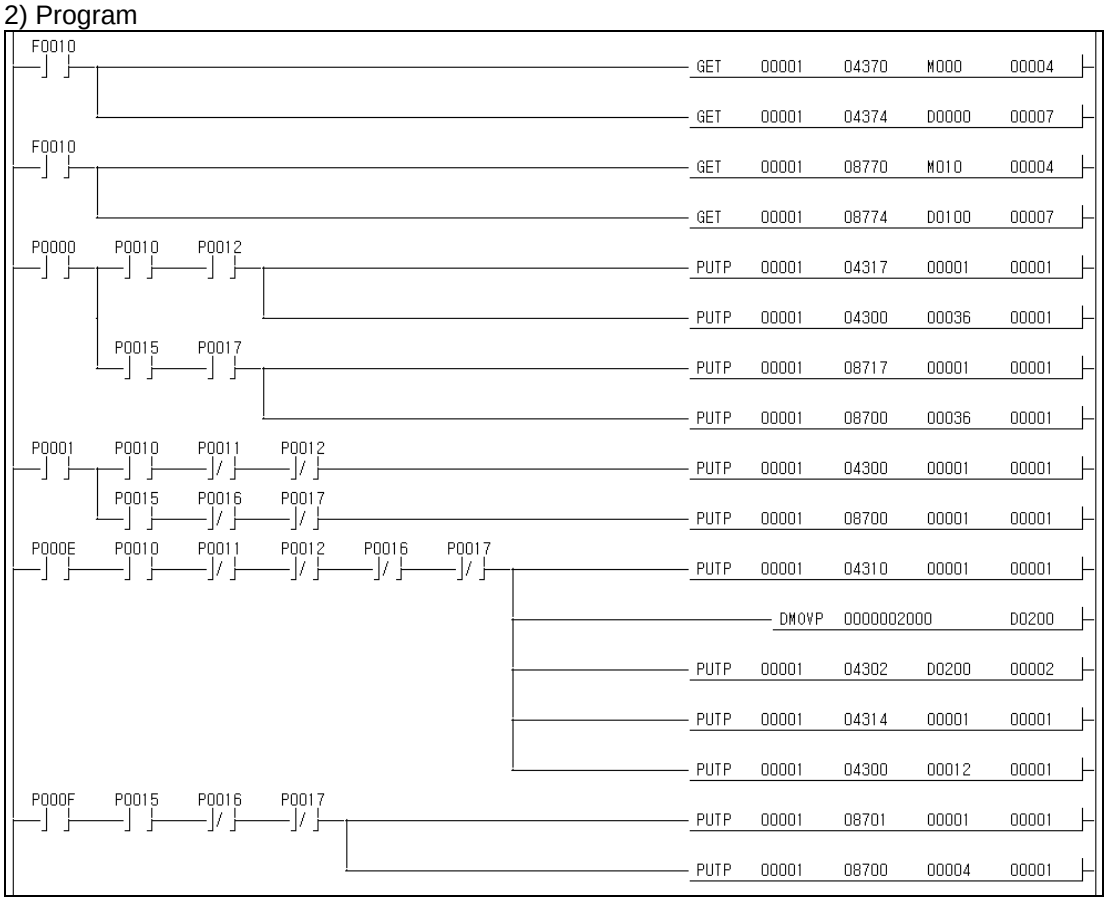
(2) Operation Order

P0001(Homing) switch ON => P000E(synchronous start by Position) switch ON => P000F(indirect start) switch ON

(3) Operation Data Setting

Items of Position data	Step no.	Coordinate	Control method	Operation pattern	Operation method	Goal position [pulse]	Circular interpolation aux. point [pulse]	M code	Acc./Dec. no.	Operation speed [pls/s]	Dwell time [ms]	Circular interpolation direction
X setting	1	Absolute	Position	End	Single	10000	0	0	1	1000	100	CW
Y setting	1	Absolute	Position	End	Single	15000	0	0	1	1500	100	CW

2) Program



11.2.10 Synchronous Start by Speed

1) Description

(1) Used device

Device	Description
P0000	X, Y axis error reset, output prohibit release switch
P0001	X axis synchronous stop switch
P0002	Y axis start switch
P000E	X axis synchronous start by speed switch
P000F	Y axis stop switch
P0010	X axis command receive signal
P0011	X axis signal in operation
P0012	X axis error status signal
P0015	Y axis command receive signal
P0016	Y axis signal in operation
P0017	Y axis error status signal
M000 ~ M003	X axis status information read (operation status bit information/ axis information/ external I/O signal status)
D0000 ~ D0006	X axis operation information read (current position/speed/step no./M code/error information)
M010 ~ M013	Y axis status information read (operation status bit information/ axis information/ external I/O signal status)
D0100 ~ D0106	Y axis operation information read (current position/speed/step no./M code/error information)

(2) Operation Order

P000E(synchronous start by speed) switch ON => P0002(Start) switch ON => P000F(Stop) switch ON => P0002(Start) switch ON => P000F(Stop) switch ON => P0001(synchronous stop) switch ON

▷ If using Toggle switch when Y axis deceleration stop, the error occurs.

(3) Operation Data Setting

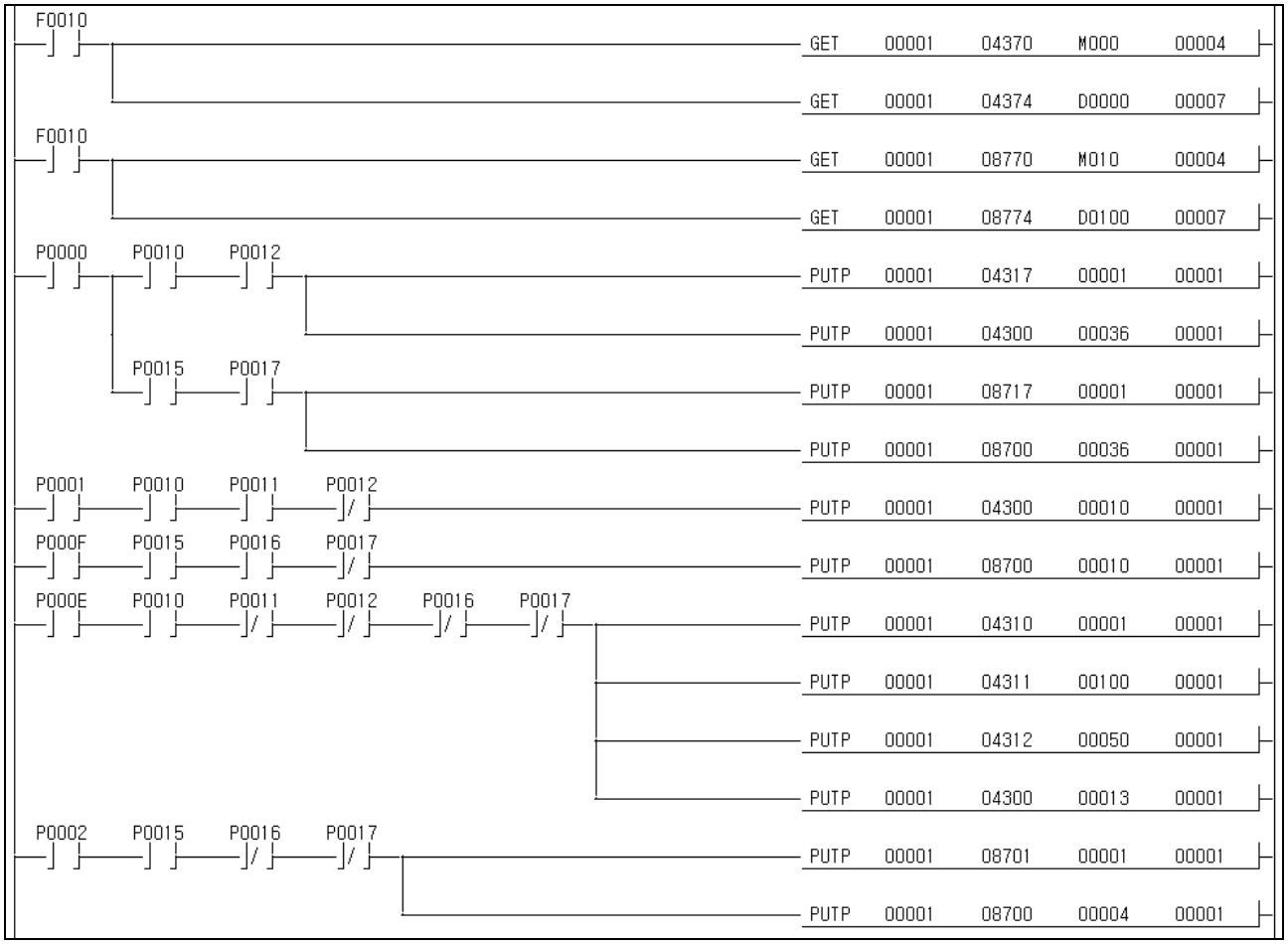
Items of Position data	Step no.	Coordinate	Control method	Operation pattern	Operation method	Goal position [pulse]	Circular interpolation aux. point [pulse]	M code	Acc./Dec. no.	Operation speed [pls/s]	Dwell time [ms]	Circular interpolation direction
X setting	1	Absolute	Speed	End	Single	0	0	0	1	1000	100	CW
Y setting	1	Absolute	Speed	End	Single	0	0	0	1	1000	100	CW

(4) Synchronous start by speed setting

Command 1	Main axis	1:Y axis	4310
	Main axis rate	100	4311
	Subordinate axis rate	50	4312

} Address of Internal memory

2) Program


F0010
GET 00001 04370 M000 00004
GET 00001 04374 D0000 00007
F0010
GET 00001 08770 M010 00004
GET 00001 08774 D0100 00007
P0000 P0010 P0012
PUTP 00001 04317 00001 00001
PUTP 00001 04300 00036 00001
P0015 P0017
PUTP 00001 08717 00001 00001
PUTP 00001 08700 00036 00001
P0001 P0010 P0011 P0012
PUTP 00001 04300 00010 00001
P000F P0015 P0016 P0017
PUTP 00001 08700 00010 00001
P000E P0010 P0011 P0012 P0016 P0017
PUTP 00001 04310 00001 00001
PUTP 00001 04311 00100 00001
PUTP 00001 04312 00050 00001
PUTP 00001 04300 00013 00001
P0002 P0015 P0016 P0017
PUTP 00001 08701 00001 00001
PUTP 00001 08700 00004 00001

11.2.11 Emergency Stop

1) Description
(1) Used device

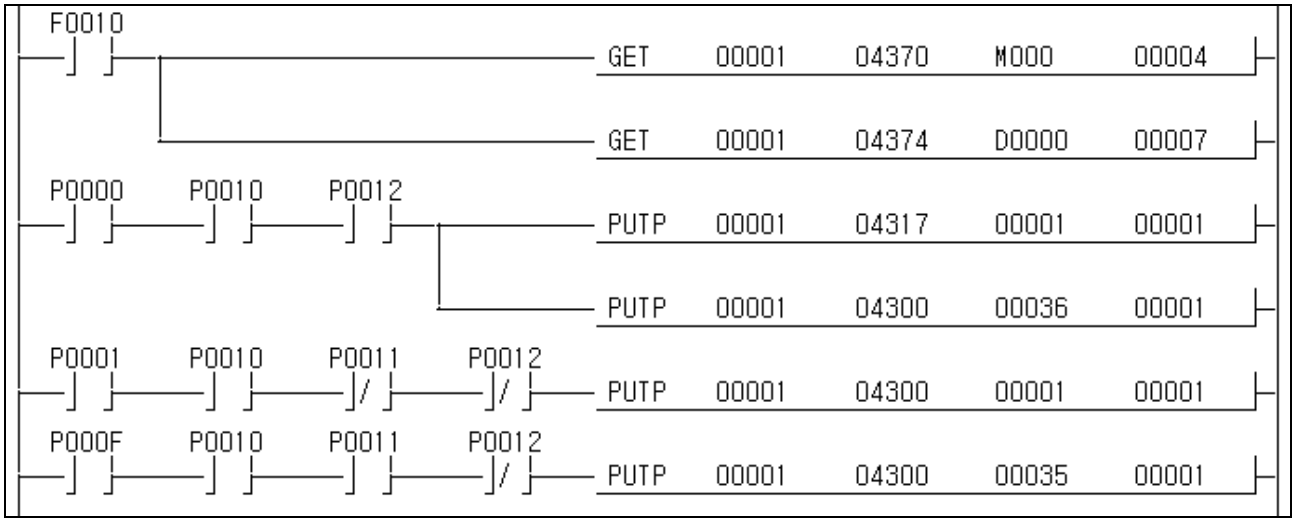
Device	Description
P0000	In case of emeregency stop, error reset, output prohibit release switch
P0001	X axis homing switch
P000F	Emergency stop switch when homing
P0010	X axis command receive signal
P0011	X axis signal in operation
P0012	X axis error status signal
M000 ~ M003	X axis status information read (operation status bit information/ axis information/ external I/O signal status)
D0000 ~ D0006	X axis operation information read (current position/speed/step no./M code/ error information)

(2) Operation Order

P0001(Homing) switch ON,OFF => P000F(Emergency stop) switch ON,OFF

▷ In case of 2 axis (G4/6F-PP2O,G4/6F-PP2D) or 3 axis module (G4/6F-PP3O,G4/6F-PP3D), when emergency stop, 2 axis or 3 axis stops emergently at the same time and when error reset, output prohibit will be released at the same time.
In case of 3 axis emergency stop, please use Emergency stop signal of SERVO drive.

2) Program



11.2.12 Jog Operation

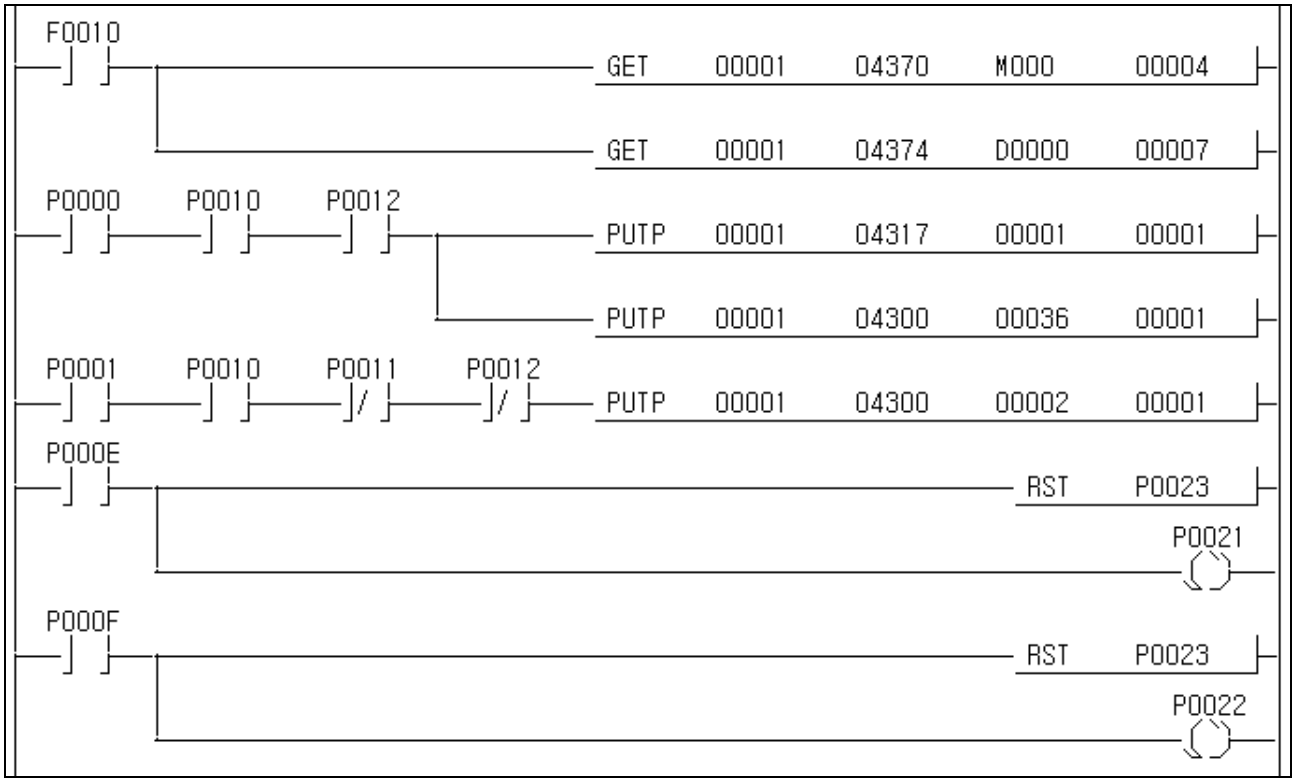
1) Description
(1) Used device

Device	Description
P0000	X axis error reset, output prohibit release switch
P0001	X axis floating point switch
P000E	X axis Jog low speed normal rotation
P000F	X axis Jog low speed reverse rotation
P0010	X axis command receive signal
P0011	X axis signal in operation
P0012	X axis error status signal
M000 ~ M003	X axis status information read (operation status bit information/ axis information/ external I/O signal status)
D0000 ~ D0006	X axis operation information read (current position/speed/step no./M code/ error information)

(2) Operation Order

P0001(Floating point) switch ON,OFF => P000E(Jog low speed normal rotation) switch ON => P000E(Jog low speed low speed normal rotation) switch OFF => P000F(Jog low speed reverse rotation) switch ON => P000F(Jog low speed reverse rotation) switch OFF

2) Program



11.2.13 Manual Pulse Generator (or Encoder Operation)

1) Description
(1) Used device

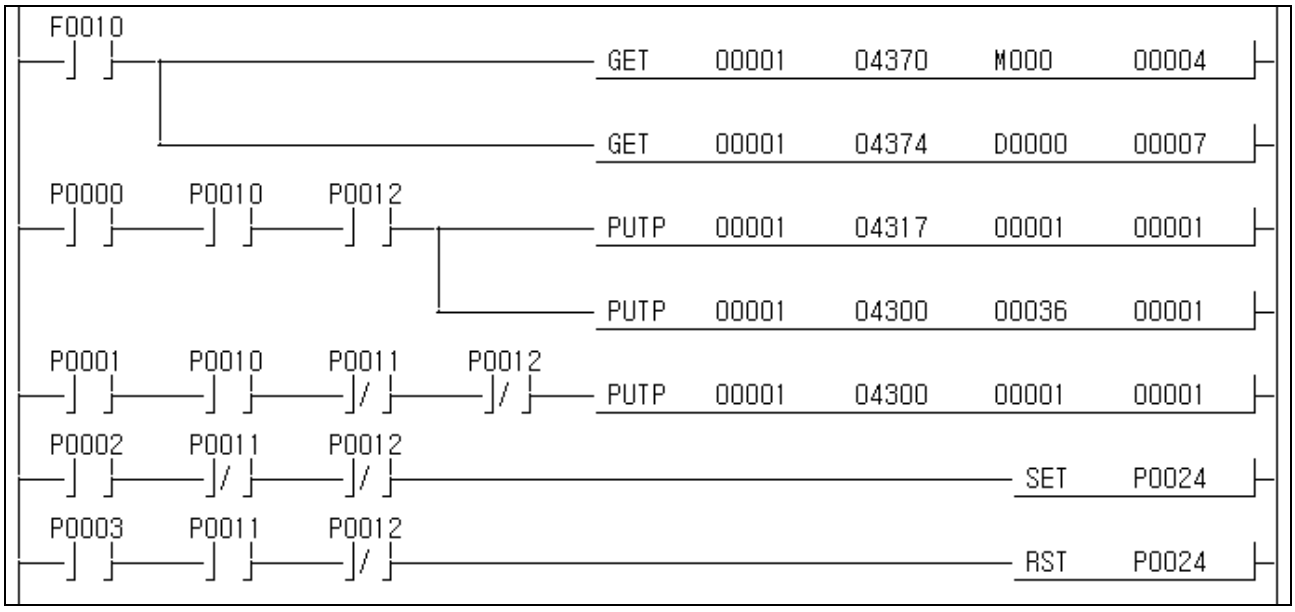
Device	Description
P0000	X axis error reset, output prohibit release switch
P0001	X axis homing switch
P0002	X axis MPG operation permit
P0003	X axis MPG operation prohibit
P0010	X axis command receive signal
P0011	X axis signal in operation
P0012	X axis error status signal
M000 ~ M003	X axis status information read (operation status bit information/ axis information/ external I/O signal status)
D0000 ~ D0006	X axis operation information read (current position/speed/step no./M code/ error information)

(2) Operation Order

P0001(Homing) switch ON,OFF => P0002(MPG operation permit) switch ON,OFF => P0003(MPG operation prohibit) switch ON,OFF

▷ In case of operation by external encoder input, it is also required to use P contact signal which is same as that of MPG operation.

2) Program



11.2.14 Inching Operation

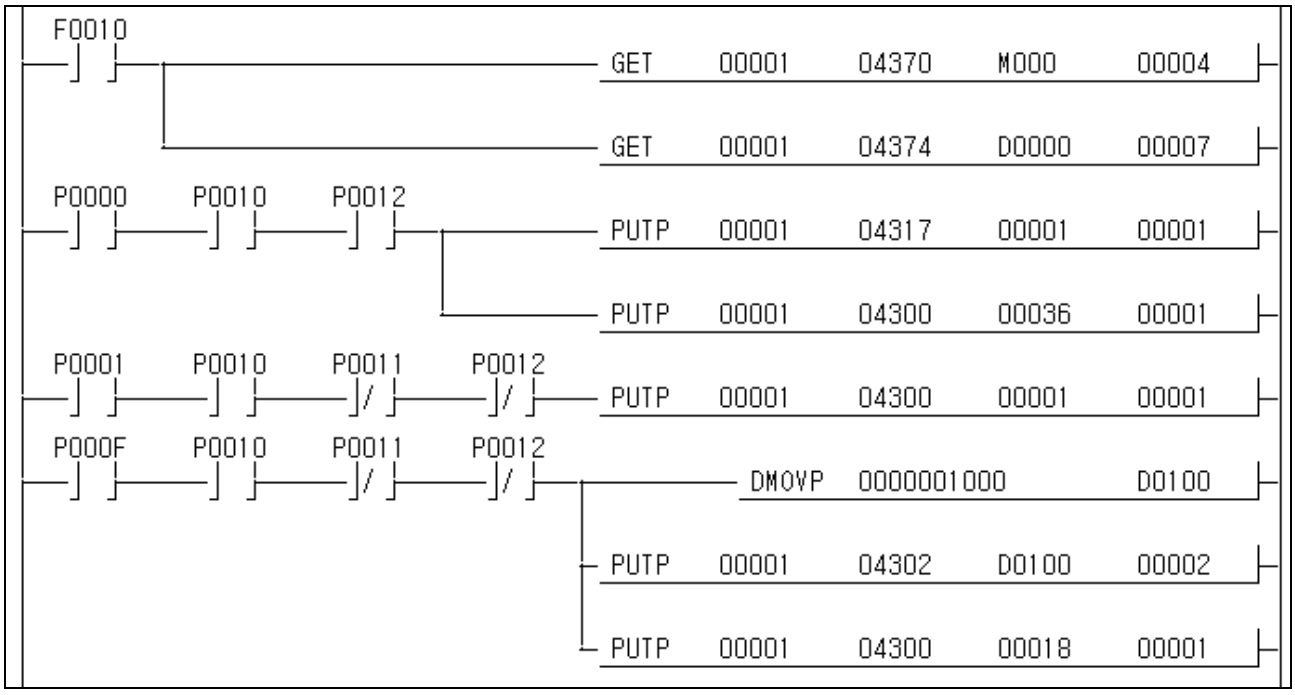
1) Description
(1) Used device

Device	Description
P0000	X axis error reset, output prohibit release switch
P0001	X axis homing switch
P000F	X axis inching switch
P0010	X axis command receive signal
P0011	X axis signal in operation
P0012	X axis error status signal
D0100 ~ D0101	Inching transfer amount
M000 ~ M003	X axis status information read (operation status bit information/ axis information/ external I/O signal status)
D0000 ~ D0006	X axis operation information read (current position/speed/step no./M code/ error information)

(2) Operation Order

P0001(Homing) switch ON,OFF => P000F(Inching operation) switch ON,OFF

2) Program



11.2.15 Return to the position before Manual Operation

1) Description

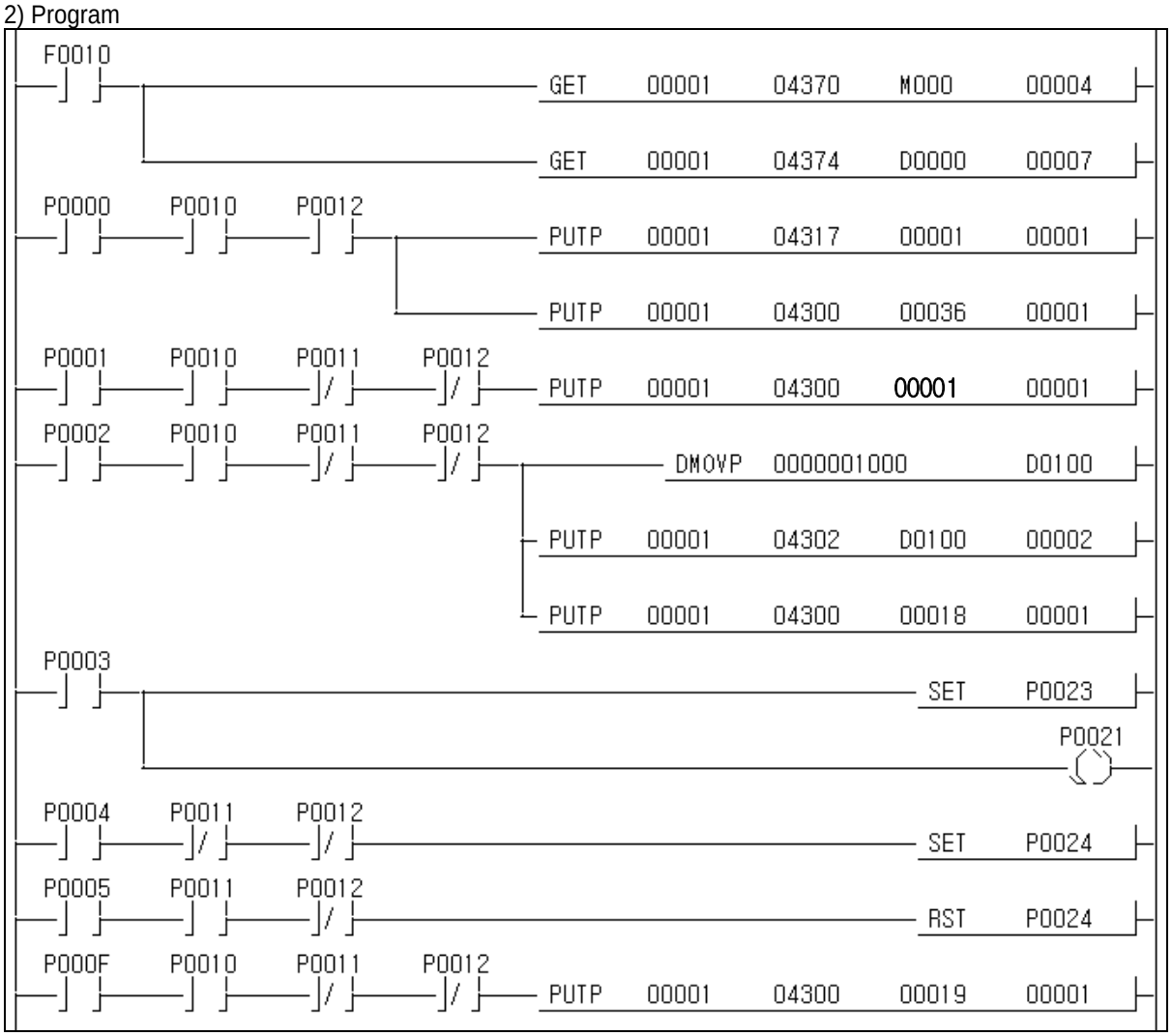
(1) Used device

Device	Description
P0000	X axis error reset, output prohibit release switch
P0001	X axis homing switch
P0002	X axis inching operation switch
P0003	X axis Jog high speed normal rotation switch
P0004	X axis MPG operation permit switch
P0005	X axis MPG operation prohibit switch
P000F	X axis return to the position before manual operation switch
P0010	X axis command receive signal
P0011	X axis signal in operation
P0012	X axis error status signal
D0100 ~ D0101	Inching transfer amount (1000 pulse)
M000 ~ M003	X axis status information read (operation status bit information/ axis information/ external I/O signal status)
D0000 ~ D0006	X axis operation information read (current position/speed/step no./M code/ error information)

(2) Operation Order

P0001(Homing) switch ON,OFF => P0002(Inching operation) switch ON,OFF => P0003(Jog high speed normal rotation) switch ON,OFF => P0004(MPG operation permit) switch ON,OFF => P0005(MPG operation prohibit) switch ON,OFF => P000F(Return to the position before Manual operation) switch ON,OFF

2) Program



11.2.16 Speed Override

1) Description
(1) Used device

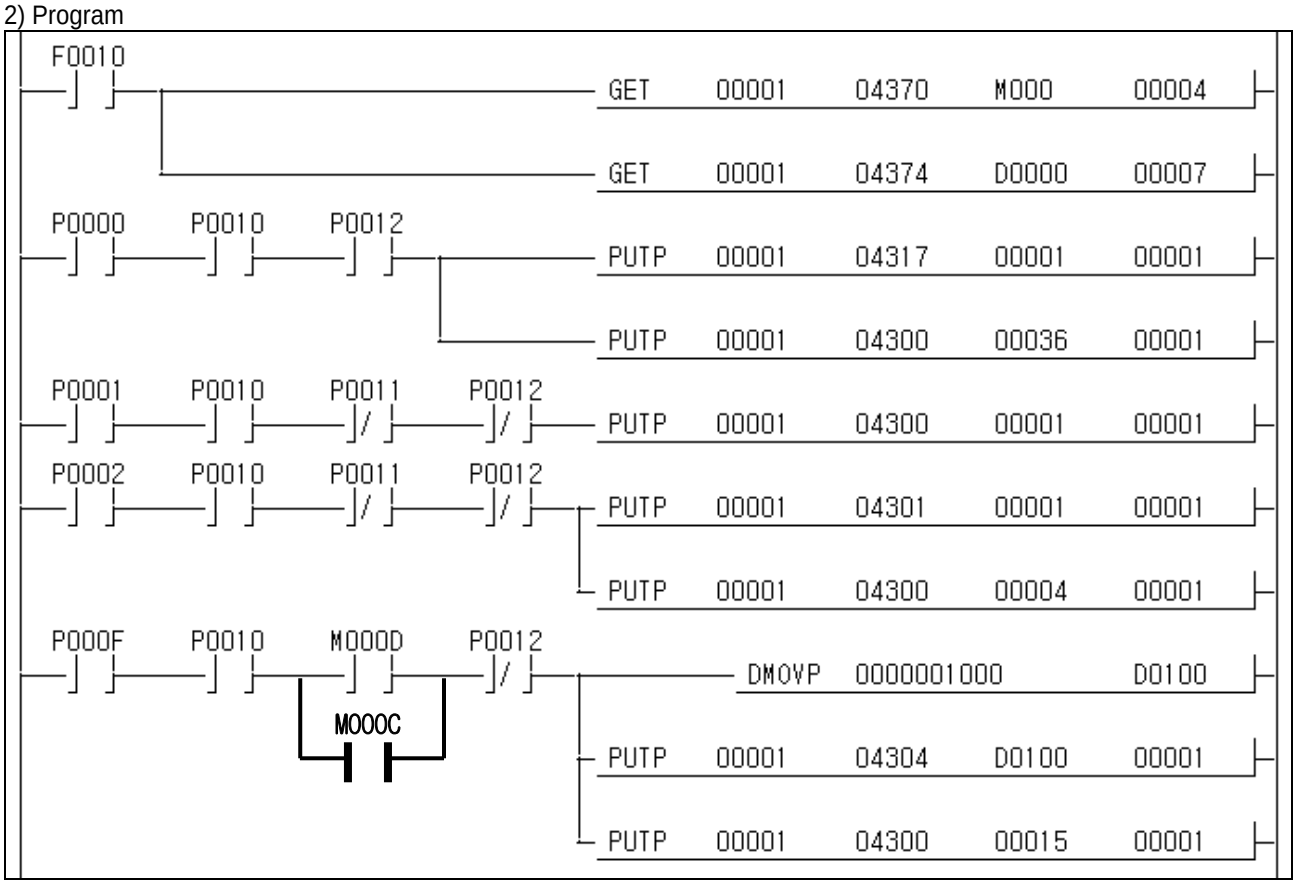
Device	Description
P0000	X axis error reset, output prohibit release switch
P0001	X axis homing switch
P0002	X axis indirect start switch
P000F	X axis speed overide switch
P0010	X axis command receive signal
P0011	X axis signal in operation
P0012	X axis error status signal
MOOOD	X axis signal in constant speed
D0100 ~ D0101	Speed override setting value (1000pps)
M000 ~ M003	X axis status information read (operation status bit information/ axis information/ external I/O signal status)
D0000 ~ D0006	X axis operation information read (current position/speed/step no./M code/ error information)

(2) Operation Order
P0001(Homing) switch ON,OFF => P0002(indirect start) switch ON,OFF => P000F(Speed override) switch ON,OFF

(3) Operation Data Setting

Items of Position data	Step no.	Coordinate	Control method	Operation pattern	Operation method	Goal position [pulse]	Circular interpolation aux. point [pulse]	M code	Acc./Dec. no.	Operation speed [pls/s]	Dwell time [ms]	Circular interpolation direction
X setting	1	Absolute	Position	End	Single	100000	0	0	1	5000	100	CW

2) Program



11.2.17 Position Override

1) Description
(1) Used device

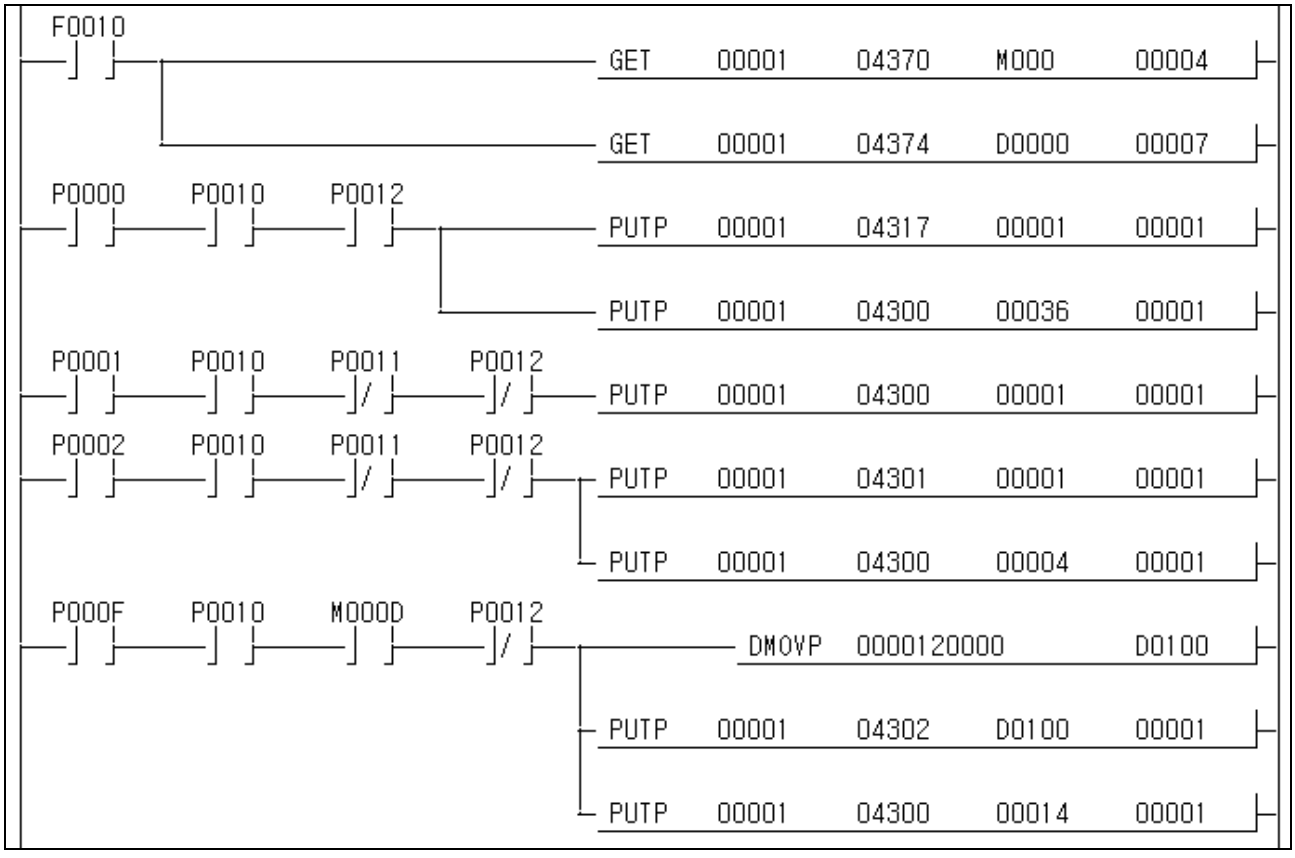
Device	Description
P0000	X axis error reset, output prohibit release switch
P0001	X axis homing switch
P0002	Xaxis indirect start switch
P000F	X axis position override switch
P0010	X axis command receive signal
P0011	X axis signal in operation
P0012	X axis error status signal
MOOOD	X axis setting in contant speed
D0100 ~ D0101	Position override setting value (20000pulse)
M000 ~ M003	X axis status information read (operation status bit information/ axis information/ external I/O signal status)
D0000 ~ D0006	X axis operation information read (current position/speed/step no./M code/ error information)

(2) Operation Order
P0001(Homing) switch ON,OFF => P0002(Indirect start) switch ON,OFF => P000F(Position override) switch ON,OFF

(3) Operation Data Setting

Items of Position data	Step no.	Coordinate	Control method	Operation pattern	Operation method	Goal position [pulse]	Circular interpolation aux. point [pulse]	M code	Acc./Dec. no.	Operation speed [pls/s]	Dwell time [ms]	Circular interpolation direction
X setting	1	Absolute	Position	End	Single	100000	0	0	1	5000	100	CW

2) Program



11.2.18 Positioning Speed Override

1) Description

(1) Used device

Device	Description
P0000	X axis error reset, output prohibit release switch
P0001	X axis homing switch
P0002	X axis indirect switch
P000F	X axis positioning speed override switch
P0010	X axis command receive signal
P0011	X axis signal in operation
P0012	X axis error status signal
MOOOD	X axis signal in constant speed
D0100 ~ D0101	Positioning value (50000pulse)
D0102 ~ D0103	Speed setting value (10000pps)
M000 ~ M003	X axis status information read (operation status bit information/ axis information/ external I/O signal status)
D0000 ~ D0006	X axis operation status read (current position/speed/step no./M code/error information)

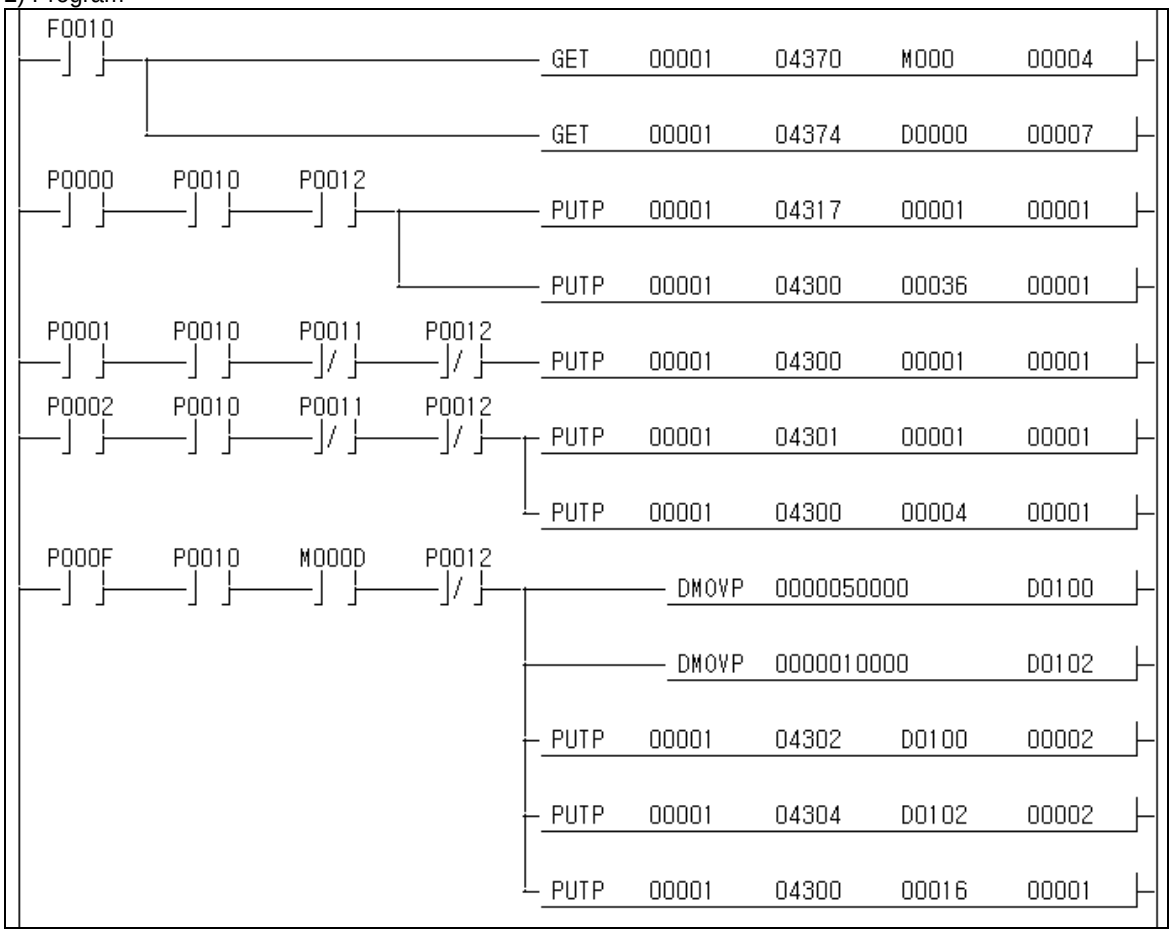
(2) Operation Order

P0001(Homing) switch ON,OFF => P0002(Indirect start) switch ON,OFF => P000F(Positioning speed override) switch ON,OFF

(3) Operation Data Setting

Items of Position data	Step no.	Coordinate	Control method	Operation pattern	Operation method	Goal position [pulse]	Circular interpolation aux. point [pulse]	M code	Acc./Dec. no.	Operation speed [pls/s]	Dwell time [ms]	Circular interpolation direction
X setting	1	Absolute	Position	End	Single	100000	0	0	1	5000	100	CW

2) Program



11.2.19 Operation Step No. Change by Continuous Operation

1) Description

(1) Used device

Device	Description
P0000	X axis error reset, output prohibit release switch
P0001	X axis homing switch
P0002	X axis start switch
P000F	X axis operation step no. change by continuous operation switch
P0010	X axis command receive signal
P0011	X axis signal in operation
P0012	X axis error status signal
P0020	X axis start signal
MOOOD	X axis signal in constant speed
D0004	X axis current operation step no.
M000 ~ M003	X axis status information read (operation status bit information/ axis information/ external I/O signal status)
D0000 ~ D0006	X axis operation status read (current position/speed/step no./M code/error information)

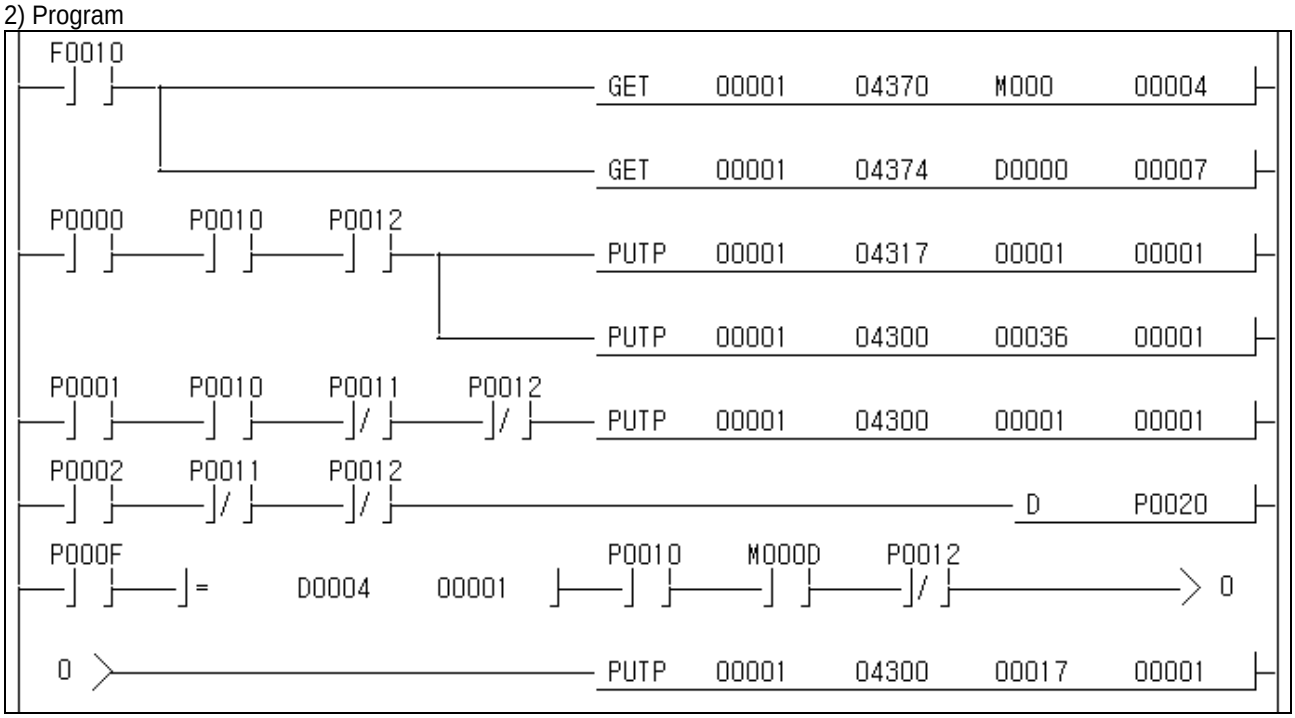
(2) Operation Order

P0001(Homing) switch ON,OFF => P0002(Start) switch ON,OFF => P000F(Operation step no. change by Continuous operation) switch ON,OFF

(3) Operation Data Setting

Items of Position data	Step no.	Coordinate	Control method	Operation pattern	Operation method	Goal position [pulse]	Circular interpolation aux. point [pulse]	M code	Acc./Dec. no.	Operation speed [pls/s]	Dwell time [ms]	Circular interpolation direction
X setting	1	Absoute	Position	Conti.	Single	100000	0	0	1	500	100	CW
	2	Absoute	Position	Conti.	Single	200000	0	0	1	1500	100	CW
	3	Absolute	Position	End	Single	0	0	0	1	2000	100	CW

2) Program



11.2.20 SKIP Operation

1) Description
(1) Used device

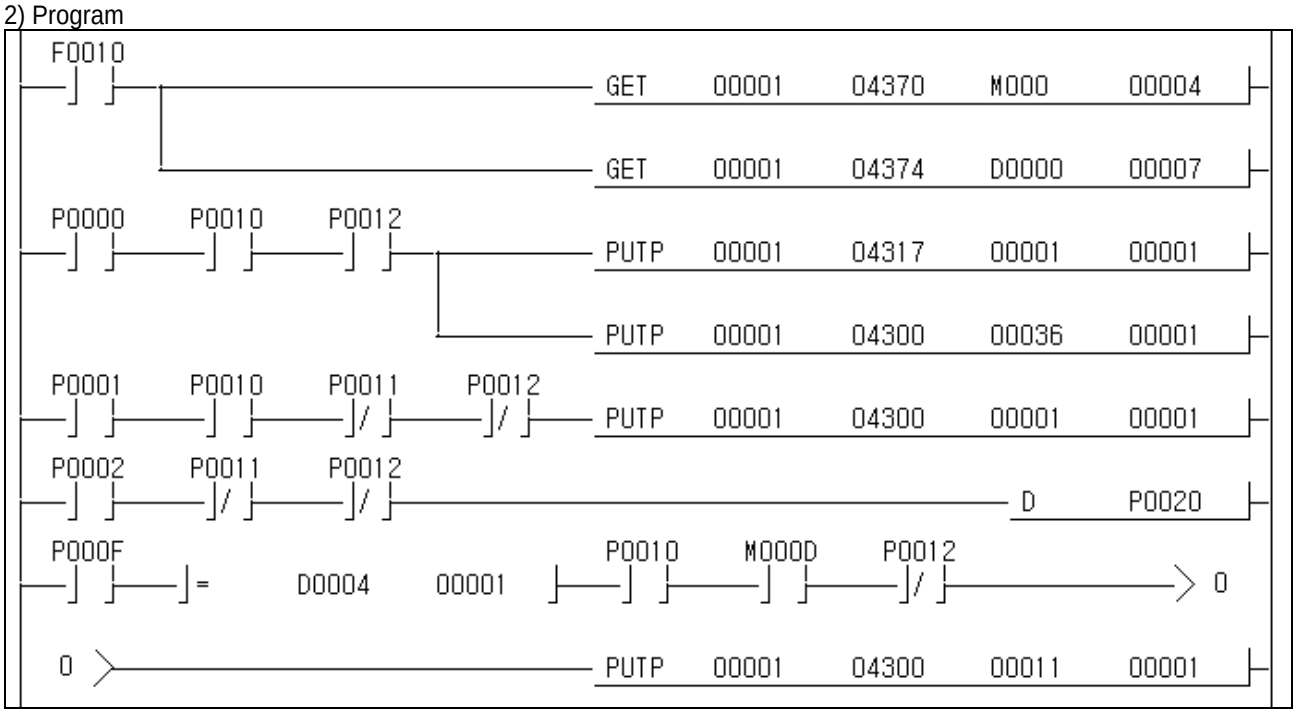
Device	Description
P0000	X axis error reset, output prohibit release switch
P0001	X axis homing switch
P0002	X axis start switch
P000F	X axis skip operation switch
P0010	X axis command receive signal
P0011	X axis signal in operation
P0012	X axis error status signal
P0020	X axis start signal
MOOOD	X axis signal in constant speed
D0004	X axis current operation step no.
M000 ~ M003	X axis status information read (operation status bit information/ axis information/ external I/O signal status)
D0000 ~ D0006	X axis operation information read (current position/speed/step no./M code/ error information)

(2) Operation Order
P0001(Homing) switch ON,OFF => P0002(Start) switch ON,OFF => P000F(Skip operation) switch ON,OFF

(3) Operation Data Setting

Items of Position data	Step no.	Coordinate	Control method	Operation pattern	Operation method	Goal position [pulse]	Circular interpolation aux. point [pulse]	M code	Acc./Dec. no.	Operation speed [pls/s]	Dwell time [ms]	Circular interpolation direction
X setting	1	Absolute	Position	Conti.	Single	10000	0	0	1	500	100	CW
	2	Absolute	Position	Conti.	Single	20000	0	0	1	1500	100	CW
	3	Absolute	Position	End	Single	30000	0	0	1	2000	100	CW

2) Program



11.2.21 Operation Step No. Change in Repeat Operation

1) Description

(1) Used device

Device	Description
P0000	X axis error reset, output prohibit release switch
P0001	X axis homing switch
P0002	X axis start switch
P000F	X axis operation step no. change switch in repeat operation switch
P0010	X axis command receive signal
P0011	X axis signal in operation
P0012	X axis error status signal
P0020	X axis start signal
M000 ~ M003	X axis status information read (operation status bit information/ axis information/ external I/O signal status)
D0000 ~ D0006	X axis operation information read (current position/speed/step no./M code/ error information)

(2) Operation Order

P0001(Homing) switch ON,OFF => P0002(Start) switch ON,OFF => P000F(Operation step no. change in Repeat operation) switch ON,OFF => P0002(Start) switch ON,OFF

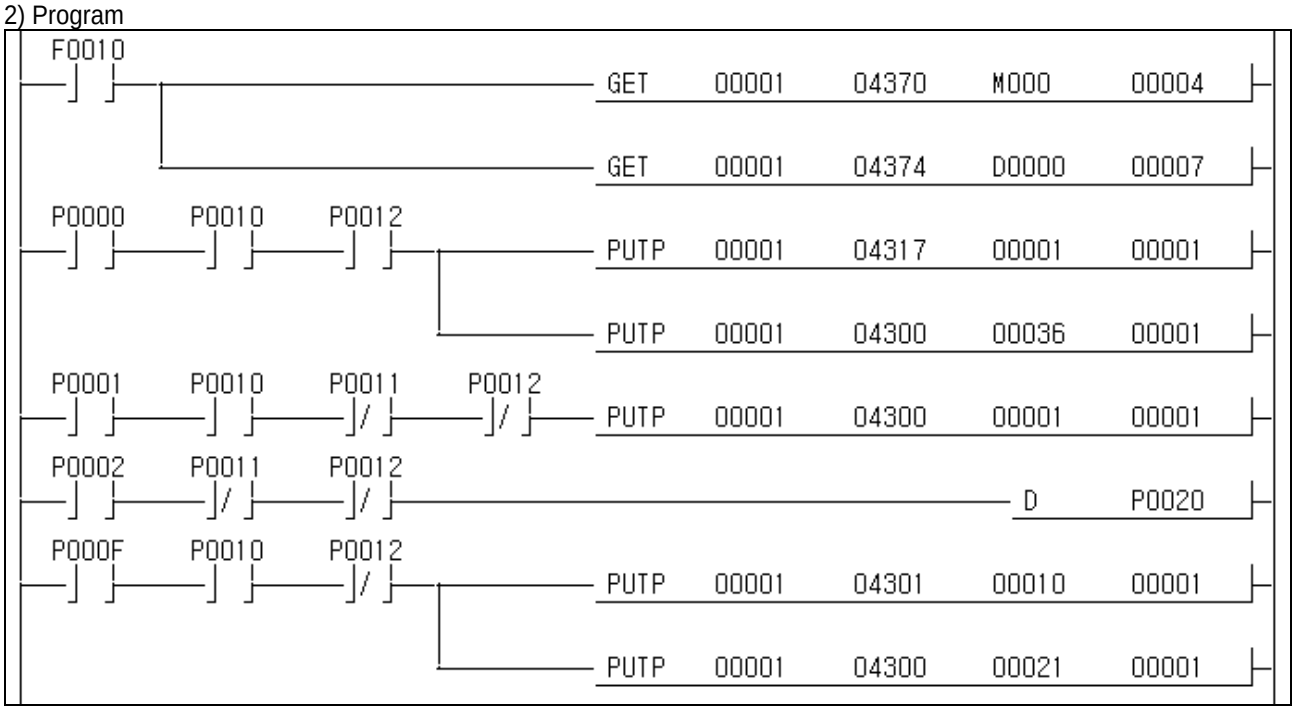
(3) Operation Data Setting

Items of Position data

X setting

Step no.	Coordinate	Control method	Operation pattern	Operation method	Goal position [pulse]	Circular interpolation aux. point [pulse]	M code	Acc./Dec. no.	Operation speed [pls/s]	Dwell time [ms]	Circular interpolation direction
1	Absolute	Position	Go-on	Single	10000	0	0	1	500	100	CW
2	Absolute	Position	End	Repeat	0	0	0	1	1000	100	CW
10	Absolute	Position	Go-on	Single	15000	0	0	1	1000	100	CW
11	Absolute	position	End	Repeat	0	0	0	1	2000	100	CW

2) Program



11.2.22 Current Position Change

1) Description
(1) Used device

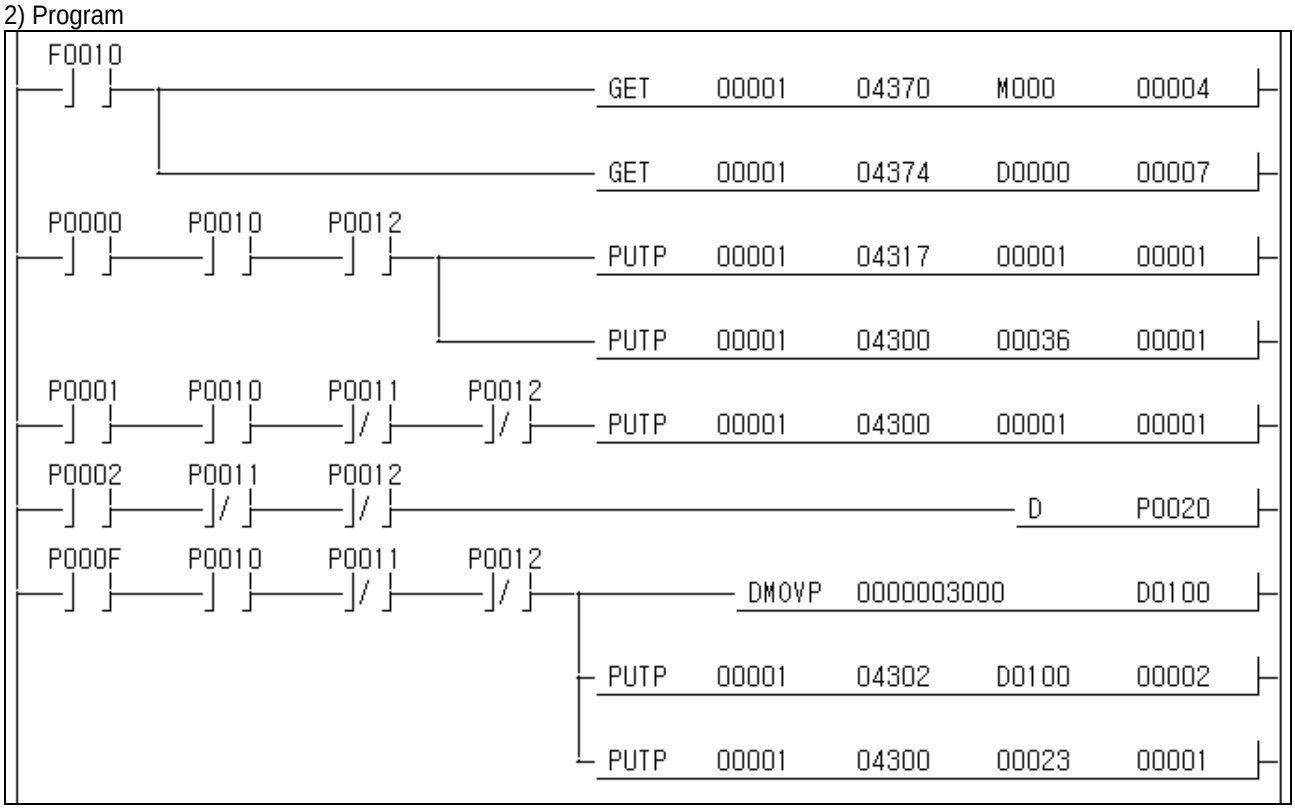
Device	Description
P0000	X axis error reset, output prohibit release switch
P0001	X axis homing switch
P0002	X axis start switch
P000F	X axis current position change switch
P0010	X axis command receive signal
P0011	X axis signal in operation
P0012	X axis error status signal
P0020	X axis start signal
D0100 ~ D0101	Current position preset setting value (3000)
M000 ~ M003	X axis status information read (operation status bit information/ axis information/ external I/O signal status)
D0000 ~ D0006	X axis operation information read (current position/speed/step no./M code/ error information)

(2) Operation Order
P0001(Homing) switch ON,OFF => P000F(Current position change) switch ON,OFF => P0002(Start) switch ON,OFF

(3) Operation Data Setting

Items of Position data	Step no.	Coordinate	Control method	Operation pattern	Operation method	Goal position [pulse]	Circular interpolation aux. point [pulse]	M code	Acc./Dec. no.	Operation speed [pls/s]	Dwell time [ms]	Circular interpolation direction
X setting	1	Absolute	Position	End	Single	10000	0	0	1	500	100	CW

2) Program



11.2.23 Speed Teaching

1) Description
(1) Used device

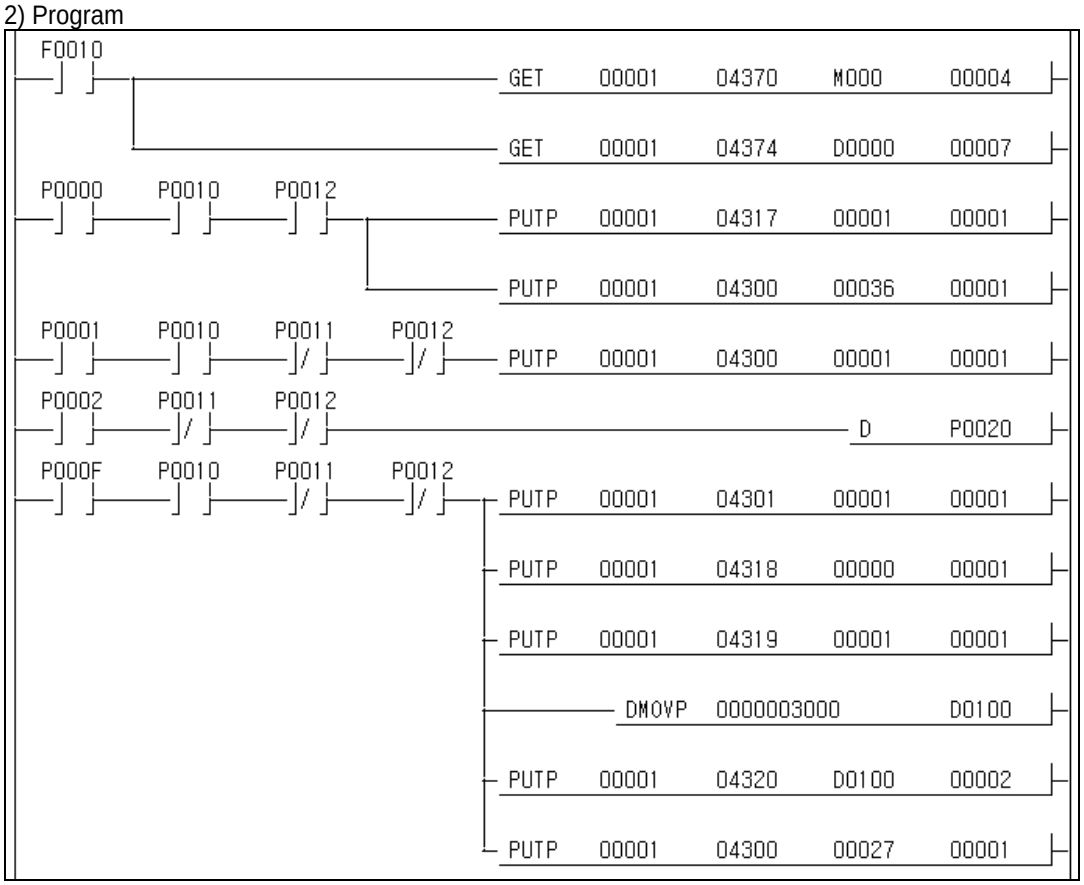
Device	Description
P0000	X axis error reset, output prohibit release switch
P0001	X axis homing switch
P0002	X axis start switch
P000F	X axis speed teaching switch
P0010	X axis command receive signal
P0011	X axis signal in operation
P0012	X axis error status signal
P0020	X axis start signal
D0100 ~ D0101	X axis speed teaching data (3000)
M000 ~ M003	X axis status information read (operation status bit information/ axis information/ external I/O signal status)
D0000 ~ D0006	X axis operation information read (current position/speed/step no./M code/ error information)

(2) Operation Order
P0001(Homing) switch ON,OFF => P000F(Speed teaching) switch ON,OFF => P0002(Start) switch ON,OFF

(3) Operation Data Setting

Items of Position data	Step no.	Coordinate	Control method	Operation pattern	Operation method	Goal position [pulse]	Circular interpolation aux. point [pulse]	M code	Acc./Dec. no.	Operation speed [pls/s]	Dwell time [ms]	Circular interpolation direction
X setting	1	Absolute	Position	End	Single	10000	0	0	1	0	100	CW

2) Program



Internal memory setting

4301 : 1(Step no.)
4318 : 0
(RAM teaching)
4319 : 1
(Speed teaching)
4320~4321 : 3000
(Teaching data)
4300 : 27
(Command code)

11.2.24 Position Teaching

1) Description

(1) Used device

Device	Description
P0000	X axis error reset, output prohibit release switch
P0001	X axis homing switch
P0002	X axis start switch
P000F	X axis speed teaching switch
P0010	X axis command receive signal
P0011	X axis signal in operation
P0012	X axis error status signal
P0020	X axis start signal
D0100 ~ D0101	X axis speed teaching data (5000)
M000 ~ M003	X axis status information read (operation status bit information/ axis information/ external I/O signal status)
D0000 ~ D0006	X axis operation information read (current position/speed/step no./M code/ error information)

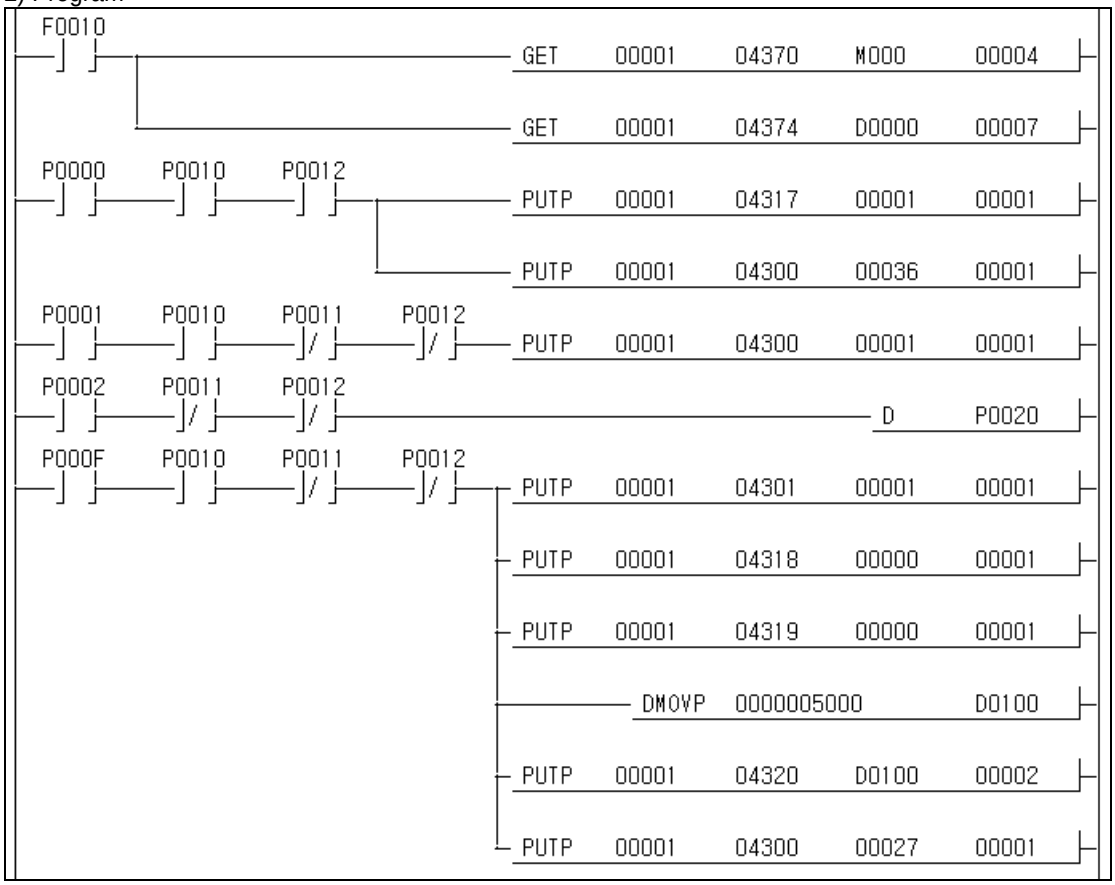
(2) Operation Order

P0001(Homing) switch ON,OFF => P000F(Position teaching) switch ON,OFF => P0002(Start) switch ON,OFF

(3) Operation Data Setting

Items of Position data	Step no.	Coordinate	Control method	Operation pattern	Operation method	Goal position [pulse]	Circular interpolation aux. point [pulse]	M code	Acc./Dec. no.	Operation speed [pls/s]	Dwell time [ms]	Circular interpolation direction
X setting	1	Absolute	Position	End	Single	0	0	0	1	500	100	CW

2) Program



Internal memory setting

4301 : 1(Step no.)
4318 : 0
(RAM teaching)
4319 : 0
(Position teaching)
4320~4321 : 5000
(Teaching data)
4300 : 27
(Command code)

11.2.25 Parameter Change

1) Description
(1) Used device

Device	Description
P0000	X axis error reset, output prohibit release switch
P0001	X axis homing switch
P0002	X axis start switch
P000F	X axis parameter change switch
P0010	X axis command receive signal
P0011	X axis signal in operation
P0012	X axis error status signal
P0020	X axis start signal
MOOOD	X axis signal in constant speed
D0004	X axis current operation step no.
M000 ~ M003	X axis status information read (operation status bit information/ axis information/ external I/O signal status)
D0000 ~ D0006	X axis operation information read (current position/speed/step no./M code/ error information)

(2) Operation Order
P0001(Homing) switch ON,OFF => P000F(Parameter change) switch ON,OFF => P0002(Start) switch ON,OFF

(3) Operation Data Setting

Items of Position data	Step no.	Coordinate	Control method	Operation pattern	Operation method	Goal position [pulse]	Circular interpolation aux. point [pulse]	M code	Acc./Dec. no.	Operation speed [pls/s]	Dwell time [ms]	Circular interpolation direction
X setting	1	Absolute	Position	End	Single	10000	0	0	1	1000	100	CW

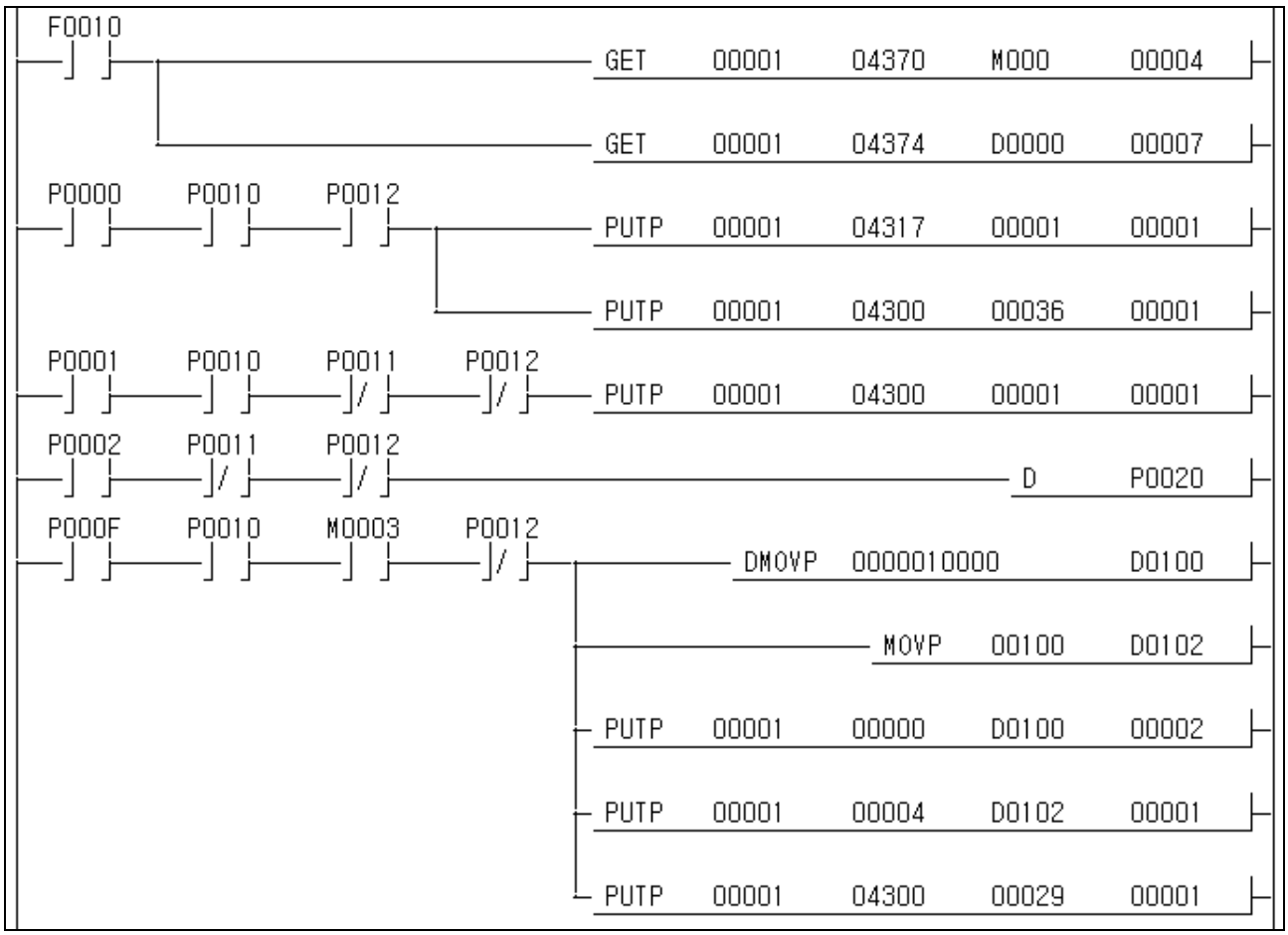
(4) Basic Parameter Setting

Basic parameter	Unit	0: pulse
	Pulse number per 1 rotation	20000 pls
	Transfer distance per 1 rotation	20000 pls
	Double precision unit	0: x1
	Pulse output mode	0: CW/CCW
	Bias speed	1 pls/s
	Speed limit	100000 pls/s
	Inc./Dec. time 1	500 ms
	Inc./Dec. time 2	1000 ms
	Inc./Dec. time 3	1500 ms
	Inc./Dec. time 4	2000 ms

(5) Internal Memory Basic Parameter Setting

Address of internal memory	Contents of internal memory	Setting value
0 ~ 1	Speed limit	200000
4	Acc./Dec. time 1	100
4300	Command code	29

2) Program


F0010
GET 00001 04370 M000 00004
GET 00001 04374 D0000 00007
P0000 P0010 P0012
PUTP 00001 04317 00001 00001
PUTP 00001 04300 00036 00001
P0001 P0010 P0011 P0012
PUTP 00001 04300 00001 00001
P0002 P0011 P0012
D P0020
P000F P0010 M0003 P0012
DMOVP 0000010000 D0100
MOVP 00100 D0102
PUTP 00001 00000 D0100 00002
PUTP 00001 00004 D0102 00001
PUTP 00001 04300 00029 00001

11.2.26 M code mode

1) Description

(1) Used device

Device	Description
P0000	X axis error reset, output prohibit release switch
P0001	X axis homing switch
P0002	X axis start switch
P000F	X axis M code release switch
P0010	X axis command receive signal
P0011	X axis signal in operation
P0012	X axis error status signal
P0020	X axis start signal
MOOO3	X axis M code ON signal
M000 ~ M003	X axis status information read (operation status bit information/ axis information/ external I/O signal status)
D0000 ~ D0006	X axis operation information read (current position/speed/step no./M code/ error information)

(2) Opeation Order

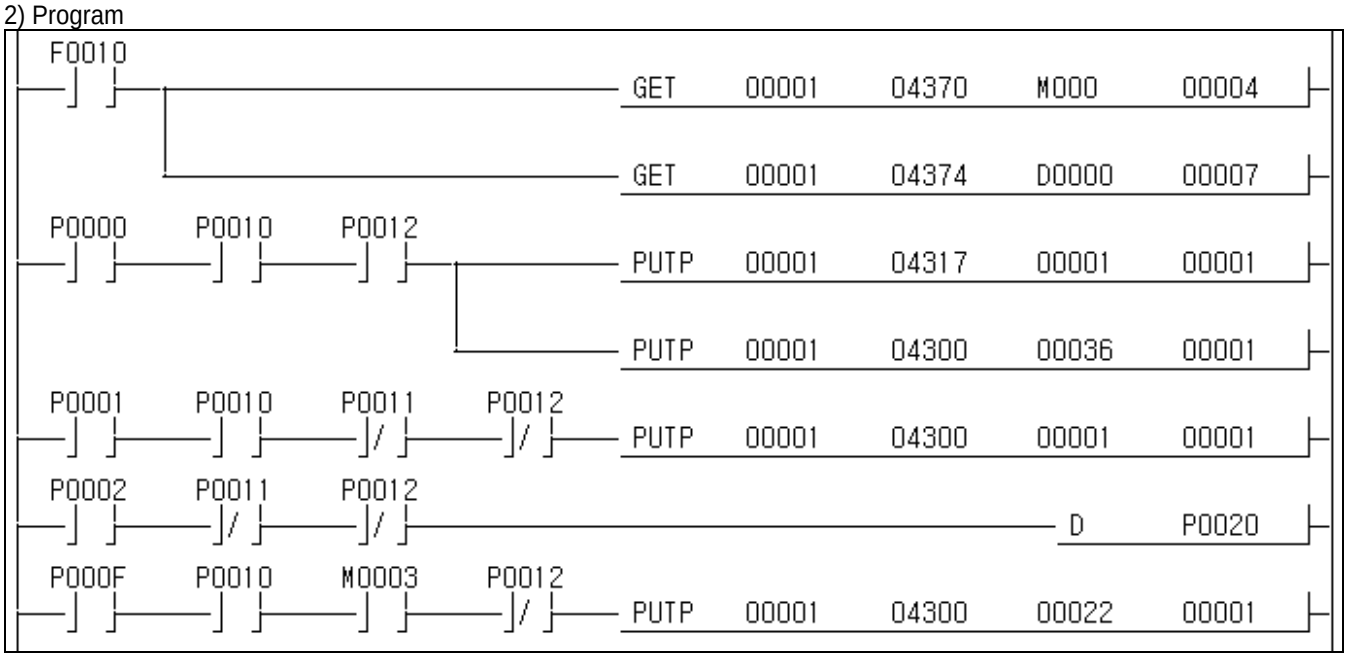
P0001(Homing) switch ON,OFF => P0002(Start) switch ON,OFF => P000F(M code release) switch ON,OFF => P000F(M code release) switch ON,OFF => P000F(M code release) switch ON,OFF

(3) Operation Data and Parameter Setting

Items of Position data	Step no.	Coordinate	Control method	Operation pattern	Operation method	Goal position [pulse]	Circular interpolation aux. point [pulse]	M code	Acc./Dec. no.	Operation speed [pls/s]	Dwell time [ms]	Circular interpolation direction
X setting	1	Absolute	Position	Go-on	Single	10000	0	1	1	1000	100	CW
	2	Absolute	Position	Go-on	Single	20000	0	2	1	1500	100	CW
	3	Absolute	Position	End	Single	0	0	3	1	2000	100	CW

Extended parameter setting => M code output=> 2:AFTER

2) Program



11.2.27 Zone setting

1) Description

(1) Used device

Device	Description
P0000	X axis error reset, output prohibit release switch
P0001	X axis homing switch
P0002	X axis start switch
P000E	X axis ZONE output permit
P000F	X axis ZONE output prohibit
P0010	X axis command receive signal
P0011	X axis signal in operation
P0012	X axis error status signal
P0020	X axis start signal
M000 ~ M003	X axis status information read (operation status bit information/ axis information/ external I/O signal status)
D0000 ~ D0006	X axis operation information read (current position/speed/step no./M code/ error information)

(2) Operation Order

P0001(Homing) switch ON,OFF => P000E(ZONE output permit) switch ON,OFF => P0002(Start) switch ON,OFF => P000F(ZONE output prohibit) switch ON,OFF => P0002(Start) switch ON,OFF

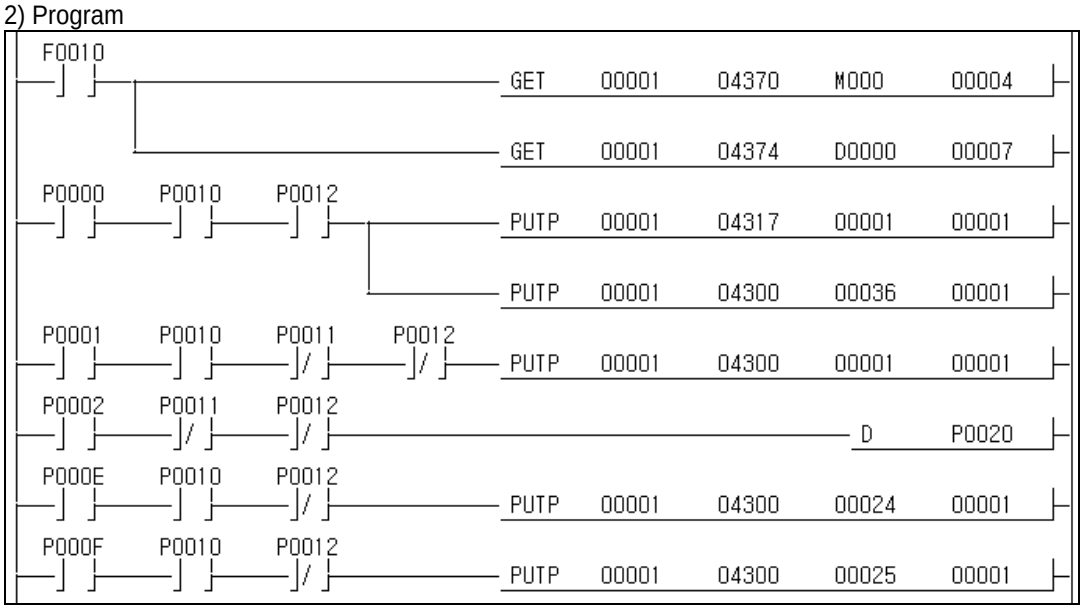
(3) Operation Data Setting

Items of Position data	Step no.	Coordinate	Control method	Operation pattern	Operation method	Goal position [pulse]	Circular interpolation aux. point [pulse]	M code	Acc./Dec. no.	Operation speed [pls/s]	Dwell time [ms]	Circular interpolation direction
X setting	1	Absolute	Position	End	Single	10000	0	0	1	500	100	CW

(4) Common Parameter Setting

ZONE output mode	0: Single output
ZONE1 axis setting	0: X axis
ZONE2 axis setting	0: X axis
ZONE3 axis setting	0: X axis
ZONE1 ON starting point	0 pls
ZONE1 ON end point	1000 pls
ZONE2 ON starting point	1500 pls
ZONE2 ON end point	2500 pls
ZONE3 ON start point	3000 pls
ZONE3 ON end point	4000 pls

2) Program



11.2.28 Operation Data Setting

1) Description
(1) Used device

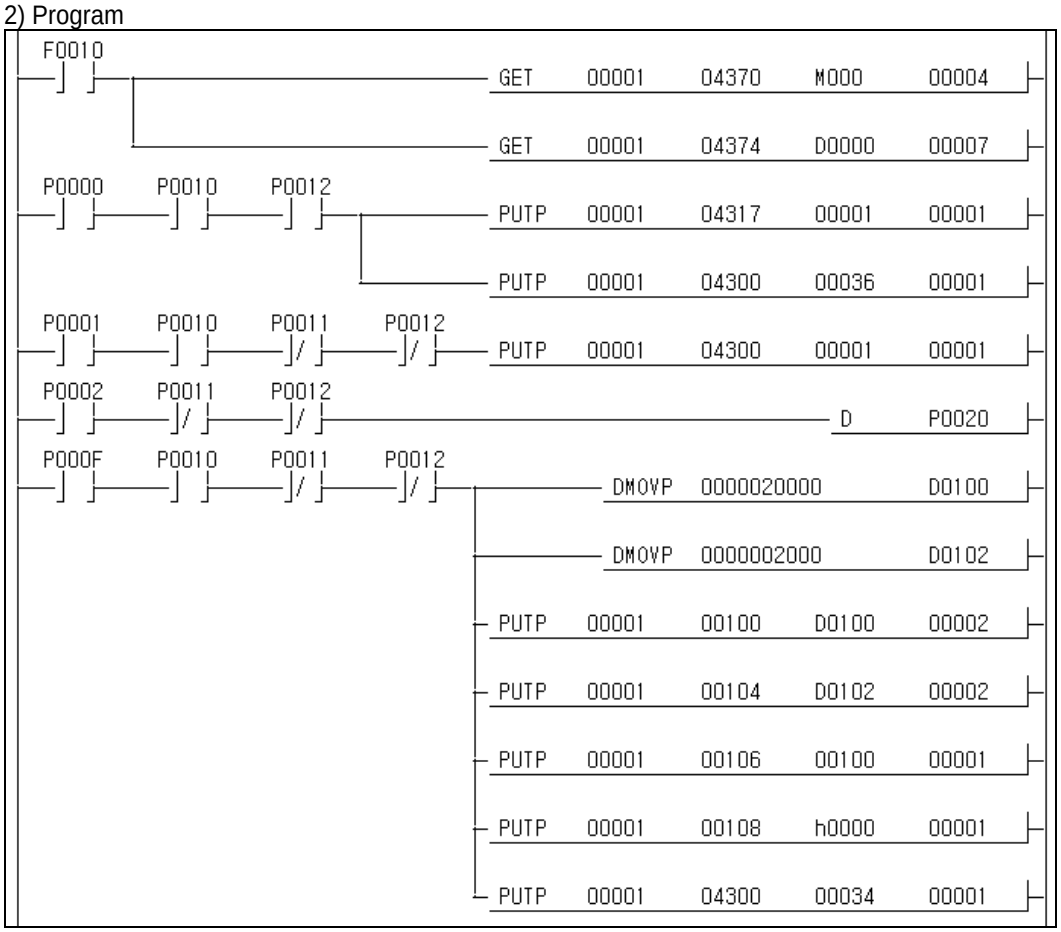
Device	Description
P0000	X axis error reset, output prohibit release switch
P0001	X axis homing switch
P0002	X axis start switch
P000F	X axis operation data setting switch
P0010	X axis command receive signal
P0011	X axis signal in operation
P0012	X axis error status signal
P0020	X axis start signal
M000 ~ M003	X axis status information read (operation status bit information/ axis information/ external I/O signal status)
D0000 ~ D0006	X axis operation information read (current position/speed/step no./M code/ error information)

(2) Operation Order
P0001(Homing) switch ON,OFF => P000F(Operation data setting) switch ON,OFF => P0002(Start) switch ON,OFF

(3) Operation Data after setting

Items of Position data	Step no.	Coordinate	Control method	Operation pattern	Operation method	Goal position [pulse]	Circular interpolation aux. point [pulse]	M code	Acc./Dec. no.	Operation speed [pls/s]	Dwell time [ms]	Circular interpolation direction
X setting	1	Absolute	Position	End	Single	20000	0	**0**	1	2000	100	CW

2) Program



Internal memory setting

100~101 : 20000
(Goal position)
104~105 : 2000
(Operation speed)
106 : 100
(Dwell time)
10 : h0000
(Control word)
4300 : 34
(Command code)

11.2.29 Point Operation

1) Description

(1) Used device

Device	Description
P0000	X axis error reset, output prohibit release switch
P0001	X axis homing switch
P000F	X axis Point operation switch
P0010	X axis command receive signal
P0011	X axis signal in operation
P0012	X axis error status signal
M000 ~ M003	X axis status information read (operation status bit information/ axis information/ external I/O signal status)
D0000 ~ D0006	X axis operation information read (current position/speed/step no./M code/ error information)

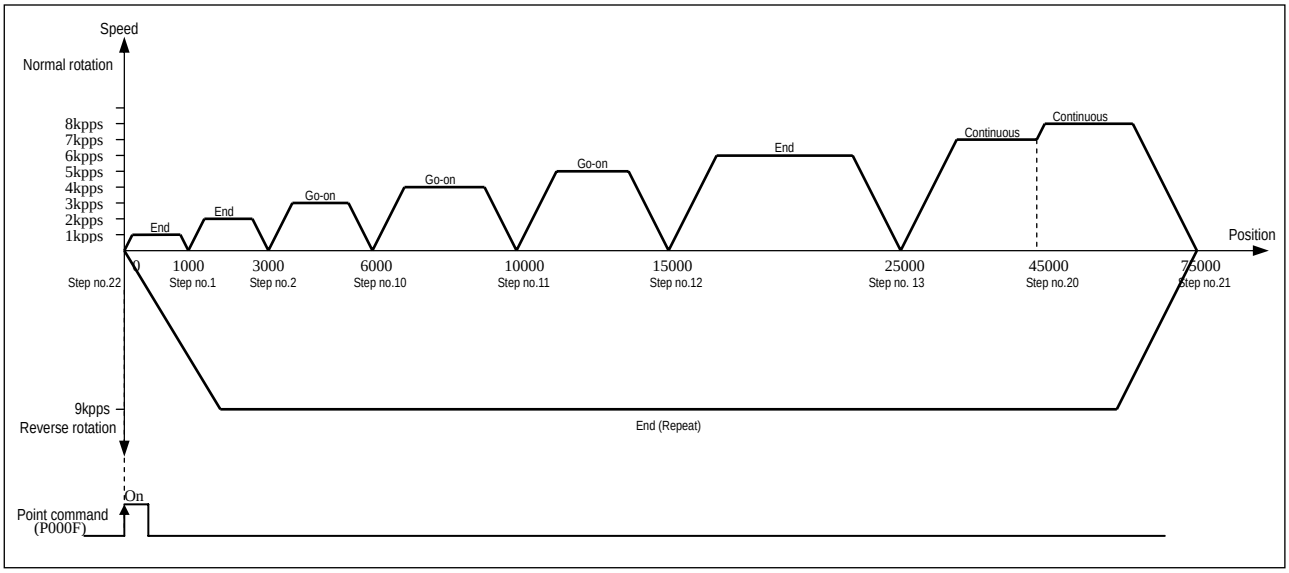
(2) Operation Order

P0001(Homing) switch ON,OFF => P000F(Point operation) switch ON,OFF

(3) Operation Data Setting

Items of Position data	Step no.	Coordinate	Control method	Operation pattern	Operation method	Goal position [pulse]	Circular interpolation aux. point [pulse]	M code	Acc./Dec. no.	Operation speed [pls/s]	Dwell time [ms]	Circular interpolation direction
X setting	1	Absolute	Position	End	Single	1000	0	**0**	1	1000	20	CW
	2	Absolute	Position	End	Single	3000	0	**0**	1	2000	20	CW
	10	Absolute	Position	Go-on	Single	6000	0	**0**	1	3000	20	CW
	11	Absolute	Position	Go-on	Single	10000	0	**0**	1	4000	20	CW
	12	Absolute	Position	Go-on	Single	15000	0	**0**	1	5000	20	CW
	13	Absolute	Position	End	Single	25000	0	**0**	1	6000	20	CW
	20	Absolute	Position	Conti.	Single	45000	0	**0**	2	7000	20	CW
	21	Absolute	Position	Conti.	Single	75000	0	**0**	2	8000	20	CW
	22	Absolute	Position	End	Repeat	0	0	**0**	2	9000	20	CW

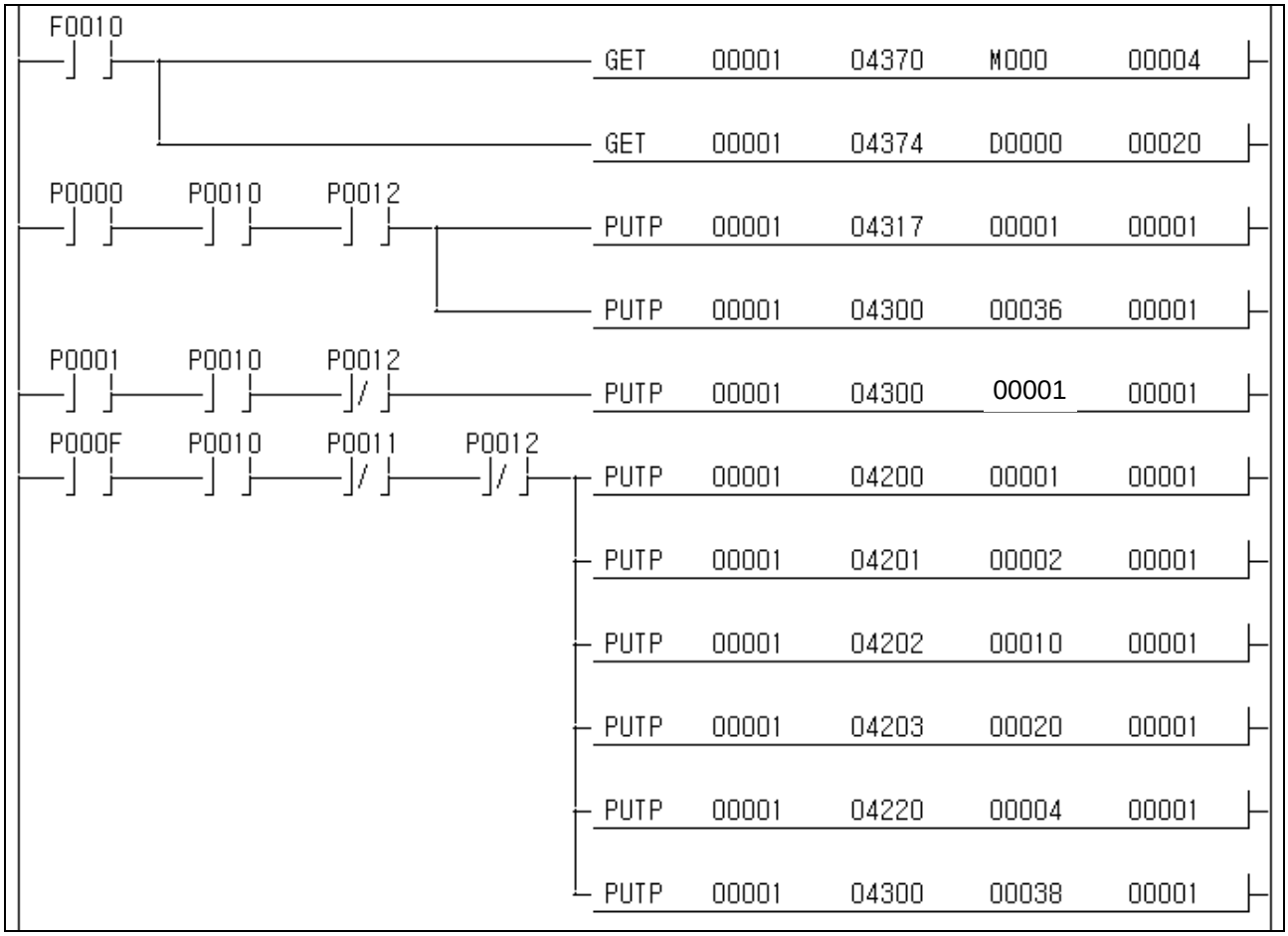
(4) Operation pattern



(5) Internal memory setting

Address of internal memory	Contents of internal memory	Setting value
4200	Point operation setting 1	1
4201	Point operation setting 2	2
4202	Point operation setting 3	10
4203	Point operation setting 4	20
4220	Point number	4
4300	Command code	38

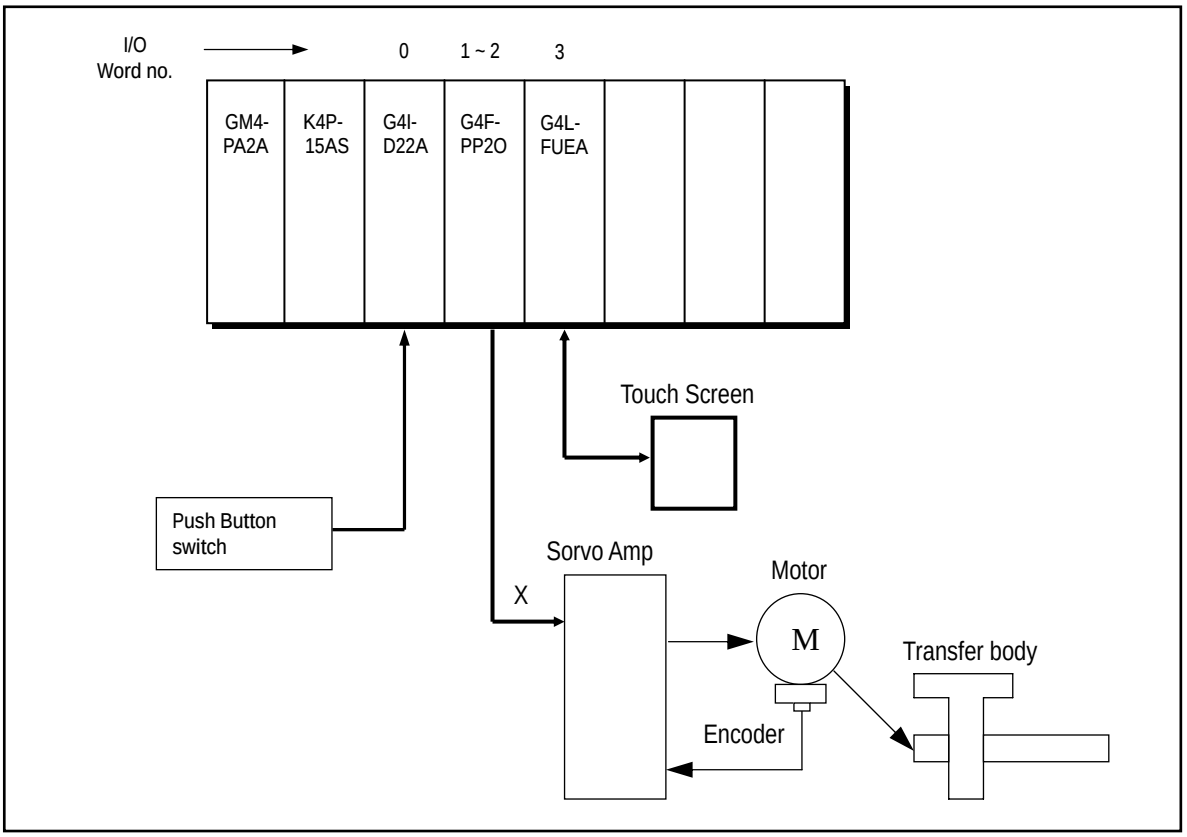
2) Program



11.2 Application Program

11.2.1 Position Teaching and Speed Teaching by MMI

1) System configuration



2) Description

After setting goal position, normal rotation speed, reverse rotation speed in Touch Screen by using teaching command, if you start after homing, Servo motor starts to rotate as much as position and speed move data set in Touch Screen.

As RAM teaching mode is used as the program by position teaching and speed teaching, the number of teaching is not limited.

3) Used device

Device	Description
P0000	X axis error reset, output prohibit release switch
P0001	X axis homing switch
P0002	X axis position teaching switch
P0003	X axis normal rotation speed teaching switch
P0004	X axis reverse rotation speed teaching switch
P000F	X axis start switch
P0010	X axis command receive signal
P0011	X axis signal in operation
P0012	X axis error status signal
P0020	X axis start signal
D0500 ~ D0501	X axis position teaching data
D0540 ~ D0541	X axis normal rotation speed teaching data
D0542 ~ D0543	X axis reverse rotation speed teaching data
M000 ~ M003	X axis status information read (operation status bit information/ axis information/ external I/O signal status)
D0000 ~ D0006	X axis operation information read (current position/speed/step no./M code/error information)

4) Operation Order

P0001(Homing) switch ON,OFF => P0002(Position teaching) switch ON,OFF => P0003(normal rotation speed teaching) switch ON,OFF => P000F(Start) switch ON,OFF => P0004(reverse rotation speed teaching) switch ON,OFF => P000F(Start) switch ON,OFF

5) Operation Data Setting

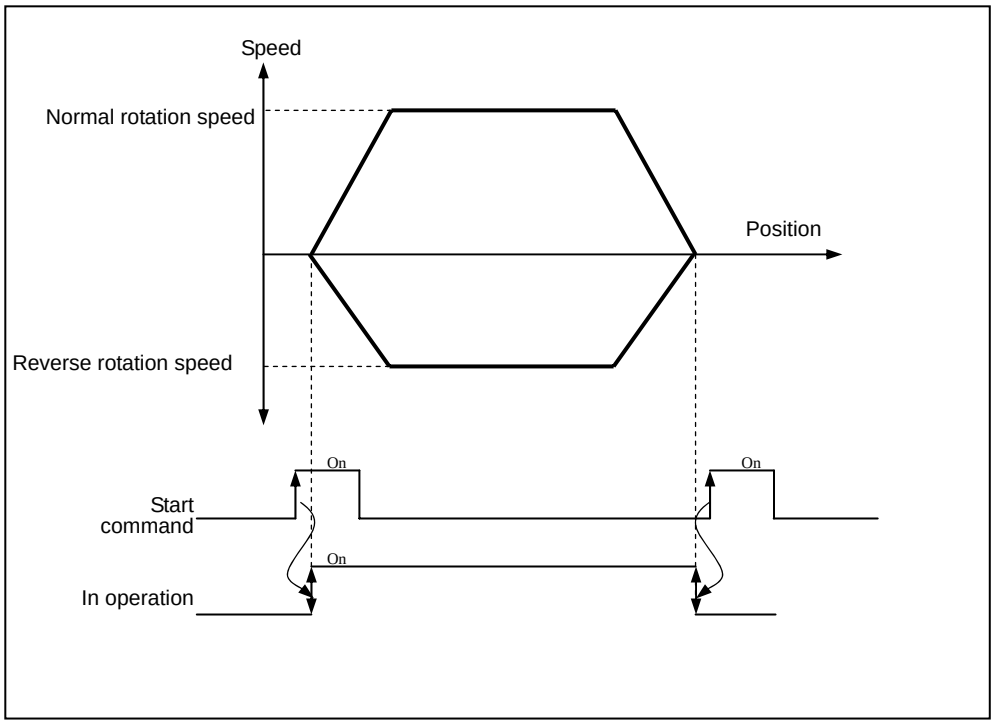
Items of Position data	Step no.	Coordinate	Control method	Operation pattern	Operation method	Goal position [pulse]	Circular interpolation aux. point [pulse]	M code	Acc./Dec. no.	Operation speed [pls/s]	Dwell time [ms]	Circular interpolation direction
X setting	1	Absolute	Position	End	Single	10000	0	**0**	1	500	20	CW
	2	Absolute	Position	End	Repeat	0	0	**0**	1	500	20	CW

6) Internal Memory Setting

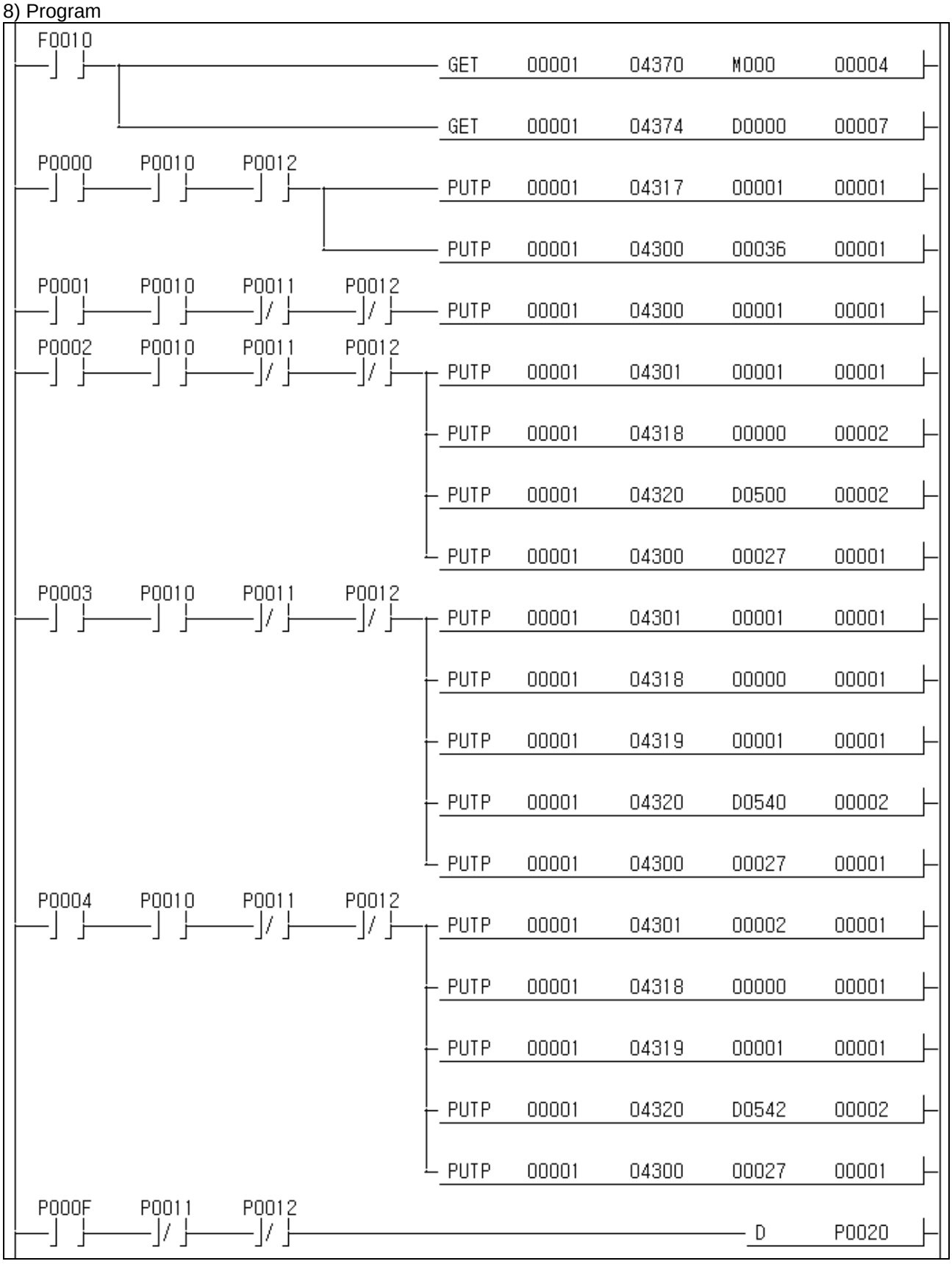
Address of Internal memory	Contents of Internal memory	Teaching setting value (P0002)	Teaching setting value (P0003)	Teaching setting value (P0004)
4301	Teaching step no.	1	1	2
4318	RAM teaching(0),ROM teaching(1)	0	0	0
4319	Position teaching(0), speed teaching(1)	0	1	1
4320 ~ 4321	Teaching data setting	D0500~D0501	D0540~D0541	D0542~D0543
4300	Command code	27	27	27

▷ Teaching data setting value set in Touch Screen is saved as the setting value.

7) Operation pattern



8) Program


F0010
GET 00001 04370 M000 00004
GET 00001 04374 D0000 00007
P0000 P0010 P0012
PUTP 00001 04317 00001 00001
PUTP 00001 04300 00036 00001
P0001 P0010 P0011 P0012
PUTP 00001 04300 00001 00001
P0002 P0010 P0011 P0012
PUTP 00001 04301 00001 00001
PUTP 00001 04318 00000 00002
PUTP 00001 04320 D0500 00002
PUTP 00001 04300 00027 00001
P0003 P0010 P0011 P0012
PUTP 00001 04301 00001 00001
PUTP 00001 04318 00000 00001
PUTP 00001 04319 00001 00001
PUTP 00001 04320 D0540 00002
PUTP 00001 04300 00027 00001
P0004 P0010 P0011 P0012
PUTP 00001 04301 00002 00001
PUTP 00001 04318 00000 00001
PUTP 00001 04319 00001 00001
PUTP 00001 04320 D0542 00002
PUTP 00001 04300 00027 00001
P000F P0011 P0012
D P0020

11.2.2 End Operation, Go-on Operation, Continuous Operation Positioning

1) System Configuration

System configuration is same as Art. 11.2.1.

Point

▶The methods to fix the origin are 3 types : the method by origin return (homing), the method by floating point, the method by current position preset.

2) Used device

Device	Description
P0000	X axis error reset, output prohibit release switch
P0001	X axis homing switch
P000F	X axis start switch
P0010	X axis command receive signal
P0011	X axis signal in operation
P0012	X axis error status signal
P0020	X axis start signal
M000 ~ M003	X axis status information read (operation status bit information/ axis information/ external I/O signal status)
D0000 ~ D0006	X axis operation information read (current position/speed/step no./M code/error information)

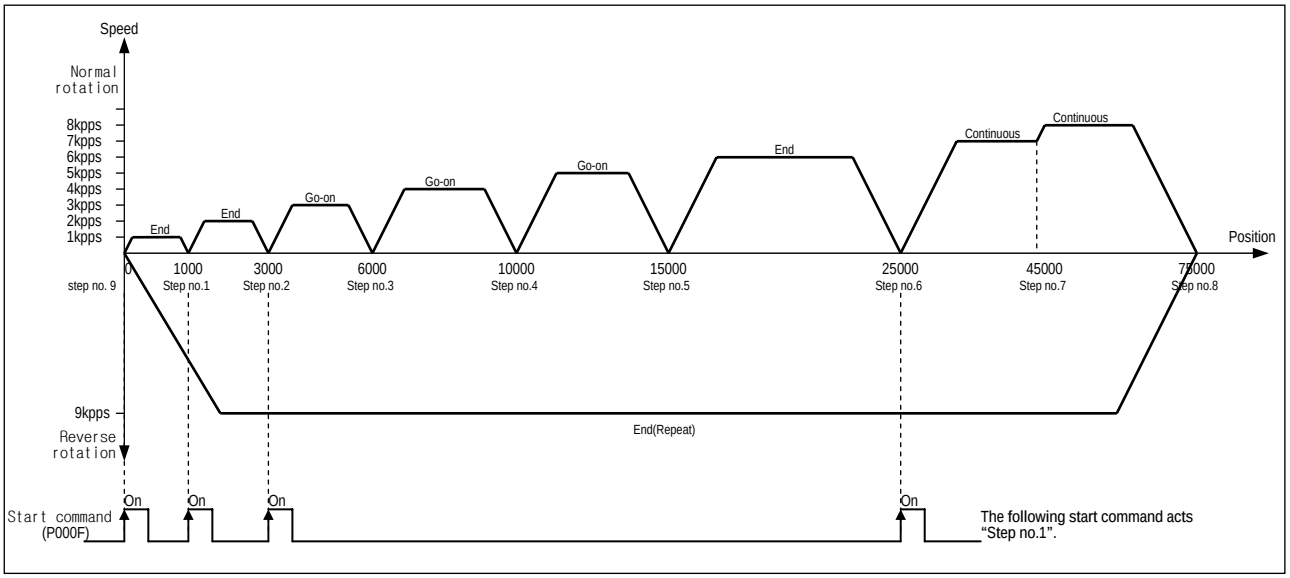
3) Operatin Order

P0001(Homing) switch ON,OFF => P000F(Start) switch ON,OFF 4 times

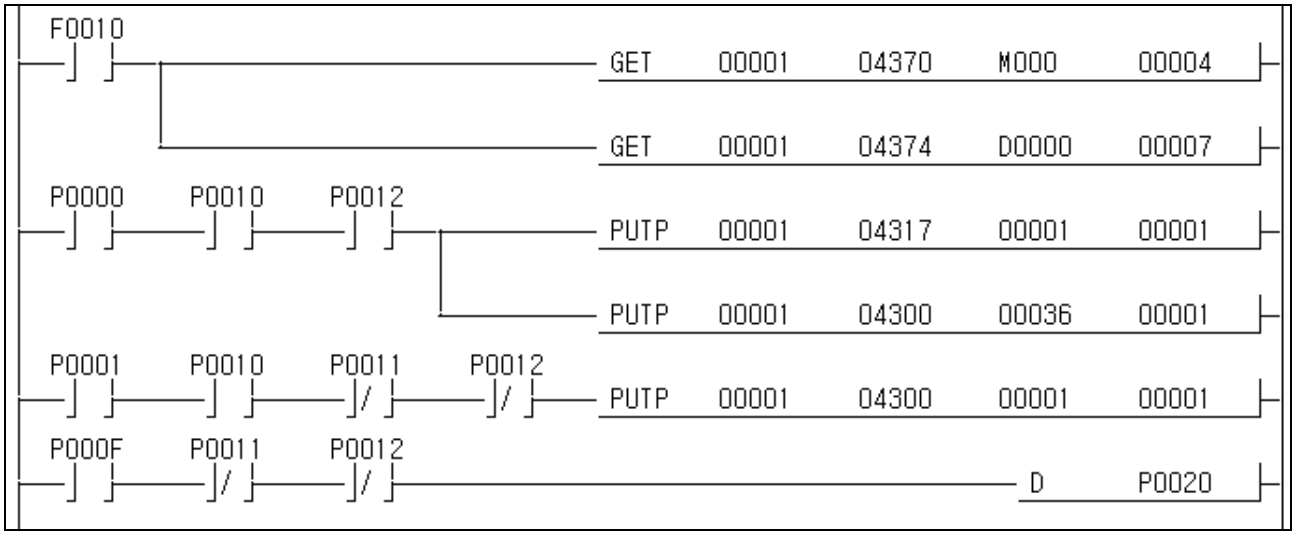
4) Operation Data Setting

Items of Position data	Step no.	Coordinate	Control method	Operation pattern	Operation method	Goal position [pulse]	Circular interpolation aux. point [pulse]	M code	Acc./Dec. no.	Operation speed [pls/s]	Dwell time [ms]	Circular interpolation direction
X setting	1	Relative	Position	End	Single	1000	0	**0**	1	1000	20	CW
	2	Relative	Position	End	Single	2000	0	**0**	1	2000	20	CW
	3	Relative	Position	Go-on	Single	3000	0	**0**	1	3000	20	CW
	4	Relative	Position	Go-on	Single	4000	0	**0**	1	4000	20	CW
	5	Relative	Position	Go-on	Single	5000	0	**0**	1	5000	20	CW
	6	Relative	Position	End	Single	10000	0	**0**	1	6000	20	CW
	7	Relative	Position	Conti.	Single	20000	0	**0**	1	7000	20	CW
	8	Relative	Position	Conti.	Single	30000	0	**0**	1	8000	20	CW
	9	Relative	Position	End	Repeat	0	0	**0**	1	9000	20	CW

5) Operation pattern



6) Program



11.2.3 Positioning by M code

1) System Configuration

System configuration is same as Art. 11.2.1.

2) Used device

Device	Description
P0000	X axis error reset, output prohibit release switch
P0001	X axis homing switch
P0002	X axis M code release switch
P000F	X axis start switch
P0010	X axis command receive signal
P0011	X axis signal in operation
P0012	X axis error status signal
P0020	X axis start signal
M000 ~ M003	X axis status information read (operation status bit information/ axis information/ external I/O signal status)
D0000 ~ D0006	X axis operation information read (current position/speed/step no./M code/error information)

3) Operation Order

P0001(Homing) switch ON,OFF => P000F(Start) switch ON,OFF => P0002(M code release) switch ON,OFF => P000F(Start) switch ON,OFF => P0002(M code release) switch ON,OFF => P0002(M code release) switch ON,OFF => P000F(Start) switch ON,OFF => P0002(M code release) switch ON,OFF => P0002(M code release) switch ON,OFF

▷ Please refer to Start command, M code OFF command of Operation pattern.

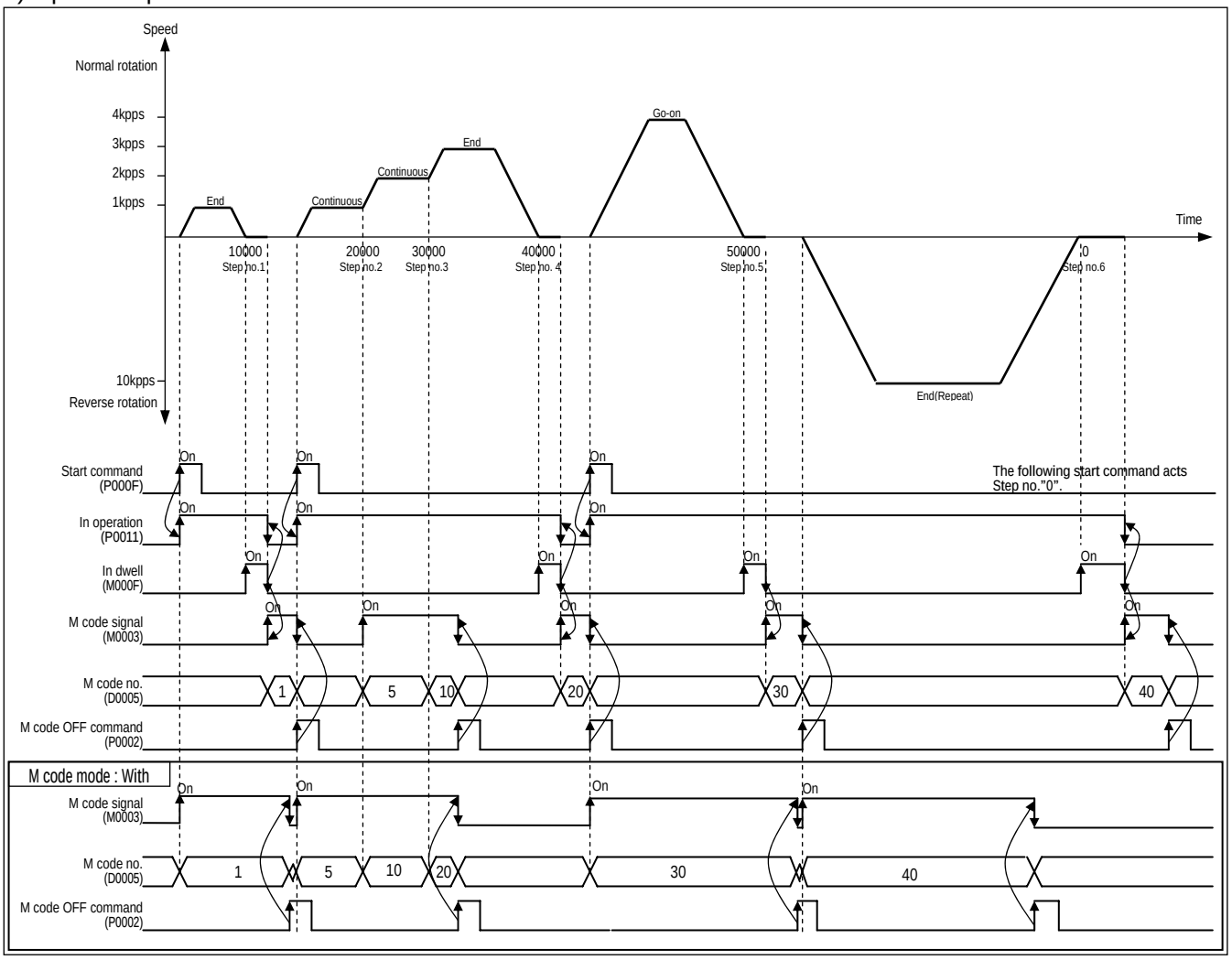
4) Operation Data Setting

Items of Position data	Step no.	Coordinate	Control method	Operation pattern	Operation method	Goal position [pulse]	Circular interpolation aux. point [pulse]	M code	Acc./Dec. no.	Operation speed [pls/s]	Dwell time [ms]	Circular interpolation direction
X setting	1	Absolute	Position	End	Single	10000	0	**1**	1	1000	100	CW
	2	Absolute	Position	Conti.	Single	20000	0	**5**	1	1000	100	CW
	3	Absolute	Position	Conti.	Single	30000	0	**10**	1	2000	100	CW
	4	Absolute	Position	End	Single	40000	0	**20**	1	3000	100	CW
	5	Absolute	Position	Go-on	Single	50000	0	**30**	1	4000	100	CW
	6	Absolute	Position	End	Repeat	0	0	**40**	1	5000	100	CW

5) Extended Parameter Setting

Extended parameter	M code output	2:AFTER

5) Operation pattern

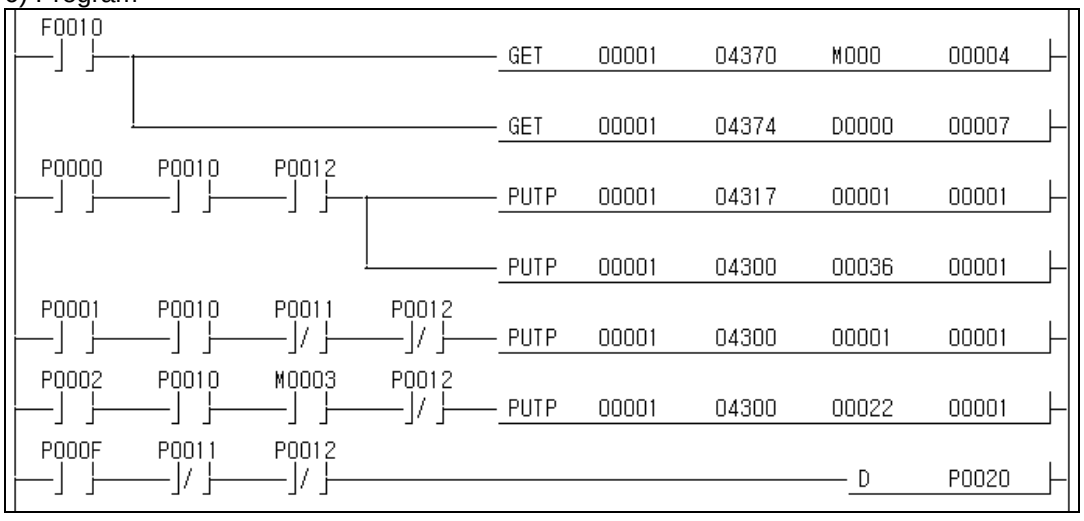


Point

▶In case of Continuous Operation mode, M code signal is changed with the corresponding M code no. without stop whenever operation step no. is changed , and the operation continues.

▶In case of Go-on Operation mode, if M code signal is ON, it is required to change M code ON signal with “OFF” before operating the next operation step no.

6) Program



11.2.4 2 axis Linear Interpolation Operation

1) System Configuration

System configuration is the system that Y axis SERVO motor is added to Artc. 11.2.1 X axis SERVO motor.

2) Used device

Device	Description
P0000	X, Y axis error reset, output prohibit release switch
P0001	X, Y axis homing switch
P000F	2 axis linear interpolation operation switch
P0010	X axis command receive signal
P0011	X axis signal in operation
P0012	X axis error status signal
M000 ~ M003	X axis status information read (operation status bit information/ axis information/ external I/O signal status)
D0000 ~ D0006	X axis operation information read (current position/speed/step no./M code/error information)
P0015	Y axis command receive signal
P0016	Y axis signal in operation
P0017	Y axis error status signal
M010 ~ M013	Y axis status information read (operation status bit information/ axis information/ external I/O signal status)
D0010 ~ D0016	Y axis operation information read (current position/speed/step no./M code/error information)

3) Operation Order

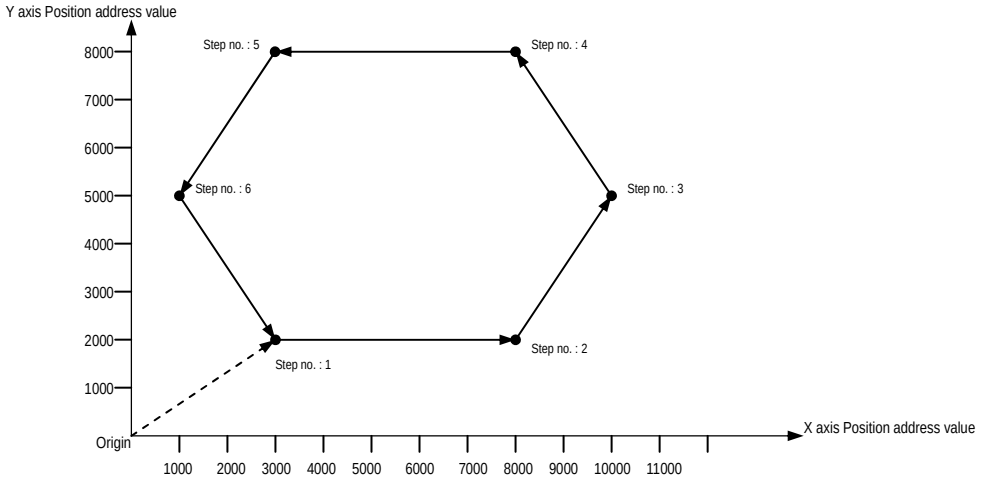
P0001(Homing) switch ON,OFF => P000F(linear interpolation) switch ON,OFF => P000F(linear interpolation) switch ON,OFF

4) Operation Data Setting

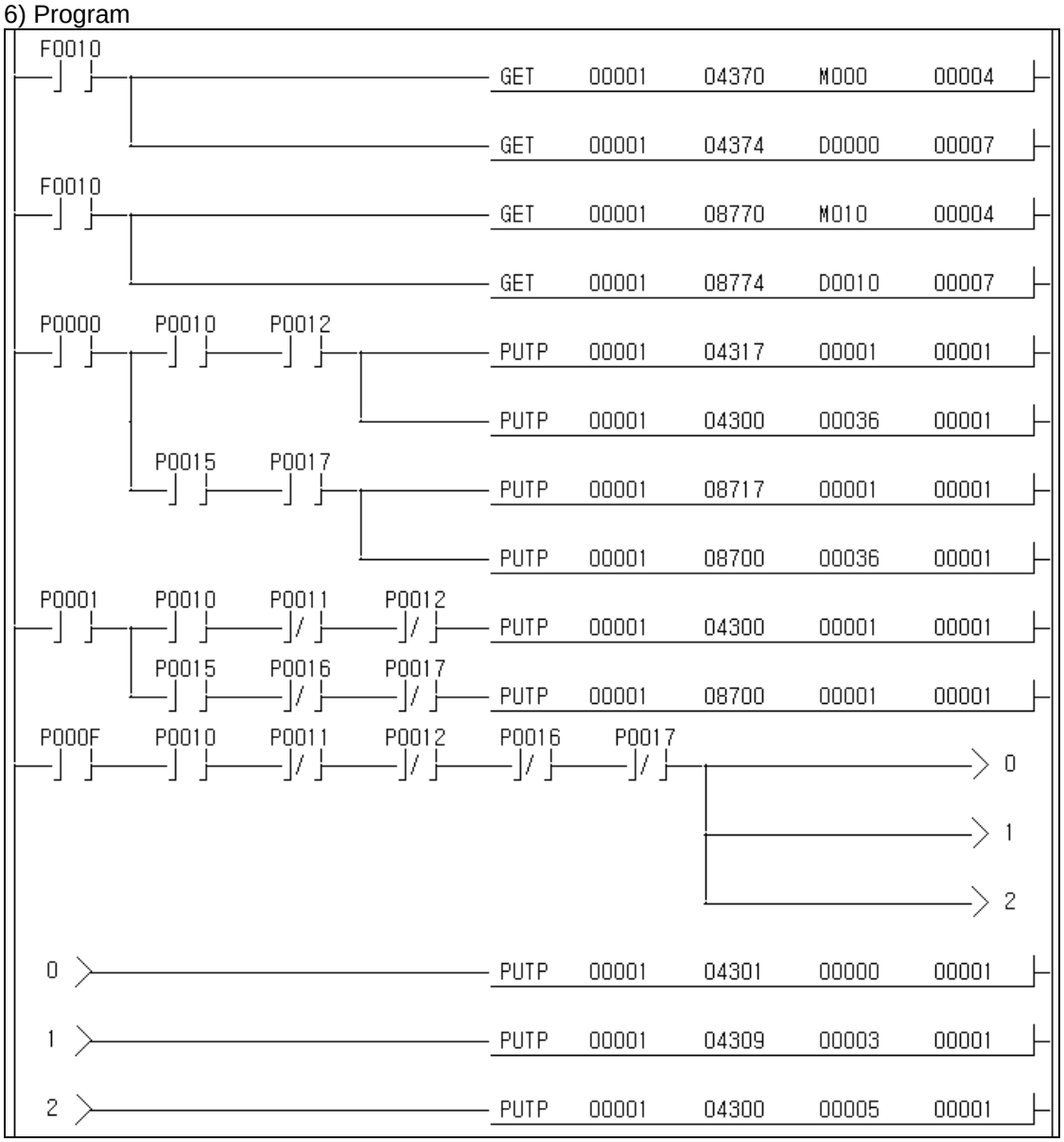
Items of Position data	Step no.	Coordinate	Control method	Operation pattern	Operation method	Goal position [pulse]	Circular interpolation aux. point [pulse]	M code	Acc./Dec. no.	Operation speed [pls/s]	Dwell time [ms]	Circular interpolation direction
X setting	1	Absolute	Position	End	Single	3000	0	**0**	1	1000	100	CW
	2	Absolute	Position	Go-on	Single	8000	0	**0**	1	1000	100	CW
	3	Absolute	Position	Go-on	Single	10000	0	**0**	1	1000	100	CW
	4	Absolute	Position	Go-on	Single	8000	0	**0**	1	1000	100	CW
	5	Absolute	Position	Go-on	Single	3000	0	**0**	1	1000	100	CW
	6	Absolute	Position	Go-on	Repeat	1000	0	**0**	1	1000	100	CW

Items of Position data	Step no.	Coordinate	Control method	Operation pattern	Operation method	Goal position [pulse]	Circular interpolation aux. point [pulse]	M code	Acc./Dec. no.	Operation speed [pls/s]	Dwell time [ms]	Circular interpolation direction
Y setting	1	Absolute	Position	End	Single	2000	0	**0**	1	1000	100	CW
	2	Absolute	Position	Go-on	Single	2000	0	**0**	1	1000	100	CW
	3	Absolute	Position	Go-on	Single	5000	0	**0**	1	1000	100	CW
	4	Absolute	Position	Go-on	Single	8000	0	**0**	1	1000	100	CW
	5	Absolute	Position	Go-on	Single	8000	0	**0**	1	1000	100	CW
	6	Absolute	Position	Go-on	Repeat	5000	0	**0**	1	1000	100	CW

5) Operation pattern

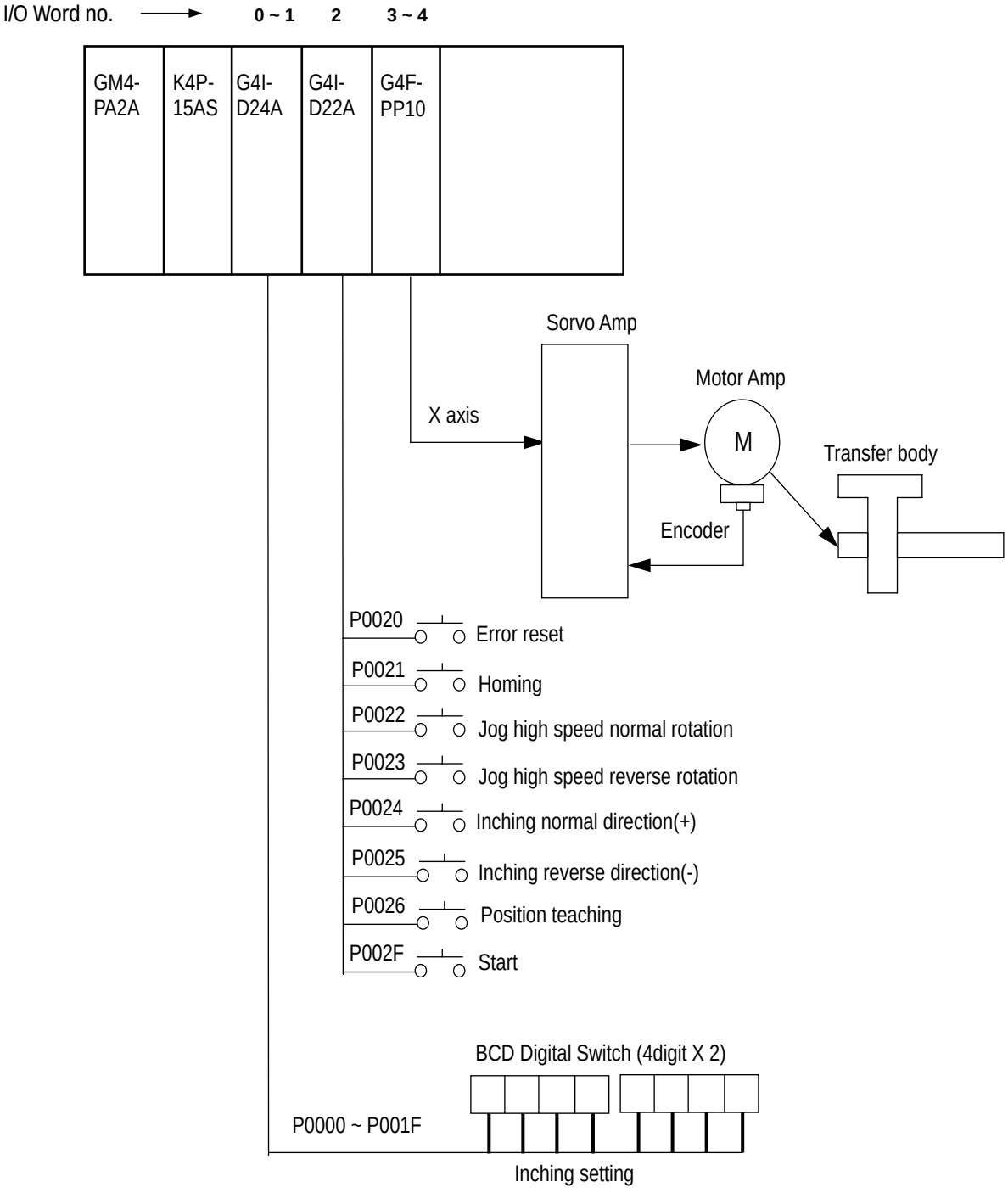


6) Program



11.2.5 Position Teaching by Jog Operation and Inching Operation

1) System Configuration



2) Used device

Device	Description
P0020	X axis error reset, output prohibit release switch
P0021	X axis homing switch
P0022	X axis Jog high speed normal rotation switch
P0023	X axis Jog high speed reverse rotation switch
P0024	X axis inching normal rotation switch
P0025	X axis inching reverse rotation switch
P0026	X axis position teaching switch
P002F	X axis start switch
P0030	X axis command receive signal
P0031	X axis signal in operation
P0032	X axis error status signal
P0040	X axis start signal
D0000 ~ D0001	X axis current position
D0100 ~ D0101	Incing normal rotation setting value
D0102 ~ D0103	Incing reverse rotation setting value
M000 ~ M003	X axis status information read (operation status bit information/ axis information/ external I/O signal status)
D0000 ~ D0006	X axis operation information read (current position/speed/step no./M code/error information)

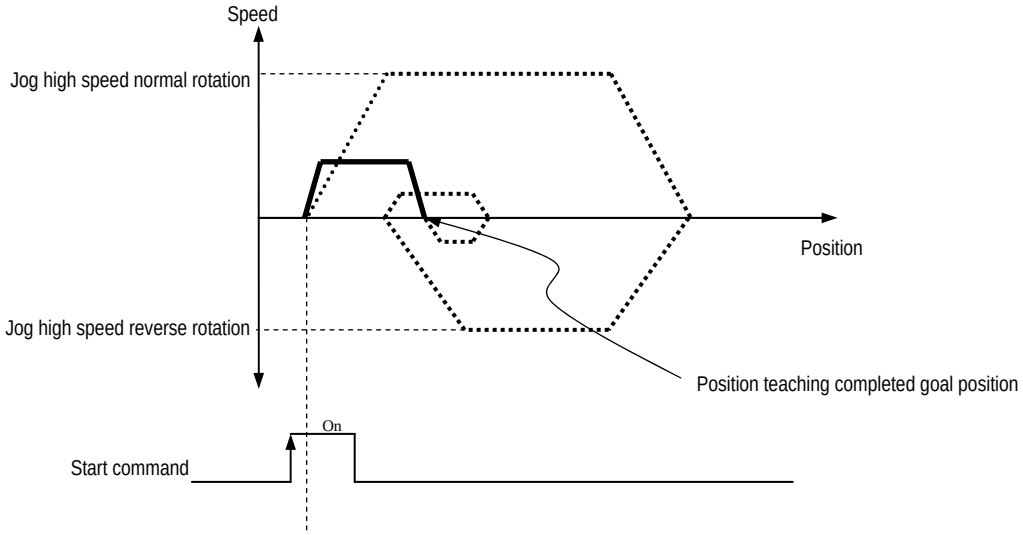
3) Operation Order

P0021(Homing) switch ON,OFF => P0022(Jog high speed normal rotation) switch ON,OFF => P0023(Jog high speed reverse rotation) switch ON,OFF => Inching transfer amount setting by BCD digital switch => P0024(inching normal rotation) switch ON,OFF => Inching transfer amount setting by BCD digital switch => P0025(inching reverse rotation) switch ON,OFF => P0026(position teaching) switch ON,OFF => P0021(Homing) switch ON,OFF => P002F(Start) switch ON,OFF

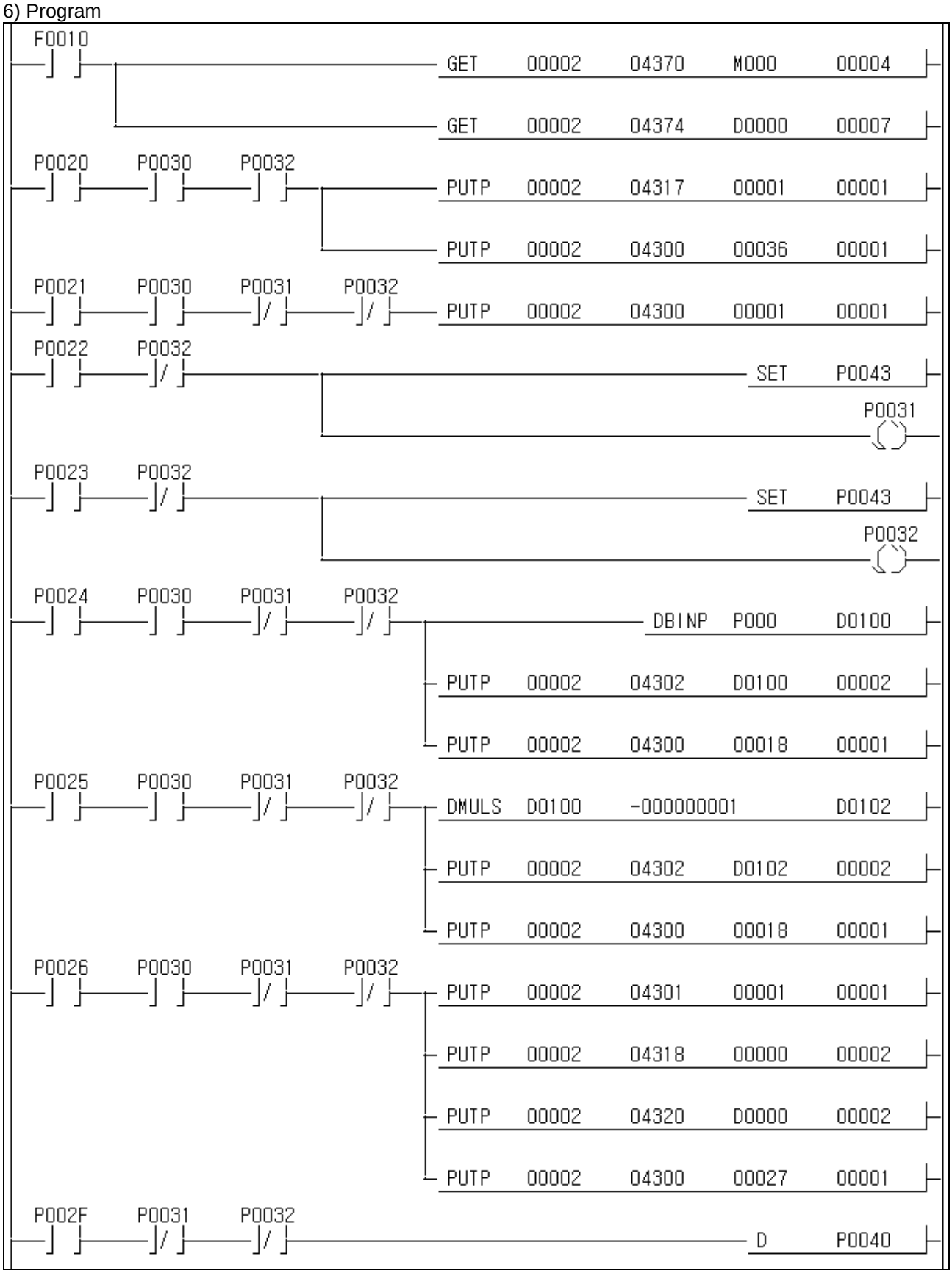
4) Operation Data Setting

Items of Position data	Step no.	Coordinate	Control method	Operation pattern	Operation method	Goal position [pulse]	Circular interpolation aux. point [pulse]	M code	Acc./Dec. no.	Operation speed [pls/s]	Dwell time [ms]	Circular interpolation direction
X setting	1	Absolute	Position	End	Single	0	0	**0**	1	1000	100	CW
	2	Absolute	Position	End	Single	0	0	**0**	1	0	0	CW

5) Operation pattern

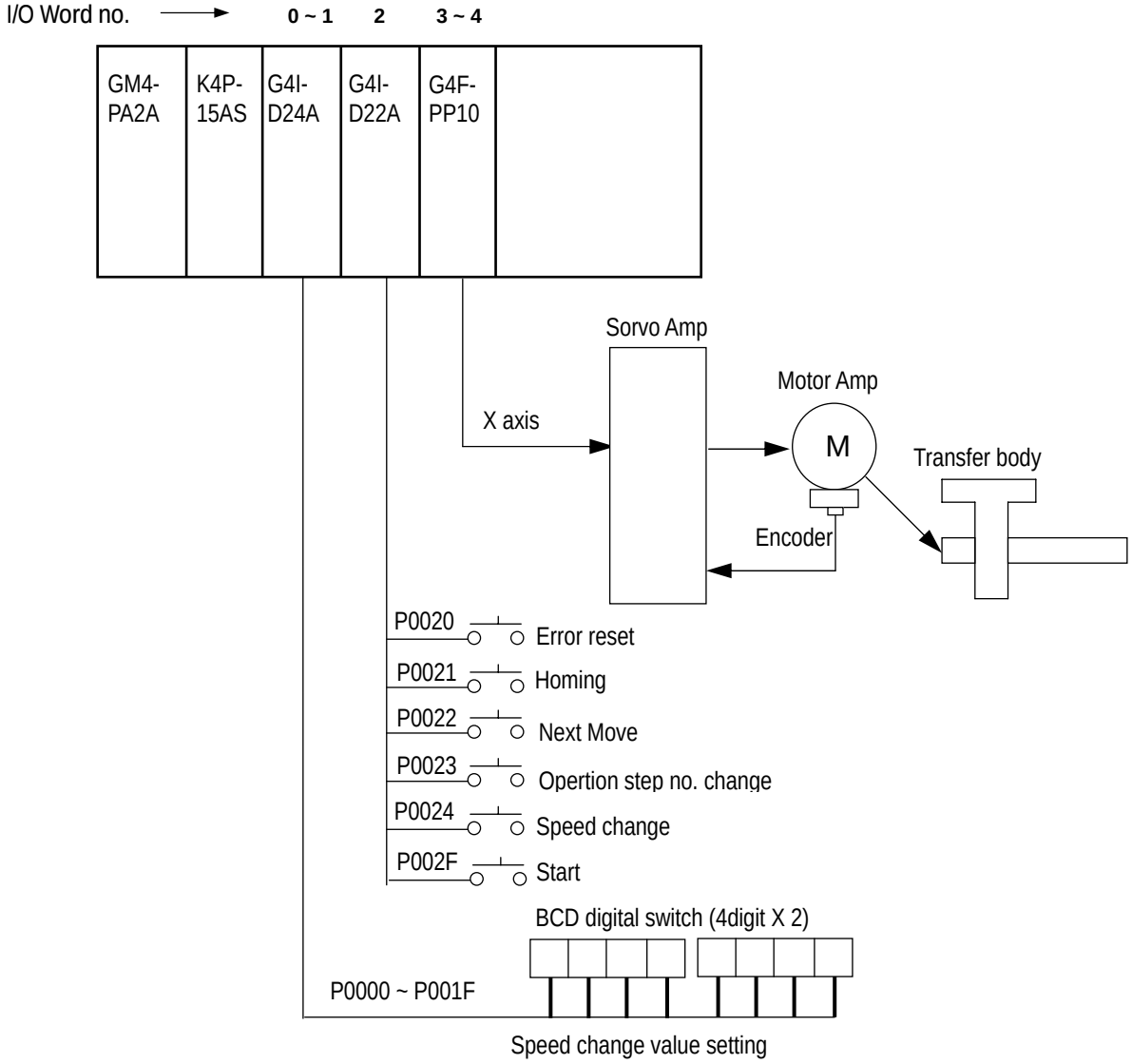


6) Program


F0010
GET 00002 04370 M000 00004
GET 00002 04374 D0000 00007
P0020 P0030 P0032
PUTP 00002 04317 00001 00001
PUTP 00002 04300 00036 00001
P0021 P0030 P0031 P0032
PUTP 00002 04300 00001 00001
P0022 P0032
SET P0043
P0031
P0023 P0032
SET P0043
P0032
P0024 P0030 P0031 P0032
DBINP P000 D0100
PUTP 00002 04302 D0100 00002
PUTP 00002 04300 00018 00001
P0025 P0030 P0031 P0032
DMULS D0100 -000000001 D0102
PUTP 00002 04302 D0102 00002
PUTP 00002 04300 00018 00001
P0026 P0030 P0031 P0032
PUTP 00002 04301 00001 00001
PUTP 00002 04318 00000 00002
PUTP 00002 04320 D0000 00002
PUTP 00002 04300 00027 00001
P002F P0031 P0032
D P0040

11.2.6 Speed Change, Next Move

1) System Configuration



2) Used device

Device	Description
P0020	X axis error reset, output prohibit release switch
P0021	X axis homing switch
P0022	X axis Next Move switch
P0023	X axis operation step no. change switch
P0024	X axis speed change switch
P002F	X axis start switch
P0030	X axis command receive signal
P0031	X axis signal in operation
P0032	X axis error status signal
P0040	X axis start signal
D0100 ~ D0001	Speed change setting value
M000 ~ M003	X axis status information read (operation status bit information/ axis information/ external I/O signal status)
D0000 ~ D0006	X axis operation information read (current position/speed/step no./M code/error information)

3) Description

After changing position speed with speed change value set by digital switch during positioning operation by after homing and carrying out the next step operation by Next Move command during continuous operation by operation step no. change, positioning operation is completed.

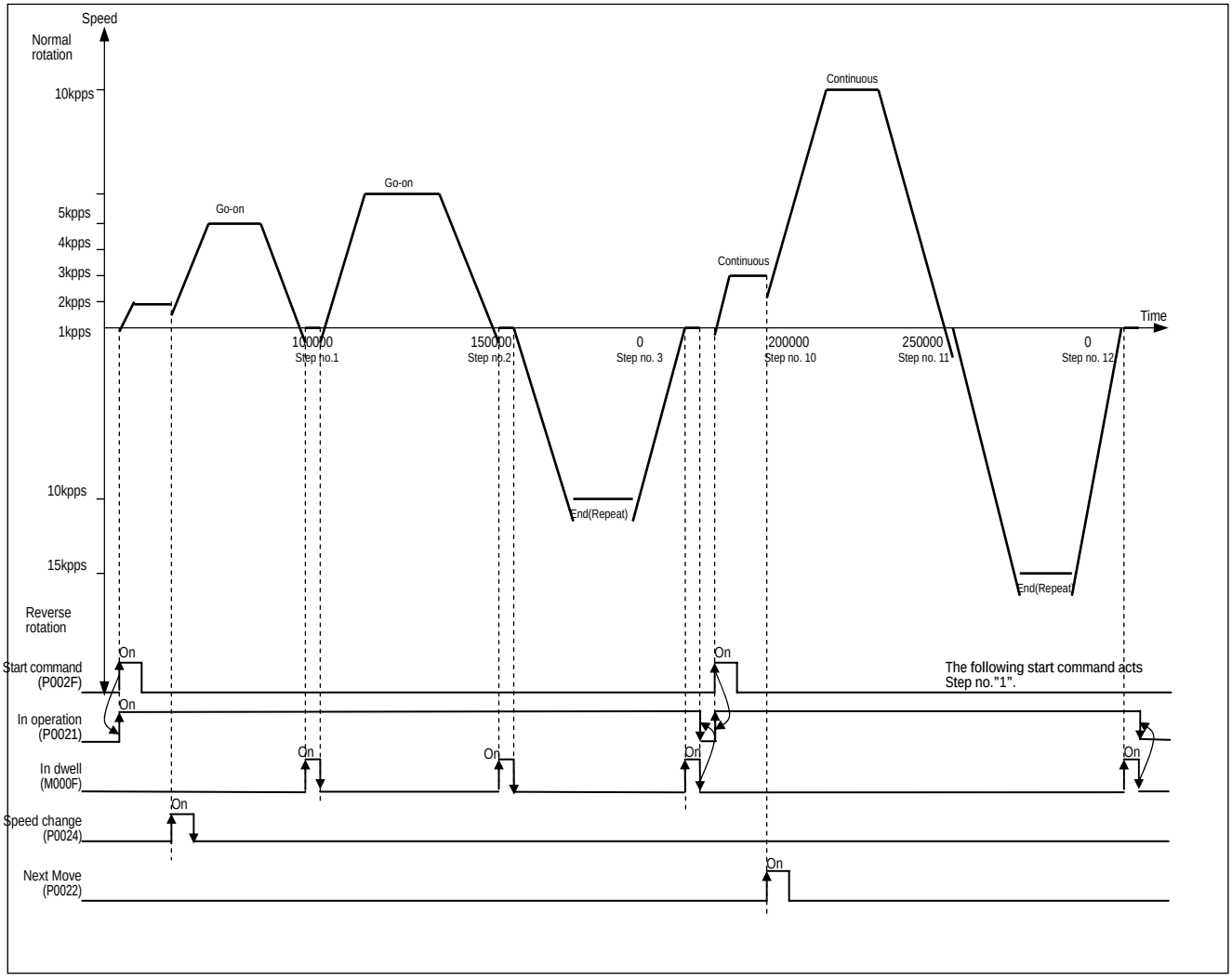
4) Operation Order

P0021(Homing) switch ON,OFF => P002F(Start) switch ON,OFF => Speed change value setting by BCD digital switch => P0024(Speed change) switch ON,OFF => P0023(operation step no. change) switch ON,OFF => P002F(Start) switch ON,OFF => P0022(Next Move) switch ON,OFF

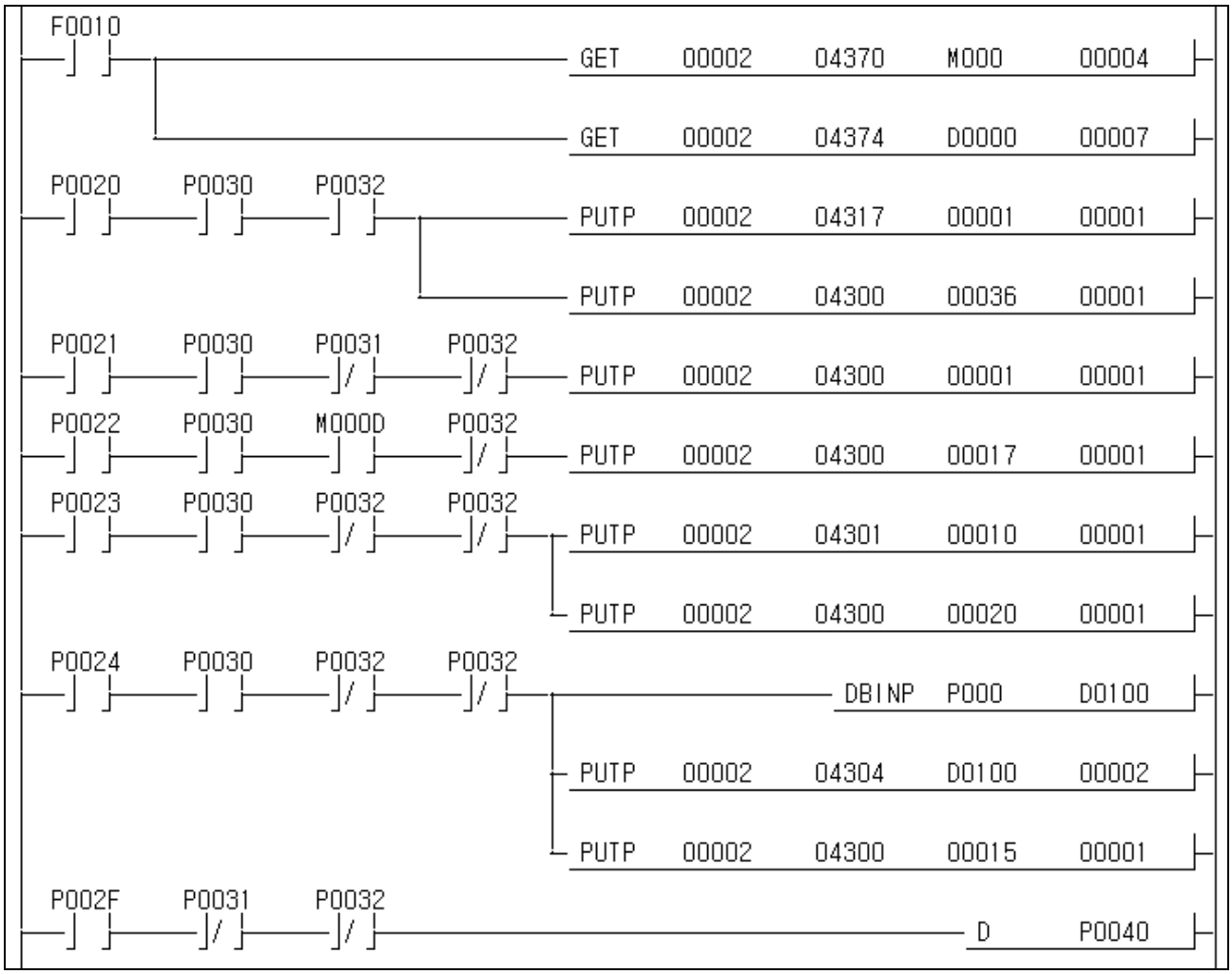
5) Operation Data Setting

Items of Position data	Step no.	Coordinate	Control method	Operation pattern	Operation method	Goal position [pulse]	Circular interpolation aux. point [pulse]	M code	Acc./Dec. no.	Operation speed [pls/s]	Dwell time [ms]	Circular interpolation direction
X setting	1	Absolute	Position	Go-on	Single	100000	0	**0**	1	1000	100	CW
	2	Absolute	Position	Go-on	Single	150000	0	**0**	1	5000	100	CW
	3	Absolute	Position	End	Repeat	0	0	**0**	1	10000	100	CW
	10	Absolute	Position	Conti.	Single	200000	0	**0**	1	2000	0	CW
	11	Absolute	Position	Conti.	Single	250000	0	**0**	1	10000	0	CW
	12	Absolute	Position	End	Repeat	0	0	**0**	1	15000	0	CW

6) Operation pattern



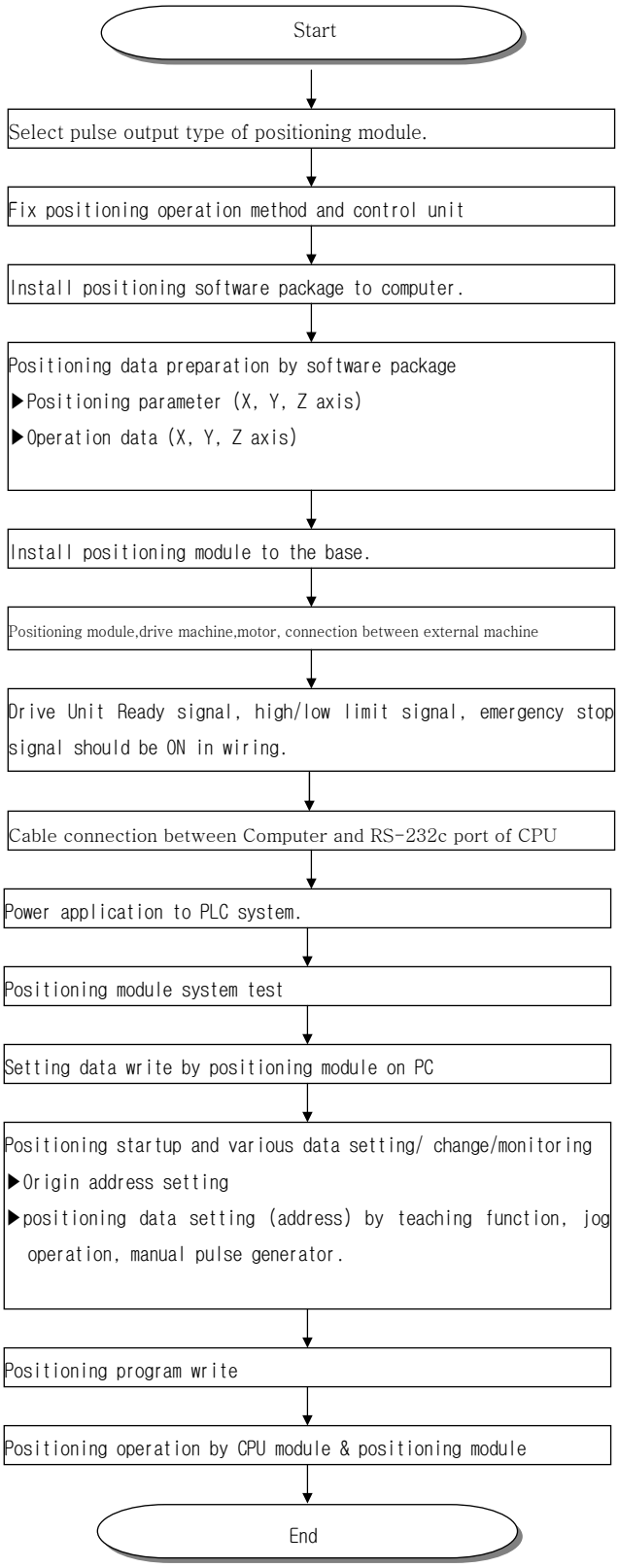
7) Program


F0010
GET 00002 04370 M000 00004
GET 00002 04374 D0000 00007
P0020 P0030 P0032
PUTP 00002 04317 00001 00001
PUTP 00002 04300 00036 00001
P0021 P0030 P0031 P0032
PUTP 00002 04300 00001 00001
P0022 P0030 M000D P0032
PUTP 00002 04300 00017 00001
P0023 P0030 P0032 P0032
PUTP 00002 04301 00010 00001
PUTP 00002 04300 00020 00001
P0024 P0030 P0032 P0032
DBINP P000 D0100
PUTP 00002 04304 D0100 00002
PUTP 00002 04300 00015 00001
P002F P0031 P0032
D P0040

Chapter 12 Operation Order and Installation

12.1 Operation Order

▶Here describes the Operation order in case of positioning operation by positioning



Select one from Open Collector and Line Driver.

Fix the homing method, coordinate, operation mode, control unit for positioning operation.

Prepared by software package.

Power application when CPU module is "STOP".

Wiring status check by positioning module LED indicator or software package

Written by software package

Operated by software package startup mode.
Check if positioning parameter, position data, speed data setting value is correct and save them by changing if necessary.

GMWIN or KGL-WIN

12.2 Installation

12.2.1 Installation Environment

This machine has a good reliability regardless of installation environment but cares should be taken in the following items to guarantee the reliability and safety of the system.

1) Environment Condition

- Install the control panel available for water-proof, anti-vibration.
- The place free from continuous impact or vibration.
- The place not exposed to direct rays.
- The place with no dew phenomena by rapid temperature change.
- The place where surrounding temperature maintains 0-55℃.

2) Installation Construction

- In case of processing the screw hole or wiring, cares should be taken not to put the wiring remnants to PLC inside.
- Install on the good place to operate.
- Do not install the high voltage machine on the same Panel.
- The distance from duct or surrounding module shall be more than 50mm.
- Ground to the place where surrounding noise environment is good enough.

12.2.2 Notices in Handling

Here describes the notices in handling the positioning module from opening to installation.

1) Do not fall down or apply the strong impact.
2) Do not remove PCB from the case. It may cause the failure.
3) In wiring, cares should be taken not to put the wiring remnants or foreign materials to the upper part of module. If something entered, it should be removed.
4) The removal of module in the status of power ON, is prohibited.

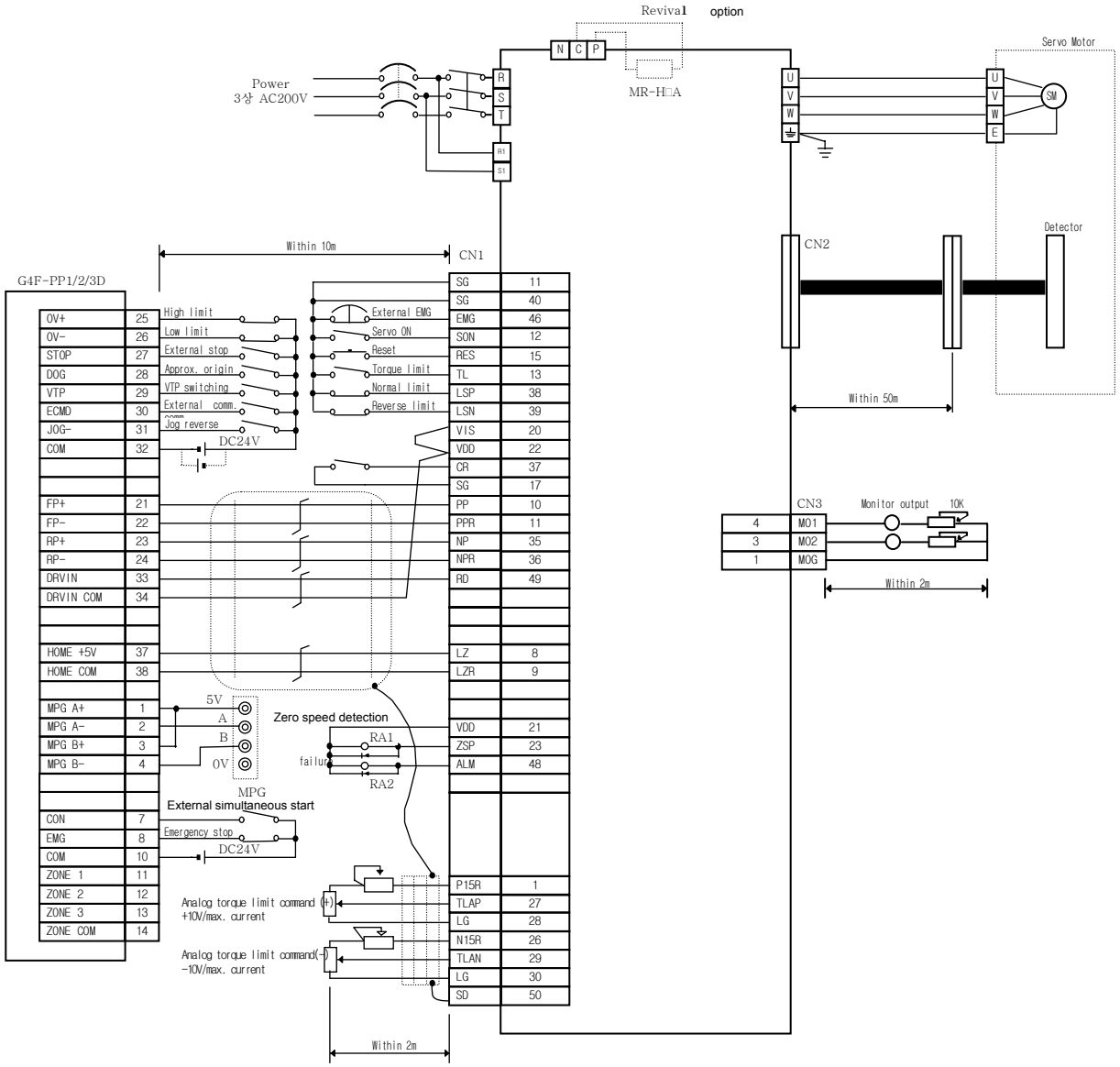
12.3 Wiring

12.3.1 Notices in Wiring

1) The length of connecting cable between positioning module and drive machine shall be as short as possible. (Max. length : 2m).
2) For cross current and external I/O signal of positioning module, it is required to use the separate cables to avoid the surge or induction noise generated from the cross current.
3) The wires should be selected considering surrounding temperature, allowable current and it is recommended to be more than max.size AWG22(0.3㎟).
4) In wiring, if it is too close to the high temperature machine or material or it is directly contacted to the oil for a long time, the short-circuit will occur that may cause the damage or malfunction.
5) Make sure to check the polarity before applying the external contact signal to the terminal board.
6) In case of wiring the high voltage cable and power cables together, the induction obstacle occurs that may cause the malfunction or failure.
7) In case of wiring by the pipe, the grounding of pipe is required.
8) For the power supplied from outside (DC 5V, DC24V), it is required to use the safe and stable power.
9) In case that there is considered to be the noise source in wiring between positioning module and drive machine, it is required to use and connect Twist pair and sealed cable for the wiring of output pulse that comes from the positioning and enters into the motor driver

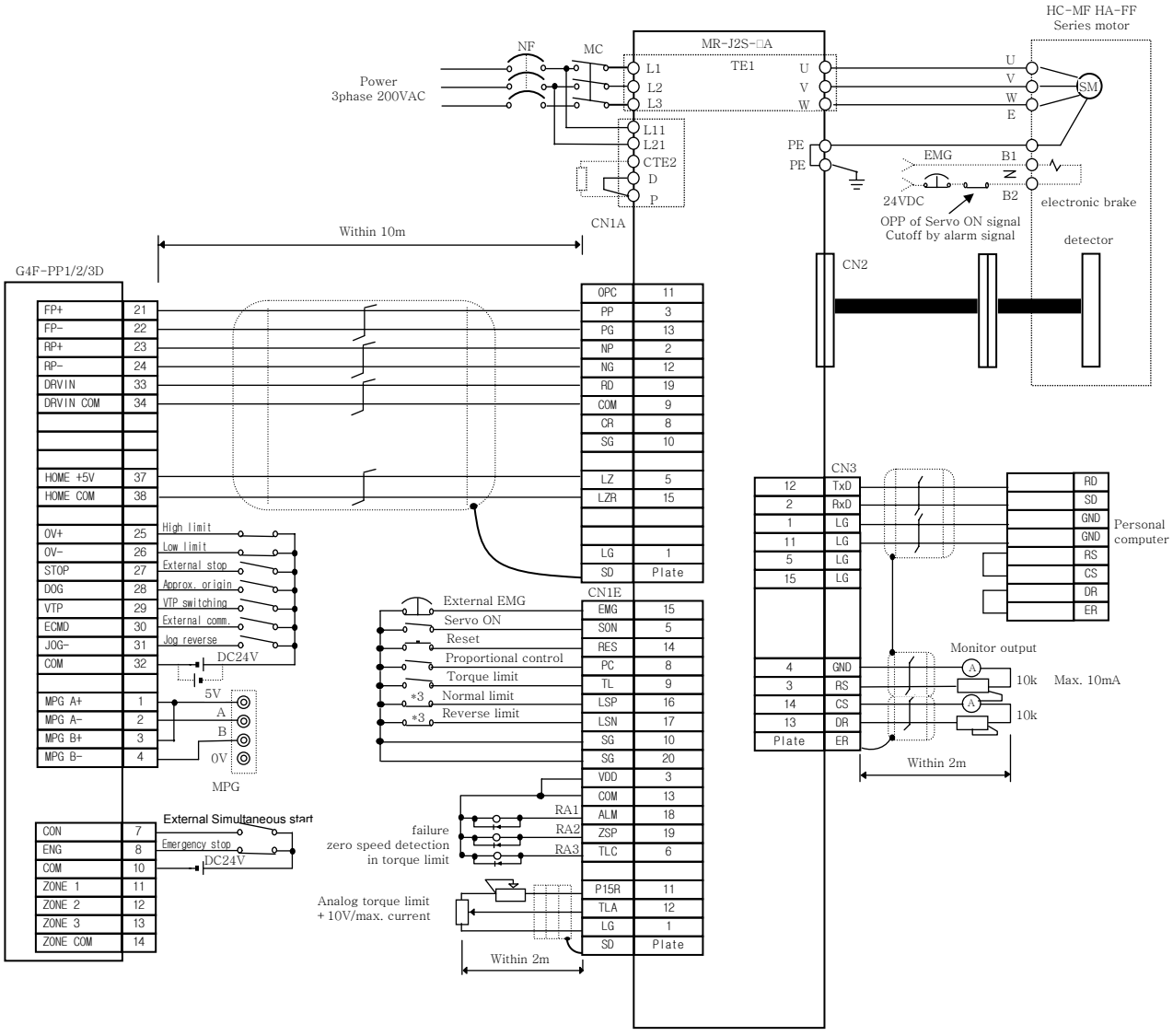
12.3.2 Connection Example of Servo and Stepping Motor Drive Machine

1) MR-H□A Connection (Line drive)

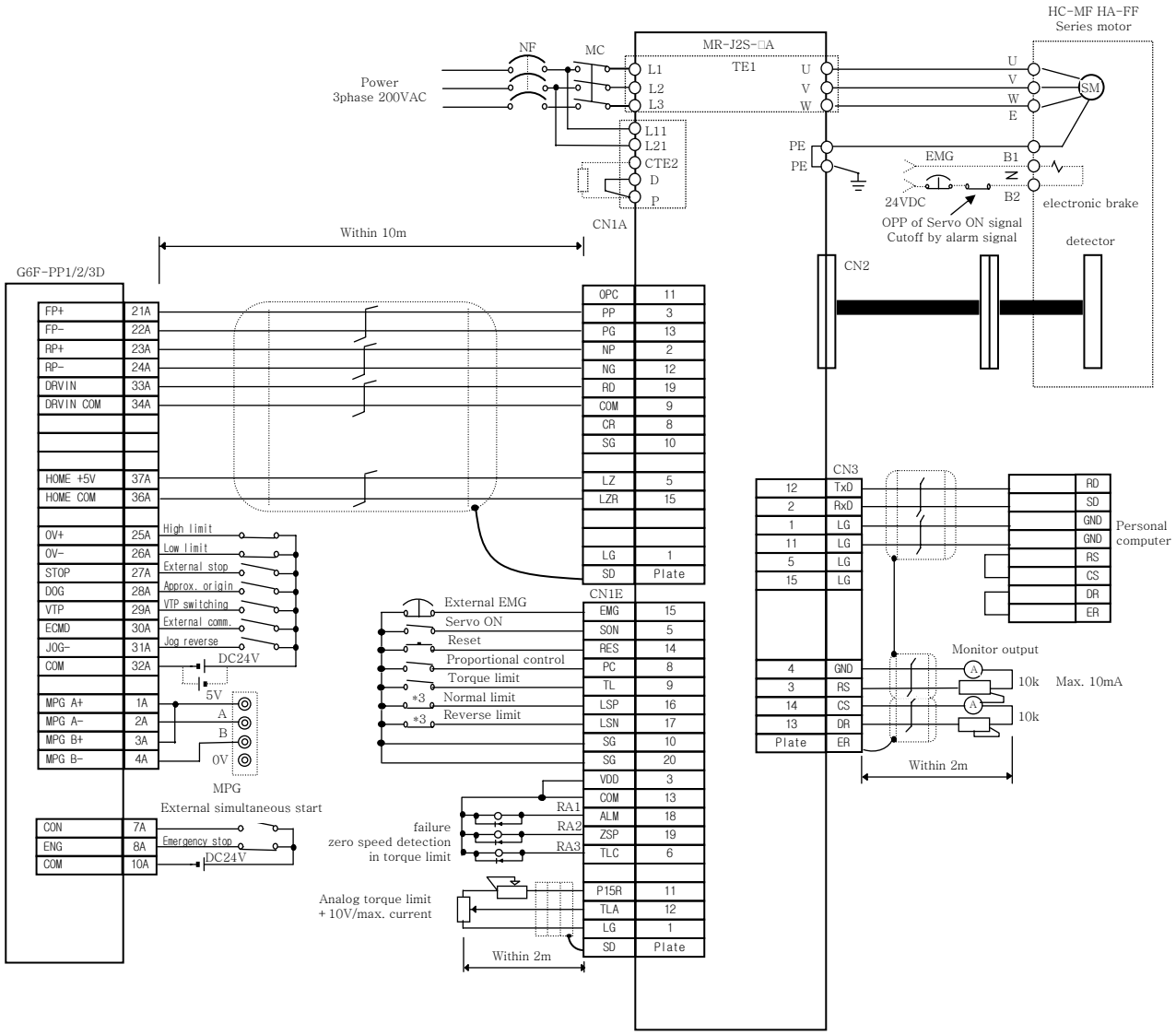


2) MR-J2/J2S-□A Connection (Line drive)

(1) G4F-PP1/2/3D

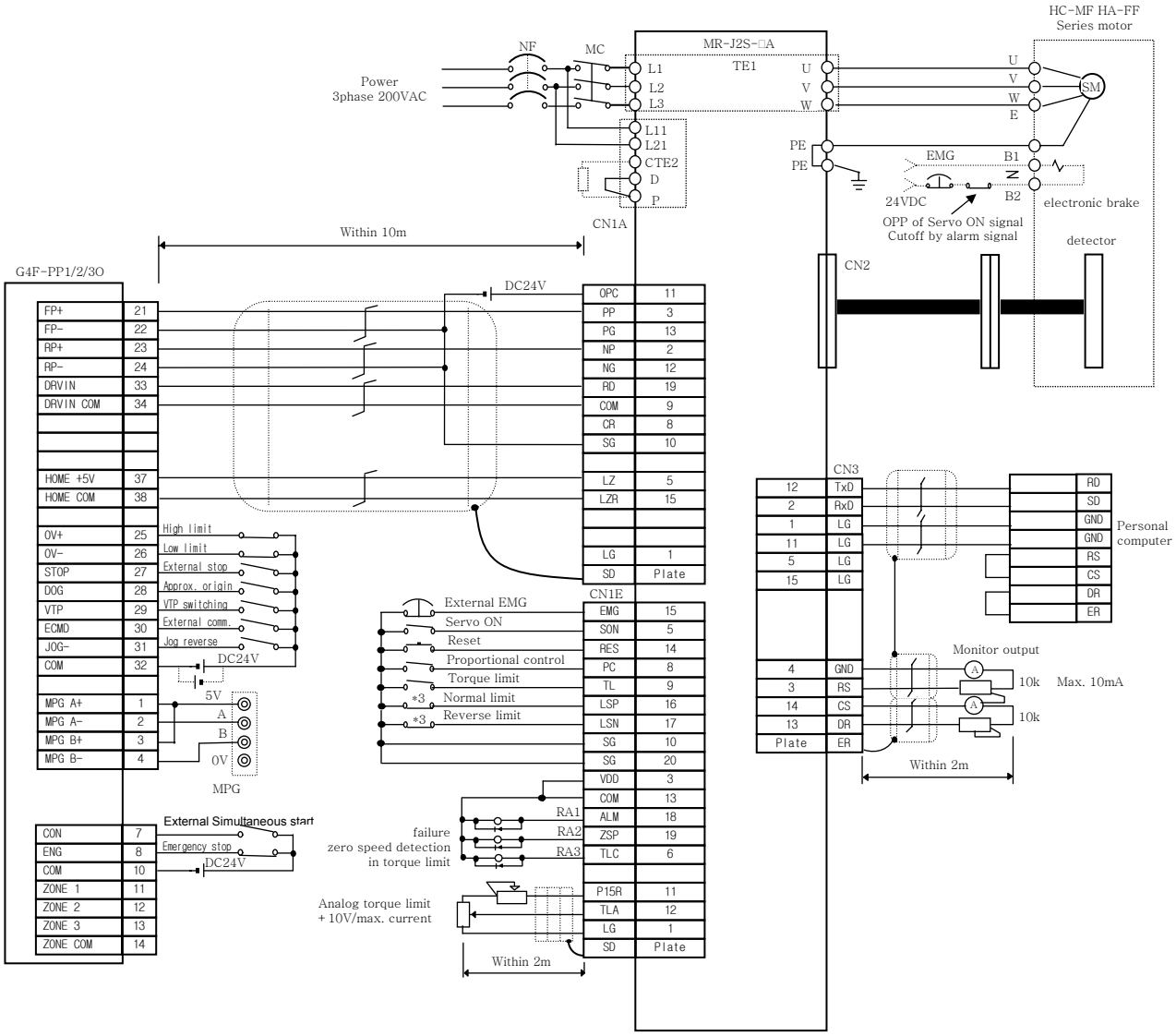


(2) G6F-PP1/2/3D

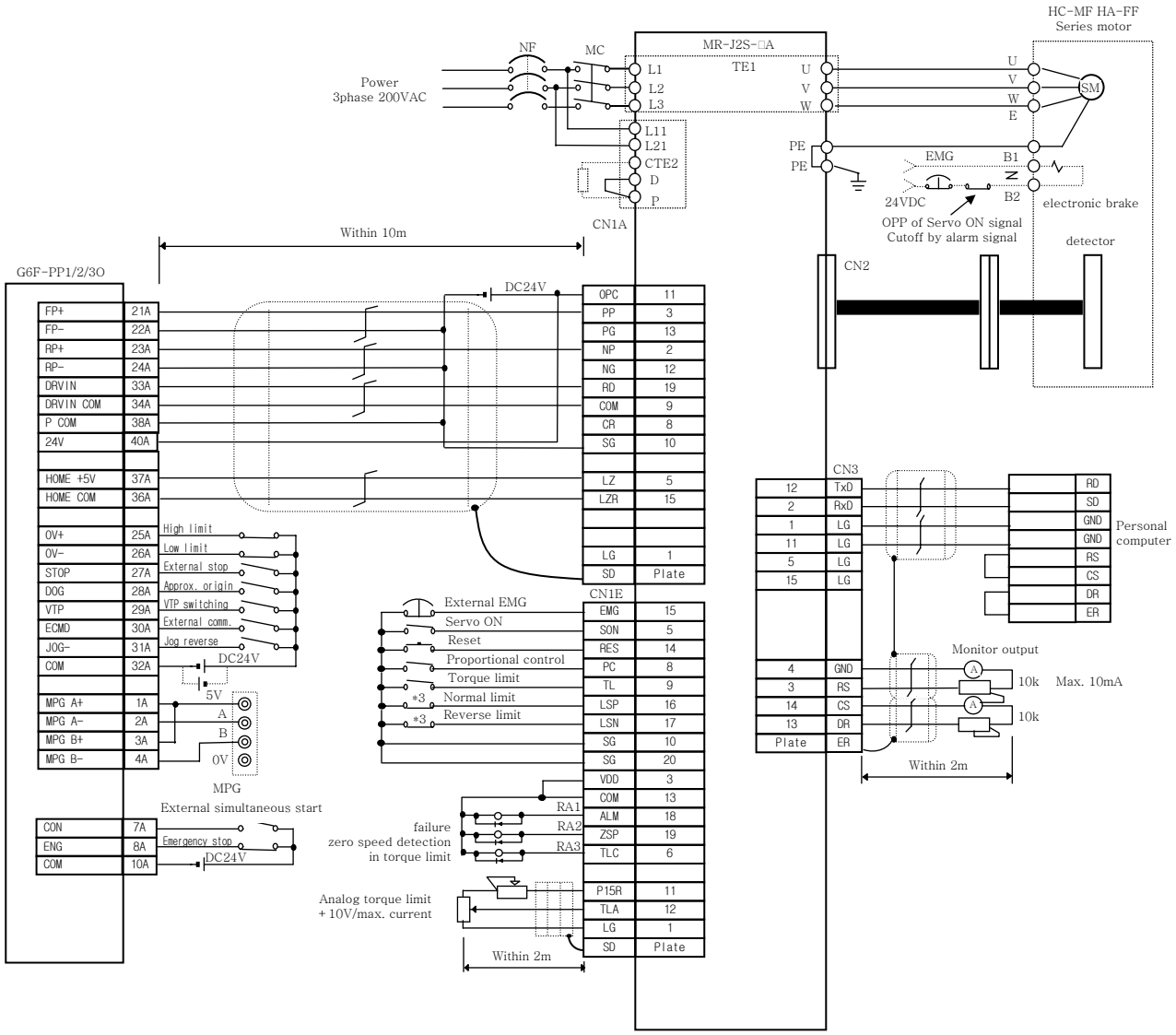

HC-MF HA-FF
Series motor
NF
MC
MR-J2S-□A
Power
3phase 200VAC
L1
L2
L3
TE1
U
V
W
L11
L21
CTE2
D
P
PE
PE
EMG
B1
B2
24VDC
OPP of Servo ON signal
Cutoff by alarm signal
electronic brake
detector
CN2
CN1A
Within 10m
G6F-PP1/2/3D
FP+ 21A
FP- 22A
RP+ 23A
RP- 24A
DRVIN 33A
DRVIN COM 34A
HOME +5V 37A
HOME COM 36A
OV+ 25A
OV- 26A
STOP 27A
DOG 28A
VTP 29A
ECMD 30A
JOG- 31A
COM 32A
MPG A+ 1A
MPG A- 2A
MPG B+ 3A
MPG B- 4A
High limit
Low limit
External stop
Approx. origin
VTP switching
External comm.
Jog reverse
DC24V
5V
A
B
0V
MPG
External simultaneous start
CON 7A
ENG 8A
COM 10A
Emergency stop
DC24V
OPC 11
PP 3
PG 13
NP 2
NG 12
RD 19
COM 9
CR 8
SG 10
LZ 5
LZR 15
LG 1
SD Plate
CN1E
External EMG
Servo ON
Reset
Proportional control
Torque limit
*3 Normal limit
*3 Reverse limit
EMG 15
SON 5
RES 14
PC 8
TL 9
LSP 16
LSN 17
SG 10
SG 20
VDD 3
COM 13
ALM 18
ZSP 19
TLC 6
P15R 11
TLA 12
LG 1
SD Plate
failure
zero speed detection
in torque limit
RA1
RA2
RA3
Analog torque limit
+10V/max. current
Within 2m
CN3
12 TxD
2 RxD
1 LG
11 LG
5 LG
15 LG
RD
SD
GND
GND
RS
CS
DR
ER
Personal
computer
Monitor output
4 GND
3 RS
14 CS
13 DR
Plate ER
10k
Max. 10mA
10k
Within 2m

3) MR-J2/J2S-□A Connection (Open Collector)

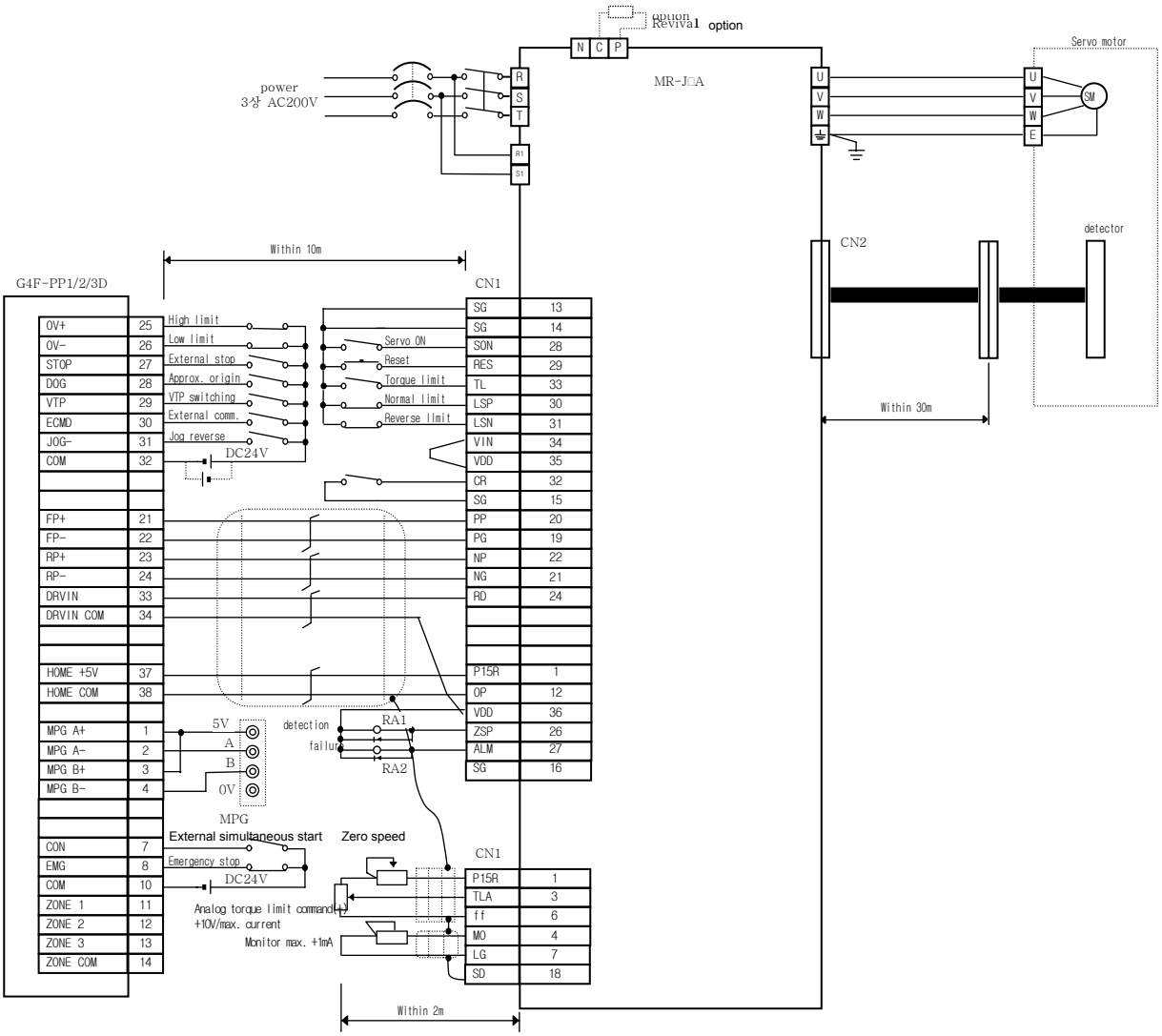
(1) G4F-PP1/2/3O



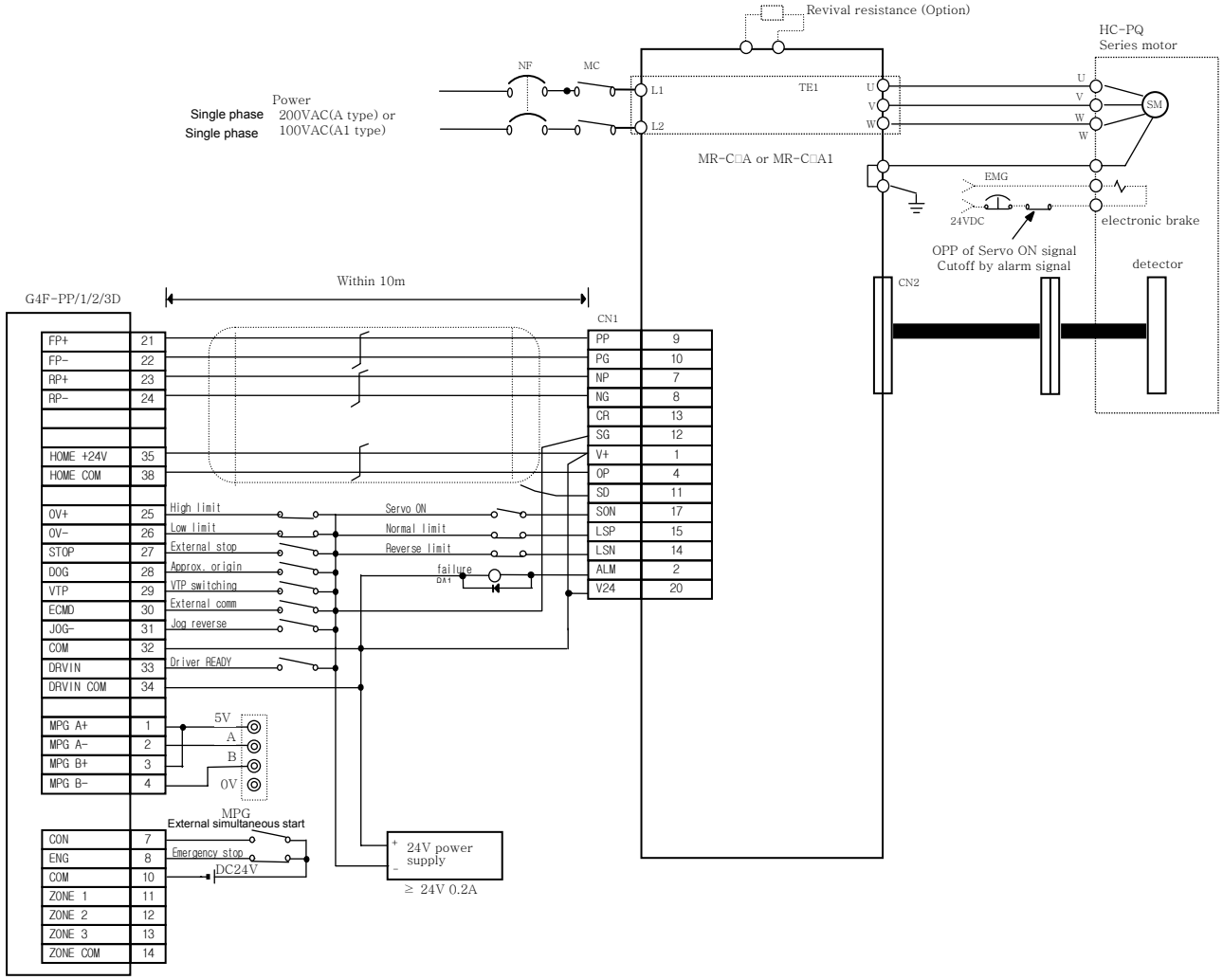
(2) G6F-PP1/2/3O


HC-MF HA-FF
Series motor
NF
MC
MR-J2S-□A
Power
3phase 200VAC
L1
L2
L3
TE1
U
V
W
L11
L21
CTE2
D
P
PE
PE
EMG
B1
B2
24VDC
OPP of Servo ON signal
Cutoff by alarm signal
electronic brake
detector
CN2
CN1A
Within 10m
G6F-PP1/2/3O
DC24V
FP+ 21A
FP- 22A
RP+ 23A
RP- 24A
DRVIN 33A
DRVIN COM 34A
P COM 38A
24V 40A
HOME +5V 37A
HOME COM 36A
OV+ 25A
OV- 26A
STOP 27A
DOG 28A
VTP 29A
ECMD 30A
JOG- 31A
COM 32A
High limit
Low limit
External stop
Approx. origin
VTP switching
External comm.
Jog reverse
DC24V
MPG A+ 1A
MPG A- 2A
MPG B+ 3A
MPG B- 4A
5V
A
B
0V
MPG
External simultaneous start
CON 7A
ENG 8A
COM 10A
Emergency stop
DC24V
OPC 11
PP 3
PG 13
NP 2
NG 12
RD 19
COM 9
CR 8
SG 10
LZ 5
LZR 15
LG 1
SD Plate
CN1E
External EMG
Servo ON
Reset
Proportional control
Torque limit
*3 Normal limit
*3 Reverse limit
EMG 15
SON 5
RES 14
PC 8
TL 9
LSP 16
LSN 17
SG 10
SG 20
VDD 3
COM 13
ALM 18
ZSP 19
TLC 6
P15R 11
TLA 12
LG 1
SD Plate
RA1
RA2
RA3
failure
zero speed detection
in torque limit
Analog torque limit
+10V/max. current
Within 2m
CN3
12 TxD
2 RxD
1 LG
11 LG
5 LG
15 LG
RD
SD
GND
GND
RS
CS
DR
ER
Personal
computer
Monitor output
4 GND
3 RS
14 CS
13 DR
Plate ER
10k
Max. 10mA
10k
Within 2m

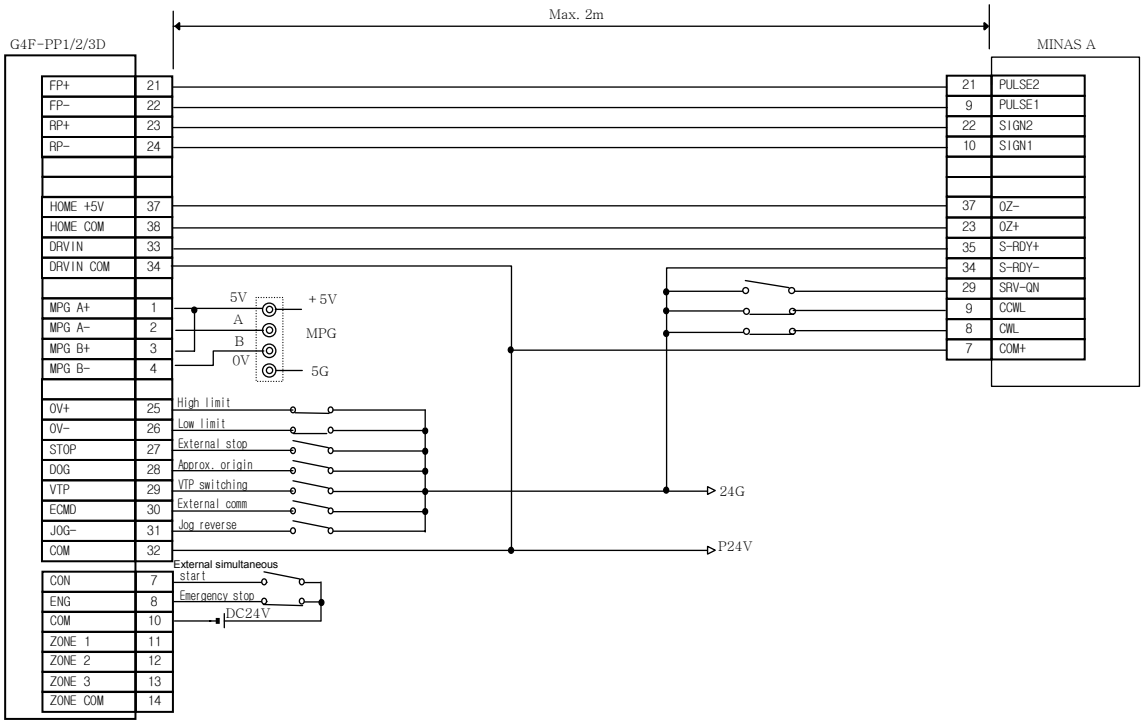
4) MR-J□A Connection (Line drive)



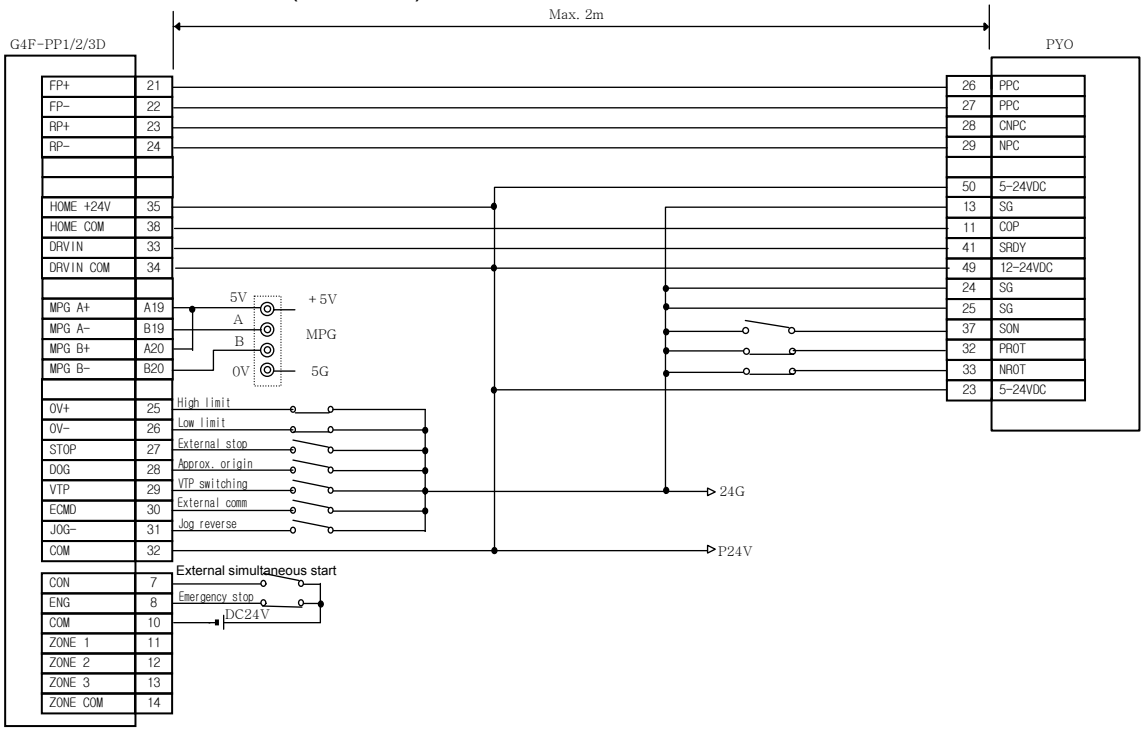
5) MR-C□A Connection (Line drive)



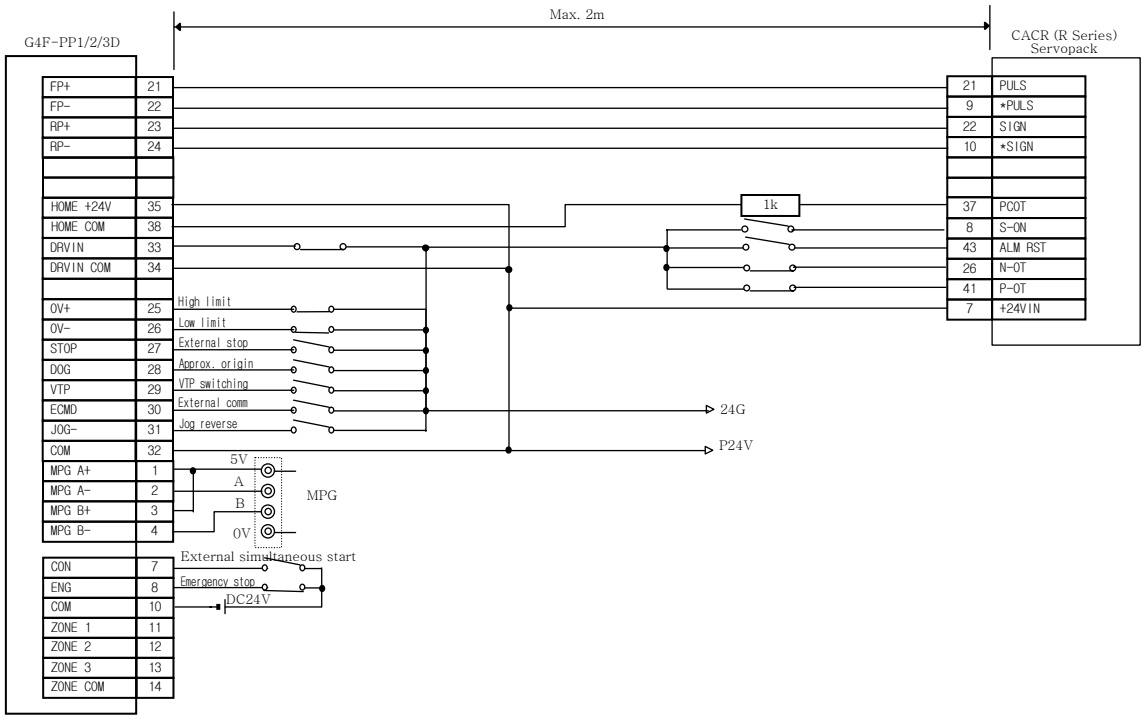
6) MINAS A Series Connection (Line drive)



7) PYO Series Connection (Line drive)

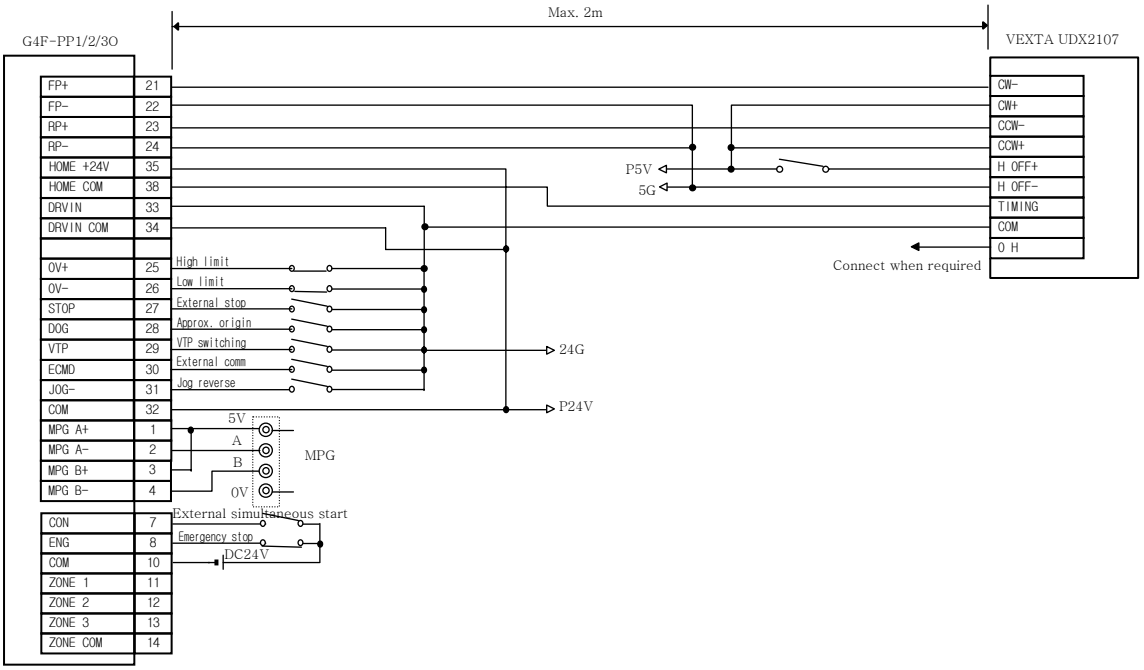


8) CACR(R Series) Connection (Line drive)

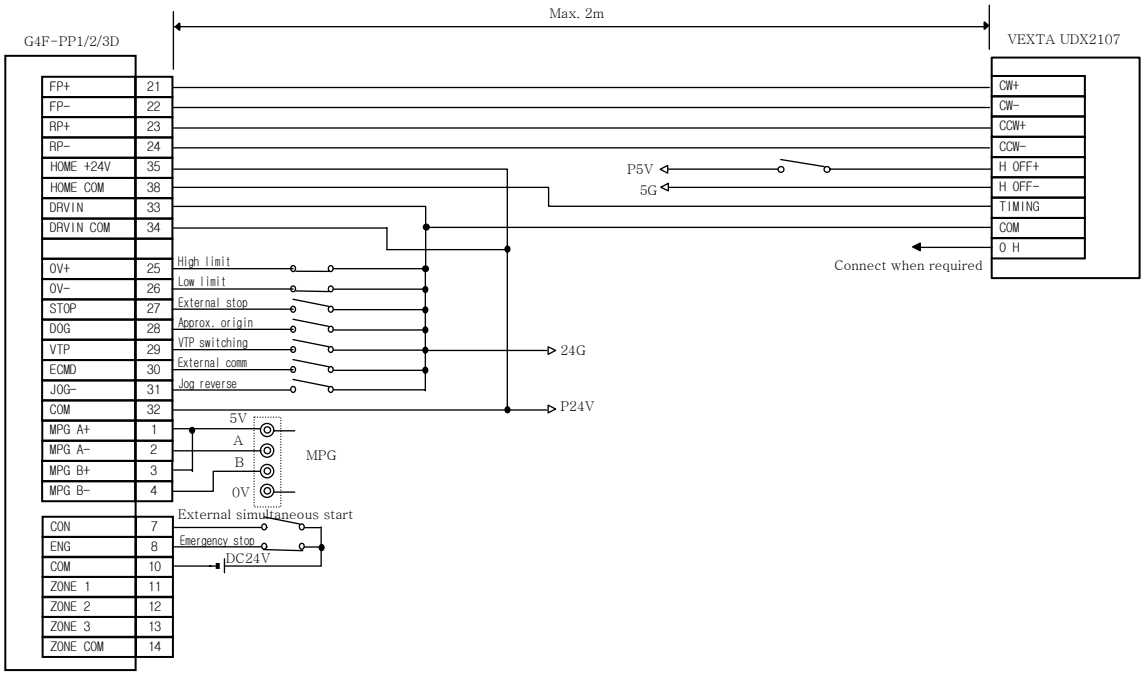


9) VEXTA UDX2107 Connection

(1) Open Collector

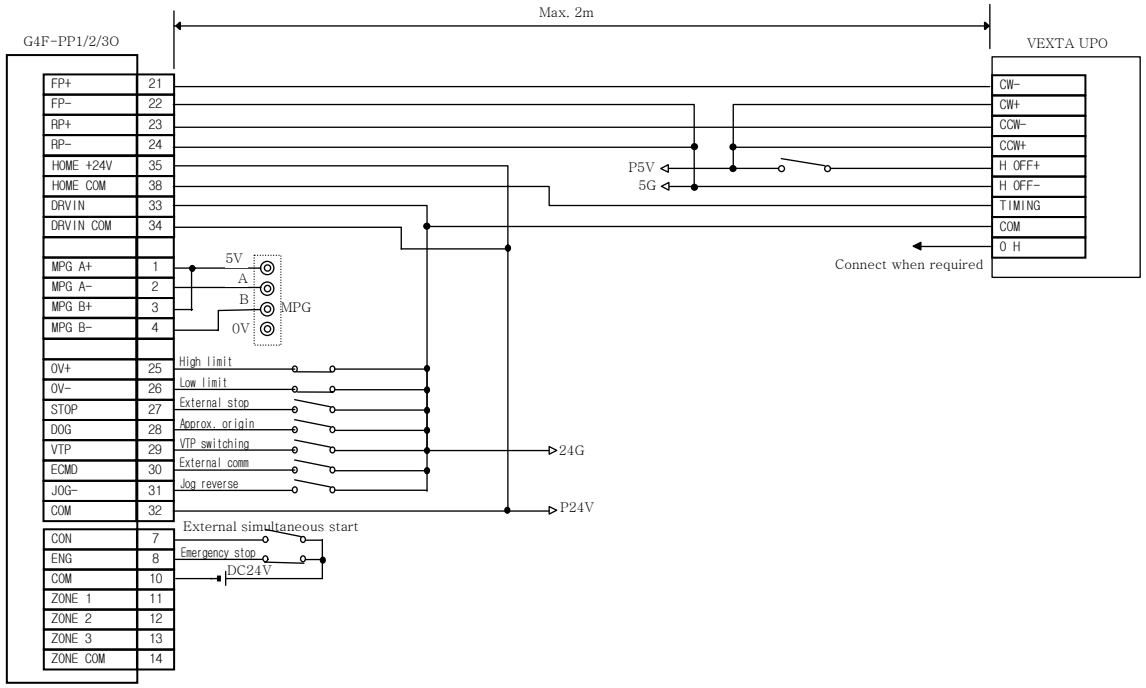


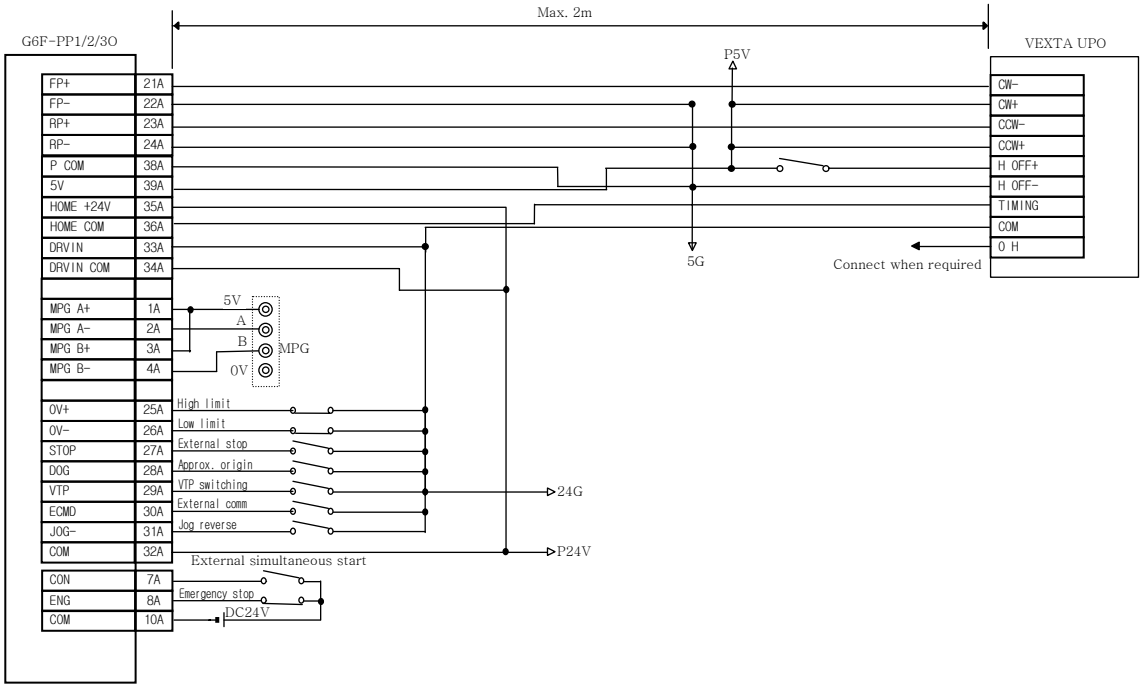
(2) Line Drive



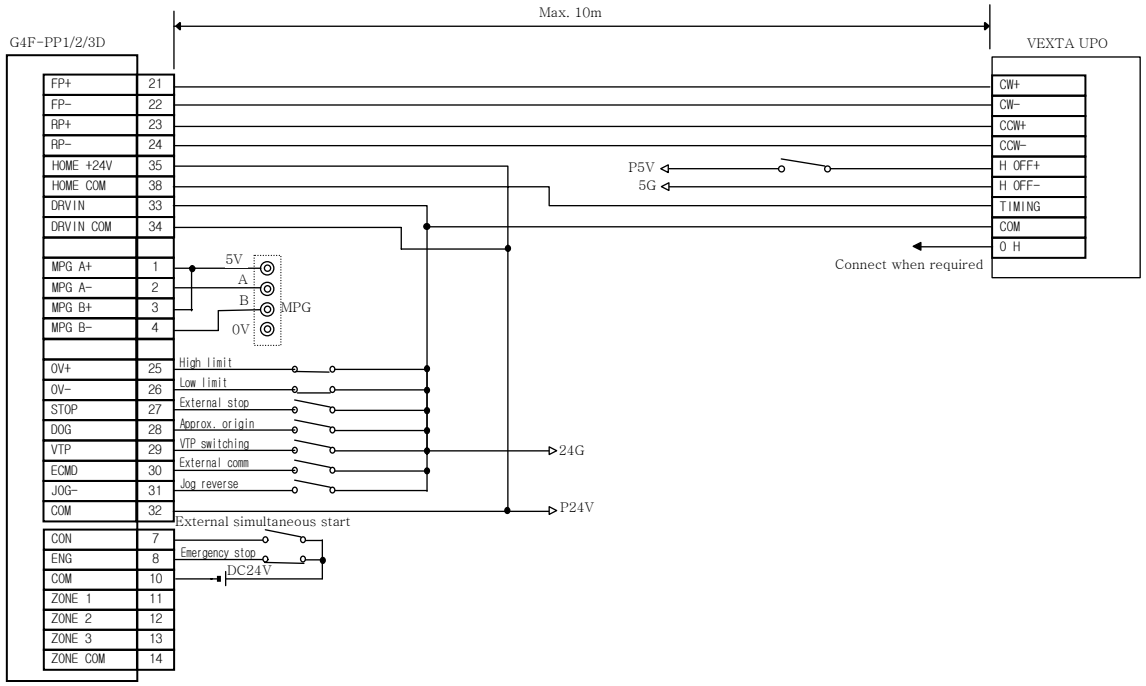
10) VEXTA UPD Connection

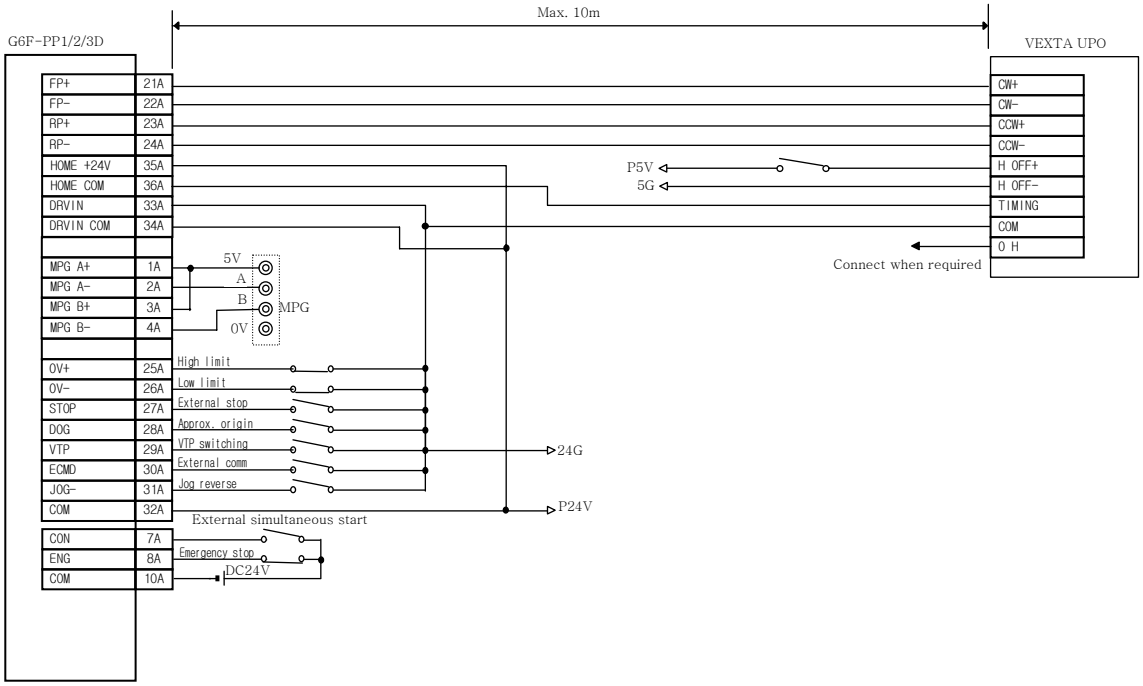
(1) Open Collector





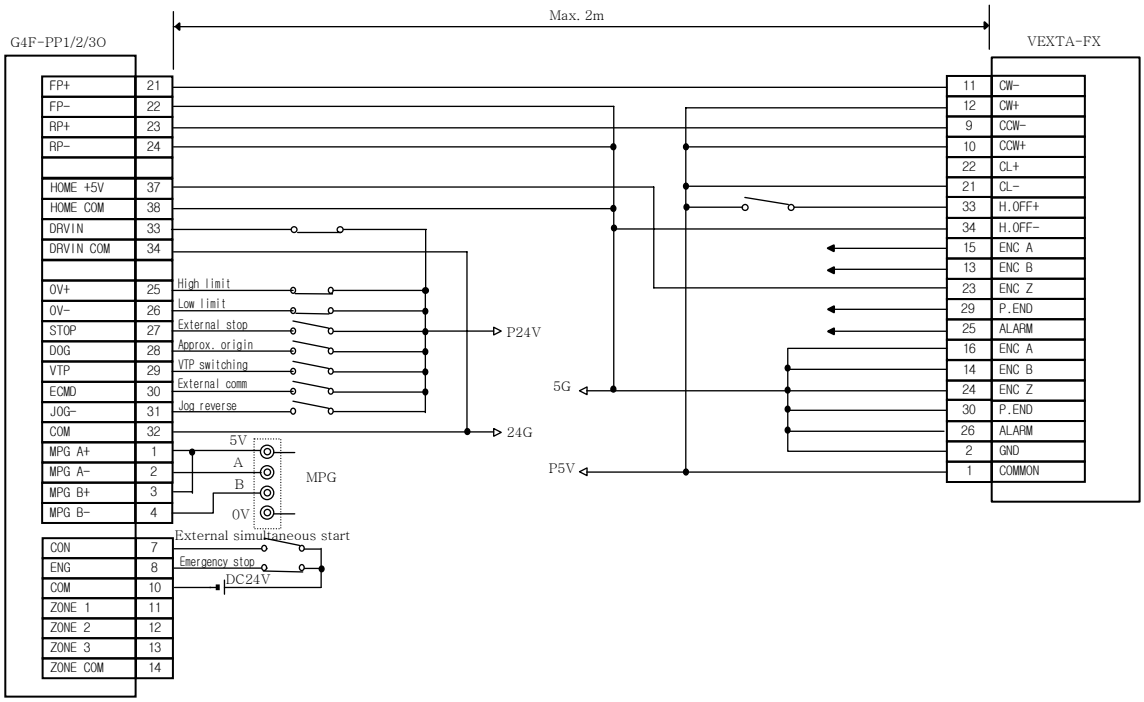
(2) Line Drive


Max. 10m
G4F-PP1/2/3D
VEXTA UPO
FP+ 21
FP- 22
RP+ 23
RP- 24
HOME +24V 35
HOME COM 38
DRVIN 33
DRVIN COM 34
MPG A+ 1
MPG A- 2
MPG B+ 3
MPG B- 4
OV+ 25
OV- 26
STOP 27
DOG 28
VTP 29
ECMD 30
JOG- 31
COM 32
CON 7
ENG 8
COM 10
ZONE 1 11
ZONE 2 12
ZONE 3 13
ZONE COM 14
CW+
CW-
CCW+
CCW-
H OFF+
H OFF-
TIMING
COM
0 H
P5V
5G
Connect when required
5V
A
B
MPG
0V
High limit
Low limit
External stop
Approx. origin
VTP switching
External comm
Jog reverse
24G
P24V
External simultaneous start
Emergency stop
DC24V

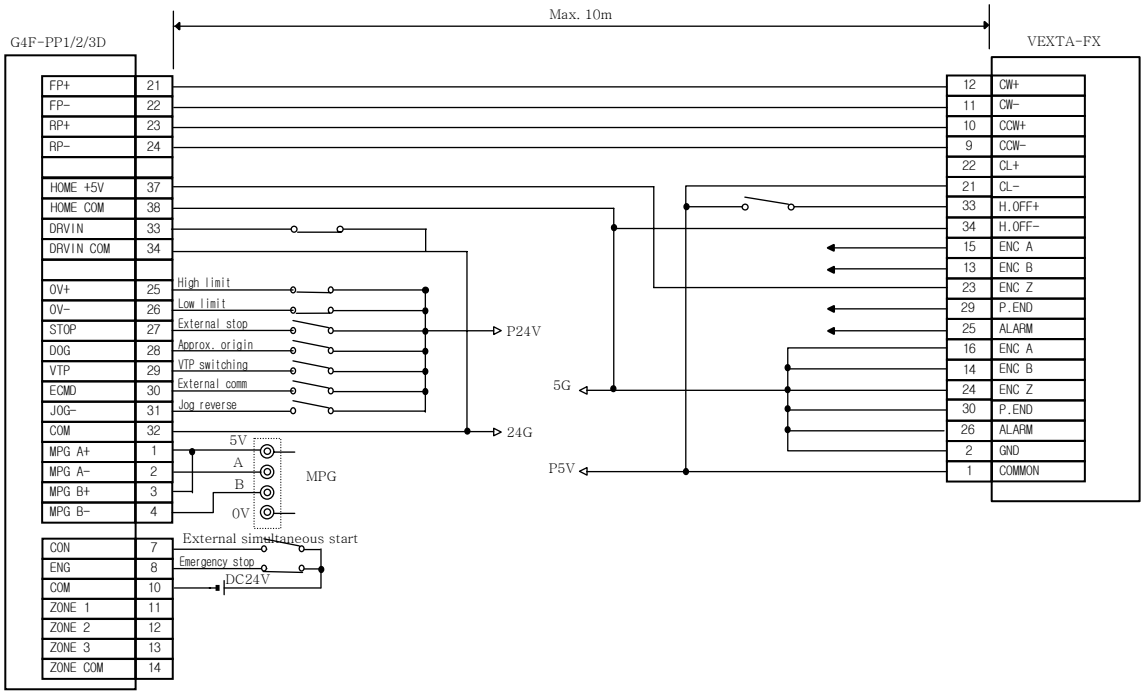

Max. 10m
G6F-PP1/2/3D
VEXTA UPO
FP+ 21A
FP- 22A
RP+ 23A
RP- 24A
HOME +24V 35A
HOME COM 36A
DRVIN 33A
DRVIN COM 34A
MPG A+ 1A
MPG A- 2A
MPG B+ 3A
MPG B- 4A
OV+ 25A
OV- 26A
STOP 27A
DOG 28A
VTP 29A
ECMD 30A
JOG- 31A
COM 32A
CON 7A
ENG 8A
COM 10A
CW+
CW-
CCW+
CCW-
H OFF+
H OFF-
TIMING
COM
0 H
P5V
5G
Connect when required
5V
A
B
MPG
0V
High limit
Low limit
External stop
Approx. origin
VTP switching
External comm
Jog reverse
24G
P24V
External simultaneous start
Emergency stop
DC24V

11) VEXTA-FX Connection

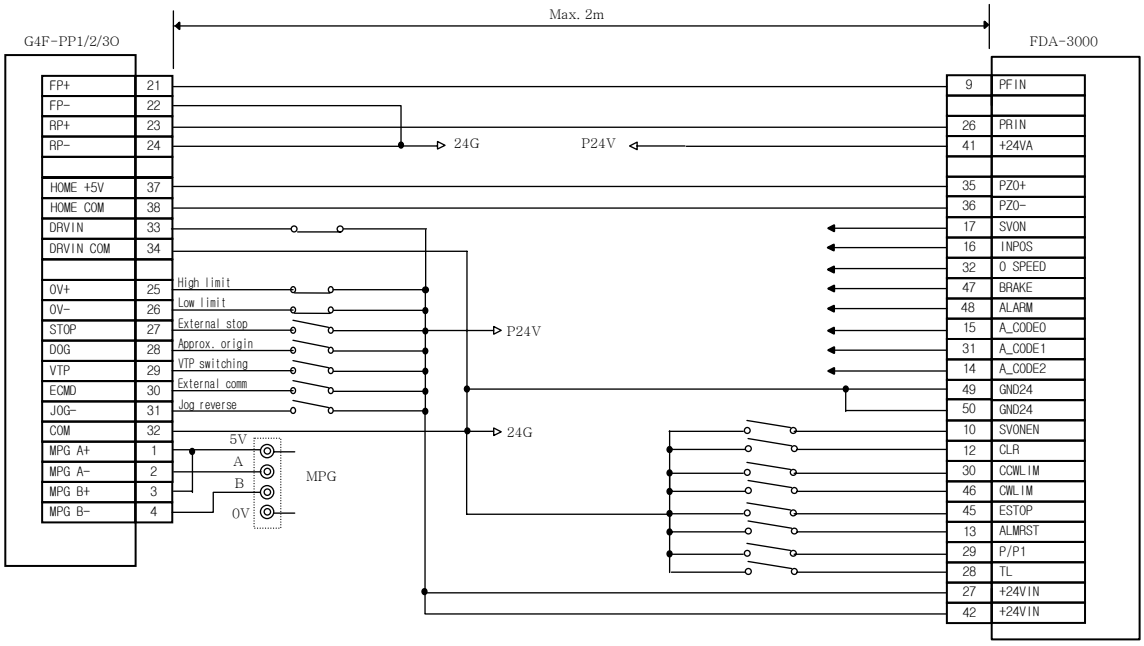
(1) Open Collector



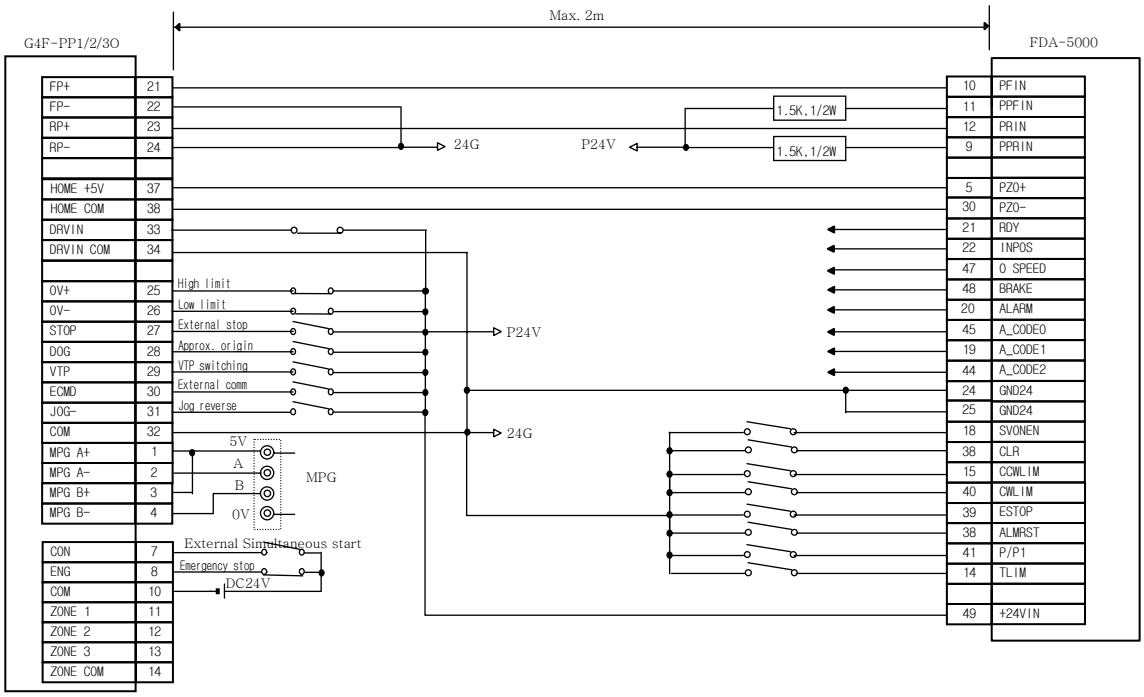
(2) Line Drive



12) FDA-3000 AC Servo Driver Connection (Open Collector)

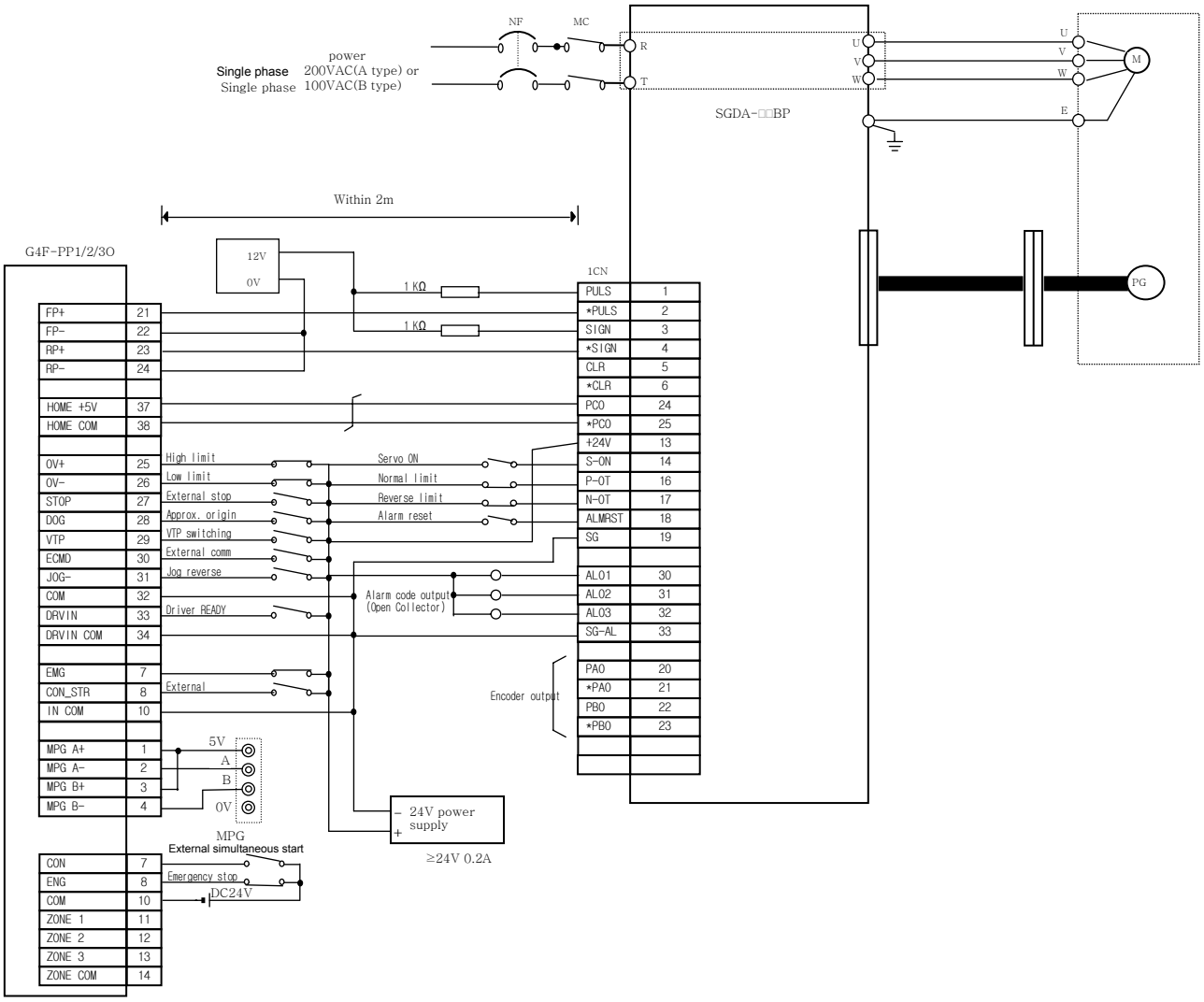


13) FDA-5000 AC Servo Driver Connection (Open Collector)

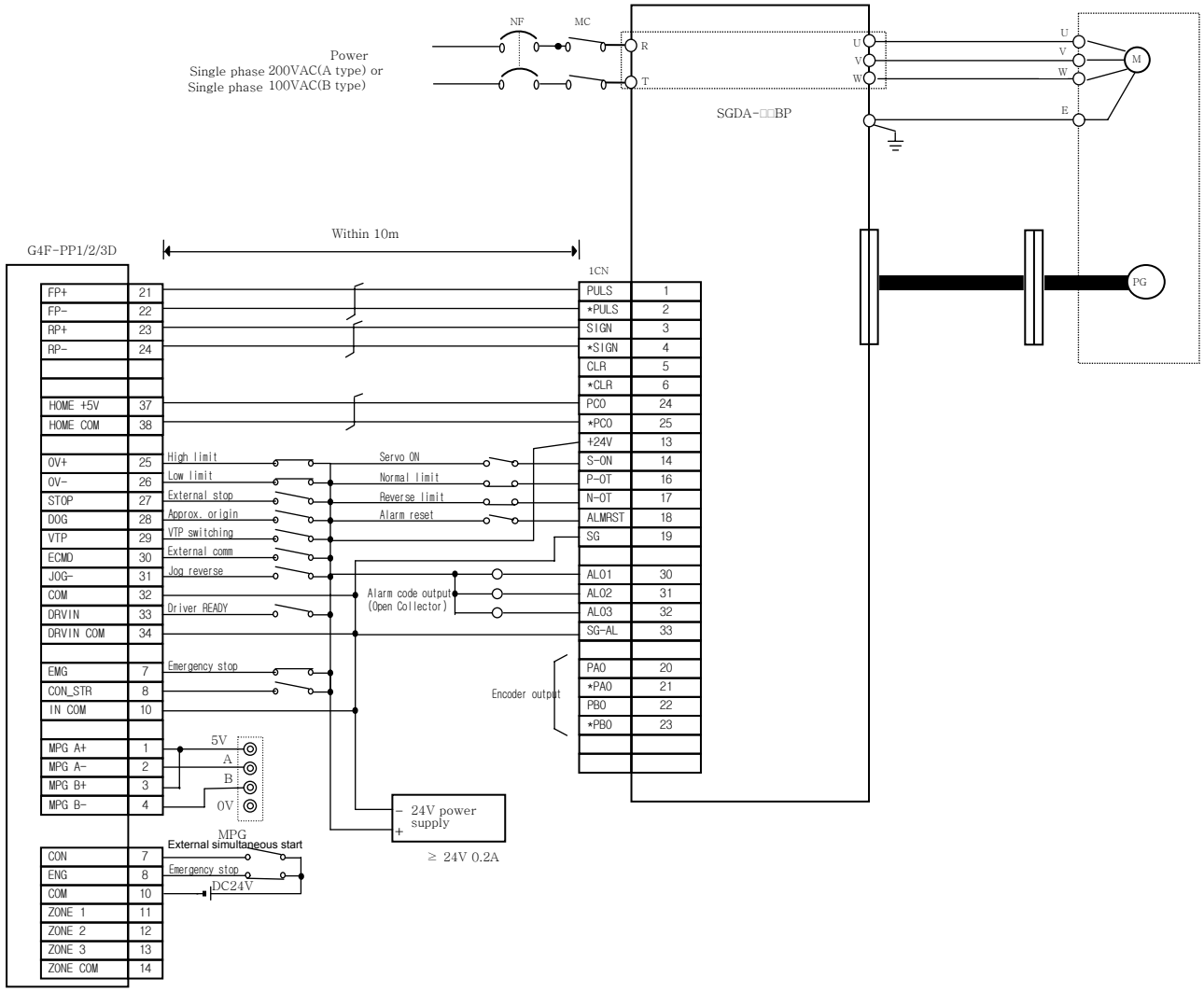


14) SGDA-□□□P Connection Example

(1) Open Collector



(2) Line Drive


Power
Single phase 200VAC(A type) or
Single phase 100VAC(B type)
NF
MC
R
T
U
V
W
SGDA-□□BP
U
V
W
E
M
PG
Within 10m
G4F-PP1/2/3D
1CN
FP+ 21
FP- 22
RP+ 23
RP- 24
HOME +5V 37
HOME COM 38
OV+ 25
OV- 26
STOP 27
DOG 28
VTP 29
ECMD 30
JOG- 31
COM 32
DRVIN 33
DRVIN COM 34
EMG 7
CON_STR 8
IN COM 10
MPG A+ 1
MPG A- 2
MPG B+ 3
MPG B- 4
CON 7
ENG 8
COM 10
ZONE 1 11
ZONE 2 12
ZONE 3 13
ZONE COM 14
PULS 1
*PULS 2
SIGN 3
*SIGN 4
CLR 5
*CLR 6
PC0 24
*PC0 25
+24V 13
S-ON 14
P-OT 16
N-OT 17
ALMRST 18
SG 19
AL01 30
AL02 31
AL03 32
SG-AL 33
PA0 20
*PA0 21
PB0 22
*PB0 23
High limit
Low limit
External stop
Approx. origin
VTP switching
External comm
Jog reverse
Driver READY
Servo ON
Normal limit
Reverse limit
Alarm reset
Alarm code output
(Open Collector)
Encoder output
5V
A
B
0V
MPG
External simultaneous start
Emergency stop
DC24V
- 24V power supply
+
≥ 24V 0.2A

Appendix 1 Positioning Terminology

2-Phase pulse

A phase and B phase pulse strings exist. The phase difference exists and automatically is added to or deducted from pulse count. Standard phase difference is 90∅ (in electronic angle). If B phase is behind A phase at the normal rotation direction (B phase is ON after A phase), A phase shall be behind B phase at the reverse rotation direction and delayed. (A phase is ON following A phase). With this way, normal rotation and reverse rotation (addition /deduction) shall be done automatically.

Absolute Encoder

This outputs each data within one time motor rotation to external goal point. Absolute Encoder is available to output 360 degree with 8~12 bit. Incremental Encoder has the weakness to lose the axis position if power is Cut-off. But, Absolute Encoder never loses the axis position even if the power cut-off. Several codes such as binary code and BCD code are available to output. Absolute Encoder is more expensive, elaborate and bigger than Incremental Encoder.

Absolute Coordinate

Absolute coordinate uses “0” as a standard and indicates the address by the distance from “0”. The direction is not fixed but automatically fixed according to the setting goal position address. Another address system is Relative coordinate.

Acceleration Time

This parameter acceleration time means the time that reaches to the speed limit value from the stop status. Thus this gets to shorten in proportion to the reduction of the fixed speed. Acceleration time shall be fixed by some factors such as mechanical inertial, motor torque and load resistance torque.

Position Address

This is the numeric value that indicates the positioning position by the units such as mm, inch, degree or pulse. Position Address shall be read after setting by Relative coordinate or Absolute coordinate, or written again by position teaching.

AFTER mode

This is the mode to output M code after positioning (after stop). According to M code output, drilling dimension can be selected or clamping can be executed.

Auto tuning

The response and safety features of the machine run by Servo motor are subject to the change of inertial moment and strength caused by the change of machine load. This function adjusts automatically speed loop gain and position loop gain to be harmonized with the machine status. Thus the action of the machine is maintained in the optimized status. For the machine that has big load fluctuation, the real time auto tuning should be used.

Trapezoidal acceleration/deceleration

The operation pattern that the time and speed graph has trapezoidal shape when positioning operation.

Backlash Compensation

As like normal direction is changed to reverse or reverse direction is changed to normal, there is sometimes backlash in gear when rotation direction is changed. This occurs when using warm gear. Because of this backlash, in case of 1m(3.2feet) left feed after 1m right feed, it is not accurate for the machine to return to the original position. Thus,

without additional feed corresponding to the backlash, the machine cannot reach the original position. In this case, set the backlash compensation to make up the difference.

Back up function

While power is cut-off, the setting value of positioning parameter and operation data saved in positioning module shall be saved in Flash memory and available to read, write and change in positioning software and PLC sequence program.

Ball screw

One type of screw with the balls arranged on the pitch like ball bearing, which enables reduce the backlash and rotate by a little power.

Bias Speed

When the machine starts to move, it needs the large torque but the torque may be unstable when the speed is “0” in the stepping motor. Thus it enables to smooth the movement by starting with the given speed. Bias speed is the speed fixed at the starting point. It is set usually more than 50 ~ 70pps with the reference to the speed-torque features of stepping motor and driver.

Bipolar drive constant current system)

This is the system for the stepping motor operation. In this case, the residual magnet current direction flowing on the fixed magnet coil is contrary and the residual magnet current direction has bipolar direction (+/-). This enables motor coil to be used effectively and obtain the large output torque at the low speed.

Internal Memory

This is the memory used to save the data temporarily when sending/receiving between PLC CPU and positioning module. To use the data for the action by the program, it is saved first in positioning module internal memory temporarily. As it is available to read and write the latest data, positioning module uses the internal memory.

Busy

This is the signal that indicates “in positioning operation” and it shall be “ON” during positioning action or Dwell Time.

Counterclockwise

This means the rotation to the contrary clockwise (CCW). In case of motor, this is fixed by the end of the axis (load axis).

Speed/Position control switching signal

This is the signal used to convert the running speed control to the position control. There are the signal by internal program command and the signal by external input.

Circular interpolation

This is automatic operation pattern that the machine path makes the circle when carrying out the positioning action for horizontal feed and longitudinal feed motor at the same time. The circle or the circle-type can be made by this type of circular interpolation and avoid the obstacles in the machine feed path.

Interpolation Operation Speed

The speed of the subordinate axis during linear interpolation or circular interpolation operation shall be calculated according to the speed and feed distance of main axis and feed distance of subordinate axis. In this case, the operation speed of subordinate axis is called as interpolation operation speed.

Appendix 1 Positioning Terminology

Control unit

This is the setting unit as the basis of positioning data and includes the units such as mm, inch, degree, pulse. The setting unit affects all operation data and parameter.

Continuous operation

This is the control method that operation pattern without stop is connected like speed control. Even if the rotation direction (normal, reverse) is changed, this continuous operation is available.

Homing low speed (Creep speed)

This is the speed that the machine moves very slowly. When returning to the origin, it is difficult for the machine to stop correctly while it is active in high speed. Thus it is required to convert the movement speed to the homing low speed before stop. In this case, the homing low speed is called as Creep speed.

Clockwise

This means the same rotation direction as the rotating hands of a clock.(CW) when you see the end of the axis (load axis) from motor.

The number of operation data

In order to carry out the positioning to more than 2 addresses, each position is allocated by operation step no. such as No1,No2,No3. After then, positioning is accomplished according to this operation step. In case of G4F-PP1/2/3O, G4F-PP1/2/3D, positioning up to 600 steps per axis are available.

Deceleration ratio

This is the rate when the machine decelerates by using the saw-toothed gear and is smaller than 1.

Deceleration ratio = input gear rotation number / output gear rotation number

Deceleration time

Deceleration time is the time from speed limit value to the stop status. Thus, it gets to shorten in proportion to the reduction of the given speed.

Deviation count

The function to count feed pulse generated from positioning module and convert the count pulse to D/A converter of Servo driver and deduct encoder feedback pulse of Servo motor from feed pulse. And it is embedded inside Servo driver to start Servo motor by deviation value (droop pulse) of feed pulse and feedback pulse until the feed pulse becomes “0”.

Line drive output (Differential output type)

One type of encoder feedback pulse output which enables the RF transmission and has the noise-resistance. Thus this is also used for high speed signal transmission such as I/O of pulse string. Generally, the transmission part is Driver and the receiving part is Receiver and the dedicated IC is used. Pulse I/O of positioning module and high speed counter module enables Line driver I/O.

Near point DOG signal)

This is the signal used when homing by the origin input during near point DOG signal ON section and by the origin input during OFF section, and by ON/OFF signal of near point.

Drive unit

The pulse command output from positioning module is the low voltage, low current command that has insufficient energy for motor drive. This drive unit amplifies such pulse command output to drive the motor.

This is the accessory for Servo motor and stepping motor and there are two types : Servo drive unit for Servo motor and stepping drive unit for stepping motor.

Drive Ready signal (Drive unit ready)

This is the output when the Servo drive unit for Servo motor is in normal status (Servo ON). This signal maintains OFF when the power of Servo drive is OFF or in case of Servo OFF, Servo Alarm, Servo emergency stop.

Droop pulse

If the speed command from positioning module is executed in normal status, the machine shall be behind and not available to follow because of the mechanical inertial. Thus, the method to postpone the speed command pulse by the accumulation in the deviation counter of Servo motor can be used. These accumulated pulses are called “droop pulse”. Deviation counter generates the droop pulse and when the machine stops, it returns to “0”.

Dwell time

This is the time to be fixed to adjust the droop pulse as “0” in the deviation counter of Servo driver after completing the pulse output from positioning module. If this time is very short, the positioning shall be not accurate.

Dynamic brake

When protection circuit acts because of the power cut-off, Emergency stop (EMG) signal, this function is used for the short circuit between Servo motor terminals through the resistance and discharges the rotation energy into heat and may cause the sudden stop without motor inertia. Braking power is generated by electromagnetic brake only when operating the motor to get a big brake torque. As electromagnetic brake does not have maintainability, this is used together with mechanical brake to prevent the falling of vertical axis.

Electromagnetic brake

This is applied only for the motor equipped with electromagnetic brake. Electromagnetic brake is used to prevent the sliding as protective function when the power is cut-off, operating the vertical axis, or when the motor stops. Electromagnetic brake acts in the status that external electromagnetic brake power is not applied.

Electronic gear

This function increases/decreases command pulse from positioning module by 500 times from 1/50 electrically. Thus positioning speed and transfer distance can be controlled by electronic gear ratio magnification. If electronic gear ratio setting is changed, positioning operation speed and the setting transfer distance shall be changed and when setting, it should be Servo OFF and within the setting range to avoid malfunction and crush.

Emergency stop

This applies emergency stop signal to the positioning module to stop emergently regardless of operation status of positioning module. In case of 2, 3 axis positioning module, 2 axis and 3 axis stop emergently at the same time. Thus for the individual emergency stop of each axis, emergency stop signal of Servo driver is used.

External regenerative brake resistor

Called as regenerative resistor. When the machine moves by the motor, the power is supplied to the motor from amplifier. But in case of machine and motor, the rotation energy flows to the amplifier contrarily when motor decelerates or when load

operation is downward. External regenerative resistor consumes the regenerative energy as resistance and obtains the regenerative brake torque and enables the overall acceptability of regenerative system during stop. Also it is used for the frequent acceleration/deceleration.

High speed homing

When high speed homing, the axis does not detect the near point dog and returns to the mechanical origin. This is effective only in the status that the positioning such as floating point or homing is completed.

Feed pulse

This is the output pulse from positioning module to Servo driver or stepping driver. It is also called as command pulse.

Feed screw

This is the basic screw mechanically in the positioning by screw rotation. Ball crew is often used to reduce backlash and numeric error.

Feedback pulse

In order to check if the machine acts reliably according to command pulse generated from positioning module, if command pulse is generated against 10,000 pulse, the feedback pulse of 10,000 pulse returns from Servo encoder. After then, the residual deviation value (droop pulse) becomes “0” and it is judged that it complied with command pulse very well.

Refer to “deviation counter”terminology.

Fixed-feed

This is the feeding of the fixed dimension to cut 제지 and bar work piece by the goal dimension. The increasing system positioning is often used.

Flash memory

This is used to save the parameter and positioning data for the backup memory without battery. As there is no battery, it is not necessary to maintain the battery.

External input high limit (Forward limit switch signal)

This is the input signal to inform the user that the high limit switch (b contact configuration, always ON) is activated out of the action range where the positioning control is carried out. The positioning action stops when external normal direction limit switch signal (b contact) is OFF.

G code

This is the standardized (coded) 2 digit value (00~99) that indicates various control function of numeric control module. It is also called “G function”.

Ex;

G01 Linear interpolation

G02 Circular interpolation CW

G04 Dwell

G28 Homing

G50 Max. Spindle speed setting

Gain

The change of ratio between two values that have a proportional relation. In case of Graph, it is the change of tilting of characteristic curve. For example, when 10 is output for the 10 input, output will be changed as 12.5 by changing the gain.

GD^2

Inertial moment. Total sum of each small area dimension composing of the material that multiplies by the square of each distance (r) of each area from the given straight line.

The relation $I=\int r^2 dm GD^2$ is given together with gravity acceleration g by 4gl.

Incremental encoder

This is the device that output ON/OFF pulse simply by the axis rotation. 1 phase type outputs only A phase pulse and does not indicate the axis rotation direction. 2 phase type outputs A phase and B phase pulse string and indicates the rotation direction. When B phase pulse string is changed with ON if A phase ON, it is judged that the direction is normal but if A phase is ON when B phase is ON, it is judged to be reverse direction. There is also another type of incremental encoder that has Zero signal. The incremental encoder used most generally outputs 100~10,000 pulse per one time axis rotation.

Relative coordinate (Incremental system)

Relative coordinate regards the current value always as “0”. The position is described by goal direction (sign of position address) and the moving distance. It is called as “relative address system”. This is used for the fixed-feed control.

Inertia

This is the attribute of an object having no effect from outside in the place that maintains the current condition. Inertia moment.

Interlock

Under this condition, the machine cannot move to next action until the current running action is completed. This function is used for the protection of the damage and malfunction of device.

Interpolation operation

This is the synchronous action of several motor to carry out the complex function. Each motor can be set freely by positioning distance, acceleration/deceleration time, speed and other factors. These can be combined to move the goal by line or circle. Linear interpolation and Circular interpolation are available. Circular interpolation uses two motors.

Inverter

This is the device to change DC with AC. This device changes the motor speed by converting the actual commercial frequency 50Hz or 60Hz to DC. And then it changes it with 5~120Hz AC again and controls the motor speed.

Jog

This is a kind of manual operation and carries out Jog action by the setting value such as Jog high speed and Jog low speed of manual operation parameter without setting the operation data. If Jog operation is ON for a long time, the error occurs by stroke high/low limit value.

KPPS

Abbreviation of “Kilo pulses per second”. 80kpps equals to 80,000pulse/sec.

Limit switch

This is the switch to stop the moving object on both sides of moving device for the safety. The circuit is pressed by the object moving the switch to activate the contact and will be activated by the forced power-off. For example, press the actuator as below to activate the internal micro switch. There are several types.

Linear interpolation

Linear interpolation operation acts two motors at the same time for horizontal feed and longitudinal feed to move the objects diagonally through positioning

module. 3 motors can be active. It is required to set the same number of positioning operation data per axis.

Load inertia ratio

Refer to GDL^2/GDM^2 "GD^2"terminology.

Low inertia motor

This is the motor used when the frequent acceleration/deceleration repeats. In case of low inertia motor, the diameter of motor is reduced and the longitudinal is longer to cover the torque. This enables the inertial moment to reduce by 1/3 of standard motor. The ideal load inertia ratio is greater than or smaller than 1.

M code (Machine code)

This is additional function interlocking in order to replace the drill, tighten or loosen the clap, raise or lower the welding electrode and indicate several data as auxiliary action of positioning operation. M code mode has two types of mode : AFTER mode or WITH mode. When M code is ON, the machine does not carry out the positioning operation of next step. M code becomes OFF by PLC program. 1 ~ 65535 M code no. set by the user can be set from operation data item and monitored or indicated on the external display by using the peripheral.

Machine feed value

When completion of homing, the origin address is saved. This value does not change even if the latest position and latest value of the machine coordinate set by the machine that has the origin address as a basis, are changed.

Manual pulse generator

The handle of this device is rotated manually to generate the pulse. This device is used when carrying out the correct positioning manually.

Main axis

This is the direction that positioning data is executed at first in case of interpolation operation. For example, in case of X,Y axis positioning, the axis that has the largest movement shall be main axis. And the speed follows this axis. The speed of subordinate axis is disregarded.

Movement amount per pulse

When using the units such as mm,inch,degree etc, movement amount is calculated and outputted from the machine to show how much the motor moves per pulse. This is the same as the positioning detection unit. The movement amount per axis rotation from the motor is as follows:

Movement amount per pulse= (P rate * movement amount per rotation)/no.of pulse per encoder rotation

Multi-phase pulse

This is the combination of pulse that has more than 2 phase difference. Ex) 2 phase pulse etc.

Change rate (Increase rate) setting

P rate. Refer to "P rate"terminology.

Numerical control language

This is the language of paper tape with a punch hole that indicates the numerical control to the numerical control module. Numerical language is composed of EIA code (EIA language),ISO code(ISO standard), and JIS code (JIS standard).

Near point dog

This is a limit switch located before the origin. When this switch is ON, the homing speed changes with creep speed. Thus, the time required to switch ON for this switch should be longer than the time necessary for the deceleration from the homing

speed to creep speed.

Numerical control

This is the existing positioning by using the numerical control module. This control can be used to carry out high precision, more than 3 axis high speed control. This is available to carry out movement control for complicated bending and surface.

Origin

This is the position set as the basis for positioning. The positioning of absolute coordinate cannot start without standard point.

Operation pattern

This is the action to be executed after fixing the positioning operation data.

1) If selecting ”End”, the operation will stop after fixing the positioning.

2) If selecting ”Go-on”, the next step no. shall be executed after fixing the positioning.

3) If selecting ”Continuous”, the next step no. shall be executed automatically without stop after fixing the positioning.

Homing method

There are 5 types of Homing method. The method is different according to machine structure, stop precision etc. Homing shall be executed after setting homing parameter.

1) Origin detection after near point OFF
2) Origin detection after deceleration when near point ON
3) Origin detection by the origin and high/low limit
4) Origin detection by near point signal
5) High speed origin detection

Homing parameter

This parameter is necessary for homing. This is set by the machine design. Thus for the change of this parameter, the machine design should be changed in advance. The origin is the basis for the action of positioning. Thus as if the origin is lost because of the power cutoff during positioning, the power shall be OFF and the machine is operated manually, it is available to return the origin by carrying out the homing. If homing command is executed, the machine moves to search the near point dog regardless of current value and stops at the origin. In this case, the current value becomes the origin address. (in case of homing method by near point)

P magnification pulse

This is a coefficient to amplify the feedback pulse per axis rotation by 2times, 3times, 1/2 or 1/3. This is the ratio of feed pulse and feedback pulse. For example, if the number of pulse per motor axis rotation is set as 2400 pulse, P ratio shall be 2 and the result shall be the same as 1200 pulse. The rotation per pulse shall be 0.15 degree when it is set as 2400 pulse per rotation. But this is 0.3 degree when 1200 pulse. With P ratio, the positioning accuracy drop increases.

Position control

This is the control of position and dimension such as fixed-feed, positioning, numerical control etc. This is always controlled by feed pulse. There is speed control also. Even if the same Servo motor is using, Servo driver may be different.

Position loop gain

This is the ratio of deviation counter droop pulse for the command pulse frequency.

Position loop gain = Command pulse frequency / droop pulse (sec^{-1})

Increase the gain to promote the stop precision. But if position loop gain increases too much, over shooting occurs and the action shall be unstable. If position loop gain is too low, the machine will stop smoother but the stop deviation increases.

Position loop mode

This is a Servo control mode used for positioning. This is a mode for position control. Other Servo control mode includes speed loop mode to carry out speed control and torque loop mode to carry out torque control (current control).

Positioning

This is to move the machine from one point to the goal point correctly. Movement includes the distance, direction, speed set by the user. Positioning is used for the action such as paper cutting, board punching, installation of parts to PCB, welding etc. This is also used for Robot.

Positioning complete signal

This is the signal generated when positioning is completed. The machine movement will stop after positioning complete signal is ON.

Positioning operation data

This is an operation data for the user to carry out the positioning. This will be set by the user according to the number of point (the number of address) that positioning is carried out. In case of G4F-PP1/2/3O, G4F-PP1/2/3D, there is 600 points. In principal, positioning is executed from step no.1 in accordance with the order of step no. of operation data.

Positioning parameter

This is the basic data to carry out positioning. Data type includes unit, movement amount per pulse, max. speed limit value, high/low stroke value, acceleration/decelera- tion time, pulse output mode etc. Parameters have initial value to change the value to meet the control condition.

PTP control (Point to point control)

This is a type of positioning control. The branches to pass by this control method are required to set operation step on the path in advance. Only the movement to the given goal position is required. Here can be the combination of End, Go-on, Continuous operation pattern.

Pulse

This is ON/OFF conversion of current (voltage) for a very short time. One pulse string is a series of pulse. G4F-PP1/2/3O, G4F-PP1/2/3D is the module that generates the pulse.

Pulse generator

This is the device to generate the pulse. For example, this includes the device (encoder) installed on the motor axis that generates the pulse when the axis rotates and digital device. 1 phase type outputs one pulse string. 2 phase type outputs two pulse strings that have the phase difference. It is available to output 600 ~ 1,000,000 pulse per axis rotation.

Pulse output mode of driver

This is the method used to generate normal direction operation and reverse direction operation command to Servo motor. The using type is different according to the machine maker. In case of Type A, normal operation pulse and reverse operation pulse shall be outputted from separate terminals. In case of Type B, normal operation pulse and reverse operation pulse shall be outputted from the same terminal and

normal/reverse direction operation classification signal shall be outputted from different terminals.

Regenerative brake option

This function is used to carry out acceleration/deceleration frequently as one option. Refer to “External regenerative resistor”.

Resolver

This device resolves two voltages of analog input and detects the angle. This is also called as “2 phase synchro”. For 1 phase voltage input, the axis rotation angle is converted to the 2 phase vertical voltage (analog voltage) and outputted.

Reverse limit switch signal

This is the input signal to inform the user that reverse limit switch (b contact configuration. Always ON) out of movement range to carry out positioning control is activated. The positioning action will stop when reverse limit switch signal (b contact) is OFF.

Turn Table

This is a round table that the product is located. The positioning control is carried out while the product is turning within the range of 360 degree.

S pattern acceleration/deceleration

In this pattern, acceleration and deceleration follows the sine curve and the movement is smooth. S pattern ratio can be set up to 1~100%.

Sequence control

This means a sequence program that the completion of a serial of action is detected by switch. By this signal, the action like next action start shall be carried out and controlled in order.

Servo motor

This is the motor that turns according to the command. Servo motor responds very quickly and carries out frequent high speed and high precision start/stop. There are two types of Servo motor : DC type and AC type available for large capacity motor. Generally, the pulse generator (encoder) for speed detection is installed and the feedback control is carried out frequently.

SFC (Sequential function chart)

SFC is the optimized programming method to carry out the automatic control of the machine in sequence with PLC.

Skip function

When skip signal in entered, the running positioning will stop and the next step positioning will be carried out automatically.

Subordinate axis

During linear interpolation/circular interpo-lation operation, the speed of subordinate axis shall be calculated automatically from positioning data. This axis moves by operation data of main axis and position address of subordinate axis.

Speed control

Speed control is carried out usually by Servo motor. This is the application for the rotation, welding speed, homing speed of rotation grinder. Speed control is different from position control because current position (address) cannot be controlled.

Speed integral compensation

This is one item of Servo parameter from positioning data. During speed control, it is used to heighten the frequency response and improve the transition characteristics. When adjusting speed loop gain, if over shooting during

acceleration/deceleration remains in many, it will be effective to increase this value. This compensation shall be set as ms unit.

Speed limit value

This is max. speed for positioning. If other speed data is set as higher than this value, the error will occur. The setting acceleration time is the time from stop status to speed limit value.

Speed loop gain

This is one item of Servo parameter from positioning data. This means the speed of control response during speed control. When load inertia moment ratio increases, the speed response of control system will decrease and the action shall be unstable. If such a thing happens, the action could be improved by increasing this value. If speed loop gain increases too much, the overshoot will be large and occur while motor vibration noise is acting or stops.

Speed loop mode

This is Servo control mode used for positioning. This is one mode to carry out speed control. Refer to “Position loop mode”.

Step out

The stepping motor rotates in proportion to the number of pulse while the rotation of motor breaks away if the excessive load is applied to the motor. This is called as ‘step out’. If the step out occurs, it is required to replace the motor with new motor that has bigger torque. The step out may cause to increase the positioning deviation.

Stepping motor

This is the motor to rotate the given angle (ex: 0.15∅) when 1 pulse is generated. Because of this reason, it is available to obtain the rotation in proportion to the number of pulse. 2~5 phase stepping motor is available. In case of 3 phase type, the motor rotates from A to C order when the voltage is supplied. Cares should be taken for the step out when overloading.

External stop signal

This is the input signal to stop the action from external input right away in the positioning control. When external stop signal (a contact) is ON, the action will stop.

Stroke limit

This is the range available for the positioning action or the range that the machine can move without any damage. (The movement out of this range is available in Jog operation mode). For the action using the warm gear, the stroke limit shall be set according to the length of screw.

Sudden stop

This stop is carried out within the shorter time than deceleration time set by parameter.

Torque control

By this function, the limit of resistance torque applied to the motor that is used for positioning will be fixed. If the excessive torque is applied to the motor, the power shall be OFF. When the excessive torque is applied to the motor, it may cause the sudden increase of current. If the stress different from motor consumption occurs, the motor life will be reduced. This function uses the sudden increase of torque when the machine homing gives the command to stop the motor.

Torque loop mode

This is called as “current loop mode”. Refer to

“Positioning loop mode”terminology.

Torque ripple

This means the change of torque width or deviation of torque.

Turn table

This is the turn table that is turning by the power. This table is used by dividing into the necessary position from 360 degree rotation. The unit of positioning control is “degree”.

Unit setting

This is the setting of the unit for the actual address or movement amount necessary for positioning. The available units are mm,inch,degree,pulse. The initial value of parameter is pulse unit.

WITH mode

This is the mode that carries out the positioning start and M code output at the same time. This mode enables the voltage to apply to the welding electrodes and to display the positioning speed and it shall be ON when the positioning starts.

XY table

This is the device to move the table to X, Y direction to carry out the positioning easily. There are some products available to use commercially.

Zero signal

This is called as “PGO of pulse generator (one time detection per axis rotation)”. This is also called as “Z phase”. Refer to “pulse generator” terminology.

Appendix 2 Internal Memory Address of Operation Data

1) Internal Memory Address of X Operation data

Step no.	Goal position		Circular interpolation aux. point		Operation speed		Dwell time	M code no.	Control word
	Low	High	Low	High	Low	High			
1	100	101	102	103	104	105	106	107	108
2	109	110	111	112	113	114	115	116	117
3	118	119	120	121	122	123	124	125	126
4	127	128	129	130	131	132	133	134	135
5	136	137	138	139	140	141	142	143	144
6	145	146	147	148	149	150	151	152	153
7	154	155	156	157	158	159	160	161	162
8	163	164	165	166	167	168	169	170	171
9	172	173	174	175	176	177	178	179	180
10	181	182	183	184	185	186	187	188	189
11	190	191	192	193	194	195	196	197	198
12	199	200	201	202	203	204	205	206	207
13	208	209	210	211	212	213	214	215	216
14	217	218	219	220	221	222	223	224	225
15	226	227	228	229	230	231	232	233	234
16	235	236	237	238	239	240	241	242	243
17	244	245	246	247	248	249	250	251	252
18	253	254	255	256	257	258	259	260	261
19	262	263	264	265	266	267	268	269	270
20	271	272	273	274	275	276	277	278	279
21	280	281	282	283	284	285	286	287	288
22	289	290	291	292	293	294	295	296	297
23	298	299	300	301	302	303	304	305	306
24	307	308	309	310	311	312	313	314	315
25	316	317	318	319	320	321	322	323	324
26	325	326	327	328	329	330	331	332	333
27	334	335	336	337	338	339	340	341	342
28	343	344	345	346	347	348	349	350	351
29	352	353	354	355	356	357	358	359	360
30	361	362	363	364	365	366	367	368	369
31	370	371	372	373	374	375	376	377	378
32	379	380	381	382	383	384	385	386	387
33	388	389	390	391	392	393	394	395	396
34	397	398	399	400	401	402	403	404	405
35	406	407	408	409	410	411	412	413	414
36	415	416	417	418	419	420	421	422	423
37	424	425	426	427	428	429	430	431	432
38	433	434	435	436	437	438	439	440	441
39	442	443	444	445	446	447	448	449	450
40	451	452	453	454	455	456	457	458	459
41	460	461	462	463	464	465	466	467	468
42	469	470	471	472	473	474	475	476	477
43	478	479	480	481	482	483	484	485	486
44	487	488	489	490	491	492	493	494	495
45	496	497	498	499	500	501	502	503	504
46	505	506	507	508	509	510	511	512	513
47	514	515	516	517	518	519	520	521	522
48	523	524	525	526	527	528	529	530	531
49	532	533	534	535	536	537	538	539	540
50	541	542	543	544	545	546	547	548	549

Step no.	Goal position		Circular interpolation aux. point		Operation speed		Dwell time	M code no.	Control word
	Low	High	Low	High	Low	High			
51	550	551	552	553	554	555	556	557	558
52	559	560	561	562	563	564	565	566	567
53	568	569	570	571	572	573	574	575	576
54	577	578	579	580	581	582	583	584	585
55	586	587	588	589	590	591	592	593	594
56	595	596	597	598	599	600	601	602	603
57	604	605	606	607	608	609	610	611	612
58	613	614	615	616	617	618	619	620	621
59	622	623	624	625	626	627	628	629	630
60	631	632	633	634	635	636	637	638	639
61	640	641	642	643	644	645	646	647	648
62	649	650	651	652	653	654	655	656	657
63	658	659	660	661	662	663	664	665	666
64	667	668	669	670	671	672	673	674	675
65	676	677	678	679	680	681	682	683	684
66	685	686	687	688	689	690	691	692	693
67	694	695	696	697	698	699	700	701	702
68	703	704	705	706	707	708	709	710	711
69	712	713	714	715	716	717	718	719	720
70	721	722	723	724	725	726	727	728	729
71	730	731	732	733	734	735	736	737	738
72	739	740	741	742	743	744	745	746	747
73	748	749	750	751	752	753	754	755	756
74	757	758	759	760	761	762	763	764	765
75	766	767	768	769	770	771	772	773	774
76	775	776	777	778	779	780	781	782	783
77	784	785	786	787	788	789	790	791	792
78	793	794	795	796	797	798	799	800	801
79	802	803	804	805	806	807	808	809	810
80	811	812	813	814	815	816	817	818	819
81	820	821	822	823	824	825	826	827	828
82	829	830	831	832	833	834	835	836	837
83	838	839	840	841	842	843	844	845	846
84	847	848	849	850	851	852	853	854	855
85	856	857	858	859	860	861	862	863	864
86	865	866	867	868	869	870	871	872	873
87	874	875	876	877	878	879	880	881	882
88	883	884	885	886	887	888	889	890	891
89	892	893	894	895	896	897	898	899	900
90	901	902	903	904	905	906	907	908	909
91	910	911	912	913	914	915	916	917	918
92	919	920	921	922	923	924	925	926	927
93	928	929	930	931	932	933	934	935	936
94	937	938	939	940	941	942	943	944	945
95	946	947	948	949	950	951	952	953	954
96	955	956	957	958	959	960	961	962	963
97	964	965	966	967	968	969	970	971	972
98	973	974	975	976	977	978	979	980	981
99	982	983	984	985	986	987	988	989	990
100	991	992	993	994	995	996	997	998	999

Step no.	Goal position		Circular interpolation aux. point		Operation speed		Dwell time	M code no.	Control word
	Low	High	Low	High	Low	High			
101	1000	1001	1002	1003	1004	1005	1006	1007	1008
102	1009	1010	1011	1012	1013	1014	1015	1016	1017
103	1018	1019	1020	1021	1022	1023	1024	1025	1026
104	1027	1028	1029	1030	1031	1032	1033	1034	1035
105	1036	1037	1038	1039	1040	1041	1042	1043	1044
106	1045	1046	1047	1048	1049	1050	1051	1052	1053
107	1054	1055	1056	1057	1058	1059	1060	1061	1062
108	1063	1064	1065	1066	1067	1068	1069	1070	1071
109	1072	1073	1074	1075	1076	1077	1078	1079	1080
110	1081	1082	1083	1084	1085	1086	1087	1088	1089
111	1090	1091	1092	1093	1094	1095	1096	1097	1098
112	1099	1100	1101	1102	1103	1104	1105	1106	1107
113	1108	1109	1110	1111	1112	1113	1114	1115	1116
114	1117	1118	1119	1120	1121	1122	1123	1124	1125
115	1126	1127	1128	1129	1130	1131	1132	1133	1134
116	1135	1136	1137	1138	1139	1140	1141	1142	1143
117	1144	1145	1146	1147	1148	1149	1150	1151	1152
118	1153	1154	1155	1156	1157	1158	1159	1160	1161
119	1162	1163	1164	1165	1166	1167	1168	1169	1170
120	1171	1172	1173	1174	1175	1176	1177	1178	1179
121	1180	1181	1182	1183	1184	1185	1186	1187	1188
122	1189	1190	1191	1192	1193	1194	1195	1196	1197
123	1198	1199	1200	1201	1202	1203	1204	1205	1206
124	1207	1208	1209	1210	1211	1212	1213	1214	1215
125	1216	1217	1218	1219	1220	1221	1222	1223	1224
126	1225	1226	1227	1228	1229	1230	1231	1232	1233
127	1234	1235	1236	1237	1238	1239	1240	1241	1242
128	1243	1244	1245	1246	1247	1248	1249	1250	1251
129	1252	1253	1254	1255	1256	1257	1258	1259	1260
130	1261	1262	1263	1264	1265	1266	1267	1268	1269
131	1270	1271	1272	1273	1274	1275	1276	1277	1278
132	1279	1280	1281	1282	1283	1284	1285	1286	1287
133	1288	1289	1290	1291	1292	1293	1294	1295	1296
134	1297	1298	1299	1300	1301	1302	1303	1304	1305
135	1306	1307	1308	1309	1310	1311	1312	1313	1314
136	1315	1316	1317	1318	1319	1320	1321	1322	1323
137	1324	1325	1326	1327	1328	1329	1330	1331	1332
138	1333	1334	1335	1336	1337	1338	1339	1340	1341
139	1342	1343	1344	1345	1346	1347	1348	1349	1350
140	1351	1352	1353	1354	1355	1356	1357	1358	1359
141	1360	1361	1362	1363	1364	1365	1366	1367	1368
142	1369	1370	1371	1372	1373	1374	1375	1376	1377
143	1378	1379	1380	1381	1382	1383	1384	1385	1386
144	1387	1388	1389	1390	1391	1392	1393	1394	1395
145	1396	1397	1398	1399	1400	1401	1402	1403	1404
146	1405	1406	1407	1408	1409	1410	1411	1412	1413
147	1414	1415	1416	1417	1418	1419	1420	1421	1422
148	1423	1424	1425	1426	1427	1428	1429	1430	1431
149	1432	1433	1434	1435	1436	1437	1438	1439	1440
150	1441	1442	1443	1444	1445	1446	1447	1448	1449

Step no.	Goal position		Circular interpolation aux. point		Operation speed		Dwell time	M code no.	Control word
	Low	High	Low	High	Low	High			
151	1450	1451	1452	1453	1454	1455	1456	1457	1458
152	1459	1460	1461	1462	1463	1464	1465	1466	1467
153	1468	1469	1470	1471	1472	1473	1474	1475	1476
154	1477	1478	1479	1480	1481	1482	1483	1484	1485
155	1486	1487	1488	1489	1490	1491	1492	1493	1494
156	1495	1496	1497	1498	1499	1500	1501	1502	1503
157	1504	1505	1506	1507	1508	1509	1510	1511	1512
158	1513	1514	1515	1516	1517	1518	1519	1520	1521
159	1522	1523	1524	1525	1526	1527	1528	1529	1530
160	1531	1532	1533	1534	1535	1536	1537	1538	1539
161	1540	1541	1542	1543	1544	1545	1546	1547	1548
162	1549	1550	1551	1552	1553	1554	1555	1556	1557
163	1558	1559	1560	1561	1562	1563	1564	1565	1566
164	1567	1568	1569	1570	1571	1572	1573	1574	1575
165	1576	1577	1578	1579	1580	1581	1582	1583	1584
166	1585	1586	1587	1588	1589	1590	1591	1592	1593
167	1594	1595	1596	1597	1598	1599	1600	1601	1602
168	1603	1604	1605	1606	1607	1608	1609	1610	1611
169	1612	1613	1614	1615	1616	1617	1618	1619	1620
170	1621	1622	1623	1624	1625	1626	1627	1628	1629
171	1630	1631	1632	1633	1634	1635	1636	1637	1638
172	1639	1640	1641	1642	1643	1644	1645	1646	1647
173	1648	1649	1650	1651	1652	1653	1654	1655	1656
174	1657	1658	1659	1660	1661	1662	1663	1664	1665
175	1666	1667	1668	1669	1670	1671	1672	1673	1674
176	1675	1676	1677	1678	1679	1680	1681	1682	1683
177	1684	1685	1686	1687	1688	1689	1690	1691	1692
178	1693	1694	1695	1696	1697	1698	1699	1700	1701
179	1702	1703	1704	1705	1706	1707	1708	1709	1710
180	1711	1712	1713	1714	1715	1716	1717	1718	1719
181	1720	1721	1722	1723	1724	1725	1726	1727	1728
182	1729	1730	1731	1732	1733	1734	1735	1736	1737
183	1738	1739	1740	1741	1742	1743	1744	1745	1746
184	1747	1748	1749	1750	1751	1752	1753	1754	1755
185	1756	1757	1758	1759	1760	1761	1762	1763	1764
186	1765	1766	1767	1768	1769	1770	1771	1772	1773
187	1774	1775	1776	1777	1778	1779	1780	1781	1782
188	1783	1784	1785	1786	1787	1788	1789	1790	1791
189	1792	1793	1794	1795	1796	1797	1798	1799	1800
190	1801	1802	1803	1804	1805	1806	1807	1808	1809
191	1810	1811	1812	1813	1814	1815	1816	1817	1818
192	1819	1820	1821	1822	1823	1824	1825	1826	1827
193	1828	1829	1830	1831	1832	1833	1834	1835	1836
194	1837	1838	1839	1840	1841	1842	1843	1844	1845
195	1846	1847	1848	1849	1850	1851	1852	1853	1854
196	1855	1856	1857	1858	1859	1860	1861	1862	1863
197	1864	1865	1866	1867	1868	1869	1870	1871	1872
198	1873	1874	1875	1876	1877	1878	1879	1880	1881
199	1882	1883	1884	1885	1886	1887	1888	1889	1890
200	1891	1892	1893	1894	1895	1896	1897	1898	1899

Step no.	Goal position		Circular interpolation aux. point		Operation speed		Dwell time	M code no.	Control word
	Low	High	Low	High	Low	High			
201	1900	1901	1902	1903	1904	1905	1906	1907	1908
202	1909	1910	1911	1912	1913	1914	1915	1916	1917
203	1918	1919	1920	1921	1922	1923	1924	1925	1926
204	1927	1928	1929	1930	1931	1932	1933	1934	1935
205	1936	1937	1938	1939	1940	1941	1942	1943	1944
206	1945	1946	1947	1948	1949	1950	1951	1952	1953
207	1954	1955	1956	1957	1958	1959	1960	1961	1962
208	1963	1964	1965	1966	1967	1968	1969	1970	1971
209	1972	1973	1974	1975	1976	1977	1978	1979	1980
210	1981	1982	1983	1984	1985	1986	1987	1988	1989
211	1990	1991	1992	1993	1994	1995	1996	1997	1998
212	1999	2000	2001	2002	2003	2004	2005	2006	2007
213	2008	2009	2010	2011	2012	2013	2014	2015	2016
214	2017	2018	2019	2020	2021	2022	2023	2024	2025
215	2026	2027	2028	2029	2030	2031	2032	2033	2034
216	2035	2036	2037	2038	2039	2040	2041	2042	2043
217	2044	2045	2046	2047	2048	2049	2050	2051	2052
218	2053	2054	2055	2056	2057	2058	2059	2060	2061
219	2062	2063	2064	2065	2066	2067	2068	2069	2070
220	2071	2072	2073	2074	2075	2076	2077	2078	2079
221	2080	2081	2082	2083	2084	2085	2086	2087	2088
222	2089	2090	2091	2092	2093	2094	2095	2096	2097
223	2098	2099	2100	2101	2102	2103	2104	2105	2106
224	2107	2108	2109	2110	2111	2112	2113	2114	2115
225	2116	2117	2118	2119	2120	2121	2122	2123	2124
226	2125	2126	2127	2128	2129	2130	2131	2132	2133
227	2134	2135	2136	2137	2138	2139	2140	2141	2142
228	2143	2144	2145	2146	2147	2148	2149	2150	2151
229	2152	2153	2154	2155	2156	2157	2158	2159	2160
230	2161	2162	2163	2164	2165	2166	2167	2168	2169
231	2170	2171	2172	2173	2174	2175	2176	2177	2178
232	2179	2180	2181	2182	2183	2184	2185	2186	2187
233	2188	2189	2190	2191	2192	2193	2194	2195	2196
234	2197	2198	2199	2200	2201	2202	2203	2204	2205
235	2206	2207	2208	2209	2210	2211	2212	2213	2214
236	2215	2216	2217	2218	2219	2220	2221	2222	2223
237	2224	2225	2226	2227	2228	2229	2230	2231	2232
238	2233	2234	2235	2236	2237	2238	2239	2240	2241
239	2242	2243	2244	2245	2246	2247	2248	2249	2250
240	2251	2252	2253	2254	2255	2256	2257	2258	2259
241	2260	2261	2262	2263	2264	2265	2266	2267	2268
242	2269	2270	2271	2272	2273	2274	2275	2276	2277
243	2278	2279	2280	2281	2282	2283	2284	2285	2286
244	2287	2288	2289	2290	2291	2292	2293	2294	2295
245	2296	2297	2298	2299	2300	2301	2302	2303	2304
246	2305	2306	2307	2308	2309	2310	2311	2312	2313
247	2314	2315	2316	2317	2318	2319	2320	2321	2322
248	2323	2324	2325	2326	2327	2328	2329	2330	2331
249	2332	2333	2334	2335	2336	2337	2338	2339	2340
250	2341	2342	2343	2344	2345	2346	2347	2348	2349

Step no.	Goal position		Circular interpolation aux. point		Operation speed		Dwell time	M code no.	Control word
	Low	High	Low	High	Low	High			
251	2350	2351	2352	2353	2354	2355	2356	2357	2358
252	2359	2360	2361	2362	2363	2364	2365	2366	2367
253	2368	2369	2370	2371	2372	2373	2374	2375	2376
254	2377	2378	2379	2380	2381	2382	2383	2384	2385
255	2386	2387	2388	2389	2390	2391	2392	2393	2394
256	2395	2396	2397	2398	2399	2400	2401	2402	2403
257	2404	2405	2406	2407	2408	2409	2410	2411	2412
258	2413	2414	2415	2416	2417	2418	2419	2420	2421
259	2422	2423	2424	2425	2426	2427	2428	2429	2430
260	2431	2432	2433	2434	2435	2436	2437	2438	2439
261	2440	2441	2442	2443	2444	2445	2446	2447	2448
262	2449	2450	2451	2452	2453	2454	2455	2456	2457
263	2458	2459	2460	2461	2462	2463	2464	2465	2466
264	2467	2468	2469	2470	2471	2472	2473	2474	2475
265	2476	2477	2478	2479	2480	2481	2482	2483	2484
266	2485	2486	2487	2488	2489	2490	2491	2492	2493
267	2494	2495	2496	2497	2498	2499	2500	2501	2502
268	2503	2504	2505	2506	2507	2508	2509	2510	2511
269	2512	2513	2514	2515	2516	2517	2518	2519	2520
270	2521	2522	2523	2524	2525	2526	2527	2528	2529
271	2530	2531	2532	2533	2534	2535	2536	2537	2538
272	2539	2540	2541	2542	2543	2544	2545	2546	2547
273	2548	2549	2550	2551	2552	2553	2554	2555	2556
274	2557	2558	2559	2560	2561	2562	2563	2564	2565
275	2566	2567	2568	2569	2570	2571	2572	2573	2574
276	2575	2576	2577	2578	2579	2580	2581	2582	2583
277	2584	2585	2586	2587	2588	2589	2590	2591	2592
278	2593	2594	2595	2596	2597	2598	2599	2600	2601
279	2602	2603	2604	2605	2606	2607	2608	2609	2610
280	2611	2612	2613	2614	2615	2616	2617	2618	2619
281	2620	2621	2622	2623	2624	2625	2626	2627	2628
282	2629	2630	2631	2632	2633	2634	2635	2636	2637
283	2638	2639	2640	2641	2642	2643	2644	2645	2646
284	2647	2648	2649	2650	2651	2652	2653	2654	2655
285	2656	2657	2658	2659	2660	2661	2662	2663	2664
286	2665	2666	2667	2668	2669	2670	2671	2672	2673
287	2674	2675	2676	2677	2678	2679	2680	2681	2682
288	2683	2684	2685	2686	2687	2688	2689	2690	2691
289	2692	2693	2694	2695	2696	2697	2698	2699	2700
290	2701	2702	2703	2704	2705	2706	2707	2708	2709
291	2710	2711	2712	2713	2714	2715	2716	2717	2718
292	2719	2720	2721	2722	2723	2724	2725	2726	2727
293	2728	2729	2730	2731	2732	2733	2734	2735	2736
294	2737	2738	2739	2740	2741	2742	2743	2744	2745
295	2746	2747	2748	2749	2750	2751	2752	2753	2754
296	2755	2756	2757	2758	2759	2760	2761	2762	2763
297	2764	2765	2766	2767	2768	2769	2770	2771	2772
298	2773	2774	2775	2776	2777	2778	2779	2780	2781
299	2782	2783	2784	2785	2786	2787	2788	2789	2790
300	2791	2792	2793	2794	2795	2796	2797	2798	2799

Step no.	Goal position		Circular interpolation aux. point		Operation speed		Dwell time	M code no.	Control word
	Low	High	Low	High	Low	High			
301	2800	2801	2802	2803	2804	2805	2806	2807	2808
302	2809	2810	2811	2812	2813	2814	2815	2816	2817
303	2818	2819	2820	2821	2822	2823	2824	2825	2826
304	2827	2828	2829	2830	2831	2832	2833	2834	2835
305	2836	2837	2838	2839	2840	2841	2842	2843	2844
306	2845	2846	2847	2848	2849	2850	2851	2852	2853
307	2854	2855	2856	2857	2858	2859	2860	2861	2862
308	2863	2864	2865	2866	2867	2868	2869	2870	2871
309	2872	2873	2874	2875	2876	2877	2878	2879	2880
310	2881	2882	2883	2884	2885	2886	2887	2888	2889
311	2890	2891	2892	2893	2894	2895	2896	2897	2898
312	2899	2900	2901	2902	2903	2904	2905	2906	2907
313	2908	2909	2910	2911	2912	2913	2914	2915	2916
314	2917	2918	2919	2920	2921	2922	2923	2924	2925
315	2926	2927	2928	2929	2930	2931	2932	2933	2934
316	2935	2936	2937	2938	2939	2940	2941	2942	2943
317	2944	2945	2946	2947	2948	2949	2950	2951	2952
318	2953	2954	2955	2956	2957	2958	2959	2960	2961
319	2962	2963	2964	2965	2966	2967	2968	2969	2970
320	2971	2972	2973	2974	2975	2976	2977	2978	2979
321	2980	2981	2982	2983	2984	2985	2986	2987	2988
322	2989	2990	2991	2992	2993	2994	2995	2996	2997
323	2998	2999	3000	3001	3002	3003	3004	3005	3006
324	3007	3008	3009	3010	3011	3012	3013	3014	3015
325	3016	3017	3018	3019	3020	3021	3022	3023	3024
326	3025	3026	3027	3028	3029	3030	3031	3032	3033
327	3034	3035	3036	3037	3038	3039	3040	3041	3042
328	3043	3044	3045	3046	3047	3048	3049	3050	3051
329	3052	3053	3054	3055	3056	3057	3058	3059	3060
330	3061	3062	3063	3064	3065	3066	3067	3068	3069
331	3070	3071	3072	3073	3074	3075	3076	3077	3078
332	3079	3080	3081	3082	3083	3084	3085	3086	3087
333	3088	3089	3090	3091	3092	3093	3094	3095	3096
334	3097	3098	3099	3100	3101	3102	3103	3104	3105
335	3106	3107	3108	3109	3110	3111	3112	3113	3114
336	3115	3116	3117	3118	3119	3120	3121	3122	3123
337	3124	3125	3126	3127	3128	3129	3130	3131	3132
338	3133	3134	3135	3136	3137	3138	3139	3140	3141
339	3142	3143	3144	3145	3146	3147	3148	3149	3150
340	3151	3152	3153	3154	3155	3156	3157	3158	3159
341	3160	3161	3162	3163	3164	3165	3166	3167	3168
342	3169	3170	3171	3172	3173	3174	3175	3176	3177
343	3178	3179	3180	3181	3182	3183	3184	3185	3186
344	3187	3188	3189	3190	3191	3192	3193	3194	3195
345	3196	3197	3198	3199	3200	3201	3202	3203	3204
346	3205	3206	3207	3208	3209	3210	3211	3212	3213
347	3214	3215	3216	3217	3218	3219	3220	3221	3222
348	3223	3224	3225	3226	3227	3228	3229	3230	3231
349	3232	3233	3234	3235	3236	3237	3238	3239	3240
350	3241	3242	3243	3244	3245	3246	3247	3248	3249

Step no.	Goal position		Circular interpolation aux. point		Operation speed		Dwell time	M code no.	Control word
	Low	High	Low	High	Low	High			
351	3250	3251	3252	3253	3254	3255	3256	3257	3258
352	3259	3260	3261	3262	3263	3264	3265	3266	3267
353	3268	3269	3270	3271	3272	3273	3274	3275	3276
354	3277	3278	3279	3280	3281	3282	3283	3284	3285
355	3286	3287	3288	3289	3290	3291	3292	3293	3294
356	3295	3296	3297	3298	3299	3300	3301	3302	3303
357	3304	3305	3306	3307	3308	3309	3310	3311	3312
358	3313	3314	3315	3316	3317	3318	3319	3320	3321
359	3322	3323	3324	3325	3326	3327	3328	3329	3330
360	3331	3332	3333	3334	3335	3336	3337	3338	3339
361	3340	3341	3342	3343	3344	3345	3346	3347	3348
362	3349	3350	3351	3352	3353	3354	3355	3356	3357
363	3358	3359	3360	3361	3362	3363	3364	3365	3366
364	3367	3368	3369	3370	3371	3372	3373	3374	3375
365	3376	3377	3378	3379	3380	3381	3382	3383	3384
366	3385	3386	3387	3388	3389	3390	3391	3392	3393
367	3394	3395	3396	3397	3398	3399	3400	3401	3402
368	3403	3404	3405	3406	3407	3408	3409	3410	3411
369	3412	3413	3414	3415	3416	3417	3418	3419	3420
370	3421	3422	3423	3424	3425	3426	3427	3428	3429
371	3430	3431	3432	3433	3434	3435	3436	3437	3438
372	3439	3440	3441	3442	3443	3444	3445	3446	3447
373	3448	3449	3450	3451	3452	3453	3454	3455	3456
374	3457	3458	3459	3460	3461	3462	3463	3464	3465
375	3466	3467	3468	3469	3470	3471	3472	3473	3474
376	3475	3476	3477	3478	3479	3480	3481	3482	3483
377	3484	3485	3486	3487	3488	3489	3490	3491	3492
378	3493	3494	3495	3496	3497	3498	3499	3500	3501
379	3502	3503	3504	3505	3506	3507	3508	3509	3510
380	3511	3512	3513	3514	3515	3516	3517	3518	3519
381	3520	3521	3522	3523	3524	3525	3526	3527	3528
382	3529	3530	3531	3532	3533	3534	3535	3536	3537
383	3538	3539	3540	3541	3542	3543	3544	3545	3546
384	3547	3548	3549	3550	3551	3552	3553	3554	3555
385	3556	3557	3558	3559	3560	3561	3562	3563	3564
386	3565	3566	3567	3568	3569	3570	3571	3572	3573
387	3574	3575	3576	3577	3578	3579	3580	3581	3582
388	3583	3584	3585	3586	3587	3588	3589	3590	3591
389	3592	3593	3594	3595	3596	3597	3598	3599	3600
390	3601	3602	3603	3604	3605	3606	3607	3608	3609
391	3610	3611	3612	3613	3614	3615	3616	3617	3618
392	3619	3620	3621	3622	3623	3624	3625	3626	3627
393	3628	3629	3630	3631	3632	3633	3634	3635	3636
394	3637	3638	3639	3640	3641	3642	3643	3644	3645
395	3646	3647	3648	3649	3650	3651	3652	3653	3654
396	3655	3656	3657	3658	3659	3660	3661	3662	3663
397	3664	3665	3666	3667	3668	3669	3670	3671	3672
398	3673	3674	3675	3676	3677	3678	3679	3680	3681
399	3682	3683	3684	3685	3686	3687	3688	3689	3690
400	3691	3692	3693	3694	3695	3696	3697	3698	3699

2) Internal Memory Address of Y Operation data

Step no.	Goal position		Circular interpolation aux. point		Operation speed		Dwell time	M code no.	Control word
	Low	High	Low	High	Low	High			
1	4500	4501	4502	4503	4504	4505	4506	4507	4508
2	4509	4510	4511	4512	4513	4514	4515	4516	4517
3	4518	4519	4520	4521	4522	4523	4524	4525	4526
4	4527	4528	4529	4530	4531	4532	4533	4534	4535
5	4536	4537	4538	4539	4540	4541	4542	4543	4544
6	4545	4546	4547	4548	4549	4550	4551	4552	4553
7	4554	4555	4556	4557	4558	4559	4560	4561	4562
8	4563	4564	4565	4566	4567	4568	4569	4570	4571
9	4572	4573	4574	4575	4576	4577	4578	4579	4580
10	4581	4582	4583	4584	4585	4586	4587	4588	4589
11	4590	4591	4592	4593	4594	4595	4596	4597	4598
12	4599	4600	4601	4602	4603	4604	4605	4606	4607
13	4608	4609	4610	4611	4612	4613	4614	4615	4616
14	4617	4618	4619	4620	4621	4622	4623	4624	4625
15	4626	4627	4628	4629	4630	4631	4632	4633	4634
16	4635	4636	4637	4638	4639	4640	4641	4642	4643
17	4644	4645	4646	4647	4648	4649	4650	4651	4652
18	4653	4654	4655	4656	4657	4658	4659	4660	4661
19	4662	4663	4664	4665	4666	4667	4668	4669	4670
20	4671	4672	4673	4674	4675	4676	4677	4678	4679
21	4680	4681	4682	4683	4684	4685	4686	4687	4688
22	4689	4690	4691	4692	4693	4694	4695	4696	4697
23	4698	4699	4700	4701	4702	4703	4704	4705	4706
24	4707	4708	4709	4710	4711	4712	4713	4714	4715
25	4716	4717	4718	4719	4720	4721	4722	4723	4724
26	4725	4726	4727	4728	4729	4730	4731	4732	4733
27	4734	4735	4736	4737	4738	4739	4740	4741	4742
28	4743	4744	4745	4746	4747	4748	4749	4750	4751
29	4752	4753	4754	4755	4756	4757	4758	4759	4760
30	4761	4762	4763	4764	4765	4766	4767	4768	4769
31	4770	4771	4772	4773	4774	4775	4776	4777	4778
32	4779	4780	4781	4782	4783	4784	4785	4786	4787
33	4788	4789	4790	4791	4792	4793	4794	4795	4796
34	4797	4798	4799	4800	4801	4802	4803	4804	4805
35	4806	4807	4808	4809	4810	4811	4812	4813	4814
36	4815	4816	4817	4818	4819	4820	4821	4822	4823
37	4824	4825	4826	4827	4828	4829	4830	4831	4832
38	4833	4834	4835	4836	4837	4838	4839	4840	4841
39	4842	4843	4844	4845	4846	4847	4848	4849	4850
40	4851	4852	4853	4854	4855	4856	4857	4858	4859
41	4860	4861	4862	4863	4864	4865	4866	4867	4868
42	4869	4870	4871	4872	4873	4874	4875	4876	4877
43	4878	4879	4880	4881	4882	4883	4884	4885	4886
44	4887	4888	4889	4890	4891	4892	4893	4894	4895
45	4896	4897	4898	4899	4900	4901	4902	4903	4904
46	4905	4906	4907	4908	4909	4910	4911	4912	4913
47	4914	4915	4916	4917	4918	4919	4920	4921	4922
48	4923	4924	4925	4926	4927	4928	4929	4930	4931
49	4932	4933	4934	4935	4936	4937	4938	4939	4940
50	4941	4942	4943	4944	4945	4946	4947	4948	4949

Step no.	Goal position		Circular interpolation aux. point		Operation speed		Dwell time	M code no.	Control word
	Low	High	Low	High	Low	High			
51	4950	4951	4952	4953	4954	4955	4956	4957	4958
52	4959	4960	4961	4962	4963	4964	4965	4966	4967
53	4968	4969	4970	4971	4972	4973	4974	4975	4976
54	4977	4978	4979	4980	4981	4982	4983	4984	4985
55	4986	4987	4988	4989	4990	4991	4992	4993	4994
56	4995	4996	4997	4998	4999	5000	5001	5002	5003
57	5004	5005	5006	5007	5008	5009	5010	5011	5012
58	5013	5014	5015	5016	5017	5018	5019	5020	5021
59	5022	5023	5024	5025	5026	5027	5028	5029	5030
60	5031	5032	5033	5034	5035	5036	5037	5038	5039
61	5040	5041	5042	5043	5044	5045	5046	5047	5048
62	5049	5050	5051	5052	5053	5054	5055	5056	5057
63	5058	5059	5060	5061	5062	5063	5064	5065	5066
64	5067	5068	5069	5070	5071	5072	5073	5074	5075
65	5076	5077	5078	5079	5080	5081	5082	5083	5084
66	5085	5086	5087	5088	5089	5090	5091	5092	5093
67	5094	5095	5096	5097	5098	5099	5100	5101	5102
68	5103	5104	5105	5106	5107	5108	5109	5110	5111
69	5112	5113	5114	5115	5116	5117	5118	5119	5120
70	5121	5122	5123	5124	5125	5126	5127	5128	5129
71	5130	5131	5132	5133	5134	5135	5136	5137	5138
72	5139	5140	5141	5142	5143	5144	5145	5146	5147
73	5148	5149	5150	5151	5152	5153	5154	5155	5156
74	5157	5158	5159	5160	5161	5162	5163	5164	5165
75	5166	5167	5168	5169	5170	5171	5172	5173	5174
76	5175	5176	5177	5178	5179	5180	5181	5182	5183
77	5184	5185	5186	5187	5188	5189	5190	5191	5192
78	5193	5194	5195	5196	5197	5198	5199	5200	5201
79	5202	5203	5204	5205	5206	5207	5208	5209	5210
80	5211	5212	5213	5214	5215	5216	5217	5218	5219
81	5220	5221	5222	5223	5224	5225	5226	5227	5228
82	5229	5230	5231	5232	5233	5234	5235	5236	5237
83	5238	5239	5240	5241	5242	5243	5244	5245	5246
84	5247	5248	5249	5250	5251	5252	5253	5254	5255
85	5256	5257	5258	5259	5260	5261	5262	5263	5264
86	5265	5266	5267	5268	5269	5270	5271	5272	5273
87	5274	5275	5276	5277	5278	5279	5280	5281	5282
88	5283	5284	5285	5286	5287	5288	5289	5290	5291
89	5292	5293	5294	5295	5296	5297	5298	5299	5300
90	5301	5302	5303	5304	5305	5306	5307	5308	5309
91	5310	5311	5312	5313	5314	5315	5316	5317	5318
92	5319	5320	5321	5322	5323	5324	5325	5326	5327
93	5328	5329	5330	5331	5332	5333	5334	5335	5336
94	5337	5338	5339	5340	5341	5342	5343	5344	5345
95	5346	5347	5348	5349	5350	5351	5352	5353	5354
96	5355	5356	5357	5358	5359	5360	5361	5362	5363
97	5364	5365	5366	5367	5368	5369	5370	5371	5372
98	5373	5374	5375	5376	5377	5378	5379	5380	5381
99	5382	5383	5384	5385	5386	5387	5388	5389	5390
100	5391	5392	5393	5394	5395	5396	5397	5398	5399

Step no.	Goal position		Circular interpolation aux. point		Operation speed		Dwell time	M code no.	Control word
	Low	High	Low	High	Low	High			
101	5400	5401	5402	5403	5404	5405	5406	5407	5408
102	5409	5410	5411	5412	5413	5414	5415	5416	5417
103	5418	5419	5420	5421	5422	5423	5424	5425	5426
104	5427	5428	5429	5430	5431	5432	5433	5434	5435
105	5436	5437	5438	5439	5440	5441	5442	5443	5444
106	5445	5446	5447	5448	5449	5450	5451	5452	5453
107	5454	5455	5456	5457	5458	5459	5460	5461	5462
108	5463	5464	5465	5466	5467	5468	5469	5470	5471
109	5472	5473	5474	5475	5476	5477	5478	5479	5480
110	5481	5482	5483	5484	5485	5486	5487	5488	5489
111	5490	5491	5492	5493	5494	5495	5496	5497	5498
112	5499	5500	5501	5502	5503	5504	5505	5506	5507
113	5508	5509	5510	5511	5512	5513	5514	5515	5516
114	5517	5518	5519	5520	5521	5522	5523	5524	5525
115	5526	5527	5528	5529	5530	5531	5532	5533	5534
116	5535	5536	5537	5538	5539	5540	5541	5542	5543
117	5544	5545	5546	5547	5548	5549	5550	5551	5552
118	5553	5554	5555	5556	5557	5558	5559	5560	5561
119	5562	5563	5564	5565	5566	5567	5568	5569	5570
120	5571	5572	5573	5574	5575	5576	5577	5578	5579
121	5580	5581	5582	5583	5584	5585	5586	5587	5588
122	5589	5590	5591	5592	5593	5594	5595	5596	5597
123	5598	5599	5600	5601	5602	5603	5604	5605	5606
124	5607	5608	5609	5610	5611	5612	5613	5614	5615
125	5616	5617	5618	5619	5620	5621	5622	5623	5624
126	5625	5626	5627	5628	5629	5630	5631	5632	5633
127	5634	5635	5636	5637	5638	5639	5640	5641	5642
128	5643	5644	5645	5646	5647	5648	5649	5650	5651
129	5652	5653	5654	5655	5656	5657	5658	5659	5660
130	5661	5662	5663	5664	5665	5666	5667	5668	5669
131	5670	5671	5672	5673	5674	5675	5676	5677	5678
132	5679	5680	5681	5682	5683	5684	5685	5686	5687
133	5688	5689	5690	5691	5692	5693	5694	5695	5696
134	5697	5698	5699	5700	5701	5702	5703	5704	5705
135	5706	5707	5708	5709	5710	5711	5712	5713	5714
136	5715	5716	5717	5718	5719	5720	5721	5722	5723
137	5724	5725	5726	5727	5728	5729	5730	5731	5732
138	5733	5734	5735	5736	5737	5738	5739	5740	5741
139	5742	5743	5744	5745	5746	5747	5748	5749	5750
140	5751	5752	5753	5754	5755	5756	5757	5758	5759
141	5760	5761	5762	5763	5764	5765	5766	5767	5768
142	5769	5770	5771	5772	5773	5774	5775	5776	5777
143	5778	5779	5780	5781	5782	5783	5784	5785	5786
144	5787	5788	5789	5790	5791	5792	5793	5794	5795
145	5796	5797	5798	5799	5800	5801	5802	5803	5804
146	5805	5806	5807	5808	5809	5810	5811	5812	5813
147	5814	5815	5816	5817	5818	5819	5820	5821	5822
148	5823	5824	5825	5826	5827	5828	5829	5830	5831
149	5832	5833	5834	5835	5836	5837	5838	5839	5840
150	5841	5842	5843	5844	5845	5846	5847	5848	5849

Step no.	Goal position		Circular interpolation aux. point		Operation speed		Dwell time	M code no.	Control word
	Low	High	Low	High	Low	High			
151	5850	5851	5852	5853	5854	5855	5856	5857	5858
152	5859	5860	5861	5862	5863	5864	5865	5866	5867
153	5868	5869	5870	5871	5872	5873	5874	5875	5876
154	5877	5878	5879	5880	5881	5882	5883	5884	5885
155	5886	5887	5888	5889	5890	5891	5892	5893	5894
156	5895	5896	5897	5898	5899	5900	5901	5902	5903
157	5904	5905	5906	5907	5908	5909	5910	5911	5912
158	5913	5914	5915	5916	5917	5918	5919	5920	5921
159	5922	5923	5924	5925	5926	5927	5928	5929	5930
160	5931	5932	5933	5934	5935	5936	5937	5938	5939
161	5940	5941	5942	5943	5944	5945	5946	5947	5948
162	5949	5950	5951	5952	5953	5954	5955	5956	5957
163	5958	5959	5960	5961	5962	5963	5964	5965	5966
164	5967	5968	5969	5970	5971	5972	5973	5974	5975
165	5976	5977	5978	5979	5980	5981	5982	5983	5984
166	5985	5986	5987	5988	5989	5990	5991	5992	5993
167	5994	5995	5996	5997	5998	5999	6000	6001	6002
168	6003	6004	6005	6006	6007	6008	6009	6010	6011
169	6012	6013	6014	6015	6016	6017	6018	6019	6020
170	6021	6022	6023	6024	6025	6026	6027	6028	6029
171	6030	6031	6032	6033	6034	6035	6036	6037	6038
172	6039	6040	6041	6042	6043	6044	6045	6046	6047
173	6048	6049	6050	6051	6052	6053	6054	6055	6056
174	6057	6058	6059	6060	6061	6062	6063	6064	6065
175	6066	6067	6068	6069	6070	6071	6072	6073	6074
176	6075	6076	6077	6078	6079	6080	6081	6082	6083
177	6084	6085	6086	6087	6088	6089	6090	6091	6092
178	6093	6094	6095	6096	6097	6098	6099	6100	6101
179	6102	6103	6104	6105	6106	6107	6108	6109	6110
180	6111	6112	6113	6114	6115	6116	6117	6118	6119
181	6120	6121	6122	6123	6124	6125	6126	6127	6128
182	6129	6130	6131	6132	6133	6134	6135	6136	6137
183	6138	6139	6140	6141	6142	6143	6144	6145	6146
184	6147	6148	6149	6150	6151	6152	6153	6154	6155
185	6156	6157	6158	6159	6160	6161	6162	6163	6164
186	6165	6166	6167	6168	6169	6170	6171	6172	6173
187	6174	6175	6176	6177	6178	6179	6180	6181	6182
188	6183	6184	6185	6186	6187	6188	6189	6190	6191
189	6192	6193	6194	6195	6196	6197	6198	6199	6200
190	6201	6202	6203	6204	6205	6206	6207	6208	6209
191	6210	6211	6212	6213	6214	6215	6216	6217	6218
192	6219	6220	6221	6222	6223	6224	6225	6226	6227
193	6228	6229	6230	6231	6232	6233	6234	6235	6236
194	6237	6238	6239	6240	6241	6242	6243	6244	6245
195	6246	6247	6248	6249	6250	6251	6252	6253	6254
196	6255	6256	6257	6258	6259	6260	6261	6262	6263
197	6264	6265	6266	6267	6268	6269	6270	6271	6272
198	6273	6274	6275	6276	6277	6278	6279	6280	6281
199	6282	6283	6284	6285	6286	6287	6288	6289	6290
200	6291	6292	6293	6294	6295	6296	6297	6298	6299

Step no.	Goal position		Circular interpolation aux. point		Operation speed		Dwell time	M code no.	Control word
	Low	High	Low	High	Low	High			
201	6300	6301	6302	6303	6304	6305	6306	6307	6308
202	6309	6310	6311	6312	6313	6314	6315	6316	6317
203	6318	6319	6320	6321	6322	6323	6324	6325	6326
204	6327	6328	6329	6330	6331	6332	6333	6334	6335
205	6336	6337	6338	6339	6340	6341	6342	6343	6344
206	6345	6346	6347	6348	6349	6350	6351	6352	6353
207	6354	6355	6356	6357	6358	6359	6360	6361	6362
208	6363	6364	6365	6366	6367	6368	6369	6370	6371
209	6372	6373	6374	6375	6376	6377	6378	6379	6380
210	6381	6382	6383	6384	6385	6386	6387	6388	6389
211	6390	6391	6392	6393	6394	6395	6396	6397	6398
212	6399	6400	6401	6402	6403	6404	6405	6406	6407
213	6408	6409	6410	6411	6412	6413	6414	6415	6416
214	6417	6418	6419	6420	6421	6422	6423	6424	6425
215	6426	6427	6428	6429	6430	6431	6432	6433	6434
216	6435	6436	6437	6438	6439	6440	6441	6442	6443
217	6444	6445	6446	6447	6448	6449	6450	6451	6452
218	6453	6454	6455	6456	6457	6458	6459	6460	6461
219	6462	6463	6464	6465	6466	6467	6468	6469	6470
220	6471	6472	6473	6474	6475	6476	6477	6478	6479
221	6480	6481	6482	6483	6484	6485	6486	6487	6488
222	6489	6490	6491	6492	6493	6494	6495	6496	6497
223	6498	6499	6500	6501	6502	6503	6504	6505	6506
224	6507	6508	6509	6510	6511	6512	6513	6514	6515
225	6516	6517	6518	6519	6520	6521	6522	6523	6524
226	6525	6526	6527	6528	6529	6530	6531	6532	6533
227	6534	6535	6536	6537	6538	6539	6540	6541	6542
228	6543	6544	6545	6546	6547	6548	6549	6550	6551
229	6552	6553	6554	6555	6556	6557	6558	6559	6560
230	6561	6562	6563	6564	6565	6566	6567	6568	6569
231	6570	6571	6572	6573	6574	6575	6576	6577	6578
232	6579	6580	6581	6582	6583	6584	6585	6586	6587
233	6588	6589	6590	6591	6592	6593	6594	6595	6596
234	6597	6598	6599	6600	6601	6602	6603	6604	6605
235	6606	6607	6608	6609	6610	6611	6612	6613	6614
236	6615	6616	6617	6618	6619	6620	6621	6622	6623
237	6624	6625	6626	6627	6628	6629	6630	6631	6632
238	6633	6634	6635	6636	6637	6638	6639	6640	6641
239	6642	6643	6644	6645	6646	6647	6648	6649	6650
240	6651	6652	6653	6654	6655	6656	6657	6658	6659
241	6660	6661	6662	6663	6664	6665	6666	6667	6668
242	6669	6670	6671	6672	6673	6674	6675	6676	6677
243	6678	6679	6680	6681	6682	6683	6684	6685	6686
244	6687	6688	6689	6690	6691	6692	6693	6694	6695
245	6696	6697	6698	6699	6700	6701	6702	6703	6704
246	6705	6706	6707	6708	6709	6710	6711	6712	6713
247	6714	6715	6716	6717	6718	6719	6720	6721	6722
248	6723	6724	6725	6726	6727	6728	6729	6730	6731
249	6732	6733	6734	6735	6736	6737	6738	6739	6740
250	6741	6742	6743	6744	6745	6746	6747	6748	6749

Step no.	Goal position		Circular interpolation aux. point		Operation speed		Dwell time	M code no.	Control word
	Low	High	Low	High	Low	High			
251	6750	6751	6752	6753	6754	6755	6756	6757	6758
252	6759	6760	6761	6762	6763	6764	6765	6766	6767
253	6768	6769	6770	6771	6772	6773	6774	6775	6776
254	6777	6778	6779	6780	6781	6782	6783	6784	6785
255	6786	6787	6788	6789	6790	6791	6792	6793	6794
256	6795	6796	6797	6798	6799	6800	6801	6802	6803
257	6804	6805	6806	6807	6808	6809	6810	6811	6812
258	6813	6814	6815	6816	6817	6818	6819	6820	6821
259	6822	6823	6824	6825	6826	6827	6828	6829	6830
260	6831	6832	6833	6834	6835	6836	6837	6838	6839
261	6840	6841	6842	6843	6844	6845	6846	6847	6848
262	6849	6850	6851	6852	6853	6854	6855	6856	6857
263	6858	6859	6860	6861	6862	6863	6864	6865	6866
264	6867	6868	6869	6870	6871	6872	6873	6874	6875
265	6876	6877	6878	6879	6880	6881	6882	6883	6884
266	6885	6886	6887	6888	6889	6890	6891	6892	6893
267	6894	6895	6896	6897	6898	6899	6900	6901	6902
268	6903	6904	6905	6906	6907	6908	6909	6910	6911
269	6912	6913	6914	6915	6916	6917	6918	6919	6920
270	6921	6922	6923	6924	6925	6926	6927	6928	6929
271	6930	6931	6932	6933	6934	6935	6936	6937	6938
272	6939	6940	6941	6942	6943	6944	6945	6946	6947
273	6948	6949	6950	6951	6952	6953	6954	6955	6956
274	6957	6958	6959	6960	6961	6962	6963	6964	6965
275	6966	6967	6968	6969	6970	6971	6972	6973	6974
276	6975	6976	6977	6978	6979	6980	6981	6982	6983
277	6984	6985	6986	6987	6988	6989	6990	6991	6992
278	6993	6994	6995	6996	6997	6998	6999	7000	7001
279	7002	7003	7004	7005	7006	7007	7008	7009	7010
280	7011	7012	7013	7014	7015	7016	7017	7018	7019
281	7020	7021	7022	7023	7024	7025	7026	7027	7028
282	7029	7030	7031	7032	7033	7034	7035	7036	7037
283	7038	7039	7040	7041	7042	7043	7044	7045	7046
284	7047	7048	7049	7050	7051	7052	7053	7054	7055
285	7056	7057	7058	7059	7060	7061	7062	7063	7064
286	7065	7066	7067	7068	7069	7070	7071	7072	7073
287	7074	7075	7076	7077	7078	7079	7080	7081	7082
288	7083	7084	7085	7086	7087	7088	7089	7090	7091
289	7092	7093	7094	7095	7096	7097	7098	7099	7100
290	7101	7102	7103	7104	7105	7106	7107	7108	7109
291	7110	7111	7112	7113	7114	7115	7116	7117	7118
292	7119	7120	7121	7122	7123	7124	7125	7126	7127
293	7128	7129	7130	7131	7132	7133	7134	7135	7136
294	7137	7138	7139	7140	7141	7142	7143	7144	7145
295	7146	7147	7148	7149	7150	7151	7152	7153	7154
296	7155	7156	7157	7158	7159	7160	7161	7162	7163
297	7164	7165	7166	7167	7168	7169	7170	7171	7172
298	7173	7174	7175	7176	7177	7178	7179	7180	7181
299	7182	7183	7184	7185	7186	7187	7188	7189	7190
300	7191	7192	7193	7194	7195	7196	7197	7198	7199

Step no.	Goal position		Circular interpolation aux. point		Operation speed		Dwell time	M code no.	Control word
	Low	High	Low	High	Low	High			
301	7200	7201	7202	7203	7204	7205	7206	7207	7208
302	7209	7210	7211	7212	7213	7214	7215	7216	7217
303	7218	7219	7220	7221	7222	7223	7224	7225	7226
304	7227	7228	7229	7230	7231	7232	7233	7234	7235
305	7236	7237	7238	7239	7240	7241	7242	7243	7244
306	7245	7246	7247	7248	7249	7250	7251	7252	7253
307	7254	7255	7256	7257	7258	7259	7260	7261	7262
308	7263	7264	7265	7266	7267	7268	7269	7270	7271
309	7272	7273	7274	7275	7276	7277	7278	7279	7280
310	7281	7282	7283	7284	7285	7286	7287	7288	7289
311	7290	7291	7292	7293	7294	7295	7296	7297	7298
312	7299	7300	7301	7302	7303	7304	7305	7306	7307
313	7308	7309	7310	7311	7312	7313	7314	7315	7316
314	7317	7318	7319	7320	7321	7322	7323	7324	7325
315	7326	7327	7328	7329	7330	7331	7332	7333	7334
316	7335	7336	7337	7338	7339	7340	7341	7342	7343
317	7344	7345	7346	7347	7348	7349	7350	7351	7352
318	7353	7354	7355	7356	7357	7358	7359	7360	7361
319	7362	7363	7364	7365	7366	7367	7368	7369	7370
320	7371	7372	7373	7374	7375	7376	7377	7378	7379
321	7380	7381	7382	7383	7384	7385	7386	7387	7388
322	7389	7390	7391	7392	7393	7394	7395	7396	7397
323	7398	7399	7400	7401	7402	7403	7404	7405	7406
324	7407	7408	7409	7410	7411	7412	7413	7414	7415
325	7416	7417	7418	7419	7420	7421	7422	7423	7424
326	7425	7426	7427	7428	7429	7430	7431	7432	7433
327	7434	7435	7436	7437	7438	7439	7440	7441	7442
328	7443	7444	7445	7446	7447	7448	7449	7450	7451
329	7452	7453	7454	7455	7456	7457	7458	7459	7460
330	7461	7462	7463	7464	7465	7466	7467	7468	7469
331	7470	7471	7472	7473	7474	7475	7476	7477	7478
332	7479	7480	7481	7482	7483	7484	7485	7486	7487
333	7488	7489	7490	7491	7492	7493	7494	7495	7496
334	7497	7498	7499	7500	7501	7502	7503	7504	7505
335	7506	7507	7508	7509	7510	7511	7512	7513	7514
336	7515	7516	7517	7518	7519	7520	7521	7522	7523
337	7524	7525	7526	7527	7528	7529	7530	7531	7532
338	7533	7534	7535	7536	7537	7538	7539	7540	7541
339	7542	7543	7544	7545	7546	7547	7548	7549	7550
340	7551	7552	7553	7554	7555	7556	7557	7558	7559
341	7560	7561	7562	7563	7564	7565	7566	7567	7568
342	7569	7570	7571	7572	7573	7574	7575	7576	7577
343	7578	7579	7580	7581	7582	7583	7584	7585	7586
344	7587	7588	7589	7590	7591	7592	7593	7594	7595
345	7596	7597	7598	7599	7600	7601	7602	7603	7604
346	7605	7606	7607	7608	7609	7610	7611	7612	7613
347	7614	7615	7616	7617	7618	7619	7620	7621	7622
348	7623	7624	7625	7626	7627	7628	7629	7630	7631
349	7632	7633	7634	7635	7636	7637	7638	7639	7640
350	7641	7642	7643	7644	7645	7646	7647	7648	7649

Step no.	Goal position		Circular interpolation aux. point		Operation speed		Dwell time	M code no.	Control word
	Low	High	Low	High	Low	High			
351	7650	7651	7652	7653	7654	7655	7656	7657	7658
352	7659	7660	7661	7662	7663	7664	7665	7666	7667
353	7668	7669	7670	7671	7672	7673	7674	7675	7676
354	7677	7678	7679	7680	7681	7682	7683	7684	7685
355	7686	7687	7688	7689	7690	7691	7692	7693	7694
356	7695	7696	7697	7698	7699	7700	7701	7702	7703
357	7704	7705	7706	7707	7708	7709	7710	7711	7712
358	7713	7714	7715	7716	7717	7718	7719	7720	7721
359	7722	7723	7724	7725	7726	7727	7728	7729	7730
360	7731	7732	7733	7734	7735	7736	7737	7738	7739
361	7740	7741	7742	7743	7744	7745	7746	7747	7748
362	7749	7750	7751	7752	7753	7754	7755	7756	7757
363	7758	7759	7760	7761	7762	7763	7764	7765	7766
364	7767	7768	7769	7770	7771	7772	7773	7774	7775
365	7776	7777	7778	7779	7780	7781	7782	7783	7784
366	7785	7786	7787	7788	7789	7790	7791	7792	7793
367	7794	7795	7796	7797	7798	7799	7800	7801	7802
368	7803	7804	7805	7806	7807	7808	7809	7810	7811
369	7812	7813	7814	7815	7816	7817	7818	7819	7820
370	7821	7822	7823	7824	7825	7826	7827	7828	7829
371	7830	7831	7832	7833	7834	7835	7836	7837	7838
372	7839	7840	7841	7842	7843	7844	7845	7846	7847
373	7848	7849	7850	7851	7852	7853	7854	7855	7856
374	7857	7858	7859	7860	7861	7862	7863	7864	7865
375	7866	7867	7868	7869	7870	7871	7872	7873	7874
376	7875	7876	7877	7878	7879	7880	7881	7882	7883
377	7884	7885	7886	7887	7888	7889	7890	7891	7892
378	7893	7894	7895	7896	7897	7898	7899	7900	7901
379	7902	7903	7904	7905	7906	7907	7908	7909	7910
380	7911	7912	7913	7914	7915	7916	7917	7918	7919
381	7920	7921	7922	7923	7924	7925	7926	7927	7928
382	7929	7930	7931	7932	7933	7934	7935	7936	7937
383	7938	7939	7940	7941	7942	7943	7944	7945	7946
384	7947	7948	7949	7950	7951	7952	7953	7954	7955
385	7956	7957	7958	7959	7960	7961	7962	7963	7964
386	7965	7966	7967	7968	7969	7970	7971	7972	7973
387	7974	7975	7976	7977	7978	7979	7980	7981	7982
388	7983	7984	7985	7986	7987	7988	7989	7990	7991
389	7992	7993	7994	7995	7996	7997	7998	7999	8000
390	8001	8002	8003	8004	8005	8006	8007	8008	8009
391	8010	8011	8012	8013	8014	8015	8016	8017	8018
392	8019	8020	8021	8022	8023	8024	8025	8026	8027
393	8028	8029	8030	8031	8032	8033	8034	8035	8036
394	8037	8038	8039	8040	8041	8042	8043	8044	8045
395	8046	8047	8048	8049	8050	8051	8052	8053	8054
396	8055	8056	8057	8058	8059	8060	8061	8062	8063
397	8064	8065	8066	8067	8068	8069	8070	8071	8072
398	8073	8074	8075	8076	8077	8078	8079	8080	8081
399	8082	8083	8084	8085	8086	8087	8088	8089	8090
400	8091	8092	8093	8094	8095	8096	8097	8098	8099

3) Internal Memory Address of Z Operation data

Step no.	Goal position		Circular interpolation aux. point		Operation speed		Dwell time	M code no.	Control word
	Low	High	Low	High	Low	High			
1	8900	8901	8902	8903	8904	8905	8906	8907	8908
2	8909	8910	8911	8912	8913	8914	8915	8916	8917
3	8918	8919	8920	8921	8922	8923	8924	8925	8926
4	8927	8928	8929	8930	8931	8932	8933	8934	8935
5	8936	8937	8938	8939	8940	8941	8942	8943	8944
6	8945	8946	8947	8948	8949	8950	8951	8952	8953
7	8954	8955	8956	8957	8958	8959	8960	8961	8962
8	8963	8964	8965	8966	8967	8968	8969	8970	8971
9	8972	8973	8974	8975	8976	8977	8978	8979	8980
10	8981	8982	8983	8984	8985	8986	8987	8988	8989
11	8990	8991	8992	8993	8994	8995	8996	8997	8998
12	8999	9000	9001	9002	9003	9004	9005	9006	9007
13	9008	9009	9010	9011	9012	9013	9014	9015	9016
14	9017	9018	9019	9020	9021	9022	9023	9024	9025
15	9026	9027	9028	9029	9030	9031	9032	9033	9034
16	9035	9036	9037	9038	9039	9040	9041	9042	9043
17	9044	9045	9046	9047	9048	9049	9050	9051	9052
18	9053	9054	9055	9056	9057	9058	9059	9060	9061
19	9062	9063	9064	9065	9066	9067	9068	9069	9070
20	9071	9072	9073	9074	9075	9076	9077	9078	9079
21	9080	9081	9082	9083	9084	9085	9086	9087	9088
22	9089	9090	9091	9092	9093	9094	9095	9096	9097
23	9098	9099	9100	9101	9102	9103	9104	9105	9106
24	9107	9108	9109	9110	9111	9112	9113	9114	9115
25	9116	9117	9118	9119	9120	9121	9122	9123	9124
26	9125	9126	9127	9128	9129	9130	9131	9132	9133
27	9134	9135	9136	9137	9138	9139	9140	9141	9142
28	9143	9144	9145	9146	9147	9148	9149	9150	9151
29	9152	9153	9154	9155	9156	9157	9158	9159	9160
30	9161	9162	9163	9164	9165	9166	9167	9168	9169
31	9170	9171	9172	9173	9174	9175	9176	9177	9178
32	9179	9180	9181	9182	9183	9184	9185	9186	9187
33	9188	9189	9190	9191	9192	9193	9194	9195	9196
34	9197	9198	9199	9200	9201	9202	9203	9204	9205
35	9206	9207	9208	9209	9210	9211	9212	9213	9214
36	9215	9216	9217	9218	9219	9220	9221	9222	9223
37	9224	9225	9226	9227	9228	9229	9230	9231	9232
38	9233	9234	9235	9236	9237	9238	9239	9240	9241
39	9242	9243	9244	9245	9246	9247	9248	9249	9250
40	9251	9252	9253	9254	9255	9256	9257	9258	9259
41	9260	9261	9262	9263	9264	9265	9266	9267	9268
42	9269	9270	9271	9272	9273	9274	9275	9276	9277
43	9278	9279	9280	9281	9282	9283	9284	9285	9286
44	9287	9288	9289	9290	9291	9292	9293	9294	9295
45	9296	9297	9298	9299	9300	9301	9302	9303	9304
46	9305	9306	9307	9308	9309	9310	9311	9312	9313
47	9314	9315	9316	9317	9318	9319	9320	9321	9322
48	9323	9324	9325	9326	9327	9328	9329	9330	9331
49	9332	9333	9334	9335	9336	9337	9338	9339	9340
50	9341	9342	9343	9344	9345	9346	9347	9348	9349

Step no.	Goal position		Circular interpolation aux. point		Operation speed		Dwell time	M code no.	Control word
	Low	High	Low	High	Low	High			
51	9350	9351	9352	9353	9354	9355	9356	9357	9358
52	9359	9360	9361	9362	9363	9364	9365	9366	9367
53	9368	9369	9370	9371	9372	9373	9374	9375	9376
54	9377	9378	9379	9380	9381	9382	9383	9384	9385
55	9386	9387	9388	9389	9390	9391	9392	9393	9394
56	9395	9396	9397	9398	9399	9400	9401	9402	9403
57	9404	9405	9406	9407	9408	9409	9410	9411	9412
58	9413	9414	9415	9416	9417	9418	9419	9420	9421
59	9422	9423	9424	9425	9426	9427	9428	9429	9430
60	9431	9432	9433	9434	9435	9436	9437	9438	9439
61	9440	9441	9442	9443	9444	9445	9446	9447	9448
62	9449	9450	9451	9452	9453	9454	9455	9456	9457
63	9458	9459	9460	9461	9462	9463	9464	9465	9466
64	9467	9468	9469	9470	9471	9472	9473	9474	9475
65	9476	9477	9478	9479	9480	9481	9482	9483	9484
66	9485	9486	9487	9488	9489	9490	9491	9492	9493
67	9494	9495	9496	9497	9498	9499	9500	9501	9502
68	9503	9504	9505	9506	9507	9508	9509	9510	9511
69	9512	9513	9514	9515	9516	9517	9518	9519	9520
70	9521	9522	9523	9524	9525	9526	9527	9528	9529
71	9530	9531	9532	9533	9534	9535	9536	9537	9538
72	9539	9540	9541	9542	9543	9544	9545	9546	9547
73	9548	9549	9550	9551	9552	9553	9554	9555	9556
74	9557	9558	9559	9560	9561	9562	9563	9564	9565
75	9566	9567	9568	9569	9570	9571	9572	9573	9574
76	9575	9576	9577	9578	9579	9580	9581	9582	9583
77	9584	9585	9586	9587	9588	9589	9590	9591	9592
78	9593	9594	9595	9596	9597	9598	9599	9600	9601
79	9602	9603	9604	9605	9606	9607	9608	9609	9610
80	9611	9612	9613	9614	9615	9616	9617	9618	9619
81	9620	9621	9622	9623	9624	9625	9626	9627	9628
82	9629	9630	9631	9632	9633	9634	9635	9636	9637
83	9638	9639	9640	9641	9642	9643	9644	9645	9646
84	9647	9648	9649	9650	9651	9652	9653	9654	9655
85	9656	9657	9658	9659	9660	9661	9662	9663	9664
86	9665	9666	9667	9668	9669	9670	9671	9672	9673
87	9674	9675	9676	9677	9678	9679	9680	9681	9682
88	9683	9684	9685	9686	9687	9688	9689	9690	9691
89	9692	9693	9694	9695	9696	9697	9698	9699	9700
90	9701	9702	9703	9704	9705	9706	9707	9708	9709
91	9710	9711	9712	9713	9714	9715	9716	9717	9718
92	9719	9720	9721	9722	9723	9724	9725	9726	9727
93	9728	9729	9730	9731	9732	9733	9734	9735	9736
94	9737	9738	9739	9740	9741	9742	9743	9744	9745
95	9746	9747	9748	9749	9750	9751	9752	9753	9754
96	9755	9756	9757	9758	9759	9760	9761	9762	9763
97	9764	9765	9766	9767	9768	9769	9770	9771	9772
98	9773	9774	9775	9776	9777	9778	9779	9780	9781
99	9782	9783	9784	9785	9786	9787	9788	9789	9790
100	9791	9792	9793	9794	9795	9796	9797	9798	9799

Step no.	Goal position		Circular interpolation aux. point		Operation speed		Dwell time	M code no.	Control word
	Low	High	Low	High	Low	High			
101	9800	9801	9802	9803	9804	9805	9806	9807	9808
102	9809	9810	9811	9812	9813	9814	9815	9816	9817
103	9818	9819	9820	9821	9822	9823	9824	9825	9826
104	9827	9828	9829	9830	9831	9832	9833	9834	9835
105	9836	9837	9838	9839	9840	9841	9842	9843	9844
106	9845	9846	9847	9848	9849	9850	9851	9852	9853
107	9854	9855	9856	9857	9858	9859	9860	9861	9862
108	9863	9864	9865	9866	9867	9868	9869	9870	9871
109	9872	9873	9874	9875	9876	9877	9878	9879	9880
110	9881	9882	9883	9884	9885	9886	9887	9888	9889
111	9890	9891	9892	9893	9894	9895	9896	9897	9898
112	9899	9900	9901	9902	9903	9904	9905	9906	9907
113	9908	9909	9910	9911	9912	9913	9914	9915	9916
114	9917	9918	9919	9920	9921	9922	9923	9924	9925
115	9926	9927	9928	9929	9930	9931	9932	9933	9934
116	9935	9936	9937	9938	9939	9940	9941	9942	9943
117	9944	9945	9946	9947	9948	9949	9950	9951	9952
118	9953	9954	9955	9956	9957	9958	9959	9960	9961
119	9962	9963	9964	9965	9966	9967	9968	9969	9970
120	9971	9972	9973	9974	9975	9976	9977	9978	9979
121	9980	9981	9982	9983	9984	9985	9986	9987	9988
122	9989	9990	9991	9992	9993	9994	9995	9996	9997
123	9998	9999	10000	10001	10002	10003	10004	10005	10006
124	10007	10008	10009	10010	10011	10012	10013	10014	10015
125	10016	10017	10018	10019	10020	10021	10022	10023	10024
126	10025	10026	10027	10028	10029	10030	10031	10032	10033
127	10034	10035	10036	10037	10038	10039	10040	10041	10042
128	10043	10044	10045	10046	10047	10048	10049	10050	10051
129	10052	10053	10054	10055	10056	10057	10058	10059	10060
130	10061	10062	10063	10064	10065	10066	10067	10068	10069
131	10070	10071	10072	10073	10074	10075	10076	10077	10078
132	10079	10080	10081	10082	10083	10084	10085	10086	10087
133	10088	10089	10090	10091	10092	10093	10094	10095	10096
134	10097	10098	10099	10100	10101	10102	10103	10104	10105
135	10106	10107	10108	10109	10110	10111	10112	10113	10114
136	10115	10116	10117	10118	10119	10120	10121	10122	10123
137	10124	10125	10126	10127	10128	10129	10130	10131	10132
138	10133	10134	10135	10136	10137	10138	10139	10140	10141
139	10142	10143	10144	10145	10146	10147	10148	10149	10150
140	10151	10152	10153	10154	10155	10156	10157	10158	10159
141	10160	10161	10162	10163	10164	10165	10166	10167	10168
142	10169	10170	10171	10172	10173	10174	10175	10176	10177
143	10178	10179	10180	10181	10182	10183	10184	10185	10186
144	10187	10188	10189	10190	10191	10192	10193	10194	10195
145	10196	10197	10198	10199	10200	10201	10202	10203	10204
146	10205	10206	10207	10208	10209	10210	10211	10212	10213
147	10214	10215	10216	10217	10218	10219	10220	10221	10222
148	10223	10224	10225	10226	10227	10228	10229	10230	10231
149	10232	10233	10234	10235	10236	10237	10238	10239	10240
150	10241	10242	10243	10244	10245	10246	10247	10248	10249

Step no.	Goal position		Circular interpolation aux. point		Operation speed		Dwell time	M code no.	Control word
	Low	High	Low	High	Low	High			
151	10250	10251	10252	10253	10254	10255	10256	10257	10258
152	10259	10260	10261	10262	10263	10264	10265	10266	10267
153	10268	10269	10270	10271	10272	10273	10274	10275	10276
154	10277	10278	10279	10280	10281	10282	10283	10284	10285
155	10286	10287	10288	10289	10290	10291	10292	10293	10294
156	10295	10296	10297	10298	10299	10300	10301	10302	10303
157	10304	10305	10306	10307	10308	10309	10310	10311	10312
158	10313	10314	10315	10316	10317	10318	10319	10320	10321
159	10322	10323	10324	10325	10326	10327	10328	10329	10330
160	10331	10332	10333	10334	10335	10336	10337	10338	10339
161	10340	10341	10342	10343	10344	10345	10346	10347	10348
162	10349	10350	10351	10352	10353	10354	10355	10356	10357
163	10358	10359	10360	10361	10362	10363	10364	10365	10366
164	10367	10368	10369	10370	10371	10372	10373	10374	10375
165	10376	10377	10378	10379	10380	10381	10382	10383	10384
166	10385	10386	10387	10388	10389	10390	10391	10392	10393
167	10394	10395	10396	10397	10398	10399	10400	10401	10402
168	10403	10404	10405	10406	10407	10408	10409	10410	10411
169	10412	10413	10414	10415	10416	10417	10418	10419	10420
170	10421	10422	10423	10424	10425	10426	10427	10428	10429
171	10430	10431	10432	10433	10434	10435	10436	10437	10438
172	10439	10440	10441	10442	10443	10444	10445	10446	10447
173	10448	10449	10450	10451	10452	10453	10454	10455	10456
174	10457	10458	10459	10460	10461	10462	10463	10464	10465
175	10466	10467	10468	10469	10470	10471	10472	10473	10474
176	10475	10476	10477	10478	10479	10480	10481	10482	10483
177	10484	10485	10486	10487	10488	10489	10490	10491	10492
178	10493	10494	10495	10496	10497	10498	10499	10500	10501
179	10502	10503	10504	10505	10506	10507	10508	10509	10510
180	10511	10512	10513	10514	10515	10516	10517	10518	10519
181	10520	10521	10522	10523	10524	10525	10526	10527	10528
182	10529	10530	10531	10532	10533	10534	10535	10536	10537
183	10538	10539	10540	10541	10542	10543	10544	10545	10546
184	10547	10548	10549	10550	10551	10552	10553	10554	10555
185	10556	10557	10558	10559	10560	10561	10562	10563	10564
186	10565	10566	10567	10568	10569	10570	10571	10572	10573
187	10574	10575	10576	10577	10578	10579	10580	10581	10582
188	10583	10584	10585	10586	10587	10588	10589	10590	10591
189	10592	10593	10594	10595	10596	10597	10598	10599	10600
190	10601	10602	10603	10604	10605	10606	10607	10608	10609
191	10610	10611	10612	10613	10614	10615	10616	10617	10618
192	10619	10620	10621	10622	10623	10624	10625	10626	10627
193	10628	10629	10630	10631	10632	10633	10634	10635	10636
194	10637	10638	10639	10640	10641	10642	10643	10644	10645
195	10646	10647	10648	10649	10650	10651	10652	10653	10654
196	10655	10656	10657	10658	10659	10660	10661	10662	10663
197	10664	10665	10666	10667	10668	10669	10670	10671	10672
198	10673	10674	10675	10676	10677	10678	10679	10680	10681
199	10682	10683	10684	10685	10686	10687	10688	10689	10690
200	10691	10692	10693	10694	10695	10696	10697	10698	10699

Step no.	Goal position		Circular interpolation aux. point		Operation speed		Dwell time	M code no.	Control word
	Low	High	Low	High	Low	High			
201	10700	10701	10702	10703	10704	10705	10706	10707	10708
202	10709	10710	10711	10712	10713	10714	10715	10716	10717
203	10718	10719	10720	10721	10722	10723	10724	10725	10726
204	10727	10728	10729	10730	10731	10732	10733	10734	10735
205	10736	10737	10738	10739	10740	10741	10742	10743	10744
206	10745	10746	10747	10748	10749	10750	10751	10752	10753
207	10754	10755	10756	10757	10758	10759	10760	10761	10762
208	10763	10764	10765	10766	10767	10768	10769	10770	10771
209	10772	10773	10774	10775	10776	10777	10778	10779	10780
210	10781	10782	10783	10784	10785	10786	10787	10788	10789
211	10790	10791	10792	10793	10794	10795	10796	10797	10798
212	10799	10800	10801	10802	10803	10804	10805	10806	10807
213	10808	10809	10810	10811	10812	10813	10814	10815	10816
214	10817	10818	10819	10820	10821	10822	10823	10824	10825
215	10826	10827	10828	10829	10830	10831	10832	10833	10834
216	10835	10836	10837	10838	10839	10840	10841	10842	10843
217	10844	10845	10846	10847	10848	10849	10850	10851	10852
218	10853	10854	10855	10856	10857	10858	10859	10860	10861
219	10862	10863	10864	10865	10866	10867	10868	10869	10870
220	10871	10872	10873	10874	10875	10876	10877	10878	10879
221	10880	10881	10882	10883	10884	10885	10886	10887	10888
222	10889	10890	10891	10892	10893	10894	10895	10896	10897
223	10898	10899	10900	10901	10902	10903	10904	10905	10906
224	10907	10908	10909	10910	10911	10912	10913	10914	10915
225	10916	10917	10918	10919	10920	10921	10922	10923	10924
226	10925	10926	10927	10928	10929	10930	10931	10932	10933
227	10934	10935	10936	10937	10938	10939	10940	10941	10942
228	10943	10944	10945	10946	10947	10948	10949	10950	10951
229	10952	10953	10954	10955	10956	10957	10958	10959	10960
230	10961	10962	10963	10964	10965	10966	10967	10968	10969
231	10970	10971	10972	10973	10974	10975	10976	10977	10978
232	10979	10980	10981	10982	10983	10984	10985	10986	10987
233	10988	10989	10990	10991	10992	10993	10994	10995	10996
234	10997	10998	10999	11000	11001	11002	11003	11004	11005
235	11006	11007	11008	11009	11010	11011	11012	11013	11014
236	11015	11016	11017	11018	11019	11020	11021	11022	11023
237	11024	11025	11026	11027	11028	11029	11030	11031	11032
238	11033	11034	11035	11036	11037	11038	11039	11040	11041
239	11042	11043	11044	11045	11046	11047	11048	11049	11050
240	11051	11052	11053	11054	11055	11056	11057	11058	11059
241	11060	11061	11062	11063	11064	11065	11066	11067	11068
242	11069	11070	11071	11072	11073	11074	11075	11076	11077
243	11078	11079	11080	11081	11082	11083	11084	11085	11086
244	11087	11088	11089	11090	11091	11092	11093	11094	11095
245	11096	11097	11098	11099	11100	11101	11102	11103	11104
246	11105	11106	11107	11108	11109	11110	11111	11112	11113
247	11114	11115	11116	11117	11118	11119	11120	11121	11122
248	11123	11124	11125	11126	11127	11128	11129	11130	11131
249	11132	11133	11134	11135	11136	11137	11138	11139	11140
250	11141	11142	11143	11144	11145	11146	11147	11148	11149

Step no.	Goal position		Circular interpolation aux. point		Operation speed		Dwell time	M code no.	Control word
	Low	High	Low	High	Low	High			
251	11150	11151	11152	11153	11154	11155	11156	11157	11158
252	11159	11160	11161	11162	11163	11164	11165	11166	11167
253	11168	11169	11170	11171	11172	11173	11174	11175	11176
254	11177	11178	11179	11180	11181	11182	11183	11184	11185
255	11186	11187	11188	11189	11190	11191	11192	11193	11194
256	11195	11196	11197	11198	11199	11200	11201	11202	11203
257	11204	11205	11206	11207	11208	11209	11210	11211	11212
258	11213	11214	11215	11216	11217	11218	11219	11220	11221
259	11222	11223	11224	11225	11226	11227	11228	11229	11230
260	11231	11232	11233	11234	11235	11236	11237	11238	11239
261	11240	11241	11242	11243	11244	11245	11246	11247	11248
262	11249	11250	11251	11252	11253	11254	11255	11256	11257
263	11258	11259	11260	11261	11262	11263	11264	11265	11266
264	11267	11268	11269	11270	11271	11272	11273	11274	11275
265	11276	11277	11278	11279	11280	11281	11282	11283	11284
266	11285	11286	11287	11288	11289	11290	11291	11292	11293
267	11294	11295	11296	11297	11298	11299	11300	11301	11302
268	11303	11304	11305	11306	11307	11308	11309	11310	11311
269	11312	11313	11314	11315	11316	11317	11318	11319	11320
270	11321	11322	11323	11324	11325	11326	11327	11328	11329
271	11330	11331	11332	11333	11334	11335	11336	11337	11338
272	11339	11340	11341	11342	11343	11344	11345	11346	11347
273	11348	11349	11350	11351	11352	11353	11354	11355	11356
274	11357	11358	11359	11360	11361	11362	11363	11364	11365
275	11366	11367	11368	11369	11370	11371	11372	11373	11374
276	11375	11376	11377	11378	11379	11380	11381	11382	11383
277	11384	11385	11386	11387	11388	11389	11390	11391	11392
278	11393	11394	11395	11396	11397	11398	11399	11400	11401
279	11402	11403	11404	11405	11406	11407	11408	11409	11410
280	11411	11412	11413	11414	11415	11416	11417	11418	11419
281	11420	11421	11422	11423	11424	11425	11426	11427	11428
282	11429	11430	11431	11432	11433	11434	11435	11436	11437
283	11438	11439	11440	11441	11442	11443	11444	11445	11446
284	11447	11448	11449	11450	11451	11452	11453	11454	11455
285	11456	11457	11458	11459	11460	11461	11462	11463	11464
286	11465	11466	11467	11468	11469	11470	11471	11472	11473
287	11474	11475	11476	11477	11478	11479	11480	11481	11482
288	11483	11484	11485	11486	11487	11488	11489	11490	11491
289	11492	11493	11494	11495	11496	11497	11498	11499	11500
290	11501	11502	11503	11504	11505	11506	11507	11508	11509
291	11510	11511	11512	11513	11514	11515	11516	11517	11518
292	11519	11520	11521	11522	11523	11524	11525	11526	11527
293	11528	11529	11530	11531	11532	11533	11534	11535	11536
294	11537	11538	11539	11540	11541	11542	11543	11544	11545
295	11546	11547	11548	11549	11550	11551	11552	11553	11554
296	11555	11556	11557	11558	11559	11560	11561	11562	11563
297	11564	11565	11566	11567	11568	11569	11570	11571	11572
298	11573	11574	11575	11576	11577	11578	11579	11580	11581
299	11582	11583	11584	11585	11586	11587	11588	11589	11590
300	11591	11592	11593	11594	11595	11596	11597	11598	11599

Step no.	Goal position		Circular interpolation aux. point		Operation speed		Dwell time	M code no.	Control word
	Low	High	Low	High	Low	High			
301	11600	11601	11602	11603	11604	11605	11606	11607	11608
302	11609	11610	11611	11612	11613	11614	11615	11616	11617
303	11618	11619	11620	11621	11622	11623	11624	11625	11626
304	11627	11628	11629	11630	11631	11632	11633	11634	11635
305	11636	11637	11638	11639	11640	11641	11642	11643	11644
306	11645	11646	11647	11648	11649	11650	11651	11652	11653
307	11654	11655	11656	11657	11658	11659	11660	11661	11662
308	11663	11664	11665	11666	11667	11668	11669	11670	11671
309	11672	11673	11674	11675	11676	11677	11678	11679	11680
310	11681	11682	11683	11684	11685	11686	11687	11688	11689
311	11690	11691	11692	11693	11694	11695	11696	11697	11698
312	11699	11700	11701	11702	11703	11704	11705	11706	11707
313	11708	11709	11710	11711	11712	11713	11714	11715	11716
314	11717	11718	11719	11720	11721	11722	11723	11724	11725
315	11726	11727	11728	11729	11730	11731	11732	11733	11734
316	11735	11736	11737	11738	11739	11740	11741	11742	11743
317	11744	11745	11746	11747	11748	11749	11750	11751	11752
318	11753	11754	11755	11756	11757	11758	11759	11760	11761
319	11762	11763	11764	11765	11766	11767	11768	11769	11770
320	11771	11772	11773	11774	11775	11776	11777	11778	11779
321	11780	11781	11782	11783	11784	11785	11786	11787	11788
322	11789	11790	11791	11792	11793	11794	11795	11796	11797
323	11798	11799	11800	11801	11802	11803	11804	11805	11806
324	11807	11808	11809	11810	11811	11812	11813	11814	11815
325	11816	11817	11818	11819	11820	11821	11822	11823	11824
326	11825	11826	11827	11828	11829	11830	11831	11832	11833
327	11834	11835	11836	11837	11838	11839	11840	11841	11842
328	11843	11844	11845	11846	11847	11848	11849	11850	11851
329	11852	11853	11854	11855	11856	11857	11858	11859	11860
330	11861	11862	11863	11864	11865	11866	11867	11868	11869
331	11870	11871	11872	11873	11874	11875	11876	11877	11878
332	11879	11880	11881	11882	11883	11884	11885	11886	11887
333	11888	11889	11890	11891	11892	11893	11894	11895	11896
334	11897	11898	11899	11900	11901	11902	11903	11904	11905
335	11906	11907	11908	11909	11910	11911	11912	11913	11914
336	11915	11916	11917	11918	11919	11920	11921	11922	11923
337	11924	11925	11926	11927	11928	11929	11930	11931	11932
338	11933	11934	11935	11936	11937	11938	11939	11940	11941
339	11942	11943	11944	11945	11946	11947	11948	11949	11950
340	11951	11952	11953	11954	11955	11956	11957	11958	11959
341	11960	11961	11962	11963	11964	11965	11966	11967	11968
342	11969	11970	11971	11972	11973	11974	11975	11976	11977
343	11978	11979	11980	11981	11982	11983	11984	11985	11986
344	11987	11988	11989	11990	11991	11992	11993	11994	11995
345	11996	11997	11998	11999	12000	12001	12002	12003	12004
346	12005	12006	12007	12008	12009	12010	12011	12012	12013
347	12014	12015	12016	12017	12018	12019	12020	12021	12022
348	12023	12024	12025	12026	12027	12028	12029	12030	12031
349	12032	12033	12034	12035	12036	12037	12038	12039	12040
350	12041	12042	12043	12044	12045	12046	12047	12048	12049

Step no.	Goal position		Circular interpolation aux. point		Operation speed		Dwell time	M code no.	Control word
	Low	High	Low	High	Low	High			
351	12050	12051	12052	12053	12054	12055	12056	12057	12058
352	12059	12060	12061	12062	12063	12064	12065	12066	12067
353	12068	12069	12070	12071	12072	12073	12074	12075	12076
354	12077	12078	12079	12080	12081	12082	12083	12084	12085
355	12086	12087	12088	12089	12090	12091	12092	12093	12094
356	12095	12096	12097	12098	12099	12100	12101	12102	12103
357	12104	12105	12106	12107	12108	12109	12110	12111	12112
358	12113	12114	12115	12116	12117	12118	12119	12120	12121
359	12122	12123	12124	12125	12126	12127	12128	12129	12130
360	12131	12132	12133	12134	12135	12136	12137	12138	12139
361	12140	12141	12142	12143	12144	12145	12146	12147	12148
362	12149	12150	12151	12152	12153	12154	12155	12156	12157
363	12158	12159	12160	12161	12162	12163	12164	12165	12166
364	12167	12168	12169	12170	12171	12172	12173	12174	12175
365	12176	12177	12178	12179	12180	12181	12182	12183	12184
366	12185	12186	12187	12188	12189	12190	12191	12192	12193
367	12194	12195	12196	12197	12198	12199	12200	12201	12202
368	12203	12204	12205	12206	12207	12208	12209	12210	12211
369	12212	12213	12214	12215	12216	12217	12218	12219	12220
370	12221	12222	12223	12224	12225	12226	12227	12228	12229
371	12230	12231	12232	12233	12234	12235	12236	12237	12238
372	12239	12240	12241	12242	12243	12244	12245	12246	12247
373	12248	12249	12250	12251	12252	12253	12254	12255	12256
374	12257	12258	12259	12260	12261	12262	12263	12264	12265
375	12266	12267	12268	12269	12270	12271	12272	12273	12274
376	12275	12276	12277	12278	12279	12280	12281	12282	12283
377	12284	12285	12286	12287	12288	12289	12290	12291	12292
378	12293	12294	12295	12296	12297	12298	12299	12300	12301
379	12302	12303	12304	12305	12306	12307	12308	12309	12310
380	12311	12312	12313	12314	12315	12316	12317	12318	12319
381	12320	12321	12322	12323	12324	12325	12326	12327	12328
382	12329	12330	12331	12332	12333	12334	12335	12336	12337
383	12338	12339	12340	12341	12342	12343	12344	12345	12346
384	12347	12348	12349	12350	12351	12352	12353	12354	12355
385	12356	12357	12358	12359	12360	12361	12362	12363	12364
386	12365	12366	12367	12368	12369	12370	12371	12372	12373
387	12374	12375	12376	12377	12378	12379	12380	12381	12382
388	12383	12384	12385	12386	12387	12388	12389	12390	12391
389	12392	12393	12394	12395	12396	12397	12398	12399	12400
390	12401	12402	12403	12404	12405	12406	12407	12408	12409
391	12410	12411	12412	12413	12414	12415	12416	12417	12418
392	12419	12420	12421	12422	12423	12424	12425	12426	12427
393	12428	12429	12430	12431	12432	12433	12434	12435	12436
394	12437	12438	12439	12440	12441	12442	12443	12444	12445
395	12446	12447	12448	12449	12450	12451	12452	12453	12454
396	12455	12456	12457	12458	12459	12460	12461	12462	12463
397	12464	12465	12466	12467	12468	12469	12470	12471	12472
398	12473	12474	12475	12476	12477	12478	12479	12480	12481
399	12482	12483	12484	12485	12486	12487	12488	12489	12490
400	12491	12492	12493	12494	12495	12496	12497	12498	12499

Appendix 2 Internal Memory Address of Operation Data

1) Internal Memory Address of X Operation data

Step no.	Goal position		Circular interpolation aux. point		Operation speed		Dwell time	M code no.	Control word
	Low	High	Low	High	Low	High			
1	100	101	102	103	104	105	106	107	108
2	109	110	111	112	113	114	115	116	117
3	118	119	120	121	122	123	124	125	126
4	127	128	129	130	131	132	133	134	135
5	136	137	138	139	140	141	142	143	144
6	145	146	147	148	149	150	151	152	153
7	154	155	156	157	158	159	160	161	162
8	163	164	165	166	167	168	169	170	171
9	172	173	174	175	176	177	178	179	180
10	181	182	183	184	185	186	187	188	189
11	190	191	192	193	194	195	196	197	198
12	199	200	201	202	203	204	205	206	207
13	208	209	210	211	212	213	214	215	216
14	217	218	219	220	221	222	223	224	225
15	226	227	228	229	230	231	232	233	234
16	235	236	237	238	239	240	241	242	243
17	244	245	246	247	248	249	250	251	252
18	253	254	255	256	257	258	259	260	261
19	262	263	264	265	266	267	268	269	270
20	271	272	273	274	275	276	277	278	279
21	280	281	282	283	284	285	286	287	288
22	289	290	291	292	293	294	295	296	297
23	298	299	300	301	302	303	304	305	306
24	307	308	309	310	311	312	313	314	315
25	316	317	318	319	320	321	322	323	324
26	325	326	327	328	329	330	331	332	333
27	334	335	336	337	338	339	340	341	342
28	343	344	345	346	347	348	349	350	351
29	352	353	354	355	356	357	358	359	360
30	361	362	363	364	365	366	367	368	369
31	370	371	372	373	374	375	376	377	378
32	379	380	381	382	383	384	385	386	387
33	388	389	390	391	392	393	394	395	396
34	397	398	399	400	401	402	403	404	405
35	406	407	408	409	410	411	412	413	414
36	415	416	417	418	419	420	421	422	423
37	424	425	426	427	428	429	430	431	432
38	433	434	435	436	437	438	439	440	441
39	442	443	444	445	446	447	448	449	450
40	451	452	453	454	455	456	457	458	459
41	460	461	462	463	464	465	466	467	468
42	469	470	471	472	473	474	475	476	477
43	478	479	480	481	482	483	484	485	486
44	487	488	489	490	491	492	493	494	495
45	496	497	498	499	500	501	502	503	504
46	505	506	507	508	509	510	511	512	513
47	514	515	516	517	518	519	520	521	522
48	523	524	525	526	527	528	529	530	531
49	532	533	534	535	536	537	538	539	540
50	541	542	543	544	545	546	547	548	549

Step no.	Goal position		Circular interpolation aux. point		Operation speed		Dwell time	M code no.	Control word
	Low	High	Low	High	Low	High			
51	550	551	552	553	554	555	556	557	558
52	559	560	561	562	563	564	565	566	567
53	568	569	570	571	572	573	574	575	576
54	577	578	579	580	581	582	583	584	585
55	586	587	588	589	590	591	592	593	594
56	595	596	597	598	599	600	601	602	603
57	604	605	606	607	608	609	610	611	612
58	613	614	615	616	617	618	619	620	621
59	622	623	624	625	626	627	628	629	630
60	631	632	633	634	635	636	637	638	639
61	640	641	642	643	644	645	646	647	648
62	649	650	651	652	653	654	655	656	657
63	658	659	660	661	662	663	664	665	666
64	667	668	669	670	671	672	673	674	675
65	676	677	678	679	680	681	682	683	684
66	685	686	687	688	689	690	691	692	693
67	694	695	696	697	698	699	700	701	702
68	703	704	705	706	707	708	709	710	711
69	712	713	714	715	716	717	718	719	720
70	721	722	723	724	725	726	727	728	729
71	730	731	732	733	734	735	736	737	738
72	739	740	741	742	743	744	745	746	747
73	748	749	750	751	752	753	754	755	756
74	757	758	759	760	761	762	763	764	765
75	766	767	768	769	770	771	772	773	774
76	775	776	777	778	779	780	781	782	783
77	784	785	786	787	788	789	790	791	792
78	793	794	795	796	797	798	799	800	801
79	802	803	804	805	806	807	808	809	810
80	811	812	813	814	815	816	817	818	819
81	820	821	822	823	824	825	826	827	828
82	829	830	831	832	833	834	835	836	837
83	838	839	840	841	842	843	844	845	846
84	847	848	849	850	851	852	853	854	855
85	856	857	858	859	860	861	862	863	864
86	865	866	867	868	869	870	871	872	873
87	874	875	876	877	878	879	880	881	882
88	883	884	885	886	887	888	889	890	891
89	892	893	894	895	896	897	898	899	900
90	901	902	903	904	905	906	907	908	909
91	910	911	912	913	914	915	916	917	918
92	919	920	921	922	923	924	925	926	927
93	928	929	930	931	932	933	934	935	936
94	937	938	939	940	941	942	943	944	945
95	946	947	948	949	950	951	952	953	954
96	955	956	957	958	959	960	961	962	963
97	964	965	966	967	968	969	970	971	972
98	973	974	975	976	977	978	979	980	981
99	982	983	984	985	986	987	988	989	990
100	991	992	993	994	995	996	997	998	999

Step no.	Goal position		Circular interpolation aux. point		Operation speed		Dwell time	M code no.	Control word
	Low	High	Low	High	Low	High			
101	1000	1001	1002	1003	1004	1005	1006	1007	1008
102	1009	1010	1011	1012	1013	1014	1015	1016	1017
103	1018	1019	1020	1021	1022	1023	1024	1025	1026
104	1027	1028	1029	1030	1031	1032	1033	1034	1035
105	1036	1037	1038	1039	1040	1041	1042	1043	1044
106	1045	1046	1047	1048	1049	1050	1051	1052	1053
107	1054	1055	1056	1057	1058	1059	1060	1061	1062
108	1063	1064	1065	1066	1067	1068	1069	1070	1071
109	1072	1073	1074	1075	1076	1077	1078	1079	1080
110	1081	1082	1083	1084	1085	1086	1087	1088	1089
111	1090	1091	1092	1093	1094	1095	1096	1097	1098
112	1099	1100	1101	1102	1103	1104	1105	1106	1107
113	1108	1109	1110	1111	1112	1113	1114	1115	1116
114	1117	1118	1119	1120	1121	1122	1123	1124	1125
115	1126	1127	1128	1129	1130	1131	1132	1133	1134
116	1135	1136	1137	1138	1139	1140	1141	1142	1143
117	1144	1145	1146	1147	1148	1149	1150	1151	1152
118	1153	1154	1155	1156	1157	1158	1159	1160	1161
119	1162	1163	1164	1165	1166	1167	1168	1169	1170
120	1171	1172	1173	1174	1175	1176	1177	1178	1179
121	1180	1181	1182	1183	1184	1185	1186	1187	1188
122	1189	1190	1191	1192	1193	1194	1195	1196	1197
123	1198	1199	1200	1201	1202	1203	1204	1205	1206
124	1207	1208	1209	1210	1211	1212	1213	1214	1215
125	1216	1217	1218	1219	1220	1221	1222	1223	1224
126	1225	1226	1227	1228	1229	1230	1231	1232	1233
127	1234	1235	1236	1237	1238	1239	1240	1241	1242
128	1243	1244	1245	1246	1247	1248	1249	1250	1251
129	1252	1253	1254	1255	1256	1257	1258	1259	1260
130	1261	1262	1263	1264	1265	1266	1267	1268	1269
131	1270	1271	1272	1273	1274	1275	1276	1277	1278
132	1279	1280	1281	1282	1283	1284	1285	1286	1287
133	1288	1289	1290	1291	1292	1293	1294	1295	1296
134	1297	1298	1299	1300	1301	1302	1303	1304	1305
135	1306	1307	1308	1309	1310	1311	1312	1313	1314
136	1315	1316	1317	1318	1319	1320	1321	1322	1323
137	1324	1325	1326	1327	1328	1329	1330	1331	1332
138	1333	1334	1335	1336	1337	1338	1339	1340	1341
139	1342	1343	1344	1345	1346	1347	1348	1349	1350
140	1351	1352	1353	1354	1355	1356	1357	1358	1359
141	1360	1361	1362	1363	1364	1365	1366	1367	1368
142	1369	1370	1371	1372	1373	1374	1375	1376	1377
143	1378	1379	1380	1381	1382	1383	1384	1385	1386
144	1387	1388	1389	1390	1391	1392	1393	1394	1395
145	1396	1397	1398	1399	1400	1401	1402	1403	1404
146	1405	1406	1407	1408	1409	1410	1411	1412	1413
147	1414	1415	1416	1417	1418	1419	1420	1421	1422
148	1423	1424	1425	1426	1427	1428	1429	1430	1431
149	1432	1433	1434	1435	1436	1437	1438	1439	1440
150	1441	1442	1443	1444	1445	1446	1447	1448	1449

Step no.	Goal position		Circular interpolation aux. point		Operation speed		Dwell time	M code no.	Control word
	Low	High	Low	High	Low	High			
151	1450	1451	1452	1453	1454	1455	1456	1457	1458
152	1459	1460	1461	1462	1463	1464	1465	1466	1467
153	1468	1469	1470	1471	1472	1473	1474	1475	1476
154	1477	1478	1479	1480	1481	1482	1483	1484	1485
155	1486	1487	1488	1489	1490	1491	1492	1493	1494
156	1495	1496	1497	1498	1499	1500	1501	1502	1503
157	1504	1505	1506	1507	1508	1509	1510	1511	1512
158	1513	1514	1515	1516	1517	1518	1519	1520	1521
159	1522	1523	1524	1525	1526	1527	1528	1529	1530
160	1531	1532	1533	1534	1535	1536	1537	1538	1539
161	1540	1541	1542	1543	1544	1545	1546	1547	1548
162	1549	1550	1551	1552	1553	1554	1555	1556	1557
163	1558	1559	1560	1561	1562	1563	1564	1565	1566
164	1567	1568	1569	1570	1571	1572	1573	1574	1575
165	1576	1577	1578	1579	1580	1581	1582	1583	1584
166	1585	1586	1587	1588	1589	1590	1591	1592	1593
167	1594	1595	1596	1597	1598	1599	1600	1601	1602
168	1603	1604	1605	1606	1607	1608	1609	1610	1611
169	1612	1613	1614	1615	1616	1617	1618	1619	1620
170	1621	1622	1623	1624	1625	1626	1627	1628	1629
171	1630	1631	1632	1633	1634	1635	1636	1637	1638
172	1639	1640	1641	1642	1643	1644	1645	1646	1647
173	1648	1649	1650	1651	1652	1653	1654	1655	1656
174	1657	1658	1659	1660	1661	1662	1663	1664	1665
175	1666	1667	1668	1669	1670	1671	1672	1673	1674
176	1675	1676	1677	1678	1679	1680	1681	1682	1683
177	1684	1685	1686	1687	1688	1689	1690	1691	1692
178	1693	1694	1695	1696	1697	1698	1699	1700	1701
179	1702	1703	1704	1705	1706	1707	1708	1709	1710
180	1711	1712	1713	1714	1715	1716	1717	1718	1719
181	1720	1721	1722	1723	1724	1725	1726	1727	1728
182	1729	1730	1731	1732	1733	1734	1735	1736	1737
183	1738	1739	1740	1741	1742	1743	1744	1745	1746
184	1747	1748	1749	1750	1751	1752	1753	1754	1755
185	1756	1757	1758	1759	1760	1761	1762	1763	1764
186	1765	1766	1767	1768	1769	1770	1771	1772	1773
187	1774	1775	1776	1777	1778	1779	1780	1781	1782
188	1783	1784	1785	1786	1787	1788	1789	1790	1791
189	1792	1793	1794	1795	1796	1797	1798	1799	1800
190	1801	1802	1803	1804	1805	1806	1807	1808	1809
191	1810	1811	1812	1813	1814	1815	1816	1817	1818
192	1819	1820	1821	1822	1823	1824	1825	1826	1827
193	1828	1829	1830	1831	1832	1833	1834	1835	1836
194	1837	1838	1839	1840	1841	1842	1843	1844	1845
195	1846	1847	1848	1849	1850	1851	1852	1853	1854
196	1855	1856	1857	1858	1859	1860	1861	1862	1863
197	1864	1865	1866	1867	1868	1869	1870	1871	1872
198	1873	1874	1875	1876	1877	1878	1879	1880	1881
199	1882	1883	1884	1885	1886	1887	1888	1889	1890
200	1891	1892	1893	1894	1895	1896	1897	1898	1899

Step no.	Goal position		Circular interpolation aux. point		Operation speed		Dwell time	M code no.	Control word
	Low	High	Low	High	Low	High			
201	1900	1901	1902	1903	1904	1905	1906	1907	1908
202	1909	1910	1911	1912	1913	1914	1915	1916	1917
203	1918	1919	1920	1921	1922	1923	1924	1925	1926
204	1927	1928	1929	1930	1931	1932	1933	1934	1935
205	1936	1937	1938	1939	1940	1941	1942	1943	1944
206	1945	1946	1947	1948	1949	1950	1951	1952	1953
207	1954	1955	1956	1957	1958	1959	1960	1961	1962
208	1963	1964	1965	1966	1967	1968	1969	1970	1971
209	1972	1973	1974	1975	1976	1977	1978	1979	1980
210	1981	1982	1983	1984	1985	1986	1987	1988	1989
211	1990	1991	1992	1993	1994	1995	1996	1997	1998
212	1999	2000	2001	2002	2003	2004	2005	2006	2007
213	2008	2009	2010	2011	2012	2013	2014	2015	2016
214	2017	2018	2019	2020	2021	2022	2023	2024	2025
215	2026	2027	2028	2029	2030	2031	2032	2033	2034
216	2035	2036	2037	2038	2039	2040	2041	2042	2043
217	2044	2045	2046	2047	2048	2049	2050	2051	2052
218	2053	2054	2055	2056	2057	2058	2059	2060	2061
219	2062	2063	2064	2065	2066	2067	2068	2069	2070
220	2071	2072	2073	2074	2075	2076	2077	2078	2079
221	2080	2081	2082	2083	2084	2085	2086	2087	2088
222	2089	2090	2091	2092	2093	2094	2095	2096	2097
223	2098	2099	2100	2101	2102	2103	2104	2105	2106
224	2107	2108	2109	2110	2111	2112	2113	2114	2115
225	2116	2117	2118	2119	2120	2121	2122	2123	2124
226	2125	2126	2127	2128	2129	2130	2131	2132	2133
227	2134	2135	2136	2137	2138	2139	2140	2141	2142
228	2143	2144	2145	2146	2147	2148	2149	2150	2151
229	2152	2153	2154	2155	2156	2157	2158	2159	2160
230	2161	2162	2163	2164	2165	2166	2167	2168	2169
231	2170	2171	2172	2173	2174	2175	2176	2177	2178
232	2179	2180	2181	2182	2183	2184	2185	2186	2187
233	2188	2189	2190	2191	2192	2193	2194	2195	2196
234	2197	2198	2199	2200	2201	2202	2203	2204	2205
235	2206	2207	2208	2209	2210	2211	2212	2213	2214
236	2215	2216	2217	2218	2219	2220	2221	2222	2223
237	2224	2225	2226	2227	2228	2229	2230	2231	2232
238	2233	2234	2235	2236	2237	2238	2239	2240	2241
239	2242	2243	2244	2245	2246	2247	2248	2249	2250
240	2251	2252	2253	2254	2255	2256	2257	2258	2259
241	2260	2261	2262	2263	2264	2265	2266	2267	2268
242	2269	2270	2271	2272	2273	2274	2275	2276	2277
243	2278	2279	2280	2281	2282	2283	2284	2285	2286
244	2287	2288	2289	2290	2291	2292	2293	2294	2295
245	2296	2297	2298	2299	2300	2301	2302	2303	2304
246	2305	2306	2307	2308	2309	2310	2311	2312	2313
247	2314	2315	2316	2317	2318	2319	2320	2321	2322
248	2323	2324	2325	2326	2327	2328	2329	2330	2331
249	2332	2333	2334	2335	2336	2337	2338	2339	2340
250	2341	2342	2343	2344	2345	2346	2347	2348	2349

Step no.	Goal position		Circular interpolation aux. point		Operation speed		Dwell time	M code no.	Control word
	Low	High	Low	High	Low	High			
251	2350	2351	2352	2353	2354	2355	2356	2357	2358
252	2359	2360	2361	2362	2363	2364	2365	2366	2367
253	2368	2369	2370	2371	2372	2373	2374	2375	2376
254	2377	2378	2379	2380	2381	2382	2383	2384	2385
255	2386	2387	2388	2389	2390	2391	2392	2393	2394
256	2395	2396	2397	2398	2399	2400	2401	2402	2403
257	2404	2405	2406	2407	2408	2409	2410	2411	2412
258	2413	2414	2415	2416	2417	2418	2419	2420	2421
259	2422	2423	2424	2425	2426	2427	2428	2429	2430
260	2431	2432	2433	2434	2435	2436	2437	2438	2439
261	2440	2441	2442	2443	2444	2445	2446	2447	2448
262	2449	2450	2451	2452	2453	2454	2455	2456	2457
263	2458	2459	2460	2461	2462	2463	2464	2465	2466
264	2467	2468	2469	2470	2471	2472	2473	2474	2475
265	2476	2477	2478	2479	2480	2481	2482	2483	2484
266	2485	2486	2487	2488	2489	2490	2491	2492	2493
267	2494	2495	2496	2497	2498	2499	2500	2501	2502
268	2503	2504	2505	2506	2507	2508	2509	2510	2511
269	2512	2513	2514	2515	2516	2517	2518	2519	2520
270	2521	2522	2523	2524	2525	2526	2527	2528	2529
271	2530	2531	2532	2533	2534	2535	2536	2537	2538
272	2539	2540	2541	2542	2543	2544	2545	2546	2547
273	2548	2549	2550	2551	2552	2553	2554	2555	2556
274	2557	2558	2559	2560	2561	2562	2563	2564	2565
275	2566	2567	2568	2569	2570	2571	2572	2573	2574
276	2575	2576	2577	2578	2579	2580	2581	2582	2583
277	2584	2585	2586	2587	2588	2589	2590	2591	2592
278	2593	2594	2595	2596	2597	2598	2599	2600	2601
279	2602	2603	2604	2605	2606	2607	2608	2609	2610
280	2611	2612	2613	2614	2615	2616	2617	2618	2619
281	2620	2621	2622	2623	2624	2625	2626	2627	2628
282	2629	2630	2631	2632	2633	2634	2635	2636	2637
283	2638	2639	2640	2641	2642	2643	2644	2645	2646
284	2647	2648	2649	2650	2651	2652	2653	2654	2655
285	2656	2657	2658	2659	2660	2661	2662	2663	2664
286	2665	2666	2667	2668	2669	2670	2671	2672	2673
287	2674	2675	2676	2677	2678	2679	2680	2681	2682
288	2683	2684	2685	2686	2687	2688	2689	2690	2691
289	2692	2693	2694	2695	2696	2697	2698	2699	2700
290	2701	2702	2703	2704	2705	2706	2707	2708	2709
291	2710	2711	2712	2713	2714	2715	2716	2717	2718
292	2719	2720	2721	2722	2723	2724	2725	2726	2727
293	2728	2729	2730	2731	2732	2733	2734	2735	2736
294	2737	2738	2739	2740	2741	2742	2743	2744	2745
295	2746	2747	2748	2749	2750	2751	2752	2753	2754
296	2755	2756	2757	2758	2759	2760	2761	2762	2763
297	2764	2765	2766	2767	2768	2769	2770	2771	2772
298	2773	2774	2775	2776	2777	2778	2779	2780	2781
299	2782	2783	2784	2785	2786	2787	2788	2789	2790
300	2791	2792	2793	2794	2795	2796	2797	2798	2799

Step no.	Goal position		Circular interpolation aux. point		Operation speed		Dwell time	M code no.	Control word
	Low	High	Low	High	Low	High			
301	2800	2801	2802	2803	2804	2805	2806	2807	2808
302	2809	2810	2811	2812	2813	2814	2815	2816	2817
303	2818	2819	2820	2821	2822	2823	2824	2825	2826
304	2827	2828	2829	2830	2831	2832	2833	2834	2835
305	2836	2837	2838	2839	2840	2841	2842	2843	2844
306	2845	2846	2847	2848	2849	2850	2851	2852	2853
307	2854	2855	2856	2857	2858	2859	2860	2861	2862
308	2863	2864	2865	2866	2867	2868	2869	2870	2871
309	2872	2873	2874	2875	2876	2877	2878	2879	2880
310	2881	2882	2883	2884	2885	2886	2887	2888	2889
311	2890	2891	2892	2893	2894	2895	2896	2897	2898
312	2899	2900	2901	2902	2903	2904	2905	2906	2907
313	2908	2909	2910	2911	2912	2913	2914	2915	2916
314	2917	2918	2919	2920	2921	2922	2923	2924	2925
315	2926	2927	2928	2929	2930	2931	2932	2933	2934
316	2935	2936	2937	2938	2939	2940	2941	2942	2943
317	2944	2945	2946	2947	2948	2949	2950	2951	2952
318	2953	2954	2955	2956	2957	2958	2959	2960	2961
319	2962	2963	2964	2965	2966	2967	2968	2969	2970
320	2971	2972	2973	2974	2975	2976	2977	2978	2979
321	2980	2981	2982	2983	2984	2985	2986	2987	2988
322	2989	2990	2991	2992	2993	2994	2995	2996	2997
323	2998	2999	3000	3001	3002	3003	3004	3005	3006
324	3007	3008	3009	3010	3011	3012	3013	3014	3015
325	3016	3017	3018	3019	3020	3021	3022	3023	3024
326	3025	3026	3027	3028	3029	3030	3031	3032	3033
327	3034	3035	3036	3037	3038	3039	3040	3041	3042
328	3043	3044	3045	3046	3047	3048	3049	3050	3051
329	3052	3053	3054	3055	3056	3057	3058	3059	3060
330	3061	3062	3063	3064	3065	3066	3067	3068	3069
331	3070	3071	3072	3073	3074	3075	3076	3077	3078
332	3079	3080	3081	3082	3083	3084	3085	3086	3087
333	3088	3089	3090	3091	3092	3093	3094	3095	3096
334	3097	3098	3099	3100	3101	3102	3103	3104	3105
335	3106	3107	3108	3109	3110	3111	3112	3113	3114
336	3115	3116	3117	3118	3119	3120	3121	3122	3123
337	3124	3125	3126	3127	3128	3129	3130	3131	3132
338	3133	3134	3135	3136	3137	3138	3139	3140	3141
339	3142	3143	3144	3145	3146	3147	3148	3149	3150
340	3151	3152	3153	3154	3155	3156	3157	3158	3159
341	3160	3161	3162	3163	3164	3165	3166	3167	3168
342	3169	3170	3171	3172	3173	3174	3175	3176	3177
343	3178	3179	3180	3181	3182	3183	3184	3185	3186
344	3187	3188	3189	3190	3191	3192	3193	3194	3195
345	3196	3197	3198	3199	3200	3201	3202	3203	3204
346	3205	3206	3207	3208	3209	3210	3211	3212	3213
347	3214	3215	3216	3217	3218	3219	3220	3221	3222
348	3223	3224	3225	3226	3227	3228	3229	3230	3231
349	3232	3233	3234	3235	3236	3237	3238	3239	3240
350	3241	3242	3243	3244	3245	3246	3247	3248	3249

Step no.	Goal position		Circular interpolation aux. point		Operation speed		Dwell time	M code no.	Control word
	Low	High	Low	High	Low	High			
351	3250	3251	3252	3253	3254	3255	3256	3257	3258
352	3259	3260	3261	3262	3263	3264	3265	3266	3267
353	3268	3269	3270	3271	3272	3273	3274	3275	3276
354	3277	3278	3279	3280	3281	3282	3283	3284	3285
355	3286	3287	3288	3289	3290	3291	3292	3293	3294
356	3295	3296	3297	3298	3299	3300	3301	3302	3303
357	3304	3305	3306	3307	3308	3309	3310	3311	3312
358	3313	3314	3315	3316	3317	3318	3319	3320	3321
359	3322	3323	3324	3325	3326	3327	3328	3329	3330
360	3331	3332	3333	3334	3335	3336	3337	3338	3339
361	3340	3341	3342	3343	3344	3345	3346	3347	3348
362	3349	3350	3351	3352	3353	3354	3355	3356	3357
363	3358	3359	3360	3361	3362	3363	3364	3365	3366
364	3367	3368	3369	3370	3371	3372	3373	3374	3375
365	3376	3377	3378	3379	3380	3381	3382	3383	3384
366	3385	3386	3387	3388	3389	3390	3391	3392	3393
367	3394	3395	3396	3397	3398	3399	3400	3401	3402
368	3403	3404	3405	3406	3407	3408	3409	3410	3411
369	3412	3413	3414	3415	3416	3417	3418	3419	3420
370	3421	3422	3423	3424	3425	3426	3427	3428	3429
371	3430	3431	3432	3433	3434	3435	3436	3437	3438
372	3439	3440	3441	3442	3443	3444	3445	3446	3447
373	3448	3449	3450	3451	3452	3453	3454	3455	3456
374	3457	3458	3459	3460	3461	3462	3463	3464	3465
375	3466	3467	3468	3469	3470	3471	3472	3473	3474
376	3475	3476	3477	3478	3479	3480	3481	3482	3483
377	3484	3485	3486	3487	3488	3489	3490	3491	3492
378	3493	3494	3495	3496	3497	3498	3499	3500	3501
379	3502	3503	3504	3505	3506	3507	3508	3509	3510
380	3511	3512	3513	3514	3515	3516	3517	3518	3519
381	3520	3521	3522	3523	3524	3525	3526	3527	3528
382	3529	3530	3531	3532	3533	3534	3535	3536	3537
383	3538	3539	3540	3541	3542	3543	3544	3545	3546
384	3547	3548	3549	3550	3551	3552	3553	3554	3555
385	3556	3557	3558	3559	3560	3561	3562	3563	3564
386	3565	3566	3567	3568	3569	3570	3571	3572	3573
387	3574	3575	3576	3577	3578	3579	3580	3581	3582
388	3583	3584	3585	3586	3587	3588	3589	3590	3591
389	3592	3593	3594	3595	3596	3597	3598	3599	3600
390	3601	3602	3603	3604	3605	3606	3607	3608	3609
391	3610	3611	3612	3613	3614	3615	3616	3617	3618
392	3619	3620	3621	3622	3623	3624	3625	3626	3627
393	3628	3629	3630	3631	3632	3633	3634	3635	3636
394	3637	3638	3639	3640	3641	3642	3643	3644	3645
395	3646	3647	3648	3649	3650	3651	3652	3653	3654
396	3655	3656	3657	3658	3659	3660	3661	3662	3663
397	3664	3665	3666	3667	3668	3669	3670	3671	3672
398	3673	3674	3675	3676	3677	3678	3679	3680	3681
399	3682	3683	3684	3685	3686	3687	3688	3689	3690
400	3691	3692	3693	3694	3695	3696	3697	3698	3699

2) Internal Memory Address of Y Operation data

Step no.	Goal position		Circular interpolation aux. point		Operation speed		Dwell time	M code no.	Control word
	Low	High	Low	High	Low	High			
1	4500	4501	4502	4503	4504	4505	4506	4507	4508
2	4509	4510	4511	4512	4513	4514	4515	4516	4517
3	4518	4519	4520	4521	4522	4523	4524	4525	4526
4	4527	4528	4529	4530	4531	4532	4533	4534	4535
5	4536	4537	4538	4539	4540	4541	4542	4543	4544
6	4545	4546	4547	4548	4549	4550	4551	4552	4553
7	4554	4555	4556	4557	4558	4559	4560	4561	4562
8	4563	4564	4565	4566	4567	4568	4569	4570	4571
9	4572	4573	4574	4575	4576	4577	4578	4579	4580
10	4581	4582	4583	4584	4585	4586	4587	4588	4589
11	4590	4591	4592	4593	4594	4595	4596	4597	4598
12	4599	4600	4601	4602	4603	4604	4605	4606	4607
13	4608	4609	4610	4611	4612	4613	4614	4615	4616
14	4617	4618	4619	4620	4621	4622	4623	4624	4625
15	4626	4627	4628	4629	4630	4631	4632	4633	4634
16	4635	4636	4637	4638	4639	4640	4641	4642	4643
17	4644	4645	4646	4647	4648	4649	4650	4651	4652
18	4653	4654	4655	4656	4657	4658	4659	4660	4661
19	4662	4663	4664	4665	4666	4667	4668	4669	4670
20	4671	4672	4673	4674	4675	4676	4677	4678	4679
21	4680	4681	4682	4683	4684	4685	4686	4687	4688
22	4689	4690	4691	4692	4693	4694	4695	4696	4697
23	4698	4699	4700	4701	4702	4703	4704	4705	4706
24	4707	4708	4709	4710	4711	4712	4713	4714	4715
25	4716	4717	4718	4719	4720	4721	4722	4723	4724
26	4725	4726	4727	4728	4729	4730	4731	4732	4733
27	4734	4735	4736	4737	4738	4739	4740	4741	4742
28	4743	4744	4745	4746	4747	4748	4749	4750	4751
29	4752	4753	4754	4755	4756	4757	4758	4759	4760
30	4761	4762	4763	4764	4765	4766	4767	4768	4769
31	4770	4771	4772	4773	4774	4775	4776	4777	4778
32	4779	4780	4781	4782	4783	4784	4785	4786	4787
33	4788	4789	4790	4791	4792	4793	4794	4795	4796
34	4797	4798	4799	4800	4801	4802	4803	4804	4805
35	4806	4807	4808	4809	4810	4811	4812	4813	4814
36	4815	4816	4817	4818	4819	4820	4821	4822	4823
37	4824	4825	4826	4827	4828	4829	4830	4831	4832
38	4833	4834	4835	4836	4837	4838	4839	4840	4841
39	4842	4843	4844	4845	4846	4847	4848	4849	4850
40	4851	4852	4853	4854	4855	4856	4857	4858	4859
41	4860	4861	4862	4863	4864	4865	4866	4867	4868
42	4869	4870	4871	4872	4873	4874	4875	4876	4877
43	4878	4879	4880	4881	4882	4883	4884	4885	4886
44	4887	4888	4889	4890	4891	4892	4893	4894	4895
45	4896	4897	4898	4899	4900	4901	4902	4903	4904
46	4905	4906	4907	4908	4909	4910	4911	4912	4913
47	4914	4915	4916	4917	4918	4919	4920	4921	4922
48	4923	4924	4925	4926	4927	4928	4929	4930	4931
49	4932	4933	4934	4935	4936	4937	4938	4939	4940
50	4941	4942	4943	4944	4945	4946	4947	4948	4949

Step no.	Goal position		Circular interpolation aux. point		Operation speed		Dwell time	M code no.	Control word
	Low	High	Low	High	Low	High			
51	4950	4951	4952	4953	4954	4955	4956	4957	4958
52	4959	4960	4961	4962	4963	4964	4965	4966	4967
53	4968	4969	4970	4971	4972	4973	4974	4975	4976
54	4977	4978	4979	4980	4981	4982	4983	4984	4985
55	4986	4987	4988	4989	4990	4991	4992	4993	4994
56	4995	4996	4997	4998	4999	5000	5001	5002	5003
57	5004	5005	5006	5007	5008	5009	5010	5011	5012
58	5013	5014	5015	5016	5017	5018	5019	5020	5021
59	5022	5023	5024	5025	5026	5027	5028	5029	5030
60	5031	5032	5033	5034	5035	5036	5037	5038	5039
61	5040	5041	5042	5043	5044	5045	5046	5047	5048
62	5049	5050	5051	5052	5053	5054	5055	5056	5057
63	5058	5059	5060	5061	5062	5063	5064	5065	5066
64	5067	5068	5069	5070	5071	5072	5073	5074	5075
65	5076	5077	5078	5079	5080	5081	5082	5083	5084
66	5085	5086	5087	5088	5089	5090	5091	5092	5093
67	5094	5095	5096	5097	5098	5099	5100	5101	5102
68	5103	5104	5105	5106	5107	5108	5109	5110	5111
69	5112	5113	5114	5115	5116	5117	5118	5119	5120
70	5121	5122	5123	5124	5125	5126	5127	5128	5129
71	5130	5131	5132	5133	5134	5135	5136	5137	5138
72	5139	5140	5141	5142	5143	5144	5145	5146	5147
73	5148	5149	5150	5151	5152	5153	5154	5155	5156
74	5157	5158	5159	5160	5161	5162	5163	5164	5165
75	5166	5167	5168	5169	5170	5171	5172	5173	5174
76	5175	5176	5177	5178	5179	5180	5181	5182	5183
77	5184	5185	5186	5187	5188	5189	5190	5191	5192
78	5193	5194	5195	5196	5197	5198	5199	5200	5201
79	5202	5203	5204	5205	5206	5207	5208	5209	5210
80	5211	5212	5213	5214	5215	5216	5217	5218	5219
81	5220	5221	5222	5223	5224	5225	5226	5227	5228
82	5229	5230	5231	5232	5233	5234	5235	5236	5237
83	5238	5239	5240	5241	5242	5243	5244	5245	5246
84	5247	5248	5249	5250	5251	5252	5253	5254	5255
85	5256	5257	5258	5259	5260	5261	5262	5263	5264
86	5265	5266	5267	5268	5269	5270	5271	5272	5273
87	5274	5275	5276	5277	5278	5279	5280	5281	5282
88	5283	5284	5285	5286	5287	5288	5289	5290	5291
89	5292	5293	5294	5295	5296	5297	5298	5299	5300
90	5301	5302	5303	5304	5305	5306	5307	5308	5309
91	5310	5311	5312	5313	5314	5315	5316	5317	5318
92	5319	5320	5321	5322	5323	5324	5325	5326	5327
93	5328	5329	5330	5331	5332	5333	5334	5335	5336
94	5337	5338	5339	5340	5341	5342	5343	5344	5345
95	5346	5347	5348	5349	5350	5351	5352	5353	5354
96	5355	5356	5357	5358	5359	5360	5361	5362	5363
97	5364	5365	5366	5367	5368	5369	5370	5371	5372
98	5373	5374	5375	5376	5377	5378	5379	5380	5381
99	5382	5383	5384	5385	5386	5387	5388	5389	5390
100	5391	5392	5393	5394	5395	5396	5397	5398	5399

Step no.	Goal position		Circular interpolation aux. point		Operation speed		Dwell time	M code no.	Control word
	Low	High	Low	High	Low	High			
101	5400	5401	5402	5403	5404	5405	5406	5407	5408
102	5409	5410	5411	5412	5413	5414	5415	5416	5417
103	5418	5419	5420	5421	5422	5423	5424	5425	5426
104	5427	5428	5429	5430	5431	5432	5433	5434	5435
105	5436	5437	5438	5439	5440	5441	5442	5443	5444
106	5445	5446	5447	5448	5449	5450	5451	5452	5453
107	5454	5455	5456	5457	5458	5459	5460	5461	5462
108	5463	5464	5465	5466	5467	5468	5469	5470	5471
109	5472	5473	5474	5475	5476	5477	5478	5479	5480
110	5481	5482	5483	5484	5485	5486	5487	5488	5489
111	5490	5491	5492	5493	5494	5495	5496	5497	5498
112	5499	5500	5501	5502	5503	5504	5505	5506	5507
113	5508	5509	5510	5511	5512	5513	5514	5515	5516
114	5517	5518	5519	5520	5521	5522	5523	5524	5525
115	5526	5527	5528	5529	5530	5531	5532	5533	5534
116	5535	5536	5537	5538	5539	5540	5541	5542	5543
117	5544	5545	5546	5547	5548	5549	5550	5551	5552
118	5553	5554	5555	5556	5557	5558	5559	5560	5561
119	5562	5563	5564	5565	5566	5567	5568	5569	5570
120	5571	5572	5573	5574	5575	5576	5577	5578	5579
121	5580	5581	5582	5583	5584	5585	5586	5587	5588
122	5589	5590	5591	5592	5593	5594	5595	5596	5597
123	5598	5599	5600	5601	5602	5603	5604	5605	5606
124	5607	5608	5609	5610	5611	5612	5613	5614	5615
125	5616	5617	5618	5619	5620	5621	5622	5623	5624
126	5625	5626	5627	5628	5629	5630	5631	5632	5633
127	5634	5635	5636	5637	5638	5639	5640	5641	5642
128	5643	5644	5645	5646	5647	5648	5649	5650	5651
129	5652	5653	5654	5655	5656	5657	5658	5659	5660
130	5661	5662	5663	5664	5665	5666	5667	5668	5669
131	5670	5671	5672	5673	5674	5675	5676	5677	5678
132	5679	5680	5681	5682	5683	5684	5685	5686	5687
133	5688	5689	5690	5691	5692	5693	5694	5695	5696
134	5697	5698	5699	5700	5701	5702	5703	5704	5705
135	5706	5707	5708	5709	5710	5711	5712	5713	5714
136	5715	5716	5717	5718	5719	5720	5721	5722	5723
137	5724	5725	5726	5727	5728	5729	5730	5731	5732
138	5733	5734	5735	5736	5737	5738	5739	5740	5741
139	5742	5743	5744	5745	5746	5747	5748	5749	5750
140	5751	5752	5753	5754	5755	5756	5757	5758	5759
141	5760	5761	5762	5763	5764	5765	5766	5767	5768
142	5769	5770	5771	5772	5773	5774	5775	5776	5777
143	5778	5779	5780	5781	5782	5783	5784	5785	5786
144	5787	5788	5789	5790	5791	5792	5793	5794	5795
145	5796	5797	5798	5799	5800	5801	5802	5803	5804
146	5805	5806	5807	5808	5809	5810	5811	5812	5813
147	5814	5815	5816	5817	5818	5819	5820	5821	5822
148	5823	5824	5825	5826	5827	5828	5829	5830	5831
149	5832	5833	5834	5835	5836	5837	5838	5839	5840
150	5841	5842	5843	5844	5845	5846	5847	5848	5849

Step no.	Goal position		Circular interpolation aux. point		Operation speed		Dwell time	M code no.	Control word
	Low	High	Low	High	Low	High			
151	5850	5851	5852	5853	5854	5855	5856	5857	5858
152	5859	5860	5861	5862	5863	5864	5865	5866	5867
153	5868	5869	5870	5871	5872	5873	5874	5875	5876
154	5877	5878	5879	5880	5881	5882	5883	5884	5885
155	5886	5887	5888	5889	5890	5891	5892	5893	5894
156	5895	5896	5897	5898	5899	5900	5901	5902	5903
157	5904	5905	5906	5907	5908	5909	5910	5911	5912
158	5913	5914	5915	5916	5917	5918	5919	5920	5921
159	5922	5923	5924	5925	5926	5927	5928	5929	5930
160	5931	5932	5933	5934	5935	5936	5937	5938	5939
161	5940	5941	5942	5943	5944	5945	5946	5947	5948
162	5949	5950	5951	5952	5953	5954	5955	5956	5957
163	5958	5959	5960	5961	5962	5963	5964	5965	5966
164	5967	5968	5969	5970	5971	5972	5973	5974	5975
165	5976	5977	5978	5979	5980	5981	5982	5983	5984
166	5985	5986	5987	5988	5989	5990	5991	5992	5993
167	5994	5995	5996	5997	5998	5999	6000	6001	6002
168	6003	6004	6005	6006	6007	6008	6009	6010	6011
169	6012	6013	6014	6015	6016	6017	6018	6019	6020
170	6021	6022	6023	6024	6025	6026	6027	6028	6029
171	6030	6031	6032	6033	6034	6035	6036	6037	6038
172	6039	6040	6041	6042	6043	6044	6045	6046	6047
173	6048	6049	6050	6051	6052	6053	6054	6055	6056
174	6057	6058	6059	6060	6061	6062	6063	6064	6065
175	6066	6067	6068	6069	6070	6071	6072	6073	6074
176	6075	6076	6077	6078	6079	6080	6081	6082	6083
177	6084	6085	6086	6087	6088	6089	6090	6091	6092
178	6093	6094	6095	6096	6097	6098	6099	6100	6101
179	6102	6103	6104	6105	6106	6107	6108	6109	6110
180	6111	6112	6113	6114	6115	6116	6117	6118	6119
181	6120	6121	6122	6123	6124	6125	6126	6127	6128
182	6129	6130	6131	6132	6133	6134	6135	6136	6137
183	6138	6139	6140	6141	6142	6143	6144	6145	6146
184	6147	6148	6149	6150	6151	6152	6153	6154	6155
185	6156	6157	6158	6159	6160	6161	6162	6163	6164
186	6165	6166	6167	6168	6169	6170	6171	6172	6173
187	6174	6175	6176	6177	6178	6179	6180	6181	6182
188	6183	6184	6185	6186	6187	6188	6189	6190	6191
189	6192	6193	6194	6195	6196	6197	6198	6199	6200
190	6201	6202	6203	6204	6205	6206	6207	6208	6209
191	6210	6211	6212	6213	6214	6215	6216	6217	6218
192	6219	6220	6221	6222	6223	6224	6225	6226	6227
193	6228	6229	6230	6231	6232	6233	6234	6235	6236
194	6237	6238	6239	6240	6241	6242	6243	6244	6245
195	6246	6247	6248	6249	6250	6251	6252	6253	6254
196	6255	6256	6257	6258	6259	6260	6261	6262	6263
197	6264	6265	6266	6267	6268	6269	6270	6271	6272
198	6273	6274	6275	6276	6277	6278	6279	6280	6281
199	6282	6283	6284	6285	6286	6287	6288	6289	6290
200	6291	6292	6293	6294	6295	6296	6297	6298	6299

Step no.	Goal position		Circular interpolation aux. point		Operation speed		Dwell time	M code no.	Control word
	Low	High	Low	High	Low	High			
201	6300	6301	6302	6303	6304	6305	6306	6307	6308
202	6309	6310	6311	6312	6313	6314	6315	6316	6317
203	6318	6319	6320	6321	6322	6323	6324	6325	6326
204	6327	6328	6329	6330	6331	6332	6333	6334	6335
205	6336	6337	6338	6339	6340	6341	6342	6343	6344
206	6345	6346	6347	6348	6349	6350	6351	6352	6353
207	6354	6355	6356	6357	6358	6359	6360	6361	6362
208	6363	6364	6365	6366	6367	6368	6369	6370	6371
209	6372	6373	6374	6375	6376	6377	6378	6379	6380
210	6381	6382	6383	6384	6385	6386	6387	6388	6389
211	6390	6391	6392	6393	6394	6395	6396	6397	6398
212	6399	6400	6401	6402	6403	6404	6405	6406	6407
213	6408	6409	6410	6411	6412	6413	6414	6415	6416
214	6417	6418	6419	6420	6421	6422	6423	6424	6425
215	6426	6427	6428	6429	6430	6431	6432	6433	6434
216	6435	6436	6437	6438	6439	6440	6441	6442	6443
217	6444	6445	6446	6447	6448	6449	6450	6451	6452
218	6453	6454	6455	6456	6457	6458	6459	6460	6461
219	6462	6463	6464	6465	6466	6467	6468	6469	6470
220	6471	6472	6473	6474	6475	6476	6477	6478	6479
221	6480	6481	6482	6483	6484	6485	6486	6487	6488
222	6489	6490	6491	6492	6493	6494	6495	6496	6497
223	6498	6499	6500	6501	6502	6503	6504	6505	6506
224	6507	6508	6509	6510	6511	6512	6513	6514	6515
225	6516	6517	6518	6519	6520	6521	6522	6523	6524
226	6525	6526	6527	6528	6529	6530	6531	6532	6533
227	6534	6535	6536	6537	6538	6539	6540	6541	6542
228	6543	6544	6545	6546	6547	6548	6549	6550	6551
229	6552	6553	6554	6555	6556	6557	6558	6559	6560
230	6561	6562	6563	6564	6565	6566	6567	6568	6569
231	6570	6571	6572	6573	6574	6575	6576	6577	6578
232	6579	6580	6581	6582	6583	6584	6585	6586	6587
233	6588	6589	6590	6591	6592	6593	6594	6595	6596
234	6597	6598	6599	6600	6601	6602	6603	6604	6605
235	6606	6607	6608	6609	6610	6611	6612	6613	6614
236	6615	6616	6617	6618	6619	6620	6621	6622	6623
237	6624	6625	6626	6627	6628	6629	6630	6631	6632
238	6633	6634	6635	6636	6637	6638	6639	6640	6641
239	6642	6643	6644	6645	6646	6647	6648	6649	6650
240	6651	6652	6653	6654	6655	6656	6657	6658	6659
241	6660	6661	6662	6663	6664	6665	6666	6667	6668
242	6669	6670	6671	6672	6673	6674	6675	6676	6677
243	6678	6679	6680	6681	6682	6683	6684	6685	6686
244	6687	6688	6689	6690	6691	6692	6693	6694	6695
245	6696	6697	6698	6699	6700	6701	6702	6703	6704
246	6705	6706	6707	6708	6709	6710	6711	6712	6713
247	6714	6715	6716	6717	6718	6719	6720	6721	6722
248	6723	6724	6725	6726	6727	6728	6729	6730	6731
249	6732	6733	6734	6735	6736	6737	6738	6739	6740
250	6741	6742	6743	6744	6745	6746	6747	6748	6749

Step no.	Goal position		Circular interpolation aux. point		Operation speed		Dwell time	M code no.	Control word
	Low	High	Low	High	Low	High			
251	6750	6751	6752	6753	6754	6755	6756	6757	6758
252	6759	6760	6761	6762	6763	6764	6765	6766	6767
253	6768	6769	6770	6771	6772	6773	6774	6775	6776
254	6777	6778	6779	6780	6781	6782	6783	6784	6785
255	6786	6787	6788	6789	6790	6791	6792	6793	6794
256	6795	6796	6797	6798	6799	6800	6801	6802	6803
257	6804	6805	6806	6807	6808	6809	6810	6811	6812
258	6813	6814	6815	6816	6817	6818	6819	6820	6821
259	6822	6823	6824	6825	6826	6827	6828	6829	6830
260	6831	6832	6833	6834	6835	6836	6837	6838	6839
261	6840	6841	6842	6843	6844	6845	6846	6847	6848
262	6849	6850	6851	6852	6853	6854	6855	6856	6857
263	6858	6859	6860	6861	6862	6863	6864	6865	6866
264	6867	6868	6869	6870	6871	6872	6873	6874	6875
265	6876	6877	6878	6879	6880	6881	6882	6883	6884
266	6885	6886	6887	6888	6889	6890	6891	6892	6893
267	6894	6895	6896	6897	6898	6899	6900	6901	6902
268	6903	6904	6905	6906	6907	6908	6909	6910	6911
269	6912	6913	6914	6915	6916	6917	6918	6919	6920
270	6921	6922	6923	6924	6925	6926	6927	6928	6929
271	6930	6931	6932	6933	6934	6935	6936	6937	6938
272	6939	6940	6941	6942	6943	6944	6945	6946	6947
273	6948	6949	6950	6951	6952	6953	6954	6955	6956
274	6957	6958	6959	6960	6961	6962	6963	6964	6965
275	6966	6967	6968	6969	6970	6971	6972	6973	6974
276	6975	6976	6977	6978	6979	6980	6981	6982	6983
277	6984	6985	6986	6987	6988	6989	6990	6991	6992
278	6993	6994	6995	6996	6997	6998	6999	7000	7001
279	7002	7003	7004	7005	7006	7007	7008	7009	7010
280	7011	7012	7013	7014	7015	7016	7017	7018	7019
281	7020	7021	7022	7023	7024	7025	7026	7027	7028
282	7029	7030	7031	7032	7033	7034	7035	7036	7037
283	7038	7039	7040	7041	7042	7043	7044	7045	7046
284	7047	7048	7049	7050	7051	7052	7053	7054	7055
285	7056	7057	7058	7059	7060	7061	7062	7063	7064
286	7065	7066	7067	7068	7069	7070	7071	7072	7073
287	7074	7075	7076	7077	7078	7079	7080	7081	7082
288	7083	7084	7085	7086	7087	7088	7089	7090	7091
289	7092	7093	7094	7095	7096	7097	7098	7099	7100
290	7101	7102	7103	7104	7105	7106	7107	7108	7109
291	7110	7111	7112	7113	7114	7115	7116	7117	7118
292	7119	7120	7121	7122	7123	7124	7125	7126	7127
293	7128	7129	7130	7131	7132	7133	7134	7135	7136
294	7137	7138	7139	7140	7141	7142	7143	7144	7145
295	7146	7147	7148	7149	7150	7151	7152	7153	7154
296	7155	7156	7157	7158	7159	7160	7161	7162	7163
297	7164	7165	7166	7167	7168	7169	7170	7171	7172
298	7173	7174	7175	7176	7177	7178	7179	7180	7181
299	7182	7183	7184	7185	7186	7187	7188	7189	7190
300	7191	7192	7193	7194	7195	7196	7197	7198	7199

Step no.	Goal position		Circular interpolation aux. point		Operation speed		Dwell time	M code no.	Control word
	Low	High	Low	High	Low	High			
301	7200	7201	7202	7203	7204	7205	7206	7207	7208
302	7209	7210	7211	7212	7213	7214	7215	7216	7217
303	7218	7219	7220	7221	7222	7223	7224	7225	7226
304	7227	7228	7229	7230	7231	7232	7233	7234	7235
305	7236	7237	7238	7239	7240	7241	7242	7243	7244
306	7245	7246	7247	7248	7249	7250	7251	7252	7253
307	7254	7255	7256	7257	7258	7259	7260	7261	7262
308	7263	7264	7265	7266	7267	7268	7269	7270	7271
309	7272	7273	7274	7275	7276	7277	7278	7279	7280
310	7281	7282	7283	7284	7285	7286	7287	7288	7289
311	7290	7291	7292	7293	7294	7295	7296	7297	7298
312	7299	7300	7301	7302	7303	7304	7305	7306	7307
313	7308	7309	7310	7311	7312	7313	7314	7315	7316
314	7317	7318	7319	7320	7321	7322	7323	7324	7325
315	7326	7327	7328	7329	7330	7331	7332	7333	7334
316	7335	7336	7337	7338	7339	7340	7341	7342	7343
317	7344	7345	7346	7347	7348	7349	7350	7351	7352
318	7353	7354	7355	7356	7357	7358	7359	7360	7361
319	7362	7363	7364	7365	7366	7367	7368	7369	7370
320	7371	7372	7373	7374	7375	7376	7377	7378	7379
321	7380	7381	7382	7383	7384	7385	7386	7387	7388
322	7389	7390	7391	7392	7393	7394	7395	7396	7397
323	7398	7399	7400	7401	7402	7403	7404	7405	7406
324	7407	7408	7409	7410	7411	7412	7413	7414	7415
325	7416	7417	7418	7419	7420	7421	7422	7423	7424
326	7425	7426	7427	7428	7429	7430	7431	7432	7433
327	7434	7435	7436	7437	7438	7439	7440	7441	7442
328	7443	7444	7445	7446	7447	7448	7449	7450	7451
329	7452	7453	7454	7455	7456	7457	7458	7459	7460
330	7461	7462	7463	7464	7465	7466	7467	7468	7469
331	7470	7471	7472	7473	7474	7475	7476	7477	7478
332	7479	7480	7481	7482	7483	7484	7485	7486	7487
333	7488	7489	7490	7491	7492	7493	7494	7495	7496
334	7497	7498	7499	7500	7501	7502	7503	7504	7505
335	7506	7507	7508	7509	7510	7511	7512	7513	7514
336	7515	7516	7517	7518	7519	7520	7521	7522	7523
337	7524	7525	7526	7527	7528	7529	7530	7531	7532
338	7533	7534	7535	7536	7537	7538	7539	7540	7541
339	7542	7543	7544	7545	7546	7547	7548	7549	7550
340	7551	7552	7553	7554	7555	7556	7557	7558	7559
341	7560	7561	7562	7563	7564	7565	7566	7567	7568
342	7569	7570	7571	7572	7573	7574	7575	7576	7577
343	7578	7579	7580	7581	7582	7583	7584	7585	7586
344	7587	7588	7589	7590	7591	7592	7593	7594	7595
345	7596	7597	7598	7599	7600	7601	7602	7603	7604
346	7605	7606	7607	7608	7609	7610	7611	7612	7613
347	7614	7615	7616	7617	7618	7619	7620	7621	7622
348	7623	7624	7625	7626	7627	7628	7629	7630	7631
349	7632	7633	7634	7635	7636	7637	7638	7639	7640
350	7641	7642	7643	7644	7645	7646	7647	7648	7649

Step no.	Goal position		Circular interpolation aux. point		Operation speed		Dwell time	M code no.	Control word
	Low	High	Low	High	Low	High			
351	7650	7651	7652	7653	7654	7655	7656	7657	7658
352	7659	7660	7661	7662	7663	7664	7665	7666	7667
353	7668	7669	7670	7671	7672	7673	7674	7675	7676
354	7677	7678	7679	7680	7681	7682	7683	7684	7685
355	7686	7687	7688	7689	7690	7691	7692	7693	7694
356	7695	7696	7697	7698	7699	7700	7701	7702	7703
357	7704	7705	7706	7707	7708	7709	7710	7711	7712
358	7713	7714	7715	7716	7717	7718	7719	7720	7721
359	7722	7723	7724	7725	7726	7727	7728	7729	7730
360	7731	7732	7733	7734	7735	7736	7737	7738	7739
361	7740	7741	7742	7743	7744	7745	7746	7747	7748
362	7749	7750	7751	7752	7753	7754	7755	7756	7757
363	7758	7759	7760	7761	7762	7763	7764	7765	7766
364	7767	7768	7769	7770	7771	7772	7773	7774	7775
365	7776	7777	7778	7779	7780	7781	7782	7783	7784
366	7785	7786	7787	7788	7789	7790	7791	7792	7793
367	7794	7795	7796	7797	7798	7799	7800	7801	7802
368	7803	7804	7805	7806	7807	7808	7809	7810	7811
369	7812	7813	7814	7815	7816	7817	7818	7819	7820
370	7821	7822	7823	7824	7825	7826	7827	7828	7829
371	7830	7831	7832	7833	7834	7835	7836	7837	7838
372	7839	7840	7841	7842	7843	7844	7845	7846	7847
373	7848	7849	7850	7851	7852	7853	7854	7855	7856
374	7857	7858	7859	7860	7861	7862	7863	7864	7865
375	7866	7867	7868	7869	7870	7871	7872	7873	7874
376	7875	7876	7877	7878	7879	7880	7881	7882	7883
377	7884	7885	7886	7887	7888	7889	7890	7891	7892
378	7893	7894	7895	7896	7897	7898	7899	7900	7901
379	7902	7903	7904	7905	7906	7907	7908	7909	7910
380	7911	7912	7913	7914	7915	7916	7917	7918	7919
381	7920	7921	7922	7923	7924	7925	7926	7927	7928
382	7929	7930	7931	7932	7933	7934	7935	7936	7937
383	7938	7939	7940	7941	7942	7943	7944	7945	7946
384	7947	7948	7949	7950	7951	7952	7953	7954	7955
385	7956	7957	7958	7959	7960	7961	7962	7963	7964
386	7965	7966	7967	7968	7969	7970	7971	7972	7973
387	7974	7975	7976	7977	7978	7979	7980	7981	7982
388	7983	7984	7985	7986	7987	7988	7989	7990	7991
389	7992	7993	7994	7995	7996	7997	7998	7999	8000
390	8001	8002	8003	8004	8005	8006	8007	8008	8009
391	8010	8011	8012	8013	8014	8015	8016	8017	8018
392	8019	8020	8021	8022	8023	8024	8025	8026	8027
393	8028	8029	8030	8031	8032	8033	8034	8035	8036
394	8037	8038	8039	8040	8041	8042	8043	8044	8045
395	8046	8047	8048	8049	8050	8051	8052	8053	8054
396	8055	8056	8057	8058	8059	8060	8061	8062	8063
397	8064	8065	8066	8067	8068	8069	8070	8071	8072
398	8073	8074	8075	8076	8077	8078	8079	8080	8081
399	8082	8083	8084	8085	8086	8087	8088	8089	8090
400	8091	8092	8093	8094	8095	8096	8097	8098	8099

3) Internal Memory Address of Z Operation data

Step no.	Goal position		Circular interpolation aux. point		Operation speed		Dwell time	M code no.	Control word
	Low	High	Low	High	Low	High			
1	8900	8901	8902	8903	8904	8905	8906	8907	8908
2	8909	8910	8911	8912	8913	8914	8915	8916	8917
3	8918	8919	8920	8921	8922	8923	8924	8925	8926
4	8927	8928	8929	8930	8931	8932	8933	8934	8935
5	8936	8937	8938	8939	8940	8941	8942	8943	8944
6	8945	8946	8947	8948	8949	8950	8951	8952	8953
7	8954	8955	8956	8957	8958	8959	8960	8961	8962
8	8963	8964	8965	8966	8967	8968	8969	8970	8971
9	8972	8973	8974	8975	8976	8977	8978	8979	8980
10	8981	8982	8983	8984	8985	8986	8987	8988	8989
11	8990	8991	8992	8993	8994	8995	8996	8997	8998
12	8999	9000	9001	9002	9003	9004	9005	9006	9007
13	9008	9009	9010	9011	9012	9013	9014	9015	9016
14	9017	9018	9019	9020	9021	9022	9023	9024	9025
15	9026	9027	9028	9029	9030	9031	9032	9033	9034
16	9035	9036	9037	9038	9039	9040	9041	9042	9043
17	9044	9045	9046	9047	9048	9049	9050	9051	9052
18	9053	9054	9055	9056	9057	9058	9059	9060	9061
19	9062	9063	9064	9065	9066	9067	9068	9069	9070
20	9071	9072	9073	9074	9075	9076	9077	9078	9079
21	9080	9081	9082	9083	9084	9085	9086	9087	9088
22	9089	9090	9091	9092	9093	9094	9095	9096	9097
23	9098	9099	9100	9101	9102	9103	9104	9105	9106
24	9107	9108	9109	9110	9111	9112	9113	9114	9115
25	9116	9117	9118	9119	9120	9121	9122	9123	9124
26	9125	9126	9127	9128	9129	9130	9131	9132	9133
27	9134	9135	9136	9137	9138	9139	9140	9141	9142
28	9143	9144	9145	9146	9147	9148	9149	9150	9151
29	9152	9153	9154	9155	9156	9157	9158	9159	9160
30	9161	9162	9163	9164	9165	9166	9167	9168	9169
31	9170	9171	9172	9173	9174	9175	9176	9177	9178
32	9179	9180	9181	9182	9183	9184	9185	9186	9187
33	9188	9189	9190	9191	9192	9193	9194	9195	9196
34	9197	9198	9199	9200	9201	9202	9203	9204	9205
35	9206	9207	9208	9209	9210	9211	9212	9213	9214
36	9215	9216	9217	9218	9219	9220	9221	9222	9223
37	9224	9225	9226	9227	9228	9229	9230	9231	9232
38	9233	9234	9235	9236	9237	9238	9239	9240	9241
39	9242	9243	9244	9245	9246	9247	9248	9249	9250
40	9251	9252	9253	9254	9255	9256	9257	9258	9259
41	9260	9261	9262	9263	9264	9265	9266	9267	9268
42	9269	9270	9271	9272	9273	9274	9275	9276	9277
43	9278	9279	9280	9281	9282	9283	9284	9285	9286
44	9287	9288	9289	9290	9291	9292	9293	9294	9295
45	9296	9297	9298	9299	9300	9301	9302	9303	9304
46	9305	9306	9307	9308	9309	9310	9311	9312	9313
47	9314	9315	9316	9317	9318	9319	9320	9321	9322
48	9323	9324	9325	9326	9327	9328	9329	9330	9331
49	9332	9333	9334	9335	9336	9337	9338	9339	9340
50	9341	9342	9343	9344	9345	9346	9347	9348	9349

Step no.	Goal position		Circular interpolation aux. point		Operation speed		Dwell time	M code no.	Control word
	Low	High	Low	High	Low	High			
51	9350	9351	9352	9353	9354	9355	9356	9357	9358
52	9359	9360	9361	9362	9363	9364	9365	9366	9367
53	9368	9369	9370	9371	9372	9373	9374	9375	9376
54	9377	9378	9379	9380	9381	9382	9383	9384	9385
55	9386	9387	9388	9389	9390	9391	9392	9393	9394
56	9395	9396	9397	9398	9399	9400	9401	9402	9403
57	9404	9405	9406	9407	9408	9409	9410	9411	9412
58	9413	9414	9415	9416	9417	9418	9419	9420	9421
59	9422	9423	9424	9425	9426	9427	9428	9429	9430
60	9431	9432	9433	9434	9435	9436	9437	9438	9439
61	9440	9441	9442	9443	9444	9445	9446	9447	9448
62	9449	9450	9451	9452	9453	9454	9455	9456	9457
63	9458	9459	9460	9461	9462	9463	9464	9465	9466
64	9467	9468	9469	9470	9471	9472	9473	9474	9475
65	9476	9477	9478	9479	9480	9481	9482	9483	9484
66	9485	9486	9487	9488	9489	9490	9491	9492	9493
67	9494	9495	9496	9497	9498	9499	9500	9501	9502
68	9503	9504	9505	9506	9507	9508	9509	9510	9511
69	9512	9513	9514	9515	9516	9517	9518	9519	9520
70	9521	9522	9523	9524	9525	9526	9527	9528	9529
71	9530	9531	9532	9533	9534	9535	9536	9537	9538
72	9539	9540	9541	9542	9543	9544	9545	9546	9547
73	9548	9549	9550	9551	9552	9553	9554	9555	9556
74	9557	9558	9559	9560	9561	9562	9563	9564	9565
75	9566	9567	9568	9569	9570	9571	9572	9573	9574
76	9575	9576	9577	9578	9579	9580	9581	9582	9583
77	9584	9585	9586	9587	9588	9589	9590	9591	9592
78	9593	9594	9595	9596	9597	9598	9599	9600	9601
79	9602	9603	9604	9605	9606	9607	9608	9609	9610
80	9611	9612	9613	9614	9615	9616	9617	9618	9619
81	9620	9621	9622	9623	9624	9625	9626	9627	9628
82	9629	9630	9631	9632	9633	9634	9635	9636	9637
83	9638	9639	9640	9641	9642	9643	9644	9645	9646
84	9647	9648	9649	9650	9651	9652	9653	9654	9655
85	9656	9657	9658	9659	9660	9661	9662	9663	9664
86	9665	9666	9667	9668	9669	9670	9671	9672	9673
87	9674	9675	9676	9677	9678	9679	9680	9681	9682
88	9683	9684	9685	9686	9687	9688	9689	9690	9691
89	9692	9693	9694	9695	9696	9697	9698	9699	9700
90	9701	9702	9703	9704	9705	9706	9707	9708	9709
91	9710	9711	9712	9713	9714	9715	9716	9717	9718
92	9719	9720	9721	9722	9723	9724	9725	9726	9727
93	9728	9729	9730	9731	9732	9733	9734	9735	9736
94	9737	9738	9739	9740	9741	9742	9743	9744	9745
95	9746	9747	9748	9749	9750	9751	9752	9753	9754
96	9755	9756	9757	9758	9759	9760	9761	9762	9763
97	9764	9765	9766	9767	9768	9769	9770	9771	9772
98	9773	9774	9775	9776	9777	9778	9779	9780	9781
99	9782	9783	9784	9785	9786	9787	9788	9789	9790
100	9791	9792	9793	9794	9795	9796	9797	9798	9799

Step no.	Goal position		Circular interpolation aux. point		Operation speed		Dwell time	M code no.	Control word
	Low	High	Low	High	Low	High			
101	9800	9801	9802	9803	9804	9805	9806	9807	9808
102	9809	9810	9811	9812	9813	9814	9815	9816	9817
103	9818	9819	9820	9821	9822	9823	9824	9825	9826
104	9827	9828	9829	9830	9831	9832	9833	9834	9835
105	9836	9837	9838	9839	9840	9841	9842	9843	9844
106	9845	9846	9847	9848	9849	9850	9851	9852	9853
107	9854	9855	9856	9857	9858	9859	9860	9861	9862
108	9863	9864	9865	9866	9867	9868	9869	9870	9871
109	9872	9873	9874	9875	9876	9877	9878	9879	9880
110	9881	9882	9883	9884	9885	9886	9887	9888	9889
111	9890	9891	9892	9893	9894	9895	9896	9897	9898
112	9899	9900	9901	9902	9903	9904	9905	9906	9907
113	9908	9909	9910	9911	9912	9913	9914	9915	9916
114	9917	9918	9919	9920	9921	9922	9923	9924	9925
115	9926	9927	9928	9929	9930	9931	9932	9933	9934
116	9935	9936	9937	9938	9939	9940	9941	9942	9943
117	9944	9945	9946	9947	9948	9949	9950	9951	9952
118	9953	9954	9955	9956	9957	9958	9959	9960	9961
119	9962	9963	9964	9965	9966	9967	9968	9969	9970
120	9971	9972	9973	9974	9975	9976	9977	9978	9979
121	9980	9981	9982	9983	9984	9985	9986	9987	9988
122	9989	9990	9991	9992	9993	9994	9995	9996	9997
123	9998	9999	10000	10001	10002	10003	10004	10005	10006
124	10007	10008	10009	10010	10011	10012	10013	10014	10015
125	10016	10017	10018	10019	10020	10021	10022	10023	10024
126	10025	10026	10027	10028	10029	10030	10031	10032	10033
127	10034	10035	10036	10037	10038	10039	10040	10041	10042
128	10043	10044	10045	10046	10047	10048	10049	10050	10051
129	10052	10053	10054	10055	10056	10057	10058	10059	10060
130	10061	10062	10063	10064	10065	10066	10067	10068	10069
131	10070	10071	10072	10073	10074	10075	10076	10077	10078
132	10079	10080	10081	10082	10083	10084	10085	10086	10087
133	10088	10089	10090	10091	10092	10093	10094	10095	10096
134	10097	10098	10099	10100	10101	10102	10103	10104	10105
135	10106	10107	10108	10109	10110	10111	10112	10113	10114
136	10115	10116	10117	10118	10119	10120	10121	10122	10123
137	10124	10125	10126	10127	10128	10129	10130	10131	10132
138	10133	10134	10135	10136	10137	10138	10139	10140	10141
139	10142	10143	10144	10145	10146	10147	10148	10149	10150
140	10151	10152	10153	10154	10155	10156	10157	10158	10159
141	10160	10161	10162	10163	10164	10165	10166	10167	10168
142	10169	10170	10171	10172	10173	10174	10175	10176	10177
143	10178	10179	10180	10181	10182	10183	10184	10185	10186
144	10187	10188	10189	10190	10191	10192	10193	10194	10195
145	10196	10197	10198	10199	10200	10201	10202	10203	10204
146	10205	10206	10207	10208	10209	10210	10211	10212	10213
147	10214	10215	10216	10217	10218	10219	10220	10221	10222
148	10223	10224	10225	10226	10227	10228	10229	10230	10231
149	10232	10233	10234	10235	10236	10237	10238	10239	10240
150	10241	10242	10243	10244	10245	10246	10247	10248	10249

Step no.	Goal position		Circular interpolation aux. point		Operation speed		Dwell time	M code no.	Control word
	Low	High	Low	High	Low	High			
151	10250	10251	10252	10253	10254	10255	10256	10257	10258
152	10259	10260	10261	10262	10263	10264	10265	10266	10267
153	10268	10269	10270	10271	10272	10273	10274	10275	10276
154	10277	10278	10279	10280	10281	10282	10283	10284	10285
155	10286	10287	10288	10289	10290	10291	10292	10293	10294
156	10295	10296	10297	10298	10299	10300	10301	10302	10303
157	10304	10305	10306	10307	10308	10309	10310	10311	10312
158	10313	10314	10315	10316	10317	10318	10319	10320	10321
159	10322	10323	10324	10325	10326	10327	10328	10329	10330
160	10331	10332	10333	10334	10335	10336	10337	10338	10339
161	10340	10341	10342	10343	10344	10345	10346	10347	10348
162	10349	10350	10351	10352	10353	10354	10355	10356	10357
163	10358	10359	10360	10361	10362	10363	10364	10365	10366
164	10367	10368	10369	10370	10371	10372	10373	10374	10375
165	10376	10377	10378	10379	10380	10381	10382	10383	10384
166	10385	10386	10387	10388	10389	10390	10391	10392	10393
167	10394	10395	10396	10397	10398	10399	10400	10401	10402
168	10403	10404	10405	10406	10407	10408	10409	10410	10411
169	10412	10413	10414	10415	10416	10417	10418	10419	10420
170	10421	10422	10423	10424	10425	10426	10427	10428	10429
171	10430	10431	10432	10433	10434	10435	10436	10437	10438
172	10439	10440	10441	10442	10443	10444	10445	10446	10447
173	10448	10449	10450	10451	10452	10453	10454	10455	10456
174	10457	10458	10459	10460	10461	10462	10463	10464	10465
175	10466	10467	10468	10469	10470	10471	10472	10473	10474
176	10475	10476	10477	10478	10479	10480	10481	10482	10483
177	10484	10485	10486	10487	10488	10489	10490	10491	10492
178	10493	10494	10495	10496	10497	10498	10499	10500	10501
179	10502	10503	10504	10505	10506	10507	10508	10509	10510
180	10511	10512	10513	10514	10515	10516	10517	10518	10519
181	10520	10521	10522	10523	10524	10525	10526	10527	10528
182	10529	10530	10531	10532	10533	10534	10535	10536	10537
183	10538	10539	10540	10541	10542	10543	10544	10545	10546
184	10547	10548	10549	10550	10551	10552	10553	10554	10555
185	10556	10557	10558	10559	10560	10561	10562	10563	10564
186	10565	10566	10567	10568	10569	10570	10571	10572	10573
187	10574	10575	10576	10577	10578	10579	10580	10581	10582
188	10583	10584	10585	10586	10587	10588	10589	10590	10591
189	10592	10593	10594	10595	10596	10597	10598	10599	10600
190	10601	10602	10603	10604	10605	10606	10607	10608	10609
191	10610	10611	10612	10613	10614	10615	10616	10617	10618
192	10619	10620	10621	10622	10623	10624	10625	10626	10627
193	10628	10629	10630	10631	10632	10633	10634	10635	10636
194	10637	10638	10639	10640	10641	10642	10643	10644	10645
195	10646	10647	10648	10649	10650	10651	10652	10653	10654
196	10655	10656	10657	10658	10659	10660	10661	10662	10663
197	10664	10665	10666	10667	10668	10669	10670	10671	10672
198	10673	10674	10675	10676	10677	10678	10679	10680	10681
199	10682	10683	10684	10685	10686	10687	10688	10689	10690
200	10691	10692	10693	10694	10695	10696	10697	10698	10699

Step no.	Goal position		Circular interpolation aux. point		Operation speed		Dwell time	M code no.	Control word
	Low	High	Low	High	Low	High			
201	10700	10701	10702	10703	10704	10705	10706	10707	10708
202	10709	10710	10711	10712	10713	10714	10715	10716	10717
203	10718	10719	10720	10721	10722	10723	10724	10725	10726
204	10727	10728	10729	10730	10731	10732	10733	10734	10735
205	10736	10737	10738	10739	10740	10741	10742	10743	10744
206	10745	10746	10747	10748	10749	10750	10751	10752	10753
207	10754	10755	10756	10757	10758	10759	10760	10761	10762
208	10763	10764	10765	10766	10767	10768	10769	10770	10771
209	10772	10773	10774	10775	10776	10777	10778	10779	10780
210	10781	10782	10783	10784	10785	10786	10787	10788	10789
211	10790	10791	10792	10793	10794	10795	10796	10797	10798
212	10799	10800	10801	10802	10803	10804	10805	10806	10807
213	10808	10809	10810	10811	10812	10813	10814	10815	10816
214	10817	10818	10819	10820	10821	10822	10823	10824	10825
215	10826	10827	10828	10829	10830	10831	10832	10833	10834
216	10835	10836	10837	10838	10839	10840	10841	10842	10843
217	10844	10845	10846	10847	10848	10849	10850	10851	10852
218	10853	10854	10855	10856	10857	10858	10859	10860	10861
219	10862	10863	10864	10865	10866	10867	10868	10869	10870
220	10871	10872	10873	10874	10875	10876	10877	10878	10879
221	10880	10881	10882	10883	10884	10885	10886	10887	10888
222	10889	10890	10891	10892	10893	10894	10895	10896	10897
223	10898	10899	10900	10901	10902	10903	10904	10905	10906
224	10907	10908	10909	10910	10911	10912	10913	10914	10915
225	10916	10917	10918	10919	10920	10921	10922	10923	10924
226	10925	10926	10927	10928	10929	10930	10931	10932	10933
227	10934	10935	10936	10937	10938	10939	10940	10941	10942
228	10943	10944	10945	10946	10947	10948	10949	10950	10951
229	10952	10953	10954	10955	10956	10957	10958	10959	10960
230	10961	10962	10963	10964	10965	10966	10967	10968	10969
231	10970	10971	10972	10973	10974	10975	10976	10977	10978
232	10979	10980	10981	10982	10983	10984	10985	10986	10987
233	10988	10989	10990	10991	10992	10993	10994	10995	10996
234	10997	10998	10999	11000	11001	11002	11003	11004	11005
235	11006	11007	11008	11009	11010	11011	11012	11013	11014
236	11015	11016	11017	11018	11019	11020	11021	11022	11023
237	11024	11025	11026	11027	11028	11029	11030	11031	11032
238	11033	11034	11035	11036	11037	11038	11039	11040	11041
239	11042	11043	11044	11045	11046	11047	11048	11049	11050
240	11051	11052	11053	11054	11055	11056	11057	11058	11059
241	11060	11061	11062	11063	11064	11065	11066	11067	11068
242	11069	11070	11071	11072	11073	11074	11075	11076	11077
243	11078	11079	11080	11081	11082	11083	11084	11085	11086
244	11087	11088	11089	11090	11091	11092	11093	11094	11095
245	11096	11097	11098	11099	11100	11101	11102	11103	11104
246	11105	11106	11107	11108	11109	11110	11111	11112	11113
247	11114	11115	11116	11117	11118	11119	11120	11121	11122
248	11123	11124	11125	11126	11127	11128	11129	11130	11131
249	11132	11133	11134	11135	11136	11137	11138	11139	11140
250	11141	11142	11143	11144	11145	11146	11147	11148	11149

Step no.	Goal position		Circular interpolation aux. point		Operation speed		Dwell time	M code no.	Control word
	Low	High	Low	High	Low	High			
251	11150	11151	11152	11153	11154	11155	11156	11157	11158
252	11159	11160	11161	11162	11163	11164	11165	11166	11167
253	11168	11169	11170	11171	11172	11173	11174	11175	11176
254	11177	11178	11179	11180	11181	11182	11183	11184	11185
255	11186	11187	11188	11189	11190	11191	11192	11193	11194
256	11195	11196	11197	11198	11199	11200	11201	11202	11203
257	11204	11205	11206	11207	11208	11209	11210	11211	11212
258	11213	11214	11215	11216	11217	11218	11219	11220	11221
259	11222	11223	11224	11225	11226	11227	11228	11229	11230
260	11231	11232	11233	11234	11235	11236	11237	11238	11239
261	11240	11241	11242	11243	11244	11245	11246	11247	11248
262	11249	11250	11251	11252	11253	11254	11255	11256	11257
263	11258	11259	11260	11261	11262	11263	11264	11265	11266
264	11267	11268	11269	11270	11271	11272	11273	11274	11275
265	11276	11277	11278	11279	11280	11281	11282	11283	11284
266	11285	11286	11287	11288	11289	11290	11291	11292	11293
267	11294	11295	11296	11297	11298	11299	11300	11301	11302
268	11303	11304	11305	11306	11307	11308	11309	11310	11311
269	11312	11313	11314	11315	11316	11317	11318	11319	11320
270	11321	11322	11323	11324	11325	11326	11327	11328	11329
271	11330	11331	11332	11333	11334	11335	11336	11337	11338
272	11339	11340	11341	11342	11343	11344	11345	11346	11347
273	11348	11349	11350	11351	11352	11353	11354	11355	11356
274	11357	11358	11359	11360	11361	11362	11363	11364	11365
275	11366	11367	11368	11369	11370	11371	11372	11373	11374
276	11375	11376	11377	11378	11379	11380	11381	11382	11383
277	11384	11385	11386	11387	11388	11389	11390	11391	11392
278	11393	11394	11395	11396	11397	11398	11399	11400	11401
279	11402	11403	11404	11405	11406	11407	11408	11409	11410
280	11411	11412	11413	11414	11415	11416	11417	11418	11419
281	11420	11421	11422	11423	11424	11425	11426	11427	11428
282	11429	11430	11431	11432	11433	11434	11435	11436	11437
283	11438	11439	11440	11441	11442	11443	11444	11445	11446
284	11447	11448	11449	11450	11451	11452	11453	11454	11455
285	11456	11457	11458	11459	11460	11461	11462	11463	11464
286	11465	11466	11467	11468	11469	11470	11471	11472	11473
287	11474	11475	11476	11477	11478	11479	11480	11481	11482
288	11483	11484	11485	11486	11487	11488	11489	11490	11491
289	11492	11493	11494	11495	11496	11497	11498	11499	11500
290	11501	11502	11503	11504	11505	11506	11507	11508	11509
291	11510	11511	11512	11513	11514	11515	11516	11517	11518
292	11519	11520	11521	11522	11523	11524	11525	11526	11527
293	11528	11529	11530	11531	11532	11533	11534	11535	11536
294	11537	11538	11539	11540	11541	11542	11543	11544	11545
295	11546	11547	11548	11549	11550	11551	11552	11553	11554
296	11555	11556	11557	11558	11559	11560	11561	11562	11563
297	11564	11565	11566	11567	11568	11569	11570	11571	11572
298	11573	11574	11575	11576	11577	11578	11579	11580	11581
299	11582	11583	11584	11585	11586	11587	11588	11589	11590
300	11591	11592	11593	11594	11595	11596	11597	11598	11599

Step no.	Goal position		Circular interpolation aux. point		Operation speed		Dwell time	M code no.	Control word
	Low	High	Low	High	Low	High			
301	11600	11601	11602	11603	11604	11605	11606	11607	11608
302	11609	11610	11611	11612	11613	11614	11615	11616	11617
303	11618	11619	11620	11621	11622	11623	11624	11625	11626
304	11627	11628	11629	11630	11631	11632	11633	11634	11635
305	11636	11637	11638	11639	11640	11641	11642	11643	11644
306	11645	11646	11647	11648	11649	11650	11651	11652	11653
307	11654	11655	11656	11657	11658	11659	11660	11661	11662
308	11663	11664	11665	11666	11667	11668	11669	11670	11671
309	11672	11673	11674	11675	11676	11677	11678	11679	11680
310	11681	11682	11683	11684	11685	11686	11687	11688	11689
311	11690	11691	11692	11693	11694	11695	11696	11697	11698
312	11699	11700	11701	11702	11703	11704	11705	11706	11707
313	11708	11709	11710	11711	11712	11713	11714	11715	11716
314	11717	11718	11719	11720	11721	11722	11723	11724	11725
315	11726	11727	11728	11729	11730	11731	11732	11733	11734
316	11735	11736	11737	11738	11739	11740	11741	11742	11743
317	11744	11745	11746	11747	11748	11749	11750	11751	11752
318	11753	11754	11755	11756	11757	11758	11759	11760	11761
319	11762	11763	11764	11765	11766	11767	11768	11769	11770
320	11771	11772	11773	11774	11775	11776	11777	11778	11779
321	11780	11781	11782	11783	11784	11785	11786	11787	11788
322	11789	11790	11791	11792	11793	11794	11795	11796	11797
323	11798	11799	11800	11801	11802	11803	11804	11805	11806
324	11807	11808	11809	11810	11811	11812	11813	11814	11815
325	11816	11817	11818	11819	11820	11821	11822	11823	11824
326	11825	11826	11827	11828	11829	11830	11831	11832	11833
327	11834	11835	11836	11837	11838	11839	11840	11841	11842
328	11843	11844	11845	11846	11847	11848	11849	11850	11851
329	11852	11853	11854	11855	11856	11857	11858	11859	11860
330	11861	11862	11863	11864	11865	11866	11867	11868	11869
331	11870	11871	11872	11873	11874	11875	11876	11877	11878
332	11879	11880	11881	11882	11883	11884	11885	11886	11887
333	11888	11889	11890	11891	11892	11893	11894	11895	11896
334	11897	11898	11899	11900	11901	11902	11903	11904	11905
335	11906	11907	11908	11909	11910	11911	11912	11913	11914
336	11915	11916	11917	11918	11919	11920	11921	11922	11923
337	11924	11925	11926	11927	11928	11929	11930	11931	11932
338	11933	11934	11935	11936	11937	11938	11939	11940	11941
339	11942	11943	11944	11945	11946	11947	11948	11949	11950
340	11951	11952	11953	11954	11955	11956	11957	11958	11959
341	11960	11961	11962	11963	11964	11965	11966	11967	11968
342	11969	11970	11971	11972	11973	11974	11975	11976	11977
343	11978	11979	11980	11981	11982	11983	11984	11985	11986
344	11987	11988	11989	11990	11991	11992	11993	11994	11995
345	11996	11997	11998	11999	12000	12001	12002	12003	12004
346	12005	12006	12007	12008	12009	12010	12011	12012	12013
347	12014	12015	12016	12017	12018	12019	12020	12021	12022
348	12023	12024	12025	12026	12027	12028	12029	12030	12031
349	12032	12033	12034	12035	12036	12037	12038	12039	12040
350	12041	12042	12043	12044	12045	12046	12047	12048	12049

Step no.	Goal position		Circular interpolation aux. point		Operation speed		Dwell time	M code no.	Control word
	Low	High	Low	High	Low	High			
351	12050	12051	12052	12053	12054	12055	12056	12057	12058
352	12059	12060	12061	12062	12063	12064	12065	12066	12067
353	12068	12069	12070	12071	12072	12073	12074	12075	12076
354	12077	12078	12079	12080	12081	12082	12083	12084	12085
355	12086	12087	12088	12089	12090	12091	12092	12093	12094
356	12095	12096	12097	12098	12099	12100	12101	12102	12103
357	12104	12105	12106	12107	12108	12109	12110	12111	12112
358	12113	12114	12115	12116	12117	12118	12119	12120	12121
359	12122	12123	12124	12125	12126	12127	12128	12129	12130
360	12131	12132	12133	12134	12135	12136	12137	12138	12139
361	12140	12141	12142	12143	12144	12145	12146	12147	12148
362	12149	12150	12151	12152	12153	12154	12155	12156	12157
363	12158	12159	12160	12161	12162	12163	12164	12165	12166
364	12167	12168	12169	12170	12171	12172	12173	12174	12175
365	12176	12177	12178	12179	12180	12181	12182	12183	12184
366	12185	12186	12187	12188	12189	12190	12191	12192	12193
367	12194	12195	12196	12197	12198	12199	12200	12201	12202
368	12203	12204	12205	12206	12207	12208	12209	12210	12211
369	12212	12213	12214	12215	12216	12217	12218	12219	12220
370	12221	12222	12223	12224	12225	12226	12227	12228	12229
371	12230	12231	12232	12233	12234	12235	12236	12237	12238
372	12239	12240	12241	12242	12243	12244	12245	12246	12247
373	12248	12249	12250	12251	12252	12253	12254	12255	12256
374	12257	12258	12259	12260	12261	12262	12263	12264	12265
375	12266	12267	12268	12269	12270	12271	12272	12273	12274
376	12275	12276	12277	12278	12279	12280	12281	12282	12283
377	12284	12285	12286	12287	12288	12289	12290	12291	12292
378	12293	12294	12295	12296	12297	12298	12299	12300	12301
379	12302	12303	12304	12305	12306	12307	12308	12309	12310
380	12311	12312	12313	12314	12315	12316	12317	12318	12319
381	12320	12321	12322	12323	12324	12325	12326	12327	12328
382	12329	12330	12331	12332	12333	12334	12335	12336	12337
383	12338	12339	12340	12341	12342	12343	12344	12345	12346
384	12347	12348	12349	12350	12351	12352	12353	12354	12355
385	12356	12357	12358	12359	12360	12361	12362	12363	12364
386	12365	12366	12367	12368	12369	12370	12371	12372	12373
387	12374	12375	12376	12377	12378	12379	12380	12381	12382
388	12383	12384	12385	12386	12387	12388	12389	12390	12391
389	12392	12393	12394	12395	12396	12397	12398	12399	12400
390	12401	12402	12403	12404	12405	12406	12407	12408	12409
391	12410	12411	12412	12413	12414	12415	12416	12417	12418
392	12419	12420	12421	12422	12423	12424	12425	12426	12427
393	12428	12429	12430	12431	12432	12433	12434	12435	12436
394	12437	12438	12439	12440	12441	12442	12443	12444	12445
395	12446	12447	12448	12449	12450	12451	12452	12453	12454
396	12455	12456	12457	12458	12459	12460	12461	12462	12463
397	12464	12465	12466	12467	12468	12469	12470	12471	12472
398	12473	12474	12475	12476	12477	12478	12479	12480	12481
399	12482	12483	12484	12485	12486	12487	12488	12489	12490
400	12491	12492	12493	12494	12495	12496	12497	12498	12499