CONTENTS

4. PARAMETERS FOR POSITIONING CONTROL

The seven types of parameter used for positioning control are listed below.

(1) System settings
The system settings set the modules used and axis numbers.
For details, see Section 4.1.

(2) Fixed parameters
The fixed parameters set data that is fixed - in accordance with the mechanical system for example - for each axis.
These parameter settings are used for applications such as calculating the command position when positioning control is executed.
For details, see Section 4.2.

(3) Servo parameters
The servo parameters set data - such as the servo model name and servo type - that is determined by the connected servomotor, for each axis.
These settings are used for servomotor control when positioning control is executed.
For details, see Section 4.3.

(4) Home position return data
The home position return data sets data such as the direction, method, and speed for home position return, for each axis.
This data is used when a home position return operation is executed.
For details, see Section 7.21.1.

(5) JOG operation data
The JOG operation data is the JOG speed limit value and parameter block No. data, and is set for each axis.
This data is used for positioning control executed during JOG operation.
For details, see Section 7.19.

(6) Parameter block
The parameter block includes data such as the acceleration/deceleration times and speed limit value: 16 blocks can be set when using an A171S/A273UHCPU (8 axis specification), and 64 blocks can be set when using an A273UHCPU (32 axis specification).
Parameter blocks are designated in servo programs, in the JOG operation data, and in the home position return data, and make it easier to change data such as that for acceleration and deceleration processing (acceleration/deceleration time, speed limit value) for positioning control.
For details, see Section 4.4.

(7) Limit switch output data
The limit switch output data is ON/OFF pattern data that is output when the limit switch output setting in the fixed parameters is set to "USE", and is set for the axes being used.
For the axes for which limit switch output data is set, the set ON/OFF pattern is output to external destinations during positioning control.
For details, see Section 8.1.

4. PARAMETERS FOR POSITIONING CONTROL

4.1 System Settings

(1) The settings made for the system settings include the module used (model name), motor type (model name), and axis number (1 to 4 / 1 to 8 / 1 to 32).

(2) The system setting data is set at a peripheral device.

(3) The data to be set is indicated below.
(a) When an A171SCPU is used
1) Model names of modules that can be set in system settings

Table 4.1 Module Model Names

Module Name	Model Name	Remarks	Number in Setting Example
Main base unit	A172B	2 modules can be installed. (Oue motion module)	—
	A178B	8 modules can be installed. (One motion module)	
	A178B-S1	8 modules can be installed. (Two motion modules)	
Extension base unit	A1S65B	For extension power supply + 5 slots	—
	A1S68B	For extension power supply + 8 slots	
Manual pulse generator/ synchronous encoder interface module	A171SENC	Input signals: 32 points Manual pulse generator: 1 point Synchronous encoder input: 1 point	1)
Limit output module	A1SY42	64 transistor output points, 12/24 VDC, 0.1 A	2)
Resistor regenerative option	MR-RB013	External regenerative resistor 10 W	4)
	MR-RB032	External regenerative resistor 30 W	
	MR-RB033	External regenerative resistor 30 W	
	MR-RB064	External regenerative resistor 60 W	
	MR-RB064X2	External regenerative resistor 100 W (Two connected in series)	
	MR-RB12	External regenerative resistor 100 W	
	MR-RB30	External regenerative resistor 300 W	
	MR-RB31	External regenerative resistor 300 W	
	MR-RB32	External regenerative resistor 300 W	
	MR-RB34	External regenerative resistor 300 W	
	MR-RB50	External regenerative resistor 500 W	
	MR-RB51	External regenerative resistor 500 W	
	MR-RB54	External regenerative resistor 500 W	
	MR-H11KB Standard accessory	Regenerative power 600 W, resistance value 8 Ω (2 Ω x 4) (When cooled by cooling fan: 800 W)	
	MR-H15KB Standard accessory	Regenerative power 600 W, resistance value 5 Ω (1 Ω x 5) (When cooled by cooling fan: 1300 W)	
	MR-H22KB Standard accessory	Regenerative power 600 W, resistance value 4 Ω (0.8 Ω x 5) (When cooled by cooling fan: 1300 W)	
	FR-BU	Brake unit FR-BU15/30/55K	
	FR-RC	Power supply regenerative converter	
Battery unit	MR-JBAT4	Backs up absolute position sensing	3)

2) Motor types/model names, and amplifier model names, that can be set in system settings
   • When using MR-H-B/MR-J-B

Table 4.2 Servo Amplifier Model Names When Using an MR-H-B/MR-J-B

Amplifier Model Name		Number in the Setting Example
MR-H-B	MR-H10B MR-H20B MR-H40B MR-H60B MR-H100B MR-H200B MR-H350B MR-H500B MR-H700B MR-H11KB MR-H15KB MR-H22KB	5) to 8)

Amplifier Model Name		Number in the Setting Example
MR-J-B	MR-J10B MR-J20B MR-J40B MR-J60B MR-J100B MR-J200B	5) to 8)

Table 4.3 Motor Types and Model Names When Using an MR-H-B/MR-J-B

Motor Type	Motor Model Name	Number in the Setting Example
HA-MH	HA-MH053 HA-MH13 HA-MH23 HA-MH43 HA-MH73	9) to 12)
HA-FH	HA-FH053 HA-FH13 HA-FH23 HA-FH33 HA-FH43 HA-FH63	
HA-SH 1000 rpm	HA-SH81 HA-SH121 HA-SH201 HA-SH301	
HA-SH 2000 rpm	HA-SH52 HA-SH102 HA-SH152 HA-SH202 HA-SH352 HA-SH502 HA-SH702	
HA-SH 3000 rpm	HA-SH53 HA-SH103 HA-SH153 HA-SH203 HA-SH353	

Motor Type	Motor Model Name	Number in the Setting Example
HA-RH	HA-RH103 HA-RH153 HA-RH223	9) to 12)
HA-LH	HA-LH52 HA-LH102 HA-LH152 HA-LH202 HA-LH302 HA-LH502 HA-LH702 HA-LH11K2 HA-LH15K2 HA-LH22K2	
HA-UH	HA-UH32 HA-UH52 HA-UH102 HA-UH152 HA-UH222 HA-UH352 HA-UH452	

• When using MR-J2-B

Table 4.4 Servo Amplifier Model Names When Using an MR-J2-B

Amplifier Model Name		Number in the Setting Example
MR-J2-B	MR-J2-10B MR-J2-20B MR-J2-40B MR-J2-60B MR-J2-70B MR-J2-100B	5) to 8)

Table 4.5 Motor Types and Model Names When Using an MR-J2-B

Motor Type	Motor Model Name	Number in the Setting Example
HC-MF	HC-MF053 HC-MF13 HC-MF23 HC-MF43 HC-MF73	9) to 12)
HA-FF	HA-FF053 HA-FF13 HA-FF23 HA-FF33 HA-FF43 HA-FF63	
HC-SF	HC-SF52 HC-SF102	

3) System setting examples
The system setting examples are shown in Figures 4.3 and 4.4. (The numbers 1) through 12) in these figures correspond to the numbers in Tables 4.1 through 4.5.)

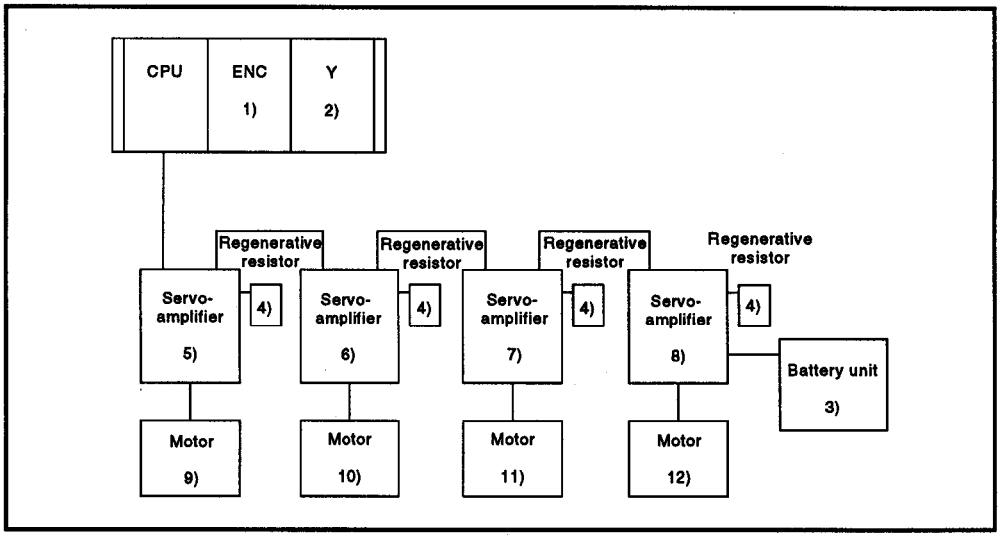


Fig. 4.1 System Settings (When no Extension Base Unit is Used)

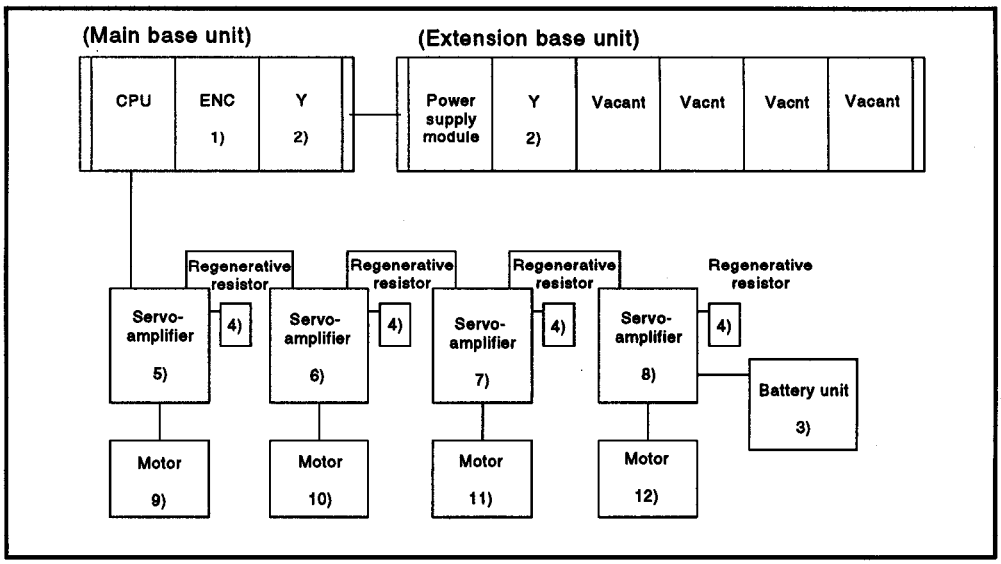


Fig. 4.2 System Settings (When an Extension Base Unit is Used)

(b) When an A273UHCPU (8/32 axis) is used

1) Model names of modules/units that can be set in system settings

Table 4.6 Module/Unit Model Names

Module/Unit Name		Model Name	Remarks			Number in Setting Example
Main base unit		A275B	Allows loading of a total of 5 motion modules and MELSEC A series standard I/O modules			—
		A278B	Allows loading of a total of 8 motion modules and MELSEC A series standard I/O modules			
Control power supply module		A61P	Input: 100/200 VAC; output: 5 VDC 8 A			1)
		A62P	Input: 200/200 VAC; output: 5 VDC 5 A, 24 VDC 0.8 A			
		A63P	Input: 24VDC; output: 5 VDC 8 A			
Motion modules	AC motor drive module	A221AM-20	Max. drive motor capacity 200 W (When using HA-FH)/100W (When using HA-MH), 2 axes (occupies 1 slot)	Main base unit / Motion extension base unit	Installed	4) to 6)
		A211AM-20	Max. drive motor capacity 600 W, 1 axis (occupies 1 slot)			
		A222AM-20	Max. drive motor capacity 600 W, 2 axes (occupies 2 slots)			
	Servo power supply module	A230P	240 to 342 VDC, 30 A output (regenerative resistor not incorporated)			7)
	Dynamic brake module	A240DY	4-axis dynamic brake			3)
	Manual pulse generator/synchronous encoder interface module	A273EX	Manual pulse generator: 3 points Tracking input: 3 points			32)
	Servo external signal module	A278LX	External output: 5 points x 8 axes; brake/dynamic brake output			2)
	Limit output module	AY42	64 transistor points 12/24 VDC, 0.1 A			31)
	Machine control module	A271DVP	PC/AT			33)
Motion extension base unit		A255B	A combined total of 5 motion modules and MELSEC A series standard I/O modules can be loaded.	Type which does not require a control power supply module	Same as PC extension base unit	—
		A268B	A combined total of 8 motion modules and MELSEC A series standard I/O modules can be loaded.	Type for which a control power supply module is loaded.		

Module/Unit Name	Model Name	Remarks	Number in Setting Example
Resistor regenerative option	MR-RB013	External regenerative resistor 10 W	14)
	MR-RB032	External regenerative resistor 30 W	
	MR-RB033	External regenerative resistor 30 W	
	MR-RB064	External regenerative resistor 60 W	
		External regenerative resistor 100 W (Two connected in series) Can only be installed with a servo power supply module	
	MR-RB064X2	External regenerative resistor 100 W (Two connected in series)	
	MR-RB10	External regenerative resistor 100 W Can only be installed with a servo power supply module	
	MR-RB12	External regenerative resistor 100 W	
	MR-RB30	External regenerative resistor 300 W	
	MR-RB31	External regenerative resistor 300 W	
	MR-RB32	External regenerative resistor 300 W	
	MR-RB34	External regenerative resistor 300 W	
	MR-RB50	External regenerative resistor 500 W	
	MR-RB51	External regenerative resistor 500 W	
	MR-RB54	External regenerative resistor 500 W	
	MR-H11KB Standard accessory	Regenerative power 600 W, resistance value 8 Ω (2 Ω x 4) (When cooled by cooling fan: 800 W)	
	MR-H15KB Standard accessory	Regenerative power 600 W, resistance value 5 Ω (1 Ω x 5) (When cooled by cooling fan: 1300 W)	
	MR-H22KB Standard accessory	Regenerative power 600 W, resistance value 4 Ω (0.8 Ω x 5) (When cooled by cooling fan: 1300 W)	
	FR-BU	Brake unit FR-BU15/30/55K	
	FR-RC	Power supply regenerative converter	
	A300RU-50	Regenerative resistor 500 W Can only be installed with a servo power supply module	
Battery unit	MR-JBAT-4	4 axes max. • Battery that serves to back up absolute position sensing (motor (absolute value)).	8)
	MR-JBAT-8	8 axes max.	

2) Motor types/model names, and amplifier model names, that can be set in system settings

Table 4.7 Motor Types and Model Names When Using an ADU

Motor Type	Motor Model Name	Number in the Setting Example
HA-MH	HA-MH053 HA-MH13 HA-MH23 HA-MH43	9) to 13)
HA-FH	HA-FH053 HA-FH13 HA-FH23 HA-FH33 HA-FH43 HA-FH63	

Motor Type	Motor Model Name	Number in the Setting Example
HA-SH 2000 rpm	HA-SH52	9) to 13)
HA-SH 3000 rpm	HA-SH53	
HA-LH	HA-LH52	
HA-UH	HA-UH32 HA-UH52	

• When using MR-H-B/MR-J-B

Table 4.8 Servo Amplifier Model Names When Using MR-H-B/MR-J-B

Amplifier Model Name		Number in the Setting Example
MR-H-B	MR-H10B MR-H20B MR-H40B MR-H60B MR-H100B MR-H200B MR-H350B MR-H500B MR-H700B MR-H11KB MR-H15KB MR-H22KB	15) to 22)

Amplifier Model Name		Number in the Setting Example
MR-J-B	MR-J10B MR-J20B MR-J40B MR-J60B MR-J100B MR-J200B	15) to 22)

Table 4.9 MR-H-B/MR-J-B Motor Types and Motor Model Names

Motor Type	Motor Model Name	Number in the Setting Example
HA-MH	HA-MH053 HA-MH13 HA-MH23 HA-MH43 HA-MH73	23) to 30)
HA-FH	HA-FH053 HA-FH13 HA-FH23 HA-FH33 HA-FH43 HA-FH63	
HA-SH 1000 rpm	HA-SH81 HA-SH121 HA-SH201 HA-SH301	
HA-SH 2000 rpm	HA-SH52 HA-SH102 HA-SH152 HA-SH202 HA-SH352 HA-SH502 HA-SH702	
HA-SH 3000 rpm	HA-SH53 HA-SH103 HA-SH153 HA-SH203 HA-SH353	

Motor Type	Motor Model Name	Number in the Setting Example
HA-RH	HA-RH103 HA-RH153 HA-RH223	23) to 30)
HA-LH	HA-LH52 HA-LH102 HA-LH152 HA-LH202 HA-LH302 HA-LH502 HA-LH702	
HA-LHK	HA-LH11K2 HA-LH15K2 HA-LH22K2	
HA-UH	HA-UH32 HA-UH52 HA-UH102 HA-UH152 HA-UH222 HA-UH352 HA-UH452	

• When using MR-J2-B

Table 4.10 Servo Amplifier Model Names When Using an MR-J2-B

Amplifier Model Name		Number in the Setting Example
MR-J2-B	MR-J2-10B MR-J2-20B MR-J2-40B MR-J2-60B MR-J2-70B MR-J2-100B	15) to 22)

Table 4.11 Motor Types and Model Names When Using an MR-J2-B

Motor Type	Motor Model Name	Number in the Setting Example
HC-MF	HC-MF053 HC-MF13 HC-MF23 HC-MF43 HC-MF73	23) to 30)
HA-FF	HA-FF053 HA-FF13 HA-FF23 HA-FF33 HA-FF43 HA-FF63	
HC-SF	HC-SF52 HC-SF102	

3) System setting examples
The system setting examples are shown in Figures 4.3 and 4.4. (The numbers 1) through 32) in these figures correspond to the numbers in Tables 4.7 through 4.11.)

<A273UHCPU (8/32 axis specification)>

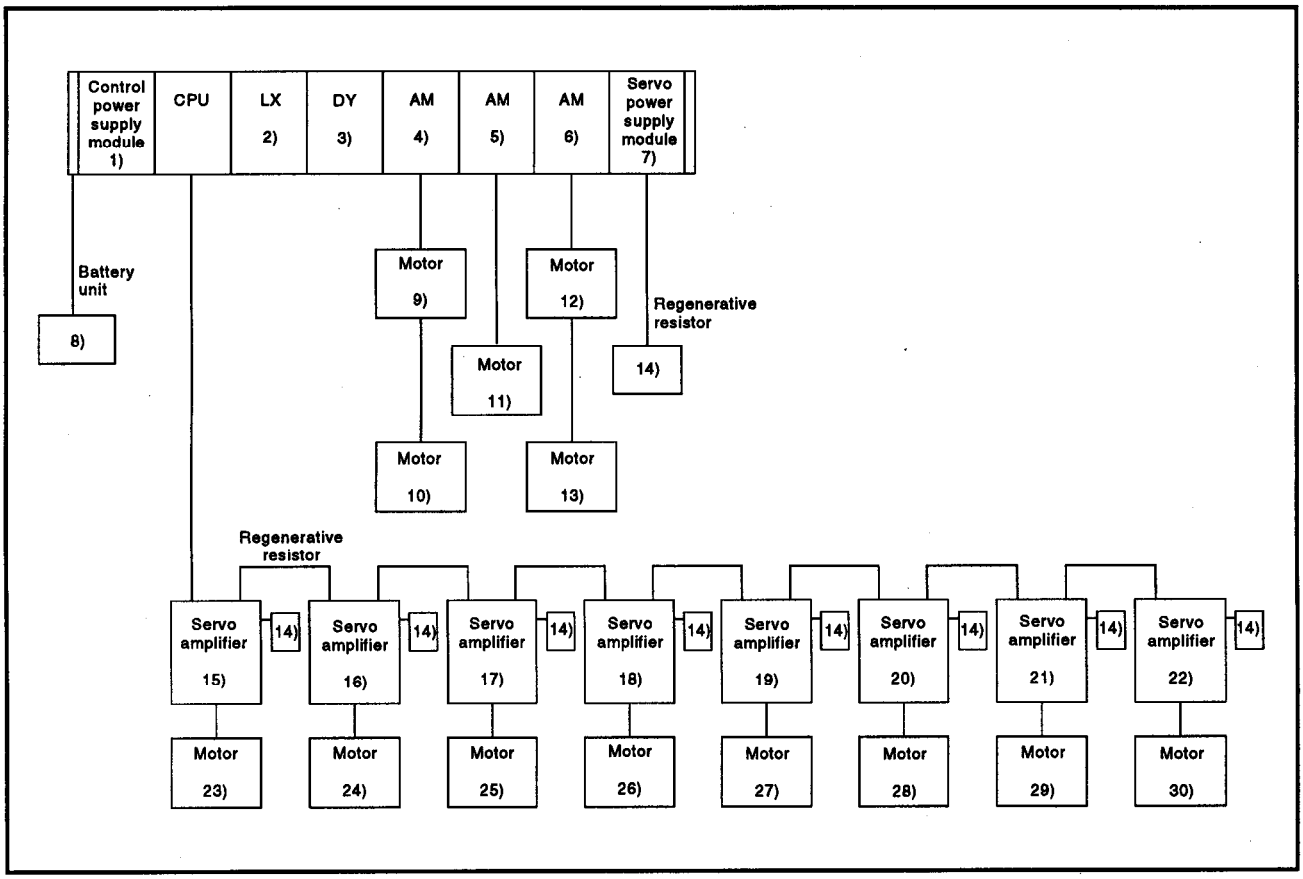


Fig. 4.3 System Settings (When no Motion Extension Base Unit is Used)

<A273UHCPU (8/32 axis specification)>

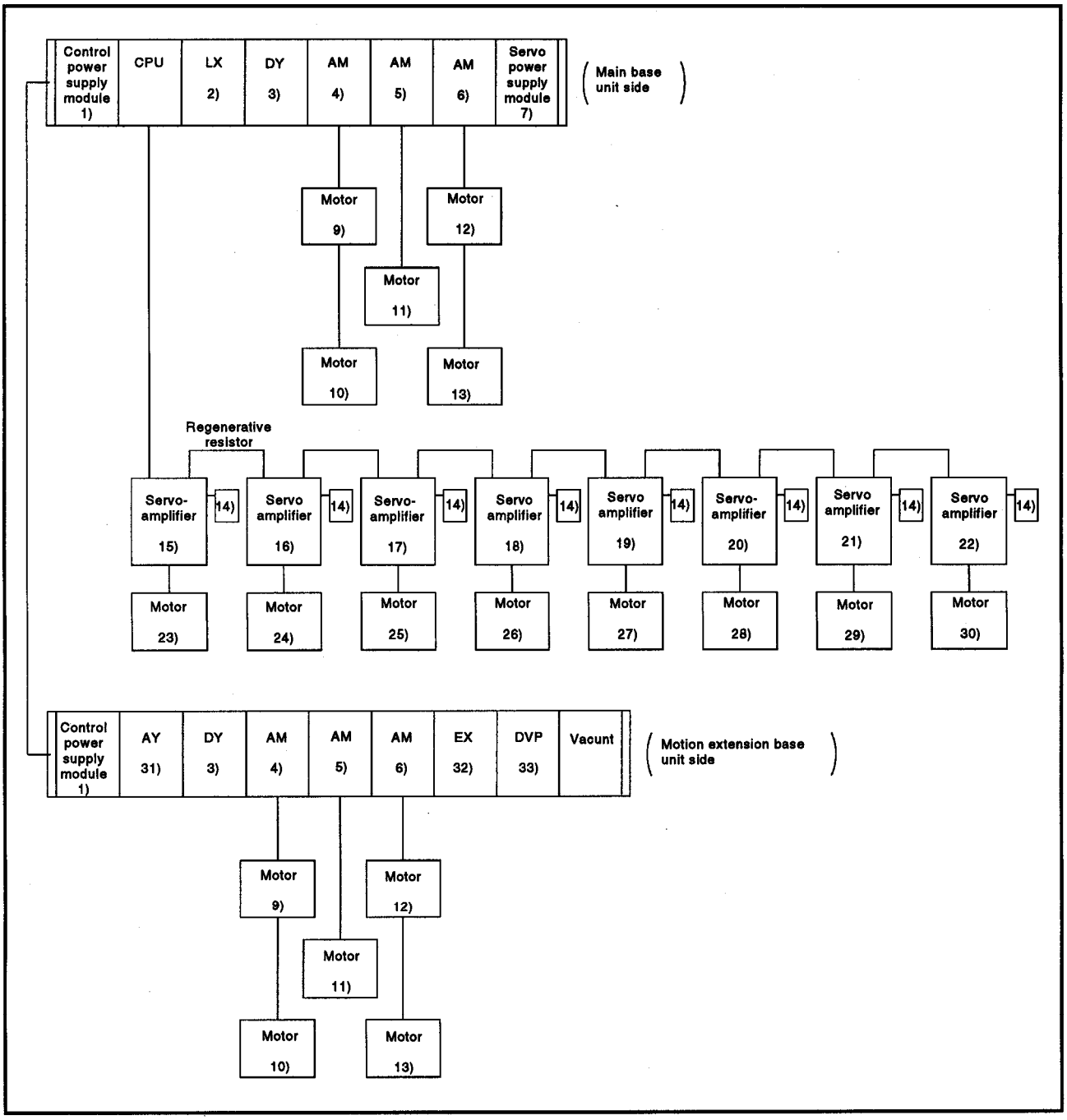


Fig. 4.4 System Settings (When a Motion Extension Base Unit Is Used)

4.2 Fixed Parameters

(1) The fixed parameters are set for each axis and their data is fixed in accordance with the mechanical system or other factors.

(2) The fixed parameters are set with a peripheral device.

(3) The fixed parameters to be set are shown in Table 4.12.

Table 4.12 Fixed Parameters

No.	Item	Setting Range								Default		Remarks	Explanatory Section
		mm		inch		degree		PULSE		Initial Value	Units		
		Setting Range	Units	Setting Range	Units	Setting Range	Units	Setting Range	Units				
1	Unit setting	0	—	1	—	2	—	3	—	3	—	• Set the command unit in positioning control for each axis.	—
2	Travel value per pulse (A): Number of pulses per revolution (Ap)	1 to 65535 PLS								20000	PLS	• Set the number of feedback pulses per motor revolution, which is determined by the mechanical system.	4.2.1
3	Travel value per pulse (A): Travel value per revolution (AL)	0.1 to 6553.5	μm	0.00001 to 0.65535	inch	0.00001 to 0.65535	degree	1 to 65535	PLS	20000	PLS	• Set the travel value per motor revolution, which is determined by the mechanical system.	
4	Travel value per pulse (A): Unit magnification (AM)	1: x 1, 10: x 10, 100: x 100, 1000: x 1000						—	—	—	—	• Set to change the magnification for the travel value per pulse.	
5	Backlash compensation amount*	0 to 65535.5	μm	0 to 0.65535	inch	0 to 0.65535	degree	0 to 65535	PLS	0	PLS	• Set the amount of backlash in the machine. • Every time the positioning direction changes during positioning, compensation by the backlash compensation amount is executed. The expression below shows the setting range. 0≤(backlash compensation amount) x AP/AL·AM≤65535	8.3
6	Upper stroke limit*	-214748364.8 to 214748364.7	μm	-21474.83648 to 21474.83647	inch	0 to 359.99999	degree	-2147483648 to 2147483647	PLS	2147483647	PLS	• Set the upper limit for the machine travel value. The expression below shows the setting range. (SV13 only) -2147483648≤(upper stroke limit) x AP/AL·AM ≤ 2147483647	4.2.2
7	Lower stroke limit*	-214748364.8 to 214748364.7	μm	-21474.83648 to 21474.83647	inch	0 to 359.99999	degree	-2147483648 to 2147483647	PLS	0	PLS	• Set the lower limit for the machine travel value. The expression below shows the setting range. (SV13 only) -2147483648≤(lower stroke limit) x AP/AL·AM ≤2147483647	

Table 4.12 Fixed Parameters (Continued)

No.	Item	Setting Range								Default		Remarks	Explanatory Section
		mm		inch		degree		PULSE		Initial Value	Units		
		Setting Range	Units	Setting Range	Units	Setting Range	Units	Setting Range	Units				
8	Command in-position range*	0.1 to 214748364.7	μm	0.00001 to 21474.83647	inch	0.00001 to 359.99999	degree	1 to 2147483647	PLS	100	PLS	• Set the position at which the command in-position signal (M1603+20n/Xn3/ M2403+20n) is turned ON [(positioning address) – (present value)]. The expression below shows the setting range. 1≤(command in-position range) x AP/AL·AM≤32767	4.2.3
9	Limit switch output used/not used	0: Not used 1: Used								0	—	• Set whether the limit switch output function is used or not for each axis.	8.1

* : The display of the possible setting range differs according to the electronic gear value.

4.2.1 Setting the number of pulses per revolution / travel value per revolution / unit magnification

This section explains how to set the number of pulses per revolution, the travel value per revolution, and the unit magnification.

(1) Setting method 1

(a) Finding the smallest position resolution (Δl).
The smallest position resolution (Δl) is determined by the travel value per revolution (ΔS) and the number of encoder feedback pulses (P_f).

$$\Delta l = \frac{\Delta S}{P_f}$$

(b) Finding the unit magnification (A_M)
Find the unit magnification on the basis of Δl determined as described in (a) above. However, make sure that the smallest command unit is not smaller than Δl.

Δl found in (a) [mm]	Smallest Command Unit [mm]	Unit Magnification (A_M)
$0.00001 < \Delta l \leq 0.0001$	0.0001	1
$0.0001 < \Delta l \leq 0.001$	0.001	10
$0.001 < \Delta l \leq 0.01$	0.01	100
$0.01 < \Delta l \leq 0.1$	0.1	1000

[Example] Assuming that the travel value per revolution (ΔS) is 10 [mm] and the number of encoder feedback pulses (P_f) is 1200 [pulse/rev]:

$$\Delta l = \frac{10\ [\text{mm}]}{12000\ [\text{pulse/rev}]} = 0.00083 \rightarrow 0.0001 < 0.00083 \leq 0.001$$

This means that the smallest command unit is 0.001 [mm] and the unit magnification (A_M) is 10.
Therefore, 0.001 [mm] units can be specified in commands.

(c) Finding the travel value per revolution (A_L).
If the unit magnification (A_M) is "1", the travel value per revolution is the value of A_L, unchanged. If the unit magnification (A_M) is a value other than "1", the travel value per revolution is the product of A_L and A_M.

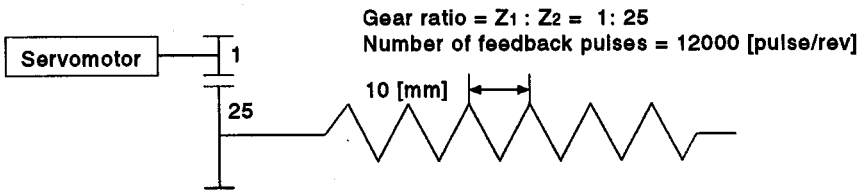
[Example] Assume that the travel value per revolution is 10 [mm] and the unit magnification is 10:

$$A_L = \frac{10000.0\ [\mu\text{m}]}{10} = 1000.0\ [\mu\text{m}]$$

Accordingly, 1000.0 [μm] is set as the travel value per revolution (A_L) in this case.

(d) Number of pulses per revolution (A_P)
Set the number of feedback pulses per revolution of the encoder.

(e) The number of pulses per revolution, travel value per revolution, and unit magnification for the example configuration shown here are calculated below.



1) Travel value per feedback pulse

$$\Delta S = 10 \times \frac{Z_1}{Z_2} = 10 \times \frac{1}{25}$$

$$\Delta l = \frac{\Delta S}{P_f} = \frac{10}{25 \times 12000} = 0.000033... \rightarrow \Delta l = 0.0001$$

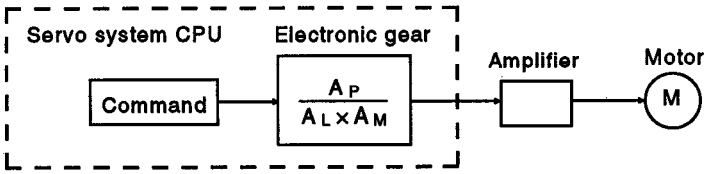
2) Unit magnification (A_M)
Since Δl is 0.0001, the unit magnification (A_M) is "1".

3) Travel distance per revolution (A_L)

$$A_L = \frac{10\,[mm]}{25} = 0.4\,[mm] = 400.0\,[\mu m]$$

4) Number of pulses per revolution (A_P)
A_P = 12000 [pulse/rev] ... fixed according to the encoder model.

(2) Setting method 2
If A_L cannot be set by using setting method 1, calculate the numerator and denominator of the electronic gear, and set A_P as the numerator and A_L x A_M as the denominator.



Example: With the example configuration shown above, and under the following conditions;

{ Gear ratio = Z1:Z2 = 1:39
{ Ball screw pitch = 25.4 [mm]

$$A_L = \frac{25.4\,[mm]}{39} = 0.65128205\,[mm] = 651.28205\,[\mu m]$$

and A_L cannot be set, calculate as follows....

Electronic gear

$$= \frac{P_f}{\Delta S} \times \frac{12000\,[pulse]}{25.4\,[mm] \times 1000 \times \frac{1}{39}} = \frac{468000}{25400} = \frac{2340}{127} \quad \begin{matrix} .....A_P \\ .....A_L \times A_M \end{matrix}$$

{ A_P = 2340 [pluse]
{ A_L *= 12.7 [μm] ...and set the following values.
{ A_M = 1

*: When actually setting A_L, calculate it as indicated in the table below.

Unit	Set Value for A (when A_M is "1")
mm	Denominator x 10^{-1} [μm]
inch	Denominator x 10^{-5} [inches]
degree	Denominator x 10^{-5} [degrees]
PULSE	Denominator [pulses]

4.2.2 Upper stroke limit value/lower stroke limit value

These are the settings for the upper limit value and lower limit value in the travel range of the mechanical system.

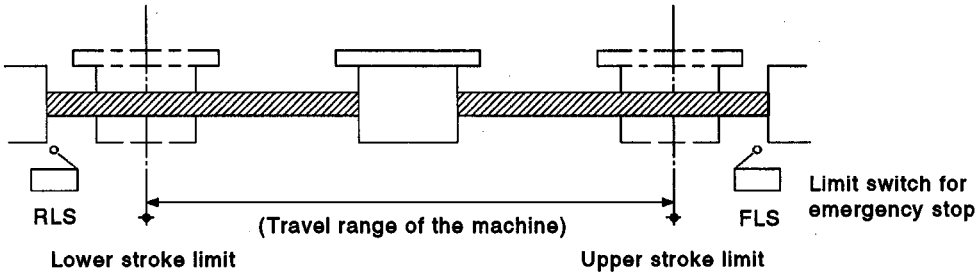


Fig. 4.5 Travel Range When Setting the Upper Stroke Limit Value and Lower Stroke Limit Value

(1) Stroke limit range check
The stroke limit range check is executed when the operations indicated in the table below are started or while they are in progress.

Operation Started	Check Executed/ Not Executed	Remarks
Positioning control	Executed	• When positioning is started, it is checked whether the feed present value is within the stroke limit range or not. If it outside the range, an error occurs (error code 106) and positioning is not executed. • When circular interpolation is in progress, if the interpolation path goes outside the stroke limit range, an error occurs (error codes: 207, 208) and axis motion decelerates to a stop.
Fixed-pitch feed control	Executed	—
Speed control (I) Speed control (II)	Not executed	• The present value becomes "0", and motion continues until the external limit signal (FLS, RLS, STOP) is received.
Speed/position switching control (including restart)	Executed	• The check is executed after the switch to position control.
JOG operation	Executed	• If the present value goes outside the stroke limit range, motion stops. Travel in the direction that returns the axes into the stroke range is possible.
Speed switching control	Executed	—
Constant speed control	Executed	—
Position follow-up control	Executed	• While positioning is in progress, it is checked whether the feed present value is within the stroke limit range. If it outside the range, an error occurs (error code 106) and positioning is not executed.
Manual pulse generator operation	Executed	• If the present value goes outside the stroke limit range, motion stops.

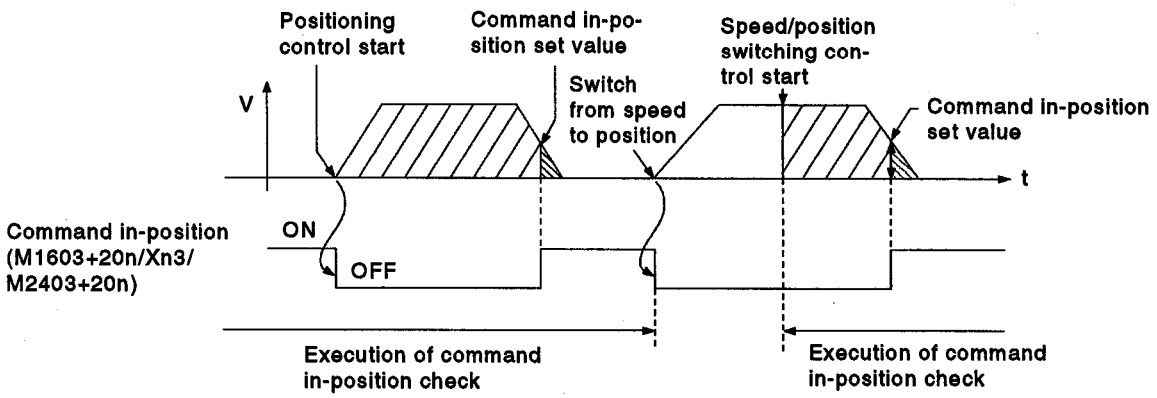
POINTS

(1) Besides setting the stroke limit upper limit value/lower limit value in the fixed parameters, the stroke limit range can also be set by using the external limit signals (FLS, RLS).

(2) When the external limit signal goes OFF, a deceleration stop is executed.
The time taken to decelerate to a stop can be set by setting the "deceleration time" and "rapid stop deceleration time" in the parameter block.

4.2.3 Command in-position range

The command in-position is the difference between the positioning address (command position) and feed present value.
Once the value for the command in-position has been set, the command in-position signal (M1603+20n/Xn3/M2403+20n) will come ON when the difference between the command position and the feed present value enters the set range [(command position – feed present value) ≤ (command in-position range)].
The command in-position range check is executed continuously during positioning control.



4.3 Servo Parameters

(1) The servo parameters are parameters set for each axis: their settings are data fixed by the specifications of the controlled motors and data required to execute servo control.

(2) The servo parameters are set with a peripheral device.

⚠ CAUTION
⚠ After setting the servo parameters at a peripheral device, execute a "RELATIVE CHECK" and execute positioning control in the "NO ERROR" status. If there is an error, check the relevant points indicated in this manual and reset it.

4.3.1 ADU servo parameters (applicable only when using A273UHCPU (8/32 axis specification))

The servo parameters to be set are indicated in Tables 4.13 through 4.14.

(1) Basic parameters

Table 4.13 Servo Parameters (Basic Parameters)

No.	Item	Setting Range								Default		Remarks	Explanatory Section
		mm		inch		degree		PULSE		Initial Value	Units		
		Setting Range	Units	Setting Range	Units	Setting Range	Units	Setting Range	Units				
*1	Amplifier setting	Not displayed on the screen											4.1
*2	Regenerative resistor												
*3	External dynamic brake												
*4	Motor type	Set automatically in accordance with the system settings.											
*5	Motor capacity												
6	Motor rpm (R)												
7	Number of feedback pulses (N)												APP. 6
*8	Direction of rotation	0: Forward rotation (CCW) when the positioning address increases. 1: Reverse rotation (CW) when the positioning address decreases.								0	—	• Set the direction of rotation as seen from the load side. Forward rotation: reverse rotation:	—
9	Automatic tuning	0: Speed only 1: Position/speed 2: Not executed								2	—	• Set the gain (speed/position, speed) for executing automatic setting	4.3.9
10	Servo responsiveness	1 to 12								1	—	• Set in order to increase servo responsiveness.	4.3.10

POINT

After changing any of the items marked "*" in the table above, turn the servo power supply on after resetting the servo system CPU with the key switch or turning the PC READY signal (M2000) ON.

(2) Adjustment parameters

Table 4.14 Servo Parameters (Adjustment Parameters)

No.	Item	Setting Range								Default		Remarks	Explanatory Section
		mm		Inch		degree		PULSE		Initial Value	Units		
		Setting Range	Units	Setting Range	Units	Setting Range	Units	Setting Range	Units				
1	Load inertia ratio	0.1 to 20.0								3.0	—	• Set the ratio of moment of load inertia for the motor.	4.3.8
2	Position control gain 1	Valid range 5 to 500 rad/sec Setting range 1 to 9999 rad/sec								70	rad/sec	• Set to increase the follow-up with respect to the position command.	4.3.3
3	Speed control gain 1	Valid range 20 to 5000 rad/sec Setting range 1 to 9999 rad/sec								1200	rad/sec	• Set to increase the follow-up with respect to the speed command.	4.3.4
4	Position control gain 2	Valid range 5 to 100 rad/sec Setting range 1 to 9999 rad/sec								25	rad/sec	• Set to increase the position response with respect to load disturbance.	4.3.3
5	Speed control gain 2	Valid range 20 to 8000 rad/sec Setting range 1 to 9999 rad/sec								600	rad/sec	• Set when vibration is generated, for example in machines with a large backlash.	4.3.4
6	Speed integral compensation	Valid range 2 to 240 rms Setting range 2 to 240 ms								20	ms	• Set the time constant for integral compensation.	4.3.5
7	Notch filter	———								—	—	• Cannot be set	—
8	Feed forward gain	0 to 150% 0: Feed forward control is not executed.								0	%	• Set the feed forward coefficient used in positioning control.	4.3.7
9	In-position range* (SV13)	0.1 to 214748364.7	μm	0.00001 to 2147.83647	inch	0.00001 to 359.99999	degree	1 to 2147483647	PLS	100	PLS	• Sets the quantity of droop pulses in the deviation counter. • The in-position signal is ON when the number of droop pulses is within the set range.	4.3.6
	In-position range* (SV22)	0.1 to 3276.7	μm	0.00001 to 0.32767	inch	0.00001 to 0.32767	degree	1 to 32767	PLS				
10	Electro-magnetic brake sequence	———								—	—	• Cannot be set	—

4.3.2 MR-[ ]-B servo parameters

The servo parameters to be set are indicated in Tables 4.15 through 4.17.

(1) Basic parameters

Table 4.15 Servo Parameters (Basic Parameters)

No.	Item	Setting Range								Default		Remarks	Explanatory Section
		mm		Inch		degree		PULSE		Initial Value	Units		
		Setting Range	Units	Setting Range	Units	Setting Range	Units	Setting Range	Units				
*1	Amplifier setting	Set automatically in accordance with the system settings.											4.1
*2	Regenerative resistor												
*3	External dynamic brake												
*4	Motor type												
*5	Motor capacity												
6	Motor rpm (R)												
7	Number of feedback pulses (N)												APP. 6
*8	Direction of rotation	0: Forward rotation (CCW) when the positioning address increases. 1: Reverse rotation (CW) when the positioning address decreases.								0	—	• Set the direction of rotation as seen from the load side. Forward rotation: reverse rotation:	—
9	Automatic tuning	0: Speed only 1: Position/speed 2: Not executed								1 *1	—	• Set the gain (speed/position, speed) for executing automatic setting	4.3.9
10	Servo responsiveness	1 to 12								1	—	• Set in order to increase servo responsiveness.	4.3.10

*1: For MR-J-B, the default is "2".

POINT

After changing any of the items marked "*" in the table above, turn the servo power supply on after resetting the servo system CPU with the key switch or turning the PC READY signal (M2000) ON.

(2) Adjustment parameters

Table 4.16 Servo Parameter List (Adjustment Parameters)

No.	Item	Setting Range								Default		Remarks	Explanatory Section
		mm		inch		degree		PULSE		Initial Value	Units		
		Setting Range	Units	Setting Range	Units	Setting Range	Units	Setting Range	Units				
1	Load inertia ratio	0.0 to 100.0								*1 3.0	—	• Set the ratio of moment of load inertia for the motor.	4.3.8
2	Position control gain 1	Valid range 4 to 1000 rad/sec Setting range 1 to 9999 rad/sec								70	rad/sec	• Set to increase the follow-up with respect to the position command.	4.3.3
3	Speed control gain 1	Valid range 20 to 5000 rad/sec Setting range 1 to 9999 rad/sec								1200	rad/sec	• Set to increase the follow-up with respect to the speed command.	4.3.4
4	Position control gain 2	Valid range 10 to 500 rad/sec Setting range 1 to 9999 rad/sec								25	rad/sec	• Set to increase the position response with respect to load disturbance.	4.3.3
5	Speed control gain 2	Valid range 20 to 5000 rad/sec Setting range 1 to 9999 rad/sec								*2 600	rad/sec	• Set when vibration is generated, for example in machines with a large backlash.	4.3.4
6	Speed integral compensation	Valid range 1 to 1000 rms Setting range 1 to 9999 rad/sec								20	ms	• Set the time constant for integral compensation.	4.3.5
7	Notch filter	0: Not used 1: 1125 2: 750 3: 562 4: 450 5: 375 6: 321 7: 281								0	Hz	• Set the frequency for the notch filter.	4.3.11
8	Feed forward gain	0 to 100% 0: Feed forward control is not executed.								0	%	• Set the feed forward coefficient used in positioning control.	4.3.7
9	*3 In-position range	0.1 to 214748364.7	μm	0.00001 to 21474.83647	inch	0.00001 to 359.99999	degree	1 to 2147483647	PLS	100	PLS	• Sets the quantity of droop pulses in the deviation counter. • The in-position signal is ON when the number of droop pulses is within the set range. The expression below shows the setting range. 1≤(in-position range) xAP/AL·AM≤32767	4.3.6
10	*4 Electro-magnetic brake sequence	0 to 1000 ms								100	ms	• Set the time delay between actuation of the electromagnetic brake and base disconnection.	4.3.12
11	Monitor output mode (monitor 1)	(MR-H-B/MR-J-B) 0: Speed (±) 1: Torque (±) 2: Speed (+) 3: Torque (+) 4: Current command output 5: Command FAT 6: Droop pulse 1/1 7: Droop pulse 1/4 8: Droop pulse 1/16 9: Droop pulse 1/32 (MR-J2-B) 0: Speed (±) 1: Torque (±) 2: Speed (+) 3: Torque (+) 4: Current command output 5: Command FAT 6: Droop pulse 1/1 7: Droop pulse 1/16 8: Droop pulse 1/64 9: Droop pulse 1/256 10: Droop pulse 1/1024								0	—	• Set the monitor items output as analog outputs in real time.	4.3.13
12	*4 Monitor output mode (monitor 2)									1	—		
13	Optional function 1 (carrier frequency selection)	0: 2.25 kHz (non low-noise operation) 3: 9 kHz (low-noise operation)								0	kHz	• Set "low noise" to improve the sound of the frequencies generated from the motor.	4.3.14
14	*4 Optional function 1 (Encoder type)	0: 2-wire type 1: 4-wire type								0	—	• Set the type of encoder cable.	4.3.14

*1: For MR-J2-B, the default is "7.0".
*2: For MR-J-B, the default is "500".
*3: The display of the possible setting range differs according to the electronic gear value.
*4: Setting not possible for MR-J-B.

Table 4.16 Servo Parameter List (Adjustment Parameters) (Continued)

No.	Item	Setting Range								Default		Remarks	Explanatory Section
		mm		Inch		degree		PULSE		Initial Value	Units		
		Setting Range	Units	Setting Range	Units	Setting Range	Units	Setting Range	Units				
15	*5 Optional function 1 (external emergency stop signal)	0 : Used 1 : Not used								0	—	• To invalidate the external emergency stop signal (EMG) set "not used".	4.3.14
16	*6 Optional function 2 (selection of no-motor operation)	0 : Invalid 1 : Valid								0	—	• To check the status without connecting a motor, set "valid".	4.3.15
17	*6 Optional function 2 (electro-magnetic brake interlock output timing)	0 : Regardless of the rotational speed of the servo motor, output occurs under any of the following conditions. • Servo OFF • Occurrence of an alarm • Emergency stop input OFF (valid) 1 : Output occurs under any of the above conditions provided that the servo motor rota tional speed is zero (expansion parameters).								0	—	• Set the interlock timing for the electromagnetic brake interlock signal.	4.3.15
18	*5 Optional function 2 (selection of microvi-bration suppres-sion function)	0 : Valid 1 : Invalid								0	—	• Set "valid" to suppress vibration on stopping.	4.3.15
19	*5 Optional function 2 (motor lock operation)	0 : Valid 1 : Invalid								0	—	• To carry out test operation without rotating the motor, set "valid".	4.3.15

*5 : Cannot be set with MR-H-B/MR-J-B
*6 : Cannot be set with MR-J2-B

(3) Expansion parameters

Table 4.17 Servo Parameters (Expansion Parameters)

No.	Item	Setting Range								Default		Remarks	Explanatory Section
		mm		Inch		degree		PULSE		Initial Value	Units		
		Setting Range	Units	Setting Range	Units	Setting Range	Units	Setting Range	Units				
1	Motion output 1 offset	(MR-HB/MR-J-B) −9999 to 9999 mv				(MR-J2-B) -999 to 999 mv				0	mv	• Set the offset value for motion output 1.	4.3.16
2	*1 Motion output 2 offset	(MR-HB/MR-J-B) −9999 to 9999 mv				(MR-J2-B) -999 to 999 mv				*3 0	mv	• Set the offset value for motion output 2.	
3	*1 Pre-alarm data selection (sampling time selection)	0: 1.77 1: 3.55 2: 7.11 3: 14.2 4: 28.4								0	ms	• Set the analog data output when an alarm occurs.	4.3.17
4	*1 Pre-alarm data selection (data selection 1)	0: Speed (±) 1: Torque (±) 2: Speed (+) 3: Torque (+) 4: Current command output 5: Command FΔT 6: Droop pulse 1/1 7: Droop pulse 1/4 8: Droop pulse 1/16 9: Droop pulse 1/32								0	—		
5	*1 Pre-alarm data selection (data selection 2)									1	—		
6	Zero speed	0 to 10000 r/min								10000	r/min	• Set the speed at which the motor speed is judged to be "0".	4.3.18
7	Excessive error alarm level	1 to 1000 kPLS								80	kPLS	• Set the value at which an excessive droop pulses alarm is output.	4.3.19
8	Closed encoder rotation direction	0: CCW 1: CW								0	—	• Set the direction of rotation of the motor and closed encoder.	¤
9	Home position return reference encoder	0: MOTOR END 1: CLOSED PLG								0	—	• Set the encoder to serve as the reference when home position return is excuted.	¤
10	Optional function 5 (PI-PID control switching)	0: Invalid 1: Switching in accordance with droop during position control valid 2: Speed amplifier proportional control valid								0	—	• Set the conditions for PI-PID control switching.	4.3.20
11	Optional function 5 (Servo readout characters) *1	0: Japanese 1: English								0	—	• Set the display format for the parameter unit.	
12	*1 PI-PID switching position droop	0 to 50000 PLS								0	PLS	• Set the amount of position droop at the switch to PI-PID control when position control is executed.	4.3.21
13	*1 *2 Torque control compensation factor	−19 to 9979								0	—	• Set to expand the torque control range up to the speed limit value in torque control.	4.3.22
14	Speed differential compensation	0 to 10000								980	—	• Set the differential compensation value for the actual speed loop.	4.3.23

*1 : Cannot be set when using MR-J-B.
*2 : Cannot be set when using MR-J2-B.
*3 : For MR-J2-B, the default is "1".

Table 4.17 Servo Parameters (Expansion Parameters) (Continued)

No.	Item	Setting Range								Default		Remarks	Explanatory Section
		mm		inch		degree		PULSE		Initial Value	Units		
		Setting Range	Units	Setting Range	Units	Setting Range	Units	Setting Range	Units				
15	Number of gear teeth at motor side	0 to 65535								0	—	• Set the ratio between the nunber of gear teeth on the motor shaft and the number of gear teeth on the encoder shaft.	—
16	Number of gear teeth at machine side	0 to 65535								0	—		—
17	Number of closed encoder pulses	0 to 65535								0	—	• Set the resolution of the closed encoder within one revolotion (64 value).	—

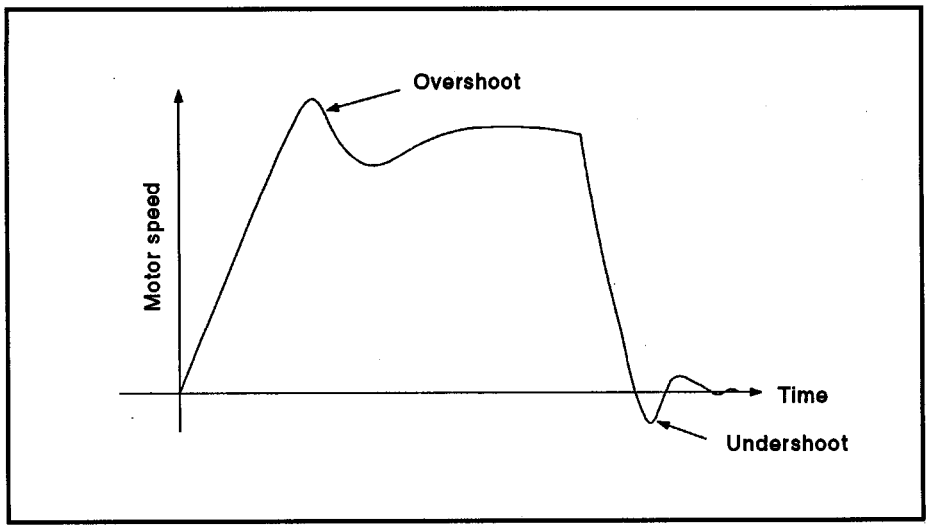
POINT

(1) The "setting range" for position control gain 1 and 2, speed control gain 1 and 2, and speed integral compensation can be set from a peripheral device, but if a setting outside the "valid range" is set, the following servo errors will occur when the power to the servo system CPU is turned ON, when the CPU is reset, and at the leading edge of the PC ready signal (M2000).

Servo Error Code	Error Contents	Processing
2613	Initial parameter error (position control gain 1)	Correct the setting for the relevant parameter so that it is within the "valid range", turn M2000 from OFF to ON, or reset with the reset key.
2614	Initial parameter error (speed control gain 1)	
2615	Initial parameter error (position control gain 2)	
2616	Initial parameter error (speed control gain 2)	
2617	Initial parameter error (speed integral compensation)	

4.3.3 Position control gain 1, 2

(1) Position control gain 1
   (a) Position control gain 1 is set in order to make the stabilization time shorter.
   (b) If the position control gain 1 is too high, it could cause overshoot and the value must therefore be adjusted so that it will not cause overshoot or undershoot.



(2) Position control gain 2
   (a) Position control gain 2 is set in order to increase position response with respect to load disturbance.
   (b) Calculate the position control gain 2 value to be set from the load inertia ratio and the speed control gain 2.

$$\text{Position control gain 2} = \frac{\text{Speed control gain 2}}{1 + \text{load inertia ratio}} \times \frac{1}{10}$$

POINTS

(1) If the position control gain 1 setting is too low, the number of droop pulses will increase and a servo error (excessive error error) will occur at high speed.

(2) The position control gain 1 setting can be checked from a peripheral device.
(For the method used to execute this check, refer to the operating manual for the peripheral device used.)

4.3.4 Position control gain 1, 2

(1) Position control gain 1
  (a) In the speed control mode
    Normally, no change is necessary.
  (b) In the position control mode
    Set to increase the follow-up with respect to commands.

(2) Speed control gain 2
  (a) Speed control gain 2 is set when vibration occurs, for example in low-rigidity machines or machines with a large backlash.
    When the speed control gain 2 setting is increased, responsiveness is improved but vibration (abnormal motor noise) becomes more likely.
  (b) A guide to setting position gain 2 is presented in Table 4.18 below.

Table 4.18 Guide to Speed Control Gain 2 Setting

Load Inertia Ratio (GD_L^2/GD_M^2)	1	3	5	10	20	30 or Greater	Remarks
Set value (ms)	800	1000	1500	2000	2000	2000	Setting possible within the range 1 to 9999 (valid range: 20 to 5000)

POINTS

(1) When the setting for speed control gain 1 is increased, the overshoot becomes greater and vibration (abnormal motor noise) occurs on stopping.

(2) The speed control gain 1 setting can be checked from a peripheral device.
(For the method used to execute this check, refer to the operating manual for the peripheral device used.)

4.3.5 Speed integral compensation

(1) This parameter is used to increase frequency response in speed control and improve transient characteristics.

(2) If the overshoot in acceleration/deceleration cannot be made smaller by adjusting speed loop gain or speed control gain, increasing the setting for the speed integral compensation value will be effective.

(3) A guide to setting the speed integral compensation is presented in Table 4.19 below.

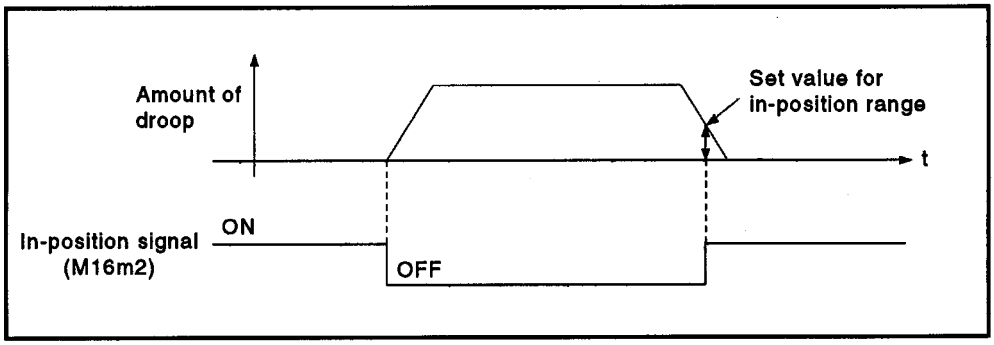
Table 4.19 Guide to Speed Integral Compensation Setting

Load Inertia Ratio (GD_L^2/GD_M^2)	1	3	5	10	20	30 or Greater	Remarks
Set value (ms)	20	30	40	60	100	200	Setting possible within the range 1 to 9999 (valid range: 1 to 1000)

4.3.6 In-position range

(1) The "in-position" refers to the quantity of droop pulses in the deviation counter.

(2) If an in-position value is set, the in-position signal (M16m2) will come ON when the difference between the position command and position feedback from the servomotor enters the set range.



4.3.7 Feed forward gain

This parameter is used to improve the follow-up of the servo system.
The setting range is as follows:

When using an ADU..... 0 to 1500 (× 0.1%)
When using an MR-[ ]-B ..... 0 to 100 (%)

4.3.8 Load inertia ratio

(1) This parameter sets the ratio of moment of load inertia for the servomotor.
The ratio of moment of load inertia is calculated using the equation below:

$$\text{Ratio of moment of load inertia} = \frac{\text{Moment of load inertia}}{\text{Motor's moment of inertia}}$$

(2) If automatic tuning is used, the result of automatic tuning is automatically set.

4.3.9 Automatic tuning

This is a function whereby the moment of inertia of the load is automatically calculated, and the most suitable gain is automatically set, by sensing the current and speed when motion starts.

POINT

When performing automatic tuning with MB-J-B, set the zero speed in the expansion parameters to at least 50 rpm.

4.3.10 Servo responsiveness setting

(1) This parameter setting is used to increase servo responsiveness. Changing the set value to a higher value in the sequence 1, 2..., 5 improves servo responsiveness.
For machines with high friction, use the set values in the range 8 through C.

Response settings

1: Low-speed response
2:
3:
4:
5: High-speed response

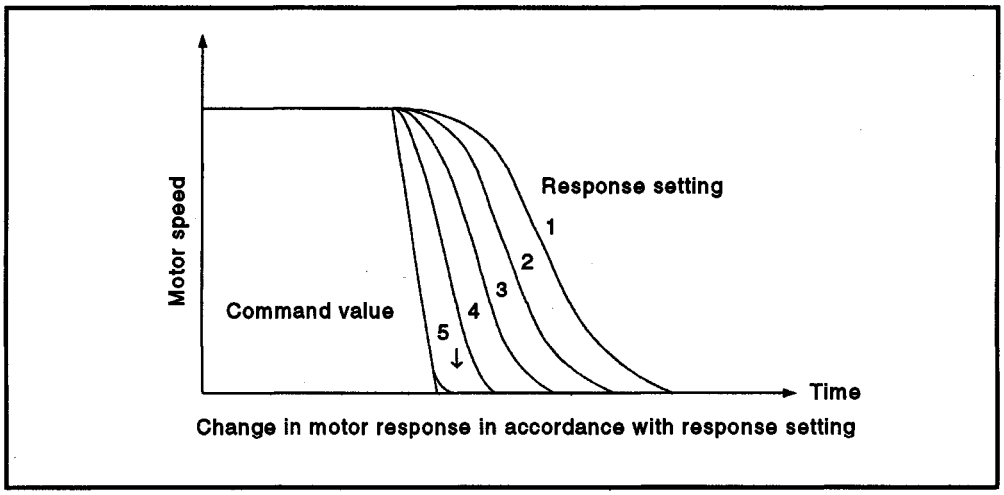
Normal machine ——— Standard mode
(MR-[ ]-B usable)

8: Low-speed response
9:
A:
B:
C: High-speed response

Machines with high friction ——— High frictional load mode
(only MR-H-B usable)

(2) Increase the response setting step by step starting from the low-speed response setting, observing the vibration and stop stabilization of the motor and machine immediately before stopping as you do so. If the machine resonates, decrease the set value.
If the load inertia is 5 times the motor inertia, make the set value 1 or greater.

(3) The figure below shows how the motor's response changes according to the servo responsiveness setting.



Change in motor response in accordance with response setting

(4) Change the servo responsiveness setting while the motor is stopped.

4.3.11 Notch filter

This parameter sets the notch frequency for the notch filter.

Set Value	Notch Frequency (Hz)
0	Not used
1	1125
2	750
3	562
4	450
5	375
6	321
7	281

4.3.12 Electromagnetic brake sequence

This parameter sets the time delay between actuation of the electromagnetic brake and base disconnection.
(applies only when using MR-H-B/MR-J2-B.)

4.3.13 Monitor output mode

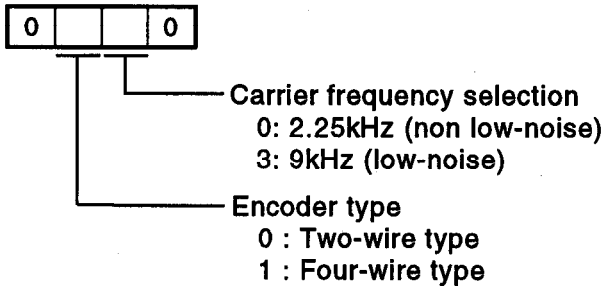
This parameter is set to output the operation status of the servo amplifier in real time as analog data.
This analog output makes it possible to check the operation status.
Note that the number of monitored items that can be set depends on the servo amplifier used, as indicated below:

When using an MR-H-B/MR-J2-B .... 2 types
When using an MR-J-B ..... 1 type

4.3.14 Optional function 1 (carrier frequency selection)

(1) Selection of carrier frequency
When low noise is set, the amount of electromagnetic noise of audible frequencies emitted from the motor can be reduced.

(2) Encoder type (applies only when using MR-H-B/MR-J2-B)
Set the type of encoder cable used.



POINT

(1) Optional function 1 (carrier frequency selection)
When low-noise is set, the continuous output capacity of the motor is reduced.

(3) External emergency stop signal (applies only when using MR-J2-B)
The external emergency stop signal (EMG) can be made invalid.
0 : External emergency stop signal is valid.
1 : External emergency stop signal is invalid (automatically turned ON internally).
Since the emergency stop signal at the MR-J2-B cannot be used, do not set "0".

4.3.15 Optional function 2 (no-motor operation selection)

(1) Selection of no-motor operation (applies when using MR-H-B/MR-J-B only)
0 : Invalid
1 : Valid
If no-motor operation is selected, the output signals that would be output if the motor were actually running can be output, and statuses indicated, without connecting the motor.
This makes it possible to check the sequence program of the PC CPU without connecting a motor.

(2) Electromagnetic brake interlock output timing (applies only when using MR-H-B/MR-J-B)
Select the output timing for the electromagnetic brake interlock signal from among the following.
0 : Regardless of the rotational speed of the servo motor, output occurs under any of the following conditions.
• Servo OFF
• Occurrence of an alarm
• Emergency stop input OFF (valid)
1 : Output occurs under any of the above conditions provided that the servo motor rotational speed is zero (expansion parameters).

(3) Selection of microvibration suppression function (applies to MR-J2-B)
Set to suppress vibration specific to the servo system on stopping.
0 : Microvibration suppression control is invalidated
1 : Microvibration suppression control is valid

(4) Motor lock operation (applies only when using MR-J2-B)
Allows test operation with the motor connected but without rotating the motor. The operation is the same as no-motor operation with MR-HB/MR-J-B.
0 : Motor lock operation is invalidated
0 : Motor lock operation is valid
When motor lock operation is made valid, operation is possible without connecting the motor. However, since when MR-J2-B is used the connected motor is automatically identified before operation is started, if no motor is connected the connected motor type may be regarded as a default, depending on the type of amplifier. If this default motor type differs from the setting made in the system settings, the controller will detect minor error 900 (motor type in system settings differs from actually mounted motor), but this will not interfere with operation.

4.3.16 Monitor output 1, 2 offset

Set the offset value for the monitored items set when setting monitor outputs 1 and 2.

POINT

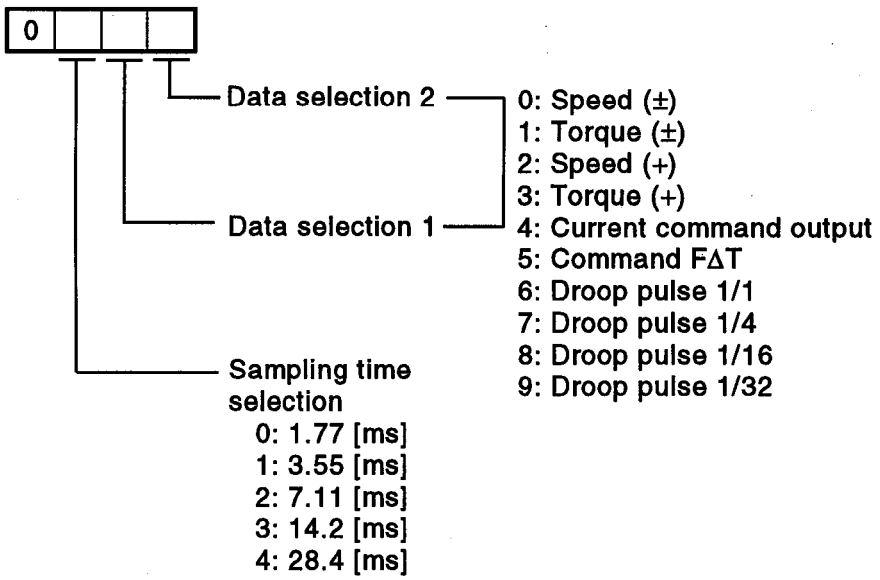
(1) Optional function 2 (no-motor operation selection)
No-motor operation differs from operation in which an actual motor is run in that, in response to signals input in no-motor operation, motor operation is simulated and output signals and status display data are created under the condition that the load torque zero and moment of load inertia are the same as the motor's moment of inertia. Accordingly, the acceleration/deceleration time and effective torque, and the peak load display value and the regenerative load ratio is always 0, which is not the case when an actual motor is run.

4.3.17 Pre-alarm data selection

Used to output from the servo amplifier in analog form the data status when an alarm occurs.
(applies only when using MR-H-B/MR-J2-B)

(1) Sampling time selection
Set the intervals in which the data status data when an alarm occurs is recorded in the servo amplifier.

(2) Data selection
Set the data output in analog form from the servo amplifier.
Two types of data can be set.



4.3.18 Zero speed

This parameter sets the speed at which the motor speed is judged to be zero.

4.3.19 Excessive error alarm level

This parameter sets the range in which the alarm for excessive droop pulses is output.

4.3.20 Optional function 5

(1) PI-PID control switching (applies only when using MR-H-B/MR-J2-B)
This parameter sets the condition under which switching from PI to PID control, or from PID control to PI control, is valid.

(2) Servo readout characters (applies only when using MR-H-B/MR-J2-B)
When the optional parameter unit is connected, set whether the screen display on the parameter unit will be in Japanese or English.

4.3.21 PI-PID switching position droop

This parameter sets the amount of position droop on switching to PI-PID control during position control. (applies only when using MR-H-B/MR-J2-B.)
The setting becomes effective when switching in accordance with the droop during position control is made valid by the setting for PI-PID control switching made using optional function 5.

4.3.22 Torque control compensation factor

This parameter is used to expand the torque control range up to the speed control value during torque control. (applies only when using MR-H-B.)
If a large value is set, the speed limit value may be exceeded and the motor may rotate.

4.3.23 Speed differential compensation

This parameter sets the differential compensation value for the actual speed loop.
In PI (proportional integration) control, if the value for speed differential compensation is set at 1000, the range for normal P (proportional) control is effective; if it is set to a value less than 1000, the range for P (proportional) control is expanded.

4.4 Parameter Block

(1) The parameter blocks serve to make setting changes easy by allowing data such as the acceleration/deceleration control to be set for each positioning processing.

(2) A maximum of 16 blocks in the case of the A171S/A273UHCPU (8 axis specification) or 64 blocks in the case of the A273UHCPU (32 axis specification), can be set as parameter blocks.

(3) Parameter blocks can be set at a peripheral device.

(4) The parameter block settings to be made are shown in Table 4.20.

Table 4.20 Parameter Block Settings

No.	Item	Setting Range								Default		Remarks	Explanatory Section
		mm		Inch		degree		PULSE		Initial Value	Units		
		Setting Range	Units	Setting Range	Units	Setting Range	Units	Setting Range	Units				
1	Interpolation control unit	0	—	1	—	2	—	3	—	3	—	• Set the units for compensation control. • Can also be used as the units for the command speed and allowable error range for circular interpolation set in the servo program.	7.1.4
2	Speed limit value	0.01 to 6000000.00	mm/ min	0.001 to 600000.000	inch/ min	0.001 to 600000.000	degree / min	1 to 1000000	PLS/ sec	200000	PLS/ sec	• Set the maximum speed for positioning/home position return. • If the positioning speed or home position return speed setting exceeds the speed limit value, control is executed at the speed limit value.	4.4.1
3	Acceleration time	1 to 65535 ms								1000	ms	• Set the time taken to reach the speed limit value from the start of motion.	
4	Deceleration time	1 to 65535 ms								1000	ms	• Set the time taken to stop from the speed limit value.	
5	Rapid stop deceleration time	1 to 65535 ms								1000	ms	• Set the time taken to stop from the speed limit value when a rapid stop is executed.	
6	S curve ratio	0 to 100 %								0	%	• Set the S curve ratio for S pattern processing. • When the S curve ratio is 0%, trapezoidal acceleration/deceleration processing is executed.	4.4.2
7	Torque limit value	1 to 500 %								300	%	• Set the torque limit value in the servo program.	—
8	Deceleration processing on STOP input	0: Deceleration stop executed based on the deceleration time. 1: Deceleration stop executed based on the rapid stop deceleration time.								0	—	• Set the deceleration processing when external signals (STOP, FLS, RLS) are input.	—
9	Allowable error range for circular interpolation	0 to 10000.0	μm	0 to 1.00000	inch	0 to 1.00000	degree	0 to 100000	PLS	100	PLS	• Set the permissible range for the locus of the arc and the set end point coordinates.	4.4.3

POINTS

(1) Parameter blocks are designated in the home position return data, JOG operation data, or servo program.

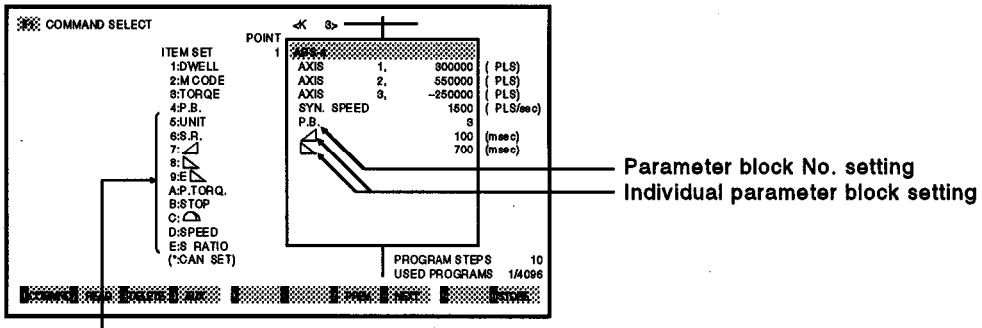
(2) The various parameter block data can be changed in the servo program. (See Section 6.3.)

POINT

(1) The data set in the parameter block is used for positioning control, home position return, and JOG operation.

(a) The parameter block No. used in positioning control is set from a peripheral device when creating a servo program. If no parameter block No. is set, control is executed in accordance with the contents of parameter block No.1. It is also possible to set parameter block data individually in the servo program.

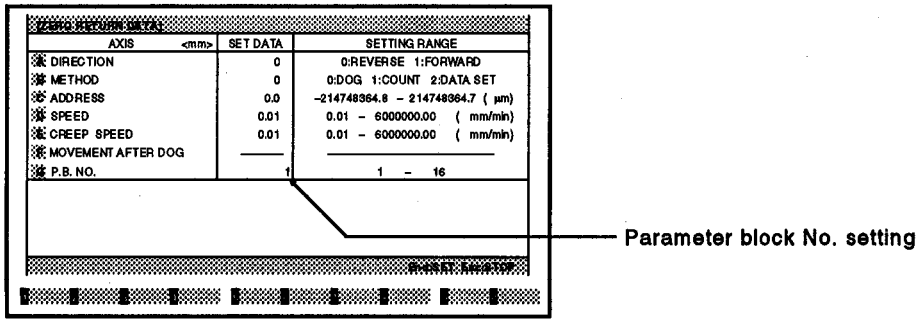
[Servo program creation screen]



(UNIT: Interpolation control unit, S.R.: Speed limit value, ◿: Acceleration time, ◺: Deceleration time, E◺: Rapid stop deceleration time, P-TORQ: Torque limit value, STOP: Deceleration processing on STOP input, ◠: Allowable error range for circular interpolation, SPEED: Changed speed when constant speed control is executed, S RATIO: S curve ratio when S pattern processing is executed)

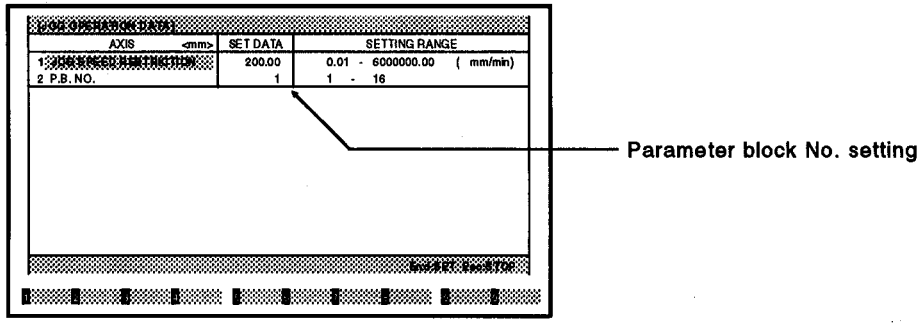
(b) The parameter block No. used for home position return is set when setting the "home position return data" with a peripheral device.

[Home position return data setting screen] <A171SCPU>



(c) The parameter block No. used for JOG operation is set when setting the "JOG operation data" with a peripheral device.

[JOG operation data setting screen] <A171SCPU>



4.4.1 Relationships among the speed limit value, acceleration time, deceleration time, and rapid stop deceleration time

The speed limit value is the maximum speed during positioning/home position return.
The acceleration time is the time taken to reach the set speed limit value from the start of positioning.
The deceleration time and rapid stop deceleration time are the time taken to effect a stop from the set speed limit value.
Accordingly, the actual acceleration time, deceleration time, and rapid stop deceleration time are faster, because the positioning speed is faster than the speed limit value.

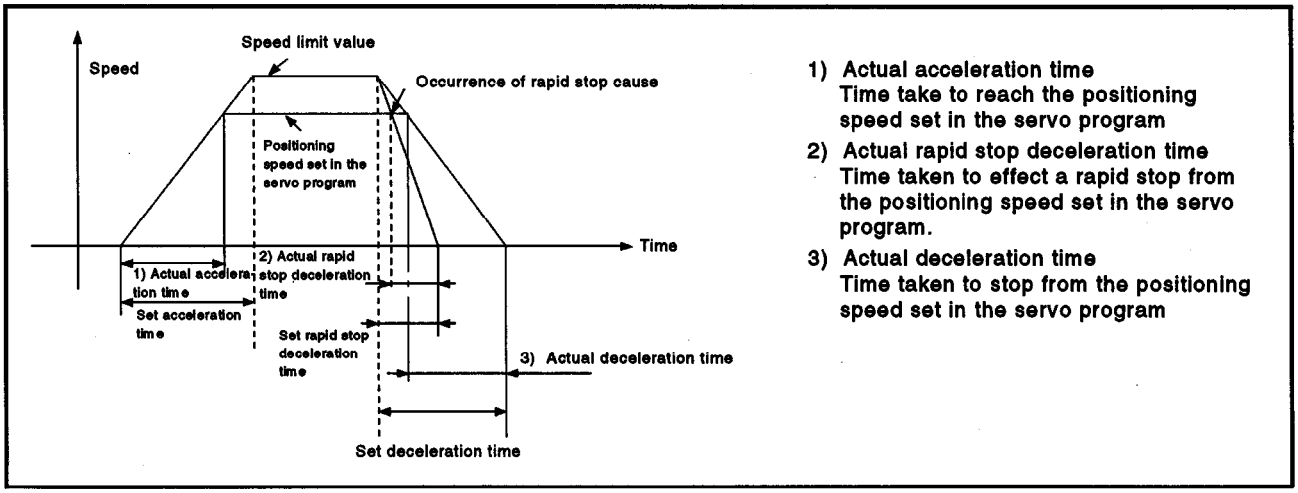
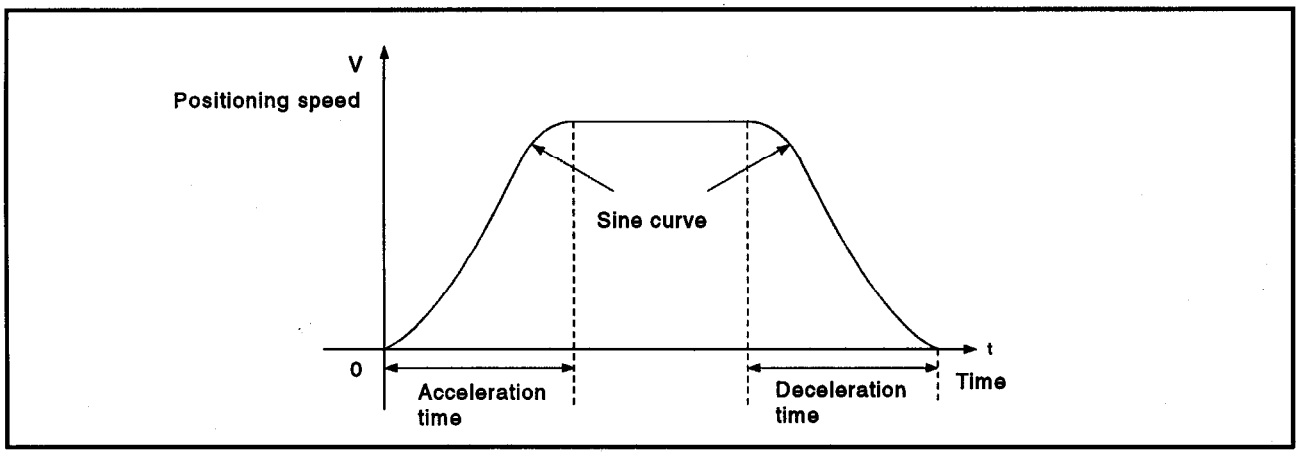


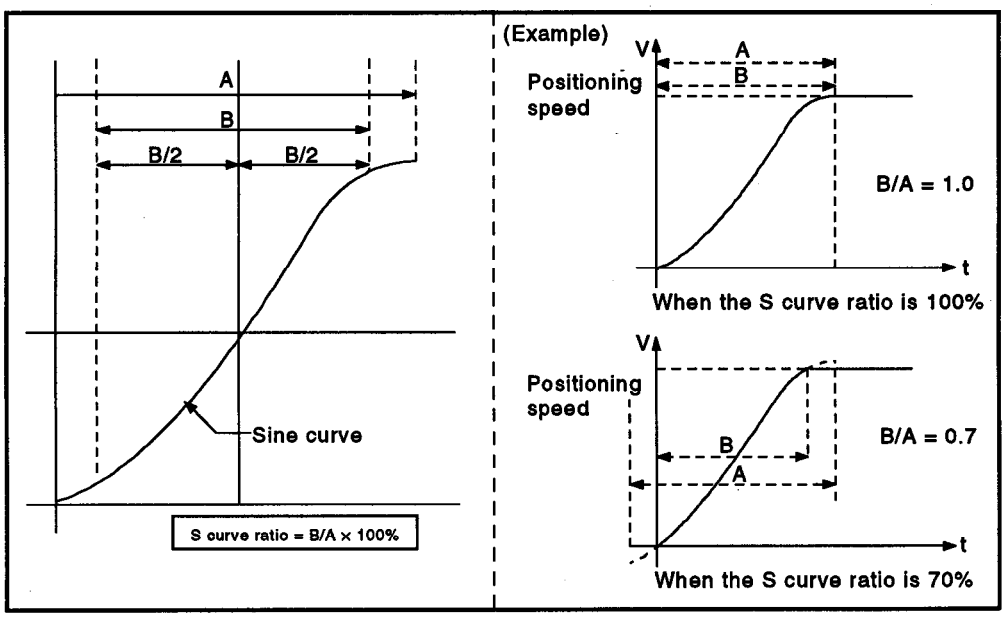
Fig. 4.6 Relationships among the Speed Limit Value, Acceleration Time, Deceleration Time, and Rapid Stop Deceleration Time

4.4.2 S curve ratio

The S curve ratio used when S pattern processing is used as the acceleration and deceleration processing method can be set. (For details on S pattern processing, see Section 7.1.7.)
The setting range for the S curve ratio is 0 to 100 (%).
If a setting that is outside the applicable range is made, an error occurs on starting, and control is executed with the S curve ratio set at 100%.
Errors are set in the servo program setting error area (D9190).
Setting an S curve ratio enables acceleration and deceleration processing to be executed gently.
The graph for S pattern processing is a sine curve, as shown below.



As shown below, the S curve ratio setting serves to select the part of the sine curve to be used as the acceleration and deceleration curve.



4.4.3 Allowable error range for circular interpolation

In control with the center point designated, the locus of the arc calculated from the start point address and center point address may not coincide with the set end point address.
The allowable error range for circular interpolation sets the allowable range for the error between the locus of the arc determined by calculation and the end point address.
If the error is within the allowable range, circular interpolation to the set end point address is executed while also executing error compensation by means of spiral interpolation.
If the setting range is exceeded, an error occurs and positioning does not start.
When such an error occurs, the relevant axis is set in the minor error code area.

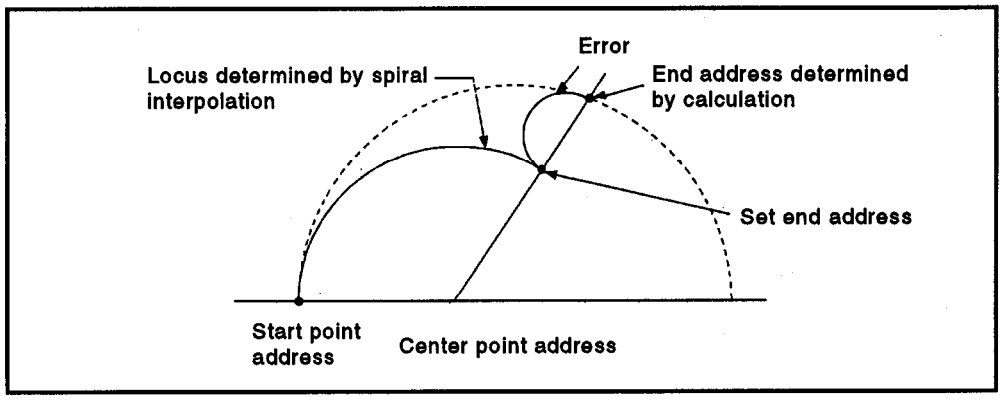


Fig. 4.7 Spiral Interpolation

5. SEQUENCE PROGRAMS AND SFC PROGRAMS

This section explains how to start a servo program using a sequence program or SFC program for positioning control, and gives other information.

5.1 Cautions on Creating a Sequence Program or SFC Program

The following cautions should be observed when creating a sequence program or SFC program.

(1) Positioning control instructions
The servo program start request instruction (DSFRP)/(SVST) (see Section 5.2) and the present value change/speed change instructions (DSFLP)/(CHGA/CHGV) instructions (see Section 5.3) are used as positioning instructions.

(2) Unusable instructions
It is not possible to use the DSFL (word data 1 word shift to left) or DSFR (word data 1 word shift to right) instruction.
If a DSFL instruction of DSFR instruction is executed, an operation error occurs and the following happens:
(a) Conditions
(b) 50(OPERATION ERROR) is stored in the self-diagnosis error code register (D9008).
(c) The step in which the DSFR or DSFL instruction was executed is stored in the error step register (D9010, D9011).
In order to shift word data, use the BMOV instruction (see Appendix 4).

(3) Dedicated devices for the PCPU
Of the servo system CPU devices, those shown in Table 5.1 are exclusively for use with the PCPU.
Check the applications of devices before using them in the sequence program (for details, see Section 3).

Table 5.1 Dedicated Devices for the PCPU

Device Name	Device No.		
	A171SCPU	A273UHCPU (8 axis specification)	A273UHCPU (32 axis specification)
Inputs	—	X0 to XFF	—
Outputs	—	Y0 to YFF	—
Internal relays	M1600 to M2047	M2000 to M2047	M2000 to M3839
Data registers	D800 to D1023		D0 to D799
Special relays	M9073 to M9079		
Special registers	D9180 to D9199		

Note that internal relays (M1600 to M2047/M2000 to M2047/M2000 to M3839) and data registers (D800 to D1023/D800 to D1023/D0 to D799) will not be latched even if a latch range setting is made for them. (The device symbols for M1600 to M2047/M2000 to M2047/M2000 to M3839 are displayed as M, L, and S by the GPP device in accordance with the M, L, and S settings in the parameters.)

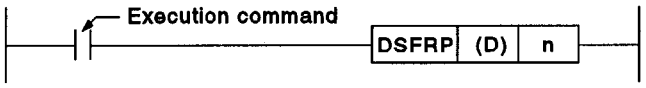
(4) SFC programs
Refer to the manuals below for details on the SFC programming method.
MELSAP II Programming Manual (IB-66361)
SW2SRX-GSV13PE Operating Manual (IB-67266)
SW2SRX-GSV22PE Operating Manual (IB-67264)

5.2 Servo Program Start Request Instruction (DSFRP/SVST)

There are two servo program start request instructions: the DSFRP instruction and the SVST instruction.
When executing positioning control, up to 3 axes can be controlled with the DSFRP instruction and up to 4 axes can be controlled with the SVST instruction.
When using an A273UHCPU (32 axis specification), the DSFRP instruction cannot be used as the start request instruction for a servo program. It can only be used as a word data shift instruction.

5.2.1 Start request instruction for 1 to 3 axes (DSFRP): when using A171SCPU/A273UHCPU (8 axis specification)

	Usable Devices																			Digit Designation	Number of Steps	Subset	Index	Carry Flag	Flag Error	
	Bit Devices							Word (16 Bit) Devices								Constants		Pointers		Level							
	X	Y	M	L	S	B	F	T	C	D	W	R	A0	A1	Z	V	K	H	P	I	N					M9012	M9010	M9011
(D)										O																	
n																	O	O					7		X		O	O

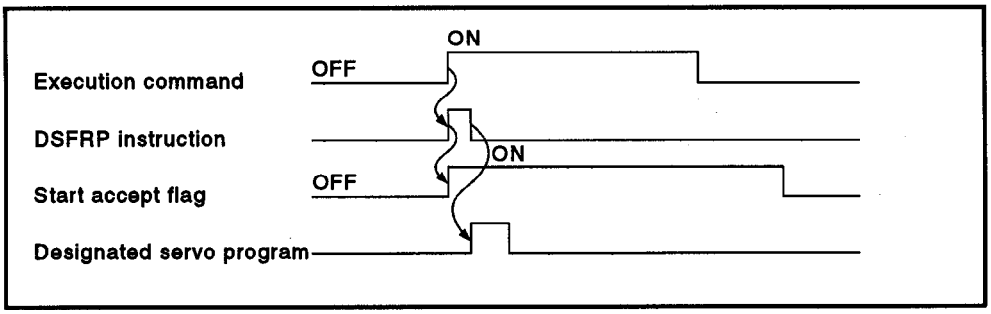


Set data

(D)	No. of axis to be started
n	No. of servo program to be executed

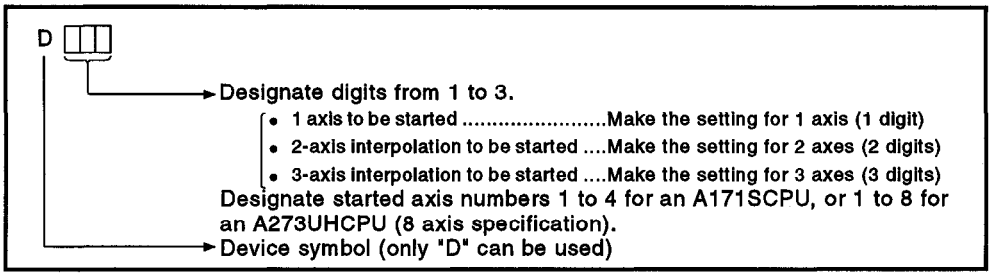
The following processing is executed at the leading edge (OFF → ON) of the DSFRP instruction:

- The start accept flag (M200n) designated in (D) is turned ON (see Section 3.2.2).
- A start request is issued for the servo program designated by "n".



[Data Settings]

(1) Setting the axes to be started
The axes to be started are set in (D) in the way shown below.



Example

The axes to be started are designated as follows.
- Axis 1 .....D1
- Axis 1 and axis 2 .....D12
- Axis 1, axis 2, and axis 3 ....D123

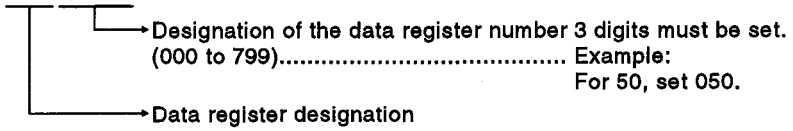
(2) Servo program No. setting
There are two types of servo program number setting: direct and indirect.
(a) In direct setting, the servo program number is designated directly as the number itself (0 to 4095).

Example

Servo program No.50 would be set as follows.
- When designated with a K device ...K50

(b) In indirect setting, the servo program number is set as a value in a data register.
The data registers that can be used are D0 to D799, and they are set as follows:

1) K3□□□□



2) It is also possible to designate a hexadecimal number (H7530 to H784F) converted from a decimal number.

Example

Make the following setting to designate the number of the servo program to be started with the data stored in data register D50:
- When designated with a K device .....K30050 .....Specifies "D50"

POINTS

(1) When two or more axes are started simultaneously, set one of the axes to be started in each servo program.
When programming a simultaneous start in which linear interpolation is to be executed with axes 1 and 2, and circular interpolation is to be executed with axes 3 and 4, set axis 1 or axis 2 and axis 3 or axis 4 (example: D13).

(2) "D" is used as the device symbol for (D), but the present value corresponding to the data register number used in the sequence program is ignored.

[Error Details]

In the following cases, an operation error occurs and the DSFRP instruction is not executed.

- When the setting for (D) comprises 4 or more digits.
- When the axis number given in any digit of (D) is a number other than 1 to 4 (A171SCPU).
- When the axis number given in any digit of (D) is a number other than 1 to 8 (A273UHCPU, 8-axis specification).
- When the same axis number is set twice in (D).
- When n is a value outside the range 0 to 4095 or 30000 to 30799.
- When the settings for (D) or n are made by indirect setting with an index register (Z, V).

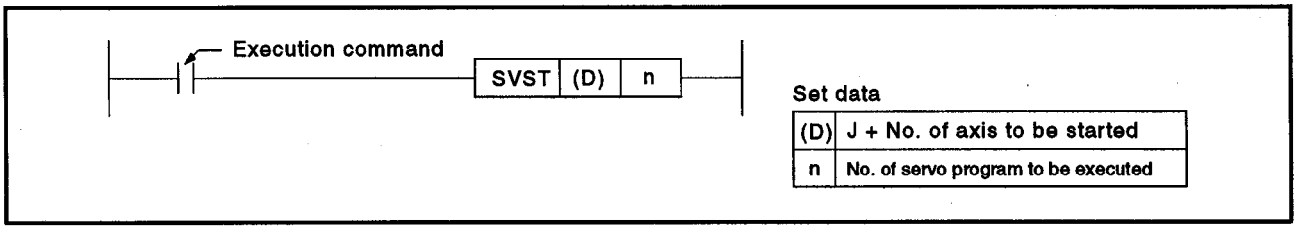
POINT

For details on sequence programs that execute start requests for servo programs in accordance with DSFRP instructions, see Section 6.5.

5.2.2 Start request instruction for 1 to 4/1 to 8 axes (SVST)

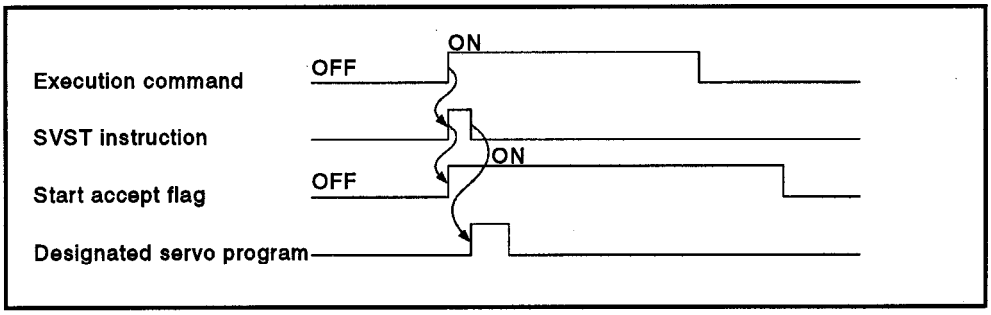
	Usable Devices																			Digit Designation	Number of Steps	Subset	Index	Carry Flag	Flag Error	
	Bit Devices							Word (16 Bit) Devices								Constants		Pointers		Level							
	X	Y	M	L	S	B	F	T	C	D	W	R	A0	A1	Z	V	K	H	P	I	N					M9012	M9010	M9011
(D)																							*1 O		13		O	O
n										O	O	O					O	O										

*1: Possible with indirect setting only



The following processing is executed at the leading edge (OFF - ON) of the SVST instruction:

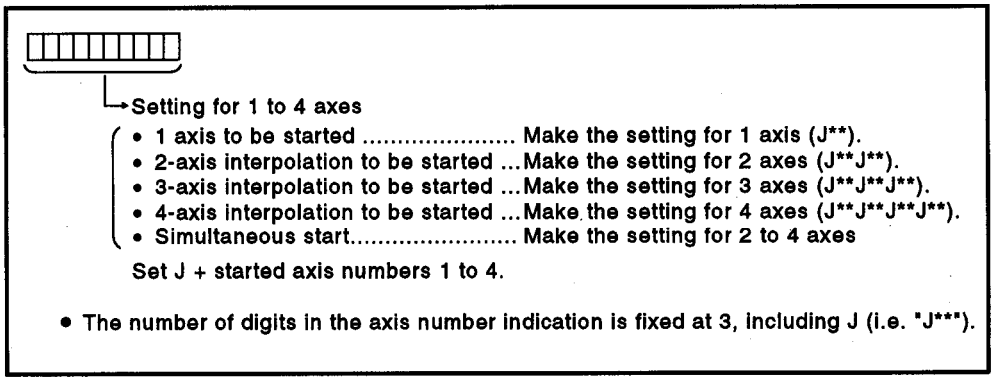
- The start accept flag (M2001+n) corresponding to the axis designated in (D) is turned ON (see Section 3.2.2).
- A start request is issued for the servo program designated by "n".



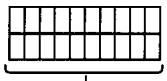
[Data Settings]

(1) Setting the axes to be started
The axes to be started are set in (D) in the way shown below.

<A171SCPU>



<A273UHCPU (8/32 axis specification)>



→Setting for 1 to 8 axes

- 1 axis to be started ..... Make the setting for 1 axis (J**).
- 2-axis interpolation to be started ...Make the setting for 2 axes (J**J**).
- 3-axis interpolation to be started ...Make the setting for 3 axes (J**J**J**).
- 4-axis interpolation to be started ...Make the setting for 4 axes (J**J**J**J**).
- Simultaneous start ..... Make the setting for 2 to 8 axes

Designate J + started axis numbers 1 to 8 for an A273UHCPU (8 axis specification), or J + started axis numbers 1 to 32 for an A273UHCPU (32 axis specification).

- The axis numbers are indicated in the order of input from the head of the bottom row, and if there are 4 or more axes, the upper row is also used.
- The number of digits in the axis number display is fixed at 3 including J (i.e. "J***").

Example

The axes to be started are designated as follows:

- Axis 1 .....J1
- Axis 1 and axis 2 .....J1J2
- Axis 1, axis 2, and axis 3 .....J1J2J3
- Axis 1, axis 2, axis 3, and axis 4 ...J1J2J3J4

(2) Servo program No. setting

There are two types of servo program number setting: direct and indirect.

(a) In direct setting, the servo program number is designated directly as the number itself (0 to 4095).

Example

Servo program No.50 would be set as follows.

- When designated with a K device ...K50

(b) In indirect setting, the servo program number is set as a value in a word device.

1) The word devices that can be used are indicated in the table below.

Word Device	CPU		
	A171S	A273UH (8 Axis Specification)	A273UH (32 Axis Specification)
D	0 to 799	0 to 8191*1	800 to 8191
W	0 to 3FF	0 to 1FFF	0 to 1FFF
R	0 to 4095	0 to 8191	0 to 8191

*1: Excluding 800 to 1023

POINT

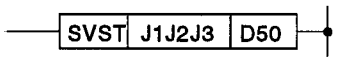
(1) When two or more axes are started simultaneously, set one of the axes to be started in each servo program.

(a) When programming a simultaneous start in which linear interpolation is to be executed with axes 1 and 2, and circular interpolation is to be executed with axes 3 and 4, set axis 1 or axis 2 and axis 3 or axis 4 (example: D13).

Example

Make the following setting to designate the number of the servo program to be started with the data stored in data register D50:

• Designation with a word device



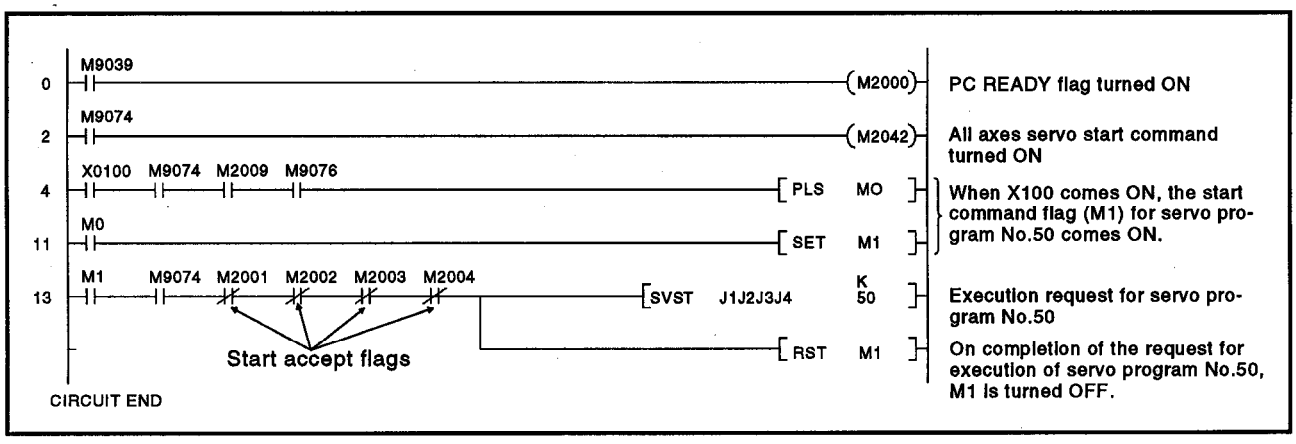
2) An index register (Z, V) or dedicated instruction (IX . IXEND) can be used for index designation of the indirectly set word device.
   - For details on index registers (Z, V), see the ACPU Programming Manual (Fundamentals) (IB-66249).
   - For details on dedicated instruction (IX . IXEND), see the AnACPU/AnUCPU Programming Manual (Dedicated) (IB-66251).

[Error Details]

In the following cases, an operation error occurs and the SVST instruction is not executed.

- When the setting for (D) is for 5 or more axes (A171SCPU).
- When the setting for (D) is for 8 or more axes (A273UHCPU, 8/32 axis specification).
- When the axis number given in any digit of (D) is a number other than J1 to J4 (A171SCPU).
- When the axis number given in any digit of (D) is a number other than J1 to J8 (A273UHCPU, 8-axis specification).
- When the axis number given in any digit of (D) is a number other than J1 to J32 (A273UHCPU, 32-axis specification).
- When the same axis number is set twice in (D).
- When the setting for n is outside the applicable range.

[Program example] <A171SCPU>

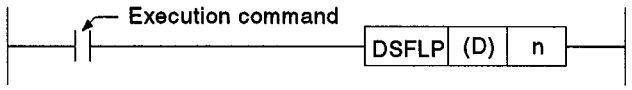


5.3 Present Value Change and Speed Change Instructions (DSFLP/CHGA, CHGV)

These instructions are used to change the present value of a stopped axis, and change the speed of an axis during positioning or JOG operation.

5.3.1 DSFLP instruction (when using A171S/A273UHCPU (8-axis specification))

	Usable Devices																			Digit Designation	Number of Steps	Subset	Index	Carry Flag	Flag Error	
	Bit Devices							Word (16 Bit) Devices								Cons-tants		Point-ers		Level							
	X	Y	M	L	S	B	F	T	C	D	W	R	A0	A1	Z	V	K	H	P	I	N					M9012	M9010	M9011
(D)										O																	
n																	O	O					7		X		O	O



(D)	Axis No. for which present value change /speed change is to be executed
n	Present value change/speed change setting

(1) The following processing is executed at the leading edge (OFF - ON) of the DSFRP instruction:

(a) Present value change

When the DSFLP instruction is executed, the present value change is executed in accordance with the following procedure.

1) The start accept flag (M2001 to M2004/M2001 to M2008) corresponding to the axis designated in (D) is turned ON.
2) The present value is changed to the contents of the present value change register for the axis designated in (D).
3) On completion of the present value change, the start accept flag is turned OFF.

(b) Speed change

When the DSFLP instruction is executed, the speed is changed in accordance with the following procedure.

1) The start accept flag (M2021 to M2024/M2021 to M2028) corresponding to the axis designated in (D) is turned ON.
2) A command to change the currently effective positioning speed to the speed stored in the speed change register for the axis designated in (D) is issued.
3) The speed change in progress flag is turned OFF.

(2) The numbers of registers used for present value change and speed change operations are indicated in the table below. (For details, see Section 3.4.2.)

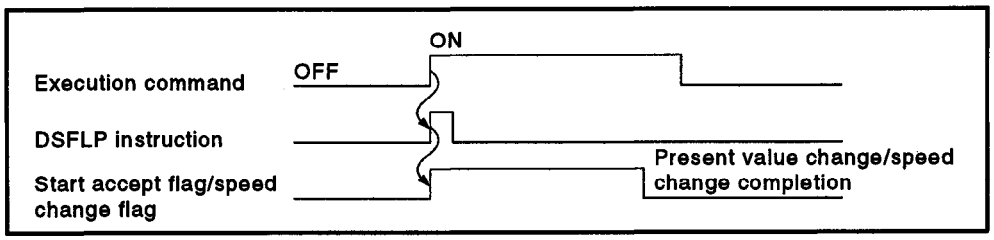
<A171SCPU>

Axis No.	Present Value Change Registers		Speed Change Registers	
	Upper	Lower	Upper	Lower
Axis 1	D961	D960	D963	D962
Axis 2	D967	D966	D969	D968
Axis 3	D973	D972	D975	D974
Axis 4	D979	D978	D981	D980

<A273UHCPU (8-Axis Specification)>

Axis No.	Present Value Change Registers		Speed Change Registers	
	Upper	Lower	Upper	Lower
Axis 1	D961	D960	D963	D962
Axis 2	D967	D966	D969	D968
Axis 3	D973	D972	D975	D974
Axis 4	D979	D978	D981	D980
Axis 5	D985	D984	D987	D986
Axis 6	D991	D990	D993	D992
Axis 7	D997	D996	D999	D998
Axis 8	D1003	D1002	D1005	D1004

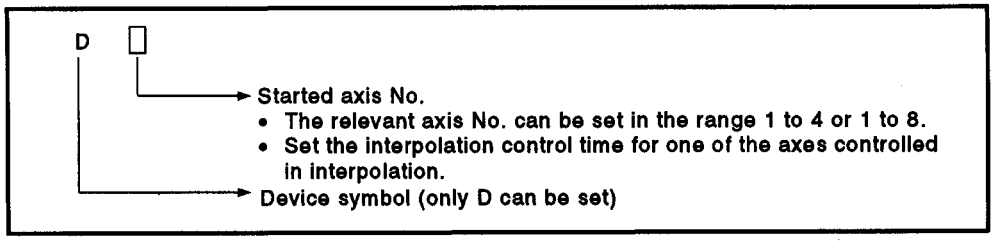
[Operation Timing]



[Data Settings]

(1) Setting the axis for which the present value change/speed change is to be executed

The axis for which the present value change/speed change set in (D) is executed is set as follows.



Example

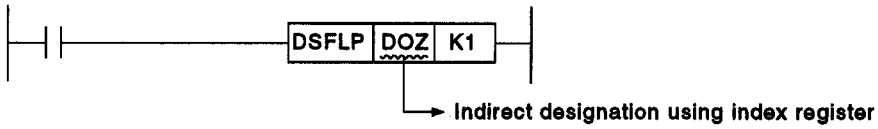
The started axis is designated as follows

- Axis 1 .....D1
- Interpolation control with axis 1 and axis 2 .....D1 or D2

(2) Present value change/speed change
The setting for a present value change/speed change is as follows.
- Present value change .....Set K0 or H0.
- Speed change .....Set K1 or H1.

POINT

When using a DSFLP instruction, it is not possible to indirectly designate (D) or n using index registers (Z, V).



If an indirect designation with an index register is made, an operation error occurs, and the DSFLP instruction is not executed.

[Error Details]

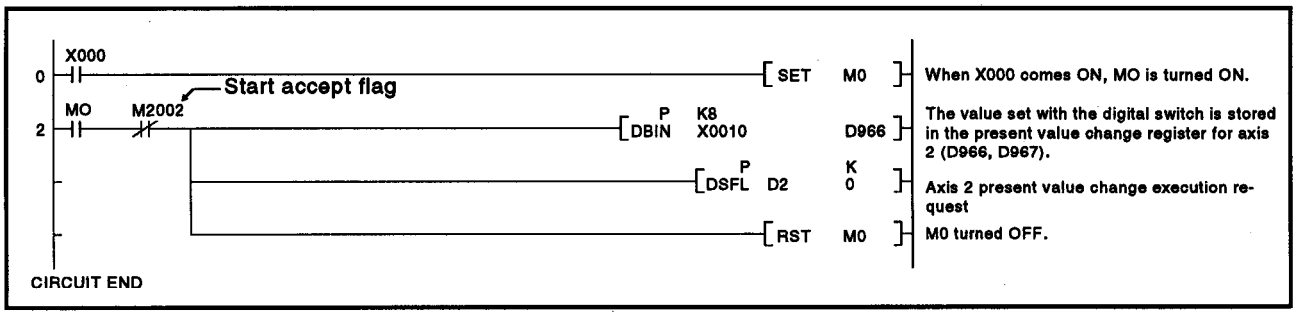
(1) In the following cases, an operation error occurs and the DSFLP instruction is not executed.
- When the setting for (D) is other than 1 to 4 or 1 to 8.
- When the setting for n is a value other than 1 or 0.
- When the setting for (D) or n has been indirectly designated using an index register (Z, V).

(2) In the following cases, a minor error (error on control change) occurs and the present value change/speed change is not executed.
When this happens, the error detection flag (M1607+20n/Xn7) is turned ON and the error code is stored in the minor error code area for the relevant axis.
- When the axis designated in (D) for the present value change is in motion.
- When the axis designated in (D) is executing a home position return or circular interpolation when the speed change is made.
- When the axis designated in (D) is decelerating when the speed change is made.
- When the speed designated by n is outside the range of 0 to the speed limit value when the speed change is made.

[Program Example]

(1) The program shown below changes the present value for axis 2 to the value designated with an 8-digit digital switch.
(a) Conditions
1) Numbers of inputs for the digital switch ...X010 to X02F
2) Present value change command .....Leading edge (OFF → ON) of X000
3) Present value change execution flag M0
4) Axis 2 start accept flag (used to determine whether axis 2 is stopped or in motion) .....M2002 (axis 2 start accept flag)

(b) Program example



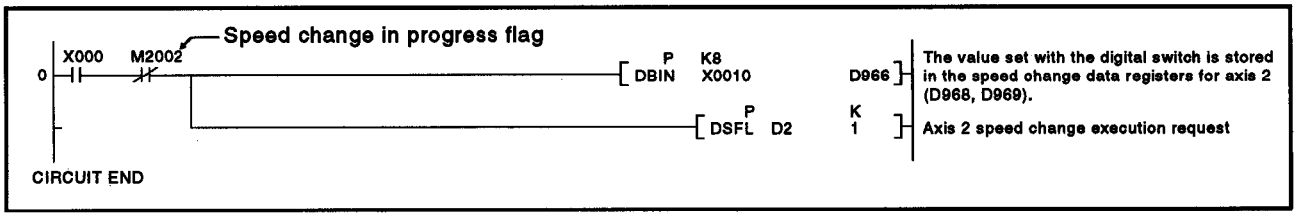
(2) The program shown below changes the positioning speed of axis 2 to the value set with an 8-digit digital switch.

(a) Conditions

1) Numbers of inputs for the digital switch ...X010 to X02F

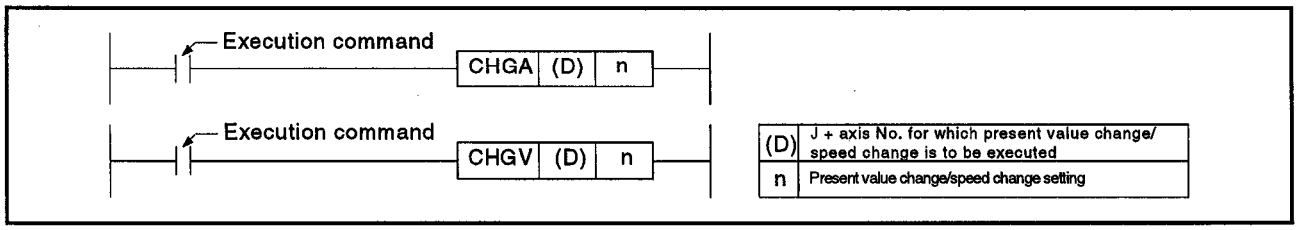
2) Speed change command .....Leading edge (OFF → ON) of X000

(b) Program example



5.3.2 CHGA/CHGV instructions

	Usable Devices																			Digit Designation	Number of Steps	Subset	Index	Carry Flag	Flag Error	
	Bit Devices							Word (16 Bit) Devices								Cons-tants		Point-ers		Level							
	X	Y	M	L	S	B	F	T	C	D	W	R	A0	A1	Z	V	K	H	P	I	N					M9012	M9010	M9011
(D)																							7		X		O	O
n										O	O	O					O	O										



(1) The following processing is executed at the leading edge (OFF - ON) of the CHGA/CHGV instruction:

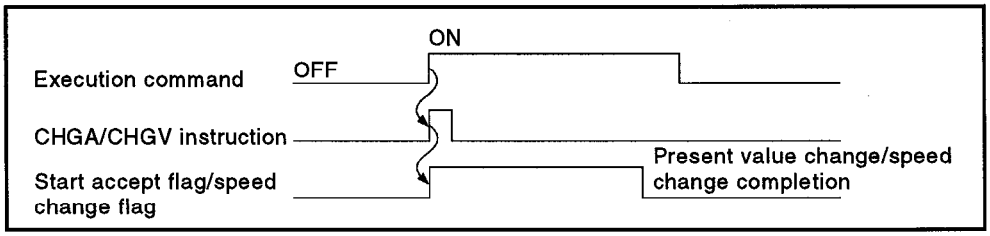
(a) Present value change
When the CHGA instruction is executed, the present value change is executed in accordance with the following procedure.

1) The start accept flag (M2001 to M2004/M2001 to M2008/M2001 to M2032) corresponding to the axis designated in (D) is turned ON.
2) The present value of the axis designated in (D) is changed to the present value designated in n.
3) On completion of the present value change, the start accept flag is turned OFF.

(b) Speed change
When the CHGV instruction is executed, the speed is changed in accordance with the following procedure.

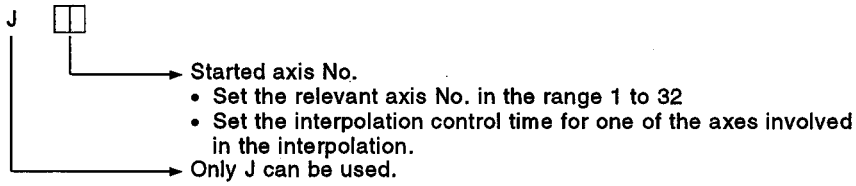
1) The start accept flag (M2021 to M2024/M2021 to M2028/M2061 to M2092) corresponding to the axis designated in (D) is turned ON.
2) The speed of the axis designated in (D) is changed to the speed designated in n.
3) The speed change in progress flag is turned OFF.

[Operation Timing]



[Data Settings]

(1) Setting the axis for which a present value change/speed change is to be executed
The axis with respect to which the present value change/speed change set in (D) is to be executed is set as follows.



Example

Axes to be started are designated as shown below.
• Axis 1 .....J1

(2) Setting the present value change/speed change
There are two types of setting for present value changes and speed changes: direct setting and indirect setting.
(a) In direct setting, the present value or speed to be changed to is specified directly as a numerical value.
(For the setting range, refer to Section 3.4.2.)

Example

If the present value to be changed to is "10", the setting is as follows.
• When designated with a K device K10

(b) The word devices that can be used are indicated in the table below.
1) The word devices that can be used are indicated in the table below.

Word Device	CPU		
	A171S	A273UH (8 Axis Specification)	A273UH (32 Axis Specification)
D	0 to 799	0 to 8191*1	800 to 8191
W	0 tp 3FF	0 to 1FFF	0 to 1FFF
R	0 to 4095	0 to 8191	0 to 8191

*1: Excluding 800 to 1023

Example

Make the following setting to designate the present value to be changed to with the data stored in data register D50:
• Designation with a word device —[CHGA J11 D50]—

2) An index register (Z, V) or dedicated instruction (IX . IXEND) can be used for index designation of the indirectly set word device.
• For details on index registers (Z, V), see the ACPU Programming Manual (Fundamentals) (IB-66249).
• For details on dedicated instructions (IX, IXEND), refer to the AnACPU/AnUCPU Programming Manual (Dedicated Instructions) (IB-66251).

[Error Details]

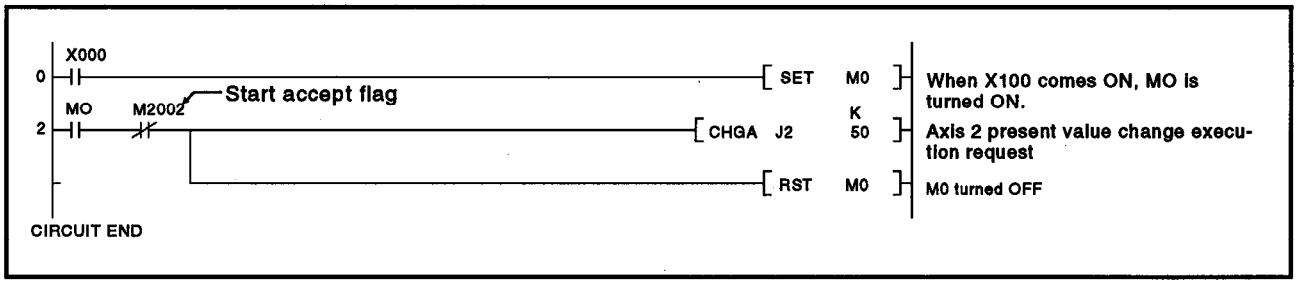
(1) In the following cases an operation error occurs and the CHGA/CHGV instruction is not executed.
- When the setting for (D) is other than J1 to J32.

(2) In the following cases, a minor error (error on control change) occurs and the present value change/speed change is not executed.
When this happens, the error detection flag (M1607+20n/Xn7/M2407+20n) is turned ON and the error code is stored in the minor error code area for the relevant axis.
- When the axis designated in (D) for the present value change is in motion.
- When the axis designated in (D) is executing a home position return or circular interpolation when the speed change is made.
- When the axis designated in (D) is decelerating when the speed change is made.
- When the speed designated by n is outside the range of 0 to the speed limit value when the speed change is made.

[Program Example]

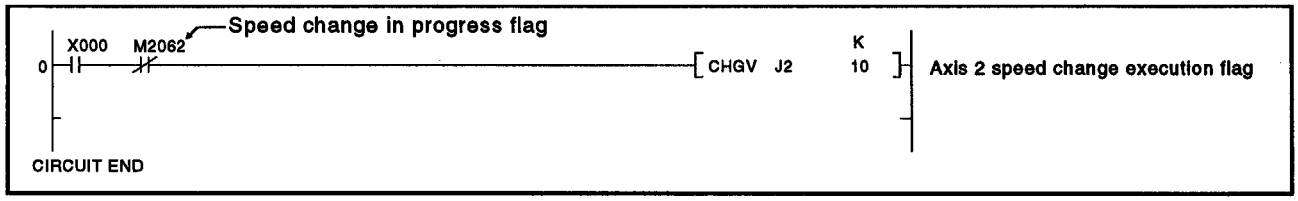
(1) The program shown below changes the present value for axis 2.
(a) Conditions
1) Present value change command .....Leading edge (OFF → ON) of X000
2) Present value change execution flag ...M0
3) Axis 2 start accept flag (used to determine whether axis 2 is stopped or in motion) .....M2002 (axis 2 start accept flag)

(b) Program example



(2) The program shown below changes the positioning speed for axis 2.
(a) Conditions
1) Speed change command .....Leading edge (OFF → ON) of X000

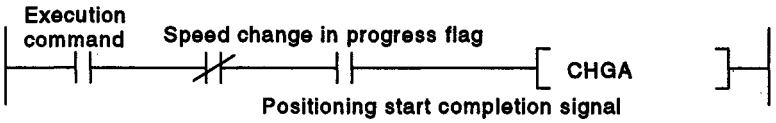
(b) Program example

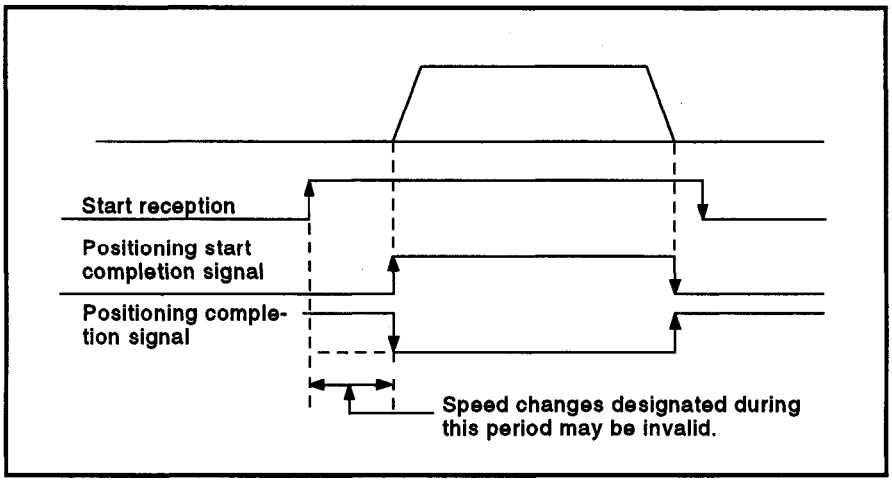


POINT

- Points to note when a speed change is performed
  - If a speed change instruction (CHGV/DSFLP) is executed in the period between execution of the servo program start request instruction (SVST/DSFRP) and the point where the "positioning start completion signal" comes ON, the speed change may be invalid. To perform speed changes in approximately the same timing as a start, be sure to enter the positioning start completion signal ON status as an interlock for execution of the speed change instruction.

Example:





5.4 SFC Programs

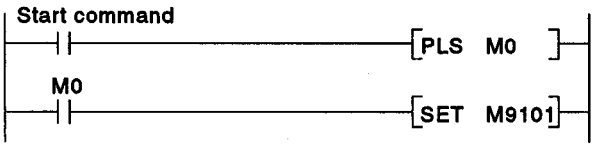
This section explains how to start servo programs using SFC programs.

5.4.1 Starting and stopping SFC programs

SFC programs are started and stopped from the main sequence program. The methods for starting and stopping SFC programs are described below.

(1) Starting SFC programs

(a) An SFC program is started by turning M9101 (SFC program start/stop) ON in the main sequence program.

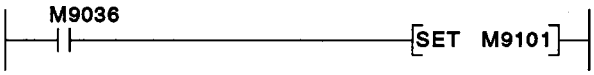


(b) There are two types of SFC program start, as indicated below, and the one that is effective is determined by the ON/OFF status of special relay M9102 (SFC program start status selection):

1) SFC program initial start
By turning special relay M9101 ON while special relay M9102 is OFF, the SFC program is started from the initial step of block 0.

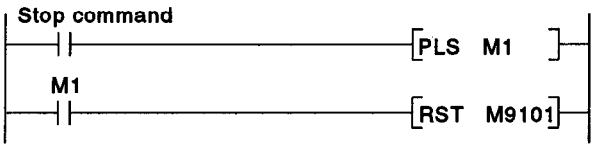
2) SFC program resumptive start
By turning special relay M9101 ON while special relay M9102 is ON, the SFC program is started from the block and step that was being executed immediately before operation was stopped.

(c) On creation of an SFC program, if no main sequence program has been created (applies only when step 0 is an END instruction), the circuit shown below is automatically created in the main sequence program area by the peripheral device.



(2) Stopping SFC programs

(a) An SFC program is stopped by turning M9101 (SFC program start/stop) OFF in the main sequence program.



(b) When an SFC program is stopped, all the operation outputs in the step being executed are turned OFF.

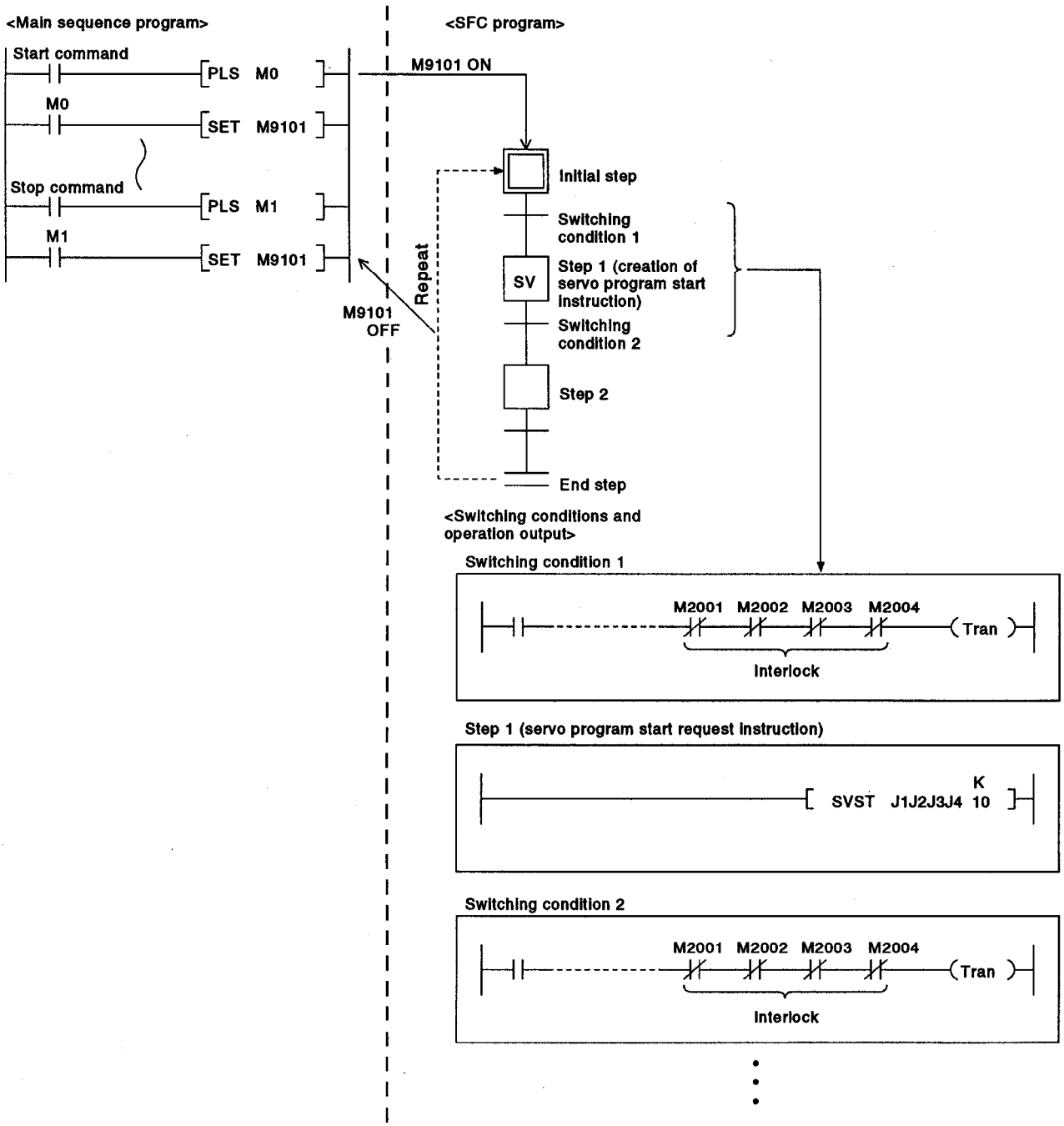
POINT

Write during run in the SFC mode is not possible with respect to the motion controller.

5.4.2 Servo program start request

A servo program can be started in one of two ways: by using the program start-up symbol intended for this purpose ([SV]), or by inputting a servo program start request instruction in the internal circuit of a normal step (□).

(1) When an [SV] step is created:



POINTS

(1) When an [SV] step is created, the servo program start request ladder block (|———[SVST ***]—|) is mandatorily inserted in the sequence program.

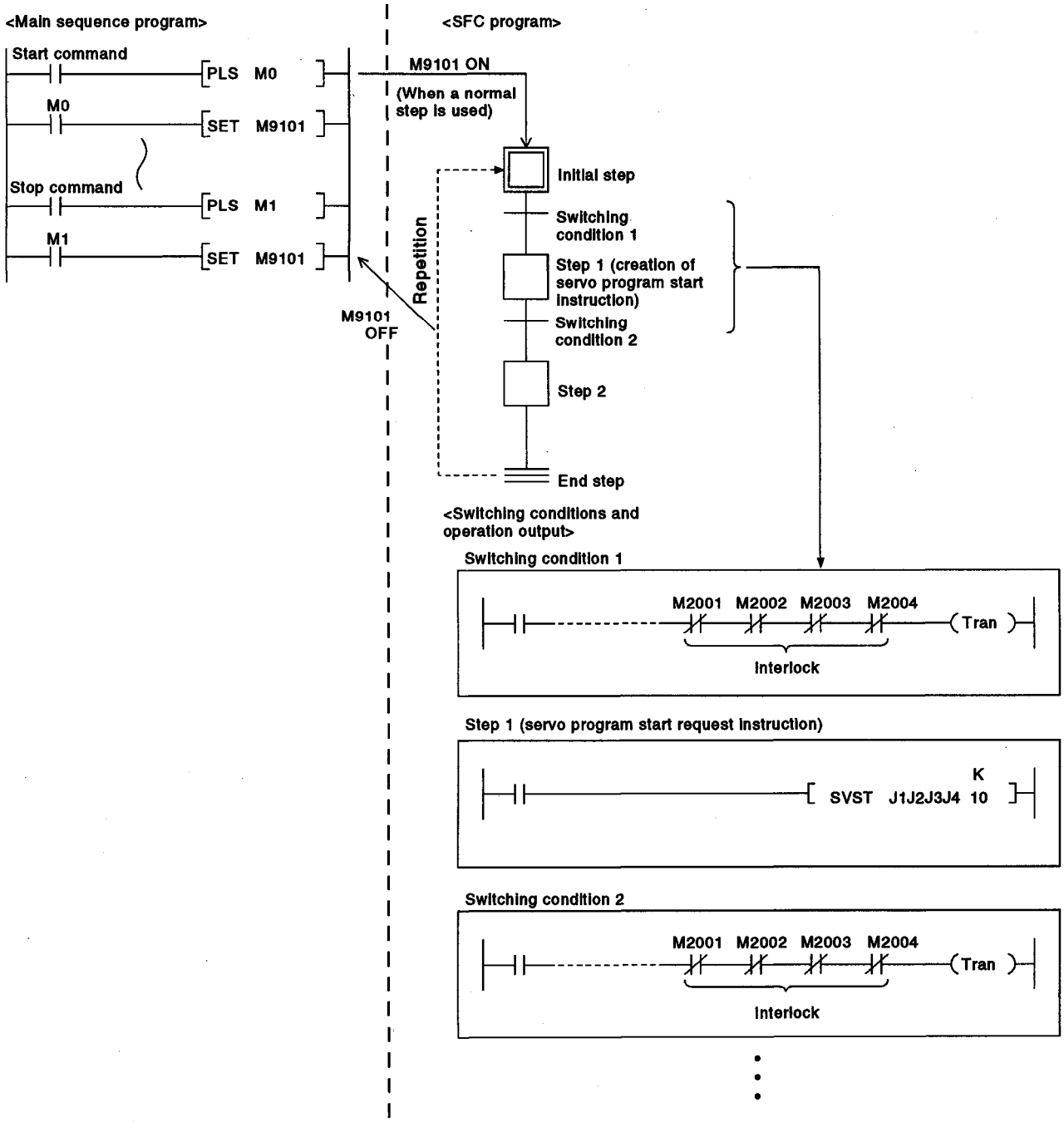
(2) When a DSFRP instruction is used, input it directly into the sequence program at a normal step (□).

(3) If an SVST instruction is edited and converted, a start accept bit (M2001 to M2004/M2001 to M2008/M2001 to M2032) is automatically inserted into the switching conditions before and after the relevant SFC step to act as an interlock.
However, if the order of steps has been changed by addition or insertion, this interlock may not be automatically added/deleted in the switching conditions. Therefore, if a step has been added or inserted, always display the switching conditions using ZOOM display and check the interlock.

(4) Only the sequence (|———[SVST ***]—|) can be set at an [SV] step. If any additional instructions are to be set, either set them in a normal step (□) or set another sequence instruction section executed in parallel as a normal step (□).

(5) For details on how to operate peripheral devices used to edit and monitor SFC programs, refer to the SW2SRX-GSV13PE Operating Manual and SW2SRX-GSV22PE Operating Manual.

(2) When a servo program start instruction is input inside a normal step (□).



POINTS

(1) When a DSFRP or DSFLP instruction is used, input it directly into the internal circuit of a normal step (□).

(2) If an SVST/DSFRP instruction is edited and converted, a start accept bit (M2001+n) is automatically inserted into the switching conditions before and after the relevant SFC step to act as an interlock.

(3) If a DSFLP instruction is edited and converted, a speed change in progress flag (M2021 to M2024/M2021 to M2028/M2061 to M2092) is automatically inserted into the switching conditions before and after the relevant SFC step to act as an interlock.

(4) Set commands such as speed change commands and stop commands, which are executed in an arbitrary timing, in the main sequence program.

(5) For details on how to operate peripheral devices used to edit and monitor SFC programs, refer to the SW2SRX-GSV13PE Operating Manual and SW2SRX-GSV22PE Operating Manual.

6. SERVO PROGRAMS FOR POSITIONING CONTROL

Servo programs serve to designate the type of the positioning control, and the positioning data, required to execute positioning control with the servo system CPU. This section explains the configuration, and method for designating, servo programs.
For details on the various types of servo program, see the explanation of positioning control in Section 7.

6.1 Servo Program Composition and Area

This section describes the composition of servo programs and the area in which a servo program is stored.

6.1.1 Servo program composition

A servo program comprises a program number, servo instructions, and positioning data.
When a program number and the required servo instructions are designated using a peripheral device, the positioning data required to execute the designated servo instructions can be set.

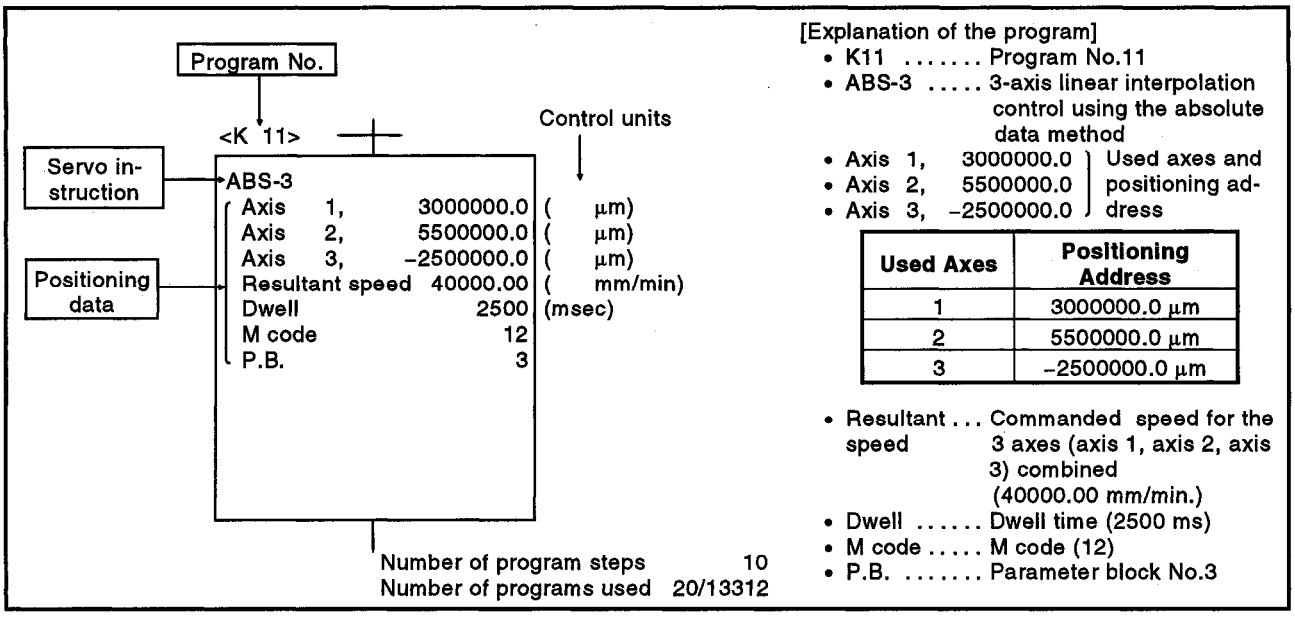


Fig. 6.1 Example Composition of a Servo Program

(1) Program No. ..... This is a number used to call the program from the sequence program: any number in the range 0 to 4095 can be set.

(2) Servo instruction ..... Indicates the type of positioning control. For details, see Section 6.2.

(3) Positioning data..... This is the data required to execute servo instructions.
The data required for execution is fixed for each servo instruction.
For details, see Section 6.3.
The follows applies for the servo program shown in Figure 6.1:

- Used axes and positioning address
- Commanded speed

} Data which must be set in order to execute the servo instruction

- Dwell time
- M code

} Data which will be set to default values for control if not set.

- P.B. (parameter block)

} Control is executed using the data of parameter block 1 (P.B.1).

6.1.2 Servo program area

(1) Servo program area
The servo program area is an internal memory of the the system CPU (not in the memory cassette) which serves to store the servo program created with a peripheral device.
The servo program area is an internal RAM.

(2) Servo program capacity
The servo program area has a capacity of 13312 steps in the case of an A171S/A273UHCPU(8 axis specification) or 14334 steps in the case of an A273UHCPU (32 axis specification).

<A171SCPU>

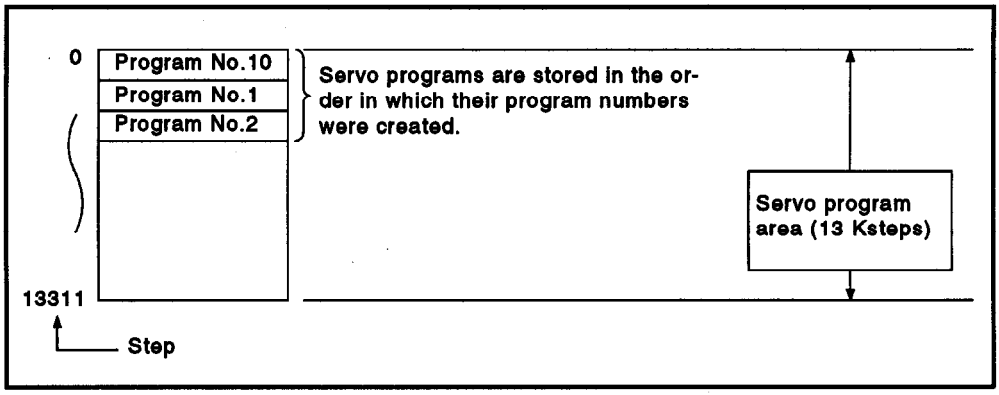


Fig. 6.2 Servo Program Area

POINT

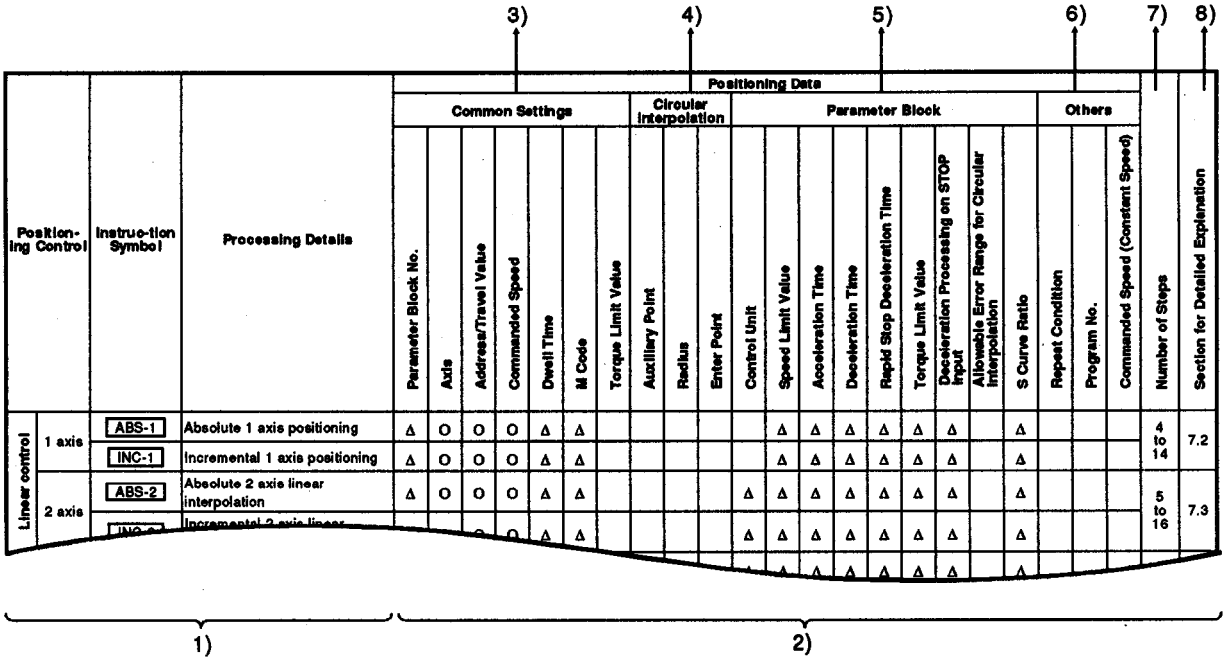
If the servo program area has insufficient capacity, execute multiple positioning control operations with one program by indirect setting of the positioning data used in the servo program. (For details on indirect setting, see Section 6.4.2.)

6.2 Servo Instructions

This section presents the servo instructions used in servo programs.

(1) How to read the servo instruction tables

Fig. 6.1 How to Read Servo Instruction Tables



Number	Explanation	
1)	Instruction symbols	Indicate the servo instructions that can be used in servo programs.
	Processing details	Provide an outline of the processing of servo instructions.
2)	(1) Indicates the positioning data that can be set for servo instructions. (a) O: Item that must be set (the servo instruction cannot be executed if this data is not set). (b) Δ: Item set if required (if this data is not set, control is executed using the default value).	
	(2) Direct setting/indirect setting is possible (except for axis No.) (a) Direct setting: Set with a numerical value. (b) Indirect setting: Set with a word device (D, W). • When the servo program is executed, control is executed in accordance with the contents of the set word device. • Some setting items are 1-word data and others are 2-word data. • In the case of 2-word data, set the head device.	
	(3) Number of steps The larger the number of settings, the larger the number of instruction steps (the number of steps is displayed when a servo program is created). (Each of the items marked Δ increases the number of steps by 1.)	
3)	Items set in common for all servo instructions.	
4)	Items set for a servo program to start circular interpolation.	
5)	Items set to execute control by changing the data in the parameter block set for the servo program (or if no data is set, the default values). (The data in the parameter block is not changed.)	
6)	Setting items other than common items, settings for circular interpolation, and parameter block settings (settings items differ according to the servo instruction)	
7)	Indicates the number of steps for each servo instruction	
8)	Indicates the section where the function explanation for using each instruction can be found.	

(2) Servo instruction list

The servo instructions that can be used in servo programs, and the positioning data set for the servo instructions, are indicated in Table 6.2. For details on the positioning data set for servo instructions, see Section 6.3.

Table 6.2 Servo Instruction List

Positioning Control		Instruction Symbol	Processing Details	Positioning Data: Common Settings: Parameter Block No.	Axis	Address/Travel Value	Commanded Speed	Dwell Time	M Code	Torque Limit Value	Circular Interpolation: Auxiliary Point	Radius	Center Point	Number of Pitches	Parameter Block: Control Unit	Speed Limit Value	Acceleration Time	Deceleration Time	Rapid Stop Deceleration Time	Torque Limit Value	Deceleration Processing on STOP Input	Allowable Error Range for Circular Interpolation	S Curve Ratio	Others: Repeat Condition	Program No.	Commanded Speed (Constant Speed)	Cancel	Start	Skip	FIN Acceleration	Number of Steps	Section for Detailed Explanation
Linear control	1 axis	ABS-1	Absolute 1 axis positioning	Δ	O	O	O	Δ	Δ							Δ	Δ	Δ	Δ	Δ	Δ		Δ				Δ	Δ			4 to 14	7.2
		INC-1	Incremental 1 axis positioning	Δ	O	O	O	Δ	Δ							Δ	Δ	Δ	Δ	Δ	Δ		Δ				Δ	Δ				
	2 axis	ABS-2	Absolute 2 axis linear interpolation	Δ	O	O	O	Δ	Δ						Δ	Δ	Δ	Δ	Δ	Δ	Δ		Δ				Δ	Δ			5 to 16	7.3
		INC-2	Incremental 2 axis linear interpolation	Δ	O	O	O	Δ	Δ						Δ	Δ	Δ	Δ	Δ	Δ	Δ		Δ				Δ	Δ				
	3 axis	ABS-3	Absolute 3 axis linear interpolation	Δ	O	O	O	Δ	Δ						Δ	Δ	Δ	Δ	Δ	Δ	Δ		Δ				Δ	Δ			7 to 18	7.4
		INC-3	Incremental 3 axis linear interpolation	Δ	O	O	O	Δ	Δ						Δ	Δ	Δ	Δ	Δ	Δ	Δ		Δ				Δ	Δ				
	4 axis	ABS-4	Absolute 4 axis linear interpolation	Δ	O	O	O	Δ	Δ						Δ	Δ	Δ	Δ	Δ	Δ	Δ		Δ				Δ	Δ			8 to 21	7.5
		INC-4	Incremental 4 axis linear interpolation	Δ	O	O	O	Δ	Δ						Δ	Δ	Δ	Δ	Δ	Δ	Δ		Δ				Δ	Δ				
Circular interpolation control	Auxiliary point designation	ABS	Absolute circular interpolation by auxiliary point designation	Δ	O	O	O	Δ	Δ						Δ	Δ	Δ	Δ	Δ	Δ	Δ		Δ				Δ	Δ			7 to 19	7.6
		INC	Incremental circular interpolation by auxiliary point designation	Δ	O	O	O	Δ	Δ						Δ	Δ	Δ	Δ	Δ	Δ	Δ		Δ				Δ	Δ				
	Radius designation	ABS	Absolute circular interpolation by radius designation, within CW180	Δ	O	O	O	Δ	Δ		O				Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ				Δ	Δ			6 to 18	7.7
		ABS	Absolute circular interpolation by radius designation, CW180 and greater	Δ	O	O	O	Δ	Δ		O				Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ				Δ	Δ				
		ABS	Absolute circular interpolation by radius designation, within CCW180	Δ	O	O	O	Δ	Δ			O			Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ				Δ	Δ				
		ABS	Absolute circular interpolation by radius designation, CCW180 and greater	Δ	O	O	O	Δ	Δ			O			Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ				Δ	Δ				
		INC	Incremental circular interpolation by radius designation, within CW180	Δ	O	O	O	Δ	Δ			O			Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ				Δ	Δ				
		INC	Incremental circular interpolation by radius designation, CW180 and greater	Δ	O	O	O	Δ	Δ			O			Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ				Δ	Δ				

O: Must be set
Δ : Set if required

Table 6.2 Servo Instruction List (Continued)

Positioning Control		Instruction Symbol	Processing Details	Positioning Data: Common Settings: Parameter Block No.	Common Settings: Axis	Common Settings: Address/Travel Value	Common Settings: Commanded Speed	Common Settings: Dwell Time	Common Settings: M Code	Common Settings: Torque Limit Value	Circular Interpolation: Auxiliary Point	Circular Interpolation: Radius	Circular Interpolation: Enter Point	Circular Interpolation: Number of Pitches	Parameter Block: Control Unit	Parameter Block: Speed Limit Value	Parameter Block: Acceleration Time	Parameter Block: Deceleration Time	Parameter Block: Rapid Stop Deceleration Time	Parameter Block: Torque Limit Value	Parameter Block: Deceleration Processing on STOP Input	Parameter Block: Allowable Error Range for Circular Interpolation	Parameter Block: S Curve Ratio	Others: Repeat Condition	Others: Program No.	Others: Commanded Speed (Constant Speed)	Others: Cancel	Others: Start	Others: Skip	Others: FIN Acceleration	Number of Steps	Section for Detailed Explanation
Circular interpolation control	Radius designation	INC	Incremental circular interpolation by radius designation, within CCW180	Δ	O	O	O	Δ	Δ			O			Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ				Δ	Δ			6 to 18	7.7
		INC	Incremental circular interpolation by radius designation, CCW180 and greater	Δ	O	O	O	Δ	Δ			O			Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ				Δ	Δ				
	Center point designation	ABS	Absolute cicular interpolation by center point designation, CW	Δ	O	O	O	Δ	Δ				O		Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ				Δ	Δ			7 to 19	7.8
		ABS	Absolute cicular interpolation by center point designation, CCW	Δ	O	O	O	Δ	Δ				O		Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ				Δ	Δ				
		INC	Incremental cicular interpolation by center point designation, CW	Δ	O	O	O	Δ	Δ				O		Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ				Δ	Δ				
		INC	Incremental cicular interpolation by center point designation, CCW	Δ	O	O	O	Δ	Δ				O		Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ				Δ	Δ				
Fixed-pitch feed	1 axis	FEED-1	1 axis fixed-pitch feed start	Δ	O	O	O	Δ	Δ							Δ	Δ	Δ	Δ	Δ	Δ		Δ				Δ	Δ			4 to 15	7.9
	2 axis	FEED-2	2 axis linear interpolation Fixed-pitch feed start	Δ	O	O	O	Δ	Δ							Δ	Δ	Δ	Δ	Δ	Δ		Δ				Δ	Δ			5 to 17	7.10
	3 axis	FEED-3	3 axis linear interpolation Fixed-pitch feed start	Δ	O	O	O	Δ	Δ							Δ	Δ	Δ	Δ	Δ	Δ		Δ				Δ	Δ			7 to 19	7.11
Speed control (I)	Forward rotation	VF	Speed control (I) Forward rotation start	Δ	O		O		Δ							Δ	Δ	Δ	Δ	Δ	Δ		Δ				Δ	Δ			3 to 12	7.12
	Reverse rotation	VR	Speed control (I) Reverse rotation start	Δ	O		O		Δ							Δ	Δ	Δ	Δ	Δ	Δ		Δ				Δ	Δ				
Speed control (II)	Forward rotation	VVF	Speed control (II) Forward rotation start	Δ	O		O		Δ	Δ						Δ	Δ	Δ	Δ	Δ	Δ		Δ				Δ	Δ			3 to 14	7.13
	Reverse rotation	VVR	Speed control (II) Reverse rotation start	Δ	O		O		Δ	Δ						Δ	Δ	Δ	Δ	Δ	Δ		Δ				Δ	Δ				
Speed/position switching control	Forward rotation	VPF	Speed/position switching control Forward rotation start	Δ	O	O	O	Δ	Δ	Δ						Δ	Δ	Δ	Δ	Δ	Δ		Δ				Δ	Δ			4 to 15	7.14.1
	Reverse rotation	VPR	Speed/position switching control Reverse rotation start	Δ	O	O	O	Δ	Δ	Δ						Δ	Δ	Δ	Δ	Δ	Δ		Δ				Δ	Δ				
	Restart	VPSTART	Speed/position switching control Restart		O																						Δ	Δ			2	7.14.2
Speed switching control		VSTART	Speed switching control, start	Δ											Δ	Δ	Δ	Δ	Δ	Δ	Δ		Δ				Δ	Δ			1 to 10	7.15.1
		VEND	Speed switching control, end																												1	

O: Must be set
Δ: Set if required

Table 6.2 Servo Instruction List (Continued)

Positioning Control	Instruction Symbol	Processing Details	Positioning Data: Common Settings: Parameter Block No.	Axis	Address/Travel Value	Commanded Speed	Dwell Time	M Code	Torque Limit Value	Circular Interpolation: Auxiliary Point	Radius	Enter Point	Number of Pitches	Parameter Block: Control Unit	Speed Limit Value	Acceleration Time	Deceleration Time	Rapid Stop Deceleration Time	Torque Limit Value	Deceleration Processing on STOP Input	Allowable Error Range for Circular Interpolation	S Curve Ratio	Others: Repeat Condition	Program No.	Commanded Speed (Constant Speed)	Cancel	Start	Skip	FIN Acceleration	Number of Steps	Section for Detailed Explanation
Speed switching control	ABS-1	Speed switching control End point address		o	o	o	Δ	Δ	Δ																	Δ	Δ			4 to 7	7. 15. 1
	ABS-2			o	o	o	Δ	Δ	Δ																	Δ	Δ			5 to 8	
	ABS-3			o	o	o	Δ	Δ	Δ																	Δ	Δ			7 to 10	
	INC-1	Speed switching control Travel value to end point		o	o	o	Δ	Δ	Δ																	Δ	Δ			4 to 7	
	INC-2			o	o	o	Δ	Δ	Δ																	Δ	Δ			5 to 8	
	INC-3			o	o	o	Δ	Δ	Δ																	Δ	Δ			7 to 10	
	VABS	Absolute designation of speed switching point			o	o		Δ	Δ																					4 to 6	
	VINC	Incremental designation of speed switching point			o	o		Δ	Δ																						
Position follow-up control	PFSTART	Position follow-up contrl start	Δ	o	o	o		Δ							Δ	Δ	Δ	Δ	Δ	Δ		Δ				Δ	Δ			4 to 16	7. 17
Constant speed control	CPSTART1	1 axis constant speed control start	Δ	o		o									Δ	Δ	Δ	Δ	Δ	Δ		Δ				Δ	Δ		Δ	3 to 14	7. 16
	CPSTART2	2 axis constant speed control start	Δ	o		o								Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ				Δ	Δ		Δ		
	CPSTART3	3 axis constant speed control start	Δ	o		o								Δ	Δ	Δ	Δ	Δ	Δ	Δ		Δ				Δ	Δ		Δ	4 to 15	
	CPSTART4	4 axis constant speed control start	Δ	o		o								Δ	Δ	Δ	Δ	Δ	Δ	Δ		Δ				Δ	Δ		Δ		
	ABS-1	Absolute designation of passing point for constant speed control		o	o			Δ	Δ																Δ			Δ		2 to 6	7. 16
	ABS-2			o	o			Δ	Δ																Δ			Δ		3 to 7	
	ABS-3			o	o			Δ	Δ																Δ			Δ		4 to 8	
	ABS-4			o	o			Δ	Δ																Δ			Δ		5 to 9	
	ABS			o	o			Δ	Δ	o															Δ			Δ		5 to 9	
	ABS			o	o			Δ	Δ		o														Δ			Δ		4 to 8	
	ABS			o	o			Δ	Δ		o														Δ			Δ			
	ABS			o	o			Δ	Δ		o														Δ			Δ			
	ABS			o	o			Δ	Δ		o														Δ			Δ			
	ABS			o	o			Δ	Δ			o													Δ			Δ		5 to 9	
	ABS			o	o			Δ	Δ			o													Δ			Δ			
	INC-1	Incremental designation of passing point for constant speed control		o	o			Δ	Δ																Δ			Δ		2 to 6	
	INC-1			o	o			Δ	Δ																Δ			Δ		3 to 7	
	INC-1			o	o			Δ	Δ																Δ			Δ		4 to 8	
	INC-1			o	o			Δ	Δ																Δ			Δ		5 to 9	
	INC			o	o			Δ	Δ	o															Δ			Δ		5 to 9	
	INC			o	o			Δ	Δ		o														Δ			Δ		4 to 8	
	INC			o	o			Δ	Δ		o														Δ			Δ			
	INC			o	o			Δ	Δ		o														Δ			Δ			

O: Must be set
Δ : Set if required

Table 6.2 Servo Instruction List (Continued)

Positioning Control	Instruction Symbol	Processing Details	Positioning Data: Common Settinge: Parameter Block No.	Common Settinge: Axis	Common Settinge: Address/Travel Value	Common Settinge: Commanded Speed	Common Settinge: Dwell Time	Common Settinge: M Code	Common Settinge: Torque Limit Value	Circular Interpolation: Auxiliary Point	Circular Interpolation: Radius	Circular Interpolation: Enter Point	Circular Interpolation: Number of Pitches	Parameter Block: Control Unit	Parameter Block: Speed Limit Value	Parameter Block: Acceleration Time	Parameter Block: Deceleration Time	Parameter Block: Rapid Stop Deceleration Time	Parameter Block: Torque Limit Value	Parameter Block: Deceleration Processing on STOP Input	Parameter Block: Allowable Error Range for Circular Interpolation	Parameter Block: S Curve Ratio	Others: Repeat Condition	Others: Program No.	Others: Commanded Speed (Constant Speed)	Others: Cancel	Others: Start	Others: Skip	Others: FIN Acceleration	Number of Steps	Section for Detailed Explanation
Constant speed control	INC	Absolute designation of passing point for constant speed control		O	O			Δ	Δ		O														Δ			Δ		4 to 8	7.16
	INC			O	O			Δ	Δ			O													Δ			Δ		5 to 9	
	INC			O	O			Δ	Δ			O													Δ			Δ			
	CPEND	Ends constant speed control					Δ																							1 to 2	
Repetition of same control	FOR-TIMES	Set the head step for repetition																					O							2	7.15.2 7.16.1
	FOR-ON																						O								
(Used for speed switching control, constant speed control)	FOR-OFF																						O								
	NEXT																													3	
Simultaneous start	START	Simultaneous start																						O						2 to 3	7.18
Home position return	ZERO	Starts home position return		O																										2	7.21
High-speed oscillation	OSC	High-speed oscillation	Δ	O	O	O		Δ											Δ								Δ	Δ			5 to 11	7.22

O: Must be set
Δ: Set if required

6.3 Positioning Data

The positioning data set for servo programs is shown in Table 6.3.

Table 6.3 Positioning Data

Name				Explanation	Setting Made With Peripheral Device					
					Default Value	Setting Range				
						mm	Inch	degree	PLUSE	
Common Settings	Parameter block No.			• Sets the parameter block on the basis of which data such as that for acceleration and deceleration processing and deceleration processing on STOP input will be set for each axis.	1	1 to 16 for A171S/A273UHCPU (8 axis specification) 1 to 64 for A273UHCPU (32 axis specification)				
	Axis			• Set the axis to be started. • For interpolation, the numbers of the axes involved in the interpolation are designated.	—	1 to 4 for A171SCPU 1 to 8 for A273UHCPU (8 axis specification) 1 to 32 for A273UHCPU (32 axis specification)				
	Address/travel value	Absolute data method	Address	Set the positioning address as an absolute address when using the absolute data method as the positioning method.	—	-214748364.8 to 214748364.7 (μm)	-21474.83648 to 21474.83647	0 to 359.99999	-2147483648 to 2147483647	
		Incremental method	Travel value	Set the positioning address as a travel value when using the incremental method as the positioning method. The direction of travel is indicated by the sign. However, only positive settings can be made for ##speed/position switching control. Positive : Forward rotation (direction in which address values increase) Negative: Reverse rotation (direction in which address values decrease)	—	For other than ##speed/position switching control				
						0 to 2147483647				
						For speed/position switching control				
						0 to 214748364.7 (μm)	0 to 21474.83647	0 to 21474.83647	0 to 2147483647	
	Commanded speed			• Sets the positioning speed. • The units for the speed are the "control units" set in the parameter block. • For interpolation, this setting is the resultant speed/long-axis reference speed/reference axis speed. (Applies to PTP control only)	—	0.01 to 6000000.00 (mm/min)	0.001 to 600000.000 (inch/min)	0.001 to 600000.000 (degree/min)	1 to 1000000 (PLS/sec)	
	Dwell time			• Set the time from positioning to the positioning address to output of the positioning completion signal (M1601+20n/Xn1/M2401+20n).	0 (ms)	0 to 5000 (ms)				
	M code			• Set the M code • For speed switching control and constant speed control, different settings can be made for each point. • The setting is updated each time motion is started or at each designated point.	0	0 to 255				
	Torque limit value			• Set the torque limit value • When motion is started, the torque limit set in the parameter block is used, but in speed switching control a different value can be set for each point and the set torque values can be made effective at designated points.	Torque limit setting (%) in the parameter block	1 to 500 (%)				
Circular Interpolation	Auxiliary point	Absolute data method		• Set when executing circular interpolation by designating an auxiliary point.	—	-214748364.8 to 214748364.7 (μm)	-21474.83648 to 21474.83647	0 to 359.99999	-2147483648 to 2147483647	
		Incremental method				0 to 2147483647				
	Radius	Absolute data method		• Set when executing circular interpolation by designating a radius. • The setting ranges, which depend on the positioning method used, are shown to the right.	—	0.1 to 429496729.4 (μm)	0.00001 to 42949.67294	0 to 359.99999	1 to 4294967294	
		Incremental method				0.1 to 214748364.7 (μm)	0.00001 to 21474.83647	0.00001 to 21474.83647	1 to 2147483647	
	Center point	Absolute data method		• Set when executing circular interpolation by designating a center point.	—	-214748364.8 to 214748364.7 (μm)	-21474.83648 to 21474.83647	0 to 359.99999	-2147483648 to 2147483647	
		Incremental method				0 to 2147483647				
	Number of pitches			• Set when performing helical interpolation	—	0 to 999				

	Settings Made Using the Sequence Program (Indirect Setting)					Indirect Setting		Processing in Event of Setting Error		
	Default Value	Setting Range				Possible/Not Possible	Number of Words Used	*4 Error Item Data (Stored in D9190)	Control Using Default Value	Starting not Possible
		mm	Inch	degree	PLUSE					
	1	1 to 16 for A171S/A273UHCPU (8 axis specification) 1 to 64 for A273UHCPU (32 axis specification)				O	1	1	O	
	—	—				X	—	—		
	—	−2147483648 to 2147483647 (×10^{-1}μm)	−2147483648 to 2147483647 (×10^{-5}inch)	0 to 35999999 (×10^{-5}degree)	−2147483648 to 2147483647					
	—	For other than speed/position switching control				O	2	n03 *1		O
		0 to 2147483647								
		For speed/position switching control						—		
		0 to 2147483647 (×10^{-1}μm)	0 to 2147483647 (×10^{-5}inch)	0 to 2147483647 (×10^{-5}degree)	0 to 2147483647					
	—	1 to 600000000 (×10^{-2}mm/min)	1 to 600000000 (×10^{-3}inch/min)	1 to 600000000 (×10^{-3}degree/min)	1 to 1000000 (PLS/sec)	O	2	4	O *2	O *3
	0 (ms)	0 to 5000 (ms)				O	1	5	O	
	0	0 to 255				O	1	6	O	
	Torque limit setting (%) in the parameter block	1 to 500 (%)				O	1	7	O	
	—	−2147483648 to 2147483647 (×10^{-1}μm)	−2147483648 to 2147483647 (×10^{-5}inch)	0 to 35999999 (×10^{-5}degree)	−2147483648 to 2147483647	O	2 × 2	n08 *1		
		0 to 2147483647								
	—	1 to 4294967294 (×10^{-1}μm)	1 to 4294967294 (×10^{-5}inch)	0 to 35999999 (×10^{-5}degree)	1 to 4294967294	O	2	n09 *1		O
		1 to 2147483647 (×10^{-1}μm)	1 to 2147483647 (×10^{-5}inch)	1 to 2147483647 (×10^{-5}degree)	1 to 2147483647					
	—	−2147483648 to 2147483647 (×10^{-1}μm)	−2147483648 to 2147483647 (×10^{-5}inch)	0 to 35999999 (×10^{-5}degree)	−2147483648 to 2147483647	O	2 × 2	n10 *1		
		0 to 2147483647								
	—	0 to 999				O	1	28		

REMARKS

*1: The "n" in n03, n08, n09, n10, indicates the axis number (1 to 4/1 to 8/1 to 32).

*2: When an error occurs because the speed limit value is exceeded, control is executed at the speed limit value.

*3: Applies when the commanded speed is "0".

*4: If there are multiple errors in the same program, the latest error item data is stored.

Table 6.3 Positioning Data (Continued)

	Name	Explanation	Setting Made With Peripheral Device					
			Default Value	Setting Range				
				mm	Inch	degree	PLUSE	
Parameter block	Control unit	• It is possible to set only those items in the set parameter block data that you want to change. • For details on each data item, see Section 4.4 "Parameter Block".	3	0	1	2	3	
	Speed limit value		200.000 (PLS/sec)	0.01 to 6000000.00 (mm/min)	0.001 to 600000.000 (inch/min)	0.001 to 600000.000 (degree/min)	1 to 1000000 (PLS/sec)	
	Acceleration time		1000 (ms)	1 to 65535 (ms)				
	Deceleration time		1000 (ms)	1 to 65535 (ms)				
	Rapid stop deceleration time		1000 (ms)	1 to 65535 (ms)				
	S curve ratio		0 (%)	1 to 100 (%)				
	Torque limit value		300 (%)	1 to 500 (%)				
	Deceleration processing on STOP input		0	0: Deceleration to a stop in accordance with the deceleration time 1: Deceleration to a stop in accordance with the rapid stop deceleration time				
	Allowable error range for circular interpolation		100 (PLS)	0 to 100000	0 to 100000	0 to 100000	0 to 100000	
Others	##Repeat condition	Set the repeat condition for repetition between the FOR-TIMES instruction and the NEXT instruction.	—	1 to 32767				
	Program No.	Set the program numbers for simultaneous starts.	—	0 to 4095				
	Commanded speed (constant speed)	Set the speed for points part way through positioning in the servo program.	—	0.01 to 6000000.00 (mm/min)	0.001 to 600000.000 (inch/min)	0.001 to 600000.000 (degree/min)	1 to 1000000 (PLS/sec)	
	Cancel	Set to end execution of a servo program by deceleration to a stop by turning ON a designated bit device in that program.	—	X, Y, M, TC, TT, CC, CT, B, F				
	Start	• Set to automatically start a designated program after execution of "cancel" above. • Can only be set when "cancel" has been set.	—	K0 to K4095				
	Skip	Set in order to cancel positioning at a pass point and carry out positioning at the next pass point by turning ON a designated bit device during execution of positioning at each of the pass points associated with a constant speed control instruction.	—	X, Y, M, TC, TT, CC, CT, B, F				
	FIN acceleration/ deceleration	Set in order to execute positioning at each pass point associated with a constant speed control instruction by turning ON the FIN signal.	—	1 to 5000 (ms)				

	Settings Made Using the Sequence Program (Indirect Setting)					Indirect Setting		Processing in Event of Setting Error		
	Default Value	Setting Range				Possible/Not Possible	Number of Words Used	*4 Error Item Data (Stored in D9190)	Control Using Default Value	Starting not Possible
		mm	Inch	degree	PLUSE					
	3	0	1	2	3	O	1	11		
	200.000 (PLS/sec)	1 to 600000000 ($\times10^{-2}$mm/min)	1 to 600000000 ($\times10^{-3}$inch/min)	1 to 600000000 ($\times10^{-3}$degree/min)	1 to 1000000 (PLS/sec)	O	2	12		
	1000 (ms)	1 to 65535 (ms)				O	1	13		
	1000 (ms)	1 to 65535 (ms)				O	1	14		
	1000 (sm)	1 to 65535 (ms)				O	1	15	O	
	0 (%)	1 to 100 (%)				O	2	21		
	300 (%)	1 to 500 (%)				O	1	16		
	0	0: Deceleration to a stop in accordance with the deceleration time 1: Deceleration to a stop in accordance with the rapid stop deceleration time				O	1	—		
	100 (PLS)	0 to 100000				O	2	17		
	—	1 to 32767				O	—	18	Controlled by K1	
	—	0 to 4095				O	—	19		O
	—	1 to 600000000 ($\times10^{-2}$mm/min)	1 to 600000000 ($\times10^{-3}$inch/min)	1 to 600000000 ($\times10^{-3}$degree/min)	1 to 1000000 (PLS/sec)	O	2	4	O *2	O *3
	—	—				—	—	—		
	—	0 to 4095				O	1	—		
	—	—				—	—	—		
	—	1 to 5000(ms)				O	1	13	O	

REMARKS

*2: When an error occurs because the speed limit value is exceeded, control is executed at the speed limit value.

*3: Applies when the commanded speed is "0".

*4: If there are multiple errors in the same program, the latest error item data is stored.

6.4 Method for Setting Positioning Data

This section explains how to set the positioning data used in a servo program. There are two ways to set positioning data, as follows:

(1) Designating numerical values.....see Section 6.4.1

(2) Indirect designation using word devices.....see Section 6.4.2

It is possible to combine data setting by designating numerical values and indirect designation using word devices in the same servo program.

6.4.1 Setting by designating numerical values

The method of setting by designating numerical values is a method whereby each positioning data item is set as a numerical value and becomes fixed data.
Data can only be set and corrected at a peripheral device.

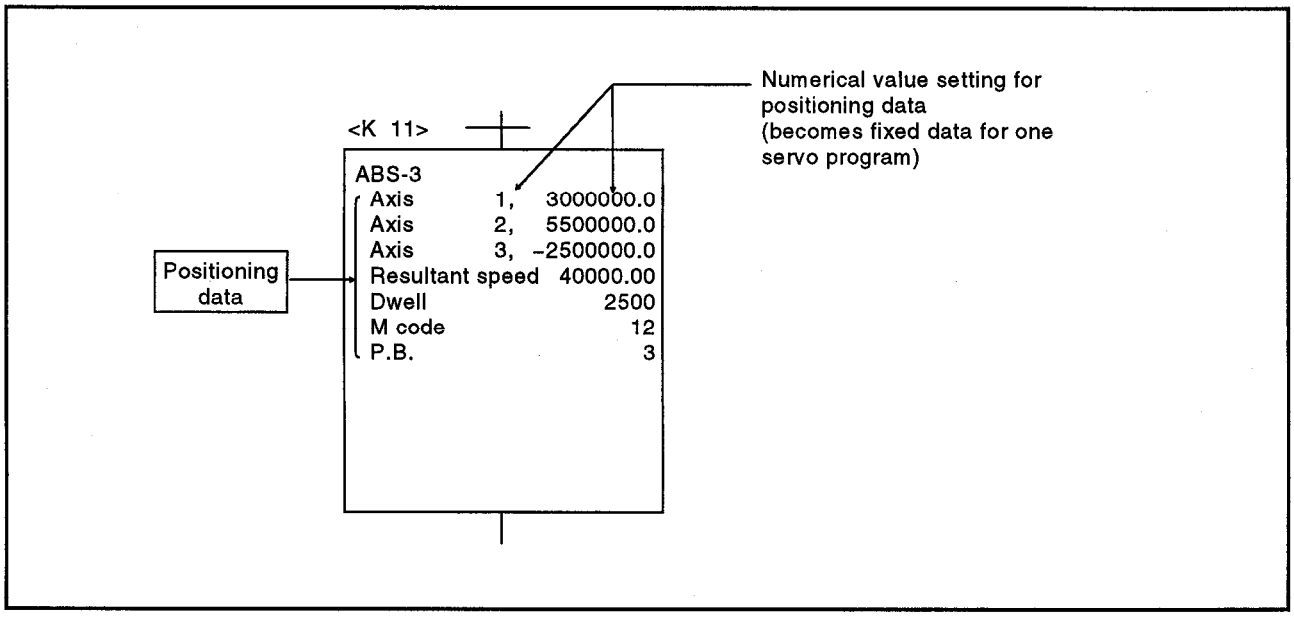


Fig.6.3 Example of Setting Positioning Data by Numerical Value Setting

6.4.2 Setting by using word devices (D, W)

The method of setting by using word devices is a method whereby a word device (D, W) number is designated in the positioning data designated for the servo program.
By changing the contents (data) of the designated word device with the sequence program, it is possible to use the same servo program to execute more than one positioning control.

(1) Devices for setting indirect data
The devices that can be used for setting indirect data are data registers (D) and link registers (W). (Word devices other than data registers and link registers cannot be used.)
The data registers which can be used are indicated in the table below.

Word Device	CPU		
	A171S	A273UH (8 Axis Specification)	A273UH (32 Axis Specification)
D	0 to 799	0 to 8191 *	800 to 8191
W	0 to 3FF	0 to 1FFF	0 to 1FFF

*1: Excluding 800 to 1023

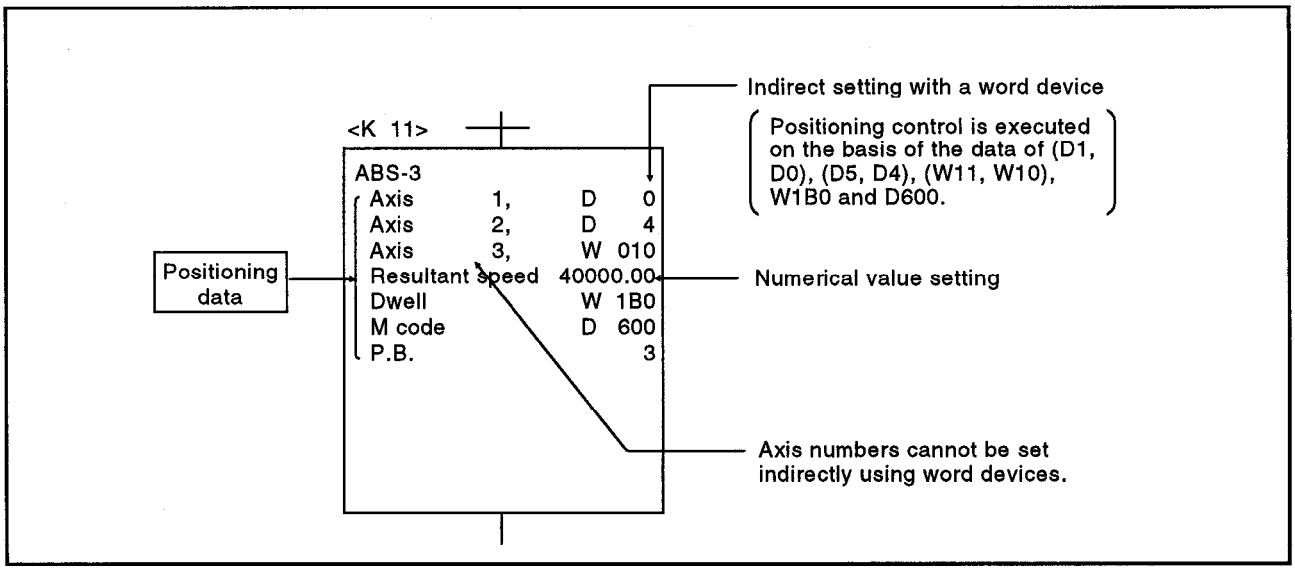


Fig.6.3 Example of Setting Positioning Data by Numerical Value Setting

(2) Input of Positioning Data
In indirect setting with word devices, the word device data is input when the PCPU executes the servo program.
Accordingly, when positioning control is executed, after data is set in the device used for indirect setting, the servo program start request signal must be issued.

POINTS

(1) It is not possible to indirectly set axis numbers using word devices with a servo program.

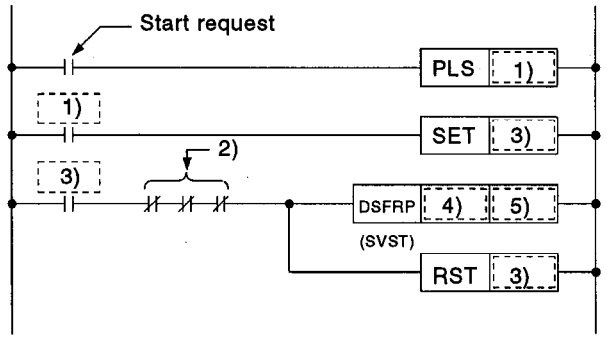
(2) Establish an interlock by using a start accept signal (M2001 to M2004/M2001 to M2008/M2001 to M2032) to ensure that the device data designated for indirect setting is not changed until the designated axis has accepted the start command .
If the data is changed before the start command is accepted, positioning control in accordance

6.5 Creating Sequence Programs to Start Servo Programs

This section describes sequence programs that execute positioning control by using servo programs.

6.5.1 Case where the servo program is executed once only

The general concept for a program that executes a designated servo program once only in response to the start request is shown in Figure 6.5.



When the start request comes ON, if the designated axis is not in motion, a request to execute a DSFRP/SVST instruction is issued.

Servo program start request issued in response to DSFRP/SVST instruction.

On completion of execution of the DSFRP/SVST instruction, the device designated at 1) is reset.

* The applications of 1) to 5) are indicated below.

1): Start request leading edge detection flag (devices that can be used: Y, M, L, S, B, F)

2): Start accept flag (set a number of flags corresponding to the number of axes designated in the servo program)

3): DSFRP/SVST instruction execution request flag (devices that can be used: Y, M, L, S, B, F)

4): Axis No. designated in the servo program

5): Started servo program No. (K0 to K4095)

Example

A sequence program that issues a start request for servo program No.10 - which executes circular interpolation with axis 3 and axis 4 - when X000 comes ON, is shown below.

(1) Condition

The flags that can be used with sequence programs are indicated below.

Flag Name		Device No.
Flag for recording the start request		M10
DSFRP/SVST instruction execution request flag		M11
Start accept flag	Axis 3	M2003
	Axis 4	M2004

(2) Sequence program example

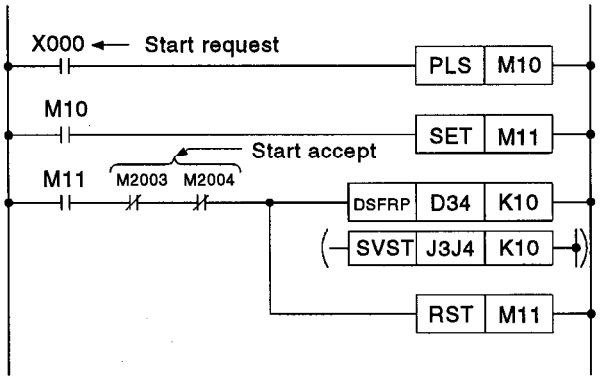
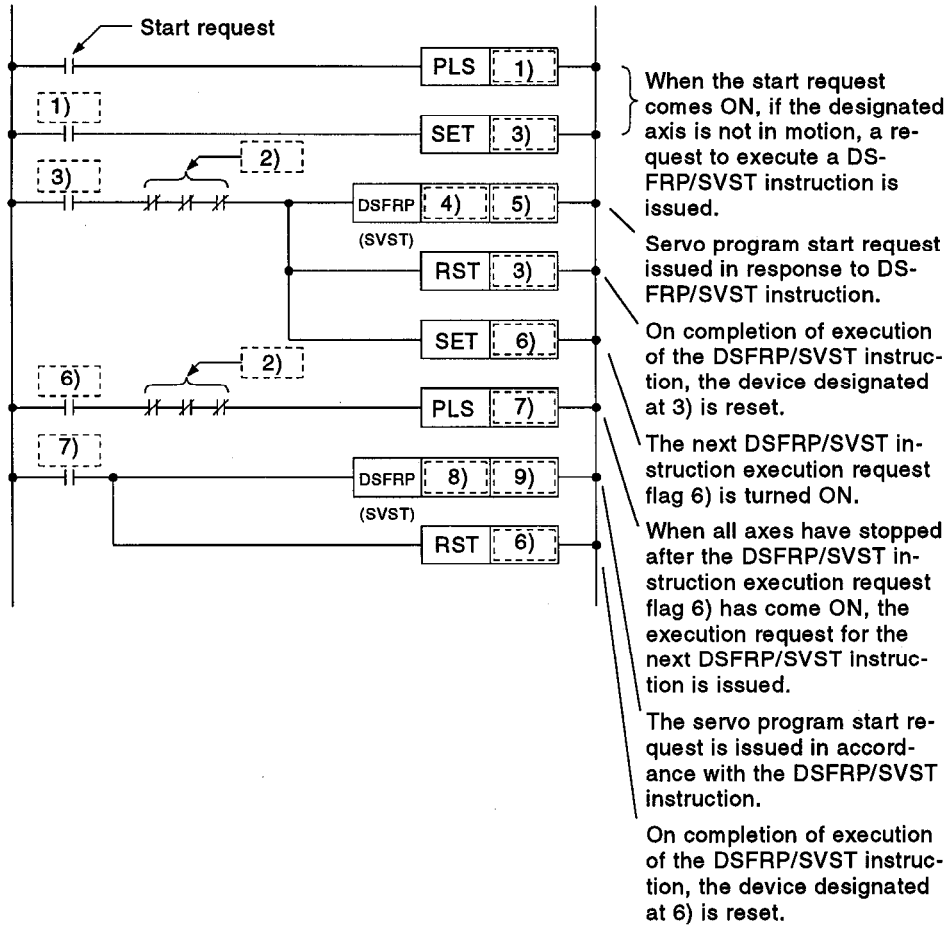


Fig. 6.5 Sequence Program for Starting a Servo Program

6.5.2 Case where different servo programs are executed consecutively

The general concept for a program that, on completion of positioning in accordance with a servo program executed in response to a start request, executes the next servo program, is shown in Figure 6.6. below.



* The applications of 1) to 9) are indicated below.

1): Start request leading edge detection flag (devices that can be used: Y, M, L, S, B, F)

2): Start accept flag (set a number of flags corresponding to the number of axes designated in the servo program)

3), 7): DSFRP/SVST instruction execution request flag (devices that can be used: Y, M, L, S, B, F)

4), 8): Axis No. designated in the servo program

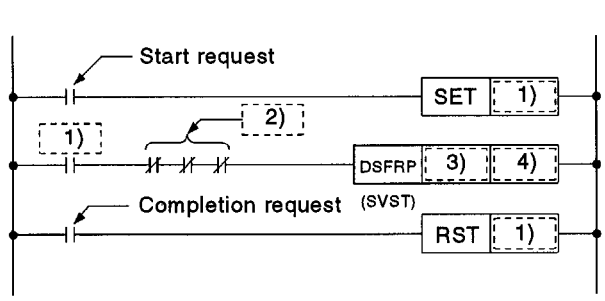
5), 9): Started servo program No. (K0 to K4095)

6): Start request recording flag (Y, M, L, S, B, F)

Fig. 6.6 Sequence Program for Starting Servo Programs

6.5.3 Case where the same servo program is executed repeatedly

The general concept for a program that executes repeated positioning control in accordance with the same servo program is indicated in Figure 6.7.



* The applications of 1) to 4) are indicated below.

1): DSFRP/SVST instruction execution request flag (devices that can be used: Y, M, L, S, B, F)

2): Start accept flag (set a number of flags corresponding to the number of axes designated in the servo program)

3): Axis No. designated in the servo program

4): Started servo program No. (K0 to K4095)

Fig. 6.7 Sequence Program For Starting a Servo Program