MITSUBISHI

MOTION CONTROLLER (SV13/22) (REAL MODE)

Programming Manual

type A173UHCPU, A273UHCPU

MITSUBISHI ELECTRIC

INTORODUCTION

Thank you for purchasing the Mitsubishi Motion Controller/Personal Machine Controller. This instruction manual describes the handling and precautions of this unit. Incorrect handing will lead to unforeseen events, so we ask that you please read this manual thoroughly and use the unit correctly.
Please make sure that this manual is delivered to the final user of the unit and that it is stored for future reference.

Precautions for Safety

Please read this instruction manual and enclosed documents before starting installation, operation, maintenance or inspections to ensure correct usage. Thoroughly understand the machine, safety information and precautions before starting operation.
The safety precautions are ranked as "Warning" and "Caution" in this instruction manual.

WARNING	When a dangerous situation may occur if handling is mistaken leading to fatal or major injuries.
CAUTION	When a dangerous situation may occur if handling is mistaken leading to medium or minor injuries, or physical damage.

Note that some items described as cautions may lead to major results depending on the situation. In any case, important information that must be observed is described.

For Sate Operations

1. Prevention of electric shocks

WARNING
Never open the front case or terminal covers while the power is ON or the unit is running, as this may lead to electric shocks.
Never run the unit with the front case or terminal cover removed. The high voltage terminal and charged sections will be exposed and may lead to electric shocks.
Never open the front case or terminal cover at times other than wiring work or periodic inspections even if the power is OFF. The insides of the control unit and servo amplifier are charged and may lead to electric shocks.
When performing wiring work or inspections, turn the power OFF, wait at least ten minutes, and then check the voltage with a tester, etc. Failing to do so may lead to electric shocks.
Always ground the control unit, servo amplifier and servomotor with Class 3 grounding. Do not ground commonly with other devices.
The wiring work and inspections must be done by a qualified technician.
Wire the units after installing the control unit, servo amplifier and servomotor. Failing to do so may lead to electric shocks or damage.
Never operate the switches with wet hands, as this may lead to electric shocks.
Do not damage, apply excessive stress, place heavy things on or sandwich the cables, as this may lead to electric shocks.
Do not touch the control unit, servo amplifier or servomotor terminal blocks while the power is ON, as this may lead to electric shocks.
Do not touch the internal power supply, internal grounding or signal wires of the control unit and servo amplifier, as this may lead to electric shocks.

2. For fire prevention

CAUTION
Install the control unit, servo amplifier, servomotor and regenerative resistor on inflammable material. Direct installation on flammable material or near flammable material may lead to fires.
If a fault occurs in the control unit or servo amplifier, shut the power OFF at the servo amplifier's power source. If a large current continues to flow, fires may occur.
When using a regenerative resistor, shut the power OFF with an error signal. The regenerative resistor may abnormally overheat due to a fault in the regenerative transistor, etc., and may lead to fires.
Always take heat measures such as flame proofing for the inside of the control panel where the servo amplifier or regenerative resistor is installed and for the wires used. Failing to do so may lead to fires.

3. For injury prevention

⚠ CAUTION
⚠ Do not apply a voltage other than that specified in user's manual, or the instruction manual for the product you are using on any terminal. Doing so may lead to destruction or damage. ⚠ Do not mistake the terminal connections, as this may lead to destruction or damage. ⚠ Do not mistake the polarity (+/–), as this may lead to destruction or damage. ⚠ The servo amplifier's heat radiating fins, regenerative resistor and servo amplifier, etc., will be hot while the power is ON and for a short time after the power is turned OFF. Do not touch these parts as doing so may lead to burns. ⚠ Always turn the power OFF before touching the servomotor shaft or coupled machines, as these parts may lead to injuries. ⚠ Do not go near the machine during test operations or during operations such as teaching. Doing so may lead to injuries.

4. Various precautions

Strictly observe the following precautions.
Mistaken handling of the unit may lead to faults, injuries or electric shocks.

(1) System structure

⚠ CAUTION
⚠ Always install a leakage breaker on the control unit and servo amplifier power source. ⚠ If installation of a magnetic contactor for power shut off during an error, etc., is specified in the instruction manual for the servo amplifier, etc., always install the magnetic contactor. ⚠ Install an external emergency stop circuit so that the operation can be stopped immediately and the power shut off. ⚠ Use the control unit, servo amplifier, servomotor and regenerative resistor with the combinations listed in the instruction manual. Other combinations may lead to fires or faults. ⚠ If safety standards (ex., robot safety rules, etc.,) apply to the system using the control unit, servo amplifier and servomotor, make sure that the safety standards are satisfied. ⚠ If the operation during a control unit or servo amplifier error and the safety direction operation of the control unit differ, construct a countermeasure circuit externally of the control unit and servo amplifier. ⚠ In systems where coasting of the servomotor will be a problem during emergency stop, servo OFF or when the power is shut OFF, use dynamic brakes. ⚠ Make sure that the system considers the coasting amount even when using dynamic brakes. ⚠ In systems where perpendicular shaft dropping may be a problem during emergency stop, servo OFF or when the power is shut OFF, use both dynamic brakes and magnetic brakes. ⚠ The dynamic brakes must be used only during emergency stop and errors where servo OFF occurs. These brakes must not be used for normal braking. ⚠ The brakes (magnetic brakes) assembled into the servomotor are for holding applications, and must not be used for normal braking. ⚠ Construct the system so that there is a mechanical allowance allowing stopping even if the stroke end limit switch is passed through at the max. speed.

⚠ CAUTION

- ⚠ Use wires and cables that have a wire diameter, heat resistance and bending resistance compatible with the system.
- ⚠ Use wires and cables within the length of the range described in the instruction manual.
- ⚠ The ratings and characteristics of the system parts (other than control unit, servo amplifier, servomotor) must be compatible with the control unit, servo amplifier and servomotor.
- ⚠ Install a cover on the shaft so that the rotary parts of the servomotor are not touched during operation.
- ⚠ There may be some cases where holding by the magnetic brakes is not possible due to the life or mechanical structure (when the ball screw and servomotor are connected with a timing belt, etc.). Install a stopping device to ensure safety on the machine side.

(2) Parameter settings and programming

⚠ CAUTION

- ⚠ Set the parameter values to those that are compatible with the control unit, servo amplifier, servomotor and regenerative resistor model and the system application. The protective functions may not function if the settings are incorrect.
- ⚠ The regenerative resistor model and capacity parameters must be set to values that conform to the operation mode, servo amplifier and servo power unit. The protective functions may not function if the settings are incorrect.
- ⚠ Set the mechanical brake output and dynamic brake output validity parameters to values that are compatible with the system application. The protective functions may not function if the settings are incorrect.
- ⚠ Set the stroke limit input validity parameter to a value that is compatible with the system application. The protective functions may not function if the setting is incorrect.
- ⚠ Set the servomotor encoder type (increment, absolute position type, etc.) parameter to a value that is compatible with the system application. The protective functions may not function if the setting is incorrect.
- ⚠ Set the servomotor capacity and type (standard, low-inertia, flat, etc.) parameter to values that are compatible with the system application. The protective functions may not function if the settings are incorrect.
- ⚠ Set the servo amplifier capacity and type parameters to values that are compatible with the system application. The protective functions may not function if the settings are incorrect.
- ⚠ Use the program commands for the program with the conditions specified in the instruction manual.
- ⚠ Set the sequence function program capacity setting, device capacity, latch validity range, I/O assignment setting, and validity of continuous operation during error detection to values that are compatible with the system application. The protective functions may not function if the settings are incorrect.
- ⚠ Some devices used in the program have fixed applications, so use these with the conditions specified in the instruction manual.
- ⚠ The input devices and data registers assigned to the link will hold the data previous to when communication is terminated by an error, etc. Thus, an error correspondence interlock program specified in the instruction manual must be used.
- ⚠ Use the interlock program specified in the special function unit's instruction manual for the program corresponding to the special function unit.

(3) Transportation and installation

⚠ CAUTION

- ⚠ Transport the product with the correct method according to the weight.
- ⚠ Use the servomotor suspension bolts only for the transportation of the servomotor. Do not transport the servomotor with machine installed on it.
- ⚠ Do not stack products past the limit.
- ⚠ When transporting the control unit or servo amplifier, never hold the connected wires or cables.
- ⚠ When transporting the servomotor, never hold the cables, shaft or detector.
- ⚠ When transporting the control unit or servo amplifier, never hold the front case as it may fall off.
- ⚠ When transporting, installing or removing the control unit or servo amplifier, never hold the edges.
- ⚠ Install the unit according to user's manual, or the instruction manual for the product you are using in a place where the weight can be withstood.
- ⚠ Do not get on or place heavy objects on the product.
- ⚠ Always observe the installation direction.
- ⚠ Keep the designated clearance between the control unit or servo amplifier and control panel inner surface or the control unit and servo amplifier, control unit or servo amplifier and other devices.
- ⚠ Do not install or operate control units, servo amplifiers or servomotors that are damaged or that have missing parts.
- ⚠ Do not block the intake/outtake ports of the servomotor with cooling fan.
- ⚠ Do not allow conductive matter such as screw or cutting chips or combustible matter such as oil enter the control unit, servo amplifier or servomotor.
- ⚠ The control unit, servo amplifier and servomotor are precision machines, so do not drop or apply strong impacts on them.
- ⚠ Securely fix the control unit and servo amplifier to the machine according to the instruction manual. If the fixing is insufficient, these may come off during operation.
- ⚠ Always install the servomotor with reduction gears in the designated direction. Failing to do so may lead to oil leaks.
- ⚠ Store and use the unit in the following environmental conditions.

Environment	Conditions	
	Control unit/servo amplifier	Servomotor
Ambient temperature	0°C to +55°C (With no freezing)	0°C to +40°C (With no freezing)
Ambient humidity	According to each instruction manual.	80%RH or less (With no dew condensation)
Storage temperature	According to each instruction manual.	–20°C to +65°C
Atmosphere	Indoors (where not subject to direct sunlight). No corrosive gases, flammable gases, oil mist or dust must exist.	
Altitude	1000m or less above sea level.	
Vibration	According to each instruction manual.	

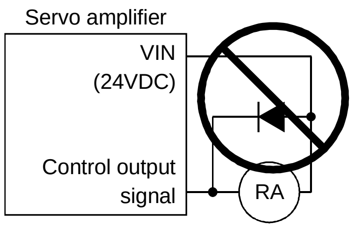
CAUTION

- When coupling with the synchronization encoder or servomotor shaft end, do not apply impact such as by hitting with a hammer. Doing so may lead to detector damage.
- Do not apply a load larger than the tolerable load onto the servomotor shaft. Doing so may lead to shaft breakage.
- When not using the unit for a long time, disconnect the power line from the control unit or servo amplifier.
- Place the control unit and servo amplifier in static electricity preventing vinyl bags and store.
- When storing for a long time, contact the Service Center or Service Station.

(4) Wiring

CAUTION

- Correctly and securely wire the wires. Reconfirm the connections for mistakes and the terminal screws for tightness after wiring. Failing to do so may lead to run away of the servomotor.
- After wiring, install the protective covers such as the terminal covers to the original positions.
- Do not install a phase advancing capacitor, surge absorber or radio noise filter (option FR-BIF) on the output side of the servo amplifier.
- Correctly connect the output side (terminals U, V, W). Incorrect connections will lead the servomotor to operate abnormally.
- Do not connect a commercial power supply to the servomotor, as this may lead to trouble.
- Do not mistake the direction of the surge absorbing diode installed on the DC relay for the control signal output of brake signals, etc. Incorrect installation may lead to signals not being output when trouble occurs or the protective functions not functioning.



- Do not connect or disconnect the connection cables between each unit, the encoder cable or sequence expansion cable while the power is ON.
- Securely tighten the cable connector fixing screws and fixing mechanisms. Insufficient fixing may lead to the cables combing off during operation.
- Do not bundle the power line or cables.

(5) Trial operation and adjustment

CAUTION

- Confirm and adjust the program and each parameter before operation. Unpredictable movements may occur depending on the machine.
- Extreme adjustments and changes may lead to unstable operation, so never make them.
- When using the absolute position system function, on starting up, and when the controller or absolute value motor has been replaced, always perform a home position return.

(6) Usage methods

⚠ CAUTION

⚠ Immediately turn OFF the power if smoke, abnormal sounds or odors are emitted from the control unit, servo amplifier or servomotor.

⚠ Always execute a test operation before starting actual operations after the program or parameters have been changed or after maintenance and inspection.

⚠ The units must be disassembled and repaired by a qualified technician.

⚠ Do not make any modifications to the unit.

⚠ Keep the effect or magnetic obstacles to a minimum by installing a noise filter or by using wire shields, etc. Magnetic obstacles may affect the electronic devices used near the control unit or servo amplifier.

⚠ Use the units with the following conditions.

Item	Conditions
Input power	According to the separate instruction manual.
Input frequency	According to the separate instruction manual.
Tolerable momentary power failure	According to the separate instruction manual.

(7) Remedies for errors

⚠ CAUTION

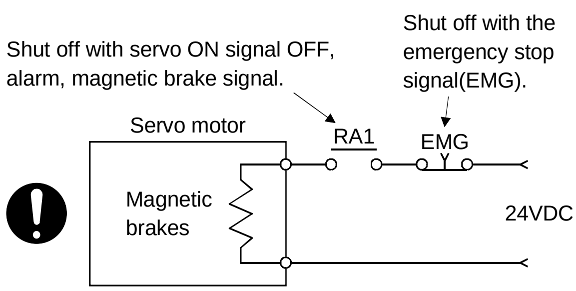
⚠ If an error occurs in the self diagnosis of the control unit or servo amplifier, confirm the check details according to the instruction manual, and restore the operation.

⚠ If a dangerous state is predicted in case of a power failure or product failure, use a servomotor with magnetic brakes or install a brake mechanism externally.

⚠ Use a double circuit construction so that the magnetic brake operation circuit can be operated by emergency stop signals set externally.

⚠ If an error occurs, remove the cause, secure the safety and then resume operation.

⚠ The unit may suddenly resume operation after a power failure is restored, so do not go near the machine. (Design the machine so that personal safety can be ensured even if the machine restarts suddenly.)



(8) Maintenance, inspection and part replacement

⚠ CAUTION

⚠ Perform the daily and periodic inspections according to the instruction manual.

⚠ Perform maintenance and inspection after backing up the program and parameters for the control unit and servo amplifier.

⚠ Do not place fingers or hands in the clearance when opening or closing any opening.

⚠ Periodically replace consumable parts such as batteries according to user's manual, or the instruction manual for the product you are using.

⚠ CAUTION

- ⚠ Do not touch the lead sections such as ICs or the connector contacts.
- ⚠ Do not place the control unit or servo amplifier on metal that may cause a power leakage or wood, plastic or vinyl that may cause static electricity buildup.
- ⚠ Do not perform a megger test (insulation resistance measurement) during inspection.
- ⚠ When replacing the control unit or servo amplifier, always set the new unit settings correctly.
- ⚠ When the controller or absolute value motor has been replaced, carry out a home position return operation using one of the following methods, otherwise position displacement could occur.

  1) After writing the servo data to the PC using peripheral device software, switch on the power again, then perform a home position return operation.

  2) Using the backup function of the peripheral device software, load the data backed up before replacement.
- ⚠ After maintenance and inspections are completed, confirm that the position detection of the absolute position detector function is correct.
- ⚠ Do not short circuit, charge, overheat, incinerate or disassemble the batteries.
- ⚠ The electrolytic capacitor will generate gas during a fault, so do not place your face near the control unit or servo amplifier.
- ⚠ The electrolytic capacitor and fan will deteriorate. Periodically change these to prevent secondary damage from faults. Replacements can be made by the Service Center or Service Station.

(9) Disposal

⚠ CAUTION

- ⚠ Dispose of this unit as general industrial waste.
- ⚠ Do not disassemble the control unit, servo amplifier or servomotor parts.
- ⚠ Dispose of the battery according to local laws and regulations.

(10) General cautions

⚠ CAUTION

- ⚠ All drawings provided in the instruction manual show the state with the covers and safety partitions removed to explain detailed sections. When operating the product, always return the covers and partitions to the designated positions, and operate according to the instruction manual.

Revisions

The manual number is given on the bottom left of the back cover.

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1. GENERAL DESCRIPTION

This manual describes the positioning control parameters required to execute positioning control with the motion controller (SV13/22 real mode), the devices used specifically for positioning, and the method used for positioning.
The positioning control capabilities of the motion controller (SV13/22 real mode) are indicated in the table below.

Applicable CPU	Number of Axes Controlled in Positioning Control
A173UHCPU(-S1)	32
A273UHCPU	32

In this manual, the CPUs cited in the table above are collectively referred to as "servo system CPUs".
The following software packages are used to make system settings, and to set, test, and monitor parameters and servo programs.
- SW2SRX-GSV13PE software package................ Abbreviated to "GSV13PE"
- SW2SRX-GSV22PE software package................ Abbreviated to "GSV22PE"

⚠ CAUTION

- ⚠ When designing the system, provide external protective and safety circuits to ensure safety in the event of trouble with the motion controller.
- ⚠ There are electronic components which are susceptible to the effects of static electricity mounted on the printed circuit board. When handling printed circuit boards with bare hands you must ground your body or the work bench.
  Do not touch current-carrying or electric parts of the equipment with bare hands.
- ⚠ Make parameter settings within the ranges stated in this manual.
- ⚠ Use the program instructions that are used in programs in accordance with the conditions stipulated in this manual.
- ⚠ Some devices for use in programs have fixed applications: they must be used in accordance with the conditions stipulated in this manual.

REMARK

(1) Abbreviations used in this manual are shown in the following table.

Names	Abbreviation
IBM PC/AT in which PC-DOS V5.0 or later version is installed	IBM PC
MR-H-BN/MR-J2S-B/MR-J2-B type servo amplifier	MR-☐-B
AC motor drive module	ADU

IBM PC/AT is a register trade mark of the International Business Machines Corporation.

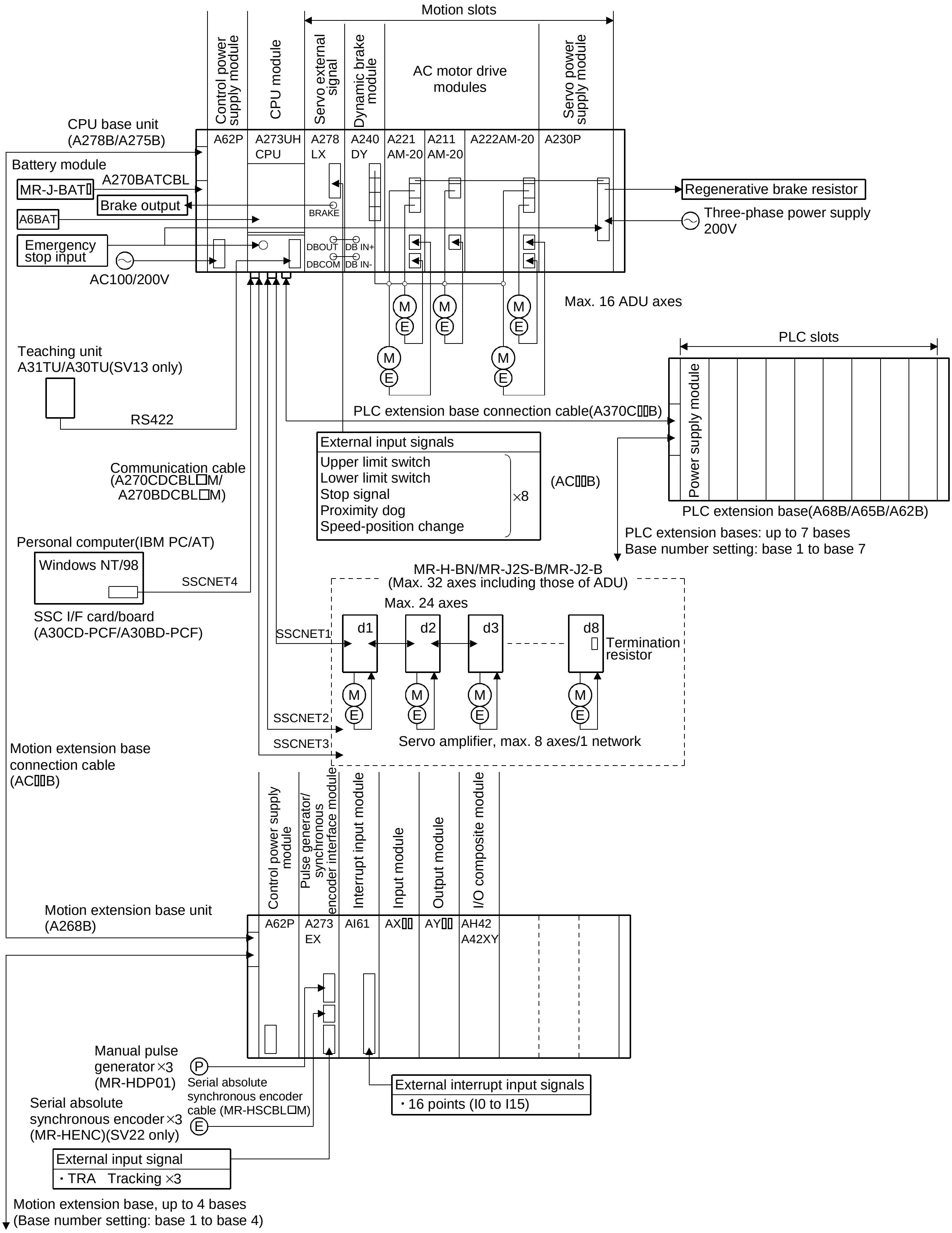
Differences between A273UHCPU, A173UHCPU(-S1) and A172SHCPUN

	Item		A173UHCPU(-S1)	A172SHCPUN	A273UHCPU
Motion control	Number of control axes		32-axes	8-axes	32-axes
	Operation cycle		SV13: 3.5ms/1 to 20 axes 7.1ms/21 to 32 axes SV22: 3.5ms/1 to 12 axes 7.1ms/13 to 24 axes 14.2ms/25 to 32 axes	3.5ms/1 to 8 axes	SV13: 3.5ms/1 to 12 axes 7.1ms/13 to 24 axes 14.2ms/25 to 32 axes SV22: 3.5ms/1 to 8 axes 7.1ms/9 to 18 axes 14.2ms/19 to 32 axes
	Cam data		A173UHCPU: Max. 64 pcs. A173UHCPU-S1: Max. 256 pcs.	Max. 64 pcs.	Max. 256 pcs.
Sequence control	PLC CPU		A3UCPU equivalent	A2SHCPU (memory enhanced) equivalent	A3UCPU equivalent
	Processing speed (µs/step)		0.15	Direct: 0.25 to 1.9 Refresh: 0.25	0.15
	Number of real I/O points		2048 points(Range of one extension base)	1024 points	2048 points
	Number of I/O device points		8192 points	2048 points	8192 points
	Memory capacity		256k bytes (for A173UHCPU) 1024k bytes (for A173UHCPU-S1)	192k bytes	Varies with memory cassette
	Program capacity	Main sequence	30k steps	30k steps	30k steps
		Sub sequence	30k steps	None	30k steps
	Number of device points	Internal relay (M)	8192 points	2048 points	8192 points
		Link relay (B)	8192 points	1024 points	8192 points
		Timer (T)	2048 points	256 points	2048 points
		Data register (D)	8192 points	1024 points	8192 points
		Link register (W)	8192 points	1024 points	8192 points
		Annunciator (F)	2048 points	256 points	2048 points
		Index register (V, Z)	14 points	2 points	14 points
	Number of PLC extension bases		1 base	1 base	7 bases
System configuration	Number of SSCNET interfaces		4 channels	2 channels	4 channels
	Number of motion slots		8 slots (A178B-S3 use)	2 slots (A178B-S1 use)	8 slots × up to 4 extension bases allowed
	Pulse generator/synchronous encoder, external signal input modules		Four A172SENC modules usable	One A172SENC module usable	Four A287EX/A273EX usable
	PBUS I/O module		256 points	256 points	256 points
	Manual pulse generator		3 pcs. usable	1 pc. usable	3 pcs. usable
	Synchronous encoder (SV22)		4 pcs. usable	1 pc. usable	12 pcs. usable
	High-speed read	NMI input	1 point	1 point	3 points
		PLC input module	8 points	8 points	8 points
Compatibility	Sequence program/parameters Servo program Mechanical system program (SV22) Cam data (SV22P)		Those started on A173UHCPU and created on A273UHCPU (32-axes feature) by file read can be used as is.	———	———
	System settings Parameters		Must be set anew.	———	———

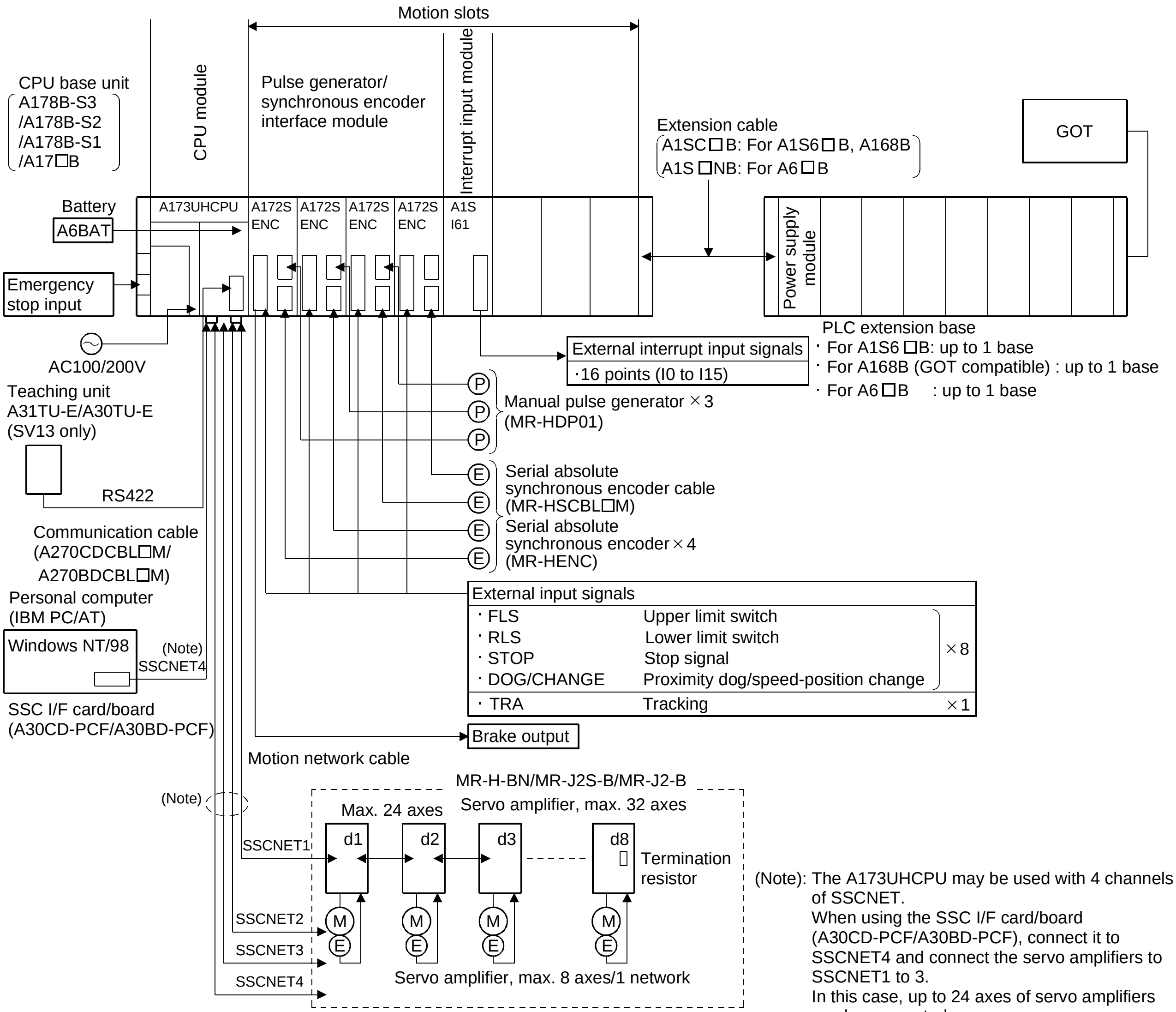
1.1 System Configuration

1.1.1 A273UHCPU System overall configuration

The following system configuration assumes use of the A273UHCPU.



1.1.2 A173UHCPU(-S1) System overall configuration



(Note): The A173UHCPU may be used with 4 channels of SSCNET.
When using the SSC I/F card/board (A30CD-PCF/A30BD-PCF), connect it to SSCNET4 and connect the servo amplifiers to SSCNET1 to 3.
In this case, up to 24 axes of servo amplifiers can be connected.

POINTS

(1) Use the A168B when using the bus-connection type GOT.
(2) Using the A31TU teaching unit provided with deadman switch requires the exclusively used A31TUCBL03M connection cable between the CPU module and A31TU connector. The A31TU will not operate at all if it is connected directly with the RS422 connector of the CPU, without using the exclusively used cable.
Also, after disconnecting the A31TU, fit the A31SHORTCON short connector designed for A31TUCBL.
(3) The motion slots also accept PLC A1S I/O modules.
(4) The motion slots accept one A1SI61 interrupt input module.
This module is designed for only event/NMI input to the motion CPU and is irrelevant to PLC interrupt programs.
(5) The motion slots accept up to 256 I/O points.
(6) The I/O numbers of the I/O modules loaded in the motion slots should be later than the I/O numbers used with the PLC slots.

1.2 Table of Software Package

Use	Peripheral Devices		Programming Software Package				Operating System Software Package Model Name		Teaching function
				Model Name	Applicable version		For A173UH	For A273UH	
					For A173UH	For A273UH			
For conveyor assembly **SV13** (With Motion SFC)	IBM PC/AT	NT/98	Japanese	SW3RNC-GSV	From 00F on	Without restriction	SW3RN-SV13B	SW3RN-SV13X	Yes
			English	SW3RNC -GSVE	Without restriction	Without restriction			
For conveyor assembly **SV13** (Without Motion SFC)	IBM PC/AT	DOS	Japanese	SW2SRX-GSV13P	From 0AC on	——	SW2SRX-SV13B	SW0SRX-SV13V	Yes
			English	SW2SRX-GSV13PE	From 00J on	——			
		NT/98	Japanese	SW3RNC-GSV	From 00F on	From 00F on			
			English	SW3RNC-GSVE	Without restriction	——			
For automatic machinery **SV22** (With Motion SFC)	IBM PC/AT	NT/98	Japanese	SW3RNC-GSV	From 00F on	Without restriction	SW3RN-SV22A	SW3RN-SV22W	No
			English	SW3RNC -GSVE	Without restriction	Without restriction			
For automatic machinery **SV22** (Without Motion SFC)	IBM PC/AT	DOS	Japanese	SW2SRX-GSV22P	From 0AC on	——	SW2SRX-SV22A	SW0SRX-SV22C	No
				SW0SRX-CAMP	From 00B on	——			
			English	SW2SRX-GSV22PE	From 00J on	——			
				SW0SRX-CAMPE	Without restriction	——			
		NT/98	Japanese	SW3RNC-GSV	From 00F on	From 00F on			
			English	SW3RNC-GSVE	Without restriction	——			

(1) Software package versions which accept the setting of the MR-J2S-B servo amplifier
For the following combinations of the programming software packages and operating system software packages, the MR-J2S-B servo amplifier is made usable by setting the servo amplifier to the "MR-J2S series" and the servo motor to "Auto" in the programming software package system settings.

Programming Software Package		Operating System Software Package			
Model	**Version**	**A273UHCPU**	**Version**	**A173UHCPU(-S1)**	**Version**
SW2SRX-GSV13P	AD or later	SW2SRX-SV13V	AF or later	SW2SRX-SV13B	AF or later
SW2SRX-GSV13PE	J or later				
SW2NX-GSV13P	AC or later	SW2NX-SV13V	AF or later	SW2NX-SV13B	AF or later
SW2SRX-GSV22P	AD or later	SW2SRX-SV22U	AF or later	SW2SRX-SV22A	AF or later
SW2SRX-GSV22PE	J or later				
SW2NX-GSV22P	AC or later	SW2NX-SV22U	AF or later	SW2NX-SV22A	AF or later
SW3RNC-GSV	G or later	SW2SRX-SV13V	AF or later	SW2SRX-SV13B	AF or later
SW3RNC-GSVE		SW2SRX-SV22U		SW2SRX-SV22A	

1.3 Positioning Control by the Servo System CPU

A servo system CPU can execute positioning control and sequence control for 32 axes by means of a CPU for multi-axis positioning control (hereafter called the "PCPU") and a CPU for sequence control (hereafter called the "SCPU"). Sequence control capabilities are equivalent to those of A3U.

(1) Control handled by the SCPU
  (a) Sequence control
  The SCPU controls I/O modules and special function modules in accordance with the sequence program.
  (The method for executing a sequence program is the same as for an A3UCPU.)

  (b) Start of positioning start in accordance with sequence program, and setting of positioning data
    1) The Start requests execution of servo programs by means of the SVST instruction (up to 4 axes for interpolation).
    2) It changes current values or speed by means of the CHGA/CHGV instruction.
    3) It changes the torque limit value by means of the CHGT instruction.
    4) It executes JOG operation.
    5) It sets the data required to execute manual pulse generator operation.

(2) Control handled by the PCPU
  (a) The PCPU executes servo programs whose execution is requested by a SVST instruction issued by the sequence program, and performs the set positioning control.
  Positioning control data is defined in the positioning control parameters and the servo program.

  (b) It changes the feed current value or positioning speed at the servo side in accordance with the current values or speeds set by CHGA/CHGV instructions issued by the sequence program.

  (c) It changes the torque limit value of the designated axis to that defined by the CHGT instruction.

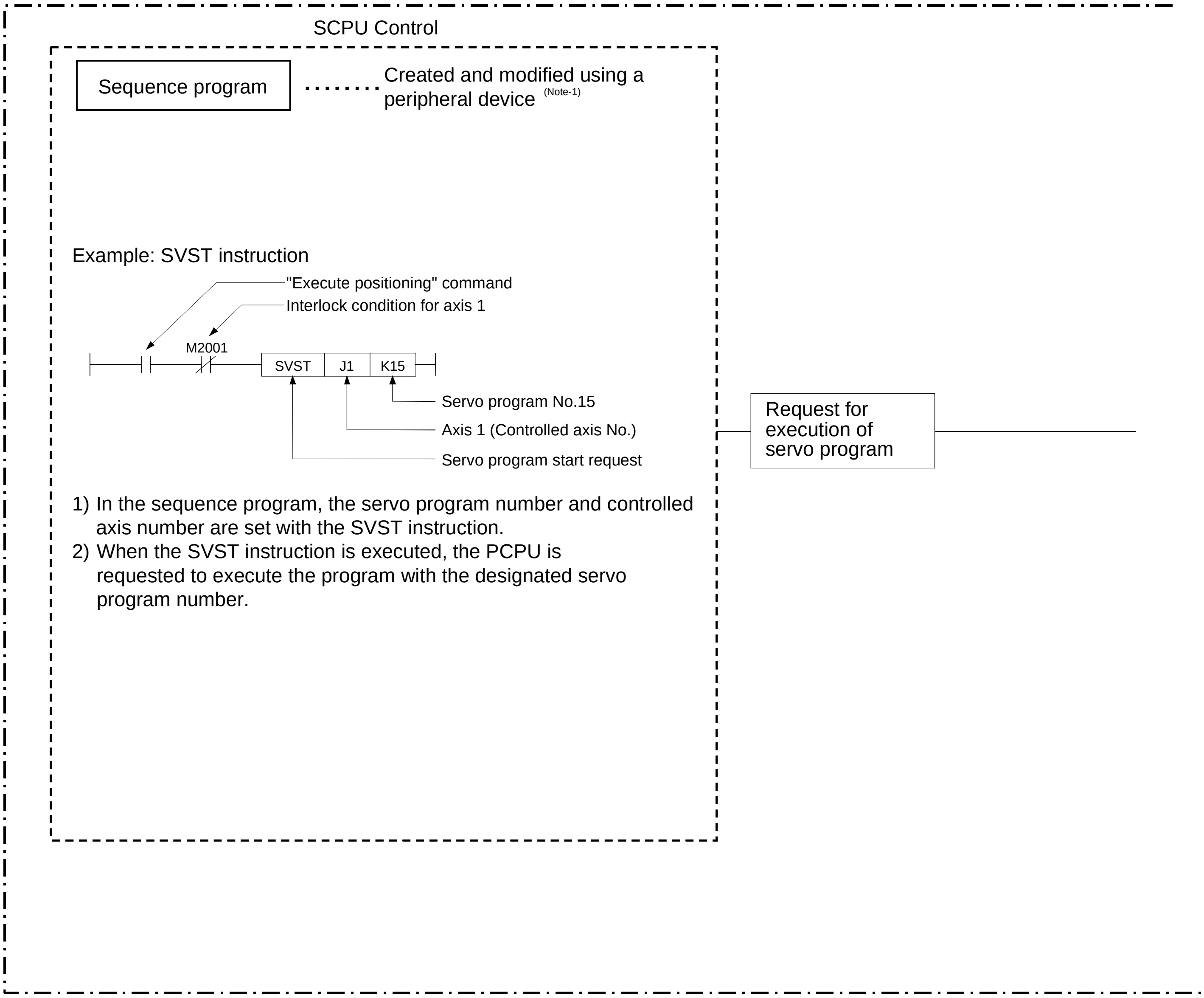
  (d) It executes positioning when the manual pulse generator is used.

  (e) It executes the teaching designated with the teaching unit (A30TU-E/A31TU-E).

[Executing Positioning Control with a Servo System CPU]

The servo system CPU executes positioning control in accordance with the servo programs designated by the sequence program of the SCPU.
An overview of the method used for positioning control is presented below.

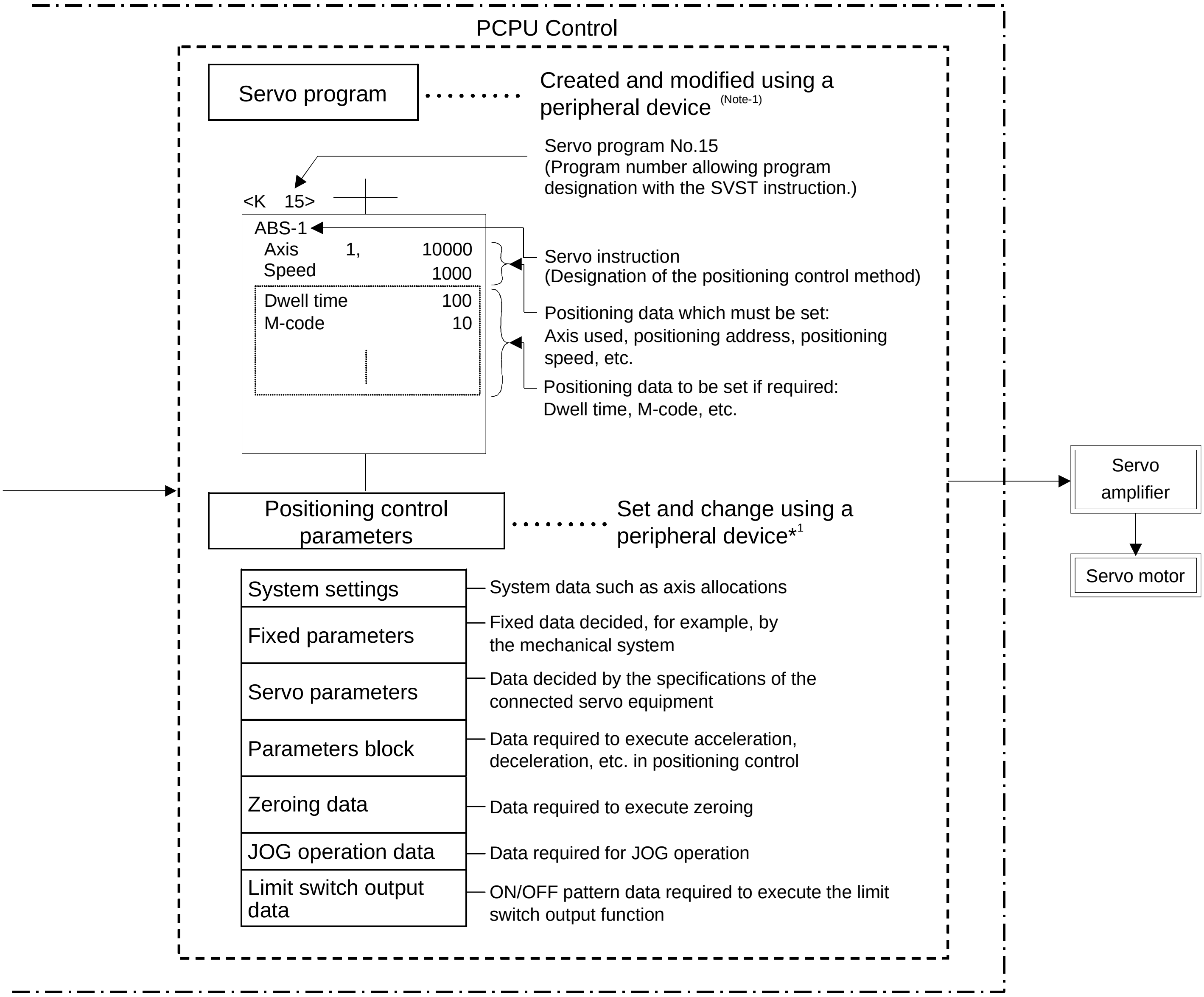
Servo System CPU System



(1) Servo programs and positioning control parameters are set using a peripheral device.

(2) Positioning is started by the sequence program (SVST instruction).
   (a) The servo program number and controlled axis number are designated by the SVST instruction.
      1) The servo program number can be set either directly or indirectly.
      2) The controlled axis number can only be set directly.

(3) The positioning specified by the designated servo program is executed.



REMARK

(Note-1): Any of the following peripheral devices, running the SW2SRX-GSV13PE/SW2SRX-GSV22PE software, can be used.

- An IBM PC/AT or 100% compatible machine in which PC-DOS 5.0 or a later version has been installed (hereafter called an “IBM PC”)

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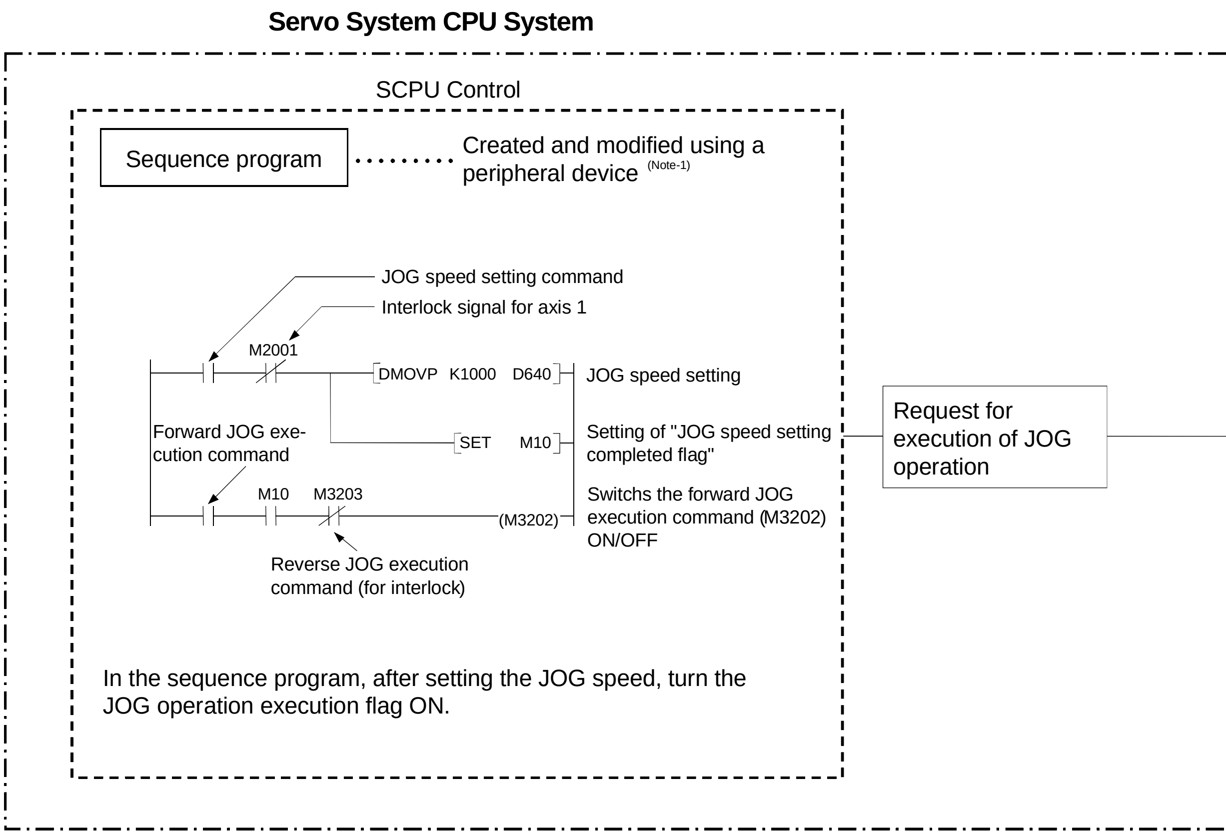
[Executing JOG Operation with a Servo System CPU]

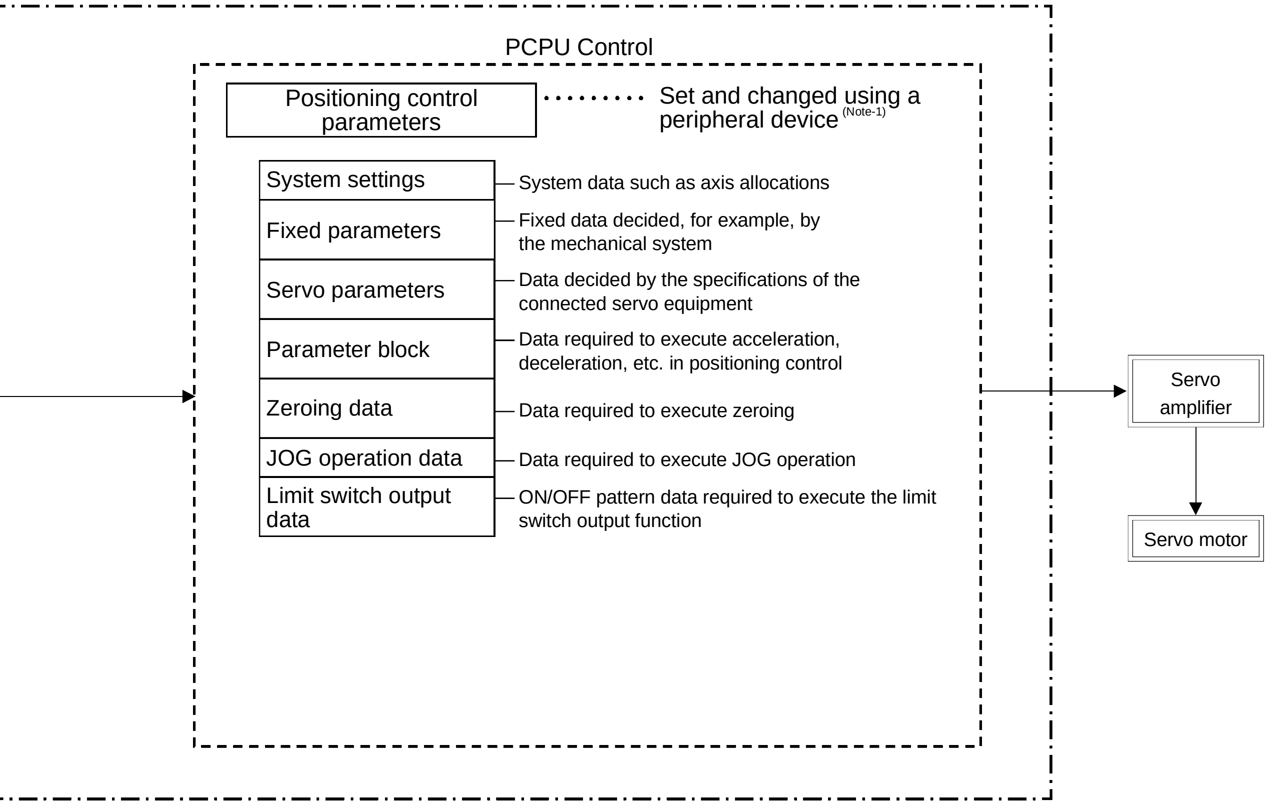
The servo system CPU can be used to perform JOG operation on a designated axis in accordance with a sequence program.
An overview of JOG operation is presented below.



(1) Set the positioning control parameters using a peripheral device.

(2) Using the sequence program, set the JOG speed in the JOG operation speed setting register for each axis.

(3) JOG operation is executed while the JOG operation execution flag is kept ON by the sequence program.



REMARK

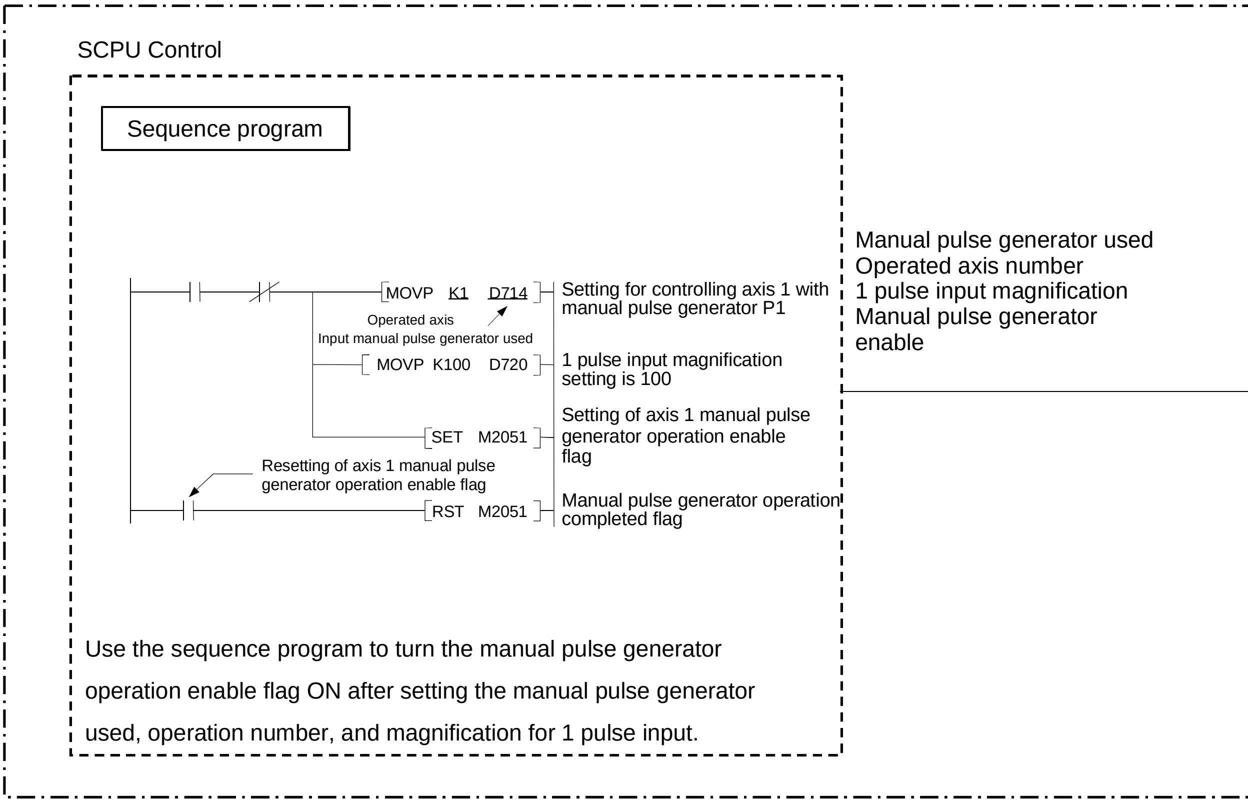
(Note-1): Any of the following peripheral devices, running the SW2SRX-GSV13PE/SW2SRX-GSV22PE software, can be used.

- IBM PC

[Executing Manual Pulse Generator Operation with a Servo System CPU]

When executing positioning control with a manual pulse generator connected to an A273EX or A172SENC, manual pulse generator operation must be enabled by the sequence program.
An overview of positioning control using manual pulse generator operation is presented below.

Servo System CPU System

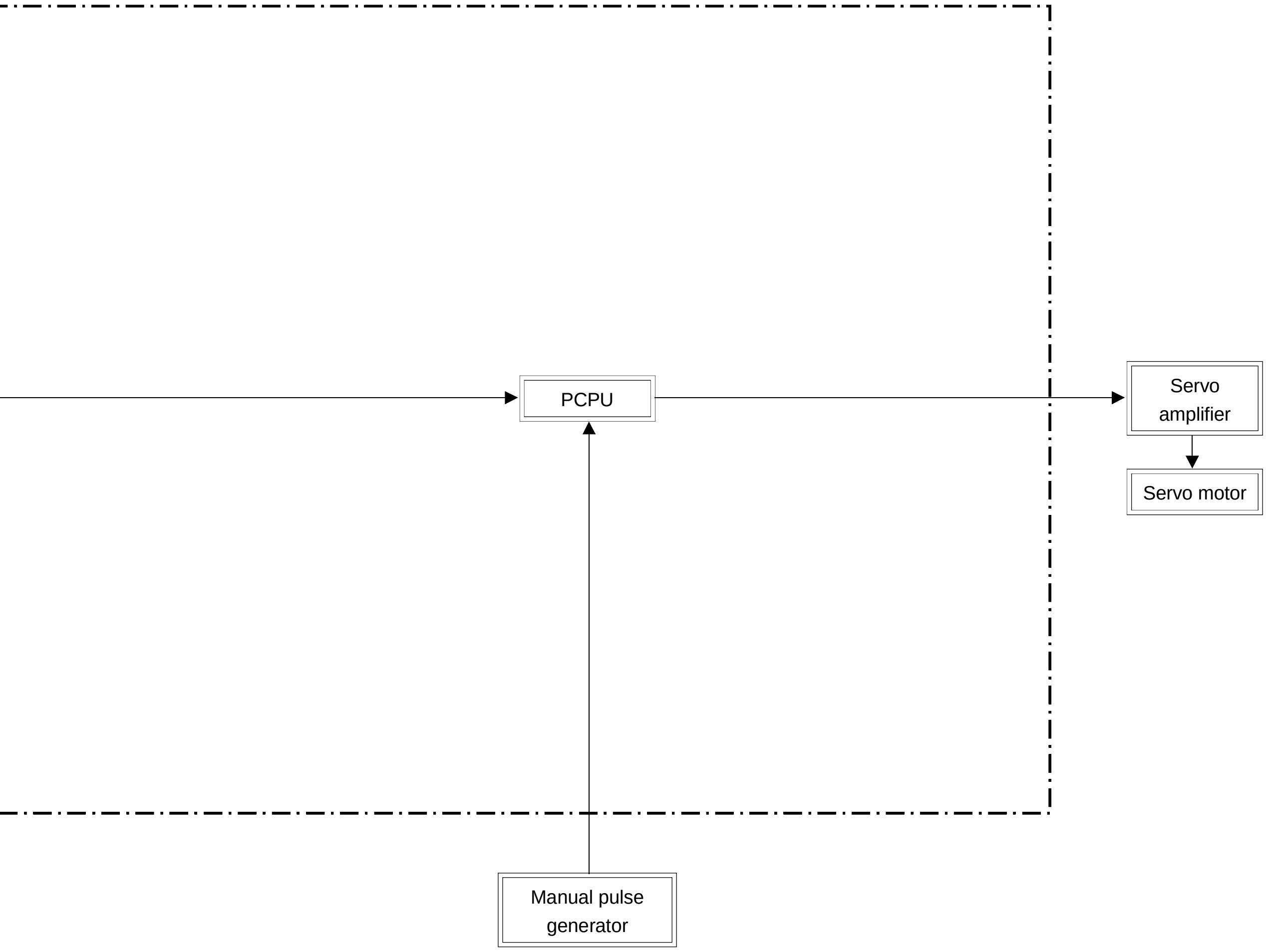


(1) Set the manual pulse generator used, operated axis number, and magnification for 1 pulse input by using the sequence program.

(2) Turn the manual pulse generator operation enable flag ON by using the sequence program.
.... Manual pulse generator operation enabled

(3) Perform positioning by operating the manual pulse generator.

(4) Turn the manual pulse generator operation enable flag OFF by using the sequence program.
.... Manual pulse generator operation completed


PCPU
Servo amplifier
Servo motor
Manual pulse generator

(1) Positioning control parameters
The positioning control parameters are classified into the seven types shown below.
Parameter data can be set and corrected interactively by using a peripheral device.

	Item	Description	Reference
1	System settings	The system settings set the modules used, axis numbers, etc.	Section 4.1
2	Fixed parameters	Fixed parameters are set for each axis. Their settings are predetermined by the mechanical system. They are used for servo motor control during positioning control.	Section 4.2
3	Servo parameters	Servo parameters are set for each axis. Their settings are predetermined by the type of servomotor connected. They are set to control the servomotors during positioning control.	Section 4.3
4	Zeroing data	Zeroing data is set for each axis. The return direction, return method, return speed, etc. are set for zeroing.	Section 7.21
5	JOG operation	JOG operation data is set for each axis. The speed limit value and parameter block number are set for JOG operation.	Section 7.19
6	Parameter block	Up to 16 parameter blocks are set for acceleration, deceleration, speed control, etc. during positioning control. They are designated by the servo program, JOG operation data, and zeroing data to easily change acceleration and deceleration (acceleration time, deceleration time, and speed limit value) during positioning control.	Section 4.4
7	Limit switch output data	Limit switch output data (ON/OFF pattern data) is set for each axis to be used when "USE" is set for the limit switch output setting in the fixed parameter. When positioning control takes place on an axis for which limit switch output data has been set, the set ON/OFF pattern of the axis is output to an external destination.	Section 8.1

(2) Servo program
A servo program is a program for executing positioning control and is run in response to a start request from the sequence program.
It comprises a program number, servo instructions, and positioning data.
For details, see Chapter 6.
- Program No. .... This number is designated in the sequence program.
- Servo instruction .... This instruction indicates the type of positioning control to be executed.
- Positioning data .... This data is required to execute servo instructions. The data required is fixed for each servo instruction.

(3) Sequence program
The sequence program serves to enable the execution of positioning control by servo programs, JOG operation, and manual pulse generator operation.
For details, see Chapter 5.

2. PERFORMANCE SPECIFICATIONS

2.1 SCPU Performance Specifications

Table 2.1 gives the performance specifications of the SCPU.

Table 2.1 SCPU Performance Specifications

<table>
<tr><th colspan="3">Item</th><th>A273UHCPU</th><th colspan="2">A173UHCPU(-S1)</th></tr>
<tr><td colspan="3">Control method</td><td colspan="3">Stored program repeated operation</td></tr>
<tr><td colspan="3">I/O control method</td><td colspan="3">Refresh mode/direct mode (selectable)</td></tr>
<tr><td colspan="3">Programming language</td><td colspan="3">Sequence control dedicated language
(Relay symbol language, logic symbol language, MELSAP II (SFC))</td></tr>
<tr><td colspan="2" rowspan="4">Number of instructions</td><td>Sequence instructions</td><td colspan="3">22</td></tr>
<tr><td>Basic instructions</td><td colspan="3">252</td></tr>
<tr><td>Special instructions</td><td colspan="3">204</td></tr>
<tr><td>Motion dedicated instructions</td><td colspan="3">4</td></tr>
<tr><td colspan="2">Processing speed (μs)
(Sequence instruction)</td><td>Refresh method</td><td colspan="3">0.15 μs/step</td></tr>
<tr><td colspan="3">Number of I/O points</td><td colspan="3">8192 (X/Y0 to X/Y1FFF)</td></tr>
<tr><td colspan="3">Number of real I/O points</td><td>2048 (X/Y0 to X/Y7FF)</td><td colspan="2">2048 (X/Y0 to X/Y7FF)</td></tr>
<tr><td colspan="3">Watchdog timer (WDT)</td><td colspan="3">2000ms</td></tr>
<tr><td colspan="3" rowspan="2">Memory capacity (internal RAM)</td><td rowspan="2">Max. 1024k bytes</td><td>Standard</td><td>192k bytes(Equivalent to A3NMCA-24)</td></tr>
<tr><td>-S1</td><td>768k bytes(Equivalent to A3AMCA-96)</td></tr>
<tr><td colspan="2" rowspan="2">Program capacity</td><td>Main sequence program</td><td colspan="3">Max. 30 k steps</td></tr>
<tr><td>Sub-sequence program</td><td colspan="3">Max. 30 k steps</td></tr>
<tr><td rowspan="11">Device</td><td colspan="2">Number of internal relays (M) (Note-1)</td><td>8191 points
(M0 to M999, M2048 to M8191)</td><td colspan="2" rowspan="3">Total 8191 points common to M, L, S
(set with parameters)</td></tr>
<tr><td colspan="2">Number of latch relays (L)</td><td>1048 points (M1000 to M2047)</td></tr>
<tr><td colspan="2">Number of step relays (S)</td><td>0 point (none at initial status)</td></tr>
<tr><td colspan="2">Number of link relays (B)</td><td colspan="3">8192 points (B0 to B1FFF)</td></tr>
<tr><td rowspan="3">Timers (T)</td><td>Points</td><td colspan="3">2048 points (256 points at initial status)</td></tr>
<tr><td>Specifications</td><td colspan="3"><table>
<tr><th></th><th>Time setting</th><th>Device</th></tr>
<tr><td>100 ms timer</td><td>0.1 to 3276.7s</td><td>T0 to T199</td></tr>
<tr><td>10 ms timer</td><td>0.01 to 327.67s</td><td>T200 to T255</td></tr>
<tr><td>100 ms elapsed time indicator</td><td>0.1 to 3276.7s</td><td>none at initial status</td></tr>
<tr><td>Expansion timer</td><td>Word device (D, W, R) is used to set time.</td><td>T256 to T2047</td></tr>
</table></td></tr>
<tr><td></td><td colspan="3">Set with parameters</td></tr>
<tr><td rowspan="3">Counters (C)</td><td>Points</td><td colspan="3">1024 points (256 points at initial status)</td></tr>
<tr><td>Specifications</td><td colspan="3"><table>
<tr><th></th><th>Setting range</th><th>Device</th></tr>
<tr><td>Normal counter</td><td>1 to 32767</td><td>C0 to C255</td></tr>
<tr><td>Interrupt program counter</td><td>Can be set within the range C244 to C255.</td><td>none at initial status</td></tr>
<tr><td>Expansion counter</td><td>Word device (D, W, R) is used to set count value.</td><td>C256 to C1023</td></tr>
</table></td></tr>
<tr><td></td><td colspan="3">Set with parameters</td></tr>
</table>

Table 2.1 SCPU Performance Specifications (Continued)

<table>
<tr><th colspan="2">Item</th><th colspan="2">A273UHCPU</th><th colspan="2">A173UHCPU(-S1)</th></tr>
<tr><td rowspan="9">Device</td><td>Number of data registers (D) (Note-1)</td><td colspan="4">8192 points (D0 to D8191)</td></tr>
<tr><td>Number of link registers (W)</td><td colspan="4">8192 points (W0 to W1FFF)</td></tr>
<tr><td>Number of annunciators (F)</td><td colspan="4">2048 points (F0 to F2047)</td></tr>
<tr><td>Number of file registers (R)</td><td colspan="4">Max. 8192 points (R0 to R8191) (set with parameters)</td></tr>
<tr><td>Number of accumulators (A)</td><td colspan="4">2 points (A0, A1)</td></tr>
<tr><td>Number of index registers (V, Z)</td><td colspan="4">14 points (V, V1 to V6, Z, Z1 to Z6)</td></tr>
<tr><td>Number of pointers (P)</td><td colspan="4">256 points (P0 to P255)</td></tr>
<tr><td>Number of interrupt pointers (I)</td><td colspan="4">32 points (I0 to I31)</td></tr>
<tr><td>Number of special-function relays (M)</td><td colspan="4">256 points (M9000 to M9255)</td></tr>
<tr><td colspan="2">Number of special-function registers (D)</td><td colspan="4">256 points (D9000 to D9255)</td></tr>
<tr><td colspan="2" rowspan="2">Number of expansion file register block (Note-2)</td><td colspan="2" rowspan="2">Max. 46 blocks
(set by memory capacity)</td><td>Standard</td><td>Max. 10 blocks</td></tr>
<tr><td>-S1</td><td>Max. 46 blocks</td></tr>
<tr><td colspan="2">Number of comments</td><td colspan="4">Max. 4032 (64k bytes), 1 point = 16 bytes
(Set in 64-point unit)</td></tr>
<tr><td colspan="2">Number of expansion comments (Note-3)</td><td colspan="4">Max. 3968 points (63k bytes), 1 point = 16 bytes
(Set in 64-point unit)</td></tr>
<tr><td colspan="2">Self-diagnostic function</td><td colspan="2">Watchdog error monitoring, memory/CPU/input/output/battery, etc error detection</td><td colspan="2">Watchdog error monitoring
(Watchdog timer fixed to 200ms)</td></tr>
<tr><td colspan="2">Operation mode on error</td><td colspan="4">Select stop/continue</td></tr>
<tr><td colspan="2">Output mode selection when switching from STOP to RUN</td><td colspan="4">Select re-output operation status before STOP (default) or output after operation execution.</td></tr>
<tr><td colspan="2">Clock function (Note-4)</td><td colspan="4">Year, month, day, hour, minute, day of the week (leap year automatic distinction)</td></tr>
<tr><td colspan="2">Program/parameter storage in ROM</td><td colspan="2">Max. 64 kbytes</td><td colspan="2">Not possible</td></tr>
<tr><td colspan="2">RUN-time start method</td><td colspan="4">Initial start</td></tr>
<tr><td colspan="2">Latch (power failure compensation) range</td><td colspan="4">L1000 to L2047 (default) (Latch range can be set for L, B, T, C, D, W)</td></tr>
<tr><td colspan="2">Remote run/pause contact</td><td colspan="4">Using X0 to X1FFF, one point can be set for each of the RUN and PAUSE contacts.</td></tr>
<tr><td colspan="2">I/O assignment</td><td colspan="4">Number of occupied I/O points and module type can be registered.</td></tr>
<tr><td colspan="2">Step run</td><td colspan="4">Sequence program operation can be executed and stopped.</td></tr>
<tr><td colspan="2">Interrupt processing</td><td colspan="4">Using interrupt or fixed-cycle interrupt signal, interrupt program can be executed.</td></tr>
<tr><td colspan="2">Data link</td><td colspan="4">MELSECNET/10, MELSECNET II</td></tr>
</table>

(Note-1): Range of positioning dedicated devices differs depending on the OS. For details, see Chapter 3.

(Note-2): No. of extension fide register blocks varies depending on the setting of program capacity, No. of file registers, or No. of comments.

(Note-3): The expansion comments are not stored in the internal memory of the CPU.

(Note-4): The year data by the clock element is only the lower two digits of the year.
When used in sequence control, the data must be compensated for the sequence program in some applications of using the data.

2.2 PCPU Performance Specifications

Table 2.2 PCPU Performance Specifications

<table>
<tr><th colspan="2">Item</th><th>A273UHCPU</th><th>A173UHCPU(-S1)</th></tr>
<tr><td colspan="2">Number of control axes</td><td colspan="2">32 axes (simultaneous: 2 to 4 axes, independent: 32 axes)</td></tr>
<tr><td colspan="2">Interpolation functions</td><td colspan="2">Linear interpolation (max. 4 axes), circular interpolation (2 axes)</td></tr>
<tr><td colspan="2">Control modes</td><td colspan="2">PTP(point to point), speed control, speed/position control, fixed-pitch feed, constant-speed control, position follow-up control, speed switching control, high-speed oscillation control</td></tr>
<tr><td colspan="2">Control units</td><td colspan="2">mm • inch • degree • PULSE</td></tr>
<tr><td colspan="2">Programming language</td><td colspan="2">Dedicated instructions (sequence ladders + servo programs)
SFC programming of servo programs is also possible.</td></tr>
<tr><td rowspan="2">Motion program</td><td>Capacity</td><td colspan="2">14334 steps</td></tr>
<tr><td>Number of points for positioning</td><td colspan="2">Approx. 100 points/axis
(These values vary depending on the programs. Positioning data can be designated indirectly.)</td></tr>
<tr><td colspan="2">Program setting method</td><td colspan="2">Setting with an IBM PC A30TU-E/A31TU-E (SV13 only), running the GSV☐☐PE software</td></tr>
<tr><td rowspan="4">Positioning</td><td>Method</td><td colspan="2">PTP : Selection of absolute data method or incremental method
Speed/positioning control, fixed-pitch feed : Incremental method
Constant-speed control, speed switching control : The absolute method and incremental method can be used together
Position follow-up control, high-speed oscillation control : Absolute data method</td></tr>
<tr><td>Position commands</td><td colspan="2">Commands can be selected for each axis.
<table>
<tr><th>Control Unit</th><th>Command Unit</th><th>Address Setting Range</th><th>Travel Value Setting Range</th></tr>
<tr><td>mm</td><td>$\times 10^{-1}$ μm</td><td rowspan="2">−2147483648 to 2147483647</td><td rowspan="4">0 to ±2147483647</td></tr>
<tr><td>inch</td><td>$\times 10^{-5}$ inch</td></tr>
<tr><td>degree</td><td>$\times 10^{-5}$ degree</td><td>0 to 35999999</td></tr>
<tr><td>PULSE</td><td>× 1 PULSE</td><td>−2147483648 to 2147483647</td></tr>
</table></td></tr>
<tr><td>Speed command (command unit)</td><td colspan="2">
<table>
<tr><th>Control Unit</th><th colspan="2">Speed Setting range</th></tr>
<tr><td>mm</td><td>0.01 to 6000000.00</td><td>(mm/min)</td></tr>
<tr><td>inch</td><td>0.001 to 600000.00</td><td>(inch/min)</td></tr>
<tr><td>degree</td><td>0.001 to 2147483.647</td><td>(degree/min) (Note-1)</td></tr>
<tr><td>PULSE</td><td>1 to 10000000</td><td>(PLS/s) (Note-1)</td></tr>
</table></td></tr>
<tr><td>High speed oscillation function</td><td colspan="2">One specified axis can be reciprocated in sine waveform.</td></tr>
<tr><td rowspan="2">Acceleration/ deceleration control</td><td>Automatic trapezoidal acceleration/ deceleration</td><td colspan="2">
<table>
<tr><th>Acceleration-fixed acceleration/deceleration</th></tr>
<tr><td>Acceleration time: 1 to 65535ms
Deceleration time: 1 to 65535ms</td></tr>
</table></td></tr>
<tr><td>S-curve acceleration/ deceleration</td><td colspan="2">S-curve ratio setting : 0 to 100%</td></tr>
<tr><td rowspan="2">Compensation</td><td>Backlash compensation</td><td colspan="2">(0 to 65535) × position command unit (units converted to PULSE : 0 to 65535 PULSE)</td></tr>
<tr><td>Electronic gear</td><td colspan="2">Compensation function for error in actual travel value with respect to command value</td></tr>
<tr><td colspan="2">Zeroing function</td><td colspan="2">When an absolute position system is not used : Selection of proximity dog type or count type
When an absolute position system is used : Selection of data set type, proximity dog type or count type</td></tr>
<tr><td colspan="2">JOG operation function</td><td colspan="2">Provided</td></tr>
</table>

Table 2.2 PCPU Performance Specifications (Continued)

<table>
<tr><th colspan="2">Item</th><th>A273UHCPU</th><th>A173UHCPU(-S1)</th></tr>
<tr><td colspan="2">Manual pulse generator operation function</td><td>• A maximum of three manual pulse generator can be connected.
• A maximum of three manual pulse generators can be operated.
• Setting of magnification : 1 to 100. It is possible to set the smoothing magnification.</td><td>• A maximum of three manual pulse generator can be connected.
• A maximum of three manual pulse generators can be operated.
• Setting of magnification : 1 to 100. It is possible to set the smoothing magnification.
• One A172SENC is required per piece.</td></tr>
<tr><td colspan="2">M-function</td><td colspan="2">M-code output function provided</td></tr>
<tr><td colspan="2">Limit switch output function</td><td colspan="2">Number of output points 8 point/axis
Number of ON/OFF setting points 10 points/axis</td></tr>
<tr><td rowspan="2">High-speed reading of designated data</td><td>Number of input points</td><td>Max. 11 points
(TRA input of A273EX (3 points) + one motion slot sequencer input module (8 points))</td><td>Max. 9 points
(TRA input of A172SENC (1 points) + one motion slot sequencer input module (8 points))</td></tr>
<tr><td>Data latch timing</td><td colspan="2">At leading edge of the TRA input signal
Within 0.8ms of the signal leading edge for the sequencer input module.</td></tr>
<tr><td colspan="2">Absolute position system</td><td colspan="2">Possible with a motor equipped with an absolute position detector.
(Possible to select the absolute data method or incremental method for each axis)</td></tr>
<tr><td colspan="2">PBUS I/O module</td><td colspan="2">256 points</td></tr>
</table>

(Note-1) : A setting range has been extended with a high resolution encoder.

3. POSITIONING SIGNALS

The internal signals of the servo system CPU and the external signals sent to the servo system CPU are used as positioning signals.

(1) Internal signals
Of the devices available in the servo system CPU, the following four types are used for the internal signals of the servo system CPU.
- Internal relay (M).............................. M2000 to M3839 (1840 points)
- Special relay (SP.M) .... M9073 to M9079 (7 points)
- Data register (D) .... D0 to D799 (800 points)
- Special register (SP.D) .... D9180 to D9199 (20 points)

(2) External signals
The external signals input to the servo system CPU are the upper and lower stroke end limit switch input signals, stop signals, proximity dog signal, speed/position switching signal, and manual pulse generator input signals.
- Upper and lower stroke end limit switch input signal .... Signals that control the upper limit and lower limit of the positioning range
- Stop signal .... Stop signal for speed control
- Proximity dog signal......................... The ON/OFF signal from the proximity dog
- Speed/position switching signal....... Signal that switches control from speed to position control
- Manual pulse generator input .... Signal from the manual pulse generator

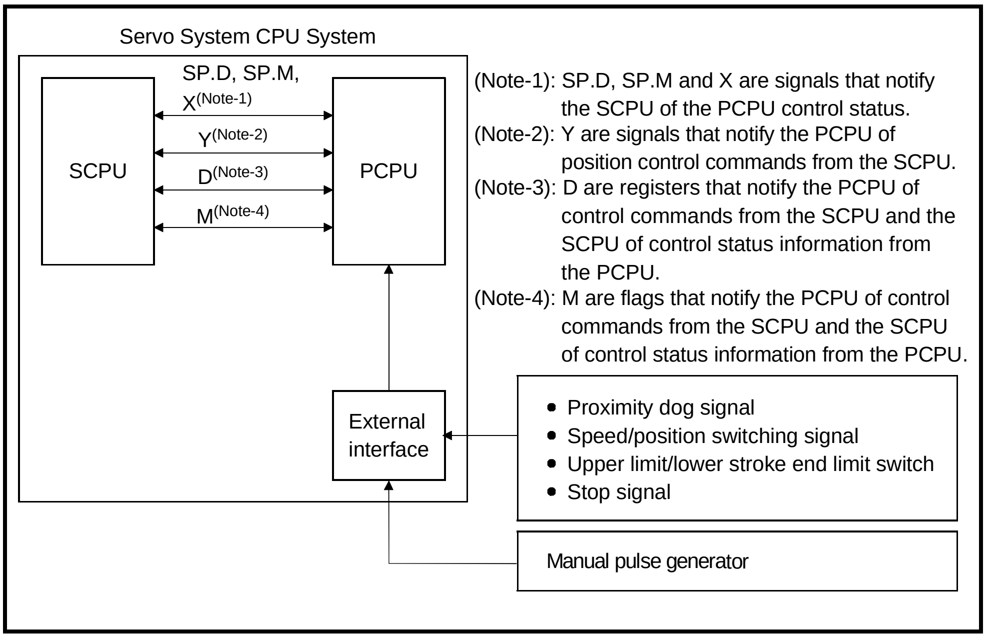


Fig.3.1 Flow of positioning Signals

3. POSITIONING SIGNAL

The following section describes the positioning devices.
It indicates the device refresh cycles for signals with the positioning direction PCPU→SCPU and the device fetch cycles for those with the positioning direction SCPU→PCPU.

3.1 Internal Relays

(1) List of internal relays

Device No.	Purpose
M0	User device (2000 points)
M2000	Common device (320 points)
M2320	Unusable (80 points)
M2400	Axis status (20 points × 32 axes)
M3040	Unusable (160 points)
M3200 M3839	Axis command signal (20 points × 32 axes)
M3840 M8191	User device (4352 points)

POINTS

- Total Number of User Device Points

  6352 points

(1) Internal relays for positioning control are not latched even inside the latch range.
In this manual, in order to indicate that internal relays for positioning control are not latched, the expression used in this text is "M2000 to M3839".

(2) Internal relays for positioning control are monitored from peripheral devices as shown below.
   (a) When peripheral devices are started with GSV13PE/GSV22PE, positioning control internal relays within a latch range are indicated by L2000 to L3839.

(2) Axis statuses

Axis No.	Device Number
1	M2400 to M2419
2	M2420 to M2439
3	M2440 to M2459
4	M2460 to M2479
5	M2480 to M2499
6	M2500 to M2519
7	M2520 to M2539
8	M2540 to M2559
9	M2560 to M2579
10	M2580 to M2599
11	M2600 to M2619
12	M2620 to M2639
13	M2640 to M2659
14	M2660 to M2679
15	M2680 to M2699
16	M2700 to M2719
17	M2720 to M2739
18	M2740 to M2759
19	M2760 to M2779
20	M2780 to M2799
21	M2800 to M2819
22	M2820 to M2839
23	M2840 to M2859
24	M2860 to M2879
25	M2880 to M2899
26	M2900 to M2919
27	M2920 to M2939
28	M2940 to M2959
29	M2960 to M2979
30	M2980 to M2999
31	M3000 to M3019
32	M3020 to M3039

Signal Name

<table>
<tr><th rowspan="6"></th><th rowspan="2" colspan="3">Signal name</th><th colspan="3">Refresh cycle</th><th colspan="3">Import cycle</th><th rowspan="6">Signal direction</th></tr>
<tr><th colspan="3">Number of set axes</th><th colspan="3">Number of set axes</th></tr>
<tr><td rowspan="4"></td><td rowspan="2">SV13</td><td>A173UHCPU</td><td>1 to 20</td><td>21 to 32</td><td>——</td><td>1 to 20</td><td>21 to 32</td><td>——</td></tr>
<tr><td>A273UHCPU</td><td>1 to 12</td><td>13 to 24</td><td>25 to 32</td><td>1 to 12</td><td>13 to 24</td><td>25 to 32</td></tr>
<tr><td rowspan="2">SV22</td><td>A173UHCPU</td><td>1 to 12</td><td>13 to 24</td><td>25 to 32</td><td>1 to 12</td><td>13 to 24</td><td>25 to 32</td></tr>
<tr><td>A273UHCPU</td><td>1 to 8</td><td>9 to 18</td><td>19 to 32</td><td>1 to 8</td><td>9 to 18</td><td>19 to 32</td></tr>
<tr><td>0</td><td colspan="3">Positioning start completion</td><td rowspan="7">3.5ms</td><td rowspan="7">7.1ms</td><td rowspan="7">14.2ms</td><td rowspan="20" colspan="3"></td><td rowspan="20">SCPU←PCPU</td></tr>
<tr><td>1</td><td colspan="3">Positioning completion</td></tr>
<tr><td>2</td><td colspan="3">In-position</td></tr>
<tr><td>3</td><td colspan="3">Command in-position</td></tr>
<tr><td>4</td><td colspan="3">Speed controlling</td></tr>
<tr><td>5</td><td colspan="3">Speed-position switching latch</td></tr>
<tr><td>6</td><td colspan="3">Zero point passage</td></tr>
<tr><td>7</td><td colspan="3">Error detection</td><td colspan="3">Immediate</td></tr>
<tr><td>8</td><td colspan="3">Servo error detection</td><td>3.5ms</td><td>7.1ms</td><td>14.2ms</td></tr>
<tr><td>9</td><td colspan="3">Zeroing request</td><td>10ms</td><td colspan="2">20ms</td></tr>
<tr><td>10</td><td colspan="3">Zeroing completion</td><td>3.5ms</td><td>7.1ms</td><td>14.2ms</td></tr>
<tr><td>11</td><td colspan="3">External signal FLS</td><td rowspan="4">10ms</td><td rowspan="4" colspan="2">20ms</td></tr>
<tr><td>12</td><td colspan="3">External signal RLS</td></tr>
<tr><td>13</td><td colspan="3">External signal STOP</td></tr>
<tr><td>14</td><td colspan="3">External signal DOG</td></tr>
<tr><td>15</td><td colspan="3">Servo ON/OFF status</td><td rowspan="2">3.5ms</td><td rowspan="2">7.1ms</td><td rowspan="2">14.2ms</td></tr>
<tr><td>16</td><td colspan="3">Torque limiting signal</td></tr>
<tr><td>17</td><td colspan="3">External signal CHANGE</td><td>10ms</td><td colspan="2">20ms</td></tr>
<tr><td>18</td><td colspan="3">User unusable</td><td colspan="3">———</td></tr>
<tr><td>19</td><td colspan="3">M-code outputting signal</td><td>3.5ms</td><td>7.1ms</td><td>14.2ms</td></tr>
</table>

(3) Axis command signals

Axis No.	Device Number
1	M3200 to M3219
2	M3220 to M3239
3	M3240 to M3259
4	M3260 to M3279
5	M3280 to M3299
6	M3300 to M3319
7	M3320 to M3339
8	M3340 to M3359
9	M3360 to M3379
10	M3380 to M3399
11	M3400 to M3419
12	M3420 to M3439
13	M3440 to M3459
14	M3460 to M3479
15	M3480 to M3499
16	M3500 to M3519
17	M3520 to M3539
18	M3540 to M3559
19	M3560 to M3579
20	M3580 to M3599
21	M3600 to M3619
22	M3620 to M3639
23	M3640 to M3659
24	M3660 to M3679
25	M3680 to M3699
26	M3700 to M3719
27	M3720 to M3739
28	M3740 to M3759
29	M3760 to M3779
30	M3780 to M3799
31	M3800 to M3819
32	M3820 to M3839

Signal Name

	Signal name			Refresh cycle			Import cycle			Signal direction
				Number of set axes			Number of set axes			
		SV13	A173UHCPU	1 to 20	21 to 32	——	1 to 20	21 to 32	——	
			A273UHCPU	1 to 12	13 to 24	25 to 32	1 to 12	13 to 24	25 to 32	
		SV22	A173UHCPU	1 to 12	13 to 24	25 to 32	1 to 12	13 to 24	25 to 32	
			A273UHCPU	1 to 8	9 to 18	19 to 32	1 to 8	9 to 18	19 to 32	
0	Stop command						3.5ms	7.1ms	14.2ms	SCPU→PCPU
1	Sudden stop command									
2	Forward rotation JOG start						10ms	20ms		
3	Reverse rotation JOG start									
4	Completion signal OFF command									
5	Speed-position switching enable						3.5ms	7.1ms	14.2ms	
6	Limit switch output enable									
7	Error reset						10ms	20ms		
8	Servo error reset									
9	Start-time external stop input/disable						At start			
10	User unusable						——			
11	User unusable									
12	Feed current value update request command						At start			
13	User unusable						——			
14	User unusable									
15	Servo off						3.5ms	7.1ms	14.2ms	
16	User unusable									
17	User unusable									
18	User unusable									
19	FIN signal						3.5ms	7.1ms	14.2ms	

(4) Common devices

Device Number	Signal Name			Refresh Cycle			Import Cycle			Signal Direction
				Number of set axes			Number of set axes			
		SV13	A173UHCPU	1 to 20	21 to 32	——	1 to 20	21 to 32	——	
			A273UHCPU	1 to 12	13 to 24	25 to 32	1 to 12	13 to 24	25 to 32	
		SV22	A173UHCPU	1 to 12	13 to 24	25 to 32	1 to 12	13 to 24	25 to 32	
			A273UHCPU	1 to 8	9 to 18	19 to 32	1 to 8	9 to 18	19 to 32	
M2000	PLC ready flag						10ms	20ms		SCPU→PCPU
M2001	Axis 1	Start acceptance flag		10ms						SCPU←PCPU
M2002	Axis 2									
M2003	Axis 3									
M2004	Axis 4									
M2005	Axis 5									
M2006	Axis 6									
M2007	Axis 7									
M2008	Axis 8									
M2009	Axis 9									
M2010	Axis 10									
M2011	Axis 11									
M2012	Axis 12									
M2013	Axis 13									
M2014	Axis 14									
M2015	Axis 15									
M2016	Axis 16									
M2017	Axis 17									
M2018	Axis 18									
M2019	Axis 19									
M2020	Axis 20									
M2021	Axis 21									
M2022	Axis 22									
M2023	Axis 23									
M2024	Axis 24									
M2025	Axis 25									
M2026	Axis 26									
M2027	Axis 27									
M2028	Axis 28									
M2029	Axis 29									
M2030	Axis 30									
M2031	Axis 31									
M2032	Axis 32									
M2033	User unusable			——			——			——
M2034	Personal computer link communication error flag			10ms						
M2035	User unusable (5 points)			——			——			——
M2036										
M2037										
M2038										
M2039										
M2040	Speed change point designation flag						Start			SCPU→PCPU
M2041	System setting error flag			10ms						SCPU←PCPU
M2042	All-axis servo ON command						3.5ms	7.1ms	14.2ms	SCPU→PCPU
M2043	User unusable (4 points)			——			——			——
M2044										
M2045										
M2046										
M2047	Motion slot fault detection flag			10ms						SCPU←PCPU
M2048	JOG simultaneous start command						10ms	20ms		SCPU→PCPU
M2049	All-axis servo ON acceptance flag			END						SCPU←PCPU
M2050	Start buffer full									
M2051	Manual pulse generator 1 enable flag						10ms	20ms		SCPU→PCPU
M2052	Manual pulse generator 2 enable flag									
M2053	Manual pulse generator 3 enable flag									
M2054	User unusable (7 points)			——			——			——
M2055										
M2056										
M2057										
M2058										
M2059										
M2060										
M2061	Axis 1	Speed changing flag		END						SCPU←PCPU
M2062	Axis 2									
M2063	Axis 3									
M2064	Axis 4									
M2065	Axis 5									
M2066	Axis 6									
M2067	Axis 7									
M2068	Axis 8									
M2069	Axis 9									
M2070	Axis 10									
M2071	Axis 11									
M2072	Axis 12									
M2073	Axis 13									
M2074	Axis 14									
M2075	Axis 15									
M2076	Axis 16									
M2077	Axis 17									
M2078	Axis 18									
M2079	Axis 19									
M2080	Axis 20	Speed changing flag		END						SCPU←PCPU
M2081	Axis 21									
M2082	Axis 22									
M2083	Axis 23									
M2084	Axis 24									
M2085	Axis 25									
M2086	Axis 26									
M2087	Axis 27									
M2088	Axis 28									
M2089	Axis 29									
M2090	Axis 30									
M2091	Axis 31									
M2092	Axis 32									
M2093	User unusable (35 points)			——			——			——
M2094										
M2095										
M2096										
M2097										
M2098										
M2099										
M2100										
M2101										
M2102										
M2103										
M2104										
M2105										
M2106										
M2107										
M2108										
M2109										
M2110										
M2111										
M2112										
M2113										
M2114										
M2115										
M2116										
M2117										
M2118										
M2119										
M2120										
M2121										
M2122										
M2123										
M2124										
M2125										
M2126										
M2127										
M2128	Axis 1	Automatically decelerating flag		3.5ms	7.1ms	14.2ms				SCPU←PCPU
M2129	Axis 2									
M2130	Axis 3									
M2131	Axis 4									
M2132	Axis 5									
M2133	Axis 6									
M2134	Axis 7									
M2135	Axis 8									
M2136	Axis 9									
M2137	Axis 10									
M2138	Axis 11									
M2139	Axis 12									
M2140	Axis 13									
M2141	Axis 14									
M2142	Axis 15									
M2143	Axis 16									
M2144	Axis 17									
M2145	Axis 18									
M2146	Axis 19									
M2147	Axis 20									
M2148	Axis 21									
M2149	Axis 22									
M2150	Axis 23									
M2151	Axis 24									
M2152	Axis 25									
M2153	Axis 26									
M2154	Axis 27									
M2155	Axis 28									
M2156	Axis 29									
M2157	Axis 30									
M2158	Axis 31									
M2159	Axis 32									

"END" in the Refresh Cycle field indicates "50ms" or "PLC program scan time", which is longer.

Device Number	Signal Name		Refresh Cycle			Import Cycle			Signal Direction
			Number of set axes			Number of set axes			
	SV13	A173UHCPU	1 to 20	21 to 32	——	1 to 20	21 to 32	——	
		A273UHCPU	1 to 12	13 to 24	25 to 32	1 to 12	13 to 24	25 to 32	
	SV22	A173UHCPU	1 to 12	13 to 24	25 to 32	1 to 12	13 to 24	25 to 32	
		A273UHCPU	1 to 8	9 to 18	19 to 32	1 to 8	9 to 18	19 to 32	
M2160	User unusable (80 points)		——			——			——
M2161									
M2162									
M2003									
M2164									
M2165									
M2166									
M2167									
M2168									
M2169									
M2170									
M2171									
M2172									
M2173									
M2174									
M2175									
M2176									
M2177									
M2178									
M2179									
M2180									
M2181									
M2182									
M2183									
M2184									
M2185									
M2186									
M2187									
M2188									
M2189									
M2190									
M2191									
M2192									
M2193									
M2194									
M2195									
M2196									
M2197									
M2198									
M2199									
M2200									
M2201									
M2202									
M2203									
M2204									
M2205									
M2206									
M2207									
M2208									
M2209									
M2210									
M2211									
M2212									
M2213									
M2214									
M2215									
M2216									
M2217									
M2218									
M2219									
M2220									
M2221									
M2222									
M2223									
M2224									
M2225									
M2226									
M2227									
M2228									
M2229									
M2230									
M2231									
M2232									
M2233									
M2234									
M2235									
M2236									
M2237									
M2238									
M2239									

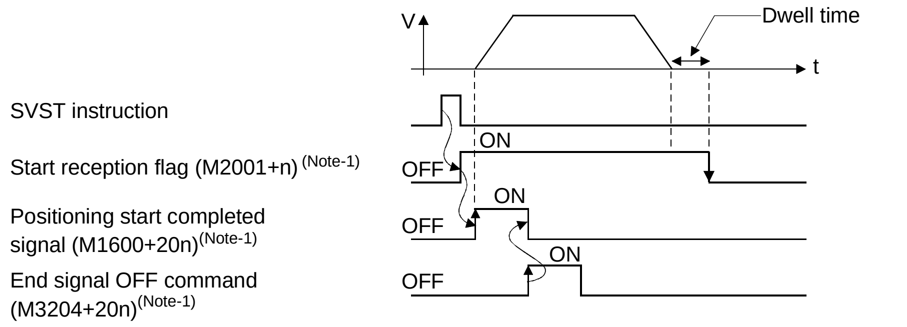
Device Number	Signal Name		Refresh Cycle			Import Cycle			Signal Direction
			Number of set axes			Number of set axes			
	SV13	A173UHCPU	1 to 20	21 to 32	——	1 to 20	21 to 32	——	
		A273UHCPU	1 to 12	13 to 24	25 to 32	1 to 12	13 to 24	25 to 32	
	SV22	A173UHCPU	1 to 12	13 to 24	25 to 32	1 to 12	13 to 24	25 to 32	
		A273UHCPU	1 to 8	9 to 18	19 to 32	1 to 8	9 to 18	19 to 32	
M2240	Axis 1	Speed change accepting flag "0"	3.5ms	7.1ms	14.2ms				SCPU←PCPU
M2241	Axis 2								
M2242	Axis 3								
M2243	Axis 4								
M2244	Axis 5								
M2245	Axis 6								
M2246	Axis 7								
M2247	Axis 8								
M2248	Axis 9								
M2249	Axis 10								
M2250	Axis 11								
M2251	Axis 12								
M2252	Axis 13								
M2253	Axis 14								
M2254	Axis 15								
M2255	Axis 16								
M2256	Axis 17								
M2257	Axis 18								
M2258	Axis 19								
M2259	Axis 20								
M2260	Axis 21								
M2261	Axis 22								
M2262	Axis 23								
M2263	Axis 24								
M2264	Axis 25								
M2265	Axis 26								
M2266	Axis 27								
M2267	Axis 28								
M2268	Axis 29								
M2269	Axis 30								
M2270	Axis 31								
M2271	Axis 32								
M2272	User unusable (48 points)		——			——			——
M2273									
M2274									
M2275									
M2276									
M2277									
M2278									
M2279									
M2280									
M2281									
M2282									
M2283									
M2284									
M2285									
M2286									
M2287									
M2288									
M2289									
M2290									
M2291									
M2292									
M2293									
M2294									
M2295									
M2296									
M2297									
M2298									
M2299									
M2300									
M2301									
M2302									
M2303									
M2304									
M2305									
M2306									
M2307									
M2308									
M2309									
M2310									
M2311									
M2312									
M2313									
M2314									
M2315									
M2316									
M2317									
M2318									
M2319									

"END" in the Refresh Cycle field indicates "50ms" or "PLC program scan time", which is longer.

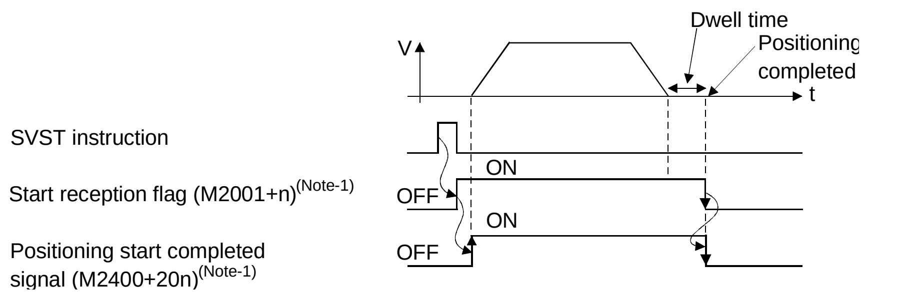
3.1.1 Axis status

(1) Positioning start completed signal (M2400+20n)
   (a) This signal comes ON when starting of positioning control of the axis designated by the SVST instruction in the sequence program is completed. It does not come ON when positioning control starts due to a zeroing, JOG operation or manual pulse generator operation.
   It can be used, for example, to read an M-code when positioning is started. (See Section 8.2.)
   (b) The positioning start completed signal goes OFF at the leading edge (OFF→ON) of the end signal OFF command (M3204+20n) or when positioning is completed.

At the leading edge (OFF → ON) of the end signal OFF command (M1804+20n)



When positioning is completed



REMARK

(Note-1):In the preceding descriptions, "n" in M2001+n, M3204+20n, etc. indicates a value for each axis No. in the following tables.

Axis No.	n	Axis No.	n	Axis No.	n	Axis No.	n
1	0	9	8	17	16	25	24
2	1	10	9	18	17	26	25
3	2	11	10	19	18	27	26
4	3	12	11	20	19	28	27
5	4	13	12	21	20	29	28
6	5	14	13	22	21	30	29
7	6	15	14	23	22	31	30
8	7	16	15	24	23	32	31

Make the following calculation to find the device number corresponding to each axis.

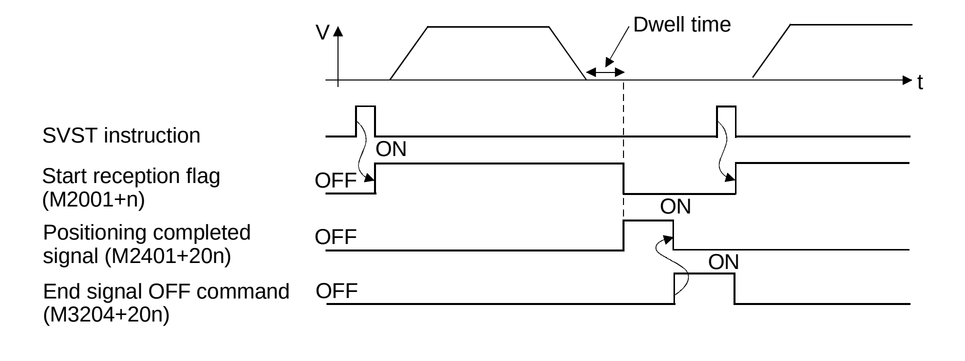
(Example) M3200+20n (stop command) = M3200+20×31=M3820
M3215+20n (servo off) = M3215+20×31=M3835

(2) Positioning completed signal (M2401+20n)

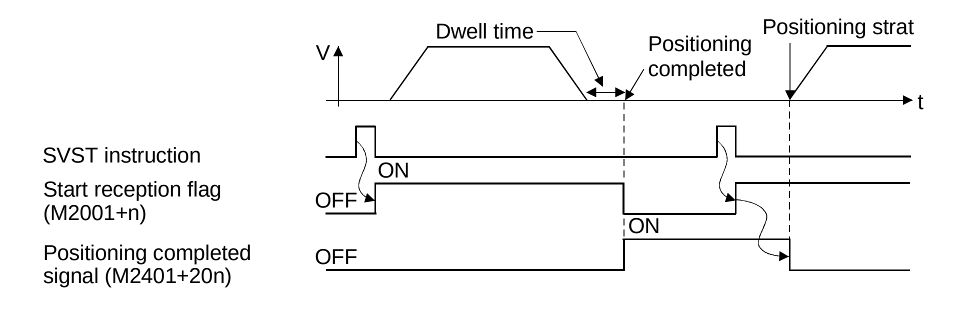
(a) This signal comes ON when positioning control of the axis designated by the SVST instruction in the sequence program is completed.
It does not come ON when positioning control is started, or stopped part way through, due to a zeroing, JOG operation, manual pulse generator operation, or speed control.
It does not come on when positioning is stopped part way through.
It can be used, for example, to read an M-code on completion of positioning. (See Section 8.2.)

(b) The positioning completed signal goes OFF at the leading edge (OFF→ON) of the end signal OFF command (M3204+20n), or when a positioning control start is completed.

At the leading edge (OFF → ON) of the end signal OFF command (M3204+20n)

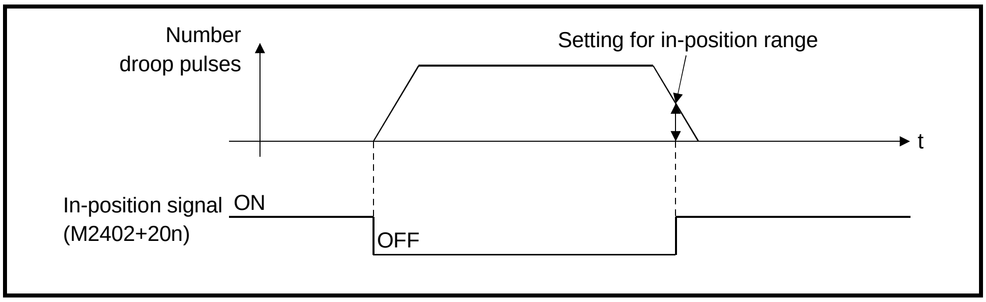


When the next positioning control start is completed



(3) In-position signal (M2402+20n)

(a) The in-position signal comes ON when the number of droop pulses in the deviation counter enters the "in-position range" set in the servo parameters. It goes off when axis motion starts.

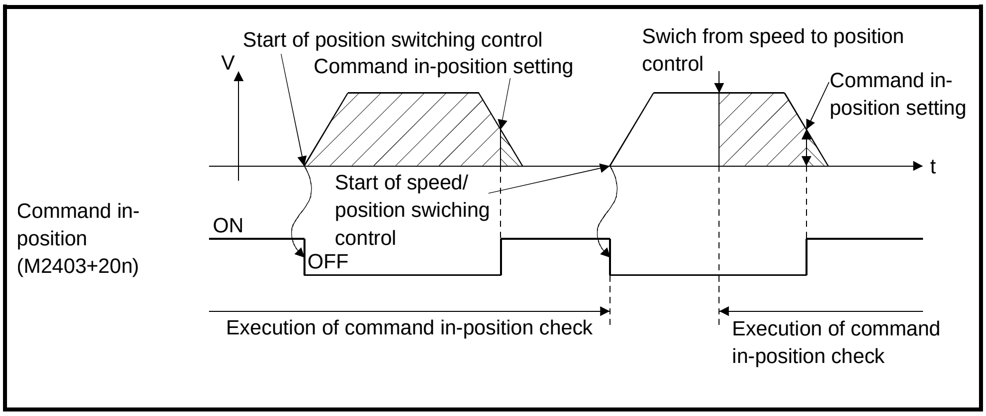


(b) An in-position check is performed in the following cases.
- When the servo power supply is switched on
- After automatic acceleration/deceleration is started during positioning control
- After deceleration is started as a result of the JOG start signal going OFF
- When manual pulse generator operation is in progress
- After the proximity dog comes ON during a zeroing
- After deceleration is started as a result of a stop command
- When a speed change to a speed of "0" is executed

(4) Command in-position signal (M2403+20n)

(a) The command in-position signal comes ON when the absolute value of the difference between the command position and the feed current value enters the "command in-position range" set in the fixed parameters.
It goes OFF in the following cases.
- When positioning control starts
- When a zeroing is executed
- When speed control is executed
- When JOG operation is performed
- When manual pulse generator operation is performed

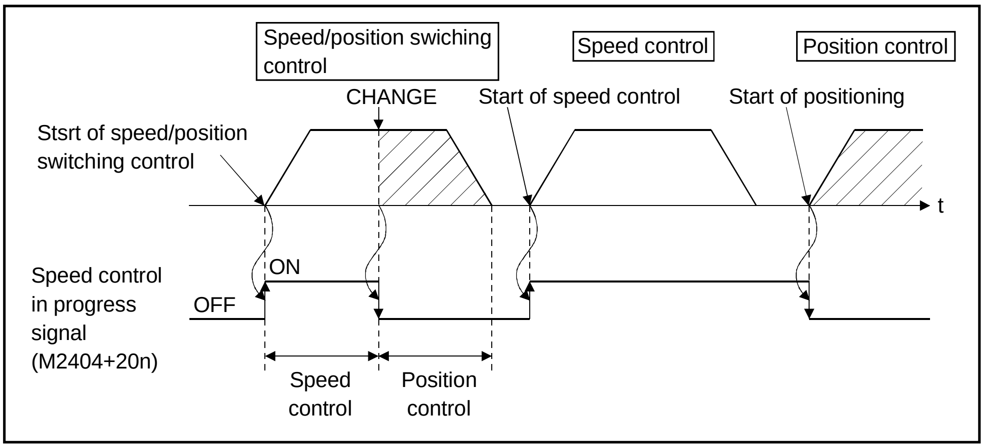
(b) Command in-position checks are continually performed during positioning control.
Command in-position checks are not performed during speed control or during speed control in speed/position switching control.



(5) Speed control in progress signal (M2404+20n)

(a) The speed control in progress signal is ON during speed control and is used to determine whether speed control or position control is currently being executed.
In speed/position switching control, it remains ON until the switch from speed control to position control is executed on receipt of the CHANGE signal from an external source.

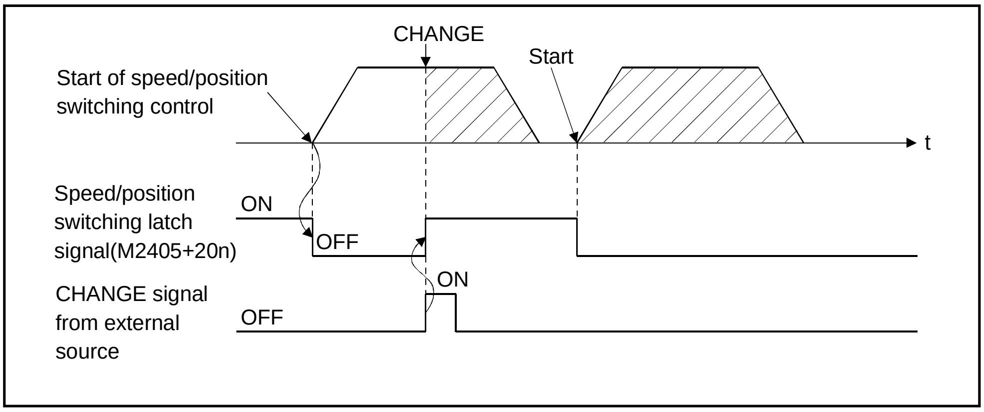
(b) The speed control in progress signal is OFF when the power is switched ON and during position control.



(6) Speed/position switching latch signal (M2405+20n)

(a) The speed/position switching latch signal comes ON when control is switched from speed control to position control.
It can be used as an interlock signal to enable or disable changing of the travel value in position control.

(b) The signal goes OFF when any of the following are started.
- Position control
- Speed/position switching control
- Speed control
- JOG operation
- Manual pulse generator operation

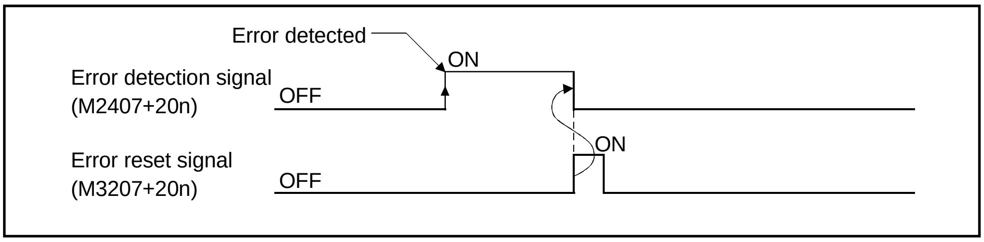


(7) Zero pass signal (M2406+20n)
This signal comes ON when the zero point is passed after the power to the servo amplifier has been switched ON.
Once the zero point has been passed, the signal remains ON until the CPU has been reset.
In the zeroing method of proximity dog or count type, however, the signal goes OFF once at the start of zeroing and comes ON again when the next zero point is passed.

(8) Error detection signal (M2407+20n)

(a) The error detection signal comes ON when a minor error or major error is detected and is used to determine whether or not errors have occurred.
When a minor error is detected, the corresponding error code(Note-1) is stored in the minor error code storage area.(see section 3.2.1)
When a major error is detected, the corresponding error code(Note-2) is stored in the major error code storage area. (see section 3.2.1)

(b) When the error reset signal (M3207+20n) comes ON, the error detection signal goes OFF.



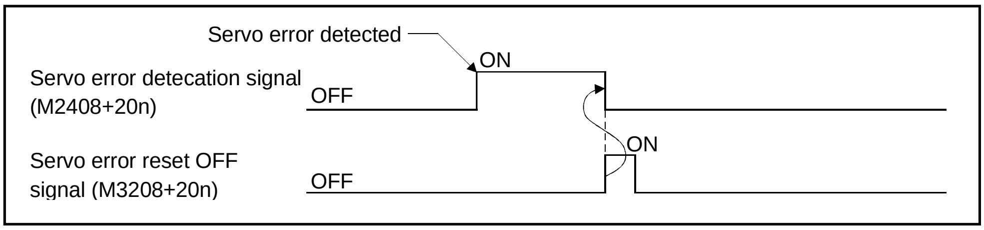
REMARKS

(Note-1):For details on the error codes when minor errors occur, see Appendix 2.2.
(Note-2):For details on the error codes when major errors occur, see Appendix 2.3.

(9) Servo error detection signal (M2408+20n)

(a) The servo error detection signal comes ON when an error occurs at the servo amplifier side (excluding errors that cause alarms, and emergency stops) (Note-1), and is used to determine whether or not servo errors have occurred.
When an error is detected at the servo amplifier side, the corresponding error code(Note-1) is stored in the servo error code storage area.

(b) The servo error detection signal goes OFF when the servo error reset signal (M3208+20n) comes ON, or when the servo power supply is switched back on.



REMARK

(Note-1):For details on the error codes of errors detected at the servo amplifier side, see Appendix 2.4.

(10) Zeroing request signal (M2409+20n)
This signal comes ON when it is necessary to confirm the home position address when the power is switched on or during positioning control.

(a) When not using an absolute value system
1) The zeroing request signal comes ON in the following cases:
- When the power is switched on, or the servo system CPU is reset.
- During a zeroing operation.

2) The zeroing request signal goes OFF when the zeroing operation is completed.

(b) When using an absolute value system
1) The zeroing request signal comes on in the following cases:
- During a zeroing operation.
- When a backup data (reference value) sum check error occurs (when the power is switched on).

2) The zeroing request signal goes OFF when the zeroing operation is completed.

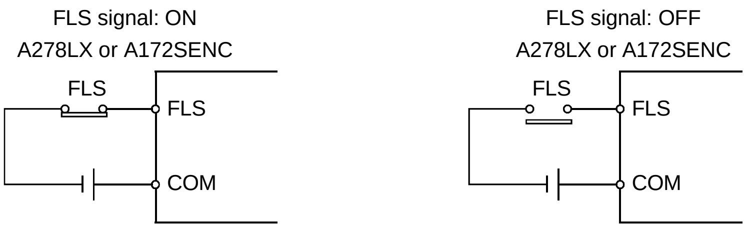
(11) Zeroing completed signal (M2410+20n)
(a) The zeroing completed signal comes ON when the execution of a zeroing operation in accordance with a servo program has been completed normally.

(b) It goes OFF when positioning is started, when JOG operation is started, or when manual pulse generator operation is started.

(c) If an attempt is made to execute a proximity dog zeroing while the zeroing completed signal is ON, the "ZERO RETURN START" error occurs, making it impossible to start the zeroing.

(12) FLS signal (M2411+20n)
(a) FLS signal is controlled by the ON/OFF status of the upper stroke end limit switch input (FLS) to the A278LX or A172SENC from an external source.
- Upper stroke end limit switch input OFF ...... FLS signal : ON
- Upper stroke end limit switch input ON .... FLS signal : OFF

(b) The status of the upper stroke end limit switch input (FLS) when the FLS signal is ON/OFF is indicated in the figure below.

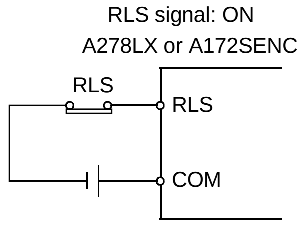


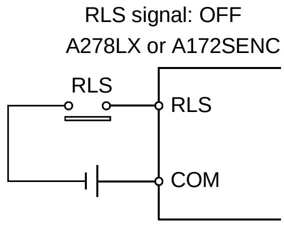
(13) RLS signal (M2412+20n)

(a)The RLS signal is controlled by the ON/OFF status of the lower stroke end limit switch input (FLS) to the A278LX or A172SENC from an external source.

- Lower stroke end limit switch input OFF ...... RLS signal: ON
- Lower stroke end limit switch input ON .... RLS signal: OFF

(b) The status of the lower stroke end limit switch input (RLS) when the RLS signal is ON/OFF is indicated in the figure below.



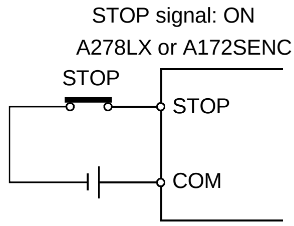


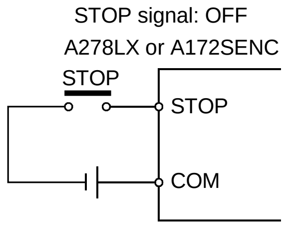
(14) STOP signal (M2413+20n)

(a) The STOP signal is controlled by the ON/OFF status of the stop signal (STOP) sent to the A278LX or A172SENC from an external source.

- Stop signal OFF ..... STOP signal: OFF
- Stop signal ON .... STOP signal: ON

(b) The status of the external stop switch (STOP) when the STOP signal is ON/OFF is indicated in the figure below.





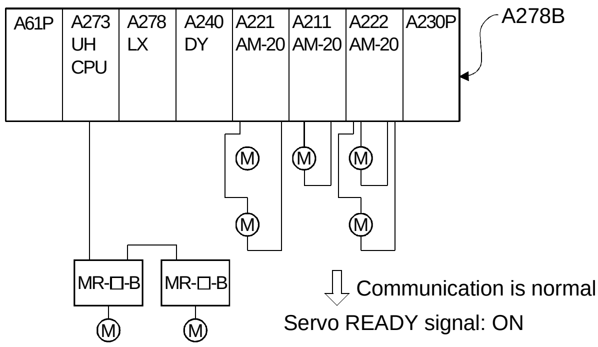
(15) DOG signal (M2414+20n)

(a) The DOG signal is controlled by the ON/OFF status of the external proximity dog (DOG) switch connected to the A278LX or A172SENC.

(b) Independently of whether the "normally open contact input" or "normally closed contact input" is specified in the system settings, the proximity dog signal turns ON when the proximity dog switch turns ON, and the proximity dog signal turns OFF when the proximity dog switch turns OFF.

(c) At the setting of the "normally open contact input" in the system settings, the proximity dog input is provided when the proximity dog switch turns ON. At the setting of the "normally closed contact input", the proximity dog input is provided when the proximity dog switch turns OFF.

(16) Servo READY signal (M2415+20n)
   (a) The servo READY signal comes ON when the servo amplifiers connected to each axis are in the READY status.
   (b) The signal goes OFF in the following cases.
      • When M2042 is OFF
      • When no servo amplifier is installed
      • When the servo parameters have not been set
      • When the power supply module has received an emergency stop input from an external source
      • When the M3215+20n signal comes ON and establishes the servo OFF status
      • When a servo error occurs
        For details, see Appendix 2.4 "Servo Errors"



POINT

(1) If the ADU using axis results in a servo error, the servo-off axis varies with the system settings as indicated below.
(Only when the A273UHCPU is used)

Processing Setting for ADU Servo Error	Servo-Off Axis
System-based servo off	All axes in the system including the axis which resulted in a servo error
Only own-axis servo off	Axis which resulted in a servo error

(2) When an axis driven by an MR-□-B becomes subject to a servo error, the affected axis only goes into the servo OFF status.

(17) Torque control in progress signal (M2416+20n)
   Signals for axes whose torque is being controlled are ON.

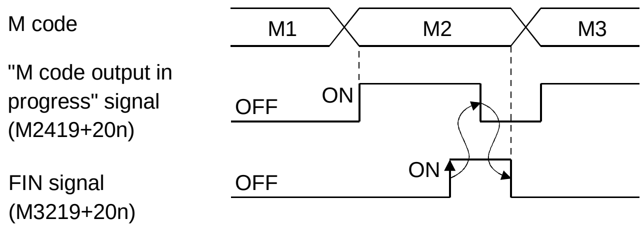
(18) CHANGE signal (M2417+20n)
   (a) The CHANGE signal is controlled by the ON/OFF status of the external speed-position control change input (CHANGE) switch connected to the A278LX or A172SENC.
      • When speed-position change input is OFF......... CHANGE signal: OFF
      • When speed-position change input is ON........... CHANGE signal: ON

(b) When the CHANGE signal is ON/OFF, the status of the speed change switch (CHANGE) is as shown below.

(19) M-code output signal (M2419+20n)

(a) This signal indicates M-code output in progress.

(b) This signal is set to OFF at the time of stop command, cancel signal, skip signal or FIN signal input.



POINTS

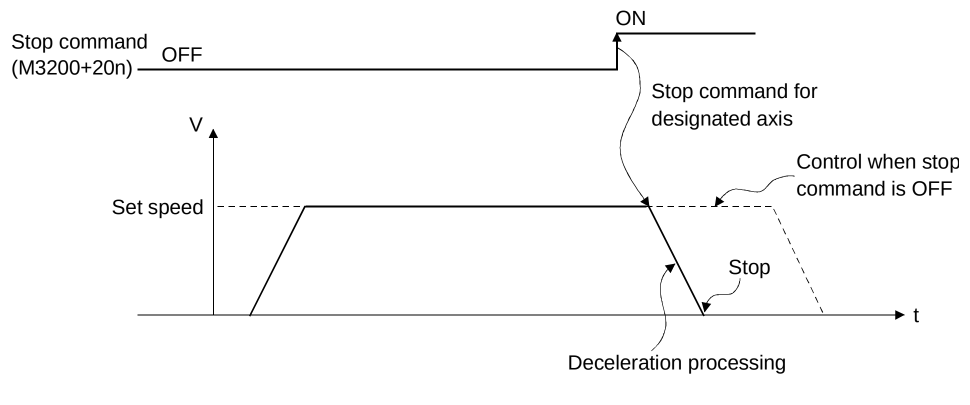
(1) The FIN signal and "M-code output in progress" signal are both for the FIN signal wait function.

(2) The FIN signal and "M-code output in progress" signal are effective only when FIN acceleration/deceleration is designated in the servo program. Otherwise, the FIN signal wait function is disabled, and the "M-code output in progress" signal is not set to ON.

3.1.2 Axis command signals

(1) Stop command (M3200+20n)

(a) The stop command is a signal used to stop an axis that is currently being driven and becomes effective at its leading edge (OFF→ON). (An axis for which the stop command is ON cannot be started.)



(b) It can also be used as the stop command when speed control is being executed.
(For details on speed control, see Section 7.12 or Section 7.13.)

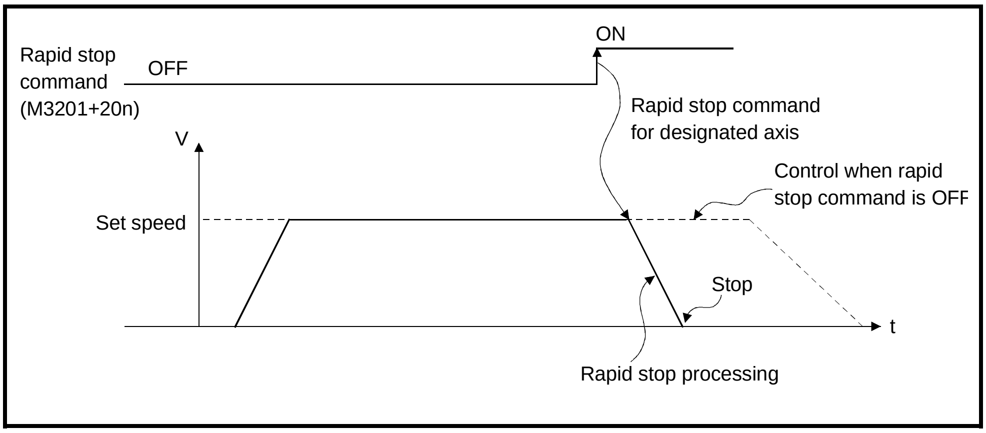
Control Being Executed	Processing when the Stop Command Comes ON	
	If Control is Being Executed	If Deceleration Stop Processing is Being Executed
Position control Speed control (I, II) JOG operation	The axis decelerates to a stop in the deceleration time set in the parameter block or servo program.	The stop command is ignored and deceleration stop processing continues.
Manual pulse generator operation	An immediate stop is executed, with no deceleration processing.	—
Zeroing	(1) The axis decelerates to a stop in the deceleration time set in the parameter block. (2) A "stop during zeroing" error occurs and the error code (202) is stored in the minor error storage area for each axis.	

POINT

If a stop is executed by turning ON the stop command (M3200+20n) during a zeroing operation, re-execute the zeroing operation.
If the stop command came ON after the proximity dog came ON in the zeroing operation, first retract to a position before the point where the proximity dog comes ON using JOG operation or positioning, and then execute the zeroing operation again.

(2) Rapid stop command (M3201+20n)

(a) The rapid stop command is a signal used to rapidly stop an axis that is currently being driven and becomes effective at its leading edge (OFF→ON). (An axis for which the rapid stop command is ON cannot be started.)



(b) The details of stop processing when the rapid stop command comes ON are presented in the table below.

Control Being Executed	Processing when the Rapid Stop Command Comes ON	
	If Control is Being Executed	If Deceleration Stop Processing is Being Executed
Position control Speed control (I, II) JOG operation	The axis decelerates to a stop in the deceleration time set in the parameter block or servo program.	Deceleration processing is canceled and rapid stop processing executed instead.
Manual pulse generator operation	An immediate stop is executed, with no deceleration processing.	—
Zeroing	(1) The axis decelerates to a stop in the rapid stop deceleration time set in the parameter block. (2) A "stop during zeroing" error occurs and the error code (203) is stored in the minor error storage area for each axis.	

POINT

If a stop is executed by turning ON the rapid stop command (M3201+20n) during a zeroing operation, re-execute the zeroing operation. If the rapid stop command came ON after the proximity dog came ON in the zeroing operation, first retract to a position before the point where the proximity dog comes ON using JOG operation or positioning, and then execute the zeroing operation again.

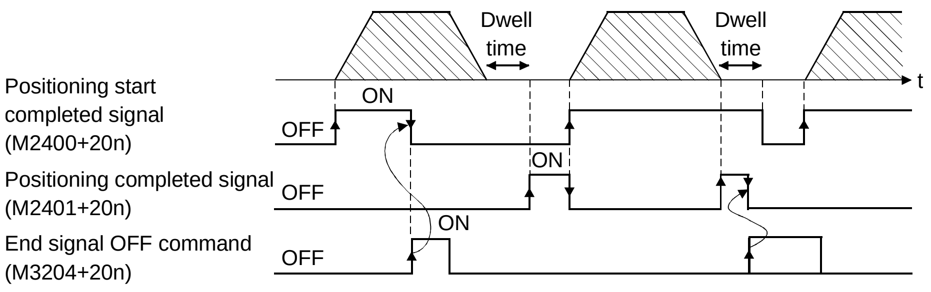
(3) Forward JOG start command (M3202+20n)/Reverse JOG start command (M3203+20n)
  (a) While the sequence program keeps M3202+20n ON, JOG operation is executed in the direction in which address numbers increase. When M3202+20n is turned OFF, a deceleration stop is executed in the deceleration time set in the parameter block.

  (b) While the sequence program keeps M3203+20n ON, JOG operation is executed in the direction in which address numbers decrease. When M3203+20n is turned OFF, a deceleration stop is executed in the deceleration time set in the parameter block.

POINT

Establish an interlock in the sequence program to make it impossible for the forward JOG start command (M3202+20n) and the reverse JOG start command (M3203+20n) to be ON at the same time.

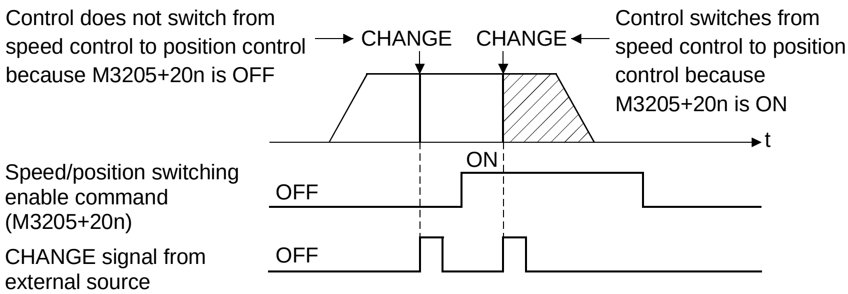
(4) End signal OFF command (M3204+20n)
  (a) The end signal OFF command is used to turn off the positioning start completed signal (M2400+20n) and the positioning completed signal (M2401+20n) by using the sequence program.



POINT

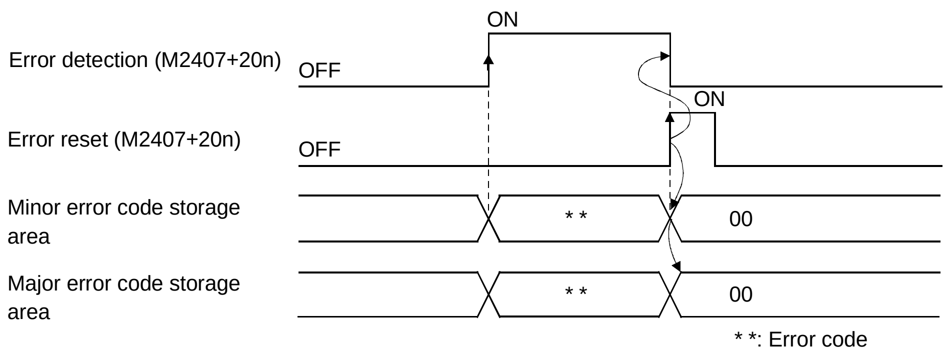
Do not turn the end signal OFF command ON with a PLS command.
If it is turned ON with a PLS command, it will not be possible to turn OFF the positioning start completed signal (M2400+20n) or the positioning completed signal (M2401+20n).

(5) Speed/position switching enable command (M3205+20n)
  (a) The speed/position switching enable command is used to make the CHANGE signal (signal for switching from speed to position control) effective from an external source.
   - ON .... Control switches from speed control to position control when the CHANGE signal comes ON.
   - OFF ...... Control does not switch from speed to position control even if the CHANGE signal comes ON.

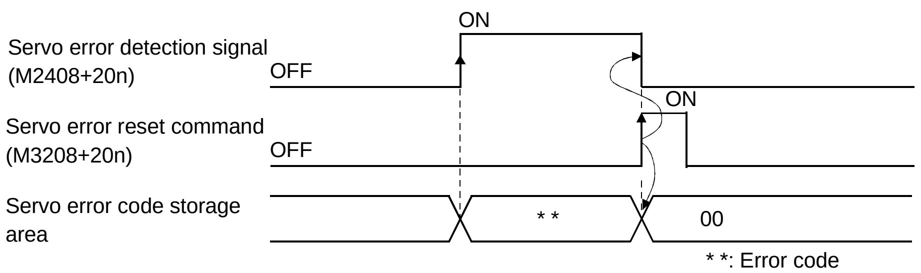


(6) Limit switch output enable command (M3206+20n)
The limit switch output enable command is used to enable limit switch output.
- ON........ The limit switch output ON/OFF pattern can be output.
- OFF...... Limit switch output goes OFF.

(7) Error reset command (M3207+20n)
The error reset command is used to clear the minor error code or major error code storage area of an axis for which the error detection signal has come ON (M2407+20n: ON), and reset the error detection signal (M2407+20n).



(8) Servo error reset command (M3208+20n)
The servo error reset command is used to clear the servo error code storage area of an axis for which the servo error detection signal has come ON (M2408+20n: ON), and reset the servo error detection signal (M2408+20n).



POINT

Do not turn the error reset command (M3207+20n) or servo error reset command (M3208+20n) ON with a PLS command.
If a PLS command is used, it will not be possible to reset the error or servo error.

REMARK

For details on minor error code, major error code, and servo error code storage areas, see Appendix 2.

(9) External STOP input/invalid when starting command (M3209+20n)
This signal is used to make external STOP signal input valid or invalid.
- ON.........External STOP input is set as invalid, and even axes for which STOP input is currently ON can be started.
- OFF.......External STOP input is set as valid, and axes for which STOP input is currently ON cannot be started.

POINT

To stop an axis by external STOP input after it has been started with the M3209+20n command ON, switch the STOP input from OFF to ON (if STOP input is ON when the axis is started, switch it from ON to OFF to ON).

(10) Feed current value update request command (M3212+20n)
This signal is used to set whether the feed current value will be cleared or not when motion is started in speed/position switching control.
- ON........ The feed current value is updated, starting from when motion is started.
  The feed current value is not cleared on starting.
- OFF...... The feed current value is updated, starting from when motion is started.
  The feed current value is cleared on starting.

POINT

When motion is started with M3212+20n, leave M3212+20n ON until positioning control has been completed.
If M3212+20n is turned OFF part way through, the feed current value may not be reliable.

(11) Servo OFF command (M3215+20n)
The servo OFF command is used to establish the servo OFF status (free run status).
- M3215+20n : OFF ..... Servo ON
- M3215+20n : ON .... Servo OFF (free run status)

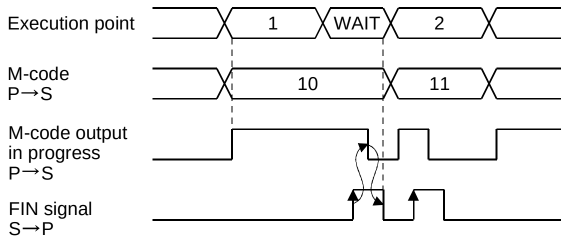
This command is not effective during positioning and should therefore be executed on completion of positioning.

⚠ CAUTION

⚠ Turn the power supply at the servo side OFF before turning a servomotor by hand.

(12) FIN signal (M3219+20n)
When an M-code is set in a point during positioning, travel to the next block does not take place until the FIN signal state changes as follows:
OFF→ON→OFF
Positioning to the next block begins after the FIN signal state changes as above.

```
<K   0>
  CPSTART2
   Axis        1
   Axis        2
   Speed                    10000
   FIN  acceleration/         100  [ms]
   deceleration
1  ABS-2
   Axis        1,          200000
   Axis        2,          200000
   M code                      10
2  ABS-2
   Axis        1,          300000
   Axis        2,          250000
   M code                      11
3  ABS-2
   Axis        1,          350000
   Axis        2,          300000
   M code                      12
4  ABS-2
   Axis        1,          400000
   Axis        2,          400000
  CPEND
```



Timing Chart for Operation Description

1. Once positioning to point 1 beings, M-code 10 is output and the M-code output in progress signal goes ON.
2. After the PLC takes appropriate action, the FIN signal goes ON. Travel to the next point does not take place unless the FIN signal goes ON.
3. When the PLC's action causes the FIN signal to go ON, the M-code output in progress signal goes OFF.
4. After the M-code output in progress goes OFF,the PLC takes appropriate action so that the FIN signal goes OFF. Positioning to the next point 2 beings through the above steps.

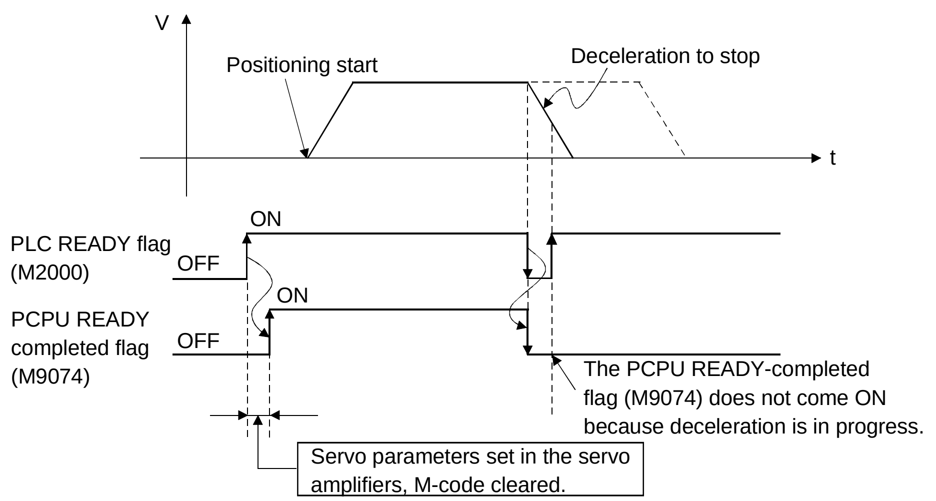
3.1.3 Common Device

POINTS

(1) Internal relays for positioning control are not latched even inside the latch range.
In this manual, in order to indicate that internal relays for positioning control are not latched, the expression used in this text is "M2000 to M2319".

(2) The range of devices allocated as internal relays for positioning control cannot be used by the user even if their applications have not been set.

(1) Sequencer READY flag (M2000) .... Signal sent from SCPU to PCPU
- (a) This signal serves to notify the PCPU that the SCPU is normal. It is switched ON and OFF by the sequence program.
  1) While M2000 is ON, the positioning control or zeroing specified by the servo program, or the JOG operation or manual pulse generator operation specified by the sequence program, can be executed.
  2) Even if M2000 is turned ON while the test mode for testing from a peripheral device is effective (while M9075 is ON), control in 1) above will not be executed.
- (b) The fixed parameters, servo parameters, and limit switch output parameters can only be changed using a peripheral device when M2000 is OFF. If an attempt is made to change this data while M2000 is ON, an error will occur.
- (c) When M2000 is switched from OFF to ON, the following processing occurs.
  1) Processing details
     - The servo parameters are transferred to the servo amplifier.
     - The M-code storage area for all axes is cleared.
     - The default value of 300% is set in the torque limit value storage area. (See Section 4.4.)
     - The PCPU READY-completed flag (M9074) is turned ON.
  2) If there is an axis currently being driven, an error occurs, and the processing in (c) 1) above is not executed.
  3) While the test mode is in effect, the processing in (c) 1) above is not executed. When the test mode is cancelled, the processing in (c) 1) above is executed if M2000 is ON.

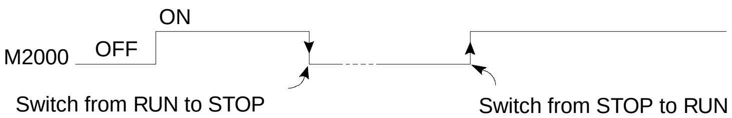


(d) When M2000 is switched from ON to OFF, the following processing is executed.

1) Processing details
- The PCPU READY-completed flag (M9074) is turned OFF.
- The axis being driven is decelerated to a stop.

POINT

The PLC READY flag (M2000) goes OFF when the servo system CPU is in the STOP status. When the RUN status is re-established, the status is the same as before the STOP was executed.

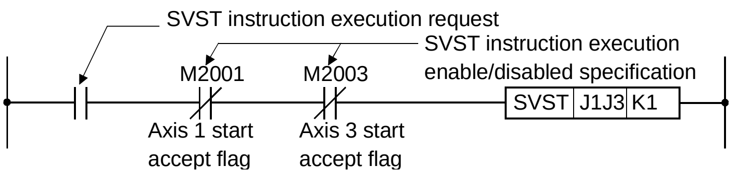


(2) Start accept flag (M2001+n)............................ Signal sent from PCPU to SCPU

(a) The start accept flag comes ON when the positioning start (SVST) instruction is executed in the sequence program: use it as an interlock to enable or disable execution of the SVST instruction.

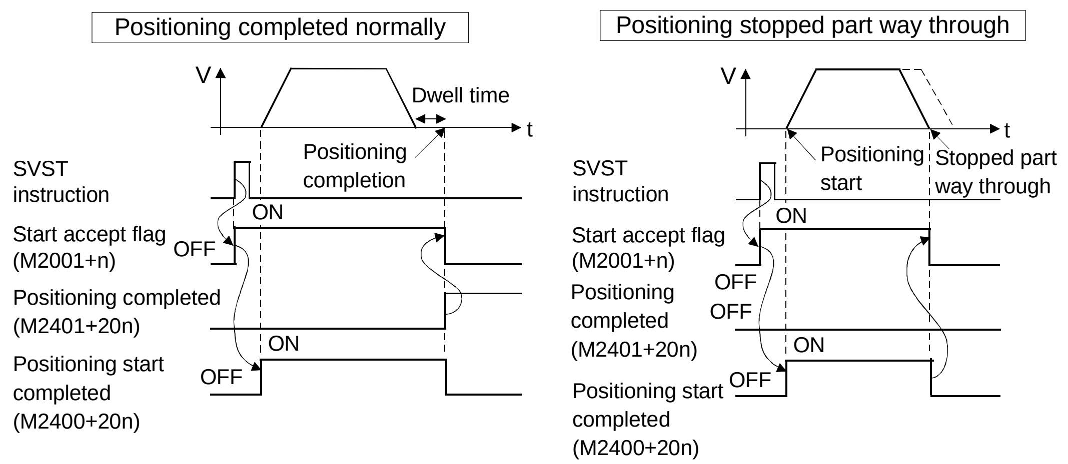
Example

When requesting execution of the servo programs for positioning on axis 1 and axis 3, use the start accept flags in the way shown below.

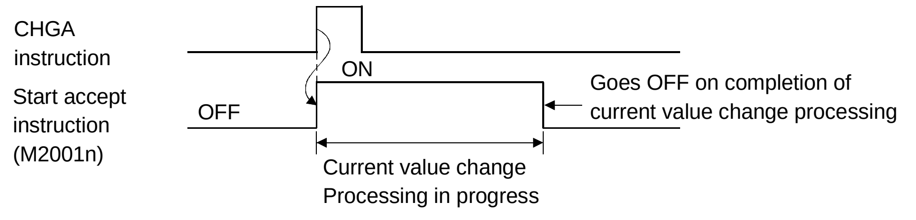


(b) The start accept flag ON/OFF processing takes the following form.

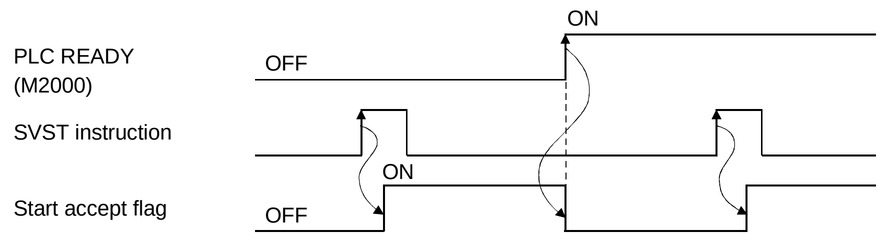
1) The start accept flag for the designated axis comes ON in response to a SVST instruction, and goes OFF on completion of positioning.
The start accept flag will also go OFF if positioning is stopped part way through.
(However, if positioning is stopped part way through by a speed change to speed 0, the start accept flag will remain ON.)



2) When positioning control is executed by turning ON the JOG operation command (M3202+20n or M3203+20n), the start accept flag goes OFF when positioning is stopped by turning the JOG operation command OFF.
3) The start accept flag is ON while the manual pulse generator enable flag (M2051 to M2053: ON) is ON.
The start accept flag is OFF while the manual pulse generator enable flag (M2051 to M2053: OFF) is OFF.
4) The start accept flag is ON during a current value change initiated by a CHGA instruction. It goes OFF on completion of the current value change.



5) When M2000 is OFF, execution of a SVST instruction causes the start accept flag to come ON; the flag goes OFF when M2000 comes ON.



CAUTION

The user must not turn start accept flags ON/OFF.
- If a start accept flag that is ON is switched OFF with the sequence program or a peripheral device, no error will occur but the positioning operation will not be reliable. Depending on the type of machine, it might operate in an unanticipated manner.
- If a start accept flag that is OFF is switched ON with the sequence program or a peripheral device, no error will occur at that time, but the next time an attempt is made to start the axis an error will occur during a start accept flag being ON and the axis will not start.

REMARK

A numerical value corresponding to an axis number is entered for "n" in "M2001 + n".

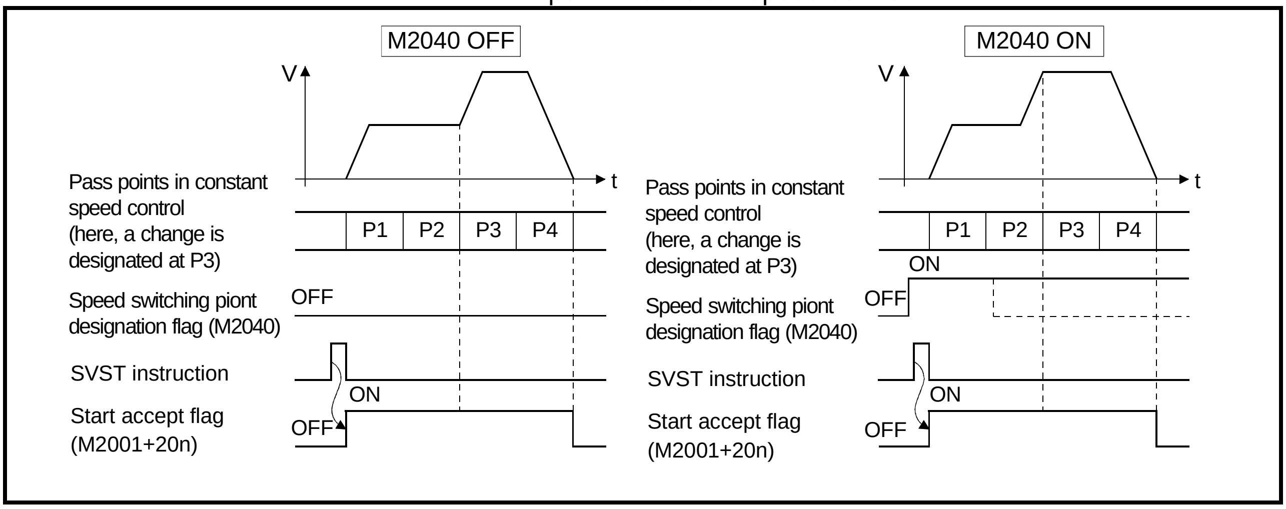
Axis No.	n	Axis No.	n	Axis No.	n	Axis No.	n
1	0	9	8	17	16	25	24
2	1	10	9	18	17	26	25
3	2	11	10	19	18	27	26
4	3	12	11	20	19	28	27
5	4	13	12	21	20	29	28
6	5	14	13	22	21	30	29
7	6	15	14	23	22	31	30
8	7	16	15	24	23	32	31

(3) PC link communication error flag (M2034) ....Signal sent from PCPU to SCPU
This flag comes ON when an error occurs during personal computer linking communication.
OFF : No PC link communication error
ON : PC link communication error detected
(Flag changes to OFF if normal communication is restored.)
For details on PC link communication error, see APPENDIX 2-5.

(4) Speed switching point designation flag (M2040).....................Signal sent from SCPU to PCPU

OS	SV13	SV22
Device No.	M2040	

The speed switching point designation flag is used when a speed change is designated at the pass point in constant speed control.
(a) By turning M2040 ON before the start of constant speed control (before the servo program is started using the SVST instruction), control can be executed with a speed change at the start of the pass point.
  • OFF ....Speed is changed to a designated speed at a pass point in constant speed control.
  • ON ....Speed has been changed to a designated speed at a pass point in constant speed control.



(5) System setting error flag (M2041) .... Signal sent from PCPU to SCPU
When the power is switched ON, or when the servo system CPU is reset, the system setting data set with a peripheral device is input, and a check is performed to determine if the set data matches the module mounting status (of the CPU base unit and extension base units).
- ON............. Error
- OFF........... Normal

(a) When an error occurs, the ERROR LED at the front of the CPU comes on. Also, the error log can be known from the peripheral devices started by GSV13PE or GSV22PE.

(b) When M2041 is ON, positioning cannot be started. You must eliminate the cause of the error and switch the power back ON, or reset the servo system CPU.

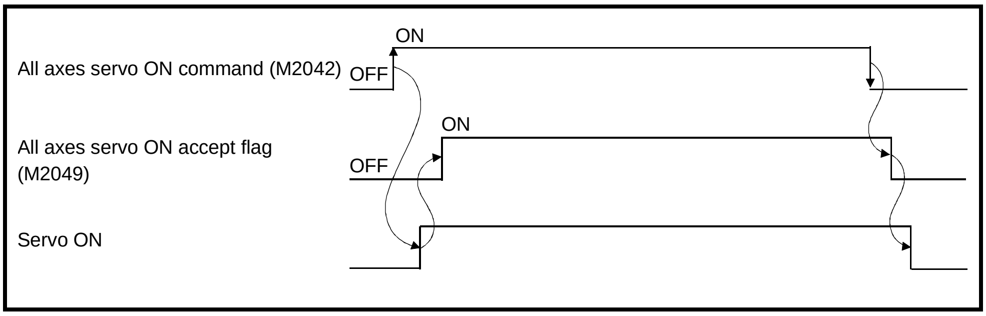
REMARK

Even if a module is loaded at a slot set as "NO USE" in the system setting data set with a peripheral device, that slot will be regarded as not used.

(6) All axes servo ON command (M2042) .... Signal from SCPU to PCPU
The all axes servo ON command is used to enable servo operation.

(a) Servo operation enabled — M2042 is turned ON while the servo OFF signal (M3215+20n) is OFF and there is no servo error.

(b) Servo operation disable ....
- M2042 is OFF
- The servo OFF signal (M3215+20n) is ON
- Servo error



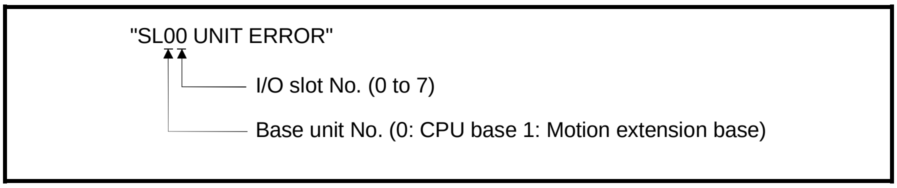
POINT

M2042 has been turned ON, it will not go OFF even if the CPU is set in the STOP status.

(7) Optional slot module error detection flag (M2047) .... Signal from PCPU to SCPU
This flag is used to determine whether the status of modules mounted on the CPU base unit and extension base units is "normal" or "abnormal".
- ON ....When mounted module is abnormal
- OFF ....When mounted module is normal

The module information when the power is switched ON and module information after the power has been switched ON is always checked and errors are detected.

(a) When M2047 comes ON, the ERROR LED of the A273UHCPU lights.

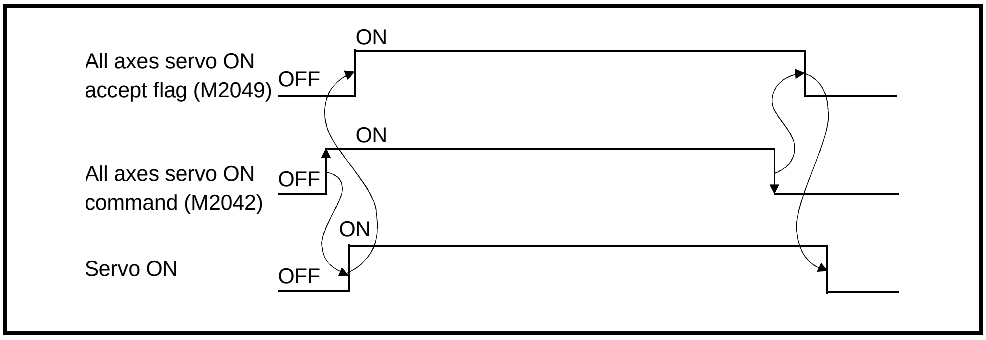


(b) Use the sequence program to execute appropriate processing (stopping the driven axis, establishing the servo OFF status) when an error occurs.

(8) JOG simultaneous start command (M2048) ....Signal sent from SCPU to PCPU
(a) When M2048 is turned ON, JOG operation is simultaneously started on the axis for which JOG operation is to be executed as set in the JOG operation simultaneous start axis setting register (D710 to D713).

(b) When M2048 is turned OFF, motion on the axis currently executing JOG operation decelerates to a stop.

(9) All axes servo ON accept flag (M2049)......... Signal sent from PCPU to SCPU
The all axes servo ON accept flag serves to notify that servo operation is possible.
- ON ....The servo motor can be driven.
- OFF ....The servo motor cannot be driven.



(10) Start buffer full (M2050) .... Signal sent from PCPU to SCPU
(a) This signal comes on when 64 or more requests have been issued simultaneously to the PCPU by means of position start (SVST) instructions in the sequence program.

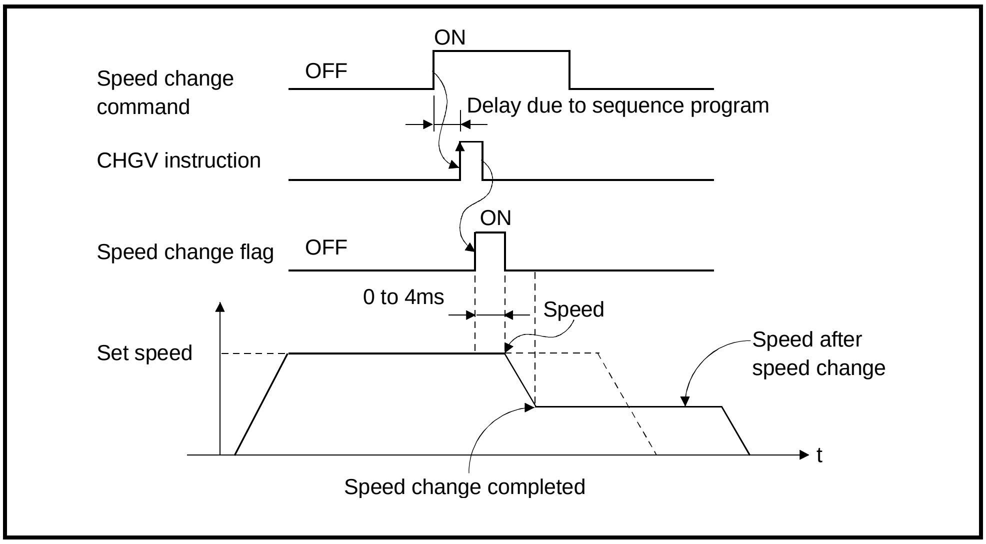
(b) Reset M2050 by using the sequence program.

(11) Manual pulse generator enable flag (M2051 to M2053)..........Signal sent from SCPU to PCPU
The manual pulse generator enable flags set the enabled or disabled status for positioning with the pulse input from the manual pulse generators connected to P1 to P3 (Note) of the A273EX or A172SENC.
- ON ....Positioning control is executed in accordance with the input from the manual pulse generators.
- OFF........Positioning with the manual pulse generators is not possible because the input from the manual pulse generators is ignored.

REMARK

(Note): For details on the P1 to P3 connector of the A273EX or A172SENC, refer to the Motion Controller User's Manual.

(12) Speed change flags (M2061+n) ....Signal from PCPU to SCPU
The speed change flags come ON when a speed change is executed in response to a control change (CHGV) instruction in the sequence program: use them for interlocks in speed change programs.



REMARK

A numerical value corresponding to an axis number is entered for "n" in "M2061+ n".

Axis No.	n	Axis No.	n	Axis No.	n	Axis No.	n
1	0	9	8	17	16	25	24
2	1	10	9	18	17	26	25
3	2	11	10	19	18	27	26
4	3	12	11	20	19	28	27
5	4	13	12	21	20	29	28
6	5	14	13	22	21	30	29
7	6	15	14	23	22	31	30
8	7	16	15	24	23	32	31

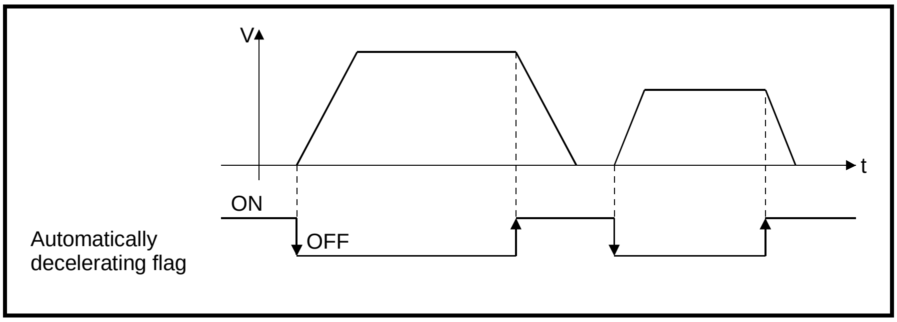
(13) Automatically decelerating flag (M2128 to M2159) .... Signal from PCPU to SCPU

This signal is ON while automatic deceleration processing is performed under positioning control or position follow-up control.

(a) Under position follow-up control, this flag is ON during automatic deceleration to the command address, but turns OFF if the command address is changed during that time.

(b) Under control in any control system, this flag turns OFF on normal start completion.

(c) In any of the following cases, the automatically decelerating flag does not turn ON.
- During deceleration due to JOG signal turned OFF
- During manual pulse generator operation
- At midway deceleration due to stop command or stop cause occurrence
- When travel value is 0



The automatically decelerating flag list is given below.

Axis No.	Device No.	Axis No.	Device No.	Axis No.	Device No.	Axis No.	Device No.
1	M2128	9	M2136	17	M2144	25	M2152
2	M2129	10	M2137	18	M2145	26	M2153
3	M2130	11	M2138	19	M2146	27	M2154
4	M2131	12	M2139	20	M2147	28	M2155
5	M2132	13	M2140	21	M2148	29	M2156
6	M2133	14	M2141	22	M2149	30	M2157
7	M2134	15	M2142	23	M2150	31	M2158
8	M2135	16	M2143	24	M2151	32	M2159

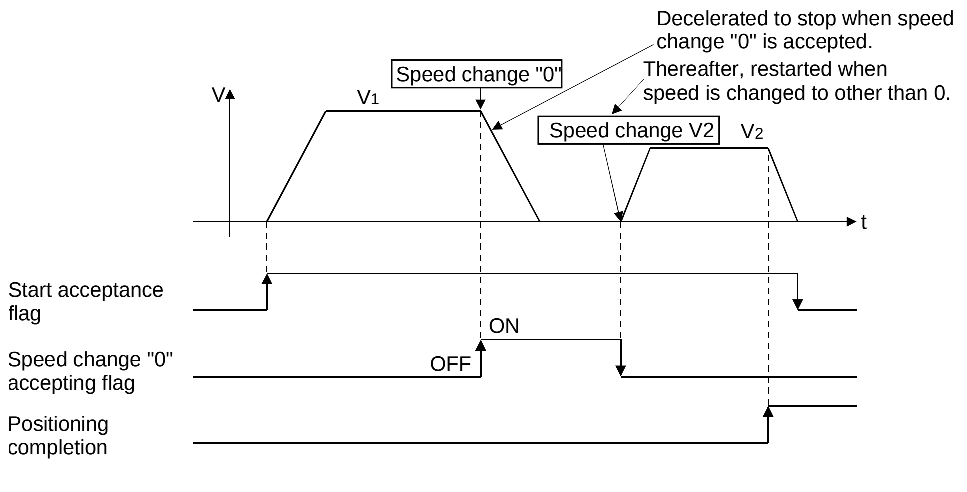
REMARK

In the SV22 virtual mode, the flag is that of the virtual servo motor shaft.

(14) Speed change "0" accepting flag (M2240 to M2271) .... Signal from PCPU to SCPU

The speed change "0" accepting flag is ON while a speed change request for speed "0" is being accepted.

This signal turns ON when the speed change request for speed "0" is accepted during a start. After that, this signal turns OFF when a speed change to other than speed "0" is accepted or on completion of a stop due to a stop cause.



The speed change "0" accepting flag list is given below.

Axis No.	Device No.	Axis No.	Device No.	Axis No.	Device No.	Axis No.	Device No.
1	M2240	9	M2248	17	M2256	25	M2264
2	M2241	10	M2249	18	M2257	26	M2265
3	M2242	11	M2250	19	M2258	27	M2266
4	M2243	12	M2251	20	M2259	28	M2267
5	M2244	13	M2252	21	M2260	29	M2268
6	M2245	14	M2253	22	M2261	30	M2269
7	M2246	15	M2254	23	M2262	31	M2270
8	M2247	16	M2255	24	M2263	32	M2271

REMARK

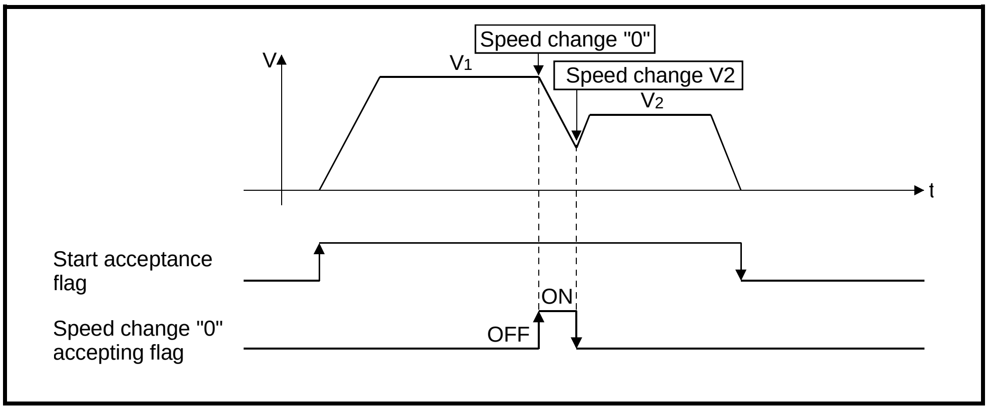
(1) Even during a stop, the ON status of the start acceptance flag (M2001 to M2032) indicates that the speed change "0" request is accepted. Check with this speed change "0" flag.

(2) During interpolation, the flags corresponding to the interpolation axes are set.

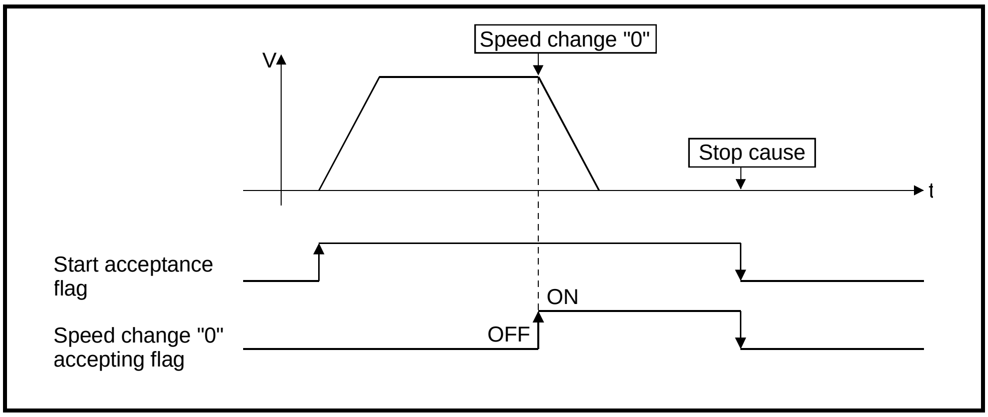
(3) In any of the following cases, the speed change "0" request is invalid.
- After deceleration due to JOG OFF
- During manual pulse generator operation
- After positioning automatic deceleration start
- After deceleration due to stop cause

(4) In the SV22 virtual mode, the flag is that of the virtual servo motor shaft.

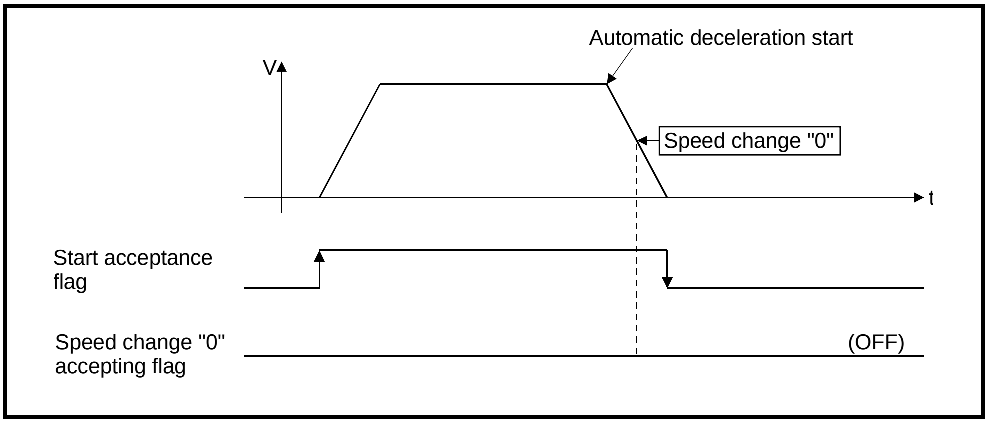
(a) The flag turns OFF if a speed change request for other than speed "0" occurs during deceleration to a stop due to speed change "0".



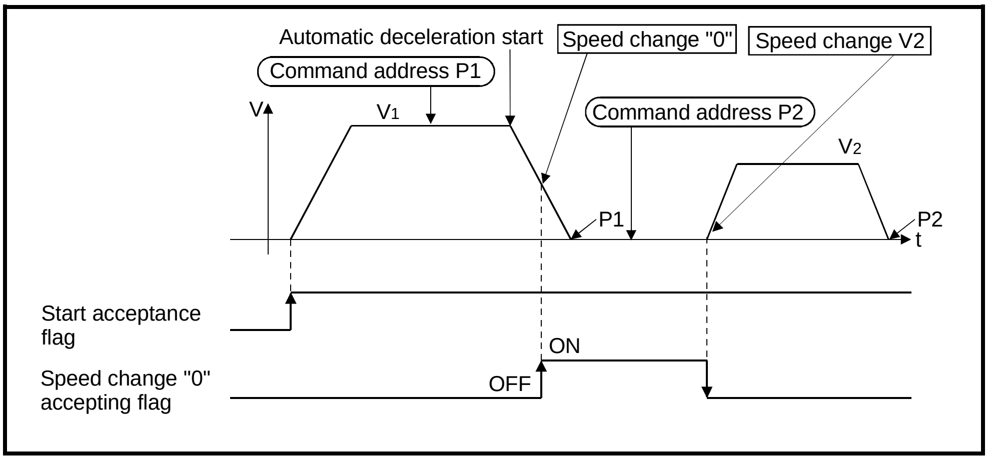
(b) The flag turns OFF if a stop cause occurs after speed change "0" acceptance.



(c) The speed change "0" accepting flag does not turn ON if a speed change "0" occurs after an automatic deceleration start.



(d) Under position follow-up control, the speed change "0" accepting flag turns ON if a speed change "0" occurs after an automatic deceleration start to the "specified address".



REMARK

Under position follow-up control, the axis will not start if the "command address" is changed during speed change "0" acceptance.

3.2 Data Registers

(1) Data registers

Device No.	Purpose
D0	Axis monitor device (20 points × 32axes)
D640	Control change register (2 points × 32 axes)
D704 D799	Common device (96 points)
D800 D8191	User device (7392 points)

POINT

- Total number of user device points

  800 points

(2) Axis monitor devices

Axis No.	Device Number
1	D0 to D19
2	D20 to D39
3	D40 to D59
4	D60 to D79
5	D80 to D99
6	D100 to D119
7	D120 to D139
8	D140 to D159
9	D160 to D179
10	D180 to D199
11	D200 to D219
12	D220 to D239
13	D240 to D259
14	D260 to D279
15	D280 to D299
16	D300 to D319
17	D320 to D339
18	D340 to D359
19	D360 to D379
20	D380 to D399
21	D400 to D419
22	D420 to D439
23	D440 to D459
24	D460 to D479
25	D480 to D499
26	D500 to D519
27	D520 to D539
28	D540 to D559
29	D560 to D579
30	D580 to D599
31	D600 to D619
32	D620 to D639

Signal name

	Signal name		Refresh cycle			Import cycle			Unit	Signal direction
			Number of set axes			Number of set axes				
	SV13	A173UHCPU	1 to 20	21 to 32	——	1 to 20	21 to 32	——		
		A273UHCPU	1 to 12	13 to 24	25 to 32	1 to 12	13 to 24	25 to 32		
	SV22	A173UHCPU	1 to 12	13 to 24	25 to 32	1 to 12	13 to 24	25 to 32		
		A273UHCPU	1 to 8	9 to 18	19 to 32	1 to 8	9 to 18	19 to 32		
0 1	Feed current value		3.5ms	7.1ms	14.2ms				Command unit	SCPU←PCPU
2 3	Actual current value		3.5ms	7.1ms	14.2ms				Command unit	SCPU←PCPU
4 5	Deviation counter value		3.5ms	7.1ms	14.2ms				PLS	SCPU←PCPU
6	Minor error code		Immediate						——	SCPU←PCPU
7	Major error code		Immediate						——	SCPU←PCPU
8	Servo error code		10ms	20ms					——	SCPU←PCPU
9	Zeroing second travel value		3.5ms	7.1ms	14.2ms				PLS	SCPU←PCPU
10 11	After-DOG/CHANGE ON travel value		END						Command unit	SCPU←PCPU
12	Execution program No.		At start						——	SCPU←PCPU
13	M-code		3.5ms	7.1ms	14.2ms				——	SCPU←PCPU
14	Torque limit value		3.5ms	7.1ms	14.2ms				%	SCPU←PCPU
15	Constant-speed control data set pointer		At start/during start						——	SCPU←PCPU
16 17	Travel value change register					3.5ms	7.1ms	14.2ms	Command unit	SCPU→PCPU
18 19	STOP input-time real current value		END (Note)						Command unit	SCPU←PCPU

"END" in the Refresh Cycle field indicates "50ms" or "PLC program scan time", which is longer.

(3) Control change registers

Axis No.	Device Number	Signal Name
1	D640, D641	
2	D642, D643	
3	D644, D645	
4	D646, D647	
5	D648, D649	
6	D650, D651	
7	D652, D653	
8	D654, D655	
9	D656, D657	
10	D658, D659	
11	D660, D661	
12	D662, D663	
13	D664, D665	
14	D666, D667	
15	D668, D669	
16	D670, D671	
17	D672, D673	
18	D674, D675	
19	D676, D677	
20	D678, D679	
21	D680, D681	
22	D682, D683	
23	D684, D685	
24	D686, D687	
25	D688, D689	
26	D690, D691	
27	D692, D693	
28	D694, D695	
29	D696, D697	
30	D698, D699	
31	D700, D701	
32	D702, D703	

	Signal Name			Refresh cycle			Import cycle			Unit	Signal direction
				Number of set axes			Number of set axes				
		SV13	A173UHCPU	1 to 20	21 to 32	——	1 to 20	21 to 32	——		
			A273UHCPU	1 to 12	13 to 24	25 to 32	1 to 12	13 to 24	25 to 32		
		SV22	A173UHCPU	1 to 12	13 to 24	25 to 32	1 to 12	13 to 24	25 to 32		
			A273UHCPU	1 to 8	9 to 18	19 to 32	1 to 8	9 to 18	19 to 32		
0 1	JOG speed setting register						At start			Command unit	SCPU→PCPU

(4) Common devices

Device Number	Signal Name			Refresh Cycle			Import Cycle			Signal Direction
				Number of set axes			Number of set axes			
		SV13	A173UHCPU	1 to 20	21 to 32	———	1 to 20	21 to 32	———	
			A273UHCPU	1 to 12	13 to 24	25 to 32	1 to 12	13 to 24	25 to 32	
		SV22	A173UHCPU	1 to 12	13 to 24	25 to 32	1 to 12	13 to 24	25 to 32	
			A273UHCPU	1 to 8	9 to 18	19 to 32	1 to 8	9 to 18	19 to 32	
D704	User unusable (6 points)			———			———			———
D705										
D706										
D707										
D708										
D709										
D710	JOG operation simultaneous start axis setting register						At start			SCPU→PCPU
D711										
D712										
D713										
D714	Manual pulse generator 1 axis No. setting register						On leading edge of manual pulse generator enable			
D715										
D716	Manual pulse generator 2 axis No. setting register									
D717										
D718	Manual pulse generator 3 axis No. setting register									
D719										
D720	Axis 1	Manual pulse generator 1-pulse input magnification setting register								
D721	Axis 2									
D722	Axis 3									
D723	Axis 4									
D724	Axis 5									
D725	Axis 6									
D726	Axis 7									
D727	Axis 8									
D728	Axis 9									
D729	Axis 10									
D730	Axis 11									
D731	Axis 12									
D732	Axis 13									
D733	Axis 14									
D734	Axis 15									
D735	Axis 16									
D736	Axis 17									
D737	Axis 18									
D738	Axis 19									
D739	Axis 20									
D740	Axis 21									
D741	Axis 22									
D742	Axis 23									
D743	Axis 24									
D744	Axis 25									
D745	Axis 26									
D746	Axis 27									
D747	Axis 28									
D748	Axis 29									
D749	Axis 30									
D750	Axis 31									
D751	Axis 32									
D752	Manual pulse generator 1 smoothing magnification setting register									
D753	Manual pulse generator 2 smoothing magnification setting register									
D754	Manual pulse generator 3 smoothing magnification setting register									
D755	User unusable (5 points)									
D756										
D757										
D758										
D759										
D760	Limit switch output disable setting register						3.5ms	7.1ms	14.2ms	SCPU→PCPU
D761										
D762										
D763										
D764										
D765										
D766										
D767										
D768										
D769										
D770										
D771										
D772										
D773										
D774										
D775										
D776	Limit switch output status storage register									
D777										
D778										
D779										
D780										
D781										
D782										
D783										
D784										
D785										
D786										
D787										
D788										
D789										
D790										
D791										
D792	Servo amplifier type			At power-on						
D793										
D794										
D795										
D796										
D797										
D798										
D799										

3.2.1 Monitoring data area

The monitoring data area is used by the PCPU to store data such as the feed current value during positioning control, the real current value, and the number of droop pulses in the deviation counter.
It can be used to check the positioning control status using the sequence program.
The user cannot write data into the monitoring data area (with the exception of the travel value register).
For details on the delay time between a positioning device (input, internal relay, special relay) going ON or OFF and storage of data in the monitor data area, see APPENDIX 6 "Processing Times".

(1) Feed current value register (D0+20n) ....Data from the PCPU to the SCPU
   (a) This register stores the target address output to the servo amplifier on the basis of the positioning address/travel value designated in the servo program.
      1) In fixed-pitch feed control, the travel value counted up from 0 after motion starts is stored.
      2) In speed/position switching control, the current value counted up from the address when motion starts is stored.
         However, the address at start time varies depending on the ON/OFF status of the feed current value update command (M3212+20n) at start time.
         - M3212+20n: OFF.........Resets the feed current value to 0 at start time.
         - M3212+20n: ON...........Not reset the feed current value at start time.
      3) During speed control, "0" is stored.
   (b) The stroke range check is performed on this feed current value data.

(2) Real current value register (D2+20n) ....Data from the PCPU to the SCPU
   (a) This register stores the current value attained in real travel (the feed current value minus the droop pulses in the deviation counter).
   (b) In the stopped status, the feed current value is equal to the real current value.

(3) Deviation counter value register (D4+20n)....Data from the PCPU to the SCPU
   This register stores the difference between the feed current value and the real current value.

(4) Minor error code register (D6+20n).......... Data from the PCPU to the SCPU
   (a) This register stores the relevant error code (see Appendix 2.2) when a minor error occurs.
      If another minor error occurs, the previous error code is overwritten by the new error code.
   (b) Minor error codes can be cleared by an error reset signal (M3207+20n).

(5) Major error code register (D7+20n)...........Data from the PCPU to the SCPU
   (a) This register stores the relevant error code (see Appendix 2.3) when a major error occurs.
      If another major error occurs, the previous error code is overwritten by the new error code.
   (b) Major error codes can be cleared by an error reset signal (M3207+20n).

(6) Servo error code register (D8+20n) ....Data from the PCPU to the SCPU
   (a) This register stores the relevant error code (see Appendix 2.4) when a servo error occurs.
   If another servo error occurs, the previous error code is overwritten by the new error code.

   (b) Servo error codes can be cleared by a servo error reset signal (M3208+20n).

(7) Zeroing second travel value register (D9+20n)............................... Data from the PCPU to the SCPU
   If the position at which motion stops in accordance with the travel value setting (see Section 7.21) after the proximity dog has been switched ON by a peripheral device is not the zero point, the servo system CPU will initiate a second travel to the zero point. The travel value for travel to the zero point during this second operation is stored in this register (with no sign appended).
   When the feedback pulse count of the motor connected is 131072 PLS, the value found by dividing the second travel value to home position by 10 is stored.
   Note that in the case of a data set type zeroing operation, the data remains unchanged (the previous value stands).

(8) Travel value after proximity dog comes ON register
   (D10+20n, D11+20n) ....Data from the PCPU to the SCPU
   (a) When a zeroing operation is performed, the travel value from the point where the proximity dog comes ON to the point where the zeroing operation is completed is stored in this register (with no sign appended).

   (b) In speed/position switching control, the travel value during position control is stored in this register (with no sign appended).

(9) Executed program number register (D12+20n) .... Data from the PCPU to the SCPU
   (a) The program number of the program being executed is stored in this register when the SVST instruction is executed.

   (b) In JOG operation and manual pulse generator operation, the values indicated below are stored in this register.
      1) JOG operation..................................... FFFF
      2) Manual pulse generator operation .... FFFE
      3) When the power is turned on............... FF00

   (c) When either of the following is being executed by a peripheral device in the test mode, FFFD is stored in this register.
      1) A zeroing
      2) A position loop gain or position control gain 1 check in servo diagnosis.

(10) M-code register (D13+20n) ....Data from the PCPU to the SCPU
   (a) The M-code(Note) set for the executed servo program is stored in this register when positioning starts. If no M-code is set for the servo program, the value stored is "0".

   (b) If positioning is started by a means other than a servo program, the existing value does not change.

   (c) The stored value changes to "0" at the leading edge of the PLC READY signal (M2000).

REMARK

(Note): See the following sections for details on M-codes and reading M-codes.
- M-code ....Section 8.2
- M-code reading ....Appendix 4.1

(11) Torque limit value register (D14+20n).........Data from the PCPU to the SCPU
This register stores the value for the torque limit imposed on the servo system. The default value of 300% is stored in this register when the power to the servo system is turned on or at the leading edge of the PLC READY signal (M2000).

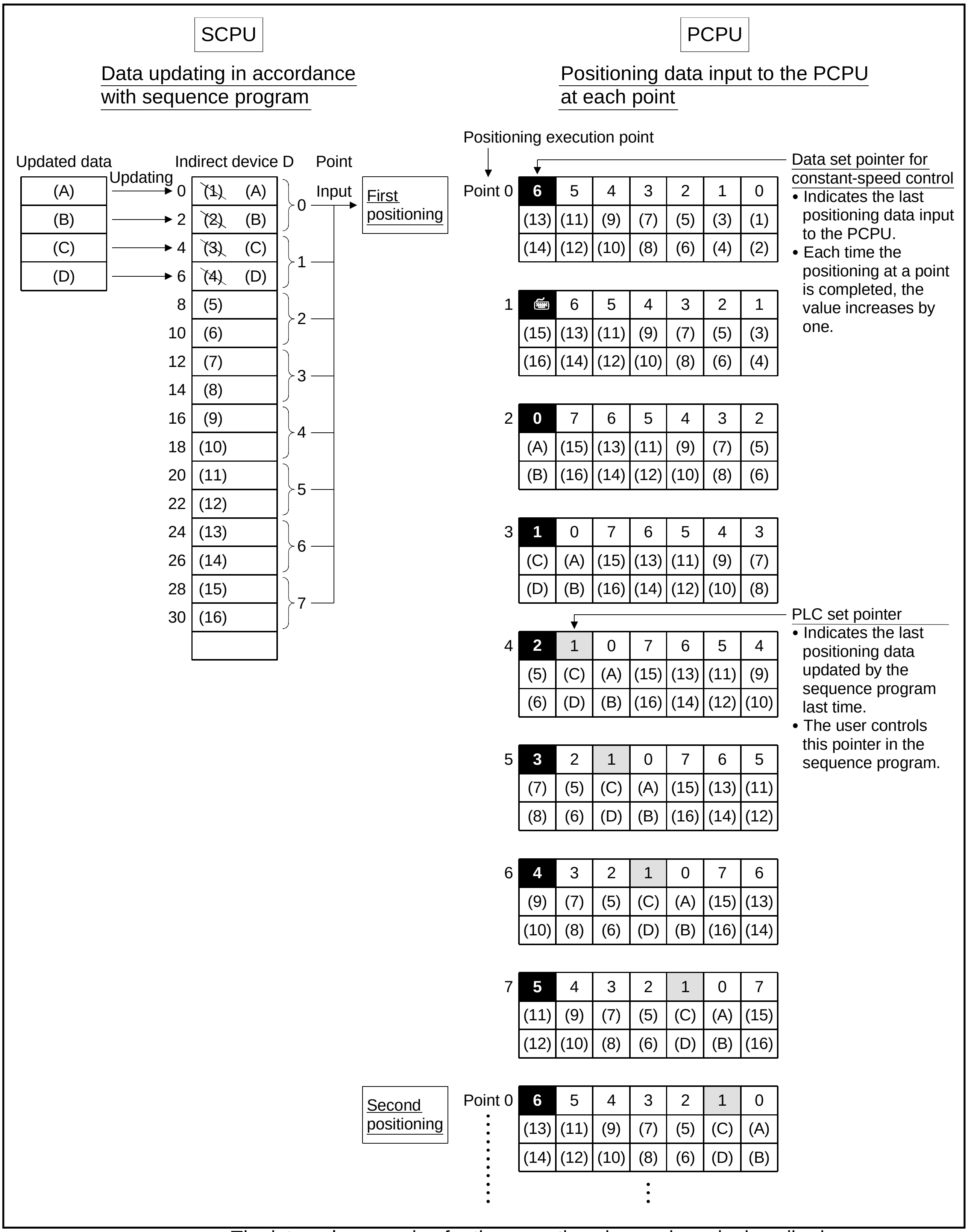
(12) Constant-speed control data set pointer (D15+20n)......... Data from the PCPU to the SCPU
This pointer is used in constant-speed control when specifying positioning data indirectly and substituting positioning data during operation.
It stores a "point" that indicates which of the values stored in indirect devices has been input to the PCPU when positioning is being repeated by using a repeat instruction (FOR-TIMES, FOR-ON, FOR-OFF).
Use this pointer in conjunction with the PLC set pointer (controlled by the user in the sequence program) - which indicates the extent to which the positioning data has been updated by the SCPU - to confirm which positioning data is to be updated.
The use of the data set pointer and PLC set pointer for constant-speed control is explained here using the example servo program below.

```
            <K    0>
Pass point
   9   CPSTART2
        Axis        1
        Axis        2
        Speed                D200
   *   FOR-TIMES
                             D202
   1   ABS-2                          ...0
        Axis        1,         D0
        Axis        2,         D2
   2   ABS-2                          ...1
        Axis        1,         D4
        Axis        2,         D6
   3   ABS-2                          ...2
        Axis        1,         D8
        Axis        2,        D10
   4   ABS-2                          ...3
        Axis        1,        D12
        Axis        2,        D14
   5   ABS-2                          ...4
        Axis        1,        D16
        Axis        2,        D18
   6   ABS-2                          ...5
        Axis        1,        D20
        Axis        2,        D22
   7   ABS-2                          ...6
        Axis        1,        D24
        Axis        2,        D26
   8   ABS-2                          ...7
        Axis        1,        D28
        Axis        2,        D30
   ▪   NEXT
   9   CPEND
```

Point
▪ Poins are set in the order
FOR-TIMES
FOR-ON
FOR-OFF
NEXT
0, 1, 2, etc., starting from the head of the sequence defined by the following repeat instructions :

The input of positioning data to the PCPU on updating the positioning data in indirect devices D0 to D6 when 2-axes constant-speed control is executed using the servo program shown above is described overpage.

[Input of positioning data to the PCPU]



The internal processing for the operation shown above is described overpage.

[Internal processing]

(a) On starting the operation, the positioning data of points 0 to 6 ((1) to (14)) is input to the PCPU.
At this time, the last point of the data to be input - which is point "6" - is stored in the data set pointer for constant-speed control.
The "6" stored in the data set pointer for constant-speed control indicates that updating of the positioning data stored in points 0 to 6 is possible.

(b) The positioning data of points 0 and 1 ((A) to (D)) is updated in accordance with the sequence program.
The last positioning data to be rewritten - which is the data of point "1" - is stored in the PLC set pointer (which must be controlled by the user in the sequence program). Updating of positioning data of points 2 to 6 (data (5) to (14)) remains possible.

(c) On completion of the positioning for point 0, the value in the data set pointer for constant-speed control is automatically incremented by one to "7".
At this time, the positioning data of point 0 ((1) to (2)) is discarded and the positioning data for point 7 ((15) to (16)) is input to the PCPU.

(d) Hereafter, each time the positioning for a point is completed, the positioning data shifts one place.
The positioning data that can be updated is the data after that indicated by the PLC set pointer: this is the data which has not yet been input to the PCPU.
Consequently, after completion of the positioning corresponding to point 3, even if the values stored in indirect devices D8 and D10 are updated by the sequence program, the point 2 positioning data that is input to the PCPU will not be updated and the second positioning will be executed using the unupdated data.
In other words, the data set pointer for constant-speed control is a pointer that indicates data that has not yet been input to the PCPU and can be updated by the sequence program.

POINT

Number of points that can be defined by a repeat instruction
- Create a subprogram to create at least eight points.
- If there are less than eight points and these include pass points with small travel values, the positioning at each point may be completed, and the data input to the PCPU, before the data has been updated by the sequence program.
- Create a sufficient number of points to ensure that data will not be input to the PCPU before the SCPU has updated the values in the indirect devices.

(13) Travel value change register (D16+20n, D17+20n) .... Data from the SCPU to the PCPU
This is the area used when the position control travel value is changed in speed/position switching control (see Section 7.14).

(14) Real current value when STOP is input register
(D18+20n, D19+20n) .... Data from the PCPU to the SCPU
This register stores the real current value when a STOP signal is input from an external source.

3.2.2 Control change registers

The control change data storage area stores JOG operation speed data.

Table 3.1 Control Change Data Storage Area List

Name	Axis 1	Axis 2	Axis 3	Axis 4	Axis 5	Axis 6	Axis 7	Axis 8
JOG speed setting register	D641, D640	D643, D642	D645, D644	D647, D646	D649, D648	D651, D650	D653, D652	D655, D654
	Axis 9	**Axis 10**	**Axis 11**	**Axis 12**	**Axis 13**	**Axis 14**	**Axis 15**	**Axis 16**
	D657, D656	D659, D658	D661, D660	D663, D662	D665, D664	D667, D666	D669, D668	D671, D670
	Axis 17	**Axis 18**	**Axis 19**	**Axis 20**	**Axis 21**	**Axis 22**	**Axis 23**	**Axis 24**
	D673, D672	D675, D674	D677, D676	D679, D678	D681, D680	D683, D682	D685, D684	D687, D686
	Axis 25	**Axis 26**	**Axis 27**	**Axis 28**	**Axis 29**	**Axis 30**	**Axis 31**	**Axis 32**
	D689, D688	D691, D690	D693, D692	D695, D694	D697, D696	D699, D698	D701, D700	D703, D702

POINT

- Since a current value change/speed change is made commandable by the CHGA/CHGV instruction, there are no current value change registers/speed change registers.

(1) JOG speed setting registers (D640+2n) ..... Data from SCPU to PCPU

(a) These registers store JOG speed for JOG operation.

(b) The JOG speed setting ranges are indicated below.

Unit / Item	mm		inch		degree		PULSE	
	Setting range	Unit	Setting range	Unit	Setting range	Unit	Setting range	Unit
JOG speed	1 to 600000000	$\times 10^{-2}$ mm/min	1 to 600000000	$\times 10^{-3}$ inch/min	1 to 2147483647	$\times 10^{-3}$ degree /min	1 to 10000000	PLS/s

(c) The JOG speed is the value stored in the JOG speed setting registers on the leading edge (OFF to ON) of the JOG start signal.
The JOG speed cannot be changed if data is changed during JOG operation.

(d) Refer to Section 7.19 for details of JOG operation.

3.2.3 Common devices

(1) JOG operation simultaneous start axis setting registers
(D710 to D713).. Data from SCPU to PCPU

(a) These registers are used to set the axis No. and directions of the axis whose JOG operation will be started simultaneously.

	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0	
D710	Axis 16	Axis 15	Axis 14	Axis 13	Axis 12	Axis 11	Axis 10	Axis 9	Axis 8	Axis 7	Axis 6	Axis 5	Axis 4	Axis 3	Axis 2	Axis 1	Forward rotation JOG
D711	Axis 32	Axis 31	Axis 30	Axis 29	Axis 28	Axis 27	Axis 26	Axis 25	Axis 24	Axis 23	Axis 22	Axis 21	Axis 20	Axis 19	Axis 18	Axis 17	
D712	Axis 16	Axis 15	Axis 14	Axis 13	Axis 12	Axis 11	Axis 10	Axis 9	Axis 8	Axis 7	Axis 6	Axis 5	Axis 4	Axis 3	Axis 2	Axis 1	Reverse rotation JOG
D713	Axis 32	Axis 31	Axis 30	Axis 29	Axis 28	Axis 27	Axis 26	Axis 25	Axis 24	Axis 23	Axis 22	Axis 21	Axis 20	Axis 19	Axis 18	Axis 17	

Make JOG operation simultaneous start axis setting with 1/0.
1 : Simultaneous start executed
0 : Simultaneous start not executed

(b) Refer to Section 7.19.3 for details of simultaneous JOG operation start.

(2) Manual pulse generator-controlled axis No. setting registers
(D714 to D719).. Data from SCPU to PCPU

(a) These registers store the axis No. which will be controlled by manual pulse generators.

		b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
P1	D714	Axis 16	Axis 15	Axis 14	Axis 13	Axis 12	Axis 11	Axis 10	Axis 9	Axis 8	Axis 7	Axis 6	Axis 5	Axis 4	Axis 3	Axis 2	Axis 1
	D715	Axis 32	Axis 31	Axis 30	Axis 29	Axis 28	Axis 27	Axis 26	Axis 25	Axis 24	Axis 23	Axis 22	Axis 21	Axis 20	Axis 19	Axis 18	Axis 17
P2	D716	Axis 16	Axis 15	Axis 14	Axis 13	Axis 12	Axis 11	Axis 10	Axis 9	Axis 8	Axis 7	Axis 6	Axis 5	Axis 4	Axis 3	Axis 2	Axis 1
	D717	Axis 32	Axis 31	Axis 30	Axis 29	Axis 28	Axis 27	Axis 26	Axis 25	Axis 24	Axis 23	Axis 22	Axis 21	Axis 20	Axis 19	Axis 18	Axis 17
P3	D718	Axis 16	Axis 15	Axis 14	Axis 13	Axis 12	Axis 11	Axis 10	Axis 9	Axis 8	Axis 7	Axis 6	Axis 5	Axis 4	Axis 3	Axis 2	Axis 1
	D719	Axis 32	Axis 31	Axis 30	Axis 29	Axis 28	Axis 27	Axis 26	Axis 25	Axis 24	Axis 23	Axis 22	Axis 21	Axis 20	Axis 19	Axis 18	Axis 17

Make manual pulse generator-controlled axis setting with 1/0.
1 : Specified axis
0 : Unspecified axis

(b) Refer to Section 7.20 for details of manual pulse generator operation.

(3) Manual pulse generator 1-pulse input magnification setting registers (D720 to D751).. Data from SCPU to PCPU

(a) This register is used to set the magnification (1 to 100) per pulse of the input pulse count from the manual pulse generator for manual pulse generator operation.

1-Pulse Input Magnification Setting Register	Corresponding Axis No.	Setting Range	1-Pulse Input Magnification Setting Register	Corresponding Axis No.	Setting Range
D720	Axis 1	1 to 100	D736	Axis 17	1 to 100
D721	Axis 2		D737	Axis 18	
D722	Axis 3		D738	Axis 19	
D723	Axis 4		D739	Axis 20	
D724	Axis 5		D740	Axis 21	
D725	Axis 6		D741	Axis 22	
D726	Axis 7		D742	Axis 23	
D727	Axis 8		D743	Axis 24	
D728	Axis 9		D744	Axis 25	
D729	Axis 10		D745	Axis 26	
D730	Axis 11		D746	Axis 27	
D731	Axis 12		D747	Axis 28	
D732	Axis 13		D748	Axis 29	
D733	Axis 14		D749	Axis 30	
D734	Axis 15		D750	Axis 31	
D735	Axis 16		D751	Axis 32	

(b) Refer to Section 7.20 for details of manual pulse generator operation.

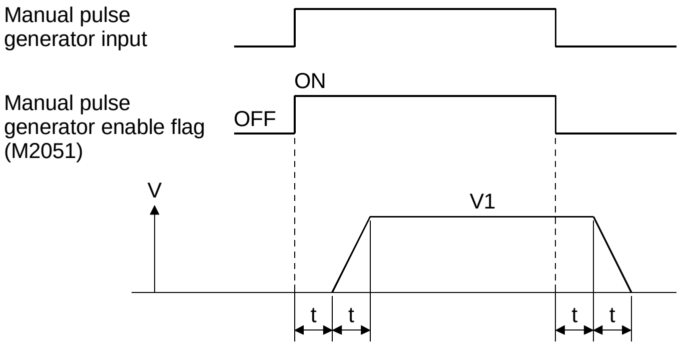
(4) Manual pulse generator smoothing magnification setting area
(D752 to D754) .... Data from SCPU to PCPU

(a) These devices are used to set the smoothing time constants of manual pulse generators.

Manual Pulse Generator Smoothing Magnification Setting Register	Setting Range
Manual pulse generator 1 (P1) : D752	0 to 59
Manual pulse generator 2 (P2) : D753	
Manual pulse generator 3 (P3) : D754	

(b) When the smoothing magnification is set, the smoothing time constant is as indicated by the following expression.
Smoothing time constant (t) = (smoothing magnification + 1) $\times$ 56.8 [ms]

(c) Operation



Output speed (V1) = (number of input pulses/ms) $\times$ (manual pulse generator 1-pulse input magnification setting)
Travel value (L) = (travel value per pulse) $\times$ number of input pulses $\times$ (manual pulse generator 1-pulse input magnification setting)

REMARKS

1) The travel value per pulse of the manual pulse generator is as indicated below.
   - Setting unit
     - mm : 0.1μm
     - inch : 0.00001inch
     - degree : 0.00001degree
     - PULSE : 1 PLS
2) The smoothing time constant is 56.8ms to 3408ms.

(5) Limit switch output disable setting registers
(D760 to D775)... Data from SCPU to PCPU

(a) These registers are used to disable the external outputs of the limit switch outputs on a point by point basis. Set the corresponding bit to 1 to disable the limit switch output and turn OFF the external output.

	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
D760	LY0F	LY0E	LY0D	LY0C	LY0B	LY0A	LY09	LY08	LY07	LY06	LY05	LY04	LY03	LY02	LY01	LY00
	For axis 2								For axis 1							
D761	LY1F	LY1E	LY1D	LY1C	LY1B	LY1A	LY19	LY18	LY17	LY16	LY15	LY14	LY13	LY12	LY11	LY10
	For axis 4								For axis 3							
D762	LY2F	LY2E	LY2D	LY2C	LY2B	LY2A	LY29	LY28	LY27	LY26	LY25	LY24	LY23	LY22	LY21	LY20
	For axis 6								For axis 5							
D763	LY3F	LY3E	LY3D	LY3C	LY3B	LY3A	LY39	LY38	LY37	LY36	LY35	LY34	LY33	LY32	LY31	LY30
	For axis 8								For axis 7							
D764	LY4F	LY4E	LY4D	LY4C	LY4B	LY4A	LY49	LY48	LY47	LY46	LY45	LY44	LY43	LY42	LY41	LY40
	For axis 10								For axis 9							
D765	LY5F	LY5E	LY5D	LY5C	LY5B	LY5A	LY59	LY58	LY57	LY56	LY55	LY54	LY53	LY52	LY51	LY50
	For axis 12								For axis 11							
D766	LY6F	LY6E	LY6D	LY6C	LY6B	LY6A	LY69	LY68	LY67	LY66	LY65	LY64	LY63	LY62	LY61	LY60
	For axis 14								For axis 13							
D767	LY7F	LY7E	LY7D	LY7C	LY7B	LY7A	LY79	LY78	LY77	LY76	LY75	LY74	LY73	LY72	LY71	LY70
	For axis 16								For axis 15							
D768	LY8F	LY8E	LY8D	LY8C	LY8B	LY8A	LY89	LY88	LY87	LY86	LY85	LY84	LY83	LY82	LY81	LY80
	For axis 18								For axis 17							
D769	LY9F	LY9E	LY9D	LY9C	LY9B	LY9A	LY99	LY98	LY97	LY96	LY95	LY94	LY93	LY92	LY91	LY90
	For axis 20								For axis 19							
D770	LYAF	LYAE	LYAD	LYAC	LYAB	LYAA	LYA9	LYA8	LYA7	LYA6	LYA5	LYA4	LYA3	LYA2	LYA1	LYA0
	For axis 22								For axis 21							
D771	LYBF	LYBE	LYBD	LYBC	LYBB	LYBA	LYB9	LYB8	LYB7	LYB6	LYB5	LYB4	LYB3	LYB2	LYB1	LYB0
	For axis 24								For axis 23							
D772	LYCF	LYCE	LYCD	LYCC	LYCB	LYCA	LYC9	LYC8	LYC7	LYC6	LYC5	LYC4	LYC3	LYC2	LYC1	LYC0
	For axis 26								For axis 25							
D773	LYDF	LYDE	LYDD	LYDC	LYDB	LYDA	LYD9	LYD8	LYD7	LYD6	LYD5	LYD4	LYD3	LYD2	LYD1	LYD0
	For axis 28								For axis 27							
D774	LYEF	LYEE	LYED	LYEC	LYEB	LYEA	LYE9	LYE8	LYE7	LYE6	LYE5	LYE4	LYE3	LYE2	LYE1	LYE0
	For axis 30								For axis 29							
D775	LYFF	LYFE	LYFD	LYFC	LYFB	LYFA	LYF9	LYF8	LYF7	LYF6	LYF5	LYF4	LYF3	LYF2	LYF1	LYF0
	For axis 32								For axis 31							

1) Specify 1 or 0 to set each bit.
   1: Disable ...... Limit switch output remains OFF.
   0: Enable ...... Limit switch output turns ON/OFF based on set data.
2) "LY" in LY00 to LYFF indicates limit switch output.

(6) Limit switch output status storage registers
(D776 to D791).. Data from PCPU to SCPU

(a) The output states (ON/OFF) of the limit switch outputs set on the peripheral device and output to the AY42 are stored in terms of 1 and 0.
- ON 1
- OFF...............0

(b) These registers can be used to export the limit switch output data in the sequence program, for example.

	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
D776	LY0F	LY0E	LY0D	LY0C	LY0B	LY0A	LY09	LY08	LY07	LY06	LY05	LY04	LY03	LY02	LY01	LY00
	For axis 2								For axis 1							
D777	LY1F	LY1E	LY1D	LY1C	LY1B	LY1A	LY19	LY18	LY17	LY16	LY15	LY14	LY13	LY12	LY11	LY10
	For axis 4								For axis 3							
D778	LY2F	LY2E	LY2D	LY2C	LY2B	LY2A	LY29	LY28	LY27	LY26	LY25	LY24	LY23	LY22	LY21	LY20
	For axis 6								For axis 5							
D779	LY3F	LY3E	LY3D	LY3C	LY3B	LY3A	LY39	LY38	LY37	LY36	LY35	LY34	LY33	LY32	LY31	LY30
	For axis 8								For axis 7							
D780	LY4F	LY4E	LY4D	LY4C	LY4B	LY4A	LY49	LY48	LY47	LY46	LY45	LY44	LY43	LY42	LY41	LY40
	For axis 10								For axis 9							
D781	LY5F	LY5E	LY5D	LY5C	LY5B	LY5A	LY59	LY58	LY57	LY56	LY55	LY54	LY53	LY52	LY51	LY50
	For axis 12								For axis 11							
D782	LY6F	LY6E	LY6D	LY6C	LY6B	LY6A	LY69	LY68	LY67	LY66	LY65	LY64	LY63	LY62	LY61	LY60
	For axis 14								For axis 13							
D783	LY7F	LY7E	LY7D	LY7C	LY7B	LY7A	LY79	LY78	LY77	LY76	LY75	LY74	LY73	LY72	LY71	LY70
	For axis 16								For axis 15							
D784	LY8F	LY8E	LY8D	LY8C	LY8B	LY8A	LY89	LY88	LY87	LY86	LY85	LY84	LY83	LY82	LY81	LY80
	For axis 18								For axis 17							
D785	LY9F	LY9E	LY9D	LY9C	LY9B	LY9A	LY99	LY98	LY97	LY96	LY95	LY94	LY93	LY92	LY91	LY90
	For axis 20								For axis 19							
D786	LYAF	LYAE	LYAD	LYAC	LYAB	LYAA	LYA9	LYA8	LYA7	LYA6	LYA5	LYA4	LYA3	LYA2	LYA1	LYA0
	For axis 22								For axis 21							
D787	LYBF	LYBE	LYBD	LYBC	LYBB	LYBA	LYB9	LYB8	LYB7	LYB6	LYB5	LYB4	LYB3	LYB2	LYB1	LYB0
	For axis 24								For axis 23							
D788	LYCF	LYCE	LYCD	LYCC	LYCB	LYCA	LYC9	LYC8	LYC7	LYC6	LYC5	LYC4	LYC3	LYC2	LYC1	LYC0
	For axis 26								For axis 25							
D789	LYDF	LYDE	LYDD	LYDC	LYDB	LYDA	LYD9	LYD8	LYD7	LYD6	LYD5	LYD4	LYD3	LYD2	LYD1	LYD0
	For axis 28								For axis 27							
D790	LYEF	LYEE	LYED	LYEC	LYEB	LYEA	LYE9	LYE8	LYE7	LYE6	LYE5	LYE4	LYE3	LYE2	LYE1	LYE0
	For axis 30								For axis 29							
D791	LYFF	LYFE	LYFD	LYFC	LYFB	LYFA	LYF9	LYF8	LYF7	LYF6	LYF5	LYF4	LYF3	LYF2	LYF1	LYF0
	For axis 32								For axis 31							

1 or 0 is stored into each bit of D776 to D791.
ON 1
OFF........0

REMARK

LY in LY□□ of D776 to D791 indicates limit switch output.

(7) Servo amplifier type (D792 to D799) .... Data from PCPU to SCPU
The servo amplifier types set in system settings are stored when the servo system CPU control power supply (A6□P) is switched on or reset.

	b15 to b12	b11 to b8	b7 to b4	b3 to b1
D792	Axis 4	Axis 3	Axis 2	Axis 1
D793	Axis 8	Axis 7	Axis 6	Axis 5
D794	Axis 12	Axis 11	Axis 10	Axis 9
D795	Axis 16	Axis 15	Axis 14	Axis 13
D796	Axis 20	Axis 19	Axis 18	Axis 17
D797	Axis 24	Axis 23	Axis 22	Axis 21
D798	Axis 28	Axis 27	Axis 26	Axis 25
D799	Axis 32	Axis 31	Axis 30	Axis 29

Servo amplifier type
- 0 ..... Unused axis
- 1 ..... ADU (CPU base)
- 2 ..... MR-□-B
- 3 ..... ADU (motion extension base)

3.3 Special Relays (SP.M)

The servo system CPU has 256 special relay points from M9000 to M9255.
Of there, the 7 points from M9073 to M9079 are used for positioning control, and their applications are indicated in Table 3.2.

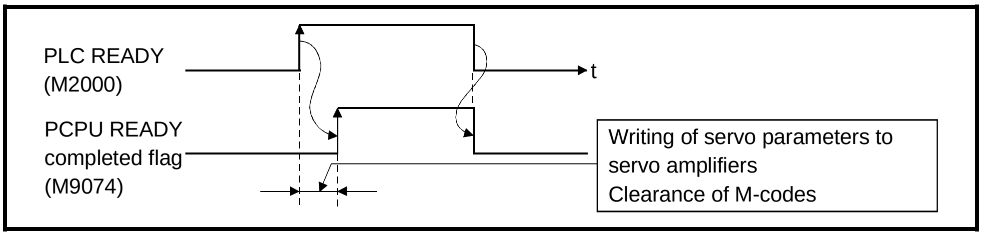
Table 3.2 Special Relays

Device No.	Signal Name	Signal Direction	Refresh Cycle	Fetch Cycle
M9073	PCPU WDT error flag	PCPU → SCPU	END	
M9074	PCPU REDAY-completed flag			
M9075	In-test-mode flag			
M9076	External emergency stop input flag			
M9077	Manual pulse generator axis setting error flag			
M9078	Test mode request error flag			
M9079	Servo program setting error flag			

(1) WDT error flag (M9073)..................................Signal sent from PCPU to SCPU
This flag comes ON when a "watchdog timer error" is detected by the PCPU's self-diagnosis function.
When the PCPU detects a WDT error, it executes an immediate stop without deceleration on the driven axis.
When the WDT error flag has come ON, reset the servo system CPU with the key switch.
If M9073 remains ON after resetting, there is a fault at the PCPU side.
The error cause is stored in the PCPU error cause storage area (D9184) (see Section 3.5.2).

(2) PCPU REDAY-completed flag (M9074)...........Signal sent from PCPU to SCPU
This flag is used to determine whether the PCPU is normal or abnormal from the sequence program.
(a) When the PLC READY flag (M2000) turns from OFF to ON, the fixed parameters, servo parameters, limit switch output data, etc., are checked, and if no error is detected the PCPU READY-completed flag comes ON.
The servo parameters are written to the servo amplifiers and the M-codes are cleared.

(b) When the PLC READY flag (M2000) goes off, the PCPU READY-completed flag also goes OFF



(3) In-test-mode(M9075) .... Signal from PCPU to SCPU
   (a) This flag is used to determine whether or not a test mode established from a peripheral device is currently effective. Use it, for example, for an interlock effective when starting a servo program with the SVST instruction in the sequence program.
      - ON ....When the test mode is not in effect
      - OFF ....When the test mode is in effect

   (b) If a test mode request is issued from a peripheral device but the test mode is not established, the test mode request error flag (M9078) comes ON.

(4) External emergency stop input flag (M9076) ....Signal from PCPU to SCPU
   This flag is used to check the ON or OFF status of external emergency stop signal input at the EMG terminal.
   - ON........External emergency stop input is ON
   - OFF......External emergency stop input is OFF

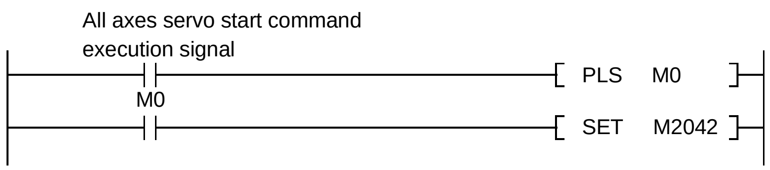
(5) Manual pulse generator axis setting error flag (M9077) .... Signal sent from PCPU to SCPU
   (a) This flag is used to determine whether the setting in the manual pulse generator axis setting register (D714 to D719) is normal or abnormal.
      - ON ....When D714 to D719 is normal
      - OFF ....When D714 to D719 is abnormal

   (b) When M9077 comes ON, the error contents are stored in the manual pulse generator axis setting error register (D9185 to D9187).

(6) Test mode request error flag (M9078) ....Signal sent from PCPU to SCPU
(a) This flag comes ON if the test mode is not established when a test mode request is sent from a peripheral device
(b) When M9078 comes ON, the error contents are stored in the test mode request error register (D9182, D9183).

POINTS

(1) When an emergency stop signal (EMG) is input during positioning, the feed current value is advanced within the rapid stop deceleration time set in the parameter block. At the same time, the servo OFF status is established because the all axes servo start command (M2042) goes OFF. When the rapid stop deceleration time has elapsed after input of the emergency stop signal, the feed current value returns to the value at the point when the emergency stop was initiated.
(2) If the emergency stop is reset before the emergency stop deceleration time has elapsed, a servo error occurs.
(3) If you do not want to establish the servo ON status immediately after an emergency stop has been reset, include the following section in the sequence program.



(7) Servo program setting error flag (M9079)............... Signal from PCPU to SCPU
This flag is used to determine whether the positioning data of the servo program designated by the SVST instruction is normal or abnormal.
- OFF...... Normal
- ON........ Abnormal

3.4 Special Register (SP.D)

A servo system CPU has 256 special register points from D9000 to D9255.
Of these, the 20 points from D9180 to D9199 are used for positioning control.
The special registers used for positioning are shown in the table below (for the applications of special registers other than D9180 to D9199, see Appendix 3.2.)

Table 3.3 Special Register List

<table>
<tr><th rowspan="6">Device Number</th><th colspan="3" rowspan="2">Signal Name</th><th colspan="3">Refresh Cycle</th><th colspan="3">Import Cycle</th><th rowspan="6">Signal Direction</th></tr>
<tr><th colspan="3">Number of set axes</th><th colspan="3">Number of set axes</th></tr>
<tr><th rowspan="4"></th><th rowspan="2">SV13</th><th>A173UHCPU</th><th>1 to 20</th><th>21 to 32</th><th>——</th><th>1 to 20</th><th>21 to 32</th><th>——</th></tr>
<tr><th>A273UHCPU</th><th>1 to 12</th><th>13 to 24</th><th>25 to 32</th><th>1 to 12</th><th>13 to 24</th><th>25 to 32</th></tr>
<tr><th rowspan="2">SV22</th><th>A173UHCPU</th><th>1 to 12</th><th>13 to 24</th><th>25 to 32</th><th>1 to 12</th><th>13 to 24</th><th>25 to 32</th></tr>
<tr><th>A273UHCPU</th><th>1 to 8</th><th>9 to 18</th><th>19 to 32</th><th>1 to 8</th><th>9 to 18</th><th>19 to 32</th></tr>
<tr><td>D9180</td><td colspan="3" rowspan="2">User usable</td><td colspan="3" rowspan="2">——</td><td colspan="3" rowspan="2">——</td><td rowspan="2">——</td></tr>
<tr><td>D9181</td></tr>
<tr><td>D9182</td><td colspan="3" rowspan="2">Test mode request error information</td><td colspan="3" rowspan="2">At test mode request</td><td colspan="3" rowspan="6"></td><td rowspan="6">SCPU←PCPU</td></tr>
<tr><td>D9183</td></tr>
<tr><td>D9184</td><td colspan="3">PCPU WDT error cause</td><td colspan="3">At PCPU WDT error occurrence</td></tr>
<tr><td>D9185</td><td colspan="3" rowspan="3">Manual pulse generator axis setting error information</td><td colspan="3" rowspan="3">On leading edge of manual pulse generator enable</td></tr>
<tr><td>D9186</td></tr>
<tr><td>D9187</td></tr>
<tr><td>D9188</td><td colspan="3">User usable</td><td colspan="3">——</td><td colspan="3">——</td><td>——</td></tr>
<tr><td>D9189</td><td colspan="3">Error program No.</td><td colspan="3" rowspan="2">At start</td><td colspan="3" rowspan="4"></td><td rowspan="4">SCPU←PCPU</td></tr>
<tr><td>D9190</td><td colspan="3">Error item information</td></tr>
<tr><td>D9191</td><td colspan="3" rowspan="2">Servo amplifier loading information</td><td colspan="3">At power-on and</td></tr>
<tr><td>D9192</td><td>10ms</td><td colspan="2">20ms</td></tr>
<tr><td>D9193</td><td colspan="3" rowspan="3">User usable</td><td colspan="3" rowspan="3">——</td><td colspan="3" rowspan="3">——</td><td rowspan="3">——</td></tr>
<tr><td>D9194</td></tr>
<tr><td>D9195</td></tr>
<tr><td>D9196</td><td colspan="3">Personal computer link communication error code</td><td>3.5ms</td><td>7.1ms</td><td>14.2ms</td><td colspan="3"></td><td>SCPU←PCPU</td></tr>
<tr><td>D9197</td><td colspan="3" rowspan="3">User usable</td><td colspan="3" rowspan="3">——</td><td colspan="3" rowspan="3">——</td><td rowspan="3">——</td></tr>
<tr><td>D9198</td></tr>
<tr><td>D9199</td></tr>
</table>

(1) Test mode request error information (D9182, D9183) .... Data from PCPU to SCPU
If there are starting axis at a test mode request from the peripheral device, a test mode request error occurs, the error flag (M9078) turns ON, and the starting/stopping data of the corresponding axis are stored.

	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
D9182	Axis16	Axis15	Axis14	Axis13	Axis12	Axis11	Axis10	Axis9	Axis8	Axis7	Axis6	Axis5	Axis4	Axis3	Axis2	Axis1
D9183	Axis32	Axis31	Axis30	Axis29	Axis28	Axis27	Axis26	Axis25	Axis24	Axis23	Axis22	Axis21	Axis20	Axis19	Axis18	Axis17

Stores the operating/stopped status of each axis
• 0: Stopped
• 1: Operating

(2) PCPU error cause(D9184) ....Data from the PCPU to the SCPU
This register is used to identify the nature of errors occurring in the PCPU part of the sequence program.

<table>
<tr><th>Error Code</th><th>Error Cause</th><th>Operation when Error Occurs</th><th>Action to Take</th></tr>
<tr><td>1</td><td>PCPU software fault 1</td><td rowspan="4">All axes stop immediately, after which operation cannot be started.</td><td rowspan="4">Reset with the reset key.</td></tr>
<tr><td>2</td><td>PCPU operation synchronization time over</td></tr>
<tr><td>3</td><td>PCPU software fault 2</td></tr>
<tr><td>30</td><td>PCPU/SCPU hard ware fault</td></tr>
<tr><td>100 to 107
110 to 117
120 to 127
130 to 137
140 to 147</td><td>AC servo motor drive module CPU fault
100
Indicates the slot No.(0 to 7) where the AC motor drive module with the fault is loaded.
Indicates the stage No. of the base on which the AC motor drive module with the fault is loaded.
0: CPU base
1: Extension base 1st stage
2: Extension base 2nd stage
3: Extension base 3rd stage
4: Extension base 4th stage</td><td>The servo error detection flag (M2408+20n) of the corresponding axis turns ON, resulting in a servo-off status.
After that, operation is performed in accordance with "ADU servo error-time processing setting" in system settings.</td><td>Perform reset with the key.
If the error occurs after reset, change the ADU module since it may be faulty.</td></tr>
<tr><td>200 to 207
210 to 217
220 to 227
230 to 237
240 to 247</td><td>Hardware fault of module loaded on motion CPU base unit or extension base unit.
200
Indicates the slot No.(0 to 7) where the module with the fault is loaded.
Indicates the stage No. of the base on which the module with the fault is loaded.
0: CPU base
1: Extension base 1st stage
2: Extension base 2nd stage
3: Extension base 3rd stage
4: Extension base 4th stage</td><td rowspan="4">All axes stop immediately, after which operation cannot be started.</td><td rowspan="2">Reset with the reset key.
If the error reoccurs after resetting, the relevant module or the relevant slot(base unit) is probably faulty: replace the module/base unit.</td></tr>
<tr><td>250 to 253</td><td>Separate servo amplifier (MR-□-B) interface hardware fault
250
Faulty SSCNET No.
0: SSCNET 1
1: SSCNET 2
2: SSCNET 3
3: SSCNET 4</td></tr>
<tr><td>300</td><td>PCPU software fault 3</td><td>Reset with the reset key.</td></tr>
<tr><td>301</td><td>8 or more points of CPSTART instruction were used to start programs in excess of simultaneously startable programs.<table><tr><th></th><th>Number of simultaneously startable programs</th></tr><tr><td>Conventional function version</td><td>20</td></tr><tr><td>Function added version</td><td>14</td></tr></table></td><td>Perform reset with the key.
Use 8 or more points of CPSTART instruction to start programs within the number of simultaneously startable programs.</td></tr>
</table>

(3) Manual pulse generator axis setting error information (D9185 to D9187).. Data from PCPU to SCPU
If an error is found by the set data check made on the leading edge of the manual pulse generator enable signal, the following error information is stored into D9185 to D9187 and the manual pulse generator axis setting error flag (M9077) turns ON.

	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
D9185	0	0	0	0	0	0	0	0	0	0	P3	P2	P1	P3	P2	P1

b2 to b0: Store the axis setting errors of the manual pulse generators connected to P1 to P3 of A273EX.
- 0: Normal
- 1: Setting error

(Axis setting in each digit is other than 1 to 32)

b5 to b3: Store the smoothing magnification setting errors of the manual pulse generators connected to P1 to P3 of A273EX.
- 0: Normal
- 1: Setting error

(Axis setting in each digit is other than 0 to 59)

b15 to b6: All turn to 0.

D9186	Axis16	Axis15	Axis14	Axis13	Axis12	Axis11	Axis10	Axis9	Axis8	Axis7	Axis6	Axis5	Axis4	Axis3	Axis2	Axis1
D9187	Axis32	Axis31	Axis30	Axis29	Axis28	Axis27	Axis26	Axis25	Axis24	Axis23	Axis22	Axis21	Axis20	Axis19	Axis18	Axis17

Store the 1-pulse input magnification setting errors of the axes.
- 0: Stopping
- 1: Operating

(Input magnification of each axis is other than 1 to 100)

(4) Error program No. (D9189) ....Data from the PCPU to the SCPU
(a) When an error occurs at servo program operation (SVST instruction), stores the number of the subprogram (range: 0 to 4095) affected by the error when the subprogram setting error flag (M9079) comes ON.

(b) If, once an error program number has been stored, an error occurs in another servo program, the program number of the subprogram with the new error is stored.

(5) Error item information (D9190) ....Data from the PCPU to the SCPU
The servo program setting error flag (M9079) comes ON and the error code that corresponds to the error is stored in this device.
For details of servo program setting errors, see Appendix 2-1.

(6) Servo amplifier loading information
(D9191 to D9192)...Data from PCPU to SCPU
When the servo system CPU control power supply (A6□P) is switched on or reset, the servo amplifier and option slot loading states are checked and its results are stored.
The axis which turned from non-loading to loading status after power-on is handled as loaded. However, the axis which turned from loading to non-loading status remains as loaded.

	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
D9191	Axis16	Axis15	Axis14	Axis13	Axis12	Axis11	Axis10	Axis9	Axis8	Axis7	Axis6	Axis5	Axis4	Axis3	Axis2	Axis1
D9192	Axis32	Axis31	Axis30	Axis29	Axis28	Axis27	Axis26	Axis25	Axis24	Axis23	Axis22	Axis21	Axis20	Axis19	Axis18	Axis17

→ Servo amplifier loading status
- Loaded••••••• 1
- Non-loaded••• 0

(a) Servo amplifier installation status
1) Installed/not installed status
- "installed" status............... The MR-□-B is normal
(i.e. communication with the servo amplifier is normal)
- "not installed" status......... No servo amplifier is installed.
The servo amplifier power is OFF.
Normal communication with the servo amplifier is not possible due, for example, to a connecting cable fault.

2) The system settings and servo amplifier installation statuses are indicated below.

System Settings	ADU		MR-□-B	
	Loaded	Not loaded	Loaded	Not loaded
Used (axis No. setting)	1 is stored	Major error	1 is stored	0 is stored
Unused	0 is stored	0 is stored	0 is stored	0 is stored

(7) PC link communication error code (D9196)
When an error occurs during PC link communication, the error code that corresponds to the error is stored in this device.

PC Communication Error Code Storage Register	**Contents**
D9196	00: No error 01: Receiving timing error 02: CRC error 03: Communication response code error 04: Receiving flame error 05: Communication task start error (Each error code is reset to 00 when normal communication is restarted.)

For details of PC link communication errors, see Appendix 2.5.

4. PARAMETERS FOR POSITIONING CONTROL

4.1 System Settings

(1) System settings such as base unit selection, unit allocation, axis number setting in programs, servo motor setting (model name), and servo amplifier setting (model name) are made according to the actual system.
(No settings are required when the unit is used as a PLC extension base.)

(2) Data settings and modifications can be made interactively for some peripheral devices.

(3) When you set the "MR-J2S series" or "MR-H large-capacity series" for the servo amplifier, set the "automatic motor series" and automatic for the servo motor.

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 4.1.

Table 4.1 Fixed Parameters

No.	Item	Setting Range (mm) Setting Range	Units	(inch) Setting Range	Units	(degree) Setting Range	Units	(PULSE) Setting Range	Units	Default Initial Value	Default Units	Remarks	Explanatory Section
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 (A_P)	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 (A_L)	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.	4.2.1
4	Travel value per pulse (A): Unit magnification (A_M)	1: ×1, 10: ×10, 100: ×100, 1000: ×1000						—	—	—	—	• Set to change the magnification for the travel value per pulse.	4.2.1
5	Backlash compensation amount (Note)	0 to 6553.5	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) × AP/AL・AM ≤ 65535	8.3
6	Upper stroke limit (Note)	−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) × AP/AL・AM ≤ 2147483647	4.2.2
7	Lower stroke limit (Note)	−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) × AP/AL・AM ≤ 2147483647	4.2.2
8	Command in-position range (Note)	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) − (current value)]. The expression below shows the setting range. 1 ≤ (command in-position range) × 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

(Note) :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).

$$\Delta 1 = \frac{\Delta S}{Pf}$$

(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.

(For unit setting [mm])

Δl found in (a) [mm]	Smallest Command Unit [mm]	Unit Magnification (A_M)
0.00001 < Δl ≤ 0.0001	0.0001	1
0.0001 < Δl ≤ 0.001	0.001	10
0.001 < Δl ≤ 0.01	0.01	100
0.01 < Δl ≤ 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 8192 [PLS/rev]:

$$\Delta 1 = \frac{10[mm]}{8192[PLS/rev]} = 0.00122 \rightarrow 0.001 < 0.00122 \leq 0.01$$

This means that the smallest command unit is 0.01 [mm] and the unit magnification (A_M) is 100.
Therefore, 0.01 [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.

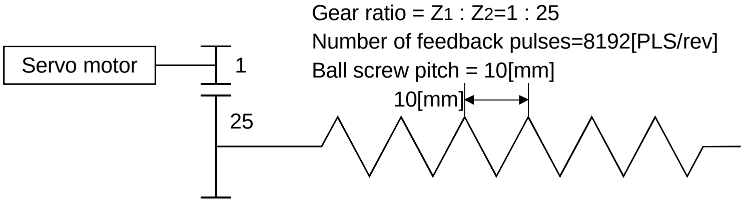
[Example] Assume that the travel value per revolution is 10 [mm] and the unit magnification is 100:

$$A_L = \frac{10000.0[\mu m]}{100} = 100.0[\mu m]$$

Accordingly, 100.0 [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

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

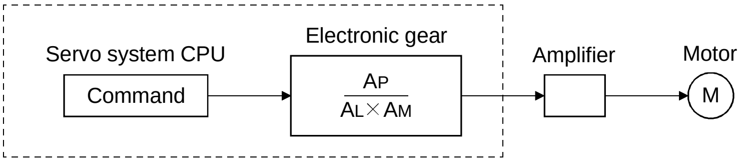
$$\Delta l=\frac{\Delta S}{Pf}=\frac{10[mm]}{25\times8192}=0.000049[mm] .... \rightarrow \Delta l=0.0001[mm]$$

2) Unit magnification (A_M)
   Since Δl is 0.0001[mm], the unit magnification (A_M) is "1".
3) Travel distance per revolution (A_L)

$$A_L=\frac{10[mm]\times1}{25}=0.4[mm]=400.0[\mu m]$$

4) Number of pulses per revolution (A_P)
   A_P = 8192 [PLS/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 $A_L \times A_M$ as the denominator.



The electronic gear is represented by the following relational expression.

$$\text{Electronic gear} = \frac{\text{Number of feedback pulses (Pf)}}{\text{Travel value per revolution } (\Delta S)}$$

$$= \frac{\text{Number of pulses per revolution } (A_P)}{\text{Travel value per motor revolution } (A_L) \times \text{unit magnification } (A_M)}$$

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

$$\begin{cases}\text{Gear ratio}=Z_1 : Z_2=1 : 39\\ \text{Ball screw pitch}=25.4[mm]=25.4\times1000 = 25400.0[\mu m]\end{cases}$$

$$A_L=\frac{25.4[mm]}{29}=0.65128205[mm]$$
$$=651.28205[\mu m]$$

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

Elecronic gear

$$=\frac{Pf}{\Delta S}\times\frac{8192[PLS]}{25.4[mm]\times1000\times\frac{1}{39}}=\frac{319488}{25400.0[\mu m]}\begin{matrix}\cdots\cdot A_P\\ \cdots\cdot A_L\times A_M\end{matrix}$$

Here, since the setting range of A_P is 1 to 65535 [PLS] and that of A_L is 0.1 to 6553.5 [µm], reduce them to within their setting ranges.

$$\frac{A_P}{A_L\times A_M}=\frac{19968}{1587.5}$$

Thus,

$$\begin{cases}A_P=19968[PLS]\\ A_L(\text{Note})=1587.5[\mu m] \text{ .... and set the following values}\\ A_M=1\end{cases}$$

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.

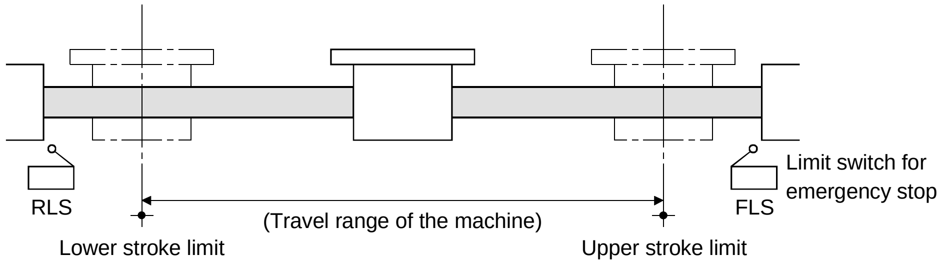


Fig. 4.1 Travel Range When Setting the Upper Stroke Limit Value and Lower Stroke Limit Value

(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 current 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 current 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 current value goes outside the stroke limit range, motion stops. Travel in the direction that returns the axis 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 current 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 current value goes outside the stroke limit range, motion stops.

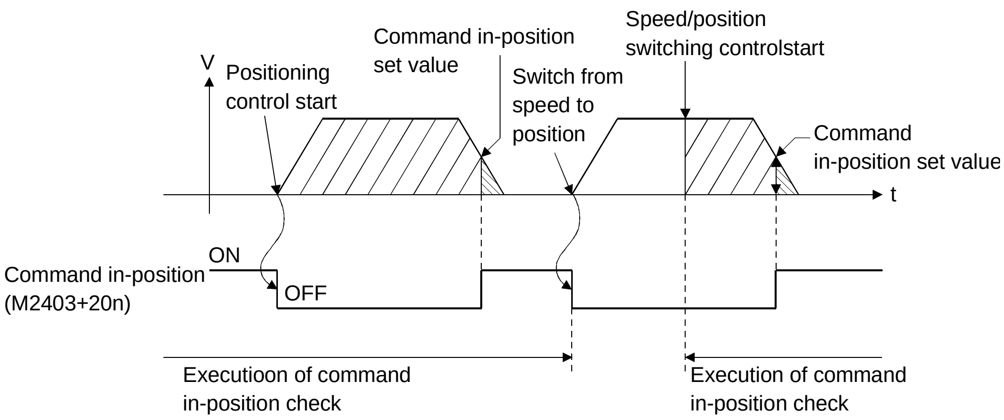
POINTS

(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 current value.
Once the value for the command in-position has been set, the command in-position signal (M2403 + 20n) will come ON when the difference between the command position and the feed current value enters the set range [(command position – feed current 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 Servo parameters of ADU (only when A273UHCPU is used)

Tables 4.2 and 4.3 indicate the servo parameters to be set.
(1) Basic parameters

Table 4.2 Servo Parameter (Basic Parameter) List

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				
(Note) 1	Amplifier setting												—
(Note) 2	Regenerative resistor	Not displayed on the screen.											—
(Note) 3	External dynamic brake	Not displayed on the screen.											—
(Note) 4	Motor type	Set automatically in accordance with the system settings.											—
(Note) 5	Motor capacity	Set automatically in accordance with the system settings.											—
6	Motor rpm (R)	Set automatically in accordance with the system settings.											—
7	Number of feedback pulses (N)	Set automatically in accordance with the system settings.											—
8 (Note)	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 responsive-ness	1 to 12								1	—	• Set in order to increase servo responsiveness.	4.3.10

(Note-1) : If you have changed the setting of any of the items marked "Note" in the above table, reset the servo system CPU with the key switch or turn PLC ready (M2000) off, then on, and switch on servo power.

(2) Adjustment parameters

Table 4.3 Servo Parameter (Adjustment Parameter) List

<table>
<tr><th rowspan="3">No.</th><th rowspan="3">Item</th><th colspan="8">Setting Range</th><th colspan="2">Default</th><th rowspan="3">Remarks</th><th rowspan="3">Expla-natory Section</th></tr>
<tr><th colspan="2">mm</th><th colspan="2">inch</th><th colspan="2">degree</th><th colspan="2">PULSE</th><th rowspan="2">Initial Value</th><th rowspan="2">Units</th></tr>
<tr><th>Setting Range</th><th>Units</th><th>Setting Range</th><th>Units</th><th>Setting Range</th><th>Units</th><th>Setting Range</th><th>Units</th></tr>
<tr><td>1</td><td>Load inertia ratio</td><td colspan="8">0.1 to 20.0</td><td>3.0</td><td>—</td><td>• Set the ratio of load inertia moment to motor inertia moment.</td><td>4.3.8</td></tr>
<tr><td>2</td><td>Position control gain 1</td><td colspan="8">Valid range 5 to 500 rad/s Setting range 1 to 9999 rad/s</td><td>70</td><td>rad/s</td><td>• Make setting to increase trackability for the position command.</td><td>4.3.3</td></tr>
<tr><td>3</td><td>Speed control gain 1</td><td colspan="8">Valid range 20 to 5000 rad/s Setting range 1 to 9999 rad/s</td><td>1200</td><td>rad/s</td><td>• Make setting to increase trackability for the speed command.</td><td>4.3.4</td></tr>
<tr><td>4</td><td>Position control gain 2</td><td colspan="8">Valid range 5 to 100 rad/s Setting range 1 to 9999 rad/s</td><td>25</td><td>rad/s</td><td>• Make setting to increase position response for load disturbance.</td><td>4.3.3</td></tr>
<tr><td>5</td><td>Speed control gain 2</td><td colspan="8">Valid range 20 to 8000 rad/s Setting range 1 to 9999 rad/s</td><td>600</td><td>rad/s</td><td>• Make setting when vibration occurs on machinery having large backlash.</td><td>4.3.4</td></tr>
<tr><td>6</td><td>Speed integral compensation</td><td colspan="8">Valid range 2 to 240 rms Setting range 2 to 240 rad/s</td><td>20</td><td>ms</td><td>• Set the time constant of integral compensation.</td><td>4.3.5</td></tr>
<tr><td>7</td><td>Notch filter</td><td colspan="8">—</td><td>—</td><td>—</td><td>• Cannot be set.</td><td>—</td></tr>
<tr><td>8</td><td>Feed forward gain</td><td colspan="8">0 to 150%
0: Feed forward control is not executed.</td><td>0</td><td>%</td><td>• Set the feed forward coefficient for position control.</td><td>4.3.7</td></tr>
<tr><td rowspan="2">9</td><td>In-position range(SV13) (Note)</td><td>0.1 to 214748364.7</td><td>μm</td><td>0.00001 to 21474.83647</td><td>inch</td><td>0.00001 to 359.99999</td><td>degree</td><td>1 to 2147483647</td><td>PLS</td><td rowspan="2">100</td><td rowspan="2">PLS</td><td rowspan="2">• Set the droop pulse value of the deviation counter.
•The in-position signal turns ON when droop pulses are within the setting range.</td><td rowspan="2">4.3.6</td></tr>
<tr><td>In-position range(SV22) (Note)</td><td>0.1 to 3276.7</td><td>μm</td><td>0.00001 to 0.32767</td><td>inch</td><td>0.00001 to 0.32767</td><td>degree</td><td>1 to 32767</td><td>PLS</td></tr>
<tr><td>10</td><td>Electromagnetic brake sequence</td><td colspan="8">—</td><td>—</td><td>—</td><td>• Cannot be set.</td><td>4.3.12</td></tr>
</table>

(Note) : The setting range indication varies with the electronic gear value.

4.3.2 MR-□-B servo parameters

The servo parameters to be set are indicated in Tables 4.4 through 4.6.

(1) Basic parameters
For the servo parameters of the MR-J2S-B, refer to the "SSCNET-Compatible MR-J2S-□B Servo Amplifier Instruction Manual (SH-030001).

Table 4.4 Servo Parameters (Basic Parameters)

No.	Item	Setting Range: mm Setting Range	mm Units	inch Setting Range	inch Units	degree Setting Range	degree Units	PULSE Setting Range	PULSE Units	Default: Initial Value	Default: Units	Remarks	Explanatory Section
(Note) 1	Amplifier setting	Set automatically in accordance with the system settings.											—
(Note) 2	Regenerative resistor												
(Note) 3	External dynamic brake												
(Note) 4	Motor type												
(Note) 5	Motor capacity												
6	Number of motor revolution (R)												
7	Number of feedback pulses (N)												APP. 5
8	Rotating direction	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	—	• Set the gain (speed/position, speed) for executing automatic setting.	4.3.9
10	Servo responsive-ness	1 to 12								1	—	• Set in order to increase servo responsiveness.	4.3.10

(Note-1) : After changing any of the items marked "Note" in the table above, turn the servo power supply on after resetting the servo system CPU with the key switch or turning the PLC READY signal (M2000) ON.

(2) Adjustment parameters

Table 4.5 Servo Parameter List (Adjustment Parameters)

No.	Item	Setting Range: mm Setting Range	Units	inch Setting Range	Units	degree Setting Range	Units	PULSE Setting Range	Units	Default Initial Value	Units	Remarks	Expla-natory Section
1	Load inertia ratio	0.0 to 100.0								3.0 (Note-1)	—	• 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/s Setting range 1 to 9999 rad/s								70	rad/s	• 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/s Setting range 1 to 9999 rad/s								1200	rad/s	• 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/s Setting range 1 to 9999 rad/s								25	rad/s	• 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/s Setting range 1 to 9999 rad/s								600	rad/s	• 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/s								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	In-position range (Note-2)	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) × AP/AL・AM ≤ 32767	4.3.6
10	Electromag-netic 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-BN) 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				(MR-J2S-B/MR-J2-B) 0: Speed (±) 1: Torque (±) 2: Speed (+) 3: Torque (+) 4: Current command output 5: Command FΔT 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	Monitor output mode (monitor 2)									1	—		

(Note-1) : For MR-J2S-B/MR-J2-B, the default is "7.0".

(Note-2) : The display of the possible setting range differs according to the electronic gear value.

Table 4.5 Servo Parameter List (Adjustment Parameters) (Continued)

No.	Item	Setting Range								Default		Remarks	Expla-natory Section
		mm		inch		degree		PULSE		Initial Value	Units		
		Setting Range	Units	Setting Range	Units	Setting Range	Units	Setting Range	Units				
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	Optional function 1 (Encoder type)	0: 2-wire type 1: 4-wire type								0	—	• Set the type of encoder cable.	4.3.14
15	Optional function 1 (external emergency stop signal) (Note-3)	0: Used 1: Not used								1	—	• To invalidate the external emergency stop signal (EMG) set "not used".	4.3.14
16	Optional function 2 (selection of no-motor operation) (Note-4)	0: Invalid 1: Valid								0	—	• To check the status without connecting a motor, set "valid".	4.3.15
17	Optional function 2 (electro-magnetic brake interlock output timing) (Note-4)	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).								0	—	• Set the interlock timing for the electromagnetic brake interlock signal.	4.3.15
18	Optional function 2 (selection of microvibration suppression function) (Note-3)	0: Valid 1: Invalid								0	—	• Set "valid" to suppress vibration on stopping.	4.3.15
19	Optional function 2 (motor lock operation) (Note-3)	0: Valid 1: Invalid								0	—	• To carry out test operation without rotating the motor, set "valid".	4.3.15

(Note-3) : Cannot be set with MR-H-BN
(Note-4) : Cannot be set with MR-J2S-B/MR-J2-B

(3) Expansion parameters

Table 4.6 Servo Parameters (Expansion Parameters)

<table>
<tr><th rowspan="3">No.</th><th rowspan="3">Item</th><th colspan="8">Setting Range</th><th colspan="2">Default</th><th rowspan="3">Remarks</th><th rowspan="3">Expla-natory Section</th></tr>
<tr><th colspan="2">mm</th><th colspan="2">inch</th><th colspan="2">degree</th><th colspan="2">PULSE</th><th rowspan="2">Initial Value</th><th rowspan="2">Units</th></tr>
<tr><th>Setting Range</th><th>Units</th><th>Setting Range</th><th>Units</th><th>Setting Range</th><th>Units</th><th>Setting Range</th><th>Units</th></tr>
<tr><td>1</td><td>Motion output 1 offset</td><td colspan="4">(MR-H-BN)
–9999 to 9999 mv</td><td colspan="4">(MR-J2S-B/MR-J2-B)
–999 to 999 mv</td><td>0</td><td>mv</td><td>• Set the offset value for motion output 1.</td><td rowspan="2">4.3.16</td></tr>
<tr><td>2</td><td>Motion output 2 offset)</td><td colspan="4">(MR-H-BN)
–9999 to 9999 mv</td><td colspan="4">(MR-J2S-B/MR-J2-B)
–999 to 999 mv</td><td>0
(Note-2)</td><td>mv</td><td>• Set the offset value for motion output 2.</td></tr>
<tr><td>3</td><td>Pre-alarm data selection (sampling time selection)</td><td colspan="8">0: 1.77
1: 3.55
2: 7.11
3: 14.2
4: 28.4</td><td>0</td><td>ms</td><td rowspan="3">• Set the analog data output when an alarm occurs.</td><td rowspan="3">4.3.17</td></tr>
<tr><td>4</td><td>Pre-alarm data selection (data selection 1)</td><td colspan="8" rowspan="2">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</td><td>0</td><td>—</td></tr>
<tr><td>5</td><td>Pre-alarm data selection (data selection 2)</td><td>1</td><td>—</td></tr>
<tr><td>6</td><td>Zero speed</td><td colspan="8">0 to 10000 r/min</td><td>10000</td><td>r/min</td><td>• Set the speed at which the motor speed is judged to be "0".</td><td>4.3.18</td></tr>
<tr><td>7</td><td>Excessive error alarm level</td><td colspan="8">1 to 1000kPLS</td><td>80</td><td>kPLS</td><td>• Set the value at which an excessive droop pulses alarm is output.</td><td>4.3.19</td></tr>
<tr><td>8</td><td>Close encoder rotation direction</td><td colspan="12" rowspan="2">Unusable</td></tr>
<tr><td>9</td><td>Zeroing reference encoder</td></tr>
<tr><td>10</td><td>Optional function 5 (PI-PID control switching)</td><td colspan="8">0: Invalid
1: Switching in accordance with droop during position control valid
2: Speed amplifier proportional control valid</td><td>0</td><td>—</td><td>• Set the conditions for PI-PID control switching.</td><td rowspan="2">4.3.20</td></tr>
<tr><td>11</td><td>Optional function 5 (Servo readout characters)</td><td colspan="8">0: Japanese
1: English</td><td>0</td><td>—</td><td>• Set the display format for the parameter unit.</td></tr>
<tr><td>12</td><td>PI-PID switching position droop</td><td colspan="8">0 to 50000 PLS</td><td>0</td><td>PLS</td><td>• Set the amount of position droop at the switch to PI-PID control when position control is executed.</td><td>4.3.21</td></tr>
<tr><td>13</td><td>Torque control compensation factor(Note-1)</td><td colspan="8">–19 to 9979</td><td>0</td><td>—</td><td>• Set to expand the torque control range up to the speed limit value in torque control.</td><td>4.3.22</td></tr>
<tr><td>14</td><td>Speed differential compensation</td><td colspan="8">0 to 1000</td><td>980</td><td>—</td><td>• Set the differential compensation value for the actual speed loop.</td><td>4.3.23</td></tr>
</table>

(Note-1) : Cannot be set when using MR-J2S-B/MR-J2-B.

(Note-2) : For MR-J2S-B/MR-J2-B, the default is "1".

Table 4.6 Servo Parameters (Expansion Parameters) (Continued)

No.	Item	Setting Range								Default		Remarks	Expla-natory 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	Unusable											
16	Number of gear teeth at machine side												
17	Number of closed encoder pulses												

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 PLC ready signal (M2000).

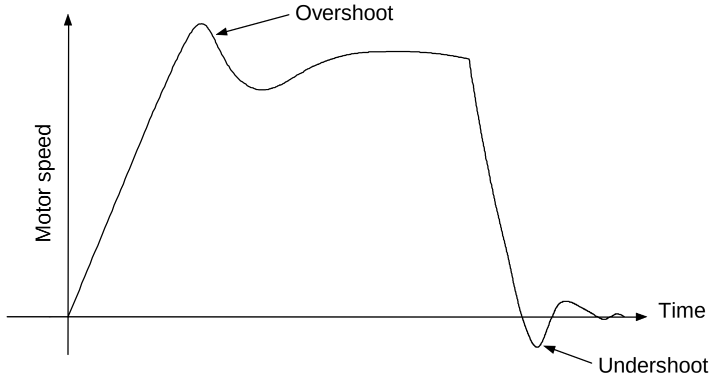
Servo Error Code	Error Contents	Processing
2613	Initial parameter error (position control gain 1)	Correct the setting for the relevant parameter so that it is within the "valid range", turn M2000 from OFF to ON, or reset with the reset key.
2614	Initial parameter error (speed control gain 1)	
2615	Initial 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) 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 4.7 below.

Table 4.7 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 4.8 below.

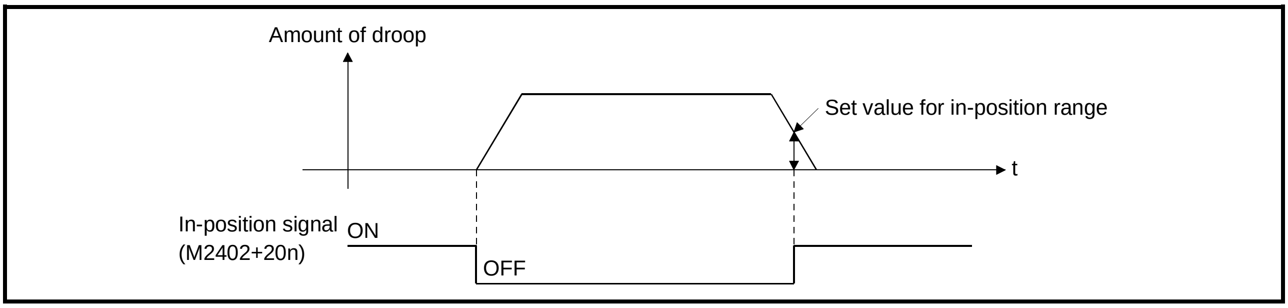
Table 4.8 Guide to Speed Integral Compensation Setting

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 (M2402 + 20n) 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 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.

4.3.10 Servo responsiveness setting

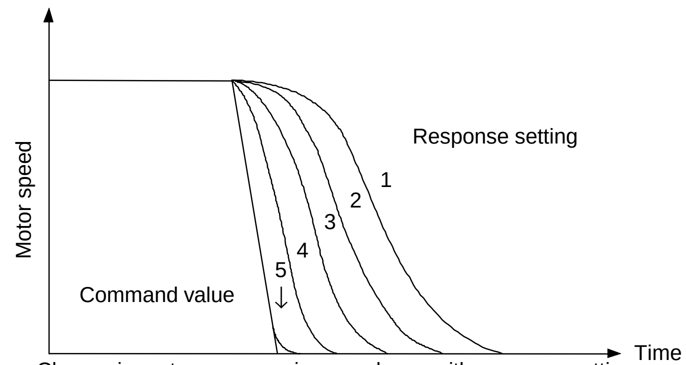
(1) This parameter setting is used to increase servo responsiveness.
Changing the set value to a higher value in the sequence 1, 2..., 5 improves servo responsiveness.
For machines with high friction, use the set values in the range 8 through C.

Response settings

Response settings	Machine	Mode
1: Low-speed response 2: 3: 4: 5: High-speed response	Normal machine (MR-☐-B usable)	Standard mode
8: Low-speed response 9: A: B: C: High-speed response	Machines with high friction (only MR-H-BN usable)	High frictional load mode

(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 more.

(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.

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.
Number of monitored item : 2 types

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
Set the type of encoder cable used.

0			0

Carrier frequency selection
0: 2.25kHz (non low-noise)
3: 9kHz (low-noise)

Encoder type
0: 2-wire type
1: 4-wire type

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-J2S-B/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-BN 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 sequencer CPU without connecting a motor.

(2) Electromagnetic brake interlock output timing (applies only when using MR-H-BN)
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-J2S-B/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-J2S-B/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-H-BN.
0: Motor lock operation is invalidated
1: Motor lock operation is valid
When motor lock operation is made valid, operation is possible without connecting the motor. However, since when MR-J2S-B/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.

(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.

0			

Data selection 2
Data selection 1
0:Speed (±)
1: Torque (±)
2: Speed (+)
3: Torque (+)
4: Current command output
5: Command F∆T
6: Droop pulse 1/1
7: Droop pulse 1/4
8: Droop pulse 1/16
9: Droop pulse 1/32

Sampling time selection
0: 1.77[ms]
1: 3.55[ms]
2: 7.11[ms]
3: 14.2[ms]
4: 28.4[ms]

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
This parameter sets the condition under which switching from PI to PID control, or from PID control to PI control, is valid.

(3) Servo readout characters
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.
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-BN.)
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 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 4.9.

Table 4.9 Parameter Block Settings

No.	Item	Setting Range								Default		Remarks	Expla-natory Section
		mm		inch		degree		PULSE					
		Setting Range	Units	Setting Range	Units	Setting Range	Units	Setting Range	Units	Initial Value	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 2147483.647	degree/min	1 to 1000000	PLS/s	200000	PLS/s	• Set the maximum speed for positioning/zeroing. • If the positioning speed or zeroing speed setting exceeds the speed limit value, control is executed at the speed limit value.	4.4.1
3	Acceleration time	1 to 65535ms								1000	ms	• Set the time taken to reach the speed limit value from the start of motion.	
4	Deceleration time	1 to 65535ms								1000	ms	• Set the time taken to stop from the speed limit value.,	
5	Rapid stop deceleration time	1 to 65535ms								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

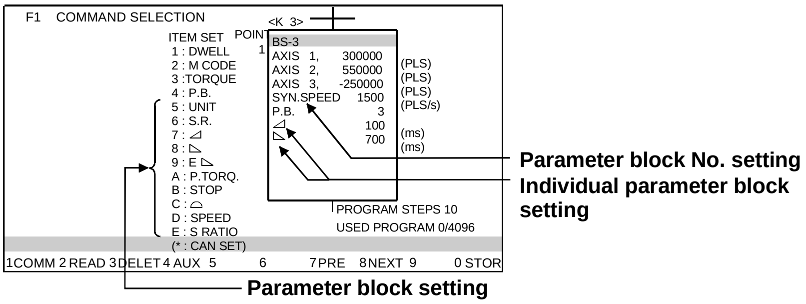
(1) Parameter blocks are designated in the zeroing data, JOG operation data, or servo program.
(2) The various parameter block data can be changed in the servo program. (See Section 6.3.)

POINT

(1) The data set in the parameter block is used for positioning control, zeroing, 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.

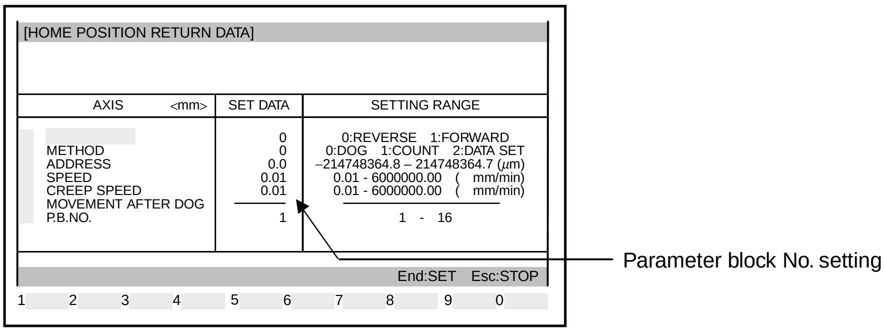
[Servo program creation screen]



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: Change speed when constant-speed control is executed,
S RATIO: S-curve ratio when S-pattern processing is executed

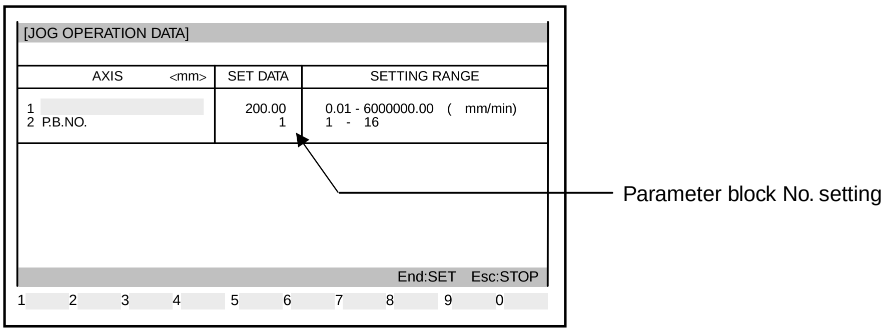
(b) The parameter block No. used for zeroing is set when setting the " zeroing data" with a peripheral device.

[Zeroing data setting screen]



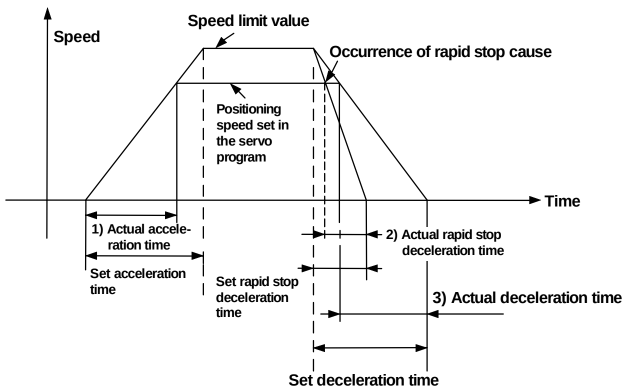
(c) The parameter block No. used for JOG operation is set when setting the "JOG operation data" with a peripheral device.

[JOG operation data setting screen]



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/zeroing.
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.



1) Actual acceleration time
Time take to reach the positioning speed set in the servo program

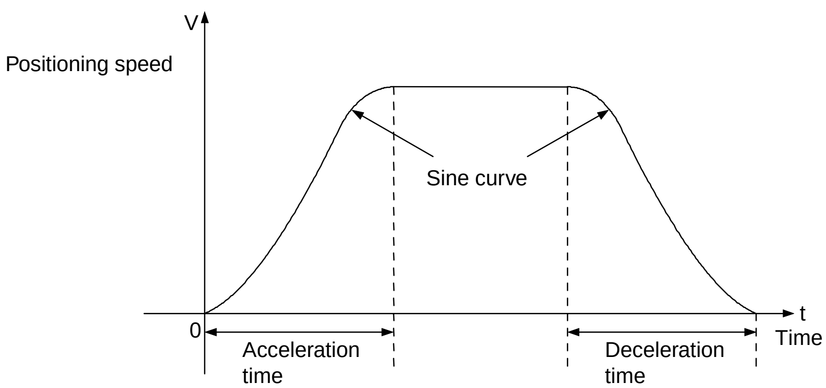
2) Actual rapid stop deceleration time
Time taken to effect a rapid stop from the positioning speed set in the servo program

3) Actual deceleration time
Time taken to stop from the positioning speed set in the servo program

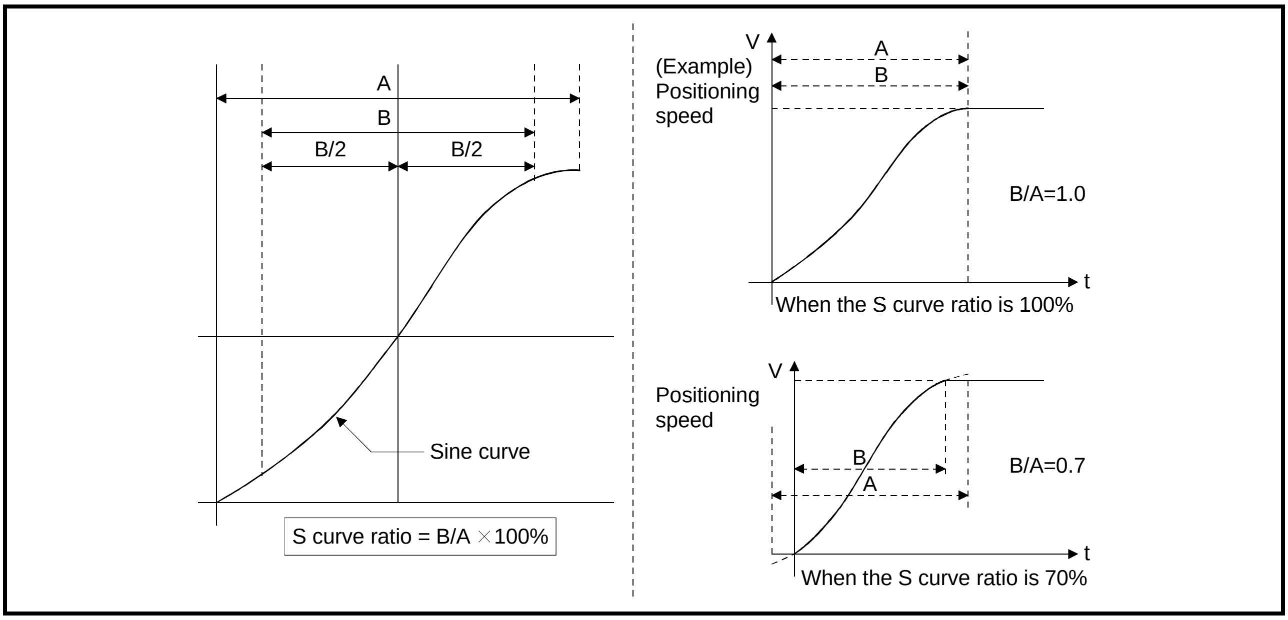
Fig. 4.2 Relationships among the Speed Limit Value, Acceleration Time, Deceleration Time, and Rapid Stop Deceleration Time

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.

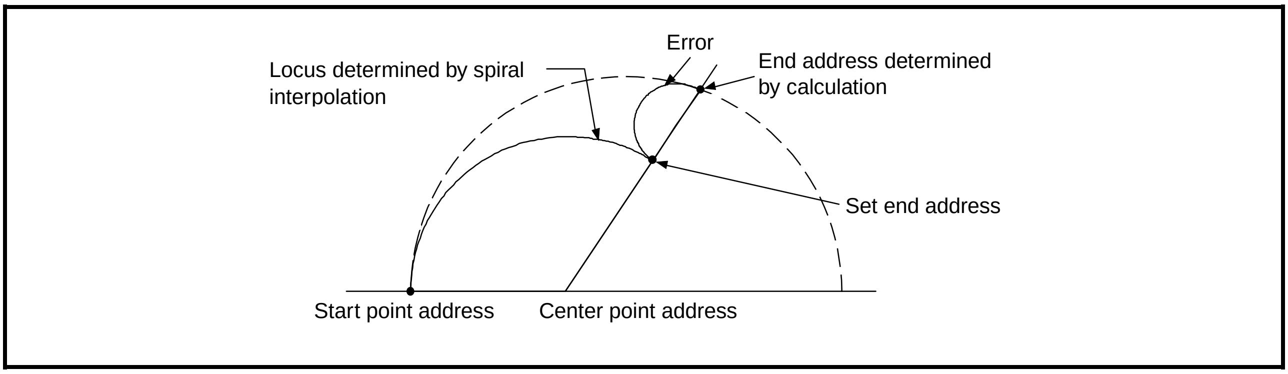


Fig. 4.3 Spiral Interpolation

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 (SVST) (see Section 5.2) and the current value change/speed change instructions (CHGA/CHGV) instructions (see Section 5.3) are used as positioning instructions.

(2) 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.
Internal relays	M2000 to M3839
Data registers	D0 to D799
Special relays	M9073 to M9079
Special registers	D9180 to D9199

Note that internal relays (M2000 to M3839) and data registers (D0 to D799) will not be latched even if a latch range setting is made for them. (The device symbols for 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.)

(3) 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/SW0IX-CAMPE Operating Manual (IB-67399)

5.2 Servo Program Start Request Instruction (SVST)

There is a servo program start request instruction (SVST).
When executing positioning control, up to 4 axes can be controlled with the SVST instruction.

5.2.1 Start request instruction for 1 to 32 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	M 9010	M 9011
(D)																							13		(Note) ○		○	○
n										○	○	○					○	○										

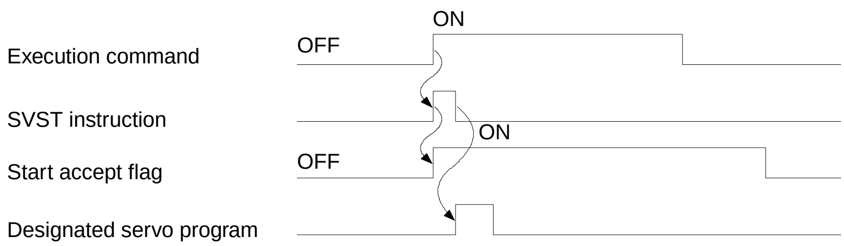
(Note) : Possible with indirect setting only

SEQUENCE PROGRAM

	Setting data	Setting range	
(D)	J+No. of axis to be started	J1 to J32	
n	No. of servo program to be executed	Direct designation	0 to 4095
		Indirect designation (1 word)	D800 to D8191 W0 to W1FFF R0 to R8191

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 3.1.3).
- A start request is issued for the servo program designated by "n".



[Data Settings]

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

○ Setting for 1 to 32 axes
- 1 axis to be started .... Make the setting for 1 axis (J**)
- 2 axes interpolation to be started ... Make the setting for 2 axes (J**J**)
- 3 axes interpolation to be started ... Make the setting for 3 axes (J**J**J**)
- 4 axes interpolation to be started ... Make the setting for 8 axes (J**J**J**J**)
- Simultaneous Start .... Make the setting for 2 to 8 axes

○ Designate J+started axis number 1 to 32

- The number of digits in the axis number display is fixed at 3 including J (i.e. "J**")

---- Example ----

The axis 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	Usable Devices
D	800 to 8191
W	0 to 1FFF
R	0 to 8191

POINT

(1) When 2 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: J1J3).

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

SVST	J1J2J3	D50

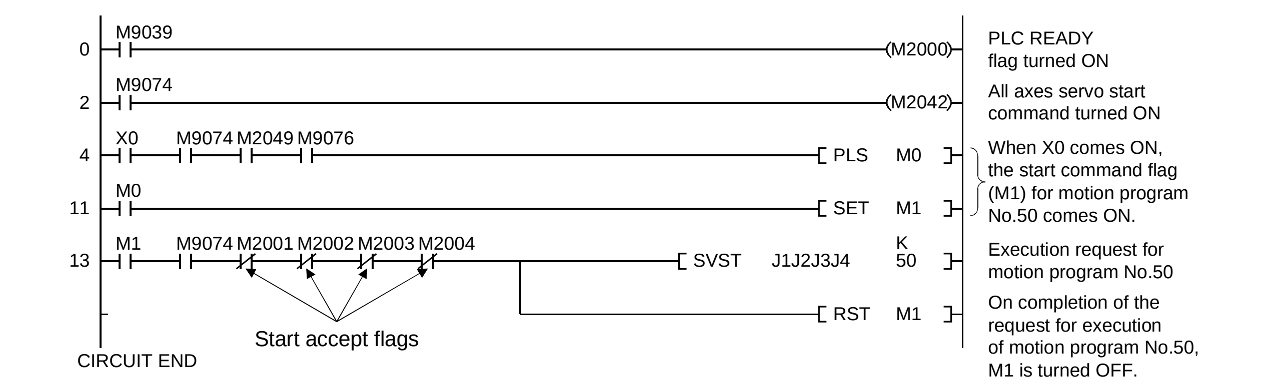
2) An index register (Z, V) or dedicated instruction (IX .IXEND) can be used for index designation of the indirectly set word device.
   - For details on index registers (Z, V), see the ACPU Programming Manual (Fundamentals) (IB-66249).
   - For details on dedicated instruction (IX. IXEND), see the AnACPU/ 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 .
- When the axis number given in any digit of (D) is a number other than J1 to J32.
- When the same axis number is set twice in (D).
- When the setting for n is outside the applicable range.

[Program example]



5.3 Current Value Change Instructions (CHGA)

These instructions are used to change the current value of a stopped axis.

5.3.1 CHGA instructions

	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	M 9010	M 9011
(D)																							7		(Note) ○		○	○
n										○	○	○					○	○										

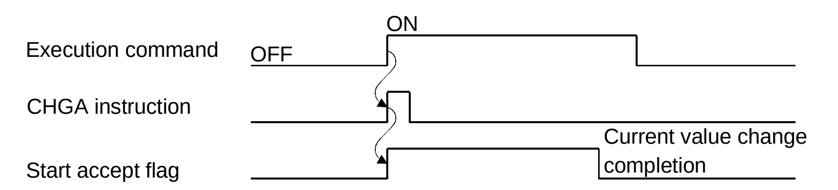
(Note) : Possible with indirect setting only.

SEQUENCE PROGRAM

	Setting data	Setting range	
(D)	J + No. of current value change axis	J1 to J32	
n	Setting of current value to be changed	Direct designation	mm : -2147483648 to 2147483647 $\times 10^{-1}\mu m$ inch : -2147483648 to 2147483647 $\times 10^{-5}$inch deg : 0 to 35999999 $\times 10^{-5}$deg PLS : -2147483648 to 2147483647 PLS
		Indirect designation	D800 to D8191 W0 to W1FFF R0 to R8191

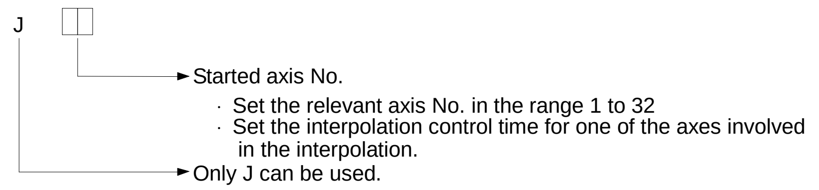
(1) The following processing is executed at the leading edge (OFF→ON) of the CHGA instruction:
   1) The start accept flag (M2001 to M2032) corresponding to the axis designated in (D) is turned ON.
   2) The current value of the axis designated in (D) is changed to the current value designated in n.
   3) On completion of the current value change, the start accept flag is turned OFF.

[Operation Timing]



[Data Settings]

(1) Setting the axis for which a current value change is to be executed
The axis with respect to which the current value 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 current value change
There are two types of setting for current value changes: direct setting and indirect setting.

(a) In direct setting, the current value to be changed to is specified directly as a numerical value.

---- Example ----

If the current value to be changed "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	Usable Devices
D	800 to 8191
W	0 to 1FFF
R	0 to 8191

---- Example ----

Make the following setting to designate the current 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) can be used for index designation of the indirectly set word device.

[Error Details]

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

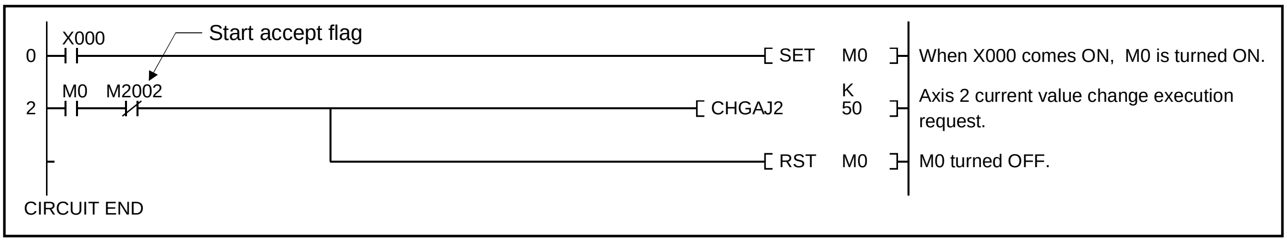
(2) In the following cases, a minor error (error on control change) occurs and the current value change is not executed.
When this happens, the error detection flag (M2407+20n) is turned ON and the error code is stored in the minor error code area for the relevant axis.
- When the axis designated in (D) for the current value change is in motion.

[Program Example]

The program shown below changes the current value for axis 2.

(1) Conditions
1) Current value change command .... Leading edge (OFF→ON) of X000
2) Current 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)

(2) Program example



5.4 Speed Change Instructions (CHGV)

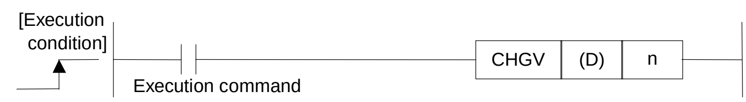
This instruction is used to change the speed of an axis during positioning or JOG operation.

5.4.1 CHGV instructions

	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	M 9010	M 9011
(D)																							7		(Note) ○		○	○
n										○	○	○					○	○										

(Note) : Possible with indirect setting only

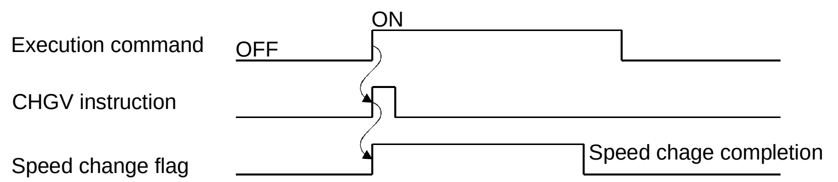
SEQUENCE PROGRAM



	Setting data	Setting range	
(D)	J + No. of current value change axis	J1 to 32	
n	Setting of current value to be changed	Direct designation	mm : –600000000 to 600000000 $\times10^{-2}$mm/min inch : –600000000 to 600000000 $\times10^{-3}$inch/min deg : –2147483648 to 2147483647 $\times10^{-3}$deg/min PLS : –10000000 to 10000000 PLS/min
		Indirect designation	D800 to D8191 W0 to W1FFF R0 to R8191

(1) The following processing is executed at the leading edge (OFF→ON) of the CHGV instruction:
   1) The speed change flag (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 current value designated in n.
   3) The speed change in progress flag is turned OFF.

[Operation Timing]



[Data Settings]

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

J □□

- □□ → Started axis No.
  - Set the relevant axis No. in the range 1 to 32 .
  - Set the interpolation control time for one of the axes involved in the interpolation.
- J → Only J can be used.

Example

Axis to be started are designated as shown below.

- Axis 1 .... J1

(2) Setting the speed change
There are two types of setting for speed changes: direct setting and indirect setting.

(a) In direct setting, the speed to be changed to is specified directly as a numerical value.

Example

If the speed to be changed "10", the setting 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	Usable Devices
D	800 to 8191
W	0 to 1FFF
R	0 to 8191

Example

Make the following setting to designate the speed to be changed to with the data stored in data register D50:

- Designation with a word device   CHGV J11 D50

2) An index register (Z, V) can be used for index designation of the indirectly set word device.

[Error Details]

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

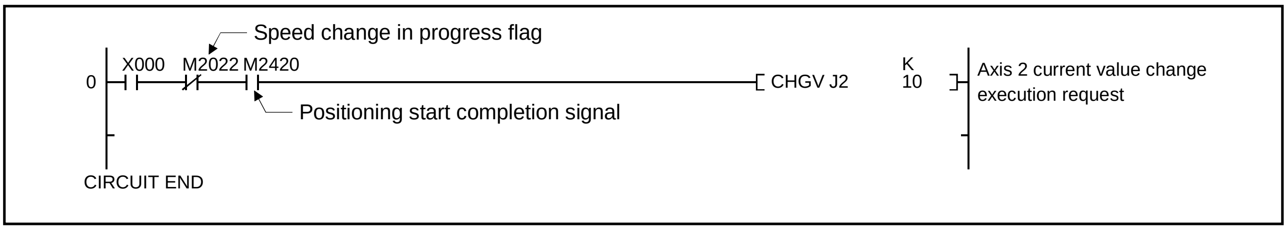
(2) In the following cases, a minor error (error on control change) occurs and the speed change is not executed.
When this happens, the error detection flag (M2407+20n) is turned ON and the error code is stored in the minor error code area for the relevant axis.
- When the axis designated in (D) is executing a zeroing 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]

The program shown below changes the current value for axis 2.

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

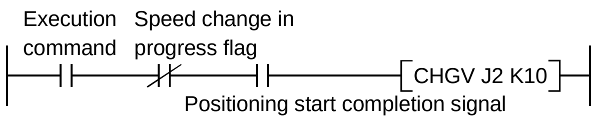
(2) Program example

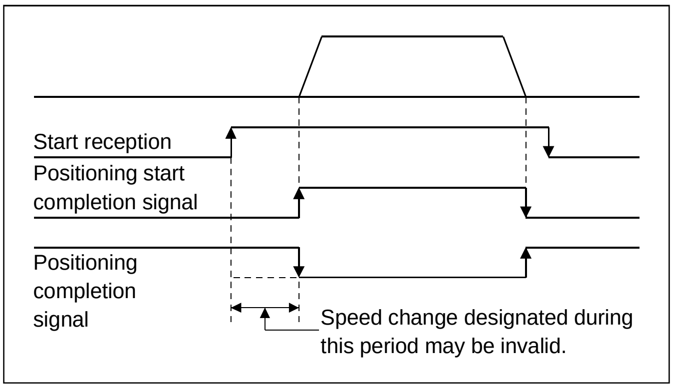


POINT

- Points to note when a speed change is performed
  - If a speed change instruction (CHGV) is executed in the period between execution of the servo program start request instruction (SVST) 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)





5.5 Retracing during Positioning

When a minus speed is designated in the CHGV instruction at the start to make a speed change request, deceleration begins at that time and retracing starts on completion of deceleration. The following operations can be performed by the servo instructions.

Control mode	Servo instruction	Operation
Linear control	ABS-1 ABS-2 ABS-3 ABS-4 INC-1 INC-2 INC-3 INC-4	The travel direction is reversed on completion of deceleration, and retracing takes place and stops (waits) at the positioning start point according to the absolute value of the designated speed. In circular interpolation, retracing takes place on the circular track.
Circular interpolation control	ABS Circular INC Circular	
Fixed-pitch feed control	FEED-1 FEED-2 FEED-3	
Constant-speed control	CPSTART1 CPSTART2 CPSTART3 CPSTART4	The travel direction is reversed on completion of deceleration, and retracing takes place and stops (waits) at the preceding point according to the absolute value of the designated speed.
Speed control (I)	VF VR	The travel direction is reversed on completion of deceleration according to the absolute value of the designated speed. Retracing does not stop unless the stop command is entered.
Speed control (II)	VVF VVR	
Speed/position control	VPF VPR VPSTART	Retracing is not possible. A normal speed change request is assumed. A minor error 305 is returned and a speed limit value is used for control.
Position follow-up control	PFSTART	
Speed switching control	VSTART	
JOG operation		
High speed oscillation	OSC	Speed cannot be changed. A minor error 310 is returned.
Zeroing	ZERO	Speed cannot be changed. A minor error 301 is returned.

(Reference) Minor error 301 : Speed has been changed during zeroing.
Minor error 305 : The designated speed is not within the range from 0 to the speed limit value.
Minor error 310 : Speed has been changed during high speed oscillation.

[Control Details]

(1) When speed is changed to minus speed, control takes place as shown in the table above according to the control mode in use.

(2) The designated retracing speed is indicated by the absolute value of the change speed. When it exceeds a speed limit value, a minor error 305 is returned and retracing is controlled according to the speed limit value.

(3) When stopping (waiting) continues at a return position, processing takes place as follows.
  (a) Signal status
  - Start accept (M2001+n) ON (remains in the status before CHGV execution)
  - Positioning start completion (M2400 + 20n) ON (remains in the status before CHGV execution)
  - Positioning completion (M2401+20n) OFF
  - In-position (M2402+20n) ON
  - Command in-position (M2403+20n) OFF
  - Speed change "0" accept flag (M2240+n) ON

  (b) When attempting a start again, change the speed to plus speed.

  (c) When terminating positioning, set the stop command to ON.

  (d) When attempting a minus speed change again, it is ignored.

(4) Retracing takes place in the speed control mode as follows.
  (a) When changing the travel direction again, change the speed to plus speed.

  (b) When stopping retracing, set the stop command to ON.

  (c) When making minus speed change again, speed change is made in the reverse direction.

[Error Details]

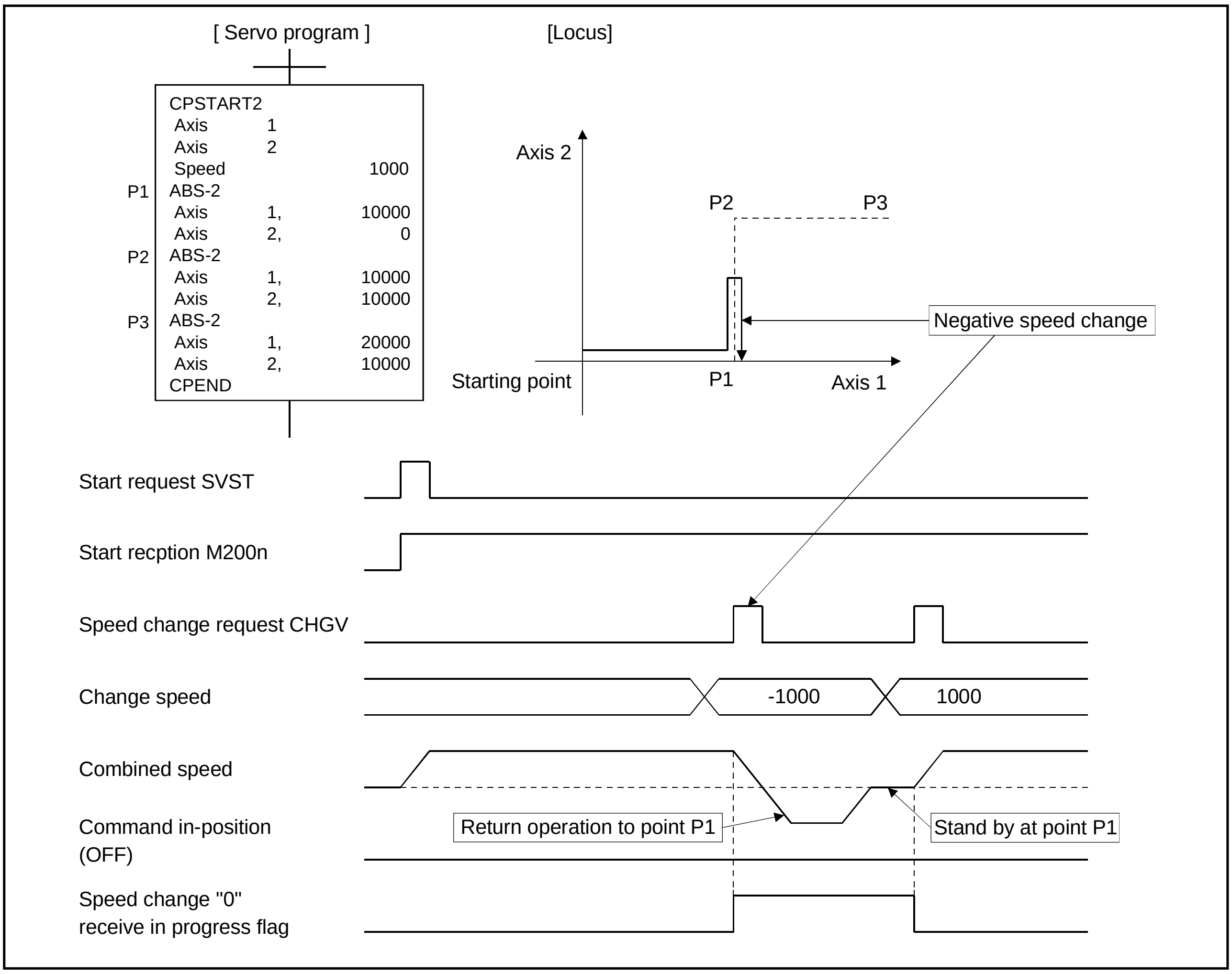
(1) While start is attempted in the control mode allowing retracing, a minor error 305 is returned and retracing is controlled according to a speed limit value so long as the absolute value of a change speed (minus) exceeds the speed limit value.

(2) In constant-speed control, retracing is controlled according to a speed designated in the program (speed clamp control in speed change during constant-speed control) so long as the absolute value of a change speed (minus) exceeds the speed designated in the servo program. In this case, no error is returned.

(3) No control takes place after automatic deceleration starts. A minor error 303 is returned.

[Example of Operation during Constant-Speed Control]

The following describes the operations to be performed for a retracing request made during constant-speed control.

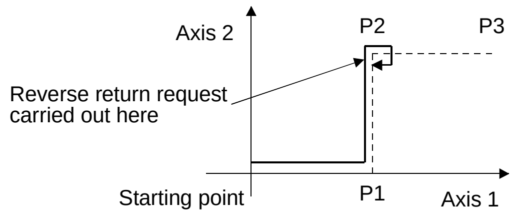


When a minus speed change is attempted during positioning to P2, retracing is performed up to P1 along the track designated in the program, then processing is suspended there.

POINTS

(1) When the M code FIN wait function is used during constant speed control, a retracing request made in the FIN wait status (stopped status) is ignored.

(2) In the above example, retracing to P2 is performed when a retracing request is made immediately before P2 and P2 is passed during deceleration.



5.6 Torque Limit Value Change Request (CHGT)

In the real mode, the sequence program can change the torque limit value regardless of whether it is operating or being stopped.
The following describes this process.

5.6.1 CHGT instructions

	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)																							7		(Note) ○		○	○
n										○	○	○					○	○										

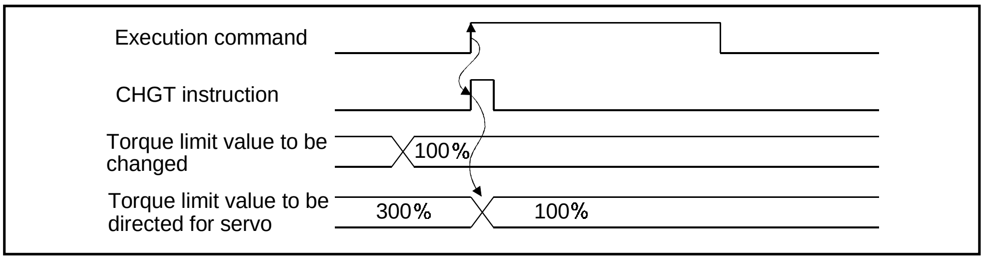
(Note) : possible with indirect setting only

	Setting data	Setting range	
(D)	J + No. of torque limit value change axis	J1 to J32	
n	Change torque limit value	Direct designation	1 to 0 (%)
		Indirect designation (1 word)	D800 to D8191 W0 to W1FFF R0 to R8191

[Control Details]

In the real mode, the sequence program changes the torque limit value of the designated axis at the leading edge of a CHGT instruction execution command (OFF→ON).

(1) In the real mode, the torque limit value can be changed at any time for axis after servo start completion regardless of the servo status (start, stop, servo ON, and servo OFF).



(2) Relation to the torque limit value designated in the servo program

Start

At normal start, a torque limit value is directed to the servo of the start axis according to the torque set by the servo program or the torque limit value of the designated parameter block. At interpolation start, it is directed to the servo of the interpolation axis.

↓

Execution of the CHGT instruction causes the set torque limit value to be directed only to the designated axis.

↓

When the servo program starts, the torque limit value to be directed to the servo at JOG operation start is clamped to that changed by the CHGT instruction. Namely, the value is effective only when the torque limit value designated by the servo program or parameter block is lower than that changed by the CHGT instruction. Clamp processing of this torque limit value varies from axis to axis.

Start in progress

1) When the following torque limit values are set, they cannot be changed to values greater than the torque limit value changed by the CHGT instruction.
   - Torque limit value at intermediate points during constant speed control or speed switching control
   - Torque limit value at position control switching points during speed/position switching control
   - Torque limit value during speed control II
2) The CHGT instruction can change the torque limit value to any value greater than the limit value designated in the servo program or parameter block.

[Error Details]

(1) Setting must be made in the range 1 to 500(%). When the setting is made outside this range, a minor error 311 is returned and the torque limit value is not changed.

(2) When the CHGT instruction is executed for an axis not started yet, a minor error 312 is returned and the torque limit value is not changed.

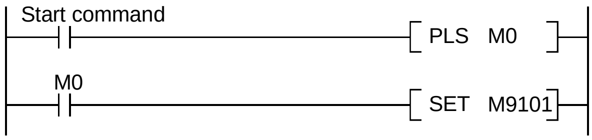
5.7 SFC Programs

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

5.7.1 Starting and stopping SFC programs

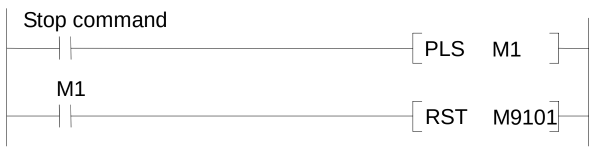
SFC programs are started and stopped from the main sequence program. The methods for starting and stopping SFC programs are described below.

(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.



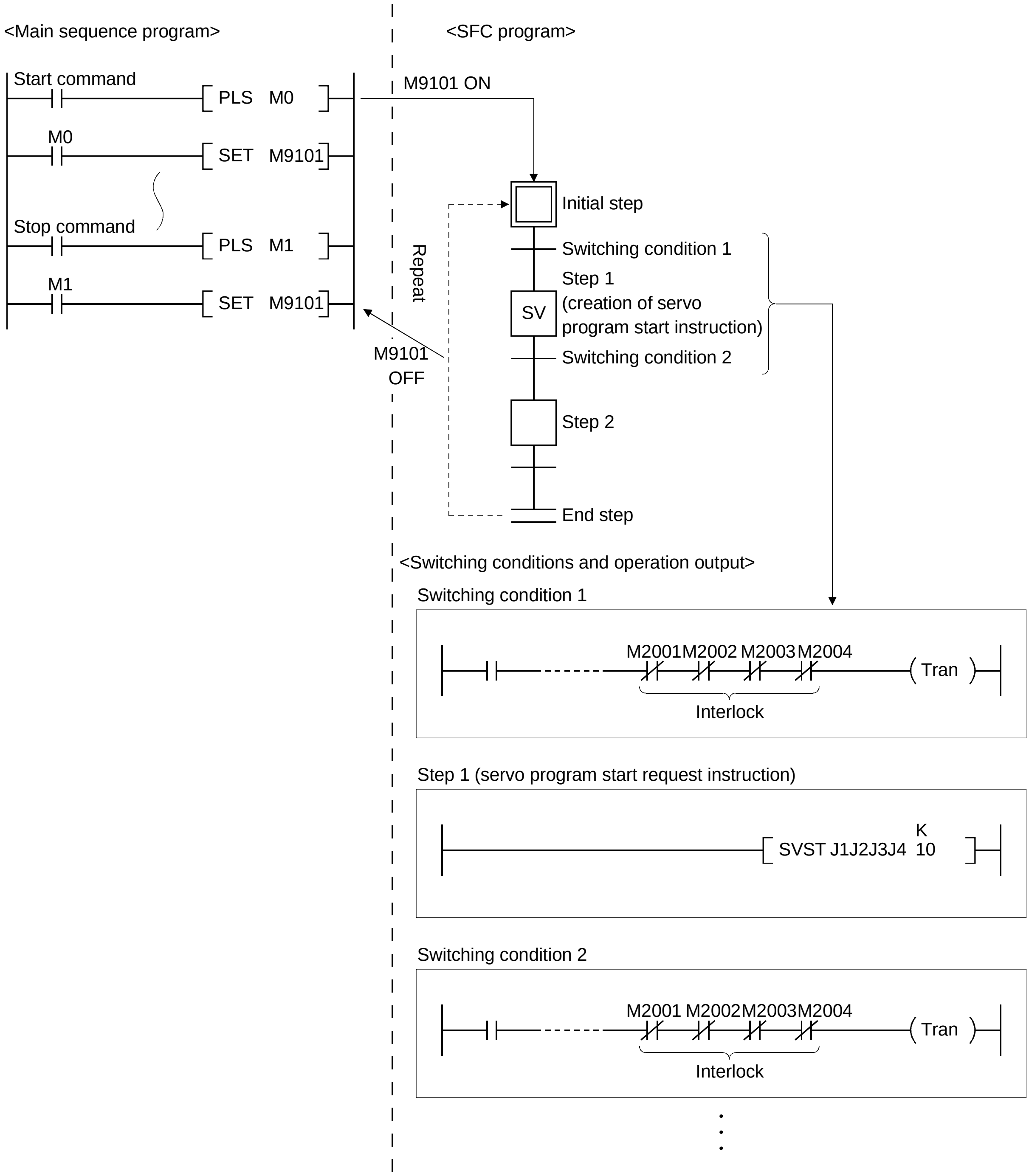
   (b) When an SFC program is stopped, all the operation outputs in the step being executed are turned OFF.

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

5.7.2 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.



POINT

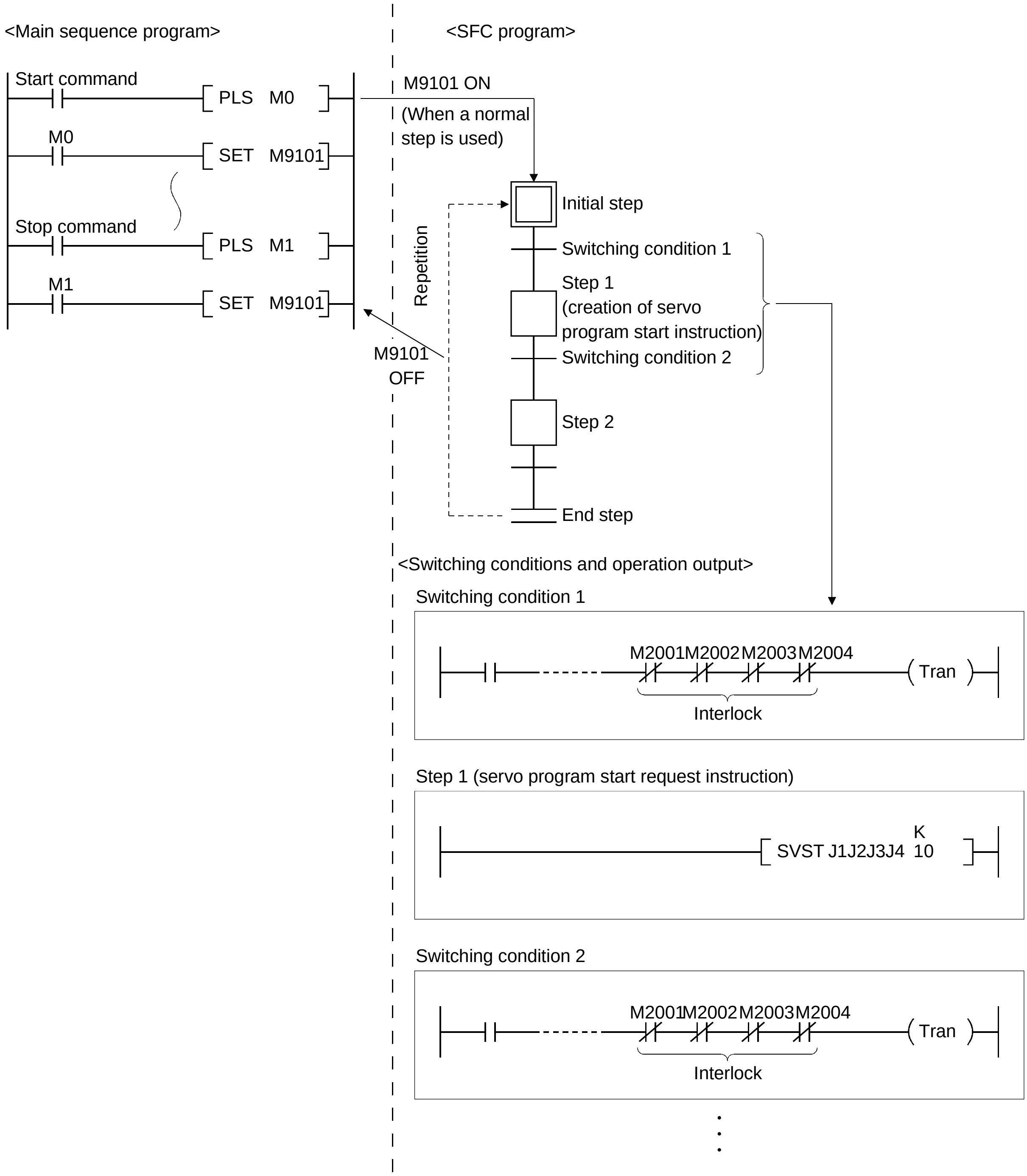
(1) When an [SV] step is created, the servo program start request ladder block (├──[SVST ***]┤) is mandatorily inserted in the sequence program.

(2) If an SVST instruction is edited and converted, a start accept bit (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.

(3) 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 (☐).

(4) 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) If an SVST/CHGA 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.

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

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

(4) 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.

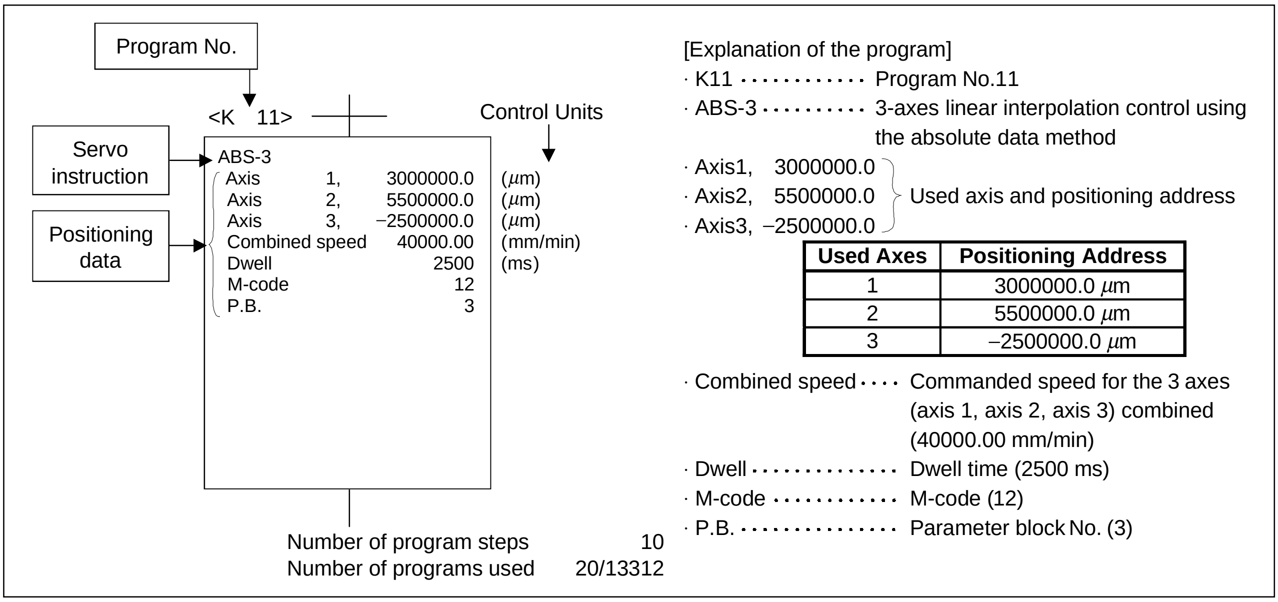


Fig. 6.1 Example Composition of a Servo Program

(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 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 14334 steps.

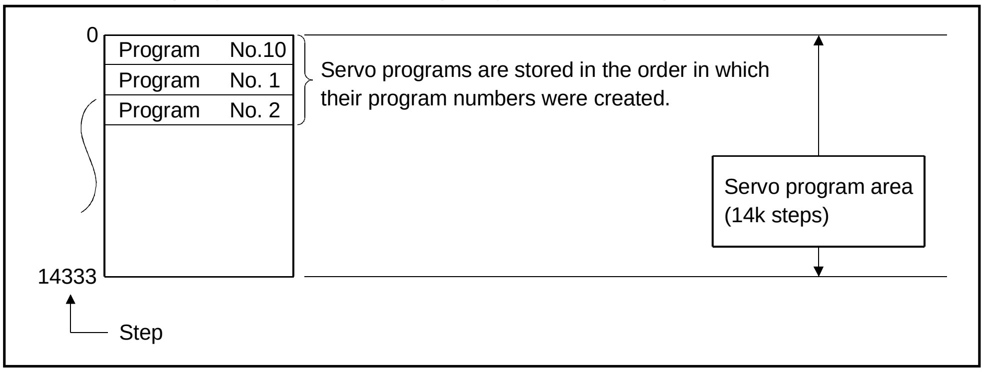


Fig. 6.2 Servo Program Area

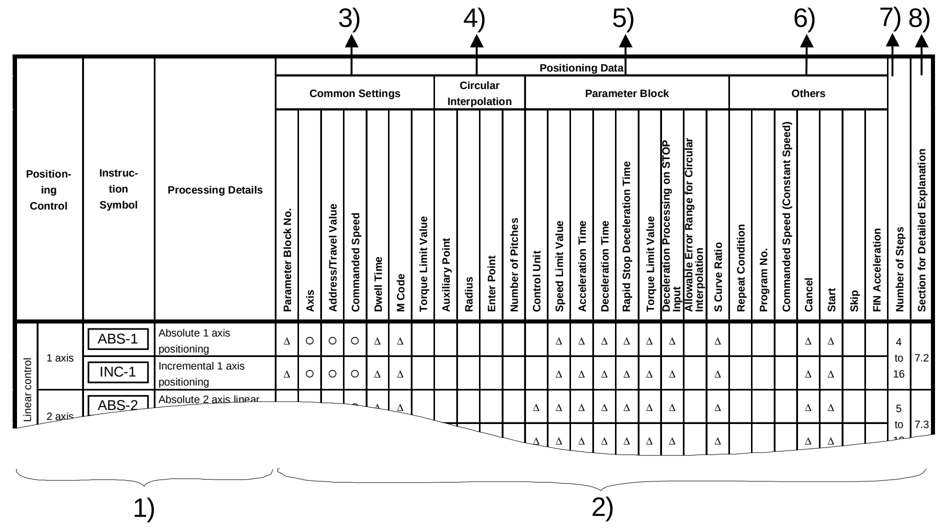
POINT

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) ○: 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 number of instruction steps increases depending on the number of setting items (the number of steps is indicated at the time of servo program creation). (The number of steps is minimal when setting is made only for instructions and ○ items. It is incremented by one each time one Δ item is added.)	
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

Position-ing Control		Instruction Symbol	Processing Details	Positioning Data: Common Settings							Circular Interpolation				Parameter Block									Others							Number of Steps	Section for Detailed Explanation
				Parameter Block No.	Axis	Address/Travel Value	Commanded Speed	Dwell Time	M-Code	Torque Limit Value	Auxiliary Point	Radius	Enter Point	Number of Pitches	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	Repeat Condition	Program No.	Commanded Speed (Constant Speed)	Cancel	Start	Skip	FIN Acceleration		
Linear control	1-axis	ABS-1	Absolute 1-axis positioning	Δ	○	○	○	Δ	Δ							Δ	Δ	Δ	Δ	Δ	Δ		Δ				Δ	Δ			4 to 16	7.2
		INC-1	Incremental 1-axis positioning	Δ	○	○	○	Δ	Δ							Δ	Δ	Δ	Δ	Δ	Δ		Δ				Δ	Δ				
	2-axes	ABS-2	Absolute 2-axes linear interpolation	Δ	○	○	○	Δ	Δ						Δ	Δ	Δ	Δ	Δ	Δ	Δ		Δ				Δ	Δ			5 to 18	7.3
		INC-2	Incremental 2-axes linear interpolation	Δ	○	○	○	Δ	Δ						Δ	Δ	Δ	Δ	Δ	Δ	Δ		Δ				Δ	Δ				
	3-axes	ABS-3	Absolute 3-axes linear interpolation	Δ	○	○	○	Δ	Δ						Δ	Δ	Δ	Δ	Δ	Δ	Δ		Δ				Δ	Δ			7 to 20	7.4
		INC-3	Incremental 3-axes linear interpolation	Δ	○	○	○	Δ	Δ						Δ	Δ	Δ	Δ	Δ	Δ	Δ		Δ				Δ	Δ				
	4-axes	ABS-4	Absolute 4-axes linear interpolation	Δ	○	○	○	Δ	Δ						Δ	Δ	Δ	Δ	Δ	Δ	Δ		Δ				Δ	Δ			8 to 23	7.5
		INC-4	Incremental 4-axes linear interpolation	Δ	○	○	○	Δ	Δ						Δ	Δ	Δ	Δ	Δ	Δ	Δ		Δ				Δ	Δ				
Circular interpolation control	Auxil-iary point desig-nation	ABS	Absolute circular interpolation by auxiliary point designation	Δ	○	○	○	Δ	Δ		○				Δ	Δ	Δ	Δ	Δ	Δ	Δ		Δ				Δ	Δ			7 to 21	7.6
		INC	Incremental circular interpolation by auxiliary point designation	Δ	○	○	○	Δ	Δ		○				Δ	Δ	Δ	Δ	Δ	Δ	Δ		Δ				Δ	Δ				
	Radius desig-nation	ABS	Absolute circular interpolation by radius designation, less than CW180°	Δ	○	○	○	Δ	Δ			○			Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ				Δ	Δ			6 to 20	7.7
		ABS	Absolute circular interpolation by radius designation, CW180° or more	Δ	○	○	○	Δ	Δ			○			Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ				Δ	Δ				
		ABS	Absolute circular interpolation by radius designation, less than CCW180°	Δ	○	○	○	Δ	Δ			○			Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ				Δ	Δ				
		ABS	Absolute circular interpolation by radius designation, CCW180° or more	Δ	○	○	○	Δ	Δ			○			Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ				Δ	Δ				
		INC	Incremental circular interpolation by radius designation, less than CW180°	Δ	○	○	○	Δ	Δ			○			Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ				Δ	Δ				
		INC	Incremental circular interpolation by radius designation, CW180° or more	Δ	○	○	○	Δ	Δ			○			Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ				Δ	Δ				
		INC	Incremental circular interpolation by radius designation, less than CCW180°	Δ	○	○	○	Δ	Δ			○			Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ				Δ	Δ				
		INC	Incremental circular interpolation by radius designation, CCW180° or more	Δ	○	○	○	Δ	Δ			○			Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ				Δ	Δ				
	Center point desig-nation	ABS	Absolute circular interpolation by center point designation, CW	Δ	○	○	○	Δ	Δ				○		Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ				Δ	Δ			7 to 21	7.8
		ABS	Absolute circular interpolation by center point designation, CCW	Δ	○	○	○	Δ	Δ				○		Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ				Δ	Δ				
		INC	Incremental circular interpolation by center point designation, CW	Δ	○	○	○	Δ	Δ				○		Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ				Δ	Δ				
		INC	Incremental circular interpolation by center point designation, CCW	Δ	○	○	○	Δ	Δ				○		Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ				Δ	Δ				

○ : Must be set
Δ : Set if required

Positioning Control		Instruction Symbol	Processing Details	Positioning Data																											Number of Steps	Section for Detailed Explanation
				Common Settings							Circular Interpolation				Parameter Block									Others								
				Parameter Block No.	Axis	Address/Travel Value	Commanded Speed	Dwell Time	M-Code	Torque Limit Value	Auxiliary Point	Radius	Enter Point	Number of Pitches	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	Repeat Condition	Program No.	Commanded Speed (Constant Speed)	Cancel	Start	Skip	FIN Acceleration		
Helical interpolation control	Auxiliary point designation	ABH	Absolute, auxiliary point-specified, helical interpolation	Δ	○	○	○	Δ	Δ		○			○	Δ	Δ	Δ	Δ	Δ	Δ	Δ		Δ				Δ	Δ			10 to 27	7.9
		INH	Incremental, auxiliary point-specified, helical interpolation	Δ	○	○	○	Δ	Δ		○			○	Δ	Δ	Δ	Δ	Δ	Δ	Δ		Δ				Δ	Δ				
	Radius designation	ABH	Absolute, radius-specified, helical interpolation less than CW180°	Δ	○	○	○	Δ	Δ			○		○	Δ	Δ	Δ	Δ	Δ	Δ	Δ		Δ				Δ	Δ			9 to 26	7.10
		ABH	Absolute, radius-specified, helical interpolation CW180° or more	Δ	○	○	○	Δ	Δ			○		○	Δ	Δ	Δ	Δ	Δ	Δ	Δ		Δ				Δ	Δ				
		ABH	Absolute, radius-specified, helical interpolation less than CCW180°	Δ	○	○	○	Δ	Δ			○		○	Δ	Δ	Δ	Δ	Δ	Δ	Δ		Δ				Δ	Δ				
		ABH	Absolute, radius-specified, helical interpolation CCW180° or more	Δ	○	○	○	Δ	Δ			○		○	Δ	Δ	Δ	Δ	Δ	Δ	Δ		Δ				Δ	Δ				
		INH	Incremental, radius-specified, helical interpolation less than CW180°	Δ	○	○	○	Δ	Δ			○		○	Δ	Δ	Δ	Δ	Δ	Δ	Δ		Δ				Δ	Δ				
		INH	Incremental, radius-specified, helical interpolation CW180° or more	Δ	○	○	○	Δ	Δ			○		○	Δ	Δ	Δ	Δ	Δ	Δ	Δ		Δ				Δ	Δ				
		INH	Incremental, radius-specified, helical interpolation less than CCW180°	Δ	○	○	○	Δ	Δ			○		○	Δ	Δ	Δ	Δ	Δ	Δ	Δ		Δ				Δ	Δ				
		INH	Incremental, radius-specified, helical interpolation CCW180° or more	Δ	○	○	○	Δ	Δ			○		○	Δ	Δ	Δ	Δ	Δ	Δ	Δ		Δ				Δ	Δ				
	Center point designation	ABH	Absolute, central point-specified, helical interpolation CW	Δ	○	○	○	Δ	Δ				○	○	Δ	Δ	Δ	Δ	Δ	Δ	Δ		Δ				Δ	Δ			10 to 27	7.11
		ABH	Absolute, central point-specified, helical interpolation CCW	Δ	○	○	○	Δ	Δ				○	○	Δ	Δ	Δ	Δ	Δ	Δ	Δ		Δ				Δ	Δ				
		INH	Incremental, central point-specified, helical interpolation CW	Δ	○	○	○	Δ	Δ				○	○	Δ	Δ	Δ	Δ	Δ	Δ	Δ		Δ				Δ	Δ				
		INH	Incremental, central point-specified, helical interpolation CCW	Δ	○	○	○	Δ	Δ				○	○	Δ	Δ	Δ	Δ	Δ	Δ	Δ		Δ				Δ	Δ				

○ : Must be set
Δ : Set if required

Table 6.2 Servo Instruction List (Continued)

Positioning Control		Instruction Symbol	Processing Details	Positioning Data																											Number of Steps	Section for Detailed Explanation
				Common Settings							Circular Interpolation				Parameter Block									Others								
				Parameter Block No.	Axis	Address/Travel Value	Commanded Speed	Dwell Time	M-Code	Torque Limit Value	Auxiliary Point	Radius	Enter Point	Number of Pitches	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	Repeat Condition	Program No.	Commanded Speed (Constant Speed)	Cancel	Start	Skip	FIN Acceleration		
Fixed-pitch feed	1 axis	FEED-1	1-axis fixed-pitch feed start	Δ	○	○	○	Δ	Δ							Δ	Δ	Δ	Δ	Δ	Δ		Δ				Δ	Δ			4 to 17	7.9
	2 axis	FEED-2	2-axes linear interpolation Fixed-pitch feed start	Δ	○	○	○	Δ	Δ						Δ	Δ	Δ	Δ	Δ	Δ	Δ		Δ				Δ	Δ			5 to 19	7.10
	3 axis	FEED-3	3-axes linear interpolation Fixed-pitch feed start	Δ	○	○	○	Δ	Δ						Δ	Δ	Δ	Δ	Δ	Δ	Δ		Δ				Δ	Δ			7 to 21	7.11
Speed control (I)	Forward rotation	VF	Speed control (I) Forward rotation start	Δ	○		○		Δ							Δ	Δ	Δ	Δ	Δ	Δ		Δ				Δ	Δ			3 to 14	7.12
	Reverse rotation	VR	Speed control (I) Reverse rotation start	Δ	○		○		Δ							Δ	Δ	Δ	Δ	Δ	Δ		Δ				Δ	Δ				
Speed control (II)	Forward rotation	VVF	Speed control (II) Forward rotation start	Δ	○		○		Δ	Δ						Δ	Δ	Δ	Δ	Δ	Δ		Δ				Δ	Δ			3 to 16	7.13
	Reverse rotation	VVR	Speed control (II) Reverse rotation start	Δ	○		○		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	○	○	○	Δ	Δ	Δ						Δ	Δ	Δ	Δ	Δ	Δ		Δ				Δ	Δ			4 to 17	7.14.1
	Reverse rotation	VPR	Speed/position switching control Reverse rotation start	Δ	○	○	○	Δ	Δ	Δ						Δ	Δ	Δ	Δ	Δ	Δ		Δ				Δ	Δ				
	Re-start	VPSTART	Speed/position switching control Restart		○																						Δ	Δ			2 to 4	7.14.2
Speed switching control		VSTART	Speed switching control, start	Δ											Δ	Δ	Δ	Δ	Δ	Δ	Δ		Δ				Δ	Δ			1 to 12	7.15.1
		VEND	Speed switching control, end																												1	
		ABS-1	Speed switching control End point address		○	○	○	Δ	Δ	Δ																	Δ	Δ			4 to 9	
		ABS-2			○	○	○	Δ	Δ	Δ																	Δ	Δ			5 to 10	
		ABS-3			○	○	○	Δ	Δ	Δ																	Δ	Δ			7 to 12	
		INC-1	Speed switching control Travel value to end point		○	○	○	Δ	Δ	Δ																	Δ	Δ			4 to 9	
		INC-2			○	○	○	Δ	Δ	Δ																	Δ	Δ			5 to 10	
		INC-3			○	○	○	Δ	Δ	Δ																	Δ	Δ			7 to 12	
		VABS	Absolute designation of speed switching point			○	○		Δ	Δ																					4 to 6	
		VINC	Incremental designation of speed switching point			○	○		Δ	Δ																						
Position follow-up control		PFSTART	Position follow-up control start	Δ	○	○	○		Δ							Δ	Δ	Δ	Δ	Δ	Δ		Δ				Δ	Δ			4 to 18	7.17
Constant-speed control		CPSTART1	1-axis constant-speed control start	Δ	○		○									Δ	Δ	Δ	Δ	Δ	Δ		Δ				Δ	Δ		Δ	3 to 17	7.16
		CPSTART2	2-axes constant-speed control start	Δ	○		○								Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ				Δ	Δ		Δ		
		CPSTART3	3-axes constant-speed control start	Δ	○		○								Δ	Δ	Δ	Δ	Δ	Δ	Δ		Δ				Δ	Δ		Δ	4 to 18	
		CPSTART4	4-axes constant-speed control start	Δ	○		○								Δ	Δ	Δ	Δ	Δ	Δ	Δ		Δ				Δ	Δ		Δ		

○ : Must be set
Δ : Set if required

Table 6.2 Servo Instruction List (Continued)

Positioning Control	Instruction Symbol	Processing Details	Positioning Data: Common Settings							Circular Interpolation				Parameter Block									Others							Number of Steps	Section for Detailed Explanation
			Parameter Block No.	Axis	Address/Travel Value	Commanded Speed	Dwell Time	M-Code	Torque Limit Value	Auxiliary Point	Radius	Enter Point	Number of Pitches	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	Repeat Condition	Program No.	Commanded Speed (Constant Speed)	Cancel	Start	Skip	FIN Acceleration		
Constant-speed control	ABS-1	Constant-speed, passing point absolute designation		○	○			Δ	Δ																Δ			Δ		2 to 7	7.16
	ABS-2			○	○			Δ	Δ																Δ			Δ		3 to 8	
	ABS-3			○	○			Δ	Δ																Δ			Δ		4 to 9	
	ABS-4			○	○			Δ	Δ																Δ			Δ		5 to 10	
	ABS			○	○			Δ	Δ	○															Δ			Δ			
	ABS			○	○			Δ	Δ		○														Δ			Δ		4 to 9	
	ABS			○	○			Δ	Δ		○														Δ			Δ			
	ABS			○	○			Δ	Δ		○														Δ			Δ			
	ABS			○	○			Δ	Δ		○														Δ			Δ			
	ABS			○	○			Δ	Δ			○													Δ			Δ		5 to 10	
	ABS			○	○			Δ	Δ			○													Δ			Δ			
	ABH			○	○			Δ	Δ	○			○												Δ			Δ		9 to 14	
	ABH			○	○			Δ	Δ		○		○												Δ			Δ		8 to 13	
	ABH			○	○			Δ	Δ		○		○												Δ			Δ			
	ABH			○	○			Δ	Δ		○		○												Δ			Δ			
	ABH			○	○			Δ	Δ		○		○												Δ			Δ			
	ABH			○	○			Δ	Δ			○	○												Δ			Δ		9 to 14	
	ABH			○	○			Δ	Δ			○	○												Δ			Δ			
	INC-1	Constant-speed, passing point incremental designation		○	○			Δ	Δ																Δ			Δ		2 to 7	
	INC-2			○	○			Δ	Δ																Δ			Δ		3 to 8	
	INC-3			○	○			Δ	Δ																Δ			Δ		4 to 9	
	INC-4			○	○			Δ	Δ																Δ			Δ		5 to 10	
	INC			○	○			Δ	Δ	○															Δ			Δ			
	INC			○	○			Δ	Δ		○														Δ			Δ		4 to 9	
	INC			○	○			Δ	Δ		○														Δ			Δ			
	INC			○	○			Δ	Δ		○														Δ			Δ			
	INC			○	○			Δ	Δ		○														Δ			Δ			
	INC			○	○			Δ	Δ			○													Δ			Δ		5 to 10	
	INC			○	○			Δ	Δ			○													Δ			Δ			

○ : Must be set
Δ : Set if required

Positioning Control	Instruction Symbol	Processing Details	Parameter Block No.	Axis	Address/Travel Value	Commanded Speed	Dwell Time	M-Code	Torque Limit Value	Auxiliary Point	Radius	Enter Point	Number of Pitches	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	Repeat Condition	Program No.	Commanded Speed (Constant Speed)	Cancel	Start	Skip	FIN Acceleration	Number of Steps	Section for Detailed Explanation
			Positioning Data																												
			Common Settings							Circular Interpolation				Parameter Block									Others								
Constant-speed control	INH	Constant-speed, passing point incremental designation		○	○			Δ	Δ	○			○												Δ			Δ		9 to 14	7.16
	INH			○	○			Δ	Δ		○		○												Δ			Δ		8 to 13	
	INH			○	○			Δ	Δ		○		○												Δ			Δ			
	INH			○	○			Δ	Δ		○		○												Δ			Δ			
	INH			○	○			Δ	Δ		○		○												Δ			Δ			
	INH			○	○			Δ	Δ			○	○												Δ			Δ		9 to 14	
	INH			○	○			Δ	Δ			○	○												Δ			Δ			
	CPEND	Constant-speed control end					Δ																							1to 2	
Repetition of same control	FOR-TIMES	Set the head step for repetition																					○							2	7.15.2 7.16.1
	FOR-ON																						○								
(User for speed switching control, constant-speed control)	FOR-OFF																						○								
	NEXT																													3	
Simultaneous start	START	Simultaneous start																						○						2 to 3	7.18
Zeroing	ZERO	Starts zeroing		○																										2	7.21
High-speed oscillation	OSC	High-speed oscillation	Δ	○	○	○		Δ											Δ							Δ	Δ			5 to 13	7.22

○ : 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	PULSE
Common Settings		Parameter block No.	● Sets the parameter block on the basis of which data such as that for acceieration and deceleration processing and deceleration processing on STOP input will be set for each axis.		1	1 to 64			
Common Settings		Axis	● Set the axis to be started. ● For interpolation , the numbers of the axes involved in the interpolation are designated.		——	1 to 32			
Common Settings	Address/travel value	Absolute date method	Address	Set the positioning address as an absolute address when using the absolute data method as the positioning method.	——	–214748364.8 to 21474836.7 (μm)	–21474.83648 to 21474.83647	0 to 359.99999	–2147483648 to 2147483647
Common Settings	Address/travel value	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)	For speed/position switching control: 0 to 21474.83647	For speed/position switching control: 0 to 21474.83647	For speed/position switching control: 0 to 2147483647
Common Settings		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 2147483.647 (degree/min)	1 to 10000000 (PLS/s)
Common Settings		Dwell time	● Set the time from positioning to the positioning address to output of the positioning completion signal (M2401+20n).		0 (ms)	0 to 5000 (ms)			
Common Settings		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			
Common Settings		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•Helical	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
Circular Interpolation•Helical	Auxiliary point	Incremental method				0 to ±2147483647			
Circular Interpolation•Helical	Radius	Absolute data method	● Set when executing circular interpolation by designating a radius. ● The sitting ranges, which depend on the positioning method used, are shown to the right.		——	0.1 to 429496729.5 (μm)	0.00001 to 42949.67295	0 to 359.99999	1 to 4294967295
Circular Interpolation•Helical	Radius	Incremental method				0.1 to 214748364.7 (μm)	0.00001 to 21474.83647	0.00001 to 21474.83647	1 to 2147483647
Circular Interpolation•Helical	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
Circular Interpolation•Helical	Center point	Incremental method				0 to ±2147483647			
Helical		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		
Setting Range				Possible/Not Possible	Number of Words Used	Error Item Data (Note-4) (Stored in D9190)	Control Using Default Value	Starting not Possible
mm	inch	degree	PULSE					
1 to 64				○	1	1	○	
——				×	——	——		○
–2147483648 to 2147483647 ($\times 10^{-1}$ μm)	–2147483648 to 2147483647 ($\times 10^{-5}$ inch)	0 to 35999999 ($\times 10^{-5}$ degree)	–2147483648 to 2147483647	○	2	n03 (Note-1)		
For other than speed/position switching control								
0 to ±2147483647								
For speed/position switching control						——		
0 to 2147483647 ($\times 10^{-1}$ μm)	0 to 2147483647 ($\times 10^{-5}$ inch)	0 to 2147483647 ($\times 10^{-5}$ degree)	0 to 2147483647					
1 to 600000000 ($\times 10^{-2}$ mm/min)	1 to 600000000 ($\times 10^{-3}$ inch/min)	1 to 2147483647 ($\times 10^{-3}$ degree/min)	1 to 10000000 (PLS/s)	○	2	4	○ (Note-2)	○ (Note-3)
0 to 5000 (ms)				○	1	5	○	
0 to 255				○	1	6	○	
1 to 500 (%)				○	1	7	○	
–2147483648 to 2147483647 ($\times 10^{-1}$ μm)	–2147483648 to 2147483647 ($\times 10^{-5}$ inch)	0 to 35999999 ($\times 10^{-5}$ degree)	–2147483648 to 2147483647	○	2×2	n08 (Note-1)		○
0 to ±2147483647								
1 to 4294967295 ($\times 10^{-1}$ μm)	1 to 4294967295 ($\times 10^{-5}$ inch)	0 to 35999999 ($\times 10^{-5}$ degree)	1 to 4294967295	○	2	n09 (Note-1)		
1 to 2147483647 ($\times 10^{-1}$ μm)	1 to 2147483647 ($\times 10^{-5}$ inch)	1 to 2147483647 ($\times 10^{-5}$ degree)	1 to 2147483647					
–2147483648 to 2147483647 ($\times 10^{-1}$ μm)	–2147483648 to 2147483647 ($\times 10^{-5}$ inch)	0 to 35999999 ($\times 10^{-5}$ degree)	–2147483648 to 2147483647	○	2×2	n010 (Note-1)		
0 to ±2147483647								
0 to 999				○	1	28		

REMARKS

(Note-1) : The "n" in n03, n08, n09, n10, indicates the axis number (1 to 32).
(Note-2) : When an error occurs because the speed limit value is exceeded, control is executed at the speed limit value.
(Note-3) : Applies when the commanded speed is "0".
(Note-4) : If there are multiple errors in the same program, the latest error item data is stored.

Table 6.3 Positioning Data (Continued)

<table>
<tr><th colspan="2" rowspan="3">Name</th><th rowspan="3">Explanation</th><th colspan="5">Setting Made With Peripheral Device</th></tr>
<tr><th rowspan="2">Default Value</th><th colspan="4">Setting Range</th></tr>
<tr><th>mm</th><th>inch</th><th>degree</th><th>PULSE</th></tr>
<tr><td rowspan="9">Parameter block</td><td>control unit</td><td rowspan="9">● 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".</td><td>3</td><td>0</td><td>1</td><td>2</td><td>3</td></tr>
<tr><td>Speed limit value</td><td>200.000 (PLS/s)</td><td>0.01 to 6000000.00 (mm/min)</td><td>0.001 to 600000.000 (inch/min)</td><td>0.001 to 2147483.647 (degree/min)</td><td>1 to 10000000 (PLS/s)</td></tr>
<tr><td>Acceleration time</td><td>1000 (ms)</td><td colspan="4">1 to 65535 (ms)</td></tr>
<tr><td>Deceleration time</td><td>1000 (ms)</td><td colspan="4">1 to 65535 (ms)</td></tr>
<tr><td>Rapid stop deceleration time</td><td>1000 (ms)</td><td colspan="4">1 to 65535 (ms)</td></tr>
<tr><td>S-curve ratio</td><td>0 (%)</td><td colspan="4">1 to 100 (%)</td></tr>
<tr><td>Torque limit value</td><td>300 (%)</td><td colspan="4">1 to 500 (%)</td></tr>
<tr><td>Deceleration processing on STOP input</td><td>0</td><td colspan="4">0 : Deceleration to a stop in accordance with the deceleration time
1 : Deceleration to a stop in accordance with the rapid stop deceleration time</td></tr>
<tr><td>Allowable error range for circular interpolation</td><td>100 (PLS)</td><td>0 to 10000.0 (μm)</td><td>0 to 1.00000</td><td>0 to 1.00000</td><td>0 to 100000</td></tr>
<tr><td rowspan="7">Others</td><td>##Repeat condition</td><td>Set the repeat condition for repetition between the FOR-TIMES instruction and the NEXT instruction.</td><td>——</td><td colspan="4">1 to 32767</td></tr>
<tr><td>Program No.</td><td>Set the program numbers for simultaneous starts.</td><td>——</td><td colspan="4">0 to 4095</td></tr>
<tr><td>Commanded speed (constant-speed)</td><td>Set the speed for points part way through positioning in the servo program.</td><td>——</td><td>0.01 to 6000000.00 (mm/min)</td><td>0.001 to 600000.000 (inch/min)</td><td>0.001 to 2147483.647 (degree/min)</td><td>1 to 10000000 (PLS/s)</td></tr>
<tr><td>Cancel</td><td>Set to end execution of a servo program by deceleration to a stop by turning ON a designated bit device in that program.</td><td>——</td><td colspan="4">X, Y, M, TC, TT, CC, CT, B, F</td></tr>
<tr><td>Start</td><td>● Set to automatically start a designated program after execution of "cancel" above.
● Can only be set when "cancel" has been set.</td><td>——</td><td colspan="4">K0 to K4095</td></tr>
<tr><td>Skip</td><td>Set in order to cancel positioning at a pass point and carry out positioning a 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.</td><td>——</td><td colspan="4">X, Y, M, TC, TT, CC, CT, B, F</td></tr>
<tr><td>FIN acceleration/ deceleration</td><td>Set in order to execute positioning at each pass point associated with a constant-speed control instruction by turning ON the FIN signal.</td><td>——</td><td colspan="4">1 to 5000 (ms)</td></tr>
</table>

Settings Made Using the Sequence Program (Indirect Setting)				Indirect Setting		Processing in Event of Setting Error		
Setting Range				Possible/Not Possible	Number of Words Used	Error Item Data(note-4) (Stored in D9190)	Control Using Default Value	Starting not Possible
mm	inch	degree	PULSE					
0	1	2	3	○	1	11		
1 to 600000000 ($\times 10^{-2}$ mm/min)	1 to 600000000 ($\times 10^{-3}$ inch/min)	1 to 2147483647 ($\times 10^{-3}$ degree/min)	1 to 10000000 (PLS/s)	○	2	12		
1 to 65535 (ms)				○	1	13		
1 to 65535 (ms)				○	1	14		
1 to 65535 (ms)				○	1	15	○	
1 to 100 (%)				○	2	21		
1 to 500 (%)				○	1	16		
0: Deceleration to a stop in accordance with the deceleration time 1: Deceleration to a stop in accordance with the rapid stop deceleration time				○	1	——		
0 to 100000				○	2	17		
1 to 32767				○	——	18	Controlled by K1	
0 to 4095				○	——	19		○
1 to 600000000 ($\times 10^{-2}$ mm/min)	1 to 600000000 ($\times 10^{-3}$ inch/min)	1 to 2147483647 ($\times 10^{-3}$ degree/min)	1 to 10000000 (PLS/s)	○	2	4	○ (Note-2)	○ (Note-3)
——				——	——	——		
0 to 4095				○	1	——		
——				——	——	——		
1 to 5000 (ms)				○	1	13	○	

REMARKS

(Note-2) : When an error occurs because the speed limit value is exceeded, control is executed at the speed limit value.
(Note-3) : Applies when the commanded speed is "0".
(Note-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.

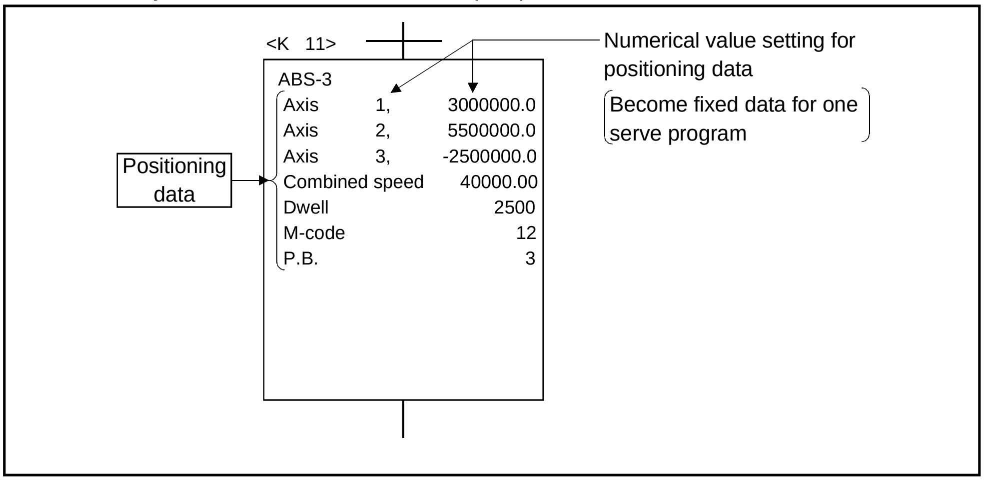


Fig. 6.3 Example of Setting Positioning Data by Numerical Value Setting

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
D	800 to 8191
W	0 to 1FFF

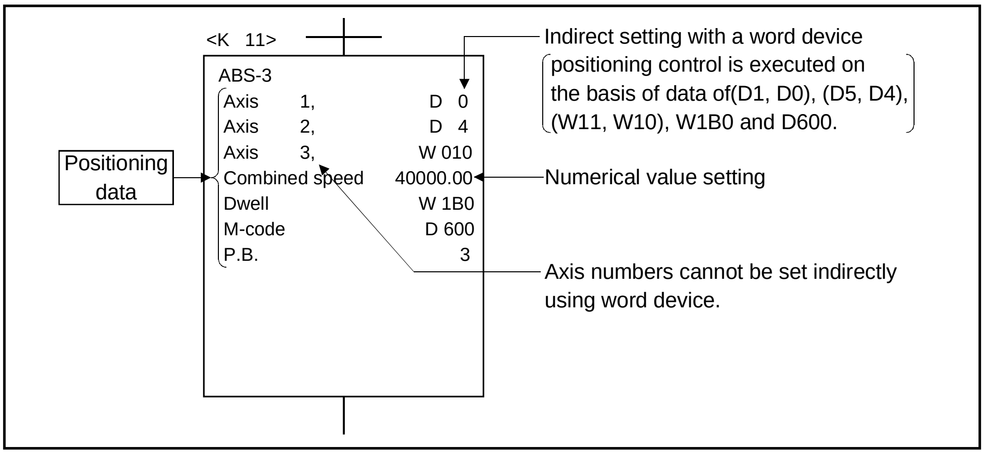


Fig. 6.4 Example of Setting Positioning Data by Numerical Value Setting

(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

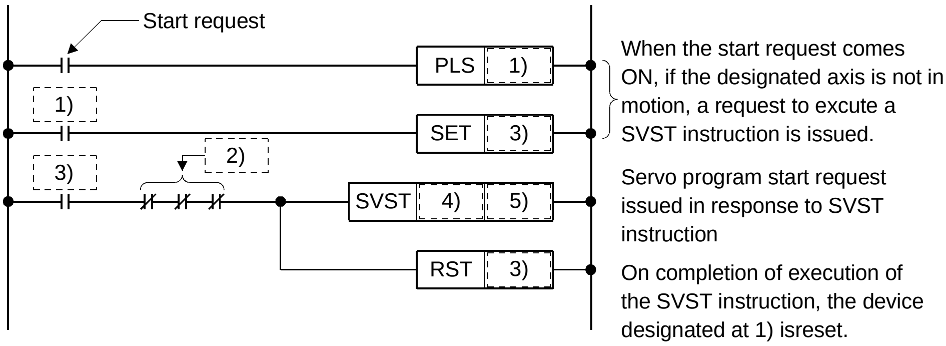
(1) It is not possible to indirectly set axis numbers using word devices with a servo program.
(2) Establish an interlock by using a start accept signal (M2001+n) to ensure that the device data designated for indirect setting is not changed until the designated axis has accepted the start command.
If 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.



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 axis designated in the servo program)
3): 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
SVST instruction execution request flag		M11
Start accept flag	Axis 3	M2003
	Axis 4	M2004

(2) Sequence program example

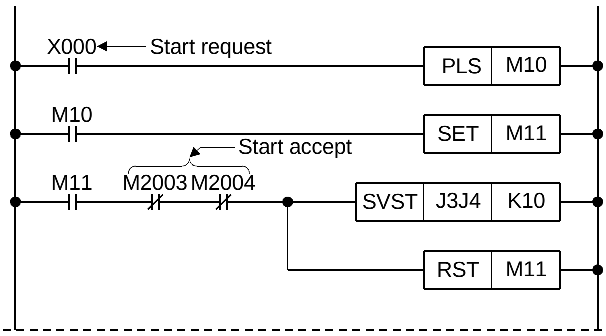
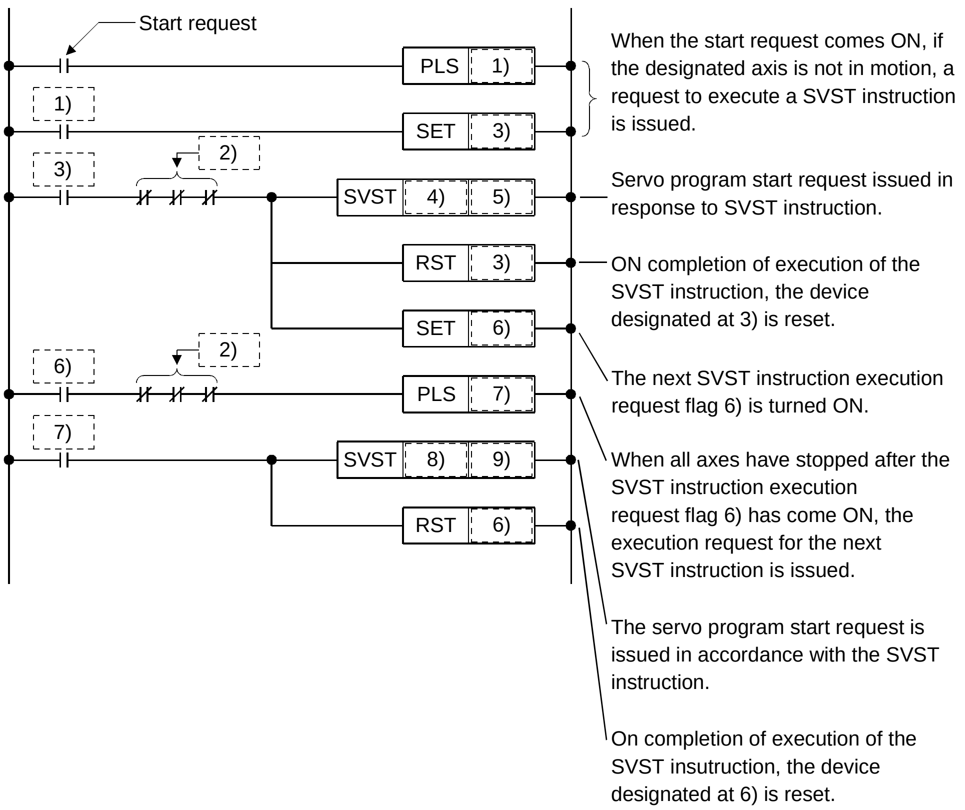


Fig. 6.5 Sequence Program for Starting a Servo Program

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.



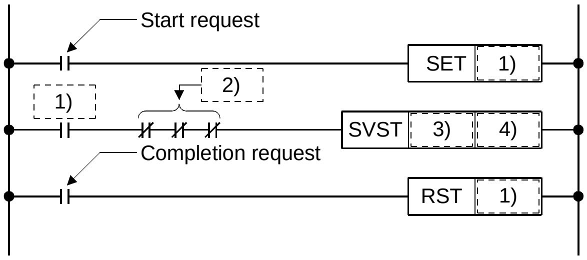
The applications of 1) to 9) are indicated below.

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 axis designated in the servo program)
3), 7): 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.



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

Servo program start request issued in ressponse to SVST instruction.

When the SVST insutruction request comes ON, the device set at 1) is reset.

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

1): 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

7. POSITIONING CONTROL

This section describes the positioning control methods.

7.1 Basics of Positioning Control

This section describes the common items for positioning control, which is described in detail from Section 7.2.

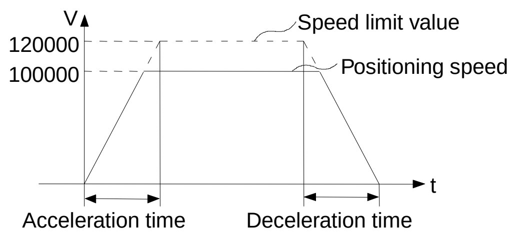
7.1.1 Positioning speed

The positioning speed is set using a servo program. See Section 6 for details about servo programs.
The real positioning speed is determined by the positioning speed setting in the servo program and the speed limit value, according to the following relationship:

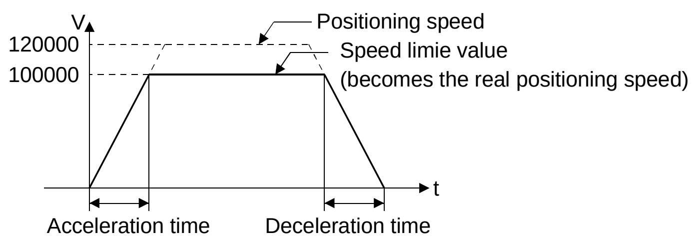
- If positioning speed setting < speed limit value
  positioning occurs at set positioning speed.
- If positioning speed setting > speed limit value
  positioning occurs at speed limit value.

Examples

(1) If the speed limit value is 120,000 mm/min. and the positioning speed setting is 100,000 mm/min., the positioning speed is controlled as follows.



(2) If the speed limit value is 100,000 mm/min. and the positioning speed setting is 120,000 mm/min., the positioning speed is controlled as follows.



7.1.2 Positioning speed under interpolation control

The positioning speed of the servo system CPU determines the travel speed of the controlled system.

(1) 1-axis linear control
Under 1-axis control, the travel speed is the positioning speed of the designated axis.

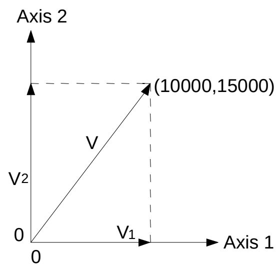
(2) Linear interpolation control
Under linear interpolation control, the controlled system is controlled at the set speed.
The positioning speed can be set for 2 to 4-axis control using one of the following three methods:
- combined speed designation
- long-axis speed designation
- reference-axis speed designation

Details of the servo system CPU control for each of these three methods are described below.

(a) Resultant speed designation
The servo system CPU uses the travel value of each axis (D_1 to D_4) to calculate the positioning speed of each axis (V_1 to V_4) from the set positioning speed (V) of the controlled system.
The positioning speed of the controlled system is called the combined speed.
Set the combined speed and the travel value of each axis in the servo program.

Example

2-axes linear interpolation control



Axis 1 travel value:
D_1 = 10,000 (PULSE)
Axis 2 travel value:
D_2 = 15,000 (PULSE)
Combined speed:
V = 7,000 (PLS/s)

[Program Example]

```
<K   50>
ABS-2
 Axis      1,        10000   (PLS)
 Axis      2,        15000   (PLS)
 Combined speed       7000   (PLS/s)
```

The servo system CPU calculates the positioning speed of each axis from the above conditions, using the following calculation formulas:

Axis 1 positioning speed: $V_1 = V \times D_1/\sqrt{D_1^2+D_2^2}$
Axis 2 positioning speed: $V_2 = V \times D_2/\sqrt{D_1^2+D_2^2}$

(b) Long-axis speed designation
The control of each axis is based on the positioning speed (long-axis speed: V) set for the axis whose positioning address is the greatest distance from the current position.
The servo system CPU uses the travel value of each of the other axes (D_1 to D_4) to calculate the positioning speed of each axis (V_1 to V_4).
Set the long-axis speed and the travel value of each axis in the servo program.

Example

4-axes linear interpolation control

Axis 1 travel value:
D_1 = 10,000 PLS
Axis 2 travel value:
D_2 = 15,000 PLS
Axis 3 travel value:
D_3 = 5,000 PLS
Axis 4 travel value:
D_4 = 20,000 PLS
Long-axis speed:
V = 7,000 PLS/s

[Program Example]

```
<K   51>
ABS-2
 Axis     1,          10000   (PLS)
 Axis     2,          15000   (PLS)
 Axis     3,           5000   (PLS)
 Axis     4,          20000   (PLS)
 Long-axis speed       7000   (PLS/s)
```

In this example, the reference axis is Axis 4, which has the greatest travel value. The positioning speed of Axis 4 is the set long-axis positioning speed. The servo system CPU calculates the positioning speed of each of the other axes using the following calculation formulas:

Axis 1 positioning speed: $V_1 = D_1/D_4 \times V$
Axis 2 positioning speed: $V_2 = D_2/D_4 \times V$
Axis 3 positioning speed: $V_3 = D_3/D_4 \times V$

Conversions are conducted as follows if the control units are not identical for each axis.

1) Combination of axes set in millimeters and inches
   a) If interpolation control units are millimeters
      - Travel value : For axis set to inches, the travel value is converted to millimeters using the formula:inch set value × 25.4 = mm set value.
      - Speed : Speed control of each axis is based on the long-axis speed, which is the positioning speed of the axis with the greatest travel value after conversion.
   b) If interpolation control units are inches
      - Travel value : For axis set to millimeters, the travel value is converted to inches using the formula: mm set value ÷ 25.4
      - Speed : Speed control of each axis is based on the long-axis speed, which is the positioning speed of the axis with the greatest travel value after conversion.
2) Discrepancy between interpolation control units and control units
      - Travel value : The electronic gear converts the travel value for the axis to PULSE.
      - Speed : Speed control of each axis is based on the long-axis speed, which is the positioning speed of the axis with the greatest travel value after conversion. For axis where interpolation control units and control units match, the electronic gear converts the positioning speed to units of PLS/ s and this speed is used as the long-axis speed.

POINTS

(1) Speed limit value and positioning speed
- The set speed limit value applies to the long-axis speed.
- Note that the combined speed may exceed the speed limit value if long-axis speed designation is used.

Example

During 2-axes linear interpolation with the following settings, the combined speed exceeds the speed limit value.

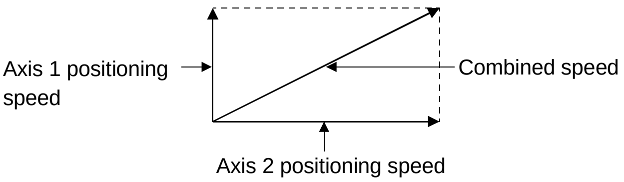
Axis 1 travel value: 100 PLS
Axis 2 travel value: 200 PLS
Long-axis speed: 50 PLS/s
Speed limit value: 55 PLS /s

[Program Example]

```
<K   51>
ABS-2
 Axis   1,        10000   (PLS)
 Axis   2,        15000   (PLS)
 Axis   3,         5000   (PLS)
 Axis   4,        20000   (PLS)
 Long-axis speed   7000   (PLS/s)
```

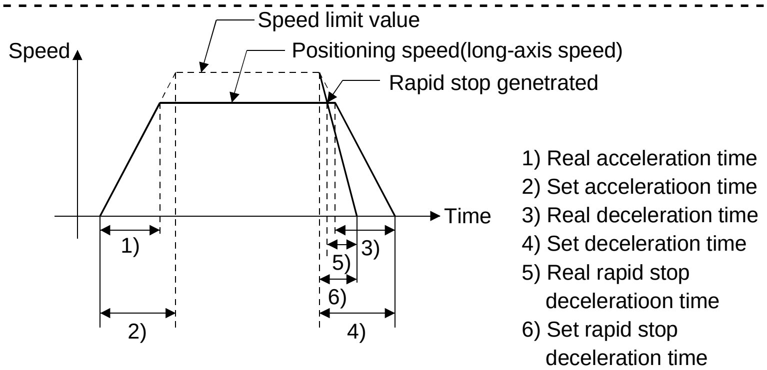
In this example, the reference axis is Axis 2, which has the greatest travel value; therefore the set speed limit value applies to Axis 2.
In this case, the positioning speed of each axis and the combined speed are as follows:

Axis 1 positioning speed: $(100/200) \times 50 = 25$ PLS /s
Axis 2 positioning speed: 50 PLS /s
Combined speed: $\sqrt{25^2+50^2} = 55.9$ PLS /s



The combined speed exceeds the speed limit value setting of 55.

(2) Relationship between speed limit value, acceleration time, deceleration time, and rapid stop deceleration time
- The real acceleration time, deceleration time, and rapid stop deceleration time are determined by the long-axis speed setting.



(c) Reference-axis speed designation

The servo system CPU uses the travel value of each axis (D_1 to D_4) to calculate the positioning speed of each axis (V_1 to V_4) from the set positioning speed of the reference axis (reference axis speed: V).

Set the reference axis number, reference axis speed, and the travel value of each axis in the servo program.

Example

4-axes linear interpolation control

Axis 1 travel value:
D_1 = 10,000 PLS
Axis 2 travel value:
D_2 = 15,000 PLS
Axis 3 travel value:
D_3 = 5,000 PLS
Axis 4 travel value:
D_4 = 20,000 PLS
Reference axis speed:
V = 7,000 PLS /s
Reference axis number: Axis 4

In this example, Axis 4 is set as the reference axis and the control is based on the positioning speed of Axis 4.

The servo system CPU calculates the positioning speed of each of the other axes using the following calculation formulas:

Axis 1 positioning speed: $V_1 = D_1/D_4 \times V$
Axis 2 positioning speed: $V_2 = D_2/D_4 \times V$
Axis 3 positioning speed: $V_3 = D_3/D_4 \times V$

[Program Example]

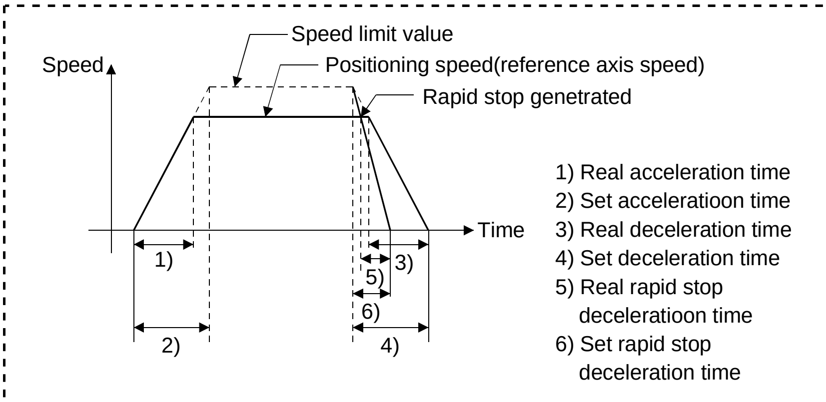
```
<K   52>
ABS-4
 Axis       1,              10000   (PLS)
 Axis       2,              15000   (PLS)
 Axis       3,               5000   (PLS)
 Axis       4,              20000   (PLS)
 Reference axis speed        7000   (PLS/s)
 Reference axis number          4
```

POINTS

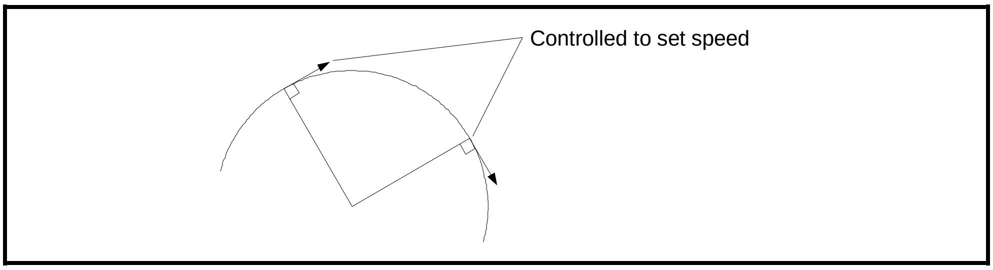
(1) Reference axis speed and positioning speed of other axes
- Note that the positioning speed of an axis with a greater travel value than the reference axis will exceed the set reference axis speed.

(2) Indirect designation of reference axis
- The reference axis can be indirectly designated using word devices D and W. See Section 6.4.2.

(3) Relationship between speed limit value, acceleration time, deceleration time, and rapid stop deceleration time
- The real acceleration time, deceleration time, and rapid stop deceleration time are determined by the reference axis speed setting.



(3) Circular interpolation control
Under circular interpolation control, the angular speed is controlled to the set speed.



7.1.3 Control units for 1-axis positioning control

Positioning control of 1-axis is conducted in the control units designated in the fixed parameters.
(The control unit designation in the parameter block is ignored.)

7.1.4 Control units for interpolation control

(1) The interpolation control units designated in the parameter block are checked against the control units designated in the fixed parameters.
For interpolation control, the result of the interpolation control units designated in the parameter block differing from the control units designated in the fixed parameters are listed in the following table.

	Interpolation Control Units in Parameter Block				**Start Method**
	mm	**inch**	**degree**	**PULSE**	
Normal start conditions	Fixed parameters designate mm and inch control units for axis.		Fixed parameters designate degree control units for axis.	Fixed parameters designate pulse control units for axis.	Control started using interpolation control units designated in the parameter block.
Unit discrepancy error (Error code 40)	Discrepancy between fixed parameter control units and the parameter block interpolation control units for all axes.				• Control started using set control units when control units match for axis under interpolation control. • Control started using the control units with the highest order of priority (see below) when control units differ for axis under interpolation control. Order or priority PLS > degree > inch > mm <Example> If axis is set to 1000 PLS and 10.000 inch, the 10.000 inch setting is considered to be 10,000 PLS.

(2) The possible combinations of control units for interpolation control for the axis is shown in the table below.

	mm	**inch**	**degree**	**PULSE**
mm	1)	2)	3)	3)
inch	2)	1)	3)	3)
degree	3)	3)	1)	3)
PULSE	3)	3)	3)	1)

Remarks
1) Same units
2) Combination of mm and inches
3) Discrepancy

(a) Same units (1))
Positioning is conducted using position commands calculated from the address, travel value, positioning speed, and electronic gear.

POINT

(1) Circular interpolation control
If control units for one axis are degrees, use degrees also for the other axis.

(b) Combination of millimeters and inches (2))

- If interpolation control units are millimeters, positioning is conducted using position commands calculated from the address, travel value, positioning speed, and electronic gear, which have been converted to millimeters using the formula: inch set value × 25.4 = mm set value.
- If interpolation control units are inches, positioning is conducted using position commands calculated from the address, travel value, positioning speed, and electronic gear, which have been converted to inches using the formula: millimeter set value ÷ 25.4 = inch set value.

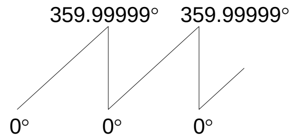
(c) Discrepancy (3))

- If a discrepancy exists between interpolation control units and the control units, the travel value and positioning speed are calculated for each axis.
  a) The electronic gear converts the travel value for the axis to PULSE.
  b) For axis where the units match, the electronic gear converts the positioning speed to units of PLS /s.
  Positioning is conducted using position commands calculated from travel values converted to PULSES and speeds and electronic gear converted to PULSE per second.
- If the interpolation control units match for two or more axes during linear interpolation with 3-axes or more, the positioning speed is calculated using the electronic gear for the axis with the lowest number.

7.1.5 Control using degrees as control units

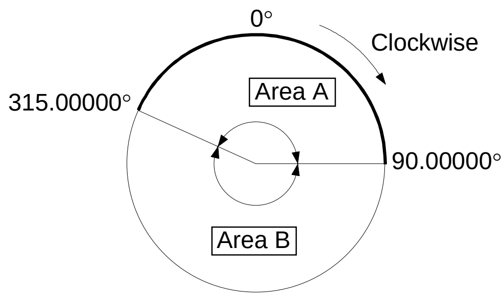
If the control units are degrees, the following items differ from when other control units are set.

(1) Current address
When degrees are set, the current addresses become ring addresses between 0° and 360°.



(2) Stroke limit valid/invalid setting
For degree settings, the upper limit value and lower limit value lie in the range between 0° and 359.99999°.

(a) If the stroke limit is valid
If the stroke limit is valid, set the stroke limit upper limit value and lower limit value in a clockwise direction.



1) For travel in area A, set the limit values as follows:
   a) Stroke limit lower limit value: 315.00000°
   b) Stroke limit upper limit value: 90.00000°
2) For travel in area B, set the limit values as follows:
   a) Stroke limit lower limit value: 90.00000°
   b) Stroke limit upper limit value: 315.00000°

(b) If the stroke limit is invalid
If the stroke limit is invalid, set the stroke limit upper limit value equal to the lower limit value.
The stroke limit settings are ignored during control.

POINT

(1) Circular interpolation is not possible for axis set with the stroke limit invalid.
(2) After you have changed the upper/lower limit value with the stroke limit valid, perform zeroing.
(3) When the stroke limit is valid in an incremental system, perform zeroing after power-on.

(3) Positioning control

Positioning control using degrees as control units is described below.

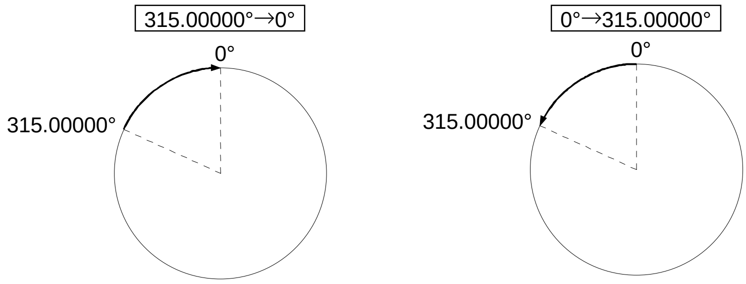
(a) Absolute data method (ABS □ instructions)

The absolute data method uses the current value as reference to position the axis in the shortest distance to the designated address.

Examples

(1) Positioning occurs clockwise to travel from the current value of 315.00000° to 0°.

(2) Positioning occurs counterclockwise to travel from the current value of 0° to 315.00000°.

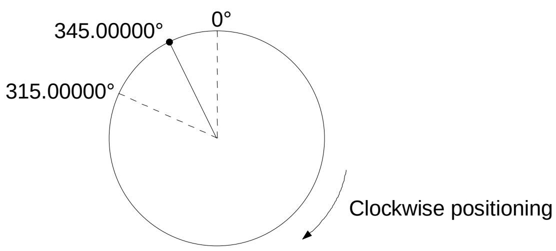


POINTS

(1) In some cases the stroke limit settings determine clockwise or counterclockwise rotation and absolute data method positioning in the shortest distance may not be possible.

Example

Travel from the current value 0° to 315.00000° must be clockwise if the stroke limit lower limit value is set to 0° and the upper limit value is set to 345.00000°.



(2) Set positioning addresses in the range between 0° and 360°.
Use the incremental method for positioning in excess of one revolution.

(b) Incremental method (INC □ instructions)

The incremental method positions the axis by a designated travel value in the designated direction.

The travel direction is designated by the sign of the travel value, as follows:

1) Positive travel value ....clockwise rotation
2) Negative travel value...............counterclockwise rotation

POINT

The incremental method permits positioning in excess of 360°.

7.1.6 Stop processing and restarting after a stop

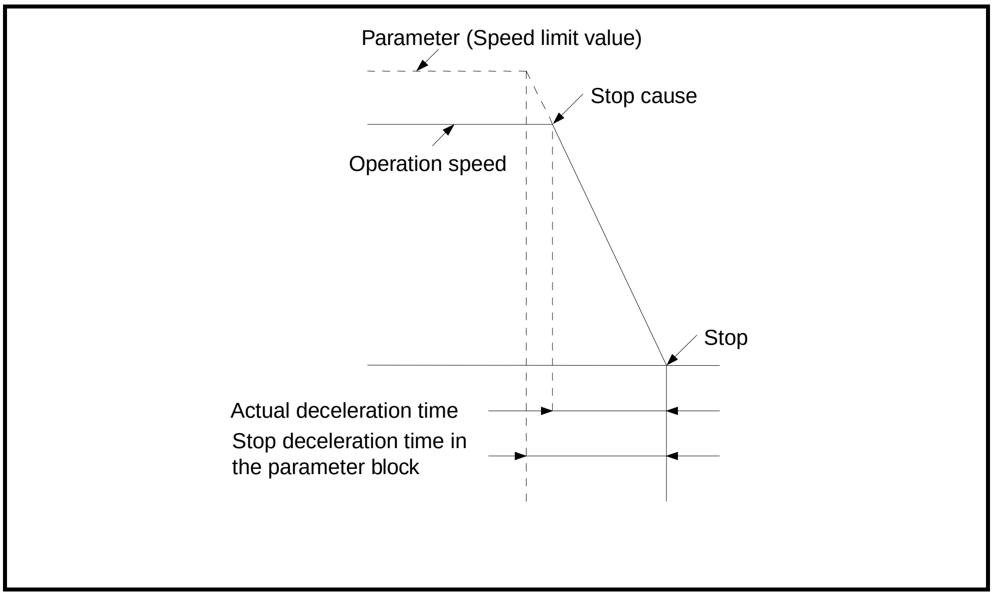
This section describes the stop processing after a stop cause is input during positioning, and restarting after a stop.

(1) Stop processing

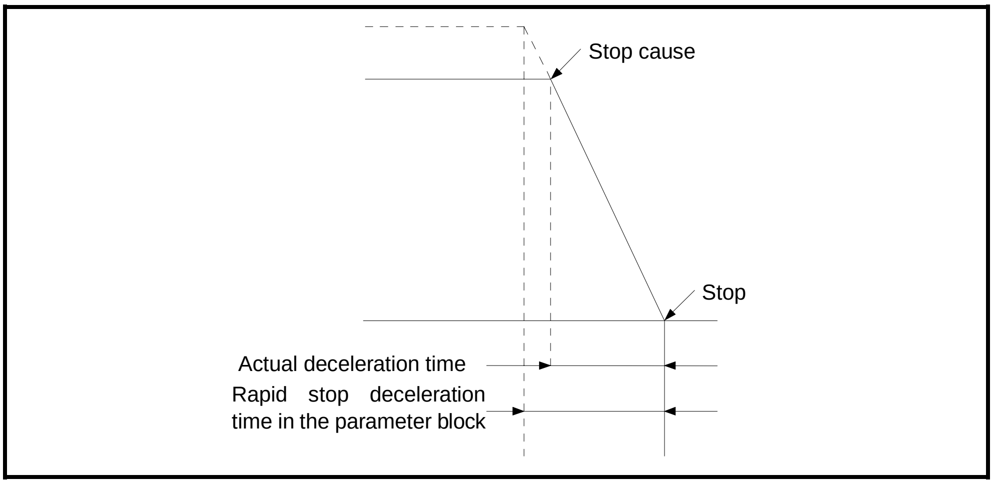
(a) Stop processing methods

Stop processing during positioning depends on the type of stop cause which was input.

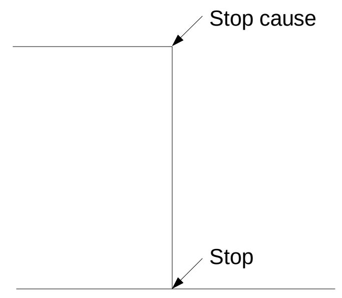
1) Deceleration stop .... Decelerates and stops according to the stop (Process 1) deceleration time parameter in the parameter block.



2) Rapid stop .... Decelerates and stops according to the rapid stop (Process 2) deceleration time parameter in the parameter block.



3) Immediate stop .... Stops without deceleration processing.
(Process 3)



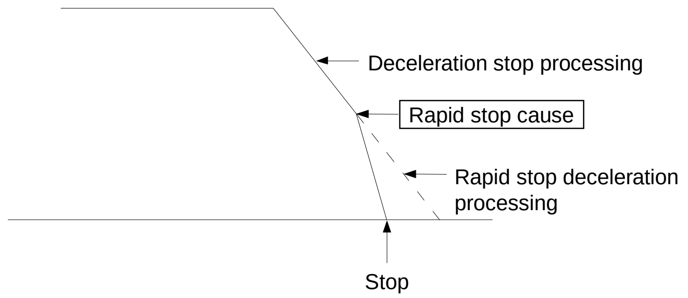
(b) Order of priority for stops
The order of priority for stops when a stop cause is input is as follows:

Process 1 < Process 2 <Process 3

Example

A rapid stop (Process 2) is started if a rapid stop cause is input during one of the following types of deceleration stop processing:

- after automatic deceleration starts during positioning control;
- during deceleration after JOG start signal turns OFF;
- during deceleration stop processing due to a stop cause (Process 1).



(c) Stop commands and stop causes
Some stop commands and stop causes affect individual axis and others affect all axes.
However, during interpolation control, stop commands and stop causes which affect individual axis also stop the interpolation axis.
For example, both Axis 1 and Axis 2 stop after input of a stop command or stop cause during interpolation control of Axis 1 and Axis 2.

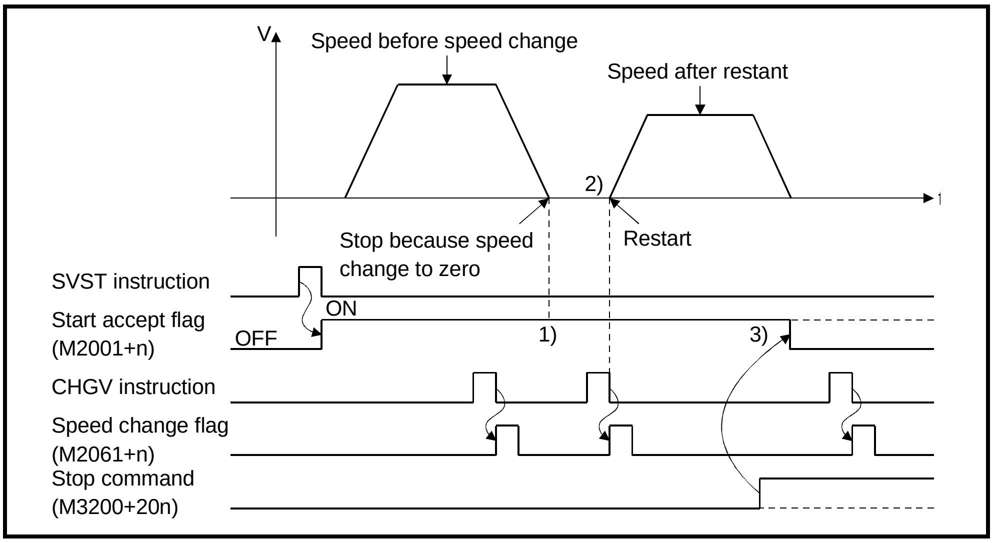
<table>
<tr><th rowspan="2">No.</th><th rowspan="2">Stop Cause</th><th rowspan="2">Individual/All Axes</th><th colspan="5">Stop</th><th rowspan="2">Error Processing</th></tr>
<tr><th>Positio-ning Control</th><th>Speed Control</th><th>Jog Operation</th><th>Zeroing</th><th>Manual Pulse Generator</th></tr>
<tr><td>1</td><td>External STOP input ON</td><td rowspan="6">Individual</td><td colspan="4">Process 1 or Process 2
(According to deceleration processing on STOP input parameter in parameter block.)</td><td rowspan="14">Process 3</td><td rowspan="9">Serious error during zeroing only</td></tr>
<tr><td>2</td><td>Stop command M3200+20n ON</td><td colspan="4">Process 1</td></tr>
<tr><td>3</td><td>Rapid stop command M3201+20n ON</td><td colspan="4">Process 2</td></tr>
<tr><td>4</td><td>External FLS input OFF</td><td colspan="4" rowspan="2">Process 1 or Process 2
(According to deceleration processing on STOP input parameter in parameter block.)</td></tr>
<tr><td>5</td><td>External RLS input OFF</td></tr>
<tr><td>6</td><td>Servo error detect M2408+20n ON</td><td colspan="4">Process 3</td></tr>
<tr><td>7</td><td>PLC ready M2000 OFF</td><td rowspan="7">All</td><td colspan="4">Process 1</td></tr>
<tr><td>8</td><td>Emergency stop from exterior (Note–2), BREAK key pressed</td><td colspan="4">Process 2</td></tr>
<tr><td>9</td><td>Servo system CPU stop</td><td colspan="4">Process 1</td></tr>
<tr><td>10</td><td>Servo system reset</td><td colspan="4">Process 3 (Note–1)</td><td>—</td></tr>
<tr><td>11</td><td>PCPU WDT error</td><td colspan="4">Process 3 (Note–1)</td><td>M9073 (WDT error) ON</td></tr>
<tr><td>12</td><td>SCPU WDT error</td><td colspan="4">Process 1</td><td>—</td></tr>
<tr><td>13</td><td>Servo system CPU power off</td><td colspan="4">Process 3 (Note–1)</td><td>—</td></tr>
<tr><td>14</td><td>Servo amplifier power off</td><td>Individual</td><td colspan="4">Process 3 (Note–1)</td><td>Serious error at start-up (no servo)</td></tr>
<tr><td>15</td><td>Speed changed to zero</td><td>Individual (Note–3)</td><td colspan="4">Process 1</td><td></td><td>—</td></tr>
</table>

(Note–1) : Emergency stop due to H/W
(Note–2) : Test mode
(Note–3) : Applies to all axes set to speed = 0 in servo program.

(2) Restarting after a Stop

(a) Control cannot be restarted after a stop command or stop cause (except changing speed to zero).
However, restarting is possible using the VSTART instruction after a stop due to the external STOP input, the stop command (M3200+20n) turning ON, or the rapid stop command (M3201+20n) turning ON during speed/position switching control.

(b) When the stop is caused by a speed change to speed "0"
When a speed change to speed "0" is executed in the CHGV instruction, operation can be restarted by executing another speed change to a speed other than "0".



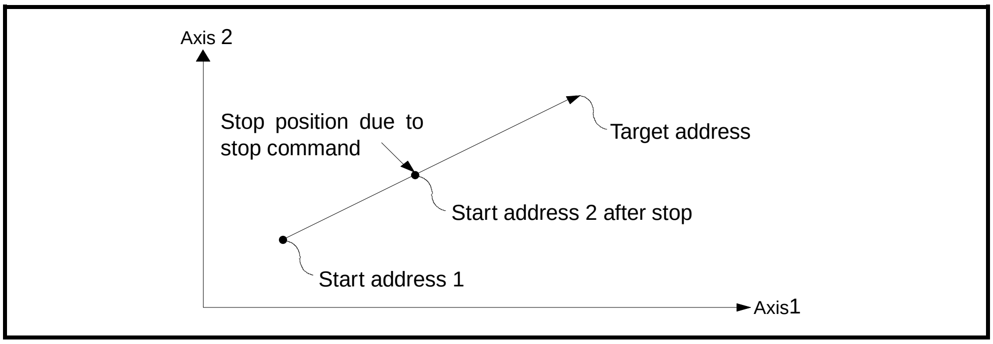
1) The start accept flag M2001+n remains ON after a stop due to changing the speed to zero.
2) Restart after changing the speed again.
3) However, control cannot be restarted after the speed is changed if the start accept flag M2001+n is turned OFF due to the stop command (M3200+20n) turning ON.

(3) Continuing positioning control

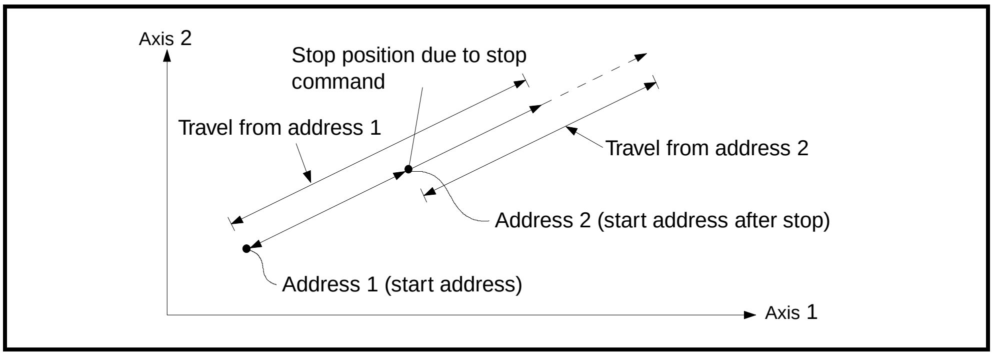
This section describes the method to continue control from the servo program number where the stop was applied by turning ON the external STOP input, the stop command (M3200+20n), or the rapid stop command (M3201+20n).

(a) 1-axis linear control/2 or 3-axes linear interpolation control

1) Absolute data method....... As a target address is designated, positioning control is possible from the stop address to the target address.

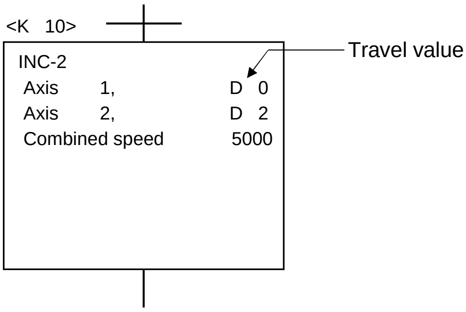


2) Incremental method........Positioning control of the travel value from the stop address.

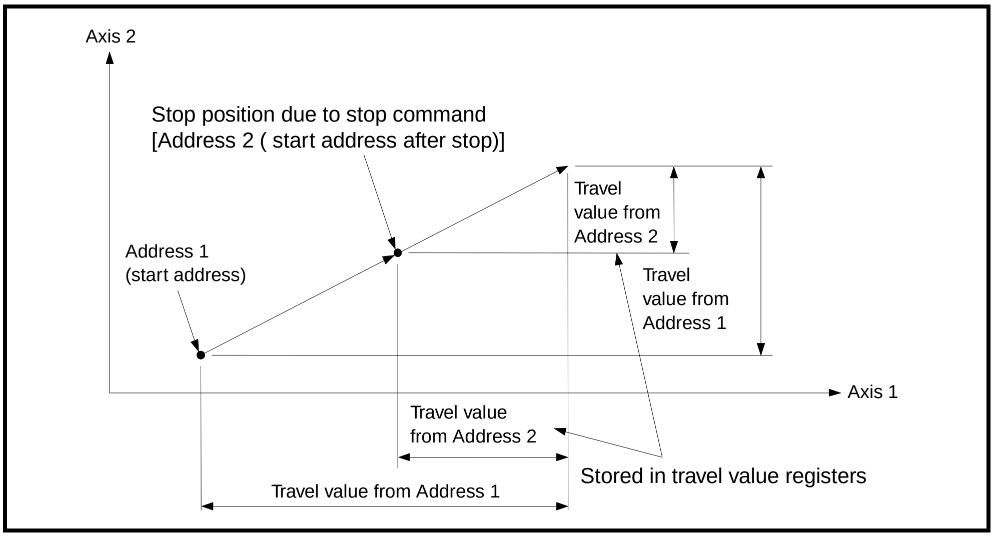


To use the incremental method to travel to the original address (calculated from start address + designated travel value) from address 2, requires the following processing in the servo program and sequence program.

[Servo Program]
Use word devices for indirect designation of the travel value in the positioning control servo program.



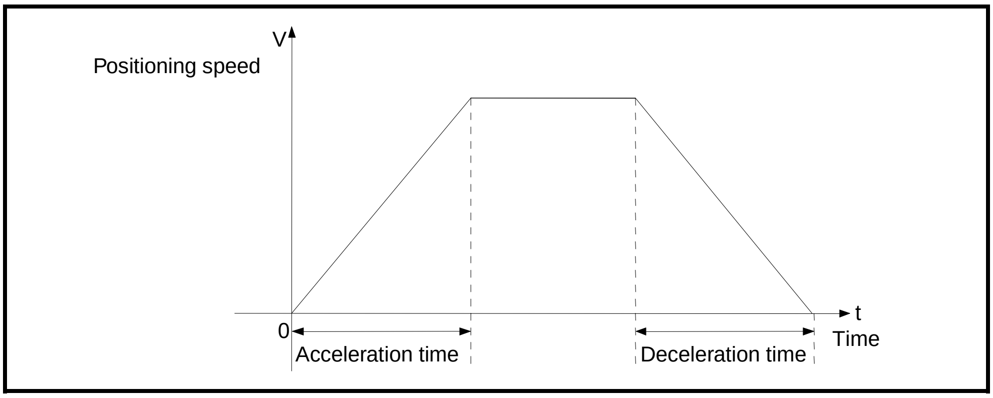
[Processing in the Sequence Program]
1. Before starting, transfer the start address to the servo system CPU word devices.
2. Add the travel value to the start address to calculate the target address.
3. Subtract the stop address from the target address to calculate the residual travel value.
4. Store the residual travel value in the servo program travel value register.
5. Run the servo program from the sequence program.



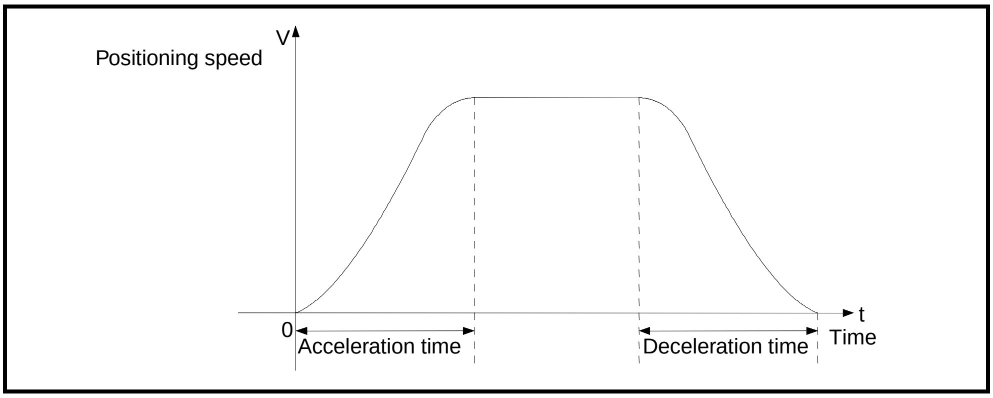
7.1.7 Acceleration and deceleration processing

Acceleration and deceleration are processed by the two methods described below.

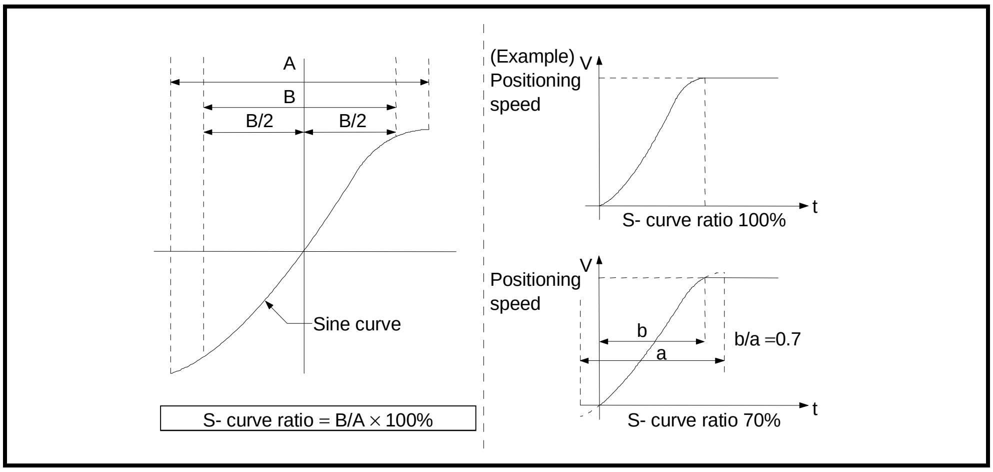
(1) Trapezoidal acceleration and deceleration processing
The conventional linear acceleration and deceleration processing. The acceleration and deceleration graph resembles a trapezoid, as shown in the diagram below.
The acceleration and deceleration times are set automatically.



(2) S-curve acceleration and deceleration processing
The S-curve ratio is set as a parameter to provide gentler acceleration and deceleration than trapezoidal processing. The acceleration and deceleration graph is sinusoidal, as shown in the diagram below.
Set the S-curve ratio in the parameter block (see Section 4.4.2) or in a servo program.



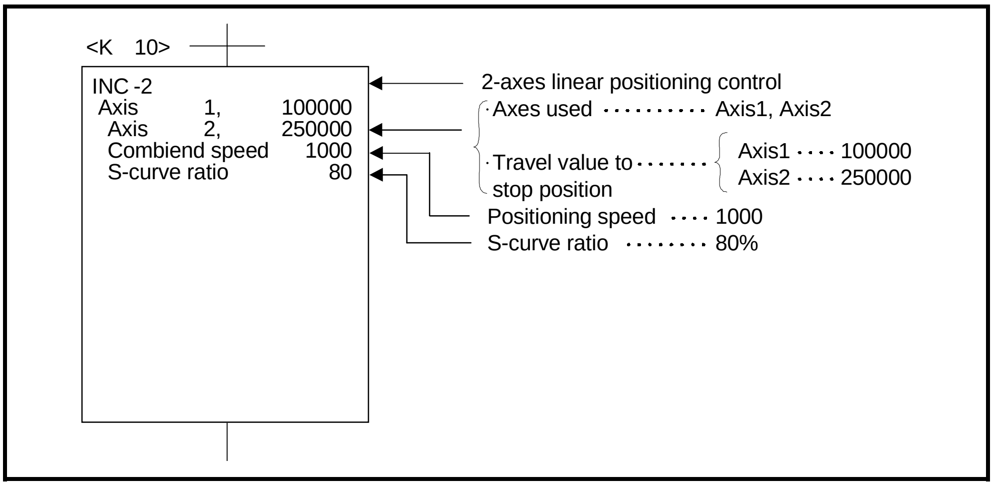
As shown in the diagram below, the S-curve ratio sets the part of the sine curve used to produce the acceleration and deceleration curve.



The S-curve ratio can be set by a servo program using one of two methods.

(a) Direct designation

The S-curve ratio is designated directly as a numeric value from 0 to 100.

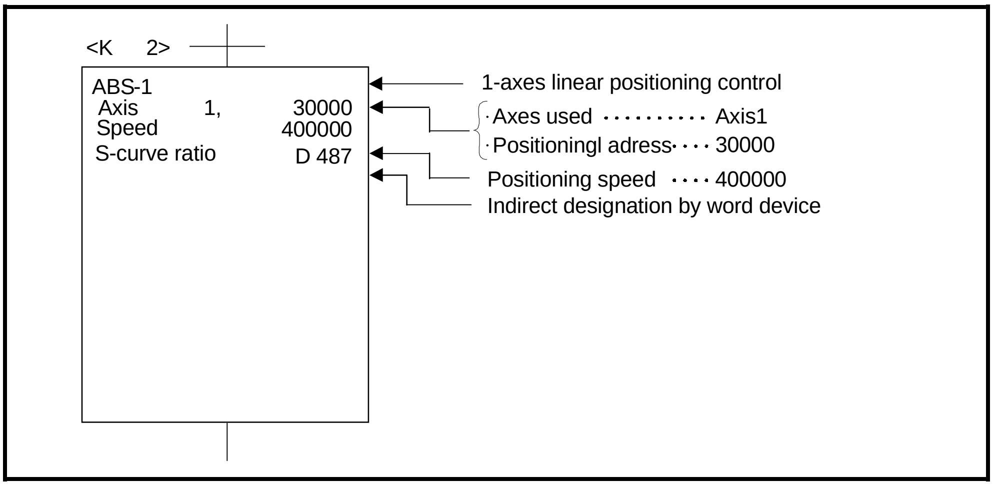


(b) Indirect designation

The S-curve ratio is set by the contents of the data registers.

The available data registers are shown below.

Word Device	Usable Device
D	800 to 8191
W	0 to 1FFF



7.2 1-Axis Linear Positioning Control

Positioning control of the designated axis from the current stop position to a fixed position.
Positioning control uses ABS-1 (absolute data method) and INC-1 (incremental method) servo instructions.

Servo Instruction	Positioning Method	Number of Controllable Axes	Items Set by Peripherals																					
			Common							Arc			Parameter Block									Others		
			Parameter Block No.	Axis	Address/Travel Value	Commanded Speed	Dwell Time	M-Code	Torque Limit Value	Auxiliary Point	Radius	Center Point	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	Cancel	Start	Speed Change
ABS-1	Absolute data	1	Δ	○	○	○	Δ	Δ						Δ	Δ	Δ	Δ	Δ	Δ		Δ	Δ	Δ	OK
INC-1	Incremental																							

○ : Must be set
Δ : Set if required

[Control Details]

Control with ABS-1 (absolute data method)

(1) Positioning control from the current stop address (pre-positioning address) to the designated address, using the home position as the reference.

(2) The travel direction is determined from the current stop address and the designated address.

Example

The travel direction is shown below if the current stop address is 1000, and the designated address is 8000.

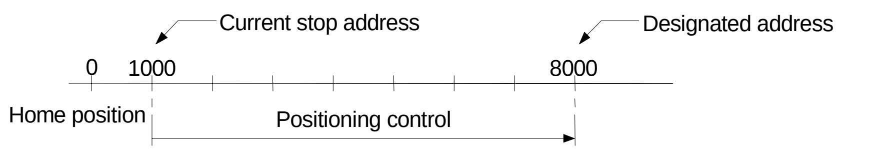


Fig.7.1 Positioning by Absolute Data Method

Control with INC-1 (incremental method)

(1) Positioning control of a designated travel value from the current stop position.

(2) The travel direction is designated by the sign of the travel value, as follows:
- Positive travel value ....forward direction (increased address)
- Negative travel value............reverse direction (decreased address)

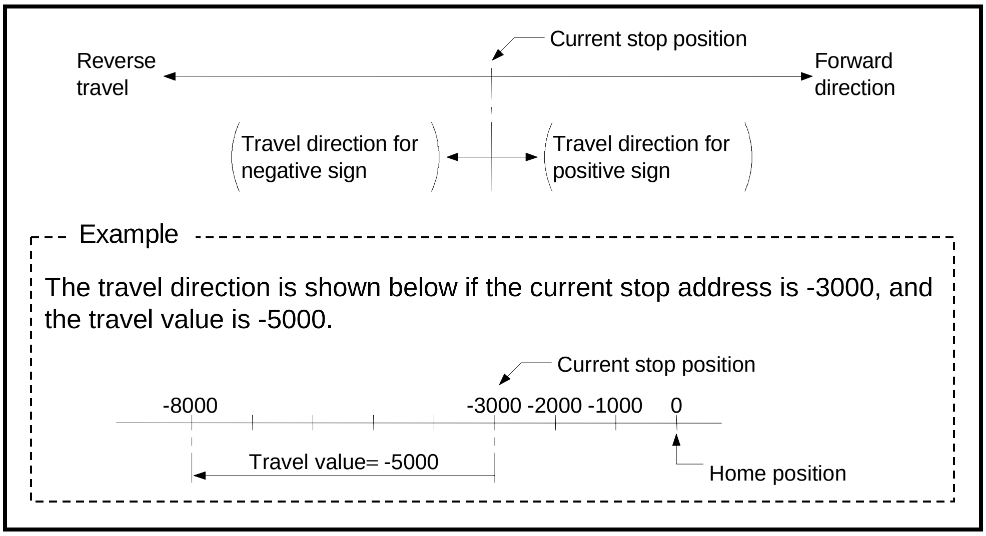


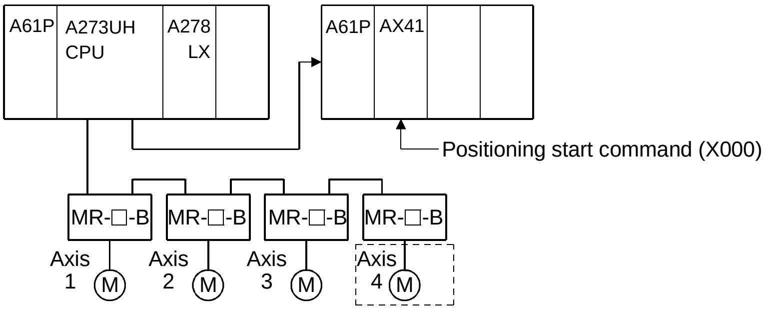
Fig.7.2 Positioning by Incremental Method

[Program Example]

This program conducts positioning control using servo program No. 0 under the conditions below.

(1) System configuration

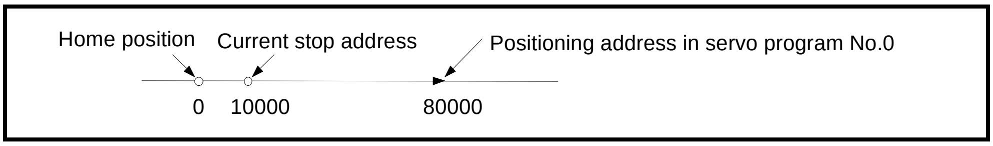
1-axis linear positioning control of Axis 4.



(2) Positioning details

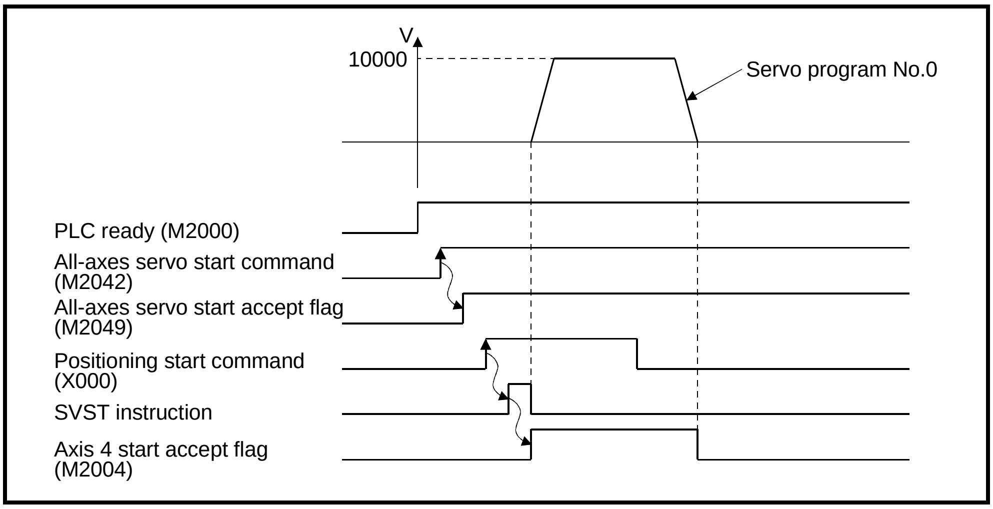
The positioning by servo program No. 0 is shown in the diagram below.

In this example, Axis 4 is used in servo program No. 0.

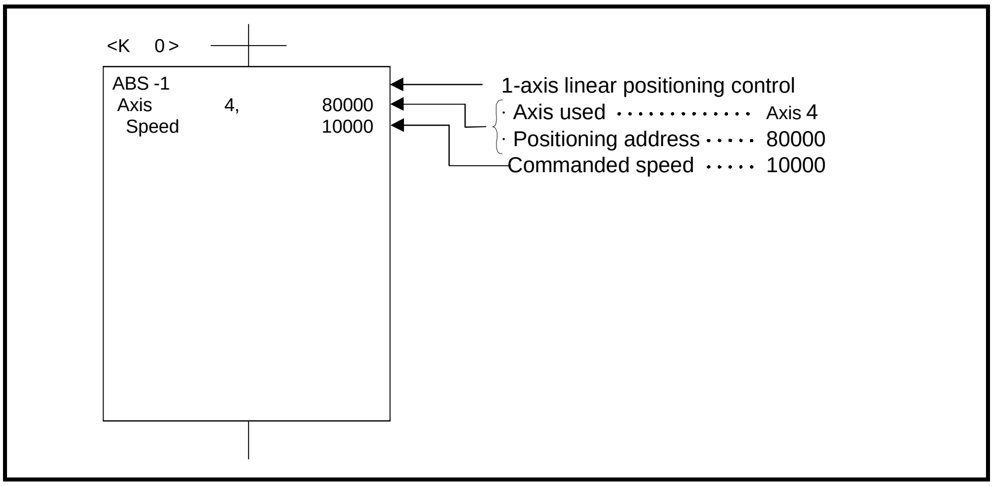


(3) Operation timing

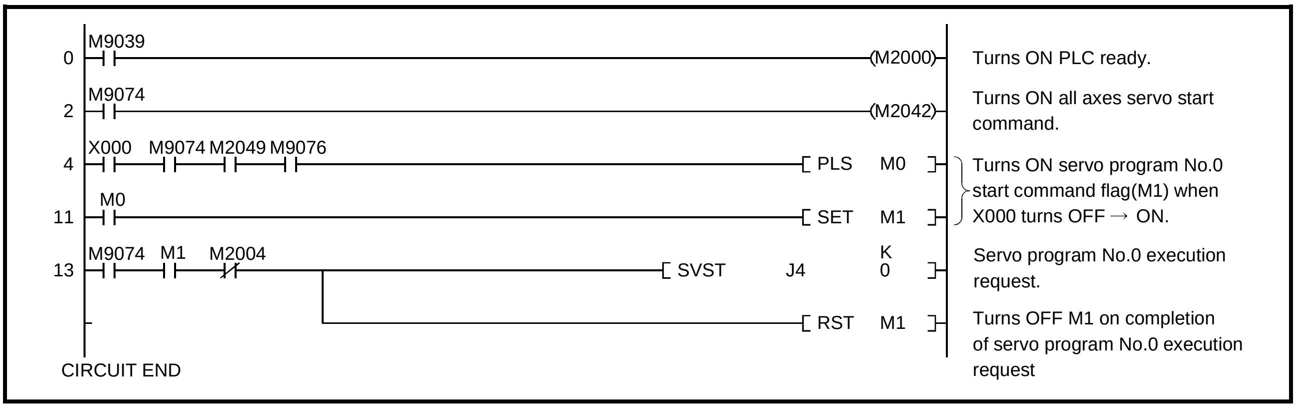
The operation timing for servo program No. 0 is shown below.



(4) Servo program example
The servo program No. 0 for positioning control is shown below.



(5) Sequence program example
The sequence program which runs the servo program is shown below.



7.3 2-Axes Linear Interpolation Control

Linear interpolation control from the current stop position with the 2-axes designated in the sequence program positioning commands.
2-axes linear interpolation control uses ABS-2 (absolute data method) and INC-2 (incremental method) servo instructions.

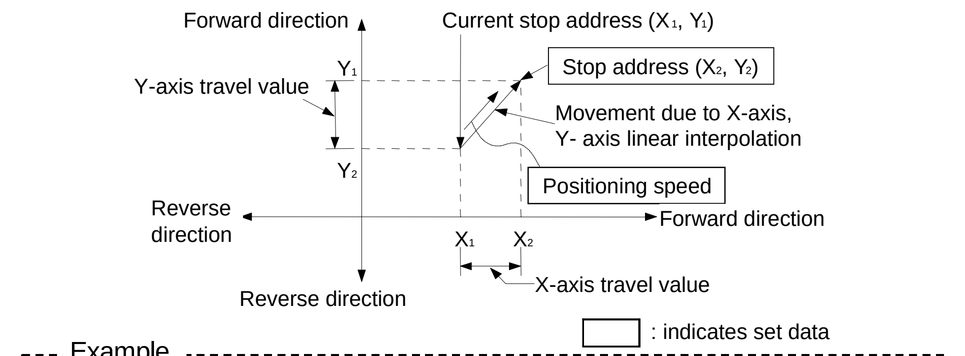
Servo Instruction	Positioning Method	Number of Controllable Axes	Items Set by Peripherals																					
			Common							Arc			Parameter Block									Others		
			Parameter Block No.	Axis	Address/Travel Value	Commanded Speed	Dwell Time	M-Code	Torque Limit Value	Auxiliary Point	Radius	Center Point	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	Cancel	Start	Speed Change
ABS-2	Absolute data	2	Δ	○	○	○	Δ	Δ					Δ	Δ	Δ	Δ	Δ	Δ	Δ		Δ	Δ	Δ	OK
INC-2	Incremental																							

○ : Must be set
Δ : Set if required

[Control Details]

Control with ABS-2 (absolute data method)

(1) Linear interpolation with 2-axes from the current stop address (X_1, Y_1) to the designated address (X_2, Y_2), using the home position as the reference.
(2) The travel direction is determined from the stop addresses and designated addresses for the respective axes.



Example

The travel direction is shown below if the current stop address is (1000, 4000), and the designated stop address is (10000, 2000).

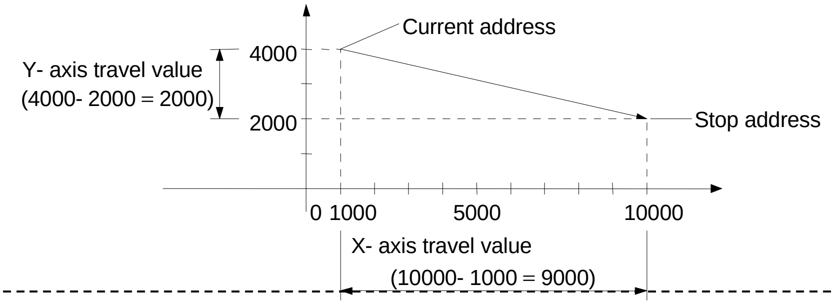
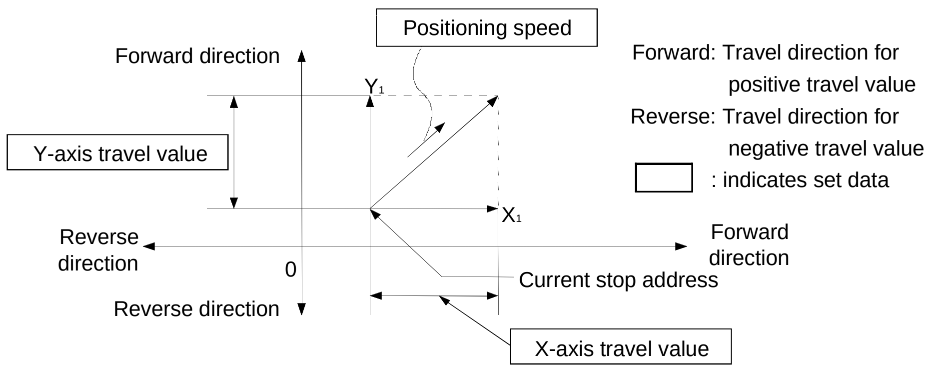


Fig.7.3 Positioning by Absolute Data Method

Control with INC-2 (incremental method)

(1) Positioning control from the current stop position to the position which is the resultant of the designated travel directions and travel values of the respective axis.

(2) The travel direction of each axis is designated by the sign of the travel value, as follows:
- Positive travel value ....forward direction (increased address)
- Negative travel value............reverse direction (decreased address)



Example

The travel direction is shown below for an X-axis travel value of 6000 and Y-axis travel value of -2000.

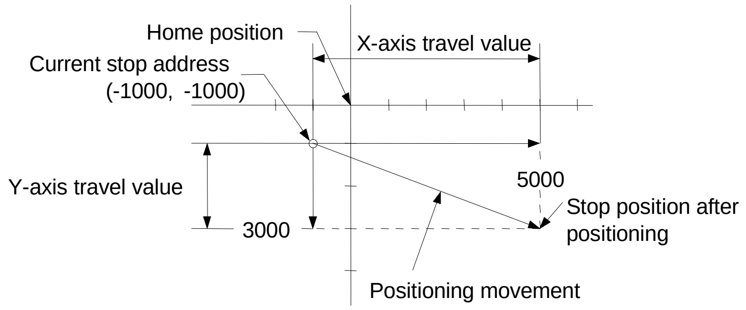
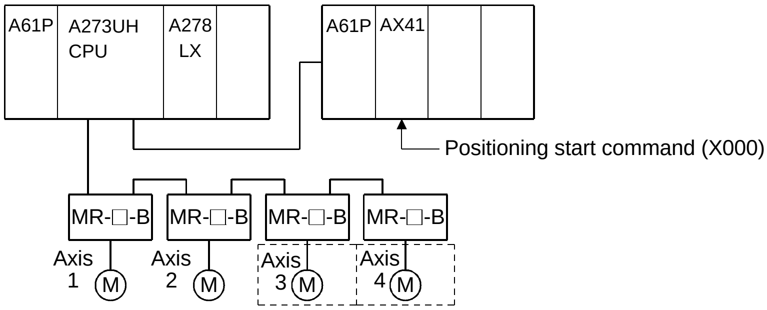


Fig.7.4 Positioning by Incremental Method

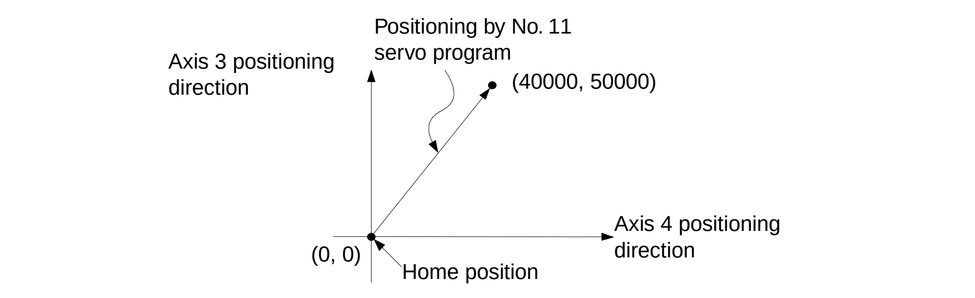
[Program Example]

This program conducts 2-axes linear interpolation control under the conditions below.

(1) System configuration
2-axes linear interpolation control of Axis 3 and Axis 4.



(2) Positioning details
The positioning by the Axis 3 and Axis 4 servo motors is shown in the diagram below.



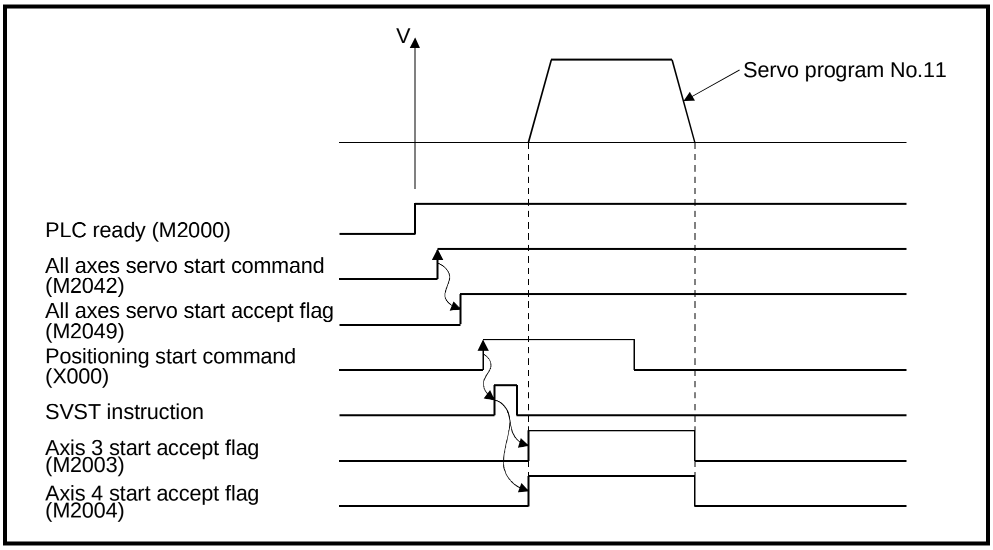
(3) Positioning conditions
(a) The positioning conditions are shown below.

Item	Servo Program Number
	No. 11
Positioning speed	30000

(b) Positioning start........... leading edge of X000 (OFF → ON)

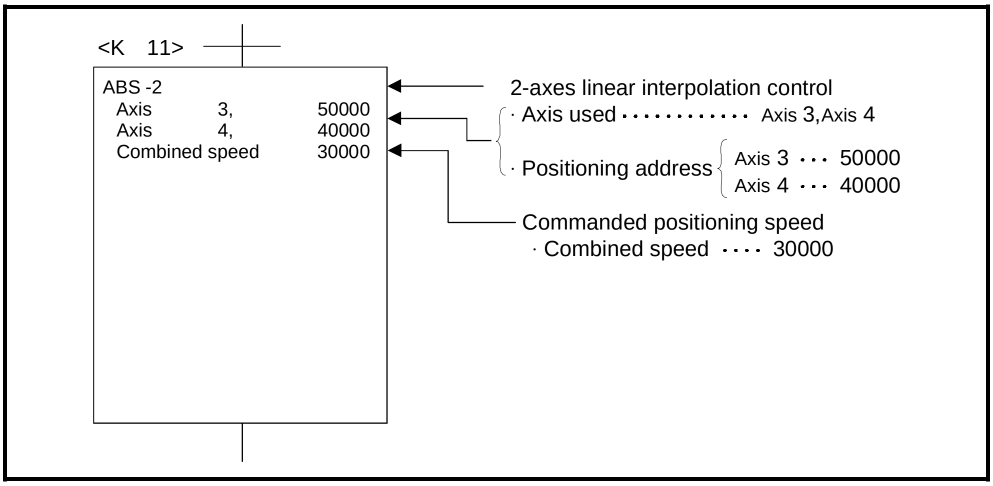
(4) Operation timing

The operation timing for 2-axes linear interpolation control is shown below.



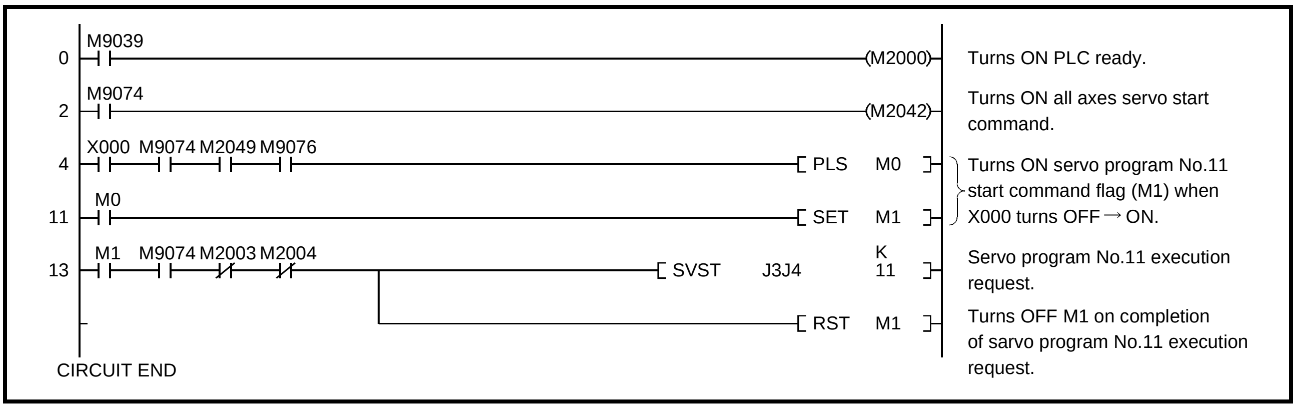
(5) Servo program

The servo program No. 11 for 2-axes linear interpolation control is shown below.



(6) Sequence program

The sequence program which runs the servo program is shown below.



7.4 3-Axes Linear Interpolation Control

Linear interpolation control from the current stop position with the 3-axes designated in the sequence program positioning commands.

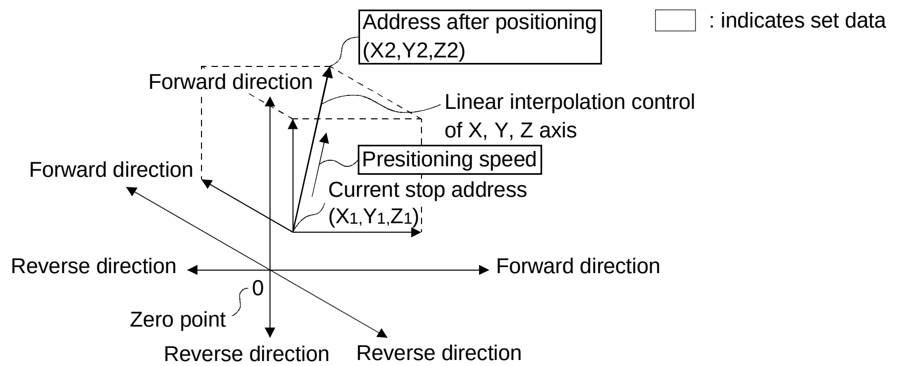
Servo Instruction	Positioning Method	Number of Controllable Axes	Items Set by Peripherals																					
			Common							Arc			Parameter Block									Others		
			Parameter Block No.	Axis	Address/Travel Value	Commanded Speed	Dwell Time	M-Code	Torque Limit Value	Auxiliary Point	Radius	Center Point	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	Cancel	Start	Speed Change
ABS-3	Absolute data	3	Δ	○	○	○	Δ	Δ					Δ	Δ	Δ	Δ	Δ	Δ	Δ		Δ	Δ	Δ	OK
INC-3	Incremental																							

○ : Must be set
Δ : Set if required

[Control Details]

Control with ABS-3 (absolute data method)

(1) Linear interpolation with 3-axes from the current stop address (X_1, Y_1, Z_1) to the designated address (X_2, Y_2, Z_2), using the home position as the reference.
(2) The travel direction is determined from the stop addresses and designated addresses for the respective axes.



Example

The travel direction is shown below if the current stop address is (1000, 2000, 1000) and the designated address is (4000, 8000, 4000).

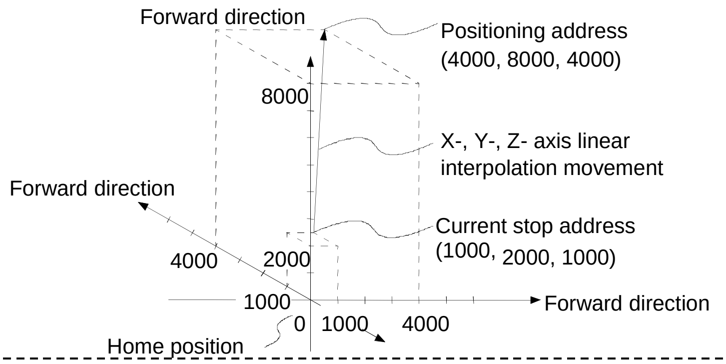
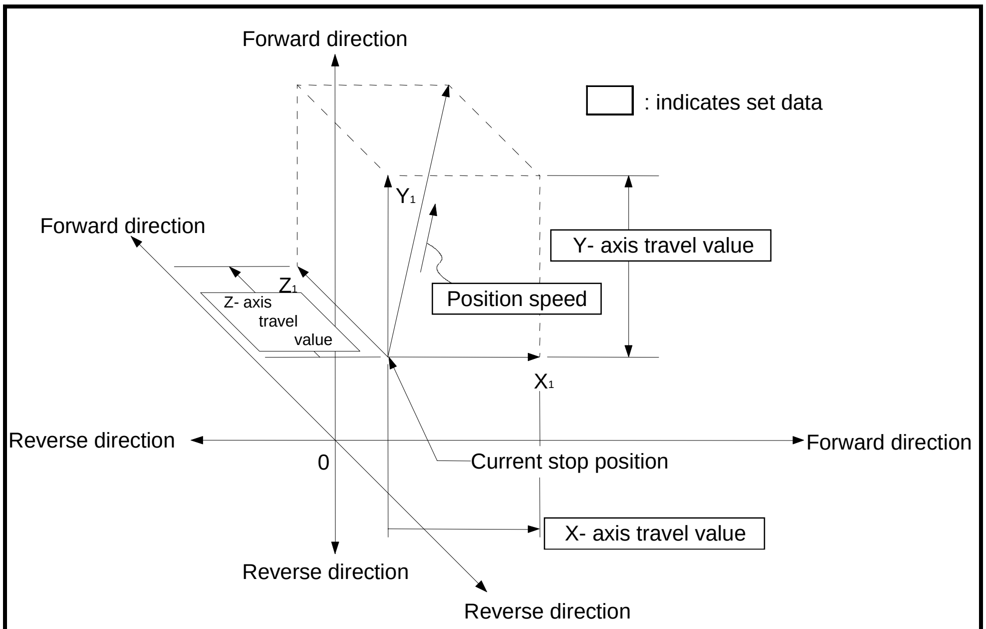


Fig.7.5 Positioning by Absolute Data Method

Control with INC-3 (incremental method)

(1) Positioning control from the current stop position to the position which is the resultant of the designated travel directions and travel values of the respective axis.

(2) The travel direction of each axis is designated by the sign of the travel value, as follows:
- Positive travel value ....forward direction (increased address)
- Negative travel value............reverse direction (decreased address)



Example

The travel direction is shown below for an X-axis travel value of 10000, a Y-axis travel value of 5000, and a Z-axis travel value of 6000.

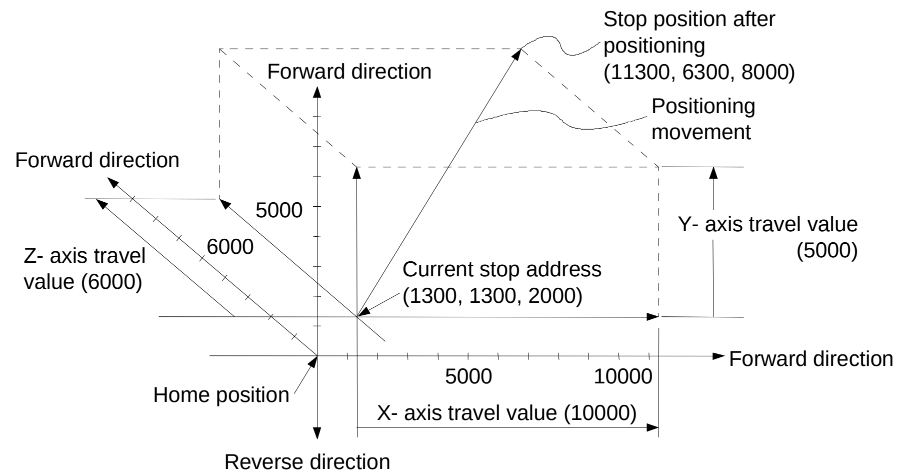
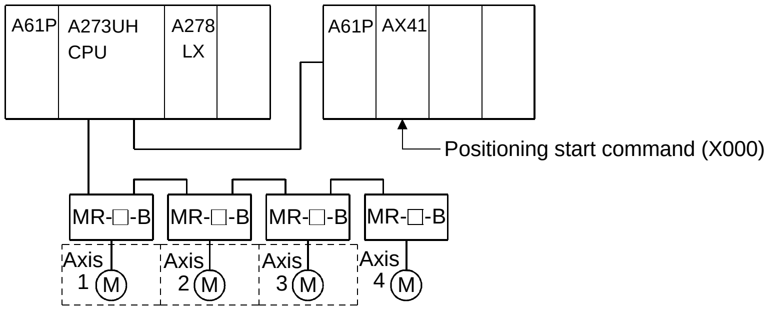


Fig.7.6 Positioning by Incremental Method

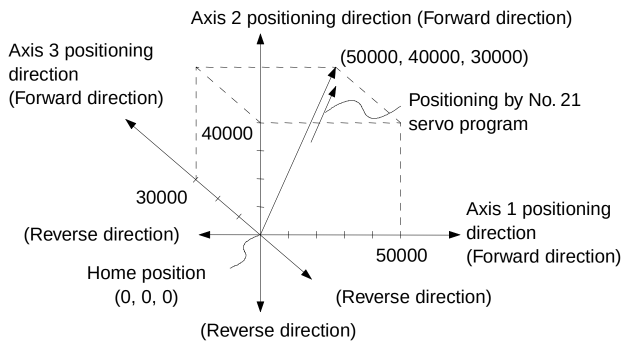
[Program Example]

This program conducts 3-axes linear interpolation control under the conditions below.

(1) System configuration
3-axes linear interpolation control of Axis 1, Axis 2, and Axis 3.



(2) Positioning details
The positioning by the Axis 1, Axis 2, and Axis 3 servomotors is shown in the diagram below.



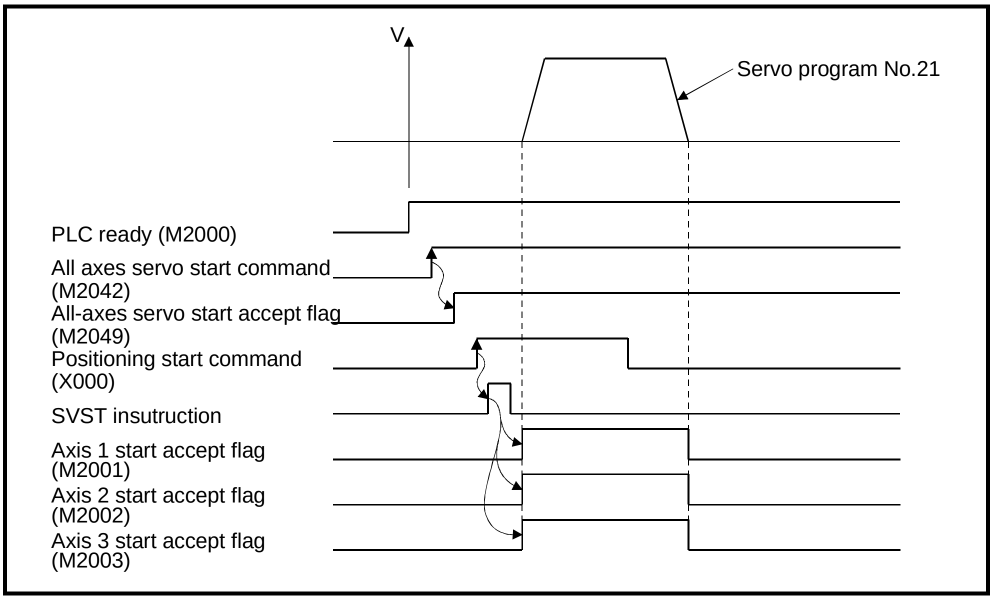
(3) Positioning conditions
(a) The positioning conditions are shown below.

Item	Servo Program Number
	No. 21
Positioning method	Absolute data
Positioning speed	1000

(b) Positioning start ....leading edge of X000 (OFF → ON)

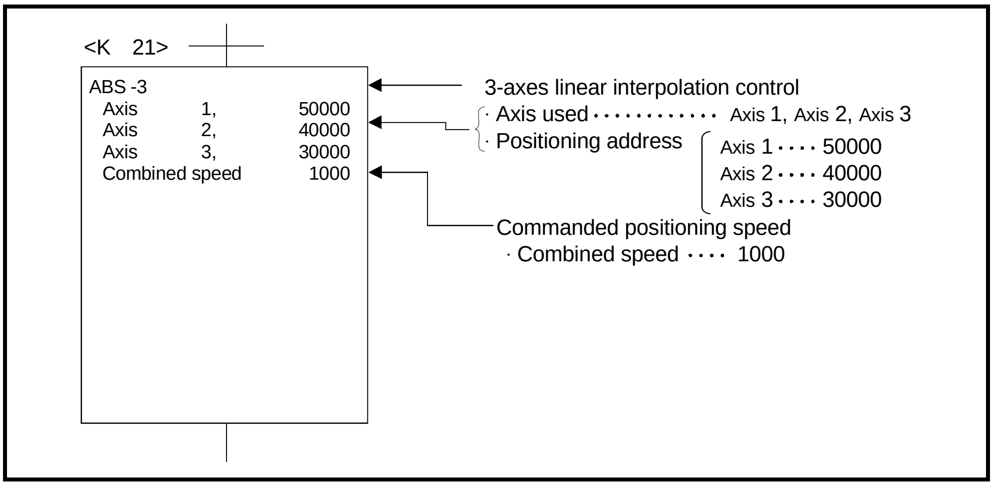
(4) Operation timing

The operation timing for 3-axes linear interpolation control is shown below.

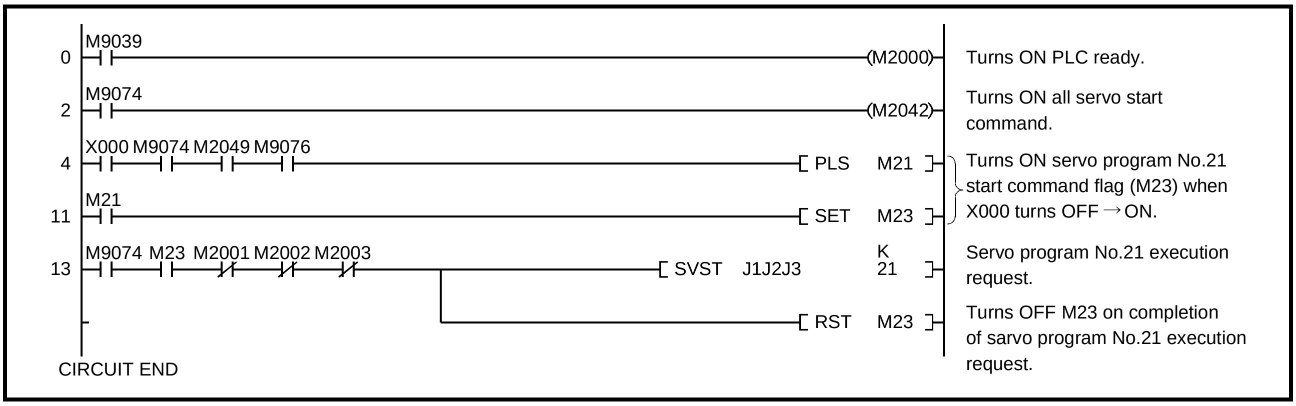


(5) Servo program

The servo program No. 21 for 3-axes linear interpolation control is shown below.



(6) Sequence program
The sequence program which runs the servo program is shown below.



7.5 4-Axes Linear Interpolation Control

Linear interpolation control from the current stop position with the 4-axes designated in the sequence program positioning commands.

Servo Instruction	Positioning Method	Number of Controllable Axes	Items Set by Peripherals: Common							Arc			Parameter Block									Others		
			Parameter Block No.	Axis	Address/Travel Value	Commanded Speed	Dwell Time	M-Code	Torque Limit Value	Auxiliary Point	Radius	Center Point	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	Cancel	Start	Speed Change
ABS-4	Absolute data	4	Δ	○	○	○	Δ	Δ					Δ	Δ	Δ	Δ	Δ	Δ	Δ		Δ	Δ	Δ	OK
INC-4	Incremental																							

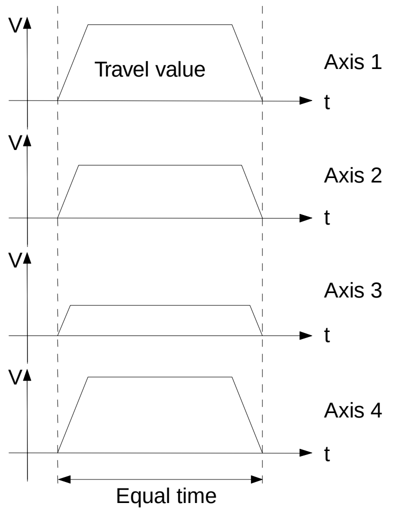
○ : Must be set
Δ : Set if required

[Control Details]

Positioning control which starts and completes positioning of the 4-axes simultaneously.

Example

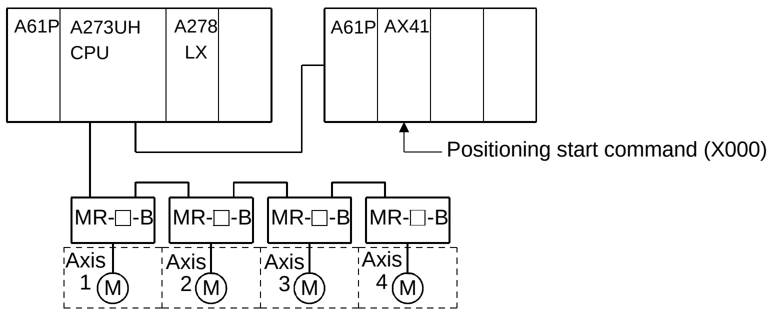
4-axes linear interpolation



[Program Example]

This program conducts 4-axes linear interpolation control under the conditions below.

(1) System configuration
4-axes linear interpolation control of Axis 1, Axis 2, Axis 3, and Axis 4.



(2) Positioning details
The positioning by the Axis 1, Axis 2, Axis 3, and Axis 4 servomotors is shown in the diagram below.

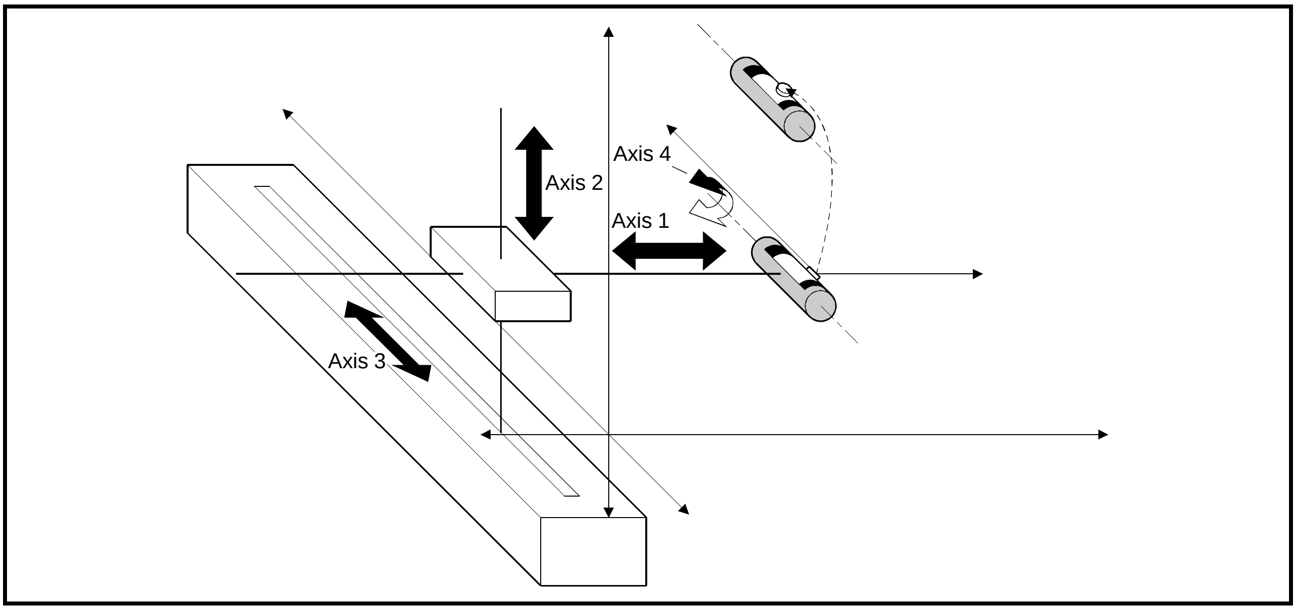


Fig.7.7 Axis Configuration

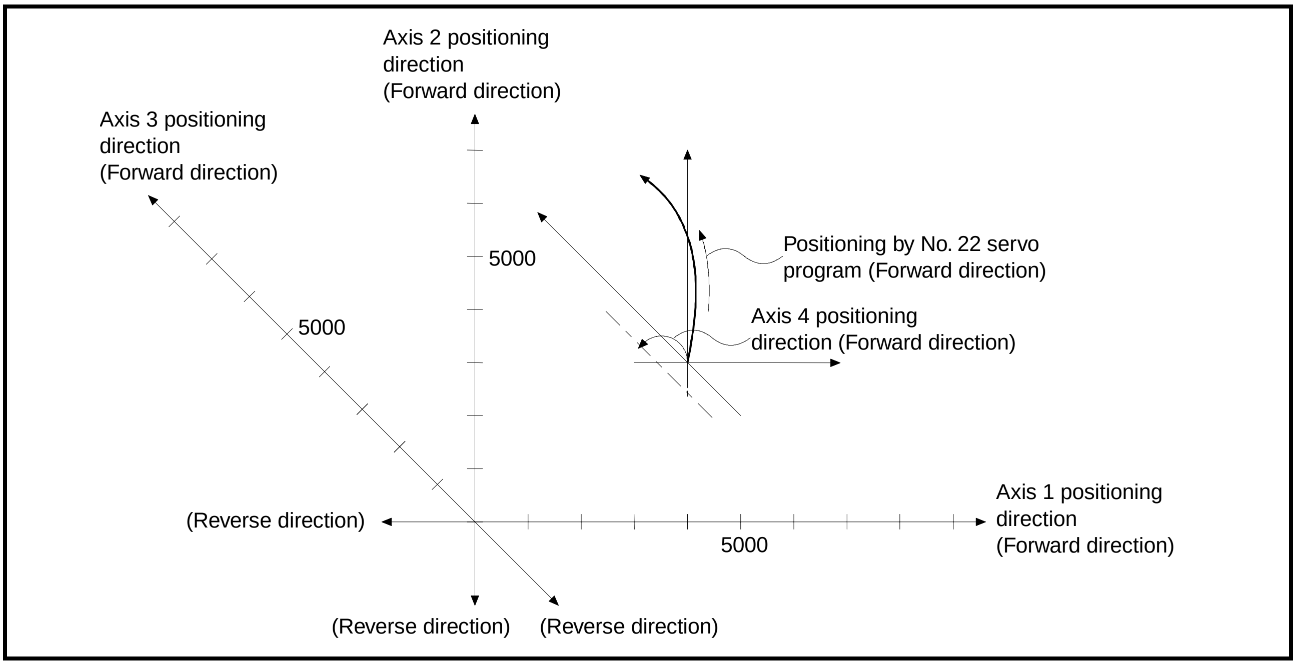


Fig.7.8 Positioning by 4-axes Linear Interpolation Control

(3) Positioning conditions

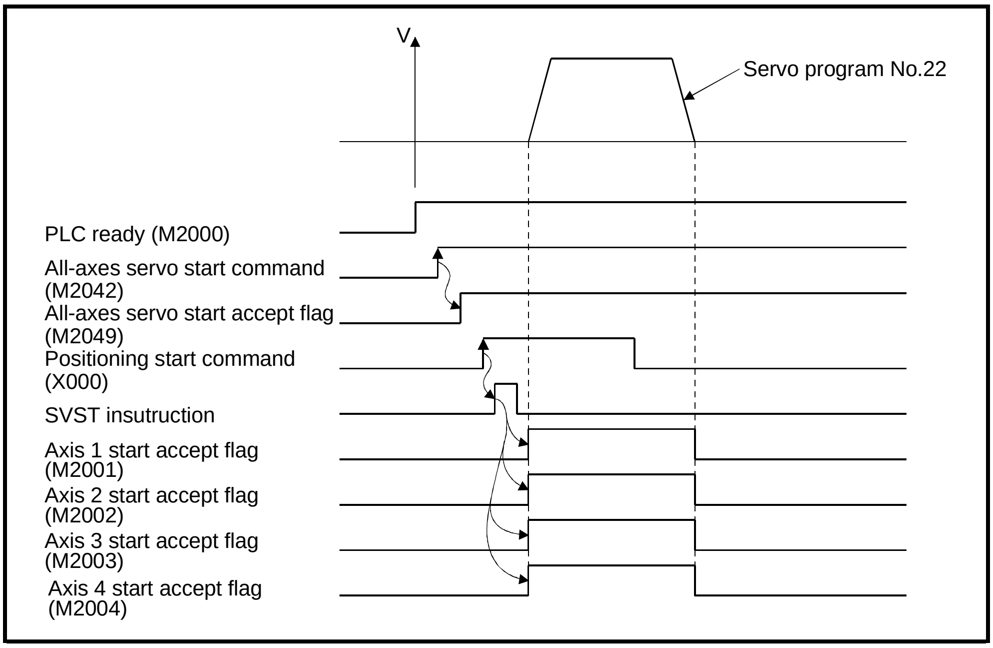
(a) The positioning conditions are shown below.

Item	Servo Program Number
	No. 22
Positioning method	Incremental
Positioning speed	1000

(b) Positioning start.................leading edge of X000 (OFF → ON)

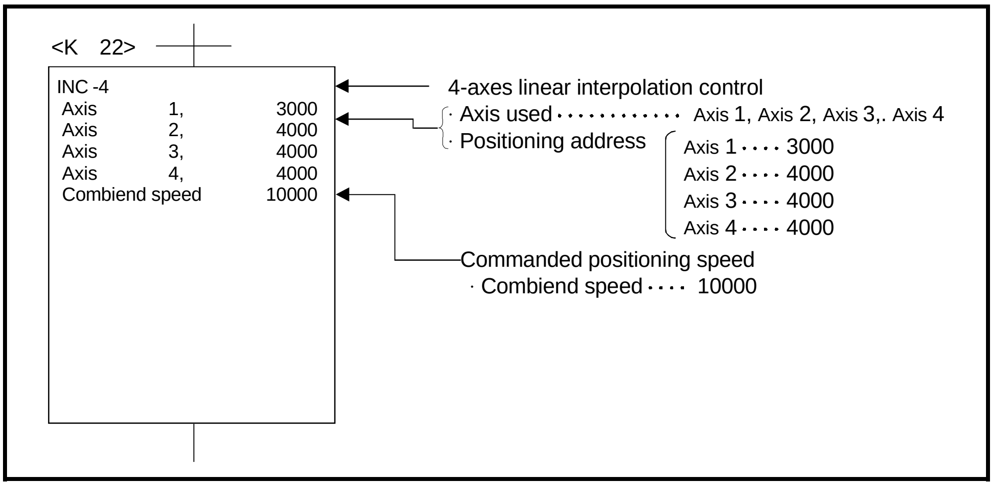
(4) Operation timing

The operation timing for 4-axes linear interpolation control is shown below.



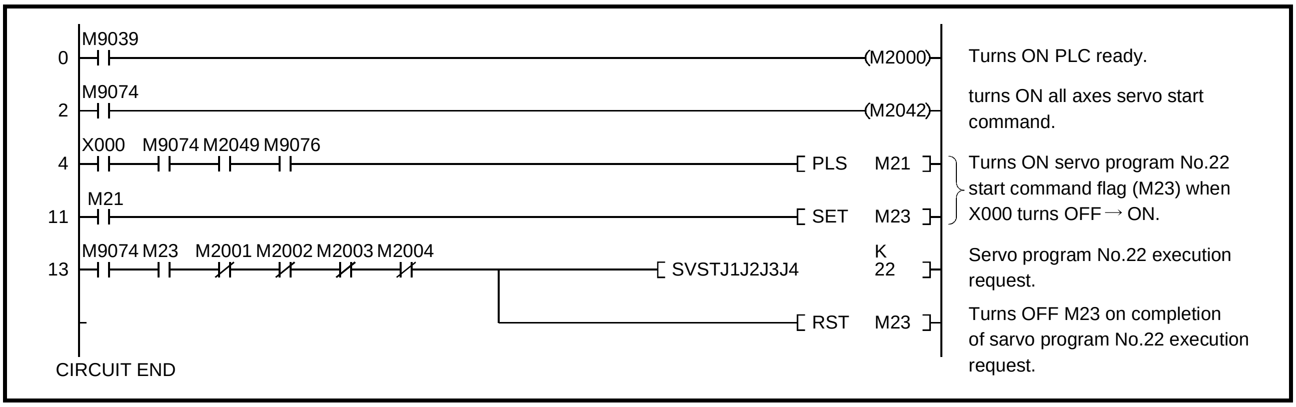
(5) Servo program

The servo program No. 22 for 4-axes linear interpolation control is shown below.



(6) Sequence program

The sequence program which runs the servo program is shown below.



7.6 Circular Interpolation Using Auxiliary Point Designation

Circular interpolation control by designating the end point address and auxiliary point address (a point on the arc).
Circular interpolation control using auxiliary point designation uses ABS (absolute data method) and INC (incremental method) servo instructions.

Servo Instruction	Positioning Method	Number of Controllable Axes	Items Set by Peripherals																					
			Common							Arc			Parameter Block									Others		
			Parameter Block No.	Axis	Address/Travel Value	Commanded Speed	Dwell Time	M-Code	Torque Limit Value	Auxiliary Point	Radius	Center Point	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	Cancel	Start	Speed Change
ABS	Absolute data	2	Δ	○	○	○	Δ	Δ		○			Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	OK
INC	Incremental																							

○ : Must be set
Δ : Set if required

[Control Details]

Control with ABS (absolute data method).

(1) Circular interpolation from the current stop address (pre-positioning address) through the designated auxiliary point address to the end point address, using the home position as the reference.

(2) The center of the arc is the point of intersection of the perpendicular bisectors of the start point address (current stop address) to the auxiliary point address, and the auxiliary point address to the end point address.

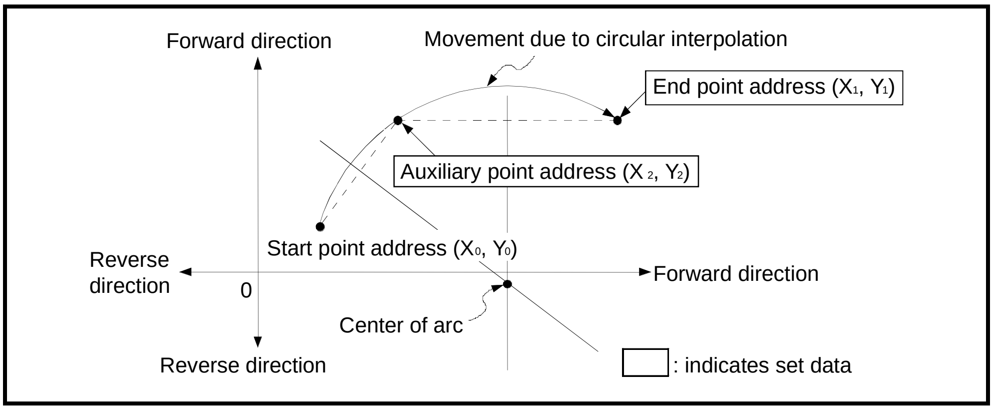


Fig.7.9 Circular Interpolation Control by Absolute Data Method

(3) The setting range for the end point address and auxiliary point address is -2^{31} to $+2^{31}-1$.
(4) The maximum arc radius is $2^{32}-1$.

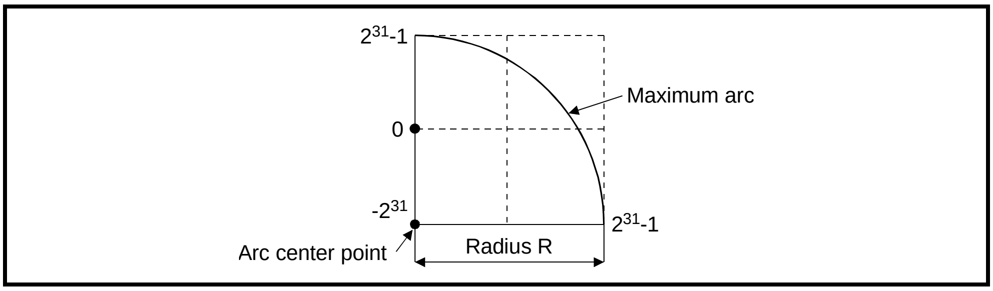


Fig.7.10 Maximum Arc

Control with INC (incremental method)

(1) Circular interpolation from the current stop address (pre-positioning address) through the designated auxiliary point address to the end point address.
(2) The center of the arc is the point of intersection of the perpendicular bisectors of the start point address (current stop address) to the auxiliary point address, and the auxiliary point address to the end point address.

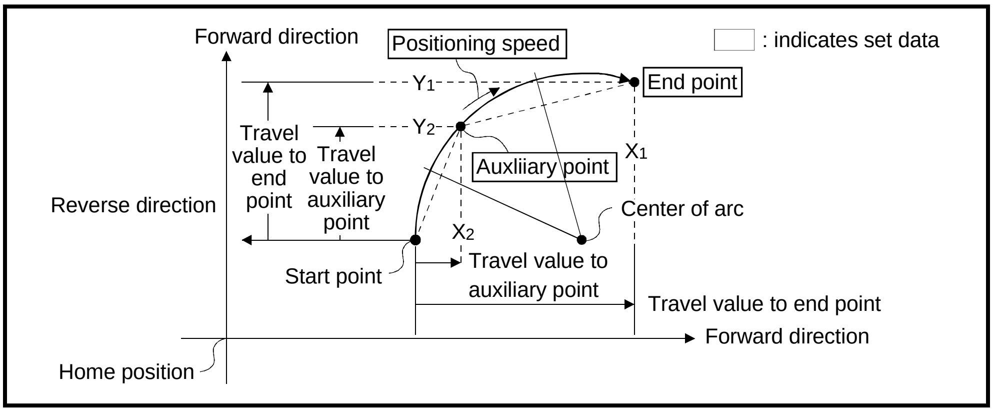


Fig.7.11 Circular Interpolation Control by Incremental Method

(3) The setting range for the travel value to the end point address and auxiliary point address is 0 to $\pm(2^{31}-1)$.
(4) The maximum arc radius is $2^{31}-1$.
If the designated end point and auxiliary point result in a radius more than $2^{31}-1$, an error occurs at the start and error code 107 is stored in the data register.

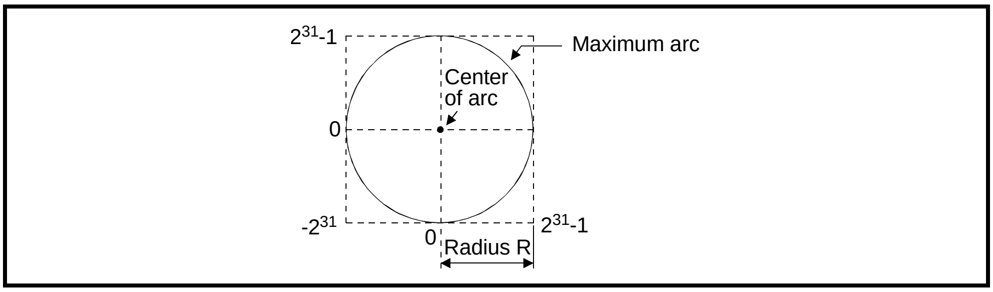


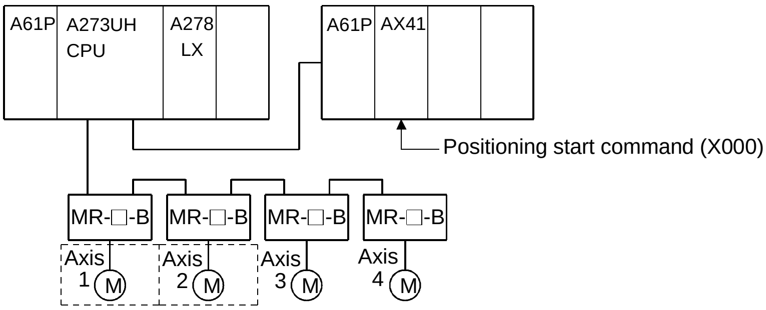
Fig.7.12 Maximum Arc

[Program Example]

This program conducts circular interpolation control using auxiliary point designation under the conditions below.

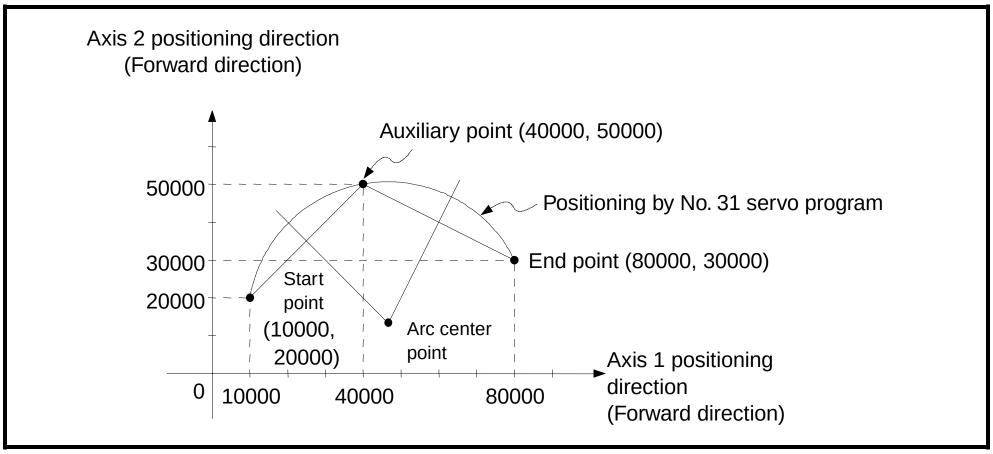
(1) System configuration

Circular interpolation control of Axis 1 and Axis 2 using auxiliary point designation.



(2) Positioning details

The positioning by the Axis 1 and Axis 2 servomotors is shown in the diagram below.



(3) Positioning conditions

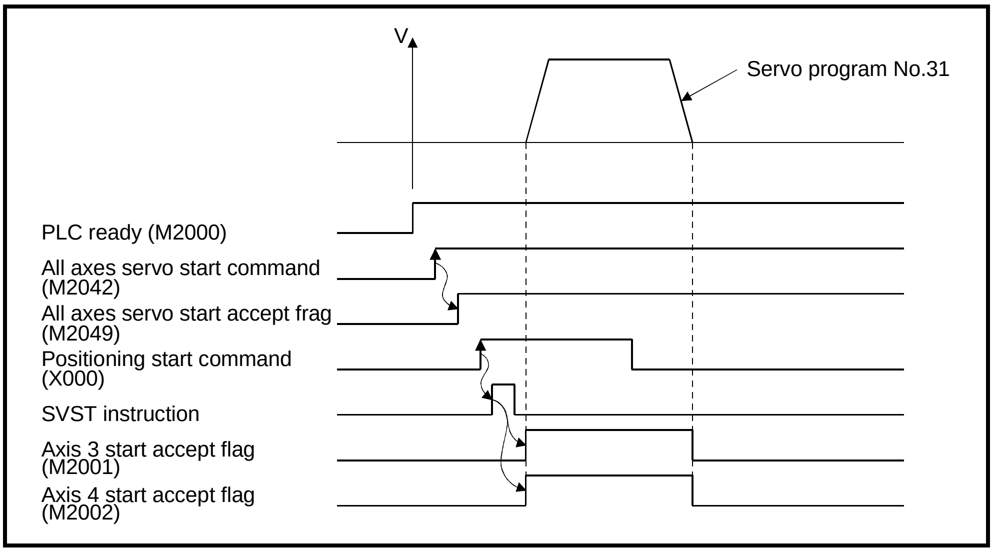
(a) The positioning conditions are shown below.

Item	Servo Program Number
	No. 31
Positioning method	Absolute data
Positioning speed	1000

(b) Positioning start .... leading edge of X000 (OFF → ON)

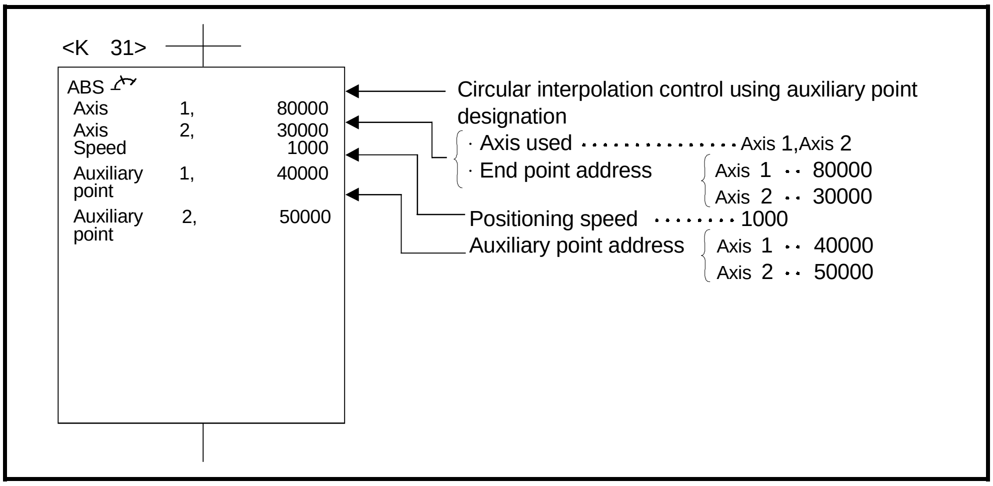
(4) Operation timing

The operation timing for circular interpolation control using auxiliary point designation is shown below.



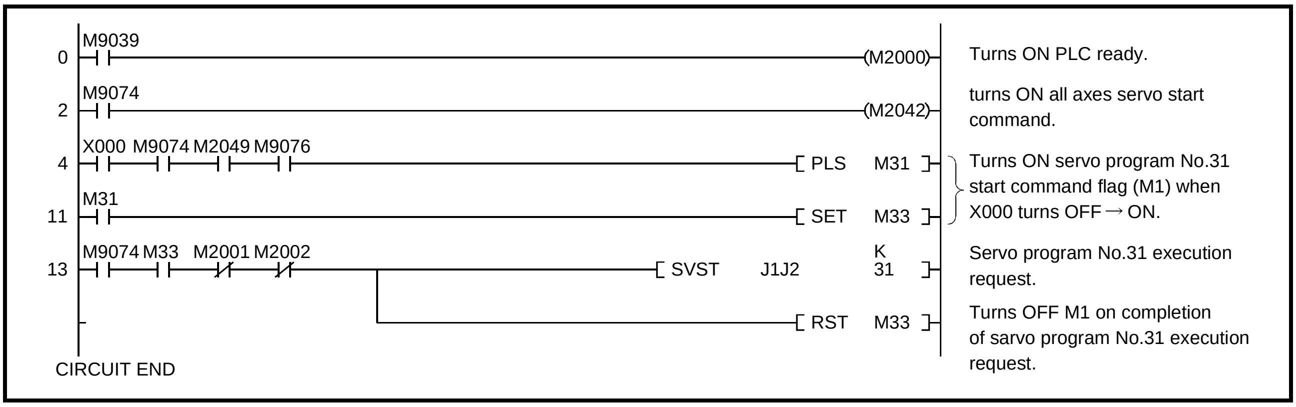
(5) Servo program

The servo program No. 31 for circular interpolation control using auxiliary point designation is shown below.



(6) Sequence program

The sequence program which runs the servo program is shown below.



7.7 Circular Interpolation Using Radius Designation

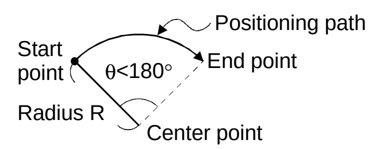
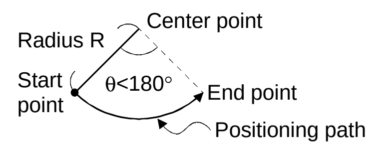
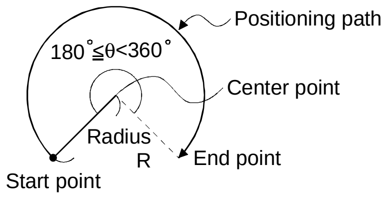
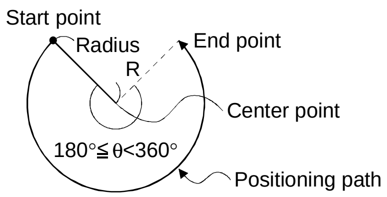
Circular interpolation control by designating the end point and arc radius.
Circular interpolation control using radius designation uses ABS ↷ , ABS ⤸ , ABS ⤹ , and ABS ↻ (absolute method) and INC ↷ , INC ⤸ , INC ⤹ , and INC ↻ (incremental method) servo instructions.

Servo Instruction	Positioning Method	Number of Controllable Axes	Items Set by Peripherals																						Speed Change
			Common							Arc			Parameter Block										Others		
			Parameter Block No.	Axis	Address/Travel Value	Commanded Speed	Dwell Time	M-Code	Torque Limit Value	Auxiliary Point	Radius	Center Point	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	Cancel	Start	
ABS ↷	Absolute	2	Δ	○	○	○	Δ	Δ			○		Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	OK
ABS ⤸																								
ABS ⤹																								
ABS ↻																								
INC ↷	Incremental																							
INC ⤸																								
INC ⤹																								
INC ↻																								

○ : Must be set
Δ : Set if required

[Control Details]

Details of control with the servo instructions are shown in the table below.

Instruction	Servomotor Direction of Rotation	Max. Controllable Angle of Arc	Positioning Path
ABS	Clockwise	0°< θ < 180°	
INC			
ABS	Counterclockwise		
INC			
ABS	Clockwise	180°≤ θ < 360°	
INC			
ABS	Counterclockwise		
INC			

Control with ABS ↷ , ABS ↷ , ABS , ↶ , and ABS ↶
(absolute data method)

(1) Circular interpolation of an arc of the designated radius from the current stop address (pre-positioning address) to the designated end point address, using the home position as the reference.

(2) The center of the arc lies at the point of intersection of the designated radius and the perpendicular bisector of the start point address (current stop address) to the end point address.

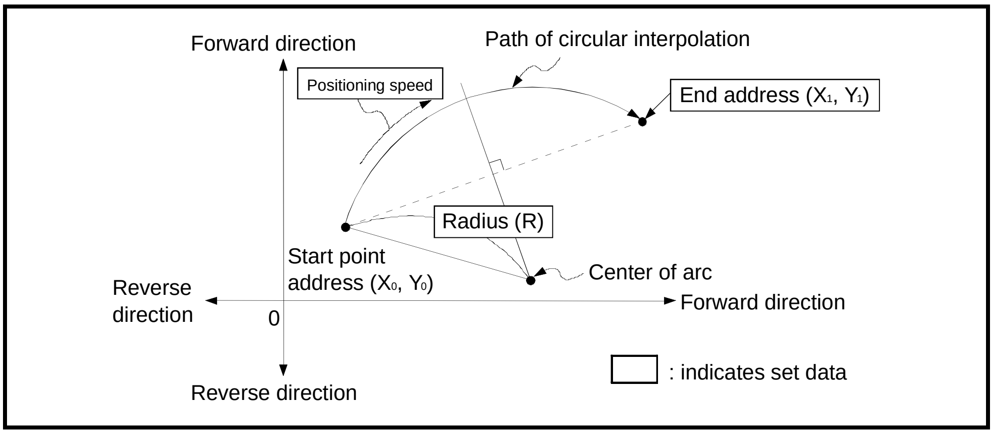


Fig.7.13 Circular Interpolation Control by Absolute Data Method

(3) The setting range for the end point address is -2^{31} to ($2^{31}-1$).

(4) The maximum arc radius is $2^{31}-1$.

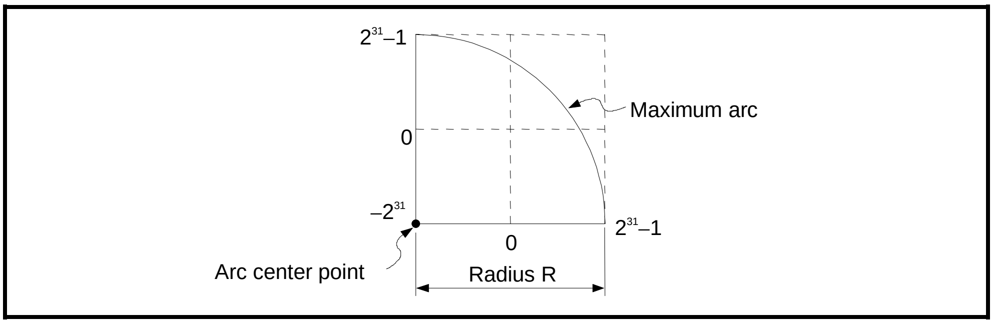


Fig.7.14 Maximum Arc

Control with INC , INC , INC , , and INC
(incremental method)

(1) Circular interpolation of an arc of the designated radius from the current stop address (0, 0) to the designated end point address.

(2) The center of the arc lies at the point of intersection of the designated radius and the perpendicular bisector of the start point address (current stop address) to the end point address.

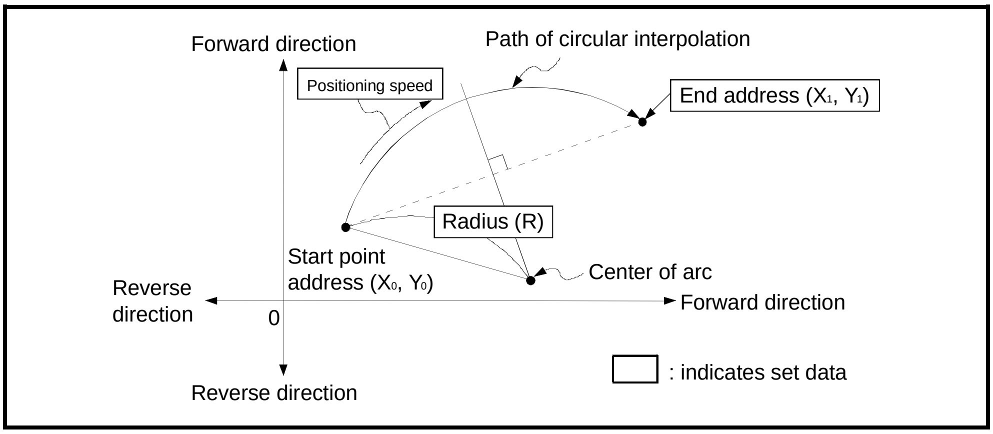


Fig.7.15 Circular Interpolation Control by Incremental Method

(3) The setting range for the end point address is -2^{31} to ($2^{31}-1$).

(4) The maximum arc radius is $2^{31}-1$.

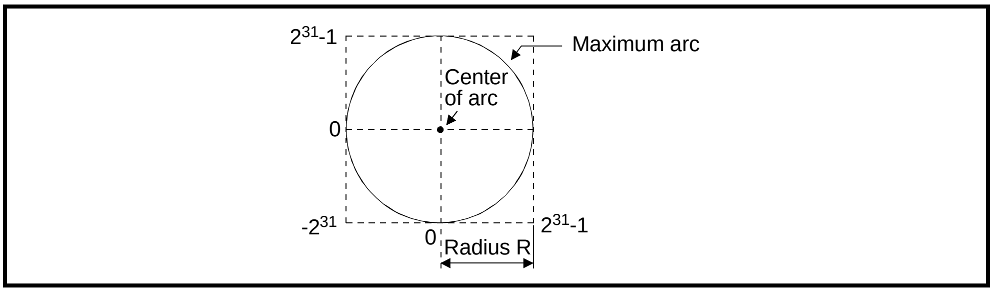
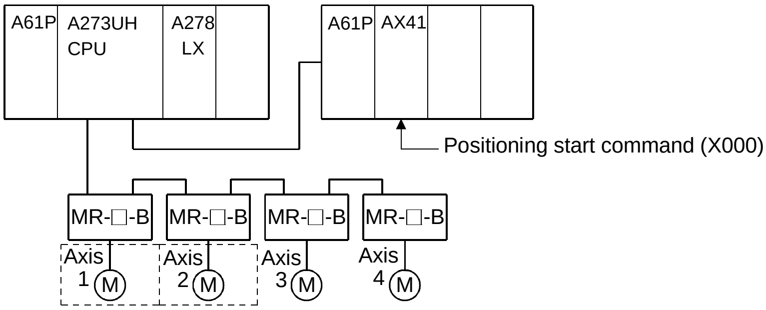


Fig.7.16 Maximum Arc

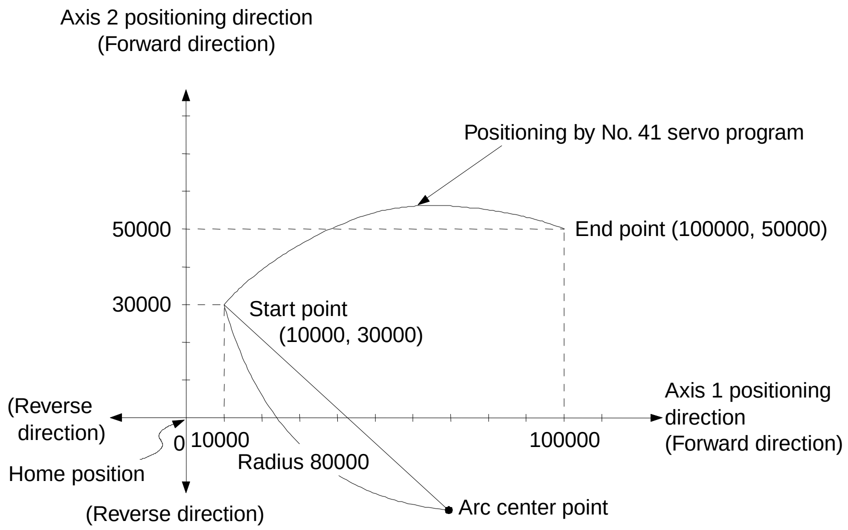
[Program Example]

This program conducts circular interpolation control using radius designation under the conditions below.

(1) System configuration
Circular interpolation control of Axis 1 and Axis 2 using radius designation.



(2) Positioning details
The positioning by the Axis 1 and Axis 2 servomotors is shown in the diagram below.

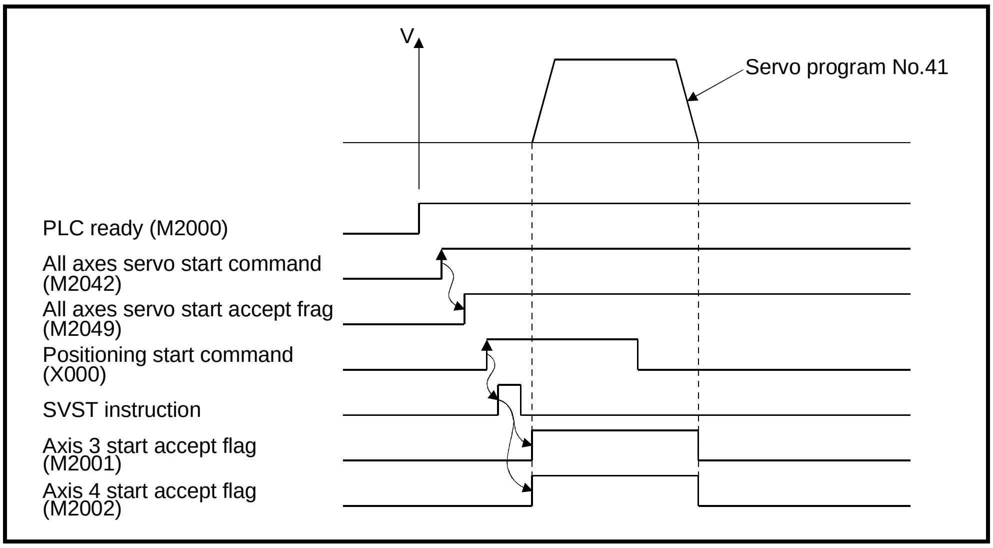


(3) Positioning conditions
(a) The positioning conditions are shown below.

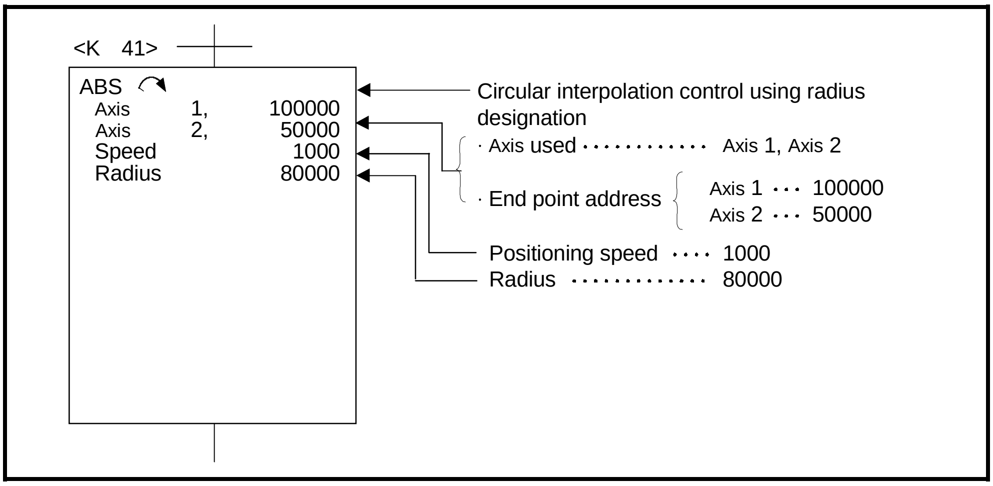
Item	Servo Program Number
	No. 41
Positioning method	Absolute data
Positioning speed	1000

(b) Positioning start .... leading edge of X000 (OFF → ON)

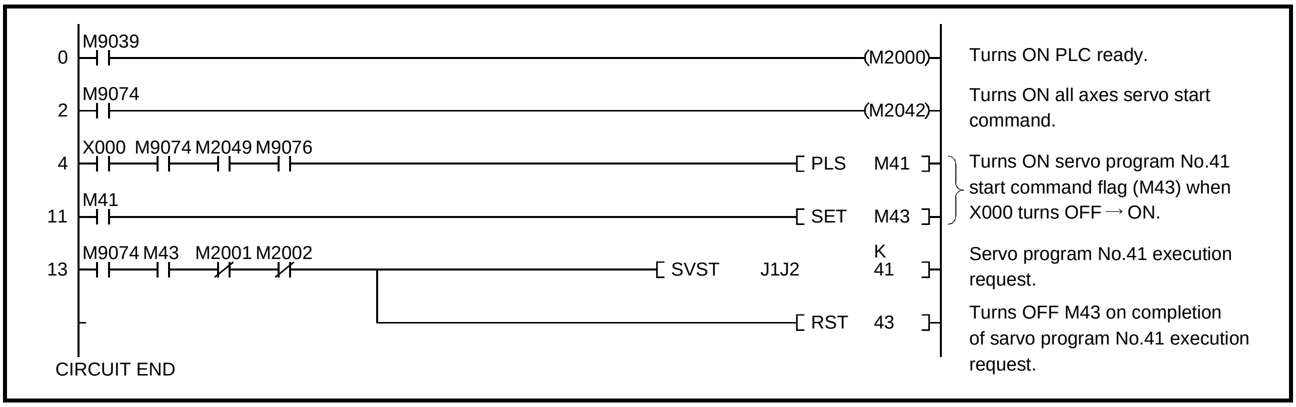
(4) Operation timing
The operation timing for circular interpolation control using radius designation is shown below.



(5) Servo program
The servo program No. 41 for circular interpolation control using radius designation is shown below.



(6) Sequence program
The sequence program which runs the servo program is shown below.



7.8 Circular Interpolation Using Center Point Designation

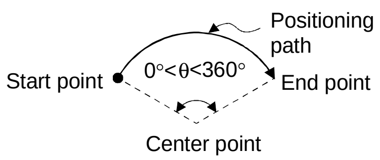
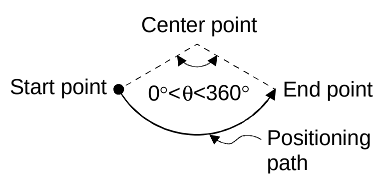
Circular interpolation control by designating the end point and arc center point. Circular interpolation control using center point designation uses ABS ↻ and ABS ↺ (absolute data method) and INC ↻ and INC ↺ (incremental method) servo instructions.

Servo Instruction	Positioning Method	Number of Controllable Axes	Items Set by Peripherals																					
			Common							Arc			Parameter Block									Others		
			Parameter Block No.	Axis	Address/Travel Value	Commanded Speed	Dwell Time	M Code	Torque Limit Value	Auxiliary Point	Radius	Center Point	Control Units	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	Cancel	Start	Speed Change
ABS ↻ ABS ↺	Absolute data	2	Δ	○	○	○	Δ	Δ				○	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	OK
INC ↻ INC ↺	Incremental																							

○ : Must be set
Δ : Set if required

[Control Details]

Details of control with the servo instructions are shown in the table below.

Instruction	Servomotor Direction of Rotation	Max. Controllable Angle of Arc	Positioning Path
ABS ↻ INC ↻	Clockwise	$0° < \theta < 360°$	
ABS ↺ INC ↺	Counterclockwise		

Control with ABS ↻ and ABS ↺ (absolute data method)

(1) Circular interpolation of an arc with a radius equivalent to the distance between the start point and center point, between the current stop address (pre-positioning address used as the start point address) and the designated end point address, using the home position as the reference.

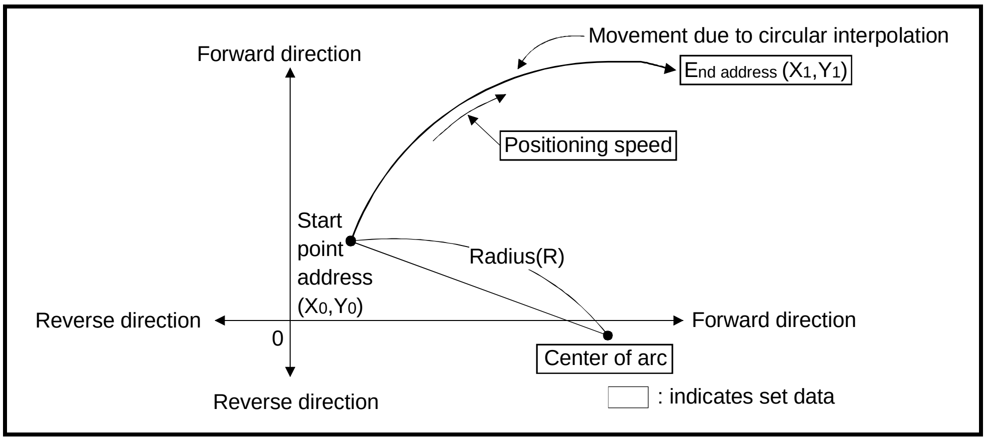


Fig.7.17 Circular Interpolation Control by Absolute Date Method

(2) To conduct positioning control of a full circle, divide the circular interpolation control into two operations.

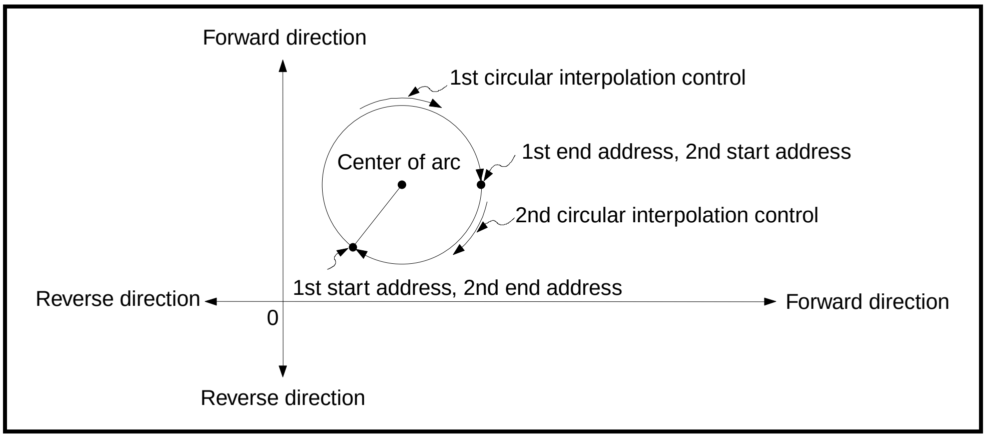


Fig.7.18 Positioning Control of a Full Circle

(3) The setting range for the end point address and arc center point is -2^{31} to $(2^{31}-1)$.

(4) The maximum arc radius is $2^{32}-1$.

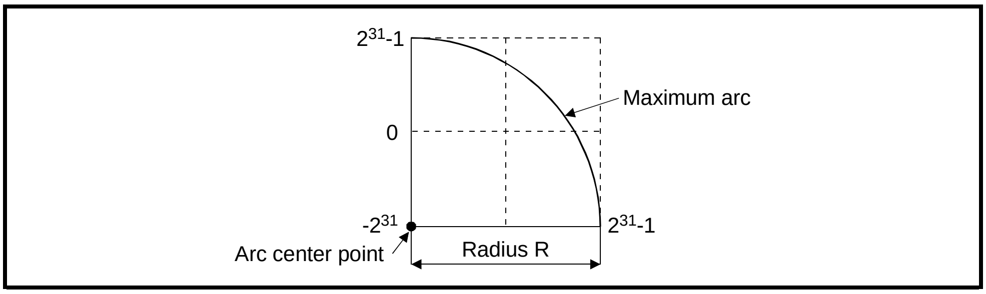


Fig.7.19 Maximum Arc

Control with INC ⌒ and INC ⌣ (incremental method)

(1) Circular interpolation of an arc from the current stop address (start point address, 0, 0) with a radius equivalent to the distance between the start point (0, 0) and center point.

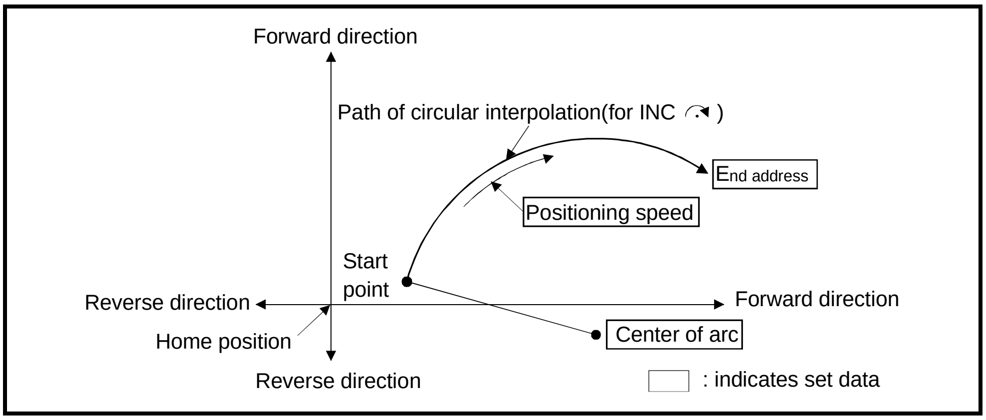


Fig.7.20 Circular Interpolation Control by Incremental Method (INC ⌒)

(2) To conduct positioning control of a full circle, divide the circular interpolation control into two operations.

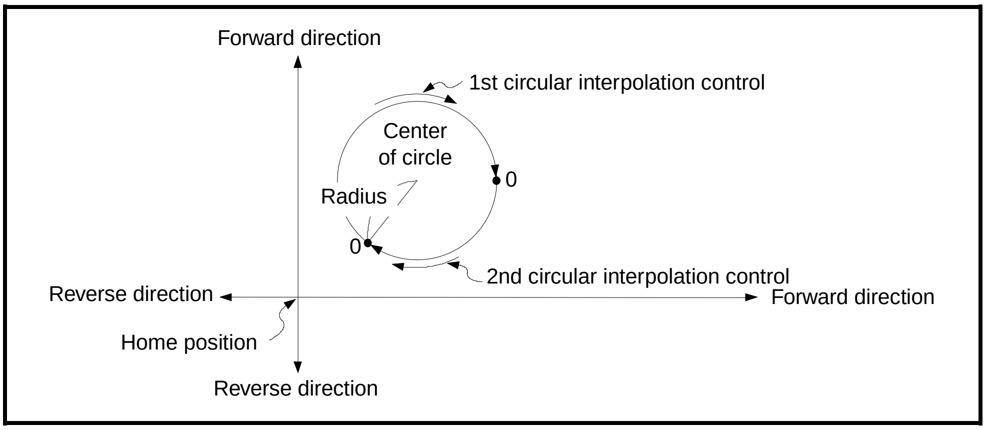


Fig.7.21 Positioning Control of a Full Circle

(3) The setting range for the center point and travel value to the end point is 0 to $\pm(2^{31}-1)$.

(4) The maximum arc radius is $2^{31}-1$.
If the designated end point and center point result in a radius more than $2^{31}-1$, an error occurs at the start and error code 109 is stored in the data register.

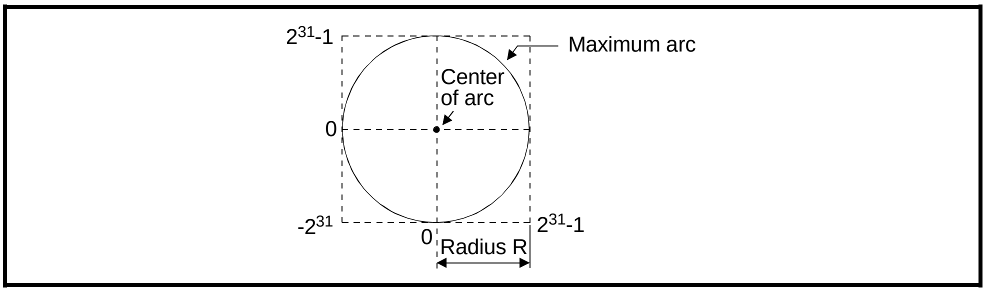
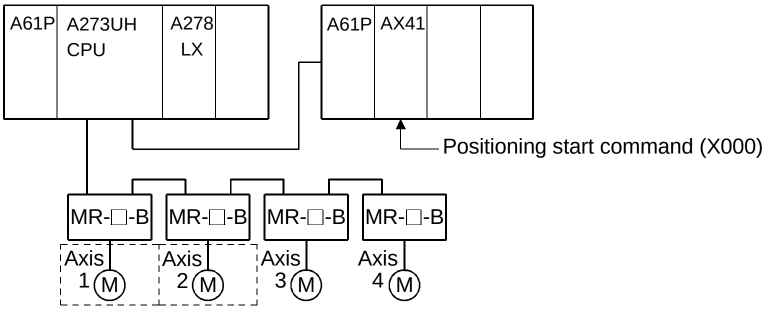


Fig.7.21 Maximum Arc Radius

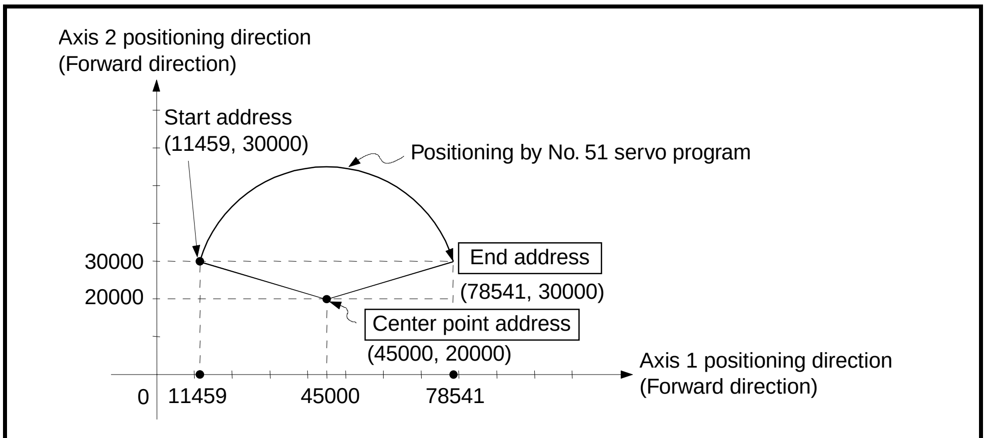
[Program Example]

This program conducts circular interpolation control using center point designation under the conditions below.

(1) System configuration
Circular interpolation control of Axis 1 and Axis 2 using center point designation.



(2) Positioning details
The positioning by the Axis 1 and Axis 2 servomotors is shown in the diagram below.

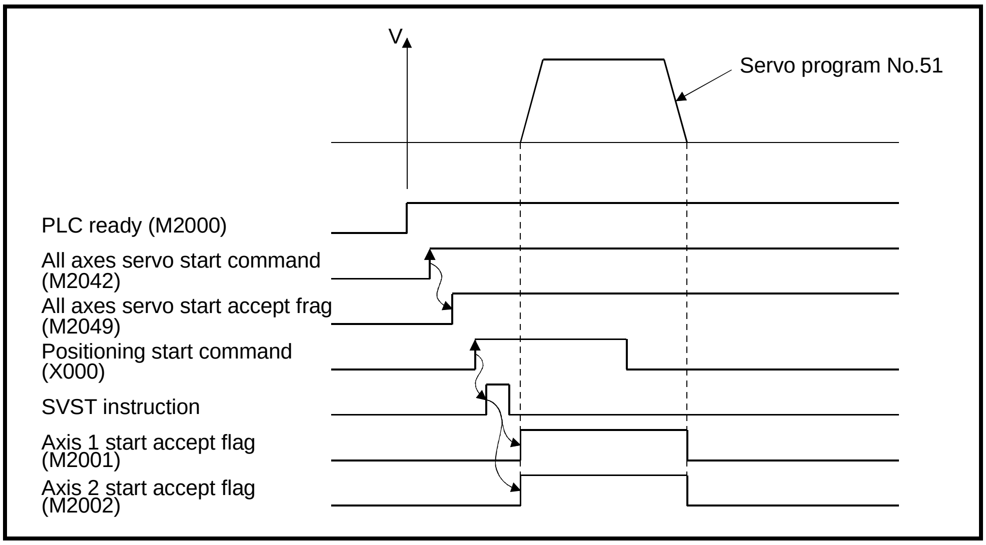


(3) Positioning conditions
(a) The positioning conditions are shown below.

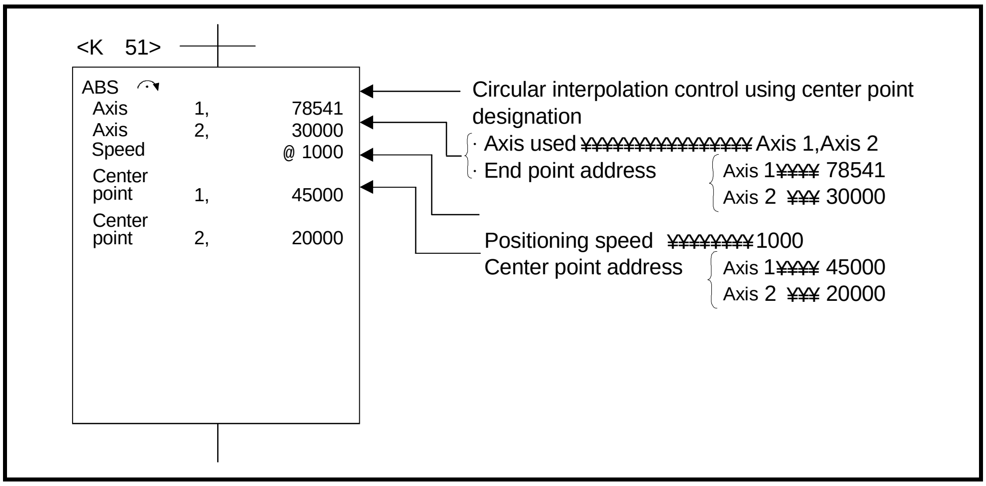
Item	Servo Program Number
	No. 51
Positioning method	Absolute data
Positioning speed	1000

(b) Positioning start .... leading edge of X000 (OFF→ON)

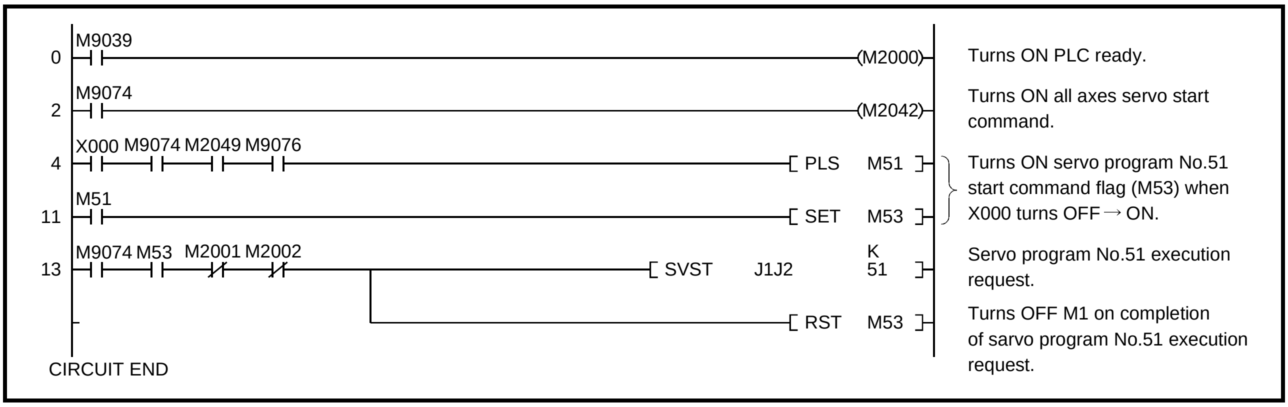
(4) Operation timing
The operation timing for circular interpolation control using center point designation is shown below.



(5) Servo program
The servo program No. 51 for circular interpolation control using center point designation is shown below.



(6) Sequence program
The sequence program which runs the servo program is shown below.



7.9 1-Axis Fixed-Pitch Feed Control

Positioning control to move the axis designated with the sequence program positioning commands by the designated travel value from the current stop position.
Fixed-pitch feed control uses the FEED-1 servo instruction.

Servo Instruction	Positioning Method	Number of Controllable Axes	Items Set by Peripherals																					Speed Change
			Common							Arc			Parameter Block									Others		
			Parameter Block No.	Axis	Address/Travel Value	Commanded Speed	Dwell Time	M-Code	Torque Limit Value	Auxiliary Point	Radius	Center Point	Control Units	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	Cancel	Start	
FEED-1	Incremental	1	Δ	○	○	○	Δ	Δ						Δ	Δ	Δ	Δ	Δ	Δ		Δ	Δ	Δ	OK

○ : Must be set
Δ : Set if required

[Control Details]

(1) Positioning control through the designated travel value from the current stop position (0).

(2) The travel direction is designated by the sign of the travel value, as follows:
- Positive travel value .... forward direction (increased address)
- Negative travel value........... reverse direction (decreased address)

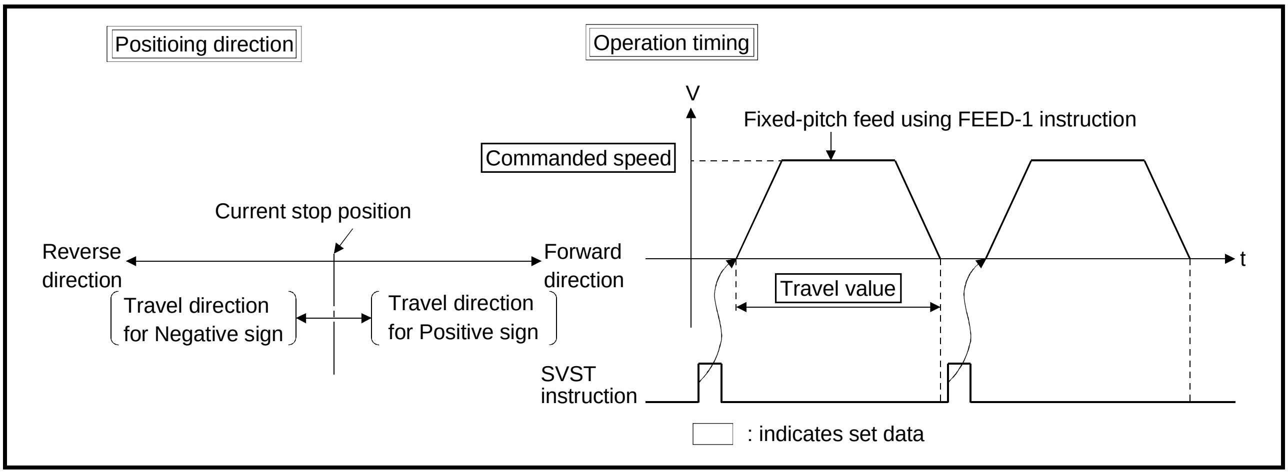


Fig.7.23 1-Axis Fixed-Pitch Feed Control

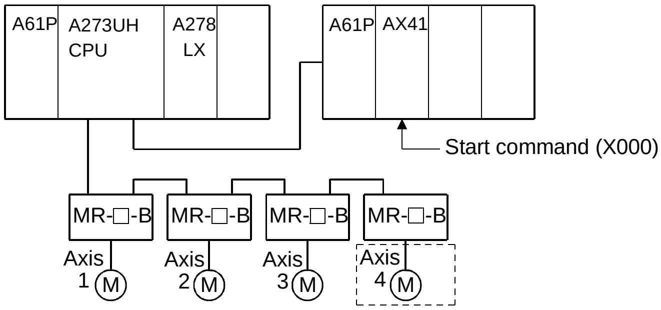
POINT

Do not set the travel value to zero for fixed-pitch feed control.
If the travel value is set t o zero, fixed-pitch feed ends with no feed taking place.

[Program Example]

This program conducts repeated 1-axis fixed-pitch feed control under the conditions below.

(1) System configuration
Fixed-pitch feed control of Axis 4.



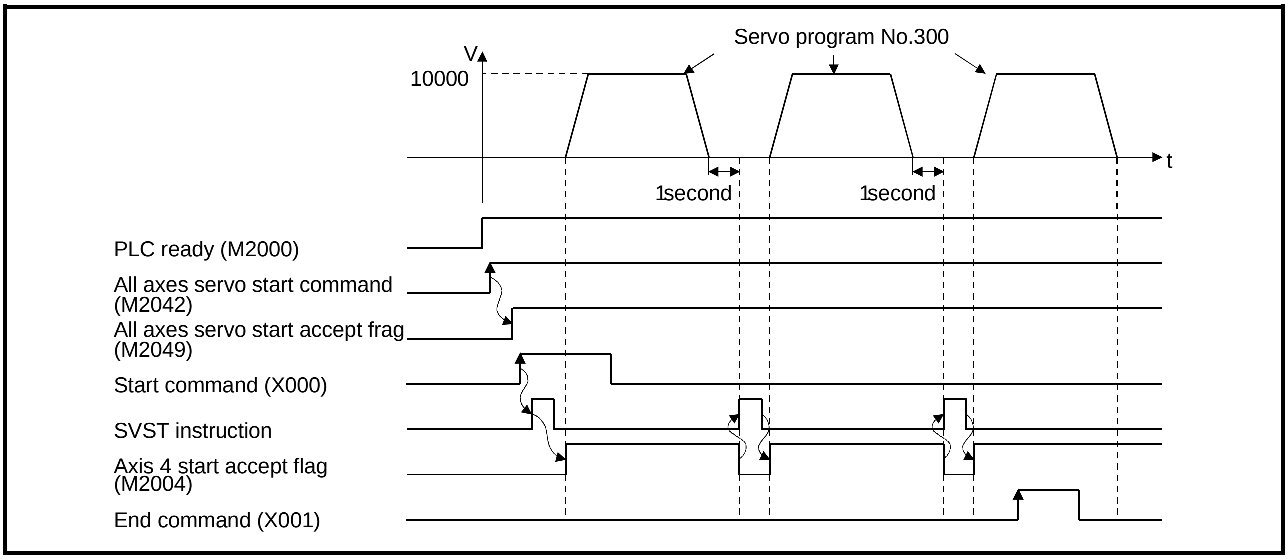
(2) Fixed-pitch feed control conditions
(a) The positioning conditions are shown below.

Item	Setting
Servo program number	No. 300
Controlled axis	Axis 4
Control speed	10000
Travel value	100000

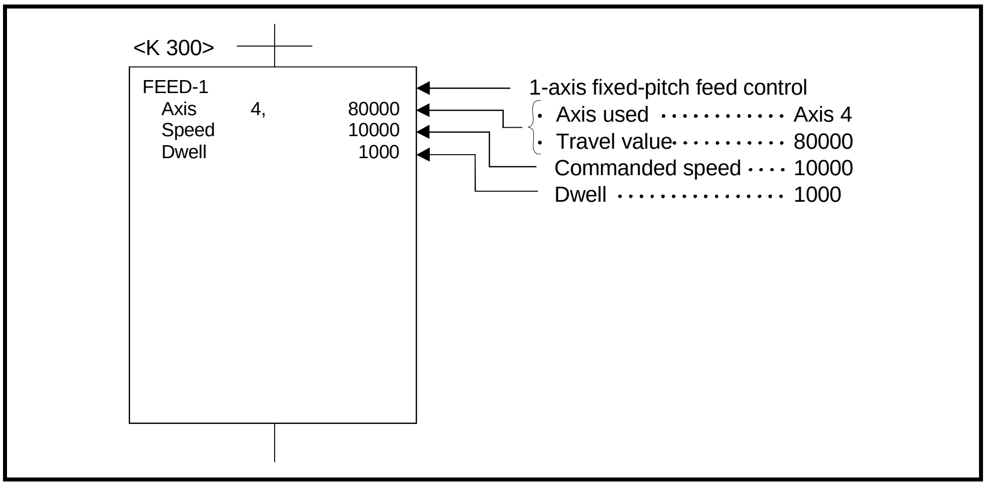
(b) Fixed-pitch feed control start command ....leading edge of X000 (OFF→ ON)

(c) Fixed-pitch feed control end command ......leading edge of X001 (OFF→ON)

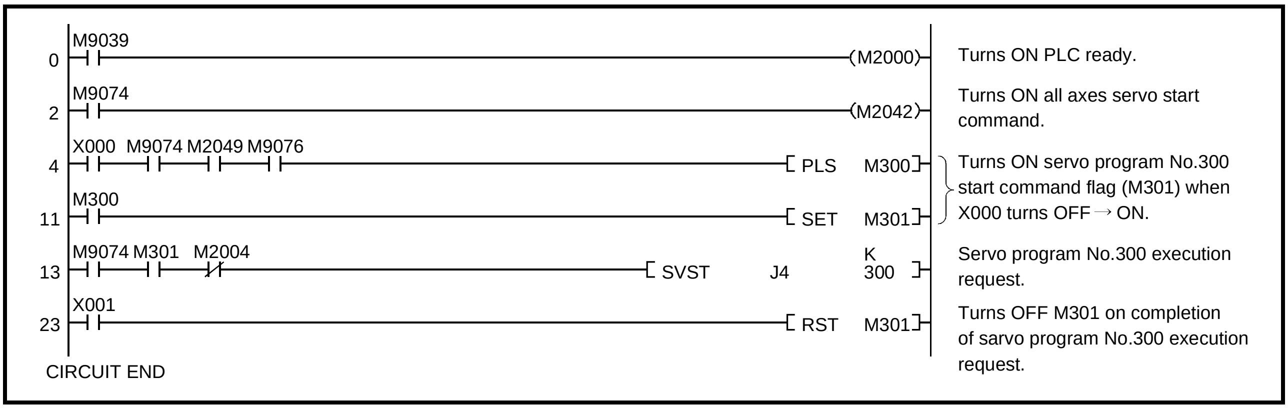
(3) Operation timing
The operation timing for fixed-pitch feed control is shown below.



(4) Servo program
The servo program No. 300 for fixed-pitch feed control is shown below.



(5) Sequence program
The sequence program which runs the servo program is shown below.



7.10 Fixed-Pitch Feed Control Using 2-Axes Linear Interpolation

Fixed-pitch feed control using 2-axes linear interpolation from the current stop position with the 2-axes designated in the sequence program positioning commands.
Fixed-pitch feed control using 2-axes linear interpolation uses the FEED-2 servo instruction.

Servo Instruction	Positioning Method	Number of Controllable Axes	Items Set by Peripherals																					Speed Change
			Common							Arc			Parameter Block									Others		
			Parameter Block No.	Axis	Address/Travel Value	Commanded Speed	Dwell Time	M-Code	Torque Limit Value	Auxiliary Point	Radius	Center Point	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	Cancel	Start	
FEED-2	Incremental	2	Δ	○	○	○	Δ	Δ					Δ	Δ	Δ	Δ	Δ	Δ	Δ		Δ	Δ	Δ	OK

○ : Must be set
Δ : Set if required

[Control Details]

(1) Positioning control from the current stop position (0) to the position which is the resultant of the designated travel directions and travel values of the respective axes.

(2) The travel direction is designated by the sign of the travel value, as follows:
- Positive travel value ....forward direction (increased address)
- Negative travel value.........reverse direction (decreased address)

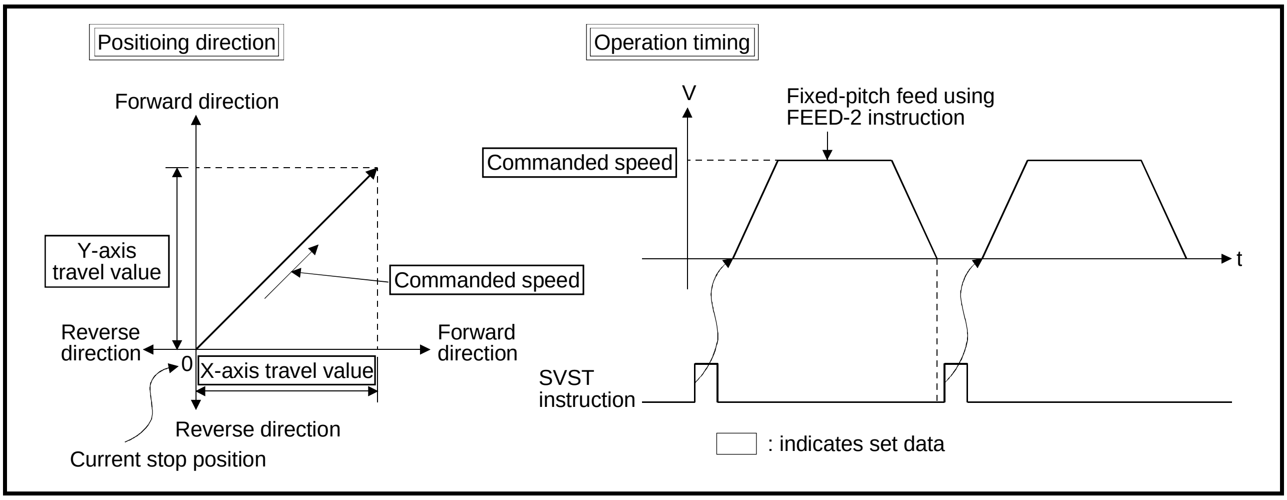


Fig.7.24 Fixed-Pitch Feed Control Using 2-Axes Linear Interpolation

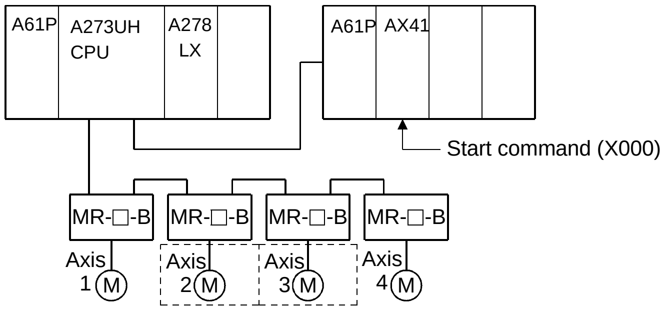
POINT

(1) Do not set the travel value to zero for fixed-pitch feed control.
The following results if the travel value is set to zero:
(a) If both axes are set to zero, the fixed-pitch feed ends with no feed taking place.
(b) If the travel value is set to zero for one axis only, fixed-pitch feed control will not occur at the normal positioning speed for the axis set to a non-zero travel value.

[Program Example]

This program conducts fixed-pitch feed control using 2-axes linear interpolation under the conditions below.

(1) System configuration
Fixed-pitch feed control using 2-axes linear interpolation of Axis 2 and Axis 3.

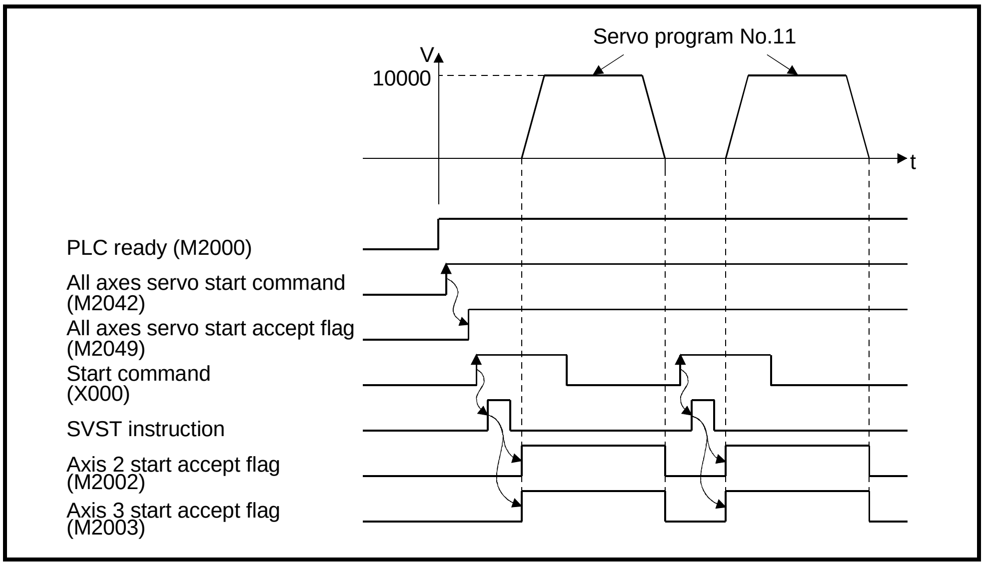


(2) Positioning conditions
The fixed-pitch feed control conditions are shown below.

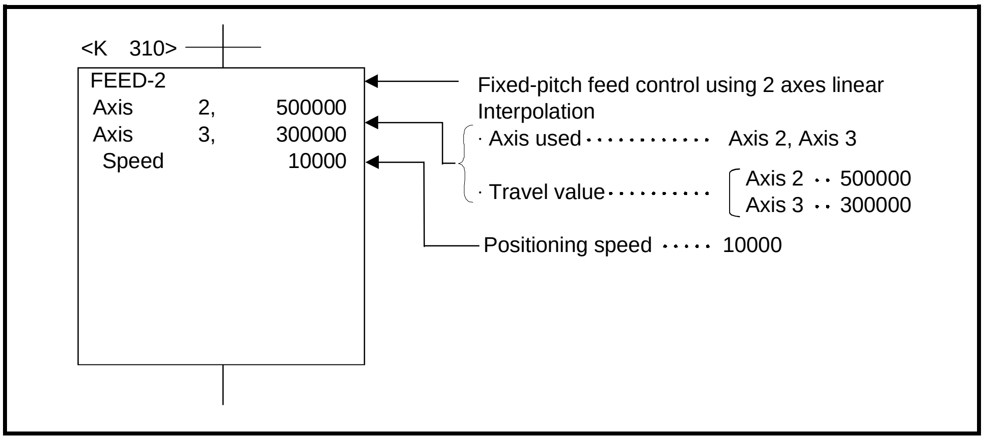
Item	Setting	
Servo program number	No. 310	
Positioning speed	10000	
Controlled axis	Axis 2	Axis 3
Travel value	500000	300000

(a) Fixed-pitch feed control start command .... leading edge of X000 (OFF → ON)

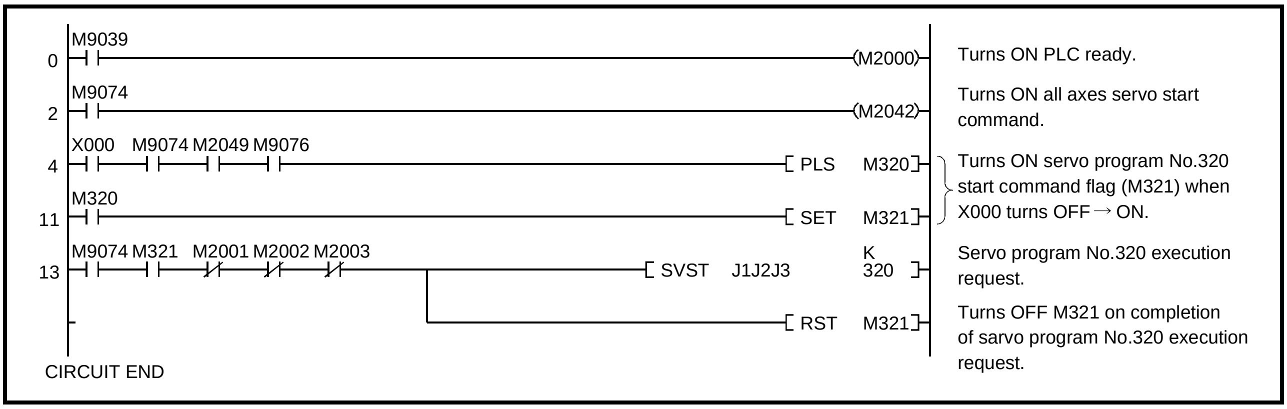
(3) Operation timing
The operation timing for fixed-pitch feed control using 2-axes linear interpolation is shown below.



(4) Servo program
The servo program No. 310 for fixed-pitch feed control using 2-axes linear interpolation is shown below.



(5) Sequence program
The sequence program which runs the servo program is shown below.



7.11 Fixed-Pitch Feed Control Using 3-Axes Linear Interpolation

Fixed-pitch feed control using 3-axes linear interpolation from the current stop position with the 3-axes designated in the sequence program positioning commands.
Fixed-pitch feed control using 3-axes linear interpolation uses the FEED-3 servo instruction.

Servo Instruction	Positioning Method	Number of Controllable Axes	Items Set by Peripherals																					Speed Change
			Common							Arc			Parameter Block									Others		
			Parameter Block No.	Axis	Address/Travel Value	Commanded Speed	Dwell Time	M-Code	Torque Limit Value	Auxiliary Point	Radius	Center Point	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	Cancel	Start	
FEED-3	Incremental	3	Δ	○	○	○	Δ	Δ					Δ	Δ	Δ	Δ	Δ	Δ	Δ		Δ	Δ	Δ	OK

○ : Must be set
Δ : Set if required

[Control Details]

(1) Positioning control from the current stop position (0) to the position which is the resultant of the designated travel directions and travel values of the respective axes.

(2) The travel direction is designated by the sign of the travel value, as follows:
- Positive travel value ....forward direction (increased address)
- Negative travel value.........reverse direction (decreased address)

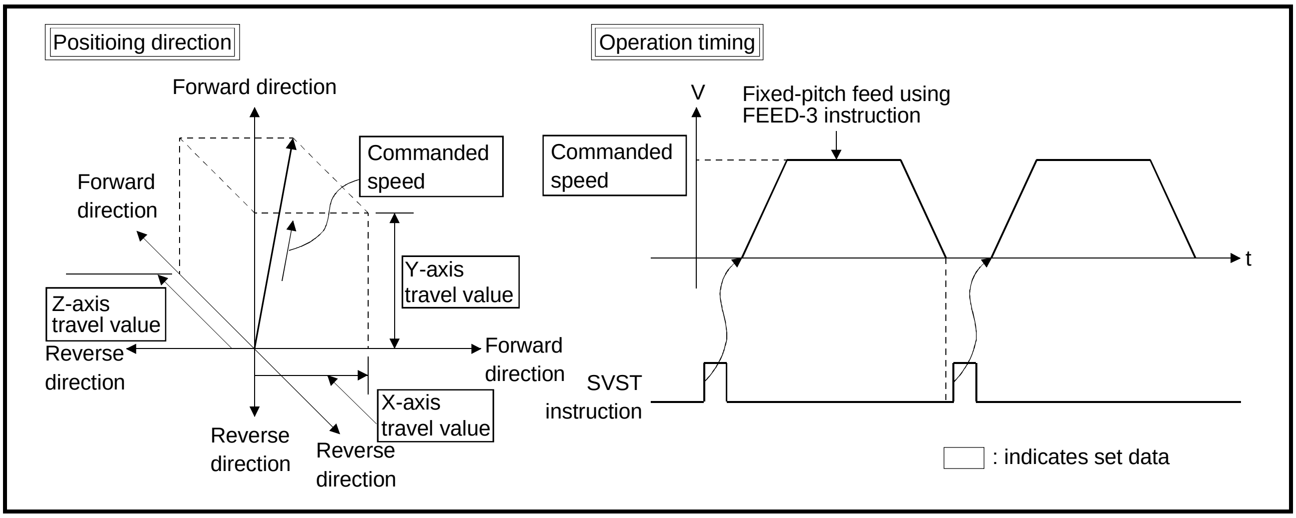


Fig.7.25 Fixed-Pitch Feed Control Using 3-Axes Linear Interpolation

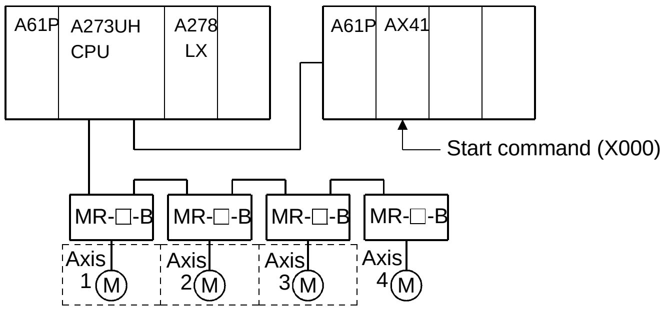
POINT

(1) Do not set the travel value to zero for fixed-pitch feed control.
The following results if the travel value is set to zero:
(a) If all three axes are set to zero, the fixed-pitch feed ends with no feed taking place.
(b) If the travel value is set to zero for any of the 3-axes, fixed-pitch feed control will not occur at the normal positioning speed for the axis or axes set to a non-zero travel value.

[Program Example]

This program conducts fixed-pitch feed control using 3-axes linear interpolation under the conditions below.

(1) System configuration
Fixed-pitch feed control using 3-axes linear interpolation of Axis, 1, Axis 2, and Axis 3.

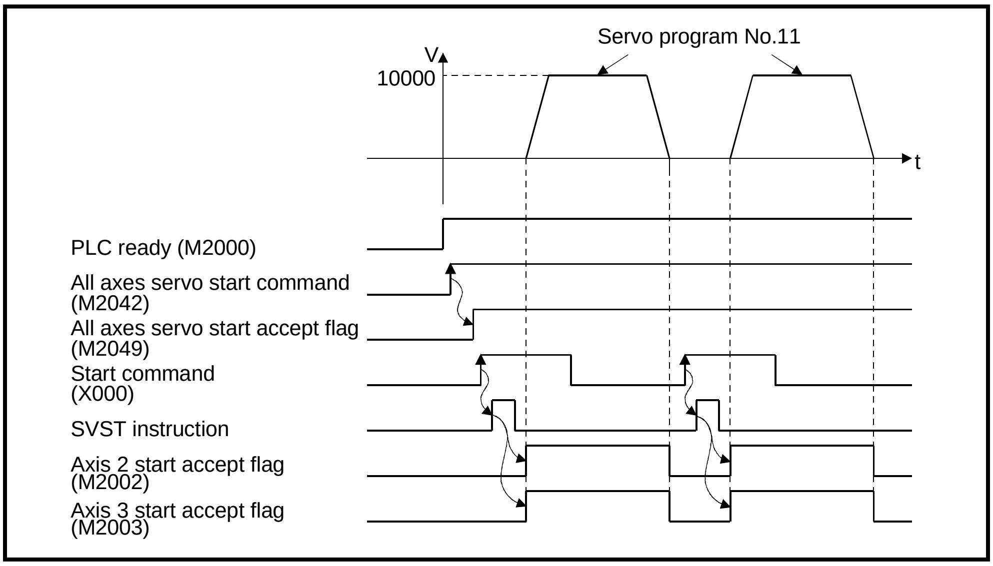


(2) System configuration
(a) The positioning conditions are shown below.

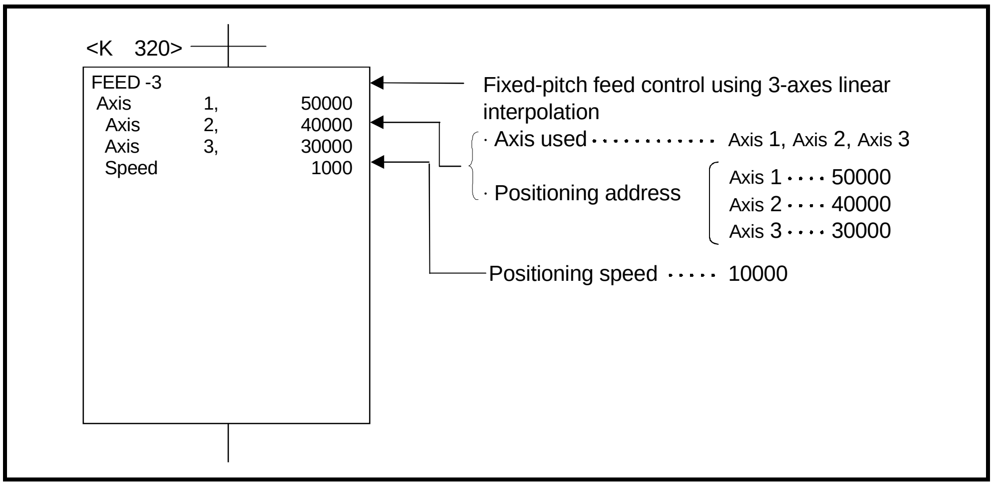
Item	Setting		
Servo program number	No. 320		
Positioning speed	1000		
Controlled axes	Axis 1	Axis 2	Axis 3
Travel value	50000	40000	30000

(b) Fixed-pitch feed control start command....... leading edge of X000 (OFF → ON)

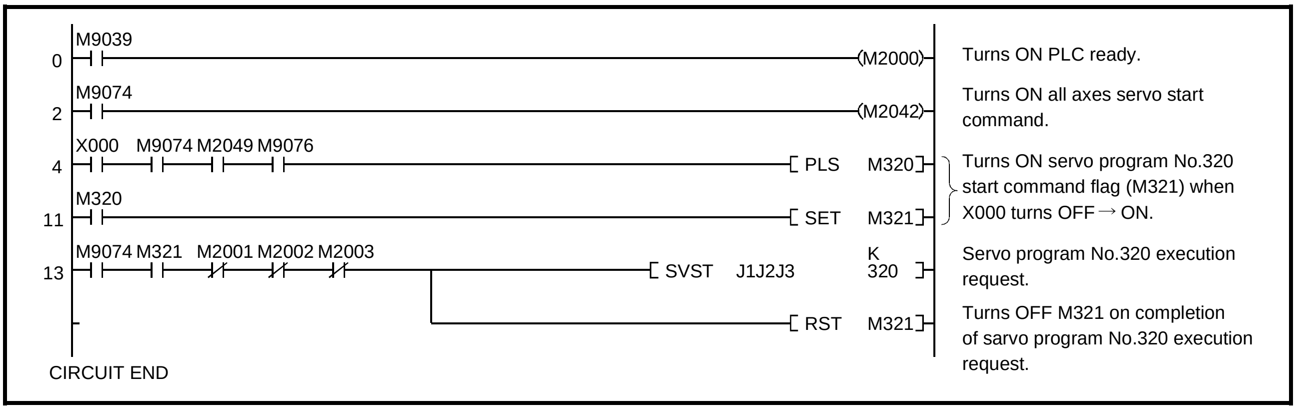
(3) Operation timing
The operation timing for fixed-pitch feed control using 3-axes linear interpolation is shown below.



(4) Servo program
The servo program No. 320 for fixed-pitch feed control using 3-axes linear interpolation is shown below.



(5) Sequence program
The sequence program which runs the servo program is shown below.



7.12 Speed Control (I)

(1) Speed control of the axis designated in the sequence program positioning commands.

(2) Control includes positioning loops for control of servo amplifiers.

(3) Speed control (I) uses the VF (forward) and VR (reverse) servo instructions.

Servo Instruction	Positioning Method	Number of Controllable Axes	Items Set by Peripherals																					Speed Change
			Common							Arc			Parameter Block									Others		
			Parameter Block No.	Axis	Address/Travel Value	Commanded Speed	Dwell Time	M-Code	Torque Limit Value	Auxiliary Point	Radius	Center Point	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	Cancel	Start	
VF VR	—	1	Δ	○		○		Δ						Δ	Δ	Δ	Δ	Δ	Δ		Δ	Δ	Δ	OK

○ : Must be set
Δ : Set if required

[Control Details]

(1) Controls the axis at the designated speed between the start of servo motor operation and the input of the stop command.
- VF......... movement in forward direction
- VR .... movement in reverse direction

(2) The present value does not change at zero.

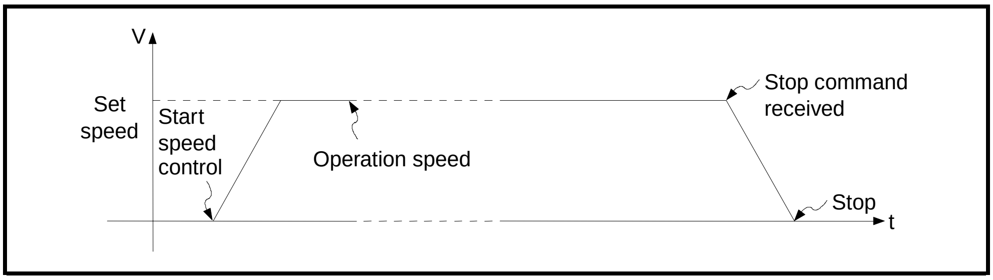


Fig.7.26 Speed Control (I)

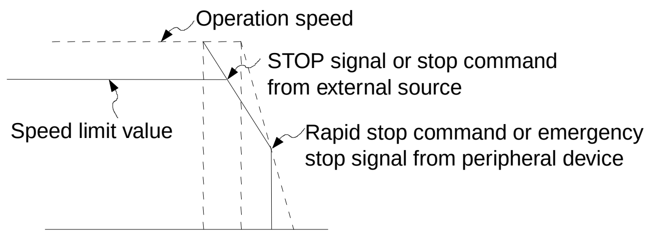
(3) Stop commands and stop processing
The stop commands and stop processing for speed control are listed in Figure 7.1.

Fig. 7.1 Stop Commands and Stop Processing

Stop Command	Stop Condition	Stopped Axis	Stop Processing
External STOP signal	OFF → ON	Designated axis	Deceleration stop according to the deceleration time on STOP input designated in the parameter block or by a servo instruction.
Stop command (M3200+20n)			Deceleration stop according to the deceleration time designated in the parameter block or by a servo instruction.
Rapid stop command (Note-1) (M3201+20n)			Deceleration stop according to the rapid stop deceleration time designated in the parameter block or by a servo instruction.
Emergency stop from peripheral device (Note-1) (test mode)	Key input	All axes	Deceleration stop according to the rapid stop deceleration time designated in the parameter block or by a servo instruction.
Speed changed to 0	Value stored in speed change register	Designated axis	Deceleration stop according to the deceleration time designated in the parameter block or by a servo instruction.

POINT

(Note-1): The rapid stop command and emergency stop from a peripheral device are valid during deceleration due to input of an external STOP signal or the stop command (M3200+20n), and processing according to the rapid stop deceleration time parameter starts at the time the stop condition occurs.



[Cautions]

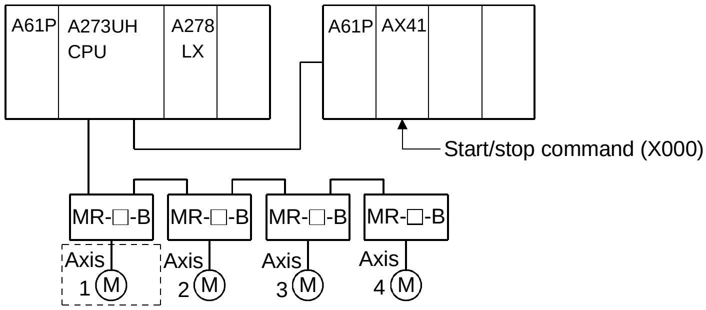
(1) After running speed control using the absolute data system, the feed current value cannot be set to zero by the following operations:
- Reset with the RUN key
- Turning on the servo power supply (OFF → ON)

(2) The dwell time cannot be set.

[Program Example]

This program conducts speed control (I) under the conditions below.

(1) System configuration
Speed control (I) of Axis 1.



(2) Speed control (I) conditions

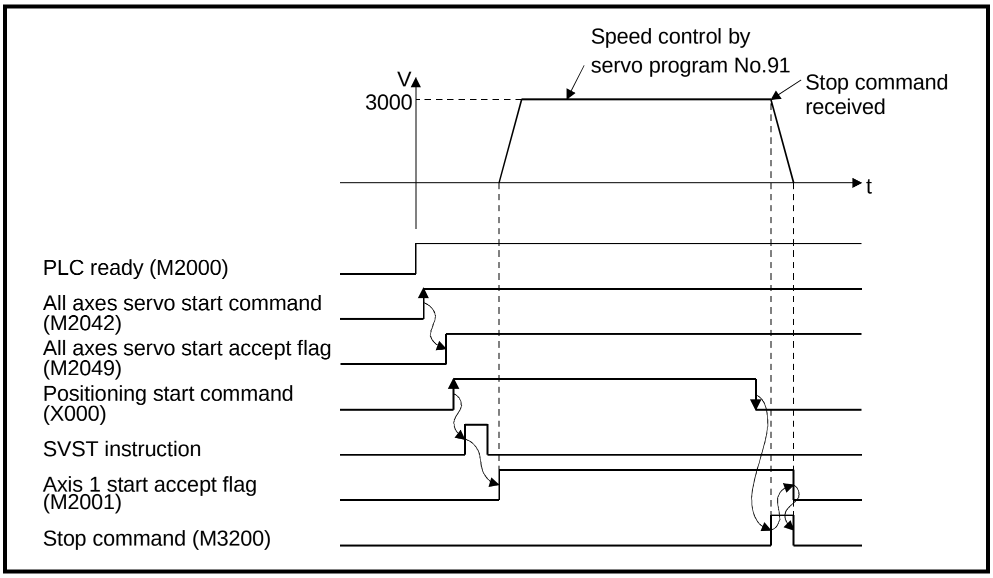
(a) The speed control (I) conditions are shown below.

Item	Setting
Servo program number	No. 91
Controlled axis	Axis 1
Control speed	3000
Rotation direction	Forward

(b) Speed control (I) start command........ leading edge of X000 (OFF → ON)

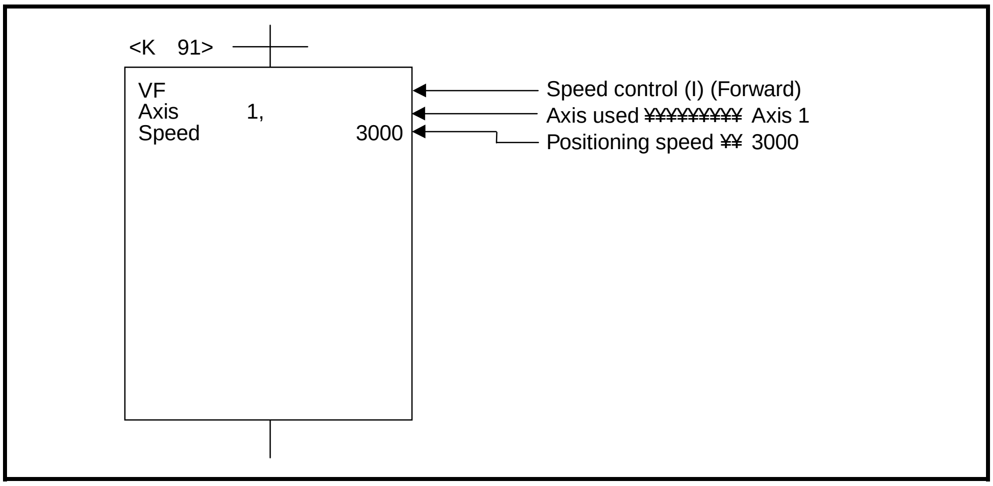
(c) Speed control (I) stop command........ trailing edge of X000 (ON → OFF)

(3) Operation timing
The operation timing for speed control (I) is shown below.



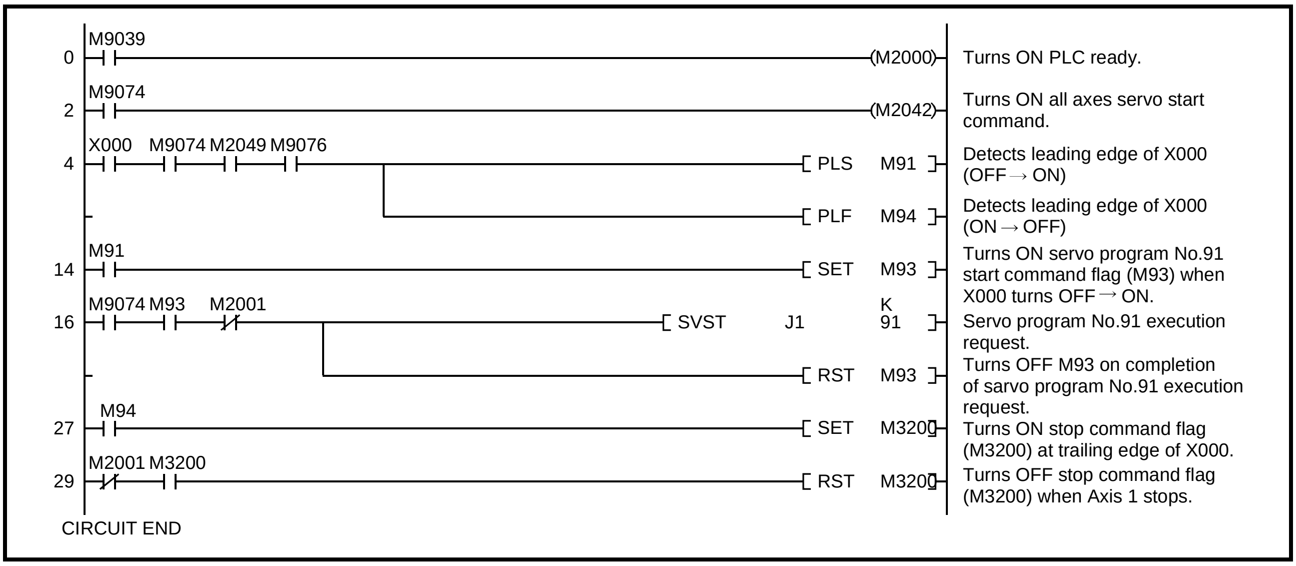
(4) Servo program

The servo program No. 91 for speed control (I) is shown below.



(5) Sequence program

The sequence program which runs the servo program is shown below.



7.13 Speed Control (II)

(1) Speed control of the axis designated in the sequence program positioning commands.

(2) Control does not include positioning loops for control of servo amplifiers. Use stopper control to current errors becoming excessive.

(3) Speed control (II) uses the VVF (forward) and VVR (reverse) servo instructions.

Servo Instruction	Positioning Method	Number of Controllable Axes	Items Set by Peripherals																					Speed Change
			Common							Arc			Parameter Block									Others		
			Parameter Block No.	Axis	Address/Travel Value	Commanded Speed	Dwell Time	M-Code	Torque Limit Value	Auxiliary Point	Radius	Center Point	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	Cancel	Start	
VVF VVR	—	1	Δ	○		○		Δ	Δ					Δ	Δ	Δ	Δ	Δ	Δ		Δ	Δ	Δ	OK

○ : Must be set
Δ : Set if required

[Control Details]

(1) Controls the axis at the designated speed between the start of servomotor operation and the input of the stop command.
- VVF ....movement in forward direction
- VVR.......movement in reverse direction

(2) The current value or deviation counter do not change at zero.

(3) When the setting for "torque" is set in a servo program and an indirect designation is made, the torque limit value can be changed during operation by changing the value of the indirect device.

(4) The stop command and stop processing are the same as for speed control(I).

[Cautions]

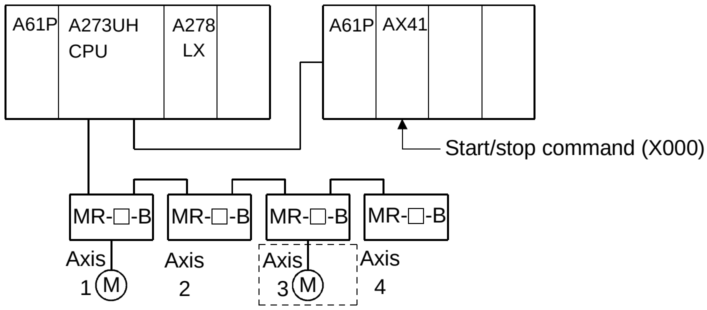
(1) After running speed control using the absolute data system, the feed current value cannot be set to zero by resetting with the RUN key.

(2) The dwell time cannot be set.

[Program Example]

This program conducts speed control (II) under the conditions below.

(1) System configuration
Speed control (II) of Axis 3.



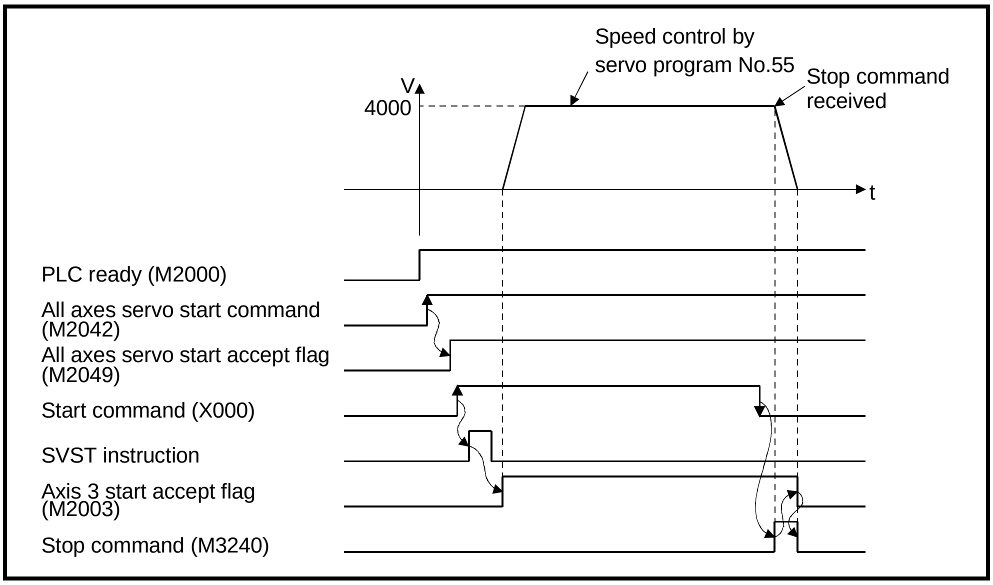
(2) Speed control (II) conditions
(a) The speed control (II) conditions are shown below.

Item	Setting
Servo program number	No. 55
Controlled axis	Axis 3
Control speed	4000
Rotation direction	Forward

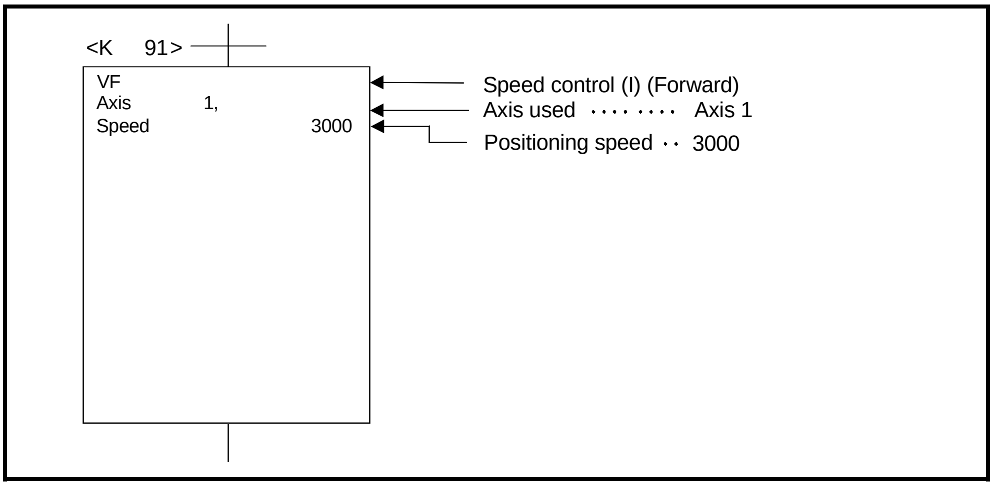
(b) Speed control (II) start command .... leading edge of X000 (OFF → ON)

(c) Speed control (II) stop command .... trailing edge of X000 (ON → OFF)

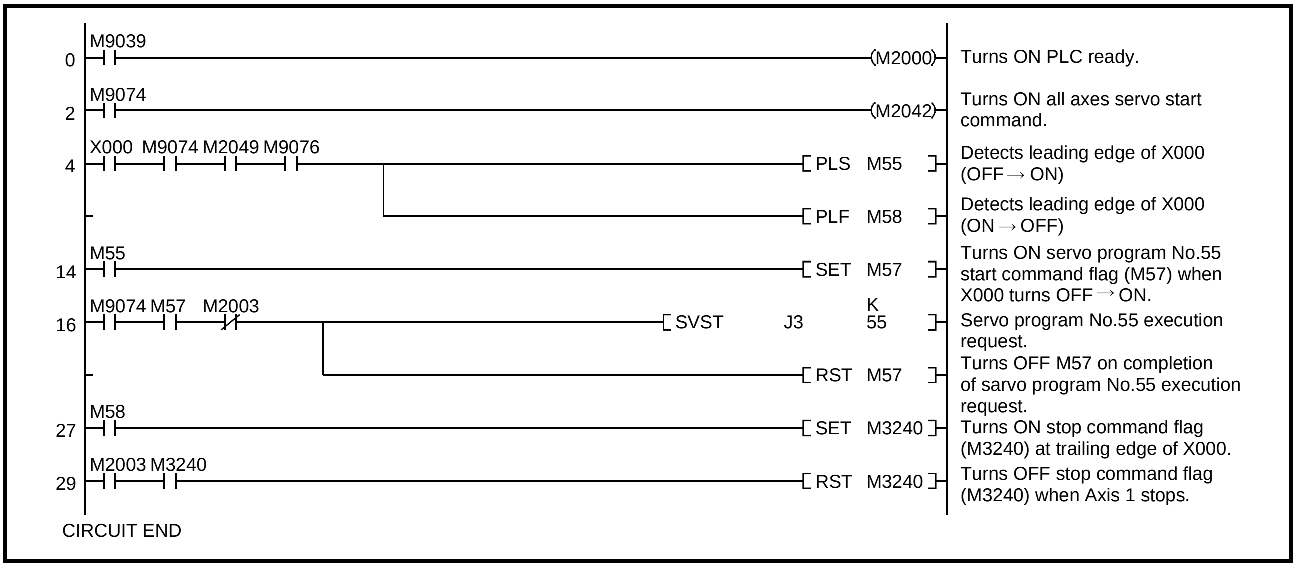
(3) Operation timing
The operation timing for speed control (II) is shown below.



(4) Servo program
The servo program No. 55 for speed control (II) is shown below.



(5) Sequence program
The sequence program which runs the servo program is shown below.



7.14 Speed/Position Switching Control

7.14.1 Starting speed/position switching control

Speed/position switching control of the axis designated in the sequence program positioning commands.
Speed/position switching control uses the VPF (forward), VPR (reverse), and VPSTART (restart) servo instructions.

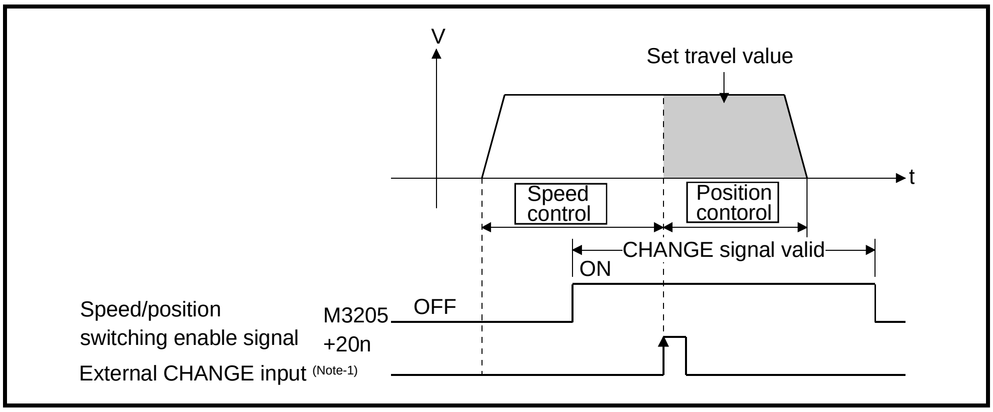
Servo Instruction	Positioning Method	Number of Controllable Axes	Items Set by Peripherals																					
			Common							Arc			Parameter Block									Others		
			Parameter Block No.	Axis	Address/Travel Value	Commanded Speed	Dwell Time	M-Code	Torque Limit Value	Auxiliary Point	Radius	Center Point	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	Cancel	Start	Speed Change
VPF VPR	Incremental	1	Δ	○	○	○	Δ	Δ	Δ					Δ	Δ	Δ	Δ	Δ	Δ		Δ	Δ	Δ	OK

○ : Must be set
Δ : Set if required

[Control Details]

(1) The servomotor starts under speed control, but on input of the external CHANGE signal the control changes from speed control to position control and the axis is positioned by the designated travel value.
- VPF.........movement in forward direction (direction in which addresses increase)
- VPR ....movement in reverse direction (direction in which addresses decrease)

(2) The external CHANGE signal is only valid when M3205+20n (Speed/position switching enable signal) is ON. If M3205+20n turns ON after the CHANGE signal turns ON, no speed/position switching occurs and speed control is continued.



REMARKS

(Note-1) : The external CHANGE signal is an external input to the A278LX/A172SENC CHENGE terminal. When "normally open contact input" is set in the system settings, CHANGE input occurs when the CHANGE signal comes ON, and when "normally closed contact input" is set, CHANGE input occurs when the CHANGE signal goes OFF. (See the A173UHCPU/A273UHCPU Motion Controller User's Manual for details.)

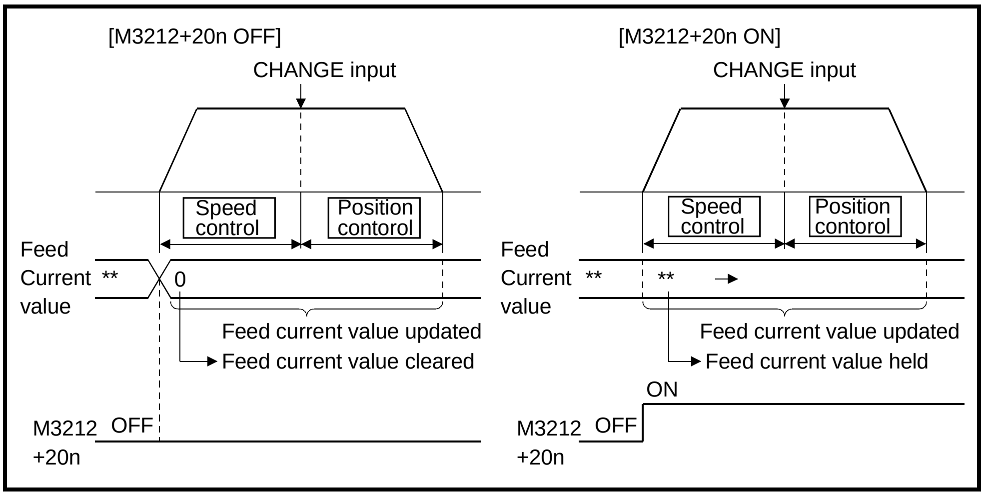
(3) Feed current value processing
The feed current value is determined in one of the following two ways according to the ON/OFF status of M3212+20n (feed current value update request command) when speed/position switching control is started.

(a) M3212+20n .... OFF
- The feed current value is cleared to zero at the start of speed/position switching control.
- TheZ feed current value is updated from the start of control (speed control).
- The feed current value after control is stopped is as follows:

[Feed current value after stopping] = [Travel value under speed control] + [Travel value under position control]

(b) M3212+20n .... ON
- The feed current value is not cleared at start of speed/position switching control.
- The feed current value is updated from the start of control (speed control).
- The axis makes a deceleration stop if the feed current value exceeds the stroke limit.
- The feed current value after control is stopped is as follows:

[Feed current value after stopping] = [Address before speed control] + [Travel value under speed control] + [Travel value under position control]



POINT

If control is started by turning M3212+20n ON, leave M3212+20n ON until positioning control is completed.

The feed current value cannot be guaranteed if M3212+20n is turned OFF during control.

(4) Changing travel value during speed control
After speed/position switching control is started, the travel value for position control can be changed while speed control is in progress. Follow the procedure described below to change the travel value.
(a) Indirectly designate the travel value in the servo program using the 2-word data registers shown in the table below.

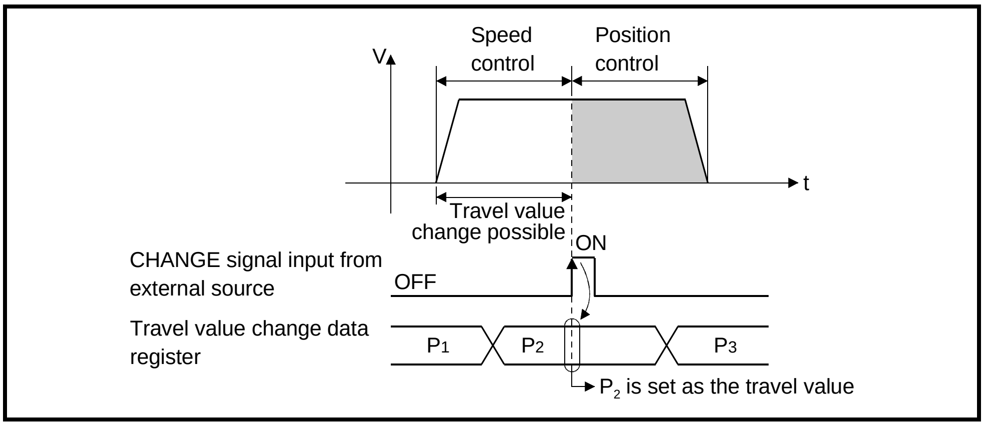
Axis No.	Data Register Number for Indirect Designation	Data Registers to Change Travel Value	
		Most-Significant Data	Least-Significant Data
1	D16	D17	D16
2	D36	D37	D36
3	D56	D57	D56
4	D76	D77	D76
5	D96	D97	D96
6	D116	D117	D116
7	D136	D137	D136
8	D156	D157	D156
9	D176	D177	D176
10	D196	D197	D196
11	D216	D217	D216
12	D236	D237	D236
13	D256	D257	D256
14	D276	D277	D276
15	D296	D297	D296
16	D316	D317	D316
17	D336	D337	D336
18	D356	D357	D356
19	D376	D377	D376
20	D396	D397	D396
21	D416	D417	D416
22	D436	D437	D436
23	D456	D457	D456
24	D476	D477	D476
25	D496	D497	D496
26	D516	D517	D516
27	D536	D537	D536
28	D556	D557	D556
29	D576	D577	D576
30	D596	D597	D596
31	D616	D617	D616
32	D636	D637	D636

Example

The following servo program moves Axis 4 in the forward direction at speed 50000 under speed control and after the external CHANGE signal turns ON, it executes position control for the travel value designated in registers D76 and D77.

```
<K   11>
VPF
 Axis      4,            D  76   <---- Indicates indirect designation of travel value
 Speed               50000
```

(b) The sequence program sets the travel value in the travel value change data register while speed control is in progress. When the external CHANGE signal turns ON, the contents of the travel value change data register are set as the travel value.

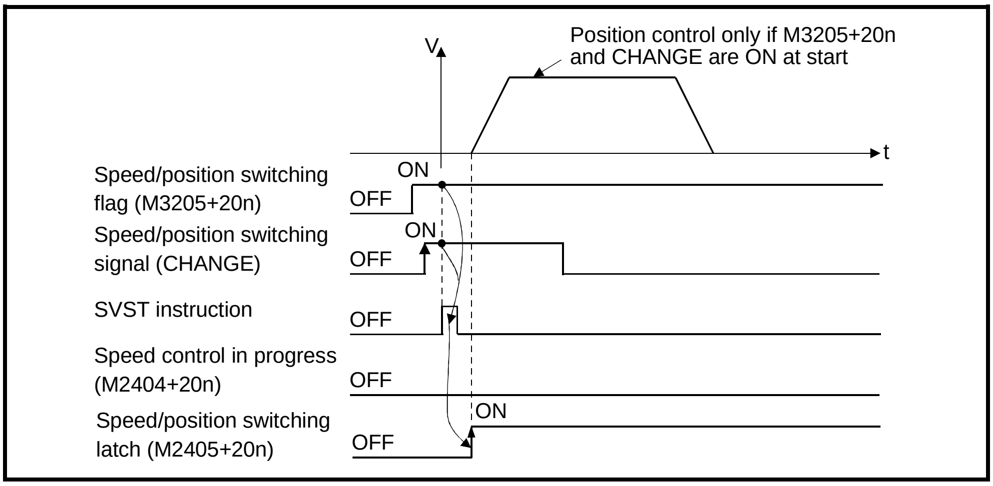


(5) Travel value area after proximity point dog turns ON
The travel value since the position mode was selected by the external CHANGE signal is stored in the travel value area (see section 3.2.1) when the proximity dog turns ON.

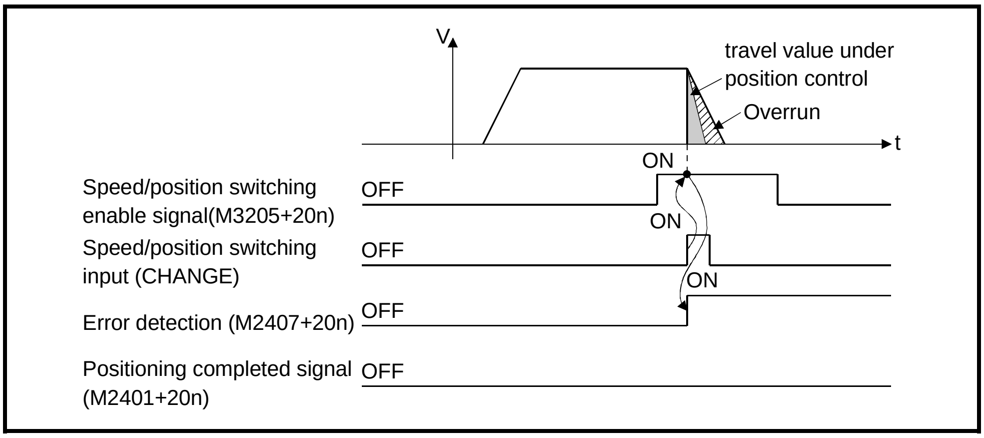
[Cautions]

(1) Items checked when the external CHANGE signal turns ON
Speed control switches to position control when the external CHANGE signal turns ON if the following conditions are met:
- The start accept flag (M2001+n) is ON.
- Speed control is in progress after start of speed/position switching control.
- Speed/position switching enable signal (M3205+20n) is ON.

(2) To omit speed control
Position control only is executed if M3205+20n and the CHANGE signal are ON when control starts. The speed control signal (M2404+20n) does not turn ON.



(3) If travel value under position control is less than deceleration distance
   (a) If the position control travel value is less than the deceleration distance at the controlled speed, deceleration processing starts immediately when CHANGE is input.
   (b) The difference between travel value for the deceleration stop and position control is the overrun. If an overrun occurs, the error detection signal (M2407+20n) turns ON and error code 209 is stored in the data register.
   (c) The positioning completed signal (M2401+20n) does not turn ON.



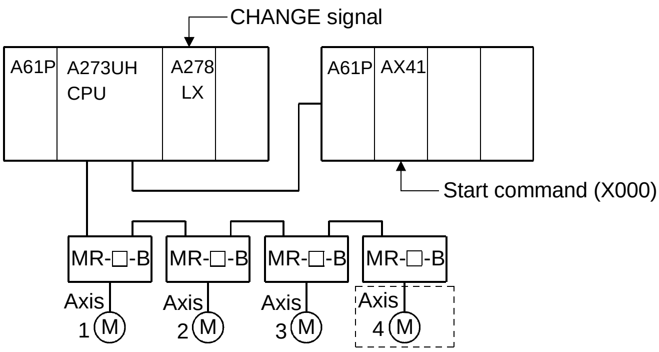
(4) Stroke limit check
   No stroke limit range check is made during the speed mode. If the travel value exceeds the stroke limit range, a minor error (error code: 210) occurs when position mode is selected, and a deceleration stop occurs.

(5) Switching time from speed control to position control
   Switching from speed control to position control takes 1 ms after the external CHANGE signal turns ON.

[Program Example]

This program executes speed/position switching control under the conditions below.

(1) System configuration
   Speed/position switching control of Axis 4.



(2) Positioning conditions

(a) The positioning conditions are shown below.

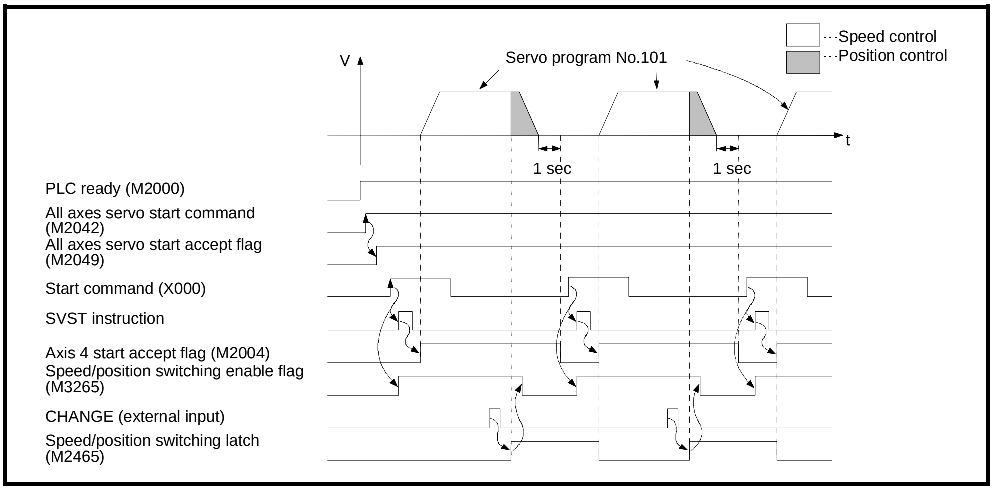
Item	Setting
Servo program number	No. 101
Controlled axis	Axis 4
Positioning control travel value	40000
Commanded speed	1000

(b) Positioning start command........................... leading edge of X000 (OFF → ON)

(c) Speed/position switching enable flag M3265

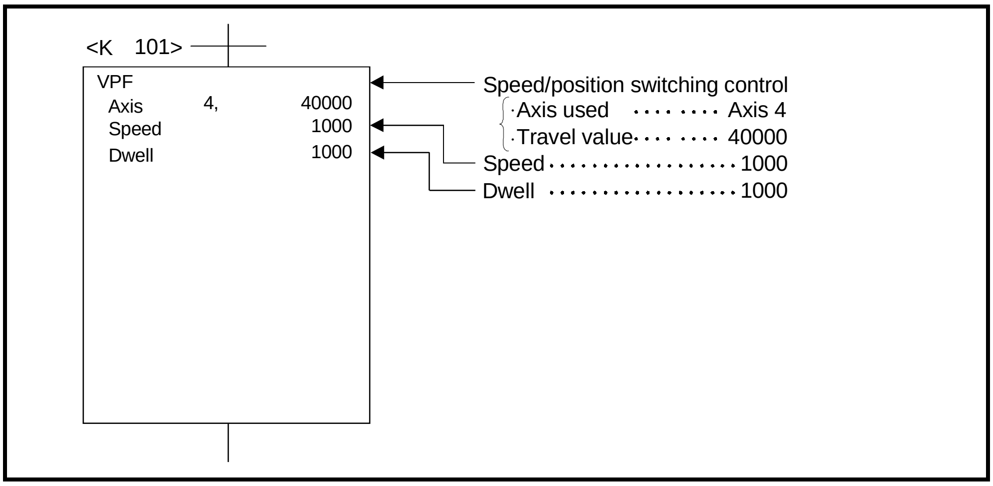
(3) Operation timing

The operation timing for speed/position switching control is shown below.

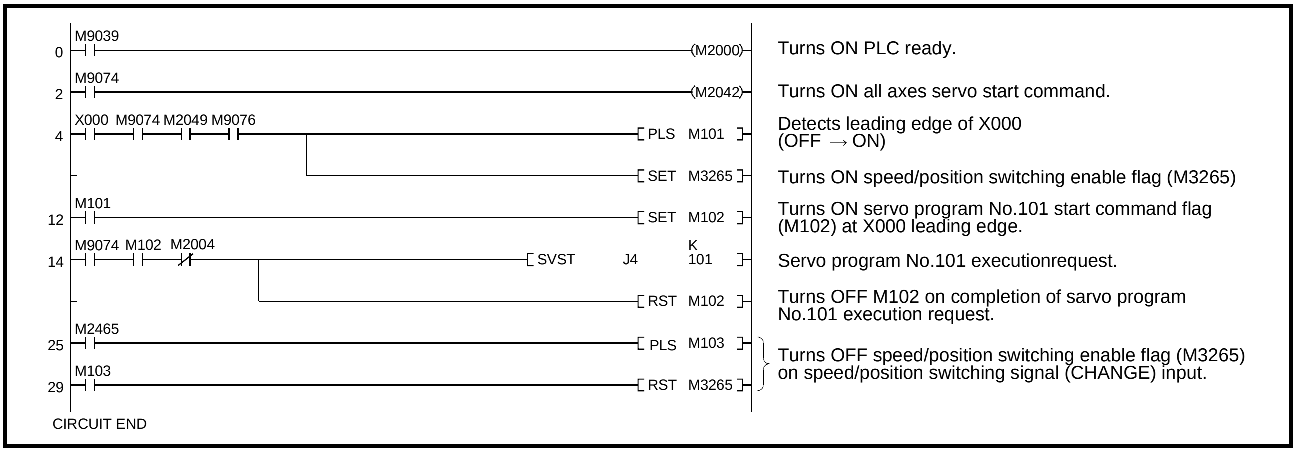


(4) Servo program

The servo program No. 101 for speed/position switching control is shown below.



(5) Sequence program
The sequence program which runs the servo program is shown below.



7.14.2 Restarting speed/position switching control

Restarting (continuing) speed/position switching control after a stop due to a stop command. Control is restarted using the VPSTART servo instruction.

Servo Instruction	Positioning Method	Number of Controllable Axes	Items Set by Peripherals																					
			Common							Arc			Parameter Block									Others		
			Parameter Block No.	Axis	Address/Travel Value	Commanded Speed	Dwell Time	M-Code	Torque Limit Value	Auxiliary Point	Radius	Center Point	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	Cancel	Start	Speed Change
VPSTART				○																		Δ	Δ	

○ : Must be set
Δ : Set if required

[Control Details]

(1) Speed/position switching control is continued after it was stopped due to a stop command.

(2) Restarting using VPSTART is valid whether the stop occurred during speed control or position control.

(a) If the stop occurred during speed control, then speed control continues and switches to position control when the CHANGE signal turns ON.

(The control conditions after restarting are the same as the previous speed/position switching control conditions. See 7.14.1 "Starting Speed/Position Switching Control".)

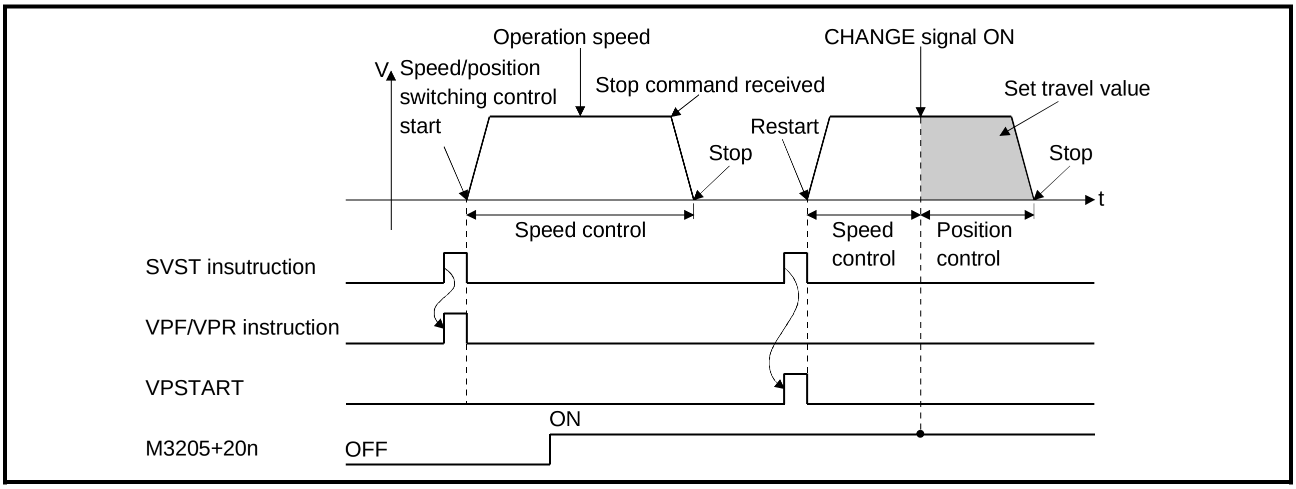


Fig.7.27 Restarting During Speed Control

(b) If the stop occurred during position control, then position control continues until the positioning reaches the set travel value.
The travel value after the restart is calculated as follows:

Travel value after restart (P2)	=	Set travel value (P)	+	Travel value be-fore stop (P1)

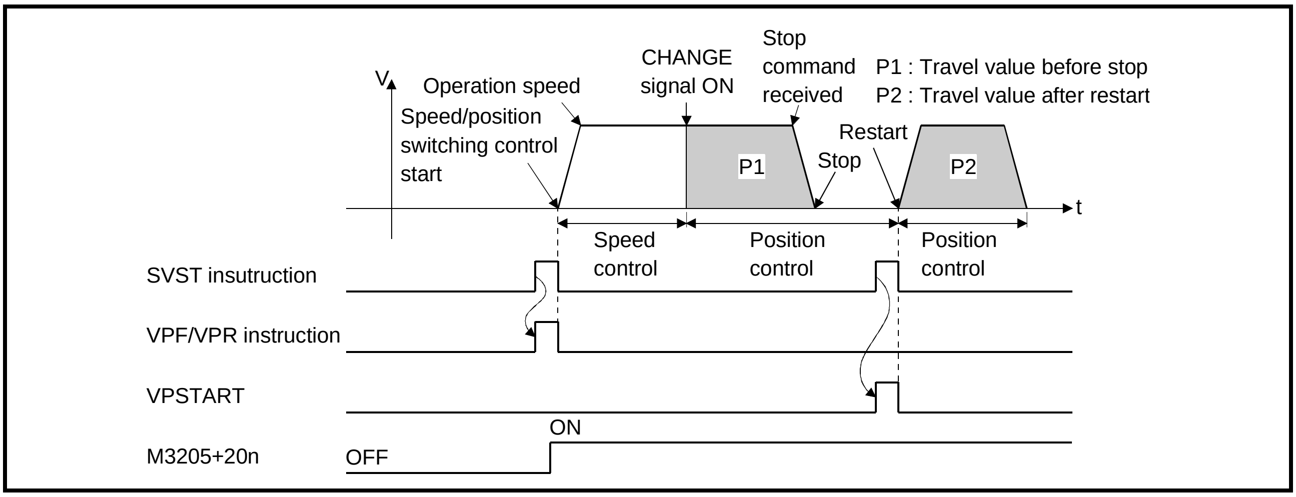


Fig.7.28 Restarting During Speed Control

(3) The speed at restart is the speed stored when the VPF/VPR instruction occurred.
Therefore, even if a speed change occurred before the stop, control restarts at the speed set at the time of VPF/VPR instruction execution.

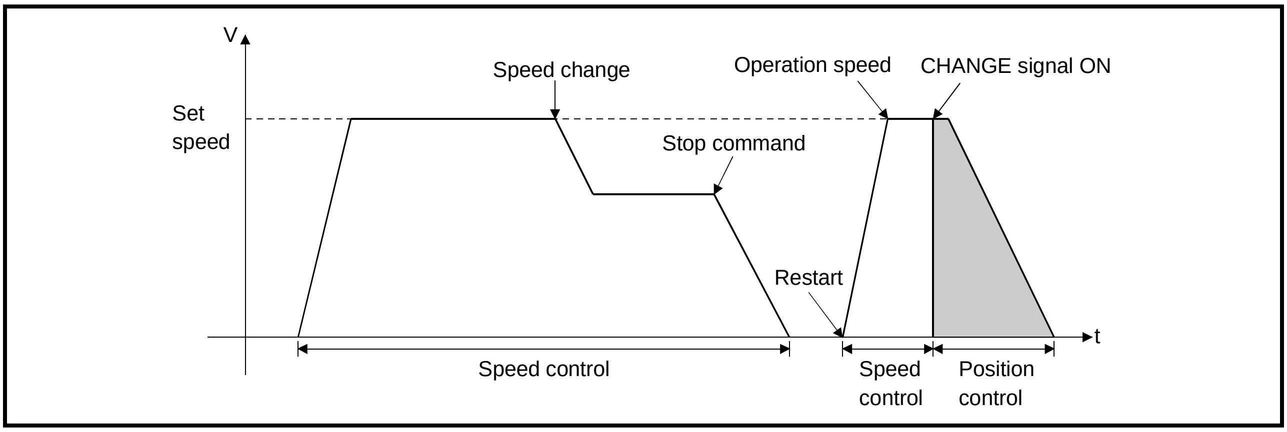
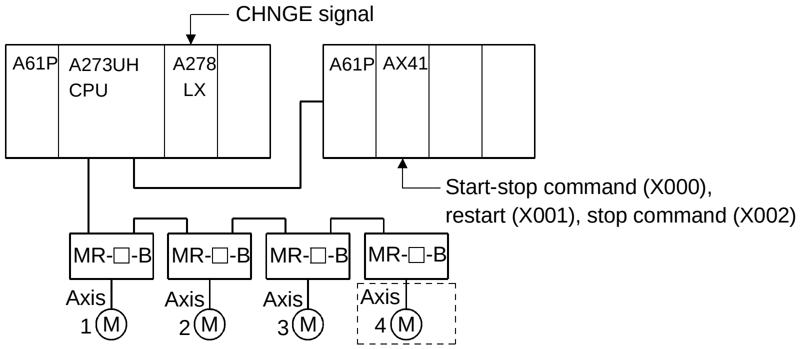


Fig.7.29 Restarting After Speed Change

[Program Example]

This program restarts speed/position switching control after a stop, under the conditions below.

(1) System configuration
Speed/position switching control of Axis 4.



(2) Positioning conditions

(a) The positioning conditions are shown below.

Item	Setting	
	Speed/Position Switching Control	Restart
Servo program number	No. 101	No. 102
Controlled axis	Axis 4	Axis 4
Positioning control travel value	40000	—
Commanded speed	1000	—

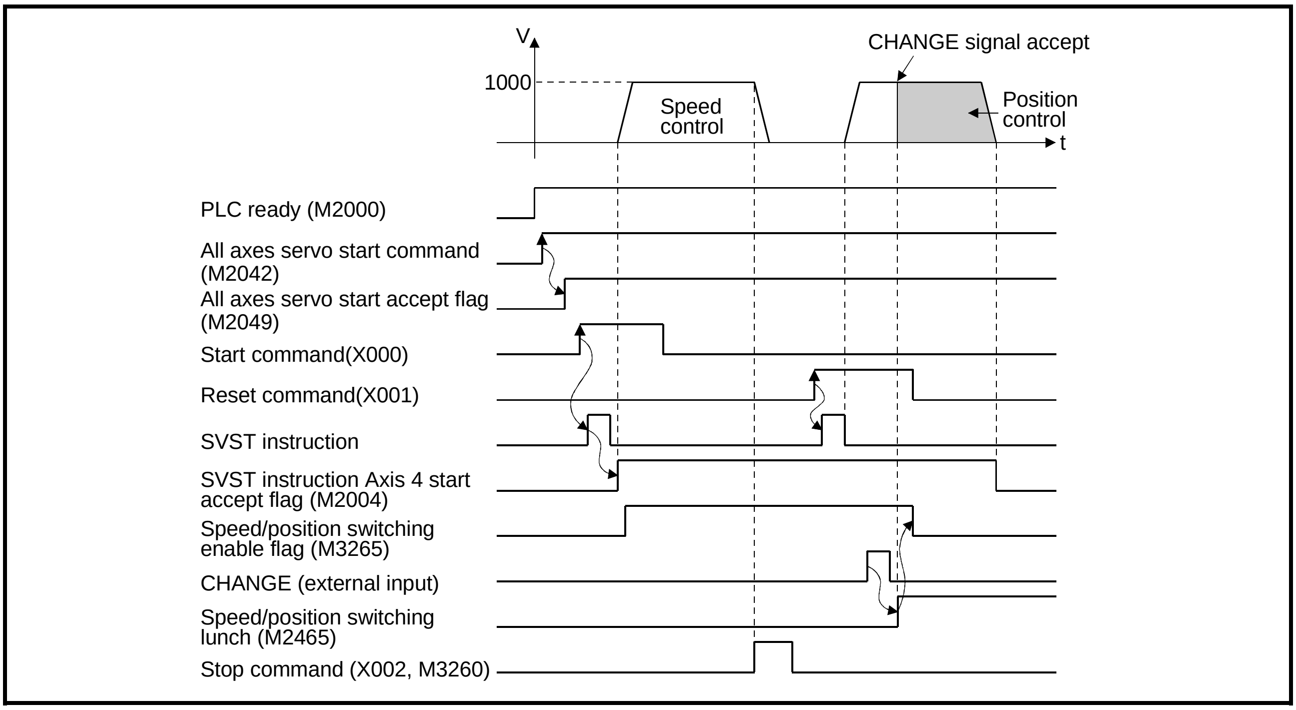
(b) Positioning start command .... leading edge of X000 (OFF → ON)

(c) Speed/position switching enable flag M3265

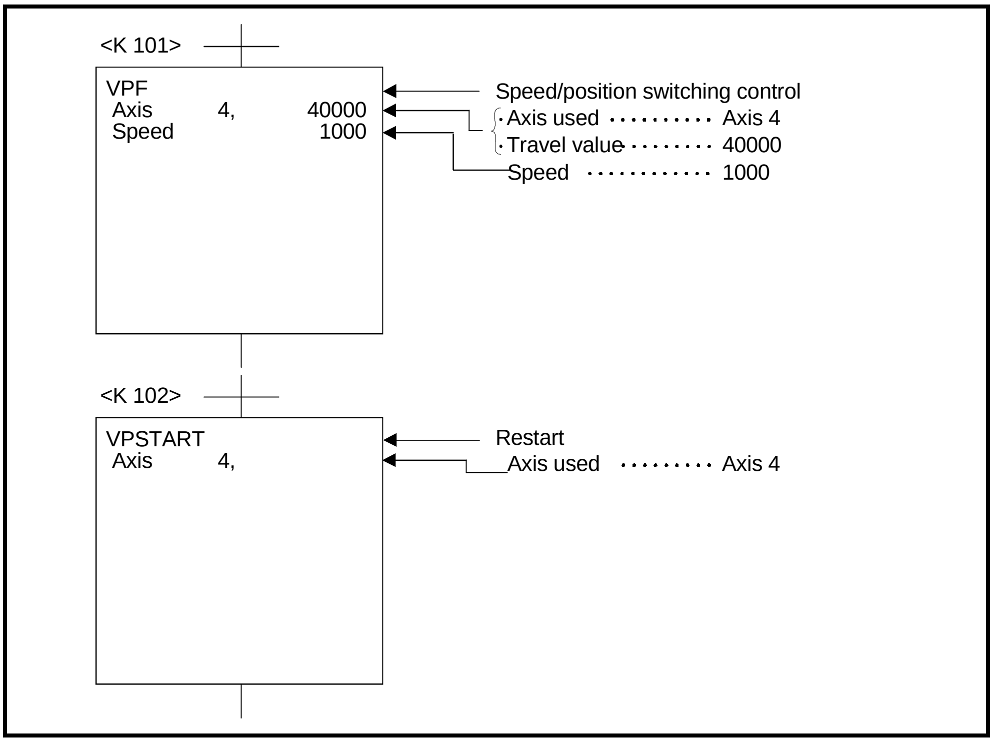
(d) Restart command .... leading edge of X001 (OFF → ON)

(e) Stop command .... leading edge of X002 (OFF → ON)

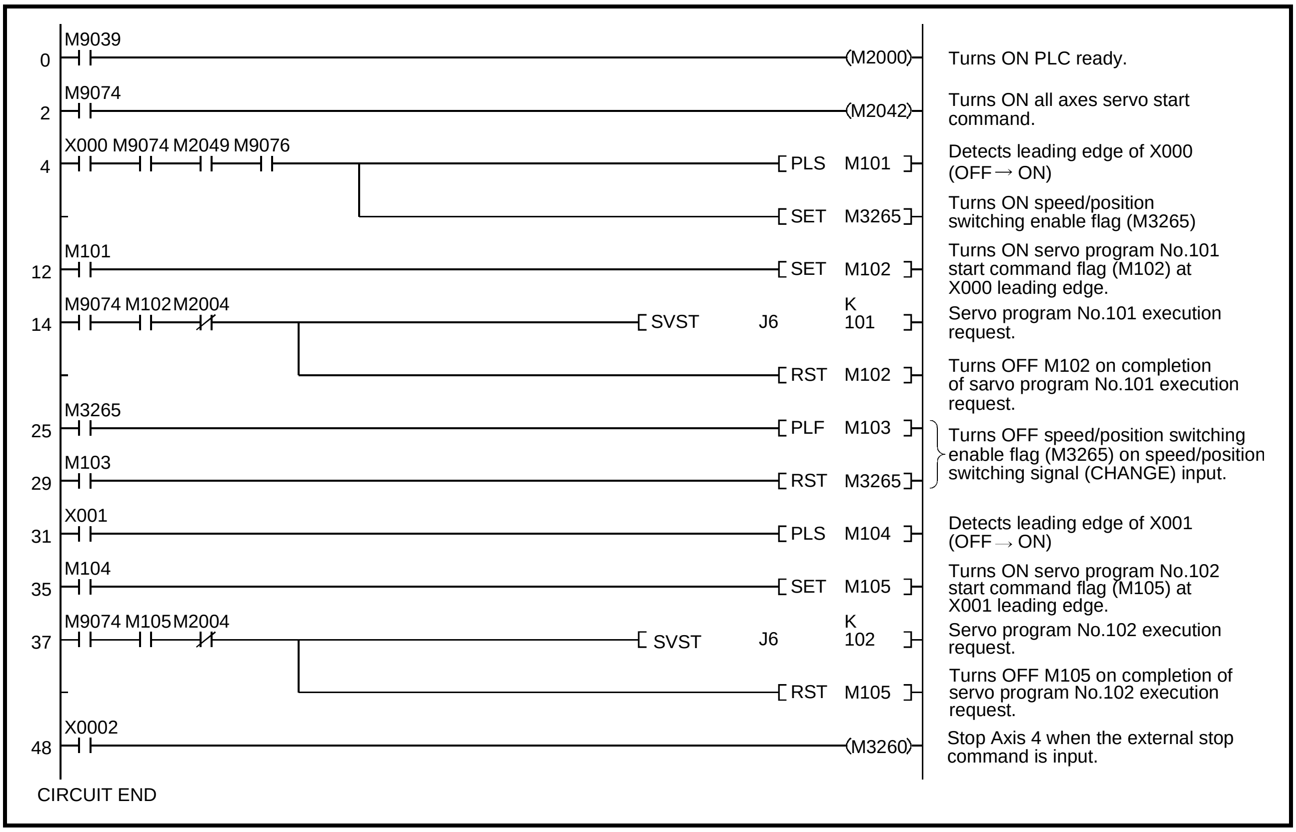
(3) Operation timing
The operation timing for speed/position switching control and restarting is shown below.



(4) Servo program
The servo program No. 101 for speed/position switching control and No. 102 for restarting are shown below.



(5) Sequence program
The sequence program which runs the servo programs is shown below.



7.15 Speed-Switching Control

(1) After a single control start, the speed is switched for positioning control to the preset speed-switching points.

(2) The speed-switching points and speed are set by the servo program.

(3) Repeated instructions permit repeated control between any speed-switching points.

(4) M-codes and torque limit values can be changed at each speed-switching point.

7.15.1 Starting speed-switching control, speed-switching points, end designation

Servo Instruction		Positioning Method	Number of Controllable Axes	Items Set by Peripherals: Common							Arc			Parameter Block									Others		Speed Change
				Parameter Block No.	Axis	Address/Travel Value	Commanded Speed	Dwell Time	M-Code	Torque Limit Value	Auxiliary Point	Radius	Center Point	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	Cancel	Start	
Start	VSTART	—	—	Δ										Δ	Δ	Δ	Δ	Δ	Δ	Δ		Δ	Δ	Δ	—
End	VEND																								
End point address	ABS-1	Absolute data	1		○	○	○	Δ	Δ	Δ													Δ	Δ	OK
	ABS-2		2																						
	ABS-3		3																						
Travel value to end point	INC-1	Incremental	1																						
	INC-2		2																						
	INC-3		3																						
Speed-switching point	VABS	Absolute data	—			○	○		Δ	Δ															—
	VABC	Incremental																							

○ : Must be set
Δ : Set if required

[Control Details]

Starting and ending speed-switching control

Speed-switching control is started and ended using the following instructions:

(1) VSTART
  Starts speed-switching control.

(2) VEND
  Ends speed-switching control.

End address and travel value to end point

The speed-switching control end address and travel value to the end point, positioning method, and positioning speed to the end point are set using the following instructions:

(1) ABS-1/INC-1
  Designate 1-axis linear positioning control.
  The control details are described in Section 7.2 "1-axis Linear Positioning Control".

(2) ABS-2/INC-2
  Designate 2-axes linear interpolation control.
  The control details are described in Section 7.3 "2-axes Linear Interpolation Control".

(3) ABS-3/INC-3
  Designate 3-axes linear interpolation control.
  The control details are described in Section 7.4 "3-axes Linear Interpolation Control".

Speed-switching point setting

The address (travel value) to the speed-switching point and the positioning speed are set using the following instructions:

(1) VABS
  Designates the speed-switching point using the absolute data method.

(2) VINC
  Designates the speed-switching point using the incremental method.

POINT

The settings for speed-switching point (travel value) and the positioning speed under 2 or 3-axes linear interpolation control apply to the axis designated for speed-switching control end address and travel value to the end point (with the ABS/INC instructions).

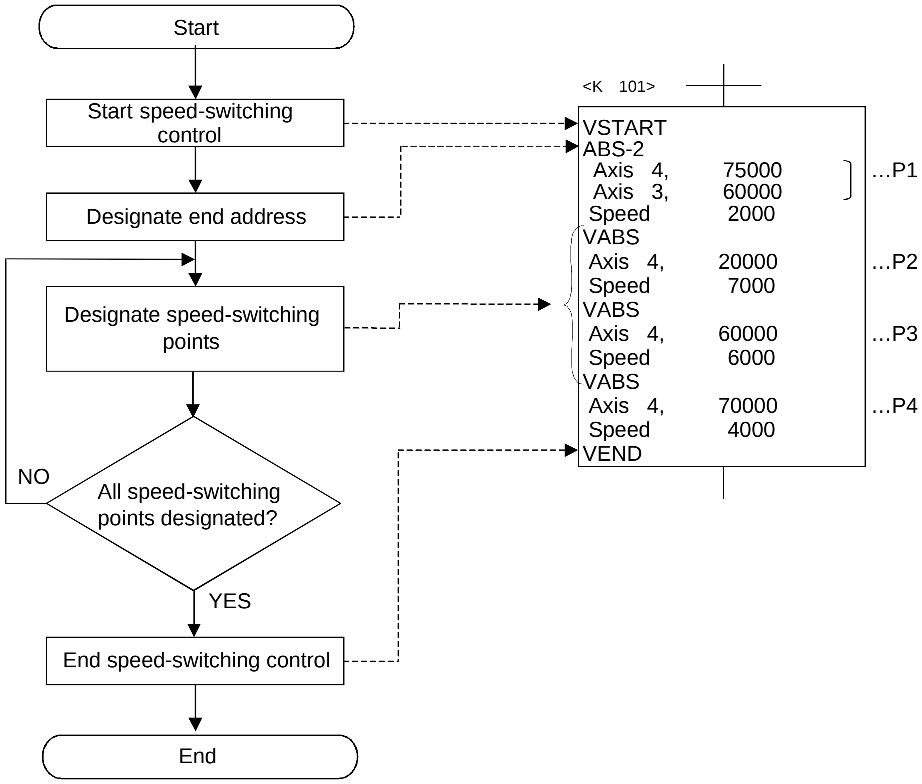
```
VSTART
ABS-2
Axis    2,    75000
Axis    3,    60000
Speed          2000
```

Speed-switching point (travel value) set for these axes.

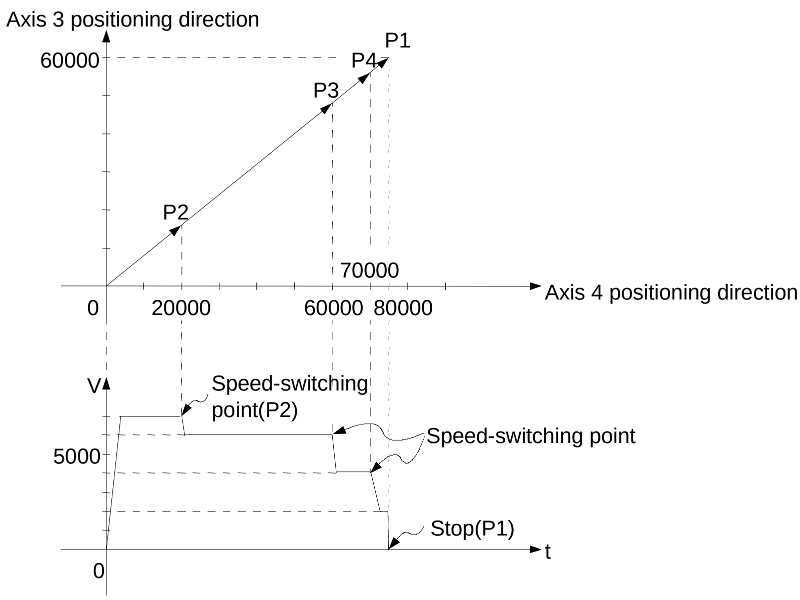
Operation timing and the procedure to write servo programs

The method to write servo programs for speed-switching control and the operation timing are shown in below.

[Servo program]



[Operation timing]



[Cautions]

(1) The number of control axis cannot be changed while control is in progress.

(2) Designation of position switching points can use a combination of the absolute data method (ABS□) and the incremental method (INC□).

(3) A speed-switching point cannot be designated as an address which results in a change in travel direction. If the address results in a change in direction, the error code 215 is stored in the minor error register for the axis and a deceleration stop occurs.

(4) A maximum of 768 steps (approximately 100 points) can be designated in a speed-switching control program.

(5) When control is started a check is made to ensure that the end address lies in the stroke range.
If the check determines that positioning would result in an axis moving out of the stroke limit range, the error code 106 is stored in the minor error register for the axis and operation does not start.

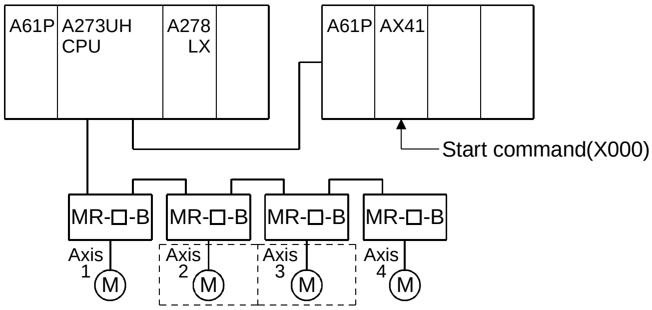
(6) Speed switching is not carried out if the travel value between speed-switching points is so short that the next speed-switching point is reached while speed switching is still in progress.

(7) If no M-code is designated for a speed-switching point, the M-code from the previous point is retained.

[Program Example]

This program executes speed-switching control under the conditions below.

(1) System configuration
Speed-switching control of Axis 2 and Axis 3.



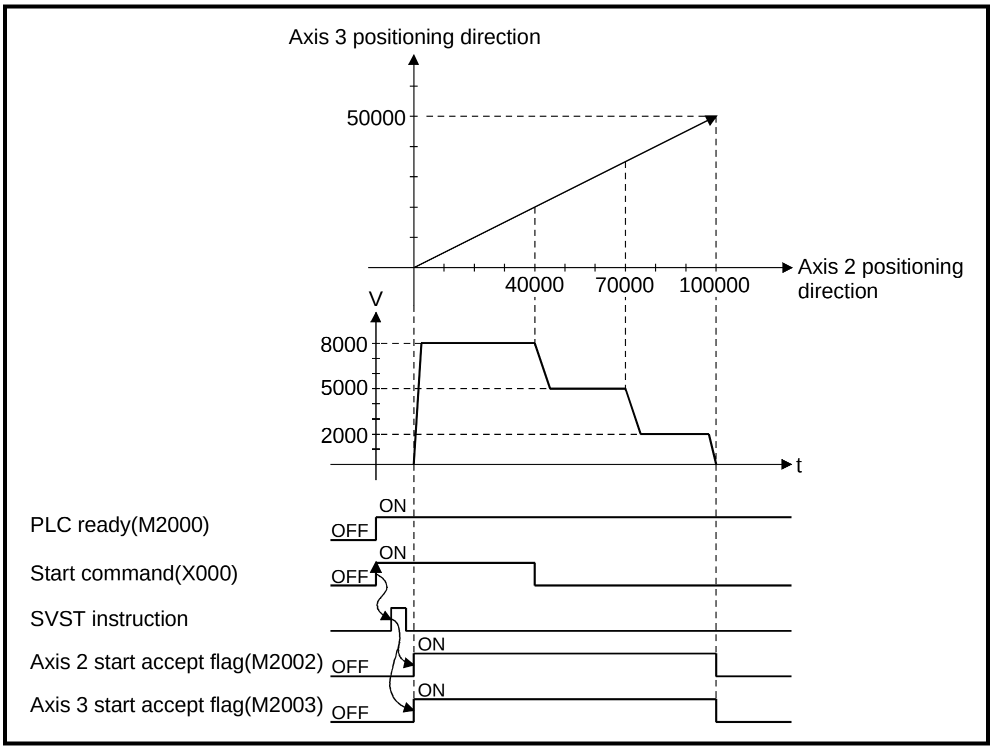
(2) Positioning conditions

(a) The speed-switching control conditions are shown below.

Item	Setting	
Servo program number	No. 500	
Controlled axis	Axis 2	Axis 3
End address	100000	50000

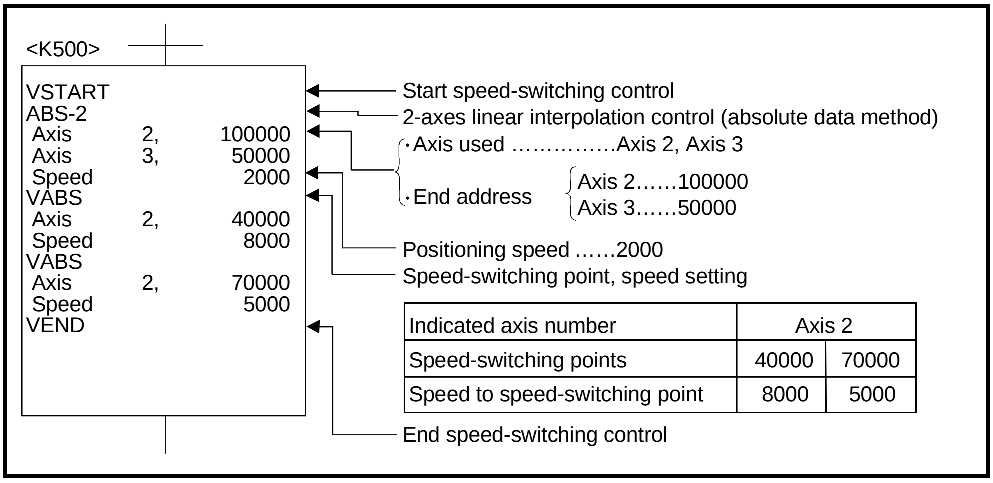
(b) Speed-switching control start command....... leading edge of X000 (OFF → ON)

(3) Operation timing and speed-switching positions
The operation timing for speed-switching control and the speed-switching points are shown below.



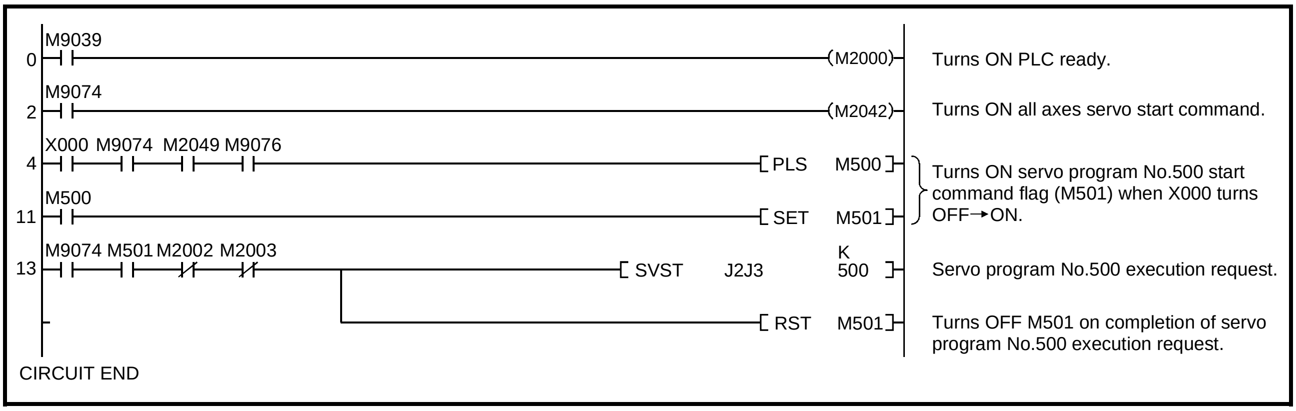
(4) Servo program

The servo program No. 500 for speed-switching control is shown below.



(5) Sequence program

The sequence program which runs the servo program is shown below.



7.15.2 Setting speed-switching points using repeat instructions

Repeated execution between any speed-switching points.

Servo Instruction	Positioning Method	Number of Controllable Axes	Items Set by Peripherals																						Speed Change
			Common							Arc			Parameter Block									Others			
			Parameter Block No.	Axis	Address/Travel Value	Commanded Speed	Dwell Time	M-Code	Torque Limit Value	Auxiliary Point	Radius	Center Point	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	Repeated Condition	Cancel	Start	
FOR-TIMES																									
FOR-ON	—	—																				○	Δ	Δ	—
FOR-OFF																									
NEXT	—	—																							

○ : Must be set
Δ : Set if required

[Control Details]

Setting the Start of the Repeated Range

The start of the repeated range is designated using the following instructions:

(1) FOR-TIMES (number of loops setting)
  (a) The designated repeated range is executed the set number of times.
  (b) The setting range is (1 to 32767).
    An out-of-range setting between –32768 and 0 is controlled as a setting of 1.
  (c) The following devices are available to set the number of repeats:
    1) Data register (D)
    2) Link register (W)
    Indirect designation
    3) Decimal constant (K)
    4) Hexadecimal constant (H)

(2) FOR-ON (loop-out trigger condition setting)
  (a) The set repeated range is executed while the designated bit device is ON.
  (b) The following devices are available to set the loop-out trigger condition:
    1) Input (X)
    2) Output (Y)
    3) Internal relay (M)/Special relay (SP.M)
    4) Latch relay (L)
    5) Link relay (B)
    6) Annunciator (F)

(3) FOR-OFF (loop-out trigger condition setting)
   (a) The set repeated range is executed while the designated bit device is OFF.
   (b) The following devices are available to set the loop-out trigger condition:
      1) Input (X)
      2) Output (Y)
      3) Internal relay (M)/Special relay (SP.M)
      4) Latch relay (L)
      5) Link relay (B)
      6) Annunciator (F)

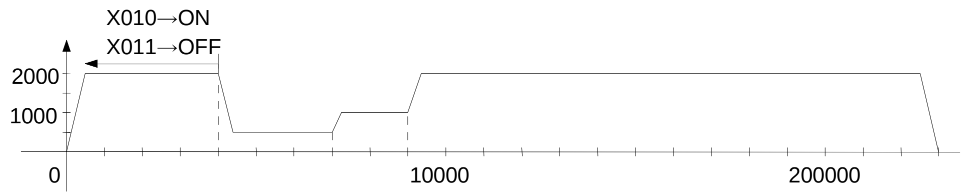
Repeated operation using FOR-TIMES, FOR-ON, and FOR-OFF is shown below.

[Servo Program]

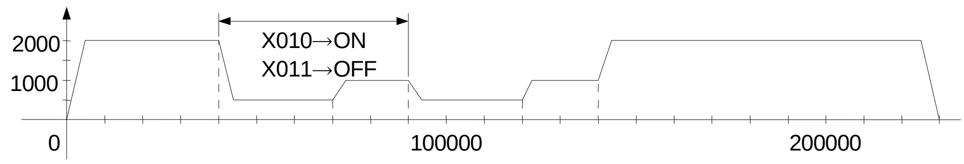
```
<K 701>
VSTART
INC-2
 Axis     1,     230000
 Axis     2,     100000
 Speed             2000
VINC
 Axis     1,      40000
 Speed             2000
 1)
                     2)
VINC                          ┐
 Axis     1,      30000       │
 Speed              500       │
VINC                          ├ 3)
 Axis     1,      20000       │
 Speed             1000       ┘
NEXT
VEND
```

1)	2)		
	Condition 1	**Condition 2**	**Condition 3**
FOR-TIMES	K1	K2	K3
FOR-ON	X010 → ON from start	X010 → ON during first execution of 3)	X010 → ON during third execution of 3)
FOR-OFF	X010 → OFF from start	X011 → OFF during first execution of 3)	X011 → OFF during third execution of 3)

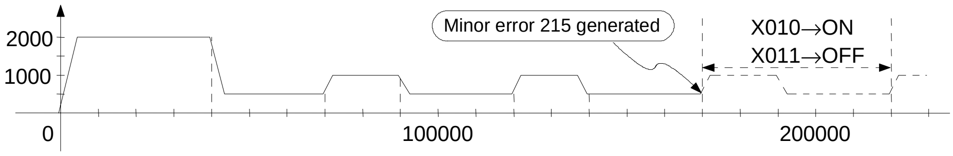
(1) Operation under condition 1



(2) Operation under condition 2



(3) Operation under condition 3

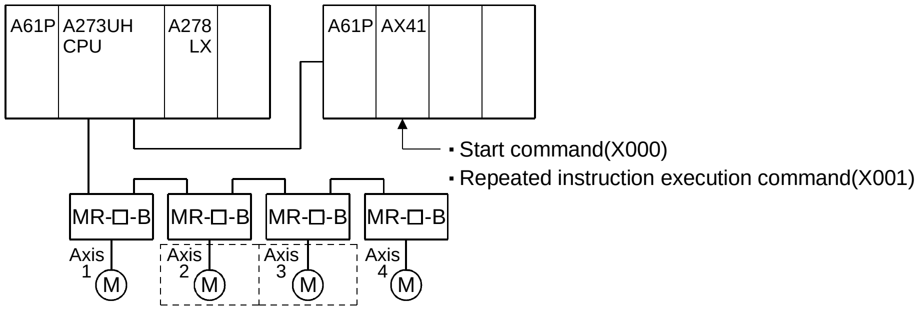


Error generated because the distance to the stop position exceeds the travel value.

[Program example]

This program executes repeated speed-switching control under the conditions below.

(1) System configuration
Speed-switching control of Axis 2 and Axis 3.



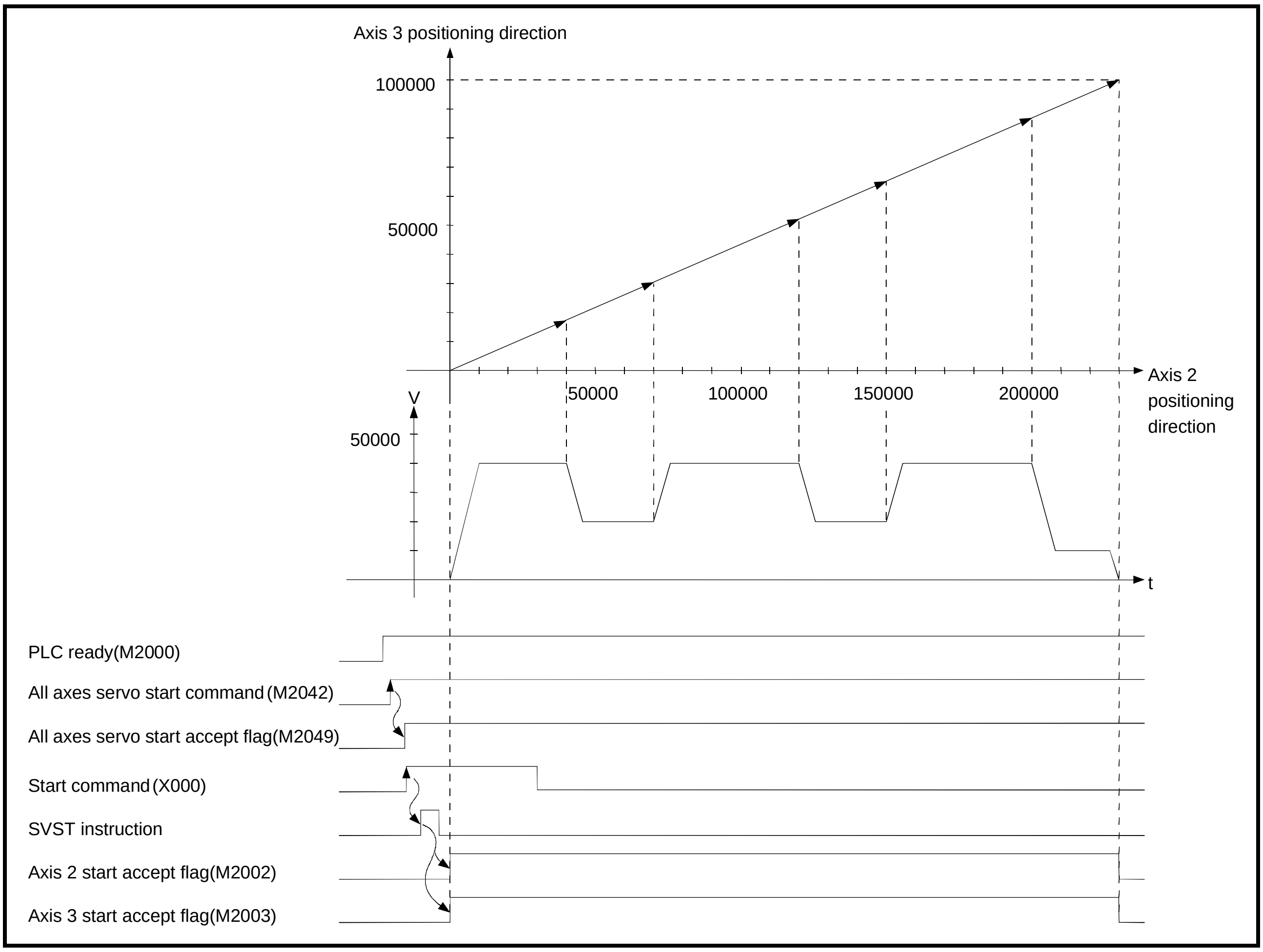
(2) Positioning conditions

(a) The speed-switching control conditions are shown below.

Item	Setting	
Servo program number	No. 501	
Controlled axes	Axis 2	Axis 3
End address	230000	100000

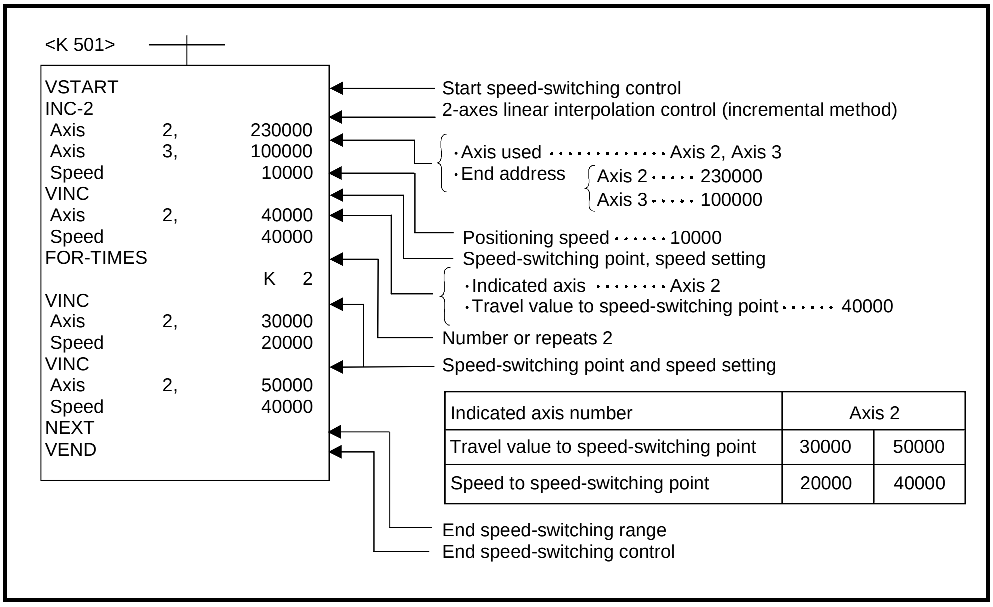
(b) Speed-switching control start command ...... leading edge of X000 (OFF → ON)

(3) Operation timing and speed-switching positions
The operation timing for speed-switching control and the speed-switching points are shown below.



(4) Servo program

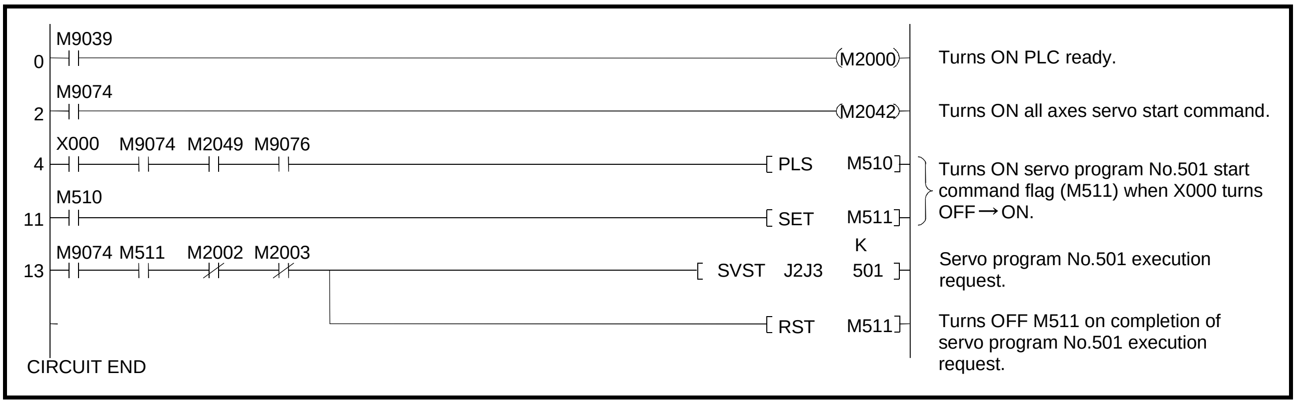
The servo program No. 501 for speed-switching control is shown below.



Indicated axis number	Axis 2	
Travel value to speed-switching point	30000	50000
Speed to speed-switching point	20000	40000

(5) Sequence program

The sequence program which runs the servo program is shown below.



7.16 Constant-Speed Control

(1) After a single control start, positioning control is executed using the designated positioning method and positioning speed to the preset pass point.

(2) The positioning method and positioning speed can be changed for each pass point.

(3) Set the following parameters with the servo program.
- pass point
- positioning method from one pass point to the next pass point.
- positioning speed from one pass point to the next pass point.

(4) Repeat instructions permit repeated control between any pass points.

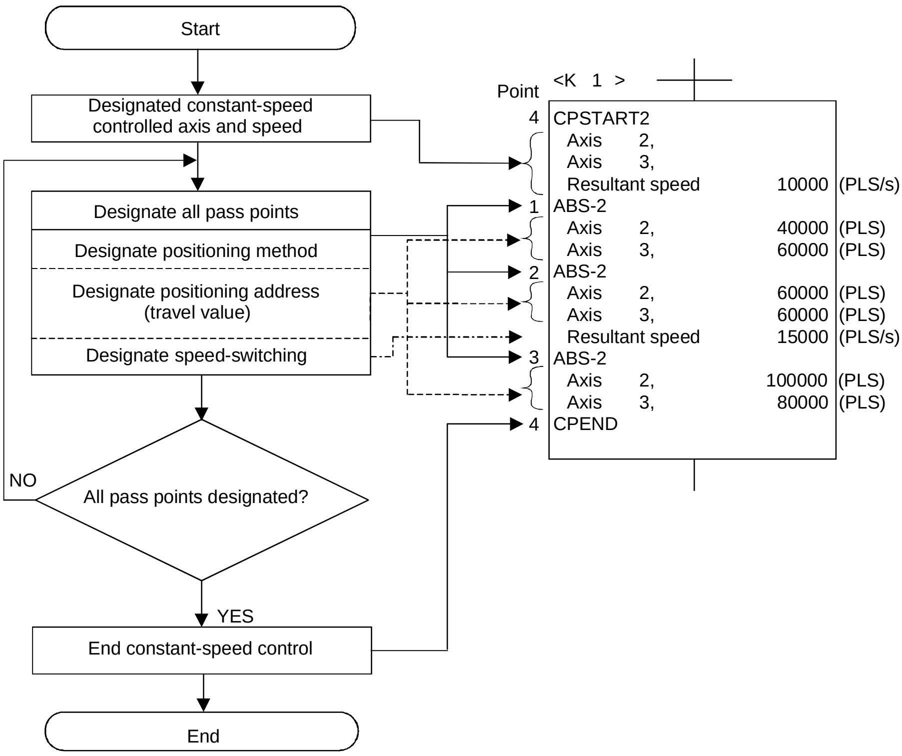
(5) M-code and torque limit value can be changed at each pass point.

(6) From 1 to 4-axes can be controlled.

[Procedure to Write Servo Programs]

The method to write servo programs for constant-speed control is shown below.

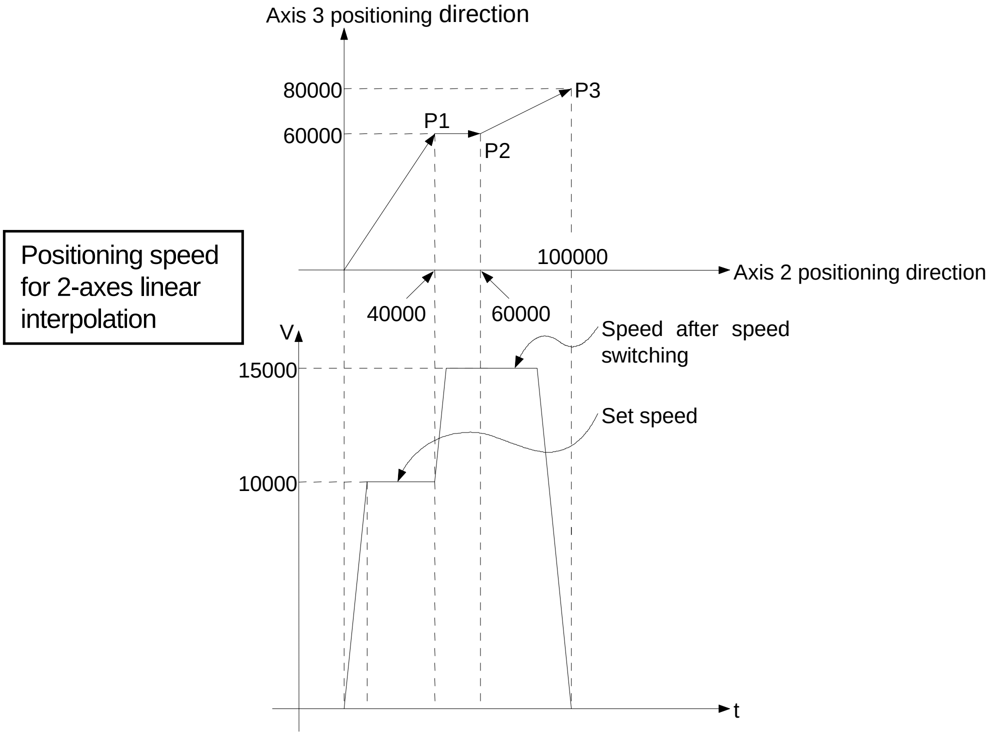
[Procedure] [Example: Servo program for 2-axes constant-speed control]



[Operation Timing]

The operation timing for constant-speed control is shown below.

[Example: Operation timing for 2-axes constant-speed control]



[Caution]

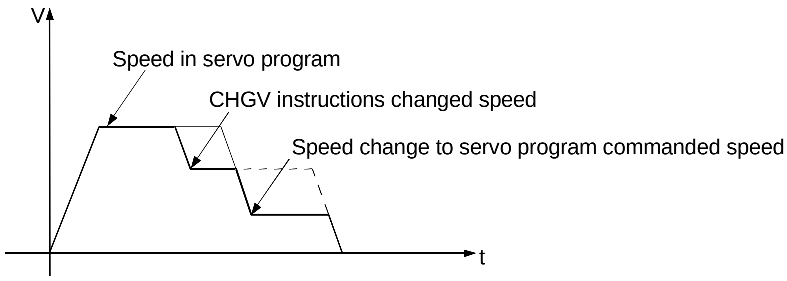
(1) The number of controllable axis cannot be changed while control is in progress.

(2) Positioning control to the pass points can use a combination of the absolute data method (ABS☐) and the incremental method (INC☐).

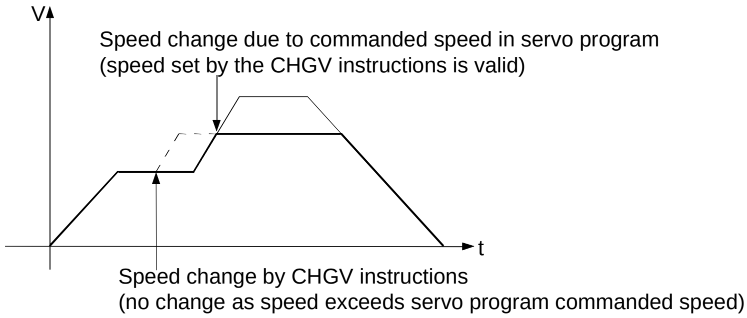
(3) A pass point can be designated as an address which results in a change in travel direction.
However, a servo error or some other error may occur if acceleration processing occurs at a pass point for 1-axis constant-speed control but no acceleration or deceleration processing occurs at the pass point for 2 to 4-axes constant-speed control.

(4) Speed change is possible after start
Note the following points when changing the speed.
(a) If constant-speed control includes circular interpolation using center point designation
Error compensation (see Section 4.4.3) may not function normally if the speed is changed when a discrepancy (within the allowable error range for circular interpolation) exists between the designated end-point address and the arc path calculated from the start address and center-point address.
Therefore, if the circular interpolation using center point designation positioning method is used under constant-speed control, ensure that the set start address, center-point address, and end address lie correctly on the arc.

(b) If both a servo program and the CHGV instructions are used for the speed change in the same program
The lower of the speed changed by the CHGV instructions and the speed set by the servo program is selected.
The CHGV instructions are executed if the changed speed is lower than the speed set in the servo program; otherwise the CHGV instructions are not executed.
1) If CHGV changed speed > servo program set speed
The speed set in the servo program is selected.



2) If CHGV changed speed < servo program set speed
The speed changed by the CHGV instructions is valid.



(5) An overrun occurs if the distance remaining to the final positioning point when the final positioning point is detected is less than the deceleration distance at the positioning speed (commanded speed).
If an overrun occurs, the error code 211 (overrun error) is stored in the minor error register for the axis.

(6) A maximum of 768 steps (approximately 100 points) can be designated in a constant-speed control program.

(7) If positioning moves outside the stroke limit range after control is started, the error code 106 is stored in the minor error register for the axis and a deceleration stop occurs.

(8) The minimum travel value between constant-speed control pass points is determined as follows:

Commanded speed $\times$ 0.02 < Travel distance (PLS)

Positioning speed drops if the distance between pass points is extremely short.

Example

If pass points are set at 1-PULSE intervals, the positioning speed becomes 280 pps, regardless of the commanded speed setting.

7.16.1 Setting Pass points using Repeated Instructions

This section describes the method of designating the pass points used for repeated execution between pass points.

Servo Instruction	Positioning Method	Number of Controllable Axes	Items Set by Peripherals																						Speed Change
			Common							Arc			Parameter Block									Others			
			Parameter Block No.	Axis	Address/Travel Value	Commanded Speed	Dwell Time	M-Code	Torque Limit Value	Auxiliary Point	Radius	Center Point	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	Repeated Condition	Cancel	Start	
FOR-TIMES FOR-ON FOR-OFF	—	—																				○	Δ	Δ	—
NEXT	—	—																							

○ : Must be set
Δ : Set if required

[Control Details]

Setting the start of the repeated range

The start of the repeated range is designated using the following instructions:

(1) FOR-TIMES (number of loops setting)
   (a) The designated repeated range is executed the set number of times.

   (b) The setting range is (1 to 32767).
   If an out-of-range setting between –32768 and 0 is designated, control is executed with a setting of "1".

   (c) The following devices are available to set the number of repetitions:
   1) Data register (D) ⎫ Indirect designation
   2) Link register (W) ⎭
   3) Decimal constant (K)
   4) Hexadecimal constant (H)

(2) FOR-ON (loop-out trigger condition setting)
   (a) The set repeated range is executed while the designated bit device is ON.

   (b) The following devices are available to set the loop-out trigger condition:
   1) Input (X)
   2) Output (Y)
   3) Internal relay (M)/Special relay (SP.M)
   4) Latch relay (L)
   5) Link relay (B)
   6) Annunciator (F)

(3) FOR-OFF (loop-out trigger condition setting)

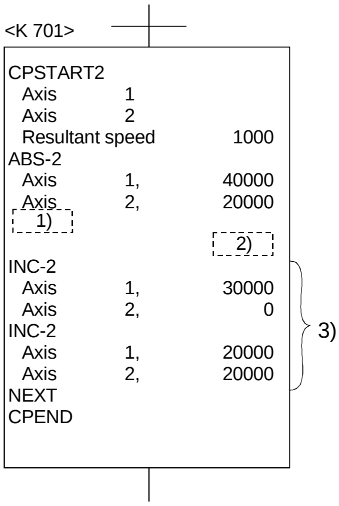
(a) The set repeated range is executed while the designated bit device is OFF.

(b) The following devices are available to set the loop-out trigger condition:

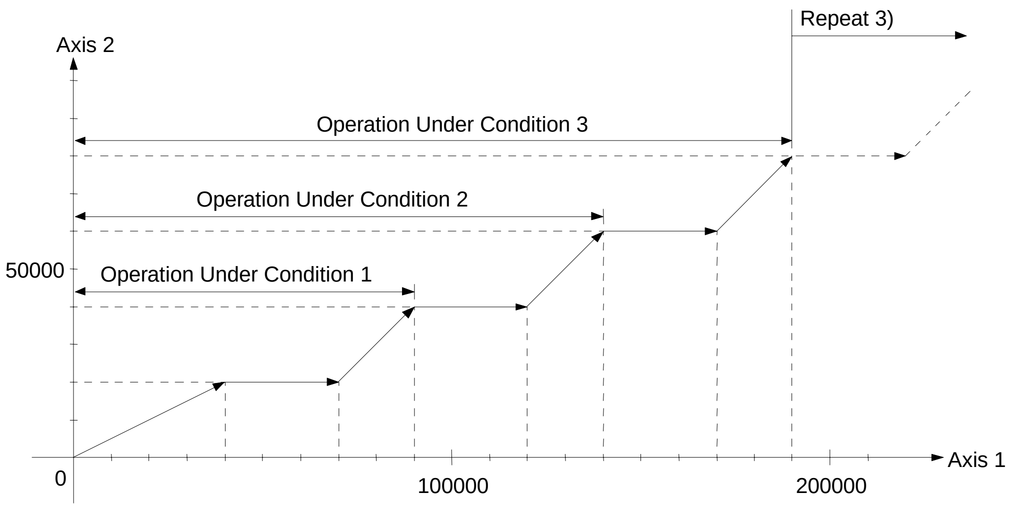
1) Input (X)
2) Output (Y)
3) Internal relay (M)/Special relay (SP.M)
4) Latch relay (L)
5) Link relay (B)
6) Annunciator (F)

Repeated operation using FOR-TIMES, FOR-ON, and FOR-OFF is shown below.

[Servo Program]



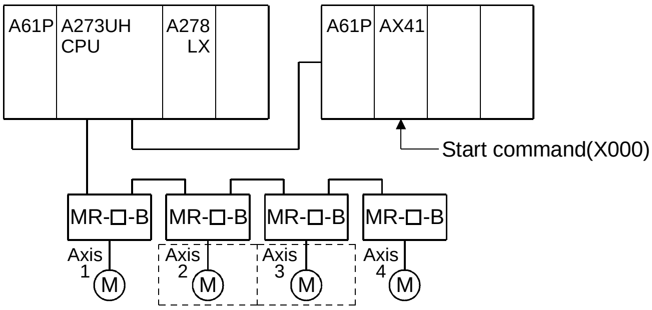
1)	2)		
	Condition 1	**Condition 2**	**Condition 3**
FOR-TIMES	K1	K2	K3
FOR-ON	X010 → ON from start	X010 → ON during first execution of 3)	X010 → ON during third execution of 3)
FOR-OFF	X010 → OFF from start	X011 → OFF during first execution of 3)	X011 → OFF during third execution of 3)



[Program Example]

This program executes repeated constant-speed control under the conditions below.

(1) System configuration
Constant-speed control of Axis 2 and Axis 3.

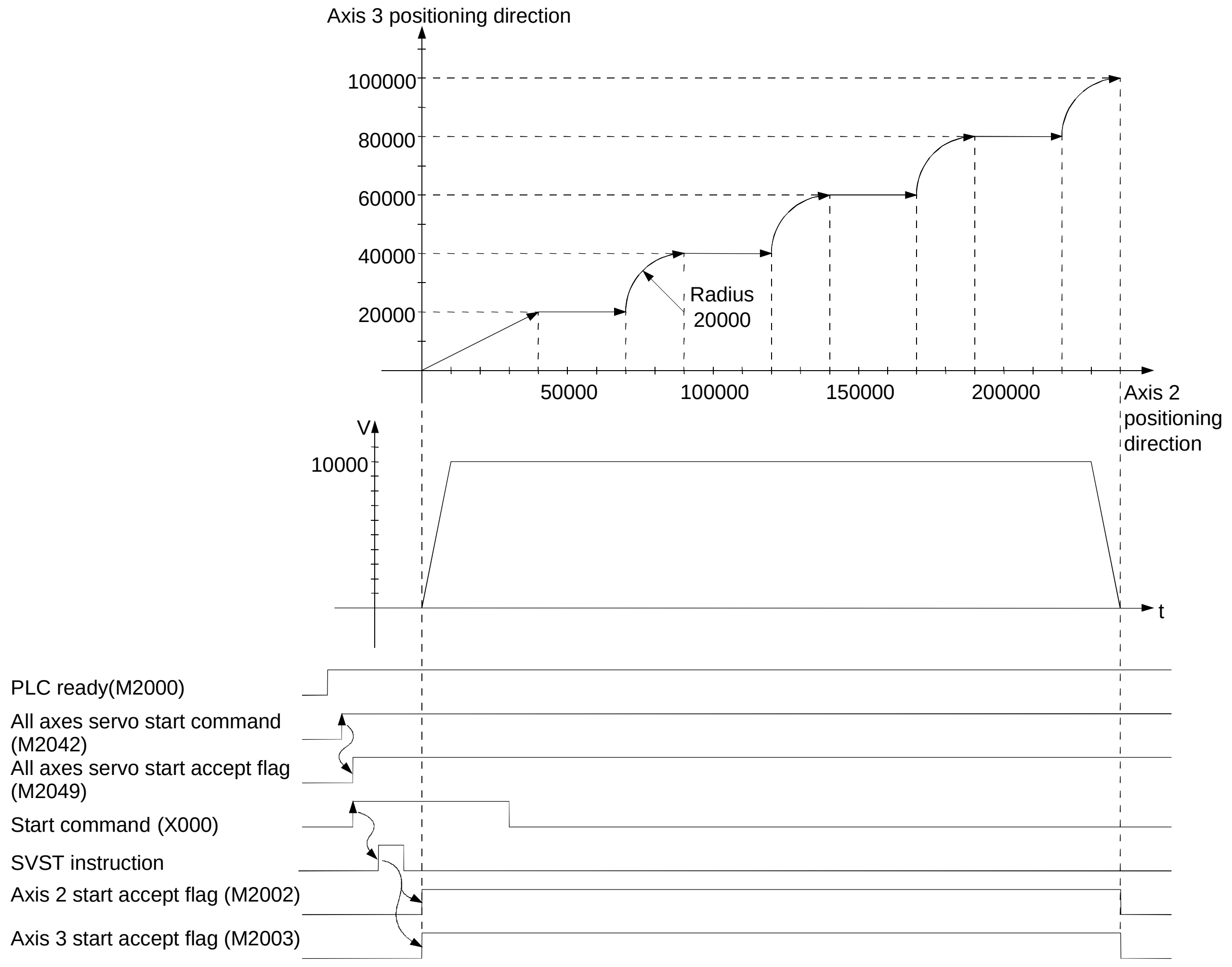


(2) Positioning conditions
(a) The constant-speed control conditions are shown below.

Item	Setting
Servo program number	No. 510
Controlled axes	Axis 2, Axis 3
Positioning speed	10000

(b) Constant-speed control start command .... leading edge of X000 (OFF → ON)

(3) Operation timing
The operation timing for constant-speed control is shown below.



(4) Servo program

The servo program No. 510 for constant-speed control is shown below.

```
<K 510>
CPSTART2
 Axis        2
 Axis        3
 Speed                 10000
ABS-2
 Axis        2,        40000
 Axis        3,        20000
FOR-TIMES
             K             4
INC-2
 Axis        2,        30000
 Axis        3,            0
INC ↷
 Axis        2,        20000
 Axis        3,        20000
 Radius                20000
NEXT
CPEND
```

Start constant-speed control

Axis used ··············· Axis 2, Axis 3

Positioning speed ········ 10000

Pass point setting

Number of repetitions 4

Pass point setting

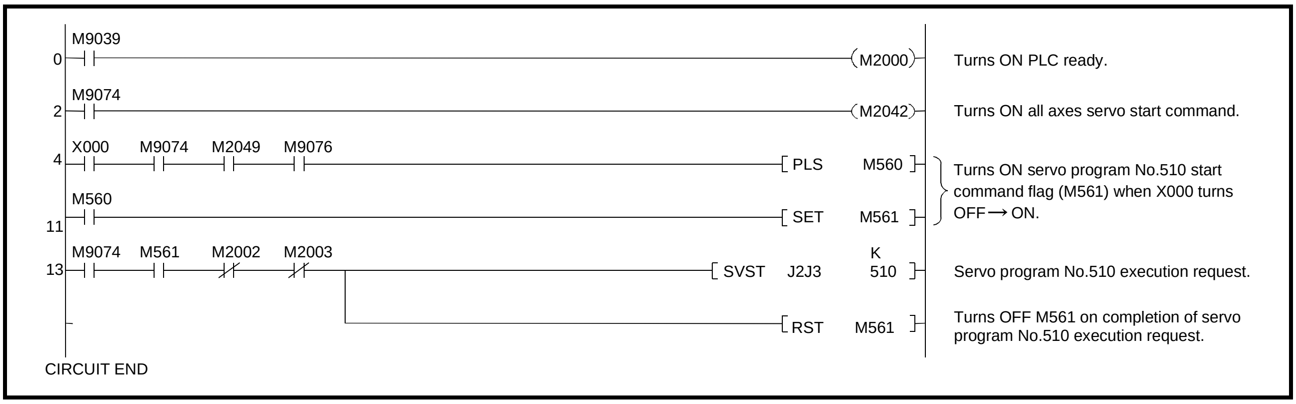
Positioning Method		2-axes linear interpolation	Circular interpolation control using radius designation
Travel value	Axis 2	30000	20000
	Axis 3	0	20000

End constant-speed range

End constant-speed control

(5) Sequence program

The sequence program which runs the servo program is shown below.



7.16.2 Speed switching during instruction execution

The speed can be designated for each pass point during a constant-speed control instruction.
The speed change from a point can be designated directly or indirectly in the servo program.

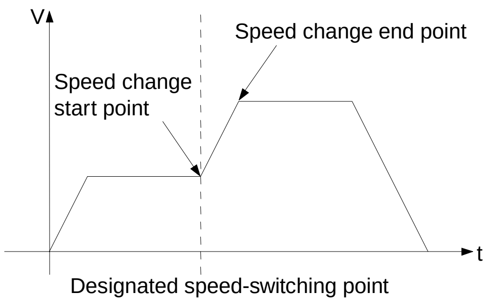
[Cautions]

(1) The speed can be changed during servo instruction execution for 1 to 4-axes constant-speed control.

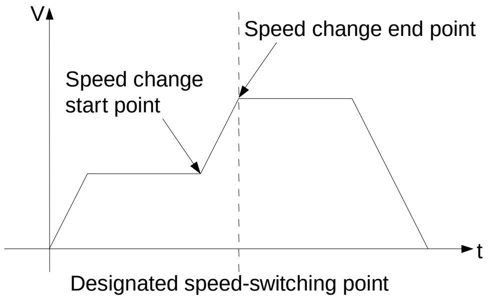
(2) The speed command can be set for each point.

(3) The speed-switching point designation flag M2040 (see Section 3.1.3) can be turned ON before control is started to set the designated speed-switching point as the end point for the speed change.
The speed change timing is shown below for the cases where the speed-switching point designation flag M2016 is ON and OFF.

(a) M2040 is OFF
The speed change starts at the designated speed-switching point.



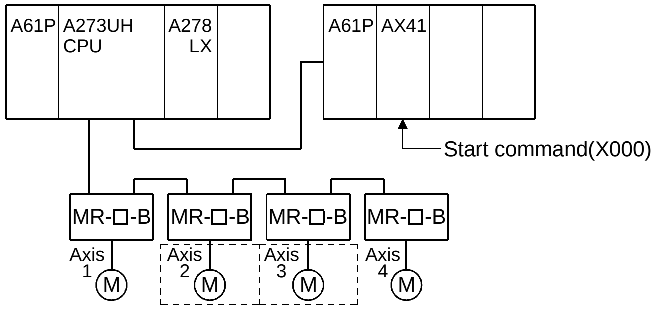
(b) M2040 is ON
The speed change ends at the designated speed-switching point.



[Program Example]

This program turns ON M2040 during constant-speed control instruction execution and changes the speed, under the conditions below.

(1) System configuration
Switches speed for Axis 1 and Axis 2.

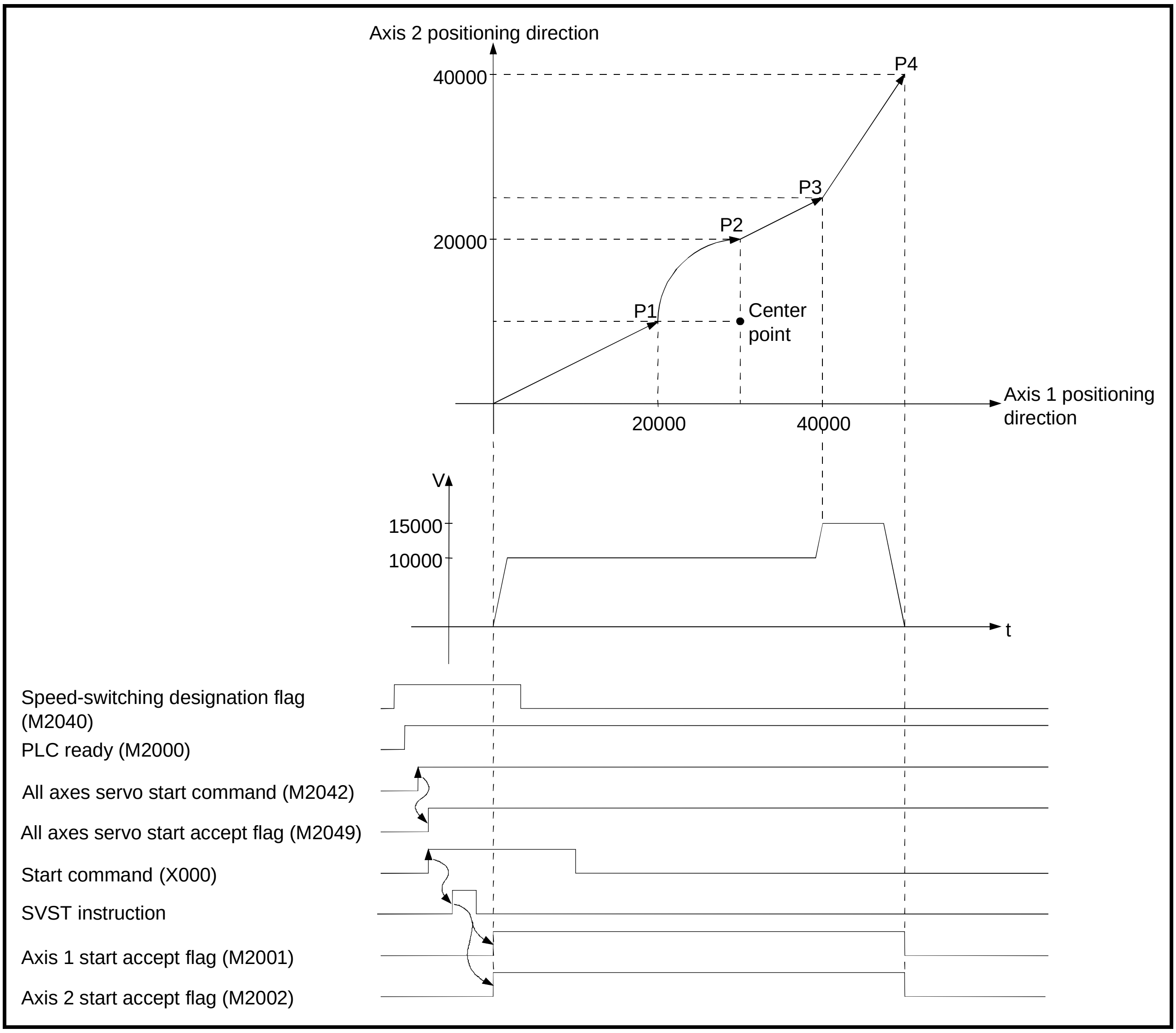


(2) Positioning conditions
(a) The speed switching conditions are shown below.

Item		Setting			
Servo program number		310			
Positioning speed		10000			
Positioning method		2-axes linear interpolation	Circular interpolation using center point designation	2-axes linear interpolation	2-axes linear interpolation
Pass point	Axis 1	20000	30000	40000	50000
	Axis 2	10000	20000	25000	40000

(b) Constant-speed control with speed switching start command .... leading edge of X000 (OFF $\rightarrow$ ON)

(3) Operation timing and speed-switching positions
The operation timing and positions for speed switching are shown below.



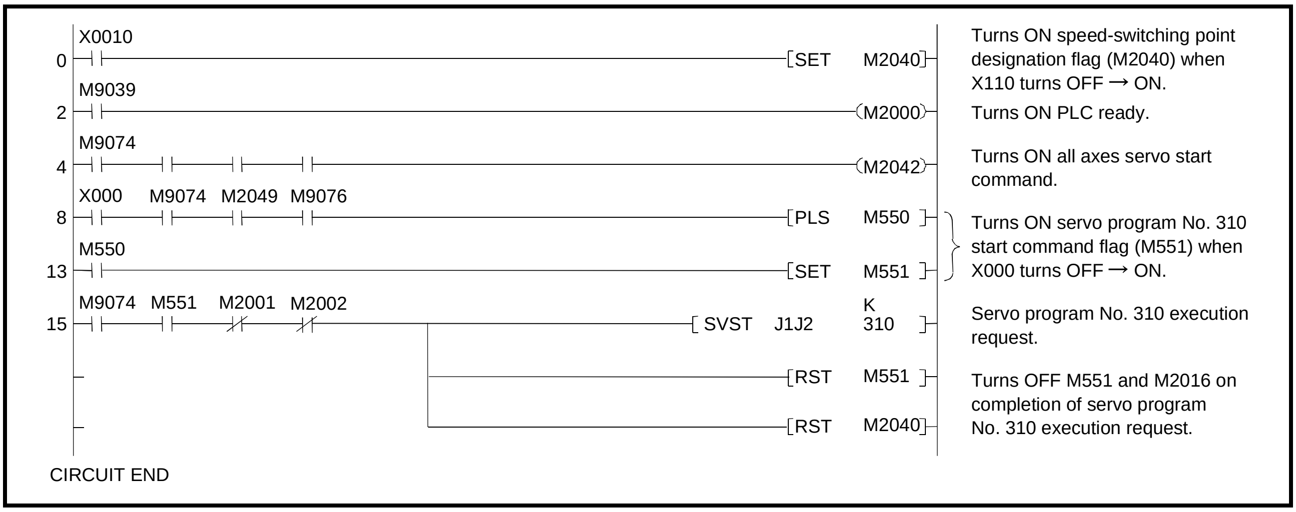
(4) Servo program

The servo program No. 310 for speed switching is shown below.

```
<K 310>
CPSTART2
  Axis      1
  Axis      2
  Speed             10000
 ABS-2                        ← P1 designation
  Axis      1,      20000
  Axis      2,      10000
 ABS ⌒                        ← P2 designation
  Axis      1,      30000
  Axis      2,      20000
  Center    1,      30000
  Center    2,      10000
 ABS-2                        ← P3 designation
  Axis      1,      40000
  Axis      2,      25000
  Speed             15000     ← Speed change
ABS-2                         ← P4 designation
  Axis      1,      50000
  Axis      2,      40000
CPEND
```

(5) Sequence program

The sequence program which runs the servo program is shown below.



7.16.3 One-axis constant-speed control

Servo Instruction		Positioning Method	Number of Controllable Axes	Items Set by Peripherals																								
				Common							Arc			Parameter Block										Others					
				Parameter Block No.	Axis	Address/Travel Value	Commanded Speed	Dwell Time	M-Code	Torque Limit Value	Auxiliary Point	Radius	Center Point	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	Commanded Speed (constant-speed)	Cancel	Start	Skip	FIN acceleration	Speed Change
Start	CPSTART1	–	1	Δ	○		○								Δ	Δ	Δ	Δ	Δ	Δ		Δ		Δ	Δ		Δ	OK
End	CPEND	–	–					Δ																				
Pass point	ABS-1	Absolute data	1		○	○			Δ	Δ													Δ			Δ		
	INC-1	Incremental	1		○	○			Δ	Δ													Δ			Δ		

○ : Must be set
Δ : Set if required

[Control Details]

Starting and ending one-axis constant-speed control

1-axis constant-speed control is started and ended using the following instructions:

(1) CPSTART1
Starts 1-axis constant-speed control. Sets the axis number used and the commanded speed.

(2) CPEND
Ends the 1-axis constant-speed control which was started using CPSTART1.

Positioning control method to the pass point

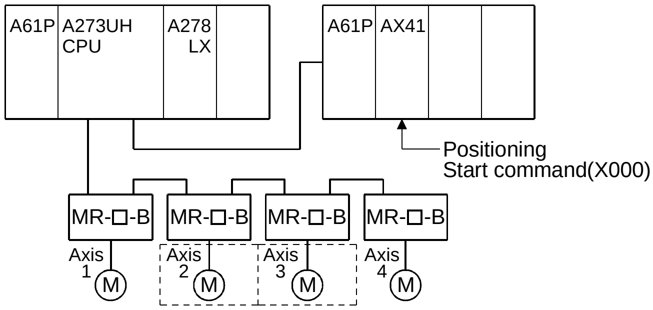
The positioning control to the point where control is changed is designated using the following instructions:

(1) ABS-1/INC-1
Designates 1-axis linear positioning control.
See Section 7.2 "1-axis Linear Positioning Control" for details.

[Program Example]

This program executes repeated 1-axis constant-speed control under the conditions below.

(1) System configuration
Constant-speed control for Axis 4.

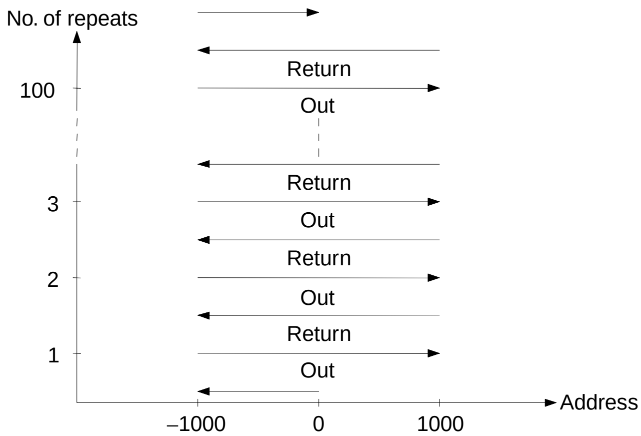


(2) Positioning conditions
(a) The constant-speed control conditions are shown below.

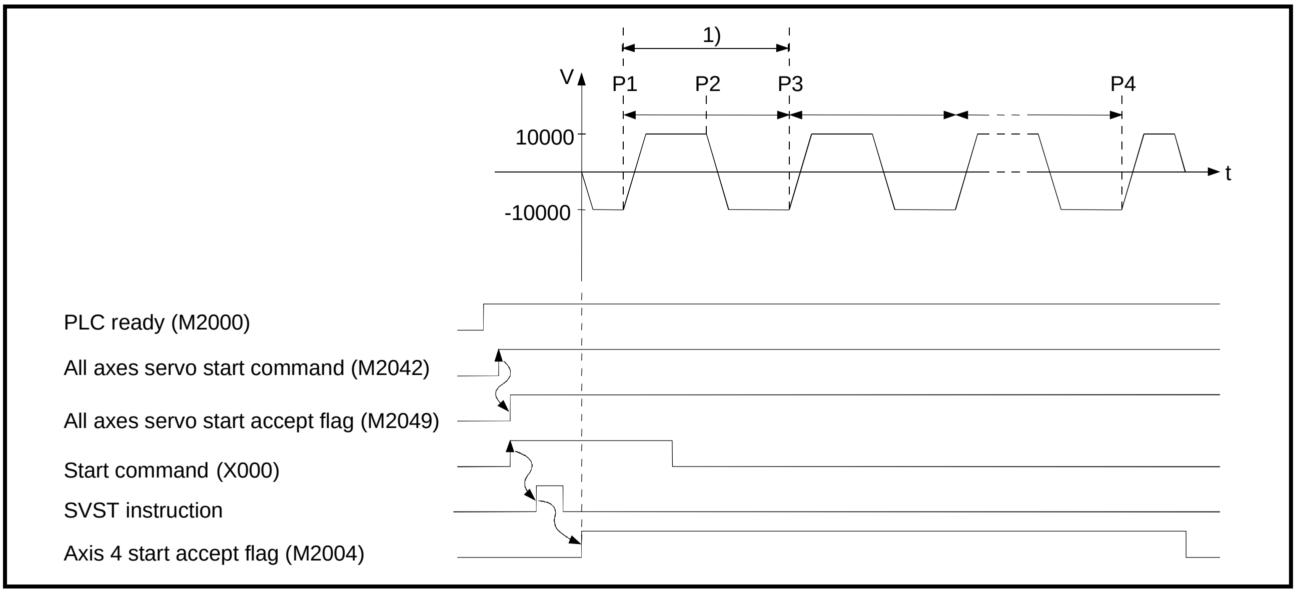
Item		Setting
Servo program number		500
Controlled axis		Axis 4
Positioning speed		10000
Number of repetitions		100
Pass point travel value	P1	–1000
	P2	2000
	P3	–2000
	P4	1000

(b) Constant-speed control start command ....leading edge of X000 (OFF → ON)

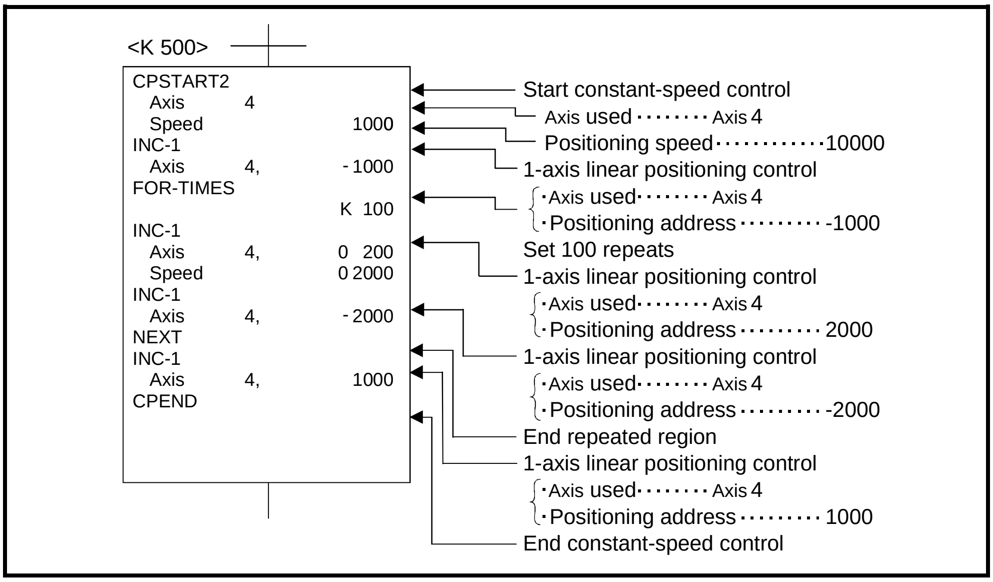
(3) Details of positioning operation



(4) Operation timing
The operation timing for servo program No. 500 is shown below.

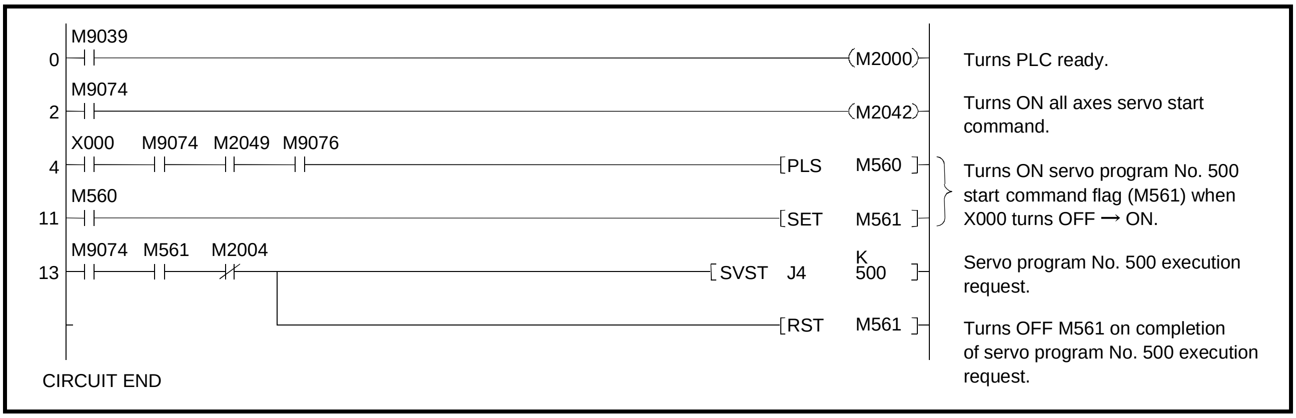


(5) Servo program
The servo program No. 500 for constant-speed control is shown below.



(6) Sequence program

The sequence program which runs the servo program is shown below.



7.16.4 2 to 4-axes constant-speed control

Constant-speed control for the 2 to 4-axes designated with the sequence program positioning commands.

Servo Instruction		Positioning Method	Number of Controllable Axes	Items Set by Peripherals: Common							Arc			Parameter Block									Others					Speed Change
				Parameter Block No.	Axis	Address/Travel Value	Commanded Speed	Dwell Time	M-Code	Torque Limit Value	Auxiliary Point	Radius	Center Point	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	Commanded Speed (constant-speed)	Cancel	Start	Skip	FIN acceleration	
Start	CPSTART2	–	2	Δ	○		○								Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ		Δ	Δ		Δ	
	CPSTART3		3	Δ	○		○								Δ	Δ	Δ	Δ	Δ	Δ		Δ		Δ	Δ		Δ	
	CPSTART4		4	Δ	○		○								Δ	Δ	Δ	Δ	Δ	Δ		Δ		Δ	Δ		Δ	
End	CPEND		–					Δ																				
Pass Point	ABS-2	Absolute data	2		○	○			Δ	Δ													Δ			Δ		
	ABS-3		3		○	○			Δ	Δ													Δ			Δ		
	ABS-4		4		○	○			Δ	Δ													Δ			Δ		
	ABS		2		○	○			Δ	Δ	○															Δ		
	ABS ABS ABS ABS		2		○	○			Δ	Δ		○											Δ			Δ		OK
	ABS ABS		2		○	○			Δ	Δ			○										Δ			Δ		
	INC-2	Incremental	2		○	○			Δ	Δ													Δ			Δ		
	INC-3		3		○	○			Δ	Δ													Δ			Δ		
	INC-4		4		○	○			Δ	Δ													Δ			Δ		
	INC		2		○	○			Δ	Δ	○												Δ			Δ		
	INC INC INC INC		2		○	○			Δ	Δ		○											Δ			Δ		
	INC INC		2		○	○			Δ	Δ			○										Δ			Δ		

○ : Must be set
Δ : Set if required

[Control Details]

Starting and Ending 2- to 4-axes Constant-Speed Control

2-, 3-, or 4-axes constant-speed control is started and ended using one of the following instructions:

(1) CPSTART2
Starts 2-axes constant-speed control.
Sets the axis numbers used and the commanded speed.

(2) CPSTART3
Starts 3-axes constant-speed control.
Sets the axis numbers used and the commanded speed.

(3) CPSTART4
Starts 4-axes constant-speed control.
Sets the axis numbers used and the commanded speed.

(4) CPEND
Ends the 2, 3, or 4-axes constant-speed control which was started using CPSTART2, CPSTART3, or CPSTART4.

Positioning Control Method to the Pass Point

The positioning control to the point where control is changed is designated using the following instructions:

(1) ABS-2/INC-2
Designates 2-axes linear interpolation control.
See Section 7.3 "2-axes Linear Interpolation Control" for details.

(2) ABS-3/INC-3
Designates 3-axes linear interpolation control.
See Section 7.4 "3-axes Linear Interpolation Control" for details.

(3) ABS-4/INC-4
Designates 4-axes linear interpolation control.
See Section 7.5 "4-axes Linear Interpolation Control" for details.

(4) ABS/INC
Designates circular interpolation control using auxiliary point designation.
See Section 7.6 "Circular Interpolation Using Auxiliary Point Designation" for details.

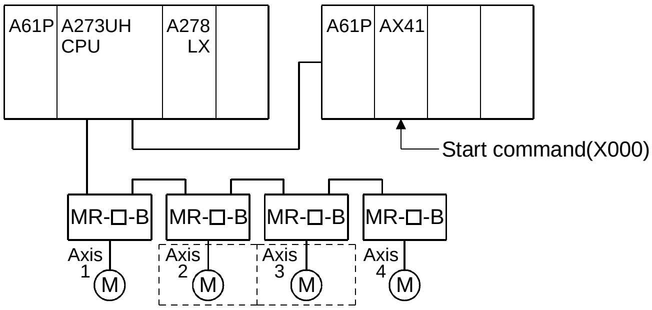
(5) ABS/INC , ABS/INC , ABS/INC , ABS/INC
Designates circular interpolation control using radius designation.
See Section 7.7 "Circular Interpolation Using Radius Designation" for details.

(6) ABS/INC , ABS/INC
Designates circular interpolation control using center point designation.
See Section 7.8 "Circular Interpolation Using Center Point Designation" for details.

[Program Example]

(1) This program executes 2-axes constant-speed control under the conditions below.

(a) System configuration
Constant-speed control for Axis 2 and Axis 3.



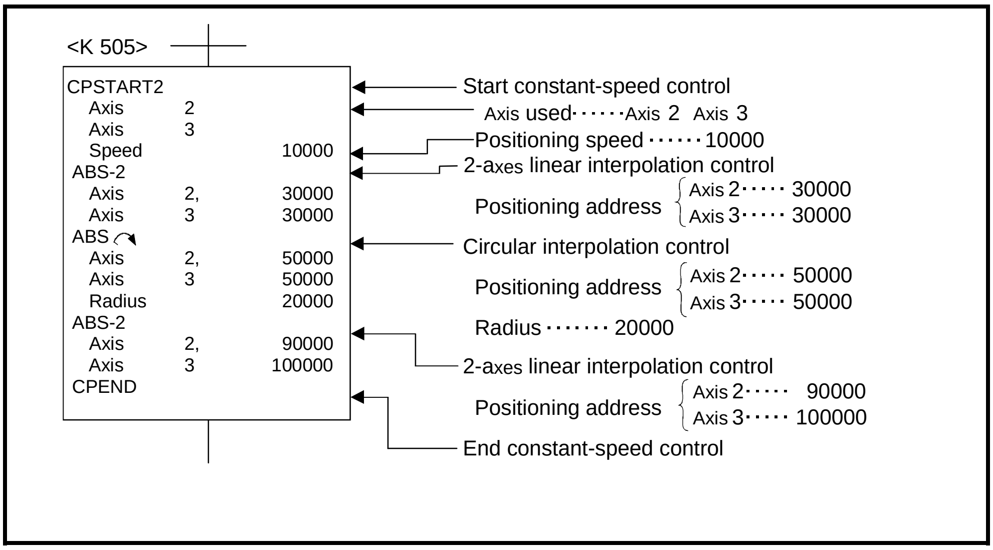
(b) Positioning conditions

1) The constant-speed control conditions are shown below.

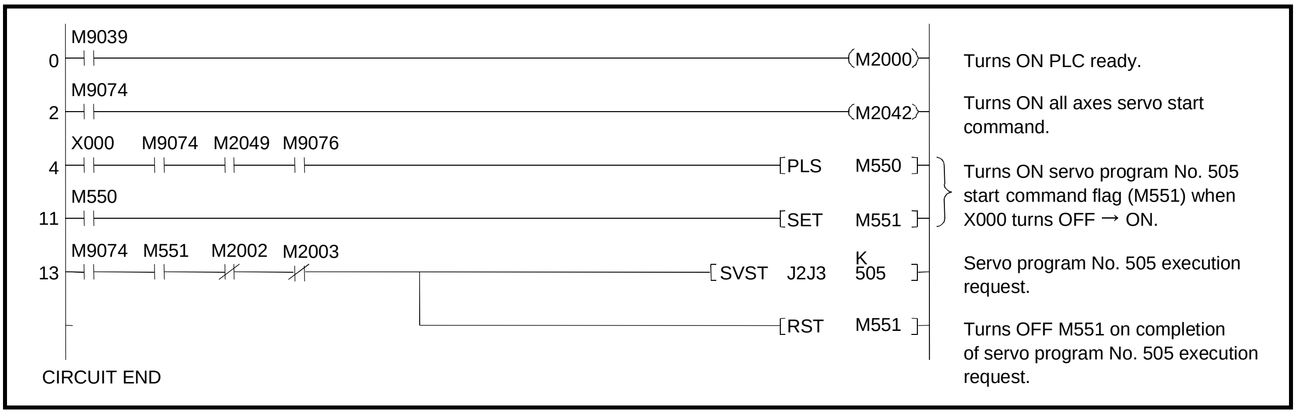
Item		Setting		
Servo program number		505		
Positioning speed		10000		
Positioning method		2-axes linear interpolation	Circular Interpolation Using Radius Designation	2-axes linear interpolation
Pass point	Axis 2	30000	50000	90000
	Axis 3	30000	50000	100000

2) Constant-speed control start command........ leading edge of X000 (OFF → ON)

(c) Servo program
Servo program No. 505 for constant-speed control is shown below.



(d) Sequence program
The sequence program which runs the servo program is shown below.

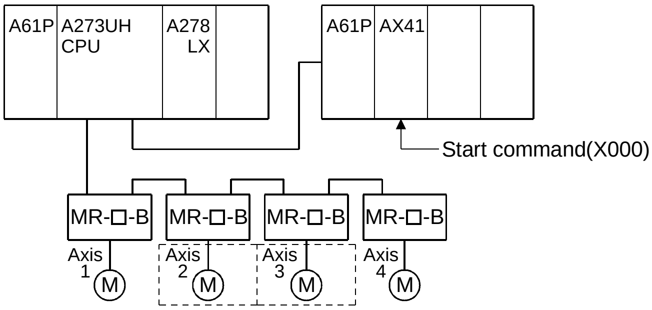


[Program Example]

(2) This program executes 4-axes constant-speed control under the conditions below.

(a) System configuration

Constant-speed control for Axis 1, Axis 2, Axis 3, and Axis 4.



(b) Positioning details

Positioning is performed by the Axis 1, Axis 2, Axis 3 and Axis 4 servomotors.

The positioning by the Axis 1, Axis 2, Axis 3, and Axis 4 servomotors is shown in the diagram below.

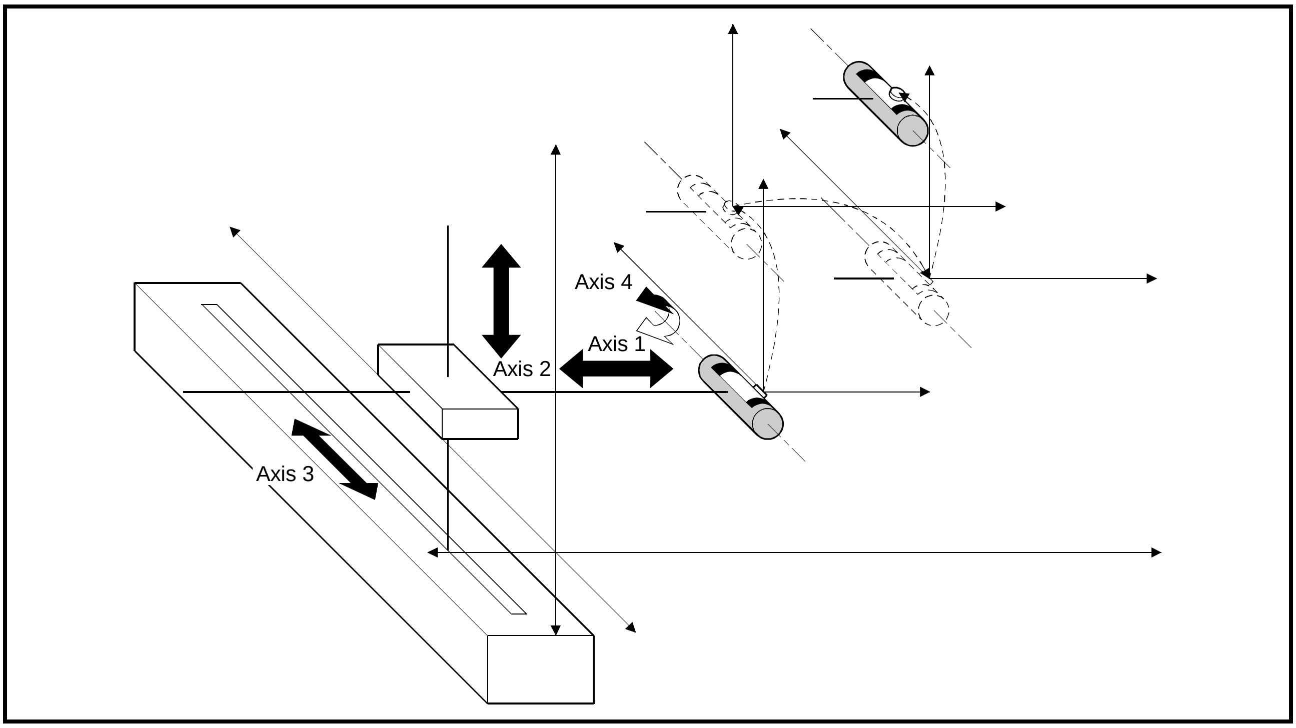


Fig.7.30 Axis Configuration

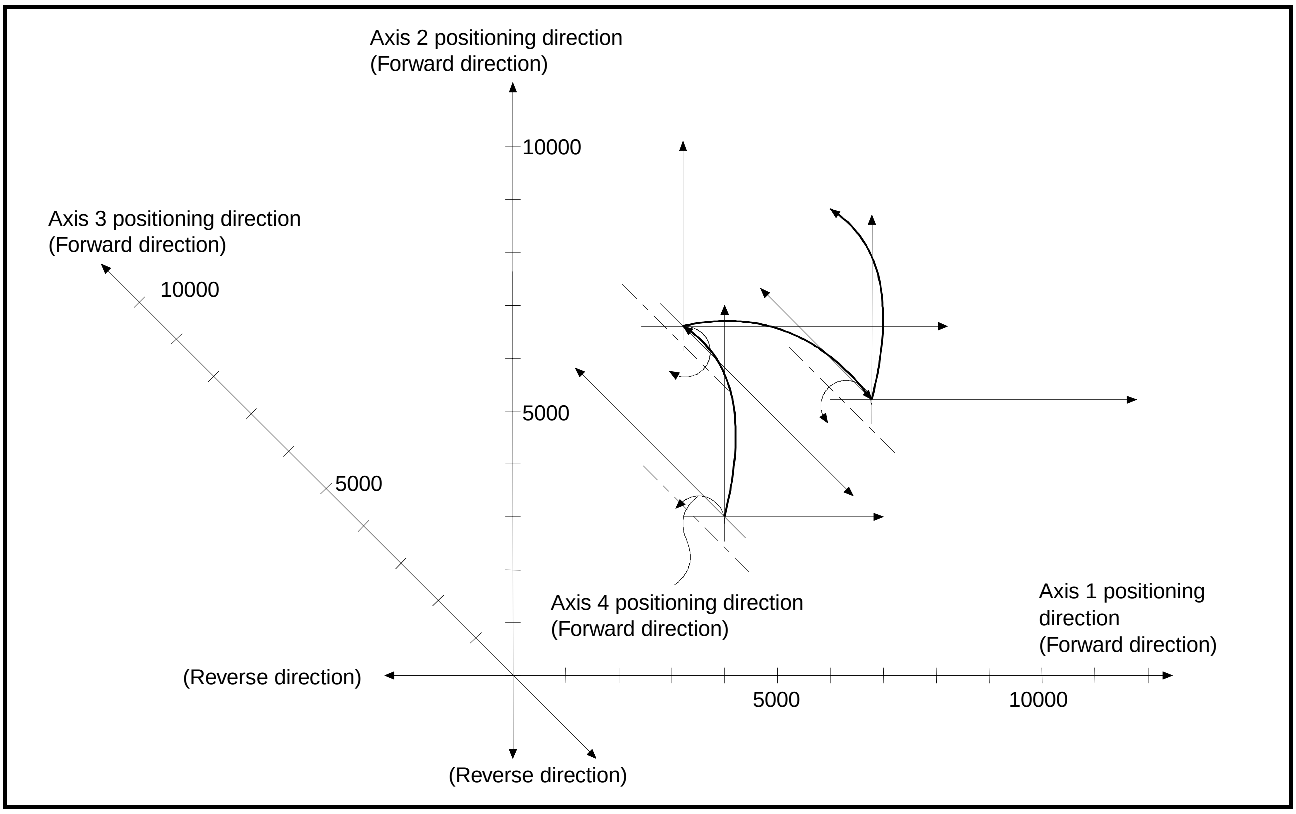


Fig.7.31 Positioning by 4-Axes Constant-Speed Control

(c) Positioning conditions

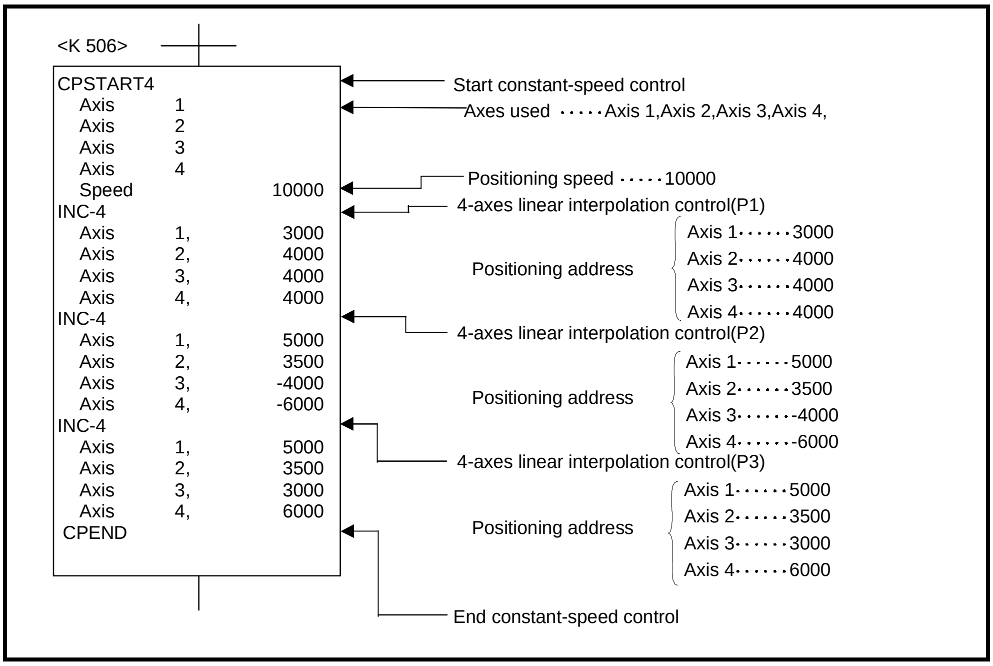
1) The constant-speed control conditions are shown below.

Item		Setting		
Servo program number		506		
Positioning speed		10000		
Positioning method		4-axes linear interpolation	4-axes linear interpolation	4-axes linear interpolation
Pass point	Axis 1	3000	5000	5000
	Axis 2	4000	3500	3500
	Axis 3	4000	–4000	3000
	Axis 4	4000	–6000	6000

2) Constant-speed control start command........ leading edge of X000 (OFF → ON)

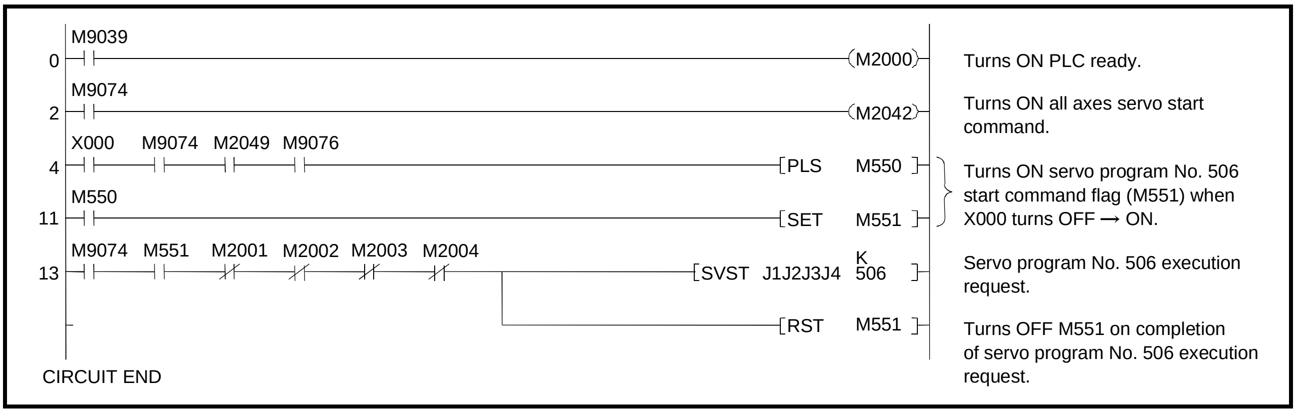
(d) Servo program

The servo program No. 506 for constant-speed control is shown below.



(e) Sequence program

The sequence program which runs the servo program is shown below.



7.16.5 Pass point skip function

This is a function whereby, by setting a skip signal for each pass point associated with a constant speed control instruction, positioning at the current point can be canceled and positioning carried out at the next point.

[Data setting]

(1) Skip signal devices
The following devices can be designated as skip signal devices.
X, Y, M, TC, TT, CC, CT, B, F

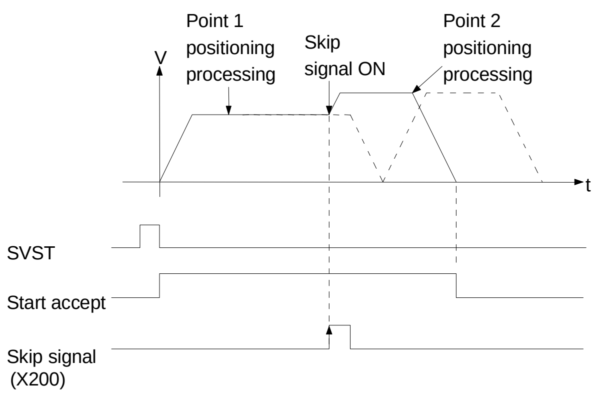
[Notes]

(1) If absolute circular interpolation is designated at or beyond the point where the skip signal was designated, set absolute linear interpolation up to that point. Otherwise, an error occurs and operation stops.

(2) When a skip signal is input at the final point, deceleration to a stop occurs at that point and the program is ended.

[Program example]

```
<K    0>
   CPSTART2
     Axis       1
     Axis       2
     Speed                 10000
1  ABS-2
     Axis       1,        100000
     Axis       2,        200000
     Speed                 10000
     Skip                   X200
2  ABS-2
     Axis       1,        200000
     Axis       2,        200000
     Speed                 15000
   CPEND
```



⚠ CAUTION

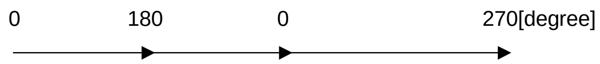
⚠ The operation that takes place on execution of a skip designated during constant-speed control, when an axis for which "degree" is designated as the unit and which has no stroke range is included, is described here. If, under these conditions, there is an ABS instruction following the skip, the final positioning point and the travel distance in the program as a whole will be the same ragardless of whether the skip is executed or not. Examples are presented below.

(1) When all the instructions after the skip are INC instructions:

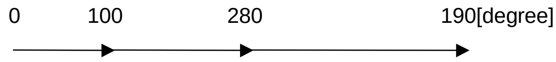
Program example

```
CPSTART1
 Axis      1
 Speed           @10.000
INC-1
 Axis      1,  180.00000
 Skip               X100
INC-1
 Axis      1,  180.00000
INC-1
 Axis      1,  270.00000
CPEND
```

Motion when skip is not executed



Motion when skip is executed
(when the skip occurs at 100 [degree])

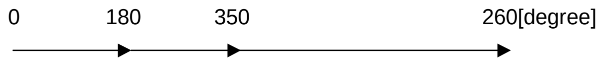


(2) When the instruction immediately following the skip is an ABS instruction

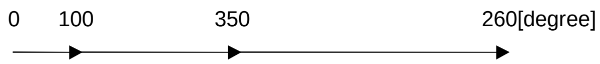
Program example

```
CPSTART1
 Axis      1
 Speed          @ 10.000
INC-1
 Axis      1,  180.00000
 Skip               X100
ABS-1
 Axis      1,  350.00000
INC-1
 Axis      1,  270.00000
CPEND
```

Motion when skip is not executed



Motion when skip is executed
(when the skip occurs at 100 [degree])

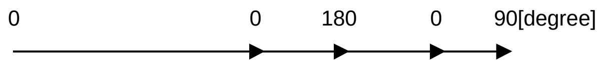


(3) When the instruction immediately following the skip is an INC instruction and there is an ABS instruction after that

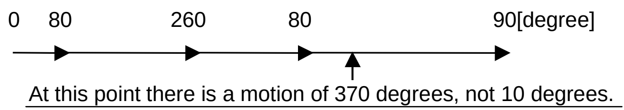
Program example

```
CPSTART1
 Axis      1
 Speed            10.000
INC-1
 Axis      1,  360.00000
 Skip               X100
INC-1
 Axis      1,  180.00000
INC-1
 Axis      1,  180.00000
ABS-1
 Axis      1,   90.00000
CPEND
```

Motion when skip is not executed



Motion when skip is executed
(when the skip occurs at 80 [degree])



7.16.6 FIN signal wait function

This is a function whereby, when the FIN wait function is selected and an M code is set for each point on the way, the end of processing of each point on the way is synchronized with the FIN signal, and positioning at the subsequent point is carried out when the FIN signal comes ON.

[Data setting]

(1) When the FIN signal wait function is selected, the fixed acceleration/deceleration time method is used.
Set the acceleration/deceleration time within the range 1 ms to 5000ms in the servo program by using the "FIN acceleration/deceleration" option.
Indirect setting is also possible by using D and w devices (1 word).

[Notes]

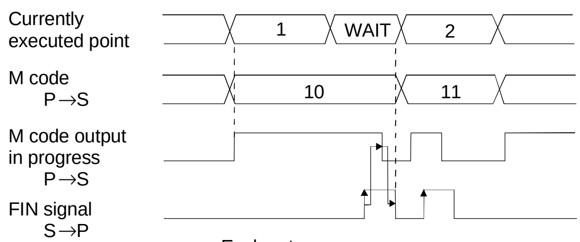
(1) If the acceleration/deceleration time designation is outside the permissible range, the servo program setting error "13" will occur on starting and control will be performed with an acceleration/deceleration time of 1000 ms.

(2) When interpolation is performed, the M code output in progress signal is output for all interpolation axes. In this case, turn ON the signal for one of the interpolating axes.

(3) When an M code is set at the final point, positioning is completed after the FIN signal has gone from OFF to ON to OFF.

[Program example]

```
<K    0>
   CPSTART2
     Axis        1
     Axis        2
     Speed                      10000
     FIN acceleration/            100  [ms]
     deceleration
1  ABS-2
     Axis        1,            200000
     Axis        2,            200000
     M code                        10
2  ABS-2
     Axis        1,            300000
     Axis        2,            250000
     M code                        11
3  ABS-2
     Axis        1,            350000
     Axis        2,            300000
     M code                        12
4  ABS-2
     Axis        1,            400000
     Axis        2,            400000
   CPEND
```

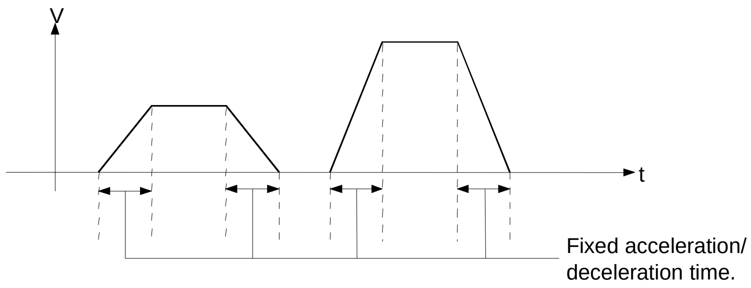


Explanatory

1. When the positioning at point 1 starts, an M code is output and the M code output in progress signal comes ON.
2. On receiving this signal, the relevant processing is performed at the sequencer, and then the FIN signal is switched ON. Operation does not proceed to the next point until the FIN signal comes ON.
3. When the FIN signal is turned ON from the programmable controller, the M code output in progress signal goes OFF.
4. After the M code output in progress signal has gone OFF, the FIN signal is turned OFF from the sequencer. After that, positioning at the next point, point 2, starts.

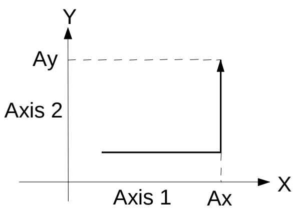
POINTS

The fixed acceleration/deceleration method is a type of acceleration/ deceleration processing whereby even if the command speed changes, the time taken up by acceleration/deceleration remains fixed.

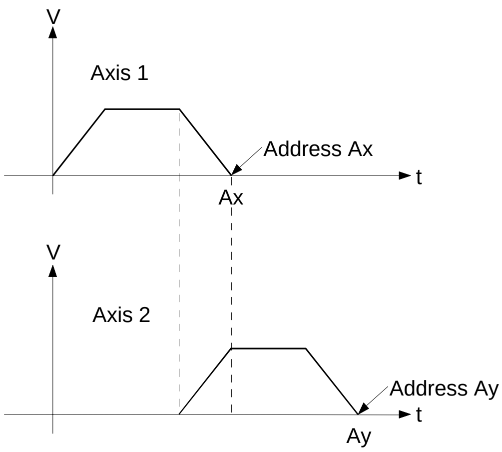


(1) When the fixed acceleration/deceleration method is used, the following processing and parameters are invalidated.
- Rapid stop deceleration time in parameter block
- Completion point designation method for speed change point
- S curve acceleration/deceleration

(2) When the type of positioning operation shown below (constant-speed control) is performed, the speed processing for each axis is as shown below.



Positioning operation



Constant-speed control processing of each axis

7.17 Position Follow-Up Control

After a single control start, positioning occurs to the address set with the word device of the servo system CPU designated in the servo program.
Position follow-up control is started using the PFSTART servo program instruction.

Servo Instruction	Positioning Method	Number of Controllable Axes	Items Set by Peripherals																					
			Common							Arc			Parameter Block									Others		
			Parameter Block No.	Axis	Address/Travel Value	Commanded Speed	Dwell Time	M-Code	Torque Limit Value	Auxiliary Point	Radius	Center Point	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	Cancel	Start	Speed Change
PFSTART	Absolute	1	Δ	○	○	○		Δ						Δ	Δ	Δ	Δ	Δ	Δ		Δ	Δ	Δ	OK

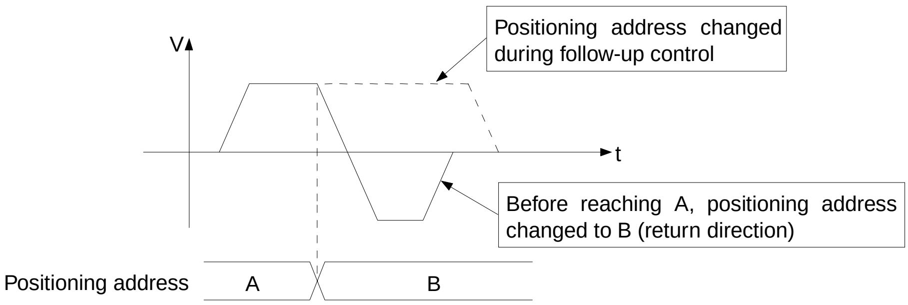
○ : Must be set
Δ : Set if required

[Control Details]

Control Using PFSTART Instruction

(1) Positioning to the address set with the word device of the servo system CPU designated in the servo program.

(2) Position follow-up control is executed until the stop instruction is input.
If the word device value changes while control is progress, positioning is executed to the changed address.



[Cautions]

(1) The number of controllable axes is limited to one.

(2) Only the absolute method (ABS☐) is used for positioning control to the pass points.

(3) The speed can be changed after control is started.
The changed speed remains valid until the stop command is input.

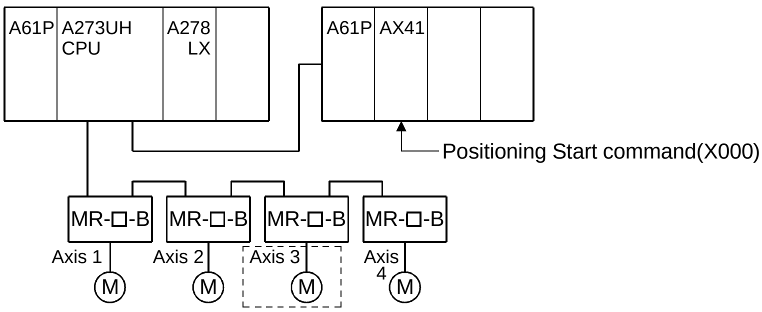
(4) Set the positioning address in the servo program using indirect designation with the word devices D and W.

(5) Use only even-numbered devices for indirect designation of positioning addresses in a servo program.
If odd-numbered devices are used, when an attempt is made to start the control error 141 occurs and control does not start.

(6) Positioning speeds can be set in the servo program using indirect designation with the word devices D and W.
However, this set speed is valid only at the start of position follow-up control (on execution of SVST, instructions) and the speed does not change if the indirect designations are changed while control is in progress.

[Program Example]

(1) System configuration
Position follow-up control of Axis 3.



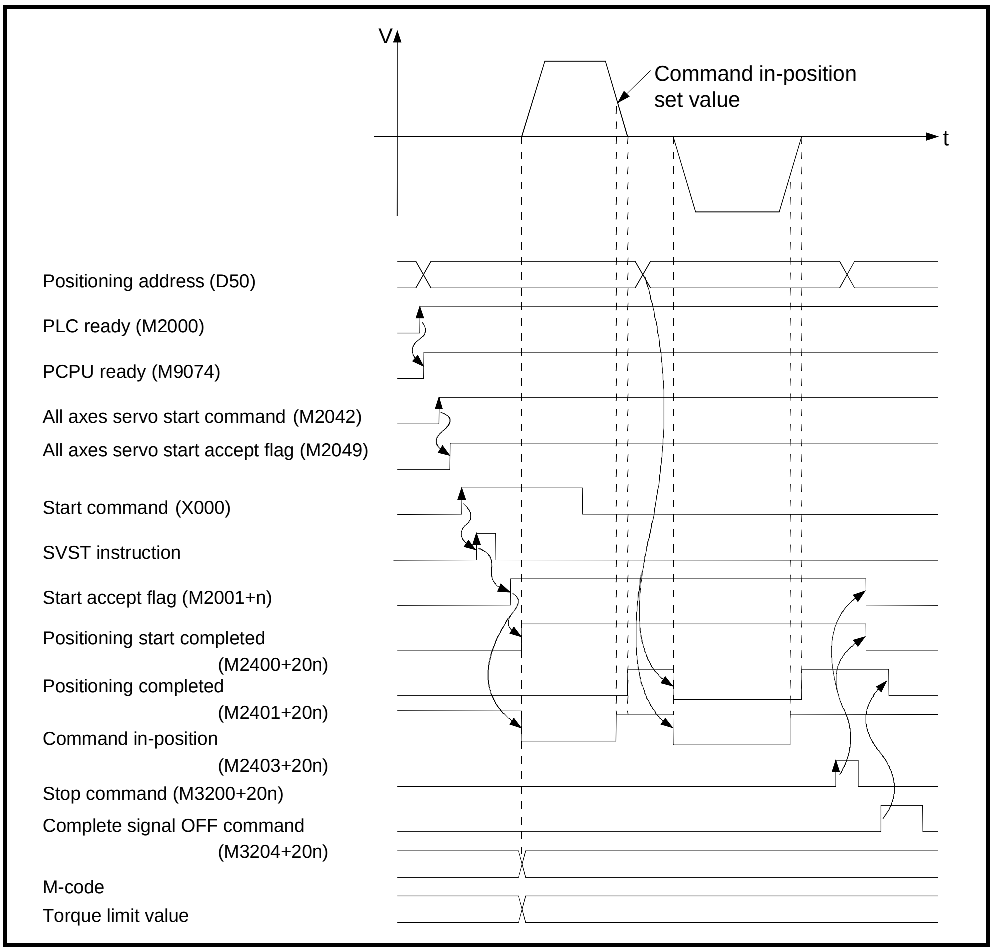
(2) Positioning conditions
(a) The position follow-up conditions are shown below.

Item	Setting
Servo program number	100
Controlled axis	Axis 3
Positioning address	D50
Positioning speed	20000

(b) Position follow-up control start command .... leading edge of X000 (OFF → ON)

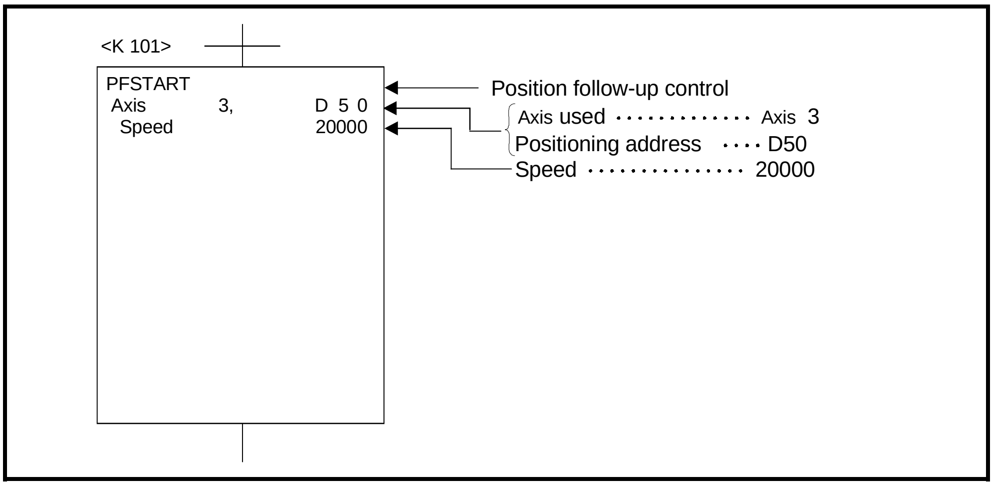
(3) Operation timing

The operation timing for position follow-up control is shown below.



(4) Servo program

The servo program No. 100 for position follow-up control is shown below.



(5) Sequence program

The sequence program which runs the servo program is shown below.

Turns ON PLC ready.

Turns ON all axes servo start command.

Transfers No. 100 servo program to D50 when X000 turns OFF → ON.

Servo program No. 100 execution request.

Turns ON the stop command on completion of servo program No. 100 execution request.

7.18 Simultaneous Start

After a single control start, the designated servo programs start simultaneously.
Use the START instruction to simultaneously start servo programs.

Servo Instruction	Positioning Method	Number of Controllable Axes	Items Set by Peripherals: Common							Arc			Parameter Block									Others		Speed Change
			Parameter Block No.	Axis	Address/Travel Value	Commanded Speed	Dwell Time	M-Code	Torque Limit Value	Auxiliary Point	Radius	Center Point	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	Cancel	Start	
START	▲	▲																					○	▲

○ : Must be set
▲ : Varies with the servo program which makes simultaneous start.

[Control Details]

Control Using START Instruction

(1) Simultaneously start the designated servo programs.

(2) Any servo program can be designated, except the simultaneous start (START instruction) servo program.

(3) Up to 3 servo programs can be designated.

(4) After the simultaneous start, each axis is controlled by the designated servo program.

[Cautions]

(1) A check is made at the simultaneous start. An error occurs and operation does not start in the cases shown in the table below.

Error	Error Processing	Stored Codes: D9189	Stored Codes: D9190
Designated servo program does not exist	Servo program setting error flag (M9079): ON Start accept flag (M2001+n): OFF	Program number causing error on simultaneous start	19
START instruction designated as servo program			
The designated servo program start axis is already designated.			
A servo program cannot start due to an error		Program number for which error occurred on simultaneous start	Error Item Data (see Section 6.3)

(2) The servo programs cannot be designated for the START instruction using indirect designation.

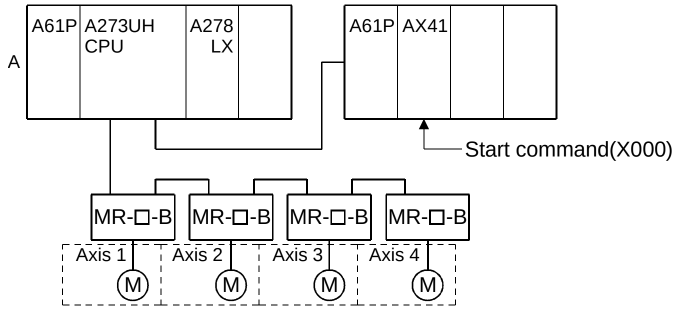
(3) If the servo programs designated for the START instruction include fixed-pitch feed control or speed/position switching control, start may be delayed a maximum of 1 second compared to other speed control or position control.

[Program Example]

This program executes simultaneous start under the conditions below.

(1) System configuration

Simultaneous start of Axis 1, Axis 2, Axis 3, and Axis 4.



(2) Quantity and numbers of servo programs designated

(a) Designated servo programs: 3

(b) Designated servo program numbers

Servo Program No.	Axis	Control Details
1	1, 2	Circular interpolation control
14	3	Speed control
45	4	Zeroing control

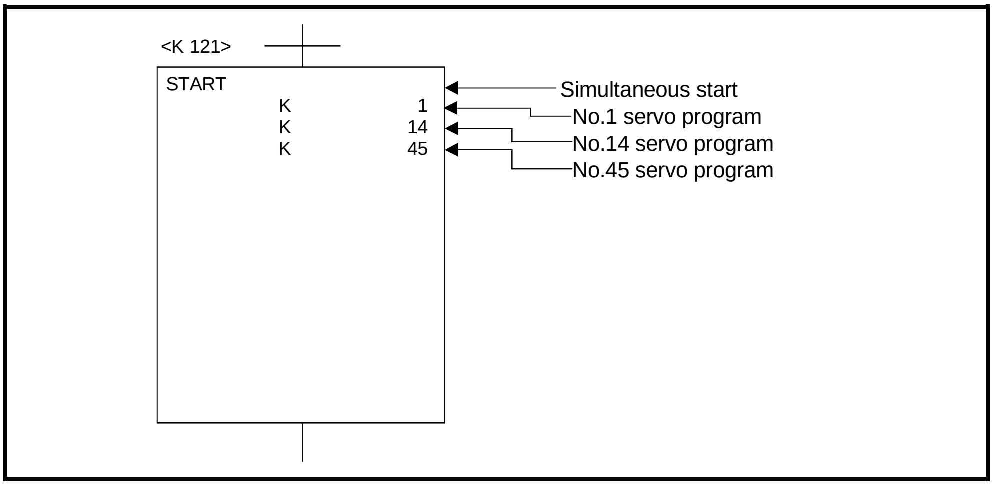
(3) Start conditions

(a) Simultaneous start servo program number ....No. 121

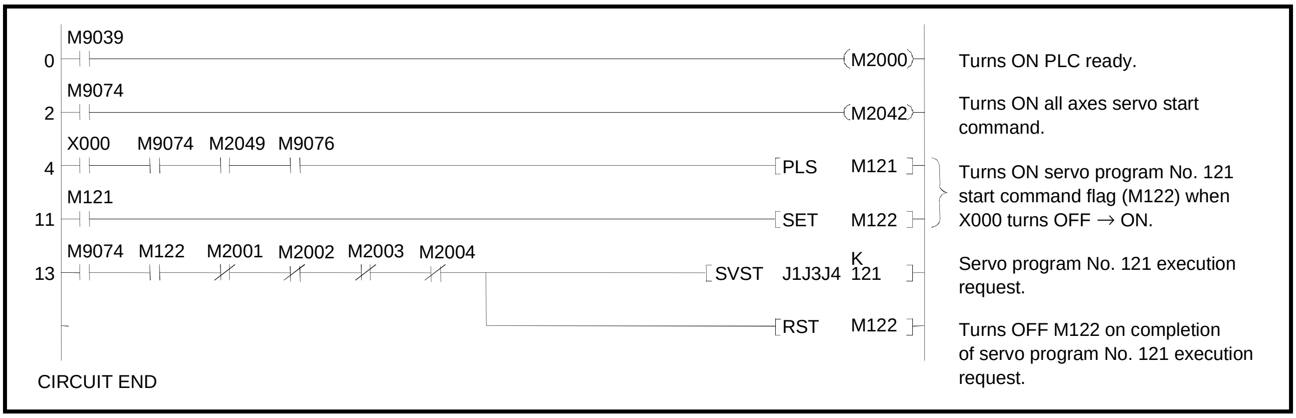
(b) Simultaneous start run command...........................leading edge of X100 (OFF → ON)

(4) Servo program

The simultaneous start servo program No. 121 is shown below.



(5) Sequence program
The sequence program which runs the servo program is shown below.



7.19 JOG Operation

Runs the set JOG operation.
Individual start or simultaneous start can be used for JOG operation.
JOG operation can be run from a sequence program or in a peripheral device test mode.
(For information on running JOG operation in a peripheral device test mode, refer to the operation manual for the appropriate peripheral device.)
To carry out JOG operation, the JOG operation must be set for each axis.

7.19.1 JOG operation data

The JOG operation data is the data required to carry out JOG operation.
Set the JOG operation data from a peripheral device.

Table 7.2 Table of JOG Operation Data

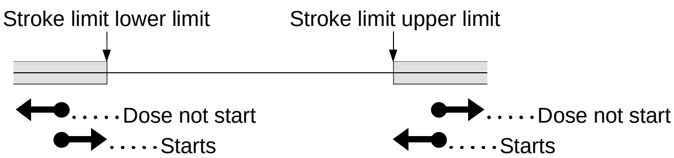
No.	Item	Setting Range								Default		Remarks	Explanatory Section
		mm		inch		degree		PULSE		Initial Value	Units		
		Setting Range	Units	Setting Range	Units	Setting Range	Units	Setting Range	Units				
1	JOG speed limit value	0.01 to 6000000.00	mm/min	0.001 to 600000.000	inch/min	0.001 to 2147483.647	degree/min	1 to 10000000	PLS/s	20000	PLS/s	• Sets the max. speed during JOG operation. • The JOG speed limit value becomes the JOG operation speed if the JOG operation speed is set more than JOG speed limit value.	–
2	Parameter block setting	1 to 16								1	–	• Sets the parameter block number used for JOG operation.	4.4

(1) JOG operation data check
A relative check of the JOG operation data is executed at the following times:
- Power on
- On PLC ready (M2000) leading edge (OFF → ON)
- When test mode is selected.

(2) Data error processing
- Only data for which errors were detected during the relative check is changed to its default value for JOG operation control.
- The error code corresponding to the data for axis where an error was detected is stored in the data register.

POINT

(1) JOG operation to a position outside the fixed parameter stroke limit cannot be started.
However, JOG operation is possible in the direction from outside the stroke limit to back inside the stroke limit.



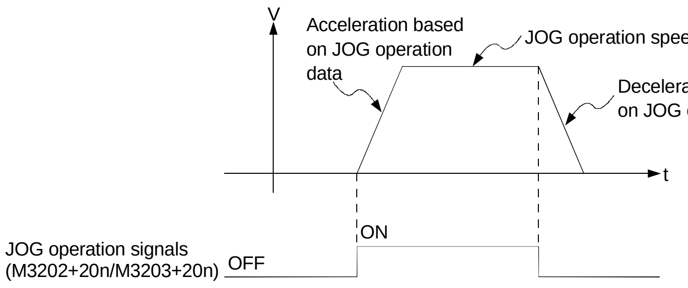
7.19.2 Individual start

Starts JOG operation for the designated axes.
JOG operation is controlled by the following JOG operation signals:

- Forward JOG operation .... M3202+20n
- Reverse JOG operation .... M3203+20n

[Control Details]

(1) JOG operation continues at the speed value stored in the JOG operation speed setting register while the JOG operation signal remains ON and a deceleration stop occurs when the JOG operation signal turns OFF.
Control of acceleration and deceleration is based on the JOG operation data settings.



JOG operation carried out for axis for which the JOG operation signal is ON.

(2) The JOG operation signal, JOG operation setting register, and setting range for each axis are shown in the table below.

<table>
<tr><th rowspan="2">No.</th><th colspan="2">JOG Operation</th><th colspan="2">JOG Operation Setting Register</th><th colspan="2">mm</th><th colspan="2">inch</th><th colspan="2">degree</th><th colspan="2">PULSE</th></tr>
<tr><th>Forward JOG</th><th>Reverse JOG</th><th>Most Significant</th><th>Least Significant</th><th>Setting Range</th><th>Units</th><th>Setting Range</th><th>Units</th><th>Setting Range</th><th>Units</th><th>Setting Range</th><th>Units</th></tr>
<tr><td>1</td><td>M3202</td><td>M3203</td><td>D641</td><td>D640</td><td rowspan="32">1 to 600000000</td><td rowspan="32">10^{-2} mm/min</td><td rowspan="32">1 to 600000000</td><td rowspan="32">10^{-3} inch/min</td><td rowspan="32">1 to 2147483647</td><td rowspan="32">10^{-3} degree/min</td><td rowspan="32">1 to 10000000</td><td rowspan="32">PLS/s</td></tr>
<tr><td>2</td><td>M3222</td><td>M3223</td><td>D643</td><td>D642</td></tr>
<tr><td>3</td><td>M3242</td><td>M3243</td><td>D645</td><td>D644</td></tr>
<tr><td>4</td><td>M3262</td><td>M3263</td><td>D647</td><td>D646</td></tr>
<tr><td>5</td><td>M3282</td><td>M3283</td><td>D649</td><td>D648</td></tr>
<tr><td>6</td><td>M3302</td><td>M3303</td><td>D651</td><td>D650</td></tr>
<tr><td>7</td><td>M3322</td><td>M3323</td><td>D653</td><td>D652</td></tr>
<tr><td>8</td><td>M3342</td><td>M3343</td><td>D655</td><td>D654</td></tr>
<tr><td>9</td><td>M3362</td><td>M3363</td><td>D657</td><td>D656</td></tr>
<tr><td>10</td><td>M3382</td><td>M3383</td><td>D659</td><td>D658</td></tr>
<tr><td>11</td><td>M3402</td><td>M3403</td><td>D661</td><td>D660</td></tr>
<tr><td>12</td><td>M3422</td><td>M3423</td><td>D663</td><td>D662</td></tr>
<tr><td>13</td><td>M3442</td><td>M3443</td><td>D665</td><td>D664</td></tr>
<tr><td>14</td><td>M3462</td><td>M3463</td><td>D667</td><td>D666</td></tr>
<tr><td>15</td><td>M3482</td><td>M3483</td><td>D669</td><td>D668</td></tr>
<tr><td>16</td><td>M3502</td><td>M3503</td><td>D671</td><td>D670</td></tr>
<tr><td>17</td><td>M3522</td><td>M3523</td><td>D673</td><td>D672</td></tr>
<tr><td>18</td><td>M3542</td><td>M3543</td><td>D675</td><td>D674</td></tr>
<tr><td>19</td><td>M3562</td><td>M3563</td><td>D677</td><td>D676</td></tr>
<tr><td>20</td><td>M3582</td><td>M3583</td><td>D679</td><td>D678</td></tr>
<tr><td>21</td><td>M3602</td><td>M3603</td><td>D681</td><td>D680</td></tr>
<tr><td>22</td><td>M3622</td><td>M3623</td><td>D683</td><td>D682</td></tr>
<tr><td>23</td><td>M3642</td><td>M3643</td><td>D685</td><td>D684</td></tr>
<tr><td>24</td><td>M3662</td><td>M3663</td><td>D687</td><td>D686</td></tr>
<tr><td>25</td><td>M3682</td><td>M3683</td><td>D689</td><td>D688</td></tr>
<tr><td>26</td><td>M3702</td><td>M3703</td><td>D691</td><td>D690</td></tr>
<tr><td>27</td><td>M3722</td><td>M3723</td><td>D693</td><td>D692</td></tr>
<tr><td>28</td><td>M3742</td><td>M3743</td><td>D695</td><td>D694</td></tr>
<tr><td>29</td><td>M3762</td><td>M3763</td><td>D697</td><td>D696</td></tr>
<tr><td>30</td><td>M3782</td><td>M3783</td><td>D699</td><td>D698</td></tr>
<tr><td>31</td><td>M3802</td><td>M3803</td><td>D701</td><td>D700</td></tr>
<tr><td>32</td><td>M3822</td><td>M3823</td><td>D703</td><td>D702</td></tr>
</table>

POINT

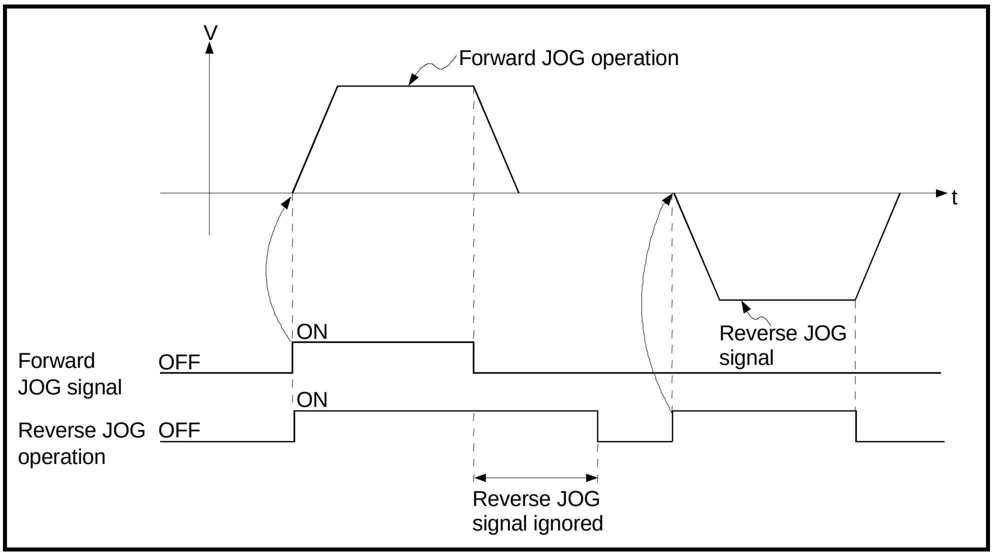
To set the JOG operation speed using a sequence program, store a value in the JOG operation speed setting register which is 100 times the real speed in units of millimeters or 1000 times the speed in units of inches or degrees.

Example

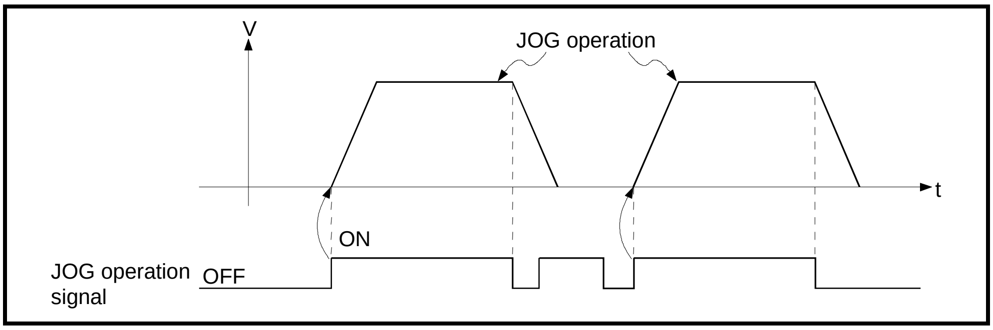
To set a JOG operation speed of 6000.00 mm/min., store the value 600000 in the JOG operation speed setting register.

[Cautions]

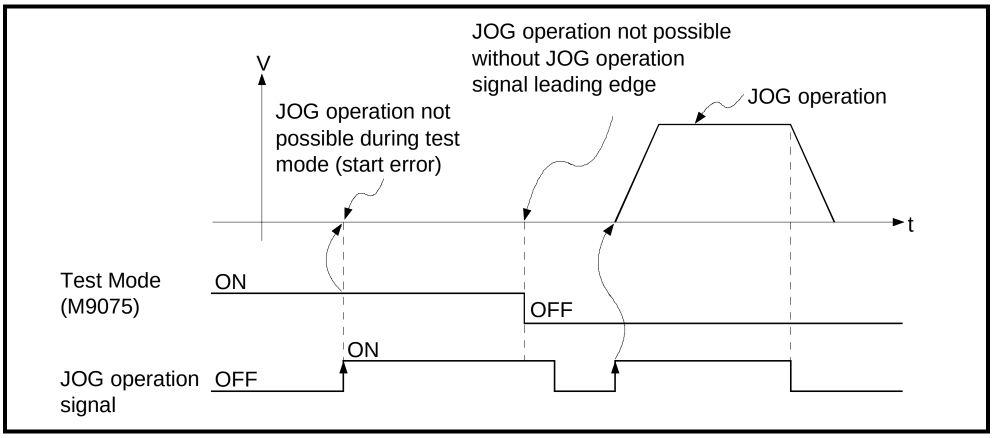
(1) Forward JOG operation occurs if the forward JOG signal (M3202+20n) and reverse JOG signal (M3203+20n) turn ON simultaneously for a single axis. When the axis decelerated to a stop after the forward JOG signal had turned OFF, reverse JOG operation is not performed if the reverse JOG signal is ON. Reverse JOG operation is started when the reverse JOG signal is turned from OFF to ON after that.



(2) If the JOG operation signal turns ON during deceleration which was started when the JOG operation signal turned OFF, JOG operation is not performed after the axis has decelerated to a stop. JOG operation is started when the JOG operation signal is turned from OFF to ON after that.



(3) JOG operation cannot be started by the JOG operation signals (M3202+20n/M3203+20n) in a peripheral device test mode. JOG operation starts on the leading edge (OFF → ON) of the JOG operation signal after the test mode is reset.

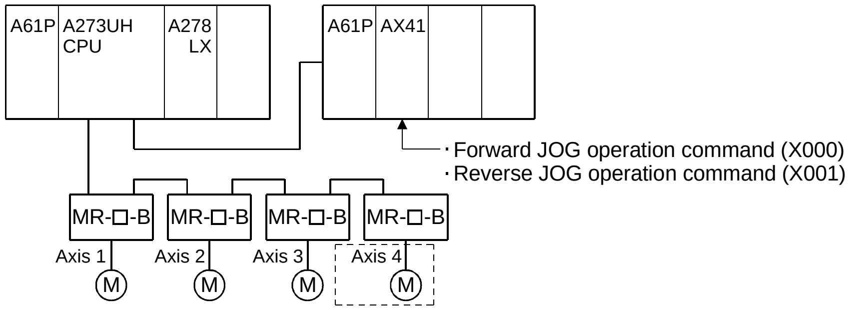


[Program Example]

This program executes JOG operation under the conditions below.

(1) System configuration

JOG operation of Axis 4.



(2) JOG operation conditions

(a) Axis number..............................Axis 4

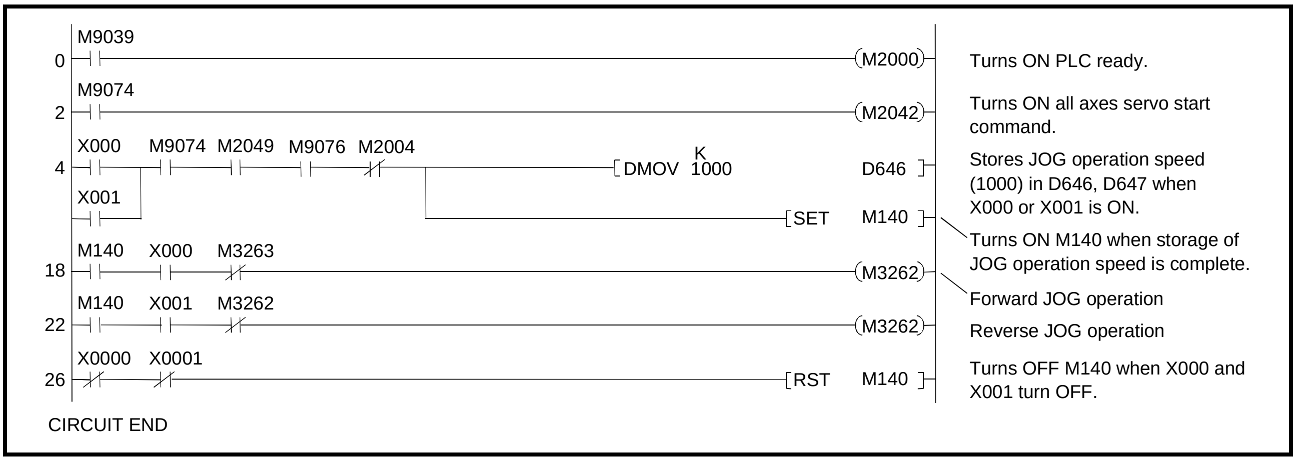
(b) JOG operation speed 1000

(c) JOG operation commands

1) Forward JOG operation........X000 ON

2) Reverse JOG operation ....X001 ON

(3) Sequence program

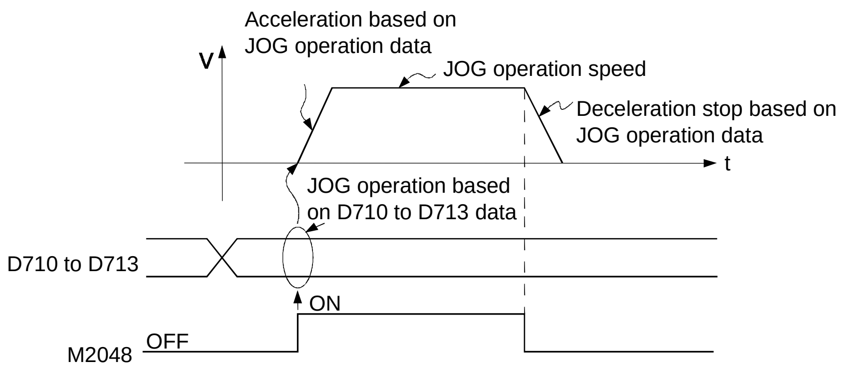


7.19.3 Simultaneous start

Simultaneously starts JOG operation designated for multiple axes.

[Control Details]

(1) JOG operation continues at the speed value stored in the JOG operation speed setting register for each axis while the JOG simultaneous start command (M2048) remains ON, and a deceleration stop occurs when M2048 turns OFF. Control of acceleration and deceleration is based on the JOG operation data settings.

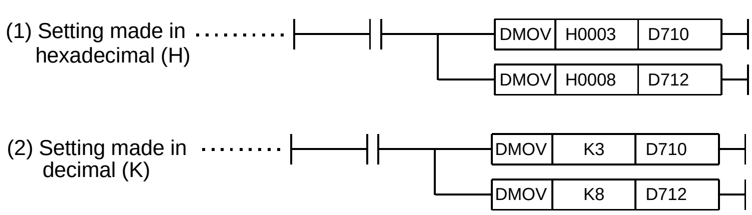


(2) JOG operation is carried out on the axis set in the JOG simultaneous start axis setting area (D710 to D713).

	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0	
D710	Axis 16	Axis 15	Axis 14	Axis 13	Axis 12	Axis 11	Axis 10	Axis 9	Axis 8	Axis 7	Axis 6	Axis 5	Axis 4	Axis 3	Axis 2	Axis 1	Forward rotation JOG
D711	Axis 32	Axis 31	Axis 30	Axis 29	Axis 28	Axis 27	Axis 26	Axis 25	Axis 24	Axis 23	Axis 22	Axis 21	Axis 20	Axis 19	Axis 18	Axis 17	
D712	Axis 16	Axis 15	Axis 14	Axis 13	Axis 12	Axis 11	Axis 10	Axis 9	Axis 8	Axis 7	Axis 6	Axis 5	Axis 4	Axis 3	Axis 2	Axis 1	Reverse rotation JOG
D713	Axis 32	Axis 31	Axis 30	Axis 29	Axis 28	Axis 27	Axis 26	Axis 25	Axis 24	Axis 23	Axis 22	Axis 21	Axis 20	Axis 19	Axis 18	Axis 17	

Make JOG operation simultaneous start axis setting with 1/0.
1: Simultaneous start executed
2: Simultaneous start not executed

The following example assumes that the MOV instructions are used to make setting to perform forward rotation JOG operation of axes 1 and 2 and reverse rotation JOG operation of axis 4.



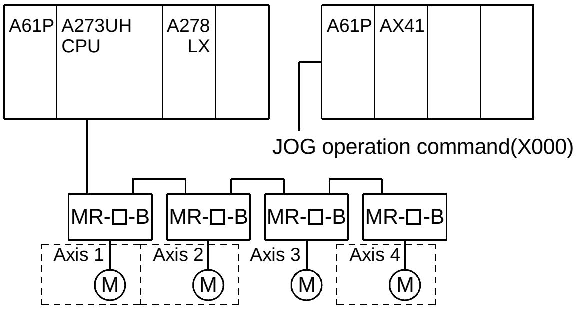
(3) The JOG operation speed setting registers are described below.

<table>
<tr><th rowspan="3">No.</th><th colspan="2" rowspan="2">JOG Operation</th><th colspan="2" rowspan="2">JOG Operation Setting Register</th><th colspan="8">Setting Range</th></tr>
<tr><th colspan="2">mm</th><th colspan="2">inch</th><th colspan="2">degree</th><th colspan="2">PULSE</th></tr>
<tr><th>Forward JOG</th><th>Reverse JOG</th><th>Most Significant</th><th>Least Significant</th><th>Setting Range</th><th>Units</th><th>Setting Range</th><th>Units</th><th>Setting Range</th><th>Units</th><th>Setting Range</th><th>Units</th></tr>
<tr><td>1</td><td>M3202</td><td>M3203</td><td>D641</td><td>D640</td><td rowspan="32">1 to 600000000</td><td rowspan="32">10^{-2} mm/min</td><td rowspan="32">1 to 600000000</td><td rowspan="32">10^{-3} inch/min</td><td rowspan="32">1 to 2147483647</td><td rowspan="32">10^{-3} degree/min</td><td rowspan="32">1 to 10000000</td><td rowspan="32">PLS/s</td></tr>
<tr><td>2</td><td>M3222</td><td>M3223</td><td>D643</td><td>D642</td></tr>
<tr><td>3</td><td>M3242</td><td>M3243</td><td>D645</td><td>D644</td></tr>
<tr><td>4</td><td>M3262</td><td>M3263</td><td>D647</td><td>D646</td></tr>
<tr><td>5</td><td>M3282</td><td>M3283</td><td>D649</td><td>D648</td></tr>
<tr><td>6</td><td>M3302</td><td>M3303</td><td>D651</td><td>D650</td></tr>
<tr><td>7</td><td>M3322</td><td>M3323</td><td>D653</td><td>D652</td></tr>
<tr><td>8</td><td>M3342</td><td>M3343</td><td>D655</td><td>D654</td></tr>
<tr><td>9</td><td>M3362</td><td>M3363</td><td>D657</td><td>D656</td></tr>
<tr><td>10</td><td>M3382</td><td>M3383</td><td>D659</td><td>D658</td></tr>
<tr><td>11</td><td>M3402</td><td>M3403</td><td>D661</td><td>D660</td></tr>
<tr><td>12</td><td>M3422</td><td>M3423</td><td>D663</td><td>D662</td></tr>
<tr><td>13</td><td>M3442</td><td>M3443</td><td>D665</td><td>D664</td></tr>
<tr><td>14</td><td>M3462</td><td>M3463</td><td>D667</td><td>D666</td></tr>
<tr><td>15</td><td>M3482</td><td>M3483</td><td>D669</td><td>D668</td></tr>
<tr><td>16</td><td>M3502</td><td>M3503</td><td>D671</td><td>D670</td></tr>
<tr><td>17</td><td>M3522</td><td>M3523</td><td>D673</td><td>D672</td></tr>
<tr><td>18</td><td>M3542</td><td>M3543</td><td>D675</td><td>D674</td></tr>
<tr><td>19</td><td>M3562</td><td>M3563</td><td>D677</td><td>D676</td></tr>
<tr><td>20</td><td>M3582</td><td>M3583</td><td>D679</td><td>D678</td></tr>
<tr><td>21</td><td>M3602</td><td>M3603</td><td>D681</td><td>D680</td></tr>
<tr><td>22</td><td>M3622</td><td>M3623</td><td>D683</td><td>D682</td></tr>
<tr><td>23</td><td>M3642</td><td>M3643</td><td>D685</td><td>D684</td></tr>
<tr><td>24</td><td>M3662</td><td>M3663</td><td>D687</td><td>D686</td></tr>
<tr><td>25</td><td>M3682</td><td>M3683</td><td>D689</td><td>D688</td></tr>
<tr><td>26</td><td>M3702</td><td>M3703</td><td>D691</td><td>D690</td></tr>
<tr><td>27</td><td>M3722</td><td>M3723</td><td>D693</td><td>D692</td></tr>
<tr><td>28</td><td>M3742</td><td>M3743</td><td>D695</td><td>D694</td></tr>
<tr><td>29</td><td>M3762</td><td>M3763</td><td>D697</td><td>D696</td></tr>
<tr><td>30</td><td>M3782</td><td>M3783</td><td>D699</td><td>D698</td></tr>
<tr><td>31</td><td>M3802</td><td>M3803</td><td>D701</td><td>D700</td></tr>
<tr><td>32</td><td>M3822</td><td>M3823</td><td>D703</td><td>D702</td></tr>
</table>

[Program Example]

This program executes simultaneous start of JOG operations under the conditions below.

(1) System configuration
JOG operation of Axis 1, Axis 2, and Axis 4.

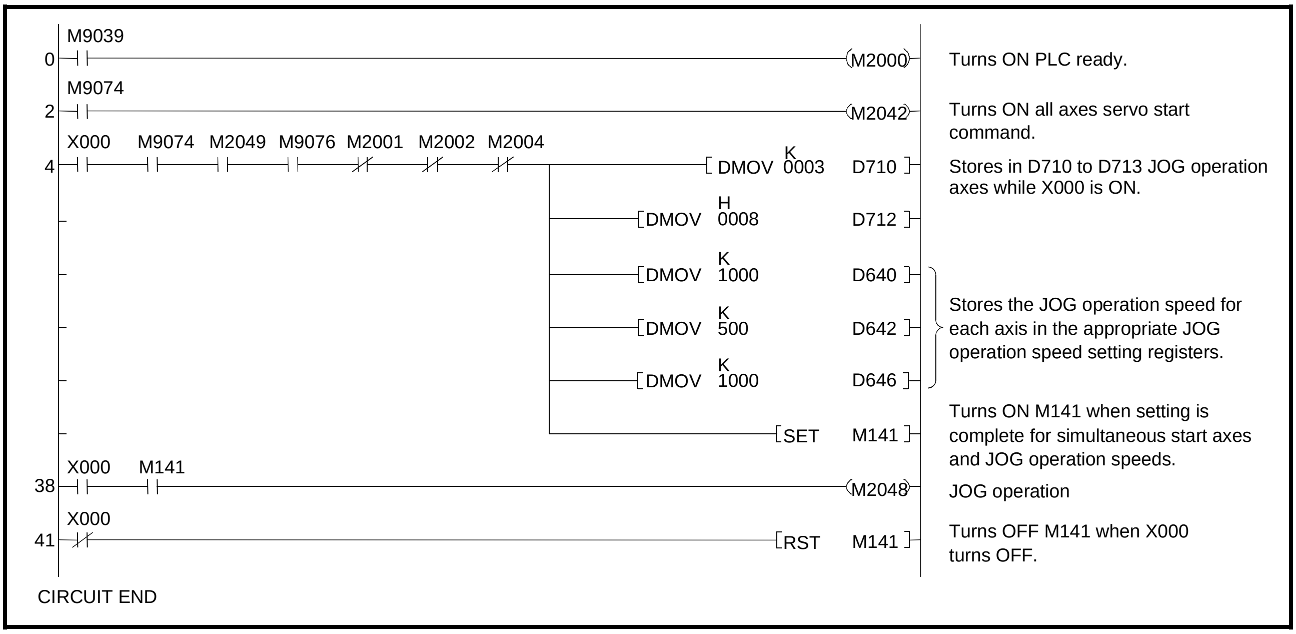


(2) JOG operation conditions
(a) The JOG operation conditions are tabled below.

Item	JOG		
Axis number	Axis 1	Axis 2	Axis 4
JOG operation speed	1000	500	1000
JOG operation direction	Forward	Forward	Reverse

(b) JOG operation command ...... X000 ON

(3) Sequence program



7.20 Manual Pulse Generator Operation

Positioning control according to the number of pulses input from the manual pulse generator.
Simultaneous operation of 1 to 3-axes is possible with one manual pulse generator; the number of modules that can be connected is as shown below.

Number Connectable to the Manual Pulse Generator
1

POINT

- When the A273UHCPU is used and two or more A273EX modules are loaded, connect a manual pulse generator to the first A273EX (counted from slot 0 of the CPU base).
  (The manual pulse generator is valid for the first module only.)
- When the A173UHCPU is used, one A172SENC is required per manual pulse generator. Connect a manual pulse generator to each of the first to third A172SENC.

[Control Details]

(1) Positioning of the axis set in the manual pulse generator axis setting register according to the PULSE input from the manual pulse generator.
Manual pulse generator operation is only valid while the manual pulse generator enable flag is ON.

Manual Pulse Generator Connecting Position	Manual Pulse Generator Axis Setting Register	Manual Pulse Generator Enable Flag
P1	D714, D715	M2051
P2	D716, D717	M2052
P3	D718, D719	M2053

(2) The travel value and output speed are shown below for positioning control due to manual pulse generator output.

(a) Travel value

The travel value due to the input of PULSE from a manual pulse generator is calculated using the following formula.

[travel value] = [travel value per PULSE] × [number of input PULSE] × [manual pulse generator input multiplication factor setting]

$$[\text{Travel value per pulse}] = \frac{[\text{Travel value per rotation (AL)}] \times [\text{Unit magnification (AM)}]}{[\text{Number of PULSE per rotation (AP)}]}$$

The travel value per PULSE during manual PULSE generator operation is shown in the following table.

Units	Travel Value
mm	0.1 μm
inch	0.00001 inch
degree	0.00001 degree
PULSE	1 PULSE

For units of millimeters, the commanded travel value for input of one pulse is: (0.1 μm) × (1 PULSE) × (manual pulse generator input magnification setting)

(b) Output speed

The output speed is the positioning speed corresponding to the number of PULSE input from a manual pulse generator in unit time.

[output speed] = [input PULSE per 1 ms] × [manual PULSE generator input multiplication factor setting]

(3) Setting the axis controlled by the manual pulse generator

(a) The axis controlled by the manual pulse generator are set in the manual pulse generator axis setting register (D714 to D719).

Example

Make the following setting when controlling axis 1, 22 and 30 using the manual pulse generator 1.

	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
D714	Axis 16	Axis 15	Axis 14	Axis 13	Axis 12	Axis 11	Axis 10	Axis 9	Axis 8	Axis 7	Axis 6	Axis 5	Axis 4	Axis 3	Axis 2	Axis 1
D715	Axis 32	Axis 31	Axis 30	Axis 29	Axis 28	Axis 27	Axis 26	Axis 25	Axis 24	Axis 23	Axis 22	Axis 21	Axis 20	Axis 19	Axis 18	Axis 17

(1) Setting made in hexadecimal (H) ······ DMOV H20200001 D714

(2) Setting made in decimal (K) ······ DMOV K538968065 D714

(4) Manual pulse generator 1-pulse input magnification setting

(a) Make magnification setting for 1 pulse input from the manual pulse generator axis-by-axis.

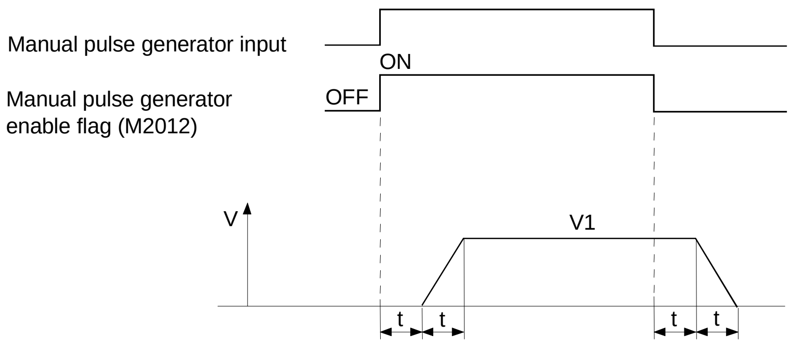
1- PULSE Input Magnification Setting Register	Corresponding Axis No.	Setting Range
D720	Axis 1	1 to 100
D721	Axis 2	
D722	Axis 3	
D723	Axis 4	
D724	Axis 5	
D725	Axis 6	
D726	Axis 7	
D727	Axis 8	
D728	Axis 9	
D729	Axis 10	
D730	Axis 11	
D731	Axis 12	
D732	Axis 13	
D733	Axis 14	
D734	Axis 15	
D735	Axis 16	
D736	Axis 17	
D737	Axis 18	
D738	Axis 19	
D739	Axis 20	
D740	Axis 21	
D741	Axis 22	
D742	Axis 23	
D743	Axis 24	
D744	Axis 25	
D745	Axis 26	
D746	Axis 27	
D747	Axis 28	
D748	Axis 29	
D749	Axis 30	
D750	Axis 31	
D751	Axis 32	

(5) At the leading edge of the manual pulse generator enable flag, a check is made in the manual pulse generator 1- PULSE input magnification setting registers of the manual pulse generator input magnifications set for the appropriate axis.
If an out-of-range value is detected, the manual pulse generator axis setting error register (D9185 to D9187) and manual pulse generator axis setting error flag (M9077) are set and a value of 1 is used for the magnification.

(6) Manual pulse generator smoothing magnification setting
Set a magnification to smooth the leading edge and trailing edge of manual pulse generator operation.

Manual Pulse Generator Smoothing Magnification Setting Register	Setting Range
Manual Puls Generator (P1) : D752	0 to 59
Manual Puls Generator (P2) : D753	
Manual Puls Generator (P3) : D754	

(a) Operation



Output speed (V1) = [number of input PULSES /ms] × [manual pulse generator 1 PULSE input magnification setting]

Travel value (L) = [travel value per PULSE] × [number of input PULSES] × [manual pulse generator 1 PULSE input magnification setting]

REMARKS

(1) The travel value per manual pulse generator pulse is as follows.
- Setting unit
  - mm : 0.1 μm
  - inch : 0.00001 inch
  - degree : 0.00001 degree
  - PULSE : 1 PULSE

(2) The smoothing time constant is a value in the range 56.8ms to 3408ms.

(7) Details of errors occurring during the setting of data for manual pulse generator operation are shown in the table below.

Error Details	Error Processing
A digit was set outside the ranges 1 to 32.	• Digit ignored where error occurred. • Manual pulse generator of valid axis with settings in rang es 1 to 32.
The designated axis is set for manual pulse generator operation.	• Duplicated designated axis ignored. • Executes the manual pulse generator operation set first.
More than 4 digits set	• All set axes ignored

[Cautions]

(1) The start accept flag turns ON for axis during manual pulse generator operation.
Consequently, positioning control or zeroing cannot be started by the servo system CPU or a peripheral device.
Turn OFF the manual pulse generator enable flag when manual pulse generator operation is complete.

(2) The torque limit value is fixed at 300% during manual pulse generator operation.

(3) When the manual pulse generator enable flag comes ON for a driven axis, for example one performing positioning control or JOG operation, error 214 is set for the relevant axis and manual pulse generator input is not enables. After the axis has been stopped, the rise of the manual pulse generator enable flag is validated, the manual pulse generator input enabled status is established, the start accept flag comes ON, and input from the manual pulse generator is accepted.

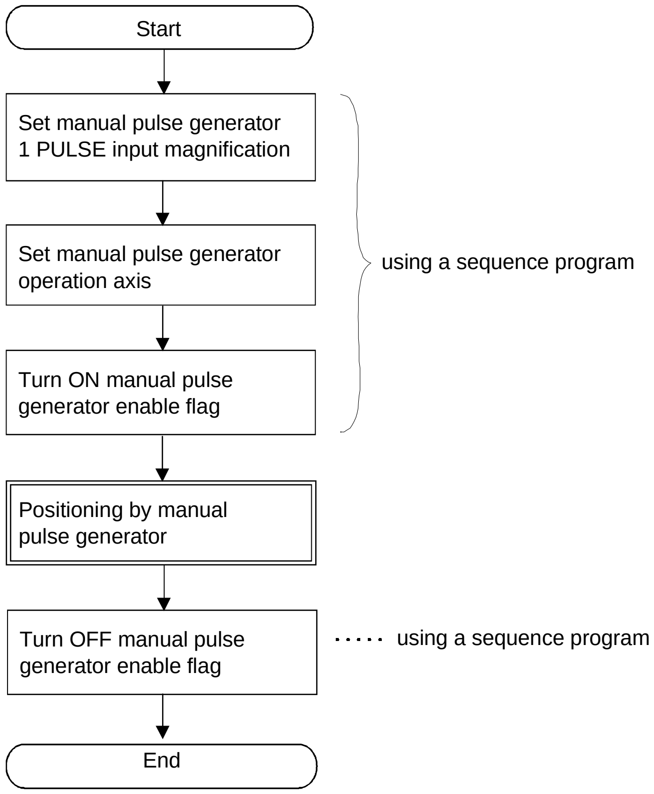
(4) If the manual pulse generator enable flag for another manual pulse generator No. is turned ON for an axis currently performing manual pulse generator operation, error 214 is set for the relevant axis and the input of that manual pulse generator is not enabled.

(5) If, after the manual pulse generator enable flag has been turned OFF, it is turned ON again for an axis that is performing smoothing deceleration, error 214 is set and manual pulse generator input is not enabled. Turn the manual pulse generator enable flag ON after smoothing deceleration to a stop (after the start accept flag has gone OFF).

(6) If, after the manual pulse generator enable flag has been turned OFF, another axis is set during smoothing deceleration and the same manual pulse generator enable flag is turned ON again, manual pulse generator input will not be enabled. In this case, the manual pulse generator axis setting error bit of the manual pulse generator axis setting error storage register (D9185 to D9187) comes ON, and the manual pulse generator axis setting error flag (M9077) comes ON. Establish an interlock such that the start accept flag of the designated axis going OFF is a condition for the manual pulse generator enable flag coming ON.

[Procedure for Manual Pulse Generator Operation]

The procedure for manual pulse generator operation is shown below.

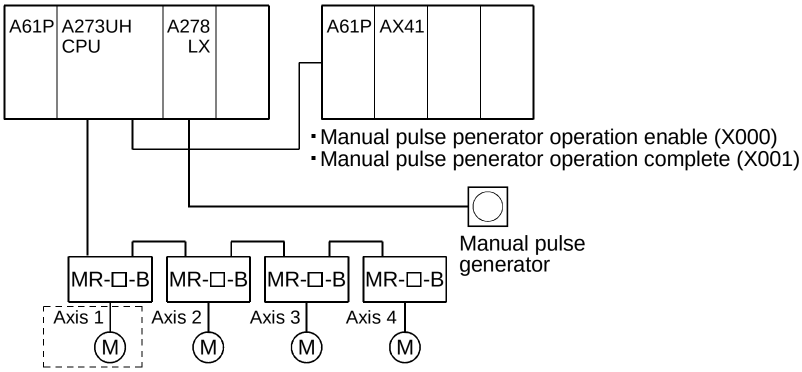


[Program Example]

This program executes manual pulse generator operation under the conditions below.

(1) System configuration

Manual pulse generator operation of Axis 1.



(2) Manual pulse generator operation conditions

(a) Manual pulse generator operation axis.............. Axis 1

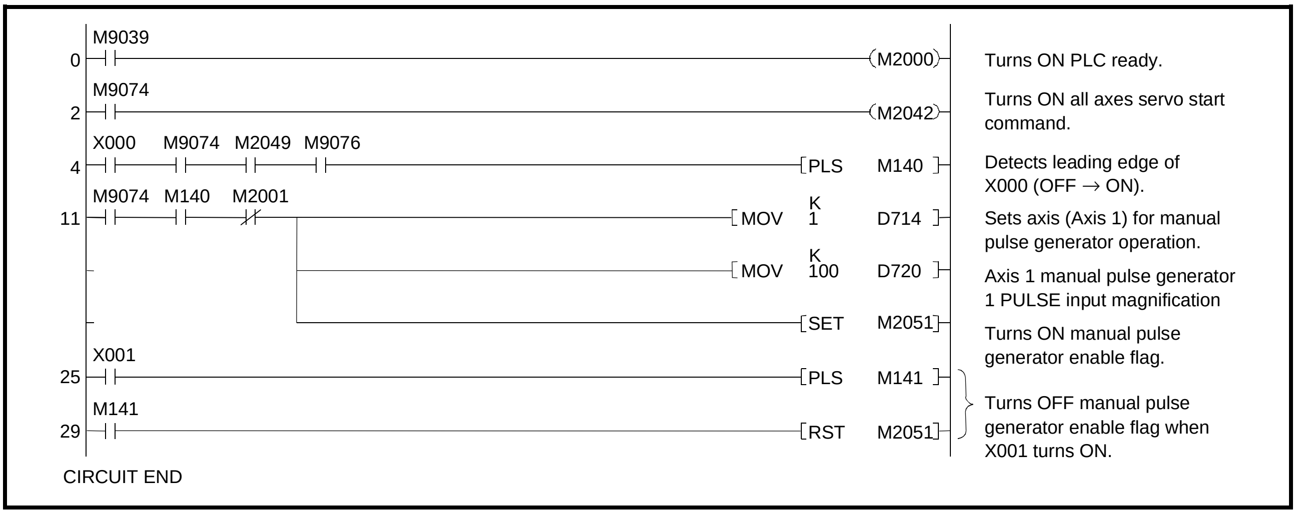
(b) Manual pulse generator 1 PULSE input magnification 100

(c) Manual pulse generator operation enable .... leading edge of X000 (OFF → ON)

(d) Manual pulse generator operation complete ..... leading edge of X001 (OFF → ON)

(3) Sequence program

A sequence program for manual pulse generator operation is shown below.



7.21 Home Position Return

(1) Use zeroing at power on and other times where confirmation that axis is at the machine home position is required.

(2) The following three methods of home position return are available:
- Proximity dog method } Used when not using an absolute position system
- Count method }
- Data set method..........................Recommended for an absolute-position system

(3) To carry out zeroing, the zeroing data must be set for each axis.

7.21.1 Zeroing data

The zeroing data is the data required to carry out zeroing.
Set the zeroing data from a peripheral device.

Table 7.3 Table of Home Position Return Data

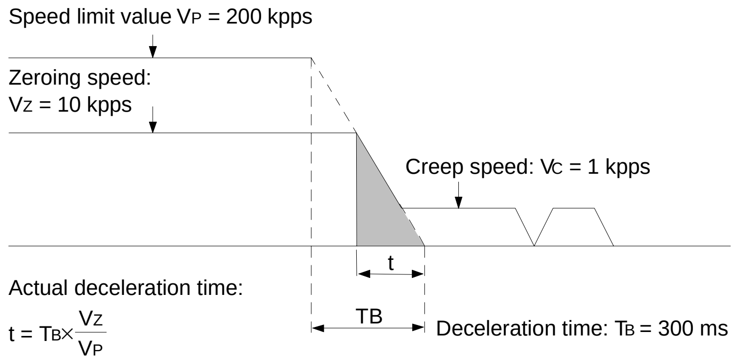
No.	Item	Setting Range								Default	Remarks	Explan-atory Section
		mm		inch		degree		PULSE		Initial		
		Setting Range	Units	Setting Range	Units	Setting Range	Units	Setting Range	Units	Value		
1	Zeroing direction	0: reverse direction (decreased address) 1: forward direction (increased address)								0	• Sets the direction for zeroing.	–
2	Zeroing method	0: near-zero point dog method 1: count method 2: data set method								0	• Sets the zeroing method. • The proximity dog method or count method is recommended for a servo amplifier which does not support absolute data, and the data set method is recommended for a servo amplifier which supports absolute data.	–
3	Home position address	–2147483648 to 2147483647	$\times 10^{-1}$ μm	–2147483648 to 2147483647	$\times 10^{-5}$ inch	0 to 35999999	$\times 10^{-5}$ degree	–2147483648 to 2147483647	PLS	0	• Sets the current value of the home position after zeroing. • It is recommended that the home position address is set at the stroke limit upper limit or lower limit.	–
4	Zeroing speed	0.01 to 6000000.00	mm/min	0.001 to 600000.000	inch/min	0.001 to 2147483.647	degree/min	1 to 10000000	PLS/s	1	• Sets the speed for zeroing.	–
5	Creep speed	0.01 to 6000000.00	mm/min	0.001 to 600000.000	inch/min	0.001 to 2147483.647	degree/min	1 to 10000000	PLS/s	1	• Sets the creep speed (low speed immediately before stopping after deceleration from zeroing speed) after the proximity dog.	–
6	Travel value after proximity dog	0 to 214748364.7	μm	0 to 21474.83647	inch	0 to 21474.83647	degree	0 to 2147483647	PLS	–	• Sets the travel value after the proximity dog for the count method. • Set more than the deceleration distance at the zeroing speed.	7.21.1 (1)
7	Parameter block setting	1 to 64								1	• Sets the parameter block to use for zeroing (see Section 4.4).	–

(1) Setting the travel value after proximity dog
   (a) This parameter sets the travel value after the proximity dog turns ON for zeroing using the count method.
   (b) After the proximity dog turns ON, the home position is the first zero-point after travel by the set travel value is complete.
   (c) Set the travel value after the proximity dog turns ON more than the deceleration distance at the zeroing speed.

Example

The deceleration distance is calculated as shown below from the speed limit value, zeroing speed, creep speed, and deceleration time.

[Zeroing operation]



Actual deceleration time:

$$t = T_B \times \frac{V_Z}{V_P}$$

[Deceleration distance (shaded area under graph)]

$$= \frac{1}{2} \times \frac{V_Z}{1000} \times t$$

Change in speed per millisecond

$$= \frac{V_Z}{2000} \times \frac{T_B \times V_Z}{V_P}$$

$$= \frac{10 \times 10^3}{2000} \times \frac{300 \times 10 \times 10^3}{200 \times 10}$$

= 75 ········ Set greater than 75.

POINT

A zeroing must be made after the servo motor has been rotated more than one revolution to pass the axis through the Z-phase (motor reference position signal).
For a proximity dog type or count type zeroing, the distance between the point where the zeroing program is started and the deceleration stop point before second travel must be such that the servo motor is rotated more than one revolution to pass the axis through the Z-phase.
When a data setting type zeroing is made in an ABS (absolute position) system, the motor must also have been rotated more than one revolution by JOG operation or the like to pass the axis through the Z-phase.

7.21.2 Zoering by the proximity dog method

(1) Proximity dog method
Using the proximity dog method, the home position is the first zero point after the proximity dog turns OFF.

(2) Zeroing by the proximity dog method
The zeroing operation using the proximity dog method is shown in Fig. 7.31.

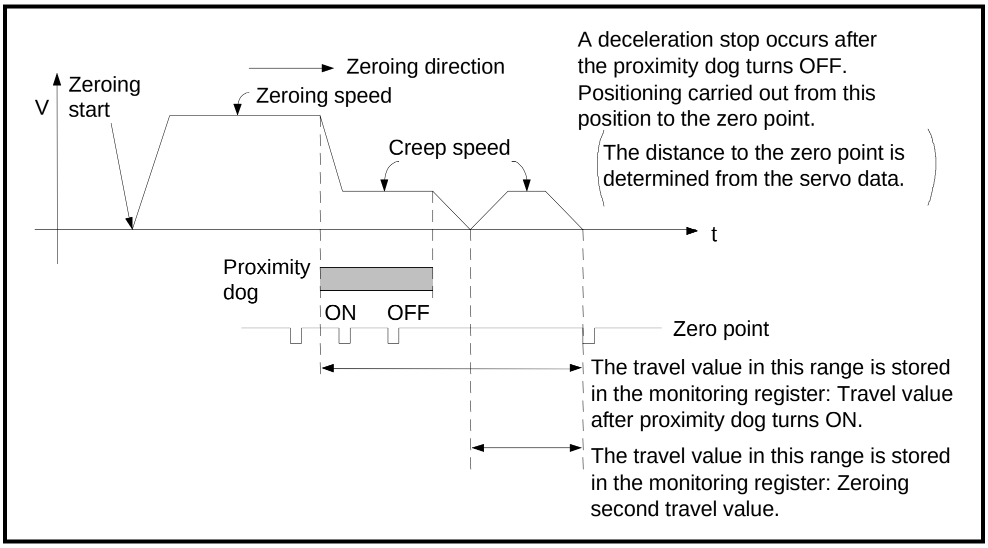
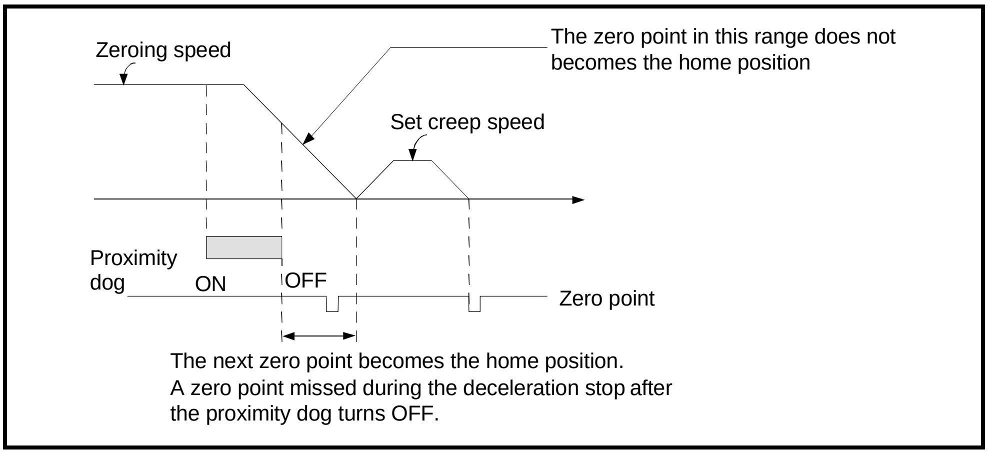


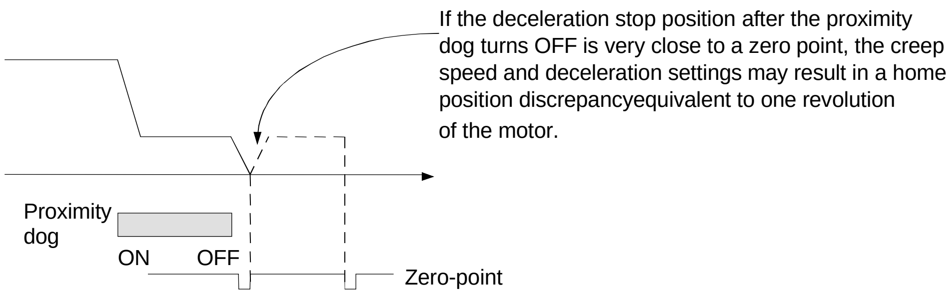
Fig. 7.31 Operation of Zeroing by the Proximity Dog Method

(3) Running zeroing
To run zeroing, use the servo program described in Section 7.21.5.

(4) Cautions
Take note of the following points during zeroing by the proximity dog method.
(a) Keep the proximity dog ON during deceleration from the zeroing speed to the creep speed.
A deceleration stop occurs if the proximity dog turns OFF before deceleration to the creep speed, and the proximity becomes the home position.



(b) Adjust the position where the proximity dog turns OFF, such that the zeroing second travel value becomes half the travel value for one revolution of the motor.
A home position discrepancy equivalent to one revolution of the motor may occur if the zeroing travel value is less than half the travel value for one revolution of the motor.



IMPORTANT

(1) In the following cases, before starting the zeroing, use JOG operation or some other method to return the axis to a position before where the proximity dog turned ON. Zeroing will not start unless the axis is returned to a position before the proximity dog position.
(a) Zeroing from a position after the proximity dog turned OFF.
(b) When the power is turned ON after zeroing was completed.

7.21.3 Zeroing by the count method

(1) Count method
Using the count method, the home position is the first zero point after a designated distance (travel value after proximity dog turns ON) after the proximity dog turns ON.
The travel value after the proximity dog turns ON is set in the table of zeroing data shown in section 7.21.1.

(2) Zeroing by the count method
The zeroing operation using the count method is shown in Fig. 7.32.

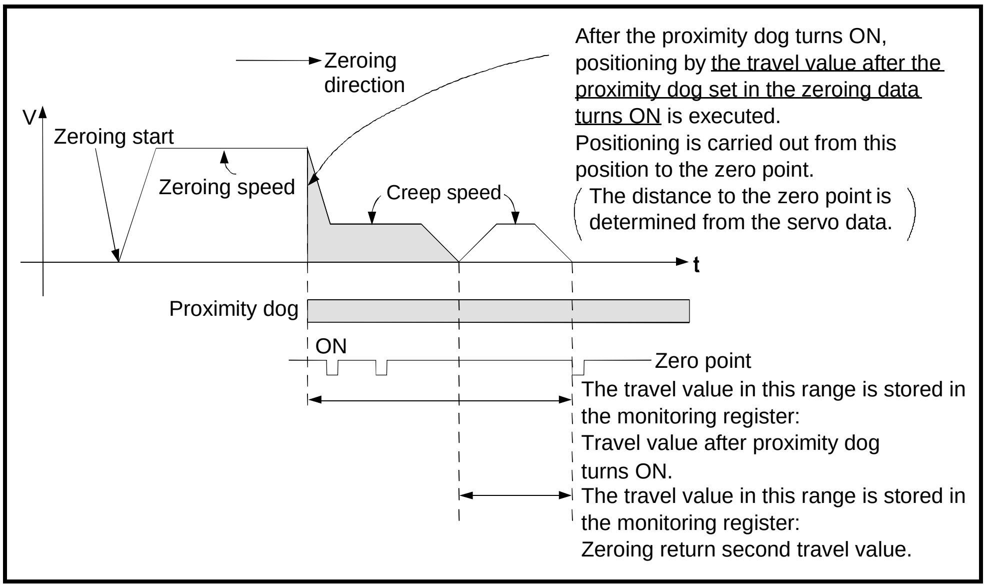


Fig. 7.32 Operation of Zeroing by the Count Method

(3) Running zeroing
To run zeroing, use the servo program described in Section 7.21.5.

(4) Cautions
(a) Maintain sufficient distance between the position where the proximity dog turns OFF and the home position.
(b) Using the count method, zeroing or resumptive start of zeroing is possible when the proximity dog turns ON. To carry out zeroing or resumptive start of zeroing when the proximity dog turns ON, return the axis to a position where the proximity dog is OFF before starting the zeroing.

7.21.4 Zeroing by the data set method

(1) Data set method
The data set method is a zeroing method which does not use the proximity dogs. This method can be used with the absolute position system.

(2) Zeroing by the data set method
The address current value becomes the home position address when the zeroing operation is run with the SVST instruction.

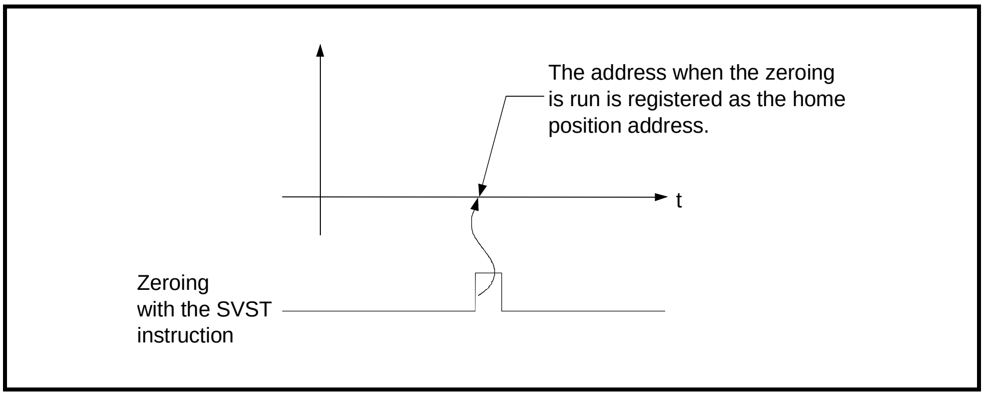


Fig. 7.33 Operation of Zeroing by the Date Set Method

(3) Executing zeroing
To execute zeroing, use the servo program described in Section 7.21.5.

(4) Cautions
(a) A zero point must be passed between turning on the power and executing zeroing.
A no zero point passed error occurs if zeroing is executed before a zero point is passed.
After a no zero point passed error occurs, reset the error and turn the servo motor at least one revolution using JOG operation before running the zeroing operation again.
Use the zero point passed signal (M2406+20n) to check that a zero point is passed.

(b) Starting zeroing with the data set method when not using the absolute position system has the same function as the current value change command.

(c) The zeroing data required for the data set method are the zeroing method and home position address.

7.21.5 Zeroing servo program

Zeroing uses the ZERO servo instruction.

Servo Instruction	Positioning Method	Number of Controllable Axes	Items Set by Peripherals																					Speed Change
			Common							Arc			Parameter Block									Others		
			Parameter Block No.	Axis	Address/Travel Value	Commanded Speed	Dwell Time	M-Code	Torque Limit Value	Auxiliary Point	Radius	Center Point	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			
ZERO	–	1		○														Δ						

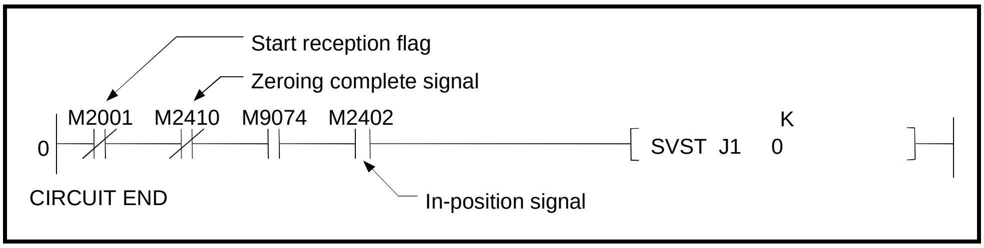
○ : Must be set
Δ : Set if required

[Control Details]

(1) Zeroing is carried out using the method designated in the zeroing data (see Section 7.21.1).
Refer to the following sections for details about the zeroing methods:
- Proximity dog method .... Section 7.21.2
- Count method .... Section 7.21.3
- Data set method............................... Section 7.21.4

[Caution]

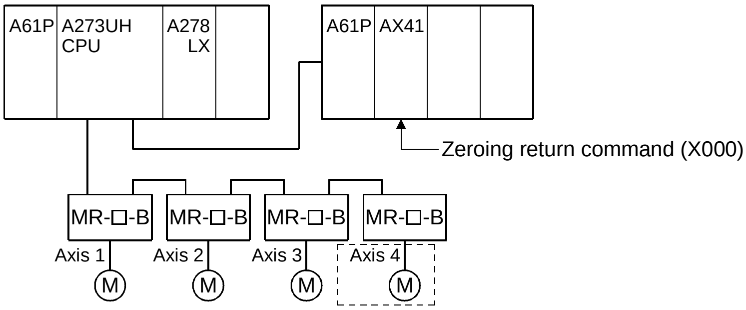
(1) If the following circuit conducts zeroing using the proximity dog method after the PLC ready flag (M2000) turns ON but before the PCPU ready flag (M9074) turns ON, another zeroing request is issued after zeroing is complete.
Therefore, apply interlock conditions to M9074 and M2402+20n (in-position signal) when carrying out a zeroing. (See program example.)



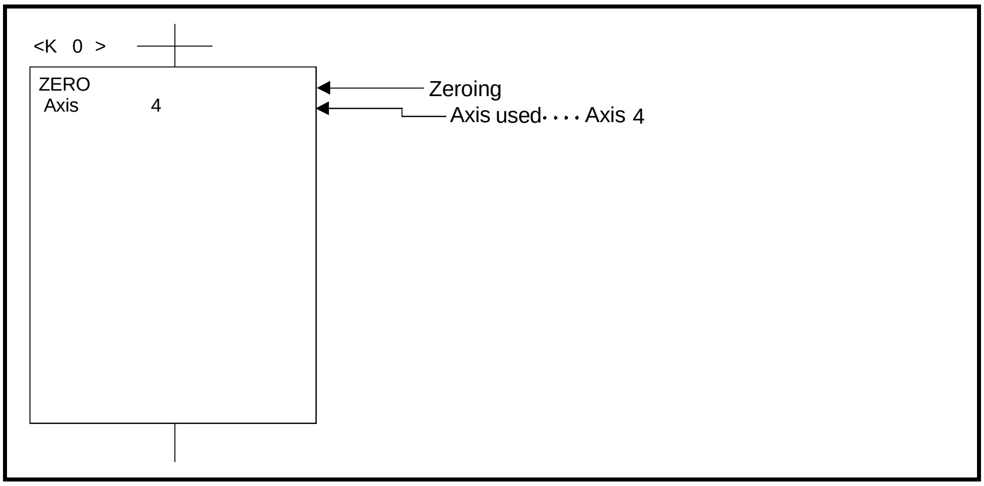
[Program Example]

This program carries out zeroing using servo program No. 0, under the conditions below.

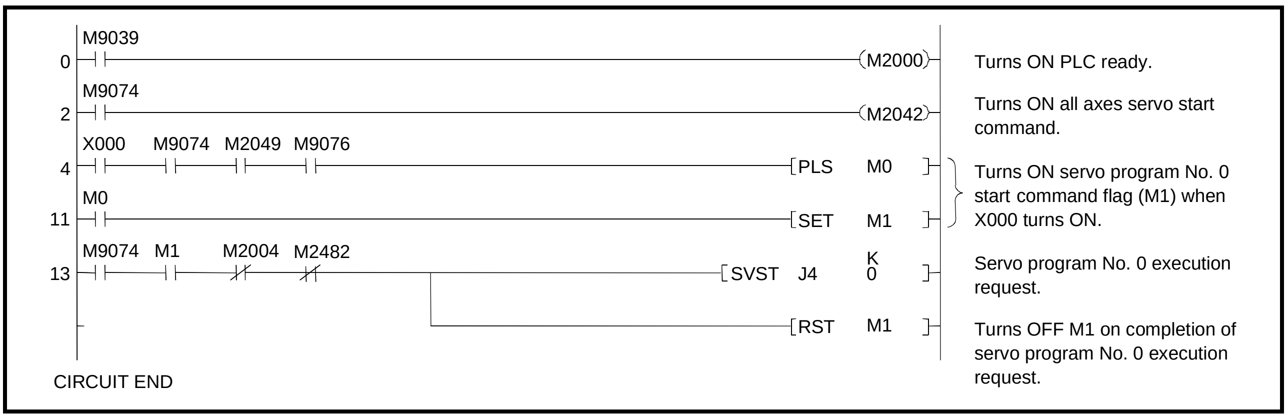
(1) System configuration
Zeroing of Axis 4.



(2) Servo program example
Servo program No. 0 for zeroing is shown below.



(3) Sequence program example
The sequence program which runs the servo program is shown below.



7.22 High-Speed Oscillation

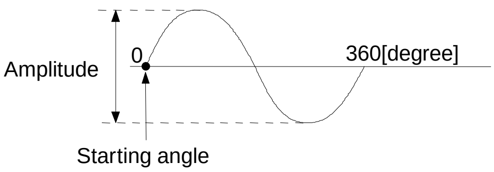
Positioning of a designated axis is

Servo Instruction	Positioning Method	Number of Controllable Axes	Items Set by Peripherals																					Speed Change
			Common							Arc				Parameter Block									Others		
			Parameter Block No.	Axis	Address/Travel Value	Commanded Speed	Dwell Time	M-Code	Torque Limit Value	Auxiliary Point	Radius	Center Point	Number of Pitches	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	Cancel	Start	
OSC	–	1	Δ	○	○	○		Δ											Δ				Δ	Δ	NG

○ : Must be set
Δ : Set if required

[Control details]

The designated axis caused to oscillate on a designated sine wave.
Acceleration/deceleration processing is not performed.



(1) Amplitude
Designate the amplitude of the oscillation in the setting units.
The amplitude can be set in the range 1 to 2147483647.

(2) Starting angle
Set the angle on the sine curve at which oscillation is to start.
The setting range is 0 to 359.9 (degrees)

(3) Frequency
Set how many sine curve cycles occur in one minute.
The setting range is 1 to 5000 (CPM).

POINT

Since acceleration/deceleration processing is not performed, you should set the starting angle to 90 degrees or 270 degrees in order to avoid an abrupt start.

[Notes]

(1) If the amplitude setting is outside the permissible range, the servo program setting error "25" occurs and operation does not start.

(2) If the starting angle setting is outside the permissible range, the servo program setting error "26" occurs and operation does not start.

(3) If the frequency setting is outside the permissible range, the servo program setting error "27" occurs and operation does not start.

(4) After starting, operation is continually repeated until a stop signal is input.

(5) Speed changes during operation are not possible. Attempted speed changes will cause minor error "310".

[Example program]

An example of a program for high-speed oscillation is shown below.

```
<K    6>
OSC
  Axis              1
  Start angle    90.0   [degree]
  Amplitude      1000   [PLS]
  Frequency       100   [CPM]
```

8. AUXILIARY AND APPLIED FUNCTIONS

This section describes the auxiliary and applied functions available for positioning control by the servo system CPU.

(1) Limit switch output function..Section 8.1

(2) M-code output function...Section 8.2

(3) Backlash compensation function ....Section 8.3

(4) Torque limit function...Section 8.4

(5) Electronic gear function..Section 8.5

(6) Absolute positioning system...Section 8.6

(7) Skip function..Section 8.7

(8) Teaching function..Section 8.8

(9) High-speed reading of designated data ....Section 8.9

(10) Servo program cancel/start function ....Section 8.10

(11) Enhanced Current Value Control ....Section 8.11

8.1 Limit Switch Output Function

The limit switch output function allows the A1SY42 output module or AY42 output module to output ON/OFF signals corresponding to the positioning address set for each axis.

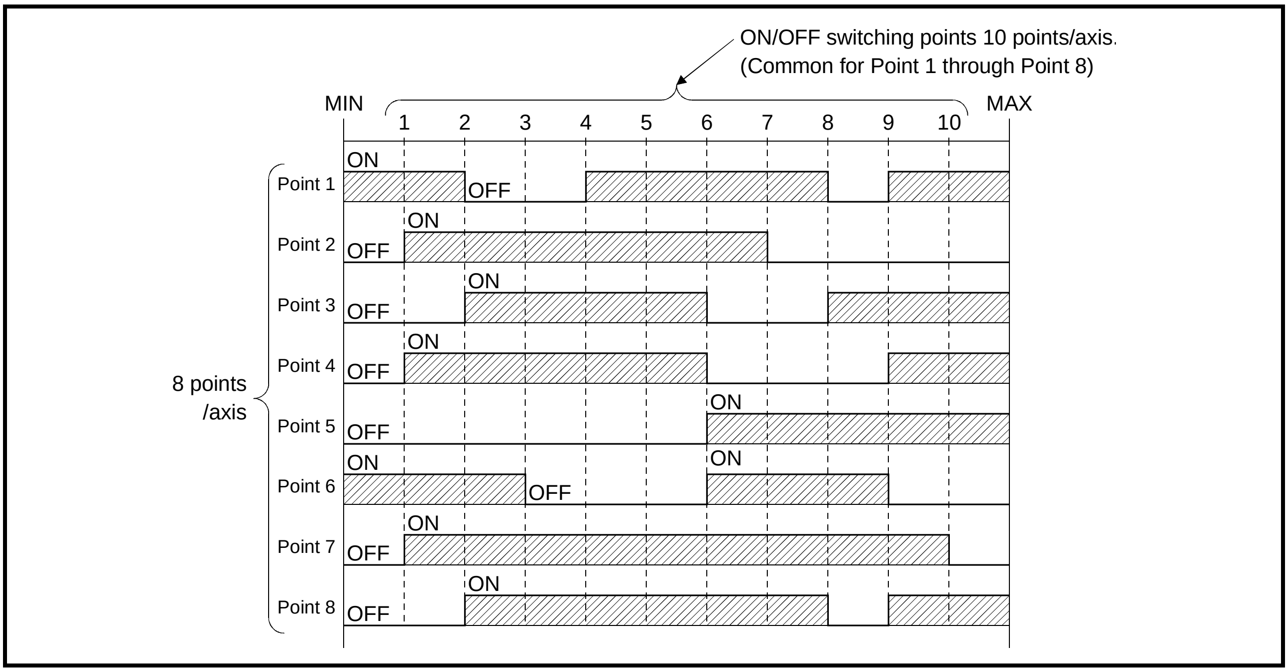
8.1.1 Limit switch output data

Item	Settings		Initial Value	Comments
ON/OFF point setting	• −2147483648 to 2147483647 ($\times 10^{-1}\mu$m, $\times 10^{-5}$inch, PULSE) • 0 to 35999999 (10^{-5}degree)	Units $\times 10^{-1}\mu$m $\times 10^{-5}$inch 10^{-5}degree PLS	0	• Up to 10 points can be set for each axis.

8.1.2 Limit switch output function

[Control Details]

(1) The limit switch function outputs the ON/OFF pattern from the A1SY42/ AY42 at the set addresses.
Before running the limit switch output function, the ON/OFF point addresses and the ON/OFF pattern must be set from a peripheral device.
(Settings cannot be made by the sequence program.)
The number of limit switch outputs per axis and the ON/OFF points are as follows:
(a) Number of limit switch output points .... 8 points/axis, total 256 points
(b) ON/OFF points... 10 points/axis
Set an address in the stroke limit range for each point.



(2) Limit Switch Enable/Disable Setting
The following devices can be used to enable or disable the limit switch output from each axis or each point.

Table 8.1 Limit Switch Enable/Disable Settings

Set Data/Device	Setting Unit	Processing	Set Data Valid Timing
Limit switch output used/not used setting in the fixed parameters.	Axis	Used Set ON/OFF pattern can be output for the appropriate axis. Not Used All outputs OFF for the appropriate axis.	(1) Leading edge of sequencer ready (M2000) (2) When test mode is started
Limit switch output enable signal (M3206 + 20n)	Axis	ON ON/OFF pattern is output for the appropriate axis based on the set ON/OFF pattern and the limit switch output disable setting registers (D760 and D775). OFF All outputs OFF for the appropriate axis.	Limit switch output used/not used setting in the fixed parameters is set to "used."
Limit switch output disable setting registers (D760 and D775)	Point	Disable bit (1) Outputs corresponding to disable bits set to "1" are OFF. Enable bit (0) Outputs corresponding to enable bits set to "0" output an ON/OFF pattern based on the set ON/OFF pattern.	While M3206 + 20n is ON.

REMARK

The data in Table 8.1 is also valid during the test mode set by a peripheral device.

(3) Cautions

(a) The limit switch output is based on the "feed current value" for each axis after sequencer ready (M2000) turns ON and the PCPU ready flag (M9074) is ON.
All points turn OFF when the PCPU ready flag (M9074) turns OFF.

(b) While the PCPU ready flag (M9074) is ON and the feed current value is outside the set stroke limits, the limit switch output is based on M3206 + 20n.
Consequently, the user should apply an interlock to ensure that the sequence program turns M3206 + 20n ON inside the stroke limit range only.

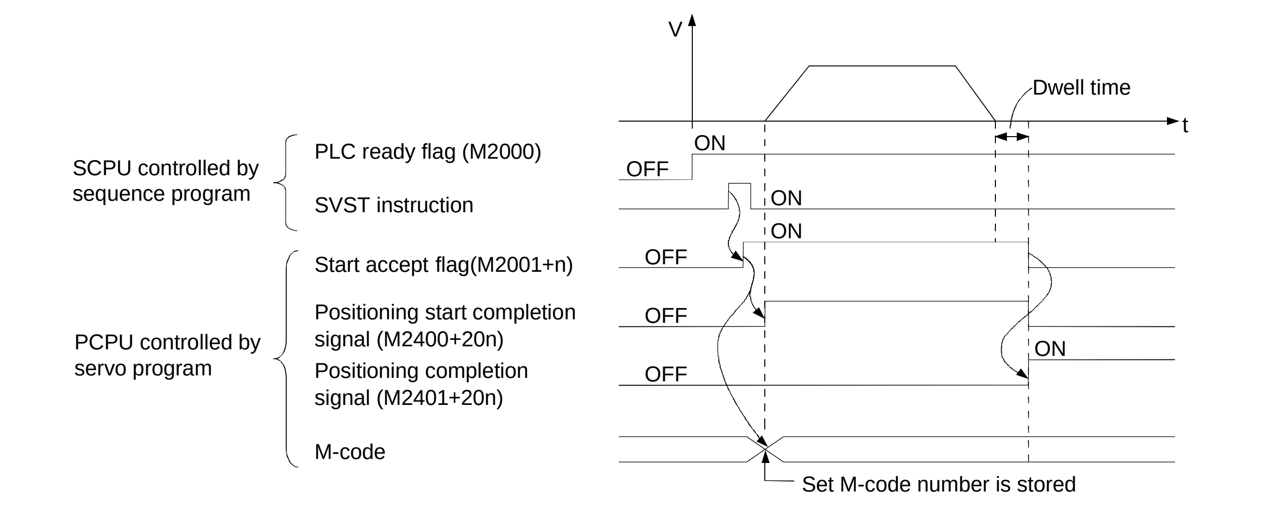
8.2 M-Code Output Function

An M-code is a code number between 0 and 255 which can be set for each positioning control. During positioning control execution, these M-codes are read by the sequence program to check the current servo program and to command auxiliary operations, such as clamping, drill rotation, and tool changing.

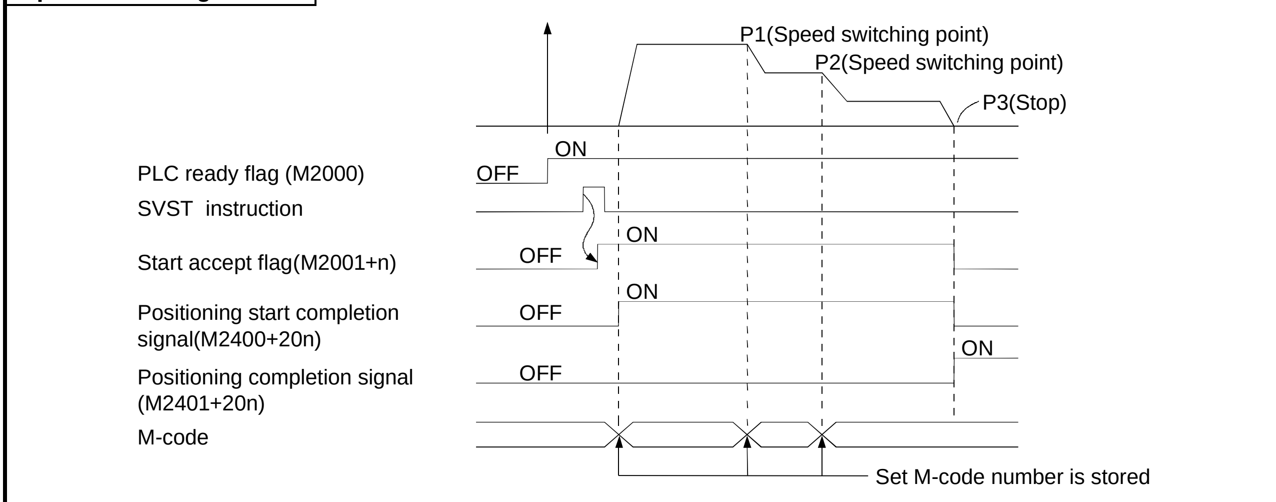
(1) Setting M-codes
The M-code can be set when a servo program is written or modified using a peripheral device. One M-code can be set for each servo program.

(2) M-code storage and read timing
(a) M-codes are stored in the M-code register for the designated axis on positioning start completion and at designated points (speed switching control, constant-speed control).
During interpolation control, the M-code is stored for all axes under interpolation control.
(b) To read an M-code on positioning start completion, use the positioning start completion signal (M2400 + 20n) as the read command.
(c) To read an M-code on positioning completion, use the positioning completion signal (M2400 + 20n) as the read command.

Position control or speed control



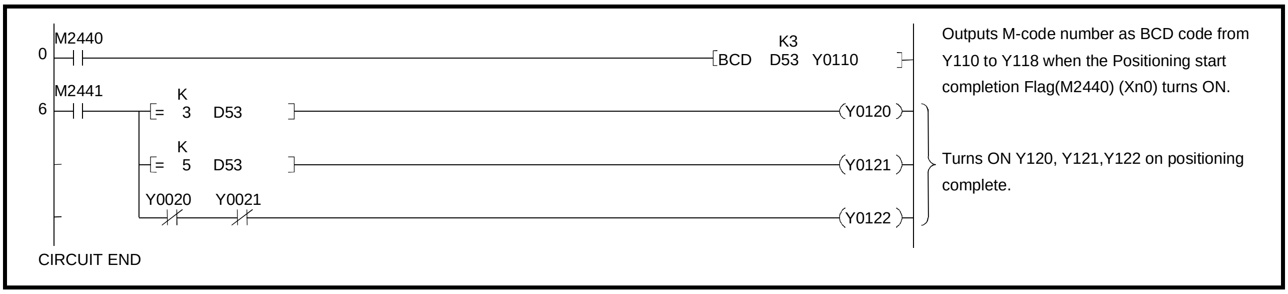
Speed switching control



(3) Resetting M-codes
The M-codes can be reset by clearing the M-code output devices to zero.
Use this method during positioning control to carry out operations unrelated to the servo program, such as when it has been difficult to output the M-code during the previous positioning control.
However, an M-code output from the servo program takes priority over an M-code set for an intermediate point under speed switching control or constant-speed control.

(4) Program example
(a) A sequence program to read M-codes is shown below, using the following conditions.
1) Axis used .... Axis 3
2) Processing on positioning start due to M-code
.... M-code number output as BCD code from Y110 to Y118
3) Processing on positioning completion due to M-code
a) if M-code = 3.............................. turn ON Y120
b) if M-code = 5.............................. turn ON Y121
c) if M-code is not 3 or 5................ turn ON Y122

(b) The sequence program based on the above conditions is shown below.



8.3 Backlash Compensation Function

The backlash compensation function compensates for the backlash amount in the mechanical system. When the backlash compensation amount is set, extra pulses equivalent to the backlash compensation amount are output after a change in travel direction resulting from positioning control, JOG operation, or manual pulse generator operation.

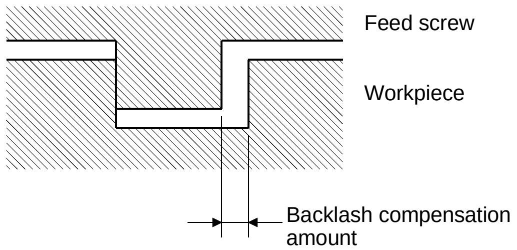


Fig.8.1 Backlash Compensation Amount

(1) Setting the backlash compensation amount
The backlash compensation amount is one of the fixed parameters, and is set for each axis using a peripheral device.
The setting range differs according to whether mm, inch, degree, or pulse units are used, as shown below.

(a) Millimeter units
- 0 to 6553.5
- $0 \leq \dfrac{\text{(Backlash compensation amount)}}{\text{(Travel value per PULSE)}} \leq 65535\text{(PLS)}$

(Decimal fraction rounded down.)

(b) Inch or Degree Units
- 0 to 0.65535
- $0 \leq \dfrac{\text{(Backlash compensation amount)}}{\text{(Travel value per PULSE)}} \leq 65535\text{(PLS)}$

(Decimal fraction rounded down.)

(c) Pulse Units
- 0 to 65535
- $0 \leq \dfrac{\text{(Backlash compensation amount)} \times \text{(PULSES per rotation)}}{\text{(Travel value per rotation)}} \leq 65535\text{(PLS)}$

(Decimal fraction rounded down.)

(2) Backlash compensation processing
The details of backlash compensation processing are shown in the table below.

Table 8.2 Details of Backlash Compensation Processing

Condition	Processing
First motion after power on	• No backlash compensation if travel direction = zeroing direction. • Backlash compensation if travel direction ≠ zeroing direction.
JOG operation start	• Minimum backlash amount on first JOG operation after travel direction change.
Positioning start	• Backlash compensation if travel direction changed.
Manual PULSE generator operation	• If travel direction changed.
Zeroing start	• Backlash compensation amount is valid after zeroing is started.
Absolute position system	• Status stored at power off and applied to absolute position system.

POINTS

(1) The feed pulses equivalent to the backlash compensation amount are not added to the feed current value.
(2) Zeroing is required after the backlash compensation amount is changed. The original backlash compensation amount is retained until zeroing is carried out.

8.4 Torque Limit Function

The torque limit function controls the torque generated by the servomotor within the set range.
The torque is controlled to the set torque limit value if the torque required during positioning control exceeds the set limit value.

(1) Torque limit value set range
Set the torque limit value between 1% and 500% of the rated torque.

(2) How to set the torque limit value
Set the torque limit value using a peripheral device, as described below.

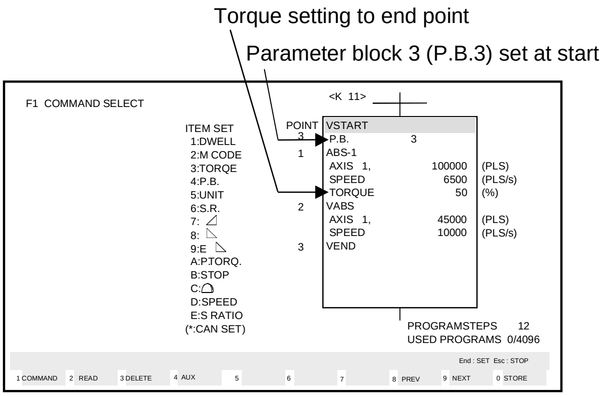
(a) Setting in the Parameter Block (See Section 4.4)
Set the Torque limit value parameter in the parameter block.
Using the servo program to designate which parameter block number is used allows the servomotor torque to be controlled to a torque limit value for any positioning control.

(b) Setting with a Servo Program
Designating the torque limit value with the servo program allows restriction of the servomotor torque to the designated torque limit value during execution of the servo program.

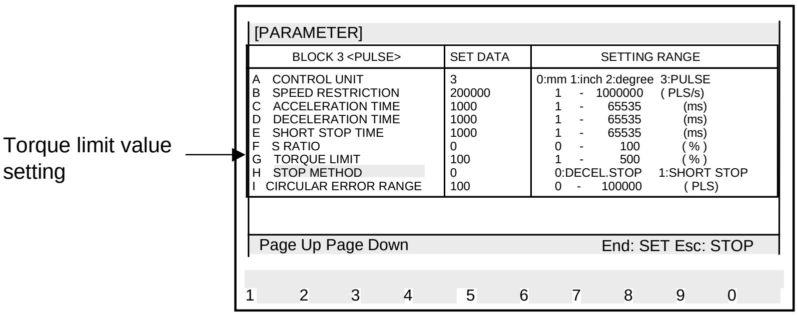
Examples

[Setting the torque limit value for speed switching control (VSTART)]

(1) Servo program



(2) Parameter block



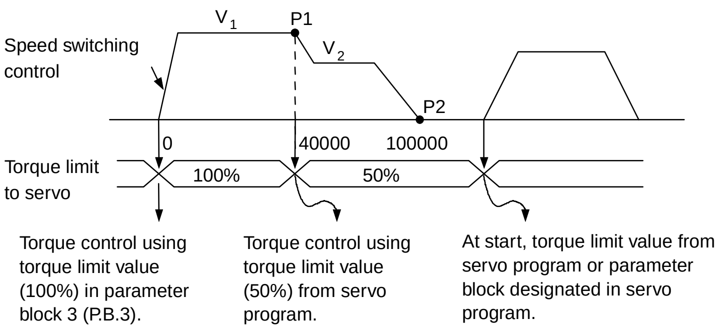
[PARAMETER]

BLOCK 3 <PULSE>	SET DATA	SETTING RANGE
A CONTROL UNIT	3	0:mm 1:inch 2:degree 3:PULSE
B SPEED RESTRICTION	200000	1 - 1000000 (PLS/s)
C ACCELERATION TIME	1000	1 - 65535 (ms)
D DECELERATION TIME	1000	1 - 65535 (ms)
E SHORT STOP TIME	1000	1 - 65535 (ms)
F S RATIO	0	0 - 100 (%)
G TORQUE LIMIT	100	1 - 500 (%)
H STOP METHOD	0	0:DECEL.STOP 1:SHORT STOP
I CIRCULAR ERROR RANGE	100	0 - 100000 (PLS)

Page Up Page Down End: SET Esc: STOP

1 2 3 4 5 6 7 8 9 0

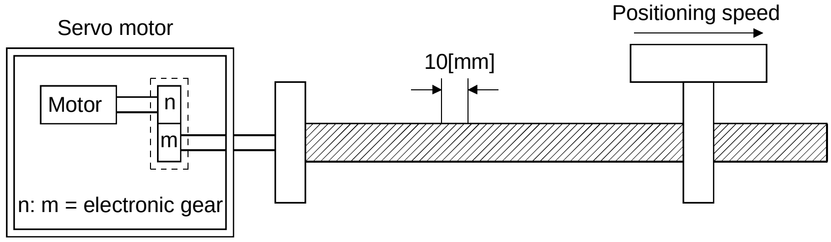
(3) General description of operation



8.5 Electronic Gear Function

The electronic gear function changes the travel value per PULSE.
The electronic gear is set by setting the travel value per PULSE (see Section 4.2.1).
Using the electronic gear function allows positioning control without the need to select the encoder to match the mechanical system.

[Example]



PULSES per motor revolution..............10000 [PLS]
Travel value per motor revolution ....10 mm [mm]

(1) Electronic gear 1:1 (electronic gear setting = 1)

$$\text{Travel value per PULSE} = \frac{\text{Travel value per motor revolution}}{\text{PULSES per motor revolution}} = \frac{10\ [\text{mm}]}{10000\ [\text{PLS}]}$$

$$= 0.001\ [\text{mm/PLS}]$$

Positioning control is executed at the commanded speed.

(2) Electronic gear 2:1 (electronic gear setting = 0.5)

$$\text{Travel value per PULSE} = \frac{\text{Travel value per motor revolution}}{\text{PULSES per motor revolution}} = \frac{5\ [\text{mm}]}{10000\ [\text{PLS}]}$$

$$= 0.0005\ [\text{mm/PLS}]$$

Positioning control is executed faster than the commanded speed.

(3) Electronic gear 1:2 (electronic gear setting = 2)

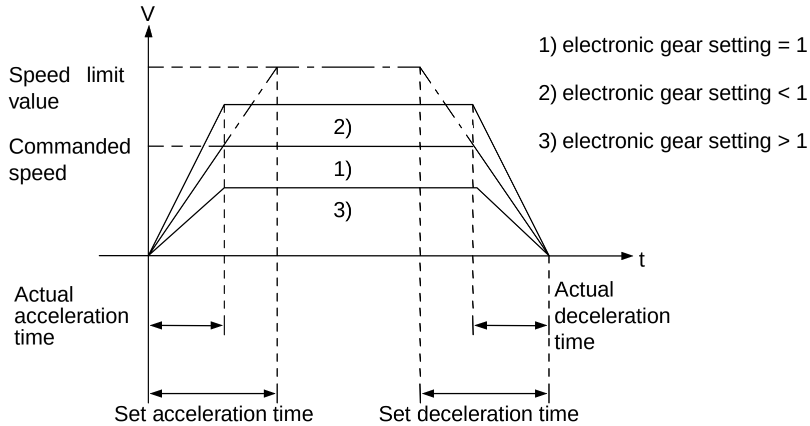
$$\text{Travel value per PULSE} = \frac{\text{Travel value per motor revolution}}{\text{PULSES per motor revolution}} = \frac{20\ [\text{mm}]}{10000\ [\text{PLS}]}$$

$$= 0.002\ [\text{mm/PLS}]$$

Positioning control is executed slower than the commanded speed.

The relationship between the commanded speed (positioning speed set in the servo program) and actual speed (actual positioning speed) is shown below for different electronic gear settings.

- if electronic gear setting = 1, commanded speed = actual speed
- if electronic gear setting < 1, commanded speed < actual speed
- if electronic gear setting > 1, commanded speed > actual speed



The speed limit value, acceleration time, and deceleration time are data from the designated parameter block.

Fig.8.2 Relationship Between Commanded Speed and Actual Speed

8.6 Absolute Positioning System

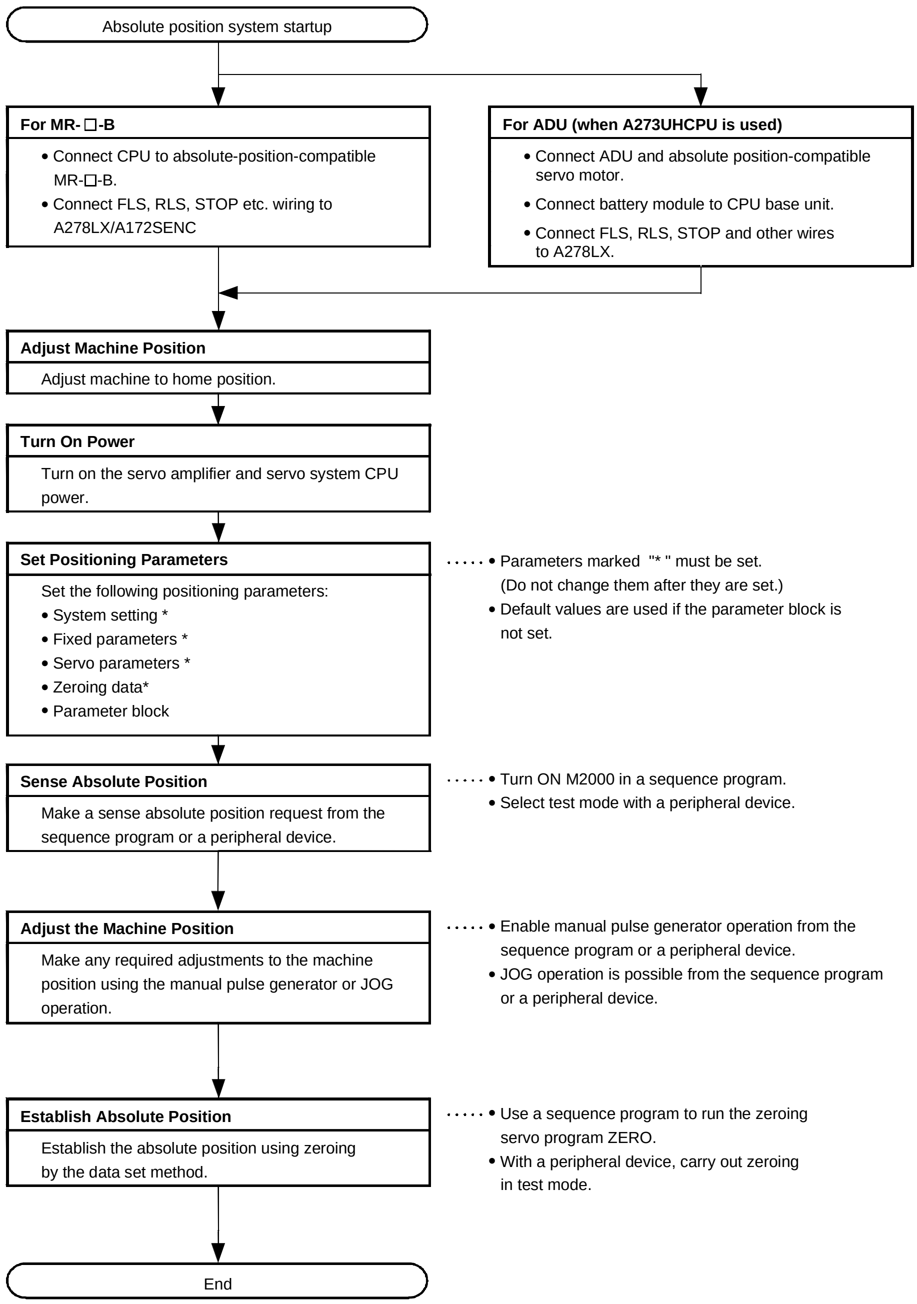
The absolute positioning system can be used for positioning control when using an absolute-position-compatible servomotor and MR-□-B.

Zeroing is not necessary using the absolute positioning system because after the machine position is initially established at system startup, the absolute position is sensed each time the power is turned on.

The machine position is established using a zeroing initiated from the sequence program or a peripheral device.

(1) Absolute position system startup procedure

The system startup procedure is shown below.



(2) In the absolute positioning system, the absolute position may be lost under the following conditions:
Re-establish the absolute position using zeroing or by aligning the machine position and using current value change.

(a) After removing or replacing the battery unit.

(b) On occurrence of a servo battery error (detected at servo amplifier power on).

(c) After the mechanical system is disturbed by a shock.

(3) Power of allowed traveling points can be monitored in the system setting mode of a peripheral device, and the current value history can be monitored in the monitor mode.
(For details on monitoring power of allowed traveling points and the current value history, refer to the operating manual for the peripheral device being used.)

(a) Current value history monitor

1) Month/day/hour/minute
The time when a zeroing is completed or the servo amplifier power is turned ON or OFF is indicated.
In order to display the time correctly, it is necessary to first set the clock data at the programmable controller side, then switch ON M9028 (clock data read request) from the sequence program.

2) Encoder current value
When using MR-H-BN (version BCD-B13W000-B2 or later) , MR-J2S-B(without restriction) or MR-J2-B (version BCD-B20W200-A1 or later), the multiple revolution data and within-one-revolution data read from the encoder is displayed.
(Note): For the encoder current value in the home position data area, the encoder current value when the motor is within the in-position range after completion of a zeroing is displayed (not the encoder value at the home position).

3) Servo command value
The command value issued to the servo amplifier is displayed.

4) Monitor current value
The current value controlled within the servo system CPU is displayed.
(Note) : A value close to the feed current value is displayed, but, since the monitor current value and feed current value are different data, the display of different values does not indicate an error.

5) Alarms
When an error involving resetting of the current value occurs while the servo amplifier power is ON, an error code is displayed. For details of the error, refer to the error contents area (related error list) at the bottom of the screen.

⚠ CAUTION
⚠ After removing or replacing the battery unit, correctly install the new unit and establish the absolute position. ⚠ After a servo battery error occurs, eliminate the cause of the error and ensure operation is safe before establishing the absolute position. ⚠ After the mechanical system is disturbed by a shock, make the necessary checks and repairs, and ensure operation is safe before establishing the absolute position.

POINTS

(1) The address setting range for absolute position system is −2147483648 to 2147483647.
It is not possible to restore position commands that exceed this limit, or current values, after a power interruption.
When performing an infinite feed operation, solve this problem by setting the units to degrees.

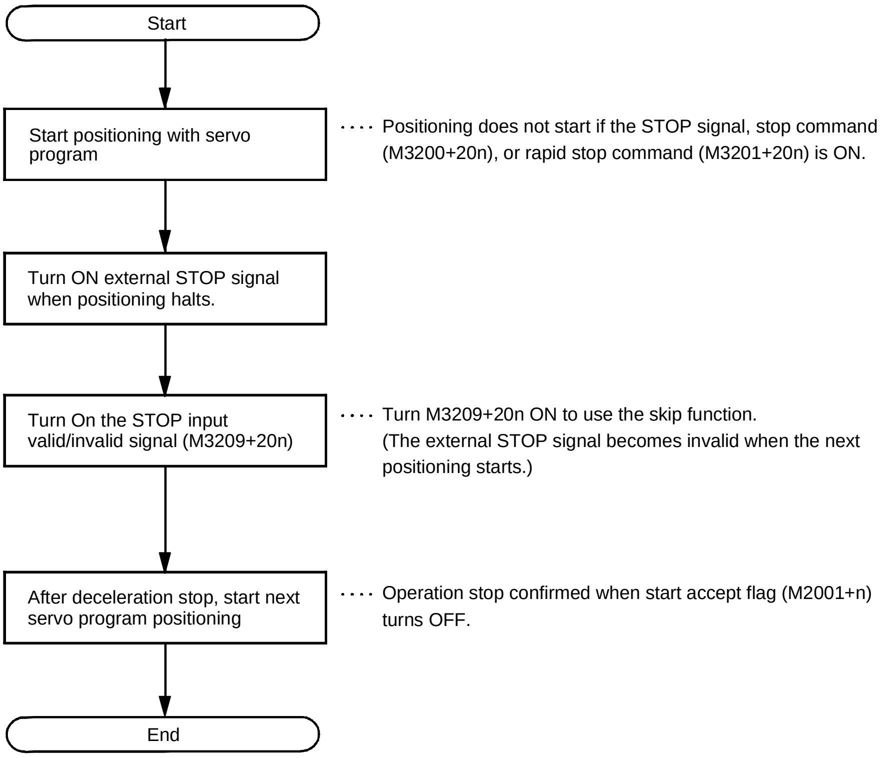
(2) Even when the current value address is changed by a current value change instruction, the restored data for the current value after a power interruption is the value based on the status prior to execution of the current value change instruction.

(3) When zeroing has not been completed, restoration of the current value after a power interruption is not possible.

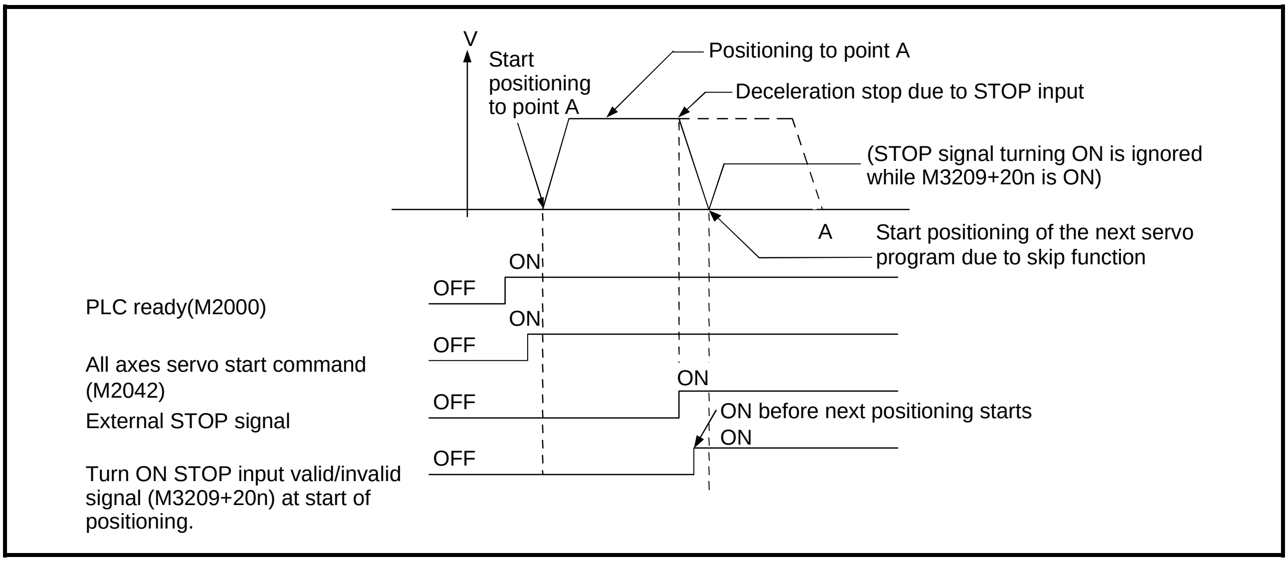
8.7 Skip Function

Based on an external input, the skip function halts the current positioning and executes the next positioning control.
The servo system CPU can run the skip function according to the external STOP signal and the sequence program.

(1) The procedure for using the skip function based on the external STOP signal and the sequence program is shown below.



(2) Operation timing
The operation timing of the skip function is shown in the diagram below.



8.8 Teaching Function

The teaching function allows the operator to teach the servo system CPU when the target position (address) is unknown or to align with an object.

(1) Teaching methods
Two teaching methods are available: "address teaching" and "program teaching."

(a) Address teaching
Writes the current value to the designated program address.
The program must be created before the address teaching method can be used.

(b) Program teaching
Writes the current value to addresses while the program is being created.

(2) For details about teaching, see the A30TU-E Teaching Unit Operating Manual (IB-67277).

8.9 High–Speed Reading of Designated Data

This function stores the designated positioning data in the designated device (D, W) with the signal from an input module mounted on the motion slot of the motion base as the trigger.
It can be set in the system setting of a peripheral device software package.

(1) Positioning data that can be set

Set Data	Number of Words	Unit	Remarks
Position command (feed current value)	2	10^{-1}μm•10^{-5}inch•10^{-5}degree•PLS	
Real current value	2	10^{-1}μm•10^{-5}inch•10^{-5}degree•PLS	
Position droop (deviation counter value)	2	PLS	
M-codes	1	-	
Torque limit value	1	%	
Motor current	1	%	
Motor rpm	2	r/min	
Servo command value	2	PLS	
Virtual servo motor feed current value	2	PLS	
Synchronous encoder current value	2	PLS	Valid in SV22 virtual mode only
Virtual servo M-code	1	-	
Current value after main shaft differential gear	2	PLS	
Current value within one revolution of cam axis	2	PLS	
Executed cam No.	1	-	
Executed stroke amount	2	10^{-1}μm•10^{-5}inch•PLS	
Any address (fixed to 4 bytes)	2	-	

(2) Modules and signals used

Input Module	Signal	Reading Timing	Number of Points Settable
A273EX	TRA	0.8ms	3
A172SENC	TRA		1
Sequencer input module	X device		8

(Note): Only one PLC input module can be used.

8.10 Servo Program Cancel/Start Function

This is a function for stopping a servo program being executed by means of a deceleration stop caused turning the cancel signal ON. When used in combination with "start" (selectable item), this function also allows a designated servo program to be automatically started after a deceleration start.

[Control details]

(1) When the cancel signal is turned ON during execution of a program for which the cancel function has been designated, the positioning processing being executed is suspended, and a deceleration stop is executed.

(2) If "start" has been designated in conjunction with "cancel", after the stop has been executed as described above, the designated servo program is started.

[Data setting]

(1) Cancel signal device
The devices that can be used as cancel signal devices are indicated below.
X, Y, M, TC, TT, CC, CT, B, F

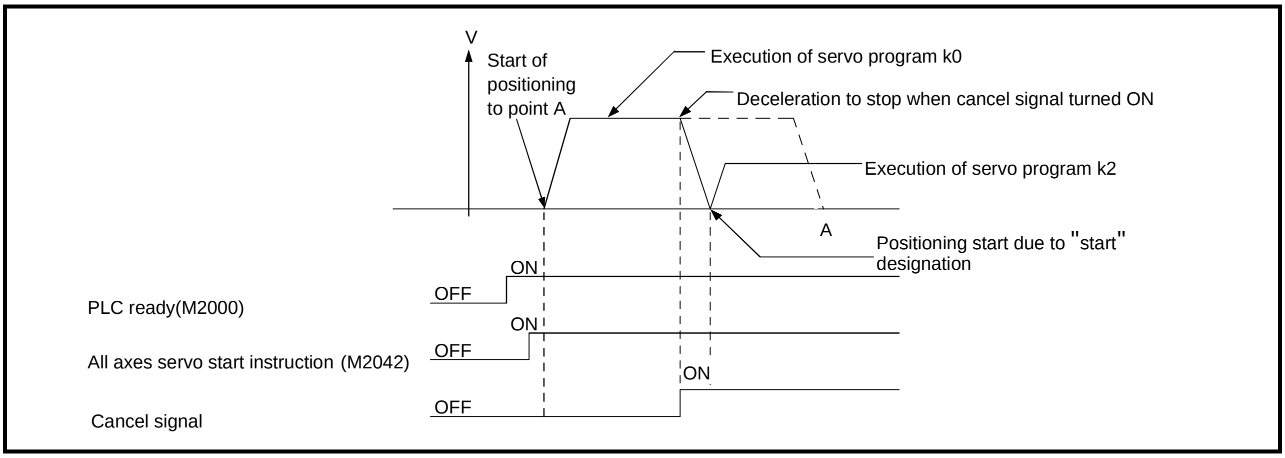
(2) Start (selectable item) setting method
Set by indirect designation (1 word) by using a constant (K) or D, W devices.

[Notes]

(1) Cannot be used with the zeroing instruction (ZERO) or simultaneous start instruction (START).
For details on whether other instructions can be used or not, refer to the servo instruction list (6.2(2)).

(2) If the axes used with a servo program designated by "start" are already in operation and the program cannot be executed, the axes decelerate to a stop and minor error "101" occurs.

[Operation timing]



[Program example]

A program example is shown bellow.

```
<K  0>
ABS-1
Axis   1,            30000
Speed                 5000   <----  Cancel signal … X0000
Cancel               X0000   <----  Start …………… K2
Start                 K  2
```

8.11 Enhanced Current Value Control

The following functions have been added to provide enhanced current value control when the ABS encode is used.

(1) Enhanced functions
  (a) Function for checking the validity of an encoder during operation
  - Checks whether encoder's variance in a 3.5ms time interval is within 180 degrees at the motor axis. (An error is indicated when the variance is not within 180 degrees.)
  - Checks whether encoder data matches feed-back positions managed by the servo amplifier. (An error is indicated when the data does not match the feed-back positions.)

  (b) Current value log monitor for checking the following values with peripheral devices
  - Encoder current value, servo commanded value, and monitor current value at power-on sequence
  - Encoder current value, servo commanded value, and monitor current value at power-off sequence
  - Encoder current value, servo commanded value, and monitor current value at zeroing

  (c) If an allowable travel value is set at power-off sequence, whether encoder data has changed exceeding the setting range at power-off sequence can be checked at servo amplifier power-on sequence. (An error is indicated when the encoder data has exceeded the setting range.)

(2) Restrictions on the combinations of positioning operating systems and positioning software packages
There are the following restrictions depending on whether the permissible travel value during power-off has been set or not.

<table>
<tr><th rowspan="2">Positioning OS Ver.</th><th>Positioning Software Package Ver.</th><th rowspan="2">Restrictions</th></tr>
<tr><th>PC/AT compatible</th></tr>
<tr><td rowspan="2">V or later</td><td>R or later (Note-1)</td><td>There are no restrictions. (When the old version of the positioning OS was removed and a new version installed, always perform a zeroing.)</td></tr>
<tr><td>Q or earlier (Note-2)</td><td>• Current value log monitor is disabled.
• Since the permissible travel value during power-off cannot be set, a minor error (error code: 901) occurs at power-on of the servo amplifier. (Note-3) (When the old version of the positioning OS was removed and a new version installed, always perform a zeroing.)</td></tr>
<tr><td rowspan="2">U or earlier</td><td>R or later (Note-1)</td><td rowspan="2">All enhanced function items are unusable.</td></tr>
<tr><td>Q or earlier (Note-2)</td></tr>
</table>

(Note-1): Permissible travel value during power-off can be set.
(Note-2): Permissible travel value during power-off cannot be set.
(Note-3): Since the permissible travel value during power-off cannot be set on the old version of the positioning software package, a minor error is displayed but it has no operational problem.

(3) Restrictions on the servo amplifiers
When the positioning operating system version V or later is used, there are the following restrictions on the combinations of the servo amplifiers and positioning software packages.

<table>
<tr><th rowspan="2">Servo Amplifier</th><th>Positioning Software Package Ver.</th><th rowspan="2">Restrictions</th></tr>
<tr><th>PC/AT compatible</th></tr>
<tr><td rowspan="2">MR-H-BN : BCD-B13W000-B2 or later
MR-J2-B : BCD-B20W200-A1 or later
MR-J2S-B : All models</td><td>R or later</td><td>There are no restrictions.</td></tr>
<tr><td>Q or earlier</td><td>Only (a) of the enhanced function items applies.</td></tr>
<tr><td rowspan="2">MR-H-BN : BCD-B13W000-B1 or earlier
MR-J2-B : BCD-B20W200-A0 or earlier
ADU : All models (when A273UHCPU is used)</td><td>R or later</td><td>Only (c) of the enhanced function items applies. (However, (b) is applicable to monitoring of other than the encoder current value.)</td></tr>
<tr><td>Q or earlier</td><td>All enhanced function items are unusable.</td></tr>
</table>

APPENDICES

APPENDIX1 SCPU ERROR CODE LIST

If an error occurs when the PLC is switched to the RUN status or is in the RUN status, the error indication and error code (including the step number) are stored in a special register by the self-diagnosis function. When an error occurs, refer to Table 1.1 for its cause and the corrective action to take.
Eliminate the cause of the error by taking the appropriate corrective action.
Error codes can be read at a peripheral device; for details on the relevant operation, see the Operating Manual for the peripheral device.

⚠ CAUTION
⚠ When an error occurs, check the points stated in this manual and reset the error.

1.1 SCPU Error Code List

The list presented below gives the error numbers, and the error contents, causes, and corrective actions for each error message.

Table 1.1 Error Code List

Error Message (When an A273UHCPU (8/32 Axes Specification) Is Used)	Contents of Special Register D9008 (BIN Value)	CPU Status	Error Contents and Cause	Corrective Action
"INSTRCT.CODE ERR" (When an instruction is executed.)	10	Stopped	An instruction code that cannot be decoded has been included in the program. (1) A ROM which includes undecodable instruction codes has been installed. (2) The memory contents have changed for some reason and now include an undecodable instruction code.	(1) Read the error step with a peripheral device, and correct the program at that step. (2) If the ROM is the problem, either rewrite its contents or replace it with a ROM into which the correct contents have been written.
"PARAMETER ERROR" (On switching on the power or resetting. On switching from {STOP / PAUSE} to {RUN / STEP RUN})	11	Stopped	The parameter data in the CPU's memory has been changed due to noise or incorrect installation of the memory.	(1) Check the installation of the memory and install it correctly. (2) Read the parameter data of the CPU memory at a peripheral device, check the data, correct it, and write the corrected data back into the memory.
"MISSING END INS." (When M9056 or M9057 is ON. On switching from {STOP / PAUSE} to {RUN / STEP RUN})	12	Stopped	(1) There is no END (FEND) instruction in the program. (2) When a subprogram is set in the parameters, there is no END instruction in the subprogram.	(1) Write an END instruction at the end of the program.
"CAN'T EXECUTE (P)" (When a CJ/SCJ/JMP/CALL(P)/ FOR-NEXT instruction is executed. On switching from {STOP / PAUSE} to {RUN / STEP RUN})	13	Stopped	(1) The jump destination designated with a CJ/SCJ/CALL/CALLP/JMP instruction does not exist, or more than one exists. (2) There is a CHG instruction but no subprogram is set. (3) Although there is no CALL instruction, there is a RET instruction in the program and is has been executed. (4) A CJ/SCJ/CALL/CALLP/JMP instruction whose jump destination is at or beyond the END instruction has been executed. (5) The number of FOR instructions does not match the number of NEXT instructions. (6) A JMP instruction has been included between a FOR and NEXT command, exiting the FOR - NEXT sequence. (7) The subroutine has been exited by execution of a JMP instruction before execution of a RET instruction. (8) Execution of a JMP instruction has caused a jump into a step in a FOR - NEXT range, or into a subroutine.	(1) Read the error step with a peripheral device, and correct the program at that step.(Correct, for example, by inserting a jump destination, or making sure there is only one jump destination.)

Table 1.1 Error Code List (Continued)

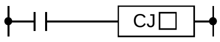
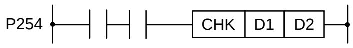
Error Message	Contents of Special Register D9008 (BIN Value)	CPU Status	Error Contents and Cause	Corrective Action
"CHK FORMAT ERR." On switching from STOP / PAUSE to RUN / STEP RUN	14	Stopped	(1) An instruction other than an LDX, LDIX, ANDX, or ANIX instruction (including NOP) has been included in the same ladder block as a CHK instruction. (2) More than one CHK instruction exists. (3) The number of contacts in a CHK instruction ladder block exceeds 150. (4) The device number of an X device in a CHK instruction ladder block exceeds X1FFE. (5) The following ladder block  has not been inserted before the CHK instruction ladder block. (6) The D1 device (number) of a CHK D1 D2 instruction is not the same as the device (number) of the contact before the CJ□ instruction. (7) The pointer P254 is not appended at the head of a CHK instruction ladder block. 	(1) Check if any of items (1) to (6) in the column to the left apply to the program with the CHK instruction ladder block, correct any problem in the program with a peripheral device, then restart program operation. (2) This error code is only valid when the I/O control method used is the direct method.
"CAN'T EXECUTE (I)" When an interruption occurs. On switching from STOP / PAUSE to RUN / STEP RUN	15	Stopped	(1) An interrupt module is used but there is no number for the corresponding interrupt pointer I in the program. Or, more than one exists. (2) There is no IRET instruction in the interrupt program. (3) There is an IRET instruction other than in the interrupt program.	(1) Check the whether or not an interrupt program corresponding to the interrupt module exists and either create an interrupt program or eliminate the duplicated I number. (2) Check if there is an IRET instruction in the interrupt program: if there is not, insert one. (3) Check if there is an IRET instruction other than in the interrupt program: if there is, delete it.
"CASSETTE ERROR" (On switching on the power or resetting.)	16	Stopped	No memory cassette is installed.	Install a memory cassette and reset.
"RAM ERROR" On switching on the power or resetting. When M9084 is turned ON in the STOP status.	20	Stopped	(1) On checking if data can be read from and written to the CPU data memory area normally, it is determined that one or both are not possible.	There is a hardware fault. Contact your system service, agent, or office, and explain the problem.
"OPE.CIRCUIT ERR." (On switching on the power or resetting.)	21	Stopped	(1) The operation circuit that executes sequence processing in the CPU does not operate normally.	
"WDT ERROR" (At any time)	22	Stopped	The scan time has exceeded the watchdog error monitor time. (1) The user program scan time has been exceeded due to the conditions. (2) A momentary power interruption has occurred during scanning, extending the scan time.	(1) Calculate and check the scan time for the user program and shorten the scan time, e.g. by using a CJ instruction. (2) Monitor the contents of special register D9005 with a peripheral device. If the contents are other than "0" the power supply voltage is unstable: in this case check the power supply and reduce voltage fluctuation.
"END NOT EXECUTE" (When END processing is executed.)”	24	Stopped	(1) When the END instruction is executed it is read as another instruction code, e.g. due to noise. (2) The END instruction has been changed to another instruction code somehow.	(1) Reset and establish the RUN status again.If the same error is displayed again, the cause is a CPU hardware error. Contact your system service, agent, or office, and explain the problem.
"WDT ERROR" (At any time)	25	Stopped	A loop has been established for execution of the sequence program, due for example to a CJ instruction, and the END instruction cannot be executed.	Check if any program will be run in an endless loop: if there is such a program, modify the program.

Table 1.1 CPU Error Code List (Continued)

Error Message	Contents of Special Register D9008 (BIN Value)	CPU Status	Error Contents and Cause	Corrective Action
"UNIT VERIFY ERR." [When an END instruction is executed. [However, no check is performed when M9084 or M9094 is ON.]]	31	Stopped (RUN)	The I/O information does not match a loaded module when the power is switched ON. (1) An I/O module (this includes special function modules) is loose, or has become detached, during operation. Or, a completely different module has been loaded.	(1) The bit in special registers D9116 to D9123 that corresponds to the module for which the verification error occurred will be set to "1": check for the module whose bit is set to "1" by monitoring these registers with a peripheral device and replace that module. (2) If the current arrangement of loaded modules is acceptable, reset with the reset switch.
"FUSE BREAK OFF" [When an END instruction is executed. [However, no check is performed when M9084 or M9094 ON.]]	32	RUN (Stopped)	There is an output module with a blown fuse.	(1) Check the blown fuse indicator LEDs of the output modules and replace the fuse of the module whose indicator LED is lit. (2) Modules with blown fuses can also be detected by using a peripheral device. The bit in special registers D9100 to D9107 that corresponds a module whose fuse has blown will be set to "1": monitor these registers to check.
"CONTROL-BUS ERR." [When FROM, TO instruction are executed. On switching on the power or resetting. On switching from {STOP PAUSE} to {RUN STEP RUN}]	40	Stopped	FROM, TO instructions cannot be executed. (1) Fault in the control bus to the special function module.	(1) There is a hardware fault of the special function module, CPU module, or base unit: replace each module/unit to find the defective one. Contact your system service, agent, or office, and explain the problem with the defective module/unit.
"SP.UNIT DOWN" [When FROM, TO instruction are executed. On switching on the power or resetting. On switching from {STOP PAUSE} to {RUN STEP RUN}]	41	Stopped	On execution of a FROM, TO instruction, a special function module was accessed but no response was received. (1) The accessed special function module is faulty.	There is a hardware fault in the accessed special function module: contact your system service, agent, or office, and explain the problem.
"LINK UNIT ERROR" [On switching on the power or resetting. On switching from {STOP PAUSE} to {RUN STEP RUN}]	42	Stopped	(1) A data link module for use with MELSECNET has been loaded at the master station.	(1) Remove the data link module for MELSECNET from the master station. After making this correction, reset and start operation from the initial status.
"I/O INT.ERROR" (When an interruption occurs.)	43	Stopped	An interruption has occurred although there is no interrupt module.	(1) There is a hardware fault in one of the modules: replace each module in turn to determine which one is defective. Contact your system service, agent, or office, and explain the problem with the defective module.
"SP.UNIT LAY.ERR." [On switching on the power or resetting. On switching from {STOP PAUSE} to {RUN STEP RUN}]	44	Stopped	(1) Three or more computer link modules have been installed for one CPU module. (2) Two or more data link modules for MELSECNET have been installed. (3) Two or more interrupt modules have been installed. (4) In the parameter settings made at a peripheral device, an allocation for a special function module has been made where there is in fact an I/O module, or vice versa.	(1) Do not install more than two computer link modules. (2) Do not install more than one data link module for MELSECNET. (3) Install only one interrupt module. (4) Re-set the I/O allocations in the parameter settings made at the peripheral device so that they agree with the loaded modules.

Table 1.1 CPU Error Code List (Continued)

Error Message	Contents of Special Register D9008 (BIN Value)	CPU Status	Error Contents and Cause	Corrective Action
"SP.UNIT ERROR" (When a FROM, TO instruction is executed)	46	Stopped (RUN)	(1) A location where there is no special function module has been accessed (when the FROM, TO instruction was executed).	(1) Read the error step using a peripheral device, check the contents of the FROM, TO instruction at that step, and correct it using the peripheral device.
"LINK PARA.ERROR" (On switching on the power or resetting. On switching from {STOP / PAUSE} to {RUN / STEP RUN})	47	RUN	(1) The data written to the link parameter area when link range settings are made by parameter setting at a peripheral device differ for some reason from the parameter data read by the CPU. (2) The setting for the total number of slave stations is "0".	(1) Write the parameters again and check. (2) If the error is displayed again, there is a hardware fault. Contact your nearest Mitsubishi service center, agent, or office, and explain the problem.
"OPERATION ERROR" (When a command is executed)	50	RUN (Stopped)	(1) The result of BCD conversion is outside the stipulated range (max. 9999 or 99999999). (2) A setting exceeding the stipulated device range has been made and operation is therefore impossible. (3) A file register has been used in the program without having made a file register capacity setting.	(1) Read the error step with a peripheral device, and correct the program at that step. (Check the device setting range, BCD conversion value, etc.)
"BATTERY ERROR" (At any time (However, no check is performed when M9084 is ON.))	70	RUN	(1) The battery voltage has fallen below the stipulated value. (2) The battery's lead connector has not been installed.	(1) Replace the battery. (2) If the battery is used to back up the RAM memory or to retain memory contents during momentary power interruptions, install a lead connector.

APPENDIX2 ERROR CODES STORED BY THE PCPU

The errors that are detected at the PCPU are servo program setting errors and positioning errors.

(1) Servo program setting errors

Servo program setting errors are errors in the positioning data set in the servo program and are checked for when a servo program is started.
They are errors that occur when the positioning data is designated indirectly.
When a servo program setting error occurs, the following happens:

- The servo program setting error flag (M9079) comes ON.
- The program number of the program in which the error occurred is stored in the error program No. register (D9189).
- The error code is stored in the error item information register (D9190).

(2) Positioning error

(a) Positioning errors are errors that occur when positioning starts or during positioning: they are classified into minor errors, major errors, and servo errors.

1) Minor errors............. These are errors generated by sequence programs or servo programs; they are assigned error codes 1 to 999.
The cause of minor errors can be eliminated by checking the error code and correcting the sequence program or servo program.

2) Major error.............. These are errors generated by external input signals or control commands from the SCPU; they are assigned error codes 1000 to 1999.
When a major error occurs, check the error code and eliminate the error cause in the external input signal status or sequence program.

3) Servo error .... These are errors detected by the servo amplifier; they are assigned error codes 2000 to 2999.
When a servo error occurs, check the error code and eliminate the error cause at the servo side.

(b) When an error occurs, the error detection signal for the relevant axis comes ON, and the error code is stored in the minor error code, major error code, or servo error code register.

Table 2.1 Error Code Registers, Error Detection Flags

Device / Error Category	Error Code Storage Register																Error Detection Signal
	Axis 1	Axis 2	Axis 3	Axis 4	Axis 5	Axis 6	Axis 7	Axis 8	Axis 9	Axis 10	Axis 11	Axis 12	Axis 13	Axis 14	Axis 15	Axis 16	
Minor error	D6	D26	D46	D66	D86	D106	D126	D146	D166	D186	D206	D226	D246	D266	D286	D306	M2407+20n
Major error	D7	D27	D47	D67	D87	D107	D127	D147	D167	D187	D207	D227	D247	D267	D287	D307	
Servo error	D8	D28	D48	D68	D88	D108	D128	D148	D168	D188	D208	D228	D248	D268	D288	D308	M2408+20n

Device / Error Category	Error Code Storage Register																Error Detection Signal
	Axis 17	Axis 18	Axis 19	Axis 20	Axis 21	Axis 22	Axis 23	Axis 24	Axis 25	Axis 26	Axis 27	Axis 28	Axis 29	Axis 30	Axis 31	Axis 32	
Minor error	D326	D346	D366	D386	D406	D426	D446	D466	D486	D506	D526	D546	D566	D586	D606	D626	M2407+20n
Major error	D327	D347	D367	D387	D407	D427	D447	D467	D487	D507	D527	D547	D567	D587	D607	D627	
Servo error	D328	D348	D368	D388	D408	D428	D448	D468	D488	D508	D528	D548	D568	D588	D608	D628	M2408+20n

(c) If another error occurs after an error code has been stored, the existing error code is overwritten, deleting it.
However, it is possible to check the history of error occurrence by using a peripheral device started up with the GSV13PE/GSV22PE software.

(d) Error detection flags and error codes are latched until the error code reset signal (M3207+20n) or servo error reset signal (M3208+20n) comes ON.

POINTS

(1) When some servo errors occur, the same error code will be stored again even if the servo error reset signal (M3208+20n: ON) is issued.

(2) When a servo error occurs, reset the servo error after first eliminating the error cause at the servo side.

2.1 Servo Program Setting Errors (Stored in D9190)

The error codes, error contents, and corrective actions for servo program setting errors are shown in Table 2.2. The "∗" in error codes marked with an asterisk indicates the axis number (1 to 32).

Table 2.2 Servo Program Setting Error List

<table>
<tr><th>Error Code Stored in D9190</th><th>Error Name</th><th>Error Contents</th><th>Error Processing</th><th>Corrective Action</th></tr>
<tr><td>1</td><td>Parameter Block number Setting error</td><td>The designated parameter block number is outside the range 1 to 64.</td><td>The servo program is executed with the parameter block number set to the default value of "1".</td><td>Designate the parameter block number in the range 1 to 64.</td></tr>
<tr><td rowspan="2">n03*</td><td rowspan="2">Address/travel value setting error (Excluding speed control and speed/position switching control)</td><td>(1) An address outside the designated range is set when executing absolute positioning control.<table><tr><th>Unite</th><th colspan="2">Address Setting Range</th></tr><tr><td>degree</td><td>1 to 35999999</td><td>$\times 10^{-5}$degree</td></tr></table></td><td rowspan="2">(1) Axis motion does not start. (When executing interpolation control, none of the interpolation control axis start.)
(2) If the error is detected during speed switching control or constant-speed control, a deceleration stop is executed.
(3) When multiple servo programs are to be executed simultaneously, if an error occurs in one servo program none of the programs are executed.</td><td>(1) If the control unit is degrees, set the address in the range 0 to 35999999.</td></tr>
<tr><td>(2) The travel value is set to –2147483648 (H80000000) when executing incremental positioning control.</td><td>(2) Set the travel value in the range 0 to $\pm(2^{31}-1)$.</td></tr>
<tr><td rowspan="2">4</td><td rowspan="2">Commanded speed error</td><td>(1) The commanded speed is set outside the range of 1 to the speed limit value.</td><td rowspan="2">(1) The axis does not start if the commanded speed is set at “0” or less.
(2) If the set commanded speed exceeds the speed limit value, control is executed at the speed limit value.</td><td rowspan="2">(1) Set the commanded speed in the range from 1 to the speed limit value.</td></tr>
<tr><td>(2) The designation for the commanded speed is outside the applicable range.<table><tr><th>Unite</th><th colspan="2">Address Setting Range</th></tr><tr><td>mm</td><td>1 to 600000000</td><td>$\times 10^{-2}$mm/min</td></tr><tr><td>inch</td><td>1 to 600000000</td><td>$\times 10^{-3}$inch/min</td></tr><tr><td>degree</td><td>1 to 600000000</td><td>$\times 10^{-3}$degree/min</td></tr><tr><td>PULSE</td><td>1 to 1000000</td><td>PLS/s</td></tr></table></td></tr>
<tr><td>5</td><td>Dwell time setting error</td><td>The dwell time is set outside the range 0 to 5000.</td><td>Control is executed using the default value of "0".</td><td>Set the dwell time in the range from 0 to 5000.</td></tr>
<tr><td>6</td><td>M-code setting error</td><td>The M-code is set outside the range 0 to 255.</td><td>Control is executed using the default value of "0".</td><td>Set the M-code in the range from 0 to 255.</td></tr>
<tr><td>7</td><td>Torque limit value setting error</td><td>The torque limit value is set outside the range 1 to 500.</td><td>Control is executed using the torque limit value set in the designated parameter block.</td><td>Set the torque limit value in the range from 1 to 500.</td></tr>
<tr><td rowspan="2">n08*</td><td rowspan="2">Auxiliary point setting error (when executing circular interpolation by designating an auxiliary point)</td><td>(1) An address outside the designated range is set when executing absolute positioning control.<table><tr><th>Unite</th><th colspan="2">Address Setting Range</th></tr><tr><td>degree</td><td>1 to 35999999</td><td>$\times 10^{-5}$degree</td></tr></table></td><td rowspan="2">Positioning control does not start.</td><td>(1) If the control unit is degrees, set the address in the range 0 to 35999999.</td></tr>
<tr><td>(2) The auxiliary point address is set to –2147483648 (H80000000) when executing incremental positioning control.</td><td>(2) Set the travel value in the range 0 to ±2147483647.</td></tr>
<tr><td rowspan="4">n09*</td><td rowspan="4">Radius setting error (when executing circular interpolation by designating a radius)</td><td>(1) An address outside the applicable range is set when executing absolute positioning control.<table><tr><th>Unite</th><th colspan="2">Address Setting Range</th></tr><tr><td>degree</td><td>1 to 35999999</td><td>$\times 10^{-5}$degree</td></tr></table></td><td rowspan="4">Positioning control does not start.</td><td>(1) If the control unit is degrees, set the address in the range 0 to 35999999.</td></tr>
<tr><td>(2) The radius is set to –2147483648 (H80000000) when executing incremental positioning control.</td><td>(2) Set the travel value in the range 0 to ±2147483647.</td></tr>
<tr><td>(3) The start point is also the end point.</td><td>(3) Set the start and end points so that they are not equal to each another.</td></tr>
<tr><td>(4) The distance between the start and end points is greater than the radius.</td><td>(4)Change the relationship between the start-to-end point distance (L) and the radius (R) so that it conforms with the following equation:
$\frac{L}{2R} \leq 1$</td></tr>
</table>

Table 2.2 Servo Program Setting Error List (Continued)

Error Code Stored in D9190	Error Name	Error Contents	Error Processing	Corrective Action
n10*	Center point setting error (when executing circular interpolation by designating a center point)	(1) An address outside the applicable range is set when executing absolute positioning control. Unite | Address Setting Range degree | 1 to 35999999 | $\times 10^{-5}$degree	Positioning control does not start.	(1) If the control unit is degrees, set the address in the range 0 to 35999999.
		(2) The center point is set to –2147483648 (H80000000) when executing incremental positioning control.		(2) Set the travel value in the range 0 to ±2147483647.
11	Interpolation control unit setting error	The interpolation control unit is set outside the range 0 to 3.	Control is executed at the default value of "3".	Set the interpolation control unit in the range 0 to 3.
12	Speed limit value setting error	The speed limit value is set outside the applicable range.	Control is executed at the default value of 200000 PLS/s.	Set the speed limit value in the specified range.
13	Acceleration time setting error	The acceleration time is set to "0".	Control is executed at the default value of 1000.	Set the acceleration time in the range 1 to 65535.
	FIN acceleration/ deceleration setting error	FIN acceleration/deceleration setting is other than 1 to 5000.		Set FIN acceleration/deceleration within range 1 to 5000.
14	Deceleration time setting error	The deceleration time is set to "0".		Set the deceleration time in the range 1 to 65535.
15	Rapid stop deceleration time setting error	The rapid stop deceleration time is set to "0".		Set the rapid stop deceleration time in the range 1 to 65535.
16	Torque limit value setting error	The torque limit value is set outside the range 1 to 500.	Control is executed at the default value of 300%.	Set the torque limit value in the range 1 to 500.
17	Allowable error range for circular interpolation setting error	The allowable error range for circular interpolation is set outside the applicable range. Unite | Address Setting Range mm | 1 to 100000 | $\times 10^{-1}$ μm inch | 1 to 100000 | $\times 10^{-5}$inch degree | 1 to 100000 | $\times 10^{-5}$degree PULSE | 1 to 100000 | PLS	Control is executed at the default value (100PLS).	Set the allowable error range for circular interpolation in the applicable range.
18	Repeat count error	The repeat count is set outside the range 1 to 32767.	Control is executed with the repeat count set to "1".	Set the repeat count in the range 1 to 32767.
19	START instruction setting error	(1) The servo program designated by the START instruction does not exist.	Positioning control does not start.	(1) Create a servo program designated by the START instruction.
		(2) There is a START instruction in the designated servo program.		(2) Delete the servo program containing the START instruction.
		(3) More than one axis has been designated for the started servo program.		(3) Do not designate more than one axis.
20	Point setting error	No point has been designated in the instruction for constant-speed control.	Positioning control does not start.	Designate a point between CPSTART and CPEND.
21	Reference axis speed setting error	In linear interpolation using the reference axis speed designation method, an axis not involved in the interpolation has been designated as the reference axis.	Positioning control does not start.	Set one of the axes involved in the interpolation as the reference axis.
22	S-curve ratio setting error	The S-curve ratio when designating S-curve acceleration/deceleration is outside the range 0 to 100%.	Control is executed with an S-curve ratio of 100%.	Set the S-curve ratio within the range 0 to 100%.
23	VSTART setting error	Not even one speed-switching point has been set between a VSTART and VEND instruction, or between a FOR and NEXT instruction.	Positioning control does not start.	Set a speed switching point between the VSTART and VEND instructions or the FOR and NEXT instructions.
24	Cancel function start program No. error	The start program No. for the cancel function has been set outside the range 0 to 4095.	Positioning control does not start.	Set the start program No. within the range 0 to 4095 and then start.
25	High-Speed oscillation command amplitude error	Operation cannot be started because the amplitude commanded for the high-speed oscillation function is outside the range 1 to 2147483647.	Positioning control does not start.	Set the commanded amplitude within the range 1 to 214783647 and then start.
26	High-Speed oscillation command starting angle error	Operation cannot be started because the commanded starting angle for the high-speed oscillation function is outside the range 0 to 3599 (×0.1 degrees).	Positioning control does not start.	Set the starting angle within the range 0 to 3599 (× 0.1 degree) and then start.
27	High-Speed oscillation command frequency error	Operation cannot be started because the commanded frequency for the high-speed oscillation function is outside the range 1 to 5000 (CPM).	Positioning control does not start.	Set the frequency within the range 1 to 5000 (CPM) and then start.

Table 2.2 Servo Program Setting Error List (Continued)

Error Code Stored in D9190	Error Name	Error Contents	Error Processing	Corrective Action
900	START instruction setting error	The servo program designated by the SVST program does not exist.	Positioning control does not start.	Set the correct servo program number.
901	START instruction setting error	The axis number set for the SVST instruction is different from the axis number set for the servo program.	Positioning control does not start.	(1) Set the correct axis number. (2) Use the SVST instruction for 4-axes linear interpolation.
902	Servo program instruction code error	The instruction code cannot be decoded (a non-existent instruction code has been designated)	Positioning control does not start.	Set the correct instruction code.
903	Start error	A virtual mode program was started in the real mode	Positioning control does not start.	Check the mode allocation for the program.
904	Start error	A real mode program was started in the virtual mode	Positioning control does not start.	Check the mode allocation for the program.
905	Start error	An instruction that cannot be used in the virtual mode (VPF, VPR, VPSTART, ZERO, VVF, VVR, OSC) was issued.	Positioning control does not start.	Correct the servo program.
906	Axis No. setting error	An axis not used in the system settings has been set for the servo program set in a SVST instruction.	Positioning control does not start.	Set an axis number that is setted in the system settings.
907	Start error	Start attempted during processing for switching from real mode to virtual mode.	Positioning control does not start.	Use M2034 (real/virtual mode switching request), M2044 (real/virtual mode status) as interlocks for starting.
908	Start error	Start attempted during processing for switching from virtual mode to real mode.		

2.2 Minor Errors

Minor errors are those that occur in the sequence program or servo program.
The error codes for these errors are from 1 to 999.
Minor errors include set data errors, positioning control start-up errors, positioning control errors, and control change errors.

(1) Set data errors (1 to 99)

These errors occur when the data set in the parameters for positioning control is not correct.
The error codes, causes, processing, and corrective actions are shown in Table 2.3 below.

Table 2.3 Set Data Error List (1 to 99)

Error Code	Data Where Error Occurred	Check Timing	Error Cause	Error Processing	Corrective Action
21		When count type, proximity dog type, or data set type zeroing is started.	The home position address of a degree axis is outside the range 0 to 35999999 ($\times 10^{-5}$degrees).		Set the home position address within the permissible range with a peripheral device.
22		When a count type or proximity dog type zeroing is started.	The zeroing speed is set outside the range of 1 to the speed limit value.		Set the zeroing speed at or below the speed limit value by using a peripheral device.
23	Zeroing data		The creep speed is set outside the range of 1 to the zeroing speed.	Zeroing is not started.	Set the creep speed at or below the zeroing speed by using a peripheral device.
24		When a count type zeroing is started.	The travel value after the proximity dog comes ON is outside the range ON2^{31}–1($\times$ unit).		Set the travel value after the proximity dog to within the permissible range with a peripheral device.
25		When a count type or proximity dog type zeroing is started.	The parameter block No. is outside the range of 1 to the maximum No. (Note-1)		Set the parameter block No. within the permissible range with a peripheral device.
40	Parameter block	When interpolation control is started	The unit for interpolation control designated in the parameter block is different from the control unit designated in the fixed parameters.	Control is executed using the control unit designated in the fixed parameters.	Designate the same control unit in the fixed parameters and servo parameters.

POINT

Sometimes, if the interpolation control unit designated in the parameter block and the control unit designated in the fixed parameters are different, no error code is stored; this depends on the combination of units designated.
For details, see Section 7.1.4.

(2) Positioning control start-up errors (100 to 199)
The errors shown in this section are those detected when positioning control is started.
Error codes, causes, processing, and corrective actions are shown in Table 2.6 below.
(Note-1) : When interpolation control is being executed, the error codes are stored in the error code storage areas of all the axes involved in the interpolation.

Table 2.4 Positioning Control Start-Up Error List (100 to 199)

Error Code	Control Mode												Error Cause	Error Processing	Corrective Action
	Positioning	Fixed-Pitch Feed	Speed	Speed/Position Switching	Speed Switching	Constant-Speed	JOG	Manual Pulse Generator	Zeroing	Position Follow-Up Control	OSC				
100	○	○	○	○	○	○	○	○	○	○	○		• The PLC ready flag (M2000) or PCPU ready flag (M9074) is OFF.	Positioning control does not start.	• Set the servo system CPU to RUN. • Turn the PLC ready flag (M2000) ON.
101	○	○	○	○	○	○	○	○	○	○	○		• The start accept flag (M2001 to M2032) of the relevant axis has been turned ON.		• Provide an interlock in the program to prevent the axis from being started while in motion (use the turning OFF of the start accept signal for the axis as the interlock condition).
103	○	○	○	○	○	○	○	○	○	○	○		• The stop command (M3200+20n) of the relevant axis has been turned ON.		• Turn the stop command (M3200+20n) OFF and start positioning.
104	○	○	○	○	○	○	○	○	○	○	○		• The rapid stop command (M3201+20n) of the relevant axis has been turned ON.		• Turn the rapid stop command (M3201+20n) OFF and start positioning.
105	○				○	○				○			• On starting, the feed current value is outside the stroke limit range.		• Move back inside the stroke range using JOG operation. • Enter inside the stroke range by executing a zeroing or current value change.
106*	○	○			○	○				○	○		• Positioning outside the stroke limit has been designated.		• Positioning end point must be within the specified stroke limit.
107	○					○							• An address that does not generate an arc was designated in circular interpolation for which an auxiliary point is designated. (Error in relationship between the start point, auxiliary point, and end point)		• Designate correct addresses in the servo program.
108*	○					○							• An address that does not make an arc was designated in circular interpolation for which a radius is designated. (Error in relationship between the start point, auxiliary point, and end point)		
109	○					○							• An address that does not generate an arc was designated in circular interpolation for which a center point is designated. (Error in relationship between the start point, auxiliary point, and end point)		
110*	○					○							• In circular interpolation, the difference between the end point address and the ideal end point exceeded the allowable error range for circular interpolation.		
111				○									• An attempt was been made to restart speed/position switching control although it had not stopped.		• Do not attempt restart when speed/position switching control has not stopped.
115									○				• The zeroing completed signal (M2410+20n) has been turned ON during a proximity dog type zeroing operation.		• Resumptive starts are not possible for zeroing return operations. Use JOG operation or positioning operation to return the axis to a point before the proximity dog signal was output, then retry the zeroing operation.

Table 2.4 Positioning Control Start-Up Error List (100 to 199) (Continued)

Error Code	Control Mode: Positioning	Fixed-Pitch Feed	Speed	Speed/Position Switching	Speed Switching	Constant-Speed	JOG	Manual Pulse Generator	Zeroing	Position Follow-Up Control	OSC		Error Cause	Error Processing	Corrective Action
116							○						• The set JOG speed is 0.	Positioning control does not start.	• Set a correct speed (within the specified range).
													• The set JOG speed exceeds the JOG speed limit value.	Control is executed at the JOG speed limit value.	
117							○						• Both forward and reverse motion were designated when simultaneously starting JOG operation programs.	Only the axis set to move in the forward direction starts.	• Set correct data.
118					○								• The speed change point is beyond the final address.	Positioning control does not start.	• Set a speed change point that is before the final address.
													• An address that causes positioning in the reverse direction is set.		• Set an address for positioning in the forward direction.
120									○				ZCT not set During second travel in dog type or count type zeroing, or when data set type zeroing is started, the zero pass signal (M2406+20n) is OFF.	Zeroing is not completed correctly.	• Carry out the zeroing after the home position has been passed.
140	○												• In linear interpolation for which a reference axis is designated the travel value of the reference axis is set at "0".	Positioning control does not start.	• Do not set an axis whose travel value is 0 as the reference axis.
141										○			• An odd number has been set for the position command device for position follow-up control.		• Set an even number for the position command device for position follow-up control.
142				○						○			• An external input signal has come ON although external input signal setting has not been performed for that signal in the system settings.		• Perform external input signal setting in system setting.

(3) Positioning control errors (200 to 299)
The errors shown in this section are those detected during positioning control.
Error codes, causes and corrective actions are shown in Table 2.5.

Table 2.5 Positioning Control Start-Up Error List (200 to 299)

Error Code	Control Mode: Positioning	Fixed-Pitch Feed	Speed	Speed/Position Switching	Speed Switching	Constant-Speed	JOG	Manual Pulse Generator	Zeroing	Position Follow-Up Control	OSC		Error Cause	Error Processing	Corrective Action
200	○	○	○	○	○	○	○	○		○	○		• The PLC ready flag (M2000) was turned OFF while positioning was being started in response to a start request issued by a sequence program.	Axis motion decelerates to a stop.	• Turn the PLC ready flag (M2000) ON after all axes have stopped.
201									○				• The PLC ready flag (M2000) was turned OFF during a zeroing operation.		• After turning the PLC ready flag (M2000) ON or turning the stop command (M3200+20n) or rapid stop command (M3201+20n) OFF, re-attempt zeroing. (In the case of a proximity dog type zeroing, use JOG operation or positioning operation to return the axis to the point before the proximity dog signal was output, and re-attempt zeroing.)
202									○				• The stop command (M3200+20n) has been turned ON during a zeroing operation.		
203									○				• The rapid stop command (M3201+20n) has been turned ON during a zeroing operation.	Axis motion stops immediately.,	
204	○	○	○	○	○	○	○	○	○	○	○		• The PLC ready flag (M2000) was turned back ON during deceleration initiated by turning OFF the PLC ready flag (M2000).	No processing	• Turn the PLC ready flag (M2000) ON after all axes have stopped. (Turning ON the PLC ready flag (M2000) during deceleration is ignored.)
206									○				• While a zeroing operation was in progress, an emergency stop was executed in the test mode at a peripheral device by pressing the [Back Space] key.	Axis motion stops immediately.	• In the case of a proximity dog type zeroing, use JOG operation or positioning operation to return the axis to the point before the proximity dog signal was output, and re-attempt zeroing. • If the proximity dog signal is turned OFF when executing a count type zeroing, use JOG operation or positioning operation to return the axis to the point before the proximity dog signal was output, and re-attempt zeroing. (In the proximity dog signal is turned ON when executing count type zeroing, re-attempt the zeroing.)
207	○				○	○	○			○			• The feed current value exceeded the stroke limit during positioning. In the case of circular interpolation, an error code is stored only for axis whose feed current value exceeded the stroke limit. In the case of linear interpolation, error codes are stored for all axes involved in the interpolation.	Axis motion decelerates to a stop.	• Correct the stroke limit or travel value setting so that positioning is executed within the stroke limit.
208	○				○	○		○					• During circular interpolation or during simultaneous operation of multiple manual pulse generators, the feed current value of another axis exceeded the stroke limit value. (For detection of other axis errors).		
209				○					○				• An overrun has occurred because the set travel value exceeds the deceleration distance when a speed/position change (CHANGE) signal is input during speed/position switching control, or when the proximity dog signal is input during count type zeroing.		• Correct the speed setting so that overrun does not occur. • Set a travel value which will not cause an overrun.
210				○									• During speed/position switching control, the set travel value exceeds the stroke limit when a speed/position switching (CHANGE) signal is input.		• Correct the stroke limit or travel value setting so that positioning is executed within the stroke limit.

Table 2.5 Positioning Control Error List (200 to 299) (Continued)

Error Code	Control Mode: Positioning	Fixed-Pitch Feed	Speed	Speed/Position Switching	Speed Switching	Constant-Speed	JOG	Manual Pulse Generator	Zeroing	Position Follow-Up Control	OSC		Error Cause	Error Processing	Corrective Action
211						○							• During positioning, an overrun occurs because the deceleration distance for the output speed is not attained at the point where the final positioning address is detected.	Axis motion decelerates to a stop.	• Set a speed at which overrun does not occur. • Set a travel value which will not cause an overrun.
214								○					• An attempt was made to control an axis already being moved by the manual pulse generator by setting the manual pulse generator operation enable flag for that axis.	The manual pulse generator input is ignored until the axis stops.	• Perform the manual pulse generator operation after the axis has stopped.
215					○								• The speed switching point address is more than the end point address. • An address to control positioning in the opposite direction was set during speed switching control.	A rapid stop is executed.	• Set the speed switching point within the range from the previous speed switching point address to the end point address.
													• The same servo program was been executed a second time.		• Modify the sequence program.
220										○			• In position follow-up control, when the control unit is "degrees", a command address outside the 0 to 35999999 has been set.	Axis motion decelerates to a stop. (M2001+n OFF)	• When the control unit is "degrees", set a command address within the range 0 to 35999999.
													• The command address has exceeded the stroke limit range in position follow-up control.		• Set an address within the stroke limit range.
225						○							• In constant speed control, the speed at the pass point exceeds the speed limit value.	The speed is kept at the speed limit value.	• Set a speed command value between 1 and the velocity limit value.

(4) Errors occurring at current value changes and speed changes (300 to 399)
The errors shown in this section are those that occur on execution of current value changes and speed changes.
Error codes, causes, processing, and corrective actions are shown in table 2.6.

Table 2.6 List of Errors that Occur at Current Value/Speed Changes

Error Code	Control Mode												Error Cause	Error Processing	Corrective Action
	Positioning	Fixed-Pitch Feed	Speed	Speed/Position Switching	Speed Switching	Constant-Speed	JOG	Manual Pulse Generator	Zeroing	Position Follow-Up Control	OSC				
300	○	○	○	○	○	○	○	○	○	○	○		• An attempt was made to change the current value data of an axis in motion. • An attempt was made to change the current value data of an axis that had not been started up. • An attempt was made to change the current value data of an axis whose status was "servo OFF".	The current value data is not changed.	• Use the following states of the following devices as interlocks to ensure that the current value of an axis in motion cannot be changed. (1) OFF state of the start accept flag (M2001 to M2032) for the relevant axis. (2) ON state of the servo READY flag M2415+20n.
301									○				• An attempt was made to change the speed of an axis executing a zeroing.	The speed is not changed.	• The speed of an axis executing a zeroing cannot be changed.
302	○					○							• An attempt was made to change the speed of an axis executing circular interpolation.		• The speed of an axis executing circular interpolation cannot be changed.
303	○	○		○	○	○				○			• An attempt was made to change the speed of an axis after automatic deceleration had started in positioning.		• The speed of an axis cannot be changed after automatic deceleration has started.
304							○						• An attempt was made to change the speed of an axis during deceleration initiated by turning OFF the JOG operation start signal (M3202+20n, M3203+20n).		• Do not attempt a speed change during deceleration initiated by turning OFF the JOG operation start signal (M3202+20n, M3203+20n).
305	○	○	○	○	○	○	○			○			• The speed to be changed to in a speed change was set outside the range of 0 to the speed limit value.	The speed is kept at the speed limit value.	• Set the speed within the range from 0 to the speed limit value.
309													• A current value change command outside the range of 0 to 35999999 ($\times 10^{-5}$ degrees) has been issued for an axis whose control units are degrees.	The current value data is not changed.	• Make a setting in the range of 0 to 35999999 ($\times 10^{-5}$ degrees).
310											○		• A speed change was attempted during high-speed oscillation. • A speed change to "0" request was issued during high-speed oscillation.	The speed is not changed.	• Do not perform speed changes during high-speed oscillation.
311													• A value outside the range 1 to 500% was set in the torque limit value change request (CHGT).	The torque limit value is not changed.	• Make a change request within the range 1 to 500% .
312													• A torque limit change request (CHGT) was made for an axis not started yet.		• Make a change request for a started axis.

(5) System errors (900 to 999)

Table 2.7 System Error List (900 to 999)

Error Code	Control Mode: Positioning	Fixed-Pitch Feed	Speed	Speed/Position Switching	Speed Switching	Constant-Speed	JOG	Manual Pulse Generator	Zeroing	Position Follow-Up Control	OSC		Error Cause	Error Processing	Corrective Action
900													• When the servo amplifier power is switched ON, the motor type set in the "system settings" differs from the motor type actually installed. (Checked only when using MR-J2S-B/ MR-J2-B)	Further operation is impossible.	• Correct the motor type setting in the system settings.
901													• When the servo amplifier power is switched ON, the motor travel value while the power was OFF is found to have exceeded the "Power of Allowed Traveling Points" setting made in the system settings.		• Check the position. Check the encoder battery.

2.3 Major Errors

Major errors are caused by external input signals or by control commands from the SCPU. The error codes for major errors are 1000 to 1999.
Major errors consist of control start-up errors, positioning errors, absolute system errors, and system errors.

(1) Positioning control start-up errors (1000 to 1099)
The errors shown in this section are those detected when positioning control is started.
Error codes, error causes, error processing and corrective actions are shown in Table 2.8.

Table 2.8 Positioning Control Start-Up Error List (1000 to 1099)

Error Code	Control Mode												Error Cause	Error Processing	Corrective Action
	Positioning	Fixed-Pitch Feed	Speed	Speed/Position Switching	Speed Switching	Constant-Speed	JOG	Manual Pulse Generator	Zeroing	Position Follow-Up Control	OSC				
1000	○	○	○	○	○	○	○	○	○	○	○		• The external stop signal of the corresponding axis was turned ON.		• Turn OFF the STOP signal.
1001	○	○	○	○	○	○	○	○	○	○	○		• When positioning was started in the forward direction (addresses increasing), the external FLS (upper limit LS) signal was turned OFF.		• Move the axis in the reverse direction in the JOG mode until it enters the external limit range.
1002	○	○	○	○	○	○	○	○	○	○	○		• When positioning was started in the reverse direction (addresses decreasing), the external RLS (lower limit LS) signal was turned OFF.		• Move the axis in the forward direction in the JOG mode until it enters the external limit range.
1003									○				• When proximity type zeroing was started, the external DOG (proximity dog) signal was turned ON.		• Move the axis to a point before the proximity dog in the JOG mode and then execute a zeroing.
1004	○	○	○	○	○	○	○	○	○	○	○		• The servo state of the corresponding axis is not servo READY. (M2415+20n: OFF). (1) The power supply to the servo amplifier is OFF. (2) Initial processing is in progress after turning on the servo amplifier. (3) The servo amplifier has not been installed. (4) A servo error has occurred. (5) Cable fault.	Positioning control does not start.	• Wait until the servo status is READY (M2415+20n: OFF).
1005	○	○	○	○	○	○	○	○	○	○	○		• The servo error detection signal of the corresponding axis (M2408+20n) was turned ON.		• Eliminate the error at the servo side, reset the servo error detection signal (M3208+20n) by using the servo error reset command (M2408+20n), then start operation.

(2) Positioning control errors (1100 to 1199)
The errors shown in this section are those detected during positioning.
Error codes, error causes, error processing, and corrective actions are shown in Table 2.9.

Table 2.9 Positioning Control Error List (1100 to 1199)

Error Code	Control Mode												Error Cause	Error Processing	Corrective Action
	Positioning	Fixed-Pitch Feed	Speed	Speed/Position Switching	Speed Switching	Constant-Speed	JOG	Manual Pulse Generator	Zeroing	Position Follow-Up Control	OSC				
1101	○	○	○	○	○	○	○	○	○	○	○		• When positioning was started in the forward direction (addresses increasing), the external FLS (upper limit LS) signal was turned OFF.	Axis motion decelerates to a stop in accordance with the "deceleration processing on STOP input" setting in the parameter block.	• Move axis in the reverse direction in the JOG mode until it enters the external limit range.
1102	○	○	○	○	○	○	○	○	○	○	○		• When positioning was started in the reverse direction (addresses decreasing), the external RLS (lower limit LS) signal was turned OFF.		• Move the axis in the forward direction in the JOG mode until it enters the external limit range.
1103									○				• The external STOP signal (stop signal) was turned ON while the axis was moving.		• When executing a proximity dog type zeroing, move the axis to a point before the proximity dog in the JOG mode and then execute a zeroing.
1104	○	○	○	○	○	○	○	○	○	○	○		• The servo error detection signal was turned ON while an axis was in motion.	The axis stops immediately without decelerating.	• After taking the appropriate corrective action for the servo error, the axis can be restarted.
1105	○	○	○	○	○	○	○	○	○	○	○		• The power supply to the servo amplifier was turned OFF while an axis was in motion. (Servo not installed status detected, cable fault, etc.) • Zeroing did not finish successfully since the axis did not stop at the home position within the in-position range.	M2415+20n turned OFF.	• Turn ON the power supply to the servo amplifier. • Check the cable to servo amplifier connecting cable. • Make gain adjustment.

(3) Absolute System Errors (1200 to 1299)
The errors shown in this section are those detected in an absolute system.
Error codes, error causes, error processing, and corrective actions are shown in Table 2.10.

Table 2.10 Absolute System Error List (1200 to 1299)

Error Code	Control Mode												Error Cause	Error Processing	Corrective Action
	Positioning	Fixed-Pitch Feed	Speed	Speed/Position Switching	Speed Switching	Constant-Speed	JOG	Manual Pulse Generator	Zeroing	Position Follow-Up Control	OSC				
1201													• When the servo amplifier power was switched ON, a sum check error occurred with the backup data in the controller. • Zeroing has not been performed. • CPU module battery error. • Zeroing was started but it was not completed normally.	Zeroing request ON	• Check the battery of the CPU module and execute a zeroing.
1202													• When the servo amplifier power is turned ON, a communication error in communication between the servo amplifier and encoder occurs.	Zeroing request ON, servo error 2016 set.	• Check the motor and encoder cables and perform zeroing again.
1203													• During operation, the amount of change in the encoder current value complies with the following expression: "Amount of change in encoder current value/3.5 ms 180° of motor revolution" After the servo amplifier power has been turned ON, a continual check is performed (in both servo ON and OFF states).	No Processing	• Check the motor and encoder cables.
1204													• During operation, the following expression holds: "Encoder current value (PLS) ≠ feedback current value (PLS) (encoder effective bit number)". After the servo amplifier power has been turned ON , a continual check is performed (in both servo ON and OFF states).		

(4) System errors (1300 to 1399, 1500 to 1599)
Errors detected at power-on.
Table 2.11 indicates the error codes, error causes, error processings and corrective actions.

Table 2.11 Main Base Side Error List (1300 to 1399, 1500 to 1599)

Error Code	Control Mode: Positioning	Fixed-Pitch Feed	Speed	Speed/Position Switching	Speed Switching	Constant-Speed	JOG	Manual Pulse Generator	Zeroing	Position Follow-Up Control	OSC		Error Cause	Error Processing	Corrective Action
1300													• The actual ADU loading status differs from the system settings. • ADU fault	Start is not made	• Reconsider the parameters. • Change the ADU.
1310													• Initial communication with the servo system CPU is not completed normally. • Servo system CPU fault or ADU fault		• Change the servo system CPU or ADU.
1500													• Servo power (A230P) is not switched on or the all axes servo ON command (M2042 ON) was given in a failure status.		• After switching servo power on, issue the all axes servo ON command. • Change the servo power supply module.
1501													• When setting was made to use the brake output of the A278LX or A172SENC, 24VDC is not supplied properly.		• Supply 24VDC power to the A278LX or A172SENC.

2.4 Servo Errors

Servo errors are classified into servo amplifier errors and servo power supply module errors.
You can set to each system what processing will be performed at servo error detection. (Only servo errors detected by the ADU (when the A273UHCPU is used))
Set the processing and system in the system settings of the peripheral device.

	Setting	Control Exercised
1	System-based servo OFF (Default)	• If a servo error occurs at any one ADU axis, all axes in that system result in servo off. (Same control as at servo-off of all axes is exercised.)
2	Only own-axis servo off	• Only the ADU axis where a servo error occurred results in servo off and the other axes are not affected. • Note that: 1) For the type which has two axes in one module, both axes result in servo off even at occurrence of a servo error at one axis. 2) Occurrence of any of the following servo errors will result in a system-based servo off status. Overcurrent (2032) Undervoltage (2810) Overregeneration (2830) Overvoltage (2833) Amplifier power supply overheat (2847)

(1) Servo amplifier errors (2000 to 2799)
The servo amplifier errors are errors detected by the servo amplifier and are assigned error codes 2000 to 2799.
In the following tables, the types of servo amplifier are indicated for ADU and for MR-□-B.
For the servo amplifier types, the ADU is abbreviated to Ⓐ and the MR-□-B as Ⓜ.
The servo error detection signal (M2408+20n) comes ON when a servo error occurs. Eliminate the cause of the error, reset the error by turning ON the servo error reset signal (M3208+20n), and reset operation. (Note that the servo error detection signal will not come ON in response to error codes in the range 2100 to 2499 because these codes are for warnings.)
(Note-1): When an excessive regeneration error (code 2030), or overload 1 or 2 error (codes 2050, 2051) occurs, the state that applied when the error occurred is stored in the servo amplifier even after the protection circuit has operated. The memory contents are cleared if the external power supply is turned OFF, but are not cleared by the reset signal.
(Note-2): Repeated resetting by turning OFF the external power supply after occurrence of error code 2030, 2050, or 2051, may cause devices to be destroyed by overheating. Only restart operation after eliminating the cause of the error.
Details of servo errors are given in Table 2.12.

⚠ CAUTION

⚠ If a controller or servo amplifier self-diagnosis error occurs, check the points stated in this manual and clear the error.

Table 2.12 Servo Amplifier Error List (2000 to 2799)

Error Code	Amplifier Type	Error Cause		When Error Checked	Error Processing	Corrective Action
		Name	Description			
2010	Ⓐ	P-N non-wiring	• P-N of the servo power supply module are not wired to P-N of the ADU.	At any time during operation.	Immediate stop	• Reconsider wiring.
	Ⓜ	Low voltage	• The power supply voltage is less than 160 VAC. (320VAC or less for 400VAC series servo) • A momentary power, interruption of 15ms or longer has occurred. • The power supply voltage dropped, for example when motion control started, due to insufficient power capacity.			• Measure the input voltage (R, S, T) with a voltmeter. • Monitor with an oscilloscope to check whether a momentary power interruption has occurred. • Review the power capacity.
2012	Ⓐ	Internal memory alarm	• ADU's SRAM fault.	• At power-on of servo amplifier		• Change the ADU.
	Ⓜ	Memory error 1	• Servo amplifier SRAM is faulty. • Servo amplifier EPROM check sum error.	• When the servo amplifier power is turned ON • At the leading edge of the PLC READY flag (M2000) • When a servo error is reset • When the power to the servo system CPU is turned ON		• Replace the servo amplifier.
2013	Ⓜ	Clock error	• Servo amplifier clock fault.	At any time during operation		• Replace the servo amplifier.
2014	Ⓐ	Watchdog	• Servo control system fault • ADU fault			• Reset and recheck the servo system CPU. • Change the ADU.
	Ⓜ		• Servo amplifier hardware fault • Servo system CPU hardware fault			• Replace the servo amplifier. • Replace the servo system CPU.
2015	Ⓐ	2-port memory alarm	• ADU's 2-port memory fault.	• At power-on of servo amplifier • At servo error reset		• Reset and recheck the servo system CPU. • Change the ADU.
	Ⓜ	Memory error 2	• Servo amplifier EEPROM fault	• When the servo amplifier power is turned ON • At the leading edge of the PLC READY flag (M2000) • When a servo error is reset • When the power to the servo system CPU is turned ON		• Replace the servo amplifier.
2016	Ⓐ	Position sensor error 1	• At initialization, communication with encoder is not normal. • The encoder type (ABS/INC) set in system settings differs from the actual encoder type.	• At power-on of servo amplifier • At servo error reset		• Reset and recheck the servo system CPU. • Change the servo motor (encoder). • Reconsider the system settings.
	Ⓜ		• Fault in communication with the encoder	• When the servo amplifier power is turned ON • At the leading edge of the PLC READY flag (M2000) • When a servo error is reset • When the power to the servo system CPU is turned ON		• Check the encoder cable connector for disconnection. • Change the servo motor. • Change the encoder cable. • Check the combination of encoder cable type (2-wire/4-wire type) and servo parameter.
2017	Ⓐ	PCB error	• ADU's analog-to-digital converter is faulty.	• At power-on of servo amplifier • At servo error reset		• Reset and recheck the servo system CPU. • Change the ADU.
	Ⓜ		• Faulty device in the servo amplifier PCB.	• When the servo amplifier power is turned ON • At the leading edge of the PLC READY flag (M2000) • When a servo error is reset • When the power to the servo system CPU is turned ON		• Replace the servo amplifier.
2019	Ⓜ	Memory error 3	• Servo amplifier flash ROM check sum error	• When the servo amplifier power is turned ON • At the leading edge of the PLC READY flag (M2000) • When a servo error is reset • When the power to the servo system CPU is turned ON		• Replace the servo amplifier.

Table 2.12 Servo Amplifier Error List (2000 to 2799) (Continued)

Error Code	Amplifier Type	Error Cause: Name	Error Cause: Description	When Error Checked	Error Processing	Corrective Action
2020	Ⓐ	Position sensor error 2	• During operation, communication with the encoder is not normal.	At any time during operation	Immediate stop	• Check wiring between the encoder and ADU. • Change the servo motor (encoder).
	Ⓜ		• Fault in communication with the encoder			• Check the encoder cable connector for disconnection. • Change the servo motor. • Change the encoder cable.
2021	Ⓜ	Converter RD off (400VAC series servo only)	• The servo-on (SON) signal turned ON when the ready signal (RD) of the converter is OFF. 1. Bus voltage is low. 2. Alarm occurring in converter.			• Remove the cause of the converter alarm. Deactivate the alarm.
2024	Ⓜ	Output ground fault	• U, V, or W of the servo amplifier output grounded			• Use a multimeter to check between the U, V, and W terminals and the case. • Use a multimeter and megger to check between the U, V, and W terminals of the motor and the core.
2025	Ⓐ	Absolute position erase	• In the absolute value encoder, the voltage of the super capacitor in the encoder is less than 2.5±0.2V. • In the absolute value encoder, speed was 500rpm or higher during a power failure.	• At power-on of servo amplifier • At servo error reset		• Change the battery (MR-JBAT□). • Check the wiring between encoder and ADU.
	Ⓜ	Battery alarm	• The voltage of the supercapacitor inside the absolute position sensor has dropped.	• When the servo amplifier power is turned ON • At the leading edge of the PLC READY flag (M2000) • When a servo error is reset • When the power to the servo system CPU is turned ON		• Turn the power ON for 2 to 3 minutes to charge the supercapacitor, switch the power OFF then ON again, and execute a zeroing.
			• The battery voltage is low.			• Turn the servo amplifier power OFF, then measure the battery voltage.
			• Failure of battery cable or battery. (Zeroing must be re-executed after clearing the error.)			• Replace the servo amplifier battery.
2026	Ⓐ	Module mismatch	• The servo parameter (system settings) does not match the real servo amplifier.	• At power-on of servo amplifier • At servo error reset		• Reconsider the system settings.
2030	Ⓜ	Excessive regeneration	• The frequency of ON/OFF switching of the power transistor for regeneration is too high. (Caution is required since the regenerative resistor could overheat.)	At any time during operation		• Reduce the frequency of acceleration and deceleration or feed speed while checking the servo monitor regeneration level (%). • Reduce the load. • Increase the servomotor capacity.
			• Servo parameter (system settings) setting error			• Check the servo parameters (regenerative resistor and motor type settings in the system settings).
			• Incorrect wiring of regenerative resistor			• Connect the regenerative resistor correctly.
			• Failure of regenerative resistor			• Replace the regenerative resistor.
			• Power transistor for regeneration damaged by short circuit			• Replace the servo amplifier.
2031	Ⓐ	Overspeed	• The command speed is too high.			• Reconsider the command speed.
			• Overshoot occurred during acceleration.			• Reconsider the servo parameter.
			• Encoder fault.			• Change the encoder.
			• Encoder cable fault or wiring mistake.			• Check the wiring between encoder and ADU.
	Ⓜ		• The motor rpm has exceeded 115% of the rated rpm.			• Check the motor rpm in the servo parameters. • Check if the number of pulses per revolution and travel value per revolution in the fixed parameters match the machine specifications.
			• An overshoot has occurred because the acceleration time constant is too small.			• If an overshoot occurs during acceleration, check the acceleration time and deceleration time in the fixed parameters.
			• An overshoot has occurred because the servo system is unstable.			• If overshoot occurs, increase the speed integral compensation by adjusting the position loop gain / position control gain 1, 2, speed loop gain / speed control gain 1, 2 in the servo parameters.
			• Encoder fault.			• Check the encoder cable for wire breakage. • Change the servo motor.

Table 2.12 Servo Amplifier Error List (2000 to 2799) (Continued)

Error Code	Amplifier Type	Error Cause: Name	Error Cause: Description	When Error Checked	Error Processing	Corrective Action
2032	Ⓐ	Overcurrent	• The servo motor connected is not as set.	• At power-on of servo amplifier • At servo error reset	Immediate stop	• Reconsider the system settings.
			• The U, V, and W phases of the ADU output resulted in a short circuit or ground fault.			• Check the servo motor cable.
			• Wiring mistake of the U, V, and W phases of the ADU output.			• Correct the servo motor wiring.
			• Damage to the ADU's transistor module. • ADU fault.			• Change the ADU.
			• Coupling fault of servo motor and encoder.			• Change the servo motor.
			• The servo motor oscillated.			• Reconsider the servo parameters.
	Ⓜ		• U, V, W in the servo amplifier outputs have short circuited with each other.	At any time during operation		• Check if there is a short circuit between U, V, W of the servo amplifier outputs.
			• U, V, W in the servo amplifier outputs have shorted to ground.			• Check if U, V, W of the servo amplifier outputs have been grounded to the ground terminal. Check if U, V, W of the servomotor are grounded to the core. If grounding is found, replace the servo amplifier and/or motor.
			• Incorrect wiring of U, V, W phases in the servo amplifier outputs.			• Correct the wiring.
			• The servo amplifier transistor is damaged.			• Replace the servo amplifier.
			• Failure of coupling between servomotor and encoder			• Replace the servomotor.
			• Encoder cable failure			• Replace the encoder cable.
			• A servomotor that does not match the setting has been connected.			• Check the connected motor set in the system settings.
			• The servomotor oscillated.			• Check and adjust the gain value set in the servo parameters.
			• Noise entered the overcurrent detection circuit.			• Check if any relays or valves are operating in the vicinity.
2033	Ⓜ	Overvoltage	• The converter bus voltage has reached 400 V or more. (800VAC or more for 400VAC series servo) • The frequency of acceleration and deceleration was too high for the regenerative ability. • The regenerative resistor has been connected incorrectly.			• Increase the acceleration time and deceleration time in the fixed parameters. • Check the connection between C and P of the terminal block for the terminal block for regenerative resistance.
			• The regenerative resistor in the servo amplifier is destroyed.			• Measure between C and P of the terminal block for regenerative resistance with a multimeter; if abnormal, replace the servo amplifier. (Measure about 3 minutes after the charge lamp has gone out.)
			• The power transistor for regeneration is damaged.			• Replace the servo amplifier.
			• The power supply voltage is too high.			• Measure the input voltage (R, S, T) with a voltmeter.
2034	Ⓜ	Communications error	• Error in data received from the servo system CPU			• Check the connection of the motion bus cable. • Check if there is a disconnection in the motion us cable. • Check if the motion bus cable is clamped correctly.

Table 2.12 Servo Amplifier Error List (2000 to 2799) (Continued)

Error Code	Amplifier Type	Error Cause: Name	Error Cause: Description	When Error Checked	Error Processing	Corrective Action
2035	Ⓐ	Data error	• The command speed is too high. • Servo system CPU fault.	At any time during operation	Immediate stop	• Reconsider the command speed. • Change the servo system CPU.
	Ⓜ		• There is excessive variation in the position commands from the servo system CPU; commanded speed is too high. • Noise has entered the commands from the servo system CPU.			• Check the commanded speed, and the number of pulses per revolution and travel value per revolution in the fixed parameters. • Check the connection of the motion bus cable connector. • Check if the motion bus cable is clamped correctly. • Check if the motion bus cable is clamped correctly. • Check if any relays or valves are operating in the vicinity.
2036	Ⓐ	Transmission error	• Servo system CPU fault.			• Change the servo system CPU.
	Ⓜ		• Fault in communication with the servo system CPU			• Check the connection of the motion bus cable connector. • Check if there is a disconnection in the motion bus cable. • Check if the motion bus cable is clamped correctly.
2042	Ⓜ	Feedback error	• Encoder signal fault			• Replace the servomotor.
2045	Ⓐ	Amplifier fin overheat	• The ADU fan is at a stop. • The continuous output current of the ADU is exceeded. • ADU's thermal sensor fault.			• Change the ADU fan. • Reduce the load. • Change the ADU.
	Ⓜ	Fin overheating	• The heat sink in the servo amplifier is overheated. • Amplifier error (rated output exceeded) • Power repeatedly switched ON/OFF during overload. • Cooling fault			• If the effective torque of the servomotor is high, reduce the load. • Reduce the frequency of acceleration and deceleration. • Check if the amplifier's fan has stopped. (MR-H150B or higher) • Check if the passage of cooling air is obstructed. • Check if the temperature inside the panel is too high (range: 0 to +55°C). • Check if the electromagnetic brake was actuated from an external device during operation. • Replace the servo amplifier.
2046	Ⓐ	Motor overheating	• The thermal protector built in the servo motor malfunctioned. • The continuous output of the servo motor is exceeded.			• Change the servo motor. • Reduce the load.
	Ⓜ		• The servomotor is overloaded. • The servomotor and regenerative option are overheated. • The thermal protector incorporated in the encoder is faulty.			• If the effective torque of the servomotor is high, reduce the load. • Check the ambient temperature of the servomotor (range: 0 to +40°C). • Replace the servomotor.

Table 2.12 Servo Amplifier Error List (2000 to 2799) (Continued)

Error Code	Amplifier Type	Error Cause		When Error Checked	Error Processing	Corrective Action
		Name	Description			
2050	Ⓐ	Overload	• The rated current of the servo motor is exceeded.	At any time during operation	Immediate stop	• Load inertia or friction is too large.
			• Reduce the load. • Hunting due to parameter setting mistake.			• Reconsider the servo parameters.
	Ⓜ	Overload 1	• An overload current of about 200% has been continuously supplied to the servo amplifier and servomotor.			• Check if there has been a collision at the machine. • If the load inertia is very large, either increase the time constant for acceleration and deceleration or reduce the load. • If hunting occurs, adjust the position loop gain in the servo parameters. • Check the connection of U, V, W of the servo amplifier and servomotor. • Check for disconnection of the encoder cable. • Replace the servomotor.
2051	Ⓜ	Overload 2	• The servo amplifier and servomotor were overloaded at a torque close to the maximum torque (95% or more of the current control value).			• Check if there has been a collision at the machine. • If the load inertia is very large, either increase the time constant for acceleration and deceleration or reduce the load. • If hunting occurs, adjust the position loop gain / position control gain 1, 2, speed loop gain/ speed control gain 1, 2 in the servo parameters. • Check the connection of U, V, W of the servo amplifier and servomotor. • Check for disconnection of the encoder cable. • Replace the servomotor. • If the voltage of the bus in the servo amplifier has dropped (charge lamp has gone out), replace the servo amplifier.

Table 2.12 Servo Amplifier Error List (2000 to 2799) (Continued)

Error Code	Amplifier Type	Error Cause: Name	Error Cause: Description	When Error Checked	Error Processing	Corrective Action
2052	A	Excessive error	• The deviation counter value exceeded the specified value. • Inertia is too large to make enough acceleration.	At any time during operation	Immediate stop	• Reconsider the servo parameters.
			• Encoder or cable fault.			• Change the encoder or cable.
	M		• The droop pulses of the deviation counter exceeded the error excessive alarm level set in the servo parameters.			• Check if there has been a collision at the machine. • Increase the time constant for acceleration and deceleration. • Increase the position loop gain / position control gain 1, 2, in the servo parameters. • Check the encoder cable for wire breakage. • Replace the servomotor. • If the voltage of the bus in the servo amplifier has dropped (charge lamp has gone out), replace the servo amplifier.
2057	A	Hardware alarm	• ADU hardware fault.			• Change the ADU.
2086	M	RS232 communication error	• Parameter unit communication error		Operation continues	• Check for disconnection of the parameter unit cable. • Replace the parameter unit.
2102	A	Battery warning	• The absolute value encoder battery voltage dropped.			• Change the battery (MR-JBAT-□).
	M		• The voltage of the battery installed in the servo amplifier has become low.			• Replace the battery.
2103	M	Battery disconnection warning	• The power supply voltage to the absolute position sensor has become low.			• Replace the battery. • Check the encoder cable for wire breakage. • Replace the servomotor. • Replace the servo amplifier.
2140	M	Excessive regeneration warning	• An excessive regeneration error (2030) is likely to occur (regeneration of 85% of the maximum load capacity for the regenerative resistor has been detected).			• Refer to the details on the excessive regeneration error (2030).
2141	A	Overload warning	• The 80% level of the overload error (2050) level was detected.			• Refer to details of the overload error (2050).
	M		• An overload error (2050, 2051) is likely to occur (85% of overload level detected).			• Refer to the details on the overload errors (2050, 2051).
2143	A	Absolute value counter warning	• Encoder fault.			• Change the encoder.
2146	M	Servo emergency stop	• The connection between 1A and 1B (emergency stop input) of CN6 of the servo amplifier encoder has been broken.			• Establish a short circuit between 1A and 1B of CN6 of the servo amplifier encoder.
2147	A	Emergency stop	• Brought to an emergency stop.		Immediate stop	• Release the emergency stop.
	M		• An emergency stop (EMG) signal has been input from the servo system CPU.			
2149	M	Main circuit OFF warning	• The servo ON (SON) signal was turned ON while the contactor was OFF. • The main circuit bus voltage fell to 215 V or lower at 50 rpm or lower.		Operation continues	• Turn the main circuit contactor or circuit power supply ON.
2196	M	Home position setting error warning	• After a home position set command, the droop pulses did not come within the in-position range.			• Re-attempt zeroing.

Table 2.12 Servo Amplifier Error List (2000 to 2799) (Continued)

<table>
<tr><th rowspan="2">Error Code</th><th rowspan="2">Amplifier Type</th><th colspan="2">Error Cause</th><th rowspan="2">When Error Checked</th><th rowspan="2">Error Processing</th><th rowspan="2">Corrective Action</th></tr>
<tr><th>Name</th><th>Description</th></tr>
<tr><td>2201
to
2224</td><td>Ⓐ</td><td>Parameter warning</td><td>• The parameter that was set is unauthorized.
<table>
<tr><td>2201</td><td>Amplifier setting</td></tr>
<tr><td>2202</td><td>Motor type</td></tr>
<tr><td>2203</td><td>Motor capacity</td></tr>
<tr><td>2204</td><td>Number of feedback pulses</td></tr>
<tr><td>2205</td><td>In-position range</td></tr>
<tr><td>2206</td><td>Position control gain 2 (actual position gain)</td></tr>
<tr><td>2207</td><td>Speed control gain 2 (actual speed gain)</td></tr>
<tr><td>2208</td><td>Speed integral compensation</td></tr>
<tr><td>2209</td><td>Forward rotation torque limit value</td></tr>
<tr><td>2210</td><td>Reverse rotation torque limit value</td></tr>
<tr><td>2211</td><td>Emergency stop time delay</td></tr>
<tr><td>2212</td><td>Position control gain 1 (model position gain)</td></tr>
<tr><td>2213</td><td>Speed control gain 1 (model speed gain)</td></tr>
<tr><td>2214</td><td>Load inertia ratio</td></tr>
<tr><td>2215</td><td>Error excessive alarm level</td></tr>
<tr><td>2216</td><td>Special compensation processing</td></tr>
<tr><td>2217</td><td>Special servo processing</td></tr>
<tr><td>2218</td><td>Td dead zone compensation</td></tr>
<tr><td>2219</td><td>Feed forward gain</td></tr>
<tr><td>2220</td><td>Unbalance torque compensation</td></tr>
<tr><td>2221</td><td>Dither command</td></tr>
<tr><td>2222</td><td>Gain operation time</td></tr>
<tr><td>2223</td><td>Servo response level setting</td></tr>
<tr><td>2224</td><td>—</td></tr>
</table></td><td>At any time during operation</td><td>Operation continues</td><td>• Reconsider the system settings and servo parameters.</td></tr>
</table>

Table 2.12 Servo Amplifier Error List (2000 to 2799) (Continued)

Error Code	Amplifier Type	Error Cause		When Error Checked	Error Processing	Corrective Action
		Name	Description			
2301 to 2336	Ⓜ	Parameter alarm	• The servo parameter value is outside the setting range. (Any unauthorized parameter is ignored and the value before setting is retained.) 2301 Amplifier setting 2302 Regenerative resistance 2303 Motor type 2304 Motor capacity 2305 Motor rpm 2306 Number of feedback pulses 2307 Rotating direction setting 2308 Automatic tuning setting 2309 Servo responsibility 2310 Torque limit (forward) 2311 Torque limit (reverse) 2312 Load inertia ratio 2313 Position control gain 1 2314 Speed control gain 1 2315 Position control gain 2 2316 Speed control gain 2 2317 Speed integral compensation 2318 Notch filter 2319 Feed forward coefficient 2320 In-position range 2321 Electromagnetic brake sequence output 2322 Monitor output mode selection 2323 Optional function 1 2324 Optional function 2 2325 Optional function 3 2326 Optional function 4 2327 Monitor output 1 offset 2328 Monitor output 2 offset 2329 Pre-alarm data selection 2330 Zero speed 2331 Excessive error alarm level 3232 Optional function 5 3233 Optional function 6 2334 PI-PID switching position droop 2335 Torque limit compensation factor 2336 Speed integral compensation (actual speed differential compensation)	At any time during operation	Operation continues	• Check the setting ranges of the servo parameters.

Table 2.14 Servo Amplifier Error List (2000 to 2799) (Continued)

<table>
<tr><th rowspan="2">Error Code</th><th rowspan="2">Amplifier Type</th><th colspan="2">Error Cause</th><th rowspan="2">When Error Checked</th><th rowspan="2">Error Processing</th><th rowspan="2">Corrective Action</th></tr>
<tr><th>Name</th><th>Description</th></tr>
<tr><td>2301
to
2324</td><td>Ⓐ</td><td>Parameter alarm</td><td>• The servo parameter value is outside the setting range. (Any unauthorized parameter is ignored and the value before setting is retained.)
<table>
<tr><td>2301</td><td>Amplifier setting</td></tr>
<tr><td>2302</td><td>Motor type</td></tr>
<tr><td>2303</td><td>Motor capacity</td></tr>
<tr><td>2304</td><td>Number of feedback pulses</td></tr>
<tr><td>2305</td><td>In-position range</td></tr>
<tr><td>2306</td><td>Position control gain 2 (actual position gain)</td></tr>
<tr><td>2307</td><td>Speed control gain 2 (actual speed gain)</td></tr>
<tr><td>2308</td><td>Speed integral compensation</td></tr>
<tr><td>2309</td><td>Forward rotation torque limit value</td></tr>
<tr><td>2310</td><td>Reverse rotation torque limit value</td></tr>
<tr><td>2311</td><td>Emergency stop time delay</td></tr>
<tr><td>2312</td><td>Position control gain 1 (model position gain)</td></tr>
<tr><td>2313</td><td>Speed control gain 1 (model speed gain)</td></tr>
<tr><td>2314</td><td>Load inertia ratio</td></tr>
<tr><td>2315</td><td>Error excessive alarm level</td></tr>
<tr><td>2316</td><td>Special compensation processing</td></tr>
<tr><td>2317</td><td>Special servo processing</td></tr>
<tr><td>2318</td><td>Td dead zone compensation</td></tr>
<tr><td>2319</td><td>Feed forward gain</td></tr>
<tr><td>2320</td><td>Unbalance torque compensation</td></tr>
<tr><td>2321</td><td>Dither command</td></tr>
<tr><td>2322</td><td>Gain operation time</td></tr>
<tr><td>2323</td><td>Servo response level setting</td></tr>
<tr><td>2324</td><td>—</td></tr>
</table></td><td>At any time during operation</td><td rowspan="2">Operation continues</td><td>• Check the setting ranges of the servo parameters.</td></tr>
<tr><td>2500</td><td>Ⓐ</td><td>Parameter alarm</td><td>• Among the servo parameters, any of the following items is unauthorized.
• Amplifier
• External regenerative brake resistor setting
• Motor type
• Motor capacity</td><td>• At power-on of servo amplifier
• At servo error reset</td><td>• Reconsider the system settings and servo parameters.</td></tr>
</table>

Table 2.12 Servo Amplifier Error List (2000 to 2799) (Continued)

Error Code	Amplifier Type	Error Cause		When Error Checked	Error Processing	Corrective Action
		Name	Description			
2501 to 2524	Ⓐ	Parameter alarm	• The parameter that was set is unauthorized. 2501 Amplifier setting 2502 Motor type 2503 Motor capacity 2504 Number of feedback pulses 2505 In-position range 2506 Position control gain 2 (actual position gain) 2507 Speed control gain 2 (actual speed gain) 2508 Speed integral compensation 2509 Forward rotation torque limit value 2510 Reverse rotation torque limit value 2511 Emergency stop time delay 2512 Position control gain 1 (model position gain) 2513 Speed control gain 1 (model speed gain) 2514 Load inertia ratio 2515 Error excessive alarm level 2516 Special compensation processing 2517 Special servo processing 2518 Td dead zone compensation 2519 Feed forward gain 2520 Unbalance torque compensation 2521 Dither command 2522 Gain operation time 2523 Servo response level setting 2524 —	• At power-on of servo amplifier • On PLC ready (M2000) leading edge • At servo error reset	Operation continues	• Reconsider the system settings and servo parameters.

Table 2.12 Servo Amplifier Error List (2000 to 2799) (Continued)

Error Code	Amplifier Type	Error Cause		When Error Checked	Error Processing	Corrective Action
		Name	Description			
2601 to 2636	Ⓜ	Initial parameter alarm	• The parameter setting is wrong. • The parameter data was corrupted. 2601 Amplifier setting 2602 Regenerative resistance 2603 Motor type 2604 Motor capacity 2605 Motor rpm 2606 Number of feedback pulses 2607 Rotating direction setting 2608 Automatic tuning setting 2609 Servo responsibility 2610 Torque limit (forward) 2611 Torque limit (reverse) 2612 Load inertia ratio 2613 Position control gain 1 2614 Speed control gain 1 2615 Position control gain 2 2616 Speed control gain 2 2617 Speed integral compensation 2618 Notch filter 2619 Feed forward coefficient 2620 In-position range 2621 Electromagnetic brake sequence output 2622 Monitor output mode selection 2623 Optional function 1 2624 Optional function 2 2625 Optional function 3 2626 Optional function 4 2627 Monitor output 1 offset 2628 Monitor output 2 offset 2629 Pre-alarm data selection 2630 Zero speed 2631 Excessive error alarm level 3632 Optional function 5 3633 Optional function 6 2634 PI-PID switching position droop 2635 Torque limit compensation factor 2636 Speed integral compensation (real speed differential compensation)	• At power-on of servo amplifier • On PLC ready (M2000) leading edge • At servo error reset • At power-on of servo system CPU	Immediate stop	• After checking and correcting the parameter setting, turn the servo system CPU power OFF, then ON, reset the servo system CPU with the key, or turn PLC ready (M2000) OFF, then ON.

Table 2.12 Servo Amplifier Error List (2000 to 2799) (Continued)

Error Code	Amplifier Type	Error Cause		When Error Checked	Error Processing	Corrective Action
		Name	Description			
2601 to 2624	Ⓐ	Initial parameter alarm	• The parameter setting is wrong. • The parameter data was corrupted. 2601 Amplifier setting 2602 Motor type 2603 Motor capacity 2604 Number of feedback pulses 2605 In-position range 2606 Position control gain 2 (actual position gain) 2607 Speed control gain 2 (actual speed gain) 2608 Speed integral compensation 2609 Forward rotation torque limit value 2610 Reverse rotation torque limit value 2611 Emergency stop time delay 2612 Position control gain 1 (model position gain) 2613 Speed control gain 1 (model speed gain) 2614 Load inertia ratio 2615 Error excessive alarm level 2616 Special compensation processing 2617 Special servo processing 2618 Td dead zone compensation 2619 Feed forward gain 2620 Unbalance torque compensation 2621 Dither command 2622 Gain operation time 2623 Servo response level setting 2624 —	• At power-on of servo amplifier • On PLC ready (M2000) leading edge • At servo error reset • At power-on of servo system CPU	Immediate stop	• After checking and correcting the parameter setting, turn the servo system CPU power OFF, then ON, reset the servo system CPU with the key, or turn PLC ready (M2000) OFF, then ON.

(2) Servo power supply module errors (2800 to 2999)

The servo power supply module errors are detected by the servo amplifier and assigned error codes 2800 to 2999.

When any of the servo errors occurs, the servo error detection signal (M2408+20n) turns ON. Eliminate the error cause and turn ON the servo error reset (M3208+20n) to reset the servo error, and make a restart. (However, the servo error detection signal will not turn ON for any of the error codes 2900 to 2999 as they are warning.)

(Note-1): For regenerative alarm protection (error code 2830), the status when the protective circuit was activated is still retained in the servo amplifier after activation. The data stored is cleared when the external power is switched OFF, but is not cleared by the RESET signal.

(Note-2): If the external power is switched OFF repeatedly to reset the error code 2830, overheat may lead to damage to the devices. Therefore, resume operation after removing the cause without fail.

The servo power supply module error definitions are given in Table 2.13.

Table 2.13 Servo Power Supply Module Error (2800 to 2999) List

Error Code	Error Cause: Name	Error Cause: Description	When Error Checked	Error Processing	Corrective Action
2810	Undervoltage	• The power supply voltage of the servo power supply module fell below 170VAC. • Instantaneous power failure occurred.	At any time during operation	Immediate stop	• Reconsider the power supply equipment.
		• Load is too large.			• Reconsider the power supply capacity.
2830	Excessive regeneration	• High-duty operation or continuous regenerative operation caused the max. load capacity of the regenerative brake resistor to be exceeded.			• Reconsider the operation pattern, e.g. decrease the acceleration/deceleration frequencies or reduce the speed.
		• Regenerative power transistor was damaged.			• Change the servo power supply module.
		• Regenerative brake resistor setting mistake in system settings			• Reconsider the system settings.
		• Regenerative brake resistor wiring mistake.			• Correct the wiring.
2833	Overvoltage	• Regenerative brake resistor connection mistake.			• Correct the wiring.
		• Regenerative power transistor was damaged.			• Change the servo power supply module.
		• Regenerative brake resistor is dead.			• Change the regenerative brake resistor.
		• Power supply voltage is high.			• Reconsider the power supply equipment.
2847	Amplifier power supply overheat	• The servo power supply module fan is at a stop.			• Change the fan.
		• The continuous output current of the servo power supply module is exceeded.			• Reduce the load.
		• Thermal sensor fault.			• Change the servo power supply module.
2940	Excessive regeneration warning	• 80% level of the excessive regeneration error (2830) was detected.		Operation continues	• Refer to details of the excessive regeneration error (2830).

2.5 PC Link Communication Errors

Table 2.14 PC Link Communication Error Codes

Error Codes Stored in D9196	Error Description	Action to Take
01	A receiving packet for PC link communication does not arrive. The arrival timing of the receiving packet is too late.	• Check whether the PC has been switched ON. • Check whether the communication cable has been connected firmly. • Check whether the communication cable has been broken. • Check whether the A30BD-PCF or A30CD-PCF has been mounted normally.
02	A receiving packet CRC code is invalid.	• Check whether there is a noise source near the PC. • Check whether the communication cable has been connected firmly. • Check whether the communication cable has been broken.
03	A receiving packet data ID is invalid.	• Check whether the A30BD-PCF or A30CD-PCF has been mounted normally. • Replace the A30BD-PCF or A30CD-PCF.
04	The number of received frames is invalid.	• Check whether the communication cable has been connected firmly. • Check whether the communication cable has been broken. • Check whether there is a noise source near the PC.
05	A PC communication task is not active yet.	• Start the PC communication task.

2.6 LED Indications when Errors Occur at the PCPU

When the errors listed below occur, they are indicated by the "ERROR" LED on the front panel of the CPU module. The error message can be read on the error list monitor screen of the peripheral device.
For details on the operating procedure, refer to the operating manual for the peripheral device.

Table 2.15 LED Indications When Errors Occur at PCPU

A173UHCPU (S1) LED Indication ●:On ○:Off	A273UHCPU Front LED Indication	Error Cause	Error Check Timing	Operation when Error Occurs	Error Set Device	Corrective Action
●	LAY ERROR (SL■■) (Note) Base No. + slot No.	• The slot set in "system settings" contains no or different module.	At power-on At reset with reset key	• Start is disabled.	• System setting error flag (M2041) ON	• Match "system settings" with the actual module and reset with the reset key.
●	AXIS NO MULTIDEF	• There are overlapping axis number settings in "system settings".				
●	AMP NO SETTING	• Not one axis number is set in "system settings".				
—	PW NO SETTING	• When the ADU axis is set in "system settings", the servo power supply module (A230P) is not set.				
●	SYS.SET DATA ERR	• "System settings data" is not written. • "System settings data" was written without relative check, or was written with an error found in relative check. • Memory cassette battery is dead.				
●	AXIS NO. ERROR	• The axis number set in "system settings" is more than the number of control axis.				
●	I/O POINTS OVER	• The total I/O points of the PLC I/O modules set to the motion slots in "system settings" are more than 256 points.				
●	AMP TYPE ERROR■■ Axis No. (01 to 32)	• The amplifier type (MR-H-BN/MR-J2-B/MR-J2S-B) set in "system settings" differs from the actual amplifier type (MR-H-BN/MR-J2-B/MR-J2S-B)	At power-on of servo amplifier	• Only the corresponding axis is not put in servo ON status and cannot be started.		
—	ADU ERROR (SL■■) (Note) Base No. + slot No.	• ADU hardware fault.	At power-on (At reset with reset key)	• The corresponding ADU axis cannot be placed in servo ON status.	• Servo error detection flag (M2408+20n) ON • Servo error code device (D08+20n) set	• Change the ADU.
For servo error ● For warning ○	SV.ERROR■■■■(■■) Servo error code Axis No. (01 to 32) ▪E (**) indicates that the code is common to all axes.	• Servo error or warning occurrence	Any time	• For the MR-H-BN /MR-J2S-B axis, only that axis is put in servo OFF status. • For the ADU axis, processing is performed in accordance with the setting of "ADU servo error processing".	• Servo error detection flag (M2408+20n) ON • Servo error code device (D08+20n) set	• Remove the error cause and reset the servo error. If the servos of all axes return to normal after servo error reset, the LED indication goes off.

Table 2.15 LED Indications When Errors Occur at PCPU (Continued)

A173UHCPU (S1) LED Indication ●:On ○:Off	A273UHCPU Front LED Indication	Error Cause	Error Check Timing	Operation when Error Occurs	Error Set Device	Corrective Action
	SV. ERROR■■■■(P■) Servo error code Indicates the "n"th servo power supply module.	• Servo power supply module (A230P)-detected servo error or warning occurrence	Any time	• In that line, all axes are put in servo OFF status.	• Servo error detection flag (M2408+20n) ON • Servo error code device (D08+20n) set	• Remove the error cause and reset the servo error. If the servos of all axes return to normal after servo error reset, the LED indication goes off.
	SYS. ERR. ■■■■(P■) System error code (major error) detected by servo power supply module Indicates the "n"th servo power supply module. Indicates the system error which is independent of the servo power supply module line.	• Servo power supply module (A230P)-detected system error (major error) occurrence		• In that line, all axes are put in servo OFF status.	• Major error detection flag (M2407+20n) ON • Major error code device (D07+20n) set	• Remove the error cause and give all-axis servo ON command. If all axes are put in servo ON status properly, the LED goes off.
●	SL■■ UNIT ERROR (Note) Base No. + slot No.	• Motion slot module fault detection (During operation, the module has come off or is coming off)			• Motion slot module fault detection flag (M2047) ON	• Switch power off and load the module properly.
●	PCPU WDT ERR. ■■■ PCPU WDT error code	• PCPU WDT error occurrence		• All axes stop immediately.	• PCPU WDT error flag (M9073) ON • PCPU WDT error cause (D9184) set	• Refer to Sections 3.3, 3.4.

(Note) Indicates the base number, slot number and slot information in error.

(SL□□)
- Slot Number in error
  - 0: I/O slot 0
  - to
  - 7: I/O slot 7
- Base number in error
  - 0: CPU base
  - 1: Motion extension base 1
  - 2: Motion extension base 2
  - 3: Motion extension base 3
  - 4: Motion extension base 4

REMARK

n in Table 2.15 (Error Set Device) is the value corresponding to the axis number.

Axis No.	n	Axis No.	n	Axis No.	n	Axis No.	n
1	0	9	8	17	16	25	24
2	1	10	9	18	17	26	25
3	2	11	10	19	18	27	26
4	3	12	11	20	19	28	27
5	4	13	12	21	20	29	28
6	5	14	13	22	21	30	29
7	6	15	14	23	22	31	30
8	7	16	15	24	23	32	31

Make the following calculation to find the device number corresponding to each axis.

(Example) M2408+20n (Servo error detection flag) = M2408+20×31=M3028
D07+20n (Major error code device) = D07+20×31=D627

APPENDIX3 SPECIAL RELAYS AND SPECIAL REGISTERS

3.1 Special Relays (SP, M)

The special relays are internal relays with fixed applications in the programmable controller. Accordingly, they must not be turned ON and OFF in sequence programs (those (Note-1) and (Note-2) in the table are exceptions).

Table 3.1 Special Relay List

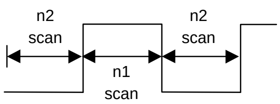
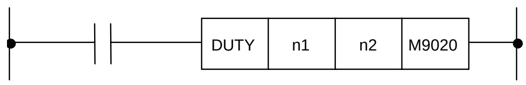
Number	Name	Stored Data	Explanation
M9000 (Note-1)	Fuse blown	OFF Normal ON There is a module with a blown fuse.	● Comes ON even if there is only one output module with a blown fuse, and remains ON even after return to normal.
M9002 (Note-1)	I/O unit verify error	OFF Normal ON Error	● Comes ON if there is a discrepancy between the actual I/O modules and the registered information when the power is turned on.
M9004	MINI link error	OFF Normal ON Error	● Turns ON if there is an error-detected module at the master station of MINI link. Remains ON if the module returns to normal.
M9005 (Note-1)	AC DOWN detection	OFF AC DOWN detected ON AC DOWN not detected	● Comes ON when there is a momentary power interruption not exceeding 20 ms; reset by turning the power OFF then ON again.
M9006	Battery low	OFF Normal ON Low battery voltage	● Comes ON when the battery voltage falls below the stipulated value; goes OFF when normal battery voltage is re-established.
M9007 (Note-1)	Battery low latch	OFF Normal ON Low battery voltage	● Comes ON when the battery voltage falls below the stipulated value; remains ON even after normal battery voltage is re-established.
M9008 (Note-1)	Self-diagnostic error	OFF No error ON Error	● Comes ON when an error occurs as a result of self-diagnosis.
M9009	Annunciator detection	OFF No F number detected ON F number detected	● Comes ON when OUT F, SET F instructions are executed. Goes OFF when 0 is stored in D9124.
M9011 (Note-1)	Operation error flag	OFF No error ON Error	● Comes on when an operation error occurs during execution of an application instruction; remains ON even after the error is cleared.
M9012	Carry flag	OFF Carry OFF ON Carry ON	● Carry flag used in an application instruction.
M9016	Data memory clear flag	OFF No processing ON Output cleared	● When M9016 is ON, all data memory contents, including those in the latch range but with the exception of special relays/registers, are cleared on reception of remote RUN from a computer or other device.
M9017	Data memory clear flag	OFF No processing ON Output cleared	● When M9017 is ON, all data memory contents that are not latched, with the exception of special relays/registers, are cleared on reception of remote RUN from a computer or other device.
M9020	User timing clock No.0		● Relay repeats ON/OFF switching at fixed scan intervals. ● Starts from the OFF status when the power is turned ON or on resetting. ● The ON/OFF intervals are set with the DUTY instruction. 
M9021	User timing clock No.1		
M9022	User timing clock No.2		
M9023	User timing clock No.3		
M9024	User timing clock No.4		

Table 3.1 Special Relay List (Continued)

Number	Name	Stored Data	Explanation
M9025 (Note-1)	Clock data set request	OFF No processing ON Data set request	● Writes the clock data stored in D9025 to D9028 to the clock devices after execution of the END instruction in the scan in which M9025 is switched ON.
M9026	Clock data error	OFF No error ON Error	● Comes ON when there is an error in he clock data (D9025 to D9028) values. OFF when there is no error.
M9028 (Note-2)	Clock data read request	OFF No processing ON Read request	● When M2098 is ON, the clock data is read to D9025 to D9028 as BCD data.
M9029 (Note-2)	Data communication request batch processing	OFF Batch processing not performed ON Batch processing performed	● By turning ON M9029 in the sequence program, the data communication requests accepted during one scan are all handled at the END processing of that scan. ● Data communication request batch processing can be turned from ON/OFF to OFF/ON during RUN. ● The default is OFF. (The data communication requests are handled one by one at every END processing in their accepted order.)
M9030	0.1 second clock	0.05 SEC. 0.05 SEC.	● These relays generate the 0.1 second, 0.2 second, 1 second, 2 second, and 1 minute clocks. ● These relays do not go ON/OFF with each scan but when their respective fixed intervals have elapsed, even during a scan. ● These relays start from the OFF status when the power is turned on or resetting.
M9031	0.2 second clock	0.1 SEC. 0.1 SEC.	
M9032	1 second clock	0.5 SEC. 0.5 SEC.	
M9033	2 second clock	1 SEC. 1 SEC.	
M9034	1 minute clock	30 SEC. 30 SEC.	
M9036	Always ON	ON OFF	● Relay used for initialization during a sequence program or as a dummy contact for an application instruction. ● M9036 and M9037 retain their ON or OFF status regardless of the settings of the key switch on the front of the CPU, but M9038 and M9039 change in accordance with the key switch status. They go OFF when the key switch is set to the STOP position. When the key switch is at a position other than STOP, M9038 comes ON for one scan only, and M9039 goes OFF for one scan only.
M9037	Always OFF	ON OFF	
M9038	ON for 1 scan only after RUN	ON OFF 1 scan	
M9039	RUN flag (OFF for 1 scan only after RUN)	ON OFF 1 scan	
M9040	PAUSE enable coil	OFF PAUSE disable ON PAUSE enabled	● When the RUN/STOP key switch is set to PAUSE or the remote PAUSE contact is turned on, provided M9040 is ON, the PAUSE status is established and M9041 comes ON.
M9041	PAUSE status contact	OFF PAUSE not in effect ON PAUSE in effect	
M9042	STOP status contact	OFF STOP not in effect ON STOP in effect	● ON when the RUN/STOP key switch is set to STOP.
M9043	Sampling trace completed	OFF Sampling trace in progress ON Sampling trace completed	● Comes ON on completion of the number of sampling traces set in the parameters are completed after execution of the STRA instruction. After that, it is reset by execution of the STRAR instruction.
M9044	Sampling trace	0→1 Same as STRA execution 1→0 Same as STRAR execution	● Turning M9044 ON/OFF enables the STRA / STRAR instruction to be executed simulatively. (M9044 is forced to be turned ON/OFF by the peripheral device.) The STRA instruction is executed when M9044 turns from OFF to ON. The STRAR instruction is executed when M9044 turns from ON to OFF. The sampling trace condition is governed by D9044.
M9045	Watchdog timer (WDT) reset	OFF WDT is not reset. ON WDT is reset.	● Turning M9045 ON resets the WDT when the ZCOM instruction or data communication request batch processing is executed. (Used when the scan time exceeds 200ms.)
M9046	Sampling trace	OFF Trace not in progress ON Trace in progress	● ON during execution of a sampling trace
M9047	Sampling trace preparation	OFF Sampling trace stop ON Sampling trace start	● A sampling trace cannot be executed unless M9047 has been turned ON. When M9047 is turned OFF, the sampling trace is stopped.

Table 3.1 Special Relay List (Continued)

Number	Name	Stored Data	Explanation
M9049	Number of output characters selection	OFF Output until NULL code ON 16 characters output	● When M9049 is OFF, output continues until the NULL (00H) code. When M9049 is ON, ASCII code for 16 characters is output.
M9052 (Note-2)	SEG instruction switch	OFF 7-segment display ON I/O part refresh	● When M9052 is ON it is executed as the I/O partial refresh instruction. When M9052 is ON, it is executed as the 7-segment display instruction.
M9053 (Note-2)	EI/DI instruction switch	OFF Sequence interrupt control ON Link interrupt control	● Turn ON when a link refresh enable/disable (EI, DI) instruction is executed.
M9054	STEP RUN flag	OFF STEP RUN not in effect ON STEP RUN in effect	● ON when the RUN/STOP key switch is set to the RUN position.
M9055	Status latch completion flag	OFF Not completed ON Completed	● Comes ON when status latch is completed. Goes OFF on execution of a reset instruction.
M9056	Main side P/I setting request	ON During P/I set request OFF Other than during P/I set request	● Turns ON the P/I set request at completion of transfer of the other program (e.g. subprogram when the main program is during run) during run. Automatically turned OFF at completion of P/I setting.
M9057	Sub side P/I setting request	ON During P/I set request OFF Other than during P/I set request	
M9058	Main side P/I setting completion	Turns ON instantaneously at completion of P/I setting.	● Turns ON instantaneously at completion of P/I setting and turns OFF immediately.
M9059	Sub side P/I setting completion	Turns ON instantaneously at completion of P/I setting.	
M9065	Split processing execution detection	OFF Not during split processing ON During split processing	● ON during execution of the instruction for AD57(S1) or AD58 in split processing and turns OFF at completion of execution (split processing is not performed).
M9066 (Note-2)	Split processing request flag	OFF Batch processing ON Split processing	● M9066 is turned ON to split-process the instruction which is designed for AD57(S1) or AD58 and has long processing time since that instruction increases the scan time substantially.
M9070 (Note-2)	A8UPU/A8PUJ search time	OFF Without read time reduction ON Read time reduction	● Turned ON to reduce the time required for the A8UPU/A8PUJ to search. (In this case, the scan time of the CPU increases 10%.)
M9081	Communication request registration area busy signal	OFF Communication request registration areas free ON No communication request registration areas free	● Turns ON when there are no free registration areas among the 32 areas used for registering the standby instructions (FROM/TO) to be given to the MNET/MINI(-S3).
M9084 (Note-2)	Error check	OFF Error check executed ON No error check	● Set whether or not the error check shown below is executed on END instruction processing. (Used to shorten END instruction processing time.) (1) Blown fuse check (2) I/O module verification check (3) Battery check
M9091 (Note-1)	Instruction error flag	OFF No error ON Error occurrence	● Turns ON at occurrence of an instruction-related error. Remains ON if the condition returns to normal.
M9094 (Note-2) (Note-3)	I/O change flag	OFF Not changed ON Changed	● After setting the first I/O number of the changed I/O module to D9094, turning M9094 ON enables the I/O module to be changed online. (Only one module may be changed in single setting.) ● When making an I/O change during RUN, use the program or the test mode of the peripheral device. During STOP, use the test mode of the peripheral device. ● Do not change the RUN/STOP mode to the other until I/O change is finished.
M9100	Presence/absence of SFC program	OFF SFC program absent ON SFC program present	● Turns ON when the SFC work area is secured for the SFC program registered. ● OFF when there is no SFC program registered or the SFC work area is not secured.
M9101 (Note-2)	Start/stop of SFC program	OFF SFC program stop ON SFC program start	● Turned ON by the user to start the SFC program. Turn OFF to turn OFF the operation output of the execution step and stop the SFC program.
M9102 (Note-2)	Starting status of SFC program	OFF Initial start ON Continuous start	● Choose the start step when the SFC program is restarted by M9101. ON : The execution conditions at an SFC program stop are all cleared and the program is started at the initial step of block 0. OFF : The SFC program is started at the execution block and execution step it had been stopped. ● Once turned ON, M9102 is latched (compensated for power failure) by the system.
M9103 (Note-2)	Presence/absence of consecutive transition	OFF Without consecutive transition ON With consecutive transition	● Select whether or not to execute all the steps whose transition conditions have held within one scan when the transition conditions of consecutive steps have all held. ON : Executed consecutively. (With consecutive transition) OFF : One step is executed at each scan. (Without consecutive transition)
M9104	Consecutive transition inhibit flag	OFF Transition finished ON Transition not executed	● Turns ON when consecutive transition is not executed during consecutive transition, and turns OFF when the transition of one step is finished. Describing M9104 under the AND condition as a transition condition inhibits the consecutive transition of the corresponding step.

Table 3.1 Special Relay List (Continued)

<table>
<tr><th>Number</th><th>Name</th><th>Stored Data</th><th>Explanation</th></tr>
<tr><td>M9108
(Note-2)</td><td>Step transition monitoring timer start(Corresponding to D9108)</td><td rowspan="7">OFF Monitoring timer reset
ON Monitoring timer start</td><td rowspan="7">● Turned ON to start the timing of the step transition monitoring timer. Turn OFF to reset the monitoring timer.</td></tr>
<tr><td>M9109
(Note-2)</td><td>Step transition monitoring timer start(Corresponding to D9109)</td></tr>
<tr><td>M9110
(Note-2)</td><td>Step transition monitoring timer start(Corresponding to D9110)</td></tr>
<tr><td>M9111
(Note-2)</td><td>Step transition monitoring timer start(Corresponding to D9111)</td></tr>
<tr><td>M9112
(Note-2)</td><td>Step transition monitoring timer start(Corresponding to D9112)</td></tr>
<tr><td>M9113
(Note-2)</td><td>Step transition monitoring timer start(Corresponding to D9113)</td></tr>
<tr><td>M9114
(Note-2)</td><td>Step transition monitoring timer start(Corresponding to D9114)</td></tr>
<tr><td>M9180</td><td>Active step sampling trace completion flag</td><td>OFF Trace start
ON Trace completion</td><td>● Turns ON at completion of sampling trace of all specified blocks, and turns OFF at a sampling trace start.</td></tr>
<tr><td>M9181</td><td>Active step sampling trace execution flag</td><td>OFF Trace not yet executed
ON Trace being executed</td><td>● Turns ON during execution of sampling trace, and turns OFF at completion or stop.</td></tr>
<tr><td>M9182
(Note-2)</td><td>Active step sampling trace enable</td><td>OFF Trace disable/stop
ON Trace enable</td><td>● Select whether to enable or disable sampling trace execution.
ON : Sampling trace execution is enabled.
OFF : Sampling trace execution is disabled.
Turn it OFF during sampling trace execution to stop trace.</td></tr>
<tr><td>M9196
(Note-2)</td><td>Operation output at block stop</td><td>OFF Coil output OFF
ON Coil output ON</td><td>● Select the operation output at a block stop.
ON : The ON/OFF status of the coil used for the operation output of the step executed at a block stop is retained.
OFF : All coil outputs are turned OFF. (The operation output provided by the SET instruction is retained independently of whether M9196 is ON or OFF.)</td></tr>
<tr><td>M9197
•
M9198</td><td>Fuse blown-I/O verify error indication switching</td><td>ON/OFF combination of M9197 and M9198 is changed to switch indication.</td><td><table><tr><th>M9197</th><th>M9198</th><th>Display Range</th></tr><tr><td>OFF</td><td>OFF</td><td>X/Y0 to 7F0 states</td></tr><tr><td>ON</td><td>OFF</td><td>X/Y800 to FF0 states</td></tr><tr><td>OFF</td><td>ON</td><td>X/Y1000 to 17F0 states</td></tr><tr><td>ON</td><td>ON</td><td>X/Y1800 to 1FF0 states</td></tr></table>● The I/O module numbers of the fuse blown module indication (D9100 to D9107) and I/O module verify error indication (D9116 to D9123) are changed.
● Indication is changed at END.</td></tr>
<tr><td>M9199</td><td>Online sampling trace/status latch data restoration</td><td>OFF Data not restored
ON Data restored</td><td>● Restores the set data stored in the CPU to enable resumption of sampling trace/status latch when it is executed.
● Turn M9199 ON when sampling trace/status latch is executed again. (Data need not be written again by peripheral device.)</td></tr>
</table>

Device number	Signal name	Signal direction	Refresh cycle	Fetch cycle
M9073	PCPUWDT error flag	PCPU→SCPU	END	
M9074	PCOU ready completion flag			
M9075	Test mode flag			
M9076	External rapid stop input flag			
M9077	Manual pulse generator axis setting error flag			
M9078	Test mode request error flag			
M9079	Servo program setting error flag			

POINTS

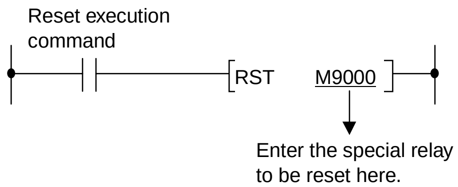
(1) All special relays, M, are turned OFF by turning the power, OFF, performing latch clear, or resetting with the RESET key switch.
When the RUN key switch is set to "STOP", the special relay settings are retained.

(2) The special relays marked "Note-1" in the table above remain "ON" even after a return to normal. They must therefore be turned OFF by using one of the following methods.

(a) Method using the user program
Insert the ladder block at right into the program and turn the reset execution command contact ON to clear the special relay.

(b) Method using a peripheral device
Perform a forced reset using the test function of the peripheral device.
For details on this operation, refer to the manual for the peripheral device.

(c) Turn the special relay OFF by setting the RESET key switch on the front panel of the CPU module to "RESET".



(3) The ON/OFF status of special relays marked "Note-2" in the table above is controlled by the sequence program.

(4) The ON/OFF status of special really marks "Note-3"in the tables above is controlled by the test mode for the peripheral device.

(5) The special relays marked "Note-4" are reset only when power is switched from OFF to ON.

3.2 Special Registers (SP.D)

The special registers are data registers used for specific purposes in the programmable controller. Therefore, do not write data to the special registers in the program (with the exception of those whose numbers are marked(Note-2) in the table).
Of the special relays, those from D9180 to D9199 are used for positioning control.

Table 3.2 Special Register List

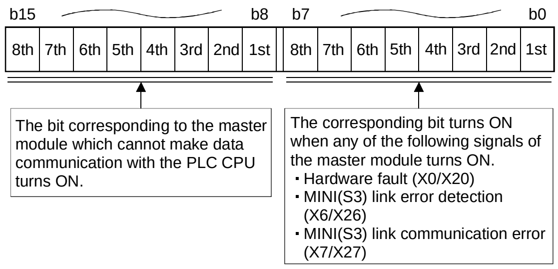
Number	Name	Stored Data	Explanation
D9000	Fuse blown	Number of module with blown fuse	● When modules with a blown fuse are detected, the lowest I/O number of the detected modules is stored in hexadecimal in this special relay. (Example: Blown fuses at the output modules Y50 to 6F... "50" is stored in hexadecimal.) For monitoring at a peripheral device, use hexadecimal display monitor operations. (Cleared when the contents of D9100 are all "0".)
D9002	I/O unit verify error	I/O module verification error module number	● If I/O modules that do not match the registered data are detected when the power is turned on, the first I/O number of the lowest module number among the detected modules is stored in hexadecimal (the storage method is the same as for D9000). When monitoring with a peripheral device, use a hexadecimal display monitoring operation. (Cleared when all contents of D9116 to D9123 are reset to zero.)
D9004 (Note-1)	MINI link error	Parameter-set (1 to 8 modules) states are stored.	● Stores the MINI(S3) link error detection states of the loaded master modules. 
D9005 (Note-4)	AC DOWN counter	AC DOWN occurrence count	● 1 is added to the stored value each time the input voltage becomes 80% or less of the rating while the CPU module is performing an operation, and the value is stored in BIN code.
D9008 (Note-4)	Self-diagnostic error	Self-diagnostic error number	● 1 is added to the stored value when an error is found as a result of self-diagnosis, the error number, and the value is stored in BIN code.
D9009	Annunciator detection	F number at which external failure has occurred	● When one of F0 to 2047 is turned on by OUT F or SET F , the F number detected earliest among the F numbers which have been turned on is stored in BIN code. ● D9009 can be cleared by executing a RST F or LEDR instruction. If another F number has been detected, the clearing of D9009 causes the next number to be stored in D9009.
D9010	Error step	Step number at which operation error has occurred	● If access to the module which has been set as a special module could not be made at a STOP→RUN time, the module No. of the special module is stored. ● When an operation error occurs during execution of an application instruction, the step No. where the error occurred is stored in BIN cod, and thereafter, every time an operation error occurs the contents of D9010 are updated.
D9011	Error step	Step number at which operation error has occurred	● When an operation error occurs during execution of an application instruction, the step number at which the error occurs is stored in this register in BIN code. Since storage is executed when M9011 changes from OFF to ON, the contents of D9011 cannot be updated unless it is cleared by the user program.
D9014	I/O control mode	I/O control mode number	● The set control mode is represented as follows: 3: I/O in refresh mode

Table 3.2 Special Register List (Continued)

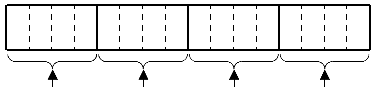
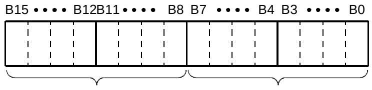
Number	Name	Stored Data	Explanation
D9015	CPU operating states	Operating states of CPU	● The CPU operation states indicated in the figure below are stored in D9015. B15 • • • • B12B11 • • • • B8 B7 • • • • B4 B3 • • • • B0  CPU key switch (Remains unchanged in remote run/stop mode) 0 RUN 1 STOP 2 PAUSE * 3 STEP RUN Remote RUN/STOP by parameter setting 0 RUN 1 STOP 2 PAUSE* Status in program 0 Other than below 1 STOP instruction execution Remote RUN/STOP by computer 0 RUN 1 STOP 2 PAUSE* *: When the CPU is in the RUN status and M9040 is OFF, the CPU remains in RUN mode even if set to PAUSE.
D9016	Program number	Sequence program in execution is stored in BIN.	● Stores the currently executed sequence program with any of the following code numbers. 0 : ROM main 3 : RAM sub 2 6 : ROM sub 2 9 : EEP-ROM sub 1 1 : RAM main 4 : RAM sub 3 7 : ROM sub 3 A : EEP-ROM sub 2 2 : RAM sub 1 5 : ROM sub 1 8 : EEP-ROM main B : EEP-ROM sub 3
D9017	Scan time	Minimum scan time (10 ms units)	● At each END instruction, if the scan time is shorter than the contents of D9017, the new value is stored in this register. In other words, the minimum value for scan time is stored in D9017, in BIN code.
D9018	Scan time	Scan time (10 ms units)	● The scan time is stored in BIN code at each END instruction and is always rewritten.
D9019	Scan time	Maximum scan time (10 ms units)	● At each END instruction, if the scan time is longer than the contents of D9019, the new value is stored in this register. In other words, the maximum value for scan time is stored in D9019, in BIN code.
D9020 (Note-2)	Constant scan	Constant scan time (user-specified in 10 ms units)	● When user programs are executed at fixed intervals, used to set the execution intervals, in 10 ms units. 0 : Constant scan function not used 1 to 200 : Constant scan function used program executed at intervals of (set value)×10 ms.
D9021	Scan time	Scan time (1 ms units)	● The scan time is stored in BIN code at each END instruction and is always rewritten.
D9022	Time	Time	● Incremented by 1 per second.
D9025 (Note-2)	Clock data	Clock data (year, month)	● The year (last two digits) and month are stored in BCD code in D9025 as shown below. B15 • • • • B12B11 • • • • B8 B7 • • • • B4 B3 • • • • B0  Year Month Example : July, 1993 H9307

Table 3.2 Special Register List (Continued)

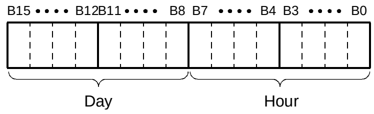
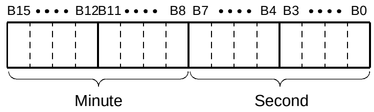
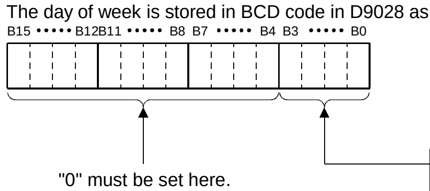
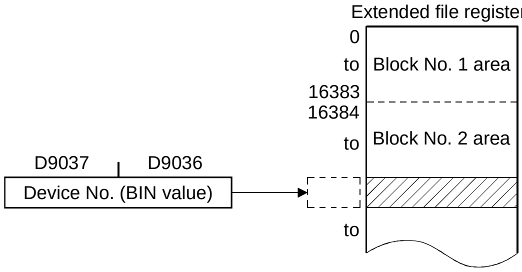
Number	Name	Stored Data	Explanation
D9026 (Note-2)	Clock data	Clock data (day, hour)	● The day and hour are stored in BCD code in D9026 as shown below.  B15 •••• B12 B11 •••• B8 B7 •••• B4 B3 •••• B0 Day Hour Example : 31st, 10th hour H3110
D9027 (Note-2)	Clock data	Clock data (minute, second)	● The minute and second are stored in BCD code in D9027 as shown below.  B15 •••• B12 B11 •••• B8 B7 •••• B4 B3 •••• B0 Minute Second Example : 35ms, 48s H3548
D9028 (Note-2)	Clock data	Clock data (0, day of week)	● The day of week is stored in BCD code in D9028 as shown below.  B15 ••••• B12 B11 ••••• B8 B7 ••••• B4 B3 ••••• B0 "0" must be set here. Example : Friday H0005 Day of week 0 Sunday 1 Monday 2 Tuesday 3 Wednesday 4 Thursday 5 Friday 6 Saturday
D9035	Extended file register	Used block No.	● The block No. of the extended file registers in current use is stored in BIN.
D9036 D9037	For specifying extended file register device number	Device number for direct access to any device of extended file register	● Using a BIN value, specify in two words of D9036 and D9037 the device number of the extended file register to be accessed directly. Specify any of the consecutive device numbers starting at R0 in block No. 1, regardless of the block No.  Extended file registers 0 to Block No. 1 area 16383 16384 to Block No. 2 area D9037 D9036 Device No. (BIN value) to

Table 3.2 Special Register List (Continued)

Number	Name	Stored Data	Explanation
M9038 (Note-2) M9039 (Note-2)	LED display priority	Priorities 1 to 4 Priorities 5 to 7	● The element numbers for priorities 1 to 4 (D9038) and 5 to 7 (D9039) for the lighting (or flashing) of the ERROR LED when an error occurs, are set and changed. B15••••B12 B11••••B8 B7 ••••B4 B3 ••••B0 B15••••B12 B11••••B8 B7 ••••B4 B3 ••••B0 – 7 6 5 4 3 2 1(Position) Priority Even if "0" is set, errors which cause CPU operation to stop (including parameter settings) are unconditionally displayed on the LED display. Default values: D9038=H4321 D9039=H0765 Element No. / Content: 0. Not displayed 1. I/O verify, fuse blown 2. Special module, Link parameter, Operation error 3. CHK instruction error 4. Annunciator 5. LED instruction-related 6. Battery error 7. Clock data
D9044	For sampling trace	Step or time for sampling trace	● When M9044 is turned ON/OFF by the peripheral device to activate the $\boxed{\text{STRA}}$ or $\boxed{\text{STRAR}}$ sampling trace instruction, the value stored in D9044 is used as a sampling trace condition. Scan - 0 Time - Time (10ms increments) } Stored in BIN
D9049	SFC work area	Extended file register block No.	● Stores the block No. of the extended file registers used as an SFC work area. Upper 8 bits .... Block No. is stored. Lower 8 bits .... Step number is stored.
D9050	SFC program error number	Error number which occurred in SFC program	● Stores in BIN the error number which occurred in the SFC program. 0 : No error 80 : SFC program parameter error 81 : Simultaneously executed step count excess 82 : Block starting error 83 : SFC program operation error
D9051	Error block	Block number where error occurred	● Stores in BIN the block number where error occurred in the SFC program. Note that if error 82 occurred, the start source block number is stored.
D9052	Error step	Step number where error occurred	● Stores in BIN the step number where error 83 occurred in the SFC program. When error 80 or 81 occurred, "0" is stored. When error 82 occurred, the block starting step number is stored.
D9053	Error transition	Transition condition number where error occurred	● Stores in BIN the transition condition number where error 83 occurred in the SFC program. When error 80, 81 or 82 occurred, "0" is stored.
D9054	Error sequence step	Sequence step number where error occurred	● Stores in BIN the transition condition or operation output sequence step number where error 83 occurred in the SFC program.
D9055	Status latch	Status latch step	● Stores in BIN the step number which was being executed when status latch was executed.
D9072	PC communication check	Computer link data check	● Used when making a self-loopback check.
D9081	Number of free communication request registration areas	Number of free communication request registration areas	● Stores the number of free request registration areas for communication with the MNET/MINI(-S3). (Max. 32 areas)
D9085	Time check value setting register	Default value = 10s	● Stores the time check value for execution of the link instruction (ZNRD, ZNWR) for MELSECNET/10. ● Setting range : 1 to 65535s ● Setting increments : 1s ● When the setting is 0, operation is performed with the default value of 10s.
D9090 (Note-1)	Special function module count excess	Special function module count excess	● Stores in BIN the value found by dividing the "first I/O number of the last registered special function module" by 16 when the number of registerable special function modules is exceeded.
D9091 (Note-1)	Detail error number	Self-diagnostic detail error number	● Stores in BIN the detail error number at self-diagnosis occurrence.
D9094 (Note-2) (Note-3)	Replaced I/O starting I/O number	Replaced I/O starting I/O number	● Stores in BIN the upper two digits of the first I/O number of the I/O module dismounted/mounted online. Example: Input module X2F0→H2F

Table 3.2 Special Register List (Continued)

Number	Name	Stored Data	Explanation
D9100 to D9107	Fuse blown module	16 point-based bit pattern of fuse blown modules	● Stores in a bit pattern the fuse-blown output module numbers (16 point increments). (When parameter setting was made, the preset numbers are used.) ● The fuse blown states of the output modules on remote stations are also detected. Bit: 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0 D9100: 0 0 0 1 (YC0) 0 0 0 1 (Y80) 0 0 0 0 0 0 0 0 D9101: 1 (Y1F0) 0 0 0 0 1 (Y1A) 0 0 0 0 0 0 0 0 0 0 D9107: 0 0 0 0 1 (Y7B0) 0 0 0 0 0 0 0 1 (Y730) 0 0 0 Indicates fuse-blown state. ● Turn ON/OFF M9197 and M9198 to change the displayed I/O module number range. ● The fuse-blown module data are cleared by turning OFF M9000 (fuse blown).
D9116 to D9123	I/O module verify error	16 point-based bit pattern of verify error modules	● Stores the I/O module numbers (16 point increments) when the I/O modules whose I/O module information is different from the registered information are detected at power-on. (When parameter setting was made, the preset I/O module numbers are used.) ● The I/O module information of remote stations is also detected. Bit: 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0 D9116: 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 (X/Y 0) D9117: 0 0 0 0 0 0 1 (X/Y 190) 0 0 0 0 0 0 0 0 0 D9123: 0 1 (X/Y 7F0) 0 0 0 0 0 0 0 0 0 0 0 0 0 0 Indicates I/O module verify error. ● Turn ON/OFF M9197 and M9198 to change the displayed I/O module number range. ● The verify error data are cleared by turning OFF M9002 (verify error).
D9124	Annunciator detection quantity	Number of detected annunciators	● When one of F0 to 255 is turned on by an $\boxed{\text{OUT F}}$ or $\boxed{\text{SET F}}$, 1 is added to the contents of D9124. When the $\boxed{\text{RST F}}$ or $\boxed{\text{LED R}}$ instruction is executed, 1 is subtracted from the contents of D9124. (This may also be done with the INDICATOR RESET switch on the front of the CPU module.) The number of annunciators that has been turned on by $\boxed{\text{OUT F}}$ or $\boxed{\text{SET F}}$ is stored in D9124: the maximum stored value is 8.

Table 3.2 Special Register List (Continued)

<table>
<tr><th>Number</th><th>Name</th><th>Stored Data</th><th>Explanation</th></tr>
<tr><td>D9125
to
D9132</td><td>Annunciator detection number</td><td>Annunciator detection number</td><td>

- When F numbers in the range F0 to 2047 are turned on by OUT F or SET F, they are entered in D9125 to D9132 in ascending order of register numbers.
  An F number which is turned off by RST F is erased from D9125 to D9132, and the contents of the data registers following the one where the erased F number was stored are each shifted to the preceding data register. When the LEDR instruction is executed, the contents of D9125 to D9132 are shifted upward by one.
  (This may also be done with the INDICATOR RESET switch on the front of the CPU module.)
  When there are 8 annunciator detections, a 9th one is not stored in D9125 to D9132 even if detected.

<table>
<tr><th></th><th></th><th>SET F50</th><th>SET F25</th><th>SET F99</th><th>RST F25</th><th>SET F15</th><th>SET F70</th><th>SET F65</th><th>SET F38</th><th>SET F110</th><th>SET F151</th><th>SET F210</th><th>LEDR</th><th></th></tr>
<tr><td>D9009</td><td>0</td><td>50</td><td>50</td><td>50</td><td>50</td><td>50</td><td>50</td><td>50</td><td>50</td><td>50</td><td>50</td><td>50</td><td>99</td><td>··· detection number</td></tr>
<tr><td>D9124</td><td>0</td><td>1</td><td>2</td><td>3</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>8</td><td>8</td><td>··· detection quantity</td></tr>
<tr><td>D9125</td><td>0</td><td>50</td><td>50</td><td>50</td><td>50</td><td>50</td><td>50</td><td>50</td><td>50</td><td>50</td><td>50</td><td>50</td><td>99</td><td rowspan="8">detection number</td></tr>
<tr><td>D9126</td><td>0</td><td>0</td><td>25</td><td>25</td><td>99</td><td>99</td><td>99</td><td>99</td><td>99</td><td>99</td><td>99</td><td>99</td><td>15</td></tr>
<tr><td>D9127</td><td>0</td><td>0</td><td>0</td><td>99</td><td>0</td><td>15</td><td>15</td><td>15</td><td>15</td><td>15</td><td>15</td><td>15</td><td>70</td></tr>
<tr><td>D9128</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>70</td><td>70</td><td>70</td><td>70</td><td>70</td><td>70</td><td>65</td></tr>
<tr><td>D9129</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>65</td><td>65</td><td>65</td><td>65</td><td>65</td><td>38</td></tr>
<tr><td>D9130</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>38</td><td>38</td><td>38</td><td>38</td><td>110</td></tr>
<tr><td>D9131</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>110</td><td>110</td><td>110</td><td>151</td></tr>
<tr><td>D9132</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>151</td><td>151</td><td>210</td></tr>
</table>
</td></tr>
</table>

POINTS

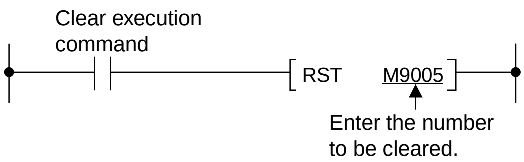
(1) All special register data is cleared by the power-off, latch clear, and reset operations. The data is retained when the RUN/STOP key switch is set to STOP.

(2) The contents of the special relays marked “Note-1” in the table above are not cleared even after the normal status is restored. To clear the contents, use one of the following methods:

(a) Using a user program
Insert the ladder block shown at right into the program and turn on the clear execution command contact to clear the contents of the register.

(b) Using a peripheral device
Using the test function of a peripheral device, set the register to "0" by using current value change or forced reset.
For details on the operation involved, refer to the manual for the relevant peripheral device.

(c) Set the special register to "0" by setting the RESET key switch on the front of the CPU to the RESET position.



(3) For special registers marked “Note-2”, data is written in the sequence program.

(4) For the special registers marked “Note-3”, data are written in the test mode of the peripheral device.

(5) The special registers marked “Note-4” are cleared only when power is switched from OFF to ON.

Table 3.2 Special Register List (Continued)

<table>
<tr><th>Number</th><th>Name</th><th>Stored Data</th><th>Explanation</th></tr>
<tr><td>D752</td><td>Manual pulse generator 1 (P1) smoothing magnification setting area</td><td rowspan="3">Manual pulse generator smoothing magnification setting area</td><td rowspan="3">● Stores the smoothing time constant of the manual pulse generator.
● The smoothing time constant is calculated by the following expression. Smoothing time constant (t) = (smoothing magnification + 1) × 56.8 [ms] Note that the setting range of the smoothing magnification is 0 to 59.</td></tr>
<tr><td>D753</td><td>Manual pulse generator 2 (P2) smoothing magnification setting area</td></tr>
<tr><td>D754</td><td>Manual pulse generator 3 (P3) smoothing magnification setting area</td></tr>
<tr><td>D776
to
D791</td><td>Axis 1 to 32 limit switch output status storing area</td><td>Limit switch output status storing area
1 : ON
0 : OFF</td><td>● Stores 1 or 0 to indicate the output status (ON/OFF) to the limit switch output AY42 set on the peripheral device.
1 : ON
0 : OFF
● May be used to export the limit switch output data in a sequence program.
<table>
<tr><th></th><th>b15</th><th>b14</th><th>b13</th><th>b12</th><th>b11</th><th>b10</th><th>b9</th><th>b8</th><th>b7</th><th>b6</th><th>b5</th><th>b4</th><th>b3</th><th>b2</th><th>b1</th><th>b0</th></tr>
<tr><td>D776</td><td>LY0F</td><td>LY0E</td><td>LY0D</td><td>LY0C</td><td>LY0B</td><td>LY0A</td><td>LY09</td><td>LY08</td><td>LY07</td><td>LY06</td><td>LY05</td><td>LY04</td><td>LY03</td><td>LY02</td><td>LY01</td><td>LY00</td></tr>
<tr><td></td><td colspan="8">For axis 2</td><td colspan="8">For axis 1</td></tr>
<tr><td>D777</td><td>LY1F</td><td>LY1E</td><td>LY1D</td><td>LY1C</td><td>LY1B</td><td>LY1A</td><td>LY19</td><td>LY18</td><td>LY17</td><td>LY16</td><td>LY15</td><td>LY14</td><td>LY13</td><td>LY12</td><td>LY11</td><td>LY10</td></tr>
<tr><td></td><td colspan="8">For axis 4</td><td colspan="8">For axis 3</td></tr>
</table>
<table>
<tr><th></th><th>b15</th><th>b14</th><th>b13</th><th>b12</th><th>b11</th><th>b10</th><th>b9</th><th>b8</th><th>b7</th><th>b6</th><th>b5</th><th>b4</th><th>b3</th><th>b2</th><th>b1</th><th>b0</th></tr>
<tr><td>D790</td><td>LYEF</td><td>LYEE</td><td>LYED</td><td>LYEC</td><td>LYEB</td><td>LYEA</td><td>LYE9</td><td>LYE8</td><td>LYE7</td><td>LYE6</td><td>LYE5</td><td>LYE4</td><td>LYE3</td><td>LYE2</td><td>LYE1</td><td>LYE0</td></tr>
<tr><td></td><td colspan="8">For axis 30</td><td colspan="8">For axis 29</td></tr>
<tr><td>D791</td><td>LYFF</td><td>LYFE</td><td>LYFD</td><td>LYFC</td><td>LYFB</td><td>LYFA</td><td>LYF9</td><td>LYF8</td><td>LYF7</td><td>LYF6</td><td>LYF5</td><td>LYF4</td><td>LYF3</td><td>LYF2</td><td>LYF1</td><td>LYF0</td></tr>
<tr><td></td><td colspan="8">For axis 32</td><td colspan="8">For axis 31</td></tr>
</table>
Each bit of D776 to D791 stores 1/0.
1) 1 : ON
2) 0 : OFF</td></tr>
<tr><td>D792
to
D799</td><td>Servo amplifier type</td><td>Servo amplifier type</td><td>● Stores the servo amplifier type specified in the system settings at power-on or rest.
<table>
<tr><th></th><th>b15 to b12</th><th>b11 to b8</th><th>b7 to b4</th><th>b3 to b0</th></tr>
<tr><td>D792</td><td>Axis 4</td><td>Axis 3</td><td>Axis 2</td><td>Axis 1</td></tr>
<tr><td>D793</td><td>Axis 8</td><td>Axis 7</td><td>Axis 6</td><td>Axis 5</td></tr>
<tr><td>D794</td><td>Axis 12</td><td>Axis 11</td><td>Axis 10</td><td>Axis 9</td></tr>
<tr><td>D795</td><td>Axis 16</td><td>Axis 15</td><td>Axis 14</td><td>Axis 13</td></tr>
<tr><td>D796</td><td>Axis 20</td><td>Axis 19</td><td>Axis 18</td><td>Axis 17</td></tr>
<tr><td>D797</td><td>Axis 24</td><td>Axis 23</td><td>Axis 22</td><td>Axis 21</td></tr>
<tr><td>D798</td><td>Axis 28</td><td>Axis 27</td><td>Axis 26</td><td>Axis 25</td></tr>
<tr><td>D799</td><td>Axis 32</td><td>Axis 31</td><td>Axis 30</td><td>Axis 29</td></tr>
</table>
Servo amplifier type
・0 ..... Unused axis
・1 ..... ADU (CPU base)
・2 ..... MR-□-B
・5 ..... ADU (motion extension base)</td></tr>
<tr><td>D9182
to
D9183</td><td>Test mode request error</td><td>Test mode request error</td><td>● Stores the starting axis data when the test mode request error flag (M9078) turns ON.
<table>
<tr><th></th><th>b15</th><th>b14</th><th>b13</th><th>b12</th><th>b11</th><th>b10</th><th>b9</th><th>b8</th><th>b7</th><th>b6</th><th>b5</th><th>b4</th><th>b3</th><th>b2</th><th>b1</th><th>b0</th></tr>
<tr><td>D9182</td><td>Axis 16</td><td>Axis 15</td><td>Axis 14</td><td>Axis 13</td><td>Axis 12</td><td>Axis 11</td><td>Axis 10</td><td>Axis 9</td><td>Axis 8</td><td>Axis 7</td><td>Axis 6</td><td>Axis 5</td><td>Axis 4</td><td>Axis 3</td><td>Axis 2</td><td>Axis 1</td></tr>
<tr><td>D9183</td><td>Axis 32</td><td>Axis 31</td><td>Axis 30</td><td>Axis 29</td><td>Axis 28</td><td>Axis 27</td><td>Axis 26</td><td>Axis 25</td><td>Axis 24</td><td>Axis 23</td><td>Axis 22</td><td>Axis 21</td><td>Axis 20</td><td>Axis 19</td><td>Axis 18</td><td>Axis 17</td></tr>
</table>
Stores starting/stopping state of each axis.
・0: Stopping
・1: Starting</td></tr>
</table>

Table 3.2 Special Register List (Continued)

<table>
<tr><th>Number</th><th>Name</th><th>Stored Data</th><th>Explanation</th></tr>
<tr><td>D9184</td><td>Cause of PCPU error</td><td>PCPU WDT error number</td><td>
● The PCPU WDT errors tabled below are stored in D9184.
<table>
<tr><th>Error Code</th><th>Error Cause</th></tr>
<tr><td>1</td><td>PCPU software fault 1</td></tr>
<tr><td>2</td><td>PCPU excessive operation frequency</td></tr>
<tr><td>3</td><td>PCPU software fault 2</td></tr>
<tr><td>30</td><td>Hardware fault between PCPU and SCPU</td></tr>
<tr><td>100 to 107
110 to 117
120 to 127
130 to 137
140 to 147</td><td>AC motor drive module CPU fault
100
Indicates the slot No.(0 to 7) where the AC motor drive module with the fault is loaded.
Indicates the stage No. of the base on which the AC motor drive module with the fault is loaded.
0: CPU base
1: Extension base 1st stage
2: Extension base 2nd stage
3: Extension base 3rd stage
4: Extension base 4th stage</td></tr>
<tr><td>200 to 207
210 to 217
220 to 227
230 to 237
240 to 247</td><td>Motion CPU base/extension base-loaded module hardware fault
200
Indicates the slot No.(0 to 7) where the module with the fault is loaded.
Indicates the stage No. of the base on which the module with the fault is loaded.
0: CPU base
1: Extension base 1st stage
2: Extension base 2nd stage
3: Extension base 3rd stage
4: Extension base 4th stage</td></tr>
<tr><td>250 to 253</td><td>Separated servo amplifier (MR-□-B) interface hardware fault
250
Faulty SSCNET No.
0: SSCNET 1
1: SSCNET 2
2: SSCNET 3
3: SSCNET 4</td></tr>
<tr><td>300</td><td>PCPU software fault 3</td></tr>
<tr><td>301</td><td>21 or more programs were started simultaneously by the CPSTART instruction of 8 or more points.
Up to 20 programs may be started simultaneously by the CPSTART instruction of 8 or more points.</td></tr>
</table>
</td></tr>
</table>

Table 3.2 Special Register List (Continued)

<table>
<tr><th>Number</th><th>Name</th><th>Stored Data</th><th>Explanation</th></tr>
<tr><td>D9185
to
D9187</td><td>Manual pulse generator axis setting error</td><td>Manual pulse generator axis setting error</td><td>
● Stores the definitions of manual pulse generator axis setting errors when the manual pulse generator axis setting error flag (M9077) turns ON.
<table>
<tr><td></td><td>b15</td><td>b14</td><td>b13</td><td>b12</td><td>b11</td><td>b10</td><td>b9</td><td>b8</td><td>b7</td><td>b6</td><td>b5</td><td>b4</td><td>b3</td><td>b2</td><td>b1</td><td>b0</td></tr>
<tr><td>D9195</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>P3</td><td>P2</td><td>P1</td><td>P3</td><td>P2</td><td>P1</td></tr>
</table>
→ Stores the axis setting errors of the manual pulse generators connected to P1 to P3 of A273EX.
・0: Normal
・1: Setting error
(Axis setting in any digit is other than 1 to 8)
→ Stores the smoothing magnification setting errors of the manual pulse generators connected to P1 to P3 of A273EX.
・0: Normal
・1: Setting error
(Axis setting in any digit is other than 1 to 59)
→ All turn to 0.
<table>
<tr><td>D9186</td><td>Axis 16</td><td>Axis 15</td><td>Axis 14</td><td>Axis 13</td><td>Axis 12</td><td>Axis 11</td><td>Axis 10</td><td>Axis 9</td><td>Axis 8</td><td>Axis 7</td><td>Axis 6</td><td>Axis 5</td><td>Axis 4</td><td>Axis 3</td><td>Axis 2</td><td>Axis 1</td></tr>
<tr><td>D9187</td><td>Axis 32</td><td>Axis 31</td><td>Axis 30</td><td>Axis 29</td><td>Axis 28</td><td>Axis 27</td><td>Axis 26</td><td>Axis 25</td><td>Axis 24</td><td>Axis 23</td><td>Axis 22</td><td>Axis 21</td><td>Axis 20</td><td>Axis 19</td><td>Axis 18</td><td>Axis 17</td></tr>
</table>
→ Stores 1-pulse input magnification setting error of each axis.
・0: Normal
・1: Setting error
(Input magnification of any axis is other than 1 to 100)
</td></tr>
<tr><td>D9189</td><td>Error program No.</td><td>Error program number</td><td>● Stores the subprogram number (range: 0 to 4095) affected by the error when the subprogram setting error flag (M9079) comes ON.
● If, once an error program number has been stored, an error occurs in another servo program, the program number of the program with the new error is stored.</td></tr>
<tr><td>D9190</td><td>Error item information</td><td>Servo program setting error number</td><td>
● Stores the error code corresponding to the setting item in error when the servo program setting error flag (M9079) turns ON.
<table>
<tr><th>Error Code</th><th>Error Definition</th></tr>
<tr><td>900</td><td>The servo program set in the SVST instruction does not exist.</td></tr>
<tr><td>901</td><td>The axis No. set in the SVST instruction differs from the axis No. set in the servo program.</td></tr>
<tr><td>902</td><td>The instruction code cannot be decoded. (There is an impossible instruction code.)</td></tr>
<tr><td>906</td><td>The servo program set in the SVST instruction has the unused axis in system settings.</td></tr>
<tr><td>Error item data</td><td>The servo program setting item set in the SVST instruction has an error.
The error item in Section 6.3 is stored.</td></tr>
</table>
</td></tr>
<tr><td>D9191
to
D9192</td><td>Servo amplifier loading information</td><td>Servo amplifier loading information</td><td>
● Stores the result of servo amplifier and optional slot loading status check made at power-on or reset.
<table>
<tr><td></td><td>b15</td><td>b14</td><td>b13</td><td>b12</td><td>b11</td><td>b10</td><td>b9</td><td>b8</td><td>b7</td><td>b6</td><td>b5</td><td>b4</td><td>b3</td><td>b2</td><td>b1</td><td>b0</td></tr>
<tr><td>D9191</td><td>Axis 16</td><td>Axis 15</td><td>Axis 14</td><td>Axis 13</td><td>Axis 12</td><td>Axis 11</td><td>Axis 10</td><td>Axis 9</td><td>Axis 8</td><td>Axis 7</td><td>Axis 6</td><td>Axis 5</td><td>Axis 4</td><td>Axis 3</td><td>Axis 2</td><td>Axis 1</td></tr>
<tr><td>D9192</td><td>Axis 32</td><td>Axis 31</td><td>Axis 30</td><td>Axis 29</td><td>Axis 28</td><td>Axis 27</td><td>Axis 26</td><td>Axis 25</td><td>Axis 24</td><td>Axis 23</td><td>Axis 22</td><td>Axis 21</td><td>Axis 20</td><td>Axis 19</td><td>Axis 18</td><td>Axis 17</td></tr>
</table>
<table>
<tr><th colspan="2">Servo amplifier loading status</th></tr>
<tr><td>0</td><td>No loading or ADU fault, MR-□-B power off or connection cable fault (Note)</td></tr>
<tr><td>1</td><td>Servo amplifier loading status</td></tr>
</table>
(Note): For the ADU, no loading causes a major error to be displayed if the axis number is set in system settings.
</td></tr>
</table>

APPENDIX4 EXAMPLE PROGRAMS

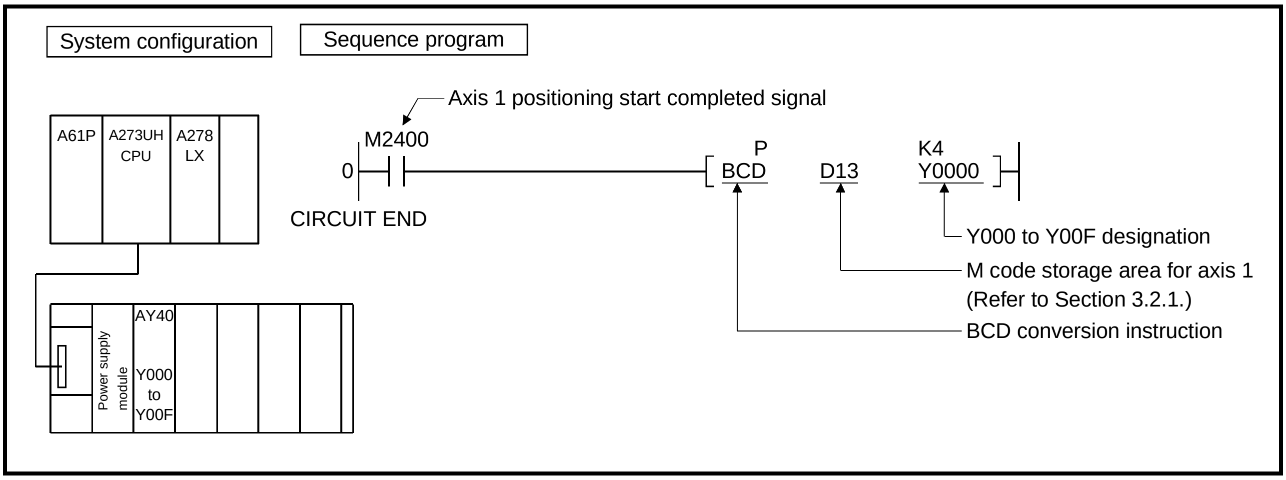
4.1 Reading M Codes

An example of a program for reading an M code on completion of positioning start or on completion of positioning is shown here.
The distinction between positioning start completion and positioning completion is made with the following signals.

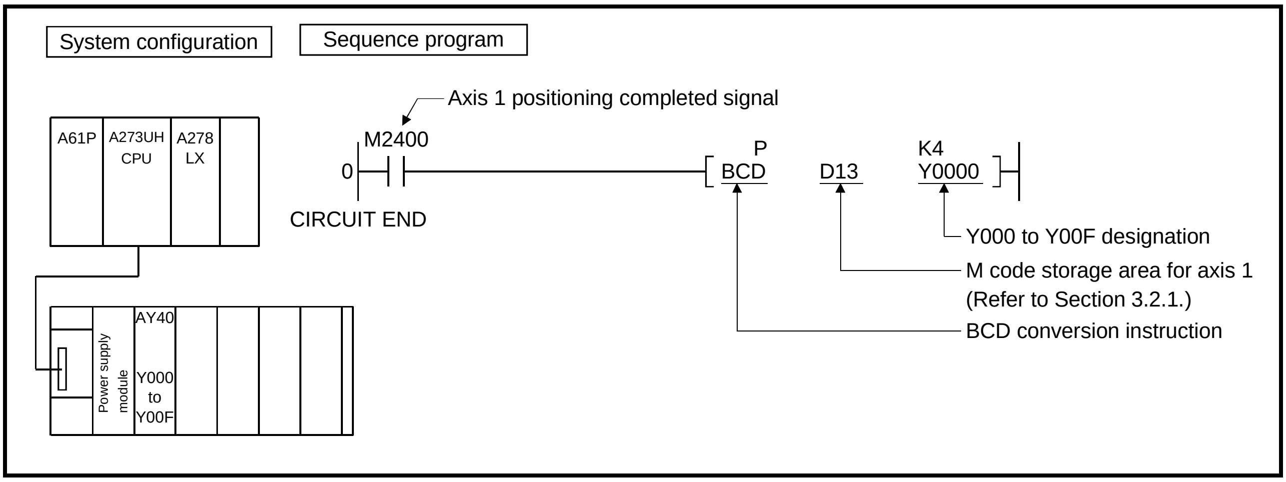
- Positioning start completed ....M2400+20n (positioning start completed signal)
- Positioning completed..................M2401+20n (positioning completed signal)

[Program Example]

(1) A program that outputs the M code for axis 1 from Y000 to Y00F to an external destination on completion of positioning start and after conversion to BCD code, is shown here.



(2) A program that outputs the M code for axis 1 from Y000 to Y00F to an external destination on completion of positioning and after conversion to BCD code, is shown here.



4.2 Error Code Reading

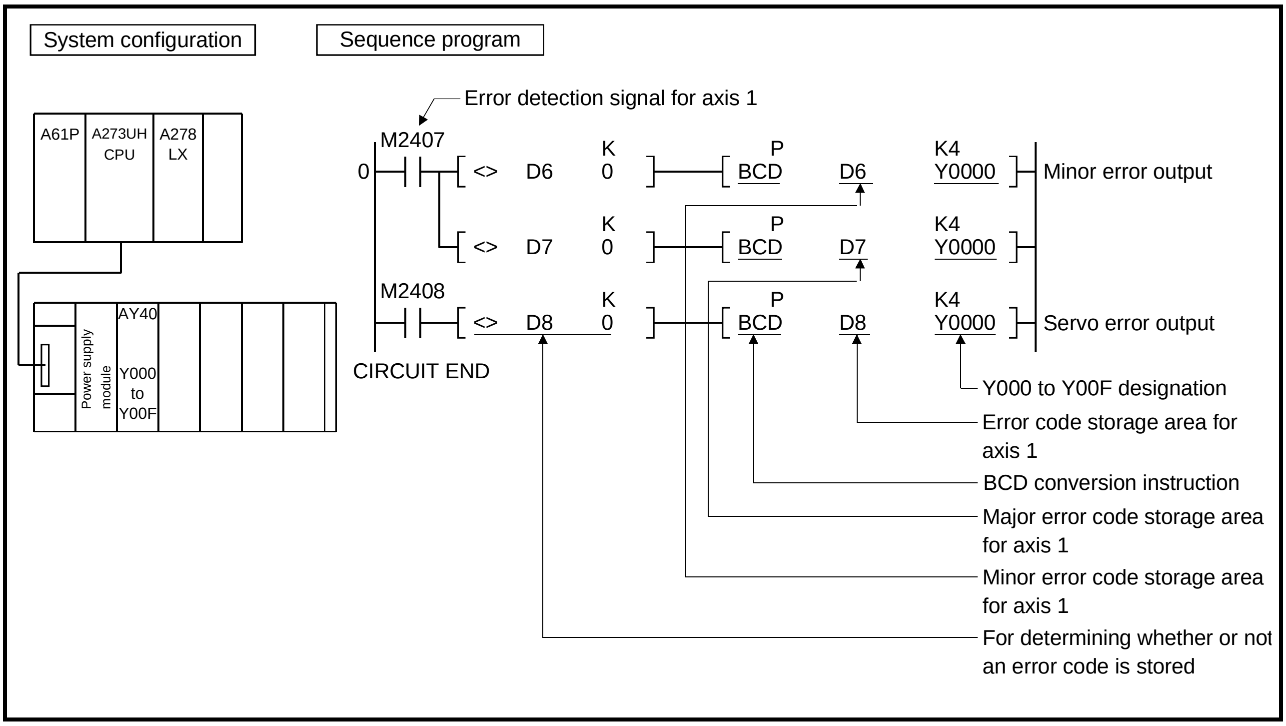
A program that reads the error code when an error occurs is shown here.
The following signals are used to determine whether or not an error has occurred:

- Minor errors, major errors............Error detection signal (M2407+20n)
- Servo errors.................................Servo error detection signal (M2408+20n)

POINT
(1) The following delay occurs between the leading edge (OFF→ON) of M2407+20n/M2408+20n and storage of the error code. (a) If the sequence program scan time is less than 80 ms, there will be a delay of up to 80 ms. (b) If the sequence program scan time is longer than 80 ms, there will be a delay of up to one scan time. Program so that error code reading is executed after sufficient time has elapsed for error codes to be written in the various error code storage areas after M2407+20n/M2408+20n comes ON.

[Program Example]

(1) A program that converts the error code to BCD and outputs it to Y000 to Y00F when an axis 1 error occurs (minor error, major error) is shown here.

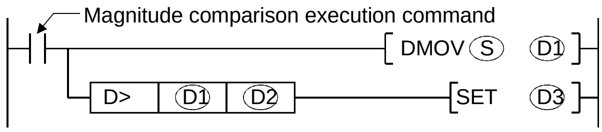


4.3 Magnitude Comparison and Four Fundamental Operations of 32-Bit Monitor Data

When a machine value, real current value or deviation counter value is used to perform magnitude comparison or four fundamental operations, the value must be transferred to another device memory once and the device memory of the transfer destination be used to perform processing as described below.

(1) Magnitude comparison example

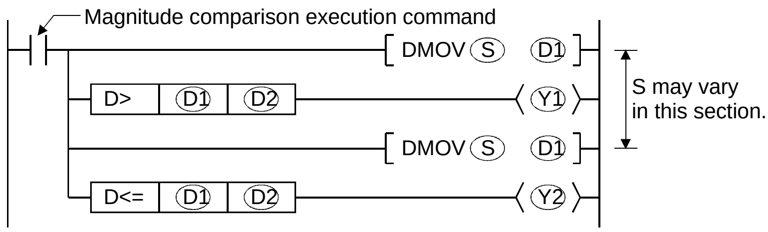
(a) To set the device when the machine value has become more than the set value



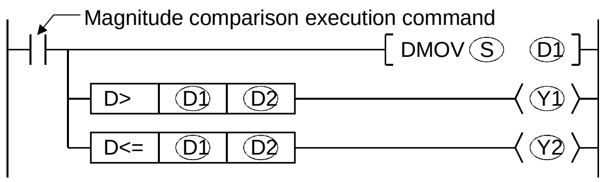
1) S, D1, D2 and D3 indicate the following.
S : Machine value
D1 : Device memory for temporary storage
D2 : Set value for magnitude comparison
D3 : Device for setting magnitude comparison result

(b) When one piece of monitor data is referred to many times to perform comparison processing, intended operation may not be performed if the monitor data is transferred every processing as shown in program example 1. In program example 1, neither Y1 nor Y2 may turn ON. (This also applies to the case of 16-bit monitor data.)
This is because the S value varies asynchronously with the sequencer scan. To perform such processing, transfer the monitor data to another device memory once, and after that, use that value to perform comparison processing as shown in program example 2.

[Program example 1]

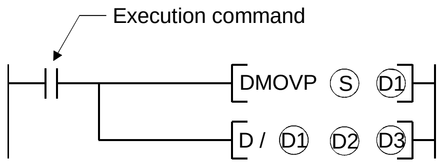


[Program example 2]



1) S, D1, D2, Y1 and Y2 indicate the following.
S : Machine value
D1 : Device memory for temporary storage
D2 : Set value for magnitude comparison
Y1 : Magnitude comparison result output device (Result: more than)
Y2 : Magnitude comparison result output device (Result: Equal to or less than)

(2) Four fundamental operations example
To divide the real current value by the set value



1) S, D1, D2 and D3 indicate the following.
S : Real current value
D1 : Device memory for temporary storage
D2 : Division
D3 : Operation result storage device

APPENDIX 5 SETTING RANGE OF INDIRECTLY DESIGNATED DEVICES

All settings by servo programs (positioning address, commanded speed, M code, etc.) can be designated indirectly by sequencer devices, excluding the axis numbers.

(1) Device range
The number of device words and device range in indirect designation are shown below.

<table>
<tr><th colspan="2">Item</th><th>Number of device words</th><th>Device setting range</th><th>Remarks</th></tr>
<tr><td rowspan="6">Common</td><td>Address/travel</td><td>2</td><td rowspan="22"><table><tr><th>Device</th><th>Range</th></tr><tr><td>D</td><td>800 to 8191</td></tr><tr><td>W</td><td>0000 to 1FFF</td></tr></table></td><td rowspan="18"></td></tr>
<tr><td>Commanded speed</td><td>2</td></tr>
<tr><td>Dwell time</td><td>1</td></tr>
<tr><td>M code</td><td>1</td></tr>
<tr><td>Torque limit value</td><td>1</td></tr>
<tr><td>Parameter block number</td><td>1</td></tr>
<tr><td rowspan="3">Arc</td><td>Auxiliary point</td><td>2</td></tr>
<tr><td>Radius</td><td>2</td></tr>
<tr><td>Center</td><td>2</td></tr>
<tr><td rowspan="9">Parameter block</td><td>Control unit</td><td>1</td></tr>
<tr><td>Speed limit value</td><td>2</td></tr>
<tr><td>Acceleration time</td><td>1</td></tr>
<tr><td>Deceleration time</td><td>1</td></tr>
<tr><td>Rapid stop deceleration time</td><td>1</td></tr>
<tr><td>Torque limit value</td><td>1</td></tr>
<tr><td>STOP input deceleration</td><td>1</td></tr>
<tr><td>Circular interpolation error allowance range</td><td>2</td></tr>
<tr><td>S curve comparison</td><td>1</td></tr>
<tr><td rowspan="7">Others</td><td>Program number</td><td>1</td><td>Simultaneous start</td></tr>
<tr><td>FIN acceleration time</td><td>1</td><td></td></tr>
<tr><td>Start program number</td><td>1</td><td>Cancel & start</td></tr>
<tr><td>Repeat condition (number of repetitions)</td><td>1</td><td></td></tr>
<tr><td>Repeat condition (ON/OFF)</td><td>Bit</td><td><table><tr><th>Device</th><th>Range</th></tr><tr><td>X</td><td>0000 to 1FFF</td></tr><tr><td>Y</td><td>0000 to 1FFF</td></tr><tr><td>M/L</td><td>0 to 8191</td></tr><tr><td>M</td><td>9000 to 9255</td></tr><tr><td>B</td><td>0000 to 1FFF</td></tr><tr><td>F</td><td>0 to 2047</td></tr></table></td><td></td></tr>
<tr><td>Skip condition</td><td>Bit</td><td rowspan="2"><table><tr><th>Device</th><th>Range</th></tr><tr><td>X</td><td>0000 to 1FFF</td></tr><tr><td>Y</td><td>0000 to 1FFF</td></tr><tr><td>M/L</td><td>0 to 8191</td></tr><tr><td>M</td><td>9000 to 9255</td></tr><tr><td>B</td><td>0000 to 1FFF</td></tr><tr><td>F</td><td>0 to 2047</td></tr><tr><td>TT (Timer contact)</td><td>0 to 2047</td></tr><tr><td>TC (Timer coil)</td><td>0 to 2047</td></tr><tr><td>CT (Counter contact)</td><td>0 to 1023</td></tr><tr><td>CC (Counter coil)</td><td>0 to 1023</td></tr></table></td><td rowspan="2"></td></tr>
<tr><td>Cancel condition</td><td>Bit</td></tr>
</table>

(Note) Setting cannot be made in the synchronous encoder axis area.

POINT

Be sure to designate even-numbered devices for 2-word designation items.
Be sure to use the DMOV(P) instruction when setting data in these devices by sequence programs.

(2) Device data fetch

Data for indirectly designated devices is fetched by the PCPU at the start of the servo program.
For this reason, set data in the devices before starting the servo program, and never change the devices unless servo program start is complete.
The following describes the procedures by start method for setting data in devices and the points to note.

<table>
<tr><th>Start method</th><th>Setting method</th><th>Notes</th></tr>
<tr><td>Start by SVST instruction</td><td>Designate data in devices.
↓
Start by SVST.</td><td rowspan="2">Don't change the indirectly designated device until the positioning start completion signal of the start axis goes ON.</td></tr>
<tr><td>Automatic start by cancel & start</td><td>Set data in the indirectly designated device chosen by the start program.
↓
Turns the cancel command device ON.</td></tr>
<tr><td>Designating loop (FOR - NEXT) point data in the CPSTART instruction indirectly</td><td>Designate initial command data in the indirectly designated device.
↓
Start by SVST (or set the cancel command device to ON).
↓
Read the value of constant speed control data set pointer of the started axis, and update the data fetched by PCPU.</td><td>For details, see the positioning signal data register "Monitoring data Area".</td></tr>
</table>

APPENDIX 6 PROCESSING TIMES

The following tables list the processing time of each instruction for positioning control in the servo system CPU.

(1) Motion operation cycle (ms)

CPU	A273UHCPU			A173UHCPU(-S1)		
Number of set axes (SV22)	1 to 8	9 to 18	19 to 32	1 to 12	13 to 24	25 to 32
Number of set axis (SV13)	1 to 12	13 to 24	25 to 32	1 to 20	21 to 32	—
Operation cycle	3.5ms	7.1ms	14.2ms	3.5ms	7.1ms	14.2ms

(2) SCPU instruction processing time (μs)

Number of set axes		1 to 32
SVST	1 axis started	35
	2 or 3-axes started	70
	Error	150
CHGV		20
CHGA		25
CHGT		20
END		Max.5000

(3) CPU processing time (ms)

CPU	A273UHCPU			A173UHCPU(-S1)		
Number of set axes (SV22)	1 to 8	9 to 18	19 to 32	1 to 12	13 to 24	25 to 32
Number of set axis (SV13)	1 to 12	13 to 24	25 to 32	1 to 20	21 to 32	—
Servo program start processing time (Note-1)	4 to 11	10 to 18	14 to 21	4 to 11	10 to 18	14 to 21
Speed change response	0 to 4	0 to 8	0 to 14	0 to 4	0 to 8	0 to 14
Torque limit value change response	0 to 4	0 to 4	0 to 4	0 to 4	0 to 4	0 to 4
Simultaneous start processing time (Note-2)	7 to 17	10 to 24	14 to 28	7 to 17	10 to 24	14 to 28
Time from PLC ready flag (M2000) ON to PCPU ready flag (M9074) ON	8 to 100	90 to 400	8 to 800	8 to 100	90 to 400	100 to 800

(Note-1): The FEED instruction varies greatly depending on the condition (whether other axes are operating or being stopped).

(Note-2): This processing time varies depending on the commands to be started simultaneously. Use this time merely for reference.

For other sequence program instruction processing times, refer to the ACPU Programming Manual.

(4) Axis statuses

Axis No.	Device Number
1	M2400 to M2419
2	M2420 to M2439
3	M2440 to M2459
4	M2460 to M2479
5	M2480 to M2499
6	M2500 to M2519
7	M2520 to M2539
8	M2540 to M2559
9	M2560 to M2579
10	M2580 to M2599
11	M2600 to M2619
12	M2620 to M2639
13	M2640 to M2659
14	M2660 to M2679
15	M2680 to M2699
16	M2700 to M2719
17	M2720 to M2739
18	M2740 to M2759
19	M2760 to M2779
20	M2780 to M2799
21	M2800 to M2819
22	M2820 to M2839
23	M2840 to M2859
24	M2860 to M2879
25	M2880 to M2899
26	M2900 to M2919
27	M2920 to M2939
28	M2940 to M2959
29	M2960 to M2979
30	M2980 to M2999
31	M3000 to M3019
32	M3020 to M3039

Signal Name

	Signal name			Refresh cycle			Import cycle			Signal direction
				Number of set axes			Number of set axes			
		SV13	A173UHCPU	1 to 20	21 to 32	——	1 to 20	21 to 32	——	
			A273UHCPU	1 to 12	13 to 24	25 to 32	1 to 12	13 to 24	25 to 32	
		SV22	A173UHCPU	1 to 12	13 to 24	25 to 32	1 to 12	13 to 24	25 to 32	
			A273UHCPU	1 to 8	9 to 18	19 to 32	1 to 8	9 to 18	19 to 32	
0	Positioning start completion			3.5ms	7.1ms	14.2ms				SCPU←PCPU
1	Positioning completion									
2	In-position									
3	Command in-position									
4	Speed controlling									
5	Speed-position switching latch									
6	Zero point passage									
7	Error detection			Immediate						
8	Servo error detection			3.5ms	7.1ms	14.2ms				
9	Zeroing request			10ms	20ms					
10	Zeroing completion			3.5ms	7.1ms	14.2ms				
11	External signal FLS			10ms	20ms					
12	External signal RLS									
13	External signal STOP									
14	External signal DOG									
15	Servo ON/OFF status			3.5ms	7.1ms	14.2ms				
16	Torque limiting signal									
17	External signal CHANGE			10ms	20ms					
18	User unusable			———						
19	M-code outputting signal			3.5ms	7.1ms	14.2ms				

(5) Axis command signals

Axis No.	Device Number	Signal Name
1	M3200 to M3219	(see table below)
2	M3220 to M3239	
3	M3240 to M3259	
4	M3260 to M3279	
5	M3280 to M3299	
6	M3300 to M3319	
7	M3320 to M3339	
8	M3340 to M3359	
9	M3360 to M3279	
10	M3380 to M3299	
11	M3400 to M3419	
12	M3420 to M3439	
13	M3440 to M3459	
14	M3460 to M3479	
15	M3480 to M3499	
16	M3500 to M3519	
17	M3520 to M3539	
18	M3540 to M3559	
19	M3560 to M3579	
20	M3580 to M3599	
21	M3600 to M3619	
22	M3620 to M3639	
23	M3640 to M3659	
24	M3660 to M3679	
25	M3680 to M3699	
26	M3700 to M3719	
27	M3720 to M3739	
28	M3740 to M3759	
29	M3760 to M3779	
30	M3780 to M3799	
31	M3800 to M3819	
32	M3820 to M3839	

	Signal name			Refresh cycle			Import cycle			Signal direction
				Number of set axes			Number of set axes			
		SV13	A173UHCPU	1 to 20	21 to 32	——	1 to 20	21 to 32	——	
			A273UHCPU	1 to 12	13 to 24	25 to 32	1 to 12	13 to 24	25 to 32	
		SV22	A173UHCPU	1 to 12	13 to 24	25 to 32	1 to 12	13 to 24	25 to 32	
			A273UHCPU	1 to 8	9 to 18	19 to 32	1 to 8	9 to 18	19 to 32	
0	Stop command						3.5ms	7.1ms	14.2ms	SCPU→PCPU
1	Sudden stop command									
2	Forward rotation JOG start						10ms	20ms		
3	Reverse rotation JOG start									
4	Completion signal OFF command									
5	Speed-position switching enable						3.5ms	7.1ms	14.2ms	
6	Limit switch output enable									
7	Error reset						10ms	20ms		
8	Servo error reset									
9	Start-time external stop input/disable						At start			
10	User unusable						———			
11	User unusable									
12	Feed current value update request command						At start			
13	User unusable						———			
14	User unusable									
15	Servo off						3.5ms	7.1ms	14.2ms	
16	User unusable									
17	User unusable									
18	User unusable									
19	FIN signal						3.5ms	7.1ms	14.2ms	

(6) Axis monitor devices

Axis No.	Device Number
1	D0 to D19
2	D20 to D39
3	D40 to D59
4	D60 to D79
5	D80 to D99
6	D100 to D119
7	D120 to D139
8	D140 to D159
9	D160 to D179
10	D180 to D199
11	D200 to D219
12	D220 to D239
13	D240 to D259
14	D260 to D279
15	D280 to D299
16	D300 to D319
17	D320 to D339
18	D340 to D359
19	D360 to D379
20	D380 to D399
21	D400 to D419
22	D420 to D439
23	D440 to D459
24	D460 to D479
25	D480 to D499
26	D500 to D519
27	D520 to D539
28	D540 to D559
29	D560 to D579
30	D580 to D599
31	D600 to D619
32	D620 to D639

Signal name

	Signal name		Refresh cycle			Import cycle			Unit	Signal direction
			Number of set axes			Number of set axes				
	SV13	A173UHCPU	1 to 20	21 to 32	——	1 to 20	21 to 32	——		
		A273UHCPU	1 to 12	13 to 24	25 to 32	1 to 12	13 to 24	25 to 32		
	SV22	A173UHCPU	1 to 12	13 to 24	25 to 32	1 to 12	13 to 24	25 to 32		
		A273UHCPU	1 to 8	9 to 18	19 to 32	1 to 8	9 to 18	19 to 32		
0 1	Feed current value		3.5ms	7.1ms	14.2ms				Command unit	SCPU←PCPU
2 3	Real current value								Command unit	
4 5	Deviation counter value								PLS	
6	Minor error code		Immediate						——	
7	Major error code								——	
8	Servo error code		10ms	20ms					——	
9	Zeroing second travel value		3.5ms	7.1ms	14.2ms				PLS	
10 11	After-DOG/CHANGE ON travel value		END						Command unit	
12	Execution program No.		At start						——	
13	M-code		3.5ms	7.1ms	14.2ms				——	
14	Torque limit value								%	
15	Constant-speed control data set pointer		At start/during start						——	
16 17	Travel value change register					3.5ms	7.1ms	14.2ms	Command unit	SCPU→PCPU
18 19	STOP input-time real current value		END						Command unit	SCPU←PCPU

"END" in the Refresh Cycle field indicates "50ms" or "PLC program scan time", which is longer.

(3) Control change registers

Axis No.	Device Number	Signal Name
1	D640, D641	
2	D642, D643	
3	D644, D645	
4	D646, D647	
5	D648, D649	
6	D650, D651	
7	D652, D653	
8	D654, D655	
9	D656, D657	
10	D658, D659	
11	D660, D661	
12	D662, D663	
13	D664, D665	
14	D666, D667	
15	D668, D669	
16	D670, D671	
17	D672, D673	
18	D674, D675	
19	D676, D677	
20	D678, D679	
21	D680, D681	
22	D682, D683	
23	D684, D685	
24	D686, D687	
25	D688, D689	
26	D690, D691	
27	D692, D693	
28	D694, D695	
29	D696, D697	
30	D698, D699	
31	D700, D701	
32	D702, D703	

	Signal Name			Refresh cycle			Import cycle			Unit	Signal direction
				Number of set axes			Number of set axes				
		SV13	A173UHCPU	1 to 20	21 to 32	——	1 to 20	21 to 32	——		
			A273UHCPU	1 to 12	13 to 24	25 to 32	1 to 12	13 to 24	25 to 32		
		SV22	A173UHCPU	1 to 12	13 to 24	25 to 32	1 to 12	13 to 24	25 to 32		
			A273UHCPU	1 to 8	9 to 18	19 to 32	1 to 8	9 to 18	19 to 32		
01	Feed current value						At start			Command unit	SCPU→PCPU

(8) Common devices

Device Number	Signal Name		Refresh Cycle			Import Cycle			Signal Direction
			Number of set axes			Number of set axes			
	SV13	A173UHCPU	1 to 20	21 to 32	——	1 to 20	21 to 32	——	
		A273UHCPU	1 to 12	13 to 24	25 to 32	1 to 12	13 to 24	25 to 32	
	SV22	A173UHCPU	1 to 12	13 to 24	25 to 32	1 to 12	13 to 24	25 to 32	
		A273UHCPU	1 to 8	9 to 18	19 to 32	1 to 8	9 to 18	19 to 32	
M2000	PLC ready flag					10ms	20ms		SCPU→PCPU
M2001	Axis 1	Start acceptance flag	10ms						SCPU←PCPU
M2002	Axis 2								
M2003	Axis 3								
M2004	Axis 4								
M2005	Axis 5								
M2006	Axis 6								
M2007	Axis 7								
M2008	Axis 8								
M2009	Axis 9								
M2010	Axis 10								
M2011	Axis 11								
M2012	Axis 12								
M2013	Axis 13								
M2014	Axis 14								
M2015	Axis 15								
M2016	Axis 16								
M2017	Axis 17								
M2018	Axis 18								
M2019	Axis 19								
M2020	Axis 20								
M2021	Axis 21								
M2022	Axis 22								
M2023	Axis 23								
M2024	Axis 24								
M2025	Axis 25								
M2026	Axis 26								
M2027	Axis 27								
M2028	Axis 28								
M2029	Axis 29								
M2030	Axis 30								
M2031	Axis 31								
M2032	Axis 32								
M2033	User unusable		———			———			———
M2034	Personal computer link communication error flag		10ms						
M2035	User unusable (5 points)		———			———			———
M2036									
M2037									
M2038									
M2039									
M2040	Speed change point designation flag					Start			SCPU→PCPU
M2041	System setting error flag		10ms						SCPU←PCPU
M2042	All-axes servo ON command					3.5ms	7.1ms	14.2ms	SCPU→PCPU
M2043	User unusable (4 points)		———			———			———
M2044									
M2045									
M2046									
M2047	Motion slot fault detection flag		10ms						SCPU←PCPU
M2048	JOG simultaneous start command					10ms	20ms		SCPU→PCPU
M2049	All-axes servo ON acceptance flag		END						SCPU←PCPU
M2050	Start buffer full								
M2051	Manual pulse generator 1 enable flag					10ms	20ms		SCPU→PCPU
M2052	Manual pulse generator 2 enable flag								
M2053	Manual pulse generator 3 enable flag								
M2054	User unusable (7 points)		———			———			———
M2055									
M2056									
M2057									
M2058									
M2059									
M2060									
M2061	Axis 1	Speed changing flag	END						SCPU←PCPU
M2062	Axis 2								
M2063	Axis 3								
M2064	Axis 4								
M2065	Axis 5								
M2066	Axis 6								
M2067	Axis 7								
M2068	Axis 8								
M2069	Axis 9								
M2070	Axis 10								
M2071	Axis 11								
M2072	Axis 12								
M2073	Axis 13								
M2074	Axis 14								
M2075	Axis 15								
M2076	Axis 16								
M2077	Axis 17								
M2078	Axis 18								
M2079	Axis 19								

Device Number	Signal Name		Refresh Cycle			Import Cycle			Signal Direction
			Number of set axes			Number of set axes			
	SV13	A173UHCPU	1 to 20	21 to 32	——	1 to 20	21 to 32	——	
		A273UHCPU	1 to 12	13 to 24	25 to 32	1 to 12	13 to 24	25 to 32	
	SV22	A173UHCPU	1 to 12	13 to 24	25 to 32	1 to 12	13 to 24	25 to 32	
		A273UHCPU	1 to 8	9 to 18	19 to 32	1 to 8	9 to 18	19 to 32	
M2080	Axis 20	Speed changing flag	END						SCPU←PCPU
M2081	Axis 21								
M2082	Axis 22								
M2083	Axis 23								
M2084	Axis 24								
M2085	Axis 25								
M2086	Axis 26								
M2087	Axis 27								
M2088	Axis 28								
M2089	Axis 29								
M2090	Axis 30								
M2091	Axis 31								
M2092	Axis 32								
M2093	User unusable (35 points)		———			———			———
M2094									
M2095									
M2096									
M2097									
M2098									
M2099									
M2100									
M2101									
M2102									
M2103									
M2104									
M2105									
M2106									
M2107									
M2108									
M2109									
M2110									
M2111									
M2112									
M2113									
M2114									
M2115									
M2116									
M2117									
M2118									
M2119									
M2120									
M2121									
M2122									
M2123									
M2124									
M2125									
M2126									
M2127									
M2128	Axis 1	Automatically decelerating flag	3.5ms	7.1ms	14.2ms				SCPU←PCPU
M2129	Axis 2								
M2130	Axis 3								
M2131	Axis 4								
M2132	Axis 5								
M2133	Axis 6								
M2134	Axis 7								
M2135	Axis 8								
M2136	Axis 9								
M2137	Axis 10								
M2138	Axis 11								
M2139	Axis 12								
M2140	Axis 13								
M2141	Axis 14								
M2142	Axis 15								
M2143	Axis 16								
M2144	Axis 17								
M2145	Axis 18								
M2146	Axis 19								
M2147	Axis 20								
M2148	Axis 21								
M2149	Axis 22								
M2150	Axis 23								
M2151	Axis 24								
M2152	Axis 25								
M2153	Axis 26								
M2154	Axis 27								
M2155	Axis 28								
M2156	Axis 29								
M2157	Axis 30								
M2158	Axis 31								
M2159	Axis 32								

"END" in the Refresh Cycle field indicates "50ms" or "PLC program scan time", which is longer.

Device Number	Signal Name			Refresh Cycle			Import Cycle			Signal Direction
				Number of set axes			Number of set axes			
		SV13	A173UHCPU	1 to 20	21 to 32	——	1 to 20	21 to 32	——	
			A273UHCPU	1 to 12	13 to 24	25 to 32	1 to 12	13 to 24	25 to 32	
		SV22	A173UHCPU	1 to 12	13 to 24	25 to 32	1 to 12	13 to 24	25 to 32	
			A273UHCPU	1 to 8	9 to 18	19 to 32	1 to 8	9 to 18	19 to 32	
M2160	User unusable (80 points)			——			——			——
M2161										
M2162										
M2003										
M2164										
M2165										
M2166										
M2167										
M2168										
M2169										
M2170										
M2171										
M2172										
M2173										
M2174										
M2175										
M2176										
M2177										
M2178										
M2179										
M2180										
M2181										
M2182										
M2183										
M2184										
M2185										
M2186										
M2187										
M2188										
M2189										
M2190										
M2191										
M2192										
M2193										
M2194										
M2195										
M2196										
M2197										
M2198										
M2199										
M2200										
M2201										
M2202										
M2203										
M2204										
M2205										
M2206										
M2207										
M2208										
M2209										
M2210										
M2211										
M2212										
M2213										
M2214										
M2215										
M2216										
M2217										
M2218										
M2219										
M2220										
M2221										
M2222										
M2223										
M2224										
M2225										
M2226										
M2227										
M2228										
M2229										
M2230										
M2231										
M2232										
M2233										
M2234										
M2235										
M2236										
M2237										
M2238										
M2239										

Device Number	Signal Name			Refresh Cycle			Import Cycle			Signal Direction
				Number of set axes			Number of set axes			
		SV13	A173UHCPU	1 to 20	21 to 32	——	1 to 20	21 to 32	——	
			A273UHCPU	1 to 12	13 to 24	25 to 32	1 to 12	13 to 24	25 to 32	
		SV22	A173UHCPU	1 to 12	13 to 24	25 to 32	1 to 12	13 to 24	25 to 32	
			A273UHCPU	1 to 8	9 to 18	19 to 32	1 to 8	9 to 18	19 to 32	
M2240	Axis 1	Speed change accepting flag "0"		3.5ms	7.1ms	14.2ms				SCPU←PCPU
M2241	Axis 2									
M2242	Axis 3									
M2243	Axis 4									
M2244	Axis 5									
M2245	Axis 6									
M2246	Axis 7									
M2247	Axis 8									
M2248	Axis 9									
M2249	Axis 10									
M2250	Axis 11									
M2251	Axis 12									
M2252	Axis 13									
M2253	Axis 14									
M2254	Axis 15									
M2255	Axis 16									
M2256	Axis 17									
M2257	Axis 18									
M2258	Axis 19									
M2259	Axis 20									
M2260	Axis 21									
M2261	Axis 22									
M2262	Axis 23									
M2263	Axis 24									
M2264	Axis 25									
M2265	Axis 26									
M2266	Axis 27									
M2267	Axis 28									
M2268	Axis 29									
M2269	Axis 30									
M2270	Axis 31									
M2271	Axis 32									
M2272	User unusable (48 points)			——			——			——
M2273										
M2274										
M2275										
M2276										
M2277										
M2278										
M2279										
M2280										
M2281										
M2282										
M2283										
M2284										
M2285										
M2286										
M2287										
M2288										
M2289										
M2290										
M2291										
M2292										
M2293										
M2294										
M2295										
M2296										
M2297										
M2298										
M2299										
M2300										
M2301										
M2302										
M2303										
M2304										
M2305										
M2306										
M2307										
M2308										
M2309										
M2310										
M2311										
M2312										
M2313										
M2314										
M2315										
M2316										
M2317										
M2318										
M2319										

"END" in the Refresh Cycle field indicates "50ms" or "PLC program scan time", which is longer.

(9) Common devices

Device Number	Signal Name		Refresh Cycle			Import Cycle			Signal Direction
			Number of set axes			Number of set axes			
	SV13	A173UHCPU	1 to 20	21 to 32	——	1 to 20	21 to 32	——	
	SV13	A273UHCPU	1 to 12	13 to 24	25 to 32	1 to 12	13 to 24	25 to 32	
	SV22	A173UHCPU	1 to 12	13 to 24	25 to 32	1 to 12	13 to 24	25 to 32	
	SV22	A273UHCPU	1 to 8	9 to 18	19 to 32	1 to 8	9 to 18	19 to 32	
D704 D705 D706 D707 D708 D709	User unusable (6 points)		——			——			——
D710 D711 D712 D713	JOG operation simultaneous start axis setting register					At start			SCPU→PCPU
D714 D715	Manual pulse generator 1 axis No. setting register					On leading edge of manual pulse generator enable			
D716 D717	Manual pulse generator 2 axis No. setting register								
D718 D719	Manual pulse generator 3 axis No. setting register								
D720	Axis 1	Manual pulse generator 1-pulse input magnification setting register							
D721	Axis 2								
D722	Axis 3								
D723	Axis 4								
D724	Axis 5								
D725	Axis 6								
D726	Axis 7								
D727	Axis 8								
D728	Axis 9								
D729	Axis 10								
D730	Axis 11								
D731	Axis 12								
D732	Axis 13								
D733	Axis 14								
D734	Axis 15								
D735	Axis 16								
D736	Axis 17								
D737	Axis 18								
D738	Axis 19								
D739	Axis 20								
D740	Axis 21								
D741	Axis 22								
D742	Axis 23								
D743	Axis 24								
D744	Axis 25								
D745	Axis 26								
D746	Axis 27								
D747	Axis 28								
D748	Axis 29								
D749	Axis 30								
D750	Axis 31								
D751	Axis 32								
D752	Manual pulse generator 1 smoothing magnification setting register								
D753	Manual pulse generator 2 smoothing magnification setting register								
D754	Manual pulse generator 3 smoothing magnification setting register								
D755 D756 D757 D758 D759	User unusable (5 points)								
D760 D761 D762 D763 D764 D765 D766 D767 D768 D769 D770 D771 D772 D773 D774 D775	Limit switch output disable setting register					3.5ms	7.1ms	14.2ms	SCPU→PCPU
D776 D777 D778 D779 D780 D781 D782 D783 D784 D785 D786 D787 D788 D789 D790 D791	Limit switch output status storage register								
D792 D793 D794 D795 D796 D797 D798 D799	Servo amplifier type		At power-on						

(10) Special Register

Device No.	Signal Name	Signal Direction	Refresh Cycle	Fetch Cycle
M9073	PCPU WDT error flag	PCPU → SCPU	END	
M9074	PCPU REDAY-completed flag			
M9075	In-test-mode flag			
M9076	External emergency stop input flag			
M9077	Manual pulse generator axis setting error flag			
M9078	Test mode request error flag			
M9079	Servo program setting error flag			

"END" in the Refresh Cycle field indicates "50ms" or "PLC program scan time", which is longer.

(11) Special Register

Device Number	Signal Name			Refresh Cycle			Import Cycle			Signal Direction
				Number of set axes			Number of set axes			
		SV13	A173UHCPU	1 to 20	21 to 32	——	1 to 20	21 to 32	——	
			A273UHCPU	1 to 12	13 to 24	25 to 32	1 to 12	13 to 24	25 to 32	
		SV22	A173UHCPU	1 to 12	13 to 24	25 to 32	1 to 12	13 to 24	25 to 32	
			A273UHCPU	1 to 8	9 to 18	19 to 32	1 to 8	9 to 18	19 to 32	
D9180	User usable			——			——			——
D9181										
D9182	Test mode request error information			At test mode request						SCPU←PCPU
D9183										
D9184	PCPU WDT error cause			At PCPU WDT error occurrence						
D9185	Manual pulse generator axis setting error information			On leading edge of manual pulse generator enable						
D9186										
D9187										
D9188	User usable			——			——			——
D9189	Error program No.			At start						SCPU←PCPU
D9190	Error item information									
D9191	Servo amplifier loading information			At power-on and						
D9192				10ms	20ms					
D9193	User usable			——			——			——
D9194										
D9195										
D9196	Personal computer link communication error code			3.5ms	7.1ms	14.2ms				SCPU←PCPU
D9197	User usable			——			——			——
D9198										
D9199										

APPENDIX 7 ELECTRONIC GEAR SETTING EXAMPLES

In addition to the electronic gear setting method explained in Section 4.2 Fixed Parameters of this manual, this section provides various electronic gear setting examples.
Use them as reference for parameter setting.

Basic concept of the electronic gear
The basic concept of the electronic gear is represented by the following expression.

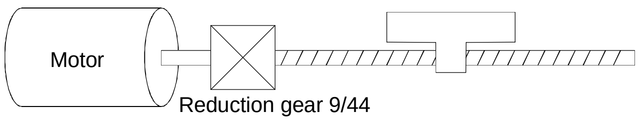
$$\text{Electronic gear} = \frac{\text{AP (number of pulses per motor revolution)}}{\Delta\text{S (machine travel value per motor revolution)}}$$

Replacing the electronic gear by the actually set AP, AL and AM gives:

$$\frac{\text{Number of pulses per motor revolution (AP)}}{\text{Travel value per motor revolution (AL)} \times \text{unit magnification (AM)}} = \frac{\text{AP (number of pulses per motor revolution)}}{\Delta\text{S (machine travel value per motor revolution)}}$$

Therefore, set the AP, AL and AM values with which the above relational expression will hold.
However, since the values that may be set as AP, AL and AM have their permissible ranges, the values calculated from the above relational expression must be brought within the AP, AL and AM setting ranges.

(1) For ball screw + reduction gear
When the ball screw pitch is 10mm, the motor is the HC-MF (8192PLS/rev) and the reduction ratio of the reduction gear is 9/44



First, find how many millimeters the load (machine) will travel (ΔS) when the motor turns one revolution (AP).

AP (number of pulses per motor revolution) = 8192 (PLS)

ΔS (machine travel value per motor revolution)= ball screw pitch×reduction ratio

=10(mm)×9/44

=10000.0(μm)×9/44

When the control unit is mm, the minimum command unit is 0.1μm.

Substitute this for the above relational expression.
At this time, make calculation with the reduction ratio 9/44 remaining as a fraction.

$$\frac{\text{AP}}{\Delta\text{S}} = \frac{\text{AP}}{\text{AL}\times\text{AM}} = \frac{8192(\text{PLS})}{10000.0(\mu\text{m})\times 9/44}$$

$$= \frac{8192(\text{PLS})\times 44}{10000.0(\mu\text{m})\times 9}$$

$$\frac{A_P}{A_L \times A_M} = \frac{8192(\text{PLS}) \times 44}{10000.0(\mu\text{m}) \times 9}$$

$$= \frac{360448}{90000.0}$$

Here, reduce the above result since the AP setting must be made not more than 65535.

$$\frac{A_P}{A_L \times A_M} = \frac{45056}{11250.0}$$

Next, since the AL setting range is up to 6553.5, set 1125.0 as AL and multiply it by 10 with AM.

$$\frac{A_P}{A_L \times A_M} = \frac{45056(A_P)}{1125.0(A_L) \times 10(A_M)}$$

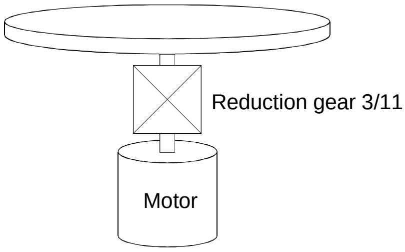
Thus, AP, AL and AM to be set are as follows.

AP=45056
AL=1125.0
AM=10

(2) When PULSE (pulse) is set as the control unit
When using PULSE (pulse) as the control unit, set the electronic gear as follows.
AP=number of pulses per motor revolution
AL=number of pulses per motor revolution
AM=1

For example, when the motor is the HC-MF (8192PLS/rev)
AP=8192
AL=8192
AM=1

(3) When degree is set as the control unit for a rotary axis
When the rotary axis is used, the motor is HC-SF (16384PLS/rev) and the reduction ratio of the reduction gear is 3/11



First, find how many degrees the load (machine) will travel (ΔS) when the motor turns one revolution (AP).
AP(number of pulses per motor revolution) =16384 (PLS)
ΔS(machine travel value per motor revolution) = 360.00000(degree)×reduction ratio
=16384(PLS)×3/11
Substitute this for the above relational expression.
At this time, make calculation with the reduction ratio 3/11 remaining as a fraction.

$$\frac{A_P}{\Delta S} = \frac{A_P}{A_L \times A_M} = \frac{16384(\text{PLS})}{360.00000(\text{degree}) \times 3/11}$$

$$= \frac{16384(\text{PLS}) \times 11}{360.00000(\text{degree}) \times 3}$$

$$= \frac{180224}{1080.00000}$$

Here, reduce the above result since the AP setting must be made not more than 65535.

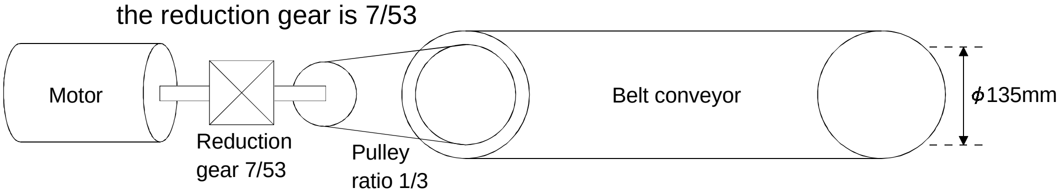
$$\frac{A_P}{A_L \times A_M} = \frac{11264}{67.50000}$$

Next, since the AL setting range is up to 0.65535, set 0.06750 as AL and multiply it by 1000 with AM.

$$\frac{A_P}{A_L \times A_M} = \frac{11264(A_P)}{0.06750(A_L) \times 1000(A_M)}$$

Thus, AP, AL and AM to be set are as follows.
AP=11264
AL=0.06750
AM=1000

(4) When mm is set as the control unit for conveyor drive (calculation including π)
When the belt conveyor drive is used, the conveyor diameter is 135mm, the pulley ratio is 1/3, the motor is HC-SF (16384PLS/rev) and the reduction ratio of the reduction gear is 7/53



As the travel value of the conveyor is used to exercise control, set mm as the control unit.
First, find how many millimeters the load (machine) will travel (ΔS) when the motor turns one revolution (AP).

AP (number of pulses per motor revolution) = 16384 (PLS)
ΔS (machine travel value per motor revolution) = 135000.0(μm)$\times\pi\times$reduction ratio
= 135000.0(μm)$\times\pi\times$7/53$\times$1/3

Substitute this for the above relational expression.
At this time, make calculation with the reduction ratio 7/53$\times$1/3 remaining as a fraction.

$$\frac{A_P}{\Delta S} = \frac{A_P}{A_L \times A_M} = \frac{16384(\text{PLS})}{135000.0(\mu\text{m}) \times \pi \times 7/53 \times 1/3}$$

$$= \frac{16384(\text{PLS}) \times 53 \times 3}{135000.0(\mu\text{m}) \times \pi \times 7}$$

Here, make calculation on the assumption that π is equal to 3.14159.

$$\frac{A_P}{\Delta S} = \frac{A_P}{A_L \times A_M} = \frac{2605056}{2968802.6}$$

Here, reduce the above result since the AP setting must be made not more than 65535.

$$\frac{A_P}{A_L \times A_M} = \frac{1302528}{1484401.3}$$

The above fraction cannot be reduced further.
Here, since the AP setting range is not more than 6553.5 and the AL setting range is not more than 6553.5, ignore the least significant digits of both the denominator and numerator as 0.
Then,

$$\frac{A_P}{A_L \times A_M} = \frac{1302500}{1484400.0}$$

Further reduce the fraction.

$$\frac{A_P}{A_L \times A_M} = \frac{2605}{2968.8}$$

Thus, AP, AL and AM to be set are as follows.
AP=2605
AL=2968.8
AM=1

This setting will produce an error for the true machine value, but it cannot be helped. This error is as follows.

$$\left(\frac{29688/2605}{29688026/2605056} - 1\right) \times 100 = 0.002(\%)$$

It is equivalent to an about 0.02mm error in continuous 1m feed.

MITSUBISHI ELECTRIC CORPORATION

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