MITSUBISHI

MOTION CONTROLLER (SV13/22) (REAL MODE)

Programming Manual

type A171SCPU,A273UCPU

MITSUBISHI ELECTRIC

REVISIONS

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

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INTRODUCTION

Thank you for purchasing the Mitsubishi Motion Controller/Personal Machine Controller. This instruction manual describes the handling and precautions of this unit. Incorrect handling 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 Safe 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 the instruction manual 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.
- ⚠ Use wires and cables that have a wire diameter, heat resistance and bending resistance compatible with the system.

⚠ CAUTION

- ⚠ 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 the instruction manual 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.

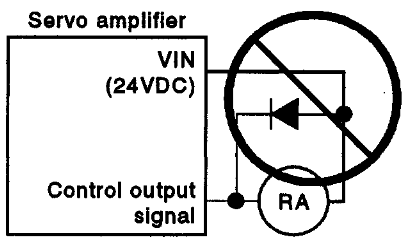
⚠ After wiring, install the protective covers such as the terminal covers to the original positions.

⚠ 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.

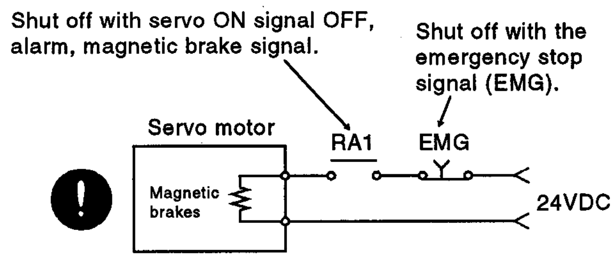
(7) Remedies for errors

⚠ 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 the instruction manual.

⚠ 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. ⚠ Under no circumstances will Mitsubishi Electric be liable or responsible for any consequential damage that may arise as a result of the installation or use of this equipment. All examples and diagrams shown in this manual are intended only as an aid to understanding the text, not to guarantee operation. Mitsubishi Electric will accept no responsibility for actual use of the product based on these illustrative examples. Owing to the very great variety in possible applications of this equipment, you must satisfy yourself as to its suitability for your specific application.

CONTENTS

1. GENERAL DESCRIPTION

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

Applicable CPU	Number of Axes Controlled In Positioning Control
A171SCPU	4
A273UHCPU (8 axis specification)	8
A273UHCPU (32 axis specification)	3

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.

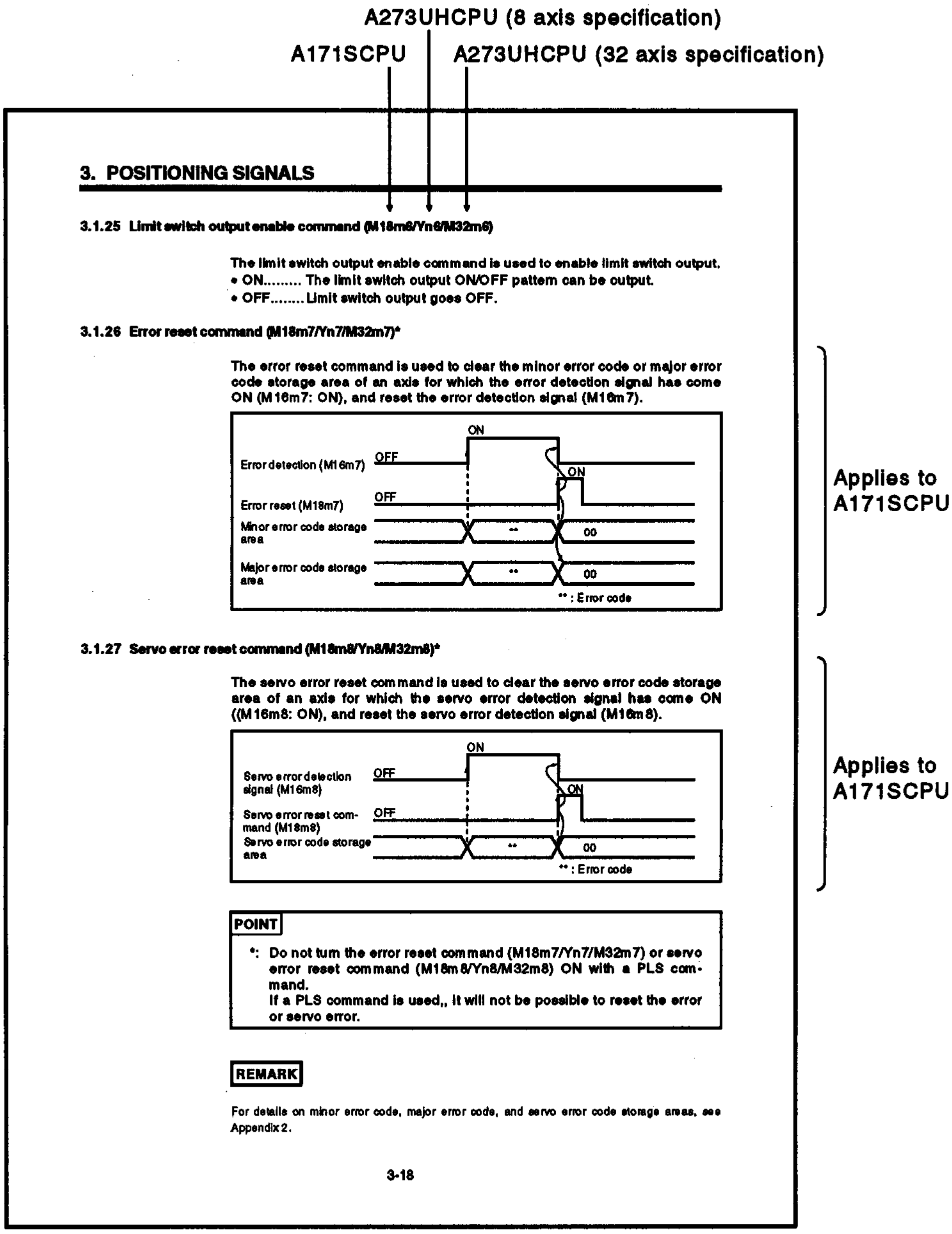
⚠ Use the program instructions that are used in programs in accordance with the conditions stipulated in this manual.

⚠ Some devices for use in programs have fixed applications: they must be used in accordance with the conditions stipulated in this manual.

1

Conventions Used in this Manual

Positioning signals are always indicated in the following order: signal for A171SCPU → signal for A273UHCPU (8 axis specification) → signal for A273UHCPU (32 axis specification). If only one positioning signal is indicated, this means that the signal is used in common by all three CPUs.
The explanatory text is written with reference to the A171SCPU: if you are not using an A171SCPU, the positioning signals in the text should be read as the positioning signals for the CPU you are using.
(For the positioning signals used with each CPU, refer to Appendix 6.)



3. POSITIONING SIGNALS

3.1.25 Limit switch output enable command (M18m6/Yn6/M32m6)

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.

3.1.26 Error reset command (M18m7/Yn7/M32m7)*

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 (M16m7: ON), and reset the error detection signal (M16m7).

3.1.27 Servo error reset command (M18m8/Yn8/M32m8)*

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 ((M16m8: ON), and reset the servo error detection signal (M16m8).

POINT

*: Do not turn the error reset command (M18m7/Yn7/M32m7) or servo error reset command (M18m8/Yn8/M32m8) 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.

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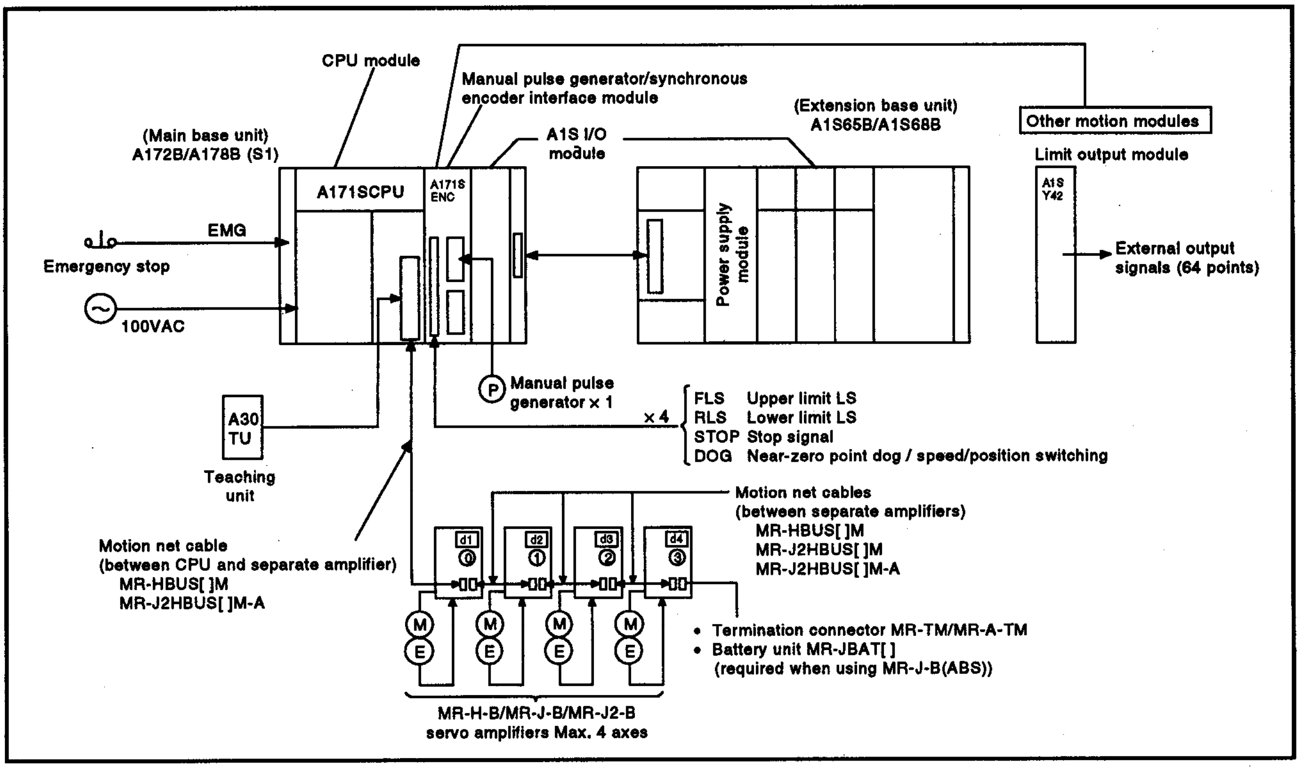
1. GENERAL DESCRIPTION

An example system configuration for the motion controller (SV13/22) is shown below.

[When Using A171SCPU]



In the servo amplifier configuration indicated below, a maximum of 4 axes can be controlled in positioning control.

- MR-H-B/MR-J-B/MR-J2-B servo amplifiers only
  (Max. 4 axes)

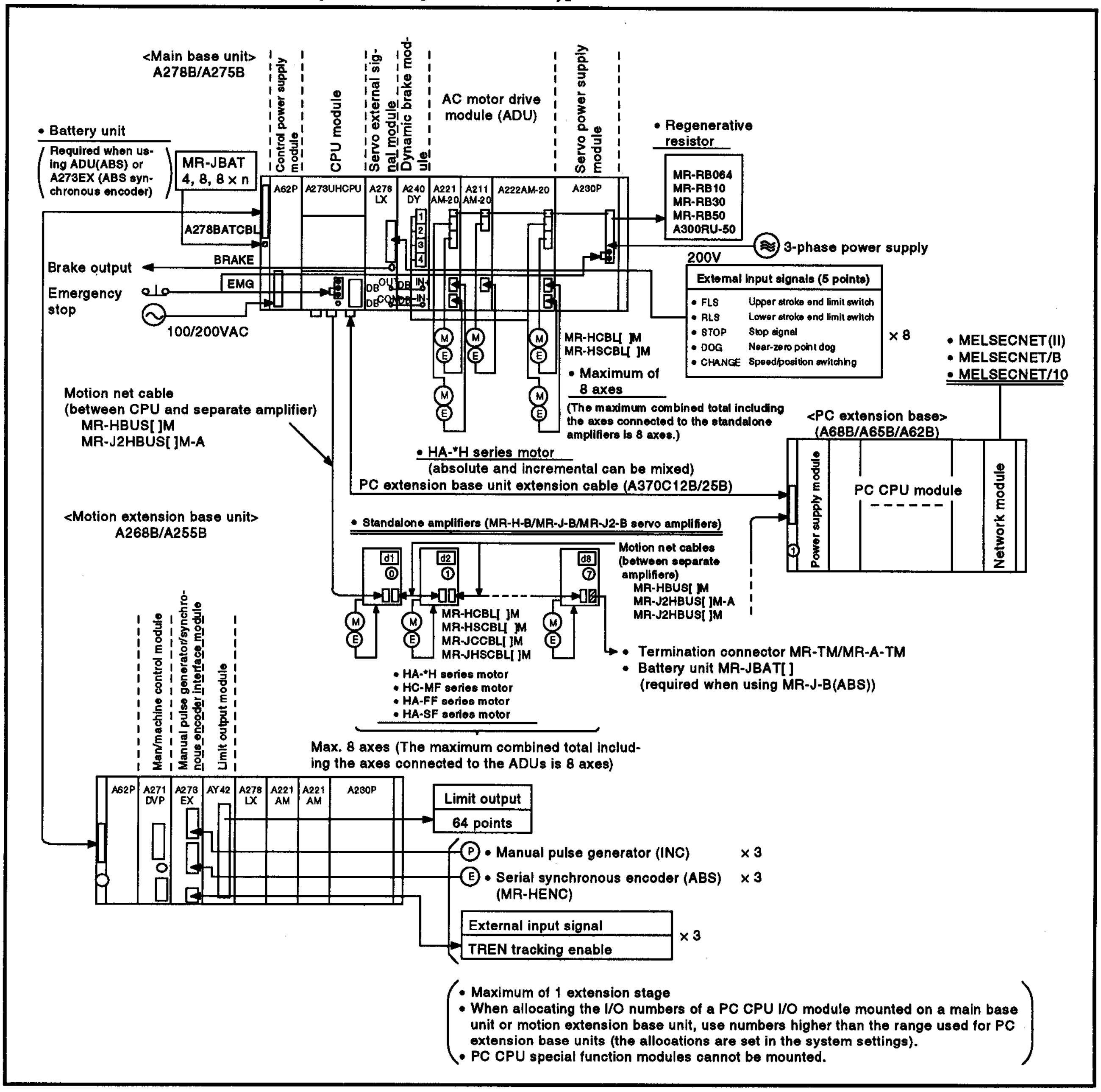
[Note]

(1) One extension base unit can be connected to a servo system CPU.

(2) The extension base units which can be used are the following:
- A1S65B (extension power supply plus 5 slots)
- A1S68B (extension power supply plus 8 slots)

(3) When the power supply to the servo system CPU is switched ON and OFF, erroneous process outputs may temporarily be made due to the delay between the servo system CPU power supply and the external power supply for processing (especially DC), and the difference in startup times.
For example, if the power supply to the servo system CPU comes on after the external power supply for processing comes on at a DC output module, the DC output module may temporarily give erroneous outputs when the power to the servo system CPU comes on.
Accordingly a circuit that ensures that the power supply to the servo system CPU comes on first should be constructed.

[When Using A273UHCPU (8 Axis Specification)]



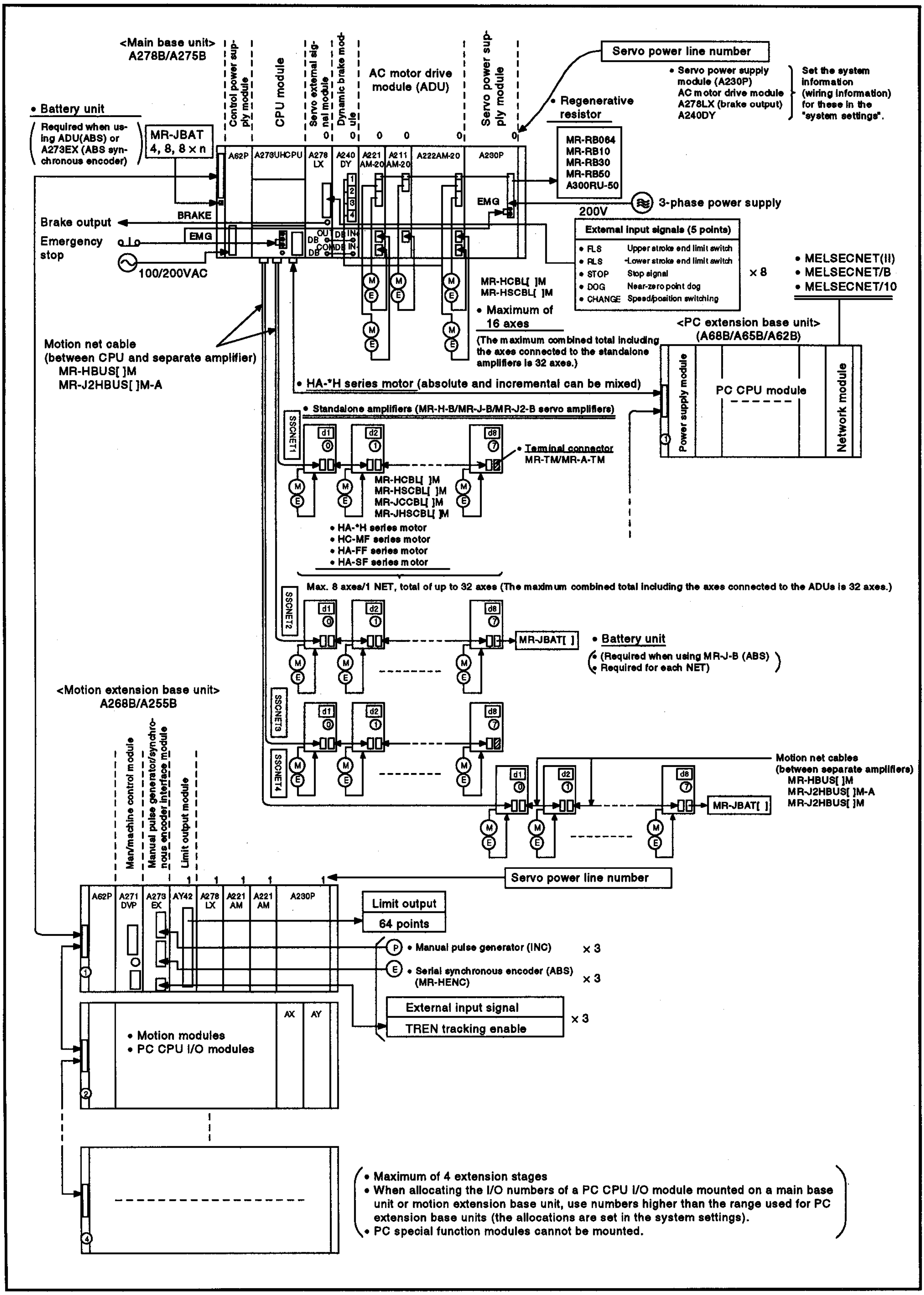
With the servo amplifier configurations indicated below, positioning control of up to 8 axes is possible.

(1) AC motor drive modules (max. 8 axes) + MR-H-B/MR-J-B/MR-J2-B servo amplifiers (max. 8 axes) <total of 8 axes>

(2) AC motor drive modules only
- Main base units only (max. 8 axes)
- Main base unit (max. 8 axes) + motion extension base unit (max. 8 axes) <total of 8 axes>

(3) MR-H-B/MR-J-B/MR-J2-B amplifiers only (max. 8 axes)

[When Using A273UHCPU (32 Axis Specification)]



With the servo amplifier configurations indicated below, positioning control of up to 32 axes is possible.

(1) AC motor drive modules (max. 16 axes) * + MR-H-B/MR-J-B/MR-J2-B servo amplifiers (max. 32 axes) <total of 32 axes>

* An AC motor drive module can control a total of 16 axes, including main base units and motion extension base units.

(2) MR-H-B/MR-J-B/MR-J2-B servo amplifiers only (max. 32 axes)

In the text of this manual, "AC motor drive module" is abbreviated to ADU. MR-H-B/MR-J-B/MR-J2-B servo amplifiers are abbreviated to MR-[ ]-B. ADUs and MR-[ ]-Bs are collectively referred to as servo amplifiers.

[Notes]

(1) A servo system CPU can be connected to a maximum of one motion extension base unit when using an A273UHCPU (8 axis specification) or four motion extension base units when using an A273UHCPU (32 axis specification).

(2) The motion extension base units which can be used are indicated below.
- A255B (control power supply not required)
- A268B (control power supply required)

However, the maximum total of ADUs (in terms of the number of controlled axes) that can be connected to one servo system CPU is 8 axes for an A273UHCPU (8 axis specification) and 32 axes for an A273UHCPU (32 axis specification).

(3) When the power supply to the servo system CPU is switched ON and OFF, erroneous process outputs may temporarily be made due to the delay between the servo system CPU power supply and the external power supply for processing (especially DC), and the difference in startup times.
For example, if the power supply to the servo system CPU comes on after the external power supply for processing comes on at a DC output module, the DC output module may temporarily give erroneous outputs when the power to the servo system CPU comes on.
Accordingly a circuit that ensures that the power supply to the servo system CPU comes on first should be constructed.

1. GENERAL DESCRIPTION

1.1 Positioning Control by the Servo System CPU

A servo system CPU can execute positioning control and sequence control for 4 axes when using an A171SCPU, 8 axes when using an A273UHCPU (8 axis specification), and 32 axes when using an A273UHCPU (32 axis specification), 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 A1S series CPUs when using an A171SCPU, and to those of A3U series CPUs when using an A273UHCPU (8 or 32 axis specification).

(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 A1SCPU or A3UCPU).

  (b) Start of positioning in accordance with sequence program, and setting of positioning data
    1) The SCPU requests execution of servo programs by means of the DSFRP instruction (up to 3 axes for interpolation) or the SVST instruction (up to 4 axes for interpolation).
    2) It changes present values and speed by means of the DSFLP instruction or GHGA/CHGV instruction.
    3) It executes JOG operation.
    4) 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 DSFRP/SVST instruction issued by the sequence program, and performs the set positioning control.

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

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

  (d) It executes the teaching designated with the teaching unit (A30TU).

1. GENERAL DESCRIPTION

[Executing Positioning Control with a Servo System CPU]

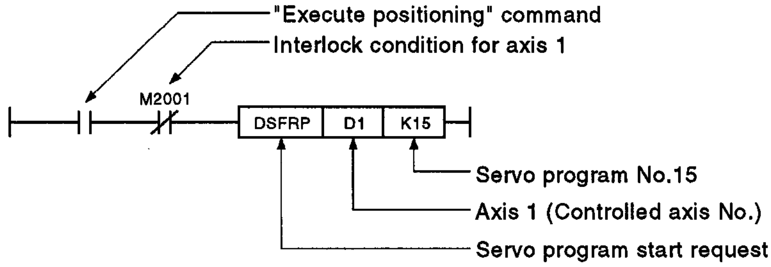
The servo system CPU executes positioning control in accordance with the servo programs designated by the sequence program of the SCPU.
An overview of the method used for positioning control is presented below.

Servo System CPU System

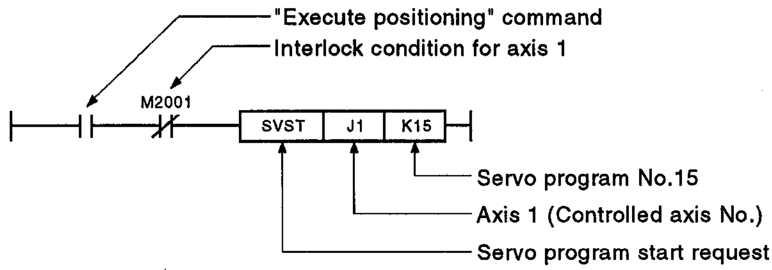
SCPU Control

Sequence program ..... Created and modified using a peripheral device *1

Example: DSFRP instruction



Example: SVST instruction



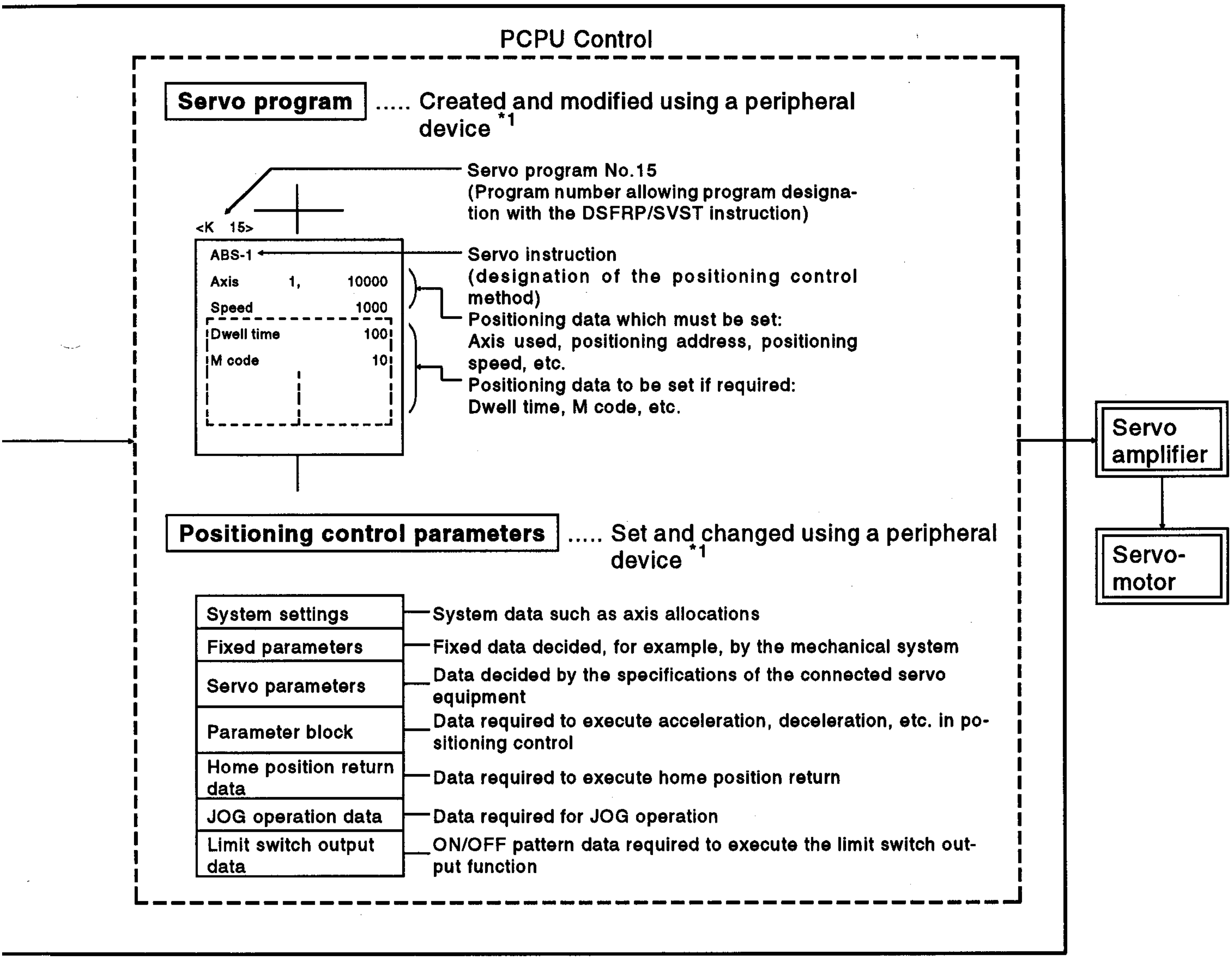
1) In the sequence program, the servo program number and controlled axis number are set with the DSFRP/SVST instruction.
2) When the DSFRP/SVST instruction is executed, the PCPU is requested to execute the program with the designated servo program number.

Request for execution of servo program

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

(2) Positioning is started by the sequence program (DSFRP/SVST instruction).
   (a) The servo program number and controlled axis number are designated by the DSFRP/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

*1: Any of the following peripheral devices, running the GSV13PE/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")
- An A271DVP man/machine control module in which PC-DOS 5.0 or a later version has been installed (hereafter called an "A271DVP")

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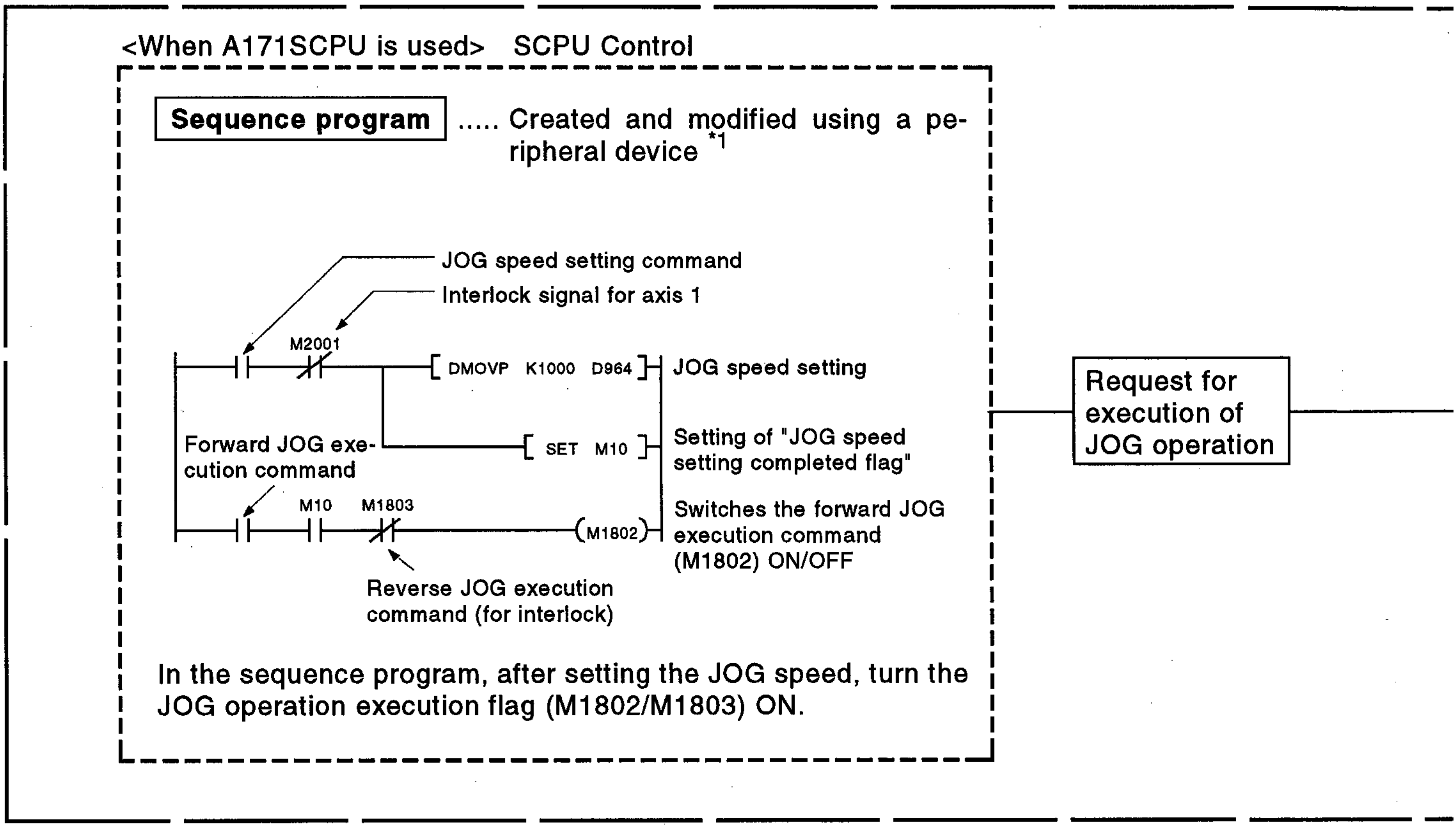
[Executing JOG Operation with a Servo System CPU]

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.

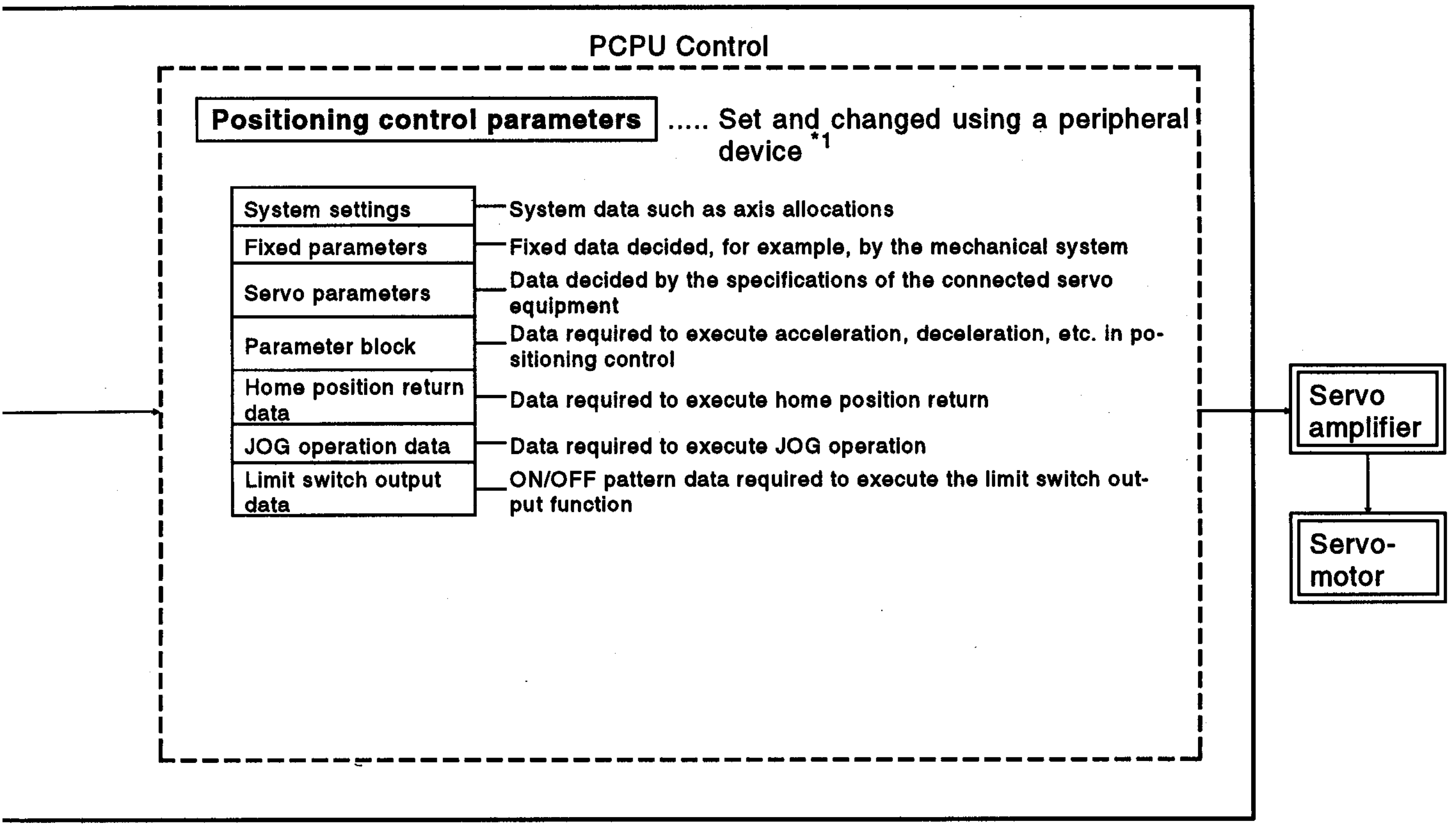
Servo System CPU System



(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 fkag (M1802 or M1803)*2 is kept ON by the sequence program. (When A171SCPU is used)
- M1802.....Forward JOG operation
- M1803.....Reverse JOG operation



REMARKS

*1: Any of the following peripheral devices, running the GSV13PE/GSV22PE software, can be used.

- IBM PC
- A271DVP

*2: Set the JOG operation execution flag that corresponds to the axis number in the table below.
<When using A171SCPU>

Axis No.	Forward rotation	Reverse rotation
1	M1802	M1803
2	M1822	M1823
3	M1842	M1843
4	M1862	M1863

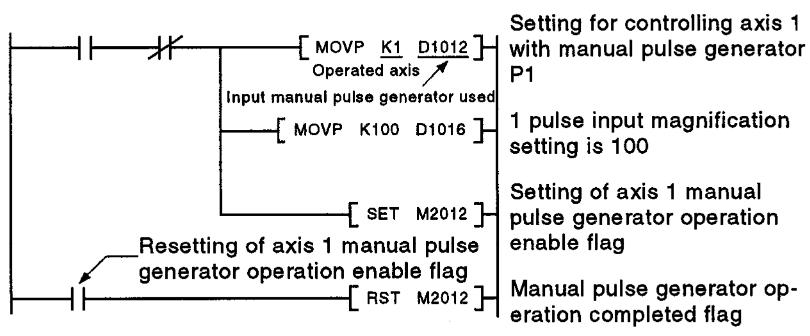
[Executing Manual Pulse Generator Operation with a Servo System CPU]

When executing positioning control with a manual pulse generator connected to an A171SENC (if using an A171SCPU) or A273EX (if using an A273UHCPU (8/32 axis specification)), 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

<When A171SCPU is used> SCPU Control

Sequence program



Use the sequence program to turn the manual pulse generator operation enable flag ON after setting the manual pulse generator used, operation number, and magnification for 1 pulse input.

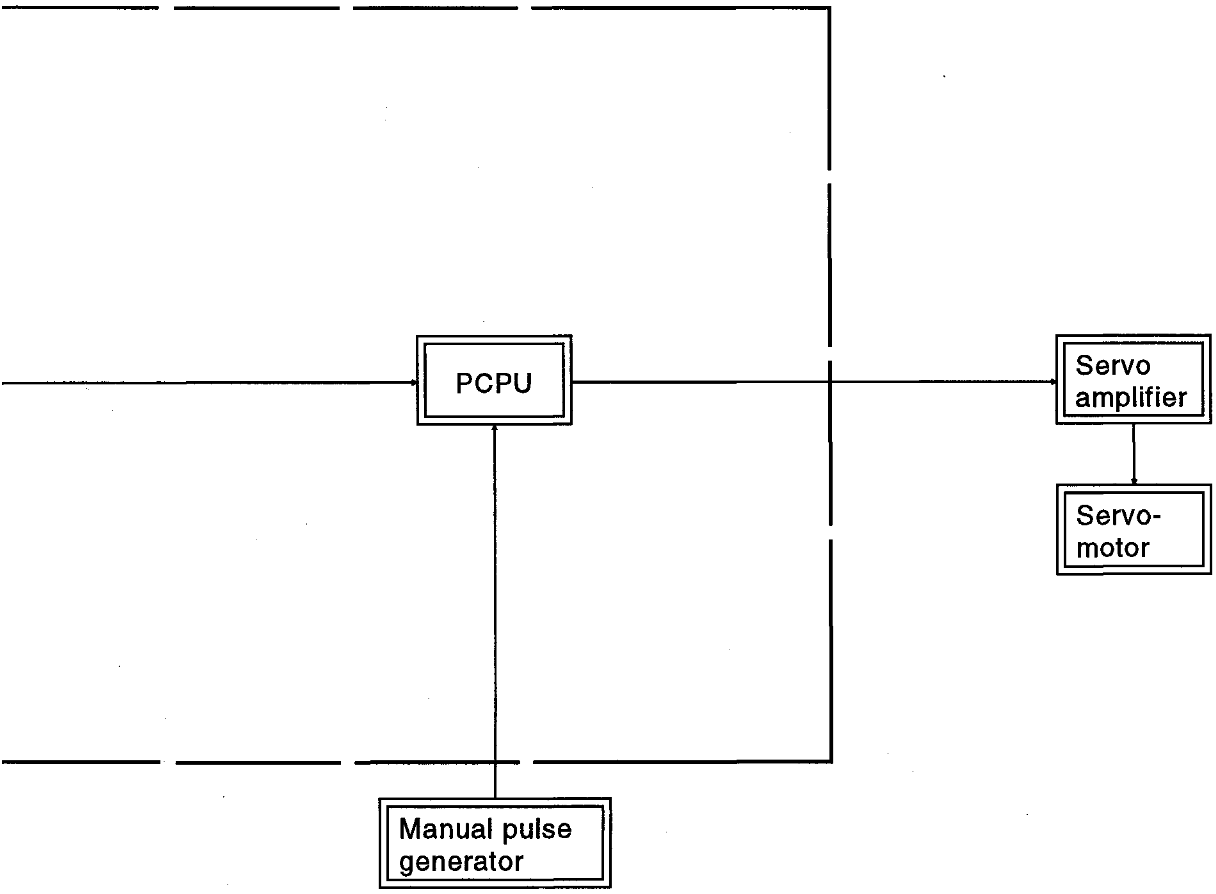
Manual pulse generator used
Operated axis number
1 pulse input magnification
Manual pulse generator enable

(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.

(a) System settings
The system settings set the modules used, axis numbers, etc.
For details, see Section 4.1.
1) Base unit setting
2) Amplifier setting (MR-[ ]-B)
3) Servomotor setting
4) Position detection method setting
5) Axis number setting
6) Regenerative resistor used/not used setting
7) Dynamic brake unit used/not used setting
8) Servo input module/other optional module used/not used setting

(b) Fixed parameters
The following data is set for each axis as the fixed parameters: the settings are predetermined by, for example, the mechanical system. The settings are used for purposes including calculation of the designated position when positioning control is executed.
For details, see Section 4.2.
1) Units for positioning control
2) Number of pulses per motor revolution
3) Travel value per motor revolution
4) Unit magnification
5) Backlash compensation amount
6) Upper/lower stroke limit values
7) Command in-position range
8) Limit switch output used/not used setting

(c) Servo parameters
The following data are set for each axis as the servo parameters: the settings are predetermined by the type of servomotor connected. These parameters are set to control the servomotors during positioning control.
For details, see Section 4.3.
1) Amplifier setting
2) Regenerative resistor used/not used
3) External dynamic brake
4) Motor type
5) Motor capacity
6) Motor rpm
7) Number of feedback pulses
8) Direction of rotation
9) Auto tuning
10) Servo responsibility setting
11) Load inertia ratio
12) Position control gain 1, 2
13) Speed control gain 1, 2
14) Speed integral compensation
15) Feed forward gain

16) In-position range

(When using MR-[ ]-B)
1) Amplifier setting
2) Regenerative resistor used/not used
3) External dynamic brake used/not used
4) Motor type
5) Motor capacity
6) Motor rpm
7) Number of feedback pulses
8) Direction of rotation
9) Automatic tuning
10) Servo responsibility setting
11) Load inertia ratio
12) Position control gain 1
13) Speed control gain 1
14) Position control gain 2
15) Speed control gain 2
16) Speed integral compensation
17) Notch filter
18) Feed forward gain
19) In-position range
20) Electromagnetic brake sequence
21) Monitor output mode
    - Monitor 1
    - Monitor 2
22) Optional function 1
    - Carrier frequency selection
    - External emergency stop signal
    - Encoder type setting
23) Optional function 2
    - No-motor operation selection
    - Electromagnetic brake interlock output timing
    - Microvibration suppression function selection
    - Motor lock operation
24) Monitor output 1 offset
25) Monitor output 2 offset
26) Pre-alarm data selection
    - Sampling time selection
    - Data selection 1
    - Data selection 2
27) Zero speed
28) Excessive error alarm level
29) Optional function 5
    - PI-PID control switching
    - Servo read character
    - Dynamic brake
30) PI-PID switching position droop
31) Torque control compensation factor
32) Speed differential compensation

(d) Home position return data
The following data are set for each axis as the home position return data, which is used when a home position return is executed.
For details, see Section 7.21.
1) Home position return direction
2) Home position return method
3) Home position address
4) Home position return speed
5) Creep speed
6) Travel after near-zero point dog
7) Parameter block number

(e) JOG operation data
The following data are set for each axis as the JOG operation data, which is used when positioning control is executed using JOG operation.
For details, see Section 7.19.
1) JOG speed limit value
2) Parameter block number

(f) Parameter block
The following data can be set as the parameter block data, for up to 16 blocks if using an A171S/A273UHCPU (8 axis specification), or up to 64 blocks if using an A273UHCPU (32 axis specification).
This makes it easy to change settings such as those for acceleration/deceleration processing (acceleration/deceleration time, speed control value) for positioning control.
For details, see Section 4.4.
1) Interpolation control unit
2) Speed limit value
3) Acceleration time
4) Deceleration time
5) Rapid stop deceleration time
6) S curve ratio
7) Torque limit value
8) Deceleration processing on STOP input
9) Allowable error range for circular interpolation

(g) Limit switch output data
The limit switch output data is set for the used axis when "USE" is set for the limit switch output setting in the fixed parameters.
When positioning control of an axis for which limit switch output data has been set is executed, the set ON/OFF pattern is output to an external destination.
For details, see Section 8.1.
1) Limit switch output ON/OFF pattern

(2) Servo programs
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 Section 6.
- Program number ....This is the number used to designate the servo program from the sequence program.
- Servo instructions .....These indicate the type of positioning control to be executed.
- Positioning data ....This is the data 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 Section 5.

1.2 Function Upgrades

The functions that have been added or modified since the former version are indicated below.

(1) Addition of high-speed reading function
A function which allows a maximum of 11 types of data out of 16 types - including feed present value and deviation counter value - to be read simultaneously to a specified device with a signal from an input module mounted on a motion base unit as the trigger, has been added.

(2) Addition of function for canceling/starting program being executed
By designating the cancel function in advance in a servo program, a deceleration stop can be caused by inputting a cancel signal (designated bit device) while that program is being executed.
Designating the start function too makes it possible to automatically start a designated servo program after the stop.

(3) Constant speed control instruction function upgrade
The following three functions have been added.
(a) Skip function
By setting a skip signal (designated bit device) at each pass point, positioning to that pass point can be canceled by switching on the skip signal, whereupon positioning at the next point will be performed.

(b) FIN signal wait function
This is a function whereby, by designating the FIN signal wait function and setting an M code for each pass point, the completion of each pass point can be synchronized with FIN signal ON.

(c) Circular interpolation function with CPSTART3, CPSTART4
Circular interpolation with two axes is now possible.

(4) Addition of high-speed oscillation function
Control for sine wave oscillation on one axis is now possible.

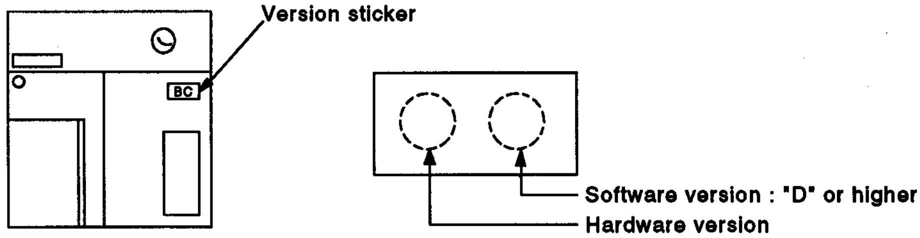
(5) Compatibility with MR-J2-B type servo amplifiers

(6) Present value management when using an absolute encoder has been improved (for details, see Section 1.2.1).

To use the functions (1) to (6) on the previous page, use the OS for positioning and positioning software package indicated below.

[When using A171SCPU]

- CPU version
  Use an A171SCPU for which "D" or higher is marked as the software version on the front of the module.
  ("C" and previous versions cannot be used.)



- OS for positioning

Model	OS Ver.
SW0SRX-SV13M SW0SRX-SV22L	"U" or higher

- Positioning software package

Model	OS Ver.
SW2SRX-GSV13P SW2SRX-GSV22P	"P" or higher

[When using A273UHCPU]

- OS for positioning

Model	OS Ver.
SW2SRX-SV13K SW2SRX-SV13V SW2SRX-SV22J SW2SRX-SV22U	"U" or higher

- Positioning software package

Model	OS Ver.
SW2SRX-GSV13P SW2SRX-GSV22P	"P" or higher

1.2.1 Improved present value managment

By adding the functions described below, present value management when using an absolute encoder has been improved.

(1) Added functions.

(a) An encoder data validity check is now possible during operation.

- It is checked whether the amount of change at the encoder in 3.5 ms intervals corresponds to rotation within 180° at the motor shaft. (If abnormal, an error is displayed.)
- Consistency between the encoder data and the feedback position controlled at the servo amplifier is checked. (If abnormal, an error is displayed.)

(b) Addition of the present value history monitor has enabled monitoring of the following data at a peripheral device.

- Encoder present value/servo command value/monitor present value when the power is switched ON.
- Encoder present value/servo command value/monitor present value when the power is switched OFF.
- Encoder present value/servo command value/monitor present value when a home position return is performed.

(c) By setting the allowable travel while the power is OFF, a change in the encoder data to a value outside the setting range while the power is OFF can now be checked when the servo amplifier power is turned ON. (If abnormal, an error is displayed.)

(2) Restrictions due to the combination of positioning OS and positioning software package.

The following restrictions apply, depending on whether an allowable travel while the power is OFF is set or not.

Positioning OS Version	Positioning Software Package Version	Restrictions
V or later	R or later *1	There are no restrictions. (When a new version positioning OS is installed in place of an old version, it is essential to execute a home position return.)
	Q or earlier *2	• Present value history monitor cannot be used. • Since the allowable travel while the power is OFF cannot be set, a minor error (error code: 901 to 9010) occurs when the servo amplifier power is turned on. (When a new version positioning OS is installed in place of an old version, its is essential to execute a home position return.)
U or earlier	R or later *1	None of the function upgrades can be used.
	Q or earlier *2	

*1: Allowable travel while the power is OFF can be set.

*2: Allowable travel while the power is OFF cannot be set.

*3: Since the allowable travel while the power is OFF cannot be set when using an old version positioning software package a minor error is displayed, but this poses no problem to operation.

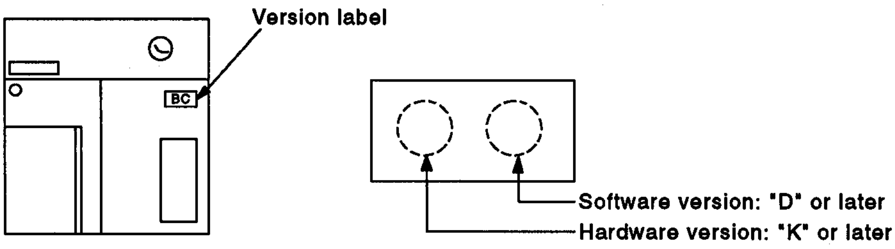
(3) Restrictions due to servo amplifier.

The following restrictions apply depending on the combination of servo amplifier and positioning software package used when using positioning OS version V or later.

Servo Amplifier	Positioning Software Package Version	Restrictions
MR-H-B: BCD-B13W000-B2 or later MR-J2-B: BCD-B20W200-A1 or later	R or later	There are no restrictions.
	Q or earlier	Only the function upgrade described in item (a) applies.
MR-H-B: BCD-B13W000-B1 or later MR-J2-B: BCD-B20W200-A0 or later MR-J-B: All models ADU: All models	R or later	Only the function upgrade described in item (c) applies. (However, with respect to item (b), monitoring is possible with the exception of the encoder present value.)
	Q or earlier	None of the function upgrades can be used.

(4) Restrictions on the servo system CPU.

[When using A171SCPU]
- CPU version
  Use an A171SCPU for which the hardware version indicated on the front of the module is "K" and the software version indicated "D" or later.
  (A171SCPUs whose hardware version is "J" or earlier, or whose software version is "C" or earlier, cannot be used.)



[When using A273UHCPU]
- There are no restrictions due to the hardware.

2. PERFORMANCE SPECIFICATIONS

Table 2.1 gives the performance specifications of the PCPU.

Table 2.1 PCPU Performance Specifications

<table>
<tr><th colspan="3">Item</th><th>PCPU Performance/Specifications</th></tr>
<tr><td rowspan="3">Number of control axes</td><td colspan="2">A171SCPU</td><td>4 axes (simultaneous: 2 to 4 axes, independent: 4 axes)</td></tr>
<tr><td colspan="2">A273UHCPU (8 axis specification)</td><td>8 axes (simultaneous: 2 to 4 axes, independent: 8 axes)</td></tr>
<tr><td colspan="2">A273UHCPU (32 axis specification)</td><td>32 axes (simultaneous: 2 to 4 axes, independent: 32 axes)</td></tr>
<tr><td colspan="3">Interpolation functions</td><td>Linear interpolation (4 axes max.), and circular interpolation (2 axes)</td></tr>
<tr><td colspan="3">Control modes</td><td>PTP (point to point), speed control, speed/position control, fixed-pitch feed, constant speed control, position follow-up control</td></tr>
<tr><td colspan="3">Control units</td><td>mm · inch · degree · PULSE</td></tr>
<tr><td rowspan="5">Program</td><td colspan="2">Languages</td><td>Dedicated instructions (sequence ladders + servo programs).
SFC programming of servo programs also possible.</td></tr>
<tr><td rowspan="2">Capacity</td><td>A171S/A273UHCPU (8 axis specification)</td><td>13K steps (13312 steps)</td></tr>
<tr><td>A273UHCPU (32 axis specification)</td><td>14334k steps</td></tr>
<tr><td colspan="2">Number of points for positioning</td><td>Approx. 400 points/axis (depending on the program)
Positioning data can be indirectly designated.</td></tr>
<tr><td colspan="2">Setting method</td><td>Setting with an IBM PC, or A271DVP running the GSV13PE/ GSV22PE software.</td></tr>
<tr><td rowspan="4">Positioning</td><td colspan="2">Method</td><td>PTP.................................. Selection of absolute data method or incremental method
Speed/positioning control,... fixed pitch feed Incremental method
Constant speed control....... Absolute data method and incremental method can be used together
Position follow-up control.... Absolute data method</td></tr>
<tr><td colspan="2">Position commands</td><td>The four types of command unit indicated below 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>-2147483648 to 2147483647</td><td rowspan="4">0 to ±2147483647</td></tr><tr><td>inch</td><td>$\times 10^{-5}$ inch</td><td>-2147483648 to 2147483647</td></tr><tr><td>degree</td><td>$\times 10^{-5}$ degree</td><td>0 to 35999999</td></tr><tr><td>PULSE</td><td>PULSE</td><td>-2147483648 to 2147483647</td></tr></table></td></tr>
<tr><td colspan="2">Speed command (command unit)</td><td>0.01 to 6000000.00 (mm/min)
0.001 to 600000.000 (inch/min)
0.001 to 600000.000 (degree/min)
1 to 1000000 (PLS/s)</td></tr>
<tr><td colspan="2">High-speed oscillation function</td><td>One designated axis can be made to oscillate on a sine wave.</td></tr>
<tr><td rowspan="2">Acceleration/ deceleration processing</td><td colspan="2">Automatic trapezoidal acceleration/deceleration</td><td>Acceleration time ....1 to 65535 (ms)
Deceleration time ....1 to 65535 (ms)</td></tr>
<tr><td colspan="2">S curve acceleration/deceleration</td><td>S curve ratio setting 0 to 100 (%)</td></tr>
<tr><td rowspan="2">Compensation</td><td colspan="2">Backlash compensation</td><td>(0 to 65535) × position command unit (units converted to pulses: 0 to 65535 pulses)</td></tr>
<tr><td colspan="2">Electronic gear</td><td>Compensation function for error in actual travel value with respect to command value</td></tr>
<tr><td colspan="3">Home position return function</td><td>When an absolute position system is not used:
Selection of near-zero point dog type or count type.
When an absolute position system is used:
Selection of data set type, near-zero point dog type or count type.</td></tr>
<tr><td colspan="3">JOG operation function</td><td>Provided</td></tr>
<tr><td rowspan="2">Manual pulse generator operation function</td><td colspan="2">A171SCPU</td><td>A maximum of one manual pulse generator can be connected.
Use a sequence program to set the number of the axis to be controlled.
It is possible to set the smoothing magnification.</td></tr>
<tr><td colspan="2">A273UHCPU (8/32 axis specification)</td><td>A maximum of three manual pulse generators can be connected.
Use a sequence program to set the numbers of the axes to be controlled.
It is possible to set the smoothing magnification.</td></tr>
</table>

2. PERFORMANCE SPECIFICATIONS

Table 2.1 PCPU Performance Specifications (Continued)

Item			PCPU Performance/Specifications
M function			M code output function provided
Limit switch output function			Up to 8 points per axis, and 10 ON/OFF setting points, can be set.
Absolute position system			Possible with a motor equipped with an absolute position detector. (Possible to select the absolute data method or incremental method for each axis)
High-speed reading of designated data	Number of points read	A171SCPU	Max. 9 points (TREN input of A171SENC (1 point) + one PC input module (8 points)
		A273UHCPU (8/32 axis specification)	Max. 11 points (TREN input of A273EX (3 points) + one PC input module (8 points)
	Reading timing	TREN input	At leading edge of the TREN input signal.
		PC input module input	Within 0.8 ms of the signal leading edge

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 six types are used for the internal signals of the servo system CPU.

• Inputs (X)	A273UHCPU (8 axis specification)	X0 to XFF (256 points)
• Outputs (Y)	A273UHCPU (8 axis specification)	Y0 to YFF (256 points)
• Internal relays (M)	A171SCPU	M1600 to M2047 (148 points)
	A273UHCPU (8 axis specification)	M2000 to M2047 (48 points)
	A273UHCPU (32 axis specification)	M2000 to M3839 (1840 points)
• Special relays (SP.M)	M9073 to M9079 (7 points)	
• Data registers (D)	A171SCPU/ A273UHCPU (8 axis specification)	D800 to D1023 (224 points)
	A273UHCPU (32 axis specifications)	D0 to D799 (800 points)
• Special registers (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, near-zero point dog signal, speed/position switching signal, and manual pulse generator input signals.

• Upper and lower stroke end limit switch input signals	ignals that control the upper limit and lower limit of the positioning range
• Stop signal	Stop signal for speed control
• Near-zero point dog signal	The ON/OFF signal from the near-zero point dog
• Speed/position switching signal	Signal that switches control from speed to position control
• Manual pulse generator input	Signal from the manual pulse generator

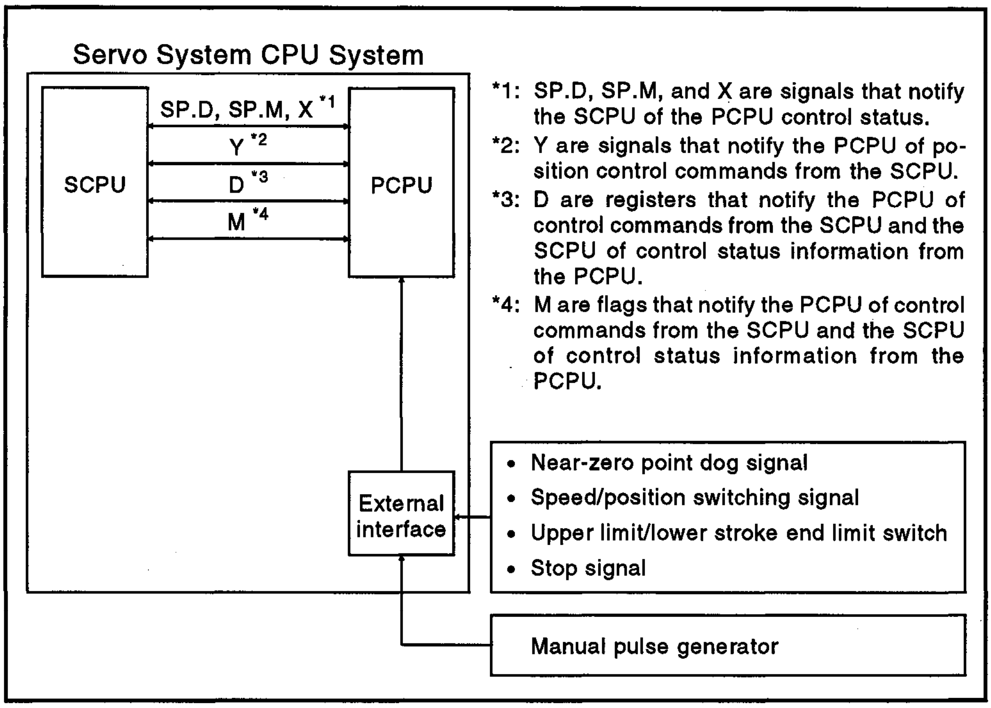


Fig. 3.1 Flow of Positioning Signals

3.1 Axis Input/Output Signals

The servo system CPU has I/O (X, Y) devices and internal relay (M) devices, and the ranges of devices that are used for positioning control are fixed as shown below.

Servo System CPU	I/O / Internal Relay	Range for Positioning Control
A171SCPU	M/L0 to M/L2047	M1600 to M1999
A273UHCPU (8 axis specification)	X/Y0 to X/Y1FFF	X/Y0 to X/YFF
A273UHCPU (32 axis specification)	M/L0 to M/L8191	M2400 to M3839

The devices for positioning control are used as axis I/O signals and their applications are fixed as shown in Table 3.1 and Table 3.2.

Table 3.1 Axis Input Signals

Signal Name		Device No. A171SCPU	Device No. A273UHCPU (8 axis specification)	Device No. A273UHCPU (32 axis specification)	Signal Direction
Positioning start completed		M1600+20n	Xn0	M2400+20n	PCPU → SCPU
Positioning completed		M1601+20n	Xn1	M2401+20n	
In-position		M1602+20n	Xn2	M2402+20n	
Command in-position		M1603+20n	Xn3	M2403+20n	
Speed control in progress		M1604+20n	Xn4	M2404+20n	
Speed/position switching latch		M1605+20n	Xn5	M2405+20n	
Zero pass		M1606+20n	Xn6	M2406+20n	
Error detection		M1607+20n	Xn7	M2407+20n	
Servo error detection		M1608+20n	Xn8	M2408+20n	
Home position return request		M1609+20n	Xn9	M2409+20n	
Home position return completed		M1610+20n	XnA	M2410+20n	
External signals	FLS	M1611+20n	XnB	M2411+20n	
	RLS	M1612+20n	XnC	M2412+20n	
	STOP	M1613+20n	XnD	M2413+20n	
	DOG/CHANGE	M1614+20n	—	—	
	DOG	—	XnE	M2414+20n	
Servo READY		M1615+20n	XnF	M2415+20n	
Torque control in progress		M1616+20n	XD0+n	M2416+20n	
CHANGE signal		—	XD8+n	M2417+20n	
Unusable		M1618+20n	XF0+n	M2418+20n	
"M code output in progress" signal		M1619+20n	XC0+n	M2419+20n	

REMARK

"m" and "n" in Table 3.1 represent the numerical value that corresponds to the axis number.

<A171SCPU>

Axis No.	n
1	0
2	2
3	4
4	6

<A273UHCPU (8 axis specification)>

Axis No.	n
1	0
2	1
3	2
4	3
5	4
6	5
7	6
8	7

<A273UHCPU (32 axis specification)>

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

* Calculate the device numbers that correspond to each axis when using an A273UHCPU (32 axis specification) as follows.
  Example: 32 axes use
  M2400+20n (positioning completed) = M2400+20x31 = M3020
  M2417+20n (CHANGE signal) = M2417+20x31 = M3037

Table 3.2 Axis Output Signal

Signal Name	Device No.			Signal Direction
	A171SCPU	A273UHCPU (8 axis specification)	A273UHCPU (32 axis specification)	
Stop command	M1800+20n	Yn0	M3200+20n	SCPU → PCPU
Rapid stop command	M1801+20n	Yn1	M3201+20n	
Forward JOG start	M1802+20n	Yn2	M3202+20n	
Reverse JOG start	M1803+20n	Yn3	M3203+20n	
End signal OFF command	M1804+20n	Yn4	M3204+20n	
Speed/position switching enabled	M1805+20n	Yn5	M3205+20n	
Limit switch output enable	M1806+20n	Yn6	M3206+20n	
Error reset	M1807+20n	Yn7	M3207+20n	
Servo error reset	M1808+20n	Yn8	M3208+20n	
External STOP input valid/ invalid when starting	M1809+20n	Yn9	M3209+20n	
Unusable	M1810+20n	YnA	M3210+20n	
	M1811+20n	YnB	M3211+20n	
Feed present value update request command	M1812+20n	YnC	M3212+20n	
Unusable	M1813+20n	YnD	M3213+20n	
	M1814+20n	YnE	M3214+20n	
Servo OFF	M1815+20n	YnF	M3215+20n	
Unusable	M1816+20n	—	M3216+20n	
	M1817+20n	—	M3217+20n	
	M1818+20n	—	M3218+20n	
FIN signal	M1819+20n	YC0+n	M3219+20n	

REMARK

"m" and "n" in Table 3.2 represent the numerical values that correspond to the axis numbers.

<A171SCPU>

Axis No.	n
1	0
2	2
3	4
4	6

<A273UHCPU (8 axis specification)>

Axis No.	n
1	0
2	1
3	2
4	3
5	4
6	5
7	6
8	7

<A273UHCPU (32 axis specification)>

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

* Calculate the device numbers that correspond to each axis when using an A273UHCPU (32 axis specification) as follows.
Example: 32 axes used
M3200+20n (stop command) = M3200+20x31 = M3820
M3215+20n (servo OFF) = M3215+20x31 = M3835

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 are not latched, the expression used in the text is "M1600 to M1999/M2400 to M3839".

(2) When the internal relays for positioning control are monitored with a peripheral device, the following happens:
(a) With a peripheral device running on the GSV13PE/GSV22PE software package, the internal relays for positioning control which are set in the latch range are displayed as L1600 to L1999/L2400 to L3839.

3.1.1 Positioning start completed signal (M1600+20n/Xn0/M2400+20n)

(1) This signal comes ON when starting of positioning control of the axis designated by the DSFRP/SVST instruction in the sequence program is completed.
It does not come ON when positioning control starts due to a home position return, 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.)

(2) The positioning start completed signal goes OFF at the leading edge (OFF → ON) of the end signal OFF command (M1804+20n) or when positioning is completed.

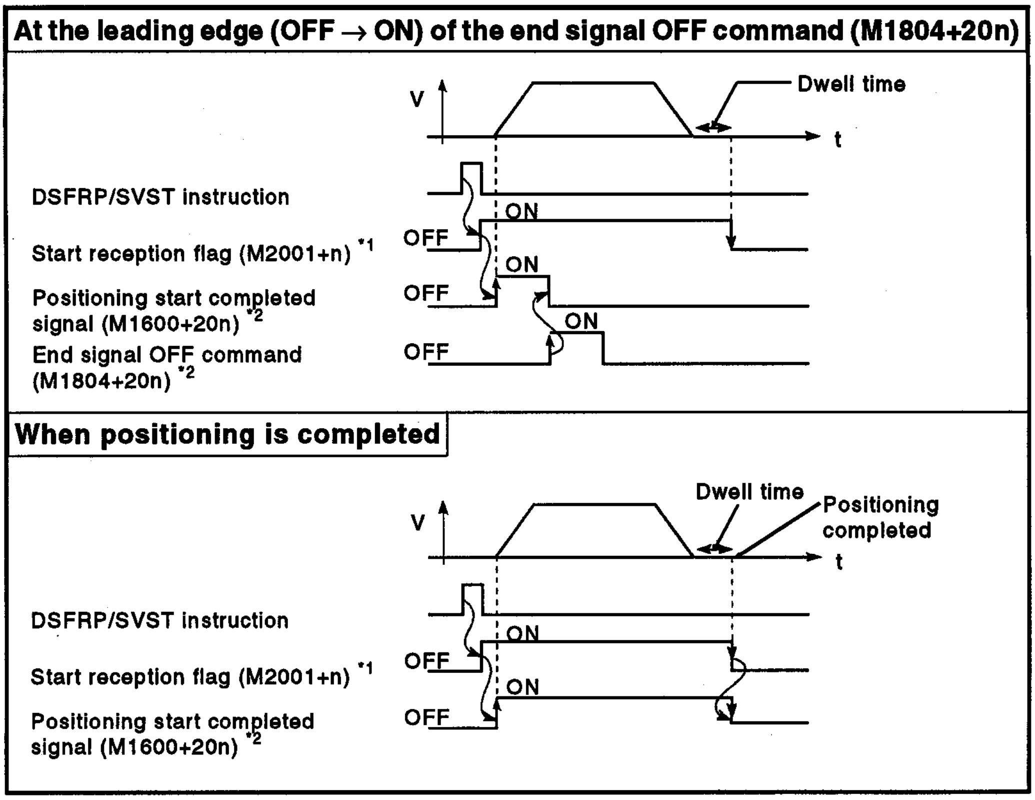


Fig. 3.2 Positioning Start Completed Signal ON/OFF Timing

REMARKS

*1: The "n" in "M2001+n is a value corresponding to an axis number, as shown in the table below.
*2: The "n" in M1600+20n and M1804+20n indicates a numerical value corresponding to the axis number, as indicated in the table below.

<When using A171SCPU>

Axis No.	n
1	0
2	1
3	2
4	3

3.1.2 Positioning completed signal (M1601+20n/Xn1/M2401+20n)

(1) This signal comes ON when positioning control of the axis designated by the DSFRP/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 home position return, 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.)

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

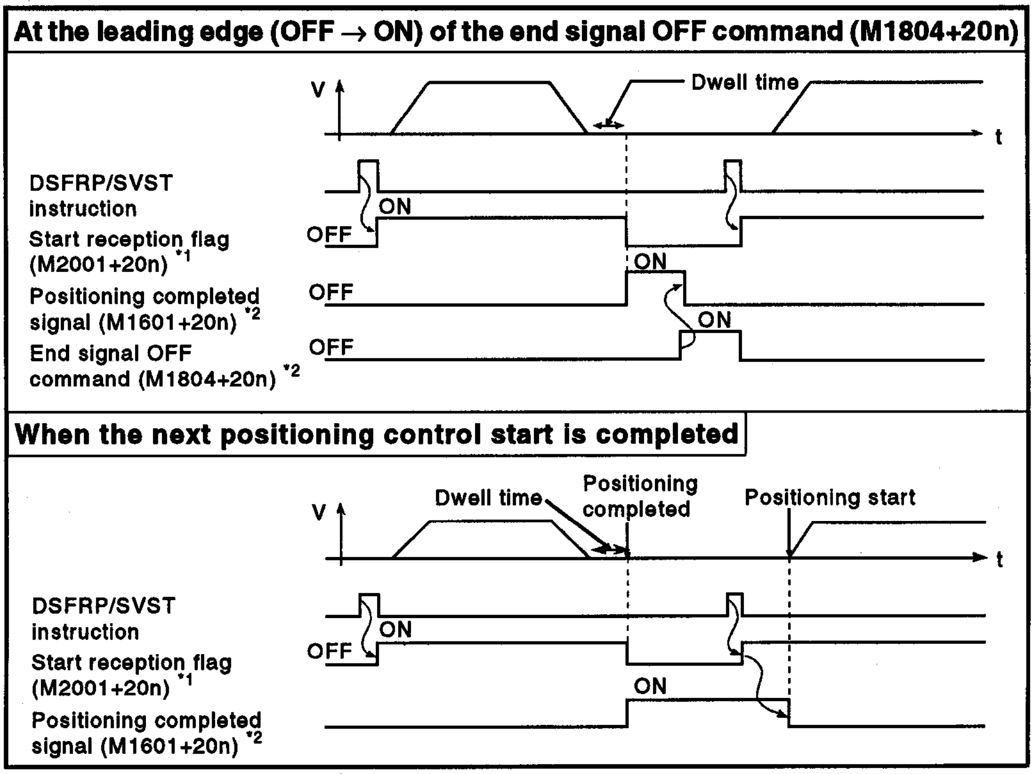


Fig. 3.3 Positioning Completed Signal ON/OFF Timing

REMARKS

*1: The "n" in "M2001+n is a value corresponding to an axis number, as shown in the table below.

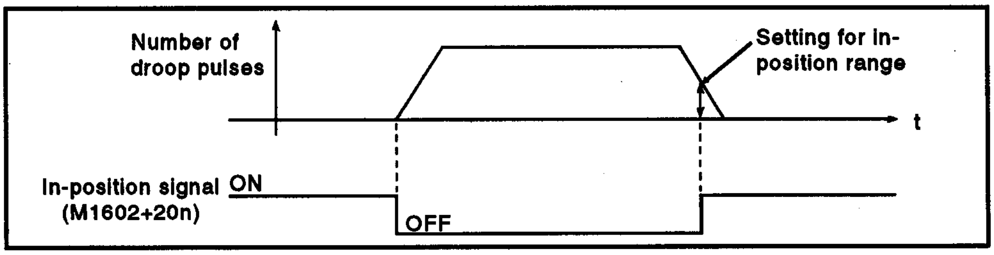
*2: The "n" in M1601+20n and M1804+20n indicates a numerical value corresponding to the axis number, as indicated in the table below.

<When using A171SCPU>

Axis No.	n
1	0
2	1
3	2
4	3

3.1.3 In-position signal (M1602+20n/Xn2/M2402+20n)

(1) 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.

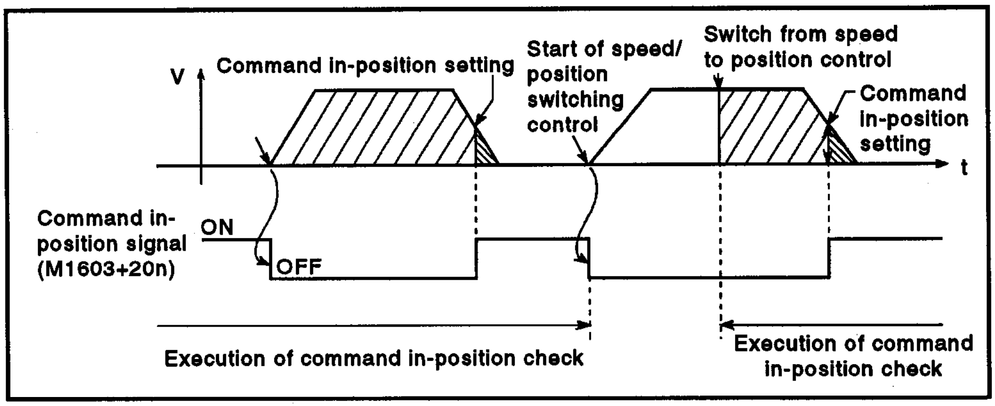


(2) An in-position check is performed in the following cases.
- When the servo power supply is switched on
- After automatic acceleration/deceleration is started during positioning control
- After deceleration is started as a result of the JOG start signal going OFF
- When manual pulse generator operation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

3.1.4 Command in-position signal (M1603+20n/Xn3/M2403+20n)

(1) The command in-position signal comes ON when the absolute value of the difference between the command position and the feed present 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 home position return is executed
- When speed control is executed
- When JOG operation is performed
- When manual pulse generator operation is performed

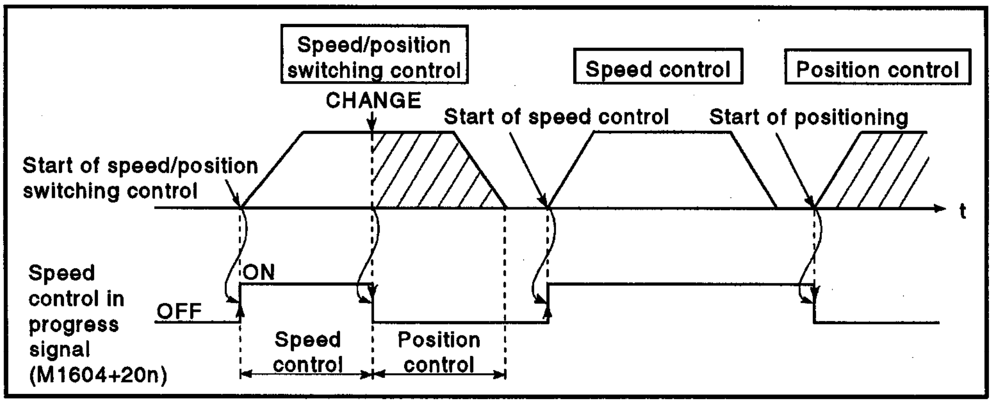
(2) Command in-position checks are continually performed during positioning control.
Command in-position checks are not performed during speed control or during speed control in speed/position switching control.



3.1.5 Speed control in progress signal (M1604+20n/Xn4/M2404+20n)

(1) 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.

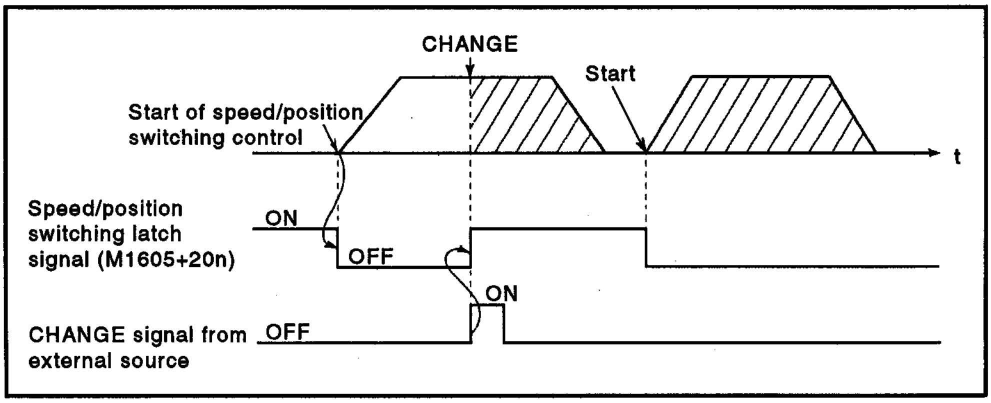
(2) The speed control in progress signal is OFF when the power is switched ON and during position control.



3.1.6 Speed/position switching latch signal (M1605+20n/Xn5/M2405+20n)

(1) 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.

(2) 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



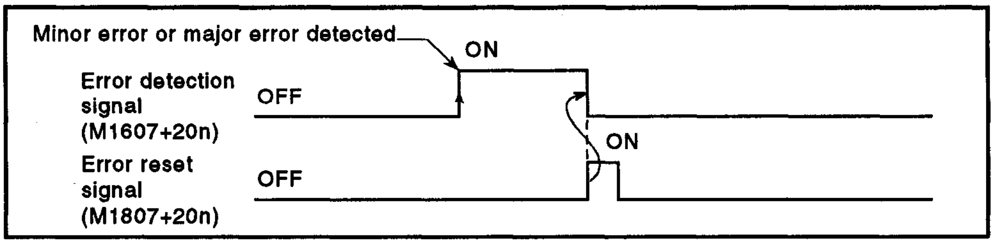
3.1.7 Zero pass signal (M1606+20n/Xn6/M2406+20n)

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.

3.1.8 Error detection signal (M1607+20n/Xn7/M2407+20n)

(1) 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*1 is stored in the minor error code storage area (see Section 3.4.1).
When a major error is detected, the corresponding error code*2 is stored in the major error code storage area (see Section 3.4.1).

(2) When the error reset signal (M1807+20n) comes ON, the error detection signal goes OFF.



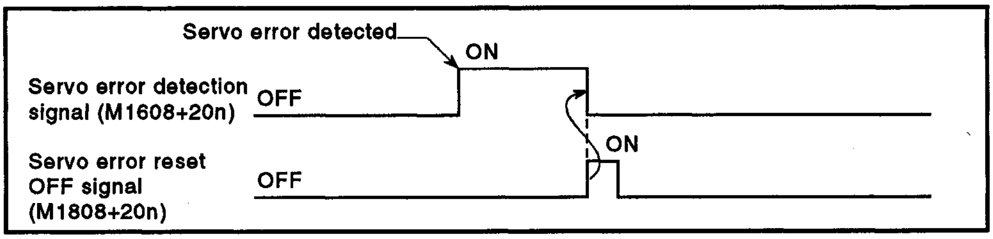
REMARKS

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

3.1.9 Servo error detection signal (M1608+20n/Xn8/M2408+20n)

(1) The servo error detection signal comes ON when an error occurs at the servo amplifier side (excluding errors that cause alarms, and emergency stops)*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*1 is stored in the servo error code storage area.

(2) The servo error detection signal goes OFF when the servo error reset signal (M1808+20n) comes ON, or when the servo power supply is switched back on.



REMARK

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

3.1.10 Home position return request signal (M1609+20n/Xn9/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.

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

  (b) The home position return request signal goes OFF when the home position return operation is completed.

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

  (b) The home position return request signal goes OFF when the home position return operation is completed.

3.1.11 Home position return completed signal (M1610+20n/XnA/M2410+20n)

(1) The home position return completed signal comes ON when the execution of a home position return operation in accordance with a servo program has been completed normally.

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

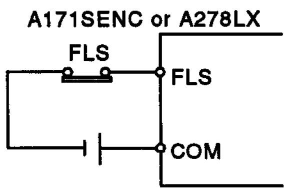
(3) If an attempt is made to execute a near-zero-point dog home position return while the home position return completed signal is ON, the "ZERO RETURN START" error occurs, making it impossible to start the home position return.

3.1.12 FLS signal (M1611+20n/XnB/M2411+20n)

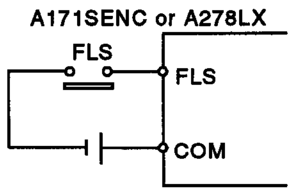
(1) FLS signal is controlled by the ON/OFF status of the upper stroke end limit switch input (FLS) to the A171SENC or A278LX from an external source.
  - Upper stroke end limit switch input OFF........FLS signal: ON
  - Upper stroke end limit switch input ON...........FLS signal: OFF

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

FLS signal: ON



FLS signal: OFF

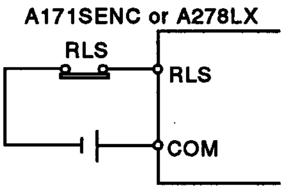


3.1.13 RLS signal (M1612+20n/XnC/M2412+20n)

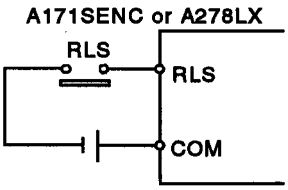
(1) The RLS signal is controlled by the ON/OFF status of the lower stroke end limit switch input (FLS) to the A171SENC or A278LX from an external source.
- Lower stroke end limit switch input OFF.........RLS signal: ON
- Lower stroke end limit switch input ON...........RLS signal: OFF

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

RLS signal: ON



RLS signal: OFF

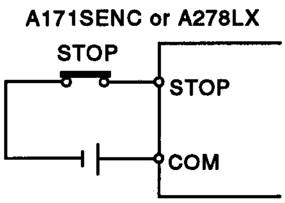


3.1.14 STOP signal (M1613+20n/XnD/M2413+20n)

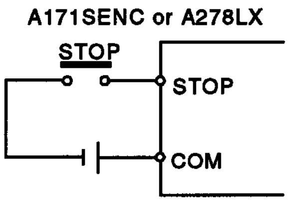
(1) The STOP signal is controlled by the ON/OFF status of the stop signal (STOP) sent to the A171SENC or A278LX from an external source.
- Stop signal OFF.............STOP signal: OFF
- Stop signal ON..............STOP signal: ON

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

STOP signal: ON



STOP signal: OFF



3.1.15 DOG/CHANGE signal (M1614+20n): when A171SCPU used

(1) The DOG/CHANGE signal is controlled by the ON/OFF status of the near-zero-point dog input or the speed/position switching input (DOG/CHANGE) sent to the A171SENC from an external source.

(2) Regardless of the "normally open contact input" and "normally closed contact input" settings in the system settings, the DOG/CHANGE signal comes on when the near-zero-point dog signal or change signal comes ON.

(3) When "normally open contact input" is set in the system settings, near-zero-point dog or CHANGE input occurs when the near-zero-point dog or change signal comes ON, and when "normally closed contact input" is set, near-zero-point dog or CHANGE input occurs when the near-zero-point dog or change signal goes OFF.

3.1.16 DOG signal (XnE/M2414+20n): when A273UHCPU (8/32-axis specification) is used

(1) The DOG signal is controlled by the ON/OFF status of the near-zero point dog (DOG) notified to the A278LX from an external source.

(2) Regardless of the "normally open contact input" and "normally closed contact input" settings in the system settings, the near-zero-point dog signal comes ON when the near-zero-point dog comes ON, and goes OFF when the near-zero-point dog goes OFF.

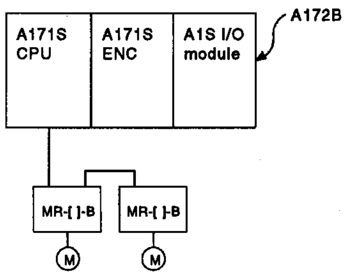
(3) When "normally open contact input" is set in the system settings, near-zero-point dog input occurs when the near-zero-point dog comes ON, and when "normally closed contact input" is set, near-zero-point dog input occurs when the near-zero-point dog goes OFF.

3.1.17 Servo READY signal (M1615+20n/XnF/M2415+20n)

(1) The servo READY signal comes ON when the servo amplifiers connected to each axis are in the READY status.

(2) 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 M1815+20n/YnF/M3215+20n signal comes ON and establishes the servo OFF status
- When a servo error occurs
  For details, see Appendix 2.4 "Servo Errors"

(a) When an A171SCPU is used



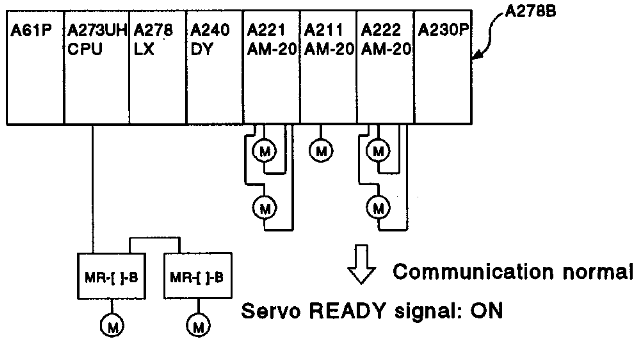
POINTS

(1) When an axis driven by an ADU becomes subject to a servo error, the axes that go into the servo OFF status depend on the system settings, as follows. (Applies only when using A273UHCPU (8/32 axis specification))

Setting for processing when ADU servo error occurs	"Servo OFF" axes
System servo OFF	All axes in the system including the one subject to servo error
Servo OFF of affected axis only	Only the axis subject to 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.

(b) When an A273UHCPU is used



3.1.18 Torque control in progress signal (M1616+20n/XDn/M2416+20n)

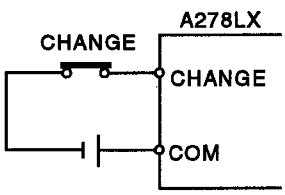
Signals for axes whose torque is being controlled are ON.

3.1.19 CHANGE signal (XD8+n/M2417+20n): When A273UHCPU (8/32-axis specification) is used

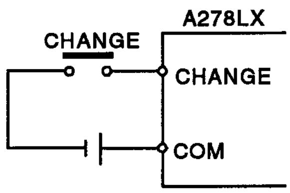
(1) The CHANGE signal is controlled by the ON/OFF status of the speed/position switching input (CHANGE) to the A278LX from an external source.
- Speed/position switching input OFF..........CHANGE signal: OFF
- Speed/position switching input ON............CHANGE signal: ON

(2) The status of the speed switching switch (CHANGE) when the CHANGE signal is ON and OFF is indicated in the figure below.

CHANGE signal: ON

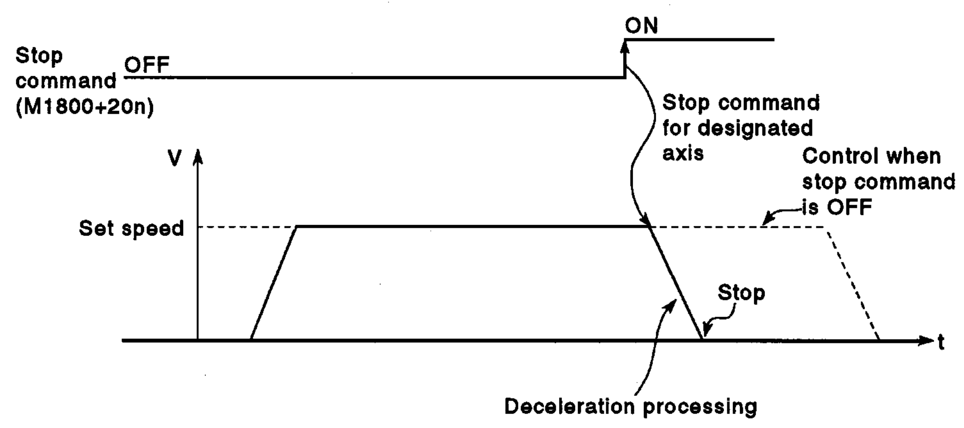


CHANGE signal: OFF



3.1.20 Stop command (M1800+20n/Yn0/M3200+20n)

(1) 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.)



(2) 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.)

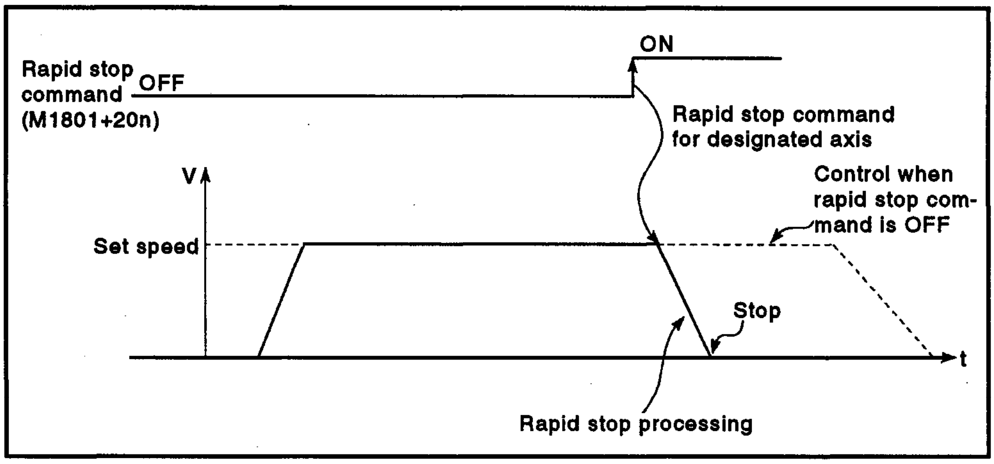
Control Being Executed	Processing when the Stop Command Comes ON	
	If Control Is Being Executed	If Deceleration Stop Processing Is Being Executed
Position control Speed control (I, II) JOG operation	The axis decelerates to a stop in the deceleration time set in the parameter block or servo program.	The stop command is ignored and deceleration stop processing continues.
Manual pulse generator operation	An immediate stop is executed, with no deceleration processing.	—
Home position return	(1) The axis decelerates to a stop in the deceleration time set in the parameter block. (2) A "stop during home position return" 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 (M1800+20n/Yn0/M3200+20n) during a home position return operation, re-execute the home position return operation.
If the stop command came ON after the near-zero point dog came ON in the home position return operation, first retract to a position before the point where the near-zero point dog comes ON using JOG operation or positioning, and then execute the home position return operation again.

3.1.21 Rapid stop command (M1801+20n/Yn1/M3201+20n)

(1) 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.)



(2) 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 cancelled and rapid stop processing executed instead.
Manual pulse generator operation	An immediate stop is executed, with no deceleration processing.	—
Home position return	(1) The axis decelerates to a stop in the rapid stop deceleration time set in the parameter block. (2) A "stop during home position return" 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 (M1801+20n/Yn1/M3201+20n) during a home position return operation, re-execute the home position return operation.
If the rapid stop command came ON after the near-zero point dog came ON in the home position return operation, first retract to a position before the point where the near-zero point dog comes ON using JOG operation or positioning, and then execute the home position return operation again.

3.1.22 Forward JOG start command (M1802+20n/Yn2/M3202+20n) / Reverse JOG start command (M1803+20n/Yn3/M3203+20n)

(1) While the sequence program keeps M1802+20n ON, JOG operation is executed in the direction in which address numbers increase. When M1802+20n is turned OFF, a deceleration stop is executed in the deceleration time set in the parameter block.

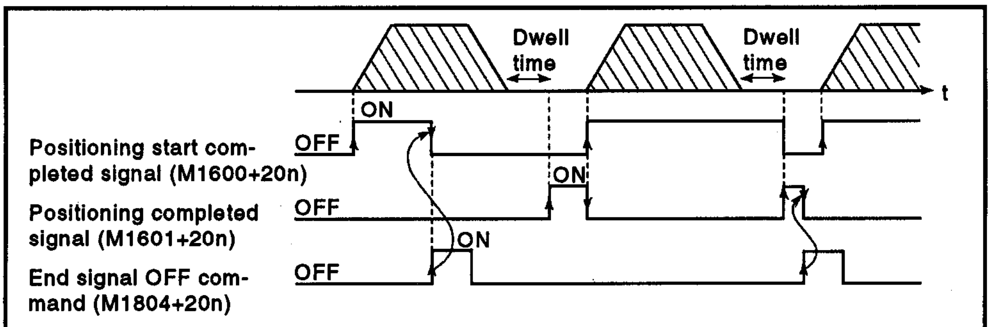
(2) While the sequence program keeps M1803+20n ON, JOG operation is executed in the direction in which address numbers decrease.
When M1803+20n is turned OFF, a deceleration stop is executed in the deceleration time set in the parameter block.

POINT

Establish an interlock in the sequence program to make it impossible for the forward JOG start command (M1802+20n/Yn2/M3202+20n) and the reverse JOG start command (M1803+20n/Yn3/M3203+20n) to be ON at the same time.

3.1.23 End signal OFF command (M1804+20n/Yn4/M3204+20n)

(1) The end signal OFF command is used to turn off the positioning start completed signal (M1600+20n) and the positioning completed signal (M1601+20n) by using the sequence program.

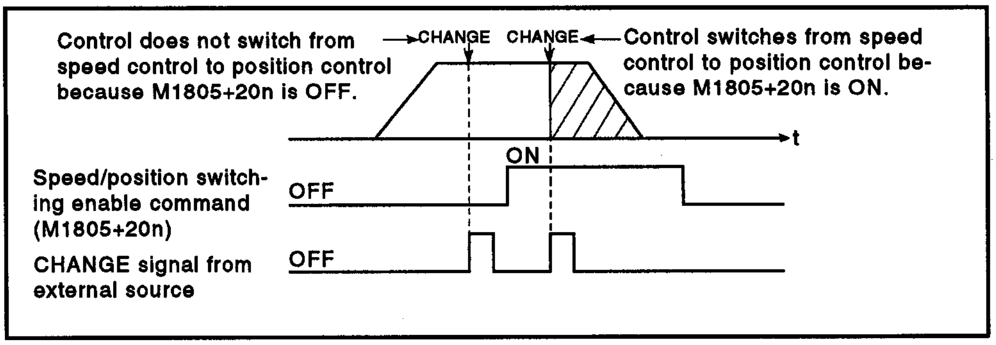


POINT

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 (M1600+20n/Xn0/M2400+20n) or the positioning completed signal (M1601+20n/Xn1/M2401+20n).

3.1.24 Speed/position switching enable command (M1805+20n/Yn5/M3205+20n)

(1) 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.



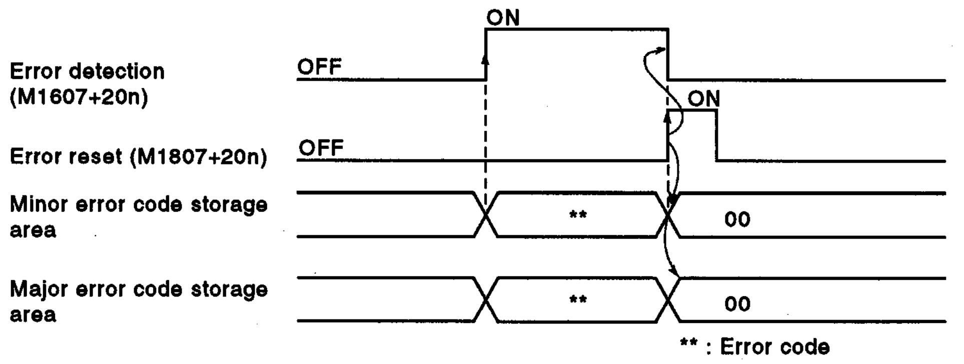
3.1.25 Limit switch output enable command (M1806+20n/Yn6/M3206+20n)

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.

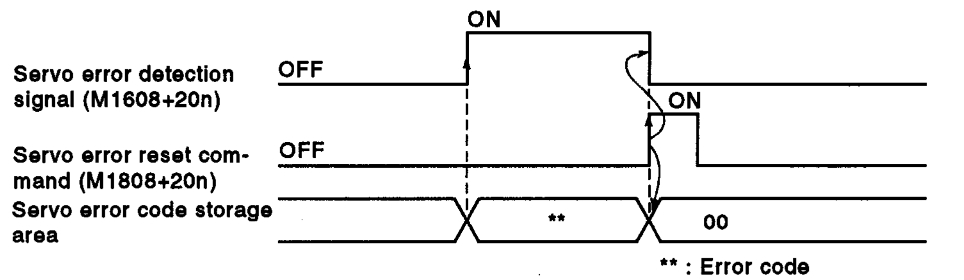
3.1.26 Error reset command (M1807+20n/Yn7/M3207+20n)*

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 (M1607+20n: ON), and reset the error detection signal (M1607+20n).



3.1.27 Servo error reset command (M1808+20n/Yn8/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 ((M1808+20n: ON), and reset the servo error detection signal (M1808+20n).



POINT

*: Do not turn the error reset command (M1807+20n/Yn7/M3207+20n) or servo error reset command (M1808+20n/Yn8/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.

3.1.28 External STOP input/invalid when starting command (M1809+20n/Yn9/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 M1809+20n/Yn9/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).

3.1.29 Feed present value update request command (M1812+20n/YnC/M3212+20n)

This signal is used to set whether the feed present value will be cleared or not when motion is started in speed/position switching control.

- ON......... The feed present value is updated, starting from when motion is started.
  The feed present value is not cleared on starting.
- OFF........ The feed present value is updated, starting from when motion is started.
  The feed present value is cleared on starting.

POINT

When motion is started with M1812+20n/YnC/M3212+20n, leave M1812+20n ON until positioning control has been completed.
If M1812+20n/YnC/M3212+20n is turned OFF part way through, the feed present value may not be reliable.

3.1.30 Servo OFF command (M1815+20n/YnF/M3215+20n)

The servo OFF command is used to establish the servo OFF status (free run status).

- M1815+20n : OFF.....Servo ON
- M1815+20n : ON.......Servo OFF (free run status)

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

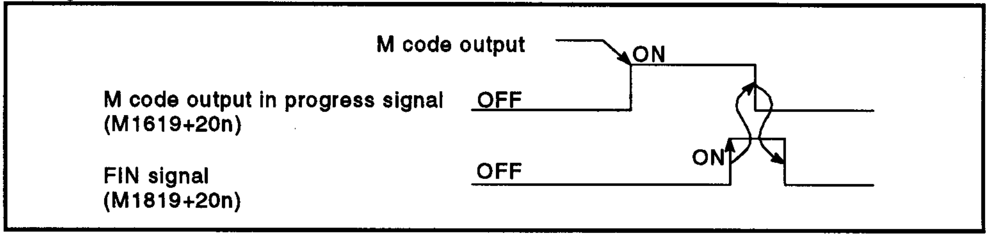
⚠ CAUTION

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

3.1.31 FIN signal (M1819+20n/YC0+n/M3219+20n)

(1) This is a signal to stop the output of an M code.

(2) It goes OFF when the M code output in progress signal (M1619+20n) goes OFF.

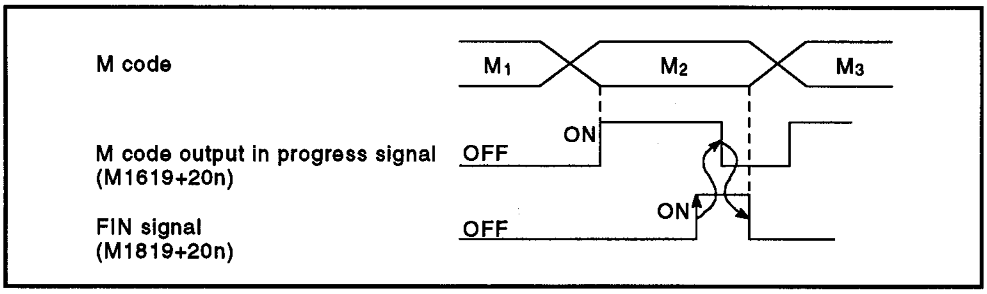


3.1.32 M code output in progress signal (M1619+20n/XC0+n/M2419+20n)

(1) This signal indicates that an M code is being output.

(2) To terminate M code output, turn the FIN signal (M1819+20n) ON.

(3) This signal goes OFF on input of a stop command, cancel signal, or skip signal.



POINTS

(1) The FIN signal and M code output in progress signals are used for the purposes of the FIN signal wait function.

(2) The M code output in progress signal only becomes effective when the FIN signal wait function is designated in a servo program. If this function is not designated, the signal will not come ON even when an M code is being output.

3.2 Internal Relays (M)

An A171SCPU has 2048 internal relay/latch relay points from M/L0 to M/L2047, and an A273UHCPU (8/32 axis specification) has 8192 internal/latch relay points from M/L0 to M/L8191.
Of these, M2000 to M2047 are used for positioning control in the case of the A171SCPU/A273UHCPU (8 axis specification), and M2000 to M2399 are used for positioning control in the case of the A273UHCPU (32 axis specification). The applications of these devices are indicated in the table below.

Table 3.3 Internal Relays

Signal Name	Device No.						Signal Direction
	A171SCPU		A273UHCPU (8 axis specification)		A273UHCPU (32 axis specification)		
	SV13	SV22	SV13	SV22	SV13	SV22	
PC READY	M2000						SCPU→PCPU
Start reception flag	M2001 (axis 1) to M2004 (axis 4)		M2001 (axis 1) to M2008 (axis 8)		M2001 (axis 1) to M2032 (axis 32)		PCPU→SCPU
All-axis servo ON reception flag	M2009		M2009		M2049		
Manual pulse generator enable flag	M2012		M2012 to M2014		M2051 to M2053		SCPU→PCPU
JOG simultaneous start command	M2015		M2015		M2048		SCPU→PCPU
Speed switching point designation flag*	M2016	M2040	M2016	M2040	M2040		
Start buffer full	M2020		M2020		M2050		PCPU→SCPU
Speed change flags	M2021 (axis 1) to M2024 (axis 4)		M2021 (axis 1) to M2028 (axis 8)		M2061 (axis 1) to M2092 (axis 32)		
System setting error flag	M2041						
All axis servo start command	M2042						SCPU→PCPU
Optional slot module error detection flag	M2047						PCPU→SCPU
Automatic deceleration in progress flag	—		—		M2128 (axis 1) to M2159 (axis 32)		
"Accepting speed change [0]"	—		—		M2240 (axis 1) to M2271 (axis 32)		

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 are not latched, the expression used in the text is "M2000 to M2047".

(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.

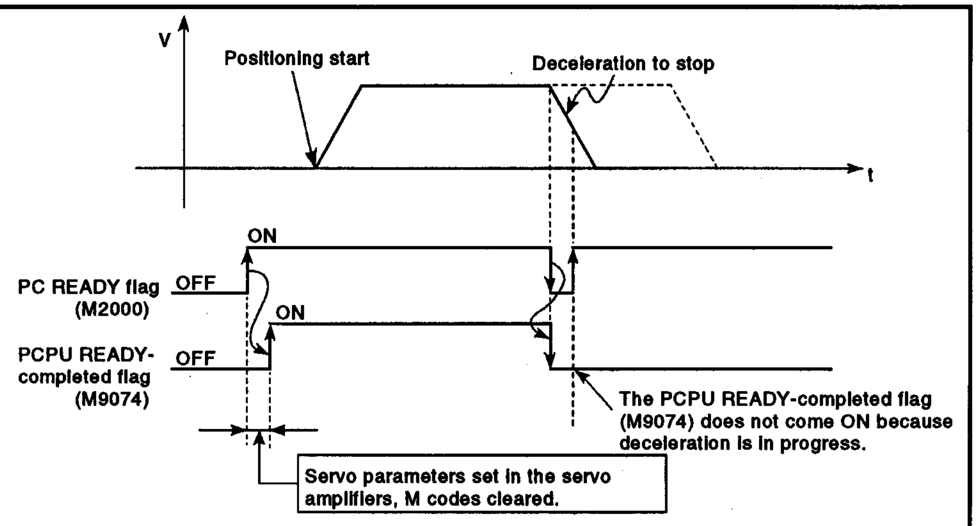
(3) * : When using an A171S/A273UHCPU (8 axis specification), the device number used for the speed switching point designation flag is different for the SV13 and SV22.

3.2.1 PC READY flag (M2000) ..... Signal sent from SCPU to PCPU

(1) This signal serves to notify the PCPU that the SCPU is normal. It is switched ON and OFF by the sequence program.
   (a) While M2000 is ON, the positioning control or home position return specified by the servo program, or the JOG operation or manual pulse generator operation specified by the sequence program, can be executed.
   (b) While M2000 is OFF, and while the test mode for testing from a peripheral device is effective (while the "in-test-mode flag" (M9075) is ON), the control in (a) above will not be executed even if M2000 is turned ON.

(2) 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.

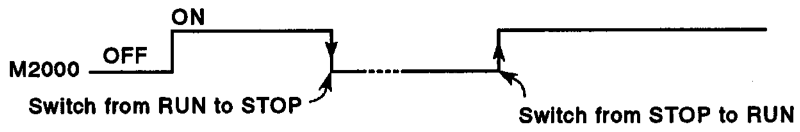
(3) When M2000 is switched from OFF to ON, the following processing occurs.
   (a) Processing details
      1) The servo parameters are transferred to the servo amplifier.
      2) The M code storage area for all axes is cleared.
      3) The default value of 300% is set in the torque limit value storage area. (See Section 4.4.)
      4) The PCPU READY-completed flag (M9074) is turned ON.
   (b) If there is an axis currently being driven, an error occurs, and the processing in 3 (a) above is not executed.
   (c) While the test mode is in effect, the processing in 3 (a) above is not executed. When the test mode is cancelled, the processing in 3 (a) will be executed if M2000 is ON.



(4) When M2000 is switched from ON to OFF, the following processing is executed.
   (a) Processing details
      1) The PCPU READY-completed flag (M9074) is turned OFF.
      2) The axis being driven is decelerated to a stop.

POINT

The PC 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.



3.2.2 Start accept flag (M2001 to M2004/M2001 to M2008/M2001 to M2032) ..... Signal sent from PCPU to SCPU

REMARK

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

<A171SCPU>

Axis No.	n
1	0
2	2
3	4
4	6

<A273UHCPU (8 axis specification)>

Axis No.	n
1	0
2	1
3	2
4	3
5	4
6	5
7	6
8	7

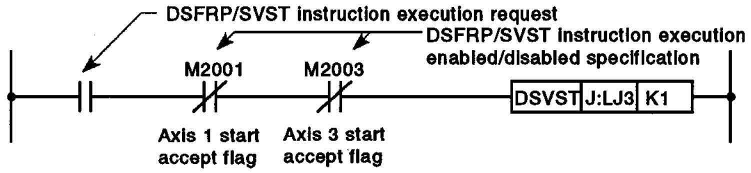
<A273UHCPU (32 axis specification)>

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

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

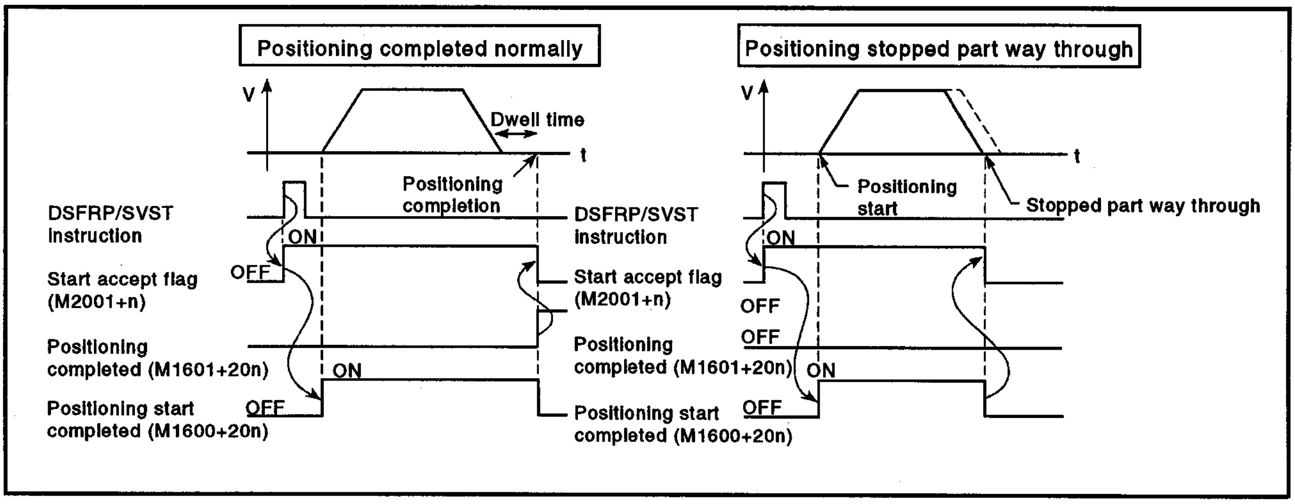
Example

When requesting execution of the servo programs for positioning on axis 1 and axis 2, use the start accept flags in the way shown below.



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

(a) The start accept flag for the designated axis comes ON in response to a DSFRP/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.)



(b) When positioning control is executed by turning ON the JOG operation command (M1802+20n or M1803+20n), the start accept flag goes OFF when positioning is stopped by turning the JOG operation command OFF.

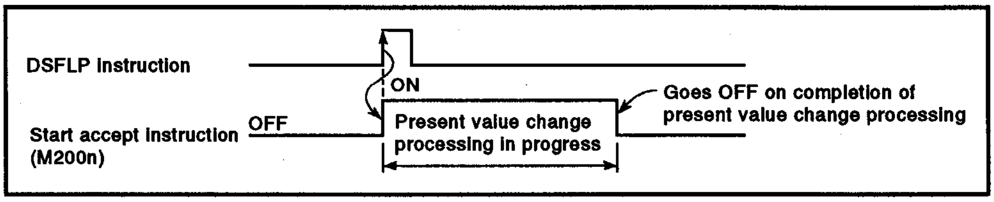
(c) The start accept flag is ON while the manual pulse generator enable flag (M2012: ON) is ON.
The start accept flag is OFF while the manual pulse generator enable flag (M2015: OFF) is OFF.

⚠ CAUTION

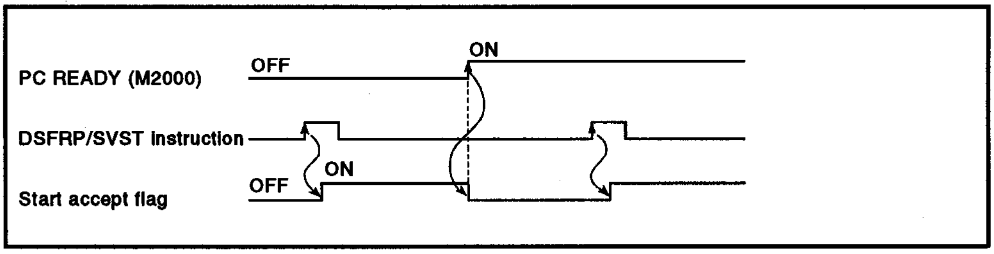
⚠ The user must not turn start accept flags ON/OFF.

- 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.

(d) The start accept flag is ON during a present value change initiated by a DSFLP instruction. It goes OFF on completion of the present value change.



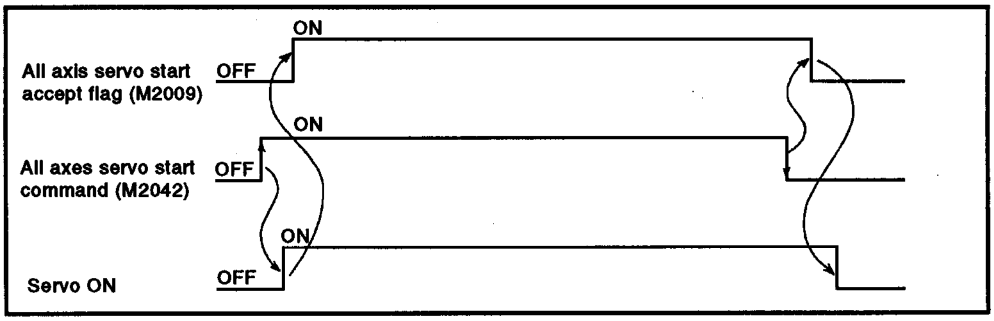
(3) When M2000 is OFF, execution of a DSFRP/SVST instruction causes the start accept flag to come ON; the flag goes OFF when M2000 comes ON.



3.2.3 All axis servo start accept flag (M2009) ..... Signal sent from PCPU to SCPU

The all axis servo start accept flag serves to notify that servo operation is possible.

- ON .... The servomotor can be driven.
- OFF .... The servomotor cannot be driven.



3.2.4 Manual pulse generator enable flag (M2012/M2012 to M2014/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*/P1 to P3* of the A171SENC/A273EX.

- 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

*: For details on the P1 connector of the A171SENC, refer to the A171SCPU Motion Controller User's Manual.
For details on the P1 to P3 connectors of the A273EX, refer to the A273UHCPU (8/32 axis specification) Motion Controller User's Manual.

3.2.5 JOG simultaneous start command (M2015/M2015/M2048) ..... Signal sent from SCPU to PCPU

(1) When M2015 is turned ON, JOG operation is simultaneously started on the axes for which JOG operation is to be executed (of axes 1 to 4) as set in the JOG operation simultaneous start axis setting register (D1015).

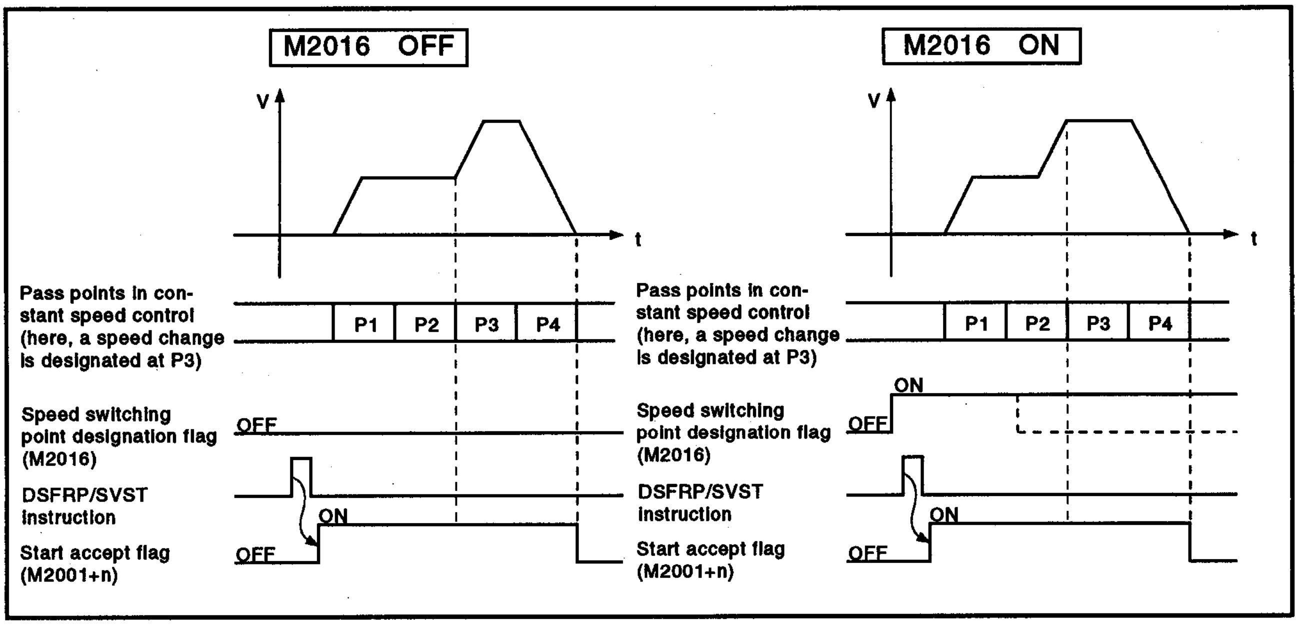
(2) When M2015 is turned OFF, motion on the axis currently executing JOG operation decelerates to a stop.

3.2.6 Speed switching point designation flag (M2016, M2040) ...... Signal sent from SCPU to PCPU

CPU Model	A171SCPU		A273UHCPU (8 axis specification)		A273UHCPU (32 axis specification)	
OS	SV13	SV22	SV13	SV22	SV13	SV22
Device No.	M2016	M2040	M2016	M2040	M2040	

The speed switching point designation flag is used when a speed change is designated at the pass point in constant speed control.

(1) By turning M2016 ON before the start of constant speed control (before the servo program is started using the DSFRP/SVST instruction), control can be executed with a speed change at the start of the pass point.



(2) After completion of start accept processing, the speed switching point designation flag can be turned OFF at any time.

3.2.7 Start buffer full (M2020/M2020/M2050) ... Signal sent from PCPU to SCPU

(1) This signal comes on when 16 or more requests (A171S) or 64 or more requests (A273UH) have been issued simultaneously to the PCPU by means of position start (DSFRP/SVST) instructions and/or control change (DSFLP) instructions in the sequence program.

(2) Reset M2020 by using the sequence program.

3.2.8 Speed change flags (M2021+n/M2021+n/M2061+n) ..... Signal from PCPU to SCPU

REMARK

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

<A171SCPU>

Axis No.	n
1	0
2	2
3	4
4	6

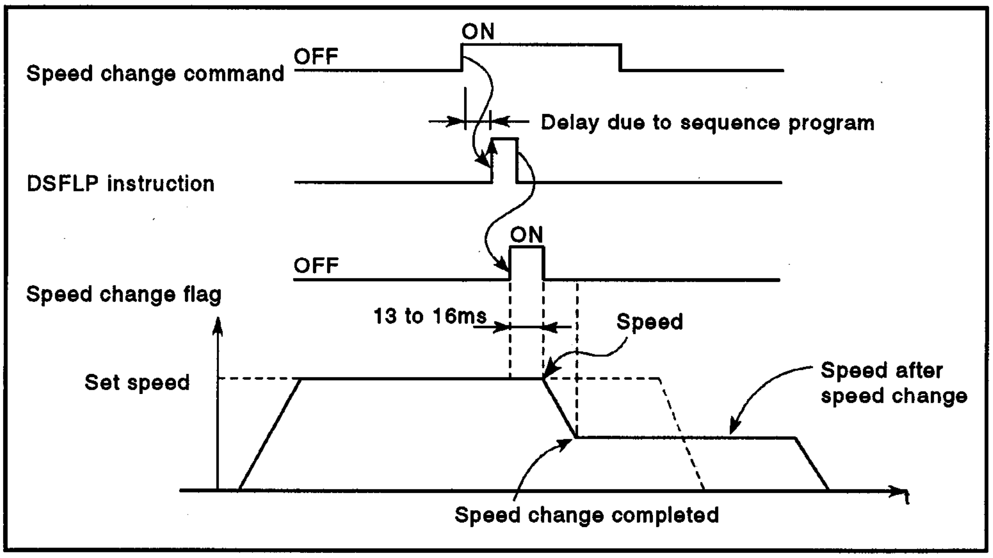
<A273UHCPU (8 axis specification)>

Axis No.	n
1	0
2	1
3	2
4	3
5	4
6	5
7	6
8	7

<A273UHCPU (32 axis specification)>

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

The speed change flags come ON when a speed change is executed in response to a control change (DSFLP/CHGV) instruction in the sequence program: use them for interlocks in speed change programs.



3.2.9 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 main base unit and extension base units).

- ON ....Error
- OFF ....Normal

(1) When using an A273UHCPU (8/32 axis specification), if an error occurs the cause of the error is indicated by the LEDs on the front of the CPU. When using an A171SCPU, if an error occurs the ERROR LED on the front of the CPU lights. It is possible to check the history of errors that have occurred by using a peripheral device (peripheral device running the GSV13PE/GSV22PE software).

(2) 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

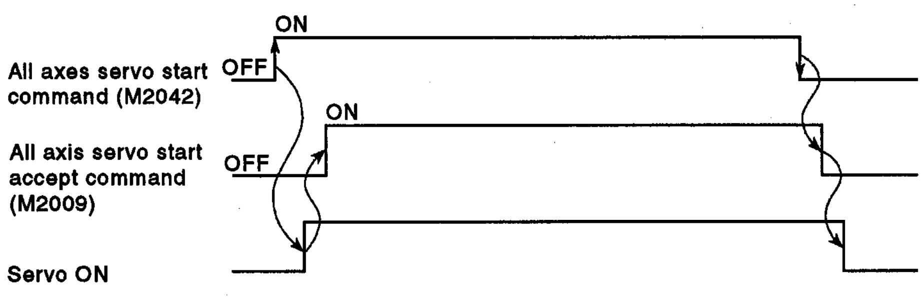
Even if a module is loaded at a slot set as "NO USE" in the system setting data set with a peripheral device, that slot will be regarded as not used.

3.2.10 All axes servo start command (M2042) ..... Signal from SCPU to PCPU

The all axes servo start command is used to enable servo operation.

(1) Servo operation enabled ..... M2042 is turned ON while the servo OFF signal (YnF) is OFF and there is no servo error.

(2) Servo operation disable .....
- M2042 is OFF
- The servo OFF signal (YnF) is ON
- Servo error



POINT

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

3.2.11 Optional slot module error detection flag (M2047) ..... Signal from PCPU to SCPU

(1) When using an A171SCPU
This flag is used to determine whether the status of modules mounted to the main 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 are always checked and errors are detected.
(a) When M2047 comes ON, the ERROR LED of the A171SCPU lights.
(b) Use the sequence program to execute the appropriate processing (stopping the driven axis, establishing the servo OFF status) when an error occurs.

(2) When using an A273UHCPU (8/32 axis specification)
This flag is used to determine whether the status of modules mounted to base units or motion extension base units is "normal" or "abnormal".
- ON .... When the mounted module is abnormal
- OFF ....When the mounted module is abnormal

The module information when the power is switched ON and module information after the power has been switched ON are continually checked and errors detected.
(a) When M2047 comes ON, the LED indicator on the A273UHCPU displays the following message.

```
"SL0 0 UNIT ERROR"
    ↑ ↑
    | └I/O slot No. (0 to 7)
    └──Base unit No. (0: main base  1: motion extension base)
```

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

3.2.12 Automatic deceleration in progress flag (M2128 to M2159): when using an A273UHCPU (32 axis specification) ..... Signal sent from PCPU to SCPU

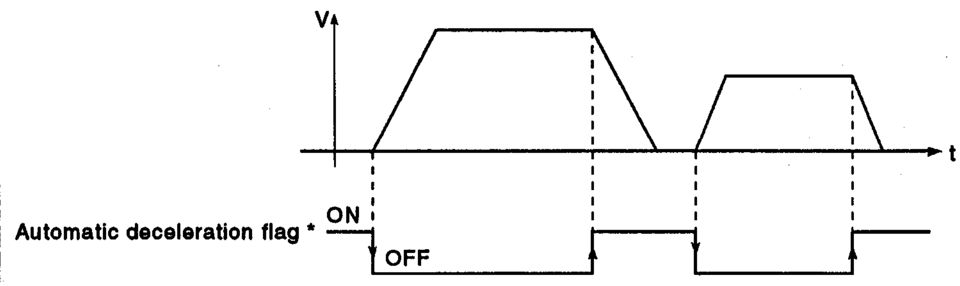
This signal is ON during automatic deceleration processing in position control or position follow-up control.

(1) This flag is ON during automatic deceleration to the command address in position follow-up control, but will go OFF if the command address is changed.

(2) This flag goes OFF on normal start completion, regardless of the control mode used.

(3) The automatic deceleration flag does not come ON in the following cases.
- During deceleration caused by turning the JOG signal OFF.
- During manual pulse generator operation
- When deceleration is started part way through positioning due to a stop command or stop cause.

- When the travel value is 0



*: The automatic deceleration flags are tabled below.

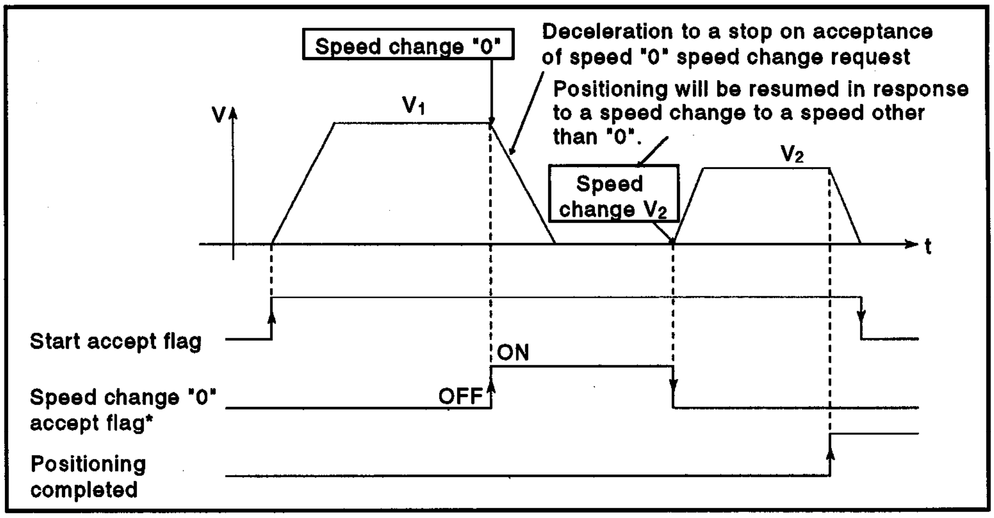
Axis No.	Device No.	Axis No.	Device No.	Axis No.	Device No.	Axis No.	Device No.
1	M2128	9	M2136	17	M2144	25	M2152
2	M2129	10	M2137	18	M2145	26	M2153
3	M2130	11	M2138	19	M2146	27	M2154
4	M2131	12	M2139	20	M2147	28	M2155
5	M2132	13	M2140	21	M2148	29	M2156
6	M2133	14	M2141	22	M2149	30	M2157
7	M2134	15	M2142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

REMARK

In the SV22 virtual mode, this flag becomes the flag for the virtual servomotor axis.

3.2.13 Speed change "0" accept flag : when A273UHCPU (32 axis specification) is used ..... Signal sent from PCPU to SCPU

The speed change "0" accept flag is ON while a request for a speed change to speed "0" is being accepted.
It comes ON when a request for a speed change to speed "0" is accepted while an axis is being driven. After that, it will go OFF if a request for a speed change to a speed other than "0" is accepted, or on stop completion due to a stop cause.



*: The speed change "0" accept flags are tabled below.

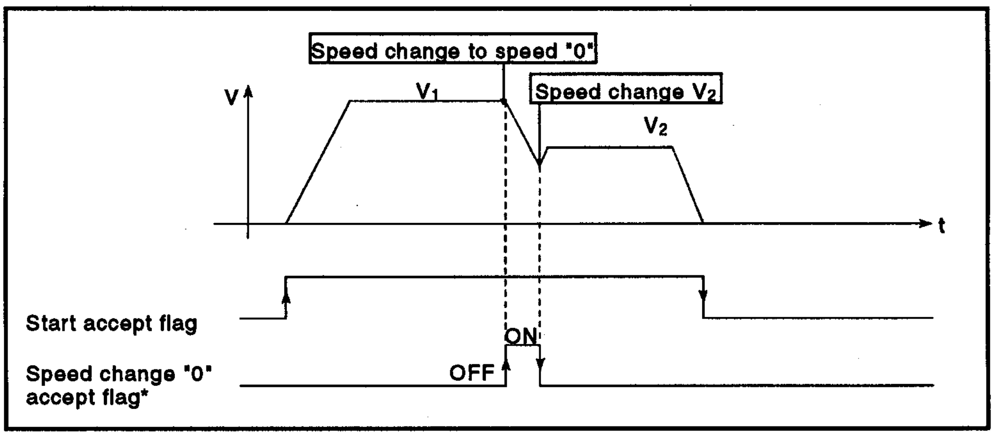
Axis No.	Device No.	Axis No.	Device No.	Axis No.	Device No.	Axis No.	Device No.
1	M2240	9	M2248	17	M2256	25	M2264
2	M2241	10	M2249	18	M2257	26	M2265
3	M2242	11	M2250	19	M2258	27	M2266
4	M2243	12	M2251	20	M2259	28	M2267
5	M2244	13	M2252	21	M2260	29	M2268
6	M2345	14	M2253	22	M2261	30	M2269
7	M2246	15	M2254	23	M2262	31	M2270
8	M2247	16	M2255	24	M2263	32	M2271

REMARKS

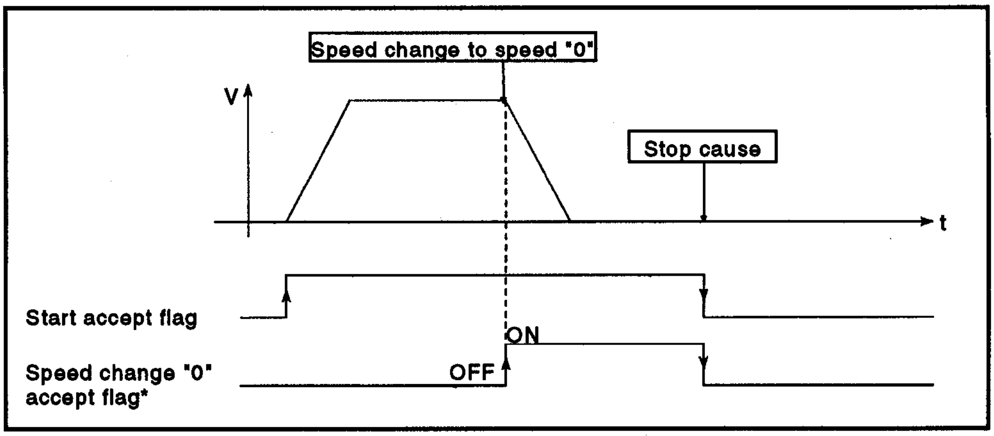
(1) If a start accept flag (M2001 to M2032) is ON even though positioning is stopped, it indicates that a request for a speed change to speed "0" has been accepted. Check this with the speed change "0" accept flag.
(2) When interpolation is performed, a number of flags corresponding to the number of axes on which interpolation is performed are set.
(3) In the following cases, a request for a speed change to speed "0" is invalid.
- After deceleration due to JOG OFF
- During manual pulse generator operation
- After the start of automatic deceleration in positioning
- After deceleration due to a stop cause

(4) In the SV22 virtual mode, this flag becomes the flag for the virtual servomotor axis.

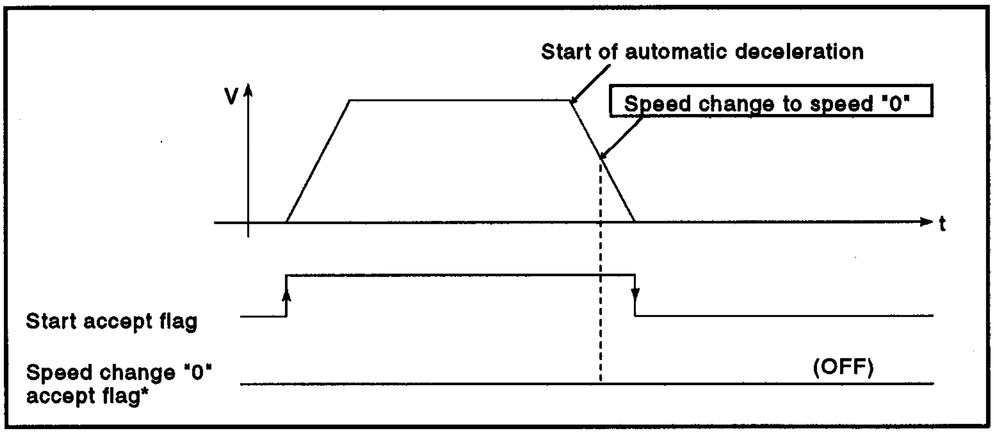
(1) If a request for a speed change to a speed other than "0" is issued during deceleration to a stop initiated by a speed change to speed "0", this flag goes OFF.



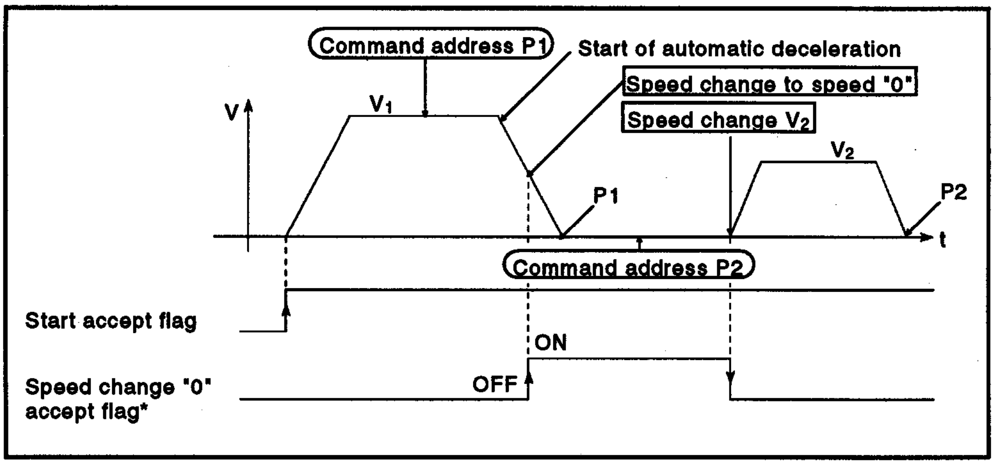
(2) This flag goes OFF when a stop cause occurs after acceptance of a request for a speed change to speed "0".



(3) If the speed change to speed "0" occurs after automatic deceleration has started, the speed change "0" accept flag will not come ON.



(4) During position follow-up control, the speed change "0" accept flag will come ON even if the speed change to speed 0 occurs after automatic deceleration to the command address has started.



REMARK

(1) During position follow-up control also, if the command address is changed while the speed change to speed "0" is being accepted, the relevant positioning will not be executed.

3.3 Special Relays (SP.M)

The servo system CPU has 256 special relay points from M9000 to M9255. Of these, the 7 points from M9073 to M9079 are used for positioning control, and their applications are indicated in Table 3.4.

Table 3.4 Special Relays

Device No.	Signal Name	Signal Direction
M9073	WDT error flag	PCPU → SCPU
M9074	PCPU READY-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	

3.3.1 WDT error flag (M9073) ..... Signal sent from PCPU to SCPU

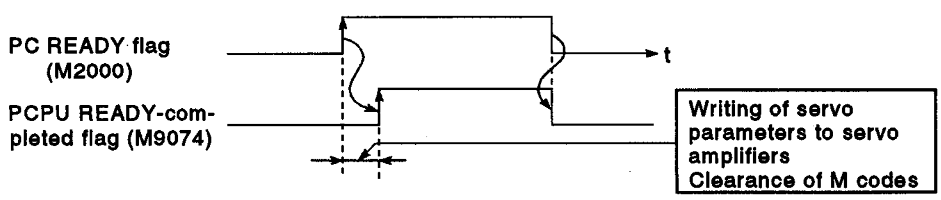
This flag comes ON when a "watchdog timer error" is detected by the PCPU's self-diagnosis function.
When the PCPU detects a WDT error, it executes an immediate stop without deceleration on the driven axis.
When the WDT error flag has come ON, reset the servo system CPU with the key switch.
If M9073 remains 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).

3.3.2 PCPU READY-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.

(1) When the PC 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.

(2) When the PC READY flag (M2000) goes off, the PCPU READY-completed flag also goes OFF.



3.3.3 In-test-mode (M9075) ..... Signal from PCPU to SCPU

(1) 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 a DSFRP/SVST instruction in the sequence program.
- ON .... When the test mode is not in effect
- OFF .... When the test mode is in effect

(2) 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.

3.3.4 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

3.3.5 Manual pulse generator axis setting error flag (M9077) ..... Signal sent from PCPU to SCPU

(1) This flag is used to determine whether the setting in the manual pulse generator axis setting register (D1012) is normal or abnormal.
- ON .... When D1012 is normal
- OFF .... When D1012 is abnormal

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

3.3.6 Test mode request error flag (M9078) ..... Signal sent from PCPU to SCPU

(1) This flag comes ON if the test mode is not established when a test mode request is sent from a peripheral device.

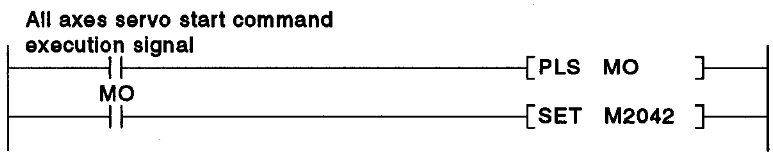
(2) When M9078 comes ON, the error contents are stored in the test mode request error register (D9188).

POINTS

(1) When an emergency stop signal (EMG) is input during positioning, the feed present 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 present 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.



3.3.7 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 a DSFRP/SVST instruction is normal or abnormal.

- OFF........Normal
- ON ....Abnormal

3.4 Data Registers (D)

An A171SCPU has 1024 data register points from D0 to D1023, and an A273UHCPU (8/32 axis specification) has 8192 data register points from D0 to D8191.
In the case of an A171SCPU or A273UHCPU (8 axis specification), the 224 points from D800 to D1023, and in the case of an A273UHCPU (32 axis specification) the 800 points from D0 to D799, are used for positioning control, and the applications of these devices are shown in the following table.

<A171SCPU>

Table 3.5 Data Registers

Device No.	Signal Name		Device No.	Signal Name
D800 to D819	Axis 1 monitoring data	First data register number 0 Feed present value L 1 Feed present value H 2 Actual present value L 3 Actual present value H 4 Deviation counter value L 5 Deviation counter value H 6 Minor error code 7 Major error code 8 Servo error code 9 Travel value when the near-zero point dog is ON L 10 Travel value when the near-zero point dog is ON H 11 Home position return second travel value 12 Executed program number 13 M code 14 Torque limit value 15 Travel value change register L 16 Travel value change register H 17 Actual present value when STOP is input L 18 Actual present value when STOP is input H 19 For constant speed control	D1012	Setting register for axis number controlled with manual pulse generator
D820 to D839	Axis 2 monitoring data		D1013	Unusable
D840 to D859	Axis 3 monitoring data		D1014	Unusable
D860 to D879	Axis 4 monitoring data		D1015	JOG operation simultaneous start axis setting register
D880 to D959	Unusable		D1016	1 pulse input magnification setting register of manual pulse generator for axis 1
D960 to D965	Axis 1 control change data storage area	First data register number 0 Present value change register L 1 Present value change register H 2 Speed change register L 3 Speed change register H 4 JOG speed setting register L 5 JOG speed setting register H	D1017	1 pulse input magnification setting register of manual pulse generator for axis 2
D966 to D971	Axis 2 control change data storage area		D1018	1 pulse input magnification setting register of manual pulse generator for axis 3
D972 to D977	Axis 3 control change data storage area		D1019	1 pulse input magnification setting register of manual pulse generator for axis 4
D978 to D983	Axis 4 control change data storage area		D1020 to D1023	Unusable
D984 to D1007	Unusable			
D1008 to D1009	Limit switch output disable setting			
D1010 to D1011	Unusable			

<A273UHCPU
(8 axis specification)>

Table 3.6 Data Registers

<table>
<tr><th>Device No.</th><th colspan="2">Signal Name</th><th>Device No.</th><th>Signal Name</th></tr>
<tr><td>D800
to
D819</td><td>Axis 1 monitoring data</td><td rowspan="8">First data register number
0, 1: Feed present value (L, H)
2, 3: Actual present value (L, H)
4, 5: Deviation counter value (L, H)
6: Minor error code
7: Major error code
8: Servo error code
9, 10: Travel value when the near-zero point dog is ON (L, H)
11: Home position return second travel value
12: Executed program number
13: M code
14: Torque limit value
15, 16: Travel value change register (L, H)
17, 18: Actual present value when STOP is input (L, H)
19: For constant speed control</td><td>D1012</td><td>Setting register for axis number controlled with manual pulse generator 1</td></tr>
<tr><td>D820
to
D839</td><td>Axis 2 monitoring data</td><td>D1013</td><td>Setting register for axis number controlled with manual pulse generator 2</td></tr>
<tr><td>D840
to
D859</td><td>Axis 3 monitoring data</td><td>D1014</td><td>Setting register for axis number controlled with manual pulse generator 3</td></tr>
<tr><td>D860
to
D879</td><td>Axis 4 monitoring data</td><td>D1015</td><td>JOG operation simultaneous start axis setting register</td></tr>
<tr><td>D880
to
D899</td><td>Axis 5 monitoring data</td><td>D1016</td><td>1 pulse input magnification setting register of manual pulse generator for axis 1</td></tr>
<tr><td>D900
to
D919</td><td>Axis 6 monitoring data</td><td>D1017</td><td>1 pulse input magnification setting register of manual pulse generator for axis 2</td></tr>
<tr><td>D920
to
D939</td><td>Axis 7 monitoring data</td><td>D1018</td><td>1 pulse input magnification setting register of manual pulse generator for axis 3</td></tr>
<tr><td>D940
to
D959</td><td>Axis 8 monitoring data</td><td>D1019</td><td>1 pulse input magnification setting register of manual pulse generator for axis 4</td></tr>
<tr><td>D960
to
D965</td><td>Axis 1 control change data storage area</td><td rowspan="8">First data register number
0, 1: Present value change register (L, H)
2, 3: Speed change register (L, H)
4, 5: JOG speed setting register (L, H)</td><td>D1020</td><td>1 pulse input magnification setting register of manual pulse generator for axis 5</td></tr>
<tr><td>D966
to
D971</td><td>Axis 2 control change data storage area</td><td>D1021</td><td>1 pulse input magnification setting register of manual pulse generator for axis 6</td></tr>
<tr><td>D972
to
D977</td><td>Axis 3 control change data storage area</td><td>D1022</td><td>1 pulse input magnification setting register of manual pulse generator for axis 7</td></tr>
<tr><td>D978
to
D983</td><td>Axis 4 control change data storage area</td><td>D1023</td><td>1 pulse input magnification setting register of manual pulse generator for axis 8</td></tr>
<tr><td>D984
to
D989</td><td>Axis 5 control change data storage area</td><td></td><td></td></tr>
<tr><td>D990
to
D995</td><td>Axis 6 control change data storage area</td><td></td><td></td></tr>
<tr><td>D996
to
D1001</td><td>Axis 7 control change data storage area</td><td></td><td></td></tr>
<tr><td>D1002
to
D1007</td><td>Axis 8 control change data storage area</td><td></td><td></td></tr>
<tr><td>D1008
to
D1011</td><td colspan="2">Limit switch output disable setting</td><td></td><td></td></tr>
</table>

<A273UHCPU
(32 axis specification)>

Table 3.7 Data Registers

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

Data Register Names:

First data register number

0	Feed present value	L
1		H
2	Actual present value	L
3		H
4	Deviation counter value	L
5		H
6	Minor error code	
7	Major error code	
8	Servo error code	
9	Home position return second travel value	
10	Travel value when the near-zero point dog is ON	L
11		H
12	Executed program number	
13	M code	
14	Torque limit value	
15	For constant speed control	
16	Travel value change register	L
17		H
18	Actual present value when STOP is input	L
19		H

<A273UHCPU
(32 axis specification)> **Table 3.7 Data Registers (Continued)**

Device No.	Signal Name	Device No.	Signal Name	Data Register Names
D640 D641	Axis 1 JOG speed data storage area	D672 D673	Axis 17 JOG speed data storage area	
D642 D643	Axis 2 JOG speed data storage area	D674 D675	Axis 18 JOG speed data storage area	
D644 D645	Axis 3 JOG speed data storage area	D676 D677	Axis 19 JOG speed data storage area	
D646 D647	Axis 4 JOG speed data storage area	D678 D679	Axis 20 JOG speed data storage area	
D648 D649	Axis 5 JOG speed data storage area	D680 D681	Axis 21 JOG speed data storage area	
D650 D651	Axis 6 JOG speed data storage area	D682 D683	Axis 22 JOG speed data storage area	
D652 D653	Axis 7 JOG speed data storage area	D684 D685	Axis 23 JOG speed data storage area	First data register number 0 JOG speed setting register L 1 H
D654 D655	Axis 8 JOG speed data storage area	D686 D687	Axis 24 JOG speed data storage area	
D656 D657	Axis 9 JOG speed data storage area	D688 D689	Axis 25 JOG speed data storage area	
D658 D659	Axis 10 JOG speed data storage area	D690 D691	Axis 26 JOG speed data storage area	
D660 D661	Axis 11 JOG speed data storage area	D692 D693	Axis 27 JOG speed data storage area	
D662 D663	Axis 12 JOG speed data storage area	D694 D695	Axis 28 JOG speed data storage area	
D664 D665	Axis 13 JOG speed data storage area	D696 D697	Axis 29 JOG speed data storage area	
D666 D667	Axis 14 JOG speed data storage area	D698 D699	Axis 30 JOG speed data storage area	
D668 D669	Axis 15 JOG speed data storage area	D700 D701	Axis 31 JOG speed data storage area	
D670 D671	Axis 16 JOG speed data storage area	D702 D703	Axis 32 JOG speed data storage area	

<A273UHCPU
(32 axis specification)> **Table 3.7 Data Registers (Continued)**

Device No.	Signal Name	Device No.	Signal Name
D704 to D709	Unusable	D737	1 pulse input magnification setting register of manual pulse generator for axis 18
D710 to D713	JOG operation simultaneous start axis setting register	D738	1 pulse input magnification setting register of manual pulse generator for axis 19
D714 D715	Setting register for axis number controlled with manual pulse generator 1	D739	1 pulse input magnification setting register of manual pulse generator for axis 20
D716 D717	Setting register for axis number controlled with manual pulse generator 2	D740	1 pulse input magnification setting register of manual pulse generator for axis 21
D718 D719	Setting register for axis number controlled with manual pulse generator 3	D741	1 pulse input magnification setting register of manual pulse generator for axis 22
D720	1 pulse input magnification setting register of manual pulse generator for axis 1	D742	1 pulse input magnification setting register of manual pulse generator for axis 23
D721	1 pulse input magnification setting register of manual pulse generator for axis 2	D743	1 pulse input magnification setting register of manual pulse generator for axis 24
D722	1 pulse input magnification setting register of manual pulse generator for axis 3	D744	1 pulse input magnification setting register of manual pulse generator for axis 25
D723	1 pulse input magnification setting register of manual pulse generator for axis 4	D745	1 pulse input magnification setting register of manual pulse generator for axis 26
D724	1 pulse input magnification setting register of manual pulse generator for axis 5	D746	1 pulse input magnification setting register of manual pulse generator for axis 27
D725	1 pulse input magnification setting register of manual pulse generator for axis 6	D747	1 pulse input magnification setting register of manual pulse generator for axis 28
D726	1 pulse input magnification setting register of manual pulse generator for axis 7	D748	1 pulse input magnification setting register of manual pulse generator for axis 29
D727	1 pulse input magnification setting register of manual pulse generator for axis 8	D749	1 pulse input magnification setting register of manual pulse generator for axis 30
D728	1 pulse input magnification setting register of manual pulse generator for axis 9	D750	1 pulse input magnification setting register of manual pulse generator for axis 31
D729	1 pulse input magnification setting register of manual pulse generator for axis 10	D751	1 pulse input magnification setting register of manual pulse generator for axis 32
D730	1 pulse input magnification setting register of manual pulse generator for axis 11	D752*	Manual pulse generator 1 (P1) smoothing magnification setting area
D731	1 pulse input magnification setting register of manual pulse generator for axis 12	D753*	Manual pulse generator 2 (P2) smoothing magnification setting area
D732	1 pulse input magnification setting register of manual pulse generator for axis 13	D754*	Manual pulse generator 3 (P3) smoothing magnification setting area
D733	1 pulse input magnification setting register of manual pulse generator for axis 14	D755 to D759	Unusable
D734	1 pulse input magnification setting register of manual pulse generator for axis 15	D760 to D775	Limit switch output disable setting
D735	1 pulse input magnification setting register of manual pulse generator for axis 16	D776* to D791	Limit switch output status storage area
D736	1 pulse input magnification setting register of manual pulse generator for axis 17	D792* to D799	Servo amplifier type

*: Treated as a special register in this manual. For details, see Section 3.5.

3.4.1 Monitoring data area (D800 to D879/D800 to D959/D0 to D639) ..... Data sent from the PCPU to the SCPU

The monitoring data area is used by the PCPU to store data such as the feed present value during positioning control, the actual present 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 7 "Processing Times".

<A171SCPU> **Table 3.8 Monitoring Data Areas**

Names	Axis 1	Axis 2	Axis 3	Axis 4
Feed present value	D801,D800	D821,D820	D841,D840	D861,D860
Actual present value	D803,D802	D823,D822	D843,D842	D863,D862
Deviation counter value	D805,D804	D825,D824	D845,D844	D865,D864
Minor error code	D806	D826	D846	D866
Major error code	D807	D827	D847	D867
Servo error code	D808	D828	D848	D868
Travel value after near-zero point dog comes ON	D810,D809	D830,D829	D850,D849	D870,D869
Home position return second travel value	D811	D831	D851	D871
Executed program number	D812	D832	D852	D872
M code	D813	D833	D853	D873
Torque limit value	D814	D834	D854	D874
Travel value change register	D816,D815	D836,D835	D856,D855	D876,D875
Actual present value when STOP is input	D818,D817	D838,D837	D858,D857	D878,D877
Constant speed control data set pointer	D819	D839	D859	D879

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Table 3.9 Monitoring Data Areas

Name	Axis 1	Axis 2	Axis 3	Axis 4	Axis 5	Axis 6	Axis 7	Axis 8
Feed present value	D801,D800	D821,D820	D841,D840	D861,D860	D881,D880	D901,D900	D921,D920	D941,D940
Actual present value	D803,D802	D823,D822	D843,D842	D863,D862	D883,D882	D903,D902	D923,D922	D943,D942
Deviation counter value	D805,D804	D825,D824	D845,D844	D865,D864	D885,D884	D905,D904	D925,D924	D945,D944
Minor error code	D806	D826	D846	D866	D886	D906	D926	D946
Major error code	D807	D827	D847	D867	D887	D907	D927	D947
Servo error code	D808	D828	D848	D868	D888	D908	D928	D948
Travel value after near-zero point dog comes ON	D810,D809	D830,D829	D850,D849	D870,D869	D890,D889	D910,D909	D930,D929	D950,D949
Home position return second travel value	D811	D831	D851	D871	D891	D911	D931	D951
Executed program number	D812	D832	D852	D872	D892	D912	D932	D952
M code	D813	D833	D853	D873	D893	D913	D933	D953
Torque limit value	D814	D834	D854	D874	D894	D914	D934	D954
Travel value change register	D816,D815	D836,D835	D856,D855	D876,D875	D896,D895	D916,D915	D936,D935	D956,D955
Actual present value when STOP is input	D818,D817	D838,D837	D858,D857	D878,D877	D898,D897	D918,D917	D938,D937	D958.D959
Constant speed control data set pointer	D819	D839	D859	D879	D899	D919	D939	D959

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Table 3.10 Monitoring Data Areas

Name	Axis 1	Axis 2	Axis 3	Axis 4	Axis 5	Axis 6	Axis 7	Axis 8
Feed present value	D1,D0	D21,D20	D41,D40	D61,D60	D81,D80	D101,D100	D121,D120	D141,D140
Actual present value	D3,D2	D23,D22	D43,D42	D63,D62	D83,D82	D103,D102	D123,D122	D143,D142
Deviation counter value	D5,D4	D25,D24	D45,D44	D65,D64	D85,D84	D105,D104	D125,D124	D145,D144
Minor error code	D6	D26	D46	D66	D86	D106	D126	D146
Major error code	D7	D27	D47	D67	D87	D107	D127	D147
Servo error code	D8	D28	D48	D68	D88	D108	D128	D148
Home position return second travel value	D9	D29	D49	D69	D89	D109	D129	D149
Travel value after near-zero point dog comes ON	D11,D10	D31,D30	D51,D50	D71,D70	D91,D90	D111,D110	D131,D130	D151,D150
Executed program number	D12	D32	D52	D72	D92	D112	D132	D152
M code	D13	D33	D53	D73	D93	D113	D133	D153
Torque limit value	D14	D34	D54	D74	D94	D114	D134	D154
Constant speed control data set pointer	D15	D35	D55	D75	D95	D115	D135	D155
Travel value change register	D17,D16	D37,D36	D57,D56	D77,D76	D97,D96	D117,D116	D137,D136	D157,D156
Actual present value when STOP is input	D19,D18	D39,D38	D59,D58	D79,D78	D99,D98	D119,D118	D139,D138	D159,D158

Name	Axis 17	Axis 18	Axis 19	Axis 20	Axis 21	Axis 22	Axis 23	Axis 24
Feed present value	D321,D320	D341,D340	D361,D360	D381,D380	D401,D400	D421,D420	D441,D440	D461,D460
Actual present value	D323,D322	D343,D342	D363,D362	D383,D382	D403,D402	D423,D422	D443,D442	D463,D462
Deviation counter value	D325,D324	D345,D344	D365,D364	D385,D384	D405,D404	D425,D424	D445,D444	D465,D464
Minor error code	D326	D346	D366	D386	D406	D426	D446	D466
Major error code	D327	D347	D367	D387	D407	D427	D447	D467
Servo error code	D328	D348	D368	D388	D408	D428	D448	D468
Home position return second travel value	D329	D349	D369	D389	D409	D429	D449	D469
Travel value after near-zero point dog comes ON	D331,330	D351,D350	D371,D370	D391,D390	D411,D410	D431,D430	D451,D450	D471,D470
Executed program number	D332	D352	D372	D392	D412	D432	D452	D472
M code	D333	D353	D373	D393	D413	D433	D453	D473
Torque limit value	D334	D354	D374	D394	D414	D434	D454	D474
Constant speed control data set pointer	D335	D355	D375	D395	D415	D435	D455	D475
Travel value change register	D337,D336	D357,D356	D377,D376	D397,D396	D417,D416	D437,D436	D457,D456	D477,D476
Actual present value when STOP is input	D339,D338	D359,D358	D379,D378	D399,D398	D419,D418	D439,D438	D459,D458	D479,D478

Axis 9	Axis 10	Axis 11	Axis 12	Axis 13	Axis 14	Axis 15	Axis 16
D161,D160	D181,D180	D201,D200	D221,D220	D241,D240	D261,D260	D281,D280	D301,D300
D163,D162	D183,D182	D203,D202	D223,D222	D243,D242	D263,D262	D283,D282	D303,D302
D165,D164	D185,D184	D205,D204	D225,D224	D245,D244	D265,D264	D285,D284	D305,D304
D166	D186	D206	D226	D246	D266	D286	D306
D167	D187	D207	D227	D247	D267	D287	D307
D168	D188	D208	D228	D248	D268	D288	D308
D169	D189	D209	D229	D249	D269	D289	D309
D171,D170	D191,D190	D211,D210	D231,D230	D251,D250	D271,D270	D291,D290	D311,D310
D172	D192	D212	D232	D252	D272	D292	D312
D173	D193	D213	D233	D253	D273	D293	D313
D174	D194	D214	D234	D254	D274	D294	D314
D175	D195	D215	D235	D255	D275	D295	D315
D177,D176	D197,D196	D217,D216	D237,D236	D257,D256	D277,D276	D297,D296	D317,D316
D179,D178	D199,D198	D219,D218	D239,D238	D259,D258	D279,D278	D299,D298	D319,D318

Axis 25	Axis 26	Axis 27	Axis 28	Axis 29	Axis 30	Axis 31	Axis 32
D481,D480	D501,D500	D521,D520	D541,D540	D561,D560	D581,D580	D601,D600	D621,D620
D483,D482	D503,D502	D523,D522	D543,D542	D563,D562	D583,D582	D603,D602	D623,D622
D485,D484	D505,D504	D525,D524	D545,D544	D565,D564	D585,D584	D605,D604	D625,D624
D486	D506	D526	D546	D566	D586	D606	D626
D487	D507	D527	D547	D567	D587	D607	D627
D488	D508	D528	D548	D568	D588	D608	D628
D489	D509	D529	D549	D569	D589	D609	D629
D491,D490	D511,D510	D531,D530	D551,D550	D571,D570	D591,D590	D611,D610	D631,D630
D492	D512	D532	D552	D572	D592	D612	D632
D493	D513	D533	D553	D573	D593	D613	D633
D494	D514	D534	D554	D574	D594	D614	D634
D495	D515	D535	D555	D575	D595	D615	D635
D497,D496	D517,D516	D537,D536	D557,D556	D577,D576	D597,D596	D617,D616	D637,D636
D499,D498	D519,D518	D539,D538	D559,D558	D579,D578	D599,D598	D619,D618	D639,D638

(1) Feed present value register .... 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.
  (b) The stroke range check is performed on this feed present value data.

(2) Actual present value register .... Data from the PCPU to the SCPU
  (a) This register stores the present value attained in actual travel (the feed present value minus the droop pulses in the deviation counter).
    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 present value counted up from the address when motion starts is stored.
    3) During speed control, "0" is stored.
  (b) In the stopped status, the feed present value is equal to the actual present value.

(3) Deviation counter value register .... Data from the PCPU to the SCPU
This register stores the difference between the feed present value and the actual present value.

(4) Minor error code register .... 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 (M1807+20n).

(5) Major error code register .... 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 (M1807+20n).

(6) Servo error code register .... 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 (M1808+20n).

(7) Travel value after near-zero point dog comes ON register .... Data from the PCPU to the SCPU

(a) When a home position return operation is performed, the travel value from the point where the near-zero point dog comes ON to the point where the home position return 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).

(8) Home position return second travel value register .... Data from the PCPU to the SCPU
If the position at which motion stops in accordance with the travel value setting after the near-zero point dog has been switched ON by a peripheral device (see Section 7.21) 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).
Note that in the case of a data set type home position return operation, the data remains unchanged (the previous value stands).

(9) Executed program number register .... Data from the PCPU to the SCPU

(a) The program number of the program being executed is stored in this register when the DSFRP/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 home position retur
2) A position loop gain or position control gain 1 check in servo diagnosis.

(10) M code register ..... Data from the PCPU to the SCPU

(a) The M code* 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 PC READY signal (M2000).

REMARK

*: See the following sections for details on M codes and reading M codes.
- M code..................... Section 8.2
- M code reading......... Appendix 6.3

(11) Torque limit value register .... 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 PC READY signal (M2000).

(12) Travel value change register .... 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).

(13) Actual present value when STOP is input register .... Data from the PCPU to the SCPU
This register stores the actual present value when a STOP signal is input from an external source.

(14) Constant speed control data set pointer ... 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 PC 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 PC set pointer for constant speed control is explained here using the example servo program below.

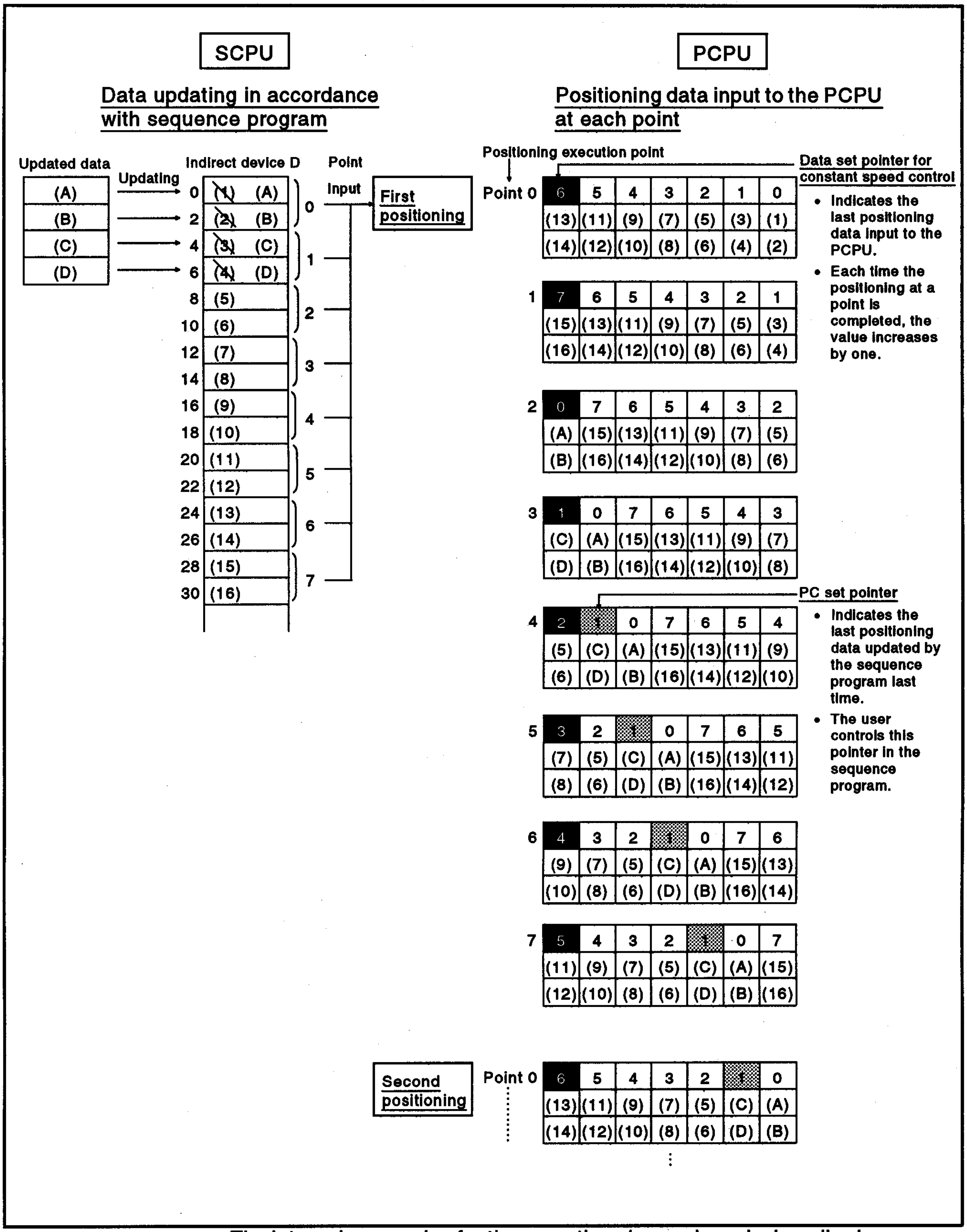
```
              <K    0>
Pass point
    9   CPSTART2
          Axis    1
          Axis    2
          Speed          D200
    *   FOR-TIMES
                         D202
    1   ABS-2                   ...0
          Axis    1,     D0
          Axis    2,     D2
    2   ABS-2                   ...1
          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

- Points 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-axis 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]

(1) 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.

(2) 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 PC 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.

(3) 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.

(4) 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 PC 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

(1) 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.

3.4.2 Data storage area for control change (D960 to D983/D960 to D1007/D640 to D703) ..... Data from the SCPU to the PCPU

The data storage area for control change is the area for storing present value change data, speed change data, and JOG operating speed data.

<A171SCPU>

Table 3.11 Data Storage Areas for Control Change

Name	Axis 1	Axis 2	Axis 3	Axis 4
Present value change register	D961,D960	D967,D966	D973,D972	D979,D978
Speed change register	D963,D962	D969,D968	D975,D974	D981,D980
JOG speed setting register	D965,D964	D971,D970	D977,D976	D983,D982

<A273UHCPU (8 axis specification)>

Table 3.12 Data Storage Areas for Control Change

Name	Axis 1	Axis 2	Axis 3	Axis 4	Axis 5	Axis 6	Axis 7	Axis 8
Present value change register	D961,D960	D967,D966	D973,D972	D979,D978	D985,D984	D991,D990	D997,D996	D1003, D1002
Speed change register	D963,D962	D969,D968	D975,D974	D981,D980	D987,D986	D993,D992	D999,D998	D1005, D1004
JOG speed setting register	D965,D964	D971,D970	D977,D976	D983,D982	D989,D988	D995,D994	D1001, D1000	D1007, D1006

<A273UHCPU (32 axis specification)>

Table 3.13 Data Storage Areas for Control Change

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

POINTS

- When using an A171SCPU/A273UHCPU (8 axis specification), either the DSFLP instruction or CHGA/CHGV instruction can be used to execute present value changes/speed changes.
- When using an A273UHCPU (32 axis specification), present value changes/speed changes can be commanded with a CHGA/CHGV instruction and there is therefore no present value change register or speed change register.

(1) Present value change register (when using A171SCPU/A273UHCPU (8 axis specification) only)

(a) This register stores the feed present value after the change when the feed present value of a stopped axis is changed.

(b) The ranges of values that can be set in the present value change register are indicated below.

Item \ Units	mm Setting Range	mm Units	inch Setting Range	inch Units	degree Setting Range	degree Units	PLUSE Setting Range	PLUSE Units	Remarks
Present value change value	-2147483648 ~2147483647	$\times 10^{-1}$ µm	-2147483648 ~2147483647	$\times 10^{-5}$ inch	0~35999999	$\times 10^{-5}$ degree	-2147483648 ~2147483647	PLS	Even if the set value is outside the stroke range, no error will occur.

(c) When the positioning control change instruction (DSFLP) is executed, the value stored in the present value change register becomes the feed present value.

(d) For details on present value changes, see Section 8.8.

(2) Speed change register (when using A171SCPU/A273UHCPU (8 axis specification) only)

(a) This register stores the speed after the change when the speed of an axis in motion is changed.

(b) The setting ranges for the speed change register are indicated below.

Item \ Units	mm Setting Range	mm Units	inch Setting Range	inch Units	degree Setting Range	degree Units	PLUSE Setting Range	PLUSE Units
Speed change value	0~600000000	$\times 10^{-2}$ mm/min	0~600000000	$\times 10^{-3}$ inch/min	0~600000000	$\times 10^{-3}$ degree/min	0~1000000	PLS/sec

(c) When the positioning control change instruction (DSFLP) is executed, the value stored in the speed change register becomes the positioning speed.

(d) For details on speed changes, see Section 8.7.

(3) JOG speed setting register

(a) This register stores the JOG speed during JOG operation.

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

Item \ Units	mm Setting Range	mm Units	inch Setting Range	inch Units	degree Setting Range	degree Units	PLUSE Setting Range	PLUSE Units
JOG speed	1~600000000	$\times 10^{-2}$ mm/min	1~600000000	$\times 10^{-3}$ inch/min	1~600000000	$\times 10^{-3}$ degree/min	1~1000000	PLS/sec

(c) At the leading edge (OFF - ON) of the JOG start signal, the value stored in the JOG speed setting register becomes the effective value.
It is only possible to change the data during JOG operation: the JOG speed cannot be changed.

(d) For details on JOG operation, see Section 7.19.

3.4.3 Limit switch output disable setting register (D1008 to D1009/D1008 to D1011/D760 to D775) ..... Data from the SCPU to the PCPU

(1) This is a register for disabling the external output of limit switch output in 1 point units. If a bit is set to "1", the output of the corresponding limit switch is disabled, then the external output goes OFF.

<A171SCPU>

	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
D1008	LY0F	LY0E	LY0D	LY0C	LY0B	LY0A	LY09	LY08	LY07	LY06	LY05	LY04	LY03	LY02	LY01	LY00
	For axis 2								For axis 1							
D1009	LY1F	LY1E	LY1D	LY1C	LY1B	LY1A	LY19	LY18	LY17	LY16	LY15	LY14	LY13	LY12	LY11	LY10
	For axis 4								For axis 3							

1) "1" or "0" is stored for each bit.
   1: Disable ......The limit switch output status is OFF.
   0: Enable ....The limit switch output comes ON and goes OFF in accordance with the set data.
2) LY of LY00 to LY1F shows the limit switch output.

<A273UHCPU (8 axis specification)>

	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
D1008	LY0F	LY0E	LY0D	LY0C	LY0B	LY0A	LY09	LY08	LY07	LY06	LY05	LY04	LY03	LY02	LY01	LY00
	For axis 2								For axis 1							
D1009	LY1F	LY1E	LY1D	LY1C	LY1B	LY1A	LY19	LY18	LY17	LY16	LY15	LY14	LY13	LY12	LY11	LY10
	For axis 4								For axis 3							
D1010	LY2F	LY2E	LY2D	LY2C	LY2B	LY2A	LY29	LY28	LY27	LY26	LY25	LY24	LY23	LY22	LY21	LY20
	For axis 6								For axis 5							
D1011	LY3F	LY3E	LY3D	LY3C	LY3B	LY3A	LY39	LY38	LY37	LY36	LY35	LY34	LY33	LY32	LY31	LY30
	For axis 8								For axis 7							

1) "1" or "0" is stored for each bit.
   1: Disable ......The limit switch output status is OFF.
   0: Enable ....The limit switch output comes ON and goes OFF in accordance with the set data.
2) LY of LY00 to LY3F shows the limit switch output.

<A273UHCPU (32 axis specification)>

	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 30							

1) "1" or "0" is stored for each bit.
   1: Disable ......The limit switch output status is OFF.
   0: Enable ....The limit switch output comes ON and goes OFF in accordance with the set data.
2) LY of LY00 to LYFF shows the limit switch output.

3.4.4 Registers for setting axis numbers controlled by manual pulse generators (D1012/D1012 to D1014/D714 to D719) ..... Data from the SCPU to the PCPU

(1) These registers store the axis numbers controlled by manual pulse generators.

<A171SCPU>

	b15 ~ b12	b11 ~ b8	b7 ~ b4	b3 ~ b0
P1 D1012				
		3 digits	2 digits	1 digit

With a maximum of 3 decimal digits, set the controlled axes (1 to 4) for each digit.

<A273UHCPU (8 axis specification)>

	b15 ~ b12	b11 ~ b8	b7 ~ b4	b3 ~ b0
P1 D1012				
P2 D1013				
P3 D1014				
		3 digits	2 digits	1 digit

With a maximum of 3 decimal digits, set the controlled axes (1 to 8) for each digit.

<A273UHCPU (32 axis specification)>

		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

The axes to be controlled by manual pulse generator are set by setting 1 or 0:
1 : Designated axis
0 : Undesignated axis

(2) For details on manual pulse generator operation, see Section 7.20.

3.4.5 JOG operation simultaneous start axis setting register (D1015/D1015/D710 to D713) ..... Data from the SCPU to the PCPU

(1) This register is used to set the axis numbers of axes on which JOG operation is to be executed, and the direction of motion.

<A171SCPU>

	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
D1015					Axis 4	Axis 3	Axis 2	Axis 1					Axis 4	Axis 3	Axis 2	Axis 1

b15–b8: Axes started in reverse JOG operation; b7–b0: Axes started in forward JOG operation

* The possible settings for each axis moved in a simultaneous start JOG operation are "1" or "0".
1: Simultaneous start executed
0: Simultaneous start not executed

<A273UHCPU (8 axis specification)>

	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
D1015	Axis 8	Axis 7	Axis 6	Axis 5	Axis 4	Axis 3	Axis 2	Axis 1	Axis 8	Axix 7	Axis 6	Axis 5	Axis 4	Axis 3	Axis 2	Axis 1

b15–b8: Axes started in reverse JOG operation; b7–b0: Axes started in forward JOG operation

* The possible settings for each axis moved in a simultaneous start JOG operation are "1" or "0".
1: Simultaneous start executed
0: Simultaneous start not executed

<A273UHCPU (32 axis specification)>

	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 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 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	

* The possible settings for each axis moved in a simultaneous start JOG operation are "1" or "0".
1: Simultaneous start executed
0: Simultaneous start not executed

(2) For details on simultaneous starting in JOG operation, see Section 7.19.3.

3.4.6 1 pulse input magnification setting registers for manual pulse generators (D1016 to D1019/ D1016 to D1023/D720 to D751) ..... Data from the SCPU to the PCPU

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

<A171SCPU>

1-pulse Input Magnification Setting Register	Corresponding Axis No.	Setting Range
D1016	Axis 1	1 to 100
D1017	Axis 2	
D1018	Axis 3	
D1019	Axis 4	

<A273UHCPU (8-axis)>

1-pulse Input Magnification Setting Register	Corresponding Axis No.	Setting Range
D1016	Axis 1	1 to 100
D1017	Axis 2	
D1018	Axis 3	
D1019	Axis 4	
D1020	Axis 5	
D1021	Axis 6	
D1022	Axis 7	
D1023	Axis 8	

<A273UHCPU (32-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	

(2) For details on manual pulse generator operation, see Section 7.20.

3.5 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. In the case of an A273UHCPU (32-axis specification), some of the devices used for positioning control are data registers (D752 to D754, D760 to D799). In this manual, these data registers used for positioning control are treated as special registers.
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.)

<A171SCPU> **Table 3.14 Special Registers**

Device Number	Signal Name
D9180	Limit switch output status storage area for axis 1 and axis 2
D9181	Limit switch output status storage area for axis 3 and axis 4
D9182	Unusable
D9183	
D9184	PCPU error cause
D9185	Servo amplifier type
D9186	
D9187	Manual pulse generator axis setting error
D9188	Test mode request error
D9189	Error program number
D9190	Error item information
D9191	Servo amplifier loading information
D9192	Area for setting the manual pulse generator smoothing magnification
D9193	Unusable
D9194	
D9195 to D9199	Unusable

<A273UHCPU
(8 axis specification)> **Table 3.15 Special Registers**

Device Number	Signal Name
D9180	Limit switch output status storage area for axis 1 and axis 2
D9181	Limit switch output status storage area for axis 3 and axis 4
D9182	Limit switch output status storage area for axis 5 and axis 6
D9183	Limit switch output status storage area for axis 7 and axis 8
D9184	PCPU error cause
D9185	Servo amplifier type
D9186	
D9187	Manual pulse generator axis setting error
D9188	Test mode request error
D9189	Error program number
D9190	Error item information
D9191	Servo amplifier loading information
D9192	Area for setting the manual pulse generator (P1) smoothing magnification
D9193	Area for setting the manual pulse generator (P2) smoothing magnification
D9194	Area for setting the manual pulse generator (P3) smoothing magnification
D9195 to D9199	Unusable

<A273UHCPU
(32 axis specification)> **Table 3.16 Special Registers**

Device Number	Signal Name
D752*	Area for setting the manual pulse generator (P1) smoothing magnification
D753*	Area for setting the manual pulse generator (P2) smoothing magnification
D754*	Area for setting the manual pulse generator (P3) smoothing magnification
D776* to D791	Limit switch output status storage area
D792* to D799	Servo amplifier type
D9180 to D9181	Unusable
D9182 to D9183	Test mode request error
D9184	PCPU error cause
D9185 to D9187	Manual pulse generator setting error
D9188	Unusable
D9189	Error program number
D9190	Error item information
D9191	Servo amplifier loading information
D9192	
D9193 to D9199	Unusable

*: Data registers used

3.5.1 Limit switch output status storage area (D9180 to D9181/D9180 to D9183/D776 to D791) ... Data from the PCPU to the SCPU

(1) Stores the output status (ON/OFF) for limit switch output to AY42 set with a peripheral device, as "1" or "0".
- ON......... 1
- OFF........0

(2) This area can be used for purposes such as outputting limit switch output data to external destinations by using the sequence program.

<A171SCPU>

	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
D9180	LY0F	LY0E	LY0D	LY0C	LY0B	LY0A	LY09	LY08	LY07	LY06	LY05	LY04	LY03	LY02	LY01	LY00
	For axis 2								For axis 1							
D9181	LY1F	LY1E	LY1D	LY1C	LY1B	LY1A	LY19	LY18	LY17	LY16	LY15	LY14	LY13	LY12	LY11	LY10
	For axis 4								For axis 3							

* "1" or "0" is set at each bit of D9180 to D9181.
- ON..............1
- OFF............0

REMARK

"LY" in LY[ ][ ] of D9180 to D9181 indicates a limit switch output.

<A273UHCPU (8 axis specification)>

	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
D9180	LY0F	LY0E	LY0D	LY0C	LY0B	LY0A	LY09	LY08	LY07	LY06	LY05	LY04	LY03	LY02	LY01	LY00
	For axis 2								For axis 1							
D9181	LY1F	LY1E	LY1D	LY1C	LY1B	LY1A	LY19	LY18	LY17	LY16	LY15	LY14	LY13	LY12	LY11	LY10
	For axis 4								For axis 3							
D9182	LY2F	LY2E	LY2D	LY2C	LY2B	LY2A	LY29	LY28	LY27	LY26	LY25	LY24	LY23	LY22	LY21	LY20
	For axis 6								For axis 5							
D9183	LY3F	LY3E	LY3D	LY3C	LY3B	LY3A	LY39	LY38	LY37	LY36	LY35	LY34	LY33	LY32	LY31	LY30
	For axis 8								For axis 7							

* "1" or "0" is set at each bit of D9180 to D9183.
- ON..............1
- OFF............0

REMARK

"LY" in LY[ ][ ] of D9180 to D9181 indicates a limit switch output.

<A273UHCPU (32 axis specification)>

	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 set at each bit of D776 to D791.
  • ON..............1 • OFF............0

REMARK

"LY" in LY[ ][ ] of D776 to D791 indicates a limit switch output.

3.5.2 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 servo system.

(1) When using an A171SCPU

Error Code	Error Cause	Operation when Error Occurs	Action to Take
2	PCPU operation synchronization time over	All axes stop immediately, after which operation cannot be started.	Reset with the reset key.
3	SCPU software fault 2		
300	SCPU software fault 3		

(2) When using an A273UHCPU (8 axis specification)

Error Code	Error Cause	Operation when Error Occurs	Action to Take
1	PCPU software fault 1	All axes stop immediately, after which operation cannot be started.	Reset with the reset key.
2	PCPU operation synchronization time over		
3	PCPU software fault 2		
30	PCPU/SCPU hardware fault		
100 to 107 110 to 117	CPU fault of AC motor drive module 1 0 0 Indicates the slot number (0 to 7) where the AC motor drive module with the fault is loaded. Indicates the stage number of the base on which the AC motor drive module with the fault is loaded. 0: Main base 1: Extension base (1st extension stage)	The servo error detected flag (X0n8) for the relevant axis comes ON and the servo OFF status is established. Thereafter, operation follows the setting for action to take in the event of an ADU servo error made in the system settings.	Reset with the reset key. If the error reoccurs after resetting, the ADU is probably faulty: replace it.
200 to 207 210 to 217	Hardware fault of module loaded on motion main base unit or extension base unit. 2 0 0 Indicates the slot number (0 to 7) where the module with the fault is loaded. Indicates the stage number of the base on which the module with the fault is loaded. 0: Main base 1: Extension base (1st extension stage)	All axes stop immediately, after which operation cannot be started.	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.
250 to 251	Standalone servo amplifier (MR-[ ]-B) interface hard ware fault. 2 5 0 Faulty SSCNET No. 0: SSCNET	All axes stop immediately, after which operation cannot be started.	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.
300	PCPU software fault 3		Reset with the reset key.

(3) When using an A273UHCPU (32 axis specification)

<table>
<tr><th>Error Code</th><th>Error Cause</th><th>Operation when Error Occurs</th><th>Action 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 hardware fault</td></tr>
<tr><td>100 to 107
110 to 117
120 to 127
130 to 137
140 to 147</td><td>CPU fault of AC motor drive module
1 0 0
Indicates the slot number (0 to 7) where the AC motor drive module with the fault is loaded.
Indicates the stage number of the base on which the AC motor drive module with the fault is loaded.
0: Main base
1: Extension base (1st extension stage)
2: Extension base (2nd extension stage)
3: Extension base (3rd extension stage)
4: Extension base (4th extension stage)</td><td>The servo error detected flag (M2408+20n) for the relevant axis comes ON and the servo OFF status is established. Thereafter, operation follows the setting for action to take in the event of an ADU servo error mede in the system settings.</td><td>Reset with the reset key. If the error reoccurs after resetting, the ADU is probaly faulty: replace it.</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 main base unit or extension base unit.
2 0 0
Indicates the slot number (0 to 7) where the module with the fault is loaded.
Indicates the stage number of the base on which the module with the fault is loaded.
0: Main base
1: Extension base (1st extension stage)
2: Extension base (2nd extension stage)
3: Extension base (3rd extension stage)
4: Extension base (4th extension 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>Standalone servo amplifier (MR-[ ]-B) interface hard ware fault.
2 5 0
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>CPSTART instructions of 8 or more points have been executed, exceeding the number of programs that can be started simultaneously.<table><tr><th></th><th>Number of Programs that can be Started Simultaneously</th></tr><tr><td>Version with conventional functions</td><td>20</td></tr><tr><td>Version with additional functions</td><td>14</td></tr></table></td><td>Reset with the reset key. Modify so that CPSTART instructions of 8 or more points do not exceed the number of programs that can be started simultaneously.</td></tr>
</table>

3.5.3 Servo amplifier classification (D9185/D9185 to 9186/D792 to D799) ... Data from the PCPU to the SCPU

(1) When an A171SCPU is used
On switching on the power to, or resetting, the servo system CPU, the servo amplifier type set in the system settings is set in these devices.

	b15 to b12	b11 to b8	b7 to b4	b3 to 0
D9185	Axis 4	Axis 3	Axis 2	Axis 1

Servo amplifier type
- 0........... Unused axis
- 2........... MR-[ ]-B

(2) When an A273UHCPU (8/32 axis specification) is used
On switching on the control power supply (A6[ ]P) to the servo system CPU or resetting, the servo amplifier type set in the system settings is set in these devices.

<A273UHCPU (8 axis specification)>

	b15 to b12	b11 to b8	b7 to b4	b3 to 0
D9185	Axis 4	Axis 3	Axis 2	Axis 1
D9186	Axis 8	Axis 7	Axis 6	Axis 5

Servo amplifier type
- 0........... Unused axis
- 1........... ADU (main base unit)
- 2........... MR-[ ]-B
- 5........... ADU (motion extension base unit)

<A273UHCPU (32 axis specification)>

	b15 to b12	b11 to b8	b7 to b4	b3 to 0
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 (main base unit)
- 2........... MR-[ ]-B
- 5........... ADU (motion extension base unit)

3.5.4 Manual pulse generator axis setting error (D9187/D9187/D9185 to D9187) ... Data from the PCPU to the SCPU

Stores the contents of a manual pulse generator axis setting error when the manual pulse generator axis setting error flag (M9077) comes ON.

<A171SCPU>

	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
D9187	0	0	0	0	Axis 4	Axis 3	Axis 2	Axis 1	0	0	0	0	P1	0	0	P1

- b0: Stores manual axis setting errors for manual pulse generators connected to A171SENC.
  - 0: Normal
  - 1: Setting error
    (When the axis setting for each digit is outside the range 1 to 4)
- b1 to b2: All set to "0"
- b3: Stores smoothing magnefication setting errors for the manual pulse generator connected to the A171SENC.
  - 0: Normal
  - Setting error
    (Magnification setting for each unit outside the range 1 to 59)
- b4 to b7: All set to "0"
- b8 to b11: Stores setting errors for the 1 pulse input magnification setting for each axis.
  - 0: Normal
  - 1: Setting error
    (When the input magnification setting for each axis is outside the range 1 to 100)
- b12 to b15: All set to "0"

<A273UHCPU (8 axis specification)>

	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
D9187	Axis 8	Axis 7	Axis 6	Axis 5	Axis 4	Axis 3	Axis 2	Axis 1	0	0	P3	P2	P1	P3	P2	P1

- b0 to b2: Stores axis setting errors for manual pulse generators connected to P1 to P3 of A273EX.
  - 0: Normal
  - 1: Setting error
    (When the axis setting for each digit is outside the range 1 to 8)
- b3 to b5: Stores smoothing magnification setting errors for the manual pulse generator connected to the A273EX (P1 to P3).
  - 0: Normal
  - 1: Setting error
    (Magnification setting outside the 1 to 59 range)
- b6 to b7: All set to "0"
- b8 to b15: Stores setting errors for the 1 pulse input magnification setting for each axis.
  - 0: Normal
  - 1: Setting error
    (When the input magnification setting for each axis is outside the range 1 to 100)

<A273UHCPU (32 axis specification)>

	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	P1	P2	P3	P3	P2	P1

- b2 to b0: Stores axis setting errors for manual pulse generators connected to P1 to P3 of A273EX.
  - 0: Normal
  - 1: Setting error
    (When the axis setting for each digit is outside the range 1 to 32)
- b5 to b3: Stores smoothing magnification setting errors for the manua1 pulse generators connected to P1 to P3 of the A273EX.
  - 0: Normal
  - 1: Setting error
    (When the smoothing magnification setting for each axis is outside the range 0 to 59)
- b15 to b6: All set to "0"

	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
D9186	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
D9187	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

- Stores setting errors for the 1 pulse input magnification setting for each axis.
  - 0: Normal
  - 1: Setting error
    (When the input magnification setting for each axis is outside the range 1 to 100)

3.5.5 Test mode request error (D9188/D9188/D9182 to D9183) ... Data from the PCPU to the SCPU

Stores the data of axes being operated when the test mode request error flag (M9078) comes ON.

<A171SCPU>

	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
D9188	0	0	0	0	0	0	0	0	0	0	0	0	Axis 4	Axis 3	Axis 2	Axis 1

- b3 to b0: Stores the operating/stopped status of each axis
  - 0: Stopped
  - 1: Operating
- b15 to b4: All set to "0"

<A273UHCPU (8 axis specification)>

	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
D9188	0	0	0	0	0	0	0	0	Axis 8	Axis 7	Axis 6	Axis 5	Axis 4	Axis 3	Axis 2	Axis 1

b7 to b0: Stores the operating/stopped status of each axis
- 0: Stopped
- 1: Operating

b15 to b8: All set to "0"

<A273UHCPU (32 axis specification)>

	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
D9182	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
D9183	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

Store the operating/stopped status of each axis
- 0: Stopped
- 1: Operating

3.5.6 Error program No. (D9189) ... Data from the PCPU to the SCPU

(1) Stores the number of the subprogram (range: 0 to 4095) affected by the error when the subprogram setting error flag (M9079) comes ON.

(2) 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.

3.5.7 Error item information (D9190) ... Data from the PCPU to the SCPU

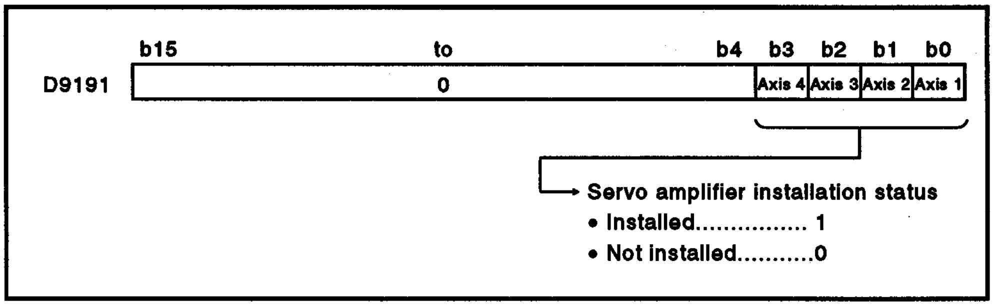
When the servo program setting error flag (M9079) comes ON, the error code that corresponds to the relevant setting item is stored in this device.

Error Code	Error Contents
900	The servo program set for the DSFRP/SVST instruction does not exist.
901	The axis number set for the DSFRP/SVST instruction is different from the axis number set in the servo program.
902	The instruction code cannot be decoded. (A non-existent instruction code has been designated.)
906	An axis designated as unused in the system settings is set in the subprogram set for the DSFRP/SVST instruction.
Error item data	There is an error in the setting items of the servo program set for the DSFRP/SVST instruction. The error item data indicated in Section 6.3 is stored.

3.5.8 Servo amplifier installation information (D9191/D9191/D9191 to D9192) ... Data from the PCPU to the SCPU

(1) When an A171SCPU is used
On switching on the control power supply to the servo system CPU or resetting, the servo amplifier installation status is checked and the result is set in this device.
Lower 4 bits ... Servo amplifier installation status

The "installed" status will be stored for axes for which an amplifier is installed after the power is switched on. However, if the amplifier for an axis is removed, the "installed" status will not change to "not installed".



(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 Setting	MR-[ ]-B	
	Installed	Not Installed
Used (axis number setting)	"1" is stored	"0" is stored
Unused	"0" is stored	"0" is stored

(2) When an A273UHCPU (8/32 axis specification) is used
On switching on the control power supply (A6[ ]P) to the servo system CPU or resetting, the servo amplifier and option slot installation status is checked and the result is stored in this device.
Lower 8 bits .... Servo amplifier installation status (when A273UHCPU (8 axis specification) is used only).

The "installed" status will be stored for axes for which an amplifier is installed after the power is switched on. However, if the amplifier for an axis is removed, the "installed" status will not change to "not installed".

<A273UHCPU (8 axis specification)>

	b15 to b8	b7	b6	b5	b4	b3	b2	b1	b0
D9191	0	Axis 8	Axis 7	Axis 6	Axis 5	Axis 4	Axis 3	Axis 2	Axis 1

Servo amplifier installation status
- Installed................ 1
- Not installed...........0

<A273UHCPU (32 axis specification)>

	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
D9191	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
D9192	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

Servo amplifier installation status
- Installed................ 1
- Not installed...........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 Setting	ADU		MR-[ ]-B	
	Installed	Not Installed	Installed	Not Installed
Used (axis number 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

3.5.9 Area for setting the smoothing magnification for the manual pulse generator (D9192/D9192 to D9194/D752 to D754) ... Data from the SCPU to the PCPU

(1) This device stores the manual pulse generator smoothing time constant.

<A17ASCPU>

Manual Pulse Generator Smoothing Magnification Setting Register	Setting Range
D9192	0 to 59

<A273UHCPU (8-axis)>

Manual Pulse Generator Smoothing Magnification Setting Register	Setting Range
Manual pulse generator 1 (P1): D9192	0 to 59
Manual pulse generator 2 (P2): D9193	
Manual pulse generator 3 (P3): D9194	

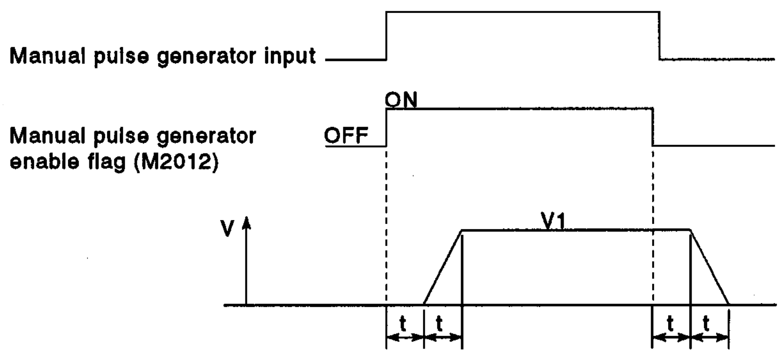
<A273UHCPU (32-axis)>

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	

(2) The setting range for the smoothing magnification is 0 to 59.

(3) When the smoothing magnification is set, the smoothing time constant is determined by the formula given below.
Smoothing time constant (t) = (smoothing magnification + 1) × 56.8 [ms]

(4) Operation



$$\text{Output speed (V1)} = \left(\begin{array}{l}\text{number of input}\\ \text{pulses / ms}\end{array}\right) \times \left(\begin{array}{l}\text{1 manual pulse generator pulse}\\ \text{input magnification setting}\end{array}\right)$$

$$\text{Travel value (L)} = \left(\begin{array}{l}\text{travel value}\\ \text{per pulse}\end{array}\right) \times \begin{array}{l}\text{number of}\\ \text{input pulses}\end{array} \times \left(\begin{array}{l}\text{1 manual pulse generator pulse}\\ \text{input magnification setting}\end{array}\right)$$

REMARKS

1) The travel value per manual pulse generator pulse is set in one of the following units.
- Setting unit
  - mm : 0.1 μm
  - inch : 0.00001 inch
  - degree : 0.00001 degree
  - PULSE : 1 pulse

2) The range for the smoothing time constant is 56.8 ms to 3408 ms.

4. PARAMETERS FOR POSITIONING CONTROL

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

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

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

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

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

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

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

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

4.1 System Settings

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

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

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

Table 4.1 Module Model Names

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

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

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

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

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

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

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

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

- When using MR-J2-B

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

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

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

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

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

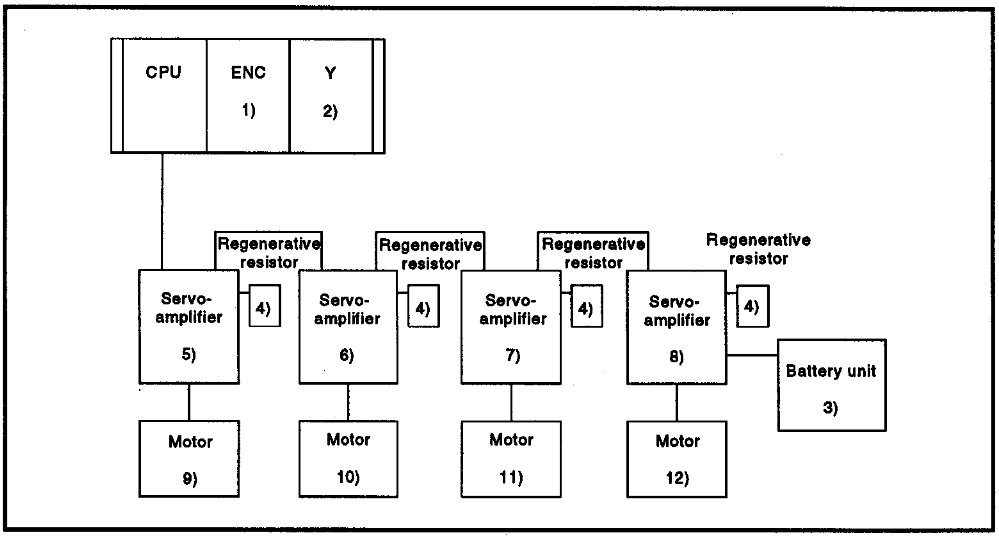


Fig. 4.1 System Settings (When no Extension Base Unit is Used)

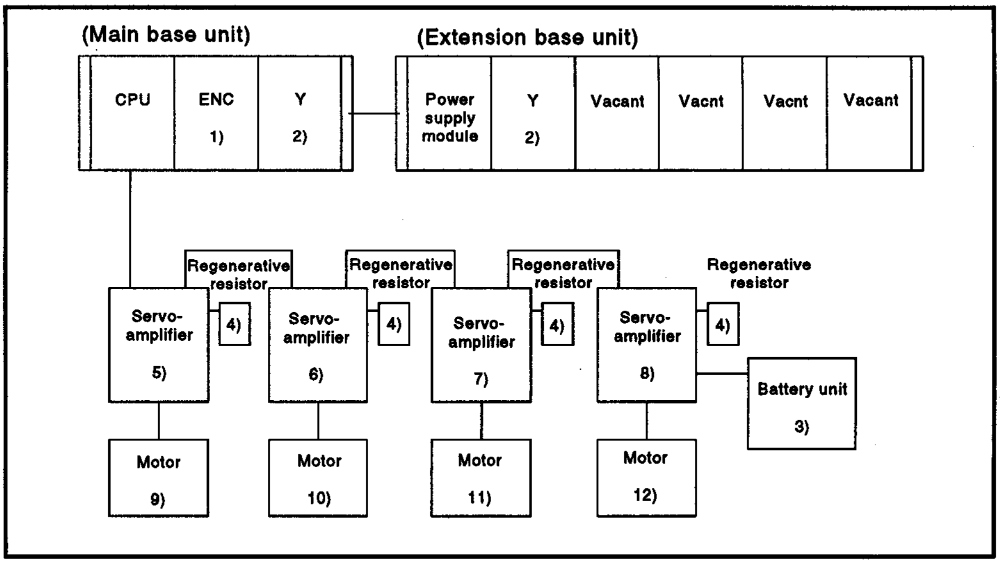


Fig. 4.2 System Settings (When an Extension Base Unit is Used)

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

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

Table 4.6 Module/Unit Model Names

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

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

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

Table 4.7 Motor Types and Model Names When Using an ADU

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

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

• When using MR-H-B/MR-J-B

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

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

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

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

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

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

- When using MR-J2-B

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

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

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

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

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

<A273UHCPU (8/32 axis specification)>

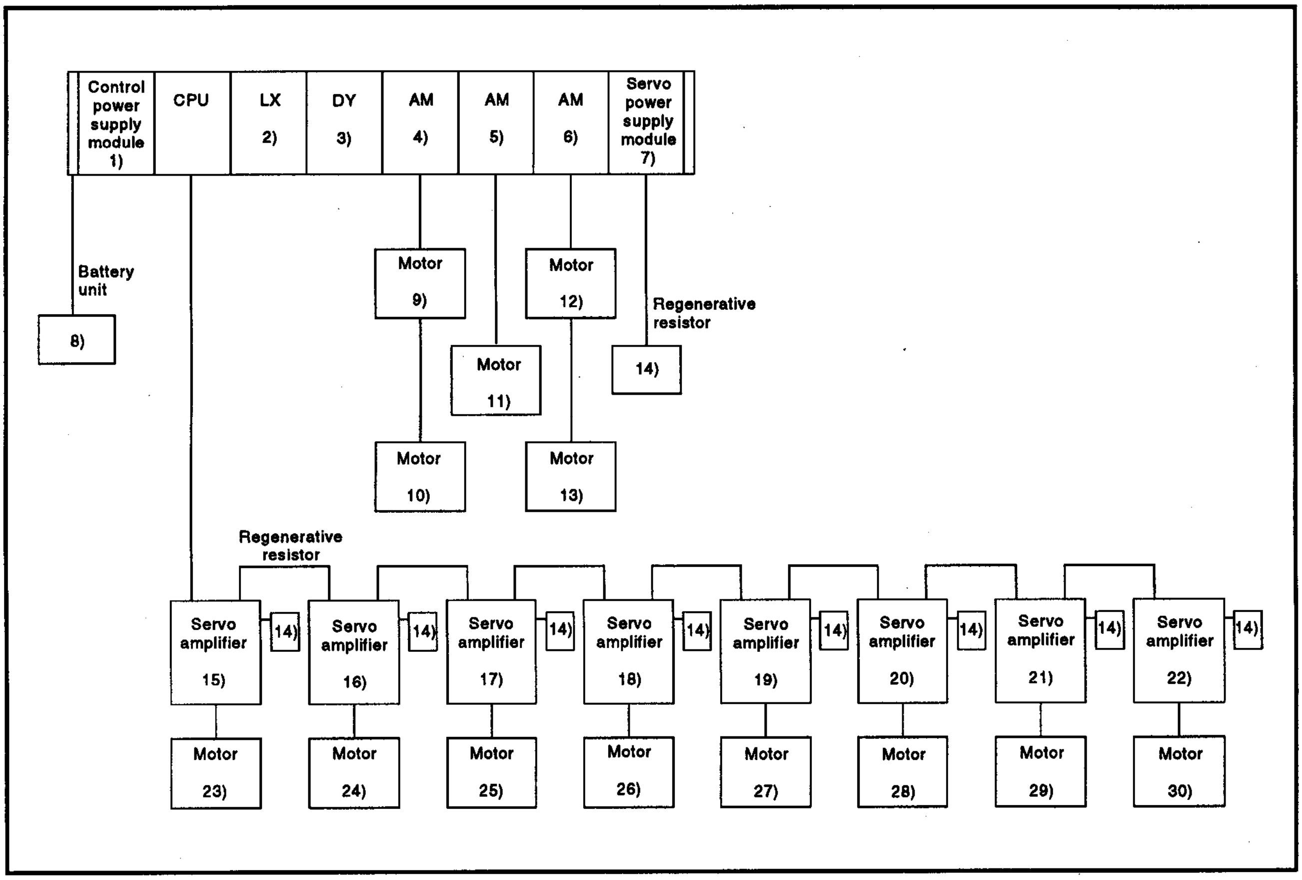


Fig. 4.3 System Settings (When no Motion Extension Base Unit is Used)

<A273UHCPU (8/32 axis specification)>

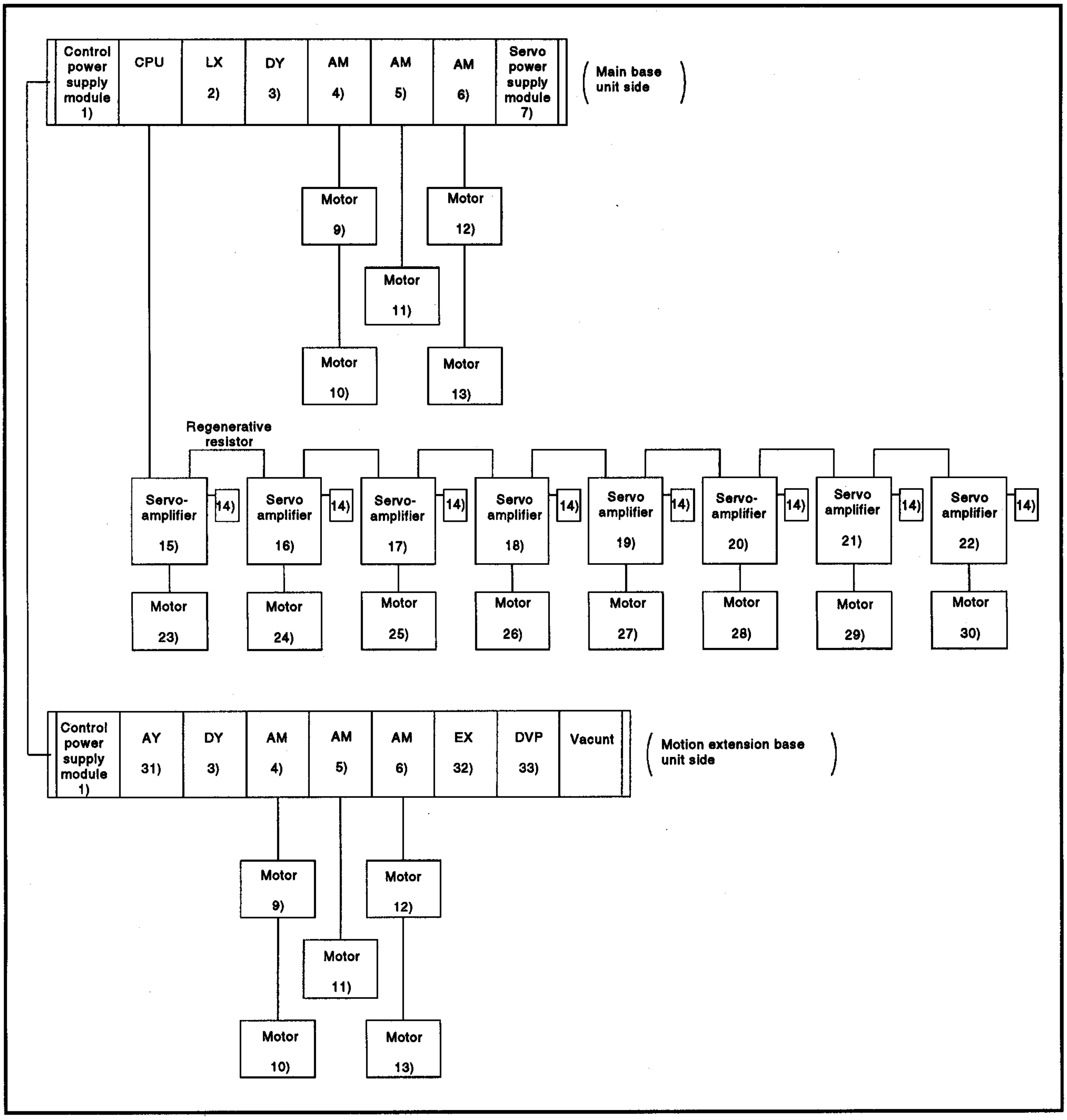


Fig. 4.4 System Settings (When a Motion Extension Base Unit Is Used)

4.2 Fixed Parameters

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

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

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

Table 4.12 Fixed Parameters

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

Table 4.12 Fixed Parameters (Continued)

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

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

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

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

(1) Setting method 1

(a) Finding the smallest position resolution (Δl).

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

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

(b) Finding the unit magnification (A_M)

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

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

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

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

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

(c) Finding the travel value per revolution (A_L).

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

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

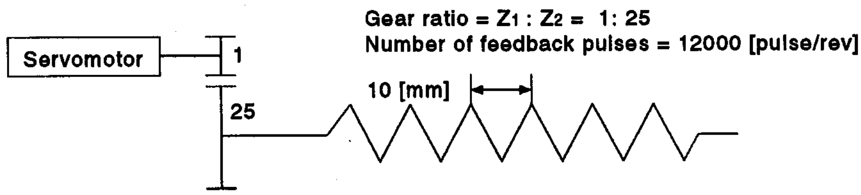
$$A_L = \frac{10000.0\ [\mu\text{m}]}{10} = 1000.0\ [\mu\text{m}]$$

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

(d) Number of pulses per revolution (A_P)

Set the number of feedback pulses per revolution of the encoder.

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



1) Travel value per feedback pulse

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

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

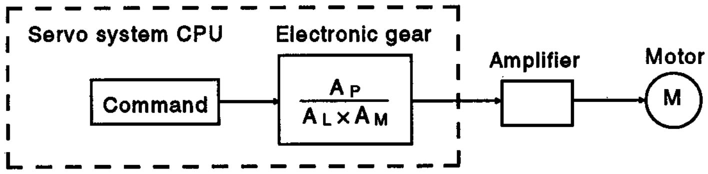
2) Unit magnification (A_M)
Since Δl is 0.0001, the unit magnification (A_M) is "1".

3) Travel distance per revolution (A_L)

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

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

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



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

Gear ratio = Z_1:Z_2 = 1:39
Ball screw pitch = 25.4 [mm]

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

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

Electronic gear

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

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

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

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

4.2.2 Upper stroke limit value/lower stroke limit value

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

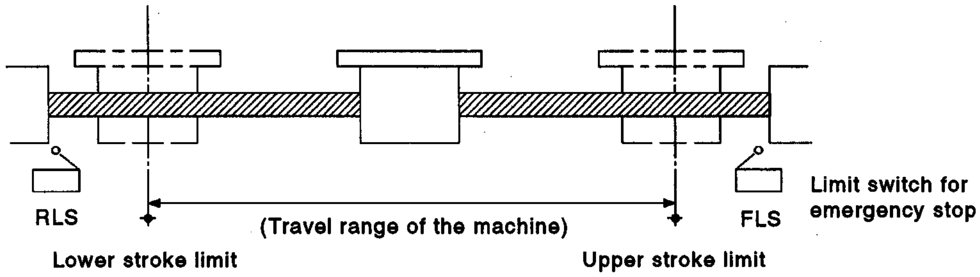


Fig. 4.5 Travel Range When Setting the Upper Stroke Limit Value and Lower Stroke Limit Value

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

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

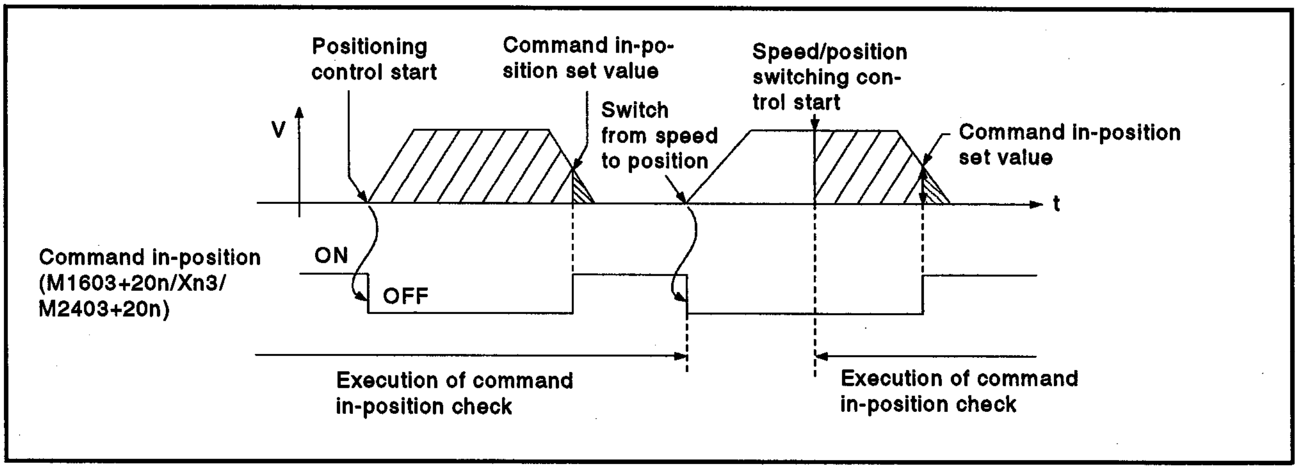
POINTS

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

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

4.2.3 Command in-position range

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



4.3 Servo Parameters

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

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

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

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

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

(1) Basic parameters

Table 4.13 Servo Parameters (Basic Parameters)

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

POINT

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

(2) Adjustment parameters

Table 4.14 Servo Parameters (Adjustment Parameters)

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

4.3.2 MR-[ ]-B servo parameters

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

(1) Basic parameters

Table 4.15 Servo Parameters (Basic Parameters)

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

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

POINT

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

(2) Adjustment parameters

Table 4.16 Servo Parameter List (Adjustment Parameters)

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

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

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

<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">Explanatory 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>15</td><td>*5 Optional function 1 (external emergency stop signal)</td><td colspan="8">0 : Used
1 : Not used</td><td>0</td><td>—</td><td>• To invalidate the external emergency stop signal (EMG) set "not used".</td><td>4.3.14</td></tr>
<tr><td>16</td><td>*6 Optional function 2 (selection of no-motor operation)</td><td colspan="8">0 : Invalid
1 : Valid</td><td>0</td><td>—</td><td>• To check the status without connecting a motor, set "valid".</td><td>4.3.15</td></tr>
<tr><td>17</td><td>*6 Optional function 2 (electro-magnetic brake interlock output timing)</td><td colspan="8">0 : Regardless of the rotational speed of the servo motor, output occurs under any of the following conditions.
• Servo OFF
• Occurrence of an alarm
• Emergency stop input OFF (valid)
1 : Output occurs under any of the above conditions provided that the servo motor rota tional speed is zero (expansion parameters).</td><td>0</td><td>—</td><td>• Set the interlock timing for the electromagnetic brake interlock signal.</td><td>4.3.15</td></tr>
<tr><td>18</td><td>*5 Optional function 2 (selection of microvi-bration suppres-sion function)</td><td colspan="8">0 : Valid
1 : Invalid</td><td>0</td><td>—</td><td>• Set "valid" to suppress vibration on stopping.</td><td>4.3.15</td></tr>
<tr><td>19</td><td>*5 Optional function 2 (motor lock operation)</td><td colspan="8">0 : Valid
1 : Invalid</td><td>0</td><td>—</td><td>• To carry out test operation without rotating the motor, set "valid".</td><td>4.3.15</td></tr>
</table>

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

(3) Expansion parameters

Table 4.17 Servo Parameters (Expansion Parameters)

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

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

Table 4.17 Servo Parameters (Expansion Parameters) (Continued)

No.	Item	Setting Range								Default		Remarks	Explanatory Section
		mm		inch		degree		PULSE		Initial Value	Units		
		Setting Range	Units	Setting Range	Units	Setting Range	Units	Setting Range	Units				
15	Number of gear teeth at motor side	0 to 65535								0	—	• Set the ratio between the nunber of gear teeth on the motor shaft and the number of gear teeth on the encoder shaft.	—
16	Number of gear teeth at machine side	0 to 65535								0	—		—
17	Number of closed encoder pulses	0 to 65535								0	—	• Set the resolution of the closed encoder within one revolotion (ŏ4 value).	—

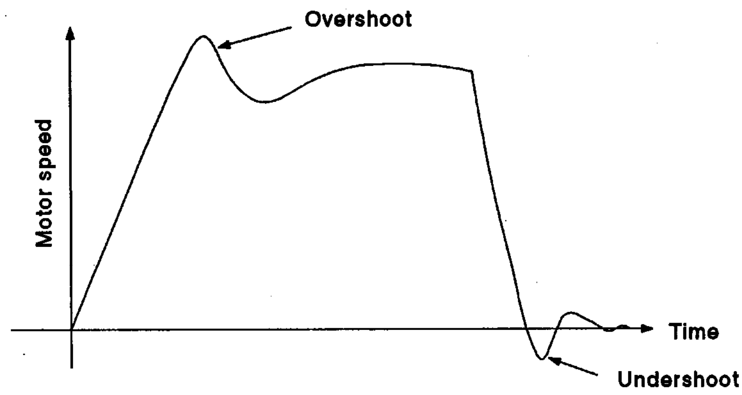
POINT

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

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

4.3.3 Position control gain 1, 2

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



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

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

POINTS

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

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

4.3.4 Position control gain 1, 2

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

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

Table 4.18 Guide to Speed Control Gain 2 Setting

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

POINTS

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

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

4.3.5 Speed integral compensation

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

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

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

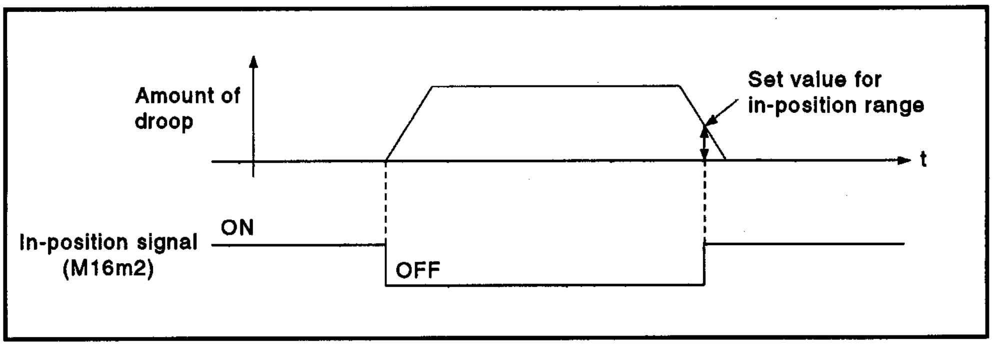
Table 4.19 Guide to Speed Integral Compensation Setting

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

4.3.6 In-position range

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

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



4.3.7 Feed forward gain

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

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

4.3.8 Load inertia ratio

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

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

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

4.3.9 Automatic tuning

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

POINT

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

4.3.10 Servo responsiveness setting

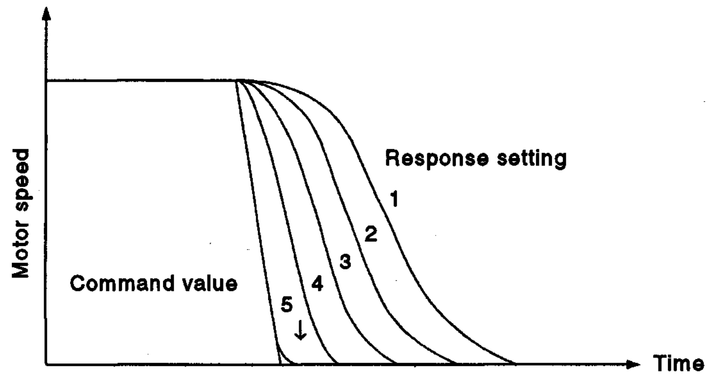
(1) This parameter setting is used to increase servo responsiveness. Changing the set value to a higher value in the sequence 1, 2..., 5 improves servo responsiveness.
For machines with high friction, use the set values in the range 8 through C.

Response settings

1: Low-speed response			
2:			
3:	Normal machine	—	Standard mode
4:	(MR-[ ]-B usable)		
5: High-speed response			
8: Low-speed response			
9:			
A:	Machines with high friction	—	High frictional load mode
B:	(only MR-H-B usable)		
C: High-speed response			

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

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



Change in motor response in accordance with response setting

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

4.3.11 Notch filter

This parameter sets the notch frequency for the notch filter.

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

4.3.12 Electromagnetic brake sequence

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

4.3.13 Monitor output mode

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

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

4.3.14 Optional function 1 (carrier frequency selection)

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

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

0			0

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

Encoder type
0 : Two-wire type
1 : Four-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-J2-B)
The external emergency stop signal (EMG) can be made invalid.
0 : External emergency stop signal is valid.
1 : External emergency stop signal is invalid (automatically turned ON internally).
Since the emergency stop signal at the MR-J2-B cannot be used, do not set "0".

4.3.15 Optional function 2 (no-motor operation selection)

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

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

1 : Output occurs under any of the above conditions provided that the servo motor rotational speed is zero (expansion parameters).

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

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

4.3.16 Monitor output 1, 2 offset

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

POINT

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

4.3.17 Pre-alarm data selection

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

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

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

0			

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

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

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

4.3.21 PI-PID switching position droop

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

4.3.22 Torque control compensation factor

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

4.3.23 Speed differential compensation

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

4.4 Parameter Block

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

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

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

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

Table 4.20 Parameter Block Settings

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

POINTS

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

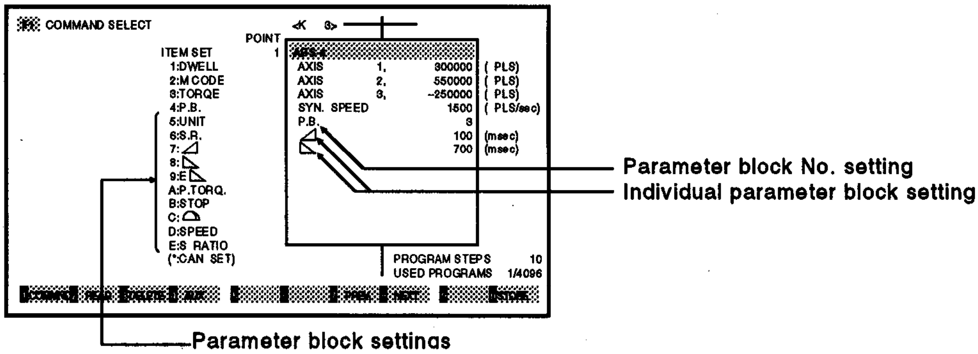
(2) The various parameter block data can be changed in the servo program. (See Section 6.3.)

POINT

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

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

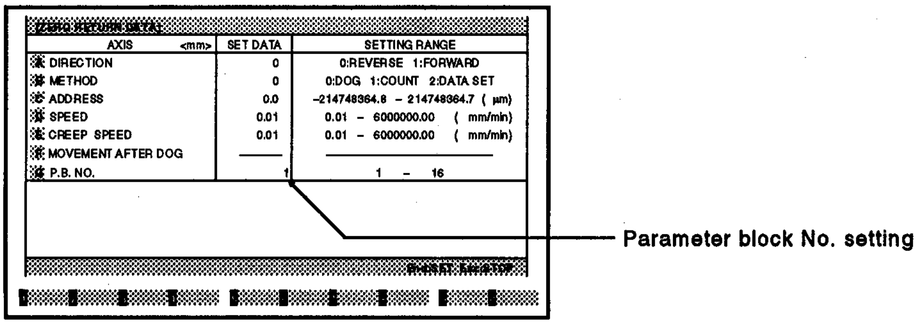
[Servo program creation screen]



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

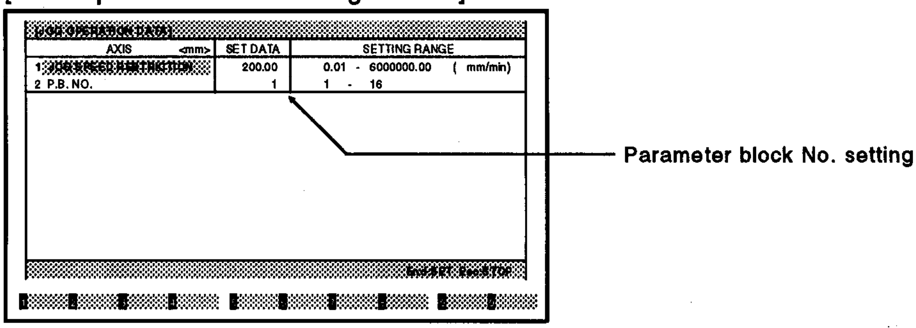
(b) The parameter block No. used for home position return is set when setting the "home position return data" with a peripheral device.

[Home position return data setting screen] <A171SCPU>



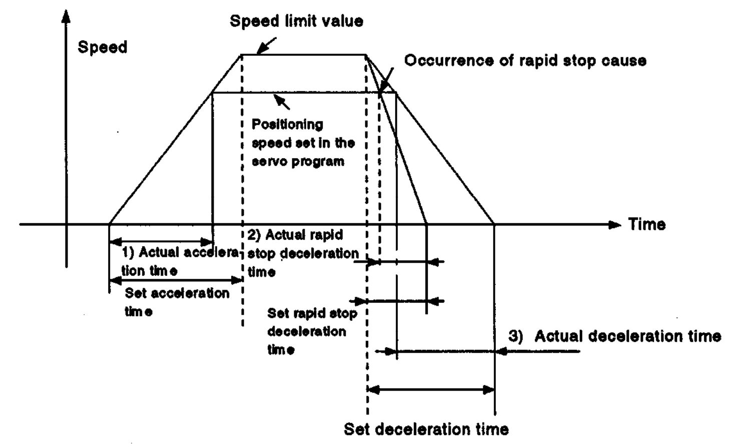
(c) The parameter block No. used for JOG operation is set when setting the "JOG operation data" with a peripheral device.

[JOG operation data setting screen] <A171SCPU>



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

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

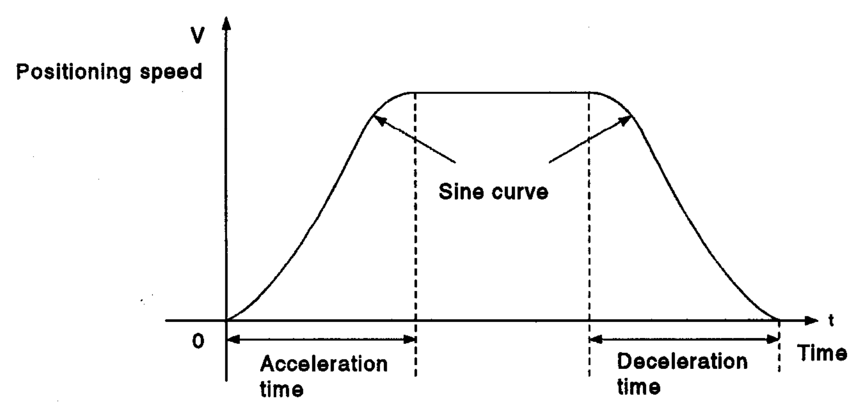


1) Actual acceleration time
   Time take to reach the positioning speed set in the servo program
2) Actual rapid stop deceleration time
   Time taken to effect a rapid stop from the positioning speed set in the servo program.
3) Actual deceleration time
   Time taken to stop from the positioning speed set in the servo program

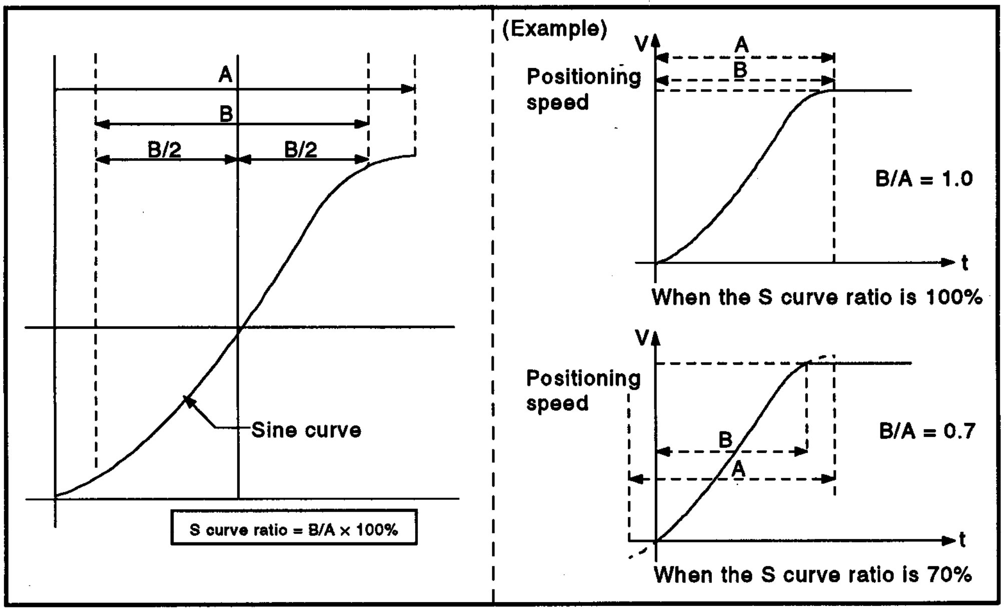
Fig. 4.6 Relationships among the Speed Limit Value, Acceleration Time, Deceleration Time, and Rapid Stop Deceleration Time

4.4.2 S curve ratio

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



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



4.4.3 Allowable error range for circular interpolation

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

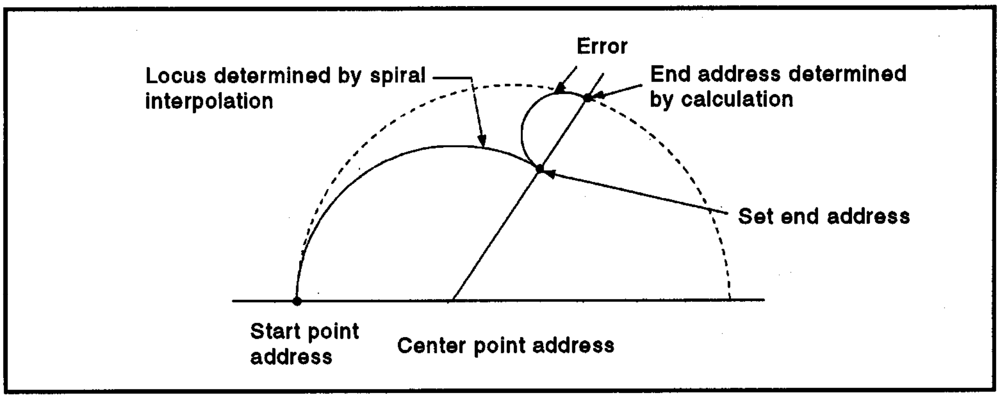


Fig. 4.7 Spiral Interpolation

5. SEQUENCE PROGRAMS AND SFC PROGRAMS

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

5.1 Cautions on Creating a Sequence Program or SFC Program

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

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

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

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

Table 5.1 Dedicated Devices for the PCPU

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

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

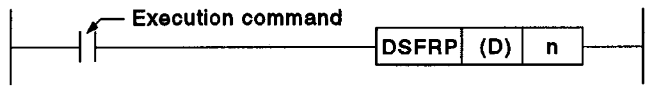
(4) SFC programs
Refer to the manuals below for details on the SFC programming method.
MELSAP II Programming Manual (IB-66361)
SW2SRX-GSV13PE Operating Manual (IB-67266)
SW2SRX-GSV22PE Operating Manual (IB-67264)

5.2 Servo Program Start Request Instruction (DSFRP/SVST)

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

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

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

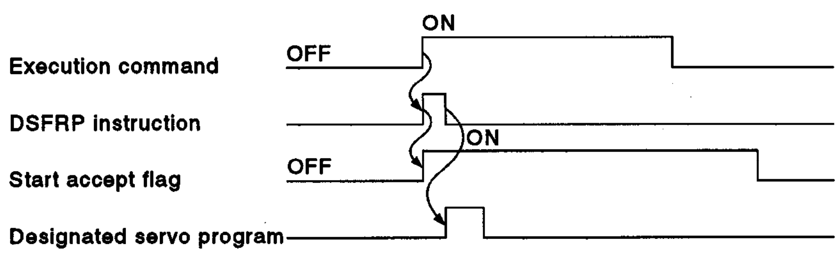


Set data

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

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

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



[Data Settings]

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

D□□□

→ Designate digits from 1 to 3.
- 1 axis to be started ....Make the setting for 1 axis (1 digit)
- 2-axis interpolation to be started ....Make the setting for 2 axes (2 digits)
- 3-axis interpolation to be started ....Make the setting for 3 axes (3 digits)

Designate started axis numbers 1 to 4 for an A171SCPU, or 1 to 8 for an A273UHCPU (8 axis specification).

→ Device symbol (only "D" can be used)

Example

The axes to be started are designated as follows.

- Axis 1 ....D1
- Axis 1 and axis 2 ....D12
- Axis 1, axis 2, and axis 3 ....D123

(2) Servo program No. setting
There are two types of servo program number setting: direct and indirect.

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

Example

Servo program No.50 would be set as follows.

- When designated with a K device ...K50

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

1) K30□□□

→ Designation of the data register number (000 to 799).. 3 digits must be set. Example: For 50, set 050.

→ Data register designation

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

Example

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

- When designated with a K device ....K30050 .....Specifies "D50"

POINTS

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

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

[Error Details]

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

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

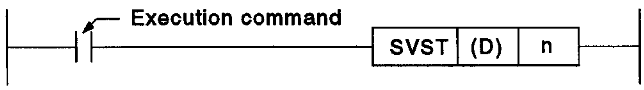
POINT

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

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

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

*1: Possible with indirect setting only

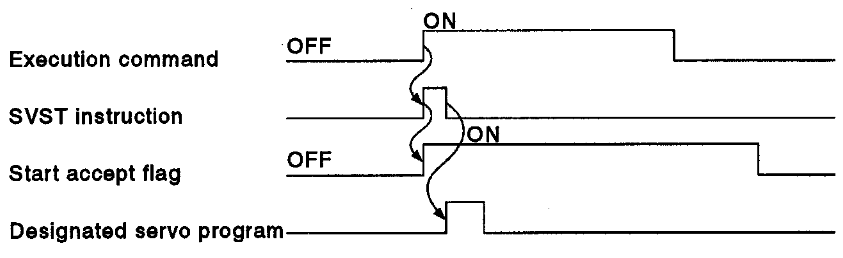


Set data

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

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

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



[Data Settings]

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

<A171SCPU>

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

Set J + started axis numbers 1 to 4.

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

<A273UHCPU (8/32 axis specification)>

← Upper row
← Lower row

Setting for 1 to 8 axes

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

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

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

Example

The axes to be started are designated as follows:

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

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

Example

Servo program No.50 would be set as follows.

- When designated with a K device ...K50

(b) In indirect setting, the servo program number is set as a value in a word device.
1) The word devices that can be used are indicated in the table below.

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

*1: Excluding 800 to 1023

POINT

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

Example

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

- Designation with a word device — [SVST | J1J2J3 | D50]

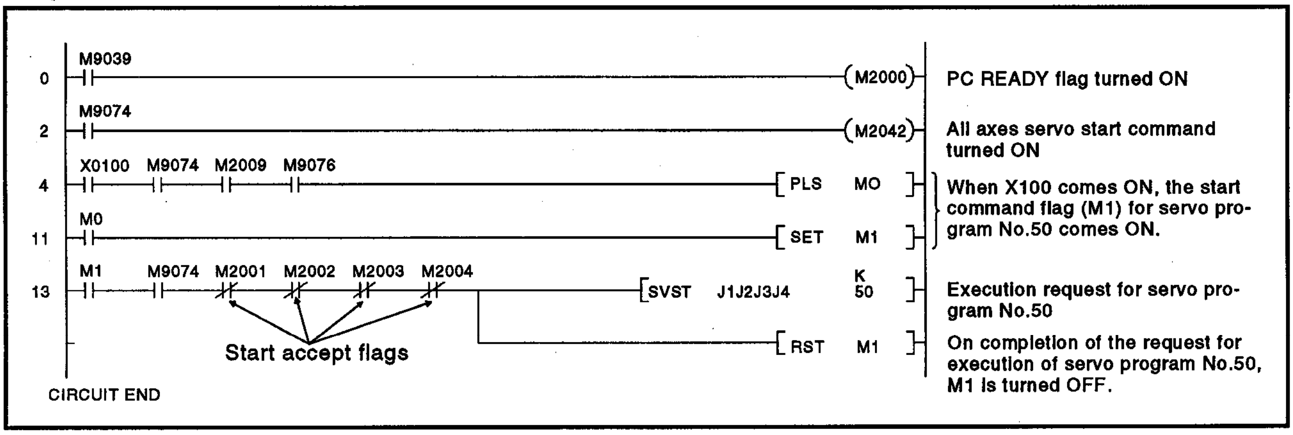
2) An index register (Z, V) or dedicated instruction (IX . IXEND) can be used for index designation of the indirectly set word device.
   - For details on index registers (Z, V), see the ACPU Programming Manual (Fundamentals) (IB-66249).
   - For details on dedicated instruction (IX . IXEND), see the 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 (A171SCPU).
- When the setting for (D) is for 8 or more axes (A273UHCPU, 8/32 axis specification).
- When the axis number given in any digit of (D) is a number other than J1 to J4 (A171SCPU).
- When the axis number given in any digit of (D) is a number other than J1 to J8 (A273UHCPU, 8-axis specification).
- When the axis number given in any digit of (D) is a number other than J1 to J32 (A273UHCPU, 32-axis specification).
- When the same axis number is set twice in (D).
- When the setting for n is outside the applicable range.

[Program example] <A171SCPU>

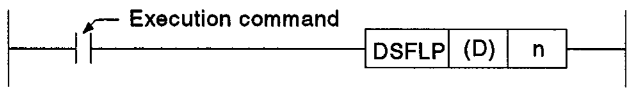


5.3 Present Value Change and Speed Change Instructions (DSFLP/CHGA, CHGV)

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

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

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



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

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

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

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

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

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

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

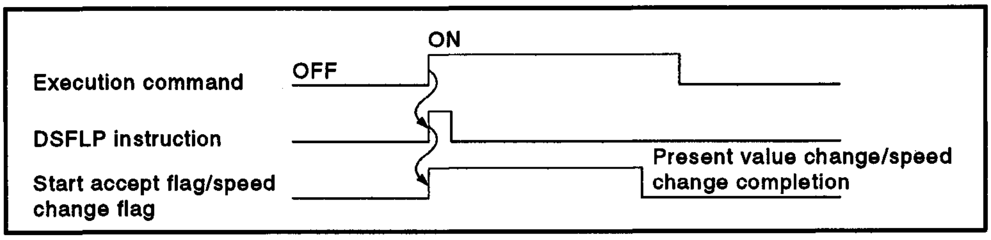
<A171SCPU>

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

<A273UHCPU (8-Axis Specification)>

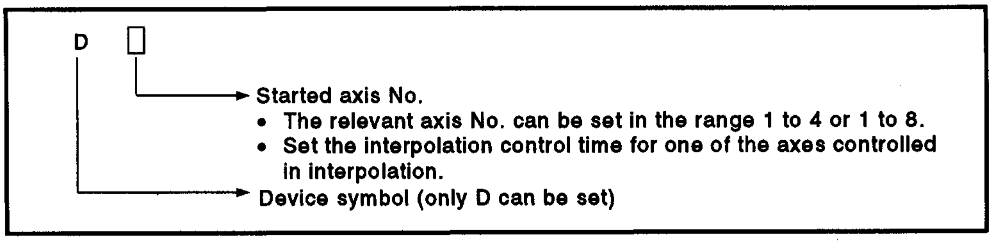
Axis No.	Present Value Change Registers		Speed Change Registers	
	Upper	Lower	Upper	Lower
Axis 1	D961	D960	D963	D962
Axis 2	D967	D966	D969	D968
Axis 3	D973	D972	D975	D974
Axis 4	D979	D978	D981	D980
Axis 5	D985	D984	D987	D986
Axis 6	D991	D990	D993	D992
Axis 7	D997	D996	D999	D998
Axis 8	D1003	D1002	D1005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

[Operation Timing]



[Data Settings]

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



Example

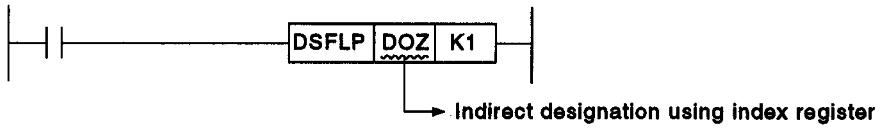
The started axis is designated as follows

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

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

POINT

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



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

[Error Details]

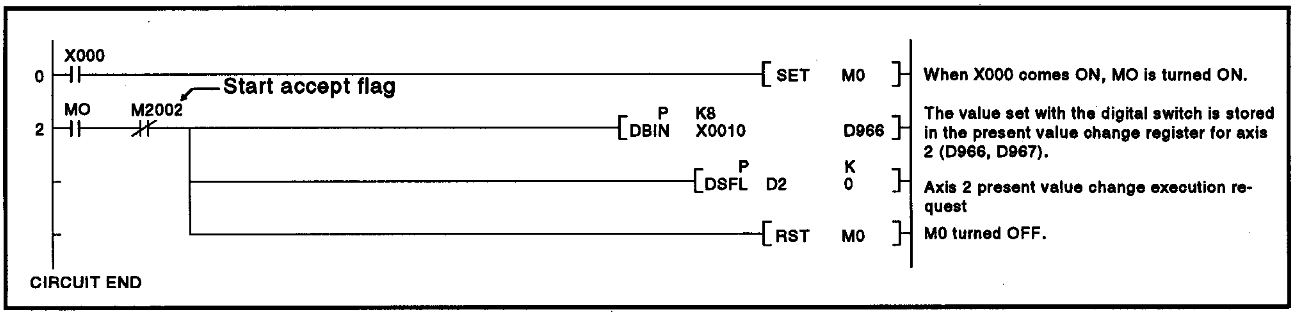
(1) In the following cases, an operation error occurs and the DSFLP instruction is not executed.
- When the setting for (D) is other than 1 to 4 or 1 to 8.
- When the setting for n is a value other than 1 or 0.
- When the setting for (D) or n has been indirectly designated using an index register (Z,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

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

[Program Example]

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

(b) Program example



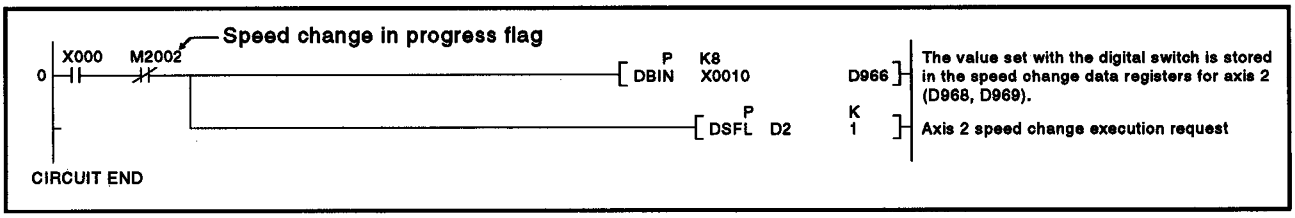
(2) The program shown below changes the positioning speed of axis 2 to the value set with an 8-digit digital switch.

(a) Conditions

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

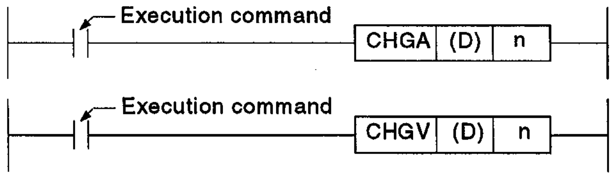
2) Speed change command ....Leading edge (OFF → ON) of X000

(b) Program example



5.3.2 CHGA/CHGV instructions

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



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

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

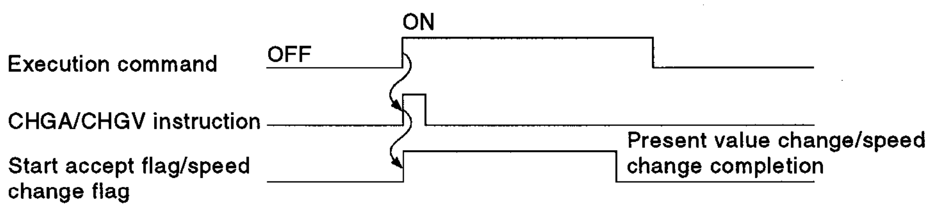
(a) Present value change
When the CHGA instruction is executed, the present value change is executed in accordance with the following procedure.

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

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

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

[Operation Timing]



[Data Settings]

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

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 ---

Axes to be started are designated as shown below.

- Axis 1 ....J1

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

(a) In direct setting, the present value or speed to be changed to is specified directly as a numerical value.
(For the setting range, refer to Section 3.4.2.)

--- Example ---

If the present value to be changed to is "10", the setting is as follows.

- When designated with a K device K10

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

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

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

*1: Excluding 800 to 1023

--- Example ---

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

- Designation with a word device —[CHGA J11 D50]—

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

- For details on index registers (Z, V), see the ACPU Programming Manual (Fundamentals) (IB-66249).
- For details on dedicated instructions (IX, IXEND), refer to the AnACPU/AnUCPU Programming Manual (Dedicated Instructions) (IB-66251).

[Error Details]

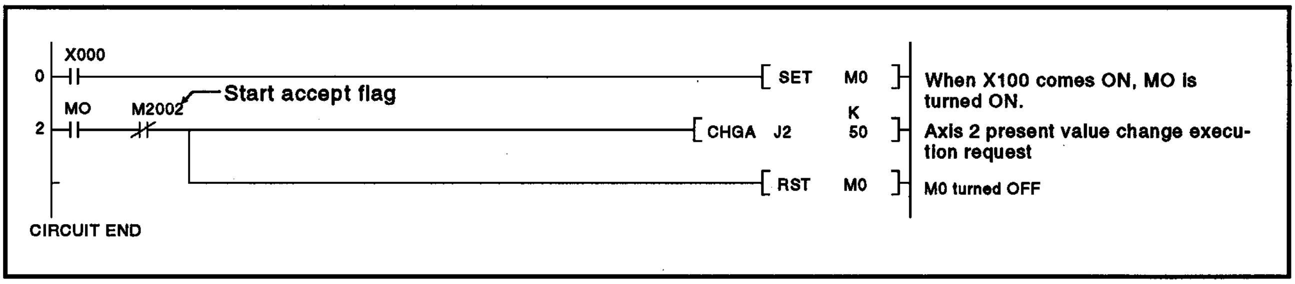
(1) In the following cases an operation error occurs and the CHGA/CHGV instruction is not executed.
- When the setting for (D) is other than J1 to J32.

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

[Program Example]

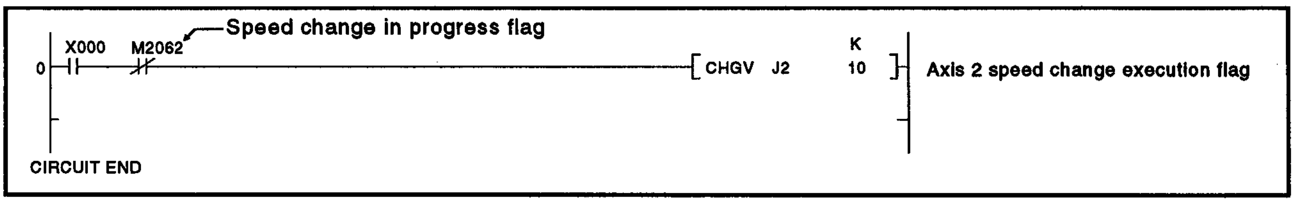
(1) The program shown below changes the present value for axis 2.
(a) Conditions
1) Present value change command ....Leading edge (OFF → ON) of X000
2) Present value change execution flag ...M0
3) Axis 2 start accept flag (used to determine whether axis 2 is stopped or in motion) ....M2002 (axis 2 start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

(b) Program example



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

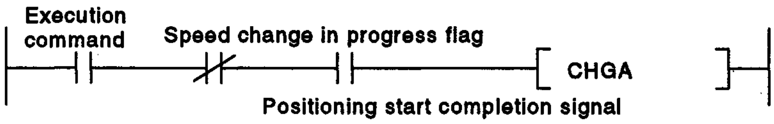
(b) Program example

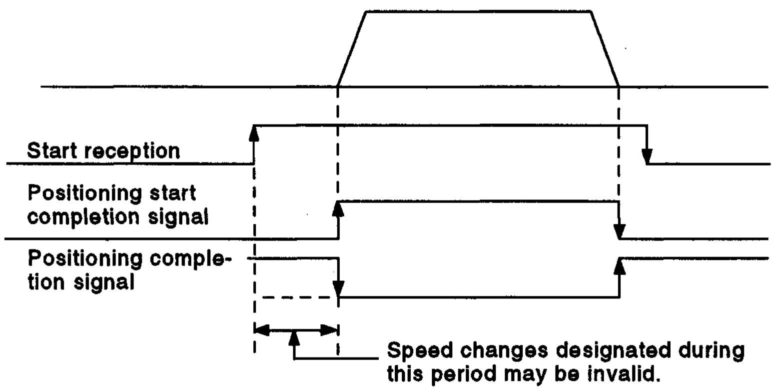


POINT

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

Example:





5.4 SFC Programs

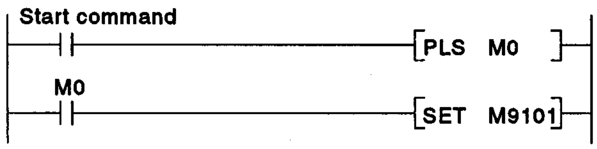
This section explains how to start servo programs using SFC programs.

5.4.1 Starting and stopping SFC programs

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

(1) Starting SFC programs

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

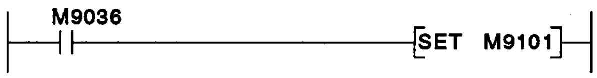


(b) There are two types of SFC program start, as indicated below, and the one that is effective is determined by the ON/OFF status of special relay M9102 (SFC program start status selection):

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

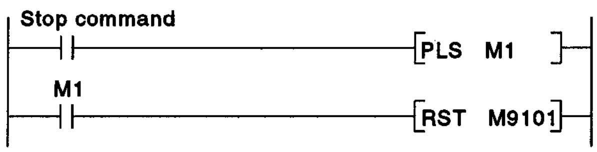
2) SFC program resumptive start
By turning special relay M9101 ON while special relay M9102 is ON, the SFC program is started from the block and step that was being executed immediately before operation was stopped.

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



(2) Stopping SFC programs

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



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

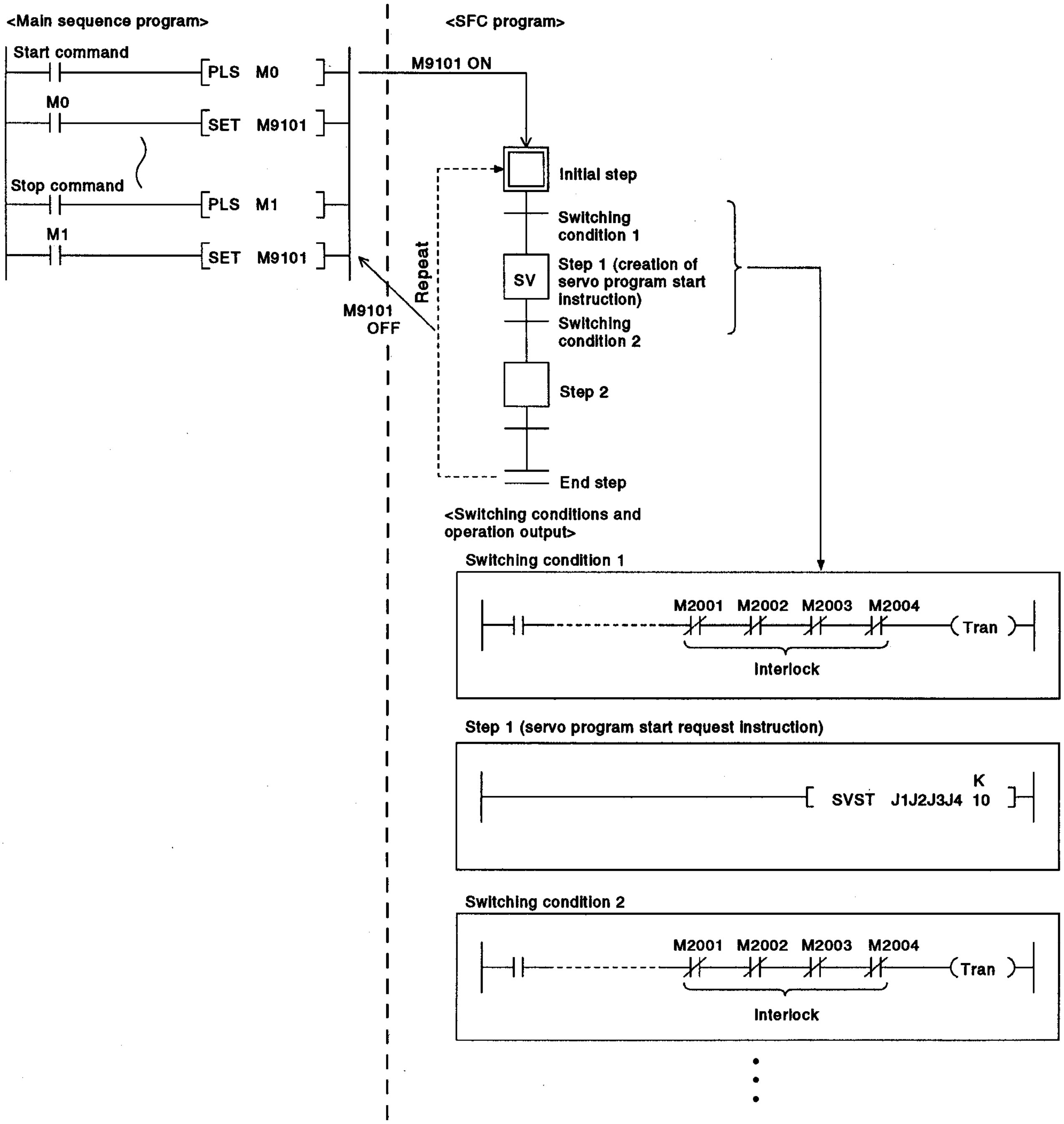
POINT

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

5.4.2 Servo program start request

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

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



POINTS

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

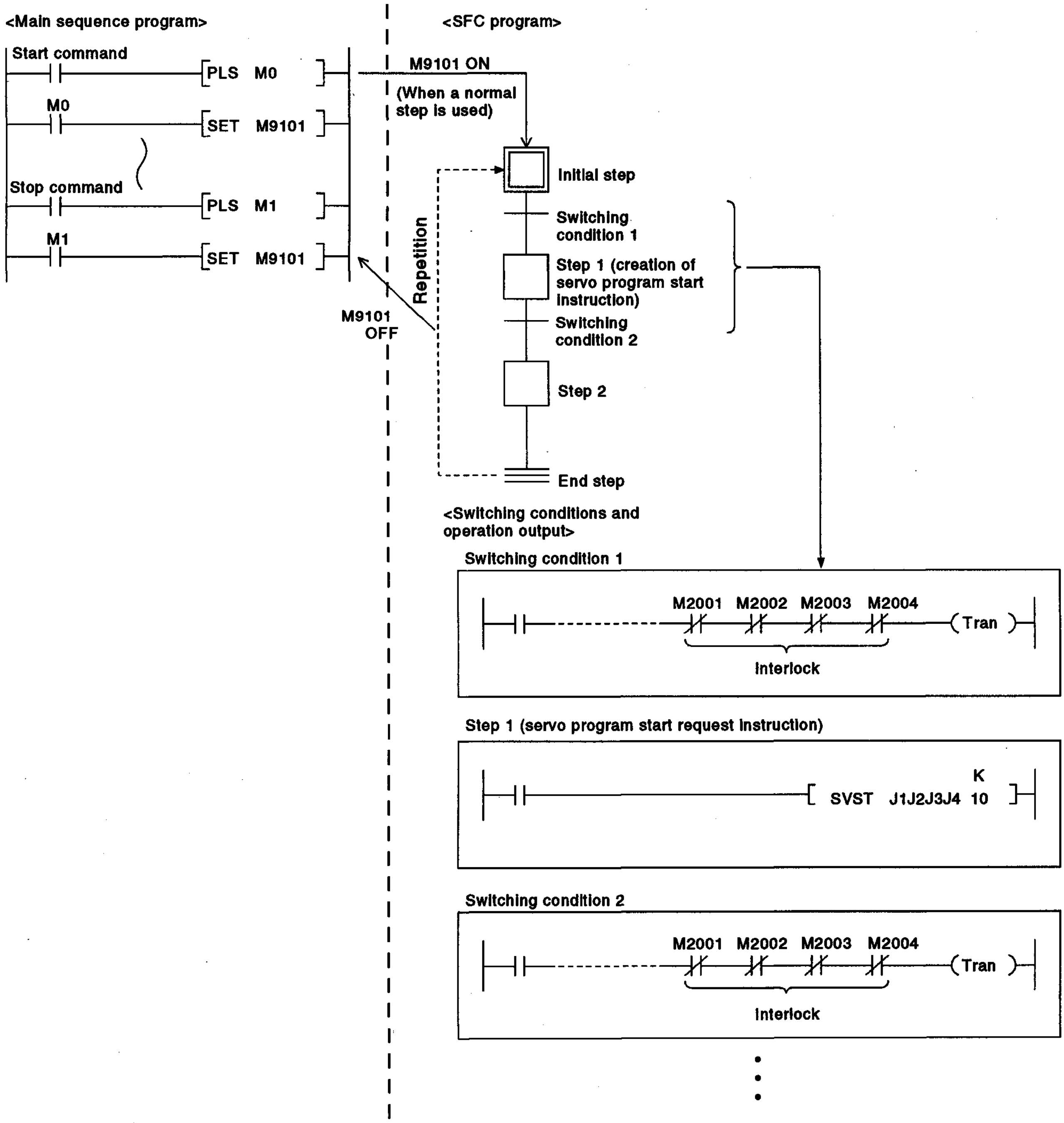
(2) When a DSFRP instruction is used, input it directly into the sequence program at a normal step (□).

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

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

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

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



POINTS

(1) When a DSFRP or DSFLP instruction is used, input it directly into the internal circuit of a normal step (☐).
(2) If an SVST/DSFRP instruction is edited and converted, a start accept bit (M2001+n) is automatically inserted into the switching conditions before and after the relevant SFC step to act as an interlock.
(3) If a DSFLP instruction is edited and converted, a speed change in progress flag (M2021 to M2024/M2021 to M2028/M2061 to M2092) is automatically inserted into the switching conditions before and after the relevant SFC step to act as an interlock.
(4) Set commands such as speed change commands and stop commands, which are executed in an arbitrary timing, in the main sequence program.
(5) For details on how to operate peripheral devices used to edit and monitor SFC programs, refer to the SW2SRX-GSV13PE Operating Manual and SW2SRX-GSV22PE Operating Manual.

6. SERVO PROGRAMS FOR POSITIONING CONTROL

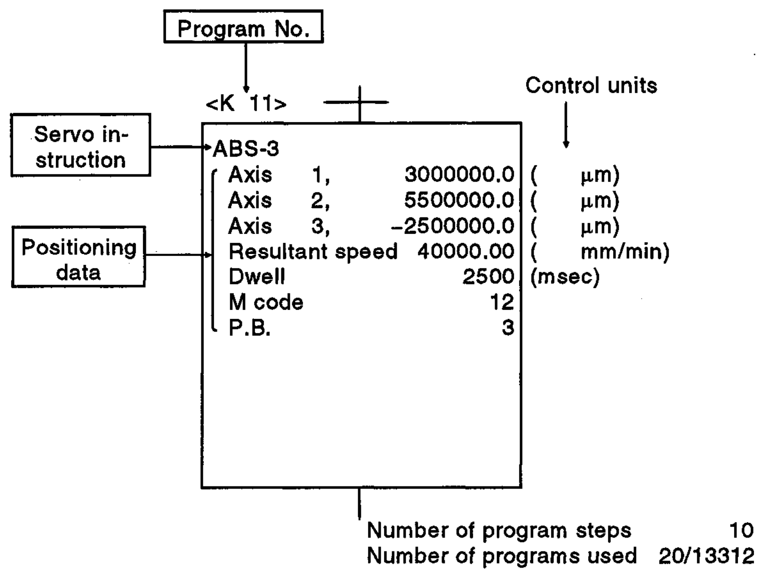
Servo programs serve to designate the type of the positioning control, and the positioning data, required to execute positioning control with the servo system CPU. This section explains the configuration, and method for designating, servo programs.
For details on the various types of servo program, see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

6.1 Servo Program Composition and Area

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

6.1.1 Servo program composition

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



[Explanation of the program]
- K11 .... Program No.11
- ABS-3 ..... 3-axis linear interpolation control using the absolute data method
- Axis 1, 3000000.0 / Axis 2, 5500000.0 / Axis 3, -2500000.0 — Used axes and positioning address

Used Axes	Positioning Address
1	3000000.0 μm
2	5500000.0 μm
3	-2500000.0 μm

- Resultant speed ... Commanded speed for the 3 axes (axis 1, axis 2, axis 3) combined (40000.00 mm/min.)
- Dwell ...... Dwell time (2500 ms)
- M code ..... M code (12)
- P.B. .... Parameter block No.3

Fig. 6.1 Example Composition of a Servo Program

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

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

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

• Used axes and positioning address • Commanded speed	Data which must be set in order to execute the servo instruction
• Dwell time • M code	Data which will be set to default values for control if not set.
• P.B. (parameter block)	Control is executed using the data of parameter block 1 (P.B.1).

6.1.2 Servo program area

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

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

<A171SCPU>

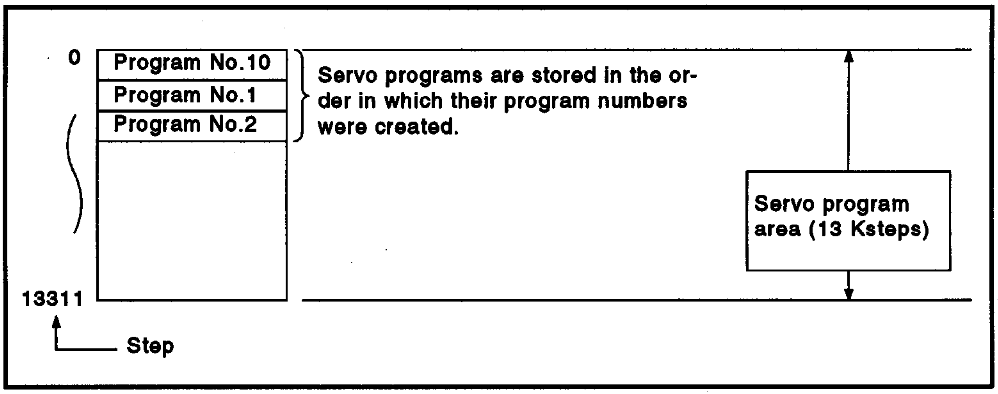


Fig. 6.2 Servo Program Area

POINT

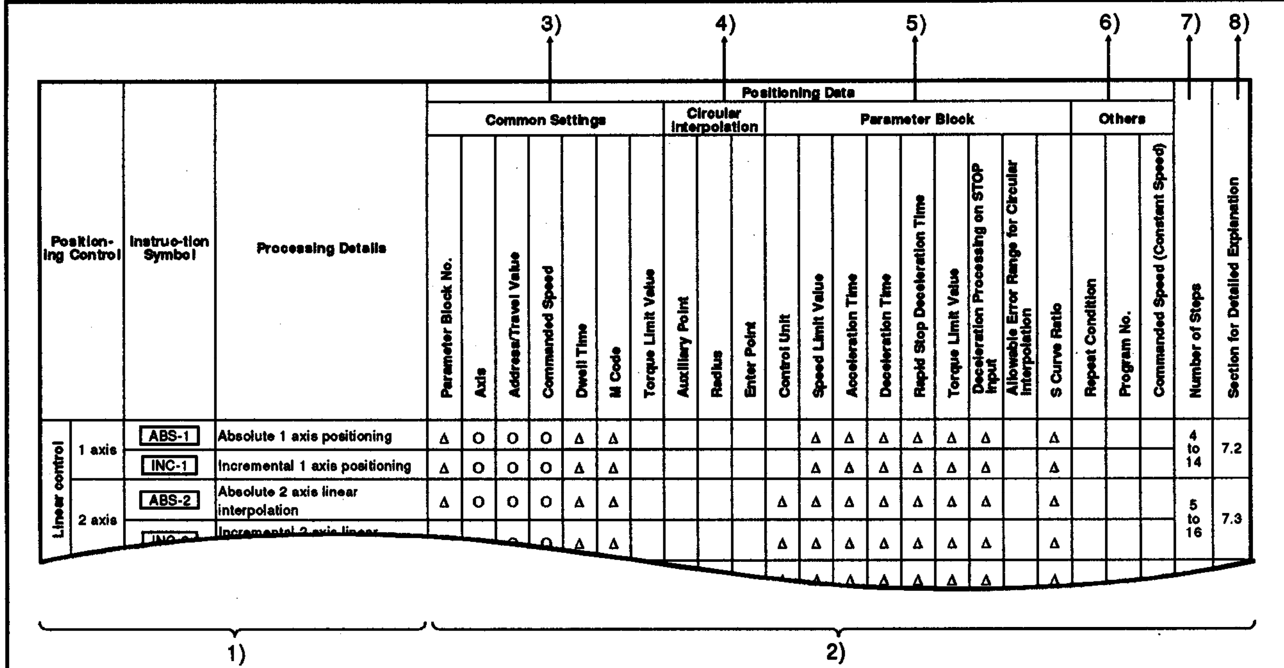
If the servo program area has insufficient capacity, execute multiple positioning control operations with one program by indirect setting of the positioning data used in the servo program. (For details on indirect setting, see Section 6.4.2.)

6.2 Servo Instructions

This section presents the servo instructions used in servo programs.

(1) How to read the servo instruction tables

Fig. 6.1 How to Read Servo Instruction Tables



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

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

Table 6.2 Servo Instruction List

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

O: Must be set
Δ : Set if required

Table 6.2 Servo Instruction List (Continued)

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

O: Must be set
Δ : Set if required

Table 6.2 Servo Instruction List (Continued)

Positioning Control	Instruction Symbol	Processing Details	Positioning Data: Common Settings							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		
Speed switching control	ABS-1	Speed switching control End point address		O	O	O	Δ	Δ	Δ																	Δ	Δ			4 to 7	7.15.1
	ABS-2			O	O	O	Δ	Δ	Δ																	Δ	Δ			5 to 8	
	ABS-3			O	O	O	Δ	Δ	Δ																	Δ	Δ			7 to 10	
	INC-1	Speed switching control Travel value to end point		O	O	O	Δ	Δ	Δ																	Δ	Δ			4 to 7	
	INC-2			O	O	O	Δ	Δ	Δ																	Δ	Δ			5 to 8	
	INC-3			O	O	O	Δ	Δ	Δ																	Δ	Δ			7 to 10	
	VABS	Absolute designation of speed switching point			O	O		Δ	Δ																					4 to 6	
	VINC	Incremental designation of speed switching point			O	O		Δ	Δ																						
Position follow-up control	PFSTART	Position follow-up contrl start	Δ	O	O	O		Δ							Δ	Δ	Δ	Δ	Δ	Δ		Δ				Δ	Δ			4 to 16	7.17
Constant speed control	CPSTART1	1 axis constant speed control start	Δ	O		O									Δ	Δ	Δ	Δ	Δ	Δ		Δ				Δ	Δ		Δ	3 to 14	7.16
	CPSTART2	2 axis constant speed control start	Δ	O		O								Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ				Δ	Δ		Δ		
	CPSTART3	3 axis constant speed control start	Δ	O		O								Δ	Δ	Δ	Δ	Δ	Δ	Δ		Δ				Δ	Δ		Δ	4 to 15	
	CPSTART4	4 axis constant speed control start	Δ	O		O								Δ	Δ	Δ	Δ	Δ	Δ	Δ		Δ				Δ	Δ		Δ		
	ABS-1	Absolute designation of passing point for constant speed control		O	O			Δ	Δ																Δ			Δ		2 to 6	7.16
	ABS-2			O	O			Δ	Δ																Δ			Δ		3 to 7	
	ABS-3			O	O			Δ	Δ																Δ			Δ		4 to 8	
	ABS-4			O	O			Δ	Δ																Δ			Δ		5 to 9	
	ABS ⌒			O	O			Δ	Δ	O															Δ			Δ		5 to 9	
	ABS ↶			O	O			Δ	Δ		O														Δ			Δ		4 to 8	
	ABS ↷			O	O			Δ	Δ		O														Δ			Δ			
	ABS ⤹			O	O			Δ	Δ		O														Δ			Δ			
	ABS ⤸			O	O			Δ	Δ		O														Δ			Δ			
	ABS ↶			O	O			Δ	Δ			O													Δ			Δ		5 to 9	
	ABS ⤹			O	O			Δ	Δ			O													Δ			Δ			
	INC-1	Incremental designation of passing point for constant speed control		O	O			Δ	Δ																Δ			Δ		2 to 6	
	INC-1			O	O			Δ	Δ																Δ			Δ		3 to 7	
	INC-1			O	O			Δ	Δ																Δ			Δ		4 to 8	
	INC-1			O	O			Δ	Δ																Δ			Δ		5 to 9	
	INC ⌒			O	O			Δ	Δ	O															Δ			Δ		5 to 9	
	INC ↶			O	O			Δ	Δ		O														Δ			Δ		4 to 8	
	INC ↷			O	O			Δ	Δ		O														Δ			Δ			
	INC ⤹			O	O			Δ	Δ		O														Δ			Δ			

O: Must be set
Δ : Set if required

Table 6.2 Servo Instruction List (Continued)

Positioning Control	Instruction Symbol	Processing Details	Positioning Data: Common 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	INC	Absolute designation of passing point for constant speed control		O	O			Δ	Δ		O														Δ			Δ		4 to 8	7.16
	INC			O	O			Δ	Δ			O													Δ			Δ		5 to 9	
	INC			O	O			Δ	Δ			O													Δ			Δ			
	CPEND	Ends constant speed control					Δ																							1 to 2	
Repetition of same control (Used for speed switching control, constant speed control)	FOR-TIMES	Set the head step for repetition																					O							2	7.15.2 7.16.1
	FOR-ON																						O								
	FOR-OFF																						O								
	NEXT																													3	
Simultaneous start	START	Simultaneous start																						O						2 to 3	7.18
Home position return	ZERO	Starts home position return		O																										2	7.21
High-speed oscillation	OSC	High-speed oscillation	Δ	O	O	O		Δ											Δ							Δ	Δ			5 to 11	7.22

O: Must be set
Δ : Set if required

6.3 Positioning Data

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

Table 6.3 Positioning Data

Name			Explanation	Default Value	Setting Made With Peripheral Device: Setting Range			
					mm	inch	degree	PLUSE
Common Settings	Parameter block No.		• Sets the parameter block on the basis of which data such as that for acceleration and deceleration processing and deceleration processing on STOP input will be set for each axis.	1	1 to 16 for A171S/A273UHCPU (8 axis specification) 1 to 64 for A273UHCPU (32 axis specification)			
Common Settings	Axis		• Set the axis to be started. • For interpolation, the numbers of the axes involved in the interpolation are designated.	—	1 to 4 for A171SCPU 1 to 8 for A273UHCPU (8 axis specification) 1 to 32 for A273UHCPU (32 axis specification)			
Common Settings / Address/travel value	Absolute data method	Address	Set the positioning address as an absolute address when using the absolute data method as the positioning method.	—	-214748364.8 to 214748364.7 (μm)	-21474.83648 to 21474.83647	0 to 359.99999	-2147483648 to 2147483647
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)	0 to 21474.83647	0 to 21474.83647	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 600000.000 (degree/min)	1 to 1000000 (PLS/sec)
Common Settings	Dwell time		• Set the time from positioning to the positioning address to output of the positioning completion signal (M1601+20n/Xn1/M2401+20n).	0 (ms)	0 to 5000 (ms)			
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	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	Auxiliary point	Incremental method			0 to 2147483647			
Circular Interpolation	Radius	Absolute data method	• Set when executing circular interpolation by designating a radius.	—	0.1 to 429496729.4 (μm)	0.00001 to 42949.67294	0 to 359.99999	1 to 4294967294
Circular Interpolation	Radius	Incremental method	• The setting ranges, which depend on the positioning method used, are shown to the right.		0.1 to 214748364.7 (μm)	0.00001 to 21474.83647	0.00001 to 21474.83647	1 to 2147483647
Circular Interpolation	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	Center point	Incremental method			0 to 2147483647			
Circular Interpolation	Number of pitches		• Set when performing helical interpolation	—	0 to 999			

Settings Made Using the Sequence Program (Indirect Setting)					Indirect Setting		Processing in Event of Setting Error		
Default Value	Setting Range				Possible/Not Possible	Number of Words Used	*4 Error Item Data (Stored in D9190)	Control Using Default Value	Starting not Possible
	mm	inch	degree	PLUSE					
1	1 to 16 for A171S/A273UHCPU (8 axis specification) 1 to 64 for A273UHCPU (32 axis specification)				O	1	1	O	
—	—				X	—	—		
—	-2147483648 to 2147483647 (x10^{-1}µm)	-2147483648 to 2147483647 (x10^{-5}inch)	0 to 35999999 (x10^{-5}degree)	-2147483648 to 2147483647	O	2	n03 *1		O
—	For other than speed/position switching control								
	0 to 2147483647								
	For speed/position switching control								
	0 to 2147483647 (x10^{-1}µm)	0 to 2147483647 (x10^{-5}inch)	0 to 2147483647 (x10^{-5}degree)	0 to 2147483647			—		
—	1 to 600000000 (x10^{-2}mm/min)	1 to 600000000 (x10^{-3}inch/min)	1 to 600000000 (x10^{-3}degree/min)	1 to 1000000 (PLS/sec)	O	2	4	O *2	O *3
0 (ms)	0 to 5000 (ms)				O	1	5	O	
0	0 to 255				O	1	6	O	
Torque limit setting (%) in the parameter block	1 to 500 (%)				O	1	7	O	
—	-2147483648 to 2147483647 (x10^{-1}µm)	-2147483648 to 2147483647 (x10^{-5}inch)	0 to 35999999 (x10^{-5}degree)	-2147483648 to 2147483647	O	2 x 2	n08 *1		
	0 to 2147483647								
—	1 to 4294967294 (x10^{-1}µm)	1 to 4294967294 (x10^{-5}inch)	0 to 35999999 (x10^{-5}degree)	1 to 4294967294	O	2	n09 *1		O
	1 to 2147483647 (x10^{-1}µm)	1 to 2147483647 (x10^{-5}inch)	1 to 2147483647 (x10^{-5}degree)	1 to 2147483647					
—	-2147483648 to 2147483647 (x10^{-1}µm)	-2147483648 to 2147483647 (x10^{-5}inch)	0 to 35999999 (x10^{-5}degree)	-2147483648 to 2147483647	O	2 x 2	n10 *1		
	0 to 2147483647								
—	0 to 999				O	1	28		

REMARKS

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

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

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

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

Table 6.3 Positioning Data (Continued)

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

Settings Made Using the Sequence Program (Indirect Setting)					Indirect Setting		Processing in Event of Setting Error		
Default Value	Setting Range				Possible/Not Possible	Number of Words Used	*4 Error Item Data (Stored in D9190)	Control Using Default Value	Starting not Possible
	mm	inch	degree	PLUSE					
3	0	1	2	3	o	1	11		
200.000 (PLS/sec)	1 to 600000000 (x10^-2mm/min)	1 to 600000000 (x10^-3inch/min)	1 to 600000000 (x10^-3degree/min)	1 to 1000000 (PLS/sec)	o	2	12		
1000 (ms)	1 to 65535 (ms)				o	1	13		
1000 (ms)	1 to 65535 (ms)				o	1	14		
1000 (sm)	1 to 65535 (ms)				o	1	15	o	
0 (%)	1 to 100 (%)				o	2	21		
300 (%)	1 to 500 (%)				o	1	16		
0	0: Deceleration to a stop in accordance with the deceleration time 1: Deceleration to a stop in accordance with the rapid stop deceleration time				o	1	—		
100 (PLS)	0 to 100000				o	2	17		
—	1 to 32767				o	—	18	Controlled by K1	
—	0 to 4095				o	—	19		o
—	1 to 600000000 (x10^-2mm/min)	1 to 600000000 (x10^-3inch/min)	1 to 600000000 (x10^-3degree/min)	1 to 1000000 (PLS/sec)	o	2	4	o *2	o *3
—	—				—	—	—		
—	0 to 4095				o	1	—		
—	—				—	—	—		
—	1 to 5000(ms)				o	1	13	o	

REMARKS

*2: When an error occurs because the speed limit value is exceeded, control is executed at the speed limit value.
*3: Applies when the commanded speed is "0".
*4: If there are multiple errors in the same program, the latest error item data is stored.

6.4 Method for Setting Positioning Data

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

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

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

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

6.4.1 Setting by designating numerical values

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

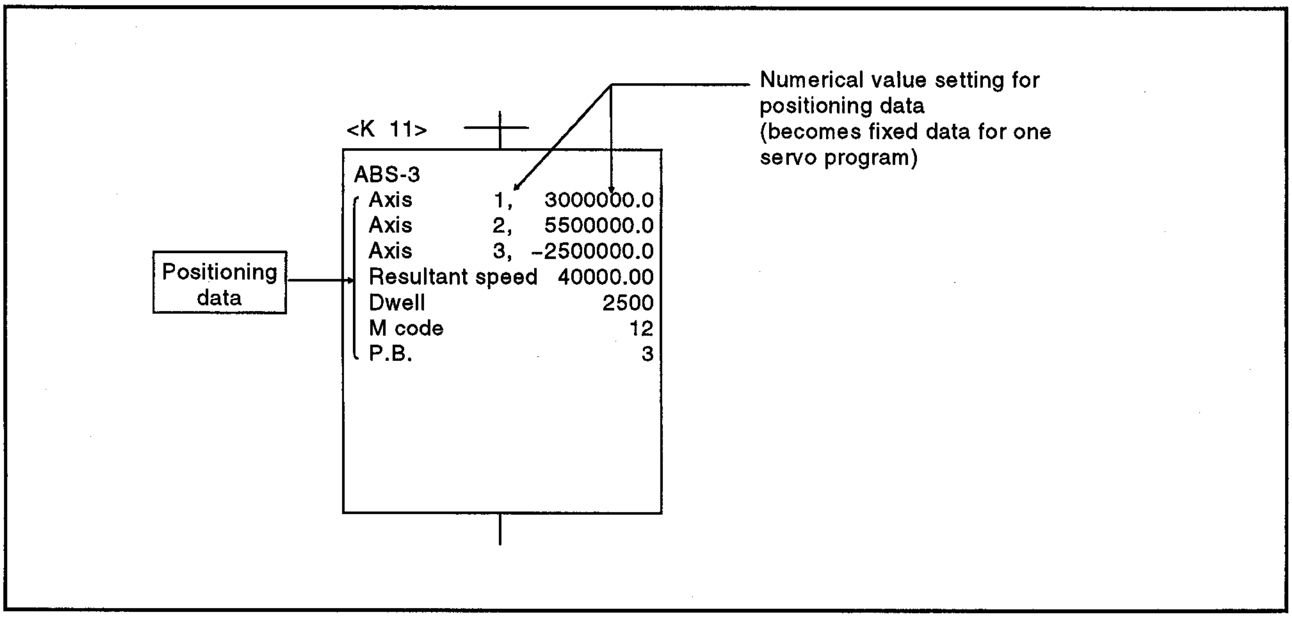


Fig.6.3 Example of Setting Positioning Data by Numerical Value Setting

6.4.2 Setting by using word devices (D, W)

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

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

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

*1: Excluding 800 to 1023

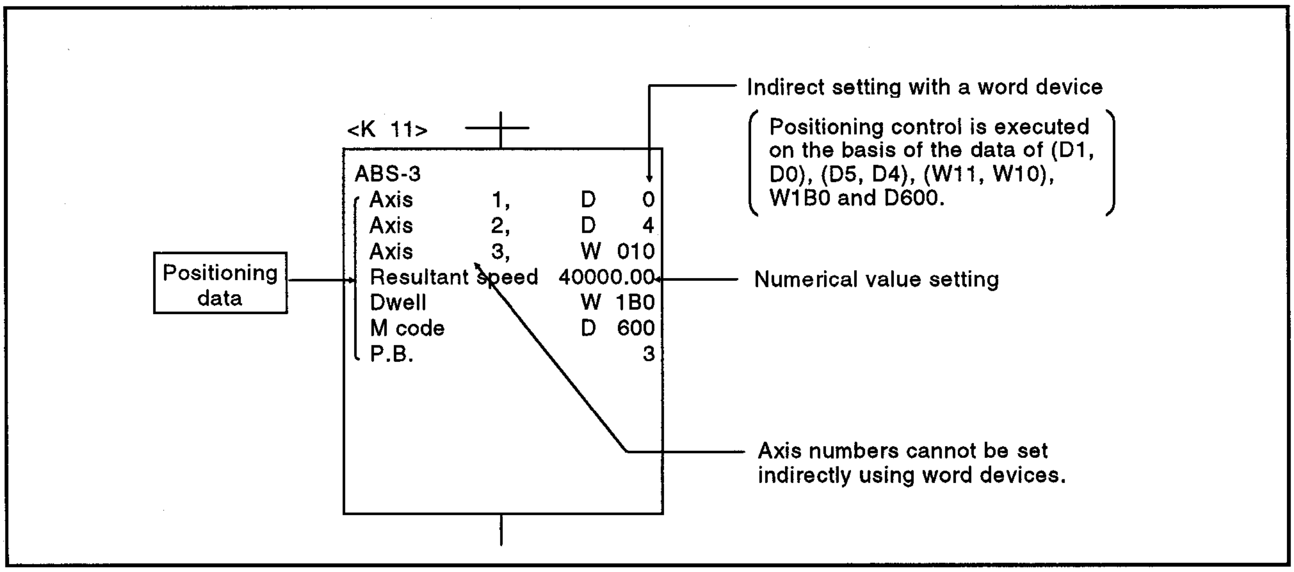


Fig.6.3 Example of Setting Positioning Data by Numerical Value Setting

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

POINTS

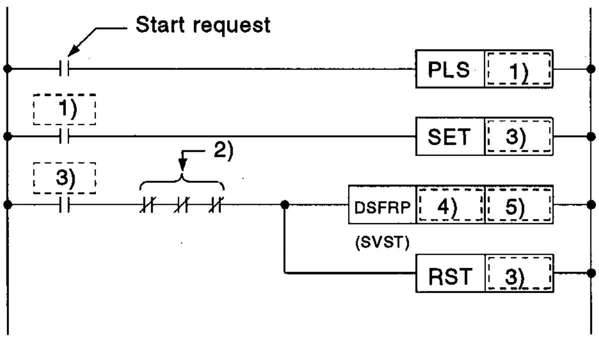
(1) It is not possible to indirectly set axis numbers using word devices with a servo program.
(2) Establish an interlock by using a start accept signal (M2001 to M2004/M2001 to M2008/M2001 to M2032) to ensure that the device data designated for indirect setting is not changed until the designated axis has accepted the start command .
If the data is changed before the start command is accepted, positioning control in accordance

6.5 Creating Sequence Programs to Start Servo Programs

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

6.5.1 Case where the servo program is executed once only

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



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

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

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

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

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

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

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

4): Axis No. designated in the servo program

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

Example

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

(1) Condition

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

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

(2) Sequence program example

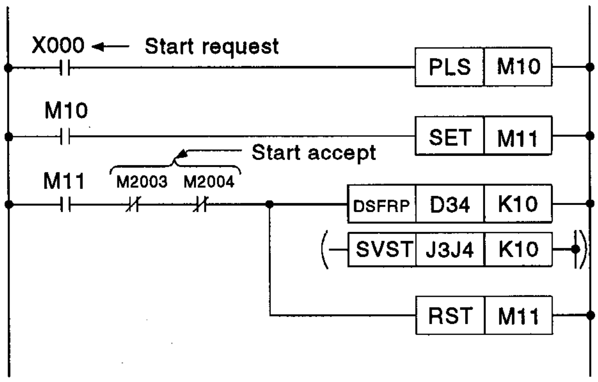
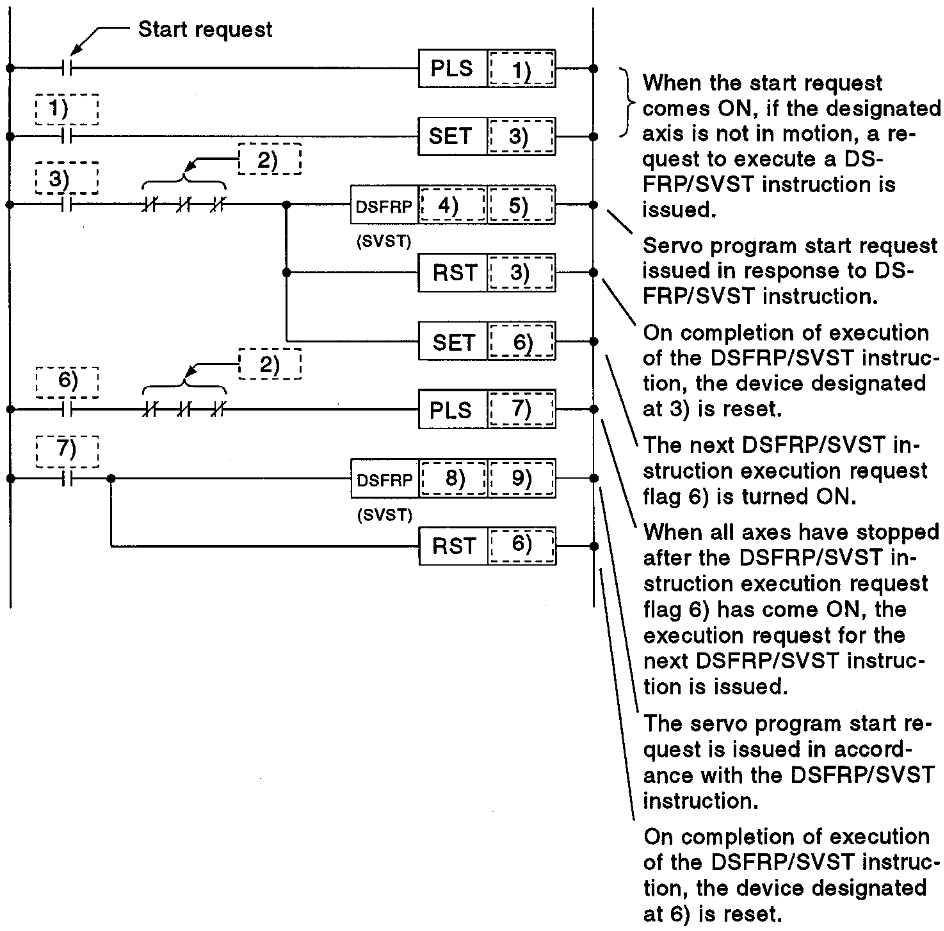


Fig. 6.5 Sequence Program for Starting a Servo Program

6.5.2 Case where different servo programs are executed consecutively

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



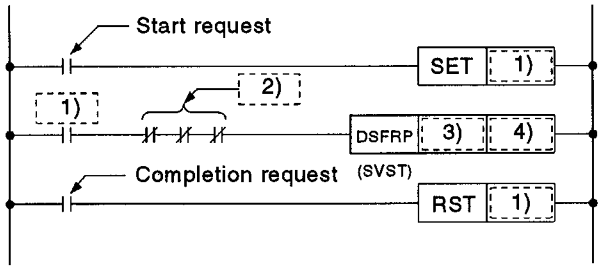
* The applications of 1) to 9) are indicated below.

1):	Start request leading edge detection flag (devices that can be used: Y, M, L, S, B, F)
2):	Start accept flag (set a number of flags corresponding to the number of axes designated in the servo program)
3), 7):	DSFRP/SVST instruction execution request flag (devices that can be used: Y, M, L, S, B, F)
4), 8):	Axis No. designated in the servo program
5), 9):	Started servo program No. (K0 to K4095)
6):	Start request recording flag (Y, M, L, S, B, F)

Fig. 6.6 Sequence Program for Starting Servo Programs

6.5.3 Case where the same servo program is executed repeatedly

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



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

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

When the ##completion request comes ON, the device set at 1) is reset.

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

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

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

3): Axis No. designated in the servo program

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

Fig. 6.7 Sequence Program For Starting a Servo Program

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.

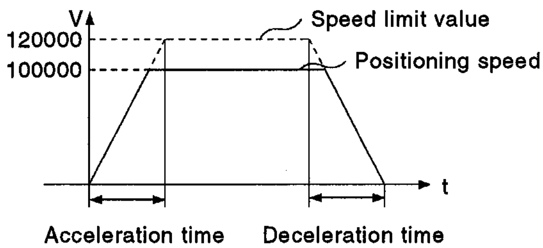
7.1.1 Positioning speed

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

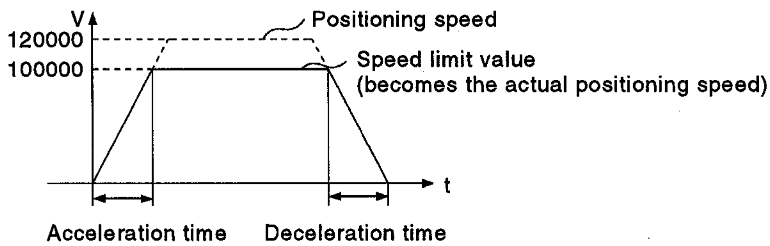
- if positioning speed setting < speed limit value
  positioning occurs at set positioning speed;
- if positioning speed setting > speed limit value
  positioning occurs at speed limit value.

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

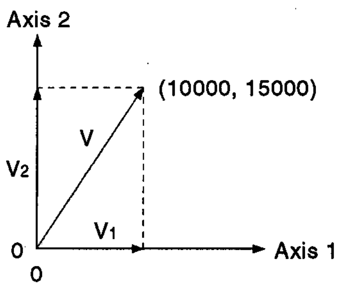
(2) Linear interpolation control
Under linear interpolation control, the controlled system is controlled at the set speed.
The positioning speed can be set for 2- to 4-axis control using one of the following three methods:
- resultant speed designation
- long-axis speed designation
- reference-axis speed 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 resultant speed.
Set the resultant speed and the travel value of each axis in the servo program.

Example

2-axis linear interpolation control



Axis 1 travel value:
D_1 = 10,000 (pulses)
Axis 2 travel value:
D_2 = 15,000 (pulses)
Resultant speed:
V = 7,000 (pulse/sec.)

[Program Example]

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

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-axis linear interpolation control

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

[Program Example]

<K 51>

ABS-4			
Axis	1,	10000	(PLS)
Axis	2,	15000	(PLS)
Axis	3,	5000	(PLS)
Axis	4,	20000	(PLS)
Long-axis speed		7000	(PLS/sec)

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 axes 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 axes 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 pulses.
   - 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 axes where interpolation control units and control units match, the electronic gear converts the positioning speed to units of pulse/sec. 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 resultant speed may exceed the speed limit value if long-axis speed designation is used.

Example

During 2-axis linear interpolation with the following settings, the resultant speed exceeds the speed limit value.

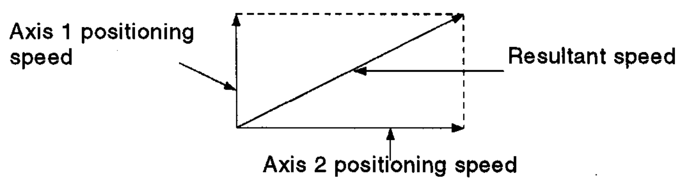
Axis 1 travel value: 100 pulses
Axis 2 travel value: 200 pulses
Long-axis speed: 50 pulse/sec.
Speed limit value: 55 pulse/sec.

[Program Example]

```
<K  2>
INC-2
  Axis        1,      100  (PLS)
  Axis        2,      200  (PLS)
  Long-axis speed      50  (PLS/sec)
```

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 resultant speed are as follows:

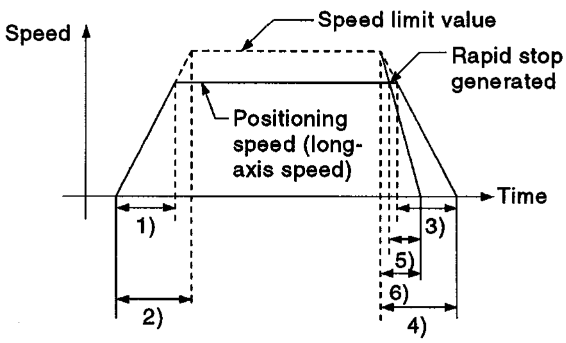
Axis 1 positioning speed: $(100/200) \times 50 = 25$ pulse/sec.
Axis 2 positioning speed: 50 pulse/sec.
Resultant speed: $\sqrt{25^2 + 50^2} = 55.9$ pulse/sec.



The resultant 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 actual acceleration time, deceleration time, and rapid stop deceleration time are determined by the long-axis speed setting.



1) Actual acceleration time
2) Set acceleration time
3) Actual deceleration time
4) Set deceleration time
5) Actual rapid stop deceleration time
6) Set rapid stop deceleration time

(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-axis linear interpolation control

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

[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/sec)
  Reference axis number   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:

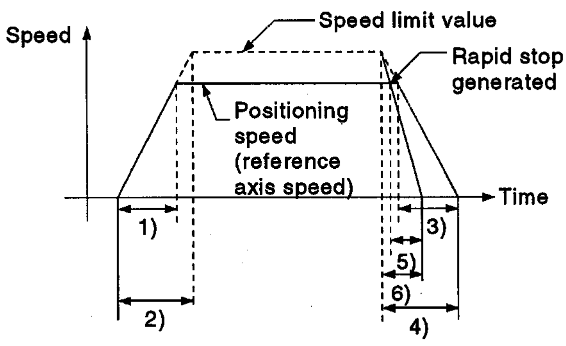
Axis 1 positioning speed: $V_1 = D_1/D_4 \times V$
Axis 2 positioning speed: $V_2 = D_2/D_4 \times V$
Axis 3 positioning speed: $V_3 = D_3/D_4 \times V$

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.

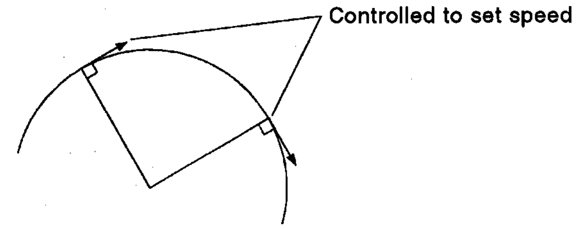
(2) Indirect designation of reference axis
- The reference axis can be indirectly designated using word devices D and W. See Section 6.4.2.

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



1) Actual acceleration time
2) Set acceleration time
3) Actual deceleration time
4) Set deceleration time
5) Actual rapid stop deceleration time
6) Set rapid stop deceleration time

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



7.1.3 Control units for one-axis positioning control

Positioning control of one 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 axes.		Fixed parameters designate degree control units for axes.	Fixed parameters designate pulse control units for axes.	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 axes under interpolation control. • Control started using the control units with the highest order of priority (see below) when control units differ for axes under interpolation control. Order or priority Pulse > degree > inch > mm <Example> If axes are set to 1000 pulses and 10.000 inch, the 10.000 inch setting is considered to be 10,000 pulses.

(2) The possible combinations of control units for interpolation control for the axes are 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 pulses.

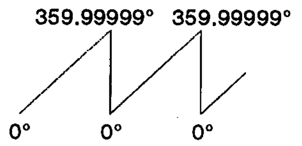
b) For axes where the units match, the electronic gear converts the positioning speed to units of pulse/sec.
Positioning is conducted using position commands calculated from travel values converted to pulses and speeds and electronic gear converted to pulses per second.

- If the interpolation control units match for two or more axes during linear interpolation with three 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

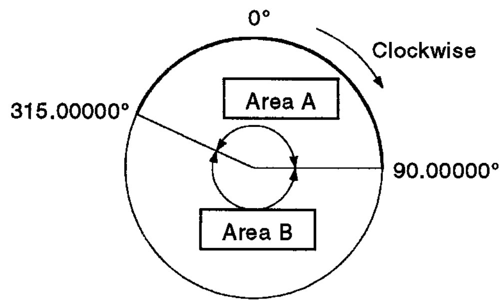
If the control units are degrees, the following items differ from when other control units are set.

(1) Present address
When degrees are set, the present 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
Circular interpolation is not possible for axes set with the stroke limit invalid.

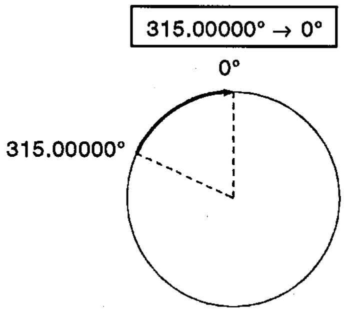
(3) Positioning control
Positioning control using degrees as control units is described below.

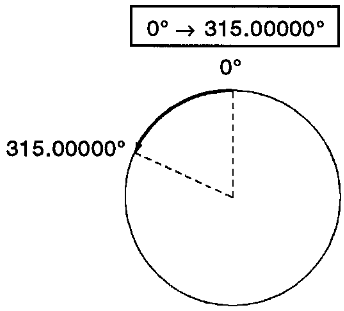
(a) Absolute data method (ABS □ instructions)
The absolute data method uses the present value as reference to position the axis in the shortest distance to the designated address.

Examples

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

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



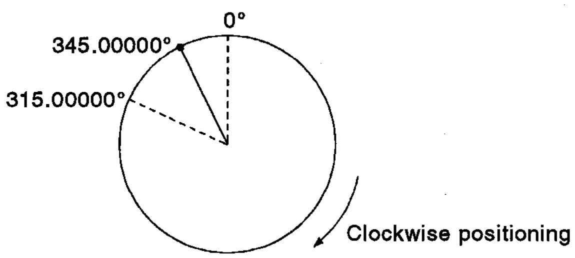


POINTS

(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 present 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

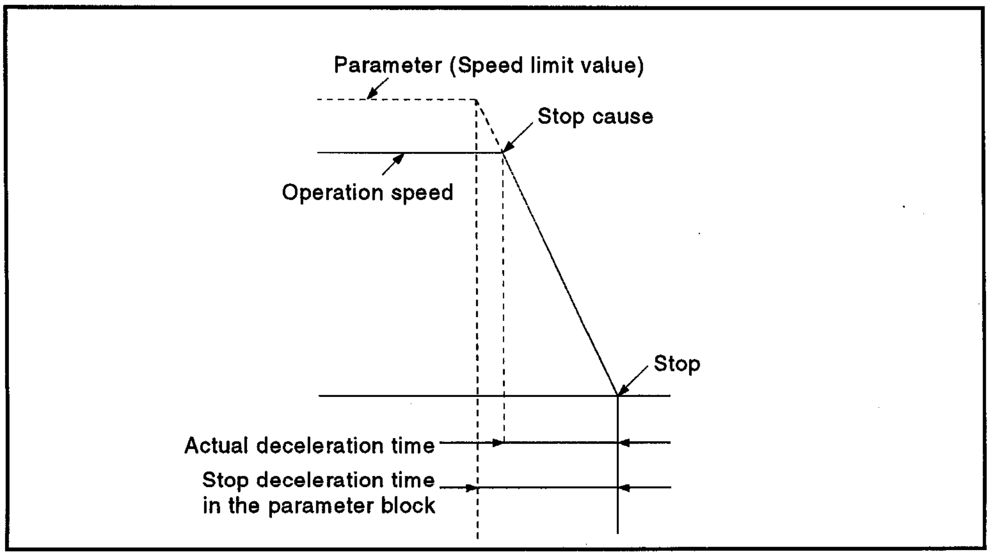
This section describes the stop processing after a stop cause is input during positioning, and restarting after a stop.

(1) Stop processing

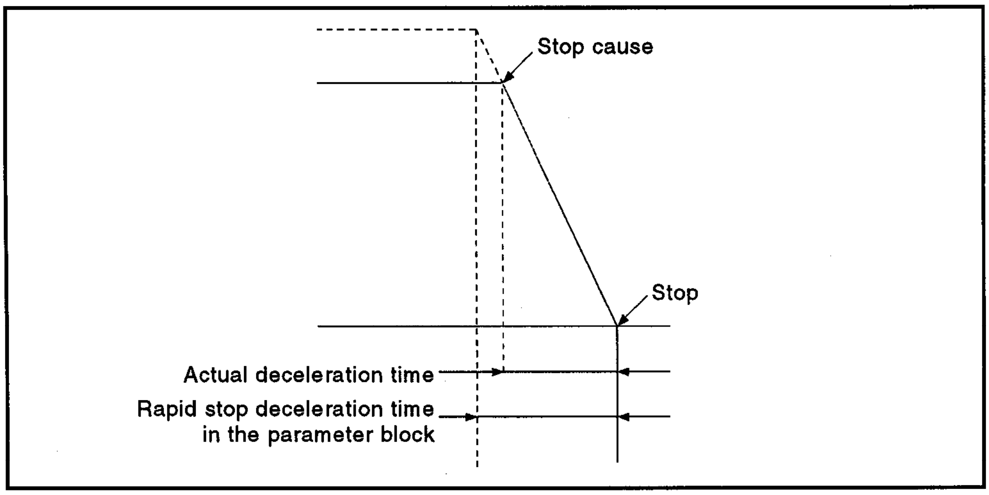
(a) Stop processing methods

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

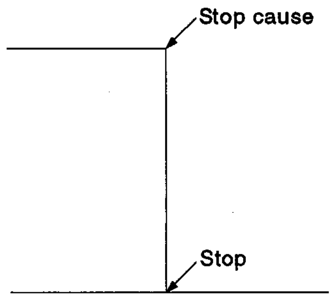
1) Deceleration stop........ Decelerates and stops according to the stop deceleration time parameter in the parameter block.
(Process 1)



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



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

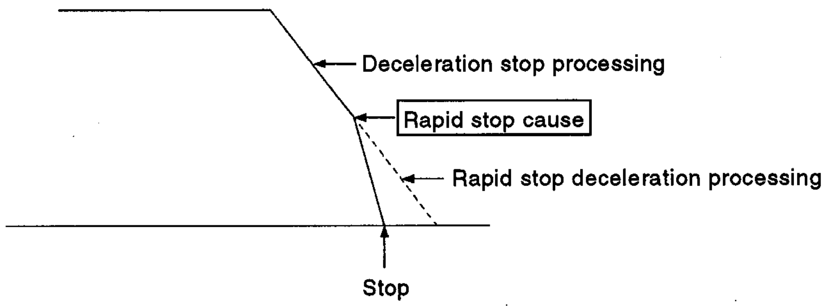


(b) Order of priority for stops
The order of priority for stops when a stop cause is input is as follows:

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 axes and others affect all axes.
However, during interpolation control, stop commands and stop causes which affect individual axes also stop the interpolation axes. 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.

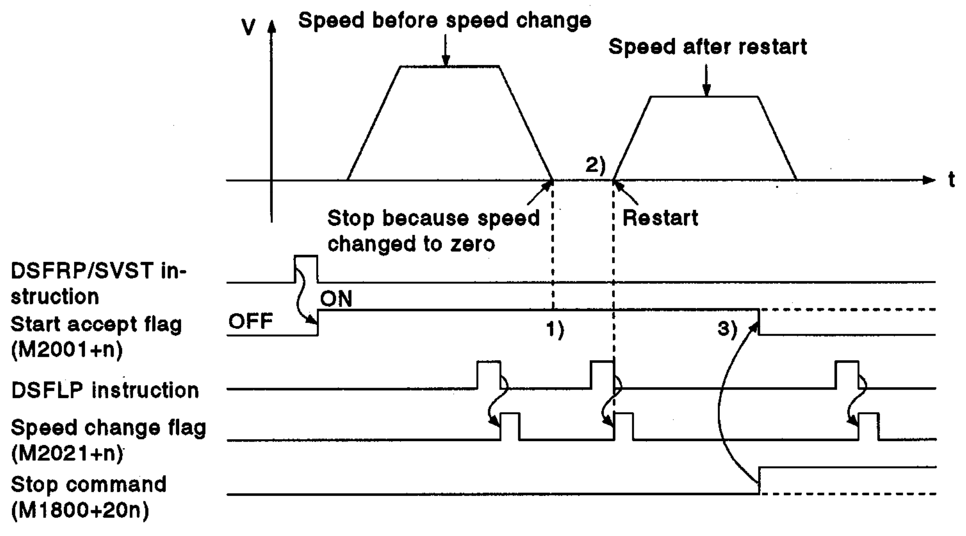
No.	Stop Cause	Individual/ All Axes	Stop					Error Processing
			Positioning Control	Speed Control	Jog Operation	Home Position Return	Manual Pulse Generator	
1	External STOP input ON	Individual	Process 1 or Process 2 (According to deceleration processing on STOP input parameter in parameter block.)				Process 3	Serious error during home position return only
2	Stop command M1800+20n/Yn0/ M3200+20n ON		Process 1					
3	Rapid stop command M1800+20n/Yn1/ M3201+20n ON		Process 2					
4	External FLS input OFF		Process 1 or Process 2 (According to deceleration processing on STOP input parameter in parameter block.)					
5	External RLS input OFF							
6	Servo error detect M1608+20n/Xn8/ M2408+20n ON		Process 3					
7	PC ready M2000 OFF	All	Process 1					
8	Emergency stop from exterior*2, BREAK key pressed		Process 2					
9	Servo system CPU stop		Process 1					
10	Servo system reset		Process 3*1					—
11	PCPU WDT error		Process 3*1					M9073 (WDT error) ON
12	SCPU WDT error		Process 1					—
13	Servo system CPU power off		Process 3*1					—
14	Servo amplifier power off	Individual	Process 3*1					Serious error at start-up (no servo)
15	Speed changed to zero	Individual*3	Process 1					—

*1: Emergency stop due to H/W
*2: Test mode
*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 (M1800+20n) turning ON, or the rapid stop command (M1801+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 DSFLP instruction, operation can be restarted by executing another speed change to a speed other than "0".

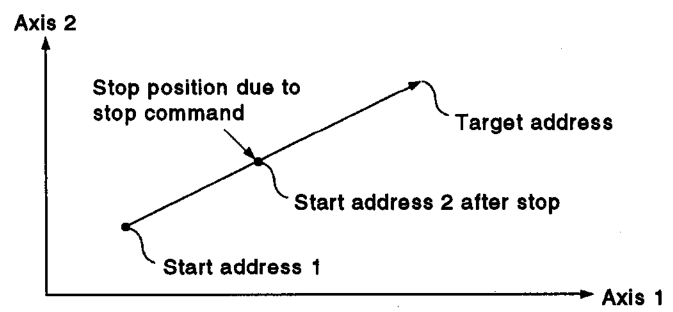


1) The start accept flag M2001+n remains ON after a stop due to changing the speed to zero.
2) Restart after changing the speed again.
3) However, control cannot be restarted after the speed is changed if the start accept flag M2001+n is turned OFF due to the stop command (M1800+20n) turning ON.

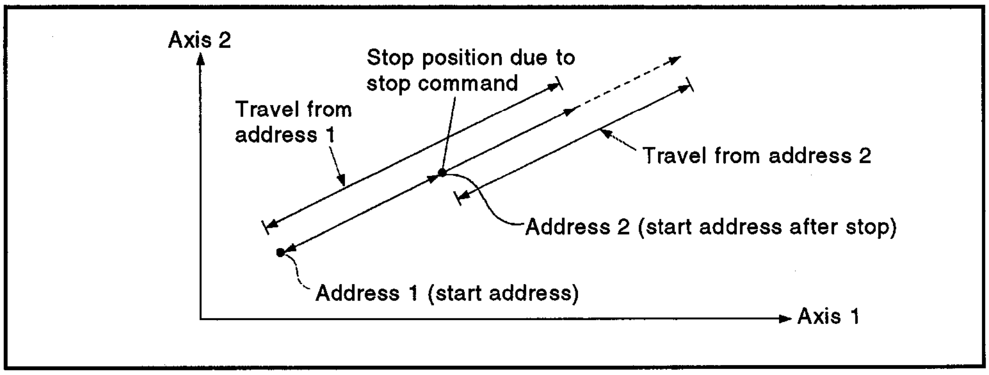
(3) Continuing positioning control
This section describes the method to continue control from the servo program number where the stop was applied by turning ON the external STOP input, the stop command (M1800+20n), or the rapid stop command (M1801+20n).

(a) One-axis linear control/2- or 3-axis 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.

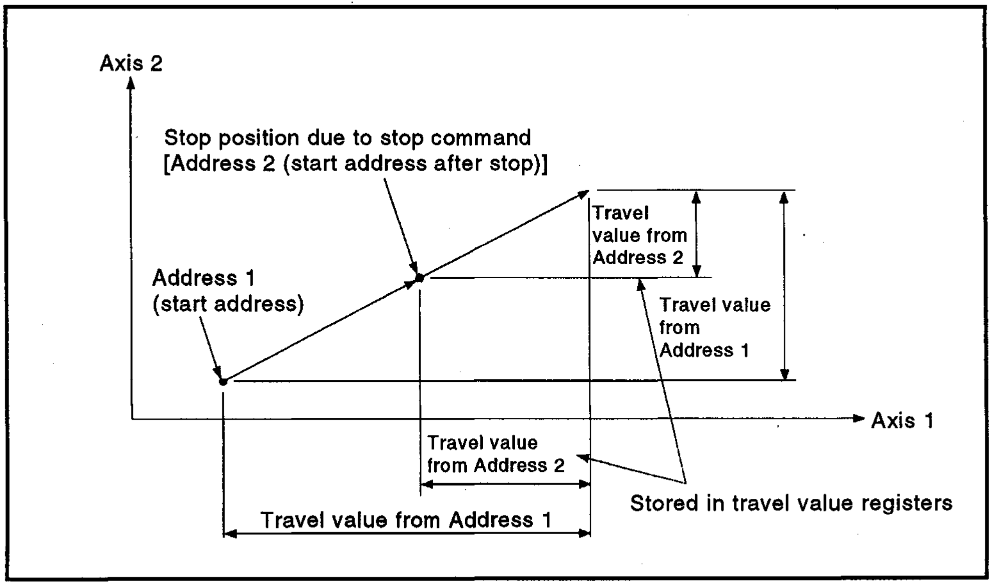
[Servo Program]
Use word devices for indirect designation of the travel value in the positioning control servo program.

```
<K 10>
INC-2
 Axis          1,    D  0
 Axis          2,    D  2
 Resultant speed     5000
```

Travel value

[Processing in the Sequence Program]

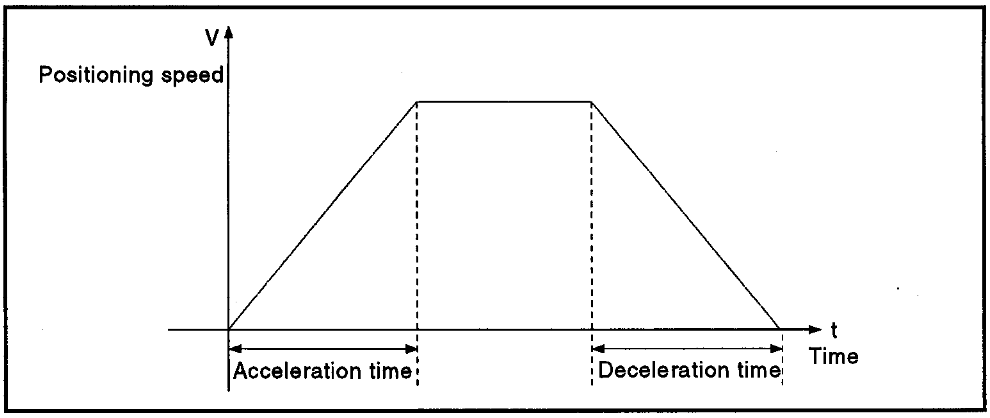
1. Before starting, transfer the start address to the servo system CPU word devices.
2. Add the travel value to the start address to calculate the target address.
3. Subtract the stop address from the target address to calculate the residual travel value.
4. Store the residual travel value in the servo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



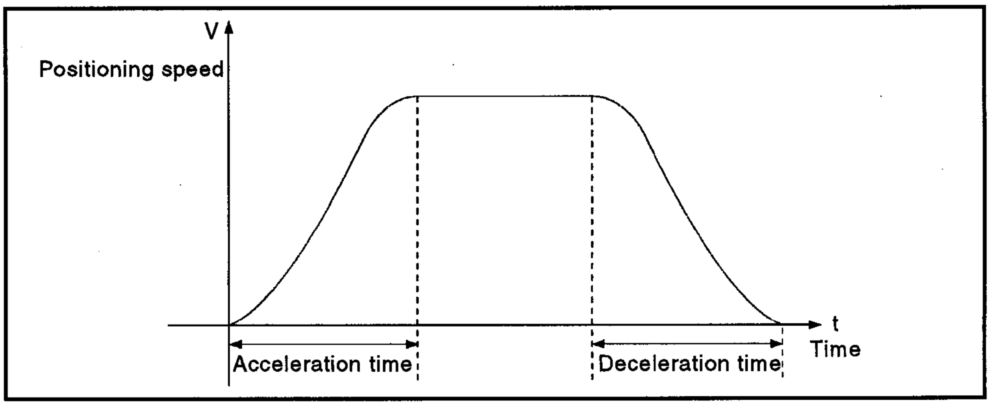
7.1.7 Acceleration and deceleration processing

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

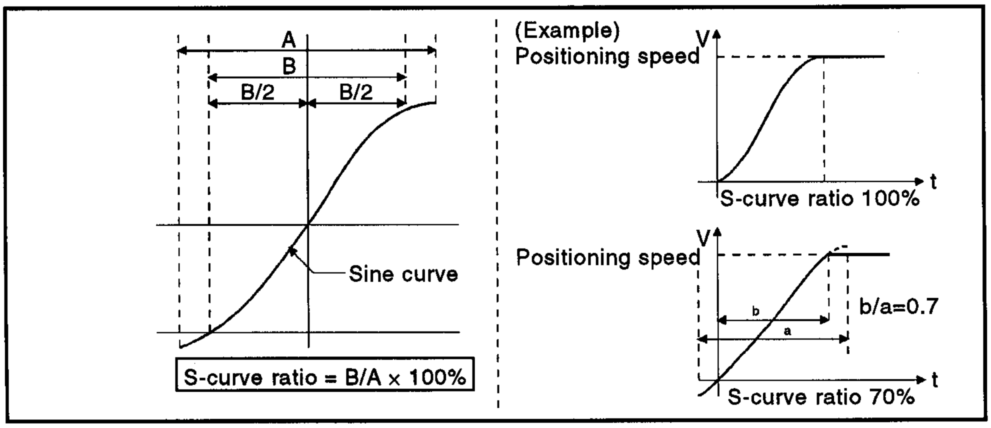
(1) Trapezoidal acceleration and deceleration processing
The conventional linear acceleration and deceleration processing. The acceleration and deceleration graph resembles a trapezoid, as shown in the diagram below.
The acceleration and deceleration times are set automatically.



(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.

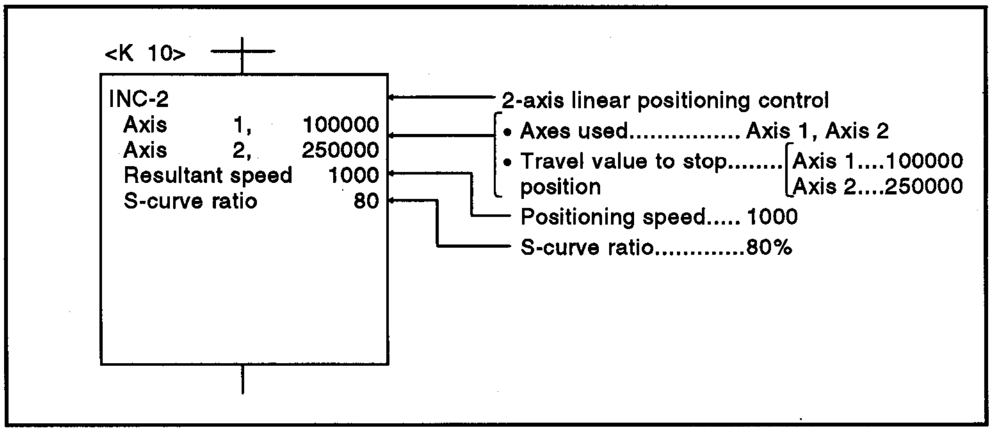


As shown in the diagram below, the S-curve ratio sets the part of the sine curve used to produce the acceleration and deceleration curve.



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

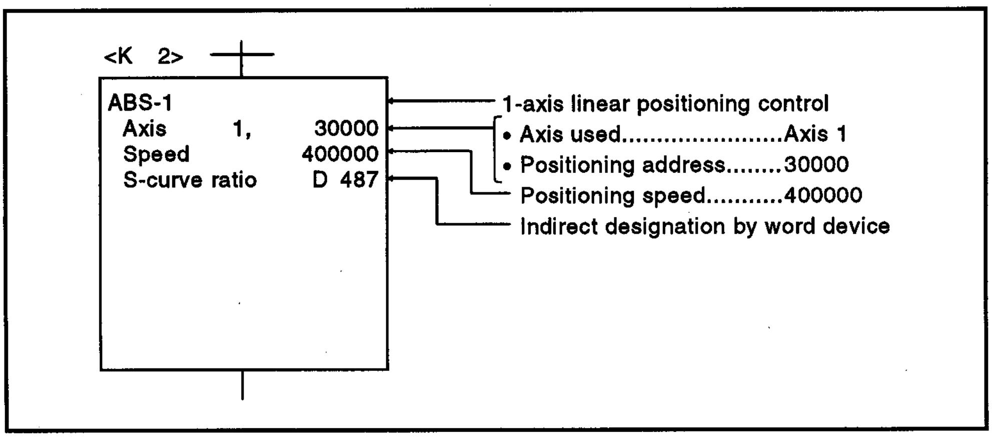
(a) Direct designation
The S-curve ratio is designated directly as a numeric value from 0 to 100.



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

*1: Excluding 800 to 1023



7.2 One-Axis Linear Positioning Control

Positioning control of the designated axis from the present 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																					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	
ABS-1	Absolute data	1	Δ	O	O	O	Δ	Δ						Δ	Δ	Δ	Δ	Δ	Δ		Δ	Δ	Δ	OK
INC-1	Incremental																							

O : Must be set
Δ : Set if required

[Control Details]

Control with ABS-1 (absolute data method).

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

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

Example

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

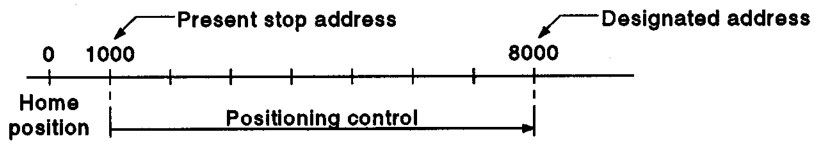


Figure 7.1 Positioning by Absolute Data Method

Control with INC-1 (incremental method)

(1) Positioning control of a designated travel value from the present 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)

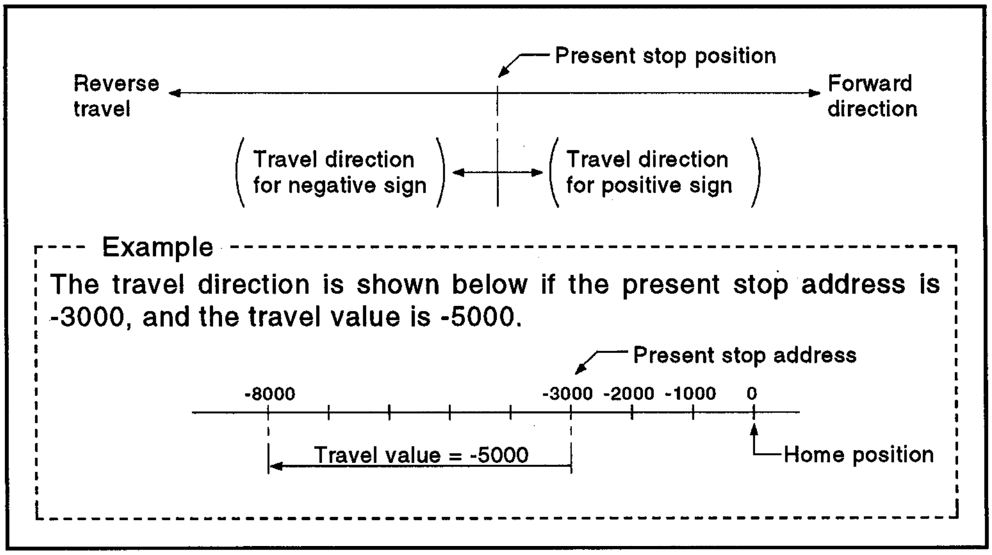
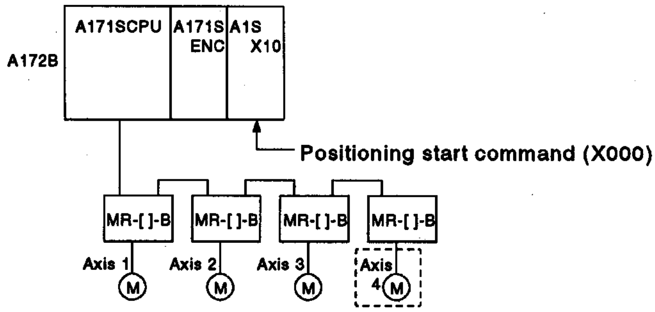


Figure 7.2 Positioning by Incremental Method

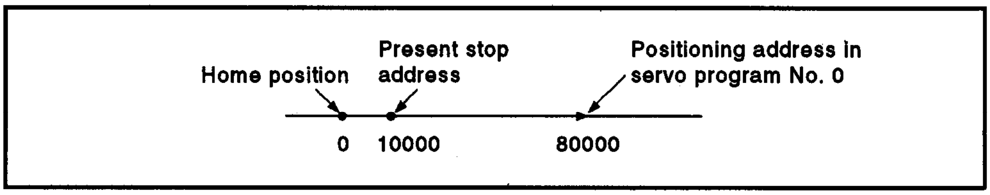
[Program Example]

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

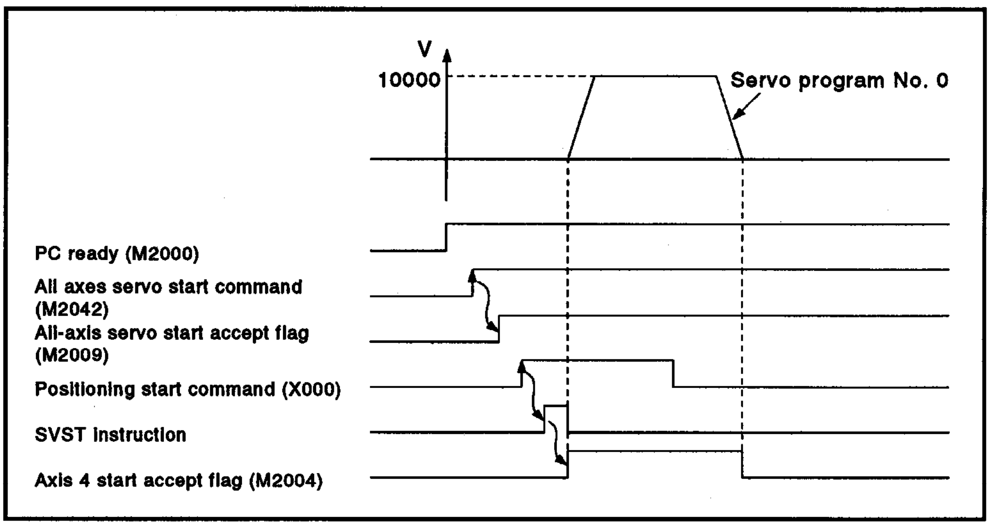
(1) System configuration
One-axis linear positioning control of Axis 4.



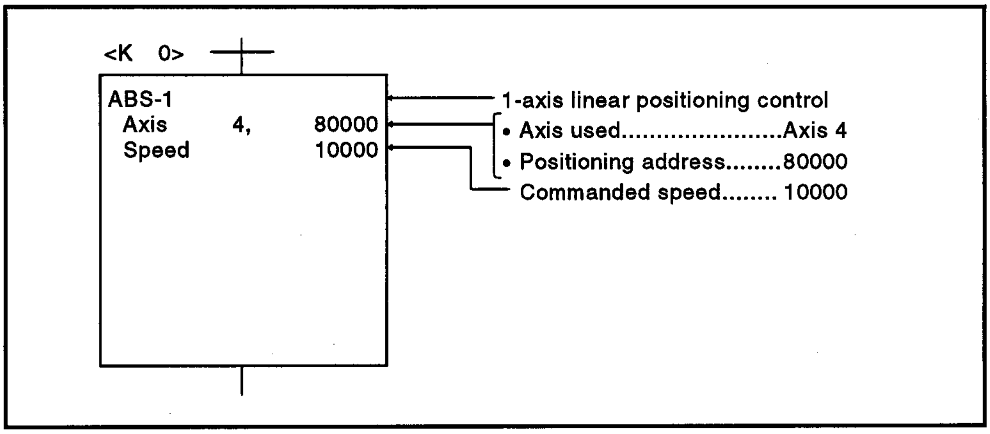
(2) Positioning details
The positioning by servo program No. 0 is shown in the diagram below.
In this example, Axis 4 is used in servo program No. 0 .



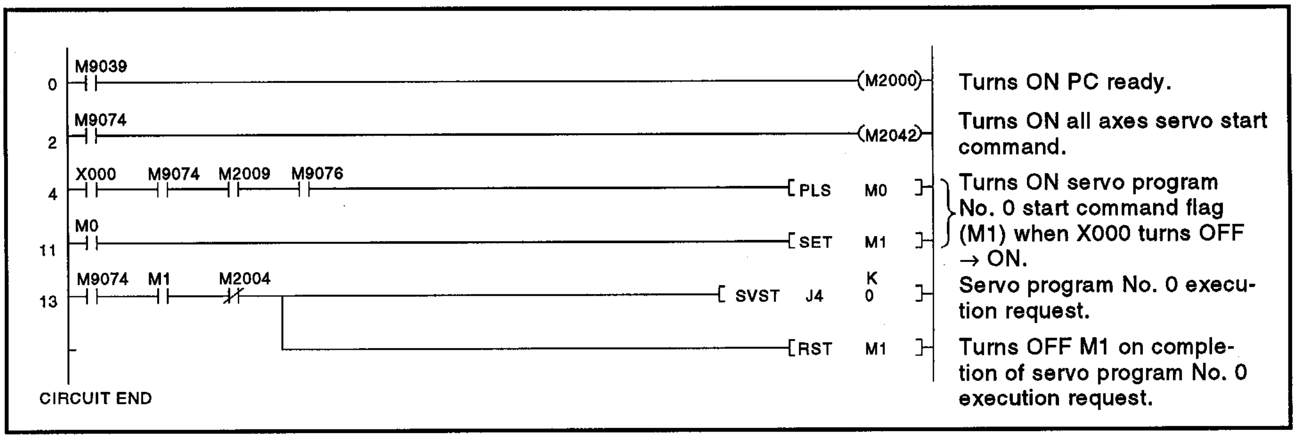
(3) Operation timing
The operation timing for servo program No. 0 is shown below.



(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 Two-Axis Linear Interpolation Control

Linear interpolation control from the present stop position with the two axes designated in the sequence program positioning commands.
Two-axis 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 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-2	Absolute data	2	Δ	O	O	O	Δ	Δ					Δ	Δ	Δ	Δ	Δ	Δ	Δ		Δ	Δ	Δ	OK
INC-2	Incremental																							

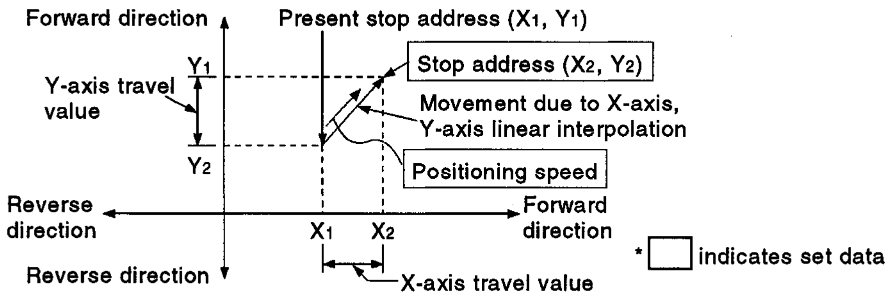
O : Must be set
Δ : Set if required

[Control Details]

Control with ABS-2 (absolute data method)

(1) Linear interpolation with two axes from the present 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 present stop address is (1000, 4000) and the designated stop address is (10000, 2000).

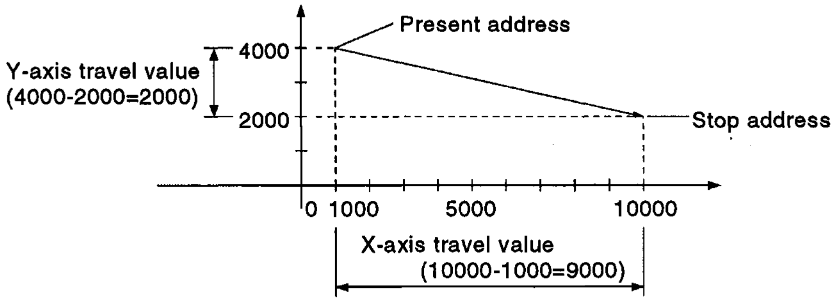
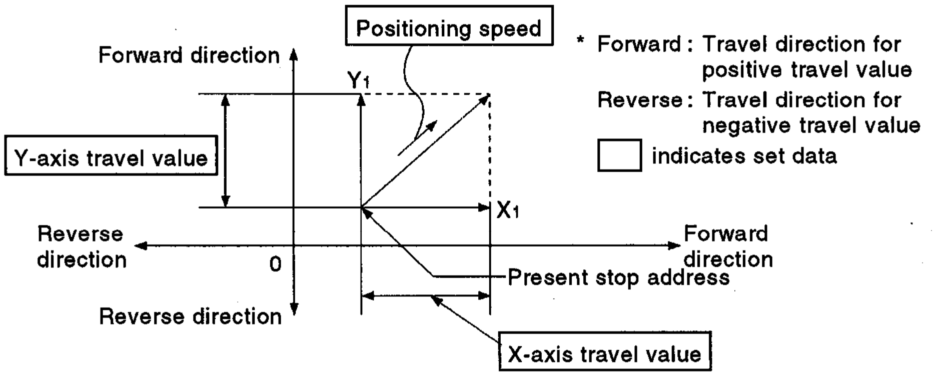


Figure 7.3 Positioning by Absolute Data Method

Control with INC-2 (incremental method)

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

(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.

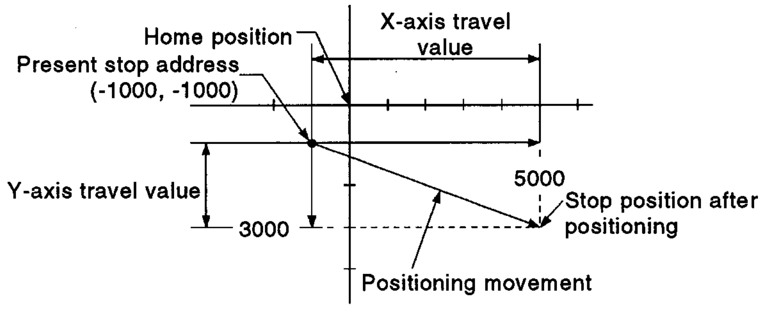
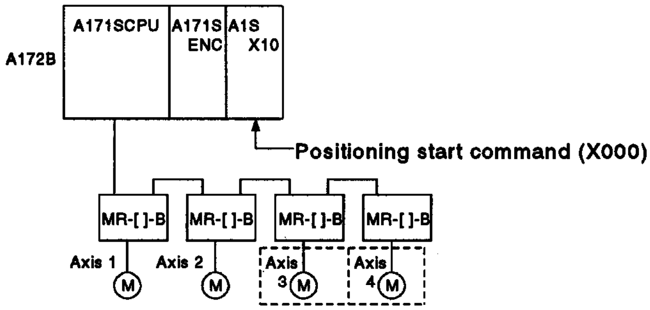


Figure 7.4 Positioning by Incremental Method

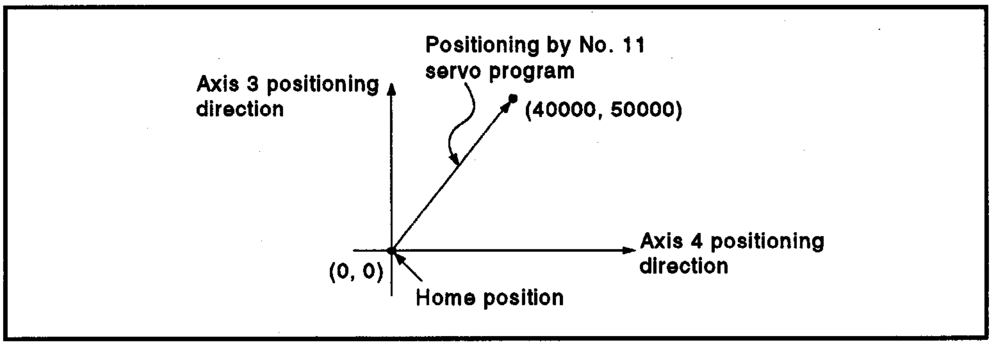
[Program Example]

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

(1) System configuration
Two-axis linear interpolation control of Axis 3 and Axis 4.



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

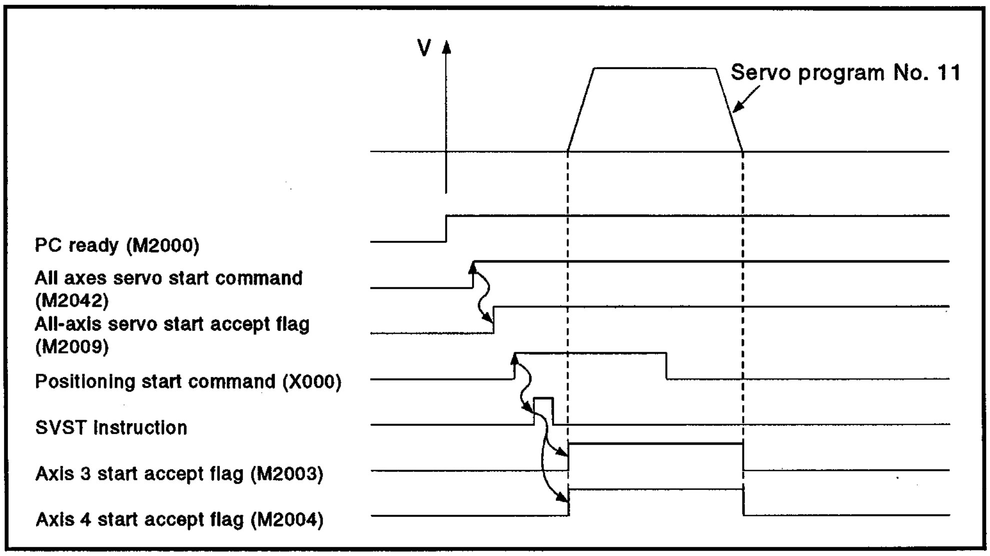


(3) Positioning conditions
(a) The positioning conditions are shown below.

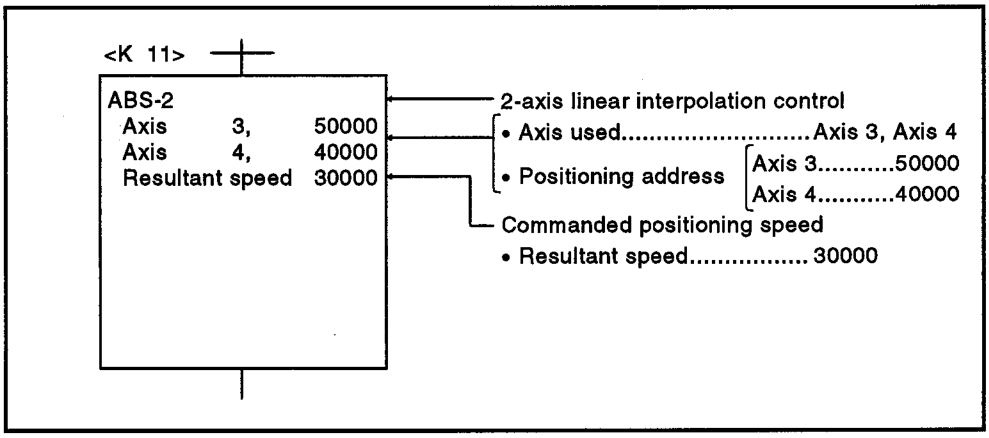
Item	Servo Program Number
	No. 11
Positioning speed	30000

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

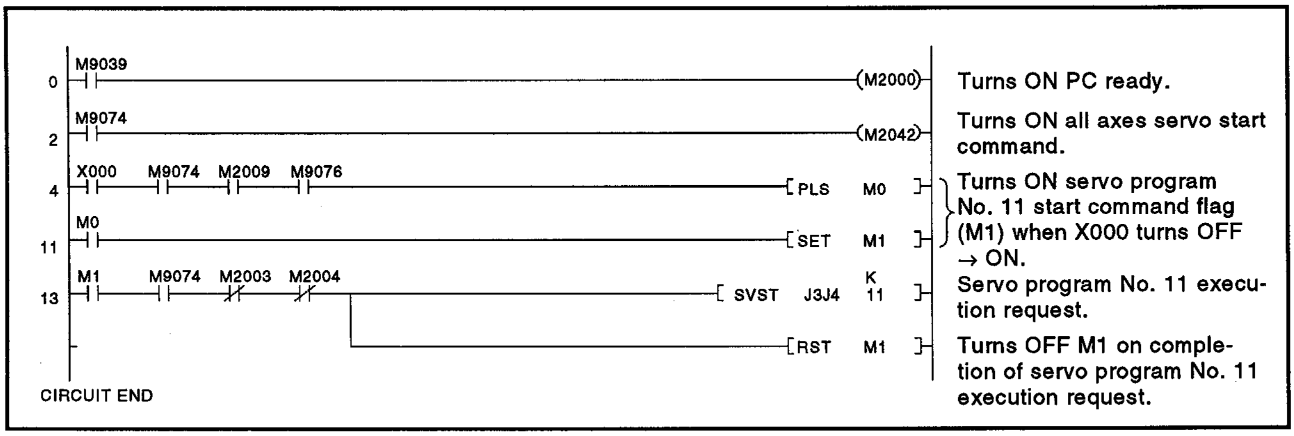
(4) Operation timing
The operation timing for 2-axis linear interpolation control is shown below.



(5) Servo program
The servo program No. 11 for 2-axis linear interpolation control is shown below.



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



7.4 Three-Axis Linear Interpolation Control

Linear interpolation control from the present stop position with the three 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 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-3	Absolute data	3	Δ	O	O	O	Δ	Δ					Δ	Δ	Δ	Δ	Δ	Δ	Δ		Δ	Δ	Δ	OK
INC-3	Incremental																							

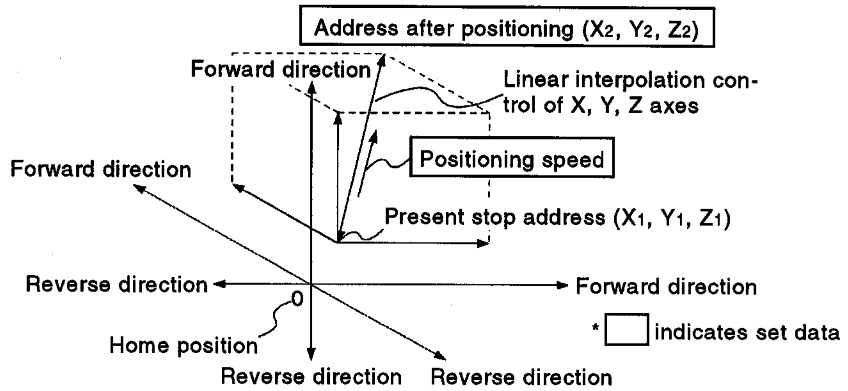
O : Must be set
Δ : Set if required

[Control Details]

Control with ABS-3 (absolute data method)

(1) Linear interpolation with three axes from the present 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 present stop address is (1000, 2000, 1000) and the designated address is (4000, 8000, 4000).

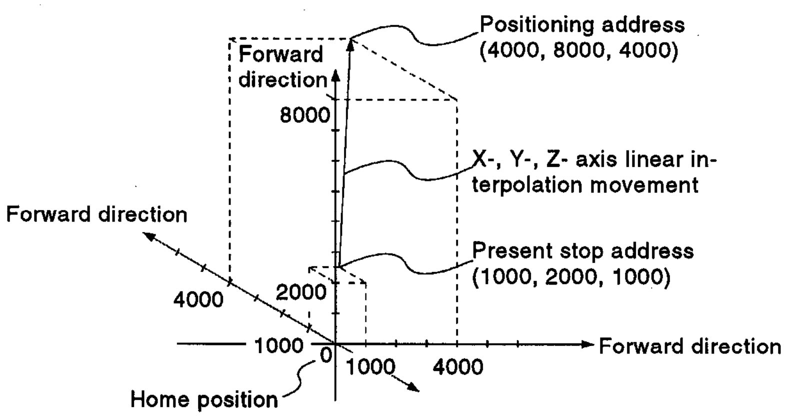
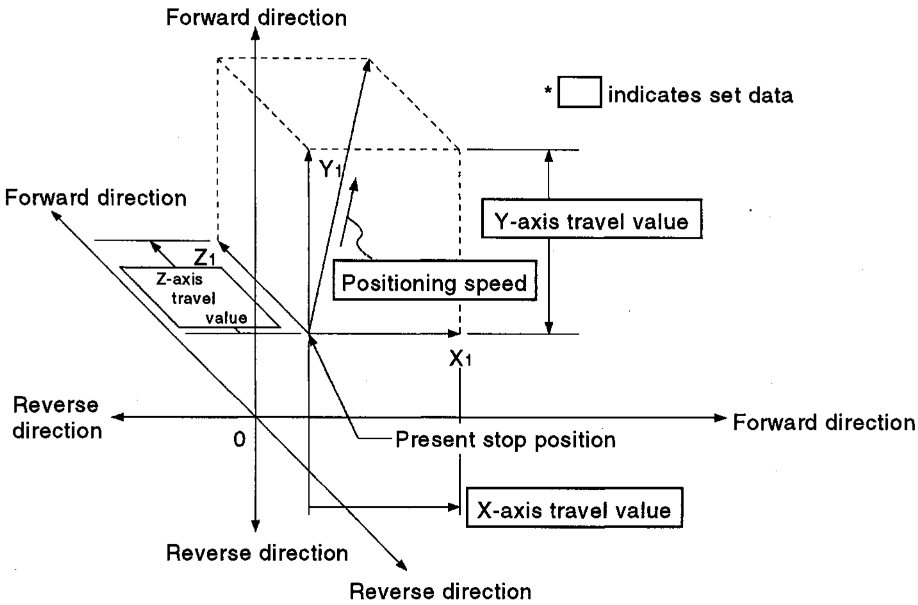


Figure 7.5 Positioning by Absolute Data Method

Control with INC-3 (incremental method)

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

(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.

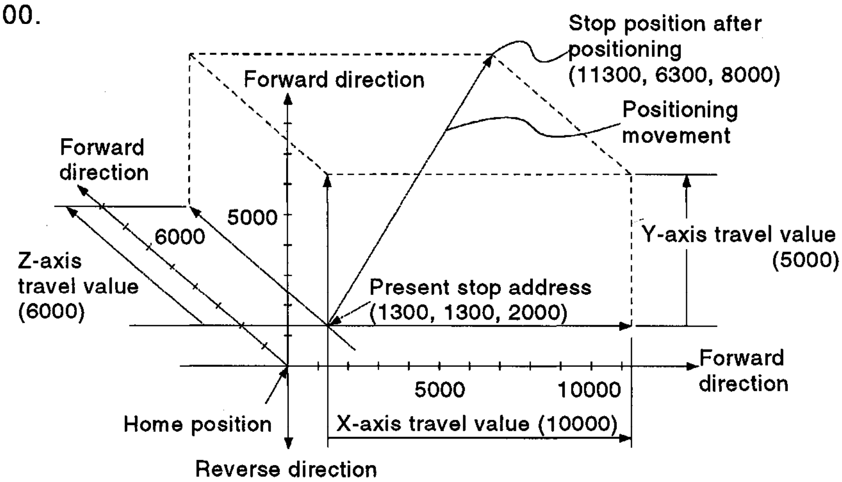
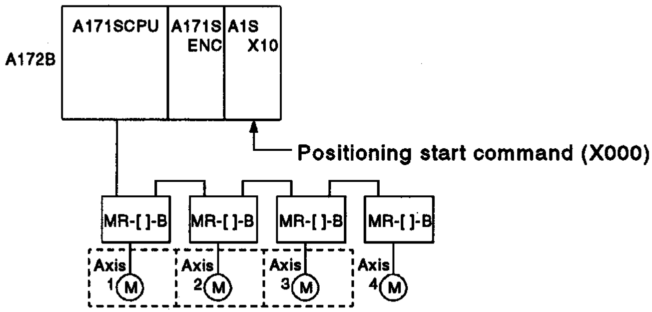


Figure 7.6 Positioning by Incremental Method

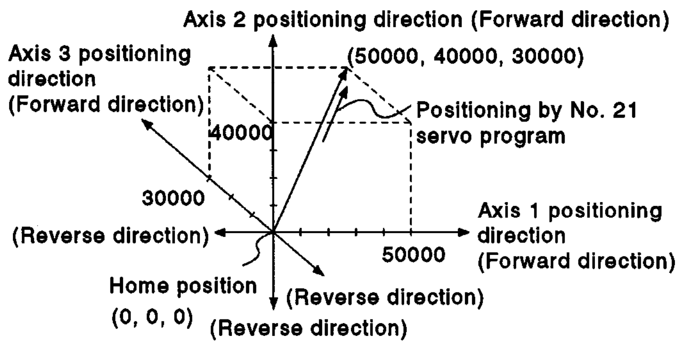
[Program Example]

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

(1) System configuration
Three-axis 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.

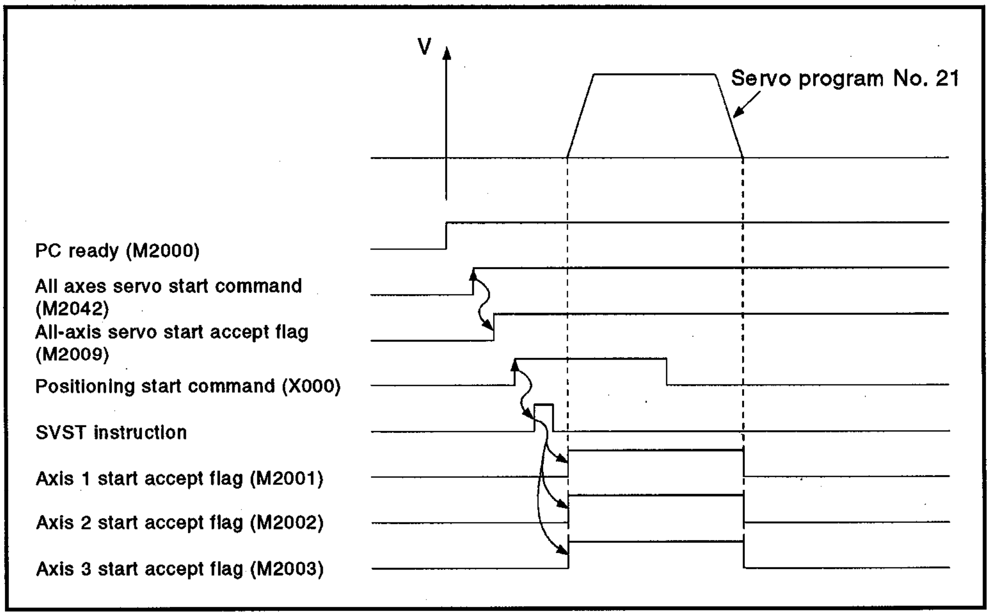


(3) Positioning conditions
(a) The positioning conditions are shown below.

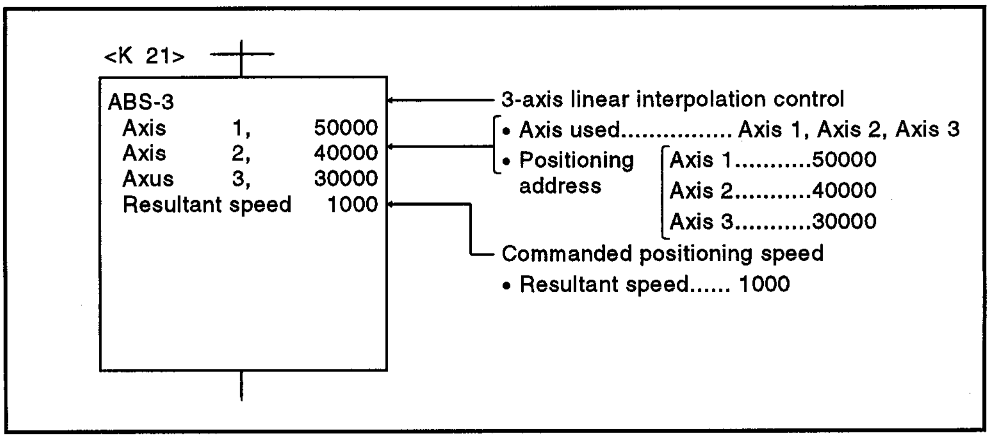
Item	Servo Program Number
	No. 21
Positioning method	Absolute data
Positioning speed	1000

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

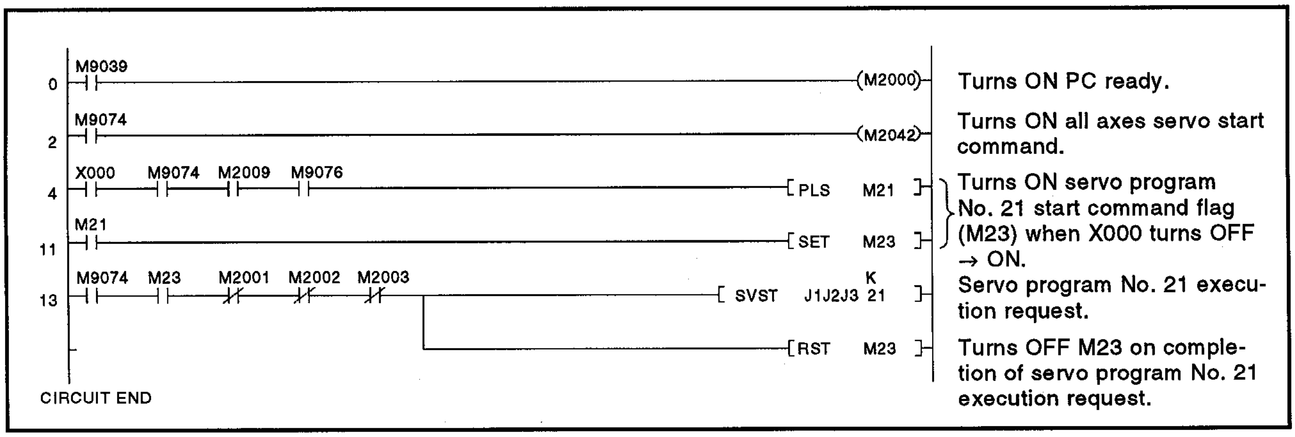
(4) Operation timing
The operation timing for 3-axis linear interpolation control is shown below.



(5) Servo program
The servo program No. 21 for 3-axis linear interpolation control is shown below.



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



7.5 Four-Axis Linear Interpolation Control

Linear interpolation control from the present stop position with the four axes designated in the sequence program positioning commands.

Servo Instruction	Positioning Method	Number of Controllable Axes	Items Set by Peripherals: Common: Parameter Block No.	Common: Axis	Common: Address/Travel Value	Common: Commanded Speed	Common: Dwell Time	Common: M Code	Common: Torque Limit Value	Arc: Auxiliary Point	Arc: Radius	Arc: Center Point	Parameter Block: Control Units	Parameter Block: Speed Limit Value	Parameter Block: Acceleration Time	Parameter Block: Deceleration Time	Parameter Block: Rapid Stop Deceleration Time	Parameter Block: Torque Limit Value	Parameter Block: Deceleration Processing on Stop Input	Parameter Block: Allowable Error Range for Circular Interpolation	Parameter Block: S-Curve Ratio	Others: Cancel	Others: Start	Speed Change
ABS-4	Absolute data	4	Δ	O	O	O	Δ	Δ					Δ	Δ	Δ	Δ	Δ	Δ	Δ		Δ	Δ	Δ	OK
INC-4	Incremental																							

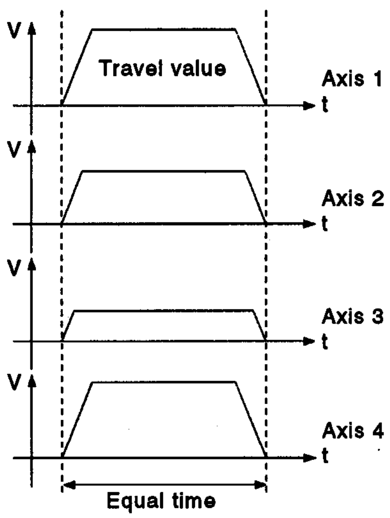
O : Must be set
Δ : Set if required

[Control Details]

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

Example

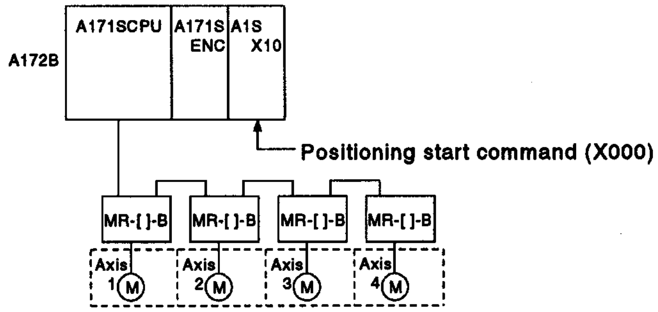
Four-axis linear interpolation



[Program Example]

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

(1) System configuration
Four-axis 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.

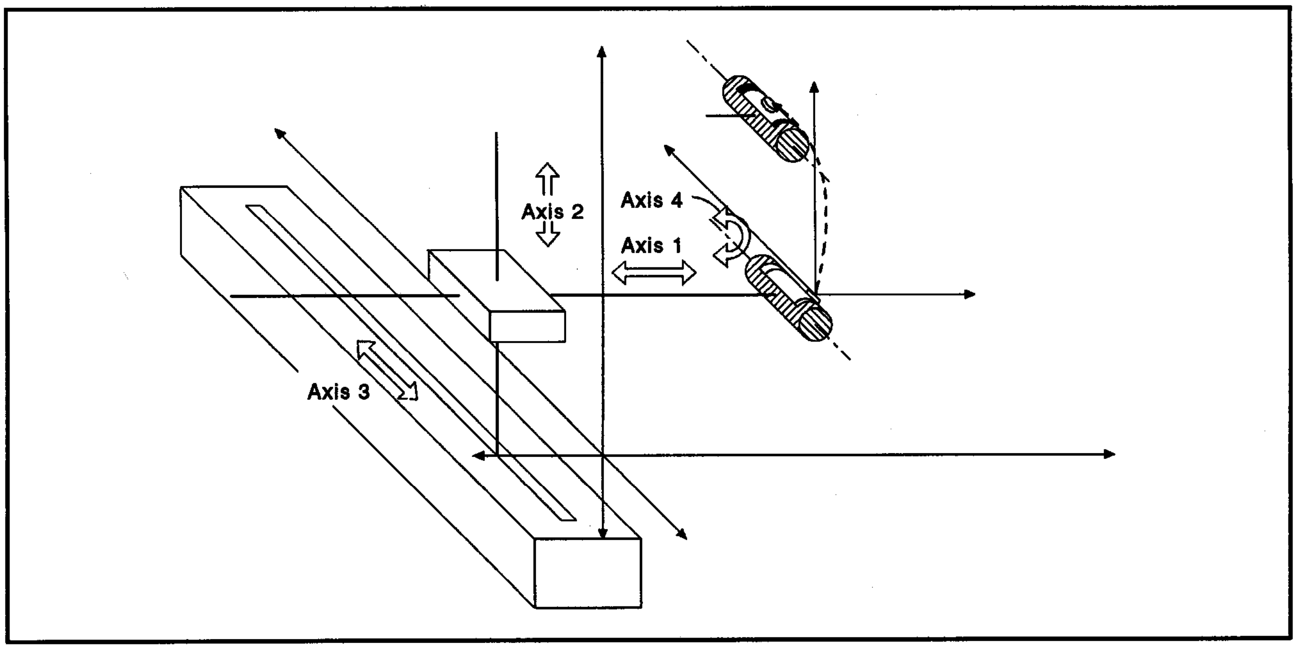


Figure 7.7 Axis Configuration

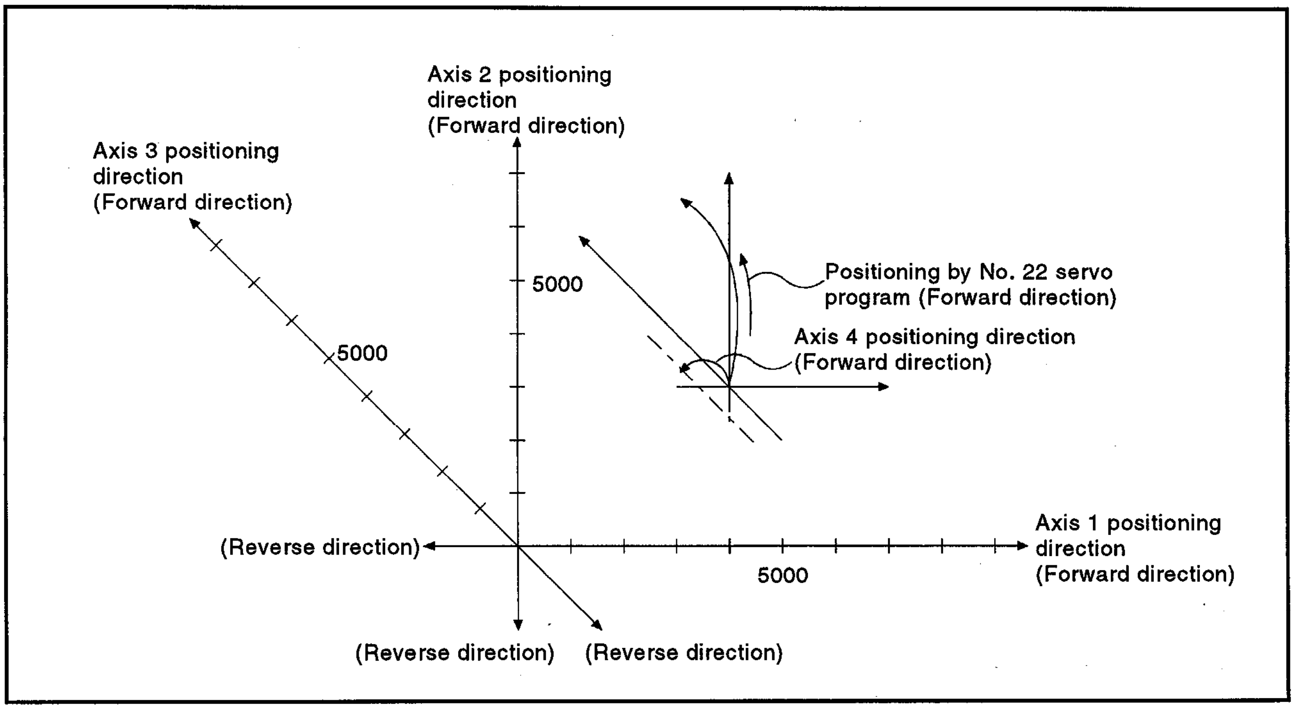


Figure 7.8 Positioning by Four-axis Linear Interpolation Control

(3) Positioning conditions

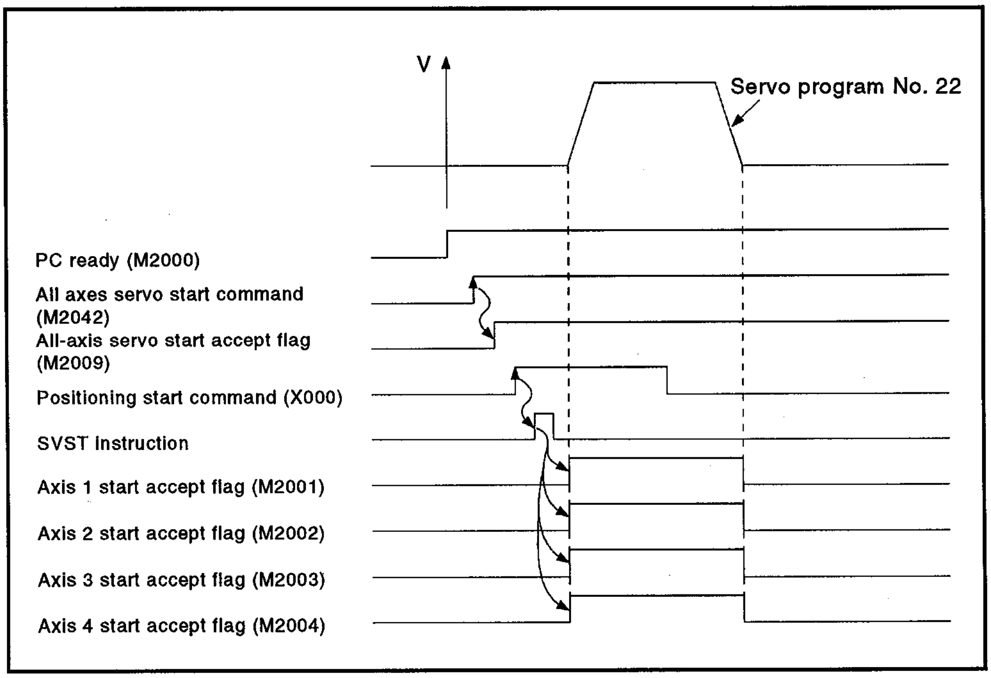
(a) The positioning conditions are shown below.

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

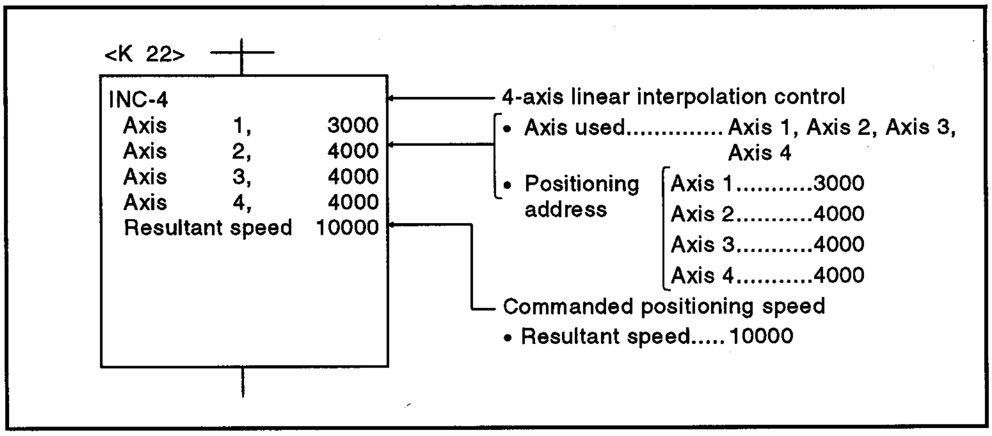
(b) Positioning start..... leading edge of X000 (OFF → ON)

(4) Operation timing

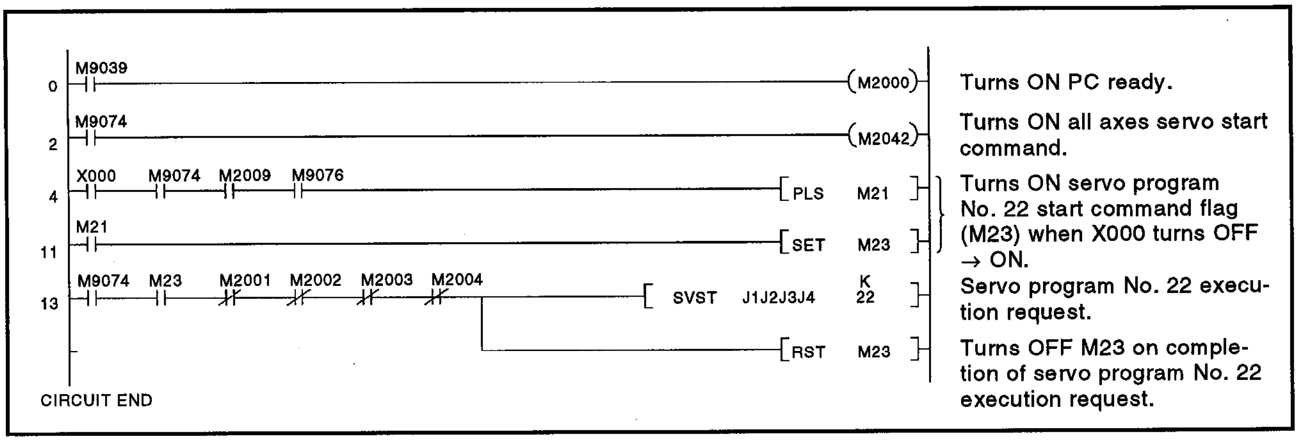
The operation timing for 4-axis linear interpolation control is shown below.



(5) Servo program
The servo program No. 22 for 4-axis 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 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 ↗	Absolute data	2	Δ	O	O	O	Δ	Δ		O			Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	NG
INC ↗	Incremental																							

O : Must be set
Δ : Set if required

[Control Details]

Control with ABS ↗ (absolute data method).

(1) Circular interpolation from the present 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 (present stop address) to the auxiliary point address, and the auxiliary point address to the end point address.

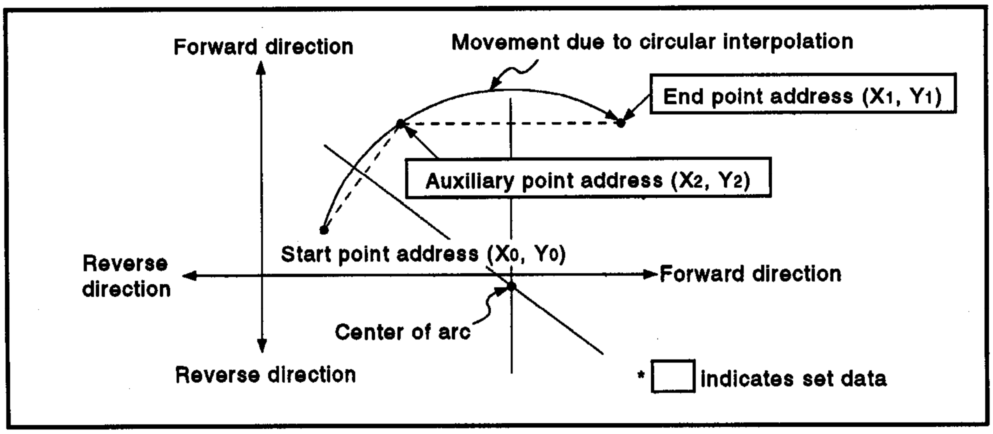


Figure 7.9 Circular Interpolation Control by Absolute Data Method

(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 $2^{31}-1$.

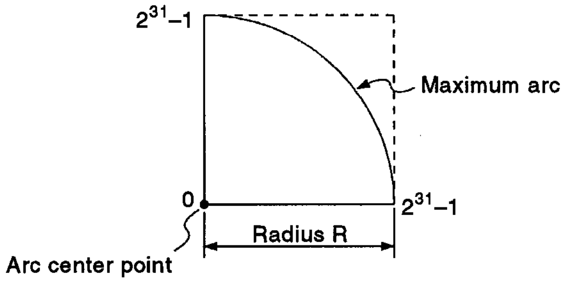


Figure 7.10 Maximum Arc

Control with INC (incremental method)

(1) Circular interpolation from the present 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 (present stop address) to the auxiliary point address, and the auxiliary point address to the end point address.

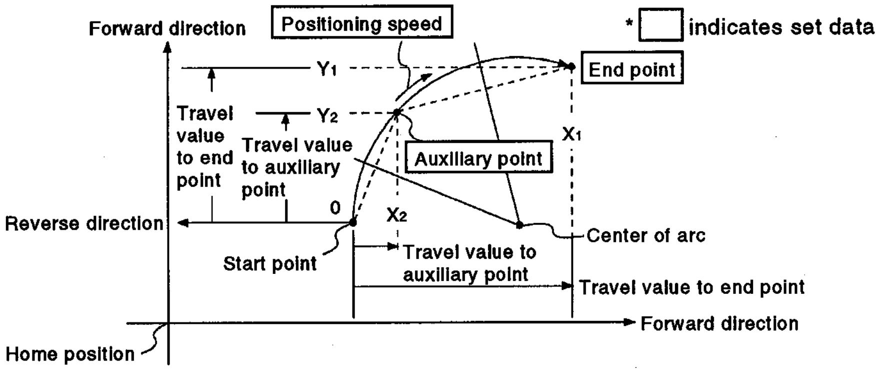
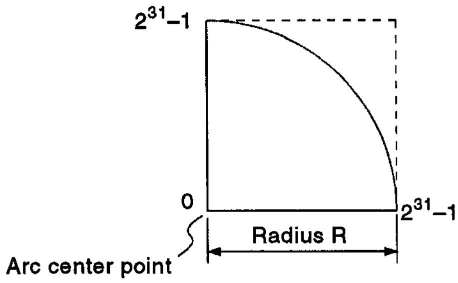


Figure 7.11 Circular Interpolation Control by Incremental Method

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

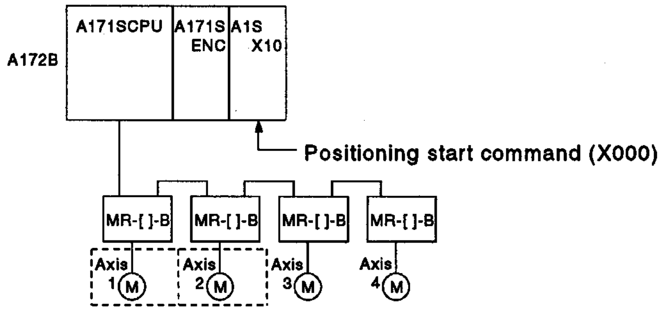
(4) The maximum arc radius is $2^{31}-1$.
If the designated end point and auxiliary point result in a radius greater than $2^{31}-1$, an error occurs at the start and error code 107 is stored in the data register.



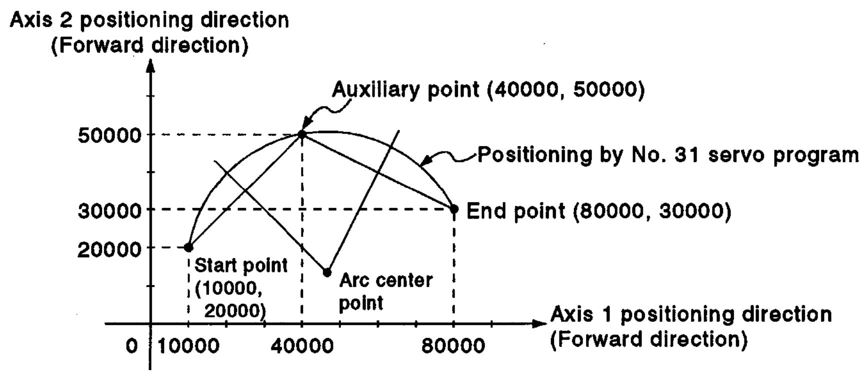
[Program Example]

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.

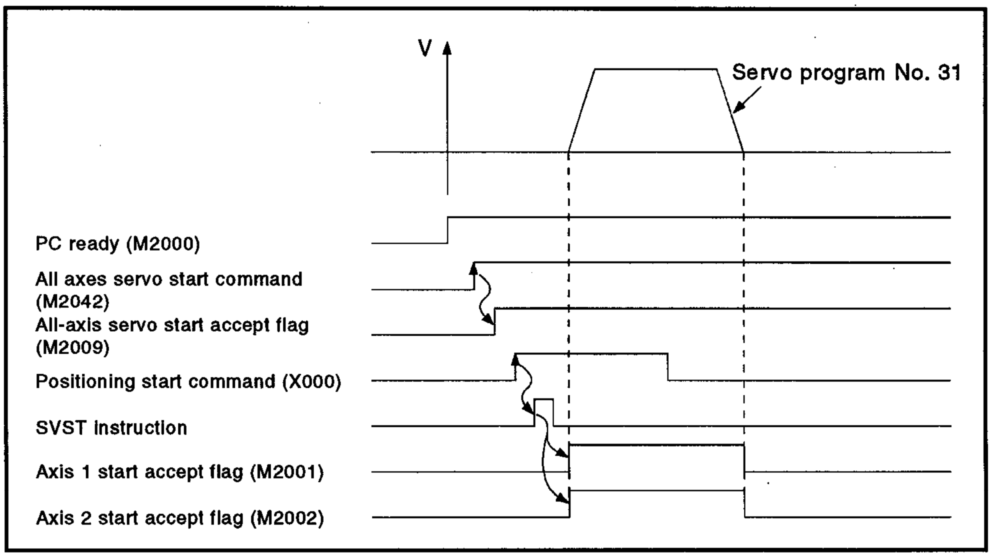


(3) Positioning conditions
(a) The positioning conditions are shown below.

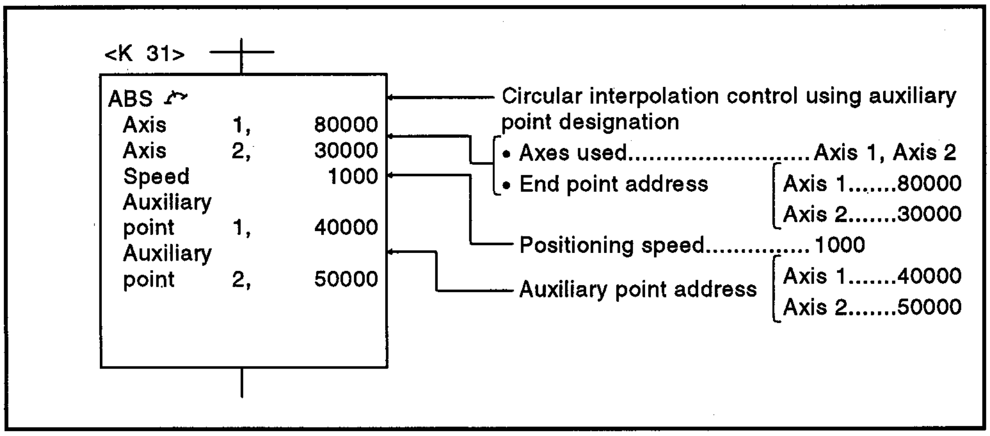
Item	Servo Program Number
	No. 31
Positioning method	Absolute data
Positioning speed	1000

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

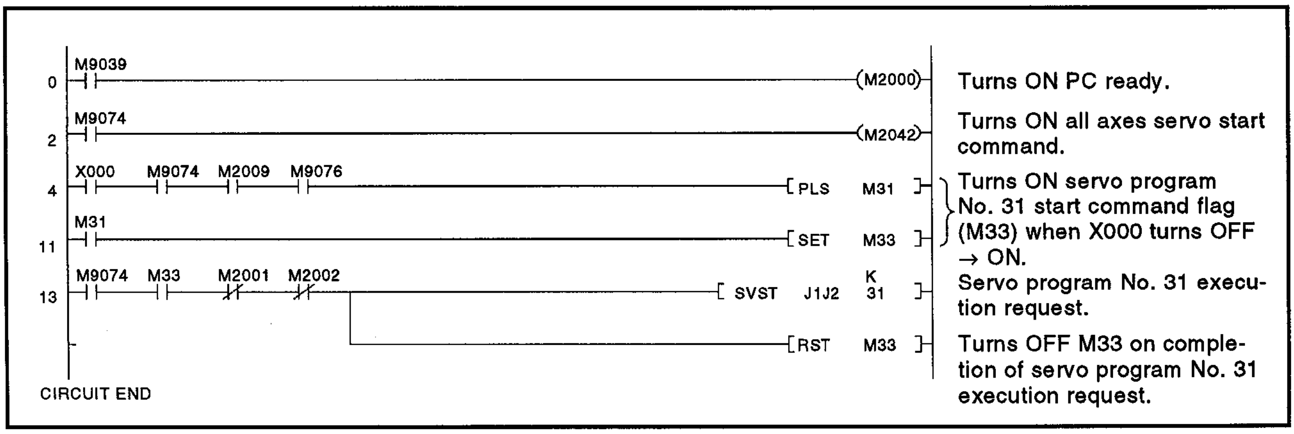
(4) Operation timing
The operation timing for circular interpolation control using auxiliary point designation is shown below.



(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

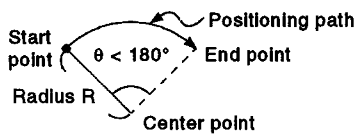
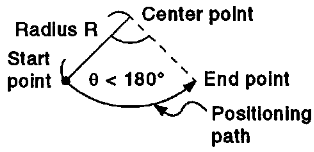
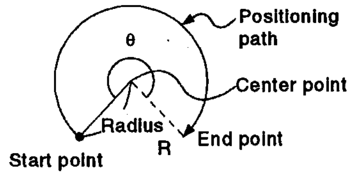
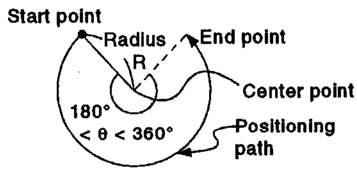
Circular interpolation control by designating the end point and arc radius.
Circular interpolation control using radius designation uses ABS↷, ABS↻, ABS↶, and ABS↺ (absolute data method) and INC↷, INC↻, INC↶, and INC↺ (incremental method) servo instructions.

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 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	
ABS ↷	Absolute data	2	Δ	O	O	O	Δ	Δ			O		Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	NG
ABS ↻																								
ABS ↶																								
ABS ↺																								
INC ↷	Incremental																							
INC ↻																								
INC ↶																								
INC ↺																								

O : 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 present 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 (present stop address) to the end point address.

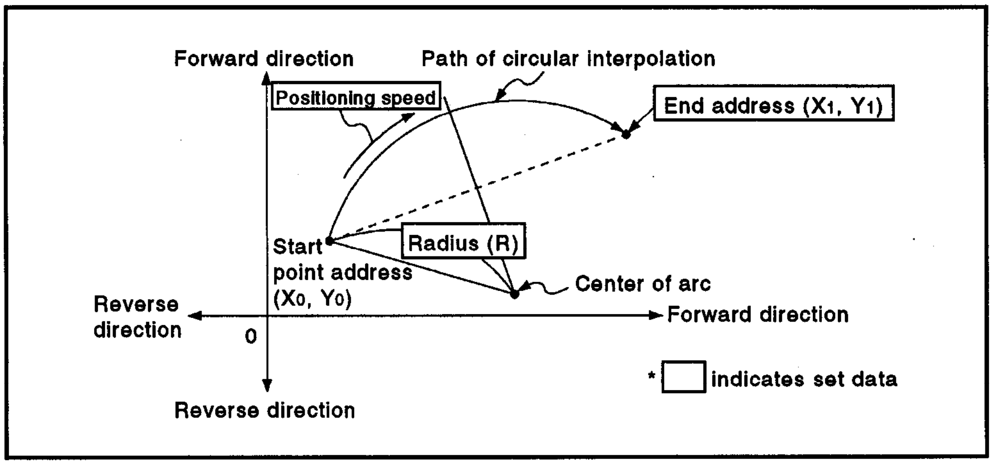


Figure 7.12 Circular Interpolation Control by Absolute Data Method

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

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

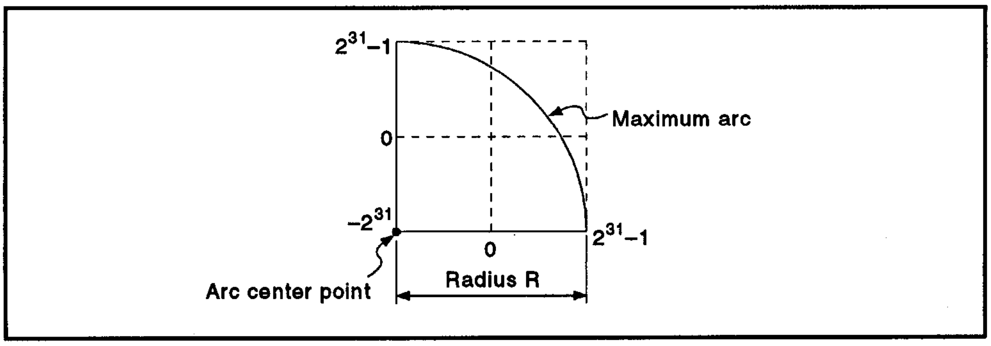


Figure 7.13 Maximum Arc

Control with INC↶, INC↷, INC↺, and INC↻ (incremental method)

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

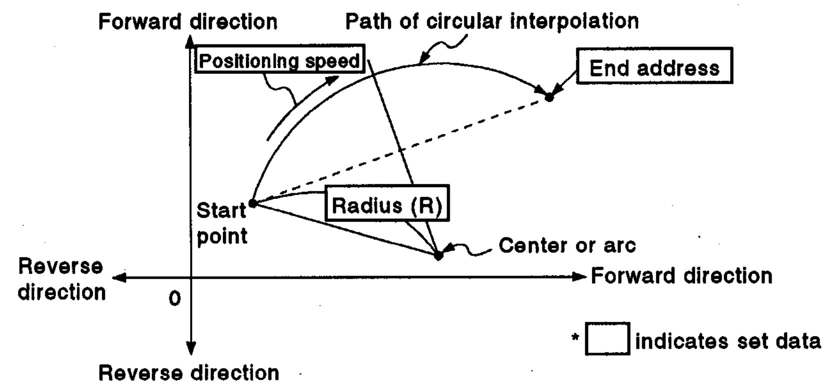


Figure 7.14 Circular Interpolation Control by Incremental Method

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

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

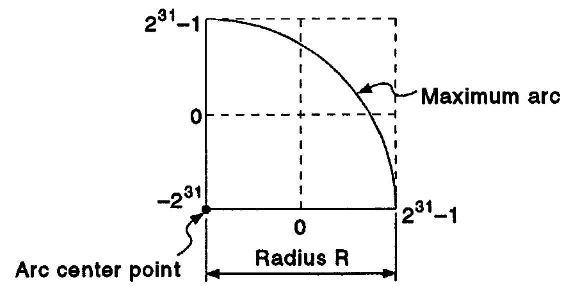
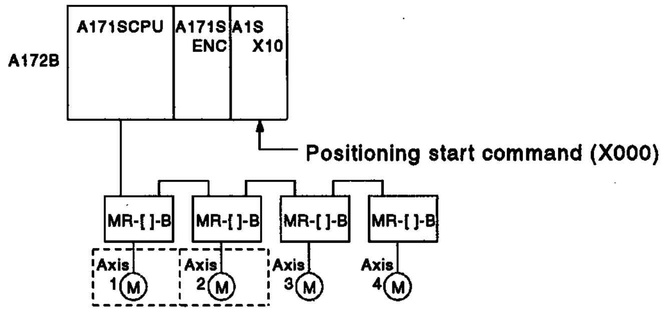


Figure 7.15 Maximum Arc

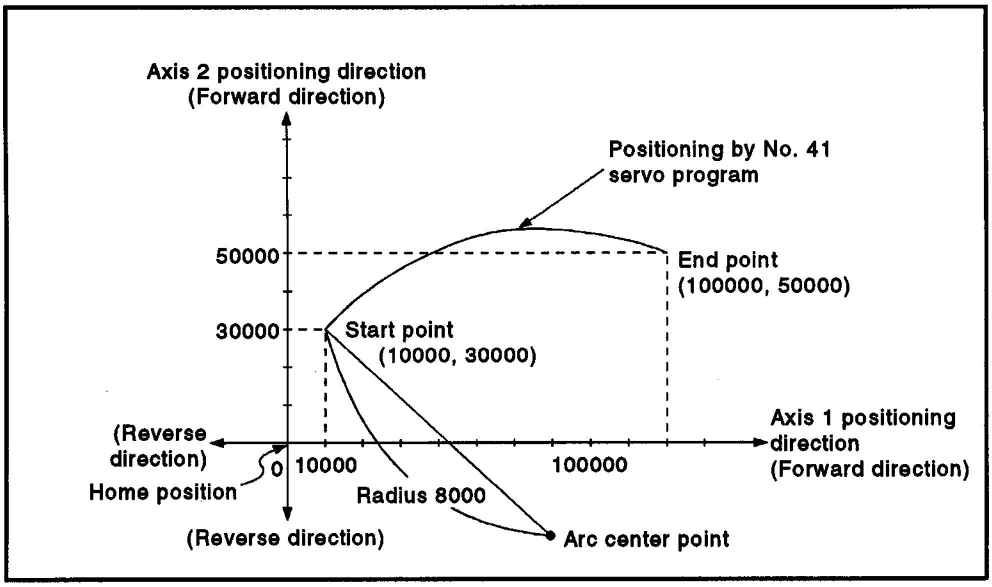
[Program Example]

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.

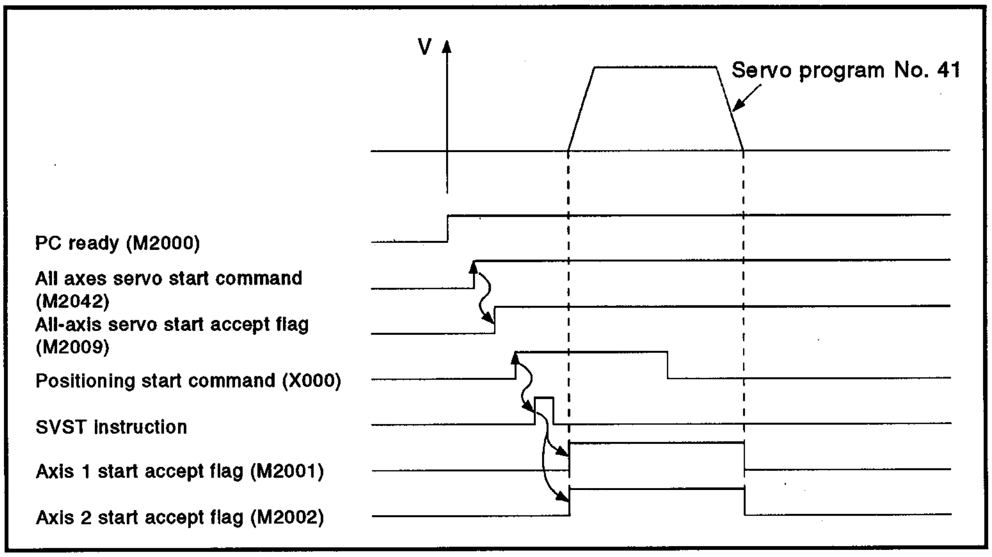


(3) Positioning conditions
(a) The positioning conditions are shown below.

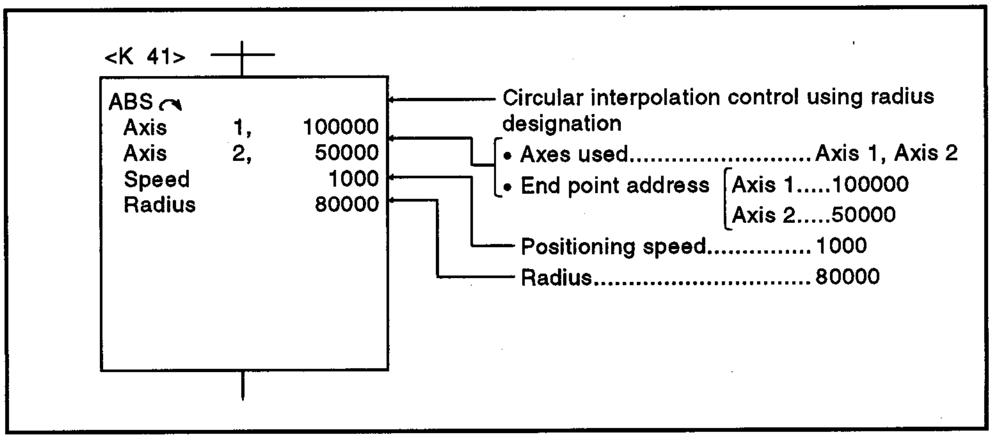
Item	Servo Program Number
	No. 41
Positioning method	Absolute data
Positioning speed	1000

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

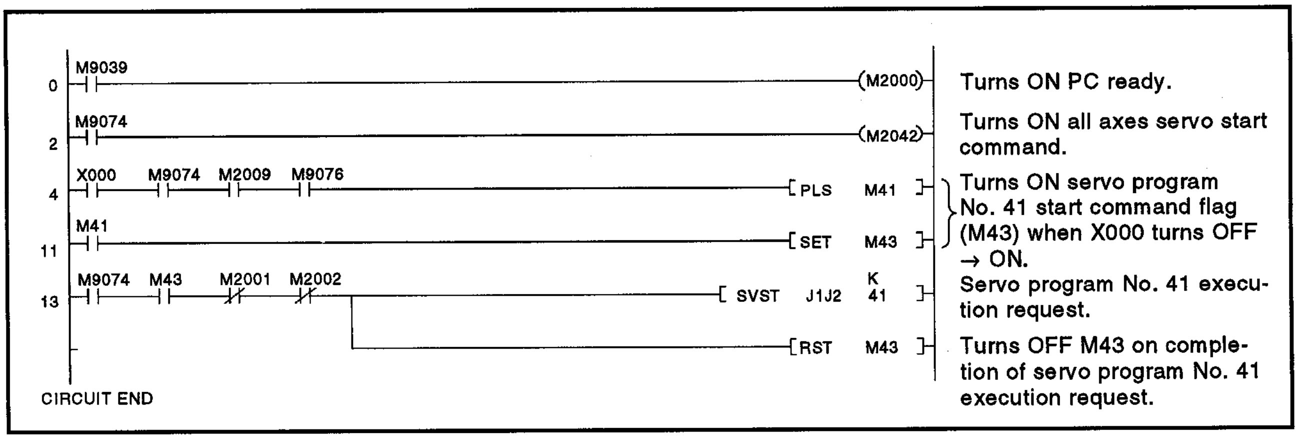
(4) Operation timing
The operation timing for circular interpolation control using radius designation is shown below.



(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

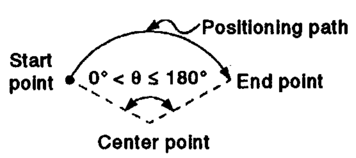
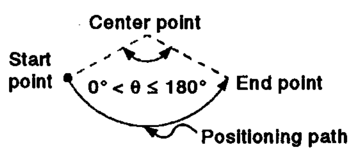
Circular interpolation control by designating the end point and arc center point.
Circular interpolation control using center point designation uses ABS↷ and ABS↶ (absolute data method) and INC↷ and INC↶ (incremental method) servo instructions.

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	o	o	o	Δ	Δ				o	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	NG
INC↷ INC↶	Incremental																							

o : 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° < θ ≤ 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 present stop address (pre-positioning address used as the start point address) and the designated end point address, using the home position as the reference.

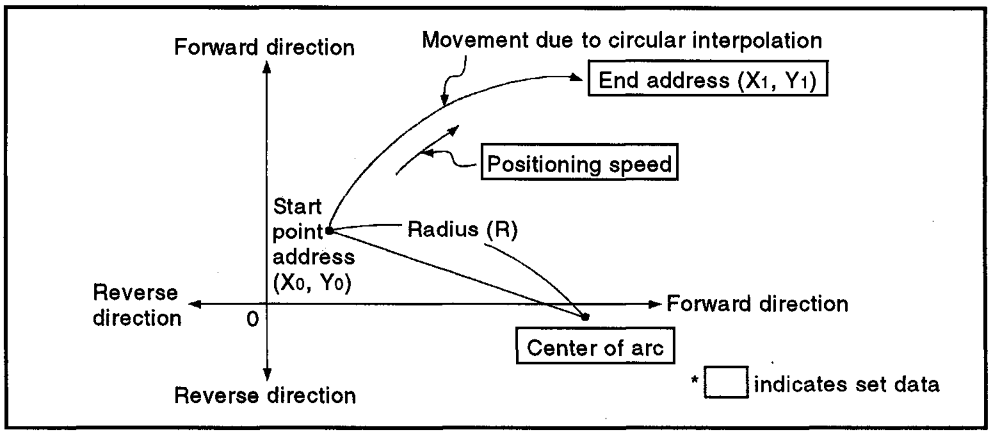


Figure 7.16 Circular Interpolation Control by Absolute Data Method

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

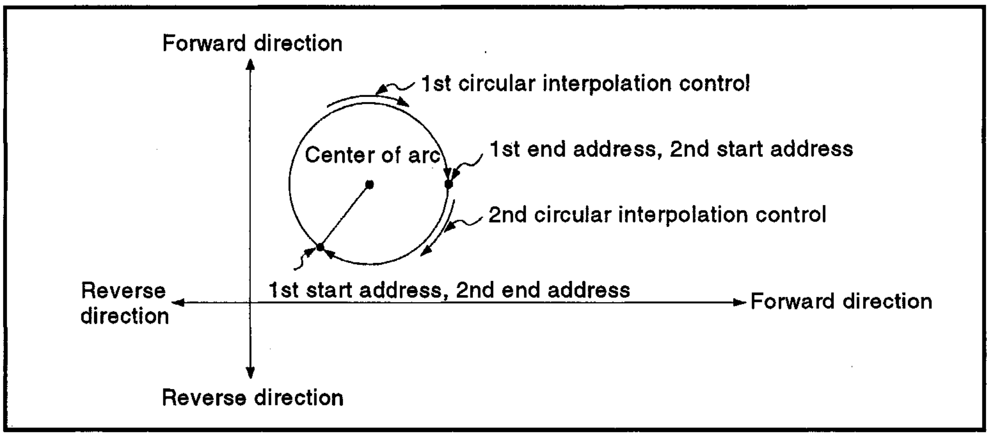


Figure 7.17 Positioning Control of a Full Circle

(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 $2^{31}-1$.

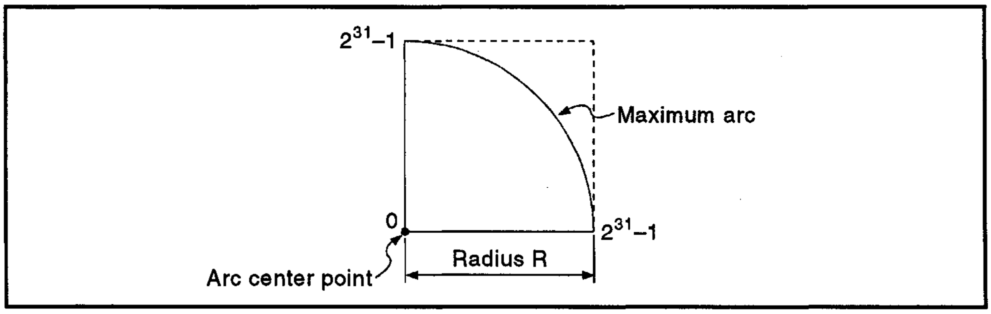


Figure 7.18 Maximum Arc

Control with INC↷ and INC↶ (incremental method)

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

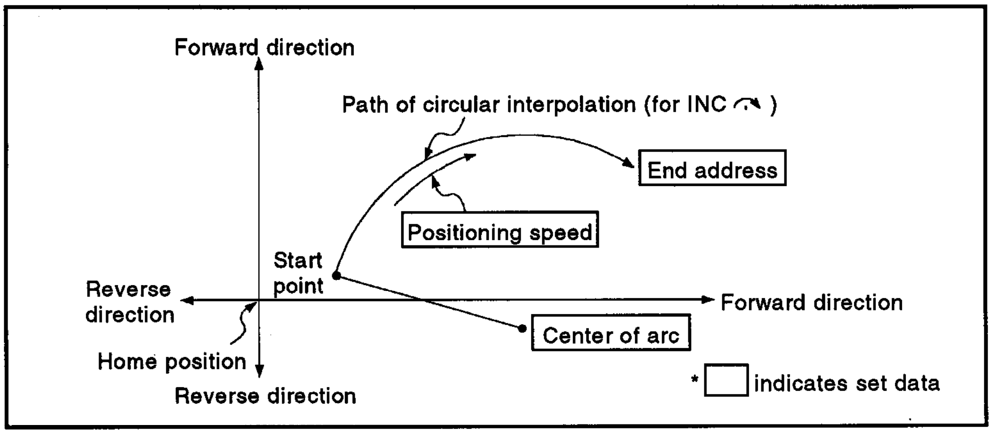


Figure 7.19 Circular Interpolation Control by Incremental Method (INC↷)

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

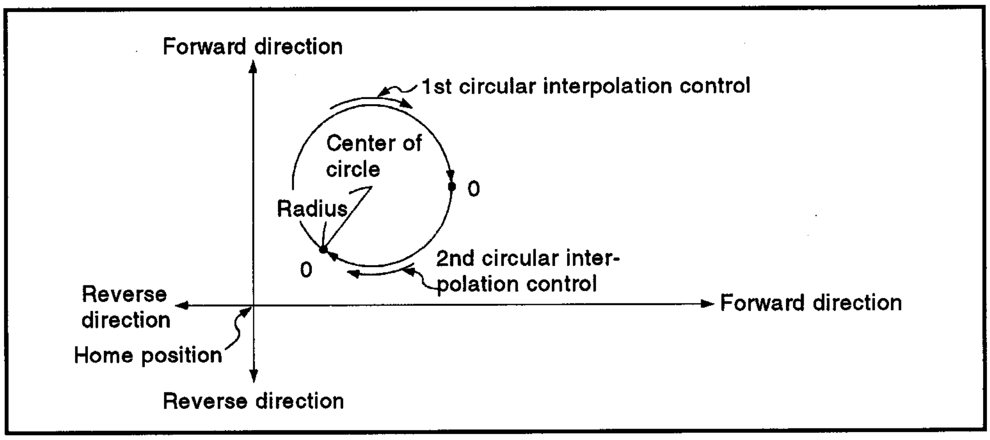


Figure 7.20 Positioning Control of a Full Circle

(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 greater than $2^{31}-1$, an error occurs at the start and error code 107 is stored in the data register.

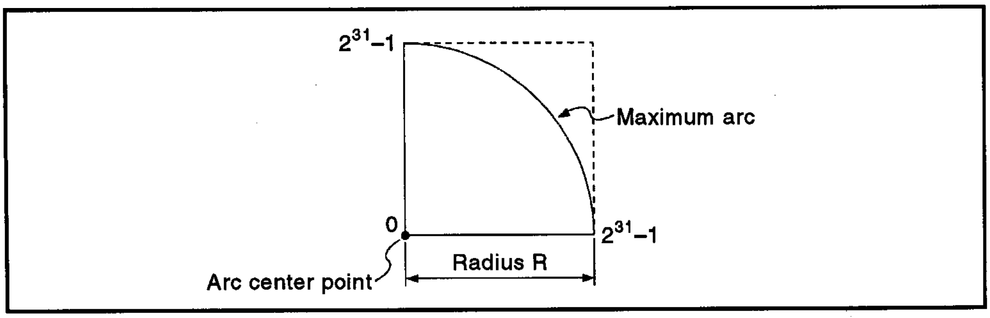
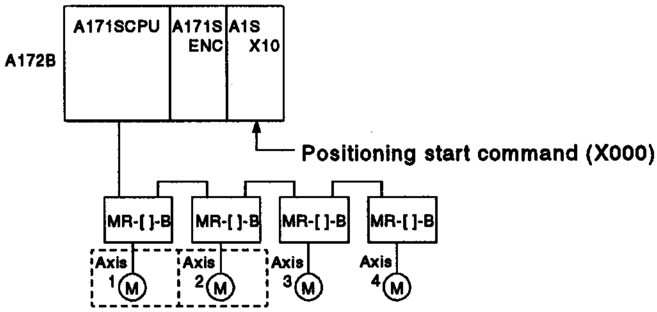


Figure 7.21 Maximum Arc Radius

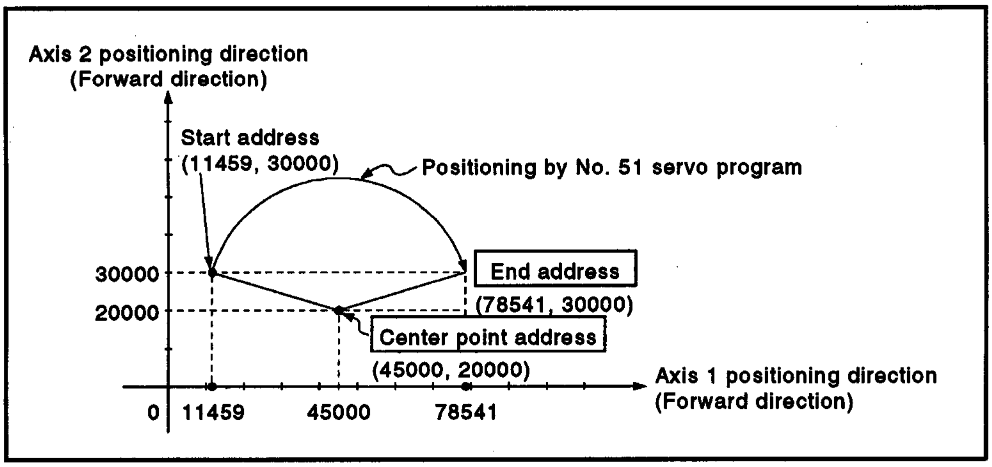
[Program Example]

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.

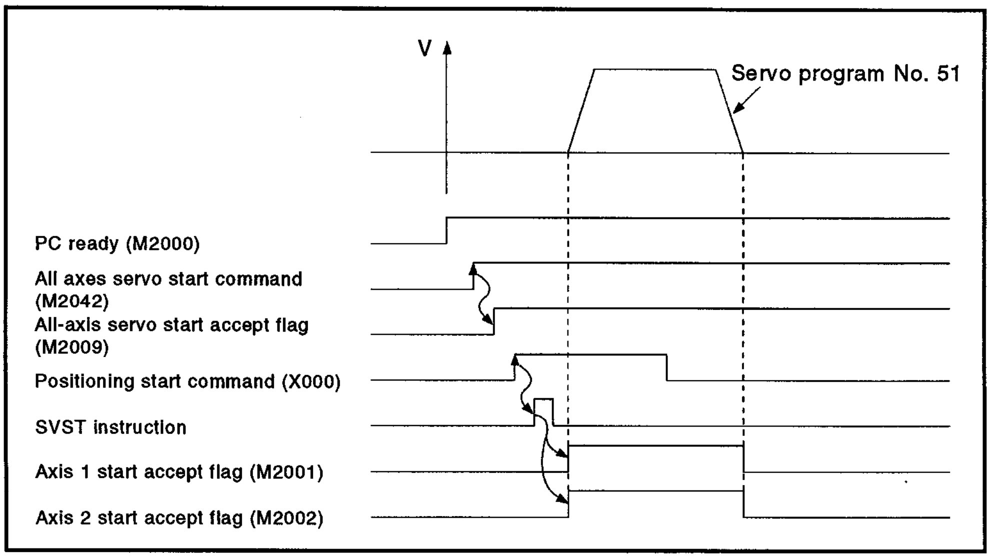


(3) Positioning conditions
(a) The positioning conditions are shown below.

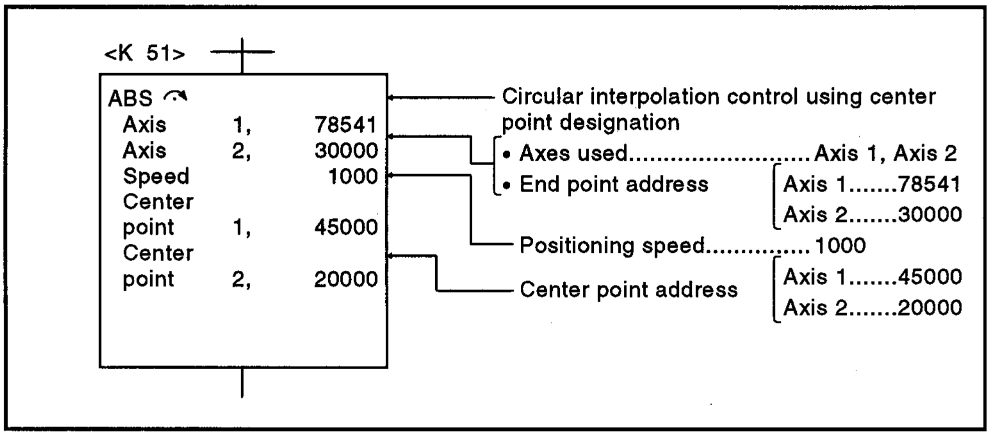
Item	Servo Program Number
	No. 51
Positioning method	Absolute data
Positioning speed	1000

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

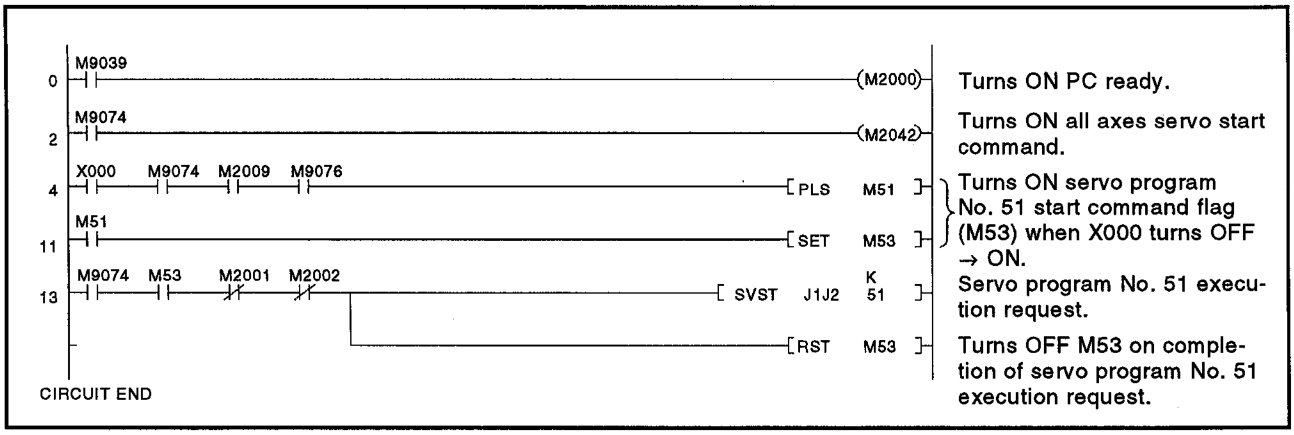
(4) Operation timing
The operation timing for circular interpolation control using center point designation is shown below.



(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 One-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 present stop position.
Fixed-pitch feed control uses the FEED-1 servo instruction.

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	
FEED-1	Incremental	1	Δ	O	O	O	Δ	Δ						Δ	Δ	Δ	Δ	Δ	Δ		Δ	Δ	Δ	OK

O : Must be set
Δ : Set if required

[Control Details]

(1) Positioning control through the designated travel value from the present 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)

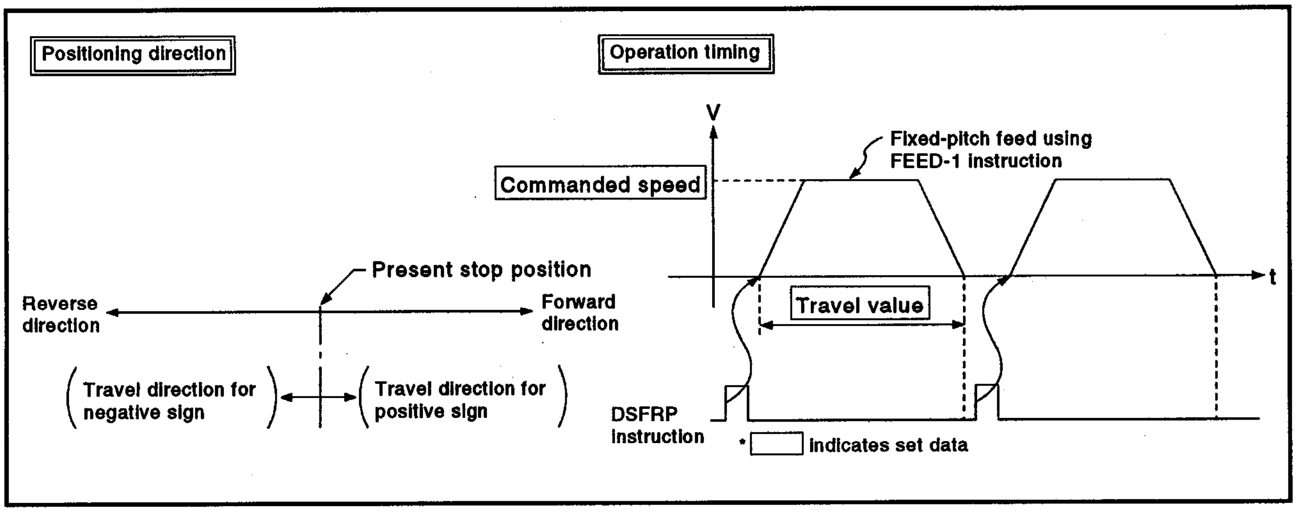


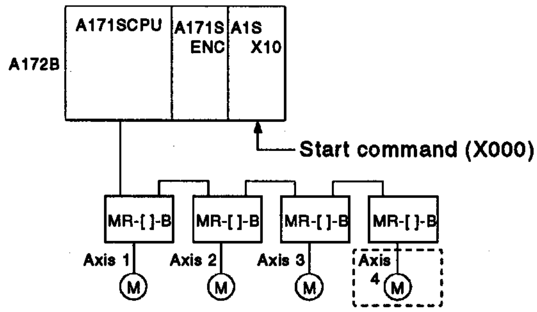
Figure 7.22 One-Axis Fixed-Pitch Feed Control

> **POINT**
>
> Do not set the travel value to zero for fixed-pitch feed control.
> If the travel value is set to 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

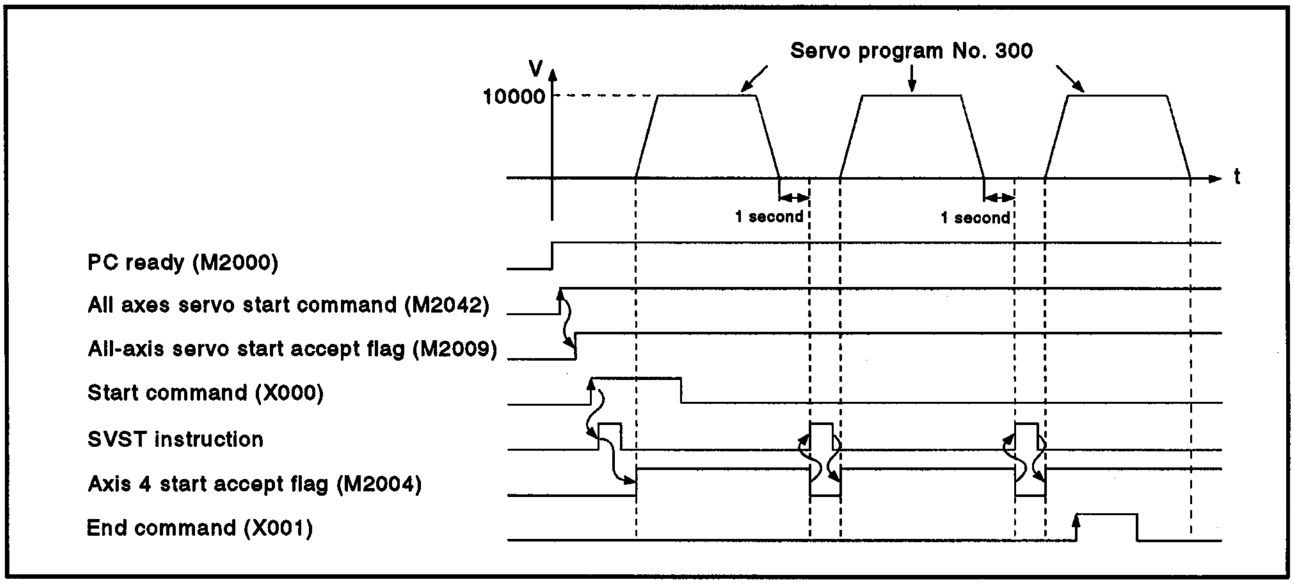
(a) The positioning conditions are shown below.

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

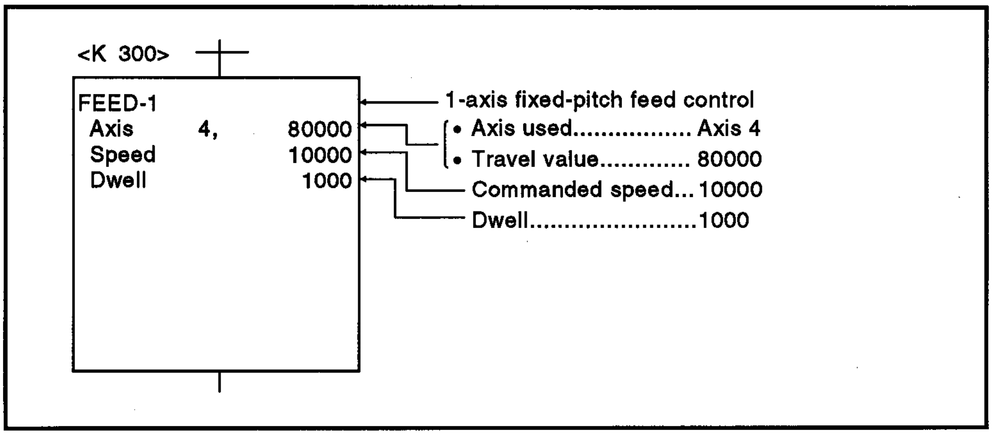
(b) Fixed-pitch feed control start command ....leading edge of X000 (OFF → ON)

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

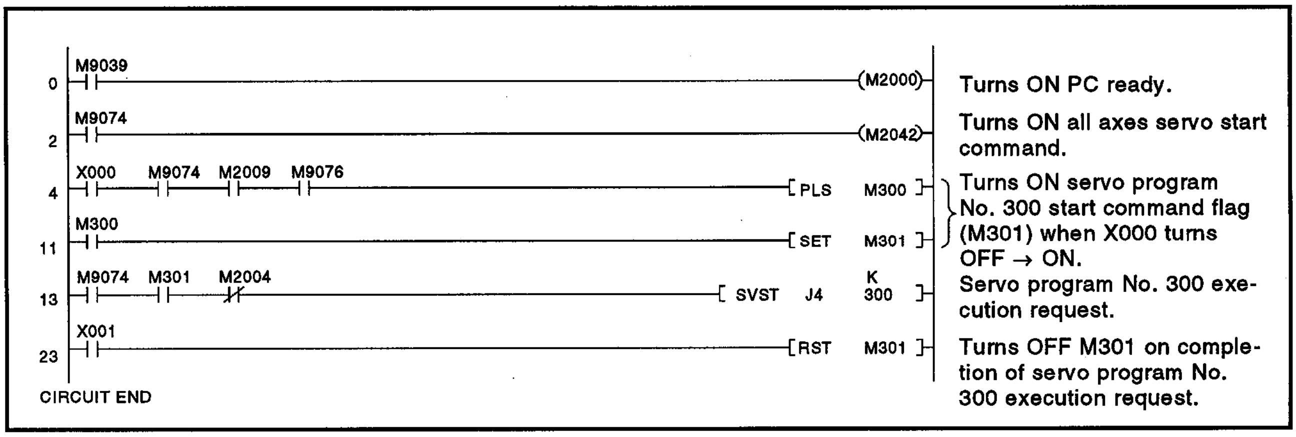
(3) Operation timing
The operation timing for fixed-pitch feed control is shown below.



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



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



7.10 Fixed-Pitch Feed Control Using Two-Axis Linear Interpolation

Fixed-pitch feed control using 2-axis linear interpolation from the present stop position with the two axes designated in the sequence program positioning commands.
Fixed-pitch feed control using two-axis linear interpolation uses the FEED-2 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
FEED-2	Incremental	2	Δ	O	O	O	Δ	Δ					Δ	Δ	Δ	Δ	Δ	Δ	Δ		Δ	Δ	Δ	OK

O : Must be set
Δ : Set if required

[Control Details]

(1) Positioning control from the present 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)

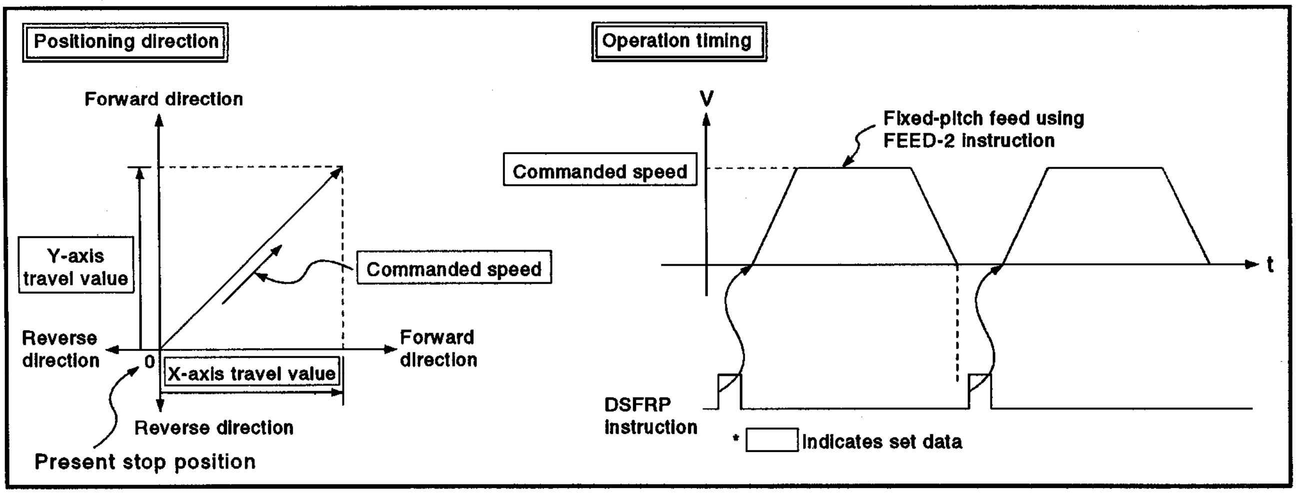


Figure 7.23 Fixed-Pitch Feed Control Using Two-Axis Linear Interpolation

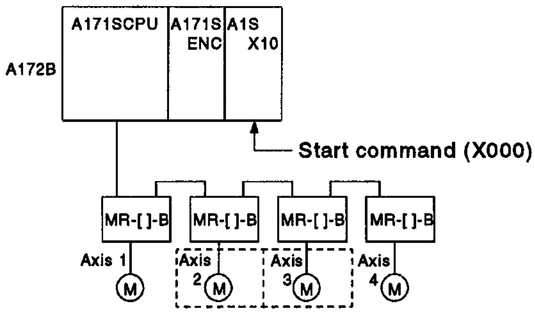
POINT

(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-axis linear interpolation under the conditions below.

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



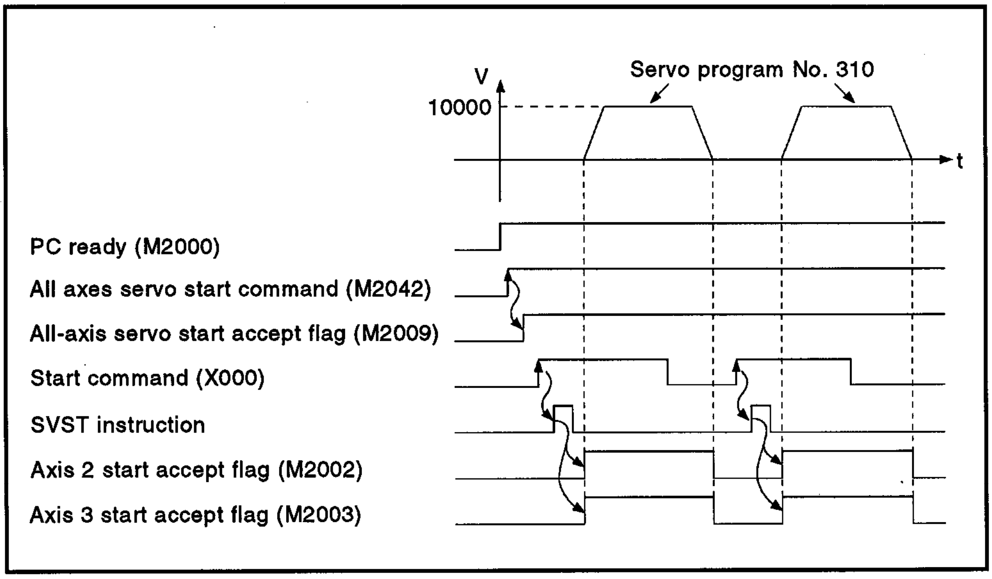
(2) Positioning conditions
The fixed-pitch feed control conditions are shown below.

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)

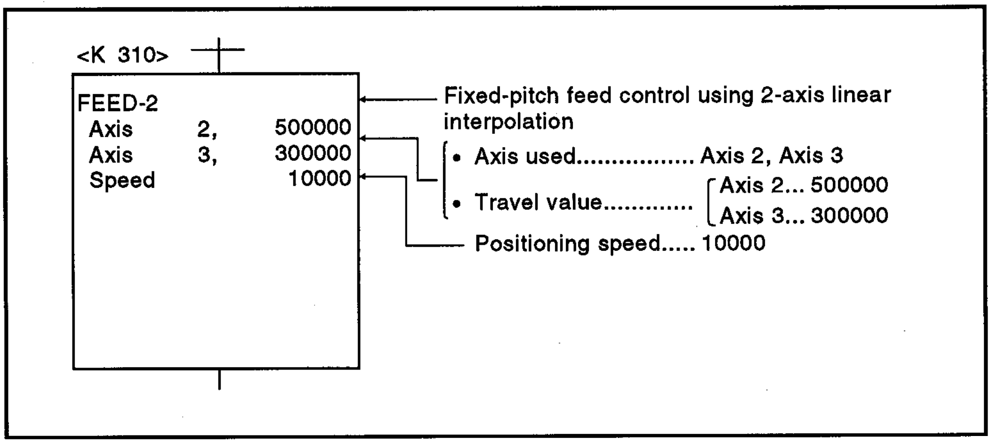
(3) Operation timing

The operation timing for fixed-pitch feed control using two-axis linear interpolation is shown below.



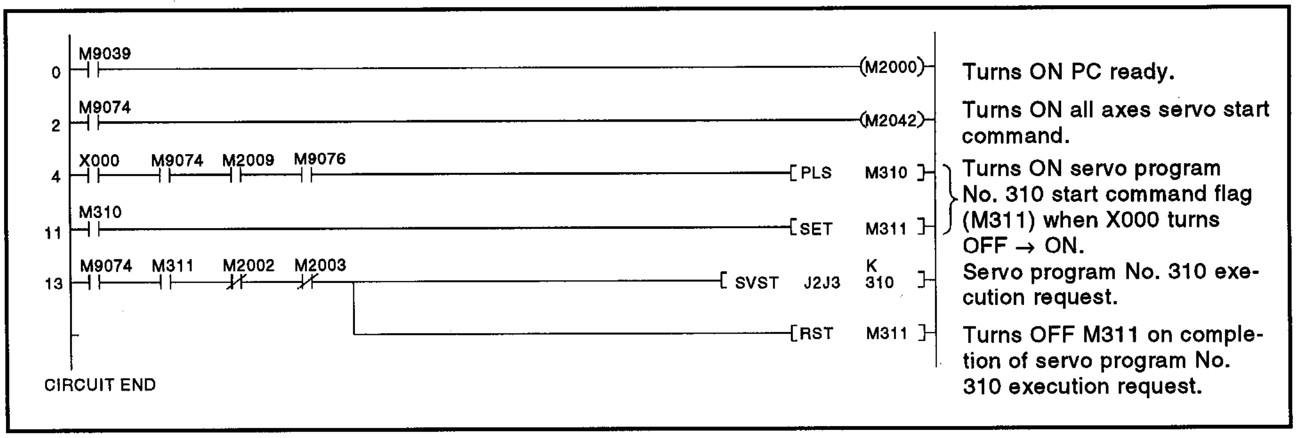
(4) Servo program

The servo program No. 310 for fixed-pitch feed control using two-axis 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 Three-Axis Linear Interpolation

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

Servo Instruction	Positioning Method	Number of Controllable Axes	Items Set by Peripherals: Common: Parameter Block No.	Axis	Address/Travel Value	Commanded Speed	Dwell Time	M Code	Torque Limit Value	Arc: Auxiliary Point	Radius	Center Point	Parameter Block: Control Unit	Speed Limit Value	Acceleration Time	Deceleration Time	Rapid Stop Deceleration Time	Torque Limit Value	Deceleration Processing on Stop Input	Allowable Error Range for Circular Interpolation	S Curve Ratio	Others: Cancel	Start	Speed Change
FEED-3	Incremental	3	Δ	O	O	O	Δ	Δ					Δ	Δ	Δ	Δ	Δ	Δ	Δ		Δ	Δ	Δ	OK

O : Must be set
Δ : Set if required

[Control Details]

(1) Positioning control from the present 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)

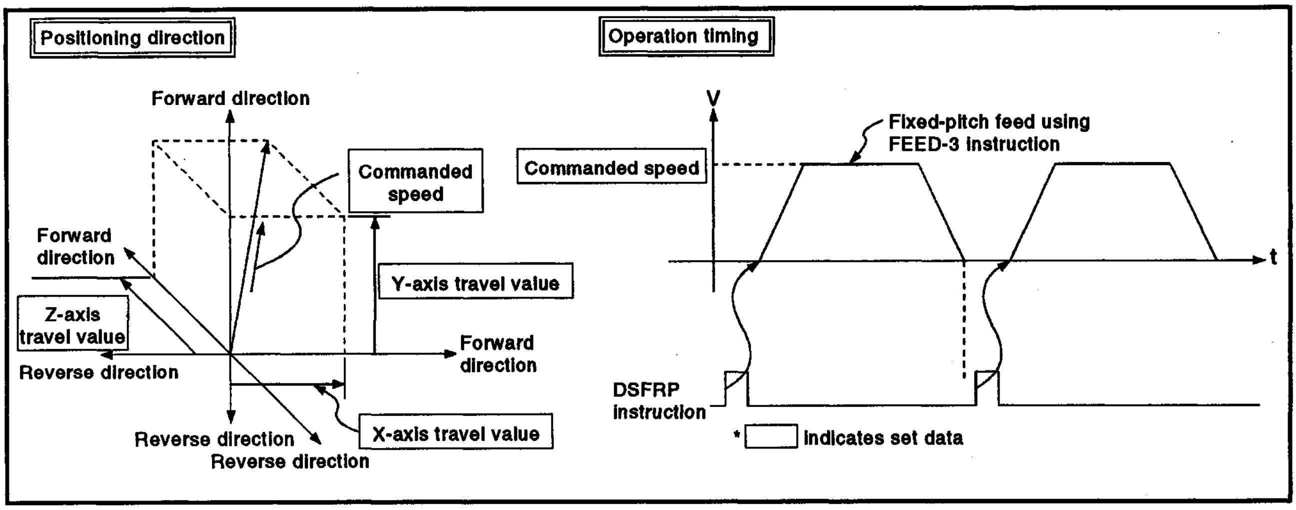


Figure 7.24 Fixed-Pitch Feed Control Using Three-Axis Linear Interpolation

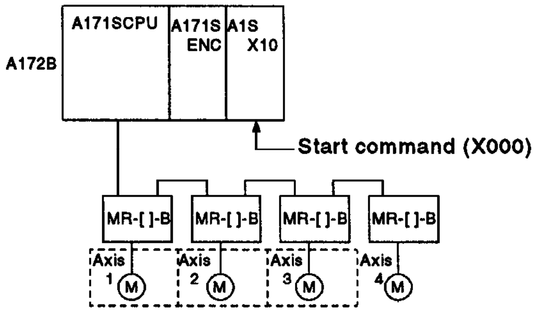
POINT

(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 three 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-axis linear interpolation under the conditions below.

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

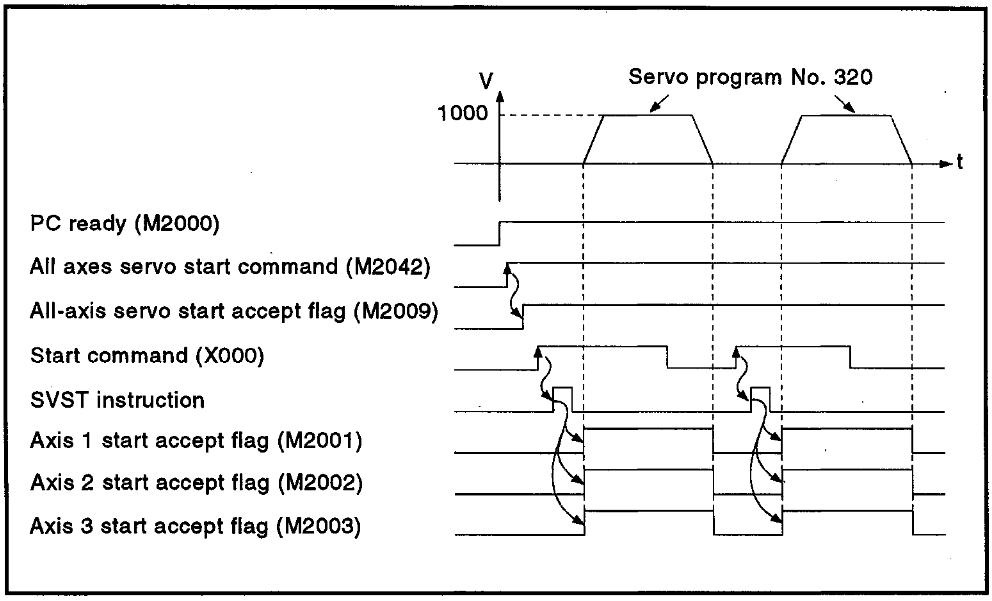


(2) System configuration
(a) The positioning conditions are shown below.

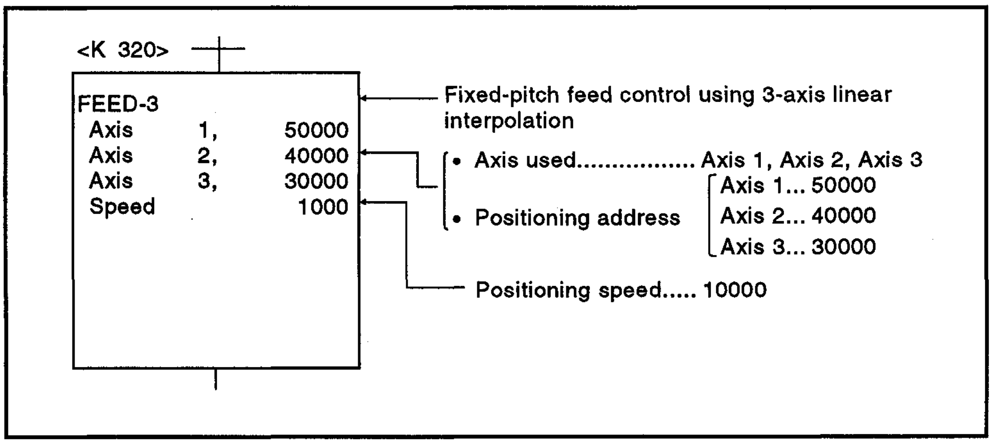
Item	Setting		
Servo program number	No. 320		
Positioning speed	1000		
Controlled axes	Axis 1	Axis 2	Axis 3
Travel value	50000	40000	30000

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

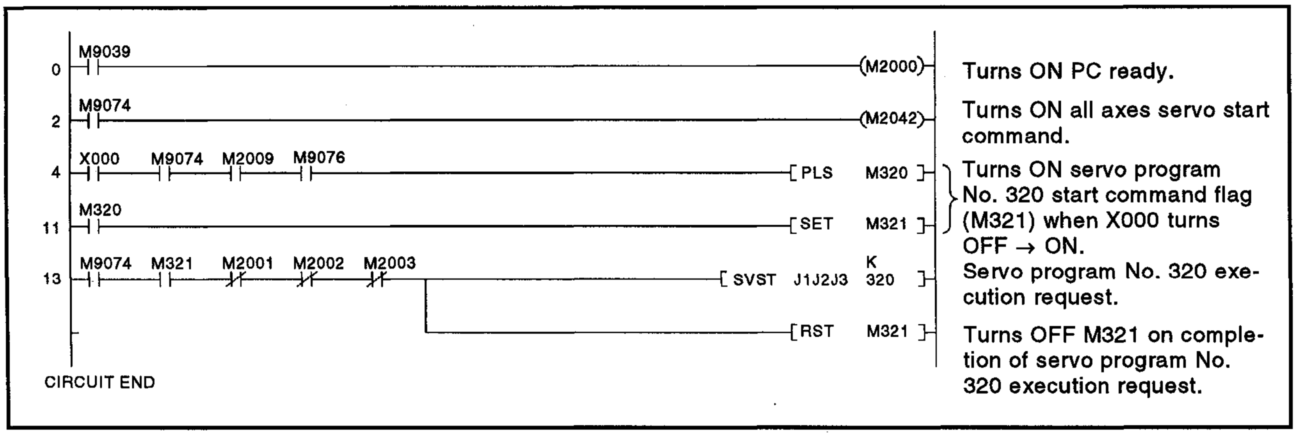
(3) Operation timing
The operation timing for fixed-pitch feed control using three-axis linear interpolation is shown below.



(4) Servo program
The servo program No. 320 for fixed-pitch feed control using three-axis 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 axes 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																					
			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
VF VR	—	1	Δ	O		O		Δ						Δ	Δ	Δ	Δ	Δ	Δ		Δ	Δ	Δ	OK

O : 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.
- VF .....movement in forward direction
- VR .... movement in reverse direction

(2) The present value does not change at zero.

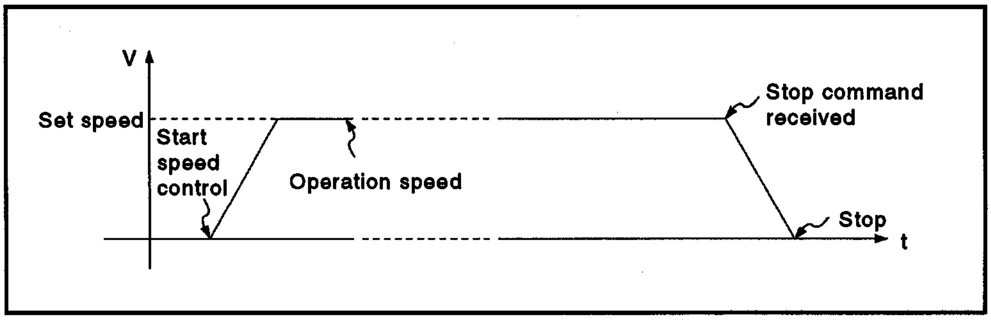


Figure 7.25 Speed Control (I)

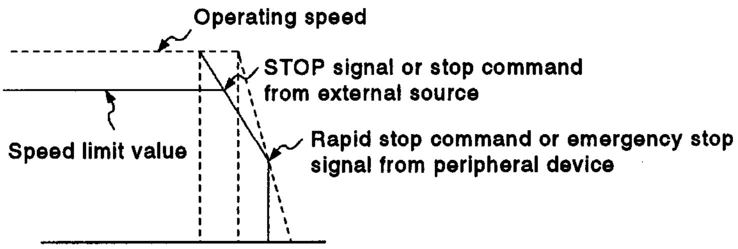
(3) Stop commands and stop processing
The stop commands and stop processing for speed control are listed in Figure 7.1.

Figure 7.1 Stop Commands and Stop Processing

Stop Command	Stop Condition	Stopped Axis	Stop Processing
External STOP signal	OFF → ON	Designa-ted axis	Deceleration stop according to the deceleration time on STOP input designated in the parameter block or by a servo instruction.
Stop command (M1800+20n/Yn0/ M3200+20n)			Deceleration stop according to the deceleration time designated in the parameter block or by a servo instruction.
Rapid stop command* (M1801+20n/Yn1/ 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* (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	Designa-ted axis	Deceleration stop according to the deceleration time designated in the parameter block or by a servo instruction.

POINT

*: 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 (M1800+20n/Yn0/M3200+20n), and processing according to the rapid stop deceleration time parameter starts at the time the stop condition occurs.



[Cautions]

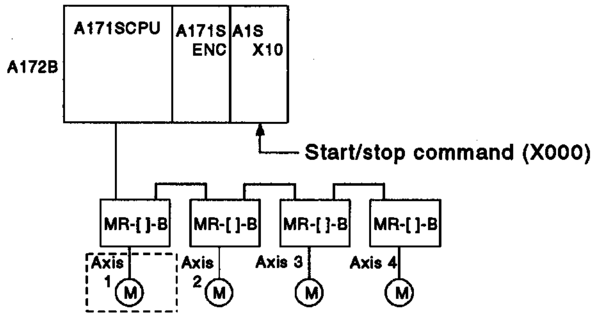
(1) After running speed control using the absolute data system, the feed present value cannot be set to zero by the following operations:
- Reset with the RUN key
- Turning on the servo power supply (OFF → ON)

(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.



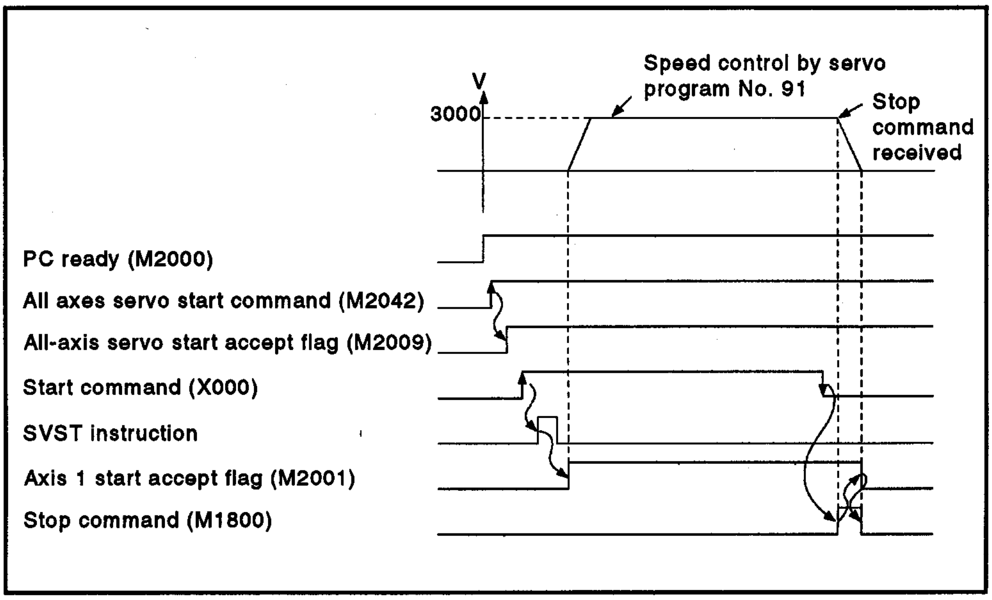
(2) Speed control (I) conditions
(a) The speed control (I) conditions are shown below.

Item	Setting
Servo program number	No. 91
Controlled axis	Axis 1
Control speed	3000
Rotation direction	Forward

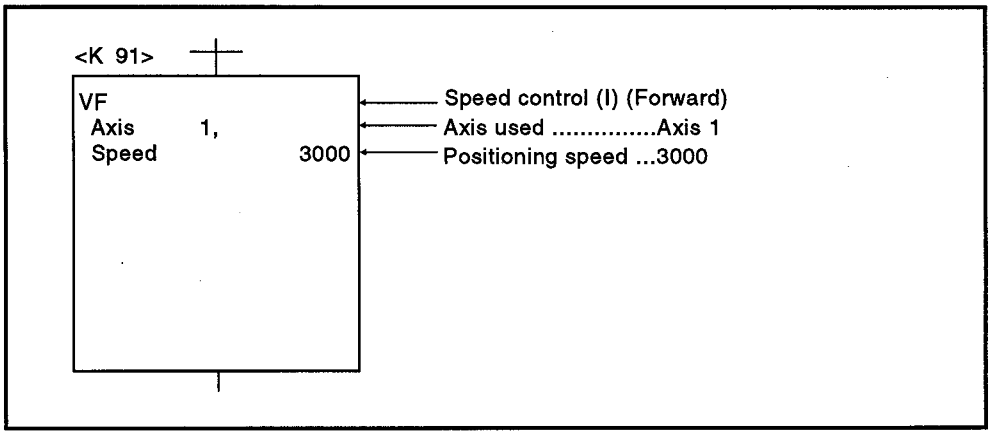
(b) Speed control (I) start command ...leading edge of X000 (OFF → ON)

(c) Speed control (I) stop command ...trailing edge of X000 (ON → OFF)

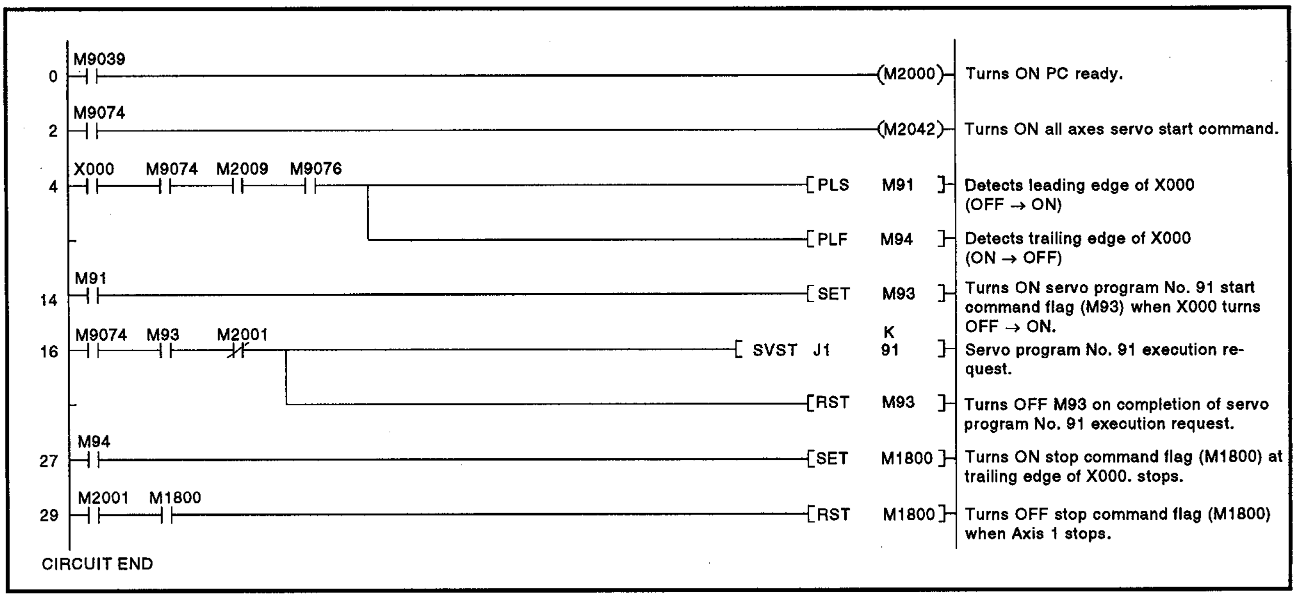
(3) Operation timing
The operation timing for speed control (I) is shown below.



(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 axes designated in the sequence program positioning commands.

(2) Control does not include positioning loops for control of servo amplifiers. Use stopper control to prevent 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																				
			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
VVF VVR	—	1	Δ	O		O		Δ	Δ					Δ	Δ	Δ	Δ	Δ	Δ		Δ	Δ	Δ	OK

O : 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 present 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 present value cannot be set to zero by resetting with the RUN key.

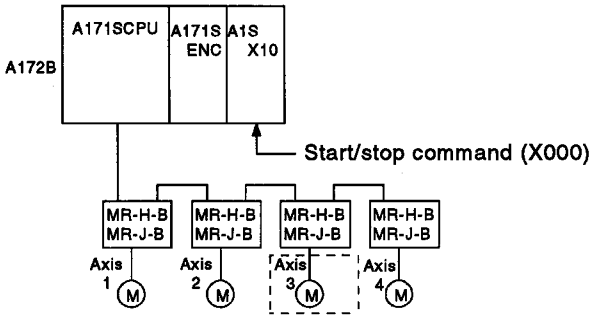
(2) The dwell time cannot be set.

(3) Cannot be used with respect to MR-J-B axes.

[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

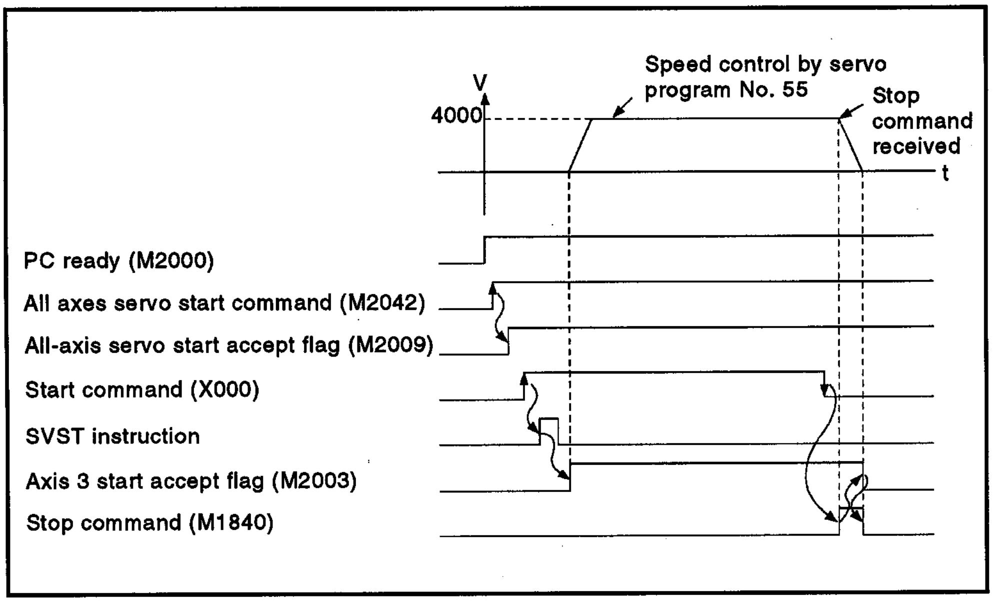
(a) The speed control (II) conditions are shown below.

Item	Setting
Servo program number	No. 55
Controlled axis	Axis 3
Control speed	4000
Rotation direction	Forward

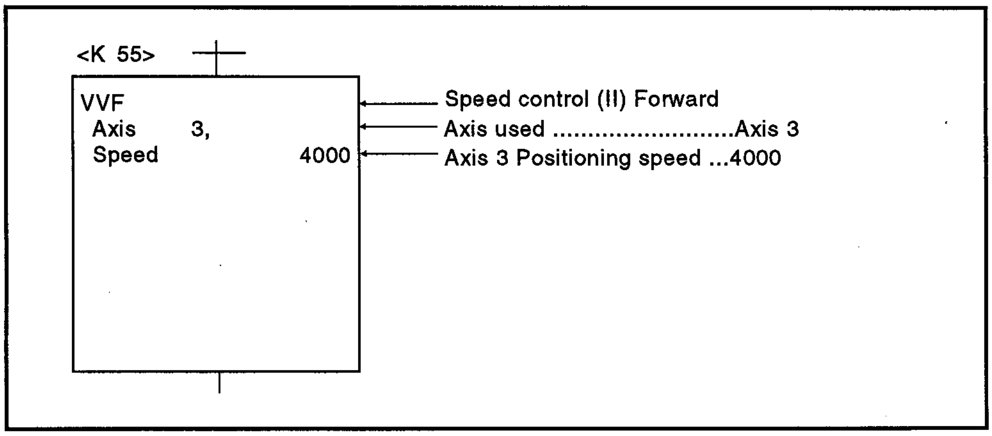
(b) Speed control (II) start command ...leading edge of X000 (OFF → ON)

(c) Speed control (II) stop command ...trailing edge of X000 (ON → OFF)

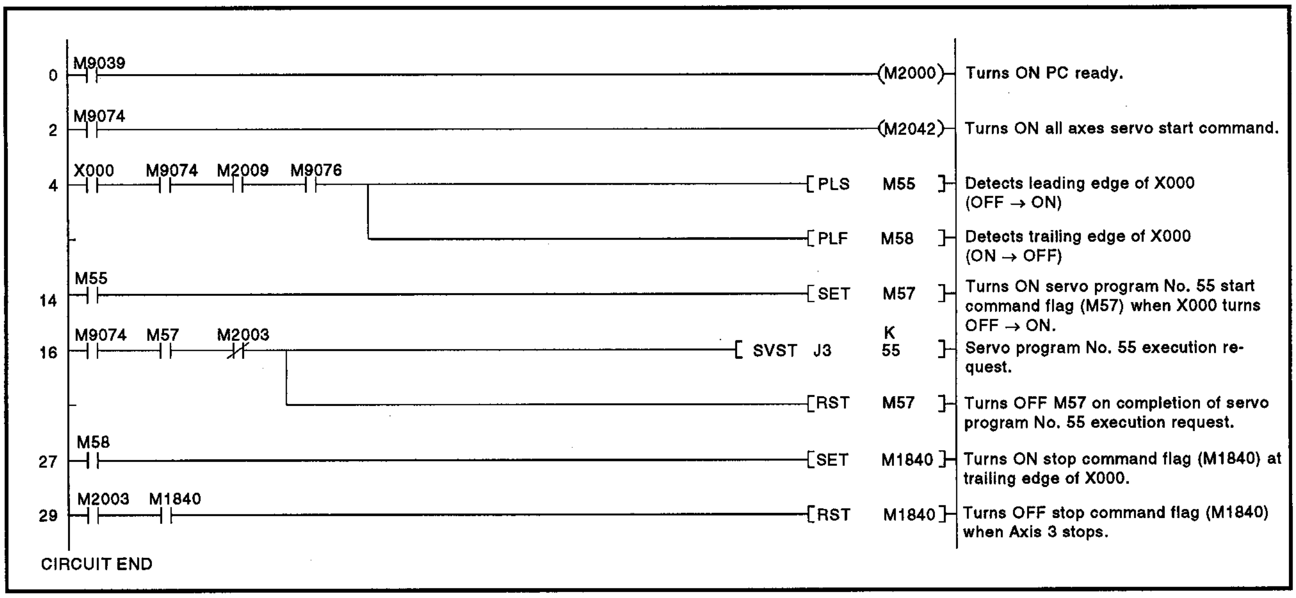
(3) Operation timing
The operation timing for speed control (II) is shown below.



(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 axes designated in the sequence program positioning commands.
Speed/position switching control uses the VPF (forward), VPR (reverse), and VPSTART (restart) servo instructions.

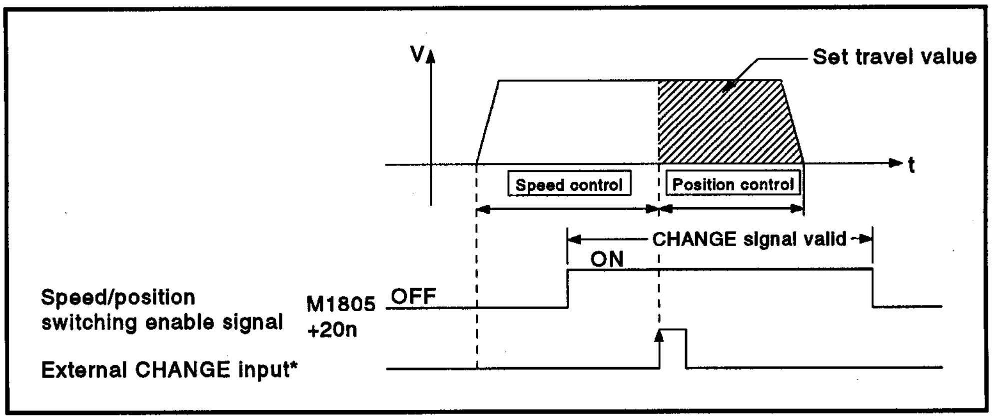
Servo Instruction	Positioning Method	Number of Controllable Axes	Items Set by Peripherals																					
			Common							Arc			Paramter Block									Others		
			Parameter Block No.	Axis	Address/Travel Value	Commanded Speed	Dwell Time	M Code	Torque Limit Value	Auxiliary Point	Radius	Center Point	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	O	O	O	Δ	Δ	Δ					Δ	Δ	Δ	Δ	Δ	Δ		Δ	Δ	Δ	OK

O : 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 M1805+20n (Speed/position switching enable signal) is ON. If M1805+20n turns ON after the CHANGE signal turns ON, no speed/position switching occurs and speed control is continued.



REMARKS

*: 1) When using A171SCPU, the external CHANGE signal is an external input to the A171SENC DOG/CHENGE terminal. When "normally open contact input" is set in the system settings, CHANGE input occurs when the DOG/CHANGE signal comes ON, and when "normally closed contact input" is set, CHANGE input occurs when the DOG/CHANGE signal goes OFF. (See the A171SCPU Motion Controller User's Manual (IB-67276) for details.)

2) When using A273UHCPU (8/32-axis specification), the external CHANGE signal is an external input to the A278LX CHANGE terminal. (See the A273UHCPU (8/32-axis specification) Motion Controller User's Manual (IB-67262) for details.)

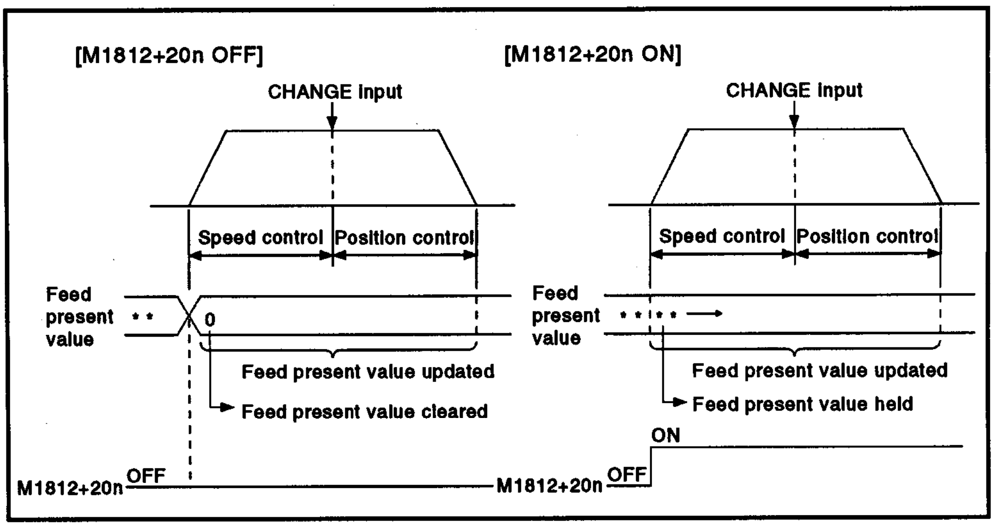
(3) Feed present value processing
The feed present value is determined in one of the following two ways according to the ON/OFF status of M1812+20n (feed present value update request command) when speed/position switching control is started.

(a) M1812+20n...... OFF
- The feed present value is cleared to zero at the start of speed/position switching control.
- The feed present value is updated from the start of control (speed control).
- The feed present value after control is stopped is as follows:

[Feed present value after stopping] = [Travel value under speed control] + [Travel value under position control]

(b) M1812+20n...... ON
- The feed present value is not cleared at start of speed/position switching control.
- The feed present value is updated from the start of control (speed control).
- The axis makes a deceleration stop if the feed present value exceeds the stroke limit.
- The feed present value after control is stopped is as follows:

[Feed present value after stopping] = [Address before speed control] + [Travel value under speed control] + [Travel value under position control]



POINT

If control is started by turning M1812+20n/YnC/M3212+20n ON, leave M1812+20n/YnC/M3212+20n ON until positioning control is completed. The feed present value cannot be guaranteed if M1812+20n /YnC/ 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.

<A171SCPU>

Axis No.	Data Register Number for Indirect Designation	Data Registers to Change Travel Value	
		Most-Significant Data	Least-Significant Data
1	D815	D816	D815
2	D835	D836	D835
3	D855	D856	D855
4	D875	D876	D875

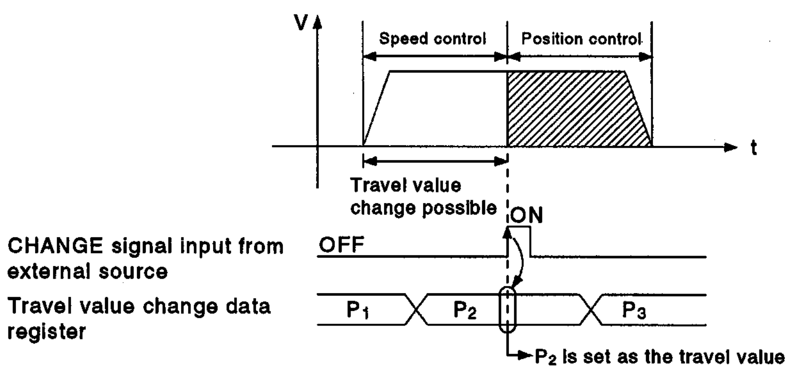
* See Sections 3.4 for the data register numbers used in indirect designation of travel values with A273UHCPU (8/32-axis specification).

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 D875 and D876.

```
<K 11>
VPF
 Axis     4,      D 875   ← 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.

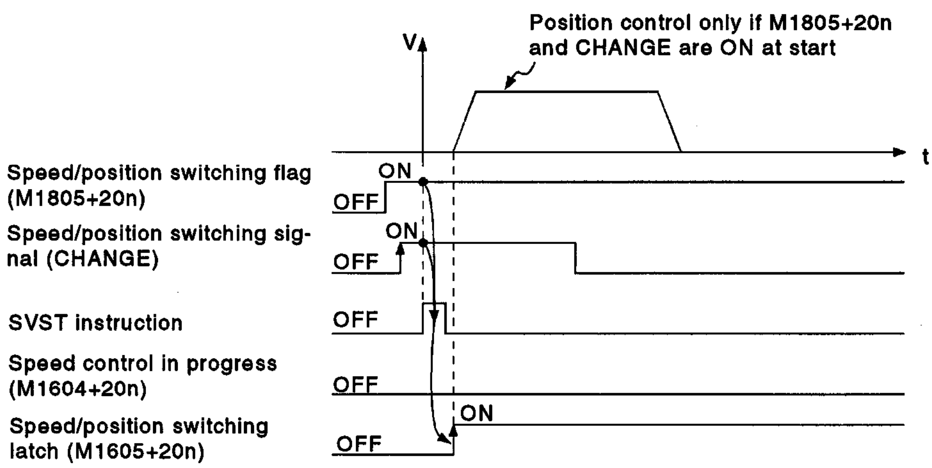


(5) Travel value area after near-zero point dog turns ON
The travel value since the position mode was selected by the external CHANGE signal is stored in the travel value area (see section 3.4.1) when the near-zero point dog turns ON.

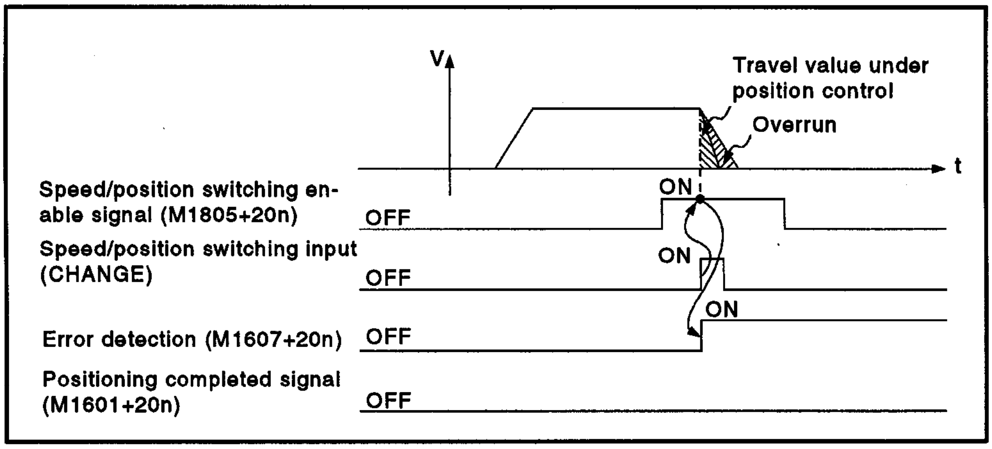
[Cautions]

(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+1) is ON.
- Speed control is in progress after start of speed/position switching control.
- Speed/position switching enable signal (M1805+20n) is ON.

(2) To omit speed control
Position control only is executed if M1805+20n and the CHANGE signal are ON when control starts. The speed control signal (M1604+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 (M1607+20n) turns ON and error code 209 is stored in the data register.
(c) The positioning completed signal (M1601+20n) does not turn ON.

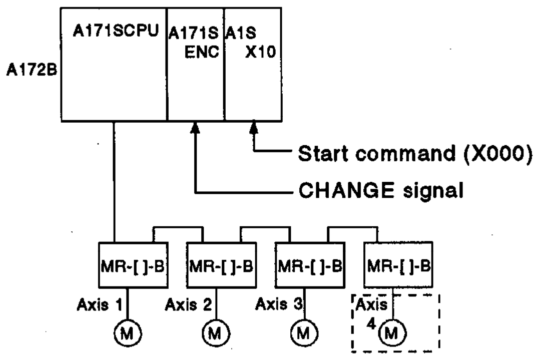


(4) Stoke limit check
No stroke limit range check is made during the speed mode. If the travel value exceeds the stroke limit range, a minor error (error code: 210) occurs when position mode is selected, and a deceleration stop occurs.

(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.

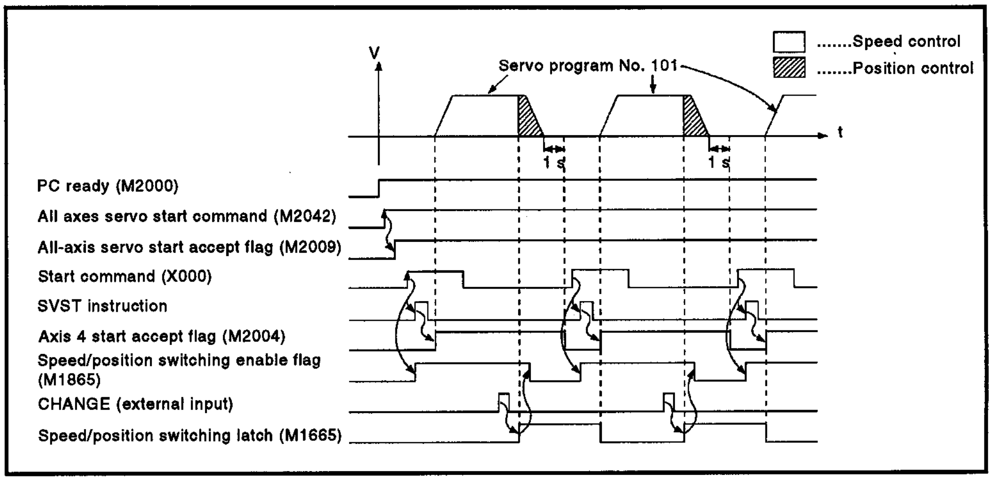
Item	Setting
Servo program number	No. 101
Controlled axis	Axis 4
Positioning control travel value	40000
Commanded speed	1000

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

(c) Speed/position switching enable flag M1865

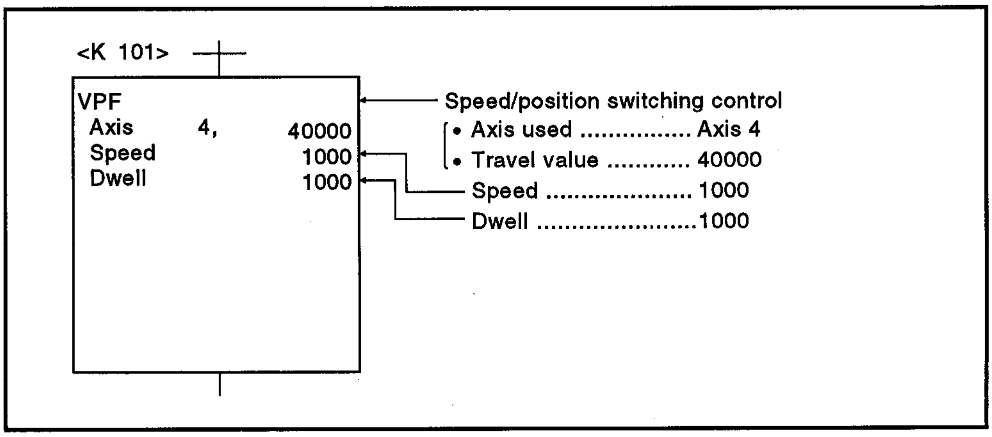
(3) Operation timing

The operation timing for speed/position switching control is shown below.



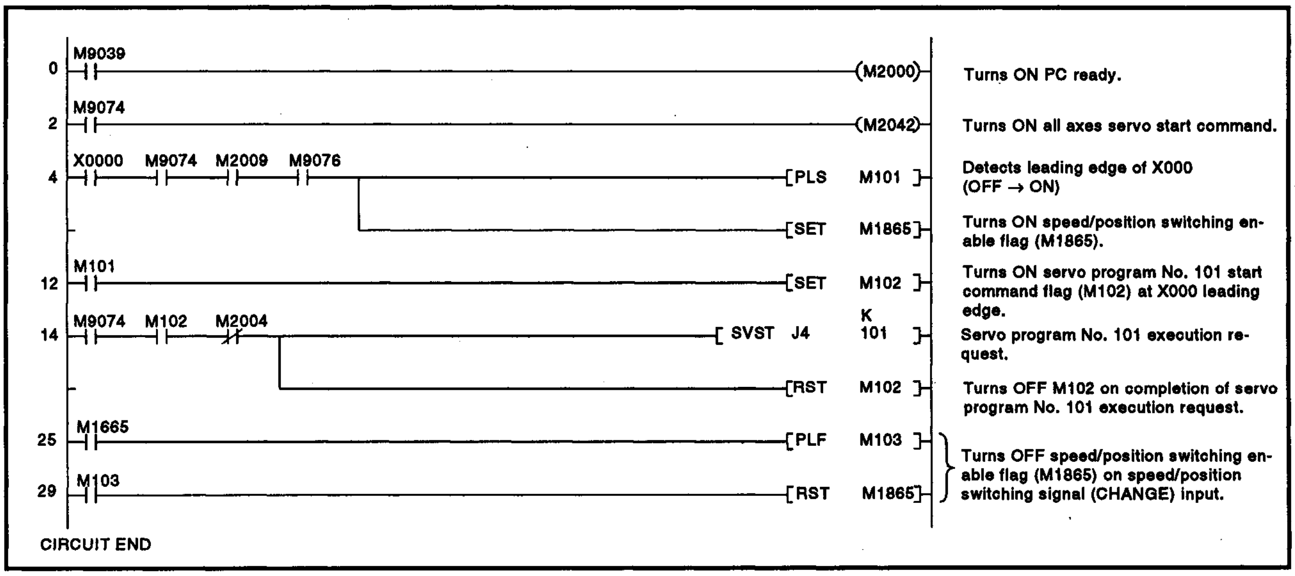
(4) Servo program

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																					Speed Change
			Common							Arc			Paramter 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	
VPSTART				o																		Δ	Δ	

o : 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 Switcing Control".)

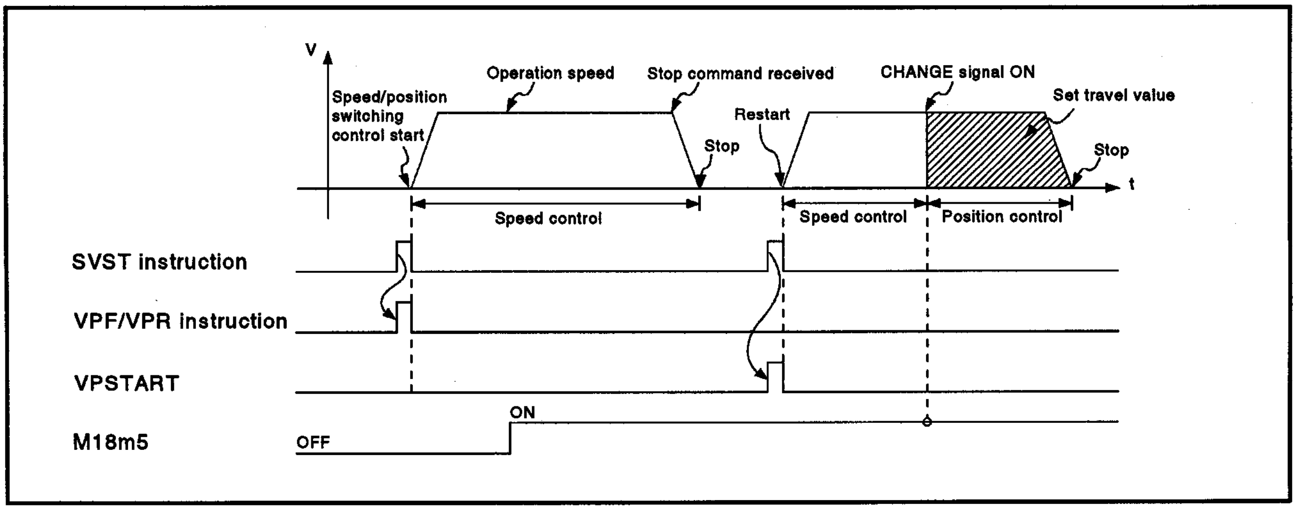


Figure 7.26 Restarting During Speed Control

(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 before stop (P1)]

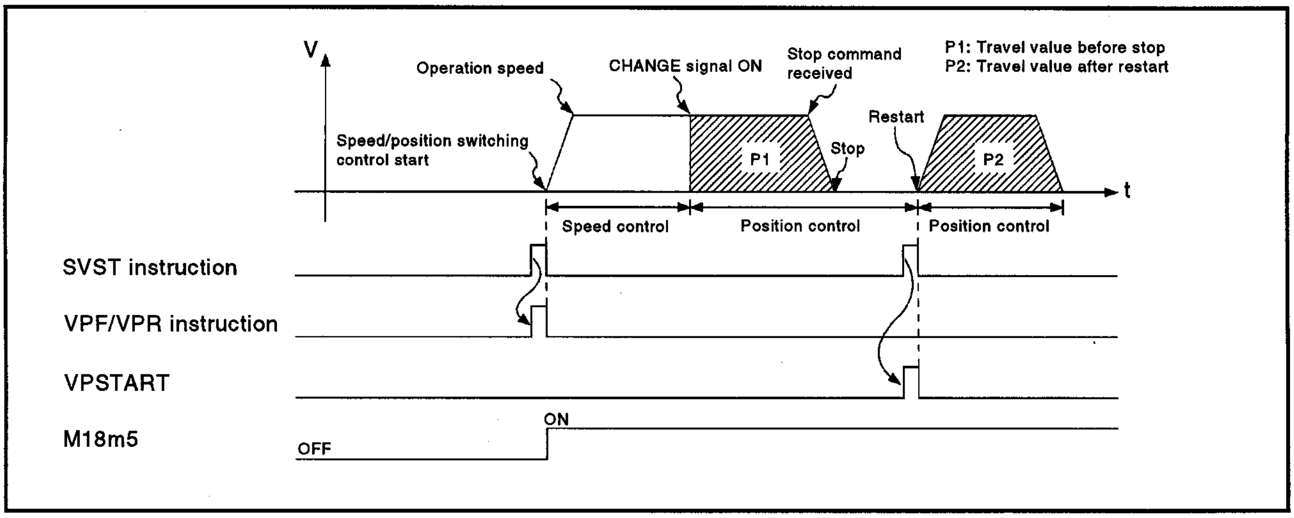


Figure 7.27 Restarting During Speed Control

(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.

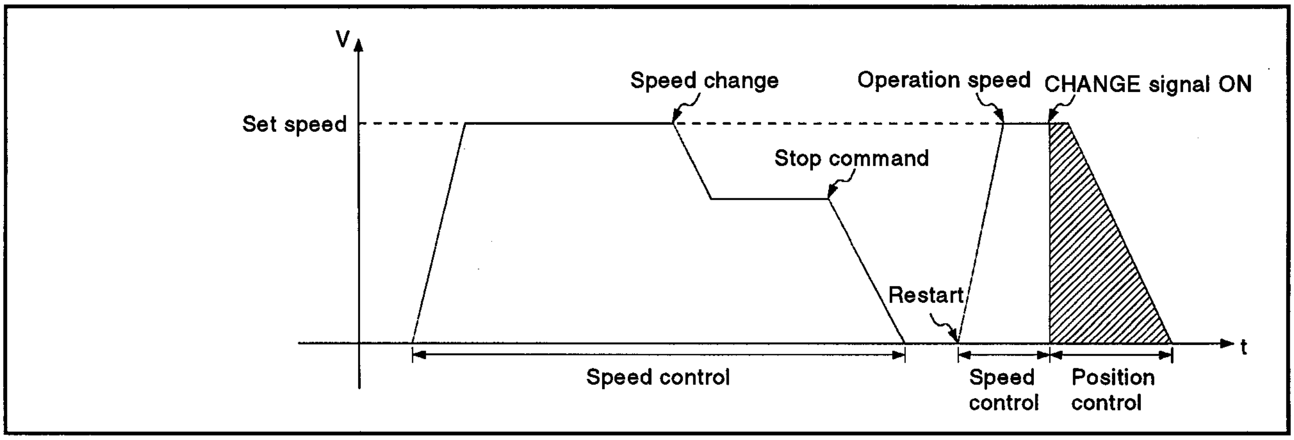
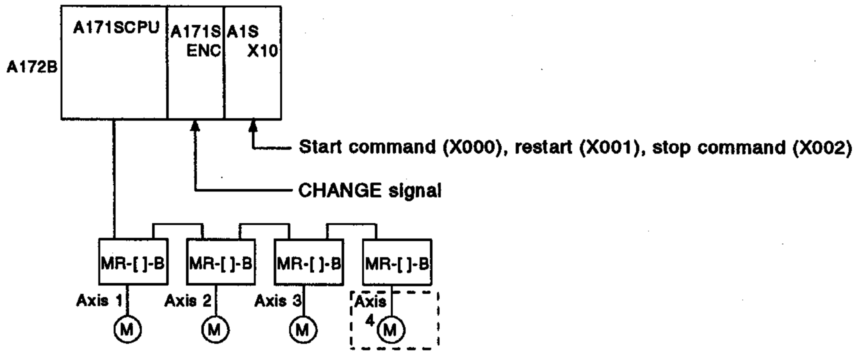


Figure 7.28 Restarting After Speed Change

[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	—

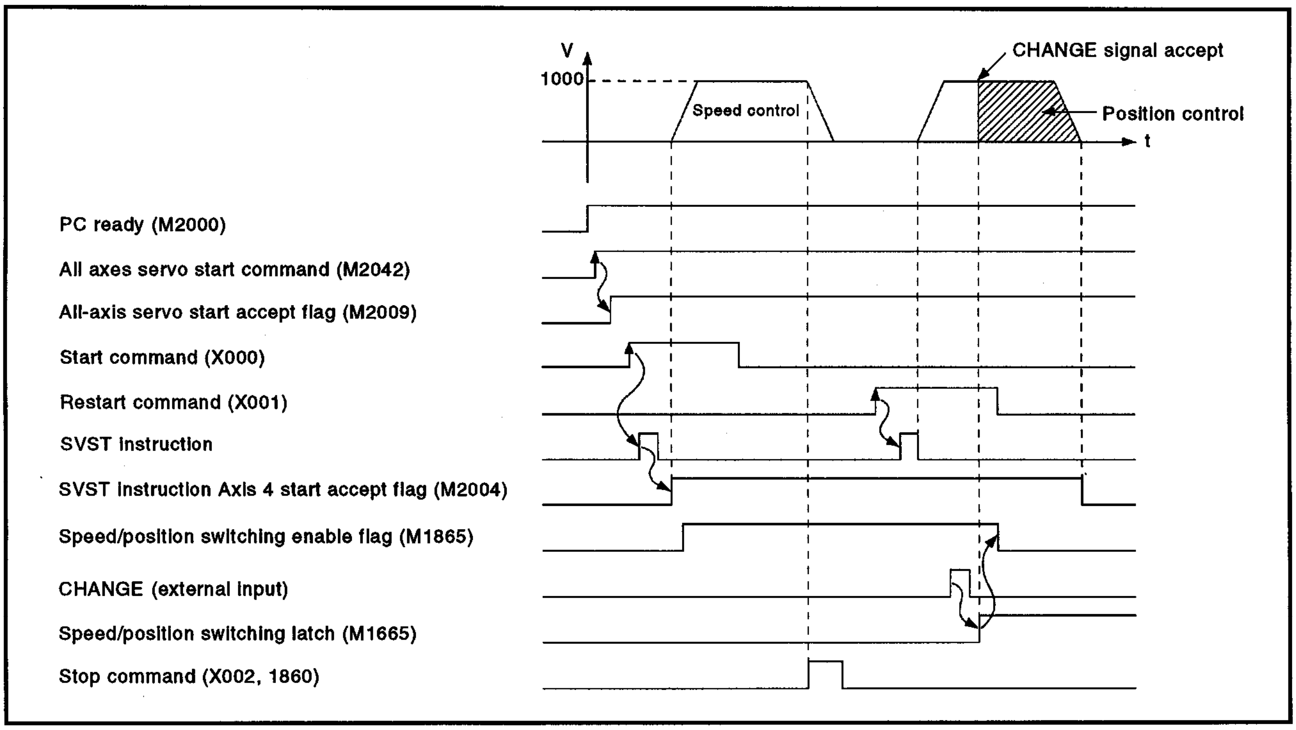
(b) Positioning start command ....leading edge of X000 (OFF → ON)

(c) Speed/position switching enable flag M1865

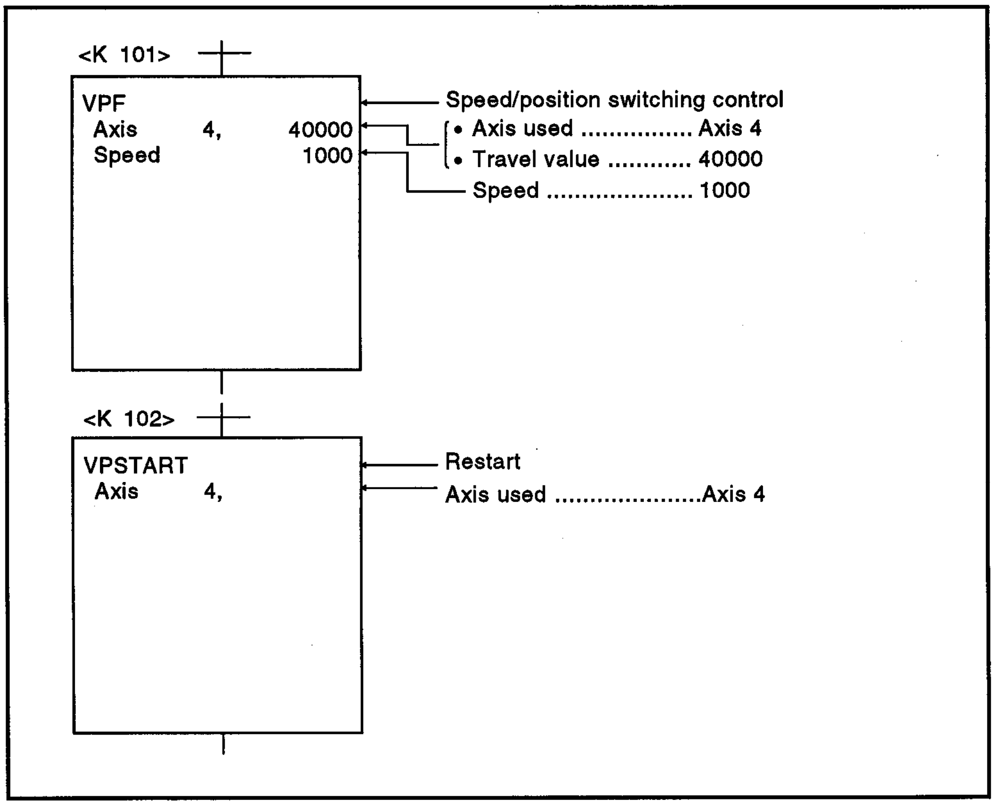
(d) Restart command ....leading edge of X001 (OFF → ON)

(e) Stop command ....leading edge of X002 (OFF → ON)

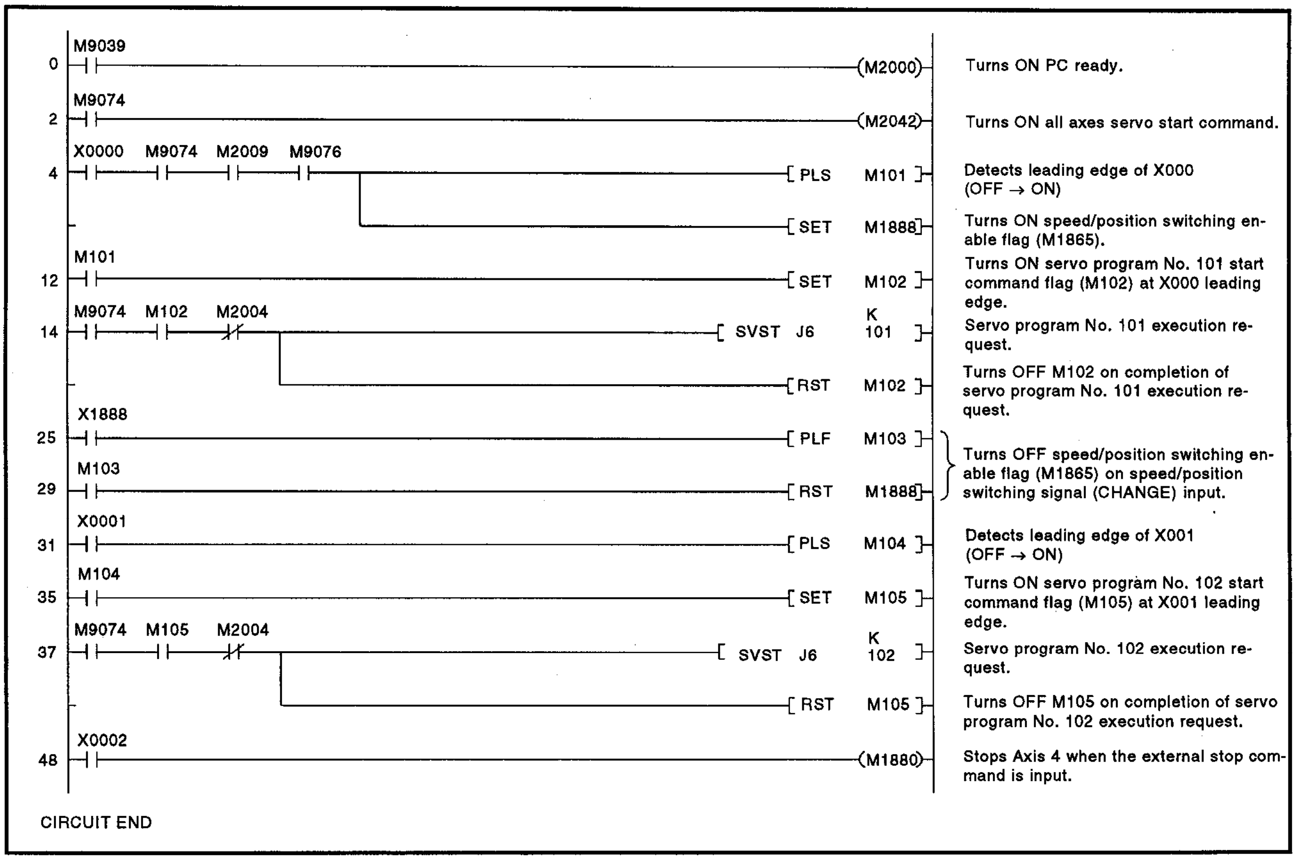
(3) Operation timing
The operation timing for speed/position switching control and restarting is shown below.



(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		
				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
Start	VSTART	—	—	Δ										Δ	Δ	Δ	Δ	Δ	Δ	Δ		Δ	Δ	Δ	—
End	VEND																								
End point address	ABS-1	Absolute data	1		O	O	O	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	—			O	O		Δ	Δ															—
	VABC	Incremental																							

O : 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 one-axis linear positioning control.
The control details are described in Section 7.2 "One-axis Linear Positioning Control".

(2) ABS-2/INC-2
Designate two-axis linear interpolation control.
The control details are described in Section 7.3 "Two-axis Linear Interpolation Control".

(3) ABS-3/INC-3
Designate three-axis linear interpolation control.
The control details are described in Section 7.4 "Three-axis 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-axis linear interpolation control apply to the axes designated for speed-switching control end address and travel value to the end point (with the ABS/INC instructions).

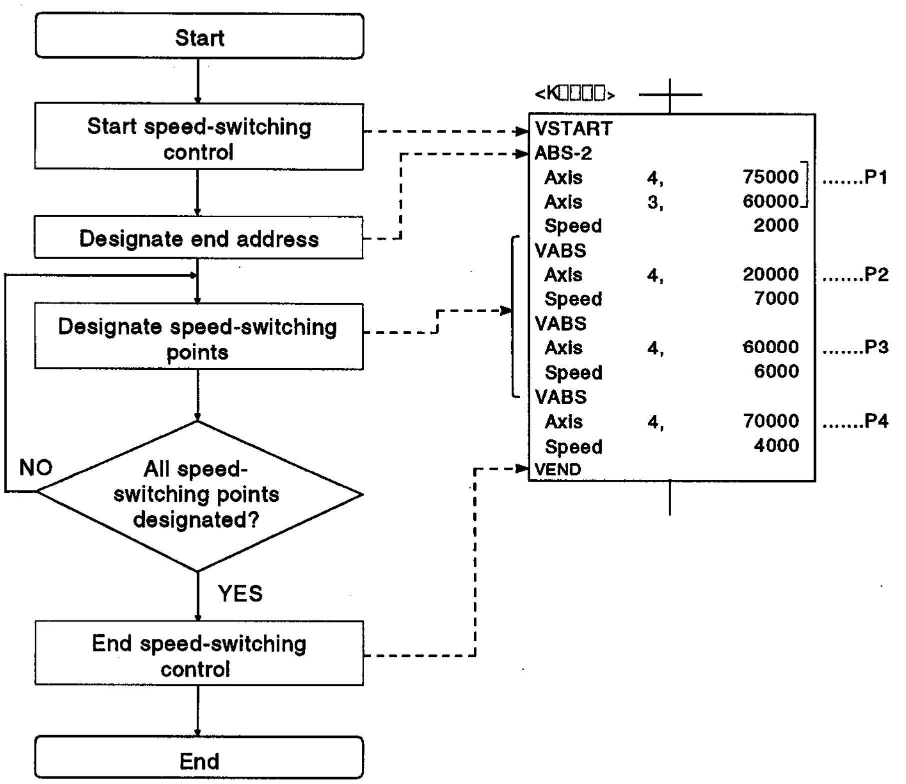
```
VSTART
ABS-2
 Axis     2,       75000
 Axis     3,       60000
 Speed              2000
```

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 Figure 7.29.

[Servo program]



[Operation timing]

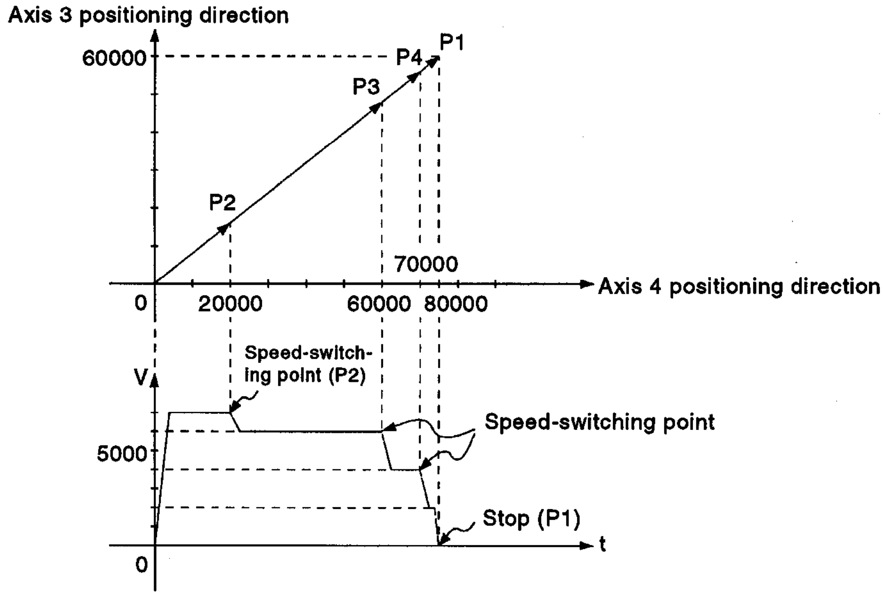


Figure 7.29 Servo Program for Speed/Position Switching Control And Operation Timing

[Cautions]

(1) The number of controllable axes 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.

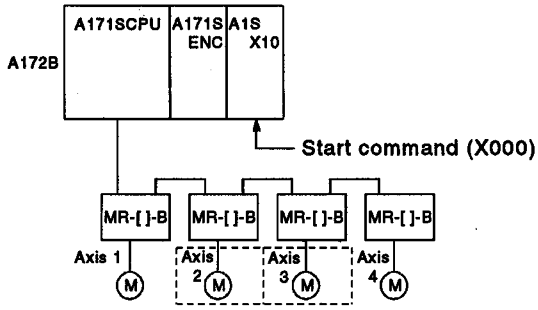
(6) Speed switching is not carried out if the travel value between speed-switching points is so short that the next speed-switching point is reached while speed switching is still in progress.

(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.



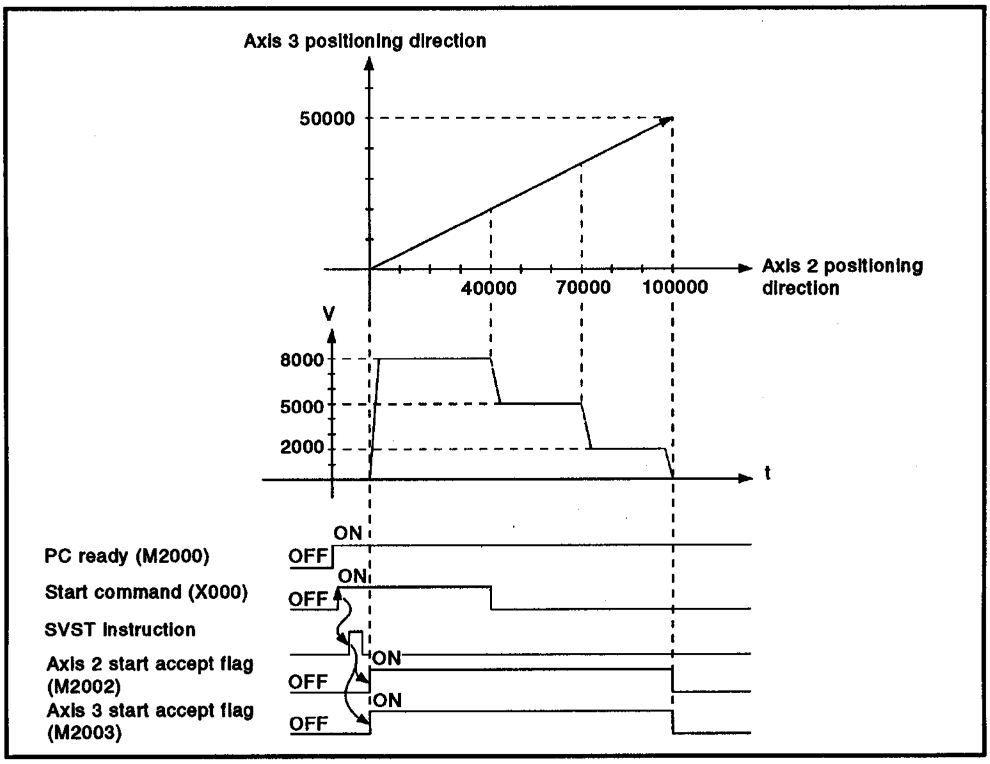
(2) Positioning conditions

(a) The speed-switching control conditions are shown below.

Item	Setting	
Servo program number	No. 500	
Controlled axes	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.



⚠ 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 regardless 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

0 → 180 → 0 → 270 [degree]

Motion when skip is executed
(when the skip occurs at 100 [degree])

0 → 100 → 280 → 190 [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
INC-1
 Axis     1,   350.00000
INC-1
 Axis     1,   270.00000
CPEND
```

Motion when skip is not executed

0 → 180 → 350 → 270 [degree]

Motion when skip is executed
(when the skip occurs at 100 [degree])

0 → 100 → 350 → 270 [degree]

Whether or not the skip occurs, the final positioning point will be the same.

(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

0 → 0 → 180 → 0 → 90 [degree]

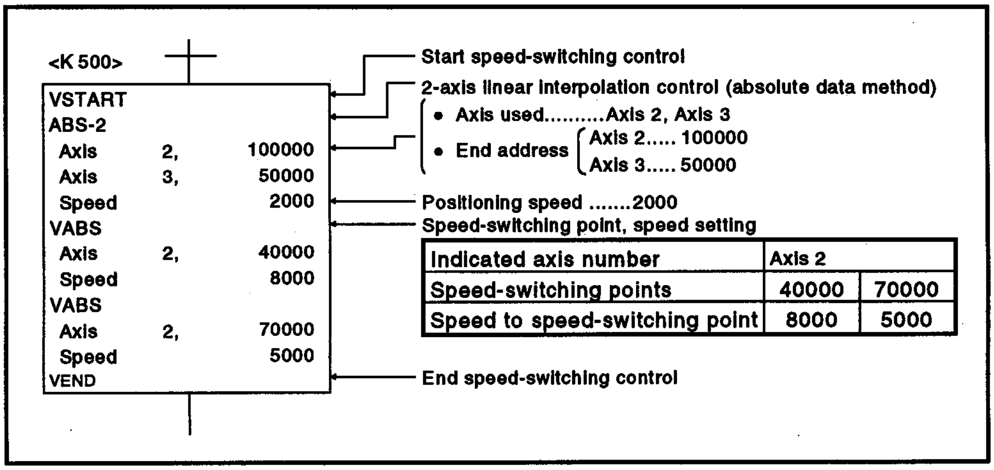
Motion when skip is executed
(when the skip occurs at 80 [degree])

0 → 80 → 260 → 80 → 90 [degree]

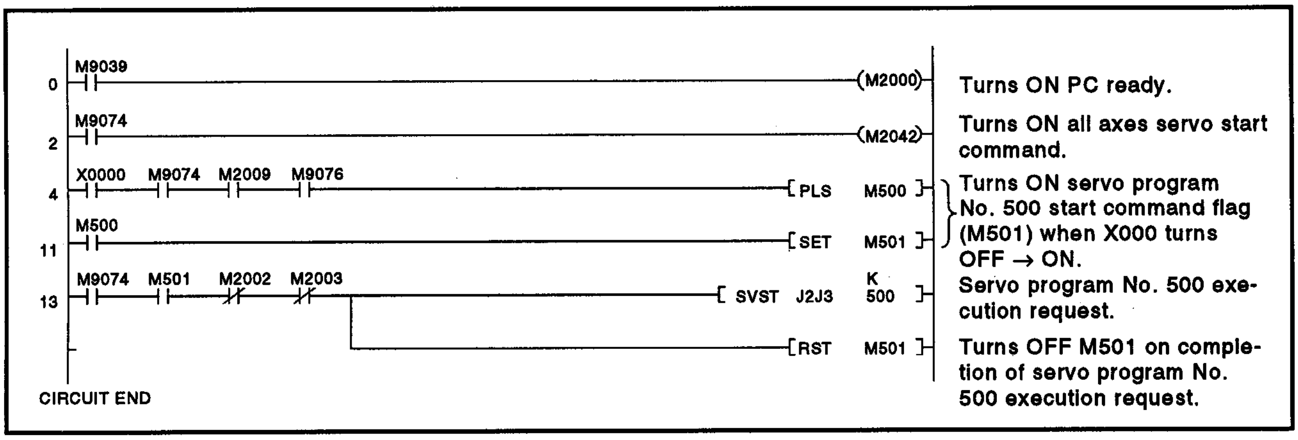
At this point there is a motion of 370 degrees, not 10 degrees.

Whether or not the skip occurs, the final positioning point will be the same.

(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 FOR-OFF	—	—																				O	Δ	Δ	—
NEXT	—	—																							

O : 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)

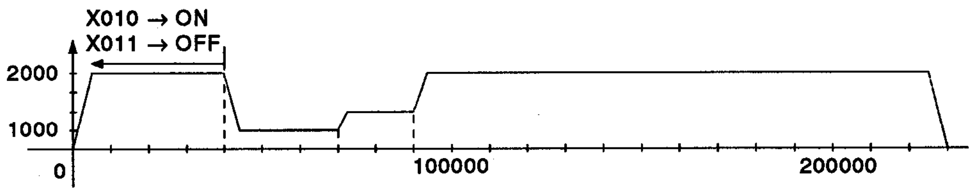
Repeated operation using FOR-TIMES, FOR-ON, and FOR-OFF is shown below.

[Servo Program]

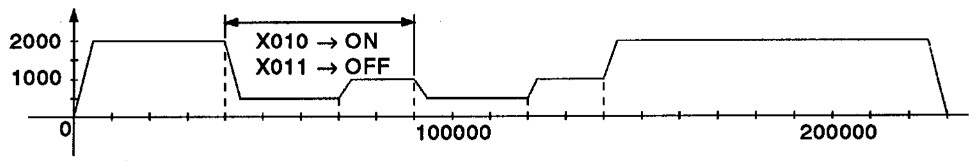
```
<K 701>
VSTART
INC-2
 Axis     1,    230000
 Axis     2,    100000
 Speed            2000
VINC
 Axis     1,     40000
 Speed            2000
1)
                   2)
VINC                         )
 Axis     1,     30000       |
 Speed             500       |
VINC                         | 3)
 Axis     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	X011 → OFF from start	X011 → OFF during first execution of 3)	X011 → OFF during third execution of 3)

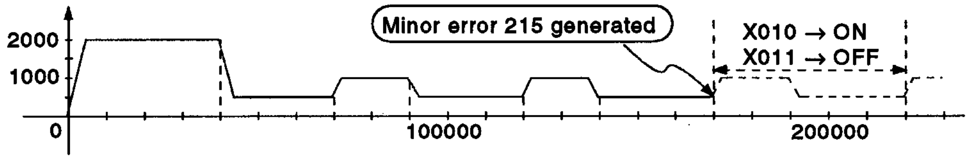
(1) Operation under condition 1



(2) Operation under condition 2



(3) Operation under condition 3

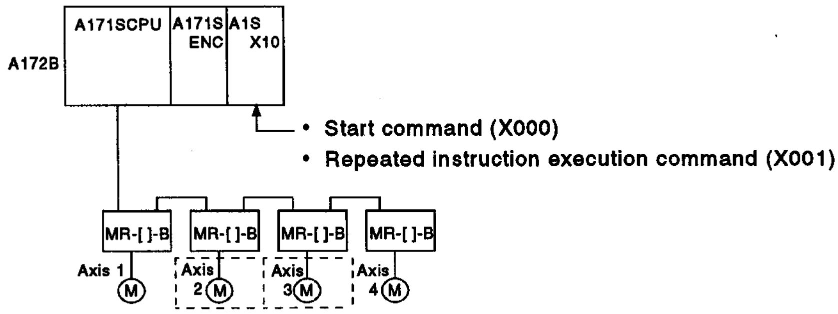


Error generated because the distance to the stop position exceeds the travel value.

[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.

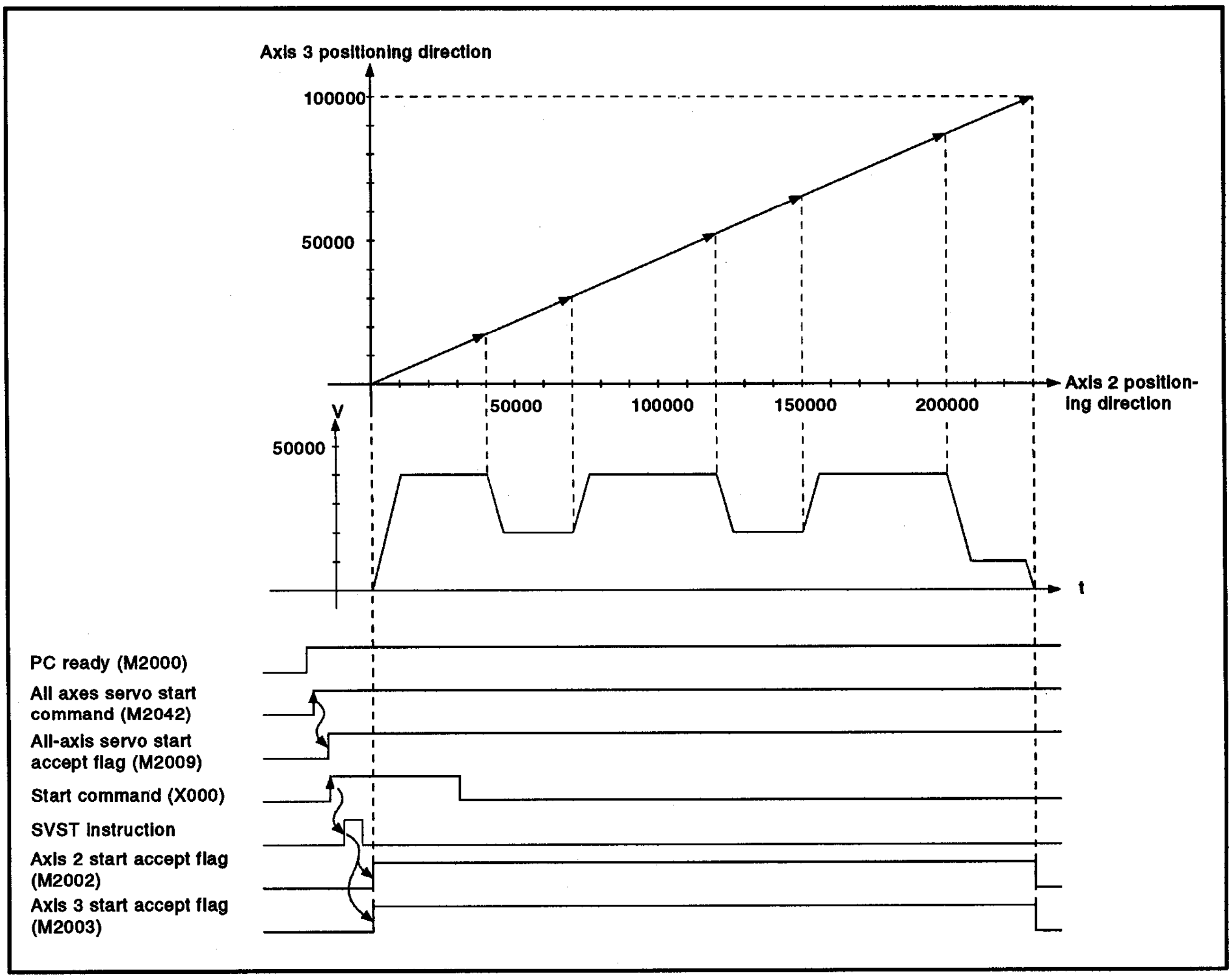


(2) Positioning conditions
(a) The speed-switching control conditions are shown below.

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.

```
<K 501>
VSTART
INC-2
 Axis      2,     230000
 Axis      3,     100000
 Speed             10000
VINC
 Axis      2,      40000
 Speed             40000
FOR-TIMES
                  K    2
VINC
 Axis      2,      30000
 Speed             20000
VINC
 Axis      2,      50000
 Speed             40000
NEXT
VEND
```

Start speed-switching control
2-axis linear interpolation control (incremental method)
- Axis used..........Axis 2, Axis 3
- End address: Axis 2... 230000; Axis 3... 100000

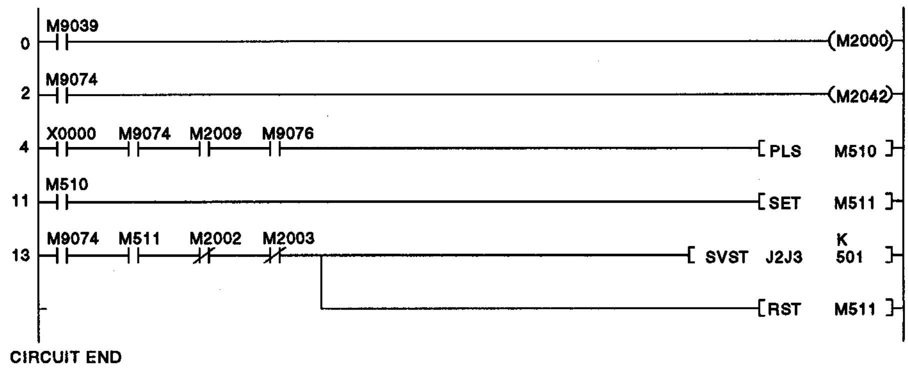
Positioning speed 10000
Speed-switching point, speed setting
- Indicated axis ...Axis 2
- Travel value to speed-switching point 40000

Number of repeats 2
Speed-switching point and speed setting

Indicated axis number	Axis 2	
Travel value to speed-switching point	30000	50000
Speed to speed-switching point	20000	40000

End speed-switching range
End speed-switching control

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



Turns ON PC ready.
Turns ON all axes servo start command.
Turns ON servo program No. 501 start command flag (M511) when X000 turns OFF → ON.
Servo program No. 501 execution request.
Turns OFF M511 on completion of servo program No. 501 execution request.

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.

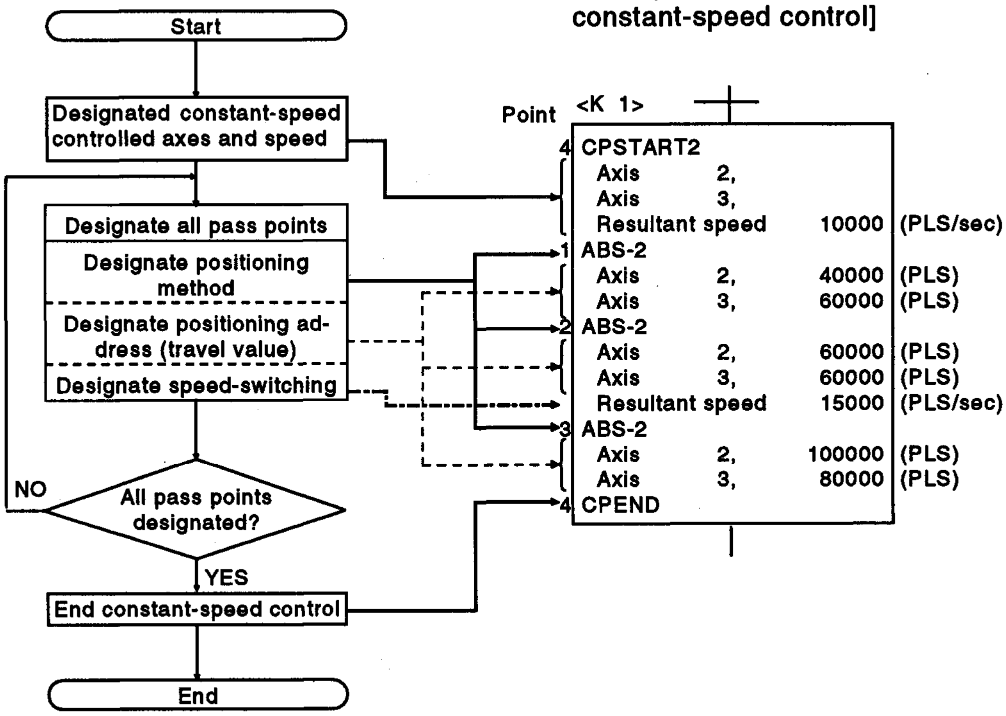
(6) From one to four axes can be controlled.

[Procedure to Write Servo Programs]

The method to write servo programs for constant-speed control is shown below.

[Procedure]

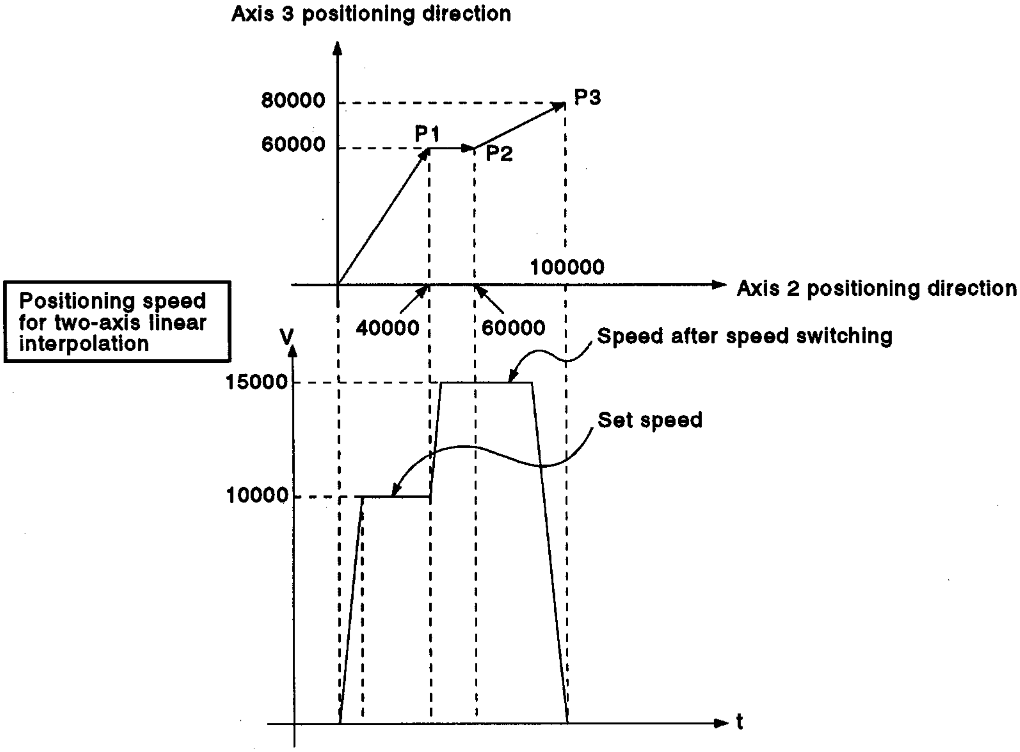
[Example: Servo program for 2-axis constant-speed control]



[Operation Timing]

The operation timing for constant-speed control is shown below.

[Example: Operation timing for 2-axis constant-speed control]



[Caution]

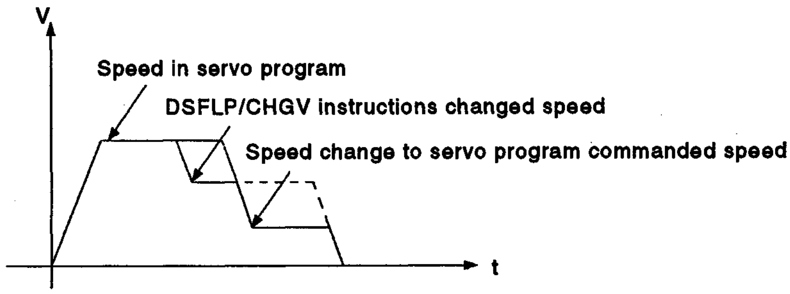
(1) The number of controllable axes cannot be changed while control is in progress.

(2) Positioning control to the pass points can use a combination of the absolute data method (ABS□) and the incremental method (INC□).

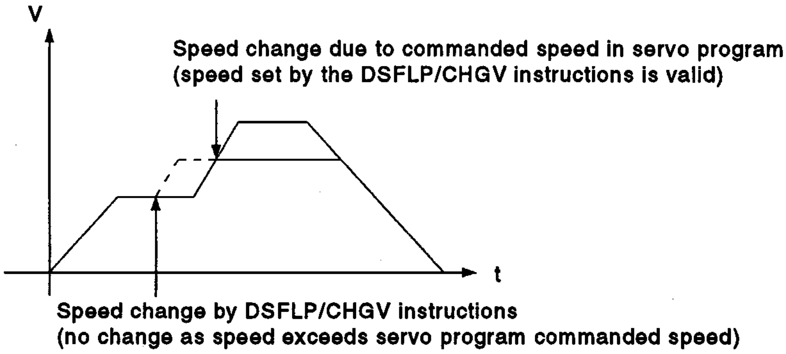
(3) A pass point can be designated as an address which results in a change in travel direction.
However, a servo error or some other error may occur if acceleration processing occurs at a pass point for 1-axis constant-speed control but no acceleration or deceleration processing occurs at the pass point for 2- to 4-axis 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 DSFLP/CHGV instructions are used for the speed change in the same program
The lower of the speed changed by the DSFLP/CHGV instructions and the speed set by the servo program is selected.
The DSFLP/CHGV instructions are executed if the changed speed is lower than the speed set in the servo program; otherwise the DSFLP/CHGV instructions are not executed.
1) If DSFLP/CHGV changed speed>servo program set speed
The speed set in the servo program is selected.



2) If DSFLP/CHGV changed speed<servo program set speed
The speed changed by the DSFLP/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 x 0.02 < Travel distance (pulses)

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																						
			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	Repeated Condition	Cancel	Start	Speed Change
FOR-TIMES FOR-ON FOR-OFF	—	—																				O	Δ	Δ	—
NEXT	—	—																							

O: 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) — 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:

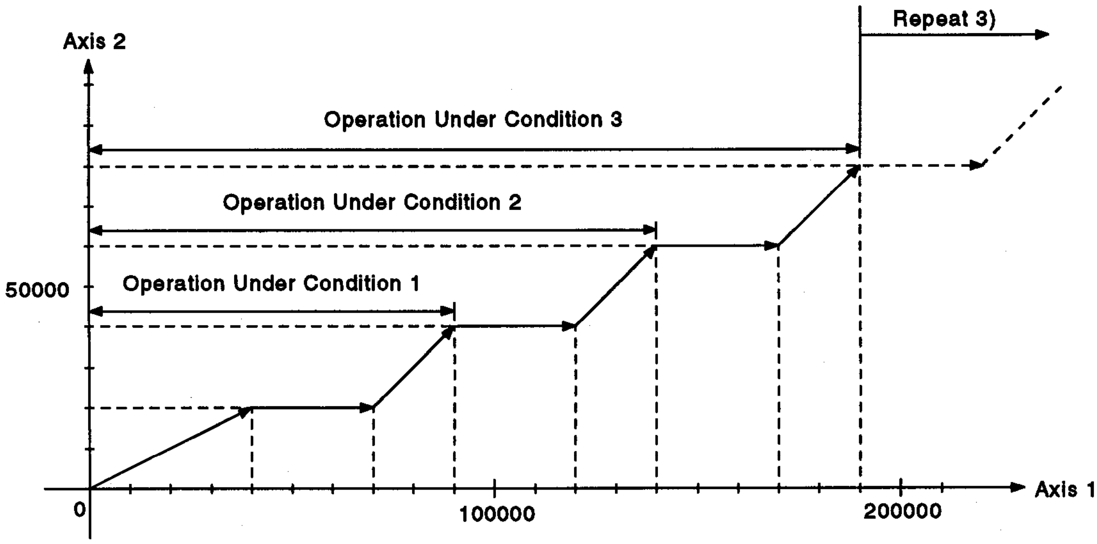
1) Input (X)
2) Output (Y)
3) Internal relay (M)/Special relay (SP.M)
4) Latch relay (L)
5) Link relay (B)
6) Annunciator (F)

Repeated operation using FOR-TIMES, FOR-ON, and FOR-OFF is shown below.

[Servo Program]

```
CPSTART2
  Axis        1,
  Axis        2,
  Resultant speed      1000
ABS-2
  Axis        1,      40000
  Axis        2,      20000
 1)
                        2)
INC-2                         ┐
  Axis        1,      30000   │
  Axis        2,          0   │
INC-2                         │ 3)
  Axis        1,      20000   │
  Axis        2,      20000   ┘
NEXT
CPEND
```

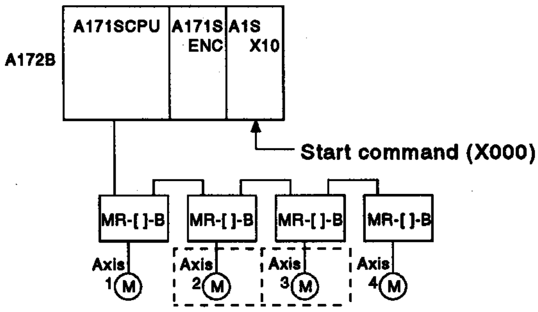
1)	2)		
	Condition 1	**Condition 2**	**Condition 3**
FOR-TIMES	K1	K2	K3
FOR-ON	X010 → ON from start	X010 → ON during first execution of 3)	X010 → ON during second execution of 3)
FOR-OFF	X011 → OFF from start	X011 → OFF during first execution of 3)	X011 → OFF during second execution of 3)



[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.



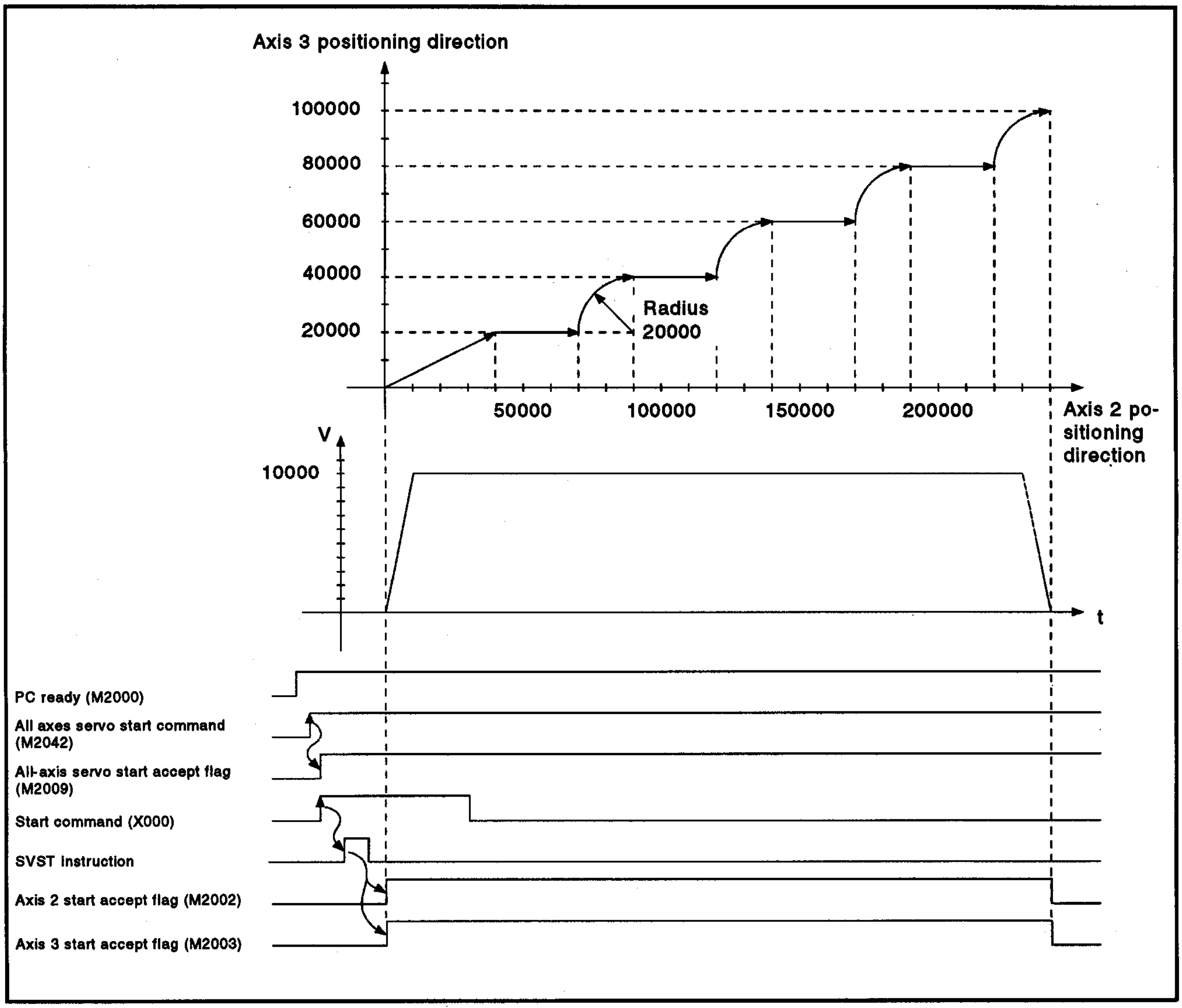
(2) Positioning conditions

(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

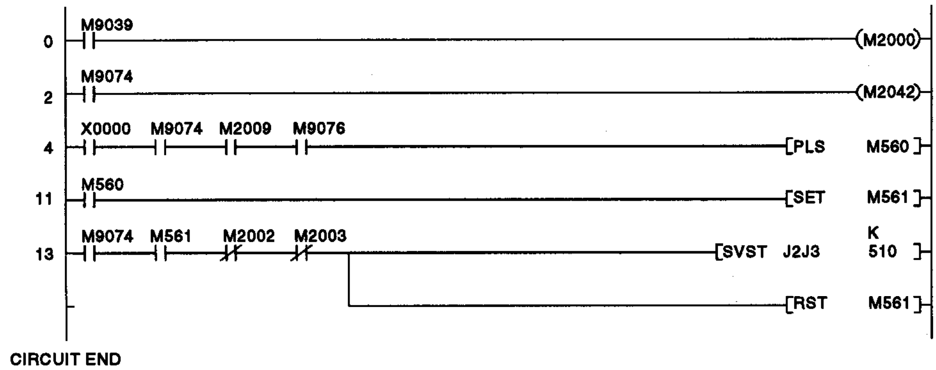
The servo program No. 510 for constant-speed control is shown below.

```
<K 510>
CPSTART2                      ← Start constant-speed control
  Axis    2,                  ← Axes used.............Axis 2, Axis 3
  Axis    3,
  Speed           10000       ← Positioning speed...10000
ABS-2                         ← Pass point setting
  Axis    2,      40000
  Axis    3,      20000
FOR-TIMES                     ← Number of repetitions 4
              K       4
INC-2                         ← Pass point setting
  Axis    2,      30000
  Axis    3,          0
INC ⌒
  Axis    2,      20000
  Axis    3,      20000
  Radius          20000
NEXT                          ← End constant-speed range
CPEND                         ← End constant-speed control
```

Positioning Method		2-Axis Linear Interpolation	Circular Interpolation Control Using Radius Designation
Travel value	Axis 2	30000	20000
	Axis 3	0	20000

(5) Sequence program

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



Turns ON PC ready.

Turns ON all axes servo start command.

Turns ON servo program No. 510 start command flag (M561) when X000 turns OFF → ON.

Servo program No. 510 execution request.

Turns OFF M561 on completion of servo program No. 510 execution request.

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.

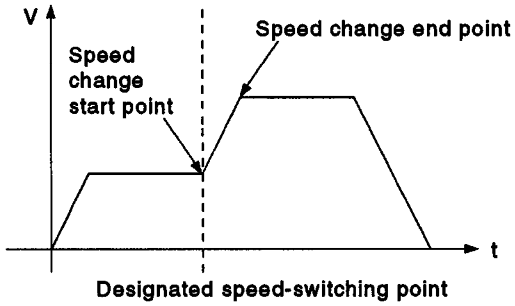
[Cautions]

(1) The speed can be changed during servo instruction execution for 1- to 4-axis constant-speed control.

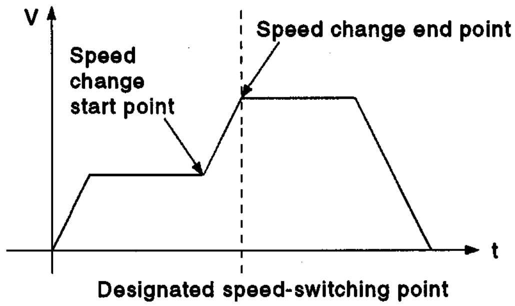
(2) The speed command can be set for each point.

(3) The speed-switching point designation flag M2016 (see Section 3.2.6) 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) M2016 is OFF
The speed change starts at the designated speed-switching point.



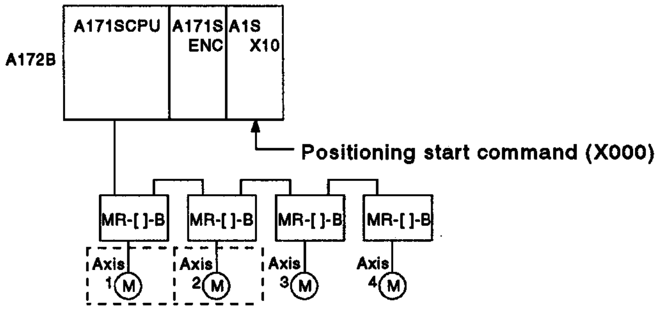
(b) M2016 is ON
The speed change ends at the designated speed-switching point.



[Program Example]

This program turns ON M2016 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.

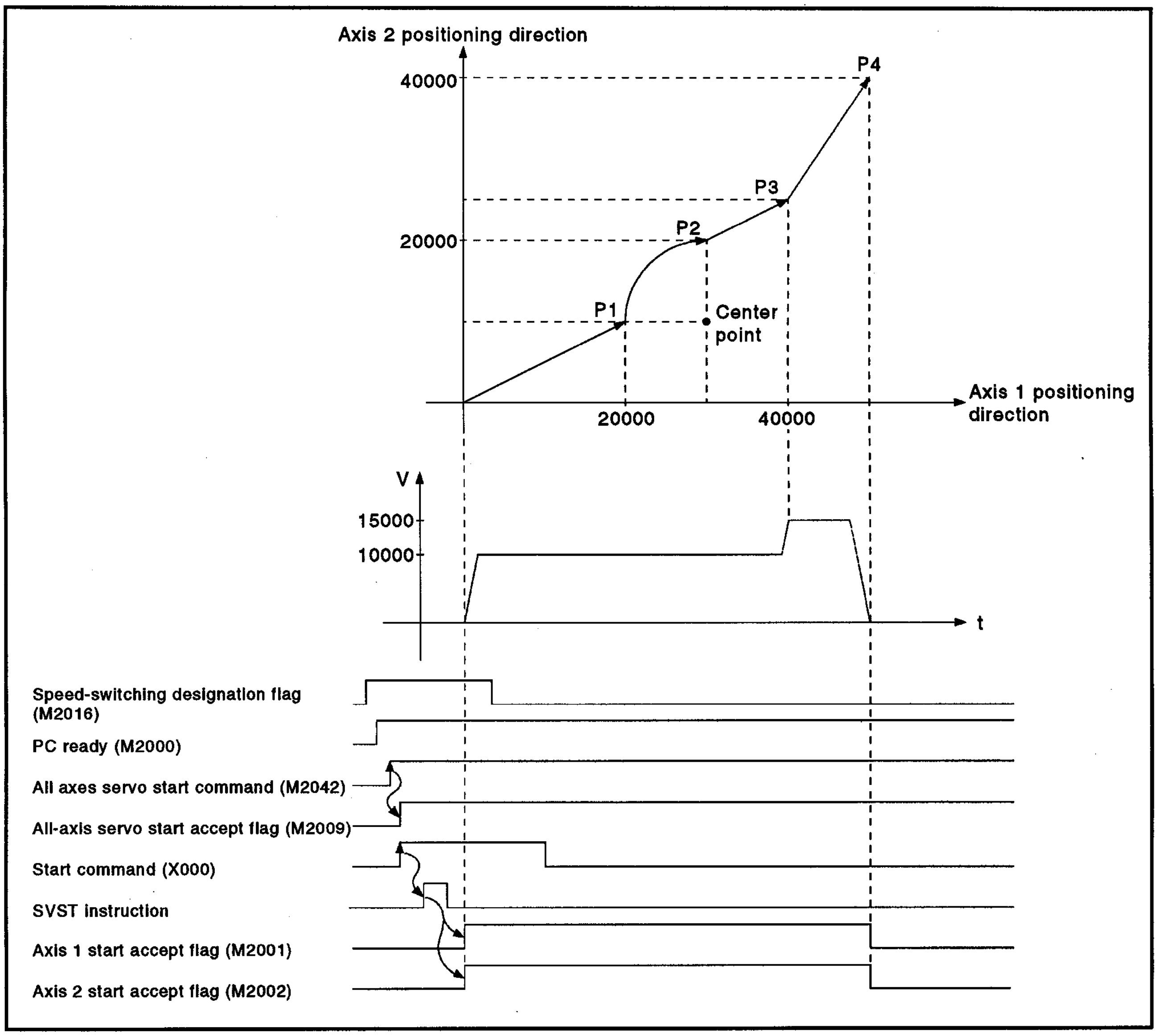


(2) Positioning conditions
(a) The speed switching conditions are shown below.

Item		Setting			
Servo program number		310			
Positioning speed		10000			
Positioning method		2-axis linear interpolation	Circular interpolation using center point designation	2-axis linear interpolation	2-axis 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 → ON)

(3) Operation timing and speed-switching positions
The operation timing and positions for speed switching are shown below.



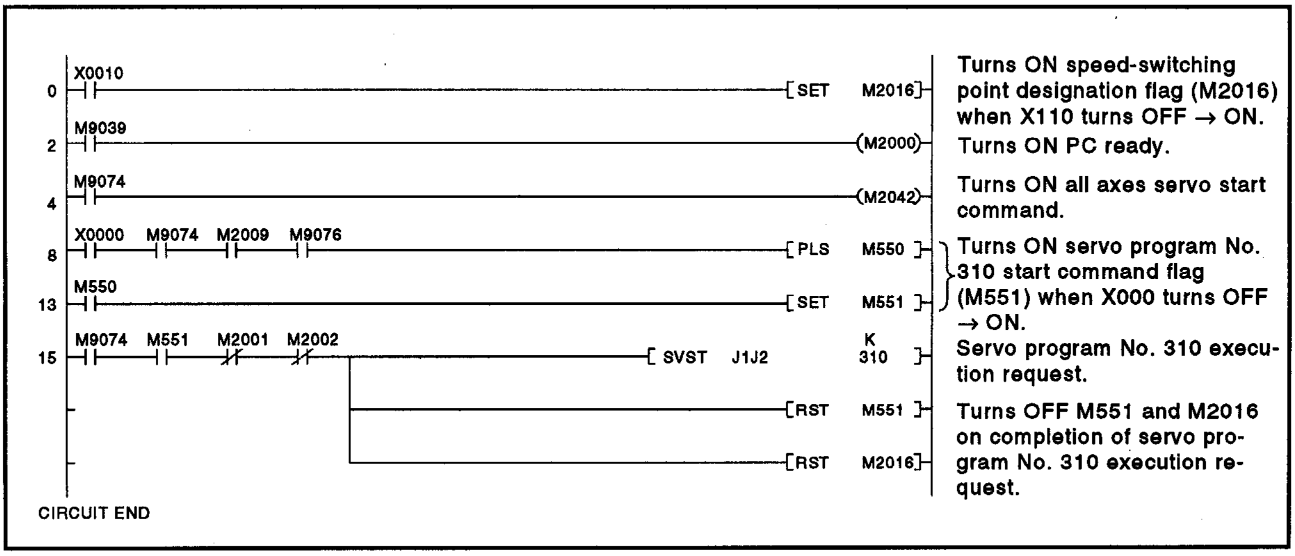
(4) Servo program

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

Constant-speed control for the one axis designated with the sequence program positioning commands.

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	Commanded speed (constant-speed)	Cancel	Start	Skip	FIN acceleration		
Start	CPSTART1	—	1	Δ	O		O								Δ	Δ	Δ	Δ	Δ	Δ		Δ		Δ	Δ		Δ		
End	CPEND	—	—					Δ																					OK
Pass point	ABS-1	Absolute data	1		O	O			Δ	Δ													Δ			Δ			
	INC-1	Incremental	1		O	O			Δ	Δ													Δ			Δ			

O : Must be set
Δ : Set if required

[Control Details]

Starting and ending one-axis constant-speed control

One-axis constant-speed control is started and ended using the following instructions:

(1) CPSTART1
Starts one-axis constant-speed control. Sets the axis number used and the commanded speed.

(2) CPEND
Ends the one-axis constant-speed control which was started using CPSTART1.

Positioning control method to the pass point

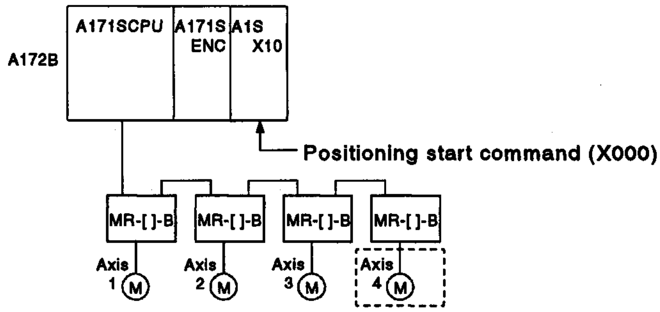
The positioning control to the point where control is changed is designated using the following instructions:

(1) ABS-1/INC-1
Designates one-axis linear positioning control.
See Section 7.2 "One-axis Linear Positioning Control" for details.

[Program Example]

This program executes repeated one-axis constant-speed control under the conditions below.

(1) System configuration
Constant-speed control for Axis 4.



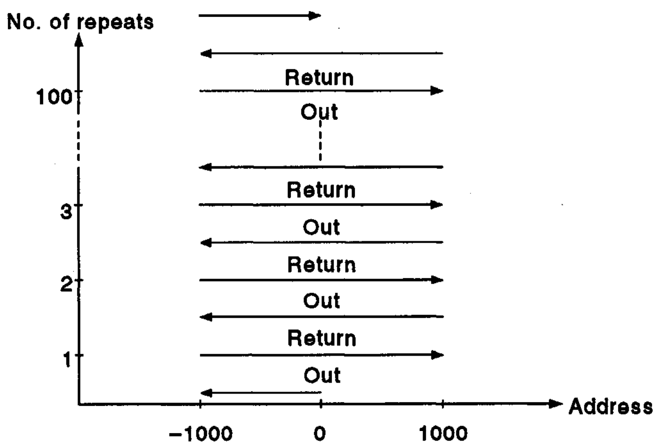
(2) Positioning conditions

(a) The constant-speed control conditions are shown below.

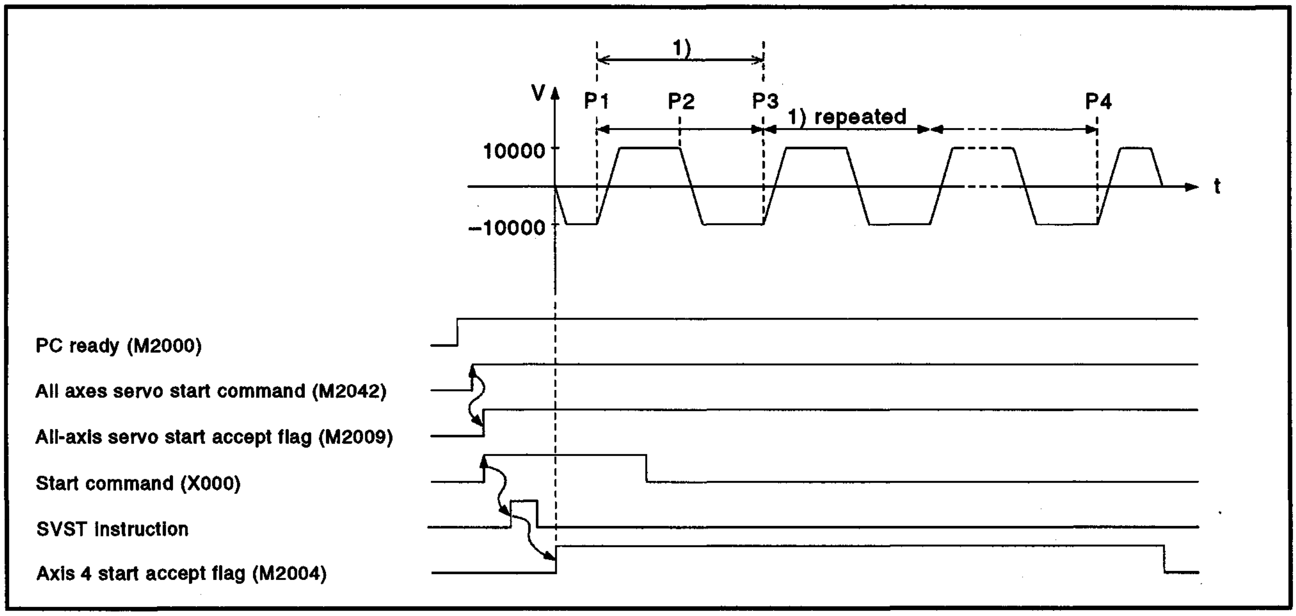
Item		Setting
Servo program number		500
Controlled axis		Axis 4
Positioning speed		10000
Number of repetitions		100
Pass point travel value	P1	−1000
	P2	2000
	P3	−2000
	P4	1000

(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.

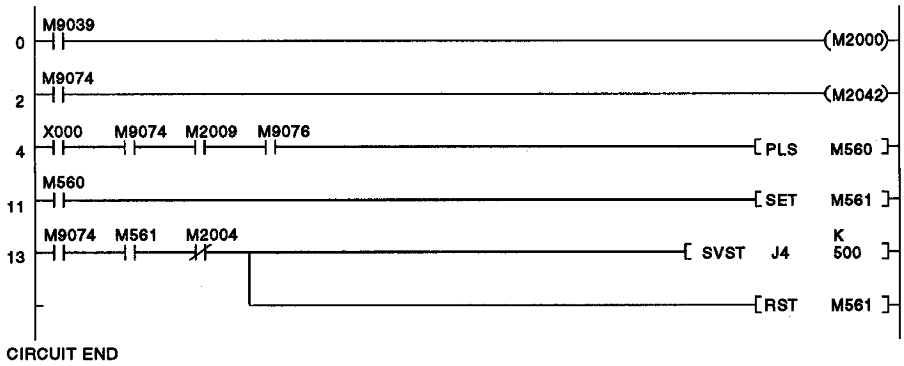


(5) Servo program
The servo program No. 500 for constant-speed control is shown below.

```
<K 500>
CPSTART1
  Axis      4
  Speed           10000
INC-1
  Axis      4,    -1000
FOR-TIMES
                K   100
INC-1
  Axis      4,     2000
INC-1
  Axis      4,    -2000
NEXT
INC-1
  Axis      4,     1000
CPEND
```

- Start constant-speed control
  - Axis used............... Axis 4
  - Positioning speed............... 10000
- One-axis linear positioning control
  - • Axis used............... Axis 4
  - • Positioning address............ -1000
- Set 100 repeats
- One-axis linear positioning control
  - • Axis used............... Axis 4
  - • Positioning address............ 2000
- One-axis linear positioning control
  - • Axis used............... Axis 4
  - • Positioning address............ -2000
- End repeated region
- One-axis linear positioning control
  - • Axis used............... Axis 4
  - • Positioning address............ 1000
- End constant-speed control

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



Turns ON PC ready.

Turns ON all axes servo start command.

Turns ON servo program No. 500 start command flag (M561) when X000 turns OFF → ON.

Servo program No. 500 execution request.

Turns OFF M561 on completion of servo program No. 500 execution request.

7.16.4 Two- to four-axis constant-speed control

Constant-speed control for the two, three, or four axes designated with the sequence program positioning commands.

Servo Instruction		Positioning Method	Number of Controllable Axes	Items Set by Peripherals: Common: Parameter Block No.	Axis	Address/Travel Value	Commanded Speed	Dwell Time	M Code	Torque Limit Value	Arc: Auxiliary Point	Radius	Center Point	Parameter Block: 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	Others: Commanded speed (constant-speed)	Cancel	Start	Skip	FIN Acceleration	Speed Change
Start	CPSTART2	—	2	Δ	O		O								Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ		Δ	Δ		Δ	
	CPSTART3		3	Δ	O		O								Δ	Δ	Δ	Δ	Δ	Δ		Δ		Δ	Δ		Δ	
	CPSTART4		4	Δ	O		O								Δ	Δ	Δ	Δ	Δ	Δ		Δ		Δ	Δ		Δ	
End	CPEND		—					Δ																				
Pass point	ABS-2	Absolute data	2		O	O			Δ	Δ													Δ			Δ		OK
	ABS-3		3		O	O			Δ	Δ													Δ			Δ		
	ABS-4		4		O	O			Δ	Δ													Δ			Δ		
	ABS		2		O	O			Δ	Δ	O															Δ		
	ABS ABS ABS ABS		2		O	O			Δ	Δ		O											Δ			Δ		
	ABS ABS		2		O	O			Δ	Δ			O										Δ			Δ		
	INC-2	Incremental	2		O	O			Δ	Δ													Δ			Δ		
	INC-3		3		O	O			Δ	Δ													Δ			Δ		
	INC-4		4		O	O			Δ	Δ													Δ			Δ		
	INC		2		O	O			Δ	Δ	O												Δ			Δ		
	INC INC INC INC		2		O	O			Δ	Δ		O											Δ			Δ		
	INC INC		2		O	O			Δ	Δ			O										Δ			Δ		

O : Must be set
Δ : Set if required

[Control Details]

Starting and Ending Two- to Four-Axis Constant-Speed Control

Two-, three-, or four-axis constant-speed control is started and ended using one of the following instructions:

(1) CPSTART2
Starts two-axis constant-speed control.
Sets the axis numbers used and the commanded speed.

(2) CPSTART3
Starts three-axis constant-speed control.
Sets the axis numbers used and the commanded speed.

(3) CPSTART4
Starts four-axis constant-speed control.
Sets the axis numbers used and the commanded speed.

(4) CPEND
Ends the two-, three-, or four-axis 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 two-axis linear interpolation control.
See Section 7.3 "Two-axis Linear Interpolation Control" for details.

(2) ABS-3/INC-3
Designates three-axis linear interpolation control.
See Section 7.4 "Three-axis Linear Interpolation Control" for details.

(3) ABS-4/INC-4
Designates four-axis linear interpolation control.
See Section 7.5 "Four-axis 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.

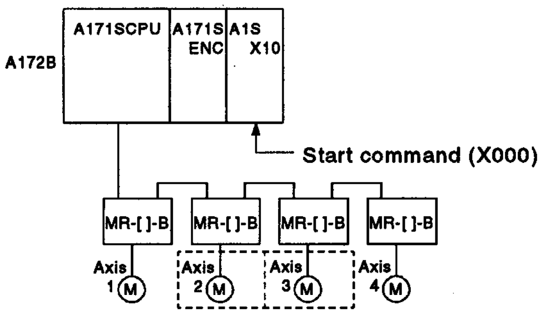
(5) ABS/INC , ABS/INC , ABS/INC , ABS/INC
Designates circular interpolation control using radius designation.
See Section 7.7 "Circular Interpolation Using Radius Designation" for details.

(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 two-axis constant-speed control under the conditions below.

(a) System configuration
Constant-speed control for Axis 2 and Axis 3.



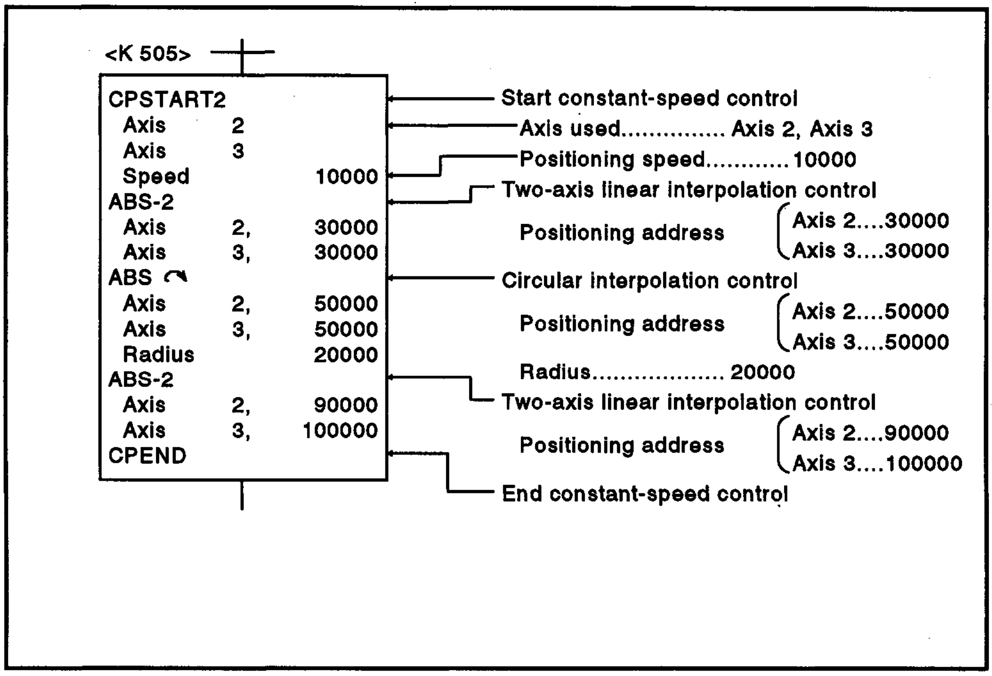
(b) Positioning conditions

1) The constant-speed control conditions are shown below.

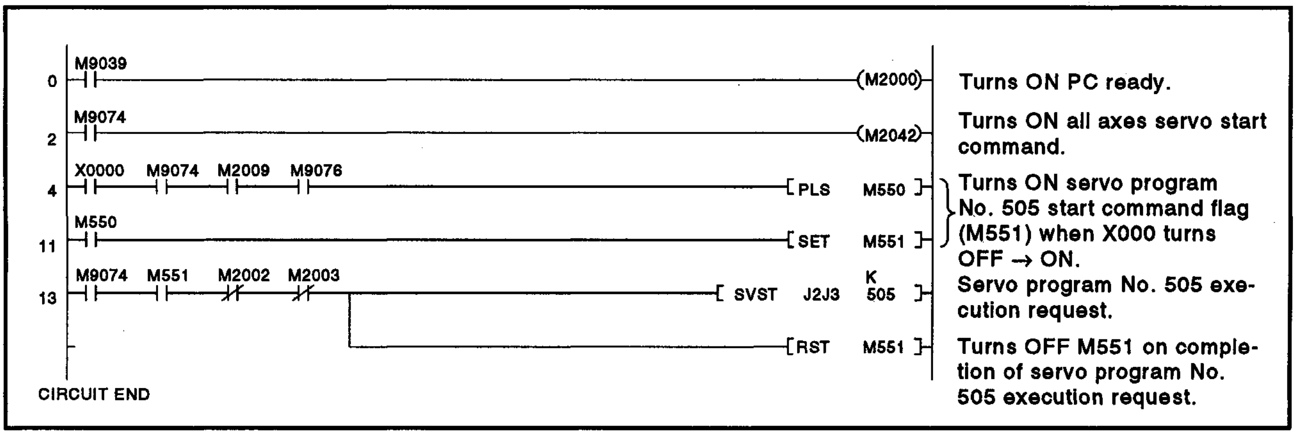
Item		Setting		
Servo program number		505		
Positioning speed		10000		
Positioning method		2-axis linear interpolation	Circular Interpolation Using Radius Designation	2-axis linear interpolation
Pass point	Axis 2	30000	50000	90000
	Axis 3	30000	50000	100000

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.

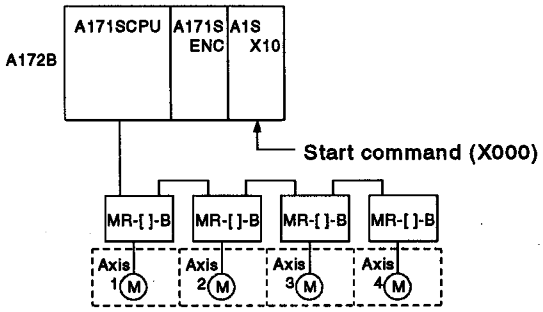


[Program Example]

(2) This program executes four-axis 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

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

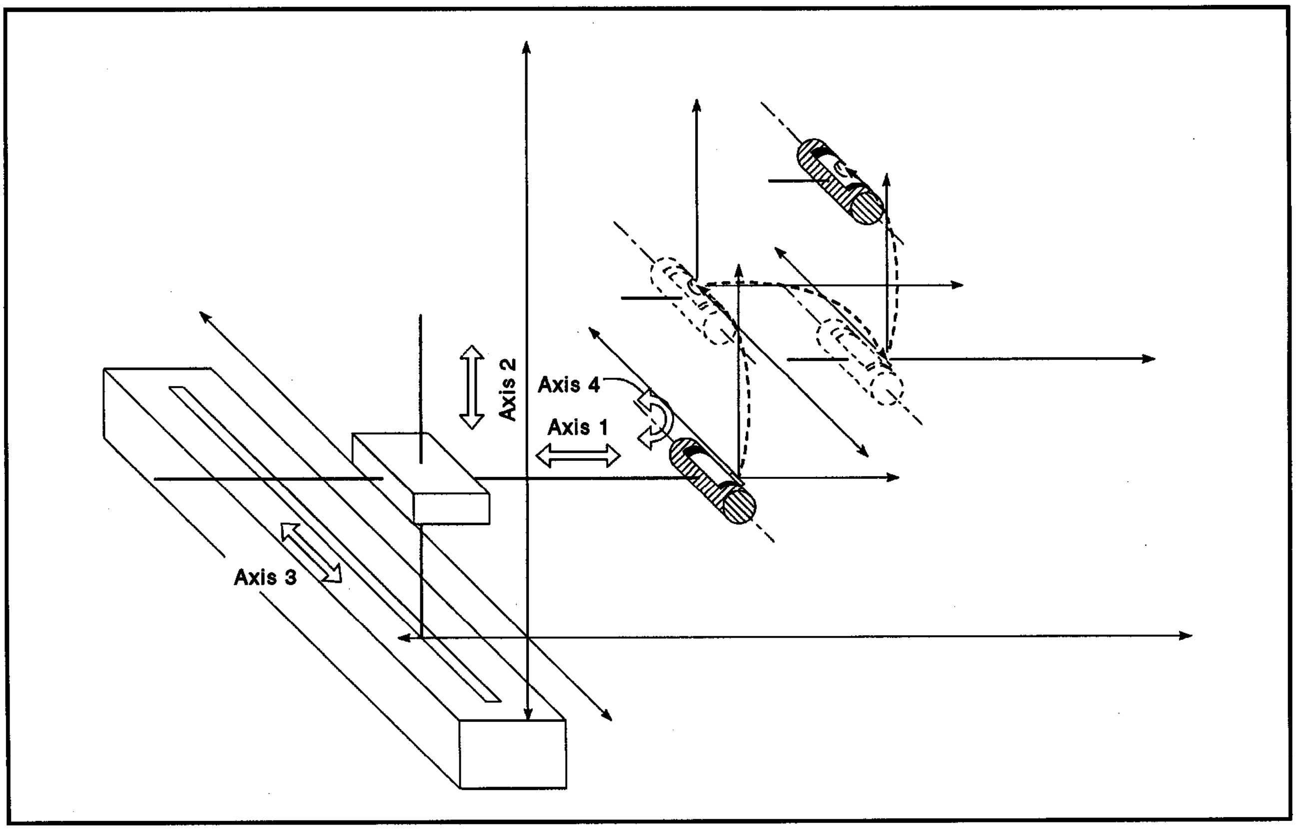


Figure 7.30 Axis Configuration

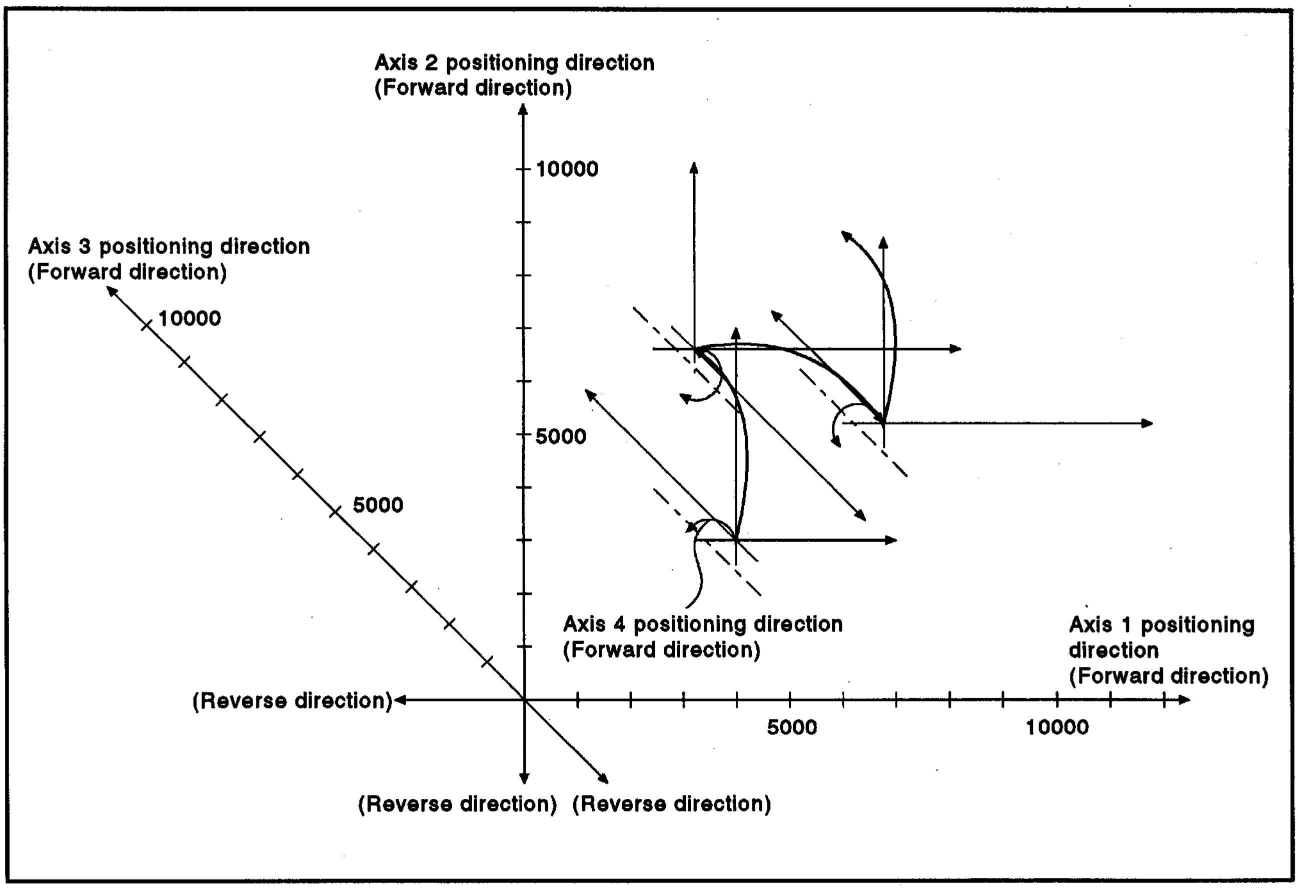


Figure 7.31 Positioning by Four-Axis Constant-Speed Control

(c) Positioning conditions

1) The constant-speed control conditions are shown below.

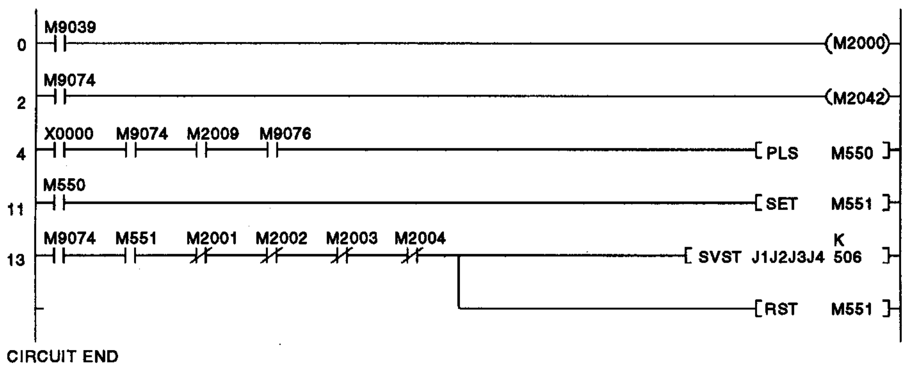
Item		Setting		
Servo program number		506		
Positioning speed		10000		
Positioning method		4-Axis Linear Interpolation	4-Axis Linear Interpolation	4-Axis Linear Interpolation
Pass point	Axis 1	3000	5000	5000
	Axis 2	4000	3500	3500
	Axis 3	4000	−4000	3000
	Axis 4	4000	−6000	6000

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.

```
<K 506>
CPSTART4                    ← Start constant-speed control
 Axis    1                  ← Axes used... Axis 1, Axis 2 , Axis 3, Axis 4
 Axis    2
 Axis    3
 Axis    4
 Speed          10000       ← Positioning speed...... 10000
INC-4                       ← Four-axis linear interpolation control (P1)
 Axis    1,     3000          Positioning address  Axis 1........3000
 Axis    2,     4000                               Axis 2........4000
 Axis    3,     4000                               Axis 3........4000
 Axis    4,     4000                               Axis 4........4000
INC-4                       ← Four-axis linear interpolation control (P2)
 Axis    1,     5000          Positioning address  Axis 1........5000
 Axis    2,     3500                               Axis 2........3500
 Axis    3,    -4000                               Axis 3........-4000
 Axis    4,    -6000                               Axis 4........-6000
INC-4                       ← Four-axis linear interpolation control (P3)
 Axis    1,     5000          Positioning address  Axis 1........5000
 Axis    2,     3500                               Axis 2........3500
 Axis    3,     3000                               Axis 3........3000
 Axis    4,     6000                               Axis 4........6000
CPEND                       ← End constant-speed control
```

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



Turns ON PC ready.

Turns ON all axes servo start command.

Turns ON servo program No. 506 start command flag (M551) when X000 turns OFF → ON.

Servo program No. 506 execution request.

Turns OFF M551 on completion of servo program No. 506 execution request.

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 device
The following devices can be designated as skip signal devices.
X, Y, M, TC, TT, CC, CT, B, F

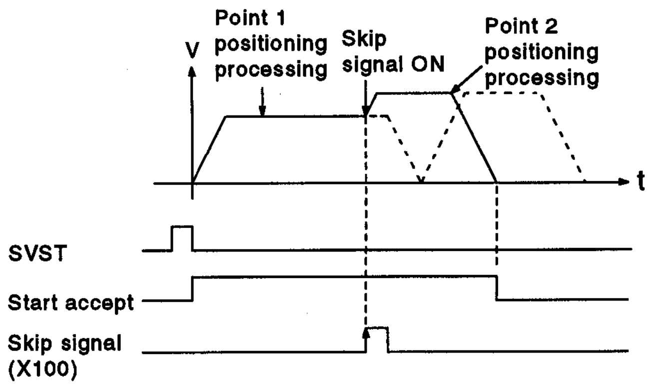
[Notes]

(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
```



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 5000 ms 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]

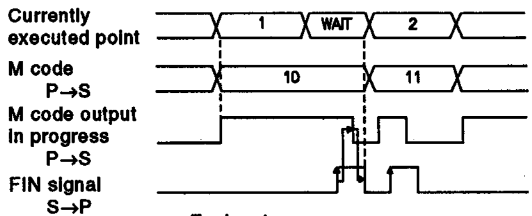
(1) If the acceleration/deceleration time designation is outside the permissible range, the servo program setting error "13" will occur on starting and control will be performed with an acceleration/deceleration time of 1000 ms.

(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
```

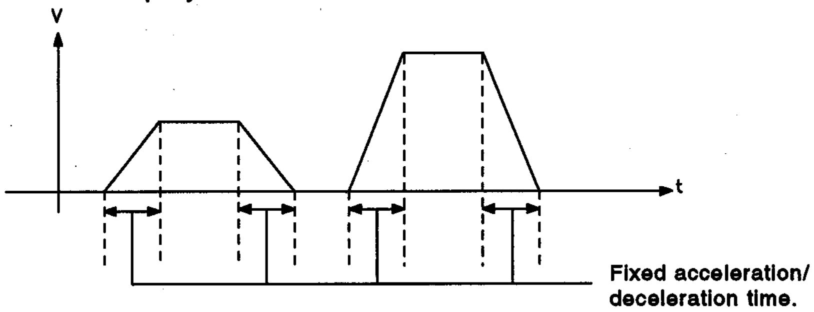


Explanatory

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 PC, 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 programmable controller. After that, positioning at the next point, point 2, starts.

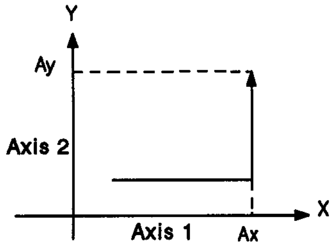
POINT

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.

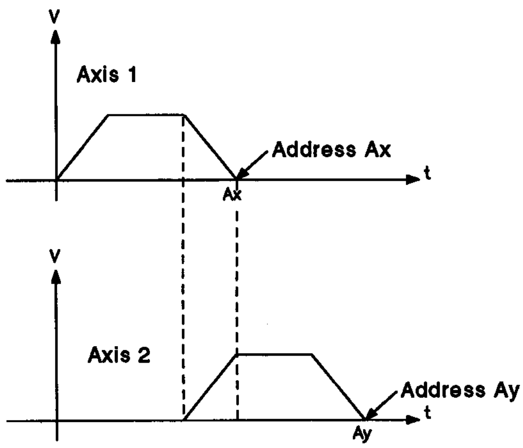


(1) When the fixed acceleration/deceleration method is used, the following processing and parameters are invalidated.
   - Rapid stop deceleration time in parameter block
   - Completion point designation method for speed change point
   - "S" curve acceleration/deceleration

(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	O	O	O		Δ						Δ	Δ	Δ	Δ	Δ	Δ		Δ	Δ	Δ	OK

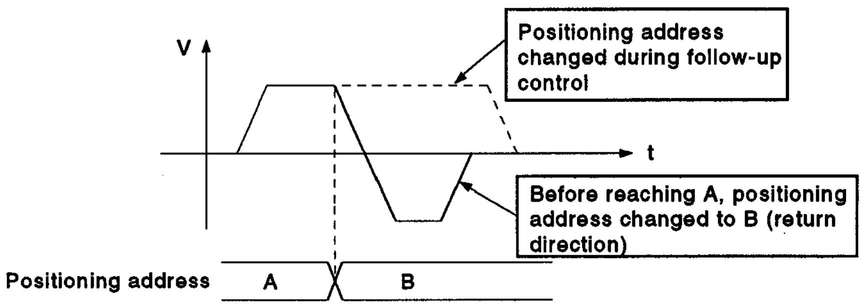
O : Must be set
Δ : Set if required

[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 data 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.

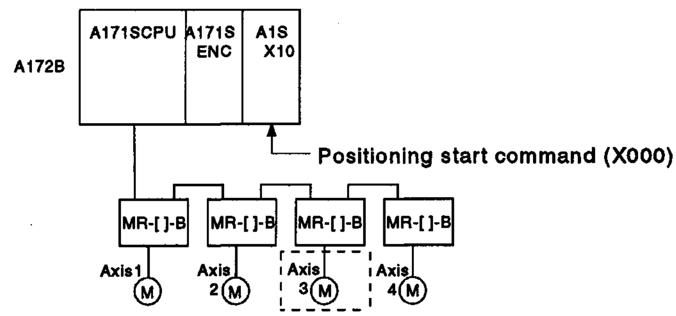
(4) Set the positioning address in the servo program using indirect designation with the word devices D and W.

(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, DSFRP 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.

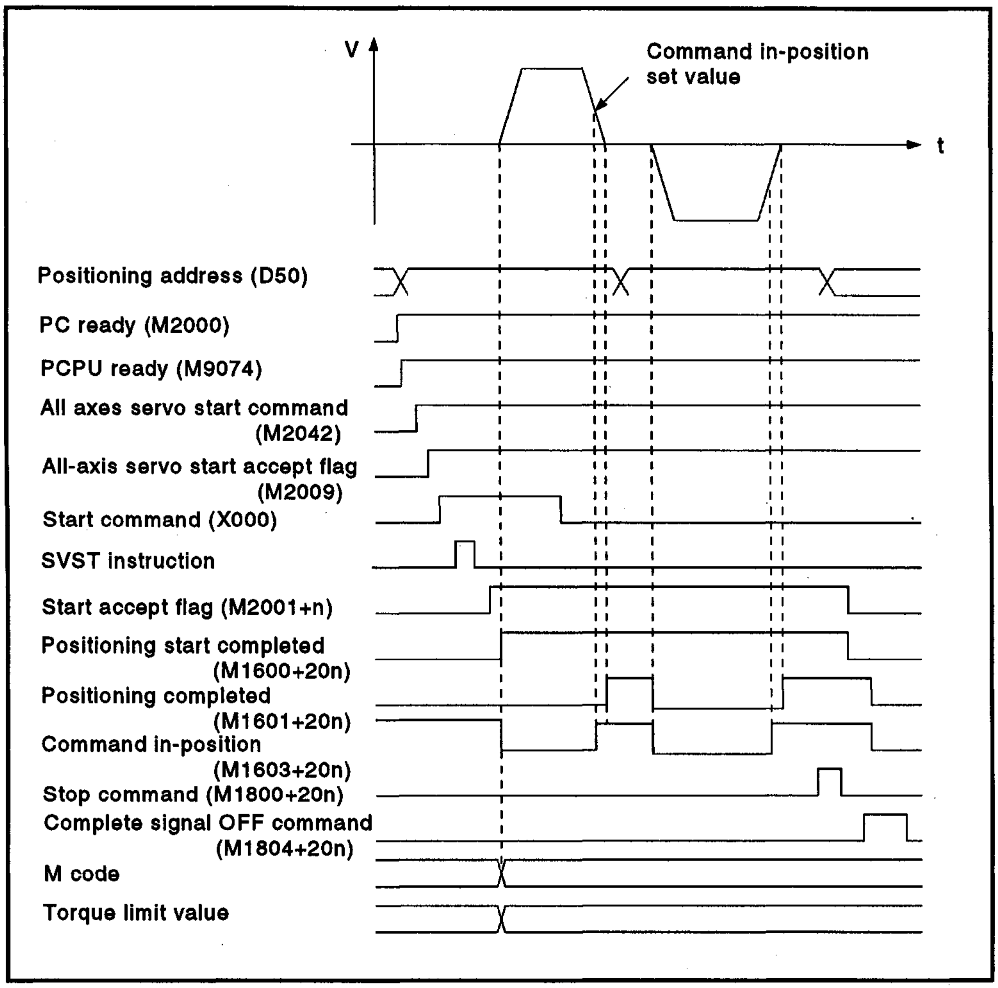


(2) Positioning conditions
(a) The position follow-up conditions are shown below.

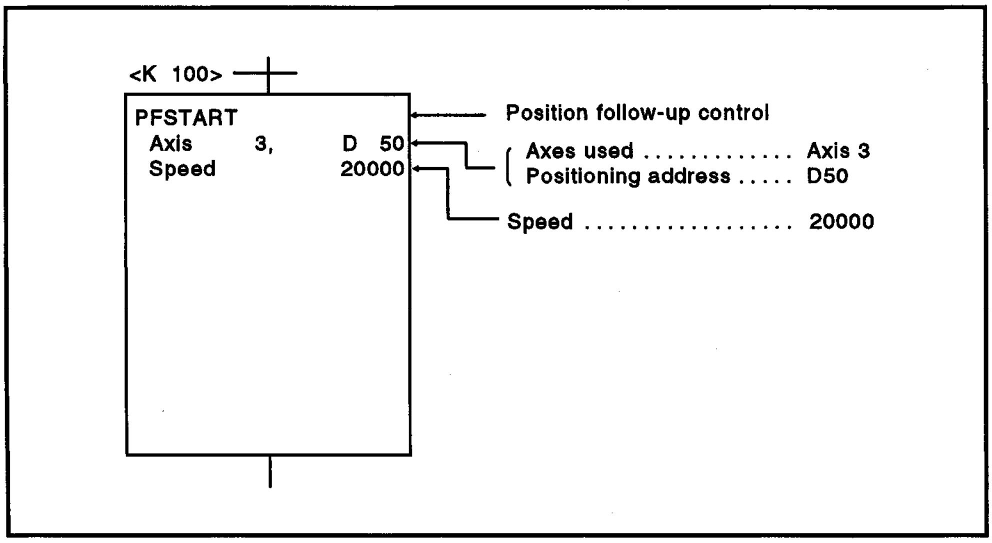
Item	Setting
Servo program number	100
Controlled axis	Axis 3
Positioning address	D50
Positioning speed	20000

(b) Position follow-up control start command .... leading edge of X000 (OFF → ON)

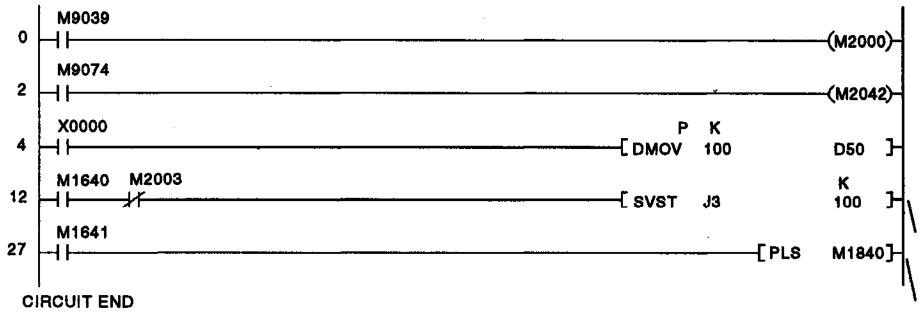
(3) Operation timing
The operation timing for position follow-up control is shown below.



(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 PC 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		
			Parameter Block No.	Axis	Address/Travel Value	Commanded Speed	Dwell Time	M Code	Torque Limit Value	Auxiliary Point	Radius	Center Point	ontrol 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	Condition of repetitions	Program number	Speed Change
START	*	*																					o	*

o : Must be set
* : Differs according to servo program started.

[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 three 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			
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)

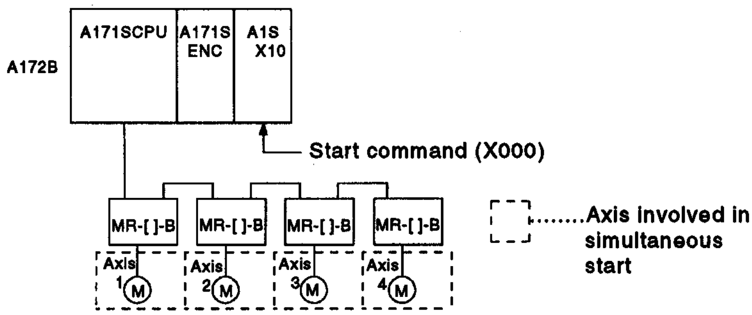
(2) The servo programs cannot be designated for the START instruction using indirect designation.

(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 one 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

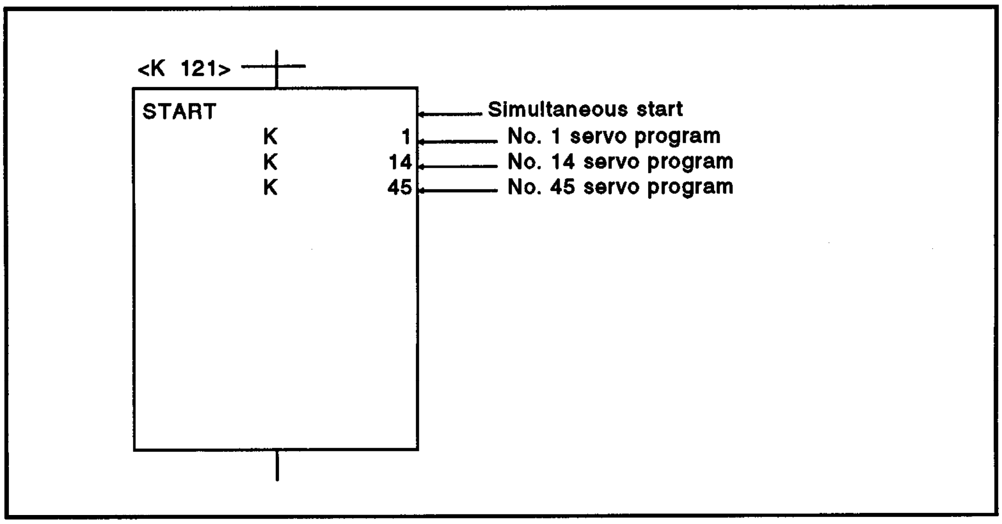
(b) Designated servo program numbers

Servo Program No.	Axis	Control Details
1	1, 2	Circular interpolation control
14	3	Speed control
45	4	Home position return control

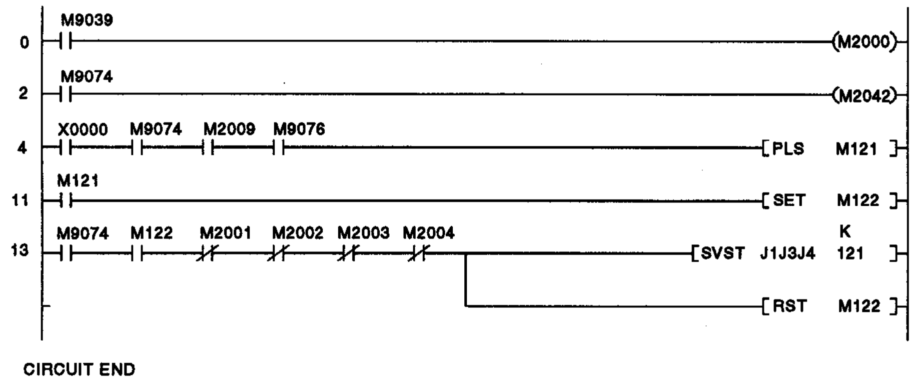
(3) Start conditions
(a) Simultaneous start servo program number.......No. 121

(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.



Turns ON PC ready.

Turns ON all axes servo start command.

Turns ON servo program No. 121 start command flag (M122) when X000 turns OFF → ON.

Servo program No. 121 execution request.

Turns OFF M122 on completion of servo program No. 121 execution request.

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

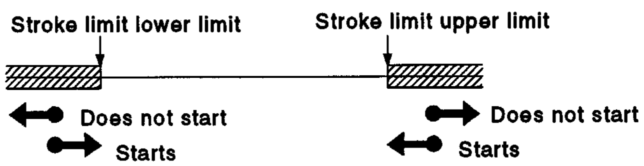
No.	Item	Setting Range								Default		Remarks	Explanatory Section
		mm		inch		degree		PULSE		Initial Value	Units		
		Setting Range	Units	Setting Range	Units	Setting Range	Units	Setting Range	Units				
1	JOG speed limit value	0.01 to 6000000.00	mm/min	0.001 to 600000.000	inch/min	0.001 to 600000.000	degree/min	1 to 1000000	PLS/sec	20000	PLS/sec	• Sets the max. speed during JOG operation. • The JOG speed limit value becomes the JOG operation speed if the JOG operation speed is set greater than JOG speed limit value.	—
2	Parameter block setting	1 to 16 (A171/A273UHCPU (8-axis specification)) 1 to 64 (A273UHCPU (32-axis specification))								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 PC 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 axes 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.



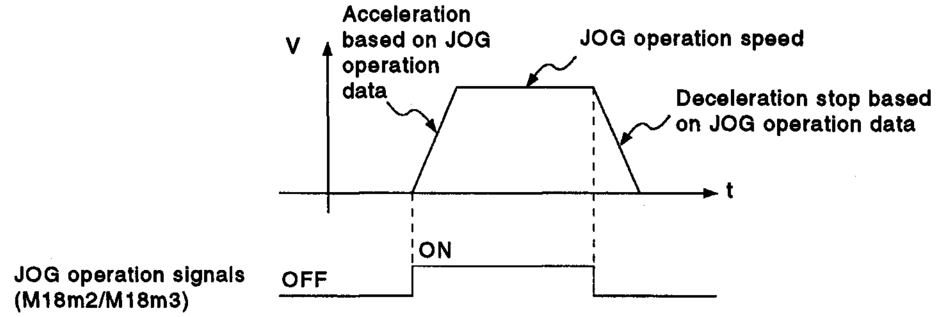
7.19.2 Individual start

Starts JOG operation for the designated axes.
JOG operation is controlled by the following JOG operation signals:

- Forward JOG operation .... M1802+20n
- Reverse JOG operation ....M1803+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 axes 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.

<A171SCPU>

No.	JOG Operation		JOG Operation Setting Register		Setting Range							
					mm		inch		degree		PULSE	
	Forward JOG	Reverse JOG	Most Significant	Least Significant	Setting Range	Units	Setting Range	Units	Setting Range	Units	Setting Range	Units
1	M1802	M1803	D965	D964	1 to 600000000	$\times 10^{-2}$ mm/min	1 to 600000000	$\times 10^{-3}$ mm/min	1 to 600000000	$\times 10^{-3}$ mm/min	1 to 1000000	PLS/sec
2	M1822	M1823	D971	D970								
3	M1842	M1843	D977	D976								
4	M1862	M1863	D983	D982								

* See Section 3.4.2 for the JOG operation signal and JOG operation setting register used for each axis with the A273UHCPU (8-/32-axis specification) However, the setting ranges are the same as those shown in the table above.

POINT

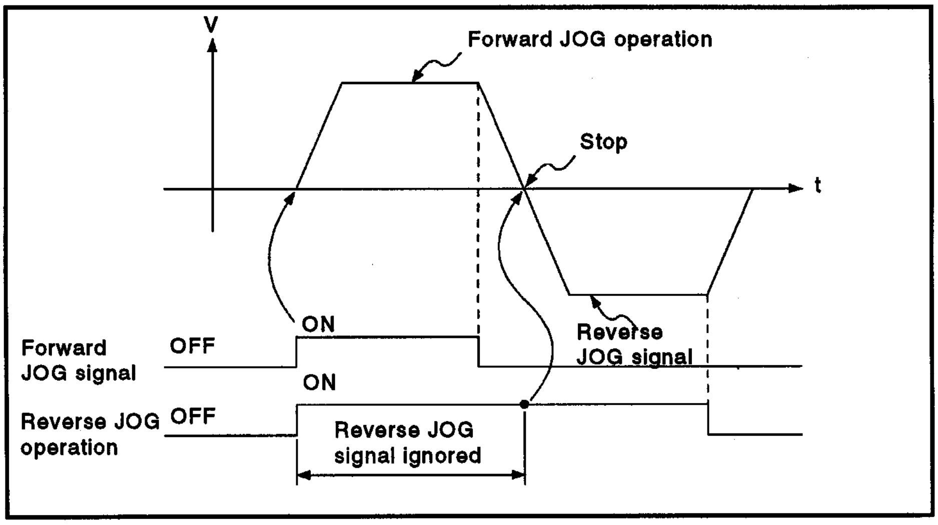
To set the JOG operation speed using a sequence program, store a value in the JOG operation speed setting register which is 100 times the actual speed in units of millimeters or 1000 times the speed in units of inches or degrees.

Example

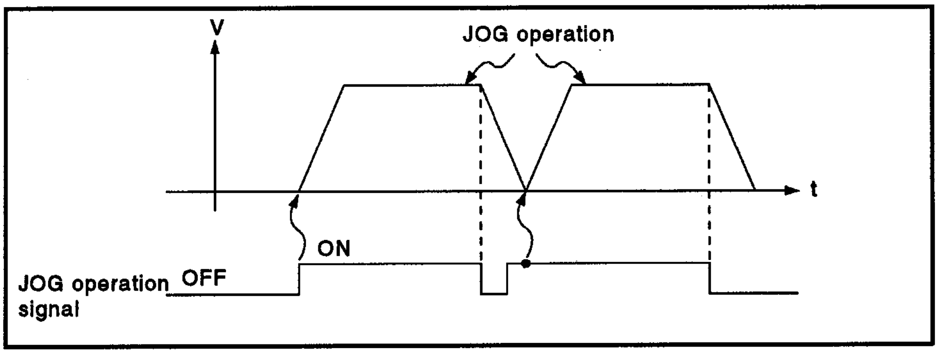
To set a JOG operation speed of 6000.00 mm/min., store the value 600000 in the JOG operation speed setting register.

[Cautions]

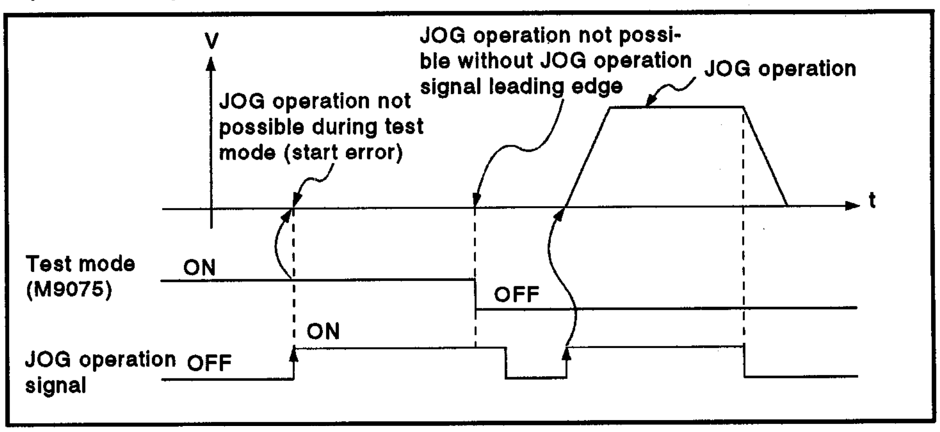
(1) Forward JOG operation occurs if the forward JOG signal (M1802+20n) and reverse JOG signal (M1803+20n) turn ON simultaneously for a single axis.
After the forward JOG signal turns OFF and deceleration stop is complete, reverse JOG operation starts if the reverse JOG operation signal remains ON.



(2) If the JOG operation signal turns back ON during deceleration after the JOG operation signal previously turned OFF, deceleration continues until the speed reaches zero before JOG operation is restarted.



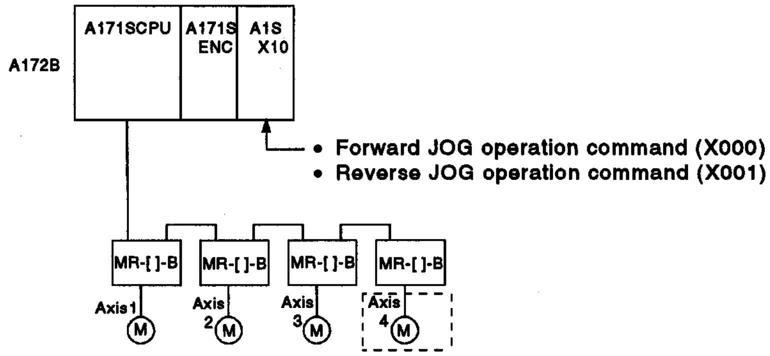
(3) JOG operation cannot be started by the JOG operation signals (M1802+20n/M1803+20n) in a peripheral device test mode.
JOG operation starts on the leading edge (OFF → ON) of the JOG operation signal after the test mode is reset.



[Program Example]

This program executes JOG operation under the conditions below.

(1) System configuration
JOG operation of Axis 4.

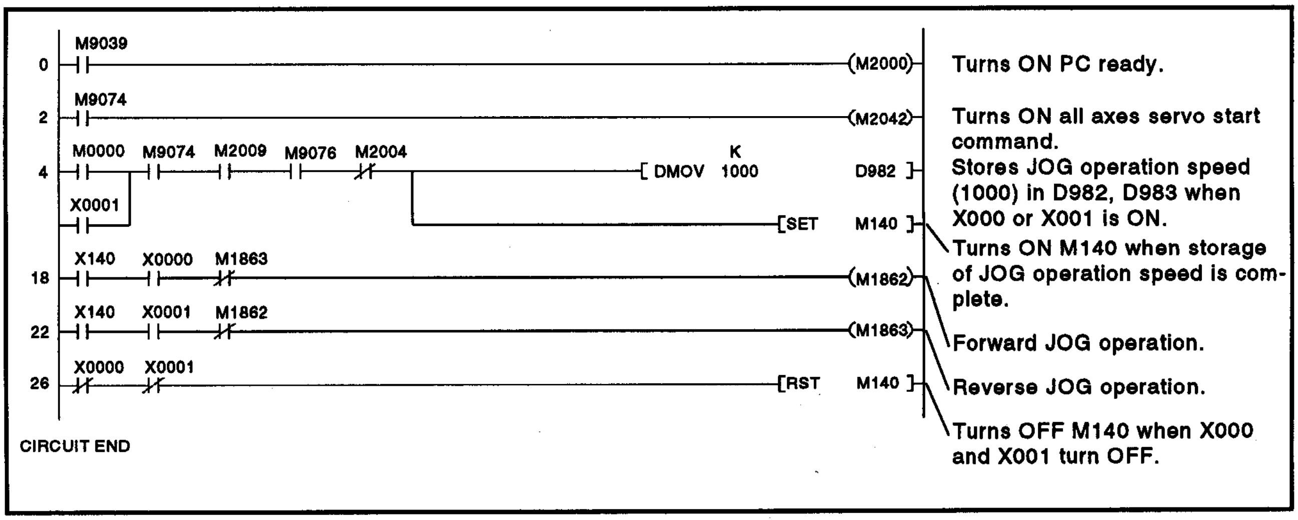


(2) JOG operation conditions
(a) Axis number .... Axis 4

(b) JOG operation speed 1000

(c) JOG operation commands
1) Forward JOG operation ....X000 ON
2) Reverse JOG operation ....X001 ON

(3) Sequence program

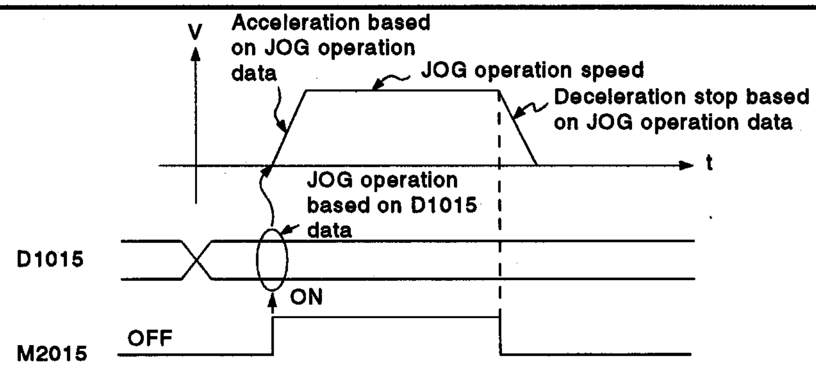


7.19.3 Simultaneous start

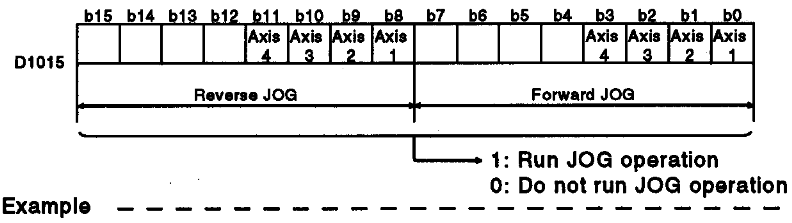
Simultaneously starts JOG operation designated for multiple axes.

[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 (M2015) remains ON, and a deceleration stop occurs when M2015 turns OFF.
Control of acceleration and deceleration is based on the JOG operation data settings.



(2) JOG operation is carried out on the axes set in the JOG simultaneous start axis setting area (D1015).



Example

Setting Axis 1 and Axis 2 to forward JOG operation and Axis 4 to reverse JOG operation using the MOV instruction.

(1)set as a hexadecimal value (H)...... MOV H0803 D1015

(2) set as a decimal value (K)............... MOV K2051 D1015

(3) The JOG operation speed setting registers are described below.

<A171SCPU>

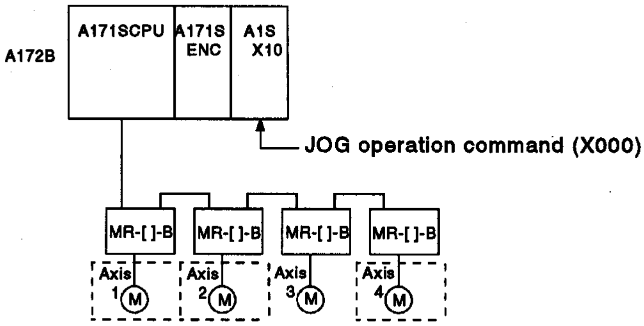
Axis No.	JOG Operation Speed Setting Register		Speed Change Value							
			mm		inch		degree		PULSE	
	Most Significant	Least Significant	Set Range	Units	Set Range	Units	Set Range	Units	Set Range	Units
1	D965	D964	1 to 600000000	$\times 10^{-2}$ mm/min	1 to 600000000	$\times 10^{-3}$ mm/min	1 to 600000000	$\times 10^{-3}$ mm/min	1 to 1000000	PLS/sec
2	D971	D970								
3	D977	D976								
4	D983	D982								

* See Section 3.4.2 for the JOG operation speed setting register used for each axis with the A273UHCPU (8-/32-axis specification) However, the speed change values are the same as those shown in the table above.

[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.

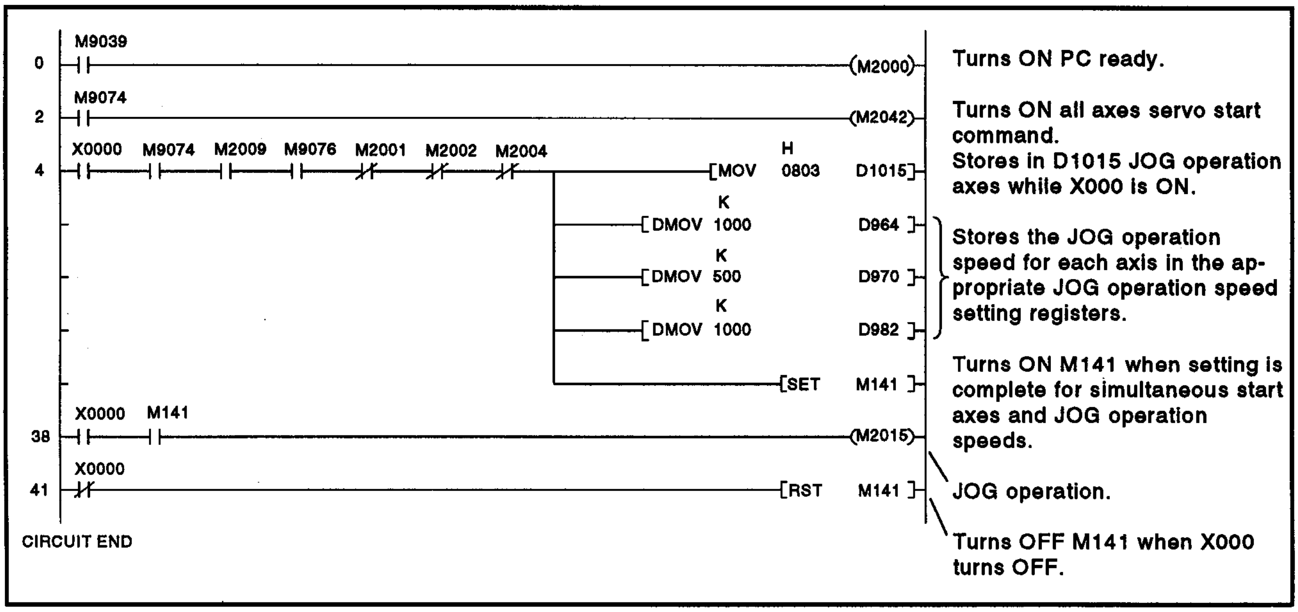


(2) JOG operation conditions
(a) The JOG operation conditions are tabled below.

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
A171SCPU	1
A273UHCPU (8-/32-axis specifcation)	3

IMPORTANT

When two or more A273EX are installed, connect the manual pulse generator to the first A273EX (counting from slot 0 of the main base unit).
(Only one manual pulse generator can be used.)

[Control Details]

(1) Positioning of the axes set in the manual pulse generator axis setting register according to the pulses input from the manual pulse generator. Manual pulse generator operation is only valid while the manual pulse generator enable flag is ON.

<A171SCPU>

Manual Pulse Generator Axis Setting Register	Manual Pulse Generator Enable Flag
D1012	D2012

<A273UHCPU (8-axis specification)>

Manual Pulse Generator Connected Position	Manual Pulse Generator Axis Setting Register	Manual Pulse Generator Enable Flag
P1	D1012	M2012
P2	D1013	M2013
P3	D1014	M2014

<A273UHCPU (32-axis specification)>

Manual Pulse Generator Connected 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 pulses from a manual pulse generator is calculated using the following formula.

[travel value] = [travel value per pulse] × [number of input pulses] × [manual pulse generator input multiplication factor setting]

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
PLUSE	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 pulses input from a manual pulse generator in unit time.

[output speed] = [input pulses per 1 ms] ×
[manual pulse generator input multiplication factor setting]

(3) Setting the axes controlled by the manual pulse generator

(a) The axes controlled by the manual pulse generator are set in the manual pulse generator axis setting register (D1012/D1012 to D1014/D714 to D719).

<A171SCPU/A273UHCPU (8-axis specification)>

The value is set as a maximum of three decimal digits, with each digit representing an axis from Axis 1 to Axis 4/Axis 1 to Axis 8. (The number of digits represents the number of simultaneously controlled axes.)

Example

Set the following value to control Axis 3 and Axis 4 with the manual pulse generator.

MOVP	K34	D1012

K34 → Axis 3 and Axis 4 designated

<A273UHCPU (32-axis specification)>

Set bits corresponding to the controlled axes (1 to 32).

Example

To control axis 1 and axis 22 and axis 30 with manual pulse generator 1, make the following settings.

	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) When set in hexadecimal (H)............ DMOV H2020001 D714

(2) When set in decimal (K)..................... DMOV K538968065 D714

REMARK

The connected position of the manual pulse generator used with the A273UHCPU (8-/32-axis specification) indicates the A273EX connector pin (P1, P2, P3) to which the manual pulse generator is connected.
See the A273UHCPU (8/32-axis specification) Motion Controller User's Manual (IB-67262 for details about A273EX.)

(4) Manual pulse generator 1-pulse input magnification
    (a) The magnification setting for a 1 pulse input from the manual pulse generator is set for each axis.

<A171SCPU>

1-pulse Input Magnification Setting Register	Corresponding Axis No.	Setting Range
D1016	Axis 1	
D1017	Axis 2	1-100
D1018	Axis 3	
D1019	Axis 4	

<A273UHCPU (8-axis)>

1-pulse Input Magnification Setting Register	Corresponding Axis No.	Setting Range
D1016	Axis 1	
D1017	Axis 2	
D1018	Axis 3	
D1019	Axis 4	1-100
D1020	Axis 5	
D1021	Axis 6	
D1022	Axis 7	
D1023	Axis 8	

<A273UHCPU (32-axis)>

1-pulse Input Magnification Setting Register	Corresponding Axis No.	Setting Range
D720	Axis 1	
D721	Axis 2	
D722	Axis 3	
D723	Axis 4	
D724	Axis 5	
D725	Axis 6	
D726	Axis 7	
D727	Axis 8	
D728	Axis 9	
D739	Axis 10	
D730	Axis 11	
D731	Axis 12	
D732	Axis 13	1-100
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 axes.
If an out-of-range value is detected, the manual pulse generator axis setting error register (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.

<A171SCPU>

Manual Pulse Generator Smoothing Magnification Setting Register	Setting Range
D9192	0 to59

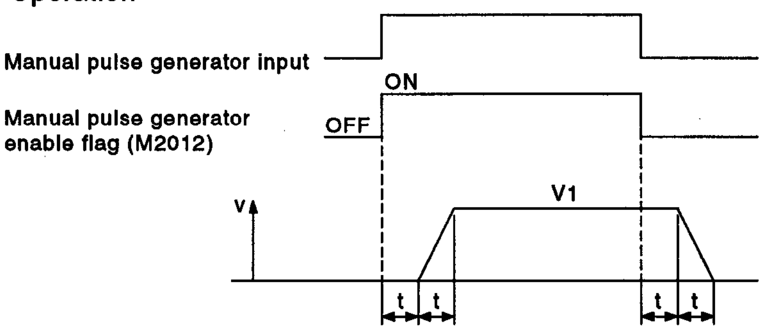
<A273UHCPU (8-axis)>

Manual Pulse Generator Smoothing Magnification Setting Register	Setting Range
Manual pulse generator 1 (P1) : D9192	0 to59
Manual pulse generator 2 (P2) : D9193	
Manual pulse generator 3 (P3) : D9194	

<A273UHCPU (32-axis)>

Manual Pulse Generator Smoothing Magnification Setting Register	Setting Range
Manual pulse generator 1 (P1) : D752	0 to59
Manual pulse generator 2 (P2) : D753	
Manual pulse generator 3 (P3) : D754	

(a) Operation



$$\text{Output speed (V1)} = \left(\begin{matrix}\text{number of input}\\\text{pulses/ms}\end{matrix}\right) \times \left(\begin{matrix}\text{manual pulse generator 1 pulse}\\\text{input magnification setting}\end{matrix}\right)$$

$$\text{Travel value (L)} = \left(\begin{matrix}\text{travel value}\\\text{per pulse}\end{matrix}\right) \times \left(\begin{matrix}\text{number}\\\text{of input}\\\text{pulses}\end{matrix}\right) \times \left(\begin{matrix}\text{manual pulse generator 1}\\\text{pulse input magnification}\\\text{setting}\end{matrix}\right)$$

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 56.8 ms to 3408 ms.

(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 1-4, 1-8, or 1-32.	• Digit ignored where error occurred. • Manual pulse generator of valid axes with settings in rang es 1-4, 1-8, or 1-32.
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 axes during manual pulse generator operation.
Consequently, positioning control or home position return 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 enabled. 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.

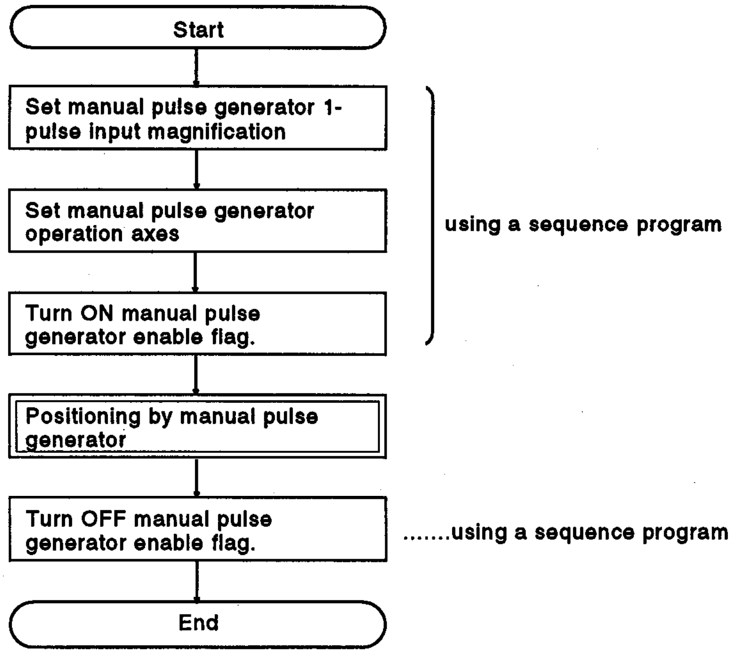
(4) If the manual pulse generator enable flag for another manual pulse generator No. is turned ON for an axis currently performing manual pulse generator operation, error 214 is set for the relevant axis and the input of that manual pulse generator is not enabled.

(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 (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]

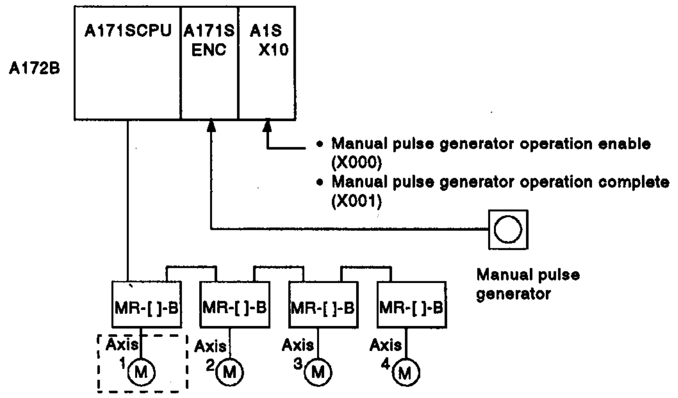
The procedure for manual pulse generator operation is shown below.



[Program Example]

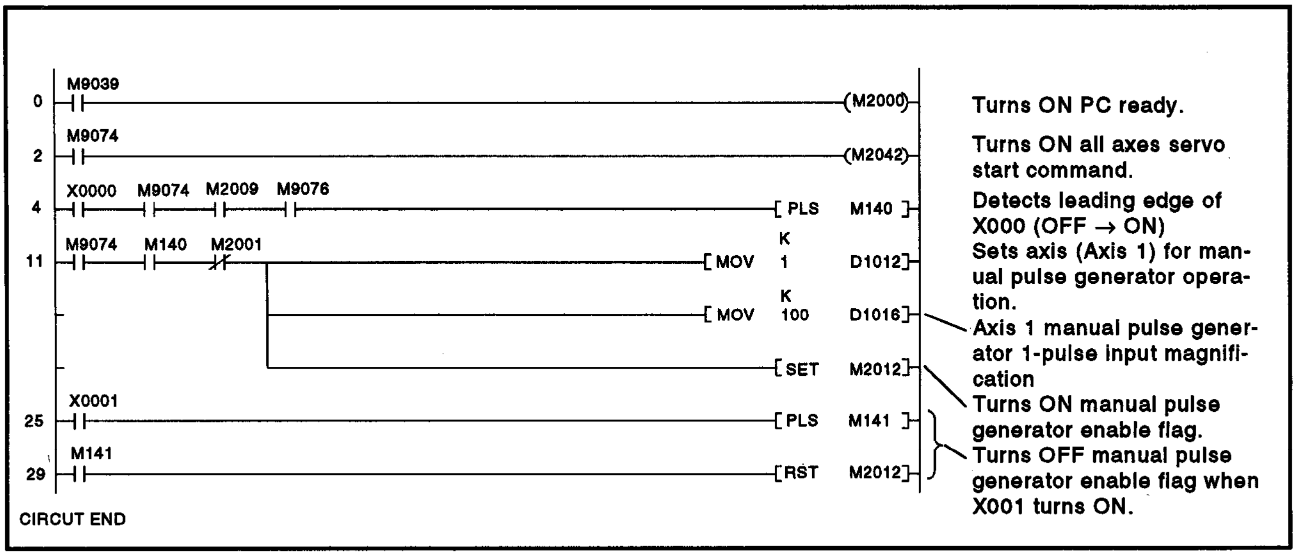
This program executes manual pulse generator operation under the conditions below.

(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 home position return at power on and other times where confirmation that axes are at the machine home position is required.

(2) The following three methods of home position return are available:
- Near-zero point dog method ⎤ Used when not using an absolute
- Count method ⎦ position system
- Data set method....................(Recommended for an absolute-position system)

(3) To carry out home position return, the home position return data must be set for each axis.

7.21.1 Home position return data

The home position return data is the data required to carry out home position return.
Set the home position return data from a peripheral device.

Table 7.3 Table of Home Position Return Data

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	Remarks	Explanatory Section
1	Home position return direction	0: reverse direction (decreased address) 1: forward direction (increased address)								0	• Sets the direction for home position return. • Axis travels in designated direction after home position return is started.	—
2	Home position return method	0: near-zero point dog method 1: count method 2: data set method								0	• Sets the home position return method. • The near-zero point 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 present value of the home position after home position return. • It is recommended that the home position address is set at the stroke limit upper limit or lower limit.	—
4	Home position return speed	0.01 to 6000000.00	mm/min	0.001 to 600000.000	inch/min	0.001 to 600000.000	degree/min	1 to 1000000	PLS/sec	1	• Sets the speed for home position return.	—
5	Creep speed	0.01 to 6000000.00	mm/min	0.001 to 600000.000	inch/min	0.001 to 600000.000	degree/min	1 to 1000000	PLS/sec	1	• Sets the creep speed (low speed immediately before stopping after deceleration from home position return speed) after the near-zero point dog.	—
6	Travel value after near-zero point 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 near-zero point dog for the count method. • Set greater than the deceleration distance at the home position return speed.	7.21.1 (1)
7	Parameter block setting	1 to 16 (A171S/A273UHCPU (8-axis specification)) 1 to 64 (A273UHCPU (32-axis specification))								1	• Sets the parameter block to use for home position return (see Section 4.4).	—

(1) Setting the travel value after near-zero point dog

(a) This parameter sets the travel value after the near-zero point dog turns ON for home position return using the count method.

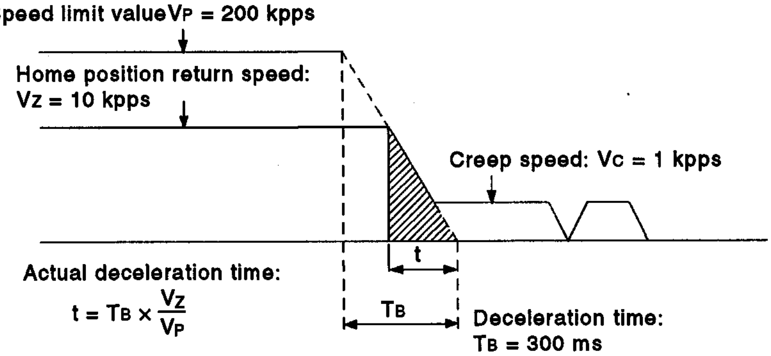
(b) After the near-zero point dog turns ON, the home position is the first zero point after travel by the set travel value is complete.

(c) Set the travel value after the near-zero point dog turns ON greater than the deceleration distance at the home position return speed.

Example

The deceleration distance is calculated as shown below from the speed limit value, home position return speed, creep speed, and deceleration time.

[Home position return operation]



[Deceleration distance (shaded area under graph)]

$$= \frac{1}{2} \times \frac{V_Z}{1000} \times t$$

$\frac{V_Z}{1000}$ — 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.

7.21.2 Home position return by the near-zero point dog method

(1) Near-zero point dog method
Using the near-zero point dog method, the home position is the first zero point after the near- zero point dog turns OFF.

(2) Home position return by the near-zero point dog method
The home position return operation using the near-zero point dog method is shown in Fig. 7.32.

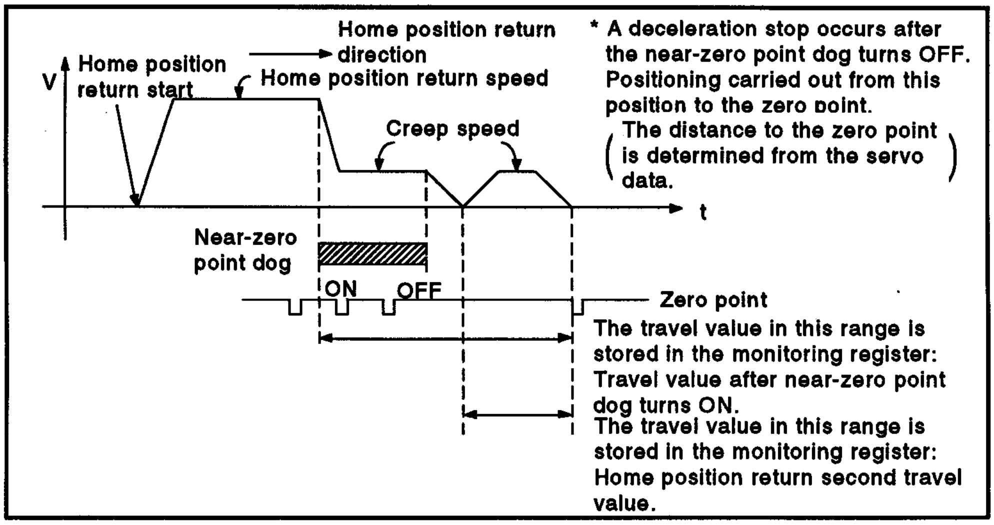
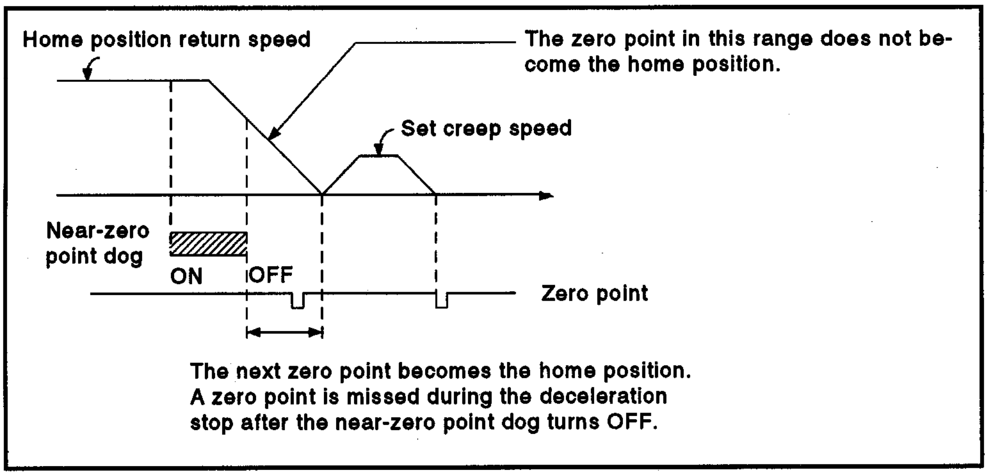


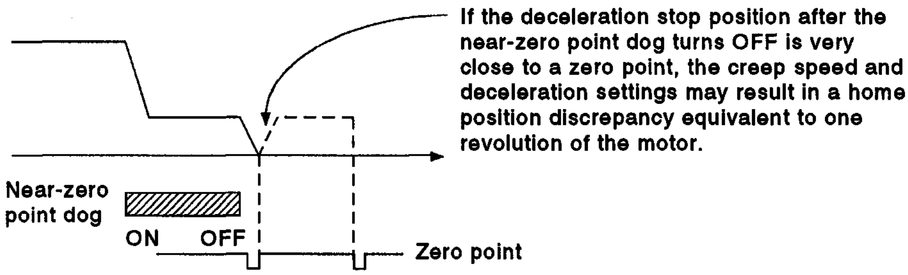
Fig. 7.32 Operation of Home Position Return by the Near-Zero Point Dog Method

(3) Running home position return
To run home position return, use the servo program described in Section 7.21.5.

(4) Cautions
Take note of the following points during home position return by the near-zero point dog method.
(a) Keep the near-zero point dog ON during deceleration from the home position return speed to the creep speed.
A deceleration stop occurs if the near-zero point dog turns OFF before deceleration to the creep speed, and the next zero point becomes the home position.



(b) Adjust the position where the near-zero point dog turns OFF, such that the home position return 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 home position return travel value is less than half the travel value for one revolution of the motor.



IMPORTANT

(1) In the following cases, before starting the home position return, use JOG operation or some other method to return the axis to a position before where the near-zero point dog turned ON. Home position return will not start unless the axis is returned to a position before the near-zero point dog position.

(a) Home position return from a position after the near-zero point dog turned OFF.

(b) When the power is turned ON after home position return was completed.

7.21.3 Home position return 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 near-zero point dog turns ON) after the near-zero point dog turns ON.
The travel value after the near-zero point dog turns ON is set in the table of home position return data shown in section 7.21.1.

(2) Home position return by the count method
The home position return operation using the count method is shown in Fig. 7.33.

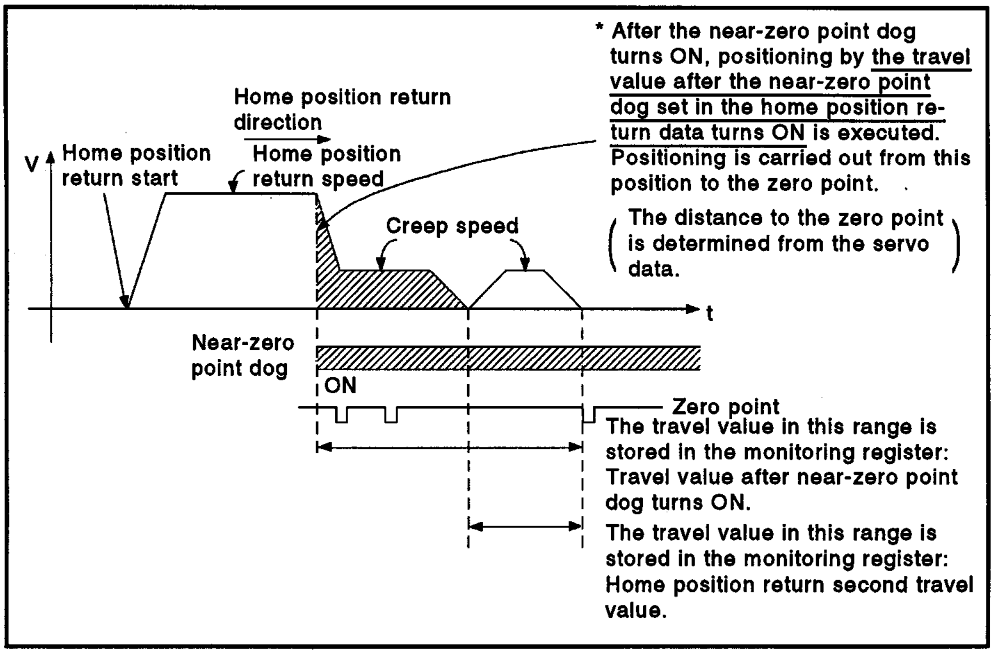


Fig. 7.33 Operation of Home Position Return by the Count Method

(3) Running home position return
To run home position return, use the servo program described in Section 7.21.5.

(4) Cautions
(a) Maintain sufficient distance between the position where the near-zero point dog turns OFF and the home position.

(b) Using the count method, home position return or resumptive start of home position return is possible when the near-zero point dog turns ON. To carry out home position return or resumptive start of home position return when the near-zero point dog turns ON, return the axis to a position where the near-zero point dog is OFF before starting the home position return.

7.21.4 Home position return by the data set method

(1) Data set method
The data set method is a home position return method which does not use the near-zero point dogs. This method can be used with the absolute position system.

(2) Home position return by the data set method
The address present value becomes the home position address when the home position return operation is run with the DSFRP instruction.

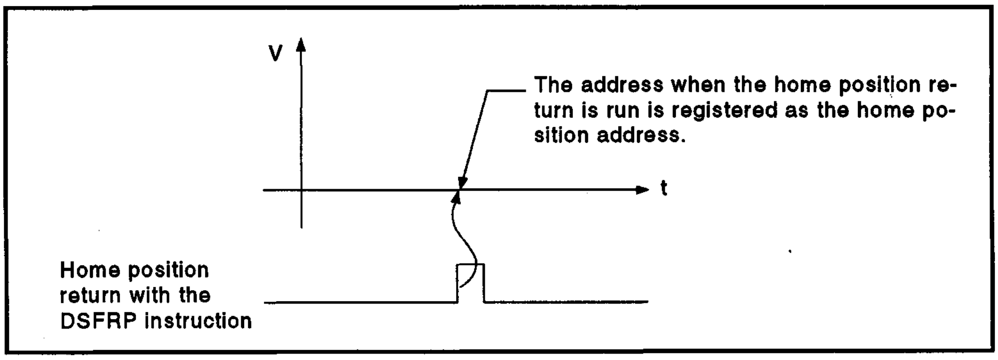


Fig. 7.34 Operation of Home Position Return by the Data Set Method

(3) Executing home position return
To execute home position return, 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 home position return.
A no zero point passed error occurs if home position return is executed before a zero point is passed.
After a no zero point passed error occurs, reset the error and turn the servomotor at least one revolution using JOG operation before running the home position return operation again.
Use the zero point passed signal (M16m6) to check that a zero point is passed.

(b) Starting home position return with the data set method when not using the absolute position system has the same function as the present value change command.

(c) The home position return data required for the data set method are the home position return method and home position address.

7.21.5 Home position return servo program

Home position return uses the ZERO servo instruction.

Servo Instruction	Positioning Method	Number of Controllable Axes	Items Set by Peripherals																					
			Common							Arc			Parameter Block											
			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			Speed Change
ZERO	—	1		o																				

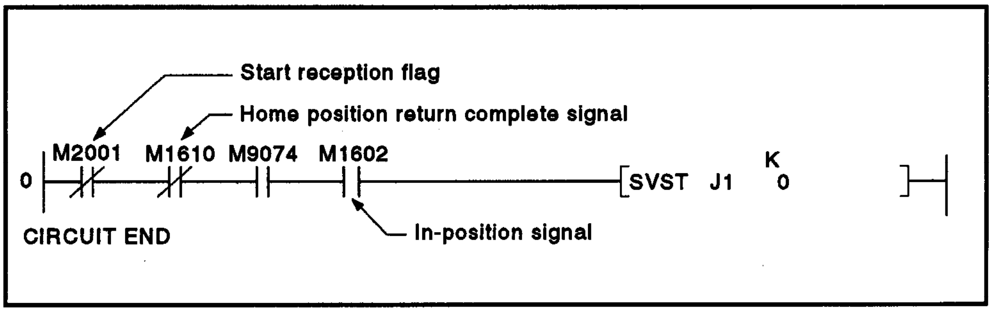
o : Must be set

[Control Details]

(1) Home position return is carried out using the method designated in the home position return data (see Section 7.21.1).
Refer to the following sections for details about the home position return methods:
- Near-zero point dog method .... Section 7.21.2
- Count method...................... Section 7.21.3
- Data set method.................... Section 7.21.4

[Caution]

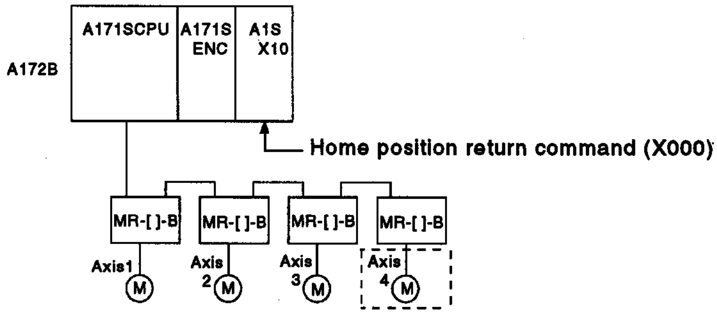
(1) If the following circuit conducts home position return using the near-zero point dog method after the PC ready flag (M2000) turns ON but before the PCPU ready flag (M9074) turns ON, another home position return request is issued after home position return is complete.
Therefore, apply interlock conditions to M9074 and X1602+20n (in-position signal) when carrying out a home position return.
(See program example.)



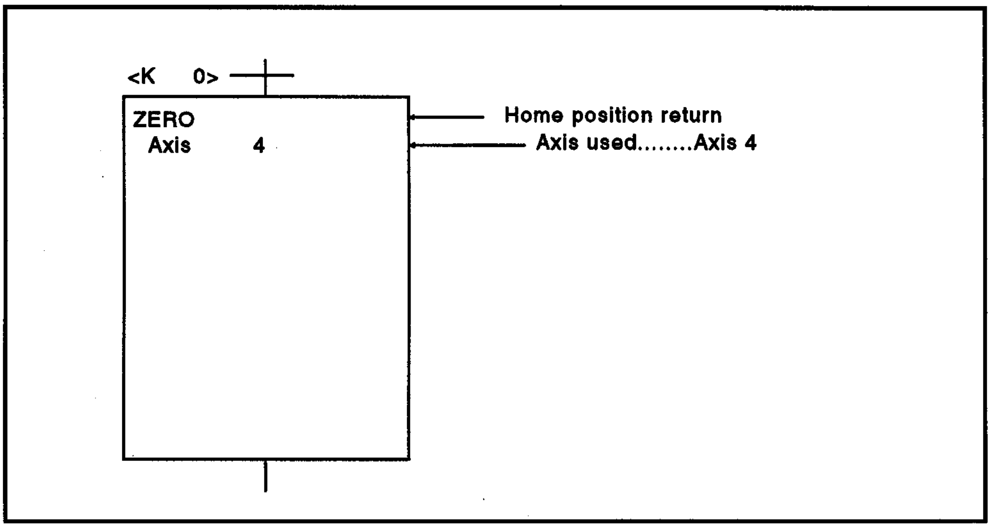
[Program Example]

This program carries out home position return using servo program No. 0, under the conditions below.

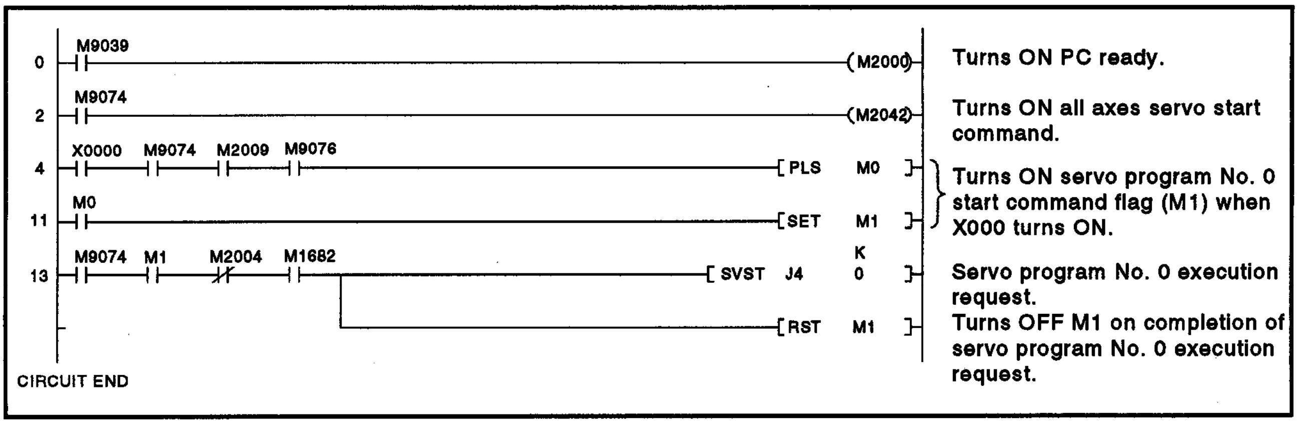
(1) System configuration
Home position return of Axis 4.



(2) Servo program example
Servo program No. 0 for home position return is shown below.



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



7.22 High-Speed Oscillation

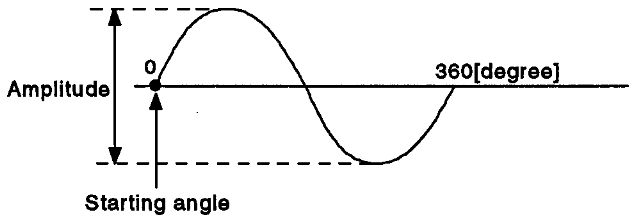
Positioning of a designated axis is performed on an oscillating sine wave.

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	Number of Pitches	Control Unit	Speed Limit Value	Acceleration Time	Deceleration Time	Rapid Stop Deceleration Time	Torque Limit Value	Deceleration Processing at STOP Input	Allowable Error Range for Circular Interpolation	S ratio	Cancel	Start	Speed Change
OSC	—	1	Δ	O	O	O		Δ											Δ				Δ	Δ	NG

O : Must be set
Δ :Set if required

[Control details]

The designated axis is 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   5>
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.

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.

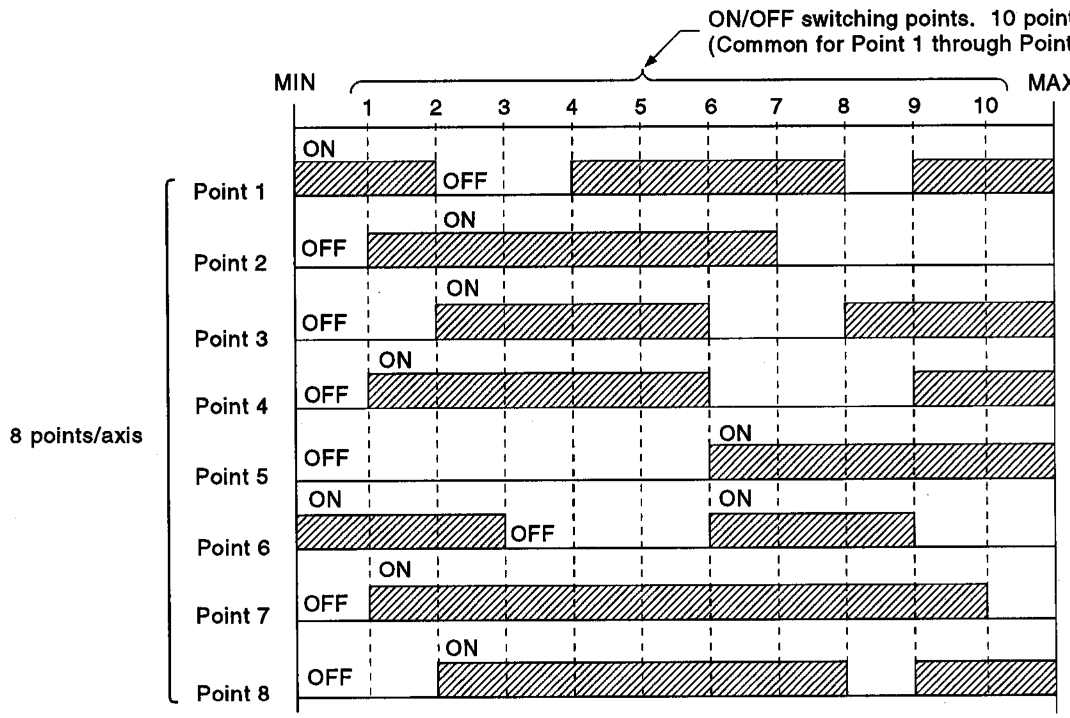
8.1.1 Limit switch output data

Item	Settings	Initial Value	Comments
ON/OFF point setting	• −2147483648 to 2147483647 ($\times 10^{-1}$ µm, $\times 10^{-5}$ inch, PLS) • 0 to 35999999 ($\times 10^{-5}$ degree) Units [$\times 10^{-1}$ µm, $\times 10^{-5}$ inch, $\times 10^{-5}$ 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 64 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 PC ready (M2000) (2) When test mode is started
Limit switch output enable signal (M1806+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 (D1008 and D1009). 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 (D1008 and D1009)	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 M1806+20n is ON.

REMARKS

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 present value" for each axis after PC 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 present value is outside the set stroke limits, the limit switch output is based on M1806+20n.
Consequently, the user should apply an interlock to ensure that the sequence program turns M1806+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 (M16m0) as the read command.

(c) To read an M code on positioning completion, use the positioning completion signal (M16m1) as the read command.

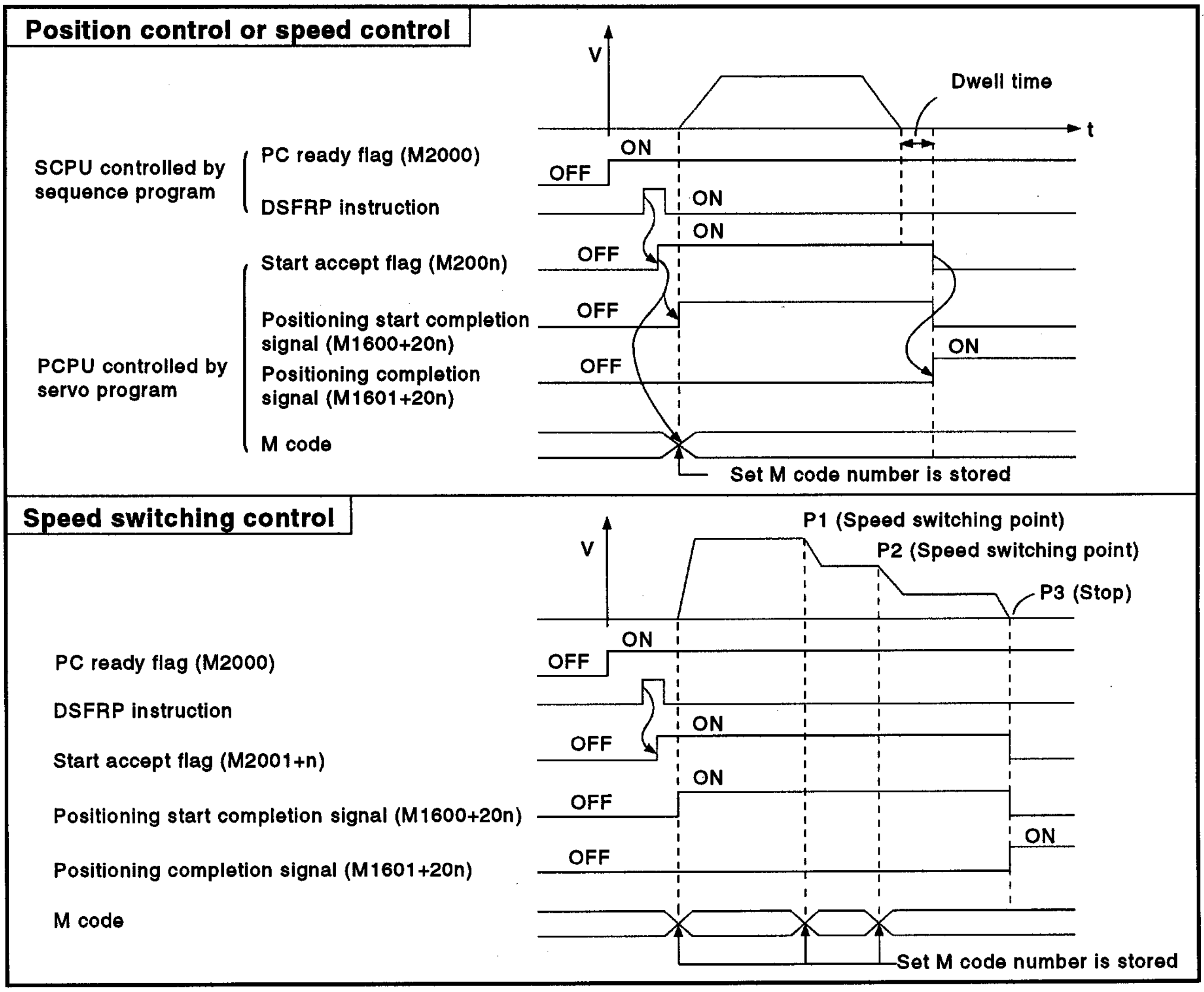
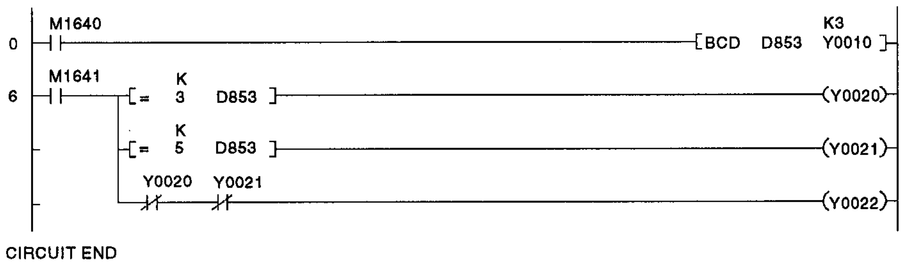


Figure 8.1 M Code Storage and Read Timing

(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.



Outputs M code number as BCD code from Y110 to Y118 when the Positioning start completion signal (M16m0) turns ON.

Turns ON Y120, Y121, Y122 on positioning complete.

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.

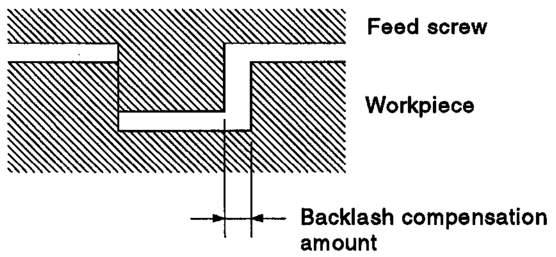


Figure 8.2 Backlash Compensation Amount

(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
- $0 \leq \frac{\text{(Backlash compensation amount)}}{\text{(Travel value per pulse)}} \leq 65535$ (PLS)

(Decimal fraction rounded down.)

(b) Inch or Degree Units
- 0 to 0.65535
- $0 \leq \frac{\text{(Backlash compensation amount)}}{\text{(Travel value per pulse)}} \leq 65535$ (PLS)

(Decimal fraction rounded down.)

(c) Pulse Units
- 0 to 65535
- $0 \leq \frac{\text{(Backlash compensation amount)} \times \text{(Pulses per rotation)}}{\text{(Travel value per rotation)}} \leq 65535$ (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 = home position return direction. • Backlash compensation if travel direction ≠ home position return 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.
Home position return start	• Backlash compensation amount is valid after home position return 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 present value.
(2) Home position return is required after the backlash compensation amount is changed.
The original backlash compensation amount is retained until home position return 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.

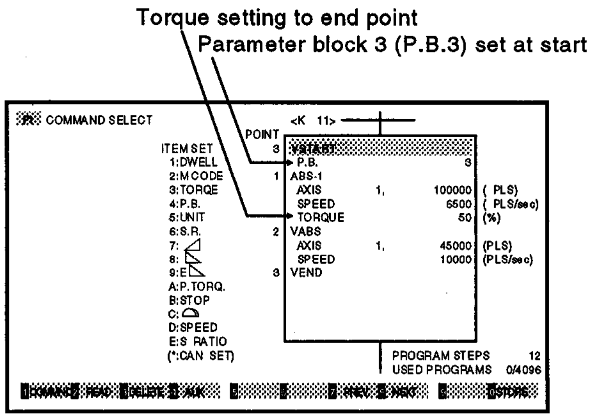
(2) How to set the torque limit value
Set the torque limit value using a peripheral device, as described below.
(a) Setting in the Parameter Block (See Section 4.4)
Set the Torque limit value parameter in the parameter block.
Using the servo program to designate which parameter block number is used allows 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.

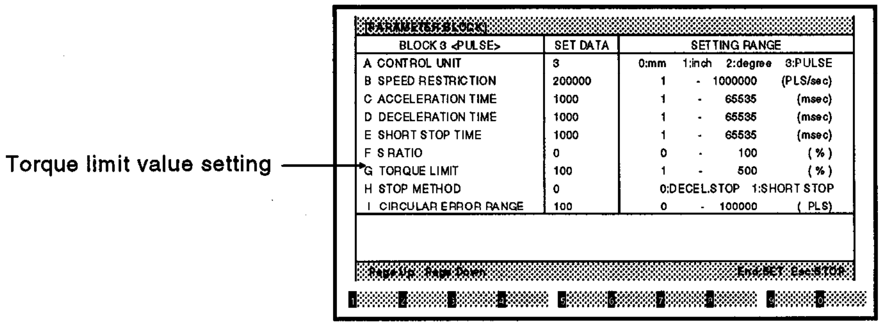
Examples

[Setting the torque limit value for speed switching control (VSTART)]

(1) Servo program

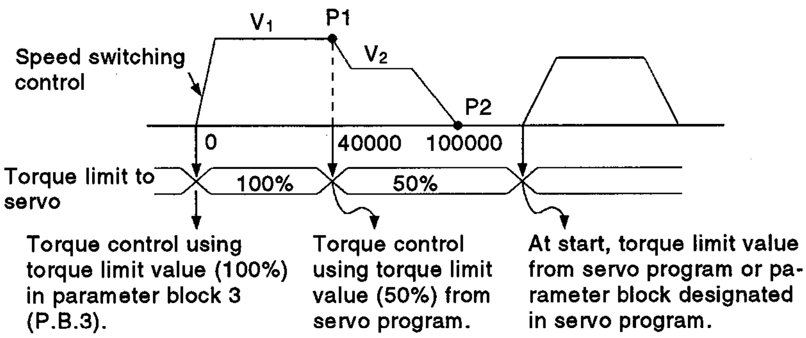


(2) Parameter block



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/sec)
C ACCELERATION TIME	1000	1 - 65535 (msec)
D DECELERATION TIME	1000	1 - 65535 (msec)
E SHORT STOP TIME	1000	1 - 65535 (msec)
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)

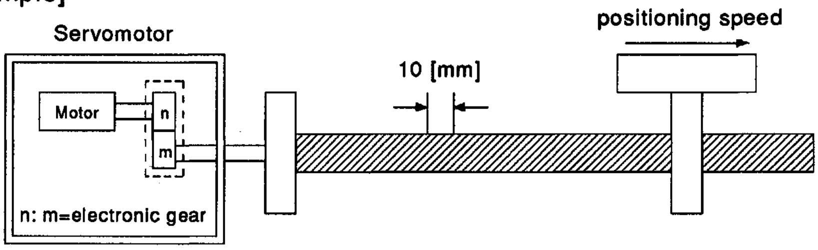
(3) General description of operation



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)

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)

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)

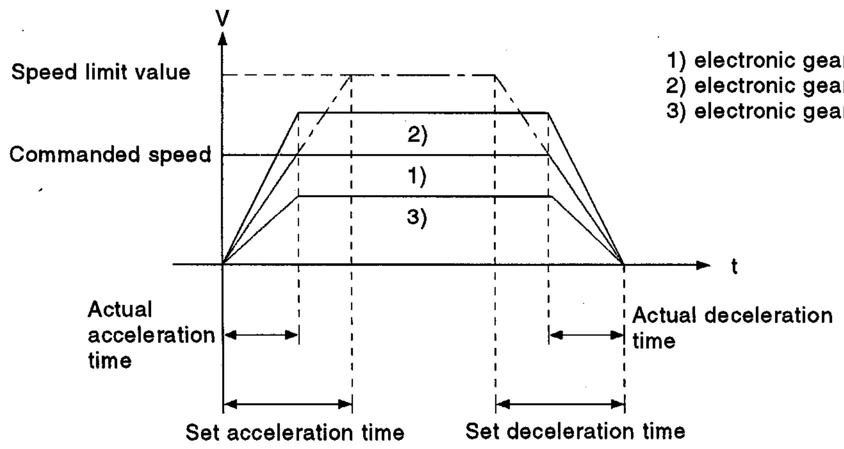
Travel value per pulse =

$$\frac{\text{Travel value per motor revolution}}{\text{Pulses per motor revolution}} = \frac{20\ [\text{mm}]}{10000\ [\text{PLS}]} = 0.002\ [\text{mm/PLS}]$$

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.

Figure 8.3 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 (A273UHCPU (8-/32-axis specification using ADU) and MR-[ ]-B.
Home position return 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 home position return initiated from the sequence program or a peripheral device.

(1) Absolute position system startup procedure
The system startup procedure is shown below.

Absolute position system startup

For MR-[ ]-B
- Connect CPU to absolute-position-compatible MR-[ ]-B.
- Connect FLS, RLS, STOP etc. wiring to A171SENC/A278LX.

<A273UHCPU (8-/32-axis specification) only>

For ADU
- Connect ADU to absolute-position-compatible servomotor.
- Connect battery unit to main base unit.
- Connect FLS, RLS, STOP etc. wiring to A278LX.

Adjust Machine Position
Adjust machine to home position.

Turn On Power
Turn on the servo amplifier and servo system CPU power.

Set Positioning Parameters
Set the following positioning parameters:
- System settings *
- Fixed parameters *
- Servo parameters *
- Home position return data *
- Parameter block

- Parameters marked * must be set. (Do not change them after they are set.)
- Default values are used if the parameter block is not set.

Sense Absolute Position
Make a sense absolute position request from the sequence program or a peripheral device.

- Turn ON M2000 in a sequence program. Select test mode with a peripheral device.

Adjust the Machine Position
Make any required adjustments to the machine position using the manual pulse generator or JOG operation.

- Enable manual pulse generator operation from the sequence program or a peripheral device.
- JOG operation is possible from the sequence program or a peripheral device.

Establish Absolute Position
Establish the absolute position using home position return by the data set method.

- Use a sequence program to run the home position return servo program ZERO.
- With a peripheral device, carry out home position return in test mode.

End

(2) In the absolute positioning system, the absolute position may be lost under the following conditions:
Re-establish the absolute position using home position return or by aligning the machine position and using present 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 present value history can be monitored in the monitor mode.
(For details on monitoring Power of Allowed Traveling Points and the present value history, refer to the operating manual for the peripheral device being used.)
(a) Present value history monitor
1) Month/day/hour/minute
The time when a home position return 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 present value
When using MR-H-B (version BCD-B13W000-B2 or later) 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 present value in the home position data area, the encoder present value when the motor is within the in-position range after completion of a home position return 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 present value
The present value controlled within the servo system CPU is displayed.
Note:A value close to the feed present value is displayed, but, since the monitor present value and feed present value are different data, the display of different values does not indicate an error.
5) Alarms
When an error involving resetting of the present 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 systems is -2147483648 to 2147483647.
It is not possible to restore position commands that exceed this limit, or present values, after a power interruption.
When performing an infinite feed operation, solve this problem by setting the units to degrees or by setting a rotary table (when using SV22).

(2) Even when the present value address is changed by a present value change instruction, the restored data for the present value after a power interruption is the value based on the status prior to execution of the present value change instruction.

(3) When home position return has not been completed, restoration of the present value after a power interruption is not possible.

8.7 Speed Change

Changes the speed for positioning control and JOG operation.
Speed change is possible with the sequence program DSFLP instruction (for A171SCPU/A273UHCPU (8-axis specification), the CHGV instruction, and in the test mode with a peripheral device.
(See the peripheral device operation manual for the method of changing the speed in the test mode with a peripheral device.)

[Control Details]

(1) Forcibly changes the speed of an axis during operation to the speed designated in the speed change register.

(2) Speed change is possible with the DSFLP instruction (for A171SCPU/ A273UHCPU (8-axis specification) and the CHGV instruction. See Section 5.3 for details about the DSFLP instruction and the CHGV instruction.

[Data Settings]

(1) The speed change registers for each axis when using the DSFLP instruction are listed in the table below.
<A171SCPU>

Axis No.	Speed Change Register	
	Most Significant	Least Significant
1	D963	D962
2	D969	D968
3	D975	D974
4	D981	D980

<A273UHCPU (8-axis specification)>

Axis No.	Speed Change Register	
	Most Significant	Least Significant
1	D963	D962
2	D969	D968
3	D975	D974
4	D981	D980
5	D987	D986
6	D993	D992
7	D999	D998
8	D1005	D1004

(2) The setting ranges for the speed change registers are shown below.

Unit / Item	mm		inch		degree		PULSE	
	Set Range	Units	Set Range	Units	Set Range	Units	Set Range	Units
Speed change value	0 to 600000000	$\times 10^{-2}$ mm/min	0 to 600000000	$\times 10^{-3}$ inch/min	0 to 600000000	$\times 10^{-3}$ degree/min	0 to 1000000	PLS/sec

POINT

To set the speed using a sequence program, store a value in the speed change register which is 100 times the actual speed in units of millimeters or 1000 times the speed in units of inches or degrees.

Example

To set a speed of 10000.00 mm/min., store the value 1000000 in the speed change register.

[Cautions]

(1) To change the speed during 2- to 4-axis linear interpolation control, change the speed of one of the axes under interpolation control.

(2) The speed units are the control units set in the parameter block.

(3) The values in the speed change registers are ignored during test mode with a peripheral device.

(4) The speed does not change if any of the following errors occurs during the check on DSFLP/CHGV instruction execution.

<table>
<tr><th colspan="2">Error Details</th><th>Error Processing</th><th>Error Code</th></tr>
<tr><td rowspan="5">Data setting error</td><td>An axis number was set outside the range 1-4 or 1-8.</td><td rowspan="4">• Error step saved in D9010, D9011.
• M9010, M9011 turn ON. (M9010 does not turn ON for (A273UHCPU (8-/32-axis specification.)</td><td rowspan="4">—</td></tr>
<tr><td>Axis number set by indirect designation using index qualification.</td></tr>
<tr><td>Present value change data not set to 0 or 1.</td></tr>
<tr><td>Present value change data set by indirect designation using index qualification.</td></tr>
<tr><td>Speed not set in range between 0 and speed limit value.</td><td>• Error detection flag (M1607+20n/Yn7/M2407+20n) turns ON.
• Error code listed at right is stored in the minor error register for each axis.</td><td>305</td></tr>
<tr><td rowspan="4">Error at speed change</td><td>Home position return in progress for designated axis.</td><td rowspan="4">• Error detection flag (M16+20n07/Yn7/M2407+20n) turns ON.
• Error code listed at right is stored in the minor error register for each axis.</td><td>301</td></tr>
<tr><td>Circular interpolation in progress for designated axis.</td><td>302</td></tr>
<tr><td>Automatic deceleration in progress under positioning control.</td><td>303</td></tr>
<tr><td>Deceleration in progress after JOG operation signal turned OFF.</td><td>304</td></tr>
</table>

(5) The speed set by the speed change is ignored in the following cases, but no error occurs:

(a) During deceleration due to a stop command;

(b) When stopped;

(c) During manual pulse generator operation.

[Operation Timing]

The operation timing for speed change is shown in Figure 8.4.

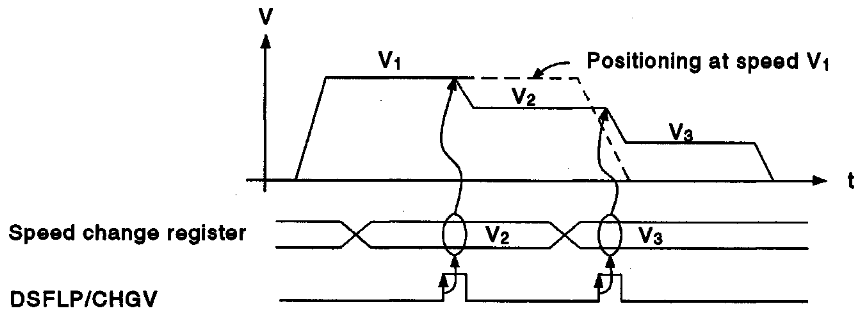


Figure 8.4 Operation Timing for Speed Change

[Program Example]

A program to change the speed is shown below, using the following conditions.

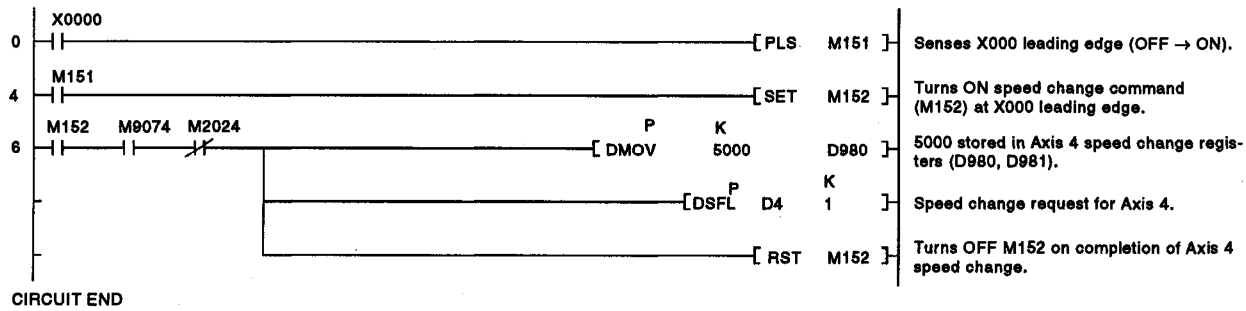
(1) Speed change conditions

(a) Axis for speed change.......... Axis 4

(b) Speed after change 5000

(c) Speed change command........ X000

(2) Sequence program



8.8 Present Value Change

Feed present value of a stopped axis can be changed with the sequence program DSFLP instruction (for A171SCPU/A273UHCPU (8-axis specification), the CHGA instruction, and in the test mode with a peripheral device. (See the peripheral device operation manual for the method of changing the present value in the test mode with a peripheral device.)

[Control Details]

(1) Changes the present value to the value designated in the present value change register.
The actual present value is also changed when the feed present value is changed.

(2) Present value change is possible with the DSFLP instruction (for A171SCPU/A273UHCPU (8-axis specification) and the CHGA instruction. See Section 5.3 for details about the DSFLP instruction and the CHGA instruction.

(3) When a present value change is executed in an absolute position system, the machine position address is changed.

[Data Settings]

(1) The present value change registers for each axis when using the DSFLP instruction are listed in the table below.
<A171SCPU>

Axis No.	Present Value Change Register	
	Most Significant	Least Significant
1	D961	D960
2	D967	D966
3	D973	D972
4	D979	D978

<A273UHCPU (8-axis specification)>

Axis No.	Present Value Change Register	
	Most Significant	Least Significant
1	D961	D960
2	D967	D966
3	D973	D972
4	D979	D978
5	D985	D984
6	D991	D990
7	D997	D996
8	D1003	D1002

(2) The setting ranges for the present value change registers are shown below.

Item \ Unit	mm		inch		degree		pulse		Comments
	Set Range	Units	Set Range	Units	Set Range	Units	Set Range	Units	
Present value change value	-2147483648 to 2147483647	$\times 10^{-1}$ µm	-2147483648 to 2147483647	$\times 10^{-5}$ inch	-2147483648 to 2147483647	$\times 10^{-5}$ degree	-2147483648 to 2147483647	PLS	No error occurs if the set value is outside the stroke range.

POINT

To set the present value using a sequence program, store a value in the present value change register which is 10 times the actual present value in units of millimeters or 100000 times the present value in units of inches or degrees.

Example

To set a present value of 100000.00 mm/min., store the value 1000000 in the present value change register.

[Cautions]

(1) The present value cannot be changed for an axis when it is being operated.
If an attempt is made to change the present value for an axis which is being operated, a minor error occurs and the error detection flag (M16m7) turns ON.
The error code 300 is stored in the minor error register for the appropriate axis.

(2) The values in the present value change registers are ignored during test mode with a peripheral device.

(3) In the absolute position system, use present value change on system startup to establish the reference position at the machine position address.

(4) The present value does not change if any of the following errors occurs during the check on DSFLP/CHGA instruction execution.

<table>
<tr><th colspan="2">Error Details</th><th>Error Processing</th></tr>
<tr><td rowspan="4">Data setting error</td><td>An axis number was set outside the range 1-4 or 1-8.</td><td rowspan="4">• Error step saved in D9010, D9011.
• M9010, M9011 turn ON. (M9010 does not turn ON for (A273UHCPU (8-/32-axis specification)</td></tr>
<tr><td>Axis number set by indirect designation using index qualification.</td></tr>
<tr><td>Present value change data not set to 0 or 1.</td></tr>
<tr><td>Present value change data set by indirect designation using index qualification.</td></tr>
<tr><td rowspan="2">Error at present value change</td><td>Axis designated for present value change is in operation.</td><td rowspan="2">• Error detection flag (M1607+20n/Yn7/M2407+20n) turns ON.
• Error code 300 is stored in the minor error register for each axis.</td></tr>
<tr><td>Servo not commissioned for axis.</td></tr>
</table>

(5) The start accept flag remains ON during present value change.

(6) Present value change is executed whether PC ready (M2000) is ON or OFF.

[Operation Timing]

The operation timing for present value change is shown in Figure 8.5.

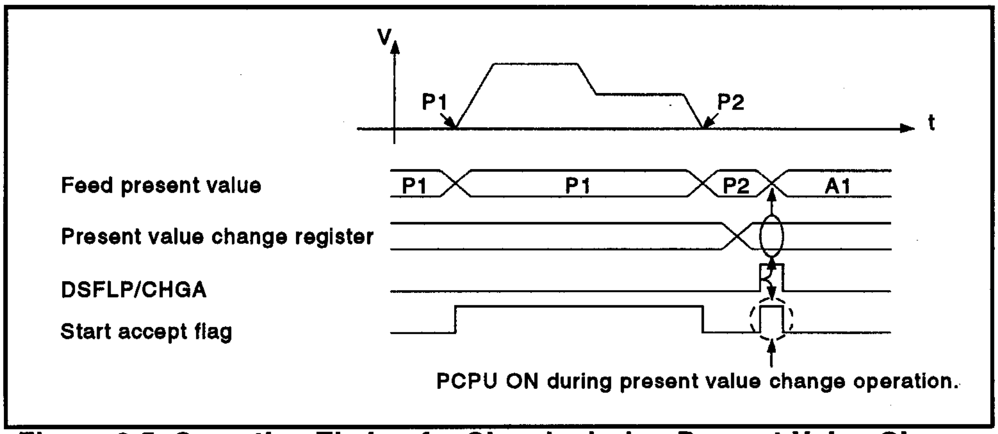


Figure 8.5 Operation Timing for Signals during Present Value Change

[Program Example]

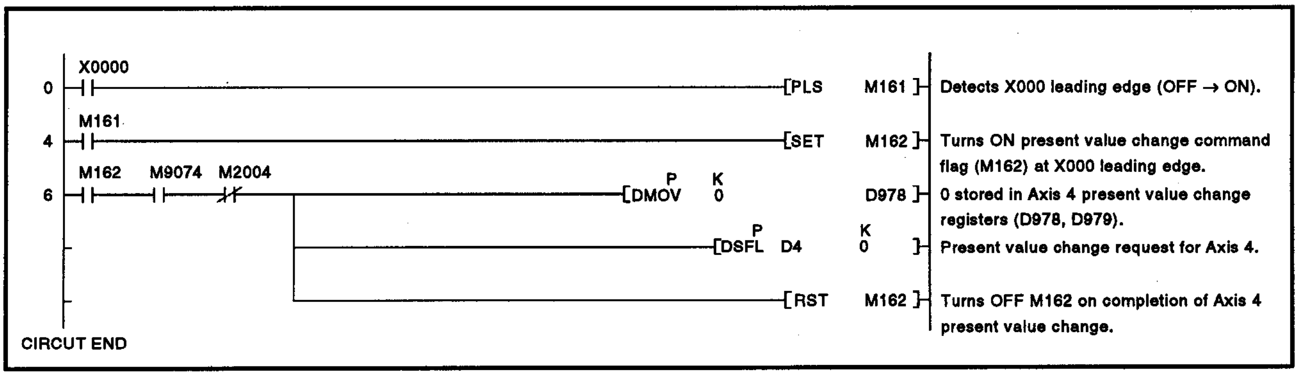
A program to change the present value is shown below, using the following conditions.

(1) Present value change conditions
   (a) Axis for present value change .... Axis 4

   (b) Present value change command X000

   (c) Present value after change 0

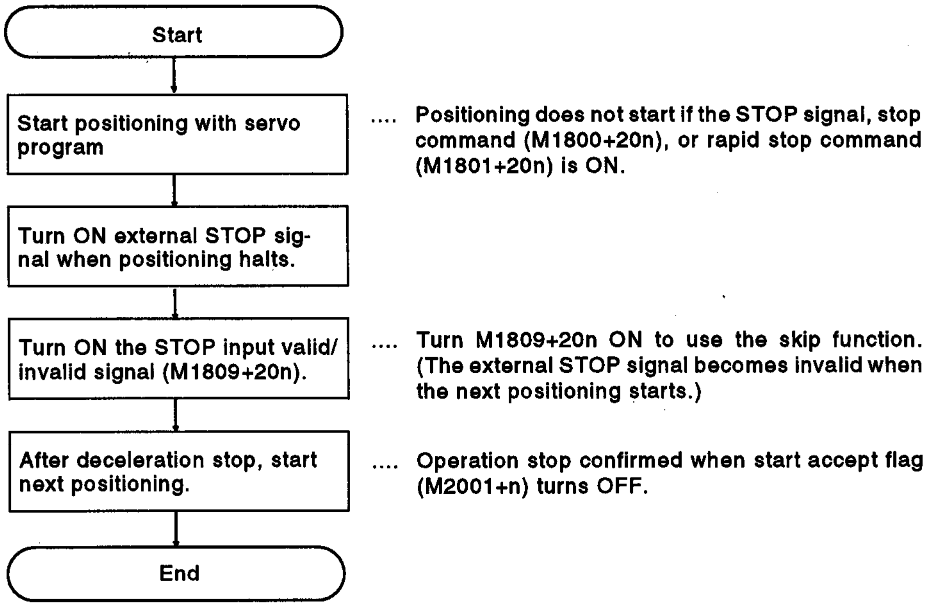
(2) Sequence program



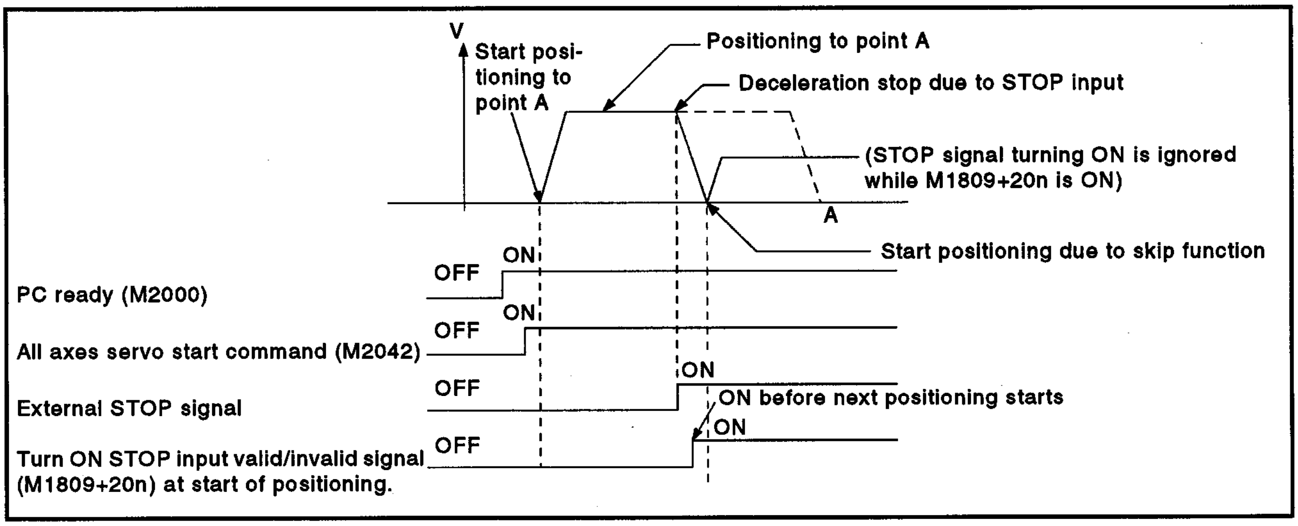
8.9 Skip Function

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.



8.10 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 present value to the designated program address. The program must be created before the address teaching method can be used.
   (b) Program teaching
   Writes the present value to addresses while the program is being created.

(2) For details about teaching, see the A30TU Teaching Unit Operating Manual (IB-67277).

8.11 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 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

1. Feed present value
2. Present value
3. Deviation counter value
4. M codes
5. Torque limit value
6. Motor current
7. Motor rpm
8. Virtual servo motor feed present value
9. Synchronous encoder present value
10. Virtual servo M code
11. Present value after differential gear of main shaft
12. Present value in one rotation of main virtual axis
13. Present value in one rotation of auxiliary input axis
14. Present value in one rotation of cam axis
15. Executed cam No.
16. Executed stroke amount

Only valid in SV22 virtual mode

(2) Modules and signals used

CPU	Input Module	Signal	Reading Timing	Number of Points Settable
When using A171SCPU	A171SENC	TREN	0.8 ms	1
	PC input module	X device		8
When using A273UHCPU (8/32-axis specification)	A273EX	TREN		3
	PC input module	X device		8

Note: Only one PC input module can be used.

8.12 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

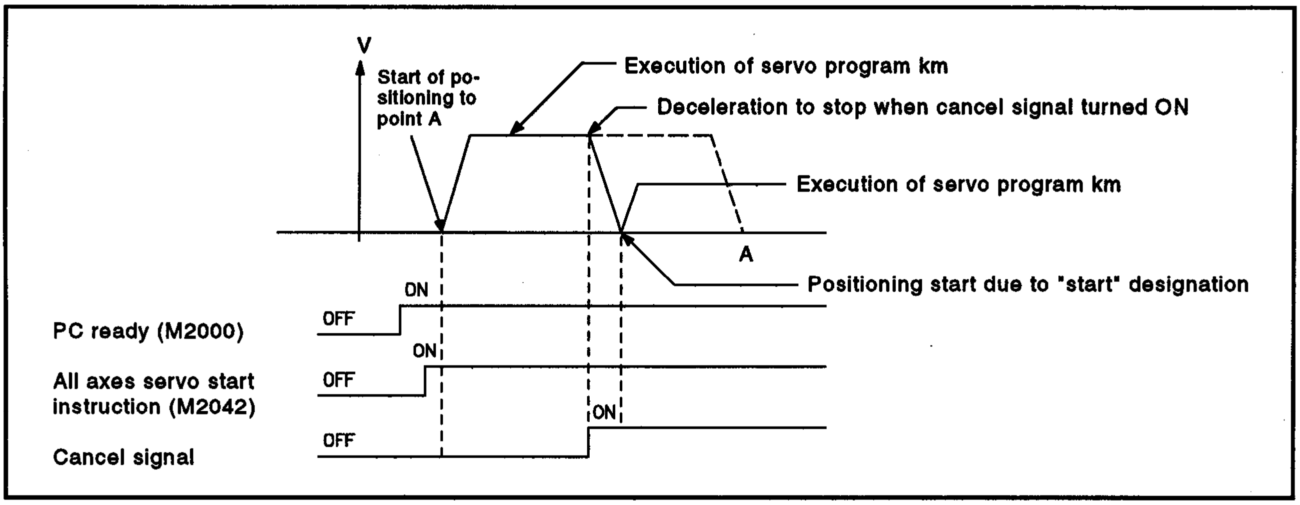
(2) Start (selectable item) setting method
Set by indirect designation (1 word) by using a constant (K) or D, W devices.

[Notes]

(1) Cannot be used with the home position return 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]



The operation timing is shown below.

[Program example]

A program example is shown below.

```
<K    0>
ABS-1
  Axis 1   1,       30000
  Speed              5000
  Cancel            X0000 <------ Cancel signal..... X0
  Start             K   2 <------ Start.................. K2
```

APPENDICES

APPENDIX 1 SCPU ERROR CODE LIST

If an error occurs when the PC 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.

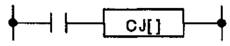
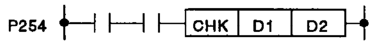
1.1 SCPU Error Code List

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 Axis 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 (When an A273UHCPU (8/32 Axis Specification) Is Used)	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 X7FE when using an A373CPU or X1FFE when using an A373U/A273U. (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 nearest Mitsubishi service center, 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 nearest Mitsubishi service center, 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.
"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.

APP

Table 1.1 Error Code List (Continued)

Error Message (When an A273UHCPU (8/32 Axis Specification) is Used)	Contents of Special Register D9008 (BIN Value)	CPU Status	Error Contents and Cause	Corrective Action
"FUSE BREAK OFF" (When an END instruction is executed. (However, no check is performed when M9084 or M9094 is 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 instructions 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 nearest Mitsubishi service center, agent, or office, and explain the problem with the defective module/unit.
"SP.UNIT DOWN" (When FROM, TO instructions 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 nearest Mitsubishi service center, 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 nearest Mitsubishi service center, 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.
"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 pe-ripheral 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 connecter 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.

APPENDIX 2 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.

<A171SCPU>

Table 2.1 Error Code Registers, Error Detection Flags

Device / Error Class	Error Code Register				Error Detection Signal
	Axis 1	Axis 2	Axis 3	Axis 4	
Minor error	D806	D826	D846	D866	M1607+20n
Major error	D807	D827	D847	D867	
Servo error	D808	D828	D848	D868	M1608+20n

<A273UHCPU
(8 axis specification)>

Table 2.2 Error Code Registers, Error Flags

Device / Error Class	Error Code Register								Error Detec-tion Signal
	Axis 1	Axis 2	Axis 3	Axis 4	Axis 5	Axis 6	Axis 7	Axis 8	
Minor error	D806	D826	D846	D866	D886	D906	D926	D946	Xn7
Major error	D807	D827	D847	D867	D887	D907	D927	D947	
Servo error	D808	D828	D848	D868	D888	D908	D928	D948	Xn8

<A273UHCPU
(32 axis specification)>

Table 2.3 Error Code Registers, Error Flags

Device / Error Class	Error Code 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 Class	Error Code 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 (M1807+20n/Yn7/M3207+20n) or servo error reset signal (M1808+20n/Yn8/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 (M1806+20n/Xn8/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

The error codes, error contents, and corrective actions for servo program setting errors are shown in Table 2.4. The "*" in error codes marked with an asterisk indicates the axis number (1 to 4/1 to 8/1 to 32).

Table 2.4 Servo Program Setting Error List

Error Code Stored in D9190	Error Name	Error Contents	Error Processing	Corrective Action
1	Parameter Block number Setting error	The designated parameter block number is outside the range 1 to 16 (A273UH 32-axis specification : 1 to 64).	The servo program is executed with the parameter block number set to the default value of "1".	Designate the parameter block number in the range 1 to 16 (1 to 64).
n03*	Address/travel value setting error (Excluding speed control and speed/ position switching control)	(1) An address outside the designated range is set when executing absolute positioning control. Units: degree / Address Setting Range: 0 to 35999999, $\times 10^{-5}$degree (2) The travel value is set to −2147483648 (H80000000) when executing incremental positioning control.	(1) Axis motion does not start. (When executing interpolation control, none of the interpolation control axes 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.	(1) If the control unit is degrees, set the address in the range 0 to 35999999. (2) Set the travel value in the range 0 to $\pm(2^{31}-1)$.
4	Commanded speed error	(1) The commanded speed is set outside the range of 1 to the speed limit value. (2) The designation for the commanded speed is outside the applicable range. Units / Address Setting Range: mm: 1 to 600000000, $\times 10^{-2}$mm/min inch: 1 to 600000000, $\times 10^{-3}$inch/min degree: 1 to 600000000, $\times 10^{-3}$degree/min PULSE: 1 to 1000000, PLS/sec	(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.	(1) Set the commanded speed in the range from 1 to the speed limit value.
5	Dwell time setting error	The dwell time is set outside the range 0 to 5000.	Control is executed using the default value of "0".	Set the dwell time in the range from 0 to 5000.
6	M code setting error	The M code is set outside the range 0 to 255.	Control is executed using the default value of "0".	Set the M code in the range from 0 to 255.
7	Torque limit value setting error	The torque limit value is set outside the range 1 to 500.	Control is executed using the torque limit value set in the designated parameter block.	Set the torque limit value in the range from 1 to 500.
n08*	Auxiliary point setting error (when executing circular interpolation by designating an auxiliary point).	(1) An address outside the designated range is set when executing absolute positioning control. Units: degree / Address Setting Range: 0 to 35999999, $\times 10^{-5}$degree (2) The travel value is set to −2147483648 (H80000000) when executing incremental positioning control. (3) The start point is also the auxiliary point, or the auxiliary point is also the end point. (4) The auxiliary point is located on a straight line between the start and end points.	Positioning control does not start.	(1) If the control unit is degrees, set the address in the range 0 to 35999999. (2) Set the travel value in the range 0 to ±2147483647. (3) Set the start, auxiliary, and end points so that they are not equal to one another. (4) Set the auxiliary point at a location not on the straight line between the start and end points.
n09*	Radius setting error (when executing circular interpolation by designating a radius)	(1) An address outside the applicable range is set when executing absolute positioning control. Units: degree / Address Setting Range: 0 to 35999999, $\times 10^{-5}$degree (2) The travel value is set to −2147483648 (H80000000) when executing incremental positioning control. (3) The start point is also the end point. (4) The distance between the start and end points is greater than the radius.	Positioning control does not start.	(1) If the control unit is degrees, set the address in the range 0 to 35999999. (2) Set the travel value in the range 0 to ±2147483647. (3) Set the start and end points so that they are not equal to each other. (4)Change the relationship between the start-to-end point distance (L) and the radius (R) so that it conforms with the following equation: $\frac{L}{2R} \leq 1$

Table 2.4 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. Units: degree; Address Setting Range: 0 to 35999999, $\times 10^{-5}$degree (2) The travel value is set to −2147483648 (H80000000) when executing incremental positioning control.	Positioning control does not start.	(1) If the control unit is degrees, set the address in the range 0 to 35999999. (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/sec.	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.
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. Units / Address Setting Range (1 to 100000): mm: $\times 10^{-1}\mu m$ inch: $\times 10^{-5}$inch degree: $\times 10^{-5}$degree PULSE: 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. (2) There is a START instruction in the designated servo program. (3) More than one axis has been designated for the started servo program.	Positioning control does not start.	(1) Create a servo program designated by the START instruction. (2) Delete the servo program containing the START instruction. (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. (Applies with A273UHCPU (8/32 axis specification) only.)	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 2147483647 and then start.
26	High-speed oscillation 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 (x 0.1 degrees).	Positioning control does not start.	Set the starting angle within the range 0 to 3599 (x 0.1 degrees) and then start.
27	High-speed oscillation 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 2.4 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 DSFRP/SVST program does not exist.	Positioning control does not start.	Set the correct servo program number.
901	START instruction setting error	(1) The axis number set for the DSFRP/SVST instruction is different from the axis number set for the servo program. (2) A DSFRP instruction has been used when executing 4-axis linear interpolation.	Positioning control does not start.	(1) Set the correct axis number. (2) Use the SVST instruction for 4-axis 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 DSFRP/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, 900)
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 2.5 below.

Table 2.5 Set Data Error List (1 to 99, 900)

Error Code	Data Where Error Occurred	Check Timing	Error Cause	Error Processing	Corrective Action
21	Home position return data	When count type, near-zero-point dog type, or data set type home position return is started.	The home position address of a degree axis is outside the range 0 to 35999999 (x 10^{-5} degrees).	Home position return is not started.	Set the home position address within the permissible range with a peripheral device.
22		When a count type or near-zero-point dog type home position return is started.	The home position return speed is set outside the range of 1 to the speed limit value.		Set the home position return speed at or below the speed limit value by using a peripheral device.
23			The creep speed is set outside the range of 1 to the home position return speed.		Set the creep speed at or below the home position return speed by using a peripheral device.
24		When a count type home position return is started.	The travel value after the near-zero-point dog comes ON is outside the range ON2^{31}-1 (x unit).		Set the travel value after the near-zero-point dog to within the permissible range with a peripheral device.
25		When a count type or near-zero-point dog type home position return is started.	The parameter block No. is outside the range of 1 to the maximum No.*		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.
*: 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 2.6 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	Home Position Return	Position Follow-Up Control	OSC				
100	O	O	O	O	O	O	O	O	O	O	O		• The PC ready flag (M2000) or PCPU ready flag (M9074) is OFF.		• Set the servo system CPU to RUN. • Turn the PC ready flag (M2000) ON.
101	O	O	O	O	O	O	O	O	O	O	O		• The start accept flag (M2001 to M2004/M2001 to M2008/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	O	O	O	O	O	O	O	O	O	O	O		• The stop command (M1800+20n/Yn0/M3200+20n) of the relevant axis has been turned ON.		• Turn the stop command (M1800+20n/Yn0/M3200+20n) OFF and start positioning.
104	O	O	O	O	O	O	O	O	O	O	O		• The rapid stop command (M1801+20n/Yn1/M3201+20n) of the relevant axis has been turned ON.		• Turn the rapid stop command (M1801+20n/Yn1/M3201+20n) OFF and start positioning.
105	O				O	O				O			• On starting, the feed present value is outside the stroke limit range.		• Move back inside the stroke range using JOG operation. • Enter inside the stroke range by executing a home position return or present value change.
106*	O	O			O	O				O	O		• Positioning outside the stroke limit has been designated.		• Positioning end point must be within the specified stroke limit.
107	O					O							• 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)	Positioning control does not start.	• Designate correct addresses in the servo program.
108*	O					O							• 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	O					O							• 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*	O					O							• In circular interpolation, the difference between the end point address and the ideal end point exceeded the allowable error range for circular interpolation.		
111				O									• 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									O				• The home position return completed signal (M1610+20n/XnA/M2410+20n) has been turned ON during a near-zero point dog type home position return operation.		• Resumptive starts are not possible for home position return operations. Use JOG operation or positioning operation to return the axis to a point before the near-zero point dog signal was output, then retry the home position return operation.

Table 2.6 Positioning Control Start-Up Error List (100 to 199) (Continued)

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	Home Position Return	Position Follow-Up Control	OSC				
116							o						• 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								o					• 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					o								• 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										o			ZCT not set During second travel in dog type or count type home position return, or when data set type home position return is started, the zero pass signal (M1606+20n/Xn6/M2406+20n) is OFF.	Home position return is not completed correctly.	• Carry out the home position return after the home position has been passed.
136			o										• A VVF/VVR instruction has been used for an MR-[ ]-B axis.	Positioning control does not start.	• MR-J-B axes cannot be started with VVF/VVR instructions: use VF/VR instructions instead.
140	o												• In linear interpolation for which a reference axis is designated, the travel value of the reference axis is set at "0".		• Do not set an axis whose travel value is 0 as the reference axis.
141											o		• 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				o						o			• 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 2.7.

Table 2.7 Positioning Control 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	Home Position Return	Position Follow-Up Control	OSC		Error Cause	Error Processing	Corrective Action
200	o	o	o	o	o	o	o	o		o	o		• The PC 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 PC ready flag (M2000) ON after all axes have stopped.
201									o				• The PC ready flag (M2000) was turned OFF during a home position return operation.		• After turning the PC ready flag (M2000) ON or turning the stop command (M1800+20n/Yn0/M3200+20n) or rapid stop command (M1801+20n/Yn1/M3201+20n) OFF, re-attempt home position return. (In the case of a near-zero point dog type home position return, use JOG operation or positioning operation to return the axis to the point before the near-zero point dog signal was output, and re-attempt home position return.)
202									o				• The stop command (M1800+20n/Yn0/M3200+20n) has been turned ON during a home position return operation.		
203									o				• The rapid stop command (M1801+20n/Yn1/M3201+20n) has been turned ON during a home position return operation.	Axis motion stops immediately.	
204	o	o	o	o	o	o	o	o	o	o	o		• The PC ready flag (M2000) was turned back ON during deceleration initiated by turning OFF the PC ready flag (M2000).	No processing	• Turn the PC ready flag (M2000) ON after all axes have stopped. (Turing ON of the PC ready flag (M2000) during deceleration is ignored.)
206									o				• While a home position return 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 near-zero point dog type home position return, use JOG operation or positioning operation to return the axis to the point before the near-zero point dog signal was output, and re-attempt home position return. • If the near-zero point dog signal is turned OFF when executing a count type home position return, use JOG operation or positioning operation to return the axis to the point before the near-zero point dog signal was output, and re-attempt home position return. (If the near-zero point dog signal is turned ON when executing count type home position return, re-attempt the home position return.)
207	o				o	o	o			o			• The feed present value exceeded the stroke limit during positioning. In the case of circular interpolation, an error code is stored only for axes whose feed present 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	o				o	o		o					• During circular interpolation or during simultaneous operation of multiple manual pulse generators, the feed present value of another axis exceeded the stroke limit value. (For detection of other axis errors).		
209				o					o				• 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 near-zero-point dog signal is input during count type home position return.		• Correct the speed setting so that overrun does not occur. • Set a travel value which will not cause an overrun.
210				o									• 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 2.7 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	Home Position Return	Position Follow-Up Control	OSC		Error Cause	Error Processing	Corrective Action
211						o							• 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								o					• 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					o								• The speed switching point address is greater 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										o			• 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+20n 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										o			• 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 present value changes and speed changes (300 to 399)
The errors shown in this section are those that occur on execution of present value changes and speed changes.
Error codes, causes, processing, and corrective actions are shown in table 2.8.

Table 2.8 List of Errors that Occur at Present 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	Home Position Return	Position Follow-Up Control	OSC				
300	o	o	o	o	o	o	o	o	o	o	o		• An attempt was made to change the present value data of an axis in motion. • An attempt was made to change the present value data of an axis that had not been started up. • An attempt was made to change the present value data of an axis whose status was "servo OFF".	The present value data is not changed.	• Use the following states of the following devices as interlocks to ensure that the present value of an axis in motion cannot be changed. (1) OFF state of the start accept flag (M2001 to M2004/M2001 to M2008/M2001 to M2032) for the relevant axis (2) ON state of the servo READY flag XnF
301									o				• An attempt was made to change the speed of an axis executing a home position return.	The speed is not changed.	• The speed of an axis executing a home position return cannot be changed.
302	o					o							• An attempt was made to change the speed of an axis executing circular interpolation.	The speed is not changed.	• The speed of an axis executing circular interpolation cannot be changed.
303	o	o		o	o	o				o			• An attempt was made to change the speed of an axis after automatic deceleration had started in positioning.	The speed is not changed.	• The speed of an axis cannot be changed after automatic deceleration has started.
304							o						• An attempt was made to change the speed of an axis during deceleration initiated by turning OFF the JOG operation start signal (M1802+20n, M1803+20n/Yn2, Yn3/M3202+20n, M3203+20n).	The speed is not changed.	• Do not attempt a speed change during deceleration initiated by turning OFF the JOG operation start signal (M1802+20n, M1803+20n/Yn2, Yn3/M3202+20n, M3203+20n).
305	o	o	o	o	o	o	o			o			• 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 present value change command outside the range of 0 to 35999999 (× 10^{-5} degrees) has been issued for an axis whose control units are degrees.	The present value data is not changed.	• Make a setting in the range of 0 to 35999999 (× 10^{-5} degrees).
310											o		• 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.

(5) System errors (900 to 999)

Table 2.9 System Error List (900 to 999)

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	Home Position Return	Position Follow-Up Control	OSC				
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-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 2.10.

Table 2.10 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	Home Position Return	Position Follow-Up Control	OSC				
1000	o	o	o	o	o	o	o	o	o	o	o		• The external stop signal of the corresponding axis was turned ON.		• Turn OFF the STOP signal.
1001	o	o	o	o	o	o	o	o	o	o	o		• 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	o	o	o	o	o	o	o	o	o	o	o		• 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									o				• When near-zero point type home position return was started, the external DOG (near-zero point dog) signal was turned ON.		• Move the axis to a point before the near-zero point dog in the JOG mode and then execute a home position return.
1004	o	o	o	o	o	o	o	o	o	o	o		• The servo state of the corresponding axis is not servo READY. (M1615+20n/XnF/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 (M1615+20n/XnF/M2415+20n : OFF).
1005	o	o	o	o	o	o	o	o	o	o	o		• The servo error detection signal of the corresponding axis (M1608+20n/Xn8/M2408+20n) was turned ON.		• Eliminate the error at the servo side, reset the servo error detection signal (M1608+20n/Xn8/M2408+20n) by using the servo error reset command (M1808+20n/Yn8/M3208+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 2.11.

Table 2.11 Positioning Control Error List (1100 to 1199)

Error Code	Control Mode: Positioning	Fixed-Pitch Feed	Speed	Speed/Position Switching	Speed Switching	Constant Speed	JOG	Manual Pulse Generator	Home Position Return	Position Follow-Up Control	OSC		Error Cause	Error Processing	Corrective Action
1101	O	O	O	O	O	O	O	O	O	O	O		• 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	O	O	O	O	O	O	O	O	O	O	O		• 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									O				• The external STOP signal (stop signal) was turned ON while the axis was moving.		• When executing a near-zero point dog type home position return, move the axis to a point before the near-zero point dog in the JOG mode and then execute a home position return.
1104	O	O	O	O	O	O	O	O	O	O	O		• The servo error detection signal (Xn8) 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	O	O	O	O	O	O	O	O	O	O	O		• The power supply to the servo amplifier was turned OFF while an axis was in motion. (Servo not installed status detected, cable fault, etc.)	M1615+20n/ XnF/M2415 +20n turned OFF.	• Turn ON the power supply to the servo amplifier. • Check the cable to servo amplifier connecting cable.

(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 2.12.

Table 2.12 Absolute Sysyem Error List (1200 to 1299)

Error Code	Control Mode: Positioning	Fixed-Pitch Feed	Speed	Speed/Position Switching	Speed Switching	Constant Speed	JOG	Manual Pulse Generator	Home Position Return	Position Follow-Up Control	OSC		Error Cause	Error Processing	Corrective Action
1201													• When the servo amplifier power was switched ON, a sum check error occurred with the backup data in the controller. Home position return has not been performed. CPU module battery error.	Home position return request (X0n9) ON	• Check the battery of the CPU module and execute a home position return.
1202*													• When the servo amplifier power is turned ON, a communication error in communication between the servo amplifier and encoder occurs.	Home position return request (X0n9) ON, servo error 2016 set.	• Check the motor and encoder cables and perform home position return again.
1203*													• During operation, the amount of change in the encoder present value complies with the following expression : "Amount of change in encoder present 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 present value (PLS) ≠ feedback present 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).		

* : These errors occur only when using MR-H-B and MR-J2-B servo amplifiers.

(4) System error (1300 to 1399, 1500 to 1599)
This is an error that is detected when the power is turned on.
Error codes, error causes, error processing, and corrective actions are shown in Table 2.13.

Table 2.13 Main Base Unit Error List (1300 to 1399, 1500 to 1599)

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	Home Position Return	Position Follow-Up Control	OCR				
1300													• System setting differs from actual ADU installation status. • ADU defective.	Positioning control does not start.	• Review the parameter settings. • Replace the ADU.
1310													• Initial communication with servo system CPU not completed correctly. • Servo system CPU defective, or ADU defective.		• Replace the servo system CPU or ADU.
1500													• The servo power supply (A230P) is not on, or the all axes servo ON command (M2042 ON) was given during a fault status.		• Issue the all axes servo ON command after turning on the servo power supply. • Replace the servo power supply module.
1501													• When use of A278LX brake output is set, 24 VDC is not supplied correctly.		• Supply a 24 VDC power supply to the A278LX.

2.4 Servo Errors

Servo errors include servo amplifier errors and servo power supply module errors (only when using an A273UHCPU (8/32 axis specification)).
[When using A273UHCPU (32-axis specification)]
When using A273UHCPU (32-axis specification), the processing when a servo error is detected can be set separately for each system.
(However, this applies only to servo errors detected at the ADU.)
The processing and systems are set in the system settings at a peripheral device.

	Setting	Control Details
1	System servo OFF (default)	• If even one ADU axis is subject to a servo error, servo OFF is established for all the axes in that system. (Same control as when all axes servo OFF is performed.)
2	Servo OFF of affected axis only	• Only the ADU axis subject to the servo error goes into the servo OFF status and other axes are unaffected. • However: (1) Where there are two axes per module, if one of the axes is subject to a servo error then both axes go into the servo OFF status. (2) When the following servo errors occur, servo OFF for individual systems becomes effective. Overcurrent (2032) Insufficient voltage (2810) Excessive regeneration (2830) Overvoltage (2833) Amplifier power supply overheated (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.
Servo errors include errors at an ADU (only when using an A273UHCPU (8/32 axis specification)) and errors at an MR-[ ]-B.
In the following tables, the types of servo amplifier are indicated by symbols: (A) for "ADU", and (M) for MR-[ ]-B.
The servo error detection signal (M1608+20n/Xn8/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 (M1808+20n/Yn8/ 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.
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 2.14.

⚠ CAUTION

⚠ If a controller or servo amplifier self-diagnosis error occurs, check the points stated in this manual and clear the error.

Table 2.14 Servo Amplifier Error List (2000 to 2799)

Error Code	Amplifier Type	Error Cause: Name	Error Cause: Description	When Error Checked	Error Processing	Corrective Action
2010	(A)	P-N not connected.	• P-N of the ADU are not connected to P-N of the servo power supply module.	At any time during operation.	Immediate stop.	• Review the wiring.
2010	(M)	Low voltage	• The power supply voltage is less than 160 VAC.	At any time during operation.	Immediate stop.	• Measure the input voltage (R, S, T) with a voltmeter.
			• A momentary power interruption of 15 ms or longer has occurred.			• Monitor with an oscilloscope to check whether a momentary power interruption has occurred.
			• The power supply voltage dropped, for example when motion control started, due to insufficient power capacity.			• Review the power capacity.
2012	(A)	Internal memory error	• ADU SRAM fault	• When the servo amplifier power is turned ON.	Immediate stop.	• Replace the ADU.
2012	(M)	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 PC READY flag (M2000) • When a servo error is reset • When the power to the servo system CPU is turned ON	Immediate stop.	• Replace the servo amplifier.
2013	(M)	Clock error	• Servo amplifier clock fault.	At any time during operation	Immediate stop.	• Replacė the servo amplifier.
2014	(A)	Watchdog	• Fault in servo control system	At any time during operation	Immediate stop.	• Reset the servo system CPU and check again.
			• ADU failure			• Replace the ADU.
2014	(M)	Watchdog	• Servo amplifier hardware fault • Servo system CPU hardware fault	At any time during operation	Immediate stop.	• Replace the servo amplifier. • Replace the servo system CPU.
2015	(A)	2-port memory error	• Faulty 2-port memory in ADU	• When the servo amplifier power is turned ON • When a servo error is reset	Immediate stop.	• Reset the servo system CPU and check again. • Replace the ADU.
2015	(M)	Memory error 2	• Servo amplifier EEPROM fault	• When the servo amplifier power is turned ON • At the leading edge of the PC READY flag (M2000) • When a servo error is reset • When the power to the servo system CPU is turned ON	Immediate stop.	• Replace the servo amplifier.
2016	(A)	Position sensor error 1	• Communication with the encoder is not normal at initialization. • The encoder type set in the system settings (ABS/INC) does not match the encoder actually connected.	• When the servo amplifier power is turned ON • When a servo error is reset	Immediate stop.	• Reset the servo system CPU and check again. • Replace the servomotor (encoder). • Review the system settings.
2016	(M)	Position sensor error 1	• Fault in communication with the encoder	• When the servo amplifier power is turned ON • At the leading edge of the PC READY flag (M2000) • When a servo error is reset • When the power to the servo system CPU is turned ON	Immediate stop.	• Check if the connector of the encoder cable is loose. • Replace the servomotor. • Replace the encoder cable.
2017	(A)	PCB error	• ADU A/D onverter faulty	• When the servo amplifier power is turned ON • When a servo error is reset	Immediate stop.	• Reset the servo system CPU and check again. • Replace the ADU.
2017	(M)	PCB error	• Faulty device in the servo amplifier PCB.	• When the servo amplifier power is turned ON • At the leading edge of the PC READY flag (M2000) • When a servo error is reset • When the power to the servo system CPU is turned ON	Immediate stop.	• Replace the servo amplifier.
2019	(M)	Memory error 3	• Servo amplifier flash ROM check sum error	• When the servo amplifier power is turned ON • At the leading edge.of the PC READY flag (M2000) • When a servo error is reset • When the power to the servo system CPU is turned ON	Immediate stop.	• Replace the servo amplifier.

Table 2.14 Servo Amplifier Error List (2000 to 2799) (Continued)

Error Code	Amplifier Type	Error Cause		When Error Checked	Error Processing	Corrective Action
		Name	Description			
2020	(A)	Position sensor error 2	• Communication with the encoder was not performed normally during operation.	At any time during operation	Immediate stop	• Check the connection between the encoder and ADU. • Replace the servomotor (encoder).
	(M)		• Fault in communication with the encoder			• Check if the connector of the encoder cable is loose. • Replace the servomotor. • Replace the encoder cable.
2024	(M)	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 tocheck between the U, V, and W terminals of the motor and the core.
2025	(A)	Absolute position lost	• The voltage of the supercapacitor inside the absolute encoder has dropped below 2.5 ±0.2 V. • The absolute encoder rotated at greater than 500 rpm during a momentary power interruption.	• When the servo amplifier power is turned ON • When a servo error is reset		• Replace the battery (MR-JBAT-[ ]). • Check the connection between the encoder and ADU.
	(M)	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 PC 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 home position return.
			• The battery voltage is low.			• Turn the servo amplifier power OFF, then measure the battery voltage.
			• Failure of battery cable or battery. (Home position return must be re-executed after clearing the error.)			• Replace the servo amplifier battery.
2026	(A)	Unit mismatch	• There is a discrepancy between the servo parameters (system settings) and the actually installed servo amplifier.	• When the servo amplifier power is turned ON • When a servo error is reset		• Review the system settings.
2030	(M)	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	(A)	Overspeed	• The commanded speed is too high.			• Review the commanded speed.
			• An overshoot occurred during acceleration.			• Review the servo parameters.
			• Encoder failure			• Replace the encoder.
			• Failure or incorrect wiring of encoder cable			• Check the connection between the encoder and ADU.

Table 2.14 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
2031	(M)	Overspeed	• The motor rpm has exceeded 115% of the rated rpm.	At any time during operation	Immediate stop	• 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.
			• Position sensor fault.			• Check if the encoder cable is disconnected. • Replace the servomotor.
2032	(A)	Overcurrent	• A servomotor that does not match the setting has been connected.	• When the servo amplifier power is turned ON • When a servo error is reset		• Review the system settings.
			• The U, V, W phases in the ADU outputs have shorted with each other or to ground.			• Check the servomotor cable.
			• Incorrect wiring of U, V, W phases in the ADU outputs			• Correct the servomotor wiring.
			• The transistor module of the ADU is damaged. • ADU failure			• Replace the ADU.
			• Failure of coupling between the servomotor and encoder			• Replace the servomotor.
			• The servomotor oscillated.			• Review the servo parameters.
	(M)		• 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	(M)	Overvoltage	• The converter bus voltage has reached 400 V or more. • 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.

Table 2.14 Servo Amplifier Error List (2000 to 2799) (Continued)

Error Code	Amplifier Type	Error Cause		When Error Checked	Error Processing	Corrective Action
		Name	Description			
2034	(M)	Communica-tions error	• Error in data received from the servo system CPU	At any time during operation	Immediate stop	• 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.
2035	(A)	Data error	• The commanded speed is too high.			• Review the commanded speed.
			• Servo system CPU failure			• Replace the servo system CPU.
	(M)		• There is excessive variation in the position commands from the servo system CPU; commanded speed is too high.			• Check the commanded speed, and the number of pulses per revolution and travel value per revolution in the fixed parameters.
			• Noise has entered the commands from the servo system CPU.			• 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	(A)	Transmission error	• Servo system CPU failure			• Replace the servo system CPU.
	(M)		• 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	(M)	Feedback error	• Encoder signal fault			• Replace the servomotor.
2045	(A)	Amplifier fin overheating	• The fan of the ADU has stopped.			• Replace the fan of the ADU.
			• The continuous output current rating of the ADU was exceeded.			• Reduce the load.
			• Failure of ADU thermal sensor			• Replace the ADU.
	(M)	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	(A)	Motor overheating	• The thermal protector incorporated in the servomotor operated.			• Replace the servomotor.
			• The continuous output rating of the motor has been exceeded.			• Reduce the load.
	(M)		• The servomotor is overloaded.			• If the effective torque of the servomotor is high, reduce the load.
			• The servomotor and regenerative option are overheated.			• Check the ambient temperature of the servomotor (range: 0 to +40°C).
			• The thermal protector incorporated in the encoder is faulty.			• Replace the servomotor.

Table 2.14 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
2050	(A)	Overload	• The rated current of the motor has been exceeded. • The load inertia or friction is too great.	At any time during operation	Immediate stop	• Reduce the load.
2050	(A)	Overload	• Hunting occurred due to parameter setting error.	At any time during operation	Immediate stop	• Review the servo parameters.
2050	(M)	Overload 1	• An overload current of about 200% has been continuously supplied to the servo amplifier and servomotor.	At any time during operation	Immediate stop	• 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 ervo 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	(M)	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).	At any time during operation	Immediate stop	• 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.
2052	(A)	Excessive error	•The deviation counter value has exceeded the stipulated value. • Adequate acceleration is not possible because the inertia is too great.	At any time during operation	Immediate stop	• Review the servo parameters.
2052	(A)	Excessive error	• Encoder or cable failure.	At any time during operation	Immediate stop	• Replace the encoder, cable.
2052	(M)	Excessive error	• The difference between the servo amplifier command pulses and feedback pulses has exceeded 80000 pulses.	At any time during operation	Immediate stop	• 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 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.
2057	(A)	Hardware fault	• Hardware fault in an ADU	At any time during operation	Immediate stop	• Replace the ADU
2086	(M)	RS232 communication error	• Parameter unit communication error	At any time during operation	Operation continues	• Check for disconnection of the parameter unit cable. • Replace the parameter unit.
2102	(A)	Battery warning	• The voltage of the backup battery for the absolute encoder has become low.	At any time during operation	Operation continues	• Replace the battery (MR-JBAT-[ ]).
2102	(M)	Battery warning	• The voltage of the battery installed in the servo amplifier has become low.	At any time during operation	Operation continues	• Replace the battery.
2103	(M)	Battery disconnection warning	• The power supply voltage to the absolute position sensor has become low.	At any time during operation	Operation continues	• Replace the battery. • Check for disconnection of the encoder cable. • Replace the servomotor. • Replace the servo amplifier.

Table 2.14 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
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).	At any time during operation	Operation continues	• Refer to the details on the excessive regeneration error (2030).
2141	(A)	Overload warning	• A load of 80% of the level that will cause an overload error (2050) has been detected.	At any time during operation	Operation continues	• Refer to the details on the overload error (2050).
2141	(M)	Overload warning	• An overload error (2050, 2051) is likely to occur (85% of overload level detected).	At any time during operation	Operation continues	• Refer to the details on the overload errors (2050, 2051).
2143	(A)	Absolute position counter warning	• Encoder failure	At any time during operation	Operation continues	• Replace 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.	At any time during operation	Operation continues	• Establish a short circuit between 1A and 1B of CN6 of the servo amplifier encoder.
2147	(A)	Emergency stop	• An emergency stop has been executed.	At any time during operation	Immediate stop	• Release the emergency stop.
2147	(M)	Emergency stop	• An emergency stop (EMG) signal has been input from the servo system CPU.	At any time during operation	Immediate stop	• Release the emergency stop.
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.	At any time during operation	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.	At any time during operation	Operation continues	• Re-attempt home position return.
2201 to 2224	(A)	Parameter warning	• An incorrect parameter setting has been made. 2201 Amplifier setting 2202 Motor type 2203 Motor capacity 2204 Number of feedback pulese 2205 In-position range 2206 Position control gain 2 (Actual position gain) 2207 Speed control gain 2 (Actual speed gain) 2208 Speed integral compensation 2209 Torque limit (forward) 2210 Torque limit (reverse) 2211 Emergency stop time delay 2212 Position control gain 1 (Model position gain) 2213 Speed control gain 1 (Model speed gain) 2214 Load inertia ratio 2215 Excessive error alarm level 2216 Special compensation processing 2217 Special servo processing 2218 Td dead band compensation 2219 Feed forward gain 2220 Torque imbalance compensation 2221 Dither control 2222 Gain operation time 2223 Servo responsibility 2224 —	At any time during operation	Operation continues	• Review the system settings and servo parameters.

Table 2.14 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	(M)	Parameter error	• Out-of-range parameter setting has been designated. Incorrect parameter values are ignored and the values before setting are 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 2332 Optional function 5 2333 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 servo parameter setting range.

Table 2.14 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 2324	(A)	Parameter error	• Out-of-range parameter setting has been designated. Incorrect parameter values are ignored and the values before setting are retained. 2301 Amplifier setting 2302 Motor type 2303 Motor capacity 2304 Number of feedback pulese 2305 In-position range 2306 Position control gain 2 (Actual position gain) 2307 Speed control gain 2 (Actual speed gain) 2308 Speed integral compensation 2309 Torque limit (forward) 2310 Torque limit (reverse) 2311 Emergency stop time delay 2312 Position control gain 1 (Model position gain) 2313 Speed control gain 1 (Model speed gain) 2314 Load inertia ratio 2315 Excessive error alarm level 2316 Special compensation processing 2317 Special servo processing 2318 Td dead band compensation 2319 Feed forward gain 2320 Torque imbalance compensation 2321 Dither control 2322 Gain operation time 2323 Servo responsibility 2324 —	At any time during operation	Operation continues	• Check the servo parameter setting range.
2500	(A)	Parameter error	• The following servo parameters were set incorrectly. • Amplifier/external regenerative resistance setting • Motor type • Motor capacity	• When the servo amplifier power is turned ON • When a servo error is reset		• Review the system settings and the servo parameters.

Table 2.14 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	(A)	Parameter error	• Incorrect parameter settings have been made. 2501 Amplifier setting 2502 Motor type 2503 Motor capacity 2504 Number of feedback pulese 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 Torque limit (forward) 2510 Torque limit (reverse) 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 Excessive error alarm level 2516 Special compensation processing 2517 Special servo processing 2518 Td dead band compensation 2519 Feed forward gain 2520 Torque imbalance compensation 2521 Dither control 2522 Gain operation time 2523 Servo responsibility 2524 —	• When the servo amplifier power is turned ON • At the leading edge of the PC READY flag (M2000) • When a servo error is reset	Operation continues	• Review the system settings and the servo parameters.

Table 2.14 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
2601 to 2636	(M)	Initial parameter error	• The set parameter values are incorrect. • The parameter data has been destroyed. 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 2632 Optional function 5 2633 Optional function 6 2634 PI-PID switching position droop 2635 Torque limit compensation factor 2636 Speed integral compensation (actual speed differential compensation)	• When the servo amplifier power supply is turned ON • At the leading edge of the PC READY flag (M2000) • When a servo error is reset • When the power to the servo system CPU is turned ON	Immediate stop	• Check and change the set parameter values, then switch the power to the servo system CPU OFF then ON again, press the reset key, or turn the PC READY flag (M2000) OFF then ON again.

(2) Servo power supply module errors (2800 to 2999: only applicable when using 273UHCPU (8/32 axis specification))
Servo power supply module errors are detected by the servo amplifier, and their codes are 2800 to 2999.
The servo error detection signal (M1608+20n/Xn8/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 (M1808+20n/Yn8/M3208+20n), and reset operation. (Note that the servo error detection signal will not come ON in response to error codes in the range 2900 to 2999 because these codes are for warnings.)
Note: 1. Regarding the excessive regeneration error (error code 2830), the state at the time the error occurred remains stored in the servo amplifier even after the protection circuit has operated. The memory contents are cleared when the external power supply is turned OFF, but are not cleared by the RESET signal.
2. If error code 2830 is repeatedly reset by turning OFF the external power supply, devices may be destroyed due to overheating: only restart operation after the cause of the error has been completely eliminated.

The servo power supply module errors are shown in Table 2.15.

Table 2.15 Servo Power Supply Module Error List (2800 to 2999)

Error Code	Error Cause		When Error Checked	Error Processing	Corrective Action
	Name	Description			
2810	Low voltage	• The voltage to the power supply module fell below 170 VAC. • A momentary power interruption occurred.	At any time during operation	Immediate stop	• Review the power supply equipment.
		• The load is too great.			• Review the power capacity.
2830	Excessive regeneration	• The maximum load capacity of the regenerative resistor has been exceeded due to frequent operation or continuous regenerative operation.			• Review the operation pattern, either by reducing the frequency of acceleration and deceleration or reducing the speed.
		• The power transistor for regeneration has been damaged.			• Replace the servo power supply module.
		• The regenerative resistor setting in the system settings is incorrect.			• Review the system settings.
		• The regenerative resistor is wired incorrectly.			• Connect the wiring correctly.
2833	Overvoltage	• The regenerative resistor is connected incorrectly.			• Correct the wiring.
		• The power transistor for regeneration has been damaged.			• Replace the servo power supply module.
		• The regenerative resistor is destroyed.			• Replace the regenerative resistor.
		• The power supply voltage is too high.			• Review the power supply equipment.
2847	Amplifier power supply overheating	• The servo power supply module fan is stopped.			• Replace the fan.
		• The continuous output current of the power supply module has been exceeded.			• Reduce the load.
		• Thermal sensor fault.			• Replace the servo power supply module.
2940	Excessive regeneration warning	• 80% of the level that would cause an excessive regeneration error (2830) was detected.		Operation continues.	• Refer to the details on the excessive regeneration error (2830).

2.5 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 A171SCPU, and the LED on the front panel of the A273UHCPU. 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 2.16 LED Indications When Errors Occur at PCPU

A171SCPU "ERROR" LED ●: Lit ○: Not lit	LED Display on Front Panel of A273UHCPU	Error Cause	Error Check Timing	Operation when Error Occurs	Error Set Device	Corrective Action
●	LAY ERROR (SL■■) (*1) Base No. + slot No.	• The slot set in the "system settings" has nothing mounted in it, or has a different module mounted in it.				• Set the "system settings" correctly in accordance with the modules actually mounted, then reset with the RESET key switch.
●	AXIS NO MULTIDEF	• Axis number settings are duplicated in the "system settings".				
●	AMP NO SETTING	• Not even one axis No. has been set in the "system settings".				
—	PW NO SETTING	• When an ADU axis has been set in the system settings, no servo power supply module (A230P) has been set.				
●	SYS SET DATA ERR	• No system setting data has been written. • The system setting data has been written without performing a relative check. Or it has been written although an error occurred in the relative check. • There is no battery in the memory cassette.	When power switched ON On resetting with the RESET key switch	• Start is disabled.	• System setting error flag (M2041) ON	
●	AXIS NO ERROR	• An axis No. that exceeds the "number of controlled axes" setting in the "system settings" has been set.				
●	I/O POINTS OVER	• The total number of I/O points of the PC I/O modules set in motion slots in the "system settings" exceeds 256.				
●	AMP TYPE ERROR■■ Axis No. (01 to 32)	• The amplifier type set in the "system settings" (MR-H-B/MR-J-B/MR-J2-B) disagrees with the amplifier type actually installed.	When the servo amplifier power is turned ON	• Servo operation does not start for the relevant axis only. Starting of this axis is disabled.		

Note : "—" in the A171SCPU "ERROR" LED area indicates errors that do not occur with A171SCPU.

Table 2.16 LED Indications When Errors Occur at PCPU (Continued)

A171SCPU "ERROR" LED ● : Lit ○ : Not lit	LED Display on Front Panel of A273UHCPU	Error Cause	Error Check Timing	Operation when Error Occurs	Error Set Device	Corrective Action
●	A.D.U. .E.R.R.O.R. .(.S.L.■.■.) (*1) Base No. + slot No.	•ADU hardware error	When the power is switched ON (or on resetting with the RESET key switch)	The servo ON status cannot be established for the relevant ADU axis.		•Try replacing the ADU.
For servo error ● For warning ○	S.V. .E.R.R.O.R.■.■.■.■.(.■.■.) Servo error code Axis No. (01to 32) • "(**)" if applicable to all axes.	•Occurrence of a servo error or servo warning •When using A171SCPU, the LED does not light for a warning. (SV13, SV22, Ver.U or later)	At all times	•In the case of MR-H-B, MR-J-B, and MR-J2-B axes, only the relevant axis enters the servo OFF status. •In the case of ADU axes, the operation follows the ADU servo error processing.	•Servo error detection flag (M1608+20n/Xn8/M2408+20n) ON •Servo error code device (D808+20n/D808+20n/D08+20n) set	•Eliminate the error cause and perform a servo error reset. After servo error reset, if the servo status is normal at all axes, the LED display is cleared.
—	S.V. .E.R.R.O.R.■.■.■.■.(.P.■.) Servo error code Indicates "n" for the "nth" servo power supply	•Occurrence of servo error detected at a servo power supply module (A230P)		•All axes in the affected system assume the servo OFF status.		
—	S.Y.S. .E.R.R.. ■.■.■.■.(.P.■.) System error code (major error) detected at a servo power supply Indicates "n" for the "nth" servo power supply module. When using A273UHCPU (32-axis specitication), indicates a system error that is unconnected with the servo power supply module system.	•Occurrence of a system error (major error) detected at a servo power supply module.			•Major error detection flag (M1607+20N/Xn7/M2407+20n) ON. •Major error code device (D807+20n/D807+20n/D07+20n) set.	•Eliminate the error cause and issue the all axes servo ON command. If all axes enter the servo ON status normally, the LED display is cleared.
●	S.L.■.■. .U.N.I.T. .E.R.R.O.R. (*1) Base No. + slot No.	•Detection of motion slot module abnormality (module comes out, or is loose, during operation)			•Motion slot module error detection flag (M2047) ON	•Switch off the power and mount the module correctly.
●	P.C.P.U. .W.D.T. .E.R.R.. ■.■.■ PCPU WDT error code	•Occurrence of a PCPU WDT error		Immediate stop of all axes	•PCPU WDT error flag •(M9073) ON PCPU WDT error cause (D9184) set	•See Section 3.5.2.

(*1) Indicates the base No., slot No., and the slot information where the error occurred.

(SL□□)

- Slot No. at which the error occurred
  - 0 : I/O slot 0
  - to to
  - 7 : I/O slot 7
- Extension stage of the base unit where the error occurred
  - 0 : Main base unit
  - 1 : First motion extension base unit
  - 2 : Second motion extension base unit
  - 3 : Third motion extension base unit
  - 4 : Fourth motion extension base unit

REMARK

Numerical values corresponding to axis numbers are entered for "m" and "n" in Table 2.16 (error set device).

<A171SCPU>

Axis No.	n
1	0
2	1
3	2
4	3

<A273UHCPU (8-axis specification)>

Axis No.	n
1	0
2	1
3	2
4	3
5	4
6	5
7	6
8	7

<A273UHCPU (32 axis specification)>

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

* Calculate "n" when using A273UHCPU (8-axis specification), and the device No. corresponding to each axis when using A273UHCPU (32-axis specification), as shown below.
  Example : For 32 axes...
  M2408+20n (servo error detection flag) = M2408+20x31 = M3028
  D07+20n (major error code device) = D07+20x31 = D627

APPENDIX 3 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 marked *1 and *2 in the table are exceptions).

Table 3.1 Special Relay List

Number	Name	Stored Data	Explanation	Applicability	
				A273UH	A171S
M9000*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*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*1	MINI link error	OFF Normal ON Error	• Come ON when a module detects an error at the master station of the MINI link. Remains ON even after return to normal.	●	●
M9005*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*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*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.	●	●
M9010	Operation error flag	OFF No error ON Error	• Comes on when an operation error occurs during execution of an application instruction; goes OFF when the error is cleared. Cannot be used with A273UHCPU (8/32 axis specification).	—	●
M9011*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*2	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*2	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.	●	●

Table 3.1 Special Relay List (Continued)

Number	Name	Stored Data	Explanation	Applicability	
				A273UH	A171S
M9020	User timing clock No.0	n2 scan / n1 scan / n2 scan	• 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. DUTY n1 n2 M9020	●	●
M9021	User timing clock No.1				
M9022	User timing clock No.2				
M9023	User timing clock No.3				
M9024	User timing clock No.4				
M9025*2	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 the clock data (D9025 to D9028) values. OFF when there is no error.	●	●
M9027	Clock data display	OFF No processing ON Display	• Displays the clock data (D9025 to D9028) on the LED display on the front panel of the CPU module, as the month, day, hour, minute, and second.	●	—
M9028*2	Clock data read request	OFF No processing ON Read request	• When M9028 is ON, the clock data is read to D9025 to D9028 as BCD data.	●	●
M9029*2	Data communication request batch processing	OFF Batch processing not performed ON Batch processing performed	• By turning M9029 ON in the sequence program, all of the data communication requests received during one scan are processed at the END processing of that scan. • Data communication request processing can be switched between ON and OFF during the RUN status. • The default is OFF (one request at a time is processed at END processing, in the order in which the data communication requests were received).	●	—
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		●	●

Table 3.1 Special Relay List (Continued)

Number	Name	Stored Data	Explanation	Applicability	
				A273UH	A171S
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 executing [STRA] 1→0 Same as executing [STRAR]	• By switching M9044 ON/OFF the [STRA]/[STRAR] instruction can be executed. (M9044 is turned ON/OFF by executing forced ON/OFF at a peripheral device.) M9044 OFF → ON : [STRA] instruction M9044 ON → OFF : [STRAR] instruction The sampling trace condition depends on D9044.	●	—
M9045	Watchdog timer (WDT) reset	OFF WDT is not reset ON WDT is reset	• By turning M9045 ON, WDT can be reset when a ZCOM instruction is executed or when data communication request batch processing is executed. (Used when the scan time exceeds 200 ms.)	●	—
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.	●	●
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.	●	●
M9051	CHG instruction execution disable	OFF Enabled ON Disabled	• Turned ON to disable execution of the CHG instruction. • Turn ON when issuing a program transfer request; automatically turned OFF on completion of transfer.	●	—
M9052*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*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 set request	ON P, I set being requested OFF Other than when P, I set being requested	• These relays switch ON the P, I set request on completion of program transfer while another program is being run (for example a subprogram during execution of a main program). Automatically turned OFF on completion of P, I setting.	●	—
M9057	Sub side P, I set request	ON P, I set being requested OFF Other than when P, I set being requested		●	—

Table 3.1 Special Relay List (Continued)

Number	Name	Stored Data	Explanation	Applicability	
				A273UH	A171S
M9058	Main program P, I set complete	Momentarily ON on completion of P, I setting	• Comes ON momentarily on completion of P, I setting, then goes OFF immediately.	●	—
M9059	Subprogram P, I set complete	Momentarily ON on completion of P, I setting		●	—
M9065	Partial processing execution detection	OFF Partial processing not in progress ON Partial processing in progress	• ON during partial processing of an instruction given with respect to AD57(S1) or AD58; goes OFF on completion of this execution (when partial processing is not being performed).	●	—
M9066*2	Partial processing request flag	OFF Batch processing ON Partial processing	• When an instruction with a long processing time is executed with respect to AD57(S1) or AD58 and the scan time is lengthened, this instruction can be dealt with by partial processing by turning M9066 ON.	●	—
M9070*2	A8UPU/A8PUJ search time	OFF No reduction of reading time ON Reading time reduced	• By turning this relay ON, the time required for a search at an A8UPU/A8PUJ can be shortened. (In this case the scan time is increased by 10%.)	●	—
M9081	Communication request entry areas busy signal	OFF Communication request entry areas available ON Communication request entry areas not available	• 32 entry areas are provided for FROM/TO instructions waiting for execution at MNET/MINI(-S3); this relay comes ON when there are no more empty areas.	●	—
M9084*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*1	Instruction error flag	OFF No error ON Error	• Comes ON when an instruction related error occurs. Remains ON even after return to normal.	●	—
M9094*2 *3	I/O change flag	OFF No replacement ON Replacement	• When M9094 is turned ON after the head I/O number of the I/O module to be replaced has been set in it, it is possible to replace the I/O module in the online status. (It is only possible to replace one I/O module per setting.) • To replace an I/O module in the RUN mode, use the program or a peripheral device to turn this relay ON; to replace an I/O module in the STOP mode, use the test mode of a peripheral device to turn this relay ON. • Do not switch between RUN and STOP modes until I/O module replacement is completed.	●	—
M9100	Existence of SFC program	OFF No SFC program ON SFC program exists	• ON when an SFC program is registered and a work area for SFC has been secured. • OFF when no SFC program is registered, or the work area for SFC could not be secured.	●	—
M9101*2	SFC program start/stop	OFF SFC program stop ON SFC program start	• Turned ON by the user in order to start an SFC program. When turned OFF, the operation output of the step being executed is turned OFF and the SFC program is stopped.	●	—

Table 3.1 Special Relay List (Continued)

Number	Name	Stored Data	Explanation	Applicability A273UH	Applicability A171S
M9102*2	SFC program start status	OFF Initial start ON Continued start	• Selects the start step when an SFC program is restarted using M9101. When OFF : All execution statuses that applied when the SFC program was stopped are cleared and the program is started from the initial step of block 0. When ON : The SFC program is started from the block and step that were being executed when it was stopped. • Once this relay has been turned ON, it is latched (memory back up) by the system.	●	—
M9103*2	Continuous transition setting	OFF Continuous transition ineffective ON Continuous transition effective	• Selects whether or not to execute all the steps whose transition conditions have been satisfied in one scan in cases where all the transition conditions of consecutive steps have been satisfied. When ON : Steps are executed continuously (continuous transition effective). When OFF : One step at a time is executed within the scan (continuous transition ineffective).	●	—
M9104	Continuous transition prevention flag	OFF At completion of transition ON Before transition	• When continuous transition is effective, ON when continuous transition is not being performed and goes OFF when the transition of one step is completed. By writing M9104 with an AND condition as the transition condition, continuous transition of the relevant step can be prevented.	●	—
M9108*2	Step transition monitor timer start (corresponds to D9108)	OFF Monitor timer reset ON Monitor timer reset start	• Turned ON to start timing by the step transition monitor timer. When turned OFF, the monitor timer is reset.	●	—
M9109*2	Step transition monitor timer start (corresponds to D9109)				
M9110*2	Step transition monitor timer start (corresponds to D9110)				
M9111*2	Step transition monitor timer start (corresponds to D9111)				
M9112*2	Step transition monitor timer start (corresponds to D9112)				
M9113*2	Step transition monitor timer start (corresponds to D9113)				
M9114*2	Step transition monitor timer start (corresponds to D9114)				
M9180	Active step sampling trace completed flag	OFF Trace start ON Trace complete	• Comes ON on completion of sampling trace for all designated blocks, and goes OFF at the start of sampling trace.	●	—
M9181	Active step sampling trace execution flag	OFF Trace not executed yet ON Trace being executed	• ON during sampling trace execution, goes OFF on completion or suspension of sampling trace.	●	—

Table 3.1 Special Relay List (Continued)

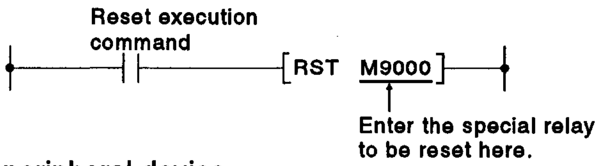
<table>
<tr><th rowspan="2">Number</th><th rowspan="2">Name</th><th rowspan="2">Stored Data</th><th rowspan="2">Explanation</th><th colspan="2">Applicability</th></tr>
<tr><th>A273UH</th><th>A171S</th></tr>
<tr><td>M9182*2</td><td>Active step sampling trace enabled</td><td>OFF Trace disabled/ suspended
ON Trace enabled</td><td>• Selects whether to enable or disable sampling trace.
When ON
: Execution of sampling trace is enabled.
When OFF
: Execution of sampling trace is disabled. When this relay is turned OFF during execution of sampling trace, the trace is suspended.</td><td>●</td><td>—</td></tr>
<tr><td>M9196*2</td><td>Operation output at block stop</td><td>OFF Coil output OFF
ON Coil output ON</td><td>• Selects the operation output when a block stop is executed.
When ON
: The coil ON/OFF status used for the operation output of the step that was being executed when the block was stopped is retained.
When OFF
: All coil outputs are turned OFF. (Operation output by a SET instruction is retained regardless of the ON/OFF status of M9196.)</td><td>●</td><td>—</td></tr>
<tr><td>M9197
·
M9198</td><td>Fuse blown / I/O verify error display switching</td><td>The display is selected by the combination of the M9197 ON/OFF and M9198 ON/OFF statuses.</td><td><table><tr><th>M9197</th><th>M9198</th><th>Display Range</th></tr><tr><td>OFF</td><td>OFF</td><td>Statuses X/Y0 to 7F0</td></tr><tr><td>ON</td><td>OFF</td><td>Statuses X/Y800 to FF0</td></tr><tr><td>OFF</td><td>ON</td><td>Statuses X/Y1000 to 17F0</td></tr><tr><td>ON</td><td>ON</td><td>Statuses X/Y1800 to 1FF0</td></tr></table>• Selects the I/O module numbers for fuse blown module display (D9100 to D9107) and I/O module verify error display (D9116 to D9123).
• The display selection is executed at END processing.</td><td>●</td><td>—</td></tr>
<tr><td>M9199</td><td>Online sampling trace status latch data restore</td><td>OFF Data not restored
ON Data restored</td><td>• Restores the set data stored in the CPU and enables restarting of operation after sampling trace/status latch has been executed.
• For re-execution, turn M9199 ON. (It is not necessary to write the data from a peripheral device again.)</td><td>●</td><td>—</td></tr>
</table>

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 "*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 "*2" in the table above is controlled by the sequence program.

(4) The ON/OFF status of special relays marked "*3" in the table above is controlled in the test mode of a peripheral device.

(5) The status of special relays marked "*4" in the table above is only reset on switching the power 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 *2 in the table).
Of the special relays, those from D9180 to D9199 are used for positioning control.

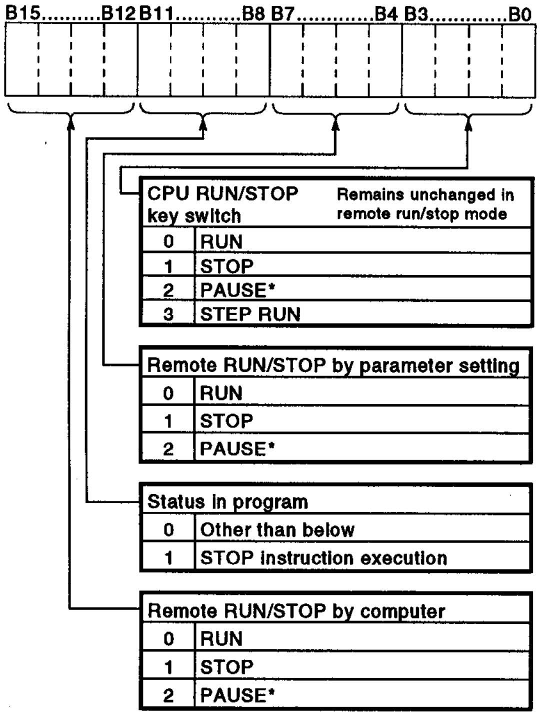
Table 3.2 Special Register List

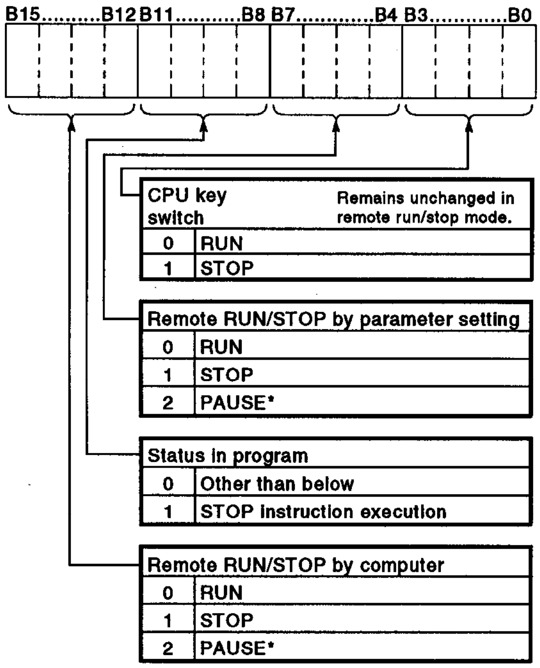
Number	Name	Stored Data	Explanation	Applicability	
				A273UH	A171S
D9000	Fuse blown	Number of module with blown fuse	• When modules with blown fuses are detected, the lowest module number among the detected modules is stored in hexadecimal. (Example: when the fuses of output modules Y50 to 6F have blown, "50" is stored in hexadecimal.) When monitoring with a peripheral device, use a hexadecimal display monitoring operation. (Cleared when all contents of D9100 to D9107 are reset to zero.)	●	—
			• 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. (Exampl:: Blown fuse at the output module 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*1	MINI link error	Indicates the status for the number of master modules set in the parameters (1 to 8)	• Stores the MINI(S3) link error detected status for the master modules installed. b15 ― b8 b7 ― b0 8th 7th 6th 5th 4th 3th 2th 1th 8th 7th 6th 5th 4th 3th 2th 1th (b15–b8) Bits corresponding to master modules which cannot communicate with the PC CPU. (b7–b0) By turning ON the master module signals indicated below, the relevant bit is turned ON. • Hardware error (X0/X20) • MINI(S3) link error detected (X6/X26) • MINI(S3) link communication error (X7/X27)	●	—
D9005*1	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*1	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.		

Table 3.2 Special Register List (Continued)

Number	Name	Stored Data	Explanation	Applicability A273UH	Applicability A171S
D9009	Annunciator detection	F number at which external failure has occurred	• When one of F0 to F255 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.	—	●
			• When one of F0 to F255 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, or by setting the INDICATOR RESET switch on the front of the CPU to ON. 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	• When it has not been possible to access a module for which a special function module setting has been made at STOP → RUN, the module No. of the special function module is stored in this special register. • When an operation error occurs during execution of an application instruction, the step No. where the error occurred is stored in BIN code, and thereafter every time an operation error occurs the contents of D9010 are updataed.	●	—
			• When an operation error occurs during execution of an application instruction, the step No. where the error occurred is stored in BIN code, 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 I/O control method is represented as follows: 3: Refresh method for both input and output	●	—
			• The set control mode is represented as follows: 0: I/O in direct mode 3: I/O in refresh mode	—	●

Table 3.2 Special Register List (Continued)

<table>
<tr><th rowspan="2">Number</th><th rowspan="2">Name</th><th rowspan="2">Stored Data</th><th rowspan="2">Explanation</th><th colspan="2">Applicability</th></tr>
<tr><th>A273UH</th><th>A171S</th></tr>
<tr><td rowspan="2">D9015</td><td rowspan="2">CPU operating states</td><td rowspan="2">Operating states of CPU</td><td>• The operating states of the CPU are stored in D9015 as shown below.


*: When the CPU is in the RUN mode and M9040 is off, the RUN mode remains in effect even if an attempt is made to change to the PAUSE mode.</td><td>●</td><td>—</td></tr>
<tr><td>• The CPU operating states indicated in the figure below are stored in D9015.


*: When the CPU is in the RUN status and M9040 is OFF, the CPU remains in RUN mode even if set to PAUSE.</td><td>—</td><td>●</td></tr>
</table>

Table 3.2 Special Register List (Continued)

Number	Name	Stored Data	Explanation	Applicability	
				A273UH	A171S
D9016	Program No.	The type of sequence program being executed is stored as a BIN value.	• The type of sequence program currently being executed is stored under one of the following code numbers. 0: ROM main 4: RAM sub 3 8: EEP-ROM main 1: RAM main 5: ROM sub 1 9: EEP-ROM sub 1 2: RAM sub 1 6: ROM sub 2 A: EEP-ROM sub 2 3: RAM sub 2 7: ROM sub 3 B: EEP-ROM sub 3	●	—
	ROM/RAM setting	0 : ROM 1 : RAM 2 : E^2ROM	• Indicates the setting for the memory selection chip; one of the values 0 to 2 is set in BIN code.	—	●
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*2	Constant scan	Constant scan time (user-specified in 10 ms units)	• When a user program is executed at fixed intervals, set the interval in 10 ms units. 0 : Constant scan function not used 1 to 20 : Constant scan function used Execution at (set value)x10 ms inter vals	—	●
			• 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)x10 ms.	●	—
D9021	Scan time	Scan time (1 ms units)	• The scan time is stored in BIN code at each END processing, overwriting the existing value.	●	—
D9022	Time	Time	• Counts up +1 for each second.	●	—
D9025*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.......B12 B11.........B8 B7...........B4 B3...........B0 Year / Month Example : July 1993 H9307	●	●
D9026*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*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 : 35 ms, 48 s H3548	●	●

Table 3.2 Special Register List (Continued)

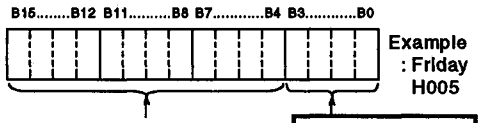
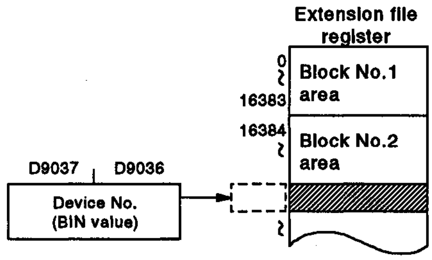
Number	Name	Stored Data	Explanation	Applicability	
				A273UH	A171S
D9028[*2]	Clock data	Clock data (, day of week)	• The day of the week is stored in BCD code in D9028 as shown below.  Day of week 0 Sunday 1 Monday 2 Tuesday 3 Wednesday 4 Thursday 5 Friday 6 Saturday	●	●
D9035	Extension file register	Used block No.	• The block No. of the currently used extension file register is stored in BIN code.	●	—
D9036 D9037	For extension file register device No. designation	Device No. when directly accessing individual devices of the file register	• Designate the device numbers in the file register that are to be directly read or written to as a BIN value in the 2 words D9036 and D9037. Device numbers are designated as consecutive numbers beginning with R0 of block No.1, regardless of block numbers.  	●	—

Table 3.2 Special Register List (Continued)

<table>
<tr><th rowspan="2">Number</th><th rowspan="2">Name</th><th rowspan="2">Stored Data</th><th rowspan="2">Explanation</th><th colspan="2">Applicability</th></tr>
<tr><th>A273UH</th><th>A171S</th></tr>
<tr><td rowspan="2">D9038*2

D9039*2</td><td rowspan="2">LED display priority</td><td rowspan="2">Priorities 1 to 4

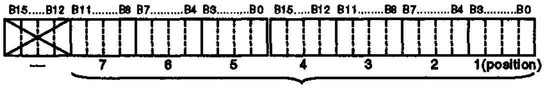
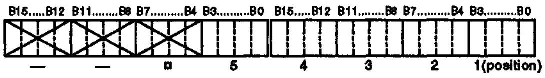
Priorities 5 to 7</td><td>• The element numbers for display priorities 1 to 4 (D9038) and 5 to 7 (D9039) of the LED display of the CPU module are set and changed.

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 :
H9038=H4321
H9039=H0765
<table><tr><th>Element No.</th><th>Content</th></tr><tr><td>0.</td><td>Not displayed</td></tr><tr><td>1.</td><td>I/O verify, fuse blown</td></tr><tr><td>2.</td><td>Special function module, link parameters, operation error</td></tr><tr><td>3.</td><td>CHK instruction error</td></tr><tr><td>4.</td><td>Annunciator</td></tr><tr><td>5.</td><td>LED instruction related</td></tr><tr><td>6.</td><td>Parity error</td></tr><tr><td>7.</td><td>Clock data</td></tr></table></td><td>●</td><td>—</td></tr>
<tr><td>• 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.

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=H0006
<table><tr><th>Element No.</th><th>Content</th></tr><tr><td>0.</td><td>Not displayed</td></tr><tr><td>1.</td><td>I/O verify, fuse blown</td></tr><tr><td>2.</td><td>Special function module, link parameters, SFC parameters, SFC operation</td></tr><tr><td>3.</td><td>CHK instruction error</td></tr><tr><td>4.</td><td>Annunciator (F)</td></tr><tr><td>5.</td><td>LED instruction related</td></tr><tr><td>6.</td><td>Parity error</td></tr></table></td><td>—</td><td>●</td></tr>
<tr><td>D9044</td><td>For sampling trace</td><td>Step or time for sampling trace</td><td>• The value that D9044 contains is used as a sampling trace condition when the sampling trace instruction [STRA], [STRAR] is executed by switching ON/OFF M9044 from the peripheral device.
For scan —— Set "0".
For time —— Set the time in 10 ms units.
The value is stored in BIN.</td><td>●</td><td>—</td></tr>
<tr><td>D9049</td><td>SFC work area</td><td>Extension file register block number</td><td>• The extension file register block number used as the SFC work area is stored.
Higher 8 bits .... Block number is stored.
Lower 8 bits ..... Step number is stored.</td><td>●</td><td>—</td></tr>
<tr><td>D9050</td><td>SFC program error code</td><td>Error code generated during SFC program execution</td><td>• Error codes generated during SFC program execution are stored in BIN code.
0 : No error
80 : SFC program parameter error
81 : Number of simultaneous execution steps exceeded
82 : Block start error
83 : SFC program operation error</td><td>●</td><td>—</td></tr>
</table>

Table 3.2 Special Register List (Continued)

Number	Name	Stored Data	Explanation	Applicability	
				A273UH	A171S
D9051	Error block	Block number in which an error occurred	• Block numbers at which errors occurred during SFC program execution are stored in BIN code. In the case of error code 82, the start block step number is stored.	●	—
D9052	Error step	Step number at which an error occurred	• The step number at which error 83 occurred during SFC program execution is stored in BIN code. In the case of error code 80 or 81, "0" is stored. In the case of error code 82, the block start step number is stored.	●	—
D9053	Error transition	Transition condition number at which an error occurred	• The transition condition number at which error 83 occurred during SFC program execution is stored in BIN code. In the case of error code 80, 81, or 82, "0" is stored.	●	—
D9054	Error sequence step	Sequence step number at which an error occurred	• The sequence step number of the transition condition and operation output when error 83 occurred during SFC program execution is stored in BIN code.	●	—
D9055	Status latch	Status latch step	• The step number executed when the status is latched is stored in BIN code.	●	—
D9072	PC communication check	Computer link data check	• Used at self-loopback check	●	—
D9081	Empty communication request entry areas	Empty communication request entry areas	• The number of empty communication request entry areas in which communication requests to MNET/MINI(S3) can be entered is stored (Max. 32).	●	—
D9085	Time check value setting register	Default value 10 s	• The time check value at execution of a MELSECNET/10 link instruction (ZNRD, ZNWR) is stored. • Setting range : 1 to 65535 sec • Setting unit : 1 sec • If the set value is "0", the default of "10 sec" is used for operation.	●	—
D9090*1	Excessive special function modules	Too many special function modules	• When the number of special function modules mounted is excessive, the value "(head I/O number of the last special function module entered) / 16" is stored as a BIN value.	●	—
D9091*1	Detailed error numbers	Self-diagnostic detailed error numbers	• The detailed error number when a self-diagnostic error occurs is stored.	●	—
D9094*2	Replacement I/O first I/O number	Replacement I/O first I/O number	• Stores the upper two digits of the first I/O number of an I/O module that is removed/replaced in the online status. Example: Input module X2F0 → H2F	●	—

Table 3.2 Special Register List (Continued)

Number	Name	Stored Data	Explanation	Applicability A273UH	Applicability A171S
D9100 to D9107	Fuse blown module	Bit pattern in units of 16 points, indicating the modules whose fuses have blown	• The numbers of output modules whose fuses have blown are input as a bit pattern (in units of 16 points). (If the module numbers are set by parameter, the parameter-set numbers are stored.) • The blown fuse statuses of the output modules of remote stations are also detected. 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0 D9100: 0 0 0 1 (Y10) 0 0 0 1 (Y80) 0 0 0 0 0 0 0 0 D9101: 1 0 0 0 0 1 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 a blown fuse • By switching M9197 and M9198 ON and OFF, the I/O module number display range is switched. • To clear the data of a module whose fuse is blown, turn OFF M9000 (fuse blown).	●	—
D9100*1 D9101*1			• Output module numbers of the (in units of 16 points) of output modules whose fuses have blown or whose external power supply has been switched OFF are entered in a bit pattern. (Preset output number when parameter setting has been performed.) 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0 D9100: 0 0 0 1 (Y10) 0 0 0 1 (Y80) 0 0 0 0 0 0 0 0 D9101: 1 (Y1F0) 0 0 0 0 1 (Y1A0) 0 0 0 0 0 0 0 0 0 0 Indicates a blown fuse (Since the error is not cleared even after returning to normal, it must be cleared with a program.)	●	—

Table 3.2 Special Register List (Continued)

Number	Name	Stored Data	Explanation	Applicability	
				A273UH	A171S
D9116 to D9123	Input/Output module verification error	Bit pattern, in units of 16 points, indicating the modules with verification errors.	• When the power is turned on, the module numbers of the I/O modules whose information differs from the registered I/O module information are set in this register (in units of 16 points). (If the I/O numbers are set by parameter, the parameter-set numbers are stored.) • The I/O module information of remote stations can be detected. 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 01) 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 Indicates an I/O module verification error • By switching M9197 and M9198 ON and OFF, the I/O module number display range is switched. • To clear the verify error, turn OFF M9002 (verify error).	●	—
D9116*1 D9117*1			• When an I/O modules whose data is different from that entered are detected, the I/O module numbers (in units of 16 points) are entered in a bit pattern. (Preset I/O module numbers when parameter setting has been performed.) 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 01) D9117 0 0 0 0 0 0 1 (X/Y 190) 0 0 0 0 0 0 0 0 0 Indicates an I/O module verification error (Since the error is not cleared even after returning to normal, it must be cleared with a program.)	—	●
D9124	Annunciator detection quantity	Number of detected annunciators	• When one of F0 to 2047 is turned ON by OUT F or SET F, 1 is added to the contents of D9124. When an RST F or LED R instruction is executed, 1 is subtracted from the contents of D9124. (This can also be achieved with the INDICATOR RESET switch on the front panel of the CPU module.) The maximum number of annunciators switched ON by OUT F or SET F that can be stored in D9124 is 8.	●	—
			• When one of F0 to 255 is turned on by an OUT F or SET F, 1 is added to the contents of D9124. When the RST F or LED R instruction is executed, 1 is subtracted from the contents of D9124. The number of annunciators that has been turned on by OUT F or SET F is stored in D9124: the maximum stored value is 8.	—	●

Table 3.2 Special Register List (Continued)

Number	Name	Stored Data	Explanation	Applicability A273UH	Applicability A171S
D9125 to D9132	Annunciator detection number	Annunciator detection number	• When one of F0 to 2047 is turned ON by OUT F or SET F, the F number which has been turned ON is entered in D9125 to D9132, in due order, in BIN code. An F number which has been turned OFF by RST F is erased from D9125 to D9132 and the contents of data registers succeeding the data register from which the F number was erased are shifted to the preceding data registers. By executing the LED R instruction, the contents of D9125 to D9132 are shifted upward by one. (This can also be done with the INDICATOR RESET switch on the front of the CPU module.) When there are 8 annunciator detections, a 9th will not be stored in D9125 to D9132 even if detected.	●	—
			• When F numbers in the range F0 to 255 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. When there are 8 annunciator detections, a 9th one is not stored in D9125 to D9132 even if detected.	—	●

		SET F50	SET F25	SET F19	SET F25	SET F15	SET F70	SET F65	SET F38	SET F110	SET F151	SET F210	LEDR	
D9009	0	50	50	50	50	50	50	50	50	50	50	50	99	← Detection number
D9124	0	1	2	3	2	3	4	5	6	7	8	8	8	← Detection quantity
D9125	0	50	50	50	50	50	50	50	50	50	50	50	99	
D9126	0	0	25	25	99	99	99	99	99	99	99	99	15	
D9127	0	0	0	99	0	15	15	15	15	15	15	15	70	
D9128	0	0	0	0	0	0	70	70	70	70	70	70	65	Detection number
D9129	0	0	0	0	0	0	0	65	65	65	65	65	38	
D9130	0	0	0	0	0	0	0	0	38	38	38	38	110	
D9131	0	0	0	0	0	0	0	0		110	110	110	151	
D9132	0	0	0	0	0	0	0	0	0		151	151	210	

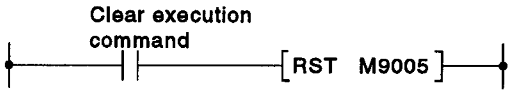
		SET F50	SET F25	SET F19	SET F25	SET F15	SET F70	SET F65	SET F38	SET F110	SET F151	SET F210	LEDR
D9009	0	50	50	50	50	50	50	50	50	50	50	50	99
D9124	0	1	2	3	2	3	4	5	6	7	8	8	8
D9125	0	50	50	50	50	50	50	50	50	50	50	50	99
D9126	0	0	25	25	99	99	99	99	99	99	99	99	15
D9127	0	0	0	99	0	15	15	15	15	15	15	15	70
D9128	0	0	0	0	0	0	70	70	70	70	70	70	65
D9129	0	0	0	0	0	0	0	65	65	65	65	65	38
D9130	0	0	0	0	0	0	0	0	38	38	38	38	110
D9131	0	0	0	0	0	0	0	0		110	110	110	151
D9132	0	0	0	0	0	0	0	0	0		151	151	210

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 *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 present 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 "*2", data is written in the sequence program.

(4) For special registers marked "*3", data is written in the test mode of a peripheral device.

(5) For special registers marked "*4", data is cleared only when the power is turned ON.

(1) A171SCPU/A273UHCPU (8-axis specifications)

Table 3.3 Special Register List

<table>
<tr><th>Number</th><th>Name</th><th>Stored Data</th><th>Explanation</th></tr>
<tr>
<td>D9180
to
D9183</td>
<td>Limit switch output storage area</td>
<td>Limit switch output storage area
1: ON
0: OFF</td>
<td>
• The status of output (ON/OFF) to limit switch output AY42 set with a peripheral device is stored as "1" or "0".
1: ON
0: OFF
• These registers can be used to output limit switch output data to an external device using the sequence program.
(1) A171SCPU
<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>D9180</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>D9181</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>
* "1" or "0" is stored for each of the bits in D9180 and D9181.
1) 1..........ON
2) 0..........OFF
D9182 to D9183 are not used (cannot be used by the user).
(2) A273UHCPU (8 axis specification)
<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>D9180</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>D9181</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>
<tr><td>D9182</td><td>LY2F</td><td>LY2E</td><td>LY2D</td><td>LY2C</td><td>LY2B</td><td>LY2A</td><td>LY29</td><td>LY28</td><td>LY27</td><td>LY26</td><td>LY25</td><td>LY24</td><td>LY23</td><td>LY22</td><td>LY21</td><td>LY20</td></tr>
<tr><td></td><td colspan="8">For axis 6</td><td colspan="8">For axis 5</td></tr>
<tr><td>D9183</td><td>LY3F</td><td>LY3E</td><td>LY3D</td><td>LY3C</td><td>LY3B</td><td>LY3A</td><td>LY39</td><td>LY38</td><td>LY37</td><td>LY36</td><td>LY35</td><td>LY34</td><td>LY33</td><td>LY32</td><td>LY31</td><td>LY30</td></tr>
<tr><td></td><td colspan="8">For axis 8</td><td colspan="8">For axis 7</td></tr>
</table>
* "1" or "0" is stored for each of the bits in D9180 through D9183.
1) 1..........ON
2) 0..........OFF
</td>
</tr>
</table>

Table 3.3 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.
(1) When using an A171SCPU
<table>
<tr><th>Error Code</th><th>Error Cause</th></tr>
<tr><td>2</td><td>• PCPU excessive operation frequency</td></tr>
<tr><td>3</td><td>• SCPU software fault 2</td></tr>
<tr><td>300</td><td>• SCPU software fault 3</td></tr>
</table>
(2) When using an A273UHCPU (8-axis specification)
<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</td><td>AC motor drive module CPU error
1 0 0
• Indicates the slot No. (0 to 7) where the AC motor drive module with the error is loaded.
• Indicates the stage number of the base on which the AC motor drive module with the error is loaded.
(0: main base, 1: extension base)</td></tr>
<tr><td>200
to
207

210
to
217</td><td>Hardware fault of module loaded in main base unit or motion extension base unit.
2 0 0
• Indicates the slot No. (0 to 7) where the module with the error is loaded.
• Indicates the stage number of the base on which the module with the error is loaded.
(0: main base, 1: extension base)</td></tr>
<tr><td>250
to
251</td><td>Separate servo amplifier (MR-[ ]-B) interface hardware fault
2 5 0
Fault SSCNET No.
0: SSCNET 1</td></tr>
<tr><td>300</td><td>PCPU software fault 3</td></tr>
<tr><td>301</td><td>CPSTART instructions for 8 or more points simultaneously started for 21 or more programs.
CPSTART instructions for 8 or more points can only be started simultaneously for up to 20 programs.</td></tr>
</table>
</td>
</tr>
</table>

Table 3.3 Special Register List (Continued)

<table>
<tr><th>Number</th><th>Name</th><th>Stored Data</th><th>Explanation</th></tr>
<tr><td>D9185</td><td rowspan="2">Servo amplifier type</td><td rowspan="2">Servo amplifier type</td><td rowspan="2">• On switching the power ON or resetting, the servo amplifier type set in the system settings is set in these devices.
(1) When an A171SCPU is used
<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>D9185</td><td>Axis 4</td><td>Axis 3</td><td>Axis 2</td><td>Axis 1</td></tr>
</table>
→ Servo amplifier type
• 0....... Unused axis
• 2....... MR-[ ]-B

(2) When an A273UHCPU (8 axis specification) is used
<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>D9185</td><td>Axis 4</td><td>Axis 3</td><td>Axis 2</td><td>Axis 1</td></tr>
<tr><td>D9186</td><td>Axis 8</td><td>Axis 7</td><td>Axis 6</td><td>Axis 5</td></tr>
</table>
→ Servo amplifier type
• 0....... Unused axis
• 1....... ADU (main base)
• 2....... MR-[ ]-B
• 5....... ADU (extension base)</td></tr>
<tr><td>D9186</td></tr>
<tr><td>D9187</td><td>Manual pulse generator axis setting error</td><td>Manual pulse generator axis setting error</td><td>• Stores the contents of the manual pulse generator axis setting error when the manual pulse generator axis setting flag (M9077) comes ON.
(1) When an A171SCPU is used
<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>D9187</td><td>0</td><td>0</td><td>0</td><td>0</td><td>Axis 4</td><td>Axis 3</td><td>Axis 2</td><td>Axis 1</td><td>0</td><td>0</td><td>0</td><td>0</td><td>P1</td><td>0</td><td>0</td><td>P1</td></tr>
</table>
→ All set to "0"
→ Stores setting errors for the 1 pulse input magnification setting for each axis.
• 0 : Normal
• 1 : Setting error
(When the input magnification for any axis is outside the range 1 to 100)
→ All set to "0"
→ Stores setting errors for manual pulse generators connected to the A171SENC.
• 0 : Normal
• 1 : Setting error
(When the setting for any axis is outside the range 1 to 4)
→ All set to "0"
→ Stores manual pulse generator smoothing magnification setting errors for manual pulse generators connected to A171SENC.
• 0 : Normal
• 1 : Setting error
(When the axis setting for any digit is outside the range 1 to 59)

(2) When an A273UHCPU (8 axis specification) is used
<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>D9187</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><td>0</td><td>0</td><td>P1</td><td>P2</td><td>P4</td><td>P3</td><td>P2</td><td>P1</td></tr>
</table>
→ All set to "0"
→ Stores setting errors for the 1 pulse input magnification setting for each axis.
• 0 : Normal
• 1 : Setting error
(When the input magnification for any axis is outside the range 1 to 100)
→ Stores axis setting errors for the manual pulse generators connected to P1 to P3 of the A273EX.
• 0 : Normal
• 1 : Setting error
(When the axis setting for any digit is outside the range 1 to 8)
→ Stores manual pulse generator smoothing magnification setting errors for the manual pulse generators conected to P1 to P3 or A273EX.
• 0 : Normal
• 1 : Setting error
(When the axis setting for any digit is outside the range 1 to 59)</td></tr>
</table>

Table 3.3 Special Register List (Continued)

Number	Name	Stored Data	Explanation
D9188	Test mode request error	Test mode request error	• Stores the data of axes being operated when the test mode request error flag (M9078) comes ON. (1) When an A171SCPU is used b15 b14 b13 b12 b11 b10 b9 b8 b7 b6 b5 b4 b3 b2 b1 b0 D9188: 0 0 0 0 0 0 0 0 0 0 0 0 Axis 4 Axis 3 Axis 2 Axis 1 b15 to b4: All set to "0" b3 to b0: Stores the operating/stopped status of each axis: • 0 : Stopped • 1 : Operating (2) When A273UHCPU (8 axis specification) is used b15 b14 b13 b12 b11 b10 b9 b8 b7 b6 b5 b4 b3 b2 b1 b0 D9188: 0 0 0 0 0 0 0 0 Axis 8 Axis 7 Axis 6 Axis 5 Axis 4 Axis 3 Axis 2 Axis 1 b7 to b0: Stores the operating/stopped status of each axis: • 0 : Stopped • 1 : Operating b15 to b8: All set to "0"
D9189	Error program No.	Error program number	• 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.
D9190	Error item information	Servo program setting error number	• When the servo program setting error flag (M9079) comes ON, the error code that corresponds to the relevant setting item is stored in this device. (See the error code table below.)

Error Code	Error Contents
900	The servo program set for the DSFRP/SVST instruction does not exist.
901	The axis number set for the DSFRP/SVST instruction is different from the axis number set in the servo program.
902	The instruction code cannot be decoded (there is a questionable instruction code).
906	An axis designated as unused in the system settings is set in the subprogram set for the DSFRP/SVST instruction.
Error item data	There is an error in the settings of the servo program set for the DSFRP/SVST instruction. The error item in 6.3 is stored.

Table 3.3 Special Register List (Continued)

<table>
<tr><th>Number</th><th>Name</th><th>Stored Data</th><th>Explanation</th></tr>
<tr><td>D9191</td><td>Servo amplifier installation information</td><td>Servo amplifier installation information</td><td>• When the power is turned ON, or on resetting, the servo amplifier and option slot installation statuses are checked and the results stored in this device.
(1) When an A171SCPU is used
<table>
<tr><th></th><th>b15 to b12 b11 to b8 b7 to b4</th><th>b3</th><th>b2</th><th>b1</th><th>b0</th></tr>
<tr><td>D9191</td><td>0</td><td>Axis 4</td><td>Axis 3</td><td>Axis 2</td><td>Axis 1</td></tr>
</table>
<table>
<tr><th colspan="2">Servo amplifier installation status</th></tr>
<tr><td>0</td><td>Not installed, or ADU fault, MR-[ ]-B power OFF, or connecting cable fault</td></tr>
<tr><td>1</td><td>Installed</td></tr>
</table>
(2) When an A273UHCPU (8 axis specification) is used
<table>
<tr><th></th><th>b15 to b12 b11 to 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>D9191</td><td>0</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>
</table>
<table>
<tr><th colspan="2">Servo amplifier installation status</th></tr>
<tr><td>0</td><td>Not installed, or ADU fault, MR-[ ]-B power OFF, or connecting cable fault *1</td></tr>
<tr><td>1</td><td>Installed</td></tr>
</table>
*1: In the case of an ADU, if the module is not installed although an axis number has been set in the system settings, a major error is displayed.</td></tr>
<tr><td>D9192</td><td>Area for setting the smoothing magnification for manual pulse generator 1 (P1)</td><td rowspan="3">Areas for setting manual pulse generator smoothing magnifications</td><td rowspan="3">• Stores the manual pulse generator smoothing time constant.
• The smoothing time constant is calculated using the following formula:
$$\text{Smoothing time constant (t)} = \left(\text{Smoothing magnification} + 1\right) \times 56.8[\text{ms}]$$
The setting range for smoothing magnification is 0 to 59.</td></tr>
<tr><td>D9193</td><td>Area for setting the smoothing magnification for manual pulse generator 2 (P2) (A273UH only)</td></tr>
<tr><td>D9194</td><td>Area for setting the smoothing magnification for manual pulse generator 3 (P3) (A273UH only)</td></tr>
</table>

(2) A273UHCPU (32 specification)

Table 3.4 Special Register List

<table>
<tr><th>Number</th><th>Name</th><th>Stored Data</th><th>Explanation</th></tr>
<tr><td>D752*</td><td>Area for setting the smoothing magnification for manual pulse generator 1 (P1)</td><td rowspan="3">Areas for setting manual pulse generator smoothing magnifications</td><td rowspan="3">• Stores the manual pulse generator smoothing time constant.
• The smoothing time constant is calculated using the following formula:
$$\text{Smoothing time constant (t)} = \left(\text{Smoothing magnification} + 1\right) \times 56.8\text{[ms]}$$
The setting range for smoothing magnification is 0 to 59.</td></tr>
<tr><td>D753*</td><td>Area for setting the smoothing magnification for manual pulse generator 2 (P2)</td></tr>
<tr><td>D754*</td><td>Area for setting the smoothing magnification for manual pulse generator 3 (P3)</td></tr>
<tr><td>D776 to D791 *</td><td>Storage area for axis 1 to axis 32 limit switch output statuses</td><td>Limit switch output storage area
1: ON
0: OFF</td><td>• The status of output (ON/OFF) to limit switch output AY42 set with a peripheral device is stored as "1" or "0".
1: ON
0: OFF
• These registers can be used to output limit switch output data to an external device using the 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>
<tr><td colspan="17">to</td></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>
* "1" or "0" is stored for each of the bits in D776 to D791.
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>• On switching the power ON or resetting, the servo amplifier type set in the system settings is set in these devices.
<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 type1)
• 0......Unused axis
• 1......ADU (main base)
• 2......MR-[ ]-B
• 5......ADU (extension base)</td></tr>
</table>

*: Data registers are used (see Section 3.5).

Table 3.4 Special Register List (Continued)

<table>
<tr><th>Number</th><th>Name</th><th>Stored Data</th><th>Explanation</th></tr>
<tr><td>D9182
to
D9183</td><td>Test mode request error</td><td>Test mode request error</td><td>• Stores the data of axes being operated when the test mode request error flag (M9078) comes 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 the operating/stopped status of each axis:
• 0: Stopped
• 1: Operating</td></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 error
1 □ □
• Indicates the slot No. (0 to 7) where the AC motor drive module with the error is loaded.
• Indicates the stage number of the base on which the AC motor drive module with the error is loaded.
(0: main base, 1: extension base, 2: extension base, 3: extension base, 4: extension base)</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 in main base unit or motion extension base unit.
2 □ □
• Indicates the slot No. (0 to 7) where the module with the error is loaded.
• Indicates the stage number of the base on which the module with the error is loaded.
(0: main base, 1: extension base, 2: extension base, 3: extension base, 4: extension base)</td></tr>
<tr><td>250
to
253</td><td>Separate servo amplifier (MR-[ ]-B) interface hardware fault
2 5 □
Fault 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>CPSTART instructions for 8 or more points simultaneously started for 21 or more programs.
CPSTART instructions for 8 or more points can only be started simultaneously for up to 20 programs.</td></tr>
</table></td></tr>
</table>

Table 3.4 Special Register List (Continued)

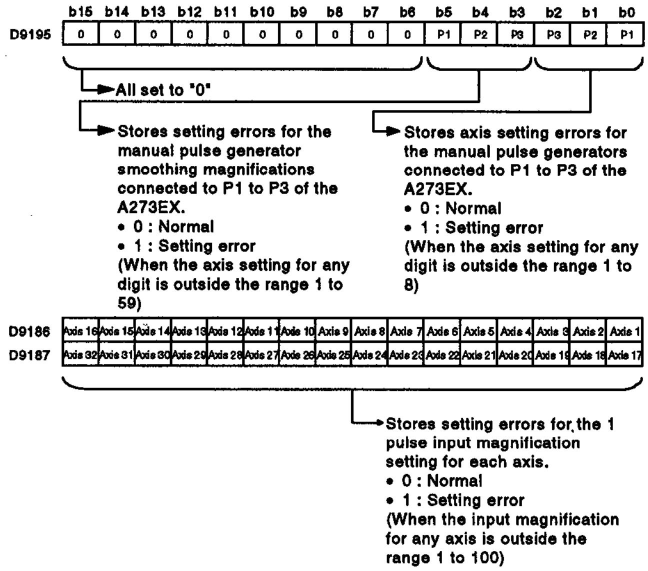
<table>
<tr><th>Number</th><th>Name</th><th>Stored Data</th><th>Explanation</th></tr>
<tr><td>D9185
to
D9187</td><td>Manual pulse generator axis setting error</td><td>Manual pulse generator axis setting error</td><td>• Stores the contents of the manual pulse generator axis setting error when the manual pulse generator axis setting flag (M9077) comes ON.

</td></tr>
<tr><td>D9180
to
D9183</td><td>Limit switch output storage area</td><td></td><td></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>• When the servo program setting error flag (M9079) comes ON, the error code that corresponds to the relevant setting item is stored in this device.
<table>
<tr><th>Error Code</th><th>Error Contents</th></tr>
<tr><td>900</td><td>The servo program set for the DSFRP/SVST instruction does not exist.</td></tr>
<tr><td>901</td><td>The axis number set for the DSFRP/SVST instruction is different from the axis number set in the servo program.</td></tr>
<tr><td>902</td><td>The instruction code cannot be decoded (there is a questionable instruction code).</td></tr>
<tr><td>906</td><td>An axis designated as unused in the system settings is set in the subprogram set for the DSFRP/SVST instruction.</td></tr>
<tr><td>Error item data</td><td>There is an error in the settings of the servo program set for the DSFRP/SVST instruction. The error item in 6.3 is stored.</td></tr>
</table></td></tr>
</table>

Table 3.4 Special Register List (Continued)

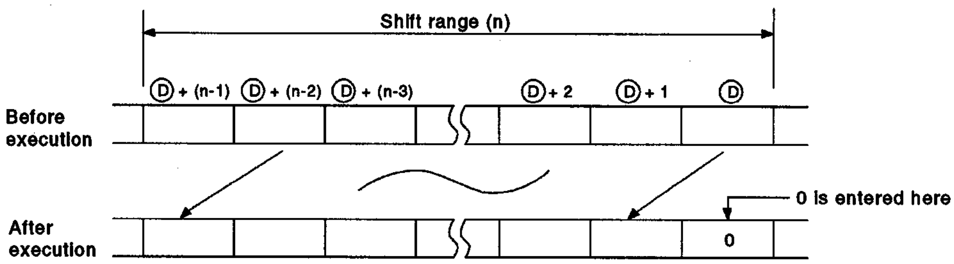
<table>
<tr><th>Number</th><th>Name</th><th>Stored Data</th><th>Explanation</th></tr>
<tr>
<td>D9191
to
D9192</td>
<td>Servo amplifier installation information</td>
<td>Servo amplifier installation information</td>
<td>• When the power is turned ON, or on resetting, the servo amplifier and option slot installation statuses are checked and the results stored in this device.
<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>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 installation status</th></tr>
<tr><td>0</td><td>Not installed, or ADU fault, MR-[ ]-B power OFF, or connecting cable fault *1</td></tr>
<tr><td>1</td><td>Installed</td></tr>
</table>
*1: In the case of an ADU, if the module is not installed although an axis number has been set in the system settings, a major error is displayed.</td>
</tr>
</table>

*: Data registers are used (see Section 3.5).

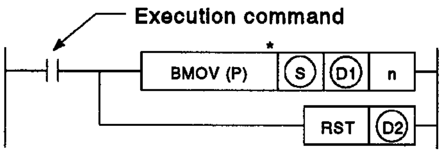
APPENDIX 4 EXAMPLE PROGRAMS

4.1 Word Data 1 Word Shift to Left

(1) A program for shifting to the left a range of devices that comprises n points and starts with a designated word device is shown here.



(2) Word data can be shifted one word to the left by using the BMOV (P) instruction and RST instruction.
The format for a program for shifting data one word to the left by using the BMOV (P) instruction and RST instruction is shown in Figure 4.1.



(1) S, D1, D2, and n are explained below.
S, D2: Head number of the devices to be shifted to the left
D1 : Number of (word device designated by S + 1) device
n : Number of shifted devices

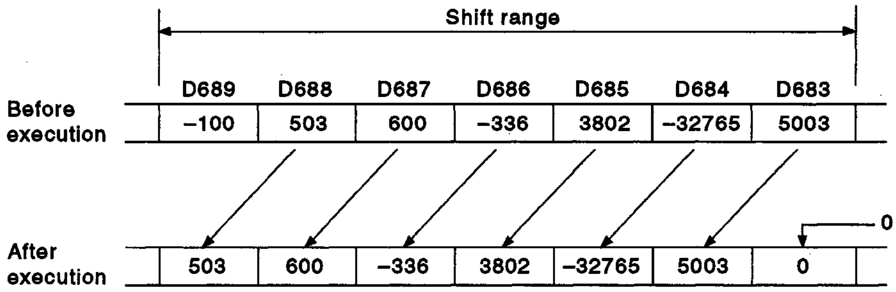
(2) *: BMOV(P) indicates the BMOV instruction and the BMOVP instruction.

Fig. 4.1 Format for Left Shift Using BMOV(P) Instruction and RST Instruction

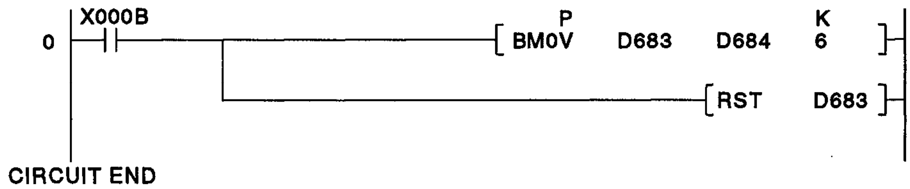
Example

(1) A program that shifts the contents of D683 to D689 one word to the left at the leading edge (OFF → ON) of XB is shown here.

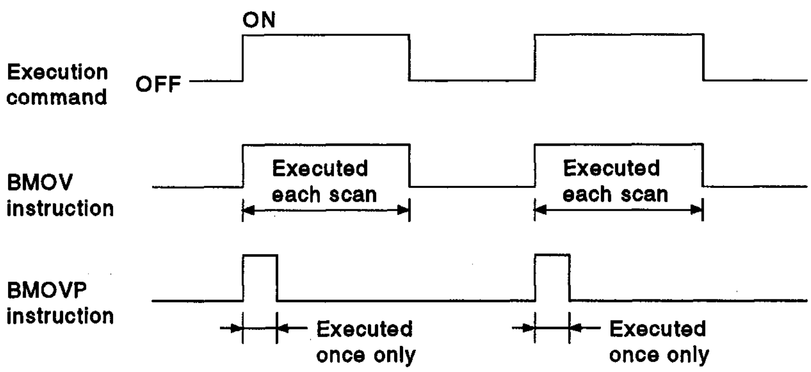
[Operation]



[Program Example]

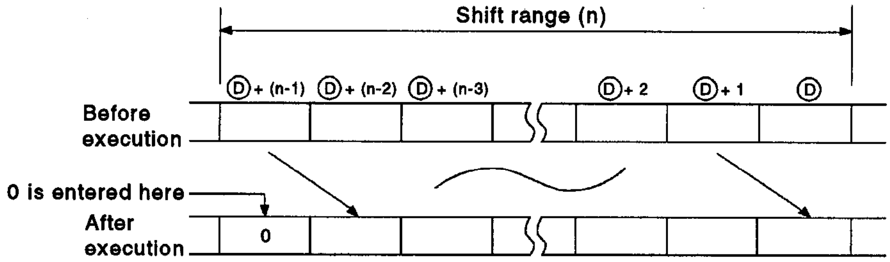


(3) Execution condition
The execution condition when the BMOV instruction and BMOVP instruction are used is as follows.

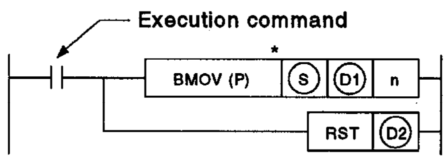


4.2 Word Data 1 Word Shift to Right

(1) A program for shifting to the right a range of devices that comprises n points and starts with a designated word device is shown here.



(2) Word data can be shifted one word to the right by using the BMOV (P) instruction and RST instruction.
The format for a program for shifting data one word to the right by using the BMOV (P) instruction and RST instruction is shown in Figure 4.2.



(1) S, D1, D2, and n are explained below.
- S : Head number of the devices to be shifted to the right
- D1 : Number of (word device designated by S + 1) device
- D2 : Final device number of word devices to be shifted to right
- n : Number of shifted devices

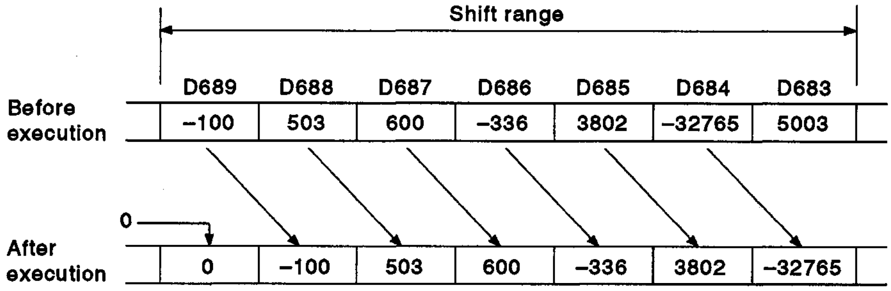
(2) *: BMOV(P) indicates the BMOV instruction and the BMOVP instruction.

Fig. 4.2 Format for Right Shift Using BMOV(P) Instruction and RST Instruction

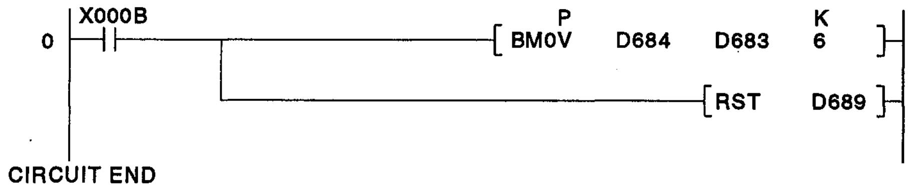
---- Example

(1) A program that shifts the contents of D683 to D689 one word to the right at the leading edge (OFF → ON) of XB is shown here.

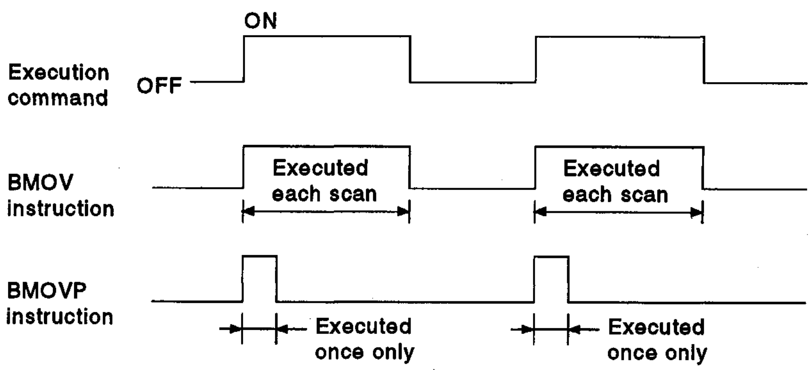
[Operation]



[Program Example]



(3) Execution condition
The execution condition when the BMOV instruction and BMOVP instruction are used is as follows.



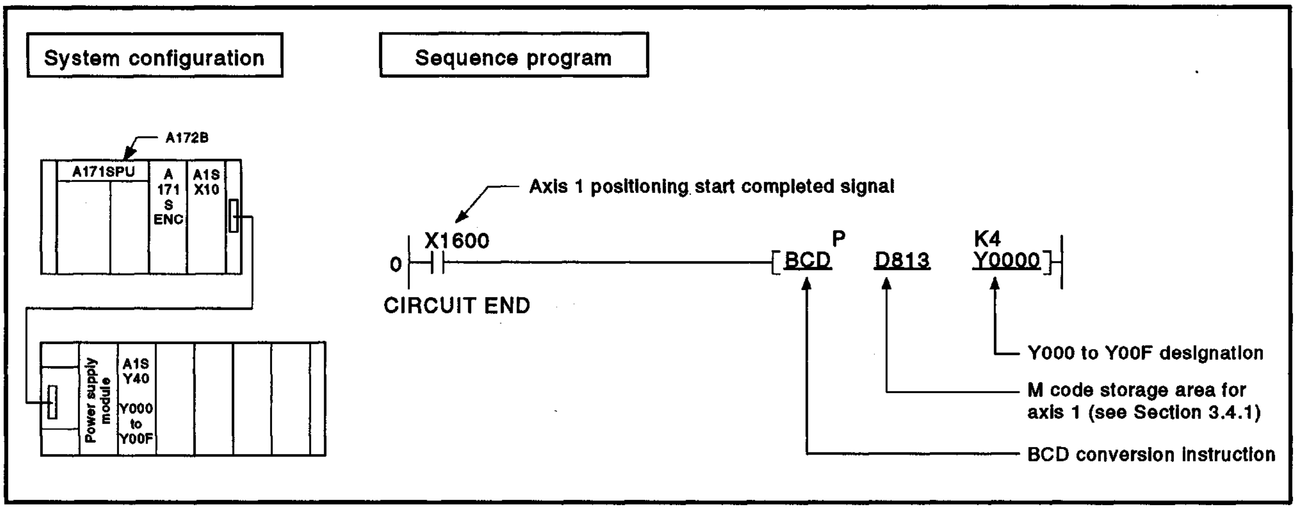
4.3 Reading M Codes

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.

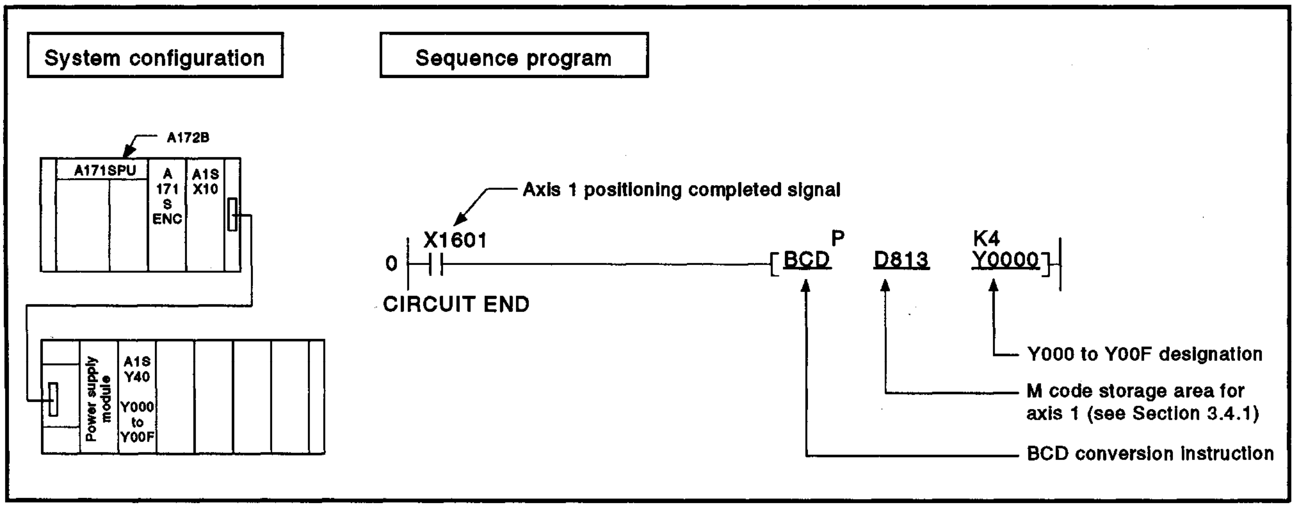
- Positioning start completed ... M1600+20n (positioning start completed signal)
- Positioning completed ....M1601+20n (positioning completed signal)

[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.



4.4 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:

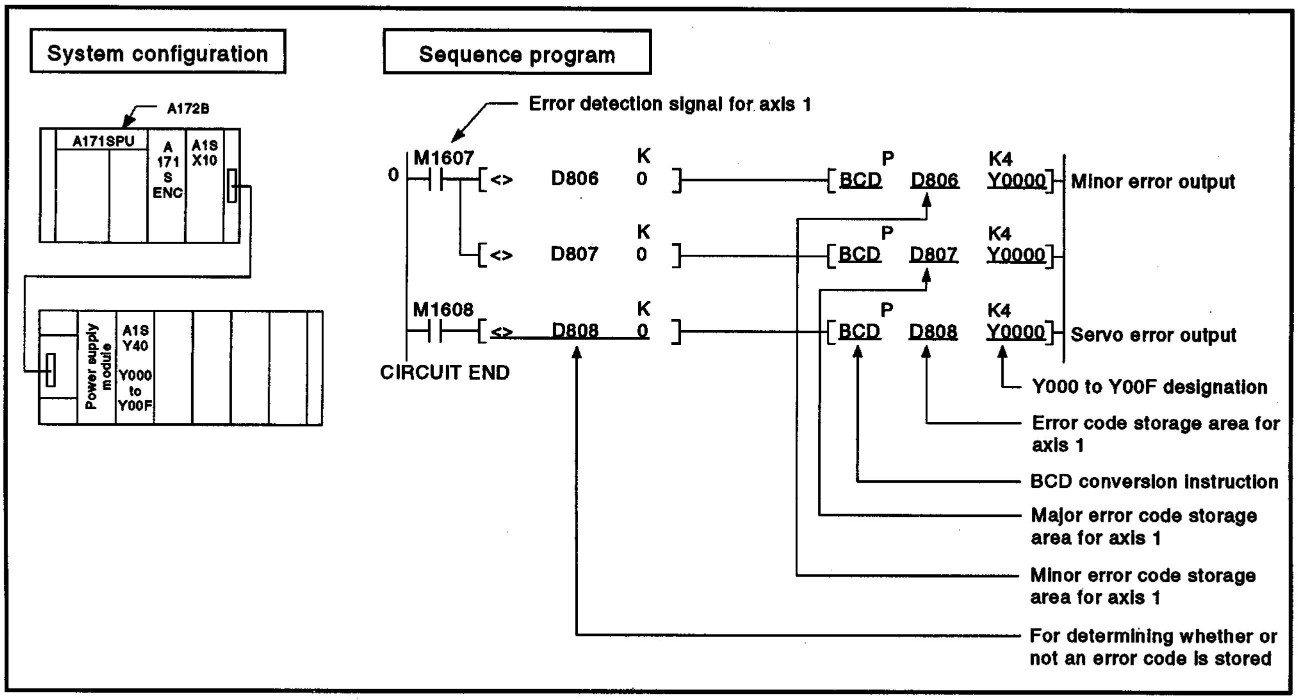
- Minor errors, major errors .....Error detection signal (M1607+20n)
- Servo errors ....Servo error detection signal (M1608+20n)

POINT

(1) The following delay occurs between the leading edge (OFF → ON) of M1607+20n/M1608+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 M1607+20n/M1608+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.



APPENDIX 5 RATED MOTOR SPEED AND NUMBER OF FEEDBACK PULSES FOR EACH SERVOMOTOR TYPE

The rated motor speed and number of feedback pulses for each servomotor type is shown in Table 5.1.

Table 5.1 Rated Motor Speed and Number of Feedback Pulses for Each Servomotor Type

Motor Model Name	Rated Motor Speed [rpm]	Number of Feedback Pulses [PLS]
HA-MH053		
HA-MH13		
HA-MH23		
HA-MH43		
HA-MH73	3000	8192
HA-FH053		
HA-FH13		
HA-FH23		
HA-FH33		
HA-FH43		
HA-FH63		
HA-SH81		
HA-SH121	1000	
HA-SH201		
HA-SH301		
HA-SH52		
HA-SH102		
HA-SH152	2000	
HA-SH202		
HA-SH352		
HA-SH502		
HA-SH702		16384
HA-SH53		
HA-SH103		
HA-SH153		
HA-SH203	3000	
HA-SH353		
HA-RH103		
HA-RH153		
HA-RH223		
HA-LH52		
HA-LH102		
HA-LH152	2000	
HA-LH202		
HA-LH302		
HA-LH502		
HA-LH102		
HA-LH152	2000	
HA-LH202		
HA-LH302		
HA-LH502		
HA-LH702		
HA-LH11K2		16384
HA-LH15K2	2000	
HA-LH22K2		
HA-UH32		
HA-UH52		
HA-UH102	2000	
HA-UH152		
HA-UH222		
HA-UH352		
HA-UH452		
HA-FF053		
HA-FF13		
HA-FF23		
HA-FF33		
HA-FF43	3000	8192
HA-FF63		
HC-MF053		
HC-MF13		
HC-MF23		
HC-MF43		
HC-MF73		
HC-SF52	2000	16384
HC-SF102		

APPENDIX 6 SIGNALS FOR POSITIONING

6.1 Internal Relays

<A171SCPU> **Table 6.1 Axis I/O Signal List**

Signal Name		Device No. Axis 1	Axis 2	Axis 3	Axis 4	Signal Direction
Positioning start completed		M1600	M1620	M1640	M1660	PCPU → SCPU
Positioning completed		M1601	M1621	M1641	M1661	
In-position		M1602	M1622	M1642	M1662	
Command in-position		M1603	M1623	M1643	M1663	
Speed control in progress		M1604	M1624	M1644	M1664	
Speed/position switching latch		M1605	M1625	M1645	M1665	
Zero pass		M1606	M1626	M1646	M1666	
Error detection		M1607	M1627	M1647	M1667	
Servo error detection		M1608	M1628	M1648	M1668	
Home position return request		M1609	M1629	M1649	M1669	
Home position return completed		M1610	M1630	M1650	M1670	
External signals	FLS	M1611	M1631	M1651	M1671	
	RLS	M1612	M1632	M1652	M1672	
	STOP	M1613	M1633	M1653	M1673	
	DOG/CHANGE	M1614	M1634	M1654	M1674	
Servo READY		M1615	M1635	M1655	M1675	
Torque control in progress		M1616	M1636	M1656	M1676	
Unusable		M1617	M1637	M1657	M1677	
		M1618	M1638	M1658	M1678	
M code output in progress signal		M1619	M1639	M1659	M1679	
Stop command		M1800	M1820	M1840	M1860	SCPU → PCPU
Rapid stop command		M1801	M1821	M1841	M1861	
Forward JOG start		M1802	M1822	M1842	M1862	
Reverse JOG start		M1803	M1823	M1843	M1863	
End signal OFF command		M1804	M1824	M1844	M1864	
Speed/position switching enabled		M1805	M1825	M1845	M1865	
Limit switch output enable		M1806	M1826	M1846	M1866	
Error reset		M1807	M1827	M1847	M1867	
Servo error reset		M1808	M1828	M1848	M1868	
External STOP input valid/invalid when starting		M1809	M1829	M1849	M1869	
Unusable		M1810	M1830	M1850	M1870	
		M1811	M1831	M1851	M1871	
Feed present value update request command		M1812	M1832	M1852	M1872	
Unusable		M1813	M1833	M1853	M1873	
		M1814	M1834	M1854	M1874	
Servo OFF		M1815	M1835	M1855	M1875	
Unusable		M1816	M1836	M1856	M1876	
		M1817	M1837	M1857	M1877	
		M1818	M1838	M1858	M1878	
FIN signal		M1819	M1839	M1859	M1879	

<A273UHCPU (8 axis specification)> **Table 6.2 Axis I/O Signal List**

Signal Name		Device No.								Signal Direction
		Axis 1	Axis 2	Axis 3	Axis 4	Axis 5	Axis 6	Axis 7	Axis 8	
Positioning start completed		X00	X10	X20	X30	X40	X50	X60	X70	PCPU → SCPU
Positioning completed		X01	X11	X21	X31	X41	X51	X61	X71	
In-position		X02	X12	X22	X32	X42	X52	X62	X72	
Command in-position		X03	X13	X23	X33	X43	X53	X63	X73	
Speed control in progress		X04	X14	X24	X34	X44	X54	X64	X74	
Speed/position switching latch		X05	X15	X25	X35	X45	X55	X65	X75	
Zero pass		X06	X16	X26	X36	X46	X56	X66	X76	
Error detection		X07	X17	X27	X37	X47	X57	X67	X77	
Servo error detection		X08	X18	X28	X38	X48	X58	X68	X78	
Home position return request		X09	X19	X29	X39	X49	X59	X69	X79	
Home position return completed		X0A	X1A	X2A	X3A	X4A	X5A	X6A	X7A	
External signals	FLS	X0B	X1B	X2B	X3B	X4B	X5B	X6B	X7B	
	RLS	X0C	X1C	X2C	X3C	X4C	X5C	X6C	X7C	
	STOP	X0D	X1D	X2D	X3D	X4D	X5D	X6D	X7D	
	DOG	X0E	X1E	X2E	X3E	X4E	X5E	X6E	X7E	
Servo READY		X0F	X1F	X2F	X3F	X4F	X5F	X6F	X7F	
M code output in progress signal		XC0	XC1	XC2	XC3	XC4	XC5	XC6	XC7	
Torque control in progress		XD0	XD1	XD1	XD3	XD4	XD5	XD6	XD7	
CHANGE signal		XD8	XD9	XDA	XDB	XDC	XDD	XDE	XDF	
Stop command		Y00	Y10	Y20	Y30	Y40	Y50	Y60	Y70	SCPU → PCPU
Rapid stop command		Y01	Y11	Y21	Y31	Y41	Y51	Y61	Y71	
Forward JOG start		Y02	Y12	Y22	Y32	Y42	Y52	Y62	Y72	
Reverse JOG start		Y03	Y13	Y23	Y33	Y43	Y53	Y63	Y73	
End signal OFF command		Y04	Y14	Y24	Y34	Y44	Y54	Y64	Y74	
Speed/position switching enabled		Y05	Y15	Y25	Y35	Y45	Y55	Y65	Y75	
Limit switch output enable		Y06	Y16	Y26	Y36	Y46	Y56	Y66	Y76	
Error reset		Y07	Y17	Y27	Y37	Y47	Y57	Y67	Y77	
Servo error reset		Y08	Y18	Y28	Y38	Y48	Y58	Y68	Y78	
External STOP input valid/invalid when starting		Y09	Y19	Y29	Y39	Y49	Y59	Y69	Y79	
Unusable		Y0A	Y1A	Y2A	Y3A	Y4A	Y5A	Y6A	Y7A	
		Y0B	Y1B	Y2B	Y3B	Y4B	Y5B	Y6B	Y7B	
Feed present value update request command		Y0C	Y1C	Y2C	Y3C	Y4C	Y5C	Y6C	Y7C	
Unusable		Y0D	Y1D	Y2D	Y3D	Y4D	Y5D	Y6D	Y7D	
		Y0E	Y1E	Y2E	Y3E	Y4E	Y5E	Y6E	Y7E	
Servo OFF		Y0F	Y1F	Y2F	Y3F	Y4F	Y5F	Y6F	Y7F	
FIN signal		YC0	YC1	YC2	YC3	YC4	YC5	YC6	YC7	

MEMO

<A273UHCPU (32 axis specification)>

Table 6.3 Axis I/O Signal List

Signal Name		Device No.							
		Axis 1	**Axis 2**	**Axis 3**	**Axis 4**	**Axis 5**	**Axis 6**	**Axis 7**	
Positioning start completed		M2400	M2420	M2440	M2460	M2480	M2500	M2520	
Positioning completed		M2401	M2421	M2441	M2461	M2481	M2501	M2521	
In-position		M2402	M2422	M2442	M2462	M2482	M2502	M2522	
Command in-position		M2403	M2423	M2443	M2463	M2483	M2503	M2523	
Speed control in progress		M2404	M2424	M2444	M2464	M2484	M2504	M2524	
Speed/position switching latch		M2405	M2425	M2445	M2465	M2485	M2505	M2525	
Zero pass		M2406	M2426	M2446	M2466	M2486	M2506	M2526	
Error detection		M2407	M2427	M2447	M2467	M2487	M2507	M2527	
Servo error detection		M2408	M2428	M2448	M2468	M2488	M2508	M2528	
Home position return request		M2409	M2429	M2449	M2469	M2489	M2509	M2529	
Home position return completed		M2410	M2430	M2450	M2470	M2490	M2510	M2530	
External signals	FLS	M2411	M2431	M2451	M2471	M2491	M2511	M2531	
	RLS	M2412	M2432	M2452	M2472	M2492	M2512	M2532	
	STOP	M2413	M2433	M2453	M2473	M2493	M2513	M2533	
	DOG	M2414	M2434	M2454	M2474	M2494	M2514	M2534	
Servo READY		M2415	M2435	M2455	M2475	M2495	M2515	M2535	
Torque control in progress		M2416	M2436	M2456	M2476	M2496	M2516	M2536	
CHANGE signal		M2417	M2437	M2457	M2477	M2497	M2517	M2537	
Unusable		M2418	M2438	M2458	M2478	M2498	M2518	M2538	
M code output in progress signal		M2419	M2439	M2459	M2479	M2499	M2519	M2539	
Stop command		M3200	M3220	M3240	M3260	M3280	M3300	M3320	
Rapid stop command		M3201	M3221	M3241	M3261	M3281	M3301	M3321	
Forward JOG start		M3202	M3222	M3242	M3262	M3282	M3302	M3322	
Reverse JOG start		M3203	M3223	M3243	M3263	M3283	M3303	M3323	
End signal OFF command		M3204	M3224	M3244	M3264	M3284	M3304	M3324	
Speed/position switching enabled		M3205	M3225	M3245	M3265	M3285	M3305	M3325	
Limit switch output enable		M3206	M3226	M3246	M3266	M3286	M3306	M3326	
Error reset		M3207	M3227	M3247	M3267	M3287	M3307	M3327	
Servo error reset		M3208	M3228	M3248	M3268	M3288	M3308	M3328	
External STOP input valid/invalid when starting		M3209	M3229	M3249	M3269	M3289	M3309	M3329	
Unusable		M3210	M3230	M3250	M3270	M3290	M3310	M3330	
		M3211	M3231	M3251	M3271	M3291	M3311	M3331	
Feed present value update request command		M3212	M3232	M3252	M3272	M3292	M3312	M3332	
Unusable		M3213	M3233	M3253	M3273	M3293	M3313	M3333	
		M3214	M3234	M3254	M3274	M3294	M3314	M3334	
Servo OFF		M3215	M3235	M3255	M3275	M3295	M3315	M3335	
Unusable		M3216	M3236	M3256	M3276	M3296	M3316	M3336	
		M3217	M3237	M3257	M3277	M3297	M3317	M3337	
		M3218	M3238	M3258	M3278	M3298	M3318	M3338	
FIN signal		M3219	M3239	M3259	M3279	M3299	M3319	M3339	

	Axis 8	Axis 9	Axis 10	Axis 11	Axis 12	Axis 13	Axis 14	Axis 15	Axis 16	Signal Direction
	M2540	M2560	M2580	M2600	M2620	M2640	M2660	M2680	M2700	
	M2541	M2561	M2581	M2601	M2621	M2641	M2661	M2681	M2701	
	M2542	M2562	M2582	M2602	M2622	M2642	M2662	M2682	M2702	
	M2543	M2563	M2583	M2603	M2623	M2643	M2663	M2683	M2703	
	M2544	M2564	M2584	M2604	M2624	M2644	M2664	M2684	M2704	
	M2545	M2565	M2585	M2605	M2625	M2645	M2665	M2685	M2705	
	M2546	M2566	M2586	M2606	M2626	M2646	M2666	M2686	M2706	
	M2547	M2567	M2587	M2607	M2627	M2647	M2667	M2687	M2707	PCPU → SCPU
	M2548	M2568	M2588	M2608	M2628	M2648	M2668	M2688	M2708	
	M2549	M2569	M2589	M2609	M2629	M2649	M2669	M2689	M2709	
	M2550	M2570	M2590	M2610	M2630	M2650	M2670	M2690	M2710	
	M2551	M2571	M2591	M2611	M2631	M2651	M2671	M2691	M2711	
	M2552	M2572	M2592	M2612	M2632	M2652	M2672	M2692	M2712	
	M2553	M2573	M2593	M2613	M2633	M2653	M2673	M2693	M2713	
	M2554	M2574	M2594	M2614	M2634	M2654	M2674	M2694	M2714	
	M2555	M2575	M2595	M2615	M2635	M2655	M2675	M2695	M2715	
	M2556	M2576	M2596	M2616	M2636	M2656	M2676	M2696	M2716	
	M2557	M2577	M2597	M2617	M2637	M2657	M2677	M2697	M2717	
	M2558	M2578	M2598	M2618	M2638	M2658	M2678	M2698	M2718	
	M2559	M2579	M2599	M2619	M2639	M2659	M2679	M2699	M2719	
	M3340	M3360	M3380	M3400	M3420	M3440	M3460	M3480	M3500	
	M3341	M3361	M3381	M3401	M3421	M3441	M3461	M3481	M3501	
	M3342	M3362	M3382	M3402	M3422	M3442	M3462	M3482	M3502	
	M3343	M3363	M3383	M3403	M3423	M3443	M3463	M3483	M3503	
	M3344	M3364	M3384	M3404	M3424	M3444	M3464	M3484	M3504	
	M3345	M3365	M3385	M3405	M3425	M3445	M3465	M3485	M3505	
	M3346	M3366	M3386	M3406	M3426	M3446	M3466	M3486	M3506	
	M3347	M3367	M3387	M3407	M3427	M3447	M3467	M3487	M3507	
	M3348	M3368	M3388	M3408	M3428	M3448	M3468	M3488	M3508	
	M3349	M3369	M3389	M3409	M3429	M3449	M3469	M3489	M3509	SCPU → PCPU
	M3350	M3370	M3390	M3410	M3430	M3450	M3470	M3490	M3510	
	M3351	M3371	M3391	M3411	M3431	M3451	M3471	M3491	M3511	
	M3352	M3372	M3392	M3412	M3432	M3452	M3472	M3492	M3512	
	M3353	M3373	M3393	M3413	M3433	M3453	M3473	M3493	M3513	
	M3354	M3374	M3394	M3414	M3434	M3454	M3474	M3494	M3514	
	M3355	M3375	M3395	M3415	M3435	M3455	M3475	M3495	M3515	
	M3356	M3376	M3396	M3416	M3436	M3456	M3476	M3496	M3516	
	M3357	M3377	M3397	M3417	M3437	M3457	M3477	M3497	M3517	
	M3358	M3378	M3398	M3418	M3438	M3458	M3478	M3498	M3518	
	M3359	M3379	M3399	M3419	M3439	M3459	M3479	M3499	M3519	

Table 6.3 Axis I/O Signal List (Continued)

Signal Name		Device No.						
		Axis 17	Axis 18	Axis 19	Axis 20	Axis 21	Axis 22	Axis 23
Positioning start completed		M2720	M2740	M2760	M2780	M2800	M2820	M2840
Positioning completed		M2721	M2741	M2761	M2781	M2801	M2821	M2841
In-position		M2722	M2742	M2762	M2782	M2802	M2822	M2842
Command in-position		M2723	M2743	M2763	M2783	M2803	M2823	M2843
Speed control in progress		M2724	M2744	M2764	M2784	M2804	M2824	M2844
Speed/position switching latch		M2725	M2745	M2765	M2785	M2805	M2825	M2845
Zero pass		M2726	M2746	M2766	M2786	M2806	M2826	M2846
Error detection		M2727	M2747	M2767	M2787	M2807	M2827	M2847
Servo error detection		M2728	M2748	M2768	M2788	M2808	M2828	M2848
Home position return request		M2729	M2749	M2769	M2789	M2809	M2829	M2849
Home position return completed		M2730	M2750	M2770	M2790	M2810	M2830	M2850
External signals	FLS	M2731	M2751	M2771	M2791	M2811	M2831	M2851
	RLS	M2732	M2752	M2772	M2792	M2812	M2832	M2852
	STOP	M2733	M2753	M2773	M2793	M2813	M2833	M2853
	DOG	M2734	M2754	M2774	M2794	M2814	M2834	M2854
Servo READY		M2735	M2755	M2775	M2795	M2815	M2835	M2855
Torque control in progress		M2736	M2756	M2776	M2796	M2816	M2836	M2856
CHANGE signal		M2737	M2757	M2777	M2797	M2817	M2837	M2857
Unusable		M2738	M2758	M2778	M2798	M2818	M2838	M2858
M code output in progress signal		M2739	M2759	M2779	M2799	M2819	M2839	M2859
Stop command		M3520	M3540	M3560	M3580	M3600	M3620	M3640
Rapid stop command		M3521	M3541	M3561	M3581	M3601	M3621	M3641
Forward JOG start		M3522	M3542	M3562	M3582	M3602	M3622	M3642
Reverse JOG start		M3523	M3543	M3563	M3583	M3603	M3623	M3643
End signal OFF command		M3524	M3544	M3564	M3584	M3604	M3624	M3644
Speed/position switching enabled		M3525	M3545	M3565	M3585	M3605	M3625	M3645
Limit switch output enable		M3526	M3546	M3566	M3586	M3606	M3626	M3646
Error reset		M3527	M3547	M3567	M3587	M3607	M3627	M3647
Servo error reset		M3528	M3548	M3568	M3588	M3608	M3628	M3648
External STOP input valid/invalid when starting		M3529	M3549	M3569	M3589	M3609	M3629	M3649
Unusable		M3530	M3550	M3570	M3590	M3610	M3630	M3650
		M3531	M3551	M3571	M3591	M3611	M3631	M3651
Feed present value update request command		M3532	M3552	M3572	M3592	M3612	M3632	M3652
Unusable		M3533	M3553	M3573	M3593	M3613	M3633	M3653
		M3534	M3554	M3574	M3594	M3614	M3634	M3654
Servo OFF		M3535	M3555	M3575	M3595	M3615	M3635	M3655
Unusable		M3536	M3556	M3576	M3596	M3616	M3636	M3656
		M3537	M3557	M3577	M3597	M3617	M3637	M3657
		M3538	M3558	M3578	M3598	M3618	M3638	M3658
FIN signal		M3539	M3559	M3579	M3599	M3619	M3639	M3659

Axis 24	Axis 25	Axis 26	Axis 27	Axis 28	Axis 29	Axis 30	Axis 31	Axis 32	Signal Direction
M2860	M2880	M2900	M2920	M2940	M2960	M2980	M3000	M3020	PCPU → SCPU
M2861	M2881	M2901	M2921	M2941	M2961	M2981	M3001	M3021	
M2862	M2882	M2902	M2922	M2942	M2962	M2982	M3002	M3022	
M2863	M2883	M2903	M2923	M2943	M2963	M2983	M3003	M3023	
M2864	M2884	M2904	M2924	M2944	M2964	M2984	M3004	M3024	
M2865	M2885	M2905	M2925	M2945	M2965	M2985	M3005	M3025	
M2866	M2886	M2906	M2926	M2946	M2966	M2986	M3006	M3026	
M2867	M2887	M2907	M2927	M2947	M2967	M2987	M3007	M3027	
M2868	M2888	M2908	M2928	M2948	M2968	M2988	M3008	M3028	
M2869	M2889	M2909	M2929	M2949	M2969	M2989	M3009	M3029	
M2870	M2890	M2910	M2930	M2950	M2970	M2990	M3010	M3030	
M2871	M2891	M2911	M2931	M2951	M2971	M2991	M3011	M3031	
M2872	M2892	M2912	M2932	M2952	M2972	M2992	M3012	M3032	
M2873	M2893	M2913	M2933	M2953	M2973	M2993	M3013	M3033	
M2874	M2894	M2914	M2934	M2954	M2974	M2994	M3014	M3034	
M2875	M2895	M2915	M2935	M2955	M2975	M2995	M3015	M3035	
M2876	M2896	M2916	M2936	M2956	M2976	M2996	M3016	M3036	
M2877	M2897	M2917	M2937	M2957	M2977	M2997	M3017	M3037	
M2878	M2898	M2918	M2938	M2958	M2978	M2998	M3018	M3038	
M2879	M2899	M2919	M2939	M2959	M2979	M2999	M3019	M3039	
M3660	M3680	M3700	M3720	M3740	M3760	M3780	M3800	M3820	SCPU → PCPU
M3661	M3681	M3701	M3721	M3741	M3761	M3781	M3801	M3821	
M3662	M3682	M3702	M3722	M3742	M3762	M3782	M3802	M3822	
M3663	M3683	M3703	M3723	M3743	M3763	M3783	M3803	M3823	
M3664	M3684	M3704	M3724	M3744	M3764	M3784	M3804	M3824	
M3665	M3685	M3705	M3725	M3745	M3765	M3785	M3805	M3825	
M3666	M3686	M3706	M3726	M3746	M3766	M3786	M3806	M3826	
M3667	M3687	M3707	M3727	M3747	M3767	M3787	M3807	M3827	
M3668	M3688	M3708	M3728	M3748	M3768	M3788	M3808	M3828	
M3669	M3689	M3709	M3729	M3749	M3769	M3789	M3809	M3829	
M3670	M3690	M3710	M3730	M3750	M3770	M3790	M3810	M3830	
M3671	M3691	M3711	M3731	M3751	M3771	M3791	M3811	M3831	
M3672	M3692	M3712	M3732	M3752	M3772	M3792	M3812	M3832	
M3673	M3693	M3713	M3733	M3753	M3773	M3793	M3813	M3833	
M3674	M3694	M3714	M3734	M3754	M3774	M3794	M3814	M3834	
M3675	M3695	M3715	M3735	M3755	M3775	M3795	M3815	M3835	
M3676	M3696	M3716	M3736	M3756	M3776	M3796	M3816	M3836	
M3677	M3697	M3717	M3737	M3757	M3777	M3797	M3817	M3837	
M3678	M3698	M3718	M3738	M3758	M3778	M3798	M3818	M3838	
M3679	M3699	M3719	M3739	M3759	M3779	M3799	M3819	M3839	

<A171SCPU> **Table 6.4 Internal Relay List**

Device Number	Signal Name	Signal Direction
M2000	PC READY flag	SCPU → PCPU
M2001	Axis 1 start accept flag	PCPU → SCPU
M2002	Axis 2 start accept flag	
M2003	Axis 3 start accept flag	
M2004	Axis 4 start accept flag	
M2005 to M2008	Unusable	—
M2009	All-axis servo start accept flag	PCPU → SCPU
M2010 to M2011	Unusable	—
M2012	Manual pulse generator enable flag	SCPU → PCPU
M2013	Unusable	—
M2014		
M2015	JOG simultaneous start command	SCPU → PCPU
M2016	When using SV13: Speed switching point designation flag	
	When using SV22: Unusable	—
M2017 to M2019	Unusable	
M2020	Start buffer full	PCPU → SCPU
M2021	Axis 1 speed change flag	
M2022	Axis 2 speed change flag	
M2023	Axis 3 speed change flag	
M2024	Axis 4 speed change flag	
M2025 to M2039	Unusable	—
M2040	When using SV13: Unusable	
	When using SV22: Speed switching point designation flag	SCPU → PCPU
M2041	System setting error flag	PCPU → SCPU
M2042	All axes servo start command	SCPU → PCPU
M2043 to M2046	Unusable	—
M2047	Optional slot module error detection flag	PCPU → SCPU

<A273UHCPU
(8-axis specification)> **Table 6.5 Internal Relay List**

<table>
<tr><th>Device Number</th><th>Signal Name</th><th>Signal Direction</th></tr>
<tr><td>M2000</td><td>PC READY flag</td><td>SCPU → PCPU</td></tr>
<tr><td>M2001</td><td>Axis 1 start accept flag</td><td rowspan="9">PCPU → SCPU</td></tr>
<tr><td>M2002</td><td>Axis 2 start accept flag</td></tr>
<tr><td>M2003</td><td>Axis 3 start accept flag</td></tr>
<tr><td>M2004</td><td>Axis 4 start accept flag</td></tr>
<tr><td>M2005</td><td>Axis 5 start accept flag</td></tr>
<tr><td>M2006</td><td>Axis 6 start accept flag</td></tr>
<tr><td>M2007</td><td>Axis 7 start accept flag</td></tr>
<tr><td>M2008</td><td>Axis 8 start accept flag</td></tr>
<tr><td>M2009</td><td>All-axis servo start accept flag</td></tr>
<tr><td>M2010
to
M2011</td><td>Unusable</td><td>—</td></tr>
<tr><td>M2012</td><td>Manual pulse generator 1 enable flag</td><td rowspan="5">SCPU → PCPU</td></tr>
<tr><td>M2013</td><td>Manual pulse generator 2 enable flag</td></tr>
<tr><td>M2014</td><td>Manual pulse generator 3 enable flag</td></tr>
<tr><td>M2015</td><td>JOG simultaneous start command</td></tr>
<tr><td rowspan="2">M2016</td><td>When using SV13: Speed switching point designation flag</td></tr>
<tr><td>When using SV22: Unusable</td><td rowspan="2">—</td></tr>
<tr><td>M2017
to
M2019</td><td>Unusable</td></tr>
<tr><td>M2020</td><td>Start buffer full</td><td rowspan="9">PCPU → SCPU</td></tr>
<tr><td>M2021</td><td>Axis 1 speed change flag</td></tr>
<tr><td>M2022</td><td>Axis 2 speed change flag</td></tr>
<tr><td>M2023</td><td>Axis 3 speed change flag</td></tr>
<tr><td>M2024</td><td>Axis 4 speed change flag</td></tr>
<tr><td>M2025</td><td>Axis 5 speed change flag</td></tr>
<tr><td>M2026</td><td>Axis 6 speed change flag</td></tr>
<tr><td>M2027</td><td>Axis 7 speed change flag</td></tr>
<tr><td>M2028</td><td>Axis 8 speed change flag</td></tr>
<tr><td>M2029
to
M2039</td><td>Unusable</td><td rowspan="2">—</td></tr>
<tr><td rowspan="2">M2040</td><td>When using SV13: Unusable</td></tr>
<tr><td>When using SV22: Speed switching point designation flag</td><td>SCPU → PCPU</td></tr>
<tr><td>M2041</td><td>System setting error flag</td><td>PCPU → SCPU</td></tr>
<tr><td>M2042</td><td>All axes servo start command</td><td>SCPU → PCPU</td></tr>
<tr><td>M2043
to
M2046</td><td>Unusable</td><td>—</td></tr>
<tr><td>M2047</td><td>Motion slot module error detection flag</td><td>PCPU → SCPU</td></tr>
</table>

<A273UHCPU
(32-axis specification)>

Table 6.6 Internal Relay List

Device No.	Signal Name	Signal Direction
M2000	PC READY flag	PCPU → SCPU
M2001	Axis 1 start accept flag	
M2002	Axis 2 start accept flag	
M2003	Axis 3 start accept flag	
M2004	Axis 4 start accept flag	
M2005	Axis 5 start accept flag	
M2006	Axis 6 start accept flag	
M2007	Axis 7 start accept flag	
M2008	Axis 8 start accept flag	
M2009	Axis 9 start accept flag	
M2010	Axis 10 start accept flag	
M2011	Axis 11 start accept flag	
M2012	Axis 12 start accept flag	
M2013	Axis 13 start accept flag	
M2014	Axis 14 start accept flag	
M2015	Axis 15 start accept flag	
M2016	Axis 16 start accept flag	
M2017	Axis 17 start accept flag	
M2018	Axis 18 start accept flag	
M2019	Axis 19 start accept flag	
M2020	Axis 20 start accept flag	
M2021	Axis 21 start accept flag	
M2022	Axis 22 start accept flag	
M2023	Axis 23 start accept flag	
M2024	Axis 24 start accept flag	
M2025	Axis 25 start accept flag	
M2026	Axis 26 start accept flag	
M2027	Axis 27 start accept flag	
M2028	Axis 28 start accept flag	
M2029	Axis 29 start accept flag	
M2030	Axis 30 start accept flag	
M2031	Axis 31 start accept flag	
M2032	Axis 32 start accept flag	
M2033 to M2039	Unusable	—
M2040	Speed switching point designation flag	SCPU → PCPU
M2041	System setting error flag	PCPU → SCPU
M2042	All axes servo start flag	SCPU → PCPU
M2043 to M2046	Unusable	—
M2047	Motion slot module error detection flag	PCPU → SCPU
M2048	JOG simultaneous start command	SCPU → PCPU
M2049	All axis servo start accept flag	PCPU → SCPU
M2050	Start buffer full	
M2051	Manual pulse generator 1 enable flag	SCPU → PCPU
M2052	Manual pulse generator 2 enable flag	
M2053	Manual pulse generator 3 enable flag	
M2054 to M2060	Unusable	—
M2061	Axis 1 speed change flag	PCPU → SCPU
M2062	Axis 2 speed change flag	
M2063	Axis 3 speed change flag	
M2064	Axis 4 speed change flag	
M2065	Axis 5 speed change flag	
M2066	Axis 6 speed change flag	
M2067	Axis 7 speed change flag	
M2068	Axis 8 speed change flag	
M2069	Axis 9 speed change flag	
M2070	Axis 10 speed change flag	
M2071	Axis 11 speed change flag	
M2072	Axis 12 speed change flag	
M2073	Axis 13 speed change flag	
M2074	Axis 14 speed change flag	
M2075	Axis 15 speed change flag	
M2076	Axis 16 speed change flag	
M2077	Axis 17 speed change flag	
M2078	Axis 18 speed change flag	
M2079	Axis 19 speed change flag	
M2080	Axis 20 speed change flag	
M2081	Axis 21 speed change flag	
M2082	Axis 22 speed change flag	
M2083	Axis 23 speed change flag	
M2084	Axis 24 speed change flag	
M2085	Axis 25 speed change flag	
M2086	Axis 26 speed change flag	
M2087	Axis 27 speed change flag	
M2088	Axis 28 speed change flag	
M2089	Axis 29 speed change flag	
M2090	Axis 30 speed change flag	
M2091	Axis 31 speed change flag	
M2092	Axis 32 speed change flag	
M2093 to M2127	Unusable	—
M2128	Axis 1 automatic deceleration flag	PCPU → SCPU
M2129	Axis 2 automatic deceleration flag	
M2130	Axis 3 automatic deceleration flag	
M2131	Axis 4 automatic deceleration flag	
M2132	Axis 5 automatic deceleration flag	
M2133	Axis 6 automatic deceleration flag	
M2134	Axis 7 automatic deceleration flag	
M2135	Axis 8 automatic deceleration flag	
M2136	Axis 9 automatic deceleration flag	
M2137	Axis 10 automatic deceleration flag	
M2138	Axis 11 automatic deceleration flag	
M2139	Axis 12 automatic deceleration flag	
M2140	Axis 13 automatic deceleration flag	
M2141	Axis 14 automatic deceleration flag	
M2142	Axis 15 automatic deceleration flag	
M2143	Axis 16 automatic deceleration flag	
M2144	Axis 17 automatic deceleration flag	
M2145	Axis 18 automatic deceleration flag	
M2146	Axis 19 automatic deceleration flag	
M2147	Axis 20 automatic deceleration flag	
M2148	Axis 21 automatic deceleration flag	
M2149	Axis 22 automatic deceleration flag	

Table 6.6 Internal Relay List (Continued)

Device No.	Signal Name	Signal Direction
M2150	Axis 23 automatic deceleration flag	PCPU → SCPU
M2151	Axis 24 automatic deceleration flag	
M2152	Axis 25 automatic deceleration flag	
M2153	Axis 26 automatic deceleration flag	
M2154	Axis 27 automatic deceleration flag	
M2155	Axis 28 automatic deceleration flag	
M2156	Axis 29 automatic deceleration flag	
M2157	Axis 30 automatic deceleration flag	
M2158	Axis 31 automatic deceleration flag	
M2159	Axis 32 automatic deceleration flag	
M2160 to M2239	Unusable	—
M2240	Axis 1 speed change "0" accept flag	PCPU → SCPU
M2241	Axis 2 speed change "0" accept flag	
M2242	Axis 3 speed change "0" accept flag	
M2243	Axis 4 speed change "0" accept flag	
M2244	Axis 5 speed change "0" accept flag	
M2245	Axis 6 speed change "0" accept flag	
M2246	Axis 7 speed change "0" accept flag	
M2247	Axis 8 speed change "0" accept flag	
M2248	Axis 9 speed change "0" accept flag	
M2249	Axis 10 speed change "0" accept flag	
M2250	Axis 11 speed change "0" accept flag	
M2251	Axis 12 speed change "0" accept flag	
M2252	Axis 13 speed change "0" accept flag	
M2253	Axis 14 speed change "0" accept flag	
M2254	Axis 15 speed change "0" accept flag	PCPU → SCPU
M2255	Axis 16 speed change "0" accept flag	
M2256	Axis 17 speed change "0" accept flag	
M2257	Axis 18 speed change "0" accept flag	
M2258	Axis 19 speed change "0" accept flag	
M2259	Axis 20 speed change "0" accept flag	
M2260	Axis 21 speed change "0" accept flag	
M2261	Axis 22 speed change "0" accept flag	
M2262	Axis 23 speed change "0" accept flag	
M2263	Axis 24 speed change "0" accept flag	
M2264	Axis 25 speed change "0" accept flag	
M2265	Axis 26 speed change "0" accept flag	
M2266	Axis 27 speed change "0" accept flag	
M2267	Axis 28 speed change "0" accept flag	
M2268	Axis 29 speed change "0" accept flag	
M2269	Axis 30 speed change "0" accept flag	
M2270	Axis 31 speed change "0" accept flag	
M2271	Axis 32 speed change "0" accept flag	
M2272 to M2319	Unusable	—

<A171SCPU/A273UHCPU (8/32-axis specification)> **Table 6.7 Special Relay List**

Device No.	Signal Name	Signal Direction
M9073	WDT error flag	PCPU → SCPU
M9074	PCPU READY-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	

6.2 Data Registers (D)

<A171SCPU>

Table 6.8 Data Register List

<table>
<tr><th>Device No.</th><th colspan="2">Signal Name</th></tr>
<tr><td>D800
to
D819</td><td>Axis 1 monitoring data</td><td rowspan="4">First data register number<table>
<tr><td>0</td><td rowspan="2">Feed present value</td><td>L</td></tr>
<tr><td>1</td><td>H</td></tr>
<tr><td>2</td><td rowspan="2">Actual present value</td><td>L</td></tr>
<tr><td>3</td><td>H</td></tr>
<tr><td>4</td><td rowspan="2">Deviation counter value</td><td>L</td></tr>
<tr><td>5</td><td>H</td></tr>
<tr><td>6</td><td colspan="2">Minor error code</td></tr>
<tr><td>7</td><td colspan="2">Major error code</td></tr>
<tr><td>8</td><td colspan="2">Servo error code</td></tr>
<tr><td>9</td><td rowspan="2">Travel value when the near-zero point dog is ON</td><td>L</td></tr>
<tr><td>10</td><td>H</td></tr>
<tr><td>11</td><td colspan="2">Home position return second travel value</td></tr>
<tr><td>12</td><td colspan="2">Executed program number</td></tr>
<tr><td>13</td><td colspan="2">M code</td></tr>
<tr><td>14</td><td colspan="2">Torque limit value</td></tr>
<tr><td>15</td><td rowspan="2">Travel value change register</td><td>L</td></tr>
<tr><td>16</td><td>H</td></tr>
<tr><td>17</td><td rowspan="2">Actual present value when STOP is input</td><td>L</td></tr>
<tr><td>18</td><td>H</td></tr>
<tr><td>19</td><td colspan="2">For constant speed control</td></tr>
</table></td></tr>
<tr><td>D820
to
D839</td><td>Axis 2 monitoring data</td></tr>
<tr><td>D840
to
D859</td><td>Axis 3 monitoring data</td></tr>
<tr><td>D860
to
D879</td><td>Axis 4 monitoring data</td></tr>
<tr><td>D880
to
D959</td><td colspan="2">Unusable</td></tr>
<tr><td>D960
to
D965</td><td>Axis 1 control change data storage area</td><td rowspan="4">First data register number<table>
<tr><td>0</td><td rowspan="2">Present value change register</td><td>L</td></tr>
<tr><td>1</td><td>H</td></tr>
<tr><td>2</td><td rowspan="2">Speed change register</td><td>L</td></tr>
<tr><td>3</td><td>H</td></tr>
<tr><td>4</td><td rowspan="2">JOG speed setting register</td><td>L</td></tr>
<tr><td>5</td><td>H</td></tr>
</table></td></tr>
<tr><td>D966
to
D971</td><td>Axis 2 control change data storage area</td></tr>
<tr><td>D972
to
D977</td><td>Axis 3 control change data storage area</td></tr>
<tr><td>D978
to
D983</td><td>Axis 4 control change data storage area</td></tr>
<tr><td>D984
to
D1007</td><td colspan="2">Unusable</td></tr>
<tr><td>D1008
to
D1009</td><td colspan="2">Limit switch output disable setting</td></tr>
<tr><td>D1010
to
D1011</td><td colspan="2">Unusable</td></tr>
</table>

Device No.	Signal Name
D1012	Setting register for axis number controlled with manual pulse generator
D1013 to D1014	Unusable
D1015	JOG operation simultaneous start axis setting register
D1016	1 pulse input magnification setting register of manual pulse generator for axis 1
D1017	1 pulse input magnification setting register of manual pulse generator for axis 2
D1018	1 pulse input magnification setting register of manual pulse generator for axis 3
D1019	1 pulse input magnification setting register of manual pulse generator for axis 4
D1020 to D1023	Unusable

<A273UHCPU
(8-axis specification)>

Table 6.9 Data Register List

<table>
<tr><th>Device No.</th><th colspan="2">Signal Name</th><th>Device No.</th><th>Signal Name</th></tr>
<tr><td>D800 to D819</td><td>Axis 1 monitoring data</td><td rowspan="8">First data register number
0–1: Feed present value (L/H)
2–3: Actual present value (L/H)
4–5: Deviation counter value (L/H)
6: Minor error code
7: Major error code
8: Servo error code
9–10: Travel value when the near-zero point dog is ON (L/H)
11: Home position return second travel value
12: Executed program number
13: M code
14: Torque limit value
15–16: Travel value change register (L/H)
17–18: Actual present value when STOP is input (L/H)
19: For constant speed control</td><td>D1012</td><td>Setting register for axis number controlled with manual pulse generator 1</td></tr>
<tr><td>D820 to D839</td><td>Axis 2 monitoring data</td><td>D1013</td><td>Setting register for axis number controlled with manual pulse generator 2</td></tr>
<tr><td>D840 to D859</td><td>Axis 3 monitoring data</td><td>D1014</td><td>Setting register for axis number controlled with manual pulse generator 3</td></tr>
<tr><td>D860 to D879</td><td>Axis 4 monitoring data</td><td>D1015</td><td>JOG operation simultaneous start axis setting register</td></tr>
<tr><td>D880 to D899</td><td>Axis 5 monitoring data</td><td>D1016</td><td>1 pulse input magnification setting register of manual pulse generator for axis 1</td></tr>
<tr><td>D900 to D919</td><td>Axis 6 monitoring data</td><td>D1017</td><td>1 pulse input magnification setting register of manual pulse generator for axis 2</td></tr>
<tr><td>D920 to D939</td><td>Axis 7 monitoring data</td><td>D1018</td><td>1 pulse input magnification setting register of manual pulse generator for axis 3</td></tr>
<tr><td>D940 to D959</td><td>Axis 8 monitoring data</td><td>D1019</td><td>1 pulse input magnification setting register of manual pulse generator for axis 4</td></tr>
<tr><td>D960 to D965</td><td>Axis 1 control change data storage area</td><td rowspan="8">First data register number
0–1: Present value change register (L/H)
2–3: Speed change register (L/H)
4–5: JOG speed setting register (L/H)</td><td>D1020</td><td>1 pulse input magnification setting register of manual pulse generator for axis 5</td></tr>
<tr><td>D966 to D971</td><td>Axis 2 control change data storage area</td><td>D1021</td><td>1 pulse input magnification setting register of manual pulse generator for axis 6</td></tr>
<tr><td>D972 to D977</td><td>Axis 3 control change data storage area</td><td>D1022</td><td>1 pulse input magnification setting register of manual pulse generator for axis 7</td></tr>
<tr><td>D978 to D983</td><td>Axis 4 control change data storage area</td><td>D1023</td><td>1 pulse input magnification setting register of manual pulse generator for axis 8</td></tr>
<tr><td>D984 to D989</td><td>Axis 5 control change data storage area</td><td></td><td></td></tr>
<tr><td>D990 to D995</td><td>Axis 6 control change data storage area</td><td></td><td></td></tr>
<tr><td>D996 to D1001</td><td>Axis 7 control change data storage area</td><td></td><td></td></tr>
<tr><td>D1002 to D1007</td><td>Axis 8 control change data storage area</td><td></td><td></td></tr>
<tr><td>D1008 to D1011</td><td colspan="2">Limit switch output disable setting</td><td></td><td></td></tr>
</table>

<A273UHCPU
(32-axis specification)> **Table 6.10 Data Register List**

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

Data Register Names:

First data register number

0	Feed present value	L
1		H
2	Actual present value	L
3		H
4	Deviation counter value	L
5		H
6	Minor error code	
7	Major error code	
8	Servo error code	
9	Home position return second travel value	
10	Travel value when the near-zero point dog is ON	L
11		H
12	Executed program number	
13	M code	
14	Torque limit value	
15	For constant speed control	
16	Travel value change register	L
17		H
18	Actual present value when STOP is input	L
19		H

<A273UHCPU
(32-axis specification)> **Table 6.10 Data Register List (Continued)**

Device No.	Signal Name	Device No.	Signal Name	Data Register Names
D640 D641	Axis 1 JOG speed data storage area	D672 D673	Axis 17 JOG speed data storage area	First data register number 0 — JOG speed setting register — L 1 — H
D642 D643	Axis 2 JOG speed data storage area	D674 D675	Axis 18 JOG speed data storage area	
D644 D645	Axis 3 JOG speed data storage area	D676 D677	Axis 19 JOG speed data storage area	
D646 D647	Axis 4 JOG speed data storage area	D678 D679	Axis 20 JOG speed data storage area	
D648 D649	Axis 5 JOG speed data storage area	D680 D681	Axis 21 JOG speed data storage area	
D650 D651	Axis 6 JOG speed data storage area	D682 D683	Axis 22 JOG speed data storage area	
D652 D653	Axis 7 JOG speed data storage area	D684 D685	Axis 23 JOG speed data storage area	
D654 D655	Axis 8 JOG speed data storage area	D686 D687	Axis 24 JOG speed data storage area	
D656 D657	Axis 9 JOG speed data storage area	D688 D689	Axis 25 JOG speed data storage area	
D658 D659	Axis 10 JOG speed data storage area	D690 D691	Axis 26 JOG speed data storage area	
D660 D661	Axis 11 JOG speed data storage area	D692 D693	Axis 27 JOG speed data storage area	
D662 D663	Axis 12 JOG speed data storage area	D694 D695	Axis 28 JOG speed data storage area	
D664 D665	Axis 13 JOG speed data storage area	D696 D697	Axis 29 JOG speed data storage area	
D666 D667	Axis 14 JOG speed data storage area	D698 D699	Axis 30 JOG speed data storage area	
D668 D669	Axis 15 JOG speed data storage area	D700 D701	Axis 31 JOG speed data storage area	
D670 D671	Axis 16 JOG speed data storage area	D702 D703	Axis 32 JOG speed data storage area	

<A273UHCPU
(32-axis specification)> **Table 6.10 Data Register List (Continued)**

Device No.	Signal Name	Device No.	Signal Name
D704 to D709	Unusable	D737	1 pulse input magnification setting register of manual pulse generator for axis 18
D710 to D713	JOG operation simultaneous start axis setting register	D738	1 pulse input magnification setting register of manual pulse generator for axis 19
D714 D715	Setting register for axis number controlled with manual pulse generator 1	D739	1 pulse input magnification setting register of manual pulse generator for axis 20
D716 D717	Setting register for axis number controlled with manual pulse generator 2	D740	1 pulse input magnification setting register of manual pulse generator for axis 21
D718 D719	Setting register for axis number controlled with manual pulse generator 3	D741	1 pulse input magnification setting register of manual pulse generator for axis 22
D720	1 pulse input magnification setting register of manual pulse generator for axis 1	D742	1 pulse input magnification setting register of manual pulse generator for axis 23
D721	1 pulse input magnification setting register of manual pulse generator for axis 2	D743	1 pulse input magnification setting register of manual pulse generator for axis 24
D722	1 pulse input magnification setting register of manual pulse generator for axis 3	D744	1 pulse input magnification setting register of manual pulse generator for axis 25
D723	1 pulse input magnification setting register of manual pulse generator for axis 4	D745	1 pulse input magnification setting register of manual pulse generator for axis 26
D724	1 pulse input magnification setting register of manual pulse generator for axis 5	D746	1 pulse input magnification setting register of manual pulse generator for axis 27
D725	1 pulse input magnification setting register of manual pulse generator for axis 6	D747	1 pulse input magnification setting register of manual pulse generator for axis 28
D726	1 pulse input magnification setting register of manual pulse generator for axis 7	D748	1 pulse input magnification setting register of manual pulse generator for axis 29
D727	1 pulse input magnification setting register of manual pulse generator for axis 8	D749	1 pulse input magnification setting register of manual pulse generator for axis 30
D728	1 pulse input magnification setting register of manual pulse generator for axis 9	D750	1 pulse input magnification setting register of manual pulse generator for axis 31
D729	1 pulse input magnification setting register of manual pulse generator for axis 10	D751	1 pulse input magnification setting register of manual pulse generator for axis 32
D730	1 pulse input magnification setting register of manual pulse generator for axis 11	D752*	Manual pulse generator 1 (P1) smoothing magnification setting area
D731	1 pulse input magnification setting register of manual pulse generator for axis 12	D753*	Manual pulse generator 2 (P2) smoothing magnification setting area
D732	1 pulse input magnification setting register of manual pulse generator for axis 13	D754*	Manual pulse generator 3 (P3) smoothing magnification setting area
D733	1 pulse input magnification setting register of manual pulse generator for axis 14	D756 to D759	Unusable
D734	1 pulse input magnification setting register of manual pulse generator for axis 15	D760 to D775	Limit switch output disable setting
D735	1 pulse input magnification setting register of manual pulse generator for axis 16	D776 to D791	Limit switch output status storage area
D736	1 pulse input magnification setting register of manual pulse generator for axis 17	D792 to D799	Servo amplifier type

*: Treated as a special register. For details, see Section 3.5.

<A171SCPU> **Table 6.11 Special Register List**

Device Number	Signal Name
D9180	Limit switch output status storage area for axis 1 and axis 2
D9181	Limit switch output status storage area for axis 3 and axis 4
D9182	Unusable
D9183	
D9184	PCPU error cause
D9185	Servo amplifier type
D9186	
D9187	Manual pulse generator axis setting error
D9188	Test mode request error
D9189	Error program number
D9190	Error item information
D9191	Servo amplifier loading information
D9192	Area for setting the manual pulse generator smoothing magnification
D9193	Unusable
D9194	
D9195 to D9199	Unusable

<A273UHCPU (8-axis specification)> **Table 6.12 Special Register List**

Device Number	Signal Name
D9180	Limit switch output status storage area for axis 1 and axis 2
D9181	Limit switch output status storage area for axis 3 and axis 4
D9182	Limit switch output status storage area for axis 5 and axis 6
D9183	Limit switch output status storage area for axis 7 and axis 8
D9184	PCPU error cause
D9185	Servo amplifier type
D9186	
D9187	Manual pulse generator axis setting error
D9188	Test mode request error
D9189	Error program number
D9190	Error item information
D9191	Servo amplifier loading information
D9192	Area for setting the manual pulse generator (P1) smoothing magnification
D9193	Area for setting the manual pulse generator (P2) smoothing magnification
D9194	Area for setting the manual pulse generator (P3) smoothing magnification
D9195 to D9199	Unusable

<A273UHCPU
(32-axis specification)> **Table 6.13 Special Register List**

Device Number	Signal Name
D752*	Area for setting the manual pulse generator (P1) smoothing magnification
D753*	Area for setting the manual pulse generator (P2) smoothing magnification
D754*	Area for setting the manual pulse generator (P3) smoothing magnification
D776 to * D791	Limit switch output status storage area
D792 to * D799	Servo amplifier type
D9180 to D9181	Unusable
D9182 to D9183	Test mode request error
D9184	PCPU error cause
D9185 to D9187	Manual pulse generator setting error
D9188	Unusable
D9189	Error program number
D9190	Error item information
D9191 to D9192	Servo amplifier loading information
D9193 to D9199	Unusable

*: Data registers used (See Section 3.5)

APPENDIX 7 PROCESSING TIMES

The processing times for each signal and each instruction when performing positioning control with a servo system CPU are indicated here.

(1) Operation cycle for each servo system CPU
The processing times for performing positioning control operation with each servo system CPU are indicated below.

	A171SCPU		A273UHCPU		
Set number of axes	1 to 3	4	1 to 12	13 to 24	25 to 32
Operation cycle	3.5 ms	7.1 ms	3.5 ms	7.1 ms	14.2 ms

(2) PCPU processing cycle
The processing time at the PCPU after detection of the start request signal and PC ready (M2000) signal ON is indicated below.

	A171SCPU	A273UHCPU (8-axis specification)		A273UHCPU			
Number of axes used	4 axes	4 axes	8 axes	4 axes	8 axes	16 axes	32 axes
Servo program processing time	7 to 14 ms*1	4 to 11 ms		4 to 11 ms		10 to 18 ms	14 to 21 ms
Speed change response time	7 to 14 ms	0 to 4 ms		0 to 4 ms		0 to 8 ms	0 to 14 ms
PC ready (M2000) ON→ PCPU ready completed flag (M9074) ON	100 to 300 ms	80 to 100 ms		8 to 100 ms		90 to 400 ms	100 to 800 ms
Simultaneous start processing time	7 to 17 ms*2	7 to 17 ms		7 to 17 ms		10 to 24 ms	14 to 28 ms

*1 : For FEED, VPF, and VPR, this differs greatly according to the conditions. If the other axes are stopped it is 14 to 28 ms.
*2 : The range of 7 to 17 ms should be regarded as a guide only.

(3) Common devices
The processing times for the common devices for each axis in positioning control are indicated below. For each signal whose direction of transmission is "PCPU → SCPU", the cycle for notification from the PCPU to the SCPU is indicated. For signals whose direction of transmission is "SCPU → PCPU", the cycle for notification from the SCPU to the PCPU, or the cycle for detection at the PCPU, is indicated.

Signal Name	Device No.			Signal Direction	A171SCPU		A273UHCPU			
							8-axis Specification	32-axis Specification		
	A171SCPU	A273UHCPU (8-axis specification)	A273UHCPU (32-axis specification)		Set Number of Axes		Set Number of Axes	Set Number of Axes		
					1 to 3	4	1 to 8	1 to 12	13 to 24	25 to 32
Axis start accept flags	M2001 to M2004	M2001 to M2008	M2001 to M2032	PCPU→SCPU	10 ms	10 ms	10 ms	10 ms	10 ms	10 ms
All-axis servo start accept flag	M2009	M2009	M2049		10 ms	10 ms	10 ms	END *1	END *1	END *1
Axis speed change flags	M2021 to M2024	M2021 to M2028	M2061to M2092		END *1	END *1	END *1	END *1	END *1	END *1
System setting error flag	M2041	M2041	M2041		END *1	END *1	END *1	END *1	END *1	END *1
Optional slot module error detection flag	M2047	M2047	M2047		END *1	END *1	END *1	END *1	END *1	END *1
Automatic deceleration flags	—	—	M2128 to M2159		—	—	—	3.5 ms	7.1 ms	14.2 ms
Speed change "0" accept flags	—	—	M2240 to M2271		—	—	—	3.5 ms	7.1 ms	14.2 ms
Limit switch output status storage areas	D9180 to D9181	D9180 to D9183	D776 to D791		3.5 ms	7.1 ms	3.5 ms	3.5 ms	7.1 ms	14.2 ms
Areas for setting the manual pulse generator smoothing magnifications	D9192	D9192 to D9194	D752 to D754	SCPU→PCPU	At leading edge of manual pulse generator enable signal	At leading edge of manual pulse generator enable signal	At leading edge of manual pulse generator enable signal	At leading edge of manual pulse generator enable signal	At leading edge of manual pulse generator enable signal	At leading edge of manual pulse generator enable signal
Limit switch output enable/disable setting	D1008 to D1009	D1008 to D1011	D760 to D775		3.5 ms	7.1 ms	3.5 ms	3.5 ms	7.1 ms	14.2 ms
Manual pulse generator axis setting	D1012	D1012 to D1014	D714 to D719		At leading edge of manual pulse generator enable signal	At leading edge of manual pulse generator enable signal	At leading edge of manual pulse generator enable signal	At leading edge of manual pulse generator enable signal	At leading edge of manual pulse generator enable signal	At leading edge of manual pulse generator enable signal
JOG operation simultaneous start axis setting	D1015	D1015	D710 to D713		At start	At start	At start	At start	At start	At start
Manual pulse generator 1 pulse input magnification	D1016 to D1019	D1016 to D1023	D720 to D751		At leading edge of manual pulse generator enable signal	At leading edge of manual pulse generator enable signal	At leading edge of manual pulse generator enable signal	At leading edge of manual pulse generator enable signal	At leading edge of manual pulse generator enable signal	At leading edge of manual pulse generator enable signal
Present value change register	D960 to D1007	D960 to D1007	—		When DSFLP instruction is executed	When DSFLP instruction is executed	When DSFLP instruction is executed	—	—	—
Speed change register			—		When DSFLP instruction is executed	When DSFLP instruction is executed	When DSFLP instruction is executed	—	—	—
JOG speed setting register			D640 to D703		At start	At start	At start	At start	At start	At start

END *1 : With A171SCPU : "80 ms" or "PC program scan time", whichever is longer
With A273UHCPU : "50 ms" or PC program scan time, whichever is longer

(4) Devices specific to each axis
The processing times for the devices for each axis in positioning control are indicated below. For each signal whose direction of transmission is "PCPU → SCPU", the cycle for notification from the PCPU to the SCPU is indicated. For signals whose direction of transmission is "SCPU → PCPU", the cycle for notification from the SCPU to the PCPU, or the cycle for detection at the PCPU, is indicated.

Signal Name	Device No.			Signal Direction	A171SCPU		A273UHCPU			
							8-axis Specification	32-axis Specification		
	A171SCPU	A273UHCPU (8-axis specification)	A273UHCPU (32-axis specification)		Set Number of Axes		Set Number of Axes	Set Number of Axes		
					1 to 3	4	1 to 8	1 to 12	13 to 24	25 to 32
Positioning start completed	M1600 to M1759	X000 to X0FF	M2400 to M3039	PCPU→ SCPU	3.5 ms	7.1 ms	3.5 ms	3.5 ms	7.1 ms	14.2 ms
Positioning completed					3.5 ms	7.1 ms	3.5 ms	3.5 ms	7.1 ms	14.2 ms
In-position					3.5 ms	7.1 ms	3.5 ms	3.5 ms	7.1 ms	14.2 ms
Command in-position					3.5 ms	7.1 ms	3.5 ms	3.5 ms	7.1 ms	14.2 ms
Speed control in progress					3.5 ms	7.1 ms	3.5 ms	3.5 ms	7.1 ms	14.2 ms
Speed/position switching latch					3.5 ms	7.1 ms	3.5 ms	3.5 ms	7.1 ms	14.2 ms
Zero pass					3.5 ms	7.1 ms	3.5 ms	3.5 ms	7.1 ms	14.2 ms
Error detection					3.5 ms	7.1 ms	3.5 ms	3.5 ms	7.1 ms	14.2 ms
Servo error detection					3.5 ms	7.1 ms	3.5 ms	3.5 ms	7.1 ms	14.2 ms
Home position return request					3.5 ms	7.1 ms	3.5 ms	3.5 ms	7.1 ms	14.2 ms
Home position return completed					3.5 ms	7.1 ms	3.5 ms	3.5 ms	7.1 ms	14.2 ms
Servo ON/OFF status					3.5 ms	7.1 ms	3.5 ms	3.5 ms	7.1 ms	14.2 ms
Torque control in progress					3.5 ms	7.1 ms	3.5 ms	3.5 ms	7.1 ms	14.2 ms
Stop command	M1400 to M1559	Y000 to Y070	M3200 to M3839	SCPU→ PCPU	3.5 ms	7.1 ms	3.5 ms	3.5 ms	7.1 ms	14.2 ms
Rapid stop command					3.5 ms	7.1 ms	3.5 ms	3.5 ms	7.1 ms	14.2 ms
Speed/position switching enabled					3.5 ms	7.1 ms	3.5 ms	3.5 ms	7.1 ms	14.2 ms
Limit switch output enable					3.5 ms	7.1 ms	3.5 ms	3.5 ms	7.1 ms	14.2 ms
External STOP input/invalid at start					At start	At start	At start	At start	At start	At start
Feed present value update request command					At start	At start	At start	At start	At start	At start
Servo OFF					3.5 ms	7.1 ms	3.5 ms	3.5 ms	7.1 ms	14.2 ms
Feed present value	D800 to D959	D800 to D959	D0 to D639	PCPU→ SCPU	END*1	END*1	3.5 ms	3.5 ms	7.1 ms	14.2 ms
Actual present value					END*1	END*1	3.5 ms	3.5 ms	7.1 ms	14.2 ms
Deviation counter value					END*1	END*1	3.5 ms	3.5 ms	7.1 ms	14.2 ms
Home position return second travel value					3.5 ms	7.1 ms	3.5 ms	3.5 ms	7.1 ms	14.2 ms
Travel value after near-zero-point dog ON					END*1	END*1	END*1	END*1	END*1	END*1
Executed program No.					At start	At start	At start	At start	At start	At start
M code					3.5 ms	7.1 ms	3.5 ms	3.5 ms	7.1 ms	14.2 ms
Torque limit value					3.5 ms	7.1 ms	3.5 ms	3.5 ms	7.1 ms	14.2 ms
Travel value change register					3.5 ms	7.1 ms	3.5 ms	3.5 ms	7.1 ms	14.2 ms
Actual present value when STOP is input					END*1	END*1	END*1	END*1	END*1	END*1

END *1 : With A171SCPU : "80 ms" or "PC program scan time", whichever is longer
With A273UHCPU : "50 ms" or PC program scan time, whichever is longer

(5) Processing time for DSFRP/SVST instructions, DSFLP instruction, END instruction
The processing times for each instruction used in sequence programs used for e.g. positioning control start are indicated below. For the processing times of sequence program instructions other than the ones indicated below, refer to the ACPU Programming Manual (Common Instructions) IB-66250.
A171SCPU .... Same as the processing time for A1SCPU
A273UHCPU .... Same as the processing time for A3UCPU

			A171SCPU	A273UHCPU (8-axis specification)		A273UHCPU (32-axis specification)			
		Number of axes used	4 axes	4 axes	8 axes	4 axes	8 axes	16 axes	32 axes
DSFRP	1-axis start		180 μs	25 μs		—			
	2-axis. 3-axis start		200 μs	25 μs		—			
	Error occurrence		850 μs	120 μs		—			
DSFLP	Present value change	When normal	120 μs	10 μs		—			
		Error	770 μs	25 μs		—			
	Speed control	When normal	80 μs	15 μs		—			
		Error	700 μs	30 μs		—			
SVST	1-axis start		190 μs	35 μs		35 μs			
	2 to 4 axis start		700 μs	70 μs		70 μs			
	Error		900 μs	150 μs		150 μs			
END			7600 μs	5000 μs		5000 μs			

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