MITSUBISHI

MOTION CONTROLLER (SV13/22) (REAL MODE)

Programming Manual

type A172SHCPUN,A171SHCPUN

MITSUBISHI ELECTRIC

INTORODUCTION

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

Precautions for Safety

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

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

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

For Sate Operations

1. Prevention of electric shocks

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

2. For fire prevention

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

3. For injury prevention

⚠ CAUTION

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

4. Various precautions

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

(1) System structure

⚠ CAUTION

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

⚠ CAUTION

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

(2) Parameter settings and programming

⚠ CAUTION

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

(3) Transportation and installation

⚠ CAUTION

⚠ Transport the product with the correct method according to the weight.

⚠ Use the servomotor suspension bolts only for the transportation of the servomotor. Do not transport the servomotor with machine installed on it.

⚠ Do not stack products past the limit.

⚠ When transporting the control unit or servo amplifier, never hold the connected wires or cables.

⚠ When transporting the servomotor, never hold the cables, shaft or detector.

⚠ When transporting the control unit or servo amplifier, never hold the front case as it may fall off.

⚠ When transporting, installing or removing the control unit or servo amplifier, never hold the edges.

⚠ Install the unit according to user's manual, or the instruction manual for the product you are using in a place where the weight can be withstood.

⚠ Do not get on or place heavy objects on the product.

⚠ Always observe the installation direction.

⚠ Keep the designated clearance between the control unit or servo amplifier and control panel inner surface or the control unit and servo amplifier, control unit or servo amplifier and other devices.

⚠ Do not install or operate control units, servo amplifiers or servomotors that are damaged or that have missing parts.

⚠ Do not block the intake/outtake ports of the servomotor with cooling fan.

⚠ Do not allow conductive matter such as screw or cutting chips or combustible matter such as oil enter the control unit, servo amplifier or servomotor.

⚠ The control unit, servo amplifier and servomotor are precision machines, so do not drop or apply strong impacts on them.

⚠ Securely fix the control unit and servo amplifier to the machine according to the instruction manual. If the fixing is insufficient, these may come off during operation.

⚠ Always install the servomotor with reduction gears in the designated direction. Failing to do so may lead to oil leaks.

⚠ Store and use the unit in the following environmental conditions.

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

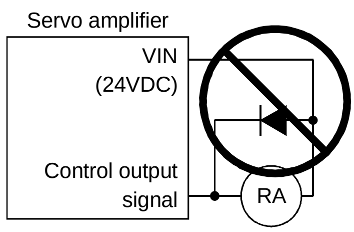
CAUTION

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

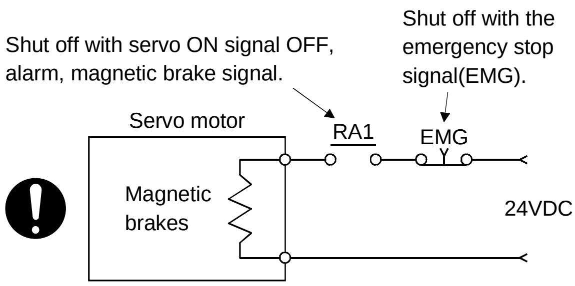
- Immediately turn OFF the power if smoke, abnormal sounds or odors are emitted from the control unit, servo amplifier or servomotor.
- Always execute a test operation before starting actual operations after the program or parameters have been changed or after maintenance and inspection.
- The units 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.
- As for use with CE mark-compatible installations, refer to the “EMC Installation Guidelines” (data number IB (NA)-67320) for motion controllers, and to the corresponding EMC guideline data for other equipment such as servo amplifiers and inverters.
- 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 use's manual, or the instruction manual for the product you are using.

⚠ CAUTION
⚠ Do not touch the lead sections such as ICs or the connector contacts. ⚠ Do not place the control unit or servo amplifier on metal that may cause a power leakage or wood, plastic or vinyl that may cause static electricity buildup. ⚠ Do not perform a megger test (insulation resistance measurement) during inspection. ⚠ When replacing the control unit or servo amplifier, always set the new unit settings correctly. ⚠ When the controller or absolute value motor has been replaced, carry out a home position return operation using one of the following methods, otherwise position displacement could occur. 1) After writing the servo data to the PC using peripheral device software, switch on the power again, then perform a home position return operation. 2) Using the backup function of the peripheral device software, load the data backed up before replacement. ⚠ After maintenance and inspections are completed, confirm that the position detection of the absolute position detector function is correct. ⚠ Do not short circuit, charge, overheat, incinerate or disassemble the batteries. ⚠ The electrolytic capacitor will generate gas during a fault, so do not place your face near the control unit or servo amplifier. ⚠ The electrolytic capacitor and fan will deteriorate. Periodically change these to prevent secondary damage from faults. Replacements can be made by the System Service or Service Station.

(9) Disposal

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

(10) General cautions

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

Revisions

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

Print Date	*Manual Number	Revision
Apr., 1998	IB(NA)-67396-B	First edition
Jul., 2001	IB(NA)-67396-C	Addition APPENDIX 4.5 Correction INTRODUCTION, For Sate Operations 3, 4, CONTENTS, Chapter1, 1.1.1, 1.1.2, 1.2, 1.3, 2.1, 2.3, Chapter3, 3.1, 3.1.1, 3.1.2, 3.1.3, 3.2, 3.2.1, 3.2.2, 3.2.3, 3.3, 3.4, 4.1, 4.2.1, 4.2.2, 4.2.3, 4.3.1, 4.3.8, 4.3.9, 4.3.11, 4.3.12, 4.3.13, 4.3.14, 4.3.16, 4.4, 4.4.1, 4.4.2, 4.4.3, 5.1, 5.2.1, 5.2.2, 5.3, 5.3.1, 5.3.2, 5.4.1, 5.4.2, 5.5, 5.6, 5.7.1, 6.1.1, 6.1.2, 6.3, 6.4.1, 6.4.2, 7.1.2, 7.1.3, 7.1.4, 7.1.5, 7.1.6, 7.1.7, 7.2, 7.3, 7.4, 7.5, 7.6, 7.7, 7.8, 7.9, 7.10, 7.11, 7.12, 7.13, 7.14.1, 7.14.2, 7.15.1, 7.15.2, 7.16, 7.16.1, 7.16.2, 7.16.3, 7.16.4, 7.16.6, 7.17, 7.18, 7.19, 7.19.2, 7.19.3, 7.20, 7.21, 7.21.1, 7.21.2, 7.21.3, 8.1.2, 8.2, 8.3, 8.4, 8.6, 8.7, 8.8, 8.9, 8.10, 8,11, APPENDIX1, APPENDIX2, APPENDIX3, APPENDIX4, APPENDIX5,

CONTENTS

1. GENERAL DESCRIPTION

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

Applicable CPU	Number of Axes Controlled in Positioning Control
A172SHCPUN	8
A171SHCPUN	4

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-GSV13P software package
- SW2NX-GSV13P software package .... Abbreviated to "GSV13P"
- SW2SRX-GSV22P software package
- SW2NX-GSV22P software package .... Abbreviated to "GSV22P"

⚠ 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.

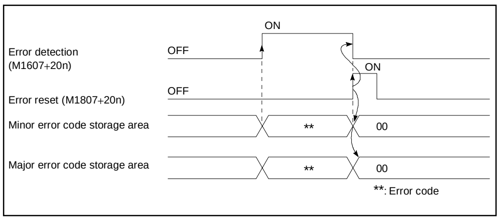
Conventions Used in this Manual

Positioning signals are always indicated in the following order: signal for A172SHCPUN → signal for A171SHCPUN. If only one positioning signal is indicated, this means that the signal is used in common by both CPUs.
The explanatory text is written with reference to the A172SHCPUN: if you are not using an A172SHCPUN, the positioning signals should be read as the positioning signals for the CPU you are using.
(For the positioning signals used with each CPU, refer to Chapter 3.)
When using the motion controller (SV22), also use the A172SHCPUN/A171SHCPUN-compatible programming manual (SV22 virtual mode) (IB-67359).
(Somes user devices differ between the SV13 and SV22.)

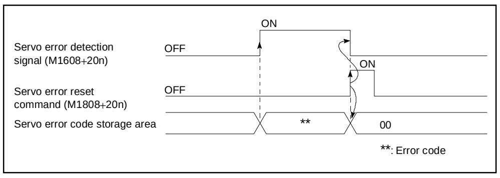
3. POSITIONING SIGNALS

(6) Limit switch output enable command (M1806+20n)
The limit switch output enable command is used to enable limit switch output.
- ON .... The limit switch output ON/OFF pattern can be output.
- OFF ...... Limit switch output goes OFF.

(7) Error reset command (M1807+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).



(8) Servo error reset command (M1808+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 (M1608+20n: ON), and reset the servo error detection signal (M1608+20n).



POINT

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

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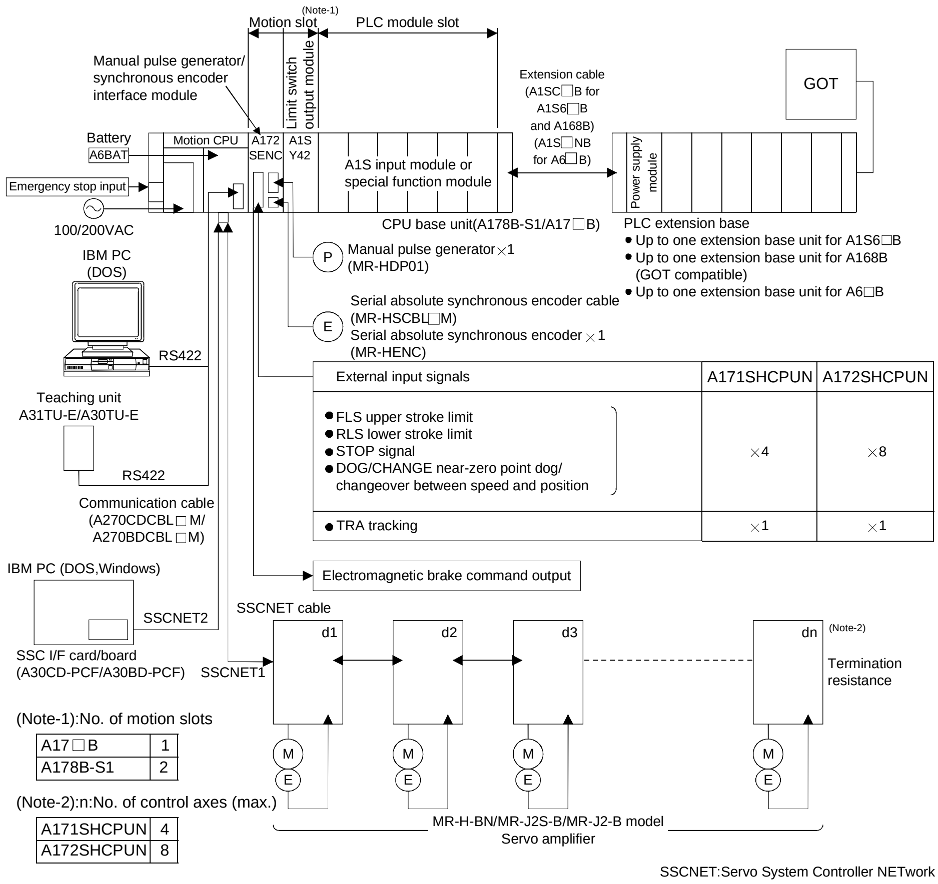
1. GENERAL DESCRIPTION

1.1 System Configuration

1.1.1 A172SHCPUN/A171SHCPUN System overall configuration



POINTS

(1) When using the PLC extension base and bus connection type GOT, select the A168B as the PLC extension base. When not using the PLC extension base, you can connect the bus connection type GOT directly to the extension connector of the CPU base unit.

(2) When using a teaching unit A31TU-E with a dead-man switch, a dedicated connecting cable A31TUCBL03M is required between the CPU unit and A31TU-E connector. If the A31TU-E is connected directly to the RS422 connector of the CPU without using a dedicated cable, the A31TU-E will not operate at all. After disconnecting the A31TU-E, attach a short-circuit connector A31SHORTCON for A31TUCBL.

(3) In a motion module, a PLC A1S I/O modules can also be installed.

(4) Though the external input signals of A172SENC are reserved for eight axes, for A171SHCPUN, set those for the first half four axes (PX0 to PX0F).

(5) 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.

1.1.2 System configuration precautions

The following table summarizes the notes on system configuration, system setup items, and relative checks that differ from those of the A171SCPU.

<table>
<tr><th>Product Name</th><th>Module Name</th><th>Number of Available Modules</th><th>System Setup Item</th><th>Relative Check</th><th>Notes and Remarks</th></tr>
<tr><td>Separated servo amplifier</td><td>MR-J2S-B
MR-J2-B
MR-H-BN</td><td>• Max. 8 axes for A172SHCPUN
• Max. 4 axes for A171SHCPUN</td><td>1. MR-J2-B allows the use of the following motors with high-resolution encoders.
• HC-MF***W1 (32768PLS)
• HA-FF***W1 (32768PLS)
• HC-SF**2W2 (131072PLS)
2. [Allowable travel value during power-off]
When ABS motor is used, set the allowable travel value during servo amplifier power-off by rpm (rotations per minute).
This setting value is used for checking when the servo amplifier is switched ON.<table><tr><th>Setting range</th><th>Default value</th></tr><tr><td>0 to 16383 (rpm)</td><td>10 (rpm)</td></tr></table></td><td></td><td>• Connect the servo amplifier to the 'SSCNET1' interface.
• The setting range changes for high-resolution encoder support.</td></tr>
<tr><td>Manual pulse generator /synchronous encoder interface module</td><td>A172SENC</td><td>1</td><td>1. External signals
(1) Set the axis numbers of external signals FLS, RLS, STOP, and DOG/CHANGE for A172SENC CTRL connector signals PX0 to PX1F.
Axes need not be set unless they are used by external signals.<table><tr><th>CPU unit</th><th>Setting range</th><th>Default value</th></tr><tr><td>A172SHCPUN</td><td>Set axes 1 to 8 for PX0 to PX1F.</td><td>Axes 1 to 8 are set.</td></tr><tr><td>A171SHCPUN</td><td>Set axes 1 to 4 for the first half (PX0 to PX0F).</td><td>Axes 1 to 4 are set.</td></tr></table></td><td>• The same axis number must not be set.</td><td>• The external signal setup window has been improved for a better understanding.
• The conventional A171SENC can also be used for A171SHCPUN and A172SHCPUN. However, it must be set as A172SENC during system setting.</td></tr>
<tr><td>Man/machine control module</td><td>A271DVP</td><td>0</td><td>Not available. Settings cannot be made.</td><td></td><td></td></tr>
<tr><td>PLC CPU I/O module (motion slot)</td><td>A1SX□□
A1SY□□
A1SH42</td><td>Up to 128 I/O points (total)</td><td>1. Set the number of points and the starting I/O number for PC CPU I/O modules to be mounted on the motion extension base unit.
The number to be set must not precede the I/O numbers for use by the PLC extension base unit.<table><tr><th>CPU unit</th><th>Effective setting range</th><th>Default value</th></tr><tr><td>A172SHCPUN</td><td>X/Y0~X/Y3FF</td><td>——</td></tr><tr><td>A171SHCPUN</td><td>X/Y0~X/Y1FF</td><td>——</td></tr></table></td><td>• The total number of points must be less than or equal to 256.
• The starting I/O number plus number of occupied points must be less than or equal to X/Y800.</td><td>• Though settings can be made within a range of X/Y0 to X/Y7FF, they must be made in the range defined in the left-hand column.</td></tr>
<tr><td rowspan="2">PLC extension base unit</td><td>A1S68B
A1S65B</td><td>1 stage</td><td rowspan="2" colspan="2"></td><td>• Use this unit for systems capable of one-stage extension.</td></tr>
<tr><td>A168B</td><td>1 stage</td><td>• Use this unit for bus connection GOT.</td></tr>
</table>

POINT

1. <u>When using the existing A171SCPU user program and parameters, perform the following procedure:</u>
   (1) Start the programming S/W package by A172SHCPUN or A171SHCPUN, then read the sequence file and servo file created for A171SCPU via the File Read function.
   ↓
   (2) Display the System Setup screen.
   The existing system status is displayed with the following alert:
   (Start by A172SHCPUN)

Replaces A171SCPU with A172SHCPUN.	......The character string "A171SHCPUN" is displayed only when A171SHCPUN is used for startup.
Replaces A171SENC with A172SENC.	......This message is displayed only when A171ENC has been set.
YES NO	

   ↓
   (3) Select "YES" and the existing settings will be replaced with those for the startup CPU module.
   Select "NO" and the existing A171SCPU settings will remain in effect.

   (Note): Other than system setup data can be used without change.

1.2 Table of Software Package

Use	Peripheral Devices		Programming Software Package			Operating System Software Package Model Name		Teaching function
				Model Name	Applicable version For A172SH/A171SH	For A172SH	For A171SH	
For conveyor assembly **SV13** (With Motion SFC)	IBM PC/AT	NT/ 98	Japanese	SW3RNC-GSV	Without restriction	SW3RN-SV13D	——	Yes
			English	SW3RNC -GSVE	Without restriction			
For conveyor assembly **SV13** (Without Motion SFC)	IBM PC/AT	DOS	Japanese	SW2SRX-GSV13P	From 00T on	SW0SRX-SV13D	SW0SRX-SV13G	Yes
			English	SW2SRX-GSV13PE	From 00F on			
		NT/ 98	Japanese	SW3RNC-GSV	From 00E on			
			English	SW3RNC-GSVE	Without restriction			
	PC98		Japanese	SW2NX-GSV13P	From 00Q on	SW0NX-SV13D	SW0NX-SV13G	
For automatic machinery**SV22** (With Motion SFC)	IBM PC/AT	NT/ 98	Japanese	SW3RNC-GSV	Without restriction	SW3RN-SV22C	——	No
			English	SW3RNC -GSVE	Without restriction			
For automatic machinery**SV22** (Without Motion SFC)	IBM PC/AT	DOS	Japanese	SW2SRX-GSV22P	From 00T on	SW0SRX-SV22C	SW0SRX-SV22F	No
				SW0SRX-CAMP	From 00B on			
			English	SW2SRX-GSV22PE	From 00F on			
				SW0IX-CAMPE	Without restriction			
		NT/ 98	Japanese	SW3RNC-GSV	From 00E on			
			English	SW3RNC-GSVE	Without restriction			
	PC98		Japanese	SW2NX-GSV22P	Without restriction	SW0NX- SV22C	SW0NX- SV22F	
				SW0NX-CAMP	Without restriction			

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

Programming Software Package		Operating System Software Package			
Model	Version	For A172SHCPUN	Version	For A171SHCPUN	Version
SW2SRX-GSV13P	AD or later	SW0SRX-SV13D	AF or later	SW0SRX-SV13G	AF or later
SW2SRX-GSV13PE	J or later				
SW2NX-GSV13P	AC or later	SW0NX-SV13D	AF or later	SW0NX-SV13G	AF or later
SW2SRX-GSV22P	AD or later	SW0SRX-SV22C	AF or later	SW0SRX-SV22F	AF or later
SW2SRX-GSV22PE	J or later				
SW2NX-GSV22P	AC or later	SW0NX-SV22C	AF or later	SW0NX-SV22F	AF or later
SW3RNC-GSV	G or later	SW0SRX-SV13D	AF or later	SW0SRX-SV13G	AF or later
SW3RNC-GSVE		SW0SRX-SV22C		SW0SRX-SV22F	

1.3 Positioning Control by the Servo System CPU

A servo system CPU can execute positioning control and sequence control for 4 axes when using an A171SHCPUN, 8 axes when using an A172SHCPUN 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 A2SHCPU-S1 when using an A172SHCPUN, and to those of A2SHCPU when using an A171SHCPUN.

(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 A2SHCPU-S1 or A2SHCPU.)

   (b) Start of positioning start 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 current values or speed by means of the DSFLP instruction or CHGA/CHGV instruction.
      3) It changes the torque limit value by means of the CHGT instruction.
      4) It executes JOG operation.
      5) It sets the data required to execute manual pulse generator operation.

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

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

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

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

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

[Executing Positioning Control with a Servo System CPU]

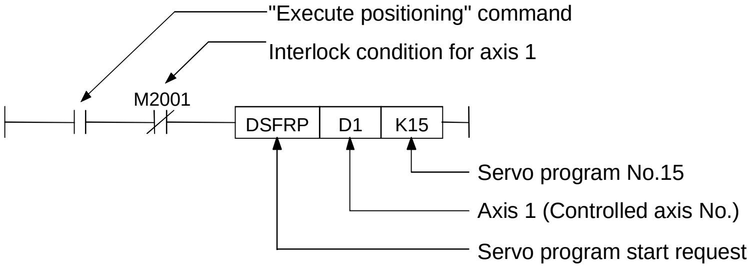
The servo system CPU executes positioning control in accordance with the servo programs designated by the sequence program of the SCPU.
An overview of the method used for positioning control is presented below.

Servo System CPU System

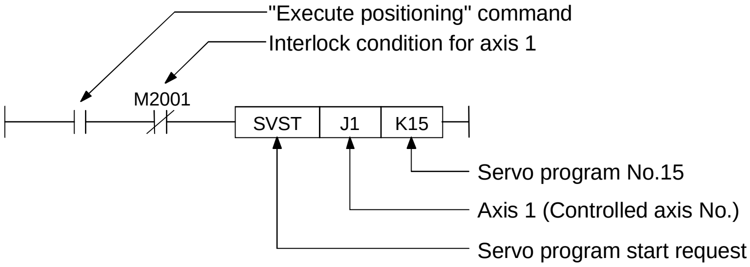
SCPU Control

Sequence program ········ Created and modified using a peripheral device (Note)

Example: DSFRP instruction



Example: SVST instruction



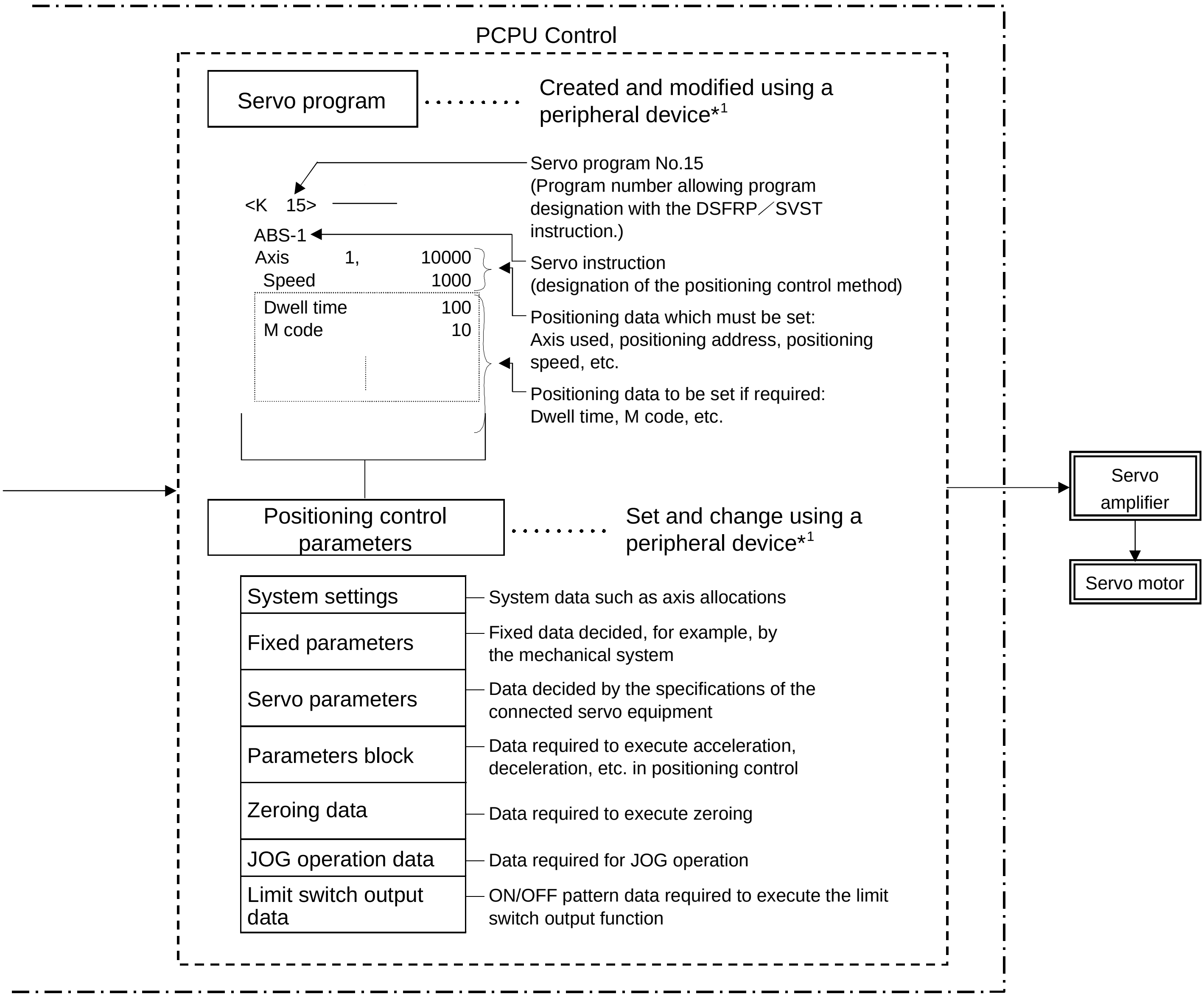
1) In the sequence program, the servo program number and controlled axis number are set with the DSFRP/SVST instruction.
2) When the DSFRP/SVST instruction is executed, the PCPU is requested to execute the program with the designated servo program number.

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

(Note): 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”)

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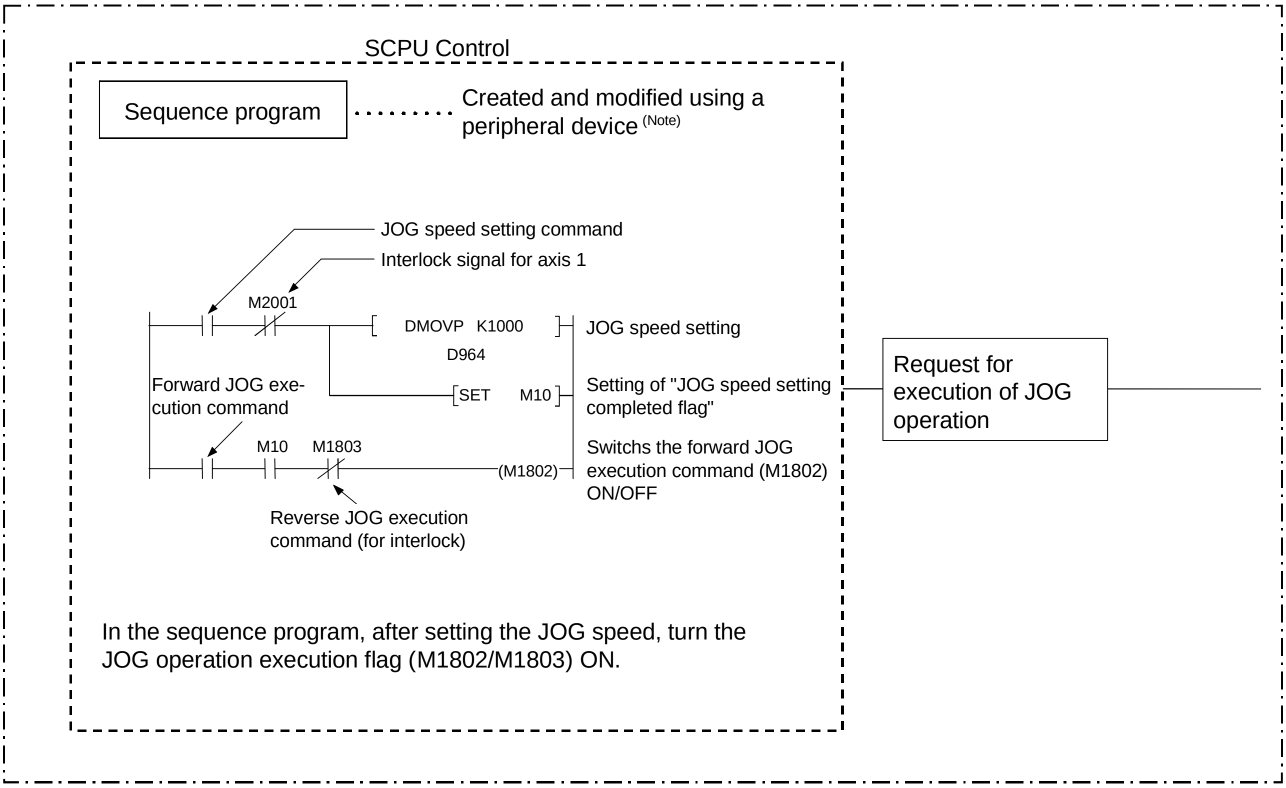
[Executing JOG Operation with a Servo System CPU]

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.

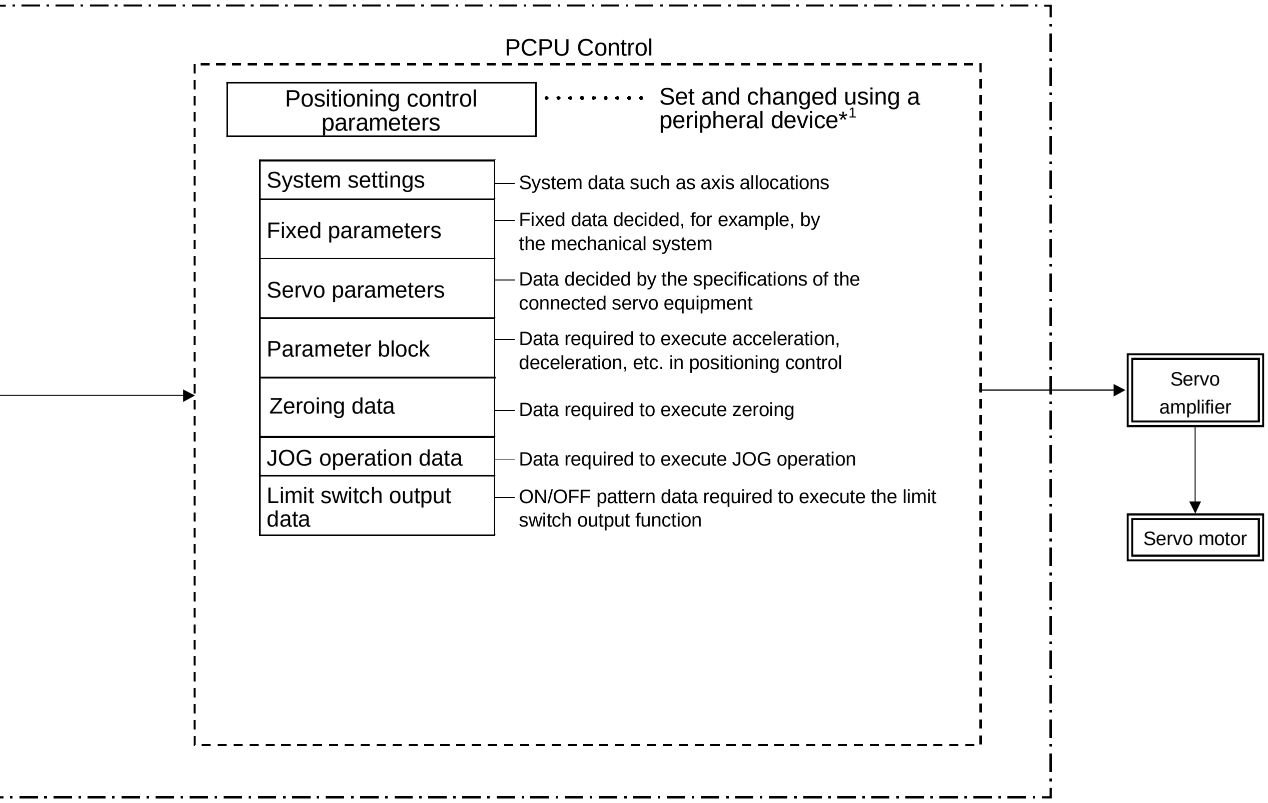
Servo System CPU System



(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 flag is kept ON by the sequence program.



REMARK

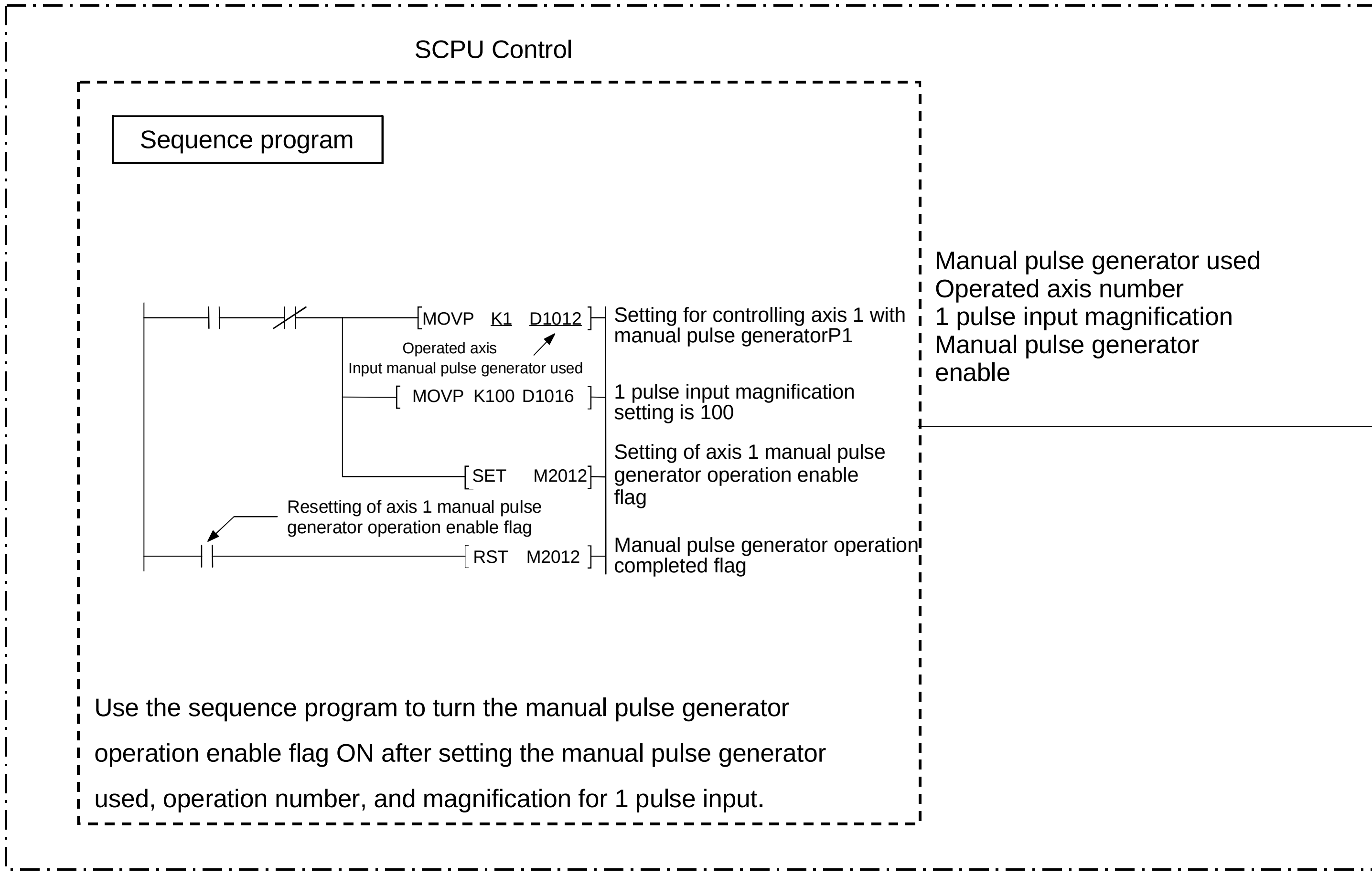
(Note): Any of the following peripheral devices, running the GSV13PE/GSV22PE software, can be used.

- IBM PC

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

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

Servo System CPU System

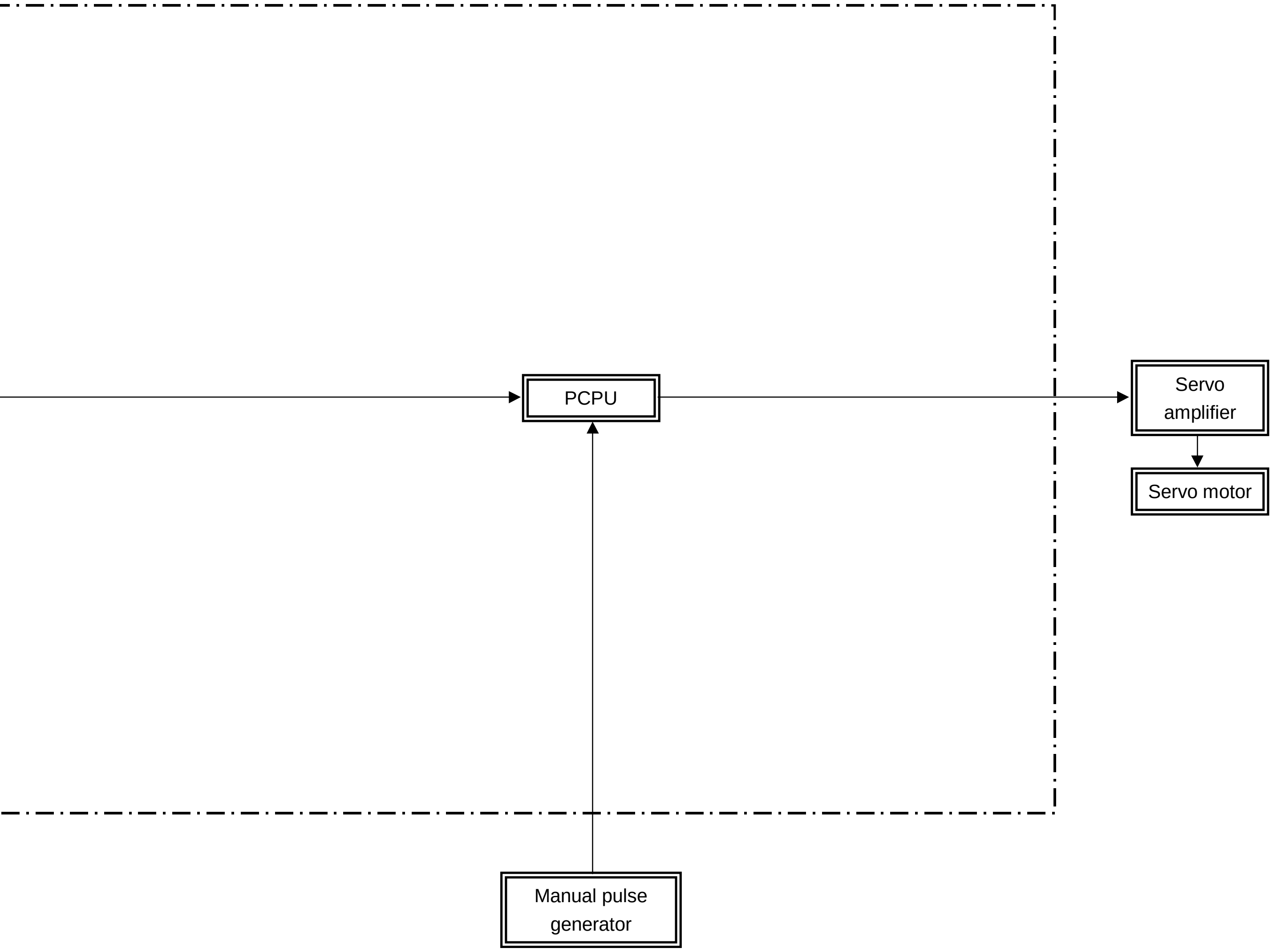


(1) Set the manual pulse generator used, operated axis number, and magnification for 1 pulse input by using the sequence program.

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

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

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


PCPU
Servo
amplifier
Servo motor
Manual pulse
generator

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

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

(2) Servo program
A servo program is a program for executing positioning control and is run in response to a start request from the sequence program.
It comprises a program number, servo instructions, and positioning data.
For details, see Chapter 6.

- Program No. .... This number is designated in the sequence program.
- Servo instruction .... This instruction indicates the type of positioning control to be executed.
- Positioning data .... This data is required to execute servo instructions. The data required is fixed for each servo instruction.

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

2. PERFORMANCE SPECIFICATIONS

2.1 SCPU Performance Specifications

Table 2.1 gives the performance specifications of the SCPU.

Table 2.1 SCPU Performance Specifications

<table>
<tr><th colspan="3">Item</th><th>A172SHCPUN</th><th>A171SHCPUN</th></tr>
<tr><td colspan="3">Control method</td><td colspan="2">Stored program repeated operation</td></tr>
<tr><td colspan="3">I/O control method</td><td colspan="2">Refresh method/direct method (selectable)</td></tr>
<tr><td colspan="3">Programming language</td><td colspan="2">Sequence control dedicated language
(Relay symbol language, logic symbol language, MELSAP II (SFC))</td></tr>
<tr><td colspan="2" rowspan="5">Number of instructions</td><td>Sequence instructions</td><td colspan="2">26</td></tr>
<tr><td>Basic instructions</td><td colspan="2">131</td></tr>
<tr><td>Applied instructions</td><td colspan="2">102</td></tr>
<tr><td>Special dedicated instructions</td><td colspan="2">12</td></tr>
<tr><td>Motion dedicated instructions</td><td colspan="2">6</td></tr>
<tr><td colspan="2" rowspan="2">Processing speed (μs)
(Sequence instruction)</td><td>Direct method</td><td colspan="2">0.25 to 1.9 μs/step</td></tr>
<tr><td>Refresh method</td><td colspan="2">0.25 μs/step</td></tr>
<tr><td colspan="3">Number of I/O points</td><td colspan="2">2048 (X/Y0 to X/Y7FF)</td></tr>
<tr><td colspan="3">Number of real I/O points</td><td>1024 (X/Y0 to X/Y3FF)</td><td>512 (X/Y0 to X/Y1FF)</td></tr>
<tr><td colspan="3">Watchdog timer (WDT)</td><td colspan="2">10 to 2000ms</td></tr>
<tr><td colspan="3">Memory size (internal RAM)</td><td>192 kbytes</td><td>64 kbytes</td></tr>
<tr><td colspan="2" rowspan="3">Program capacity</td><td>Main sequence program</td><td>Max. 30 k steps</td><td>Max. 14 k steps</td></tr>
<tr><td>Sub-sequence program</td><td>None</td><td>None</td></tr>
<tr><td>Micro computer program</td><td>Max. 58 kbytes</td><td>Max. 26 kbytes</td></tr>
<tr><td rowspan="21">Device</td><td colspan="2">No. of internal relays (M) (Note-1)</td><td>1000 (M0 to M999)</td><td rowspan="3">Total 2048 points common to
M, L, S
(set with parameters)</td></tr>
<tr><td colspan="2">No. of latch relays (L)</td><td>1048 points (M1000 to M2047)</td></tr>
<tr><td colspan="2">No. of step relays (S)</td><td>0 point (none at initial status)</td></tr>
<tr><td colspan="2">No. of link relays (B)</td><td colspan="2">1024 points (B0 to B3FF)</td></tr>
<tr><td rowspan="3">Timers (T)</td><td>Points</td><td colspan="2">256 points</td></tr>
<tr><td>Specifications</td><td colspan="2"><table><tr><th></th><th>Time setting</th><th>Device</th></tr><tr><td>100 ms timer</td><td>0.1 to 3276.7s</td><td>T0 to T199</td></tr><tr><td>10 ms timer</td><td>0.01 to 327.67s</td><td>T200 to T255</td></tr><tr><td>100 ms elapsed time indicator</td><td>0.1 to 3276.7s</td><td>none at initial status</td></tr></table></td></tr>
<tr><td></td><td colspan="2">Set with parameters</td></tr>
<tr><td rowspan="3">Counters (C)</td><td>Points</td><td colspan="2">256 points</td></tr>
<tr><td>Specifications</td><td colspan="2"><table><tr><th></th><th>Setting range</th><th>Device</th></tr><tr><td>Normal counter</td><td>1 to 32767</td><td>C0 to C255</td></tr><tr><td>Interrupt program counter</td><td>1 to 32767</td><td>none at initial status</td></tr></table></td></tr>
<tr><td></td><td colspan="2">Set with parameters</td></tr>
<tr><td colspan="2">No. of data registers (D) (Note-1)</td><td colspan="2">1024 points (D0 to D1023)</td></tr>
<tr><td colspan="2">No. of link registers (W)</td><td colspan="2">1024 points (W0 to W3FF)</td></tr>
<tr><td colspan="2">No. of annunciators (F)</td><td colspan="2">256 points (F0 to F255)</td></tr>
<tr><td colspan="2">No. of file registers (R)</td><td colspan="2">Max. 8192 points (R0 to R8191) (set with parameters)</td></tr>
<tr><td colspan="2">No. of accumulators (A)</td><td colspan="2">2 points (A0, A1)</td></tr>
<tr><td colspan="2">No. of index registers (V, Z)</td><td colspan="2">2 points (V, Z)</td></tr>
<tr><td colspan="2">No. of pointers (P)</td><td colspan="2">256 points (P0 to P255)</td></tr>
<tr><td colspan="2">No. of interrupt pointers (I)</td><td colspan="2">32 points (I0 to I31)</td></tr>
<tr><td colspan="2">No. of special-function relays (M)</td><td colspan="2">256 points (M9000 to M9255)</td></tr>
</table>

Table 2.1 SCPU Performance Specifications (Continued)

Item	A172SHCPUN	A171SHCPUN
No. of special-function registers (D)	256 points (D9000 to D9255)	
No. of expansion file register block	Max. 11 blocks (set by memory capacity)	Max. 3 blocks (set by memory capacity)
No. of comments	Max. 4032 (64 kbytes), 1 point = 16 bytes (Set in 64-point unit)	
Number of expansion comments (Note-2)	Max. 3968 points (63 kbytes), 1 point = 16 bytes (Set in 64-point unit)	
Self-diagnostic function	Watchdog error monitoring, memory/CPU/input/output/battery, etc. error detection	
Operation mode on error	Select stop/continue	
Output mode selection when switching from STOP to RUN	Select re-output operation status before STOP (default) or output after operation execution.	
Clock function	Year, month, day, hour, minute, day of the week (leap year automatic distinction)	
Program/parameter storage in ROM	Not possible	

(Note-1) : Range of positioning dedicated devices differs depending on the OS. For details, see Chapter 3.
(Note-2) : The expansion comments are not stored in the internal memory of the CPU.

2.2 PCPU Performance Specifications

Table 2.2 PCPU Performance Specifications

<table>
<tr><th colspan="2">Item</th><th>A172SHCPUN</th><th>A171SHCPUN</th></tr>
<tr><td colspan="2">Number of control axes</td><td>8 axes (simultaneous: 2 to 4 axes, independent: 8 axes)</td><td>4 axes (simultaneous: 2 to 4 axes, independent: 4 axes)</td></tr>
<tr><td colspan="2">Interpolation functions</td><td colspan="2">Linear interpolation (4 axes max.), circular interpolation (2 axes)</td></tr>
<tr><td colspan="2">Control modes</td><td colspan="2">PTP(point to point), speed control, speed/position control, fixed-pitch feed, constant speed control, position follow-up control, speed switching control, high-speed oscillation control</td></tr>
<tr><td colspan="2">Control units</td><td colspan="2">mm • inch • degree • PULSE</td></tr>
<tr><td colspan="2">Programming language</td><td colspan="2">Dedicated instructions (sequence ladders + servo programs)
* SFC programming of servo programs is also possible.</td></tr>
<tr><td rowspan="3">Servo program</td><td>Capacity</td><td colspan="2">13k steps (13312 steps)</td></tr>
<tr><td rowspan="2">Number of points for positioning</td><td>Approx. 400 points/axis</td><td>Approx. 800 points/axis</td></tr>
<tr><td colspan="2">(These values vary depending on the programs. Positioning data can be designated indirectly.)</td></tr>
<tr><td colspan="2">Program setting method</td><td colspan="2">Setting with an IBM PC A30TU-E/A31TU-E (SV13 only), running the GSV[ ][ ]P software</td></tr>
<tr><td rowspan="3">Positioning</td><td>Method</td><td colspan="2">PTP : Selection of absolute data method or incremental method
Speed/positioning control, fixed-pitch feed : Incremental method
Constant speed control, speed switching control : The absolute method and incremental method can be used together
Position follow-up control : Absolute data method</td></tr>
<tr><td>Position commands</td><td colspan="2">Commands can be selected for each axis.<table>
<tr><th>Control Unit</th><th>Command Unit</th><th>Address Setting Range</th><th>Travel Value Setting Range</th></tr>
<tr><td>mm</td><td>$\times 10^{-1}$ μm</td><td rowspan="2">–2147483648 to 2147483647</td><td rowspan="4">0 to ±2147483647</td></tr>
<tr><td>inch</td><td>$\times 10^{-5}$ inch</td></tr>
<tr><td>degree</td><td>$\times 10^{-5}$ degree</td><td>0 to 35999999</td></tr>
<tr><td>PULSE</td><td>× 1 PULSE</td><td>–2147483648 to 2147483647</td></tr>
</table></td></tr>
<tr><td>Speed command (command unit)</td><td colspan="2"><table>
<tr><th>Control Unit</th><th colspan="2">Speed Setting range</th></tr>
<tr><td>mm</td><td>0.01 to 6000000.00</td><td>(mm/min)</td></tr>
<tr><td>inch</td><td>0.001 to 600000.00</td><td>(inch/min)</td></tr>
<tr><td>degree</td><td>0.001 to 2147483.647</td><td>(degree/min) (Note)</td></tr>
<tr><td>PULSE</td><td>1 to 10000000</td><td>(PLS/s) (Note)</td></tr>
</table></td></tr>
<tr><td rowspan="2">Acceleration/ deceleration control</td><td>Automatic trapezoidal acceleration/ deceleration</td><td colspan="2"><table>
<tr><th>Acceleration-fixed acceleration/deceleration</th><th>Time-fixed acceleration/deceleration</th></tr>
<tr><td>Acceleration time: 1 to 65535ms
Deceleration time: 1 to 65535ms</td><td>Acceleration/deceleration time: 1 to 5000ms
(Only constant speed control is possible.)</td></tr>
</table></td></tr>
<tr><td>S-curve acceleration/ deceleration</td><td colspan="2">S-curve ratio setting: 0 to 100%</td></tr>
<tr><td rowspan="2">Compensation</td><td>Backlash compensation</td><td colspan="2">(0 to 65535) × position command unit (units converted to PULSES: 0 to 65535 PLS)</td></tr>
<tr><td>Electronic gear</td><td colspan="2">Compensation function for error in actual travel value with respect to command value</td></tr>
<tr><td colspan="2">Zeroing function</td><td colspan="2">When an absolute position system is not used : Selection of proximity dog type or count type
When an absolute position system is used : Selection of data set type, proximity dog type or count type</td></tr>
<tr><td colspan="2">JOG operation function</td><td colspan="2">Provided</td></tr>
</table>

Table 2.2 PCPU Performance Specifications (Continued)

Item		A172SHCPUN	A171SHCPUN
Manual pulse generator operation function		A maximum of one manual pulse generator can be connected. A maximum of three manual pulse generators can be operated. Setting of magnification: 1 to 100. It is possible to set the smoothing magnification.	
M-function		M-code output function provided M-code completion wait function provided	
Skip function		Provided	
Limit switch output function		Number of output points	8 point/axis
		Number of ON/OFF setting points	10 points/axis
High-speed reading of designated data	Number of input points	Max. 9 points (TRA input of A172SENC (1 point) + one motion slot PLC input module (8 points))	
	Data latch timing	At leading edge of the TRA input signal Within 0.8ms of the signal leading edge for the PLC input module	
Absolute position system		Made compatible by fitting battery to servo amplifier. (Possible to select the absolute data method or incremental method for each axis)	

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

2.3 Differences between A172SHCPUN/A171SHCPUN and A171S(S3)

	Item		A172SHCPUN	A171SHCPUN	A171SCPU(S3)
Motion	Number of control axes		8 axes	4 axes	4 axes
Motion	Computing frequency		3.5ms/1 to 8 axes	3.5ms/1 to 4 axes	SV13: 3.5 ms/1 to 3 axes 7.1 ms/4 axes
PLC	PLC CPU		Equivalent to reinforced I/O memory of A2SHCPU	Equivalent to A2SHCPU	Equivalent to A1SCPU
PLC	Processing speed (µs) (Sequence instruction)	Direct method	0.25 to 1.9 µs/step		1.0 to 2.3 µs/step
PLC		Refresh method	0.25 µs/step		1.0 µs/step
PLC	No. of I/O		2048 I/O		——
PLC	No. of actual I/O		1024 I/O	512 I/O	256 I/O
PLC	Memory capacity (built-in RAM)		192 kbytes (Equivalent to A3NMCA24)	64 kbytes (Equivalent to A3NMCA8)	32 kbytes
PLC	Program capacity (main sequence)		Max. 30 k step	Max. 14 k step	Max. 8 k step
PLC	No. of file register (R)		Max. 8192 points		Max. 4096 points
PLC	No. of expansion file register blocks (Note)		Max. 7 blocks	Max. 3 blocks	None
PLC	MELSECNET/J		○ (Supported by special commands)		○ (By means of FROM/TO commands)
PLC	Number of PLC extension base unit		Max. one		Max. one
System configuration	Manual pulse generator synchronous encoder interface module		A172SENC (Corresponding to external signal input 8-axes)		A171SENC (Corresponding to external signal input 4-axes)
System configuration	No. of SSCNET I/F		2CH. SSCNET1 .... For connection of servo amplifier SSCNET2 .... For personal computer link dedicated		A171S : 1CH. A171S-S3 : 2CH. (as given to the left)
System configuration	No. of available A271DVP		Unavailable		Max. two
System configuration	Teaching unit (OS with teaching function)	A30TU-E	○		○
System configuration		A31TU-E	○ (with deadman switch)		×
Compatibility	Sequence program, parameter		After starting A172SH/A171SH and reading a file, those created by A171SCPU can be used as it is.		
Compatibility	Servo program				
Compatibility	Mechanical system program (SV22)				
Compatibility	Parameter				
Compatibility	System setting		By making sure of system setting screen after being started up by A172SH/A171SH and reading a file, changeover below is carried out: now the system is ready for operation. A171SCPU → A172SH/A171SHCPUN A171SENC → A172SENC		
Additional functions	Support of high-resolution encoder (32768PLS/131072PLS)		○		×
Additional functions	A torque limit value can be changed from a sequence program (GHGT instruction addition).	Real Mode	○		×
Additional functions	Retracing during positioning		○		×

(Note): No. of expansion file register blocks varies depending on the setting of program capacity, No. of file registers, and No. of comments.

3. POSITIONING SIGNALS

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

(1) Internal signals
Of the devices available in the servo system CPU, the following four types are used for the internal signals of the servo system CPU.
- Internal relay (M).............................. M1600 to M2047 (148 points)
- Special relay (SP.M) .... M9073 to M9079 (7 points)
- Data register (D) .... D800 to D1023 (224 points)
- Special register (SP.D) .... D9180 to D9199 (20 points)

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

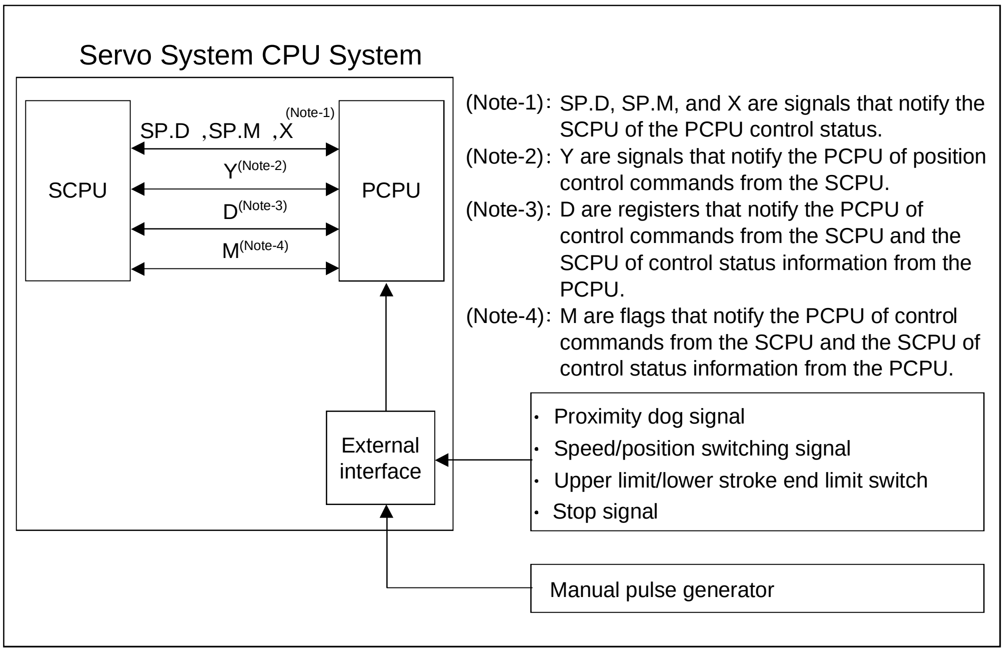


Fig. 3.1 Flow of Positioning Signals

POINTS

When the monitor data (machine values, actual current values, deviation counter, etc.) stored in the data registers (D) are used for magnitude comparison or four function arithmetic, they must be transferred to another device memory once and then processed.
For transfer, refer to "Appendix-4.5".

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

3.1 Internal Relays

(1) List of internal relays

A172SHCPUN(SV13)

Device No.	Purpose
M0	User device (1600 points)
M1600	Axis status (20 points×8 axes)
M1760	Unusable (40 points)
M1800	Axis command signal (20 points×8 axes)
M1960	Common device (88 points)
M2000	
M2047	

A171SHCPUN(SV13)

Device No.	Purpose
M0	User device (1600 points)
M1600	Axis status (20 points×4 axes)
M1680	Unusable (120 points)
M1800	Axis command signal (20 points×4 axes)
M1880	Unusable (40 points)
M1960	Common device (88 points)
M2000	
M2047	

A172SHCPUN
(SV22 VIRTUAL mode)

Device No.	Purpose
M0	User device (1360 points)
M1360	Synchronous encoder axis status (4 points×1 axis)
M1364	User device (236 points)
M1600	Axis status (20points×8 axes)
M1760	Unusable (40 points)
M1800	Axis command signal (20 points×8 axes)
M1960	Common device (88 points)
M2000	
M2047	

A171SHCPUN
(SV22 VIRTUAL mode)

Device No.	Purpose
M0	User device (1360 points)
M1360	Synchronous encoder axis status (4 points×1 axis)
M1364	User device (236 points)
M1600	Axis status (20points×4axes)
M1680	Unusable (120 points)
M1800	Axis command signal (20 points×4 axes)
M1880	Unusable (40 points)
M1960	Common device (88 points)
M2000	
M2047	

POINTS

- Total Number of User Device Points

	SV13	SV Real mode
A172SHCPUN	1600 points	1596 poitns
A171SHCPUN	1600 points	1596 points

(1) Internal relays for positioning control are not latched even inside the latch range.
In this manual, in order to indicate that internal relays for positioning control are not latched, the expression used in this text is "M1600 to M1999".

(2) Internal relays for positioning control are monitored from peripheral devices as shown below.
(a) When peripheral devices are started with GSV13P/GSV22P, positioning control internal relays within a latch range are indicated by L1600 to L1999.

(2) Axis status

Axis No.	A172SHCPUN Device Number	A171SHCPUN Device Number	Signal Name
1	M1600 to M1619	M1600 to M1619	
2	M1620 to M1639	M1620 to M1639	
3	M1640 to M1659	M1640 to M1659	
4	M1660 to M1679	M1660 to M1679	
5	M1680 to M1699		
6	M1700 to M1719		
7	M1720 to M1739		
8	M1740 to M1759		

	Signal Name	Signal Direction	Refresh Cycle	Fetch Cycle
0	Positioning start completed	SCPU ← PCPU	3.5ms	
1	Positioning completed			
2	In-position			
3	Command in-position			
4	Speed control in progress			
5	Speed/position switching latch			
6	Zero pass			
7	Error detection		Immediately	
8	Servo error detection		3.5ms	
9	Zeroing request		10ms	
10	Zeroing completed		3.5ms	
11	External signal FLS		10ms	
12	External signal RLS			
13	External signal STOP			
14	External signal DOG/CHANGE			
15	Servo ON/OFF		3.5ms	
16	Torque control in progress			
17	Unusable		——	
18	Unusable		——	
19	M-code output in progress		3.5ms	

(3) Axis command signals

Axis No.	A172SHCPUN Device Number	A171SHCPUN Device Number	Signal Name
1	M1800 to M1819	M1800 to M1819	
2	M1820 to M1839	M1820 to M1839	
3	M1840 to M1859	M1840 to M1859	
4	M1860 to M1879	M1860 to M1879	
5	M1880 to M1899		
6	M1900 to M1919		
7	M1920 to M1939		
8	M1940 to M1959		

	Signal Name	Signal Direction	Refresh Cycle	Fetch Cycle
0	Stop command	SCPU → PCPU		3.5ms
1	Rapid stop command			
2	Forward JOG start			10ms
3	Reverse JOG start			
4	End signal OFF command			
5	Speed/position switching enabled			3.5ms
6	Limit switch output enable			
7	Error reset			10ms
8	Servo error reset			
9	External STOP input valid/invalid when starting			Start timing
10	Unusable			——
11	Unusable			
12	Feed current value update request command			Start timing
13	Unusable			——
14	Unusable			
15	Servo OFF			3.5ms
16	Unusable			——
17	Unusable			
18	Unusable			
19	FIN signal			3.5ms

(4) Common devices

A172SHCPUN

Device Number	Signal Name		Signal Direction	Refresh Cycle	Fetch Cycle
M1960	Unusable (40 points)			——	——
M1961					
M1962					
M1963					
M1964					
M1965					
M1966					
M1967					
M1968					
M1969					
M1970					
M1971					
M1972					
M1973					
M1974					
M1975					
M1976					
M1977					
M1978					
M1979					
M1980					
M1981					
M1982					
M1983					
M1984					
M1985					
M1986					
M1987					
M1988					
M1989					
M1990					
M1991					
M1992					
M1993					
M1994					
M1995					
M1996					
M1997					
M1998					
M1999					
M2000	PLC READY flag		SCPU→PCPU		10ms
M2001	Axis 1	START accept flag (8 points)	SCPU←PCPU	10ms	
M2002	Axis 2				
M2003	Axis 3				
M2004	Axis 4				
M2005	Axis 5				
M2006	Axis 6				
M2007	Axis 7				
M2008	Axis 8				
M2009	All-axes servo ON accept flag				
M2010	Unusable (2 points)			——	——
M2011					
M2012	Manual pulse generator enable flag		SCPU→PCPU		10ms
M2013	Unusable (2 points)			——	——
M2014					
M2015	JOG simultaneous start command		SCPU→PCPU		10ms
M2016	CPU completion point setting				Start timing
M2017	Unusable (3 points)			——	——
M2018					
M2019					
M2020	Start buffer full		SCPU←PCPU	END	
M2021	Axis 1	Speed change flag (8 points)			
M2022	Axis 2				
M2023	Axis 3				
M2024	Axis 4				
M2025	Axis 5				
M2026	Axis 6				
M2027	Axis 7				
M2028	Axis 8				
M2029	Unusable (5 points)			——	——
M2030					
M2031					
M2032					
M2033					
M2034	PC link communication error flag		SCPU←PCPU	END	
M2035	Unusable (6 points)			——	——
M2036					
M2037					
M2038					
M2039					
M2040					
M2041	System setting error flag		SCPU←PCPU	END	
M2042	All-axes servo ON command		SCPU→PCPU		3.5ms
M2043	Unusable (4 points)			——	——
M2044					
M2045					
M2046					
M2047	Motion slot module error detection flag		SCPU←PCPU	END	

A172SHCPUN

Device Number	Signal Name		Signal Direction	Refresh Cycle	Fetch Cycle
M1960	Unusable (40 points)			——	——
M1961					
M1962					
M1963					
M1964					
M1965					
M1966					
M1967					
M1968					
M1969					
M1970					
M1971					
M1972					
M1973					
M1974					
M1975					
M1976					
M1977					
M1978					
M1979					
M1980					
M1981					
M1982					
M1983					
M1984					
M1985					
M1986					
M1987					
M1988					
M1989					
M1990					
M1991					
M1992					
M1993					
M1994					
M1995					
M1996					
M1997					
M1998					
M1999					
M2000	PLC READY flag		SCPU→PCPU		10ms
M2001	Axis 1	START accept flag (4 points)	SCPU←PCPU	10ms	
M2002	Axis 2				
M2003	Axis 3				
M2004	Axis 4				
M2005	Unusable (4 points)			——	——
M2006					
M2007					
M2008					
M2009	All-axes servo ON accept flag		SCPU←PCPU	10ms	
M2010	Unusable (2 points)			——	——
M2011					
M2012	Manual pulse generator enable flag		SCPU→PCPU		10ms
M2013	Unusable (2 points)			——	——
M2014					
M2015	JOG simultaneous start command		SCPU→PCPU		10ms
M2016	CPU completion point setting				Start timing
M2017	Unusable (3 points)			——	——
M2018					
M2019					
M2020	Start buffer full		SCPU←PCPU	END	
M2021	Axis 1	Speed change flag (4 points)			
M2022	Axis 2				
M2023	Axis 3				
M2024	Axis 4				
M2025	Unusable (9 points)			——	——
M2026					
M2027					
M2028					
M2029					
M2030					
M2031					
M2032					
M2033					
M2034	PC link communication error flag		SCPU←PCPU	END	
M2035	Unusable (6 points)			——	——
M2036					
M2037					
M2038					
M2039					
M2040					
M2041	System setting error flag		SCPU←PCPU	END	
M2042	All-axes servo ON command		SCPU→PCPU		3.5ms
M2043	Unusable (4 points)			——	——
M2044					
M2045					
M2046					
M2047	Motion slot module error detection flag		SCPU←PCPU	END	

* The entry "END" in the Refresh Cycle column indicates 80ms or a longer sequence program scan time.

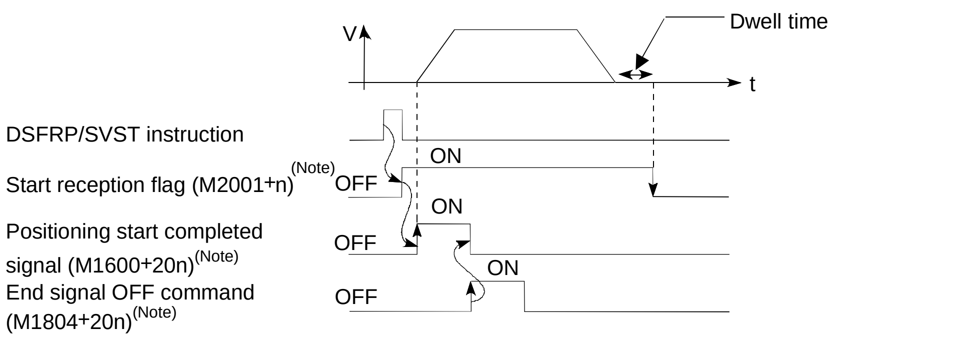
3.1.1 Axis status

(1) Positioning start completed signal (M1600+20n)

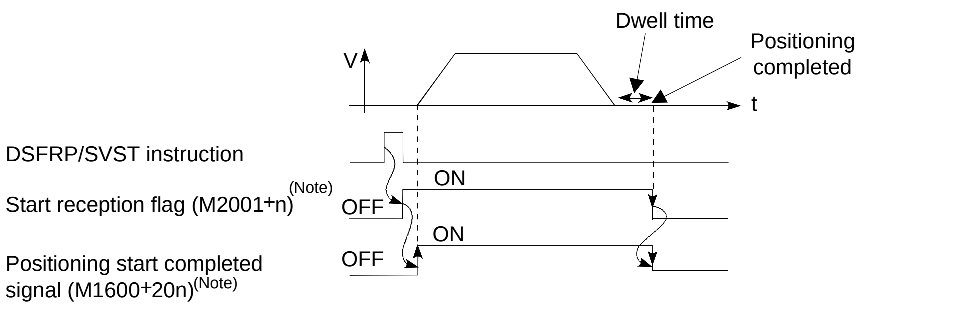
(a) This signal comes ON when starting of positioning control of the axis designated by the DSFRP/SVST instruction in the sequence program is completed.
It does not come ON when positioning control starts due to a zeroing, JOG operation or manual pulse generator operation.
It can be used, for example,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

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

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



When positioning is completed



REMARK

(Note) :In the preceding descriptions, "n" in M2001+n, M1600+20n, M1804+20n, etc. indicates a value for each axis No. in the following tables.

<When A172SHCPUN is used>

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

<When A171SHCPUN is used>

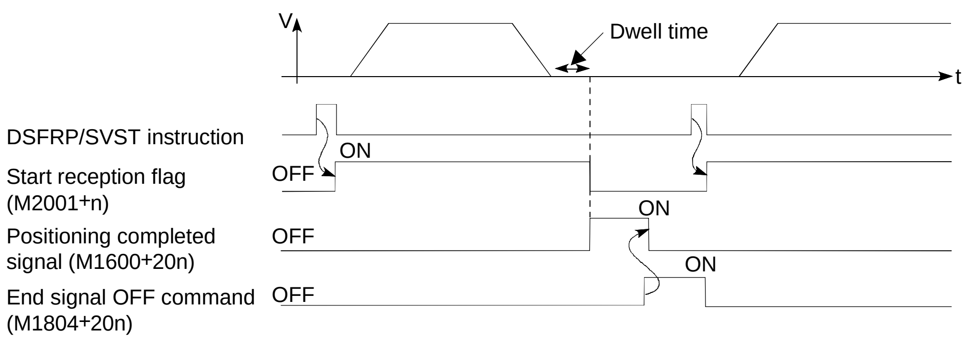
Axis No.	n
1	0
2	1
3	2
4	3

(2) Positioning completed signal (M1601+20n)

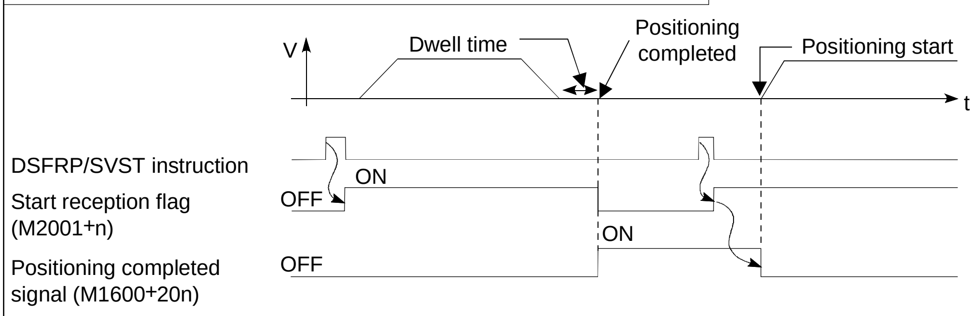
(a) This signal comes ON when positioning control of the axis designated by the DSFRP/SVST instruction in the sequence program is completed.
It does not come ON when positioning control is started, or stopped part way through, due to a zeroing, JOG operation, manual pulse generator operation, or speed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

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

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

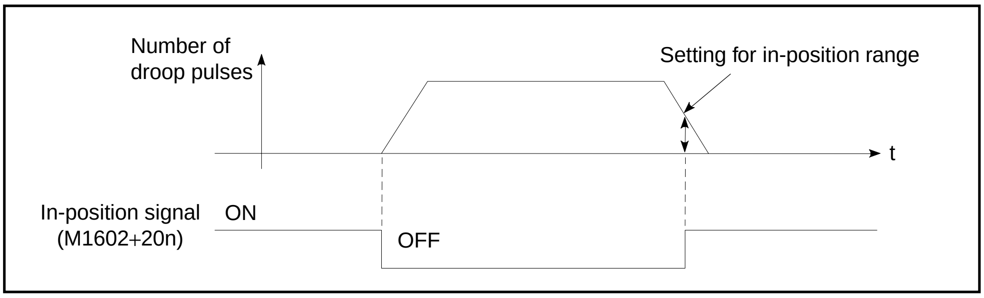


When the next positioning control start is completed



(3) In-position signal (M1602+20n)

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

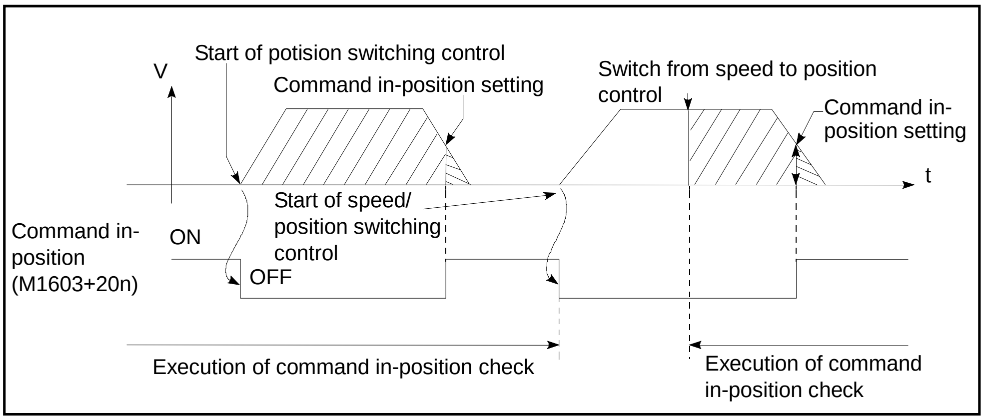


(b) An in-position check is performed in the following cases.
- When the servo power supply is switched on
- After automatic acceleration/deceleration is started during positioning control
- After deceleration is started as a result of the JOG start signal going OFF
- When manual pulse generator operation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

(4) Command in-position signal (M1603+20n)

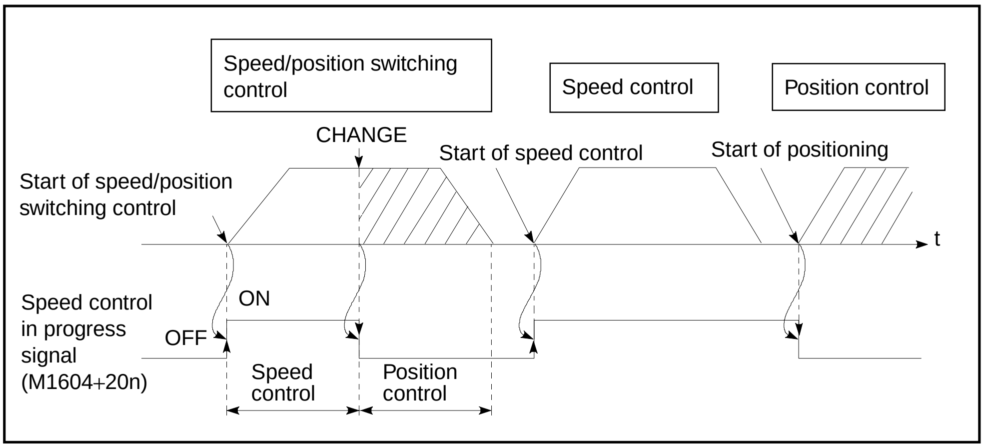
(a) The command in-position signal comes ON when the absolute value of the difference between the command position and the feed current value enters the "command in-position range" set in the fixed parameters.
It goes OFF in the following cases.
- When positioning control starts
- When a zeroing is executed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

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



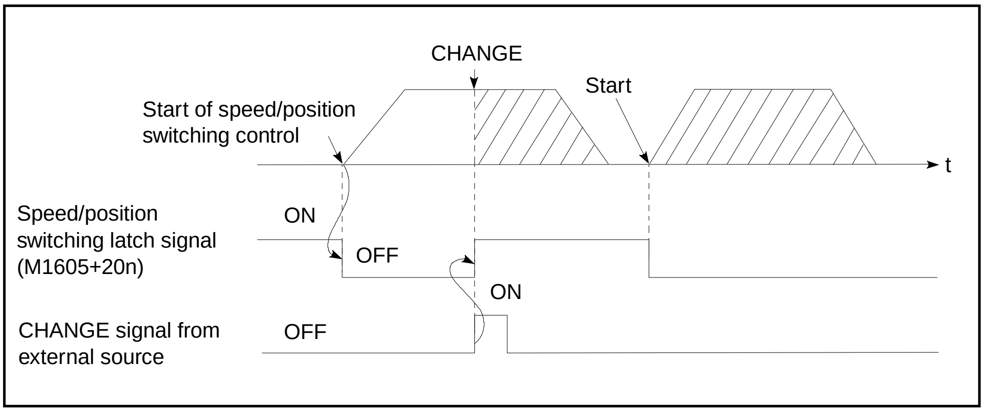
(5) Speed control in progress signal (M1604+20n)
   (a) The speed control in progress signal is ON during speed control and is used to determine whether speed control or position control is currently being executed.
   In speed/position switching control, it remains ON until the switch from speed control to position control is executed on receipt of the CHANGE signal from an external source.

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



(6) Speed/position switching latch signal (M1605+20n)
   (a) The speed/position switching latch signal comes ON when control is switched from speed control to position control.
   It can be used as an interlock signal to enable or disable changing of the travel value in position control.

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

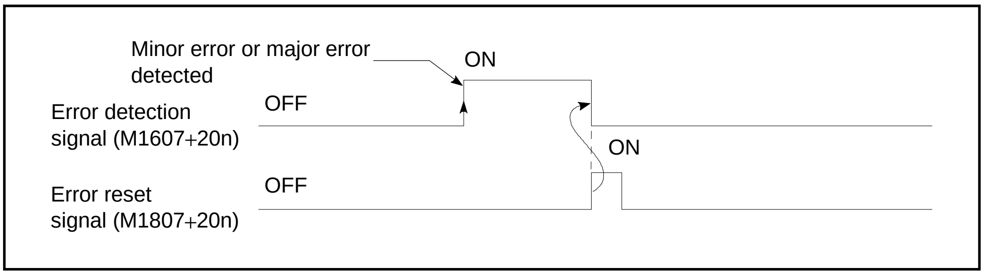


(7) Zero pass signal (M1606+20n)
   This signal comes ON when the zero point is passed after the power to the servo amplifier has been switched ON.
   Once the zero point has been passed, the signal remains ON until the CPU has been reset.
   In the zeroing method of proximity dog or count type, howver, the signal goes OFF once at the start of zeroing and comes ON again when the next zero point is passed.

(8) Error detection signal (M1607+20n)

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

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



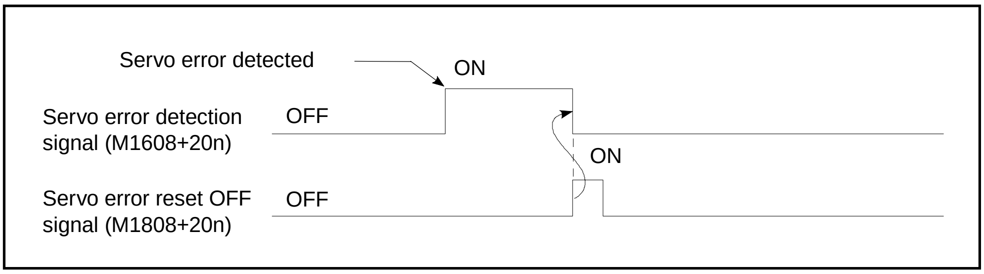
REMARKS

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

(9) Servo error detection signal (M1608+20n)

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

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



REMARK

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

(10) Zeroing request signal (M1609+20n)
This signal comes ON when it is necessary to confirm the home position address when the power is switched on or during positioning control.

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

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

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

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

(11) Zeroing completed signal (M1610+20n)
(a) The zeroing completed signal comes ON when the execution of zeroing operation in accordance with a servo program has been completed normally.

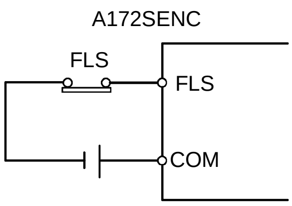
(b) It goes OFF when positioning is started, when JOG operation is started, or when manual pulse generator operation is started.

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

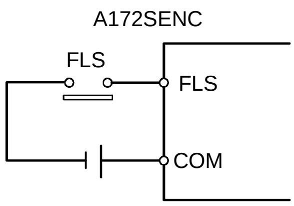
(12) FLS signal (M1611+20n)
(a) FLS signal is controlled by the ON/OFF status of the upper stroke end limit switch input (FLS) to the A172SENC from an external source.
- Upper stroke end limit switch input OFF ...... FLS signal: ON
- Upper stroke end limit switch input ON .... FLS signal: OFF

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

FLS signal: ON



FLS signal: OFF



(13) RLS signal (M1612+20n)

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

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

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

(14) STOP signal (M1613+20n)

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

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

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

(15) DOG/CHANGE signal (M1614+20n)

(a) The DOG signal is set to ON/OFF by proximity dog signal input (DOG) to the A172SENC during zeroing.
The CHANGE signal is set to ON/OFF by speed/position switching signal input (CHANGE) during speed/position switching control.

(b) A contact input or B contact input can be selected by system setting.

(16) Servo READY signal (M1615+20n)

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

(b) The signal goes OFF in the following cases.

- When M2042 is OFF
- When no servo amplifier is installed
- When the servo parameters have not been set
- When the power supply module has received an emergency stop input from an external source
- When the M1815+20n signal comes ON and establishes the servo OFF status
- When a servo error occurs
  For details, see Appendix 2.4 "Servo Errors"

POINT
When an axis driven by an MR-[ ]-B becomes subject to a servo error, the affected axis only goes into the servo OFF status.

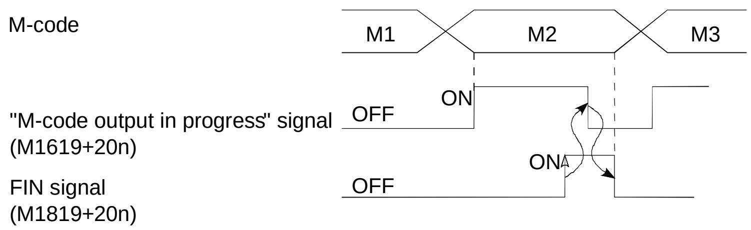
(17) Torque control in progress signal (M1616+20n)

Signals for axes whose torque is being controlled are ON.

(18) M-code output signal (M1619+20n)

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

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

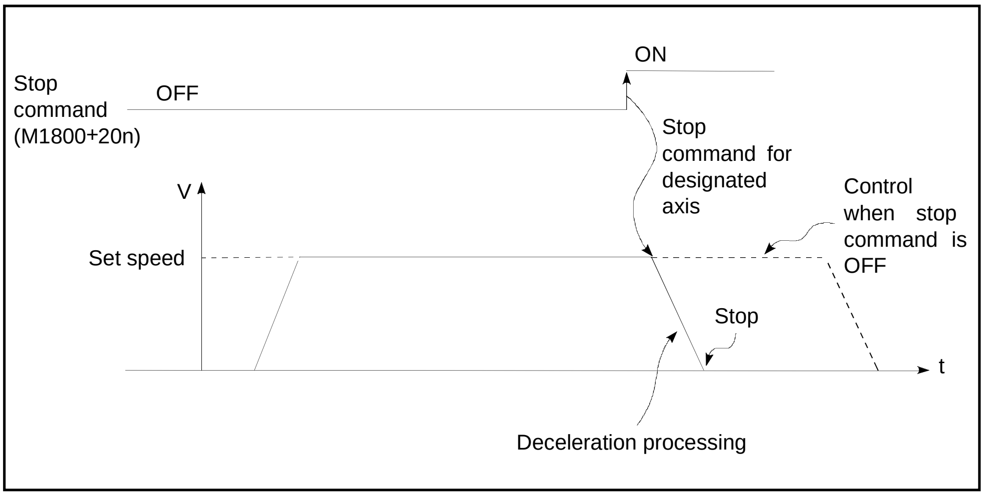


POINTS
(1) The FIN signal and "M-code output in progress" signal are both for the FIN signal wait function. (2) The FIN signal and "M-code output in progress" signal are effective only when FIN acceleration/deceleration is designated in the servo program. Otherwise, the FIN signal wait function is disabled,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

3.1.2 Axis command signals

(1) Stop command (M1800+20n)

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



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

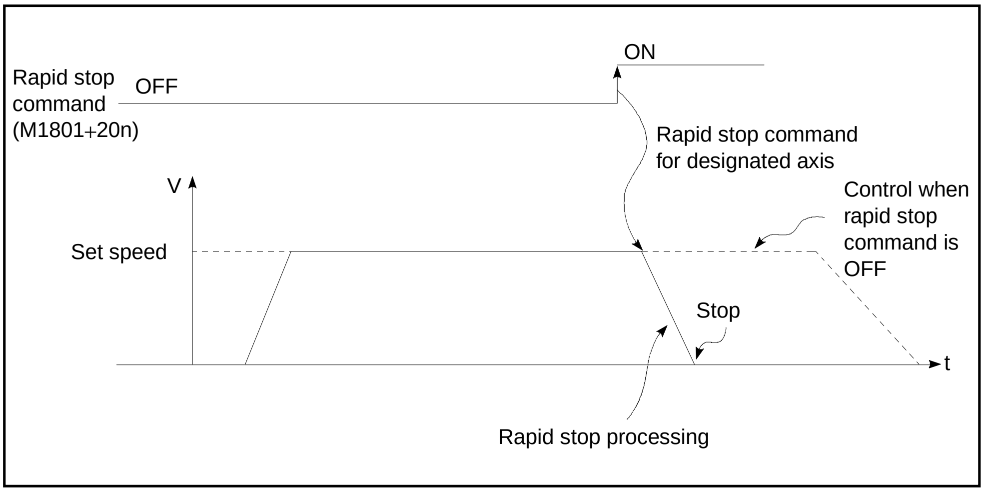
Control Being Executed	Processing when the Stop Command Comes ON: If Control is Being Executed	Processing when the Stop Command Comes ON: If Deceleration Stop Processing is Being Executed
Position control Speed control (I, II) JOG operation	The axis decelerates to a stop in the deceleration time set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

(2) Rapid stop command (M1801+20n)

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



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

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

POINT

If a stop is executed by turning ON the rapid stop command (M1801+20n) during a zeroing operation, re-execute the zeroing operation. If the rapid stop command came ON after the proximity dog came ON in the zeroing operation, first retract to a position before the point where the proximity dog comes ON using JOG operation or positioning, and then execute the zeroing operation again.

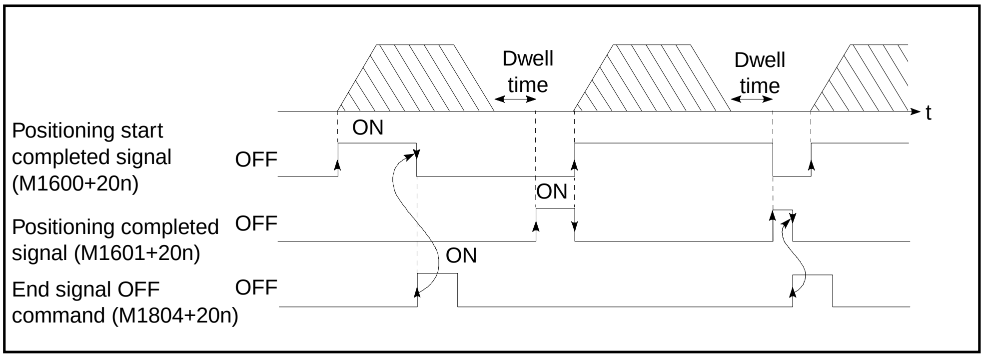
(3) Forward JOG start command (M1802+20n)/Reverse JOG start command (M1803+20n)
(a) While the sequence program keeps M1802+20n ON, JOG operation is executed in the direction in which address numbers increase. When M1802+20n is turned OFF, a deceleration stop is executed in the deceleration time set in the parameter block.

(b) 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) and the reverse JOG start command (M1803+20n) to be ON at the same time.

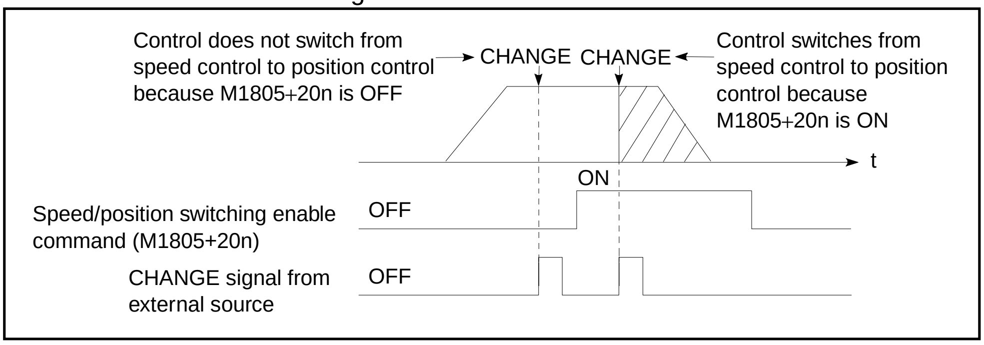
(4) End signal OFF command (M1804+20n)
(a) The end signal OFF command is used to turn off the positioning start completed signal (M1600+20n) and the positioning completed signal (M1601+20n) by using the sequence program.



POINT

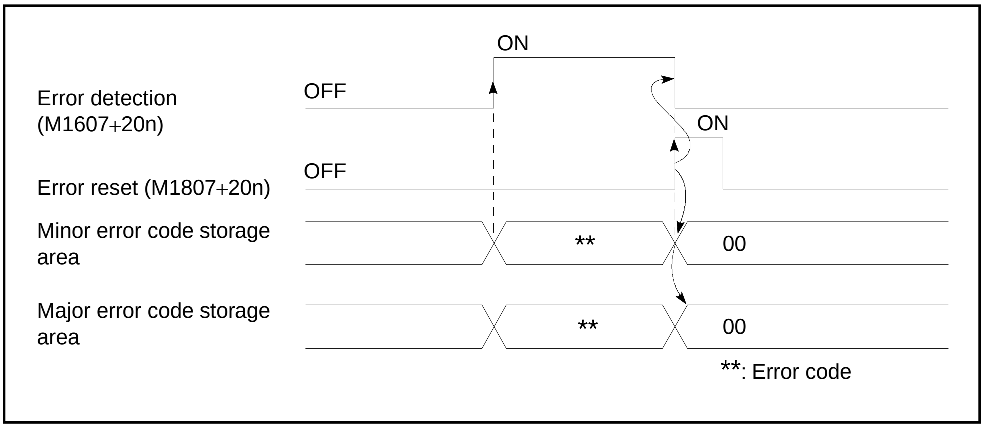
Do not turn the end signal OFF command ON with a PLS command.
If it is turned ON with a PLS command, it will not be possible to turn OFF the positioning start completed signal (M1600+20n) or the positioning completed signal (M1601+20n).

(5) Speed/position switching enable command (M1805+20n)
(a) The speed/position switching enable command is used to make the CHANGE signal (signal for switching from speed to position control) effective from an external source.
- ON .... Control switches from speed control to position control when the CHANGE signal comes ON.
- OFF ...... Control does not switch from speed to position control even if the CHANGE signal comes ON.

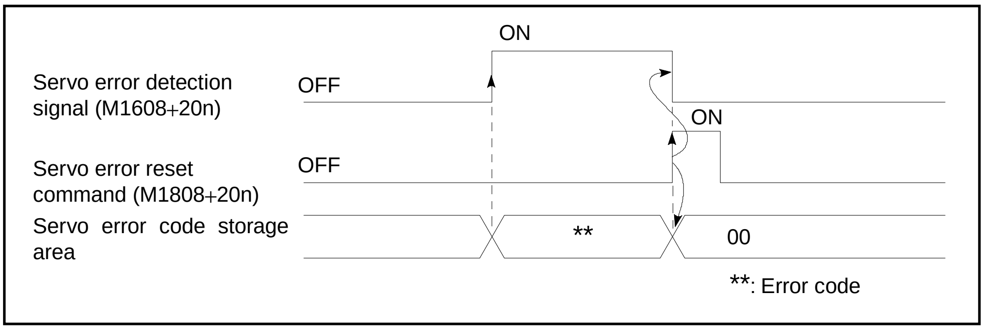


(6) Limit switch output enable command (M1806+20n)
The limit switch output enable command is used to enable limit switch output.
- ON........ The limit switch output ON/OFF pattern can be output.
- OFF...... Limit switch output goes OFF.

(7) Error reset command (M1807+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).



(8) Servo error reset command (M1808+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 (M1608+20n: ON), and reset the servo error detection signal (M1608+20n).



POINT

*: Do not turn the error reset command (M1807+20n) or servo error reset command (M1808+20n) ON with a PLS command.
If a PLS command is used, it will not be possible to reset the error or servo error.

REMARK

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

(9) External STOP input/invalid when starting command (M1809+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 command ON, switch the STOP input from OFF to ON (if STOP input is ON when the axis is started, switch it from ON to OFF to ON).

(10) Feed current value update request command (M1812+20n)
This signal is used to set whether the feed current value will be cleared or not when motion is started in speed/position switching control.
- ON........ The feed current value is updated, starting from when motion is started.
  The feed current value is not cleared on starting.
- OFF...... The feed current value is updated, starting from when motion is started.
  The feed current value is cleared on starting.

POINT

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

(11) Servo OFF command (M1815+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.

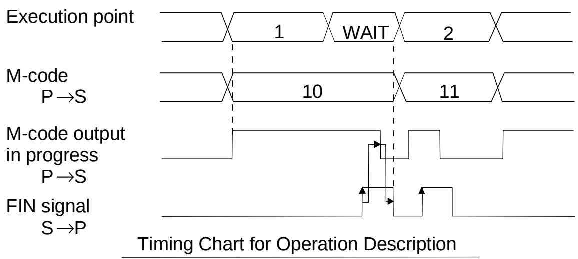
CAUTION

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

(12) FIN signal (M1819+20n)

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

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



Timing Chart for Operation Description

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

3.1.3 Common Device

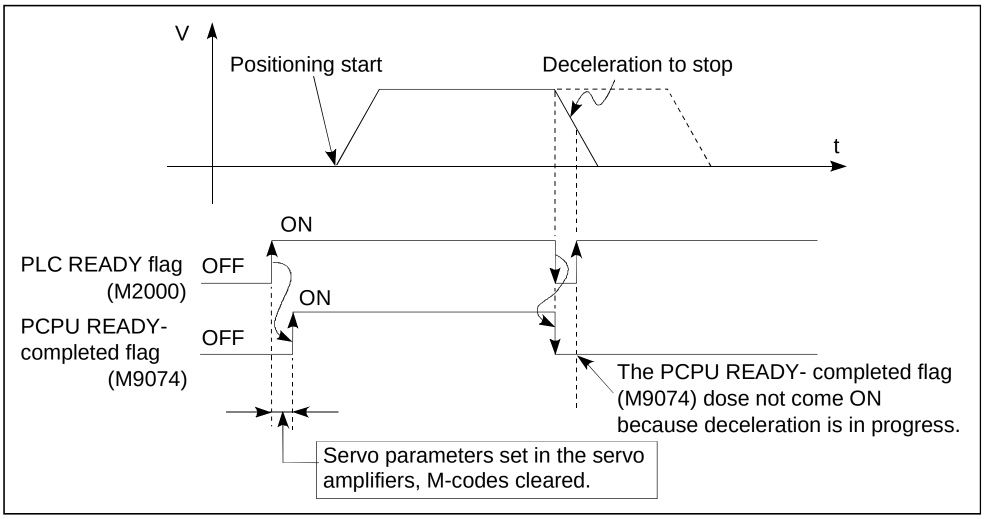
POINTS
(1) Internal relays for positioning control are not latched even inside the latch range. In this manual, in order to indicate that internal relays for positioning control are not latched, the expression used in this text is "M2000 to M2047". (2) The range of devices allocated as internal relays for positioning control cannot be used by the user even if their applications have not been set.

(1) PLC READY flag (M2000).........Signal sent from SCPU to PCPU

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

(b) The fixed parameters, servo parameters, and limit switch output parameters can only be changed using a peripheral device when M2000 is OFF. If an attempt is made to change this data while M2000 is ON, an error will occur.

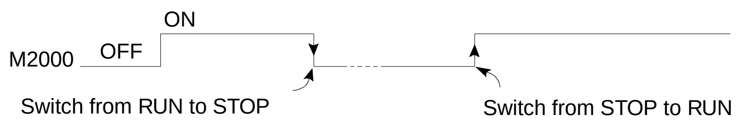
(c) When M2000 is switched from OFF to ON, the following processing occurs.
   1) Processing details
      - The servo parameters are transferred to the servo amplifier.
      - The M-code storage area for all axes is cleared.
      - The default value of 300% is set in the torque limit value storage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



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

POINT

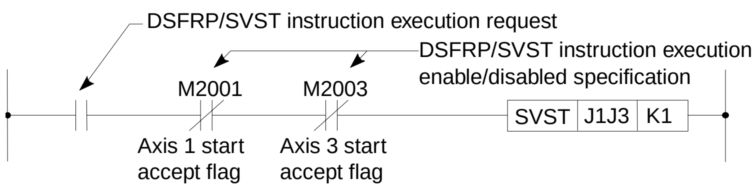
The PLC READY flag (M2000) goes OFF when the servo system CPU is in the STOP status. When the RUN status is re-established, the status is the same as before the STOP was executed.



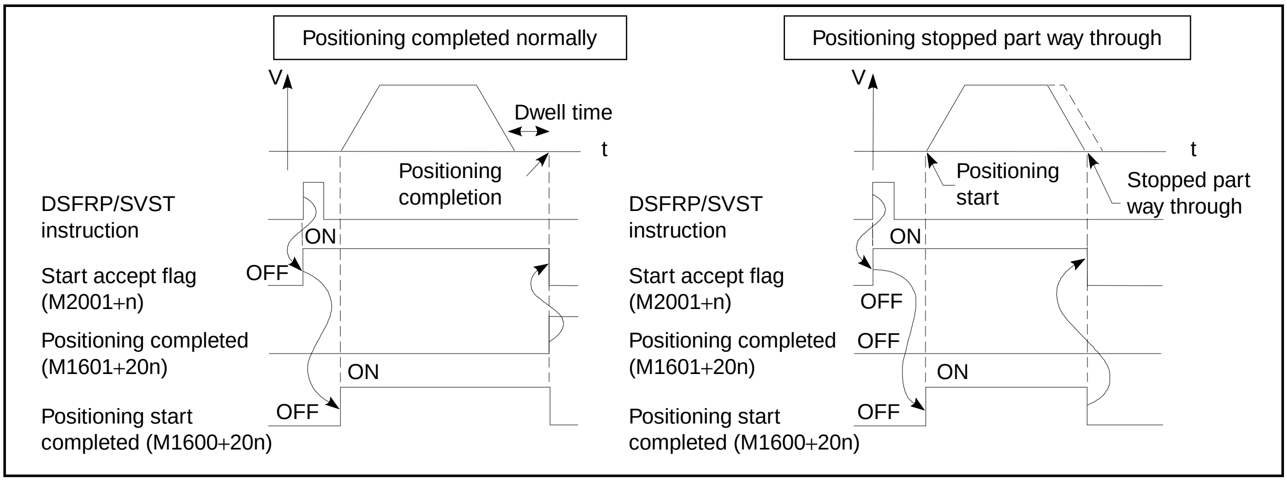
(2) Start accept flag (M2001+n)...........Signal sent from PCPU to SCPU
(a) The start accept flag comes ON when the positioning start (DSFRP/ SVST) instruction is executed in the sequence program: use it as an interlock to enable or disable execution of the DSFRP/SVST instruction.

Example

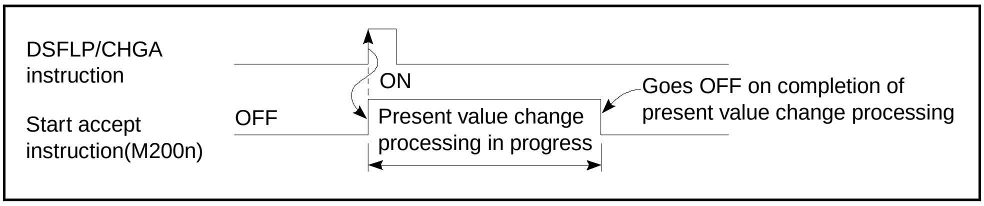
When requesting execution of the servo programs for positioning on axis 1 and axis 3, use the start accept flags in the way shown below.



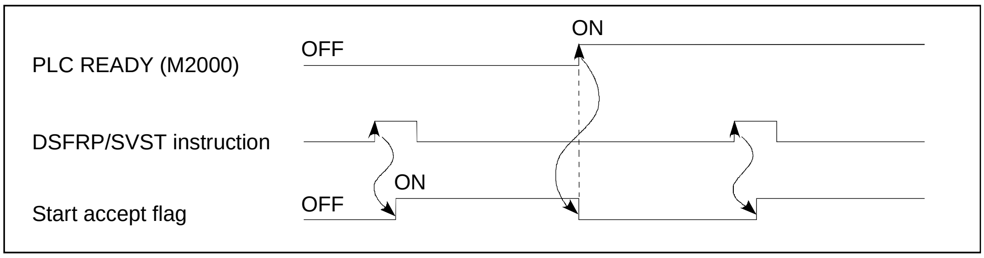
(b) The start accept flag ON/OFF processing takes the following form.
1) The start accept flag for the designated axis comes ON in response to a DSFRP/SVST instruction, and goes OFF on completion of positioning. The start accept flag will also go OFF if positioning is stopped part way through.
(However,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



2) 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.
3) 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 (M2012: OFF) is OFF.
4) The start accept flag is ON during a current value change initiated by a DSFLP instruction. It goes OFF on completion of the present value change.



5) 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.



⚠ CAUTION

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

REMARK

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

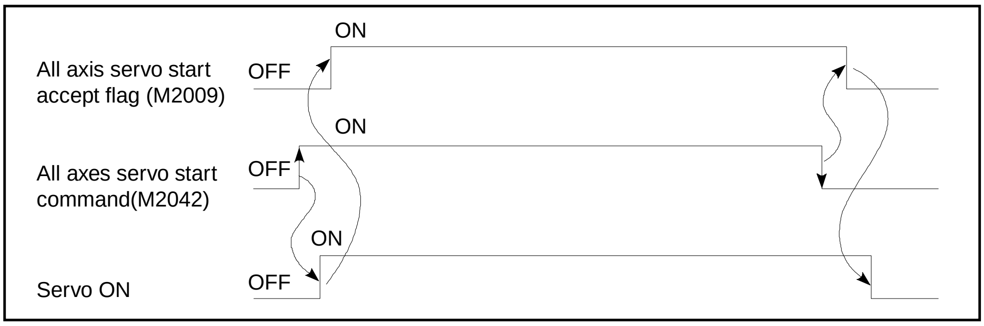
<A172SHCPUN>

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

<A171SHCPUN>

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

(3) All axis servo ON 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.



(4) Manual pulse generator enable flag (M2012).......... 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(Note) of the A172SENC.
- ON ....Positioning control is executed in accordance with the input from the manual pulse generators.
- OFF ....Positioning with the manual pulse generators is not possible because the input from the manual pulse generators is ignored.

REMARK

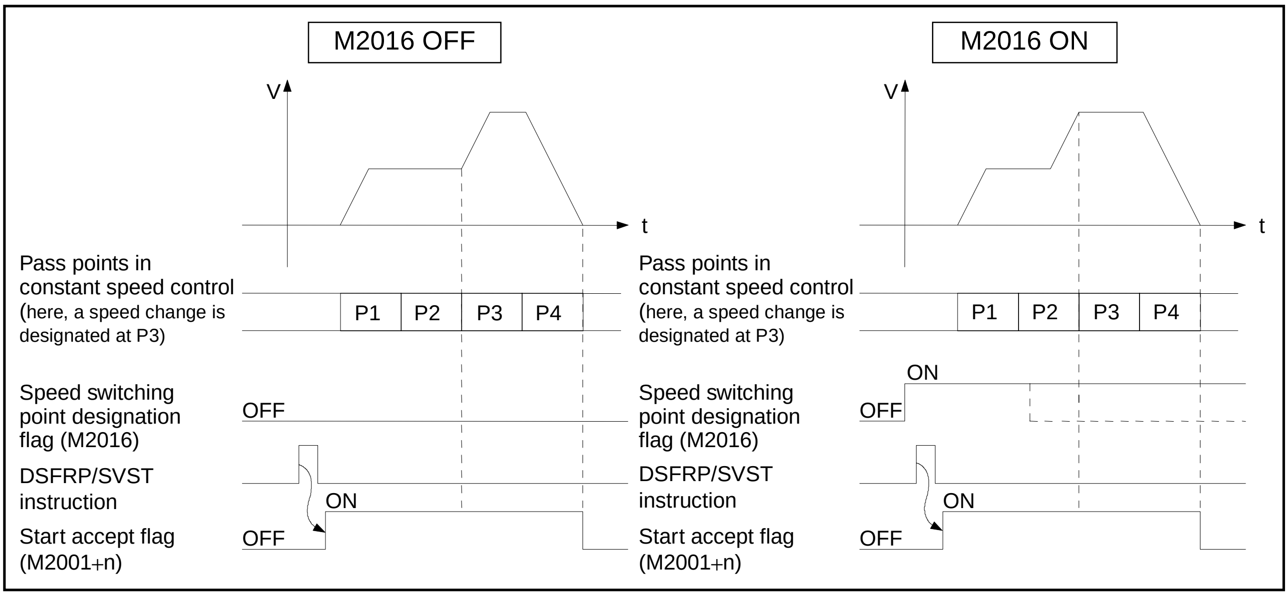
(Note): For details on the P1 connector of the A172SENC, refer to the A173UHCPU/A172SHCPUN/A171SHCPUN Motion Controller User's Manual.

(5) JOG simultaneous start command (M2015) ....Signal sent from SCPU to PCPU
(a) 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).
(b) When M2015 is turned OFF, motion on the axis currently executing JOG operation decelerates to a stop.

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

OS	SV13	SV22
Device No.	M2016	M2040

The speed switching point designation flag is used when a speed change is designated at the pass point in constant speed control.
(a) By turning 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.
- OFF ....Speed is changed to a designated speed at a pass point in constant speed control.
- ON ....Speed has been changed to a designated speed at a pass point in constant speed control.



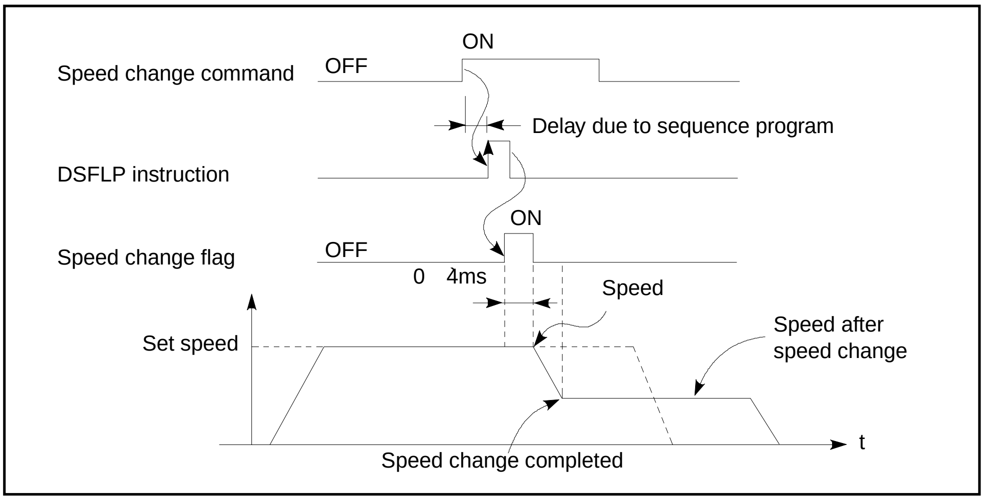
(b) After completion of start accept processing, the speed switching point designation flag can be turned OFF at any time.

(7) Start buffer full (M2020) .... Signal sent from PCPU to SCPU

(a) This signal comes on when 16 or more requests 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.

(b) Reset M2020 by using the sequence program.

(8) Speed change flags (M2021+n)..........Signal from PCPU to SCPU
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.



REMARK

A numerical value corresponding to an axis number is entered for "n" in "M2021+ n".

<A172SHCPUN>

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

<A171SHCPUN>

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

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

(10) 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

(a) When an error occurs, the ERROR LED at the front of the CPU comes on. Also, the error log can be known from the peripheral devices started by GSV13P or GSV22P.

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

REMARK

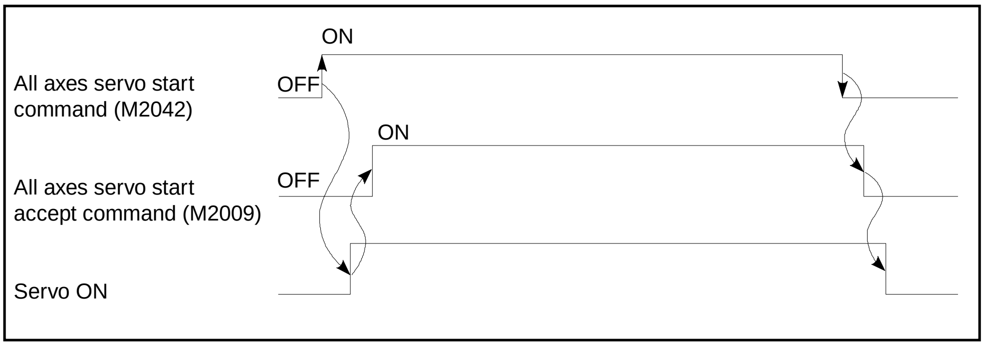
Even if a module is loaded at a slot set as "NO USE"
in the system setting data set with a peripheral device, that slot will be regarded as not used.

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

(a) Servo operation enabled........... M2042 is turned ON while the servo OFF signal (M1815+20n) is OFF and there is no servo error.

(b) Servo operation disable............

- M2042 is OFF
- The servo OFF signal (YnF) is ON
- Servo error



POINT

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

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

This flag is used to determine whether the status of modules mounted on the 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 is always checked and errors are detected.

(a) When M2047 comes ON, the ERROR LED of the A172SHCPUN or A171SHCPUN lights.

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

3.2 Data Registers

(1) Data registers

A172SHCPUN(SV13)

Device No.	Purpose
D0	User device (800 points)
D800	Axis monitor device (20 points x 8 axes)
D960	Control change register (6 points x 8 axes)
D1008 D1023	Common device (16 points)

A171SHCPUNSV(13)

Device No.	Purpose
D0	User device (800 points)
D800	Axis monitor device (20 points x 4 axes)
D880	Unusable (80 points)
D960	Control change register (6 points x 4 axes)
D984	Unusable (24 points)
D1008 D1023	Common device (16 points)

A172SHCPUN(SV13)
(SV22 REAL mode)

Device No.	Purpose
D0	User device (748 points)
D748	Synchronous encoder axis monitor device (4 points x 1 axis)
D752	User device(48 points)
D800	Axis monitor device (20 points x 8 axes)
D960	Control change register (6 points x 8 axes)
D1008 D1023	Common device (16 points)

A171SHCPUNSV(13)

Device No.	Purpose
D0	User device (800 points)
D748	Synchronous encoder axis monitor device (4 points x 1 axis)
D752	User device(48 points)
D800	Axis monitor device (20 points x 4 axes)
D880	Unusable (80 points)
D960	Control change register (6 points x 4 axes)
D984	Unusable(24 points)
D1008 D1023	Common device (16 points)

POINT

- Total number of user device points

	SV13	SV22 Real mode
A172SHCPUN	800 points	796 points
A171SHCPUN	800 points	796 points

(2) Axis monitor devices

Axis No.	A172SHCPUN Device No.	A171SHCPUN Device No.
1	D800 to D819	D800 to D819
2	D820 to D839	D820 to D839
3	D840 to D859	D840 to D859
4	D860 to D879	D860 to D879
5	D880 to D899	
6	D900 to D919	
7	D920 to D939	
8	D940 to D959	

Signal Name

	Signal Name	Unit	Signal Direction	Refresh Cycle	Fetch Cycle
0 1	Feed current value	Command unit	SCPU ←PCPU	3.5ms	
2 3	Real current value	Command unit			
4 5	Deviation counter value	PLS			
6	Minor error code	—		Immediately	
7	Major error code	—			
8	Servo error code	—		10ms	
9 10	Travel value when the proximity DOG/CHANGE is ON	Command unit		END	
11	Zeroing second travel value	PLS		3.5ms	
12	Execution program number	—			
13	M-code	—			
14	Torque limit value	%			
15 16	Travel value change register	Command unit	SCPU →PCPU		3.5ms
17 18	Real current value when STOP is input	Command unit	SCPU ←PCPU	END	
19	Data set pointer for constant speed control	—		At driving or during driving	

(3) Control change registers

Axis No.	A172SHCPUN Device No.	A171SHCPUN Device No.
1	D960 to D965	D960 to D965
2	D966 to D971	D966 to D971
3	D972 to D977	D972 to D977
4	D978 to D983	D978 to D983
5	D984 to D989	
6	D990 to D995	
7	D996 to D1001	
8	D1002 to D1007	

Signal Name

	Signal Name	Unit	Signal Direction	Refresh Cycle	Fetch Cycle
0 1	Current value change register	Command unit	SCPU →PCPU		DSFLP execution
2 3	Speed change register	Command unit			DSFLP execution
4 5	JOG speed setting register (Note)	Command unit			At driving

(Note) : ▭ This register is a backup register.

* The entry "END" in the Refresh Cycle column indicates 80ms or a longer sequence program scan time.

(4) Common devices

A172SHCPUN

Device No.	Signal Name		Signal Direction	Refresh Cycle	Fetch Cycle
D1008	Limit switch output disable setting register (4 points)		SCPU →PCPU		3.5ms
D1009					
D1010					
D1011					
D1012	Setting Register for a axis number controlled with manual pulse generator 1				Manual pulse generator operation enabled
D1013	Unusable (2 points)			—	—
D1014					
D1015	JOG operation simultaneous start axis setting register		SCPU →PCPU		At driving
D1016	Axis 1	1 pulse input modification setting register for manual pulse generators (8 points)			Manual pulse generator operation enabled
D1017	Axis 2				
D1018	Axis 3				
D1019	Axis 4				
D1020	Axis 5				
D1021	Axis 6				
D1022	Axis 7				
D1023	Axis 8				

A171SHCPUN

Device No.	Signal Name		Signal Direction	Refresh Cycle	Fetch Cycle
D1008	Limit switch output disable setting register (2 points)		SCPU →PCPU		3.5ms
D1009					
D1010	Unusable (2 points)			—	—
D1011					
D1012	Setting Register for a axis number controlled with manual pulse generator 1		SCPU →PCPU		Manual pulse generator operation enabled
D1013	Unusable (2 points)			—	—
D1014					
D1015	JOG operation simultaneous start axis setting register		SCPU →PCPU		At driving
D1016	Axis 1	1 pulse input modification setting register for manual pulse generator (4 points)			Manual pulse generator operation enabled
D1017	Axis 2				
D1018	Axis 3				
D1019	Axis 4				
D1020	Unusable (4 points)			—	—
D1021					
D1022					
D1023					

3.2.1 Monitoring data area

The monitoring data area is used by the PCPU to store data such as the feed current value during positioning control, the real current value, and the number of droop pulses in the deviation counter.
It can be used to check the positioning control status using the sequence program.
The user cannot write data into the monitoring data area (with the exception of the travel value register).
For details on the delay time between a positioning device (input, internal relay, special relay) going ON or OFF and storage of data in the monitor data area, see APPENDIX 7 “Processing Times”.

(1) Feed current value register (D800+20n) ....Data from the PCPU to the SCPU
   (a) This register stores the target address output to the servo amplifier on the basis of the positioning address/travel value designated in the servo program.
      1) In fixed-pitch feed control, the travel value counted up from 0 after motion starts is stored.
      2) In speed/position switching control, the current value counted up from the address when motion starts is stored.
         However, the address at start time varies depending on the ON/OFF status of the feed current value update command (M1812+20n) at start time.
         - M1812+20n: OFF.........Resets the feed current value to 0 at start time.
         - M1812+20n: ON...........Not reset the feed current value at start time.
      3) During speed control, "0" is stored.

   (b) The stroke range check is performed on this feed current value data.

(2) Real current value register (D802+20n) ....Data from the PCPU to the SCPU
   (a) This register stores the current value attained in actual travel (the feed current value minus the droop pulses in the deviation counter).

   (b) In the stopped status, the feed current value is equal to the real current value.

(3) Deviation counter value register (D804+20n)Data from the PCPU to the SCPU
   This register stores the difference between the feed current value and the real current value.

(4) Minor error code register (D806+20n)...... Data from the PCPU to the SCPU
   (a) This register stores the relevant error code (see Appendix 2.2) when a minor error occurs.
      If another minor error occurs, the previous error code is overwritten by the new error code.

   (b) Minor error codes can be cleared by an error reset signal (M1807+20n).

(5) Major error code register (D807+20n).......Data from the PCPU to the SCPU
   (a) This register stores the relevant error code (see Appendix 2.3) when a major error occurs.
      If another major error occurs, the previous error code is overwritten by the new error code.

   (b) Major error codes can be cleared by an error reset signal (M1807+20n).

(6) Servo error code register (D808+20n) ....Data from the PCPU to the SCPU
(a) This register stores the relevant error code (see Appendix 2.4) when a servo error occurs.
If another servo error occurs, the previous error code is overwritten by the new error code.

(b) Servo error codes can be cleared by a servo error reset signal (M1808+20n).

(7) Travel value after proximity dog comes ON register (D809+20n)............... Data from the PCPU to the SCPU
(a) When a zeroing operation is performed, the travel value from the point where the proximity dog comes ON to the point where the zeroing operation is completed is stored in this register (with no sign appended).

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

(8) Zeroing second travel value register (D811+20n)...........................Data from the PCPU to the SCPU
If the position at which motion stops in accordance with the travel value setting after the proximity 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).
When the feedback pulse count of the motor connected is 131072 PLS, the value found by dividing the second travel value to home position by 10 is stored.
Note that in the case of a data set type zeroing operation, the data remains unchanged (the previous value stands).

(9) Executed program number register (D812+20n) ...... 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 zeroing
2) A position loop gain or position control gain 1 check in servo diagnosis.

(10) M-code register (D813+20n) .... Data from the PCPU to the SCPU
(a) The M-code(Note) set for the executed servo program is stored in this register when positioning starts. If no M-code is set for the servo program, the value stored is "0".

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

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

REMARK

(Note): See the following sections for details on M-codes and reading M-codes.

- M-code .... Section 8.2
- M-code reading .... Appendix 4.3

(11) Torque limit value register (D814+20n).......Data from the PCPU to the SCPU
This register stores the value for the torque limit imposed on the servo system. The default value of 300% is stored in this register when the power to the servo system is turned on or at the leading edge of the PC READY signal (M2000).

(12) Travel value change register (D815+20n)........ Data from the SCPU to the PCPU
This is the area used when the position control travel value is changed in speed/position switching control (see Section 7.14).

(13) Real current value when STOP is input register (D817+20n) ....Data from the PCPU to the SCPU
This register stores the real current value when a STOP signal is input from an external source.

(14) Constant speed control data set pointer (D819+20n) .... Data from the PCPU to the SCPU

This pointer is used in constant speed control when specifying positioning data indirectly and substituting positioning data during operation.

It stores a "point" that indicates which of the values stored in indirect devices has been input to the PCPU when positioning is being repeated by using a repeat instruction (FOR-TIMES, FOR-ON, FOR-OFF).

Use this pointer in conjunction with the PLC set pointer (controlled by the user in the sequence program) - which indicates the extent to which the positioning data has been updated by the SCPU - to confirm which positioning data is to be updated.

The use of the data set pointer and PLC set pointer for constant speed control is explained here using the example servo program below.

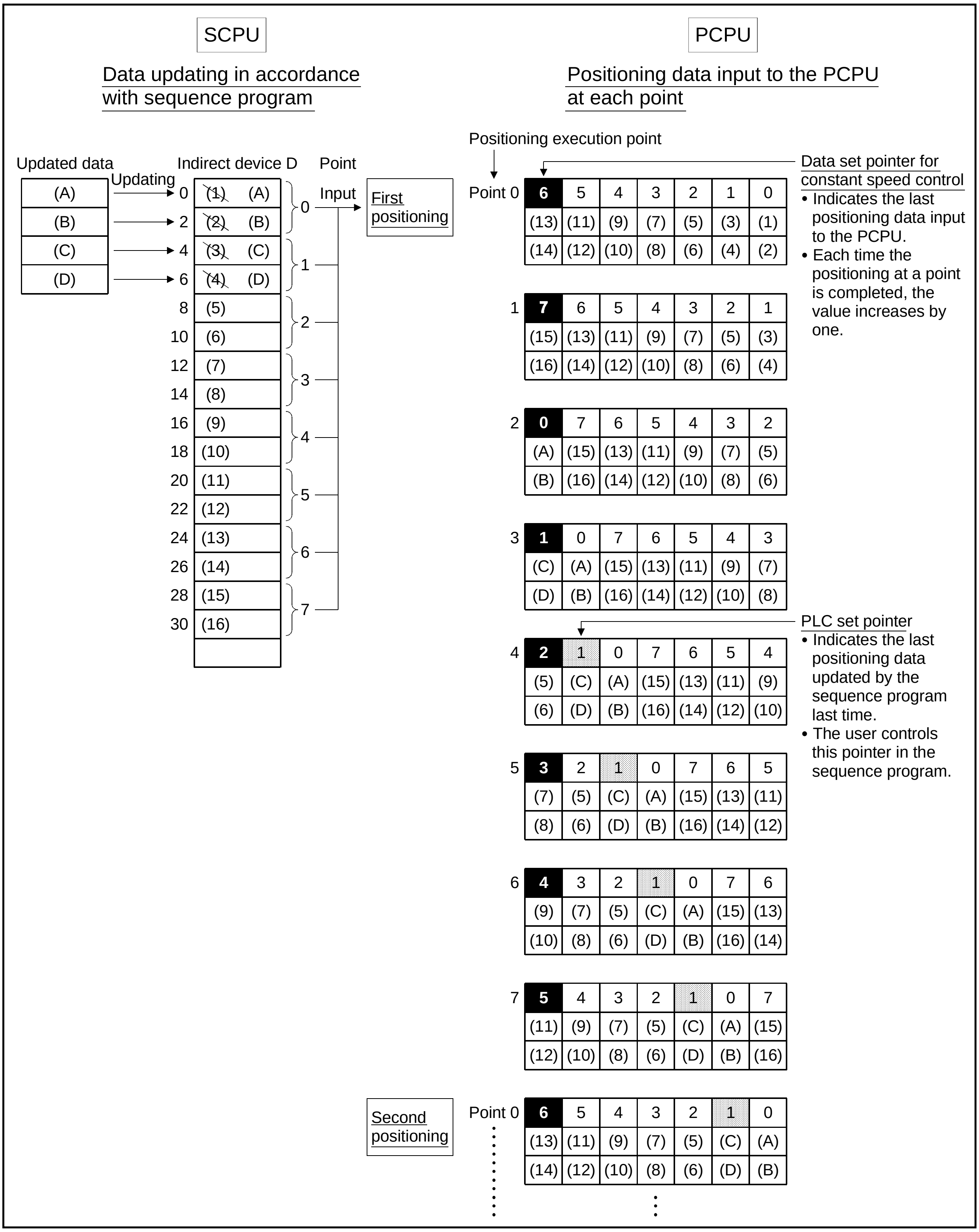
```
Pass point     <K   0  >
     9   CPSTART2
          Axis        1
          Axis        2
          Speed                D200
     *   FOR-TIMES                              Point
                               D202
     1   ABS-2                         ... 0
          Axis        1,         D0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

- 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-axes constant speed control is executed using the servo program shown above is described overpage.

[Input of positioning data to the PCPU]



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

[Internal processing]

(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

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.

3.2.2 Data storage area for control change

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

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Table 3.11 Data Storage Areas for Control Change

Name	Axis 1	Axis 2	Axis 3	Axis 4	Axis 5	Axis 6	Axis 7	Axis 8
Current 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

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Table 3.12 Data Storage Areas for Control Change

Name	Axis 1	Axis 2	Axis 3	Axis 4
Current 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

POINTS

- Either the DSFLP instruction or CHGA/CHGV instruction can be used to executed current value changes/speed changes.
- The current value/speed change register is used only when the current value or speed is changed by the DSFLP instruction.

(1) Current value change register (D960+6n)...... Data from the SCPU to the PCPU
(a) This register stores the feed current value after the change when the feed current value of a stopped axis is changed.

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

Item \ Units	mm		inch		degree		PLUSE		Remarks
	Setting Range	Units	Setting Range	Units	Setting Range	Units	Setting Range	Units	
Current 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 current value change register becomes the feed current value.

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

(2) Speed change register (D962+6n).......Data from the SCPU to the PCPU
(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		inch		degree		PLUSE	
	Setting Range	Units	Setting Range	Units	Setting Range	Units	Setting Range	Units
Speed change value	−600000000 ~600000000	$\times 10^{-2}$ mm/min	−600000000 ~600000000	$\times 10^{-3}$ inch/min	−2147483648 ~2147483647	$\times 10^{-3}$ degree/min	0~10000000	PLS/s

(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 (D964+6n) ...... Data from the SCPU to the PCPU
(a) This register stores the JOG speed during JOG operation.

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

Item \ Units	mm		inch		degree		PLUSE	
	Setting Range	Units	Setting Range	Units	Setting Range	Units	Setting Range	Units
JOG speed	1~600000000	$\times 10^{-2}$ mm/min	1~600000000	$\times 10^{-3}$ inch/min	−2147483648 ~2147483647	$\times 10^{-3}$ degree/min	1~10000000	PLS/s

(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.

3.2.3 Common device

(1) Limit switch output disable setting register (D1008 to D1011).......... Data from the SCPU to the PCPU

(a) 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.

<A172SHCPUN>

	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.

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	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 LY3F shows the limit switch output.

(2) Registers for setting axis numbers controlled by manual pulse generators (D1012) ......Data from the SCPU to the PCPU

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

	b15 – b12	b11 – b8	b7 – b4	b3 – b0
D1012		3 digits	2 digits	1 digits

With a maximum of 3 decimal digits, set the controlled axes for each digit.
A172SHCPUN Axis 1 to 8
A171SHCPUN Axis 1 to 4

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

(3) JOG operation simultaneous start axis setting register (D1015) ....Data from the SCPU to the PCPU

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

<A172SHCPUN>

	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	Axis 7	Axis 6	Axis 5	Axis 4	Axis 3	Axis 2	Axis 1
	Axes started in reverse JOG operation								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

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	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
	Axes started in reverse JOG operation								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

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

(4) 1 pulse input magnification setting registers for manual pulse generators (D1016 to D1023).. Data from the SCPU to the PCPU

(a) 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.

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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	

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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	

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

3.3 Special Relays (SP.M)

The servo system CPU has 256 special relay points from M9000 to M9255.
Of there, the 7 points from M9073 to M9079 are used for positioning control, and their applications are indicated in Table 3.13.

Table 3.13 Special Relays

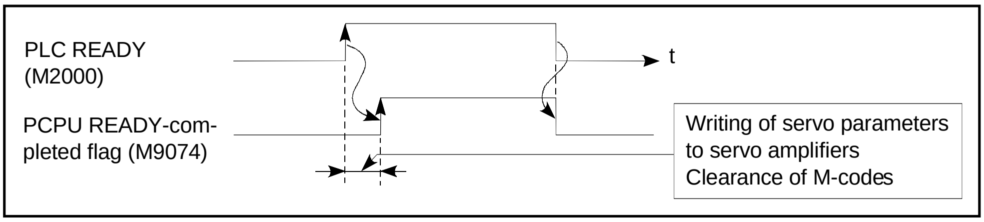
Device No.	Signal Name	Signal Direction	Refresh Cycle	Fetch Cycle
M9073	PCPU WDT error flag	PCPU → SCPU	END	
M9074	PCPU REDAY-completed flag			
M9075	In-test-mode flag			
M9076	External emergency stop input flag			
M9077	Manual pulse generator axis setting error flag			
M9078	Test mode request error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

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

(2) PCPU REDAY-completed flag (M9074)...... Signal sent from PCPU to SCPU
This flag is used to determine whether the PCPU is normal or abnormal from the sequence program.

(a) When the PLC READY flag (M2000) turns from OFF to ON, the fixed parameters, servo parameters, limit switch output data, etc., are checked, and if no error is detected the PCPU READY-completed flag comes ON.
The servo parameters are written to the servo amplifiers and the M-codes are cleared.

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



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

(a) This flag is used to determine whether or not a test mode established from a peripheral device is currently effective. Use it, for example, for an interlock effective when starting a servo program with 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

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

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

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

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

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

(6) Test mode request error flag (M9078) ......Signal sent from PCPU to SCPU
   (a) This flag comes ON if the test mode is not established when a test mode request is sent from a peripheral device

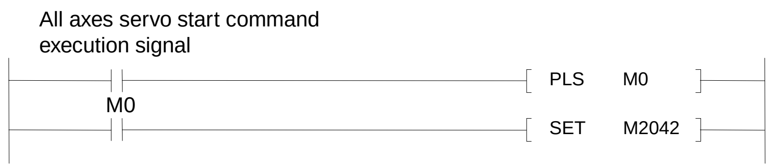
   (b) When M9078 comes ON, the error contents are stored in the test mode request error register (D9188).

POINTS

(1) When an emergency stop signal (EMG) is input during positioning, the feed current value is advanced within the rapid stop deceleration time set in the parameter block. At the same time, the servo OFF status is established because the all axes servo start command (M2042) goes OFF. When the rapid stop deceleration time has elapsed after input of the emergency stop signal, the feed current value returns to the value at the point when the emergency stop was initiated.

(2) If the emergency stop is reset before the emergency stop deceleration time has elapsed, a servo error occurs.

(3) If you do not want to establish the servo ON status immediately after an emergency stop has been reset, include the following section in the sequence program.



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

3.4 Special Register (SP.D)

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

Table 3.14 Special Registers

<table>
<tr><th>Device Number</th><th>Signal Name</th><th>Signal Direction</th><th>Refresh Cycle</th><th>Fetch Cycle</th><th>A172SH</th><th>A171SH</th></tr>
<tr><td>D9180</td><td>Limit switch output status storage area for axis 1 and axis 2</td><td rowspan="12">SCPU ←PCPU</td><td rowspan="4">3.5ms</td><td rowspan="12"></td><td rowspan="18">○</td><td rowspan="2">○</td></tr>
<tr><td>D9181</td><td>Limit switch output status storage area for axis 3 and axis 4</td></tr>
<tr><td>D9182</td><td>Limit switch output status storage area for axis 5 and axis 6</td><td rowspan="2">—</td></tr>
<tr><td>D9183</td><td>Limit switch output status storage area for axis 7 and axis 8</td></tr>
<tr><td>D9184</td><td>PCPUWDT error cause</td><td>At PCPU WDT error occurrence</td><td rowspan="14">○</td></tr>
<tr><td>D9185</td><td rowspan="2">Servo amplifier type</td><td rowspan="2">Power ON</td></tr>
<tr><td>D9186</td></tr>
<tr><td>D9187</td><td>Manual pulse generator axis setting error information</td><td>Manual pulse generator operation enabled</td></tr>
<tr><td>D9188</td><td>Test mode request error information</td><td>Test mode request</td></tr>
<tr><td>D9189</td><td>Error program number</td><td rowspan="2">At driving</td></tr>
<tr><td>D9190</td><td>Error item information</td></tr>
<tr><td>D9191</td><td>Servo amplifier loading information</td><td>Power ON, 10 ms</td></tr>
<tr><td>D9192</td><td>Area for setting the manual pulse generator (P1) smoothing magnification</td><td>SCPU →PCPU</td><td></td><td>Manual pulse generator operation enabled</td></tr>
<tr><td>D9193</td><td rowspan="3">Unusable</td><td rowspan="3">—</td><td rowspan="3"></td><td rowspan="3">—</td></tr>
<tr><td>D9194</td></tr>
<tr><td>D9195</td></tr>
<tr><td>D9196</td><td>PC link communication error code</td><td>SCPU ←PCPU</td><td>3.5ms</td><td></td></tr>
<tr><td>D9199</td><td>Unusable</td><td>—</td><td></td><td>—</td></tr>
</table>

(1) Limit switch output status storage register (D9180 to D9183) ...... Data from PCPU to SCPU

(a) This register stores the output status (ON/OFF) for limit switch output to AY42 with a peripheral device as "1" or "0".

- ON 1
- OFF 0

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

<A172SHCPUN>

	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							

(Note) : "1" or "0" is set at each bit of D9180 to D9183
· ON ····· 1
· OFF ···· 0

<A171SHCPUN>

	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							

(Note) : "1" or "0" is set at each bit of D9180 to D9183
· ON ······ 1
· OFF ····· 0

REMARKS

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

(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.

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		
200 201	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.
250 251	SSCNET interface hardware fault 2 5 0 Faulty SSCNET No. 0 : SSCNET 1 (Amplifier interface) 1 : SSCNET 2 (PC link interface)		Exchange the CPU unit.
300	PCPU software fault 3		Reset with the reset key.

(3) Servo amplifier classification (D9185 to D9186).......Data from PCPU to SCPU
On switching on the power to the servo system CPU or resetting, the servo amplifier type set in the system settings is set in these devices.

(a) A172SHCPUN

	b15 to b12	b11 to b8	b7 to b4	b3 to b0
D9185	Axis 4	Axis 3	Axis 2	Axis 1
D9186	Axis 8	Axis 7	Axis 6	Axis 5

Servo amplifier type
· 0 ······· Unused axis
· 2 ······· MR-□-B

(b) A171SHCPUN

	b15 to b12	b11 to b8	b7 to b4	b3 to b0
D9185	Axis 4	Axis 3	Axis 2	Axis 1
D9186	0			

Servo amplifier type
· 0 ······· Unused axis
· 2 ······· MR-□-B

(4) Manual pulse generator axis setting error (D9187) .... Data from PCPU to SCPU
When an error is detected in checking the setting at the leading edge of the manual pulse generator enable signal, the contents of the error are set in D9187 and the manual pulse generator axis setting error flag (M9077) comes ON.

(a) A172SHCPUN

	b15							b8		b3		b0
D9187	**Axis 8**	**Axis 7**	**Axis 6**	**Axis 5**	**Axis 4**	**Axis 3**	**Axis 2**	**Axis 1**	**0**	**p1**	**0**	**p1**

· 1 pulse input magnification setting error
0: Normal
1: Setting error
(When the input magnification setting is outside the range 1 to 100)

· Manual pulse generator axis setting error
0: Normal
1: Setting error
(When the axis setting for each digit is outside the range 1 to 8)

· Manual pulse generator smoothing magnification setting error
0: Normal
1: Setting error
(When the magnification setting is outside the range 0 to 59)

(b) A171SHCPUN

	b15	b11			b8		b3		b0
D9187	0	Axis 4	Axis 3	Axis 2	Axis 1	0	p1	0	p1

· 1 pulse input magnification setting error
0: Normal
1: Setting error
(When the input magnification setting is outside the range 1 to 100)

· Manual pulse generator axis setting error
0: Normal
1: Setting error
(When the axis setting is outside the range 1 to 4)

· Manual pulse generator smoothing magnification setting error
0: Normal
1: Setting error
(When the magnification setting is outside the range 0 to 59)

(5) Test mode request error (D9188) ...... Data from PCPU to SCPU
When there is an axis being operated in making a test mode request from a peripheral device, the test mode request error flag (M9078) comes ON and the data of each axis being operated or stopped is stored.

(a) A172SHCPUN

	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

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

All set to “0”

(b) A171SHCPUN

	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

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

All set to “0”

(6) Error program No. (D9189) ....Data from the PCPU to the SCPU
  (a) Stores the number of the subprogram (range: 0 to 4095) affected by the error when the subprogram setting error flag (M9079) comes ON.

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

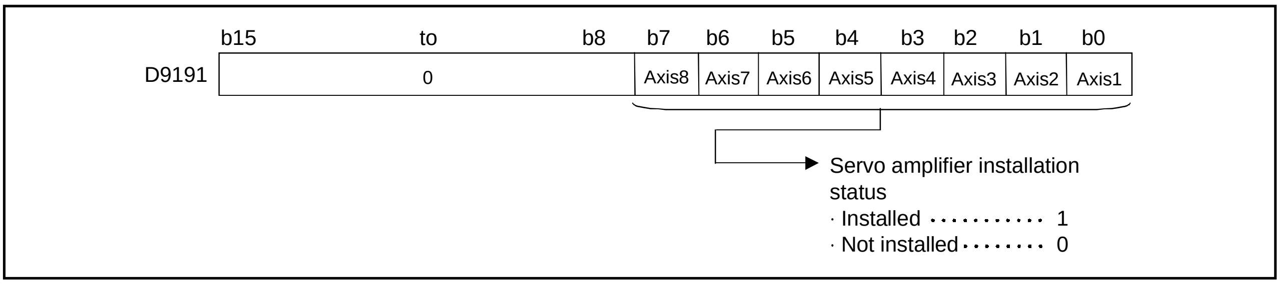
(7) Error item information (D9190) ......Data from the PCPU to the SCPU
  When an error occurs at servo program operation (DSFRP/SVST instruction), the servo program setting error flag (M9079) comes ON and the error code that corresponds to the error is stored in this device.

  For details of servo program setting errors, see Appendix 2-1.

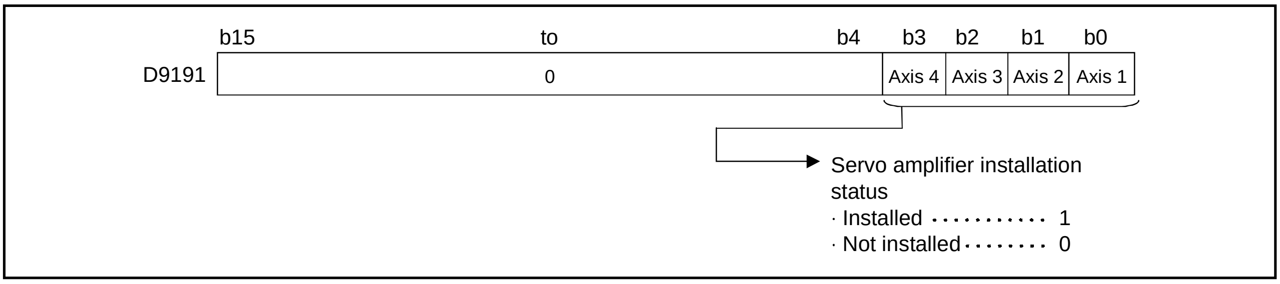
(8) Servo amplifier installation information (D9191) ....Data from the PCPU to the SCPU
  On switching on the control power supply to the servo system CPU or resetting, the servo amplifier installation status is checked and the result is set in this device.
    Lower 4 bits ...... Servo amplifier installation 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".

<A172SHCPUN>



<A171SHCPUN>



(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

(9) Area for setting the smoothing magnification for the manual pulse generator (D9192) ......Data from the SCPU to the PCPU

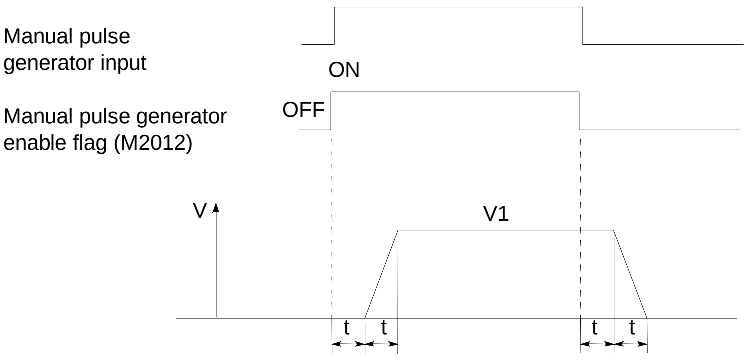
(a) This device stores the manual pulse generator smoothing time constant.

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

(b) When the smoothing magnification is set, the smoothing time constant is determined by the formula given below.

Smoothing time constant (t) = (smoothing magnification + 1)$\times$56.8 [ms]

(c) 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 PLS

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

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

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

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

4. PARAMETERS FOR POSITIONING CONTROL

4.1 System Settings

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

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

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

4.2 Fixed Parameters

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

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

(3) The fixed parameters to be set are shown in Table 4.1.

Table 4.1 Fixed Parameters

No.	Item	Setting Range: mm Setting Range	mm Units	inch Setting Range	inch Units	degree Setting Range	degree Units	PULSE Setting Range	PULSE Units	Default: Initial Value	Default: Units	Remarks	Expla-natory Section
1	Unit setting	0	—	1	—	2	—	3	—	3	—	• Set the command unit in positioning control for each axis.	—
2	Travel value per pulse (A): Number of pulses per revolution (A_P)	1 to 65535 PLS								20000	PLS	• Set the number of feedback pulses per motor revolution, which is determined by the mechanical system.	4.2.1
3	Travel value per pulse (A): Travel value per revolution (A_L)	0.1 to 6553.5	μm	0.00001 to 0.65535	inch	0.00001 to 0.65535	degree	1 to 65535	PLS	20000	PLS	• Set the travel value per motor revolution, which is determined by the mechanical system.	4.2.1
4	Travel value per pulse (A): Unit magnification (A_M)	1: ×1, 10: ×10, 100: ×100, 1000: ×1000						—	—	—	—	• Set to change the magnification for the travel value per pulse.	4.2.1
5	Backlash compensation amount*	0 to 6553.5	μm	0 to 0.65535	inch	0 to 0.65535	degree	0 to 65535	PLS	0	PLS	• Set the amount of backlash in the machine. • Every time the positioning direction changes during positioning, compensation by the backlash compensation amount is executed. The expression below shows the setting range. 0 ≤ (backlash compensation amount) × AP/AL • AM ≤ 65535	8.3
6	Upper stroke limit*	–214748364.8 to 214748364.7	μm	–21474.83648 to 21474.83647	inch	0 to 359.99999	degree	–2147483648 to 2147483647	PLS	2147483647	PLS	• Set the upper limit for the machine travel value. The expression below shows the setting range. (SV13 only) –2147483648 ≤ (upper stroke limit) × AP/AL • AM ≤ 2147483647	4.2.2
7	Lower stroke limit*	–214748364.8 to 214748364.7	μm	–21474.83648 to 21474.83647	inch	0 to 359.99999	degree	–2147483648 to 2147483647	PLS	0	PLS	• Set the lower limit for the machine travel value. The expression below shows the setting range. (SV13 only) –2147483648 ≤ (lower stroke limit) × AP/AL • AM ≤ 2147483647	4.2.2
8	Command in-position range*	0.1 to 214748364.7	μm	0.00001 to 21474.83647	inch	0.00001 to 359.99999	degree	1 to 2147483647	PLS	100	PLS	• Set the position at which the command in-position signal (M1603 + 20n/Xn3/M2403 + 20n) is turned ON [(positioning address) – (current value)]. The expression below shows the setting range. 1 ≤ (command in-position range) × AP/AL • AM ≤ 32767	4.2.3
9	Limit switch output used/not used	0: Not used 1: used								0	—	• Set whether the limit switch output function is used or not for each axis.	8.1

*: 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.

(For unit setting [mm])

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 8192 [PLS/rev]:

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

This means that the smallest command unit is 0.01 [mm] and the unit magnification (A_M) is 100.
Therefore, 0.01 [mm] units can be specified in commands.

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

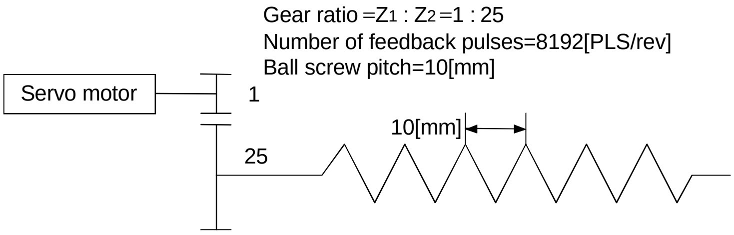
[Example] Assume that the travel value per revolution is 10 [mm] and the unit magnification is 10:

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

Accordingly, 100.0 [μm] is set as the travel value per revolution (A_L) in this case.

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

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



1) Travel value per feedback pulse

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

$$\Delta l = \frac{\Delta S}{P_f} = \frac{10\ [\mathrm{mm}]}{25 \times 8192} = 0.000049[\mathrm{mm}]\ .... \rightarrow \Delta l = 0.0001[\mathrm{mm}]$$

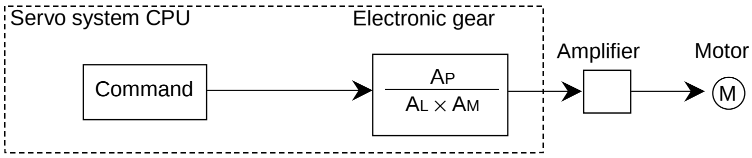
2) Unit magnification (A_M)
Since Δl is 0.0001[mm], the unit magnification (A_M) is "1".

3) Travel distance per revolution (A_L)

$$A_L = \frac{10\ [\mathrm{mm}] \times 1}{25} = 0.4\ [\mathrm{mm}] = 400.0\ [\mu \mathrm{m}]$$

4) Number of pulses per revolution (A_P)
A_P = 8192 [PLS/rev] ... fixed according to the encoder model.

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



The electronic gear is represented by the following relational expression.

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

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

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

$$\left\{ \begin{array}{l} \text{Gear ratio} = Z_1 : Z_2 = 1 : 39 \\ \text{Ball screw pitch} = 25.4\ [\mathrm{mm}] = 25.4 \times 1000 = 25400.0\ [\mu \mathrm{m}] \end{array} \right.$$

$$A_L = \frac{25.4\ [\mathrm{mm}]}{29} = 0.65128205\ [\mathrm{mm}]$$

$$= 651.28205\ [\mu \mathrm{m}]$$

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

$$= \frac{P_f}{\Delta S} \times \frac{8192\ [\mathrm{PLS}]}{25400.0\ [\mu \mathrm{m}] \times \dfrac{1}{39}} = \frac{319448}{25400} \begin{array}{l} ....A_P \\ ....A_L \times A_M \end{array}$$

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

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

Thus,

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

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

(Note) : When actually setting AL, calculate it as indicated in the table below.

4.2.2 Upper stroke limit value/lower stroke limit value

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

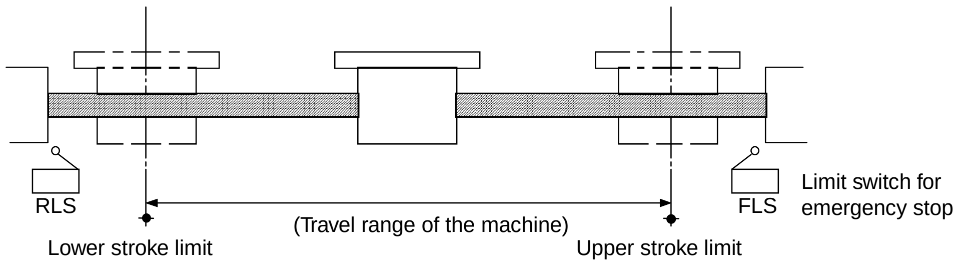


Fig. 4.1 Travel Range When Setting the Upper Stroke Limit Value and Lower Stroke Limit Value

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

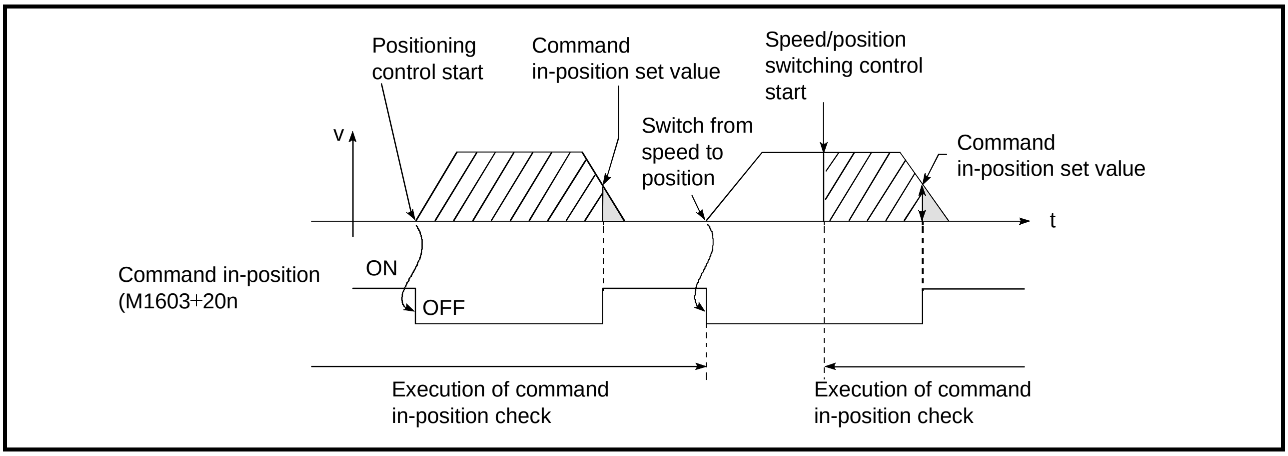
Operation Started	Check Executed/ Not Executed	Remarks
Positioning control	Executed	• When positioning is started, it is checked whether the feed current value is within the stroke limit range or not. If it outside the range, an error occurs (error code 106) and positioning is not executed. • When circular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

POINTS

(1) Besides setting the stroke limit upper limit value/lower limit value in the fixed parameters, the stroke limit range can also be set by using the external limit signals (FLS, RLS).
(2) When the external limit signal goes OFF, a deceleration stop is executed. The time taken to decelerate to a stop can be set by setting the "deceleration time" and "rapid stop deceleration time" in the parameter block.

4.2.3 Command in-position range

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



4.3 Servo Parameters

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

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

⚠ CAUTION

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

4.3.1 MR-□-B servo parameters

The servo parameters to be set are indicated in Tables 4.2 through 4.4.

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

Table 4.2 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. 5
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	—	• 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 PLC READY signal (M2000) ON.

(2) Adjustment parameters

Table 4.3 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								3.0 (Note-1)	—	• Set the ratio of moment of load inertia for the motor.	4.3.8
2	Position control gain 1	Valid range 4 to 1000 rad/s Setting range 1 to 9999 rad/s								70	rad/s	• Set to increase the follow-up with respect to the position command.	4.3.3
3	Speed control gain 1	Valid range 20 to 5000 rad/s Setting range 1 to 9999 rad/s								1200	rad/s	• Set to increase the follow-up with respect to the speed command.	4.3.4
4	Position control gain 2	Valid range 10 to 500 rad/s Setting range 1 to 9999 rad/s								25	rad/s	• Set to increase the position response with respect to load disturbance.	4.3.3
5	Speed control gain 2	Valid range 20 to 5000 rad/s Setting range 1 to 9999 rad/s								600	rad/s	• Set when vibration is generated, for example in machines with a large backlash.	4.3.4
6	Speed integral compensation	Valid range 1 to 1000 rms Setting range 1 to 9999 rad/s								20	ms	• Set the time constant for integral compensation.	4.3.5
7	Notch filter	0: Not used 1: 1125 2: 750 3: 562 4: 450 5: 375 6: 321 7: 281								0	Hz	• Set the frequency for the notch filter.	4.3.11
8	Feed forward gain	0 to 100% 0: Feed forward control is not executed.								0	%	• Set the feed forward coefficient used in positioning control.	4.3.7
9	In-position range (Note-2)	0.1 to 214748364.7	μm	0.00001 to 21474.83647	inch	0.00001 to 359.99999	degree	1 to 2147483647	PLS	100	PLS	• Sets the quantity of droop pulses in the deviation counter. • The in-position signal is ON when the number of droop pulses is within the set range. The expression below shows the setting range. 1 ≤ (in-position range) × AP/AL • AM ≤ 32767	4.3.6
10	Electromagnetic 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/N) 0: Speed (±) 1: Torque (±) 2: Speed (+) 3: Torque (+) 4: Current command output 5: Command FΔT 6: Droop pulse 1/1 7: Droop pulse 1/4 8: Droop pulse 1/16 9: Droop pulse 1/32				(MR-J2S-B/MR-J2-B) 0: Speed (±) 1: Torque (±) 2: Speed (+) 3: Torque (+) 4: Current command output 5: Command FΔT 6: Droop pulse 1/1 7: Droop pulse 1/16 8: Droop pulse 1/64 9: Droop pulse 1/256 10: Droop pulse 1/1024				0	—	• Set the monitor items output as analog outputs in real time.	4.3.13
12	Monitor output mode (monitor 2)									1	—		

(Note-1): For MR-J2-B, the default is "7.0".
(Note-2): The display of the possible setting range differs according to the electronic gear value.

Table 4.3 Servo Parameter List (Adjustment Parameters) (Continued)

No.	Item	Setting Range								Default		Remarks	Explanatory Section
		mm		inch		degree		PULSE		Initial Value	Units		
		Setting Range	Units	Setting Range	Units	Setting Range	Units	Setting Range	Units				
13	Optional function 1 (carrier frequency selection)	0: 2.25 kHz (non low-noise operation) 3: 9 kHz (low-noise operation)								0	kHz	• Set "low noise" to improve the sound of the frequencies generated from the motor.	4.3.14
14	Optional function 1 (Encoder type)	0: 2-wire type 1: 4-wire type								0	—	• Set the type of encoder cable.	4.3.14
15	Optional function 1 (external emergency stop signal)	0: Used 1: Not used								1	—	• To invalidate the external emergency stop signal (EMG) set "not used".	4.3.14
16	Optional function 2 (selection of no-motor operation)(Note-3)	0: Invalid 1: Valid								0	—	• To check the status without connecting a motor, set "valid".	4.3.15
17	Optional function 2 (electro-magnetic brake interlock output timing)	0: Regardless of the rotational speed of the servo motor, output occurs under any of the following conditions. • Servo OFF • Occurrence of an alarm • Emergency stop input OFF (valid) 1: Output occurs under any of the above conditions provided that the servo motor rotational speed is zero (expansion parameters).								0	—	• Set the interlock timing for the electromagnetic brake interlock signal.	4.3.15
18	Optional function 2 (selection of microvibration suppression function)(Note-3)	0: Valid 1: Invalid								0	—	• Set "valid" to suppress vibration on stopping.	4.3.15
19	Optional function 2 (motor lock operation)(Note-3)	0: Valid 1: Invalid								0	—	• To carry out test operation without rotating the motor, set "valid".	4.3.15

(Note-3): Setting not possible for MR-H-BN.

(3) Expansion parameters

Table 4.4 Servo Parameters (Expansion Parameters)

<table>
<tr><th rowspan="3">No.</th><th rowspan="3">Item</th><th colspan="8">Setting Range</th><th colspan="2">Default</th><th rowspan="3">Remarks</th><th rowspan="3">Expla-
natory
Section</th></tr>
<tr><th colspan="2">mm</th><th colspan="2">inch</th><th colspan="2">degree</th><th colspan="2">PULSE</th><th rowspan="2">Initial Value</th><th rowspan="2">Units</th></tr>
<tr><th>Setting Range</th><th>Units</th><th>Setting Range</th><th>Units</th><th>Setting Range</th><th>Units</th><th>Setting Range</th><th>Units</th></tr>
<tr><td>1</td><td>Motion output 1 offset</td><td colspan="4">(MR-H-BN)
–9999 to 9999 mv</td><td colspan="4">(MR-J2S-B/MR-J2-B)
–999 to 999 mv</td><td>0</td><td>mv</td><td>• Set the offset value for motion output 1.</td><td rowspan="2">4.3.16</td></tr>
<tr><td>2</td><td>Motion output 2 offset</td><td colspan="4">(MR-H-BN)
–9999 to 9999 mv</td><td colspan="4">(MR-J2S-B/MR-J2-B)
–999 to 999 mv</td><td>0(Note-2)</td><td>mv</td><td>• Set the offset value for motion output 2.</td></tr>
<tr><td>3</td><td>Pre-alarm data selection (sampling time selection)</td><td colspan="8">0: 1.77
1: 3.55
2: 7.11
3: 14.2
4: 28.4</td><td>0</td><td>ms</td><td rowspan="3">• Set the analog data output when an alarm occurs.</td><td rowspan="3">4.3.17</td></tr>
<tr><td>4</td><td>Pre-alarm data selection (data selection 1)</td><td colspan="8" rowspan="2">0: Speed (±)
1: Torque (±)
2: Speed (+)
3: Torque (+)
4: Current command output
5: Command FΔT
6: Droop pulse 1/1
7: Droop pulse 1/4
8: Droop pulse 1/16
9: Droop pulse 1/32</td><td>0</td><td>—</td></tr>
<tr><td>5</td><td>Pre-alarm data selection (data selection 2)</td><td>1</td><td>—</td></tr>
<tr><td>6</td><td>Zero speed</td><td colspan="8">0 to 10000 r/min</td><td>10000</td><td>r/min</td><td>• Set the speed at which the motor speed is judged to be "0".</td><td>4.3.18</td></tr>
<tr><td>7</td><td>Excessive error alarm level</td><td colspan="8">1 to 1000kPLS</td><td>80</td><td>kPLS</td><td>• Set the value at which an excessive droop pulses alarm is output.</td><td>4.3.19</td></tr>
<tr><td>8</td><td>Close encoder rotation direction</td><td colspan="12" rowspan="2">Unusable</td></tr>
<tr><td>9</td><td>Home position return reference encoder</td></tr>
<tr><td>10</td><td>Optional function 5 (PI-PID control switching)</td><td colspan="8">0: Invalid
1: Switching in accordance with droop during position control valid
2: Speed amplifier proportional control valid</td><td>0</td><td>—</td><td>• Set the conditions for PI-PID control switching.</td><td rowspan="2">4.3.20</td></tr>
<tr><td>11</td><td>Optional function 5 (Servo readout characters)</td><td colspan="8">0: Japanese
1: English</td><td>0</td><td>—</td><td>• Set the display format for the parameter unit.</td></tr>
<tr><td>12</td><td>PI-PID switching position droop</td><td colspan="8">0 to 50000 PLS</td><td>0</td><td>PLS</td><td>• Set the amount of position droop at the switch to PI-PID control when position control is executed.</td><td>4.3.21</td></tr>
<tr><td>13</td><td>Torque control compensation factor(Note-1)</td><td colspan="8">–19 to 9979</td><td>0</td><td>—</td><td>• Set to expand the torque control range up to the speed limit value in torque control.</td><td>4.3.22</td></tr>
<tr><td>14</td><td>Speed differential compensation</td><td colspan="8">0 to 1000</td><td>980</td><td>—</td><td>• Set the differential compensation value for the actual speed loop.</td><td>4.3.23</td></tr>
</table>

(Note-1): Cannot be set when using MR-J2S-B/MR-J2-B.
(Note-2): For MR-J2S-B/MR-J2-B, the default is "1".

Table 4.4 Servo Parameters (Expansion 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">Expla-natory Section</th></tr>
<tr><th colspan="2">mm</th><th colspan="2">inch</th><th colspan="2">degree</th><th colspan="2">PULSE</th><th rowspan="2">Initial Value</th><th rowspan="2">Units</th></tr>
<tr><th>Setting Range</th><th>Units</th><th>Setting Range</th><th>Units</th><th>Setting Range</th><th>Units</th><th>Setting Range</th><th>Units</th></tr>
<tr><td>15</td><td>Number of gear teeth at motor side</td><td colspan="12" rowspan="3">Unusable</td></tr>
<tr><td>16</td><td>Number of gear teeth at machine side</td></tr>
<tr><td>17</td><td>Number of closed encoder pulses</td></tr>
</table>

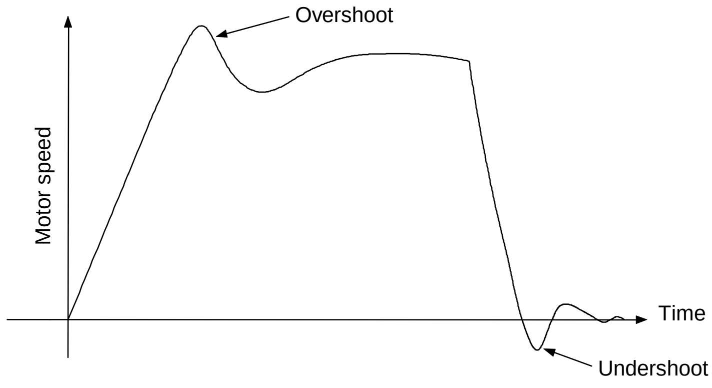
POINT

(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).

<table>
<tr><th>Servo Error Code</th><th>Error Contents</th><th>Processing</th></tr>
<tr><td>2613</td><td>Initial parameter error
(position control gain 1)</td><td rowspan="5">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.</td></tr>
<tr><td>2614</td><td>Initial parameter error
(speed control gain 1)</td></tr>
<tr><td>2615</td><td>Initial parameter error
(position control gain 2)</td></tr>
<tr><td>2616</td><td>Initial parameter error
(speed control gain 2)</td></tr>
<tr><td>2617</td><td>Initial parameter error
(speed integral compensation)</td></tr>
</table>

4.3.2 Position control gain 1, 2

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



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

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

POINTS

(1) If the position control gain 1 setting is too low, the number of droop pulses will increase and a servo error (excessive error) will occur at high speed.
(2) The position control gain 1 setting can be checked from a peripheral device.
(For the method used to execute this check, refer to the operating manual for the peripheral device used.)

4.3.3 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 4.5 below.

Table 4.5 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.)

4.3.4 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 4.6 below.

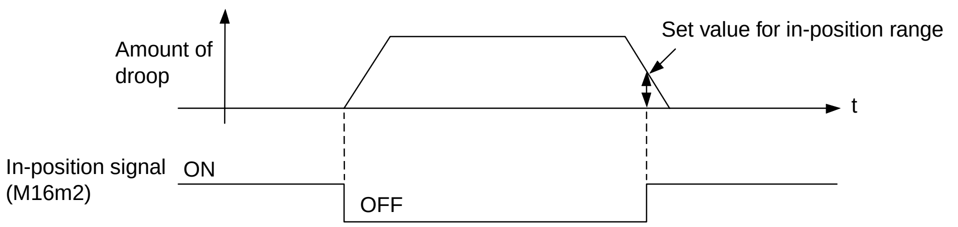
Table 4.6 Guide to Speed Integral Compensation Setting

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)

4.3.5 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 (M1602 + 20n) will come ON when the difference between the position command and position feedback from the servomotor enters the set range.



4.3.6 Feed forward gain

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

When using an MR-□-B..................0 to 100 (%)

4.3.7 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.

4.3.8 Automatic tuning

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

4.3.9 Servo responsiveness setting

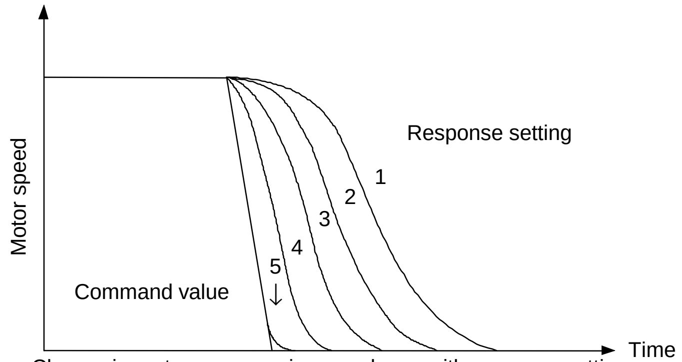
(1) This parameter setting is used to increase servo responsiveness.
Changing the set value to a higher value in the sequence 1, 2..., 5 improves servo responsiveness.
For machines with high friction, use the set values in the range 8 through C.

Response settings

Setting	Response	Machine	Mode
1:	Low-speed response	Normal machine (MR-□-B usable)	Standard mode
2:	↕		
3:			
4:			
5:	High-speed response		
8:	Low-speed response	Machines with high friction	High frictional load mode
9:	↕		
A:			
B:			
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.

4.3.10 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

4.3.11 Electromagnetic brake sequence

This parameter sets the time delay between actuation of the electromagnetic brake and base disconnection.

4.3.12 Monitor output mode

This parameter is set to output the operation status of the servo amplifier in real time as analog data.
This analog output makes it possible to check the operation status.

Number of monitored item .... 2 types

4.3.13 Optional function 1 (carrier frequency selection)

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

(2) Encoder type
Set the type of encoder cable used.

| 0 | | | 0 |

Carrier frequency selection
0: 2.25 kHz (non low-noise)
3: 9 kHz (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-J2S-B/MR-J2-B)
The external emergency stop signal (EMG) can be made invalid.
0: External emergency stop signal is valid.
1: External emergency stop signal is invalid (automatically turned ON internally).
Since the emergency stop signal at the MR-J2-B cannot be used, do not set "0".

4.3.14 Optional function 2 (no-motor operation selection)

(1) Selection of no-motor operation
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 PLC CPU without connecting a motor.

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

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

(3) Selection of microvibration suppression function (applies to MR-J2S-B/MR-J2-B)
Set to suppress vibration specific to the servo system on stopping.
0: Microvibration suppression control is invalidated
1: Microvibration suppression control is valid

(4) Motor lock operation (applies only when using MR-J2S-B/MR-J2-B)
Allows test operation with the motor connected but without rotating the motor.
The operation is the same as no-motor operation with MR-H-BN.
0: Motor lock operation is invalidated
1: Motor lock operation is valid
When motor lock operation is made valid, operation is possible without connecting the motor. However, since when MR-J2S-B/MR-J2-B is used the connected motor is automatically identified before operation is started, if no motor is connected the connected motor type may be regarded as a default, depending on the type of amplifier. If this default motor type differs from the setting made in the system settings, the controller will detect minor error 900 (motor type in system settings differs from actually mounted motor), but this will not interfere with operation.

4.3.15 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.

4.3.16 Pre-alarm data selection

Used to output from the servo amplifier in analog form the data status when an alarm occurs.

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

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

0			

Data selection 2 / Data selection 1
- 0:Speed (±)
- 1: Torque (±)
- 2: Speed (+)
- 3: Torque (+)
- 4: Current command output
- 5: Command 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]

4.3.17 Zero speed

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

4.3.18 Excessive error alarm level

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

4.3.19 Optional function 5

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

(2) Servo readout characters
When the optional parameter unit is connected, set whether the screen display on the parameter unit will be in Japanese or English.

4.3.20 PI-PID switching position droop

This parameter sets the amount of position droop on switching to PI-PID control during position control.
The setting becomes effective when switching in accordance with the droop during position control is made valid by the setting for PI-PID control switching made using optional function 5.

4.3.21 Torque control compensation factor

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

4.3.22 Speed differential compensation

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

4.4 Parameter Block

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

(2) A maximum of 16 blocks can be set as parameter blocks.

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

(4) The parameter block settings to be made are shown in Table 4.7.

Table 4.7 Parameter Block Settings

No.	Item	Setting Range								Default		Remarks	Expla-natory Section
		mm		inch		degree		PULSE					
		Setting Range	Units	Setting Range	Units	Setting Range	Units	Setting Range	Units	Initial Value	Units		
1	Interpolation control unit	0	—	1	—	2	—	3	—	3	—	• Set the units for compensation control. • Can also be used as the units for the command speed and allowable error range for circular interpolation set in the servo program.	7.1.4
2	Speed limit value	0.01 to 6000000.00	mm/min	0.001 to 600000.000	inch/min	0.001 to 2147483.647	degree/min	1 to 1000000	PLS/s	200000	PLS/s	• Set the maximum speed for positioning/zeroing • If the positioning speed or zeroing speed setting exceeds the speed limit value, control is executed at the speed limit value.	4.4.1
3	Acceleration time	1 to 65535ms								1000	ms	• Set the time taken to reach the speed limit value from the start of motion.	
4	Deceleration time	1 to 65535ms								1000	ms	• Set the time taken to stop from the speed limit value.,	
5	Rapid stop deceleration time	1 to 65535ms								1000	ms	• Set the time taken to stop from the speed limit value when a rapid stop is executed.	
6	S-curve ratio	0 to 100%								0	%	• Set the S curve ratio for S pattern processing. • When the S curve ratio is 0%, trapezoidal acceleration/deceleration processing is executed.	4.4.2
7	Torque limit value	1 to 500%								300	%	• Set the torque limit value in the servo program.	—
8	Deceleration processing on STOP input	0: Deceleration stop executed based on the deceleration time. 1: Deceleration stop executed based on the rapid stop deceleration time.								0	—	• Set the deceleration processing when external signals (STOP, FLS, RLS) are input.	—
9	Allowable error range for circular interpolation	0 to 10000.0	μm	0 to 1.00000	inch	0 to 1.00000	degree	0 to 100000	PLS	100	PLS	• Set the permissible range for the locus of the arc and the set end point coordinates.	4.4.3

POINTS

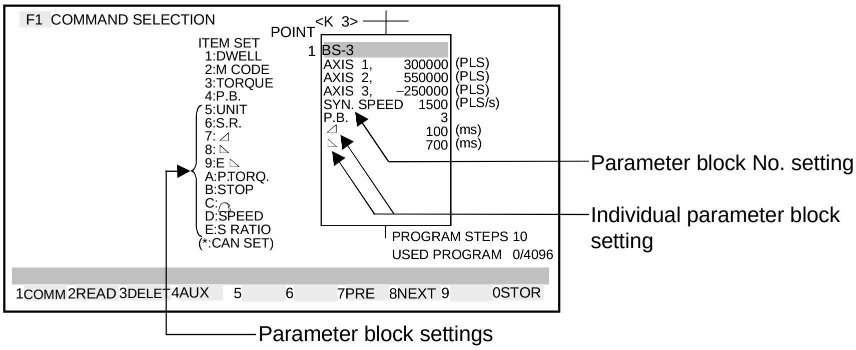
(1) Parameter blocks are designated in the zeroing data, JOG operation data, or servo program.
(2) The various parameter block data can be changed in the servo program. (See Section 6.3.)

POINT

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

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

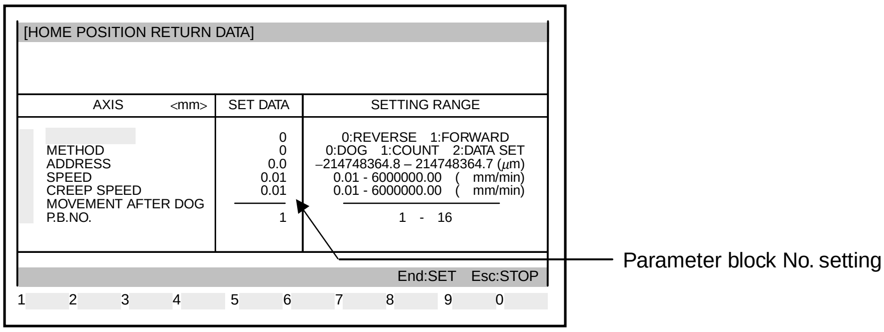
[Servo program creation screen]



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

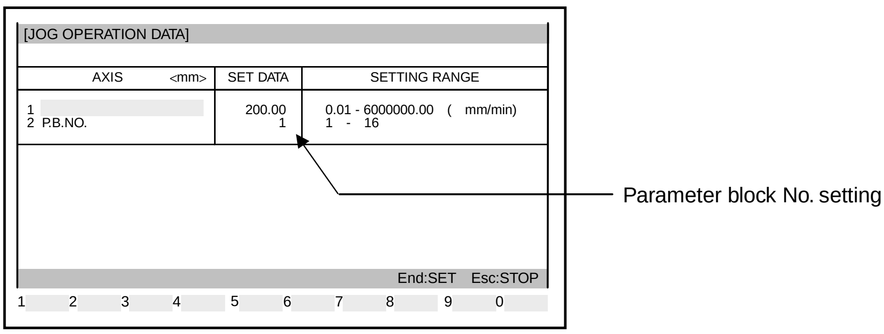
(b) The parameter block No. used for home position return is set when setting the "home position return data" with a peripheral device.

[Zeroing data setting screen]



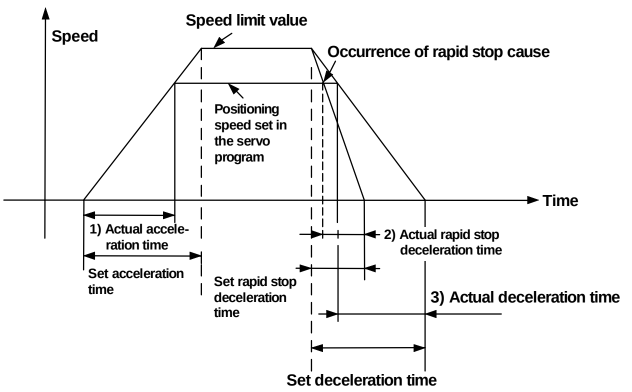
(c) The parameter block No. used for JOG operation is set when setting the "JOG operation data" with a peripheral device.

[JOG operation data setting screen]



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

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



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

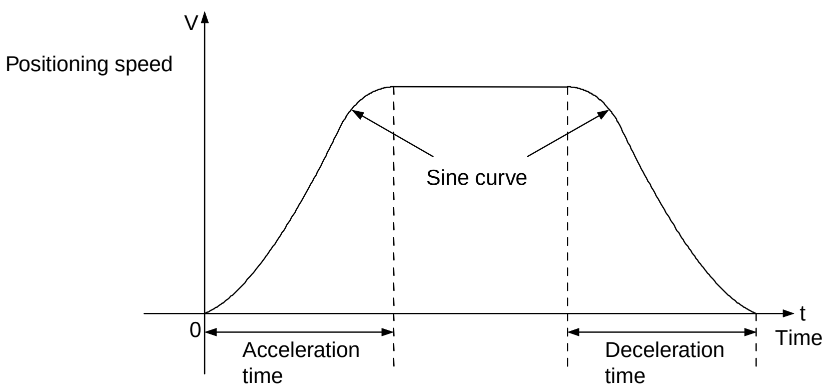
2) Actual rapid stop deceleration time
   Time taken to effect a rapid stop from the positioning speed set in the servo program

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

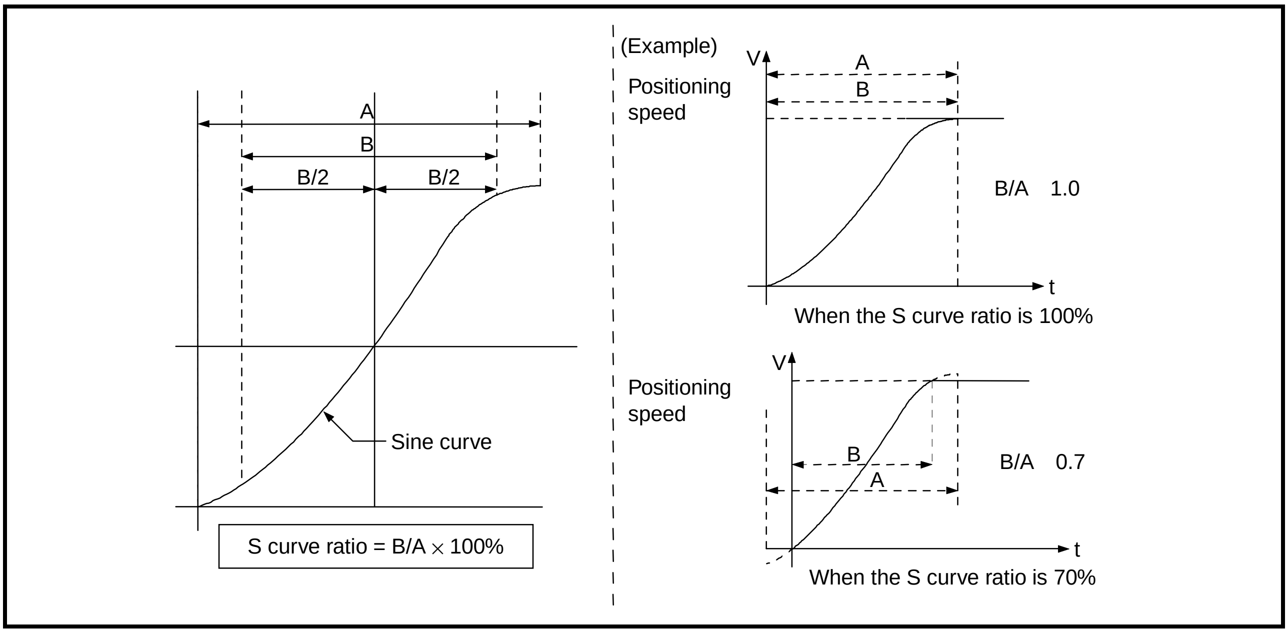
Fig. 4.6 Relationships among the Speed Limit Value, Acceleration Time, Deceleration Time, and Rapid Stop Deceleration Time

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.

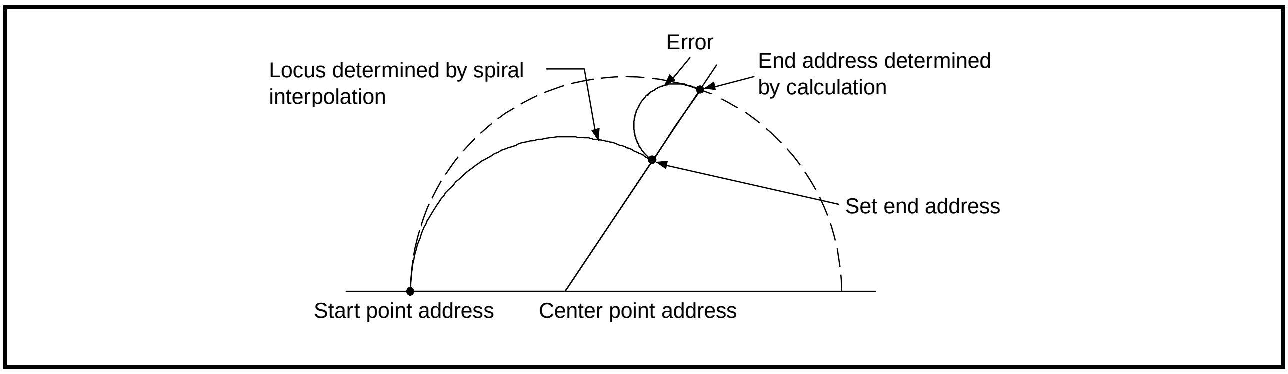


Fig. 4.7 Spiral Interpolation

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 current 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) Operation error flag (M9010, M9011) is turned ON.
(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.
Internal relays	M1600 to M2047
Data registers	D800 to D1023
Special relays	M9073 to M9079
Special registers	D9180 to D9199

Note that internal relays (M1600 to M2047) and data registers (D800 to D1023) will not be latched even if a latch range setting is made for them. (The device symbols for M1600 to M2047 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/SW0IX-CAMPE Operating Manual (IB-67398)
SW2SRX-GSV22PE/SW0IX-CAMPE Operating Manual (IB-67399)

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.

5.2.1 Start request instruction for 1 to 3 axes (DSFRP)

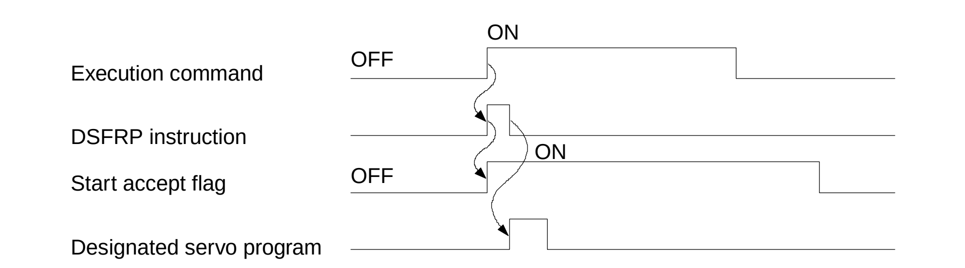
	Usable Devices																					Digit Designation	Number of Steps	Subset	Index	Carry Flag	Flag Error	
	Bit Devices							Word (16 Bit) Devices									Constants		Pointers		Level							
	X	Y	M	L	S	B	F	T	C	D	W	R	A0	A1	Z	V	K	H	P	I	N					M9012	M9010	M9011
(D)										○													7		×		○	○
n							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

SEQUENCE PROGRAM

	Setting data	Setting range		
(D)	No. of axis to be started	D1 to D8 (A172SHCPUN) D1 to D4 (A171SHCPUN)		
n	No. of servo program to be executed	Direct designation	0 to 4095	
		Indirect designation	Decimal	K30000 to K30799
			Hexadecimal	H7530 to H784F

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

- The start accept flag (M2001+n) 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 to interpolation to be started ...... Make the setting for 2 axes (2 digits)
- 3-axis to interpolation to be started ...... Make the setting for 3 axes (3 digits)

Designate started axis numbers 1 to 4 for an A171SHCPUN, or 1 to 8 for an A172SHCPUN (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 axis3 ....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) K $\boxed{3}\boxed{0}\boxed{0}\boxed{}\boxed{}$

→ Designation of the data register number 3 digits must be set.
(000 to 799) .... 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"

[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 8 (A172SHCPUN).
- When the axis number given in any digit of (D) is a number other than 1 to 4 (A171SHCPUN).
- 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).

POINTS

(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).

(2) "D" is used as a device symbol for (D), but it does not relate to data register numbers in the sequence program.

(3) For sequence programs using the DSFRP instruction for servo program start, see Section 6.5.

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

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

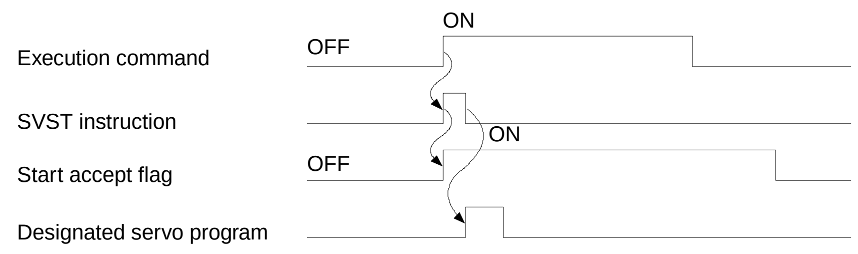
*1: Possible with indirect setting only

SEQUENCE PROGRAM

	Setting data	Setting range	
(D)	J+No. of axis to be started	J1 to J8 (A172SHCPUN) J1 to J4 (A171SHCPUN)	
n	No. of servo program to be executed	Direct designation	0 to 4095
		Indirect designation (1 word)	D0 to D799 W0 to W3FF R0 to R8191

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

- The start accept flag (M2001+n) corresponding to the axis designated in (D) is turned ON (see Section 3.2.2).
- 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.

○ Setting for 1 to 8 axes(A172SHCPUN)
○ Setting for 1 to 4 axes (A171SHCPUN)
· 1 axis to be started ·················· Make the setting for 1 axis (J**)
· 2-axes interpolation to be started ······ Make the setting for 2 axis (J** J**)
· 3-axes interpolation to be started ······ Make the setting for 3 axis (J** J** J**)
· 4-axes interpolation to be started ······ Make the setting for 4 axis (J** J** J** J**)
· Simultaneous start··················· Make the setting for 2 to 4 axis
○ Designate J + started axis number 1 to 8 for an A172SHCPUN.
○ Designate J + started axis number 1 to 4 for an A171SHCPUN.

· 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 axis3 .... J1J2J3
- Axis 1, axis 2, axis3, and axis4............... J1J2J3J4

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

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

Example

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

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

Word Device	Usable Devices
D	0 to 799
W	0 to 3FF
R	0 to 8191

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: J1J3).

Example

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

- Designation with a word device

SVST	J1J2J3	D50

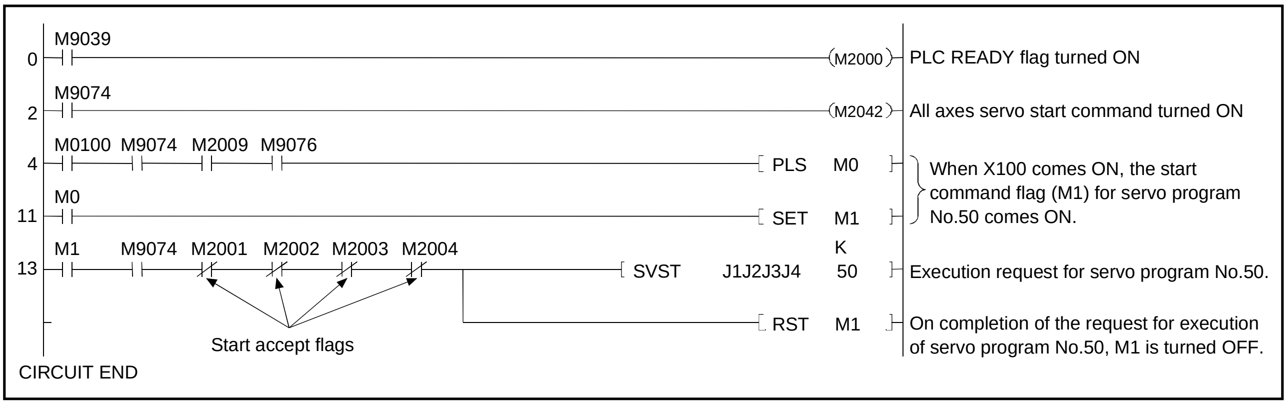
2) An index register (Z, V) can be used for index designation of the indirectly set word device.
   - For details on index registers (Z, V), see the ACPU Programming Manual (Fundamentals) (IB-66249).

[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 (A171SHCPUN).
- When the setting for (D) is for 8 or more axes (A172SHCPUN).
- When the axis number given in any digit of (D) is a number other than J1 to J4 (A171SHCPUN).
- When the axis number given in any digit of (D) is a number other than J1 to J8 (A172SHCPUN).
- When the same axis number is set twice in (D).
- When the setting for n is outside the applicable range.

[Program example]



5.3 Current Value Change Instructions (DSFLP/CHGA)

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

5.3.1 DSFLP instruction

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

SEQUENCE PROGRAM

	Setting data	Setting range
(D)	No. of currentt value change axis	D1 to D8 (A172SHCPUN) D1 to D4 (A171SHCPUN)
n	Current value change designation	K0 or H0

(1) The following processing is executed at the leading edge (OFF→ON) of the DSFLP instruction:
 1) The start accept flag (M2001 to M2008/M2001 to M2004) corresponding to the axis designated in (D) is turned ON.
 2) The current value is changed to the contents of the current value change register for the axis designated in (D).
 3) On completion of the current value change, the start accept flag is turned OFF.

(2) The numbers of registers used for current value change are indicated in the table below. (For details, see Section 3.2.2)

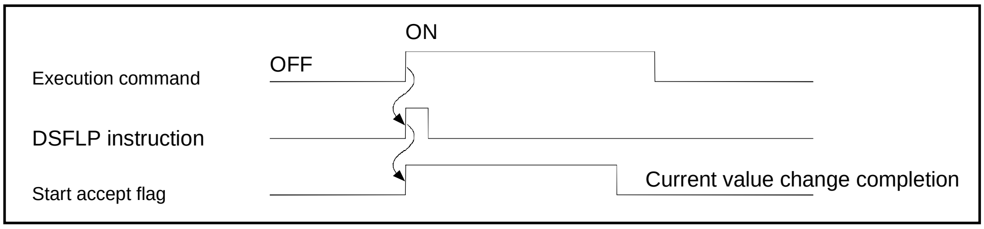
<A172SHCPUN>

Axis No.	Current Value Change Registers	
	Upper	Lower
Axis 1	D961	D960
Axis 2	D967	D966
Axis 3	D973	D972
Axis 4	D979	D978
Axis 5	D985	D984
Axis 6	D991	D990
Axis 7	D997	D996
Axis 8	D1003	D1002

<A171SHCPUN>

Axis No.	Current Value Change Registers	
	Upper	Lower
Axis 1	D961	D960
Axis 2	D967	D966
Axis 3	D973	D972
Axis 4	D979	D978

[Operation Timing]



[Data Settings]

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

D □

→ Started axis No.
· The relevant axis No. can be set in the range 1 to 4 or 1 to8.
· Set the interpolation control time for one of the axes controlled in interpolation.

→ Device symbol (only D can be set)

Example

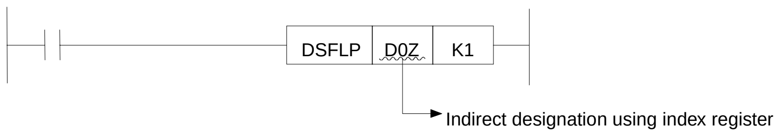
The started axis is designated as follows.

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

(2) Current value change
The setting for a current value change is as follows.
- Current value change.............Set K0 or H0.

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]

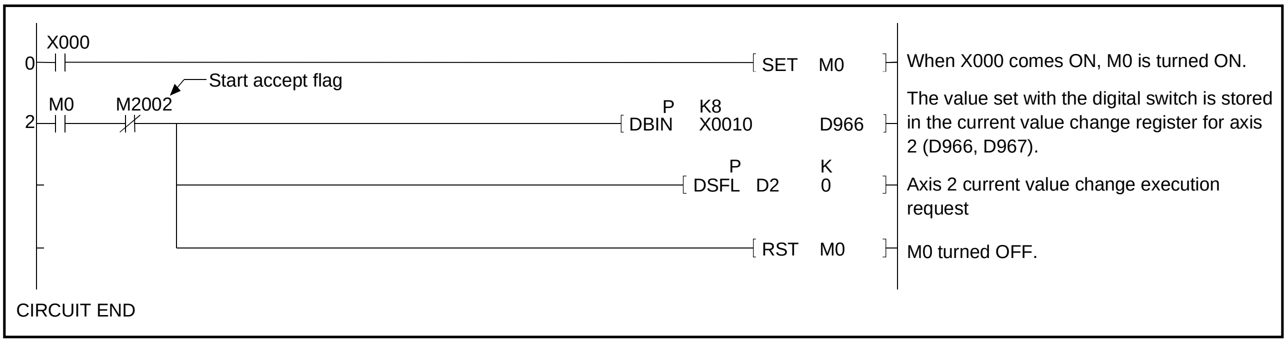
(1) In the following cases, an operation error occurs and the DSFLP instruction is not executed.
- When the setting for (D) is other than 1 to 4 or 1 to 8.
- When the setting for n is a value other than 1 or 0.
- When the setting for (D) or n has been indirectly designated using an index register (Z,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

(2) In the following cases, a minor error (error on control change) occurs and the current value change is not executed.
When this happens, the error detection flag (M1607+20n) is turned ON and the error code is stored in the minor error code area for the relevant axis.
- When the axis designated in (D) for the current value change is in motion.

[Program Example]

(1) The program shown below changes the current 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) Current value change command................... Leading edge (OFF→ON) of X000
    3) Current 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)

(2) Program example.



5.3.2 CHGA instructions

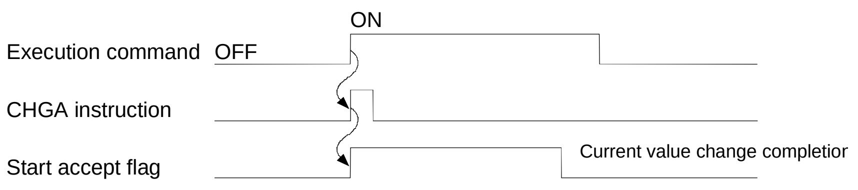
	Usable Devices																					Digit Designation	Number of Steps	Subset	Index	Carry Flag	Flag Error	
	Bit Devices							Word (16 Bit) Devices									Constants		Pointers		Level							
	X	Y	M	L	S	B	F	T	C	D	W	R	A0	A1	Z	V	K	H	P	I	N					M9012	M9010	M9011
(D)																							7		○		○	○
n								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

SEQUENCE PROGRAM

	Setting data	Setting range	
(D)	J + No. of current value change axis	J1 to J8 (A172SHCPUN) J1 to J4 (A171SHCPUN)	
n	Setting of current value to be changed	Direct designation	mm : -2147483648 to 2147483647 ×$10^{-1}$$\mu$m inch : -2147483648 to 2147483647 ×10^{-5}inch deg : 0 to 35999999 ×10^{-5}deg PLS : -2147483648 to 2147483647 PLS
		Indirect designation	D0 to D799 W0 to W3FF R0 to R8191

(1) The following processing is executed at the leading edge (OFF→ON) of the CHGA instruction:
1) The start accept flag (M2001 to M2008/M2001 to M2004) corresponding to the axis designated in (D) is turned ON.
2) The current value of the axis designated in (D) is changed to the current value designated in n.
3) On completion of the current value change, the start accept flag is turned OFF.

[Operation Timing]



[Data Settings]

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

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 current value change
There are two types of setting for current value changes: direct setting and indirect setting.

(a) In direct setting, the current value 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 current value to be changed "10", the setting is as follows.

- When designated with a K device................ K10

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

Word Device	Usable Devices
D	0 to 799
W	0 to 3FF
R	0 to 8191

Example

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

- Designation with a word device

CHGA	J11	D50

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

[Error Details]

(1) In the following cases an operation error occurs and the CHGA instruction is not executed.
- When the setting for (D) is other than J1 to J8/J1 to J4.

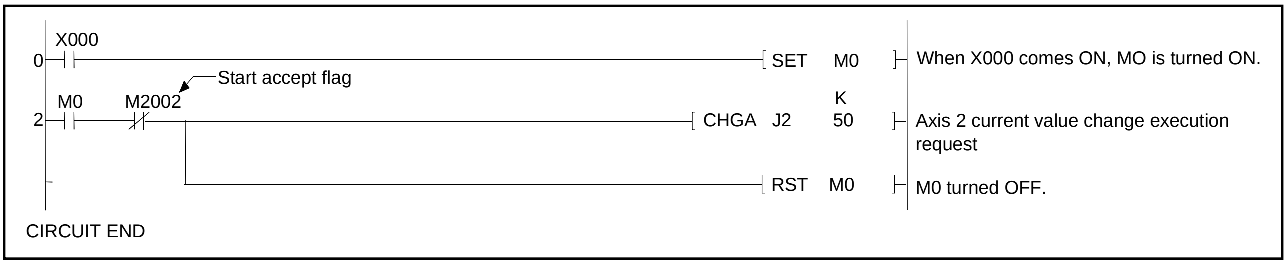
(2) In the following cases, a minor error (error on control change) occurs and the current value change/speed change is not executed.
When this happens, the error detection flag (M1607+20n) is turned ON and the error code is stored in the minor error code area for the relevant axis.
- When the axis designated in (D) for the current value change is in motion.

[Program Example]

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

(1) Conditions
1) Current value change command .... Leading edge (OFF→ON) of X000
2) Current value change execution flag M0
3) Axis 2 start accept flag
(used to determine whether axis 2 is stopped or in motion).. M2002 (axis 2 start accept flag)

(2) Program example



5.4 Speed Change Instructions (DSFLP/CHGV)

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

5.4.1 DSFLP instruction

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

SEQUENCE PROGRAM

	Setting data	Setting range
(D)	No. of speed change axis	D1 to D8 (A172SHCPUN) D1 to D4 (A171SHCPUN)
n	Speed change designation	K1 or H1

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

(a) Current value change

1) The speed change in progress (M2021 to M2028/M2021 to M2024) 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 current value change and speed change operations are indicated in the table below. (For details, see Section 3.2.2.)

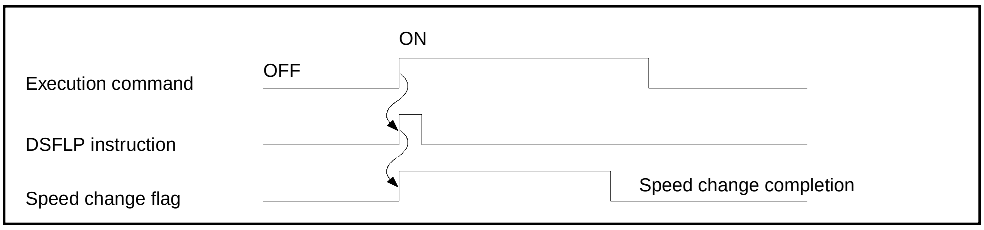
<A172SHCPUN>

Axis No.	Speed Change Registers	
	Upper	Lower
Axis 1	D963	D962
Axis 2	D969	D968
Axis 3	D975	D974
Axis 4	D981	D980
Axis 5	D987	D986
Axis 6	D993	D992
Axis 7	D999	D998
Axis 8	D1005	D1004

<A171SHCPUN>

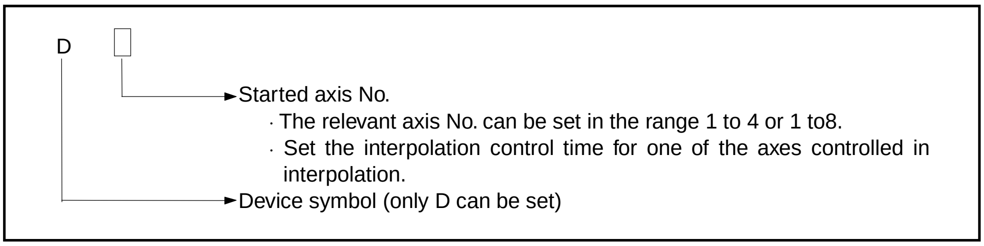
Axis No.	Speed Change Registers	
	Upper	Lower
Axis 1	D963	D962
Axis 2	D969	D968
Axis 3	D975	D974
Axis 4	D981	D980

[Operation Timing]



[Data Settings]

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



Example

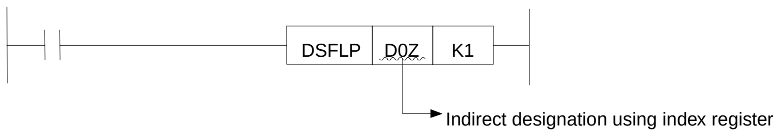
The started axis is designated as follows.

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

(2) Speed change
The setting for a present value change/speed change is as follows.
- 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 8/1 to 4.
- When the setting for n is a value other than 1.
- When the setting for (D) or n has been indirectly designated using an index register (Z, V).

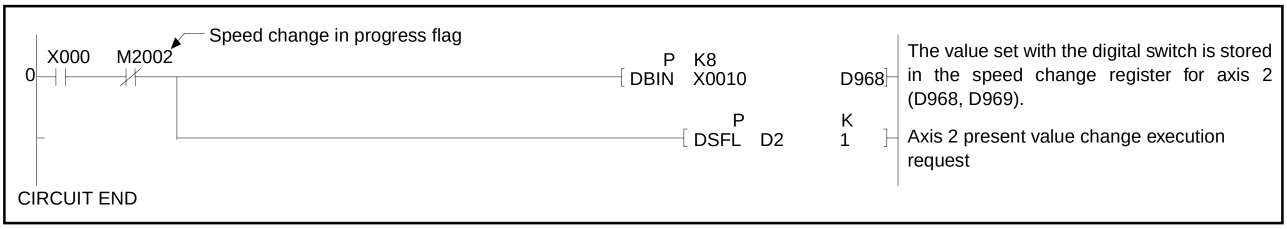
(2) In the following cases, a minor error (error on control change) occurs and the present value change/speed change is not executed.
When this happens, the error detection flag (M1607+20n) is turned ON and the error code is stored in the minor error code area for the relevant axis.
- When the axis designated in (D) is executing zeroing when the speed change is made.
- When the axis designated in (D) is decelerating when the speed change is made.
- When the absolute value of speed designated in n exceeds the speed limit value when the speed change is made.

[Program Example]

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

(1) Conditions
1) Numbers of inputs for the digital switch......... X010 to X02F
2) Speed Change command............................. Leading edge (OFF→ON) of X000

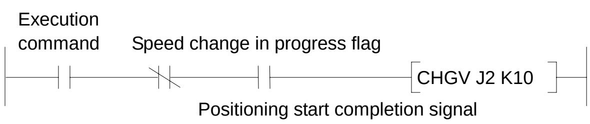
(2) Program example

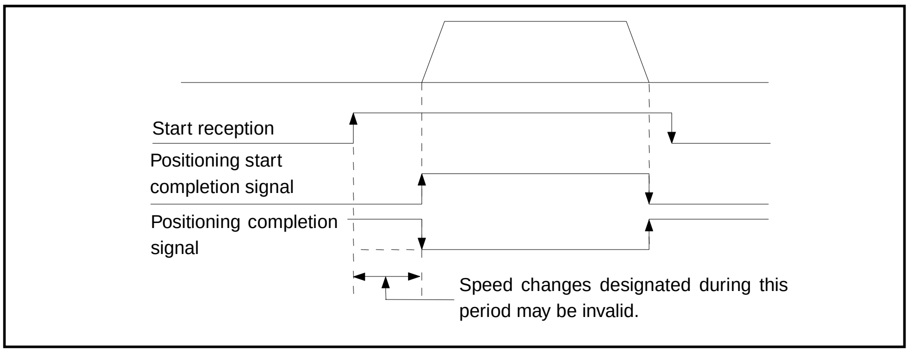


POINT

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





5.4.2 CHGV instructions

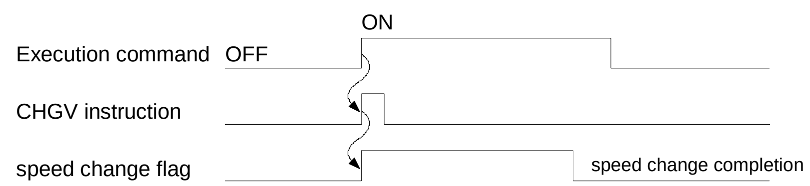
	Usable Devices																				Digit Designation	Number of Steps	Subset	Index	Carry Flag	Flag Error	
	Bit Devices							Word (16 Bit) Devices									Constants		Pointers		Level							
	X	Y	M	L	S	B	F	T	C	D	W	R	A0	A1	Z	V	K	H	P	I	N					M9012	M9010	M9011
(D)																							7		○		○	○
n									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

SEQUENCE PROGRAM

	Setting data	Setting range	
(D)	J + No. of current value change axis	J1 to J8 (A172SHCPUN) J1 to J4 (A171SHCPUN)	
n	Setting of current value to be changed	Direct designation	mm : –600000000 to 600000000 $\times 10^{-2}$mm/min inch : –600000000 to 600000000 $\times 10^{-3}$inch/min deg : –2147483648 to 2147483647 $\times 10^{-3}$deg/min PLS : –10000000 to 10000000 PLS/min
		Indirect designation	D0 to D799 W0 to W3FF R0 to R8191

(1) The following processing is executed at the leading edge (OFF→ON) of the CHGV instruction:
   1) The speed change flag (M2021 to M2028/M2021 to M2024) corresponding to the axis designated in (D) is turned ON.
   2) The speed of the axis designated in (D) is changed to the present value designated in n.
   3) The speed change in progress flag is turned OFF.

[Operation Timing]



[Data Settings]

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

J □□

→ Started axis No.
· Set the relevant axis No. in the range 1 to 8 or 1 to 4
· Set the interpolation control time for one of the axes involved in the interpolation.

→ Only J can be used.

Example

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

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

(a) In direct setting, the speed to be changed to is specified directly as a numerical value. (For the setting range, refer to Section 3.2.2.).

Example

If the speed to be changed "10", the setting as follows.
- When designated with a K device................ K10

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

Word Device	Usable Devices
D	0 to 799
W	0 to 3FF
R	0 to 8191

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   CHGV | J11 | D50

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

[Error Details]

(1) In the following cases an operation error occurs and the CHGA instruction is not executed.
- When the setting for (D) is other than J1 to J8/J1 to J4.

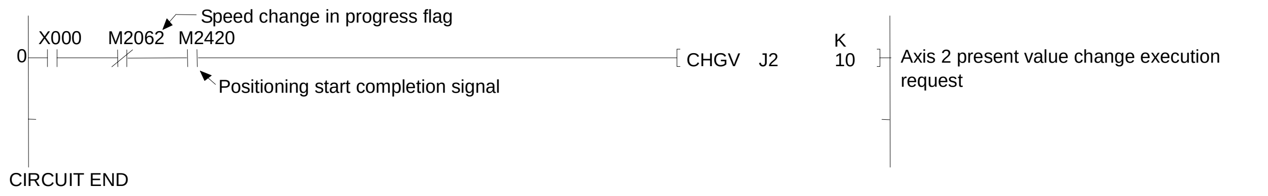
(2) In the following cases, a minor error (error on control change) occurs and the speed change is not executed.
When this happens, the error detection flag (M1607+20n) is turned ON and the error code is stored in the minor error code area for the relevant axis.
- When the axis designated in (D) is executing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

[Program Example]

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

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

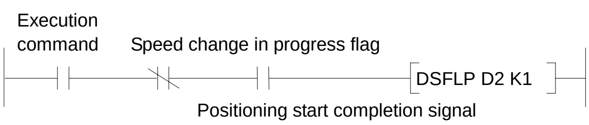
(2) Program example

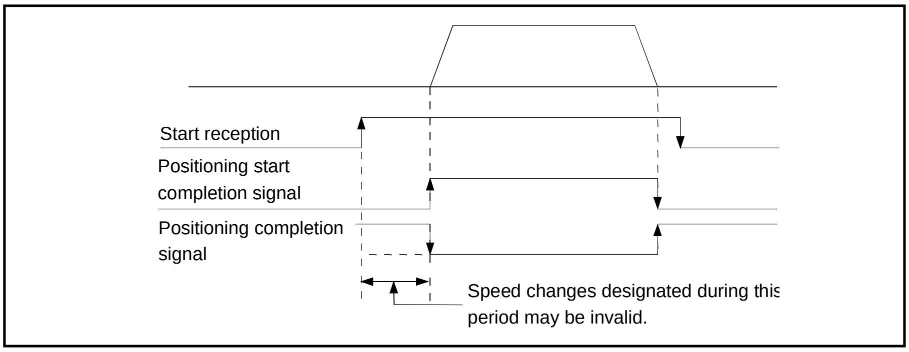


POINT

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





5.5 Retracing during Positioning

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

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

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

[Control Details]

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

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

(3) When stopping (waiting) continues at a return position, processing takes place as follows.
  (a) Signal status
  - Start accept (M2001+n) ON (remains in the status before CHGV execution)
  - Positioning start completion (M1600 + 20n) ON (remains in the status before CHGV execution)
  - Positioning completion (M1601+20n) OFF
  - In-position (M1602+20n) ON
  - Command in-position (M1603+20n) OFF
  - Speed change "0" accept flag (-) ON

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

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

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

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

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

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

[Error Details]

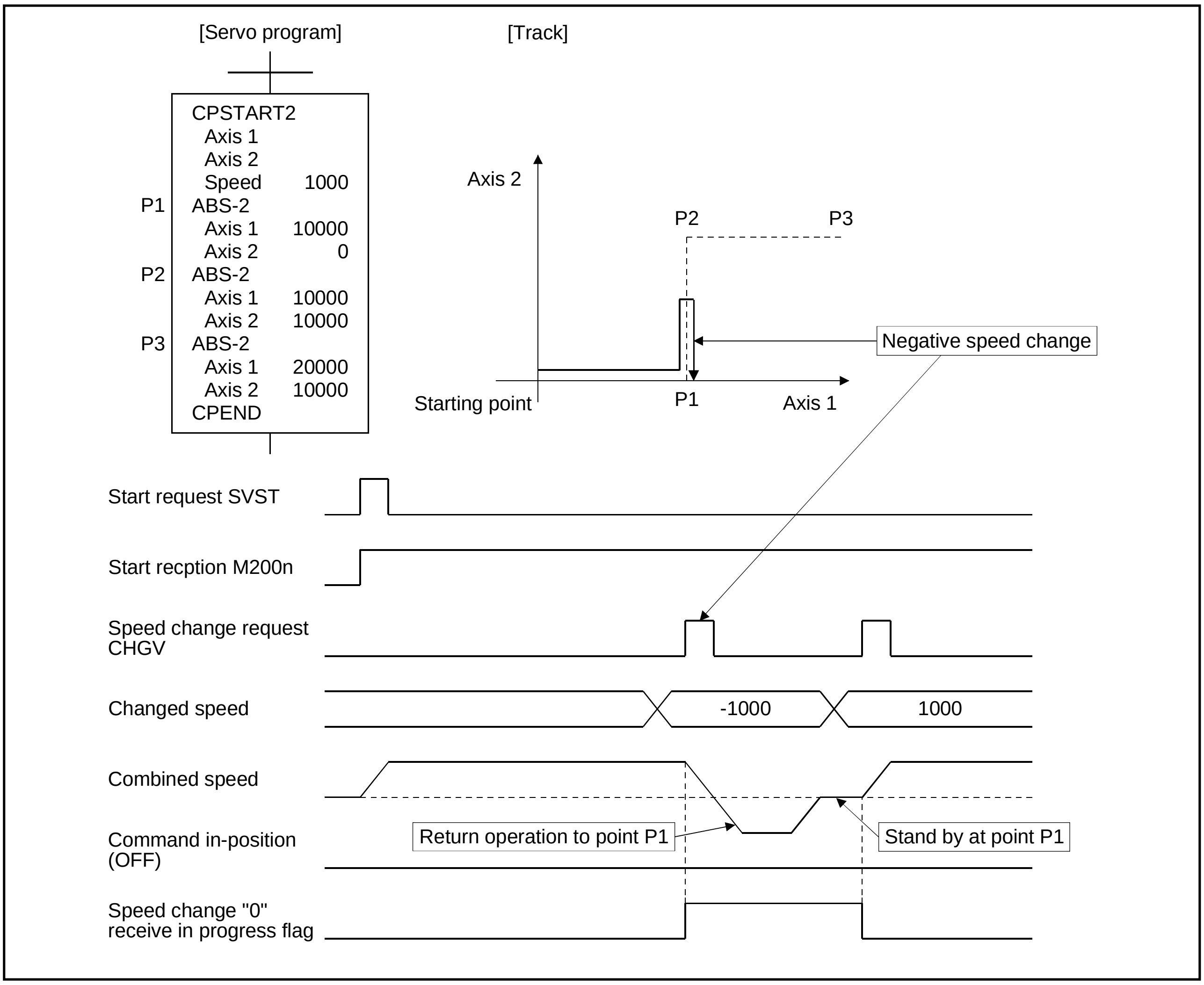
(1) While start is attempted in the control mode allowing retracing, a minor error 305 is returned and retracing is controlled according to a speed limit value so long as the absolute value of a negative change speed exceeds the speed limit value.

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

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

[Example of Operation during Constant Speed Control]

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



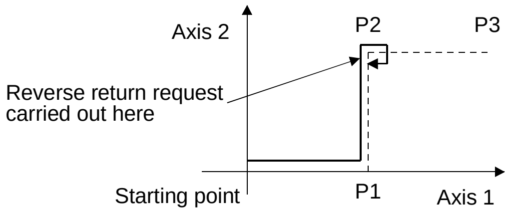
When a negative speed change is attempted during positioning to P2, retracing is performed up to P1 along the track designated in the program, then processing is suspended there.

POINTS

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

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

(3) In the A172SHCPUN and A171SHCPUN, the speed change "0" accept flag is not included in the positioning device.



5.6 Torque Limit Value Change Request (CHGT)

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

1. Torque limit value change request instruction (CHGT)

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

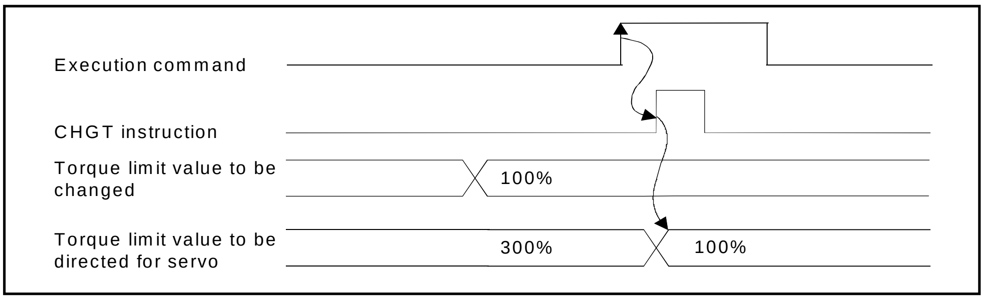
SEQUENCE PROGRAM

	Setting data	Setting range	
(D)	J + No. of torque limit value change axis	J1 to J8 (A172SHCPU) J1 to J4 (A171SHCPU)	
n	Change torque limit value	Direct designation	1 to 500 (%)
		Indirect designation (1 word)	D0 to D799 W0 to W3FF R0 to R8191

[Control Details]

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

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



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

Start

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

↓

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

↓

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

Start in progress

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

[Error Details]

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

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

5.7 SFC Programs

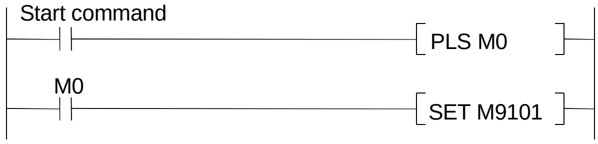
This section explains how to start servo programs using SFC programs.

5.7.1 Starting and stopping SFC programs

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

(1) Starting SFC programs

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



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

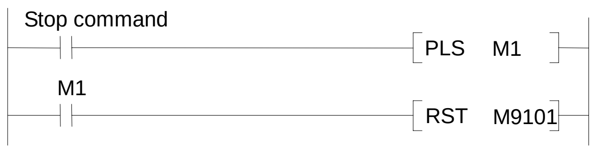
1) SFC program initial start
By turning special relay M9101 ON while special relay M9102 is OFF, the SFC program is started from the initial step of block 0.

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

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

(2) Stopping SFC programs.

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



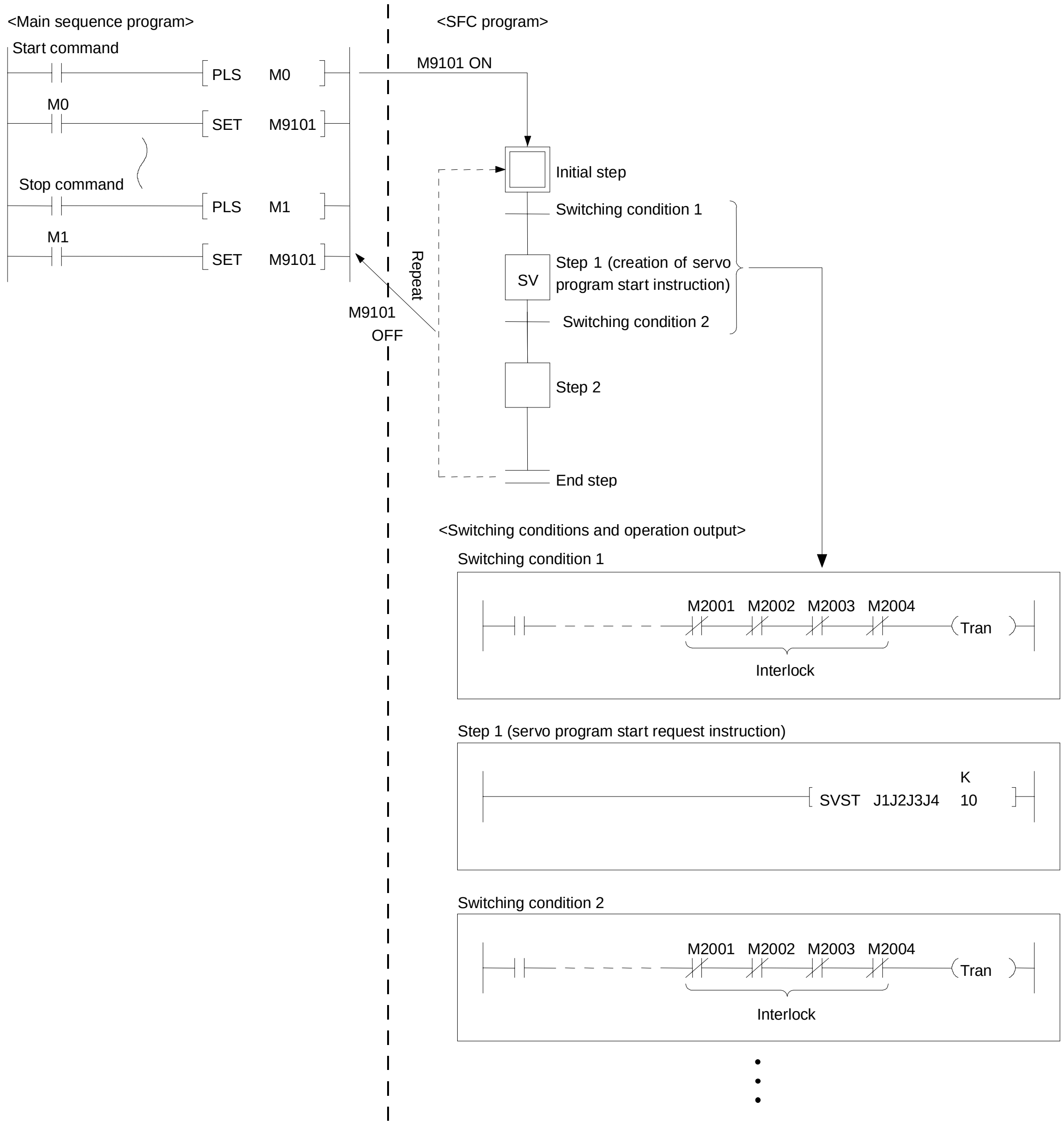
(b) When an SFC program is stopped, all the operation outputs in the step being executed are turned OFF.

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

5.7.2 Servo program start request

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

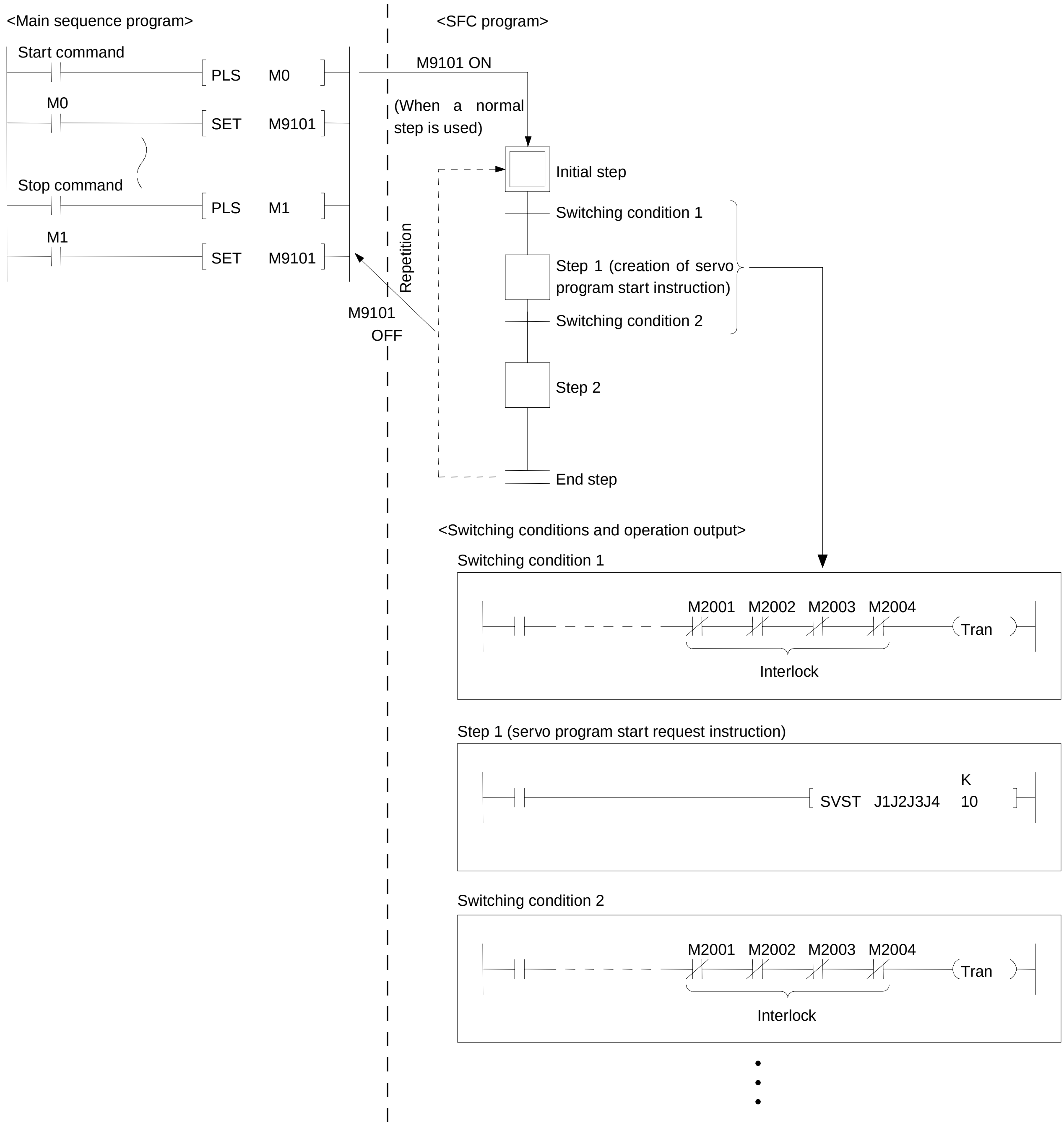
(1) When an [SV] step is created.



POINT

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



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) 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

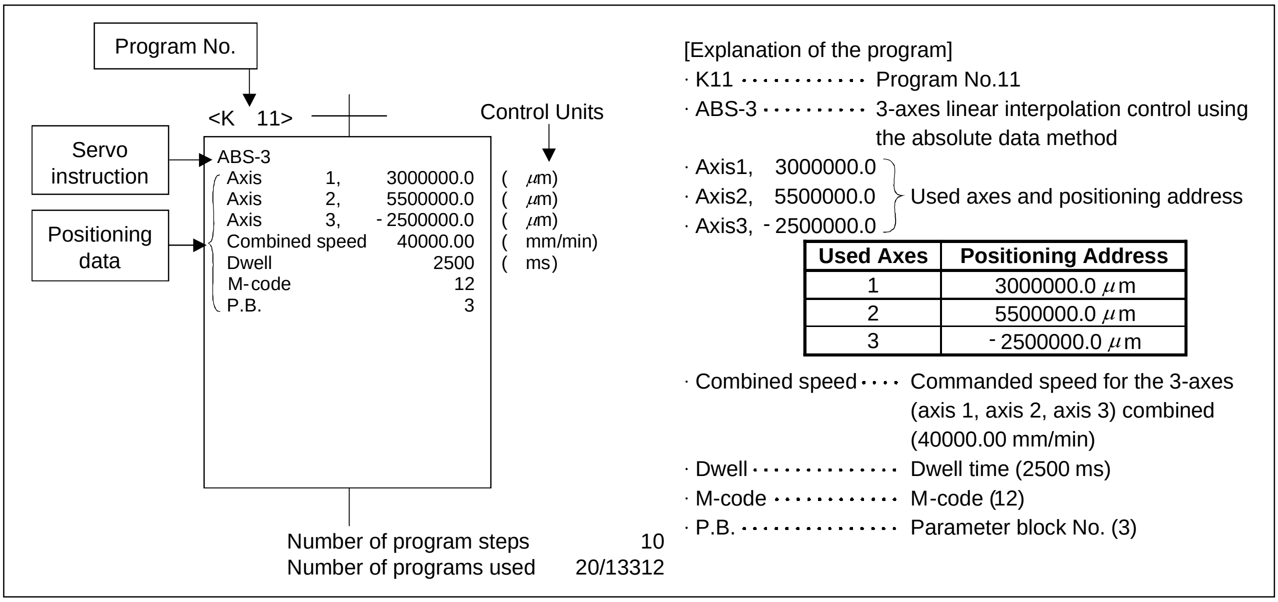
Servo programs serve to designate the type of the positioning control, and the positioning data, required to execute positioning control with the servo system CPU.
This section explains the configuration, and method for designating, servo programs.
For details on the various types of servo program, see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



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

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:

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

6.1.2 Servo program area

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

(2) Servo program capacity
The servo program area has a capacity of 13312 steps.

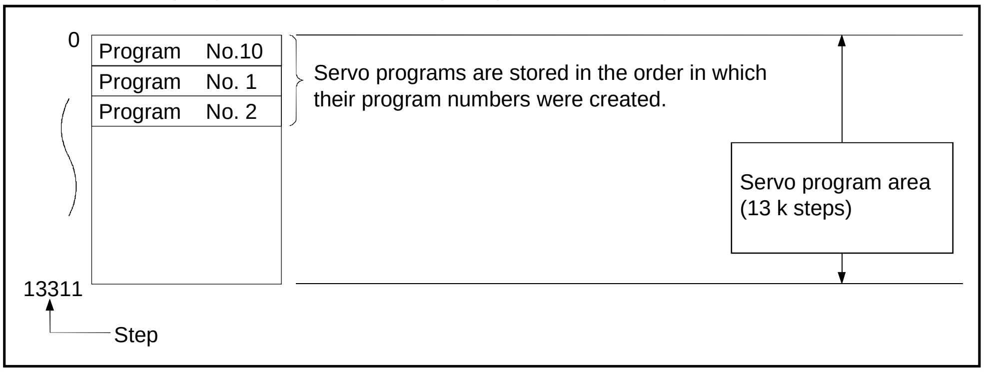


Fig. 6.2 Servo Program Area

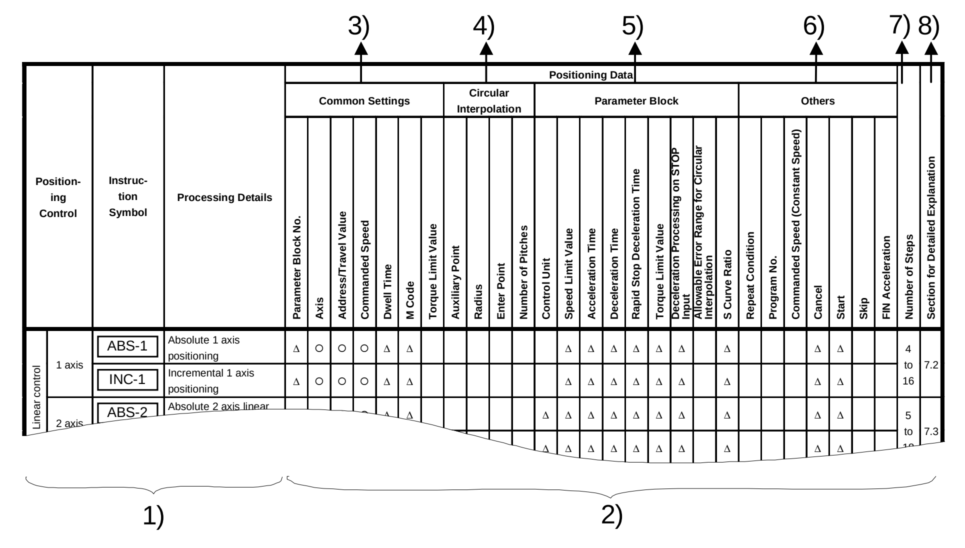
POINT
If the servo program area has insufficient capacity, execute multiple positioning control operations with one program by indirect setting of the positioning data used in the servo program. (For details on indirect setting, see Section 6.4.2.)

6.2 Servo Instructions

This section presents the servo instructions used in servo programs.

(1) How to read the servo instruction tables

Fig. 6.1 How to Read Servo Instruction Tables



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

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

Table 6.2 Servo Instruction List

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		
Linear control	1 axis	ABS-1	Absolute 1 axis positioning	Δ	○	○	○	Δ	Δ							Δ	Δ	Δ	Δ	Δ	Δ		Δ				Δ	Δ			4 to 16	7.2
		INC-1	Incremental 1 axis positioning	Δ	○	○	○	Δ	Δ							Δ	Δ	Δ	Δ	Δ	Δ		Δ				Δ	Δ				
	2 axis	ABS-2	Absolute 2 axis linear interpolation	Δ	○	○	○	Δ	Δ						Δ	Δ	Δ	Δ	Δ	Δ	Δ		Δ				Δ	Δ			5 to 18	7.3
		INC-2	Incremental 2 axis linear interpolation	Δ	○	○	○	Δ	Δ						Δ	Δ	Δ	Δ	Δ	Δ	Δ		Δ				Δ	Δ				
	3 axis	ABS-3	Absolute 3 axis linear interpolation	Δ	○	○	○	Δ	Δ						Δ	Δ	Δ	Δ	Δ	Δ	Δ		Δ				Δ	Δ			7 to 20	7.4
		INC-3	Incremental 3 axis linear interpolation	Δ	○	○	○	Δ	Δ						Δ	Δ	Δ	Δ	Δ	Δ	Δ		Δ				Δ	Δ				
	4 axis	ABS-4	Absolute 4 axis linear interpolation	Δ	○	○	○	Δ	Δ						Δ	Δ	Δ	Δ	Δ	Δ	Δ		Δ				Δ	Δ			8 to 23	7.5
		INC-4	Incremental 4 axis linear interpolation	Δ	○	○	○	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	○	○	○	Δ	Δ		○				Δ	Δ	Δ	Δ	Δ	Δ	Δ		Δ				Δ	Δ			7 to 21	7.6
		INC	Incremental circular interpolation by auxiliary point designation	Δ	○	○	○	Δ	Δ		○				Δ	Δ	Δ	Δ	Δ	Δ	Δ		Δ				Δ	Δ				
	Radius designation	ABS	Absolute circular interpolation by radius designation, within CW180°	Δ	○	○	○	Δ	Δ			○			Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ				Δ	Δ			6 to 20	7.7
		ABS	Absolute circular interpolation by radius designation, CW180° and greater	Δ	○	○	○	Δ	Δ			○			Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ				Δ	Δ				
		ABS	Absolute circular interpolation by radius designation, within CCW180°	Δ	○	○	○	Δ	Δ			○			Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ				Δ	Δ				
		ABS	Absolute circular interpolation by radius designation, CCW180° and greater	Δ	○	○	○	Δ	Δ			○			Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ				Δ	Δ				
		INC	Incremental circular interpolation by radius designation, within CW180°	Δ	○	○	○	Δ	Δ			○			Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ				Δ	Δ				
		INC	Incremental circular interpolation by radius designation, CW180° and greater	Δ	○	○	○	Δ	Δ			○			Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ				Δ	Δ				
		INC	Incremental circular interpolation by radius designation, within CCW180°	Δ	○	○	○	Δ	Δ			○			Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ				Δ	Δ				
		INC	Incremental circular interpolation by radius designation, CCW180° and greater	Δ	○	○	○	Δ	Δ			○			Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ				Δ	Δ				
	Center point designation	ABS	Absolute circular interpolation by center point designation, CW	Δ	○	○	○	Δ	Δ				○		Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ				Δ	Δ			7 to 21	7.8
		ABS	Absolute circular interpolation by center point designation, CCW	Δ	○	○	○	Δ	Δ				○		Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ				Δ	Δ				
		INC	Incremental circular interpolation by center point designation, CW	Δ	○	○	○	Δ	Δ				○		Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ				Δ	Δ				
		INC	Incremental circular interpolation by center point designation, CCW	Δ	○	○	○	Δ	Δ				○		Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ				Δ	Δ				

○ : Must be set
Δ : Set if required

Table 6.2 Servo Instruction List (Continued)

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

○ : Must be set
Δ : Set if required

Table 6.2 Servo Instruction List (Continued)

Positioning Control	Instruction Symbol	Processing Details	Positioning Data: Common Settings							Positioning Data: Circular Interpolation				Positioning Data: Parameter Block									Positioning Data: Others							Number of Steps	Section for Detailed Explanation
			Parameter Block No.	Axis	Address/Travel Value	Commanded Speed	Dwell Time	M Code	Torque Limit Value	Auxiliary Point	Radius	Enter Point	Number of Pitches	Control Unit	Speed Limit Value	Acceleration Time	Deceleration Time	Rapid Stop Deceleration Time	Torque Limit Value	Deceleration Processing on STOP Input	Allowable Error Range for Circular Interpolation	S Curve Ratio	Repeat Condition	Program No.	Commanded Speed (Constant Speed)	Cancel	Start	Skip	FIN Acceleration		
Constant speed control	ABS-1	Absolute designation of passing point for constant speed control		○	○			∆	∆																∆			∆		2 to 7	7. 16
	ABS-2			○	○			∆	∆																∆			∆		3 to 8	
	ABS-3			○	○			∆	∆																∆			∆		4 to 9	
	ABS-4			○	○			∆	∆																∆			∆		5 to 10	
	ABS ⌒			○	○			∆	∆	○															∆			∆			
	ABS ↷			○	○			∆	∆		○														∆			∆		4 to 9	
	ABS ⟳			○	○			∆	∆		○														∆			∆			
	ABS ↶			○	○			∆	∆		○														∆			∆			
	ABS ⟲			○	○			∆	∆		○														∆			∆			
	ABS ⌒·			○	○			∆	∆			○													∆			∆		5 to 10	
	ABS ◡·			○	○			∆	∆			○													∆			∆			
	INC-1	Incremental designation of passing point for constant speed control		○	○			∆	∆																∆			∆		2 to 7	
	INC-2			○	○			∆	∆																∆			∆		3 to 8	
	INC-3			○	○			∆	∆																∆			∆		4 to 9	
	INC-4			○	○			∆	∆																∆			∆		5 to 10	
	INC ⌒			○	○			∆	∆	○															∆			∆			
	INC ↷			○	○			∆	∆		○														∆			∆		4 to 9	
	INC ⟳			○	○			∆	∆		○														∆			∆			
	INC ↶			○	○			∆	∆		○														∆			∆			
	INC ⟲			○	○			∆	∆		○														∆			∆			
	INC ⌒·			○	○			∆	∆			○													∆			∆		5 to 10	
	INC ◡·			○	○			∆	∆			○													∆			∆			
	CPEND	Ends constant speed control					∆																							1to 2	
Repetition of same control	FOR-TIMES	Set the head step for repetition																					○							2	7. 15. 2 7. 16. 1
	FOR-ON																						○								
(User for speed switching control, constant speed control)	FOR-OFF																						○								
	NEXT																													3	
Simultaneous start	START	Simultaneous start																						○						2 to 3	7. 18
Zeroing	ZERO	Starts zeroing		○																										2	7. 21
High-speed oscillation	OSC	High-speed oscillation	∆	○	○	○		∆											∆							∆	∆			5 to 13	7. 22

○ : Must be set
∆ : Set if required

6.3 Positioning Data

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

Table 6.3 Positioning Data

Name				Explanation	Setting Made With Peripheral Device: Default Value	Setting Range: mm	inch	degree	PULSE
Common Settings	Parameter block No.			● Sets the parameter block on the basis of which data such as that for acceieration and deceleration processing and deceleration processing on STOP input will be set for each axis.	1	1 to 16			
Common Settings	Axis			● Set the axis to be started. ● For interpolation , the numbers of the axes involved in the interpolation are designated.	——	1 to 8 for A172SHCPU 1 to 4 for A171SHCPU			
Common Settings	Address/travel value	Absolute date method	Address	Set the positioning address as an absolute address when using the absolute data method as the positioning method.	——	–214748364.8 to 21474836.7 (μm)	–21474.83648 to 21474.83647	0 to 359.99999	–2147483648 to 2147483647
Common Settings	Address/travel value	Incremental method	Travel value	Set the positioning address as a travel value when using the incremental method as the positioning method. The direction of travel is indicated by the sign. However, only positive settings can be made for ##speed/position switching control. Positive : Forward rotation (direction in which address values increase) Negative : Reverse rotation (direction in which address values decrease)	——	For other than ##speed/position switching control: 0 to ±2147483647			
						For speed/position switching control: 0 to 214748364.7 (μm)	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 combined speed/long-axis reference speed/reference axis speed. (Applies to PTP control only)	——	0.01 to 6000000.00 (mm/min)	0.001 to 600000.000 (inch/min)	0.001 to 2147483.647 (degree/min)	1 to 10000000 (PLS/s)
Common Settings	Dwell time			● Set the time from positioning to the positioning address to output of the positioning completion signal (M1601+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. ● The sitting ranges, which depend on the positioning method used, are shown to the right.	——	0.1 to 429496729.5 (μm)	0.00001 to 42949.67295	0 to 359.99999	1 to 4294967295
Circular Interpolation	Radius	Incremental method				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		
Setting Range				Possible/Not Possible	Number of Words Used	Error Item Data (Note-4) (Stored in D9190)	Control Using Default Value	Starting not Possible
mm	inch	degree	PULSE					
1 to 16				○	1	1	○	
——				×	——	——		○
–2147483648 to 2147483647 ($\times 10^{-1}$ μm)	–2147483648 to 2147483647 ($\times 10^{-5}$ inch)	0 to 35999999 ($\times 10^{-5}$ degree)	–2147483648 to 2147483647	○	2	n03 (Note-1)		
For other than speed/position switching control								
0 to ±2147483647								
For speed/position switching control						——		
0 to 2147483647 ($\times 10^{-1}$ μm)	0 to 2147483647 ($\times 10^{-5}$ inch)	0 to 2147483647 ($\times 10^{-5}$ degree)	0 to 2147483647					
1 to 600000000 ($\times 10^{-2}$ mm/min)	1 to 600000000 ($\times 10^{-3}$ inch/min)	1 to 2147483647 ($\times 10^{-3}$ degree/min)	1 to 10000000 (PLS/s)	○	2	4	○ (note-2)	○ (Note-3)
0 to 5000 (ms)				○	1	5	○	
0 to 255				○	1	6	○	
1 to 500 (%)				○	1	7	○	
–2147483648 to 2147483647 ($\times 10^{-1}$ μm)	–2147483648 to 2147483647 ($\times 10^{-5}$ inch)	0 to 35999999 ($\times 10^{-5}$ degree)	–2147483648 to 2147483647	○	2×2	n08 (note-1)		
0 to ±2147483647								
1 to 4294967295 ($\times 10^{-1}$ μm)	1 to 4294967295 ($\times 10^{-5}$ inch)	0 to 35999999 ($\times 10^{-5}$ degree)	1 to 4294967295	○	2	n09 (Note-1)		○
1 to 2147483647 ($\times 10^{-1}$ μm)	1 to 2147483647 ($\times 10^{-5}$ inch)	1 to 2147483647 ($\times 10^{-5}$ degree)	1 to 2147483647					
–2147483648 to 2147483647 ($\times 10^{-1}$ μm)	–2147483648 to 2147483647 ($\times 10^{-5}$ inch)	0 to 35999999 ($\times 10^{-5}$ degree)	–2147483648 to 2147483647	○	2×2	n010 (Note-1)		
0 to ±2147483647								
0 to 999				○	1	28		

REMARKS

(Note-1): The "n" in n03, n08, n09, n10, indicates the axis number (1 to 4/1 to 8/1).
(Note-2): When an error occurs because the speed limit value is exceeded, control is executed at the speed limit value.
(Note-3): Applies when the commanded speed is "0".
(Note-4): If there are multiple errors in the same program, the latest error item data is stored.

Table 6.3 Positioning Data (Continued)

	Name	Explanation	Setting Made With Peripheral Device				
			Default Value	Setting Range			
				mm	inch	degree	PULSE
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/s)	0.01 to 6000000.00 (mm/min)	0.001 to 600000.000 (inch/min)	0.001 to 2147483.647 (degree/min)	1 to 10000000 (PLS/s)
	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 10000.0 (μm)	0 to 1.00000	0 to 1.00000	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 2147483.647 (degree/min)	1 to 10000000 (PLS/s)
	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 a the next pass point by turning ON a designated bit device during execution of positioning at each of the pass points associated with a constant speed control instruction.	——	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		
Setting Range				Possible/Not Possible	Number of Words Used	Error Item Data (Note-4) (Stored in D9190)	Control Using Default Value	Starting not Possible
mm	inch	degree	PULSE					
0	1	2	3	○	1	11	○	
1 to 600000000 (×10^{-2} mm/min)	1 to 600000000 (×10^{-3} inch/min)	1 to 2147483647 (×10^{-3} degree/min)	1 to 10000000 (PLS/s)	○	2	12		
1 to 65535 (ms)				○	1	13		
1 to 65535 (ms)				○	1	14		
1 to 65535 (ms)				○	1	15		
1 to 100 (%)				○	2	21		
1 to 500 (%)				○	1	16		
0: Deceleration to a stop in accordance with the deceleration time 1: Deceleration to a stop in accordance with the rapid stop deceleration time				○	1	——		
0 to 100000				○	2	17		
1 to 32767				○	——	18	Controlled by K1	
0 to 4095				○	——	19		○
1 to 600000000 (×10^{-2} mm/min)	1 to 600000000 (×10^{-3} inch/min)	1 to 2147483647 (×10^{-3} degree/min)	1 to 10000000 (PLS/s)	○	2	4	○ (Note-2)	○ (Note-3)
——				——	——	——		
0 to 4095				○	1	——		
——				——	——	——		
1 to 5000 (ms)				○	1	13	Controlled by 1000ms	

REMARKS

(Note-2): When an error occurs because the speed limit value is exceeded, control is executed at the speed limit value.

(Note-3): Applies when the commanded speed is "0".

(Note-4): If there are multiple errors in the same program, the latest error item data is stored.

6.4 Method for Setting Positioning Data

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

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

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

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

6.4.1 Setting by designating numerical values

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

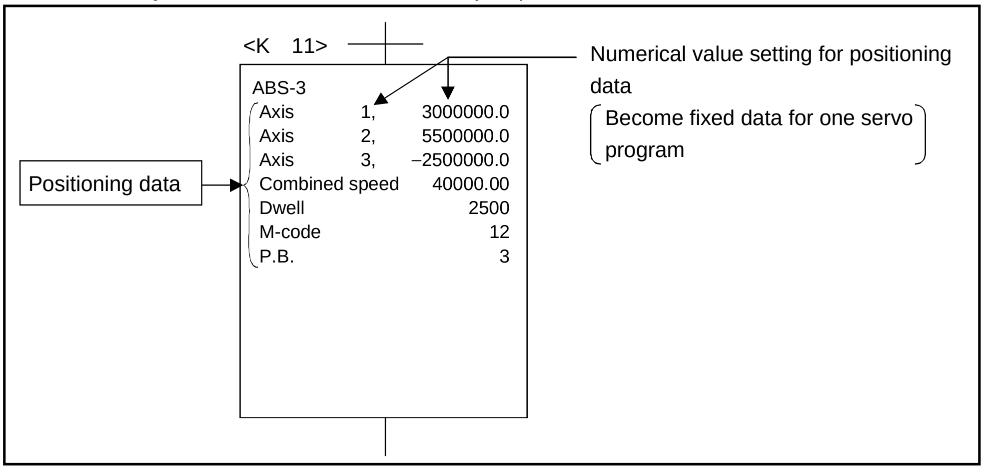


Fig. 6.3 Example of Setting Positioning Data by Numerical Value Setting

6.4.2 Setting by using word devices (D, W)

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

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

Word Device	CPU
D	0 to 799
W	0 to 3FF

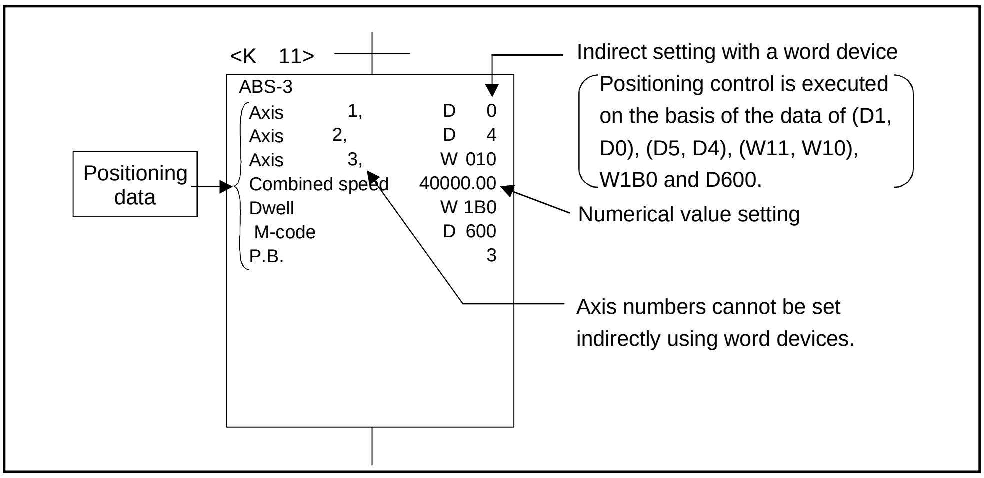


Fig. 6.4 Example of Setting Positioning Data by Numerical Value Setting

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

POINTS

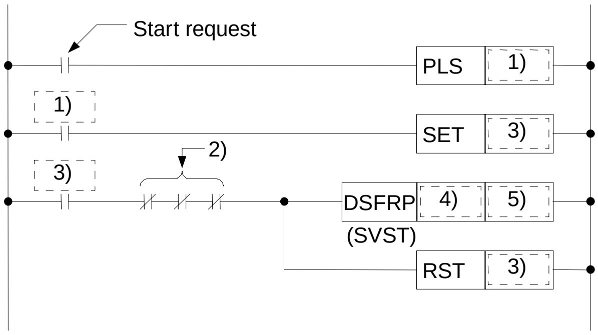
(1) It is not possible to indirectly set axis numbers using word devices with a servo program.
(2) Establish an interlock by using a start accept signal (M2001 to M2004/ M2001 to M2008) to ensure that the device data designated for indirect setting is not changed until the designated axis has accepted the start command.
If the data is changed before the start command is accepted, positioning control in accordance.

6.5 Creating Sequence Programs to Start Servo Programs

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

6.5.1 Case where the servo program is executed once only

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



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

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

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

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

1): Start request leading edge detection flag (devices that can be used: Y, M, L, S, B, F)
2): Start accept flag (set a number of flags corresponding to the number of axes designated in the servo program)
3): DSFRP/SVST instruction execution request flag (devices that can be used: Y, M, L, S, B, F)
4): Axis No. designated in the servo program
5): Started servo program No. (K0 to K4095)

Example

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

(1) Condition
The flags that can be used with sequence programs are indicated below.

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

(2) Sequence program example

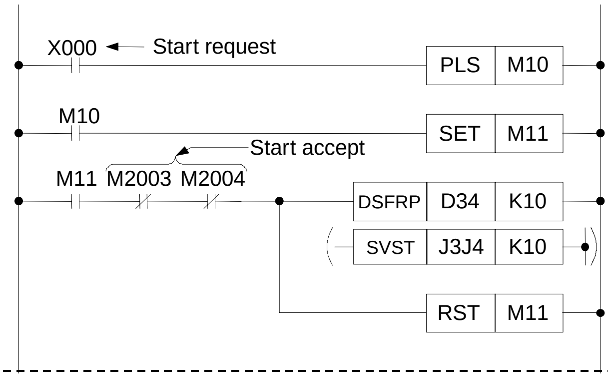
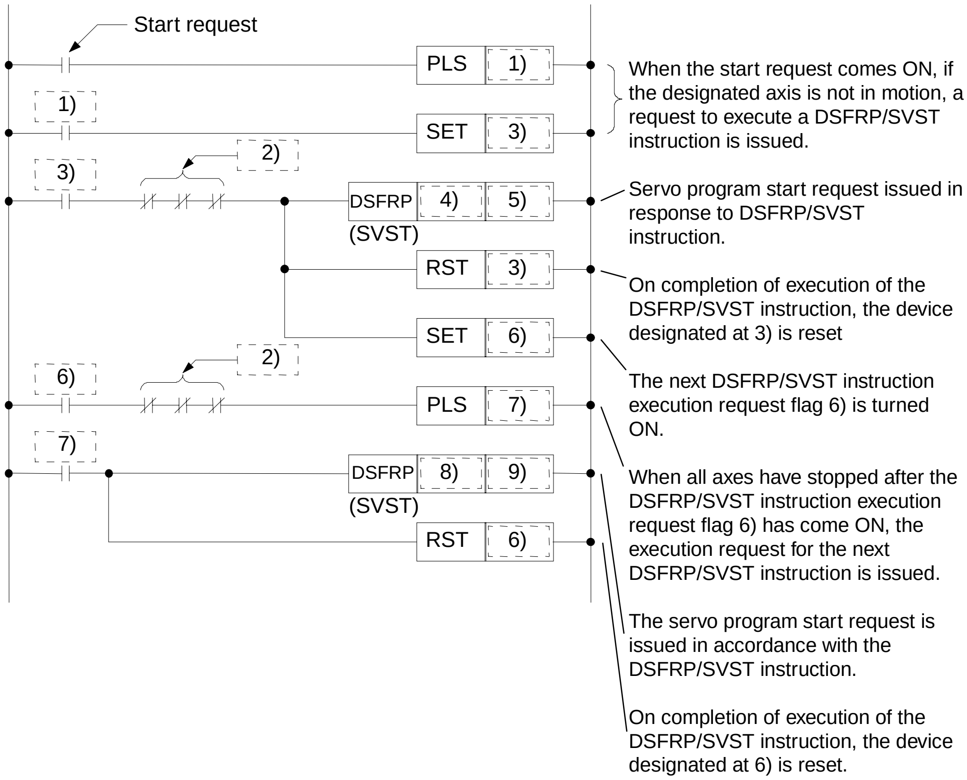


Fig. 6.5 Sequence Program for Starting a Servo Program

6.5.2 Case where different servo programs are executed consecutively

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



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

1): Start request leading edge detection flag (devices that can be used: Y, M, L, S, B, F)
2): Start accept flag (set a number of flags corresponding to the number of axes designated in the servo program)
3), 7): DSFRP/SVST instruction execution request flag (devices that can be used: Y, M, L, S, B, F)
4), 8): Axis No. designated in the servo program
5), 9): Started servo program No. (K0 to K4095)
6): Start request recording flag (Y, M, L, S, B, F)

Fig. 6.6 Sequence Program for Starting Servo Programs

6.5.3 Case where the same servo program is executed repeatedly

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

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

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

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

3): Axis No. designated in the servo program

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

Fig 6.7 Sequence Program For Starting a Servo Program

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.

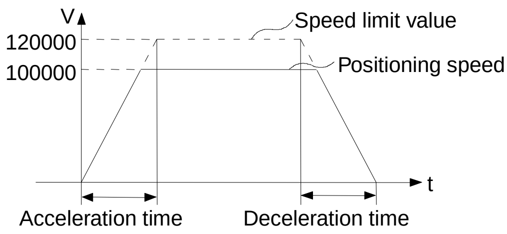
7.1.1 Positioning speed

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:

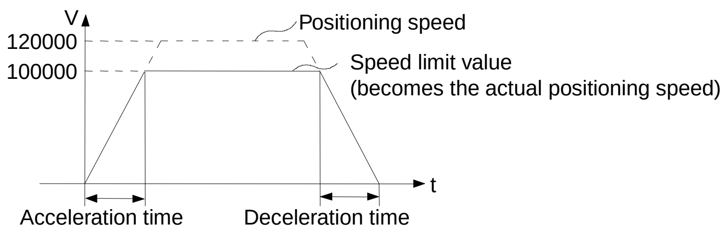
- if positioning speed setting < speed limit value
  positioning occurs at set positioning speed;
- if positioning speed setting > speed limit value
  positioning occurs at speed limit value.

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-axes control using one of the following three methods:

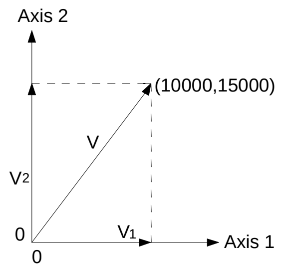
- Combined speed designation
- long-axis speed designation
- reference-axis speed designation

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

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

Example

2-axes linear interpolation control



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

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

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

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

[Program Example]

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

(b) Long-axis speed designation

The control of each axis is based on the positioning speed (long-axis speed: V) set for the axis whose positioning address is the greatest distance from the current position.

The servo system CPU uses the travel value of each of the other axes (D_1 to D_4) to calculate the positioning speed of each axis (V_1 to V_4).

Set the long-axis speed and the travel value of each axis in the servo program.

Example

4-axes linear interpolation control

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

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: $V_3 = D_3/D_4 \times V$

[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/s)

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 [PLS/s] and this speed is used as the long-axis speed.

POINTS

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

Example

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

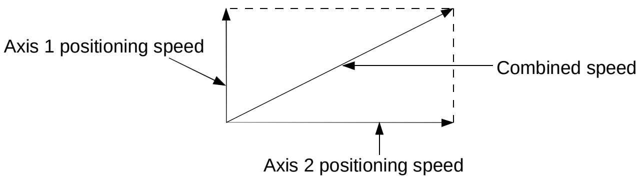
Axis 1 travel value: 100 PLS
Axis 2 travel value: 200 PLS
Long-axis speed: 50 PLS s
Speed limit value: 55 PLS /s

[Program Example]

```
<K    2 >
INC -2
  Axis         1,            100   (PLS)
  Axis         2,            200   (PLS)
 Long-axis speed              50   (PLS/s)
```

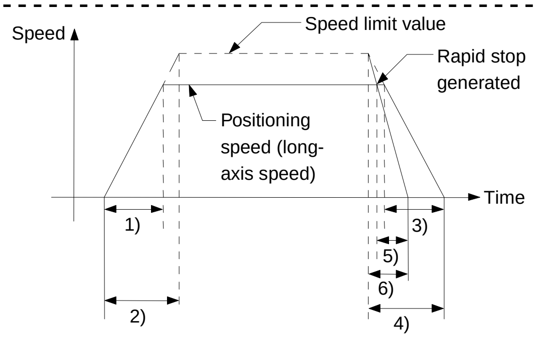
In this example, the reference axis is Axis 2, which has the greatest travel value; therefore the set speed limit value applies to Axis 2.
In this case, the positioning speed of each axis and the combined speed are as follows:

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



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

(2) Relationship between speed limit value, acceleration time, deceleration time, and rapid stop deceleration time
- The 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-axes linear interpolation control

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

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

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

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

[Program Example]

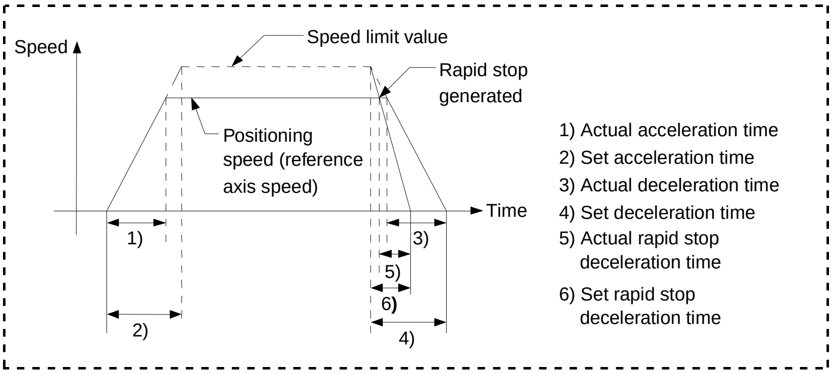
```
<K   52>
ABS-4
  Axis        1,          10000    (PLS)
  Axis        2,          15000    (PLS)
  Axis        3,           5000    (PLS)
  Axis        4,          20000    (PLS)
  Reference axis speed     7000    (PLS/s)
  Reference axis number       4
```

POINTS

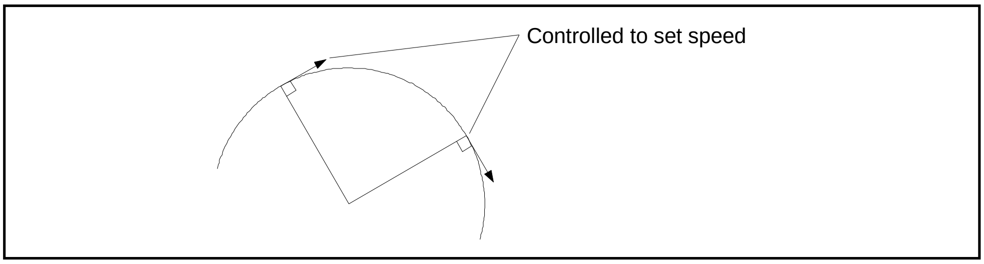
(1) Reference axis speed and positioning speed of other axes
- Note that the positioning speed of an axis with a greater travel value than the reference axis will exceed the set reference axis speed.

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

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



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



7.1.3 Control units for 1-axis positioning control

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

7.1.4 Control units for interpolation control

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

	Interpolation Control Units in Parameter Block				Start Method
	mm	inch	degree	PULSE	
Normal start conditions	Fixed parameters designate mm and inch control units for 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 PLS > 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 PLS.

(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 1-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 $\times$ 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 $\div$ 25.4 = inch set value.

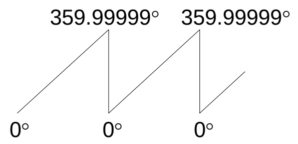
(c) Discrepancy (3))

- 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 PLS.
  b) For axes where the units match, the electronic gear converts the positioning speed to units of PLS/s.
  Positioning is conducted using position commands calculated from travel values converted to PLS and speeds and electronic gear converted to PLS/s.
- 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

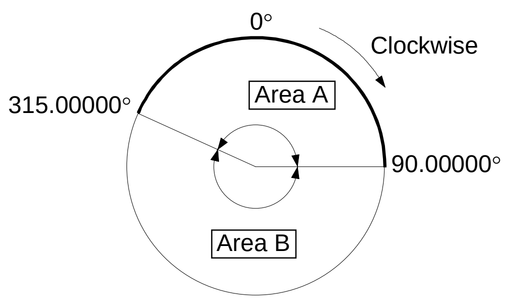
If the control units are degrees, the following items differ from when other control units are set.

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



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

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



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

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

POINT

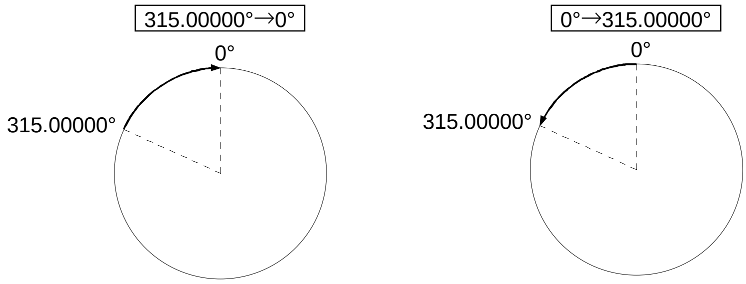
(1) Circular interpolation is not possible for axes set with the stroke limit invalid.
(2) After you have changed the upper/lower limit value with the stroke limit valid, perform zeroing.
(3) When the stroke limit is valid in an incremental system, perform zeroing after power-on.

(3) Positioning control
Positioning control using degrees as control units is described below.

(a) Absolute data method (ABS□ instructions)
The absolute data method uses the 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 current value of 315.00000° to 0°.
(2) Positioning occurs counterclockwise to travel from the current value of 0° to 315.00000°.

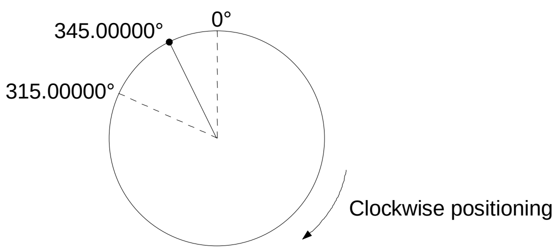


POINTS

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

Example

Travel from the 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

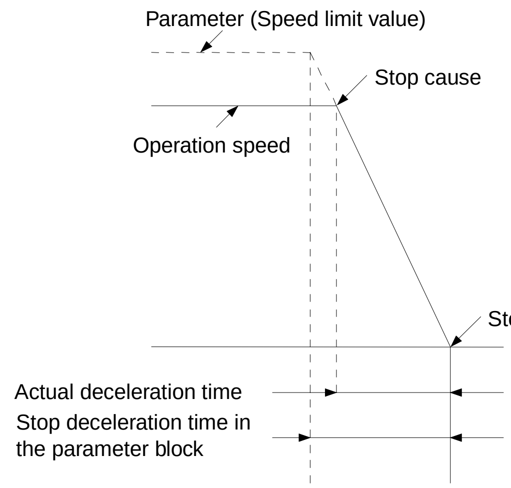
This section describes the stop processing after a stop cause is input during positioning, and restarting after a stop.

(1) Stop processing

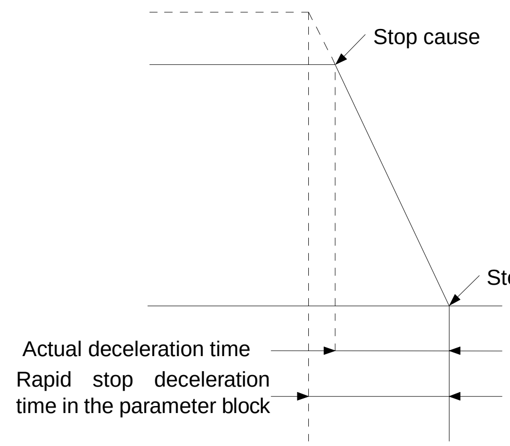
(a) Stop processing methods

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

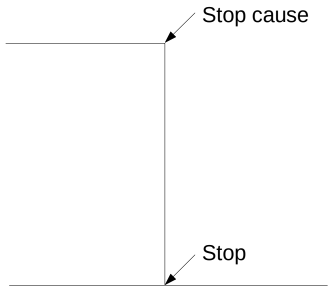
1) Deceleration stop .... Decelerates and stops according to the stop (Process 1) deceleration time parameter in the parameter block.



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



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



(b) Order of priority for stops

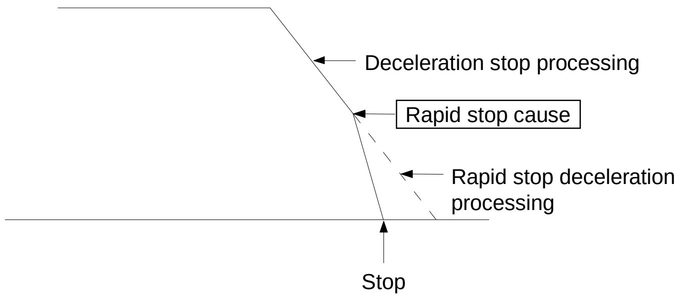
The order of priority for stops when a stop cause is input is as follows:

Process 1 < Process 2 <Process 3

Example

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

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



(c) Stop commands and stop causes
Some stop commands and stop causes affect individual 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.

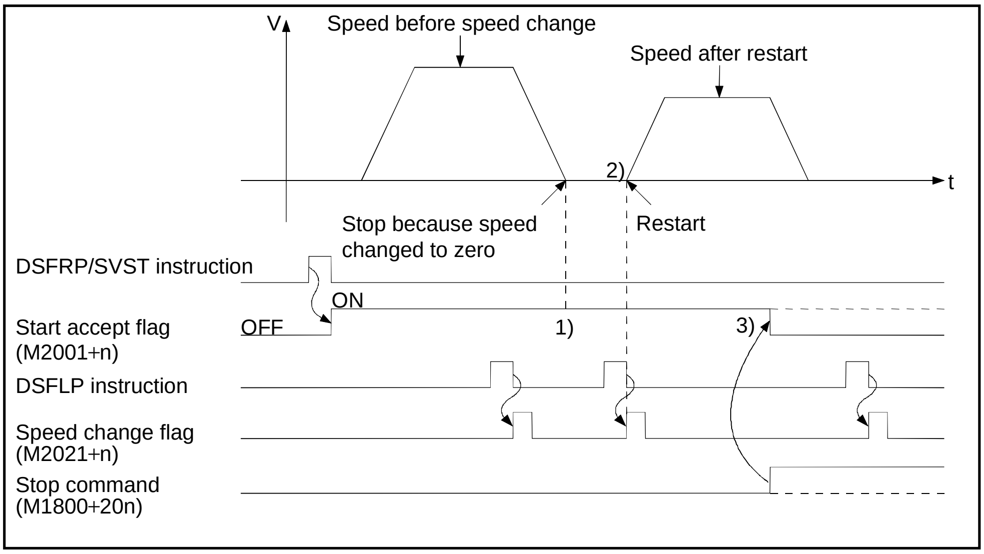
<table>
<tr><th rowspan="2">No.</th><th rowspan="2">Stop Cause</th><th rowspan="2">Individual/ All Axes</th><th colspan="5">Stop</th><th rowspan="2">Error Processing</th></tr>
<tr><th>Positioning Control</th><th>Speed Control</th><th>Jog Operation</th><th>Zeroing</th><th>Manual Pulse Generator</th></tr>
<tr><td>1</td><td>External STOP input ON</td><td rowspan="6">Individual</td><td colspan="4">Process 1 or Process 2
(According to deceleration processing on STOP input parameter in parameter block.)</td><td rowspan="14">Process 3</td><td rowspan="9">Serious error during zeroing only</td></tr>
<tr><td>2</td><td>Stop command M1800+20n/Yn0/M3200 +20n ON</td><td colspan="4">Process 1</td></tr>
<tr><td>3</td><td>Rapid stop command M1800+20n/Yn1/M3201 +20n ON</td><td colspan="4">Process 2</td></tr>
<tr><td>4</td><td>External FLS input OFF</td><td colspan="4" rowspan="2">Process 1 or Process 2
(According to deceleration processing on STOP input parameter in parameter block.)</td></tr>
<tr><td>5</td><td>External RLS input OFF</td></tr>
<tr><td>6</td><td>Servo error detect M1608+20n/Xn8/M2408 +20n ON</td><td colspan="4">Process 3</td></tr>
<tr><td>7</td><td>PLC ready M2000 OFF</td><td rowspan="7">All</td><td colspan="4">Process 1</td></tr>
<tr><td>8</td><td>Emergency stop from exterior (Note-2), BREAK key pressed</td><td colspan="4">Process 2</td></tr>
<tr><td>9</td><td>Servo system CPU stop</td><td colspan="4">Process 1</td></tr>
<tr><td>10</td><td>Servo system reset</td><td colspan="4">Process 3 (Note-1)</td><td>—</td></tr>
<tr><td>11</td><td>PCPU WDT error</td><td colspan="4">Process 3 (Note-1)</td><td>M9073 (WDT error) ON</td></tr>
<tr><td>12</td><td>SCPU WDT error</td><td colspan="4">Process 1</td><td>—</td></tr>
<tr><td>13</td><td>Servo system CPU power off</td><td colspan="4">Process 3 (Note-1)</td><td>—</td></tr>
<tr><td>14</td><td>Servo amplifier power off</td><td>Individual</td><td colspan="4">Process 3 (Note-1)</td><td>Serious error at start-up (no servo)</td></tr>
<tr><td>15</td><td>Speed changed to zero</td><td>Individual (Note-3)</td><td colspan="4">Process 1</td><td></td><td>—</td></tr>
</table>

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

(2) Restarting after a Stop

(a) Control cannot be restarted after a stop command or stop cause (except changing speed to zero).
However, restarting is possible using the VSTART instruction after a stop due to the external STOP input, the stop command (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".

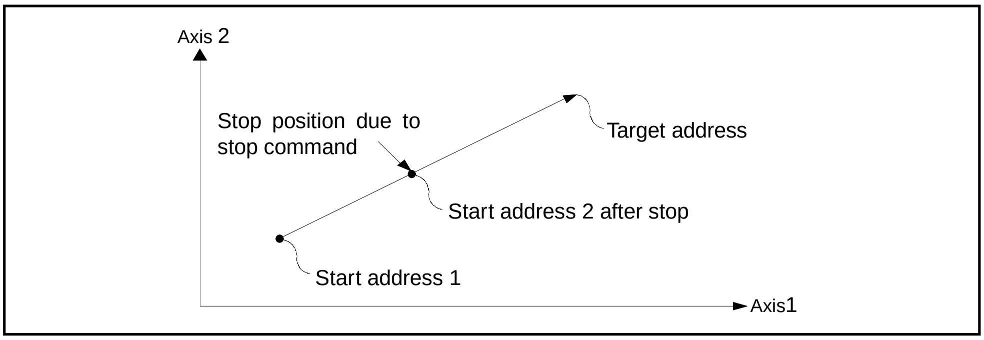


1) The start accept flag M2001+n remains ON after a stop due to changing the speed to zero.
2) Restart after changing the speed again.
3) However, control cannot be restarted after the speed is changed if the start accept flag M2001+n is turned OFF due to the stop command (M1800+20n) turning ON.

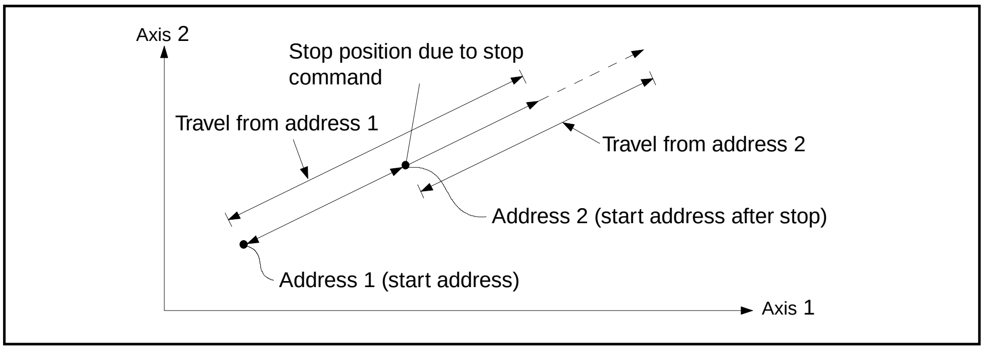
(3) Continuing positioning control
This section describes the method to continue control from the servo program number where the stop was applied by turning ON the external STOP input, the stop command (M1800+20n), or the rapid stop command (M1801+20n).

(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.

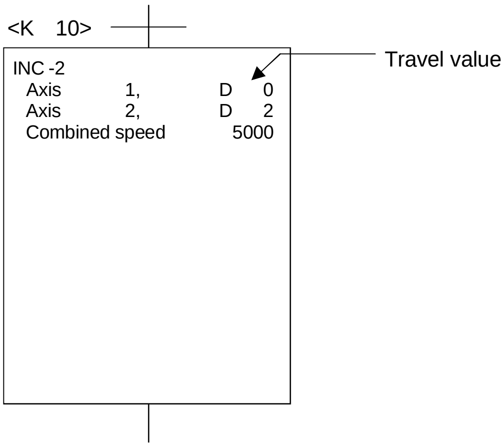


2) Incremental method .... Positioning control of the travel value from the stop address.

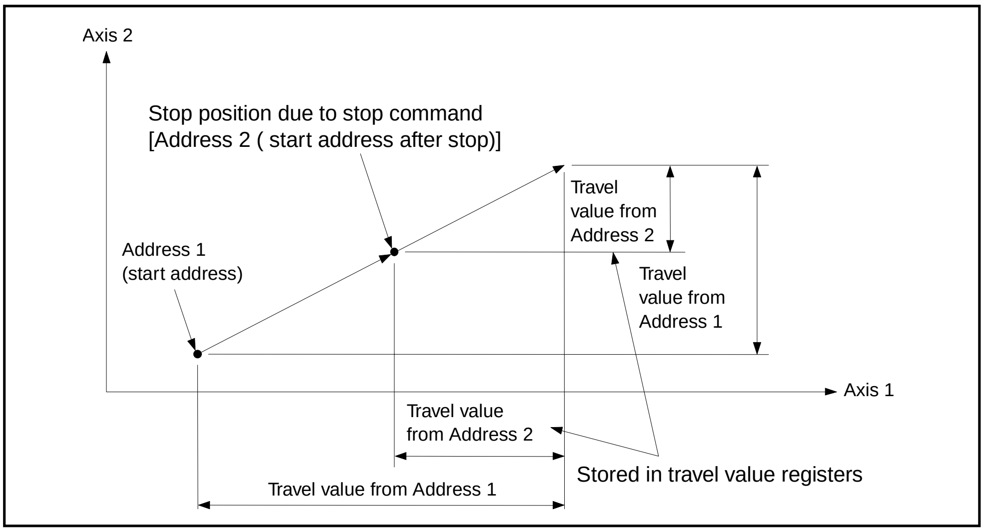


To use the incremental method to travel to the original address (calculated from start address + designated travel value) from address 2, requires the following processing in the servo program and sequence program.

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



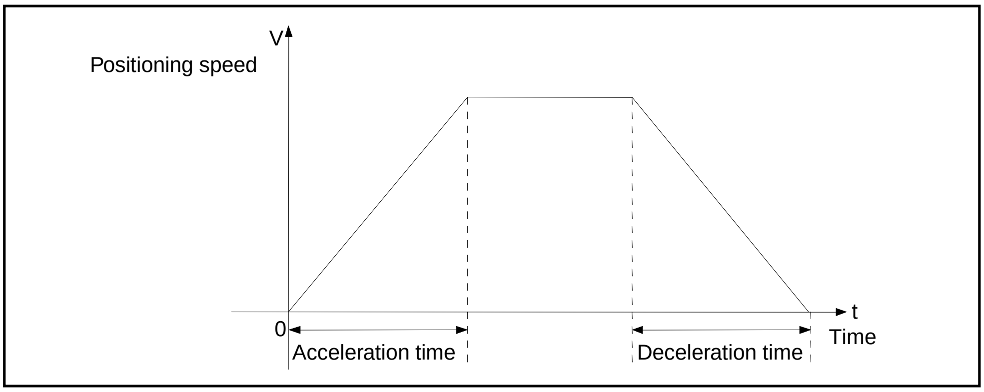
[Processing in the Sequence Program]
1. Before starting, transfer the start address to the servo system CPU word devices.
2. Add the travel value to the start address to calculate the target address.
3. Subtract the stop address from the target address to calculate the residual travel value.
4. Store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



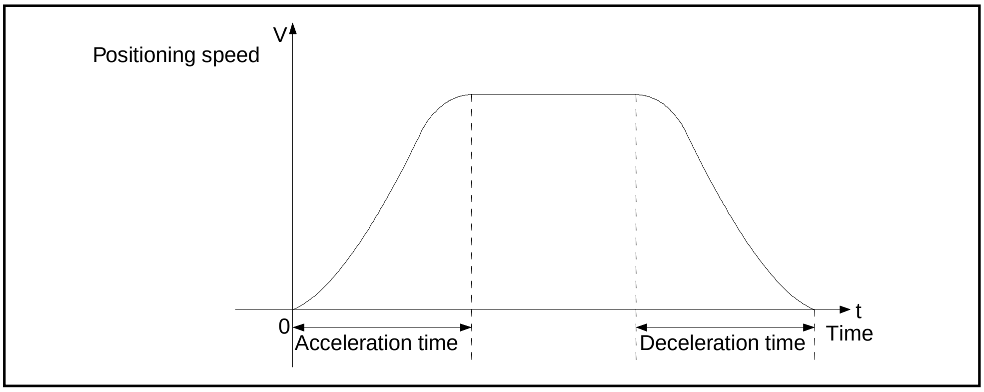
7.1.7 Acceleration and deceleration processing

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

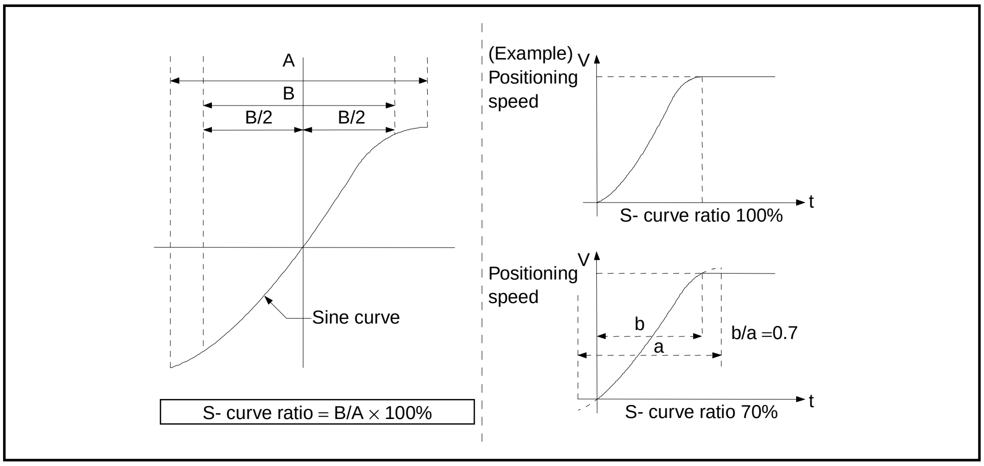
(1) Trapezoidal acceleration and deceleration processing
The conventional linear acceleration and deceleration processing. The acceleration and deceleration graph resembles a trapezoid, as shown in the diagram below.
The acceleration and deceleration times are set automatically.



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



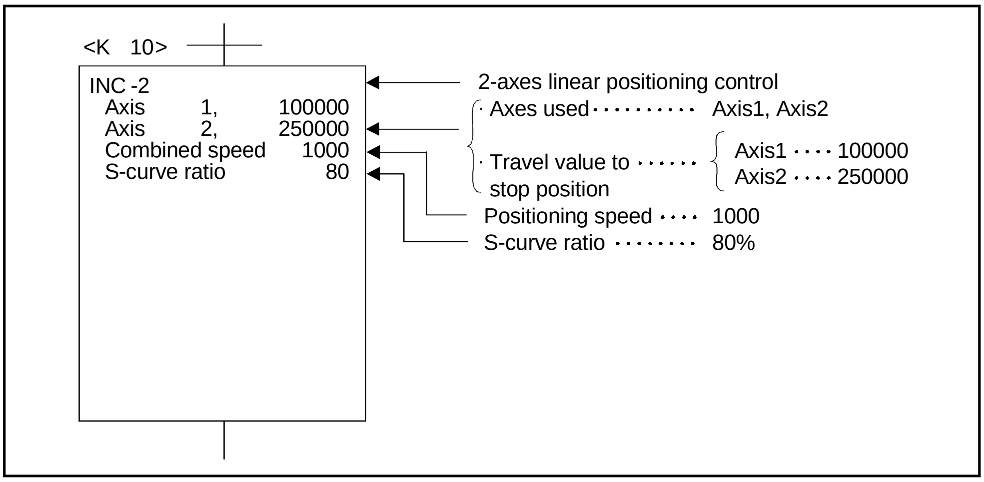
As shown in the diagram below, the S-curve ratio sets the part of the sine curve used to produce the acceleration and deceleration curve.



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

(a) Direct designation

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

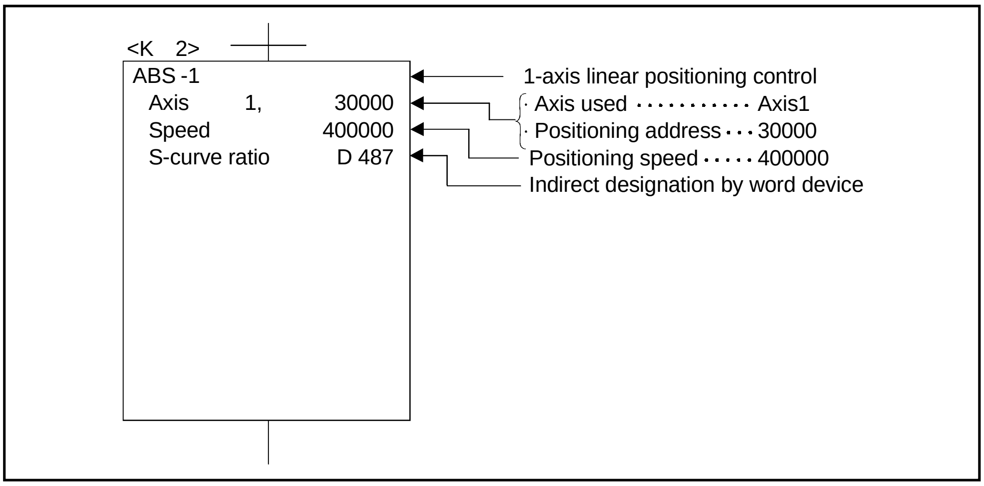


(b) Indirect designation

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

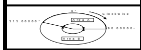
The available data registers are shown below.

Word Device	Usable Device
D	0 to 799
W	0 to 3FF



7.2 1-Axis Linear Positioning Control

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

Servo Instruction	Positioning Method	Number of Controllable Axes	Items Set by Peripherals																					
			Common							Arc			Parameter Block									Others		
			Parameter Block No.	Axis	Address/Travel Value	Commanded Speed	Dwell Time	M Code	Torque Limit Value	Auxiliary Point	Radius	Center Point	Control Unit	Speed Limit Value	Acceleration Time	Deceleration Time	Rapid Stop Deceleration Time	Torque Limit Value	Deceleration Processing on Stop Input	Allowable Error Range for Circular Interpolation	SCurve Ratio	Cancel	Start	Speed Change
ABS-1	Absolute data	1	Δ	○	○	○	Δ	Δ						Δ	Δ	Δ	Δ	Δ	Δ		Δ	Δ	Δ	OK
	Incremental																							

○ : Must be set
Δ : Set if required

[Control Details]

Control with ABS-1 (absolute data method)

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

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

Example

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

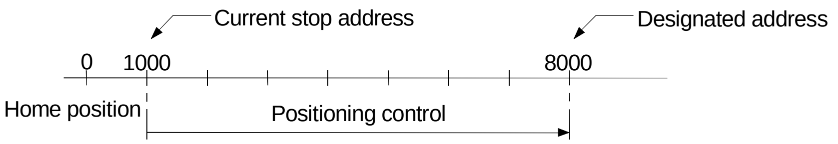


Fig. 7.1 Positioning by Absolute Data Method

Control with INC-1 (incremental method)

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

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

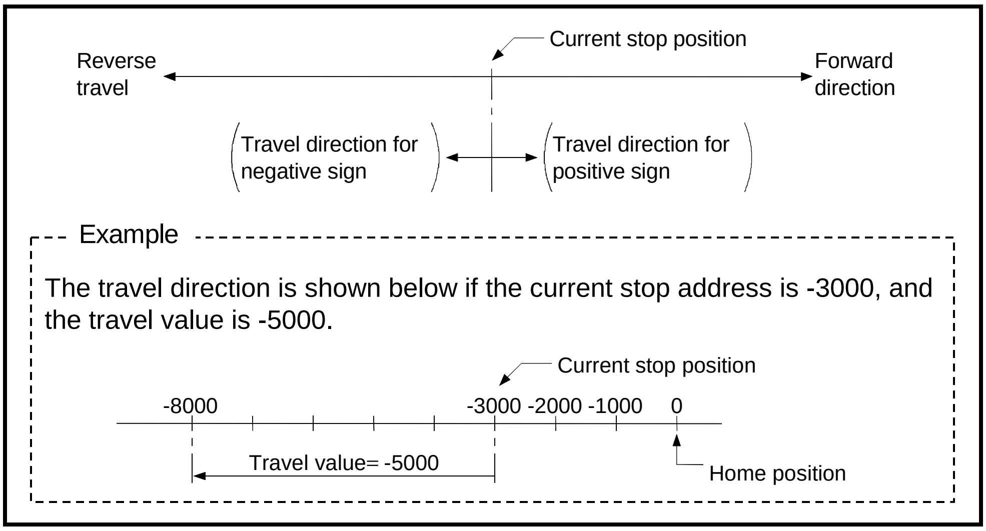
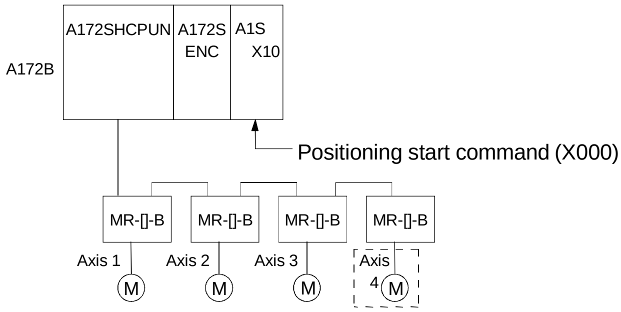


Fig.7.2 Positioning by Incremental Method

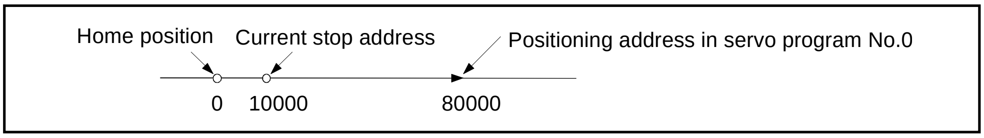
[Program Example]

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

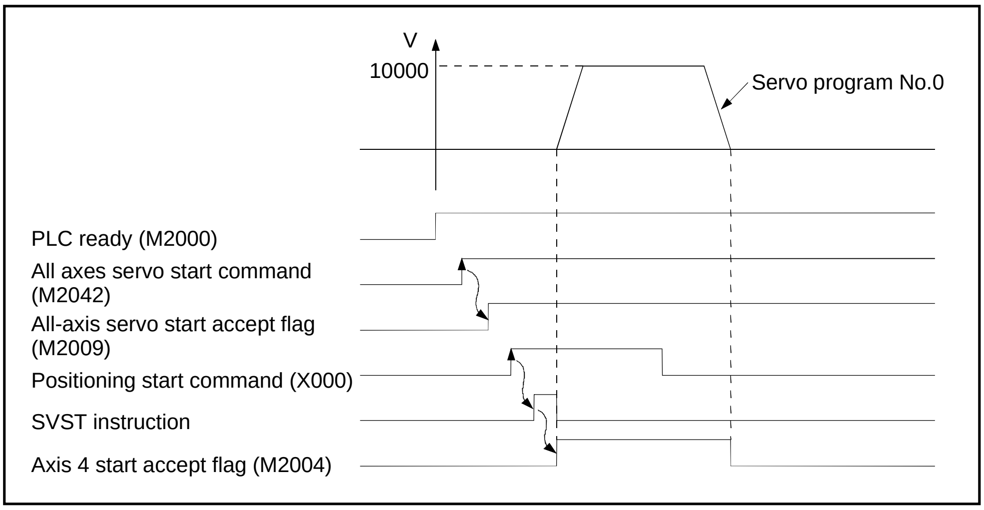
(1) System configuration
1-axis linear positioning control of Axis 4.



(2) Positioning details
The positioning by servo program No. 0 is shown in the diagram below.
In this example, Axis 4 is used in servo program No. 0.

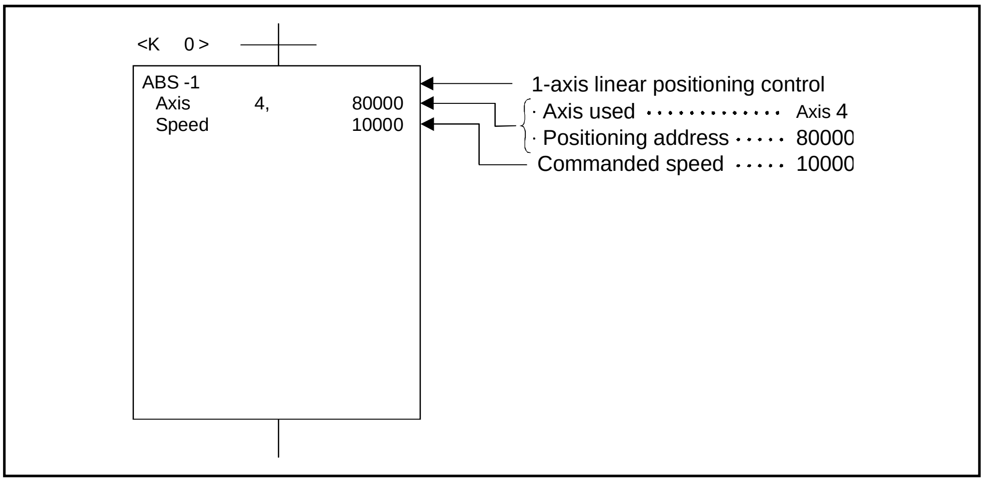


(3) Operation timing
The operation timing for servo program No. 0 is shown below.



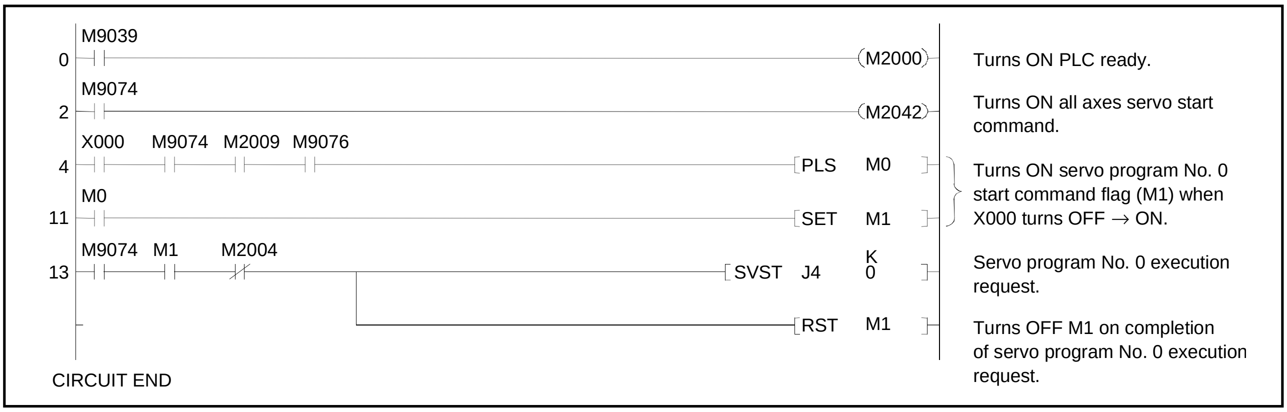
(4) Servo program example

The servo program No. 0 for positioning control is shown below.



(5) Sequence program example

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



7.3 2-Axes Linear Interpolation Control

Linear interpolation control from the present stop position with the2-axes designated in the sequence program positioning commands.
2-axes linear interpolation control uses ABS-2 (absolute data method) and INC-2 (incremental method) servo instructions.

Servo Instruction	Positioning Method	Number of Controllable Axes	Items Set by Peripherals																					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	SCurve Ratio	Cancel	Start	
	Absolute data	2	Δ	○	○	○	Δ	Δ					Δ	Δ	Δ	Δ	Δ	Δ	Δ		Δ	Δ	Δ	OK
INC-2	Incremental																							

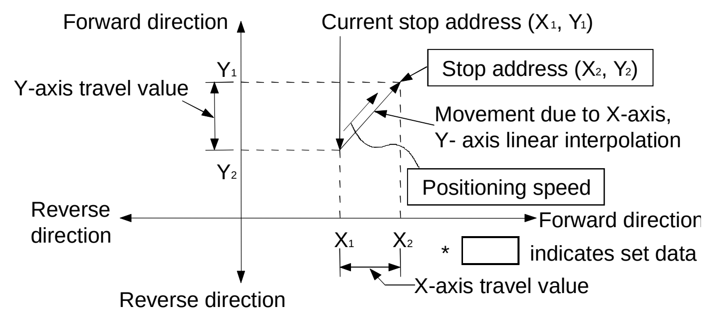
○ : Must be set
Δ : Set if required

[Control Details]

Control with ABS-2 (absolute data method)

(1) Linear interpolation with two axes from the current stop address (X_1, Y_1) to the designated address (X_2, Y_2), using the home position as the reference.

(2) The travel direction is determined from the stop addresses and designated addresses for the respective axes.



Example

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

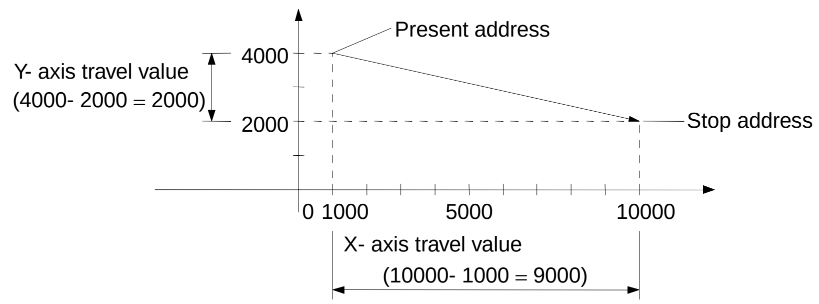
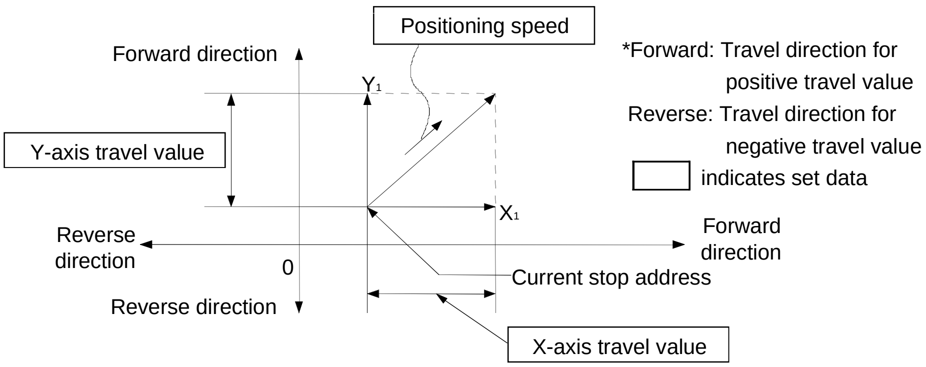


Fig. 7.3 Positioning by Absolute Data Method

Control with INC-2 (incremental method)

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

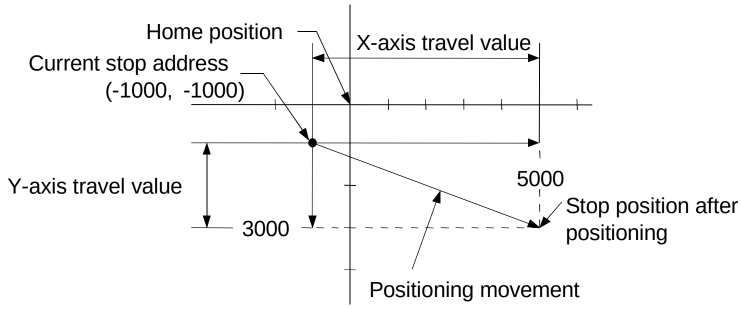
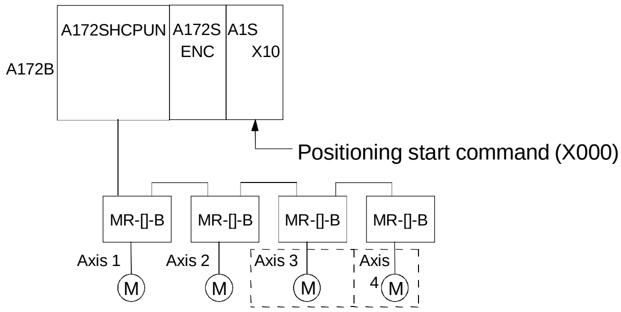


Fig. 7.4 Positioning by Incremental Method

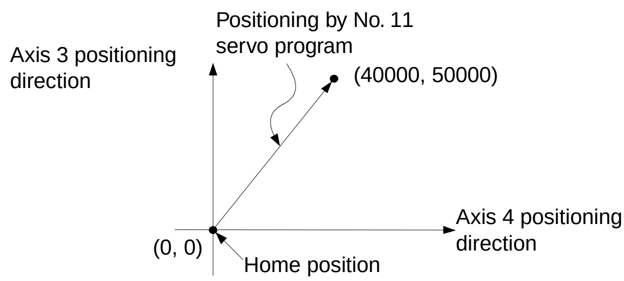
[Program Example]

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

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



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

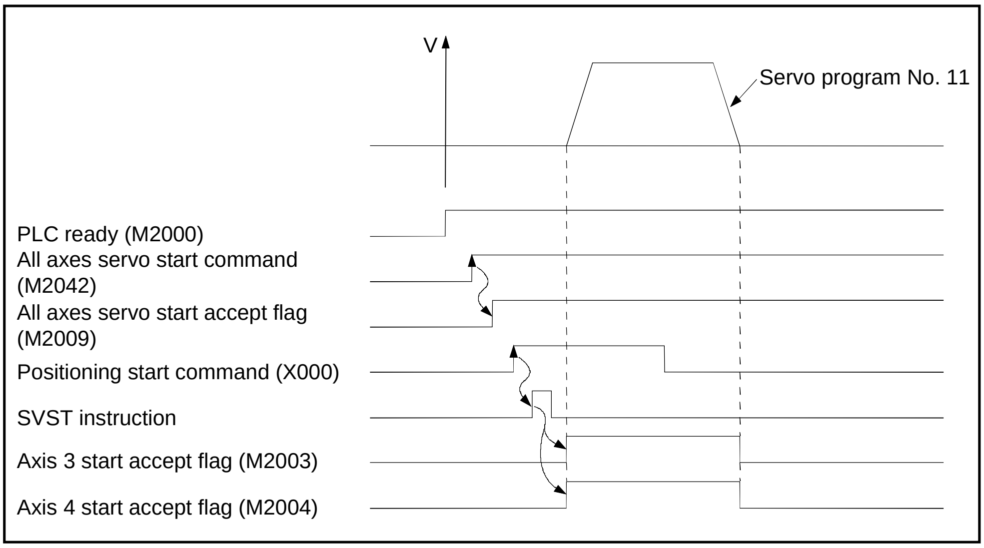


(3) Positioning conditions
(a) The positioning conditions are shown below.

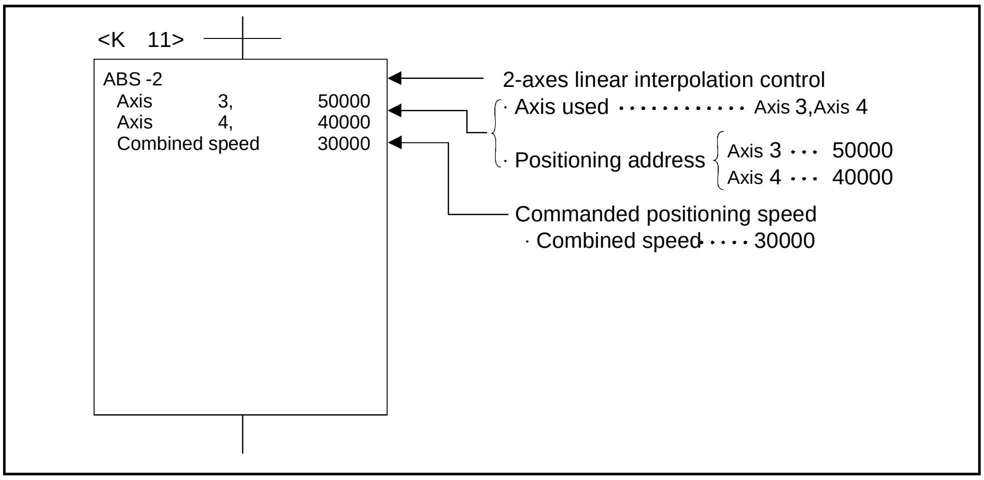
Item	Servo Program Number
	No. 11
Positioning speed	30000

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

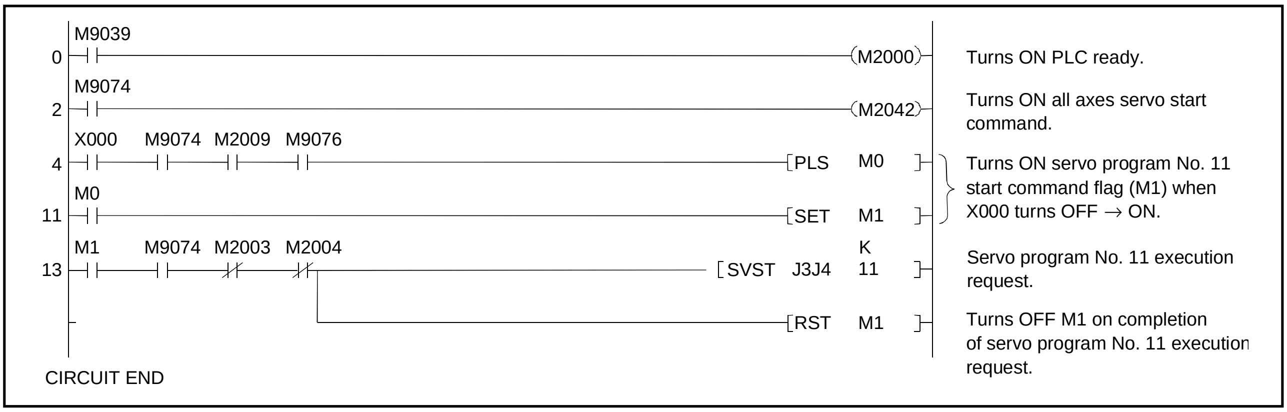
(4) Operation timing
The operation timing for 2-axes linear interpolation control is shown below.



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



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



7.4 3-Axes Linear Interpolation Control

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

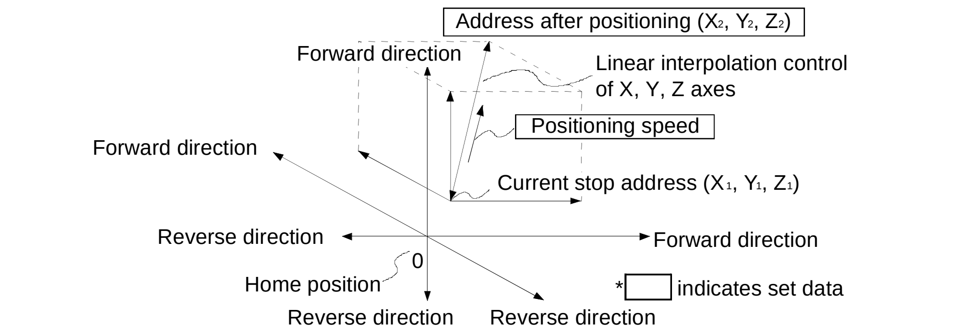
Servo Instruction	Positioning Method	Number of Controllable Axes	Parameter Block No.	Axis	Address/Travel Value	Commanded Speed	Dwell Time	M Code	Torque Limit Value	Auxiliary Point	Radius	Center Point	Control Unit	Speed Limit Value	Acceleration Time	Deceleration Time	Rapid Stop Deceleration Time	Torque Limit Value	Deceleration Processing on Stop Input	Allowable Error Range for Circular Interpolation	SCurve Ratio	Cancel	Start	Speed Change
			Items Set by Peripherals																					
			Common							Arc			Parameter Block								Others			
ABS-3	Absolute data	3	Δ	○	○	○	Δ	Δ					Δ	Δ	Δ	Δ	Δ	Δ	Δ		Δ	Δ	Δ	OK
INC-3	Incremental																							

○ : Must be set
Δ : Set if required

[Control Details]

Control with ABS-3 (absolute data method)

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



Example

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

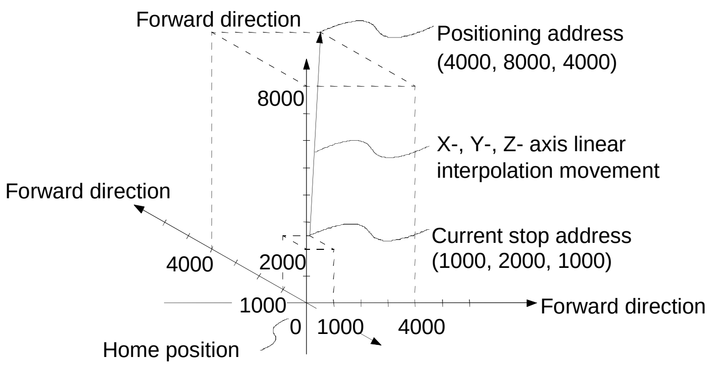
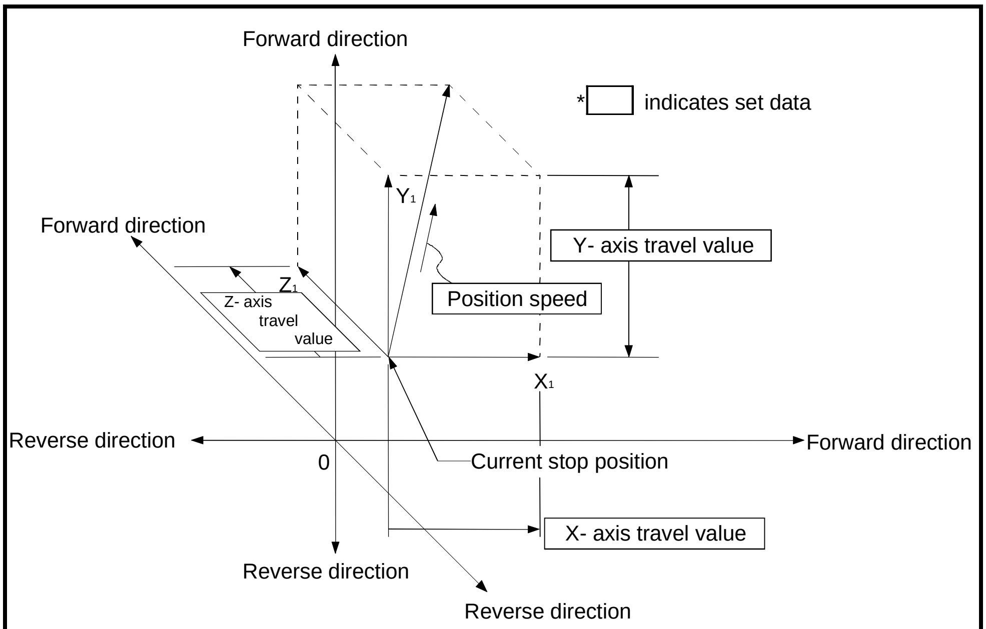


Fig. 7.5 Positioning by Absolute Data Method

Control with INC-3 (incremental method)

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

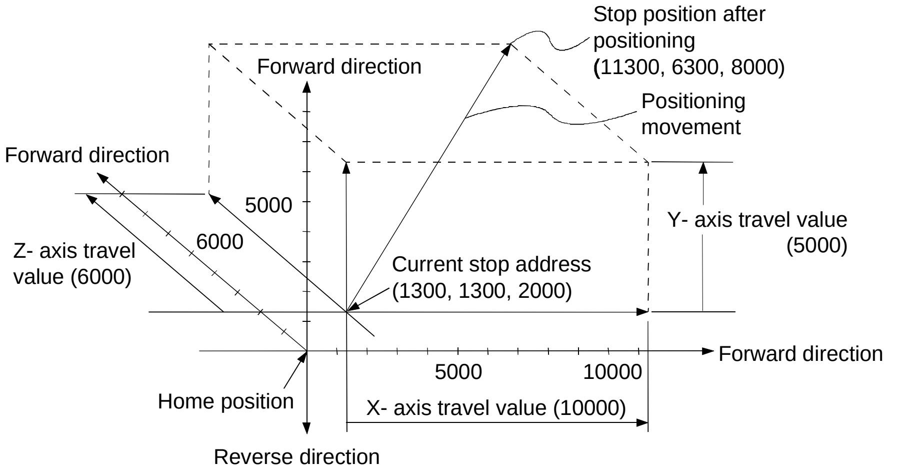
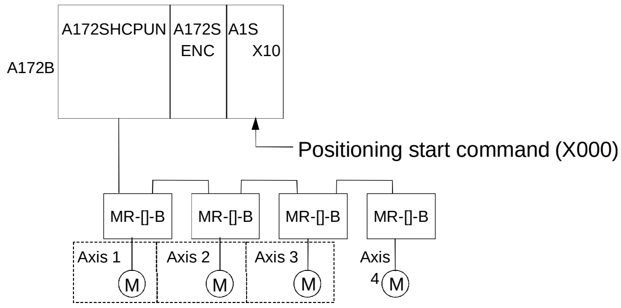


Fig. 7.6 Positioning by Incremental Method

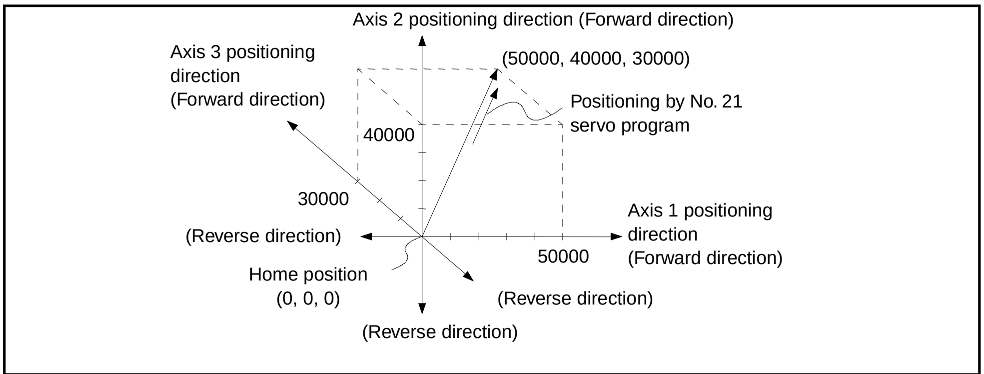
[Program Example]

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

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



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

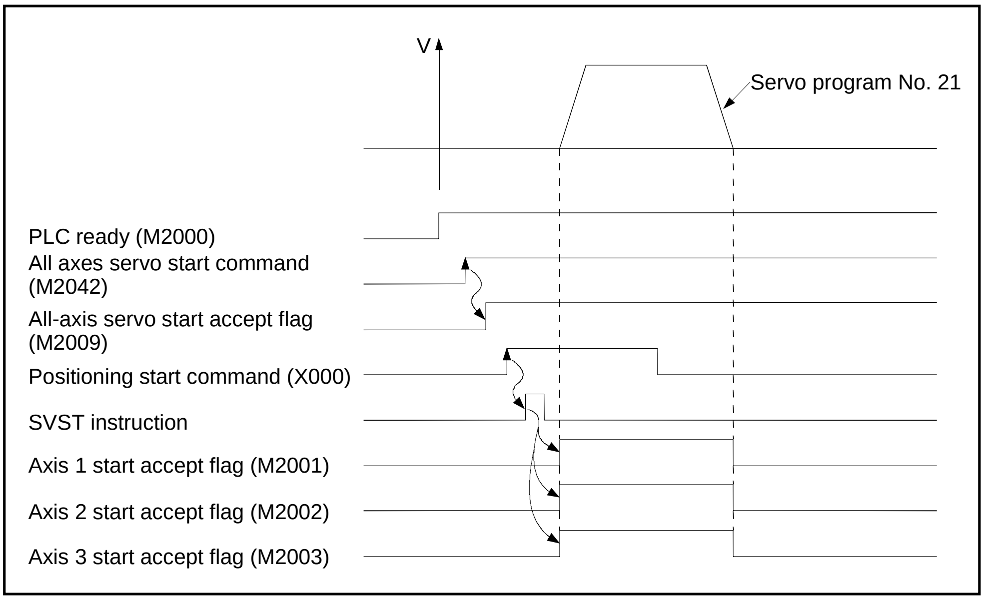


(3) Positioning conditions
(a) The positioning conditions are shown below.

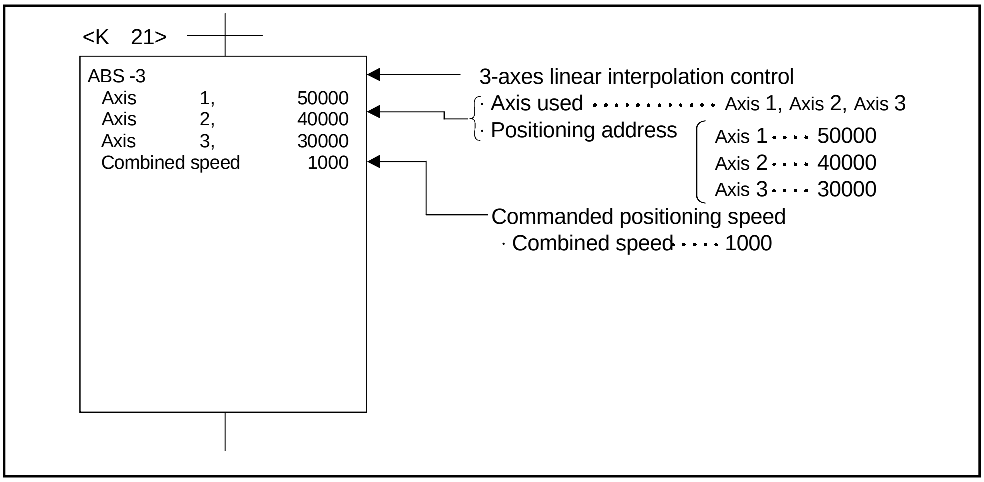
Item	Servo Program Number
	No. 21
Positioning method	Absolute data
Positioning speed	1000

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

(4) Operation timing
The operation timing for 3-axes linear interpolation control is shown below.

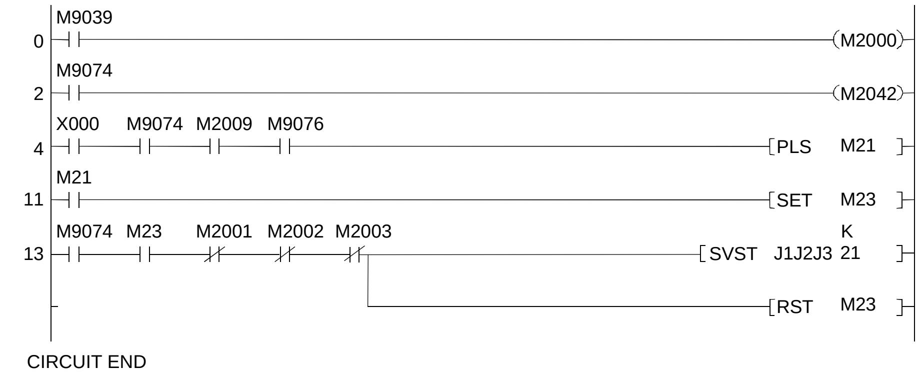


(5) Servo program
The servo program No. 21 for 3-axes linear interpolation control is shown below.



(6) Sequence program

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



Turns ON PLC ready.

Turns ON all axes servo start command.

Turns ON servo program No. 11 start command flag (M1) when X000 turns OFF → ON.

Servo program No. 11 execution request.

Turns OFF M1 on completion of servo program No. 11 execution request.

7.5 4-Axes Linear Interpolation Control

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

Servo Instruction	Positioning Method	Number of Controllable Axes	Items Set by Peripherals																					
			Common							Arc			Parameter Block									Others		
			Parameter Block No.	Axis	Address/Travel Value	Commanded Speed	Dwell Time	M Code	Torque Limit Value	Auxiliary Point	Radius	Center Point	Control Unit	Speed Limit Value	Acceleration Time	Deceleration Time	Rapid Stop Deceleration Time	Torque Limit Value	Deceleration Processing on Stop Input	Allowable Error Range for Circular Interpolation	SCurve Ratio	Cancel	Start	Speed Change
ABS-4	Absolute data	4	Δ	○	○	○	Δ	Δ					Δ	Δ	Δ	Δ	Δ	Δ	Δ		Δ	Δ	Δ	OK
INC-4	Incremental																							

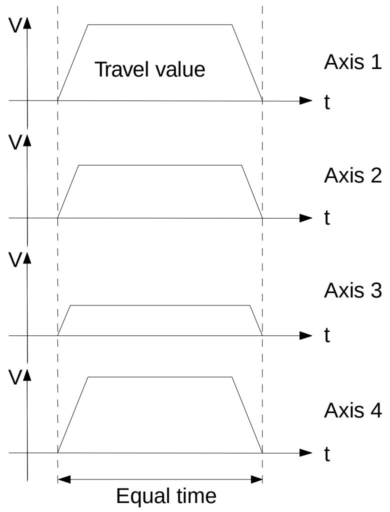
○ : Must be set
Δ : Set if required

[Control Details]

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

Example

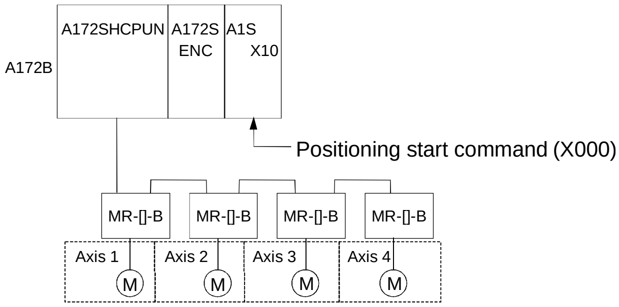
4-axes linear interpolation



[Program Example]

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

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



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

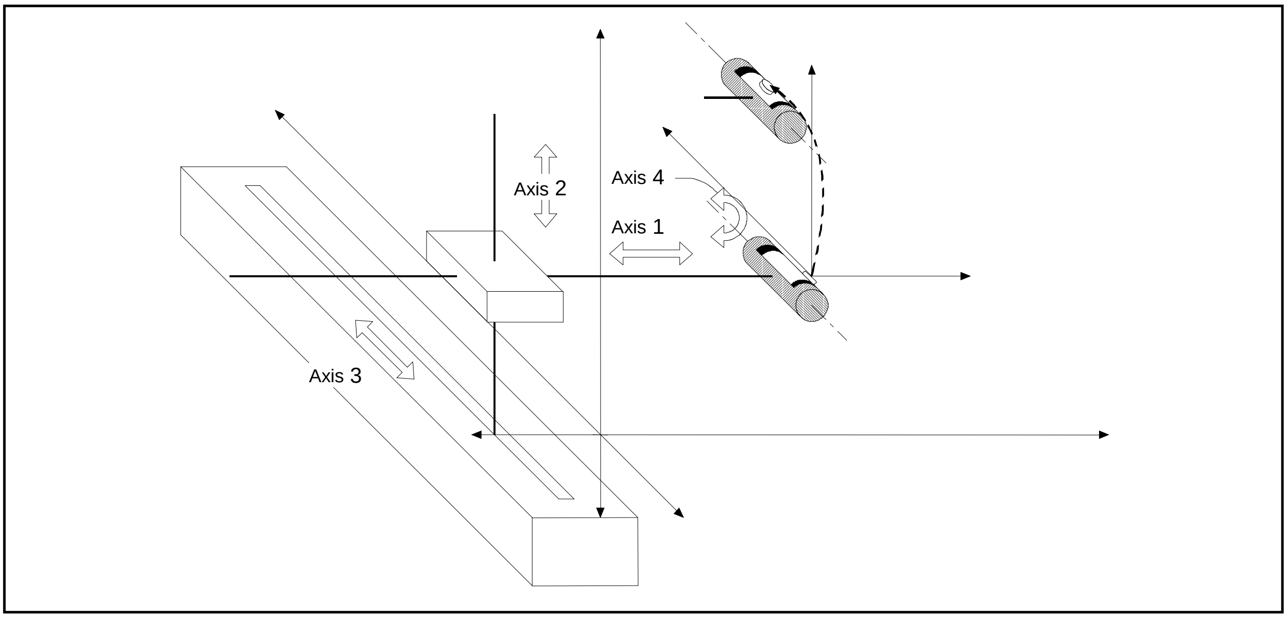


Fig. 7.7 Axis Configuration

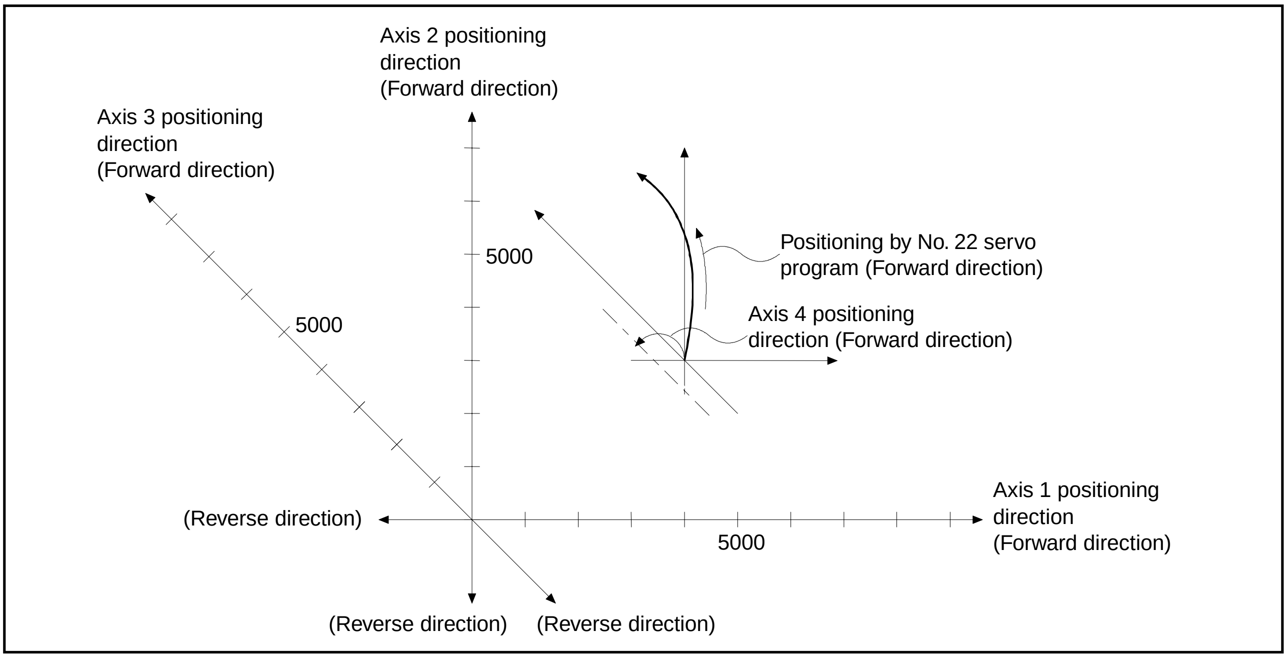


Fig. 7.8 Positioning by 4-axes Linear Interpolation Control

(3) Positioning conditions

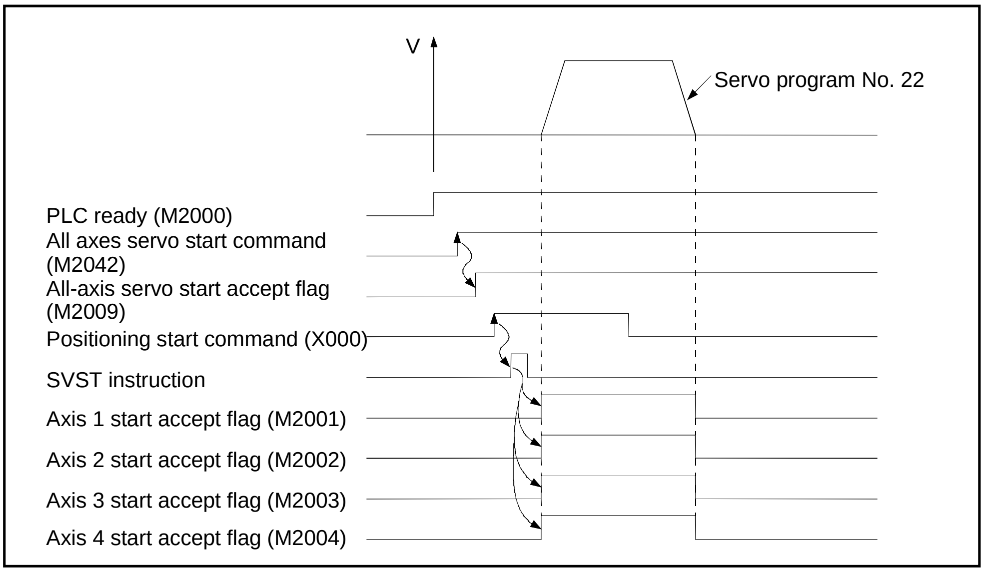
(a) The positioning conditions are shown below.

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

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

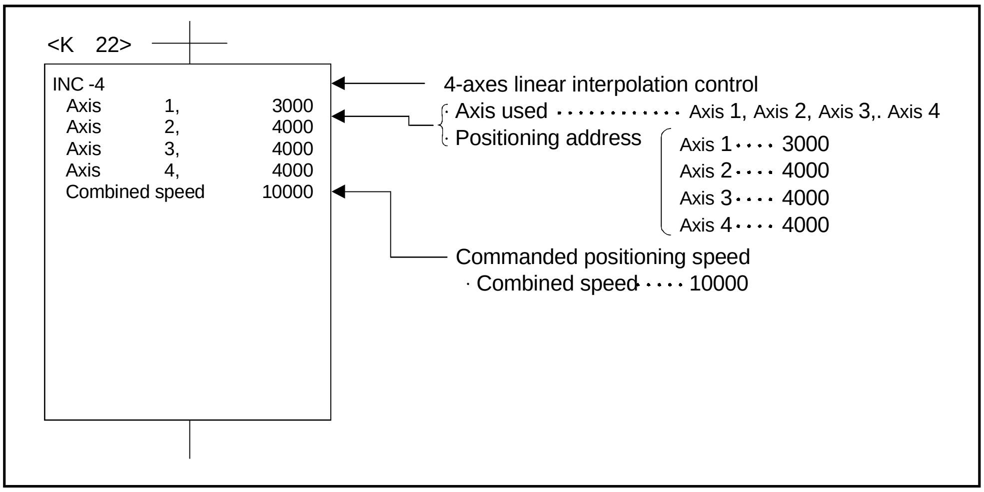
(4) Operation timing

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



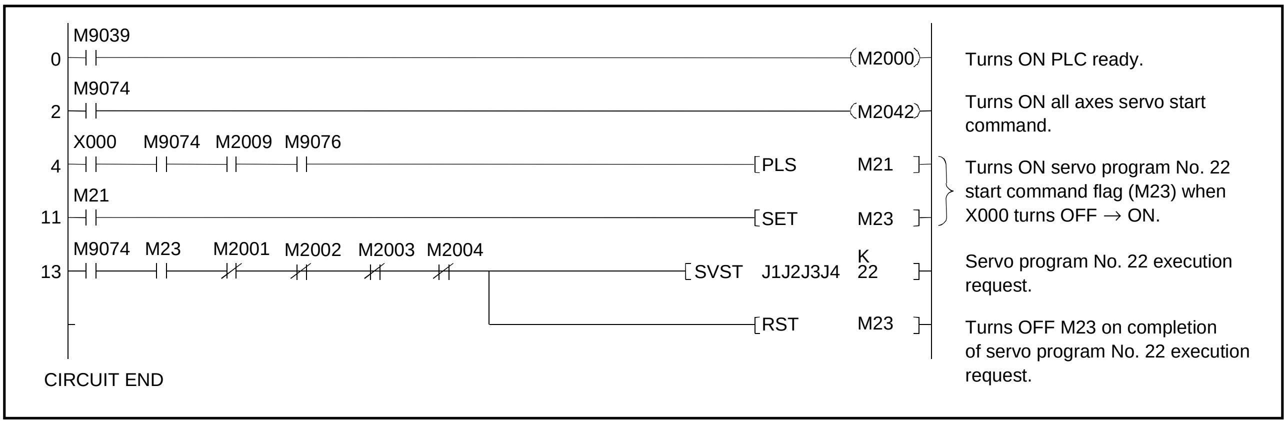
(5) Servo program

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



(6) Sequence program

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



7.6 Circular Interpolation Using Auxiliary Point Designation

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

Servo Instruction	Positioning Method	Number of Controllable Axes	Items Set by Peripherals																					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	SCurve Ratio	Cancel	Start	
ABS	Absolute data	2	Δ	○	○	○	Δ	Δ		○			Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	NG
INC	Incremental																							

○ : Must be set
Δ : Set if required

[Control Details]

Control with ABS (absolute data method).

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

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

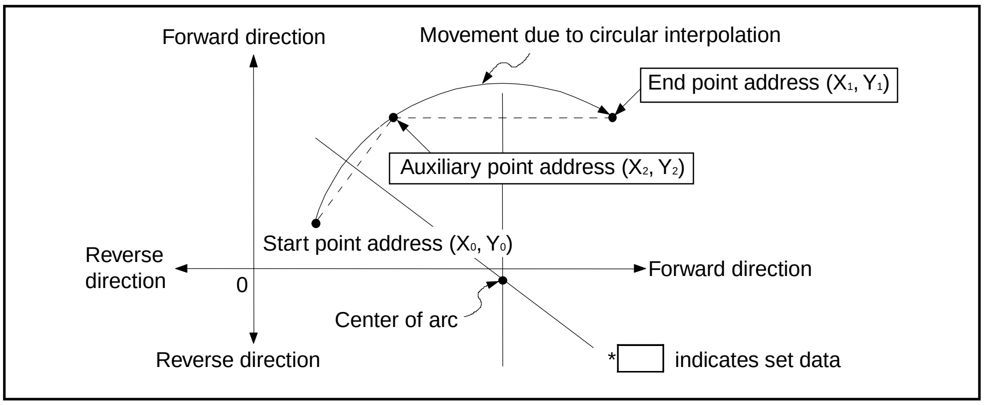


Fig. 7.9 Circular Interpolation Control by Absolute Data Method

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

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

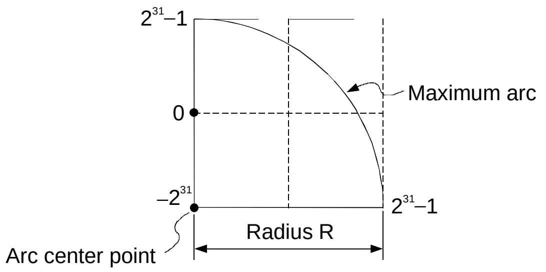


Fig. 7.10 Maximum Arc

Control with INC (incremental method)

(1) Circular interpolation from the current stop address (pre-positioning address) through the designated auxiliary point address to the end point address.

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

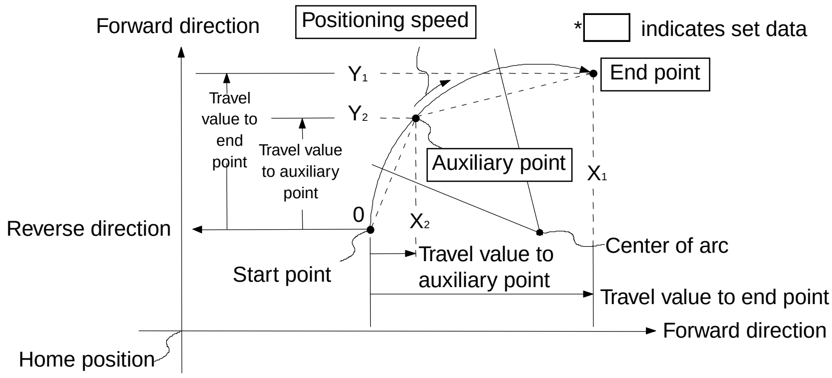


Fig. 7.11 Circular Interpolation Control by Incremental Method

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

(4) The maximum arc radius is $2^{31}-1$.
If the designated end point and auxiliary point result in a radius greater than $2^{31}-1$, an error occurs at the start and error code 107 is stored in the data register.

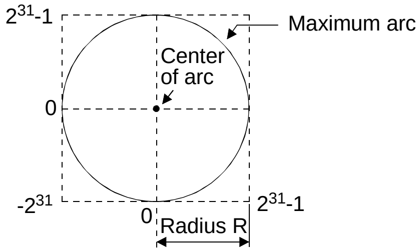


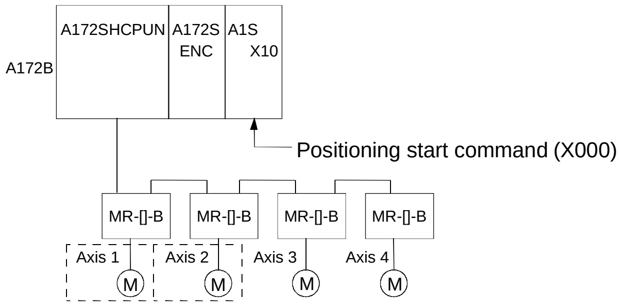
Fig. 7.12 Maximum Arc

[Program Example]

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

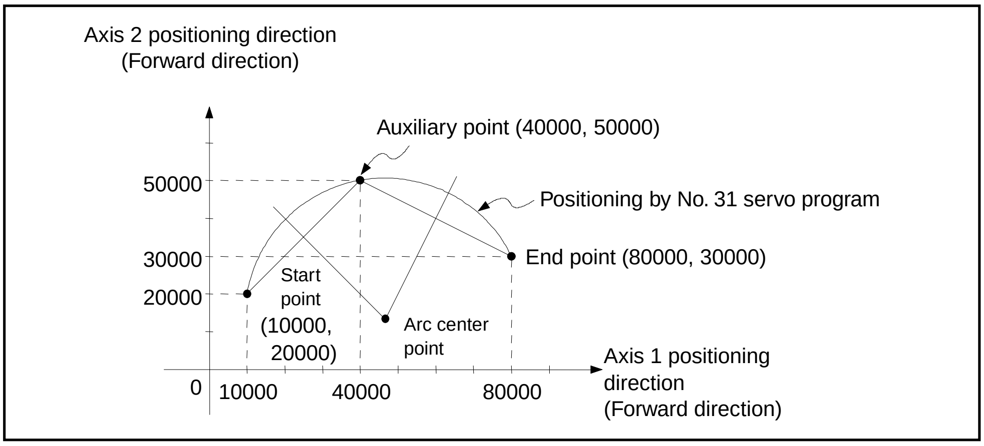
(1) System configuration

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



(2) Positioning details

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



(3) Positioning conditions

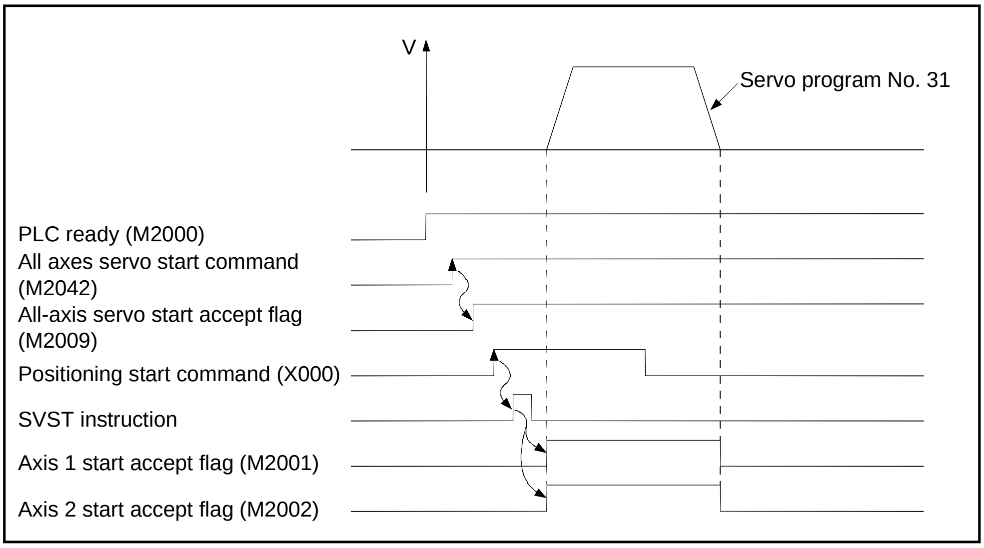
(a) The positioning conditions are shown below.

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

(b) Positioning start .... leading edge of X000 (OFF $\rightarrow$ ON)

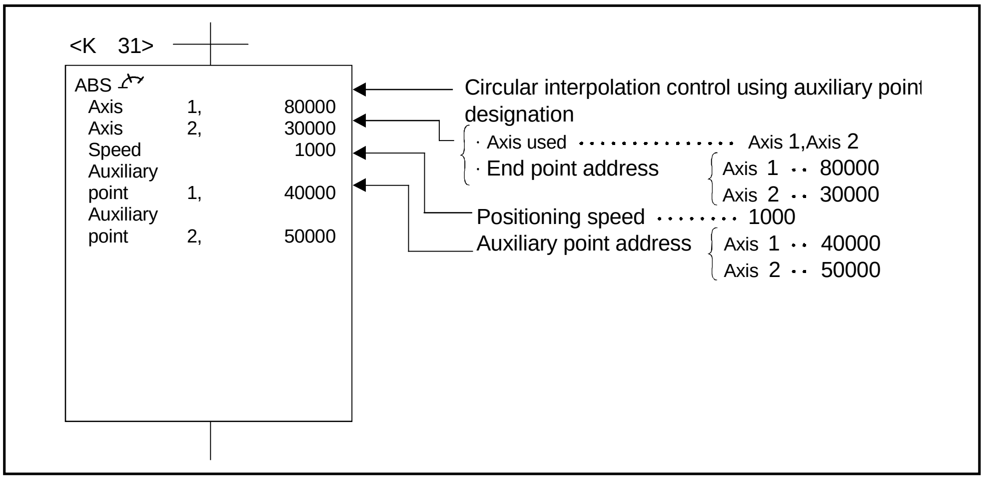
(4) Operation timing

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



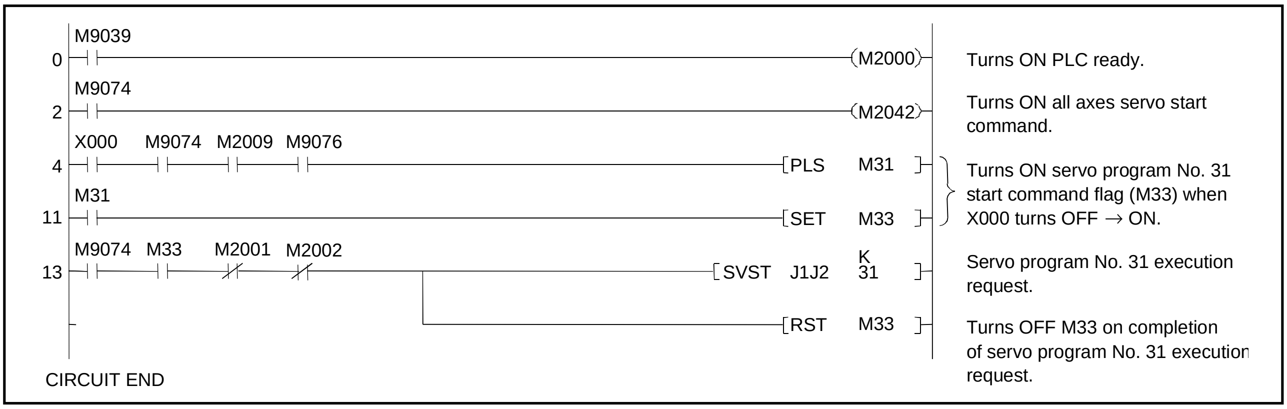
(5) Servo program

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

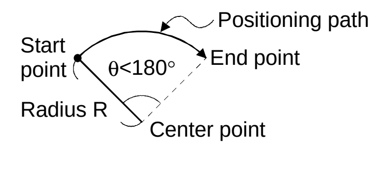
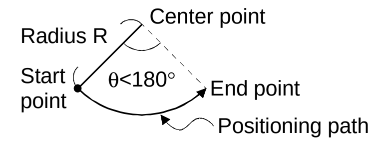
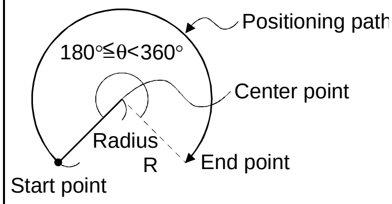
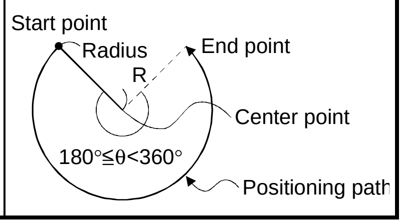
Circular interpolation control by designating the end point and arc radius.
Circular interpolation control using radius designation uses ABS ↷ , ABS ↶ , ABS ↺ , and ABS ↻ (absolute data method) and INC ↷ , INC ↶ , INC ↺ , and INC ↻ (incremental method) servo instructions.

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 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	SCurve Ratio	Cancel	Start	
ABS ↷	Absolute data	2	Δ	○	○	○	Δ	Δ			○		Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	NG
ABS ↶																								
ABS ↺																								
ABS ↻																								
INC ↷	Incremental																							
INC ↶																								
INC ↺																								
INC ↻																								

○ : Must be set
Δ : Set if required

[Control Details]

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

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

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

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

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

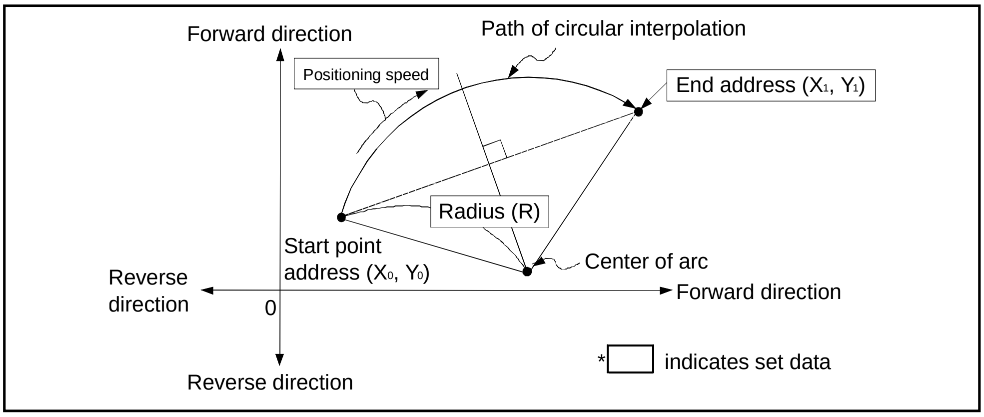


Fig. 7.13 Circular Interpolation Control by Absolute Data Method

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

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

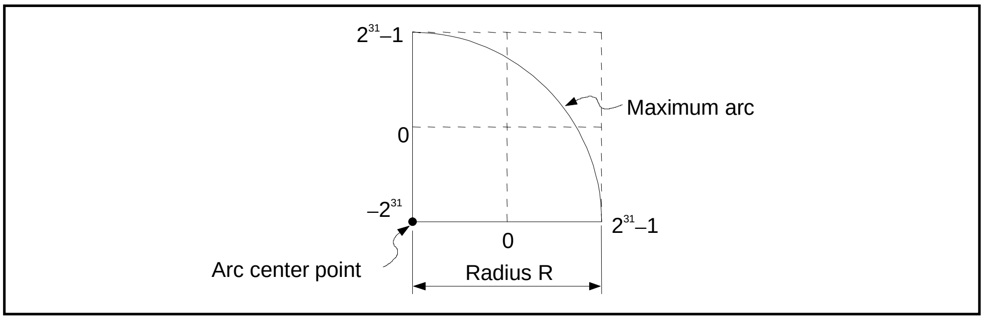


Fig. 7.14 Maximum Arc

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

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

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

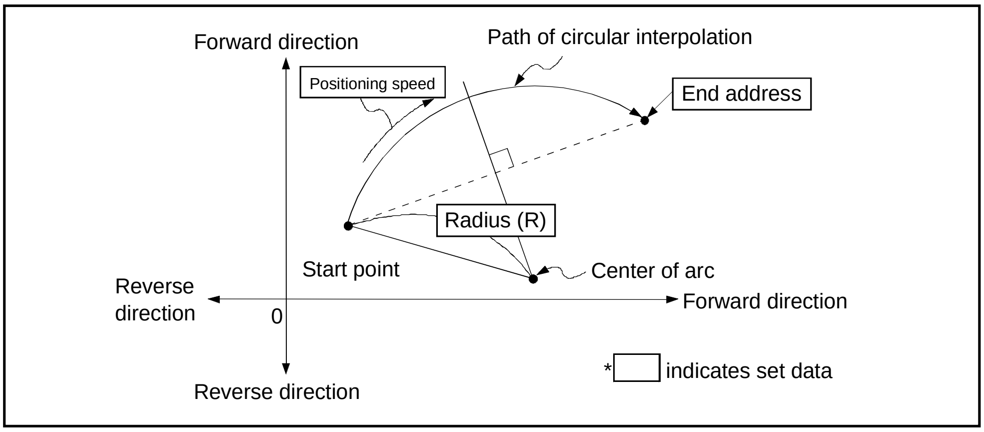


Fig. 7.15 Circular Interpolation Control by Incremental Method

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

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

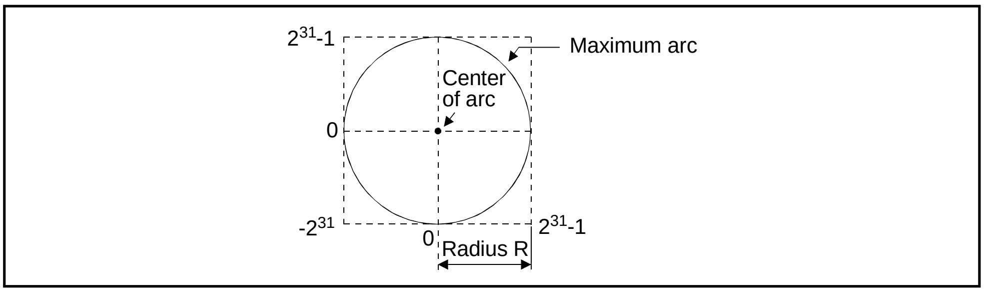


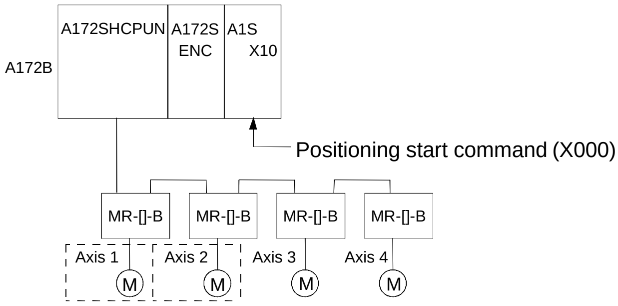
Fig. 7.16 Maximum Arc

[Program Example]

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

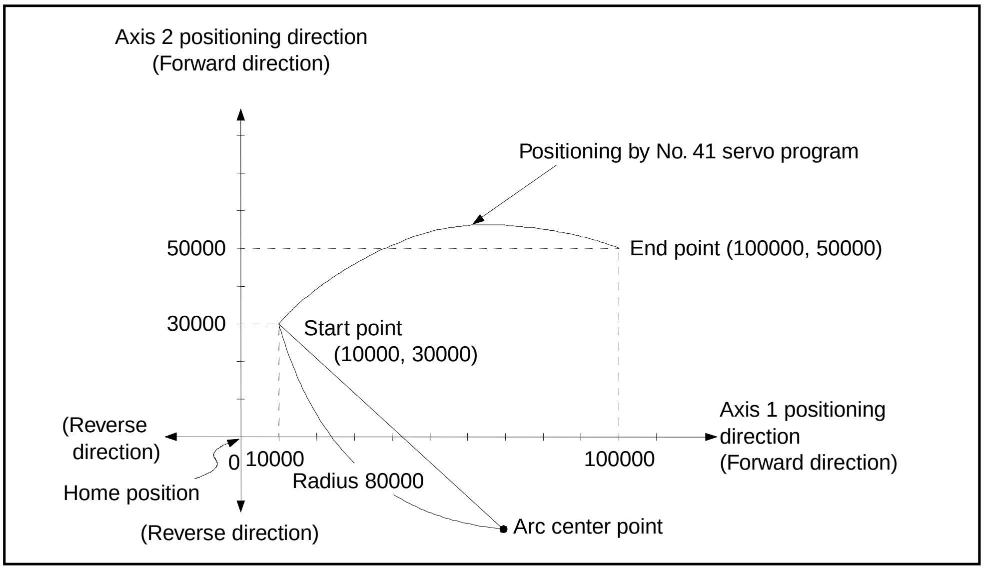
(1) System configuration

Circular interpolation control of Axis 1 and Axis 2 using radius designation.



(2) Positioning details

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



(3) Positioning conditions

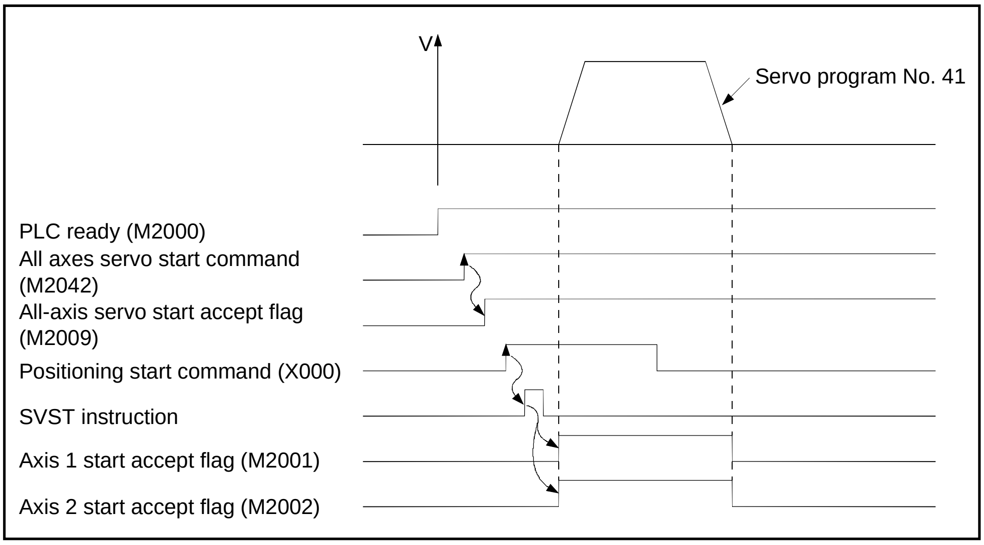
(a) The positioning conditions are shown below.

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

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

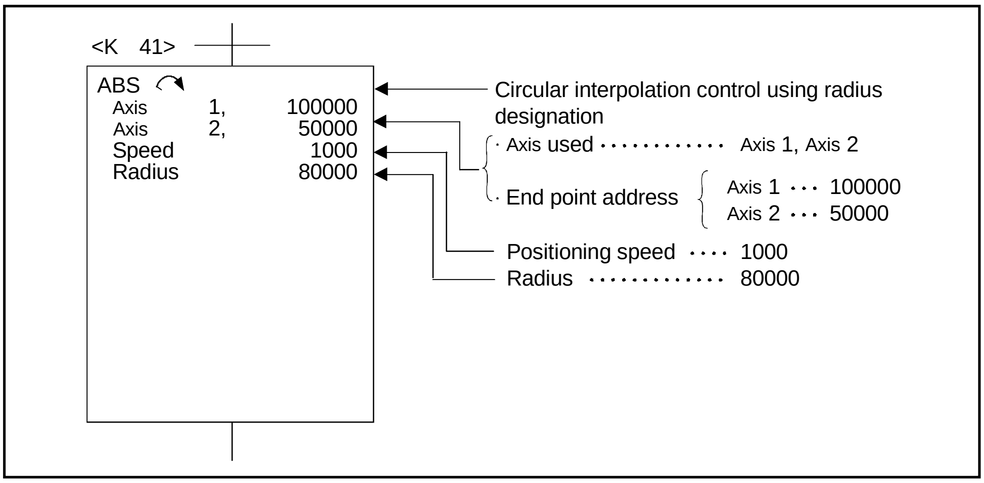
(4) Operation timing

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



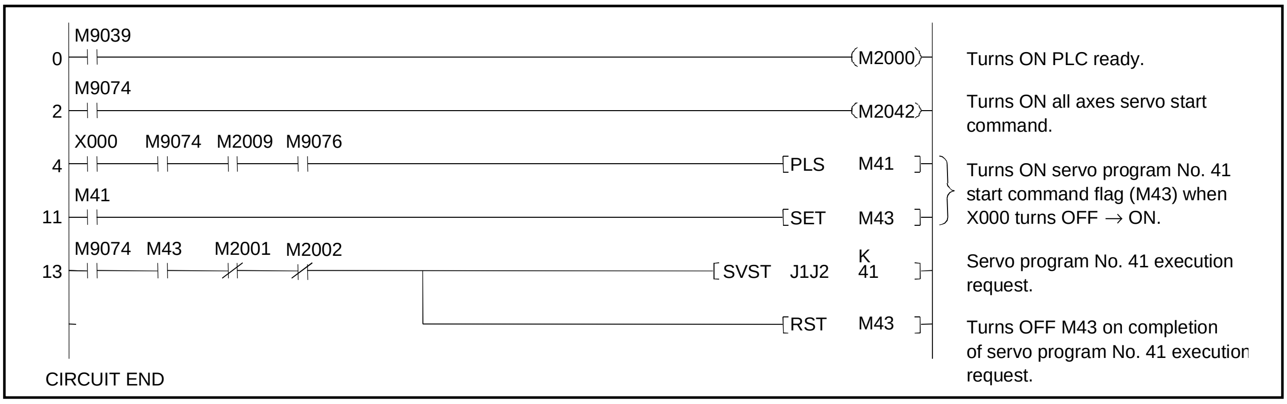
(5) Servo program

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



(6) Sequence program

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



7.8 Circular Interpolation Using Center Point Designation

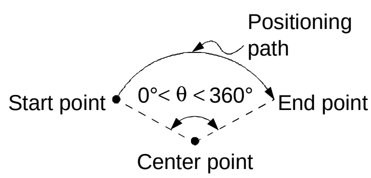
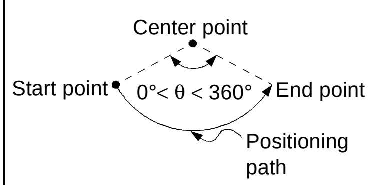
Circular interpolation control by designating the end point and arc center point. Circular interpolation control using center point designation uses ABS ↷ and ABS ↶ (absolute data method) and INC ↷ and INC ↶ (incremental method) servo instructions.

Servo Instruction	Positioning Method	Number of Controllable Axes	Items Set by Peripherals																						
			Common							Arc			Parameter Block										Others		
			Parameter Block No.	Axis	Address/Travel Value	Commanded Speed	Dwell Time	M Code	Torque Limit Value	Auxiliary Point	Radius	Center Point	Control Units	Speed Limit Value	Acceleration Time	Deceleration Time	Rapid Stop Deceleration Time	Torque Limit Value	Deceleration Processing on Stop Input	Allowable Error Range for Circular Interpolation	S-Curve Ratio	Cancel	Start	Speed Change
ABS ↷	Absolute data	2	Δ	○	○	○	Δ	Δ				○	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	NG
ABS ↶																								
INC ↷	Incremental																							
INC ↶																								

○ : Must be set
Δ : Set if required

[Control Details]

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

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

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

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

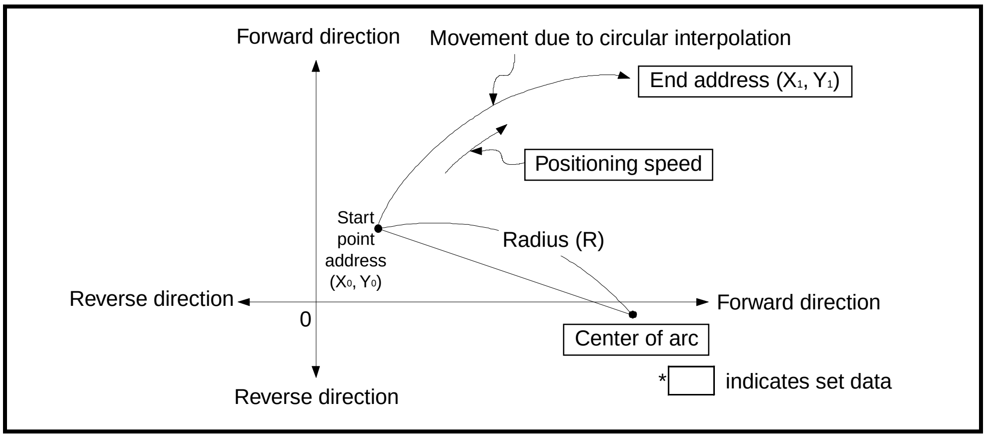


Fig. 7.17 Circular Interpolation Control by Absolute Date Method

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

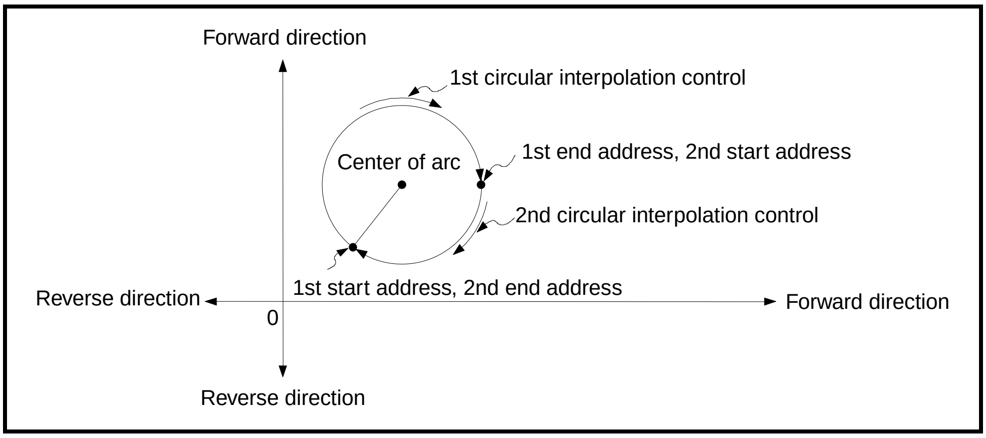


Fig. 7.18 Positioning Control of a Full Circle

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

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

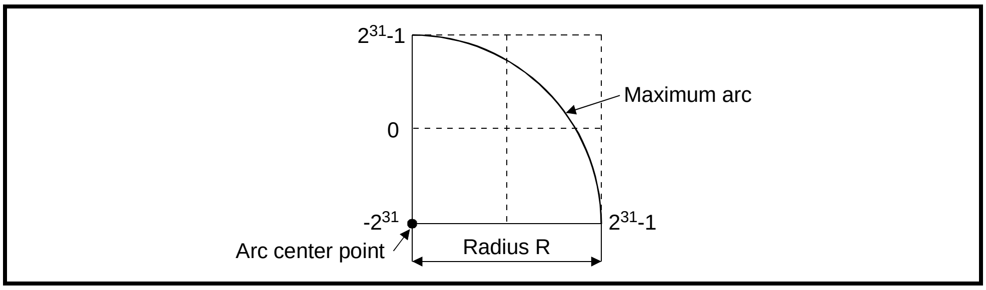


Fig. 7.19 Maximum Arc

Control with INC and INC (incremental method)

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

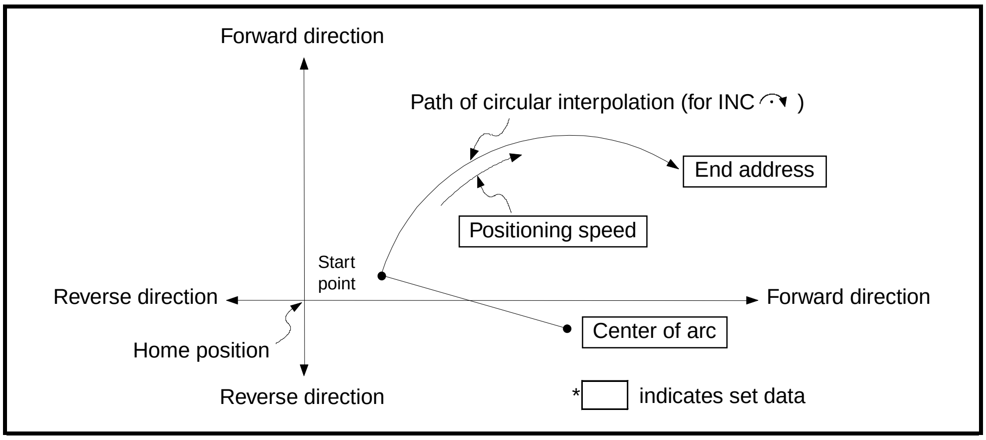


Fig. 7.20 Circular Interpolation Control by Incremental Method (INC)

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

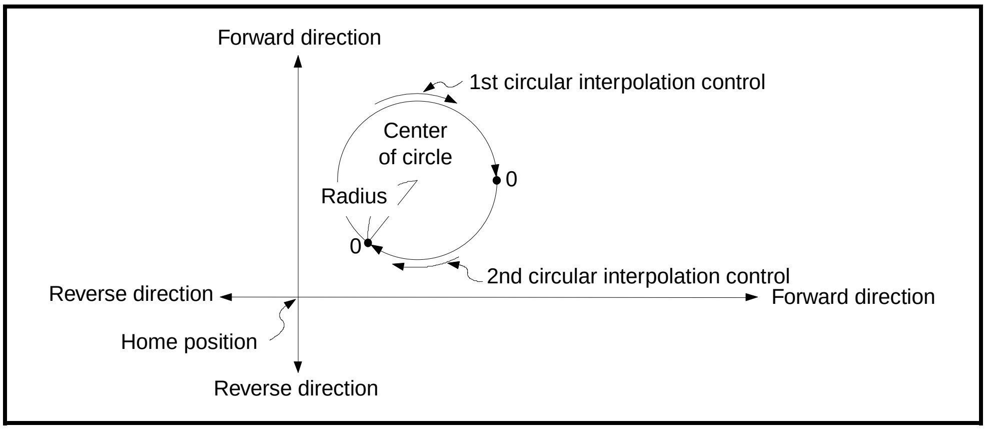


Fig. 7.21 Positioning Control of a Full Circle

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

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

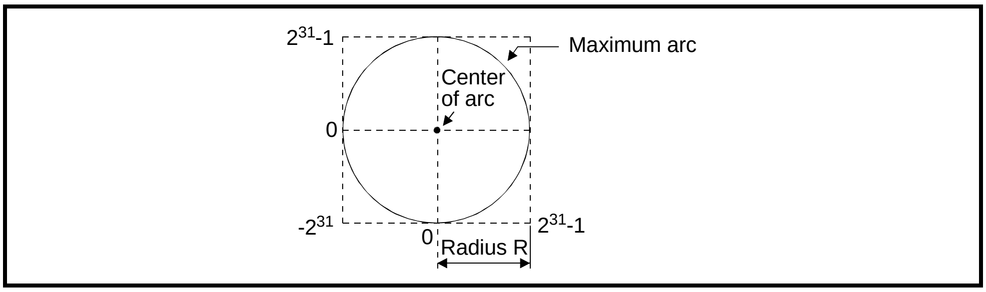
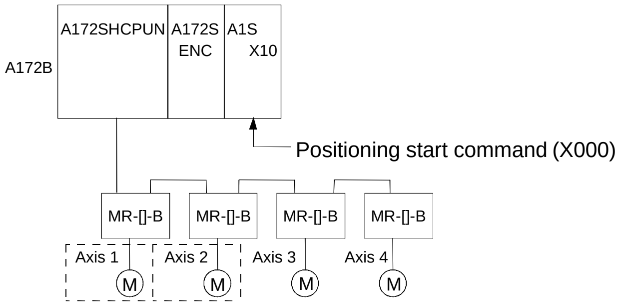


Fig. 7.22 Maximum Arc Radius

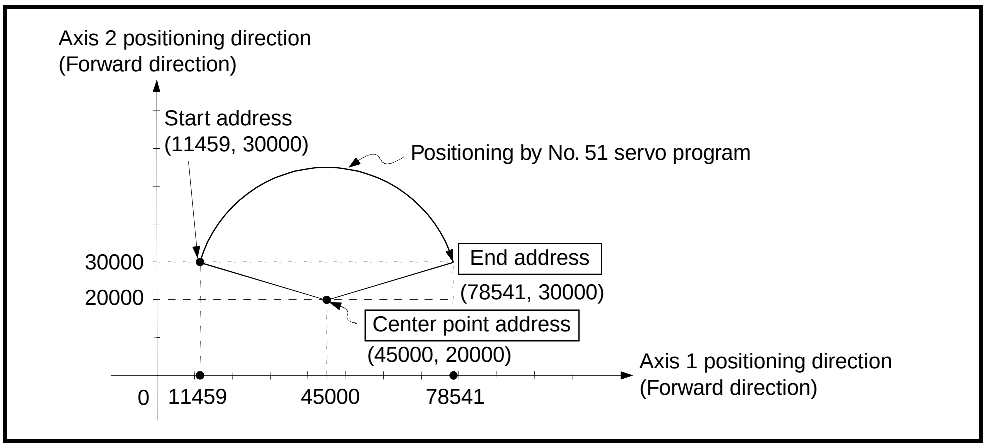
[Program Example]

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

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



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



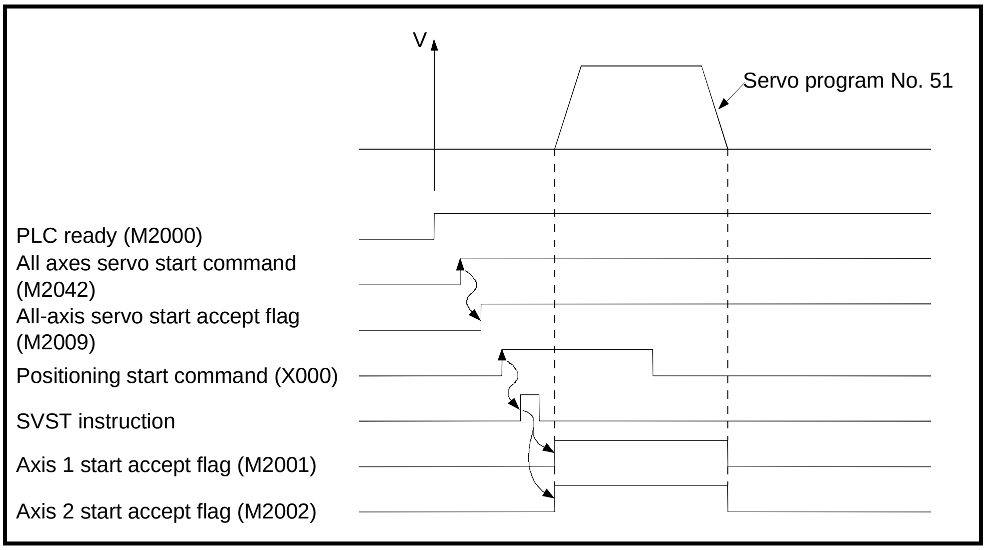
(3) Positioning conditions
(a) The positioning conditions are shown below.

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

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

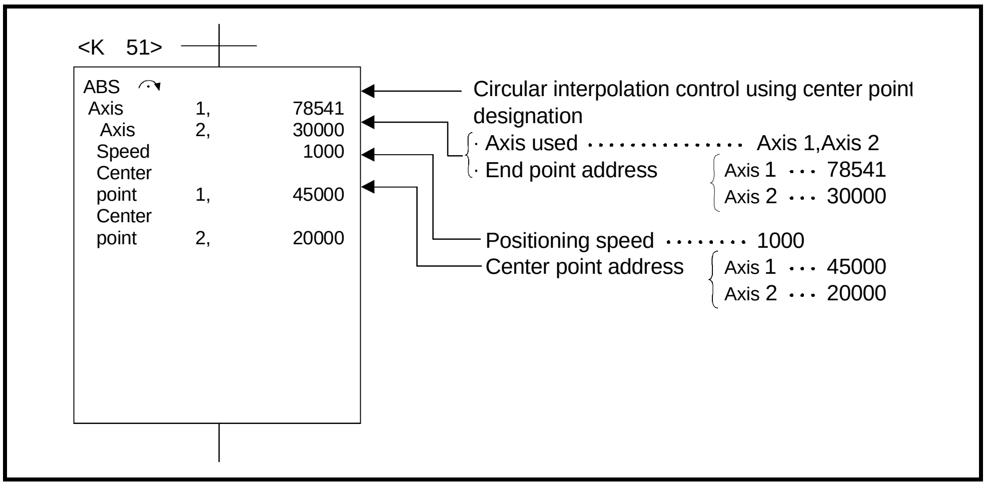
(4) Operation timing

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



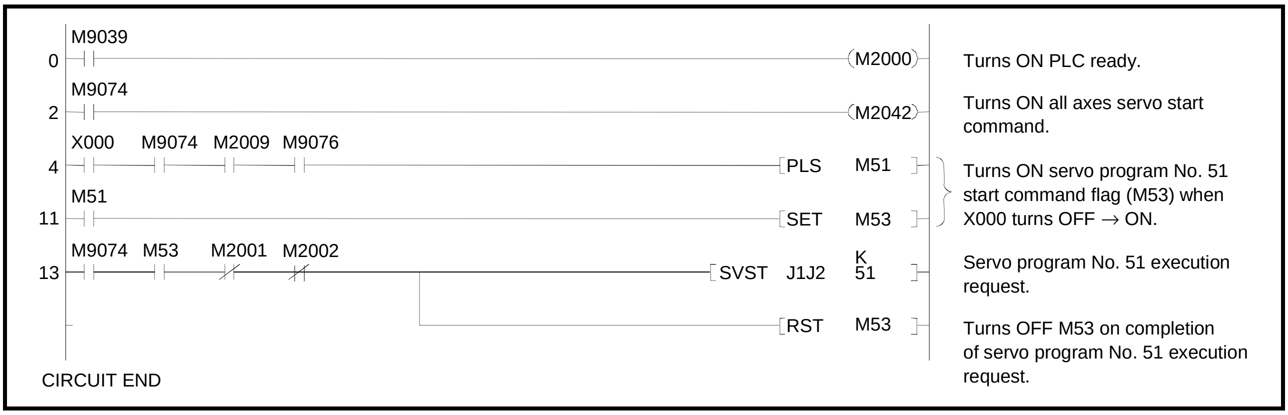
(5) Servo program

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



(6) Sequence program

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



7.9 1-Axis Fixed-Pitch Feed Control

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

Servo Instruction	Positioning Method	Number of Controllable Axes	Items Set by Peripherals																					Speed Change
			Common							Arc			Parameter Block									Others		
			Parameter Block No.	Axis	Address/Travel Value	Commanded Speed	Dwell Time	M Code	Torque Limit Value	Auxiliary Point	Radius	Center Point	Control Units	Speed Limit Value	Acceleration Time	Deceleration Time	Rapid Stop Deceleration Time	Torque Limit Value	Deceleration Processing on Stop Input	Allowable Error Range for Circular Interpolation	S-Curve Ratio	Cancel	Start	
FEED-1	Incremental	1	Δ	○	○	○	Δ	Δ						Δ	Δ	Δ	Δ	Δ	Δ		Δ	Δ	Δ	OK

○ : Must be set
Δ : Set if required

[Control Details]

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

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

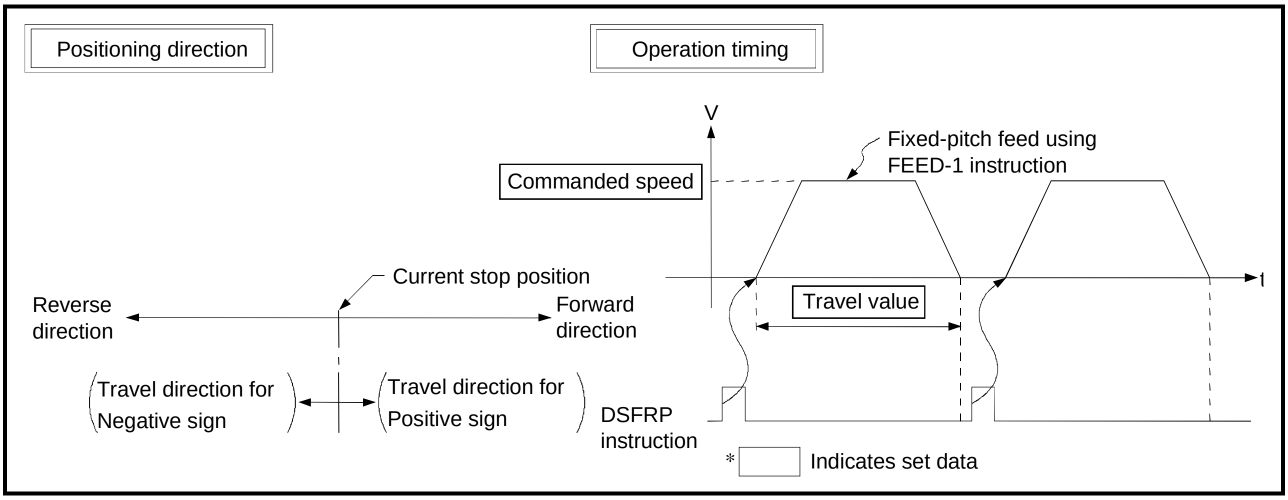


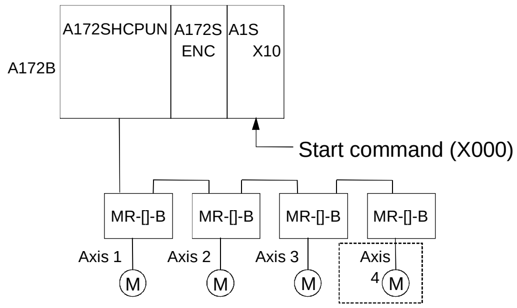
Fig. 7.23 One-Axis Fixed-Pitch Feed Control

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

[Program Example]

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

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



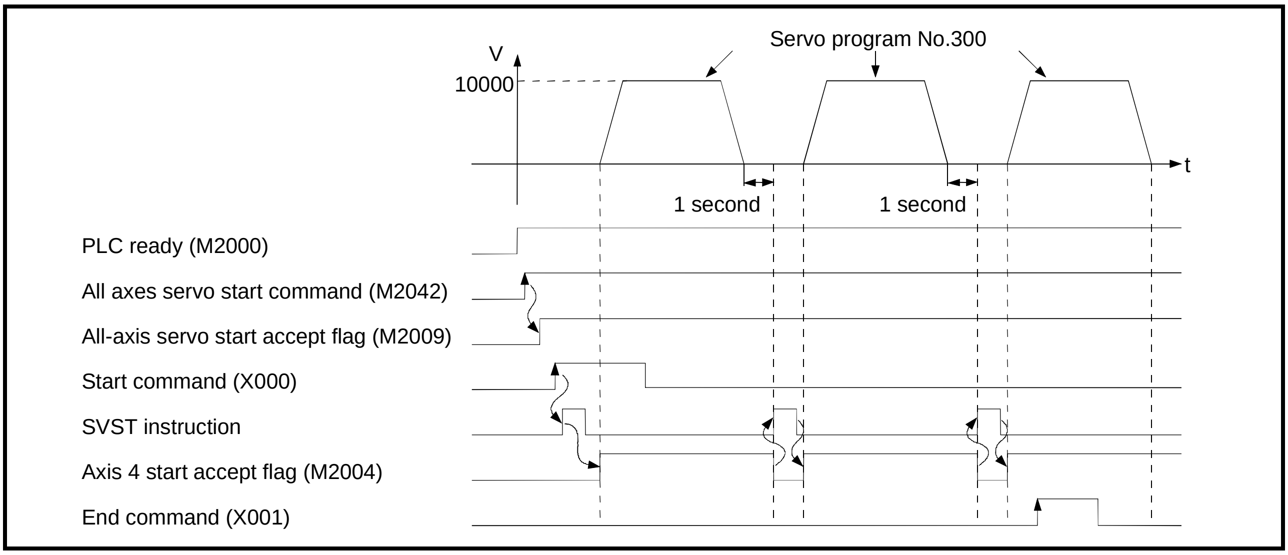
(2) Fixed-pitch feed control conditions
(a) The positioning conditions are shown below.

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

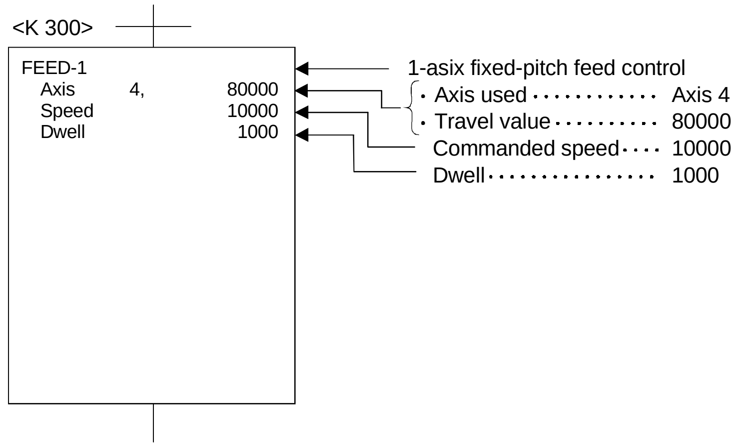
(b) Fixed-pitch feed control start command......... leading edge of X000 (OFF→ ON)

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

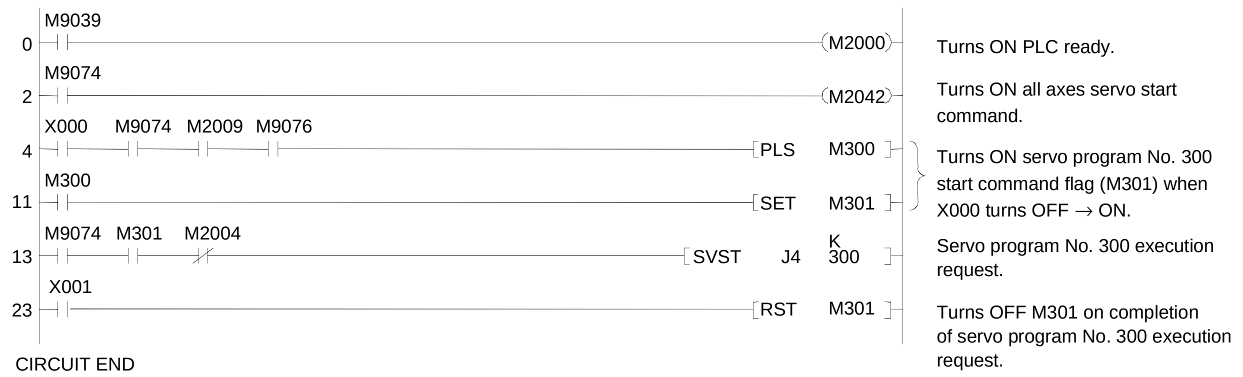
(3) Operation timing
The operation timing for fixed-pitch feed control is shown below.



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



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



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

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

Servo Instruction	Positioning Method	Number of Controllable Axes	Items Set by Peripherals																					
			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	SCurve Ratio	Cancel	Start	Speed Change
FEED-2	Incremental	2	Δ	○	○	○	Δ	Δ					Δ	Δ	Δ	Δ	Δ	Δ	Δ		Δ	Δ	Δ	OK

○ : Must be set
Δ : Set if required

[Control Details]

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

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

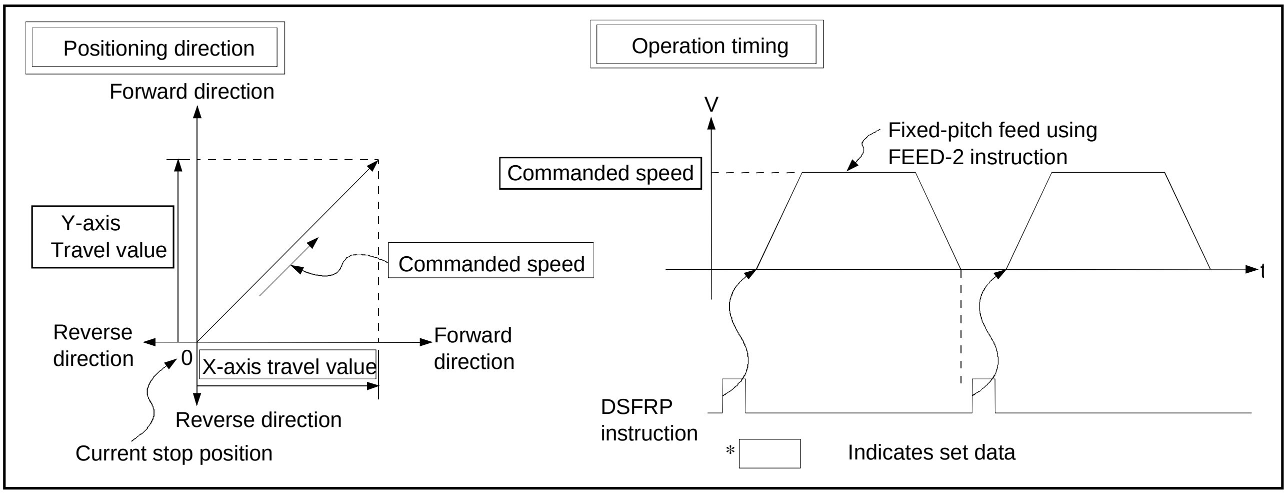


Fig. 7.24 Fixed-Pitch Feed Control Using 2-Axes Linear Interpolation

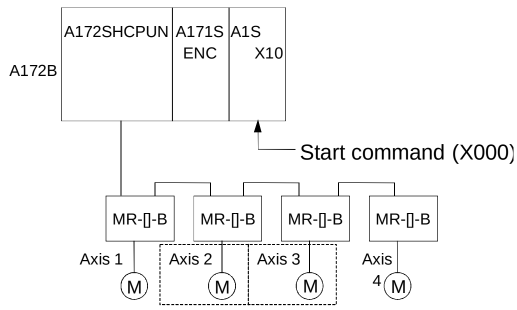
POINT

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

[Program Example]

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

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



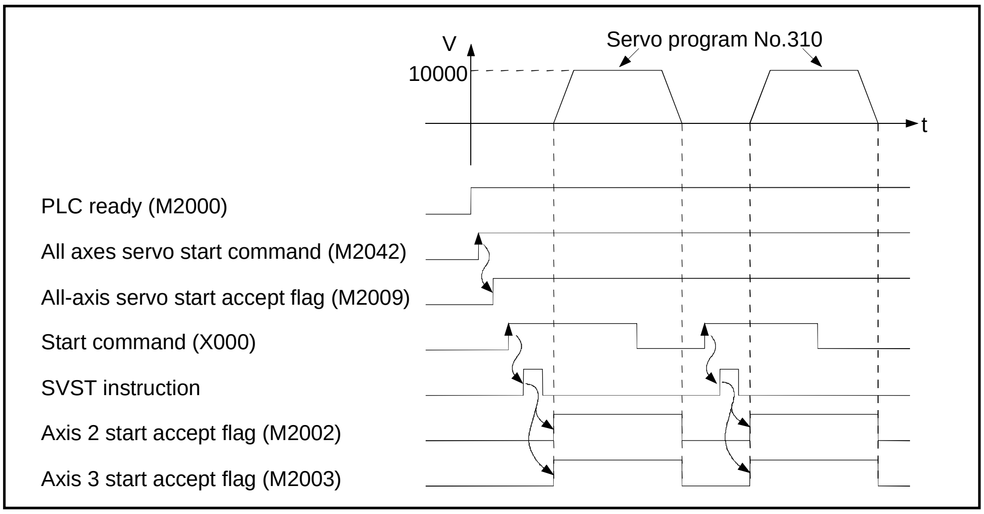
(2) Positioning conditions
The fixed-pitch feed control conditions are shown below.

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

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

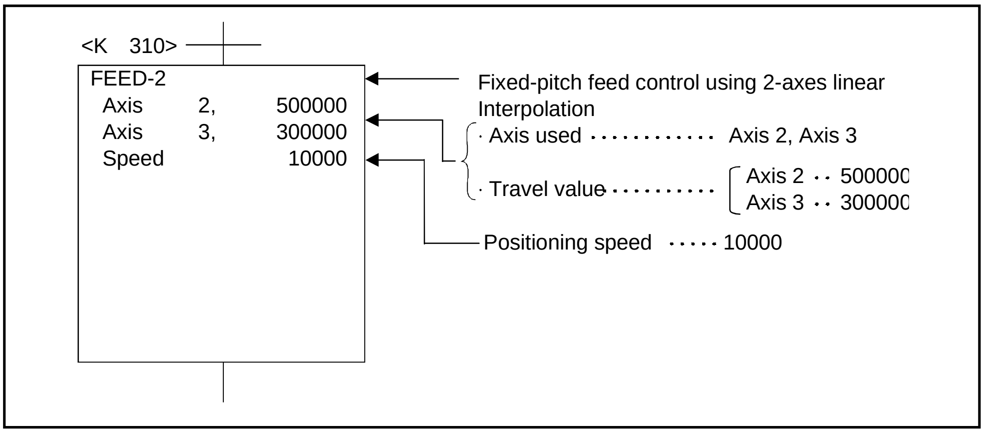
(3) Operation timing

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



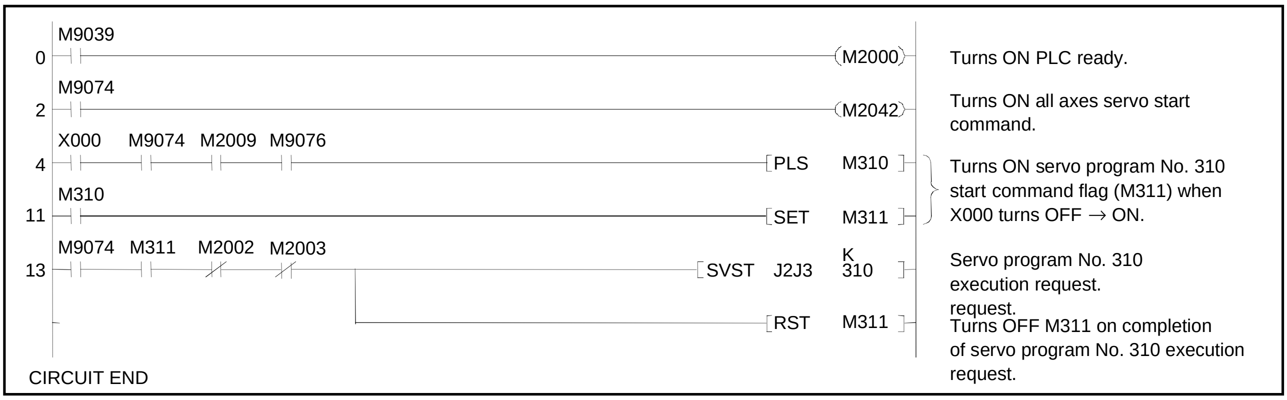
(4) Servo program

The servo program No. 310 for fixed-pitch feed control using two-axes linear interpolation is shown below.



(5) Sequence program

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



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

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

Servo Instruction	Positioning Method	Number of Controllable Axes	Items Set by Peripherals																					Speed Change
			Common							Arc			Parameter Block									Others		
			Parameter Block No.	Axis	Address/Travel Value	Commanded Speed	Dwell Time	M Code	Torque Limit Value	Auxiliary Point	Radius	Center Point	Control Unit	Speed Limit Value	Acceleration Time	Deceleration Time	Rapid Stop Deceleration Time	Torque Limit Value	Deceleration Processing on Stop Input	Allowable Error Range for Circular Interpolation	SCurve Ratio	Cancel	Start	
FEED-3	Incremental	3	Δ	○	○	○	Δ	Δ					Δ	Δ	Δ	Δ	Δ	Δ	Δ		Δ	Δ	Δ	OK

○ : Must be set
Δ : Set if required

[Control Details]

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

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

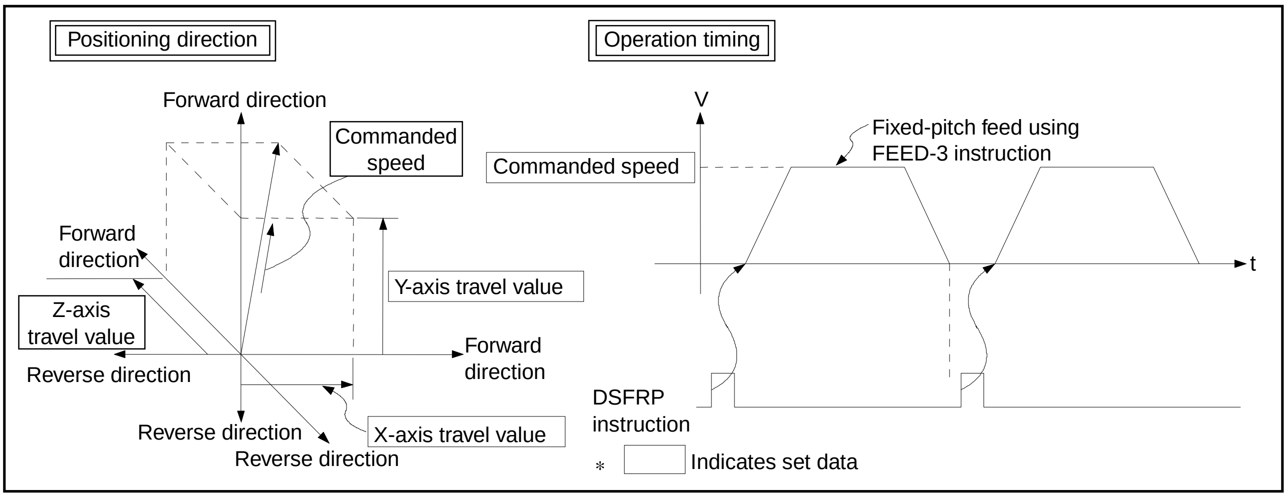


Fig. 7.25 Fixed-Pitch Feed Control Using 3-Axes Linear Interpolation

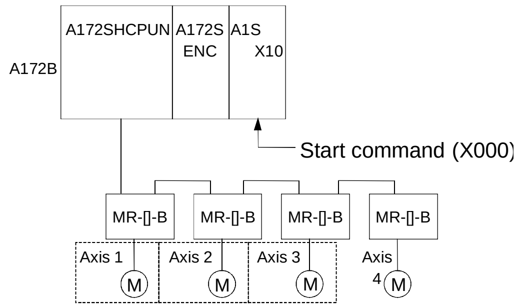
POINT

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

[Program Example]

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

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

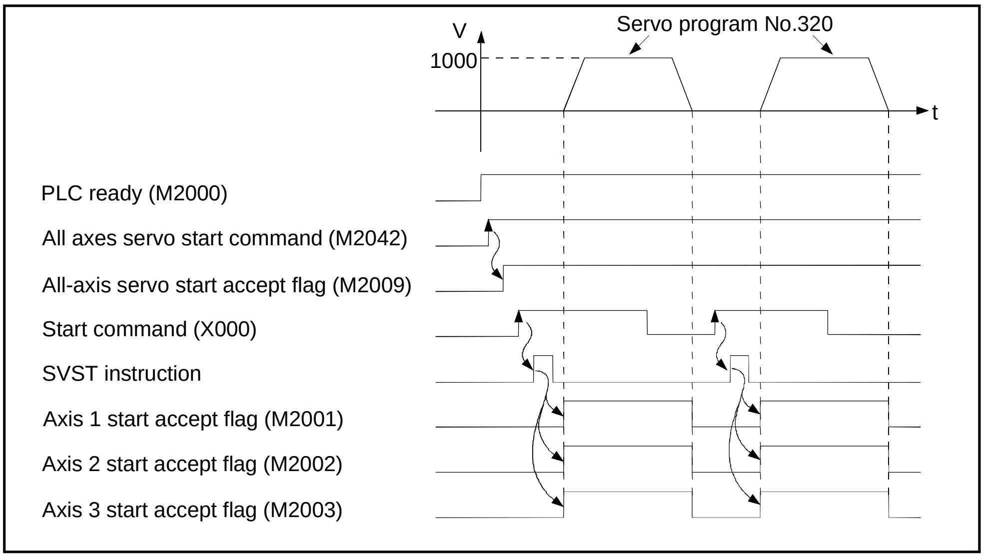


(2) System configuration
(a) The positioning conditions are shown below.

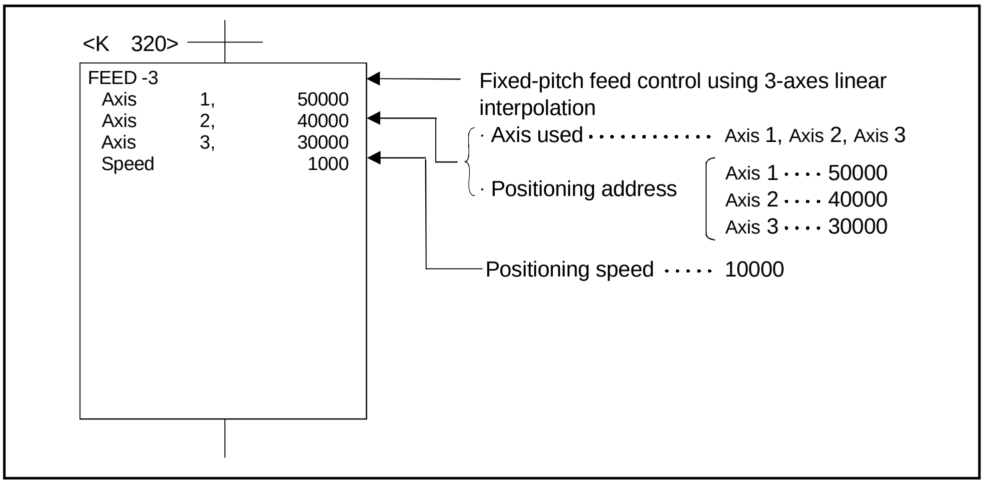
Item	Setting		
Servo program number	No. 320		
Positioning speed	1000		
Controlled axes	Axis 1	Axis 2	Axis 3
Travel value	50000	40000	30000

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

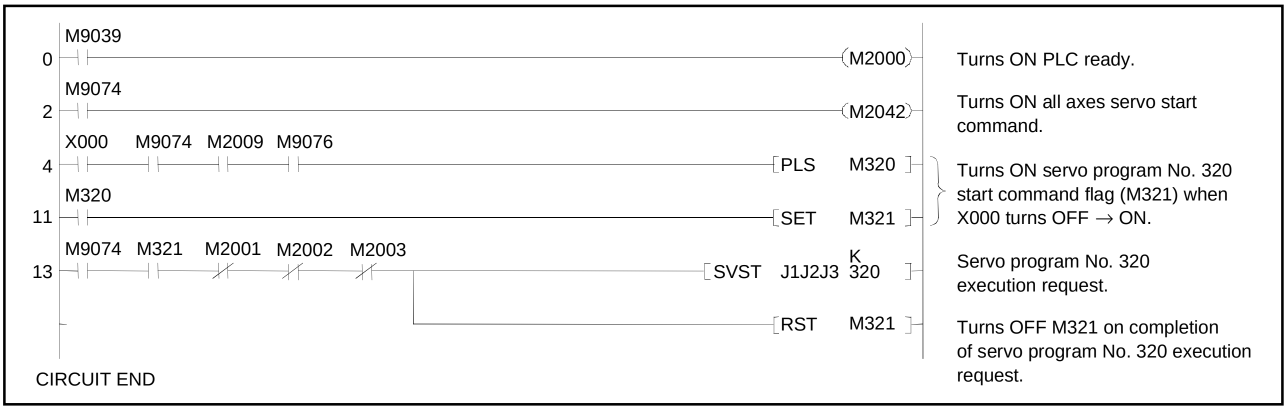
(3) Operation timing
The operation timing for fixed-pitch feed control using 3-axes linear interpolation is shown below.



(4) Servo program
The servo program No. 320 for fixed-pitch feed control using 3-axes linear interpolation is shown below.



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



7.12 Speed Control (I)

(1) Speed control of the 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	SCurve Ratio	Cancel	Start	Speed Change
VF VR	—	1	Δ	○		○		Δ						Δ	Δ	Δ	Δ	Δ	Δ		Δ	Δ	Δ	OK

○ : Must be set
Δ : Set if required

[Control Details]

(1) Controls the axis at the designated speed between the start of servomotor operation and the input of the stop command.
- VF......... movement in forward direction
- VR .... movement in reverse direction

(2) The current value does not change at zero.

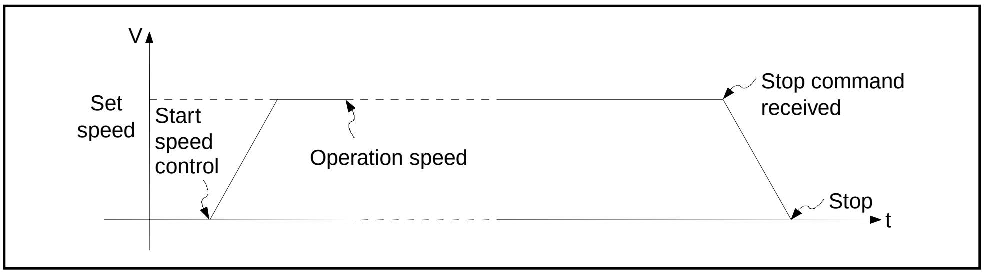


Fig. 7.26 Speed Control (I)

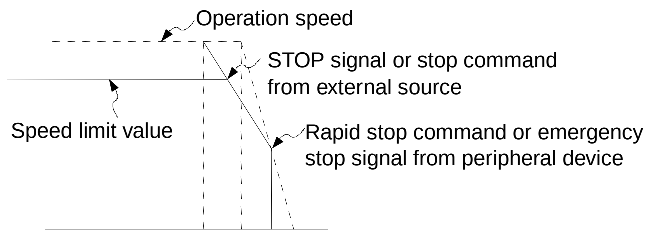
(3) Stop commands and stop processing
The stop commands and stop processing for speed control are listed in Figure 7.1.

Fig. 7.1 Stop Commands and Stop Processing

Stop Command	Stop Condition	Stopped Axis	Stop Processing
External STOP signal	OFF → ON	Designated axis	Deceleration stop according to the deceleration time on STOP input designated in the parameter block or by a servo instruction.
Stop command (M1800+20n)			Deceleration stop according to the deceleration time designated in the parameter block or by a servo instruction.
Rapid stop command(Note) (M1801+20n)			Deceleration stop according to the rapid stop deceleration time designated in the parameter block or by a servo instruction.
Emergency stop from peripheral device(Note) (test mode)	Key input	All axes	Deceleration stop according to the rapid stop deceleration time designated in the parameter block or by a servo instruction.
Speed changed to 0	Value stored in speed change register	Designated axis	Deceleration stop according to the deceleration time designated in the parameter block or by a servo instruction.

POINT

(Note): 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), and processing according to the rapid stop deceleration time parameter starts at the time the stop condition occurs.



[Cautions]

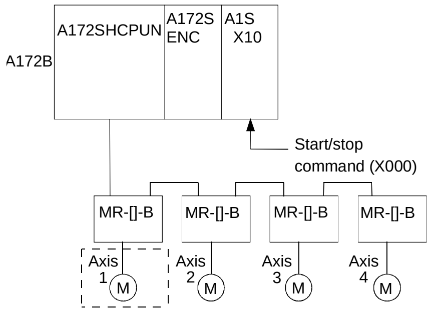
(1) After running speed control using the absolute data system, the feed present value cannot be set to zero by the following operations:
- Reset with the RUN key
- Turning on the servo power supply (OFF → ON)

(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

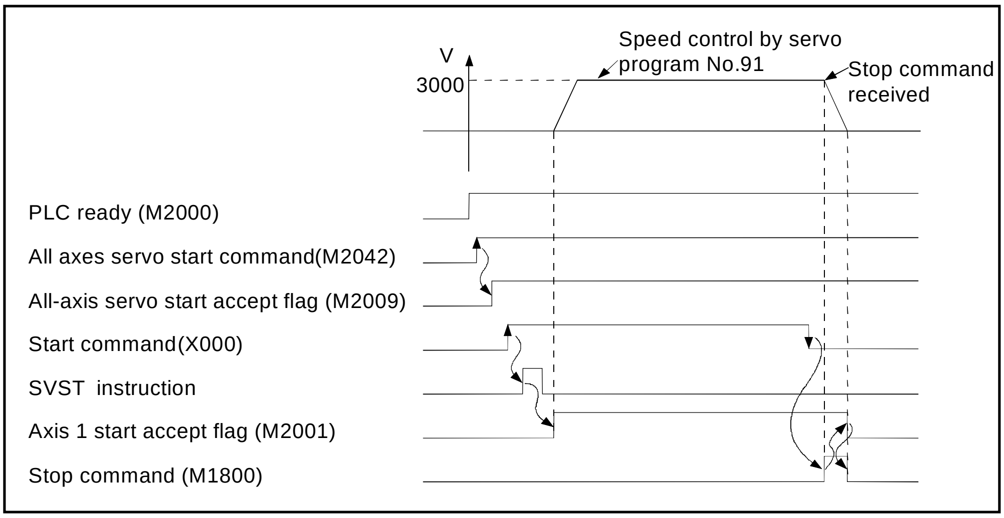
(a) The speed control (I) conditions are shown below.

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)

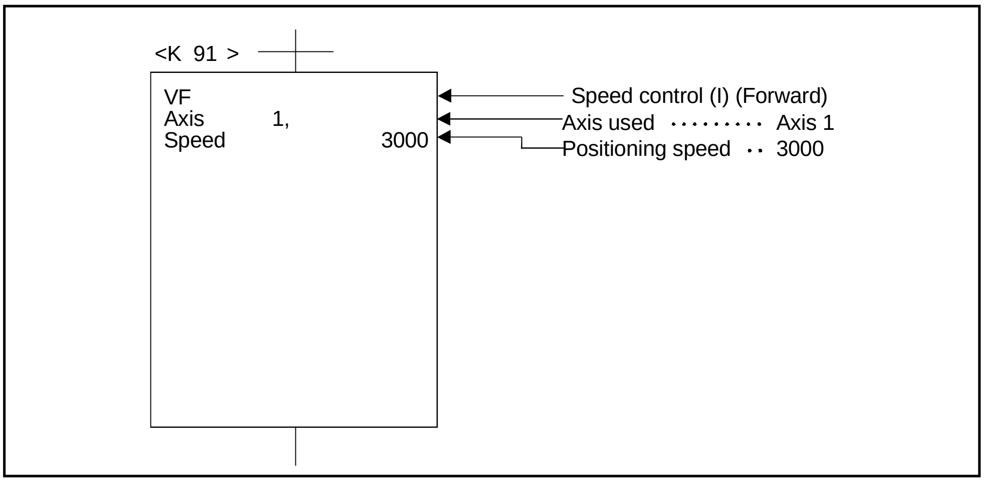
(c) Speed control (I) stop command........ trailing edge of X000 (ON → OFF)

(3) Operation timing
The operation timing for speed control (I) is shown below.



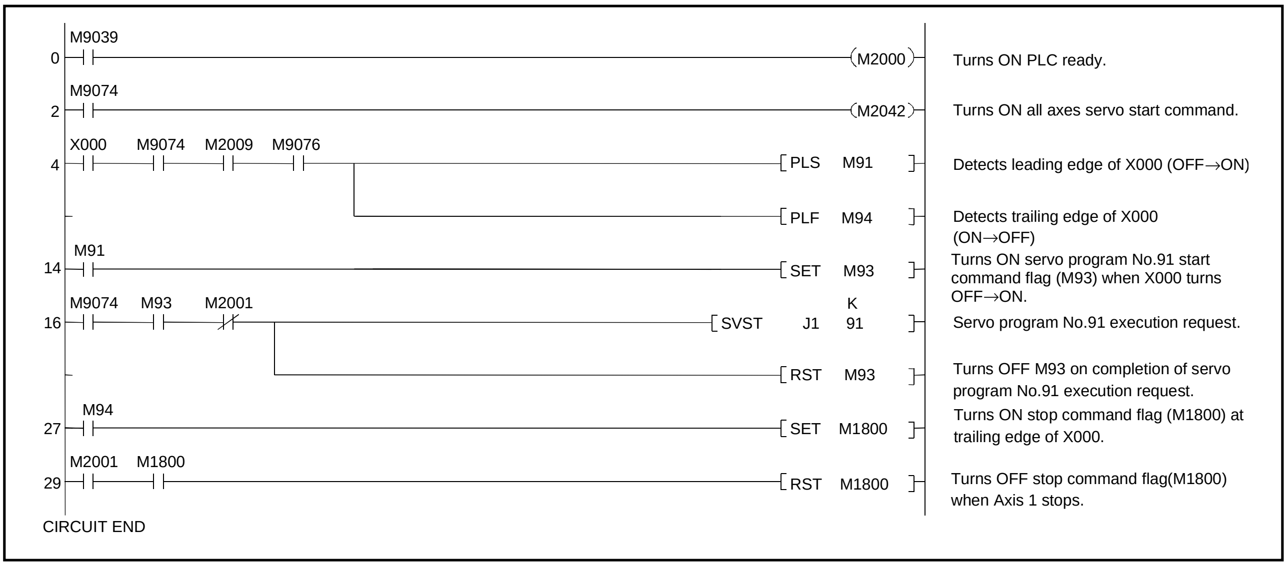
(4) Servo program

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	SCurve Ratio	Cancel	Start	Speed Change
VVF VVR	—	1	Δ	○		○		Δ	Δ					Δ	Δ	Δ	Δ	Δ	Δ		Δ	Δ	Δ	OK

○ : Must be set
Δ : Set if required

[Control Details]

(1) Controls the axis at the designated speed between the start of servomotor operation and the input of the stop command.
- VVF ....movement in forward direction
- VVR.......movement in reverse direction

(2) The current value or deviation counter do not change at zero.

(3) When the setting for "torque" is set in a servo program and an indirect designation is made, the torque limit value can be changed during operation by changing the value of the indirect device.

(4) The stop command and stop processing are the same as for speed control(I).

[Cautions]

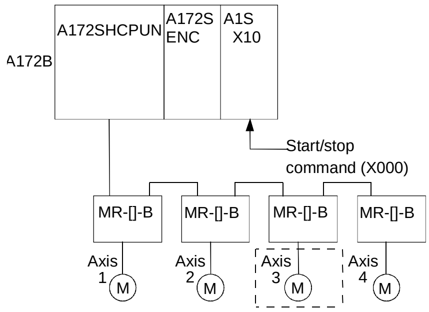
(1) After running speed control using the absolute data system, the feed current value cannot be set to zero by resetting with the RUN key.

(2) The dwell time cannot be set.

[Program Example]

This program conducts speed control (II) under the conditions below.

(1) System configuration
Speed control (II) of Axis 3.



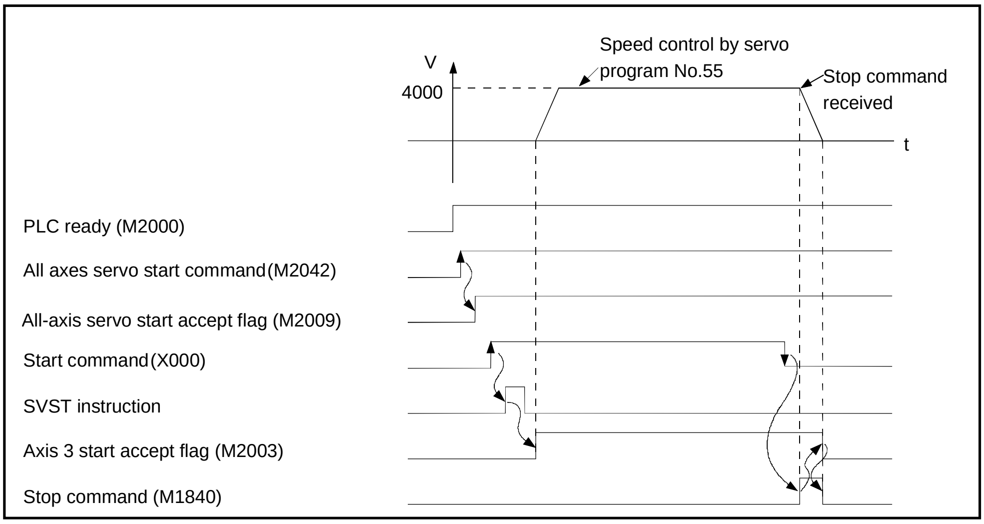
(2) Speed control (II) conditions
(a) The speed control (II) conditions are shown below.

Item	Setting
Servo program number	No. 55
Controlled axis	Axis 3
Control speed	4000
Rotation direction	Forward

(b) Speed control (II) start command .... leading edge of X000 (OFF → ON)

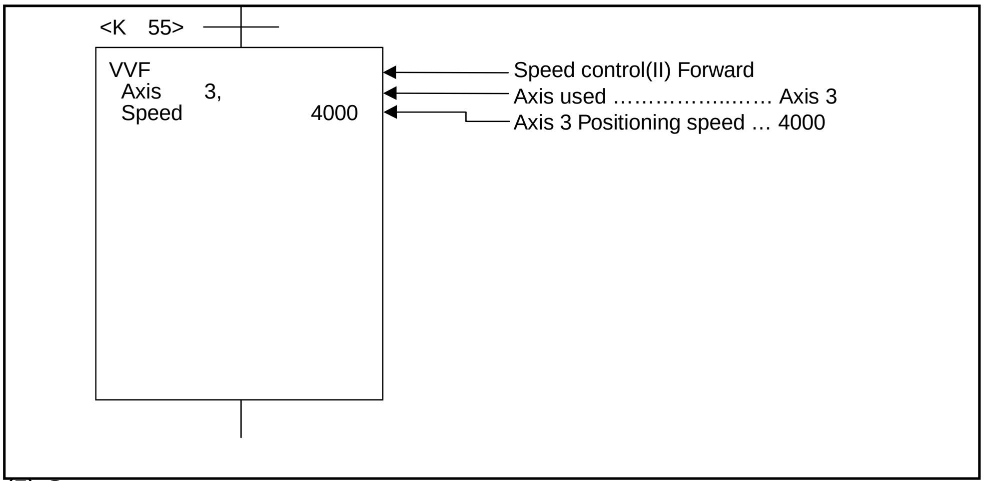
(c) Speed control (II) stop command .... trailing edge of X000 (ON → OFF)

(3) Operation timing
The operation timing for speed control (II) is shown below.



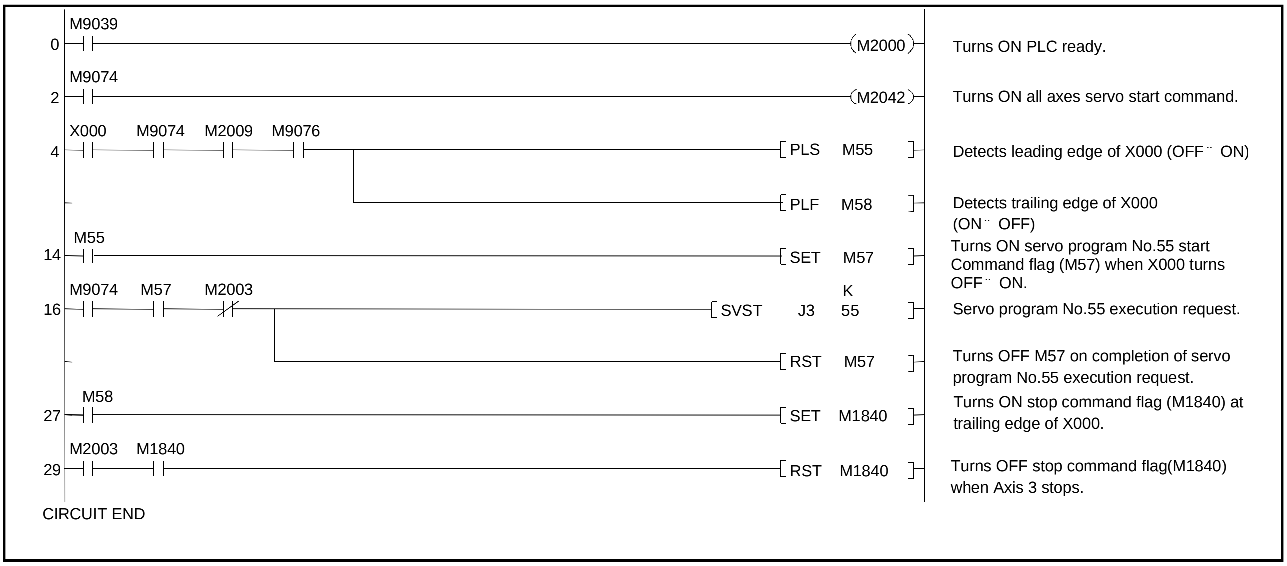
(4) Servo program

The servo program No. 55 for speed control (II) is shown below.



(5) Sequence program

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



7.14 Speed/Position Switching Control

7.14.1 Starting speed/position switching control

Speed/position switching control of the axes designated in the sequence program positioning commands.
Speed/position switching control uses the VPF (forward), VPR (reverse), and VPSTART (restart) servo instructions.

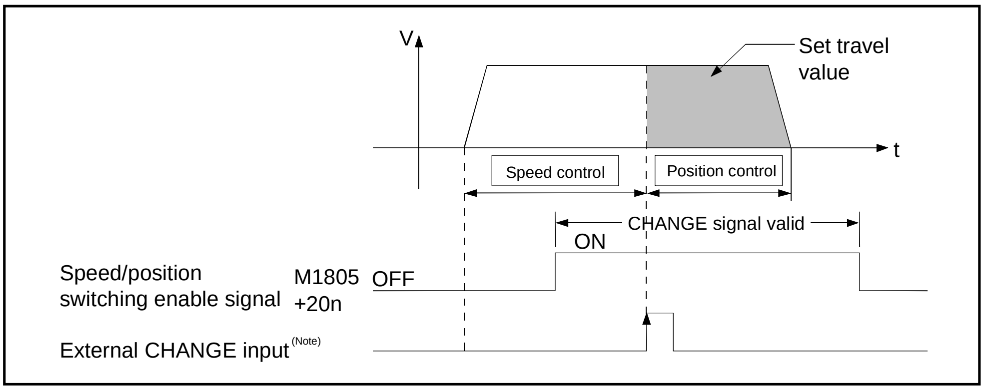
Servo Instruction	Positioning Method	Number of Controllable Axes	Items Set by Peripherals																					
			Common							Arc			Parameter Block									Others		
			Parameter Block No.	Axis	Address/Travel Value	Commanded Speed	Dwell Time	M Code	Torque Limit Value	Auxiliary Point	Radius	Center Point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

○ : Must be set
Δ : Set if required

[Control Details]

(1) The servomotor starts under speed control, but on input of the external CHANGE signal the control changes from speed control to position control and the axis is positioned by the designated travel value.
- VPF......... movement in forward direction (direction in which addresses increase)
- VPR .... movement in reverse direction (direction in which addresses decrease)

(2) The external CHANGE signal is only valid when 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

(Note): The external CHANGE signal is an external input to the A172SENC 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 A173UHCPU/A172SHCPU/A171SHCPU Motion Controller User's Manual for details.)

(3) Feed current value processing

The feed current value is determined in one of the following two ways according to the ON/OFF status of M1812+20n (feed current value update request command) when speed/position switching control is started.

(a) M1812+20n .... OFF

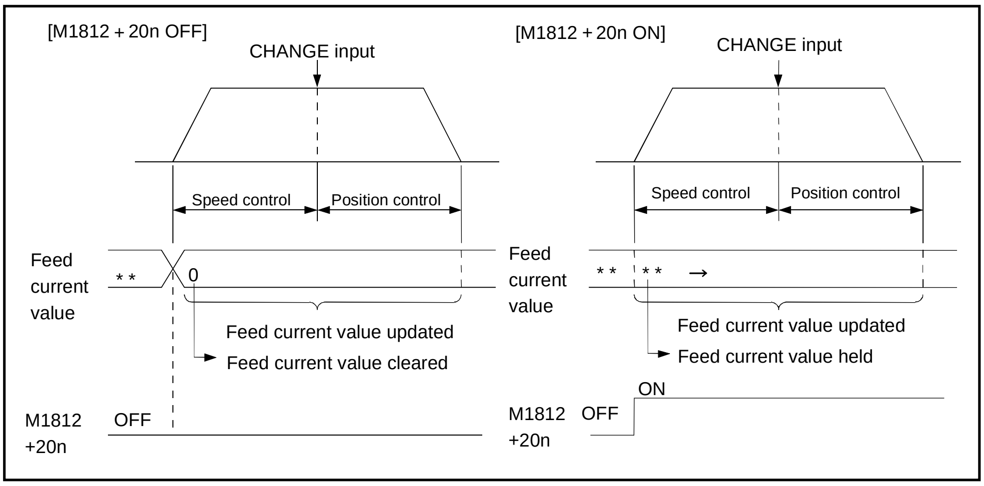
- The feed current value is cleared to zero at the start of speed/position switching control.
- The feed current value is updated from the start of control (speed control).
- The feed current value after control is stopped is as follows:

[Feed current value after stopping] = [Travel value under speed control] + [Travel value under position control]

(b) M1812+20n .... ON

- The feed current value is not cleared at start of speed/position switching control.
- The feed current value is updated from the start of control (speed control).
- The axis makes a deceleration stop if the feed current value exceeds the stroke limit.
- The feed current value after control is stopped is as follows:

[Feed current value after stopping] = [Address before speed control] + [Travel value under speed control] + [Travel value under position control]



POINT

If control is started by turning M1812+20n ON, leave M1812+20n ON until positioning control is completed.

The feed current value cannot be guaranteed if M1812+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.

<A172SHCPUN>

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
5	D895	D896	D895
6	D915	D916	D915
7	D935	D936	D935
8	D955	D956	D955

<A171SHCPUN>

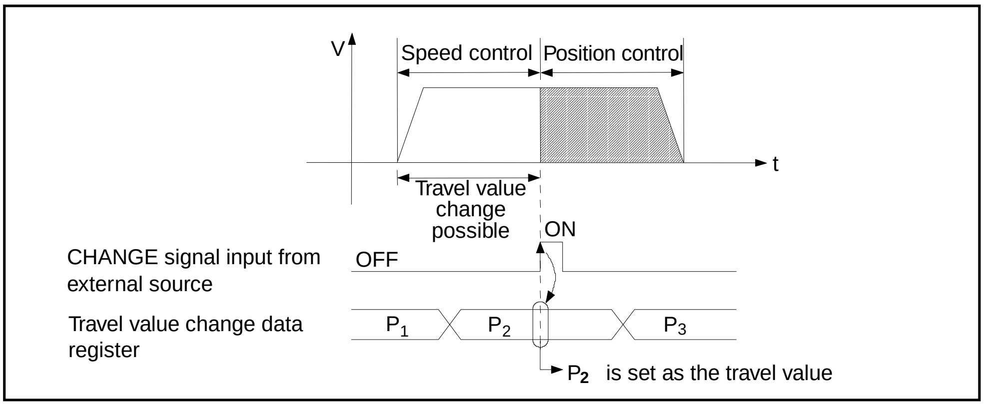
Axis No.	Data Register Number for Indirect Designation	Data Registers to Change Travel Value	
		Most-Significant Data	Least-Significant Data
1	D815	D816	D815
2	D835	D836	D835
3	D855	D856	D855
4	D875	D876	D875

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,        D875   <---- Indicates indirect designation of travel value
  Speed              50000
```

(b) The sequence program sets the travel value in the travel value change data register while speed control is in progress. When the external CHANGE signal turns ON, the contents of the travel value change data register are set as the travel value.

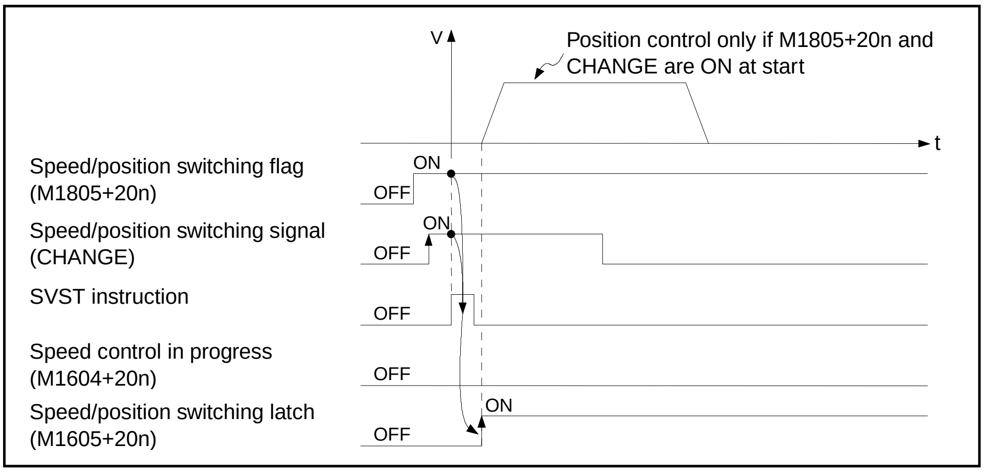


(5) Travel value area after proximity dog turns ON
The travel value since the position mode was selected by the external CHANGE signal is stored in the travel value area (see section 3.4.1) when the proximity dog turns ON.

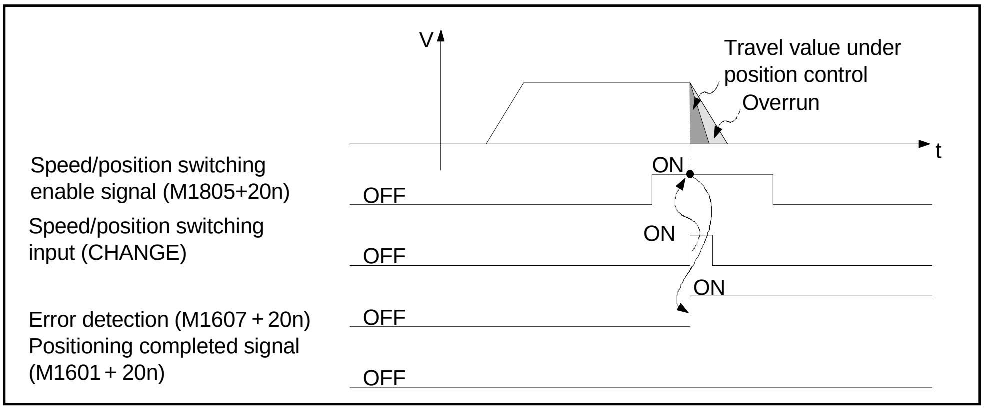
[Cautions]

(1) Items checked when the external CHANGE signal turns ON
Speed control switches to position control when the external CHANGE signal turns ON if the following conditions are met:
- The start accept flag (M2001+n) is ON.
- Speed control is in progress after start of speed/position switching control.
- Speed/position switching enable signal (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.



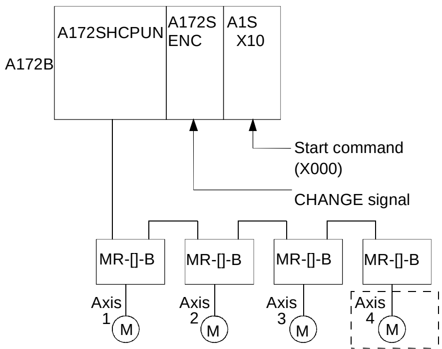
(4) Stroke limit check
   No stroke limit range check is made during the speed mode. If the travel value exceeds the stroke limit range, a minor error (error code: 210) occurs when position mode is selected, and a deceleration stop occurs.

(5) Switching time from speed control to position control
   Switching from speed control to position control takes 1 ms after the external CHANGE signal turns ON.

[Program Example]

This program executes speed/position switching control under the conditions below.

(1) System configuration
   Speed/position switching control of Axis 4.



(2) Positioning conditions

(a) The positioning conditions are shown below.

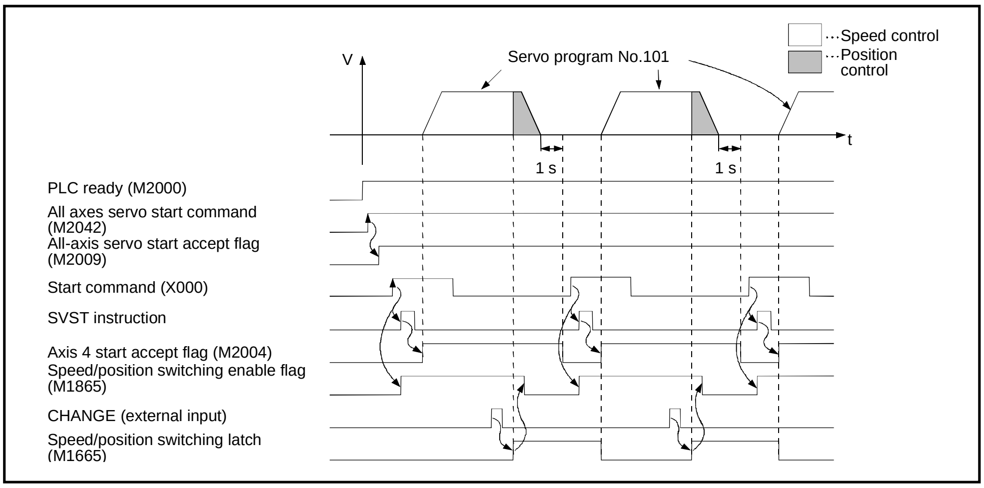
Item	Setting
Servo program number	No. 101
Controlled axis	Axis 4
Positioning control travel value	40000
Commanded speed	1000

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

(c) Speed/position switching enable flag M1865

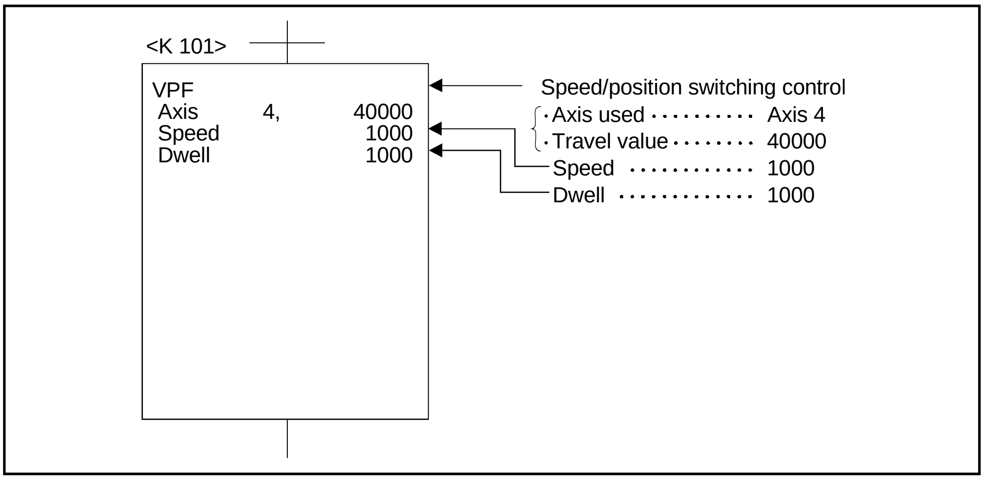
(3) Operation timing

The operation timing for speed/position switching control is shown below.

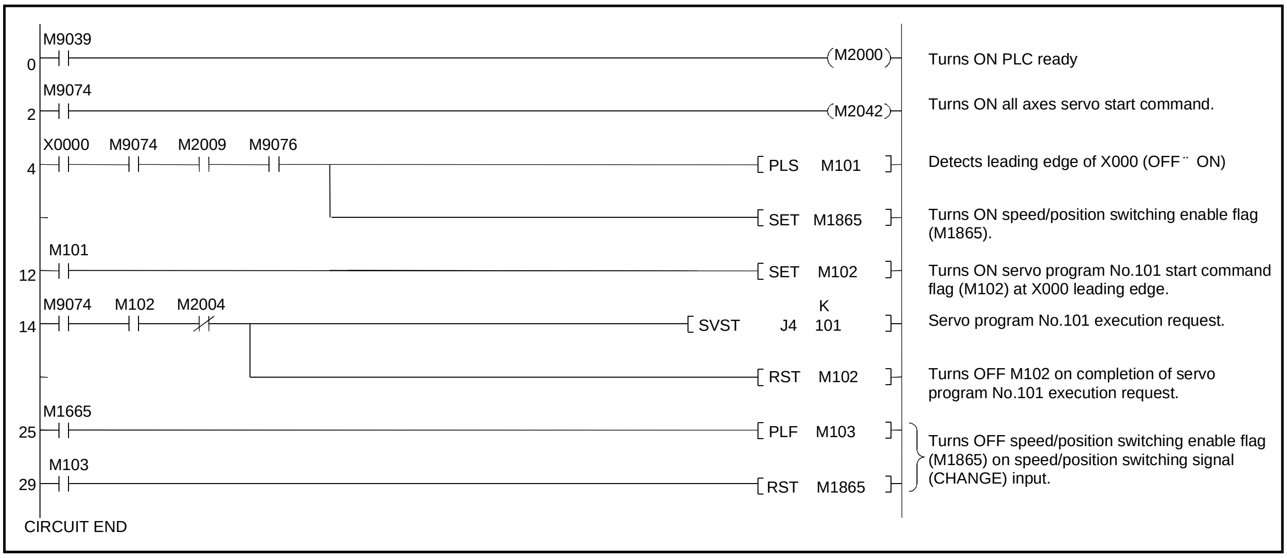


(4) Servo program

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																					
			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	SCurve Ratio	Cancel	Start	Speed Change
VPSTART				○																		Δ	Δ	

○ : Must be set
Δ : Set if required

[Control Details]

(1) Speed/position switching control is continued after it was stopped due to a stop command.

(2) Restarting using VPSTART is valid whether the stop occurred during speed control or position control.

(a) If the stop occurred during speed control, then speed control continues and switches to position control when the CHANGE signal turns ON.

The control conditions after restarting are the same as the previous speed/position switching control conditions.
See 7.14.1 "Starting Speed/Position Switching Control".

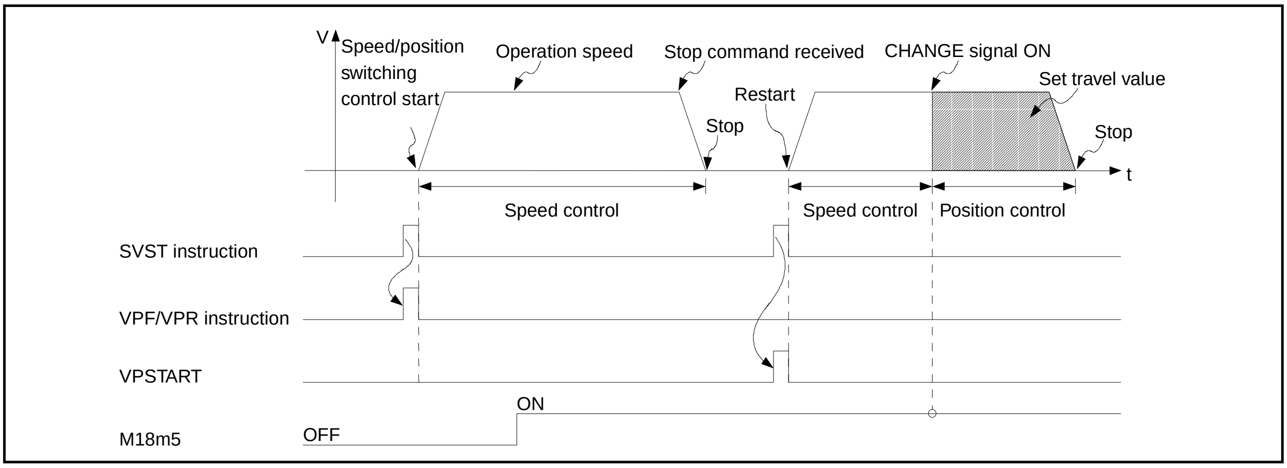


Fig. 7.27 Restarting During Speed Control

(b) If the stop occurred during position control, then position control continues until the positioning reaches the set travel value.
The travel value after the restart is calculated as follows:

[Travel value after restart (P2)] = [Set travel value (P)] + [Travel value be- fore stop (P1)]

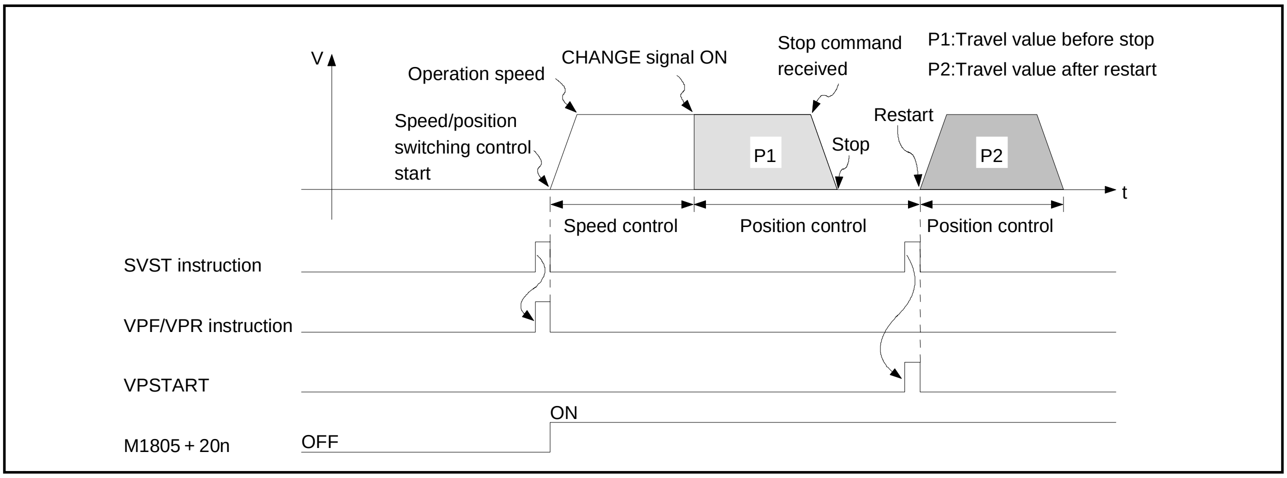


Fig. 7.28 Restarting During Speed Control

(3) The speed at restart is the speed stored when the VPF/VPR instruction occurred.
Therefore, even if a speed change occurred before the stop, control restarts at the speed set at the time of VPF/VPR instruction execution.

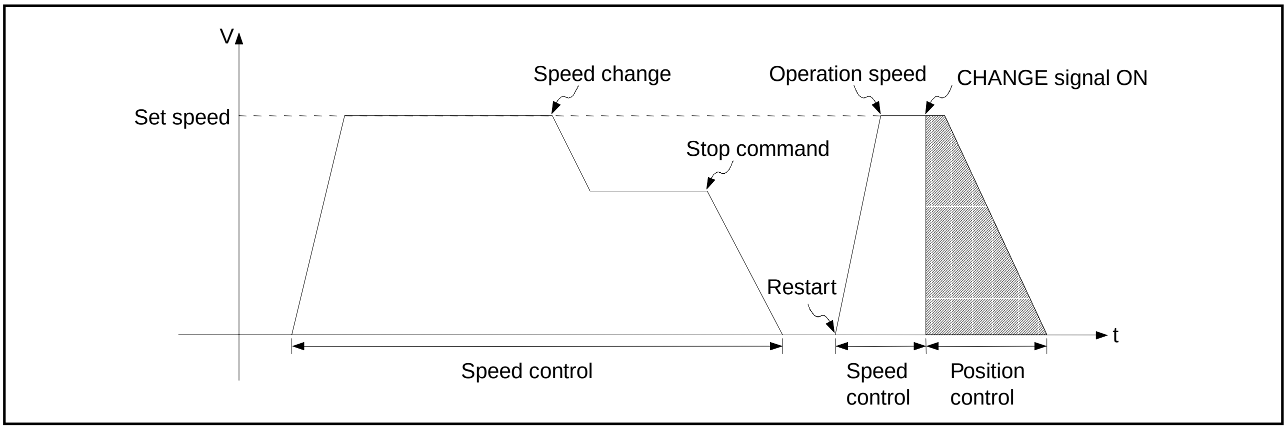
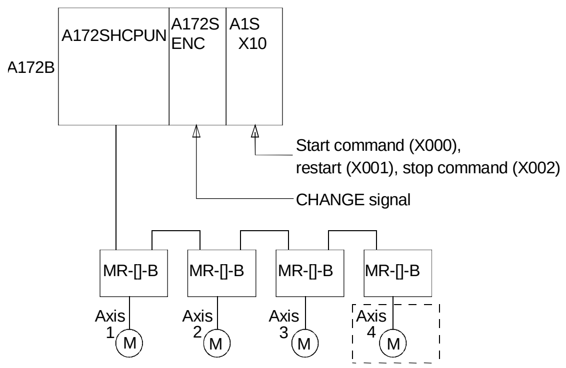


Fig. 7.29 Restarting After Speed Change

[Program Example]

This program restarts speed/position switching control after a stop, under the conditions below.

(1) System configuration
Speed/position switching control of Axis 4.



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

Item	Setting	
	Speed/Position Switching Control	Restart
Servo program number	No. 101	No. 102
Controlled axis	Axis 4	Axis 4
Positioning control travel value	40000	—
Commanded speed	1000	—

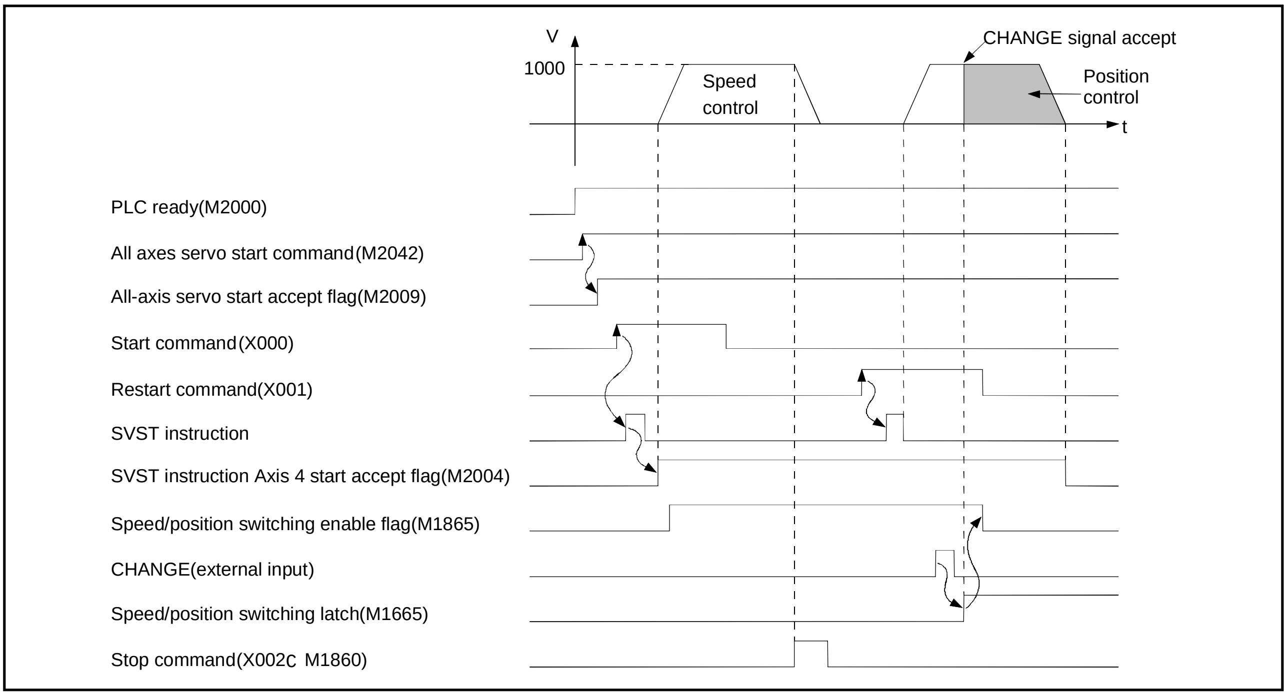
(b) Positioning start command .... leading edge of X000 (OFF → ON)

(c) Speed/position switching enable flag M1865

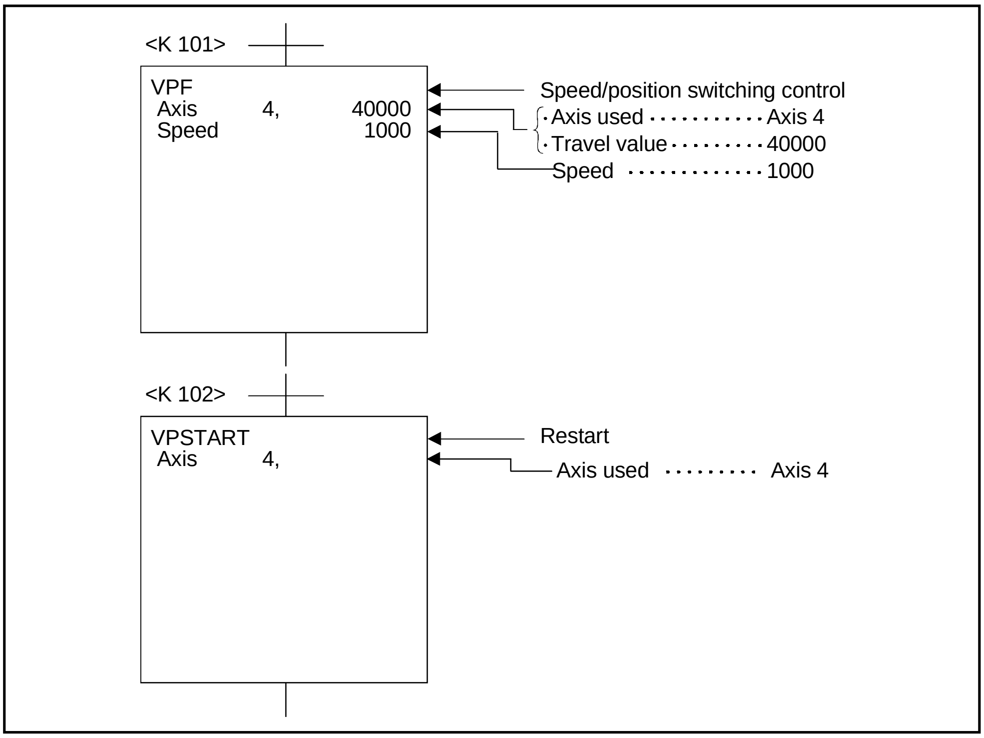
(d) Restart command .... leading edge of X001 (OFF → ON)

(e) Stop command .... leading edge of X002 (OFF → ON)

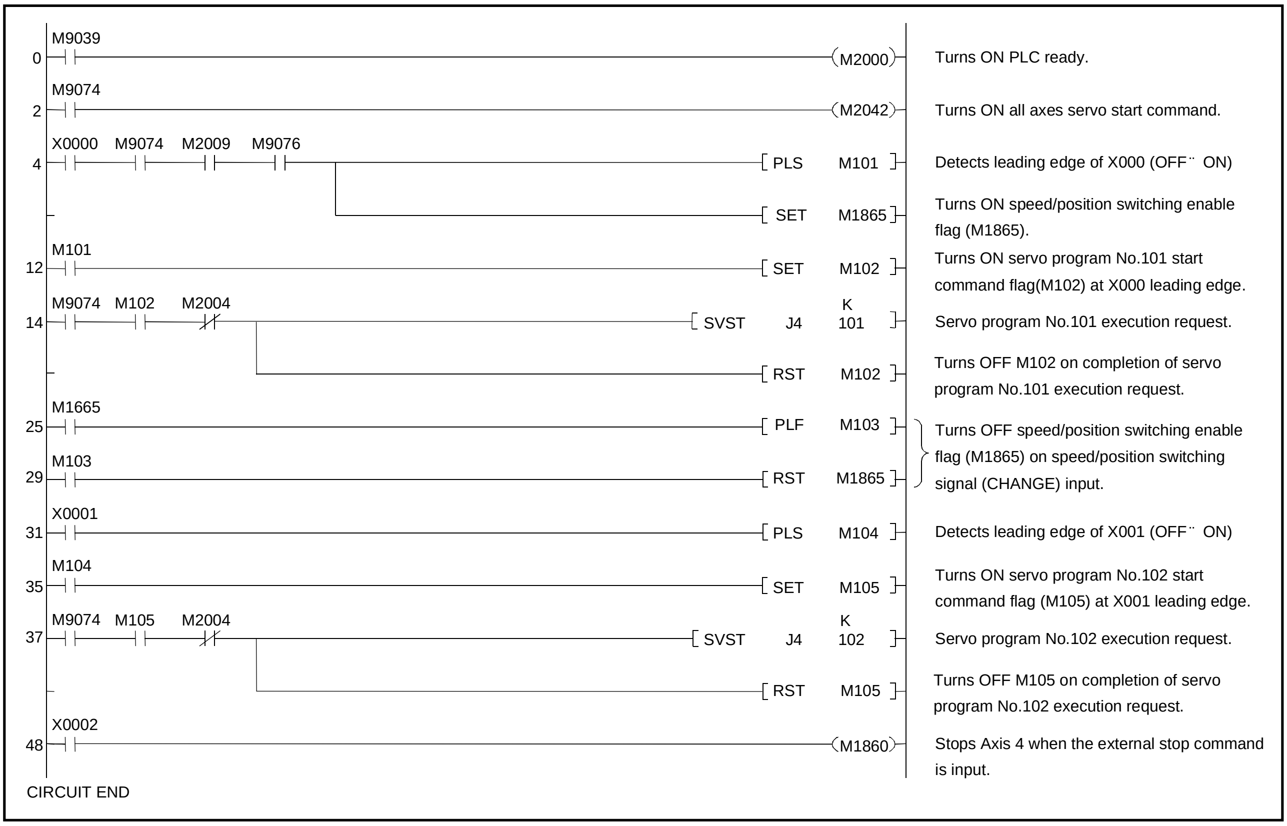
(3) Operation timing
The operation timing for speed/position switching control and restarting is shown below.



(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		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	SCurve Ratio	Cancel	Start	
Start	VSTART	—	—	Δ										Δ	Δ	Δ	Δ	Δ	Δ	Δ		Δ	Δ	Δ	—
End	VEND																								
End point address	ABS-1	Absolute data	1		○	○	○	Δ	Δ	Δ													Δ	Δ	OK
	ABS-2		2																						
	ABS-3		3																						
Travel value to end point	INC-1	Incremental	1																						
	INC-2		2																						
	INC-3		3																						
Speed-switching point	VABS	Absolute data	—			○	○		Δ	Δ															—
	VABC	Incremental																							

○ : Must be set
Δ : Set if required

[Control Details]

Starting and ending speed-switching control

Speed-switching control is started and ended using the following instructions:

(1) VSTART
Starts speed-switching control.

(2) VEND
Ends speed-switching control.

End address and travel value to end point

The speed-switching control end address and travel value to the end point, positioning method, and positioning speed to the end point are set using the following instructions:

(1) ABS-1/INC-1
Designate 1-axis linear positioning control.
The control details are described in Section 7.2 "1-axis Linear Positioning Control".

(2) ABS-2/INC-2
Designate 2-axes linear interpolation control.
The control details are described in Section 7.3 "2-axes Linear Interpolation Control".

(3) ABS-3/INC-3
Designate 3-axes linear interpolation control.
The control details are described in Section 7.4 "3-axes Linear Interpolation Control".

Speed-switching point setting

The address (travel value) to the speed-switching point and the positioning speed are set using the following instructions:

(1) VABS
Designates the speed-switching point using the absolute data method.

(2) VINC
Designates the speed-switching point using the incremental method.

POINT

The settings for speed-switching point (travel value) and the positioning speed under 2- or 3-axes linear interpolation control apply to the 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   <-- Speed-switching point (travel value) set for
Axis      3,      60000       these axes.
Speed              2000
```

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 7.30.

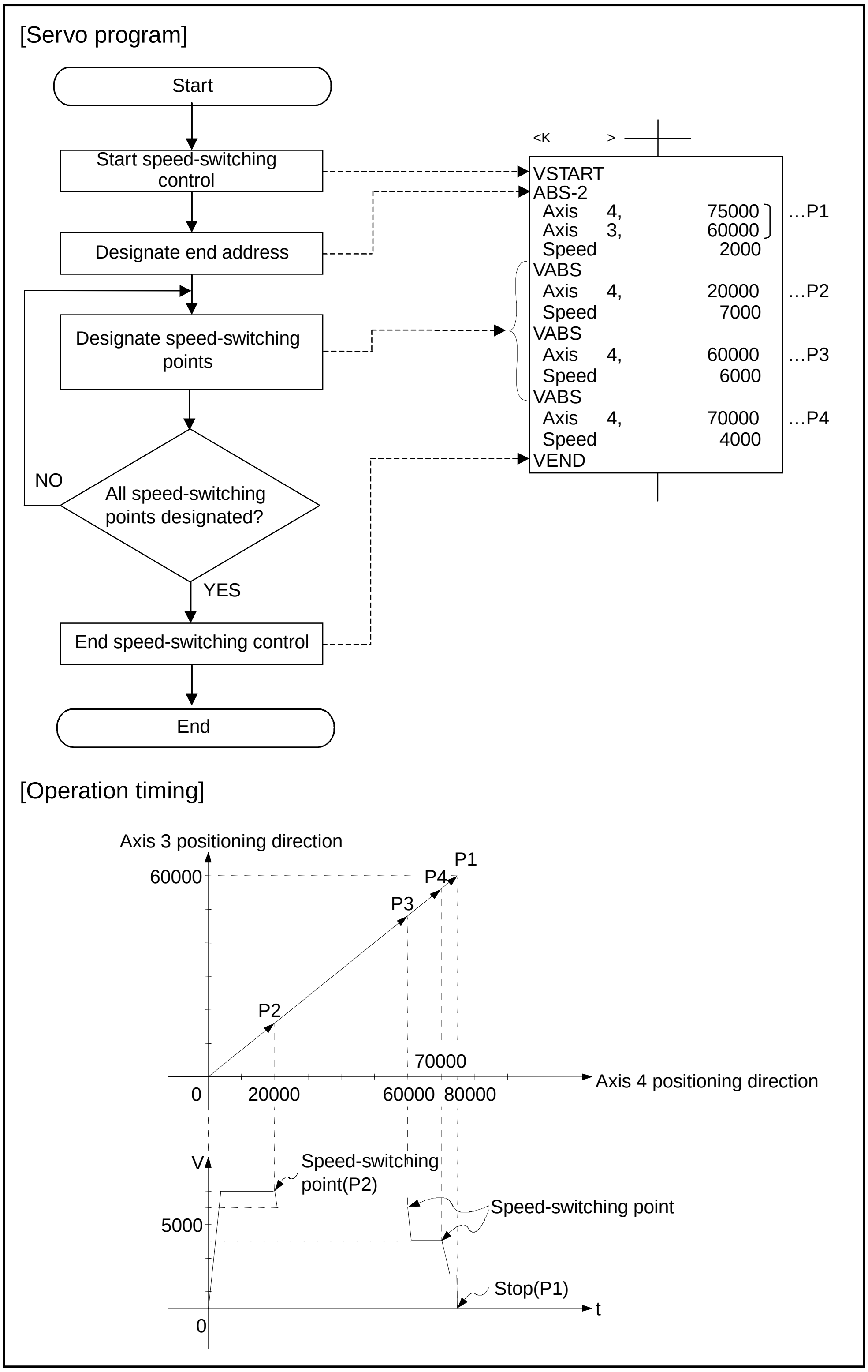


Fig. 7.30 Servo Program for Speed/Position Switching Control And Operation Timing

[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.

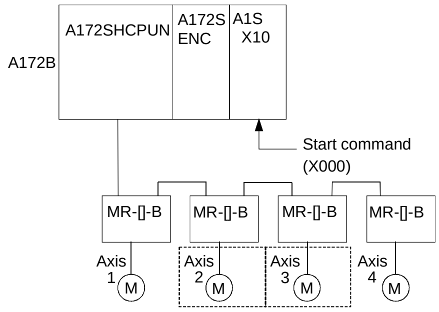
(7) If no M code is designated for a speed-switching point, the M code from the previous point is retained.

[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

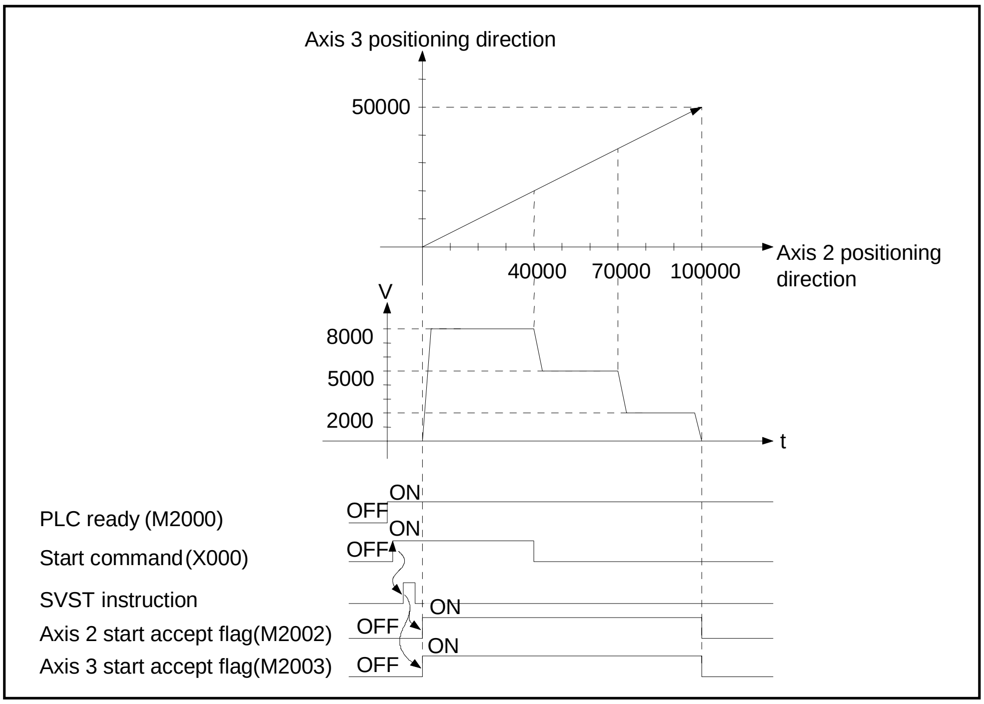
(a) The speed-switching control conditions are shown below.

Item	Setting	
Servo program number	No. 500	
Controlled axis	Axis 2	Axis 3
End address	100000	50000

(b) Speed-switching control start command....... leading edge of X000 (OFF → ON)

(3) Operation timing and speed-switching positions

The operation timing for speed-switching control and the speed-switching points are shown below.



(4) Servo program

The servo program No. 500 for speed-switching control is shown below.

```
<K500>

VSTART
ABS-2
  Axis      2,     100000
  Axis      3,      50000
  Speed              2000
VABS
  Axis      2,      40000
  Speed              8000
VABS
  Axis      2,      70000
  Speed              5000
VEND
```

Start speed-switching control

2-axes linear interpolation control (absolute data method)

- Axis used ....Axis 2, Axis 3
- End address: Axis 2......100000; Axis 3......50000

Positioning speed 2000

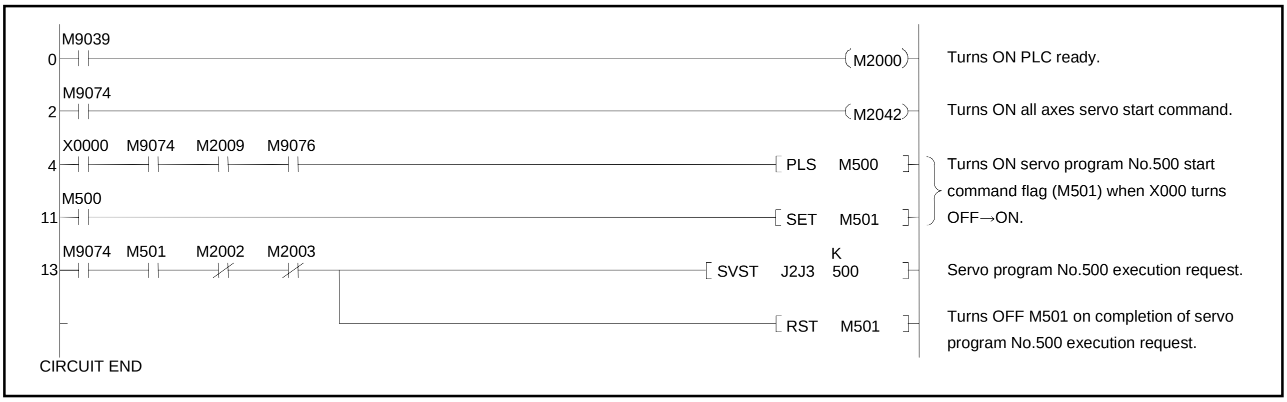
Speed-switching point, speed setting

Indicated axis number	Axis 2	
Speed-switching points	40000	70000
Speed to speed-switching point	8000	5000

End speed-switching control

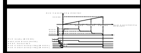
(5) Sequence program

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																						
			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	SCurve Ratio	Repeated Condition	Cancel	Start	Speed Change
 FOR-ON / FOR-OFF	—	—																				○	Δ	Δ	—
NEXT	—	—																							

○ : Must be set
Δ : Set if required

[Control Details]

Setting the Start of the Repeated Range

The start of the repeated range is designated using the following instructions:

(1) FOR-TIMES (number of loops setting)
   (a) The designated repeated range is executed the set number of times.
   (b) The setting range is (1 to 32767).
   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) — 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)

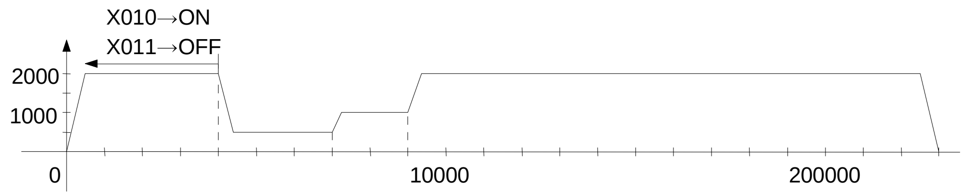
Repeated operation using FOR-TIMES, FOR-ON, and FOR-OFF is shown below.

[Servo Program]

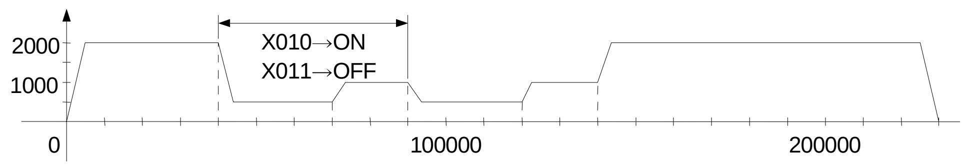
```
<K 701>
VSTART
INC-2
 Axis      1,      230000
 Axis      2,      100000
 Speed               2000
VINC
 Axis      1,       40000
 Speed               2000
 1)
                       2)
VINC
 Axis      1,       30000
 Speed                500     3)
VINC
 Axis      1,       20000
 Speed               1000
NEXT
VEND
```

1)	2)		
	Condition 1	**Condition 2**	**Condition 3**
FOR-TIMES	K1	K2	K3
FOR-ON	X010 → ON from start	X010 → ON during first execution of 3)	X010 → ON during third execution of 3)
FOR-OFF	X010 → OFF from start	X011 → OFF during first execution of 3)	X011 → OFF during third execution of 3)

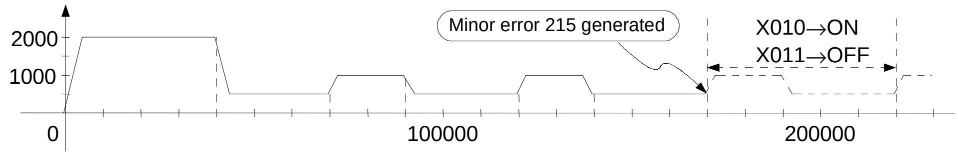
(1) Operation under condition 1



(2) Operation under condition 2



(3) Operation under condition 3

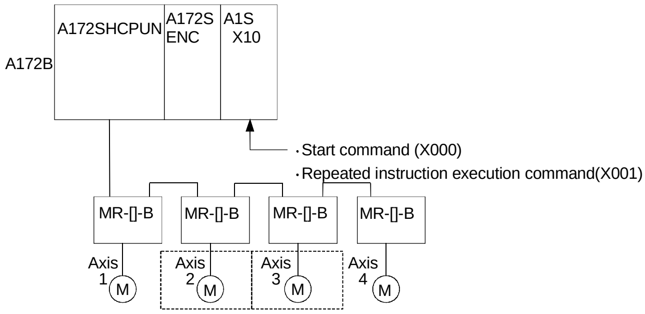


Error generated because the distance to the stop position exceeds the travel value.

[Program example]

This program executes repeated speed-switching control under the conditions below.

(1) System configuration
Speed-switching control of Axis 2 and Axis 3.



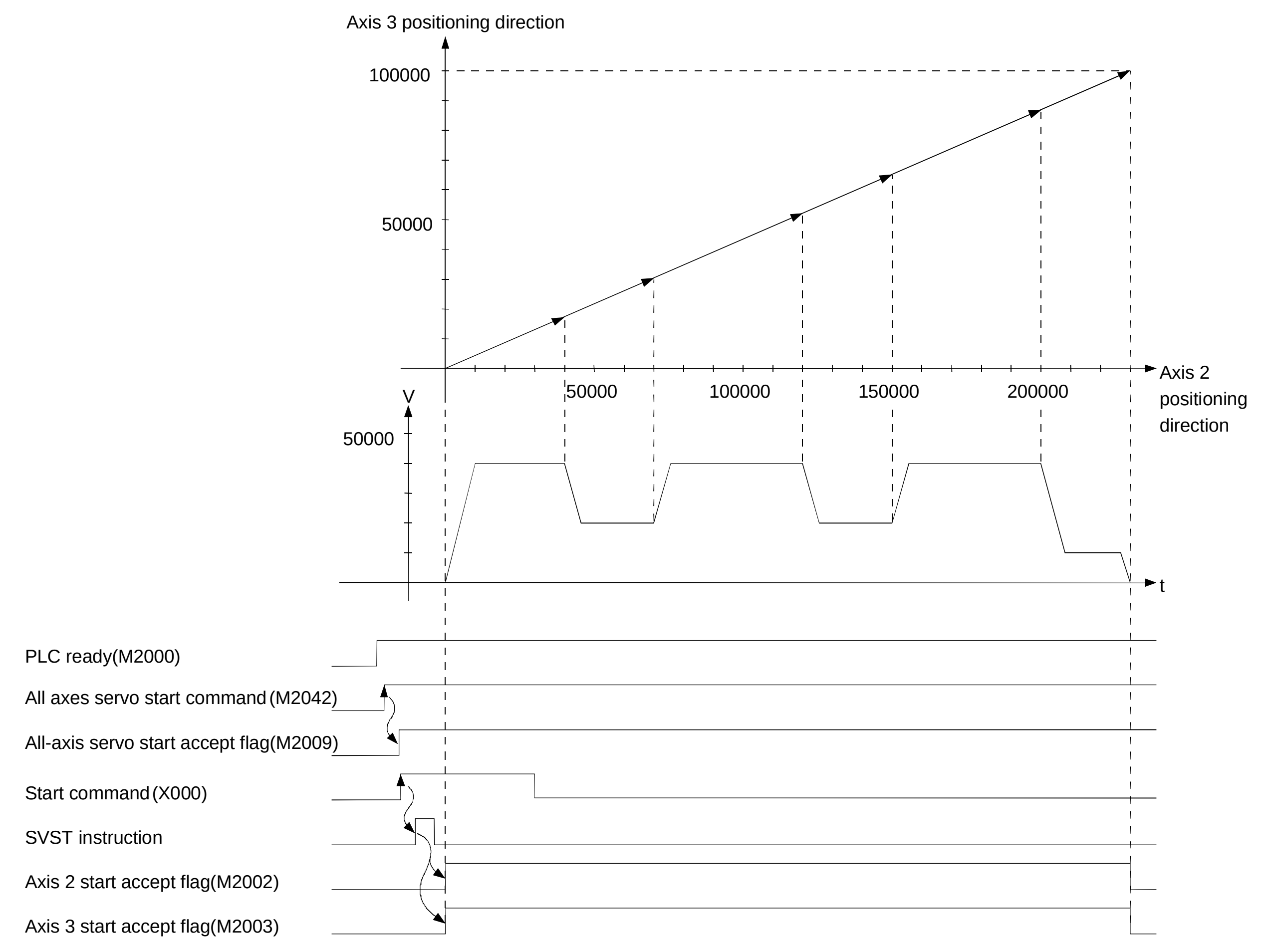
(2) Positioning conditions

(a) The speed-switching control conditions are shown below.

Item	Setting	
Servo program number	No. 501	
Controlled axes	Axis 2	Axis 3
End address	230000	100000

(b) Speed-switching control start command ...... leading edge of X000 (OFF → ON)

(3) Operation timing and speed-switching positions
The operation timing for speed-switching control and the speed-switching points are shown below.



(4) Servo program

The servo program No. 501 for speed-switching control is shown below.

```
<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
```

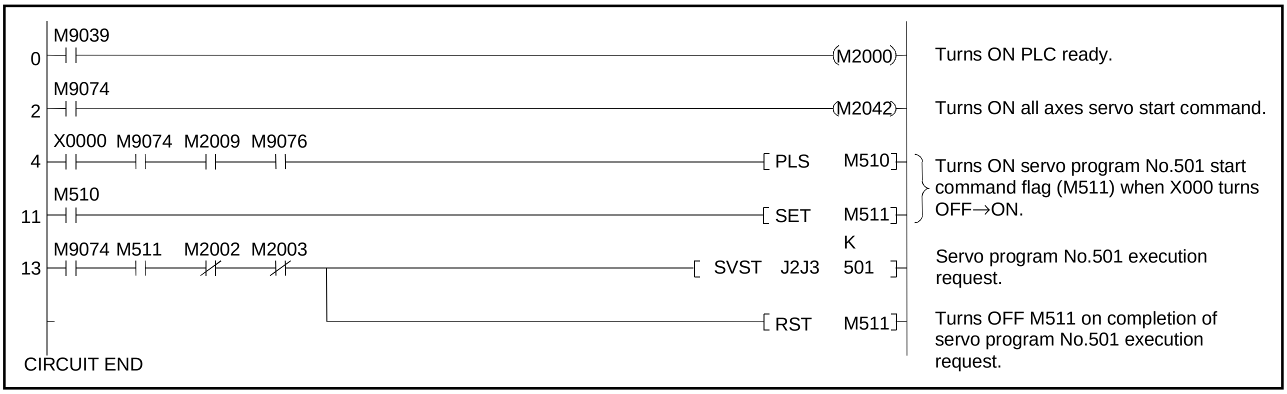
- VSTART: Start speed-switching control
- INC-2: 2-axes linear interpolation control (incremental method)
- Axis 2, 230000 / Axis 3, 100000:
  - ·Axis used ·············· Axis 2, Axis 3
  - ·End address: Axis 2 ····· 230000; Axis 3 ····· 100000
- Speed 10000: Positioning speed ······ 10000
- VINC: Speed-switching point, speed setting
  - ·Indicated axis ········ Axis 2
  - ·Travel value to speed-switching point ······ 40000
- FOR-TIMES K 2: Number or repeats 2
- VINC / VINC: 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

- NEXT: End speed-switching range
- VEND: End speed-switching control

(5) Sequence program

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



7.16 Constant-Speed Control

(1) After a single control start, positioning control is executed using the designated positioning method and positioning speed to the preset pass point.

(2) The positioning method and positioning speed can be changed for each pass point.

(3) Set the following parameters with the servo program.
- pass point
- positioning method from one pass point to the next pass point.
- positioning speed from one pass point to the next pass point.

(4) Repeat instructions permit repeated control between any pass points.

(5) M-code and torque limit value can be changed at each pass point.

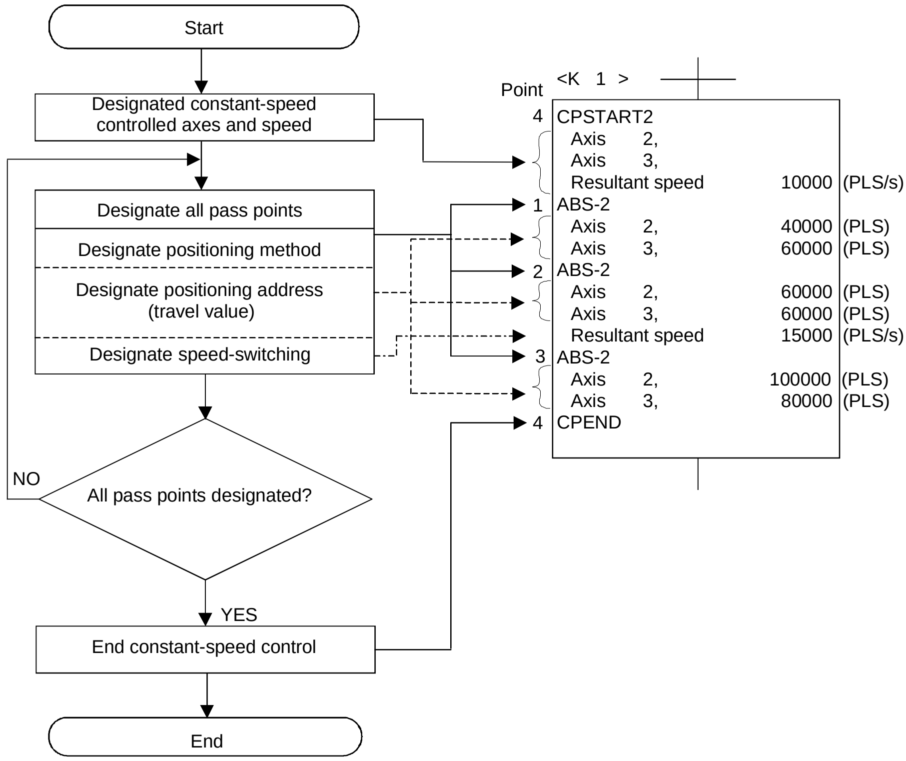
(6) From one to 4-axes can be controlled.

[Procedure to Write Servo Programs]

The method to write servo programs for constant-speed control is shown below.

[Procedure]

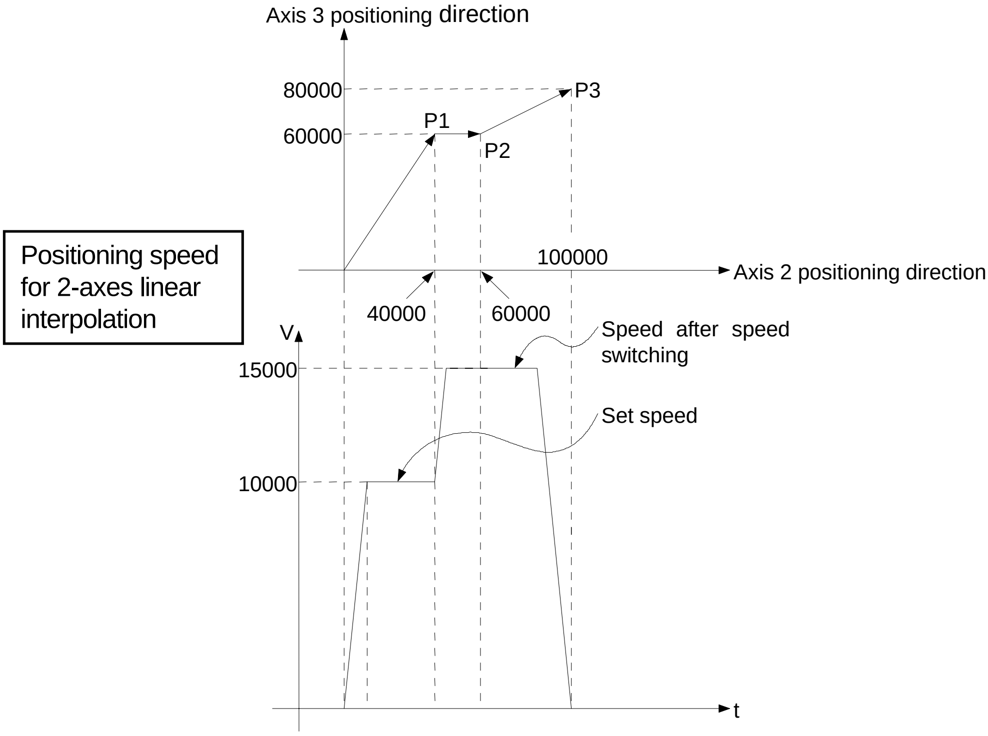
[Example: Servo program for 2-axis constant-speed control]



[Operation Timing]

The operation timing for constant-speed control is shown below.

[Example: Operation timing for 2-axes constant-speed control]



[Caution]

(1) The number of controllable 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□).

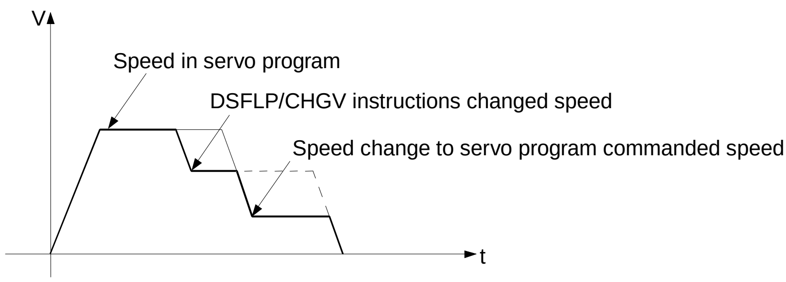
(3) A pass point can be designated as an address which results in a change in travel direction.
However, a servo error or some other error may occur if acceleration processing occurs at a pass point for 1-axis constant-speed control but no acceleration or deceleration processing occurs at the pass point for 2- to 4-axes constant-speed control.

(4) Speed change is possible after start
Note the following points when changing the speed.

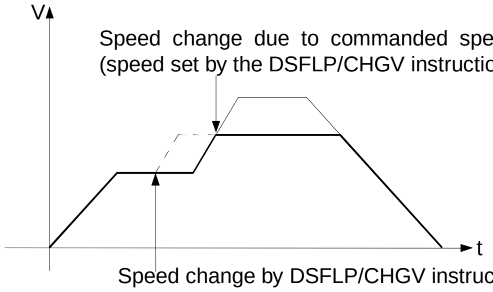
(a) If constant-speed control includes circular interpolation using center point designation
Error compensation (see Section 4.4.3) may not function normally if the speed is changed when a discrepancy (within the allowable error range for circular interpolation) exists between the designated end-point address and the arc path calculated from the start address and center-point address.
Therefore, if the circular interpolation using center point designation positioning method is used under constant-speed control, ensure that the set start address, center-point address, and end address lie correctly on the arc.

(b) If both a servo program and the 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 $\times$ 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.

<table>
<tr><th rowspan="3">Servo Instruction</th><th rowspan="3">Positioning Method</th><th rowspan="3">Number of Controllable Axes</th><th colspan="22">Items Set by Peripherals</th><th rowspan="3">Speed Change</th></tr>
<tr><th colspan="7">Common</th><th colspan="3">Arc</th><th colspan="9">Parameter Block</th><th colspan="3">Others</th></tr>
<tr><th>Parameter Block No.</th><th>Axis</th><th>Address/Travel Value</th><th>Commanded Speed</th><th>Dwell Time</th><th>M Code</th><th>Torque Limit Value</th><th>Auxiliary Point</th><th>Radius</th><th>Center Point</th><th>Control Unit</th><th>Speed Limit Value</th><th>Acceleration Time</th><th>Deceleration Time</th><th>Rapid Stop Deceleration Time</th><th>Torque Limit Value</th><th>Deceleration Processing on Stop Input</th><th>Allowable Error Range for Circular Interpolation</th><th>SCurve Ratio</th><th>Repeated Condition</th><th>Cancel</th><th>Start</th></tr>
<tr><td>FOR-TIMES</td><td rowspan="3">—</td><td rowspan="3">—</td><td rowspan="3"></td><td rowspan="3"></td><td rowspan="3"></td><td rowspan="3"></td><td rowspan="3"></td><td rowspan="3"></td><td rowspan="3"></td><td rowspan="3"></td><td rowspan="3"></td><td rowspan="3"></td><td rowspan="3"></td><td rowspan="3"></td><td rowspan="3"></td><td rowspan="3"></td><td rowspan="3"></td><td rowspan="3"></td><td rowspan="3"></td><td rowspan="3"></td><td rowspan="3"></td><td rowspan="3">○</td><td rowspan="3">Δ</td><td rowspan="3">Δ</td><td rowspan="4">—</td></tr>
<tr><td>FOR-ON</td></tr>
<tr><td>FOR-OFF</td></tr>
<tr><td>NEXT</td><td>—</td><td>—</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
</table>

○ : 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)

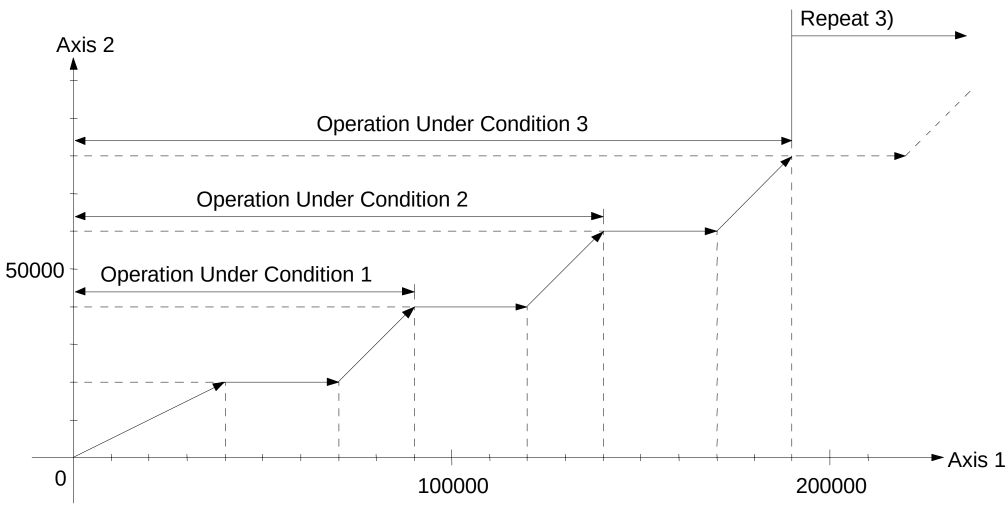
Repeated operation using FOR-TIMES, FOR-ON, and FOR-OFF is shown below.

[Servo Program]

```
<K 701>
CPSTART2
  Axis          1
  Axis          2
  Resultant speed          1000
ABS-2
  Axis          1,        40000
  Axis          2,        20000
 1)
                2)          2)
INC-2
  Axis          1,        30000
  Axis          2,            0
INC-2
  Axis          1,        20000
  Axis          2,        20000
NEXT
CPEND
```

3)

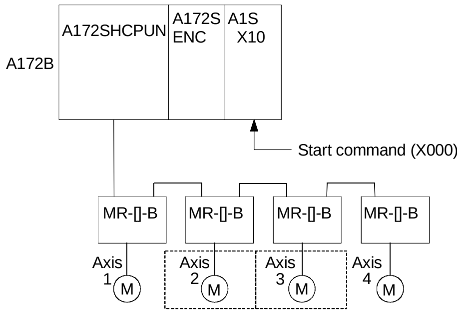
1)	2)		
	Condition 1	Condition 2	Condition 3
FOR-TIMES	K1	K2	K3
FOR-ON	X010 → ON from start	X010 → ON during first execution of 3)	X010 → ON during third execution of 3)
FOR-OFF	X010 → OFF from start	X011 → OFF during first execution of 3)	X011 → OFF during third execution of 3)



[Program Example]

This program executes repeated constant-speed control under the conditions below.

(1) System configuration
Constant-speed control of Axis 2 and Axis 3.

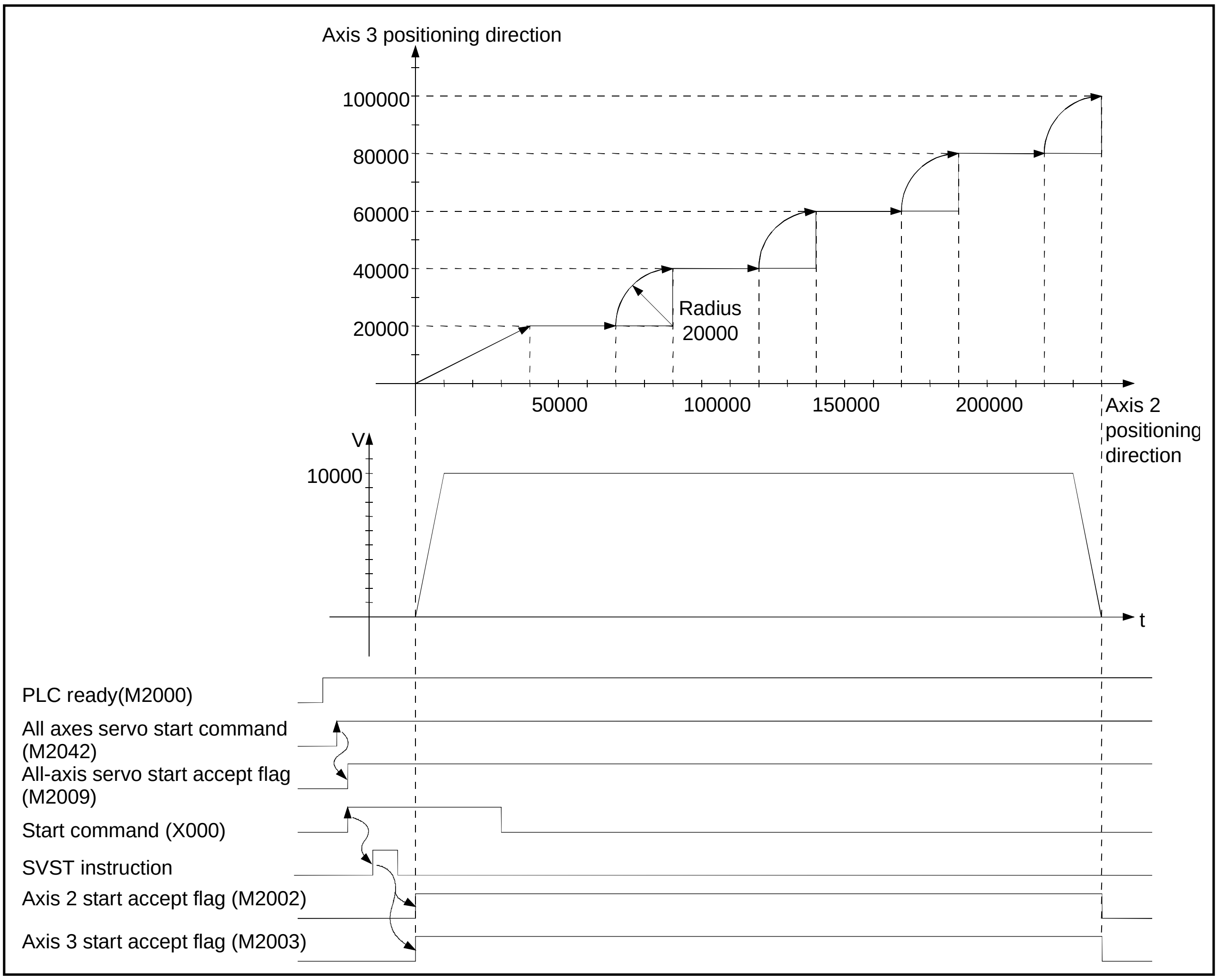


(2) Positioning conditions
(a) The constant-speed control conditions are shown below.

Item	Setting
Servo program number	No. 510
Controlled axes	Axis 2, Axis 3
Positioning speed	10000

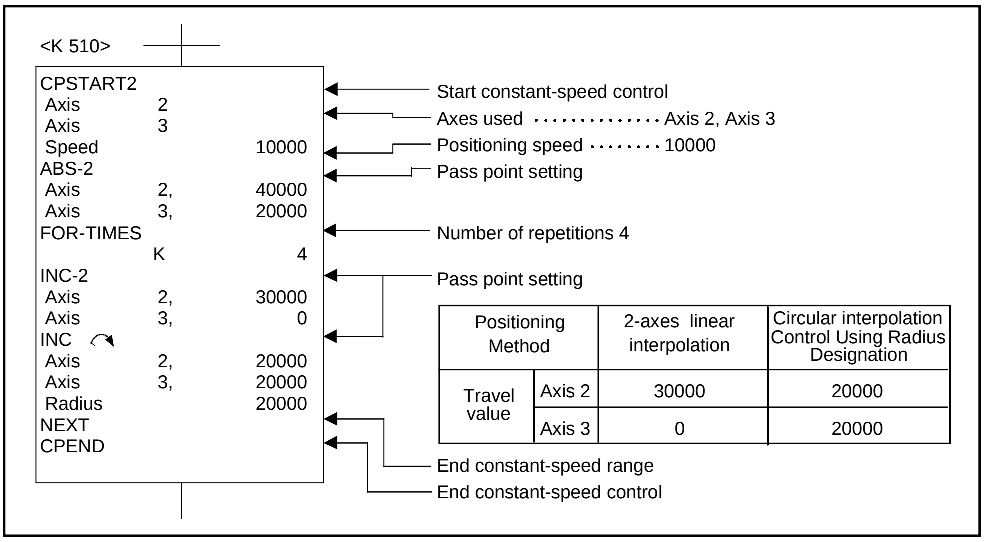
(b) Constant-speed control start command .... leading edge of X000 (OFF → ON)

(3) Operation timing
The operation timing for constant-speed control is shown below.



(4) Servo program

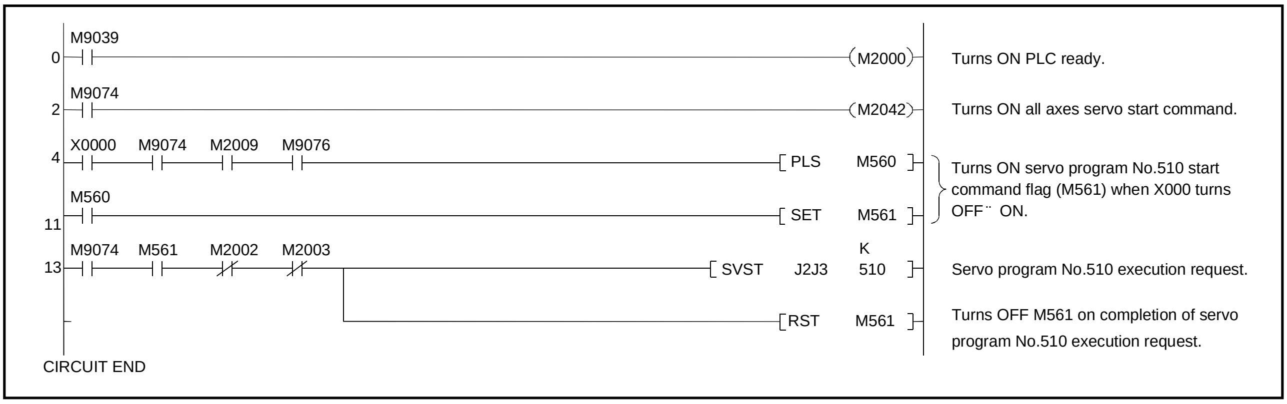
The servo program No. 510 for constant-speed control is shown below.



Positioning Method		2-axes 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.



7.16.2 Speed switching during instruction execution

The speed can be designated for each pass point during a constant-speed control instruction.
The speed change from a point can be designated directly or indirectly in the servo program.

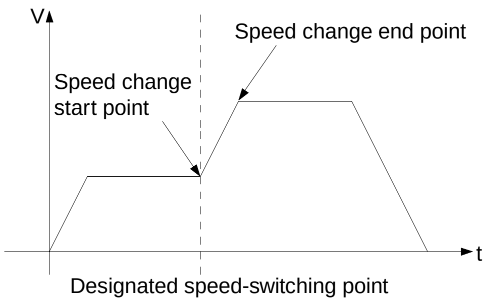
[Cautions]

(1) The speed can be changed during servo instruction execution for 1- to 4-axes constant-speed control.

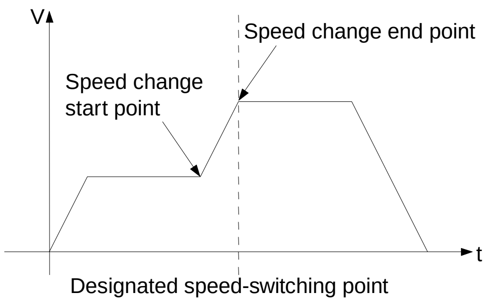
(2) The speed command can be set for each point.

(3) The speed-switching point designation flag 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.



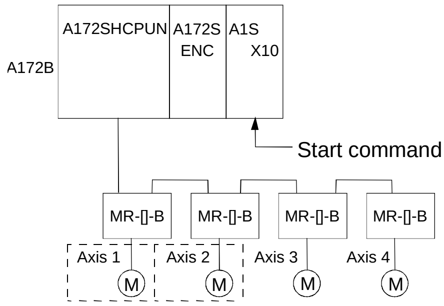
(b) M2016 is ON
The speed change ends at the designated speed-switching point.



[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.

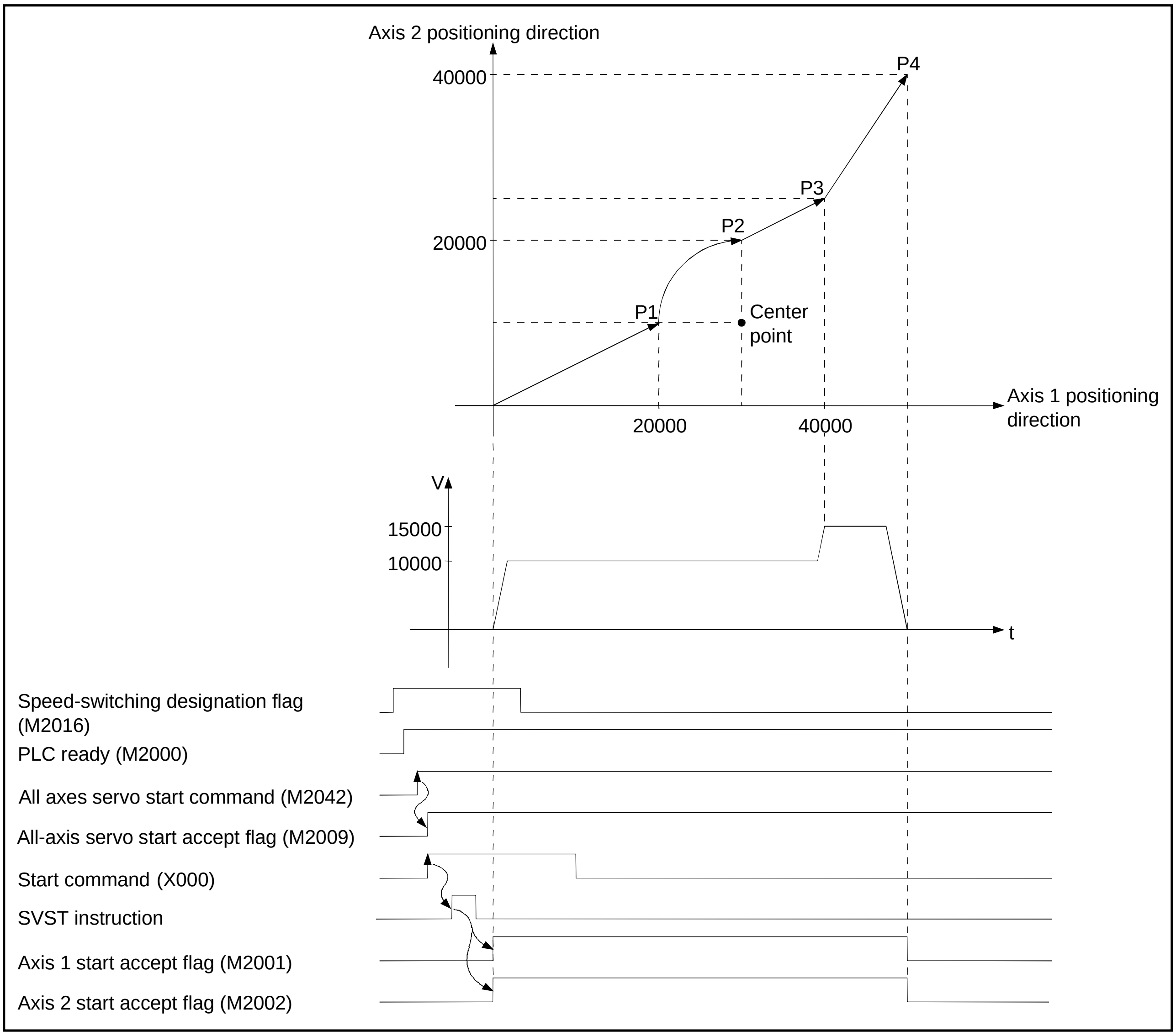


(2) Positioning conditions
(a) The speed switching conditions are shown below.

Item		Setting			
Servo program number		310			
Positioning speed		10000			
Positioning method		2-axes linear interpolation	Circular interpolation using center point designation	2-axes linear interpolation	2-axes linear interpolation
Pass point	Axis 1	20000	30000	40000	50000
	Axis 2	10000	20000	25000	40000

(b) Constant-speed control with speed switching start command .... leading edge of X000 (OFF → ON)

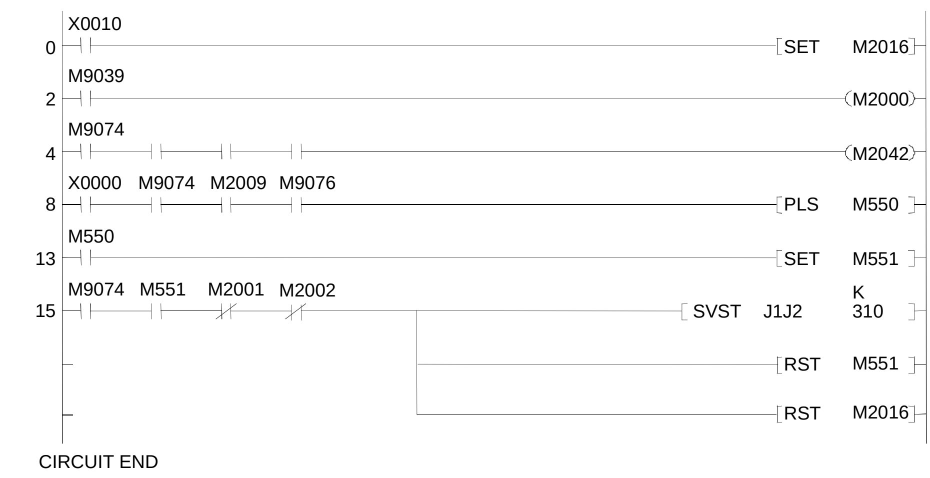
(3) Operation timing and speed-switching positions
The operation timing and positions for speed switching are shown below.



(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.



Turns ON speed-switching point designation flag (M2016) when X110 turns OFF → ON.

Turns ON PLC ready.

Turns ON all axes servo start command.

Turns ON servo program No. 310 start command flag (M551) when X000 turns OFF → ON.

Servo program No. 310 execution request.

Turns OFF M551 and M2016 on completion of servo program No. 310 execution request.

7.16.3 1-axis constant-speed control

Servo Instruction		Positioning Method	Number of Controllable Axes	Items Set by Peripherals																								
				Common							Arc			Parameter Block									Others					
				Parameter Block No.	Axis	Address/Travel Value	Commanded Speed	Dwell Time	M Code	Torque Limit Value	Auxiliary Point	Radius	Center Point	Control Unit	Speed Limit Value	Acceleration Time	Deceleration Time	Rapid Stop Deceleration Time	Torque Limit Value	Deceleration Processing on Stop Input	Allowable Error Range for Circular Interpolation	SCurve Ratio	Commanded Speed (constant-speed)	Cancel	Start	Skip	FIN acceleration	Speed Change
Start	CPSTART1	–	1	Δ	○		○								Δ	Δ	Δ	Δ	Δ	Δ		Δ		Δ	Δ		Δ	OK
End	CPEND	–	–					Δ																				
Pass point	ABS-1	Absolute data	1		○	○			Δ	Δ													Δ			Δ		
	INC-1	Incremental	1		○	○			Δ	Δ													Δ			Δ		

○ : Must be set
Δ : Set if required

[Control Details]

Starting and ending 1-axis constant-speed control

1-axis constant-speed control is started and ended using the following instructions:

(1) CPSTART1
Starts 1-axis constant-speed control. Sets the axis number used and the commanded speed.

(2) CPEND
Ends the 1-axis constant-speed control which was started using CPSTART1.

Positioning control method to the pass point

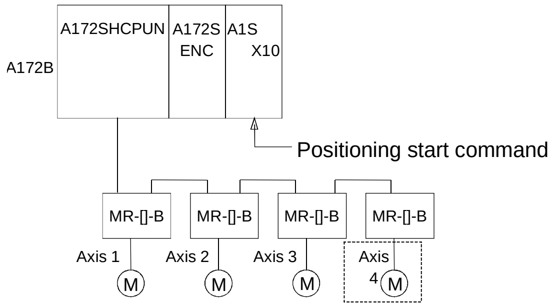
The positioning control to the point where control is changed is designated using the following instructions:

(1) ABS-1/INC-1
Designates 1-axis linear positioning control.
See Section 7.2 "1-axis Linear Positioning Control" for details.

[Program Example]

This program executes repeated 1-axis constant-speed control under the conditions below.

(1) System configuration
Constant-speed control for Axis 4.

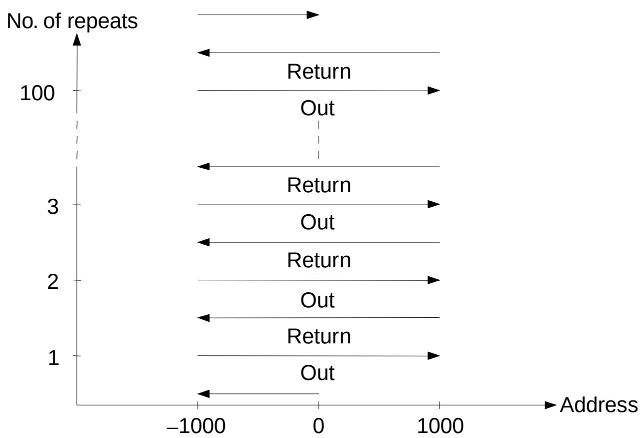


(2) Positioning conditions
(a) The constant-speed control conditions are shown below.

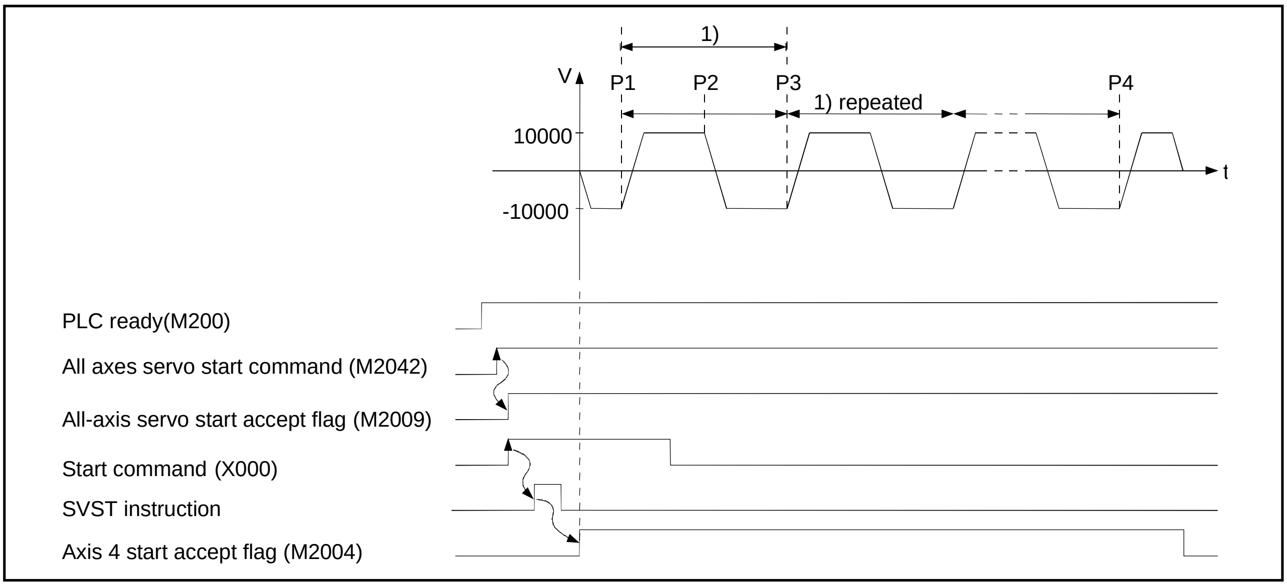
Item		Setting
Servo program number		500
Controlled axis		Axis 4
Positioning speed		10000
Number of repetitions		100
Pass point travel value	P1	–1000
	P2	2000
	P3	–2000
	P4	1000

(b) Constant-speed control start command ....leading edge of X000 (OFF → ON)

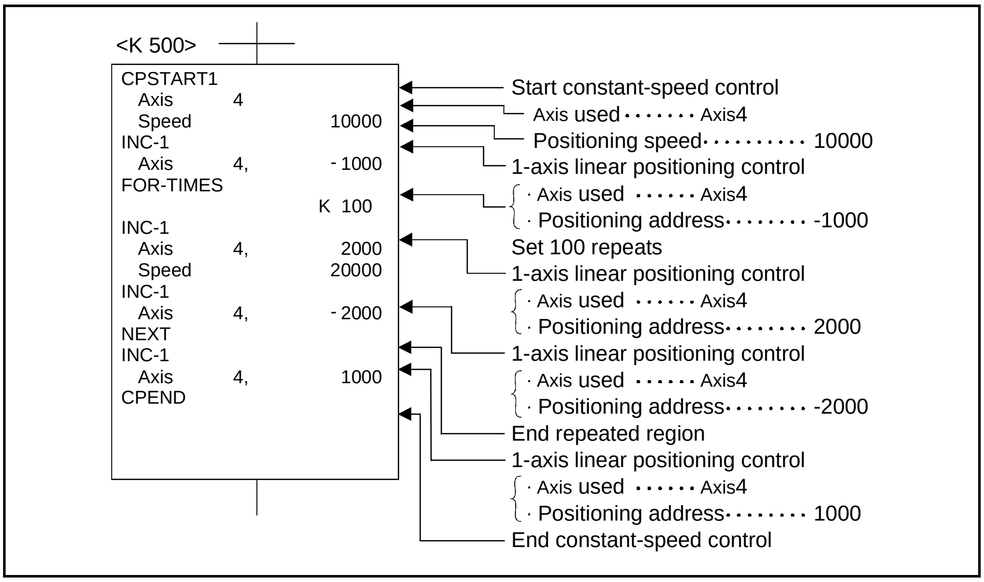
(3) Details of positioning operation



(4) Operation timing
The operation timing for servo program No. 500 is shown below.



(5) Servo program
The servo program No. 500 for constant-speed control is shown below.



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

```
     M9039
 0 ─┤ ├──────────────────────────────────────────────(M2000)─   Turns ON PLC ready.
     M9074
 2 ─┤ ├──────────────────────────────────────────────(M2042)─   Turns ON all axes servo start
                                                                command.
     X000    M9074   M2009   M9076
 4 ─┤ ├─────┤ ├─────┤ ├─────┤ ├──────────────────[PLS     M560 ]─┐ Turns ON servo program No. 500
     M560                                                          │ start command flag (M561) when
11 ─┤ ├──────────────────────────────────────────[SET     M561 ]─┘ X000 turns OFF → ON.
     M9074   M561    M2004                                  K
13 ─┤ ├─────┤ ├─────┤/├──┬───────────────────[SVST   J4   500  ]─   Servo program No. 500 execution
                         │                                          request.
                         └───────────────────────[RST     M561 ]─   Turns OFF M561 on completion
                                                                    of servo program No. 500 execution
  CIRCUIT END                                                       request.
```

7.16.4 2- to 4-axes constant-speed control

Constant-speed control for the 2, 3, or 4-axes 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 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	SCurve Ratio	Commanded Speed (constant-speed)	Cancel	Start	Skip	FIN acceleration	
Start	CPSTART2	–	2	Δ	○		○								Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ		Δ	Δ		Δ	OK
	CPSTART3		3	Δ	○		○								Δ	Δ	Δ	Δ	Δ	Δ		Δ		Δ	Δ		Δ	
	CPSTART4		4	Δ	○		○								Δ	Δ	Δ	Δ	Δ	Δ		Δ		Δ	Δ		Δ	
End	CPEND		–					Δ																				
Pass Point	ABS-2	Absolute data	2		○	○			Δ	Δ													Δ			Δ		
	ABS-3		3		○	○			Δ	Δ													Δ			Δ		
	ABS-4		4		○	○			Δ	Δ													Δ			Δ		
	ABS		2		○	○			Δ	Δ	○															Δ		
	ABS ABS ABS ABS				○	○			Δ	Δ		○											Δ			Δ		
	ABS ABS				○	○			Δ	Δ			○										Δ			Δ		
	INC-2	Incremental	2		○	○			Δ	Δ													Δ			Δ		
	INC-3		3		○	○			Δ	Δ													Δ			Δ		
	INC-4		4		○	○			Δ	Δ													Δ			Δ		
	INC		2		○	○			Δ	Δ	○												Δ			Δ		
	INC INC INC INC				○	○			Δ	Δ		○											Δ			Δ		
	INC INC				○	○			Δ	Δ			○										Δ			Δ		

○ : Must be set
Δ : Set if required

[Control Details]

Starting and Ending 2- to 4-Axes Constant-Speed Control

2-, 3-, or 4-axes constant-speed control is started and ended using one of the following instructions:

(1) CPSTART2
Starts 2-axes constant-speed control.
Sets the axis numbers used and the commanded speed.

(2) CPSTART3
Starts 3-axes constant-speed control.
Sets the axis numbers used and the commanded speed.

(3) CPSTART4
Starts 4-axes constant-speed control.
Sets the axis numbers used and the commanded speed.

(4) CPEND
Ends the 2-, 3-, or 4-axes constant-speed control which was started using CPSTART2, CPSTART3, or CPSTART4.

Positioning Control Method to the Pass Point

The positioning control to the point where control is changed is designated using the following instructions:

(1) ABS-2/INC-2
Designates 2-axes linear interpolation control.
See Section 7.3 "2-axes Linear Interpolation Control" for details.

(2) ABS-3/INC-3
Designates 3-axes linear interpolation control.
See Section 7.4 "3-axes Linear Interpolation Control" for details.

(3) ABS-4/INC-4
Designates 4-axes linear interpolation control.
See Section 7.5 "4-axes Linear Interpolation Control" for details.

(4) ABS/INC
Designates circular interpolation control using auxiliary point designation.
See Section 7.6 "Circular Interpolation Using Auxiliary Point Designation" for details.

(5) ABS/INC , ABS/INC , ABS/INC , ABS/INC
Designates circular interpolation control using radius designation.
See Section 7.7 "Circular Interpolation Using Radius Designation" for details.

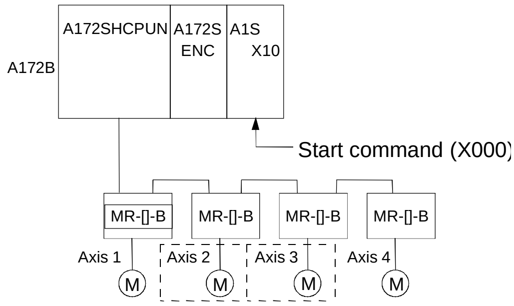
(6) ABS/INC , ABS/INC
Designates circular interpolation control using center point designation.
See Section 7.8 "Circular Interpolation Using Center Point Designation" for details.

[Program Example]

(1) This program executes 2-axes constant-speed control under the conditions below.

(a) System configuration

Constant-speed control for Axis 2 and Axis 3.



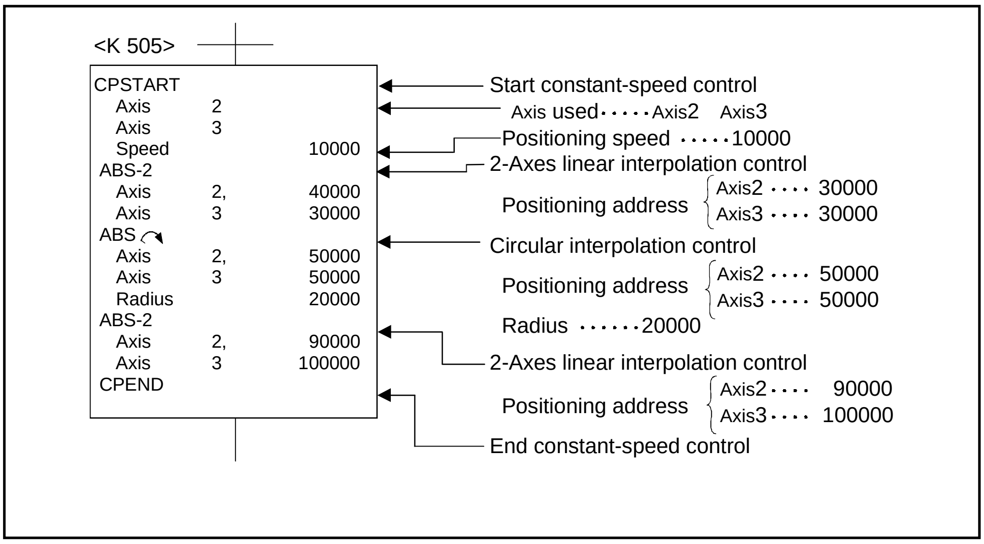
(b) Positioning conditions

1) The constant-speed control conditions are shown below.

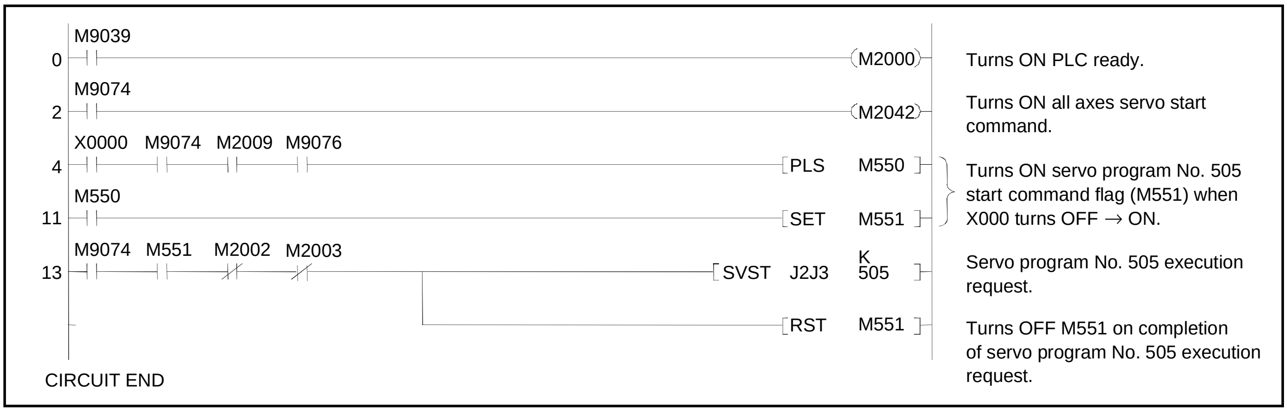
Item		Setting		
Servo program number		505		
Positioning speed		10000		
Positioning method		2-axes linear interpolation	Circular Interpolation Using Radius Designation	2-axis linear interpolation
Pass point	Axis 2	30000	50000	90000
	Axis 3	30000	50000	100000

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.

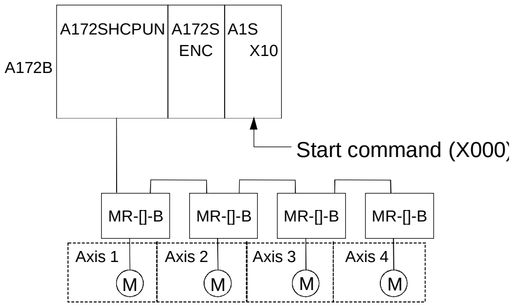


[Program Example]

(2) This program executes 4-axes constant-speed control under the conditions below.

(a) System configuration

Constant-speed control for Axis 1, Axis 2, Axis 3, and Axis 4.



(b) Positioning details

Positioning is performed by the Axis 1, Axis 2, Axis 3 and Axis 4 servomotors.

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

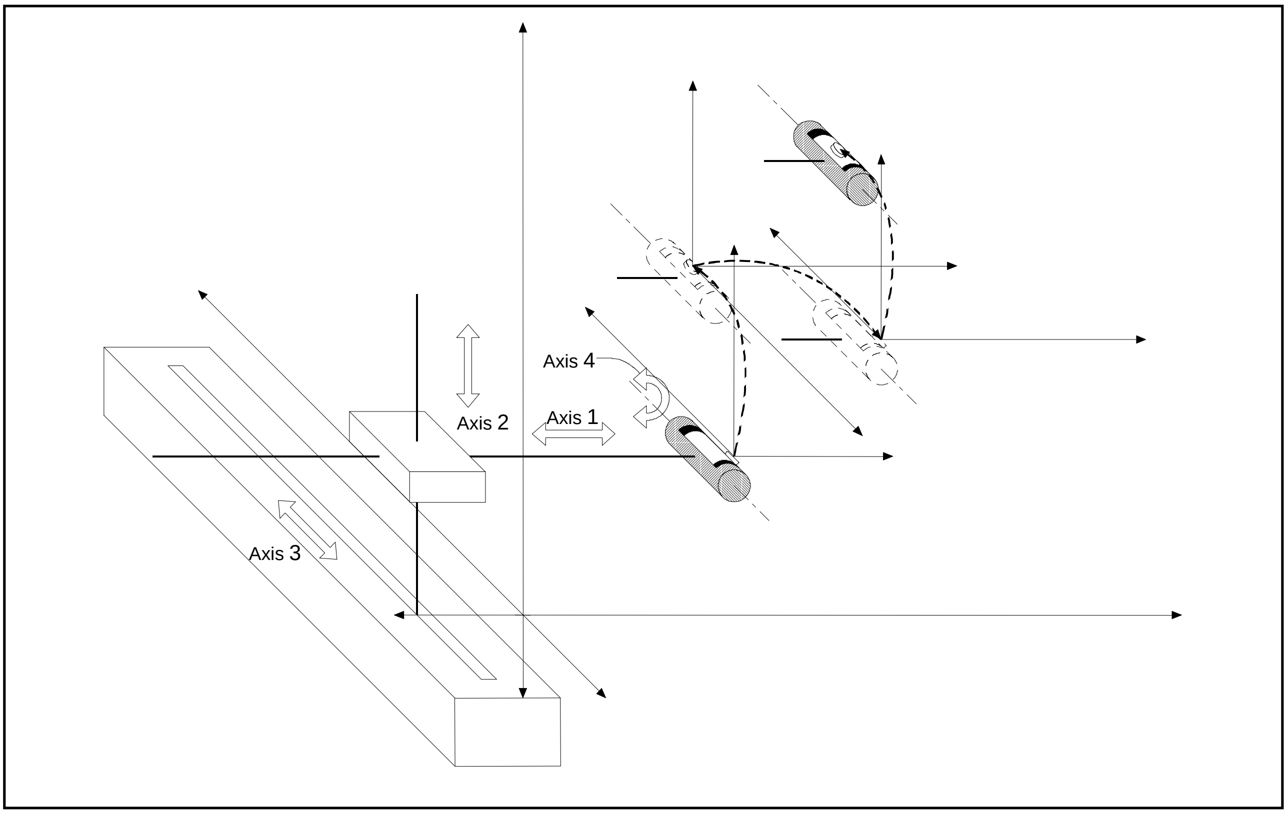


Fig. 7.30 Axis Configuration

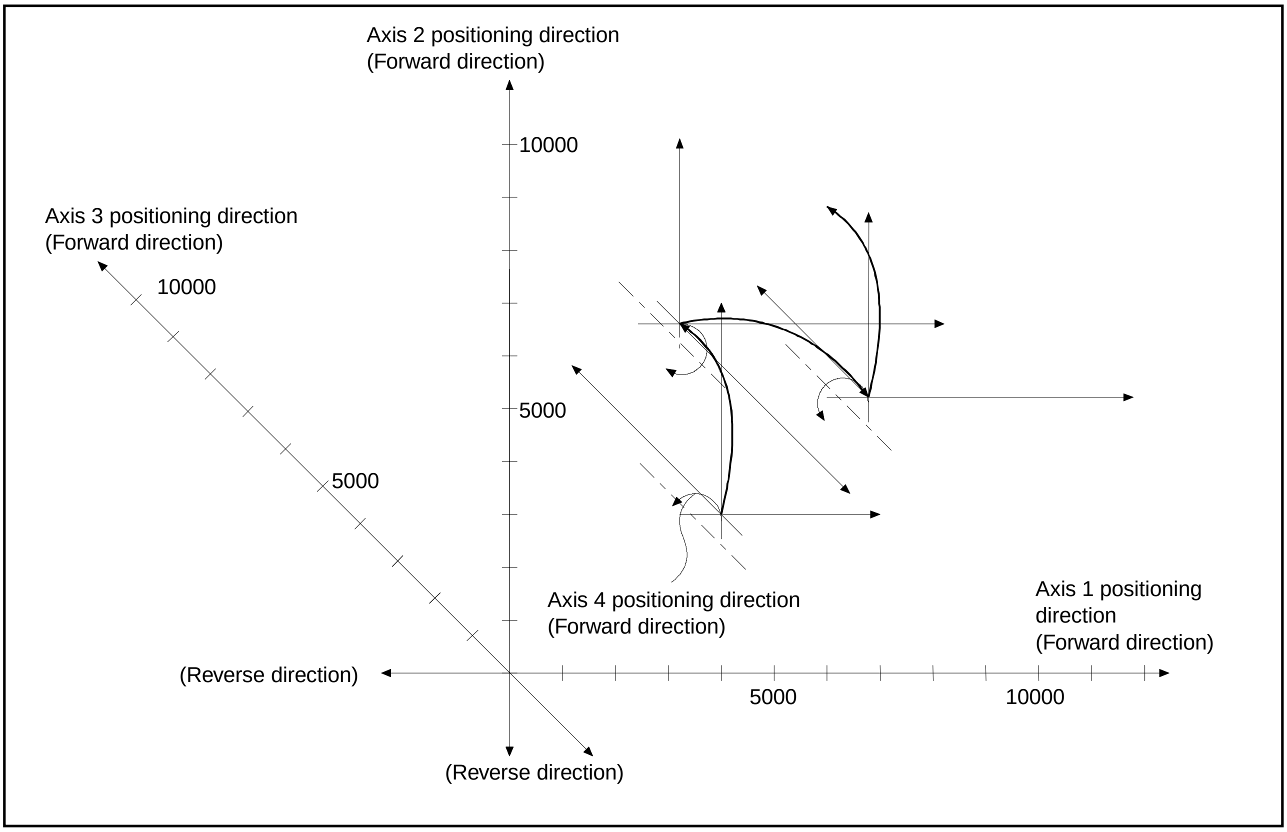


Fig. 7.32 Positioning by 4-Axes Constant-Speed Control

(c) Positioning conditions

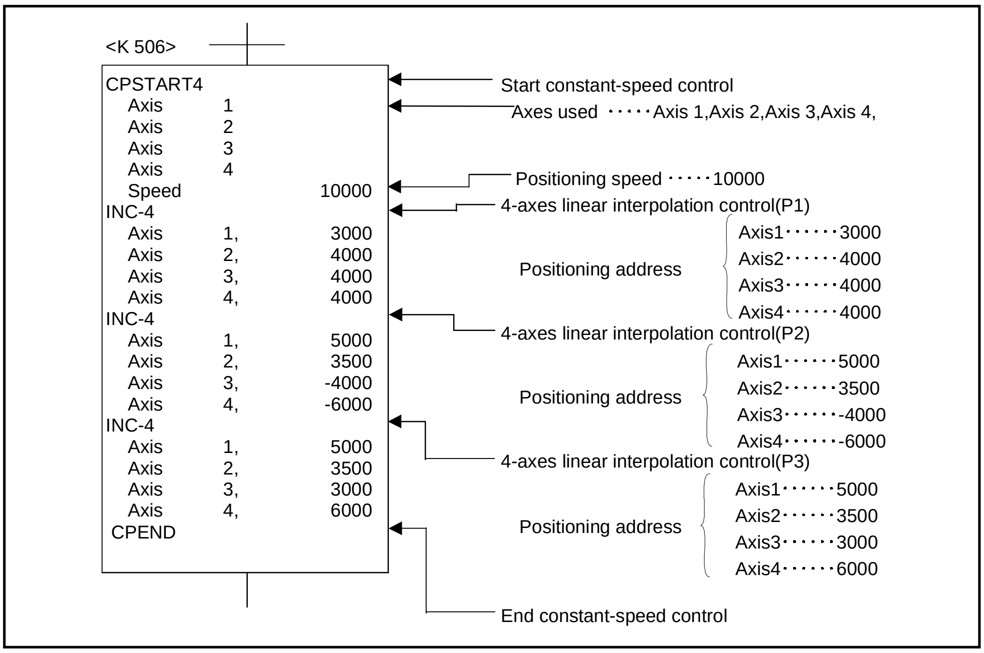
1) The constant-speed control conditions are shown below.

Item		Setting		
Servo program number		506		
Positioning speed		10000		
Positioning method		4-axes linear interpolation	4-axes linear interpolation	4-axes linear interpolation
Pass point	Axis 1	3000	5000	5000
	Axis 2	4000	3500	3500
	Axis 3	4000	–4000	3000
	Axis 4	4000	–6000	6000

2) Constant-speed control start command........ leading edge of X000 (OFF → ON)

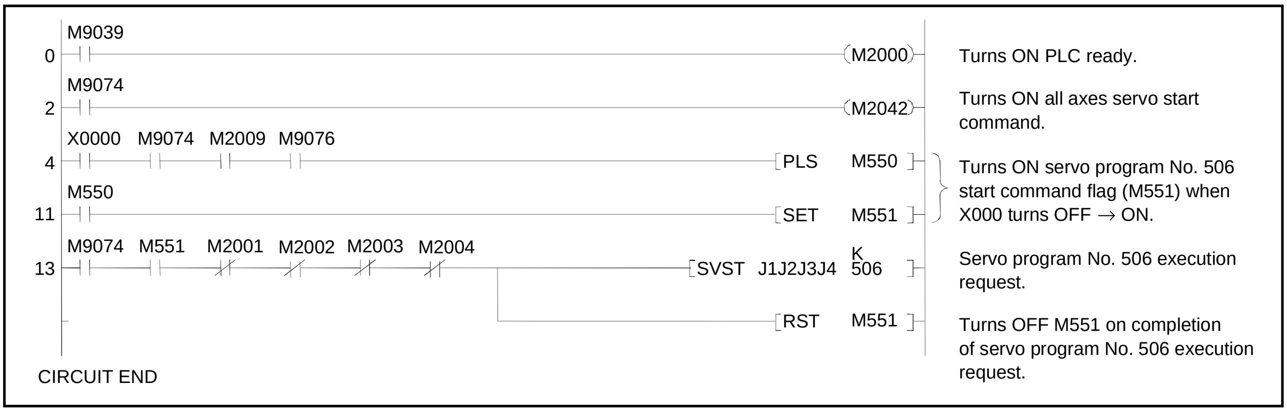
(d) Servo program

The servo program No. 506 for constant-speed control is shown below.



(e) Sequence program

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



7.16.5 Pass point skip function

This is a function whereby, by setting a skip signal for each pass point associated with a constant speed control instruction, positioning at the current point can be canceled and positioning carried out at the next point.

[Data setting]

(1) Skip signal devices
The following devices can be designated as skip signal devices.
X, Y, M, TC, TT, CC, CT, B, F

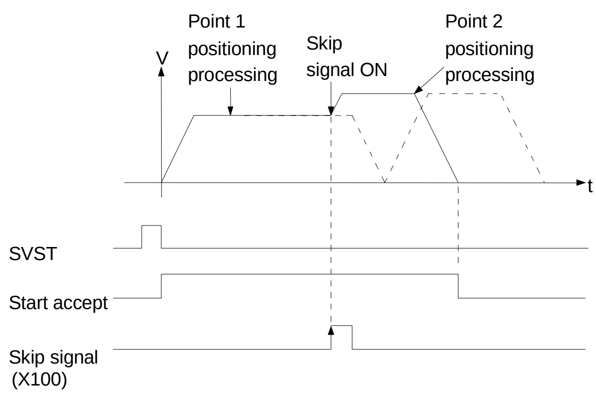
[Notes]

(1) If absolute circular interpolation is designated at or beyond the point where the skip signal was designated, set absolute linear interpolation up to that point. Otherwise, an error occurs and operation stops.

(2) When a skip signal is input at the final point, deceleration to a stop occurs at that point and the program is ended.

[Program example]

```
<K   0 >
   CPSTART2
     Axis       1
     Axis       2
     Speed               10000
1  ABS-2
     Axis       1,      100000
     Axis       2,      200000
     Speed               10000
     Skip                 X100
2  ABS-2
     Axis       1,      200000
     Axis       2,      200000
     Speed               15000
   CPEND
```



⚠ CAUTION

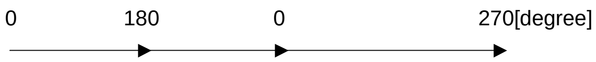
⚠ The operation that takes place on execution of a skip designated during constant speed control, when an axis for which "degree" is designated as the unit and which has no stroke range is included, is described here. If, under these conditions, there is an ABS instruction following the skip, the final positioning point and the travel distance in the program as a whole will be the same ragardless of whether the skip is executed or not. Examples are presented below.

(1) When all the instructions after the skip are INC instructions:

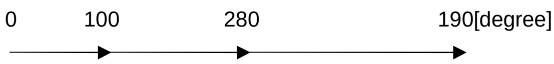
Program example

```
CPSTART1
 Axis     1
 Speed              10.000
INC-1
 Axis     1,    180.00000
 Skip                X100
INC-1
 Axis     1,    180.00000
INC-1
 Axis     1,    270.00000
CPEND
```

Motion when skip is not executed



Motion when skip is executed
(when the skip occurs at 100 [degree])

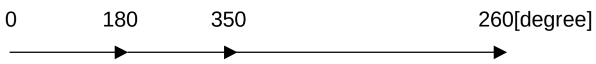


(2) When the instruction immediately following the skip is an ABS instruction

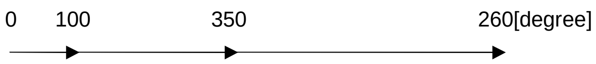
Program example

```
CPSTART1
 Axis     1
 Speed              10.000
INC-1
 Axis     1,    180.00000
 Skip                X100
ABS-1
 Axis     1,    350.00000
INC-1
 Axis     1,    270.00000
CPEND
```

Motion when skip is not executed



Motion when skip is executed
(when the skip occurs at 100 [degree])



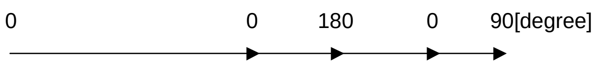
Whether or not the skip occurs, the final positioning point will be the same.

(3) When the instruction immediately following the skip is an INC instruction and there is an ABS instruction after that

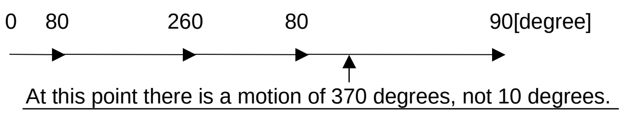
Program example

```
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



Motion when skip is executed
(when the skip occurs at 80 [degree])



Whether or not the skip occurs, the final positioning point will be the same.

7.16.6 FIN signal wait function

This is a function whereby, when the FIN wait function is selected and an M-code is set for each point on the way, the end of processing of each point on the way is synchronized with the FIN signal, and positioning at the subsequent point is carried out when the FIN signal comes ON.

[Data setting]

(1) When the FIN signal wait function is selected, the fixed acceleration/deceleration time method is used.
Set the acceleration/deceleration time within the range 1 ms to 5000ms in the servo program by using the “FIN acceleration/deceleration” option.
Indirect setting is also possible by using D and w devices (1 word).

[Notes]

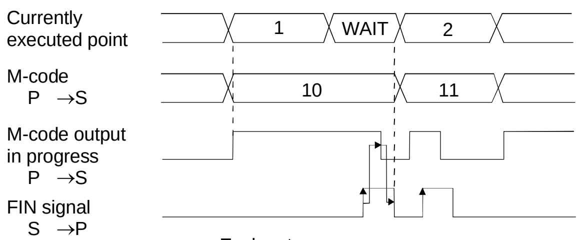
(1) If the acceleration/deceleration time designation is outside the permissible range, the servo program setting error “13” will occur on starting and control will be performed with an acceleration/deceleration time of 1000 ms.

(2) When interpolation is performed, the M-code output in progress signal is output for all interpolation axes. In this case, turn ON the signal for one of the interpolating axes.

(3) When an M-code is set at the final point, positioning is completed after the FIN signal has gone from OFF to ON to OFF.

[Program example]

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

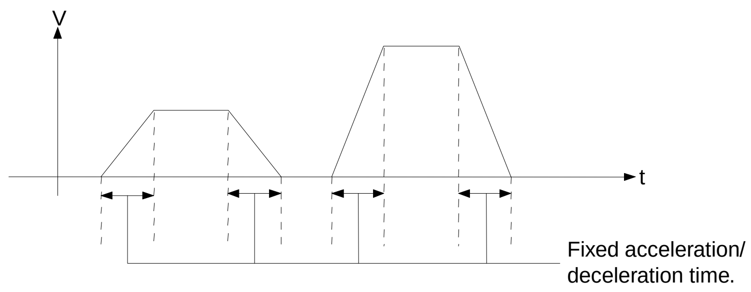


Explanatory

1. When the positioning at point 1 starts, an M-code is output and the M code output in progress signal comes ON.
2. On receiving this signal, the relevant processing is performed at the PLC, 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 PLC, 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 PLC. After that, positioning at the next point, point 2, starts.

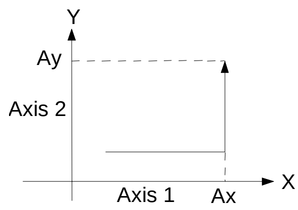
POINTS

The fixed acceleration/deceleration method is a type of acceleration/deceleration processing whereby even if the command speed changes, the time taken up by acceleration/deceleration remains fixed.

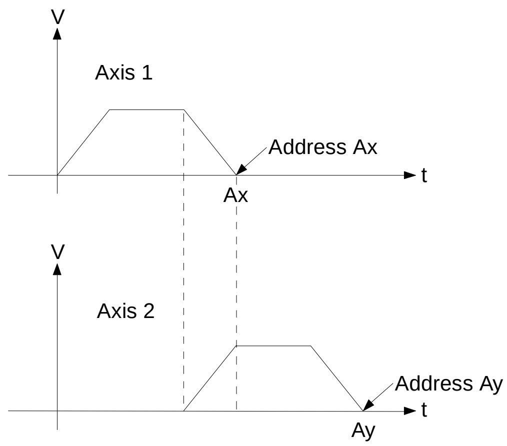


(1) When the fixed acceleration/deceleration method is used, the following processing and parameters are invalidated.
- Rapid stop deceleration time in parameter block
- Completion point designation method for speed change point
- "S" curve acceleration/deceleration

(2) When the type of positioning operation shown below (constant speed control) is performed, the speed processing for each axis is as shown below.



Positioning operation



Constant speed control processing of each axis

7.17 Position Follow-Up Control

After a single control start, positioning occurs to the address set with the word device of the servo system CPU designated in the servo program.
Position follow-up control is started using the PFSTART servo program instruction.

Servo Instruction	Positioning Method	Number of Controllable Axes	Items Set by Peripherals																					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	SCurve Ratio	Cancel	Start	
PFSTART	Absolute	1	Δ	○	○	○		Δ						Δ	Δ	Δ	Δ	Δ	Δ		Δ	Δ	Δ	OK

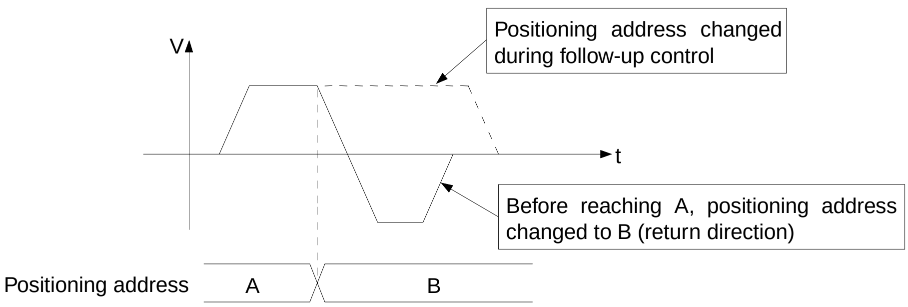
○ : Must be set
Δ : Set if required

[Control Details]

Control Using PFSTART Instruction

(1) Positioning to the address set with the word device of the servo system CPU designated in the servo program.

(2) Position follow-up control is executed until the stop instruction is input. If the word device value changes while control is progress, positioning is executed to the changed address.



[Cautions]

(1) The number of controllable axes is limited to one.

(2) Only the absolute 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.

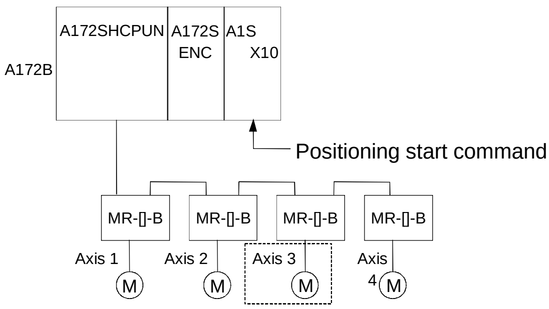
(4) Set the positioning address in the servo program using indirect designation with the word devices D and W.

(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.



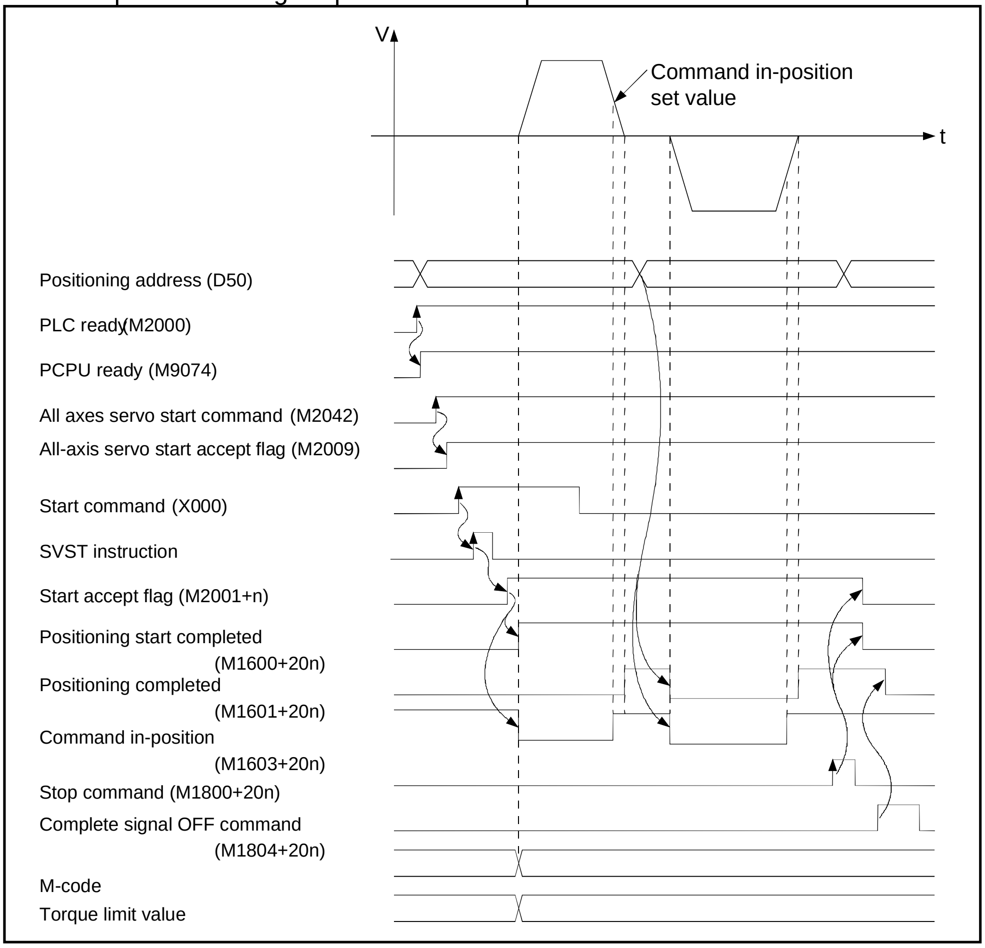
(2) Positioning conditions
(a) The position follow-up conditions are shown below.

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)

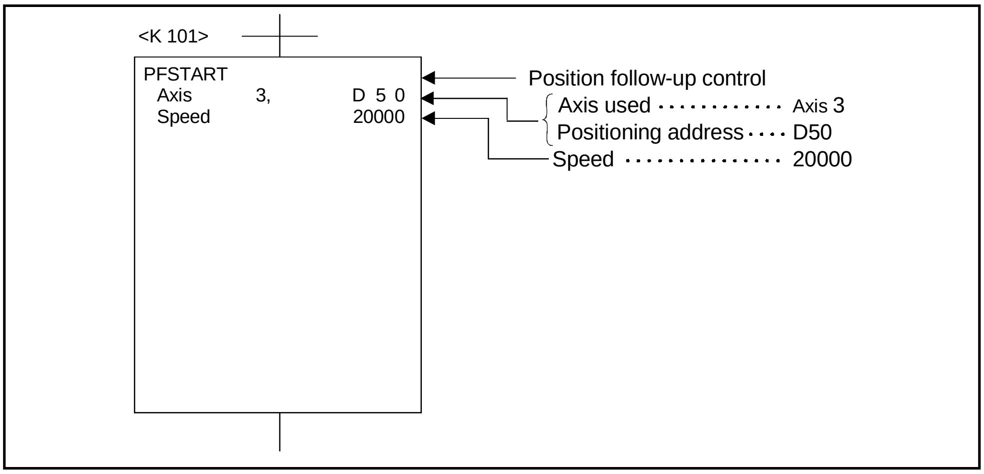
(3) Operation timing

The operation timing for position follow-up control is shown below.



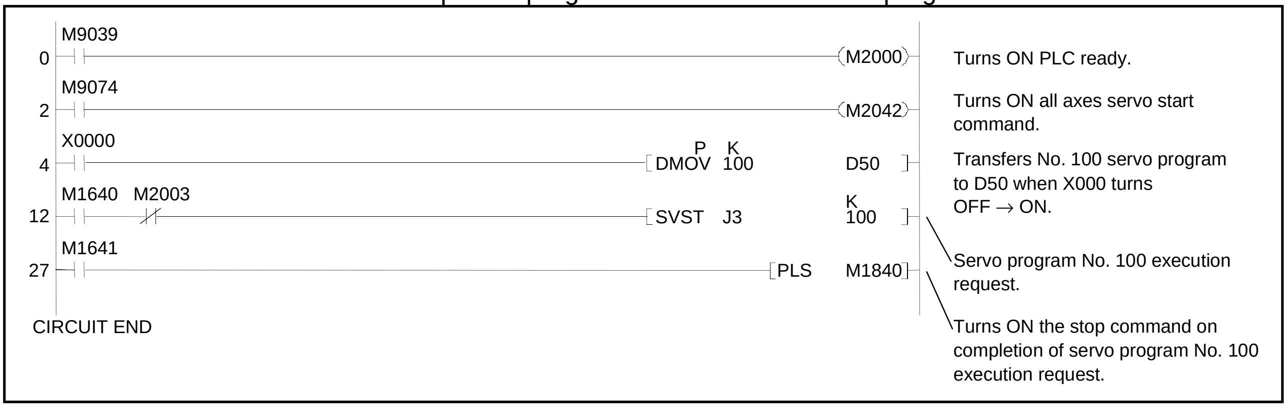
(4) Servo program

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.



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	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	SCurve Ratio	Cancel	Start	Speed Change
START	*	*																					○	*

○ : Must be set
* : Set if required

[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.

<table>
<tr><th rowspan="2">Error</th><th rowspan="2">Error Processing</th><th colspan="2">Stored Codes</th></tr>
<tr><th>D9189</th><th>D9190</th></tr>
<tr><td>Designated servo program does not exist</td><td rowspan="4">Servo program setting error flag (M9079): ON
Start accept flag (M2001+n): OFF</td><td rowspan="3">Program number causing error on simultaneous start</td><td rowspan="3">19</td></tr>
<tr><td>START instruction designated as servo program</td></tr>
<tr><td>The designated servo program start axis is already designated.</td></tr>
<tr><td>A servo program cannot start due to an error</td><td>Program number for which error occurred on simultaneous start</td><td>Error Item Data (see Section 6.3)</td></tr>
</table>

(2) The servo programs cannot be designated for the START instruction using indirect designation.

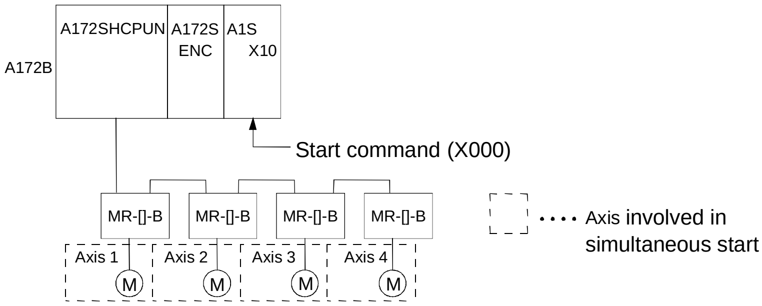
(3) If the servo programs designated for the START instruction include fixed-pitch feed control or speed/position switching control, start may be delayed a maximum of one second compared to other speed control or position control.

[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	Zeroing control

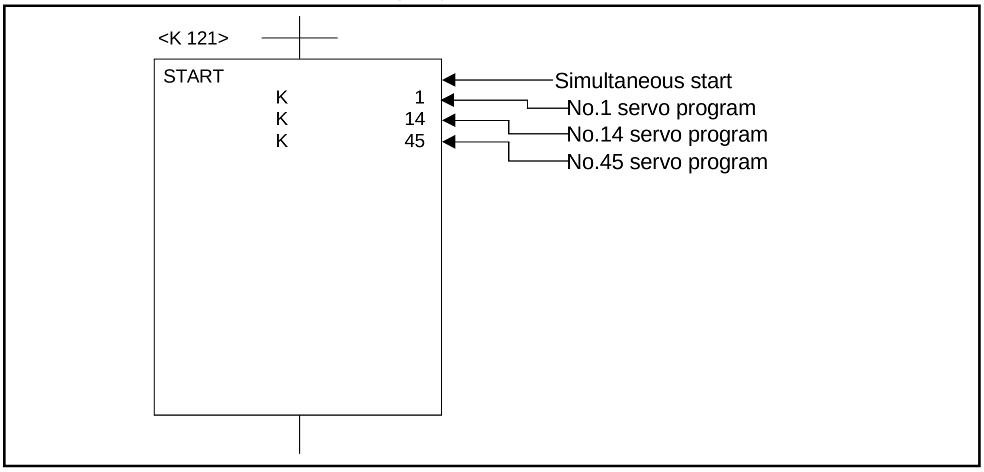
(3) Start conditions

(a) Simultaneous start servo program number ....No. 121

(b) Simultaneous start run command............................leading edge of X100 (OFF → ON)

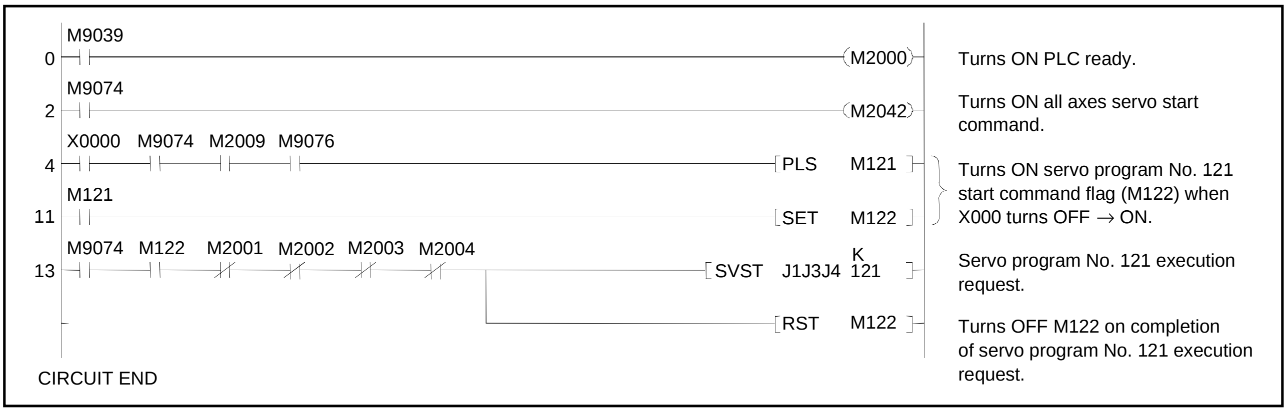
(4) Servo program

The simultaneous start servo program No. 121 is shown below.



(5) Sequence program

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



7.19 JOG Operation

Runs the set JOG operation.
Individual start or simultaneous start can be used for JOG operation.
JOG operation can be run from a sequence program or in a peripheral device test mode.
(For information on running JOG operation in a peripheral device test mode, refer to the operation manual for the appropriate peripheral device.)
To carry out JOG operation, the JOG operation must be set for each axis.

7.19.1 JOG operation data

The JOG operation data is the data required to carry out JOG operation.
Set the JOG operation data from a peripheral device.

Table 7.2 Table of JOG Operation Data

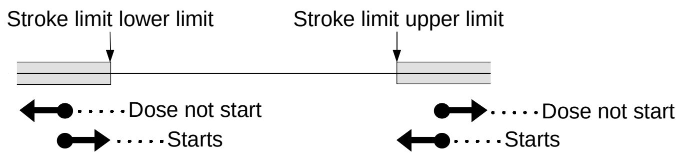
No.	Item	Setting Range								Default		Remarks	Explan-atory Section
		mm		inch		degree		PULSE		Initial Value	Units		
		Setting Range	Units	Setting Range	Units	Setting Range	Units	Setting Range	Units				
1	JOG speed limit value	0.01 to 6000000.00	mm/min	0.001 to 600000.000	inch/min	0.001 to 2147483.647	degree/min	1 to 10000000	PLS/s	20000	PLS/s	• Sets the max. speed during JOG operation. • The JOG speed limit value becomes the JOG operation speed if the JOG operation speed is set greater than JOG speed limit value.	–
2	Parameter block setting	1 to 16								1	–	• Sets the parameter block number used for JOG operation.	4.4

(1) JOG operation data check
A relative check of the JOG operation data is executed at the following times:
- Power on
- On PLC ready (M2000) leading edge (OFF → ON)
- When test mode is selected.

(2) Data error processing
- Only data for which errors were detected during the relative check is changed to its default value for JOG operation control.
- The error code corresponding to the data for 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.

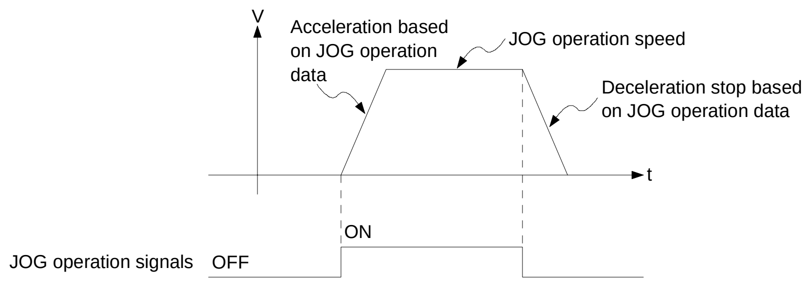


7.19.2 Individual start

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.

No.	A172SHCPUN				A171SHCPUN				Setting Range							
	JOG Operation		JOG Operation Setting Register		JOG Operation		JOG Operation Setting Register		mm		inch		degree		PULSE	
	Forward JOG	Reverse JOG	Most Significant	Least Significant	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	M1802	M1803	D965	D964	1 to 600000000	$\times10^{-2}$ mm/min	1 to 600000000	$\times10^{-3}$ inch/min	1 to 2147483647	$\times10^{-3}$ degree/min	1 to 1000000	PLS/s
2	M1822	M1823	D971	D970	M1822	M1823	D971	D970								
3	M1842	M1843	D977	D976	M1842	M1843	D977	D976								
4	M1862	M1863	D983	D982	M1862	M1863	D983	D982								
5	M1882	M1883	D987	D988	—	—	—	—								
6	M1902	M1903	D993	D994	—	—	—	—								
7	M1922	M1923	D999	D1000	—	—	—	—								
8	M1942	M1943	D1005	D1006	—	—	—	—								

POINT

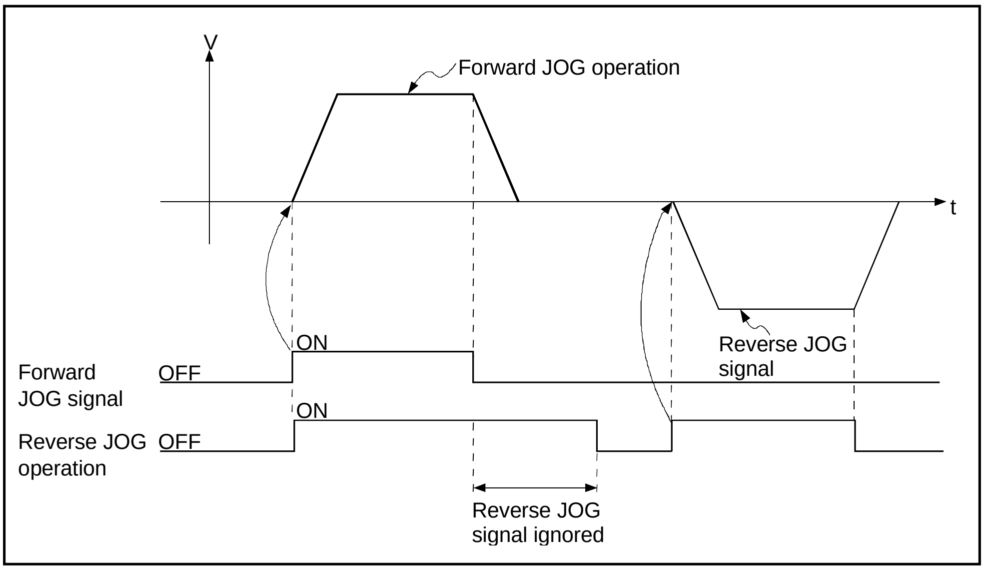
To set the JOG operation speed using a sequence program, store a value in the JOG operation speed setting register which is 100 times the actual speed in units of millimeters or 1000 times the speed in units of inches or degrees.

Example

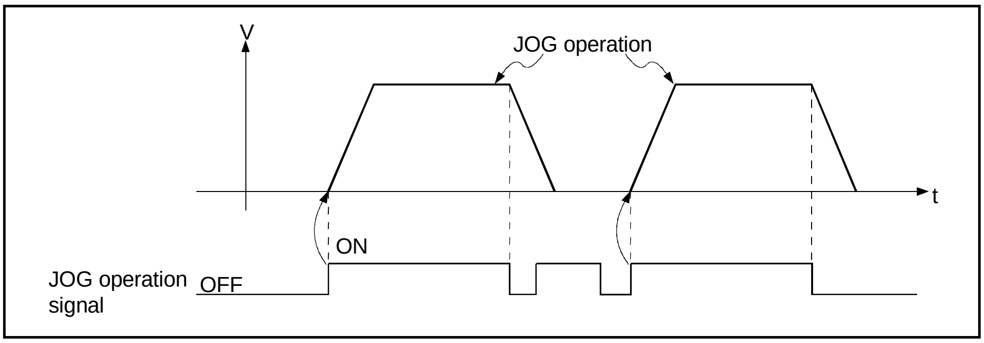
To set a JOG operation speed of 6000.00 mm/min., store the value 600000 in the JOG operation speed setting register.

[Cautions]

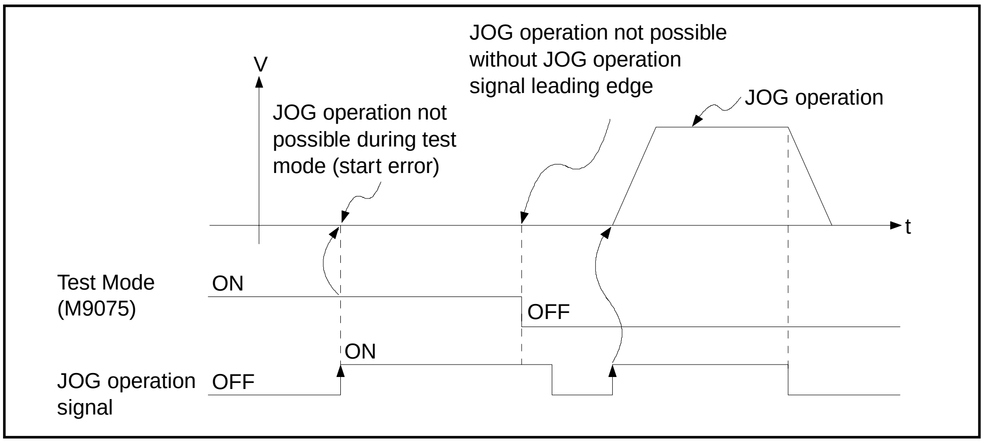
(1) Forward JOG operation occurs if the forward JOG signal (M1802+20n) and reverse JOG signal (M1803+20n) turn ON simultaneously for a single axis.
When the axis decelerated to a stop after the forward JOG signal had turned OFF, reverse JOG operation is not performed if the reverse JOG signal is ON.
Reverse JOG operation is started when the reverse JOG signal is turned from OFF to ON after that.



(2) If the JOG operation signal turns ON during deceleration which was started when the JOG operation signal turned OFF, JOG operation is not performed after the axis has decelerated to a stop. JOG operation is started when the JOG operation signal is turned from OFF to ON after that.



(3) JOG operation cannot be started by the JOG operation signals (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.

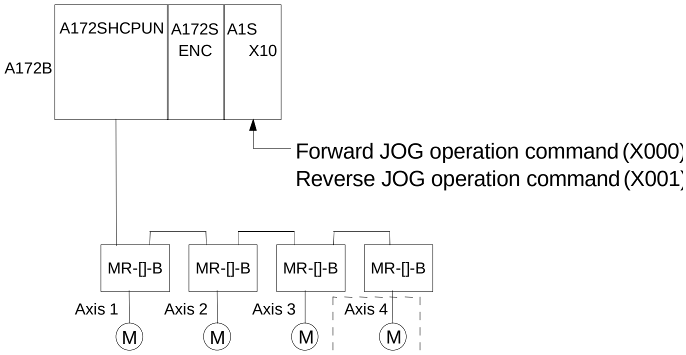


[Program Example]

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

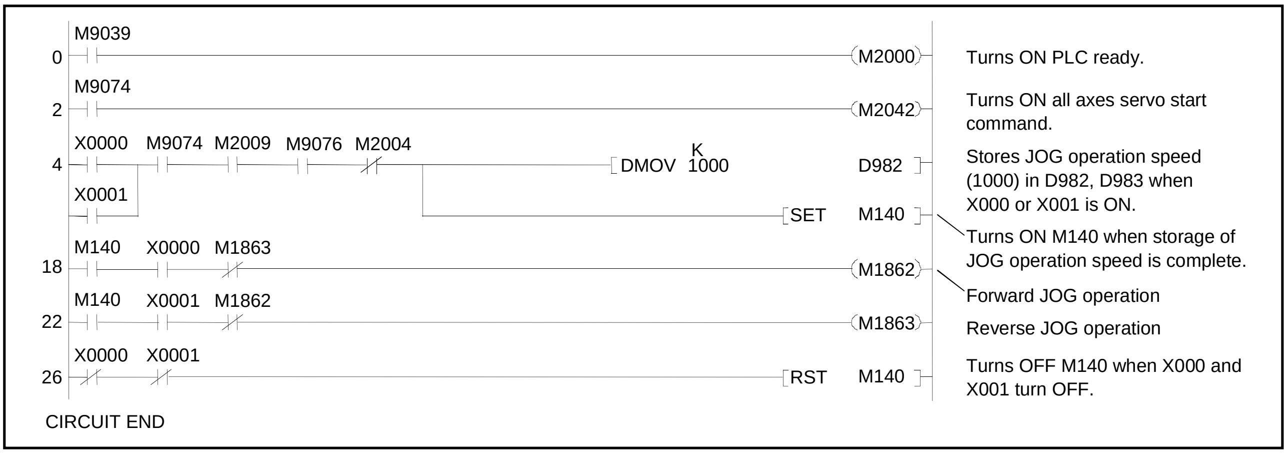
(b) JOG operation speed 1000

(c) JOG operation commands

1) Forward JOG operation........X000 ON

2) Reverse JOG operation ....X001 ON

(3) Sequence program

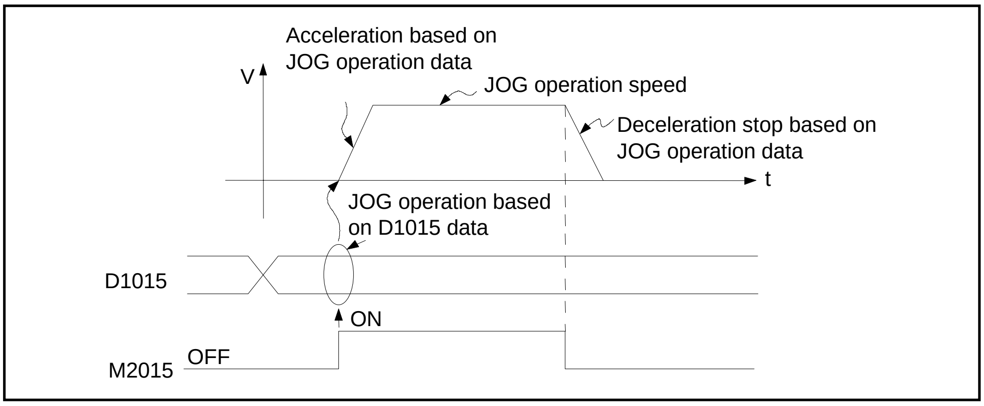


7.19.3 Simultaneous start

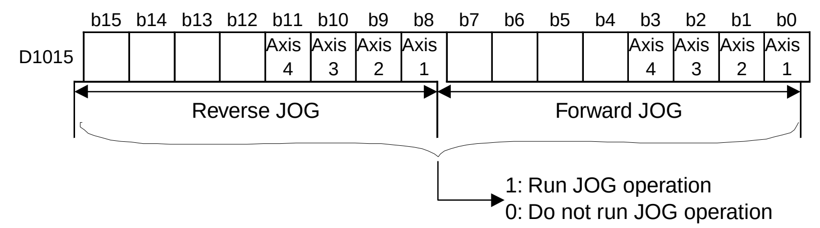
Simultaneously starts JOG operation designated for multiple axes.

[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

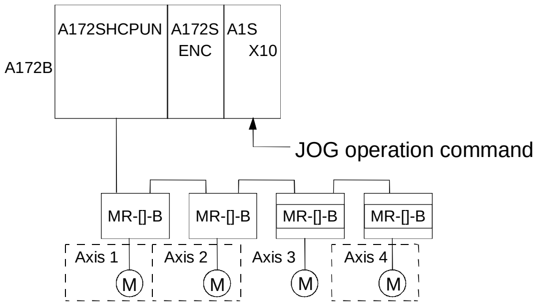
(3) The JOG operation speed setting registers are described below.

No.	A172SHCPUN				A171SHCPUN				Setting Range							
	JOG Operation		JOG Operation Setting Register		JOG Operation		JOG Operation Setting Register		mm		inch		degree		PULSE	
	Forward JOG	Reverse JOG	Most Significant	Least Significant	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	M1802	M1803	D965	D964	1 to 600000000	10^{-2} mm/min	1 to 600000000	10^{-2} inch/min	1 to 2147483647	10^{-2} degree/min	1 to 1000000	PLS/s
2	M1822	M1823	D971	D970	M1822	M1823	D971	D970								
3	M1842	M1843	D977	D976	M1842	M1843	D977	D976								
4	M1862	M1863	D983	D982	M1862	M1863	D983	D982								
5	M1882	M1883	D987	D988	—	—	—	—								
6	M1902	M1903	D993	D994	—	—	—	—								
7	M1922	M1923	D999	D1000	—	—	—	—								
8	M1942	M1943	D1005	D1006	—	—	—	—								

[Program Example]

This program executes simultaneous start of JOG operations under the conditions below.

(1) System configuration
JOG operation of Axis 1, Axis 2, and Axis 4.

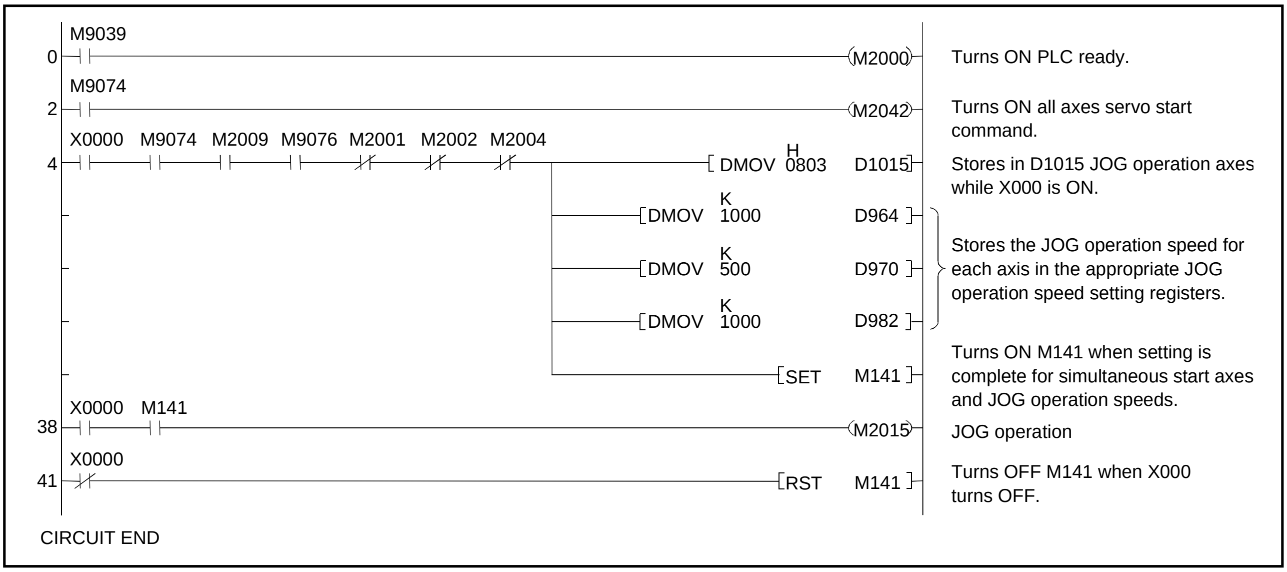


(2) JOG operation conditions
(a) The JOG operation conditions are tabled below.

Item	JOG		
Axis number	Axis 1	Axis 2	Axis 4
JOG operation speed	1000	500	1000
JOG operation direction	Forward	Forward	Reverse

(b) JOG operation command ...... X000 ON

(3) Sequence program



7.20 Manual Pulse Generator Operation

Positioning control according to the number of pulses input from the manual pulse generator.
Simultaneous operation of 1 to 3-axes is possible with one manual pulse generator; the number of modules that can be connected is as shown below.

Number Connectable to the Manual Pulse Generator
1

[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.

Manual Pulse Generator Axis Setting Register	Manual Pulse Generator Enable Flag
D1012	M2012

(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
PULSE	1 PLS

For units of millimeters, the commanded travel value for input of one pulse is: (0.1 μm) × (1 PLS) × (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).

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

Axis 3 and Axis 4 designated

(4) Manual pulse generator 1-pulse input magnification

(a) The magnification for setting for a 1 pulse input from the manual pulse generator is set for each axis.

<A172SHCPUN>

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	

<A171SHCPUN>

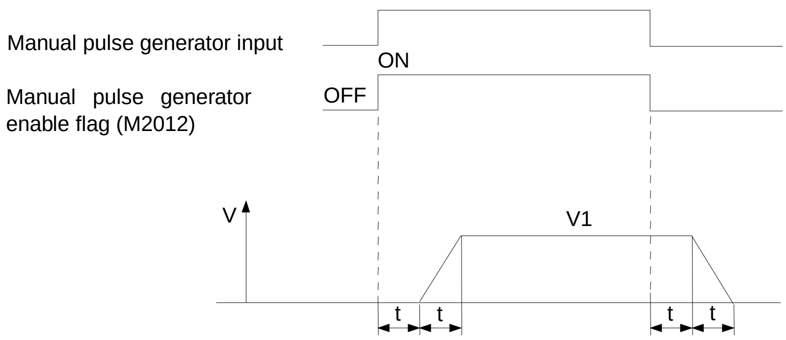
1-Pulse Input Magnification Setting Register	Corresponding Axis No.	Setting Range
D1016	Axis 1	1 to 100
D1017	Axis 2	
D1018	Axis 3	
D1019	Axis 4	

(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.

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

(a) Operation



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

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

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 PLS

(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.	• Digit ignored where error occurred. • Manual pulse generator of valid axes with settings in rang es 1-4, 1-8.
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 zeroing cannot be started by the servo system CPU or a peripheral device.
Turn OFF the manual pulse generator enable flag when manual pulse generator operation is complete.

(2) The torque limit value is fixed at 300% during manual pulse generator operation.

(3) When the manual pulse generator enable flag comes ON for a driven axis, for example one performing positioning control or JOG operation, error 214 is set for the relevant axis and manual pulse generator input is not enables. After the axis has been stopped, the rise of the manual pulse generator enable flag is validated, the manual pulse generator input enabled status is established, the start accept flag comes ON, and input from the manual pulse generator is accepted.

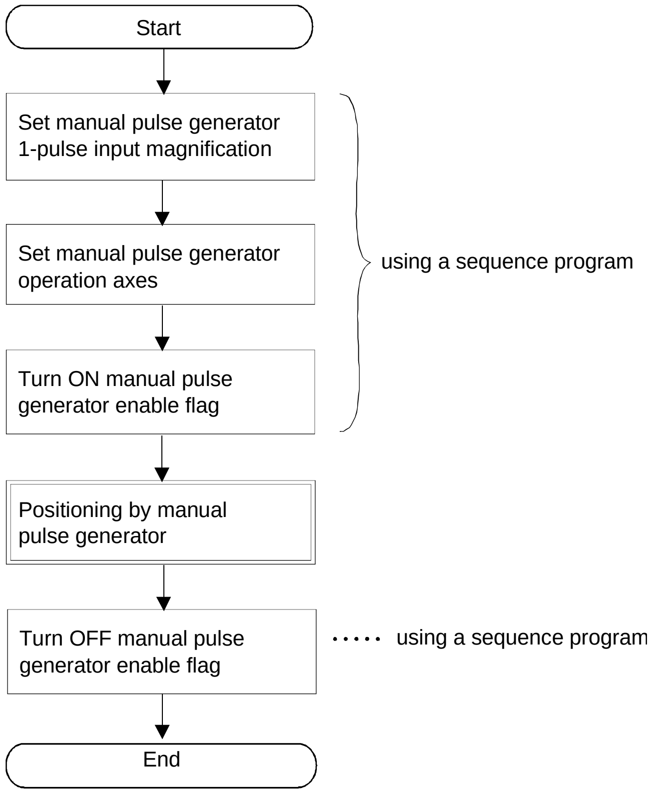
(4) If the manual pulse generator enable flag for another manual pulse generator No. is turned ON for an axis currently performing manual pulse generator operation, error 214 is set for the relevant axis and the input of that manual pulse generator is not enabled.

(5) If, after the manual pulse generator enable flag has been turned OFF, it is turned ON again for an axis that is performing smoothing deceleration, error 214 is set and manual pulse generator input is not enabled. Turn the manual pulse generator enable flag ON after smoothing deceleration to a stop (after the start accept flag has gone OFF).

(6) If, after the manual pulse generator enable flag has been turned OFF, another axis is set during smoothing deceleration and the same manual pulse generator enable flag is turned ON again, manual pulse generator input will not be enabled. In this case, the manual pulse generator axis setting error bit of the manual pulse generator axis setting error storage register (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.

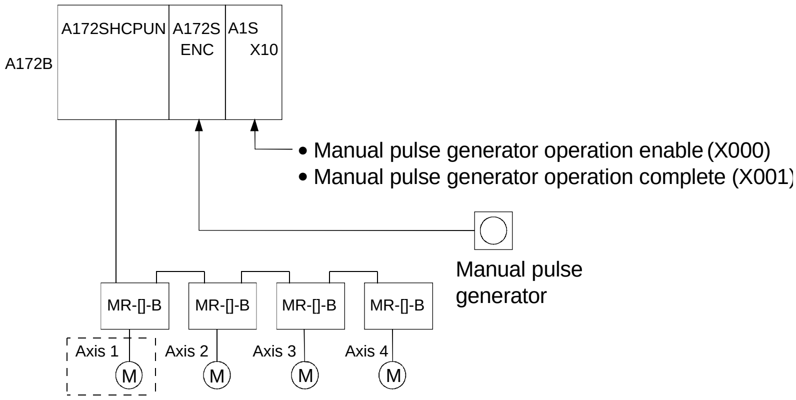


[Program Example]

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

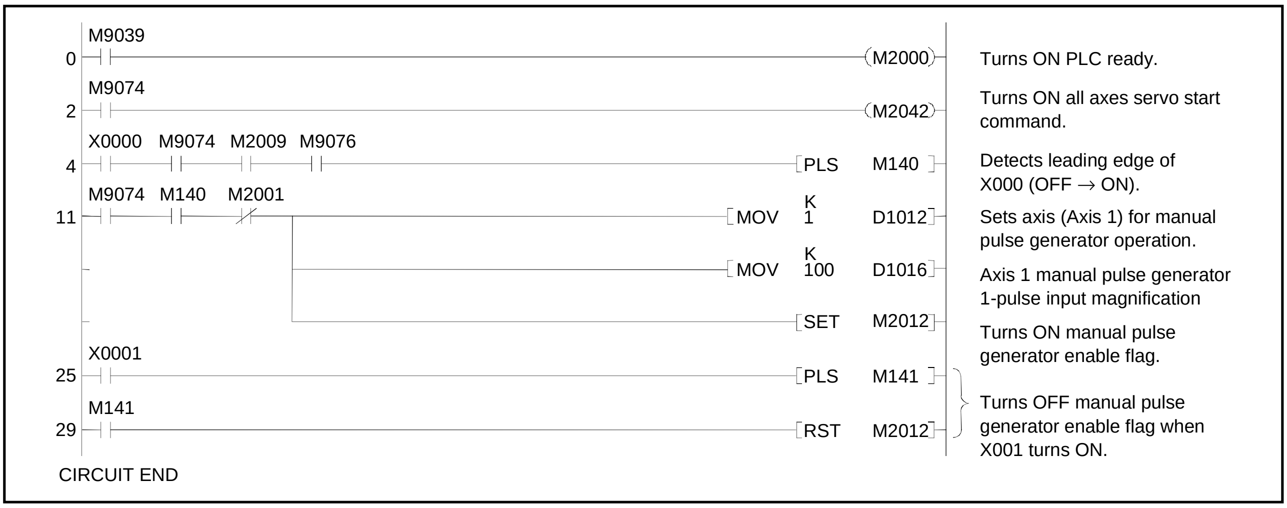
(b) Manual pulse generator 1-pulse input magnification 100

(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 Zeroing

(1) Use zeroing at power on and other times where confirmation that axes are at the machine home position is required.

(2) The following three methods of zeroing are available:
- Proximity dog method } Used when not using an absolute position
- Count method } system
- Data set method..........................(Recommended for an absolute-position system)

(3) To carry out zeroing, the zeroing data must be set for each axis.

7.21.1 Zeroing data

The zeroing data is the data required to carry out zeroing.
Set the zeroing data from a peripheral device.

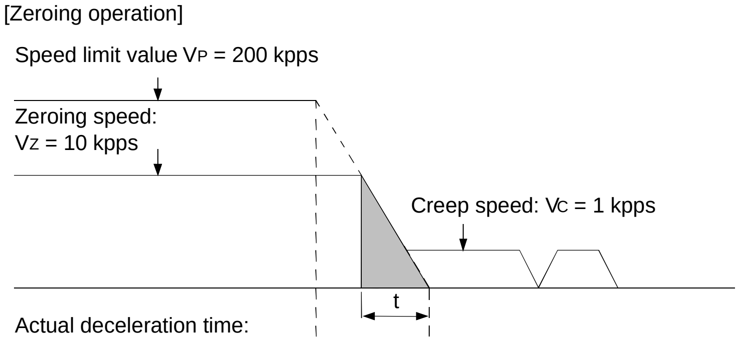
Table 7.3 Table of Zeroing Data

No.	Item	Setting Range								Default	Remarks	Explan-atory Section
		mm		inch		degree		PULSE		Initial Value		
		Setting Range	Units	Setting Range	Units	Setting Range	Units	Setting Range	Units			
1	Zeroing direction	0: reverse direction (decreased address) 1: forward direction (increased address)								0	• Sets the direction for zeroing.	–
2	Zeroing method	0: proximity dog method 1: count method 2: data set method								0	• Sets the zeroing method. • The proximity dog method or count method is recommended for a servo amplifier which does not support absolute data, and the data set method is recommended for a servo amplifier which supports absolute data.	–
3	Home position address	–2147483648 to 2147483647	$\times 10^{-1}$ μm	–2147483648 to 2147483647	$\times 10^{-5}$ inch	0 to 35999999	$\times 10^{-5}$ degree	–2147483648 to 2147483647	PLS	0	• Sets the current value of the home position after zeroing. • It is recommended that the home position address is set at the stroke limit upper limit or lower limit.	–
4	Zeroing speed	0.01 to 6000000.00	mm/min	0.001 to 600000.000	inch/min	0.001 to 2147483.647	degree/min	1 to 10000000	PLS/s	1	• Sets the speed for zeroing.	–
5	Creep speed	0.01 to 6000000.00	mm/min	0.001 to 600000.000	inch/min	0.001 to 2147483.647	degree/min	1 to 10000000	PLS/s	1	• Sets the creep speed (low speed immediately before stopping after deceleration from zeroing speed) after the proximity dog.	–
6	Travel value after proximity dog	0 to 214748364.7	μm	0 to 21474.83647	inch	0 to 21474.83647	degree	0 to 2147483647	PLS	–	• Sets the travel value after the proximity dog for the count method. • Set greater than the deceleration distance at the zeroing speed.	7.21.1 (1)
7	Parameter block setting	1 to 16								1	• Sets the parameter block to use for zeroing (see Section 4.4).	–

(1) Setting the travel value after proximity dog
  (a) This parameter sets the travel value after the proximity dog turns ON for zeroing using the count method.
  (b) After the proximity dog turns ON, the home position is the first zero point after travel by the set travel value is complete.
  (c) Set the travel value after the proximity dog turns ON greater than the deceleration distance at the zeroing speed.

Example

The deceleration distance is calculated as shown below from the speed limit value, zeroing speed, creep speed, and deceleration time.



$$t = T_B \times \frac{V_Z}{V_P}$$

[Deceleration distance (shaded area under graph)]

$$= \frac{1}{2} \times \frac{V_Z}{1000} \times t$$

Change in speed per millisecond

$$= \frac{V_Z}{2000} \times \frac{T_B \times V_Z}{V_P}$$

$$= \frac{10\times10^3}{2000} \times \frac{300\times10\times10^3}{200\times10}$$

= 75 ········ Set greater than 75.

POINT

A zeroing must be made after the servo motor has been rotated more than one revolution to pass the axis through the Z-phase (motor reference position signal).
For a proximity dog type or count type zeroing, the distance between the point where the zeroing program is started and the deceleration stop point before second travel must be such that the servo motor is rotated more than one revolution to pass the axis through the Z-phase.
When a data setting type zeroing is made in an ABS (absolute position) system, the motor must also have been rotated more than one revolution by JOG operation or the like to pass the axis through the Z-phase.

7.21.2 Zeroing by the proximity dog method

(1) Proximity dog method
Using the proximity dog method, the home position is the first zero point after the proximity dog turns OFF.

(2) Zeroing by the proximity dog method
The zeroing operation using the proximity dog method is shown in Fig. 7.33.

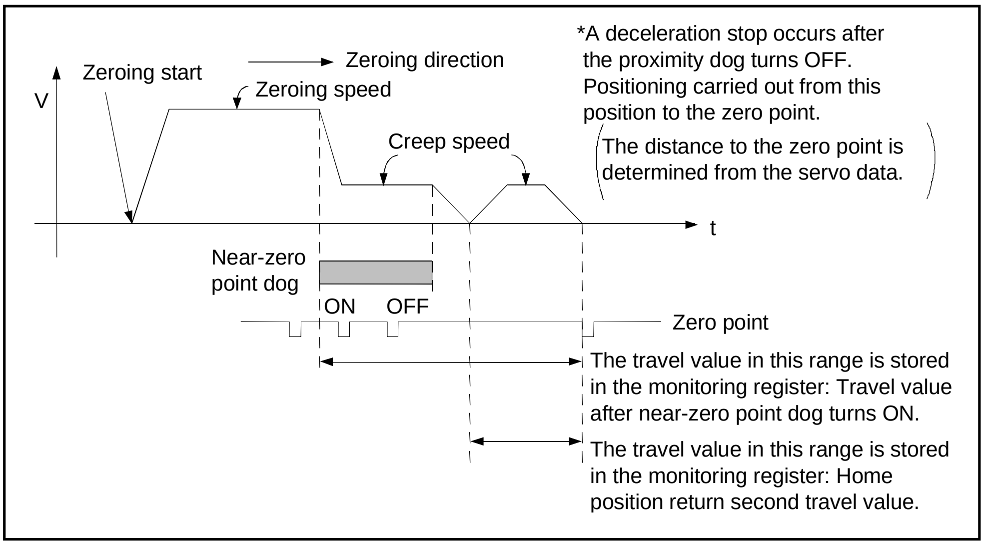
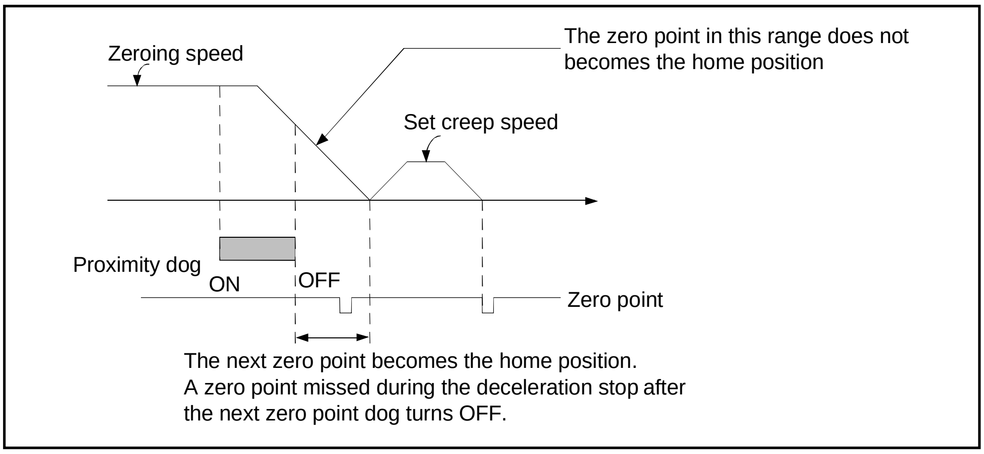


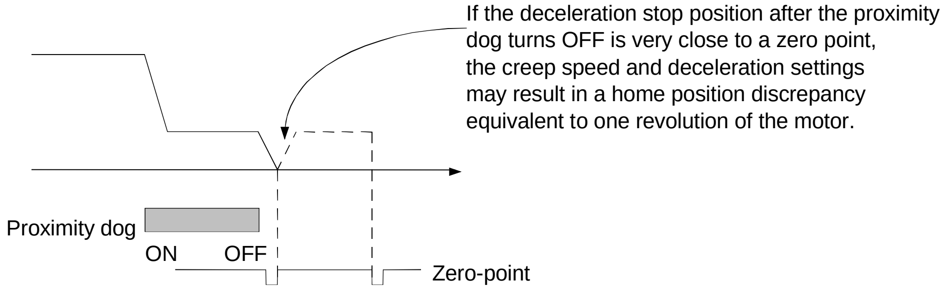
Fig. 7.33 Operation of Zeroing by the Proximity Dog Method

(3) Running zeroing
To run zeroing, use the servo program described in Section 7.21.5.

(4) Cautions
Take note of the following points during zeroing by the proximity dog method.
(a) Keep the proximity dog ON during deceleration from the zeroing speed to the creep speed.
A deceleration stop occurs if the proximity dog turns OFF before deceleration to the creep speed, and the next zero point becomes the home position.



(b) Adjust the position where the proximity dog turns OFF, such that the zeroing second travel value becomes half the travel value for one revolution of the motor.
A home position discrepancy equivalent to one revolution of the motor may occur if the zeroing travel value is less than half the travel value for one revolution of the motor.



IMPORTANT

(1) In the following cases, before starting the zeroing, use JOG operation or some other method to return the axis to a position before where the proximity dog turned ON. Zeroing will not start unless the axis is returned to a position before the proximity dog position.
  (a) Zeroing from a position after the proximity dog turned OFF.
  (b) When the power is turned ON after zeroing was completed.

7.21.3 Zeroing by the count method

(1) Count method
Using the count method, the home position is the first zero point after a designated distance (travel value after proximity dog turns ON) after the proximity dog turns ON.
The travel value after the proximity dog turns ON is set in the table of zeroing data shown in section 7.21.1.

(2) Zeroing by the count method
The zeroing operation using the count method is shown in Fig. 7.33.

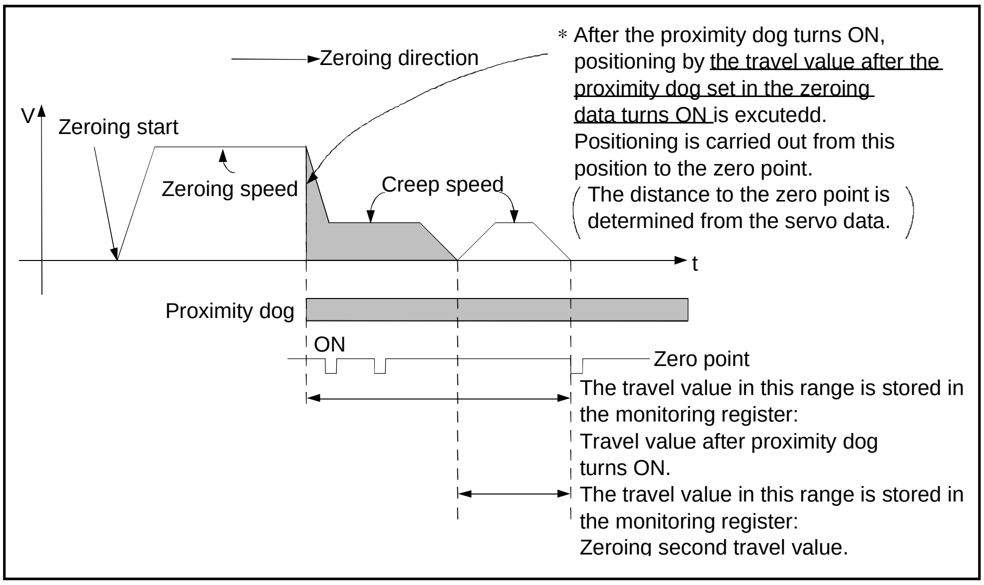


Fig. 7.34 Operation of Zeroing by the Count Method

(3) Running zeroing
To run zeroing, use the servo program described in Section 7.21.5.

(4) Cautions
(a) Maintain sufficient distance between the position where the proximity dog turns OFF and the home position.

(b) Using the count method, zeroing or resumptive start of zeroing is possible when the proximity dog turns ON. To carry out zeroing or resumptive start of zeroing when the proximity dog turns ON, return the axis to a position where the proximity dog is OFF before starting the zeroing.

7.21.4 Zoeroing by the data set method

(1) Data set method
The data set method is a zeroing method which does not use the proximity dogs. This method can be used with the absolute position system.

(2) Zeroing by the data set method
The address present value becomes the home position address when the zeroing operation is run with the DSFRP instruction.

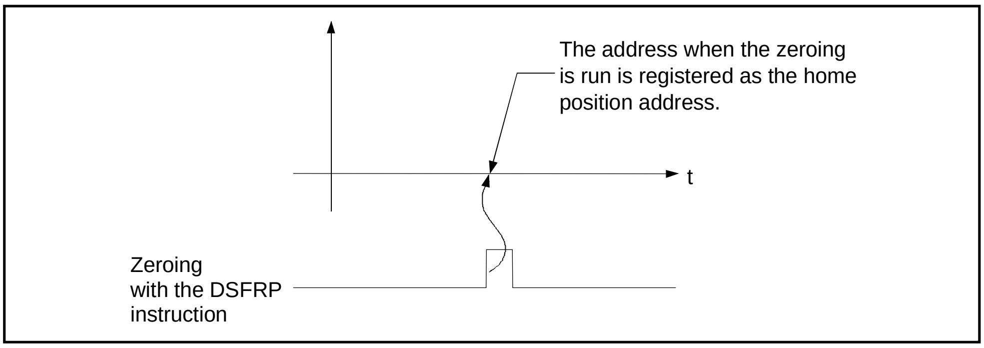


Fig. 7.35 Operation of Zeroing by the Date Set Method

(3) Executing zeroing
To execute zeroing, use the servo program described in Section 7.21.5.

(4) Cautions
(a) A zero point must be passed between turning on the power and executing zeroing.
A no zero point passed error occurs if zeroing is executed before a zero point is passed.
After a no zero point passed error occurs, reset the error and turn the servomotor at least one revolution using JOG operation before running the zeroing operation again.
Use the zero point passed signal (M1606+20n) to check that a zero point is passed.

(b) Starting zeroing with the data set method when not using the absolute position system has the same function as the current value change command.

(c) The zeroing data required for the data set method are the zeroing method and home position address.

7.21.5 Zeroing servo program

Zeroing uses the ZERO servo instruction.

Servo Instruction	Positioning Method	Number of Controllable Axes	Items Set by Peripherals																					
			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	SCurve Ratio			Speed Change
ZERO	–	1		○														Δ						

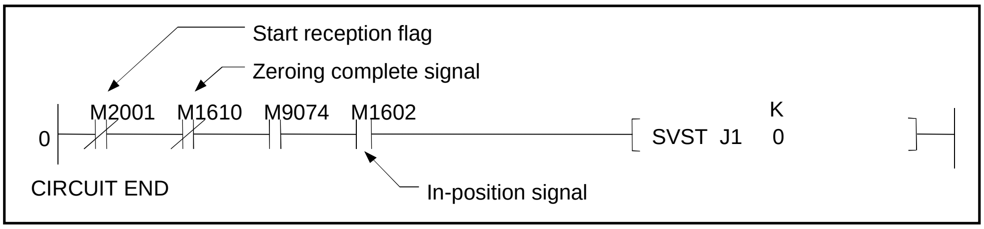
○ : Must be set

[Control Details]

(1) Zeroing is carried out using the method designated in the zeroing data (see Section 7.21.1).
Refer to the following sections for details about the zeroing methods:
- Proximity dog method .... Section 7.21.2
- Count method .... Section 7.21.3
- Data set method............................... Section 7.21.4

[Caution]

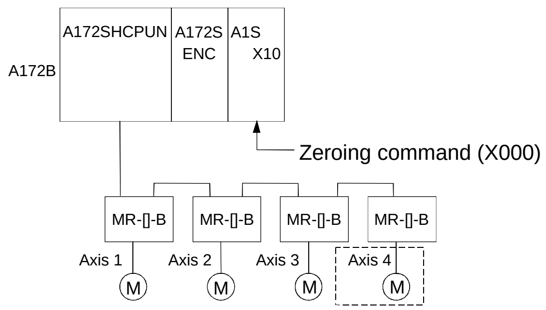
(1) If the following circuit conducts zeroing using the proximity dog method after the PLC ready flag (M2000) turns ON but before the PCPU ready flag (M9074) turns ON, another zeroing request is issued after zeroing is complete.
Therefore, apply interlock conditions to M9074 and M1602+20n (in-position signal) when carrying out a zeroing. (See program example.)



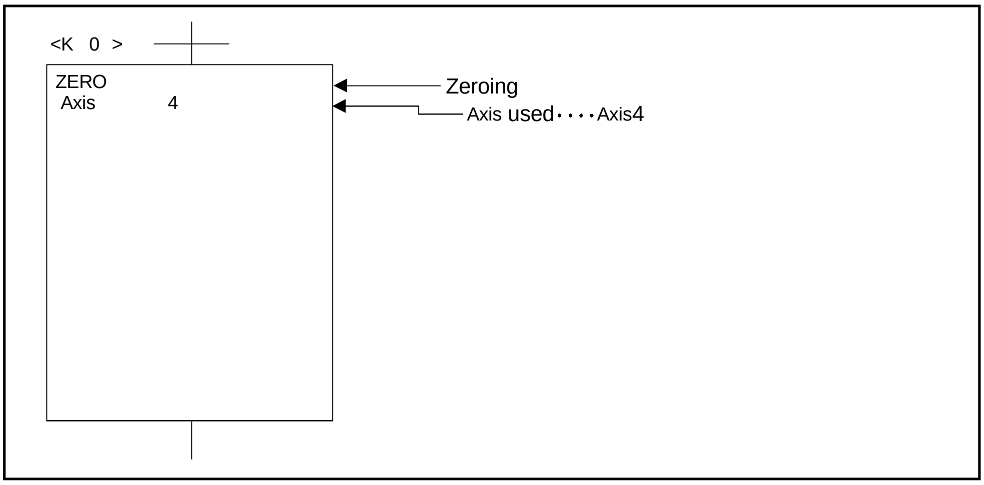
[Program Example]

This program carries out zeroing using servo program No. 0, under the conditions below.

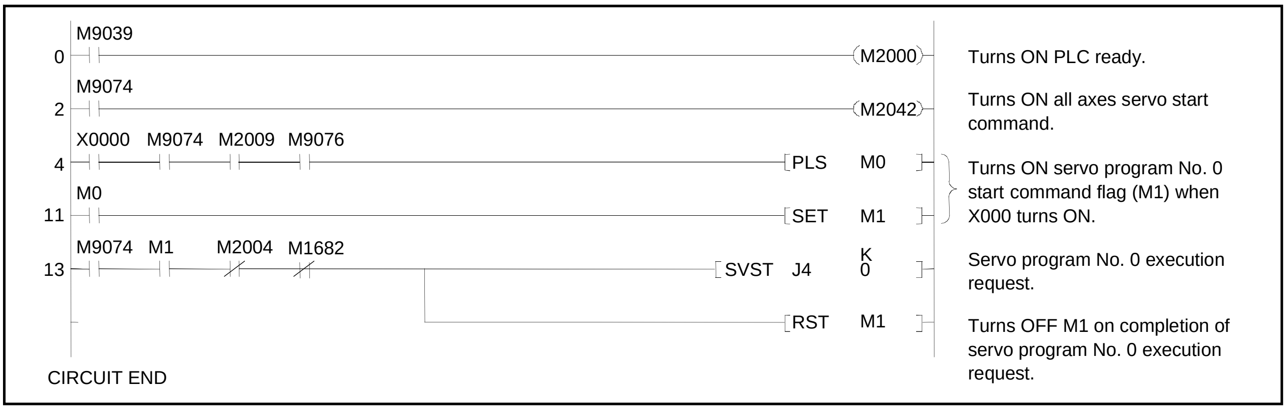
(1) System configuration
Zeroing of Axis 4.



(2) Servo program example
Servo program No. 0 for zeroing is shown below.



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



7.22 High-Speed Oscillation

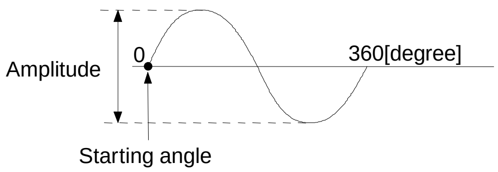
Positioning of a designated axis is

Servo Instruction	Positioning Method	Number of Controllable Axes	Items Set by Peripherals																						Speed Change
			Common							Arc				Parameter Block									Others		
			Parameter Block No.	Axis	Address/Travel Value	Commanded Speed	Dwell Time	M Code	Torque Limit Value	Auxiliary Point	Radius	Center Point	Number of Pitches	Control Unit	Speed Limit Value	Acceleration Time	Deceleration Time	Rapid Stop Deceleration Time	Torque Limit Value	Deceleration Processing on Stop Input	Allowable Error Range for Circular Interpolation	SCurve Ratio	Cancel	Start	
OSC	–	1	Δ	○	○	○		Δ											Δ				Δ	Δ	NG

○ : Must be set
Δ : Set if required

[Control details]

The designated axis caused to oscillate on a designated sine wave.
Acceleration/deceleration processing is not performed.



(1) Amplitude
Designate the amplitude of the oscillation in the setting units.
The amplitude can be set in the range 1 to 2147483647.

(2) Starting angle
Set the angle on the sine curve at which oscillation is to start.
The setting range is 0 to 359.9 (degrees)

(3) Frequency
Set how many sine curve cycles occur in one minute.
The setting range is 1 to 5000 (CPM)

POINT

Since acceleration/deceleration processing is not performed, you should set the starting angle to 90 degrees or 270 degrees in order to avoid an abrupt start.

[Notes]

(1) If the amplitude setting is outside the permissible range, the servo program setting error "25" occurs and operation does not start.

(2) If the starting angle setting is outside the permissible range, the servo program setting error "26" occurs and operation does not start.

(3) If the frequency setting is outside the permissible range, the servo program setting error "27" occurs and operation does not start.

(4) After starting, operation is continually repeated until a stop signal is input.

(5) Speed changes during operation are not possible. Attempted speed changes will cause minor error "310".

[Example program]

An example of a program for high-speed oscillation is shown below.

```
<K    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.

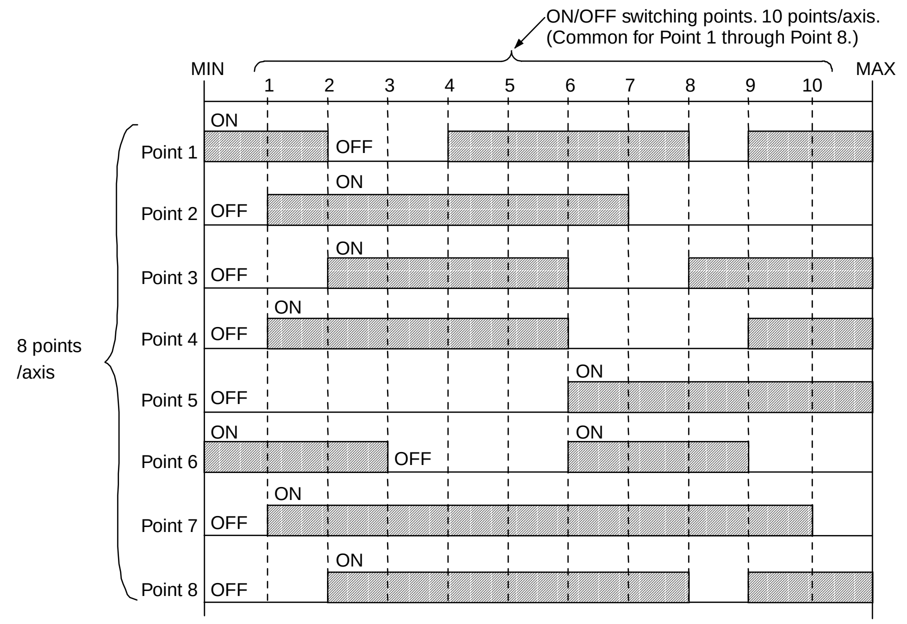
8.1.1 Limit switch output data

Item	Settings		Initial Value	Comments
ON/OFF point setting	• −2147483648 to 2147483647 ($\times 10^{-1}\mu$m, $\times 10^{-5}$inch, PLS) • 0 to 35999999 (10^{-5}degree)	Units ($\times 10^{-1}\mu$m, $\times 10^{-5}$inch, 10^{-5}degree, PLS)	0	• Up to 10 points can be set for each axis.

8.1.2 Limit switch output function

[Control Details]

(1) The limit switch function outputs the ON/OFF pattern from the A1SY42/ AY42 at the set addresses.
Before running the limit switch output function, the ON/OFF point addresses and the ON/OFF pattern must be set from a peripheral device.
(Settings cannot be made by the sequence program.)
The number of limit switch outputs per axis and the ON/OFF points are as follows:
(a) Number of limit switch output points .... 8 points/axis, total 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 PLC 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.

REMARK

The data in Table 8.1 is also valid during the test mode set by a peripheral device.

(3) Cautions
(a) The limit switch output is based on the "feed current value" for each axis after PLC ready (M2000) turns ON and the PCPU ready flag (M9074) is ON. All points turn OFF when the PCPU ready flag (M9074) turns OFF.
(b) While the PCPU ready flag (M9074) is ON and the feed current value is outside the set stroke limits, the limit switch output is based on 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 (M1600 + 20n) as the read command.
(c) To read an M-code on positioning completion, use the positioning completion signal (M1601 + 20n) as the read command.

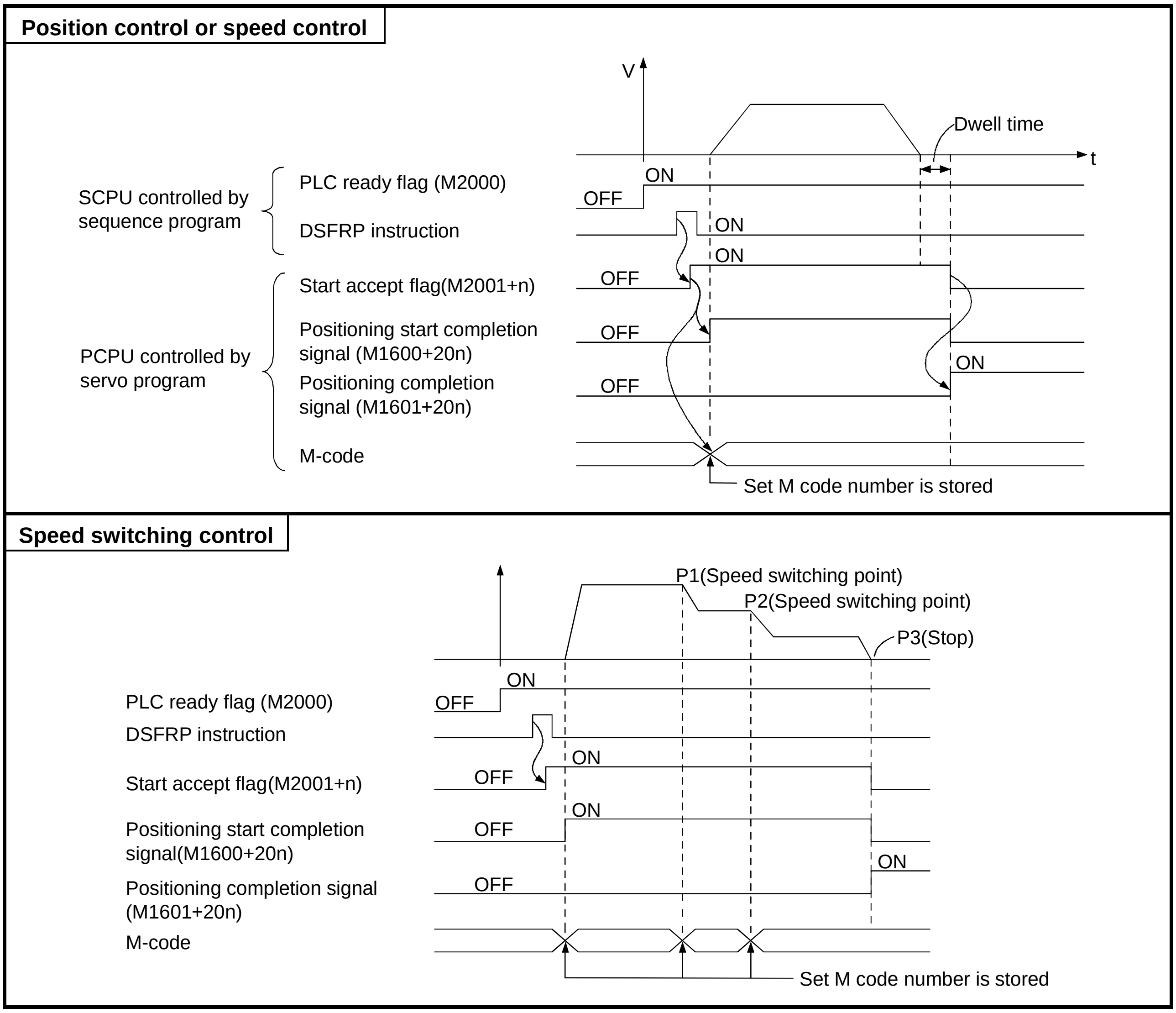
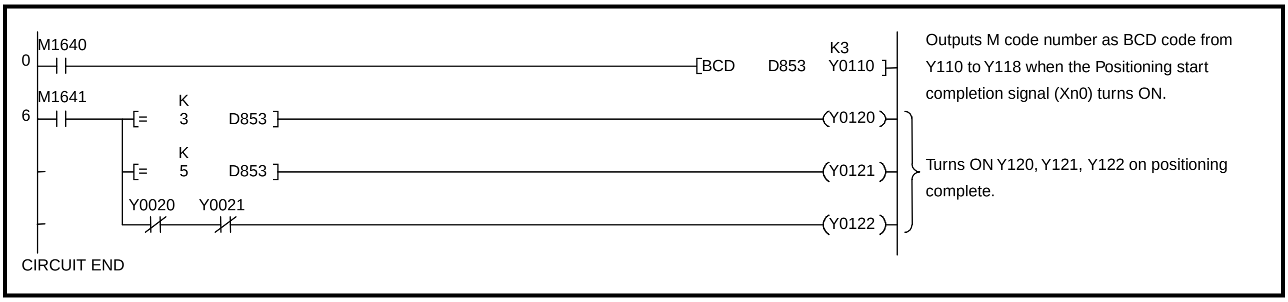


Fig. 8.1 M-code Storage and Read Timing

(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.



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.

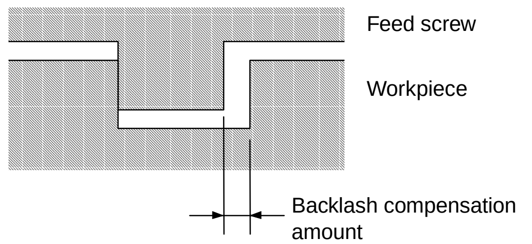


Figure 8.2 Backlash Compensation Amount

(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
- $0 \leq \dfrac{\text{(Backlash compensation amount)}}{\text{(Travel value per pulse)}} \leq 65535\text{(PLS)}$

(Decimal fraction rounded down.)

(b) Inch or Degree Units
- 0 to 0.65535
- $0 \leq \dfrac{\text{(Backlash compensation amount)}}{\text{(Travel value per pulse)}} \leq 65535\text{(PLS)}$

(Decimal fraction rounded down.)

(c) Pulse Units
- 0 to 65535
- $0 \leq \dfrac{\text{(Backlash compensation amount)} \times \text{(Pulses per rotation)}}{\text{(Travel value per rotation)}} \leq 65535\text{(PLS)}$

(Decimal fraction rounded down.)

(2) Backlash compensation processing
The details of backlash compensation processing are shown in the table below.

Table 8.2 Details of Backlash Compensation Processing

Condition	Processing
First motion after power on	• No backlash compensation if travel direction = zeroing direction. • Backlash compensation if travel direction ≠ zeroing direction.
JOG operation start	• Minimum backlash amount on first JOG operation after travel direction change.
Positioning start	• Backlash compensation if travel direction changed.
Manual pulse generator operation	• If travel direction changed.
Zeroing start	• Backlash compensation amount is valid after zeroing is started.
Absolute position system	• Status stored at power off and applied to absolute position system.

POINTS

(1) The feed pulses equivalent to the backlash compensation amount are not added to the feed current value.
(2) Zeroing is required after the backlash compensation amount is changed. The original backlash compensation amount is retained until zeroing is carried out.

8.4 Torque Limit Function

The torque limit function controls the torque generated by the servomotor within the set range.
The torque is controlled to the set torque limit value if the torque required during positioning control exceeds the set limit value.

(1) Torque limit value set range
Set the torque limit value between 1% and 500% of the rated torque.

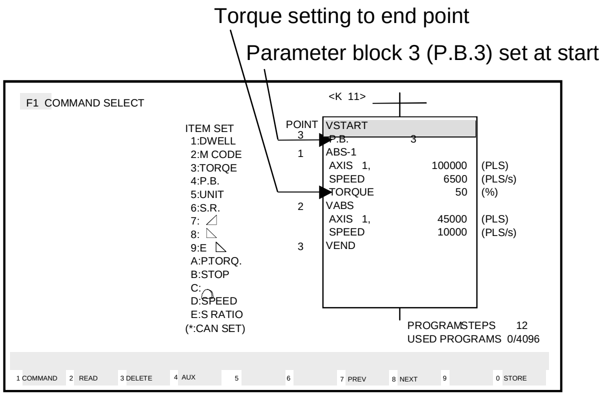
(2) How to set the torque limit value
Set the torque limit value using a peripheral device, as described below.
   (a) Setting in the Parameter Block (See Section 4.4)
   Set the Torque limit value parameter in the parameter block.
   Using the servo program to designate which parameter block number is used allows the servomotor torque to be controlled to a torque limit value for any positioning control.

   (b) Setting with a Servo Program
   Designating the torque limit value with the servo program allows restriction of the servomotor torque to the designated torque limit value during execution of the servo program.

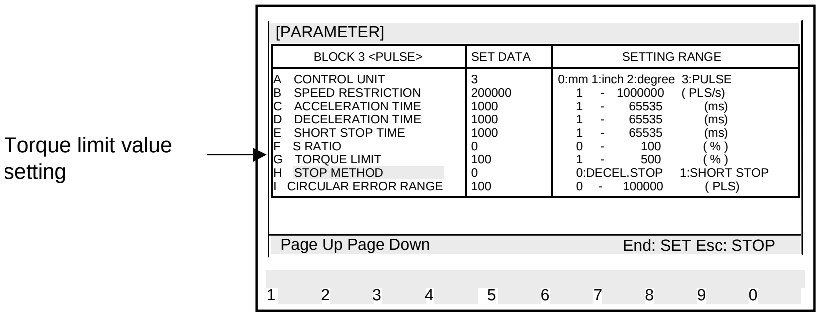
Examples

[Setting the torque limit value for speed switching control (VSTART)]

(1) Servo program

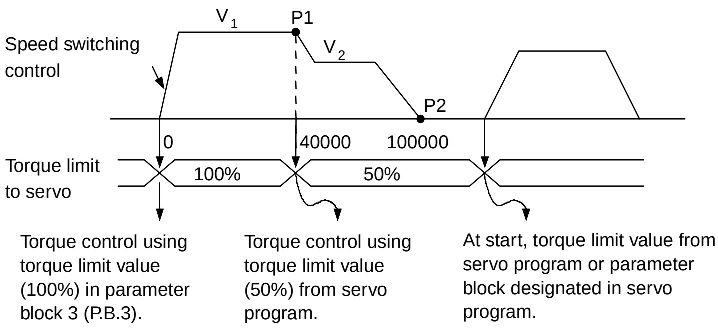


(2) Parameter block



BLOCK 3 <PULSE>	SET DATA	SETTING RANGE
A CONTROL UNIT	3	0:mm 1:inch 2:degree 3:PULSE
B SPEED RESTRICTION	200000	1 - 1000000 (PLS/s)
C ACCELERATION TIME	1000	1 - 65535 (ms)
D DECELERATION TIME	1000	1 - 65535 (ms)
E SHORT STOP TIME	1000	1 - 65535 (ms)
F S RATIO	0	0 - 100 (%)
G TORQUE LIMIT	100	1 - 500 (%)
H STOP METHOD	0	0:DECEL.STOP 1:SHORT STOP
I CIRCULAR ERROR RANGE	100	0 - 100000 (PLS)

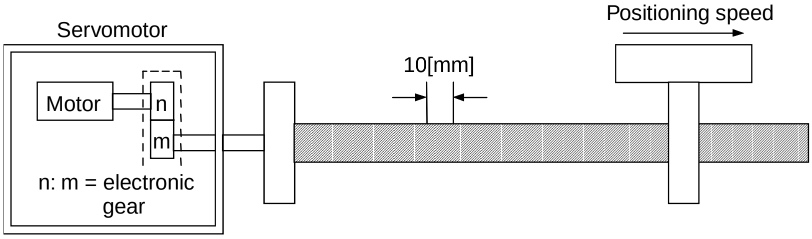
(3) General description of operation



8.5 Electronic Gear Function

The electronic gear function changes the travel value per pulse.
The electronic gear is set by setting the travel value per pulse (see Section 4.2.1).
Using the electronic gear function allows positioning control without the need to select the encoder to match the mechanical system.

[Example]



Pulses per motor revolution................10000 [PLS]
Travel value per motor revolution........10 mm [mm]

(1) Electronic gear 1:1 (electronic gear setting = 1)

$$\text{Travel value per pulse} = \frac{\text{Travel value per motor revolution}}{\text{Pulses per motor revolution}} = \frac{10\ [\text{mm}]}{10000\ [\text{PLS}]}$$

$$= 0.001\ [\text{mm/PLS}]$$

Positioning control is executed at the commanded speed.

(2) Electronic gear 2:1 (electronic gear setting = 0.5)

$$\text{Travel value per pulse} = \frac{\text{Travel value per motor revolution}}{\text{Pulses per motor revolution}} = \frac{5\ [\text{mm}]}{10000\ [\text{PLS}]}$$

$$= 0.0005\ [\text{mm/PLS}]$$

Positioning control is executed faster than the commanded speed.

(3) Electronic gear 1:2 (electronic gear setting = 2)

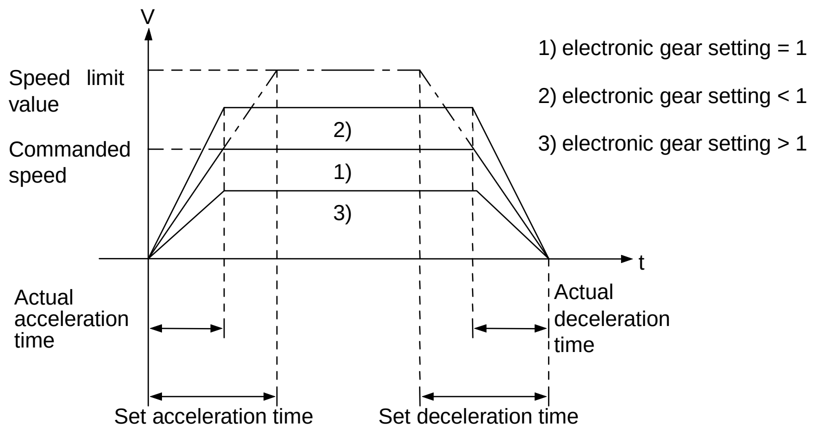
$$\text{Travel value per pulse} = \frac{\text{Travel value per motor revolution}}{\text{Pulses per motor revolution}} = \frac{20\ [\text{mm}]}{10000\ [\text{PLS}]}$$

$$= 0.002\ [\text{mm/PLS}]$$

Positioning control is executed slower than the commanded speed.

The relationship between the commanded speed (positioning speed set in the servo program) and actual speed (actual positioning speed) is shown below for different electronic gear settings.

- if electronic gear setting = 1, commanded speed = actual speed
- if electronic gear setting < 1, commanded speed < actual speed
- if electronic gear setting > 1, commanded speed > actual speed



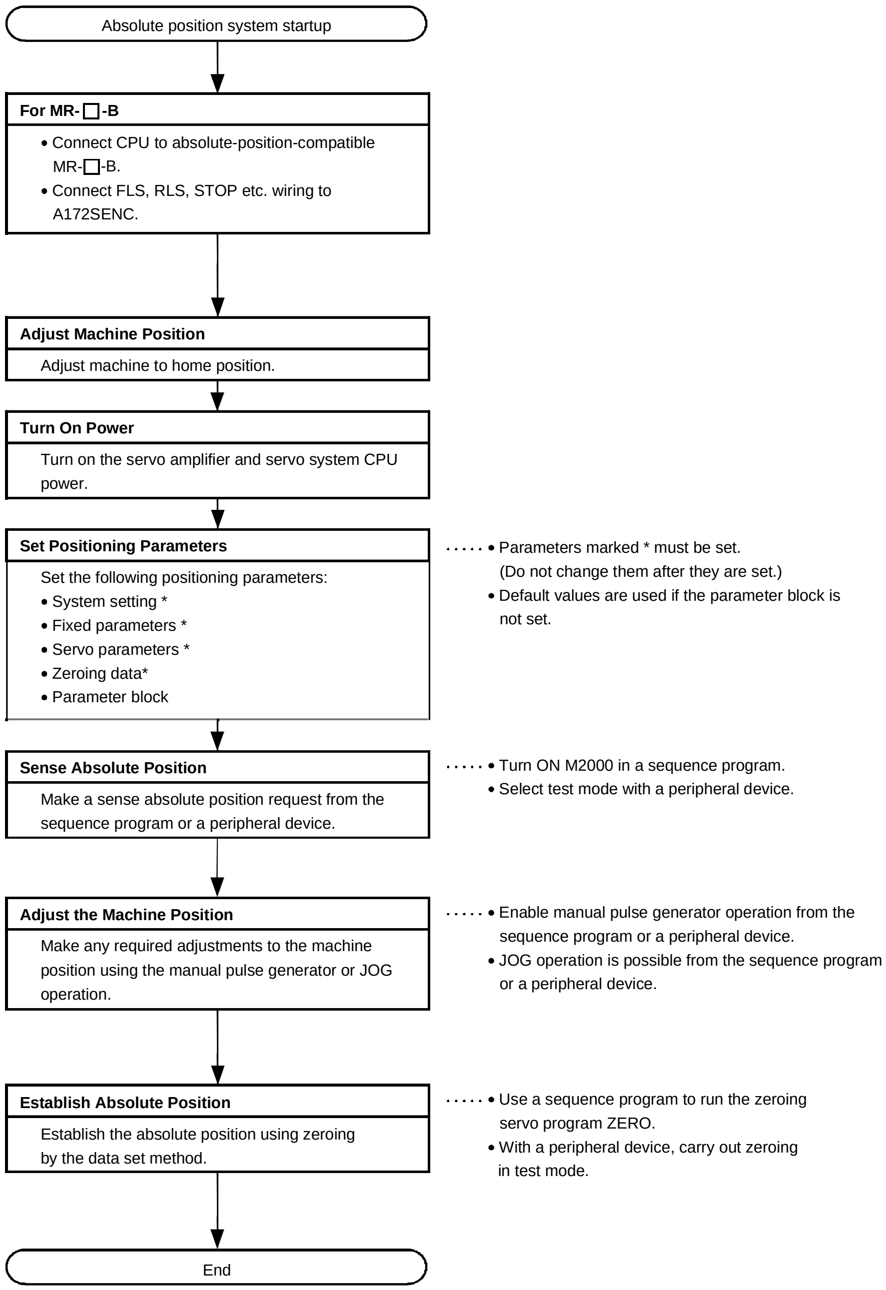
The speed limit value, acceleration time, and deceleration time are data from the designated parameter block.

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 and MR-[ ]-B.
Zeroing is not necessary using the absolute positioning system because after the machine position is initially established at system startup, the absolute position is sensed each time the power is turned on.
The machine position is established using a zeroing initiated from the sequence program or a peripheral device.

(1) Absolute position system startup procedure
The system startup procedure is shown below.



(2) In the absolute positioning system, the absolute position may be lost under the following conditions:
Re-establish the absolute position using zeroing or by aligning the machine position and using current value change.
(a) After removing or replacing the battery unit.

(b) On occurrence of a servo battery error (detected at servo amplifier power on).

(c) After the mechanical system is disturbed by a shock.

(3) Power of Allowed Traveling Points can be monitored in the system setting mode of a peripheral device, and the current value history can be monitored in the monitor mode.
(For details on monitoring Power of Allowed Traveling Points and the current value history, refer to the operating manual for the peripheral device being used.)
(a) Current value history monitor
1) Month/day/hour/minute
The time when a zeroing is completed or the servo amplifier power is turned ON or OFF is indicated.
In order to display the time correctly, it is necessary to first set the clock data at the PLC side, then switch ON M9028 (clock data read request) from the sequence program.
2) Encoder current value
When using MR-H-BN (version BCD-B13W000-B2 or later), MR-J2-B (version BCD-B20W200-A1 or later) or MR-J2S-B (without restriction) the multiple revolution data and within-one-revolution data read from the encoder is displayed.
Note: For the encoder current value in the home position data area, the encoder current value when the motor is within the in-position range after completion of a zeroing is displayed (not the encoder value at the home position).
3) Servo command value
The command value issued to the servo amplifier is displayed.
4) Monitor current value
The current value controlled within the servo system CPU is displayed.
Note: A value close to the feed current value is displayed, but, since the monitor current value and feed current value are different data, the display of different values does not indicate an error.
5) Alarms
When an error involving resetting of the current value occurs while the servo amplifier power is ON, an error code is displayed. For details of the error, refer to the error contents area (related error list) at the bottom of the screen.

⚠ CAUTION
⚠ After removing or replacing the battery unit, correctly install the new unit and establish the absolute position. ⚠ After a servo battery error occurs, eliminate the cause of the error and ensure operation is safe before establishing the absolute position. ⚠ After the mechanical system is disturbed by a shock, make the necessary checks and repairs, and ensure operation is safe before establishing the absolute position.

POINTS

(1) The address setting range for absolute position system is −2147483648 to 2147483647.
It is not possible to restore position commands that exceed this limit, or current values, after a power interruption.
When performing an infinite feed operation, solve this problem by setting the units to degrees or by setting a rotary table (when using SV22).

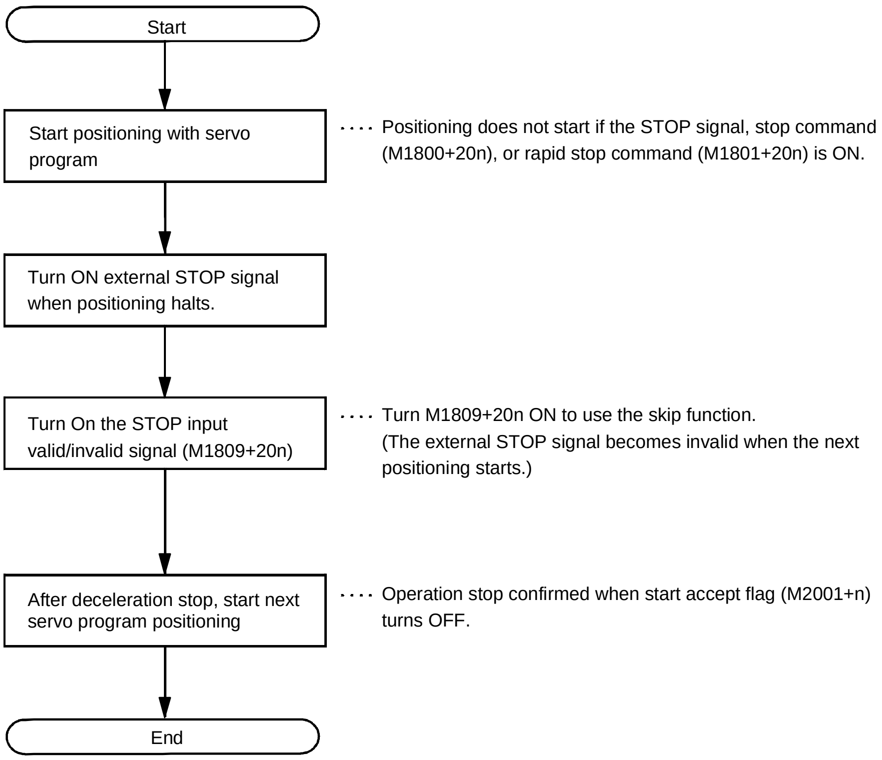
(2) Even when the current value address is changed by a current value change instruction, the restored data for the current value after a power interruption is the value based on the status prior to execution of the current value change instruction.

(3) When zeroing has not been completed, restoration of the current value after a power interruption is not possible.

8.7 Skip Function

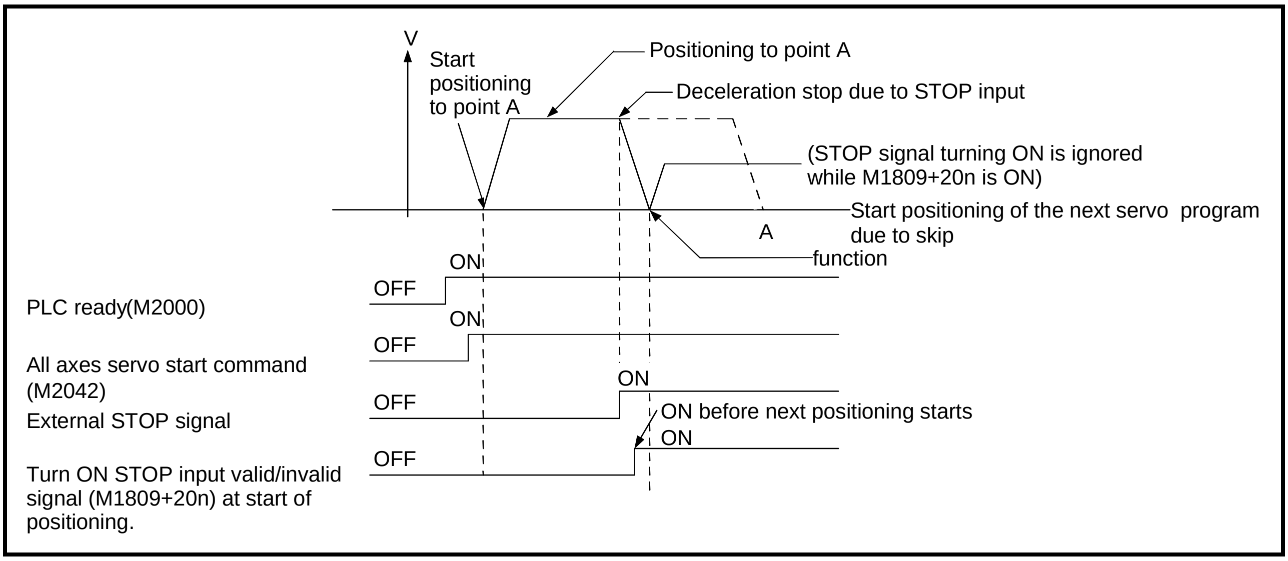
Based on an external input, the skip function halts the current positioning and executes the next positioning control.
The servo system CPU can run the skip function according to the external STOP signal and the sequence program.

(1) The procedure for using the skip function based on the external STOP signal and the sequence program is shown below.



(2) Operation timing

The operation timing of the skip function is shown in the diagram below.



8.8 Teaching Function

The teaching function allows the operator to teach the servo system CPU when the target position (address) is unknown or to align with an object.

(1) Teaching methods
Two teaching methods are available: "address teaching" and "program teaching."
   (a) Address teaching
   Writes the current value to the designated program address.
   The program must be created before the address teaching method can be used.

   (b) Program teaching
   Writes the current value to addresses while the program is being created.

(2) For details about teaching, see the A30TU Teaching Unit Operating Manual (IB-67277).

8.9 High–Speed Reading of Designated Data

This function stores the designated positioning data in the designated device (D, W) with the signal from an input module mounted on the motion base as the trigger.
It can be set in the system setting of a peripheral device software package.

(1) Positioning data that can be set

Set Data	Number of Words	Unit	Remarks
Position command (feed current value)	2	10^{-1}μm•10^{-5}inch•10^{-5}degree•PLS	
Real current value	2	10^{-1}μm•10^{-5}inch•10^{-5}degree•PLS	
Position droop (deviation counter value)	2	PLS	
M-codes	1	-	
Torque limit value	1	%	
Motor current	1	%	
Motor rpm	2	r/min	
Servo command value	2	PLS	
Virtual servo motor feed current value	2	PLS	
Synchronous encoder current value	2	PLS	Valid in SV22 virtual mode only
Virtual servo M-code	1	-	
Current value after main shaft differential gear	2	PLS	
Current value within one revolution of cam axis	2	PLS	
Executed cam No.	1	-	
Executed stroke amount	2	10^{-1}μm•10^{-5}inch•PLS	
Any address (fixed to 4 bytes)	2	-	

(2) Modules and signals used

Input Module	Signal	Reading Timing	Number of Points Settable
A172SENC	TRA	0.8ms	1
PC input module	X device		8

Note: Only one PC input module can be used.

8.10 Servo Program Cancel/Start Function

This is a function for stopping a servo program being executed by means of a deceleration stop caused turning the cancel signal ON. When used in combination with "start" (selectable item), this function also allows a designated servo program to be automatically started after a deceleration start.

[Control details]

(1) When the cancel signal is turned ON during execution of a program for which the cancel function has been designated, the positioning processing being executed is suspended, and a deceleration stop is executed.

(2) If "start" has been designated in conjunction with "cancel", after the stop has been executed as described above, the designated servo program is started.

[Data setting]

(1) Cancel signal device
The devices that can be used as cancel signal devices are indicated below.
X, Y, M, TC, TT, CC, CT, B, F

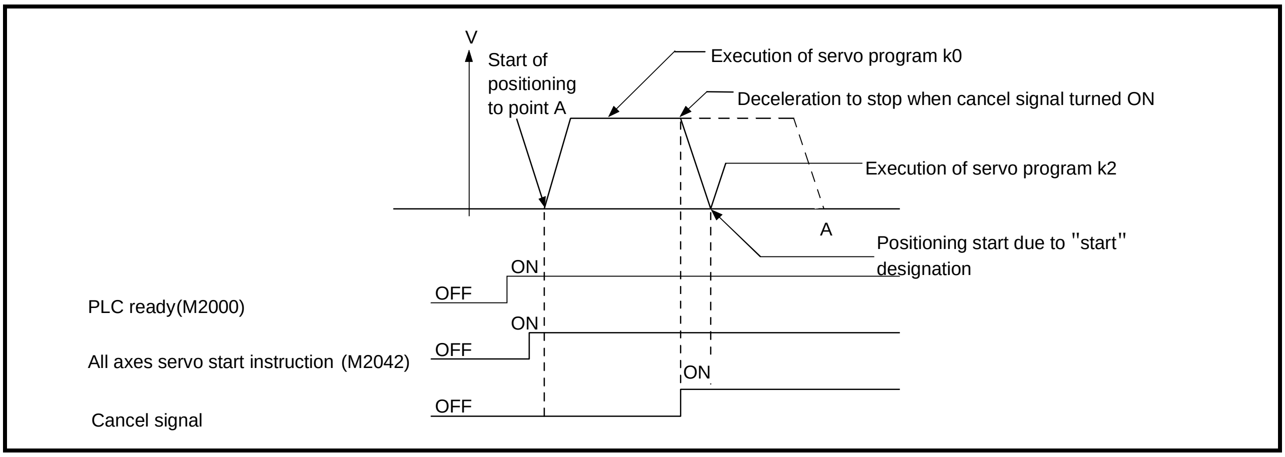
(2) Start (selectable item) setting method
Set by indirect designation (1 word) by using a constant (K) or D, W devices.

[Notes]

(1) Cannot be used with the 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]



[**Program example**]

A program example is shown bellow.

```
<K   0>
ABS-1
Axis    1,          30000
Speed                5000  <----  Cancel signal …. X0
Cancel              X0000  <----  Start …………….. K2
Start               K   2
```

8.11 Enhanced Current Value Control

The following functions have been added to provide enhanced current value control when the ABS encode is used.

(1) Enhanced functions

(a) Function for checking the validity of an encoder during operation
- Checks whether encoder's variance in a 3.5ms time interval is within 180 degrees at the motor axis. (An error is indicated when the variance is not within 180 degrees.)
- Checks whether encoder data matches feed-back positions managed by the servo amplifier. (An error is indicated when the data does not match the feed-back positions.)

(b) Current value log monitor for checking the following values with peripheral devices
- Encoder current value, servo commanded value, and monitor current value at power-on sequence
- Encoder current value, servo commanded value, and monitor current value at power-off sequence
- Encoder current value, servo commanded value, and monitor current value at home position return

(c) If an allowable travel value is set at power-off sequence, whether encoder data has changed exceeding the setting range at power-off sequence can be checked at servo amplifier power-on sequence. (An error is indicated when the encoder data has exceeded the setting range.)

(2) Restrictions on the servo amplifier

The following restrictions are imposed according to the servo amplifier combinations:

Servo amplifier	Restrictions
MR-H-BN : BCD-B13W000-B2 and after MR-J2-B : BCDB20W200-A1 and after MR-J2S-B : All types	No restrictions
MR-H-BN : BCD-B13W000-B1 and after MR-J2-B : BCD-B20W200-A0 and before MR-J-B : All types	All enhanced functions cannot be used.

APPENDICES

APPENDIX1 SCPU ERROR CODE LIST

If an error occurs when the PLC is switched to the RUN status or is in the RUN status, the error indication and error code (including the step number) are stored in a special register by the self-diagnosis function. When an error occurs, refer to Table 1.1 for its cause and the corrective action to take.
Eliminate the cause of the error by taking the appropriate corrective action.
Error codes can be read at a peripheral device; for details on the relevant operation, see the Operating Manual for the peripheral device.

⚠ CAUTION
⚠ When an error occurs, check the points stated in this manual and reset the error.

1.1 SCPU Error Code List

The list presented below gives the error numbers, and the error contents, causes, and corrective actions for each error message.

Table 1.1 Error Code List

Error Message	Contents of Special Register D9008 (BIN Value)	CPU Status	Error Contents and Cause	Corrective Action
"INSTRCT.CODE ERR" (When an instruction is executed.)	10	Stopped	An instruction code that cannot be decoded has been included in the program. (1) A ROM which includes undecodable instruction codes has been installed. (2) The memory contents have changed for some reason and now include an undecodable instruction code.	(1) Read the error step with a peripheral device, and correct the program at that step. (2) If the ROM is the problem, either rewrite its contents or replace it with a ROM into which the correct contents have been written.
"PARAMETER ERROR" (On switching on the power or resetting. On switching from {STOP / PAUSE} to {RUN / STEP RUN})	11	Stopped	The parameter data in the CPU's memory has been changed due to noise or incorrect installation of the memory.	(1) Check the installation of the memory and install it correctly. (2) Read the parameter data of the CPU memory at a peripheral device, check the data, correct it, and write the corrected data back into the memory.
"MISSING END INS." (When M9056 or M9057 is ON. On switching from {STOP / PAUSE} to {RUN / STEP RUN})	12	Stopped	(1) There is no END (FEND) instruction in the program. (2) When a subprogram is set in the parameters, there is no END instruction in the subprogram.	(1) Write an END instruction at the end of the program.
"CAN'T EXECUTE (P)" (When a CJ/SCJ/JMP/CALL(P)/ FOR-NEXT instruction is executed. On switching from {STOP / PAUSE} to {RUN / STEP RUN})	13	Stopped	(1) The jump destination designated with a CJ/SCJ/CALL/CALLP/JMP instruction does not exist, or more than one exists. (2) There is a CHG instruction but no subprogram is set. (3) Although there is no CALL instruction, there is a RET instruction in the program and is has been executed. (4) A CJ/SCJ/CALL/CALLP/JMP instruction whose jump destination is at or beyond the END instruction has been executed. (5) The number of FOR instructions does not match the number of NEXT instructions. (6) A JMP instruction has been included between a FOR and NEXT command, exiting the FOR - NEXT sequence. (7) The subroutine has been exited by execution of a JMP instruction before execution of a RET instruction. (8) Execution of a JMP instruction has caused a jump into a step in a FOR - NEXT range, or into a subroutine.	(1) Read the error step with a peripheral device, and correct the program at that step.(Correct, for example, by inserting a jump destination, or making sure there is only one jump destination.)

Table 1.1 Error Code List (Continued)

Error Message	Contents of Special Register D9008 (BIN Value)	CPU Status	Error Contents and Cause	Corrective Action
"CHK FORMAT ERR." (On switching from {STOP / PAUSE} to {RUN / STEP RUN})	14	Stopped	(1) An instruction other than an LDX, LDIX, ANDX, or ANIX instruction (including NOP) has been included in the same ladder block as a CHK instruction. (2) More than one CHK instruction exists. (3) The number of contacts in a CHK instruction ladder block exceeds 150. (4) The device number of an X device in a CHK instruction ladder block exceeds X7FE when using an A373CPU or X1FFE when using an A373U/A273U. (5) The following ladder block CJ [ ] 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. P254 CHK D1 D2	(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 system service, agent, or office, and explain the problem.
"OPE.CIRCUIT ERR." (On switching on the power or resetting.)	21	Stopped	(1) The operation circuit that executes sequence processing in the CPU does not operate normally.	
"WDT ERROR" (At any time)	22	Stopped	The scan time has exceeded the watchdog error monitor time. (1) The user program scan time has been exceeded due to the conditions. (2) A momentary power interruption has occurred during scanning, extending the scan time.	(1) Calculate and check the scan time for the user program and shorten the scan time, e.g. by using a CJ instruction. (2) Monitor the contents of special register D9005 with a peripheral device. If the contents are other than "0" the power supply voltage is unstable: in this case check the power supply and reduce voltage fluctuation.
"END NOT EXECUTE" (When END processing is executed.)"	24	Stopped	(1) When the END instruction is executed it is read as another instruction code, e.g. due to noise. (2) The END instruction has been changed to another instruction code somehow.	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 system service, agent, or office, and explain the problem.
"WDT ERROR" (At any time)	25	Stopped	A loop has been established for execution of the sequence program, due for example to a CJ instruction, and the END instruction cannot be executed.	Check if any program will be run in an endless loop: if there is such a program, modify the program.

Table 1.1 CPU Error Code List (Continued)

Error Message	Contents of Special Register D9008 (BIN Value)	CPU Status	Error Contents and Cause	Corrective Action
"UNIT VERIFY ERR." (When an END instruction is executed. (However, no check is performed when M9084 or M9094 is ON.))	31	Stopped (RUN)	The I/O information does not match a loaded module when the power is switched ON. (1) An I/O module (this includes special function modules) is loose, or has become detached, during operation. Or, a completely different module has been loaded.	(1) The bit in special registers D9116 to D9123 that corresponds to the module for which the verification error occurred will be set to "1": check for the module whose bit is set to "1" by monitoring these registers with a peripheral device and replace that module. (2) If the current arrangement of loaded modules is acceptable, reset with the reset switch.
"FUSE BREAK OFF" (When an END instruction is executed. (However, no check is performed when M9084 or M9094 ON.))	32	RUN (Stopped)	There is an output module with a blown fuse.	(1) Check the blown fuse indicator LEDs of the output modules and replace the fuse of the module whose indicator LED is lit. (2) Modules with blown fuses can also be detected by using a peripheral device. The bit in special registers D9100 to D9107 that corresponds a module whose fuse has blown will be set to "1": monitor these registers to check.
"CONTROL-BUS ERR." (When FROM, TO instruction are executed. On switching on the power or resetting. On switching from {STOP, PAUSE} to {RUN, STEP RUN})	40	Stopped	FROM, TO instructions cannot be executed. (1) Fault in the control bus to the special function module.	(1) There is a hardware fault of the special function module, CPU module, or base unit: replace each module/unit to find the defective one. Contact your nearest Mitsubishi system service, agent, or office, and explain the problem with the defective module/unit.
"SP.UNIT DOWN" (When FROM, TO instruction are executed. On switching on the power or resetting. On switching from {STOP, PAUSE} to {RUN, STEP RUN})	41	Stopped	On execution of a FROM, TO instruction, a special function module was accessed but no response was received. (1) The accessed special function module is faulty.	There is a hardware fault in the accessed special function module: contact your nearest Mitsubishi system service, agent, or office, and explain the problem.
"LINK UNIT ERROR" (On switching on the power or resetting. On switching from {STOP, PAUSE} to {RUN, STEP RUN})	42	Stopped	(1) A data link module for use with MELSECNET has been loaded at the master station.	(1) Remove the data link module for MELSECNET from the master station. After making this correction, reset and start operation from the initial status.
"I/O INT.ERROR" (When an interruption occurs.)	43	Stopped	An interruption has occurred although there is no interrupt module.	(1) There is a hardware fault in one of the modules: replace each module in turn to determine which one is defective. Contact your nearest Mitsubishi system service, agent, or office, and explain the problem with the defective module.
"SP.UNIT LAY.ERR." (On switching on the power or resetting. On switching from {STOP, PAUSE} to {RUN, STEP RUN})	44	Stopped	(1) Three or more computer link modules have been installed for one CPU module. (2) Two or more data link modules for MELSECNET have been installed. (3) Two or more interrupt modules have been installed. (4) In the parameter settings made at a peripheral device, an allocation for a special function module has been made where there is in fact an I/O module, or vice versa.	(1) Do not install more than two computer link modules. (2) Do not install more than one data link module for MELSECNET. (3) Install only one interrupt module. (4) Re-set the I/O allocations in the parameter settings made at the peripheral device so that they agree with the loaded modules.

Table 1.1 CPU Error Code List (Continued)

Error Message	Contents of Special Register D9008 (BIN Value)	CPU Status	Error Contents and Cause	Corrective Action
"SP.UNIT ERROR" (When a FROM, TO instruction is executed)	46	Stopped (RUN)	(1) A location where there is no special function module has been accessed (when the FROM, TO instruction was executed).	(1) Read the error step using a peripheral device, check the contents of the FROM, TO instruction at that step, and correct it using the peripheral device.
"LINK PARA.ERROR" (On switching on the power or resetting. On switching from {STOP / PAUSE} to {RUN / STEP RUN})	47	RUN	(1) The data written to the link parameter area when link range settings are made by parameter setting at a peripheral device differ for some reason from the parameter data read by the CPU. (2) The setting for the total number of slave stations is "0".	(1) Write the parameters again and check. (2) If the error is displayed again, there is a hardware fault. Contact your nearest Mitsubishi system service, agent, or office, and explain the problem.
"OPERATION ERROR" (When a command is executed)	50	RUN (Stopped)	(1) The result of BCD conversion is outside the stipulated range (max. 9999 or 99999999). (2) A setting exceeding the stipulated device range has been made and operation is therefore impossible. (3) A file register has been used in the program without having made a file register capacity setting.	(1) Read the error step with a peripheral device, and correct the program at that step. (Check the device setting range, BCD conversion value, etc.)
"BATTERY ERROR" (At any time (However, no check is performed when M9084 is ON.))	70	RUN	(1) The battery voltage has fallen below the stipulated value. (2) The battery's lead connector has not been installed.	(1) Replace the battery. (2) If the battery is used to back up the RAM memory or to retain memory contents during momentary power interruptions, install a lead connector.

APPENDIX2 ERROR CODES STORED BY THE PCPU

The errors that are detected at the PCPU are servo program setting errors and positioning errors.

(1) Servo program setting errors

Servo program setting errors are errors in the positioning data set in the servo program and are checked for when a servo program is started.
They are errors that occur when the positioning data is designated indirectly.
When a servo program setting error occurs, the following happens:

- The servo program setting error flag (M9079) comes ON.
- The program number of the program in which the error occurred is stored in the error program No. register (D9189).
- The error code is stored in the error item information register (D9190).

(2) Positioning error

(a) Positioning errors are errors that occur when positioning starts or during positioning: they are classified into minor errors, major errors, and servo errors.

1) Minor errors............. These are errors generated by sequence programs or servo programs; they are assigned error codes 1 to 999.
The cause of minor errors can be eliminated by checking the error code and correcting the sequence program or servo program.

2) Major error............... These are errors generated by external input signals or control commands from the SCPU; they are assigned error codes 1000 to 1999.
When a major error occurs, check the error code and eliminate the error cause in the external input signal status or sequence program.

3) Servo error .... These are errors detected by the servo amplifier; they are assigned error codes 2000 to 2999.
When a servo error occurs, check the error code and eliminate the error cause at the servo side.

(b) When an error occurs, the error detection signal for the relevant axis comes ON, and the error code is stored in the minor error code, major error code, or servo error code register.

<A171SHCPUN> **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

<A172SHCPUN> **Table 2.2 Error Code Registers, Error Flags**

Error Class \ Device	Error Code Register								Error Detection Signal
	Axis 1	Axis 2	Axis 3	Axis 4	Axis 1	Axis 2	Axis 3	Axis 4	
Minor error	D806	D826	D846	D866	D886	D906	D926	D946	M1607+20n
Major error	D807	D827	D847	D867	D887	D907	D927	D947	
Servo error	D808	D828	D848	D868	D888	D908	D928	D948	M1608+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) or servo error reset signal (M1808+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: ON) is issued.

(2) When a servo error occurs, reset the servo error after first eliminating the error cause at the servo side.

2.1 Servo Program Setting Errors (Stored in D9190)

The error codes, error contents, and corrective actions for servo program setting errors are shown in Table 2.4. The "*" in error codes marked with an asterisk indicates the axis number (1 to 4/1 to 8).

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.	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.
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. Unite | Address Setting Range degree | 1 to 35999999 | $\times10^{-5}$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. Unite | Address Setting Range mm | 1 to 600000000 | $\times10^{-2}$mm/min inch | 1 to 600000000 | $\times10^{-3}$inch/min degree | 1 to 600000000 | $\times10^{-3}$degree/min PULSE | 1 to 1000000 | PLS/s	(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. Unite | Address Setting Range degree | 1 to 35999999 | $\times10^{-5}$degree (2) The auxiliary address 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 auxiliary address in the range 0 to ±2147483647.
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. Unite | Address Setting Range degree | 1 to 35999999 | $\times10^{-5}$degree (2) The radius 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 radius in the range 0 to ±2147483647.
n10*	Center point setting error (when executing circular interpolation by designating a center point)	(1) An address outside the applicable range is set when executing absolute positioning control. Unite | Address Setting Range degree | 1 to 35999999 | $\times10^{-5}$degree (2) The center point 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 center point in the range 0 to ±2147483647.
11	Interpolation control unit setting error	The interpolation control unit is set outside the range 0 to 3.	Control is executed at the default value of "3".	Set the interpolation control unit in the range 0 to 3.
12	Speed limit value setting error	The speed limit value is set outside the applicable range.	Control is executed at the default value of 200000 PLS/s.	Set the speed limit value in the specified range.
13	Acceleration time setting error	The acceleration time is set to "0".	Control is executed at the default value of 1000.	Set the acceleration time in the range 1 to 65535.
13	FIN acceleration/ deceleration setting error	FIN acceleration/deceleration setting is other than 1 to 5000.		Set FIN acceleration/deceleration within range 1 to 5000.
14	Deceleration time setting error	The deceleration time is set to "0".		Set the deceleration time in the range 1 to 65535.
15	Rapid stop deceleration time setting error	The rapid stop deceleration time is set to "0".		Set the rapid stop deceleration time in the range 1 to 65535.

Table 2.4 Servo Program Setting Error List (Continued)

<table>
<tr><th>Error Code Stored in D9190</th><th>Error Name</th><th>Error Contents</th><th>Error Processing</th><th>Corrective Action</th></tr>
<tr><td>16</td><td>Torque limit value setting error</td><td>The torque limit value is set outside the range 1 to 500.</td><td>Control is executed at the default value of 300%.</td><td>Set the torque limit value in the range 1 to 500.</td></tr>
<tr><td>17</td><td>Allowable error range for circular interpolation setting error</td><td>The allowable error range for circular interpolation is set outside the applicable range.<table><tr><th>Unite</th><th colspan="2">Address Setting Range</th></tr><tr><td>mm</td><td rowspan="4">1 to 100000</td><td>×10^{-1} μm</td></tr><tr><td>inch</td><td>×10^{-5}inch</td></tr><tr><td>degree</td><td>×10^{-5}degree</td></tr><tr><td>PULSE</td><td>PLS</td></tr></table></td><td>Control is executed at the default value (100PLS).</td><td>Set the allowable error range for circular interpolation in the applicable range.</td></tr>
<tr><td>18</td><td>Repeat count error</td><td>The repeat count is set outside the range 1 to 32767.</td><td>Control is executed with the repeat count set to "1".</td><td>Set the repeat count in the range 1 to 32767.</td></tr>
<tr><td rowspan="3">19</td><td rowspan="3">START instruction setting error</td><td>(1) The servo program designated by the START instruction does not exist.</td><td rowspan="3">Positioning control does not start.</td><td>(1) Create a servo program designated by the START instruction.</td></tr>
<tr><td>(2) There is a START instruction in the designated servo program.</td><td>(2) Delete the servo program containing the START instruction.</td></tr>
<tr><td>(3) More than one axis has been designated for the started servo program.</td><td>(3) Do not designate more than one axis.</td></tr>
<tr><td>20</td><td>Point setting error</td><td>No point has been designated in the instruction for constant speed control.</td><td>Positioning control does not start.</td><td>Designate a point between CPSTART and CPEND.</td></tr>
<tr><td>21</td><td>Reference axis speed setting error</td><td>In linear interpolation using the reference axis speed designation method, an axis not involved in the interpolation has been designated as the reference axis.</td><td>Positioning control does not start.</td><td>Set one of the axes involved in the interpolation as the reference axis.</td></tr>
<tr><td>22</td><td>S-curve ratio setting error</td><td>The S-curve ratio when designating S-curve acceleration/deceleration is outside the range 0 to 100%.</td><td>Control is executed with an S-curve ratio of 100%.</td><td>Set the S-curve ratio within the range 0 to 100%.</td></tr>
<tr><td>23</td><td>VSTART setting error</td><td>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.)</td><td>Positioning control does not start.</td><td>Set a speed switching point between the VSTART and VEND instructions or the FOR and NEXT instructions.</td></tr>
<tr><td>24</td><td>Cancel function start program No. error</td><td>The start program No. for the cancel function has been set outside the range 0 to 4095.</td><td>Positioning control does not start.</td><td>Set the start program No. within the range 0 to 4095 and then start.</td></tr>
<tr><td>25</td><td>High-Speed oscillation command amplitude error</td><td>Operation cannot be started because the amplitude commanded for the high-speed oscillation function is outside the range 1 to 2147483647.</td><td>Positioning control does not start.</td><td>Set the commanded amplitude within the range 1 to 214783647 and then start.</td></tr>
<tr><td>26</td><td>High-Speed oscillation command starting angle error</td><td>Operation cannot be started because the commanded starting angle for the high-speed oscillation function is outside the range 0 to 3599 (×0.1 degrees).</td><td>Positioning control does not start.</td><td>Set the starting angle within the range 0 to 3599 (× 0.1 degree) and then start.</td></tr>
<tr><td>27</td><td>High-Speed oscillation command frequency error</td><td>Operation cannot be started because the commanded frequency for the high-speed oscillation function is outside the range 1 to 5000 (CPM).</td><td>Positioning control does not start.</td><td>Set the frequency within the range 1 to 5000 (CPM) and then start.</td></tr>
<tr><td>900</td><td>START instruction setting error</td><td>The servo program designated by the DSFRP/SVST program does not exist.</td><td>Positioning control does not start.</td><td>Set the correct servo program number.</td></tr>
<tr><td rowspan="2">901</td><td rowspan="2">START instruction setting error</td><td>(1) The axis number set for the DSFRP/SVST instruction is different from the axis number set for the servo program.</td><td rowspan="2">Positioning control does not start.</td><td>(1) Set the correct axis number.</td></tr>
<tr><td>(2) A DSFRP instruction has been used when executing 4-axis linear interpolation.</td><td>(2) Use the SVST instruction for 4-axis linear interpolation.</td></tr>
<tr><td>902</td><td>Servo program instruction code error</td><td>The instruction code cannot be decoded (a non-existent instruction code has been designated)</td><td>Positioning control does not start.</td><td>Set the correct instruction code.</td></tr>
<tr><td>903</td><td>Start error</td><td>A virtual mode program was started in the real mode</td><td>Positioning control does not start.</td><td>Check the mode allocation for the program.</td></tr>
<tr><td>904</td><td>Start error</td><td>A real mode program was started in the virtual mode</td><td>Positioning control does not start.</td><td>Check the mode allocation for the program.</td></tr>
<tr><td>905</td><td>Start error</td><td>An instruction that cannot be used in the virtual mode (VPF, VPR, VPSTART, ZERO, VVF, VVR, OSC) was issued.</td><td>Positioning control does not start.</td><td>Correct the servo program.</td></tr>
<tr><td>906</td><td>Axis No. setting error</td><td>An axis not used in the system settings has been set for the servo program set in a DSFRP/SVST instruction.</td><td>Positioning control does not start.</td><td>Set an axis number that is setted in the system settings.</td></tr>
<tr><td>907</td><td>Start error</td><td>Start attempted during processing for switching from real mode to virtual mode.</td><td rowspan="2">Positioning control does not start.</td><td rowspan="2">Use M2034 (real/virtual mode switching request), M2044 (real/virtual mode status) as interlocks for starting.</td></tr>
<tr><td>908</td><td>Start error</td><td>Start attempted during processing for switching from virtual mode to real mode.</td></tr>
</table>

2.2 Minor Errors

Minor errors are those that occur in the sequence program or servo program.
The error codes for these errors are from 1 to 999.
Minor errors include set data errors, positioning control start-up errors, positioning control errors, and control change errors.

(1) Set data errors (1 to 99)

These errors occur when the data set in the parameters for positioning control is not correct.

The error codes, causes, processing, and corrective actions are shown in Table 2.5 below.

Table 2.5 Set Data Error List (1 to 99)

Error Code	Data Where Error Occurred	Check Timing	Error Cause	Error Processing	Corrective Action
21	Zeroing data	When count type, proximity dog type, or data set type zeroing is started.	The home position address of a degree axis is outside the range 0 to 35999999 ($\times 10^{-5}$degrees).	Zeroing is not started.	Set the home position address within the permissible range with a peripheral device.
22		When a count type or proximity dog type zeroing is started.	The zeroing speed is set outside the range of 1 to the speed limit value.		Set the zeroing speed at or below the speed limit value by using a peripheral device.
23			The creep speed is set outside the range of 1 to the zeroing speed.		Set the creep speed at or below the zeroing speed by using a peripheral device.
24		When a count type zeroing is started.	The travel value after the proximity dog comes ON is outside the range ON2^{31}–1($\times$ unit).		Set the travel value after the proximity dog to within the permissible range with a peripheral device.
25		When a count type or proximity dog type zeroing is started.	The parameter block No. is outside the range of 1 to the maximum No. ☐		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	Zeroing	Position Follow-Up Control	OSC				
100	○	○	○	○	○	○	○	○	○	○	○		• The PLC ready flag (M2000) or PCPU ready flag (M9074) is OFF.	Positioning control does not start.	• Set the servo system CPU to RUN. • Turn the PLC ready flag (M2000) ON.
101	○	○	○	○	○	○	○	○	○	○	○		• The start accept flag (M2001 to M2004/M2001 to M2008) of the relevant axis has been turned ON.		• Provide an interlock in the program to prevent the axis from being started while in motion (use the turning OFF of the start accept signal for the axis as the interlock condition).
103	○	○	○	○	○	○	○	○	○	○	○		• The stop command (M1800+20n) of the relevant axis has been turned ON.		• Turn the stop command (M1800+20n) OFF and start positioning.
104	○	○	○	○	○	○	○	○	○	○	○		• The rapid stop command (M1801+20n) of the relevant axis has been turned ON.		• Turn the rapid stop command (M1801+20n) OFF and start positioning.
105	○				○	○				○			• On starting, the feed current value is outside the stroke limit range.		• Move back inside the stroke range using JOG operation. • Enter inside the stroke range by executing a zeroing or current value change.
106*	○	○			○	○				○	○		• Positioning outside the stroke limit has been designated.		• Positioning end point must be within the specified stroke limit.
107	○					○							• An address that does not generate an arc was designated in circular interpolation for which an auxiliary point is designated. [Error in relationship between the start point, auxiliary point, and end point]		• Designate correct addresses in the servo program.
108*	○					○							• An address that does not make an arc was designated in circular interpolation for which a radius is designated. [Error in relationship between the start point, auxiliary point, and end point]		
109	○					○							• An address that does not generate an arc was designated in circular interpolation for which a center point is designated. [Error in relationship between the start point, auxiliary point, and end point]		
110*	○					○							• In circular interpolation, the difference between the end point address and the ideal end point exceeded the allowable error range for circular interpolation.		
111				○									• An attempt was been made to restart speed/position switching control although it had not stopped.		• Do not attempt restart when speed/position switching control has not stopped.
115									○				• The zeroing completed signal (M1610+20n) has been turned ON during a near-zero point dog type zeroing operation.		• Resumptive starts are not possible for zeroing operations. Use JOG operation or positioning operation to return the axis to a point before the proximity dog signal was output, then retry the zeroing operation.

Table 2.6 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	Zeroing	Position Follow-Up Control	OSC				
116							○						• The set JOG speed is 0.	Positioning control does not start.	• Set a correct speed (within the specified range).
													• The set JOG speed exceeds the JOG speed limit value.	Control is executed at the JOG speed limit value.	
117								○					• Both forward and reverse motion were designated when simultaneously starting JOG operation programs.	Only the axis set to move in the forward direction starts.	• Set correct data.
118					○								• The speed change point is beyond the final address.	Positioning control does not start.	• Set a speed change point that is before the final address.
													• An address that causes positioning in the reverse direction is set.		• Set an address for positioning in the forward direction.
120										○			ZCT not set During second travel in dog type or count type zeroing, or when data set type zeroing is started, the zero pass signal (M1606+20n) is OFF.	Zeroing is not completed correctly.	• Carry out the zeroing after the home position has been passed.
136			○										• A VVF/VVR instruction has been used for an MR-□-B axis.	Positioning control does not start.	• MR-□-B axes cannot be started with VVF/VVR instructions: use VF/VR instructions instead.
140	○												• 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											○		• An odd number has been set for the position command device for position follow-up control.		• Set an even number for the position command device for position follow-up control.
142				○						○			• An external input signal has come ON although external input signal setting has not been performed for that signal in the system settings.		• Perform external input signal setting in system setting.

(3) Positioning control errors (200 to 299)
The errors shown in this section are those detected during positioning control.
Error codes, causes and corrective actions are shown in Table 2.7.

Table 2.7 Positioning Control Start-Up Error List (200 to 299)

Error Code	Control Mode: Positioning	Fixed-Pitch Feed	Speed	Speed/Position Switching	Speed Switching	Constant Speed	JOG	Manual Pulse Generator	Zeroing	Position Follow-Up Control	OSC		Error Cause	Error Processing	Corrective Action
200	○	○	○	○	○	○	○	○		○	○		• The PLC ready flag (M2000) was turned OFF while positioning was being started in response to a start request issued by a sequence program.	Axis motion decelerates to a stop.	• Turn the PLC ready flag (M2000) ON after all axes have stopped.
201									○				• The PLC ready flag (M2000) was turned OFF during a zeroing operation.		• After turning the PLC ready flag (M2000) ON or turning the stop command (M1800+20n) or rapid stop command (M1801+20n) OFF, re-attempt zeroing. (In the case of a proximity dog zeroing, use JOG operation or positioning operation to return the axis to the point before the proximity dog signal was output, and re-attempt zeroing.)
202									○				• The stop command (M1800+20n) has been turned ON during a zeroing operation.		
203									○				• The rapid stop command (M1801+20n) has been turned ON during a zeroing operation.	Axis motion stops immediately.,	
204	○	○	○	○	○	○	○	○	○	○	○		• The PLC ready flag (M2000) was turned back ON during deceleration initiated by turning OFF the PLC ready flag (M2000).	No processing	• Turn the PLC ready flag (M2000) ON after all axes have stopped. (Turning ON the PLC ready flag (M2000) during deceleration is ignored.)
206									○				• While a zeroing operation was in progress, an emergency stop was executed in the test mode at a peripheral device by pressing the [Back Space] key.	Axis motion stops immediately.	• In the case of a proximity dog type zeroing, use JOG operation or positioning operation to return the axis to the point before the proximity dog signal was output, and re-attempt zeroing. • If the proximity dog signal is turned OFF when executing a count type zeroing, use JOG operation or positioning operation to return the axis to the point before the proximity dog signal was output, and re-attempt zeroing. (In the proximity dog signal is turned ON when executing count type zeroing, re-attempt the zeroing.)
207	○				○	○	○			○			• The feed current value exceeded the stroke limit during positioning. In the case of circular interpolation, an error code is stored only for axes whose feed current value exceeded the stroke limit. In the case of linear interpolation, error codes are stored for all axes involved in the interpolation.	Axis motion decelerates to a stop.	• Correct the stroke limit or travel value setting so that positioning is executed within the stroke limit.
208	○				○	○		○					• During circular interpolation or during simultaneous operation of multiple manual pulse generators, the feed current value of another axis exceeded the stroke limit value. (For detection of other axis errors).		
209				○					○				• An overrun has occurred because the set travel value exceeds the deceleration distance when a speed/position change (CHANGE) signal is input during speed/position switching control, or when the proximity dog signal is input during count type zeroing.		• Correct the speed setting so that overrun does not occur. • Set a travel value which will not cause an overrun.
210				○									• During speed/position switching control, the set travel value exceeds the stroke limit when a speed/position switching (CHANGE) signal is input.		• Correct the stroke limit or travel value setting so that positioning is executed within the stroke limit.

Table 2.7 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	Zeroing	Position Follow-Up Control	OSC		Error Cause	Error Processing	Corrective Action
211						○							• During positioning, an overrun occurs because the deceleration distance for the output speed is not attained at the point where the final positioning address is detected.	Axis motion decelerates to a stop.	• Set a speed at which overrun does not occur. • Set a travel value which will not cause an overrun.
214								○					• An attempt was made to control an axis already being moved by the manual pulse generator by setting the manual pulse generator operation enable flag for that axis.	The manual pulse generator input is ignored until the axis stops.	• Perform the manual pulse generator operation after the axis has stopped.
215					○								• The speed switching point address is greater than the end point address.	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.
													• An address to control positioning in the opposite direction was set during speed switching control.		
													• The same servo program was been executed a second time.		• Modify the sequence program.
220										○			• In position follow-up control, when the control unit is "degrees", a command address outside the 0 to 35999999 has been set.	Axis motion decelerates to a stop. (M2001+n OFF)	• When the control unit is "degrees", set a command address within the range 0 to 35999999.
													• The command address has exceeded the stroke limit range in position follow-up control.		• Set an address within the stroke limit range.
225										○			• In constant speed control, the speed at the pass point exceeds the speed limit value.	The speed is kept at the speed limit value.	• Set a speed command value between 1 and the velocity limit value.

(4) Errors occurring at current value changes and speed changes (300 to 399)
The errors shown in this section are those that occur on execution of current value changes and speed changes.
Error codes, causes, processing, and corrective actions are shown in table 2.8.

Table 2.8 List of Errors that Occur at Current Value/Speed Changes

Error Code	Control Mode												Error Cause	Error Processing	Corrective Action
	Positioning	Fixed-Pitch Feed	Speed	Speed/Position Switching	Speed Switching	Constant Speed	JOG	Manual Pulse Generator	Zeroing	Position Follow-Up Control	OSC				
300	○	○	○	○	○	○	○	○	○	○	○		• An attempt was made to change the current value data of an axis in motion. • An attempt was made to change the current value data of an axis that had not been started up. • An attempt was made to change the current value data of an axis whose status was "servo OFF".	The current value data is not changed.	• Use the following states of the following devices as interlocks to ensure that the present value of an axis in motion cannot be changed. (1) OFF state of the start accept flag (M2001 to M2004/M2001 to M2008) for the relevant axis. (2) ON state of the servo READY flag M1615+20n.
301									○				• An attempt was made to change the speed of an axis executing a zeroing.	The speed is not changed.	• The speed of an axis executing zeroing cannot be changed.
302	○					○							• An attempt was made to change the speed of an axis executing circular interpolation.		• The speed of an axis executing circular interpolation cannot be changed.
303	○	○		○	○	○				○			• An attempt was made to change the speed of an axis after automatic deceleration had started in positioning.		• The speed of an axis cannot be changed after automatic deceleration has started.
304							○						• An attempt was made to change the speed of an axis during deceleration initiated by turning OFF the JOG operation start signal (M1802+20n, M1803+20n).		• Do not attempt a speed change during deceleration initiated by turning OFF the JOG operation start signal (M1802+20n, M1803+20n).
305	○	○	○	○	○	○	○			○			• The speed to be changed to in a speed change was set outside the range of 0 to the speed limit value.	The speed is kept at the speed limit value.	• Set the speed within the range from 0 to the speed limit value.
309													• A current value change command outside the range of 0 to 35999999 ($\times 10^{-5}$ degrees) has been issued for an axis whose control units are degrees.	The present value data is not changed.	• Make a setting in the range of 0 to 35999999 ($\times 10^{-5}$ degrees).
310											○		• A speed change was attempted during high-speed oscillation. • A speed change to "0" request was issued during high-speed oscillation.	The speed is not changed.	• Do not perform speed changes during high-speed oscillation.
311													• A value outside the range 1 to 500% was set in the torque limit value change request (CHGT).	The torque limit value is not changed.	• Make a change request within the range 1 to 500% .
312													• A torque limit change request (CHGT) was made for an axis not started yet.		• Make a change request for a started axis.

(5) System errors (900 to 999)

Table 2.9 System Error List (900 to 999)

Error Code	Control Mode: Positioning	Fixed-Pitch Feed	Speed	Speed/Position Switching	Speed Switching	Constant Speed	JOG	Manual Pulse Generator	Zeroing	Position Follow-Up Control	OSC		Error Cause	Error Processing	Corrective Action
900													• When the servo amplifier power is switched ON, the motor type set in the "system settings" differs from the motor type actually installed. (Checked only when using MR-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	Zeroing	Position Follow-Up Control	OSC				
1000	○	○	○	○	○	○	○	○	○	○	○		• The external stop signal of the corresponding axis was turned ON.		• Turn OFF the STOP signal.
1001	○	○	○	○	○	○	○	○	○	○	○		• When positioning was started in the forward direction (addresses increasing), the external FLS (upper limit LS) signal was turned OFF.		• Move the axis in the reverse direction in the JOG mode until it enters the external limit range.
1002	○	○	○	○	○	○	○	○	○	○	○		• When positioning was started in the reverse direction (addresses decreasing), the external RLS (lower limit LS) signal was turned OFF.		• Move the axis in the forward direction in the JOG mode until it enters the external limit range.
1003									○				• When proximity type zeroing was started, the external DOG (near-zero point dog) signal was turned ON.		• Move the axis to a point before proximity in the JOG mode and then execute a zeroing.
1004	○	○	○	○	○	○	○	○	○	○	○		• The servo state of the corresponding axis is not servo READY. (M1615+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: OFF).
1005	○	○	○	○	○	○	○	○	○	○	○		• The servo error detection signal of the corresponding axis (M1608+20n) was turned ON.		• Eliminate the error at the servo side, reset the servo error detection signal (M1608+20n) by using the servo error reset command (M1808+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	Zeroing	Position Follow-Up Control	OSC		Error Cause	Error Processing	Corrective Action
1101	○	○	○	○	○	○	○	○	○	○	○		• When positioning was started in the forward direction (addresses increasing), the external FLS (upper limit LS) signal was turned OFF.	Axis motion decelerates to a stop in accordance with the "deceleration processing on STOP input" setting in the parameter block.	• Move axis in the reverse direction in the JOG mode until it enters the external limit range.
1102	○	○	○	○	○	○	○	○	○	○	○		• When positioning was started in the reverse direction (addresses decreasing), the external RLS (lower limit LS) signal was turned OFF.		• Move the axis in the forward direction in the JOG mode until it enters the external limit range.
1103									○				• The external STOP signal (stop signal) was turned ON while the axis was moving.		• When executing a proximity dog type zeroing, move the axis to a point before the proximity dog in the JOG mode and then execute a zeroing.
1104	○	○	○	○	○	○	○	○	○	○	○		• The servo error detection signal (M1608+20n) was turned ON while an axis was in motion.	The axis stops immediately without decelerating.	• After taking the appropriate corrective action for the servo error, the axis can be restarted.
1105	○	○	○	○	○	○	○	○	○	○	○		• The power supply to the servo amplifier was turned OFF while an axis was in motion. (Servo not installed status detected, cable fault, etc.) • Zeroing did not finish successfully since the axis did not stop at the home position within the in-position range.	M1615+20n turned OFF.	• Turn ON the power supply to the servo amplifier. • Check the cable to servo amplifier connecting cable. • Make gain adjustment.

(3) Absolute System Errors (1200 to 1299)
The errors shown in this section are those detected in an absolute system.
Error codes, error causes, error processing, and corrective actions are shown in Table 2.11.

Table 2.12 Absolute System Error List (1200 to 1299)

Error Code	Control Mode												Error Cause	Error Processing	Corrective Action
	Positioning	Fixed-Pitch Feed	Speed	Speed/Position Switching	Speed Switching	Constant Speed	JOG	Manual Pulse Generator	Zeroing	Position Follow-Up Control	OSC				
1201													• When the servo amplifier power was switched ON, a sum check error occurred with the backup data in the controller. • Zeroing has not been performed. • CPU module battery error. • Zeroing was started but it was not completed normally.	Zeroing request (M1609+20n) ON	• Check the battery of the CPU module and execute a zeroing.
1202													• When the servo amplifier power is turned ON, a communication error in communication between the servo amplifier and encoder occurs.	Home position return request (M1609+20n) ON, servo error 2016 set.	• Check the motor and encoder cables and perform zeroing again.
1203													• During operation, the amount of change in the encoder current value complies with the following expression: "Amount of change in encoder current value/3.5 ms 180° of motor revolution" After the servo amplifier power has been turned ON, a continual check is performed (in both servo ON and OFF states).	No Processing	• Check the motor and encoder cables.
1204													• During operation, the following expression holds: "Encoder current value (PLS) ≠ feedback current value (PLS) (encoder effective bit number)". After the servo amplifier power has been turned ON , a continual check is performed (in both servo ON and OFF states).		

(4) System Errors (1300 to 1399, 1500 to 1599)
Errors detected at power-on.
Table 2.13 indicates the error codes, error causes, error processings and corrective actions.

Table 2.13 Main Base Side 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	Zeroing	Position Follow-Up Control	OSC				
1501													• When setting was made to use the brake output of the A278LX or A172SENC, 24VDC is not supplied properly.	Start is not made	• Supply 24VDC power to the A278LX or A172SENC.

2.4 Servo Errors

(1) Servo amplifier errors (2000 to 2799)

The servo amplifier errors are errors detected by the servo amplifier and are assigned error codes 2000 to 2799.

In the following tables, the types of servo amplifier are indicated for MR-[ ]-B.

The servo error detection signal (M1608+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), 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	Error Cause		When Error Checked	Error Processing	Corrective Action
	Name	Description			
2010	Low voltage	• The power supply voltage is less than 160 VAC. (320VAC or less for 400VAC series servo) • A momentary power, interruption of 15ms or longer has occurred. • The power supply voltage dropped, for example when motion control started, due to insufficient power capacity.	At any time during operation.	Immediate stop	• Measure the input voltage (R, S, T) with a voltmeter. • Monitor with an oscilloscope to check whether a momentary power interruption has occurred. • Review the power capacity.
2012	Memory error 1	• Servo amplifier SRAM is faulty. • Servo amplifier EPROM check sum error.	• When the servo amplifier power is turned ON • At the leading edge of the PLC READY flag (M2000) • When a servo error is reset • When the power to the servo system CPU is turned ON		• Replace the servo amplifier.
2013	Clock error	• Servo amplifier clock fault.	At any time during operation		• Replace the servo amplifier.
2014	Watchdog	• Servo amplifier hardware fault • Servo system CPU hardware fault			• Replace the servo amplifier. • Replace the servo system CPU.
2015	Memory error 2	• Servo amplifier EEPROM fault	• When the servo amplifier power is turned ON • At the leading edge of the PLC READY flag (M2000) • When a servo error is reset • When the power to the servo system CPU is turned ON		• Replace the servo amplifier.
2016	Position sensor error 1	• Fault in communication with the encoder	• When the servo amplifier power is turned ON • At the leading edge of the PLC READY flag (M2000) • When a servo error is reset • When the power to the servo system CPU is turned ON		• Check if the connector of the encoder cable is loose. • Replace the servomotor. • Replace the encoder cable.
2017	PCB error	• Faulty device in the servo amplifier PCB.	• When the servo amplifier power is turned ON • At the leading edge of the PLC READY flag (M2000) • When a servo error is reset • When the power to the servo system CPU is turned ON		• Replace the servo amplifier.
2019	Memory error 3	• Servo amplifier flash ROM check sum error	• When the servo amplifier power is turned ON • At the leading edge of the PLC READY flag (M2000) • When a servo error is reset • When the power to the servo system CPU is turned ON		• Replace the servo amplifier.
2020	Encoder error 2	• Fault in communication with the encoder	At any time during operation		• Check if the connector of the encoder cable is loose. • Replace the servomotor. • Replace the encoder cable.
2021	Converter RD off (400VAC series servo only)	• The servo-on (SON) signal turned ON when the ready signal (RD) of the converter is OFF. 1. Bus voltage is OFF. 2. Alarm occurring in converter.			• Remove the cause of the converter alarm. Deactivate the alarm.
2024	Output ground fault	• U, V, or W of the servo amplifier output grounded			• Check if the servo motor and cable have been grounded. • Correct the grounding. • Replace the servomotor.
2025	Battery alarm	• The voltage of the supercapacitor inside the absolute encoder has dropped. • The battery voltage is low. • Failure of battery cable or battery. (Home position return must be re-executed after clearing the error.)	• When the servo amplifier power is turned ON • At the leading edge of the PLC READY flag (M2000) • When a servo error is reset • When the power to the servo system CPU is turned ON		• Turn the power ON for 2 to 3 minutes to charge the supercapacitor, switch the power OFF then ON again, and execute a zeroing. • Turn the servo amplifier power OFF, then measure the battery voltage. • Replace the servo amplifier battery.

Table 2.14 Servo Amplifier Error List (2000 to 2799) (Continued)

Error Code	Error Cause		When Error Checked	Error Processing	Corrective Action
	Name	Description			
2030	Excessive regeneration	• The frequency of ON/OFF switching of the power transistor for regeneration is too high. (Caution is required since the regenerative resistor could overheat.)	At any time during operation	Immediate stop	• Reduce the frequency of acceleration and deceleration or feed speed while checking the servo monitor regeneration level (%). • Reduce the load. • Increase the servomotor capacity.
		• Servo parameter (system settings) setting error			• Check the servo parameters (regenerative resistor and motor type settings in the system settings).
		• Incorrect wiring of regenerative resistor			• Connect the regenerative resistor correctly.
		• Failure of regenerative resistor			• Replace the regenerative resistor.
		• Power transistor for regeneration damaged by short circuit			• Replace the servo amplifier.
2031	Overspeed	• The motor rpm has exceeded 115% of the rated rpm.			• Check the motor rpm in the servo parameters. • Check if the number of pulses per revolution and travel value per revolution in the fixed parameters match the machine specifications.
		• An overshoot has occurred because the acceleration time constant is too small.			• If an overshoot occurs during acceleration, check the acceleration time and deceleration time in the fixed parameters.
		• An overshoot has occurred because the servo system is unstable.			• If overshoot occurs, increase the speed integral compensation by adjusting the position loop gain / position control gain 1, 2, speed loop gain / speed control gain 1, 2 in the servo parameters.
		• Encoder fault.			• Check if the encoder cable is disconnected. • Replace the servomotor.
2032	Overcurrent	• U, V, W in the servo amplifier outputs have short circuited with each other.			• Check if there is a short circuit between U, V, W of the servo amplifier outputs.
		• U, V, W in the servo amplifier outputs have shorted to ground.			• Check if U, V, W of the servo amplifier outputs have been grounded to the ground terminal. Check if U, V, W of the servomotor are grounded to the core. If grounding is found, replace the servo amplifier and/or motor.
		• Incorrect wiring of U, V, W phases in the servo amplifier outputs.			• Correct the wiring.
		• The servo amplifier transistor is damaged.			• Replace the servo amplifier.
		• Failure of coupling between servomotor and encoder			• Replace the servomotor.
		• Encoder cable failure			• Replace the encoder cable.
		• A servomotor that does not match the setting has been connected.			• Check the connected motor set in the system settings.
		• The servomotor oscillated.			• Check and adjust the gain value set in the servo parameters.
		• Noise entered the overcurrent detection circuit.			• Check if any relays or valves are operating in the vicinity.
2033	Overvoltage	• The converter bus voltage has reached 400 V or more. (800VAC or more for 400VAC series servo) • The frequency of acceleration and deceleration was too high for the regenerative ability. • The regenerative resistor has been connected incorrectly.			• Increase the acceleration time and deceleration time in the fixed parameters. • Check the connection between C and P of the terminal block for the terminal block for regenerative resistance.
		• The regenerative resistor in the servo amplifier is destroyed.			• Measure between C and P of the terminal block for regenerative resistance with a multimeter; if abnormal, replace the servo amplifier. (Measure about 3 minutes after the charge lamp has gone out.)
		• The power transistor for regeneration is damaged.			• Replace the servo amplifier.
		• The power supply voltage is too high.			• Measure the input voltage (R, S, T) with a voltmeter.

Table 2.14 Servo Amplifier Error List (2000 to 2799) (Continued)

Error Code	Error Cause		When Error Checked	Error Processing	Corrective Action
	Name	Description			
2034	Communications 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	Data error	• There is excessive variation in the position commands from the servo system CPU; commanded speed is too high. • Noise has entered the commands from the servo system CPU.			• Check the commanded speed, and the number of pulses per revolution and travel value per revolution in the fixed parameters. • Check the connection of the motion bus cable connector. • Check if the motion bus cable is clamped correctly. • Check if the motion bus cable is clamped correctly. • Check if any relays or valves are operating in the vicinity.
2036	Transmission error	• Fault in communication with the servo system CPU			• Check the connection of the motion bus cable connector. • Check if there is a disconnection in the motion bus cable. • Check if the motion bus cable is clamped correctly.
2042	Feedback error	• Encoder signal fault			• Replace the servomotor.
2045	Fin overheating	• The heat sink in the servo amplifier is overheated. • Amplifier error (rated output exceeded) • Power repeatedly switched ON/OFF during overload. • Cooling fault			• If the effective torque of the servomotor is high, reduce the load. • Reduce the frequency of acceleration and deceleration. • Check if the amplifier's fan has stopped. (MR-H150B or higher) • Check if the passage of cooling air is obstructed. • Check if the temperature inside the panel is too high (range: 0 to +55°C). • Check if the electromagnetic brake was actuated from an external device during operation. • Replace the servo amplifier.
2046	Motor overheating	• The servomotor is overloaded. • The servomotor and regenerative option are overheated. • The thermal protector incorporated in the encoder is faulty.			• If the effective torque of the servomotor is high, reduce the load. • Check the ambient temperature of the servomotor (range: 0 to +40°C). • Replace the servomotor.
2050	Overload 1	• An overload current of about 200% has been continuously supplied to the servo amplifier and servomotor.			• Check if there has been a collision at the machine. • If the load inertia is very large, either increase the time constant for acceleration and deceleration or reduce the load. • If hunting occurs, adjust the position loop gain in the servo parameters. • Check the connection of U, V, W of the servo amplifier and servomotor. • Check for disconnection of the encoder cable. • Replace the servomotor.
2051	Overload 2	• The servo amplifier and servomotor were overloaded at a torque close to the maximum torque (95% or more of the current control value).			• Check if there has been a collision at the machine. • If the load inertia is very large, either increase the time constant for acceleration and deceleration or reduce the load. • If hunting occurs, adjust the position loop gain / position control gain 1, 2, speed loop gain/ speed control gain 1, 2 in the servo parameters. • Check the connection of U, V, W of the servo amplifier and servomotor. • Check for disconnection of the encoder cable. • Replace the servomotor. • If the voltage of the bus in the servo amplifier has dropped (charge lamp has gone out), replace the servo amplifier.

Table 2.14 Servo Amplifier Error List (2000 to 2799) (Continued)

Error Code	Error Cause		When Error Checked	Error Processing	Corrective Action
	Name	Description			
2052	Excessive error	• The droop pulses of the deviation counter exceeded the error excessive alarm level set in the servo parameters.	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.
2086	RS232 communication error	• Parameter unit communication error		Operation continues	• Check for disconnection of the parameter unit cable. • Replace the parameter unit.
2102	Battery warning	• The voltage of the battery installed in the servo amplifier has become low.			• Replace the battery. (MR-JBAT-□)
2103	Battery disconnection warning	• The power supply voltage to the absolute position sensor has become low.			• Replace the battery. • Check for disconnection of the encoder cable. • Replace the servomotor. • Replace the servo amplifier.
2140	Excessive regeneration warning	• An excessive regeneration error (2030) is likely to occur (regeneration of 85% of the maximum load capacity for the regenerative resistor has been detected).			• Refer to the details on the excessive regeneration error (2030).
2141	Overload warning	• An overload error (2050, 2051) is likely to occur (85% of overload level detected).			• Refer to the details on the overload errors (2050, 2051).
2146	Servo emergency stop	• The connection between 1A and 1B (emergency stop input) of CN6 of the servo amplifier encoder has been broken.			• Establish a short circuit between 1A and 1B of CN6 of the servo amplifier encoder.
2147	Emergency stop	• An emergency stop (EMG) signal has been input from the servo system CPU.		Immediate stop	• Release the emergency stop.
2149	Main circuit OFF warning	• The servo ON (SON) signal was turned ON while the contactor was OFF. • The main circuit bus voltage fell to 215 V or lower at 50 rpm or lower.		Operation continues	• Turn the main circuit contactor or circuit power supply ON.
2196	Home position setting error warning	• After a home position set command, the droop pulses did not come within the in-position range.			• Re-attempt zeroing.

Table 2.14 Servo Amplifier Error List (2000 to 2799) (Continued)

Error Code	Error Cause		When Error Checked	Error Processing	Corrective Action
	Name	Description			
2301 to 2336	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)

<table>
<tr><th rowspan="2">Error Code</th><th colspan="2">Error Cause</th><th rowspan="2">When Error Checked</th><th rowspan="2">Error Processing</th><th rowspan="2">Corrective Action</th></tr>
<tr><th>Name</th><th>Description</th></tr>
<tr><td>2601
to
2636</td><td>Initial parameter error</td><td>• The set parameter values are incorrect.
• The parameter data has been destroyed.
<table>
<tr><td>2601</td><td>Amplifier setting</td></tr>
<tr><td>2602</td><td>Regenerative resistance</td></tr>
<tr><td>2603</td><td>Motor type</td></tr>
<tr><td>2604</td><td>Motor capacity</td></tr>
<tr><td>2605</td><td>Motor rpm</td></tr>
<tr><td>2606</td><td>Number of feedback pulses</td></tr>
<tr><td>2607</td><td>Rotating direction setting</td></tr>
<tr><td>2608</td><td>Automatic tuning setting</td></tr>
<tr><td>2609</td><td>Servo responsibility</td></tr>
<tr><td>2610</td><td>Torque limit (forward)</td></tr>
<tr><td>2611</td><td>Torque limit (reverse)</td></tr>
<tr><td>2612</td><td>Load inertia ratio</td></tr>
<tr><td>2613</td><td>Position control gain 1</td></tr>
<tr><td>2614</td><td>Speed control gain 1</td></tr>
<tr><td>2615</td><td>Position control gain 2</td></tr>
<tr><td>2616</td><td>Speed control gain 2</td></tr>
<tr><td>2617</td><td>Speed integral compensation</td></tr>
<tr><td>2618</td><td>Notch filter</td></tr>
<tr><td>2619</td><td>Feed forward coefficient</td></tr>
<tr><td>2620</td><td>In-position range</td></tr>
<tr><td>2621</td><td>Electromagnetic brake sequence output</td></tr>
<tr><td>2622</td><td>Monitor output mode selection</td></tr>
<tr><td>2623</td><td>Optional function 1</td></tr>
<tr><td>2624</td><td>Optional function 2</td></tr>
<tr><td>2625</td><td>Optional function 3</td></tr>
<tr><td>2626</td><td>Optional function 4</td></tr>
<tr><td>2627</td><td>Monitor output 1 offset</td></tr>
<tr><td>2628</td><td>Monitor output 2 offset</td></tr>
<tr><td>2629</td><td>Pre-alarm data selection</td></tr>
<tr><td>2630</td><td>Zero speed</td></tr>
<tr><td>2631</td><td>Excessive error alarm level</td></tr>
<tr><td>2632</td><td>Optional function 5</td></tr>
<tr><td>2633</td><td>Optional function 6</td></tr>
<tr><td>2634</td><td>PI-PID switching position droop</td></tr>
<tr><td>2635</td><td>Torque limit compensation factor</td></tr>
<tr><td>2636</td><td>Speed integral compensation (actual speed differential compensation)</td></tr>
</table></td><td>• When the servo amplifier power supply is turned ON
• At the leading edge of the PLC READY flag (M2000)
• When a servo error is reset
• When the power to the servo system CPU is turned ON</td><td>Immediate stop</td><td>• 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 PLC READY flag (M2000) OFF then ON again.</td></tr>
</table>

2.5 PC Link Communication Errors

Table 2.15 PC Link Communication Error Codes

Error Codes Stored in D9196	Error Description	Action to Take
01	A receiving packet for PC link communication does not arrive. The arrival timing of the receiving packet is too late.	• Check whether the PC has been switched ON. • Check whether the communication cable has been connected firmly. • Check whether the communication cable has been broken. • Check whether the A30BD-PCF or A30CD-PCF has been mounted normally.
02	A receiving packet CRC code is invalid.	• Check whether there is a noise source near the PC. • Check whether the communication cable has been connected firmly. • Check whether the communication cable has been broken.
03	A receiving packet data ID is invalid.	• Check whether the A30BD-PCF or A30CD-PCF has been mounted normally. • Replace the A30BD-PCF or A30CD-PCF.
04	The number of received frames is invalid.	• Check whether the communication cable has been connected firmly. • Check whether the communication cable has been broken. • Check whether there is a noise source near the PC.
05	A PC communication task is not active yet.	• Start the PC communication task.

2.6 LED Indications when Errors Occur at the PCPU

When the errors listed below occur, they are indicated by the "ERROR" LED on the front panel of the A172SHCPUN, and the LED on the front panel of the A171SHCPUN. 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

"ERREOR"LED ●:Lit ○:Not lit	Error Cause	Error Check Timing	Operation when Error Occurs	Error Set Device	Corrective Action
●	• The slot set in the "system settings" has nothing mounted in it, or has a different module mounted in it.	When power switched ON On resetting with the RESET key switch	• Start is disabled.	• System setting error flag (M2041) ON	• Set the "system settings" correctly in accordance with the modules actually mounted, then reset with the RESET key switch.
●	• Axis number settings are duplicated in the "system settings".				
●	• Not even one axis No. has been set in the "system settings".				
●	• 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.				
●	• An axis No. that exceeds the "number of controlled axes" setting in the "system settings" has been set.				
●	• The total number of I/O points of the PC I/O modules set in motion slots in the "system settings" exceeds 256.				
●	• The amplifier type set in the "system settings" (MR-H-BN/MR-J2S-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.		
For servo error ● For warning ○	• Occurrence of a servo error or servo warming • When using the LED does not light for a warning.	At all times	• In the case of MR-H-BN, MR-J2S-B and MR-J2-B axes, only the relevant axis enters the servo OFF status.	• Servo error detection flag (M1608+20n) ON • Servo error code device (D808+20n) set	• Ellminate 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.
●	• 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.
●	• 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.

REMARK

Numerical values corresponding to axis numbers are entered for "n" in Table 2.16 (error set device).

<A172SHCPUN>

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

<A171SHCPUN>

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

APPENDIX3 SPECIAL RELAYS AND SPECIAL REGISTERS

3.1 Special Relays (SP, M)

The special relays are internal relays with fixed applications in the programmable controller. Accordingly, they must not be turned ON and OFF in sequence programs (those marked (Note-1) and (Note-2) in the table are exceptions).

Table 3.1 Special Relay List

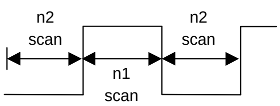
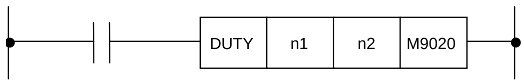
Number	Name	Stored Data	Explanation
M9000(Note-1)	Fuse blown	OFF Normal ON There is a module with a blown fuse.	● Comes ON even if there is only one output module with a blown fuse, and remains ON even after return to normal.
M9002(Note-1)	I/O unit verify error	OFF Normal ON Error	● Comes ON if there is a discrepancy between the actual I/O modules and the registered information when the power is turned on.
M9005(Note-1)	AC DOWN detection	OFF AC DOWN detected ON AC DOWN not detected	● Comes ON when there is a momentary power interruption not exceeding 20 ms; reset by turning the power OFF then ON again.
M9006	Battery low	OFF Normal ON Low battery voltage	● Comes ON when the battery voltage falls below the stipulated value; goes OFF when normal battery voltage is re-established.
M9007(Note-1)	Battery low latch	OFF Normal ON Low battery voltage	● Comes ON when the battery voltage falls below the stipulated value; remains ON even after normal battery voltage is re-established.
M9008(Note-1)	Self-diagnostic error	OFF No error ON Error	● Comes ON when an error occurs as a result of self-diagnosis.
M9009	Annunciator detection	OFF No F number detected ON F number detected	● Comes ON when OUT F, SET F instructions are executed. Goes OFF when 0 is stored in D9124.
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.
M9011(Note-1)	Operation error flag	OFF No error ON Error	● Comes on when an operation error occurs during execution of an application instruction; remains ON even after the error is cleared.
M9012	Carry flag	OFF Carry OFF ON Carry ON	● Carry flag used in an application instruction.
M9016	Data memory clear flag	OFF No processing ON Output cleared	● When M9016 is ON, all data memory contents, including those in the latch range but with the exception of special relays/registers, are cleared on reception of remote RUN from a computer or other device.
M9017	Data memory clear flag	OFF No processing ON Output cleared	● When M9017 is ON, all data memory contents that are not latched, with the exception of special relays/registers, are cleared on reception of remote RUN from a computer or other device.
M9020	User timing clock No.0		● Relay repeats ON/OFF switching at fixed scan intervals. ● Starts from the OFF status when the power is turned ON or on resetting. ● The ON/OFF intervals are set with the DUTY instruction. 
M9021	User timing clock No.1		
M9022	User timing clock No.2		
M9023	User timing clock No.3		
M9024	User timing clock No.4		

Table 3.1 Special Relay List (Continued)

Number	Name	Stored Data	Explanation
M9025 (Note-1)	Clock data set request	OFF No processing ON Data set request	● Writes the clock data stored in D9025 to D9028 to the clock devices after execution of the END instruction in the scan in which M9025 is switched ON.
M9026	Clock data error	OFF No error ON Error	● Comes ON when there is an error in he clock data (D9025 to D9028) values. OFF when there is no error.
M9028 (Note-2)	Clock data read request	OFF No processing ON Read request	● When M2098 is ON, the clock data is read to D9025 to D9028 as BCD data.
M9030	0.1 second clock	0.05 SEC. 0.05 SEC.	● These relays generate the 0.1 second, 0.2 second, 1 second, 2 second, and 1 minute clocks. ● These relays do not go ON/OFF with each scan but when their respective fixed intervals have elapsed, even during a scan. ● These relays start from the OFF status when the power is turned on or resetting.
M9031	0.2 second clock	0.1 SEC. 0.1 SEC.	
M9032	1 second clock	0.5 SEC. 0.5 SEC.	
M9033	2 second clock	1 SEC. 1 SEC.	
M9034	1 minute clock	30 SEC. 30 SEC.	
M9036	Always ON	ON OFF	● Relay used for initialization during a sequence program or as a dummy contact for an application instruction. ● M9036 and M9037 retain their ON or OFF status regardless of the settings of the key switch on the front of the CPU, but M9038 and M9039 change in accordance with the key switch status. They go OFF when the key switch is set to the STOP position. When the key switch is at a position other than STOP, M9038 comes ON for one scan only, and M9039 goes OFF for one scan only.
M9037	Always OFF	ON OFF	
M9038	ON for 1 scan only after RUN	ON OFF 1 scan	
M9039	RUN flag (OFF for 1 scan only after RUN)	ON OFF 1 scan	
M9040	PAUSE enable coil	OFF PAUSE disable ON PAUSE enabled	● When the RUN/STOP key switch is set to PAUSE or the remote PAUSE contact is turned on, provided M9040 is ON, the PAUSE status is established and M9041 comes ON.
M9041	PAUSE status contact	OFF PAUSE not in effect ON PAUSE in effect	
M9042	STOP status contact	OFF STOP not in effect ON STOP in effect	● ON when the RUN/STOP key switch is set to STOP.
M9043	Sampling trace completed	OFF Sampling trace in progress ON Sampling trace completed	● Comes ON on completion of the number of sampling traces set in the parameters are completed after execution of the STRA instruction. After that, it is reset by execution of the STRAR instruction.
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.
M9052 (Note-2)	SEG instruction switch	OFF 7-segment display ON I/O part refresh	● When M9052 is ON it is executed as the I/O partial refresh instruction. When M9052 is ON, it is executed as the 7-segment display instruction.
M9053 (Note-2)	EI/DI instruction switch	OFF Sequence interrupt control ON Link interrupt control	● Turn ON when a link refresh enable/disable (EI, DI) instruction is executed.

Table 3.1 Special Relay List (Continued)

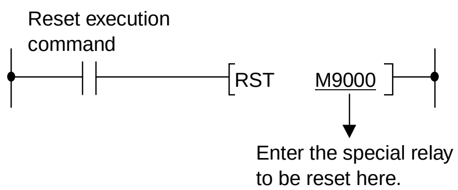
Number	Name	Stored Data	Explanation
M9054	STEP RUN flag	OFF STEP RUN not in effect ON STEP RUN in effect	● ON when the RUN/STOP key switch is set to the RUN position.
M9055	Status latch completion flag	OFF Not completed ON Completed	● Comes ON when status latch is completed. Goes OFF on execution of a reset instruction.
M9084 (Note-2)	Error check	OFF Error check executed ON No error check	● Set whether or not the error check shown below is executed on END instruction processing. (Used to shorten END instruction processing time.) (1) Blown fuse check (2) I/O module verification check (3) Battery check

Device number	Signal name	Signal direction	Refresh cycle	Fetch cycle
M9073	PCPUWDT error flag	PCPU→SCPU	END	
M9074	PCPU ready completion flag			
M9075	Test mode flag			
M9076	External rapid stop input flag			
M9077	Manual pulse generator axis setting error flag			
M9078	Test mode request error flag			
M9079	Servo program setting error flag			

POINTS

(1) All special relays, M, are turned OFF by turning the power, OFF, performing latch clear, or resetting with the RESET key switch.
When the RUN key switch is set to "STOP", the special relay settings are retained.

(2) The special relays (Note-1) in the table above remain "ON" even after a return to normal. They must therefore be turned OFF by using one of the following methods.
(a) Method using the user program
Insert the ladder block at right into the program and turn the reset execution command contact ON to clear the special relay.
(b) Method using a peripheral device
Perform a forced reset using the test function of the peripheral device.
For details on this operation, refer to the manual for the peripheral device.
(c) Turn the special relay OFF by setting the RESET key switch on the front panel of the CPU module to "RESET".



(3) The ON/OFF status of special relays (Note-2) in the table above is controlled by the sequence program.

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 (Note-2) in the table).
Of the special relays, those from D9180 to D9199 are used for positioning control.

Table 3.2 Special Register List

Number	Name	Stored Data	Explanation
D9000	Fuse blown	Number of module with blown fuse	● When modules with a blown fuse are detected, the lowest I/O number of the detected modules is stored in hexadecimal in this special relay. (Example: Blown fuses at the output modules Y50 to 6F... "50" is stored in hexadecimal.) For monitoring at a peripheral device, use hexadecimal display monitor operations. (Cleared when the contents of D9100 are all "0".)
D9002	I/O unit verify error	I/O module verification error module number	● If I/O modules that do not match the registered data are detected when the power is turned on, the first I/O number of the lowest module number among the detected modules is stored in hexadecimal (the storage method is the same as for D9000). When monitoring with a peripheral device, use a hexadecimal display monitoring operation. (Cleared when all contents of D9116 to D9123 are reset to zero.)
D9005(Note-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(Note-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.
D9009	Annunciator detection	F number at which external failure has occurred	● When one of F0 to 2047 is turned on by OUT F or SET F , the F number detected earliest among the F numbers which have been turned on is stored in BIN code. ● D9009 can be cleared by executing a RST F or LEDR instruction. If another F number has been detected, the clearing of D9009 causes the next number to be stored in D9009.
D9010	Error step	Step number at which operation error has occurred	● When an operation error occurs during execution of an application instruction, the step No. where the error occurred is stored in BIN cod, and thereafter, every time an operation error occurs the contents of D9010 are updated.
D9011	Error step	Step number at which operation error has occurred	● When an operation error occurs during execution of an application instruction, the step number at which the error occurs is stored in this register in BIN code. Since storage is executed when M9011 changes from OFF to ON, the contents of D9011 cannot be updated unless it is cleared by the user program.
D9014	I/O control mode	I/O control mode number	● The set control mode is represented as follows: 0: I/O in direct mode 3: I/O in refresh mode

Table 3.2 Special Register List

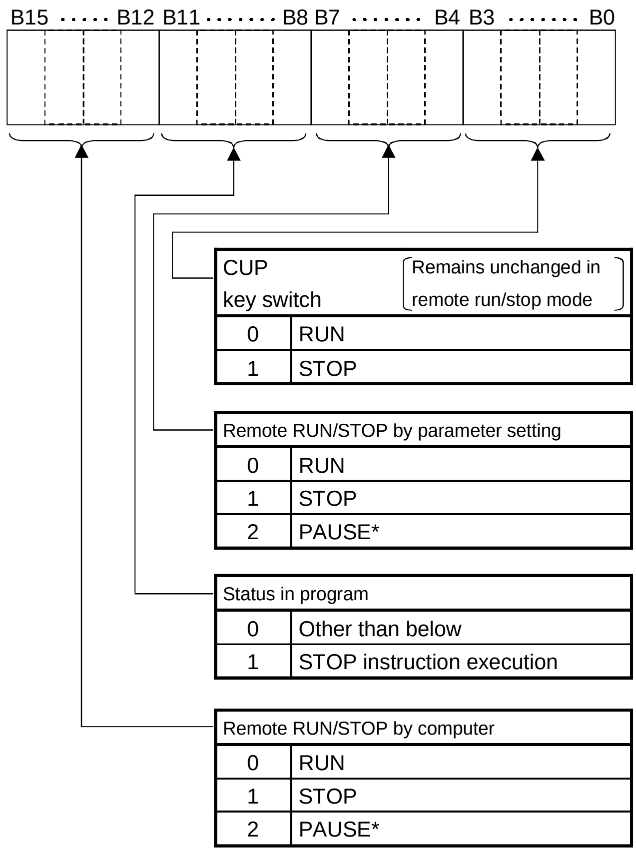
Number	Name	Stored Data	Explanation
D9015	CPU operating states	Operating states of CPU	● The CPU operation states indicated in the figure below are stored in D9015.  *: When the CPU is in the RUN status and M9040 is OFF, the CPU remains in RUN mode even if set to PAUSE.
D9016	ROM/RAM setting	0: ROM 1: 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(Note-2)	Constant scan	Constant scan time (user-specified in 10 ms units)	● When user programs are executed at fixed intervals, used to set the execution intervals, in 10 ms units. 0 : Constant scan function not used 1 to 200 : Constant scan function used program executed at intervals of (set value)×10 ms.

Table 3.2 Special Register List

Number	Name	Stored Data	Explanation
D9025 (Note-2)	Clock data	Clock data (year, month)	• The year (last two digits) and month are stored in BCD code in D9025 as shown below. B15 .... B12 B11 .... B8 B7 ..... B4 B3 ..... B0 Year (B15–B8), Month (B7–B0) Example : July, 1993 H 9307
D9026 (Note-2)	Clock data	Clock data (day, hour)	• The day and hour are stored in BCD code in D9026 as shown below. B15 .... B12 B11 .... B8 B7 ..... B4 B3 ..... B0 Day (B15–B8), Hour (B7–B0) Example : 31st, 10th hour H 3110
D9027 (Note-2)	Clock data	Clock data (minute, second)	• The minute and second are stored in BCD code in D9027 as shown below. B15 .... B12 B11 .... B8 B7 ..... B4 B3 ..... B0 Minute (B15–B8), Second (B7–B0) Example : 35ms, 48 s H 3548
D9028 (Note-2)	Clock data	Clock data (0, day of week)	• The day of week is stored in BCD code in D9028 as shown below. B15 .... B12 B11 .... B8 B7 ..... B4 B3 ..... B0 "0" must be set here. (B15–B4); Day of week (B3–B0) Example : Friday H 0005 Day of week: 0 Sunday 1 Monday 2 Tuesday 3 Wednesday 4 Thursday 5 Friday 6 Saturday
M9038 (Note-2) M9039 (Note-2)	LED display priority	Priorities 1 to 4 Priorities 5 to 7	• The element numbers for priorities 1 to 4 (D9038) and 5 to 7 (D9039) for the lighting (or flashing) of the ERROR LED when an error occurs, are set and changed. D9039: B15 .... B12 B11 ..... B8 B7 ..... B4 B3 ...... B0 — Priority: —, —, —, 5 D9038: B15 .... B12 B11 ..... B8 B7 ..... B4 B3 ...... B0 — Priority: 4, 3, 2, 1(position) **Priority** Even if "0" is set, errors which cause CPU operation to stop (including parameter settings) are unconditionally displayed on the LED display. Default values: D9038=H4321 D9039=H0006 **Element No, / Content** 0. Not displayed 1. I/O verify, fuse blown 2. Special function module, link parameters, SFC parameters, SFC operation 3. CHK instruction error 4. Annunciator (F) 5. LED instruction related 6. Parity error

Table 3.2 Special Register List

<table>
<tr><th>Number</th><th>Name</th><th>Stored Data</th><th>Explanation</th></tr>
<tr><td>D9091
D9092</td><td>Detailed error numbers</td><td>Self-diagnostic detailed error numbers</td><td>● The detailed error number when a self-diagnostic error occurs is stored.</td></tr>
<tr><td>D9100(Note-1)
D9101(Note-1)</td><td>Fuse blown module</td><td>Bit pattern in units of 16 points, indicating the modules whose fuses have blown.</td><td>● 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 bas been performed).
<table>
<tr><th></th><th>15</th><th>14</th><th>13</th><th>12</th><th>11</th><th>10</th><th>9</th><th>8</th><th>7</th><th>6</th><th>5</th><th>4</th><th>3</th><th>2</th><th>1</th><th>0</th></tr>
<tr><td>D9100</td><td>0</td><td>0</td><td>0</td><td>1
(YC0)</td><td>0</td><td>0</td><td>0</td><td>1
(Y80)</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>D9101</td><td>1
(Y1F0)</td><td>0</td><td>0</td><td>0</td><td>0</td><td>1
(Y1A0)</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td></tr>
</table>
Indicates a blown fuse
(Since the error is not cleared even after returning to normal, it must be cleared with a program.)</td></tr>
<tr><td>D9116(Note-1)
D9117(Note-1)</td><td>Input/Output module verification error</td><td>Bit pattern, in units of 16 points, indicating the modules with verification errors.</td><td>● 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.)
<table>
<tr><th></th><th>15</th><th>14</th><th>13</th><th>12</th><th>11</th><th>10</th><th>9</th><th>8</th><th>7</th><th>6</th><th>5</th><th>4</th><th>3</th><th>2</th><th>1</th><th>0</th></tr>
<tr><td>D9116</td><td>0</td><td>0</td><td>0</td><td>1</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>1
(X/Y0)</td></tr>
<tr><td>D9117</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>1
(X/Y
190)</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td></tr>
</table>
Indicates a blown fuse
(Since the error is not cleared even after returning to normal, it must be cleared with a program.)</td></tr>
<tr><td>D9124</td><td>Annunciator detection quantity</td><td>Number of detected annunciators</td><td>● 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.</td></tr>
<tr><td>D9125
to
D9132</td><td>Annunciator detection number</td><td>Annunciator detection number</td><td>● When F numbers in the range F0 to 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.
<table>
<tr><th></th><th></th><th>SET F50</th><th>SET F25</th><th>SET F99</th><th>SET F25</th><th>SET F15</th><th>SET F70</th><th>SET F65</th><th>SET F38</th><th>SET F110</th><th>SET F151</th><th>SET F210</th><th>LEDR</th></tr>
<tr><td>D9009</td><td>0</td><td>50</td><td>50</td><td>50</td><td>50</td><td>50</td><td>50</td><td>50</td><td>50</td><td>50</td><td>50</td><td>50</td><td>99</td></tr>
<tr><td>D9124</td><td>0</td><td>1</td><td>2</td><td>3</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>8</td><td>8</td></tr>
<tr><td>D9125</td><td>0</td><td>50</td><td>50</td><td>50</td><td>50</td><td>50</td><td>50</td><td>50</td><td>50</td><td>50</td><td>50</td><td>50</td><td>99</td></tr>
<tr><td>D9126</td><td>0</td><td>0</td><td>25</td><td>25</td><td>99</td><td>99</td><td>99</td><td>99</td><td>99</td><td>99</td><td>99</td><td>99</td><td>15</td></tr>
<tr><td>D9127</td><td>0</td><td>0</td><td>0</td><td>99</td><td>0</td><td>15</td><td>15</td><td>15</td><td>15</td><td>15</td><td>15</td><td>15</td><td>70</td></tr>
<tr><td>D9128</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>70</td><td>70</td><td>70</td><td>70</td><td>70</td><td>70</td><td>65</td></tr>
<tr><td>D9129</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>65</td><td>65</td><td>65</td><td>65</td><td>65</td><td>38</td></tr>
<tr><td>D9130</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>38</td><td>38</td><td>38</td><td>38</td><td>110</td></tr>
<tr><td>D9131</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>110</td><td>110</td><td>110</td><td>151</td></tr>
<tr><td>D9132</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>151</td><td>151</td><td>210</td></tr>
</table></td></tr>
</table>

POINTS

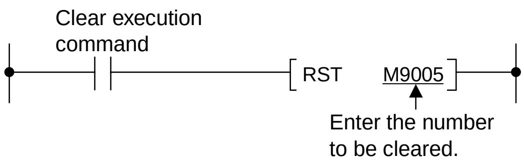
(1) All special register data is cleared by the power-off, latch clear, and reset operations. The data is retained when the RUN/STOP key switch is set to STOP.

(2) The contents of the special relays (Note-1) in the table above are not cleared even after the normal status is restored. To clear the contents, use one of the following methods:

(a) Using a user program
Insert the ladder block shown at right into the program and turn on the clear execution command contact to clear the contents of the register.

(b) Using a peripheral device
Using the test function of a peripheral device, set the register to "0" by using 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.

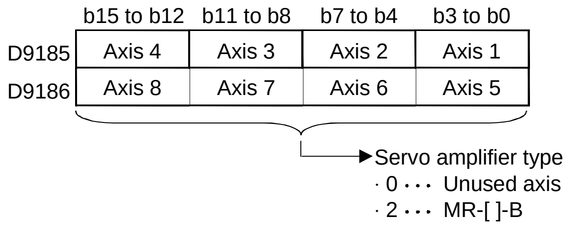


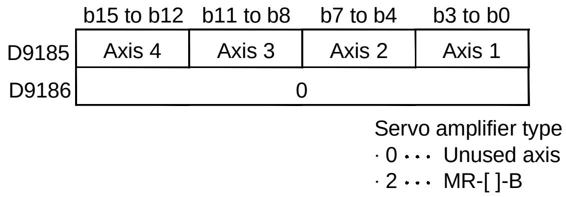
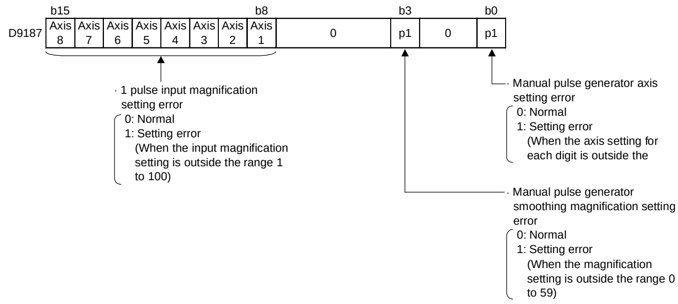
(3) For special registers (Note-2), data is written in the sequence program.

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) A172SHCPUN
<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>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>LY01</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
(2) A171SHCPUN
<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>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 through D9181.
1) 1..........ON
2) 0..........OFF
</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>200
201</td><td>Hardware fault of module loaded in main base unit or motion 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</td></tr>
<tr><td>250
251</td><td>SSCNET interface hardware fault
2 5 0
Faulty SSCNET No.
0 : SSCNET 1 (Amplifier interface)
1 : SSCNET 2 (PC link interface)</td></tr>
<tr><td>300</td><td>PCPU software fault 3</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 A172SHCPUN is used


(2) When an A171SHCPUN is used

</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 A172SHCPUN is used


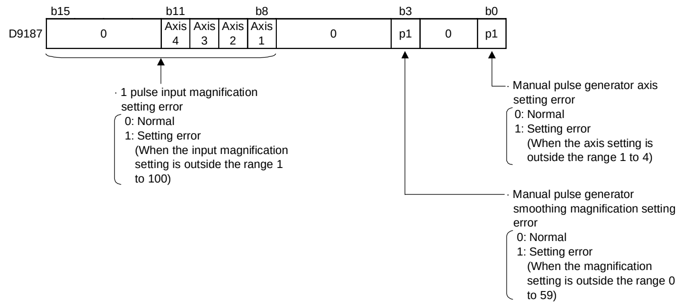
(2) When an A171SHCPUN is used

</td></tr>
</table>

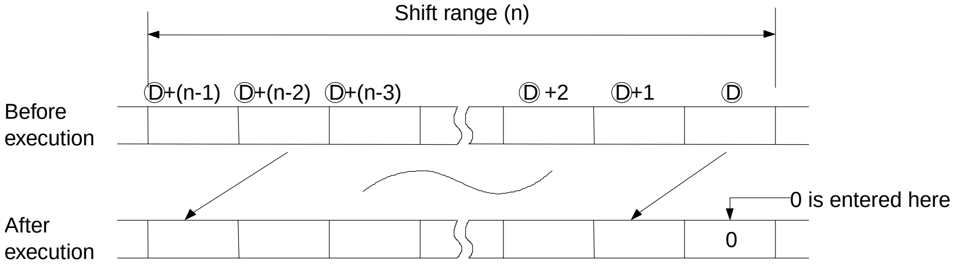
Table 3.3 Special Register List (Continued)

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 A172SHCPUN 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 b0 to b7: Stores the operating/stopped status of each axis · 0: Stopped · 1: Operating b8 to b15: All set to "0" (2) When A171SHCPUN 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 b0 to b3: Stores the operating/stopped status of each axis · 0: Stopped · 1: Operating b4 to b15: 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 Appendix 2.1.)
D9191	Servo amplifier installation information	Servo amplifier installation information	● 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 A172SHCPUN is used b15 … b8 b7 b6 b5 b4 b3 b2 b1 b0 D9191: 0 (b15 to b8) Axis8 Axis7 Axis6 Axis5 Axis4 Axis3 Axis2 Axis1 Stores the operating/stopped status of each axis · Installed ··········· 1 · Not installed ······· 0 (2) When an A171SHCPUN is used b15 … b4 b3 b2 b1 b0 D9191: 0 (b15 to b4) Axis 4 Axis 3 Axis 2 Axis 1 Stores the operating/stopped status of each axis · Installed ··········· 1 · Not installed ······· 0
D9192	Area for setting the smoothing magnification for manual pulse generator 1 (P1)	Areas for setting manual pulse generator smoothing magnifications	● Stores the manual pulse generator smoothing time constant. ● The smoothing time constant is calculated using the following formula: Smoothing time constant (t) = (Smoothing magnification+1) × 56.8 [ms] The setting range for smoothing magnification is 0 to 59.
D9196	PC link communication error code	PC link communication error code	00: No error 01: Receiving timing error 02: CPU error 03: Communication response code error 04: Receiving frame error 05: Communication task start error (Error codes are reset to 00 by normal communication restart.)

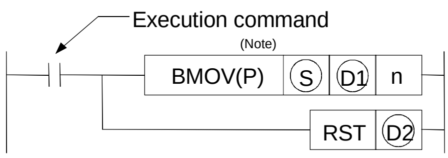
APPENDIX4 EXAMPLE PROGRAMS

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

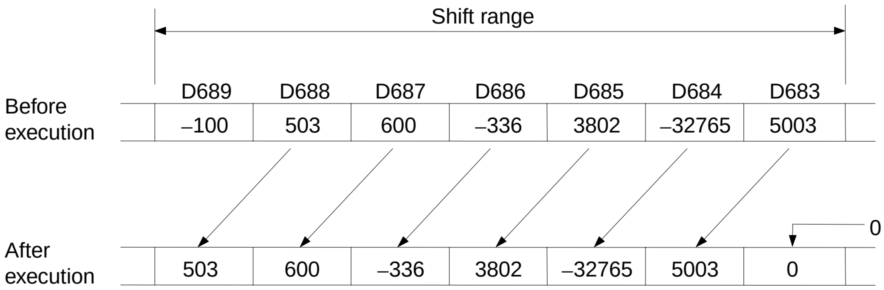
(2) (Note): BMOV(P) indicates the BMOV instruction and the BMOVP instruction.

Fig.4.1 Format for Left shift Using BMOV(P) Instruction and RST Instruction

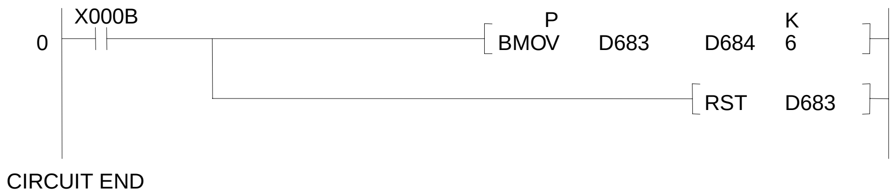
Example

(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.

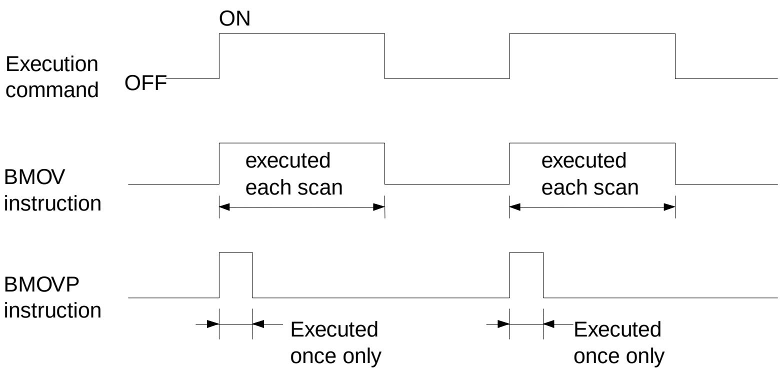
[Operation]



[Program Example]

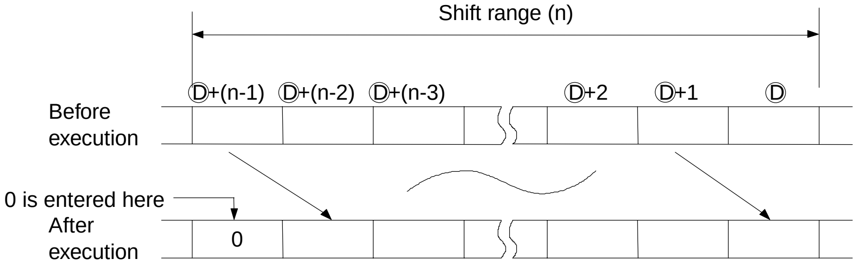


(3) Execution condition
The execution condition when the BMOV instruction and BMOVP instruction are used is as follows.

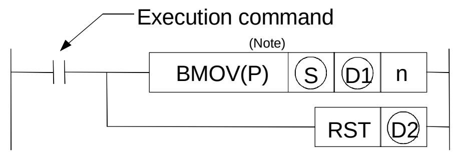


4.2 Word Data 1 Word Shift to Right

(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 be shifted to right
n : Number of shifted devices

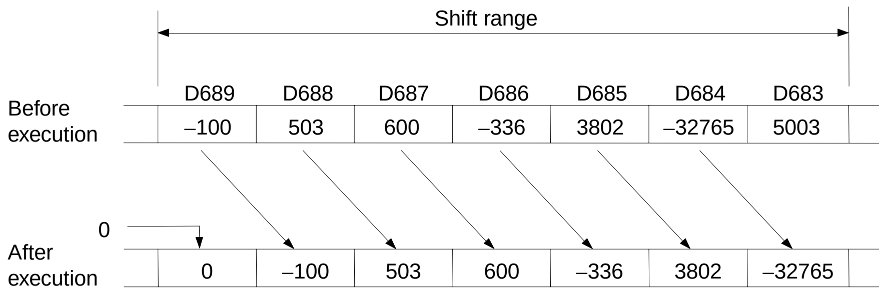
(2) (Note): BMOV(P) indicates the BMOV instruction and the BMOVP instruction.

Fig.4.2. Format for Right Shift Using BMOV(P) Instruction and RST Instruction

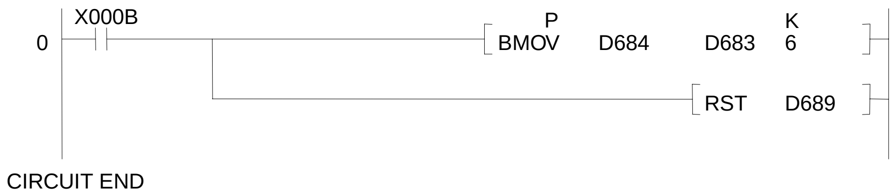
Example

(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]

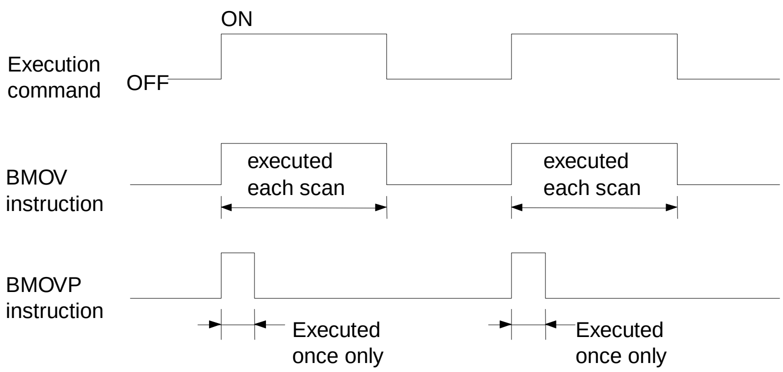


[Program Example]



(3) Execution condition

The execution condition when the BMOV instruction and BMOVP instruction are used is as follows.



4.3 Reading M-Codes

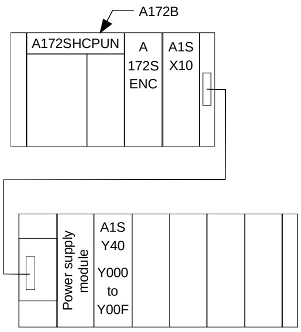
An example of a program for reading an M-code on completion of positioning start or on completion of positioning is shown here.
The distinction between positioning start completion and positioning completion is made with the following signals.

- Positioning start completed ....M1600+20n (positioning start completed signal)
- Positioning completed..................M1601+20n (positioning completed signal)

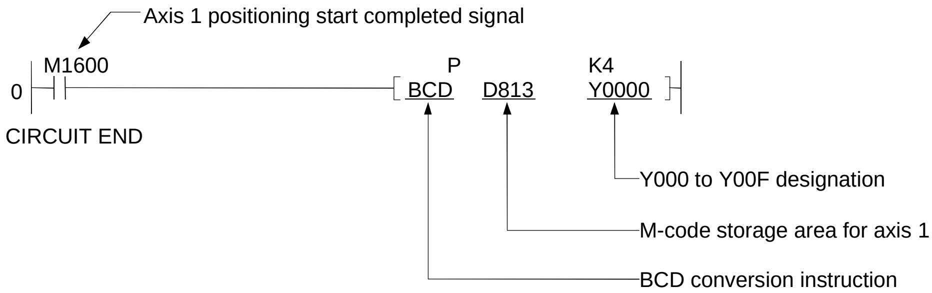
[Program Example]

(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.

System configuration

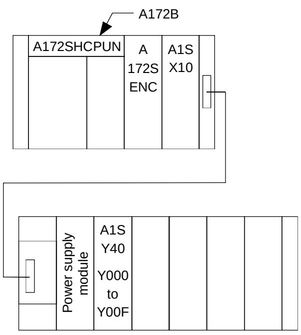


Sequence program

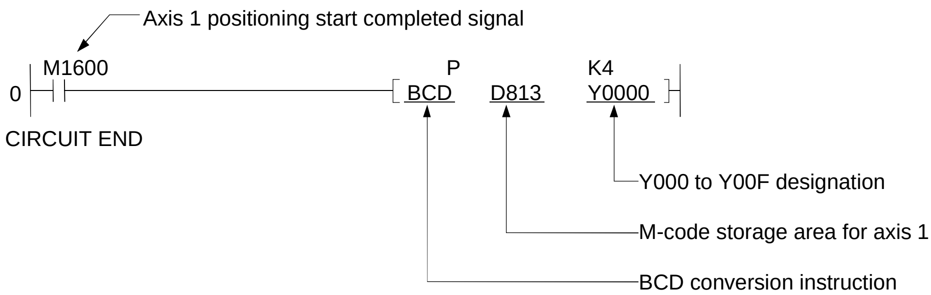


(2) A program that outputs the M-code for axis 1 from Y000 to Y00F to an external destination on completion of positioning and after conversion to BCD code, is shown here.

System configuration



Sequence program



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)

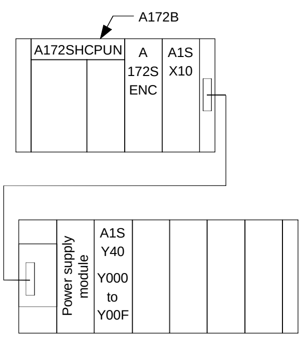
POINT

(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.

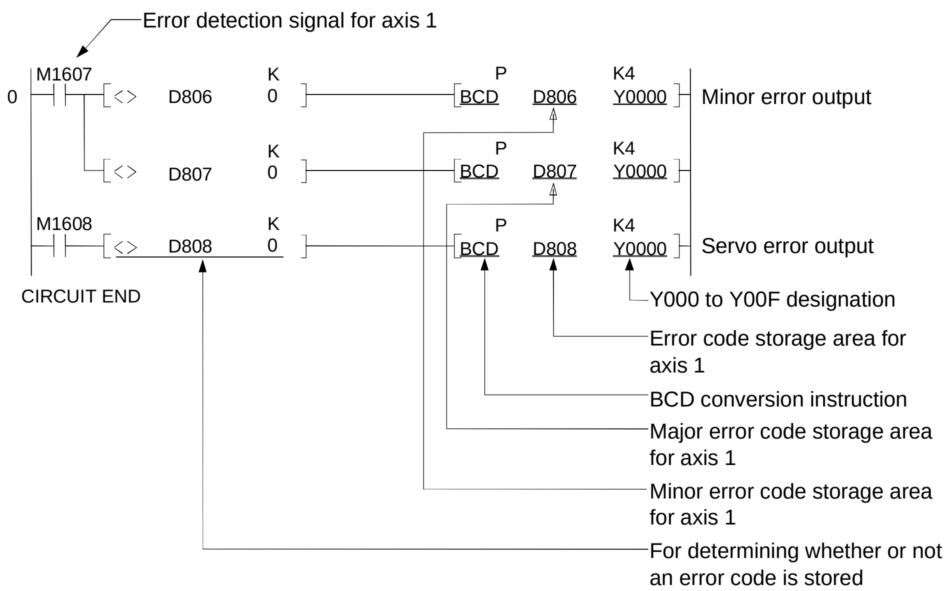
[Program Example]

(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.

System configuration



Sequence program

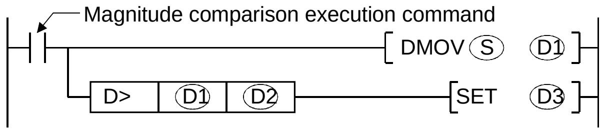


4.5 Magnitude Comparison and Four Fundamental Operations of 32-Bit Monitor Data

When a machine value, real current value or deviation counter value is used to perform magnitude comparison or four fundamental operations, the value must be transferred to another device memory once and the device memory of the transfer destination be used to perform processing as described below.

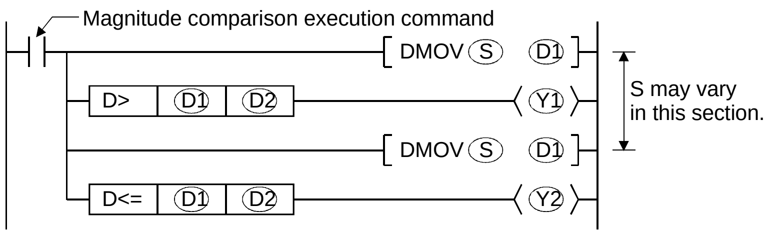
(1) Magnitude comparison example

(a) To set the device when the machine value has become more than the set value

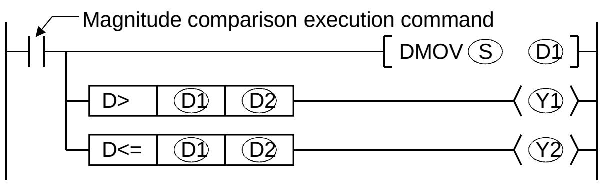


1) S, D1, D2 and D3 indicate the following.
   S : Machine value
   D1 : Device memory for temporary storage
   D2 : Set value for magnitude comparison
   D3 : Device for setting magnitude comparison result

(b) When one piece of monitor data is referred to many times to perform comparison processing, intended operation may not be performed if the monitor data is transferred every processing as shown in program example 1. In program example 1, neither Y1 nor Y2 may turn ON. (This also applies to the case of 16-bit monitor data.)
This is because the S value varies asynchronously with the sequencer scan. To perform such processing, transfer the monitor data to another device memory once, and after that, use that value to perform comparison processing as shown in program example 2.
[Program example 1]



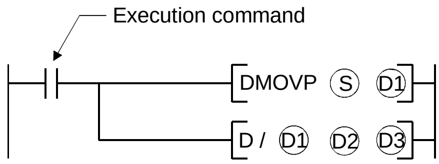
[Program example 2]



1) S, D1, D2, Y1 and Y2 indicate the following.
   S : Machine value
   D1 : Device memory for temporary storage
   D2 : Set value for magnitude comparison
   Y1 : Magnitude comparison result output device (Result: more than)
   Y2 : Magnitude comparison result output device (Result: Equal to or less than)

(2) Four fundamental operations example

To divide the real current value by the set value



1) S, D1, D2 and D3 indicate the following.
   - S : Real current value
   - D1 : Device memory for temporary storage
   - D2 : Division
   - D3 : Operation result storage device

APPENDIX 5 SETTING RANGE OF INDIRECTLY DESIGNATED DEVICES

All settings by servo programs (positioning address, commanded speed, M-code, etc.) can be designated indirectly by PLC devices, excluding the axis numbers.

(1) Device range
The number of device words and device range in indirect designation are shown below.

<table>
<tr><th colspan="2" rowspan="2">Item</th><th rowspan="2">Number of device words</th><th colspan="2">Device setting range</th><th rowspan="2">Remarks</th></tr>
<tr><th>A172SHCPUN</th><th>A171SHCPUN</th></tr>
<tr><td rowspan="6">Common</td><td>Address/travel</td><td>2</td><td colspan="2" rowspan="22"><table><tr><th>Device</th><th>Range</th></tr><tr><td>D</td><td>0 to 799</td></tr><tr><td>W</td><td>000 to 3FF</td></tr></table></td><td rowspan="18"></td></tr>
<tr><td>Commanded speed</td><td>2</td></tr>
<tr><td>Dwell time</td><td>1</td></tr>
<tr><td>M-code</td><td>1</td></tr>
<tr><td>Torque limit value</td><td>1</td></tr>
<tr><td>Parameter block number</td><td>1</td></tr>
<tr><td rowspan="3">Arc</td><td>Auxiliary point</td><td>2</td></tr>
<tr><td>Radius</td><td>2</td></tr>
<tr><td>Center</td><td>2</td></tr>
<tr><td rowspan="9">Parameter block</td><td>Control unit</td><td>1</td></tr>
<tr><td>Speed limit value</td><td>2</td></tr>
<tr><td>Acceleration time</td><td>1</td></tr>
<tr><td>Deceleration time</td><td>1</td></tr>
<tr><td>Rapid stop deceleration time</td><td>1</td></tr>
<tr><td>Torque limit value</td><td>1</td></tr>
<tr><td>STOP input deceleration</td><td>1</td></tr>
<tr><td>Circular interpolation error allowance range</td><td>2</td></tr>
<tr><td>S curve comparison</td><td>1</td></tr>
<tr><td rowspan="7">Others</td><td>Program number</td><td>1</td><td>Simultaneous start</td></tr>
<tr><td>FIN acceleration time</td><td>1</td><td></td></tr>
<tr><td>Start program number</td><td>1</td><td>Cancel & start</td></tr>
<tr><td>Repeat condition (number of repetitions)</td><td>1</td><td></td></tr>
<tr><td>Repeat condition (ON/OFF)</td><td>Bit</td><td colspan="2"><table><tr><th>Device</th><th>Range</th></tr><tr><td>X</td><td>000 to 7FF</td></tr><tr><td>Y</td><td>000 to 7FF</td></tr><tr><td>M/L</td><td>0 to 2047</td></tr><tr><td>M</td><td>9000 to 9255</td></tr><tr><td>B</td><td>000 to 3FF</td></tr><tr><td>F</td><td>0 to 255</td></tr></table></td><td></td></tr>
<tr><td>Skip condition</td><td>Bit</td><td colspan="2" rowspan="2"><table><tr><th>Device</th><th>Range</th></tr><tr><td>X</td><td>000 to 7FF</td></tr><tr><td>Y</td><td>000 to 7FF</td></tr><tr><td>M/L</td><td>0 to 2047</td></tr><tr><td>M</td><td>9000 to 9255</td></tr><tr><td>B</td><td>000 to 3FF</td></tr><tr><td>F</td><td>0 to 255</td></tr><tr><td>TT (Timer contact)</td><td>0 to 255</td></tr><tr><td>TC (Timer coil)</td><td>0 to 255</td></tr><tr><td>CT (Counter contact)</td><td>0 to 255</td></tr><tr><td>CC (Counter coil)</td><td>0 to 255</td></tr></table></td><td rowspan="2"></td></tr>
<tr><td>Cancel condition</td><td>Bit</td></tr>
</table>

POINT

Be sure to designate even-numbered devices for 2-word designation items.
Be sure to use the DMOV(P) instruction when setting data in these devices by sequence programs.

(2) Device data fetch
Data for indirectly designated devices is fetched by the PCPU at the start of the servo program.
For this reason, set data in the devices before starting the servo program, and never change the devices unless servo program start is complete.
The following describes the procedures by start method for setting data in devices and the points to note.

Start method	Setting method	Notes
Start by SVST instruction	Designate data in devices. ↓ Set the cancel command device to ON.	Don't change the indirectly designated device until the positioning start completion signal of the start axis goes ON.
Automatic start by cancel & start	Set data in the indirectly designated device chosen by the start program. ↓ Turns the cancel command device ON.	
Designating loop (FOR - NEXT) point data in the CPSTART instruction indirectly	Designate initial command data in the indirectly designated device. ↓ Start by SVST (or set the cancel command device to ON). ↓ Read the value of constant speed control data set pointer of the started axis, and update the data fetched by PCPU.	For details, see the positioning signal data register "Monitoring data Area".

APPENDIX 6 PROCESSING TIMES

The following tables list the processing time of each instruction for positioning control in the servo system CPU.

(1) Motion operation cycle (ms)

CPU	**A172SH**	**A171SH**
Number of set axes	**1 to 8**	**1 to 4**
Operation cycle	3.5ms	3.5ms

(2) SCPU instruction processing time (μs)

CPU		**A172SH**	**A171SH**
Number of set axes		**1 to 8**	**1 to 4**
SVST	1 axis started	48	
	2 or 3 axes started	105	
	Error	50	
DSFRP	1 axis started	48	
	2 to 4 axes started	65	
	Error	60	
CHGV		27	
DSFLP (speed change)	Normal	28	
	Error	50	
CHGA		32	
DSFLP (present value change)	Normal	28	
	Error	50	
CHGT		24	
END		1400	

(3) CPU processing time (ms)

CPU	**A172SH**	**A171SH**
Number of set axes	**1 to 8**	**1 to 4**
Servo program start processing time (Note-1)	4 to 11	4 to 11
Speed change response	0 to 4	0 to 4
Torque limit value change response	0 to 4	0 to 4
Simultaneous start processing time (Note-2)	7 to 17	7 to 17
Time from PLC ready flag (M2000) ON to PCPU ready flag (M9074) ON	50 to 600	50 to 350

(Note-1) : The FEED instruction varies greatly depending on the condition (whether other axes are operating or being stopped).

(Note-2) : This processing time varies depending on the commands to be started simultaneously. Use this time merely for reference.

For other sequence program instruction processing times, refer to the ACPU Programming Manual.

(4) Axis status

Axis No.	SV13D Device Number	SV13G Device Number
1	M1600 to M1619	M1600 to M1619
2	M1620 to M1639	M1620 to M1639
3	M1640 to M1659	M1640 to M1659
4	M1660 to M1679	M1660 to M1679
5	M1680 to M1699	
6	M1700 to M1719	
7	M1720 to M1739	
8	M1740 to M1759	

Signal Name

	Signal Name	Signal Direction	Refresh Cycle	Fetch Cycle
0	Positioning start completed	PCPU→SCPU	3.5ms	
1	Positioning completed			
2	In-position			
3	Command in-position			
4	Speed control in progress			
5	Speed/position switching latch			
6	Zero pass			
7	Error detection		Immediately	
8	Servo error detection		3.5ms	
9	Zeroing request		10ms	
10	Zeroing completed		3.5ms	
11	External signal FLS		10ms	
12	External signal RLS			
13	External signal STOP			
14	External signal DOG/CHANGE			
15	Servo ON/OFF		3.5ms	
16	Torque control in progress			
17	Unusable		——	
18	Unusable		——	
19	M-code output in progress		3.5ms	

(5) Axis command signals

Axis No.	SV13D Device Number	SV13G Device Number
1	M1800 to M1819	M1800 to M1819
2	M1820 to M1839	M1820 to M1839
3	M1840 to M1859	M1840 to M1859
4	M1860 to M1879	M1860 to M1879
5	M1880 to M1899	
6	M1900 to M1919	
7	M1920 to M1939	
8	M1940 to M1959	

Signal Name

	Signal Name	Signal Direction	Refresh Cycle	Fetch Cycle
0	Stop command	SCPU→PCPU		3.5ms
1	Rapid stop command			
2	Forward JOG start			10ms
3	Reverse JOG start			
4	End signal OFF command			
5	Speed/position switching enabled			3.5ms
6	Limit switch output enable			
7	Error reset			10ms
8	Servo error reset			
9	External STOP input valid/invalid when starting			Start timing
10	Unusable			——
11	Unusable			
12	Feed current value update request command			Start timing
13	Unusable			——
14	Unusable			
15	Servo OFF			3.5ms
16	Unusable			——
17	Unusable			
18	Unusable			
19	FIN signal			3.5ms

(6) Axis monitor devices

Axis No.	SV13D Device Number	SV13G Device Number	Signal Name
1	D800 to D819	D800 to D819	
2	D820 to D839	D820 to D839	
3	D840 to D859	D840 to D859	
4	D860 to D879	D860 to D879	
5	D880 to D899		
6	D900 to D919		
7	D920 to D939		
8	D940 to D959		

	Signal Name	Unit	Signal Direction	Refresh Cycle	Fetch Cycle
0 1	Feed current value	Command unit	PCPU→ SCPU	3.5ms	
2 3	Actual current value	Command unit			
4 5	Deviation counter value	PLS			
6	Minor error code	—		Immediately	
7	Major error code	—			
8	Servo error code	—		10ms	
9 10	Travel value when the proximity DOG/CHANGE is ON	Command unit		END	
11	Zeroing second travel value	PLS		3.5ms	
12	Execution program number	—			
13	M-code	—			
14	Torque limit value	%			
15 16	Travel value change register	Command unit	SCPU→ PCPU		3.5ms
17 18	Real current value when STOP is input	Command unit	PCPU→ SCPU	END	
19	Data set pointer for constant speed control	—		At driving or during driving	

(7) Control change registers

Axis No.	SV13D Device Number	SV13G Device Number	Signal Name
1	D960 to D965	D960 to D965	
2	D966 to D971	D966 to D971	
3	D972 to D977	D972 to D977	
4	D978 to D983	D978 to D983	
5	D984 to D989		
6	D990 to D995		
7	D996 to D1001		
8	D1002 to D1007		

	Signal Name	Unit	Signal Direction	Refresh Cycle	Fetch Cycle
0 1	Current value change register	Command unit	SCPU→ PCPU		DSFLP execution
2 3	Speed change register	Command unit			DSFLP execution
4 5	JOG speed setting register	Command unit			At driving

(Note) : ▭ This register is a backup register.

* The entry "END" in the Refresh Cycle column indicates 80ms or a longer sequence program scan time.

(8) Common devices

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Device Number	Signal Name		Signal Direction	Refresh Cycle	Fetch Cycle
M1960	Unusable (39 points)			——	——
M1961					
M1962					
M1963					
M1964					
M1965					
M1966					
M1967					
M1968					
M1969					
M1970					
M1971					
M1972					
M1973					
M1974					
M1975					
M1976					
M1977					
M1978					
M1979					
M1980					
M1981					
M1982					
M1983					
M1984					
M1985					
M1986					
M1987					
M1988					
M1989					
M1990					
M1991					
M1992					
M1993					
M1994					
M1995					
M1996					
M1997					
M1998					
M1999					
M2000	PLC READY flag		SCPU→PCPU		10ms
M2001	Axis 1	START accept flag (8 points)	SCPU←PCPU	10ms	
M2002	Axis 2				
M2003	Axis 3				
M2004	Axis 4				
M2005	Axis 5				
M2006	Axis 6				
M2007	Axis 7				
M2008	Axis 8				
M2009	All-axes servo ON accept flag				
M2010	Unusable (2 points)			——	——
M2011					
M2012	Manual pulse generator enable flag		SCPU→PCPU		10ms
M2013	Unusable (2 points)			——	——
M2014					
M2015	JOG simultaneous start command		SCPU→PCPU		10ms
M2016	CPU completion point setting				Start timing
M2017	Unusable (3 points)			——	——
M2018					
M2019					
M2020	Start buffer full		SCPU←PCPU	END	
M2021	Axis 1	Speed change flag (8 points)			
M2022	Axis 2				
M2023	Axis 3				
M2024	Axis 4				
M2025	Axis 5				
M2026	Axis 6				
M2027	Axis 7				
M2028	Axis 8				
M2029	Unusable (5 points)			——	——
M2030					
M2031					
M2032					
M2033					
M2034	PC link communication error flag		SCPU←PCPU	END	
M2035	Unusable (6 points)			——	——
M2036					
M2037					
M2038					
M2039					
M2040					
M2041	System setting error flag		SCPU←PCPU	END	
M2042	All-axes servo ON command		SCPU→PCPU		3.5ms
M2043	Unusable (4 points)			——	——
M2044					
M2045					
M2046					
M2047	Motion slot module error detection flag		SCPU←PCPU	END	

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Device Number	Signal Name		Signal Direction	Refresh Cycle	Fetch Cycle
M1960	Unusable (39 points)			——	——
M1961					
M1962					
M1963					
M1964					
M1965					
M1966					
M1967					
M1968					
M1969					
M1970					
M1971					
M1972					
M1973					
M1974					
M1975					
M1976					
M1977					
M1978					
M1979					
M1980					
M1981					
M1982					
M1983					
M1984					
M1985					
M1986					
M1987					
M1988					
M1989					
M1990					
M1991					
M1992					
M1993					
M1994					
M1995					
M1996					
M1997					
M1998					
M1999					
M2000	PLC READY flag		SCPU→PCPU		10ms
M2001	Axis 1	START accept flag (4 points)	SCPU←PCPU	10ms	
M2002	Axis 2				
M2003	Axis 3				
M2004	Axis 4				
M2005	Unusable (4 points)			——	——
M2006					
M2007					
M2008					
M2009	All-axes servo ON accept flag		SCPU←PCPU	10ms	
M2010	Unusable (2 points)			——	——
M2011					
M2012	Manual pulse generator enable flag		SCPU→PCPU		10ms
M2013	Unusable (2 points)			——	——
M2014					
M2015	JOG simultaneous start command		SCPU→PCPU		10ms
M2016	CPU completion point setting				Start timing
M2017	Unusable (3 points)			——	——
M2018					
M2019					
M2020	Start buffer full		SCPU←PCPU	END	
M2021	Axis 1	Speed change flag (4 points)			
M2022	Axis 2				
M2023	Axis 3				
M2024	Axis 4				
M2025	Unusable (9 points)			——	——
M2026					
M2027					
M2028					
M2029					
M2030					
M2031					
M2032					
M2033					
M2034	PC link communication error flag		SCPU←PCPU	END	
M2035	Unusable (6 points)			——	——
M2036					
M2037					
M2038					
M2039					
M2040					
M2041	System setting error flag		SCPU←PCPU	END	
M2042	All-axes servo ON command		SCPU→PCPU		3.5ms
M2043	Unusable (4 points)			——	——
M2044					
M2045					
M2046					
M2047	Motion slot module error detection flag		SCPU←PCPU	END	

* The entry “END” in the Refresh Cycle column indicates 80ms or a longer sequence program scan time.

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Device Number	Signal Name		Signal Direction	Refresh Cycle	Fetch Cycle
D1008	Limit switch output disable setting register (4 points)		SCPU →PCPU		3.5ms
D1009					
D1010					
D1011					
D1012	Setting Register for a axis number controlled with manual pulse generator 1				Manual pulse generator operation enabled
D1013	Unusable (2 points)			—	—
D1014					
D1015	JOG operation simultaneous start axis setting register		SCPU →PCPU		At driving
D1016	Axis 1	1 pulse input modification setting register for manual pulse generators (8 points)			Manual pulse generator operation enabled
D1017	Axis 2				
D1018	Axis 3				
D1019	Axis 4				
D1020	Axis 5				
D1021	Axis 6				
D1022	Axis 7				
D1023	Axis 8				

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Device Number	Signal Name		Signal Direction	Refresh Cycle	Fetch Cycle
D1008	Limit switch output disable setting register (2 points)		SCPU →PCPU		3.5ms
D1009					
D1010	Unusable (2 points)			—	—
D1011					
D1012	Setting Register for a axis number controlled with manual pulse generator 1		SCPU →PCPU		Manual pulse generator operation enabled
D1013	Unusable (2 points)			—	—
D1014					
D1015	JOG operation simultaneous start axis setting register		SCPU →PCPU		At driving
D1016	Axis 1	1 pulse input modification setting register for manual pulse generator (4 points)			Manual pulse generator operation enabled
D1017	Axis 2				
D1018	Axis 3				
D1019	Axis 4				
D1020	Unusable (4 points)			—	—
D1021					
D1022					
D1023					

(9) Special relays

Device number	Signal name	Signal direction	Refresh cycle	Fetch cycle
M9073	PCPU WDT error flag	SCPU←PCPU	END	
M9074	PCPU ready completion flag			
M9075	Test mode flag			
M9076	External rapid stop input flag			
M9077	Manual pulse generator axis setting error flag			
M9078	Test mode request error flag			
M9079	Servo program setting error flag			

(10) Special registers

Device number	Signal name	Signal direction	Refresh cycle	Fetch cycle
M9180	Limit switch output status	SCPU←PCPU	3.5ms	
D9181				
D9182				
D9183				
D9184	PCPU WDT error factor		At PCPU WDT error occurrence	
D9185	Servo amplifier type		Power ON	
D9186				
D9187	Manual pulse generator axis setting error information		Manual pulse generator operation enabled	
D9188	Test mode request error information		Test mode request	
D9189	Error program number		Start	
D9190	Error item information			
D9191	Servo amplifier installation information		Power ON, 10ms	
D9192	Manual pulse generator 1 smoothing magnification setting register	SCPU→PCPU		Manual pulse generator operation enabled
D9193	Unusable		——	——
D9194	Unusable			
D9195	Unusable			
D9196	PC link communication error code	SCPU←PCPU	3.5ms	
D9197	Unusable		——	——
D9198	Unusable			
D9199	Unusable			

* The entry "END" in the Refresh Cycle column indicates 80ms or a longer sequence program scan time.

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